

Acts, practices, and the creation of place:
Geoarchaeology of a Terra Preta de Índio site in the Central Amazon

By

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A dissertation submitted in partial satisfaction of the
requirements for the degree of

Doctor of Philosophy

in

Anthropology

in the

Graduate Division

of the

University of California, Berkeley

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Spring 2011

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Abstract

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My dissertation investigates inconsistencies in the ways Amazonia has been presented to the public and within archaeology as a discipline. It does so by bringing methods from the earth sciences to bear on sites that resist interpretation under widely accepted models for habitation of pre-Columbian Amazonia. *Terra Preta de Índio*, a type of Amazonian Dark Earth, is a dark soil produced by deliberate human action that functions as key evidence for intensive environmental and landscape remodeling in pre-Columbian Amazonia. Terra preta sites have been recognized in recent decades as likely resulting from large, permanently settled populations previously believed to be absent from Amazonia. My dissertation reconstructs patterns of daily life and village organization at a terra preta site, Antônio Galo, as a means of constructing an alternative narrative about Amazonia's past.

Prevalent narratives about Amazonia cast the region as homogenous and static, exotic, yet culturally decadent. These deeply embedded images of Amazonia have roots in early narratives of 'discovery' and 'exploration,' which are tightly interwoven with colonialist projects. Historically, archaeological contributions to knowledge about Amazonia, which make use of notions of social complexity that emerge from colonialist notions about 'civilization,' also cast Amazonia as empty and its people as passive in its development. Through an exploration of place, I examine the construction of these narratives, and then employ data that speak to Native Amazonians' active role in constructing the landscape to propose alternative narratives for Amazonia and its people.

In order to detect material traces of past acts of remodeling embedded in the archaeological soil and sediment matrix, I developed a geoarchaeological approach to investigating the household scale at Antônio Galo. I approach the matrix as a particulate body that mediates the relationship between people and their environments and also serves as the stage upon which lives are enacted. Moving away from indices of social complexity, which do not adequately address the scale of daily life in Amazonia, I examine macroscopically visible and invisible traces of the past to reconstruct places created and inhabited by people in the past. Field observations of landscape and environmental remodeling are supplemented by chemical, sedimentological, and microartifactual signatures that help to identify and characterize ancient habitation surfaces and features. Through this nuanced understanding of the various iterations of activity areas, houses, and villages that existed at Antônio Galo, I consider village organization, spatial parsing of activities, and the movement of bodies, in an attempt to recapitulate the lives of people that created and inhabited these places in the past.

This text is dedicated to all the peoples of Brazil, past, present, and future – may all of your stories be told, with dignity and respect, and in accordance with your wishes.

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Acknowledgments

Researching and writing this dissertation has been an incredibly interesting and rewarding journey. Having started off with an interest in addressing questions that seemed impossible to answer, I have traveled unexpected paths and, seem to somehow have arrived back where I began, but with a much deeper knowledge and much more refined tools. For this somewhat miraculous arrival, I owe much to my advisors and mentors, Rosemary Joyce and Eduardo Góes Neves, whose (sometimes blind) faith in the value of this process and the in the promise of this project have remarkably persisted unwavering over the past six years. Both have provided me with intellectual guidance and logistical support, and both were also willing to leave me more or less to my own devices, to develop the ways of knowing and of learning that are the primary product of my dissertation research. Rosemary was also Chair of my dissertation committee, and the practical guidance she provided in navigating the world of academia, as well as the on-demand support through crucial turning points and a variety of ‘emergencies’ did not pass unnoticed. Our conversations and discussions around fundamental aspects of materiality and of human experience undoubtedly permeate this work in ways cannot now perceive. Perhaps most importantly, both have taught me that to pursue this career, we must do it because it is meaningful and because it is our choice, not for some concrete recompense at the end of some imagined ‘tunnel;’ the reward is the privilege of transmitting to others, in an equitable and open manner, the various products of our research, while welcoming also their perspectives.

A number of other scholars have made a substantial contribution to the intellectual project materialized here. Patrick Kirch, second on my committee and a true advisor, fundamentally influenced my approach to conceptualizing and investigating archaeological sites. His unending support, logistically and methodologically, has helped me develop a new perspective on our place in the natural world. He also welcomed me into the *'ohana* of the Oceanic Archaeology Laboratory, for which I am extremely grateful. Ron Amundson, my outside committee member, patiently walked me through the fundamental concepts of soil science and geochemistry that allowed me to develop the understanding of site formation processes that was essential to comprehending my dissertation site. Wenceslau Teixeira accompanied me through analytical and conceptual projects in the lab and in the field in Manaus, our conversations always full of promise and potential; his support at Embrapa, as well as that of all the Soil Physics Laboratory staff and students, including Rodrigo, Taveira, Estevão, e Taty, was indispensable, and almost always above and beyond the call of duty.

The field portion of my dissertation project would not have gone forward without significant involvement from and collaboration of my fellow members of the Central Amazon Project (CAP), among whom I recognize director Eduardo Neves as primary facilitator and Claide Moraes as organizer, field director, and on-site coordinator. My work in Amazonia has always been very much tied to the fine pioneering work that Claide has done in the Lago do Limão region, and it has been an honor to work first as

his assistant, and now as his collaborator. I also count as essential colleagues in the realization of this project, logistically, methodologically, and conceptually, James Flexner, Helena Lima, Bruno Moraes, Anne Rapp Py-Daniel, and Myrtle Shock. Conversations with Lilian Rebellato, Manuel Arroyo-Kalin, and Morgan Schmidt, have also been invaluable. It goes without saying that all my work with the CAP at other sites, in other years, has contributed immensely to the way I think about Antônio Galo. Hence, I would like to thank all of the members of the project, among whom I count students and field assistants are equally recognized here, as well as the many scholars that have collaborated with the CAP in my time, including Adriana, Bernardo, Bob, Carol, Claudinha, Cláudio (Cróvis), Edimar (Negó), Elaine, Fernandão, Fernando (Caminhão), Francisco (Pupunha), Hermenegildo (Bené), Jaque G., Jaque B., Kazuo, Levemilson (Lei), Márjorie, Márcio, Marquito, Merrinha, Miguelito, Pitoco, Randy, Raoni, Sarah, and many others. In the same breath, I would like to thank all of the members of the Lago do Limão community for welcoming me and the CAP to their town and into their homes on countless occasions, I would especially like to thank Cláudio and Valdirene, as well as Seu Bené and Dona Hilda and their children, as well as Seu Nego and his family for opening their homes to me, and the Lago do Limão women's soccer team for always saving me a spot on their roster.

I recognize the contribution of the students of the first graduating class of the Archaeology program at the Universidade Estadual do Amazonas: Bernardo, Emilly, Leandro Pupunha, Adilon, Angela, Cristian, Daniel, Dennys, Douglas Jair, João, José, Laura, Leandro 'Iranduba,' Leandro 'Merrinha,' Lorena, Luciano, Luizinho, Lusinet, Margaret, Marcio, Mauro, Mick Jone, Pupunha, Suzanne, e Welmar, without whose very diligent field efforts the pool of data essential to this dissertation would have been considerably poorer – thank you for your hard work and commitment; I am infinitely proud of you!

To my assistants, volunteers and undergraduate research apprentices from Manaus and UC Berkeley, Alana, Alanna, Alicia, Andrew, Cássia, Carolyn, Dana L., Dana, Erin, Inbal, Katrina, Laura, Rachel D., Rachel E., Samantha, Taty, Thom, Veronica, Vanessa, and Yuan, whose diligent sorting and excellent prowess at deciphering field forms written in Portuguese provided the database that forms the core of the laboratory portion of this work.

Other scholars who have had an influence on my work and with whom I hope to continue conversations in the future include Bill Balée, Oliver Chadwick, William Denevan, Michael Heckenberger, Dirse Kern, Nigel Smith, Candace Slater, and Bill Woods. I also profited from discussion with faculty members at Berkeley, including Sabrina Agarwal, Lawrence Cohen, Meg Conkey, Bill Hanks, Christine Hastorf, Saba Mahmood, Steve Shackley, Candace Slater, Ruth Tringham, and Laurie Wilkie, all of whom, in their capacity as mentors, instructors, advisors, readers, interlocutors, and colleagues, have in some way contributed to the perspectives and results presented in this work.

I certainly could not have completed this gargantuan task without intellectual, philosophical, and recreational interludes from all the friends, colleagues, and 'affinal

kin' that have been a part of my life since I began this project. First and foremost, my cohort, Dream Team Archaeology: Christy, Colleen, James, Matt, Pat, Rob, and Teresa; my advisorial brothers and sisters, Andy, Doris, Esteban, Flavio, Julie, Jeanne, and Shanti; members of the OAL 'ohana Auntie Kat, Uncle Mark, Alex, Tom, and Jillian: and all the ARF or Anthro graduate students and affiliates that have been part of this journey, who are too numerous to name. I must single out Robby Q. Cuthrell, who was always a stone's throw away when methodological questions came up in the lab; Kim Christensen-Schwarz and Teresa Dujnic Bulger, who revised portions of this work, and who otherwise showed up at crucial moments to support me in the final throes; Carolyn, who spent numerous hours revising my bibliography; and Nico Tripcevich, whose support in all the ARF labs was always forthcoming, and of course his lovely wife, Cheyla Samuelson, who made sure I ate even when I thought it unnecessary.

Finally, I would like to acknowledge my family, without whose support throughout my life and educational career, I would never have found my way to a Berkeley PhD, and to extend to them the deepest gratitude. To my mother, Valeria, whose unwavering faith in me has seen me through extremely difficult times, and whose tough, scientific challenges have made me a better, more thoughtful scholar. To my father, Henrique, who encouraged me to pursue what I loved, and not what I thought I should be doing, and who was always on my side. To my brother, Gustavo, who, because of his fundamental belief in my abilities, has refused to allow me to achieve any but the highest honors and pursue any but the loftiest goals. To James, whose contribution to the body of data here compiled will not be forgotten, and whose infinite patience and faith, from the tenuous birth to the realization of this project, are equally inscribed in my memory. To my sister-in-law, Juliana, whose level-headed advice and constant support were always welcome. A very special thank you to my Tia Paola and Titta, 'controle central' in São Paulo, who, besides housing me and ferrying me hither and yon, have acted as couriers, switchboards, advisors, and facilitators, and to all my aunts, uncles, cousins and especially my grandmother, who have watched with curiosity and affection as I have carved this winding path, and who have served as tethering poles and waystations, as well as interlocutors, throughout my journey. Lastly, to my niece, Giulia, whose unconditional love and bubbling joy have served as constant reminders of why we are all here.

Chapter 1.

Narrativizing Amazonia: Past and Present

Thinking Amazonia

This dissertation is an attempt at performing an archaeology of place through exploration of the intersections of socio-cultural and natural systems. It is also, more broadly, an exploration into the many ways we think “Amazonia,” and into the roots and routes of this thinking. For this reason, even though the archaeology explored in this work dates to the first millennium A. D., the telling of this story will begin much later, with the first incidences of narration of encounters between Europeans and Amazonians, when these ways of thinking first took root. I will argue, throughout the first half of this text, that modern ways of conceiving of Amazonia are deeply historical, part of a recycling of notions and narratives over time, and also a result of intersections of academic fields, political projects, and philosophical movements that, through this very intersectionality, became and remained tethered together. Hence it occurred, for example, that ideas of ‘civilization,’ equated with the modern European way of being, were born out of place-bound instances of signification in Europe and abroad, and were later tied to ideas of progress, of complexity, and even to particular types of governmentality.

These ways of thinking, which arose from investigations into the global past, which also included Amazonia’s perceived past, were also simultaneously embedded in the foundational notions later used to excavate, both metaphorically and literally, Amazonia’s material past. As part of a growing current of scholars, I have crafted this project to create new means of disentangling our scientific endeavors from this web of notions that keep us tethered always to the same ideas. Emerging material evidence, in the form of anthropogenic soils, forests, landscapes, and environments requires a dramatic retro-fitting of notions to emerging data.

Routes to my investigation

As someone raised in Western education systems, I too was taught the prevailing images of Amazonia as a wild, pristine place frozen in time. Amazonia was a place of inestimable proportions, of unknown dangers and treasures, a place for intrepid explorers, and not for the faint of heart. Hugh Raffles (2002) speaks of Amazonia's “excessive nature” as a general structuring principle for the way that Westerners encounter Amazonia. I find this perspective particularly useful in this analysis, insofar as many of the arguments to be dissected in this dissertation that speak to the relationship between the environment and people in Amazonia depend precisely on the perceived inexorability of the Amazonian jungle. This “excessive nature,” which I will qualify as an expression of a ‘superlative-ness’ of Amazonia within the Western imaginary, is ubiquitous in European representation and appropriation of tropical nature

such as that of Amazonia. Examples of this kind of excess and superlative-ness are evident in visual media created to re-create or evoke 'jungles' such as that which features prominently in most peoples' vision of Amazonia (Stepan 2001), but also in the kinds of statistical figures that are cited with respect to Amazonia, which always features numbers framed to astound. Numbers report on Amazonia's prodigious size, the volume of water the river disgorges into the sea, the staggering number of new species recently identified, acreage deforested for the raising of cash crops, or the amount of the earth's carbon dioxide the forest filters. This vision of excess is often wedded to images that tether Amazonia to mystical or mysterious places or people, such as Hell, Paradise, and Cathedral, which evoke a sense of the minuteness of human existence, or Amazon and El Dorado, which promote the idea of Amazonia as an alluring sham.

In my analysis, I argue that the ideas of excess and surrealness that are the backdrop to global apprehension of Amazonia are a result of a fundamental problem of translation that led Europeans to misapprehend and misinterpret Amazonian places and peoples time and time again. The idea that intelligibility was crucial to the categorization, description, and subsequent policy-making surfaces throughout the text, and is vitally important to our understanding of the kinds of signification that occurred when Europeans first encountered New World peoples and as they proceeded with their project of categorizing and classifying the peoples of the world.

This investigation arose out of a clash that occurred when these deeply sedimented notions about what Amazonia should or could be encountered my real experience of Amazonia, as filtered through grand expectations created by recent archaeological literature and the quotidian mundaneness of archaeological practice in the Central Amazon. The inconsistencies between the received and revisionist views, highlighted by the materiality of the archaeological remains I encountered in Amazonia instigated the development of this project. As someone who had been 'brought up,' archaeologically, at sites riddled with complex but eminently visible and tangible architecture, I could not conceive of a habitation site devoid of houses. A budding archaeologist, I had stood barefoot on Maya floors from 2500 years ago, and only then understood the ability of archaeological research to populate the past. Standing in a field in Iranduba, Amazonas, Brazil, all I could think was: where did they walk? What was the land surface, the stage for the enactment of their lives? What were they doing here?

Hence, this project was always, in its most ambitious form, an attempt at rendering visible the invisible architecture of the past, at identifying the traces of ephemerality in order to begin to conceive of living people within these archaeological sites. Archaeological sites in Amazonia are extremely difficult to understand as lived-in places, because so many of the tools archaeologists have developed to study archaeology are insufficient in this place. Historical and ecological factors have honed our vision to some things while dulling it to others, and reduced the structures that we seek to ashes and dust. In some senses, seeking ancient Amazonian houses with our original toolkit is a bit like trawling for plankton – we come home empty-handed.

But our toolkit has been evolving, and Amazonianists have been finding innovative ways to elicit information from a place that had for decades been regarded as a backwater. My dissertation work builds on a solid data base that has been produced for the Central Amazon, as well as on work executed elsewhere in Amazonia, to attempt to re-create the structure of a pre-Columbian settlement at the level of the household, the level I consider most important and accessible for conceiving of living, breathing human beings inhabiting this landscape. The locus of this investigation is the Antônio Galo site, a Terra Preta de Índio site located in the interfluvium of the Negro and Solimões Rivers in the Central Amazon. Through an investigation of

microscopic and invisible traces of the past, I identify loci of human action at various scales, including evidence for individual fires, houses, paths, and for an entire, organized, intentionally constructed village.

Notes on vocabulary and usage

Throughout this text, I will engage with a number of distinct fields, each of which brings with it sets of concepts, definitions, and connotations that are specific to the discussions germane to that field. Where possible, I avoid the use of specialized jargon, and where this is not possible, I define such terms as they come up, or refer the reader to appropriate sources for adequate clarification. There are, however, a number of commonly used words or phrases that I wish to define very specifically for the purposes of this inquiry, and also foreign terms that are fundamental to an understanding of this project that should be clarified at the onset.

This section sets forth, for example, the terms I will be using to refer to the various parties involved in colonial encounters that characterize the European encroachment into the New World, and also the reasons for utilizing or avoiding certain terms. It also clarifies the usage of political and regional terms that characterize the setting of this archaeological investigation, situating this research within the context of the contemporary world.

The language of ‘discovery,’ (on the avoidance of).

One of the more challenging aspects of this dissertation is dealing closely with colonial texts, which were, of course, written in a colonialist mode of thought. Because one of the deliberate aims of this project is to move along a decolonizing tack, I have taken great pains to use existing non-colonialist or decolonizing vocabulary, and in some instances, to develop new vocabulary to talk about this literature and its legacy. Simultaneously, precisely because of the decolonizing aims of this project, I cannot ignore the very real effects that ‘colonization,’ here taken to mean the process of European claiming of ownership and occupation of foreign lands associated with voyaging of the 15th-19th centuries, has had on internal developments within colonized places and external perceptions of these same places. In fact, part of this project is to tease out the colonialist roots of the field of Amazonia archaeology, so that we can know how to work outside this project.

Part of this historiography will require engaging with specific moments in this history of colonization, and also with texts from this era, as well as with the vocabulary integral to this project. In order to avoid perpetuating the notions I have set out to deconstruct, I have employed a series of tactics which I lay out here. First, throughout this text, when referring to Europeans engaged in this voyaging, resource procurement, and settlement, I avoid the term ‘explorer,’ for example, because the places they visited were already very well known to humans, and to propose that such a thing as an Age of Exploration existed is to deny this knowledge. Similarly, I avoid language of ‘discovery.’

I should also have become clear that European notions of what constitutes ‘civilization,’ as a condition of existence, will be a major concern for this discussion. These notions were not only foundational for the discipline of anthropology and for archaeology as one of its sub-fields, but also to the creation of European policy toward peoples they regarded as enemies or as inconveniences as early as the 13th century A.D. (Williams 1990). When I refer to notions of

‘civilization,’ I also refer implicitly to categories such as ‘barbarism’ and ‘savagery,’ which, not incidentally, co-occur with ‘civilization’ in Morgan’s (1877) foundational evolutionary sequence. I do this in order to avoid the use of the latter two terms as much as possible within the context of discussions of evolutionist models and their legacy in contemporary archaeology – which is to say it is rather difficult. Finally, when I do use the term ‘civilization,’ it will always occur in single quotes, to make clear that I use it in reference to a mode of thought or a specific model, and not as a real category or condition that I believe to exist in the world. This is also meant to indicate the distance this term has traveled from its original sense, which indexed ‘civil society’ within a particular world order to its value-ladenness today. In the contemporary world, when used in earnest, the term serves or at least contributes to a colonialist project, carrying with it implications and having effects that often reach far beyond the intentions of the speaker.

Instead, when I refer to Europeans who traveled to these distant parts of the world of which they had no prior knowledge, I will refer to them as voyagers. When speaking of European travelers actively engaged in colonization, for example, as settlers or when referring to the structure of ‘colonialism’ as a conceptual framework for examining colonial relationships, I will use the term ‘colonist.’ In the place of language of discovery or exploration, I substitute reconnaissance and enumeration, terms I feel better convey the kind of work the voyagers were doing, or were charged with doing, in these often distant places.

The land and the earth: terms for navigating the Brazilian Amazonian ground.

The actual field work executed to address the problems and questions raised as part of this project was done in Brazil. Most of Amazonia lies within the borders of Brazil, and I see the Brazilian Amazon as the area exhibiting the most growth in terms of archaeological research. It is also, not surprisingly, the least known of the ‘Amazonias;’ the Amazonia with the greatest potential for research growth; and as a result of these factors, also the Amazonia that has the greatest potential to change what we know about Amazonia once it is known. Finally, the project that supported this research, and that continues to support expanding and increasingly rooted research across Amazonia is a Brazilian-run, Brazilian-funded project called the Central Amazon Project. For all these reasons, to give credit where credit is due to retain the research focus where it was born, I adhere to Brazilian Portuguese terminology for all terms that have an accepted local word. This section is an introduction to this vocabulary, so that the reader, if not a speaker of Portuguese, can adequately navigate this dissertation.

The main class of evidence explored in this dissertation is *Terra Preta do Índio*. Literally “Indian Black Earth,” *Terra Preta do Índio* is a kind of anthropogenic dark earth that emerged across Amazonia between two and five thousand years ago. *Terra preta* is today understood as a modified version of local soils that, through human intervention, has acquired a distinct, dark color, and also distinct chemical characteristics. In many parts of Amazonia, *terra preta* is valued as a nutrient-rich and resilient agricultural soil. In the Central Amazon, where this project is situated, it is contrasted with local, clay-rich, nutrient-poor Oxisols, which are locally referred to as *terra amarela*, “yellow earth.” In most places, *terra preta* is also associated with high densities of pre-Columbian ceramics, though a few instances of aceramic or pre-ceramic *terras pretas* have been reported. ‘*Terra preta*’ not only refers to the soil, it also can refer to an archaeological site or to a plot of land characterized by this black, indigenous earth. To avoid confusion, I try to reserve the term ‘*terra preta*’ for the material found at these sites, and not for sites or localities themselves.

Terra preta can appear in the literature and in parlance under various guises. In some circles, it is translated as “Indigenous Black Earth,” abbreviated IBE. It can also be called, simply, black earth or dark earth, and also anthropogenic black earth. The term *Amazonian Dark Earth* has been coined to define the range anthropogenic soils or deposits recognized as the result of human action that occurs within Amazonia. This term is useful not only because it helps put these Amazonian earths in conversation with dark earths from other parts of the world, most notably Europe, but it also allows us to speak of a range of phenomena that may not strictly qualify as terra preta. Of relevance here is *terra mulata*, a particular kind of anthropogenic Amazonian earth that was first identified as distinct from terra preta by Wim Sombroek (1966). Terra mulata was the local term used for this deposit, which is darker than Amazonian Oxisols, but not black. Sombroek’s hypothesis was that terra mulata was distinct from terra preta not only in appearance but also in origin. Noting that terra preta sites were often associated with large bands, rings, or swaths of terras mulatas, Sombroek proposed that terra preta corresponded to the village or habitation site, and terra mulata to the agricultural fields. The darkening of the soil, according to Sombroek, would have been the result of some variant of slash-and-burn cultivation and soil amendment with terra preta deposits.

Over the years, this hypothesis has engendered some debate, but the work of scholars such as Woods (2006) and Arroyo-Kalin (2008) seem to support this interpretation. For the purposes of this work, terra mulata will be treated like an ‘outfield’ soil that indexes an agricultural context.

A path through dark earths

My dissertation brings together three distinct fields of inquiry – Amazonian archaeology, postcolonial theory, and geoarchaeology – into a single work. In order to situate the reader, I provide an abridged history of Amazonianist archaeology, attempting to show the main routes through which it arrived where it is today. I explore colonialist thought and its impacts on anthropology, because it is essential for understanding the trajectory of Amazonianist archaeology, which in turn is essential to understanding the necessity and contributions of my project. My dissertation work is a geoarchaeology, not because I had previous training in the earth sciences, but because the main subject of this research is earth. As such, I also delineate the approach I take to this material and the possibilities of inquiry afforded by the material that were most relevant for thinking about Terra Preta do Índio. The path I take through these literatures and histories, charted below, re-traces the roads I took to arrive at my research questions, methods, and interpretations.

Chapter 2 outlines the history of the field of Amazonian archaeology. I begin by narrating first encounters between Europeans and native Amazonians, the encounters through which Amazonia as a region was initially conceived. I argue that, as Amazonia was being constructed as a place, notions about the peoples that inhabited Amazonia were simultaneously being assembled. This tendency is especially salient in the works of naturalists, whose observations about Amazonian peoples accompanied their detailed descriptions of the geography and biology of the regions. These narratives are introduced in this chapter as early antecedents of Amazonian ethnology, the findings of which formed the foundations of Amazonian archaeological narratives. These researchers searched for clues about the history of civilization

in Amazonia, and though most remarked upon the absence of markers of what they conceived of as civilization, they still posited complex interaction in the history of occupation of Amazonia.

Amazonian ethnology is then briefly introduced as a vehicle for understanding the key ‘fact-finding’ academic projects that established the comparative basis for interpreting archaeological remains from Amazonia. In many ways, ethnology was a natural outcome of holistic scientific recording, and this transition in history of scientific research in Amazonia is exemplified in the changing directorships and missions of key museums in Brazil. Early archeological and ethnological work based in these institutions helped frame ethnological and subsequent archaeological work in Amazonia. The first systematic presentation of this work comes in the form of the *Tropical Forest Tribes* volume of the *Handbook of South American Indians* (Steward (ed.) 1946-50), which also establishes the framework that defines Amazonia as a culture area. Lowie's (1948) characterization of the Tropical Forest culture area in relation to other culture areas in Latin America, namely the Andes and the Caribbean institutionalizes the hitherto implicit perspective of Amazonia as a place characterized by absences and lacks. More precisely, Amazonia becomes associated par excellence with a dearth of cultural traits then understood as markers of ‘high culture’ or ‘civilization.’

What follows is an intensive period of model-building punctuated by localized investigations, through which archaeologists labored to explain the cultural ‘gap’ encountered in Amazonia. Adaptationist models, which relied on environmental explanations, provided an explanatory framework for comprehending the absences and presences of high culture markers across Amazonia. Areas acknowledged to possess such markers included Marajó and associated islands at the mouth of the Amazon, but the presence of social complexity in isolated corners of Amazonia was explained through diffusionist models. Some of these explanations recalled ideas proposed by early explorers and natural scientists.

This period of burgeoning research in Amazonia is also marked by highly structured debate over the productive potential of the Amazonian environment and the implications of this potential for the development of culture. I argue that the notion of Environmental Limitation, though attributed to and associated strictly with archaeologist Betty J. Meggers, played a significant role in almost all major model-building that took place during this time (see Carneiro 1957, 1961, 1983 for exceptions). The work of Donald Lathrap and colleagues, which is generally portrayed as most diametrically opposed to that of Meggers and colleagues, is also dependent on ideas of environmental limitation or possibilism (see Neves 1999), although the creativity expressed in Lathrap's models in many ways foreshadows the work that characterizes most anthropological work that takes place in Amazonia today.

The final portion of Chapter 2 explains how increasingly focused archaeological work in a growing number of regions is making possible rigorous testing of some of these early models. A re-examination of existing evidence from the perspective of environmental plasticity and indigenous knowledge, along with a recognition of the heterogeneity of Amazonian environments has made possible an understanding of Amazonia as a historically managed landscape. These intensive regional studies take into account the particular histories of places under investigation, which means accounting not only for environmental factors specific to the areas under study, but also the effects of colonial encounters on the cultural patterns originally recorded by ethnographers often centuries after initial contact. A recognition of the de-structuring effects of war and disease that accompanied these encounters has helped contemporary archaeologists re-visit comparative frameworks established by the *Handbook*

(1946-50) with more caution. Research themes today focus on landscape management and environmental limitation, but also attempt to address older question of social complexity that have come down to us from the beginnings of Amazonian archaeology. Geoarchaeological work similar to that described here is in its nascent stages, and as I demonstrate in this work, will be crucial to generating the kind of fine-grained data that will enable us to test existing models and build new models for past, current, and future occupation of Amazonia.

The final section of this chapter situates my project within the local regional context, and also in relation to other ongoing or recently completed geoarchaeological work from Amazonia. I detail the work of the Central Amazon Project (CAP), which has provided not only the local archaeological background but also the logistical support for this dissertation. This work has established a regional chronology and relevant site distributions for the area of the confluence of the Negro and Solimões Rivers in the Central Amazon, where the Antônio Galo site is situated. This research project was undertaken in explicit collaboration with the CAP and other local entities, and is seen as a continuation of ongoing CAP work in the Lago do Limão region.

Chapter 3 explores the persistence of narrative tropes in the history of representations of Amazonia, touching upon the colonialist threads that bind together ethnohistorical, fictional, and scientific writing about Amazonia. The focus of this chapter is travel narratives, and I argue that the way most people in the world have come to know Amazonia, a quintessentially remote and inaccessible place, is through travel narratives. A kind of distancing of perspective is perceived in the way that travel narratives are written, and I consider the intersections of colonial projects, notions of ‘civilization,’ and archaeological science. Archaeologists exist within a continuum of explorers and scientists who have traveled to Amazonia and contributed to the construction of contemporary images of Amazonia as a place. The aim of this chapter is to explore archaeological engagement, direct and indirect, with narratives produced in earlier points in the construction of Amazonia, to name some of the effects of the persistence of these images on research into Amazonia's past, and to provide alternative routes to conceiving of Amazonia by combining archaeological research with an exploration of early, ‘naïve’ travel writing.

Throughout, I conceive of archaeologists as narrative-builders, as much because the interpretation of an archaeological site is necessarily a construction of a sequence of events in a place, but also because, with the advent of culture-history, archaeological practice also became engaged in the construction of grand narratives for tracing the history of humankind. Model-building is seen as a kind of narrative-building that abstracts particulars, but posits agents and entities interacting in space within some kind of a temporal framework. Within archaeological projects of generating generalizable or broadly comparative frameworks, these models, which are built through the agglomeration, normalization, and abstraction of site-based data, are subsequently instantiated in the form of grand narratives.

Over the course of the chapter, I enumerate, describe, and briefly trace the trajectory of four key images of Amazonia that I have found particularly relevant to archaeological model-building in the region. Amazonia has been cast as a land of scarcity, of plenty, of danger, and of fragility. Each of these casts is relevant to stages and modes of knowledge production about Amazonia, and is also relevant to archaeological projects and interpretive frameworks, which I attempt to link explicitly to the circulation of these images. The second half of the chapter examines the two earliest extant European accounts of voyages down what is now known as the Amazon River, which I argue represent two very distinct moments in conceiving of Amazonia. Each of these journeys – the descent of Orellana and his crew, and that of Pedro Teixeira –

provides us with glimpses of Iberian perspectives on Amazonia. The main difference between the two is analogous to the difference between strictly extractivist and strictly expansionist modes of colonialism, and I argue stems from a differential distribution of power and knowledge between the traveling and the host parties. I identify differences in the way that the narrators structure their accounts and also the way they portray the places and peoples encountered. I propose that the mode of narration preferred by Acuña, which was a condition of his situated knowledge and action, prevailed in Western narrative practice about colonized places, and is identifiable in modern scientific writing about Amazonia. The final part of the chapter attempts to interrogate these narratives by considering the narrators as material witnesses that were embedded in fields of discourse, and also by tentatively incorporating archaeological evidence into these interrogations.

Chapter 4 attempts to explore the complex relationship between the history of representation of Amazonia and the Americas in general, the project of defining European ‘civilization,’ the development of neo-evolutionist models in Anthropology, and the history of archaeological research in Amazonia as it is framed by research into social complexity. Drawing upon the research trajectory delineated in Chapter 2, I examine the implications of specific linguistic turns in the moment of defining Amazonia as a cultural area, which depend on implicit notions of what constitutes civilization. Tracing through the foundational theoretical work that turns the focus of archaeological research in Amazonia toward the environment, I identify points of contact between the development of neo-evolutionist models, the initial characterization of Amazonia, and the legacies of late-19th-Century evolutionism. This work involves a deep exploration of the language that is featured in discourses about civilization, the historical trajectory of intellectual traditions that I perceive as instrumental in translating notions from evolutionist models of ‘civilization’ to contemporary ideas about social complexity.

The outcome of this historical analysis is that the search for social complexity in Amazonia, per definitions established through place-based evolutionist models, is doomed to failure from the start. I propose a way of conceiving of social complexity that relies more on the complexity of social networks and the dynamics of communication and interaction than on particular material or historical indices of social hierarchy. I then propose an approach to understanding social interaction in Amazonia through an examination of place, which is concerned with memory, meaning, intentionality, and an analysis of investment in crafting and maintaining a social order that is reflected in the materiality of places. A place-based approach opens up the field of inquiry beyond classification of Amazonia for the purposes of creating a global comparative framework, allowing us to understand life trajectories in parts of Amazonia itself. It also makes use of data that are available at sites in the Central Amazon, rather than depending on negative evidence to make conclusions about social organizational strategies.

Terra preta stands as key evidence for investment and manipulation of the environment that directly contradicts some of the assumptions that ground foundational models about Amazonian pre-Columbian occupation. In Chapter 5, I explore the possibilities of extracting information from archaeological matrices, of which terra preta is a prime example. Not only is terra preta in itself a product of environmental modification and an index of occupation, it is also a repository of data about past human activity. This chapter considers the technical dimensions of the materials that make up the archaeological matrix – which I loosely define as the body of particulate matter the sum-total of which ‘fills’ archaeological sites and architectural features. The matrix is, in effect, all of the moveable matter that makes up an archaeological site.

This particulate matter can be referred to and conceptualized as sediment or soil, depending of the perspective of the researcher. In fact, these matrices usually have characteristics of both, as pedogenic and depositional/erosional processes are all constantly acting upon these particles. In Chapter 5, I review basic concepts behind pedological and geomorphological perspectives on particulate matrices and also applications thereof to archaeological or anthropological problems. I advocate for a combined approach that accounts for the effects of both processes on the archaeological matrix to ensure adequate understanding of site formation processes, among which I foreground anthropogenic processes.

Anthropogenesis, anthropogenic soils, and anthropogenic sediments are the focus of the final section of Chapter 5, where I discuss degrees and kinds of anthropization, as well as examples of archaeological anthropogenic matrices from various parts of the world. Terra preta is discussed in detail as an anthropogenic matrix and as an object of study, and I delineate the specific methods I intend to apply to the present study of Antônio Galo.

Chapter 6 develops the specific research questions of this project, which arise out of the micro-scale research advocated in the preceding sections. Building on previous CAP work at the Antônio Galo site (Moraes 2005, 2007), we returned to a specific portion of the site that has been recognized as well preserved, and also as presenting intelligible presumed house contexts. This sector of the site, which I have denominated the North Precinct, was investigated primarily with a view toward determining whether the mounds were indeed house contexts, and establishing the degree of spatial heterogeneity observed within this precinct. Toward this end, a mixed methodology of targeted excavations, primarily but not exclusively sited on house-mounds, and widespread coring and augering was implemented across the North Precinct.

Discovery of apparent habitation debris at the top of the mounds and construction contexts beneath the habitation layer supports the initial hypothesis, and the North Precinct is seen as an analogue of a ring village, as seen ethnographically in Central Brazil (Maybury-Lewis 1979) and the Upper Xingu (Heckenberger 2005), and tentatively also in pre-Columbian Arawak contexts in the Caribbean (Petersen 1996). The precinct conforms to expectations insofar as it is a set of house-mounds arranged in a circle around a central plaza, although no analogue for a men's house has yet been confirmed. A close analysis of field results from a core-and-auger survey suggests specialized mounds or special-function contexts within the otherwise debris-free plaza may still be verified at the site. Spatial analysis on the scale of the site and the landform, made possible through micro-topographical work has raised questions about the potentially constructed nature of the interior of the plaza, as well as the orientation of village spaces with respect to hydrographic features and other occupation areas. Limited time precluded additional testing of areas south of the North Precinct, and hence correlations between these occupations cannot yet be proposed.

Field results did yield evidence of spatial differentiation across a site, including differential deposition encountered between mounds. One of the most striking findings from fieldwork was the clarity of stratigraphy, at least at a macro-scale, which surpasses that encountered at any other site. This made possible the temporal parsing of occupation of the site into a minimum of two moments, based solely on field data, where we had observed a charcoal-rich horizon beneath what appeared to be a mixed deposit. The identification of distinct features at particular mounds confirmed the presence of an anthropic occupation that preceded construction of the house platforms. Additionally, various types of features or otherwise unique contexts were identified. We postulated some of these deposits or features might be associated

with burning contexts, ritual contexts, or house construction, although the final analysis of many of these contexts was resolved only after the completion of laboratory analyses.

Chapter 7 begins with a discussion of a re-formulation or re-focusing of research questions in light of samples and results obtained through field work. The excellent state of preservation of contexts encountered in the field allowed me to at least tentatively confirm the efficacy of particular measurements, for example, indicators of buried land surfaces. Organic carbon turned out to be a good index to use in this particular scenario where the soil used for construction was minimally modified, and distribution of sand grains seemed to correlate with this measure.

By looking at variation of chemical and granulometrical data in conjunction with micro-artifact analysis, I was able to further parse deposits that had been recognized as different but poorly understood on site. Specifically, deposits that had appeared somewhat macroscopically distinct, but more similar to each other than to habitation layers had initially been interpreted as distinct construction deposits. By combining indices for buried land surfaces with an analysis of micro-artifacts, I determined that a more likely explanation for the lower formation was that it was a buried land surface that had experienced a different kind of deposition than land surfaces that had been distinguished macroscopically by color. The kind of deposition observed in buried land surfaces beneath some house platforms potentially index use as a house floor, which changes our notions of the parsing of space across the North Precinct before the construction of the house platforms. This re-interpretation also has implications for our notions about continuity and change of occupation strategies over time, as well as of the complexity of the occupational history of the site. Microanalyses also aided in interpretation and association of specific features encountered but poorly understood during excavation, and confirmed the presence of other feature-like anomalous deposits that had not been obvious to the naked eye. Finally, this analysis has made possible the preliminary parsing of the kinds of information that would be most useful for understanding spatial or temporal variability, and also has informed notions of the resilience of different kinds of traces of human activity.

Chapter 8 examines field and laboratory data and interprets them within the proposed model. The first part provides an interpretive sequence of events at the site, considers its evolution as a place of habitation, and considers it within the broader cultural landscape. Data produced through laboratory analyses are considered in terms of success in describing spatial variation or particular activity areas across the site, with a view to reconstructing aspects of daily life at Antônio Galo. Microscopic and invisible soil and sediment signatures are considered as indices of soil and landscape modification

The results of this project have implications for understanding daily life and the materiality of existence at Antônio Galo, and for our general understanding of Amazonia before the arrival of Europeans. The site is seen as the cumulative result of momentary decisions by past inhabitants of Amazonia, and also as a locus of a continuous occupation that is more likely characterized by iterative change than by discontinuity. The kind of investment and stability of habitation attested to by the levels of re-modeling observed at this site run counter to widely accepted notions of ancient lifeways in Amazonia. Replacing, or at least amending, mainstream images of Amazonia with the images and narratives made possible through this project also makes possible a re-figuring of the present and future of Amazonia.

Chapter 2.

Archaeology in the Amazon Basin

Rough sketch

This chapter will trace three key moments in the history of archaeological work in the Amazon basin, since the region became known as such through reports of European voyagers and travelers. In the first moment, independent researchers traveling in Amazonia, and working within the realm of the holistic sciences, suggested that Amazonian peoples were embedded in a long and complex web of cultural and linguistic relationships that could be studied scientifically. The second moment is characterized by a desire to define Amazonia as a culture area, and articulate its relationship to other culture areas in Latin America, a period marked by functionalist explanations of cultural traits, environmental explanations, and diffusionist models. The third moment is marked by intensive regional study, multidisciplinary work, and explicit examination of chroniclers' accounts to examine social complexity, landscape management, and human-induced environmental change.

In order to illustrate the context within which naturalists and early scientists came to know of Amazonia and conceive of it as a region, I outline the material consequences under which Amazonia entered the European imaginary. I briefly describe the sporadic and fraught encounters that define the first moments of European imagining of this place, with a view toward demonstrating the extent to which visiting Amazonia has never been (or become) “business as usual,” at least in the conception of European and so-called Westernized or modernized visitors. This very brief descriptive section is meant to provide a temporal framework of Amazonia's entrée into or coming-into-being within a European worldview, along with a sense of the plane in which it was placed within this order. Details about how this imaginary plane came to be constructed for Amazonia by means of visual and verbal cues, and the ways that these cues were interpreted and re-figured by scientists and the public at large will be the subject of the next chapter.

The goal of this chapter is to work through the investigative traditions that characterize Amazonian archaeology, which has its roots in accounts produced through traveling, voyaging and journeying, and especially in the proto-scientific writing of geographers and naturalists of the 18th and 19th centuries. I consider the initial formation of Amazonian archaeology and anthropology to consist of scientific travel narratives that are an outgrowth of other kinds of travel narratives. I trace through the chronology of the formal field of Amazonian archaeology, contextualizing the theoretical foci within developments in Americanist archaeological theory and practice. This phase of research in Amazonia is characterized by a dominance of Americanist notions, perspectives, and practices, and is seen as responsible for the creation and widespread propagation of foundational ideas about the scope of possibility for Amazonian pre-Columbian occupation. Finally, I narrate the birth of a new set of possibilities for this history, made possible by the co-occurrence of three factors: first, the emergence of a strong, local archaeological scholarship; second, new perspectives on Amazonia's people and environments

made possible by the evolution of (decolonizing) ethnographic or ethnological work; and third, the recognition of Amazonia's nature as highly “cultured” by social and biological scientists. I consider this multi-disciplinary conjuncture to define the present moment of work in Amazonia, within which I situate myself and this project.

Setting the Stage: First encounters with Amazonia and its past

The first phase of knowledge creation about Amazonia's past involves an initial period of data-gathering and image construction, in the form of exploratory missions, followed by a period of ‘scientization,’ during which the process of describing the Amazon became increasingly codified and shaped to fit within European knowledge structures. While initial encounters between Amazonian inhabitants and Europeans were driven by institutional needs, specifically those of the Spanish Crown, later, systematic attempts to map Amazonia and its inhabitants and subjects of study were much more independent in nature. The era of the gentleman scientist emerges within the context of a global European mapping project within which the Sciences, then apprehended in a holistic manner, were being constituted as fields. By compiling detailed observation about the “natural” world, these researchers, whose long voyages took them through distinct and often unreported portions of Amazonia, began to suggest that Amazonian peoples were embedded in a long and complex web of cultural and linguistic relationships that could be studied scientifically.

By order of the crown

As powerful organizations that controlled not only large sums of money, but military forces and religious organizations, European monarchies funded and controlled most initial forays into little-known parts of the ‘New World.’ The Spanish crown was no exception, and its exploration (and exploitation) of territories in the Americas was well underway by 1541, when Spanish emissaries first stumbled into the lowland river basins covered in dense forest known today as Amazonia. From this perspective, Amazonia first entered the European imaginary as a kind of resource “mine,” and only later became attractive as a territory to occupy. The distinction between two perspectives is critical for understanding the kinds of images that emerged about Amazonia, and will be taken up in Chapter 3.

Known then as the valley of the river of the Amazons, through which flowed the Rio Marañon, this place was initially described as a heterogeneous and inhabited landscape that was populated by a variety of peoples, flora, and fauna that defied imagination. In some aspects, and at particular junctures, the valley was familiar and habitable, and in others, foreign, inhospitable, and downright terrifying. A discussion of the way initial impressions varied among voyagers, and also of the way they were communicated through a suite of representational practices and later were incorporated into grand narratives about the history of Amazonia will be taken up in Chapter 3. The purpose of this section is to situate the reader within the historical context of these early encounters, which later provided the fodder for the naming, classification, and signification of Amazonia beyond its bounds.

Accidental tourists.

Although some may name the discovery of the Amazon river to 1500, when Pinzón reports sailing in a “Mar Dulce” (freshwater sea), off the northern coast of the Portuguese territory in northern South America, which waters he likely attributed to a river, there is no reason to believe that Pinzón could have known that this body of water led to the Spanish territories in the northwest of South America. I thus consider the first complete riverine voyage from said Spanish territories to the Atlantic Ocean as the first moment that any European person conceived of this region as an entity. This place enters the European imaginary through documents composed by Friar Gaspar de Carvajal, who provides an eyewitness account of the descent, and a letter by Gonzalo Pizarro, whose role in the voyage is made clear below. These documents were written for the perusal of the Spanish crown in 1542 (Medina 1934), and, taken together, consummate the moment upon which the region we now know as Amazonia became constituted as a somewhat (albeit precariously) bounded entity for Europeans.

The first descent of the Amazon River by a European vessel was accomplished by Francisco de Orellana and his crew, sometimes cast as deserters of Pizarro’s failed voyage to the fabled “Land of Cinnamon.” Because historical documents that report on these voyages are few, temporally remote from the present time or from the time of the voyages, and in some portions only partially legible or comprehensible, the details of published accounts and translations vary. Throughout this text, I rely on Medina (1934) whose translation and analyses seem most balanced of the available accounts, to resolve conflicts of representation and for general clarification.

Rumored to exist in the region west of Quito, the “land of Cinnamon” was one of many “fabled” countries avidly sought by Europeans, and in the last days of 1539, Pizarro led one such expedition. Pizarro’s voyage ended in failure ten months later, when his most significant find consisted of a hillock covered with a few trees whose leaves, but not bark, exuded a smell comparable to that of the true cinnamon then found only in Ceylon. Whether Pizarro found ishpingo (*Ocotea quixos*), whose fruit calyx has a strong cinnamon-like aroma, due to its high concentration of Cinnamaldehyde (Naranjo et al. 1980), or a tree with a sweet-smelling leaf (*Aniba canelilla*) is still under debate, but what is certain is that the governor resolved to journey further inland in search of this valuable resource.

By the time Pizarro and his crew had reached the mouth of the Rio Napo, disease, hunger, and the difficulty of travel had put the company in such dire straits as to warrant a splitting of the party. One of his captains, Francisco de Orellana, volunteered to travel downriver with a small team in search of food for the expedition, and it appears that the two commanding officers and their respective parties failed to meet again. Having survived the passage of dangerous rapids, suffering from hunger and fear, Orellana and his companions proceeded downriver, following the route of least resistance. After waiting in vain, Pizarro and what remained of the original crew returned to Quito.

The voyage downriver undertaken by Orellana and his crew was recorded by Friar Gaspar de Carvajal (Medina 1934) over the course of 1540 and the beginning of 1541. This voyage was not strictly commissioned by the Spanish Crown, and the men were grossly unprepared for the nature and scale of the voyage which lay ahead. This set of circumstances results in a narrative that differs somewhat from the ones that follow, and in this regard, this account can be said to be one of survival and discovery, rather than one powered by economic

interests. The way that this difference of perspective and purpose functions as a representation, and its particular utility in narrative building is taken up in Chapter 3.

Reconnaissance missions and royal commissions.

Reports of the existence of the Rio Marañon, as it came to be called, a river that essentially connected Lima, the heart of the Viceroyalty of Peru, with the Atlantic Ocean, spurred desires to claim, explore, and conquer the associated “Valley of the Amazons.” In the *modus operandi* of the era, the Spanish Crown awarded the discoverer of the territory, Francisco de Orellana, governance of province, prompting what proved to be the first of several fatally failed voyages to the region. Orellana, who died upon his return to Amazonia, was soon followed by Pedro Ursúa and his crew in 1560. Ursúa and crew sought the city of El Dorado, said to lie in the provinces of the Omaguas on the banks of the Rio Marañon. This journey, which descended to the Rio Marañon via one of its upper tributaries, likely the Huallaga (Markham 1859), was prematurely cut short by a mutiny led by Lope de Aguirre and a handful of other men (Edmundson 1920; Markham 1859). The mutinous crew, led by Aguirre, is said to have descended the Marañon as far as the Rio Negro, which they then ascended, eventually reaching the Atlantic via the “streams of the Casiquiari and Orinoco” (Markham 1859:x; Brand 1941 seems to confirm this report). Unfortunately, no extant first-hand account of this voyage has been published, and all documents dealing with it seem to focus more on the mutiny itself than on data recovered during the voyage.

As noted above, cinnamon was only one of the lures for European voyagers hoping to find their fortune in Amazonia. The metallurgical prowess observed in the Andes and Central America, particularly in the manipulation of gold, along with rumors of the existence of a lake, river, or city (e.g. El Dorado) where copious amounts of gold could be secured piqued the interest of Europeans. According to Sir Walter Raleigh (2001 [1596]), the first report of the city of el Dorado, or Manoa, as it was also called, was an accidental upshot of a voyage by Diego Ordas, who perished after arriving in Guiana. According to Raleigh, one Juan Martinez, a member of the failed voyage, charged with negligence in the case of the explosion of a munitions store, was sent inland on a canoe as punishment. Martinez reports that he was rescued and held by residents of Manoa, but was unable to report on its exact location. Others who sought Manoa or El Dorado include Jeronimo Ortal de Saragosa, Hernandez de Serpa, Don Gonzalez Ximenes de Quesada, and Antonio de Berreo (Raleigh 2006 [1596]: par. 17). Brand (1941) reports on voyages by Europeans that mapped other parts of the Amazon basin, including those undertaken by envoys of the Welsers, based out of Venezuela (1528-46); George of Spires (1535-38); Phillip von Hutten (1541-45); Hernin Perez de Quesada who explored parts of the Upper Amazon basin (1569); and of course, Raleigh himself, who traveled to the Guianas in 1595, but whose reports (2001 [1596]) cover other regions, and notably tend to vary wildly from most other accounts.

European knowledge of the Amazon and Orinoco basins was expanded in the 17th and 18th centuries by voyages commissioned to map and reconnoiter the river and its surrounding region. Significant voyages include that of a Portuguese sailor known as Francisco Hernandez and the accompanying Franciscan friars or lay brothers named Domingo de Brieva and Andres de Toledo. This 1636-1637 journey was later recorded by Laureano de La Cruz in 1653 (Edmundson 1920; Ramos 1958; Meggers 1971; Reeve 1993). Following this voyage, Pedro Teixeira traveled the river in both directions from 1637-1639, accompanied by Domingo de Brieva on the way upriver (Edmundson 1920) and Father Cristoval de Acuña on his return

voyage (Markham 1859). Teixeira's voyage to Quito was later recorded by Alonso de Rojas (Edmundson 1920), while Acuña himself recorded the journey back to Grão Pará, at the mouth of the Amazon River. The final full descent of the river that I consider within this class is that realized by French cartographer Charles-Marie de la Condamine (1944 [1745]) commissioned to map the equator in 1754, traveled the length of the Rio Marañon, contributing his own reports and interpretations about the “Valley of the Amazons”. The accounts of Acuña and la Condamine will be revisited below, Acuña's in particular serving to exemplify the mode of narration that came to characterize narratives of classification and ownership produced by colonialist parties.

“Tilling the soil” in the name of ‘civilization’

These early reconnaissance missions were requisitioned for the purposes of intelligence-gathering, and with a view toward resource extraction, economic and imperial expansion, and military positioning. A subsequent series of royal commissions which followed on the heels of these exploratory voyages reflected a shift from extraction and exploitation toward settlement and ‘civilization’ of the region. Traditionally, these phases would be glossed as ‘exploration’ and ‘colonization’, respectively, but as expressed in Chapter 1, this language privileges the European perspective and casts the relationship between Europeans and the inhabitants of the Americas as one of dominance. The use of the word ‘civilization’ in place of ‘colonization’ here is deliberate, as the project of ‘civilizing’ the Amazon appears to comprise a range of actions on the ground that can be understood as belonging to two main lines of attack. One tack of the civilizing mission pertained to physically manipulating the landscape into fitting within the bounds of what was considered by European standards a ‘civilized’ place. The second part of the mission targeted the inhabitants of Amazonia as heathens in need of salvation, the first step toward transforming these ‘savages’ into ‘civilized’ people. The dual nature of this project, which attempts to create a civilized reality by targeting people and places simultaneously, reflects what I will propose in Chapter 3 is a primal effect of sensation, through which people and places are simultaneously constructed, and inevitably co-constitutive.

In keeping with this dual mission, Europeans employed a two-pronged approach of missionizing and survey within the next series of forays into Amazonia. No longer seeking to merely economically exploit the products of Amazonia, these efforts aimed to subdue, occupy, and thus take ownership of the region, either through changes in daily life or through detailed mapping of the region. As Acuña's account foreshadows, the ultimate goal of this series of missions was to make possible the reproduction of idealized European settlements throughout the ‘New World.’ As reflected in reconnaissance accounts, we can surmise that for the ‘colonizing’ force, this meant establishing “good, Spanish farms” across Amazonia. Considering, very literally, the meaning of the term *colony*, as derived from the Latin “*colonus*” meaning “settler” or “tiller,” the metaphor “tilling of the soil” is quite apt. Whether through the establishment of settler societies or through the transformation of Indians into European-style peasants, the Spanish had moved from exploitation of Amazonia and toward cultivation a Spanish way of life there.

Missionization voyages, which aimed specifically at conversion of Indians for the purposes of colonization and occupation of the land, began in the 17th century. Missions established in the upper Amazon basin were founded by Spanish priests, while those in the lower Amazon were the work of the Portuguese. Missionary accounts from the 17th and early 18th

centuries include those of Luiz Figueira and João Felipe Betendorf (Barreto and Machado 2001), and the extensive diaries of Father Samuel Fritz (1922), who recorded details of daily life among missionized Omagua in the late 17th and early 18th centuries. Other key missionaries who worked in this region include Francisco de Figueroa (1612-1666), Paul Maroni (1738), Franz Veigl (1723-1798), and Hundertpfund (ca. 1745). In the lower Amazon, near the region of Grão Pará, Portuguese friar Antonio Vieira is heralded as the chief missionary, as well as a protagonist for the native peoples (Brand 1941). Another notable friar from the lower region is Anselm von Eckart (c. 1721- c. 1809, per Brand 1941).

Another means of gaining control over a region is to map, catalog, and name the object of desire. The first voyage that was framed explicitly as exercising these technologies was that of La Condamine (1944 [1759]), who traveled down the Amazon River in the official guise of geographer. La Condamine's voyage can be considered the first scientific voyage down the Amazon River (Barreto and Machado 2001). His narrative marks the beginning of a new era of European conception of New World peoples. By the time of La Condamine's voyage, the European Enlightenment was well underway; the influences of these emergent ways of thinking are evident in La Condamine's concern with governance and with the formation of nations (1944 [1759]:82) among the mythical warrior-women known as the Amazons. Multiple projects concerned explicitly with mapping Amazonia followed, which increasingly included, as will be discussed in the next section, the enumeration, description, and classification of things, from the smallest insect to the land itself.

I ground my analysis of European aspirations for their occupation of Amazonia in a “landscape perspective” that I will discuss in greater detail in Chapter 4. By “landscape perspective,” I refer to a sensory perspective which requires and makes use of distance for signification, and which is markedly different from the kind of apprehension of three-dimensional space involved in placemaking. This perspective also has a flattening effect, due to the loss of detail that inevitably accompanies this distance. As Europeans traversed Amazonia via the Amazon River and its tributaries, landings were few and far between, such that most of the region was apprehended through visual means and other “distance-sensory” experience. As such, considering this landscape perspective as the way most of these early European travelers experienced the majority of Amazonia is important for understanding the particular kind of meaning-making that occurred in these encounters.

The encyclopaedia project

The late 17th and early 18th centuries saw the establishment of a number of societies and universities. Somewhat analogous to Spanish efforts at gaining control over parts of its empire through mapping and enumeration, the various voyages and exploratory missions sent forth by these organizations were geared toward description of the natural phenomena of the world. Naturalist scientists, trained in a variety of fields such as botany, zoology, geography, geology, and cartography set off from their homelands with the intention of enumerating, describing, and in some sense mapping the “X” of a particular geographical location. Sometimes, “X” corresponded to a particular kingdom, class, or phylum of the natural world, and in other instances, the goal was more broadly descriptive. The bodies of data acquired during these voyages and archived, organized, and published by these societies, would provide much of the

raw data that would later be incorporated into European evolutionist narratives. These bodies of data also provided the meat of modern-day encyclopaedias, and for this reason, I call this the “encyclopedia project” (after Lopiparo 2006). In the context of the exploration of Amazonia, many of these scientists, such as Charles Hartt, Herbert Smith, and Louis Agassiz concerned themselves chiefly or strictly with the flora, fauna, and geology of the regions they explored. Others, like Alexander von Humboldt and Charles Friedrich Phillip von Martius were also deeply concerned with recording the practices and characteristics of the inhabitants of the banks of the Amazon and its tributaries.

Systematic recording and collection of indigenous art and artifacts began in the Amazon in the 18th century through the work of botanists and naturalists such as Alexandre Rodrigues Ferreira and Alexander von Humboldt (Hemming 2001; Barreto and Machado 2001; Smith 1995). As a Portuguese scientist, Ferreira was granted access to the Brazilian Amazon, a courtesy not afforded to other European voyagers and naturalists including Humboldt, Wallace, and Bates, as well as Joseph Banks, and countless others (Hemming 2001). While the latter continued on their voyages to the Pacific and other parts of the New World, Humboldt proceeded to the mouth of the Casiquari in the Northwest Amazon, where he followed the holistic naturalistic practice of recording everything from the course of the river, to the nature of flora and fauna, to practices and material culture of indigenous peoples (Barreto and Machado 2001; Smith 1995). Humboldt was careful to note, beyond all that he saw, all that he did not see. The managed forests of 18th-Century Amazonia, incomprehensible to Humboldt, along with a lack of recognizable archeological ruins (i.e. monumental architecture), suggested the absence of what Humboldt considered ‘civilization.’ The remains he did observe, he took as evidence of a primitive race, which Humboldt postulated might have descended from Asian cultures (Barreto and Machado 2001).

In the context of ancient archaeological sites under investigation in the Old World, and that of Andean and Mesoamerican cities, Amazonia paled in comparison, seemingly lacking in significant history. In the absence of historical texts, and with archaeological investigations still far in the future, Amazonia’s past could only be studied within the context of its present. In this spirit, von Martius composed what can be thought of as the first evolutionist narrative of Amazonian origins (Barreto and Machado 2001). A botanist, von Martius traveled through Brazil and most of Amazonia with zoologist Johann Baptist von Spix, producing over the course of his life a number of seminal volumes on the flora and fauna of Amazonia and Brazil. The portion of his work that can be considered ethnological, which relied on quasi-ethnographic observations gathered over the course of a three-year expedition in the early 19th century (1817-1820), correlated linguistic and socio-cultural data from across the Brazilian Amazon to arrive at a model of great antiquity for the occupation of South America. Relying on Humboldt’s one-race theory, von Martius proposed that the observable characteristics of lowland South American groups were the result of devolution from an ancient high culture that he linked to known Andean ruins. Von Martius proposed the existence of undiscovered lowland ruins that might clarify this connection (Barreto and Machado 2001). Narratives such as these provided inspiration for modern anthropological and archaeological field research into Amazonian peoples.

Scientific research programs

By the early 20th century, largely in response to the cultural evolutionism that characterized the latter half of the 19th century, anthropologists began questioning the value and accuracy of over-arching theories. Rejecting the broadly comparative nature of evolutionist work, many ethnologists, especially those of the Boasian school, began intensively gathering ethnographic data as part of a historical-particularistic endeavor. Rather than attempt to insert cultures into atemporal evolutionary structures, they sought to situate cultures within their particular histories. Intensive fieldwork performed initially by independent scholars, and later by scholars explicitly affiliated with institutions and research programs, began to form a picture of the range of customs and breadth of cultural variability that existed among non-European peoples.

Because this formative period not only pre-dated, but also largely framed Amazonian archaeology, I briefly introduce the major contributors to this early ethnology of Amazonia, which I consider to run from the start of the 20th century through 1943. Subsequently, I discuss the formalization of the field of Amazonian archaeology within the context of the American four-field approach. The second half of the section delineates the ways in which the field of Amazonian archaeology, at the end of this era, began to develop along an extremely narrow tack. I describe the main research schools that developed in Amazonianist archaeology, and also the role that the environment played in this early era of model-building. Considerations of agriculture as a marker of or pathway to social complexity, which became an over-arching theme of research follow, leading to a discussion of the causes and effects of the telescoping of research themes that characterized archaeological work in Amazonia through the 1980s.

The state of the art in 1943.

Research into Amazonia's human past and present was a fairly seamless outgrowth of naturalistic research within the region, but also integrated itself into the project of concaving of a national Brazilian identity. Revisiting questions of origins proposed by von Martius, Barbosa Rodrigues and Gonçalves Dias began investigating the river basins of some of the Amazon's lower tributaries. The Museu Paraense de História Natural e Ethnographia, the first museum established in Amazonia, was founded in 1866 by Domingo Soares Ferreira Penna, a naturalist noted for his innovative attitude toward Amazonian archaeology and ethnology. Opting to study the former as prelude to the latter, Ferreira Penna in essence developed a kind of Direct Historical Approach three quarters of a century before Steward's (1942) article delineated the parameters and merits of this approach for North Americanist archaeology. Ferreira Penna recognized sambaquis, Brazilian shellmounds, as archaeological sites, and his work in Pará is marked by meticulous notes regarding the sediments, ecofacts, and artifacts that characterize the structures. In 1890, Emílio Goeldi, a prominent zoologist initially employed by Ladislau Netto at the Museu Imperial e Nacional in Rio de Janeiro, was brought to Pará to reorganize the Museu Paraense. Because of his tremendous contribution, the museum, which remained for over a century the focal set of collections on Amazonia, was renamed the Museu Paraense Emílio Goeldi (MPEG) in 1902. During this era, scientists trained in a variety of disciplines, such as geography, entomology, zoology and biology, including Charles Hartt, Adolpho Ducke, as well as Penna and Goeldi themselves, conducted archaeological research in Amazonia and participated in the construction of narratives about the origins and affiliations of Amazonian

Indians. Today, the MPEG remains a key center for research and publications within and about Amazonia.

Formal anthropological research in Amazonia began in the early 20th century, with the prolonged and extensive research of Curt Nimuendajú. Born Curt Unkel in Jena, Germany, Nimuendajú was a self-taught researcher who travelled to Brazil with the support of various institutions, including the University of California, Berkeley and the Göteborg Museum of Sweden. Over the course of nearly 40 years of intermittent but intensive fieldwork, Nimuendajú identified, mapped, and studied a number of indigenous groups in Amazonia and Brazil, meticulously observing and noting their customs, learning their languages, and creating lexicons. Among the tribes he studied intensively are those belonging to the Gê linguistic group, including the Apinayé, the Guaraní, the Tikuna, the Kanela, the Wanano, the Kaingang, and the Xerente. Along with his ethnographic work, Nimuendajú recorded physical aspects of the landscape, at one point linking the existence of abandoned terra preta sites with the antiquity of Amazonian occupation. Erland Nordenskiöld was another key anthropologist who worked in the region, and who formed part of this formative group of scholars. These young and often solitary ethnologists were said to be following in the footsteps of Karl von den Steinen, a founder of Brazilian ethnology.

The work of these anthropologists, along with the founding of the MPEG, was crucial for drawing the focus of research into the interior of Brazil, and also for inspiring young ethnologists, such as Alfred Métraux, Claude Lévi-Strauss, and Albert Gillin to conduct research in Amazonia. The maps, lexicons, and detailed descriptions produced during the first four decades of the 20th century laid the groundwork for later anthropological work, and served as the backdrop against which frameworks for understanding the deep past of Amazonia were erected.

The Handbook series.

One of the most comprehensive anthropological compendia to emerge about Amazonia appeared in Julian Steward's edited series of volumes entitled *The Handbook of South American Indians* (1946-1950). The third volume of the series, entitled *Tropical Forest Tribes*, defines the culture complex of the same name, delineating the regions within the complex could have been identified. This volume features contributions from anthropologists working across Amazonia, and presumably presented all known data about the newly-defined region. Working at the twilight of the culture-historical period of archaeology, when many American anthropologists were taking a four-field approach to the discipline, most contributors include data pertaining to more than one anthropological sub-field. The result is the inclusion of a mixture of ethnographic, linguistic, archaeological, and biological data in most chapters of the *Handbook*. Accounts of tribes almost always include contact histories, and occasionally, references to previous ethnographic or archaeological work. In some cases, a close engagement with archaeological findings or travel writings allows the author to employ a temporally comparative approach toward the anthropology of a sub-region or tribe.

Insofar as the volume constituted a state-of-the-art report on Amazonian anthropology, it was a spectacular publication. As synthesizers, Lowie and Steward pulled together disparate datasets and employed a comparative framework to create a narrative, however static, about the region – which perhaps was their only mistake. To Steward's credit, the volume is prefaced (1948b) by an extensive note on the incompleteness of source data and the incipient state of research that precluded more historically, ecologically, or anthropologically oriented syntheses.

Lowie and Steward were well aware of the pitfalls of comparing archaeological datasets with strictly contemporary ethnographic accounts. Ethnographic data reported on dynamic processes of daily life, including ephemeralities such as dance, speech, song, and movement, abstractions such as social, economic, and kinship structure, as well as the form, function, and aspects of perishable material culture including textiles and wooden implements. In contrast, archaeological data of the time reported strictly on ceramics and general site structure or location. Hence the inevitably richer, more vibrant, and more complete ethnographic data were interpreted as somehow more “true” or reliable than the archaeological data. The facile adaptation of archaeological data to fit models generated through ethnographic study was understandable and unsurprising, but unfortunately had very real consequences for the development of Amazonian archaeology. As the first and only authoritative volume about native Amazonia, the *Tropical Forest Tribes* volume of the *Handbook* laid the groundwork for general perceptions of Amazonia, and, especially in Americanist archaeology, had a fundamental impact on research development or lack thereof within the region.

Notably, the Tropical Forest culture or Tropical Forest complex (henceforth TFC), from which the volume takes its name, is treated only summarily. In his introduction to the volume, Lowie characterized the TFC as distinct from the “higher Andean civilizations by lacking architectural and metallurgical refinements” (Lowie 1948: 1). Lowie noted that the TFC peoples had in common the cultivation of manioc, the use of hammocks and rivercraft, and the manufacture of pottery. At the end of the volume, Steward's summary interpretation of the volume seeks to define the regions in which the TFC is encountered, as well as the locations of the so-called “marginal tribes.” According to Steward (1948a), TFC tribes fall higher on the evolutionary scale than the “Marginal” hunting and gathering tribes that reside in the periphery of the Amazon. Details regarding the kind of evolutionism that Steward was developing, as well as the ways in which this theoretical framework ties in with larger intellectual movements concerning European notions of 'civilization' will be discussed in Chapter 4.

Two chapters in the Tropical Forest volume of the *Handbook* deal specifically with archaeology, though only one, namely Meggers' (1948) laudably cautious summary of archaeological work in the Amazon basin, deals with Amazonia. The Amazon basin is loosely defined by Meggers as the valley that accompanies the river from its source in the Andes to its mouth in the Atlantic. Based on a handful of sites investigated along the banks of the Amazon River and in the vicinity of its mouth on the North coast of Brazil, Meggers divides the Amazon basin into four regions, for the purposes of description. Marajó Island and the Santarém site each define individual regions, by virtue of possessing combinations of traits not found elsewhere. Meggers also delineates a Northeast Brazil region, which brings together the Cunany site, located approximately 300 kilometers from the mouth of the Amazon, where the sites Caviana and Maracá demarcate its southern extent. This “Northeast” should not be confused with the region known within Brazil as “the Northeast,” which extends from Pernambuco at its northernmost point to Bahia in its southern extent. This Brazilian Northeast is understood within Brazilian regional classification as totally distinct from “the North” of Brazil, of which all states wholly contained within Amazonia are a part. Finally, Meggers identifies a “Middle Amazon” region, which appears to include the area bracketed by the sites Miracanguera, Manaus, and Tefé, a stretch of the Amazon River that corresponds to the region between the mouths of the Madeira and Tefé rivers that covers a distance of approximately 700 kilometers east to west, as the crow flies. For each region, Meggers describes the known details of relevant sites, including

dimensions and features, and also details ceramic form, paste, decoration, manufacture, and, where available, funerary contexts.

The new research paradigms: theorizing Amazonia in deep time.

The Tropical Forest Culture volume represents a unity in thinking about Amazonian archaeology, anthropology, and its long-term history that would not be matched again. The publication of the *Handbook* series coincided with the start of a transformation in Americanist archaeology, during which time archaeologists were beginning to employ increasingly sophisticated scientific methods and models to archaeological data. Although the New or Processualist archaeology officially came of age in the 1960s, the seeds for this so-called “paradigm shift” were sown in the early post-war years (Taylor 1948). As Americans became increasingly aware of the role of science in the assurance of survival as a nation, especially in wartime, ideologies of science came to influence other sectors of American life from the nutritional sciences through to the social sciences.

The end of World War II marked the beginning a new era in international relations, especially because of the de-structuring effects of major power shifts within Europe, between Europe and the United States, and between major colonizing powers and residually colonial or post-colonial states outside of Europe and North America. During this time, the importance of comprehending long-term histories of social and political interaction, change, persistence, and migration, especially in places where European colonial powers had recently withdrawn, were seen as crucial to successful internal and foreign policy development. The establishment of the National Science Foundation in the United States jump-started Americanist research in many of these places, where previously only private donors had financed expeditions, and simultaneously the United States government became increasingly interested in the intelligence generated by these and other overseas intellectual projects.

It is in this stage that the second phase of development of Amazonian archaeology took shape. As ideologies of science began to take hold in the realm of nationalistic politics, it became vitally important to systematically study the past and present of territories outside the United States. One of the principal characteristics of archaeological works produced in this era is the expansiveness of theories, evidence of an urgent need to understand, in broad strokes, how the contemporary world had come to be. Indubitably, there was also a sense in which these narratives were necessary in order to determine how other nations would be regarded, and within what class of foreign policies they would need to be placed, so as to quickly parse the world into comprehensible units. In this sense, the narratives that dominated the 1950s-70s delivered more than satisfactory goods, which explained Amazonia in simple and palatable terms. Below, I delineate and discuss the two main narratives that emerged about Amazonian ancient history during this time.

Resources and the Law of Environmental Limitation.

In the years following the publication of the *Handbook*, an environmental theoretical paradigm took shape which would dominate the study of Amazonia for a number of decades. Betty Meggers, and her husband, Clifford Evans, the couple credited with the first systematic, scientifically-driven studies of Amazonian archaeology, turned the focus of their field of

research toward an environmental or ecological perspective in the 1950s. In 1954, Meggers published her most influential article, “Environmental Limitation on Cultural Development” (1954). Framing her argument as a law of adaptation, Meggers drew a correlation between agricultural productivity, indexed by environmental variables, and social complexity. Beyond merely establishing this correlation, Meggers (1954, 1971) went as far as to assign the power of causation to environmental factors, stating that even an “advanced culture,” if transplanted into a region of poor agricultural productivity, would inevitably devolve back into a less advanced stage. Meggers' and Evans' intensive work in Amazonia began precisely during the initial post-war shift toward scientific inquiry. Their reports on excavations at the mouth of the Amazon (1957), on the Rio Napo (1968), and in British Guiana (1960) are heavily influenced by this perspective, and often rehearse the logic of Meggers' 1954 publication over and over again.

The law of environmental limitation on cultural development (Meggers 1954) became the touchstone for model-building by Meggers, Evans, and their students. Within this model, the key environmental variable which determined agricultural potential in Amazonia was soil type (Meggers 1954, 1957). Within this model, Amazonian soils, deeply weathered and nutrient-poor, would have been incapable of producing an agricultural surplus that could serve as the basis for a complex society. Meggers pointed out that Amazonian soils were unsuitable for growing protein-rich crops such as maize and beans, providing compelling examples of rapid field nutrient exhaustion under the swidden or slash-and-burn system observed in ethnographic contexts. The long-fallow cycles and constant field switching practiced by tribes under scrutiny (1971), which were only sufficient to maintain the current (low) population densities were projected into the Amazonian past. By this logic, population growth in the formative stages of pre-Columbian occupation of ancient Amazonia would have resulted in village fissioning and constant migration, requiring large territorial holdings for the relatively small bands that would have comprised the largest social unit inhabiting the majority of Amazonian lands.

Meggers' theory of environmental limitation did little more than explain the 'standard model' (per Viveiros de Castro 1996) for occupation of Amazonia, a model that was implicitly created by the numerous ethnographic accounts compiled in the TFC volume of the Handbook of South American Indians (see also Neves 1999). This model characterizes occupation of the tropical forest as consisting of by small, autonomous, semi-sedentary populations whose tribal social organization exhibited only ‘incipient’ (Meggers 1971) forms of social complexity. The chief measure of complexity for Meggers (1971) is the extent to which a formalized hierarchy extends beyond the limits of a village, but is also concerned with economic features such as occupational specialization and the presence of markets. The slash-and-burn practices of the tribes analyzed by Meggers in her 1971 volume were seen as the only agricultural system adopted by native peoples of Amazonia, and also saw agriculture in itself, narrowly defined as the raising of annual crops on clear-cut land, as the only subsistence system that could form the basis of complex social formations. The implication was that this kind of agriculture was the most, or only, technologically advanced food-procurement system, and that failure to adopt an agricultural system of this order was indicative of low-level cultural development. Current research on forest management, agroforestry, and terra preta suggest numerous other means of exploitation of the forest's domesticated and undomesticated species, some of which have been reported as highly successful and sustainable.

While Meggers' (1954, 1971) analysis of dominant soil types in Amazonia is laudable and generally correct, and while her agricultural yield and calorie production estimates are

reasonable (although, see Carneiro 1954, 1957 for starkly different numbers), especially considering that she derived them from actual ethnographic examples, there are three fault lines in her argument. First, she failed to consider the degree to which indigenous technologies could in fact impact the environment, of which terra preta presents itself as a clear counterexample; second, contemporary examples from around the world demonstrate that the modern Western model of intensive monoculture is not unequivocally successful, even in temperate climates; lastly, Meggers' projection of ethnographically observed traits and systems into Amazonia's deep past fails to acknowledge the very real and pronounced population and structural collapse that followed the introduction of European peoples, goods, and diseases into the New World.

In her synthesis volume (1971), Meggers engages with European accounts of Amazonian tribes inhabiting *várzeas* (floodplains) of the middle and lower Amazon. Her explicit engagement with this kind of source serves to fill an ethnographic lacuna resulting from the lack of surviving indigenous groups occupying this ecological zone. In this seminal work (1971), she treats reports of numerous large, continuous, densely-populated settlements ruled by local and paramount chiefs as accurate depictions of várzea occupation, a position she later (2001) reverses. However, at this juncture, the fertility and productivity of the várzea is essential to her environmental-deterministic model; the fertile várzea is the exception that proves the rule. Amazonian complexity, in its "incipient" form, is possible only under the extremely, unusually favorable conditions found in várzea ecosystems. Meggers also suggests that this level of complexity, such as that exhibited at Marajó, is a relic of ancient times, and evidence of migration to Amazonia by displaced peoples that developed some characteristics of high culture elsewhere. As 'donor regions,' those working in her tradition variously cite Japan, the Andes, and the Circum-Caribbean region (Meggers 1963, 1971; Silva and Meggers 1963). These transplanted cultures are seen to have met their demise in the unproductive soils of Amazonia.

The manner in which early historic accounts are utilized to construct a narrative of várzea occupation also betrays the environmental-deterministic theoretical orientation of the work. Meggers (1971) draws upon the early voyaging accounts by Carvajal, Acuña, and Cruz, as well as Fritz's diary, which is heavily mined for details that can be compiled into an evolutionist analysis of socio-cultural development. Although Meggers' selection of sources seems to provide adequate coverage of each of the periods addressed, her style of presentation, which conflates data from all five narratives into a single, master ethnographic narrative, is extremely problematic. Not only does this summary flatten the temporal dimension, which anywhere else would imply historicity and the potential for cultural change over time, but it also fails to account for other potential sources of cultural difference. For example, Meggers reports that the Omagua moved between 500 and 1500 kilometers upstream between 1542 and 1690, and yet fails to consider that such drastic relocation could elicit change in any aspect of daily life. Especially in the context of a model that claims subsistence practices arise from environmental conditions, this seems like a major oversight. Beyond this, it fails to account for cultural change that may have occurred through the process of relocation itself, or through processes responsible for the need for relocation. In short, by considering all five accounts comparable, and failing to consider the temporal and spatial dimensions of the problem, Meggers effectively prioritizes the ecological zone as the determining factor for cultural development.

Because of her law of environmental limitation, and also because of her prominence in Brazil and elsewhere, it is tempting to cast Meggers' work as the epitome of environmental determinism, and to draw sharp contrasts between her work and that of her contemporaries.

However, Meggers was not alone in privileging environmental factors over other kinds of data. Because natural phenomena behave in accordance with well-understood principles of survival and adaptation, and appear to behave in the most economical way possible, the behavior of natural phenomena can be said to be highly predictable. Hence, it is understandable that it seemed easier to comprehend and rely on factors outside human control, than to attempt to map out the range of possibilities that could arise out of the human mind. When faced so few concrete and comprehensible examples of what humans were actually doing against a relatively limited number of significant variables that behaved according to laws, it seems reasonable to rely on the latter for the purposes of generating comprehensible explanatory models. Similarly, it was tempting for some processualists and systems theorists (e.g. Fritz and Plog 1973; Hill 1970) to tend toward an over-reliance on the predictability of such variables, to the point of developing their hypothetico-deductive nomological method. Although Meggers' environmental limitation model predates these theoretical developments by roughly a quarter of a century, both theoretical moves were likely products of similar thinking about the value and definition of 'Science.' The pitfall of this kind of model-building in a historical science like anthropology is that it generalizes results from a particular experiment or thought-experiment to a population that is not adequately represented by the sample population. In other words, it treats as axiomatic findings or even hypotheses that are at best the product of a particularistic, historically-situated research endeavor, failing to account for the range of variability in human behavior, experience, and adaptability.

In subsequent years, many scholars responded to Meggers by building models around environmental factors, often intentionally or inadvertently relying on very axioms developed by Meggers to make their cases. The next section will outline one of the first and most well-known critiques of Meggers' narrative of the history of pre-Columbian Amazonia. Although Donald Lathrap's work is best known as a set of origin theories that contradicted Meggers' population dispersal models, environmental and ecological factors also played a significant role in his model-building. Meggers' and Lathrap's disagreements over the productive capacity of Amazonia spurred a number of debates on subsistence, environmental possibilism, and carrying capacity in Amazonia, which will also be discussed this section.

History, complexity, and the Cardiac Model.

Before outlining and dissecting Lathrap's cardiac model and the accompanying theoretical framework, a key distinction should be made between Meggers' and Lathrap's model-building approaches and their resulting grand narratives. Meggers' model relied not only on environmental factors, but also on a cyclical temporality that denies historicity. Meggers' adaptationist approach assumed that the slash-and-burn model of exploitation represented the apex of pre-modern adaptive strategies for extracting food resources from a wet tropical environment, and though she asserts that plant domestication happened in Amazonia by about 1000 B.C. (1971), her lack of attention to the history of this development results in a projection of this narrative more or less into 'time immemorial.' Lathrap (1970), on the other hand, sought to comprehend the origins of this model of exploitation, and considered the specific evolution of the tropical forest culture complex within a temporal framework. Lathrap's cardiac model (1970) also proposed a movement of peoples across the sub-regions of the Amazon, in a systematic (intentional) and sequential (historical) way. In contrast, Meggers' theories of mobility and

cyclical movement, combined with her notions of stagnation and devolution, posit a people, or peoples, who existed outside of time.

Lathrap, who taught at the University of Illinois at Urbana, was, like Steward, a product of UC Berkeley and a student of Alfred Kroeber and Carl Sauer. Working within a theoretical paradigm that was totally distinct from Meggers', Lathrap sought to integrate linguistic models of population dispersal with an understanding of plant domestication and subsistence practices, as well as the mechanisms of social integration through communal consumption, or feasting. Although Meggers' and Lathrap's approaches appear completely distinct at first blush, these two theoretical paradigms intersected in the realms of subsistence, ceramic chronology and seriation, and demography.

Following Steward, Lathrap (1968) early identified significant differences between floodplain and upland riverine environments; but rather than focusing solely on rivers as networks, and riverbanks as foci of interaction, Lathrap emphasized ecological differences between várzea and terra firme (upland) locations. This would have meant significant differences for lowland Amazonian subsistence practices, not only in terms of agriculture, but also for availability and type of riverine fauna. In an early article in the volume *Man the Hunter* (1968), Lathrap bases his assertion that Amazonian floodplains had supported complex societies on Métraux, Nimuendajú, Palmatary, and on Rowe's readings of early chronicles. His key contribution to Amazonian archaeology, his *Upper Amazon* (1970), contains not only the ceramic and linguistic data crucial for the building of his Cardiac Model, but also the building blocks for what Lathrap perceived as a pathway to social complexity in Amazonia. In Lathrap's conception, social complexity in Amazonia could be indexed by two things. First, feasting, indexed by ceramic forms identified by Lathrap as associated with the production of a kind of "manioc beer," indicated the presence of a hierarch charged with sponsoring feasting events. Second, Lathrap (1970) identified a kind of "fossilized manioc bread" that he took as evidence of warfare. Known in Portuguese as *pão de índio* or "Indian bread," this dried manioc product can be buried underground and later unearthed for sustenance, sometimes decades after burial. In folk knowledge, Amazonian Indians are said to bury *pão de índio* in strategic caches, to be unearthed and consumed during war campaigns. Thus, Lathrap interprets finds of *pão de índio* as evidence of warfare, which, again, he takes as an index of social complexity.

Lathrap's Cardiac Model (1970) envisions the floodplains of Amazonia and Northern South America as the cultural heartland of New World complex societies. In his view, both the Olmec-Maya and Chavín cultures, at the time understood as the "mother cultures" for Mesoamerica and the Andes, respectively, were in turn descendants of a 'grandmother' TFC developed in wet tropical South America. Lathrap's version of the TFC is understood as having its cultural and caloric foundation in an intensive root-crop cultivation system based specifically on manioc (1970), which Lathrap later proposes as the crucial "impetus to the New World 'Neolithic Revolution'" (1977:716). Lathrap (1977) follows Spinden (1917), Sauer (1952), Bronson (1966), and to a certain extent Kroeber (1923) in designating this revolution the single process whence all New World agriculture originated. Moving away from previous theories that proposed coastal sites as loci for development of agriculture in South America, Lathrap (1970) suggests that the origins of the South American agricultural system should be sought along the floodplains of the Amazon and other major river systems of Northern South America, including, for example, the Maracaibo and Valencia of Venezuela. His Cardiac Model thus envisions all

major New World cultures to derive from a system that originated in the heartland of Northern South America, and that subsequently radiated out to all other parts of the New World.

As a cultural anthropologist, Lathrap worked with a distinctly broader cultural dataset than Meggers. For example, in his analysis of the Chavín-Amazonia connection, he relies heavily on iconographic data, whereby he identifies elements like the caiman, the bottle gourd, and the ají pepper, all endemic to Amazonia, as central elements in the shamanistic tradition of Chavín (1973a, b; but see Sayre 2010 for a discussion of evidence that suggests a priestly, rather than shamanistic religious practice at Chavín de Huántar). In this discussion, and elsewhere, Lathrap connects the economic and cosmological center of Chavín culture to a lowland Amazonian origin, while simultaneously making an argument for long-distance communication and trade between Amazonia and the Peruvian Andes via the eastern slopes of the Cordillera Blanca. His arguments for complex, long-distance trade networks (1973c) serve to emphasize the heterogeneity of Amazonia and its cultures, as well as the importance and advantages of a riverine orientation in navigating this terrain, a characteristic he cited as central to Tropical Forest Culture complex (1968).

This era of model-building for Amazonian archaeology saw a great deal of speculation and fierce debate. Although data were few on the ground, and the Amazon vast, and at places impenetrable, a few dedicated archaeologists were, to the best of their ability, compiling and synthesizing data into plausible, testable models for pre-Columbian Amazonian habitation and social organization.

Two sides of the same coin

Lathrap and Meggers' contradictory models inevitably covered similar ground, as both scholars and their respective schools of thought were dealing with the same material facts. Beyond this, both scholars were operating within the same theoretical milieu, and theories of social complexity, along with concomitant notions of the primacy of economic mechanisms in social integration, undergird both scholars' models for pre-Columbian occupation of Amazonia. By the time Lathrap published his synthesis volume (1971), cultural ecology was well established, and the Processualist school of American archaeology was gaining a foothold. So, although the large part of his volume is a detailed and valuable culture-historical treatise that consists of an enumeration of cultural types and relies heavily on linguistic data and theories of migration, his understanding of how societies were created and evolved was remarkably similar to Meggers'.

In the final analysis, Meggers and Lathrap were not working with distinct notions of social complexity, but rather were selectively applying portions of the same family of theories. While Meggers sought to explain the absence of certain material traces of social complexity, such as metallurgy, writing, and monumental architecture, the material trappings of 'high culture,' Lathrap was seeking evidence to identify in Amazonia socio-structural forms that could point to complex systems of organization. For both Meggers and Lathrap, 'complexity' was measured to a large extent by the degree of stratification and hierarchization that would have characterized the society's overall structure, measures I will discuss in detail in Chapter 4.

Agriculture and subsistence: the stepping stone.

At the root of the notions of complexity employed by Lathrap and Meggers is a correlation between subsistence modes and 'civilization.' In traditional evolutionist narratives, agricultural modes of subsistence were an important stepping stone toward civilization. This notion, which remained at the root of models of complexity, spurred on a number of studies regarding subsistence systems and carrying capacity in Amazonia (Brochado 1980; Gross 1975; Hames and Vickers 1983; Heckenberger 1998; Smith 1980). Like Meggers, Lathrap assumed that surplus production, along with the storability and redistribution of caloric goods made possible by that surplus, were essential to the creation of hierarchical structure in Amazonia. Furthermore, like Meggers, Lathrap believed that agricultural surplus was a *sine qua non* for the development of such structures, and that this developmental sequence, in its pristine form, could occur only once within a continent. In different ways, both Meggers and Lathrap relied heavily on diffusionist mechanisms of cultural transmission and change. The fundamental difference between the two positions was that Lathrap believed that surplus production was possible in Amazonia, while Meggers did not, or was at best circumspect regarding the size and potential of this surplus. A close reading of both texts produces a startlingly simple revelation about the two scholars: with respect to cultural adaptability to Amazonian ecological zones, Meggers was a pessimist, and Lathrap was an optimist.

Several other scholars contributed to debates about carrying capacity in Amazonia, providing their own nuanced perspectives on the questions of subsistence and environmental determinism or possibilism. William Gross (1975), for example, agreed with Meggers that a limitation to subsistence production must have played an essential role in the apparently stunted development of Amazonian cultures. Rather than betting on agriculture, however, Gross detected a protein deficiency in the manioc-staple diet proposed for pre-Columbian Amazonia, discussing the difficulties in obtaining significant amounts of protein from terrestrial fauna, and annual riverine fluctuations as obstacles to year-round access to riverine fauna. The idea of a protein deficiency as a limiting factor was taken up in later discussions by Hames and Vickers (1983). Anna Roosevelt worked intensively on the Orinoco floodplains (1982, 1987), seeking evidence that a maize-based economy could have led to the formation of chiefdoms, and her work at Marajó (1991) in the Amazon delta can almost be seen as a special case of floodplain-environment archaeology. Roosevelt's optimism stemmed from mostly indirect evidence for chiefdom-level society, and from findings of maize or indirect indications of maize consumption in some contexts (1980, 1989).

A number of other scholars have contributed to the debate on floodplain complexity, often building on the work of Lathrap and Roosevelt. Brochado (1980) has done intensive sampling at Marajó in an effort to ascertain the subsistence potential of the island. The debate over carrying capacity and social complexity in the Amazon, has inspired a number of subsistence and carrying-capacity studies in the region. Carneiro's (1957, 1961, 1983) work in the Upper Xingu, one of the first subsistence studies carried out in terra firme soils to use ethnographic data in the analysis of a continuous indigenous occupation, suggested that contemporary indigenous population size was far below the carrying capacity of terra firme environments. Notably, Carneiro's (1957, 1961, 1970, 1983) explanations for levels of cultural complexity attained in Amazonia are sophisticated models, which not only take into account numerous ecological factors such as food resource life cycles, but also social factors that affect subsistence and warfare. Recent research (Heckenberger et al. 1999; Neves and Petersen 2006;

Petersen et al. 2001) suggest that Carneiro's (1957, 1961, 1983) analysis of the carrying capacity of upland riverine environments is likely correct; Amazonian habitations located on terra firme soils do not appear to be suffering developmental limitations as a result of food shortages. Details on evidence emerging from and contributing to these conclusions, which are tied to a more nuanced understanding of human-environment interactions in Amazonia, are given in the final section of this chapter.

With the exception of Carneiro (1957, 1961, 1983), most of the theorists involved in this debate accepted that Amazonian foodways relied on manioc as a main staple, which, as it turns out, may have been a significant misstep (see Neves 2007). At present, there is no conclusive evidence that allows us to assert that manioc was a chief staple of pre-Columbian Amazonian diet, if we avoid the pitfall of projecting ethnographically-observed strategies into the past. In a perceptive article, Denevan (1992a) suggests that the amount of clear-cutting required by the long-fallow cycling and field-switching associated with a 'standard model' occupation would have been impracticable before the advent of the metal axe. Instead, Denevan suggests that any kind of mobility that might have characterized pre-Colombian Amazonian occupation patterns would have involved frequent re-visiting and relatively continuous management of previously cleared forest patches.

If clear-cutting for monoculture was as uncommon as Denevan suggests, the idea of a manioc-staple diet breaks down even at the low population levels suggested by Meggers. Though it is likely that manioc was present across much of Amazonia in pre-Columbian times, little or no research has been conducted on the botanical remains that could verify or falsify this assertion. Additionally, ethnographic data suggests manioc may not have been as important in the past as it is in modern *caboclo* (Amazonian 'peasant') diets, or at least not as widespread as a main staple. For example, the Kuikuru of the Upper Xingu dispose of most of the fibrous portion (the chief 'filler' food among *caboclo* populations of the Brazilian Amazon) of *Manihot esculenta*, consuming only the simple starch (tapioca) (Schmidt 2009) extracted from the bitter poisonous tuber that is so often cast as the center of ancient Amazonian mechanisms of social integration (e.g. Lathrap 1970). This strategy, which utilizes only a fraction of the consumable part of the tuber, is consistent with plenty and not scarcity, and is in concert with Carneiro's conclusion that the Kuikuru subsistence system, which consisted of a mixed farming-hunting-foraging strategy, produces foodstuffs beyond the requirements of the existing village population.

In retrospect, the potential breakdown or failure of the idea of a manioc-staple diet ought not be surprising. There is no *a priori* reason to assume that all successful subsistence strategies must revolve around a "staple," and in fact, the idea of a staple only really makes sense in places of limited diversity of food sources, or in places where scarcity occurs, especially on a seasonal basis. A sufficiently diversified dietary system, such as that reported for the Kuikuru of the Upper Xingu by Carneiro (1957) would not subject its consumers to the seasonal scarcities that make, for example, a redistributive economy such a powerful thing. As a side note, it is also becoming increasingly clear that, from a nutritional perspective, staple diets, especially those that rely heavily upon starches such as rice, corn, or wheat, can have significant negative health consequences in cases of over-reliance on these particular starchy foods.

Removing the veil: business as usual.

Meggers' and Lathrap's theoretical schools are typically presented as diametrically opposed, and in some ways their ideas truly were. The narratives produced by the two conflicting models were chronologically or directionally opposed, and each inspired groups of students to seek different effects in Amazonia's archaeological record. However, both relied on the notion that Native Amazonians' impact on the natural environment, especially that forested area conceived of as the "Amazon jungle," was negligible. Both theorists adhered to the idea that an inability to "subdue the earth" (as in Locke 1993[1689]: 275) made social evolution beyond a predetermined level impossible. As discussed above, Meggers' and Lathrap's fundamental disagreement was more to do with their particular beliefs about environmental possibilities in Amazonia, and significantly less concerned with the subject of the abilities of Amazonian peoples to, wittingly or unwittingly, overcome Amazonia's "excessive nature" (Raffles 2002).

In addition to a general reliance on perceived possibilities afforded by the environment, scholars working in Amazonia were attempting to fit Amazonian data to models of social complexity not suited to the region, a problem of translation that I allude to in the previous section, and which I will develop in greater detail in Chapter 3. The reasons for this set of gross misperceptions are essentially historical, insofar as representations of Amazonia accumulated over hundreds of years around isolated kernels of data, and environmental, in both the hitherto inferred 'natural' sense, and the broader sense of 'that-which-surrounds-us.' First, the natural processes of decomposition and bioturbation characteristic of wet tropical environments, as well as the geographical and geological setting of Amazonia resulted in pre-existing conditions and post-depositional alterations that made archaeological contexts ordinarily associated with social complexity impossible in Amazonia. Considering the more abstract dimension of historicity and environment, external perceptions of Amazonia were shaped through the dialectical relationship between sensation (as a means to intercorporeality) and memory. In chapters 3 and 4, I argue that early European voyagers to Amazonia projected their own experiences of Amazonia's physical environment onto the peoples they observed, mistaking their own sensations of its inexorability for fact. This physicality of Amazonian environments, which I will call "foreign," juxtaposed with that of familiar environments of European and American temperate zones, has material consequences for the formation and evocation of senses of place that were essential to the processes of signification undergone by travelers to Amazonia again and again.

The landscape and the telescope.

As I will argue in Chapter 4, the kind of landscape perspective through which Europeans first apprehended Amazonia became the *modus operandi* for scientific, including archaeological, work in the region. Rather than turning their attention to diversity and heterogeneity in Amazonia, scholars were concerned with creating general narratives that could be used within global or interregional comparisons, viewing Amazonia from a distant or top-down perspective. Structurally, this strategy had a dual and seemingly contradictory effect on the development of Amazonian archaeology. On the one hand, the increasingly focused discussion among a small number of scholars intent on settling fundamental disagreements resulted in a telescoping of research topics that significantly narrowed the range of possibility of research in Amazonia. Simultaneously, the image that emerged about Amazonia became increasingly flat and featureless, as models generated in small locales, through sampling of an understandable small

area, were generalized to cover the entire Amazon basin. Like a bézier curve becomes increasingly complex as vertices are added, Amazonia's deep history was bound to gain dimensionality with additional sampling. However, an insistence on re-hashing old models resulted in the propagation of a relatively flat or two-dimensional image of Amazonian pre-Columbian life and occupation. The crafters of the Amazonian archaeological canon were akin to European landscape painters, selecting the perspective for viewing a landscape, and painting from a distance, blurring detail and highlighting select elements, such as to construct a manageable and coherent landscape that made sense in their worldview.

Historicity and Heterogeneity

In contrast with much of the work that came before, archaeologists working in the last quarter of the 20th century began developing long-term locally-based research projects aimed at a deep understanding of particular regions within Amazonia. This change in approach reflects a growing concern with understanding, unraveling, or constructing a history of Amazonia as an end in itself, and not as a means to constructing global narratives or legitimizing existing projects. The establishment of these projects also resulted in greater recognition of the heterogeneity of Amazonian environments and cultural formations, leading to a recognition of greater complexity in the grand narrative of history and occupation of Amazonia in general.

Understanding social formations as historical and contextual, I favor place-based research that carefully considers the particular historical conditions of each locale in the construction of narratives. Following the examples set forth by the research that will be exemplified in the next section, the current work approaches narrative-building of Amazonia through a contextual and historical lens.

Seeking cultural complexity: the objectivity of data and the objectivity of models.

Pursuant to the major models proposed by Meggers, Lathrap, and their contemporaries, archaeologists working in the last quarter of the 20th century set forth to test these models, or to continue conversations initiated during the post-WWII period. One of the characteristics of the work that evolved in this era is a shift towards regionally-focused projects that employed multiple lines of evidence to build models and theories “from the ground up.” Additionally, although these regionally-based models are narrated as extendable into other portions of Amazonia, they are rarely generalized wholesale; instead, researchers present their results as examples of case studies that apply within the regions studied. Given the size and heterogeneity of Amazonia, this is an appropriate attitude, although in some cases (e.g. Roosevelt 1982, 1991), these particularistic narratives are cast as either exceptions to the patterns established in previous models, or as contradictions to these models.

Examples of regionally-focused projects, which will be described in detail below, include Anna Roosevelt's projects in the Orinoco and Marajó, the work of Clark Erickson and colleagues in El Beni, Michael Heckenberger's work in the Upper Xingu, and the work of the Central Amazon Project in the confluence region of the Negro and Solimões rivers. To be clear, the section below is not meant to be an exhaustive report on the state of the art of Amazonian

archaeology, but instead considers major research projects that are directly relevant to research in the Central Amazon, or that present analogues or explanatory models useful to this analysis. Additionally, in the last decade (2000-2010) a number of other regional projects have sprung up across Amazonia, particularly in the Brazilian Amazon, which will not be discussed here for two reasons. First, the research in these regions is growing at such an incredible pace that any summary of the data and patterns suggested by this work will almost immediately be out of date. Second, the relative newness of these projects precludes any kind of summary interpretive work of their significance at this juncture.

Chiefdoms on the Orinoco and at Marajó.

The work of Anna Roosevelt, which emerged most significantly in the 1980s and 90s, was an explicit attempt at testing várzea models of occupation, and had incorporated numerous lines of evidence. Meggers' original model (1982), developed at Parmana, posited a maize-based economy, the surplus of which would make possible the rise of chiefdom-level societies. Reading European contact-period accounts through an evolutionist lens, Roosevelt focuses on passages about centralized political power, social stratification, large, dense settlements, territoriality and expansion, and intensive food production and redistribution (Roosevelt 1982, 1987). In several of her works, Roosevelt presents archaeological evidence for growth in population density, intensive seed crop agriculture, monumental earthworks, differential burial practices, long-distance trade, prestige goods, and complex iconography as evidence for chiefdoms on Amazonian floodplains (Roosevelt 1982, 1987, 1991, 1994). Roosevelt would later attempt to test this work at the mouth of the Amazon, in Marajó. In this work, corroborating interpretive evidence for the existence of social stratification and inequality often comes in the form of ethnographic analogy (Roosevelt 1991).

Roosevelt's research question likely arose out of a desire to test the apparent contradiction between descriptions provided by early chroniclers and reports arising from ethnographic and archaeological research conducted in the post-WWII era. While Roosevelt (1980, 1991) identified in travel narratives depictions of social organizational traits that associated with chiefdoms or ranked societies (*sensu* Fried 1960; Sanders and Price 1968; Service 1971), much ethnographic data (e.g. Holmberg 1950; Métraux 1948; Steward 1948a) and the corpus of work published by Meggers and colleagues would seem to indicate that such societies never existed. Lathrap's model (1970, 1973a, b), which envisioned extremely ancient complex societies in the Amazonia likely also influenced her orientation. Roosevelt's approach to these apparent contradictions was to conduct extensive and intensive work in particular geographical locations, while critically considering all lines of evidence, including travel writings, in her final analysis. In her critical engagements, Roosevelt approaches each area she investigates as a discrete unit, which may be related, but not identical, to other parts of the Amazon. In so doing, Roosevelt implicitly foregrounds the heterogeneity of the Amazonian landscape.

The case of the Xingu: Evidence for a “depopulated” chiefdom.

The work of Heckenberger in the Xingu exemplifies multidisciplinary historical anthropological research in Amazonia. Heckenberger's work focuses, on the one hand, on subsistence patterning, agriculture and sedentism (1998), and on the other, on symbolism, power and chieftaincy (2005). Working in the Kuikuru of the Upper Xingu, Heckenberger has led an

ethnoarchaeological project that aims to understand emplacement, world views, and the long-term history of the Kuikuru. Heckenberger has recognized several cultural indices in Xingu social structure that suggest a kind of social organization that could have supported paramount regional chiefs. Additionally, his analysis of settlement patterning and village arrangement suggests a highly organized landscape that corresponds to a Kuikuro cosmology and worldview that is expressed at several scales, from the region down to the body (2005, 2010). The connectedness and strict organization of the landscape is interpreted by Heckenberger and colleagues (Heckenberger et al. 2003; Heckenberger et al. 2008) as a kind of garden-city urbanism that consists of ordered, managed landscapes dotted with interconnected towns. In Heckenberger's view, these data are signs of a once large and densely settled population that exhibited an integrated structure of an extensive chiefdom, which later suffered structural and demographic collapse in the wake of European colonization, but which retained some of the key social features of this earlier form.

El Beni: the continuous landscape

Clark Erickson's work in the department of El Beni, Bolivia, is built around the notion that much information can be gained about the larger structural elements of a society by studying the spaces in between sites, or parts of the landscape not generally considered part of "sites" in the traditional sense of the word. Erickson studies landscapes as continuous, consisting of sites of habitation, roads and paths, agricultural fields, and managed plant communities. Erickson and colleagues study these aspects as part of an integrated cultural landscape, in order to trace routes of communication and trade (2001, 2003, 2006), systems of intensive and extensive agriculture (1994, 1995), and the construction of monumental works (2000; see also Erickson and Balée 2004) in El Beni. These are taken as signs of complex social-structural forms, insofar as they index large, densely settled populations and a stratified, or at least somewhat hierarchical social structure. In some cases, Erickson explicitly describes these forms as complex chiefdoms.

Erickson's landscape approach is innovative in the sense that he considers kinds of evidence traditionally ignored in archaeological social-complexity studies in Amazonia. Particularly laudable is the successful translation of abstract aspects associated with complex cultural forms, such as mobilization of large labor forces, trade and communication networks, and an intensive-agricultural subsistence base to the localized environmental and historical context of El Beni. I consider Erickson's work to be a successful application of the broadly regional 'landscape perspective' described above; complementary place-based narratives constructed at the scale of the site or household could shed light on daily practices, helping to buttress the general model of occupation constructed for the region.

Amazonian Dark Earths: from the ground up.

Terras pretas de Índio, the focus of this work, constitute a major line of evidence that can speak to a number of the theoretical issues rehearsed. A recent intensification of the study of terra preta sites, especially the work of the Central Amazon Project (CAP) (e.g. Neves and Petersen 2006; Neves, et al. 2003; Petersen, et al. 2001) has shown that they are anthropogenic deposits of vast dimensions, occurring in high frequency that often boast significant earthworks, all of which imply large population concentrations. Combined with other work revealing complex symbolic systems (e.g. Barreto 2005; Gomes 2001; Heckenberger 2005; McEwan 2001; Roosevelt 1982, 1987, 1991, 1994; Schaan 2001) and the potential for high carrying capacity in

the Amazon (Brochado 1980; Carneiro 1957, 1961, 1983; Denevan 1992, 2003; Lima et al. 2003; Heckenberger 1998; Smith 1980), these recent discoveries have spurred re-examination of existing models that populate Amazonia exclusively with small, dispersed, and economically and socio-politically independent villages. Two of the major scholars who have developed archaeological work at terra preta sites, Eduardo Neves and James Petersen emphasize landscape alteration, as indexed by terra preta and by earthworks, as signals of intensive occupation in the Central Amazon. The apparent suddenness of the transformation of the landscape, which occurs in the early portion of the first millennium A.D., also indexes a significant change in sociopolitical patterns and hints at the emergence of a new order of social complexity (Neves and Petersen 2006).

This work, largely conducted as part of the CAP has contributed substantially to a general understanding of the occupational sequence in the region. The CAP emerged as a collaboration between Heckenberger, Neves, and Petersen, and was aimed explicitly at recovering data to test Donald Lathrap's cardiac model. Building on local knowledge about the location of terra preta sites, a result of the soil's heightened agricultural productivity, the work of CAP has also significantly augmented current scientific knowledge about terra preta sites (see Figure II.1). A number of research projects (Donatti 2003; Lima et al. 2003; Moraes 2007; Neves 2003) staged in the interfluvium of the Negro and Solimões Rivers, focused in the district of Iranduba in the state of Amazonas, Brazil, have contributed toward an increasingly nuanced understanding of ceramic chronologies and the distribution of ceramic styles across and between sites in the area on the one hand, and the size and distribution of occupation sites on the other.

Contextual models

The present work builds upon the data and models produced by these intensive regional studies, taking the localized, historical perspective offered by these scholars as model of narrative-building. The aim is to produce a narrative that is in conversation with narratives that are being constructed elsewhere in Amazonia, or even locally in the Central Amazon but at a larger scale, without losing track of the very particular histories of the places under investigation. This narrative will consider the multiple scales of place that take Antônio Galo as its center, from looking at places within the site that relate to discreet, localized events or actions, through a consideration of the Central Amazon Project research area as a region.

The Central Amazon Project

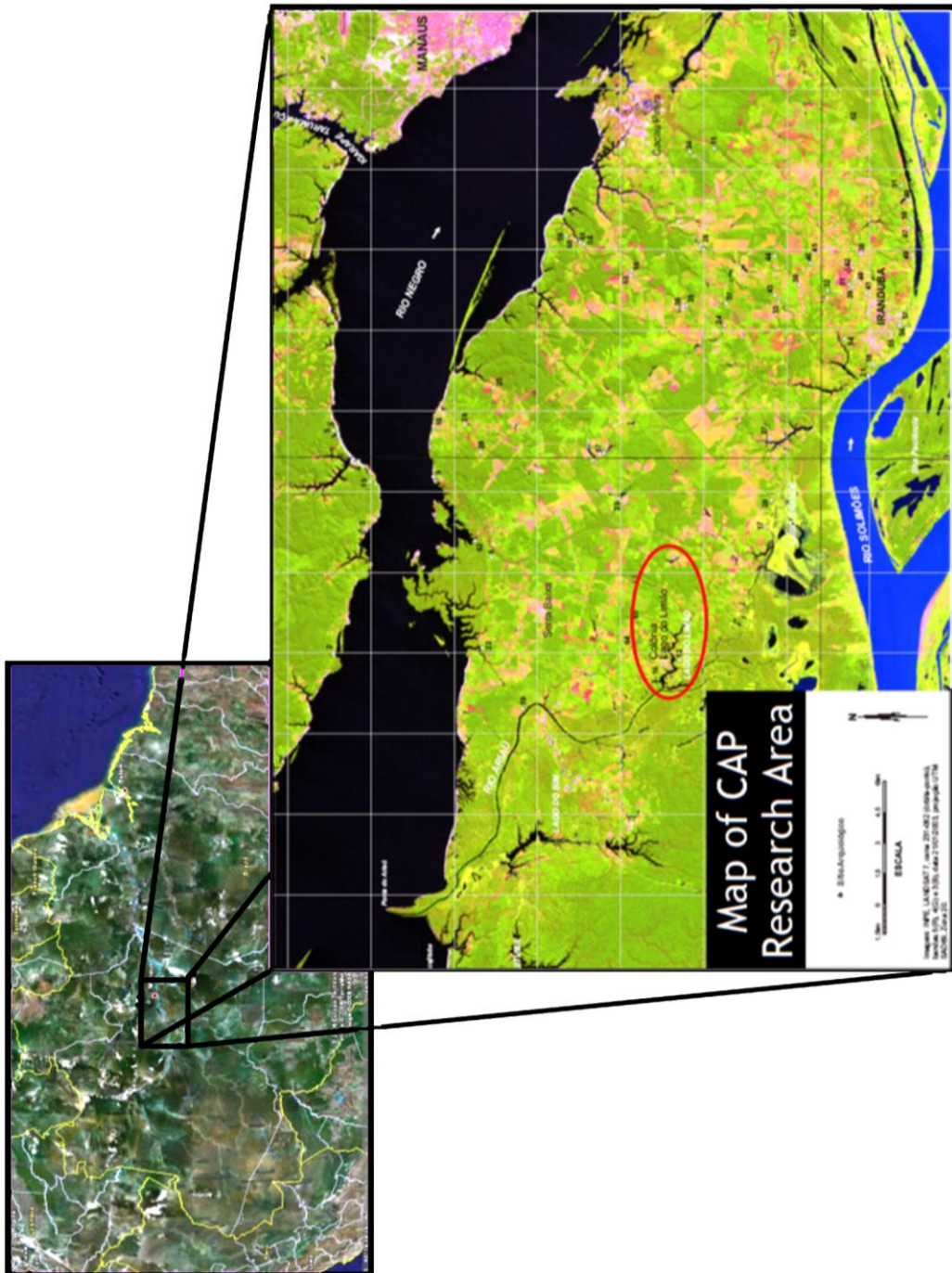
The CAP, a 15-year long archaeological research project currently under the direction of Prof. Eduardo Neves of the Museum of Archaeology and Ethnology at the University of São Paulo (MAE-USP), has expanded the archaeological knowledge base of the Central Amazon, and research by this group forms the immediate basis for the present study. For the purposes of the intensive study done by the CAP, the Central Amazon research area consists of the region of the confluence of the Negro and Solimões rivers, taken to include not only the interfluvium itself, but also the floodplains and uplands that border the two rivers upstream of the confluence. Also

included are the nearby margins of the uppermost reaches of the Rio Amazonas, defined in Brazil to begin where the Negro and Solimões Rivers meet. The western extent of the research area is more or less bounded by the Rio Aripuanã.

Designated a river (“Rio”), the Aripuanã is best defined as a channel, as it changes direction of flow and content throughout the year. Because the Negro and Solimões Rivers draw their waters from distinct hydrographic basins, which are affected by different climatic patterns, they flood at different times of year. In the months of February-July, the waters of the Aripuanã and its associated network of channels and flooded forests contains mostly black water from the Rio Negro; in July, when the tributaries of the Solimões begin to swell, the high-energy, sediment-laden waters of the Solimões edge out the black waters of the Negro, filling the interfluvial regions with whitewater and its accompanying flora and fauna. According to Neves (2003), this seasonal influx of whitewater and concomitant resources also has had an impact on the lower reaches of the Rio Negro, reflected in the size of sites found along the lower 50km of the river, immediately before it joins the Solimões to form the Rio Amazonas. The confluence region is considered to have been a strategically important area to pre-Columbian societies, not only because of its geographical position, but also due to ecological conditions.

Building on local knowledge about the location of terra preta sites, a result of the soil’s heightened agricultural productivity, the work of the CAP has also significantly augmented current scientific knowledge about terra preta sites (see Figure II.1). CAP research projects (Donatti 2003; Lima 2003; Moraes 2007; Neves 2003), predominantly staged in the interfluvium of the Negro and Solimões Rivers, have contributed toward an increasingly nuanced understanding of ceramic chronologies and styles in the area on the one hand, and the size and distribution of occupation sites on the other. Ongoing systematic survey work (Lima et al. 2003; Neves 2003) by the CAP is beginning to make possible regional-scale narratives about long-term population movement and political change in the central Amazonian basin (Neves and Petersen 2006; Lima 2008). Recognizing the need for focused, site-based analyses (Neves et al. 2004), the CAP has invested in the study of burial structures at Hatahara (Machado 2005; Rapp Py-Daniel 2009) spatial analyses of Laguinho (Schmidt et al. 2009) and Osvaldo (Portocarrero 2007), and geoarchaeological research at Hatahara (Arroyo-Kalin 2008; Rebellato 2007; Rebellato et al. 2009). Moraes’ (2007) survey of the Lago do Limão micro-region included a survey of the lake margins and preliminary sub-surface testing at a few sites, including Antônio Galo, which will be focus of this study.

Figure II.1: Map of CAP research areaç Lago do Limão region circled in red.



Mapping the Confluence Region: basic building blocks

Over the course of the late 1990s and early 2000s, the CAP implemented a number of systematic survey and excavation projects within the interfluvium. Among these, I initially point to the clay and site survey efforts undertaken under the auspices of the CAP through a major FAPESP (Fundação de Amparo de Pesquisa do Estado de São Paulo – São Paulo State Research Support Foundation) grant and the survey of the interfluvial zone by Lima and colleagues (2003), the latter part of a master's thesis project. This survey project revealed the existence of the sites Osvaldo (AM-IR-07) and Lago do Limão (AM-IR-11), the first sites recorded by the project to be considered part of the Lago do Limão micro-region. This exploratory phase also allowed for the first intensive studies of the sites Açutuba (AM-IR-02), Hatahara (AM-IR-13) and Lago Grande (AM-IR-15), all of which are located within the interfluvium of the Negro and Solimões Rivers.

Extensive excavations were undertaken at Açutuba and Hatahara, in order to delimit the spatial and temporal extent of these large and impressive sites. Açutuba, which had been previously studied and found to contain remains of four distinct ceramic complexes, was further investigated in order to serve as the basis for a regional chronology. The existing regional chronology proposed by Hilbert (1968) suggested a quadripartite division of ceramics, including the Manacapuru, Paredão, Guarita, and Itacoatiara phases for the Central Amazon. Hilbert's stylistic chronology was anchored temporally by a few radiocarbon dates, locating the earliest phases of ceramic production in the region, the co-occurring Manacapuru and Paredão phases, in the first half of the first century A.D.. These results directly contradicted Lathrap's model of early domestication and cultural elaboration in the region. Contradictions between Lathrap's model and Hilbert's results, along with the greatly expanded collections generated by the CAP in its first decade of research, prompted members of the CAP to investigate the local ceramic chronology. Results from these studies (Lima et al. 2006) largely supported Hilbert's chronology for Manacapuru, Paredão, and Guarita, discerning an earlier component, named Açutuba for the site where it was discovered. Lima (2008) provides a detailed review of the defining characteristics and range of variability in paste, construction, decoration, and firing of the four phases currently accepted for the region of the confluence of the Negro and Solimões Rivers. Ongoing studies are constantly expanding the ranges of dates accepted for each of these phases; however, the most recent published data (Heckenberger and Neves 2009) place the Açutuba phase in the period between 300 B.C. and 400 A.D.; the Manacapuru phase in the range of 400-900 A.D.; Paredão occupations in the period between 700 and 1200 A.D.; and the Guarita occupation at the end of the sequence, beginning circa 900 A.D. and continuing through to the period of initial contact with Europeans.

Hatahara is unique because of the pervasiveness of extremely dark (10YR 2/1) soil, the density of ceramics, the ubiquity of surface features eventually identified as artificial mounds, and the presence of funerary contexts. This initial study of mounded sites in the Central Amazon pointed toward a mortuary function for the mounds, which utilized terra preta and ceramics as building materials (Neves 2003). The complex morphology of the mounds and the intersection of funerary cuts and ceramic phases precluded a clear understanding of site formation processes

and mound function. Funerary urns from the Manacapuru phase had also been located in earlier, pre-mound occupations of the Hatahara site. Additionally, this field effort included intensive systematic soil sampling implemented with soil augers evenly spaced along a 100-meter grid. The purpose of this effort was to map the variability of deposition in terms of soil color and density of ceramic sherds. Subsequently, a tighter auger sampling grid was implemented, and these samples were subjected to chemical and sedimentological analyses, demonstrating that variables such as pH and phosphate could be relied upon to indicate intensity and shifting orientation of occupation across distinct ceramic phases (Rebellato 2007).

The discovery of sites near Lake Limão (see Figure II.1) spurred intensive research in this previously undocumented archaeological micro-region. Fieldwork undertaken at the Osvaldo site in 1999 (Neves 2000b) established site dimensions, depth of deposits, and initial evidence that the occupation consisted of a Manacapuru phase assemblage. Ceramic and site morphological analyses undertaken between 1999 and 2000 (Abreu 2001, Portocarrero 2008) demonstrated that the majority of ceramics did correspond with the Manacapuru phase, with a small percentage of ceramics belonging to the Paredão phase. Portocarrero's analysis also detected a circular orientation to site organization by using ceramics as an index of depositional intensity. Portocarrero's ceramic concentration map suggests a circular village arrangement similar to that seen at Lago Grande, and later Antônio Galo, Lago do Limão, and Pilão. While Osvaldo presents an overwhelming proportion of Manacapuru phase ceramics, with the occurrence of a small proportion Paredão phase ceramics, Lago Grande presents an inverse scenario. Lago Grande, a site that features a mounded semi-circular precinct is dominated by Paredão phase ceramics, featuring a small proportion of Manacapuru phase ceramics. As delineated above, the Paredão and Manacapuru phases overlap for a period of approximately two hundred years, but the exact relationship between the two ceramic phases is poorly understood. Some have suggested the Lago Grande/Osvaldo scenario suggests a relationship of exchange between two distinct ethnic groups, but data thus far obtained precludes any definitive interpretation of this pattern.

The circular village arrangement observed at these sites in the Central Amazon situates the CAP's research within regional and trans-continental debates of migration and ethnic, linguistic, or cultural affiliation. In sum, a foundational article by Maybury-Lewis (1979) identifies a spatial arrangement of villages associated with the Gê linguistic family, wherein villages consist of houses arranged in a circle around a central plaza, and a men's house or ceremonial structure is situated either in the center of this plaza or off to the side of the circular arrangement of houses. Subsequently, Heckenberger (2002), suggested an alternative model in which the circular village arrangement could also signify an Arawakan presence in the Amazon, as he argues is the case with the Kuikuru villages of the Upper Xingu.

Geoarchaeological research in Amazonia

Because terra preta is one of the main pieces of evidence that indexes not only the presence, but also the nature of pre-Columbian occupation in Amazonia, geoarchaeological studies into the structure and history of these archaeological matrices has recently intensified. The work of the CAP and related projects has led to a generalized understanding of terra preta site morphology. Identified sites often consist of a black or nearly black, ceramic-rich zone

underlain by a somewhat lighter zone that is alternately identified as *terra mulata* (dark, but not black, earth) or melanized (manganese-oxide stained) terra amarela. Beneath this layer, the soils turn yellow or red, as excavators enter what is normally referred to as 'subsoil' or 'sterile' in the archaeological literature. For now, I would like to substitute 'minimally modified' or 'apparently unmodified' soils for either of these terms, as recent findings (Caromano 2010) have shown that charcoal in these apparently 'sterile' layers can be anthropogenic, and can signal curated ancient surface vegetation. This zone corresponds to the B Horizon of the original soil.

Significant bioturbation makes the recognition of features difficult, especially near the land surface, but experience has shown that disturbance is most pronounced in the upper 20 cm of deposits; below that, preservation is relatively good, and radiocarbon samples yield dates consistent with expected values for the region and associated ceramic complexes. Black-on-black soils make subsurface features hard to discern within terra preta, but structures such as hearths are consistently identified in situ, and in some cases confirmed by post-excavation work. Dark fill makes pit features stand out where they cut through the underlying terra amarela, but homogenous colors in upper strata create a difficulty in understanding the context within which such features were produced and the chronological relationship between features. The result is a limited understanding of the internal organization of terra preta sites beyond visible surface features. Sites with multiple occupations are often understood only in the most general terms, as the apparent homogeneity of terra preta deposits creates difficulties in interpreting site stratigraphy. Intensive study of particular sites, such as that described here, is crucial to understanding terra preta formation and social organization (see also Neves et al. 2004).

This situation is further complicated by alteration undergone during abandonment periods, which in the Central Amazon can range from centuries to over a millennium. According to Holliday (1992, 2004), pedogenic (soil formation) processes can create structures in soils in as little as two centuries, and such natural structures can be mistaken for anthropogenic deposits. Even if terra preta is primarily a result of accumulatory processes induced by human action, subsequent pedogenic alteration processes demand that these deposits also be studied as soils.

Sister stories.

Two geoarchaeological studies undertaken by anthropologically trained archaeologists stand out as methodologically comparable to the present study. In the Central Amazon, Manuel Arroyo-Kalin has conducted intensive micromorphological work, accompanied by other physical and chemical analyses, in an effort to determine processes that contribute to the formation of Amazonian Dark Earths (ADEs), seen to include terras pretas and terras mulatas. Arroyo-Kalin's (2008) analysis is notable in his consideration of the constantly evolving landscapes and environments within which these anthropogenic soils formed and have since been situated. Of particular interest to this study is his suggestion that anthropogenic inputs to ADEs, mostly in the form of aquatic faunal remains, kick off feedback mechanisms that allow for the retention of nutrients beyond those which are inherent in the visible inputs themselves. Other inputs highlighted by Arroyo-Kalin, which are eminently detectable through micromorphological analysis, include microscopic pottery, charcoal, and ash.

In addition, Arroyo-Kalin's work has provided numerous methodological insights, some of which will be invoked in Chapter 7, where I discuss the geoarchaeological analyses and results of this project. The work of Morgan Schmidt (2008, 2010; see also Schmidt and Heckenberger 2009) in the Upper Xingu is also extremely relevant to this work, as Schmidt has

used intensive chemical testing across space to attempt to identify activity areas in an recently abandoned village. Schmidt's ethnoarchaeological work involves comparing soil chemical data from a currently occupied Kuikuru village to those of the neighboring plaza, the history of which is known by current inhabitants of the contemporary village. Schmidt has been able to correlate modern chemical anomalies with some of the data obtained at the historic village, advancing some hypotheses about site formation including soil movement and discreet activities. These results are relevant to the analyses proposed here, and will be drawn upon in later chapters.

Chapter 3.

Images of Amazonia

Situated Narrative

As an archaeologist, I am in the business of composing narratives. I read narratives, propose and carry out field work, and use the data I produce to elaborate new, hopefully more nuanced and informative narratives about the place I have been studying. So it is with all archaeologists. We base our models, projects, and protocols on the extant literature, and are thus situated in particular moments, along particular vectors, within the fields of discourse, narrative, and representation that make up our intellectual and mundane realities. The purpose of this chapter is to delineate these fields, and to trace the narrative tropes that have emerged as particularly important in the construction of the field of Amazonian archaeology, as it has been delineated in the previous chapter.

The relatively young field of Amazonian archaeology emerged in the 1940s and 50s within a 450-year history of representation of Amazonia, the monolith of “sedimented histories of a primal nature” (Raffles 2002) that produced and continue to reproduce the images of the Amazon that dominate popular and even scientific imaginaries. These images, often cast in a haze of mystery and wonder, have been extensively analyzed and to a certain extent classified into representative tropes, including “Green Hell,” “Green Cathedral,” “Garden of Eden” (Slater 1995, 2002); untamed or “excessive” nature (Raffles 2002, Stepan 2001). This chapter will trace the adoption and re-formulation of particular versions of these images by archaeologists participating in the research programs defined in the previous chapter.

Colonized places and the act of narration

This chapter brings together a body of literature that is not typically considered as a unit, but which has in common a kind of subject and a mode of narration. The subject matter of the literature in question, the *colonized place*, is to be understood as a place (city, drainage basin, country, climatic region, or continent) that was encountered for the first time by Europeans as part of a completely new, unprecedented experience – what was called, in their language, “discovery.” The mode of narration, to be discussed at greater length below, can be generally classified as travel writing; in this case, the definition is taken rather literally, and includes any literature produced by a person who traveled to these colonized places from the moment of first contact to the present, regardless of the author’s training, goals, or affiliations. In the case of Amazonia, I consider most Brazilians, even many inhabitants born in the major cities in the region, to be foreigners to the place, as I have argued elsewhere (Browne Ribeiro 2006). The

aim of this section is to begin to tease apart the kinds of images that emerge from these narratives, to understand how these helped shape, and were shaped by, intellectual movements in Europe, and to examine how archaeological narratives came to be entangled in the grand narratives that continue to reverberate throughout the world with respect to Amazonia.

This analysis of primary sources such as journals, fictional works such as novels, as well as formalized texts constructed within the fields of natural history, archaeology, history, and anthropology, traces changes in European representations of Amazonia over the course of the last five centuries. Of particular interest is the way the notion of ‘civilization,’ along with related concepts elaborated over the course of the 16th through 18th centuries in connection with the European Enlightenment, transformed the perspectives and motives of travelers to these distant lands. Simultaneously, travel narratives were themselves instrumental in the elaboration of concepts of ‘civilization,’ ‘barbarism,’ and ‘savagery,’ which came to dominate the discipline of anthropology at its inception. Central to this discussion is the position that the ways that Amazonia has been presented to the outside world is determined by the intelligibility of Amazonia as a region and as an inhabited place.

This chapter will begin with a discussion of narrative, as a mode of representation that is distinct from discourse. These concepts, developed in the first section, will be used to frame the discussion of travel writings, and to consider the discursive power of this form of writing within the context of the Enlightenment. Placemaking through a colonial perspective is explored within the context of key Enlightenment-period sources, and a tendency toward representation of familiar or intelligible places as civilized and unfamiliar or unintelligible ones as savage is identified. Finally, I consider how “the Amazon” came to be constituted as a region, particularly for researchers, and key representations of Amazonia are examined both historically and within the context of archaeological practice in Amazonia.

The second half of the chapter will deal specifically with narration and narrators, and the intersection and co-evolution of *grand narratives* and *particularistic narratives* about Amazonia and archaeology as a scientific discipline. Grand narratives transmit concepts about places, if ‘place’ is defined as a locale that is lived-in and experienced, understood as historically contingent, and always perspectival (see Cresswell 2006, Parkes and Thrift 1978, Pred 1990, and Relph 1976 for similar conceptions of ‘place’). Local or particularistic narratives, which address problems referring to specific times and places without reference to general models, often serve as examples that buttress general rules essential to the logic of a particular grand narrative. By analyzing the language and structure of two early European accounts of travel on the Amazon River, two seminal moments are identified in the representational history of Amazonia. These moments, each of which sets off a tradition of narration, also define the embryos of images which operate in cultural and popular conceptions of Amazonia today. The ways in which archaeologists engage directly or indirectly with these accounts and their respective narrative tropes are examined, and their potential motives for particular forms of engagement explored. Finally, the motivations of the first narrators – the European chroniclers – are interrogated alongside the archaeological evidence, in an effort to propose a new mode of narrative production.

Narrative, representation, and discourse.

During the Age of Discovery, European voyagers, fueled by the lure of the spice trade and fertile, ‘free’ lands, traveled around the world, visiting places and meeting peoples that had

no prior referent in their worldly knowledge. Upon their return to Europe, they brought home journals, engravings, and tales that conveyed their experiences to expectant eyes and ears. As the known world expanded before the eyes of Europe's inhabitants, it did so in accordance with narratives and images produced by the privileged few who ventured beyond the bounds of town and country, and within the context of local politico-religious norms. Even in today's globalized world, perceptions of the foreign depend heavily upon the fealty of the pen, camera, or other recording device of what amounts, in a comparative sense, to a handful of travelers.

In *The Languages of Archaeology* (2002), Rosemary Joyce traces the use of Bakhtinian concepts in the analysis of literary and scientific texts, and proposes their applicability to the critical analysis of historiography. Particularly relevant to this study is Joyce's (2002) exploration of the meaning, function, and occurrence of narratives, narrative styles, and narrative practice as distinct from discourse, which is explored below. Narratives are necessarily temporally situated and logically structured; furthermore, they presuppose a narrator, who observes and recounts from a particular perspective (Lamarque 1990, cited in Joyce 2002). Narratives, as stories or narrated events, are to be distinguished from narrative as the string of discursive or non-discursive descriptive entities that arises from narration, which is the act of telling or narrativizing (Joyce 2002). The act of narrativizing, or narration, according to White (1987, summarized in Joyce 2006), is temporally contextual, thus sensitive to ideologies and discourses that form the fields within which narrators operate. Comprehensive analyses of historical narratives must involve the situation of the author's work within the socio-political context of the time.

Narratives are generally conceived of as sequences of words joined to build phrases and sentences which thus convey ideas. In the context of anthropological study, we must consider the impact of images as pictorial representations that can appear as part of verbal narratives, as series of images that are narratives in and of themselves, and also as stand-alone manifestations that contain, recall, symbolize, or transmit larger narratives. Barthes (1977) suggests methods for interpreting images and their various components and connotations. Like written text, images inevitably contain (intentionally or unintentionally) encoded meanings representative of the narrator's (in this case artist's, photographer's) position, and these must be decoded. Images, especially those that appear without text, must also be seen as differentially interpretable by viewers, whose individual paths (see below, and also Pred 1990) frame the meanings produced.

The narratives to be explored in this work, even those originally composed at the dawn of the Age of Discovery, have all, by this time, been re-mixed, represented, and circulated within the context of what Mary Poovey identifies as (1995) 'mass culture'. The emergence of mass culture in the mid-19th century, according to Poovey (1995), coincides with the gradual growth of representation, conceived as the deployment of images and ideas (and narratives), as a vehicle for knowledge production and dissemination. She also considers the development of new technologies of representation, to which I will return later, that made possible the notion of a 'population'.

Poovey also conceives of a 'history of representation' (1995:185 n. 14), which provides a useful heuristic for contextualizing the role of historical narratives in knowledge production at particular times and places. This history consists of four stages, which are distinguished by the extent to which representation constituted people's ways of knowing the world, and the relationship between this way of knowing the world, and the experiential mode (Poovey:1995). Without reproducing her exposition of these concepts, it is sufficient for this discussion to note

that she begins by describing a condition in which experiential and representational modes of knowing co-exist, and ends by proposing a condition in which the dominance of mass-production and mass-culture makes it so that representational knowledge almost always precedes, and sometimes substitutes for, experiential knowledge (1995: 185 n. 14).

Finally, discourse, in this work, refers to any thread of communicative practices that is historically, socially, and culturally meaningful, and also, crucially, contextual (Blommaert 2005; Hanks 1996). Discourse, as Blommaert (2005) points out, is not merely phrase, text, or image in itself, but necessarily comprises contexts of deployment, including dates and frequency of use, locale of utterance or display, and form and distribution of publication or dissemination. Words, phrases, texts, gestures, images, and any combination of these, are thus components of discourse that are intentionally or unintentionally instantiated, and are themselves representations.

Travel writings as representations.

A study of 15th to 20th century travel narratives from European contact and colonial contexts invokes all four stages of Poovey's (1995) history of representation. Taken literally as a history, we can attempt to gauge the extent to which European travel writings, as representations, functioned in the construction of images and associated discourses "at home" in Europe (Pratt 1992). Pratt (1992) identifies significant changes in the manner in which these representations are framed by European writers, particularly in the mid-18th century, when an explosion in the production of travel writing helped non-travelers situate themselves within European imperial projects.

If this "history" is understood as degrees in the manner or extent to which representation functions in everyday knowledge production and consumption, in contrast with the role of experiential knowledge, then it is useful in situating individuals within chains of representation. Joyce's (2006) comment on White's (1987) insight on the temporal and contextual nature of historical writings emphasizes that written histories are sensitive to writers' personal convictions, as well as to contemporary discourses. Considering this, we may employ the framework of Poovey's "history" to conclude that the farther from the source an individual, and the later within the actual representational history of a place, the more susceptible that person will be to already circulating discourses and representations in constructing a mental image of that place.

Representational materials that are produced during travel are thus simultaneously the manner in which writers record their experiences, the mode through which scientific and popular discourses are expressed, and the means by which non-travelers (here in relation to a particular place, not in an absolute sense), come to know foreign places. In the colonial world, long-distance travel narratives envisioned places, remote and exotic, that became fixed in the Western imaginary as wild, static, and above all, alien to Western culture, values, and knowledge. Taking Amazonia as a case study, this chapter explores how colonized places have been constructed as a static, homogenous, exotic, and untamed lands, and how this discourse operates in four public presentations of Amazonia in particular, and the colonized world in general; that of the fierce, untamed jungle; that of the exuberant and infinite forest; that of the fragile, endangered ecosystem; and that of the beautiful and exotic paradise. These portrayals of the Amazon each operate within particular segments of the Western cultural imaginary, and have arisen through different motivations, which will be discussed below.

The formulation and propagation of these particular representations will be explored in the first half of the chapter. Focusing on the interplay between narrative and cultural imaginary, I examine the ways in which past narratives have been recycled into newer ones, often propagating colonial attitudes, but also driving new research. In the second half of the chapter, I consider the role of archaeological narratives in the often unconscious construction, promulgation, deconstruction, or censure of these representations. Archaeological engagement with ethno-historical literature is carefully examined as an example of the interplay of text, narrative, and representation, and I propose methods of analysis that promote a circumspect yet productive engagement with early accounts of Amazonia.

Placemaking and colonial history

The transition from ‘first contact’ accounts associated with reconnaissance missions to those associated with mapping, settlement, and cultivation that is articulated in Chapter 3 dovetails with Chris Godsend’s (2004) distinction between *middle ground* and *terra nullius* forms of colonialism. Middle ground colonialism is characterized by buffer zones, and also by a relative evenness in power relations between colonists and native peoples. Often, what advantages colonists possess in terms of technology is offset by the superior local knowledge of native peoples. Terra nullius colonization, in contrast, involves the systematic invasion and colonization of lands and concomitant dispossession of indigenous peoples of, at minimum, rights to access to territories. Though they do not represent temporal periods, Godsend’s middle ground and terra nullius colonialisms can exist within a sequence, and here are invoked as stages to be considered in formulating a conceptual history of colonialism.

This history of colonialism is intertwined with, and, as will be demonstrated below, instrumental to the construction of discourses on civilization that are critical to understanding modern conceptions of and research trajectories within Amazonia. It was within the colonialist period and in reference to travel writings produced through colonialist voyaging that such discourses gave birth to the opposition of *civilization* to *savagery*. Williams (1990) has pointed out that the justification for terra nullius colonialism is intimately linked to papal language referring to barbarism and savagery, used initially within the context of the Crusades, and later in loci of European colonization. Early philosophical writings that came to shape Enlightenment-period thought make use of this same language, which later would become the cornerstone evolutionary scales and progressions articulated in models of human social evolution that are discussed in detail in Chapter 4.

Here considered the final major stage in a conceptual history of European colonization, the last half-century has seen civil and human rights movements around the world promote a critical re-evaluation of images deployed during the preceding colonial period. This has also accompanied withdrawal of direct colonial powers from colonies, and prompted many to reconsider colonialism in light of a possible and hotly debated post-colonial condition. In accordance with the historical progression of colonialism, one should expect to see changes in the ways narratives about colonized places are told over the centuries, beginning with less unified visions before this discourse was constituted, followed by a shift in language associated with Enlightenment-period discourses, and finally, a revindication of the “noble savage” associated with Western scholarship of the 1960s onward.

Not only are different representational tropes traceable over time, but differences in conceptions of indigenous peoples and colonized places are connected to the nature of first encounters in distinct geographical locations. Using the Amazon as a case study I trace the way 'othering' was differentially carried out in places and landscapes that seemed familiar to European eyes and in those that most strikingly diverged from European notions of 'civilized' landscapes (see Childe 1950a, b, 1951; Redman 1978; Renfrew 1972; Sanders and Price 1968). Integral to this analysis is a consideration of indigenous practices, and extent to which they may have qualified as "abhorrent" to European sensibilities (e.g. Povinelli 2002), as well as a consideration of intelligibility of landscapes and forms of relating to the natural world.

A note on categories

Narratives that deal with colonialism and post-colonialism often tend to pit "Europeans" against "Native People", "Indigenous People", "Native Americans," etc. It is easy to suppose that at each respective moment of first contact between Europeans and non-Europeans, there were two distinct populations involved in the encounter: those who arrived on boats to claim lands, and those who, occupying those lands, saw them arrive. The use of the categories 'European' and 'Indigenous' in the context of past and present encounters naturalizes this notion. However, each of these moments was necessarily unique, as different groups of people, with differing histories and interests, met in different places and times. If one considers any given locus of European colonization in time, it becomes clear that, even if the strict distinctions between European and Indigenous seemed momentarily real at first contact, these distinctions broke down as soon as contact became prolonged and intensive.

Homi Bhabha emphasizes that all cultures are necessarily hybridized or creolized forms (Gosden 1999); while the use of terms like hybrid and Creole is not ideal, the emphasis here is on the dynamic and diverse nature of cultural forms. From the first moment of contact, as words, objects, and impressions began to flow between these distinct populations, a kind of hybridization began to take place. Hence, beyond the temporal and spatial scope of each of these first encounters, the Indigenous/European dichotomy loses all meaning. Nonetheless, the designation "Indigenous" brings together under a single term peoples who share a common set of relationships to European colonial history, and as a result, face similar challenges (Pevar 1992; Tuhiwai Smith 1999). Thus, for the purposes of this study, the two categories will be used as heuristics, with an understanding of the complications that inhere within generalizing categories.

Mastery over nature

Linda Tuhiwai Smith (1999) identifies travelers' tales as one of the primary media through which European ideas of the Other were initially created. In *Decolonizing Methodologies*, she relates how "Images of the 'cannibal' chief, the 'red' Indian, the 'witch' doctor or the 'tattooed and shrunken' head, and stories which told of savagery and primitivism, generated further interest, and therefore further opportunities, to represent the Other again" (Tuhiwai Smith 1999:8). It was through these *first contact* accounts that European conceptions

of the 'indigenous', identified by their temporally and regionally specific terms, were constructed. In this study, the term 'first contact' refers to a series of moments in history in which contact between people from Europe and inhabitants of places like the Americas and Oceania are characterized by a lack of precedent and not to any specific moment of encounter. This initial othering, which was to become the basis for European foreign policy during the expansionist period (Williams 1990), took place, not on the contested soil first visited by Europeans, but in Europe itself, before most colonists set foot in foreign lands. It was an othering in ideal terms, made possible precisely because of distance.

A natural process of differentiation, through which children learn to distinguish their bodies from their surroundings, occurs from birth onwards. This process of comparison and distinction also tends to characterize all relations of contact. However, the systematic representation of foreign peoples within a discrete social order is the product of discourses. This section shows how the particular kind of differentiation that Tuhiwai Smith (1999) calls "othering" is tied to scientific discourses on civilization that took shape over the course of the later 17th and early-to-mid 18th centuries, during the period known in Europe as the Enlightenment (Pratt 1992; Kirch 2000).

I suggest above that many foundational concepts about Europeanness as 'civilized' were developed during the Enlightenment period, partly by making use of representations furnished by first contact accounts, within the context of early middle ground colonialism. Below, I explore a particular example of an early formulation of concepts central to discourses on civilization, in which the relationship of an indigenous people to land is absolutely essential. As I will discuss in Chapter 4, a conceptualization about people cannot exist outside of a conceptualization of the place they inhabit, as people and places are co-constitutive. Hence, we must consider not only the way that othering of people occurred in colonial encounters, but also the othering of places.

European projects of colonization as settlement, the expansionist and often terra nullius form of colonialism that mostly coincided with the height of the Enlightenment, produced distinct reactions to and reports of New World landscapes in accordance with differing degrees of comprehension on the part of colonists. Landscape forms that were familiar to Europeans, particularly with respect to the way in which indigenous peoples exercised dominion over these landscapes, were represented as civilized, in sometimes overdetermined ways (e.g. Sahlins 1992). As an example, upon arrival in the urban centers of the Maya lowlands in the sixteenth century, Spanish colonizers marveled at the stunning architecture and "grand civilizations" encountered (Webster 1998). In contrast, unfamiliar treatment of the land, especially ordering by principles foreign to European worldviews, resulted in the othering of places and landscapes. Landscapes made up of components familiar to Europeans, such as field walls and palaces, were associated with civilization; those that were incomprehensible to Europeans, or associated with the European past, such as earthworks or managed forest patches, were depicted as wild, savage, or untamed. To whatever degree European colonists could readily recognize indigenous mastery over nature, to that degree could they consider the places and the people that inhabited civilized.

The question of control over nature as a necessary quality of civilization, indeed, of civilization as the rejection of nature, has been so fundamental in European thought that prominent anthropologists have invoked it as recently as the 1970s (Levi-Strauss 1971). This notion was already embedded in European thought by the time of Locke's (1993 [1689]) now infamous discourse on property, written circa 1681. This chapter of the *Second Treatise of Government* (Locke 1993) sets down criteria by which land can be said to be one's property: "as

much land as a man tills, plants, improves, cultivates, and can use the products of, so much is his property” (1993:276). The examples used to contrast this civilized act of tillage include gathering acorns and shooting deer, food procurement strategies associated with the “Indian” (1993:275). This early instantiation of 'mastery over nature, phrased in Locke as the duty to “subdue the earth,” became the touchstone of European evaluation of Indigenous effect on, and possession of, land (Mann 2006; Williams 1990). Notably, this dichotomy suggested by Locke is reminiscent of the categories *hunter-gatherer* and *agriculturalist*, a long-lived dichotomy in anthropological thought that stems directly from early evolutionist notions of 'savagery' and 'barbarism,' respectively (Morgan 1877).

Sahlins (1992) perceives that European missionaries' conceptions of Native Hawaiians, ca. 1820-40, adhered to one of two images: that of the “heathen” or that of the “stupid heathen” (1992:6). The distinction captured by Sahlins is somewhat analogous to that between Rousseau's (1987 [1755]) *noble savage*, who exist in an innocent state of nature, and Hobbes' (1996 [1651]) *savages* whose brutish lives consist of war. In either case, these conceptions presupposed a particular relationship to nature. Indigenous peoples who, according to European conceptions, were deemed uncivilized, were also seen as being ruled by, and a part of, nature. These two general depictions, combined with the multiplicity of specific images, would no doubt have caused confusion in Europe, and as we shall see, *Candide* (Voltaire 1992), a cruel reflection on human nature in which the protagonist visits South America, is a testament to the cacophony of voices that claimed authority over New World knowledge, and will feature in this analysis as well.

Imagining Amazonia

The fact that a region that exists across political borders can as easily recall notions of primitivism, wilderness, or biodiversity as policy decisions linked to a politically and geographically bounded entity suggests a need to consider how “the Amazon” came to be conceived of as a region, and how its multiple definitions as such operate in the modern world.

It is important to remember that the word “Amazon,” now inextricably linked to the a portion of land roughly (and often alternately) defined by river drainages, climatic conditions, vegetation class, and, in anthropology, culture areas, is a name for mythical Greek woman-warriors that was attached to the river Marañón (as it was then known to the Spaniards) as a result of an encounter which was almost certainly fraught with misunderstanding. Upon hearing reports of, and later encountering women warriors, the Spaniards' response was to apply to this class of woman a name, or category, which was their only referent for a social structural phenomenon that they must have seen as an aberration. Hence, the naming of the river, and subsequently of the region associated with the river and with the mythical woman-warriors, which signifies the beginning of the formulation of “Amazonia” as a concept, is a result of Spanish pre-conceived notions about the universality of gender roles in society and their perception of the “Amazonian” model as a singularly exotic. The Spaniards' need to resort to myth as a means of assimilation signals the incomprehensibility of the phenomenon. The subsequent application of the name Amazon to the region, an extension of meaning characterized by ignorance, and the continuing impossibility of defining the region's geographical boundaries mirror the incomprehensibility and mystery of the elusive Amazons themselves.

The elusiveness of “The Amazon” is borne out by the fact that the words can refer to the river itself (which, incidentally, changes names at the Peruvian-Brazilian border, and also depending on the speaker's nationality); the basin drained by the Amazon River; the “lowland” tropical forests of northern South America (which can sometimes include the Orinoco drainage); a legal or political entity composed of states or departments that serve particular purposes within national boundaries; or a culture area, especially as it has been considered by anthropologists and archaeologists. This fact of this indeterminacy leads us to ask what kind of structure permits this vague entity to exist, and perhaps the answer is that such indeterminacy, insofar as it serves a purpose, is self-propagating. In other words, as long as it is permissible to talk about the Amazon as a bounded and defined entity in the face of contradicting empirical data, it will remain elusive and indeterminate, which may be the only defining quality of the region.

The limits of the Amazon region, as well as its sub-regions, vary in accordance with the needs of the speaker. As a place of research, then, Amazonia can expand, contract, and transform according to the focus of the researcher. The fluvial geomorphologist may divide it into drainage basins while the forest ecologist might class and delimit it by vegetation type. In Chapter 4, I argue that anthropologists, particularly archaeologists, defined Amazonia not by the co-occurrence of attributes or inherent qualities, but rather as a negation of ‘high culture’ (see Baines and Yoffee 1998) and in opposition to the Andes and Andean culture complexes. The four images discussed in this section not only detail the history of representation of Amazonia, but also provide clues to the recurring aspects that undergird contemporary impressions of this place.

Four Images

Savagery, sin, and survival in the jungle: Mapping the unknown.

In the wake of de la Vega's condemnation of Amazonia as a green hell (Medina 1934), Betty Meggers' (1971) “counterfeit paradise” encapsulates the hopes and fears of missionaries and early voyagers (who are often one and the same, or whose voyages coincide) of the Amazon region. The very first encounters that occurred between Europeans and Amazonians were mediated by missionaries or men of the cloth, who considered the native inhabitants to be “heathens” in need of salvation. In the exploratory and missionizing account, the native peoples of Amazonia are simultaneously innocent children and savage heathens, at once primitive, dangerous, and pure, like the land they inhabit (de Landa 1978; Markham 1859; Medina 1934).

Introducing a new mode in knowledge production about Amazonia, French geographer Charles Marie de La Condamine (1944) distinguishes amongst native peoples of Peru on the basis of the type of landscape they inhabit: those that live in cities are Indians; villagers are dwellers; but those who live deep in the forest are referred to as savages (44). Passing reference to the constant state of war in the Amazon, and to cannibal tribes that inhabit particular corners of the basin (La Condamine 1944), recalls the writings of Hobbes (1996), who explicitly cites America as a place in which a condition of constant war can be observed.

Meggers' depiction of the Amazon as a counterfeit paradise (1971) rehearses the theme of savagery. In a correct but limited analysis, she describes Amazonian soils as infertile and unproductive, characterizing the Amazon as a whole as inhospitable to civilization. In her vision, the place known as Amazonia is a black hole of culture, a savage and indomitable land.

Her model for occupation of the Amazon, based on her “law of environmental limitation” (1954), makes an explicit and causal link between environmental productivity and cultural development, such that savage places that cannot produce adequate resources are associated with savage people. At the same time, the inhabitants of this land are ‘innocent’ of the knowledge or ability to tame this land.

Interestingly, nearly two hundred years after the first successful voyage down the Amazon River, the notion of Amazonia as ‘savage’ is not completely cemented. Fascinated by the myth of the Amazons, La Condamine (1944) devotes a chapter to the rational circumstances under which a tribe of warrior women might have come exist. Rather than depicting the Amazons as a mythical tribe, he envisions a rational republic of women who, tired of serving as pack mules for their warring husbands, and thus accustomed to the “errant life” of warriors, fled this tyranny to live independently (La Condamine 1944: 82). This suggests that, though he imagines the inhabitants of Amazonia live in a “state of war” (as in Hobbes 1996), he nevertheless locates their logic within a familiar liberal trope. Similarly, while embedded in discourses of the bizarre and abhorrent practices of New World peoples, Candide, Voltaire’s (1992) protagonist, concludes the former are just as interested, and just as motivated by memory, alliances, and grudges, as the Europeans they have left behind, a moment of self-identification that would seem impossible for those who consider the indigenous peoples of the Amazons to be savages.

Land of plenty: Rubber, spice, and the search for El Dorado.

In sharp contrast to Meggers' vision of a hostile and destructive Amazonia, Lathrap (e.g. 1970, 1973a-cayman) envisions the region as productive and plentiful, electing Central Amazonia as the origin of South and Central American. The notion of Amazonia as a “land of plenty” is as old as the savagery narrative. The first descent of the Amazon River, for example, was originally a spice-gathering expedition (Medina 1934). Since the first travel narratives reached Europe, tales of cities of gold (*El Dorado*, *Aldeia d’Ouro*, *Manoa*), golden lakes and rivers, (*L. Parima*, *R. Iquiari*, *R. Jurubech*, *R. do Ouro*) (Raleigh 2001; La Condamine 1944; Medina 1934; Fritz 1922). The riches of El Dorado, as described by these adventurers, paled in comparison to those of Mexico, Peru, Spain, and the Ottoman Empire (Raleigh 2001), a claim put to good use in the absurd comedy *Candide*; Voltaire’s protagonist, the fair-skinned Candide, stumbles accidentally upon El Dorado, whose inhabitants scoff at the “sand and pebbles” (gold and jewels) that litter their kingdom (Voltaire 1992:51). La Condamine (1944), the scientist, expresses disappointment over the absence of gold mines, villages, rivers and lakes, while carefully recording the witnessed resources of the Amazon, noting the fertility and abundance of the region, the diversity of plants and their uses, and the location of semi-precious greenstone.

The myth of El Dorado, insofar as it depicted Amazonia as a land of riches, was a narrative of promise and success, and for nearly three quarters of a century, the rubber trade fulfilled these promises (Weinstein 1983), at least for a select few. Despite the callous treatment of native peoples by European rubber barons, and the permanent scarring of the cultural and physical landscape, the city of Manaus enjoyed, for a short time, a global reputation as a colonial place. Less well known than the rubber boom are other attempts by Portuguese and Brazilian authorities to extract from the Amazon a kind of green or yellow “gold”, usually in the form of produce, but sometimes also as forest products.

Recently the myth of El Dorado has been evoked within the context of archaeological research. El Dorado been invoked in the context of contesting claims of evidence for complex societies in Amazonia (Meggers 2001). The term “black gold” has also been applied to terra preta in popular media presentations of recent advances in Amazonian archaeology (Tennessee 2007). Archaeologists and other scientists working with terra preta have been careful to qualify the limited state of knowledge about the significance of these soils in pre-Columbian times, but the conflation of knowledge about present use with expected models of occupation, combined with a persistent desire for a panacea makes it all too easy to revive the myth in the popular imaginary. After all, at the end of his adventure, Candide concludes that the kingdom of El Dorado, where nobody wants for anything, is truly “the best of all possible worlds,” and the only place where it can truly be said that all is well (1992).

Ecosystem: scientific narratives and eco-activism.

Most archaeological work that goes on today is scientific, and as such it is important to consider that scientific narratives operate in a particular way within the perspective of a lay readership. In order to understand the weight of truth-claims found within scientific literature, let us return to the discussion of narrative and meaning. In the act of reading, the reader is not only completing the construction of meaning, but is also in a position to evaluate the veracity of truth-claims put forth by the writer. It is in this instant, according to Genette (1988, cited in Joyce 2002), that the distinction between fiction and non-fiction occurs. In non-fiction, evidence is supplied to support knowledge claims, but at the same time, the reader trusts that the claims represent adequate knowledge production procedures (Harré 1990, cited in Joyce 2002).

This section will cover two general categories of scientific study undertaken in the Amazon: the naturalist perspective, which included ichthyology, ornithology, biology in general, as well as geology; and the anthropocentric perspective, which includes archaeology, anthropology, and, where appropriate, geography, soil science, and agronomy. Although the above will be discussed sequentially, it is worth noting that natural sciences once encompassed anthropology in some circles, and that ecological perspectives have been applied to both.

Barreto and Machado (2001) credit La Condamine with the first scientific survey of the Amazon. Although La Condamine’s map of the river is the first reliable map produced by Europeans (he had along a cartographer), and his observations regarding indigenous practices and Amazonian flora and fauna are richly detailed, his descent of the river, a task corollary to his assignment, was in part motivated by mythical appeal. La Condamine’s writings betray his disappointment at the absence of golden lakes and villages, the mapping of which he might have envisioned. He also attempts to explain the expedition’s failure to encounter the Amazons, proposing social-scientifically inclined explanations for their ‘disappearance’, such as integration into another tribe, or a modification of customs. This indicates that La Condamine had taken the reports of his predecessors as at least somewhat reliable.

This brings up Barreto and Machado’s (2001) excellent point that travel writings can serve as vehicles for unpacking the history of scientific study of the Amazon, and equally, as ethnohistoric sources of data. Acuña and Carvajal (Markham 1859) are amazed at the sheer size of settlement encountered in the Amazon, referring to them as belonging to great civilizations. La Condamine (1944), on the other hand, cites the extent and complexity of linguistic systems in the Amazon as evidence for the antiquity of Amazonian occupation. Sir Walter Raleigh (2001) was convinced that the entire Amazons had been subdued by the great empire of the Incas.

Although Raleigh's reasons for believing this are unclear, it is noteworthy that a very similar claim for Andean domination of the Amazon basin appears in the works of Betty Meggers (1951, 1971, 1995, 2001) three and a half centuries later. Meggers' innovation on Raleigh's thesis is that the Amazon, as a place, was so impoverished, that it served as a site of cultural devolution, because of the environment's inability to support populations of significant size. Relying on data from travel narratives that indicated the presence of large populations in certain parts of Amazonia, other scholars (Brochado 1980; Lathrap 1973a, b; Roosevelt 1982, 1987, 1991, 1994) sought to demonstrate the antiquity of Amazonian occupation, often using landscape carrying capacity as a proxy for population densities.

The use of the notion of *population* presents a particular kind of perspective on the Amazon and betrays some assumptions behind some anthropological notions of complexity, while at the same time, it results in a flattening effect that Poovey (1995) perceives to arise out of the replacement of ranges with averages, and of people with numbers. Technologies of representation such as censuses and statistics serve to parse large amounts of data about people into manageable and (semi-)intelligible data about 'populations', a concept that was essentially invented through these means (Poovey 1995). At the same time, these technologies elide difference, lumping into a 'mass sum' groups that had never previously been considered together (1995). This is precisely what the enumeration of indigenous groups, along with population estimates, does. In the Amazon, the use of a population approach function in a similar way, eliding difference and enabling the representation of the Amazon as a vast, yet homogenous place. As places are engendered by people, and population statistics allow for the representation of distinct peoples (*sensu* Pevar 1992) as a single, homogenous group, the place that contains them is then imagined as homogenous as well.

More recent work in the Central Amazon (Neves 2003; Neves and Petersen 2004; Neves et al. 2004; Petersen et al. 2001) and in the Xingu Basin (Heckenberger 1998, 2005; Heckenberger, et al. 1999) seeks to tell a different kind of story. Rather than conceiving of the Amazon as one, vast, undifferentiated region, scholars like Heckenberger and Neves are seeking to map out particular histories in particular places, with reference to political processes, social practices, and, where possible, placemaking by indigenous peoples.

Particularly in the Central Amazon, this project intersects with that of soil scientists, whose efforts for decades have revealed local and regional variations in the kinds of plant life sustainable across the Amazon, further complicating claims made by anthropologists such as Meggers, Evans, Lathrap, Carneiro, and others during the second half of the 20th century. Most recently, an increasingly cohesive group of soil scientists (Glaser 2001; Glaser and Woods 2004; Lehmann et al. 2003; Woods and McCann 1999; Woods et al. 2009) have joined forces with archaeologists studying terra preta to see if, among other things, knowledge about these indigenous anthrosols can help pave a road to sustainable agricultural practices in the Amazon.

The idea of sustainability is closely linked to the theme of deforestation, which inevitably is one of the most publicized images of the Amazon, seemingly ubiquitous in the modern Western cultural imaginary. Articles in the New York Times, Nature, Discovery, and National Geographic magazines, and countless online sources maintained by political and environmental groups portray the horrors of the destruction of the Amazon, finite forest, fragile ecosystem, where daily hundreds of unidentified species of flora and fauna are lost each day to loggers and ranchers. This notion of the fragile ecosystem brings us full circle, back to the voluminous and often overwhelming depictions by early naturalists studying the Amazon. While some exalted

the infinite diversity of species and fertility of the land, others saw terror and wilderness, and still others, untouched paradise.

Paradise: Noble savage, pristine parkland, and eco-tourism.

Rousseau's noble savage was one alternative to visions of ferocious, warlike cannibals whose primitive practices would have been abhorrent to European colonizers (see Povinelli 2002). Famously, Las Casas' *Short Account of the Destruction of the Indies* is the first known European text which describes indigenous peoples as "true and rightful masters" of the lands they occupied (1992 [1542]:13). For Las Casas (1992), the people he saw slaughtered were stewards of the land. The noble savage was revived along with Earth day in the 1970s, when the emblematic image of the crying Native American became symbolic of indigenous' people's natural instinct to protect the land, and minimize our impact on it (Mann 2005). This idea that indigenous peoples' impact on landscapes and ecosystems is negligible is ubiquitous in European thought (Locke 1993; Rousseau 1987; Mann 2005). It is not uncommon for images of the Amazon, especially those connected with tourism to be entirely empty of people, or for the people who appear in these images to be represented as part of nature. This latter conflation of person and place is evident in Millard's (2005) depiction of the deepest, darkest reaches of the River of Doubt, a tributary of the Madeira River via the Aripuanã River.

Notions of the Amazon as pristine parkland have come under fire in the last two decades, particularly through the efforts of geographers and archaeologist working in the region. Erickson (1995, 2000a, 2000b, 2006) and Balée (1989, 1993a, b, 1995; see also Erickson and Balée 2006) have determined that an entire landscape, that of the Beni in Bolivia, has been entirely constructed by human hands. Heckenberger (1998, 2001, 2003, 2005; Heckenberger et al 2003; Heckenberger et al. 2007; Heckenberger et al. 2008) and Neves (1998, 1999, 2000a, 2003), working in the Xingu and Central Amazon, respectively, have discovered monumental earthworks, plazas, ditches, and in some cases, even causeways, that reveal that much of what is forest overgrowth today is likely secondary cover, not primary forest as had been thought for decades. Finally, Denevan (2001, 2004; Denevan et al. 1984) has suggested that most of the Amazonian landscape encountered by Europeans, and still visible today, was significantly modified by Amazonians before the arrival of Europeans.

Despite efforts to present Amazonia as diverse and heterogeneous, where multiple distinct and complex histories developed within a web of long-distance relationships, many who might be considered champions of Amazonia in public spheres fall prey to idealized images of stasis and balance. Eco-tourists, those who strive to practice tourism in an ethical and conscious way, and who place value on environmental preservation and conservation help reproduce these images. A web search for images of the Amazon, or for places or geographical features therein, inevitably retrieves a myriad of links to tourism companies or eco-lodges that fill their pages with images empty of people. Tourism companies are well aware that visitors to the Amazon seek the pristine myth, and their tours are often designed to deliver the 'Amazon product' as nature, in a safe, convenient package, free of complexity, history, or political significance.

Despite the exclusivity of such vacation destinations, and the inaccessibility of the places, or perhaps because of these factors, the global imagination of the Amazon continues to be its exuberant nature and its inherent fragility – the delicately balanced ecosystem threatened by modernity, which must be recorded, witnessed, if not conserved, before Western civilization annihilates it. Eco-tourism is part voyeurism, part paternalism, and part cannibalism, as

outsiders attempt to consume the Amazon while it remains palatable. The palatable aspects – the green, the wild, the exotic, the traditional, and the gigantic – are published, over and over again, in blogs, websites, travel journals, nature magazines, and photographic journals, while the gray, the mundane, and the modern are left by the wayside, ignored, and therefore nonexistent. The images of Amazonia as ecosystem are valuable to those who work in the biological sciences, and who, correctly, contemplate the effects of modernization on existing ecosystems. But it can be argued that there is a place for everything, and that perhaps the anthropologist would do well to take on a more holistic, nuanced, and historical perspective.

Science with a capital 'S'?

The post-WWII-era wave of systematic scientific research into Amazonian archaeology has deep roots in the colonization, historiography and scientific study of the Amazon. Historically, factors such as geographic size and complexity, threat of tropical diseases, and political exclusion have made the Amazon basin almost impenetrable to Europeans. Parts of the Amazon have been made more accessible through the processes of globalization, but the majority of the region remains knowable only through representation (*sensu* Poovey 1995). Even field archaeologists and anthropologists who are privileged enough to access information about Amazonia through experiential means inevitably arrive there with notions born out of diligent perusal of representational material. This is good science; having a plan and formulating a research design is essential to ensuring a successful field season and adequate data recovery. As explored below, designing research is a kind of narrative-building, and as such, leaves us vulnerable to the influences of contemporary discourses within which we are situated. This section explores some historical trajectories that are associated with the history of scientific engagement with travel writings about Amazonia and attempts an alternative reading of travel accounts geared toward new model-building and research re-formulation.

Narratives in archaeology.

Model-building in archaeology is the construction of grand narratives: the stories that sequentially relate events that constitute the history of places. In creating grand narratives, archaeologists simultaneously construct the places these narratives are meant to explain. To assess such models and to apprehend the kinds of places they create, it is useful to consider archaeologists as narrators. Archaeological work, and thus narration, is embedded in discourses that arise as much from disciplinary practices as from grand narratives already in existence. Recalling the contextual nature of narrativizing, this section investigates archaeological practices of representation, narration and inter-disciplinary literary engagement that have contributed to changing perspectives in Amazonian archaeology over the last century. Amazonianists' perspectives are reflected not only in what they write, but also in the kind of work they do which ranges from applied field methodologies to the kinds of analytics in which they engage.

This section examines the ways that two European travel writers present Amazonia as a place or as a series of places. The interests and motivations of the narrators, to the extent they can be known, will be examined. Because places and persons are intimately linked (Cresswell 2006; Relph 1976), the narrators' depictions of Amazonian peoples encountered on their journeys are also considered. Finally, the places described in these texts are examined in light of

recent archaeological research and alternate interpretations of these travel accounts will be offered. Exploring the similarities and contradictions that arise from the juxtaposition of these disparate modes of knowing through textual and archaeological analysis allows for a better understanding of what kinds of evidence can be reliably obtained from each source, leading to a more nuanced understanding of Amazonia's history. This preliminary examination of the interplay of Amazonian travel writing and archaeological narrative is a step toward developing a kind of analysis that may promote reflexive model building within the field of Amazonian archaeology.

Archaeology, science, and travel writings as evidence.

Contributors to the *Tropical Forest Tribes* volume of the *Handbook of South American Indians* (Steward 1946-50) made liberal use of European travel narratives written between the 16th and 19th centuries. Historical documents and travel narratives were used in assembling historical sketches of migrations and the effects of European contact on particular indigenous groups. As a general rule, traveler's notes were treated as a source of historical facts, but they rarely played a critical role in ethnographic analyses (e.g. Aparicio 1948; Gillin 1948; Meggers 1948; but see Métraux 1948).

In subsequent decades, academic archaeological engagements with travel texts diminished significantly, possibly in connection with a theoretical upheaval that occurred in Americanist archaeology in the 1950s, 1960s, and 1970s. Proponents (e.g. Binford 1962, 1968; Fritz and Plog 1973; Hill 1970) of the "New Archaeology" advocated a scientific paradigm concerned with causality, covering laws and systems theory. Although not all Amazonianists subscribed to these views (e.g. Lathrap 1968, 1970, 1973a, b), some (Meggers 1954, 1957, 1979, 1990) found the nomothetic and systems theory approaches compelling. Some particularistic narratives from this era (Meggers and Evans 1957, 1960, 1968) utilize travel writings to construct historical sketches, but scholarly literature that proposed grand narratives for Amazonian prehistory (e.g. Meggers 1954, 1971, 1992, 2001) often dismissed travel narratives. Archaeologists constructing grand narratives accessed travel texts through 20th-Century syntheses, which may have seemed, in the eyes of Amazonianists, more legitimate or objective than the original travel writings.

European travel narratives were largely ignored by Amazonianists (Lathrap 1970, 1973a, b, c; Meggers 1957, 1963, 1979; Silva and Meggers 1963) through the 1960s and 1970s, in favor of 'scientific' modes of knowing. Archaeologists' reluctance to engage with such texts may have been connected with the growing role of science and objectivist thought as a tool for legitimation in archaeology. A reliance on subjective modes of knowing, such as journal and letter writing, might have posed a considerable threat to the legitimacy of archaeology as a science. Prominent Amazonianists like Lathrap and Meggers likely shared a common baseline for acceptable research process and thus may have had similar opinions on the utility of travel writings in archaeological interpretation, especially in contrast with the perceived value of so-called modern scientific research.

While Meggers, Evans, Lathrap and their respective followers were reluctant to engage with European chronicles, Roosevelt, whose work emerged most significantly in the 1980s and 90s, makes explicit and frequent use of these travel writings. Rather than use travel writings to historically contextualize archaeological data or to make generalized truth claims about the Amazon, Roosevelt (1982, 1991) treats the narratives as ethnographies that may present

analogues. These analogues, along with those provided in traditional ethnographies, were then mined for details that might help build explanatory frameworks for data collected during excavations. However, Roosevelt's failure to engage critically with these texts made her analysis vulnerable to dismissal by other Amazonianists (e.g. Meggers 2001).

Because of the significant changes brought about as a result of European exploration of the Amazon, texts such as Carvajal's and Acuña's, the only extant narratives that can be said to contain glimpses of Amazonia before European contact, cannot be ignored. Conversely, to treat them as historical or ethnographic fact, as Aparicio (1948), Gillin (1948) and Roosevelt (1982, 1991) do ignores individual, cultural or temporal biases that may have influenced European representations of events. Critical readings of travel texts allows for judicious use of the data they contain. One strategy used to establish the veracity of facts is to compare multiple narratives of the same events in much the same way that multiple eyewitnesses may be called on to report on a crime. Similarly, travel narratives can be seen as depositions that can shed light into the character of eyewitnesses. Careful examination of travel narratives with specific and relevant questions in mind can provide insights into the writers' perceptions.

Interrogating early accounts.

The first descent of the Amazon River by a European vessel was accomplished by Francisco de Orellana in 1539-41. Originally members of Francisco Pizarro's voyage to the mythical "Land of Cinnamon," Orellana and his men split off from the larger party for reasons that remain unclear. Whether the expedition downriver constituted desertion, as Garcilasso Inca de la Vega (Markham 1859) reported, or whether it was undertaken by necessity, as recorded by eyewitness Friar Gaspar de Carvajal (Medina 1934), is still debated. That Orellana's crew was so ill equipped for the journey suggests the latter was the case. Regardless, the friar reported on the character of this new land in great detail. Carvajal's narrative can be considered first and foremost a narrative of place that is interwoven with tales of experience.

One of the most prominent patterns in Carvajal's (Medina 1934) narrative is his distinction between "inhabited" and "uninhabited" country. Carvajal's primary criterion for determining the degree of habitation for a stretch of land was the presence and visibility of architecture, although plantations, usually of fruit trees, were also noted (Medina 1934: 218). Other built features that Carvajal (Medina 1934) recognized as habitation and thus civilization were roads, plazas or squares, fortifications, gates and enclosures. Villages with an inland orientation, or those which utilized coastlines for non-habitation purposes, may not have been noticed by the friar. Carvajal's predilection for familiar and productive land is evident in his comment that, along a particular stretch of river, "the land is as good, as fertile, and as normal in appearance as our Spain" (Medina 1934: 217). If orchards were taken as proxies of fertility and order, it is likely that certain kinds of managed landscapes (see Balée 1993a,b, Oliver 2001, Posey and Balée 1989, Summers 2004 and Roosevelt 1992 for contemporary analogues), may have been unrecognizable and incomprehensible to the friar. Carvajal's changing descriptions as the voyage progresses are a testament to the heterogeneous nature of the river's landscape and to the differential land-use practices of its various inhabitants.

Density of habitation, as perceived by Carvajal, is directly related to the Spaniards' chances of survival. Inhabited country is initially anticipated as a safe haven and food source, as the voyagers were generally ignorant of exploitable resources along the riverbank. Further downriver, as negative encounters with increasingly "warlike" peoples became more frequent,

inhabited country was approached grudgingly and avoided whenever possible. This changing perspective reveals a learning process whereby notions of small, independent villages that are easily subdued by superior technology were replaced by memories of large, interconnected provinces protected by organized armies.

By the time of Orellana's voyage, half a century after Europeans first reached the New World, Spain had an established presence in Peru. Chief among their goals in what was called New Spain was to obtain valuable trade goods such as silver and gold, and to convert indigenous peoples to Christianity. Pizarro's voyage to the fabled "Land of Cinnamon" was a search for a plant to substitute the costly true cinnamon from the Indies. In keeping with this pattern, Carvajal's journal reveals an interest in the goods of the land they were traversing. Aside from assessing the fertility of the land, the friar also noted the villages in which gold and silver were seen or said to exist. Carvajal recounted that Orellana ordered his men to ignore the precious metal ornaments seen in Chief Aparia's village presumably to have access to these resources at a later date. The travelers were seeking knowledge connected to their interests in trade, goods and colonization. As the Spaniards were already engaged in extractive trading and colonial practices in the Indies and elsewhere in the Americas their interest in exploitable lands and goods is not surprising. Equally understandable is the confusion Carvajal expressed with regard to the people he encountered. They are at once naïve and irrational (e.g. Medina 1934: 192-196) and extremely intelligent and skillful (e.g. Medina 1934:233), and it is clear that Carvajal had no particular expectations at any given village. Because Carvajal does not appear to have had a particular agenda in describing the people of Amazonia, his narrative could well be considered more reliable in this respect than that of his successor, Father Cristobal de Acuña.

The next successful voyage down the Amazon was accomplished by Commander Pedro Teixeira in 1637-38, in the reverse direction of Orellana's descent. Having departed from the province of Gran Para at the mouth of the Amazon and arrived unharmed in Quito, the Captain was ordered by the Viceroyalty in Quito to return via the same route and to bring two priests along to record the voyage. The account given by Acuña, from the return voyage accomplished in 1639, offers another glimpse of Spanish interest in the Amazon.

Acuña's narrative style differs from Carvajal's in that, while the latter's narrative is chronological, the former's is thematic. Acuña's description (Markham 1859), which enumerates the features of the Amazon, such as food, resources, climate, people, practices and rivers reads more like an inventory than a narrative. By organizing his account in this manner Acuña (Markham 1859) flattens differences across the basin, effectively creating a category of people known variably as "Indians," "natives," "heathens," "savages" or "barbarians." In the latter part his narrative Acuña described the major tributaries of the Amazon. This section contains some descriptions of individual tribes or groups of tribes, but the lack of precision in assigning observed customs to named tribes suggests that the priest perceived peoples across the Amazon basin in essentially the same light. The effect is an elision of heterogeneity across Amazonian space reflecting Acuña's own vision of the Amazon. The priest's attitude became the *modus operandi* for many travelers to the region in subsequent centuries.

Because Acuña chose to narrate his journey in the format of an inventory, his narrative resembles a naturalist text in that it describes the state of a particular locale without reference to actors or historicity. By writing in the present tense, he negated the possibility of change within a set of practices, which gives his narrative the same kind of permanence and timelessness that arises from the use of the ethnographic present. Thus, in addition to having a spatially

homogenizing effect, this narrative style denies temporality. The irony of this effect on the narrative as a whole is that many of its internal components contradict this illusion of atemporality. In addition to describing past European expeditions into the Amazon, Acuña relates encounters with indigenous tribes who have incorporated European tools into their material culture or whose attitudes toward Europeans have changed over time (e.g. Markham 1859: 93, 101, 108). Even while being confronted with clear evidence of temporality and culture change in Amazonia, Acuña persist in an essentialist mode.

In 1637, the year that Acuña's account begins, the political climate surrounding the Amazon was substantially more charged than it was in 1542. The number of failed voyages enumerated in Acuña's and other narratives attest to the strong desire on the part of the Spanish Crown to colonize these lands. Acuña's annoyance at Dutch encroachment upon territory claimed by Spain, his constant fear of invasion and his explicit concern with the construction of fortifiable settlements illustrate the political stress among European nations (Markham 1859). Spain's intention to settle Amazonia is explicitly stated in papers drawn up by the priests toward the end of the journey (Markham 1859:114), and implicit in the general tenor of land descriptions, which amount to prescriptions for the future land use. As Acuña descended the rivers of the Amazon, he mentally transplanted Spanish towns into the Amazon, examining the riverbanks the way a developer surveys a parcel of land. Building on the kinds of notes Carvajal made on fertility, Acuña went as far as to suggest what kinds of crops could be grown in particular districts and to enumerate Amazonian products to be exploited in commerce (e.g. Markham 1859:98,110).

Connected to this desire to colonize and tame the Amazon basin is Acuña's tendency to exalt the land and its resources. The climate was mild and temperate and so agreeable to the priest that he nearly declared the Amazon a paradise (Markham 1859: 74). Gold was said to be plentiful at lakes and rivers, although it seems clear that the priest himself had only heard tales of such deposits. In addition, fish, turtles, manatees, tapirs and birds were plentiful and remarkably easy to catch. In the same way, cultivated plants such as manioc and maize, as well as wild fruits were so abundant and easy to procure that "never apprehending that they [the Indians] will want anything the following day, they do not prepare the day before" (Markham 1859:70). This statement contradicts his own accounts of indigenous methods for food and wine preparation and storage (Markham 1859: 66-67), suggesting that unlike Carvajal, Acuña has strong preconceived notions regarding the abilities of Amazonia's indigenous inhabitants.

With few exceptions, Acuña cast the peoples he encountered in one of two roles. In generalized accounts, and especially in connection with the priest's missionizing views, they are portrayed as lost sheep who "lie in the shadow of death," (Markham 1859: 60) and whose existence was perpetuated solely through the clemency of the Christian god. In this image, which seems to be the basis of Acuña's grand narrative for the Amazon, the priest portrayed Amazonia as a version of Paradise, and its inhabitants as children, naïve and trusting, but nevertheless in need of salvation. The complement to this image is that of the savage heathens and barbarians, who will fly into war at a moment's notice. Of these, the most detailed descriptions are those of "savage", "barbarous" or "warlike" peoples, while the "friendly Indians" who are part of the European fleet are scarcely mentioned. This pattern is in keeping with that of travel narratives as a genre, in which the exotic or bizarre is privileged over that which is commonplace or familiar (Pratt 1992).

Grand Narratives Revisited

The exoticization of Amazonia in travel narratives such as Acuña's and those that followed may be chiefly responsible for our reluctance to accept that patterns of living familiar to Western sensibilities may have been in place at the time of Orellana's first descent of the river. The "standard model" (per Viveiros de Castro 1996) for pre-Columbian Amazonian occupation in the form of small, autonomous and politically decentralized villages, which has predominated over the history of Amazonian archaeology, was probably to a certain extent a product of this mode of thought (see Neves 1999 for the evolution of this model). Carvajal's observation of roads, plazas and orchards in certain provinces, which would seem preposterous to Meggers (1992), is not so absurd in light of new ethnographic and archaeological evidence from the Xingu in Brazil (Heckenberger 1998; 2005) and El Beni in Bolivia (Balée 1995, Erickson 2006). While travel writings such as Acuña's, which presented cohesive grand narratives of familiarly exotic and savage lands, were easily incorporated into early archaeological narratives, accounts like Carvajal's that presented conflicting data or ambivalent sentiment, were largely ignored.

An interrogation of the internal consistency and inherent biases of each of the narratives examined suggests that certain aspects of Carvajal's narrative, such as his descriptions of individual places, should be given a closer look. Because Carvajal was not projecting a future New Spain into Amazonian space, he would have no motivation to exaggerate the degree of 'civilization' evidenced by native inhabitants. Acuña, who seemed invested in 'selling' the Amazon to the Spanish, might have been guilty of such exaggerations.

There is cause to question Acuña's claim regarding the abundance of Amazonian food resources. However, there is little cause to adhere to a theory of environmental limitation (Meggers 1954), which suggests that Amazonia's poor soils and climatic oscillations (Meggers 1979) limited population size and cultural development in the region. Both narratives suggest a varied subsistence base, a strategy that safeguards against occasional resource shortages. Perhaps more convincing is Acuña's note that throughout their journey the Spaniards came across villages and garrisons that contained abandoned food stores. If, as a number of authors suggest (Meggers 1954, 1971; Carneiro 1970; Gross 1975), food could be a limiting factor or cause for war in these regions, then it seems unlikely that food would be left unguarded in empty villages. On the contrary, the presence of numerous food stores suggests that at least some amount of surplus could be amassed just about any place along the Amazon River. Incidental evidence of this sort is one way to avoid the pitfalls of relying on tendentious statements of the sort that populate Acuña's narrative.

A final topic which can be addressed by examining these travel narratives is that of population density. As is the case with productivity, Acuña had reason to exaggerate population figures in the Amazon. Not only does a high population density suggest fertile soils, but also, to Acuña (Markham 1859), an available labor source. It would seem, at least initially, that Carvajal would have reason to inflate numbers as well, especially on the battlefield. If a handful of Spaniards could hold in check thousands of attackers, then their dedication to the Crown could not be questioned. However, tales of valor from the first part of the journey contrast starkly with the desperation expressed at the number of people on the riverbanks toward the latter half of the trip. By then Orellana and his men were no longer conquistadors, but survivors. The peoples the Spaniards encountered near the Rio Negro, for example, were sufficiently numerous to prevent

their landing for days. Indeed, some of the largest known archaeological sites in the Amazon have been found in the Central Amazon, near the point where the Rio Negro enters the Amazon River (Petersen et al. 2001). This archaeological narrative supports Carvajal's claim in asserting that large, densely settled populations existed in Amazonia's past, as well as the particulars of their location.

Re-mixing the past

It is becoming increasingly clear that an understanding of Amazonia's past, present and future depends on the juxtaposition of multiple lines of evidence that can be obtained from different kinds of narratives. This awareness has revived interest in and spurred more critical engagements with travel narratives, from chronicles of early voyagers, to accounts of the missionization of indigenous Amazonians, to naturalistic treatises on the basin and its inhabitants and early anthropological and ethnological work from the early part of the twentieth century.

Synthetic works (e.g. Hemming 2001; Roosevelt 1994; Whitehead 1994; Barreto and Machado 2001) in this tradition draw extensively on a range of travel literature, such that their coverage is as good as or better than that of the *Handbook* (Steward 1946-50). Whitehead (1994) is of the opinion that travel writings, when engaged with critically, can be used to greatly augment archaeological data, and further, the combination of these two kinds of data with ethnographic data can contribute to a developed historical anthropology, which would significantly enrich our understanding of Amazonia. Seemingly in response, Barreto and Machado (2001) trace the historiography of the Amazon, contextualizing writers within their respective currents of narratives.

Continuing this work into the present day, this paper has attempted to contextualize those writers that produce modern narratives about Amazonia within their respective histories and narrative tropes. The last five decades have seen spirited, sometimes fierce debate over the nature of Amazonia's prehistory and its trajectory into the present. Thus disjunctive and often contradictory narratives have arisen. As all narratives are historically contingent, the narrators', who are in this case archaeologists, particular histories influence their perspectives, resulting in the privileging of certain kinds of data over others. Disentangling archaeologists' individual research trajectories from disciplinary trends and intellectual movements makes possible the re-evaluation of their motivations to produce particular kinds of narratives. Because these narratives refer to and re-invent places that have existed in the physical world, it is possible to interrogate these narratives through independent lines of evidence, including archaeological data and travel texts. Since all narrative is contextual, travel writings and archaeological narratives can be subjected to similar critical analyses of internal consistency and external reliability, and in the end, both can be grounded in the archaeological record.

Chapter 4.

From Chiefdom to House

Understanding Amazonia: a bottom-up approach

This chapter outlines the theories of social organization that have been prevalent in Amazonian archaeology and proposes an alternative model for envisioning Amazonia as a lived-in place. I argue that debates about social complexity that were rooted in colonialist modes of thought drove research and research design in the Amazon, producing narratives that fit within the goals of the colonialist project. This research trajectory resulted in a narrowing of focus with regards to the kinds of questions that were posed about human life in pre-Columbian Amazonia, such that research agendas were inevitably outwardly oriented, that is, designed within frameworks that served to inform ideas that were ‘larger than’ Amazonia. Hence, to this day little is actually known about what took place in Amazonia itself over the course of its many-thousand-year history. However, questions about the peopling of the Americas and the relationship between humans and the natural environment, examples of the kinds of interesting anthropological topics that have framed much of this research history, can only be addressed through detailed, particularistic data. Hence, the only way that knowledge about Amazonia's past can inform past understandings of and contemporary strategies for managing human impact on the environment, for example, is if truly local, particularistic knowledge from multiple points in time and space is compiled and then converted into a generalizable model.

As I suggest earlier, most archaeological research in Amazonia has revolved around addressing questions of forms and levels of social complexity. This chapter reviews notions of social complexity within the historical context of the development of these ideas which, especially in the neo-evolutionist school, appear to draw expressly on evidence from Amazonia. After exploring the roots of the social complexity debates that have dominated the history of archaeological research in Amazonia, I offer a counter-point to these debates through a consideration of narratives of place. This chapter proposes that a place-based approach has the potential to redirect research in Amazonia away from top-down model-testing approaches, which are useful but only comprise the range of possibilities proposed by existing models, and toward a bottom-up approach that grounds new models in data recovered both figuratively and literally from the ground.

The concept of place used here foregrounds the uniqueness and historicity of place, and the necessary situadeness of agents that inhabit, and by this very act, construct place. Hence, it becomes impossible to think of place without simultaneously thinking of people, of their perspectives, and of the meanings or intentions that they would have brought to each moment of their habitation and creation of places in Amazonia.

Naming and Framing – the Amazonia of Archaeological Thought

Amazonia was first framed as a region and expressed within an anthropological framework in the 1940s, with the definition of the Tropical Forest Culture complex (Steward 1948a). As is outlined in Chapter 2, the TFC volume integrates ethnographic, ethnohistoric, and archaeological data in an attempt to exemplify and define the TFC. As is often the case, this very act of definition carried with it tremendous theoretical and discursive force. For Lowie (1948a) and Steward (1948a), the Tropical Forest culture and the Marginal Tribes geographically and culturally comprise Amazonia. Steward (1948b) hypothesizes, based on what he concedes is a scarce and insufficient data set, that the Tropical Forest cultures tend to inhabit portions of Amazonia accessible by rivercraft, while the Marginals inhabit regions where fluvial transport is more difficult. The TFC peoples are hence designated by a culture complex, while the remaining peoples are named for their geographical location in relation to the areas of occurrence of the TFC. The use of “Tropical Forest Culture” in opposition to “Marginals” betrays not only the underlying notion that cultures and areas were used as comparable entities, but also that this geographical distinction was not necessarily made by means of a clearly defined set of parameters. The major aspects of this process of definition point to underlying assumptions that are instrumental to understanding the kind of tunnel vision that characterized Amazonian archaeology for so long. These assumptions must become the focus of this analysis.

First, let us recall that the TFC is defined in relation to other South or Central American cultural complexes, but also by unproblematically integrating ethnographic and archaeological data sets. As has already been discussed, this was done in an effort to achieve maximal geographical coverage, and to present data in its rawest form where adequate syntheses were not yet possible. Additionally, as a work that emerged out of a four-field tradition, integrating these data sets was a natural step. However, the very nature of the project of a handbook, the size of the project, and its authorship lent the findings published therein considerable weight. The unfortunate and probably unpredictable result is that, in spite of Steward's caveats, the ideas he and his co-authors proposed were not taken as points of departure, but largely taken as fact. One immediate upshot of the unproblematic integration of ethnographic and archaeological data was the implication that ethnographic fact could stand for historical fact, even in places where temporal disruption of occupational and cultural processes was patently obvious. By treating ethnographic and archaeological data sets as comparable, the temporal dimension of occupation in Amazonia was flattened and historicity denied.

Next, let us consider the fact that culture complexes and culture areas could stand in opposition to each other, and thus be thought of as the same category of thing. This conflation, in some ways, implies that cultures and geographical locales are co-constitutive, which I would argue is the case when both are seen as historically situated. The difficulty with Steward's classification is that it assumed no historical change. Thus, if the tropical forest could be seen as homogeneous and static, then these qualities could also be transferred onto the associated culture, in this case the TFC. The notion that there is some kind of *a priori* alignment between cultural categories and geographical location is analogous to the infamous culture-historical

practice of equating people with pots, but in some ways more insidious. Not only does this equation overly simplify the complexities of human-environment dynamics, it simultaneously suggests a deterministic orientation when coupled with the assumption that the environmental setting, Amazonia in this case, is unmodified.

Lastly, there was no clearly articulated logic that created the distinction between the TFC and the Marginal tribes, along with their paired geographical regions. In the case of the TFC, the complex is named for the kind of environment inhabited, the tropical forest, although arguably the so-called Marginal tribes also inhabited some kind of tropical forest. One might investigate the idea of a culture complex by attempting to resolve the attributes that this complex possesses, and which thus comprise it. And yet, when the TFC is first introduced, it is described chiefly as lacking the attributes which would have made it comparable in “level” to the Circum-Caribbean culture complex (see also Lathrap 1970 for a similar analysis). Thus, it is defined primarily in opposition to something it is not, rather than by the qualities it possesses. The traits the TFC do possess in common are also occasionally found among the Marginals, which further confuses the issue. Similarly, in the case of the marginal tribes, the defining factor is the relationship of the locale inhabited by these tribes to the locale inhabited by the tribes of the TFC. This definitional act creates a geographical hierarchy, which also turns out to be an ideological hierarchy, as “marginal” can mean much more than simply “existing near the edges of” or “not central;” it can carry with it connotations of liminality, precariousness, or near-non-existence. It is also worth noting that these tribes are not associated with any particular culture complex; they are thus denied membership in any larger group of peoples with whom they could then be considered to participate in social intercourse.

Analyzing the naming/framing of Amazonia thus brings us to three fundamental flaws in our anthropological foundation for Amazonia. First, the practice of conflating region, culture, and environment points us to the inability on the part of early Amazonianists to conceive of an Amazonian culture that could significantly alter the environment. Instead, Amazonians were subject to changes in the environment, a theme later taken up by Meggers in her adaptationist model for Amazonia. This assumption demonstrates that Amazonianists continued to operate within the parameters of the “mastery over nature” narrative, although in this instance, the logic is applied in the inverse direction: because the TFC represented a cultural level far beneath that which would have been aligned with 'civilization,' they could not possibly have developed the technological means to master nature. Second, the lack of historicity implied by the equal treatment of ethnographic and archaeological data seemed to cement the notion, abandoned elsewhere, that contemporary inhabitants of Amazonia were some version of Europe's contemporary ancestors. In this way, the notion of a pristine and atemporal Amazonia, which is also rooted in early “noble savage” and “savage savage” narratives, was institutionalized by the format of the volume. Finally, the lack of a coherent definition of what constituted the TFC (as opposed to what it did not constitute) placed scholars in the difficult position of having to study what was actually an incredibly heterogeneous data set under a single, ill-defined rubric

In all the wrong places...

Archaeology is an incredibly difficult science. Working with a material record that is, in many cases, only a fraction of the original material production of a culture, and working in a

temporal scale that lacks written records over 99% of the time, archaeologists are well aware of the tenuousness of their conclusions. Miraculously, anthropological archaeologists have managed to turn this astounding handicap to their benefit, taking advantage of the scarcity of data to run relatively simple thought experiments comparing vastly different places and time periods. The comparative nature of archaeology, I believe, is really only made possible because so much of the detail-richness that characterizes ethnology – detailed-richness that makes cultures unique – is composed of ephemerality. Words, thoughts, and actions, unless duly recorded, are gone instantaneously, and a large proportion of material remains decomposes or deteriorates beyond recognition within a few generations of entering the archaeological record. Even without considering the remains that never enter the archaeological record, or that depart from said record prematurely through undocumented ways, every archaeologist knows that, realistically, we have very little to work with. This, in a sense, is why we can see the forest – because the trees are few and far between. Thus, even understanding fully the paucity of data at hand, archaeologists have bravely soldiered on, crafting narratives and generalizing them to vast areas, and, on the basis of comparative studies, created models to explain human existence and the range of variation in social intercourse.

But here it becomes appropriate to remember that models are generated in particular places, because human beings inhabit places 100% of the time. There is no place-less existence, there is no decontextualized, omniscient archaeologist-narrator, no pure, objectivist scientist. As such, all archaeological models are place-specific. Though transferring models across space and time, our practice of generalization, is a generally accepted and indeed useful practice, it can often fall short of adequate description and explanation in the “receiving” region. To argue that a model must be accurate given its success in the “donor” region is tautological; the only way to assess the generalizability of a model is to rigorously test it in a new region or time period, and to be prepared to generate new explanatory frameworks and models when the fit is not quite right. The fit of models of social complexity is not quite right in Amazonia. Not only does an insistence upon relying on old models inaccurately represent the history of Amazonia, it also brings us short of the anthropological goal of understanding and explaining the breadth and variability in human experience.

In resonance with a growing current of alternative ways of perceiving Amazonia (e.g. Balée 2008; Cleary 2001; Denevan 1992, 1996; Erickson and Balée 2006; Heckenberger 2008; Heckenberger et al. 2003; Heckenberger et al. 2008; Neves 2007; Smith 1995, 1999, 2007; Whitehead 2001), this study generates data that will be compared to a range of models, but ultimately become the basis of a distinct way of perceiving past habitation in Amazonia. In order to arrive at this new model, however, we must first tread the ground that has been laid by previous archaeologists. In keeping with the goal of this dissertation, to provide alternative or more nuanced, but not necessarily radical or counter-narratives, the aim is to carefully consider each step along this trek, accounting for convergences and divergences between my approach and that of my predecessors, because ultimately, many of the questions posed and much of the data produced by early archaeologists are not only valid, but also essential to deepening our understanding of this vast and heterogeneous region.

As I move through a discussion of the development of these colonialist narratives about Amazonia, I will also point to the various ways in which these developments can be understood through the lens of place theory. Not only were Amazonianists situated actors, positioned socially, politically, and geographically in ways that influenced their writing, but their very

notions of people and places often substitute for each other. I argue in Chapter 3 that the way Europeans defined Amazonia involves a conflation of person and place, or a standing-in-for which results in this kind of conflation. This practice continues throughout the modern period, and hence the representational practices of Amazonianists that constitute this kind of conflation are also noted.

Complexity is a foreign country

From the perspective of understanding the history of archaeological thought, and particularly the history Amazonian archaeology, the concept of “social complexity,” which has had a fundamental impact on archaeology, bears consideration. This section will briefly trace through the genealogy of the idea of social complexity, which has its roots in the philosophical and political writings of the European Enlightenment, and later in the development and application of evolutionist thought in parallel with notions of civilization. An effort is made to exemplify the way that these ideas filtered into evolutionist thought in anthropology and made their way into archaeological interpretation. At this point, two key moments in this history are considered: the moment of “civilization,” in which urbanism and monumentality become essential markers of progress; and the moment of “social complexity,” in which hierarchy, economics, and bureaucracy become the axes along which societies develop on their way to particular kinds of structural arrangements.

Evolution and Civilization: brothers in arms.

In the late 19th century, philosophers, naturalists, anthropologists and sociologists became increasingly interested in ideas of evolution. Notable for their influence in anthropological thought, Lewis Henry Morgan, Herbert Spencer, and E. B. Tylor sought to explain differences in human societies by applying versions of evolutionary frameworks to different aspects of society. Although these theories varied in scope and subject matter, one constant across the board was a reliance on the notion that organisms and systems evolved from simple to complex. Morgan (1877) famously developed the unilineal three-stage evolutionary model, in which societies progressed from a state of savagery, through barbarism, and finally to civilization, each stage a more complex version of the previous, progress denoted by the introduction of particular traits. As an example, metal-working and agriculture were considered essential to progressing from savagery to barbarism. The unilineal nature of this progression was what initially made possible the conception of peoples classified as 'savages' as the 'contemporary ancestors' of Europeans. Hence, early in the history of anthropology, definitions of social complexity were closely linked to an evolutionary framework within which the telos of evolution was defined as “European Civilization.” The operationalization of these definitions, which are in themselves complex, required the observation of particular characteristics or traits that formed a ‘complex’ that resided on a particular level along the evolutionary scale.

At the turn of the 20th century, many Americanist anthropologists began to turn away from generalizing models such as the evolutionary frameworks proposed in the second half of the 19th century. In the Old World, however, the categories and evolutionary trajectories proposed by Morgan remained in use, notably in the work of prehistorian V. Gordon Childe, known as the “great synthesizer” for his various attempts to summarize and narrativize

archaeological evidence from the Old World. Childe's work, which tracked the emergence of what are classically considered the major ancient civilizations of the Old World, was rooted in the archaeology of the Near East, which I will soon argue had a significant impact in the way he framed his definitions of civilization.

Childe was a practical man, whose talents lay in the interpretation of existing evidence, rather than in the generation of theoretical structures. As such, his definitions took the form of narratives that could be distilled to trait-complexes, or occasionally, as in his brief but illuminative article, "The Urban Revolution" (Childe 1950), were literally laid out as lists of traits. The utility of this approach is evident: any structure of human fabrication – city, town, civilization – could be easily classified by reference to the appropriate trait-complex. Childe (1950) defined ten criteria by means of which cities could be defined and archaeologically identified, another indication of his practical nature. Childe's model of progress was distinctly evolutionist in nature, even if there was no explicit mention of evolutionist thought in his books. Childe's narratives about the emergence of civilization construct a positive correlation between social complexity and the degree to which a society is successful in the Darwinian evolutionary sense, that is, in survival and multiplication (Childe 1950b, 1951). Within this model, significant changes in the rate of population growth index progress or regression in civilization as a condition. Positive changes in population growth rates index 'revolutions,' which are tied to increased economic and social complexity.

The 1950's and 60's witnessed a revival of evolutionist thought in North American anthropology, with the advent of the neo-evolutionist school. Largely credited with developing neo-evolutionism, anthropologist Julian Steward proposed multilineal theories of evolution, wherein civilizations were still seen as evolving through stages of progress, but rather than necessarily following a single, predetermined path, civilizations could take a variety of routes to progress. Neo-evolutionist efforts at de-linearization or de-teleologization of evolutionary models succeeded in broadening the scope of possibility for distinct societies, such that the telos of evolution was no longer a civilization equivalent to that which characterized European societies. However, as will become clear through the examination of some of the key models that emerged from this school, the notion of progress as expressed by Childe persisted in these newer models.

Neo-evolutionists differentiated between general and specific evolution. Specific evolution was defined as descent with modification, the study of which was relevant only within a particular line of descent. General evolution, understood as movement toward greater complexity and 'higher' ways of being, measured the progress of various societies along a single scale (Sahlins and Service 1960; Steward 1955; White 1949). The concept of specific evolution was particularly useful toward developing the multilineal model proposed by neo-evolutionists, as it expressed each society's independent movement along its unique evolutionary historical trajectory. However, the concept of 'general evolution,' which made cross-cultural comparisons possible, also allowed the hierarchism expressed in discourses of civilization to persist.

Rooted in this general evolutionary perspective, anthropologists Morton Fried and Elman Service, students of Steward and White, conceptualized social organization in terms of evolutionary stages. Their models, which sought to explain the origins of the state, of social inequality, and of complex social relations, were built on the notions of progress and evolution that were closely connected to these discourses of civilization. Service (1971) conceptualized evolutionary stages based on the size and complexity of the largest independent political unit

associated with a society, producing the now famous bands, tribes or segmentary societies, chiefdoms, and states model. Fried's (1967) model depended directly on the amount of social inequality in a society, and the degree to which inequality was institutionalized, and thus his stages of social organization were named accordingly: egalitarian, ranked, stratified, and state.

Simultaneously, the language of urbanization, which proved especially useful for studying the states and city-states of Mesopotamia and the Hellenistic world, persisted in archaeological research. As was the case with his use of notions of complexity and progress, Childe's work expressed a theme that continued to permeate archaeological literature. His concept of the Urban Revolution, a second key transformation that follows the Neolithic Revolution, has been taken up by scholars of urbanism, who explicitly or implicitly treat urbanization as crucial in the development of complex social, political, and economic structure. For example, although he explicitly qualifies the Urban Revolution as less important than social stratification or institutionalization for the process of civilization, Adams (1966) uses the terms "complex society" and "urbanized society" interchangeably. In Fox's (1977) seminal work on urban anthropology, the study of urbanized societies is contrasted with that of "primitive societies," setting the stage for a field of study focused strictly on non-primitive (i.e. complex) urban societies. Webster and Sanders (2001) project this association between civilization and urbanism into the minds of sixteenth century Spanish colonists. Although urbanism and social complexity are studied in distinct theoretical arenas, research on one topic often cross-references the other, further highlighting the inferred correlation between the two.

Tracing this history, it becomes evident is that urbanism and social complexity were once both studied under the rubric of civilization. The subsequent splitting of the two lines of study is an accident of history, as much a product of geographical focus as one of theoretical specialization. Trends in the literature indicate that the study of complexity as urbanism has been favored in regions that boast abundant urban architectural remains, such as the Andes, the ancient Near East, Mesoamerica, and Southeast Asia (e.g. Adams 1966, 1972; Anderson 1984; Childe 1950a, b, 1951, 1957; Manzanilla 1996; Nichols and Charlton (eds.) 1997; Renfrew 1972; Smith 2002, 2005, 2006). Similarly many of the more influential studies of social complexity as stratification were born in regions like Oceania (see also Webster 1998), where ethnography has been particularly fruitful (e.g. Kirch 1984; Kirchoff 1955; Service 1971; Sahlins 1958). While cross-pollination among regions and approaches has occurred, it is worth noting, finally, that the designation of "state" has almost exclusively been reserved for societies classified as "urban" in the classical sense (although, see Kirch 2005, 2010 for an exception).

Think locally, act globally.

The models developed by Fried and Service had a tremendous impact on archaeological interpretation of social structure at archaeological sites. At precisely the time their models were being published, Americanist archaeology was undergoing a significant change in its methods, aims, and ambitions. The advent of the Processualist school of archaeology indexed a gradual transition away from mere descriptive research and toward explanation and cross-cultural generalization. As archaeologists increasingly sought to compare disparate cultures, they began to explicitly employ neo-evolutionist models developed by Fried and Service, because the stages of each model also served as a heuristic classification system that greatly facilitated these comparisons. The categories or evolutionary stages defined in these models were operationalized in archaeology as trait-complexes, lists of social-structural characteristics that

could be detected, or at least sought, archaeologically in order to adequately rank or classify societies. In an interesting parallel, scholars concerned with the deep history of urbanism applied similarly structured trait lists, which included many of the same terms, in order to identify urbanness and citydom among the societies or regions under their purview.

Because the category of 'chiefdoms' is particularly important to the discussion of social complexity in Amazonia, I will focus mainly on the adaptations and applications of Service's 1960 model, which deals specifically with this kind of society. Models such as Service's and Fried's were occasionally applied wholesale, but also often modified, heavily theorized, and discussed by archaeologists. One of the adaptations of Service's model that emerges as relevant to this study is the adoption of the term 'complex society,' which came to signify a social structure that was characterized by sufficient social inequality and hierarchical structure to be classifiable as a chiefdom or state-level society. In archaeology, and especially in Amazonianist archaeology, the dividing line between 'complex societies' and everything else becomes a focal point in model-building for the region. Because of the way Service defined chiefdoms, 'complex societies' became shorthand for "having a hierarchical social and political structure," which is contrasted with egalitarian or quasi-egalitarian socio-political organization.

Returning to the thesis of place, I will now examine the necessarily localized data sources for the development and characterization of the four stages in Service's evolutionary model. Because anthropology and archaeology are historical sciences, it follows that our models emerge from particular places in particular times, rather than in abstract, "laboratory" space. Thus, in an effort to understand the roots and *raison d'être* for each segment of each of these models, it is helpful to trace through the place-bound historical narrative of each development. I propose that there are two key evidence-sets or trait-complexes that each referred initially to one particular region of the world, corresponding to the place in which the model was developed; and that subsequently these place-bound models were abstracted and transferred to other portions of the globe with varying degrees of success.

As a student of Julian Steward's, Elman Service developed his model in fairly close connection to Steward's work. His detailed description and classification of bands, although it draws on data from most of the continents, is heavily reliant on examples from North America, where Steward himself did a good deal of work. His characterization of chiefdom-level society, which he defines as a redistributive society, relies heavily upon ethnographic data from Oceania. Indeed, Service notes that "Chiefdoms are most typical and most highly developed on the Polynesian and Micronesian high islands" (1971:144). One of the likely reasons for the clarity of data from Polynesia and Micronesia, as implied by Service's notes on observed rather than inferred chiefdoms, is that European contact with peoples of Remote Oceania occurred relatively late on the world stage. Hence, according to Service (1971), it is likely that significant socio-structural and demographic changes brought about through "natural" evolution or through contact with Europeans would have modified the structure of chiefdom-like societies or historical chiefdoms in places like Arabia, Indonesia, Europe, Africa, and Asia, while those of Oceania had remained intact. I submit that it is also quite likely that the reason Service's 'chiefdoms' model fit best in Oceania had much to do with the fact that Oceania is apparently one of the few places in the world where such redistributive societies were documented by modern anthropologists. Occasionally, Service makes mention of Northwest Coast and Circum-Caribbean chiefdoms in his descriptions, but by far and away his exemplifications of characteristics of chiefdoms draw upon ethnographic work undertaken in Polynesia specifically,

such as the work of Marshall Sahlins (1958, 1962), Irving Goldman (1955), and Raymond Firth (1936, 1957). This is most likely a result of the fact that the redistributive model (Sahlins 1958) was developed precisely in Oceania.

In order for a social unit to qualify as a chiefdom within Service's model, it must possess a redistributive economy that is carried forth by a person who not only enjoys a specialized social status, but who holds an office. The presence of the "official" is a sign of institutionalized social inequality that is sanctioned by rules, which means the specialized status exists independently of the personal characteristics of the official. A further sign of institutionalization of social inequality is heritable status, which often results in the creation of classes or institutionalized stratification. Heritability of status requires that rules of inheritance must be established, with a result that passing generations beget increasingly complex genealogies, the tracking of which becomes increasingly important, and eventually also serves to index this level of complexity. Hence, we may summarize a Chiefdom as follows: it is a redistributive society marked by institutionalized social inequality and stratification the structure of which is reproduced and legitimized through the enactment of complex genealogical rules of succession.

Service's chiefdom stage is particularly important, because, as Service himself notes, it serves to unite in a single class or evolutionary stage a number of societies that, until that moment, had existed in a liminal state between so-called 'primitive' (kinship-based) and 'civil' (state) societies. The major distinction that is made between tribes and chiefdoms in Service's model is the institutionalization of the 'office' of 'Chief.' The Chief has status because of his position in the appropriate lineage, which also exists in a hierarchical relationship to other lineages. Hence, the primacy of kinship in structuring society, a quality of so-called 'primitive' societies, is maintained in the social structure of chiefdoms, which are thus seen as the most complex evolutionary stage within the 'primitive' evolutionary stages.

In Service's (1971) work, the qualification 'primitive' aligns rather well with Morgan's stages of 'savagery' and 'barbarism,' insofar as all three terms refer to pre-civil society. The term 'civil,' of course, refers to societies defined as 'civilizations,' which, in Service's model, comprise the next (higher) evolutionary stage, and are left to be discussed in a distinct volume on state-level societies and civilization. The major distinction that is made between Chiefdom and State, almost unanimously, is the dissolution of kinship-based structure in deference to a civil order that is defined by governmentality. The government office of leadership has status in and of itself, and that status is afforded to the occupier *by virtue of occupying that office*. The structure of states is maintained through laws, which have no referent in the desires of or specific tie to any living persons but rather are created and enforced by the abstract entity of the state. Hence, one of the hallmarks of statehood is an organization of a highly bureaucratic – literally, "ruled by offices" – nature, which makes possible this supra-individual rule of law.

In this light, it becomes clear why 'state' comes to stand in for 'civilization,' as a concretized manifestation of a civil society. It also then becomes a matter of little intellectual work to understand the association of cities (*civitas*), the original referent for the concept of citizenship and also for anything constituting civil society, with states in particular and social complexity in general. It is no accident that the words that define what eventually is glossed as "social complexity" derive from Greco-Roman terms relating to governmentality, given that these socio-political systems are evidently the ideal models of Civilization (*Classical Civilization*), around which all European notions of civilization arose.

As such, there are two ways to conceive of or define the state. Following the tack of neo-evolutionists such as Service, we consider the bureaucratic nature of the state, its prerogative to establish a rule of law, and its monopoly of force (Service 1971), which can be applied internally, for the sake of maintaining order, and externally, for defensive or offensive purposes. Harkening back to Morgan's 'civilization,' civil society would most markedly be set apart from what came before through the advent of writing. Childe (1950a), however, specifically rejects writing as the single most important criterion for defining civilization, and points to urbanization as the crucial step toward civilization. Among the criteria for detecting a city, Childe does include writing, as well as monumental architecture, and full-time specialists, the latter often, but not necessarily, specified as metallurgists.

The latter two criteria recall and likely reflect a reading of Morgan, possibly distilled, wherein the adoption of “adobe-brick and stone” architecture, along with agriculture, marks the progression to “middle status of barbarism” and the “smelting of iron ore” is a necessary criterion for progression through to the “upper status of barbarism” (1877:12). In Childe's vision, metalworkers were necessarily full-time specialists who could only exist in societies that had progressed from 'savagery,' a stage in which people depended on wild food resources, to 'barbarism,' which indicated some production of domesticated food resources (through animal husbandry or agriculture). In Service's model, occupational specialization is a feature that results from the size and greater integration of chiefdom-level societies. Hence, if we wish to draw a parallel between the work of Service, Childe, and Morgan, we would align Morgan's middle and upper stages of barbarism with Childe's barbarism and Service's chiefdoms.

Archaeologically, social complexity was linked to physical evidence that could stand in for abstract structures or characteristics, such as stone architecture (urbanism), writing (bureaucracy), and metallurgy (craft specialization). The models for these associations resided in places like the Near East, the Mediterranean, and later Central America and the Andes, where arid conditions or the availability of materials for creating hermetically-sealed spaces made possible the preservation of a wide range of material. Importantly, cultural and genealogical continuity in these regions also permitted the translation and utilization of language, especially written language and history, to gain insight into abstractions and intangibles such as codes of law, governmental structure, and kinship systems. In the same way that chiefdoms best fit the models in Oceania, the existence of the prehistoric or ancient state was only widely accepted in places where it was defined.

The Civilizing Mission: Not seeing is believing.

In light of the way these models were developed, and the kinds of evidence that are admissible in asserting the existence of so-called complex societies, it is difficult to imagine a scenario in which a complex society could have been discovered in Amazonia. The tools available to evaluate complexity in Amazonia relied on evidence that turned out to be unobtainable in the region.

Archaeological work that discusses the presence of states draws as much upon the kinds of bureaucratic, economic, political and social structures that Service elicits as it does upon considerations of urbanization, citydom, and population density that stem from the urbanism literature. In archaeological research, states are almost always denoted by cities or a certain degree of urbanness, and the bureaucratic nature thereof is attested to in written historical records. Evidence for complex bureaucracy, non-hereditary status and market economies, all

ephemera that are preserved mainly through writing or oral traditions cannot be studied in most parts of Amazonia because of a lack of cultural continuity in the region, as well as a lack of written documents pertaining to pre-Columbian times. Status and wealth inequality are generally assessed archaeologically through the study of mortuary practices, wherein a high-status individual enjoys interment in a more elaborate setting than lower-status individual, and status is also often denoted by association of the individual with luxury grave goods. Although some examples of relatively well-preserved cemeteries have been encountered in Amazonia, these are proportionally insignificant in comparison to the number of known habitation sites. Recent findings of direct inhumations in terra preta contexts (Machado 2005; Neves 2003; Rapp Py-Daniel 2009) suggest that much funerary information has likely been destroyed through post-depositional context. Despite our understanding of this site, Hatahara, as one of the best preservation loci yet uncovered among open-air sites in Central Amazonia, Rapp Py-Daniel (2009) notes the poor preservation states of the remains uncovered and the rapid deterioration thereof following excavation. Many of the known funerary contexts associated with burial urns have been extremely difficult to associate with habitation sites, and hence our understanding of relationships between the living and the dead in pre-Columbian Amazonia is still incipient.

If archaeological indices of complexity are difficult or impossible to encounter in Amazonia, the political, economic and social dimension of Amazonian societies need to be approached through different means. In the case of urbanism and population density, again certain regional problems precluded accurate understanding of these aspects. Population density cannot be assessed for the same reason that the abstract portions of ancient Amazonian societies cannot be directly observed: lack of cultural continuity and lack of written records. Urbanism presents an even more complex problem, as urbanness is generally under-theorized, and glossed mostly as “consisting of cities.” The city, again, is under-theorized, and is often identified either as an aggregation of people, which brings us to the same problem as the population stipulation; as a place that enjoys a special and usually uneven relationship with its hinterland or periphery, which again, would require direct access to the structure of abstract phenomena; or finally, as an aggregation of buildings, which, in many parts of Amazonia, would also be essentially invisible, given the perishable construction materials preferred in this place.

Models for intermediary forms of complexity such as Service’s chiefdoms, which were defined through the study of abstractions (social structure and kinship), are difficult to apply in Amazonia, where, as I have stressed, it is difficult to argue for wholesale cultural continuity. Nevertheless, anthropologists must assume that existing cultural forms at least descend from older forms. Thus, though this approach is impossible in the Central Amazon region, where cultural disjunctures are severe to complete, it is worth noting that ethnographers working in Amazonia have repeatedly expressed surprise at the complexity of Amazonian kinship structures elsewhere. Echoing Steward’s (1948) observation about the paradox of the “marginal tribes,” Maybury-Lewis (1979) wonders at the existence of kinship structures among the Ge speaking peoples of Central Brazil that seem disproportionately complex given their “rudimentary” technology. Heckenberger (2005) interprets what one might call superfluous social structure among the Kuikuru of the Upper Xingu as evidence of remnants of a social structure designed to handle a much larger, multi-sited, tiered political system. Thus, the social structure functions as something akin to a cultural “survival.”

In the absence of traditional material markers of complex chiefdoms, the structures Heckenberger has discovered in the social organization and social memory of the Kuikuru are

generally perceived as insufficient. However, if we return to seek material correlates, we find ourselves needing to supply evidence of urbanism, metallurgy, or monumental architecture in order to make a case for complexity, and we arrive back at the original problem. In other words, the kinds of attributes that are most relied-upon for defining a chiefdom as such are again, impossible to encounter in Amazonia. A consideration of whether past Amazonian societies consisted of chiefdom-level organization, and if so, what kind of chiefly structure would have existed leaves us at a loss for physical evidence, and also leads to the realization that, in the final analysis, the social structure has been relegated to a second tier.

Hence, I argue that the greatest misstep in categorizing Amazonia as devoid of complex social structures is the acceptance that an absence of data constituted proof of absence. Because it would always have been impossible to see chiefdoms or states in Amazonia given the parameters derived by neo-evolutionists, archaeologists could not find them, and some interpreted this as evidence that they did not exist. Alternatively, there was an optimistic reliance on data supplied by early European chroniclers that sometimes resulted in logical leaps from data to interpretive narrative. The following section exemplifies some attempts at applying neo-evolutionist models to the problem of classifying Amazonian pre-Columbian history.

The TFC: neo-evolutionism in action.

The complete series of the *Handbook of South American Indians* published over the course of four years (1946-50) culled data from anthropological work performed in the 1930s and 40s. The bulk of the text in the volume reflects Americanist anthropological work of the time, most of it narrow, particularistic, and rich in details, but Steward's hand can be discerned in the introductory and concluding chapters of the Tropical Forest volume (1948), in which he makes clear connections to evolutionist models. For example, the culture complexes, and their corresponding culture areas, are defined most prominently in opposition to each other, and are considered within an evolutionary framework that is never clearly articulated. Although this publication pre-dates Steward's own cultural-ecological manifesto, *Theory of Culture Change* (1955), his framing of the TFC, while well-grounded in classical evolutionist modes of thought, foreshadowed his techno-economic theories of adaptation and culture change. Not surprisingly, these same ideas would come to frame the neo-evolutionist models proposed by Elman Service (1971) and Marshall Sahlins (1958; see also Sahlins and Service (eds.) 1960) and by his own student, Morton Fried (1960, 1967).

Notably, the TFC is defined not by fulfilling a trait-list, but by its absences, namely “architectural and metallurgical refinements” (Lowie 1948:1). The kinds of architectural refinements that Lowie cites most likely reference dressed stone architecture and monumentality. Because no explicit explanation is given for the use of architecture and metallurgy as metrics of cultural achievement, it becomes necessary to trace this selection of terms to a larger intellectual tradition. The choice of attributes used to differentiate the TFC from Andean and Circum-Caribbean cultures foreshadow not only Childe's (1951a) urbanism trait-complex, but also Steward's (1948a) own technologically-driven models that arise in his cultural ecology. These particular characteristics resonate across these two theoretical, intellectual, and regional traditions because they are both ultimately a product of deep colonialist habits of thought that are first articulated in Morgan's (1877) classical evolutionary model. Stone architecture and monumentality occur with sedentism, which, in Morgan's thesis, is tied to agriculturalism.

Agriculturalism and metallurgy, we recall, are specifically named requirements for progression from the evolutionary stage of “savagery” to that of “barbarism” (Morgan 1877).

The use of these particular attributes to define a culture complex also recalls some of the indices of “high culture” elicited by Joyce (2001; see also Baines and Yoffee 1998) in her analysis of the way wealth inequalities are institutionalized as social statuses. Joyce's article traces through the way that “high culture” is defined by elites, and treats it as an instrument utilized by elites to maintain status through these institutionalizing moves. Thus, the definition of 'high culture' or 'civilization' by means of particular attributes can also be seen as an institutionalizing move that reserves 'elite status' – in this case, 'complexity' – for those who possess the indices of 'high culture' – in this case, monumental architecture and metallurgy.

As is also made clear above, Steward's neo-evolutionism, is not fundamentally different from classical evolutionism. However, Steward's (1948a) specific analysis of the TFC in comparison to the marginal tribes does reflect a new nuance to evolutionary modeling. Here, progress is evaluated mainly through technology and subsistence, and to a much lesser extent through an analysis of social systems. This is made clear by Steward's observation that, paradoxically, the tribes he considers less developed technologically, and thus lower on an evolutionary scale, have more elaborate social systems.

Grounding Meggers' Environmental Typology.

The law of environmental limitation (1954) depends upon Meggers' typology of environments, wherein she attempts to parse the world's environments into four types based on agricultural potential. Meggers defines Type I environments as those with no agricultural potential, and includes therein deserts, swamps, tundra and other regions where agriculture, in the classical European sense of tillage of soil, is simply not practicable. The next three categories concern environments that can support agriculture, but have different degrees of improvability. Type II environments are defined as having limited agricultural potential because they cannot be improved to increase productivity. Type III environments are ones in which the agricultural potential can be increased, but to a limited extent. Type IV environments are defined by Meggers as having unlimited agricultural potential.

The criterion according to which these divisions are made, namely the degree to which an environment can be improved for the purposes of agriculture, seems logical, even if the idea of unlimited agricultural potential may seem naïve in contemporary times. For example, it appears that Type III environments are adequately defined as temperate forest zones, where, in particular European farming practices have shown that a moderate regime of crop rotation and field fallowing, combined with soil amendment can improve crop yields over intensive continuous farming. Hence, the success of soil amendment through manuring and fertilization demonstrates improvability, but fallowing shows the limited recovery potential of the ecosystems.

Unfortunately, Meggers' assessment of the kinds of places that fall into the rest of these categories is found wanting. For example, the “cradles of civilization” that she uses to exemplify environments of limited agricultural potential are, in many cases, desert or semi-desert environments that are made productive through massive irrigation projects. The environments she uses to exemplify Type II environments, those that have limited agricultural potential, are tropical forest environments. However, ethnographic and archaeological studies have shown that irrigated pondfield farming and mixed agricultural-horticultural systems in tropical forest environments are highly productive and sustainable over the long term. Hence, the productivity

of the environment depends less on the natural conditions than it does on strategies and technologies employed to adequately utilize existing resources.

A re-examination of Meggers' typology, if we consider her as a situated actor, reveals that her types are more likely to have emerged from a previously existing mental hierarchy of places than from true ecological analysis. Taking Type III environments as a starting point, we can include the larger part of Northern European and the Eastern United States, which Meggers explicitly uses to exemplify the Type III temperate forest environments. It is likely this was indeed Meggers' starting point, as she was based out of the Eastern United States, and the agricultural system practiced in these two places are the ones with which she is most familiar. From this point, Meggers can move “up” in her hierarchy, or “down.”

Meggers was influenced by Tylor, White, Steward, and Childe, as all four are cited in her seminal work on environmental limitation. Specifically these citations occur precisely in support of her argument for agriculture as the key factor in differentiating the abundance of food resources, which she cites as the most important point of interaction between humans and their environments. Meggers adopts her predecessors' thesis that agriculture caused cultural revolutions, and thus articulates the need to distinguish between agricultural productivities in order to assess concomitant effects on population size and cultural development. Given her theoretical perspective, it is scarcely surprising that Meggers elects to place the “cradles of civilization” on the next higher tier, as historic data suggest these places did support large populations for longer periods of time. Rather than describe the ecological factors, or even the technological means that make these environments inexhaustible, Meggers takes their status as “cradles of civilizations” as sufficient evidence for environmental productivity, inverting the logic of her own argument.

Hence, it is truly not surprising that when Meggers turned to defining Type II environments, she selected places that were already associated with lower evolutionary stages, such as tropical forests. In her defense, Meggers' analysis of highly weathered tropical soils, and of the disruption that occurs when the “natural vegetation cycle is broken by clearing” (Meggers 1954:803) is quite accurate. The difficulty, again, is that the only models of food production she had available in order to conduct her assessment were European soil amendment and fallow systems, and contemporary slash-and-burn practices. Projecting either of these agricultural models into Amazonia's deep past would certainly have resulted in a pessimistic vision of pre-Columbian Amazonian adaptations to tropical forest environments.

The search for social complexity in Amazonia

The majority of archaeological research in Amazonia was situated within the framework that was set forth by the *Handbook of South American Indians*. Because the aim of this publication was to produce a comparative work that presented the full range of cultures for a continent, it is not surprising that the over-arching theoretical theme that arises from the *Handbook* series revolves around the question of social complexity. In the following section, I trace two movements in the complexity debates in Amazonian archaeology. In the first movement, archaeologists attempt to fit archaeological data to existing models of social complexity using traditional trait-list complexes. There is an assumption of environmental dominance over native Amazonians. In the second phase of research, archaeologists appear to

have re-defined the fundamental relationship between native Amazonians and the environment, such that Amazonians are seen as capable of altering natural processes and re-modeling the physical reality of the Amazonian forest. As a consequence of this re-framing, the immediate reaction is to re-evaluate proposed models of occupation in light of new data or new interpretations of old data. In both cases, there appears to be a concern with the identification of or possibility of chiefdom-like societies in Amazonia.

Presence-absence: evolutionary trait lists.

Early archaeologically-derived models for pre-Columbian occupation of Amazonia applied neo-evolutionary models such as Steward's more or less wholesale. Distilling trait-lists from applications of neo-evolutionist models, Amazonianists examined archaeological evidence from various points across the Amazon basin, seeking evidence of social complexity. Major debates revolved around demographics, social inequality, and subsistence. What follows is a close analysis of at least key texts produced by scholars introduced in Chapter 2, focusing on their specific application of social complexity theory as a trait-list complex.

Meggers undertook the study of aboriginal Amazonian populations from an adaptationist perspective. For Meggers, the carrying capacity of an environment has direct bearing on the level of cultural complexity attainable. She divided the Amazon into two ecological zones; terra firme, or bluffs, and várzea, or floodplains. Using ethnographic case studies of five terra firme tribes of "independent origin and mutual isolation," Meggers (1971) constructs a model of terra firme adaptation, concluding that the highest level of cultural complexity possible in such environments is an 'incipient form' of economic, social, and political organization normally associated with 'civilization.' Relevant attributes include the presence of labor specialization and a formalized market; a multi-household chief and/or tribal council; and social groups not based on kinship, age, or sex.

In contrast, Meggers presents the várzea as a possible venue for higher social complexity in the Amazon. A similar analysis built upon reconstructions based on European travel writings reveals the várzea-based Omagua and Tapajós peoples to have possessed many of the traits commonly associated with chiefdom-level or stratified societies. However, Meggers (1971) attributes the attainment of this level of complexity to a combination of the adoption of Andean traditions and the somewhat elevated agricultural potential of the várzea. In Marajó, Meggers sees a specialized version of the várzea, where elevated agricultural potential permitted the temporary survival of higher levels of social complexity. Once again, her explanation for the origin of the people associated with this advanced social structure is diffusionist, and the "collapse" of the society is attributed to the inability of the Amazonian environment to sustain high culture.

Lathrap, whose cardiac model is commonly seen as the inverse of Meggers', (1970) narrative draws upon early European voyagers' accounts appear to report on social stratification, political integration, and complex ritual structures in Amazonia. Lathrap sees these structures as indices of complexity, the rise of which depends on the ability to create a food surplus. For Lathrap, the domestication of bitter manioc is key evidence for social complexity, but his analysis of the use of manioc goes beyond subsistence and carrying capacity. Lathrap's analysis is significantly more optimistic than Meggers' focusing on the potential afforded by the fertile and annually renewed várzeas to provide adequate resources to sustain large populations (1970:39-41, 47). Beyond that, the storability and portability of bitter manioc products presents

the possibility of amassing a food surplus, central to his argument for long-distance trade networks and for the maintenance of soldiers during long-term warfare (Lathrap 1970, 1973a). Long-distance trade and communication were possible in várzea settings, as the rivers themselves served as avenues, and these trade networks are also attested to by ethnographic examples and by the presence iconographic motifs associated with Amazonian cultivars in the Cordillera Blanca.

In addition to speaking to subsistence and the potential for social inequality through the differential amassing of surplus, Lathrap addresses mechanisms of social integration and the potential of ritual in the creation or reproduction of social inequality. He postulates a specialized ceramic form dedicated to fermentation of alcoholic manioc beverages, which he suggests served as a “lubricant for the larger patterns of interaction” (Lathrap 1970:55). Lathrap sees the Amazon as an integrated landscape, in which complex short- and long-distance trade networks, stimulated by village-based craft-specialization and facilitated by seasonal markets, form the basis of his cardiac model for the spread of Tropical Forest Culture.

Anna Roosevelt’s (1982) approach is characterized by an explicit concern with social complexity, drawing directly upon the work of neo-evolutionists such as Fried (1967) and Service (1971), as well as the archaeologists Sanders and Price (1968). Her research design in Parmana on the Orinoco floodplains assumes the existence of densely populated chiefdoms (Roosevelt 1982). Reading European contact-period accounts through a neo-evolutionist lens, Roosevelt (1982, 1987) focuses on passages about centralized political power, social stratification, large, dense settlements, territoriality and expansion, and intensive food production and redistribution. In several of her works, Roosevelt presents archaeological evidence for growth in population density, intensive seed crop agriculture, monumental earthworks, differential burial practices, long-distance trade, prestige goods, and complex iconography as evidence for chiefdoms on Amazonian floodplains (Roosevelt 1982, 1987, 1991, 1994). In her later works, corroborating interpretative evidence for the existence of social stratification and inequality often comes in the form of ethnographic analogy (Roosevelt 1991). By casting pre-Columbian Amazonian societies as chiefdoms, Roosevelt (1987) brings the study of these societies into conversation with that of complex societies in the Americas.

Complexity as urbanism: a relational model.

In light of the previous discussion, the Amazonian situation provides a problem, since it fails to present the usual primary indicators (e.g. writing, monumental architecture, metallurgy) of social complexity, as identified above (Lowie 1948; Steward 1948a). As has been established, this absence of evidence cannot be taken as a true measure of absence of particular social forms, as the likelihood of encountering said evidence in Amazonia is extremely low. This problem persists as long as complexity can only be indexed by a fixed set of attributes that are essentially non-existent at Amazonian archaeological sites. This section will explore alternative ways of conceptualizing complexity by exploring the possibility of an organic and socially detectable link between social complexity and urbanism.

Especially in archaeology, the tendency has been to associate or equate urbanism with social, political, economic, and technological complexity and integration, and in many cases, state-level organization (Adams 1966, 1972; Charlton and Nichols 1997; Childe 1950a, 1951; Redman 1978; Yoffee 2005). Other factors correlated with urban centers include regional integration, often in a center-hinterland arrangement (see below), and architectural clusters

(Flannery 1998; Holl 2006; Renfrew 1972; Smith 1973; Tringham 1973b). Unfortunately, the majority of the literature on urbanism takes the urban form, the city or town, for granted, without pausing to question whether urbanization is a process that can be studied without the 'city' or before it has been fully formed (Ciudad Ruiz et al. 2001; Doevendans 2005; Fox 1977; Smith 2005, 2002). Furthermore, models for recognizing cities, as a proxy for urbanization, rely on the same kinds of material evidence that are used for detecting social complexity, and thus also present a problem in Amazonia. As above, this problem will persist as long as urbanness continues to be defined as "having or consisting of cities." One of the aims of the section is to conceptualize urbanness in terms of social relations, such that it is useful in the study of contemporary, pre-industrial, and prehistoric settings, and such that it is distinct from notions of complexity as social stratification.

In 1972, M. G. Smith (1972) examined the ways the term 'urbanization' functions. He notes that 'urbanization' is used at once to denote "a type of settlement and a type of society". 'Urbanization,' he claims, can be used in reference to a minimum set of traits, the process of reaching this minimum, and the state attained through this process. While the first and last are concerned with form, and often amount to the same list of qualities (the first being prescriptive and the last being descriptive), the second is concerned with process. Smith identifies approaches to urbanism as focusing on geography, demography, and social criteria, and identifies a tendency in social science, already noted above, to assume a correlation between social complexity and urbanism (1972).

In an extremely useful passage, Smith (1972) deftly articulates the relationship between urbanism and complexity that had been implicit, but never clearly expressed, in the work of so many anthropologists. Smith's formulation focuses on the intangible notion of social relations. For Smith, urbanization suggests complexity of social relations in and of themselves. The notion of urbanization is often tied to "mobile, secular, heterogeneous or differentiated" (Smith 1972) populations or societies, and both Smith (1972) and Fox (1977) identify the urban center as characterized by complex social relations. Smith's (1977) mechanism for expressing the degree of complexity of relationships is the concept of "strands," where a given relationships will have as many strands as there are connections between two people. A simple network of social relations contains many multi-stranded relationships, and thus fewer relationships in all. As urban centers are associated with "an advancing division of labour," in such conditions, more 'single-stranded' interpersonal relationships arise per "typical adult member of a social system," and hence, a more complex network of relationships (Smith 1972:570). Smith further correlates social complexity, defined as a complex network of relationships, with "the size and concentration of social aggregates," (1972:570) making an argument for a demographic dimension of the problem of complexity. Since, as a population grows, the complexity of these networks of single-strand relationships also grows, then "social complexity should correlate with the size and concentration of social aggregates," and thus with urbanization (Smith 1973:570). Smith thus formulates a definition of urbanization in terms of increasing social complexity and population size.

A study of theories of urbanism and urbanization reveals two trends in defining or characterizing the 'urban.' First, all definitions of cities or urbanism foreground heterogeneity in the population (Anderson 1984; Wheatley 1973; Miksic 2000; McGahan 1984). Tringham (1973) notes the presence of multiple communities. Smith (1972) focuses on the effect of division of labor on the character of interpersonal relationships; specialization implies

differentiation within the economic sphere, but it also involves a concomitant social differentiation and a shifting social organization, which is brought about through the increasing single-strandedness of relationships. Second, urban centers are characterized by social, political, and economic integration, which means that space and resources are increasingly shared, although sometimes this sharing occurs through highly structured channels (e.g. bureaucracies). Lastly, the level of integration increases in intensity and range as urbanization increases, necessitating more complex and wider-ranging networks of communication.

With all this in mind, I propose an alternative conception of urbanization, drawing to an extent on Heckenberger's "saturated anthropogenic landscapes" (2003:1711), as well the continuous landscapes conceptualized by Erickson (1995). If urbanization is glossed as consisting of planned, organized, integrated landscapes that have been crafted through human intentionality and that exist within specific spatial, political, and economic webs of relations, then our notion of what constitutes an urbanized landscape must be expanded. In this work, Terras Pretas de Índio, insofar as they increasingly appear to index a population explosion accompanied by an intensification of sedentism and investment in landscape modification, function as potential nodes of urban interaction. In order to even begin to assess whether anything urban-like was happening at terra preta sites in the Central Amazon, we must first be able to grasp the spatial structure, degree of permanence, and activity patterns of a habitation site.

Space and Place

Many of the narratives, models and histories discussed above, as well as in Chapters 2 and 3, have been qualified as in some ways insufficient for understanding Amazonia. However, it is not my intention to suggest that those that have come before me have done insufficient work. If anything, the very fact that a few individual scholars have been able to synthesize data from across this expansive and heterogeneous region to create a coherent and traceable legacy is a testament to the high quality of scholarship by the few archaeologists that have dedicated their careers to studying this region. Even if the amount of time and resources that have been dedicated elsewhere had been applied to Amazonia, I suspect that, with the sparse tools we have had at our disposal until very recently, much of what happened in Amazonia would still elude us. As discussed above, Amazonia presents an entirely novel set of interpretive problems for which we may not have correlates, including presenting ways of structuring landscapes and environments that diverge significantly from what archaeologists have learned to recognize as ordered or anthropic. I have suggested throughout that site-based studies and studies of micro-regions, such as the ones being conducted by in the Central Amazon, in El Beni and in the Upper Xingu are the ideal approaches to building evidence-based models for occupation in Amazonia. We are fortunate to work in an era where these kinds of regionally-based models are multiplying across Amazonia, quickly narrowing the spatial and temporal gaps that have posed seemingly insurmountable interpretive difficulties for my fellow archaeologists.

I therefore propose here that we have reached a point in which it is not only possible but desirable to begin asking questions about the minutiae of daily life in pre-Columbian Amazonia. It is this level of detail that will allow us to discern discrete ethnicities or social structures, as well as their interconnectedness, across Amazonia. New sources of evidence on the macro-scale,

in the form of better regional control of site distribution and ceramic affiliation, and on the micro-scale, in the form of plant, soil, and sedimentological signals, will complement the already advanced scholarship on ceramics and other macro-artifacts.

Considering Amazonia as a series of places of various scales is one way to integrate these lines of evidence into historical and situated narrative about Amazonia's past. Place-based narratives can provide an alternative insight into integration within and between sites that utilizes data available at sites in the Central Amazon, unlike narratives about social complexity or chiefdoms, which rely on kinds of evidence that are inaccessible in this place. It is also an alternative and complementary approach to model-building that works by induction, gathering kernels of information to build a model from the bottom up. This alternative also redirects the focus from neo-evolutionist teleological projects that reproduce current narratives, toward an emphasis on locality, meaning, agency, and the very human project of placemaking.

As will be demonstrated below, the process of placemaking requires use of the senses. Human beings are only emplaced when actively engaged with the materiality of the world around them, and hence an archaeology of place is necessarily a sensuous archaeology. Additionally, an archaeology of place implicates the materiality of places, which includes environmental minutiae of places, in an ineffable way. While the emplacement approach represents a turn from the kind of environmental determinism that is associated with many of the earlier models for conceptualizing Amazonia, we must continue to consider the possibilities and constraints of the materiality of the world. What distinguishes this approach from most previous considerations of landscape and environmental factors in Amazonia is the narrowing of the lens, along with a consideration of the consciousness of subjects and their agency in the creation of place.

Landscape, place, and space.

As archaeologists transitioned away from the purely descriptive studies that characterized Culture-Historical studies, and toward explanatory studies, they became keenly aware that in order to address dynamic processes, they would have to start thinking seriously about space. The way that people moved through and organized space within a house could provide clues to the regularities within a culture, and also the variation therein. The way that larger spaces, such as sites or regions, were arranged and populated by humans in relation to their natural characteristics could answer questions about adaptation, mobility, and inter-site or inter-cultural interaction. Hence, archaeologists became increasingly interested in mapping cultural and natural phenomena, and in defining discrete scales of analysis to parse spatial data into meaningful, manageable, and comparable units. Archaeologists began to theorize the “site,” the “household,” the “region,” and, somewhat later, the “landscape.”

The section below will consider spatiality in terms of sensory experience and the process of placemaking. I examine the concept of landscape as it derives from European traditions of visuality, and in particular the way landscapes function in European painting, as products of and for the gaze. This quality of landscapes is seen to recur in anthropological and archaeological uses of the concept, which is contrasted with place. Space is briefly discussed insofar as it constitutes a different level of abstraction than landscape, and finally a discussion follows of conceptions of place that can be used to evoke not only the immediacy of place, but also its role in constituting the subject.

Landscapes and spaces.

In recent years, a number of archaeologies have taken shape, which aim to understand the relationship between people and their environment. One such approach is that of landscape archaeology. However, one of the potential missteps in conceptualizing our environments – which surround and encompass us at every turn – solely as landscapes is that a large percentage of points of contact – the experience of environmental factors – is lost. As many scholars have recently pointed out, the very notion of landscape is intimately connected with the visual sense (Cresswell 2006; Ingold 2000; Porteous 1990). This work makes use of a concept of a *landscape perspective* that refers specifically to the distance employed and evoked in viewing and conceiving of a landscape as such.

The word landscape comes from a Dutch word meaning province, or referring to a defined parcel of land, probably also such a parcel having some official set of boundaries and standing from the perspective of government. However, its English meaning evolved in the context of Renaissance painting, when landscapes were used as backdrops in portraiture. As landscape painting came into its own, scientific and mathematical advances in optics and perspective, permitted more realistic representations of figures within landscapes. Over time, landscape came to refer to a portion of land that could be seen from one spot, and, in many cases, was likely to be reserved for situations in which the land – as opposed to buildings and people – dominated the painting. In most landscape painting, the horizon – where earth (or sea) meets sky is a prominent feature, and this gives landscape painting the quality of vastness, of distance and breadth. This quality also permitted the viewer to absorb this quality of vastness and dominion, to in a sense control this vast space through the apprehension of the subjects and places depicted therein. In landscape painting, not only do the subjects appear to be a great distance away, but they also feature as “the observed.” This distancing, some argue, has come to dominate the way that vision itself is perceived in Western society.

For those of us fortunate to possess visual acuity – whether aided or unaided – vision allows us to sense things from a great distance. Some argue that this quality of vision results in a sense of detachment – that other senses, such as smell and touch, for example, are more intimate than sight. While it is often true that the tactile sense requires proximity, I would not agree that sight necessarily enacts detachment. In some cases, however, a reliance on the visual sense can facilitate distancing, and even control or the illusion of control, as occurs in the viewing of a landscape painting. In the case of the original framing of Amazonia, this aspect of sight becomes important, and will be discussed in detail once the parameters for conceiving of place in this study have been delineated.

I propose that an archaeology of landscapes runs the risk of being insufficient, especially when we consider 'landscape' to be a quintessentially European idea. As suggested at the beginning of this chapter, all models are developed in places, and seeing the world in terms of landscapes, flattened expanses of land that are framed by a horizon and dotted with people, is a kind of model, a way of parsing the world in order to make sense of it. In this light, the 'landscape' of European landscape painting is only truly comprehensible to those involved in the creation and commerce of such paintings. Certainly the ‘bucolic’ farm landscapes painted to evoke the peace and serenity of rural experience can only evoke the intended nostalgia in the painter and those who admire the painting. The farmer, no doubt, would have a different, more immediate, or differentially mediated experience of the place. This fact points to the kinds of

distancing and objectification that can occur when a landscape is viewed from afar, a point to which I shall return at the end of this section.

Landscape, then, manifests as a way of apprehending and describing the world that is chiefly about distancing, abstraction, and control. For the archaeologist, the power to abstract and control is extremely useful from an analytical perspective, as it permits the selective manipulation of data for the purposes of delineating patterns and comparing otherwise disparate data sets. This is perhaps the principal application of the concept of landscape in archaeological research, an eliciting or crafting of simplified, abstract landscapes that can be used to derive ideas about processes that would otherwise be difficult to recognize. The concept of landscapes permits us to define, prioritize, and superimpose different classes of data in order to slowly build a picture of the complex realities of past peoples' lives. For example, a 'ritual landscape' can be overlain upon a political or even physical landscape, in order to make possible the generation of correlations between one and the other. In this abstracted sense, landscape" actually functions more like 'map' or 'space;' it is an abstract representation of something that exists in the material or discursive world that permits the viewer to examine it from any and all points at once, like Ingold's (2000) surveyor.

Other approaches to landscape attempt to re-introduce the viewer into the landscape in an experiential way. Ingold (2000) suggests a 'dwelling' perspective to resolve the distance between archaeologists and the landscapes within which they work. He sees landscapes as "pregnant with the past," insofar as landscapes are all palimpsests upon which are inscribed the histories of all who have lived there. While I certainly agree that this is the case, I maintain that his approach relegates the subject to a position of "viewer," as someone who apprehends the landscape strictly through visual means. Similarly, Tilley (1994) writes about the phenomenology of landscapes that are imbued with meaning and symbolism, and carry within them indices of social memory. But in fact his landscape is not directly experienced, but rather a string of places and spaces that "relationally constitute wider contexts for social practices-landscapes" (1994:22); in other words, the places, which are imbued with memory and meaning, can be gathered as representations of themselves to produce a landscape, which, in the final analysis, is still an abstraction of reality, viewed from a fixed point in (abstract) space.

If we avert our focus from the gaze and consider experience in and of itself, I argue that there exist real, physical and material differences in the ways that senses function or are employed, that vary with cultural, gendered, and individual experience. These effects on sensation result from lived experience that takes place in a necessarily physical body. The body mediates between the external world and the subject, and also between the subject and the discursive spaces that exist among subjects. Furthermore, the body is formed and constantly altered through these dual, simultaneous processes of mediation. In this manner, a subject body is iteratively "trained" not only to move in certain ways, but also to be attuned to particular kinds of stimuli, or to interpret them with reference to frameworks appropriate to the subjectivity of the person in question. The materiality (*sensu* Joyce 2008) of stimuli that are all equally physical is thus also culturally constructed.

In his volume *Topophilia*, the geographer Yi-Fu Tuan (1974) furnishes an example of sensation and perception as culturally constructed. Tuan reports that BaMbuti Pygmies to be incapable of conceiving of horizontal distance, attributing this inability to the lack of open landscapes in the immediate surroundings they inhabit. In truth, the passage in question demonstrates nothing but that, for the subject in question, perspectival distance is unfamiliar. It

is, indeed, quite possible, that in a world of woodscapes, the longitudinal, horizontal perspective, could be culturally, socially, or practically less important than it would be other landscapes. Hence, it is conceivable that Tuan's example demonstrates some kind of specified sensory development that made sense in the cultural and environmental parameters of this individual's existence. It is, however, equally possible that other senses or other kinds of cues imperceptible to Tuan himself might have served to index distance for this individual.

This example requires us to consider the possibility that places are conceived of within multiple orders of classification, which may or may not include spatial or visual geometries. Perhaps in an environment in which the longest line of sight is less than thirty meters, distance is less often considered in terms of sight than it is via other senses. Sight itself might serve more proximate purposes. Alternatively, it may be that spatiality is considered within an entirely different framework, perhaps built on circles and spheres rather than axes and prisms, or layers and shades rather than continuous variable. If this is true, then the landscape framework emerges as useful in considering being only in certain kinds of environments, and within particular social and cultural orders. This being the case, the term landscape will be used in this study only when a European perspective is evoked (including that of the author), and only when appropriate. The notion of place, discussed in detail below, will prove more fluid, adaptable, and appropriate for the project at hand.

Another approach that received short-lived attention was spatial archaeology (e.g. Clarke 1977), an outgrowth of the New or Spatial Geography that was popularized in the 1960s and 70s, within the context of scientific positivism, an emerging trend in the social sciences of the era. Like spatial geography, spatial archaeology suffered from the limiting perspective permitted by a very particular usage of its central term. 'Space' as it refers to a geometric concept, such as Cartesian space – is inevitably empty of people, and thus analyses based solely on the use of space inevitably yielded quasi-deterministic models of social interaction, in which structures and sites constructed relations. In this view, landscape archaeology is almost preferable to spatial archaeology, for while landscape presupposes at least one person – an observer – space presupposes nothing and no one. Although the definition of space vis-à-vis place is not by any means a point of agreement among social scientists, spaces themselves are generally seen as the gaps between things – possibly places.

Tuan proposed a useful way to conceptualize the relationship between space and place: "if we think of space as that which allows movement, then place is pause" (1977). This is a good beginning, but it should perhaps not be taken too literally. Rather than thinking that place is the physical location where we stop moving, let us think about pause in a metaphorical, Shakespearean sense. Place is what gives us pause to think and feel about a locale, or more precisely, it evokes thoughts and feelings about a locale at the same time that it is created by our particular thoughts and feelings. As Watson put it, Geography, in so far as it is the study of place, is as much about the earth as it is about "our idea of the earth" (qtd. in Porteous 1990).

Thus, place is not a given or a universal, but rather a subjective construction that varies from person to person and from time to time. However, as much as place is created and re-created according to individual perception, this is not always a conscious effort, much in the way that subjects and social structures are constantly re-shaped through daily practice. The next section explores the efforts of a number of social scientists to extend concepts of action, intentionality, experience, and the body into place theory.

Conceptualizing Place.

A number of humanistic geographers have conceptualized place as explicitly contingent on human experience. For Don Parkes and Nigel Thrift (1978), the existence of place is contingent upon the existence of mental maps, which they liken to blueprints of intentionality that correspond to physical locales. Action, which is grounded in intentionality and meaning is also necessary for the realization of place (Parkes and Thrift 1978). In his *Making Histories and Constructing Human Geographies*, Allan Pred (1990) has conceptualized place as always becoming. Pred (1990) follows sociologist Anthony Giddens (1984) in envisioning a middle space between structures and agents, in which agent-based action intersects with over-arching structures. For Pred (1990), the structures are institutional projects – expectations set forth by employers, lawmakers, educators – and agency takes the form of paths, which are individual biographies. Paths and projects intersect each other, and while the individual is expected to conform to the projects, divergences are possible (Pred 1990). It is in these intersections that places are made, and at the same time, it is within the context of places that intersections occur (Pred 1990). In some ways, one might argue that places and events are co-constitutive.

Pred's schema (1990) of paths and projects, although elegant in its depiction of the intersection of biographies and structures, is not sufficiently nuanced to account for some of the momentary actions and events sometimes recorded in the archaeological record. Bourdieu's *habitus* (1972), the dispositions that regulate the way we react to externality, but which are also regulated by our bodily postures, opens up the space to consider agency on a more momentary scale. If we are not conscious of thinking about place all the time, but always in place and moving in accordance to it, then there may be something in the habitual actions of the body – our link to the world – that has a role in creating place. Geographer David Seamon (1979), following Merleau-Ponty (2003) in foregrounding bodily experience over cognition, focuses on the way movements of the body structure space, and are themselves structured in space. His "body-subject" is the driving force behind seemingly automated movements that form part of people's every-day negotiations of their physicality in the material world (Seamon 1979).

The phrase 'body-subject' comes from Merleau-Ponty's work (2003) on perception, which foregrounds the body. Sensation happens, he claims, before cognition, for the mind resides in the world (Merleau-Ponty 2003; Ingold 2000). This is the art of dwelling, in the Heideggerian (1971) sense, that which brings mind, body, and place into a conjuncture, a totality of experience. Heidegger's *dasein* (1971), being-in-the-world is one way of expressing the inextricable nature of subjectivity and place-making. Edward Relph, another humanistic geographer, takes as his point of departure "the wholeness and indivisibility of human experience" (Relph 1976). Asserting the unity of person, place, and time/act, Relph (1976) simultaneously emphasizes the ephemerality of each (a person, a place, and a time) individually. Additionally, he states that "geographical reality is the place where someone is," and that geography itself is "initially a profound and immediate experience of the world that is filled with meaning" (1976:5). Thus, meaning and intentionality are integral to the constitution of place.

Relph's work (1976) draws extensively on that of Edmund Husserl, another key figure in phenomenology, who emphasized the intentionality of human existence. Husserl's intentionality is often glossed as "aboutness," a focus on the fact that consciousness is always "consciousness of" something (Duranti 2000). In a way, this is almost the logical converse of one of the considerations of this chapter – that something is always what someone is conscious of. While the former position departs from the subject, the latter begins with the object – that is, everything

outside the subject. Addressing meaning and intentionality – Edmund Husserl’s aboutness – is a way to populate a landscape with sentient, active beings. Considering the seemingly primal nature of place, Cresswell (2006), echoing Relph (1976), proposes that subjectivity itself is constituted within place, and vice-versa. Just as a landscape necessitates an observer, a smellscape necessitates a palate, and a soundscape necessitates ears, etc., a subject needs sounds, smells, views, textures, flavors, and atmospheric modulation to be emplaced. A subject cannot exist without being in place; a place cannot exist without subjects.

People, places and deeds.

Acts and practices: tracking the subject-agent.

Because archaeology relies on material traces of the past to track the actions and movements of people, and because archaeologists are inherently concerned with temporality, archaeology is well positioned to elicit dynamic processes from static remains. Archaeological remains are seen as the results of events and actions, and we often consider the preservation of these traces to be fortuitous. To a certain extent, they are often fortuitous, as in the case of Pompeii or Tollund Man. In other cases, deliberate action is taken by humans to preserve remains, as in practices of mummification and burial. In yet other cases, intentional acts, such as major construction episodes, can fortuitously preserve the traces of past actions. These major events or deliberate actions are the kinds of processes that are most likely preserve the traces of a connected set of actions that I will define as an *act*. An *act* is a set of movements in space performed by a person that results in the deposition or removal of material “stuff;” when this act is performed in such a way that a signature or trace of this act is left in the material record, it is detectable in a subsequent moment by another or the same person. I distinguish here between 'event,' which does not presuppose or point to an agent, and 'act,' which does. Events are here understood to be natural processes over which humans have no direct control, even if it can be argued that a landslide can be the result of human-induced land degradation or a tsunami is a result of cumulative human action that is responsible for climate change. Whether the material traces of an act are preserved in the archaeological record until such time as they may be encountered by an archaeologist is a consequence of the events and acts that follow the performance of the act in question.

Acts are one kind of dynamic process the traces of which archaeologists are sometimes able to uncover under the right formation and preservation conditions. The second kind of dynamic process to be distinguished here is a 'practice,' understood to entail the same kind of intentionality as an 'act,' and in fact to be composed of sequences of acts that occur within a cyclical or recurring pattern, such that these practices in fact entail repetitive action. Repetitive action is what results in structured deposition (Joyce and Lopiparo 2005), such as the accumulation of midden refuse or the stepwise depletion of nutrients in an agricultural soil. Thus, I argue that insofar as structured deposition is the result of repetitive action, it can be said to stem from the habitus, the set of bodily dispositions held by a subject and which are enacted through practice.

In this work, a careful analysis of the pedo-stratigraphic sequence and the anomalies observed therein will be geared toward interpreting the traces of human acts and practices. As suggested in the above paragraph, acts and practices are intimately related, as the latter is

composed of a multitude of the former, if necessarily composed in a very specific manner. Both acts and practices leave traces in the ground in the form of anomalies, or depositional signatures that we cannot explain through natural processes, and thus interpret as the result of human activity. Practices, as a kind of repeated action that results in structured deposition, can also be punctuated by acts, which can manifest archaeologically as singular events that interrupt the structured deposition that results from practices. If conceived in this way, practices can be seen manifested archaeologically in, for example, layers or deposits that result from accumulatory deposition. In this same scenario, the trace of an act might be preserved in something like a pit, that interrupts or cuts through the deposit that indexes a practice.

I would like to expand our notion of structured deposition beyond just thinking of it as the way that middens build up or the way that debitage scatters when a tool is being flaked, or even the burial of certain kinds of artifacts in a structure manner, to include acts that, on a broader scale, should be considered as parts of practice. For example, the way we move dirt and stone to form house platforms or foundations not only constitute acts, but also practices, in the sense that the exact manner of moving and mounding arises from a habitus that has been formed through iteration. If we consider the building of a house as an act of deposition, the way that a series of houses are then positioned within a kind of spatial and ideal framework, then we have moved to another scale, in which we consider practices of arranging space and creating place. As such, the building of houses and the digging of pits are more than just acts or strings of acts; if enough is known about them, they can be seen as practices that characterize the movements of members of the society in question.

The reason it is important to distinguish between acts and practices is that they point to distinct temporal scales. While an act is something that has a definite start and end, and can be defined as a moment (e.g. the moment in which a pit was dug; the moment in which it was filled; the moment at which a house platform was built; etc.), a practice is a continuous, repeated process that gradually shapes not only the depositional sequence but also the lives of the people who enact those very practices. The impact on place of an act is much more palpable than the impact of practices; but the impact of practices is arguably more lasting and more constitutive of place and of the people within it.

From the ground up – to build a house

This project proposes to craft an alternative narrative about pre-Columbian habitation of Amazonia by populating an archaeological site from the Central Amazon with conscious agents possessed of memory and intentionality who craft places within an inhabited landscape. These places can be conceptualized and studied at various scales, which is how I will explore the terra preta known as Antônio Galo. This study will consider in detail the place of a neighborhood or precinct within what might be thought of as a village; the place of a house within this precinct; the places that are defined in relation to the house or houses of this precinct, such as a ‘plaza’ or a ‘backyard;’ the places within the houses or plazas or backyards that stand out, evidenced by particular anomalies, as relating to a specific act or practice; and also all of these places – village, precinct, house, plaza, backyard, feature – in and of themselves. Once these places have been considered, an attempt will be made to contextualize the Antônio Galo site as a place within the

micro-region defined by Lake Limão; within the research area understood as the confluence region of the Negro and Solimões Rivers; and within the Amazon as a macro-region.

Particularly important for the contextualization of this terra preta at the scale of the precinct and at larger scales is a consideration of existing models of mobility and permanence in Amazonia. I take this opportunity to point out that mobility and permanence are not mutually exclusive, and that our impression that this is the case is a result of fixed Western conceptions of place, house, home, village, etc., as things that are continuous (contiguous) and immobile. I propose that an inhabited territory can be seen as the setting for permanence even if village shifting occurs in a semi-annual, biennial, or decennial cycle, as long as there is continuity of habitation and use. Thus, I argue that re-occupation of a place, if it occurs by the same people as part of a cyclical movement simply enlarges the area of permanence, rather than eliminating permanence itself.

This proposal stems in part from a recognition that what we can identify as places of habitation, or village sites, in Amazonia may only signify the locations of houses, as it seems clear that terra preta indexes habitation and not agriculture. Elsewhere we have identified, with growing confidence, areas of terra mulata associated with agricultural fields. If, however, we accept that subsistence modes in pre-Columbian Amazonia may have consisted of mixed strategies including agriculture, horticulture, hunting, fishing, and gathering, it is possible that an inhabited landscape would have extended far beyond the bounds of a given terra preta or terra mulata boundary. This, in turn, raises new questions and re-frames existing questions about regional integration and communication between sites. Furthermore, in the same way that the 'house' in many tropical settings (e.g. the *kauhale* system in Hawai'i) can consist of several buildings ordered within a symbolic space (Fox 1993; Kirch and Green 2001), I suggest that the 'village' can consist of several agglomerations of houses, if they can be shown to be part of a continuous inhabited landscape. I suggest that, as is the case with the house, above, the important factor in determining boundaries of the village is the social unit rather than spatial contiguity.

This re-framing of ideas of continuity (both spatial and temporal) seriously complicates long-standing debates about village size, permanence, and mobility in Amazonia. On the one hand, Meggers' tracking of cyclical migrations of small, autonomous populations within a circumscribed region could be conceived of as a kind of permanence, but a permanence indicative of low population densities for the inhabited territory. On the other hand, Meggers' challenge to the continuity of occupation of terra preta sites could be laid to rest if it were shown that various apparently sequential occupations of a site were in fact evidence of village re-arrangement within a continuous occupation. These two scenarios highlight the importance of precise and plentiful chronometric data, as well as the need for increasingly detailed studies of individual sites. This pilot study, implemented at the Antônio Galo site, is a means of exploring the possibilities of understanding the fine-grained sequence of events and identifying specific acts and practices with a view to expanding the range of questions that can be answered about life in pre-Columbian Amazonia.

Chapter 5.

The Potentials of the Archaeological Matrix

Soils and Sediments: An Introduction

The aim of this chapter is to think through the archaeological matrix, usually understood as the material that supports and structures archaeological artifacts and features at a site, as a medium of study in itself, both in a general sense, and in particular within terra preta sites in the Central Amazon. The purpose of this study is to shift this conception of the matrix as a “skeletal structure” or otherwise passive material, towards a consideration of the matrix as a crucial source of information and active material in the creation of archaeological sites. In this study, archaeological matrix is defined as all the material that makes up an archaeological site that is not traditionally considered structural or artifactual, but also to include artifacts, and to comprise structural elements. The way that the archaeological matrix is treated, and the extent to which the distinction between artifact and matrix can be blurred, will be considered below. The term “feature”, though it has been applied to archaeological matrices that are considered anthropogenic, is avoided here because of its fluid meaning in different contexts.

Because on average 99% of archaeological sites consists of particulate or fine-earth materials that are discarded, this chapter will focus specifically on the study of soils and sediments. Most people who do not work directly with soils or sediments often use the two words interchangeably. It is important to maintain the distinction between 'soil' and 'sediment,' as these terms do refer to distinct entities, which reference distinct scales and processes of formation. More thorough definitions and explanations regarding soils and sediments follow below, but the most crucial distinction to make initially is that soils are bodies of particulate matter that exhibit an internal organization reflecting *in situ* transformational processes. Sediments are particles in themselves that have been subject to transport and deposition. Hence, it should be clear from the outset that soils and sediments are intimately related, but by no means the same thing.

I consider the ways in which archaeologists extract information from soils and sediments, ways that researchers have proposed to improve upon or innovate these methods, and circumstances under which such endeavors are valuable. Soil and pedological methods are considered separately from sediments and sedimentological methods, all within a global perspective, with the understanding that much overlap exists in the analytical techniques used in both perspectives. In the second half of the chapter, my lens is focused upon the study of soils and sediments in Amazonia, and finally narrowed to the methods and analyses employed for this particular project, a study of site formation and activity areas at Sítio Antônio Galo. This chapter will show how an integrated, systematic approach to the archaeological matrix can significantly improve interpretations of past events at cultural sites.

To say that the archaeological matrix is systematically ignored by most archaeologists is to imply that this chapter deals with wholly uncharted territory, which it does not. Many methodological advances on in the study of the archaeological matrix have been developed in

recent decades, which will be discussed in this chapter. But even from a non-specialist perspective, interpretation of the archaeological matrix is an essential part of archaeological work. Field archaeologists invariably analyze and interpret the archaeological matrix for clues that will aid in deciphering the nature and sequence of events that took place at sites of human habitation. Whether this attention to the matrix is highly systematized and thorough, or cursory and informal, distinctions in the matrix are used to differentiate between depositional episodes, to determine the nature of deposits, and in some cases, to distinguish between human and natural transport agents. Nevertheless, a lack of understanding of relevant depositional and post-depositional processes often leads to inadequate, incorrect, or incomplete notions of an archaeological matrix and its associated pedo-stratigraphic profile. Despite its implicit interpretive potential, the archaeological matrix, as the name itself indicates, is often seen as at most a structural element, which “surrounds, holds, and supports archaeological data” (Ashmore and Sharer 2009:71). As such, archaeologists are often eager to remove the soils and sediments in which macroscopic artifacts are embedded, to get the dirt out of the way, so to speak, in order to reveal the data they are seen to obscure.

As our methods become increasingly refined, it becomes ever clearer that this so-called matrix is more than just a supporting medium, but rather a data-rich medium in itself. The interest in recovering debitage and botanical remains from soils and sediments, and then subsequently micro-debitage and microbotanical remains from the same “matrix”, and even more recently, organic and chemical residues from the pores and fissures of macro-artifacts reveals that a mere question of semantics defines the difference between recovering data from the matrix and recovering parts of the matrix itself. At what point can we say that an artifact, or residue, is too small to hold archaeological significance? How can we, methodologically, differentiate between the depositional processes and pedogenic effects of a macroartifact, and a grain of sand? Indeed, our definitions of what qualifies as an ‘artifact’ has broadened considerably, and the micro-scale, including the analysis of artifacts sand-sized and smaller, is increasingly proving worth examining. This chapter is an attempt at summarizing the potentials of the archaeological matrix, so that we can know how to approach each instance of the archaeological matrix. How do we decide when to throw the matrix aside, and when to probe deeper into its composition, using ever more meticulous and specific recovery techniques and increasingly complex laboratory methods to extract information?

The answer lies in the questions we wish to address. What questions need answering in any given geographic region or culture area, and what processes are to be traced? In what way can a study of the archaeological matrix enrich interpretations, and at what cost? The research questions to be addressed, and the particular historic details and characteristics of a region or culture area determine to what extent and in what intensity these methods should be applied. In the study of pre-Columbian terra preta from the Central Amazon, a kind of archaeological remain that constitutes the site matrix, and which is simultaneously the direct result of human activity, it stands to reason that a deep and diversified focus on soil and sediment study is a useful approach. These analyses allow us to discern the composition, and potentially, origin, of archaeological sediments and soil components or residues, which can lead to a better understanding of the processes, artificial and natural, that led to their formation. The fact that preservation conditions obscure architectural features and tend to destroy organic remains highlights the importance of a close study of the matrix itself, which may contain traces of these significantly altered or degraded remains. This chapter will introduce concepts key to

interpreting the archaeological matrix and deal with particular approaches to studying the matrix in various research settings, culminating with a set of prescribed methods for the site and questions that are the focus of my dissertation.

History and applications of soils and sediments research in archaeology

Soils and sediments have been a part of archaeological research, at least implicitly, since stratigraphy first became a concern (Browman and Givens 1996). As early as the 1930s, and through the 40s and 50s, F. E. Zeuner (Barham and Macphail 1995; Zeuner 1945, 1950) began applying concepts from soil science to archaeological problems. Formalized methodologies for studying soils and sediments began in the 1950s, with the work of I. W. Cornwall (1958), and Limbrey (1975) followed suit in the 1970s. Cornwall and Limbrey offered a comprehensive understanding of basic soil science concepts, and then outlined a range of anthropological or archaeological applications of some of these techniques. Interestingly, both scholars focus on the application of soil science methods and concepts to research questions that dealt with agriculture. This orientation was probably somewhat related to the concerns of archaeology as a discipline, but interestingly enough, soil science at the time was also very much geared toward agronomy.

In more recent decades, the field of archaeological sediment research has been developed by scholars such as William Farrand and Julie Stein (1985, 2001). Soils research was spearheaded by Vance T. Holliday (1989, 1992c, 2004), and the field of micromorphology has grown significantly through the efforts of Paul Fisher, Charles French, Paul Goldberg, Richard MacPhail, and Wendy Matthews (French 2003; Fisher and Macphail 1985; Goldberg 1992; Goldberg, et al. 2001; Macphail 1983a, b, 1986; Macphail, et al. 1987; Matthews, et al. 1997). Although these three subfields – soil science, sedimentology, and micromorphology, are often presented as separate, they are usually interwoven, share some basic field techniques, and are best used in combination. Topics investigated today include agriculturally focused research, but has expanded to include formation processes of a sedimentological or pedological nature. The sedimentological school has its roots in geology, while the recent upsurge in micromorphological research could be said to reflect a recent shift in soil science, which has moved away from strictly a agronomical orientation and toward a total system approach to soil.

This field statement will cover geoarchaeological applications of methods from the earth sciences that deal specifically with particulate matter that makes up the matrix of most archaeological sites. Sometimes studied as a soil, and sometimes as a sedimentary body, this matrix is crucial to understanding not only the depositional context of other archaeological remains (i.e. movable and immovable artifacts) on scales ranging from decades to millennia (Barham and MacPhail 1995) and post-depositional site formation processes (Ferring 1992; Fisher and Macphail 1985; Goldberg, et al. 2001; Holliday 1992c, 2004; Rapp and Hill 1998; Schiffer 1987; Shackley 1975; Stein and Farrand 1985, 2001), but also the context of daily activities and practice (Hassan 1978; Hutson and Terry 2006; Manzanilla and Barba 1990; Middleton and Price 1996; Stein 1985; Wells 2004), strategies adopted by past peoples to negotiate local environments (Allen 2004; Denevan 2004b; Fèuleky 2003; Foster and Smout 1994; Glaser and Woods 2004; Groenman-Van Waateringe and Robinson 1988; Hassan 1978; Heidinga 1988; Holliday 2004; Kirch, et al. 2005; Ladefoged, et al. 1996; Lehmann, Kern, et al.

2003a; McFadgen 1980a, b; Pape 1970; Sandor 1983, 1992; Stevenson, et al. 2006; Walton 1983; Walton and Cassels 1992), and long-term human effects on the environment (Allen 1988; Cassels 1972; Cook 1963; Davidson and Simpson 1994; Denevan 2004b; Eidt 1984; Foster and Smout 1994; Glaser and Woods 2004; Groenman-Van Waateringe and Robinson 1988; Heidinga 1988; Holliday 1992c; Kirch 1997; Kirch, et al. 2005; Kirch, et al. 2004; Ladefoged, et al. 1996; Lehmann, Kern, et al. 2003a; McFadgen 1980b; Mieth and Bork 2005; Mora et al. 1990; Pape 1970; Plekhanova 2005; Sandor 1992; Stevenson, et al. 2006; Vitousek et al. 2004). Special attention will be paid to recent and developing work on anthrosols (Alexandrovskaya and Alexandrovskiy 2000; Bakker 1980; Cassels 1972; Davidson and Simpson 1994; Denevan 2004a; 1977, 1984, 1985; Glaser, Guggenberger, et al. 2004; Glaser, Zech, et al. 2004; Groenman-Van Waateringe and Robinson 1988; Lima et al. 2002; Macphail 1983; McLaughlan 2006; Middleton 2004; Pendall 1989; Plekhanova 2005; Taylor 1958; Walton 1983; Walton and Cassels 1992; Wells 2000), which in some cases, exhibit a degree of modification so significant that such archaeological soils and sediments can be regarded as artifacts in their own right. Finally, the focus will narrow to the study of Terras Pretas de Índio, a kind of site, deposit, and artifact that characterizes indigenous pre-Columbian occupation across the Central Amazon from ca. 400 B.C. to A.D. 1400 (Petersen, et al. 2001).

Soil or sediment?

In order to understand the relevant contributions of agronomy, pedology, sedimentology and soil geomorphology to archaeological research, one must first distinguish between soils and sediments. Soil is "the biochemically altered material that lies at the interface between the lithosphere and the atmosphere" (Amundson 2004:1). Soils form when parent material, such as a rock face or an alluvial (or other sedimentary) bed undergoes in situ structural and chemical modification, incorporating biological components and organic matter in the process. Because pedogenesis (soil formation) is depth-dependant, soils *sensu strictu* can only form on land surfaces which are neither constantly undergoing erosion, nor receiving sediment from another land surface (Holliday 1992a, b). Needless to say, as climatic, geomorphic, and biotic conditions change over time, land surfaces undergo periods of stability and upheaval. During periods of land surface stability, soils form (Holliday 1992a), and these are the domain of pedologists and paleopedologists. Sediments, on the other hand, are defined as organic or inorganic particulate material that has been moved from its original source, undergone transport by an agent, and been redeposited in a different location (French 2003; Hassan 1978; Shackley 1975; Stein 1985, 1992, 2001). Agents generally considered in sedimentological studies include water, wind, gravity, and glaciers; in this chapter, I will follow Stein (1985, 1992, 2001) in considering humans as transport agents as well. In contrast to soils, sediments are characteristic of dynamic environments, in which the rate of deposition outperforms the rate of pedogenesis. In the presence of archaeological sediments, sedimentological methods are also useful, although often in conjunction with pedological methods. As highlighted above, many methods are shared between pedological and sedimentological approaches, such as particle-size analysis, and thus the two approaches can easily lend themselves to integration, if the parameters of each approach are well understood.

Understanding distinctions between soil genesis and sedimentary processes is important for understanding the nature of the matrix that makes up most archaeological sites, in order to ensure the best possible interpretation of the context of human occupation and artifactual deposition. The study of site formation processes is significantly augmented by the study of soils and sediments (Ferring 1992; Gladfelter 1992; Goldberg, et al. 2001; Holliday 1992b, 2004; Rapp and Hill 1998; Stein 1992). Since pedogenesis is a relatively slow process on a human scale, portions of archaeological sites that evidence periods of heavy (human-induced) deposition are in fact archaeological sediments, unless the surface of the settlement remains stable after abandonment long enough for pedogenic processes to take effect. It is useful to note that in such cases, soil formation is a post-depositional process, which takes as its parent material the archaeological sediment. When site abandonment periods are sufficiently significant for the given soil forming conditions (climate, parent material, etc.), pedogenic processes must be taken into account in assessing soil structure and soil chemical properties. Pedogenesis may have deeply affected the original sediment, or its effects may have been negligible. In most cases, a combination of methods is recommended, as pedological and sedimentological methods produce different and complementary information. Sedimentology provides information about the origin and depositional processes of particulate material and pedology addresses questions of post-depositional processes.

On the other hand, portions of archaeological sites where deposition has been minimized (e.g. house floors, plazas, gardens), will exhibit more characteristics of a soil, provided the land surface remains stable long enough. The speed at which pedogenesis proceeds is highly variable, depending on climate, parent material, and a number of other variables (Holliday 1992b, 2004). Soils can take anywhere from hundreds to thousands of years to form (Holliday 1992b), and thus correlating the duration of occupation, the length and characteristics of periods of abandonment, and the characteristics of the material present at a site can help archaeologists understand which processes are likely to be most important in the evolution of their sites. Most pedogenic processes can only take place within a certain (locally variable) vertical distance of a land surface, and in contexts in which weathering agents, especially water, can penetrate (Amundson 2004); once a land surface is buried by a sufficiently thick or impregnable deposit, pedogenesis will halt.

Having established the criteria for understanding a particulate body, such as an archaeological matrix, as a soil or a sediment, it is worth noting that these will often exhibit characteristics of both soils and sediments. As Hassan (1978) emphasizes, the words soil and sediment are often used interchangeably by archaeologists, without sufficient thought given to the implications of this characterization. Since it is often difficult to know whether a deposit has stronger soil or sedimentary characteristics before a careful initial study is undertaken, it is best to abstain from interpretation until the basic pedological and sedimentological properties of each deposit have been established. Once these have been established, an archaeologist can decide under which conditions and for what investigative purposes the deposit will be treated as a soil or as a sediment, taking advantage of both interpretive frameworks to investigate all aspects of what the pedo-stratigraphic profile. This approach allows for a maximum amount of information to be extracted from the deposit, and indeed for the same deposit to be understood within both perspectives. It is thus recommended that a basic understanding of soils and sediments be applied to the initial analysis of a pedo-stratigraphic profile. Furthermore, for the purposes of

this paper, the word ‘matrix’ will be used as a general term for the particulate matter within which archaeological data are embedded.

This chapter is organized into sections that separate research into soils in archaeology from the application of sedimentological methods to archaeology, with an understanding that archaeological work often involves (or should involve) methods from both, and also that some methods can be equally applied to soils or sediments. However, the distinction between soils and sediment research in archaeology is made deliberately, to highlight the importance of recognizing the nature of the matrix surrounding artifacts before applying any of these methods, as even methods that can equally be applied to soils and sediments can be differentially applied, and results differentially interpreted, depending on the nature of the matrix. In the interest of simplicity, methods applicable to both fields will be introduced in the soils section.

Soils in Archaeology

Pedological concepts

Holliday defines pedology as “the study of soils in their natural setting; their morphology, genesis and classification” (Holliday 1992b:102). Archaeologists and soil scientists involved in geoarchaeological research generally base their approach on the theoretical framework for pedology set forth by Hans Jenny (1941), which understands the factors affecting soil formation as parent material, time, climate, organisms, and relief or topography (Ferring 1992; Holliday 1992b, 2004). Jenny (1941) combined the above variables into a conceptual equation known as the state factor equation, which not only helps pedologists understand soil formation as a function of the above variables, but can also be adapted into practical equations that make controlled field experiments possible (Amundson 2004; Holliday 2004). By controlling for as many variables as possible, the influence of particular factors on soil modification in the pedogenic process can be measured. Because soil formation depends on factors such as climate, topography, and parent material (the latter studied as lithology, petrology, or sedimentology), soil science is intimately linked to geology, biology, ecology, and geography. The inclusion of organisms in the state factor equation also brings soil scientists into conversation with biology and zoology, as well as anthropology.

Another major difference between soils and sediments is the nature and role of organic matter. Organic matter is essential for soil formation, and thus forms part of a soil, but is not a soil in and of itself. Sediments, on the other hand, may contain no organic matter at all, while at the same time, organic matter can be considered a sediment. Soil organic matter (SOM) arises from material that is not transported to the land surface, but rather that which is part of the biological community that inhabits that soil and partakes in the weathering processes that result in pedogenesis (Stein 1992). Most SOM is found in the A horizon, but can also occur in lower horizons, transported downward by bioturbation or migration as fine-grained humus, which adheres to clay and silt particles, as well as to larger grains, forming a cutan (coating) and accumulates in voids (Stein 1992). According to Stein, (1992) soil organic matter cycles through soil as quickly as it can be processed; the more organic matter present in a deposit, the more rapidly it will decompose, thus resulting in a more or less steady state of organic matter cycling.

This cycle must be taken into account in order to understand the significance of organic matter values for archaeological sites.

Archaeologists have long recognized the contribution of soil science to understanding stratigraphy at archaeological sites, particularly at deeply stratified or ancient sites that present buried soils. More recently, the effect of pedogenesis on surface sites has been recognized by archaeologists, and pedological concepts have been applied toward understanding diagenetic changes undergone by archaeological sediments in post-depositional periods. Although somewhat dated, the volumes written by Cornwall (1958) and Limbrey (1975) provide exceptional coverage of basic soil science concepts, and are aimed especially at archaeologists. The methods and applications presented in the latter part of both volumes reveal a significant bias towards agriculture as a research theme. A more updated review of soils and archaeology, Holliday's (2004) volume also defines key soil science concepts, and then summarizes the evolution of soils research in archaeology, introduces field and laboratory methods for the application of pedological and geomorphological concepts to archaeology, and details the application of these concepts and methods to key themes in geoarchaeology. Studies of soils in archaeological sites have been used not only to answer questions relating to site stratigraphy and site formation processes, but also for site correlation and dating, site prediction, paleolandscape and paleoenvironment reconstruction, determining human impact on soils and landscapes, detecting human activities, and predictive modeling of agricultural production (e.g. Fèuleky 2003; Goldberg, et al. 2001; Groenman-Van Waateringe and Robinson 1988; Holliday 1992c, 2004; Miller and Gleason 1994; Rapp and Hill 1998). These and other applications of pedological methods to archaeology will be discussed in detail in the section below.

Methods and Methodological Considerations.

As with any discussion of methods, it is appropriate to begin with considerations of sampling issues. Sampling methodologies for studying soils at archaeological sites, like any other sampling methodology, varies depending on the research question. Stein (1985) has a particularly helpful illustration of, for example, the various ways that one can sample an archaeological profile in the post-excavation period, depending on the particular questions raised at the site. See Holliday (2004:35-36) for a few examples of sampling strategies, and definitions of types of soil samples useful to the study of pedology in the context of archaeological research. Soil sampling can occur during excavation, in the form of bulk and spot sampling; can be conducted in conjunction with archaeological sampling; and should always be a part of post-excavation procedures undertaken in conjunction with the analysis of pedo-stratigraphic profiles.

Regardless of particular research questions, all adequate sampling strategies include a control sample (Gladfelter 1977; Quine 1995; Rapp and Gifford 1985; Rapp and Hill 1998; Stein and Farrand 1985, 2001; Stein and Rapp 1985), which ideally helps an archaeologist or soil scientist understand 'normal' conditions, or 'background' readings for a particular attribute. As Holliday (2004) puts it, sampling off-site is a way of contextualizing the archaeological soil sample within the environment and landscape that surrounds the site. In order to gauge the degree of alteration sustained by Andean terrace soils as a result of agricultural practices, Sandor (1992) emphasizes the need to pair studies of agricultural sites with those of unmodified soils. Since questions may arise as to what exactly constitutes an off-site or unmodified sample

adequate knowledge of the regional history of a study area becomes even more important. It is also worth considering what the given 'control' or 'background' sample is meant to represent. For example, if one is attempting to determine the presence or function of a feature or anomalous deposit encountered within an archaeological site, one must always sample the surrounding matrix as well in order to be able to determine to what extent and in what ways the deposit in question is 'anomalous' (Adams and Gasser 1980; Lemmstrong and Hastorf 1995).

Stratigraphy and the study of profiles.

Most archaeologists who advocate for soils research within archaeology name site stratigraphy as a crucial meeting point for archaeologists and soil scientists (e.g. Holliday 1987). Archaeologists and pedologists have fundamentally different understandings of excavation profiles. The archaeologist's perspective is theoretically much more aligned to that of the geologist or geomorphologist and understands an excavation profile as a vertically stratified series of layers and interfaces that represent a sequence of events. Both archaeologists and geologists apply the law of superposition to re-create a temporal sequence through the interpretation of stratigraphy. When studying sediment bodies, soil scientists are interested in the horizonation that occurs within or across depositional strata as a result of pedogenic processes such as weathering, decomposition, physical mixing, and vertical particle movement within a soil body. These processes form horizons, horizontally contiguous and vertically distinct zones within soils that can be interpreted to generate data about climate, biota, hydrology, time, etc. These data can point to factors of the environmental history of the rock/sediment and the conditions of its surroundings after formation. Horizons also help determine the degree to which the sedimentary body can be termed a soil.

Because of these fundamentally different perspectives, archaeologists, pedologists and geomorphologists can have vastly different approaches to stratigraphy. Barham and MacPhail (1995) have pointed out the need for a balanced approach to stratigraphy, which considers the research goals of archaeologists and geomorphologists. Critiquing so-called 'parochial' approaches to archaeological stratigraphy, Barham and MacPhail (1995b) suggest the application of "science-based techniques to the modeling of site-formation processes and stratigraphic sequence development" (Barham and MacPhail 1995b:x). To this critique I add that pedogenic processes should also be considered during the interpretation of archaeological profiles and follow him in proposing rapid and precise recording techniques such as X-radiography (Barham 1995) in order to bridge the gap between these three approaches. These processes, which quickly record the finer details of a profile, may facilitate the timely progress of archaeological work without sacrificing the geomorphological or pedological interpretive aim or the precision of data recording. One caveat is that X-radiography or similar high-resolution recording techniques should not take the place of careful field observation, as the moment of interpretation of a pedo-stratigraphic profile is also often the most opportune time to collect additional samples from the profile, which may present themselves as worth studying only after this interpretation.

Profile interpretation, whether done from a pedological or geomorphological perspective has many things in common with archaeological stratigraphy. Both traditions require the excavator to note the color (including variation), texture, and boundaries between vertically differentiated units (horizons or strata). Additional attributes, which may or may not be observed and recorded by archaeologists with no specific soils training, but which are always recorded by soil scientists include soil consistence (cohesiveness), structure, cutans, concretions, voids, and

the shape of boundaries. Pedologists often also note the nature of organic material present in the soil, the amount of biologic activity, and the presence, shape, orientation, and size of stones (Holliday 2004). The above attributes provide information on the nature of pedogenic processes taking place within a particular soil, and the degree of pedogenesis the pedon (vertical section of a profile involved in pedogenesis) has sustained. A pedon extends vertically from parent material to surface, and horizontally as far as needed to fully describe the profile, usually a meter or two (Hole and Campbell 1985). A horizontally extensive (e.g. multiple meters long) stratigraphic profile can contain various pedons (Hole and Campbell 1985).

In order to get the best possible coverage of stratigraphy over a large research area, Holliday (2004) advocates combining trenching, coring, and augering. Profiles recorded through these methods can be combined to form what Ferring (1992) calls a 'chronosequence', or a master composite stratigraphic profile (a conceptual device) that chronologically orders all soils recognized within a research area; this approach is particularly useful within alluvial settings, in which pedogenic processes are often buried by sedimentary deposits, which then serve as parent material for a superimposed soil. Establishing a chronosequence can be seen as analogous to building master stratigraphic sequence through use of the Harris Matrix (Harris 1989) in archaeology. Chronosequences will be discussed in greater detail within the context of dating techniques (see below).

Laboratory analyses.

Much of pedoarchaeological work continues in the laboratory. According to Goldberg, "traditional laboratory techniques" (1992:145) for the study of soils include granulometry, chemical analyses, and mineralogy. Included in chemical analyses are tests for pH, calcium carbonate, bulk density analysis, organic matter content, and iron and aluminum content, and phosphate analysis, which has been an important method of detecting past human activity since the 1930s (Eidt 1977, 1984; Goldberg 1992; Holliday 2004). Holliday (2004) contains a compendium of methods for extracting phosphates (Appendix 2), and a useful review of some basic laboratory methods (Appendix 3), as well an extensive list of sources for reviewing geomorphological and pedological laboratory methods (2004:38).

Dating.

As a general rule, older soils have more strongly developed profiles because pedogenesis has happened over a longer period of time (Holliday 1992b). Thus, within a particular environment, all things being equal, degree of pedogenesis can be used as a proxy for relative age. However, controlling for all the variables can be a difficult task (although see Vitousek 2006 for a possible site of application). Additionally, chronosequencing must be done cautiously, as changes in climate, or even subtle differences in parent material, such as textural changes, can affect the rate of pedogenesis (Holliday 1992). In cases of defined chronosequences, archaeological soils can be dated through comparison with these sequences (e.g. Biscoff et al 1981; Foss 1977; Holliday 1988, cited in Holliday 1992b). Mandel (1992) advocates adopting a basin-wide survey approach to minimize the possibility of erroneous chronosequence construction, and to ensure that as many geomorphologic events and pedogenic horizons as possible are included in chronosequences.

The work of Holliday and others (see 1992a for an overview and citations) at Lubbock Lake in northwest Texas has been instructive in illustrating why, in certain cases, several serial

occupations spanning hundreds or even thousands of years appear to be contained in the same deposit. In situations of relatively scant sediment deposition over prolonged periods, occupations appear compressed in a very thin profile, wherein depositional episodes can be recognized and understood within the context of environmental factors, but not necessarily associated with a particular artifact assemblage. Holliday (1992) suggests that given the relative uniformity of sedimentation observed at a draw across the Southern High Plains, diagnostic pedogenic features at other sites where sedimentation was less uniform, could be dated through correlation with analogous features at Lubbock Lake. Holliday (1992) makes a point to establish that Lubbock Lake is representative of other draws in the Southern High Plains.

Magnetic Susceptibility.

Magnetic susceptibility is defined as “the ratio between magnetisation induced in a sample and the magnetising field” (Allen 1988:72). Enhanced magnetic susceptibility, detected in the presence of maghemite (similar to, but not to be confused with magnetite) and occasionally hematite, can indicate a history of burning, but may also be induced by pedogenic processes (Allen 1988; Ketterings et al. 2000; Koch et al. 2006; Sergio et al. 2006). Working in the Bourne Valley, in East Sussex, England, Allen (1988) finds that magnetic susceptibility values in colluvial deposits in East Sussex correlate well with those of topsoil in arable environments. However, magnetic susceptibility readings are sensitive to pedogenic features such as “localized hydromorphism and redox,” as well as illuvial horizons and lithocretics (Allen 1988). The use of these techniques in combination with micromorphology may eliminate this interpretive problem (Allen 1988).

Magnetic susceptibility is usually measured through the application of a magnetic field to a soil sample, and measuring the induced field for the given sample. Koch et al. (2006) utilized Mössbauer spectroscopy of coarse (4-2mm) sands to identify the native goethite and the transformed magnetite within the particles. They also identified Al substitution for some Fe in goethite, and then correlated their findings with grain color. Finally, Ketterings et al. (2000) have shown that the occurrence of a sufficient but limited amount of organic matter in the soil facilitates conversion of goethite to maghemite, but deny that the observed coarse-grained magnetite observed in the samples was pyrogenetic. For further readings on the applications of magnetic susceptibility, see Thompson et al. (1975) and Oldfield et al. (1978), cited in Allen (1988:72), Ketterings et al. (2000), and Koch et al. (2006). For use of magnetic susceptibility specifically for the characterization or study of anthropogenic soils, see Sergio et al. (2006) and Arroyo-Kalin and colleagues (2008; Arroyo-Kalin et al. 2009).

Applied Research

Site formation processes.

Ferring (1992) focuses on the diagenetic aspect of site formation process studies, that is, he focuses on processes that occur post-depositionally, and most likely, after a site has been abandoned. Processes relevant to the understanding of site formation processes: “organic matter accumulation-decay; addition, translocation, or removal of salts; mineral oxidation-reduction; eluviation, illuviation, and shrinking-swelling of clays; and bioturbation” (1992:16-17). Eluviation and illuviation often occur in tandem, and are results of weathering processes;

eluviation is the process of loss of material, usually from an upper to a lower horizon, while illuviation is the process of accumulation of such material, also usually from an upper to a lower horizon (Limbrey 1975; Holliday 1992). Factors such as leaching, oxidation, and the movement of salts and carbonates between horizons can directly affect the preservation of bone and shell (Ferring 1992). Lastly, plant preservation is affected by leaching and oxidation, (1992), which are also key factors in soil productivity.

Ferring (1992) points out that floodplains are a special case, in which pedological and sedimentological analyses must be carried out concurrently. I argue that, though this may be a special case for pedology in undisturbed environments, this is, in fact, the case in most archaeological sites. The presence of humans automatically implies an influx of material, some organic and some inorganic that constitutes an overall influx of matrix. Although depositional processes effected by humans are quite different than those driven by natural forces, the result from a soil geomorphological perspective is the same. Of the utmost importance is determining the rate of matrix deposition, which can then “define potentials for: (a) superimposing of artifacts associated with serial occupations; (b) differential preservation of organic materials, and, (c) differential physical disturbance of original associations among artifacts and features” (Ferring 1992:17).

As is the case with pedogenesis, site formation processes are also largely dependent upon the texture of parent materials (Ferring 1992). Ferring (1992) points to the relationship between depositional rate, site occupation chronology, and artifact and feature depth, e.g. stratigraphy. The rate of deposition determines the length of an artifact’s exposure to pedogenic versus surface-erosional and other disturbing factors. The work of Ferring and Peter (1987) demonstrates how rates of accumulation affect preservation and diagenetic processes for buried artifacts.

Holliday (1992b) demonstrates how the study of pedogenesis at the Wilson-Leonard site in central Texas aided in clarifying the initial confusion caused when archaeologists encountered artifacts spanning the late Paleoindian, Archaic, and Late Prehistoric periods in a seemingly undifferentiated deposit. Recognition of phases of sedimentation and distinct soils within a single soil profile, and the dating of these, enabled archaeologists to disentangle two distinct serial occupations. Similarly successful investigations in alluvial and colluvial deposits near the Little Sioux River and in the Illinois River Valley show the versatility of this approach (Holliday 1992a:109-110). In another application of pedological analysis to the understanding of site formation processes, Haynes (1981, cited in Ferring 1992), working at the site of Spring Clovis, AZ, found that, although weathering and bioturbation had destroyed most organics, “spatial patterning of lithics was preserved” (Ferring 1992:25). Goldberg (1992) demonstrates how micromorphological analysis of sedimentary layers containing Acheulian artifacts not only helps distinguish between two depositional events associated with distinct sedimentary origins and depositional processes, but further also suggest that, given the depositional history of the matrix, the artifacts within the profile may no longer be in their original depositional configuration, i.e. that they may be in a secondary context.

Landscape reconstruction.

Foster and Smout state that "soils and associated landscapes of agricultural exploitation are therefore a repository of data about past human practice" (1994: no page number). Ferring (1992) defines site habitat reconstructions as those geared toward an understanding of the

evolution of a local landscape. Reconstructions at larger, climatic scales, such as Holliday's work (1987) in the Southern High Plains, can aid in settlement pattern studies (1992). Ferring (1992) is careful to note that for this kind of work, buried Holocene soils are preferable to terrace soils, as the latter have been subject to modification through exposure to the elements

The work of Gladfelter (1992) in the Wadi Feiran demonstrates how the reconstruction of paleoenvironments through the study of soils and sediments can be partnered with archaeology; Gladfelter's (1992) conclusions regarding the south of the region indicate a stable climate sequence, which would be consistent with a model of residential stability among hunter-gatherers, thus supporting the conclusions reached archaeologically. In the north, the situation is quite different. Gladfelter's (1992) reconstruction is of changing climatic environments, which would be suitable for a residential mobility strategy for hunter-gatherers.

Site Prediction.

Widespread and thorough mapping of soils in arid or mesic regions has long been recognized by archaeologists and geomorphologists as useful in site prediction. By identifying terraces of given ages the range of possible locations for archaeological sites or specific ages can be determined; similarly, soil chronosequences have been used to correlate Paleoindian sites (Ferring 1992). Ferring (1992) advocates the use of soil analysis and mapping in the design and implementation of site-discovery strategies during the survey phase of a project.

Along a similar tack, Bettis (1992) and Mandel (1992) focus on the utility of implementing a three dimensional soil survey within an archaeological research area before beginning archaeological work. Such surveys not only contribute to the efficiency of archaeological surveys by providing reliable data on the dates of alluvial deposits on the scale of millennia, thereby allowing archaeologists to target areas relevant to research questions, but also shed light on the relative preservation indices for each of these general time periods. As an example of the latter function of soil surveys, Mandel (1992) demonstrates that "all or most early-and middle-Holocene deposits have been removed from small valleys by erosion," taking any potential archaeological remains with them. Thus, the lack or paucity of such sites, which has led archaeologists (e.g. Benedict 1978, cited in Mandel 1992) to postulate a hiatus for the period between 8000 and 4000 B.P., may in fact be reflective of site survival rates. Instead, Mandel points to the alluvial fans of larger valleys, where such sediment has been deposited, for the remains of Archaic and Paleoindian sites. Sadly, although some artifacts may have survived the transport, the sites themselves will have been destroyed. By establishing protocols for determining the age of alluvium in the Central Des Moines Valley, Bettis (1992) builds a framework for assessing the potential for access to and preservation of archaeological remains from different periods in the local cultural sequence. Thorough mapping of valleys not only aids archaeologists in putting together sampling strategies relevant to research questions, but also helps provide a clearer picture of the rate of destruction of soils and terraces of various ages, leading to better assessment of the survival rates of potential site locations (Bettis 1992).

Landscape and environmental modification.

Techniques from geomorphology, pedology, and sedimentology are often useful in identifying human-induced modification of soils, landscapes, and environments, along with the mechanisms and processes relating to such changes. In parsing out differences between soils and sediments on the one hand, and landforms, landscapes, and environments on the other,

distinctions summarized by Stein (1992) prove quite useful. Landforms are “distinct surface features resulting from a particular geomorphic phenomenon” (Stein 1992:206 after Davidson 1985). Landscapes, in this parlance, are “stretches of country” (Harris 1968, quoted in Stein 1992), and include the land surface (a soil, sediment, or rock) and its topography, as well as vegetation, landforms, bodies of water, and architecture that intersects with or stands upon that surface. The term ‘soilscape’ has been used (Holliday 2004) to denote the pedogenic portion of a landscape, and consists of several soil bodies. Environments, on the other hand, are defined in terms of factors, biological, physical, and chemical (and in some definitions, social), which affect the development of an organism. Thus, environments intersect with landscapes, but also include factors that are not visible, and depending on the scale of focus, can be much larger or smaller than any portion of land visible from a single vantage point.

Environmental and landscape changes can include structural, textural, and chemical modifications of particular locations, movement of sediment or re-structuring of landforms, faunal and floral replacement, and climatic change generated intentionally or unintentionally through human land use. This section will cover relevant applications of pedological and sedimentological methods of analysis to all categories of problems of environmental change, with the exception of anthrosol research, which will be discussed in a later section in greater detail. For the purposes of this discussion, the term ‘anthrosol’ will be reserved for soils that have undergone significant modification, such that they would be readily recognized in the field as distinct from native soils and classified differentially in a soil survey. Alterations that can be identified within a soil body, but that do not characterize the soil, will be discussed below.

Unintentional or secondary landscape modification is often detected in soils in the form of nutrient depletion or enrichment, the anomalous presence of trace elements, or a lack or excess of organic or inorganic matter. Intentional soil modification often occurs in connection with agriculture. Major agricultural impacts on soil include movement of soils, selective plant growth, chemical enrichment (often through manuring) or nutrient depletion (in the absence of soil amendment), hydrological controls, and selective removal or addition of inorganic substances (Davidson and Simpson 1994; Eidt 1984; Mieth and Bork 2005; Stevenson et al. 2006; Taylor 1958; Walton 1983; Walton and Cassels 1992). Impacts are especially marked on marginal soils, with cultivation and manuring constituting the most significant human impacts (Davidson and Simpson 1994).

Sandor (1992) reports on the construction of terraces in New Mexico expressly for agricultural purposes. Sandor (1992) notes differences in structure and color between uncultivated and cultivated soils that indicate a decline in soil fertility, especially through loss of organic matter and nutrients in the cultivated soils; measurements of organic carbon content, N, and P confirm significant nutrient losses in the cultivated soils. Analogous nutrient depletion was observed on the Kohala leeward field system on the island of Hawai’i, where it has also been demonstrated that it is possible, in controlled contexts to analyze relative nutrient depletion resulting from agricultural intensification over time (Vitousek, et al. 2004). In Kahikinui, on the leeward slopes of Haleakalā, Maui, a consideration of hydrological, weathering, and nutrient-cycling processes reveals that agricultural digging practices pierced a layer of cinders, which would have increased nutrient availability to crops, but simultaneously accelerated nutrient depletion through leaching of mobile nutrients and increased mineral weathering (Hartshorn et al. 2006). Working on Kalaupapa Peninsula in Moloka’i, McCoy and Hartshorn (2007) identify

wind erosion as yet another soil nutrient-depleting process that is exacerbated by forest clearing geared toward agricultural intensification.

Sandor (1992) also notes soil compaction, possibly due to loss of organic matter, in cultivated terrace soils in the Sapillo Valley, which would have rendered them less amenable to root crop development. For this kind of analysis, bulk density measurements are indispensable. Notably, Sandor (1992) begins his analysis of soil change with accounts of cultivation-effected changes in erosion rates and vegetation, which in turn he deems to be the key factors responsible for subsequent changes in the soil. The main vegetation change is the lack of grass in previously cultivate areas, which may have resulted in part from climatic change, but has also undoubtedly been affected by sheet erosion and gulying which began while the fields were still under cultivation. Sheet erosion and gulying have also been detected archaeologically on Easter Island (Mieth and Bork 2005) and in the south of England (Allen 1988).

Human adaptive strategies.

Understanding paleoenvironmental conditions can shed light into adaptive or coping strategies adapted by people inhabiting marginal or variable environments. In the Sapillo Valley in New Mexico, Sandor (1992) identifies rainfall and temperature (esp. relative to frost) as the containing variables that dictated the optimum elevation range for the construction of agricultural terraces. Kirch and others (Kirch, et al. 2005; Kirch, et al. 2004) identify a similar situation on the southern leeward flank of Haleakalā Volcano, in which agriculture is limited to a narrow elevational band, which land-use was further dictated by lava flow age. Furthermore, Sandor (1992) reports that areas of gentle slope (3-10 percent) and small drainage areas were selected to “reduce the possibility of high runoff,” especially in periods of high precipitation. The location of terraces strictly on soils with argillic horizons, given the lack of similarly topographically and elevationally situated terraces indicates that soils for terracing had been selected for this quality. Soils with argillic horizons are preferable for runoff agriculture because they minimize water loss through downward leaching; instead, water is retained and runs along the slope, and is more readily available to root crops (Sandor 1992). This is particularly beneficial in arid or semi-arid regions.

Stevenson et al. (2006) describe two phases in the agricultural use of the Maunga Orito garden site at Rapa Nui. The first phase involved clearing of palm trees for the planting of yams and taro; the second includes “vener and boulder gardens” designed to deal with the increasing aridity of the soil and to mitigate the effects of wind on crops (2006: 921). In leeward Kohala, on the Big Island of Hawaii, wind and evapotranspiration are sometimes also cited as key factors that stimulated the construction of agricultural field walls (Ladefoged et al. 2003). Stevenson allows for a relatively long chronology of habitation at Rapa Nui, beginning with colonization around AD 800 and continuing for 1000 years. Initial deforestation is followed by erosion, identified in soil profiles at Maunga Orito (2006), after which point an open-field gardening technique is adopted. Stevenson (2006) suggests that demands for supra-household production by the 13th century, along with population growth and increasing deforestation and aridity in the 14th century required the abandonment of small open-field plots in favor of more sheltered, lithic-mulched fields and rock gardens.

Studies at Rapa Nui demonstrate that human impacts to marginal landscapes prone to desertification include soil erosion and gulying (Mieth and Bork 2005). Mieth and Bork (2005) identify an initial period of settlement, characterized by sustainable land-use patterns, and a

subsequent period of agricultural intensification which began with forest clearing, beginning in 1280, which resulted in sheet erosion on downslope areas. By 1400 A.D., agriculture on downslope areas became impossible due to the severe impoverishment of the soils caused by erosion (2005). Gullying, identified through observation, and quantified by proxy via erosion, also became an increasingly serious problem after the introduction of sheep to the island (Mieth and Bork 2005).

Kirch's (1997) work on Mangaia and Tikopia demonstrates the importance of considering variables such as substrate age and nutrient availability in assessing an environment's resiliency to human modification in understanding the success or failure of strategies adopted in response to changing environmental conditions. Geochemical and point-count data from several cores in Mangaia demonstrate a significant change in vegetation, as well as an increase in erosion accompanied by chemical signatures explicitly associated with "the stripping of a nutrient-rich organic soil layer...exposing the deeply weathered, nutrient-poor laterite" (1997: 33). Eroded soils settled in valley bottoms, concentrating most of the agricultural potential of these islands in very small areas, resulting in intertribal warfare and, ultimately, a culture of "terror" (1997: 33-4). Kirch (1997) compares the situation in Mangaia to that on Tikopia, where younger substrates degraded much less quickly than on Mangaia, allowing its inhabitants time to develop a horticulture system more amenable to the environmental potentials. Kirch (1997) notes that Tikopians also developed sophisticated population control mechanisms which allow for an overall sustainable mode of subsistence on the island.

Sediments in Archaeological Research

This study foregrounds the dynamic processes that allow us to think of particulate matter as sediment. Refining our understanding of site formation processes has been cited as a key goal in the incorporation of the study of the archaeological matrix within this project. As a result, I adopt a life-history approach to the study of sediments, as this holistic orientation provides the widest range of data that can inform archaeological work. A life-history approach to sedimentology involves the study of particle composition, size, texture, and structure, with a view to understanding the sediment source, its modes of transport, the conditions of its deposition, and the nature of post-depositional changes. Basic techniques for understanding these processes include the study of particle composition (lithology), grain size distributions, and morphology (Folk 1980; Hassan 1978; Shackley 1975). To this list, Hassan (1978) adds the analysis of sediment structure, such as bedding, and grading, which give clues to the depositional mode and environment associated with the sediment. Unlike the attributes in the first list, which can be studied via disaggregated samples, the recognition of bedding and grading requires in-situ study of a sediment, or the careful collection of a block sample or monolith.

Methods and methodological considerations.

Many sampling issues applicable to pedological and geomorphological research apply equally to sedimentology, such as the need for adequate coverage, representation, and control

samples. Folk (1980) describes three sampling methodologies for obtaining samples for sedimentological analysis. Channel sampling is a method useful for understanding the overall or average qualities of a stratigraphic sequence; similar to a column sample, used in pedological analysis, this method involves sampling the whole length of a profile, but rather than separating samples at distinct depths, samples are mixed to obtain an average (1980). Spot sampling, on the other hand, requires sampling of a single sedimentary bed, to the exclusion of neighboring beds; this kind of sampling allows for a more detailed study of origin, transport and depositional context, and diagenetic changes (Folk 1980; Hassan 1978).

In the application of spot sampling to a sedimentary body or profile, Folk (1980) recommends establishing a sampling grid which will produce a desired number of regularly-spaced samples across the body under study. This type of systematic sampling methodology helps eliminates bias often introduced in unsystematic or 'grab' sampling, and, as Hassan (1978) points out, allows one to trace gradual changes that may occur across a sedimentary unit. When visible horizontal or vertical distinctions are observed, each sub-unit should be sampled individually, in addition to those included in the systematic sample (Folk 1980; Hassan 1978). Samples should also represent not only the mean characteristics of a sedimentary body, but also the range of variability present within the body (Folk 1980; Hassan 1978). Stein (1985:8, Figure 1) has compiled an excellent schematic of an archaeological excavation profile, which illustrates how to tailor sampling strategies to general questions, which range from the study of depositional events and individual features, to recording 'cultural inventory', which corresponds to the general characteristics of cultural strata.

Laboratory methods.

Study of *grain size* includes not only an understanding of the range of particle sizes included in the sample, but also the degree of size sorting presented by a given sample; well-sorted samples will contain grains of relatively consistent size, while poorly-sorted ones will present more variety in grain size. Shackley (1975) covers several techniques for sorting samples by grain size for additional analysis. By studying, the mean, median, mode, and standard deviation of particle sizes within a depositional event, and comparing particle size vertically and horizontally across and between depositional events, sedimentologists gather information about sediment source, transport modes, and depositional context (Folk 1980; Hassan 1978; Stein 2001). Such analysis has proven useful in the reconstruction of paleoenvironments and topographic evolution associated with archaeological sites (e.g. Hassan 1978; Kirch and Hunt 1995; Stein and Farrand 1985, 2001). Grain size analysis can also be used to temporally correlate depositional events in discrete landforms, and in industrial contexts, for determining the likelihood of encountering exploitable resources within a sedimentary body (Folk 1980).

The relationship between grain size and distance from source is a function of "the current strength of the local environment (together with size of particles available)" (Folk 1980:3). The latter parenthetical is important, as it highlights the importance of considering environmental conditions prior to sediment transport action at the sediment source, in its depositional zone, and all along its transport route. Particle sorting in particular can provide clues as to the depositional environment (Hassan 1978); as described by Folk (1980), "city-dump" and "bean spreading" deposition represent two ends of the depositional spectrum, the first consisting of rapid and abrupt deposition that is quickly buried by a subsequent event, and the latter characterized by the

slow, repetitive deposition of sediment at a constant rate. General variables that affect sediment sorting include: available sediment size; variance of depositional mode; rate of deposition; rate of sorting; current strength; and current consistency (Folk 1980).

The study of particle *morphology* is geared toward observing the shape of individual particles within a sediment, with a view to understanding its settling behavior and conditions or movement within a transport medium, depositional environment, and paleoclimatic conditions (Folk 1980; Shackley 1975). Morphological considerations in sedimentology include the study of form (the general three-dimensional shape of the particle, as it approximates the shape of a rod, a disc, or a plate); measures of sphericity, described as the degree to which a particle approximates a sphere, and sometimes measured as the ratio between the three dimensions of a particle (although this measure makes intuitive sense, see Folk 1980:8 for a measure that better describes the movement of a particle in transport); roundness, which is a measure of the degree to which particles are rounded or angular, can yield information about transport conditions; and surface features, such as striation, polishing, percussion marks, and frosting, which evidence the particles' encounter with other particles, chemical agents, or transport agents with particular qualities (e.g. glaciers; high-velocity currents) (Folk 1980). Particle surface features can be examined with a stereo microscope (although, see Hassan 1978 for limitations) or a scanning electron microscope (Hassan 1978; Shackley 1975).

According to Folk, form and sphericity are functions of particle composition (e.g. mineralogical structure); transport and depositional conditions; and stage, which Folk identifies as the "length of time available for modifying the particle" (1980:3). Some studies have shown that lithology and size are the main variables controlling sphericity of particles; others suggest environment is a significant determinant (Folk 1980). Abnormal roundness relationships can also serve as indicators of multiple sources, as is the case in the presence of round boulders and angular pebbles, or when a harder rock presents more roundness than a softer rock in the same sediment. Similarly, poor roundness sorting can indicate multiple sources, depending on the nature of the lithology of sediment particles. Folk (1980) also identifies a hierarchy of morphological features in terms of time necessary for visible changes to take place. Surface features are the first to develop, rounding follows, then sphericity, and last, size reduction; by this logic, rounding and surface features are the best indicators of the most recent processes to have modified a sediment, while size, form, and sphericity speak to a longer time scale.

Lithostratigraphy.

The study of lithostratigraphy involves the recording of attributes of an exposed stratigraphic sequence, and correlating strata across space, in order to build a chronology aimed at understanding the sequence of depositional events across a given research area (Gilbertson 1995). As Gilbertson (1995) points out, lithostratigraphy is conceptually not too different from the kind of stratigraphic recording practiced by most archaeologists across a site. Lithofacies, subdivisions of sedimentary units that represent changes in the depositional environment (Gladfelter 2001), can be compared to archaeological depositional contexts, sometimes called facies (Stein 2001; Stein et al. 1992; Stein and Rapp 1985).

One of the key differences between lithostratigraphic study undertaken by a geologist or geomorphologists, and stratigraphic analysis performed by an archaeologist, is the question of scale. Geologists are often interested in correlating events over a much larger area, and for time periods and scales sometimes irrelevant to human occupation. On the other hand, catastrophic

events such as earthquakes, tsunamis, and volcanic eruptions can be useful tools for archaeologists to consider, as these not only occur on a human time scale, but can often be dated radiometrically (see below) with a high degree of accuracy, and identified over a wide area, making inter-site correlations possible. Dramatic depositional events can often be attributed to such extrinsic forces; however, Gilbertson (1995) cautions against relying too heavily on such explanations, noting that intrinsic factors, such as seasonal flooding or gradual sediment build-up can undergo ‘catastrophic’ change given only slight deviation from normal conditions.

A basic understanding of sedimentary processes and training in sedimentary profile interpretation can provide archaeologists with useful insights into formation processes at archaeological sites. Understanding what sediment grading and bedding represent can not only aid in comprehending environmental conditions at a site before, during, and after human occupation, but also help archaeologists differentiate between natural and cultural depositional agents and post-depositional processes. This knowledge, along with basic petrology, can also be useful in making basic interpretations about the provenance of rocks discovered within archaeological deposits.

Organic sedimentary particles.

In her treatment of organic matter in soils and sediments, Stein (1992) follows Shackley (1975) in noting that descriptive and analytical methods used for geological sediment are also applicable to the study of organic clastic sediments, such as bones, seeds, wood charcoal, shells, coral, teeth, fibers, etc., found in archaeological contexts. Thus, an archaeologist can study elements of texture (e.g. granulometry), composition (taxa, in the place of mineralogy), orientation, and surface features, to attempt to reconstruct the life-history of an organic sediment, including its origin or source, its history of transport, and the conditions of its deposition.

An archaeological sediment is “particulate matter that has been transported by some process from one location to another” (Stein 1987:339); sediment transport is achieved via an agent (clastic); an organism’s locomotion (biological); or chemical solution (chemical) (Stein 1992). Post-depositional events in the life of the sediment, such as decomposition, diagenetic changes, and exposure to environmental stresses, also form part of the analysis of organic sediments. Diagenetic changes due to pedogenesis have been discussed above.

Archaeo/paleomagnetic dating.

Paleo- and archaeomagnetic dating are techniques that can measure the passage of time by tracing directional changes in the magnetic fields of volcanic layers and sedimentary beds. Archaeomagnetism has its roots in paleomagnetism, which has been used to date geologic events, primarily through tracing magnetic pole reversals (Rapp and Hill 1998). Archaeomagnetism is a recent adaptation of paleomagnetic dating techniques to the shorter time scale of human existence (Rapp and Hill 1998). By tracing magnetic changes in discrete surfaces, layers, horizons, and beds, and comparing these with established chronologies for major reversals in the polarity of the earth’s magnetic fields and subtle changes in its precise orientation (known as secular variation), archaeologists, paleontologists, and geochronologists can establish the dates of eruption, deposition, or modification. While major reversals happen on the scale of hundreds of thousands to millions of years, secular variation, associated with slow the rotation of the earth’s magnetic core, can be detected at a scale of thousands of years

(McIntosh and Catanzariti 2006). Archaeo/paleomagnetism is an absolute dating technique when a magnetic sequence can be reliably anchored in time, either through a sufficiently detailed and extensive record of secular variation within a stratigraphic sequence, or through independent radiometric dating of associated materials. See discussions on dating soils and sediments for datable materials and techniques.

When a sediment is transported, particles become disoriented with respect to the earth's magnetic poles; at the moment of deposition (Rapp and Hill 1998), especially within the context of a 'lubricating' agent (Allen 1988) such as wind or water, particles re-orient themselves with respect to the earth's magnetic field. When correlated with artifact sequences, archaeomagnetic dating can be used to determine whether the matrix containing a stratified artifact sequence known to be a secondary deposit is also stratified (Allen 1988). In a study of artifact-rich colluvium at Bourne Valley, in East Sussex, England, Allen (1988) is able to correlate the stratified artifact sequence with the sedimentary matrix, demonstrating that: a) archaeomagnetic data accurately reflect the expected occupation periods suggested by the artifact assemblage; and b) an apparent occupational hiatus in the deposit may in fact reflect a shift from occupation to cultivation activities, as erosion continued through the Roman period.

Furthermore, this suggests that archaeomagnetism can also be used to establish whether deposition was continuous over a period of time, or whether a deposit represents a single event. Since established sedimentological methods exist to accurately determine the nature of deposition (e.g. number and sequence of events, nature and force of transport agent, and transport environment), this last hypothesis seems easily testable.

Other sediment dating techniques.

As illustrated above, sediments can be relatively dated through archaeomagnetism and lithostratigraphy, and these dates can be anchored to an absolute chronology if relevant layers can be radiometrically dated. As an example, artifacts associated with an early hominid site at Olduvai Gorge were placed within a date range once volcanic deposits above and below the archaeological layer were relatively dated with respect to tephra deposits which were radiometrically dated to ca. 250,000 years ago (Tryon and McBrearty 2002). Since sediments can include a range of materials, numerous radiometric dating techniques can be applied, including thermoluminescence and optically-stimulated luminescence dating, and isotopic techniques measuring isotopic decay ratios such as K/Ar, $^{40}\text{Ar}/^{39}\text{Ar}$, U/Th, and U/Pb (Goldberg, et al. 2001; Henderson 2000; Rapp and Hill 1998).

Radiocarbon dating of organic sedimentary particles is one of the most common dating techniques in archaeological practice. In order to better understand the significance of dates thus produced, Stein (1992) recommends the use of sedimentological analytical techniques to understand the source, mode of transport, mode of deposition, and post-depositional alterations to datable organic material (e.g. wood charcoal, shell, bone). This procedure also puts the archaeologist in a better position to gauge the likelihood that the age of the sedimentary particle is representative of the archaeological context to be dated.

Combining soil science and sedimentological approaches

The previous discussion highlights the broad range of possibilities for engaging with soils and sediments in archaeological research. The archaeological matrix must be studied via a contextual methodology, which takes into account specific research concerns, data characteristics, and time and cost limitations. Significant areas of overlap between soils and sediments research have been brought to light. Because of these areas of overlap, and also because pedogenic processes can occur at a rate that is relevant to archaeological time scales, a combination of pedological and sedimentological methods is almost always preferable to a single approach. A few approaches that effectively combine some of the above methods, especially ones that cross the boundary between pedology and sedimentology, will be examined below.

Micromorphology.

Bulk samples, though useful for chemical, granulometric, and mineralogical analyses, cannot provide the textural, structural, and chemical resolution afforded by samples taken for micromorphology. In contrast with bulk samples, which are taken in a disaggregated form, samples for micromorphology are block samples that must be taken in situ, and require the use of a supporting structure (such as a Kubiena tin) or binding material that can preserve the structure, orientation and spatial relationships between particles and voids in the sample. Fine distinctions in structure, texture and orientation of particles, of coatings, voids and evidence for diagenetic changes, as well as the can shed light on the temporal history of a site as affected by from pedogenic, geologic, and anthropogenic factors (Goldberg 1992). Micromorphology can also be a useful tool in identifying and determining the condition of micro-artifacts within their depositional and pedogenic environments. The study of micromorphology can inform paleoclimatic and paleoenvironmental reconstructions and stratigraphic interpretation, as well as shed light into pedogenic processes and past human activities (Allen 1988; Courty et al. 1989; Davidson et al. 1992; Davidson and Simpson 1994; French 2003; Goldberg 1992; Macphail 1986; Macphail and Goldberg 1995; Macphail et al. 1987; Matthews 1995; Matthews et al. 1997).

Kubiena (1938) was the first person to study petrographic thin sections of soils in order to better understand pedogenic processes. Micromorphological analyses became widespread only as late as the 1960s, and took even longer to become standard practice in archaeology, with the exception of applications by Cornwall (1958) and Darlymple (1958) as early as the 1950s (Goldberg 1992; Macphail and Goldberg 1995). The preparation of thin sections for soil micromorphology involves drying the sample, impregnating it with a hardening and adhesive agent (e.g. resin or epoxy), and then slicing and polishing (see Brewer 1987; Murphy 1986, cited in Goldberg 1992, for methods). In the interest of standardization, Bullock et al. (1985) offer a guide to nomenclature. Recent developments in the study of micromorphology and microstratigraphy are reviewed by MacPhail and Goldberg (1995) and Matthews (1995).

Micromorphological work can help distinguish between anthropogenic and natural processes, and between primary and secondary deposits. In the study of a particular thin section, Goldberg (1992) discusses evidence that points to a horizon that is in the midst of pedogenesis, but that has also been altered by human action; although agriculture is one possible explanation for the features (added charcoal, mixing of illuviated and eluviated horizons) manifested in the micromorphology samples, there is no incontrovertible evidence to support this hypothesis.

However, as with any micro-scale analytical method, micromorphology is of limited use unless studied in combination with other methods. Furthermore, as Barham and MacPhail (1995) point out, the incorporation of micromorphological analyses into large-scale projects often presents a sampling problem, wherein efforts to provide adequate micromorphological coverage of architectural and site-wide contexts results in unmanageable sample sizes. On the other hand, failure to incorporate micro-scale analyses including micromorphology, soil chemistry and granulometry, may impede the successful identification of activity areas. The work of Arroyo-Kalin and colleagues (2008; Arroyo-Kalin et al. 2009), Homsey and Capo (2006), Matarazzo et al. (2010), Shillito (2008), and Matthews et al. (2006) has shown considerable progress in successful application of micromorphological research toward understanding site formation and human activities at archaeological sites.

Organic Matter in Soils and Sediments.

Stein's chapter (1992) on understanding organic matter in archaeological sites is particularly useful, as she differentiates between organic matter originating through pedogenic processes from that deposited as part of sedimentation, especially that which considers humans as the primary agents. Stein (1992) combines methods from sedimentology and pedology to approach archaeological deposits. She notes the importance of discerning the source of organic matter in an archaeological context, its context of transport and deposition, and the ways it may have been transformed after deposition (1992).

Stein (1992) demonstrates, through three hypothetical scenarios, how the rate and duration of deposition of clastic organic (and inorganic) sediments, as well as the amount of time elapsed after abandonment of an archaeological site, help determine to what extent the organic matter present in the deposit should be considered SOM or organic sediment; it is worth noting that, in cases of what she dubs "moderate" deposition of archaeological organic sediments, in which the entire archaeological deposit falls within the weathering zone, the contributions of SOM and organic sediment to the OM content of the sediment will be neutralized over time, as all the organic matter within the deposit is homogenized (Stein 1992).

The distribution of kinds of organic matter across different landscapes depends largely on the stability of the landscape. Stable landscapes are associated with stable land surfaces, which are dominated by pedogenic processes (see above), and thus also contain soil organic matter (Stein 1992). Depositional landscapes contain little soil organic matter, as the relatively constant accumulation of sediment adds sedimentary organic matter to the matrix. Erosional contexts, which contain little organic matter, are not often discussed in archaeological soil/sediment literature (e.g. Stein 1992), as these contexts are often thought lacking in stratified deposits (but see Mieth and Bork 2005; Stevenson, et al. 2006 for an exception).

Stein (1992) identifies dating, landscape reconstruction, and archaeological site definition as the primary applications of the study of organic matter in archaeology. According to Stein (1992), one of the key archaeological applications of soil organic matter analysis for the purposes of landscape reconstruction involves the recognition and long-distance correlation of buried soil surfaces, also called unconformable discontinuities. These correlated surfaces not only form part of a chronosequence, *sensu* Ferring (1992), but can also serve to reconstruct what Stein (1992) refers to as the "paleotopography" of a site or region. Organic matter in soils can also be used to define horizontal site boundaries, stratigraphic boundaries between events, as well as "the presence of features, the source of deposits, or the presence of post-depositional

alterations” (Stein 1992:208). Failed experiments in detecting site boundaries through organic matter values may be a simple demonstration of the steady state property of organic matter cycling (see above). Above all, Stein (1992) stresses the importance of considering pedogenic processes and time lapse when comparing buried and contemporary soils.

Anthropic/anthropogenic deposits, anthrosols, and the study of terra preta.

I will begin this section with a careful consideration of the terms that can be or have been applied to the archaeological matrix. It is important to always consider the mode of formation when selecting the nomenclature for the material under study. First, a distinction must be made between the terms anthropic and anthropogenic, especially as they relate to the archaeological matrix. While the former indicates that the material is related to human activity, occupation, or existence, as the phrase “associated with” indicates, the latter suggests that humans had an active role in creating, producing, or generating the material. This definition leads to the conclusion that the archaeological matrix is always anthropic; if a material (i.e. a stratum) found within an archaeological profile cannot be associated with human beings, then it must be seen as a hiatus in human occupation. Clarifying this subtle difference also facilitates the next decision, which has to do with the extent to which the material is considered soil or sediment.

The archaeological matrix often contains both soils and sediments (e.g. Alexandrovskaya and Alexandrovskiy 2000; Stein 1992), as anthropogenic components enter into the matrix throughout the occupation of a site, at varying speed, and with varying intensity. Deposits such as colluvia resulting from anthropogenic erosion, sometimes studied as ‘man-made soils’ (e.g. Allen 1988), can be considered anthropic deposits. Because anthropic activities initiate the sediment transport event, the existence of these sediments as such is associated with human activity, and thus it would be appropriate to refer to these as anthropic sediments, in much the same way as you would refer to glacial or alluvial sediments. Many (e.g. Stein and Farrand 1985, 2001) would classify these as archaeological sediments, but, to avoid confusion with anthropogenic sediments, this term should be applied only when absolutely necessary (see below). One could also say that the *sedimentary bed* (that is, the sum total of all sediments belonging to a single depositional event, structured and graded *in situ*) is anthropogenic because it was generated through human activity.

An *anthropogenic sediment*, alternatively, is one that was itself generated through human activity; this indicates that the actual sediment grain owes its existence to human activity. Macro- and microscopic artifacts such as fragments of ceramics, lithics, metal, glass, etc. are anthropogenic sediments. These can exist within sedimentary beds that are or are not anthropogenic, as well as within soils that have or have not been significantly modified through human activity, and also fit within the class of “archaeological sediments.” However, because the terms anthropic sediment and anthropogenic sediment describe different scales of materials as well as materials arising from different formation processes, having distinct classes of agents or origins, the term *archaeological sediment* should be utilized only as a general term, or for a specific material or set of materials only when precise formation processes cannot or have not yet been ascertained.

Returning to Allen’s (1988) colluvial deposits, if the deposition resulting from anthropogenic erosion has stopped long enough for pedogenic processes to produce discernible

soil horizons, then the deposit must also be studied as a soil. Whether this deposit can then rightly be termed an anthrosol (see below) despite the fact that humans have not directly influenced the pedogenic processes, or whether it should merely be considered a pedogenically modified anthropogenic sediment is a complicated question, and one that has not yet been addressed by archaeologists, pedologists, geomorphologists, and sedimentologists working on sites that evidence such complicated sequences of formation.

It is also necessary to consider the term ‘anthrosol’ within the context of this discussion. Anthrosols are soils that have been modified, intentionally or not, by human action. According to Holliday (1992c, 2004), Britain in particular, and Europe in general, have produced the largest bodies of literature on anthrosols, although I would argue that the recent explosion of interest in Amazonian Dark Earths rivals the European literature. Some national classificatory schemes even include such distinctions as official national or locally recognized soil categories, such as the categories “Man-Made Soils” and “Cultosols” in Britain; “Anthrosols” in China (Holliday 2004); Hauula Paddy Soils in Hawaii (Kirch 1977), Maori Soils in New Zealand (Cassels 1972; Taylor 1958; Walton 1983; Walton and Cassels 1992); and Terra Preta in Brazil. Within the category of anthrosols, a distinction relating to intentionality is made by Eidt (1984; see also Eidt 1977), who reserves the term anthropic for soils unintentionally altered and anthropogenic for those modified intentionally. Although the above distinction is not utilized by all (e.g. Allen 1988), it is a useful distinction that has been taken up by some of the major scholars of anthropic and anthropogenic soils (e.g. Holliday 1992c, 2004). Following this tradition, soils will be referred to as anthropic or anthropogenic in cases for which intentionality can be reliably established; soils that are dubious in this respect are referred to as anthrosols (after Eidt 1977, 1984).

Finally, agricultural soils that have been amended by human beings, either through the addition of organic or inorganic sediments, will also be studied as soils. Because these are all by definition intentionally modified they can be classified as anthropogenic without question: these include European plaggen soils, often also called built soils, or man-made soils; Maori soils, or made soils, which occur in New Zealand; and urban soils. A few examples of research into each of the above kinds of anthrosols will be explored here, to illustrate the variety of anthrosols under study, and the breadth of their distribution.

Terra Preta do Índio, or Amazonian Dark Earth, is a soil phenomenon the origin of which under debate for an extended period. Over the last half-century, a number of geogenic origin theories have been eliminated, and the general consensus (Glaser and Woods 2004; Lehmann, Kern, et al. 2003a; Woods 2003; Woods and McCann 1999; Woods, et al. 2000) is that terra preta is an anthrosol. Whether it owes its existence to accidental or deliberate modification by Amazonia’s pre-Columbian inhabitants is still not certain, but the sheer volume of dark earth generated in particular localities, the abundance of sites, its indisputably superior agricultural qualities, and its use in monumental and funerary contexts, suggests that at some point, deliberate terra preta production began to take place. The history of the study of terra preta and the potential for future research will be discussed in greater detail below.

Plaggen soils.

Plaggen soils, originally defined in Northern Europe (Holliday 2004), are sandy, organically enriched soils that present a thickened A1 horizon that exceeds 50 cm in depth (Holliday 2004; Pape 1970; Westeringh 1988). According to Westeringh (1988), soils with A1

horizons that range between 30-50cm, and have most other characteristics of plaggen-like soils, are not considered plaggen. Thickness of the A1 horizon is important in the classification of plaggen from the perspective of formation processes; plaggen *sensu strictu* is a soil that has been intentionally and incrementally built up through the addition of a combination of manure, foreign minerals, and organic matter, usually produced as stable bedding, and then moved to cultivation fields (Holliday 2004; Pape 1970; Westeringh 1988). In attempting to explain the upsurge of plaggen production in Medieval Europe (e.g. Germany, Belgium and the Netherlands), scholars have pointed to the structuro-hydrological (Heidinga 1988) and chemico-nutritional (Holliday 2004; Pape 1970; Westeringh 1988) advantages of these additives. Plaggen soils also occur frequently in Britain and other parts of Europe (Simpson 1997 (Orkney); Conry, 1971, 72 (Ireland)), and soils similar to European plaggen soils have been studied in Peru (see Sandor, 1987, Sandor and Eash 1995), Crete, and New Zealand (see made soils, below).

In Scotland, Davidson and Simpson (1994) apply sedimentological methods to identify locations involved in plaggen production. By identifying within plaggen soils inorganic materials foreign to the locations of the plaggen (i.e. that differ significantly from those found in the soils upon which the plaggen soils were built), the authors attempt to “source” this foreign material to another part of the site, or a related site (Davidson and Simpson 1994). The authors suggest the use of micromorphological analysis to elucidate patterns in cultivation practices, and stable isotopes analysis to distinguish between marine and terrestrial origins of added organics (Davidson and Simpson 1994).

Made soils.

The “made soils” of the Maori, as they are sometime called, merit a separate section, as they are quite different in structure and depth from plaggen soils (although McFadgen 1980a, b calls them plaggen soils). Cassels, Walton, and Taylor (Cassels 1972; Taylor 1958; Walton 1983; Walton and Cassels 1992) are among the scholars who have identified and studied the made soils of New Zealand, sometimes referred to as Maori soils. These are anthropogenic deposits produced through the addition of sand or gravel temper to soils of reasonable quality; note that there is no evidence for enrichment of organic matter, and that the mineral addition actually improves drainage, whereas additions to plaggen would have retained water. Thus, conditions in these unmodified New Zealand soils are quite distinct from those of the sandy Northern European soils upon which plaggen soils were built up. There is also no evidence of significant horizon thickening on the order of magnitude that plaggen soils display.

Sands and gravels are thought to be quarried from nearby sources, such as the tephra-capped dunes near Aotea harbor, which leave behind voids aptly termed “borrow pits” (Walton 1983; Walton and Cassels 1992). The methodologies employed by Walton and Cassels (1992) examine these soils loosely within a pedological framework, as the use of terms such as ‘sandy loam,’ and contextualize their findings made soils through comparison with soil survey descriptions of a typical soil profile for the Aotea Harbor region.

According to Walton (1983), the soils that are being improved are not poor soils, but rather soils that are moderately productive. The general consensus is that these soils are being produced for growing sweet potato (Cassels 1972; Walton 1983), although Cassel’s (1972) model for New Zealand prehistory in Waikato, which projects ethnohistoric data into the past, is somewhat suspect. Made soils in the Aotea Harbor region tend to appear in terraces, and sometimes on river flats (Walton 1983: 90-1). In South Taranaki, made soils at the site of

Kokako appear in raised beds or mounds, which correspond to European examples of plaggen soils; the authors stress that this is different from the “lithic mulch” seen elsewhere (Walton and Cassels 1992; see also Stevenson 2006 for a discussion on the use of lithic mulch on Rapa Nui).

Urban soils as anthrosols.

Urban soils, which are anthrosols by definition are often palimpsests of differentially developed pedogenic horizons and buried soils associated with multiple sedimentary beds, and present significant chemical and physical alterations, as well as anomalous and sometimes polluting additives (Alexandrovskaya and Alexandrovskiy 2000). Alexandrovskaya and Alexandrovskiy (2000) propose a methodology particular to the study of urban soils, which requires the joint effort of archaeologists and pedologists. Alexandrovskaya and Alexandrovskiy (2000) identify differences between soils in central Moscow and those from surrounding suburbs such as thickness, texture/grain size, and chemistry. Specifically, the authors test for pH, phosphates, organic matter, and trace elements such as lead, copper, zinc, and arsenic (2000). Research into these soils was undertaken in order to reconstruct soilscapes and landscapes associated with three broadly-defined phases of occupation: the period immediately preceding the founding of the town; early stages of occupation, in which rural areas bordered the Kremlin; and medieval occupation (2000). This work also serves to identify classes of activities performed by the inhabitants of Moscow, and to correlate these with time intervals at the scale of the century; discontinuities in deposition in these urban soils, identified as pedogenic horizons and buried soils, are linked to periods of vegetation re-growth and gardening (2000).

Soil chemical methods and micromorphological analysis are being utilized to recognize activity areas in pre-Columbian urban sites in Mexico (Hutson and Terry 2005; Manzanilla and Barba 1992; Middleton 2004; Middleton and Price 1996; Wells 2000). Additionally, the study of dark earths is well established in European cities, especially in England (Macphail 1981, 1983; Yule 1990). MacPhail (2003) warns against summary in-field interpretations of dark deposits, especially those which tend to occur between late Roman and Early Medieval deposits. Marliac (2002) considers the study of dark earths within the context of the philosophical consequences of attributing soil or sedimentary morphology to culture or nature.

Other anthrosols.

Holliday's (2004) inclusion of work on agricultural terraces among anthrosol studies brings up the question of the extent to which human activity must be directly associated with soil thickening in order for a deposit to be considered an anthrosol. Sandor (1992) identifies alluvial and colluvial sediment transport, rather than human transport, as the processes responsible for the accumulation of sediment behind artificial dams constructed in the Sapillo Valley between A.D. 1000 and 1500. Can these thus be considered anthrosols, or is this simply an example of architectural landscape modification?

Unlike the soils in Sapillo Valley terraces, Colca Valley terrace soil was transported by hand Sandor (1992). Additionally, Colca soils do not demonstrate compaction, most likely due to indigenous management strategies designed to maintain organic matter levels within terraces (1992). The presence of buried A horizons (one of which was radiocarbon dated to 610 ± 60 B.P.), along with associated elevated phosphate values may indicate (possibly prehistoric) fertilization practices (1992). Sandor (1992) compares Colca terrace soils with European dark earths or anthrosols such as plaggen epipedons, anthropic epipedons, and agric horizons

(Groenman-Van Waateringe and Robinson 1988; Sandor 1983), as these present enrichment in nitrogen and phosphorus, and a decrease in pH. These soils are different from similar uncultivated soils of the region in that they exhibit marked changes to their A horizons, including “thickening, distinctive soil structure and pores, irregular depth distribution of organic matter” (Sandor 1992:237).

The work of Robert C. Eidt (1977, 1984, 1985) on abandoned settlement studies focuses on the identification of sites of human occupation and activity through phosphate analysis. Eidt (1984) credits W. Lorch (1940) with the innovation of utilizing data from soil analysis to detect abandoned settlements that lacked visible surface remains. Lorch's work (1940), as reported by Eidt (1984), done over the course of the 1940s and 50s, included mechanically separating micro-debris, such as ash and mortar, from soil samples, as well as the analysis of phosphate, "the principal chemical additive caused by human settlement activities" (Eidt 1984:18). Eidt (1984) states unequivocally that the recognition of soil chemical alteration, as enrichment or contamination, can only be detected when compared to valid non-affected, or background samples; all soils displaying such alteration are referred to as anthrosols (a term created to distinguish these from native soils), and the degree of alteration can be measured “in terms of effect and amount” (23).

According to Eidt, “the most intensive [chemical] soil alteration occurs in dwelling and associated work areas,” regardless of production mode or settlement intensity (1984:23). This being said, the degree of alteration discernible in a soil is proportionate to the nature, intensity, and duration of occupation, as well as the time elapsed since settlement abandonment and the nature of post-abandonment disturbances, which include, but are not limited to soil removal and agricultural activity. Agriculture and animal husbandry can also affect the amount of phosphorus present in a soil; extensive periods of agriculture without fertilization results in a decrease in phosphate, while cultivation paired with fertilization, as well as animal husbandry, increases levels of phosphate in the soil Eidt (1984). Eidt (1984) provides a baseline for understanding the orders of magnitude of phosphate associated with different classes of human activity, including ranching, at the lowest level, habitation and manufacturing, at the middle range, and charnel fields, burial areas, and industrial waste or intensive refuse deposition. Although it would be convenient to accept Eidt’s values as universal ranges, it seems more prudent to establish a set of values for each individual research and culture area.

Eidt (1984) identifies nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur as major soil elements modified through human activity. Enrichment tends to occur in areas of occupation, such as houses, towns, or villages, via excreta, refuse, fertilization, and inhumations, as well as through “accidental industrial spill or fallout” (1984:25); although Eidt is almost certainly referring to post-industrial waste, large-scale pre-industrial operations would also likely result in significance alteration of soil in the form of enrichment. Eidt also notes that industrial sites are likely to contain “a more complete list of all the elements added than those in pre-industrial sites” (1984:25). What he probably means by this is that appropriate lists of chemicals likely to occur in any given soil are region- and time-specific.

Eidt (1984) favors phosphate analysis over that of other nutrients as the majority of easily detected elements are highly susceptible to removal or alteration through reduction, oxidation, or leaching; phosphorus, on the other hand, when associated with oxygen, turns into inorganic phosphate, which is readily fixed through association with calcium, iron, and aluminum. Eidt (1984) suggests that soil phosphate levels can not only be used to identify human settlement

sites, but also to differentiate between past land-use histories (e.g. habitation v. animal husbandry) within a settlement (see Hutson and Terry 2005; Manzanilla and Barba 1990; Middleton 2004; Middleton and Price 1996; Wells 2000 for refinements of these techniques), and even to “establish relative age based on accumulated amounts” (1984:30). If this is to be undertaken, it must only be done under strict controls, and if possible, where multiple lines of evidence are can support soil nutrient data (see Meyer, et al. 2007; Vitousek, et al. 2004).

Eidt’s volume (1984) is also valuable from the perspective of understanding the precise dynamics of soil phosphorus and the various compounds it forms. Discussions of field and laboratory methods for phosphate extraction hinge on a detailed discussion of differences among organic and inorganic phosphates, so-called ‘available’ and total phosphate, and the various phosphate fractions that are differentially bound to soil particles, along with a method for fractionation (Eidt 1984). Since, as Holliday (2004) points out, phosphates can be extracted in a myriad of ways, details of any particular method will be omitted, and the reader is referred to the various sources that report on particular methods (Dormaar and Beaudoin 1991; Eidt 1977, 1984; Hassan 1981; Herz and Garrison 1998; Holliday 2004).

Terra Preta de Índio: discovery and origin theories

Terra preta, also known as in Portuguese as Terra Preta do Índio (TPI), among other variants (Kampf and Kern 2005), or Amazonian Dark Earths (ADE) in English, first became known to the scientific community through the work of geologists James Orton, Charles F. Hartt, and Herbert Smith, in the 1860s-80s (Denevan 2004a; Lehmann, Kern, et al. 2003b). Orton’s volume (1870) on the geology of Amazonia and the Andes has been cited as the first publication reporting the existence of these dark, fertile earths in the Amazon (Denevan 2004a). Hartt, a geologist appointed to the Thayer expedition of 1865-66 (Denevan 2004a; Lehmann, Kern, German, et al. 2003; Myers, et al. 2003), one of a series of trips undertaken by Louis Agassiz as part of a continuing study of Amazonian freshwater fishes. Smith (1879), Hartt’s student provided detailed descriptions of terra preta sites, commenting on their extent and likely anthropogenic origin (Denevan 2004a; Myers, et al. 2003). Similarly, British travelers Brown and Lidstone (1878) described the soils’ association with occupation debris and actually asserted that these soils were artifacts of human occupation (Denevan 2004a; Myers, et al. 2003).

Katzer (1944) was the first to physically and chemically characterize terra preta, and to estimate the frequency of its occurrence within the region of the Rio Trombetas (Denevan 2004a; Myers, et al. 2003). Some of Katzer’s most important findings include his determination that terra preta has a high organic matter content, and contains a large amount of carbon (Denevan 2004a). Formal study of terra preta within anthropology began with the work of German anthropologist Curt Nimuendajú. In the 1920s, Nimuendajú began systematically mapping terra preta sites near Santarém (Nimuendajú 1952, cited in Denevan 2004 and Myers, et. al. 2003).

In the 1940s, a series of geogenic origins were proposed for terra preta sites and artifact concentration within the sites was explained as evidence of early Amerindians’ recognition of the agricultural potential of these soils (Woods and McCann 1999). The dominant soils of the Amazon, alternately classified as ferralsols, latosols, oxisols, and vertisols, are infamous due to their limited productive capabilities, especially with respect to the question of intensive or long-term agricultural exploitation (Gross, et al. 1979; Meggers 1971; Roosevelt 1991; Roosevelt

1980). This awareness must certainly have played a role in the adoption of geogenic origin theories by many researchers. Among dominant hypotheses were a fluvio-lacustrine origin theory, which proposed that terra preta consisted of organically-enriched lake- and river-bottom sediments (e.g. Cunha Franco 1962; Falesi 1967, 1974; Faria 1946, cited in Kern, et al. 2004 and Myers, et al. 2003; Zimmermann 1958, cited in Glaser et al. 2004); a second heavily-debated theory was that of a volcanic origin for these dark soils (e.g. Brabosa de Faria 1946, Camargo 1941, cited in Kern, et al. 2004 and Myers, et al. 2003; Hilbert 1968, cited in Glaser et al. 2004). Geographer Pierre Gourou (1949a, b) was the first to reject geogenic origin theories in favor of an archaeological explanation for the production of terra preta (Denevan 2004a; Kern, et al. 2004; Myers, et al. 2003; Petersen, et al. 2001). More recently, studies of the structure and geochemistry of terra preta have put geogenic origin theories to rest; the absence of glass in these deposits helped dismiss volcanic origin theories, and granulometry demonstrated that terra preta particles were far too coarse to be lacustrine sediments (Glaser, Zech et al. 2004). Additionally, the geomorphology of the land, combined with the common upland or bluff situation of terra preta sites precludes the formulation of any logical fluvial geomorphological origin for these soils.

Terra Preta as a subject of research.

The term “terra preta” has a dual meaning in contemporary research. For soil scientists and agronomists, more often than not the term refers to a body of soil studied for its agronomically important qualities that relate to fertility, such as soil chemistry, structure, mineralogy, biota, hydrology, and other soil climatic factors. In archaeology, however, the term “terra preta” denotes a site of human occupation that is studied for its history of deposition in relation to other “layers” found on the site (which can be deposits or soil horizons), as well as in relation to other archaeological sites. The result of this divergence in perspective is that, by and large, while the former group of researchers focuses on the present and future of the soils, the latter is concerned only with the past that is embedded within them. Another way to perceive this difference in approach is that soil scientists and agronomists treat terra preta sites as homogeneous soil bodies, which are subject to natural forces, and can be understood through study of a few samples. Archaeologists treat terra preta as an indicator of human activity, and as a preservation medium for archaeological artifacts and traces of the past, which represent the activities or the past themselves. To be studied as repositories of data about past activities, terras pretas must be sampled intensively across their horizontal extents.

A growing school of researchers has begun to combine the two approaches, attempting to understand terra preta within a continuum that includes its generation through human activity, its subsequent alteration by and embedding into contemporary ecosystems, and the possibilities of its responsible exploitation for the future of Amazonia. Dutch scholar Wim Sombroek is regarded as the father of such holistic terra preta studies. Sombroek’s initial hypothesis (1966) for the origins of terra preta proposed the deposit resulted from intensive agricultural activity; theoretical advances and experimental research have revealed that agricultural activity does not produce terra preta, but rather impoverishes the soil (e.g. Petersen et al. 2001). Most researchers today accept that terra preta was formed through human activity, but whether it was an accidental by-product of daily activities, or an intentional product is still debated.

One of the chief topics under investigation today are questions regarding the process of terra preta formation, and in particular, its unique ability to retain nutrients normally lost through

leaching, and retain carbon typically recycled into Amazonian biota (Glaser and Woods 2004; Lehmann, Kern, et al. 2003a). Sombroek (1966) was the first to propose that rigorous and thorough study could lead to an understanding of terra preta formation, which could then be applied to contemporary settings. Sombroek's example provided the impetus for intensive research that goes on today, and also for the Terra Preta Nova project, aimed at applying research findings toward producing terra-preta-like soils for modern cultivation within sustainable schemes (Woods et al. 2009).

Other research topics in terra preta studies include detailed studies of soil geochemistry, mineralogy, organic matter, hydrology, biodiversity, fertility on the part of pedologists (Costa et al. 2009; da Costa et al. 2003; da Costa et al. 2009; Falcão et al. 2003; Falcão et al. 2008; Glaser et al. 2003a; Glaser, Guggenberger et al. 2004; Lehmann et al 2003; Lehmann et al. 2004; Lima et al. 2009; Madari et al. 2009; Moreira et al. 2009; Ruivo et al. 2004; Ruivo et al 2008; Steiner et al. 2008; Teixeira and Martins 2003; Teixeira et al. 2009; Thies and Suzuki 2003; Tsai et al. 2008) and of the antiquity, history, significance, and distribution of sites, their associations with faunal and botanical assemblages, and linguistic groups, and their significance to local and descendant groups, carried out by archaeologists and anthropologists (Bozarth et al. 2008; Clement et al. 2008; Denevan 2004; Erickson 2003; German et al. 2008; Hecht 2003; Myers 2004; Myers et al. 2003; Neves et al. 2003; Neves et al. 2004; Silva 2004, 2008, 2009; Steiner et al. 2008; Woods 2003; Woods and Denevan 2008; Woods and Glaser 2004; Woods and McCann 1999). Themes in archaeological and geographical research range from paleoenvironment and landscape reconstruction, subsistence strategies and site formation processes. Finally, there is a growing literature about the implications of terra preta and applications of research into the problem of terra preta for yield improvement and sustainability studies in and beyond Amazonia (Glaser and Woods 2004; Lehmann et al. 2003; Woods et al. 2008; Teixeira et al. 2009).

Sombroek's legacy in pedology, and to that of dedicated Amazonian archaeologists too numerous to name has resulted in hundreds of conference papers, articles, book chapters, and volumes dedicated to the study of terra preta, adequate coverage of which would require an extensive volume. The last decade in particular has yielded a tremendous amount of work on terra preta sites, with over half the titles commonly cited produced within that time period (Woods 2004). Terra preta studies today are interdisciplinary, as is illustrated by the compilation of numerous comprehensive edited volumes (Glaser and Woods 2004; Lehmann, Kern, et al. 2003a; Teixeira et al. 2009; Woods, et al. 2009) in the last five years, which chart the history of and illustrate the key topics in terra preta studies. Rather than rehearse this subject in this chapter, I will focus on the methods selected specifically for this study.

Terra Preta as artifact: Building a method

My research builds on work performed by soil scientists, agronomists, archaeologists, geologists, and geographers studying terra preta as well as other anthropic and anthropogenic soils and sediments from around the world. The aim of this section is to delineate analyses and approaches to studying the interface between human social systems and soils or sediments, in their various forms, that are relevant to this activity-focused study of the circular village precinct at the site of Antônio Galo.

My selection of methods involved three major considerations. First, it was necessary to ask what kinds of information would be valuable in answering the key question of this work: what were people doing on a daily basis that could be attributable to the formation of terra preta? Asking this question involved considering the possible by-products of these activities, and the traces thereof that would remain in the archaeological record in recognizable form. Second, it became necessary to consider the scale at which such traces might be recognizable, and in particular the kind of resolution that would be possible in observing these residues, especially considering the temporal gap between deposition and examination, and the environmental conditions. Lastly, I had to consider which particular lines of questioning could be addressed at the site in question, and which would be better addressed at a different kind of site.

For the sake of clarity, I will first address the third consideration, the merits of the site under study. The first consideration will be addressed in later chapters that describe field and laboratory methods. Details of the particular kinds of elemental, chemical, sedimentological, and artifactual signatures that were examined as part of a hypothesis-testing model will be discussed in Chapter 7, along with procedures and results. The question of how these residues relate to particular classes of activities, and to an overall understanding of the site's life-history will be addressed in the final chapter.

Antônio Galo was recorded as part of a systematic site discovery survey of the Lago do Limão micro-region, defined as the immediate zone found along the banks of this many-lobed “lake.” During this survey, a circular pattern of mounds was recorded in the northern portion of the Antônio Galo site. The site was thus selected for further study because the clarity of surface patterns, along with an apparent consistency in ceramic distribution, suggested relatively good preservation of a context within one ceramic phase. Although we could not be certain, initial probing had suggested the site contained a single occupation and relatively shallow deposits, making possible increased spatial coverage that could contribute toward a ‘snapshot’ vision of the occupation of the peninsula. The existence of a single, short-lived, occupation would eliminate the complications introduced by repeated site occupations, which elsewhere (e.g. Machado 2005; Neves et al. 2003; Rebellato 2007) had caused obscuring of earlier contexts through site re-modeling and intrusive features. This would also increase the probability that we were dealing with the remains of a relatively consistent set of practices, which allowed us to address the second consideration. Indeed the excellent preservation of contexts, and the relatively clear stratigraphy encountered at the site made Antônio Galo the ideal candidate for detailed, high-resolution testing of spatial patterns. Pit and hearth features, when encountered, were almost always clearly demarcated, and relatively easily understood with respect to the surrounding stratigraphy, which also demonstrated a consistent patterning across the site. Thus, it became possible not only to make comparisons at the scale of the household, here thought to correspond to earthen structures, but also at the scale of the individual activity, a fact that narrowed our scale not only in terms of people, but also in terms of time.

With this basic framework, it became clear that compositional comparisons across space could be made with relative certainty that we were dealing within a single occupational period – and that thus such comparisons were valid. Hence, a number of attributes were selected for testing across the site, all of which will be discussed below. Additionally, the presence of clear structures and features, along with the discovery of poorly understood or ‘fuzzy’ contexts, suggested we could use attributes recovered from known contexts to clarify less clear contexts.

Thus, features associated with burning, construction, refuse disposal, or architectural elements were closely examined, along with anomalous structures whose origin or genesis is still unclear.

Finally, the existence of mounds allows us to establish that there are at least two temporal units to be found at the site, both associated with the same ceramic occupation, the Paredão phase. Excavation of the mounds reveals that, in many cases, the construction material used to raise mounds clearly demarcates these two occupation phases. A close study of these interfaces helped to identify other interfaces where field observation failed to yield a clear result, or to identify areas which have undergone distinct formation processes. Furthermore, in the cases where pre- and post-mound occupations are clearly demarcated at the macroscopic level, it is also clear that an intensive occupation modified parts of the site before the mounds were constructed.

Given this information about the site, the range of questions to be addressed must be limited to those related to short-term occupations, to comparisons between habitation structures, and to the identification and interpretation, on a micro-scale, of features and anomalies that occur across the portion of the site investigated. Methods from soil science, sedimentology and archaeology were applied to compare matrix samples associated with these distinct occupation phases, and also with unmodified soils from a control location outside the site. The criteria for selection and particular details regarding this sample location are given in Chapter 6.

Total (elemental) chemistry.

Methods for determining total or elemental chemistry can reveal total amounts of individual elements found in soil or sediments. Because certain elements occur in multiple compounds, which can in turn occur in various animals, plants and objects, it is difficult to obtain precise information using only elemental chemistry. For this reason, soil scientists and geochemists look for anomalous results in the elemental profiles of soils and sediments they study, and often combine elemental chemistry with wet-chemical extractions that reveal the form in which an element is present as well as bonds between different elements (Lima et al. 2009).

An existing suite of elements that describes soil characteristics relevant to agriculture and mining has been selected to designate typical or expected elemental profiles for particular soils. These are in turn compared with obtained values to seek anomalous values or sets of values in soils under investigation. Agronomists use these elemental profiles, along with other kinds of data to classify soils, to determine their productivity, and to infer their depositional, environmental, and pedogenic history. Those working in the mining industry also use elemental profiles to map deposits, looking for locations with elemental profiles that suggest the presence of economically valuable minerals near the sample test area. Archaeologists can apply these techniques to answer analogous questions about a deposit's history and in particular, changes that cannot easily be explained by natural processes. We also look for deposits such as concentrations of refuse, building material, ceramics, or other remains of human activities. If these are not evident to the naked eye, anomalous elemental signatures can make them visible, and give us clues about where to look for an explanation.

A few specific examples of total element work on terra preta have revealed a suite of elements that tend to be elevated in terra preta sites, and hypotheses have been created to investigate these anomalies. Elements typically found to be elevated in terra preta in comparison with adjacent, unmodified soils include C, Ca, Mg, Mn, P and Zn. However, within an archaeological or cultural site, more nuanced differences may be observed. Ethnoarchaeological

work in the Upper Xingu basin (Schmidt 201) suggests a few correlations between activities and elemental enrichment. As an example, areas where manioc were being processed showed elevated levels of Fe and K in comparison with other activity areas defined across the site (Schmidt and Heckenberger 2010). Hearth areas or areas of burning demonstrated relatively low values for P and Mg, but notably higher values for Na (Schmidt 2010). Areas that demonstrated the highest concentration of P, Ca, Mg and Mn, although these values are also elevated in food preparation and consumption areas. Schmidt (2010) also suggests a possible correlation between somewhat elevated levels of Cu and a localized practice of urination.

Schmidt (2010) has also compared results from the present-day Kuikuru village under study with results from a recently abandoned adjacent village, which would have been subject to similar activity parsing and spatial organizational strategies. This brings up the point that not all the signatures encountered by Schmidt would be useful for analyses at archaeological sites, as much because we cannot always control the extent to which we are dealing with a palimpsest as because certain elements have higher mobility in soil profiles. Thus, values for K and Na would be less useful at archaeological sites because of their high mobility. Other preliminary research suggests correlations between particular elements and sources of enrichment or activities. Palm leaves, used in household construction and basketry, have been shown to be high in Mn and Zn, parameters that show marked variation across terra preta deposits (Kampf et al. 2003). Enrichment in Mg, Ca, and P has been connected to animal waste (Kern et al. 2009). Because a small range of elements can be connected with multiple behaviors, it is important to consider not only the suite of elements and the relative enrichment of each, but also alternative lines of evidence, such as mineralogical, textural and microartifactual data that can strengthen hypotheses about site spatial organization.

Soil pH and Soil Fertility Chemistry.

Soil fertility is assessed by a series of parameters traditionally derived through wet chemical procedures. Soils in Amazonia have been studied, classified, and cataloged at Embrapa since 1974, in accordance with a set of procedures that has been slowly developed and adapted for the particular needs of the region. Hence, a large library of soils and soil data has been accumulated, against which the soils from Antônio Galo can be compared. Thus, it is useful to run the full suite of analysis on the soils, from the perspective of thoroughness.

Additionally, among the standard analyses performed to assess soil fertility are a few parameters that may give insights into soil conditions and potential anthropic modifications. As an example, pH is a parameter that is especially useful in Amazonia. Where soils of the region tend to be acidic, pH is often elevated in areas of anthropic modification (Smith 1980; Glaser et al. 2004; Lehmann et al 2004). In the Kuikuru village that was part of an ethnoarchaeological study of soil modification through daily activities (Schmidt and Heckenberger 2009), the highest pH readings were obtained in middens, although manioc processing areas showed similarly elevated pH readings. Moderately high pH readings were obtained immediately in front of a house, an area of the central plaza associated with work, and lower pH readings were found elsewhere across the plaza (Schmidt and Heckenberger 2009).

Porosity and soil compaction.

Measures of compaction and porosity are used in soil science to determine the amount of force a plant has to exert to penetrate into the ground and to draw water from it, respectively.

These measures also provide insight into soil hydrology, as well as its formation history. In the study of anthropic effects on soil, for example, compaction, measured with a drop-cone penetrometer, has been used to assess the degree to which a soil can be considered degraded. The use of tractors has been known to increase soil compaction, thus degrading its fertility by providing a physical barrier to plant, especially root, development.

In an archaeological context, soil compaction can be significant in the case of identifying house floors that have been compacted for the purposes of habitation. Packed earth floors are found in many parts of the world and are particularly common in places where insects and burrowing rodents can compromise the integrity of houses. Although most houses (defined as places of permanent habitation in which people sleep) in the local village of Lago do Limão are raised wooden structures with wood flooring, or, in rare cases, brick or cinder block structures, a number of outdoor living structures, such as manioc processing structures, still feature packed-earth floors. Readings with a penetrometer taken within such structures offer resistance that registers four times as much resistance to penetration compared to readings taken elsewhere. Such floors often also constitute raised structures that provide a place of respite from accumulating or downrushing rainwater, and thus locating such purposeful compaction at a site might be indicative of a floor surface.

Porosity may also act an indicator of compaction, in cases where the penetrometer may not be sufficiently sensitive. It is hypothesized that repeated walking or tamping of soil causes the collapse of pore space within a soil. Thus, even if a soil's total porosity is not reduced through walking, it is likely that an overall difference in pore size might be significant, as the number of large pores would be expected to be significantly less than the number of small and medium-sized pores. This can be tested by saturating a soil cylinder, applying different amounts of water tension to the cylinder, and then weighing the equilibrated cylinder. The water loss at each tension value corresponds to porosity levels that can then be correlated and translated into a measure of average pore size, as greater tension is necessary to remove water from smaller pores.

Particle size analysis.

Particle size analysis is a standard soil analysis procedure, and is used to determine the amount of sand, silt, and clay in a soil. These numbers can in turn aid in soil classification, as well as serve as indicators of a soil's weathering history and approximate age. Particle size analysis can also sub-divide particle size classes, such as sand and silt, into even smaller particle size classes. Sands can be size-sorted using standardized sieves. Because of their significantly larger size than their counterparts, medium and large sand particles move differently (and less frequently downward) within a soil profile, and over time, can be known to accumulate on a soil surface. Additionally, if it can be shown that, as hypothesized, a good deal of “sand” found in terra preta consists in fact of sand-sized ceramic fragments, we may be able to trace the distribution of these micro-artifacts across profiles by examining the sand recovered from bulk soil samples. These micro-artifacts can also be examined for surface features, which could indicate the processes of fragmentation, as well as whether particular fabric types are more likely to fragment than others. Because ceramic sherds are integral component of terra preta, it is likely that these micro-artifacts, as much as any other additive have played an important role in the soil-formation process of these anthrosols. Understanding how they arrived in the soil is thus an key part of understanding the soils themselves.

Sedimentology.

Sedimentology, considered in this work as the life-history of sediments approach, includes the study of the origin, transport, deposition, and post-depositional alterations of sediments. In this case, a sedimentological study of the site would require a description of all sediments, including artifacts, in all size classes. The approach applied here draws upon methods established by Folk (1980) and Stein (1985, 2001). Because the study of ceramics, from a sedimentological perspective, is part of standard ceramic studies (in which we record the number, size, and condition of sherds, as well as some manufacturing details), I will not dwell on larger size fractions. All ceramics recovered at the point of the trowel, or in a field screen, will be analyzed separately, as part of standard Central Amazon Project (CAP) laboratory procedures. Instead, I focus on the sediments recovered from bulk samples, and mostly on the fraction sizes that would have been lost, ignored or poorly identified in the field, but which we have a chance to study closely in a laboratory sample. Details on field methodology and procedures for collecting and processing bulk soil samples are given in Chapters 6 and 7.

Sediments recovered from bulk samples from each identified context in selected units will be sorted into size fractions in order to develop an initial fragmentation index. The shape and roundness of these sediments will be recorded, and sediments will be sorted into artifact categories and general petrological classes, so that the origin and depositional history of each kind of sediment can be determined. In this way, each body of sediment or pedogenic horizon within the site can be examined for degree and kind of modification that can be attributed to human behavior, and we can begin to compare the activities that went on in each site area.

Soil Carbon.

As living bodies, most soils contain carbon, and the amount and form of carbon is a major determining factor in the way that soils behave. Elevated levels of carbon, and of black carbon specifically, are found in Amazonian Dark Earths of all types, not least in Terra Preta de Índio. Understanding the carbon content, and specifically the species of carbon in terra preta is of particular interest to soil scientists, biologists, agronomists, and ecologists, as it is believed that carbon is chiefly responsible for the increased fertility and unique behavior of terra preta within its environment. Furthermore, it is believed that, once we have fully understood the exact forms in which this carbon appears, and its effects on the biota, air, water, and, in effect, the entire terra preta ecosystem, we can transfer this knowledge to other scenarios in order to create management advantages in places of unfavorable soil conditions. Although much of this is still under debate, or perhaps because of this, obtaining a carbon profile for any site under study is absolute indispensable.

Applications in archaeology, although more mundane and immediate, may actually be easier to undertake. Carbon in soils accumulates on land surfaces, where biotic activity and plant decay concentrate carbon. Thus, paleosols or buried land surfaces can sometimes be located by measuring the amount of carbon along a pedo-stratigraphic profile at regular intervals; where a simple pedogenic profile would show a geometric decline in carbon with increased depth, a buried land surface would manifest as a spike in carbon compared to expected values. In an archaeological setting where land surfaces are notoriously hard to pinpoint, and even at Antônio Galo, where stratigraphic preservation is passable, this kind of analysis could prove crucial to understanding the development of archaeological sites, helping to underscore hiatuses and distinguishing occupation phases. Carbon profiles for areas that display clear buried soils can be

used to test for buried A horizons in other areas of the site, where stratigraphy may not be as clear. Results from these analyses will be compared with the grain size data, which may also indicate areas of accumulation of particulate material.

Finally, different kinds of carbon arise from different burning conditions and pedogenic processes. It may be possible, through the speciation of carbon, to relate contexts that have arisen from similar kinds of processes, and to differentiate between distinct activities.

Chapter 6.

Archaeology of Terra Preta (ATP)

Creating an archaeology of Terra Preta: invisible archaeologies

The Archaeology of Terra Preta (ATP) project was designed as an inquiry into the patterns that microscopic or invisible traces of human activity can reveal about spatial and social organization at terra preta sites. My work builds on and is an integral part of the extensive work of the Central Amazon Project (CAP), a long-term archaeological research effort currently under the direction of Eduardo Góes Neves of the University of São Paulo. My work expands upon current knowledge about the context and concourse of daily life at an archaeological site in the Central Amazon by investigating material yet practically invisible traces of the past embedded in the site matrix, in this case, terra preta. I elected to perform this research at the Antônio Galo site, which had been previously investigated in a preliminary manner and had been shown to exhibit the required characteristics of good preservation state and intelligible surface morphology. I employed a suite of methods drawn and adapted from the earth sciences, as described in Chapter 5, to discover material traces of past human actions and activities across the site, with a view toward parsing the spatiality of the site by assigning purposes or functions to places identified within the site and using these to map meaning onto portions of the site.

In order to situate this research, I review in detail archaeological work performed within the Lago do Limão micro-region, focusing specifically on sites that demonstrate characteristics similar to those exhibited by Antônio Galo, within the purview of the shifting research foci of the CAP. I pay particular attention to previous investigations at Antônio Galo, and Moraes' (2007) situation of the site within the archaeological region. This leads into a discussion of how relevant research questions arose, and how a research design was crafted to address these questions. Finally, I provide descriptions of field methods and field results, ending the chapter with a preliminary interpretation of the general site history.

Research design

The Antônio Galo site is located on the banks of Lake Limão, a many-lobed “lake” located in the interfluvial zone between the Negro and Solimões Rivers (Figure II.1). In the same way that the Ariáú, whose waters flood into Lake Limão, is best thought of as a channel, Lake Limão itself is truly a network of channels that fill up alternately with the white and black waters of the Solimões and Negro Rivers, respectively. Its main connection to the Rio Negro is via the Ariáú, but its southern reaches drain into or from the Solimões through independent channels to the east of the Ariáú.

Within the perspective of the CAP, the Lago do Limão micro-region is considered part of the western extent of the CAP research area, as defined in Chapter 4. Although the research area comprises the entire confluence region, the interfluvial zone has been the focus of most of the CAP's systematic research efforts (Neves et al. 2003). For this reason, and also because we believe to have a fairly good grasp of the distribution of terra firme dark earth sites of the region, my contextualization of Antônio Galo will focus on the location of the site within the interfluvial and the micro-region of the lake.

The town most closely associated with Antônio Galo is a small village or hamlet called Lago do Limão, named after the lake upon whose banks it is perched. The town of Lago do Limão is a recent coalescence of a previously dispersed subsistence farming community. When in the early 1970s, as part of a series of major state projects, the asphalt road Manoel Urbano was built, the community re-oriented itself, creating a small town along the northern margins of the lake. The center of the town is located at the terminus of a local road that runs in a roughly southerly direction from Manoel Urbano to the lake. Many residents of the previously dispersed community retained their agricultural lands, but settled more or less full time around this central communication artery. The construction of the road facilitated the community's access to other centers, like the local city of Iranduba, where the legal and municipal center of the interfluvial district of Iranduba is located. Other major cities along Manoel Urbano, to which Lago do Limão is now terrestrially connected include the tourist centers Novo Airão and Manacapuru, as well as the port city of Cacao-Pireira, which became an immediate connection to the major capital city of Manaus. A bridge currently under construction between Manaus and Cacao-Pireira is also likely to significantly alter economic and social communication between Manaus and the cities and towns of the interfluvial, including Lago do Limão.

Residents recall the changes that took place with the advent of the asphalt road, which provided faster and more immediate access to Manaus. For the farming community, one of the first effects of this construction was the means by which they could transport "farinha," a coarse flour made from manioc root that functions as the major product of outlying regions to the major commercial center. Before and immediately following the construction of the road, provisioning of the city with produce constituted many residents' chief means of integration into the larger local economic sphere dominated by Manaus. As is the case in other upland settings, the raising of crops other than manioc is only reasonably practicable on terra preta plots, and hence economic differences can arise within the town. Ranching is also practiced to a limited extent. Today, Lago do Limão also participates, increasingly, in the tourist trade facilitated by Manaus, also the local international transport hub.

The modern-day community boasts two schools, several soccer teams, and enjoys a bus service to Cacao-Pireira that comes three times daily. This connection has likely been responsible for the advent of television, cell phones, and other commodities to the town. There is a public education system that serves both children and adults in the town and some community members are involved in commerce, but a good portion of the community is still oriented around farming. The chief cultivar of the region in terms of land apportioning continues to be manioc. In some parts of the lake, heavy machinery is used in agricultural and construction pursuits, but many portions of the lake margins, including numerous terraces, remain difficult to access except by boat, and the local craft is the canoe. The narrow and often shallow channels that form the major communication network at Lago do Limão, and between the lake and neighboring regions, rarely permit the passage of any significant watercraft. The result, for

farming, is that most cultivation labor is manual, the upshot of which is relatively good preservation of archaeological contexts in these less accessible portions of the lake. This isolated context also affects the logistics of archaeological work, requiring teams to reside in the village in order to have access to infrastructure, and to commute daily to sites by canoe.

The Oxisols found in the region of Lake Limão tend to be yellowish in color, in contrast to the red ferruginous clays found elsewhere in the region (e.g. São Raimundo port of Manaus). This yellowish color of the B horizon, which often begins just 5 cm below the land surface, has led locals to contrast terra preta deposits with *terra amarela*, yellow earth, when describing plots of land. These categories are generally used in reference to evaluations of the quality of land for agricultural purposes, and thus, for a community that is mostly oriented toward subsistence farming, are very present and real categories.

The yellow or red underlying color that characterizes Oxisols is derived from iron oxides present in the soil. These form in the B horizon, and the redness or yellowness of a particular pedon is dependent upon the proportion of hematite to goethite present in the matrix. While hematite forms preferentially in warm, dry environments, goethite is more common in acidic soils that are rich in organic matter. Thus, pedogenically, the yellowish color of soils in the Lake Limão region is indicative of moist, acidic conditions, and mineralogically it indicates a high proportion of goethite in the B original soil. From the perspective of research into anthropic modification of soils, this is very interesting, as studies (Ketterings et al. 2000) have shown that goethite can be transformed into maghemite through exposure to fire or high heat.

Principal research questions

This project took as its point of departure the interpretive framework set up by exploratory work at Antônio Galo in 2004-2005. Initial mapping completed in 2004 as part of the systematic survey of the Lago do Limão micro-region had shown that the site could be subdivided into at least three spatial units: a northern portion that evidenced a circular disposition of mounds, and which consisted solely of remains associated with the Paredão phase; a central portion that featured large mounds in clusters, one of which delineated a somewhat less obvious or intact circular arrangement, where Guarita ceramics were found superimposed upon the Paredão-phase ceramics; and a southern portion featuring, again, only Paredão ceramics, but the surface morphology of which was less clearly patterned (Figure VI.1). Great care was taken to map all visible mound structures across the site, but it is worth noting that differential land use by contemporary owners of farm plots, as well as slight ecological variations supporting distinct kinds of vegetation, results in differential visibility across the site. We were fortunate to have encountered a fruit tree orchard occupying most of the northern portions of the site, including the North Precinct, which greatly facilitated visibility. By the same token, it is conceivable that portions of the map that detail areas not under cultivation at the time of the survey are incomplete as far as surface features are concerned, especially given the substantial amount of information provided by microtopography done in 2009. Additionally, the Antônio Galo site sits on a small peninsula that is split between five owners, and hence differential access afforded by individuals also affected evenness of coverage across the site.

During the brief excavation phase in 2005, the northern portion of the site, henceforth the North Precinct, was shown to contain a reconstructible vessel (Moraes 2007), indicating a high



Figure VI.1: Antônio Galo site map – mounds surveyed in 2005, overlain on satellite image.

state of preservation for remains in this sector. In contrast, ceramic fragments obtained from the southwest portion of the site revealed a higher fragmentation rate (Moraes 2007), possibly associated with more intensive use of this portion of the site in modern agricultural activities, but also possibly a result of pre-Columbian disturbances.

Establishing chronologies: sequence and contemporaneity.

One of the key questions that remained after the completion of initial work at Antônio Galo was a question of the temporal parameters of the site's occupation. The surface morphology of the site suggests three to four clusters of mounds across the site (see Figure VI.1) and differential preservation states indicated at least two distinct occupational moments. This is particularly clear in the center portion of the site, where an area of large mounds in a roughly circular arrangement, or possibly a series of circles (see Figure VI.1). The presence of two ceramic complexes on the site suggests either a re-occupation or a prolonged, continuous occupation of the site. Essential to clarifying the issue of re-occupation and of length of occupation is a series of absolute dates corresponding to the beginning and end of each occupational cluster at the site.

For now, it is sufficient to note that ceramics associated with the Paredão phase are present across the site, and generally correspond with occupations dating between 400-900 AD. At the present moment, the only reliable radiocarbon date obtained for the site of 734 ± 27 AD (OxA 15505); ten additional samples have been set aside for dating, and it is our intention to proceed with an additional intensive dating effort in the near future. This date places the occupation of the site in the early portion of the Paredão phase, and indeed the earliest ceramics found at the site are unmistakably Paredão. This early eighth-century date corresponds to the organic matter used as temper in a Paredão-phase ceramic vessel, initially selected following the 2005 excavations as representative of the start of occupation of the North Precinct. Subsequent work at the site suggests that in fact this fragment belongs to a context that was likely transposed construction fill for the house platform associated with Mound 16. Hence, the date of 734 ± 27 AD corresponds to the firing of a ceramic fragment that was discarded and subsequently re-incorporated into a structure that was occupied at some later point. Although we cannot reasonably estimate the time elapsed between the original firing of the ceramic and mound construction without a larger set of dates, site structural details uncovered during the 2009 investigations suggest that, if the above ceramic fragment does correspond to the initial use of the peninsula as a site of occupation, the circular village precinct may correspond to the terminal portion of a longer occupation.

This brings up the question of the extent to which the occupation of the North Precinct represents a distinct temporal phase from the rest of the site. Certainly, it can be assumed that the Guarita phase occupation, which occupies the central portion of the site, represents a distinct occupational episode. That the Guarita complex, associated with the polychrome tradition, represents a discontinuity with the ceramic tradition that precedes it in this region, namely the incised-rim tradition, within which we find the Manacapuru and Paredão phases (Lima 2008; Lima et al. 2006; Moraes 2007; Portocarrero 2008), is also evident in the surface morphology of the site. The mounds which we find loosely associated with Guarita ceramics are larger in size, more amorphous, and less clearly organized than those in the North Precinct. It is worth noting that one major focus of CAP investigations has been understanding the construction of earthen mounds in the Central Amazon from the perspective of ceramic phases. Most recent data (Neves

and Petersen 2005) suggest that the mounds were likely built, and the larger part of terra preta produced, by people associated with the Paredão and Manacapuru phases, and that the Guarita occupations consisted of ephemeral, largely superficial occupations that were superimposed on top of abandoned contexts produced by an earlier cultural group. It has further been suggested that while occupations associated with the Paredão and Manacapuru phases favor a circular arrangement, occupations characterized by Guarita ceramics tend to be more linear in shape (Rebellato 2007). A riverine orientation for villages occupied during the latter part of the pre-Columbian period is consistent with early European chroniclers' reports for this part of the Amazon River (Markham 1859; Medina 1934).

Because the present research was focused at the level of the household or the individual, and because of superior preservation encountered in the North Precinct, the following discussions regarding the major research themes of the project will be limited to an examination of these questions within the North Precinct.

Spatial organization: structures and activities.

Previous research at Lago do Limão had led us to generate a hypothesis about the general spatial organizational structure of the North Precinct. The circular arrangement of the mounds suggested that the mounds represented house platforms, upon which terra preta was formed as a result of occupation of the mounds. If this were the case, we would expect to find a concentration of occupational debris on top the mounds; a central plaza region essentially devoid of occupation material; and possible areas of discard behind the mounds (e.g. Schmidt 2010). The question of mound function has been especially complex in this region, as intensive excavations at multiple sites have revealed three distinct functions that can be assigned to mounds. At Hatahara, Machado (2005), and later Rapp Py-Daniel (2010) revealed that mound I was utilized as a funerary structure. In the Upper Xingu, mounding observed at a contemporary ring village is the result of refuse disposal, the mounds serving also as garden plots (Schmidt 2010). Moraes' (2007) initial interpretation for the function of mounds in the North Precinct of the Antônio Galo site is that of habitation, a hypothesis also extended to the mounds of the circular mound complex found the neighboring site Pilão. Among Moraes' (2007) arguments in support of this thesis are the evident borrow pits found at both Pilão and Antônio Galo, which suggest a major and intentional construction event; and the relative paucity of ceramic material or other domestic debris encountered in a substantial stratum of Mound 16 suggesting this was not midden accumulation. As such, it was also in our interest to further test Moraes' hypothesis of mound construction and function through intensive excavation of the mounds in addition to investigating the surrounding area.

A sampling strategy was designed which treated the three regions of the precinct delineated above as separate sampling strata. The *Mounds* stratum testing would involve at minimum testing of three mounds to verify a consistency in terms of kind, intensity, and sequence of deposition within the mounds, and, time permitting, widespread testing of multiple mounds with a view to addressing questions of hierarchy and site remodeling delineated below. This sampling strategy would also provide better insight into the function of the mounds themselves, as competing hypotheses for mound function in this region and period have been advanced. The *Plaza* stratum would be tested intensively through soil augering, in order to maximize coverage and allow for a characterization of deposition across the plaza. We also planned to excavate the plaza stratum in three locales in order to ascertain the stratigraphic

sequence and formation processes of this spatial unit. The *Behind mounds* stratum would consist of portions of the site located within a ring immediately outside of the circle described by the mounds, in order to test the hypothesis of whether deposition that occurred behind the house structures would be significantly different from that encountered at other strata.

Mobility and site remodeling.

One of the principal questions regarding the nature of pre-Columbian occupation of Amazonia is a question of settlement permanence and continuity (Meggers 1989; Heckenberger, Petersen, and Neves 1999), which also speaks to population density. Meggers (1995, 2000) argued that the large terra preta stains cited as evidence of large settlements in Amazonia were, in fact, sequential re-occupations of the same vicinity as part of a cyclical movement on the landscape associated with long-fallow cultivation cycles. Hence, it is important to understand the extent to which occupation of a particular portion of a site was continuous, and also to consider to what extent we consider continuity to correspond with stability or house permanence. In other words, how can we track settlement re-modeling, and to what extent can we argue for permanence and continuity within a shifting landscape?

In order to comprehend the North Precinct in these terms, it was necessary to test the contents and establish the construction history of as many of the mounds as possible. If all the mounds in the circular arrangements were found to have a similar structure and to be composed of similar materials, then it could be said that they were built in the same manner. Furthermore, if no evidence was encountered to suggest distinct initial conditions at the base of some of the mounds, a hypothesis could be advanced that the mounds were built at approximately the same time, or at the very least, in similar initial conditions or in accordance with similar cultural parameters. Absolute dates, where reliable datable contexts could be found, would be used to anchor these sequences in time, and to improve our understanding of the construction date for each mound.

Hence, the initial sampling design for excavation was structured to establish the characteristics of mounds of varying shape, size, and placement around the central plaza. Particular attention was paid to the characteristics and quantity of ceramic materials; characteristics of construction material, such as the physico-chemical attributes of the mound matrix and the spectrum and condition of micro-artifacts found therein; the structural nature of the interface between the mound and the previously existing land surface; and mound elevation above plaza level, or mound size. These data would be used in concert with evidence from other portions of the precinct to reconstruct a sequence of events and an occupation history of the North Precinct.

Although the focus of the dissertation is the North Precinct itself, it is difficult to ignore the potential significance of this relatively intact village arrangement in relation to the rest of the site. The high degree of preservation of deposits encountered in the North Precinct has been noted repeatedly throughout this work. Although some degree of disturbance and ceramic fragmentation observed at the site, particularly in the central and southern portions, can be attributed to modern agricultural activities at the site, disturbance of earlier archaeological contexts by later pre-Columbian occupations has been attested to elsewhere in the region, including the complex and difficult to interpret Hatahara site and the neighboring Pilão site. It is thus worth asking to what extent contextual disturbance observed south of the North Precinct is a result of subsequent re-occupations of the site or site remodeling; and if this is the case, what

could account for the superb preservation state encountered within the North Precinct? Although not all of the points raised in this section could be addressed within the scope of this research, it is worth bearing these questions in mind as we move through the data, and later when we move forward with the discussion of results.

Field research design: changing strategies

The field school began officially on June 22, 2009. The field team consisted of three PhD students and 26 undergraduate students, two field assistants from the Lago do Limão community, and was occasionally supplemented by local volunteers, usually students from Manaus or Lago do Limão. Claide P. Moraes, a PhD student at the University of São Paulo, was site director and field school instructor of record. I acted as site supervisor and supplemental instructor, and was in charge of geoarchaeological work in the field. James L. Flexner, PhD Candidate at the University of California, Berkeley, was also supplemental instructor and became project topographer and cartographer.

Lodgings and the field storage/laboratory facility were located in the town of Lago do Limão, on a property rented from a community member. As the field school started just as the flood waters were reaching their peak, transportation to and from site was possible only via watercraft. Two large canoes were rented from local community members to serve as shuttles to and from site, which was approximately a 20-minute ride from the house. The field day began with a 7am departure from the house and ended at approximately 4pm in the field. Most field equipment was left at the site, but instruments such as the total station, level, and soil-sampling equipment was transported to and from the site on a daily basis. At the end of the day, all archaeological material collected during the day was transported back to the house, which became our storage facility and later, bulk-sample processing and flotation facility.

Finding our feet: establishing spatial and temporal frameworks.

As has already been discussed, the field work undertaken to address the questions relevant to this project was a continuation of field work performed in 2004-2005. At the time the Antônio Galo site was recorded, the direction of the site's longest extent was determined, and a transect line was established for the purposes of conducting auger tests across the site. The auger initially procured for these purposes contained a 20-cm closed bucket measuring approximately 20 cm in diameter. After a few tests, we determined the efficiency of this sampling method to be unsatisfactory, due to the highly plastic nature of soils, and also to the density and size of ceramic fragments encountered. Not only were ceramics often so numerous as to impede vertical progress with the augers, there were also suffering significant damage and fragmentation through this procedure. Hence, we designed an alternative testing method which utilized a post-hole digger in place of an auger. The tests implemented thus approximate shovel-test pits, with the advantage of a longer (1m) reach and slightly better control of the consistency of test diameters along a vertical access. For the purposes of this discussion, the term "core" will refer to tests dug in this fashion, and the detailed methodology of coring as implemented by the CAP is discussed in the Survey Methodologies section, below.

A line of core tests was plotted along the site's major axis, which we plotted at 42°E of magnetic north. Core tests were conducted every 25 m along this axis (denominated the

northeast-southwest axis), and also along two other lines established perpendicular to this major axis (denominated southeast-northwest 1 and southeast-northwest 2; see Moraes 2007 for details). Coring proceeded in both directions from a central point on the site until an auger test revealed no ceramic materials or significant anthropic modification, or until the edge of the peninsula was reached.

This alignment was later retained upon the establishment of a site grid in 2005, and test units subsequently excavated as part of the preliminary phase of research were plotted in relation to these transect lines. For the purposes of the site grid, the northeasterly direction of northeast-southwest transect was designated an arbitrary north. Efforts were made to preserve a relation with the previous site grid, whereupon the cartographer designated the intersection of northeast-southwest transect and transect southeast-northwest 2 as the grid origin, 500N 500E.

During the second phase of research, in January of 2005, a 1 x 1 m test unit was excavated near the periphery of Mound 16, with a view toward characterizing the mound contexts found at Antônio Galo. Because January is a rainy month, lengthy excavations were avoided. The periphery of the mound was thought preferable to the central portion of the mound for the purposes of this initial, investigative excavation. Elsewhere in the interfluvium (Machado 2005), the excavation of multiple 1 x 1 m excavation units in terra preta mound contexts had yielded prohibitively high quantities of ceramic material given the size and scope of Master's thesis project, and also given the curatorial facilities and size of laboratory crews available at the time of Moraes' work. Thus, it was deemed necessary to proceed carefully in order to produce collections that were manageable, but also meaningful within the context of the research questions posed.

This unit, located at coordinates N938 E456, which resulted in the discovery of the partially reconstructible vessel mentioned above, also revealed a low density of ceramic material. This discovery made plausible the opening of more intensive excavations into mound contexts at this site. During the last phase of field research in the 2004-2005 period, two other excavation operations were undertaken. The first was implemented in the southwest portion of the site, at coordinates N505 E400 where the greatest concentration of material had been discovered outside of mound contexts. The second consisted of a 1 x 3 m operation situated at the highest point of mound 17, at coordinates N913 E437, N914 E437, and N915 E437. This locale was selected for its size and also for its proximity to a borrow pit identified during the survey phase of the project. The purpose of these excavations was to establish the range of variation of ceramics encountered at the site and to clarify depositional processes associated with the formation of terra preta, especially within mound contexts. This third phase of research at Antônio Galo, part of a larger, multi-sited field school being conducted by Claide P. Moraes, under the auspices of the CAP, was interrupted because of the unfortunate and untimely assassination of James B. Petersen, one of the CAP directors.

Moraes was able to include data from his investigations at Antônio Galo in his Master's thesis. His chief conclusions with respect to Antônio Galo concern formation processes and function of the mounds of the North Precinct of the site, which he considers to be constructed in a single event and utilized as house platforms, upon which terra preta was formed. His findings also revealed a predominance of Paredão ceramics across the site, and solely ceramics belonging to this phase were encountered in the excavations at the North Precinct. Hence, this preliminary work also confirmed that a single-phase occupation was present in the North Precinct.

In June-July of 2009, an intensive, 4-week phase of field work was undertaken at Antônio Galo, the results from which form the basis of this study. The project was conducted as a joint effort between the CAP and the archaeology instructors of the State University of Amazonas (UEA), Helena Lima and Anne Rapp Py-Daniel. Excavations were formally directed by Moraes, whose intention it was to include more detailed data about Antônio Galo in his PhD dissertation, which seeks to understand regional variability in the Paredão-Guarita transition. Because his field work goals coincided with mine, I was invited to co-direct field work and act as a field instructor throughout the season. The students who partook in the field work were all enrolled in the undergraduate course in Archaeology at UEA. As part of the CAP's mission is to train archaeologists and to develop local archaeological potential, this field school also served to further this goal. The length and dates of the field season were thus defined by the class schedule of the archaeology degree, which consisted of an intensive 4-week field module followed immediately by an intensive laboratory module. Also because of the educational nature of the field work, field work time was, especially toward the beginning of the season, interspersed with lectures and on-site practical exercises and demonstrations.

As is the case with almost all terra firme plots around Lake Limão, Antônio Galo was part of a subsistence farm when we encountered it in 2004. In contrast to our first encounter with the plot, when the majority of the North Precinct was clearly visible due to active arboriculture, when we arrived in mid-June of 2009, the plot, abandoned since the property changed hands in the intervening years, had become overgrown with dense secondary growth known as *capoeira baixa*. Capoeira baixa is a dense, tough, thick, low secondary growth, in this case characterized by thorny, spindly brush and a dense, tough grass that obscure visibility at the ground level. In contrast with *capoeira alta*, which consists of a well-developed over-story and relatively open understory and can indicate decades of re-growth, capoeira baixa is indicative of relatively recent (5-10 years) field abandonment. Upon our arrival at the site in mid June, the plot was impenetrable. After locating previously excavated units and old landmarks, we enlisted the students in an intensive clearing effort, cutting down all secondary growth, leaving the fruit trees in place.

This clear-cutting effort revealed that no sign of our site datum, originally part of a structure that had since been removed, remained. We re-excavated the partially excavated and backfilled 1 x 3 m operation from the 2005 field season, utilizing the long axis of this set of excavation units to re-establish the site grid and designate a new site datum. From this point, we were able to establish transects, set up excavation units, and proceed with gathering data for creating a detailed topographic map of the site.

Survey methodologies: a hybrid approach.

Because the site had been originally surveyed in 2004 and 2005, we had a fairly good idea of the shape of the circular village precinct and its relationship to the southern portions of the site. However, the exact location and shape of the mounds had only been recorded with tape and compass; additionally, the clear cutting effort, which had occasioned the more senior archaeologists on the project to walk across the precinct several times had brought to our attention a series of low mounds or berms in the central plaza that merited further definition. Hence, a total station was used to create a detailed topographic map of the site, for which points were taken at approximately two-meter intervals along east-west transects spaced two meters apart in the north-south direction. The detailed topographic map of the North Precinct (see

Figure VI.2) revealed several low mounds located in the center of the plaza, the investigation of which became part of the soil-augering project that was undertaken simultaneously. Additional mounds (27-30) previously undetected within the region surveyed in 2004 were confirmed or identified in the initial phase of topography. Exploratory survey and topographic work toward the end of the field season revealed two additional mounds (26 and 30) to the north and east of Mound 16, and also revealed the significant size of Mound 18. Results from microtopographic work will be detailed below.

While the topography team proceeded with mapping, a soil sampling team was assembled to collect data on the variability of ceramics and the matrix across the precinct. The primary tool for collecting matrix samples was a Dutch auger with a 7-cm bucket. Since the original northeast-southwest transect from 2004 only covered the eastern-most portion of the mounds on the eastern edge of the North Precinct, we decided to create two perpendicular transects aimed at bisecting the precinct along its north-south and east-west axes. The central point of the North Precinct was estimated as N900 E450 and transects N900 and E450 were established. Subsequently additional augers were taken at judgmentally selected locations, including cores taken along two additional transects (E483 and E493) established to the west of Mound 15 in order to investigate slightly elevated structures that appeared to define a pair of ramps or small mounds associated with said mound. Opportunistic cores and augers were taken at other anomalous structures observed within the plaza. A series of four cores was also implemented along the southwest portion of Mound 17, an oddly-shaped structure that appears to form a “tail” or ramp off the main portion of the mound.

All equipment involved in collecting soil samples and soil data outside of the excavations was provided by the Empresa Brasileira de Pesquisa Agropecuária, (Embrapa, or Brazilian Agricultural Research Corporation), with the express permission and guidance of Dr. Wenceslau Teixeira, then director of the Soil Physics Laboratory. The Dutch soil auger employed for this operation was 1 meter in length with a 7 cm diameter and a 20 cm bucket, a standard auger utilized by Embrapa in their field research, and also the same type of auger utilized by Rebellato (2007) and Arroyo-Kalin (2008). Auger tests were taken at 10 m intervals along transects N900 and E450. In order to preserve comparability with cores taken in previous seasons, a 20-cm interval was used for the collection of soil samples and other material encountered in the auger holes, and later in cores implemented following CAP protocol (described below). For samples taken with the auger, the maximum sampling depth was 80 cm due to the high plasticity of soils and the low resistance of the auger to the amount of torque to which it was being subjected. In some cases, a depth of 80 cm could not be reached due to the shallowness of laterite deposits. In these cases, as laterite deposits are considered to be the limit of cultural layers, reaching such a deposit in a core or auger was taken as an indication that we had reached the lower extremity of cultural deposits. Every core sample drilled was collected in its entirety, following a removal of the outer layers of the sample with the aid of a field knife. Samples were collected in 2 kg bags and labeled according to CAP protocol, which applies to all material collected in the field or produced through laboratory work.

Standard CAP protocol was followed in the collection of archaeological materials encountered during this procedure, with slight modifications to include soil sample collection. According to CAP protocol, coring is undertaken in a team of two people, in which the first person drills or excavates to obtain the sample in arbitrary levels of 20 centimeters. The second person is charged with the description of soil color and texture, and with the identification,

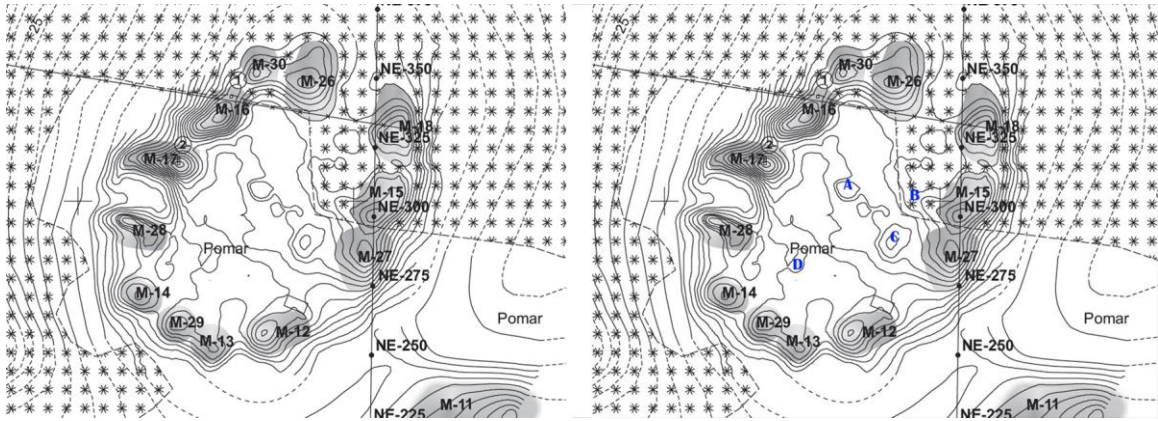
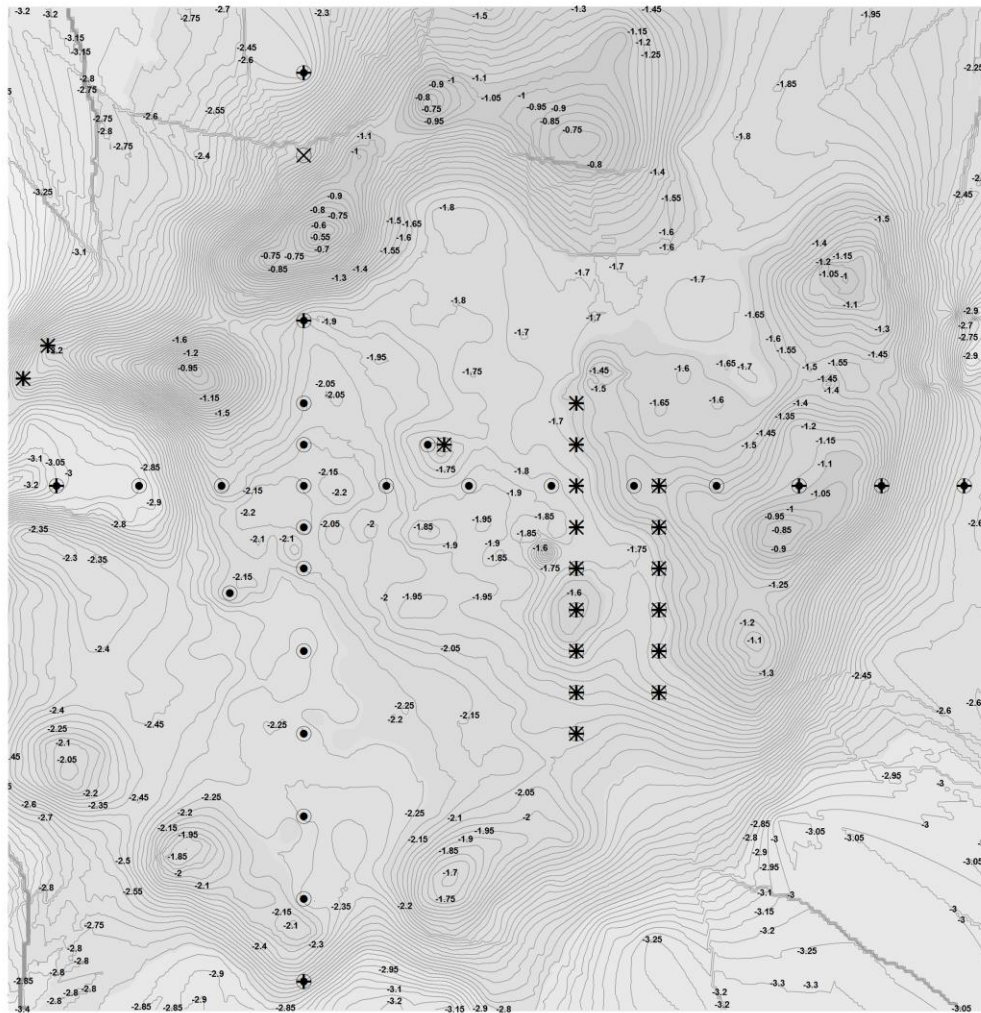


Figure VI.2: Antônio Galo North Precinct: new topographic map. Map on left shows location of potential structures identified through field walking. These are the “Inner Structures” identified later in the chapter.



Legend

- Cores Taken with "Dutch" Soil Auger
- × Cores Taken with Post-hole Digger
- + Presence of Ceramics
- Soil Sample Collected

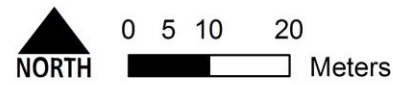


Figure VI.3: Digital elevation model of North precinct, showing locations of cores and augers.

counting, and collection of ceramic fragments and other macro-artifacts, separated from the archaeological matrix by hand. Because coring is seen as a preliminary step in field investigations used to quickly delimit the size of a site and the horizontal and vertical distribution of terra preta and macro-artifacts, sieving is not commonly employed during this step. The clay-rich nature of soils in this area justifies the temporal advantage gained by foregoing screening over the amount of information obtainable by on-site screening. In an ideal scenario, core samples would be subjected to flotation on site after samples for microanalyses had been set aside. A newly-developed flotation system for local Oxisols (described below), promises to greatly increase the kinds of information obtainable through coring methodologies.

Following description of sediments excavated with the post-hole digger, the core is back-filled in reverse-stratigraphic order, to make the disturbance effected by coring evident to future excavators. At Antônio Galo, a soil-collection step was inserted immediately following description, in which the central portion of a level excavated with the post-hole digger was collected after the separation of ceramics. Efforts were made to collect approximately 1 kg of sample, estimated by volume, using standardized sample bags.

Every effort was made to preserve consistency between the recording and collecting of materials from augers and cores (see appendix for sample site forms). Each location sampled was described with relation to the surrounding vegetation and its position within the site, as well as evident surface features such as artifact scatters and land surface morphology. Each soil level was described in terms of color, texture, and the presence and frequency of inclusions, and attempts were made to diagram major changes in color or texture in the traditional alphabetic CAP nomenclature, where A, B, and C, correspond to horizontal units of distinct color. These letters should not be taken to represent soil Horizon designations A, B, and C, although in some cases "A" does correspond to an A Horizon. Determinations of soil horizon or stratigraphic layer were made in the post-excavation analysis phase, and here the term horizontal unit is meant to refer to a segment of a particulate matrix that is recognizably distinct from that above and below it, and is understood to be somewhat homogeneous across its horizontal extent. The terms horizon and stratum are avoided at this point because no interpretive work is done on the part of the archaeologists to necessarily determine whether they are dealing with pedogenic horizons or sedimentary strata. Soil samples collected were assigned a Provenience Number (PN) out of a series of unique PNs set aside for the coring/augering operation.

These procedures were observed for all augers and cores implemented. The only way in which the two kinds of probes differed was in the separation, counting, and collection of ceramic material obtained from cores. The ability to separate ceramics is the chief reason cores were deemed preferable to augers in some instances, which will be described on a case-by-case basis. Figure VI.3 shows the locations of cores and augers implemented with each excavation tool, and also the locations where ceramics and matrix samples were collected.

The size of the sampling team for this operation was usually 4 people, not only because the educational nature of our endeavor, but also to make possible the gathering of additional data in conjunction with the core-and-auger operation. Because one of the methodological aims of this project is to increase the kinds of data quickly and easily obtainable through field work, this project served as the proving ground for analyses of compaction. As a proxy for compaction, we used measurements of soil penetration resistance PR, which allow us to assess the force necessary to penetrate a soil or sediment body in kilo-pascals. Measurements were taken with a drop-cone penetrometer equipped with a 10 kg weight and a 70-cm shaft. These measurements

of PR were taken as a proxy for soil compaction, the goal being to establish whether different areas of the site revealed different but distinct and characteristic profiles. Furthermore, anecdotal evidence and unpublished data suggest that areas of high traffic and house platforms exhibit higher compaction or PR than areas used for cultivation. It was also expected that areas of extremely low PR could indicate the presence of voids, features, or funerary urns. Thus, the instrument was also seen as a potential controlled soil probing mechanism that could be used to direct excavation to areas of the site that superficially appeared no different than other areas.

Within Embrapa methodology, it is customary to perform three repetitions with the drop-cone penetrometer for each locale sampled, where a sampling locale corresponds to a soil type. A soil type or pedon, as defined by Embrapa personnel in particular, and by soil scientists in general, usually refers to an area that far exceeds the dimensions of the North Precinct in size. Because this project aims to understand site spatial organization at the level of the individual or household, I created a unit of analysis called the “spatial unit,” which is defined through probing with the soil auger. This unit corresponds to a soil type or pedon conceptually, but is dimensionally of a much smaller scale, and has been created to facilitate spatial parsing of the site. I thus consider performing three repetitions of PR/TDR measurements within an area that I have defined as a continuous spatial unit analogous to the procedure followed by Embrapa personnel. Definitions of discrete spatial units were created and modified in the field by feeding data obtained through coring back into a sampling model. For sampling locales that were deemed unique in their outward morphology, three sets of measurements were taken around each core, spaced roughly 10-15 cm apart. When a series of adjacent locales considered to represent the same spatial unit were deemed sufficiently similar after the first set of PR readings, one reading at each of three adjacent locales was considered equivalent to three readings at one locale.

Alongside the PR measurements taken with the drop-cone penetrometer, soil moisture measurements were taken with a TDR soil moisture meter in order to account for variability in penetrability due to differential moisture. The TDR utilized was equipped with a pair of sensors 10 cm in length, thus permitting moisture measurements of soil within a 20 cm radius. For this reason, TDR readings had to be taken in alternation with the removal of auger buckets or core levels. TDR measurements were taken vertically along the soil auger or core every 20 cm starting with a depth of 10 cmbs. The length of the instrument and the size of the sampling column produced by the Dutch auger permitted sampling only to a depth of 50 cmbs, which provided readings valid up to 60 cmbs. Measurements with the drop-cone penetrometer were also taken only to a depth of approximately 60 cmbs, slight variations in final depth a consequence of the compaction of the soil at the penultimate reading of the instrument. As a final note on instrument specifications, the TDR is only suitable for measuring moisture of soils that contain relatively few voids or stone-like objects. Additionally, the probes themselves are relatively thin (less than 4 mm in diameter) and pliable, and thus not suitable for insertion into concreted soil horizons. Thus, sampling with the TDR was occasionally precluded by the soil or sedimentary structure, as was noted on the auger/core field forms. In these eventualities, testing with the drop-cone penetrometer was not suspended. Sampling with the TDR was temporarily suspended when inclement weather prevented the use of the TDR, which was not weather-proofed, and also immediately after heavy rains, which created waterlogged conditions in some portions of the site.

Initial results with the drop-cone penetrometer suggested that the instrument was suitable for distinguishing between plaza and mound contexts, and especially for finding near-superficial lenses of laterite. Cases in which an extremely low PR reading seemed to indicate an interesting sub-surface feature were tested (e.g. Sondage N913 E461), and invariably were revealed to be bioturbations devoid of cultural materials. PR data have not been calibrated to account for moisture readings as granulometric data essential for this calibration were not obtained in time for inclusion in this work. However, it is worth noting that soil moisture readings varied little over the course of the transect sampling operation, as special care was taken to avoid sampling during or immediately after a heavy rain.

Excavation protocol: on-the-go sampling.

Excavations were delineated and conducted following standard CAP protocol. Units were demarcated within the existing grid, receiving the coordinates of the northeast corner of the 1 x 1 m sampling unit, which also functioned as the unit identifier. Thus, operations consisting of more than one contiguous unit would be referred to as a series of consecutive coordinates. Depths were taken from the ground surface at an arbitrarily defined location, the selection of which was usually driven by the presence of vegetation and superficial features. Excavation was conducted in arbitrary levels of 10 cm, and most artifacts were lot-provenienced within each level, unless they were deemed to fall within a more specific provenience such as a feature or concentration of macro-remains. Artifacts and ecofacts generally encountered include ceramics, charcoal, and less frequently, faunal remains and lithics. We also uncovered fragments of varying size of trempe, a fragile, low-fired clay artifact thought to have been used to support vessels over fires. In accordance with CAP protocol, due to modern agricultural activity and the prevalence of slash-and-burn practices in the region, charcoal encountered in the uppermost 20 cm of each unit was not collected. All remains of the matrix not collected as part of bulk or spot samples (see below) was screened on-site through 5 mm mesh. Select macro-artifacts or charcoal samples were point-provenienced. All material collected was assigned a Provenience Number (PN) that denotes its three-dimensional location at the site, whether that location a lot (corresponding to a level, feature, concentration, etc.) or a point in the matrix.

According to CAP protocol, a *feature* is defined as a bounded entity that is evidenced by soil color distinct from the surrounding matrix. It may or may not exhibit a distinct texture or artifactual density, but generally can be defined as a deposit that has been used to fill a negative feature such as a cut. The term *concentration* is more loosely or subjectively defined, and usually pertains to areas of a unit that exhibit an unusually high density of macro-artifacts in comparison to the surrounding matrix. Concentrations of ceramic material are only deemed significant if the fragments appear to belong to a reconstructible vessel or if fragments co-occur with other kinds of remains. From a depositional perspective, a feature can be defined as representing a minimum of two actions: a cut and the subsequent deposition of a fill. In contrast, a concentration is more analogous to an artifact scatter, consisting of a minimum of one action, a depositional event during which related remains (artifacts and sediments) were deposited in the same locale. Features are numbered continuously across a site; hence each feature within a site will have a unique feature number, and at minimum one PN. Concentrations, like lenses and point-provenienced remains, are distinguished from the level only by a distinct PN

Collection of bulk soil samples of standardized volume, known in project nomenclature as *Amostras de Volume Constante* (AVC, or Constant Volume Sample), has been standard in

CAP excavations since at least 2002 (Neves et al. 2003), although the size of the sample collected has varied across sites. At Antônio Galo, AVCs were collected from the northeast quadrant of each 1 x 1 m excavation unit, including from adjacent units excavated, for the purposes of flotation and microanalyses. At the start of each level, a square measuring 25 x 25 cm from the northeast corner of the unit was demarcated. After the rest of the 10 cm level had been excavated, the AVC was collected in its entirety, without screening or intentional removal of ceramics. Because the AVC was the last sample collected from each level, macro-artifacts that appeared at the intersection of the AVC boundary and the rest of the unit were collected as part of the AVC; macro-artifacts that appeared at the boundary of the AVC and adjacent unexcavated units were left in situ. Evidently in some cases this has the potential to affect the total volume of soil collected as part of the AVC. Nonetheless, this approach is seen as a legitimate attempt to calculate concentration of artifacts as volume percentages, and is analogous to the use of the soil cylinder or bulk density sample taken as part of pedological sampling. In this case, the volume considered as a unit of analysis is the *in situ* volume of archaeological remains. AVC samples, which ideally corresponded to 6.25 L, also received unique PNs. Given the success of flotation operations undertaken this season, there are plans for increasing the size of the AVC in the future, thus mitigating the effects on matrix sample size effected by encountering a context consisting of densely-packed macro-artifactual remains.

Spot samples of anomalous deposits or stains in the matrix were collected over the course of excavations. This includes soil stains associated with features, the archaeological matrix surrounding concentrations, and lenses or deposits of unusual material encountered (e.g. ash lens [PN 1527] collected from unit N854 E468). Where possible, a minimum of 1 kg (estimated by volume) of material was collected from each context of interest for microanalyses and curation. Under my discretion, or that of Myrtle P. Shock, our visiting paleoethnobotanist, larger samples for flotation were also collected from select features and concentrations of charcoal. In order to ensure that a ‘control’ sample was collected to serve as the basis for comparison of anomalous deposits such as feature fills, aspects of the AVC were examined. If the AVC was deemed representative of the level in which the feature appeared, it was considered the ‘control’ sample for a given anomalous sample collected within that same level. In some cases, the AVC itself consisted of an anomalous deposit, and thus an additional bulk sample was taken from within the appropriate arbitrary level, to serve as the control sample for comparison with the AVC and other anomalous deposits.

Interpretation and sampling of pedo-stratigraphic profile.

At the conclusion of excavation of each unit, a detailed drawing of one or two representative pedo-stratigraphic profiles was produced at 1:10 scale. During this phase, interpretations were made regarding the main depositional features visible in the profile, with the aid of data from field notes and field forms. The excavators, Moraes, and I participated equally in these discussions. In keeping with CAP protocol, Layers were labeled in roman numerals, (I, II, III, etc.), in ascending order from bottom to top. To qualify as a Layer, a horizontally distinct unit had to correspond to units that appeared elsewhere on site. Other distinct depositional units were dealt with in the following manner. If a unit was part of a feature, it was designated with a feature number, and if appropriate, a lens number (e.g. Figure VI.4.a). If additional stratigraphic distinctions could be identified within a Layer, that layer was subdivided and labeled with the appropriate roman number and a letter (e.g. Figure VI.4.b).

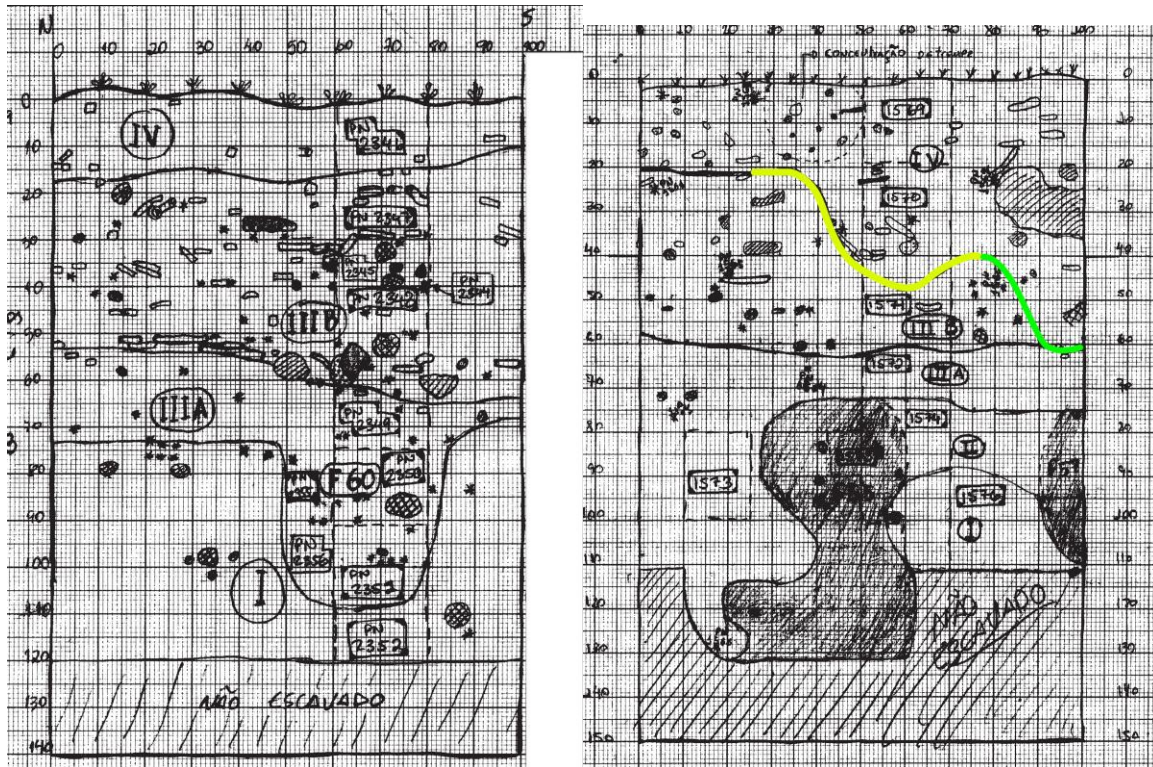


Figure VI.4: Sample profile drawings: a) Unit N895 E509, east profile; b) Unit N854 E468 east profile, showing proposed Features A (yellow) and B (green).

Given that this project was designed, in its chief orientation, to comprehend site formation processes by parsing depositional and pedogenic processes, it is worth addressing the aptness of the application of the term ‘Layer’ as it is commonly used by PAC archaeologists. In this consideration, I will apply some of the concepts derived in Chapter 5 to the problem of interpreting archaeological profiles that contain both pedological and sedimentary characteristics. From the perspective of an earth scientist, the “Layer” designation utilized by the CAP might seem problematic, as some of the “Layers” identified archaeologically in fact correspond to pedogenic horizons. Nonetheless, at least in the case of Antônio Galo, it is quite clear that some of the “layers” identified by members of the project trained strictly in archaeology do correspond to sedimentary beds or strata. The result, *prima facie*, is a confusing nomenclature whereby “Layer” represents both pedogenic and sedimentary horizontal units, where technically it should only refer to structures resulting from depositional processes. However, the four horizontal units identified at Antônio Galo make interpretive sense, as will be demonstrated below. Thus, for the sake of interpretability, simplicity, and adherence to CAP terminology, the term ‘Layer’ will be preserved in discussions of site structure, as referring to the four major horizontal units that occur across the site and thus serve to link discrete archaeological excavations.

Once the pedo-stratigraphic profile was discerned, drawn, and described, a column of samples was taken across the discrete units or contexts (Layers, features, lenses) defined in profile. Because these samples were taken from within, rather than across Layer boundaries, they were considered preferable for the purposes of microanalyses to the AVC, which was taken at arbitrary 10-cm intervals and in many cases contained mixed contexts. Along with bulk samples of at least 1 kg, bulk density samples were taken from each unit sampled as part of the sampling column. These samples were taken using metal cylinders measuring 5 cm in height and 8 cm in diameter. In contrast with sampling procedures employed by Embrapa, sample cylinders found to contain pieces of ceramic were not discarded, as ceramics are seen to be part of the archaeological matrix. Not only are ceramics an integral part of the site, they also have hydrological, thermal, and potentially nutritional (Kern et al. 2004) effects on the soils in which they are embedded. Local anecdotal evidence also suggests ceramics have significant, observable effects on agricultural yield.

Furthermore, it was determined that the selection of cylinder samples that evidenced no ceramics near the top or bottom of the cylinder would introduce undue bias into our sample, as it would be impossible to gauge in the field if a cylinder sample contained ceramics that were not visible from either surface of the sample. Hence, it was determined that, if a sample emerged with an embedded ceramic fragment, efforts would be made to cut the fragment to match the surface of the cylinder sample. This was necessary in order to ensure a known volume for the sample, as well as to adequately cap the sample in the field for transport to the laboratory. Conversely, areas of the profile that contained large (> 5cm) ceramic fragments, or areas that were particularly ceramic-rich were avoided for both practical and statistical reasons. Despite a wish to avoid sample bias by selecting against sampling in areas of especially high ceramic density, this approach was preferable as extremely large ceramics would prevent adequate sampling with the sample cylinder. Statistically, ceramic fragments significantly larger than 5cm in any dimension are likely to be at least two centimeters thick, given the fragmentation rate at this site. Thus, the presence of a large ceramic fragment in a cylinder with a 7-cm diameter and a height of 5 cm would consist of at least 40% of the cylinder sample. None of the contexts excavated contained 40% ceramics by volume, and thus the inclusion of a ceramic fragment of

this size in a sample would have definitively biased the sample. Bulk samples were generally taken from the center of the area designated for each sample; disaggregated samples from the column were taken across the entire designated area, in order to obtain a sample that represented the entire layer sample. A buffer of 2-3cm was left between layers or sample areas, in order to avoid mixing of contexts, and material within this buffer zone was discarded.

In cases where the examination of profiles introduced new questions, additional spot samples were collected, up to 1 kg per sample depending on the size of the anomaly encountered. In most cases, these spot samples were taken in order to address specific questions regarding formation processes, and it was not always possible or desirable to take concomitant bulk density samples of these deposits. Care was taken to ensure that spot samples were always paired with a 'control' or comparative sample from the surrounding matrix. The examination of profiles also revealed anomalous interfaces which could be better explained through micromorphological analyses. These samples were thus collected even though it was not clear whether a micromorphologist would be available to analyze these samples. We engineered "boxes" for the micromorphological samples utilizing clean straight-sided two-liter polyethylene bottles, plastic film, and masking tape.

Lastly, the extended availability of borrowed soil sampling equipment from Embrapa provided a good opportunity to run some verifiable tests with the PR/TDR equipment. If the aim of the PR/TDR experiments was to determine to what extent subsoil features could be detected without unnecessary excavation, or to track the position of certain kinds of horizontal units across a site with minimal temporal investment, it seemed logical to apply similar methods with this equipment in areas where the pedo-stratigraphic profile was well understood. Hence, in conjunction with column and spot sampling program, I implemented a testing program with the PR/TDR equipment in which the matrix immediately behind a known profile was tested, with a view to determining how well the PR/TDR equipment predicted the layers discovered through excavation. Depending on the size of the excavation, five to seven points along the top of the profile in question were selected. One repetition was performed with the PR at each of these positions, and three repetitions were performed with the TDR at a representative point along the profile. Given the possibility of sampling to a deeper level with the TDR, measurements with the drop-cone penetrometer were performed for the full (70 cm) length of the shaft, and TDR measurements were taken to a corresponding depth of 70 cm.

Field processing of material recovered

Materials recovered on site included ceramics, trempe fragments, lithics, fauna, charcoal, and bulk samples. Most artifacts were bagged on site according to context, and later catalogued and stored in PAC laboratory facilities in Manaus at the end of the field season. A few isolated finds of whole or mostly whole trempes, uncovered for the first time in their intact form at Antônio Galo, were treated differently. We were lucky to have a visiting conservator from the MAE-USP with us shortly after the first such find was uncovered. Silvia Cunha Lima trained us in methods for stabilizing and ensuring maximal structural preservation of these fragile artifacts on site. Intact or nearly-intact trempes had never been found in archaeological contexts in the Central Amazon, and the discovery of these contexts gave us important insights into the nature of the technology, which shall be discussed in later chapters.

Our visiting paleoethnobotanist M.P. Shock made possible on-site processing of bulk samples. Shock began by running flotation experiments with various samples of local non-archaeological soil and a number of dispersing agents. Once she had determined the optimal steps in preparing samples and processing them through her field-built flotation machine, she began processing bulk samples from the field. She was assigned a team of four students each day, corresponding roughly to excavation teams, to assist with bulk sample processing, sub-sampling, and flotation. This procedure also permitted an immediate review of material recovered from the field, allowing for error correction and clarification with the aid of the sample collectors themselves. Aside from being extremely advantageous to the project in terms of guaranteeing data clarity and minimizing recording errors with regard to the samples, this proved a valuable learning experience for the students, as they were assigned the review and processing of samples from their respective excavation units.

Processing of soil and sediment samples.

Shock's experiments revealed that air-dried soil provided the best results for flotation. Thus, field samples stored at the house were first processed by drying. Sample drying initially consisted of leaving sample bags open, but by the time the technique was perfected, samples were laid out on labeled Tyvek during the day and collected at night. We found that, on relatively dry days, samples dried in less than four hours if turned over regularly. Shock's presence at the house during the day was essential for the soil drying operation as, even after the end of the rainy season, the weather can turn in less than half an hour. Thus, it was imperative someone remain behind to collect the samples and bring them to shelter in the event of rain. Drying of samples in the sun is the most efficient method of obtaining field-dry samples that are in adequate condition for storage. However, it requires an investment in terms manpower and infrastructure that has not yet been perfected for the field, especially given the possibility of contamination or sample loss. Some concerns also exist around possible sample contamination. We are designing a field-ready sample-drying structure that can be used for soil or float samples. This will facilitate soil processing in the field, which is not only essential for flotation and preparing samples for curation, but also for minimizing the amount of cargo to be transported at the end of the season. This procedure should be incorporated regardless of whether samples will be floated in the field, as we have found that the longer field-moist samples sit in plastic bags, the more difficult it becomes to dry, subsample, and disperse the samples for the purposes of flotation.

Once the samples were dry, a sub-sample was taken for microanalyses. Upon my request, Shock set aside approximately 500 g of sample using a measuring cup. This minimum weight was calculated to include approximately 200 g for sedimentological and chemical analyses; 200 g for future phytolith analysis; and an additional 100 g for curation. The first few samples were weighed inside the tared measuring cup, and found to vary in weight between 500 and 700 grams; thereafter the measuring cup was used as a measure for sub-sampling. Bulk samples were thus curated in the field and prepared for laboratory analysis.

On-site flotation.

After sub-sampling, the volume of bulk samples was measured in a bucket calibrated to the half liter. Because of the high proportion of clay in the local soils, flotation had been a challenge in the past. In order to successfully pass the samples through recovery screens as

small as possible, Shock had to determine a suitable dispersal procedure, which would make use of a chemical agent to deflocculate the clays. Shock tested the efficacy of sodium carbonate ($\text{Na}_2(\text{CO}_3)_2$) and sodium bicarbonate (NaHCO_3), which are both obtainable in Manaus. The ideal dispersant is probably Sodium hexametaphosphate (NaPO_3), also known as HMP or Calgon, which is not readily available in the Manaus region. Additionally, the Soil Physics Laboratory at Embrapa in Manaus utilized sodium hydroxide (NaOH) as a dispersant for particle size analysis, which may also be considered, although its higher reactivity might make it less than ideal for the field. It is desirable to find a dispersant that does not contain CO_3 in order to avoid the contamination problems caused by the introduction of foreign carbonates to charcoal samples that could be used in dating applications.

Shock's experiments determined that sodium carbonate was by far and away the more effective dispersant. Samples were prepared for flotation by splitting into samples of 6-9 liters and soaking each subsample in a 15-liter bucket with approximately 40g of sodium carbonate and enough water to saturate the sample. Samples were allowed to sit in solution for a minimum of 10 minutes and a maximum of 1 hour, and were stirred occasionally with a wooden rod. Because of a lack of sufficient water pressure, samples were agitated by hand in the buckets and poured through the flotation machine, which consisted of a < 1.5 mm mesh lower screen for heavy fraction recovery and a < 0.5 mm screen for light fraction recovery. After flotation, samples were hung to dry in bundles made of labeled Tyvek and later bagged in 1-3 kg plastic sample bags labeled according to standard CAP protocol. There is no immediate plan to analyze the light fraction samples, but heavy fraction samples collected have become a significant source of data for this dissertation and will be further discussed in Chapter 7.

Field research narrative

As stated above, field work began on June 23, 2009 with brush clearing across the precinct, with a view to exposing the entire circle of mounds that comprised the North Precinct and spaces immediately behind the mounds. Over the course of the first day and a half of field work, the field crew cleared the entirety of the North Precinct that lay within the property to which we had access, which appeared to encompass the majority of the circular village context. Once this had been achieved, we set about re-locating the site grid as described above, taking the opportunity to introduce students to appropriate concepts and instruments of cartography, the latter including a total station and prism, dumpy level and stadia rod, tape, and compass.

Once the appropriate parameters were defined, we laid out four excavation units on mounds 12, 14, 16 and 18. The field class, which consisted of 27 students, was divided into five teams of five to six students, each of which would theoretically be responsible for excavation at a given locale. Throughout the field season, excavation teams were relatively consistent, with slight variation incurred by the rotation of students through the survey and soil/sediment sampling and testing tasks.

During the first week, one of the excavation teams was assigned to help Flexner gather data for the topographic map. Upon the arrival of the soil sampling equipment on June 29, the students were brought together for a brief introduction to and demonstration of the use of the equipment, which included a soil auger, a TDR moisture meter, and a drop-cone penetrometer. From June 29 through July 1, students were drawn from the various excavation teams to aid in collection of soil

data along transects designed to provide information on areas not actively being excavated. Subsequently, this equipment was put to use in the vicinity and along profiles of test units. As will become clear below, geoarchaeological sampling was also incorporated into ongoing excavation of units, although initially this process was somewhat imperfect. As communication among the senior archaeologists on site improved, this process became smoother and the quality of geoarchaeological samples also improved.

Proceedings of auger and core sample collection

Auger and core sample collection proceeded simultaneously with excavations. The goals of this set of tests were to provide preliminary data that could direct excavation in the latter part of the season, but also to test the extent to which compaction and auger data could be used to understand the site without the need to excavate. The first set of auger tests implemented at the site in 2009 were part of the ‘cross-hair’ transects designed to bisect the North Precinct from north to south and from east to west. Subsequently, other areas of the site were targeted, including surface anomalies and portions of mounds not clearly understood. These targeted strikes were designed with the results of the first set of augers in mind.

Village precinct cross-section.

The first set of auger tests implemented at the site in 2009 were part of the ‘cross-hair’ transects designed to bisect the North Precinct from north to south and from east to west. Testing began on June 29 at coordinates N840 E450 and proceeded northward along line E450 until we were satisfied that the edge of the site had been reached. In conjunction with augering, PR measurements were taken with the drop-cone penetrometer and moisture measurements recorded using the TDR moisture meter. The initial point was selected so as to fall at the edge of the clearing we created at during the first few days of the field season. This point was also thought to be behind mound 13, thus providing the opportunity to map the general characteristics of the pedo-stratigraphic profile either side of the mound. Deposits encountered at coordinates N950 E450, the northern extent of the transect, included a single ceramic fragment and a thin, “very dark brown” (10YR 2/2) superficial deposit. These remains were deemed to be colluvial. The slope that began just behind mound 16 continued toward the water, and it seemed likely that any dark deposit recovered near the surface farther north would be the result of colluvial deposition. Hence, this point became the northernmost point along the E450 transect, which was concluded on July 2.

This transect provided a cross-section of the North Precinct from north to south N850 E450 was that they belonged to mound 13; this was borne out by the results of excavation of unit N847 E450, the profile of which seems to match results from the neighboring augers. Auger N860 E450 appear to consist of a slightly modified anthropic A horizon which grades gradually into the yellow B horizon. The underlying laterite crust is somewhat shallow at this locale, appearing at 65 cmbs. The next three tests (N870 E 450, N880 E450, and N890 E450) revealed that the exposed laterite observed across the western and southwestern portions of the site was not a deposit, but rather an exposed laterite crust. This crust was also encountered at shallow depths at coordinates N910 E450 and N920 E450. Anomalous results from point N900 E450 will be addressed below. Continuing northward, auger N930 E450 was not performed, as we were precariously close to unit N931 E452, which was open and in progress. Because we

suspected we might need to expand the unit, we avoided augering in that area. Furthermore, it was reasoned that any information we might have obtained through augering would also be available and at least equally informative at the southwest corner (N930 E451) of the unit in question. Auger N940 E450 was sufficiently interesting to merit its own paragraph (below). Auger N950 E450, as described above, was the end of the transect.

Testing between N870 and N890, and at N910 along transect E450 revealed similar results, where a high concentration of laterite fragments (>50 by volume) was observed in the initial (0-20cm) level, and the laterite/plinthite crust was reached at 20 cmbs. However, auger N900 E450 deviated significantly from this pattern, wherein a 25-cm thick grayish brown (10YR 4/2) layer transitioned over the course of an additional 25 cm to a reddish-yellow matrix to a saprolitic laterite crust, which was reached c. 50 cmbs. This led us to place intermediary augers at N895 E450 and N905 E450. While N905 E450 represented a gradual transition between N900 E450 and N910 E450, auger N895 E450 exhibited characteristics even more anomalous than N900 E450, wherein the underlying laterite crust was not reached within the 80-cm depth of the test. Testing this locale was de-prioritized during this field season, but should seriously be considered for future excavations at this site in order to ascertain whether this anomaly is a natural occurrence or a result of deliberate excavation by past people. The proximity of this locale to a low structure or berm identified near the center of the plaza will be discussed below. Chemical testing of the recovered samples can also shed light on this issue.

Auger N940 E450 was the first test to exhibit bone fragments in the matrix. Attempts were made to collect these fragments, observed in level 20-40 cm, but they disintegrated upon removal from the extremely plastic black (10YR 2/1) layer in which they were embedded. This auger test also revealed ceramic fragments in the upper 60 cm and fragments of burnt earth and charcoal in its lowest (60-80 cm) level. The gray color and smooth texture of the lowest layer of the auger test and the presence of a variety of kinds of highly-fragmented artifacts in the matrix suggested a secondary context that had experienced a great deal of mixing. I suspected we might have found a midden pit and suggested we open an excavation unit near the auger hole to clarify these contexts. We thus plotted a unit at N941 E452, which is described in detail below.

The east-west transect, along northing N900 was initiated on July 2, with the establishment of the eastern extent of the transect at N900 E530. This locale was deemed the edge of the site, as the terrain drops steeply to the east of this point, into the semi-annually inundated channel that bounds the eastern edge of the site. From N900 E530 to N900 E410, samples were taken every 10 meters, to obtain an east-west cross-section of the plaza. Points N900 E530 through N900 E510 traversed the northern portion of Mound 15, just north of the apex of the mound, at a point approximately 35 cm lower in elevation than the highest point on the mound. Level 0-20 cmbs of auger N900 E530 revealed a matrix exhibiting low degrees of anthropic modification, 10YR 4/2 “dark grayish brown,” a color more consistent with terra mulata than with terra preta. The presence of ceramics in this layer is likely to be a result of colluvial effects, given the relatively steep slope of the locale tested. From 20-60 cmbs, the matrix becomes slightly yellower, but darker (10YR 3/3 “brown”) mottling appears in the lower layer. The significant presence of laterite inclusions (30%) in the upper 20 cm of the profile, followed by a lack of similar inclusions in subsequent layers is unusual, suggesting these inclusions might have been transported there. Elsewhere on site, laterite fragments have been seen used as construction material.

Of note is the fact that evidence from the transect did not reveal the underlying laterite crust within the 80-cm depth of the auger tests across the mound, and the unit excavated to the south also did not reach said layer at its maximum depth of 120 cmbd. Because of potential complications introduced by the incline, and the lack of data on the depth of the laterite crust, it is difficult to assess whether the presence of laterite in near-surface deposits could be the result of the erosion of a natural layer, or whether it was part of the archaeological context.

Points N900 E520 and N900 E510 presented contexts similar to each other, featuring a very dark (10 YR 2/1, “black”) and relatively thick (35-40 cm) terra preta layer, followed by a brown or yellowish-brown layer for the remainder of the auger. The terra preta layer features ceramic remains, charcoal, and burnt earth or trempe fragments, while the subsequent layer is characterized by small charcoal inclusions. Interestingly, N900 E510, the highest point tested on the mound, seems to have slightly lighter or thinner anthropic layers than N900 E520, which suggests a slightly heavier deposition toward the back of the mound, if we consider the front of the mound to face the interior of the plaza.

During the implementation of transect N900, point N900 E500 was considered part of Mound 15 and points N900 E490 and N900 E480 were considered part of the plaza. However, after many days of observation and field-walking, we noted that there seemed to be a sort of ramp or low platform that extended from the northwest extent of mound 16 toward the west, into the plaza region. This structure, which I call ‘Structure B,’ along with the low berm (Structure C) observed immediately west of Mound 30 (see above, Figure VI.2) gave rise to the idea of implementing core sampling along transects E483 and E493, which will be discussed below. With this in mind, field data from the three points was re-examined in the post-excavation phase. Careful analysis shows that N900 E500 departs somewhat from the pattern observed at N900 E520 and N900 E510, which may be because N900 E500 is located at the edge of mound 15 or at the edge of Structure B. The terra preta layer here is somewhat lighter in color (10YR 3/1 “very dark grayish brown”), and the subsequent layer is significantly yellower than the analogous layer observed at the two points to the east, suggesting it is in fact part of a different depositional context. N900 E490 and N900 E480 follow a very similar pattern, with a slight distinction at N900 E480, where the lower levels, which apparently represent the original B Horizon of the site, are slightly redder than to the east. This is likely due to the proximity of the laterite crust, which was revealed for the first time along this transect at N900 E480. A consideration of these deposits in light of the Layers described below, along with data from transects implemented later, suggests that points N900 E500, N900 E490 and N900 E480 are considered part of Structure B, although N900 E480 probably demarcates the very edge of this structure, and deposits there may be colluvial.

Points N900 E470 through N900 E440 are considered part of the plaza and revealed a relatively consistent pattern of deposition in the east-west direction, although it is worth noting that the N900 transect constitutes an anomaly in comparison with the E450 transect (see above). This may, in part, be due to the proximity of the transect to Structure A, located in the north-central portion of the plaza. Transect N900 seems to have traversed the southern portion of this berm, especially at points N900 E460 and N900 E470, where the terra preta layer is arguably slightly thicker and darker than it is to the east and west, and also where surface scatters of ceramics were identified. At these two points, small charcoal fragments are present to a depth of 60 cmbs, or until the contact with the laterite crust was reached. At N900 E440, there is a definitive thinning and lightening of the terra preta Layer. The laterite lens is reached at 40

cmbs. The strikingly different characteristics of augers along this transect compared to the depositional pattern expected given findings along transect E450 led to the implementation of a few additional cores and augers, as well as intensive compaction testing in this region. These will be explained, illustrated, and analyzed in the section below.

Point N900 E430 falls in the proposed borrow pit used seen as the source location for sediments employed in raising of mounds (especially Mound 30), and the remaining cores plotted along this line fall inside a small, narrow gulch that leads down to the channel below. At point N900 E430, surface deposits are very dark, but consist of at least 50% laterite, which suggests these deposits are colluvial terra preta sediments from the nearby mounds that have percolated among the in situ ironstone deposits. Test N900 E420 presents a shallow colluvial deposit over a thick (40 cm) yellowish-brown clay-rich layer that approaches the laterite crust at 60 cmbs. The final test along this line, N900 E410 presents a very thick (50-cm) dark, slightly sandy and ceramic-rich deposit that we interpret as colluvium from Mound 17, which lies directly to the north of this point. The deposits uncovered near this portion of Mound 17, described below, are very similar to those recovered at N900 E410. The laterite crust sits at approximately 65 cmbs. The thickness of this colluvial deposit and the relative shallowness of the laterite crust here, combined with the proximity to the borrow pit identified to the southeast of Mound 17 suggest this portion of transect N900 follows a narrow ramp or gully that would have run down toward the shore.

Core N990 E450 – Off-site sample.

With the intention of establishing an appropriate locale for placing an off-site unit, we decided to test the region to the north of the northernmost point on transect E450. The northerly direction was chosen for the off-site unit as it provided the greatest extent of relatively gently sloping terrain in a portion of the peninsula that we had categorized as ‘off site.’ Given the continuous nature of the inhabited landscape at in the Lake Limão region, encountering a completely unmodified context within this landform would have been almost impossible, especially given the shape of the landform. As far as our surveys suggested, most of the high portions of the terrace upon which Antônio Galo sits had been demonstrated in 2004 to contain terra preta. The northerly direction was preferable to any other direction because of slope, and also because no terra preta deposits and no ceramic remains had been recovered through coring north of approximately N935 during the 2004 survey. The region to the north of the North Precinct did feature an somewhat darker A horizon, compared with Lago do Limão Oxisols, that was consistent with anthropogenic dark earths sometimes identified as *terra mulata*. However, we proposed that, given the sloping nature of the landscape, most of this slightly darker horizon was likely to be colluvial, or in the language of pedology, a result of soil creep.

This core was plotted in advance of a test unit, in an area thus considered to lie well beyond the limits of the site. In an ideal world, the purpose of such a unit would be to provide soil samples that could serve as a control samples corresponding to pre-anthropoc periods. Because the Lake Limão region is considered to be a continuous landscape punctuated by higher and lower concentrations of archaeological material and anthropic signatures, I consider it extremely difficult to obtain such a sample in this region with any certainty. Given the morphology of the Antônio Galo peninsula, it was considered an impossibility on this landform. Hence, the northernmost extent of the peninsula was determined to be the best case scenario. The

off-site unit would serve as an example of minimally modified soils, to which the more substantial modifications observed on site could be compared.

The original intention had been to plot this test core 50 m north of the northernmost point on the E450 transect (N950), as the usual distance between transects used by the CAP to establish the extent of sites varies between 25 and 50 m. However, because water levels were unusually high during the 2009 field season, it was determined that plotting a core anywhere near N1000 would place the off-site sample so close to the shore as to result in the excavation of waterlogged contexts. Waterlogged contexts undergo significantly different pedogenic processes than non-waterlogged contexts, and this would have resulted in a sampling of the site in a region possessing little comparative value for the rest of the site. Thus, we shortened the ideal distance to 40 m instead, plotting a core at N991 E452. At the time this point was established, the original markers for the transect points had been removed, and the total station had been taken to a different project. Hence, the point for the core test was shot in using a dumpy level to extend the alignment obtained from the east profiles of units N932 E452 and N941 E452, and distance was verified using a hand tape.

This location exhibited slightly different environmental characteristics than the rest of the site. First, it was not under any kind of cultivation, and having been the property of a different landowner than the majority of the North Precinct, had been subject to distinct management over the years. Vegetation in this region was a tall, secondary-growth forest known as *capinarana*, typical of the somewhat sandier soils that characterize shorelines. Mature *capinarana* consists of tall, slender vegetation that is somewhat denser than mature secondary-growth that characterizes more clay-rich soils, but still relatively open in the understory. This more mature growth suggested a much longer period of fallowing than the region immediately surrounding the orchards at the top of the peninsula. One of the field assistants, who grew up in the region and has a deep knowledge of the history of Lago do Limão reported that this sandy, gently sloping portion of the landform had once been the site of tomato farming. Indeed, a careful study of the surface revealed low, rolling alignments that suggested the remains of agricultural furrows.

Core N991 E452 revealed slightly darkened (10YR 4/2 “dark grayish brown”) soil within the first 20-cm level, hand-textured as sandy clay. There were a few charcoal inclusions and also small fragments of laterite within the matrix. The next two levels were slightly yellower in color (10YR 5/4 “yellowish brown,” 10YR 6/4 “light yellowish brown”) and classed together for the purposes of the core, and the texture at this (20-60 cm) depth range appeared slightly more clay-rich than the preceding (0-20 cm) level. Small fragments of laterite rock were observed within the upper 40 cm, and small charcoal fragments up to a depth of 60 cm. The final 40 cm of the core were even more yellow in color, field-textured as clay, and increasingly compact as we approached 100 cmbs. Small fragments of laterite are still identified at the 60-80 cmbs depth, but are more rarified than in the previous levels, and are completely absent from the 80-100 cmbs level.

Investigating anomalous surface features.

Once the two cross-hair transects were completed, we initiated testing of the above-mentioned surface anomalies, unusual patterns, and poorly-understood mound features. Based on preliminary evidence from topographic data and observations from field-walking, four areas were designated for further testing with the soil auger, post-hole digger, and the drop-cone penetrometer and TDR moisture meter. Among these I count the berms found in the plaza and

the “tail” of Mound 17. Within the plaza, four areas correspond to low berms or slightly elevated features which seemed topographically or depositionally anomalous within the plaza (see Figure VI.2), and together constitute a fourth sampling stratum I will call the *Inner Structures* stratum. The main goal of these tests was to determine the extent to which we can understand the formation processes of these structures as intentional. First, we returned to the area around N900 E450 and the berm in the north-central portion of the plaza, which I call Structure A. We took this opportunity to examine an additional, slight berm observed approximately 10 m east of mound 28, at the western edge of the plaza, which I have called Structure D. These tests proceeded relatively quickly, and we implemented testing programs at two other locations. Two short transects were installed along coordinates E483 and E493, designed to cover the area immediately to the west of the Mound 15/27 complex, where we had tentatively identified structures B and C. We were also able to complete a set of four cores along the “tail” of mound 17, in order to try to better comprehend the formation and purpose of this structure.

Initial testing of Structure A took place in conjunction with testing of anomalies identified near N900 E450. An intensive compaction study was undertaken with the drop-cone penetrometer and TDR moisture meter, wherein points were taken every two meters along two transects (N903, N905) that were spaced two meters apart. This was done in hopes of obtaining information about the variability of the structure with minimal impact to the site and minimal temporal investment. Data recovered utilizing this instrumentation yielded extremely variable compaction profiles across Structure A. Preliminary conclusions regarding the use of this instrumentation are that the instrument is highly sensitive to extremely small anomalies, and that its applicability as a stand-alone instrument is extremely limited. This is likely due to the size of the area sampled at each point (less than 2 cm²) compared to the frequency and size of inclusions. In addition to the compaction study, Structure A was tested with the Dutch auger, and subsequently with the post-hole digger. Testing with the Dutch auger revealed a somewhat darkened (10YR 3/3 “dark brown”), 20-cm thick A Horizon, followed by a 35-cm thick mottled (10YR 6/8 “brownish yellow” and 10YR 4/3 “brown”) Layer that graded unevenly into a reddish brown (7.5YR 5/6 “strong brown”) B Horizon. These results suggested the matrix of Structure A was mostly a naturally-occurring deposit with a slightly darkened terra-mulata-like A horizon. However, subsequent testing with the post-hole digger revealed ceramics, charcoal, and trempe fragments within the upper 40 cm of the profile. This suggested the existence of at least some artificial deposits within Structure A, either in the form of an anthropic layer or in the form of a pit feature. As was the case with all other Inner Structures discovered this field season, testing of these contexts was de-prioritized in favor of more complete testing of the previously defined sampling strata.

Structure D, the low berm just to the east of Mound 28, was tested next. The point selected for testing, N887 E441, was plotted using tape and compass, taking transect points from line N450 as a reference. This slightly elevated berm is an unusual structure in the middle of a portion of the plaza characterized by the presence of laterite on the surface. The presence of soil on this exposed laterite crust suggested this may have been a built structure, which I have denoted Structure D, for the purposes of this investigation. Due to the large number of samples already collected, we limited testing of this relatively small (approx 5 x 5 m) berm to a single sample. Matrix color varies little across the 60 cm tested, from 10YR 4/2 (“dark grayish brown”) on the surface to 10YR 4/3 (“brown”) or 10YR 4/4 (“dark yellowish brownish”) at

lower levels. Burnt earth and charcoal were encountered up to a depth of 40 cmbs, which further suggests an anthropic deposit at this locale. Laterite inclusions increased in frequency from 20-60 cmbs, and toward the end of the 40-60 cmbs level, these were frequent enough to suggest we were entering the laterite crust. Hence, excavation proceeded no further at this locale.

The area in front of the Mound 15/27 complex was also investigated in detail after we noted the presence of low berms or slightly elevated structures in that area. For the purposes of this study, I have called these Structures B and C, referring to the ramp-like structure that appears to extend from the northwestern portion of Mound 15 and the low berm in front of Mound 27, respectively. Transect E483 was established to cross the highest points of the structures, and E493 was intended to investigate the possibility of a small depression located immediately in front of the mound 16/27 complex. At the time, a detailed topographic model had not yet been generated, but at present it seems clear that E483 intersected Structure C and the very edge of Structure B. Similarly, it appears that E493 passes between mound 27 and Structure C and ends on top of Structure B.

Transects E483 and E493 were implemented using the CAP coring methodology, which utilizes a post-hole digger as opposed to an auger. This was done in order to provide a slightly larger sample of the matrix, including, specifically, higher proportions of ceramics per sample taken, so as to gauge not only the depth and color of layers, but also to have a better sense of depositional patterns. Samples of the matrix were also taken in this case, in the manner described above, although matrix sampling was not the primary aim of this set of probes.

Transect E483 revealed relatively consistent deposition, featuring a dark earth layer approximately 15 cm thick, followed by a 60-80-cm layer of yellowish matrix that becomes redder toward its lower half. The terra preta layer is fairly dark (10YR 2/1 (“black”) to 10YR 3/2 (“very dark grayish brown”) along this transect, and is darkest between N895 and N905. Two slight deviations are worth noting. First, toward the southern end of the transect, from N880 through N870, a grayish-yellow Layer immediately beneath the terra preta Layer gets increasingly thicker, and ceramic and trempe fragments occur to a depth of at least 40 cmbs. This is also where a potential feature was encountered at N875 E483, suggested by a difference of 10 cm in the depth of the bottom of the terra preta layer within the 20-cm diameter of the probe.

Notably, the laterite crust was encountered across most of the E483 transect, with the exception of points N880 E483 and N885 E483, which are located near the apex of Structure C. A re-construction of the pedo-stratigraphic sequence along this axis suggests that these points also represent the deepest or thickest deposits between the surface and the laterite crust.

Transect E493 was plotted to be slightly shorter than E483, in the interest of time, but also because it was intended to highlight a perceived depression associated with the mound 15/27 complex. The current topographic model suggests it would have been useful to have continued the transect at least 15 to the north, given that the lowest point in the northeast portion of the plaza was left un-investigated. However, the present results do highlight some important features of the plaza area. First, the color of the terra preta deposit, as in transect E483, is relatively dark, varying between 10YR 2/1 (“black”) and 10YR 3/2 (“very dark grayish brown”). Second, there appears to be a distinct grayish-yellow (10YR 3/2 to 10YR 4/3) layer between the terra preta layer and the underlying B horizon, the latter having a consistently redder hue (7.5YR 5/6, “strong brown”) than analogous contexts from other parts of the site. This transect differs from the one to the west in that the laterite crust is almost completely absent from the upper 100

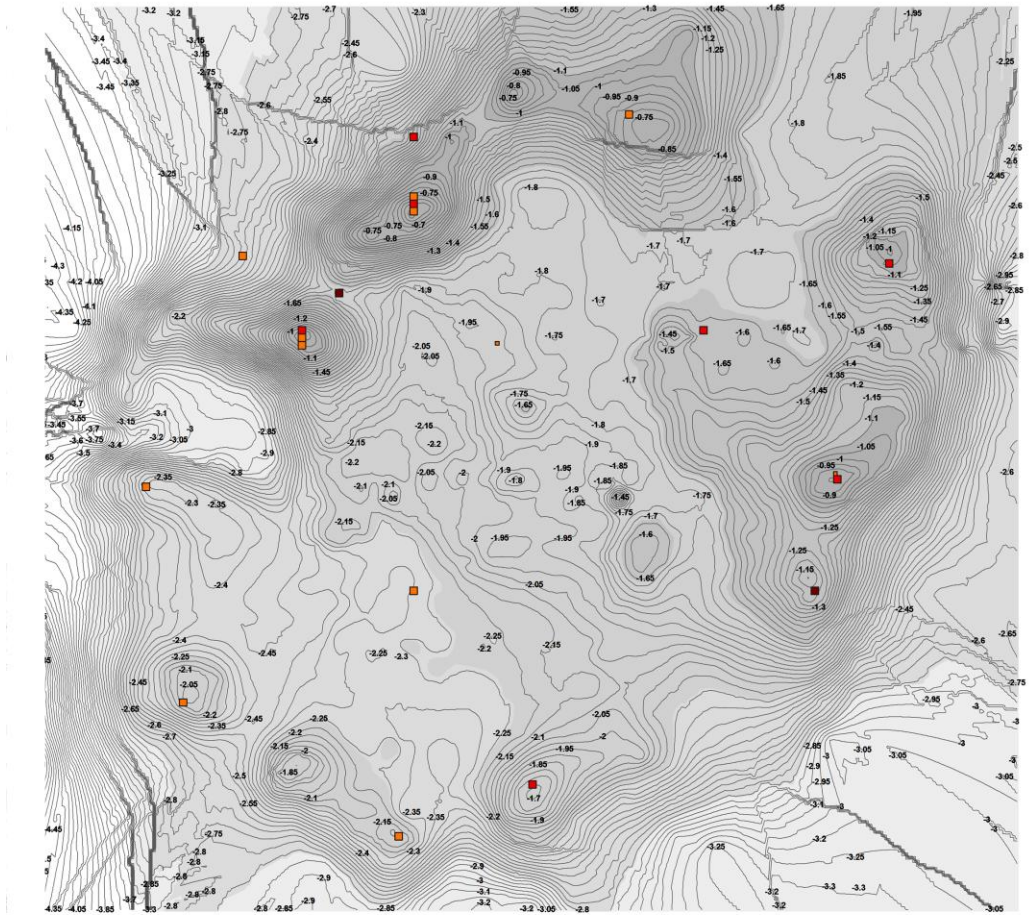
cm of the pedo-stratigraphic sequence investigated, with the exception of points N885 E493 and N890 E493, where it is glimpsed near the bottom of the core. Toward the northern end of the transect, which coincides with the highest point of Structure B at E493, the above-named grayish-yellow layer, which resembles Layer III to a certain extent, appears to be getting thicker at this apex. Finally, the southern end of the transect, represented by cores N880 E493 and N875 E493, revealed the deepest terra preta layer with the least fragmented ceramic remains uncovered within the plaza.

Because of its unusual shape, we resolved to further investigate Mound 17. The trio of units excavated at the top of the mound provided detailed information about the structure and contents of the interior of the mound, and we hoped to complement this knowledge with information about the opposite end of the mound, which seemed deliberately oriented toward the depression or access road immediately to the south of the mound. The purpose of furthering investigation at this locus was to compare the physical properties of the matrix along this portion of the mound to data recovered through excavation at the main body of the mound. Hence, the post-hole digger was selected for this area in order to provide more visibility of macro-artifactual remains, and no matrix samples were collected along this series of cores. We decided to implement this test in the second half of the season, by which point the total station was no longer available; but as we had a number of known points plotted in this area, including the points along transect N900 and the nearby units N913-915 E437 and N894 E416, which had all been plotted using the total station, we were able to plot the desired points for the cores with the aid of a dumpy level, tapes, and a compass.

In general, points sampled across this portion of Mound 17 presented thick, dark deposits and strong evidence supporting the artificiality of deposits to a depth of 55 cmbs at the southernmost (lowest) sample, and to 100cmbs at the northernmost (highest) point sampled. The laterite crust was reached or approached near the 100-cmbd mark for the two middle points sampled, but not at the two extremes of the series. At the southernmost point (N905 E413) this is likely due to the thick accumulation of colluvium near the base of the structure, which is also evident at point N900 E410; at the northernmost (highest) point, this is attributed to the height of the mound itself.

Excavation units.

Excavations began on June 25, when 1 x 1 m units were placed on top of Mounds 12, 14, 27, and 16; Mound 18 was opened on June 28 when the topography crew completed their task. These mounds were judgmentally selected for investigation so as to get coverage of a range of locales around the circle of mounds, as well as to test mounds of varying size and shape (see Figure VI.5). Table VI.1 (below) details the location, coordinates, and dates of excavation for each unit. Excavations on mounds 12, 14, and 27 were completed relatively quickly, and the excavation teams that had been working at these locales were moved to other parts of the site. Initially, there was an interest in investigating non-mound contexts. Units were opened in the plaza, at a point where surface deposits (exposed laterite crust) suggested little archaeological material would be found; and behind Mound 16, where auger testing had revealed a deep, highly plastic gray layer of sediment with tiny fragments of bone, burnt earth and ceramics well below



Legend

- AG_UnitsSampled_N880_E506
- AG_UnitsSampled_N920_E442
- AG_UnitsSampledShape
- AG_Units_Polygons

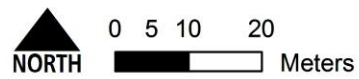


Figure VI.5: Antonio Galo site map showing units excavated and units intensively sampled.

expected depths (see Auger N940 E450, above). Subsequently, additional units were placed in different parts of the plaza, behind mounds 16 and 17, and between mounds 16 and 17.

There was also an interest in investigating mound structures that appeared to belong to a complex rather than a single mound. Surface observations of Mound 15 suggested it consisted of a mound with an upper and a lower platform. Hence, an additional unit (N895 E509) was opened to the north and west of the first unit (N880 E506). Subsequently, similar hypotheses were raised about the relationship between mounds 13 and 29 and mounds 26 and 30. Mound 28 was excavated to serve as a structural comparison for Mound 17, and to investigate the question of the surface depression observed between the two mounds.

Finally two units were excavated outside the limits of the *Behind Mounds* sampling stratum. To the north of the North Precinct, 50 meters due north of the northernmost auger test excavated, an off-site or ‘control’ unit was established. This unit consisted of a 50 x 50 cm sondage occupying the northeast quadrant of unit N992 E452. This locale was placed 40 meters to the north of the northernmost auger test, which had revealed only 1 ceramic fragment and extremely shallow deposits. To the south of the North Precinct, one unit was placed approximately 40 meters to the south of Mound 12, as an attempt to catch a glimpse of the Guarita context to the south.

The sections that follow will detail the stratigraphy and notable features of the eight units selected for further geoarchaeological analysis, highlighted below. I will treat the most representative unit first, and move through variations observed in other units, covering the five mounds first, then the off-mound contexts, and finally, the off-site unit. In addition to samples collected over the course of excavations, samples from each of these units were recovered for flotation and microanalyses during the profile drawing and interpretation phase. This process will also be discussed in detail in this chapter.

Table VI.1: Units excavated at Antôni Galo.

Locale	Unit Coordinates	PN Series	Date Initiated	Date Completed	Geoarchaeological sampling date(s)	Unit Supervisor	Note
Mound 12	N854 E468	1501-1600	June 25	July 6	July 7, 19	LCS	N/A
Mound 13	N847 E450	3401-3500	July 14	July 19	N/A	LCS	N/A
Mound 14	N865 E421	1601-1700	June 26	July 1	N/A	EL	N/A
Mound 27	N880 E506	1801-1900	June 26	July 3	N/A	MSS	N/A
Mound 15	N895 E509	2301-2400	July 4	July 14	July 13-14	FVN	N/A
Mound 15	N896 E509	2901-3000	July 9	July 9	N/A	FVN	SW quad.
Mound 16	N931 E452	1701-1800	June 25	July 20	Jul 21	LGRB	N/A
Mound 16	N932 E452	3001-3100	July 9	July 20	July 21	LGRB	N/A
Mound 16	N933 E452	3501-3600	July 15	July 20	July 21	LGRB	N/A
Mound 17	N913 E437	2601-2700	July 5	July 14	N/A	MSS	N/A
Mound 17	N914 E437	2501-2600	July 5	July 14	N/A	MSS	N/A
Mound 17	N915 E437	2401-2600	July 5	July 14	July 19	MSS	N/A
Mound 18	N924 E516	1901-2000	June 28	July 2	July 19	FVN	N/A

Mound 26	N944 E481	3101-3200	July 10	July 18	N/A	EL	N/A
Mound 28	N894 E416	2801-2900	July 10	July 11	N/A	LCS	N/A
Behind M16	N941 E452	2201-2300	July 2	July 9	July 17	EL	N/A
Behind M16 and M17	N925 E429	3301-3400	July 14	July 17	N/A	FVN	N/A
Between M16 and M17	N920 E442	3201-3300	July 13	July 14	N/A	LCS	N/A
Plaza – W portion	N880 E452	2701-2750	July 6	July 7	N/A	LCS	N/A
Plaza – NW portion	N913 E463	2751-2800	July 7	July 7	N/A	CPM	SE quad.
Plaza – NW portion	N915 E491	3601-3700	July 15	July 18	July 19	MSS	N/A
South of M12	N817 E468	3701-3800	July 14	July 19	N/A	FVN	N/A
Off-Site Unit	N992 E452	3801-3900	July 20	July 20	July 20	ABR	NE quad.

Unit N924 E516 – Mound 18.

Unit N924 E516, located on Mound 18, was selected for further analysis because it most clearly represents the four major horizontal units, or Layers, encountered across the site. Because of this clarity, this excavation will be used to illustrate the sequence of events represented by these Layers, and the reasons for favoring the CAP practice of grouping these disparate units within a single classification. In order to better understand the excavation unit, it is helpful to consider the vertical distinctions as they appeared during the course of the excavation, and to note the emergence of changes in the matrix alongside changes in macro-artifacts, also seen here as sediments that make up part of a sedimentary bed. Details regarding color, texture, and inclusions in the matrix are taken directly from the relevant field forms.

Over the course of the excavation, it was noted that ceramic remains, few and fragmentary in the first 10 cm, grew in size and quantity over the course of the first 3 levels (0-30 cmbd). These three levels form part of Layer IV, which ranges in color from 10YR 2/1 “black” to 10YR 3/1 “very dark gray.” For this unit, texture is described as essentially clay-rich throughout. From approximately 30-40 cmbd, there is a significant reduction in the size and quantity of ceramics, and an increase in the frequency of charcoal inclusions. This corresponds to the transition between layers IV and III identified in the profile. Layer III, located approximately 35-55 cmbd, is described as 10YR 3/2 “very dark grayish brown” to 10YR 4/3 “brown” in color. As the excavation proceeded into the 50-60 cmbd level, ceramics became increasingly sparser and more fragmented, and the quantity of charcoal remains began to diminish as well. At this point, the matrix begins to undergo a shift in color, becoming more yellow and irregular in color (10YR 4/3 “brown”, mottled). Level 60-70 cmbd is charcoal-rich, but ceramics-poor, and this shift corresponds to the transition between layers III and II. Level 70-80 cmbd sees a rise in the frequency of charcoal, which we later discovered was characteristic of Layer II, and an increasingly yellow color (10YR 5/6 “yellowish brown”), which suggests we are entering a deposit similar to the natural Oxisols (*terra amarela*) of the Lago do Limão region, but not as yellow as B horizon tends to be (10YR 7/6, 10YR 7/7, 10YR 7/8 “yellow”). This slight grey or brown tone to the dominantly yellow matrix suggests the presence of microscopic organic matter, especially carbon, in the matrix. Level 80-90 cmbd, the beginning of Layer I, exhibits a decrease in carbon and a complete absence of ceramics, and by the time the bottom of the level is reached, the matrix is free of ceramics and macroscopically visible charcoal. Level

90-100 cmbd is the last level excavated at this locale, no ceramic remains having been encountered in the bottom 20 cm of the excavation; the color of the matrix at this level is 10YR 7/6 “yellow”. The excavators note an increasingly clay-rich texture and higher level of compaction as they enter the lower 40 cm of the excavation unit.

The north and south profiles evidence the clearest distinctions of horizontal units identified at Mound 18. We opted to sample from the north profile because of the large bioturbation that had been encountered in the southwest quadrant throughout excavation of the upper 50 cm of the unit.

CAP nomenclature begins from the lowest layer in order to signify the earliest event that occurred at the site. In this case, Layer I should not be considered an event from the sedimentological perspective, but it can be considered the oldest essentially intact deposit exposed in the profile. Although all horizons within a pedon are actively in the state of being formed, it can be argued that the major components of this horizon are the secondary minerals, including clays and iron oxides, which formed with the original B horizon, along with ancient unweatherable or minimally weatherable materials likely to be found in the B horizon of an Oxisol. Simply put, the majority of components in this unit are likely to be “old” in comparison to the archaeological materials. There may be some recent modifications to this horizon, but I will argue that they are likely to be minimal, in comparison with the proportion of “new” components that make up the remaining Layers.

Layer II has been loosely interpreted as a buried anthropic A horizon, characterized by a high frequency of charcoal interpreted as anthropogenic. In this case, we can also consider the introduced charcoal present in Layer II as organic sediments modified, transported, and deposited by human beings. In fact, because little evidence existed to suggest that this darker Layer had in fact developed structural characteristics of a pedogenic Horizon in relation to Layer I beneath it, it is tempting to say that Layers I and II are part of an Entisol, a soil that has not yet properly developed horizons. The most important step in resolving this issue is establishing how long the charcoal present in Layer II took to accumulate, to what extent the vertical distribution of charcoal is a result of accumulation or biogenic mixing, and also how long Layer II remained exposed as part of a stable land surface between the time the charcoal was incorporated into the previously existing soil, and the time the overlying mound was built. These questions could potentially be resolved by careful mapping and dating of a few sequences of charcoal embedded in the matrix, and can also likely be addressed through micromorphological analyses, which can examine particle migration, the formation of coatings or cutans, voids, etc.

Regardless, it is clear that, at some point, Layer II was the top-most horizontal unit near a land surface that is now buried. The difficulty we have had in pinpointing the exact upper boundary of this surface is likely a result of continuing biological activity within the archaeological mound structure. This difficulty also points us to the fact that one cannot properly call this a paleosol, as these two layers are still clearly involved in pedogenesis to some extent. In the field, I encouraged students and project members to adopt the term “paleopiso,” literally “paleofloor,” which I choose to translate here as “paleo-landsurface.” One of the hypotheses posed at the end of the field season regarding this paleo-landsurface is that, in addition to anthropogenic charcoal, it likely contains other anthropically introduced sediments, the study of which might give insights into how it was formed and how the land was used prior to the construction of the mounds. These questions will be addressed in Chapter 7, where micro-artifactual analyses conducted on heavy fraction recovered through flotation are discussed.

Layer III, a grayish-yellow matrix containing generally sparse inclusions of ceramics and charcoal has been identified as a construction layer. The mixed coloring could be explained by the excavation, movement, and mixing of sediments retrieved from Layers I and II. The highly fragmented debris included in this matrix suggests the addition of midden material or surface scatter to this admixture. This Layer can be quite irregular, varying in texture across the unit. Morphologically, the Layer slopes in a direction that opposes the natural land slope; where the natural topography drops off to the west and north, the Layer we identified as a house platform construction layer appears to slope upward in these directions. Superimposing the location of the unit onto the map of the mound generated through the new topographic data reveals that the mound continues approximately 20 meters to the north of the point excavated, and that the highest point of Mound 18 is *at least half a meter higher than and 5 meters north* of the point at which the excavation was conducted, which suggests we did not precisely hit the mark of the center of the mound. Chemical, granulometric, and micro-artifactual analyses of Layer III helped establish the degree to which Layer III presents evidence of anthropic modification and to what extent it can be considered an admixture of Layers I and II.

Layer IV is perhaps the easiest of all to name, as it is the deposit for which these sites are named. Due to its very dark coloration (10YR 3/1, “very dark gray”), we can confidently call it terra preta. Other characteristics of this Layer include a generally sandier and less compacted matrix than the Layers beneath it and a high frequency of ceramic debris. The higher rate of fragmentation for ceramics in the upper 10 cm of the deposit is explained as resulting from modern agricultural activities. Generally, ceramic fragments found toward the lower part of the Layer are of larger size. Interestingly, few of the definitive characteristics of terra preta are macroscopically visible. Geochemical values should allow us to classify this layer within the accepted range of characteristics for terra preta.

At least one of the Layers present in Unit N924 E516 appears in each of the other excavation units and core/auger samples placed throughout the North Precinct. However, many of the excavation units present variations on these Layers, and in many cases one or more Layers are absent from a particular profile. Interpreting these profiles, particularly for the auger and core excavations, has been quite a challenge. Still, a few excavation units analogous to N924 E516 were encountered, and these include N913-915 E437, N944 E481, and N880 E506.

Unit N915 E437 – Mound 17.

This mound was selected for further analysis because it also clearly represents the paleosol, and because we uncovered a well-preserved burned earth feature (F61) immediately on top of the paleosol, confirming that this was indeed an old land surface. Unit N915 E437 was the northernmost of three adjacent units excavated at the top of Mound 17. One of the problems with this operation is that the top-most levels of the excavation, roughly the upper 20 cm of deposits were lost due to interruption of excavation in 2005. When the unit was uncovered at the beginning of the field season in 2009, it was clear that the excavations at the unit had been interrupted mid-level. Additionally, the exposure of the archaeological matrix and subsequent covering of the unit with black plastic sheeting (part of CAP backfill protocol in 2005) likely created unfavorable thermo-hydrological conditions that exacerbated already poor preservation conditions. Indeed, shortly after the unit was re-opened, the upper 30 cm of the profiles showed signs of drying out, and it is possible the unusually high compaction of deposits observed at this locale is a result of structural change due to altered conditions from 2005 through 2009.

Units N913 E437, N914 E437, and N915 E437 were excavated simultaneously. The first step taken once the units were uncovered was to level off the partially excavated levels. From Moraes' field notes from 2004, we knew that N913 E437 had been left halfway through the excavation of level 20-30 cmbd, while N914 E437 and N915 E437 had been interrupted as the excavators were approaching 40 cmbd. Hence, excavations of N915 E437 effectively begin at 40 cmbd, which makes it difficult to have absolute confidence in interpretations regarding the upper portion of the excavation. This is compounded by the fact that the exposed portions of the profile likely underwent significant modification during the years of exposure. Given these interpretations, and considering color, compaction, and inclusions we can say that excavations were resumed either at the transition between Layer IV and Layer III, or at the very upper limit of Layer III. It may be possible, through our characterization of profiles from other mounds, to better pinpoint this transition in this mound. The uppermost, partially-excavated level in each unit was excavated as a "cleaning" layer, and macroartifacts from these levels were collected with a low confidence in provenience. Once the bottom of each level was reached, the datum for the three-unit operation was established by measuring upward the appropriate distance (30 or 40 cm) from each unit.

For Unit N915 E437, level 30-40 cmbd is described as 10YR 3/3, "dark brown," a color generally associated with Layer I. However, unlike with most other Layer I contexts, the texture is reported as clay, and the compaction as high. PR data collected with a drop-cone penetrometer were collected in an attempt to evaluate excavators' reports of experience extremely high compaction at this locale. As is common in Layer IV contexts elsewhere on site, but also occasionally occurs in Layer III, some concentrations of trempe fragments were discovered at the bottom of the level. Because of previous disturbance, the AVC was not collected from the 30-40 cmbd level, but collection of AVC proceeded as normal beginning with the 40-50 cmbd level.

From 40-60 cmbd, the color changes to 10YR 4/2, and a few large fragments of trempe, as well as a high concentration of ceramic fragments was encountered. The excavators also noted a slight reduction in compaction in this depth range, as well as a change in texture, from clay to sandy clay, between 60 and 70 cmbd, which is accompanied by a reduction in ceramic concentration. This is an unusual pattern of compaction and it seems likely that the cycle of excavation and hydrological disturbance is responsible for this pattern. Data on texture, obtained through particle size analysis, and on compaction and moisture, obtained with the PR/TDR equipment can be compared to field texture and compaction to better understand this aspect. The following level, 70-80 cmbd, is also reported as 10YR 4/2 "dark grayish brown," and texture is reported as clay. These levels all appear to be part of Layer III, in terms of color and artifact frequency. However, this Layer III differs slightly from that in unit N924 E516 in the richness of the assemblage, as faunal and lithic remains were also found. Additionally, two ceramic spindle-whorls were found at this locale, one in unit N915 E437 and one in unit N913 E437. This pattern seems to parallel that observed at Unit N880 E506.

During the excavation of level 70-80 cmbd, a concentration of trempe fragments and charcoal was observed in N915 E437. Charcoal samples were point-plotted and collected. In the following level, at approximately 82 cmbd, a charcoal concentration surrounded by burned earth was defined, mostly within N915 E437, but crossing over into the northern portion of N914 E437. This set of remains was carefully plotted on millimeter paper at 1:10 scale and given feature number 61. The feature was collected in its entirety and set aside for further analysis. We interpret Feature 61 (F61) as the remains of a fire that occurred shortly before the construction of

the mound. The burned earth suggests relatively high temperatures, or perhaps an intentionally built “clay ring” for a fire. The extremely good preservation of the burned earth and charcoal context, along with the associated charred firewood, suggest that very little time elapsed between the burning episode and the construction of the mound. If this interpretation is correct, then F61 may have significant interpretive value. Level 80-90 cmbd likely represents Layer II, as there is a change in color to 10YR 3/6 “brown.” From 90- 120 cmbd, the levels appear to be devoid of cultural material. Color is reported as 10YR 5/8, and compaction appears to decrease as 120 cmbd is approached.

Unit N932 E452 – Mound 16.

Unit N932 E452 was the central of three adjacent excavation units, N931 E452, N932 E452, and N933 E452, opened on top of Mound 16. This operation is seen as a variation on the pattern observed at Mounds 17, 18 and 27. All four Layers were present, but a unique depositional context consisting of a layer of ceramics (detailed below) suggested this mound might have served a special purpose. Unit N931 E452 was first excavated in its entirety. Of interest at this locale was the very high frequency of occupational debris encountered, including ceramic and trempe fragments and charcoal, from the uppermost levels. A few large, well-preserved ceramic and trempe fragments were encountered at approximately 30 cmbd, a pattern analogous to concentrations of ceramic and trempe fragments encountered in the terra preta layer at other locales (N880 E506; N895 E509; N854 E468). What made this locale unique was the significant increase in size and frequency of remains encountered from approximately 45-70 cmbd. As part of the lower part of this context, we also uncovered one whole trempe and evidence of trempes that appeared to have disintegrated in situ, as well as some notable fragments of faunal remains. We initially interpreted this as a burning context.

In order to clarify the nature of the proposed burning structure, unit N932 E452 was opened just to the north of the original unit. Like the unit to the south, N932 E452 exhibited a high frequency of debris, and is especially notable for the concentration of charcoal uncovered in the level 10-20 cmbd in association with a second whole trempe. This recalls contexts uncovered near the top of Mound 15 at N880 E506, N895 E509, and also to an extent the southwest corner of N854 E468 between approximately 20 and 40 cmbd. From this point downward, the size and frequency of ceramics and trempe fragments increased as the excavation progressed, culminating again in a dense concentration now seen as a layer of ceramic and other occupational debris. When this layer was seen to extend beyond the limits of this unit, we determined it would be appropriate to expand the operation an additional meter to the north. Unit N933 E452 was opened and excavated to the level of N932 E452, where we took the opportunity to take spot samples of the matrix and create a detailed drawing of the context. We also took a number of spot samples for flotation and microanalyses in the hopes of uncovering additional clues to the formation of the deposit or the use of ceramic vessels prior to discard. The layer of ceramics, uncovered between approximately 45 and 70 cmbd, was arranged in a manner similar to those observed at the Hatahara and Laguinho sites (Machado 2005; Neves et al. 2003). This kind of arrangement is known as a “piso” or floor in the CAP nomenclature. This should not be taken to suggest that we interpret this as a floor that was built as a surface for walking; rather, the term is used to denote ceramic layers we believe to be part of mound construction.

When this layer had been evidenced across both excavation units, we began to see it as a distinct event from concentrations and burning contexts uncovered in the upper 20-30 cm of the mound, and the decision was made to study this unique context in depth. Associated with these large fragments, we found copious lenses of burned earth, samples of which were collected for further investigation. The uncovering of a total of three nearly-whole trempe and some of the largest fragments of faunal remains found at the site along with the evidence of burning suggest multiple uses to this context, which will be discussed in the next section.

Apart from the presence of this layer of ceramics, considered the lower portion of Layer III or an initial phase of construction of the mound, Units N931-933 E452 follow the same pattern of Layers as units excavated on mounds 17, 18 and 27. There is a clear Layer I, which occurs below the line of ceramics and has its upper boundary near 110 cmbd. Unlike at other locales, where the boundary between Layers I and II appears to accompany a uniformly flat or sloping land surface this diffuse boundary fluctuates between 100 and 125 cmbd. Layer II varies in thickness between 25 and 45 cm, and is marked not only by a high frequency of charcoal, but also by a few lenses of burned earth and substantial charcoal concentrations. Moraes (2010) foregrounds the similarity between these burning events and that evidenced beneath Mound 17. Layer III, including the ceramic layer, has a clearly-defined upper boundary with Layer II, which occurs between 65 and 85 cmbd. The boundary between layers III and IV is also diffuse and wavy, occurring between 20 and 30 cmbd. These fluctuations may be associated with features on the surface of the mound, and the presence of large ceramic and trempe fragments in associated deposits suggests this possibility merits further discussion.

Understanding the sequence of events related to the construction and use of this mound is important for understanding deposits uncovered in Unit N942 E452. As N942 E452 features a unique context uncovered across the site, it is interesting to attempt to establish the nature of the relationship between the housemound and the pit uncovered behind the mound.

Unit N854 E468 – Mound 12

Unit N854 E468 was located near the top of Mound 12, which we decided to investigate for its proximity to the central portion of the site, and because nearby core data from 2005 had revealed some overlap between Guarita and Paredão ceramics in this area. Among other things, this locale served to confirm that the entire North Precinct was associated strictly with a Paredão-phase occupation. This mound was also located near a modern footpath that crosses the plot, as well as the associated shed that sits on the property, now abandoned. There was some concern about potential modern disturbance to the site given its proximity to the structure, but, at least within N854 E468, this was limited to the presence of a few metal artifacts in the upper 10 cm of the profile. It is probable that modern disturbance is limited to surface scatter and limited hand-tilled agriculture, and we have established that there is as yet no way to bring heavy machinery onto the site (no adequate access roads and limited terrestrial access above the floodline).

Unit N854 E468 was notable because it exhibited all four layers, but also a series of intersecting features and anomalous deposits. Among these are Features 52 and 54-57; a concentration of trempe fragments; a number of concentrations of ceramics associated with a distinct matrix; and a grayish-white, fine-grained deposit that was not clearly identified on site. Another notable feature from unit N854 E 468 is a very distinct and abrupt contact between a dark and light deposit discovered along the south profile at a depth of approximately 110 cmbd. Not clearly identified in plan, this deposit appears to describe an “upside-down” context that is, a

lens of dark material sandwiched between two lighter matrices, wherein the lower contact between the darker deposit and Layer I is abrupt and the upper contact is diffuse.

This unit turned out to be extremely complex and difficult to understand. The upper 10 cm followed the pattern of other units on site, featuring a very dark matrix (10YR 2/1 “black”), highly fragmented ceramic remains, and a sandy clay texture. In the next 10 cm, the size and quantity of ceramic fragments increased dramatically, and clusters of ceramics began to appear. At the base of the level, a cluster of ceramic fragments arranged vertically was encountered in the southern half of the unit, identified as a “recipient” by the excavators. The sediment associated with these fragments is described as clay sand, different from the sandy clay that characterized the remainder of the level. Unfortunately, no samples of this matrix were collected due to a misunderstanding regarding sample collection protocol, although a charcoal sample was collected for the purposes of radiometric dating. Similarly, a concentration of ceramic and charcoal remains was encountered in the southeast quadrant of the unit at the base of the 20-30cm level, but no samples of this were collected during excavations. Additionally, in both cases, ceramics from observed concentrations were collected along with ceramics from elsewhere on the level. Throughout the first 30 cm of the excavation, which I consider to be Layer I, matrix color transitions slowly from 10YR 2/1 “black” to 10YR 3/3 “brown,” and compaction remains relatively low. Texture, outside of potential features or anomalies, is described as sandy clay.

At approximately 30 cmbd, the color takes on a yellowish hue, and from 30-70 cmbd is reported as 10YR 3/4 “dark yellowish brown.” From 30-50 cmbd, there is a gradual reduction in the frequency of ceramic remains encountered, and at the base of level 40-50 cmbd a small, round stain of dark, grainy sediment is identified in the southwest quadrant. This was labeled as Feature 52 (F52). The excavators also report a notable increase in laterite fragments, which have been sparse throughout the excavation thus far. Samples internal (PN 1514) and external (PN1515) to F52 were collected in level 50-60 cmbd, and F52 continued through level 60-70 cmbd, disappearing into a larger stain of dark soil before a depth of 80 cmbd was reached. The slightly increase in compaction, decrease in ceramic remains, and change in chroma are consistent with Layer III throughout the site. Oddly, F52 re-appears in level 80-90 cmbd, suggesting it cut through a shallow dark deposit.

Between 70 and 80 cmbd, a slight change in color is observed, from 10YR 3/4 to 10YR 4/6 (both described in the Munsell Soil Color Chart as “dark yellowish brown”). This is also the depth at which a mosaic of dark and light deposits is evidenced, making interpretation incredibly difficult. Circular and semi-circular features, well-defined in some areas but difficult to delineate in others, and all dark in color (10YR 4/2, “dark grayish brown”) appear at the bottom of the level. In the subsequent level, excavators spotted a fine-grained light-colored, almost grayish-white deposit of highly plastic material that was not identified. This deposit was collected in its entirety for identification, and assigned PN 1527. A light-colored circular stain was exposed at 80 cmbd, which was also clear at 90 cmbd. Because the relationship among the various stains was not entirely clear, no feature numbers were assigned and no sediment collected until 100 cmbd was reached, when the base color of the level evened out at 10YR 5/8. At this point, Features 54 and 55 were easy to demarcate, and a 5-cm level was removed in order to further clarify the contexts, at which point Feature 56 was also made clear. Although the level was split in half (vertically) for the purposes of investigation, material from both halves of the level was collected under the same PN. Once 100 cmbd was reached and all the features were

clearly defined, the excavation strategy shifted, focusing on excavating the sediments from within the features themselves, leaving Layer I, through which the features cut, at a level of 110 cmbd. At this depth, Layer I was reported as having a color of 10YR 5/6 or 10YR 5/8 “brownish yellow” and a sandy clay texture.

Of all the features identified in this level, F54 was the darkest, deepest, and clearest. Identified at a depth of 100 cmbd, F54 was excavated in 10-cm levels, its internal sediment collected diligently in its entirety from level 100-110 through 130-140 (PNs 1537, 1538, 1545, 1549). This feature contained sediments varying in color from 10YR 3/3 “brown” to 10YR 4/2 “dark grayish brown” and bottomed out at 134 cmbd. Feature 55 was also identified at 100 cmbd and was slightly lighter in color than F54. Samples of the fill were collected from each level from 100-130 cmbd (PNs 1536, 1539, 1546), ranging in color from 10YR 3/4 “dark yellowish brown” to 10YR 4/6 “yellowish brown.” Although it was still visible on the surface of level 130 cmbd, F55 contained less than 1 cm of sediment in the 130-140 cmbd level, and hence was not collected as part of this last level. Lastly, F56 which exhibited the same range of colors as F55, 10YR 3/4 “dark yellowish brown” to 10YR 4/6 “yellowish brown,” was identified at 105 cmbd and produced samples PN 1530 (110-120 cmbd) and 1547 (120-130 cmbd). The base of this feature was reached at 127 cmbd. Once all three features visible in plan had been excavated, excavation of the unit was concluded. During the profile analysis and drawing phase, an additional feature, F57 was identified in the southern half of the east profile, with a narrow section of the feature appearing on the south profile.

Unit N895 E509 – Mound 15

Unit N895 E509 was originally opened in order to clarify whether Mounds 15 and 27 were in fact distinct structures. Excavation of the unit proceeded in a manner similar to that at other units discussed. Finds of note include a whole trempe recovered at the boundary of the northwest quadrant of the unit with N896 E509 (the removal of which necessitated the excavation of the SW quadrant of N896 E509 to a depth of 30 cmbd). This unit was selected for further analysis because of a clear feature evidenced in the profile, and also because Layer II appears to be absent, pointing to local remodeling of the existing soil surface prior to mound construction.

The upper 20-30 cm of the structure make up the terra preta layer, or Layer IV, which features dark, almost black soils (10YR 2/2 “very dark brown,” 10YR 3/1 “very dark gray”), a slightly sandier texture, and large, horizontally placed fragments of flat-bottomed ceramic vessels, as well as sizeable trempe fragments. We also noted a concentration of charcoal and ceramics that co-occurred with a mottled deposit of “black earth and yellow earth.” This is worth noting in light of the combustion structure encountered within Mound 17, F61. Level 30-40 cmbd appears to denote a transition, in which the size and frequency of ceramic fragments diminishes as soil texture becomes increasingly clay-like. From 30-60 cmbd, sediment color remains relatively dark (10YR 4/3 “brown”, 10YR 3/4 “dark yellowish brown”), and the occurrence of charcoal remains constant. Ceramic remains are sparse throughout, with the exception of a marked but spatially limited increase of large ceramic fragments noted in the northeast quadrant. This pattern follows that established by at mounds 18 and 16, and thus suggests that this constitutes Layer III, the construction layer. The amount of charcoal inclusions is reported to double from 60-70 cmbd, and is thereafter sustained at this level from 70-90 cmbd, which might indicate that Layer II is present in this structure. However, the sediment color and

the presence of ceramics in level 60-70 cmbd would seem to indicate this is still an anthropic sedimentary layer. In contrast, no macro-artifacts are observed from 70-90 cmbd, which segment of the excavation was also marked by a number of scatters of large charcoal fragments appearing in various distinct portions of the unit. Feature 60 (F60) became visible in the eastern portion of the southeast quadrant during excavation of the 80-90 cmbd level. This feature, which remained visible in the profile, has raised interesting questions about the construction of this mound, which will be discussed along with the interpretation of layers in the final chapter. The final 30 cm of the excavation constitutes F60 and Layer I, a clay-rich, deep yellow (10YR 7/8) matrix that is very much consistent with expected characteristics of local Oxisols.

Unit N941 E452 – behind Mound 16.

Unit 941 E452 was initiated after an auger sample revealed deep, clay-like charcoal- and artifact-rich deposits behind Mound 16. At the time this location was selected for excavation, interesting concentrations of large fragments of ceramics and trempe were being uncovered at N931 E452, and there was some interest in expanding to the north. In order to avoid the disturbance created by the auger, and to align the new unit with the existing unit on Mound 16 in anticipation of a potential trench connecting the top of the mound with the contexts behind it, coordinates N941 E450 were selected for excavation. It was selected for further analysis because it appeared to present all four layers, and also because a large, pit feature containing charcoal and faunal remains was discovered at this locale.

Because of a small surface depression and the presence of thick clumps caused by roots, the initial levels for the corners of the unit varied by up to 18 cm. Thus, the first step taken was to remove the artificially high southeastern corner, which was higher than the rest of the unit in large part due to residual plant matter from the grass. Thus, the first level excavated was 10-20 cmbd, which contained a moderate frequency of ceramic remains, the matrix described as 10YR 2/1 “black,” sandy clay. From 20-40 cmbd, the color of the matrix changes slightly to 10YR 3/1, as is the case in many other units, and the matrix is described as loose sandy clay, becoming slightly more clay-like and compacted as the excavators approached 40 cmbd. Throughout these layers, which appear to be part of Layer I, texture is described as sandy clay.

Level 40-50 cmbd represents a transition, where matrix color changes to 10YR 4/4 (“dark yellowish brown”), compaction increases, and ceramic remains become sparser. A possible feature is also noted in the southwest quadrant of the unit, distinguished from the rest of the unit because of its darker color and looser consistency. Overall matrix texture in the rest of the unit is still described as sandy clay. From 50-60 cmbd, the presence of charcoal and ceramic remains decreased across the level, while matrix color darkened slightly to 10 YR 4/2, “dark grayish brown.” For this reason, the potential feature observed in the previous level became somewhat obscure, evidenced only by a high concentration of charcoal. Level 50-60 cmbd is the first level in this unit to be described as having a clay texture.

At the base of the subsequent level, 60-70 cmbd, matrix color had yellowed significantly to 10YR 4/6, “dark yellowish brown,” making it possible to distinguish not only Feature 58 (F58), which took up most of the southwest quadrant, but also Feature 59 (F59), a small, rounded feature located in the northwest corner, approximately 90% exposed within the unit. A portion of F59 remained visible in the north profile after the conclusion of excavation at this locale. Less than 25% of F58 was visible in the unit, which suggests it would have been rather large, possibly 125 cm in diameter, given the curvature described by the feature at the bottom of level 60-70

cmbd. If we consider the nearby auger had coordinates N940 E451, it is likely the deposits recovered with the core were part of this F58. It's also possible the feature was still larger, as it was originally identified in the unit at approximately 50 cmbd. At 70 cmbd, the matrix throughout the remainder of the unit is described as compact and inclusions of charcoal become increasingly sparse. Beginning with layer 70-80 cmbd, bulk samples were collected from F58 and F59. Feature 58 contains ceramic remains, and the color of F58 is recorded as 10 YR 4/3 "brown." Charcoal concentration continued to decrease in this level, and no ceramic remains were recovered. The matrix is described as mottled, ranging in color from 10YR 7/8 "yellow" to 7.5 YR 5/8 "strong brown" and 7.5 YR 4/4 "brown." At 80-90 cmbd, F59 disappears from the base of the unit, but continues to be visible in the north profile, which means F59 was oriented at an angle slightly skew to vertical. The color of the general matrix was 7.5YR 6/8 "reddish brown," and F58 changed color slightly, registered as 10YR 5/4 "yellowish brown." At this level, the laterite crust was reached in the northeast corner of the unit, making it so the AVC sample collected was smaller than usual. As in unit N854 E468, we opted to continue by excavating only the feature in subsequent levels; F58 was fully excavated at 101 cmbd.

Unit N915 E491 – northwest portion of plaza.

Because of the coverage afforded by the auger-and-core survey detailed above, excavations in the plaza were small and targeted. I elected to sample unit N915 E491 because it was the only locale excavated in the plaza that exposed in situ Layers, as well as a soil profile that could provide sufficient material to test. I will expand upon the excavation of this locale, but also talk briefly about the other two locations excavated within the plaza, unit N880 E452 and N913 E463, the southeast quadrant of which was excavated as a sondage.

The auger-and-core survey revealed new information about the plaza area demarcated by the mounds in the North Precinct. First, it became clear that the southwest portion of the plaza was almost devoid of soil and consisted of exposed laterite deposits or exposed laterite crust, while in the northeast corner, the pedo-stratigraphic sequence apparently consisted of soils or sediments ranging in thickness from 70 to over 100 cm in depth before reaching the laterite crust. In some instances, a relatively thick (20+ cm) layer of terra preta was discovered in this portion of the plaza. We had also discovered a series of low berms or surface elevations that further confused the issue, given that we could not be certain whether the elevations were natural surface undulations; the result of artificial build-up of some areas; or the result of excavation of others areas.

Units opened in the plaza previously had targeted the exposed laterite surface, in the first instance to clarify whether that laterite was part of a constructed feature, or whether it was continuous throughout the profile and indicative of a naturally-occurring deposit. In the second instance, a sondage was excavated a few just to the east of an auger transect, in part to clarify the change in deposits between augers N910 E450 and N920 E450, and in part in order to investigate a void discovered fortuitously by the placement of the drop-cone penetrometer near the transect line. A member of the survey team had paused to rest along the line, and the drop-cone penetrometer had sunk to a depth of over 30 cm with no added pressure. Both of these units in the laterite-rich zones had revealed some percolation of colluvial terra preta among extremely rocky layers that were peppered with bioturbations.

In order to comprehend the apparently dual nature of the plaza, Unit N915 E491 was excavated at the extreme northeast of the plaza, in a region that was determined to represent the

plaza itself and none of the perceived surface anomalies. The aim of this unit was to verify the pedo-stratigraphy of this portion of the plaza and the depth of the laterite crust, as well as to obtain samples of the matrix for testing against the *Mounds* and *Behind Mounds* contexts. This portion of the plaza was covered with especially thick brush made of woody species as well as young palms, and locating a spot that presented few major roots was difficult. Ceramics were evident on the surface, a pattern that had not been observed elsewhere in the plaza except on top of Structure A and in the vicinity of Structure C. In light of recent interpretations made through examination of a new digital elevation model, it also seems possible that N915 E491 could have been fortuitously placed on top of one such elevated structure, possibly an extension of Structure B. These more speculative interpretations are elaborated upon in the final chapter.

The uppermost layer and the first level did not exhibit terra preta colors; the colors observed were 10YR 3/2 “very dark grayish brown” and 10YR 4/2 “dark grayish brown,” colors that are associated with terra mulata in this region. The first two levels, 0-10 and 10-20 cmbd, were dominated by a large root disturbance that was filled with charcoal and what appeared to be the remains of a lizard burrow, including fragments of eggs scattered among the charcoal. Because of the highly disturbed condition of the context, analysis of this material has been de-prioritized. However, this disturbance was limited to the central and southern portion of the level, and the profiles were apparently intact. Charcoal was found in relatively high abundance throughout both of these levels. In the level 20-30 cmbd, there was a significant reduction in the quantity of ceramics encountered, and toward the bottom of the level a high percentage of laterite was encountered. There was also a distinct change in color, from 10YR 3/4 “brown” in the previous level, to 10YR 5/6 “yellowish brown.” This very abrupt transition signaled that the excavators were entering the upper reaches of Layer I. In the subsequent level, 30-40 cmbd, the matrix remained similar to that above, and there was a reduction in the amount of charcoal found. No ceramics were encountered in this level. There was a distinct change observed in soil compaction, which had been noted as low throughout the first level, and here is reported as high. Levels 40-50 and 50-60 cmbd are similar throughout to the lower reaches of level 30-40 cmbd, evidencing a highly compacted, 10YR 5/6 “yellowish brown” clay matrix with few, small charcoal inclusions and an abundance of laterite, which increased in quantity with depth. Thus, this was interpreted as Layer I, and excavations at this locale were concluded.

Sondage N992 E452 – Off-site sample.

Unit N992 E452 was plotted in the area north of the North Precinct identified above as an area considered to be off the site itself. The same alignment used to establish core N991 E452 was used to plot sondage N992 E452. Samples recovered from this unit were collected to serve as control samples to which samples recovered from the site would be compared. As established above, this area provided a less-than ideal control sample for this purpose, but was likely the best place on the Antônio Galo landform to yield a minimally modified context for sampling purposes.

Unit N992 E452 was excavated only in its NE quadrant, in the interest of efficiency, and also because of the results of the nearby auger, which had established that there was little evidence of anthropic modification at the locale. It was thus determined that little could be gained from excavating in arbitrary levels, as had been the procedure for units, and that the excavation would be undertaken following the methods of a sondage. CAP sondage excavation procedures are consistent across these 50 x 50 cm units, wherein excavation does not proceed in

stratigraphic or arbitrary levels, but rather is conducted with a view to establishing the depositional sequence through an understanding of the profiles. Hence, the deposits are excavated as quickly as possible within the 50 x 50 cm unit, and the profiles exposed for sampling, as in a pedological unit. As this is the only unit not considered to be an archaeological unit, the sequence was observed and described as a pedogenic sequence, following a modified version of layer description protocols of the USDA Soil Survey staff. Column samples were collected after the description was completed, from the East profile.

Sondage N992 E452 confirmed that there was no reason to excavate a full 1 x 1 m unit at the locale, as there was no indication that anything further could be gained by excavating a larger unit in a different mode. No structures or artifacts were identified, and the only thing that pointed to a possibility of direct anthropic modification at this locale was the relatively dark A horizon uncovered, to be discussed below.

This sondage provided insight into the particular aspects of the local soil, as well as into the accuracy of the CAP coring methodology, which are vertically subdivided into 20-cm levels. For example, while the color for level 0-20 cm of core N991 E452 had been observed and recorded as 10YR 4/2 (“dark grayish brown”), it was clear from profile recording that the existing A horizon was in fact 3 to 4 cm thick and quite dark in color, 10YR 2/2 (“brown”). This suggests that this locale, which would ordinarily have been identified as a terra mulata deposit given the color of the upper 20 cm of the core, might in fact be a terra preta deposit, as terra mulata deposits in this region usually range in color from 10YR 3/4 to 10YR 4/4 (both described in Munsell Color Chart as “dark yellowish brown”). The thinness of the A horizon is consistent with that expected from Oxisols, but on the other hand, it is clear that this horizon is significantly darker in color than expected for unmodified soils of the region, and the presence of A/B and B/A horizons, respectively 10YR 3/6 “dark yellowish brown” and 10YR 5/6 and “yellowish brown” suggests that there is at the very least a significant residual effect on the pedon by anthropically-introduced carbon. The distinction between the A/B and the B/A horizons is fairly diffuse, but clear. Horizon B/A is somewhat more plastic than A/B, and has mottling of 10YR 7/8 (“yellow”). Horizon A/B, for reasons that have not been clearly understood, presents yellowish red “5 YR 5/6” mottling. The last major distinction between the two transitional horizons is the presence of rootlets in the A/B horizon and small plinthite stains in the B/A horizon. The B horizon is identified as sharing a wavy boundary with the B/A horizon between 50 and 60 cmbs, and is significantly more clay-rich and yellow in color, such that the two colors identified 10 YR 6/6 “brownish yellow” and 10YR 7/8 “yellow” are equally distributed within the horizon. The B horizon is also significantly more compact in consistency than the preceding horizons.

Acts and practices: interpreting site pedo-stratigraphy

Stratigraphic sequences are known as such because they record sequences of events. Above, I have explained the overall sequence of events at Antônio Galo in terms of the CAP concept of Layers, which has been developed as a means toward establishing contemporaneity across a site, at least in conceptual terms. In this section, I consider the pedo-stratigraphic profiles of select units within a temporal framework, attempting to distinguish natural processes

from practices, which I define as repeated action that results in structured deposition (Richards and Thomas 1984), and acts, which I see as singular events that interrupt the structured deposition of practices. At Antônio Galo, evidence of the kind of repetitive action (Joyce and Lopiparo 2005) that results in structured deposition is materialized in the Layers identified; because each of the features observed in the units selected for further analysis is unique, they cannot properly be seen as evidence of practices, and are at this juncture interpreted as isolated acts.

The state of preservation of features and layers encountered at Antônio Galo surpassed all expectations, given previous experience of mounded sites in the region. These conditions have made possible a series of detailed interpretations about the life-history of each locale investigated, as well as the advancement of hypotheses considering particular events associated with specific deposits. This section will outline these individual life-histories, delineating the post-excavation sampling process and rationale that led to the focused laboratory investigations undertaken as part of the final stage of this project. The mounds will be treated in the first section, and the off-mound contexts will be treated separately in the second section.

Matrix sampling that took place after excavations were concluded includes sampling of layers along a vertical axis, the sampling column, as well as spot sampling of features and unusual or poorly-understood contexts and boundaries. In many cases, questions arose after the initial drawing of profiles as to the depositional processes that could account for the chosen profile interpretation, and in cases where questions remained, I discuss ways to resolve these interpretive conflicts through microanalyses. All samples taken from the profiles were taken with the intention of performing a series of microanalyses geared toward characterizing the deposits in a general way, and in some specific cases, toward addressing specific hypotheses regarding function and formation processes. These hypotheses are detailed in Chapter 7. The specific analyses performed on each sample within the context of testing these hypotheses will be addressed in Chapter 7.

Because this project was the brainchild of multiple minds, interpretive decisions were not always unanimous. In this section, I take advantage of the multiple perspectives put forth by the archaeologists involved in on-site interpretation of areas excavated to explore alternative scenarios that can be tested through microanalyses. As part of this analysis, the profile drawings produced on site are considered and alternative scenarios to be tested through microanalyses are proposed. For problems or questions that arose in the post-excavation analytical phase that cannot be addressed by analyzing the samples currently available, suggestions are made for future field work.

The background signal

Unit N992 E452 was excavated with a view to understanding what I will refer to as the underlying structure and general chemistry of the landform upon which the Antônio Galo site was superimposed. The terms “underlying” and “superimposed” should be understood as metaphorical; if we understand the landscape and soils as palimpsests, then the inscription of human presence on the previously existing landform consists of depositional practices that make contact with the existing soil on the soil surface, but subsequently migrate downward, permeating the matrix and effectively “blending” with the original soil chemical and physical

properties and creating a hybrid form. It is essential to understand the underlying properties of the original soil not only so that we may understand the pedogenic processes that incorporated the anthropogenic sediments into the new matrix, but also so that we can adequately gauge the degree to which these soils have been modified through this process. This concept, which I shall refer to as the degree of anthropization of the original soil, will become important in understanding the relationship between the various anthropic deposits encountered, as well as the relationship among said deposits. Of particular interest will be the differences in manner and degree of anthropization between Layers II and IV, which are both clearly enriched in carbon, attested to by the presence of charcoal in both layers, but also certainly in other parameters. Aside from enrichment, as already indicated in Chapter 5, we will be looking at changes in physical properties of the original soil that are identifiable in any given archaeological matrix.

Off-site Unit.

The Antônio Galo site presents several difficulties with regard to obtaining a proper background signal N992 E452 that would represent the underlying soil. Not only are difficulties encountered in the degree of anthropization evidenced by the A horizon attested to by the dark coloring and presence of charcoal inclusions, it appears as though the soil itself is significantly sandier than the kinds of deposits encountered within the site. R. Macedo, a pedologist from the Embrapa Soil Physics Laboratory who was not able to aid in the sampling in the field, but with whom I consulted before and after the field season, has informed me that sandier textures are often encountered along the slopes of these ancient terraces. Although no explanation was given, I suspect this is potentially a result of a series of higher-energy flooding in the past, which would have moved heavier sediments, such as sand, and deposited them on the upper parts of the slopes. Difficulties may also be encountered because of the slight textural differences that seem to have been observed between the lower horizons in N992 E452 on the one hand, and Layer I encountered in the on-site units on the other. The degree to which this will in fact present a difficulty may be quantifiable by comparing the physical and chemical properties of these two contexts.

Interpreting the mounds

The mounds excavated in 2009 display a relatively consistent set of traits that suggest a similar history for all mounds in the precinct. With the exception of Mound 28, all of the mounds present a Layer I with a minimum thickness of 30 cm, a fact that holds significance in this particular setting, where the presence of exposed laterite lenses on the surface of the site have stimulated debate about aspects of the original land surface in the pre-mound stage. Most of the mounds present a Layer II, which suggests we can establish that Layer II is characteristic of the 'normal' composition of a mound, and the absence of this layer can be seen as an anomaly. Layer III is again evident in all of the mounds investigated. Variations in its appearance and contents are worth investigating to better understand variability in mound construction, as well as for characterizing the source of these sediments. Without exception, Layer IV, the terra preta occupation layer, is present on all mounds, which helps us to comprehend that, small differences aside, activities that took place on each mound were similar enough to produce similar terras pretas. Variability in these deposits, to be dealt with in Chapter 7, will also aid in establishing

similarity and difference of habitation at distinct mounds. Detailed analysis of features, begun in this section and continued in Chapter 7, may also provide limited insight into this axis of difference, though a caveat must be issued with regard to the size and positioning of the excavated sample in comparison with the size and shape of mounds investigated.

Mound 18.

The excavation on mound 18 revealed four layers, as described in the above section. Layer I, the yellow, clay-rich layer is interpreted as the remnants of the original B horizon, which is slowly being modified by pedogenic processes still active today. Layer II, which shares a diffuse boundary with Layer I at approximately 75 cmbd at the northeast corner of the unit, and at 70 cmbd at the northwest corner, is charcoal rich and grayish-yellow in color. In this case, Layer II is approximately 15 cm thick, and clearly demonstrates the gentle downward slope of the original land surface in an easterly direction. Layer III, the construction layer used to raise the mound platform from plaza level, begins distinctly at 45 cmbd near the northwest corner of the unit and at 60 cmbd in the northeast corner. This Layer is drawn as sharing a diffuse boundary with Layer IV, above, and sloping down to the east accompanying Layer II, below. However, extensive photography in various kinds of lighting conditions show that Layer III in fact slopes upward from west to east, and may in fact be composed of two sub-layers, as we have seen elsewhere. I thus propose an alternate interpretation for the north profile of Unit N924 E516, which also reflects a richer knowledge of the site and deeper understanding of the significance of the layers that emerged as the field season wore on. This new interpretation can be tested against the original interpretation by comparing the chemical and physical characteristics of the AVC samples from 30-40 and 40-50 cmbd with the Layer samples taken in the post-excavation phase. Finally, Layer IV, the terra preta occupation layer, was originally drawn as varying in thickness from 20 to 40 cm, but in the light of the new interpretation, is likely 20 cm in thickness throughout the mound.

Unit N924 E416 was the simplest to sample, as it exhibited only 4 distinct contexts. The column of samples was taken from the center of the north profile, in a section relatively free of large ceramics embedded in the profile. Because of early doubts about the accuracy of the profile drawing, the sampling team was instructed to take two samples out of Layer IV. In retrospect, it would have been best to take two samples out of both Layer IV and Layer III, given that the additional samples should have been taken directly along the putative boundary. But, as has been suggested above, testing of the layer IV/III boundary can easily be undertaken by characterizing samples from the AVC column and comparing these to the profile samples analyzed. The remainder of the sampling column followed standard procedure, each layer having been sample once

When Mound 18 was initially surveyed, it appeared to be relatively small. A good portion of the mound lies in the neighboring property. The downhill slope that runs from the mound to the semi-annual channel located to the east gave the impression that the fence dividing the properties also divided the mound roughly in half. Additionally, there is a significant change in vegetation to the north of the fence, in part due to the fact that the landowner to the north did not appear to have been actively cultivating the land for at least 15 years prior, and in part because the soil itself changes dramatically with the drop in elevation. It did not become clear until later in the season, when we were able to gain access to this portion of land to expand our topographic map, that we had not excavated precisely the center of Mound 18. Hence, it is

possible that many of the kinds of features and structures encountered elsewhere are present in Mound 18 as well, and that the sequence we uncovered there is in fact representative of the periphery of mounds at the North Precinct. This highlights the importance of conducting larger, areal excavations in generating an understanding of mound use and the internal morphology of these house contexts.

Mound 17.

Mound 17 was selected for excavation because it appeared to be one of the largest mounds on site. In fact, it is now clear from topographic data that this mound is not the largest in area, but certainly features the steepest and perhaps most visually impressive slope on site along its southern edge. This slope is exaggerated by the presence of the borrow pit immediately to the south of it. Aside from this visual quality, the portion of Mound 17 exposed through excavation is very similar to that of Mound 18. The main differences between the results of Mound 17 and Mound 18 excavations are the richness of the assemblages, N913-915 E437 presenting a much higher concentration and range of remains than N924 E416, and the presence of F61 in Mound 17. However, it is worth remembering that the final analysis of topographic data revealed that the unit originally placed on Mound 18 was in fact closer to the periphery of the mound (see above), where units N913-915 E437 were actually placed at the apex of the mound. This alone might account for the difference in size and kind of assemblage. Additionally, the area excavated on Mound 17 was triple that excavated at Mound 18.

One area of Mound 17 that is certainly worth examining more closely is the ‘tail’ of the mound, which was investigated through core samples taken with a post-hole digger. Among other things, nearly all the cores exhibited a high proportion of laterite fragments in the upper levels of the cores. This suggests that the building material for constructing this tail was extracted from the laterite crust, likely the nearby borrow pit. Additionally, the presence of deep terra preta deposits along this part of the feature, terra preta that permeates laterite-rich deposits, suggests that these sediments could have been mixed prior to their use as construction material. One possible explanation was that the materials used for this portion of the mound were extracted from an already mixed layer containing dark earth, rich ceramic deposits, and laterite. If we accept this as a possibility, then we must also entertain the possibility that the “tail” structure is a late addition to the mound. This, of course, would need to be confirmed through direct absolute dating methods.

The other context of this trio of units that deserves deeper attention is F61, among the more interpretively important features discovered during this season, for a number of reasons. First, its unparalleled preservation at this site provides a true ‘snapshot’ of an act, or possibly a sequence of acts that might be called a set of practices, associated with fire. If it can be determined that the burned clay associated with the feature was intentionally placed there to form a ring, as opposed to burned in situ as a result of a surface fire, then a special function or purpose can be assigned to this feature. Second, as mentioned in the section above, the state of preservation of the feature suggests relatively immediate burial after the fire was built. If this is the case, it might be said to represent a kind of dedicatory act that took place before the mound or house platform was built, which has the potential to inform our understanding of the significance of house-building in this place. Moraes (2010) also concurs that this combustion feature could represent a ritual event associated with the raising of the house platform. In terms of our larger perspectives on the site, F61 confirms that the layer interpreted as a paleo-

landsurface was in fact a surface upon which activities, such as the building of fires, was carried out. It also gives us a fairly precise elevation for that surface immediately before mound construction, where the transition between Layers II and III can often be quite diffuse. Fourth, the state of preservation of the feature suggests not only a relatively immediate burial process, but also that Layer III constitutes a fairly effective preservation medium. Throughout the excavation process, diggers report on the highly compacted nature of the deposit. Lastly, F61 provides alternate explanations for the presence of the charcoal in Layer III, and also for the use of the peninsula before the construction of the mound, which differ from the often-cited swidden hypothesis.

Mound 16.

Mound 16 seems to be on all counts a unique context on site. As mentioned above, the transition between Layers I and II is very uneven at this locale, and Layer II is as a result extremely variable in thickness. This waviness might be random, but Layer II could also be said to present a “dip” at the interface of Layers I and II near the boundary between Units N931 E452 and N932 E452. Because the boundary between Layers I and II was quite diffuse, this pattern was not accounted for on site, but the fact that it seems to occur at the same point on both sides of the excavation trench suggests this is not merely interpretive error, especially when one considers that the profiles were drawn by two different illustrators. If we consider the aspect of this dip in reference to similar dips observed between Layers III and IV, as well as the estimated dimensions of the large feature observed at N941 E452, this may represent a large feature associated with the pre-mound occupation. Taking into account also the fact that several lenses of burnt earth that co-occur with large charcoal fragments are found well within Layer II, it becomes increasingly possible that Layer II is not simply a layer of accumulated and incorporated charcoal from a swidden context. In this locale, Layer II appears to be an accumulatory layer that is characterized by distinct, localized burning activities, some of which might have involved digging into the original B Horizon. Moraes (2010) associates the particularly large burned earth and charcoal lens encountered within Layer II in N933 E452 [PN 3539] with F61 from N914-15 E437 (Mound 17). He deems the two features analogous, suggesting both are foundational events associated with the construction of the mound. I am less certain of this, especially given the presence of at least two such lenses in the visible profiles, as well as the foregoing arguments for Layer II being the result of repeated digging and burning activities as part of the pre-mound occupation.

The ceramic deposit that marks the boundary between Layers II and III also deserves a closer discussion. Initially interpreted as a large hearth or burning feature, this context was later seen to be part of a continuous deposit or layer of debris that lay at the interface of the paleo-landsurface and the mound construction layer. As a contraction layer or “piso,” it can be seen variously to serve a ritual or structural (Machado 2005; Neves et al. 2003) purpose. Since no other mound in this precinct presented an analogous context, we suggest the presence of this layer might indicate a special function or significance for this locale. The presence of burnt earth deposits within this layer is also interesting, as these deposits are almost certainly not in situ. This would indicate a deliberate disposal of remains of burning episodes within a carefully composed disposal, construction, or dedication context. Finally, some distinctly yellow, clay-rich ‘latosol’ lenses suggest either sediment sourcing or capping of deposits within this layer. Similar latosol lenses were encountered in Layer III of Unit N880 E506, and these merit further

attention in the future. The clay-rich nature of these deposits might have served a special function or had a special significance within these contexts. For these reasons, and also given the preservation state of ceramics and trempe encountered in this context, it is perceived as a significant, perhaps ritually important place or event within the history of the site.

Layer IV, as expressed above, shares some characteristics with Layer IV deposits at other locales, specifically the presence of some large, flat ceramic fragments found in association with whole or nearly-whole trempe and charcoal concentrations. One thing that was not observable in plan view, but which becomes quite clear in the profiles is, again, the presence of “dips” at the interface between Layer III and Layer IV. As before, these are visible in both profiles, and in some cases, are associated with these concentrations of artifacts. It is possible that these contexts are indeed analogous to similar assemblages observed at Units N880 E506, N895 E509, and N854 E468, and can be considered potential features. This kind of context will be further investigated through microanalyses in Chapter 7.

Mound 15.

Mound 15 may be very important for understanding the construction of the complex, many-tiered structures we hypothesize for this site. As seen in Figure VI.4.a, our on-site interpretation of the layers visible on the profiles of Unit N895 E509, in chronological order, is as follows: I – IIIA – IIIB – IV. After much deliberation, I have decided to amend our interpretations of the profile as follows. The lowest layer is clearly Layer I, as it exhibits all the characteristics expected of this layer. However, the charcoal scatters inexplicably embedded within this layer from 70-85 cmbd require explanation. One possibility is that these scatters are the remains of an intentional fire used to clear the locale of moderately-sized woody species, but that the locale was not used intensively for cultivation thereafter. What we have labeled Layer I, therefore, could potentially be sub-divided to include a thin (5-15 cm) Layer II. Microanalyses may be able to shed light on the extent to which the upper portion of Layer I is anthropically modified, and a samples such as the 80-90 cmbd AVC could serve this purpose. However, in this case, it would have been more appropriate to take a judgmental bulk sample from the profile that included the charcoal concentration visible on the east profile. A micromorphological sample could also provide additional insight into the formation of this context.

Layer III is also unusual within this site. At approximately 50-60 cmbd a layer of large macro-artifacts, including ceramics, trempe fragments, and a large laterite fragment was encountered in the eastern portion of the unit. This was observed both in plan and in profile. Because of the striking difference in inclusions observed above and below this lens of artifacts, Layer III was split into IIIA and IIIB. Layer IIIA contained extremely fragmented macro-artifactual remains, especially in comparison to those included in Layer IIIB. The most notable difference between IIIA and IIIB is the high frequency of relatively intact ceramics found in the former, whereas the latter contained almost no ceramics. Samples have been taken from IIIA and IIIB to determine the extent to which they are different, and also the extent to which IIIA more closely resembles other Layer III deposits or Layer II samples from elsewhere on the site. Finally, as to the thickness of Layer IV, there was much discussion as to whether the boundary between III and IV should fall between 10 and 20 cmbd, where it is drawn, or lower, closer to 30 cmbd, where not only is there a significant change in color, as detailed above in section III.2.5, but also where the first significant deposit of linearly-arranged ceramics appears.

This question, and some questions regarding the formation of Feature 60 (F60), which I have not yet discussed, will be addressed in part through micro-artifactual analyses. Figure VI.4.a also shows the boundaries of samples taken for microanalyses. As shown, I divided Layer III into two separate samples, vertically, in order to determine whether sample PN 2347 more closely resembled Layer I or Layer II. Sample PN 2348 was interpreted as belonging vertically to Layer III, although the existence of F60 complicates this interpretation. The column sample for this unit was deliberately taken directly through F60 in order to secure samples from this context, and as such, these will also serve to address the question of its formation.

As is the case at most other terra preta sites, features have been difficult to recognize at Antônio Galo unless they cut through a light-colored matrix. In this case, F60 is clearly identifiable where it passes through Layer I, but it is difficult to see where its upper limit lies. The simplest explanation would be that F60 was cut from the interface between I and IIIA, that is, from the ancient, if truncated, land surface. However, the large trempe and laterite fragments present at the interface between Layers IIIA and IIIB might have been used as packing stones to hold a post in place. The trempe fragments by themselves could represent just about anything, but the laterite is extremely out of place. On the other hand, laterite would have made for significantly sturdier packing and in a place where ironstone is so easily available, one would expect to see strictly ironstone used for this purpose. It is also conceivable the feature could have been cut from the top of Layer IIIB, especially given the mottled yellow deposit that appeared in the southeast quadrant of the profile at a depth of 20-30 cmbd. Although the deposit may represent a combustion structure, the possibility that it is linked to this undefined feature should not be ignored.

Samples from within the column will form part of a series of samples that will be used to test the depths from which F60 was cut. Comparable samples from all of the appropriate layers were also taken from the south profile, as the layers, especially IIIA, were significantly thicker on this profile. Samples from the same layer will be paired, and subjected to a simple single hypothesis test, as in the example below, where PN 2343 (Layer IIIB, south profile) will be tested against PN 2348 (Layer IIIB, east profile).

H_0 : PN 2348 = PN 2343

H_1 : PN 2348 \neq PN 2343

If F60 is determined to have been cut from Layer III, that is, during the formation of Layer IV, there is a strong possibility it would have housed a major post. Moraes and Neves suggested on site this could represent the position of a principal load-bearing post associated with a house. Given the round shape of the mound, this post would have functioned as the central post in a round house. On the other hand, if the boundaries of the feature are representative of the diameter of the post, the post would have been inordinately large, given the size of the mound. If F60 is determined to have been cut from the top of Layer I, then it likely functioned as a pit. If so, especially if it served a special function, microanalyses might provide clues to what this function could have been.

Layer IIIA will be compared with other Layers II and III from across the site to determine whether the on-site interpretation of layers based on macroscopic attributes was adequate. If Layer IIIA from N895 E509 is aptly named, this constitutes a pattern observable at the more complex mound structures. The relationship between Mound 27, which did present an intact

Layer III in unit N880 E506, and Mound 15, which lacks this layer, is perhaps analogous to the relationship between Mounds 29 and 13, respectively. Unit N847 E450, on Mound 13, which will not be discussed in detail here, was also interpreted as lacking a layer II. If we are correct in designating 15/27 and 29/13 as dual-mound complexes or dual-platform structures, then the absence of Layer II in Mounds 15 and 13 may suggest that they were both built slightly later than their paired structures. Because of the proximity of the structures, it is conceivable that the ‘missing’ Layer II belonging to the later mounds would have been transformed into construction material for the earlier mounds. It would be useful to obtain absolute dates that could further inform this hypothesis, but at the very least the structural evidence seems to suggest a two-phase construction sequence.

Mound 12.

Unit N854 E468 was selected for further analysis because of the presence of many features in the unit, and especially due to the potential features – clusters of ceramics and unusual dips in the profile – that were not immediately evident in plan view. Mound 12 also appears to evidence all four layers, as well as a two-tiered Layer III (see Figure VI.4.b). As is the case throughout this unit, none of the Layer boundaries or definitions are idealized or straightforward. I will begin by analyzing the original profile completed in the field and then present an amended profile interpretation that includes considerations put forth in this section. Layer I, which corresponds to the B horizon of the original Oxisol, is bounded along its upper edge by Layer II (visible on the southern portion of the east profile, and across most of the south profile), Layer IIIA (to be discussed below) along the northern portion of the east profile, F55 in this same profile, F57 near the junction of the south and east profiles, and what appears to be a one-time depositional event along the southwest quadrant.

Two of these contact points merit further discussion. First, the contact between Layer IIIA and Layer I is unusual in shape, especially insofar as Layer IIIA appears to cut into the deposits associated with F55, undercutting the fill of F55 and occupying some of its cut. From a depositional perspective, the simplest explanation would state that, in fact, there are two fills that occupy the cut of F55, a lighter one toward the north and a darker one toward the south, and that the boundary between this lighter fill and the layer into which F55 was cut has been obscured through post-depositional processes. However, during analysis of the profile, there appeared to be no difference whatsoever within the region defined as Layer IIIA. Still, it is possible that Layer IIIA could have had a continuous lower boundary at approximately 75 cmbd, which would mean that what lies beneath it would be part of F55 and Layers I and II. It is also conceivable that Layer IIIA does fill part of the cut of F55, and also a later, ‘s-shaped’ cut that was made into F55, undercutting part of the feature fill. In order to investigate this deposit, a spot sample (PN 1573) was taken in a strategic locale, placed so as to fall above the boundaries of the cut associated with F55 and below the expected lower boundary for Layer IIIA. Thus, these deposits can be compared with those of Layer IIIA, those of F55, and those associated with Layers I and II. One thing that can be said with certainty is that Layer IIIA caps F55.

During the profile sampling stage, a buried dark earth deposit was identified in the southwest quadrant, at approximately 80 cmbd. Although this deposit occurs where layer II is expected, its appearance did not match that of a buried A horizon. The abrupt transition between the dark stain and the yellow matrix below suggests a contact between strata, not horizons. The dark deposit feature here was evident only in the profile, and is not well understood. Essentially,

it appears to be a soil dump from a shallow, nearby pit, possibly any of the identified features observed near the bottom of the excavation. It certainly indicates with great precision the location of a one-time land surface; but since it appears to blend in horizontally with the paleosol, but was clearly laid down on a surface where the A Horizon had been truncated, we can place this event before the formation of the paleosol. This may be additional evidence of very early and intensive site remodeling before the mounds were built. It may also evidence serialized construction phases, in which adjacent mounds were built sequentially, and in some cases the inhabitants found it necessary to level off the surface before building on it. In order to understand this apparent truncation, a sample was taken for micromorphological analysis across the boundary in question (PN 1579).

Layer II, which is hard to distinguish in the east profile, is quite clear in the remaining profiles, with the exception of the point at which it meets the soil dump in the south profile, at approximately $x = 35$ cm, $z = 80$ cm. The upper portion of Layer II, which would have been the land surface before Mound 12 was constructed, corresponds with approximately 75-80 cmbd, where the mosaic of features and colors observed in plan view created tremendous interpretive difficulty. However, this mosaic does provide information, insofar as the cutting of features results in small, patchy sediment dumps matching the soil colors around the cuts. Hence, Layer II is likely the layer from which many of the lower features (F54-57) identified were cut, although F52 begins above Layer II and cuts through it. Probably the only way to overcome this difficulty would be to open up several units at a time in a horizontal excavation, by means of which we might be able to identify entire features and their intersections with other features. Additionally, it is clear that not all features cut from Layer II were clearly visible in plan or in profile. As an example, the grayish-white deposit identified in the middle of level 80-90 cmbd (PN 1527) was likely contained within a feature. The deposit described an arc that began on the north profile of the northeast quadrant of the unit and curved toward the west, exiting the unit on the west profile of the northwest quadrant. Given all the burning contexts found nearby, and taking into account its highly plastic clay texture and the shape of its distribution across the northern portion of the unit, this deposit is thought to be an ash scatter. If this ash lines a circular feature, most of it is probably still intact within neighboring unexcavated units, and additional information about this deposit could still be recovered for future investigation.

As in unit N895 E509, Layer III in this unit appears to be composed of two sub-layers, Layer IIIA and IIIB. This distinction was made, again, on the basis of a relative abundance of macro-artifacts in the upper (IIIB) part of the layer as compared to the lower (IIIA) portion. This boundary also corresponds to a very slight change in color observed between levels 40-60 cmbd (10YR 4/3 "brown") and 60-80 cmbd (10YR 3/4 "dark yellowish brown"). This distinction was made with a high amount of confidence, especially as this pattern parallels that observed in N895 E509. The main question that remains about Layer IIIA is that regarding its lower boundaries, in particular its relationship to F55 and Layers I and II in the northeast quadrant of the unit.

Given what we have seen in other units and what we know characterizes this particular unit, Layer IV is precisely what we would expect: a very dark (10YR 2/1 "black," 10YR 2/2 "very dark brown") layer of dark earth characterized by a high frequency of ceramic remains and, in this unit, concentrations of remains probably corresponding to features that were difficult to identify given the black-on-black nature of the soils. As is the case elsewhere, Layer I is slightly sandier and looser than the rest of the unit.

Because it featured nearly all relevant deposits, the east profile was selected for most intensive sampling. A column of samples was taken at $x = 100$ cm, $y = 30-50$ cm, such that it passed through all of the identified layers, F55, as well as a dip in Layer I associated with aligned ceramics that looked suspiciously like a small, lined pit. The column sample include a separate sample within this potential feature. Shock also requested that I collect sediments from this locale in sufficient abundance to allow flotation of the context, as she was relatively convinced of its structural nature. Upon collection of the sample, further ceramics were located lining the context, seeming to confirm our interpretation. Bulk samples from this potential feature were taken after initial sampling as part of the microanalyses had been completed, during which time the relevant column sample had been given PN 1570. Because the bulk sample was considerably bigger than the column sample, and because it covered a larger area horizontally, it was given a new PN, 1577. At this time, bulk samples were also taken near the southeast corner of the unit, at $Y = 0-15$, $z = 35-60$ cm, immediately below a large trempe fragment (PN 1578). This represents another dip in Layer IV that happens to be associated with a concentration of charcoal. This also corresponds to the locale immediately beneath the position in which burnt-earth and charcoal concentration was identified in plan at 30 cmbd. These two samples should look significantly different from Layer IV and Layer IIIA in laboratory analyses as well.

My overall impression of Mound 12 is that it represented a place of intense activity early on. The number of features and anomalous deposits identified during and after excavation combined far exceeds the number uncovered at any of the other locales, including the mounds that were excavated more intensively. This kind of activity, which involved burning and a good deal of sediment movement started before the mounds were constructed, as evidenced by the sediment dump that occurs as part of layer II, but is also matched in the upper occupation layer (Layer IV). This suggests that the function of this locale did not alter with the construction of the mounds. The size of the mound suggests that it may have served a specialized function within the precinct, if we consider Mounds 6, 15/27 and 26/30, and also if we consider the placement of mounds and potential access points (see below). However, as is the case in all the other contexts tested, the sample we have obtained of the mound is extremely small, and it is possible that all mounds have one ‘feature-heavy’ area, but that we have not yet understood the logic of the internal arrangement of a housemound of this type. As before, the suggestion is that a large, areal excavation could elucidate the spatial structuring of a mound in particular; several areal excavations at a number of mounds would yield more information that could be used to model the distribution of activities within houses and across the site.

Places within places – beyond the mounds.

Preliminary results overwhelmingly demonstrate that the mounded contexts are distinct from contexts located off mounds. The distribution of ceramic remains and terra preta across the precinct demonstrates that there is structured deposition that parallels the circular arrangement of mounds across the precinct. Not only is the plaza relatively free of macro-remains, it also exhibits almost no in-situ terra preta, although the observation of a moderate terra preta deposit in the northeastern portion of the plaza merits further discussion and investigation. Additionally, units excavated outside the circle described by the mounds, excluding major features encountered in off-mound contexts, demonstrate a similar pattern of non-deposition, but to a

lesser extent. If one were to rank the three sampling strata in terms of macro-artifact frequency from densest to least dense deposition, the *Mounds* stratum would represent the densest deposition, followed by the *Behind Mounds* stratum, followed finally by the *Plaza* stratum.

The ensuing analysis will consider the North Precinct at the three scales that resolve themselves around the household scale. I consider the precinct as a whole, in relation to the rest of the site, the peninsula, and the region, looking broadly at the results from the topographic survey and accompanying probes. I think through how the North Precinct can be thought of as a neighborhood and what questions can be addressed regarding this scale of perception with the microanalyses proposed here. The section below considers the plaza alone, as the region that is encircled mounds, and explores in detail the data supplied and questions raised during the core and auger survey. The Inner Structures are considered in relation to each other, as well as in relation to the mounds. I explore the mounds individually, as well as particular features and anomalies that beyond how they relate to the mounds qua houses in the next two chapters.

The plaza – looking inward.

Topographic and core-and-auger survey revealed a more complex structure for the plaza of the North Precinct than previously envisioned. Initial observations of the plaza suggested it consisted mostly of an exposed laterite crust, and the initial hypothesis, proposed by Moraes in 2007, was that this exposed layer was evidence of human intervention. As core-and-auger testing proceeded, it became clear that, in various portions of the plaza, a particulate matrix made up of modified and unmodified Layers was present in thicknesses up to and exceeding 1 m. However, it also became clear that a number of low superficial features, here denominated Inner Structures and evidenced as slightly higher in elevation than the remainder of the plaza, could be worth investigating as potential built features. These features aside, I initially proposed that the plaza consisted of two distinct depositional areas recognizable from the surface, one, occupying the southwest portion of the plaza, characterized by laterite-rich deposits surrounded and in some cases percolated by a colluvial matrix of terra preta, and another, located toward the north and west of the plaza, characterized by a relatively simple two-layer pedo-stratigraphic sequence that included Layer I and a terra preta layer that should be considered a mixture of Layers II and IV. The excavation of units N880 E452 and N915 E491, as well as sondage N913 E461 seemed to corroborate this hypothesis.

In order to better comprehend the inner structures, I proposed to investigate the artificiality of these structures through a thorough mapping of the features using the available core and auger, as well as the associated drop-cone penetrometer and TDR moisture meter. Analysis on the macro-scale would count on physical properties such as matrix color, texture, compaction, and the presence, frequency, and nature of inclusions. Matrix samples were collected from each of the probes and would be compared to known anthropic and unmodified contexts from around the peninsula.

Field results, as described above, suggest that some of the structures are more likely to have been artificially raised than others. Structure C, on the other hand, seems very likely artificial. First, the peak of the structure (N885 E483) is located precisely where a slight depression in the laterite crust below suggests that, at most, the original A Horizon was relatively flat at this point. To the extent to which the laterite crust can be taken as a proxy for pre-occupation surfaces, this suggests that there was a deliberate effort to raise this structure off the ground. Second, a thickening of deposits above the laterite crust on the southern end of transect,

near coordinate N870 E483, suggests the presence of excess matrix material in this zone. Specifically, a grayish-yellow layer that could be interpreted either as a transitional layer between an A and a B horizon, or as a construction layer, gets thicker in a southerly direction, from N880 through to N870. This suggests either intentional raising of the area or colluvial build-up from erosion of sediments originally deposited in the vicinity of N885 E483. Finally, the presence of an anomaly resembling a feature at N875 E483 containing terra preta and macro-artifacts, as well as the nearby (N875 E493) thickening of the terra preta layer, in association with large ceramic fragments, suggests the original soil in this area was first excavated, and subsequently replaced with sediments from elsewhere. Due to a lack of time, this area was not farther investigated, but there is a good chance deposits located to the south of Structure C represent a distinct depositional pattern. The hypothesis raised by field data is that Structure C was intentionally constructed, and that the region immediately to the south of it served an associated depositional purpose. The anthropic nature of the layer immediately beneath the terra preta layer will be tested through microanalyses.

The artificiality of Structure B cannot be established nor can it be rejected upon the present evidence. The slight thickening of a potential construction layer near the point which is considered the apex of Structure B is not significant or conclusive enough to assign an intentional formation process to this structure. However, it may be possible to assess the extent to which this layer more closely resembles Layer II or III through microanalyses. If a significant anthropic signature can be ascertained, then it could be said that at least part of this structure was built up. However, I must interject with a further qualification of this statement. Anomalies at various points within the plaza suggest that the laterite crust, used here as a proxy for the rough contours of the paleo-landsurface, is not 100% continuous across the peninsula. This suggests that there were probably slight variations in elevation already present at the site when it first became a site of human occupation. I propose that it is possible that some of these natural features were incorporated into the shaping of structures in the North Precinct as part of placemaking activities. Hence, portions of what appears to be a continuous matrix may be in situ or not and may display different degrees of anthropization.

Structure D, though it was only tested in a single locale, is a likely candidate for a built structure given its location and the color of the associated matrix. Not only is matrix color observed at point N887 E441 darker than what is normally expected for a B horizon at this site, mottling observed within the 0-20cm level actually decreases in lower levels, the inverse of what is expected in a transition from terra preta to a typical local B horizon. Additionally, the structure is located in an area of exposed laterite crust, observed to the north, east, and west. Finally, the proximity of unit N880 E452, which revealed only laterite-rich deposits, along with the generally red (e.g. 5R 4/6 “strong brown”) hues of the B horizon in this part of the plaza, suggest the matrix found at this locale did not develop in situ.

Finally, the presence of two anomalously deep deposits immediately to the south of two of the Inner Structures suggests a pattern of use for these structures. Here I refer to the unusually deep pedo-stratigraphic profile evidenced at N895 E450, which sits just to the south and west of Structure A and the potential feature and thick terra preta layer uncovered at N875 E483 and N875 E493, to the south and southwest of Structure C. The thick terra preta layer located at N875 E493 seems to fill a presumably natural depression indicated by the depth of the laterite crust and associated B horizon. This is an unusual place to observe such an accumulation of debris if we consider that there is a real access point or path between Mounds 27 and 12.

Some aspects of the plaza remains poorly understood in a way that can only be clarified through further excavation. For example, the current topographic model suggests that unit N915 E491, thought to represent the plaza itself, may in fact be located on top of a low, semi-circular structure associated with Mound 15. This faint circle was not identified in the field through field-walking or through the initial topographic modeling, as tools available in the field were not as discerning as those utilized to build the present model. Structures of this subtlety are extremely difficult to recognize immediately after brush clearing, especially if no burning is undertaken to reduce the tangle of brush left behind by clearing. However, at the nearby site of Laguinho, which is currently under papaya cultivation (a crop that, when the trees reach maturity, provides extremely high visibility), microtopographic analysis resolved a number of similar low, horseshoe-shaped enclosures interspersed with higher mounded structures (Schmidt et al. 2009). Further investigations in this portion of the plaza could be geared toward resolving this issue through a closely-spaced grid of augers and test excavations targeted at this potential inner court. A narrow trench would also prove extremely useful toward clarifying these contexts. Using samples currently available, it is possible to examine the matrix samples recovered from unit N915 E491 with a view toward establishing the degree to which the identified layers and the evenly-spaced AVC samples more closely resemble Layers I, II, III and IV, as identified above.

The precinct: a sense of place

Microtopography work done in the North Precinct of the Antônio Galo site suggests that it was a carefully engineered landscape that oriented the residents toward an inner core, the plaza, while permitting access from outside in three different places. First, it is worth noting that the North Precinct is an apparently self-contained entity that is clearly separated from the rest of the site. Not only does it occupy the entire space of the peninsula to the north of the broad isthmus that connects it to the rest of the landform, there are also no major constructions between Mounds 12 and 27, which demarcate the southern edge of the circle, and Mound 11, the nearest large structure on the other side of the isthmus. Additionally, testing in this area (Unit N847 E468), though limited, suggests deposition here is minimal and probably in large part colluvial. Certainly, additional testing in the isthmus or saddle between the two landforms would clarify this relationship, as would testing of the southern portions of the site.

An apparent access route located between Mounds 17 and 27 suggests that though the North Precinct was a thing unto itself, there was movement and communication between the plaza and the Inner Structures of the North Precinct and places south on the peninsula. A caveat accompanies this observation, namely that this break in the circle of mounds is also the location of a modest modern wooden structure. It is conceivable that pre-Columbian structures in this area could have been disrupted by modern building activities, although, as has already been expressed, there is no known historic use of heavy machinery on this landform due to limited access routes. It is equally likely that the modern structure, and indeed footpath are situated in this break because it is a 'natural' access route to the remainder of the landmass. In excessively dry years, many of the channels that lead from the Lago do Limão town to the relatively deep channel that borders the northwestern portion of the site dry out to the point of being impassable

by canoe. We experienced this in 2004, and found that we, along with the local landowners, had better access by traversing the upper parts of the landforms on foot, reaching the precinct by walking through the southern part of the site.

There may also be two water access points along the northern portion of the site. The first is oriented toward the northwest, and also coincides with a depression or ramp observed during implementation of the N900 auger transect. This is likely the most traveled route, given that the channel to the northwest of the site never dries out. Although access to the occupation nucleus of Lake Limão, the Lago do Limão town, would be limited in dry years, access from Antônio Galo to the Ariaú, the larger channel that connects to the Negro River, is still quite good. Because the town of Lago do Limão is a recent phenomenon, I suggest that, prior to the 1970s, access to the Ariaú would have been more important than access to the portion of the lake where the town is situated. Another potential access path is located on the northeast portion of the plaza, leading to the semi-annual channel that borders the site on that side. I identify this as the space between Mounds 26 and 19, though given the relatively dense brush encountered when mapping this portion of the site, which happened toward the end of the season, there is less certainty that a structure was not missed in this gap.

The Inner Structures discovered during this field season are still poorly understood. The designation 'structure' has been given because preliminary evidence suggests that at least some of these low berms have been built. Structure A, which seemed centrally located within the plaza, was thought at the start of the field season to be something akin to a men's house, a ritual structure with specialized function that might also indicate specialized access. Ethnographic correlates of such structures in ring villages are known among the Kuikuru of the Upper Xingu (Heckenberger 2005) and also among Gê speakers of Central Brazil (Maybury-Lewis, (ed.) 1979). Initial conclusions regarding this structure suggested limited activity in this locale, especially given the lack of significant terra preta deposits identified through auger tests. However, a re-evaluation of core and auger data points to a need for further investigation of this structure. For example, the thick (45-cm) layer of anthropic deposits observed at N905 E467 does suggest significant activity on Structure A, especially as topographic cross-sections suggest that colluvial deposition would have been unlikely in this locale. Additionally, the anomaly observed between cores N890 E450 and N900 E450 shows an unexpectedly deep deposit just to the south of Structure A; if this does represent an excavated feature, it is likely associated with Structure A. Similarly, the potential feature uncovered through coring at N875 E483 could be associated with Structure C. The presence of these potential features could indicate specialized functions for these smaller structures, and an investigation of these deposits could shed light on the activities performed thereon.

The remaining structures, B and D, are equally poorly understood. Structure D is the smallest and lowest of the Inner Structures, and does not appear to be directly associated with any other structure, mound, or feature in the North Precinct. The matrix that makes up this structure is too dark and vertically uniform to have been the result of melanization of a B horizon by a darker A horizon, and in fact this layer more closely resembles Layer III than Layer II. The relatively dark matrix uncovered at N887 E441, from 20-60 cmbs, combined with artifactual remains found up to a depth of 40 cmbs suggest this is an anthropic deposit, and given the surrounding surface characteristics, I conclude this was a structure built up intentionally. However, it is unusual in that the uppermost layer of this deposit is not particularly dark (10YR 4/2). The color of this layer is consistent with terra mulata colors, but if we take terra mulata to

represent manured or amended crop fields, then this interpretation makes no sense in this locale. Structure D is located in a portion of the plaza characterized by exposed laterite, and is only approximately 5 m in diameter. The soil is heavily compacted, as reported in field forms, which would suggest it would probably not have functioned well if used as a garden plot. The placement of Structure D near the main water access route to the site would make it an unusual place to create a garden plot that would have served the needs of one household, and at the same time, it is small to provision the entire community of the North Precinct. I suggest this area was built up relatively early, consisting only of moderately modified sediments that would have come from Layers I and II, which would account for its relatively light color in comparison with other anthropic deposits found in the North Precinct. I further suggest that this structure would have served very specialized purposes, wherein burning was *not* a part of associated practices, and hence limited terra preta formation took place on Structure D. It is also conceivable that this structure ceased to be utilized during the terra preta formation period; however this hypothesis would absolutely require chronometric testing.

The structure initially identified as a ramp, Structure B, would have been associated with the Mound 15/27 complex, and this structure may be the key to comprehending the Inner Structures as a group, which I discuss below. Important for understanding Structure B and its relationship to the other structures in the precinct is establishing whether it was a structure intentionally built to direct bodies and gazes toward Mound 15.

Moraes has proposed that the Mound 15/27 complex would have been an important place within the precinct, not only because of its size, elaboration, and associated structures, but also because it sits directly opposite the northeast access point. If we conclude that Structures B and C are both associated with the Mound 15/27 complex, then it is the most elaborate platform feature within the circle, and like was a key focal point within the precinct. Similarly, Mound 16 sits directly across from the access point that leads north from the southern part of the site, and if we recall, it is the only structure on site that features a dense layer of large ceramic fragments within its construction matrix. If we take this to mean this mound had a special status within the site, we may want to consider the north-south axis to be especially important within the precinct, especially taking into consideration that an axis leading through the southern access route and Mound 16 would also pass through structures A and C, the more clearly defined of the four Inner Structures.

Understanding Structure B may be a key to comprehending the alignments or orientations of the inner structures as a group, because if we can establish that Structure B is indeed an intentionally crafted ramp, the argument can be made that the focal point in the North Precinct is in fact this particular mound complex. This would suggest that the orientation of the remaining inner structures is also structured around the Mound 15/27 complex. However, in light of recent topographic analysis, we are also confronted with the possibility that Structure B is in fact a circular feature, possibly describing a small court to the northwest of Mound 15. This might suggest a closer association between Mounds 15 and 18, which had not been considered previously. Without further investigation of the make-up and formation processes of the Inner Structures, we cannot assert that any of them was more closely associated with one mound than another. Furthermore, this question may not even be worth asking. It may in fact be true that the inner structures functioned in close association with the Mound 15/27 complex and simultaneously featured in the axially suggested by the alignment of Mound 16, Structures A and C, and the south passage. In this case, both stories are true, and may depend more on the

perspective of the observer(s), calendrics, or other realities of living an embodied, emplaced existence that is historically and temporally contingent, and meaningfully constituted within a complex social order.

From a placemaking perspective, I suggest that the highly modified Layer II observed beneath the majority of mounds excavated indexes a relatively intensive occupation of this portion of the peninsula prior to the building of the mounds. This occupation would have significantly changed the way that the various elements of the environment responded to human presence, as inputs to the local soil altered the natural cycles, including but not limited to pedogenic processes, that took place within this landscape. A hypothesis proposed in the field is that this charcoal-rich, somewhat darker layer represents either a buried terra mulata or a step in the process of terra preta formation. Samples obtained from all identified instances of Layer II will be compared, chemically and sedimentologically, with samples from Layer IV and I, to determine whether Layer II can be said to represent a 'stage' in the formation of terra preta, or whether it represents a completely different kind of occupation.

Finally, the absence of significant fine earth deposits from virtually the entirety of the site outside of mound or structural contexts requires explanation. The hypothesis generated by Moraes (2007) in 2005 and carried forth as a working hypothesis throughout the 2009 field season locates these 'missing' soils within mound construction sediments, identified here as Layer III. In order to test this hypothesis, Layer III will be compared with layers I and II, to determine to what extent Layer III can be considered a mixture of Layers I and II. Furthermore, the lack of fine earth sediments definitively associated with Layer II across the non-mound contexts of the site, or at least the difficulty in identifying Layer II outside of mound or structural contexts creates a challenge in understanding site use before mound construction. Hence, sediments from Layer III will be treated as a variant of 'midden' sediments, and studied in detail in attempt to understand the function of the site prior to mound construction.

Chapter 7.

Examining the geoarchaeological evidence

Re-framing laboratory research

The 2009 field season at Antônio Galo produced field results beyond expectations for terra preta sites in the Lago do Limão region. The level of detail at which macro-stratigraphy and field data could address events at the site has provided a good deal of insight into the phases of occupation and modes of being associated with the Antônio Galo site. However, numerous questions were raised regarding site formation processes and the nature of specific deposits. In this chapter, these questions are presented as hypotheses and the results of hypothesis testing through microanalyses are presented.

This chapter begins with a conceptualization of the three principal ways that the archaeological matrix is considered within this research project. The matrix is likened to an artifact, a container or stage, and a point of contact or means of communication between humans and their environments. Through each of these lenses, particular kinds of research questions can be asked, and different scales of analysis are appropriate. The introductory section of this chapter will point toward applications of these conceptualizations relevant to this study. A detailed description of laboratory work follows in the next major section, orienting the reader toward the specific research hypotheses to be addressed through microanalyses. In the next section, I present the theoretical approach that is employed to bridge the gap between pedological and sedimentological approaches to comprehending the archaeological matrix. Finally, hypotheses posed in the preceding chapters are addressed within the context of larger research questions that speak to placemaking at various scales.

Research questions preserved from the original research design include spatial questions that would compare the nature of depositional patterns across the initially delineated sampling strata: *Mounds*, *Behind Mounds*, and *Plaza*. A new sampling stratum was added, the *Inner Structures* sampling stratum. This chapter builds on interpretations and hypotheses posed about the temporal changes in the spatial organization and ordering of the North Precinct, including activities performed therein and transformations of place. Temporal questions originally proposed, which revolved around pre- and post-terra preta occupation have been refined, as the clearly identified earlier occupation phase, indexed by Layer II, does not seem to constitute a “pre-terra-preta” occupation. Instead, the research focus has shifted slightly toward understanding the degree to which this earlier occupation can be classed as terra preta or terra mulata occupation, or neither. In determining whether Layer II can be clearly associated with a terra preta or terra mulata occupation, I consider the extent to which it presents signs of anthropization; what these, if present, could suggest about the nature of the pre-mound occupation at Antônio Galo; and what further research could be undertaken to clarify this context. This will be considered as a major turning point in the transformation of the site, and

will also be considered within the context of the various iterations of place indexed by other acts and events identified.

New research questions raised during conduct and interpretation of field work are geared toward understanding locale-specific site-formation processes, and also toward understanding the function of particular features identified on site or the components of poorly-understood anthropogenic deposits. These, in turn, correspond to isolated or repetitive acts of landscape remodeling and placemaking. Lastly, some of the questions developed on site were methodological in nature, and aimed at testing the accuracy of traditional field interpretations, to explore the efficacy of probing methods for collecting matrix samples and for guiding excavation, and to tether field observations to chemical or physical properties of the matrix understood through laboratory work.

The matrix as artifact

This project envisions the archaeological matrix as a type of artifact, insofar as it consists of a mix of naturally occurring and manufactured components, and also insofar as it is a naturally occurring body that has been modified through human intervention. Like any other artifact, it can be studied as an entity that has certain qualities after modification that can be compared to those it possessed before human intervention, as a bone flute or shell pendant. Also like any other artifact, the archaeological matrix can be studied as a repository of data that contains evidence of the process of its modification.

How the various depositional contexts and modified horizons were created through human activity will be the focus of the first interpretive section of this chapter. Evidence of the kinds of transformations, including additions, losses, and movement of particles, that occurred to previously existing bodies of particulate matter, will be addressed. This tack applies to my study of horizons that were anthropically modified, and in this respect, it can be likened to a study of pedogenesis. Appropriate for the study of these horizons, of which Layer II is an example, is a fractional gains and losses approach (Brimhall and Dietrich 1987), utilized by soil scientists to understand the specific chemical changes undergone by soil horizons through pedogenic processes, which also involve additions, losses, and particle movement. For studying contexts that are understood as sedimentary bodies, a life-history approach to sediments will be employed, wherein I attempt to assess the source, mode of transport, depositional context, and, to a certain extent, post-depositional alterations to particles that make up these bodies. The contexts studied in this manner include all construction contexts, labeled as Layer III across the site, terra preta occupation layers, identified as Layer IV, as well as all feature matrix samples subjected to micro-analyses. These were studied as made artifacts, much in the same way as plaggens and Maori “made soils” (Cassels 1972; Taylor 1958; Walton 1992) can be understood as products of human manufacture.

The matrix as repository of data

The main difference between a shell pendant and the archaeological matrix is that a shell pendant was necessarily made intentionally, and was the sole product of this manufacturing process. The matrix may or may not have been intentionally created at some point, but, by its

very nature extending across the entire site, it also becomes the stage upon which all activity performed on the site is enacted, and by consequence the canvas upon which traces of these activities come to be inscribed. In this way, the matrix can be likened to a ceramic vessel, both a product of human action and a potential container for evidence or traces of activities and social dynamics beyond its production.

From this perspective, I examine occurrences of the archaeological matrix, such as feature fills and construction layers for microscopic or invisible traces of activities that may have taken place elsewhere on site, before the sediments that make up these contexts were moved to their present location. This approach, which seeks to identify traces of human activity through the examination of secondary deposits, is similar in theory to the examination of midden sediments for traces of daily activity (e.g. Shillito et al. 2008; Simpson and Barrett 1996). While features can more easily be linked to one or a narrow range of activities than a midden context, it is predicted that construction fill will be more difficult to parse than layered midden contexts. In this instance, micromorphological analyses could provide insights into the extent to which sediments used in construction were mixed before deposition, or whether the contexts identified as 'construction fill' actually contain in situ midden material. The utilization of micromorphological analyses is suggested as a possible step to extend understanding beyond the analyses completed and reported here.

I also examine the archaeological matrix as a structured whole, a continuous body that has incorporated and preserved the traces of human activities that were spatially discrete. These can be thought of as horizontal discontinuities within a continuous particulate body, as in the subtle differences within a house floor or gradual changes observed across the plaza; as discrete and contemporaneous stratigraphic lenses, as in the various construction layers associated with each of the mounds; and as punctual or isolated occurrences, such as features or anomalous deposits, that index a moment in time.

The interstices of social and natural systems

One of the major points of this project is to attempt to understand as many aspects as possible from both static and dynamic perspective. From a static perspective, the archaeological matrix is an artifact and a repository of data. However, it is also significantly more than that, because as has been made clear here, and as is also unquestionably understood throughout the world, Amazonia is an extremely dynamic place. The soils that support its teeming life, be it modern cities and towns or sparsely populated forest, are also in a constant state of flux or becoming. Even as the archaeological matrix at Antônio Galo consists of a series of layers or lenses of sediment introduced by human agents, pedogenic processes are working to undo the stratification created through human activity, to homogenize and then reorganize this new parent material into soil horizons. The ongoing dialectic between human and natural forces is happening now as traces of the distant past are slowly erased, but modern activity is also contributing new chemical and physical components that resist horizonation. In this light, we must also consider that this dual process would have been going on as far back as the very beginning of human habitation of this landform.

Not only is human influence evident in the color and texture of the soil and in its heightened fertility, which results from distinct, anthropogenic nutrient cycles in the soil, but also

the hydrology, surface morphology, and vegetation of the site reflect human influence. Scholars are only now beginning to understand the extent to which human beings have modified landscapes and environments in Amazonia, and in many cases this surface modification has been found in association with terra preta. Increasingly, we are faced with difficult questions regarding the primacy of plants or soils in the modified landscapes. Certainly, specific plants, such as the Caiaué (*Elacis melanococca*) are known markers of terra preta, meaning that they grow exceedingly well in terra preta, where they would scarcely be expected to survive in the nutrient-poor bluff soils that have formed on the ancient riverine terraces that constitute the greater part of lowland Amazon basin landforms. If this is true for the Caiaué, then it is likely true for other plants and life forms that inhabit Terras Pretas de Índio.

To the extent that terra preta, understood as a soil, has the potential to change the ecology of a micro-region, making possible the presence or domination of species previously scarce in that same region, the matrix should be understood as acting as a point of contact between human beings and their environments. Human action is in some sense transmitted or translated to the local ecosystem through the soil itself. The ecosystem and the environment, in turn, are integral parts of places, and hence soil change also induces a degree of placemaking beyond that which we consider evident, such as earth-moving and the construction of structures, or the organization of space to fit a social order. This is above and beyond any potential culturally specific awareness of soil type and potential designations of particular kinds of soil as sacred or imbued with special significance, which we must also consider a possibility here, given the undeniably transformative nature of terra preta with respect to the local environment as a system.

When understood as an interface, a locus of communication between human and natural systems, terra preta provides millions of microscopic windows into the impacts humans have on their environments. Although this study takes as its main case study Terras Pretas de Índio of the Central Amazon, the same can be said of terras pretas and anthropogenic soils elsewhere, and even of soils generally not considered highly modified. The chemical reactions, and physical or structural changes, and movement of soils effected by human action, in this light, can be seen as a set of interstices in the interdigitated encounter between social and natural systems.

The first major topic addressed in this chapter, which deals with microenvironmental modification, treats the matrix as a transmission medium, and seeks to understand the interstices of social and natural systems. I examine the way that the matrix records or “remembers” the anthropogenic inputs that are introduced into the soilscape as it is transformed from a naturally-occurring soil into an archaeological matrix. The second major topic, that which deals with landscape remodeling, takes the archaeological matrix as a repository of data, a palimpsest upon which the history of the occupation of the cultural site now known as Antônio Galo is inscribed. This section, which constitutes the major part of this chapter, investigates layers and features as the products of human action, and is thus also a treatment of the matrix as artifact. As will be expanded upon below, this treatment is not simply a ‘reading’ of information about the past embedded in the matrix, but is also necessarily a consideration of the way that these ‘products’ fed back into ecological processes that create or modify local and micro-environments. Hence, humans were simultaneously creating places by creating these deposits and engaging with processes of environmental and landscape modification.

Methods

Whereas the original intention had been to apply a suite of analyses evenly across the site in search of spatial and temporal patterning, the extraordinary preservation state of mound contexts required a re-framing of research questions and a change in prioritization of laboratory work. Additionally, the availability of equipment and field staff also influenced the ways that some of these questions could be addressed, obviating the need for some analyses and making possible others. This section outlines the laboratory analyses conducted on matrix samples collected during the 2009 excavation season at Antônio Galo.

Laboratory analyses completed

This chapter focuses exclusively on data derived from the off-site (geological) sampling unit and the seven archaeological excavation units described in detail in Chapter 6. With the exception of exploratory analyses on heavy fraction samples performed in Manaus (see below), all microanalyses performed on samples from the 2009 excavations at Antônio Galo were restricted to samples from these units, delineated in Table VII.1.

Table VII.1: List of units on which laboratory analyses were completed.

Locale	Unit Coordinates	PN Series	Date Initiated	Date Completed	Profile sampling date(s)	Layers Present	Note
Mound 12	N854 E468	1501-1600	June 25	July 6	July 7, 19	I, II, IIIA, IIIB, IV	N/A
Mound 15	N895 E509	2301-2400	July 4	July 14	July 13-14	I, IIIA, IIIB, IV	N/A
Mound 16	N932 E452	3001-3100	July 9	July 20	July 21	I, II, III, IV	N/A
Mound 17	N915 E437	2601-2700	July 5	July 14	July 19	I, II, III, IV	N/A
Mound 18	N924 E516	1901-2000	June 28	July 2	July 19	I, II, III, IV	N/A
Behind M16	N941 E452	2201-2300	July 2	July 9	July 17	I, II, III, IV	N/A
Plaza – NW portion	N915 E491	3601-3700	July 15	July 18	July 19	I, IV	N/A
Off-Site Unit	N992 E452	3801-3900	July 20	July 20	July 20	B, B/A, A/B, A	NE quad.

Samples collected from the sampling column were designed to permit characterization of each distinct deposit or Horizon identified within the pedo-stratigraphic profile. The excellent stratigraphic preservation encountered shifted research priorities toward understanding these Layers and features in terms of formation processes, but also as repositories of data about human activity at the site. Thus, the processing of these samples was prioritized, and samples recovered from the sampling columns were sent to Embrapa for analysis immediately following the end of field work. Analyses to be performed at Embrapa included determination of bulk density, analysis of the soil moisture retention curve as a proxy for porosity and pore size distribution, particle size analysis, and a suite of chemical extractions and measurements geared toward determining soil fertility.

This first series of samples was received by Embrapa with my assistance, in my capacity as visiting researcher at the Soil Physics Laboratory, then directed by Dr. Wenceslau Teixeira. I

oversaw the drying of samples in an outdoor drying chamber, and the subsequent grinding and sieving of samples to obtain the < 2 mm fine earth fraction required for soil physical and chemical analyses. I separated the necessary aliquots to be delivered to the physics and chemistry laboratories, and hand-delivered samples to the Soil Chemistry unit. I remained in the Physics Laboratory for four weeks, assisting in conducting particle size and soil moisture retention analyses on the core and disaggregated samples obtained from the sample columns.

During my four weeks at Embrapa, under the guidance of Dr. Teixeira, I developed a series of hypotheses to be tested using a suite of analyses to be conducted at Embrapa and at commercial or research laboratories with which we had established a research relationship. These hypotheses centered on the identification of physical or chemical traces of human activities, which have been articulated in the final section of Chapter 5. In order to test these hypotheses, three additional sets of analytical samples were prepared. These data would complement data from samples taken from the profiles, which were already undergoing analysis or preparation for analysis. First, a set of select AVC and feature matrix samples, along with samples from anomalous deposits such as the ash lens identified in Unit N854E468, was separated for standard soil chemical and physical analyses at Embrapa. These analyses match the ones performed on the first set of samples, and are described below. Of the contexts selected for characterization at Embrapa, a subset was selected for visible and near infrared (Vis/NIR) spectroscopy for carbon determination and speciation, and aliquots were accordingly separated and mailed to Sandra Oliveira Sá of the State University of Maranhão in Brazil. The third set of samples consisted of aliquots of matrix samples set aside for total elemental analysis, which included all samples taken from sampling columns, as well as a specific subset of samples set aside for the second round of chemical and physical analyses at Embrapa. All three sets of samples are currently stalled at varying stages of delivery or processing, and thus will not be enumerated here. In my final chapter, I discuss the possible future use of these samples.

As analyses progressed at Embrapa, I began splitting my time between the Embrapa and CAP laboratories, during which time I took over direction of laboratory flotation from M. P. Shock, and subsequently initiated analysis of heavy fraction samples recovered through flotation with the aid of students and volunteers from Manaus and Iranduba. During this time, we also initiated a soil-drying operation for samples collected during the core-and-auger survey, which had not been dried in the field, preparing these and other samples collected in the field for analysis and curation. Analyses of micro-artifacts recovered through flotation were performed at Archaeological Research Facility laboratories at UC Berkeley.

Bulk Density.

As described in Chapter 6, samples for bulk density analysis were taken from each context sampled within a sampling column. Cylindrical core samples were collected and sealed according to instructions provided by researchers from the Embrapa Soil Physics Laboratory. The cylinders were stored under refrigeration until the appropriate equipment at Embrapa became available. At this point, samples were unwrapped, analyzed, and weighed. Samples were then saturated in preparation for determination of the soil moisture retention curve, which procedure is described in the section discussion porosity, below. At the end of the procedure for determining soil water retention, core samples were dried in a 110°C oven for 24-48 hours, and weighed. Bulk density determination was made by dividing the weight of the oven-dry sample by the known volume.

Over the course of the initial process of sample logging and weighing, a number of flaws in sample collection were identified, which would render estimates of bulk density inaccurate. Because of errors in sampling and sample loss during packing or unpacking of soil cylinders, a number of the samples collected in the soil cylinders did not completely occupy the volume of the cylinder. Because bulk density determination using the cylinder method requires the weighed sample to have a known volume, calculations of bulk density of imperfect cylinder samples would be inaccurate. Ordinarily, a minimum of three cylinders would have been collected from each sampled context. This technique allows for replication of measurements of any given horizon or layer, and also safeguards against errors that occur during sampling that may not be immediately perceived by the sample collector. However, due to a misunderstanding between the author and Embrapa personnel, the cylinder case initially made available to the archaeological excavation only contained enough cylinders for sampling 25 layers or sample units at the rate of 1 cylinder per sampled unit. A second case of cylinders was procured in order to make possible the collection of 49 cylinder samples, which permitted coverage of the eight excavation units selected for microanalyses, still at the rate of one cylinder per layer or feature sampled.

Soil pH and soil fertility chemistry.

After drying, grinding, and sieving to < 2mm, aliquots of 120-130 g were separated from samples of the pedo-stratigraphic profile taken. These were taken to the Soil Chemistry Laboratory at Embrapa facilities in Manaus, where a suite of chemical analyses designed to assess soil fertility were performed on the selected samples. In addition to obtaining data that would make these samples comparable to all soils routinely processed at Embrapa, this suite of analyses also reported on some archaeologically relevant characteristics of the contexts analyzed. Of initial interest were pH values and organic Carbon, which have been identified by Schmidt and colleagues (Schmidt 2010; Schmidt and Heckenberger 2009) as most likely to indicate activity areas across a residential plaza in the Upper Xingu. Additionally, concentrations of Ca and exchangeable Al were of interest, the former because it might serve as an indicator of disposal or introduction of animal biomass into the soil system, and the latter because of its association with burning or heat treatment. An initial intention for values generated through this suite of analyses was limited to these four lines of evidence.

However, in light of delays in other analyses, which would have provided total elemental chemistry, elemental values provided through wet-chemical extractions, including P, C, Ca, Fe, Zn, Cu, and Mn will be given greater consideration than previously intended in the characterization and interpretation of deposits analyzed. Schmidt and Heckenberger (2009) utilize the same suite of analyses requested here in order to make preliminary interpretations about chemical signatures of activity areas, specifically comparing middens, forest soil, and plaza locales. The above parameters adequately differentiate between the three broadly-defined activity areas, and also permit the broad chemical characterization of midden deposits as well as the identification of a buried land surface (Schmidt and Heckenberger 2009). The current project draws upon this work in interpreting results from Antônio Galo. In accordance with standard Embrapa analytical procedures, concentrations of P, Na, K, Fe, Zn, Mn and Cu were obtained using the Mehlich-1 extractant, while Ca and Mg were extracted using a 1M KCl solution. Values for extractable Al were extremely low to nil, and will be disregarded in this analysis.

Particle size analysis.

Particle size analysis was conducted in the Soil Physics Laboratory, utilizing a 1M solution of sodium hydroxide as a dispersing agent. For each sample, a 20.00g aliquot was combined with 10 ml of the dispersant, agitated, and allowed to sit overnight. The following morning, sample dispersal was achieved with a rotary disperser (*Tecnal Dispersor TE-147*) for 20 minutes, in accordance with standard Embrapa procedures. Arroyo-Kalin (2008) has pointed to the difficulty in obtaining reliable textural data utilizing mechanical means of dispersal, as particles tend to de-flocculate and re-flocculate in an apparently random fashion while being agitated. He suggests micromorphological analysis as a more reliable alternative for obtaining accurate data on finer textural classes including clay and silt.

However, as the aim of the present study was not to determine textural class of the samples under study, but to gauge the quantity of sand present in a sample and to prepare these sand particles for further sedimentological analyses, this technique was deemed adequate for the study purposes. Additionally, data produced through this methodology is also comparable to analogous data produced by Embrapa at numerous sites in the region, and thus can serve to contextualize Antônio Galo within regional studies of local soils and archaeological sites.

After dispersal, sand, defined as all particles greater than 0.05 mm, was separated from the silt-clay fraction of the suspension through wet-sieving. The sand fraction was further separated, by wet-sieving, into four size classes, as follows:

Table VII.2: Particle size classes.

Size Class	Particle Size
Very Coarse	2.00-1.00 mm
Coarse	1.00-0.50 mm
Medium	0.50-0.25 mm
Fine	0.25-0.05 mm

The silt-clay suspension was collected in a 1000ml sedimentation cylinder, which was agitated according to standard procedure and allowed to settle in a in a controlled-temperature room. Clay fractions were determined through sedimentation, wherein a 50-ml aliquot of the silt-clay suspension was pipetted from a sampling depth of 10 cm approximately four hours after agitation, the exact settling time having been determined by the room temperature, and in accordance with sedimentation tables defined with reference to Stokes' Law. Sand fractions and clay suspension aliquots were transferred to pre-weighed 50-ml crucibles and dried in soil ovens for 24-48 hours before weighing.

Sedimentology: micro-artifact analysis.

Bulk samples recovered as AVC samples, as well as opportunistic samples taken of features or anomalous deposits were floated on site and at CAP laboratory facilities in Manaus, sample size permitting. Because a minimum of 500g of sample was required for microanalyses and curation, many of the feature samples, which were collected in 10-cm levels according to CAP protocol, and came from horizontally limited contexts, did not yield enough sample for flotation. In these cases, setting aside sediment for curation and microanalyses was prioritized.

As part of sedimentological analyses, micro-artifacts and non-artifactual particles recovered from the heavy fraction were sorted, counted, and weighed. Units selected for analysis included all of the units that appear in Table VII.1, with the exception of Unit N915 E437, the analysis of which was de-prioritized because its vertical sequence was incomplete because of partial excavation in 2005. Instead, unit N847 E468, the excavation of which was completed at the very end of excavations, was added to the list of units to be analyzed. Sediments from this unit observed during flotation were markedly different from those seen elsewhere, notably rich in coarse quartz sands. Because this suggested either a distinct geomorphological setting or different depositional processes during occupation of the site, and because this was our only sample from the portion of the site south of the North Precinct, samples from this unit were also set aside for heavy fraction analysis.

Processing of heavy fraction samples began in CAP facilities in Manaus. Varying experience by crew members and an initial learning curve resulted in poorly-rinsed light and heavy fraction samples for the first series of samples floated. This problem was identified when some samples pulled out for analysis at the Manaus facility were found to be extremely dirty. In many cases, samples also contained large amounts of charred plant remains, which was unexpected for the heavy fraction. Samples that were too dirty to analyze were subjected to a second round of controlled flotation. Rather than re-introduce these samples into the large flotation system, a miniature system of flotation involving plastic basins, fine (0.5mm) mesh, and a combination of manual agitation and water pressure was used to clean the samples and to separate remaining floating organic material.

A second round of flotation also somewhat reduced the frequency of charred plant remains in heavy fraction, suggesting that the presence of charred plant remains in the heavy fraction was at least in part due to procedural inconsistencies with regard to the dispersal of matrix samples or the amount of moisture in the sample. Charred botanical remains that were bound up in aggregates would not have floated, and neither would waterlogged charred remains. However, even with this system, not all charred plant remains floated out of the sample. Preliminary analyses of charred botanical remains from heavy fraction show that one third to one half of charred plant remains recovered in the heavy fraction consists of nut or palm nut shell. This preliminary sorting of charred plant remains was overseen by Robby Q. Cuthrell, an experienced paleoethnobotanist in residence at UC Berkeley, who aided in sorting and identification of types of charred remains. The excellent preservation state of remains encountered in these samples is encouraging, as is the kind of information obtainable even without adequate comparative collections. However, because charred plant remains from heavy fraction constitute only a fraction of total charred plant remains recovered, detailed analysis of all of heavy fraction charred botanical remains has not been undertaken. This is reserved for future studies, when light- and heavy-fraction charred plant remains can be studied as a complete assemblage, ideally alongside increasingly complete local comparative collections.

The analysis of clean samples began in Manaus facilities, with the aid of students from the UEA undergraduate program and local volunteers. The goal was to collect presence-absence data on all seven units set aside for further analysis. Samples were split into size fractions using standard ASTM mesh screens in mesh sizes 254 mm (1 in.); 8 mm (5/16 in.); 4.00 mm (No. 5); and 2.00 mm (No. 10). During this stage, samples were weighed before and after size fractioning, and each size fraction was scanned for presence or absence of nine categories of material, including: pottery, trempe fragment, fired clay, laterite, charred botanical remains,

bone, lithic, uncharred plant remains, and a white inclusion later identified as laterite that has been coated in a precipitate, possibly rich in calcite. By the end of the Manaus laboratory season on October 30, 2009, presence-absence data had been collected on all samples from units N854 E468, N817 E468, N915 E491, N941 E452, and N880 E452. With the exception of samples from N880 E452, which consisted entirely of laterite rock, all heavy fraction samples from these units, as well as samples from N924 E516, N895 E509, and N932 E452 were set aside for shipping to UC Berkeley for continued analysis. Unfortunately, one of the two boxes shipped to Berkeley was lost in transit, so that only three of the seven units set aside for analysis were fully analyzed according to original intent.

Samples from Units N924 E516 (Mound 18), N895 E509 (Mound 15), and N845 E468 (Mound 12), which arrived at UC Berkeley in May 2010, were processed in the Soils Laboratory of the Archaeological Research Facility at UC Berkeley from June through December 2010. All particles were sorted and counted for size fractions greater than 4mm. Sample size fractions smaller than 4 mm were split using a riffle box, with a view to obtaining samples consisting of 300-600 particles. This sample size ensured that any particle class consisting of 1% of the sample had a 99% probability of being encountered in the split. During the splitting procedure of the < 2 mm size fraction, we found that samples still contained a fair amount of dust and coarse-to-fine sand particles. Because the heavy fraction screen used for flotation had an opening slightly greater than 1 mm, the < 1mm portion of these samples was separated and was not analyzed as part of this study. Despite being smaller than the fraction sizes expected given the size of the heavy fraction screen, these smaller particles may, in future studies, yield interesting methodological information about particle dispersal rates and post-flotation fragmentation, and were thus curated for further study. Size fractions subjected to the splitting procedure correspond to particles 2-4 mm in diameter, and particles 1-2 mm diameters, as determined by passage through ASTM screens Nos. 5, 10, and 18 (1 mm). Before splitting, weights and volumes of size fractions were recorded. All splits were also weighed before storage or farther splitting, so as to track evenness and randomness in splitting procedure. Because the size fraction splits analyzed at this particle size were often as small as 1.5-3% of the sample, complementary splits were scanned whenever a count of 0 was obtained for a particle category, to address the representativeness of the split analyses. In all cases, almost no significant difference was found between the sample split fully analyzed and the split scanned, for the category of particle in question.

Sorting categories were based upon initial categories identified in Manaus during the presence-absence study, but altered and refined over the course of particle sorting. In the end, 18 categories of particles were identified, given that some were sub-categories of others. The final categories are: Ceramics, Trempe, Oxidized Fired Clay, Reduced Fired Clay, Laterite, CaCO₃ coated laterite, Charred Botanical Remains, Fauna, CaCO₃, Lithics, Quartz, Chipped Stone, River Cobble, Rock, Uncharred Organic Matter, Uncharred Seed Fragment, Uncharred Wood, and Historic Artifact.

The categories for clay and stone particles merit explanation. Clay artifacts were initially separated into “Ceramic” and “Trempe” categories, with the understanding that “Ceramic” was to be reserved for particles that were clearly vessel sherds, that is, fragments that presented a clear fabric indicative of intentional tempering and stretching or pulling associated with hand-building techniques. The artifact category “Trempe,” briefly mentioned in Chapter 6, refers to a baked or low-fired clay artifact made for the purposes of supporting vessels over a fire. Unlike

ceramics, there is no definite fabric to trempe fragments. As a rule, trempe fragments appear to be more disorganized, structurally, than ceramics, and variability in color of individual fragments suggests less care or control in firing. These fragments are more often irregularly reduced or blackened, probably a result of an unregulated “firing” atmosphere, and tend to be more rounded and eroded than ceramic fragments. Additionally, probably because they are low-fired and because the surface-to-volume ratio of trempes is low in comparison with ceramic vessels, clear surfaces are less likely to survive on trempe fragments than on ceramic fragments.

Our finds of whole or nearly-whole trempes in over the 2009 season have provided tremendous insight into the shape and finish, and also the fragility of these expediently-made artifacts. It is likely that, given the shape and irregular heating of these artifacts, many of them spalled, broke, or otherwise fell apart during use. We have also noted that trempe fragments often contain unusual inclusions, such as bone fragments, which is what leads us to suggest that trempe-making was expedient, and consisted at least in some instances of obtaining local, readily available materials, including even midden fill. In contrast, Paredão ceramics tend to be extremely well made and uniform in paste, suggesting careful clay sourcing and clay preparation for the manufacture of ceramic vessels.

This understanding of trempe structure and manufacture was essential for differentiating between ceramics and trempe fragments within the flotation heavy fraction. Nonetheless, identifying particles smaller than 4 mm as ceramic or trempe fragments with absolute certainty proved difficult. Even within the 1-2mm fraction size, some particles stood out as definitively belonging to ceramic vessels, as features such as fabric, surfaces, and firing cores made identification of ceramic sherds relatively easy. However, determining that a fired clay particle was definitely not part of a ceramic vessel was somewhat harder, considering the possibility that these fragments could potentially belong to large, coarsely-made vessels. Hence, for particle sizes smaller than 4 mm, fired clay artifacts were parsed in to three categories: Trempe; Oxidized Fired Clay; and Reduced Fired Clay, the latter two categories meant to bring to light distinct firing or burning circumstances that could have affected the particles, without necessarily associating them with an expedient or curated ceramic building technology. Possible results arising from patterning in these categories will be discussed in the interpretive sections below.

Rock particles were also sorted into numerous categories. Laterite and quartz are seen to be part of the original geological body upon which the site was formed; the separation of laterite and CaCO₃-coated laterite was made in case patterning in the relative proportion of these could be linked to human activity. River cobbles were set aside as these are often of note in bluff settlements, and the category “Chipped stone” was created to refer to any stone that appeared chipped, but that did not immediately appear to be artifactual. Finally, the term “Lithic” was reserved for any modified stone that could be clearly connected to an intentional manufacturing process. Although one probable flake was recovered in flotation, in the heavy fraction of Unit N847 E468, this was lost in transit to UC Berkeley. The absence of evidence for lithic manufacturing through this line of evidence is not surprising, as the only lithic artifacts recovered at the site were a ground-stone ax and a flaked sandstone bi-facial tool, the latter associated with the superficial Guarita occupation, which should bear no association to most deposits analyzed here. As a general rule, stone particles reveal little about human activity, but could tell something about environmental conditions before and after the occupation in question.

Macrobotanical analyses.

Flotation of bulk samples recovered from Antônio Galo yielded light fraction samples that contained varying amounts of charred botanical remains. At the time of field work, no trained paleoethnobotanist was present at the laboratory to sort or analyze recovered charred botanical remains. Because equipment available at the laboratory facility in Manaus was not adequately precise for weighing light fraction, an agreement was made to ship these samples to the Museum of Archaeology and Ethnology of the University of São Paulo (MAE-USP) for triage, sorting, and analysis. Immediately after funding and personnel were secured for these analyses, the MAE-USP laboratory facilities were significantly reduced due to the need for emergency repairs. The laboratory is still under renovation, and at the present time, all analyses originating outside the MAE-USP have been de-prioritized. Hence analysis of charred botanical remains recovered in the light fraction from flotation has been delayed. In the future, completion of these analyses will provide greater information on the paleo-environment, and will contribute to a more nuanced understanding of potential domestic contexts encountered here.

Charred plant remains recovered in the heavy fraction of flotation samples will be used in a circumspect manner, specifically in the characterization of contexts in light of presence or absence of dense or heavy charred botanical remains. These will also be examined in relation to frequency of other kinds of remains identified in the heavy fraction. The presence and frequency of dense or heavy charred plant remains is potentially interesting from the perspective of assessing the nature of the vegetation burned within each context. If charcoal was appropriately sorted by density through flotation, heavy fraction charcoal should present a higher frequency of dense hardwoods or nut/palm nut shell. Assessing the presence, absence, or relative frequencies of these kinds of charred botanical remains can help identify the degree to which anthropic activity can be said to have influenced the botanicals burned. This can be useful in assessing vegetation coverage of a burned landscape, which might be helpful in assessing the nature of vegetation associated with the paleo-landsurface identified via Layer II. This can also play a role in identifying tendencies in selective harvesting of plant materials for specific purposes associated with burning, such as fuel plants and food plants.

The dimensions of the project

This section presents the conceptual framework for integrating sedimentological and pedological concepts into an interpretive work of the formation and evolution of the archaeological matrix at Antônio Galo. A long-standing debate about anthropogenic dark earths in Amazonia revolves around the question of the extent to which the relatively thick, dark horizons encountered at the top of pedo-stratigraphic sequences at terra preta sites are the result of accretionary processes, contra the extent to which thickening observed is a result of melanization of upper B Horizons through the downward movement of microscopic charcoal. Arroyo-Kalin (2008) suggests that, for many of the well-understood sites in the Central Amazon, the accretionary aspect should not be discounted, even though biogenic mixing and eluvial processes do contribute somewhat to the downward movement of particles.

It is this awareness which has led me to approach the archaeological matrix always with the initial intent of determining to what extent each kind of process has contributed to the present

pedo-stratigraphic profile. Moving from statics to dynamics, the goal in this parsing is to use physical and chemical patterning in the matrix to distinguish traces of momentary or discrete events from those of continuous processes, and to identify indices that persist in contrast with those that tend to dissipate.

At Antônio Galo, it cannot be doubted that accretionary processes have contributed to the formation of the dark layers observed at the top of mound structures, as, evidently, no A Horizon would have existed at the time of the initial occupation of the built platforms. In retrospect, it would have been advantageous to obtain samples for micromorphological analysis near the interfaces of Layers IV and III of mound contexts in order to establish the extent to which accretionary processes combined with downward particle migration to create the contexts observed. However, as I hope to show in this chapter, distinctions between the mound construction layer and the terra preta Layer have been preserved not only in micro-artifact patterning but also in some chemical and soil physical characteristics.

I begin by investigating the vertical patterning of micro artifacts across all four Layers in order to determine the actual rate of particle movement since abandonment. Throughout, I base interpretations of natural or anthropic patterning of micro-artifacts on the Balek's (2002) observation that particle movement through bioturbation results in vertical size-sorting of particles. Larger particles are expected to occur in higher frequency at shallower depths than small particles introduced in the same depositional event. Patterns of particle distribution that do not conform to these expectations for particle movement will be considered 'native' to the layer or depth in question, and will be used to characterize the layers. Data about micro-artifact patterning will be combined with chemical and granulometric data to test the hypothesis of Layer II as a partially developed terra preta, or an anthropic deposit, such as a terra mulata, that demonstrates some measures of modification similar to that seen in terra preta.

Indices of Anthropization

In order to assess the degree to which Layer II constitutes an anthropic horizon, and whether it can be seen to represent a step toward the formation of a terra preta such as that which makes up Layer IV, it was desirable to generate indices that facilitated comparison of disparate chemical properties of the layers in question. Additionally, to the extent that we can treat the anthropic deposits found on site as an altered instantiation of the off-site soils, the comparisons made among anthropic deposits needed to be considered in reference to these unmodified or relatively unmodified soils. With this in mind, I applied concepts from soil science that are used to calculate fractional gains and losses of elements due to pedogenesis toward the generation of an analogous index of anthropization. The section below explains the analytical framework developed for generating these indices, which will be used in the subsequent section to assess the degree and modes of modification effected by human activities on the four Layers identified across the site.

Fractional gains and losses.

Pedogenesis is understood in soil science as the formation of a soil body, a vertically differentiated body of particulate matter that is generated in situ through weathering of

sedimentary layers or rock and the upward and downward movement of chemical and physical attributes. Bodies undergoing pedogenesis and their developing horizons are seen as consisting primarily of the material present in the parent material, and acquire inputs through biogenic, atmospheric, and hydrological introduction of foreign components. Simultaneously, each pedon and its associated horizons experience losses through weathering, leaching, and the upward or downward movement of particles. It can be said that the formation of horizons is expressly a result essentially of vertical losses and gains of chemical and physical components that is facilitated by physical mixing, especially by biological agents. Even the in-situ weathering of rocks and minerals, which results in chemical transformation and substitutions, is necessarily a result of the interaction between existing components and introduced components, and always facilitated by physical mixing.

Thus, we can consider each horizon an open system that experiences gains from and losses to a vertically neighboring unit, either another horizon, the parent material, or the atmosphere, and in some rare cases, a body of water. By chemically characterizing each horizon and comparing it to its parent material, assuming that it can be said the horizon in question developed from material comparable to the currently accessible parent material, we can quantify chemical alteration that characterizes each horizon. A number of equations exist for calculating this modification as fractional gains and losses that characterize a horizon. According to the original design of this study, the method designed by Brimhall and Dietrich (1987) would have been ideal. This method relies on knowing the concentration of relatively immobile elements (*i*), such as Zr or Ti to calculate fractional or percentage gains and losses (τ) of a mobile (*mob*) element in relation to the composition of the original parent material (*pm*), according to the following equation.

$$\text{Eq. (1)} \quad \tau = [(C_{mob, soil}/C_{i, soil})/(C_{mob, pm}/C_{i, pm}) - 1]$$

In the above equation, C is an elemental concentration, expressed in g/cm³. This yields an index that expresses fractional gains (+ τ) and losses (- τ) of an element, where a value of 1 would express a 100% enrichment in the given element. Hence, multiplying the above factor by 100 would yield percent enrichment.

Quantifying anthropization.

Exploratory data analyses suggest that non-pedogenic processes have contributed to differential enrichment of the pedo-stratigraphic profile of these mound structures, and further that pedogenic processes have not completely obliterated traces of this enrichment. Figure VII.1 shows that, within mound contexts, vertical trends in carbon content, for example do not behave as expected for carbon in natural pedogenic profiles, and further, differ significantly from carbon trends observed in the off-site sample unit N992 E452. Note that unit N941 E452, representing the *Behind Mounds* sampling stratum, behaves differently from the *Mounds* contexts, being somewhat similar, though not identical, to the off-site unit in its organic carbon profile. Similar

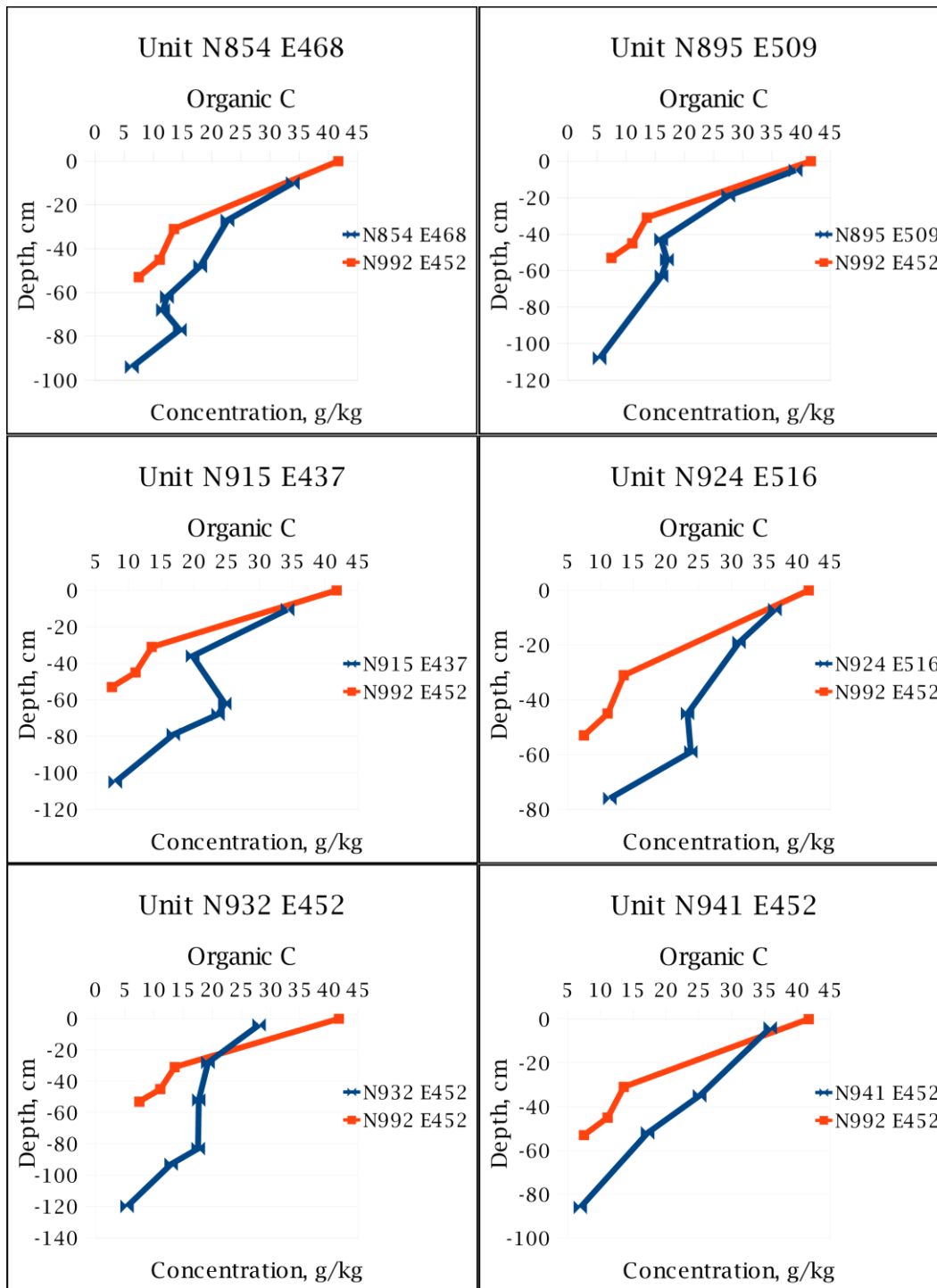


Figure VII.1: Organic Carbon profiles for mound contexts plotted against off-site unit N992 E452.

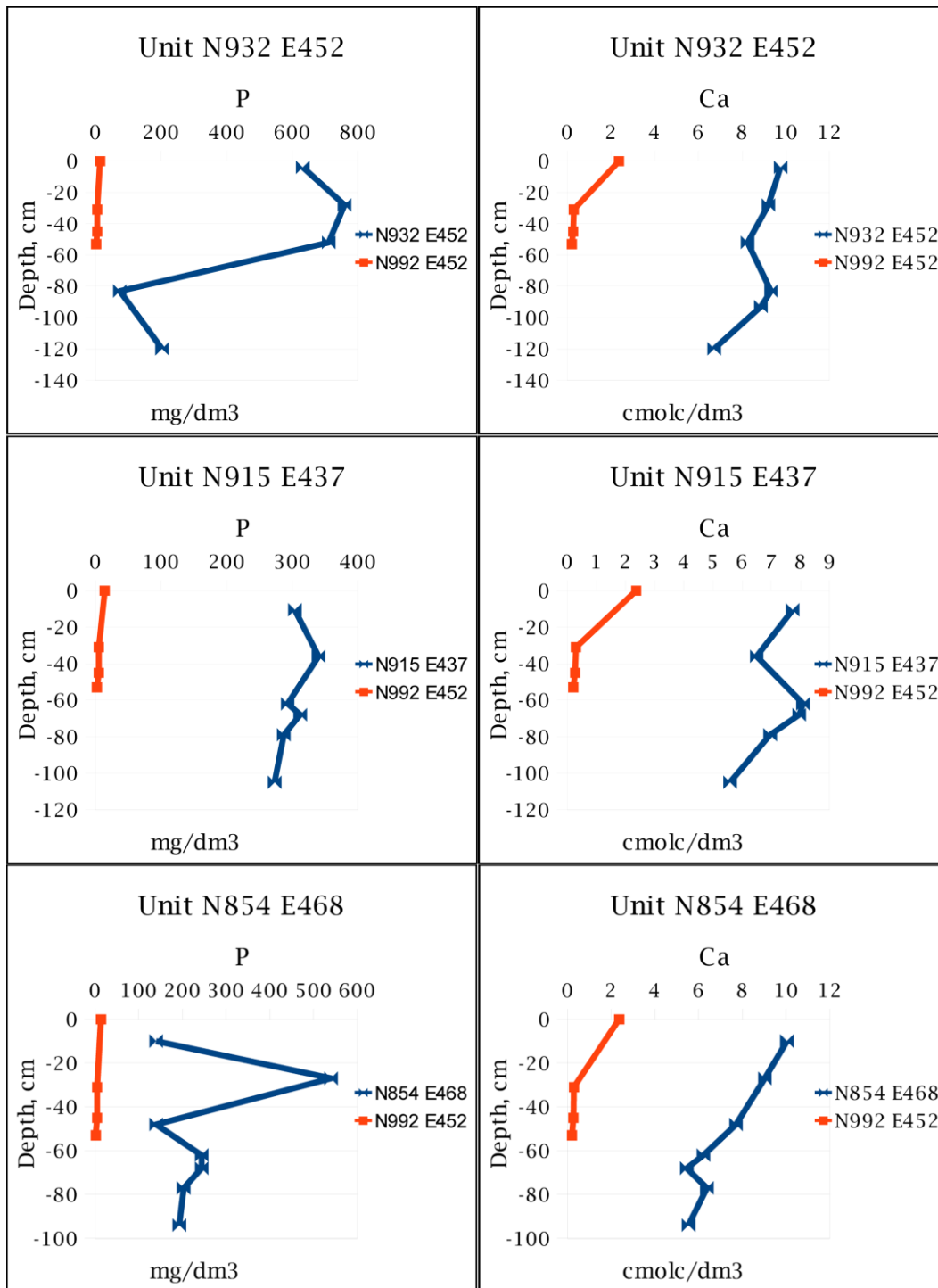


Figure VII.2: Calcium and available P for units N932 E452; N915 E437; and N854 E468, against off-site unit N992 E452.

patterns are observed for concentrations of P, and in some cases Ca, as well as in the distribution of coarse sand throughout the profile (see Figure VII.2 for examples). Trends suggest a relative increase in these components at the top of Layer II in comparison with Layers I and III. In earlier parts of this work, increases in carbon and coarse sands were associated with buried land surfaces, and it appears that this hypothesis is supported by preliminary evidence. However, beyond indexing the presence of a land surface, something that was fortuitously discernible on site, this particular observation tells us little about the nature of the occupation prior to mound construction. Characterization of the micro-artifact, chemical, and granulometric profiles of this layer should help us better understand the activities that were going on at Antônio Galo before the construction of the mounds.

I propose that, as a first step toward understanding this buried A Horizon in terms of degree and nature of anthropic modification, we use data from Layer IV to create a kind of chemical signature profile for anthropic modification at Antônio Galo. In an ideal world, I would subsequently compare this chemical profile with that of a comparable, local, unmodified or 'natural' soil, which would hopefully represent the characteristics of the soil of the peninsula before human occupation. Through this comparison, I could generate a range of expected values for chemical composition that would represent a range of anthropic modification. Because we hypothesize that Layers II and III are composed of soils and sediments from a period affected by an initial occupation that was not a full-fledged terra preta occupation, we would expect all chemical values from these two layers to fall within these theoretically-derived ranges.

Given the circumstances of the present study, two compromises had to be made with respect to the comparability of the control sample to the on-site sample. First, as expressed in Chapter 6, it is clear that, given the position of the off-site sample, the substrate sampled there was notably sandier than that observed on site. This likely would have had consequences for the way that nutrients and particles moved through the soil. Additionally, the significant darkening of the A Horizon, along with the position of the sample on the downward slope between the site and the water, suggested this locale had received some colluvial terra preta from the top of the site through erosion and soil creep. Finally, the recent history of agricultural practices at this locale, followed by the evidently long period of fallowing that permitted the maturing of secondary-growth forest, further suggest a different developmental sequence for this locale than that of the rest of the North Precinct. These three factors make this a less-than ideal soil to serve as proxy for parent material. However, this soil represents the closest thing to an unmodified version of the on-site soils identified on the peninsula. Some adjustments will be made in the treatment of samples from this unit so that they may serve as control samples, or function as proxies for parent material in the above equation. These adjustments are described in greater detail below.

Next, in accordance with the proposed research design, and beginning with some of the concepts utilized in the gains and losses model delineated above, (τ) values would be calculated for each known elemental concentration, using Ti or Zr to normalize the concentration values. For this step, an additional decision had to be made. In a traditional application of Brimhall and Dietrich's (1987) approach, each horizon sampled would be compared to the parent material beneath it. In practical applications, the parent material itself may not be reached within the excavated profile, and the lowest extent of the excavation acts as a proxy for parent material. In this case, using the local B Horizon (Layer I) may or may not be appropriate, because, given the

significant inputs to the local matrix introduced by humans, this B Horizon might be enriched or impoverished compared to its original state.

To address these complexities, and to make possible both horizontal and vertical comparisons, I propose a dual solution. First, generate a value from within the off-site sample unit that can function as a proxy for pm , given that the purpose of excavating an off-site sample is to get a sense of the ‘background’ signal of the landform. Next, use this proxy value in the generation of (τ) values for all samples tested from the on-site contexts, which will allow for comparison of all on-site samples to each other; particularly, this will permit spatial comparison among units, as all these (τ) values will have been generated with respect to the same standardized background value. Finally, generate (τ) values for the on-site samples with respect to the local B horizon of each unit, which will give the best sense of vertical variation within an excavation unit.

Since, at the present moment, we have neither Ti nor Zr values that would allow for the generation of quantitative (τ) values, and furthermore since the chemical data obtained express available elemental concentrations and not necessarily total elemental chemistry, a number of adjustments have had to be made to the initial proposed model. First, a careful consideration of the available chemical data led to the conclusion that none of the elements reported can function as adequate immobile or relatively immobile normalizing elements for the purposes of determining (τ). Second, a decision had to be made with regard to the appropriate off-site value that could act as a proxy for pm in the generation of a comparative spatial index. As sedimentary bodies, both Layers III and IV are seen as consisting of a mixture of foreign sediments, introduced through anthropic deposition, and local sediments excavated from the paleo-landsurface represented by the top of Layer II. Layer II is also considered a modified version of an ancient A Horizon. Hence, all three of the upper layers are considered instances of anthropic A Horizons or A-Horizon-derived sediments, and are compared to the A Horizon or near-surface portion of the pedo-stratigraphic sequence of the off-site sample.

Because of the long-term abandonment of the plot to the north of the North Precinct, and the subsequent enrichment of the A Horizon due to the accumulation of humus on the forest floor, using this value by itself seems inappropriate, especially as this A Horizon is a maximum of 8 cm thick. Reports by Schmidt (2009) as well as values obtained here (Figure VII.2) suggest the abandonment period of the off-site sample locale resulted in significant soil recovery in terms of organic matter, which is also indexed by forest growth. Elements that are typically impoverished across the depth of Oxisols were extremely enriched in the A Horizon of N992 E452. Similarly, because farming had been ongoing across most of the North Precinct, elements typically enriched in terras pretas were bound to be somewhat depleted in the upper horizons of the on-site samples. In order to overcome the difficulties posed by this differential treatment, near-surface (0-10 cm) values were averaged to obtain a value that might adequately represent chemical values for a sampling depth of ~15-20 cmbs. Hence, the indices I am using take the average values of the A and A/B Horizons of N992 E452 as a comparative (pm proxy) value. The 15-20 cm depth also generally corresponds to the uppermost sampling depth at units excavated on site.

Although we cannot generate quantitative figures of gains and losses effected through human behavior, useful qualitative comparisons of existing data can still be made. To this end, I developed two measures of anthropization, one that compares on-site samples to off-site

samples, rendering them comparable to each other, and a second that analyzes each profile independently, yielding information on the relative enrichment or impoverishment of available nutrients present in the anthropic layers. For the first index, chemical concentrations for the two values to be compared are normalized to the off-site B Horizon. Values for each anthropic layer are expressed as a fraction of available elemental concentrations observed in the off-site unit, N992 E452. As in the (TAU) values calculated above, this fraction is then subtracted from 1.

$$\text{Eq. (2)} \quad \mathbf{l} = [(V_{anth}/C_{B,OSU})/(C_{A-A/B,OSU}/C_{B,OSU}) - 1]$$

In the above equation, V refers to a numerical value, usually a concentration, that describes a chemical characteristic of a bulk sample; *anth* refers to the anthropogenic sample to be analyzed; *A-A/B* refers to the average of the A and A/B Horizons, seen as analogous to *pm* here; and *OSU* refers to the off-site unit location. The above equation yields an index (*l*) that expresses fractional gains (+) and losses (-) of a chemical characteristic, where a value of 1 would express a 100% enrichment in the given element.

How the matrix tracks our inputs.

I have identified two key ways in which physical and chemical inputs introduced by humans are incorporated into the existing ecosystem using soil or substrate as a medium of translation. The two mechanisms of integration are complementary in that one produces horizontal continuity and vertical discontinuity, while the other has the inverse effect, of producing vertical continuity while creating horizontal patterning. As expressed above, in a living cultural site, deposition is constantly at odds with pedogenesis; when living cultural sites are set in places like Amazonia, where dramatic fluctuations in moisture and temperature dramatically speed up pedogenesis, the opposing structuring principles of stratification and horizonation are profoundly at odds.

The two mechanisms by which anthropogenic inputs to the archaeological matrix become embedded therein are deposition and pedogenesis, and the factors that determine which process will leave a more salient mark on the soilscape, the substrate of a landscape, vary not only with the material input, but also with the mode of deposition. Borrowing from language of “remembering” employed by Chadwick et al. (2007) to express how certain chemical characteristics developed in one portion of a pedon are retained, replicated, or transmitted across a vertical segment of a pedon, I structure this analysis of micro-environmental modification of substrate in terms of two kinds of “memory” retained by the pedo-stratigraphic body that I am calling the archaeological matrix. The language of “memory,” in this case, indexes the persistence of chemical and physical characteristics in the matrix long after having been produced or introduced through human action.

One term I am coining here, *stratigraphic memory* is meant to serve as shorthand for expressing the idea that certain kinds or conditions of inputs or actions leave a stratigraphic signature that tends to persist over time in a dynamic landscape. As alluded to in the preceding theoretical section, certain elements are less mobile than others, and the same can be said of certain organic or inorganic compounds. The nature of the composition of an input may

contribute to its resistance to decomposition or de-structuring, but this is, of course, always subject to the surrounding conditions. At an archaeological site, these surrounding conditions include not only the initial conditions of the natural environment, including the specific conditions of the soil environment, but also conditions created by human beings. The way that a deposit is created or buried also contributes to its persistence or destruction in a pedo-stratigraphic profile. The signatures that fit under this rubric – the inputs “remembered” stratigraphically – create horizontally continuous units or patterns that are vertically discontinuous. Some of these are visible cues, such as coloring and patterning in macro-artifacts, which help us to define stratigraphy in the field. I propose here that macroscopically invisible stratigraphic units may also exist, in the cases where inputs corresponding to depositional units may persist in a stratigraphically distinct pattern, or where conditions created by these inputs cause the accumulation of components created or introduced post-depositionally. These signals, some of which can be recognized chemically or through micro-artifactual analysis, would index the now obscured or ‘erased’ depositional unit.

The other kind of memory that is relevant to this study is what I will call *pedogenic memory*. In this case, pedogenic memory indexes the extent to which the traces of past human activities, such as the introduction of animal waste products or deposition of sediments into the land become incorporated into the pedo-stratigraphic matrix through pedogenic processes, such as leaching, illuviation, and biological physical mixing. These processes tend to homogenize vertical distinctions between strata, erasing stratigraphy that denotes temporality. However, when such deposition is localized and spatially organized, as it often is in the case of permanent or semi-permanent human habitation sites, these signatures can persist over time, indexing the horizontal location where a particular kind of deposition took place. The mobility of a component and the time elapsed since deposition or introduction determine how long it persists, how far into the pedo-stratigraphic profile its influences will travel, and how homogenous it will appear after a time interval.

Geoarchaeological signatures at Antônio Galo

In this section, I examine specific matrix contexts uncovered at Antônio Galo as evidence of human modification of the landscape, traces of particular activities, or as points of contact that act as nodes of communication between humans and their environment. Beginning with a study of stratigraphic memory or resilience of traces of past human activity, I begin with an analysis of Layers II and III, as identified in the field. I characterize these layers, using primarily data from Unit N924 E516 to draw my principal conclusions about the defining characteristics of these layers, evaluating these findings by drawing upon similar contexts observed elsewhere on site. Layers II and III are seen as examples par excellence of stratigraphic resilience, and indices derived through the study of these layers are used elsewhere on site as robust indices of resilient contexts or resiliency. Findings from Unit N924 E516 are used to re-assess field characterization of other units. This analysis will serve to define spatial units that form the data set analyzed in the second half of this section, which focuses on spatial signals.

Spatial signals can occur through stratigraphic persistence of components (chemical or physical) within a limited spatial range, but can also be pedogenic signatures that have been incorporated into a soil body. This second tack uses a combination of stratigraphic and

pedogenic traces to parse the spatiality of the site, first at the level of the precinct, divided into its original sampling strata; then at the level of the house, which is identified not only on top of the mounds, but also beneath some of the mounds; and finally, at the level of the feature, which we interpret as the proxy of an act. At each temporal scale, previously defined spatial units are examined in light of hypotheses posed in the field, and attempts are made to interpret spatial units or anomalies in terms of human activity and non-human site formation processes. More precisely, I begin by characterizing and attempting to explain chemical and granulometric distinctions among the three spatially-defined sampling strata. Next, perceived house or domestic contexts are considered as lived-in places, but also as steps in a long-term project of remodeling, and new hypotheses about these processes are proposed. For this scale of analysis, and also for the feature-level scale, evidence pooled from multiple units about the composition of Layers characterized in the first section is combined with a consideration of the role of bioturbation and particle migration in the formation of deposits in order to interpret clear features as well as hypothetical ones, and to place them within a spatio-temporal model for the occupation of the site.

Stratigraphic resilience: landscape and environmental remodeling

This section addresses the major landscape and environmental features that occur across the landscape, and the extent to which these have been created or modified by humans. The most salient and unique features uncovered at Antônio Galo during the 2009 field season are the mound construction layer (Layer III) and the buried anthropic A horizon (Layer II). Layer II is seen as evidence of a partially developed and ‘fossilized’ dark earth that indexes not only a distinct occupation phase, but an earlier and perhaps different phase of landscape and environmental modification by human beings. Layer II may contain clues to the activities that were going on in this earlier occupation phase, and may also provide information about the earlier landscape and environmental or climatic conditions. Layer III is not only a clear index of an act of construction, it is also one of the few remaining contexts that contain traces of activities performed on the site outside the areas now covered by the mounds before the mounds were built. Given our current understanding of the occupational sequence at the site, we hypothesize that Layer III, the artifact-and-charcoal rich earthen layer that makes up the remains of house platforms is a mixture of a somewhat charcoal-enriched anthropic A Horizon, Layer II and some of the underlying B/A or B Horizon, a generally yellow, clay-rich matrix that we have identified as Layer I.

Because we are concerned here with the way that layers are indexed macroscopically, microscopically, and invisibly, this section addresses what I have called stratigraphic memory. Questions addressed here concern the extent to which particular indices of anthropic influence on the landscape or micro-environment are preserved over time, and how they can be recognized.

Chemical signatures.

At Antônio Galo, some chemical characteristics have persisted in parallel with the stratigraphy of the site; understanding the mechanisms and reasons behind this persistence will be the keys to understanding what they signify. For example, in the four units tested that were interpreted as featuring a Layer II (see Table VII.1), organic carbon, H + Al, and pH are slightly

but notably elevated at the depth interpreted as the buried A Horizon (Layer II) in three of the units (N924 E516, N932 E452, and N915 E437), and, and in the latter two, Ca and P are also significantly elevated at this sampling depth. The profile from unit N941 E452 behaves remarkably differently from the other three units interpreted as exhibiting the complete four-layer signature, and possible reasons for this, along with a potential re-interpretation of the stratigraphy of Layer II based on these findings, follow below.

Granulometric signatures

Though Arroyo-Kalin (2008) has shown that precise textural classification of Amazonian Oxisols using particle dispersal is not precise with regard to the relative proportions of silts and clays, it is worth taking particle size results as a launching point for discussions of sand size, sorting, and proportion. Sondage N992 E452 provides the background patterning for particle size distribution across depth at Antônio Galo. Table VII.3 shows the results from particle size analysis as reported by Embrapa:

Table VII.3: Particle size analysis results.

PN	Horizon	% Sand	% Silt	% Clay	Classification
3801	A	29.69%	47.91%	22.40%	Loam
3802	A/B	22.55%	49.85%	27.60%	Clay Loam
3803	B/A	20.42%	46.72%	32.86%	Clay Loam
3804	B	18.24%	46.54%	35.21%	Silty Clay Loam

Though clay and silt proportions fluctuate slightly, there is a general decline in weight of sand with increased depth, and a general increase in clay (Figure VII.3.a). Hence, as we move from the A to the B Horizon, we move gradually from what the USDA would classify as a loam into a silty clay loam (Figure VII.3.b).

Sands recovered through the PSA procedure described above also seem to provide a relatively consistent pattern in size sorting across layers. Both N992 E452 and N941 E452 (Figure VII.4) reveal an essentially linear decline in size-sorted sand with depth, with fine sand in the highest proportion, followed by medium sand, and coarse and very coarse sands in the lowest proportion. Coarse sands seem to exhibit the least amount of linearity, but this is attributed to the relatively small sample size for particles of this dimension. The consistent proportion of different-sized sands across depth suggests that the source and mode of deposition of sand-sized particles within this matrix remained relatively consistent over time. The linear decline within sand fractions with increased depth does not seem to indicate infiltration of sand into the profile across time. If this were the case, we would expect to see some degree of differential sorting across horizons, as finer particles would have migrated downward at a faster rate than larger particles. Instead, the current profile suggests higher proportions of sand near the surface are a result of weathering and eluvial losses from upper horizons. Note also (Figure VII.4) that Layers I-IV in N941 E452 seem to follow a similar pattern in terms of distribution of sand, which has implications for our considerations of field interpretation as well interpretations regarding spatial parsing of activities.

In both units N915 E437 and N932 E452, a generalized deviation from the pattern established by N992 E452 and N941 E452 was observed, wherein higher-than-expected amounts

a)

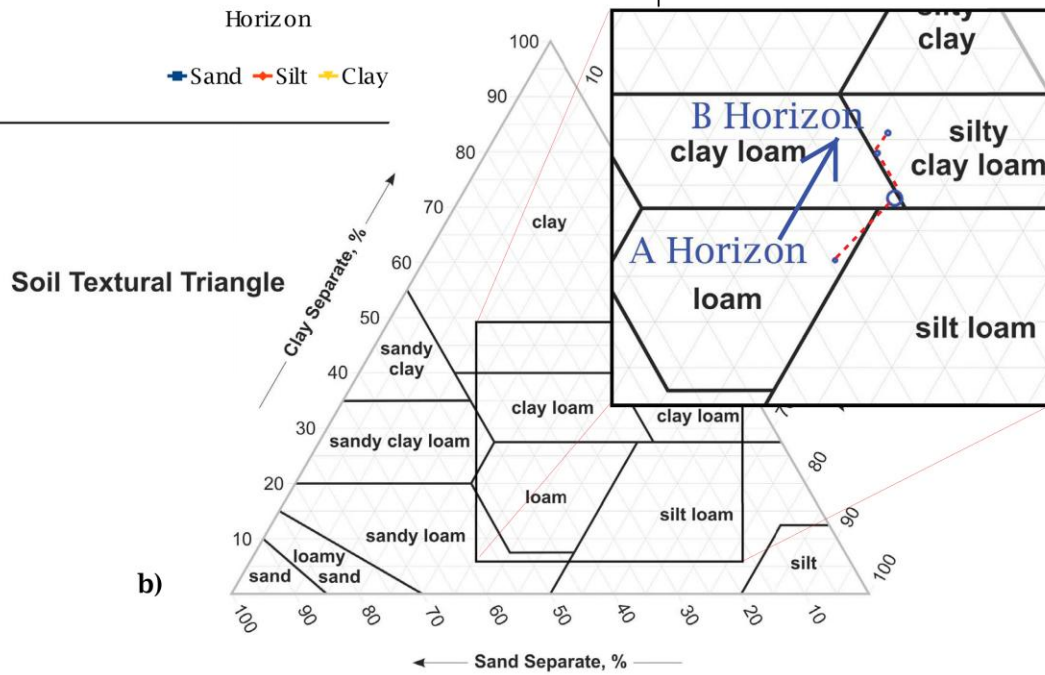
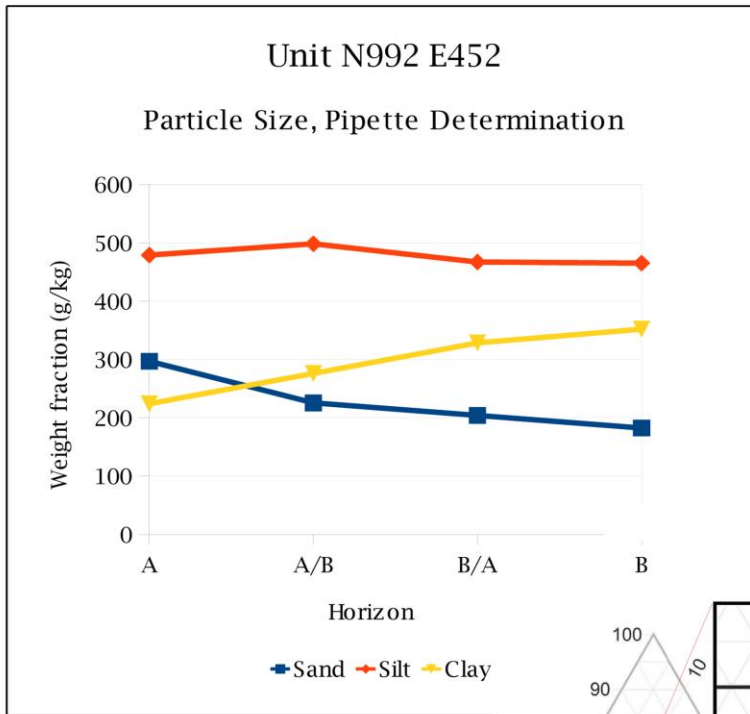


Figure VII.3: Unit N992 E452, changes in particle size with depth: a) results from particle size analysis; b) samples plotted on textural triangle (adapted from USDA 2011).

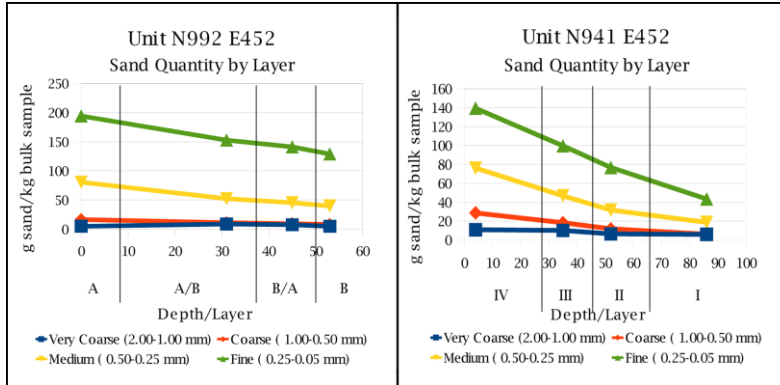


Figure VII.4: Units N992 E452 and N941 E452; sand distribution across layers, by size class.

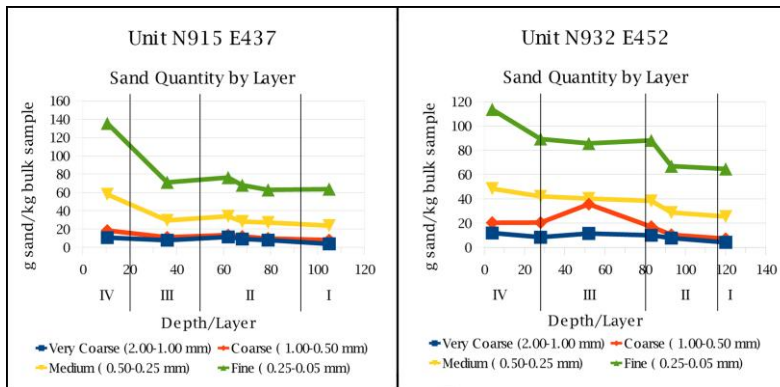


Figure VII.5: Units N992 E452 and N941 E452; sand distribution across layers, by size class.

of fine and medium sand are observed near the transition between Layers III and II (Figure VII.5). In N915 E437, an actual increase in sand is noted at the top of Layer II, while a significant deviation from the expected trend is observed at N932 E452, where slight increases in fine sand and a general leveling-out of quantities of very coarse and medium sands is observed in Layer II. As above, unit N924 E516 follows the same general pattern as units N915 E437 and N932 E452, but to a lesser extent; there is a slight increase in fine sands, and also a slight decrease in coarse and very coarse sands. The latter drop in coarser sand fractions would not have been noticed were it not for the fact that both coarse and very coarse sand increase slightly in the preceding layer.

All of the patterns thus far identified are most salient at Units N932 E452 and N915 E437, coincidentally the two largest units excavated. One other, and more meaningful thing that these two units have in common is the fact that these were the excavations where we managed to estimate the exact crest of the mound being investigated. From the perspective of post-depositional processes, the situation at the center and apex of the mound is advantageous for preservation of contexts within the mound, as this would be the place where the mound would be thickest. Theoretically, erosion rates would probably be lowest exactly at the apex of a hill. Finally, both Mounds 16 (corresponds to N932 E452) and 17 (corresponds to N915 E437) boasted unique features near the Layer II/III interface. In the case of N932 E452 a tightly-packed layer of ceramics immediately above Layer II in that unit could have provided an erosion buffer for deeper soils and horizons. Unit N915 E437 did not boast a ceramic layer, but did demonstrate a unique and fortuitously well-preserved fire feature at the interface. High compaction of overlying deposits, which was reported by students during excavation at this locale, might explain the excellent preservation of this context, seen not only in the state of the feature, but also in the preserved patterning of sands.

Micro-artifactual signatures.

One of the unexpected results of this study comes in the form of patterns suggested by charred botanical remains from heavy fraction and fragments of oxidized and reduced low-fire clay artifacts. Layer II is described throughout this work, and indeed across field forms, as a charcoal-rich layer. However, heavy fraction data from N924 E516, the only excavation unit of the three analyzed that clearly demonstrated a Layer II, shows some of the lowest proportions of charred botanical remains out of the entire profile. Across all fraction sizes, the concentration of charred botanical remains steadily decreases from level 50-60 cmbd through 70-80 cmbd, the latter level containing no charred botanical remains within most fraction sizes, with the exception of the 8-4 mm fraction (Figure VII.6). As can be seen in the drawing of the North Profile, 60-70 cmbd is the only level that is completely contained within Layer II, and is the darkest layer of the lower half of the profile. Levels 50-60 cmbd and 70-80 cmbd are both transitional layers that contain approximately 35-30% matrix from Layer II.

Because N924 E516 is the representative sample for the I-IV layer sequence, and because charred botanical remain concentration patterns are so clear across depth, I will describe the vertical distribution of charred botanical remains in this unit. At N924 E516, no charred botanical remains greater than 8 mm in diameter were encountered; this was also the case at N895 E509, but not so at N854 E468. At N924 E516, size fractions 1-2 mm and 2-4 mm show nearly identical distributions of charred botanical remains across depth, with the exception of the uppermost level (0-10 cmbd), and will be discussed, for the most part, as a unit. Charred

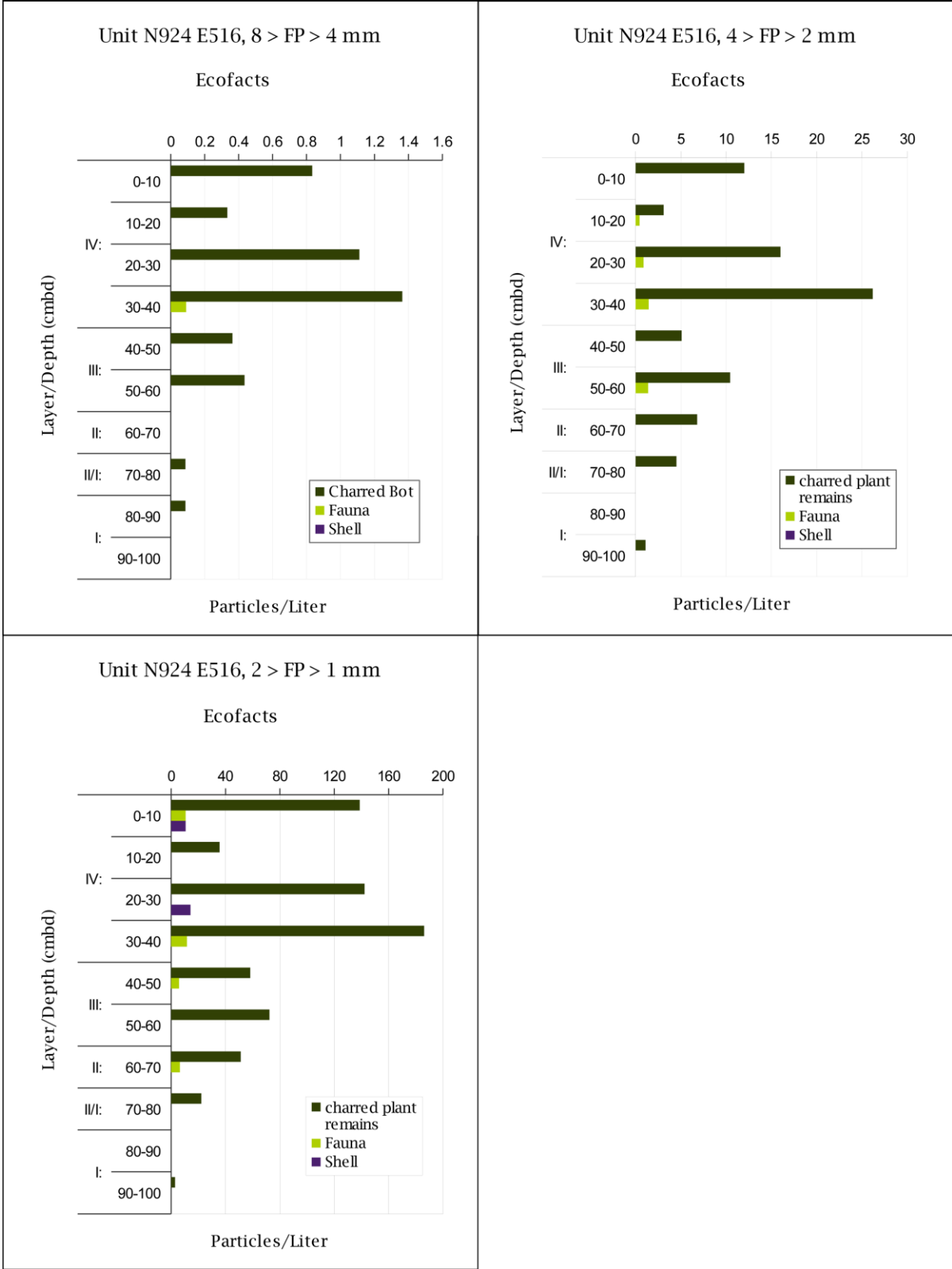


Figure VII.6: Charred botanical remains and fauna from N924 E516: 4-8 mm; 2-4 mm; 1-2 mm.

botanical particles in the 4-8 mm fraction follow a very similar pattern, with a couple of exceptions or shifts in depth. Across fraction sizes, charred botanical remains are most abundant in Layer IV, double or triple the concentration found in Layer III, the next most charcoal-rich layer. The lower two levels of Layer IV feature the highest concentrations of charred botanical remains in this locale, a fact that will be taken up in the discussion of activities and features in Section IV.3 of this chapter.

From this point, (level 30-40 cmbd), there is a consistent and significant (>50%) drop in concentration of charred botanical remains from the lower boundary of Layer IV to the upper reaches of Layer III, but the concentrations rise again in the lower level of Layer III. This level, 50-60 cmbd, which contains the transition between Layers III and II, features the highest concentration of charred botanical remains within the pre-terra-preta layers. Below this peak, there is a gradual decrease in charred botanical particles measuring 1-4 mm, from 50 through 80 cmbd, and at level 80-90 cmbd, charred plant remains are conspicuously absent, even after scanning complementary splits. For particles measuring 4-8 mm, charred plant remains are conspicuously absent from level 60-70 cmbd, a somewhat surprising result given the presence of similar particles above and below this level. This, along with the presence of smaller charred plant remains in the same level and absence of smaller particles in the subsequent level, suggests that the finding of 0 particles measuring 4-8 mm in level 60-70 cmbd is a consequence of small sample size, rather than a significant result. In other words, given that smaller particles tend to migrate downward more easily than larger particles, a charcoal-depleted layer should be evidenced among smaller particles higher in a profile than for larger particles, not lower, as is the case here.

Layer II in Unit N924 E516 also shows interesting patterning in ceramic and low-fired clay micro-artifact distribution across the lower layers (Figure VII.7). The AVC sample identified as containing deposits from the interface of Layers I and II shows a marked (100-130%) increase in the frequency of fired clay micro-artifacts with respect to the two layers above it, which belong to Layers II and III, specifically in particle sizes ranging from 4 to 254 mm in size. This abrupt increase in relatively large micro-artifacts is accompanied by a gradual decrease in small (1-4 mm) micro-artifacts within the same layers, which suggests the presence of the larger fragments at this point in the pedo-stratigraphic sequence is representative of depositional practices rather than of post-depositional particle migration. In other words, they represent an early phase of ceramic and fired-clay particle deposition that was later overlain by the mound platform. It is also worth noting that these particles are almost exclusively low-fired clay particles associated with trempe fragmentation, and also predominantly evidence reducing conditions at the last major firing event. In this particular case, it is worth considering the possibility that these low-fired clay particles could have been reduced post-depositionally if located in near-surface deposits during vegetation burning episodes. Across the contexts examined in this work, a predominance of reduced low-fired clay micro-artifacts has only been observed in surface or near-surface deposits and select feature contexts. In the larger size fractions, oxidized low-fired clay occurs in higher frequency than reduced counterparts, which generally only approach the frequency of oxidized particles in the smaller (1-4 mm) particle-size fractions.

Their location within the layering of the site, at the interfaces of Layers I and II, respectively the B and A Horizons of the paleosol buried beneath Mound 18 also merits discussion. We would normally expect to find high concentrations of artifacts at precisely the

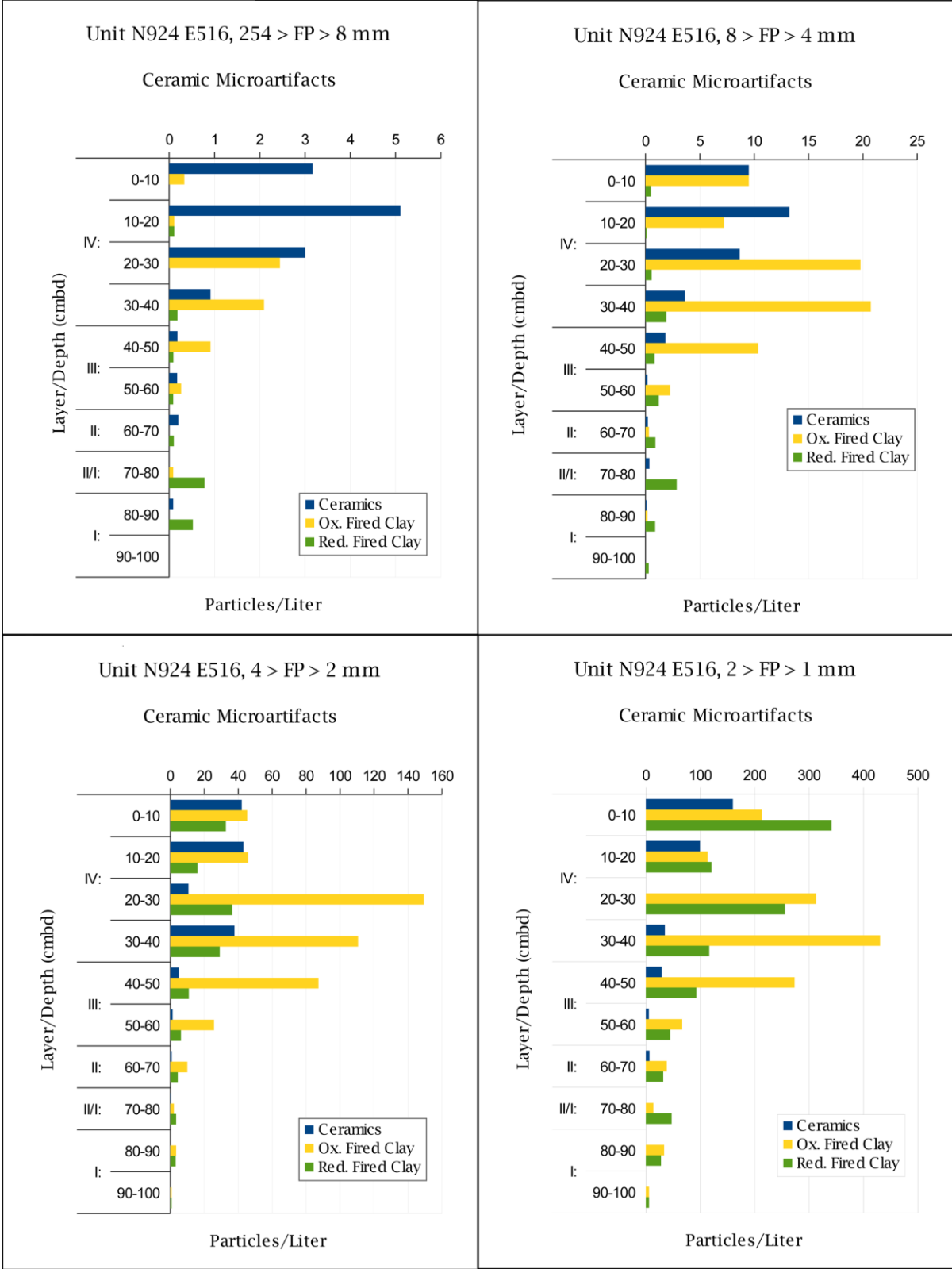


Figure VII.7: Unit N924 E516, ceramic micro-artifacts: 8-254 mm; 4-8 mm; 2-4 mm; 1-2 mm.

interface between two stratigraphic layers. The constant particle mixing experienced in soils in general, and within tropical soils in particular, requires closer scrutiny of the observed pattern, which suggests two formation scenarios. In the first scenario, the deposition of these artifacts demarcates the depth of the original land-surface, upon which the anthropic horizon accreted, thickening to its present thickness. The second scenario, which I consider more likely in light of pedogenic processes characteristic of the region, is that these artifacts migrated downward slightly through physical mixing creating a “stone line” scenario such as that observed by Johnson (1989) in California. In either case, it is quite clear that Layer II is characterized by early deposition of low-fired ceramics, which I here associate with expedient ‘cooking’ technologies.

Applications: re-reading stratigraphy.

The chemical, granulometrical, and micro-artifactual patterns noted above aid in the clarification of contexts debated or poorly understood on site. For example, questions had been raised with regard to the lower limits of Layer IIIA in Unit N895 E509, and also regarding the absence of Layer II from the northern portion of the profile sampled. The sand data for Layer N895 E509 reveals a pattern strikingly similar to that of N924 E516, and to a certain extent, N932 E452 and N854 E468. Relying solely on sand data, we would interpret the lower 2 sampled contexts (60-80 cmbd) that were field-interpreted as part of layer IIIA to belong instead to Layer II, which was not identified at N895 E509. This pattern is also corroborated to a certain extent by chemical data, which evidences a spike in P, Org C, and to a certain extent Na for at least one of the two depths sampled as part of Layer IIIA (see figure VII.8).

A re-examination of criteria used to interpret this context in the field helps resolve this question. The decision to assign a designation of Layer IIIA to this layer was not easy, and was motivated in the end by two main macroscopic observations: first, that the layer in question did not clearly exhibit, according to field observations, a higher charcoal frequency or darkening with respect to the layer above it; and second, that it appeared to contain a higher frequency of ceramic and trempe inclusions than expected for Layer II, given our findings elsewhere on site. Micro-artifactual evidence from heavy fraction suggests that there is a slight increase in the frequency of charred plant remains toward the lower reaches of Layer IIIA (60-70 cmbd) and the beginning of Layer I (70-80 cmbd), which would suggest, given initial hypotheses, the presence of an ‘invisible’ Layer II between the aforementioned layers. However, we must not forget that we are dealing only with the heavy fraction of charred plant remains, and also that our baseline unit (N924 E516) for understanding the characteristics of Layer II demonstrated a reduction, not an increase of heavy-fraction charred plant remains in comparison with neighboring layers. Hence, the charred botanical remain evidence would suggest this is not Layer II, but more likely a Layer III deposit, as originally interpreted. If we consider that a Layer III deposit would contain not only sediments from Layer II excavated from elsewhere, but also midden sediments, an increase in dense, woody remains and charred nut shell would not be unexpected here.

In contrast, chemical and sand data from N854 E468 replicates some of the patterns seen at N895 E509, and possibly some seen in N924 E516, although perhaps not perfectly. For example, the sand data would suggest that one of the upper samples from Layer IIIA (70-80 cmbd) is more similar to Layer II samples from N924 E516 than to any other Layer in the latter unit. Again, chemical data (organic C, Ca, P, and to a certain extent Na, Mg, and Zn) point to similar patterning, suggesting a buried land surface between 70 and 80 cmbd (see Figure VII.9).

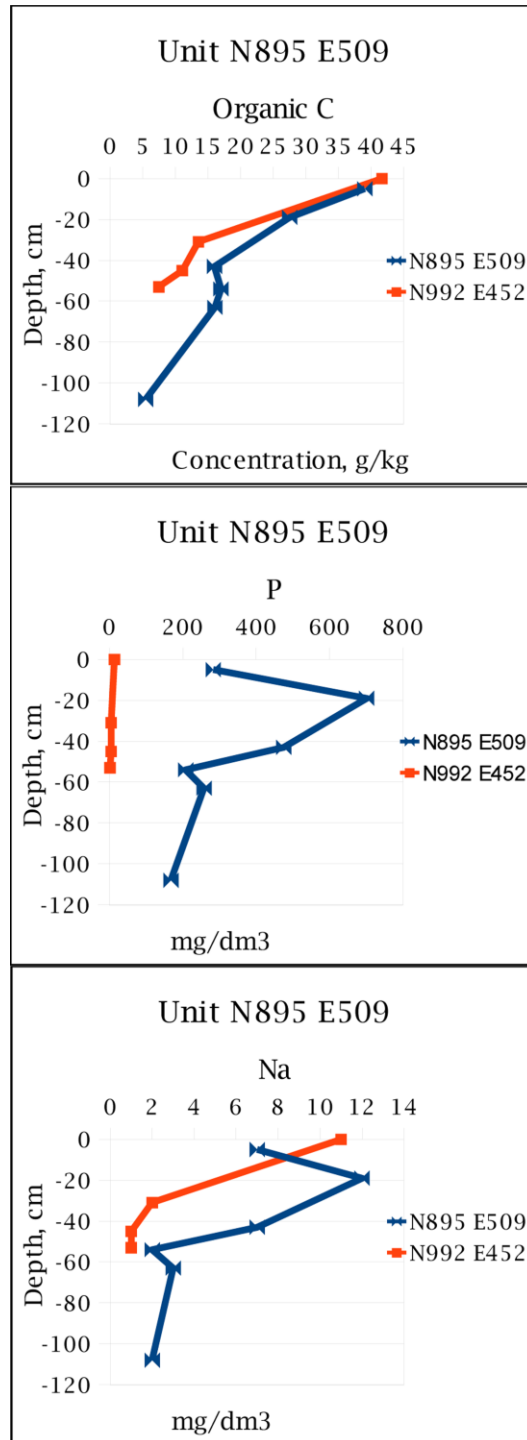


Figure VII.8: Unit N895 E509: Organic C; available P; Na.

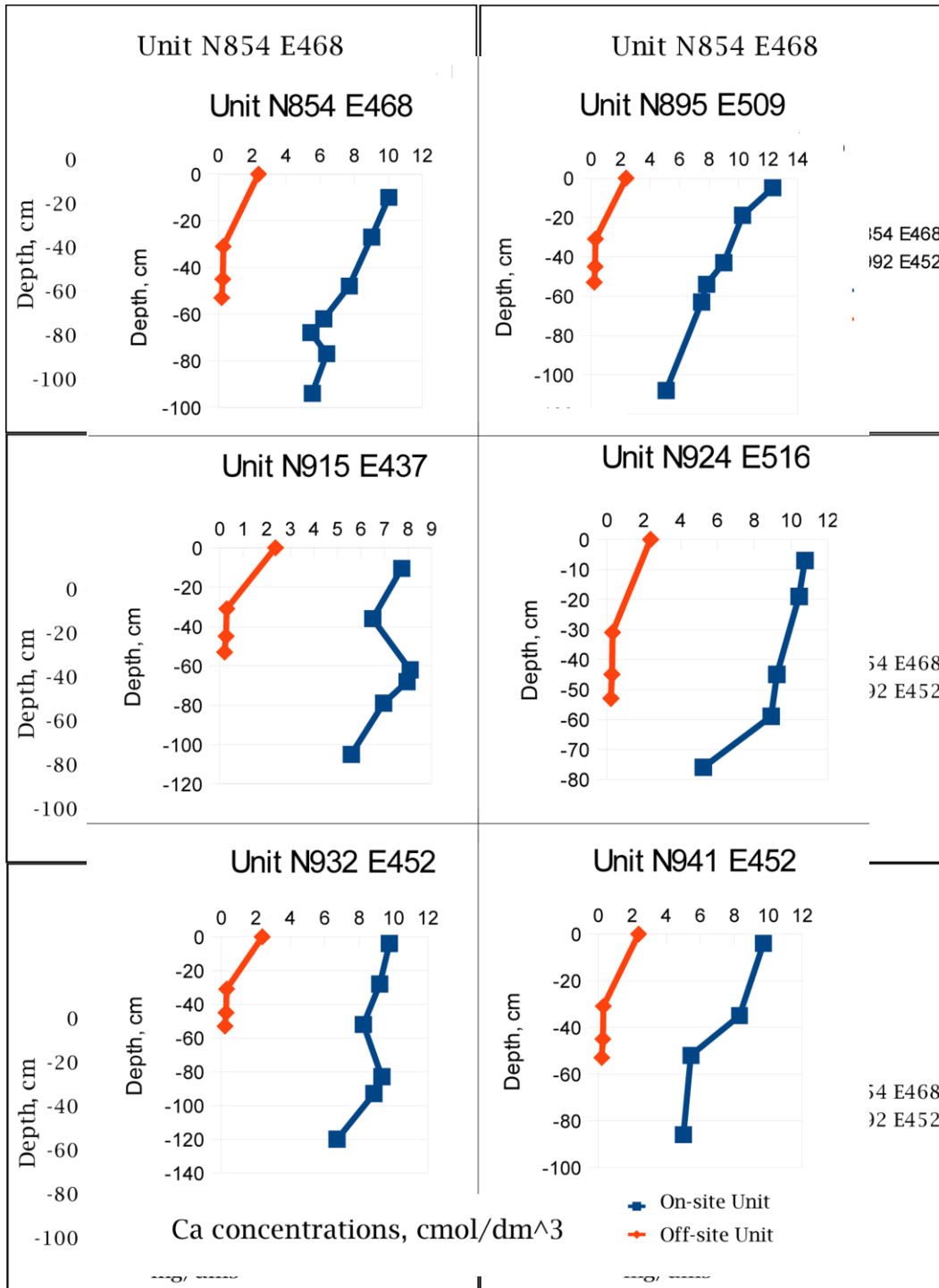


Figure VII.9: Chemical properties of N854 E468, against off-site unit N992 E468; note enrichment at approximately 70-80 cmbd.

However the lower levels (90-110 cmbd) of Layer IIIA look, micro-artificially, more like Layer II or Layer I samples than Layer IIIA samples elsewhere, featuring a significantly lower frequency of charred plant remains and an increase in frequency and relative abundance of reduced fired clay particles (Figure VII.10). Because these deposits are not homogenous and do not present the kind of vertical sorting expected from a uniform deposit, it would seem reasonable to postulate that, rather than an intrusive feature comprising the northeast portion of the lower levels of N845 E468, in fact the 50 cm interpreted in the field as part of Layer IIIA correspond to at least two distinct contexts. I propose that the upper levels of IIIA (~60-80 cmbd) correspond to the deposits similar to those encountered in layer IIIA at N895 E509, while the lower levels (~90-110 cmbd) are in fact part of a Layer I or Layer II context. What is clear is that the depositional sequence beneath Layer IIIB at Mound 12 is significantly different than beneath Layer III at Mound 18. This may suggest differential use of these two areas of the site before the mound-construction period began; or alternatively, that these mounds were constructed under distinct circumstances, perhaps at different times.

An examination of fired clay micro-artifacts sheds light on questions surrounding the characterization and history of Layer II and Layer III, as well as on the question of differential use of space. As a rule, Layer III contains fewer ceramic fragments than Layer IV, and in the case of N924 E516, more fired clay micro-artifacts than Layer II. In all three units analyzed, the relative abundance of oxidized low-fired clay micro-artifacts with respect to other clay micro-artifacts is highest in Layer III. The proportion of fired clay micro-artifacts also drops significantly toward the bottom of Layer III or near the interface of Layers IIIB and IIIA. Notably, this significant drop in fired-clay micro-artifacts coincides with unexpected peaks in charred plant remains, such as that mentioned above for N895 E509. A similar pattern is observed at N854 E468 for the interface of Layers IIIB and IIIA (50-70 cmbd).

If we consider the micro-artifactual evidence in conjunction with the chemical and granulometric evidence, we are faced with an apparent dilemma. On the one hand, these 'lower' Layer III contexts resemble Layer II granulometrically and chemically. On the other hand, they most closely resemble, but are somewhat different from 'upper' Layer III sediments, from a micro-artifactual perspective. However, if we consider that increases in sand and stratigraphic enrichment in C are taken as proxies for *buried land surfaces* (rather than Layer II per se), a third possibility arises to explain the apparent contradiction. This conjuncture of patterns (e.g. Figures VII.10 and VII.11) may index a different sort of land surface from that understood to be represented by Layer II. If Layer II is a land surface characterized by the accumulation of charcoal, such as that associated with repeated vegetation burning or deposition of charcoal-rich sediments, which we would expect to represent an 'outdoor' context, these 'lower' Layer III deposits identified in the field as Layer IIIA could represent 'clean' (debris-free) surfaces such as interior floors. If this is the case, we may have chanced upon pre-mound house contexts in units N859 E509, N854 E468, and N847 E450 (respectively, Mounds 12, 15, and 13). Given the abundance of ceramics uncovered at the interface of Layers II and III at Mound 17, the idea of a local, intensive, and potentially sedentary occupation contemporaneous with the occupation of Layer II is not absurd. Additionally, considerations surrounding the formation processes of Feature 60, as well as the potential feature observed at the interface of Layers I and II at N932 E452 and the 'upside-down' sediment dump observed in the south profile of N854 E468 further suggest a variety of activities taking place before the construction of mounds.

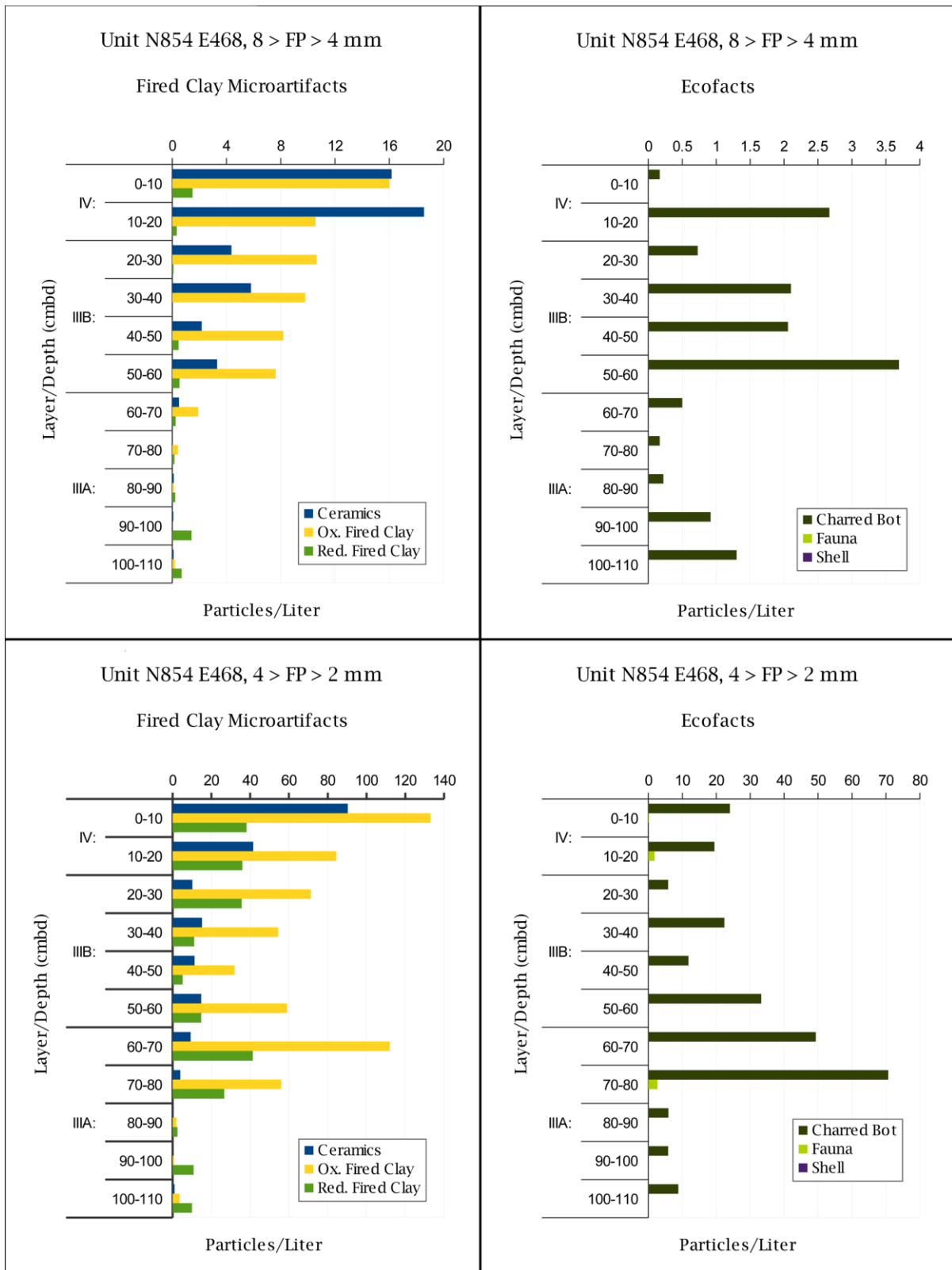


Figure VII.10: Micro-artifact patterning in Layer IIIA. Fired clay and charred botanical remains, 2-4 and 4-8 mm.

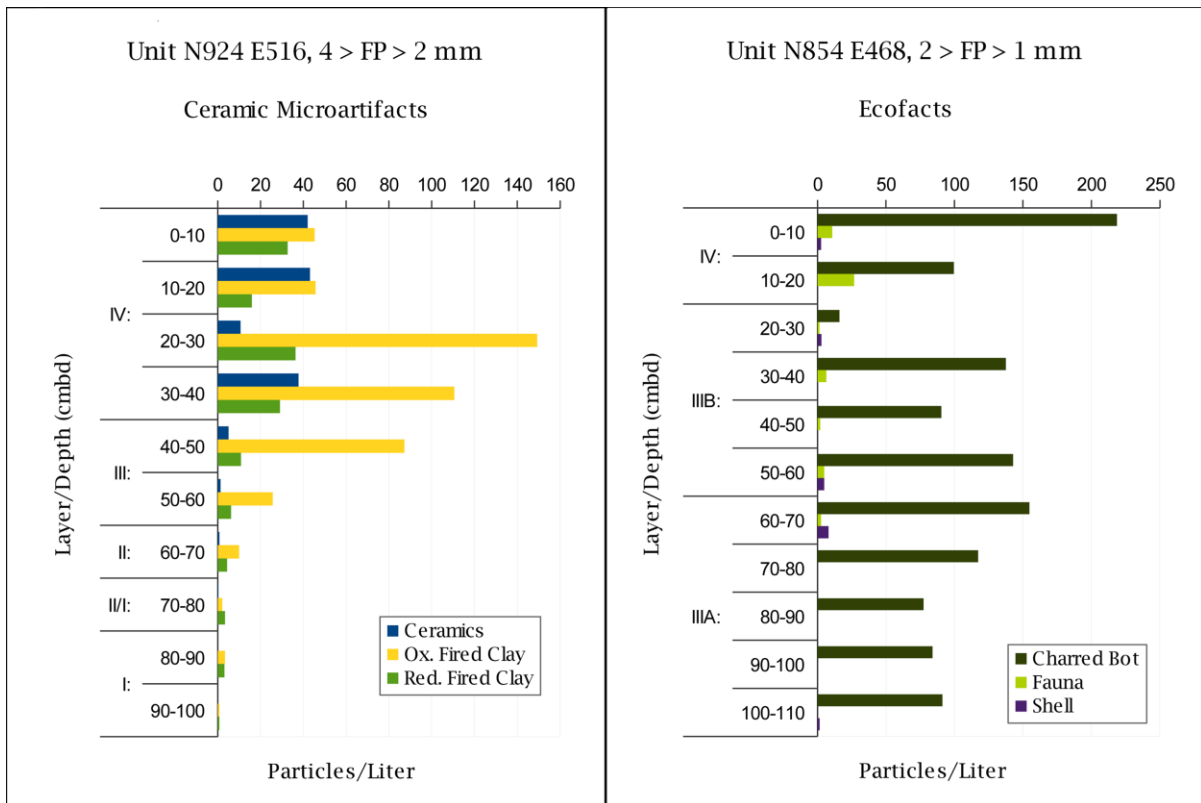


Figure VII.11: Micro-artifact patterning within Layer IIIA. Fired clay and Charred botanical remains, 1-2 mm.

Contrary to prevailing views, a number of microscopic and invisible indices resist dissolution or erasure from the pedo-stratigraphic profile, even in a pedogenically active zone such as the Central Amazon. Among sedimentological indices I include proportions of sands of different size classes, as well as micro-artifacts, even if micro-artifacts in the 1-2mm size class appear to be somewhat susceptible to percolation into non-anthropogenic layers. In fact, the sharp decline exhibited by fired clay artifacts in the 1-2 mm size fraction, when compared to the relatively slight increases in coarse sands observed through granulometric analyses points to the possibility that these increases, however small, may be the result of human intervention. However, as expressed above, the relatively low frequency coarse-sand-sized micro-artifacts (averaging < 200 particles per Liter, or less than 0.5% of the sample by volume), combined with the small sample size (20g) utilized at Embrapa for particle-size analysis makes it difficult to adequately relate these two data sources. In the future, methodological advances in sample dispersal for flotation and the inclusion of smaller, standardized mesh sizes for recovery of micro-artifacts during flotation may improve our understanding of the contribution of anthropogenic sediments to sand content in terra preta and associated anthropogenic deposits.

In light of these findings, it seems clear that the major obstacle in obtaining conclusive or quantifiable data to answer this question is in large part a problem of sample size, both in terms of the number of units sampled, but also in terms of the size of samples floated for the recovery of micro-artifacts. An improvement in these aspects can yield interpretable results that can inform our understanding of site formation processes, landscape modification, and placemaking at terra preta sites in the Central Amazon.

Spatial signals: localized deposition

This section discusses indices of anthropization that can be used to divide the site up into spatially distinct units, whether at the scale of the ring village, which here corresponds to the North Precinct, or at the scale of the hearth. I build on analyses of chemical signatures presented in the previous section, considering less resilient components that, because of their mobility, work better as indices of localities than as markers of time or specific events. Because soils are a living system, we must recall that many of these more labile components likely persist in these profiles as a function of the persistence of other components.

Physical characteristics will also be examined insofar as they can speak to localized deposition or human-induced post-depositional processes, including particle migration, sediment removal, and enhanced preservation through burial. A consideration of localized contexts, especially at the scale of the house or smaller, forces us to consider details about site formation and remodeling that would otherwise go unquestioned. A close consideration of this scale allows for a richer interpretation, but also raised concrete, answerable questions, and is crucial in formulating future research designs for Antônio Galo and similar sites.

The neighborhood.

This section examines the distinctions between plaza, mound, and “backyard,” as defined in the previous chapter. Because analyses of bulk samples from the Inner Structures defined through topographic and core-and-auger survey are still awaiting completion, no additional data

from microanalyses are available about these contexts, and they will not be discussed in this chapter.

One pattern that emerges is that which characterizes the mound contexts. Out of the five mounds analyzed, all exhibited enrichment in Organic C, P, Ca, Zn, Mn, Cu, and Na, either with respect to the off-site sample or with respect to the local (underlying) B Horizon. However, while some signals, like Organic C, P, Na, and Mg preserved stratigraphic patterning (see figures VII.1, VII.9), others behaved differently within the stratigraphic profile. Calcium, for example, is relatively consistently distributed vertically in all profiles sampled (Figure VII.12). Like Ca, pH was consistently elevated across all mound profiles sampled, generally 1 to 1.5 higher than pH measured across all four horizons of the off-site sample (Figure VII.13). At the off-site sample, pH increased slightly with depth, and while this pattern is mimicked to some extent within the mound samples (e.g. N895 E509, N924 E516), in other cases, it remains relatively steady across the entire sampled profile (N854 E456).

Because Ca and pH are the two elements that have been incorporated most evenly across pedo-stratigraphic profiles, they will be considered the primary indices of pedogenic memory at this site. This signifies that, of the parameters measured, pH and Ca are the principal chemical aspects that, within the context of new pedogenic processes set into motion as a result of anthropogenesis of the pedons in question, we would expect to be consistently elevated across a pedo-stratigraphic profile. With regard to archaeological interpretation, these are expected to be valuable indices for spatial differentiation of past activities, but are not expected to reveal stratigraphic patterning or provide temporal information.

It is worth noting that agricultural lime, which consists primarily of CaCO_3 , is a common additive recommended to reduce soil acidity, and thus the co-variance of pH and Ca is likely causal. However, the persistence of a strong signature of Ca within these contexts, regardless of whether it entered the system historically or during the pre-Columbian occupation, is significant given the abandoned state of the horticultural plot when encountered. The most recent application of lime, if it occurred at all, could not have happened within the two years prior to excavation, when the property changed hands and stopped being managed. Controlled experiments of lime application in Brazilian Oxisols resulted in Ca concentrations ranging from 1.7-3.8 cmol/dm^3 after four years' cultivation (Fageria 2001), or approximately 20-40% the concentrations encountered within the mound contexts sampled. Fageria and Baligar (2008) suggest that lime levels remained relatively stable throughout the four years of experimentation, although no temporal data on Ca concentrations is provided. Liming regimes tested on Brazilian Oxisols (Fageria and Baligar 2008) fall within limits that prevent the adverse effects of over-liming, such as restricted availability of micronutrients. The generally good state of tree crops farmed on this plot suggest liming regimes, if present, were controlled, and thus it is unlikely that Ca levels identified at Antônio Galo are strictly the result of modern lime application.

Zinc, Mn and Cu were all also significantly enriched at on-site samples in comparison with the off-site sample in the upper 40-60 cm of mound profiles, but all three have a distinct kind of distribution over the depth of the pedo-stratigraphic profile. The pattern observed for Mn is repeated across all five mound profiles, beginning with a concentration 70 to 100 times higher than that observed in the A horizon of the off-site sample, and dropping off in an increasingly steep curve, approaching the values observed in the off-site sample at approximately 50 cm, but only matching that value in Layer I. Zinc and Cu, on the other hand, behave rather erratically across the pedo-stratigraphic profiles of the mound samples, in some cases following a

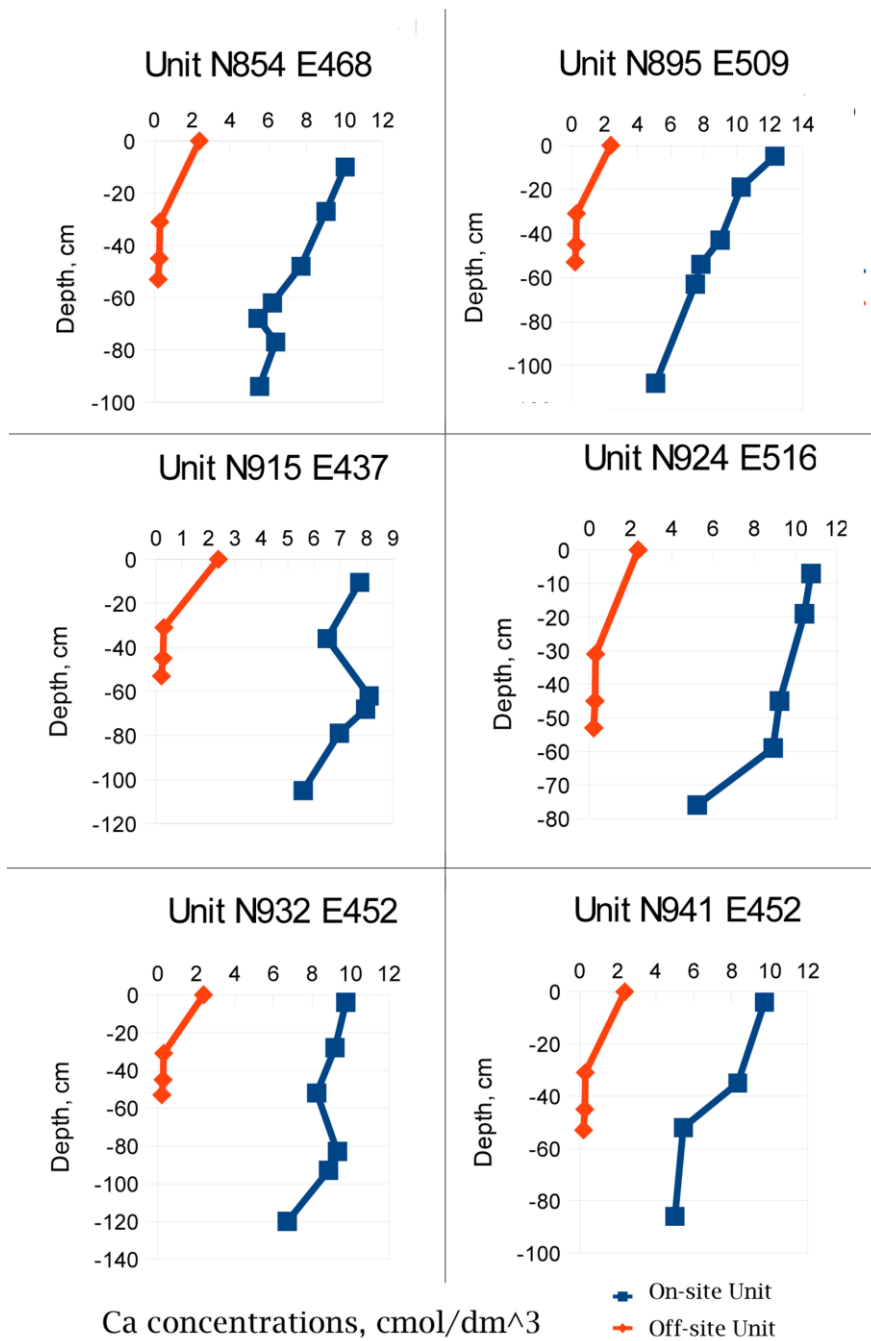


Figure VII.12: Ca concentrations for all mound and behind-mounds contexts tested

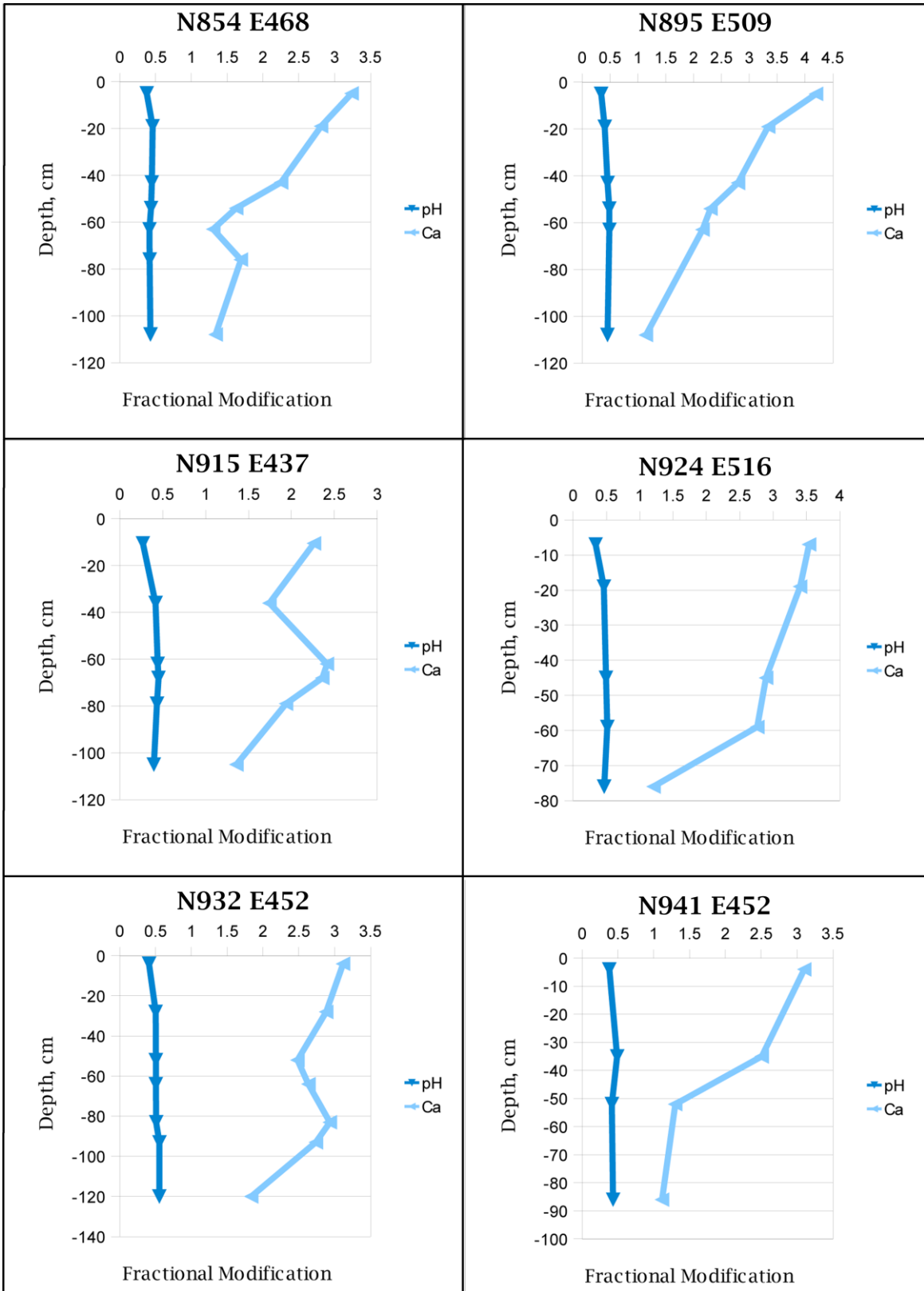


Figure VII.13: Fractional gains in pH and Ca with respect to off-site sample N992 E452.

trend approximating that of Mn (e.g. N895 E509), but in other cases, dropping off steeply, at first, and then slowly, or vice versa (see Figure VII.14). There does appear to be some patterning in Cu distribution among units not found to present a Layer II, where we have hypothesized the presence of an interior house floor.

The significance of these various chemical profiles has not been entirely understood. Enrichment in Ca, if not a result of modern soil amendment practices, is likely due to the introduction of animal biomass into the system, as was originally hypothesized, and as Arroyo-Kalin (2008) has suggested rather convincingly through micromorphological analysis. Schmidt and Heckenberger (2009) have connected isolated areas of high concentrations of Zn with micturition in ethnoarchaeological contexts, a point that will be taken up below, in the discussion of the household scale. These findings are cautiously applied, as Cu has also historically been an additive in fertilizers and soil amendments.

Also notable is the fact that the layers identified across N941 E452 behaved in a very different manner from layers sampled in all other on-site contexts. The single parameter that appears to follow a similar pattern to that observed on mound contexts is organic C, which echoes the vertical patterning of the latter. An important exception is that there is no peak localized at the point where Layer II would presumably be. This is unexpected because even at the off-site sample, organic C values appear to level off somewhat along the middle of its profile, suggesting C is accumulating or persisting at this depth. As has been noted above, this *Behind Mounds* context sample appears to be most similar to the off-site sample with respect to the distribution of sands across its profile (Figure VII.3, above), and hence I have concluded that what we had originally interpreted as part of Layer II at unit N924 E516 is more likely a melanized transitional horizon, rather than a buried anthropic A Horizon. Indeed, this locale exhibits some of the highest Mn concentrations within the upper layers of any observed on site. However, the presence of the charcoal-rich feature, F58, uncovered at this locale, along with relative enrichment in most chemical indices tested, suggests that this is indeed an anthropic area, but one of a significantly different nature than the mound contexts. The fact that this appears to be a *Behind Mounds* context consisting of a relatively unmodified soil superimposed by colluvial anthropogenic layers suggests a different series of activities might have been taking place in this zone, but without details on the composition of deposits encountered in F58, and without further data on the actual conditions attested to by the context identified as Layer II in this unit, these activities cannot be discerned.

Details on the chemical and micro-artifactual signatures of the layers observed at N941 E452 highlight the differences between the Mounds and Behind-Mounds contexts. Notably, the two uppermost layers, which we interpreted as colluvial deposits from Mound 16, are significantly enriched in Ca and P in comparison with the off-site sample, but similarities among the behavior of these elements across the profile, and with characteristics of the mound contexts, stops there. As is the case elsewhere on site, sources of enrichment are still poorly understood

Of the remaining elements, Mn can be said to behave most like the mound contexts, beginning with values approximately 10 times that of the off-site unit, and approximating the N992 E452 values at approximately 50 cmbd. The slight difference in the shape of the curve described by Mn at N941 E452 can probably be attributed to slight differences in sampling depth. For Cu and Zn, the behavior is still different. It almost appears as though the two uppermost samples from the profile belong to a different substrate than the two lowermost samples (see Figure VII.14). In the case of both elements, the uppermost samples, the ones

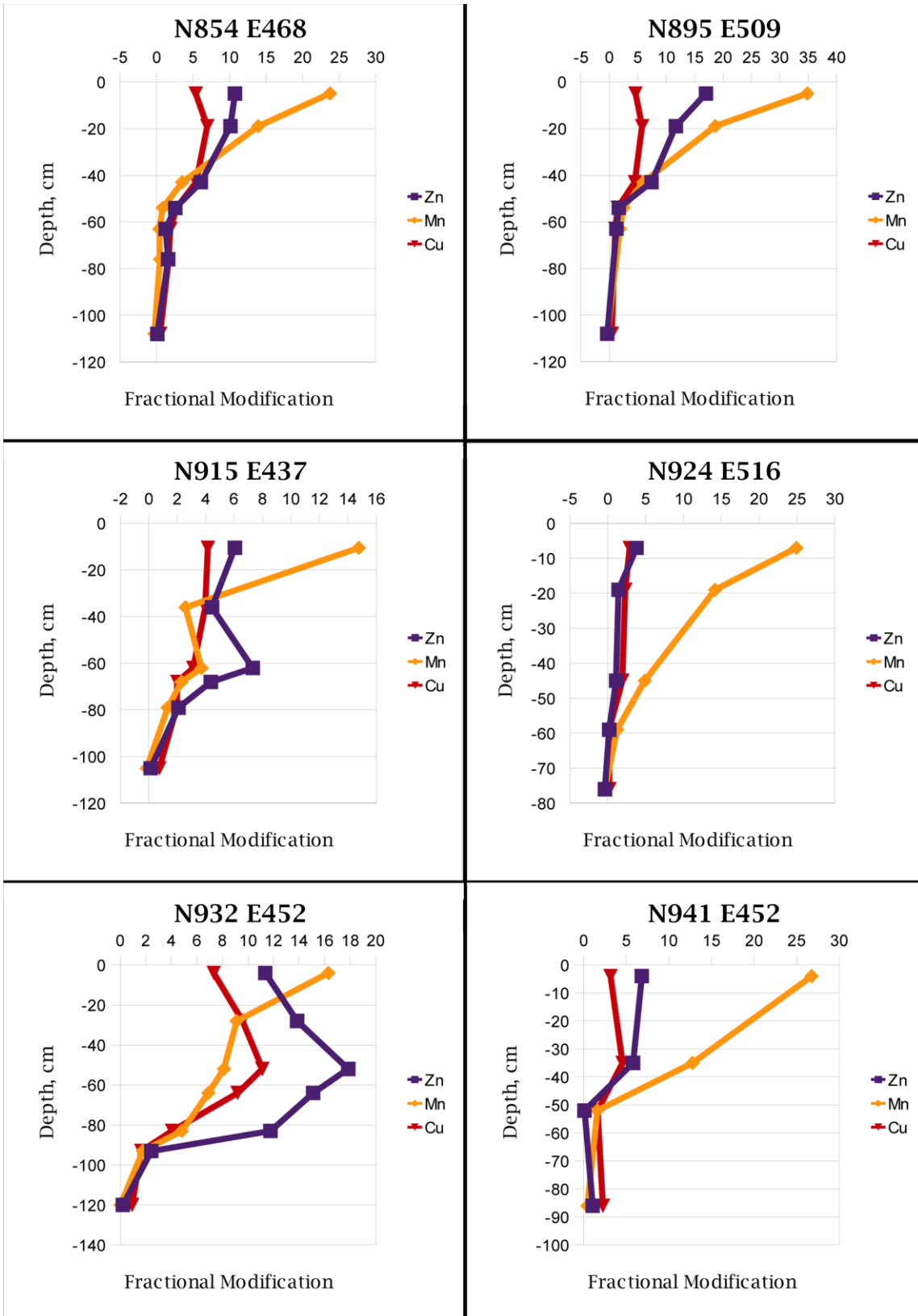


Figure VII.14: Fractional gains in concentrations of Zn, Mn, and Cu, with respect to off-site sample N992 E452.

thought to belong to Layers IV and III, behave in manner similar to the upper reaches of profiles of the same elements in the mound contexts, but the lower two samples appear to deviate completely from any pattern observed anywhere on site. Although not much can be said to explain this, it is worth observing that the context originally interpreted as Layer II in unit N941 E452 shares a very unusual boundary with Layer I within the North profile (see Chapter 6). Postulated at the time to be evidence of compaction or excavation, perhaps impressions made with a digging stick, this unusual interface was sampled for micromorphological analyses, to be implemented in the future. If this unusual contact is in some way related to the unusual profiles observed for Cu and Zn, we may be able to comprehend this through micromorphology.

About the house.

In light of findings of potential interior floor contexts uncovered at Units N854 E468 and N895 E509, patterning emerges in the distribution of Cu across pedo-stratigraphic profiles. At N895 E509 and N854 E468, slight enrichment near the surface is followed by greater enrichment at approximately 25 cmbd, and then a gradual decrease in enrichment that varies with steepness across its dimensions. At units N924 E516 and N915 E437, which exhibited a clear Layer II context, Cu follows a different pattern (Figure VII.14), peaking or at least ceasing to drop off in Layer II. Schmidt and Heckenberger (2009) have noted high concentrations of Cu in areas immediately outside of houses, but never inside, which may explain the low concentrations of Cu revealed in the house floor contexts in contrast with higher concentrations observed in some instances of Layer II. Furthermore, they have shown that, in a Kuikuru Village in the Upper Xingu, these peaks of Cu are isolated, and appear to be connected with preferred micturition areas located immediately in front of houses (Schmidt and Heckenberger 2009).

If the peak observed at N915 E437 represents such an area, then we can surmise that the excavation units placed in Mound 17 were fortuitously placed just outside a potential house. Further excavation might reveal interior floors to the west of the locale excavated in 2009. Because data are extremely preliminary at this point, this should be seen as a hypothesis to be tested in connection with questions regarding continuity of use of space across time, to be detailed below. If this interpretation is correct, the isolated combustion structure discovered immediately on top of Layer II at this locale would have been placed in front of the house, likely serving a distinct purpose from that of interior house fires. Charred botanical remains in high frequency, and of large size, were recovered from this context, and will be examined in the future in order to illuminate this question.

The features most clearly identified over the course of excavations at N854 E468 seem to corroborate the idea that Layer IIIA was a land surface upon which activities were performed. In light of findings discussed in the previous section, the lower boundary of Layer IIIA is thought to occur at approximately 75 cmbd, the level at which most features become clearly visible, and also the depth that had been tentatively assigned to the upper limit of Layer II. Two things must be noted about the locale explored in unit N854 E468 in terms of house construction and site use over time. First, the majority of features that become clearly defined in Layer II (approximately 75 cmbd) are not evident at the top of Layer IIIA, which we take to be 60 cmbd. This suggests that, as was the case with F60, these features (F54, F55, and F56) are associated with occupation before the establishment of house structures at these particular locales, or possibly a distinct kind of habitation pattern. Feature 52 is the only feature that appears to traverse the house floor layer, and could thus be associated with occupation of this layer. Notably, F52 is considerably smaller

in diameter than the other features encountered at this site, having dimensions appropriate for posts associated with houses that match the mound footprint. This also matches dimensions for post-molds encountered elsewhere on site, F53 identified in the west profile of unit N865 E421 being the clearest of these.

Finally, a striking similarity should be noted between the floors identified at N845 E468 and N895 E509: both floors appear to be the same thickness, about 15 cm thick. This raises two further questions about the formation of the floors, in terms of time and process. If the floor deposits, as encountered today, represent accumulation of fine earth deposits in a relatively debris-free environment, then the length of occupation of this floor must be significant. If the floor was constructed, as a packed-earth floor useful in deterring subterranean pests, then we must address the issue of the relative dearth of micro-artifactual remains discovered in this layer. In the case of Mound 15 (Unit N895 E509), the case can be made that the occupation of the buried house floor took place in a “pristine” environment, because Layer II is not present beneath the floor. However, in the case of Mound 12 (N854 E468), a relatively thick (20 cm) Layer II is clearly present beneath Layer IIIA. Furthermore, this Layer II exhibits the characteristics of other Layer II contexts, a dearth of heavy-fraction charred botanical remains and an increase of small (1-4 mm) reduced low-fired clay particles. These sediments are notably different from Layer II sediments at this locale and elsewhere, and it seems difficult to argue that people could have sourced ‘clean’ sediments from within the precinct in order to build this floor.

Results from excavations at N847 E468 suggest that soils from points south of the North Precinct might be distinctly sandier and more quartz-rich than those native to the North Precinct, and thus if sediments were ‘sourced’ from this area, we could potentially identify them via their quartz content. However, as explained above, the samples from N847 E468 were lost in transit, and thus testing of this potentiality must await further analyses of AVC samples or the collection of additional samples from the central and southern portions of the site. Nevertheless, both at N854 E468 and N895 E509, this deposit seals one or more pre-existing features, suggesting that at least something of a construction episode, even if accumulation also took place. Micromorphological analyses could shed light on this question, particularly in the identification of micro-stratigraphy, sweeping patterns, and downward migration of small particles, such as the charred botanical remains that characterize this layer.

If formation by deliberate construction is demonstrated, we would then need to consider a potential source for these sediments, and also the implications of sediment sourcing for our understanding of investment in house construction and permanence, at the very least. Sampling around the site, including the off-site sample to the north of the site and the unit sampled south of the North Precinct, show that these extremely sandy deposits could not have served as a source for floor sediments. There is a possibility adequate sediments would have been available elsewhere on the site, where geological samples have not been taken, but even this would suggest more intentionality and investment in building than procuring adjacent sediments to pack an earth floor. Detailed examination of micro-artifacts smaller than 1mm, along with a regimented geological sampling program may shed additional light on these questions.

Finally, if these interpretations are correct, there is a need to address the absence of Layer II from Mound 15 and its presence beneath Mound 12. Again, two competing explanations exist to explain this divergence. One possibility is that Layer IIIA in Mound 15 is contemporaneous with Layer II in Mound 12 and elsewhere, suggesting differential use of space at any given time. In this case, the house floor found beneath Mound 12 comes later, and reflects shifting

organization, population growth, or house fissioning in this second pre-mound stage. Second, one could consider that the house floors beneath Mounds 12 and 15 were contemporaneous. If this is the case, Layer II was either discontinuous across the site to begin with, or was selectively excavated in the construction of mounds. In either case, Layer II would have pre-dated the establishment of pre-mound house structures on the landscape. Detailed chronological data could help resolve this issue of contemporaneity, and would have implications for the extent to which we consider Layer II to be a “farming” context or a “gardening” context. This distinction will be discussed further in Chapter 8.

Investigating features: function and context.

One of the questions raised in Chapter 6 revolved around interpreting the limits and function of Feature 60 (F60), a clearly-defined intrusive feature that emerged in the southeast quadrant of Unit N895 E509. Feature 60 was first identified in plan view at approximately 80 cmbd, near the transition between what we identified in the field as Layer IIIA and Layer I, or near the transition between anthropic deposits and the underlying B Horizon. Feature 60 presents the classic problem faced by archaeologists working in terra preta sites: features are often identified only at the transition between the underlying yellow or red B Horizon of the native Oxisol because fill layers look, macroscopically, indistinguishable from the surrounding and overlying terra preta deposits. Hence, it has historically been challenging to establish the depth from which features cuts were created, and thus to determine the limits of the feature and its associations with other deposits. Despite relatively clear stratigraphy at Antônio Galo, field observations could not establish conclusively if F60 was cut from Layer IV or one of the Layer III deposits identified at N895 E509.

The two possible working hypotheses given the orientation of macro-artifacts visible on the east profile were that F60 was cut from the top of Layer IIIB and was associated with the terra preta occupation overlying the mound platform, or that it was cut from the top of Layer IIIA. In the latter hypothesis, the large (8-cm diameter) ironstone and trempe fragments would have supported a large post that might have functioned as the central post in a house. Samples were taken from various points within and above the clearly demarcated portion of F60 (Figure VI.4a), as well as from parts of Layers IIIA and IIIB clearly defined in the south profile, to serve as comparative samples for samples taken from the east profile.

Granulometrically, samples obtained from the clearly-defined portion of F60 are not significantly different from samples tested from Layer IIIA contexts from both the south and east profiles. A slight difference was observed in the total amount of sand encountered in samples from inside the feature as compared to samples from Layer IIIA, although there appears to be a slight if steady decrease in sand from Layer IIIB through the bottom of F60 that correlates with increasing depth. Chemical evidence may provide the clearest manner of distinguishing Layer IIIA samples from F60 samples. For example, the proportion of extractable Fe drops steadily with depth, and across Layers IIIB and IIIA, but is proportionately high and stable within F60 samples. Organic C also appears to behave differently within Layer II samples as opposed to F60 samples, hovering around 16 g/kg in Layer III and dropping to approximately 13 g/kg in F60. Zinc and Mn both follow a similar pattern, significantly higher in Layer IIIB than in Layer IIIA, which in turn presents higher levels of both elements than F60 samples. Finally, Ca occurs in higher concentrations in F60 deposits than in Layer IIIA deposits. The similarity of both sampled Layer IIIA deposits, along with these distinctions suggests F60 was a pit cut from the

old land surface and capped by Layer IIIA. This makes sense if Layer IIIA is a house floor, built up over time or intentionally built around a central post, represented by F60. Notably, Ca, Organic C, and Fe are higher than expected in F60, and most closely resemble concentrations observed in Layer IIIB. Micro-artifactual analysis would further enhance these findings, and could be performed on sand fractions obtained from remaining curated profile bulk samples.

Unit N854 E468 was selected for further analysis mainly because of the multiple, large, clearly-defined features encountered at this locale. The size of these features made it possible to collect sufficiently large bulk samples for flotation, and hence we have micro-artifactual data to characterize these features within the context of the layers that surround them. Although deposits associated with the features were likely present as high up as 80-90 cmbd, the difficulty in defining the edges of features made it such that collection of feature sediments did not begin until level 100-110 cmbd. Of all three features recognized and excavated separately in plan view, F54 contained the most striking deposits. Artifacts recovered in heavy fraction include a high frequency of ceramics of all sizes, most strikingly in the 8-254 mm size range. These ceramics are present in levels 100-110 and 120-130 cmbd, but not in the intermediate level. Ceramics are present in all size fractions in the lowest level excavated, 120-130 cmbd. A large (>254 mm) fragment of laterite rock is also present in this feature. As is the case throughout the lower levels of the excavation, there is a significant presence of reduced low-fired clay particles throughout the sample, but these only occur in the 1-4 mm size range. Unlike F54, F55 did not contain any ceramics fragments larger than 8 mm in diameter. Similarly, F56 deposits featured ceramic micro-artifacts only in the 1-8 mm size range, and presents concentrations of ceramic artifacts that are significant in comparison with level 100-110 cmbd. Additionally, these deposits contain a higher proportion of oxidized low-fired clay particles in the 1-2 mm size range. Potentially significant is the slightly higher ratio of oxidized to reduced low-fired clay particles in the 2-4 mm size range, which tend to occur toward the bottom of the feature. In all three features, concentrations of charred botanical remains occur in highest frequency near the top of the feature deposits analyzed (100-110 cmbd), and tend to decrease with depth within the higher fraction sizes. In the 1-2 mm fraction size, which is generally subject to more downward migration, botanical remains seem to accumulate near the bottom of features.

Notably, F54 is smaller in diameter and distinct in shape from F55 and F56, being more oval in shape than the latter two features. F54 is the only feature that exhibits low fragmentation of ceramic artifacts, although all three features present slightly higher concentrations of ceramics than the lower layers through which they are cut. In size fractions greater than 4 mm, none of the feature deposits resemble deposits found between 70 and 90 cmbd, presumably depth range from which these features would have been cut. Striking differences in proportion and frequency of fired clay artifacts include, for example, the predominance of oxidized low-fired clay artifacts in levels 70-80 and 80-90 cmbd for particles in the 1-4 mm range, where reduced fired-clay artifacts tend to dominate these fraction sizes in the features, but not to the extent that they are predominant in levels 90-100 and 100-110 cmbd. In fraction sizes greater than 4 mm, the presence of ceramics in almost all feature deposits makes these different from level deposits sampled between 60 and 90 cmbd, and in no instance is there any apparent continuity of patterning between these upper levels and the deposits found within the features. These discontinuities suggest that the deposits that fill these features are not incidental overburden from the construction or accumulation of Layer IIIA, but are in fact intentional fills. Indeed, in the case of F55, the fact that it preceded Layer IIIA seemed clear from the initial examination of the

pedo-stratigraphic profile. Because F54, F55, and F56 were all encountered at approximately the same depth and seem similar in fill, we can say that all three features pre-date the construction of Layer IIIA. The function of these filled pits is not understood, but future investigations into the chemical composition of these deposits should shed light on this question.

During the sampling of the pedo-stratigraphic profiles at N854 E468, a few strange ‘dips’ at the bottom of upper layers were observed. These shapes appeared to coincide with concentrations of ceramics or charcoal, and thus appeared to be distinct deposits. In the case of the concentration of ceramics observed at approximately 40 cmbd in the center of the east profile, the presence of a feature was postulated. Sample collection at this location revealed what appeared to be a ceramic-lined pit, and bulk samples were collected from inside this context and floated. Macro- and micro-artifacts from heavy fraction show that these deposits are indeed significantly different from the surrounding matrix. Referred to as Feature A (see Figure VI.4.b), this context revealed the highest proportion of ceramics of all sizes recovered from heavy fraction, with the exception of the largest (> 254 mm) fraction size. The largest proportion of large ceramic artifacts recovered in the heavy fraction came from the context I am calling Feature B, shown in Figure VI.b. Feature B represents another ‘dip’ in a layer that is associated not only with a concentration of charred botanical remains, but that also appears to be sealed by a large trempe fragment or a burnt-earth deposit. In particle sizes ranging from 4-254 mm, ceramic concentrations are significantly lower in Feature B than in Feature A, and it is worth noting that ceramics are the only class of micro-artifact recovered from these features at fraction sizes greater than 4 mm. In the 1-4 mm fraction, the highest proportion of micro-artifacts occurs in oxidized low-fired clay particles, followed by their reduced counterparts, and then ceramics. Features A and B thus appear to follow artifactual and fragmentation patterns similar to those of the features encountered near the bottom of the unit, which are associated with an early occupation of the locale. In terms of charred botanical remains and fauna, both of these features present concentrations that are comparable to those encountered in the levels through which they are cut. Thus, though concentrations of charred botanical remains were a macroscopic distinguishing characteristic of these features, the relative dearth of this kind of particle in the heavy fraction suggest most of these are low density particles, and we expect to see them in the light fraction. The distinguishing characteristic of all features analyzed at N854 E468 appears to be concentration of ceramics and proportion of oxidized versus reduced low-fired clay particles.

The final mound context that will be discussed here is a potential feature encountered at N924 E516. During excavation and recording of the pedo-stratigraphic profile, as noted in Chapter 6, there were doubts as to the precise depth of the boundary between Layers IV and III. Micro-artifactual analysis has shed light on this question. The principal doubt expressed regarded whether this boundary should coincide with the line of ceramic artifacts, which appeared to go up toward the east, exiting the profile at approximately 20 cmbd, or whether it should be determined by color and frequency of charcoal, which would have meant the profile boundary dipped downward toward the east. The latter interpretation was chosen for the initial profile drawing, mostly because the layers below Layer IV all seemed to dip downward toward the east as well. However, upon consideration of Layer III as a construction layer, and given that the constructed topography of the site went up, not down, toward the east, serious doubt was subsequently cast on this initial interpretation. Micro-artifact analysis suggests, in fact, that neither interpretation is correct. A significantly higher concentration of ceramics found within this 20-cm zone (20-40 cmbd), suggests that this is another case of a feature dug into the

construction layer and filled with ceramic-rich terra preta. As such this feature, henceforth feature C, is seen as analogous to features A and B, above. Additionally, when considered alongside the ‘dips’ observed at N932 E452 and the large ceramic and trempe fragment concentrations observed in Layer IV of N854 E468, N880 E506, and N895 E509, the somewhat larger ceramic fragments seen in profile immediately above the proposed feature suggest something of an analogous context here as well.

The unit excavated behind Mound 16, unit N941 E452, can also provide insights about structuring of activities across the site. As detailed above, the pedo-stratigraphic profile of the samples identified as belonging to the various layers show that this area was treated differently than the mound contexts. If the anthropogenic deposit that constitutes the upper two layers observed at this locale is in fact colluvial, then we have a very unusual spatial context behind Mound 16. Not only is there no in-situ terra preta deposit, there is equally no evidence of a pre-terra preta Layer II-type deposit, macroscopically or micro-analytically. It is unfortunate that the heavy fraction samples from flotation of this unit were lost in transit, as they might have had the potential to shed light on what exactly was going on at this locale.

One potential explanation for the absence of darkened or charcoal-rich anthropogenic layers at this locale might lie in future explanations of the strange patterning observed in the North profile, at the interface of what was interpreted as Layer II and Layer I (Figure VII.14, above). If the hypothesis that these are digging stick impressions is borne out, then the entire unit was likely placed within a larger pit, into which a later pit, F58, was subsequently dug. Another possibility, representing the complete opposite scenario, is that the activities going on behind Mound 16 involved maintaining a relatively clean surface, such as that observed in association with the interior floors proposed for Lower Layer III deposits encountered at N854 E468 and N895 E509, although two factors lead me to favor the first hypothesis. First, the Layer IIIA deposits are macroscopically distinct from the context that was originally interpreted as Layer II at N941 E452. Second, this latter hypothesis does not address the unusual aspect of the contact between Layers I and II at this locale.

Chapter 8

Lived-in places: a life-history of the North Precinct

Places at Antônio Galo

This project was an exercise in developing a better understanding of lifeways in ancient Amazonia through the reconstruction or conceptualization of places from Amazonia's past. Landscape and environment were foregrounded in this study not only because of the immediacy of environmental factors in the way that most of us encounter Amazonia today, but also because of the structuring effects that this immediacy has had on the construction and reconstruction of places and landscapes throughout the modern history of representation of Amazonia. The geoarchaeological approach of this study is a result of the threefold function of the cultural/archaeological soil-and-sediment matrix we call Terra Preta de Índio as an artifact, a record, and an interface between social and natural systems.

The preceding two chapters have applied this approach toward interpreting evidence recovered at the terra preta site of Antônio Galo as traces of past human action that have been in some way 'remembered' by the archaeological matrix. With the hope of understanding the kinds of places that have existed at or in connection with the locality defined by the site, I now pool together these results in a tentative reconstruction of these places. This reconstruction is tentative not only because nearly all archaeological 'reconstruction' or construction of the past is tentative to a degree, but also because the range of data fully explored herein constitute only a fraction of data that are currently being analyzed, or that have been conceptualized as potentially useful to these reconstructions. As such, the conclusions that I draw from this study come in the form of factual, methodological, and theoretical pairs of results and recommendations. The factual pairs consist of conclusions about the arrangement and use of space and concomitant hypotheses to be tested that seek to refine these findings. The methodological pairs report on the success of approaches fully explored and recommendations for new or improved methods for future research. The theoretical pair speaks back to existing models and theories about Amazonia's past and present that are prevalent in archaeology, but also looks forward to new directions of research and forms of conceptualizing this past that put the larger project of conceptualizing places in this region in conversation with historical, scientific, and political projects that act upon contemporary Amazonia.

From where we now sit

This study was an initial foray into the potentials of a household-scale archaeology of a terra preta site. Because of material availability, building traditions, and poor preservation conditions in Amazonia, many of the kinds of evidence often relied upon to

describe social formations do not number among commonly encountered classes of archaeological evidence. Architectural remains, often recognized when built from stone or plaster, are not characteristic of Amazonian building practices, and evidence made from perishable media is difficult to encounter. As part of the explanatory framework of this project, it was hypothesized that, given building practices and preservation conditions in Amazonia, the likeliest way to encounter these ‘missing’ evidence classes was to study the archaeological matrix, the body of particulate matter that consists of the major part of material remains at an archaeological site, and which consists of soils developed in situ and sediments brought to the site or moved across the site through human activity.

This study has brought to light classes of evidence that can be informative in understanding the construction and location of houses, as well as the nature or intensity of activities indexed in archaeological features. For example, understanding the vertical and horizontal distribution of micro-artifacts, here defined as all artifactual remains too small to be commonly recognized in field screening of sediments, has led to a greater understanding of the spatial parsing of an ancient land surface. Analysis of chemical parameters has forged a better understanding of the kinds of indices that are likely to persist in stratigraphic contexts, and the types of inputs or enrichment that are better thought of as the result of systemic incorporation into a portion of the pedosphere. From this, a considerable number of conclusions can be reached and hypotheses posed about the pre-Columbian history of the North Precinct at Antônio Galo. Few conclusive statements can be made about specific daily practices that took place at the site, but we can begin to talk about house construction and structure, about feature morphology, about the kinds of inputs that may have contributed to particular kinds of enrichment, and also about the continuity or discontinuity of place on the landscape.

Theoretically, we are closer to successfully marrying studies of pedogenic and depositional processes that are responsible for the formation of the sites we study. Because of the interrelatedness of these processes, it is inappropriate to select one or the other method of studying these composite bodies of particulate matter. Rather it is imperative to consider the extent to which pedogenic processes are affected and effected by the sequence (layering) of sedimentary features. At the same time, we must recognize that pedogenic processes, which are ongoing and serve to define the potentials of these deposits as resources or surfaces, are ongoing, and constantly working to “undo” stratification created through depositional processes, but also simultaneously incorporating these inputs into forming soil bodies. Hence, we can consider that the processes of pedogenesis and sedimentation (geomorphogenesis) are complementary and work within a dialectic wherein seemingly oppositional soil and sediment bodies are iteratively integrated into an increasingly complex formation.

This recognition has led to methodological advances in the study of these sites that involve a rigorous study of physical and chemical characteristics of terra preta and associated anthropic horizons or deposits at the micro scale. By adapting concepts from soil science that quantify relative elemental gains and losses in soil horizons with respect

to parent material, I developed an index for determining degree and kind of anthropic modification of the archaeological matrix that can be used to differentiate between distinct spaces and times that define the ancient cultural occupation. Below, I consider these ideas and contextualize them within a proposed suite of analytical techniques for addressing variability at the household scale at terra preta sites.

The view from the Amazonian house

This work is framed around the Amazonian house, which means it takes the house as its principal unit of analysis and the household scale as its point of departure. This framing is deliberate, because the household scale of analysis is essential to understanding the individual or person, from the perspective of which places are necessarily constructed. The perspective here is that the house might function as a fundamental organizational unit in this society, as it does in other societies that feature ring-village arrangements (Maybury-Lewis 1979). Whether this question can actually be answered, here or elsewhere, is less important at the moment than the fact that this study has been structured such that the resulting data can later be used to address questions of social organization at the household scale.

This framing also means that the various spatial scales considered here are approached from the house, which in this case, has survived on the landscape in the form of a mound. Beyond the house, there is the village, or at least the village precinct that I have called the North Precinct. This spatially discrete zone is made up of, delineated, or bounded by houses, and I suggest that differences between houses reflect differences in social organization that have been spatially expressed in the layout of the precinct. This is why a focus on the houses is essential to understanding the precinct, but also why the houses (mounds) have been grouped into a single sampling stratum, wherein the items in the set are considered comparable to each other and distinct from everything outside the set. The other sampling strata defined for this scale of analysis have also been conceptualized from the perspective of the house. There is space behind the houses, which I have referred to either as the *Behind Mounds* stratum or as the ‘backyard;’ and there is space in front of the houses, which in this case, because of the circular arrangement of the houses, forms a central *Plaza*. The importance of the plaza as a central place in the village, and the extent to which this circularity is meaningful are worth considering as future avenues of research.

The circle of houses.

This study has made possible a consideration of the changing village or precinct context over time. Mound 12, discussed in detail below, has brought to light four to five moments in the occupational history of this place, though at most three of these can be said to extend to the entire area covered by the North Precinct. Initial results from the field suggested two distinct occupational moments could be deciphered. The earlier one was characterized by burning that

was indexed by the deposition of charcoal in a thick band upon a land surface (Layer II) that was later preserved through interment. The second phase of occupation began with the construction of mounded contexts that we interpret as house platforms (Layer III) and extended through the use of the mounds and the formation of terra preta (Layer IV). This second occupation was seen as the first definitive evidence of the establishment of a ring village or at least a circular village precinct, and also initially seen as the first definitive evidence of houses within this locale.

Micro-artifactual, granulometrical, and chemical signatures were used to identify buried land surfaces that have been interpreted as interior house floors, and it is hoped that future micromorphological analyses can corroborate this interpretation. If both layers II and IIIA can be understood as land surfaces, then the superimposition of Layers II and IIIA at N854 E468 suggest that at least part of Layer II was formed before a house was built at that locale, and that a minimum of three major moments of site use should be considered. However, the absence of Layer II from other locales where Layer IIIA was observed, namely N895 E509 and N847 E450, brings up questions of contemporaneity of house features and continuity of site use. If we propose all buried house surfaces are contemporaneous, then we need to consider the possibility of removal of Layer II in some locales prior to construction of the house floor indexed by Layer IIIA. In this case, Layer II would have represented a continuous context that extended across the entire North Precinct, possibly associated with gardening or farming. Layer IIIA would then be interpreted as a subsequent stage in which residences are established at the locale. A simpler explanation dissolves this assumption of contemporaneity, in favor of a scenario in which the houses at N895 E509 and N847 E450 precede the construction of the house at N854 E468, and are thus contemporaneous with the formation of Layer II. If the three house floors are found to be sufficiently similar to be considered part of a continuous occupation, then this signifies a relatively long, stable, and intensifying occupation of the site before the construction of the mound complex. There is no evidence that the houses considered to be earlier in this scenario were abandoned, as there is nothing resembling a gardening soil on top of these floors. Thus, in this scenario, occupation of these houses persisted during the formation period of Layer II, and then also throughout the occupation of the later house atop Layer II and beneath Mound 12. Further analyses, including macro- and micro-artifactual analysis of N847 E450, as well as future micromorphological work and intensive study of botanical remains, combined with a suite of dating techniques adapted to this context, should clarify these questions.

The inner circle.

One of the other major questions raised over the course of this study relates to the extent to which the Plaza was engineered or spatially parsed. This question was initially raised when field walking prior to coring revealed two unexpected morphological distinctions that could be made across an area that had been conceived of as relatively uniform. First, we noted that the exposed laterite crust that characterized the southwest portion of the plaza did not extend to the northeast extent of the circle, or at least was not exposed on the surface in this area. Second, we noted a few subtly elevated berms within the plaza, which became increasingly easier to define as cut vegetation dried or was incrementally moved out of the area.

One of the key questions for unraveling the meaning of this differentiation of deposits relates to whether the apparent structures in the Plaza, which I have denominated the Inner Structures, were deliberately produced through human activity (excavation and mounding of particulate matter). Data from the core-and-auger survey, along with microtopographic data

collected as part of the detailed survey of the North Precinct, raised further questions about formation processes that resulted in the current morphology of the portion of the site originally conceived of as the Plaza. The appearance of thickened A horizons in unexpected places (e.g. the area between N880 E483 and N885 E483) and of inexplicably deep stratigraphy (N895 E450) or potential features (N875 E483) encountered along transects of relatively limited coverage suggested original interpretations of the Plaza as relatively uniform were incorrect.

Post-field analysis of micro-topographic data also suggests a precise ordering of the Plaza landscape that had not previously been understood. For example, it appears that structures originally thought of as ancillary structures to Mounds 15 and 27, or as potential extensions of the mound complex in the form of ramps look remarkably different in light of newly developed digital elevation models. Moraes (2010) has generated a surface model for the site wherein Structure B, thought of initially as a ramp or small mound is part of a low, circular berm that describes a small court in front of Mound 15. If this mound represents a true structure, then ideas about the orientation of mounds and relationships between them require revision, as the presence of a small courtyard to the northwest of Mound 15, along with its apparent orientation along a NE-SW axis may suggest a closer relationship between Mounds 15 and 18 than previously envisioned. However, if mounds “grow” or become increasingly elongate toward the back – if part of the formation processes of these mounds is accumulation of debris – then Mound 15 was more likely oriented so as to sit in close association with Mound 27 as originally expected. This is why understanding the detailed formation processes of a mound across its entirety is crucial. Structure C appears as a clearly defined, isolated low mound, the function or position of which is poorly understood. However, the presence of unusually thick terra preta deposits near this locale and evidence of a potential feature in this region suggest a specialized function for this area. The question that remains, even after careful post-field analysis of macroscopic data, is to what extent these deposits were modified by humans, and how.

New information regarding correlations between macroscopically recognizable signals of anthropization has also significantly re-structured the way the Inner Structures are perceived. My understanding of Layer III as a construction layer, along with the interpretation of Layer IIIA deposits as potential house floors changes the way that such grayish-yellow deposits are understood. In the past, these were often understood as transitional layers thought to have formed through pedogenic processes between dark (anthropic) terra preta deposits and yellow (unmodified) B Horizons characteristic of Amazonian Oxisols. Not only are these kinds of deposits to be considered anthropic in the presence of macro-artifacts, they can also be seen as such through an examination of chemical and micro-artifactual signatures.

Bulk samples collected through the core-and-auger survey are queued up for granulometric and basic chemical analysis. Samples have been selected for further analysis in light of questions regarding anomalous stratigraphy, potential features, and the potentially constructed nature of the Inner Structures. Findings from chemical and micro-artifactual analyses at other parts of the site have provided us with a set of tools and parameters for examining these poorly understood matrices as anthropically modified pedogenic horizons or as anthropogenic strata produced through sediment transport and deposition (i.e. excavation and construction).

Obtaining a clear picture of the extent to which these structures were constructed is important for understanding things like intentionality and the degree to which the plaza was transformed over time. If we can pinpoint a transition in the pedo-stratigraphic profile from soil

horizon to stratigraphic layer, we can begin to reconstruct the shape of the paleo-landsurface that is so crucial to our interpretation of occupation phases and re-occupation at this locale. This information would also make possible calculations of the volume of earth that was moved in order to construct these structures, if indeed they were constructed. Such figures, along with an understanding of how earth was moved, would be used to consider investment in placemaking, which has implications for considerations of permanence as well as the power of ideology and cosmology in mobilizing people to alter the landscape. Finally, understanding the built-ness of this locale allows us to conceive of a 'before' and an 'after,' which index changing perceptions of how the landscape should be ordered in order to create specific kinds of place within the plaza, and also to structure the way other places on site function or are perceived with respect to the 'new' plaza-scape.

The house itself.

Throughout the text, I have been referring to the elevated surface features observed at Antônio Galo as mounds, and indeed from a research perspective, they manifest as somewhat amorphous mounds. One of the things I would like to emphasize in this section is that, far from being 'mounds,' which suggests a somewhat haphazard arrangement of matter into a pile, these surface features were deliberately constructed to serve as part of a house. As such, they were architectural features, likely platforms, the structure and function of which was quite intentional. Unit N924 E516 provides a perfect example of this intentionality and deliberateness, as the construction layer observed in that pedo-stratigraphic profile slopes in opposition to natural topographic contours expressed in the shape of the paleo-landsurface (Layer II).

A number of functional explanations have been proposed for the raising of house platforms, such as the elevation of the house floor above flooding or poorly drained landforms or the advantages of a highly compacted house floor with respect to discouraging pests from invading a house or its food stores through subterranean attack routes. A few pieces of evidence gathered at Antônio Galo over the course of the 2009 field season suggest that, although some of these functional explanations can be seen as partially or historically responsible for the building of house platforms in general, the compelling reason for building platforms in this instance is less tangible. First, a survey of water retention conducted after heavy rains during the field season suggested that the landform was generally well drained, with the worst drainage observed at the sites of built features. The drainage explanation could be tenable if it could be demonstrated that the worst-drained contexts on site were the sub-monticular house floors. The idea of compaction as a reason for elevation of a platform is especially compelling in light of the existence of contemporary, highly compacted packed-earth structures in the surrounding area of Lago do Limão. However, even if both drainage and insulation can be demonstrated to be useful *functions* of the platform they cannot necessarily be identified as its *purpose*. The most obvious clue that the house platform was elevated due to reasons beyond utilitarian ones is the fact that in at least one instance it was built in opposition to natural topography. This architectural decision in effect changed the shape of the landform, extending the plateau so that it could accommodate a feature of the appropriate dimensions in the appropriate location with respect to the other structures on the landscape. This suggests that there was some compelling reason beyond mere functionality, such as prescriptions about the shape of the circle, the distance between houses, or the amount of effort required to elevate a structure, that played a role in the positioning and construction of the platform associated with Mound 18.

Once we begin to think of the mound as a house, we must also consider that the house itself was also likely a highly ordered place. Houses, insofar as they have walls, delineate interior and exterior spaces, access to which is granted through doorways or passageways. These, in turn, create directionality, and houses can be parsed internally in terms of spatial relational terms, such as in-front-of and behind, inside and outside, to-the-left-of, etc. For this reason, the spaces defined by these mounds cannot be thought of as homogeneous, and hence the small areas sampled out of each house-mound can only be thought of as comparable on a very general level. For example, we can consider whether the houses were all built on similar substrates, which seems not to have been the case (compare Mound 18 to Mound 19, e.g.), or whether the platforms were all raised with similar material. We can also consider to what extent the building of each individual house would have indexed a departure in use of space from a previous iteration. At Mounds 12 and 19, if indeed Layer IIIA deposits represent house floors, then we may have something of a continuous house (see Tringham 2000). In other places, it is possible that house-mounds were constructed on land that had been previously set aside for other kinds of activities.

Of the mounds examined, Mound 12 provides the most compelling case for continuity in spatial village arrangement. If the proposed interpretation for Layer IIIA as a house floor is correct, then the unit excavated at Mound 12 revealed three sequential occupations, among which some parallels can be drawn. The first phase of occupation of this locale is indexed by a series of large, shallow features which I will call 'pit' features for lack of a more descriptive term. These features are filled with deposits that are distinct from those around them, tend to contain higher proportions of ceramics and oxidized low-fired clay artifacts than any other matrix found on site, and morphologically are quite different from F52 in unit N854 E468 and F50, F51, and F53 in N841 E465. Features 54-56 are instead quite similar in morphology and content to Features A and B, identified at N854 E468 in the post-excavation phase of analysis. Further analysis is needed to establish whether similar use can be assigned to features associated with Layer II and Layer IV at Mound 12. Potential Layer IV features noted elsewhere in the North Precinct should also be further investigated along with Mound 12 features.

The occupation phase associated with the creation of Layer II and the use of Features 54-56 was followed by at least one other major occupation event, possibly two. If we consider Layer IIIA to represent a separate occupation from Layer IIIB/IV, this phase of occupation is characterized by a particular parsing of space that forbade the deposition of certain kinds of debris (low-fired clay artifacts associated with trempe discard or damage), but favored the deposition of small fragments of dense charred botanical remains. The selective deposition associated with Layer IIIA makes it distinct from what came before, but does not necessarily indicate that pit features could not be associated with this occupation, as the absence of features from this 1 x 1 m window does not signify an absence of pit features across the entire surface.

The last occupation attested to in this locale is that associated with the major construction episode indexed by Layer IIIB and the subsequent creation and accumulation of terra preta (Layer IV) on top of the house platform. This occupation phase is not only characterized by intensive deposition of charcoal of all sizes, as well as deposition of other remains that have left behind elevated levels of Organic C, P, Ca, Zn, Mn, Cu, and Na, but also by the creation and use of pit features A and B. Interestingly, if Layers IIIA and IIIB are both considered occupation surfaces, a tremendous difference in the nature of associated occupations must be acknowledged between the two phases. The occupation of Layer IIIB, indexed by Layer IV, must have been

significantly more intensive or longer than the lower occupation, or possibly was characterized by distinct daily practices. Potential explanations for this difference include differential cooking practices or a change in the way that houses were built or dismantled at the end of their ‘lives’ (see Tringham 2000). In order to further investigate this difference, I recommend intensive sampling of these layers over the course of an areal excavation, and the incorporation of micromorphological analyses to characterize these deposits and look for evidence of compaction or sweeping in association with the occupation of hypothetical floors.

Looking ahead

A number of analyses delineated in Chapter 5 would significantly inform this research. As with any major research project, I consider this to be very much a work in progress. Data from my dissertation research has provided a series of specific hypotheses that can be tested utilizing these methods, some of which have been applied as part of this project to generate new models and new testable hypotheses. In order to address these new questions, to further inform preliminary conclusions reached via the investigation presented here, and to address questions only partially considered in this thesis, I plan to return to Antônio Galo to excavate further and gather additional samples, but also will continue to carry forward laboratory work on additional samples. Ongoing laboratory analyses that are already underway are described below, in order to illustrate some of the future directions of this research.

A work in progress

A number of samples that have been prepared for analysis are currently in the CAP laboratory facility in Manaus awaiting verification and posting to analytical facilities. In other cases, samples that have been sent out for analysis were lost in transit, or have not been reported as received by the relevant laboratories. Some of the samples not accounted-for are irreplaceable, while others can be substituted with additional material currently in storage at the CAP laboratory facility in Manaus. The section below discusses the details of analyses in progress within the context of specific research questions and hypotheses that could be addressed in the future by generation of these data.

Total (elemental) chemistry.

Total chemistry analysis of metals is increasingly becoming a part of soil studies among scholars studying Amazonian Dark Earths (Arroy-Kalin 2009; Macedo 2009; Schmidt 2010). In his dissertation (2010), Schmidt utilizes Inductively-Coupled Plasma Optical Emission Spectrometry (ICP-OES) to obtain values of main and trace metals that complement values generated through wet-chemical extractions. Results from these analyses allow for a much more specific chemical characterization of identified activity areas across the current and historic Kuikuru villages sampled by Schmidt (2010). For the current project, samples were prepared for total elemental analysis by Inductively-Coupled Plasma Mass-Spectrometry (ICP-MS), with the similar intention of using metals to broaden the range of variables to be tested across the North

Precinct. Results pooled by Schmidt would be queried for similar elemental enrichment and correlations across the North Precinct of the Antônio Galo site.

Sample preparation took place in Embrapa laboratories in Manaus. Bulk samples from all eight intensively samples profiles, as well as from opportunistic locations, were air dried and ground by hand to pass through a 2mm sieve. Subsequently, approximately 50 g of sample was separated and ground using a porcelain mortar and pestle until a minimum of 35 g of < 106 μ of sample. These were documented, labeled, and packaged for shipping to ALS Chemex, and remain in Manaus awaiting logistical support to carry forth the desired analyses.

Sedimentology: analysis of sand grains.

As part of the Particle Size Analysis (PSA) procedures described above, sand grains were sorted into four size classes, dried, weighed, and bagged for further analysis. By combining analysis of sand-sized particles with heavy fraction from flotation, in the future I should be able to conduct sedimentological analyses on particles ranging from cobble size through very fine sands. The dispersion procedure utilized at Embrapa, which is remarkably simplified in comparison to standard USDA procedures which require the digestion of organic matter and removal of iron oxides has significant advantages from the perspective of an archaeologist, who is equally interested in organic particles as in mineral particles.

While sieving, washing, and manipulating sediments from Antônio Galo, I noticed that in a number of cases, sand-sized particles included charred botanical remains and minute ceramic fragments. I also noticed that these potentially informative remains were not evenly distributed across samples. In the future, I look forward to categorizing, sorting, and analyzing the surface features of sediment grains, especially the ceramic fragments. Encountering a significant proportion of ceramic fragments in a sedimentary matrix or anthropic horizon could have significant implications for understanding anthropogenic earths in Amazonia. For example, some (Lehmann et al. 2003; Nakamura et al. 2007) have observed that terra preta surface horizons have a higher proportion of sand than comparable Oxisols, but when reports of this nature do not clearly articulate reasons for a predominance of sand in anthropic layers. It would be interesting to provide data on the extent to which sources of sand in sand-rich ADEs are themselves anthropogenic, and also to quantify this introduced sediment. A significant proportion of ceramic in sand fractions could also have distinct hydrological and geochemical impacts on soil ecology.

From an archaeological perspective, understanding the rate and mode of fragmentation, as well as the source or sources of such microscopic ceramic fragments could shed significant light on the kinds of activities that took place on sites that currently boast Amazonian Dark Earth horizons or layers. In particular, studies of fragmentation can aid significantly in understanding the degree of mixing undergone by soils or sediments as part of the terra preta formation or utilization stage. Finally, preliminary results from micro-artifactual analyses suggest that some fragmented ceramics underwent burning or oxidation after fragmentation, which in itself could shed light on the formation processes of Terra Preta do Índio. The samples of size-sorted sand that were produced through analyses at Embrapa laboratories in 2009, which corresponded to processed samples from all intensively sampled units at Antônio Galo, were lost during mailing from Manaus to UC Berkeley. It is conceivable that in the future most of these analyses could be replicated with samples that remain, but because the sorting of sand after PSA was non-standard at Embrapa, this will have to wait until I can return to Manaus to repeat the procedure.

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