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Pottery Production and Social Complexity of the Bronze Age Cultures on the Chengdu Plain, Sichuan, China

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by

Kuei-chen Lin

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ABSTRACT OF THE DISSERTATION

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This dissertation attempts to explain the organization of pottery production on the ancient Chengdu Plain during the early and middle Bronze Age (*ca.* 1800-800 BC) and its relationship with social complexity. It investigates the formation of production controls and traditions in different dimensions and at various manufacturing stages of pottery production, and compares and classifies ceramics mainly from three site clusters, Sanxingdui, Shi'erqiao, and Jinsha, using a series of analyses. First, metric measurement and coefficients of variation are used to assess the degree of standardization in vessels and whether the metric dimensions form specific model values. The results suggest that

different production loci, while producing the same type of pottery vessels, had varying degrees of production control over these metric dimensions and distinctive concerns about production details. Second, mineralogical and chemical analyses show that, under the same cultural influence, potters in different locations processed and fabricated their generally available raw materials in distinctive fashions and according to unique formulae. If we broaden our point of comparison to the Sichuan Basin and beyond, the cultural idiosyncrasy of these social groups is even clearer, which forces us to consider the circumstances of individual production traditions.

The spatial arrangements and use contexts of multiple categories of craft production in these settlements reveal that the production activities of the Chengdu Plain were loosely organized at co-residential households or at the community level in response to local subsistence and social needs. Despite such loose organization and the lack of managing supervision, working groups in different loci interacted to some degree and shared manufacturing ideas. Production norms and traditions, on such occasions, were thus most likely shaped by repetitive practices of routine production procedures, rather than by institutionalized power. The accumulation of local communications allowed these domestic economies to produce intensively and distribute products across a large geographic area, signaling mutual influence across the Chengdu Plain and its neighboring regions. Through this intensive communication, social relations were created, altered, and integrated into complex networks.

The dissertation of Kuei-chen Lin is approved.

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To my parents and siblings

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I. Introduction

1. Pottery production of the ancient Chengdu Plain

As a part of the "Neolithic techno-complex," ceramic production has substantially changed human lifeways, especially how humans prepare and store food. This invention comprised an important part of social life during the Neolithic Age on the Chengdu Plain. To study ceramic crafts thus contributes to our understanding of other aspects of these societies. Earlier scholars of pottery-making technology in ancient China have speculated about the development and manipulation processes of pottery production at different times and in different regions (e.g., Zhongguo Guisuanyan Xuehui 1982; Feng Xianming 1994; Li Wenjie 1996; Chen and Wang 2003). Earlier studies have also shown that the number of settlements had dramatically increased during and after the late Neolithic period, also known as the Baodun period (*ca.* 2700-1700 BC), in the Sichuan Basin, especially along river courses (Figure I-1). The rise of agriculture and the resources of the area's dense forests might have been conducive to both population growth and the development of craft specialization, providing surplus food and fuel and thereby freeing up labor for non-subsistence activities.

Until the late Baodun period, the association among firing conditions, clay types, and vessel types was steady, which probably signifies the specialization of vessel types. Ceramic products also reached a high level of quality during this period, and firing techniques were well developed. Some of the vessel types produced find their counterparts in the Middle Yangzi River basins, more than 600 km to the east. Highly developed ceramic production like this clearly had certain corresponding social

conditions. These conditions and the social effects of the products, however, have not been fully understood and require more systemic study in several related dimensions. In this dissertation, I start from investigating the technological dimensions of pottery production, studying its natural backgrounds and the social and economic life of ancient people who made and used the products. The aim is to understand how craft production might have informed social complexity.

Located in the western Sichuan basin of southwest China and the Upper Yangzi River, a series of Neolithic walled sites have been discovered around the Chengdu Plain since 1995. They possess distinguishable construction techniques from Northern China, where walls were usually constructed by cramming earth into supporting frames, making them nearly straight. The Neolithic walls distributed across the Middle and Upper Yangzi River were similarly constructed: their builders compacted earth layer by layer from the top down and also from both sides without the help of molds or wooden frames. With this similarity, some scholars have proposed that the construction technique used for Baodun walls was inspired by then largest walled settlement at Shijiahe (*ca.* 2500-1900 BC) in the Middle Yangzi (Zhang Xuqiu 2000; He and Hunan 2007; He Jiejun et al. 2007; Yasuda 2007). Some scholars, on the other hand, have also argued that such wall-construction techniques were adapted to the natural environments and paleoclimates in which they were built. Despite this possibility, the connections between the Chengdu Plain and Shijiahe and the Liangzhu culture (*ca.* 3200-1900 BC) farther along the Lower Yangzi are reflected in the Sanxingdui (*ca.* 1700-1150 BC) and Jinsha[1] remains, which scholars recognize as successive ceremonial centers on the Chengdu Plain. These

[1] A part of the Shi'erqiao culture (*ca.* 1250-600 BC).

communications seemingly relied on the convenience of the Yangzi River and it branches. But the presence of foreign goods raises questions about the role the ancient Chengdu Plain played in exchange and, more fundamentally, how production within the Chengdu Plain was conducted to establish and broaden social relations. The construction of walled settlements and the expansion of exchange also signal the mobilization of surplus labor towards specialized activities. It is my belief that an inquiry into these production organizations and social relations has implications for the social complexity of the ancient Chengdu Plain.

In earlier studies, scholars have often assumed that the presence and complication of political management was responsible for the development of social complexity. However, archaeological evidence from the ancient Chengdu Plain lacks explicit proof that a permanent political power interfered in and oversaw craft production and other economic activities. Although the population of the Chengdu Plain has grown since the Neolithic period, most sites, except for the several walled settlements and, later on, the Jinsha core, were dispersed as ritual and urban centers seemingly moved over time. Such settlement pattern continued for a long period of time and, to a certain extent, affected the economic life and information sharing of the societies. The seemingly small-scaled yet intensive production and wide distribution of certain products, both geographically and in their contexts of use, force one to consider the relationships among social organizations, their complexity, and the organizations of production and exchange. The transition between different settlements has also pushed me to compare the material relatedness of and differences between different settlements both synchronically and diachronically so that we may understand their relationships better. Several featured sites are of special

interest to this research, including the Sanxingdui, Shi'erqiao and Jinsha site clusters. They represent the Early and Middle Bronze Age of the Sichuan Basin. In particular, more than 200 kilns have been recovered from the Jinsha site cluster[2] and many of them can be dated back to the late second or the beginning of the first millennium BC (Guojia Wenwuju 2008:119). Together, these kilns and other features and remains have yielded a large quantity of physical data about not only ceramic production, but also the economic modes of the societies.

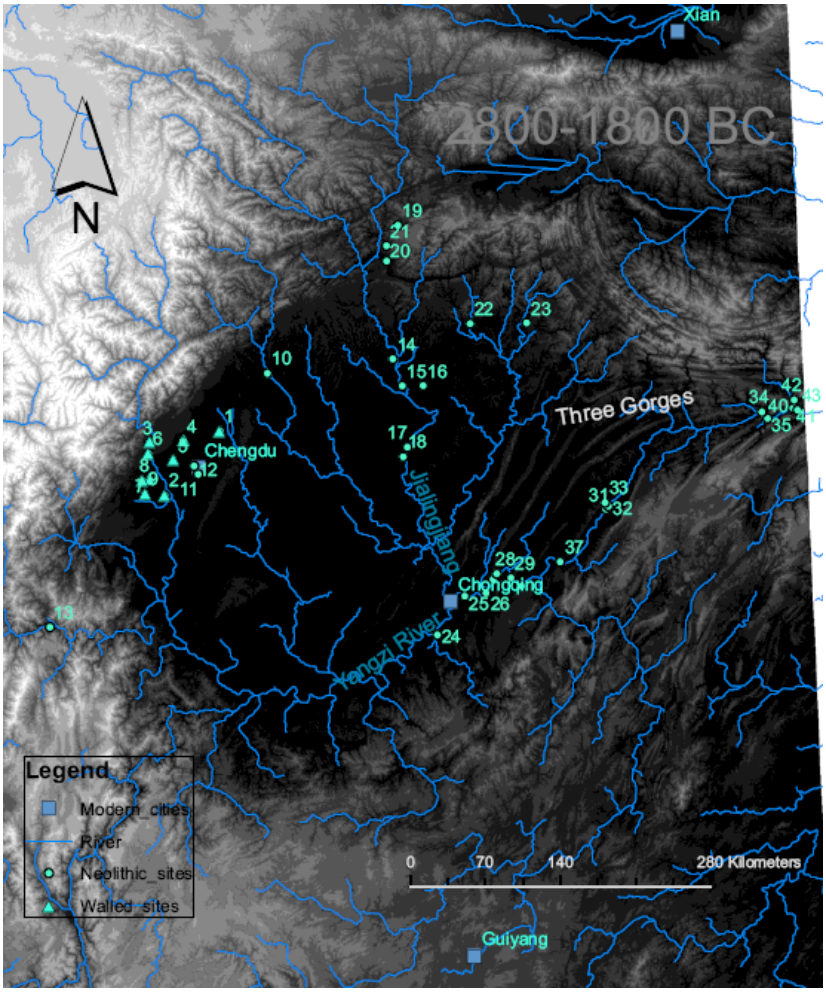


Figure I-1: Neolithic sites of the Sichuan Basin, including the several walled sites on the Chengdu Plain No.1 is Sanxingdui and no. 2 is Baodun. Shi'erqiao and Jinsha, not yet growing to large settlements during the Neolithic Age, are both close to no.12 (modern Chengdu City).

[2] Personal conservation with Zhou Zhiqing, one of the chief excavators of the Jinsha sites.

2. Research questions

The dissertation addresses several research questions:

1) How do material distinctions reflect social distinctions and how do changes in pottery production reflect social changes?

For example, was the 'downgrade' in ceramic quality in late Baodun and other contemporaneous settlements the result of declining technologies, the exhaustion of certain clay resources, population replacement, technological choices, or other economic concerns? To answer a question like this, it is important not simply to treat the 'downgrade' as a regression in production techniques or social conditions. Instead, to draw conclusions about such a phenomenon requires careful examination not only of the properties of the products themselves but also of the natural surroundings and related social divisions, including the nature of the settlements and other categories of material cultures. For instance, as some scholars have speculated, during the time the Sanxingdui settlement developed into a large center in its second phase of occupation, probably taking over the role of Baodun as the central settlement, the pottery styles of Sanxingdui seem to have changed to some extent. Coarse wares, for instance, come to predominate, and the ceramic-vessel assemblage changed (Sun 2000:50, 58). From these changes in pottery, one could argue that they were caused by the introduction and growth of metal materials that would have affected the original forms of craft production and ritual life. In considering this and other possibilities, we also need to ask a second question:

2) How are technological choices revealed or restricted in the processes of pottery manufacturing?

Although artisans might be confined by their cultural knowledge and available resources, a task can usually be accomplished by a variety of methods and thus there is space for technological choice. These choices during the different stages of production procedure reveal the social conditions as well as the practical problems artisans might have faced. Some solutions, in fact, were not always optimal, economically speaking. By discovering why potters did not always pursue optimal solutions, we can also discover the cultural concepts that influenced the potters and how they were limited by their established habits and beliefs. Similarly, whether an innovation was accepted by certain social groups and how its meaning was perhaps altered after it was adopted are not solely determined by the value of the innovation itself. Instead, the determining factor was whether it was compatible with the cultural system of the society. In other words, how the innovation was perceived and interpreted by local people is important. Artisans' and users' decision making can provide us with information about their categorization of a new entity.

3) What economic mode might have been responsible for these patterns of pottery production and this sociospatial organization?

Economic activities, including pottery production and consumption, and the use of space were often mutually shaped in ancient times, and the mode and scale of production can be understood from the archaeological remains and features that record the spatial relationships between different production activities. This also includes the information of interactions among different economic activities and their interactions with environments. From earlier studies of the ancient Chengdu Plain, we now know how best to describe domestic economies and have theories to account for these economic modes,

which in turn allow us to better understand the sociospatial patterns of the settlements under study. As a result, we should also ask:

4) What were the processes by which domestic economies grew, promoting cross-regional exchange? Further, how did various spheres of exchange interact, providing opportunities for negotiating the meaning of social things?

One might assume that the production capacity of domestic economies that mainly relied on a household division of labor was small and that utility potteries were only circulated within a limited scope. Nonetheless, the vessel types discovered in the Sichuan Basin and its neighboring regions document the considerable exchange and dispersal of manufacturing ideas. It is clear that regional interaction has not been rare between Sichuan and other regions from the late Neolithic Age on. We can see this not only in the circulation of luxury items, such as ritual bronzes that originated from the Central Plains, but also in the exchange of relatively common items used for foodways in daily life, such as pointed-bottom pottery vessels and the associated pottery assemblage characteristic of the Chengdu Plain. These different categories of exchange signal diverse scopes and channels of interaction and the resulting influence of separate spheres. For instance, ritual bronzes whose prototypes can be sourced back to Northern China and the Middle Yangzi can be found in both eastern and western Sichuan and the Upper Han River. But these exchange routes and their meanings are ambiguous. The distribution of certain pottery types from the Chengdu Plain that might have cut across the sphere of bronzes, on the other hand, suggests more intensive interaction and even cultural integration in other dimensions of social life.

3. Hypotheses and methodology

With these research questions in minds, I have also generated several hypotheses based on the current archaeological evidence and my observations. I approach these questions and test my hypotheses using several theories. The goal is not simply to understand pottery production *per se*, but, more importantly, to understand the economic and social processes of societies in the ancient Sichuan region through the study of craft production.

3.1. Craft production, cultural control, and social complexity

Scholars have used craft production and specialization to assess social complexity because production system reveals how humans used natural resources, how they transferred material things through various techniques, and how they organized labor, managed distribution, and cooperated in multiple economic activities. It has been hypothesized that the more complex the division of labor is for certain forms of craft production, the more complex social organization might be. In other words, production organization reflects social organization and is an index to social complexity. However, the complexity of the division of labor should not be assessed solely by the number of artisans involved or their skill levels. The dissection of craft production into such components as scale, degree of labor investment, spatial relationships of production loci, and the social relations between producers and consumers (cf. Costin 1991, 2000, 2001; Costin and Hagstrum 1995) constitute further typologies of production, and may offer more information for understanding its complexity.

As the most frequently encountered material remains in archaeological contexts, the products of craft production serve as the most direct evidence for inferring and assessing the intensity and technical levels of production. In the chapters that follow, I examine the

craft production of the Chengdu Plain against the several components mentioned above. In particular, because preliminary observations suggest that some pottery types appear to be uniform, which probably reveals a control over production, I examine how standardization might form. The examination of uniformity and variability is applied to the full processes of production in accordance with the concept of *chaîne opératoire*. The *chaîne opératoire* method allows us to infer categorization at different stages, from raw materials to the removal of artifacts from their life cycles. Unfortunately, earlier scholars have often overlooked the potential of different categorization in artifacts' life cycles and overemphasized the relationships between morphology and the definition of type. Through these examinations, we will be able to address how production might have been organized to share cultural values to different extent. Such information sharing also implies the intensity of local communication occurring among producers and between them and consumers.

3.2. Domestic economies

An inquiry into the organization of craft production can contribute to our understanding of the economic mode of ancient societies, because the former, together with the preparation of food, often constituted an ancient society's central economic activities. To study the organization of production is thus to understand the nature of social organization. Such a study, in turn, requires us to consider the scale and labor composition of a working group. For instance, it is worth noting that the kilns found at the Sanhe Huayuan locus of the Jinsha site joined several long houses in the wattle-and-daub style (Chengdu 2001:171). In this case, and many others, spatial relations provide information about the scale of production and its relationship to other domestic activities.

Such spatial relations might also tell us how close production was to the supply of labor, consumers, and other resources. This is important because the distribution of different activities in space allows us to infer how different types of production influenced one another and together constituted the social life of an ancient people. The scheduling of different economic activities would have required much communication over a variety of social relations. It is very likely that the production and circulation of different products helped to create or maintain a number of distinct social networks. Some scholars, for instance, have observed that the exchange of diverse crafts contributed the broadness of social relations and risk management or resilience (Folke et al. 2002).

Because most of the production remains that have been recovered from the sites under study were directly connected or related to households and residential areas, household production and domestic economies are the central theme in my study of pottery production. Some scholars have suggested that the scale of such production that was based on a household division of labor was likely very small and involved only simple social relations, perhaps solely among relatives or close friends. Some might also tend to assume that a domestic economy would not have possessed the sufficient resources, sponsorship, or skills required to produce the large quantities of luxury goods discovered in ritual contexts like Sanxingdui and Jinsha. The rich production remains and features in domestic themes in our case study and the wide circulation of some pottery types in Sichuan, however, require us to reexamine such assumptions. I suggest taking into account the possibility that sections of local communications were integrated into one or several webs of complex social relations.

3.3. Sourcing the changing social meanings of artifacts

It has been recognized, from earlier studies, that the social value of things is often culturally constructed and subject to change when used in different contexts. Such connection to certain values in a culture can be distinctive and persistent, making the connection culturally idiosyncratic. To discover how things were adapted to a cultural system often requires us to look into diverse aspects of social life. For instance, in the Sanxingdui sacrificial pit K1, pottery vessels, including pointed-bottom vessels, small and flat-based vessels, and vessel stands, were interred together with ivory, sea shells, and objects made in bronze, gold, animal bone, jade and stone. Here the vessels, like most of the ceramics found in the testing pits of the Sanxingdui site, were coarse brown or black wares without decoration (Sichuan 1999:17). Although the forming technique was perhaps not difficult and the raw material not rare, these vessels seem to have possessed a social value that differed greatly from their later use as daily staples or burial goods. It is likely that the ceramics were treated as precious items and bore symbolic meanings for these ritual related occasions. Nevertheless, it is never easy to generalize about the social functions of the vessels: comparable artifacts have been found widely distributed in many contexts, both secular and sacred, during a period slightly later than the Sanxingdui pits (i.e., the Shi'erqiao period).

During the Shi'erqiao period, many pointed-bottom vessels have been recovered from burial sites and residential areas. Comparing to their use in Sanxingdui, such vessels have cut across and challenged our established divisions for different categories of things. The meaning of these artifacts was apparently fluid, determined by the contexts of use and the social relations that encompassed them. It is, however, worth noting that,

although artifacts like these pointed-bottom vessels were used in an array of contexts and therefore carried various meanings, the assignment of meaning was not completely groundless or arbitrary. Pointed-bottom vessels were used as burial goods, and this reveals how people connected the world of the dead with that of the living through materials goods. Such use also implies the cultural importance of the vessels to that community's social life. As some distinctive artifacts might have signaled or even represented important events, it is possible that such artifacts were manipulated and interpreted to favor certain powerful social actors. In the chapters that follow, I thus investigate how such types of vessels embody social values and cultural categorization in different dimensions, and how they also provide an avenue for uncovering power relations.

4. Plan of writing

The following chapters take up a range of topics. Throughout, I describe and analyze data from an array of theories and experimental methods while discussing my observations and results.

Chapter II reviews the relevant theories and case studies that I use to address and approach current archaeological data. Although many theories and case studies have been deduced from other regions or ethnographic observations, they share much in common with the data and phenomena I study and have therefore helped me to think more deeply about my data from a fresh perspective. These theories and case studies also shed light on my own inquiries into ancient production and economic systems. I use them to construct a theoretical framework through which to address my research questions, leading to further inquiries.

Chapter III introduces the natural and cultural settings of the related sites. This background discussion focuses especially on factors that might have affected pottery production, including soil conditions and ecological systems. The sites discussed are divided into several regions, from the Chengdu Plain in the western Sichuan, to eastern Sichuan, the Middle Yangzi River basins, and the Upper Han River basins. In addition to the pottery assemblages characteristic of the Chengdu Plain and their distributions, I compare the material differences and similarities among these sites and their implications for different networks of exchange.

Chapter IV focuses on data analyses. In this chapter, I analyze several types of pointed-bottom vessel and a few other coexisting vessel types that I acquired from the Sanxingdui, Shi'erqiao, and Jinsha site clusters. I first clarify the nature of my datasets and the typological problems of earlier research, before explaining the analytical methods I apply to the data. These analytical methods are designed to explore technological choices in different dimensions. In closing, I discuss the results of these tests and their relevance for inferring the categorizations used by ancient artisans and their possible social values. Chapter V applies the theoretical framework discussed in Chapter II to the datasets studied in Chapters III and IV. Chapter VI summarizes my findings and offers a few remarks on the previous chapters and the major findings and implications of this research.

II. Craft production, its significance, and its relevance to ancient economies and social complexity

1. Introduction: craft production and social complexity

In this chapter, I attempt to clarify the concept and significance of craft production for not only economic development but also social processes in particular. This chapter therefore reviews both technological systems and human practices. In closing, I single out the social relations created by production-related activities, and expound their relevance to social complexity. With these concerns in mind and because craft production and social complexity both involve complicated ideas, I have chosen several dimensions relevant to my case study to discuss in the following. These issues are relevant to the understanding of the formation of the Sichuan culture sphere of the Bronze Age that was constituted by the circulation of a pottery assemblage and its resultant social complexity. After examining the production and distribution of this assemblage and the properties of the ceramic samples I acquired from excavation and reports, I found domestic economies suitable to account for the scale and organization of the economic units. To explore production specialization and standardization also helps us to evaluate and explain the different modes of production we have encountered in various settlements.

Since Marx and Durkheim, the correlations among craft specialization, the emergence of social complexity, and political administration have continued to be emphasized and examined from different perspectives (Murdock and Provost 1973; Childe 1981[1951]; Arnold 1985; Brumfiel and Earle 1987; Clark and Parry 1990; Kreiter 2009). In most of this literature, craft specialization and the division of labor have been thought of as causes, characteristics, or components of a complex society (e.g.,

Clark and Parry 1990:220). In this sense, it is often proposed that the need to manage increasingly complex divisions of labor would have promoted the emergence of political elites and managerial institutions (Service 1975; Rice 1981; Arnold and Munns 1994). Prudence Rice (1981:223) remarks that the practice of production may or may not be under the control of stratified elites, but if it is controlled by emerging elites, then that control can be a source for the elites to acquire power. Such a point of view has been described as the adaptationist model by Elizabeth Brumfiel and Timothy Earle (1987), who nevertheless give more weight to political interests and treat them as the main motive of elites when they actively supported production activities. Other scholars, such as Paul Roscoe et al. (1993), also emphasize nonmaterial gains outside of economic profits in addressing the formation of political centralization.

In Earle and his colleagues' political economy, craft specialization is both a result and a strategy (but not purely a cause), through which political elites fortify their status by controlling the production and distribution of prestige goods (Brumfiel and Earle 1987). In a similar argument, Peter Peregrine (1991) proposes a situation in which emerging elites create the social needs of personal ornaments for status distinction and political legitimation, emphasizing the desire of political elites to extend their power. This political economy, as Kenneth Hirth (1996:210) has concisely summarized, is normally achieved by four production strategies—intensified domestic production, labor mobilization and assigned production, hydraulic management and production control, and controlled craft economies. The relationships between emerging social classes and their control over production as well as the increase of specialization are stressed.

If craft specialization is the cause of social complexity, however, there exist some cases, such as the Peruvian ceramics studied by Dean Arnold (1975) and Melissa Hagstrum's study of the American Southwest (1985:66), in which population growth occurs together with social complexity (cf. Murdock and Provost 1973) and in which they all become the probable factors responsible for the increase of ceramic specialization. These 'factors' are apparently interrelated, even though the causal relationships between them are difficult to understand.

In such models, the common assumption is that the collective surplus of a society might have allowed crafters to detach from direct subsistence activities (Childe 1981[1951]), which might form different social classes but were nonetheless economically interdependent. It is also assumed that the more complex a society is, the more likely it will be equipped with various types of craft specialization and a pronounced division of labor in each kind of production (Franklin 1983:97). The controversy surrounding the causal relationships between political complexity and craft specialization, on one hand, reveals that any theory that proposes to explain this relationship is not universally applicable. Further, it is possible that the two phenomena are independent or have co-evolved without clear causality between them. It is also likely that their relationship is manifold in a society, because craft production might simultaneously have active and passive roles in such sociopolitical processes. For instance, though Brumfiel and Earle (1987:4) have thought of the control of craft production as a strategy to extend political power, they caution that there are societies in which specialization, exchange, and social complexity are unaccompanied. That said, if no cultural setting is specified earlier, specialization can emerge in many kinds of

societies, ranked or non-ranked, and regardless of their political complexity. As Miriam Stark (1991) has shown in her ethnoarchaeological study of the Philippines, craft production can be specialized in non-state and tribal societies, and, even in a nation, production is not always under the control of the national economy. On the other hand, this uncertainty is to no small degree derived from a disagreement and a lack of clarification about two concepts, *specialization* and *complexity*, each of which is a compound of many ideas, such that a positive correlation between them cannot be easily ensured and any assertion of their relations needs to be further broken down.

It is therefore problematic when many researchers addressed the relevance of craft specialization to social complexity without explicating what qualifies as "complex," or accepting the unspoken assumption that linked complexity with levels of decision making. In so doing, many explanations offer viewpoints similar to Earle and his colleagues' political economy (Brumfiel and Earle 1987; Earle 1997, 2002), and equate complexity with the development of some institutions, such as privileged access to economic resources and social stratification with centralized leadership (see D'Altroy et al. 1985:187). Some proposed a number of indices to measure complexity. For instance, to identify and grade the cultural complexity of a list of societies, George Murdock and Caterina Provost (1973) designed several indices to inspect those societies. Following this, John Clark and William Parry (1990:300-1) further take community size, population density, agricultural development, political integration, and social stratification as indices to measure cultural complexity. However, many of these indices, though treated as separate concepts of equal significance, are correlated to one another, as Murdock and Provost have noted earlier. Clark and Parry also suggest that, among these indices, social

stratification and political integration are particularly associated with craft specialization, whereas the other three indices of cultural complexity are less relevant in this aspect. As a result, to determine degrees of complexity simply by summing up these indices and by ranking societies accordingly would lead to the overemphasis of some elements. Despite this problem of conceptual complexity, Murdock and Provost correctly point out that a society might be highly developed in some dimensions while neglecting others.

Briefly, instead of viewing craft specialization as a derivative of complex societies, I focus my attention on the essences that constitute production activities, including producers, raw-material and product distributors, and consumers, and on their associated social relations, including their organization and exchange relationship. My belief is that these concepts and processes, including specialization and complexity, however relevant, should not be reduced to one another.

2. Craft specialization and organization

One of the fundamental problems in the discourse of production is that scholars usually have different, sometimes conflicting, definitions about specialization and have difficulty correlating them with archaeologically data, though diverse methods have been proposed to identify the presence of or to measure the degree of specialization (e.g., Rice 1981, 1984; Costin 1991; Clark 1995; Costin 2001, 2007; Flad and Hruby 2007). In such literature, time, energy, and labor producers devoted to producing a specific type of craft in relation to other subsistence activities are often employed to measure the degree or intensity of specialization. A more broadly accepted definition might be that producers who are full-time workers on a particular kind of goods to earn their livelihood are craft specialists (Muller 1984; Rice 1984:45; Muller 1987:15; see also Stark 1991). Besides

the ratio of time producers spend on specific crafts to other activities, the proportion of producers to consumers is also an indicator, by which it is believed that more specialization occurs, if the task of producing certain goods can only be achieved by a restricted number of skilled people (cf. Rice 1981:219; Cross 1990:35, 1993:65; Costin 1991). Still in other cases, *specialization* is used to denote the situations in which products are consumed by non-dependents of the producers (Clark and Parry 1990:297; Clark 2007; Flad 2011:110). These definitions of specialization, whether focusing on the ratio of producers to consumers or their relationships, reveal that social relations are important issues in considering this topic.

To identify these criteria in archaeological contexts, however, can be difficult. On the one hand, researchers have relied on the differential distribution and concentration of production tools, remains, and features in the space; and, on the other hand, in a somewhat indirect manner, investigated standardization, efficiency, and skill to infer the degree of specialization (e.g., Hagstrum 1985:65; Costin 1991, 2000; Costin and Hagstrum 1995:623). In the latter situation, it is assumed that the more time the crafter has spent practicing the same task, the more likely he or she will become skilled and proficient. In particular, *efficiency* and *standardization* are usually thought suitable for assessing subsistence production, and *skill* suitable for prestige goods. This is because standardization would supposedly reduce the time and cost of decision-making and thus enhance the efficiency of production, whereas elaborated goods, in which production cost is not the main concern and producers have to invest extra labor, are meant to be unique and either create or strengthen social differentiation (Costin and Hagstrum 1995:621). Nonetheless, such concepts as skill and efficiency are perhaps subjective and require

further comparisons in artistic elaboration, the volume of outputs given a unit of time, the uniformity of artifacts, and so on (Rice 1981:220; Costin 1991; Costin and Hagstrum 1995), for the concepts to be useful in accounting production. The dichotomy between subsistence goods and prestigious objects is not always applicable either, which has been criticized by scholars not only because variability can be intentionally or unintentionally caused for diverse reasons, but also because the definitions of subsistence and prestige domains are context dependent and there are always products that can transcend such categories (e.g., Flad 2007, 2011:24; H. Miller 2007:40).

It is also worth noting that though some goods are not "efficient" from the perspective of manufacturing cost, in which efficiency is understood as the status of becoming more productive without increasing labor input, these seemingly inefficient craft goods can still be effective in information exchange (Wobst 1977). Sander van der Leeuw (1981:235; 1984) and Clark and Parry (1990:295) have applied information theory to craft production and considered material cultures as bearers of information. From this viewpoint, craft production is the process of information encoding. To increase information loading can be achieved through complicating the structure and order of the objects. Nonetheless, as they have stressed, this embedded information is not equal to the social meanings of objects as the latter are socially constructed. That said, as objects can be categorized based on the messages and information they carry, they may, though not necessarily, denote the social functions of the artifacts. Such connection between information and certain types of goods is not fixed, however.

In addition, as production can be broken down into various components and steps and because standardization or the like indication can appear in different dimensions,

which may or may not be immediately perceptible, controversies about specialization may arise from the different foci researchers study. The confusion also arises when a social actor plays multiple social roles and when a craft producer participates in more than one kind of production activity (Clark and Parry 1990:299). To overcome these incongruities, Jon Muller (1984:490-1, 1987:15) distinguishes "site specialization" (areas of only limited activities) and "producer specialization" (crafters earning their livelihood through the certain activity); Rice (1991:262) has also added "resource specialization" to address craft specialization more specifically.

Other scholars, instead, focus on the organization manner and different contexts, where the degree of specialization differs. For instance, with an increasing scale, van der Leeuw (1977:70-1) and David Peacock (1982:6-11) have similarly separated production organizations into several categories, such as household production, household industry, individual workshops, nucleated workshops, manufactories, estate production, and institutional production. From the spatial distribution of various crafts in relation to a cluster of settlement, Maurizio Tosi (1984:23) has also designed six main types of craft specialization, which are increasingly complex. They are household, intra-settlement, inter-settlement, reciprocal, centralized control of centralized production, and centralized control of dispersed production in this order. Apparently, this typology contains not only the scale of production, but also the social control intervening the production, which is embodied in the settlement arrangement.

There also remain other criteria underlying Tosi et al.'s typologies. Brumfiel and Earle (1987:5; see also Earle 1981; Hagstrum 1985:68; Costin 1991, 2001; Spielmann 1998) state this more systematically. The criteria they use to characterize production

organizations, or the production typology, include the affiliation of the specialist (independent or attached), the nature of the demands (subsistence goods, wealth items, or services), the intensity of specialization (part-time or full-time), the scale of the production unit (individual, household, workshop, village, or large scale), and the volume of a specialist's output.

In a similar manner, Cathy Costin (1991, 2000:378, 2001; Costin and Hagstrum 1995:620-3) has referred to such parameters as *context* (similar to Brumfiel and Earle's affiliation), *concentration* (dispersed or nucleated in geographic space), *constitution* of producers (kin-based or not), and *intensity* (same as Brumfiel and Earle's intensity). Both individual parameters and the combinations of two or more parameters can be used to describe and define production organization. These parameters are useful in examining different aspects of production and in separating different types of specialization.

Nonetheless, while Costin has attempted to link certain types of production to particular social forms and believes there exist evolutional implications between the household and ex-household divisions of labor (Costin 2001:309), Costin herself and many writers have noted that multiple types of production organization often coexist in a society and any mode of division of labor can be conducted at various levels of complexity. For instance, van der Leeuw's research in the Philippines (1984:748-57) identified four types of organization in the production of pottery, including household, household industry, workshop industry, and village industry, and all were present, sometimes simultaneously, in Negros Oriental and Cebu. While serving the same kinds of products for exchange or markets, several redistribution mechanisms, with or without middlemen, were also juxtaposed.

Despite the inessential evolutionary explanation, Costin and her colleagues' parameters provide clear principles to search and examine production patterns in archaeological contexts. Different production modes that have been proposed by scholars from their observation of individual societies can also be compared based on their key features. It should be noted, however, that though the parameters are useful in recognizing and describing the production organization we encounter, the typologies of production organization that have been suggested by the above authors are not exhaustive and we should avoid simply pigeon-holing each case study. The culturally constructed roles of actors and meanings of things along with their changing relationships can also make the contents of specialization hard to understand and difficult to detect in archaeology.

Probably for these reasons, the parameters used to define organizational types, along with the types themselves, have continued to grow in response to new cases and "exceptions." For instance, Kenneth Ames (1995:158; see also Costin 2001:300-1) and Wayne Janusek (1999) have added "embedded production" to the category defined by *context* to describe the situations, in which producers neither work purely in response to common needs nor attach themselves to someone of higher social status. In fact, as several scholars have discovered in some middle-range societies, high-status elites may themselves be craftspeople, working on high-valued items, as long as they are skilled (Spielmann 1998; Inomata 2001, 2007). Being skilled, civilian crafters may also win prestige for themselves to promote social status (Helms 1993:72; Ames 1995:158).

The dilemma in distinguishing independent and attached specialization and the resulting augmentation reveal that not only do the nature of demands and the social

relations between producers and consumers matter for the differentiation of these specialization types, but the forms elites' power intervenes (i.e., whether they control raw-material allocation, production techniques and facilities, object forms, organization of labor and tasks, or product distribution) are also important in accounting for the organization of production (Costin 2001:298). Whether and at which stages production is affected by powerful elites is, in turn, related to social forms and power forms but again these relationships are not fixed. Rice et al. correctly reflect that craft specialization is an adaptive process in response to environmental diversity, resource distribution, and social conditions and needs, in which productive activities might or might not be regularized (Rice 1981:219, 1984:46-7; Kenoyer et al. 1991:46; Stark 1991:74). In the following I attempt to show that elite control is not the only explanation of why the production activities of a society are regularized or institutionalized. Instead, we should consider other possibilities, such as persistent subsistence needs or regularized consumption requirements in ritual or mortuary occasions.

2.1. Standardization and practice theory

Having briefly reviewed the components and different assessments of specialization and production organization, I go over *efficiency* and *standardization* in more details, two concepts especially relevant to studying my dataset. In particular, efficiency has often been the goal of production and information transmission. However, for items with only few "stylistic expressions," the efficiency of a craftsperson needs to be detected in other aspects of his or her products. To inspect the degree of standardization of products is one of such ways.

It has been proposed in pottery production that standardization or decreased internal variations in pottery raw material, shape, or decoration are the result of several possibilities, including but not limited to potters' perceptions and measuring techniques, their skill levels, and the experience they acquired through repetition (see Arnold and Nieves 1992). Other factors might include resource management in the cultural system (Rathje 1975), regulating tools or instruments (e.g., potter's wheels, molds, and paddles), and the demand of consumers or markets (Blackman et al. 1993; Kreiter 2009:113). That said, economic and technological or functional reasons are an important impetus to standardization. For example, to manufacture pots in a similar size would have made them easier to be installed and stacked in kilns and stores and during transportation (see Costin 1991:34). To produce goods in a standardized way would also make different parts and accessories (e.g., vessel covers and stands) replaceable or reparable if a component broke. On the other hand, diversity in products will be desired if the volume of communication grows with the expansion of the system, because as information carriers, diverse products are more likely to meet the various communication needs arising in different social dimensions (Rathje 1975; Van der Leeuw 1984). Standardization, in this manner, might prevent technological innovations because any change might impact an already established system, in which products are interlinked (Hagstrum 1985:69).

Besides the normal cost-cutting concerns, Costin and Hagstrum (1995:622) have separated the underlying driving forces behind standardization into intentional (technological, morphological, and stylistic) and mechanical (unconsciously introduced by potters). The distinction can be cut across, however. For instance, the repeated

practice in producing a batch of similar items would cause a potter to routinize and internalize conscious decision-making processes into unconscious ones (Bourdieu 1977), in which the accumulation of experiences not only forms certain rhythms and momentum and thus enhances the efficiency (Hagstrum 1985:69; Langacre et al. 1988; Costin 1991:33; Rice 1991) but also regulates the ensuing practices. With this routinized practice and the consequently patterned actions, the internal variability of a single crafter might be reduced to a minimal degree, making the actions seem as though they are regulated by rules, but in reality without such imposition (Dietler and Herbich 1998:246). The replication and variability have been analogized as signal and noise, respectively, in cultural transmission (Shennan 1989). There seems a constrained room for fluctuations (among variability) and transformations. Costin (1991:33) has stressed that different forms of production organization can all possibly lead to standardization to a varied degree and, in particular, a minimum number of producers could reduce individual variability, given that intra-personal variability is normally smaller than that between individual crafters. It is also assumed that a group of crafters, if working closely, not only shared resources and the same manufacturing knowledge but would also possess similar rhythms and could thus have their production paces synchronized. For this reason, standardization is sometimes adopted as an estimate of the number of producers or working groups (Costin and Hagstrum 1995:631).

This, again, does not mean standardization is necessarily a result of specialization, although they are often correlated and the former has been used as an index to assess the existence or degree of specialization in some studies (e.g., Rice 1981; Arnold and Nieves 1992; Blackman et al. 1993). As Rice notes (1981:220), a “metal template” can never be

perfectly replicated. Variability is nearly unavoidable in handmade products. When a desired standard exists in crafters' minds, it may reveal itself as the modes in the distributions of the measurements of the desired attributes (e.g., pot aperture or height), with the distribution ranges representing variations or 'errors' (Clarke 1978[1968]). Producers or users' "metal template" is important when we approximate an emic type because, as Blackman et al. (1993) have noted, even if all the products under study were made by "specialists," data from different times, spaces, and workshop traditions can confuse the classification of vessel types and the subsequent measurement of variability. Mistakenly lumping different types that do not coincide with producers' templates can lead to the misinterpretation of standardization estimates (Eerkens and Bettinger 2001:500). It is only when the subjects studied are under close spatial and chronological control that the comparison of such variation is meaningful (Blackman et al. 1993:60). It should also be noted that different working groups have various concerns in maintaining standardization and have distinct tolerable ranges of variation, such that variability, small for one group, may not be equally perceived by another.

Also, because standardization and variability may have various causes and do happen during various steps and aspects of production, the evaluation of standardization *per se* is not without controversy and can only be implemented by investigating different attributes of the products under comparison. The selection of attributes for standardization evaluation requires us to consider the nature of the materials as well as other cultural factors. For instance, stone, ceramic, and metal materials all have different working properties (e.g., malleability). To modify them would require a varied

investment of energy. It is therefore impractical to ask the same level of precision in metric dimensions for different materials

To assess standardization, archaeologists have devised diverse methods, including examining the metric dimensions of artifacts (Longacre et al. 1988; Kvamme et al. 1996; Roux 2003), vessel decorations (Hagstrum 1985), clay compositions for ceramics and their firing temperatures, and manufacturing techniques (Blackman et al. 1993:61). For instance, based on the painted wares from the American Southwest, Hagstrum (1985:65) has proposed measuring standardization and efficiency using the variability of design elements and labor investment, respectively. Based on their ethnoarchaeological observations in the Philippines, William Longacre and Kenneth Kvamme et al. (Longacre et al. 1988; Kvamme et al. 1996; Longacre 1999) confirm that, when working the same types of pottery in close proximity, full-time and experienced specialists tended to produce pottery with a higher level of standardization than part-time or less experienced potters. They have assessed this using the coefficient of variation (CV)[3] of metric measurements. This contrast between two or more producers and datasets suggests that standardization inherently involves comparisons not only in the differences between individual objects but also in the degrees of variation between multiple groups of objects.

Nevertheless, although standardization is a relative value and there seems no absolute threshold to determine whether a group of objects is "standardized," the instinctual drive to classify things by their uniformity or lack of uniformity based on certain properties is universal. One's diagnosis should try to reflect producers' and users' self-recognition whenever possible so that the mechanisms and implications of

[3] $cv\ (\%) = \frac{\text{Standard Diviation x 100}}{\text{Mean}}$.

standardization in ancient production can be inferred. In this manner, Jelmer Eerkens and Robert Bettinger (2001) have suggested baselines for standardization from the perspective of the human sensory system and cognition, because there are common scalar errors humans make and perceive in the most physical characteristics of objects (e.g., length, weight, area, and so on)[4]. To translate perceivable errors into quantifiable variation, they suggest that *CV* is a proper measure, because it is normalized by the mean value of the measurement of an individual dataset and thus makes measurements of different scales comparable. By so doing, it also translates the seemingly subjective perception of degrees of standardization into quantitative and comparable indicators. For instance, they found that the highest degree of standardization manual production can attain without the aid of a ruler or mold is located at about *CV*=1.7%, where variability that exceeds *CV*= 57.7% is probably made intentionally. Based on a modified measure from *CV*, they also compared variations between "functional" (e.g., the length of projectile points) and "stylistic" (e.g., painting on ceramics) attributes and discovered a clear distinction between the two classes of attributes, in which functional attributes have a smaller *CV* (Eerkens and Bettinger 2001:500-01).

Their distinction of "function" and "style" has been a concern in past studies (Sackett 1977, 1982, 1990; Wobst 1977; Binford and Sabloff 1982; D. Miller 1985; Stark 1995; Gosselain 1998; Hegmon 1998; David and Kramer 2001). For instance, some argue that, due to the specific properties of individual materials, some technologies are easier than the others to make use of these different properties to archive certain functions or

[4] According to the tests conducted by psychologists in 1830s, the human sensory system cannot discriminate variations in objects' lengths, widths, weights, or areas if they differ less than 2-3%, which are referred to as "Weber fractions" (Eerkens 2000:663; Eerkens and Bettinger 2001:494-5). That said, whether the differences between a set of objects is perceivable is not determined by their absolute but relative magnitude.

styles. Though a clear distinction may not always be possible, Eerkens and Bettinger's method helps to clarify that, while the production of artifacts is culturally conditioned, not all attributes are constrained in equal ways.

Eerkens and Bettinger's observation isolates human bodies and perception as a medium and tool for the practice of unspoken mental templates, which also measure and control how far the products have departed from the templates in the absence of rulers. This observation offers us not only a way to move between subjective perception and objective indicators, but also an important source about the formation of uniformity in production—namely, repetitive practices and bodily movements. Through these sources, we know that not all cases in which a high level of standardization was achieved were caused by a strict, central control. Instead, when the presence of such a control was lacking, as in our case study, practice theory provides a reasonable explanation for the high degree of standardization that we normally encounter in even small-scaled production. Such study of variations is also relevant to type-variety distinctions and the classification of artifacts that serve as the basis in understanding archaeological material cultures.

2.1.1. Variations and types

The intuitive human ability to assess similarity and variability seems to suggest that intuition can be relied on to define types as human perception can be relied on to group artifacts and assign newly encountered artifacts to given categories. As Irving Rouse (1939:11, 25-6) has argued, *types* are inferred from attributes, which are shared by artifacts of the same group and "appeared to be the most characteristic", whereas *modes* are a selection of attributes that "seemed to be the most significant for a cultural historical

study." It is likely that the so-called most characteristic attributes are recognized intuitively. William Adams and Ernest Adams (1991:42; see also Read 2007:296) also state that by observing how apparently different artifacts are and how they can be sorted into coherent groupings, intuitive types (gestalts) are not only constructed but also needed in the first place. This may be especially true when attributes are clearly discernible, such as the presence or absence of qualitative attributes. However, when measured dimensions are quantitative attributes distributing in a continuum, it is not always possible to define the boundaries between categories. This also often constitutes the dilemma of classification and the definition of type, where categories are not known beforehand and thus denote the necessity of quantitative methods in identifying the patterns of attributes in some cases.

The recognition of patterns of attributes is an exercise defining or discovering types. In particular, Rouse has defined a type as "patterned combinations of a set of attributes", induced from artifacts in the aggregate (Rouse 1939:11; Read 2007:114, 299). On the other hand, modes[5] may include all historically significant attributes, regardless of their relevance to the formation of a group of artifacts (Rouse 1939:12). As a wider concept than types, modes stand for "community-wide standards which influence the behavior of the artisan as he makes the artifacts" and can be directly detected through the analysis of artifacts without knowing in advance their groupings (Rouse 1939:15; also Read 2007:25). Such underlying standards, which perhaps guided the production behaviors of artisans, in turn inform the social logics and cultural systems archaeologists try to infer from material cultures.

[5] However, Rouse himself has inconsistently defined "mode." Here I only refer to his first definition, where modes are attributes of historical significance (i.e., cultural traits).

It is therefore at the conceptual level that types are extracted from and also able to suggest the relations among artifacts. They may also signal the processes and the contexts in which they are used. Types formed in this manner would to a certain degree reflect their makers' and users' concepts and categorization system within the temporal scale. Although such a reflection may not be always available, as Dwight Read (2007) has pointed out, this is what interpretations about a cultural system should be based on. To single out "cultural types," which are defined by culturally salient attributes (Read 2007:301), as opposed to "empirical types," means that analyzers are required to discover the intrinsic states of artifacts as far as possible. They should not simply impose their own orders on the artifacts (Read 1974). Thus, even though the method we use to detect standardization or to classify artifacts can be as precious as the finest resolution that the most advanced tools and instruments can provide, the results may tell us nothing about the cultural systems we hope to understand if these results do not reflect artisans' concepts about similarity and dissimilarity among artifacts (Read 1989:158) and the partitions between categories. To approach the emic view, both qualitative and quantitative methods are valid so long as they suggest patterns of cultural significance.

Whereas in qualitative data the presence and absence of particular attributes can immediately suggest patterns, for qualitative data the bifurcated or multi-model distribution of variable values are probably also signals of artisans' intentions to make separate groups of artifacts (Read 2007). For instance, the use of a specific kind of temper in ceramics, such as shell powder or grogs, is an "absolute qualitative" attribute of pottery (Read 2007:130), which has implications for potters' technical choices. The traditional distinction between coarse (sandy) and fine pottery in Chinese archaeology,

however, is not absolute. Instead, the contents of sandy temper vary case to case, depending on the original conditions of the clays and how the potters removed or added non-plastics. It is only in cases in which inclusions are deliberately removed (levigated) or added (tempered) that distributions for the volume of sand appear to be bimodal or multi-modal and may coincide with analyzers' categorization of fine and coarse textures. In more complex examples, two or more variables, such as length and width, change collectively and, when considered together, they may be useful in grouping entities, which would otherwise overlap in each of the dimensions (e.g., Shennan 1997:351; Read 2007:77). Attributes like these are culturally salient and may suggest artisans' decision making and intentions in producing artifacts with these attributes centered on certain values, yet quantitative strategies are needed in revealing the intended modes and grouping patterns.

These seemingly intentional manufacturing behaviors, as stated by Rouse, are regulated by standards shared by artisans from the same communities when they work on artifacts, leading to products that often possess similar characteristics. Such standards, however, are unspoken and probably unknown to the artisans themselves (Rouse 1939:17). Like the *habitus* of Pierre Bourdieu's practice theory (1977, 1990), such standards are formed through the unconscious, routinized bodily movements and gestures of actors. They are also a common social accumulation, whose formation involves not only the products but also the social life encompassing the entire chain of production and manufacturing activities, from raw materials to the removal of the artifacts from their contexts of use. Consensus formed in this way reminds us to investigate the mechanisms of regulation at different production stages and their relationships with types and varieties.

Although most of the craft production from the settlements studied in this dissertation was organized on a small scale for supplying daily needs, such a scale should not be flattened out into a uniformly simple structure. On the contrary, different working groups might have used particular mechanisms and tendencies that formed norms in dimensions that were culturally meaningful to them.

2.1.2. Chaîne opératoire and practice

Although personal talent, which may have been as generalized as skill, is an important factor contributing to standardization, it cannot be clearly distinguished from experience, which is an accumulation of routinized manufacturing steps. Such manufacturing steps and activity sequences that contribute to the formation of standardization or variability in resultant artifacts also account for part of the life histories of the objects or their "behavioral chains" (Schiffer 1975, 1976; Schiffer and Skibo 1987, 1997:29). Similar to Michael Schiffer's behavioral chain, the concept of *chaîne opératoire*, developed by André Leroi-Gourhan in 1964, describes the series of activities in an artifact's life history: how it was procured as raw-material, its existence as a finished product, its maintenance, its attachment to and removal from circulation, and its eventual discarding (see Edmonds 1990:56, 67; Leroi-Gourhan 1993; Sellet 1993; Dobres 2000:164; Read 2007:188). Though first proposed and applied to lithic production, the term has come to describe other types of production, including pottery production, that involve complex transformation and transfer processes. In these processes, scholars have emphasized the role of technological choices and decision makers in the creation of artifacts (e.g., Schiffer and Skibo 1987:599; Edmonds 1990:57; Lemonnier 1993:3). Read (2007:189) further argues that the conceptual or mental processes involved in the *chaîne opératoire,*

including the emic categorization of things (i.e., assigning an artifact or phenomenon to a known class) at any stage of their life histories, have made production sequences not simply technical transformations but also the manifestation of a broader ideological system. Such materialization of a broader system coincides with van der Leeuw's claim (1984:726) that the judgment of categorization is directly constrained by social contexts, in which other referents and subjects are present for comparisons. The specific social contexts that have allowed the transformations to take place should not be ignored when we study the resultant products.

Nonetheless, the (re)construction of a context is not absolute but subject to recursive comparisons. Alternative choices are often available and variability is introduced during each practice that should have been constrained by the context, making the shift of structure (context) possible (cf. Sahlins 1981; Pfaffenberger 1992). The interplay between input artifacts and existing categories also leads to mutual redefinition between artifacts and categories. The concept of practice thus accounts for both continuity and change, as van der Leeuw (1984:716, 729) has pointed out. Once shifts accumulate to a certain point, a new cognitive category is required and changes in production occur seemingly abruptly.

In some cases, to divide the production procedures into multiple stages requires several artisans to work cooperatively at different stages, implying complex interactions and collective scheduling. Such divisions of labor are related to the degree of complexity of a craft and can be an indicator of labor input (Peregrine 1991). For instance, lithic tools require multiple production steps, such as the acquisition and chipping of raw materials and the grinding and polishing of the products, which might involve a division of labor and in which energy investment is unequal. Such objects were then used, worn and torn,

possibly resharpened, and finally discarded (e.g., Kenoyer et al. 1991; Edmonds 1995; Deng Cong et al. 2007). Pottery production can also be broken down into comparable procedures though (fire) transformative technologies replace reductive ones. As Bourdieu has suggested, artisans working together likely did not know the full plan or the successive reactions of others. Instead, they act and react following past practices and histories (Bourdieu 1977:73, 1990). Familiar conditions and others' actions allow them to call forth past practices as chain reactions, but actors are also able to adjust their strategies according to changing situations. They possess individuality and collective affiliation simultaneously. In other words, although their actions seem to be regulated towards unknown project goals, they have free will and are not necessarily under certain forms of centralized control. This asks for our notice to the relationship and mediation between humans and nature (e.g., Edmonds 1990:56) and between human actors and social structure, which also helps to explain the formation of production traditions and technological changes.

2.2. Technological changes and conservatism in production

Though material transformations are constrained by structures, such transformations nonetheless remain dynamic. Through the realization and embodiment of the artisanhood, and just like the interplay between practice and structure and between artifacts and categories, artifacts and human life are mutually defined in a web of cultural meanings (Dobres 2000). With the processes of manifesting or challenging social structure, a technology, as Marcel Mauss (1990; see also Pfaffenberger 1988:249; Dobres 2000:151) has stated, should be considered as a totality of social facts and phenomena. This totality not only contains technology, but also creates the need for the technology, shaping how a

successful technology should look and further, offers space for the negotiation and contestation between different social powers. As a result, technologies, containing systems of techniques and human behaviors, should be able to reflect other dimensions of material cultures that concern archaeologists (Leroi-Gourhan 1993; see also Stark 1998:5-6).

As Bryan Pfaffenberger has argued, in his study of a new irrigation project in Sri Lanka, the "successful technology" advocated by the government comes in fact with local ecological and social impacts, including damage to river ecology, the disarrangement of water scheduling, and the increase of national debt and political conflicts (Pfaffenberger 1988:245). The government adopted this new system because the project met its need for recovering political legitimacy and because a similar strategy was used by ancient Sinhala elites. This example also illustrates how a technology is related to other social dimensions, creating social relations and customs that re-allocate the access rights to resources. As a result, a technological means is not a pure problem-solving system but involves the considerations of ideology and social relations (Pfaffenberger 1988, 1992). In such a sociotechnical system, in which the sociality of technology is recognized, technological activities produce power and meaning as well as artifacts (Pfaffenberger 1992:493, 506). As Lemonnier observes (1993), technology is itself the product of social production encompassed with social relations.

Furthermore, though practical conditions (technology availability, functional requirements, material properties and availability, and production costs) (Hayden 1998:4) and implicitly cultural or social contexts constrain production, because a task can often be fulfilled by different methods, and *vice versa*, technological variants and choices are

often available in the processes of production. As James Sackett (1990:32) writes, "there are equally viable options for attaining any given end in the making and/or use of material items." This has also made style diversity and slight morphological differences in products possible (Sackett 1990; Gosselain 1992). Olivier Gosselain (1992:559; 1998), while breaking down the manufacturing process into several steps, argues that the seemingly constrained technology (by practical resources) still allows stylistic expression and some processes allow more variation than others. Heather Lechtman also argues that technology itself has a style (1977; see also Hegmon 1998:266), by which social identity or distinctions and cultural values can be addressed. That said, technical variations and even innovations have sometimes been actively promoted or employed by actors for various reasons, such as economic and political planning, aesthetics or other ideological considerations, and that also create social difference and identity while solving practical problems. Whereas practice theory delineates a process in which social actors may not have the plan to make change, this does not mean they are blind to the technological choices available to them or that they will not use the choices to their own advantage.

It is, however, worth noting that when facing technological innovations, how people accept or deny the innovations does not always conform to modern economic considerations and can be very unpredictable in different societies or social sections. In contexts when legitimation requirements are important, for instance, conservatism is more likely to dominate production. Using several extreme examples, Lemonnier (1993) has shown that people adopt seemingly irrational or uneconomical strategies when facing dangerous situations even though they are aware of alternative choices. In these investigations, the final product or result is perhaps not the most important concern, but

the techniques, means, actions, and processes bringing things to be, are key. In these processes of "producing," besides the fulfillment of practical needs, whether innovation or novelties are adopted depends on their compatibility with the original technical and ideological domains, social relations, political views, and their combination, which would set preexistent conditions influencing whether innovation is accepted and how new things and ideas will be interpreted (Torrence and Van der Leeuw 1989:10; Guille-Escuret 1993; Lemonnier 1993). In such arguments, a technique is not an isolated component, but a part of both the production process and other social dimensions. More important, innovation is understood as a complex phenomenon, involving a process from introduction and acceptance to the implementation of new ideas (inventions) (Torrence and Van der Leeuw 1989:3). This falls in line with Robert Layton's (1989a) claim that innovation is the result of the interplay among a series of internal and external changes. From such a process, innovation also provides us with a place to know how the different components of a society work together or disjunctively when confronting novelties, during which, if a component is substituted, the original equilibrium of the system may or may not break down.

Considering the diverse social contexts in which technological change has been differently perceived, it is important that we not treat change as aberration or anomaly, as Robin Torrence and Sander van der Leeuw have pointed out (1989). Nor should prehistoric societies be thought to possess only slow or small-scale technological change. Schiffer (2011:64-5) has cautioned that rapid and continuous change might happen as a response to changing contextual factors or as a result of ongoing peer competition among artisans. Layton (1989a), on the other hand, has noted the role of frequent information

sharing among social members, based on which common consensuses are formed in determining whether an innovation will be accepted. He also notes that in such processes of consensuses forming, some figures might have been "opinion leaders" in decision-making.

But, as Margaret Nelson et al. (2011) point out, the maintenance of social diversity has extra costs as well as benefits. When collective actions and more efficient communications are needed to solve certain social problems, homogeneity and conservatism might be less risky and preferable because conformity with protocols that have already been established can often reduce communication costs, as in the situation of standardization. It has been observed that people in aggregation tend to select the most frequent models to imitate (Boyd and Richerson 1985; Kohler et al. 2004:114; Nelson et al. 2011:44). There might also be social classes of vested interests that resist technical diversity and innovation. For example, in ritual activities, through which solidarity and social ties are stressed and affiliation is attained, diversity may be minimized and controlled (Rappaport 1971; Nelson et al. 2011:29). For instance, with the case of Mimbres in American Southwest, Nelson et al. (2011) argue that such characteristics as the increase of population density, conformity behavior, reduced diversity in material culture, loss of resilience of the society[6], vulnerability to large disturbances, and social transformations are probably related, as they happened in close succession. For Nelson et al., social and material-culture diversity is a result of regional exchange; given pottery styles and technological diversity are often associated with social identity and boundaries (Wiessner 1983, 1989; Sackett 1990; Stark 1998; Gronenborn and Magnavita 2000). A high level of diversity may preserve better responses to crises and help with

[6] That is, its ability to tolerate change, to learn and to develop (Folke et al. 2002:437).

reorganization after a system fails. In a similar manner, scholars have noted that several large settlements in the Central Plain China began to cultivate diverse kinds of crops besides millet during the Longshanoid period in the third millennium BC. This diversification in crop types might be a result of the increasingly intensive interactions between regional cultures and can benefit the risk management during the complication of societies (Zhao Zhijun 2007). The diversity of varieties in a craft type is also related to the creativity of a society (Rice et al. 1981:222) and its factional competition.

2.3. Organization of production

By investigating how manufacturing technologies integrate with other dimensions of a society, we can assess the relationships between production and social system (Lemonnier 1989) and examine how the organization of production and the control of a system can be suggested by its technologies (e.g., Costin and Hagstrum 1995; Costin 2000:379-80).

2.3.1. Site functions and spatial relations

As Philip Arnold (1991:100) has argued, organization of production both conditions and is conditioned by manufacturing techniques, tools, and by the use of space. He has attempted to infer the variability in the organization of pottery production from the residue patterns of manufacturing activities and has emphasized the role of behavioral sequences in these patterns. In such variability, he has identified two extreme kinds of production activities in relation to space—spatially flexible and spatially restrictive activities. Whereas spatially flexible production can be relocated and is often intervened by other activities, spatially restrictive production tasks are fixed at certain locations (P. Arnold 1991:100-1). Coupled with other daily-life activities, it seems that spatially

flexible production is also flexible in scheduling and suitable to households. Other factors, such as space required for bodily movement, the size of labor force, the aggregative pattern of working partners, and the variability in microenvironment, can also influence the locations of production and their flexibility (P. Arnold 1991).

For instance, when the space available is reduced, perhaps due to an increase in population density, and open fire may no longer be moved around to accommodate microenvironmental conditions (e.g., wind direction), potters tend to adopt kiln fire such that production processes can be insured. The permanent facilities would further fix firing at certain locations in this situation. Following the intensification of production, it is also possible that the choice of locations often becomes less flexible because the space required to accommodate large numbers of products or semi-finished products and the time needed to enhance output increase accordingly (P. Arnold 1989:391; 1991:106-7). This intensification, along with the patchy distribution of resources, promotes the exclusive use of one locus for limited kinds of craft production and thus tends to site specialization (Muller 1984, 1987). Likewise, some firing areas only yielded certain types of ceramic products as in the case of Los Tuxtlas in Arnold's research (P. Arnold 1989; 1991:117). As many kinds of craft can be divided into several stages and different working stages were perhaps separately executed in different occasions, Jeanne Arnold and Ann Munns's survey (1994) also suggests that some groups in California's Channel Islands not only exclusively manufactured particular types of beads but only worked on them at certain stages, such as drilling.

On the other hand, different types of craft production and other activities may share the same space for the convenient access to common resources, including natural

resources, labor, and technological knowledge, information, and to exchange services (Kenoyer et al. 1991:47; Hagstrum 2001:47; H. Miller 2007). This spatial sharing and concentration would have enhanced interaction among different production systems, which Melissa Hagstrum (2001:49-50) terms "complementary technologies" and "intersecting technologies," because the scheduling and labor of different craft production in a self-sufficient system need to be reconciled, either in the complementary or intersecting way. The various production activities need also to be reconciled with agricultural tasks. The relationship between agricultural activities and pottery production, as briefly mentioned above, is ambiguous. In some cases, agricultural surplus helped to release extra labor to conduct non-subsistence activities. In other cases, other types of production, and in particular pottery manufacturing, was only an alternative subsistence strategy, such as procuring clays from barren lands or during drought seasons, that supplemented marginal resources for agriculture in agrarian societies (D. Arnold 1975, 1985; Rice 1987, 1984:49; Hagtrum 1985:66; see also Clark and Parry 1990:321; Stark 1991:72; 1995). For instance, in societies like those of the Central Andes and Chaco Canyon, in which autonomous, communal households constituted the basic production, consumption, and exchange units, labor or services were often taxed for the construction of great houses or other public projects based on familial units (Stanish 1989:8; Hagstrum 2001). Recruitment and production needs to be coordinated with, and needs to avoid competing for, daily household scheduling, which in turn is largely determined by agricultural activities (Hirth 1996:211; Hagstrum 2001:49).

In Yinxu, the capital of Late Shang in northern China, which is believed to be a state society, the political center at Xiaotun 小屯 seems to have contained several types of

craft production at the same time. However, bronze foundries that yielded large bronzes have also been discovered close to the inhabitation sites, such as Miaopu 苗圃, connecting with bone workshops (Li Yung-ti 2005, 2007). Archaeologists have speculated that these latter production activities were organized by household units (Zhongguo 1987; see Li Yung-ti 2005:3, 2007:195). The bronze foundries in residential areas yielded both items for local official use and high-status bronzes, which were offered to the royal house. The bone workshops, on the other hand, produced monotonic, utilitarian products (mostly hairpins) in large quantities (Li Yung-ti 2005:5). It seems that different classes of production, whether prestigious, less prestigious, or utilitarian, shared the same spaces and facilities, and were perhaps similarly organized. Li Yung-ti has argued that both crafts were supervised by the royal house, but were controlled to a varied degree at different production stages. That is, the control was stricter with product distribution and probably raw-material procurement, but loose and decentralized during the manufacturing procedures (casting, modifying) and in the workshop's organization (Li Yung-ti 2005:11).

Like Yinxu, in the settlements of the Chengdu plain, such as Shi'erqiao and Xinyicun, remains of several types of craft production, including textile, pottery, bone, and lithic production, are often found closely situated in, or around, residential areas. These products include both utilitarian and non-utilitarian items, and these crafts were probably produced cooperatively in the interest of community needs. However, unlike Yinxu, there is little evidence for a central control in the Chengdu Plain settlements.

Heather Miller's investigation in Indus provides another view for the classification of crafts (2007:40-1). As she has noted, not only is there no obvious distinction between

prestige and utilitarian production, because some crafts are involved in both technologies, but crafts were also lumped together based on a different logic from that presented in Hagstrum (2001). Here, the categories of "extractive-reductive" crafts (lithics, wood, and bones) and "transformative" crafts (fired clay, metallurgy) are divided mostly based on their formation technologies and processes. Different categories of crafts have different aggregation patterns, implying distinct organization means of production (H. Miller 2007:41). In this fashion, if the same process or technique, such as drilling, is applied to different materials, it will likely encourage crafters to gather different materials in one location (H. Miller 2007:43).

With these examples, it becomes clear that environmental and technological factors and managerial considerations can all influence how ancient artisans chose to locate their activities. The availability of space and constraints, and the scheduling of different kinds of activities within an area, would have required a certain level of consensus or agreement. It was a process in which human activities and spatial settings shaped each other.

2.3.2. The control of the production organization

From the spatial patterns discussed above, scholars often presume that the aggregation of production activities in space is a result of stratified control. However, it has been questioned if the location of craft production can reflect the degree of political intervention or help us to distinguish independent and attached specialization (H. Miller 2007).

From the structural Marxist perspective, the control of production, including the monopolization in resources, knowledge, labor, facilities, and distribution means, is an

important source for social differentiation and power acquisition (Fried 1967:191; Godelier et al. 1978; see also Rice 1981:220; Kipnis 1990; Brumfiel 1995:128). This is an avenue from economic to political power. Clark and Parry's analysis (1990:322; see also D'Altroy and Earle 1985; Brumfiel and Earle 1987; Earle 1997, 2002) stresses that through the exchange of surplus for prestige goods, the sponsorship of craft production (patronized or attached craft specialization) provided a means for people to accumulate economic and political capital and to acquire leadership. Such control of production organization can include both tangible and intangible norms. In addition, while production procedures can be divided into multiple steps, "control" can happen in diverse stages during the production or the circulation of objects. For Yinxu (Li Yung-ti 2005), control was reflected in the ownership of resources and products rather in the production knowledge, skills, or facilities. For the Channel Islands (Arnold and Munns 1994) control was reflected in the monopolization of transportation (plank canoes) instead of the production procedures. Through the control of transportation, a few people acquired the power to direct the distribution of products, which were otherwise produced freely in the hands of common people.

It seems that, although in Arnold and Munns' example emerging elites played an important role in organizing the distribution of the products, the organization of production is only intervened by elites to a minimal degree. Alexander Martín's survey of coastal Ecuador provides a parallel example, showing that a large number of crafters worked on shell craft production, yet they worked in a dispersed manner in individual domestic units without evident political control (Martín 2010:143). According to the distribution of debris byproducts, the shell products were unlikely to be luxury items but

were instead largely exported to northern Peru and became a complementary source of income for the increasingly populous Ecuadorian society and the nucleation of settlement. Although Martín believes that some political forms would have made the management of dense population and regional interactions more efficient, the lack of elaborated ceramics and other status goods at the site does not seem to support the presence of political managers. Instead, the exchange seems to have been conducted freely in large population and the production *per se* was perhaps self-organized in domestic units, following only tacit norms derived from trading. Martín's assumption about conflicts between individuals' interests and therefore the efficiency of elites' management is functional (Smith 2004:76). The presence or influence of managerial control should not be taken for granted or exaggerated. The formation of managerial control in the hands of a few elites is not itself equal to the reinforcement of social complexity and has explained little the efficiency of organization and complexity of production.

This is not to deny that political and centralized control over production can be present as a force to coordinate production units and activities in ancient societies. In some cases, particularly state societies, political control often played an important role in directing mass production, standardization, or the like (Sinopoli 1988). Nonetheless, scholars have often used centralized elite control to the exclusion of other explanations. For instance, in prehispanic Quiche-Maya, dwellings were shaped by patrilineages, each of which owned and controlled its own craft production system to fulfill local needs (Brown 1989). The domestic crafts were composed of repetitive types of production within each cluster of residential structures, denoting a low degree of exchange for these items among patrilineages. In this situation, ceramic designs differed by the patrilineage

and dwelling cluster (Brown 1989:384-5). This investigation shows that the "control" and intervention can come from diverse sources, including political, kinship, and dwelling organizations, as well as from consumption demands. It is also worth noting that, as dwelling units played an important role in cases like Quichan, for the same classes of products, discrete production locations tended to yield products of greater variability (Benco 1987; see also P. Arnold 1989:388).

It should also be noted that similar production organization does not necessarily lead to products of the same degree of diversity or uniformity, or *vice versa*. This has been demonstrated in Ian Hodder's ethnographic research (1981:232), in which two neighboring tribes of the Nuba are not significantly different in social complexity and share a similar degree of standardization and variety in ceramics. However, their production organizations differ from each other due to their different cultural concepts in manipulating clay-work. In Moro, all production activities are restricted in a specific location, whereas in Mesakin similar activities are conducted within individual households.

2.4. Household and domestic economies

Among the production units discussed above, the household division of labor has constituted the basis of and is embedded in other forms of specialization. The households in Quiche-Maya studied by Kenneth Brown (1989), for instance, include houses and workshops. The bronze and bone workshops found in Yinxu (Li Yung-ti 2005) are also closely related to nearby residential units. In such societies composed of segmentary lineages, households often provide the basic, self-sufficient social, economic, political, and religious unit of study (Brown 1989:386). As Gary Feinman and Linda Nicholas

(2000:120) have argued, most production, however plentiful and intensive, has been conducted within or around houses or workshops that were directly connected to houses. Although this account focuses on prehispanic Mesoamerica, it holds true for many societies with influential co-residential structures. With proper organization, it is not necessary for domestic economies to develop small-scale production or manufacture products for local use only. Even when other modes of production may provide a more voluminous output and impact societies to a greater degree, households remained a fundamental realm in producing and consuming certain categories of goods, and such production and consumption convey overarching information about social relations, autonomous units, inequality, risk management, and so on.

Furthermore, although recognized as basic economic unit, the concept of the household is composed of social (the number and relationships of the members), material (physical possessions), and behavioral (activities performed in the area) components (Wilk and Rathje 1982:618). They are often the smallest autonomous units visible in archaeology and are thought of as the totalities of the actions of household members in the processes of economic and social adaptation (e.g., Kohler et al. 2000). Dealing with households, however, has to be put into effect by dwelling units in reality, whose material remains are the results of daily behaviors (Deetz 1982:721), such that a higher level of abstraction (e.g., organizational principles) can be inferred (Wilk and Rathje 1982:620). To identify such units in archaeological data, Charles Stanish (1989:11) has adopted the modified concept of the household to focus on its repetitive patterns in *domestic functions* and *co-residentiality*, which has logically contrasted "household" with "family" (targeting kinship structure) (cf. Bender 1967:493; Sahlins 1972:77; Deetz 1982). In this

definition, a household is not a natural unit but is socially constructed. It might expand to contain more than one nuclear family or extended kin group when more labor is needed in production activities (Netting 1993:89).

For Stanish (1989), domestic functions include but are not limited to the social functions of families, such as providing food and shelter and the socialization of children (Bohannan 1963; see Bender 1967:495, 499). Similar concepts have also been deployed by other anthropologists. For instance, Richard Wilk and William Rathje (1982:621) have added to Donald Bender's idea to define the functions of households in a more general fashion—production, distribution, transmission, and reproduction. Despite in different details, these functions have been commonly realized in different households and would have left certain concentrations of remains. Yet, it is possible that the material expression of a household can be strengthened or confused by the occupations of its residents and the presence of specialized activities, as well as other factors (Schiffer et al. 1981:83; Smith 1987:302). In this regard, archaeologists have searched from architectural remains with open areas (e.g., hearth, storage, food-preparation areas, and disposal areas), floor plans or space allocation within structures, and associated burials, and have used these diverse features as indicators to measure the properties of households (Bawden 1982; Stanish 1989:11). Michael Smith (1987), on the other hand, stresses that household artifacts, such as furniture, production tools, and food serving wares, in addition to other dimensions, can be used to evaluate and compare the wealth of households. Moreover, it is has been observed that many artifacts that are a part or the extension of a household may be found in spaces without obvious association to the remains of the architecture

(Deal 1985; Tourtellot and Sabloff 1989:367). Our search in space therefore cannot be limited to the area around the structures and has to reasonably extend to areas beyond.

Through this research in sociospatial patterning, we have been able to discern broader patterns. Despite the common assumption that, in household production, products are consumed domestically mostly by relatives and friends, and are perhaps only produced when practical needs arose, everyday life and cultural knowledge have nonetheless guided the actions of most people and set broader behavioral norms in residential neighborhoods, in which social roles with varied interests act accordingly, as Kathryn Keith (2003:60) has argued. Although the household is ideally an autonomous unit in production, this goal of self-sufficiency is hardly ever achieved in reality. Reciprocity and exchange between households during food shortage, for instance, may have cut across kinship factions to be community or even region based (Spielmann 199l). In such situations, household exchange has often been connected with higher levels of exchange spheres (Upham 1982:119). Activities such as potlatches, feasts (Costin and Earle 1989; Dietler and Hayden 2001; Spielmann 2002), and household consumption rituals (e.g., weddings and burials) (Douglas and Isherwood 1979:xxiii; see also Smith 1987:313), though occurring in the context of households, also gather social factions beyond household members and create or maintain social relations and debts of duty. An extended household consumption mode like such may, in turn, be associated with greater numbers of serving and decorated wares, and also with finer divisions in vessel functions for more diverse food and drink. This may form identifiable material expression in archaeological contexts (Smith 1987:313).

The modified concept of a household, in which kinship is not the primary concern, has also challenged traditional thinking on the household division of labor, which is mostly based on the gender and age of familial members (e.g., Childe 1981[1951]). Julia Hendon (1996), for instance, stresses individual roles and interests within households. It would also be a mistake to assume household production can only achieve low-level specialization based on its simple division of labor, as Feinman (1999; Feinman and Nicholas 2000) has argued. Instead, when undertaking agricultural activities or large-scale projects, a large number of producers, who belong to the same dwelling units, may form a specialized division of labor, in which multiple workers work in parallel on the same tasks or on different parts of a sequential task. Some enduring, large-scale projects may further enlarge and complicate the household structure (Wilk and Rathje 1982:622-23).

In some instances, the distribution and management of resources as well as production and exchange modes are particularly important in influencing the size of households, which have varied with societies (Wilk and Rathje 1982; Netting 1993:89). Garth Bawden (1982:176) reported that, in the urban site Galindo of Moche V (*ca*. 600-750 AD), richer residential areas were separated from poorer ones not only by geographical location but also by the distance to drinking water, house size, the proportion of the public area inside a structure for household members (*salas*), and the quantity of status goods. In such a community some clusters of residential areas are architecturally connected to functional areas, such as ceramic workshops, re-distributive centers, llama corrals, and storage facilities, whereas some of the others are connected to

administrative complexes. Their divergent access to sociopolitical and economic activities seems to have reflected social differentiation and control.

In Marshall Sahlins's example drawn from Fiji (1957), the composition and forms of households are shaped by land resources. A household or familial head and his wife are the decision-makers who have the power to organize labor and regulate daily activities and production (Sahlins 1957:453). These relationships among household members, including their relative statuses and divisions of labor, are a microcosm for social organization (Sahlins 1957; Deetz 1982). Based on his own and other anthropologists' ethnographic observations, Sahlins (1972:101) has also found that, in domestic economies, underproduction, in which people have minimal desire to produce or accumulate surplus, might be normal. However, production can be intensified by forces from greater institutions, such as kinship groups, or by the political or ritual order, because workers for household are also included in these larger production systems.

The enlargement of household production and organization has made it sometimes difficult to distinguish it from other economies. To define it in contrast with other economies, Martín (2010:145), for instance, distinguishes household economy from political economy and suggests that the former meets cultural as well as subsistence needs for reproduction based on domestic units, whereas the latter often draws surplus from household production to gain political interests (also Hirth 1996:210). This is to focus on the use of household production for social gains. It is also recognized that the distribution and transmission of goods within households and other larger units attests to social strategies for dealing with social relations and instability. Such transmission has unavoidably brought in the issues of defining property rights, ownership, value, and

wealth along with the power relations encompassing artifacts (Wilk and Rathje 1982:627; Smith 1987; Barlett 1989:4; J. Arnold 2009).

3. Production and social relations

Growing research has shown that social organizations and relations are a complex and elaborated version of those among household members. Production and distribution modes within households often extend to broader coordination principles, by which domestic groups are organized to complete larger community-level projects. As Sahlins (1972:75) states, "the domestic economy cannot be 'seen' in isolation, uncompromised by the greater institutions to which it is always subordinated." He further adds that, in production instituted by domestic groups, the so-called "economy" is indeed meant to refer to the social groups and their relations (Sahlins 1972:76). Carol Smith (1976: 6) also writes that economic systems are "formed by exchange relations wherein communities or settlements in a territory are interrelated by their ties to one another through either a simple network or a hierarchical arrangement." She further points out that exchanges shape a regional system that accounts for not merely economic entities but also political, social, and ideological ones. With social networks, connecting diverse social actors, production units, and things, such so-called "entities" cross each other without uniform boundaries.

It is also likely that a settlement or geographical region is only part of a larger entity (Paynter 1980, 1982) and that the societal relations constituting the region are only part of a larger network, whose boundaries, again, may be unknown. Social and power relations from the level of households and communities to those of regions and cross-regions are bottom-up processes of integration and self-organization, which are

constituted by innumerable local communications. These seemingly disorderly but self-organized communications along with information processing provide sources for social complexity (e.g. Crumley 1979, 1987, 1995, 2005, 2007; Bentley and Maschner 2003; Chapman 2003, 2007; Lansing 2003; A.T. Smith 2003; Wynne-Jones and Kohring 2007). The increase in social complexity thus means the expansion and intensification of the network, in which more diverse divisions of labor and social relations increase the transmission and the amount of information.

3.1 Exchange and social boundaries

The circulation of products and/or manufacturing ideas not only delineates the exchange spheres of a social entity, but also implies the boundaries of its cultural influence. However, the social relations, including social differences, created by or involved in such circulation are not uniform for different classes of artifacts in most cases. It is the diverse roles of craft production and products that mediate, blur, reconfirm, or enforce social differences. In the case of amplifying social differences, for instance, the privileged consumption and ownership of scarce goods is stressed by those with vested interests. The use of production in communicating different social parts and communities comes in multiple forms, each guided by different products with distinct intensity, social values, information, and importance. In 1964, Joseph Caldwell developed the concept of the "interaction sphere" to describe the range shaped by various kinds of exchange among a number of cultural entities. This conceptual model has received broad attention and been used to address the increasing interactions between several Longshanoid cultures in East Asia from 4000 to 2880 BC (Chang 1986). Several of these cultures are located in current Southwest China and Yangzi River basins, and are the precursors for the cultural bodies

that are discussed in the following chapters. Their boundaries might have been shaped or reshaped by such interactions on a greater scale. The polities and social groups, under a seemingly united sphere, if recursively subdivided, however, appear uneven and unaligned. It is possible that such unevenness was caused by the different forms or aspects of material-culture and information exchange.

For instance, despite the difficulty and risk in discerning technology and style, Margaret Hardin (1984:599) emphasizes the importance of maintaining stylistic contrasts (but not necessarily the contents) for some groups. Similarly, Catherine Cameron (1998) recognizes an enduring artifact type—coursed adobe architecture as an emblemic style (Wiessner 1983), whose occurrence might be a result of population migration. However, while stylistic variations are not equal to ethnic or any other kind of group, as many archaeologists have warned (e.g., Shennan 1989), Cameron has also identified the difficulty to decode producers' information about social identity. She nonetheless points out that technological styles may inform social boundaries in an unconscious or subconscious manner (1998:191). That is, production activities, regulated by *habitus,* may develop to be peculiar historical traditions to signal the distinctions among working or social groups. Michelle Hegmon (1998:273) has accounted for such technological differences formed by *habitus* by referring to the primordialist theory[7], in which the native propensity[8] of a population is stressed. On the other hand, she argues, technological choices and inventions strategically taken and manipulated by producers or sponsors to differentiate themselves from other groups can be understood from an

[7] In the primordialist approach, ethnicity is considered a given and thought to have objective existence. People are simply born into and belong to a certain ethnic group (see summary in Isajiw 1993:2).
[8] This may include languages, appearances, myths, memories, values, symbols, and the characteristic styles of particular historic configurations (Barth 1969; A. Smith 1986).

instrumentalist perspective (Hegmon 1998:273). In either case, it should be stressed that such differences and boundaries are only drawn from the distribution patterns of material cultures but have little to say about ethnicity. It is likely that particular aspects of product designs might bear the information to reflect the distinction or similarities among certain social sections, but such information is specific and should not be overextended to other aspects of the products or other social sections.

For instance, through ethnographic observation in Kalinga, in the Philippines, Michael Graves (1985) has found that women potters formed working groups on the basis of residential proximity, who are possibly but not necessarily relatives. He compared the relevance of various factors to ceramic surface designs (the number of decorated bands), including the vessel size, the age of potters (or the year the products were made), kin groups, and working groups. In this case, the number of decorated bands is seemingly related to the birth cohort of potters but less to kin groups or working groups. Furthermore, the variations are in a predictable range within a community, wherein the designs are shared by interacting potters (Grave 1985:30). Graves argues that such information about the structural design in the number of decorated bands has been circulated in the same villages across kin and working groups, although there might be other designs that signal distinctions among kin groups or other social segments. More importantly, Graves (1985:33) and Michael Dietler and Ingrid Herbich (1989:161) all recognize the importance of personal interactions (through direct observation or gossip) within a community in the decision making of some design behavior, where potters are exposed to production information, allowing them to figure out, and reconfigure, the acceptable range of variability along with its symbolic meanings. This information

unconsciously influences the residents, through whom the potters also determine the tendencies of the technological and stylistic expressions.

From the above examples, it is clear that even for different attributes of the same class of artifacts, their formation can be informed and constrained by various social factors, which may not be mutually exclusive, so that the diverse dimensions of the artifacts do not transform in the same fashion or at the same rate. The exchange of distinct classes of material cultures further highlights the diverse ways to set "boundaries," however fluid and transient, for different social segments and to construct a complex web of relationships. Michael Mann (1986:1) has noted that when multiple types of craft production are present, each of which embodies a set of interaction relationships at various scales, they become potential sources for negotiating power relations (cf. Shennan 1989; Stein 1998; Schortman and Urban 2004). That said, through possessing, displaying, and exchanging different classes of craft products, distinct power relations may be facilitated or used to modify power distributions over networks. The exchange, including material or non-material things, can be conducted through various means, such as reciprocity, redistribution, competitive feasting, gifting, tributes, and markets (Polanyi 1957, 1975; Sahlins 1965, 1972; Renfrew 1975; Service 1975; Stanish 2003:18-29; M.E. Smith 2004:84).

For instance, utility items, in particular cookwares, which have been noted for their functions and performance in daily life, are usually the most constant and persistent vessel types, present in households of all levels of wealth. Beyond the fulfillment of functional needs, they are perhaps the most representative items of cultural idiosyncrasy. Ritualistic art styles, on the other hand, crosscuts diverse linguist and ethnic groups

(Flannery 1972:404). Due to the involved social relations and interests, it might be common for a society to develop different strategies for various categories of production. According to the observation of Jonathan Kenoyer et al. (1991:55-6), although both the lithic-bead and pottery products around Khambhat, India are highly standardized and widely distributed, their organizations are different. Whereas the production and distribution of beads is under the control of centralized workshops and stratified merchant families, the production of pottery is decentralized. Products from the latter are standardized and distributed over a wide region because the potters, who are mainly composed of kin groups, are themselves widely distributed and the consumers are equally distributed ethnic groups. The beadmaking, on the other hand, involves multiple levels of control; competence and alliance among middlemen and distributors of different stages and at various distances in a large trade network; and negotiations among different levels of social power.

3.2. The social role of things and the manipulation of power relations

Beyond their face value and physical properties, both "the ways of doing things" and the associated cultural meanings of objects, have constituted production knowledge (Hardin 1984:600). The multi-faceted roles that objects play have to be defined by their location in a web of social relationships. Many authors have argued that the social value of things can be determined by various means, naturally and artificially: through their rarity, their difficulty to access or acquire, their associated iconography and their connections to ritual symbols or foreigners, and the skill or energy that has been invested in their production (e.g., Peregrine 1991; Cabb 1993:63; Hirth 1996:214). Ivory, for instance, even though not processed, is often highly valued, perhaps because it needs to be imported from a

remote location, or because killing elephants requires a large number of hunters working together. Spatial *distance,* which is endowed with supernatural imagery, is apparently a source for evaluating the value of things beyond the mere scarcity of materials and the investment of energy (cf. Braun and Plog 1982:511; Helms 1993:32-37). Similar imagery has also been true for temporal and historical distance. However, through the manipulation of artifacts or symbolic knowledge, people may reduce the ideological distance to a certain lineage or renowned ancestors (e.g., Layton 1989b). In this manner, production, the realization of knowledge, will not only make products ritualistic but will also be a part of the ritual action. Natural resources and production sites are also potentially sacred loci, and access to them is therefore restricted.

Jonathan Friedman (1975) convincingly argues that religion can serve both ideological and economic functions in a single society. As he has shown, in places like Southeast Asia, prestige goods earned from feasting, which embody the power of one's ancestors, are translated into social rank. The creation of power is both strategic and dynamic in such cases. In fact, potters with artistic and aesthetic talents are inherently equipped with the power to create new icons for group identification, as Mary Helms (1993:72) has argued. Janet Levy (1995) and Katherine Spielmann (1998:153) have also pointed out that, in middle-range societies, it is craftspeople, who own artistic skill and are also often ritual specialists, instead of a particular social class, that create ritual icons and social identities. In such societies, social status is gradually accorded through the possession of ritual power. As a result, in societies like the Iroquois, performance of skilled ritual craftspeople can become the norm of their generation (Spielmann 1998:157). As active ritual practitioners, knowledgeable craftspeople also acquire avenues to

building status. Wealth and social value, in such cases, are measured not directly by the possession of alienable goods but are, rather, by one's distance from the supernatural (Friedman 1975:50).

Here the association between skill and ritual need creates the opportunity for people of any status to acquire power. This also implies access to social mobility, which may threaten those with vested interests, so that in societies like Shang China and the modern Pueblo, ritual knowledge and related artistic and material expressions have to be controlled by and restricted to a certain group of people (Brandt 1980, quoted in Spielmann 1998:157; Chang 1983:51). If such groups are not craftspeople themselves, then skilled artisans may be designated or sponsored for certain production goals, by which a certain degree of "attached" specialization takes place (Earle 1981; Brumfiel and Earle 1987). This in turn serves as a strategy to maintain the political power of the patrons or the so-called political economy. In this sense, social difference is promoted by sociotechnical systems through resource or product control (Engels 1972 [1884]; also Brumfiel and Earle 1987:1; Hirth 1996). In other words, social differentiation and heterogeneity derived from differential access to resources of craft production and the manipulation of the division of labor, in which items are endowed with symbolic meanings, can be used to legitimize, fuel and, occasionally, rupture power distributions. It is also possible, though, that the organization of ritual activities forms a system independent of economical and political controls (Wailes 1995). If so, multiple structures and ways of organization can coexist in a single society, where no single social order can be assured (Crumley 1987:158). This is similar to Mann's (1986) argument for multiple

sources of power, including ideological, economic, militaristic, and political power, and also to Eric Wolf's (1990) identification of varied modes of power.

Furthermore, because the value of an artifact is not unchangeable after its cultural construction, but is negotiable and subject to reevaluation over time and by situations (e.g., Mintz 1985; Appadurai 1986; Costin 1991, 2001; Chen Pochan 2006; Clark 2007; Flad 2007, 2011:24; Flad and Hruby 2007; Inomata 2001, 2007), we need to maintain flexibility the categories and *contexts* of artifacts. To achieve this goal, we may want to focus on the relations between producers and those who control the alienation of the products, dissecting the social life of things, instead of on the face values of the products. The changing contexts and value of things and the competing interpretations of their meaning make re-organization of structure possible (Crumley 1995). As a result, structures are modified and multiple sources of power are subject to mutual renegotiation.

4. Conclusion

As Rice (1984:46) has noted, the study of specialized production is a complex question that requires one to understand environmental, economic, social, organizational, ceremonial, and aesthetic factors. Study of any single aspect essentially involves the study of the others. Dietler and Herbich (1989:160) also argue that to investigate the nature of ceramic systems and stylistic change requires researchers to go through the processes of learning, interaction, and innovation. I have therefore started in this chapter to examine multiple distinct yet related perspectives on pottery production, including specialization and its symptoms, the organization of production, the practices of sequential operations (*chaîne opératoire*), decision making in technological choice, and the attendant social relations.

Although the signs of specialization are often difficult to decipher in archaeological contexts, archaeologist have searched for patterns through the investigation of relevant ethnographic cases and experimental archaeology. This has given us promising tools and common ground to assess the often confusing and difficult concepts like standardization and production organization, which are also relevant to my dissertation and are further explored in Chapter IV. Among these concepts, standardization occurring at the community level or across several interactive communities is especially important here. Its possible causes, including intentional and unconscious mechanisms, are discussed from an economic, social and cultural perspective. I also take account of the technical selection, organizational forms of production, and emic perception that have contributed to standardization.

In addition, in order to reduce the ambiguity of these concepts and phenomena, I break down production into components and steps within processes, against which the criteria of specialization can be examined. In considering the consitution of production processes, I also study the perception, interests, strategic use, and changing values of products over their life cycles. The study "mental templates" (Deetz 1967:45; quoted in Read 2007:185) and community-wide standards over various stages of production also has implications for typology, affecting how we understand a cultural system from combinational patterns and the tendencies reflected in artifacts within specific temporal scale. For instance, because of cultural idiosyncrasy, some manufacturing methods are especially associated with a few types of vessels and conceived of as the most efficient and suitable methods in producing these types. Even though such methods can be applied to produce more diverse vessels, and *vice versa*, one's choices are affected and shaped by

manufacturing traditions and thus acquire their cultural significance (Sackett 1990). Such manufacturing traditions are often formed through interactions among potters, rather than through the imposition of political control or ethnicity (cf. Hegmon 1998:276).

Manufacturing traditions and *habitus* also unwittingly constrain technological choices. It is clear that technological changes and choices are more than mere solutions to practical problems. The introduction, perception, adoption, and rejection of a technology are often influenced by a constellation of factors, including the actors' interests, social conditions, political and economic concerns, and technical achievement. By studying the social dimension of technologies, we can take into account technology's social effect, while also understanding technologies as a part of a social system and organization in which different parties negotiate their use (Lemonnier 1989). To study and identify a system of technology, then, is to include "the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance" (Nelson 1991:57).

The selective use of technologies reflects people's perception and classification of artifacts. Brian Hayden (1998) has singled out prestige technology, in contrast to practical technology, by its different strategies and purposes. Whereas the latter is used to solve practical and survival problems and to meet functional needs, prestige technology is destined to fulfill social tasks. Only after the series of technological innovations during the Upper Paleolithic and the Mesolithic did the aggrandizement, storage, and transportation of surpluses and labor become possible, and these were in fact the requirements that released people from subsistence production (Hayden 1998:15-7). Although it seems that the two types of technology are based on separate considerations,

which would sometimes lead artisans to make distinct choices, the distinction between them is context dependent (also H. Miller 2007:40-1). In accordance with social conditions, the two types of technologies do shift from time to time. As Bruno Latour (1979, 1993) and Andrew Pickering (1992:1) have argued, scientific knowledge is not purely naturalistic, but is more or less a social construction and product that the interests of certain groups may affect the development of technology and science. We may hope, at best, to classify artifacts based on technological characteristics within a specific time and space in such cases.

To understand how space has influenced technological choice and production activities, I have also reviewed the relationships between the spatial arrangement of production loci and the organization of production and examined how the latter is suggested by the technologies used. As some have argued, the aggregation patterns of production units and activities are regulated by spatial orientation, which is, in turn, determined by the microenvironment as well as other social factors. Scholars have deduced several possible reasons, such as the volume of ingredients or the immobility of facilities that might have influenced not only the choice of space but also the flexibility of relocation (P. Arnold 1991:100-1). Under the pressure to become more productive, some loci become sites specialized in manufacturing particular types or parts of artifacts. On the other hand, if several crafts are performed within the same space, scheduling and coordination among different production activities becomes critical. This involves the management of social relations derived from and encompassing production.

Also, by observing how different working groups and production activities coordinate one another and respond to the demands of consumers, we can study the

economic, political, or ritual dimension of social complexity related to production. The coordination of social relations involved even in household production, which we might consider the most basic unit of production organization, can still contain complex power relations. Scholars often argue that the household division of labor is a microcosm of social organization (Sahlins 1957; Deetz 1982) and households often constitute the unit to supply labor and/or tax for public projects. Domestic functions and co-residentiality have also made the household an efficient unit in exchanging production information. As Feinman and Nicholas's case study of Ejutla, Oaxaca, Mexico (2000) has shown, household production can yield products of high-intensity, large quantities, and careful elaboration. In their example, raw materials were not limited to local resources and the exchange networks were not restricted to local communities. However, while their networks extended as long-distance exchange, no evidence has clearly shown that Ejutla production was strictly controlled, as several counterexamples of central control have demonstrated. It would be a mistake to assume a simple correspondence between production organization and social systems. As Christine Hastorff (1990) and Charles Cobb (1993:51) have warned, the degree to which central control intervenes and the distinction between the "power to organize" and the "power over organization" needs to be discerned. Carole Crumley (1995:2) also notes that a common mistake people have often made is to confuse the hierarchy built by scalar with that built by control[9]. Because household production can both affect and be affected by larger production institutions, we should not uncritically assume a control-hierarchical relationship between different levels or scales of production organization.

[9] For scalar and control hierarchies, Crumley (1995:2) has given the examples of global-regional-local climate and American court system, respectively. In the former, different levels can affect on another. In the latter, the higher level can impose order on the lower level, but not vice versa.

Archaeologists have observed that household size varies by society, and is influenced by sociospatial patterns co-structured by production units and modes of exchange, among other factors. Social complexity is more a result of the interactions required for organizing these related activities, and less the product of ranked control. On one hand, with emerging complexity, exchange activities are both a factor and a strategy utilized by different social sectors for their own purposes to create and facilitate diverse relationships. On the other hand, exchange activities are the results of increasingly specialized production systems and increasing relationships between social segments. As the exchanges of prestigious items, luxury goods, mass commodities, and daily needs form diverse spheres of circulation and interaction, different categories of objects may have distinguishing effects and may inform diverse relations between social parties.

The spheres may or may not contribute to the formation of political or ethnic boundaries, neither of which is given or unchangeable, but develop from or are reduced by constant interactions, as Fredrik Barth (1969) has pointed out. That said, similarities seen in certain material cultures might be the result of interactions among individual artisans and working groups (Dietler and Herbich 1989), though the degree of interaction does not ensure a degree of similarity (Hardin 1984; also Graves 1985). Distinctions in material cultures, on the other hand, can be both the result and means of social differences rather than the priori conditions of ethnic or other social groups. However, although modes of exchange or interaction have no direct relation to managerial forms or group affiliations, it is in the course of such diverse interactions along with their changing cultural meanings that different social interests are negotiated and incorporated.

Similarly, the social function of an artifact is never fixed. When manufacturing processes turn raw materials into objects, the information the producers would like to convey is encoded into products, which are then woven with cultural and social meanings when they enter circulation. As the media of human interaction, the social roles of things need to be searched in the web of cultural meanings and in the relations between producers and users, instead of from the physical properties of the objects. To arbitrarily cast production of a class of artifacts as a certain type of craft specialization is to ignore fluid social relations and to oversimplify diverse constructions of social complexity. This has been seen in some of the past studies which assumed that craft specialists, as a specific social class, only occur in stratified state societies and are supported or coerced by hereditary elites. Nonetheless, as Malinowski (1922) has shown, an economic system can be very complex despite having no central control. It would be a mistake to unconditionally claim causality between craft specialization and political control or to infer social complexity directly from the organization of production. It is also problematic to assume any change in pottery production is a direct or immediate reflection of social change (cf. Rice 1981; Adams 1979, 1981).

Today, although the myth that increasing complexity can be translate as social evolution has been largely unpacked, the relationship between production organization and sociopolitical processes is still subject to debate and asks for a better explanation. By reviewing the relevant literature and case studies, I hope to locate the essences that will effectively explain changes in material culture, whether in technological dimensions, usage contexts, or social meanings. With this in mind, I suggest studying not only external impetuses, but also underlying social relations. As Barbara Stark (1981) and

Edmonds (1990) have suggested, craft production needs to be understood as part of a broader social matrix and with potentially determinative factors that are peculiar to the case under study.

III. Natural settings of the Chengdu Plain and related archaeological cultures

1. Introduction

In this chapter, I investigate the archaeological cultures developed around the Cheng Plain during mainly the early and middle Bronze Age. Settlements in other regions showing signs to have shared material cultures with the Chengdu Plain are also considered and their relevant discoveries discussed. My goal is to examine the geographic and temporal backgrounds and the natural resources that have contributed to the craft production of the region, particularly the most characteristic pottery assemblage, in the ancient Chengdu Plain. With this basis, the social effects of craft production will be further explored in the following chapters.

The Sichuan Basin measures 485,000 square-kilometers in extent; the Yangzi River flows from west to east and its tributaries (mainly the Min 岷 River and the Jialing 嘉陵 River) cover the whole basin. The Chengdu Plain is located in the western Sichuan covering an area of roughly 9,500 square kilometers at an elevation of 400 to750 meters, in which the Min River (Minjiang) and the Tuo 沱 River (Tuojiang) form alluvial plains (Figure III-1 & Figure III-2). Because the basin is situated at the intersection of Indian Ocean and Pacific monsoons, its annual precipitation can reach to more than 1,000 mm (Appendix III-fig. 1) (Ren et al. 1979, 1985). The precipitation and vegetation are more changeable towards the northern boundaries of the monsoons in north Sichuan. The warm and humid weather together with the lithology of the parent rocks have largely determined the formation and types of the surface soil and its fertility.

It has been proposed from paleoclimatic studies that the global climate was dryer 4,300 years ago, followed by a comparative humid and warm climate in the late Holocene era (Matsuoka 1994:206-210; Chen Fa-Hu et al. 2007:25). The fluctuations of environments may have caused population movement to other sustainable places and thus increased the interaction among different social groups. Pointing to the impact of climatic change, some researchers have proposed that the climatic deterioration and cooling event in the grater East Asia in 4200-3900 BP might have led to the fall of the cultures of the Yangzi River, including the Baodun 寶墩 Culture in the Upper, the Shijiahe 石家河 Culture in the Middle, and the Liangzhu 良渚 Culture in the Lower Yangzi Basins (Yasuda 2004:568; Chen Tiemei 2008:199). A similar event in about 3,000 BP might have also impacted the Sanxingdui Culture (Liu Xingshi 1983; 1998; 2005; Fu Shun et al. 2003; Fu Shun et al. 2005). However, despite these global fluctuations, the Sichuan Basin has been comparatively stable in climate and mitigated the impact of climatic crisis (Song Yuqin 2002:125). Due to local conditions, the large-scale climatic events, while leading to general deterioration, would have brought different regions of different impact such that regional variability may have existed. For instance, recent stalagmite studies on the monsoons and precipitation of ancient tropical and subtropical China show climatic variability in finer resolution and suggest that while droughts once occurred in northern China, southern China may have suffered from floods (Chen Fa-Hu et al. 2007:25).

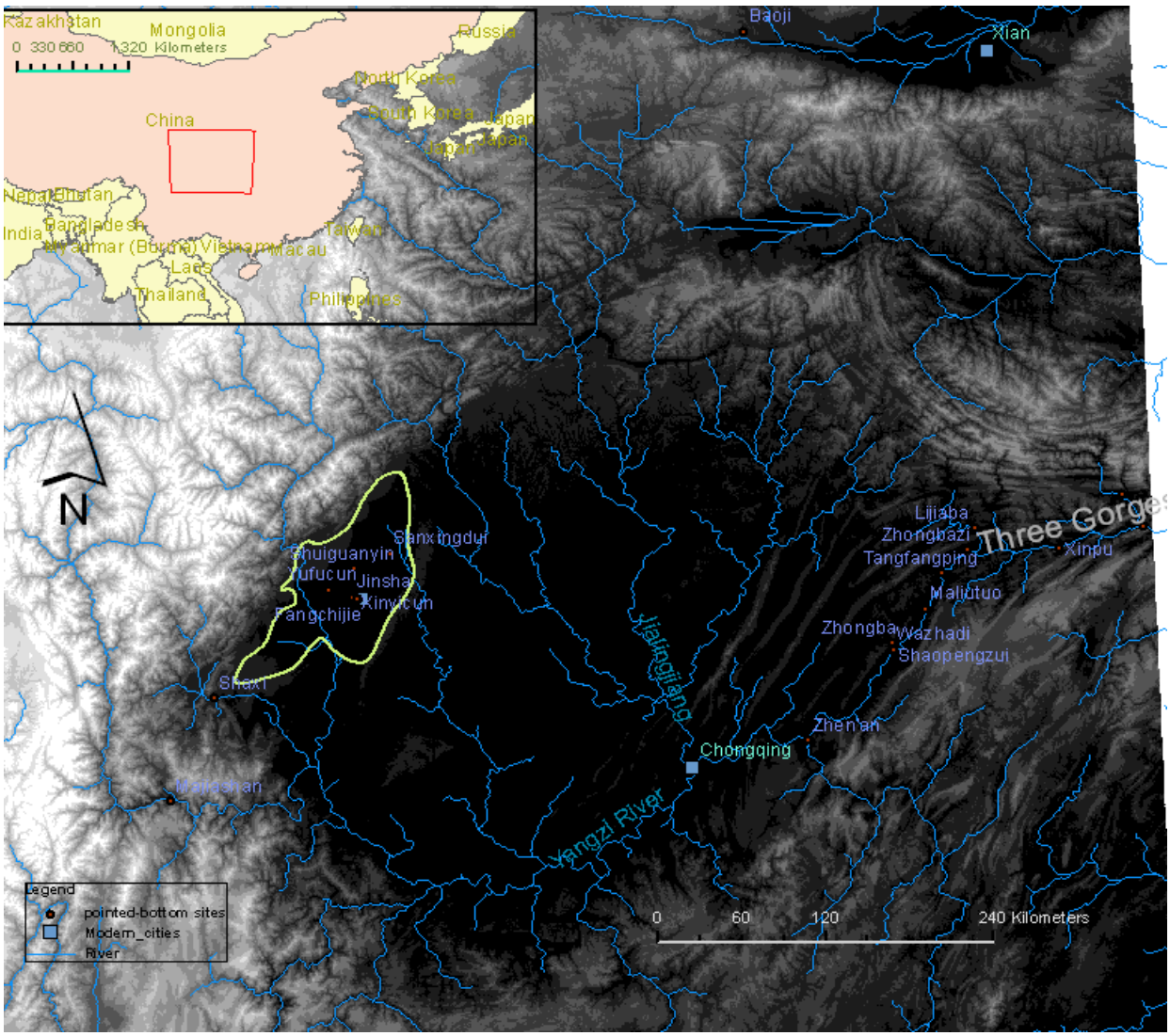


Figure III-1: Satellite map showing the Sichuan Basin (with the Chengdu Plain circled in the west).

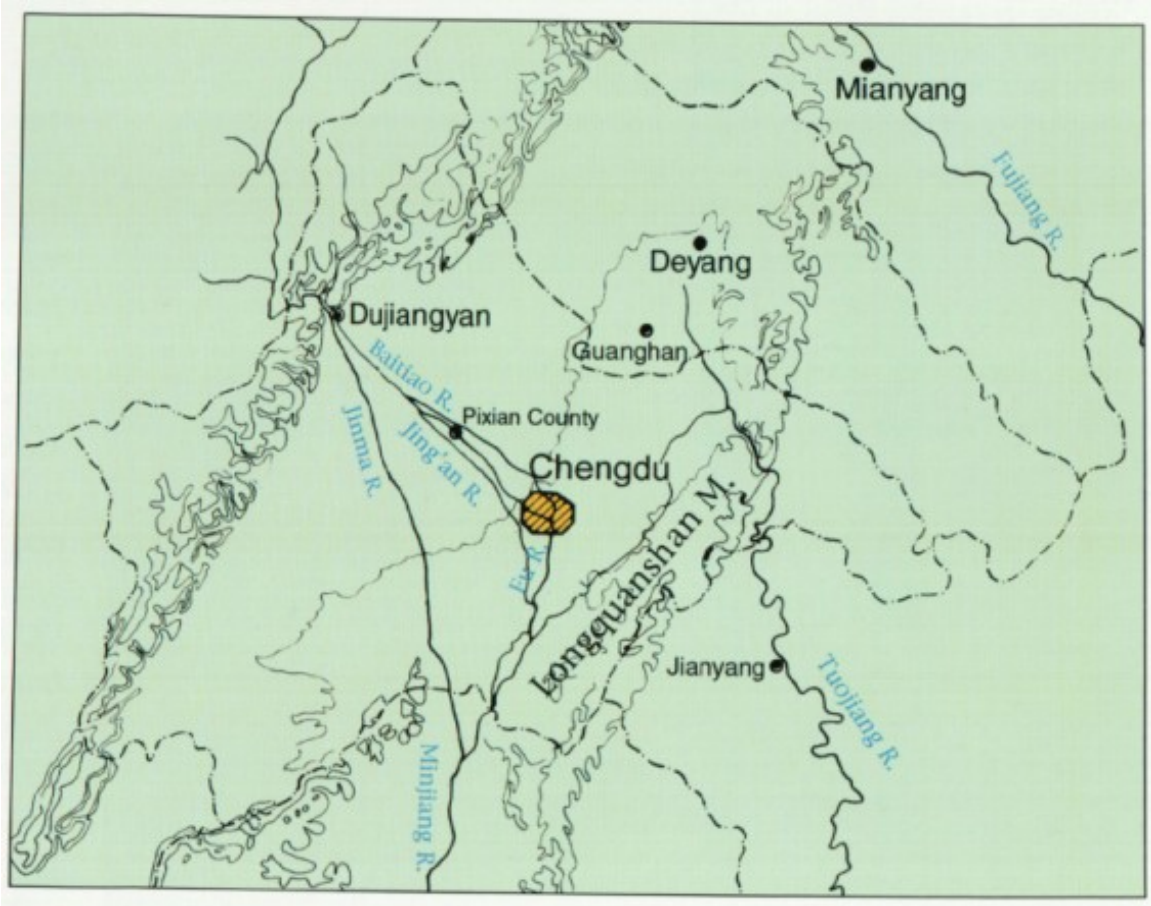


Figure III-2: The Chengdu Plain
(after Chengdu 2006e).

The effects of flooding can be detected in the stratigraphy of many sites. Under rainy conditions, the surrounding mountains of the Chengdu Plain (i.e., Longquan 龍泉 mountains to the southeast, and Qionglai 邛崍 and Longmen 龍門 mountains to the west), from which rivers brought soil and then began to deposit it, covered the plain with grey fluvo-aquic and alluvial soil during the Quaternary Period. On the other hand, hills and wolds with red beds consisting of sandstone and siltstone are also present with conglomerate underneath, which have been developing since the Cretaceous and Jurassic Periods. It turns out the main clay minerals formed in the Chengdu Plain and the large basin are mainly hydromica (illite), vermiculite, and smectite associated with kaolinite and chlorite (Cheng et al. 1990; Institute of Geography 1999:111; Zhongguo Dizhi Tuji 2002; Cao Ke et al. 2008) (Appendix III-Figure 2). Moreover, according to the observation of geologists, due to the continuous plate uplift in the surrounding mountains, though at an inconsistent rate (Liu Xingshi 1983), most igneous and sedimentary bedrocks of the basin have experienced regional metamorphism (Sichuan 1996:226). Rivers, altering their courses back and forth due to geological and climatic change, have then served as powerful weathering and transporting agents in the region to bring the mixture sources of sand and clay (or the secondary clay[10]) and sometimes even artificial remains from the upper streams down to lower reaches. Soils of mixed sources transported and deposited by rivers also provide the general raw material of pottery making and sometimes are indistinguishable from the secondary clay of other regions.

[10] Introduction about the formation of clays can be found in P. Rice's volume (1987:36).

Whereas ancient potters were likely to procure raw clays from local sources[11], the properties of the local and surrounding bedrocks and mineral ores along with the local climates and geographic conditions have significantly affected the consequent pottery products of the region. We should carefully take these factors into account when studying pottery production.

After examining the lithic ornaments and instruments found in the Sanxingdui 三星堆 site (1700-1250 BC), Su Yongjiang (1996; see also Sichuan 1999:500-521) has discovered that the minerals and rocks existing and adopted to produce the artifacts found are very diverse, including sedimentary rocks (e.g., sandstone, shale, breccia, and limestone), metamorphic rocks (e.g., mica schist, dolomite, gneiss, and slate), and igneous rocks (e.g., granite, gabbro, and tuff). Besides these minerals, tremolite was often used to produce 'jade' ornaments such as *zhang* 璋 blades and *bi* 璧 disks. Though he is uncertain of the source of the lithic materials, due to this diversity, he does suggest that the most possible sources were either nearby mountain areas, such as the Longmen Mountains, northwest to the Chengdu Plain by only 50 km, or the lower Yangzi River. A similar examination on Jinsha lithics taken by other scholars favors the local-source hypothesis (Yang Yongfu et al. 2002:198; Chengdu Shi 2006), as geologists do find reasonable geological conditions[12] and stone mines in such locations as Longxi 龍溪 in Wenchuan 汶川. Such inquiries show the difficulty provenance studies encounter in geologically complex regions like Sichuan, especially when diagnostic mineral or rock phases are not present.

[11] A discussion of the 'catchment' of clay and temper sources can be found in D. Arnold's ethnographic investigation (1991), for example.
[12] I.e., low degree of contact metamorphism, leading to rich granite, diorite, marble, serpentine, and dolomite (Sichuan 1999:514).

Despite the difficulties and potential confusion, identifying divergent sources of raw clays can still shed insights into potters' technological choices and the interactions among social groups. For example, it has long been thought, though little further details have known, that the archaeological culture of the Upper Min River and the Dadu 大渡 River had certain connections with the Majiayao 馬家窯 Culture in the Gansu-Qinghai region to the north. This has become clearer by comparing the chemical compositions of painted pottery in the two regions, which has confirmed that in Sichuan, both imports and local imitations exist and can be distinguished (Hung Ling-yu et al. 2011). I will discuss issues like this one regarding production traditions and the exchange or social networks later in my dissertation. Before doing so, however, an introduction to the relevant sites and their comparability will help us understand the characteristics of the relevant settlements and how they might be connected. The comparisons will be centered on the bronze cultures of the Chengdu Plain, especially the Shi'erqiao Culture (*ca.* 1250-600 BC), and the exemplification of sites aims to clarify the inter-site relations from the perspective of pottery production.

2. Chengdu Plain before the Shi'erqiao 十二橋 Culture (before *ca.* 1250 BC)

Before the Shi'erqiao period, a distinctive Sanxingdui Bronze culture prevailed in the Chengdu Plain, making the region, and even the whole basin, distinguishable from other regions. The Sanxingdui Culture in turn developed on the basis of the local Neolithic tradition, namely the first phase of Sanxingdui or the Baodun Culture, along with the influences from, and interactions with, other cultures. Such traditions deeply affected the

Shi'erqiao and the later cultures of the region. An overview of the preceding cultures and featured sites may enhance our understanding of the Bronze Age Chengdu Plain.

2.1. Baodun 寶敦 Culture (*ca.* 2700-1700 BC)

Since 1995, a series of walled sites have been discovered, one after another, from the Chengdu Plain. These walled settlements together made up the Neolithic culture of the Chengdu Plain and have enhanced our understanding of other contemporaneous cultures found in the entire Sichuan Basin (Jiang Zhanghua et al. 1997; Sun Hua 2000:287). These walled sites include Baodun at Xinjin 新津 (Sun and Chen1999; Chengdu et al. 2000), Yufu 魚凫 at Wenjiang 溫江 (Chengdu 1998; 2001:40-53; Jiang cheng et al. 1998), Mangcheng 芒城 at Dujiangyan 都江堰 (Chengdu and Dujiangyan 1999; Zhong Ri 2001a, 2001b), Shuanghe 雙河 (Chengdu 2002) and Zizhu 紫竹 (unpublished) at Chongzhou 崇州, and Gucheng 古城 at Pixian 郫縣 (Jiang and Yan 1999; Chengdu and Pixian 2001) (Figure III-3). All are clustered closely together, each within a range of 10-30 km of each other, and several of them seem to have been inhabited simultaneously. Because Baodun makes for the largest (*ca.* 600,000 m^2) and most characteristic settlement, these Neolithic walled-sites are together known as the sites of the Baodun Culture. Researchers have speculated that the establishment of these walled settlements in the Chengdu Plain was influenced by the cultures in the Middle Yangzi River, where the earliest walled settlement has been found so far (He and Hunan 2007; He Jiejun et al. 2007; Yasuda 2007). Archaeologists also believe that certain patterns of formation of 'cities' can be found in these two parallel regions (e.g., Yasuda 2004:560). Based on similarities between the walled settlements in the Upper and Middle Yangzi River basins, such as the cultivation of rice and traces of ritual-related activities, scholars have stressed

the importance of population growth and the complication of social organization that resulted during this city's formation. Others have also suggested that easy access to timber and rice husks in the Yangzi River valleys would have provided the necessary fuels to support pottery firing, including the pottery production around the Chengdu Plain (Yasuda 2004:561).

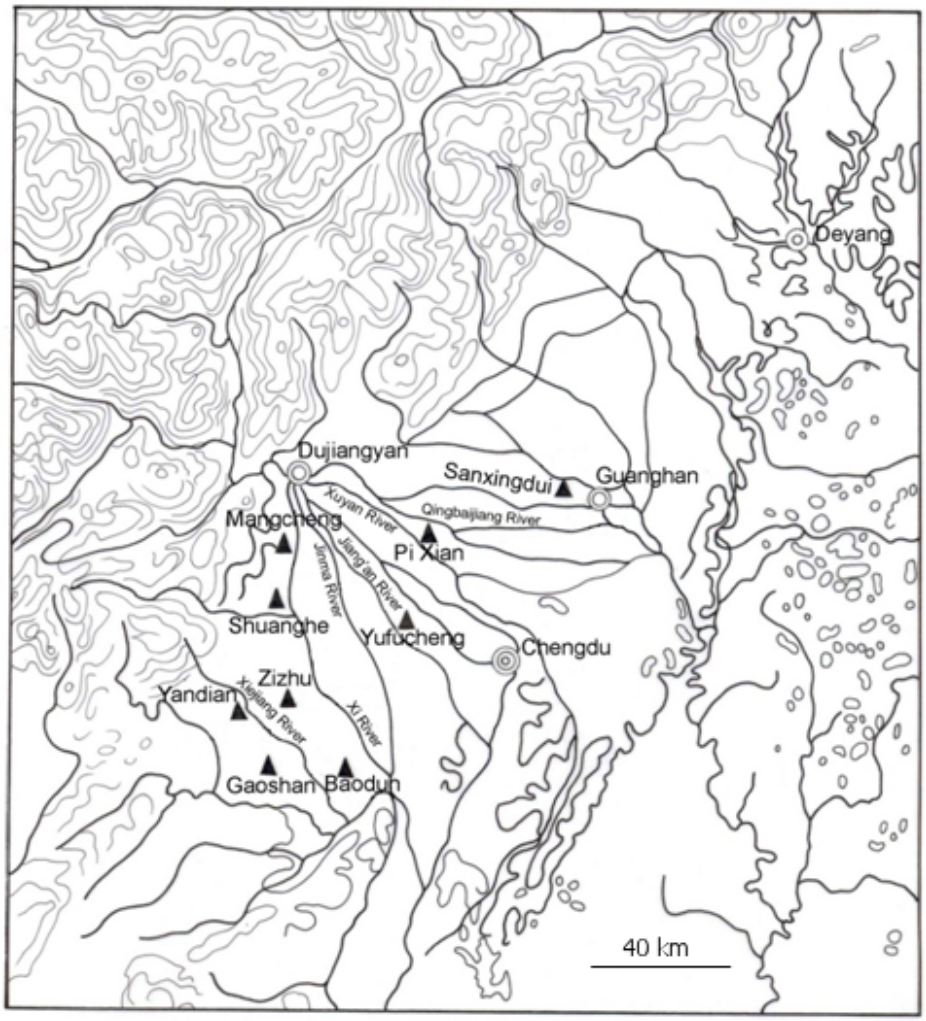


Figure III-3: Walled settlements of the Chengdu Plain

In the Chengdu Plain, archaeologists have also observed that the walled settlements often aligned with river courses and that the settlements closer to the alluvial plain center

were larger than those near the foothills (Jiang Zhanghua et al. 2000:102). Such patterns reveal the way the ancient settlers responded to their landscapes. With the growth of settlements, people had probably learnt the potentiality to transform the surrounding lands into the hinterlands of the walled centers. To incorporate the suburbs with the old centers would have shaped or reshaped the nature of the walled-settlements and relations between walled and unwalled villages.

Whereas the nature of these settlements and the mechanism needed to construct the walls and perhaps their moats are unclear, the construction projects *per se* demonstrate an investment in, as well as the organization and mobilization of, labor. One estimate suggests that the construction of the walls would have required more than 250,000 m^3 of earth to which the stamping technique was applied (Jiang Zhanghua et al. 2000:106). This would, in turn, have required a great deal of labor devoted to non-subsistence activities. The organization of labor and public activities is also reflected in the construction of a large building in Pixian Gucheng (F5), for instance. It is worth noting that the building was 550 m^2 large without any partition, and the floor inside the building was raised. Furthermore, the construction is nearly located in the center of the settlement and was surrounded by other smaller houses. These 'satellite houses', including four wattle-and-daubs (*muguniqiang* 木骨泥牆) and two stilts (*ganlan* 干欄), all faced the large building in the center (Chengdu and Pi Xian 2001:32; Jiang and Li 2002:83). The stilts first found in Pixian of the Baodun period, together with wattle-and-daubs, are both lasting building styles in the region as well as southern China. Sites such as Baodun, Mangcheng, Sanxingdui, Yufu, and, later, Shi'erqiao and Jinsha are all equipped with similar features.

As to the type site, Baodun yielded a rich assemblage of ceramics including cord-marked decorated-rim jars (*shengwen huabian guan* 繩紋花邊罐), ring-footed beakers with everted-rims (*changkou quanzu zun* 敞口圈足尊), ring-footed beakers with dish-shaped mouths (*pankou quanzu zun* 盤口圈足尊), wide-lipped vessels such as flat-bottomed beakers (*kuanyan pingdi zun* 寬沿平底尊), long-necked jars with trumpet-shaped mouths (*labakou gaoling guan* 喇叭口高領罐), and high-stemmed, mounted saucers with ring feet (*qianpan gaobing dou* 淺盤高柄豆). These vessel types also have representatives that can be found in other Neolithic settlements, including Sanxingdui (phase I), though not necessarily all together. Many of these vessels were apparently quite large, both with and without ring feet. The most frequently found vessel types are illustrated in Appendix III-Figure 5. These characteristic types are not limited to the Chengdu Plain, but are extensively distributed across the Sichuan Basin. Their counterparts can be found in eastern Sichuan, such as Shaopengzui 哨棚嘴 (*ca.* 4300-1800 BC) (Sun Hua 2000:298). The distinctive water-wave decorations that were often applied to fine wares in Baodun can also be found in such sites as Weijialiangzi 魏家梁子 (*ca.* 2700-2000 BC) further east (Wu and Cong 1996; Zhongguo 1996).

Interestingly, the potteries at one point reached a high level of quality in the very early phase of the Baodun culture, but nevertheless began to deteriorate towards the end of the Neolithic culture (e.g., Jiang Zhanghua et al. 2000:104). Fine wares that had dominated early phases (I and II) became less and less common just as their decorations became less delicate. For instance, most of the ceramics appear very coarse and loosely bonded with large inclusions, as shown by the sherds found in recent surface surveys

around the walled sites in Pixian and Yufu (Team of International Archaeology Survey 2010), both of which developed during the late Baodun phases. If this 'decline' in pottery fabrication suggests a backward development in manufacturing techniques, the coarse wares found in late Baodun nonetheless still display a deliberate selection of temper materials and tempering behavior, as angular quartz of roughly the same size is often evenly distributed in the clay matrix. Furthermore, the Chengdu Plain was not the sole place encountering a 'decline': it also occurred in many other places, including settlements in eastern Sichuan. To explain this large-scale phenomenon, population stress or movement, environmental or resource deterioration[13], social disintegration, and economic factors all need to be considered. We should also take other production systems and social life into account.

2.2. Sanxingdui 三星堆 Culture (1700-1150 BC)

Although the Sanxingdui culture represents the first bronze culture in the Sichuan Basin, the site had in fact been occupied since Neolithic times, though the inhabitants did not seem to construct any walls and the settlement had not grown to be a large one. In this early phase, the site yielded counterparts of the Baodun ceramics and is thought to be a part of the Baodun Culture (Appendix III-Figure 6). The gap between the first phase of Sanxingdui and its later ones, however, is evident in settlement scale and pottery types. It is only from the second phase that Sanxingdui grew to be the largest center, while other walled settlements in the region at the same time declined (Appendix III-Figure 7 for the layout of the walled Sanxingdui). This development, which was parallel to the introduction of metals, also signaled the advent of a new age and has been recognized as

[13] For example, deforestation and shortage of fuel (see Rice 1984:49).

the Sanxingdui Culture. It has been argued that external factors, particularly influences from the middle Yangzi and Central Plains, had promoted changes in the Chengdu Plain (Sun Hua 2000; Jiang and Li 2002:86-90; Sun and Yang 2006).

During the time metals were first adopted in Sanxingdui, it seems that pottery production in the region experienced a 'decline' in quality. As with the late Baodun settlement, coarse wares gradually replaced fine wares as the major focus of ceramic production, though vessel types remained roughly the same (Sun Hua 2000:306, 321; Chen and Liu 2002). Whether the two events were associated requires further studies. At present we can only say that, despite the decline in ceramic quality, ceramics produced in Sanxingdui were not made in a rough or slipshod way, based on an inspection of their textures and post-deposition condition. A considerable number of grayish, fine wares were discovered at the site and even coarse wares were often well fabricated. The characteristic assemblage includes jars with small, flat bases (*xiaopingdi guan* 小平底罐), ring-footed dishes (*quanzu pan* 圈足盤), high-stemmed mounted bowls (*gaobing dou* 高柄豆), bird-head-shaped dipper handles (*niaotouxing shaobing* 鳥頭形杓柄), *he* 盉 tripod, *ping* 瓶 vases, *hu* 壺 flasks, *gu* 觚 goblets, long-necked jars with trumpet-shaped mouths (*labakou gaoling guan*), closed-spouted pitchers with pouch-shaped feet (*daizu fengkou he* 袋足封口盉), and vessel covers (*qigai* 器蓋) (Appendix III-Figure 9-11). Among them, *he* seem to be the only tripods that circulated in the region. These tripods, together with *gaobing dou* and *gu*, are believed to have been inspired by the Erlitou 二里頭 culture (*ca.* 1900-1500 BC) in the Yellow River basin (e.g., Zou Heng 1996; Sun and Su 2003:73). It has also been observed that several pieces of bronze plaques inlaid with turquoise resembling Erlitou products were found at Sanxingdui although Sanxingdui

copies were cruder in design (Sichuan and Guanghan 1998:81). Owing to this resemblance to Erlitou ceramic and bronze items, scholars have usually proposed that there was once a connection between Sanxingdui and the Central Plains and that the metallurgy of Sanxingdui was developed under the stimulus of Erlitou (e.g., Sun and Su 2003:68-97).

Pointed-bottom vessels (*jiandi qi* 尖底器) had only appeared since the third phase. Yet, like another popular vessel type, *xiaopingdi guan*, they demonstrate a certain degree of standardization. This characteristic assemblage of Sanxingdui, including *jiandi zhan* and later on *jiandi bei* and *jiandi guan*, also shows its influence on other parts of the basin and beyond. The influence of Sanxingdui, if we use the pottery assemblage as a proxy, seems to have reached the Three Gorges Area and western Hubei further to the east, the Hanyuan 漢源 and Yibin 宜賓 areas to the south of Chengdu city, and the Upper Han River drainage in modern Shaanxi to the north. I revisit these when I discuss related sites.

Besides potteries, the development of a bronze-using culture from the second phase on especially made Sanxingdui into an influential and perhaps urban and religious center. A third excavation conducted in 1986 has particularly brought attention to the archaeological work of Sanxingdui, as two pits full of treasures were found. Together they yielded a considerable number of artifacts in gold, bronze, lithic, ivory, animal bone, and sea shell. The object categories include ritual vessels, ceremonial weaponry and implements, ornaments, life-form-realist items, unworked animal parts, and raw jade and gold. Only very rare potteries were recovered from this context, the vast majority of which are pointed-bottom vessels and stands. Because the pits were dug into neat rectangles in which concentrations of luxury goods were burnt before being interred layer

by layer, they are thought of as unusual sacrificial pits. The bronze items found in these pits have also become important indicators through which to trace the heritage of Sanxingdui after its collapse. It is through this tradition that Jinsha of the Shi'erqiao period is thought to be the continuing center of the plain following Sanxingdui.

The large quantity of bronzes, both in number and in volume[14], has raised much interest in their production, including raw-material and typological provenances as well as casting techniques (e.g. Jin Zhengyao et al. 1995; Falkenhausen 2002; Sun and Su 2003:399-443; Xu 2008). Although direct evidence of foundries has not been discovered, some bronze heads, vessels, and even the only life-sized, standing statue were found to contain burnt clay in their cores, indicating that they were locally produced (Sichuan 1999:22, 162; Falkenhausen 2002). In addition, production tools, such as crucibles, have been found in the settlement. The life-sized bronze tree, figures, heads, and masks have especially been considered characteristic of the regional bronze production. For some of these items, the practice of casting with section molds and spacers is clear (Xu 2008:165). Joining techniques like patch repairs were also extensively adopted. Whereas these production techniques had been well known in other bronze-era traditions, especially in the Central Plains in North China, hammering techniques, which were rarely applied elsewhere in Bronze Age China, seem to have been exclusively mastered by Sanxingdui crafters. Like a number of gold foils, bronze foils in a variety of designs with only 0.1-0.2-cm thickness are not uncommon in both pits no. 1 and 2 (Sichuan 1999:33, 315-324; Chen Fangmei 2002, unpublished). Most of them became adhered to other items during burning.

[14] An estimate made by Jay Xu (2008:179) suggests that about 1,000 kg of bronzes, covering hundreds of objects, have been recovered from two pits.

Though some Sanxingdui bronze items find easy parallels in other cultures, it seems that others preserve more individual and local characteristics. However, this simple distinction might not be always clear. In many situations, especially with bronze vessels, the manufacturing workshops and sources of prototypes have provoked debate (see for example Falkenhausen 2003a:213-216; Xu 2008:103). For instance, it has been argued that the bronze vessels demonstrate close connections with the Middle Yangzi and further downstream basins as well as southern Shaanxi, whether as imports or local imitations. Briefly, *zun* 尊[15] and *lei* 罍 vessels of Sanxingdui find their counterparts in Wushan 巫山 (Chongqing)[16], Chenggu 城固 (Shaanxi)[17], Yueyang 岳陽 (Hunan), Zaoyang 棗陽 (Hubei), and Funan 阜南 (Anhui) (Sichuan et al. 1987b; Bagley 1992; Zou Heng 1996; Chen Xiandan 1999:166; Sichuan 1999: 447-448; Xu 2008:104-107). In a number of these examples, the bronze vessels were found to contain cowry shells, small bronze, and/or jade objects in the interments. The functions of these vessels seem to have diverged from those of the Central Plains where the same vessel types were used to serve liquids, as several authors have argued (e.g., Rawson 1996:70; Falkenhausen 2003a:216).

The production of large numbers of lithic weaponry, tools[18], and ornaments along with their distinctive designs is another distinguishing feature of Sanxingdui that was also inherited by Jinsha later on. Among them, stone or jade *bi* disks, *zhang* blades or scepters, and *cong* 琮 tubes are notable ritualistic items, especially when the same types of ornaments have been widely distributed in other regions (Deng Cong 1994; Falkenhausen 2003a:199) (Appendix III-Figure 12 for the distribution of *zhang* blades). Besides, *bi*,

[15] E.g. K1:158 (Sichuan 1999:35 fig. 23) and K2②:146 (Sichuan 1999:252).
[16] E.g. Dongba B010 (Sichuan et al. 1998:9).
[17] E.g. 1963CHBSTT:1 (Zhao Congcang 2006:70)
[18] Because they do not have use wear, they could still be ritual items.

huan 環 rings, and *yuan* 瑗 rings were notably made in varied sizes, in which small items were sometimes made from the remnants of larger ones. The largest *bi* discovered so far is more than 50 cm in dimension (Sichuan and Guanghan 1998; Graham 2006[1934]:37). These types of objects, plus *huang* 璜 pendants and their raw lithics or semi-finished products, have been repeatedly found in the later sites of the Chengdu Plain, such as Shuiguanyin, Jinsha, and Xinyicun. From the quantities of lithic products and semi-finished products and the accessibility to raw materials, I suggest that the workshops for jade and stone were within, or close to, these settlements. Moreover, some objects, such as collared *yuan* rings and collared, square-holed objects (*fangkong bi* 方孔璧), which were originally made in lithics, have bronze copies. The selective implementation of the same type of objects in different media can also be found in cross-cultural passed objects, such as pointed-bottom vessels, discussed below.

With the discovery of two sacrificial pits, wall and building remains, and likely production spaces, the settlement has been regarded as the then urban center of the Chengdu Plain with its influence reaching throughout the large basin. Yet the spatial arrangement of the settlement has not been fully understood. The cemetery grounds and residential areas found so far do not seem to match the richness of the sacrificial pits. Among the limited findings, a number of residential features in simple and wattle and daub forms were recovered. They were constructed by framing walls with timbers and bamboos on which mud was plastered. The walls may have been fired to be solid. Both rectangle and circular houses can be found without a fixed pattern. They were only in moderate sizes (i.e., 10-25 m^2, see Appendix III-Figure 13, for example) (Sichuan et al. 1987a:232-236; Chen Xiandan 2010:29). As to burial grounds, cemeteries other than the

one in Rensheng 仁勝 are hardly known. The Rensheng cemetery was used for this purpose before the construction of the walls (Sanxingdui Yizhi Gongzuozhan 2004) (Appendix III-Figure 14). Although the grave goods are only very limited (i.e., mainly lithics and very few pieces of pottery and ivory are present), the burials together have yielded 61 lithic objects, illustrating the earliest jades known to the Chengdu Plain (Sichuan 2004:22). They include chisels, awls, axes, arrowheads, and disk-like or spindle whorl-like items, which might be related to production activities. Among the few potteries found, the use of a ring-footed, mounted bowl (*quanzu dou* 圈足豆) (Figure III-4) and similar items as grave goods is worth noting. The interment of *dou* with the dead and, later, the similar looking pointed-bottom *zhan* saucers constitute a distinctive mortuary custom in Sichuan. Besides these small items, the differentiation in grave goods and treatments of the dead is not evident among the burials however. There remain some burials scattered in other loci[19]. They too contain very few grave goods.

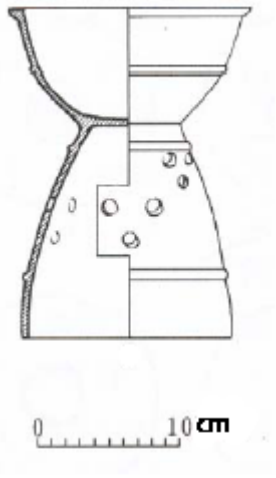


Figure III-4: Mounted bowl with openwork ring foot (97GSDgM10:8) from the Renshengcun cemetery (Sichuan 2004:19).

[19] E.g., the locus excavated during 1980-81 (Sichuan et al. 1987a:236).

3. The Shi'erqiao Culture in the Chengdu Plain (1250-600 BC)

3.1. Shi'erqiao site cluster

The Shi'erqiao site cluster is concentrated in the modern city center. Besides the type site, a number of localities were populated during roughly the same period. These sites include Fuqin Xiaoqu 撫琴小區 (Wang Yi 1991:298-302; Sun Hua 1996; Wang Yi et al. 1999), Fangchijie 方池街 (Chengdu Bowuguan and Chengdu 2003), Junpingjie 君平街, Zhihuijie 指揮街 (Sichuan and Chengdu 1987), Minshan Fandian 岷山飯店 (Wang Yi et al. 1999), Minjiang Xiaoqu 岷江小區 (Chengdu 2001c), Yangzishan Tutai 羊子山土台 (Li and Zhang 1991:137-8), Xinyicun 新一村 (Chengdu 2004e), Jinsha 金沙, and Qingjiangcun 清江村 (Pixian) (Chengdu and Pi Xian 2001b). These loci are separate but distant from each other by only a few kilometers. Moreover, most of them were situated beside the ancient Pi 郫 River. The river possibly provided another form of transportation between these sites. However, it is also probable that some of these loci were disturbed or secondarily deposited by the river as alluvia were common in the stratigraphy of some loci. In either situation, the comparable remains they have yielded have forced archaeologists to consider this site cluster an integrated archaeological culture represented by the Shi'erqiao site. Together they extended for more than ten square kilometers around the Chengdu City (Figure III-5).

Besides the sites clustering around the city, there are several sites located in the peripheral areas of the Sichuan Basin yielding pottery assemblages similar to their urban counterparts. They are Shaxi 沙溪 in Ya'an 雅安 (Sichuan et al. 1990), Maiping 麥坪, Taoping 桃坪, and Majiashan 麻家山 in Hanyuan 漢源 (Daduhe 2003; Zhongguo et al.

2006; Sichuan et al. 2008), Pingshang 坪上 in Langzhong 閬中, and Shuiguanyin 水觀音 in Xinfan 新繁 (Deng Boqing 1959). Among the pottery assemblages, pointed-bottom vessels, particularly *jiandi zhan* 尖底盞, are the most distinguished. This vessel type prevailed in the region from late Sanxingdui on to the Warring States period of the fifth-third centuries BC (Sun Hua 1996; Jiang Zhanghua 1998a; 1998b; Song Zhimin 1998, 2005). The vessel assemblage served as not only an indicator to signify the presence of the Shi'erqiao Culture and help sketch a cultural sphere, but to also distinguish it from other cultures. I sampled a number of sites and vessel types from this culture for detailed examination and their significance is discussed below.

Although Jinsha is thought to be a part of the Shi'erqiao culture, it contains a number of loci, which were jointly separated from the Shi'erqiao site by about five kilometers. The nature of the site cluster is special and I single it out in discussion in the following.

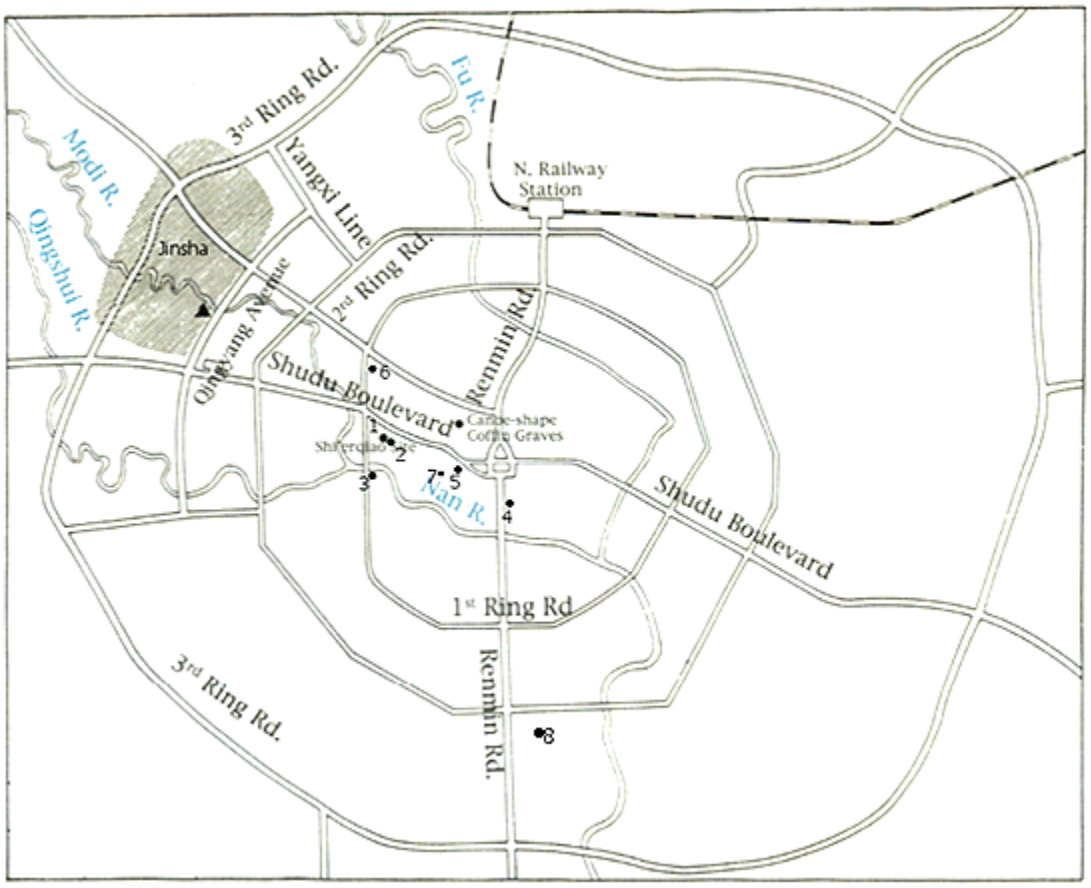


Figure III-5: Shi'erqiao site cluster in relation to modern city (center) (after Luo Kaiyu 1992; Sun Hua 1996:124 fig. 1; Chengdu 2006e:6).

1. Shi'erqiao (I-III)
2. Xinyicun
3. Qingyanggong
4. Zhihuijie
5. Shangwangjiaguai
6. Fuqintai Xiaoqu
7. Fangchijie
8. Minjiang Xiaoqu

3.1.1. Shi'erqiao type site

Two campaigns of excavation have been undertaken at the site in 1985 and 1987 (area I and II respectively). The excavation area is 15,000 m^2 in total. Remains of the Early and Middle Bronze Ages are mainly concentrated on the tenth to the thirteen layers of the stratigraphy (Appendix III-Figure 15). From the remains of this type site, its changing members of the pottery assemblage through time, and the transformation in the shape of pointed-bottom vessels, archaeologists have proposed to divide the culture into two to three phases (Sun Hua 1996;

2000:68-88; Sichuan and Chengdu 2009). Among them, the thirteenth layer of the site played a key role in linking the culture to Sanxingdui. In particular, this stratum yielded pottery types typical of Sanxingdui, including jars with small, flat bases (*xiaopingdi guan*), pointed-bottom *zhan* saucers (*jiandi zhan*), high-stemmed bowls (*gaobing dou*), bird-head-shaped dipper handles (*niaotouxing shaobing*), *he* tripodal spouted pitchers, *ping* vases, cord-marked decorated-rim jars (*shengwen huabian guan*), *hu* flasks, and vessel covers (*qigai*) (Figure III-6). These vessel types are nearly identical to the pottery assemblage of Sanxingdui and suggest a close relationship between the two cultures. In particular, *xiaopingdi guan* that seem to have been fairly standardized and abundant in Sanxingdui were also the most popular vessel type in early Shi'erqiao. They have been found through the thirteenth to eleventh layers of the stratigraphy, but the number of vessels gradually decreases over time. Conversely, pointed-bottom vessels are not frequently found during the first phase of Shi'erqiao but get richer from then on. Despite there being only a scattering of *jiandi zhan* found in the early phase, their parallel to Sanxingdui *jiandi zhan* is clear. Counterparts of the type A *jiandi zhan* from Sanxingdui sacrificial pit no. 1 can be found in Shi'erqiao (IT2⑬:4) (Shichuan and Chengdu 2009:79), Jinsha-Lanyuan (H305:1-1, 1-2, 20) (Chengdu 2003a:19) and Shuiguanyin (T43.3:1)[20] (Deng Boqing 1959:406) (Figure III-7), for example. Meanwhile, vessel types like long-necked jars (*gaoling guan*), jars with inverted-rims (*liankou guan* 敛口罐), ring-footed tureens (also known as *guixingqi* 簋形器 here), *pen* 盆 basins, and pointed-bottom *bei* cups (*jiandi bei* 尖底杯), which have rarely been found in the Sanxingdui assemblage, have been added to the early Shi'erqiao assemblage. Whereas the Sanxingdui-like vessels gradually disappeared, these new members became a lasting feature in Shi'erqiao. The overlap in pottery vessels between Shi'erqiao and Sanxingdui

[20] Where the vessel is termed as *jiandi bo* 尖底钵 by the excavators.

is thought to denote the transition from the late Sanxingdui to the early Shi'erqiao period. Furthermore, precious goods recovered from Shi'erqiao-related sites, such as bronze tools, figures, and vessels and lithic objects, are also reminiscent of Sanxingdui sacrificial pits. Scholars have suggested that the two cultures were not only closely related but that Shi'erqiao also succeeded Sanxingdui as a political center after its decline (e.g., Sun Hua 2000:9), which probably occurred between *ca.* 1300-1200 BC (Sichuan and Chengdu 2009:133).

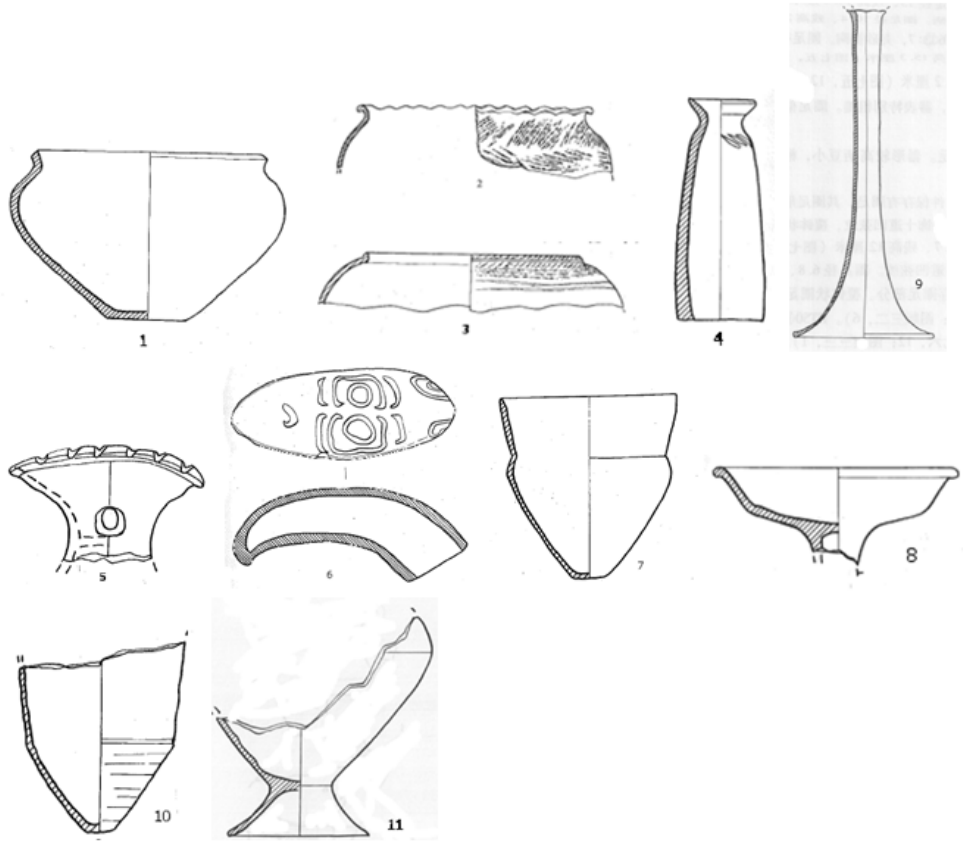


Figure III-6: Characteristic vessel types of early Shi'erqiao (13th layer) (not to scale) (Shichuan and Chengdu 2009).

1.x*iaopingdi guan* (IT2⑬:5); 2. *huabian kouyan guan* (IT23⑬:32); 3. *liankao guan* (IT24⑬:26); 4. *ping* vase (IT19⑬:14); 5. Vessel-cover button (IT16⑬:60); 6. *niaotouxing shaobing* (IT1⑬:11); 7. collared *jiandi bei* (IIT50⑬:6); 8-9. bowl (IT6⑬:5) and handle (IIT50⑬:49) of *gaobing dou*; 10. artillery-shell-shaped *jiandi bei* (IT1⑬:69); 11. ring-footed tureen (*guixingqi*) (IIT50⑬:10).

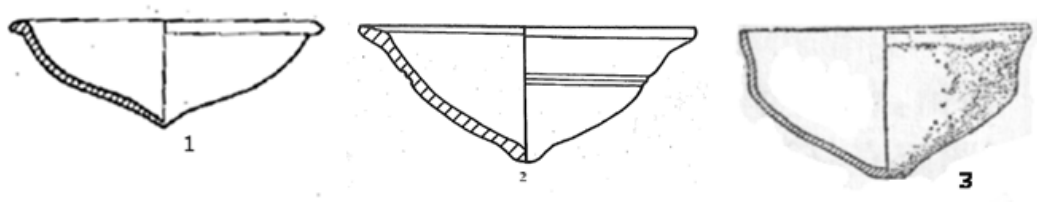


Figure III-7: *Jiandi zhan* in the early period
1. Sanxingdui K1:334 (Sichuan 1999:146, 148); 2. Shi'erqiao IT2⑬:4 (Shichuan and Chengdu 2009:79); 3. Shuiguanyin (T43.3:1) (Deng Boqing 1959:406) (no to scale).

With reference to Sanxingdui, it is possible to define the chronology of Shi'erqiao to help set a framework for discussion. If the similar pottery assemblages and other parallels between Sanxingdui and Shi'erqiao seen in the thirteenth layer of the latter offer evidence for the transition between the two cultures and help with the dating of the stratum, the continuum of the following strata and their respective dating should be in dispute. On the one hand, the excavators believe that there is a gap between the twelfth and eleventh layers, from which they have divided the locus into two phases. On the other hand, scholars like Sun Hua (1996:124) have argued that the locus was left off after the deposit of the eleventh layer, which makes the difference between the eleventh and tenth layers noticeable. For Sun, the inconformity between the twelfth and eleventh layers is relatively minor. This conflict in the degree of homogeneity might be due to the unbalanced findings of each stratum, the disturbance of some strata, and the unreliable data of ^{14}C dating. Because the remains of the eleventh and tenth layers have been largely removed by modern construction activities before archaeological excavation, I suggest that the reduced number of cultural deposits in these two layers does not speak to their inherent difference from the earlier phase. Nonetheless, the dissimilarity between the thirteenth and twelfth layers is discernible, although it might not be tremendous, as vessel types became more diverse and ceramic color moved from brownish to grayish. In this study, the chronological scheme proposed by the excavators is adopted during sampling and data-analysis. That is, the thirteenth layer is

considered as the first phase, followed by the twelfth layer, and then the eleventh through tenth layers. This rough dating scheme serves to set the thirteenth layer, which is contemporary with the last phase of Sanxingdui and late Shang in the Central Plains, at *ca.* 1300-1200 BC; the twelfth layer occurs at the transition between Shang to Zhou (*ca.* 1200-1000 BC); and the eleventh through tenth layers appear during the early Western Zhou period (*ca.* 1000-900 BC).

Besides influences from Sanxingdui, scholars like Jiang Zhanghua (2007:400) have proposed that the material culture of Shi'erqiao was affected by eastern-side contemporaries, such as the Xianglushi 香爐石 culture, perhaps owing to population movement during this time. Archaeologists suspect that with this cultural influence, vessel types such as a more voluminous, collared type of *jiandi bei* (for example, Figure III-6.7) were introduced to the Chengdu Plain via eastern Sichuan along with the hypothesized population migrations (e.g., Sun Hua 2000; Jiang Zhanghua 2003:78). In addition, the westward population movement also brought the oracle-bone-divination custom prevalent in eastern Sichuan and western Hubei but absent from the Chengdu Plain before Shi'erqiao. At the Shi'erqiao site, tortoise plastrons used for divination have been found throughout the stratigraphy, whose drilling patterns changed over time. It is believed by these authors that such a custom, though without inscriptions, originated in the Central Plains, and was first introduced to the Middle Yangzi valleys, before finally passing on to the Chengdu Plain during the Shi'erqiao period. This divination custom turned out to be one of the major differences between Sanxingdui and Shi'erqiao cultures. Through the Middle Yangzi and eastern Sichuan, artifacts and perhaps manufacturing techniques too were imported from even more afar in areas such as the Lower Yangzi drainages. Through interactions, objects and pottery types of the Chengdu Plain, including *jiandi zhan,* also reached the Middle Yangzi.

The import and export of a wide range of goods and craft demonstrates the bi-directional communications between the Chengdu Plain and other areas.

From the first phase on, the pointed-bottom vessels became the most prevalent vessel type. They are traditionally divided into three main vessel types—pointed-bottom saucers, pointed-bottom cups, and pointed-bottom jars (*jiandi guan* 尖底罐)—along with several varieties. The type-variety divisions have not, however, been clearly addressed or well defined. While different varieties of *jiandi zhan* may only differ slightly in the shape of rims and bottoms, *jiandi bei* and *jiandi guan* seem more changeable in shapes and dimensions even during the same period. Appendix III-Figure 17 and 18 for example, show different varieties of *jiandi bei*, including collared, carinated-shouldered *jiandi bei* and artillery-shell-shaped (*paodanxing* 砲彈形) *jiandi bei*. The former can be seen from Sanxingdui IV (Appendix III-Figure 11.2) and were even widely distributed in eastern Sichuan. Appendix III-Figure 19 demonstrates *jiandi guan* appeared in less fixed shapes. The changing appearance of vessel types is not only a result of temporal and spatial factors, but could also be a combinational phenomenon caused by ambiguous type-variety definitions. I will revisit this issue when discussing standardization in the next chapter.

From the twelfth layer of the stratigraphy, vessel types, such as jars with trumpet-shaped mouths (*labakou guan* 喇叭口罐), jars with carinated shoulders (*zhejian guan* 折肩罐), and kneaded vessel covers (Figure III-8) emerge as new members of the pottery assemblage. However, these vessels were neither widely distributed nor enduring. Meanwhile, vessels like *he* tripodal spouted pitchers and bird-head-shaped dipper handles became extinct. The varieties and quantities of pottery vessels gradually reduced during this period and onwards, perhaps because

of the pre-excavation removal as mentioned above. The notable lack of tripods and round-bottom vessels[21] is another distinction between the pottery of the western and eastern Sichuan Basin.

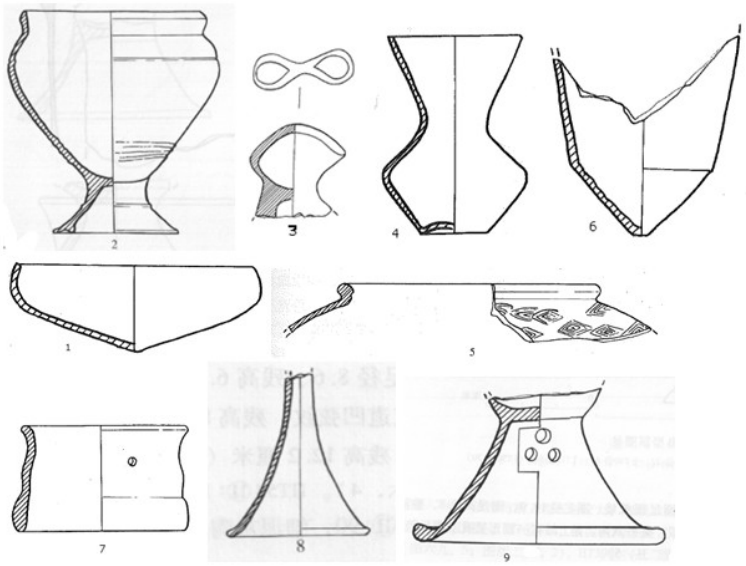


Figure III-8: Characteristic vessels of Shi'erqiao II
(not to scale) (Shichuan and Chengdu 2009:46, 51, 74, 79, 86, 89, 91, 102, 107).
1. *jiandi zhan* (IT18⑫:3); 2. ring-footed *guixingqi* (IT16⑫:35); 3. kneaded vessel cover (IT7⑫:81); 4. *labakou guan* (IT16⑫:58) 5. *liankou guan* with multi-layered rhombic marks (IT8⑫:55); 6. *jiandi bei* (IT1⑫:19); 7. vessel stand (IT1⑫:25); 8. foot of *gaobingdou* (IT23⑫:17); 9. ring foot (IT14⑫:14).

In addition to pottery vessels, the site also yielded a significant number of production tools for other materials. For instance, pottery spindle whorls have been frequently uncovered from nearly every layer of the stratigraphy, particularly the thirteenth and twelfth layers. They are normally made from fine clays, polished, and decorated with punctuations, cord marks, or other designs, some of which even bear inscribed symbols (Figure III-9). It is worth noting that as spindle whorls were sometimes found from burials together with *jiandi zhan,* as seen in the Jinsha cemeteries, the potteries likely signify certain social differences, perhaps professional differences, and were of social importance. Besides the well-made spindle whorls, such items

[21] Round-bottom vessels like *fu* 釜 cauldrons, though were popular cooking vessels in eastern Sichuan, had not been widely acknowledged in the Chengdu Plain during the Shi'erqiao period. The only evidence is one piece of *fu* found at the twelfth layer. Whether it was mixed from the late stratum is dubious.

were also sometimes produced from disused sherds. In such cases, coarse sherds originally bearing cord marks were rounded and had holes drilled in their middles (Figure III-10). Similarly processed, much rounded, broken pottery though without holes was uncovered from the area that serves an unknown end. Broken items including potteries were perhaps patched up, modified, or recycled for different uses like the case of spindle whorls. It is not always possible to identify the function of an object in such situations. In other cases, fired ceramics, after discarded, might have been reused as temper additives, which would be difficult to detect if without ethnographic observation or mineralogical analyses (Reedy 2006:146-148).

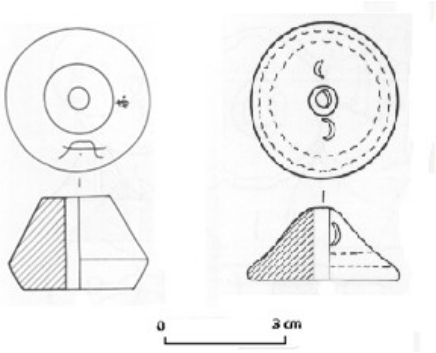


Figure III-9: Spindle whorls with inscribed symbols discovered in Shi'erqiao (IT22⑫:3; IT15⑫:77) (Shichuan and Chengdu 2009:111, 113).

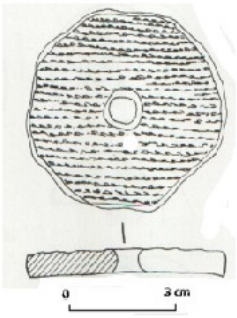


Figure III-10: Spindle whorl made from disused ceramic sherd with cord marks found in Shi'erqiao (IT8⑫:33) (Shichuan and Chengdu 2009:114).

Other categories of artifacts found in significant numbers in Shi'erqiao are stone and bone tools, which may be of importance in the ritual life as well as in providing subsistence. Besides oracle bones mentioned above, a variety of polished bone tools, such as bone awls, needles,

chisels, hairpins, and arrowheads, have been uncovered. Unworked or burnt bones were employed during ritual-related occasions from Sanxingdui and continued in Jinsha. Stone objects are another category demonstrating working processes. They are all small, polished items, such as *fu* 斧 axes, *ben* 錛 adzes, and chisels. Although the stone ornaments were discovered only in moderate numbers, semi-products are, nonetheless, not rare. For instance, 142 pieces of the so-called *panzhuangqi* 盤狀器 stone disks were uncovered at Shi'erqiao (Figure III-11:1). They were initially processed from shale, a rock type not difficult to work and drill. Figure III-11 illustrates one type of ornament, *bi* disks, and their semi-products. Same material was often used to make *huang* pendants as well. The prevalence of these objects can be sourced back to Sanxingdui, where *bi* disks were made in varied sizes.

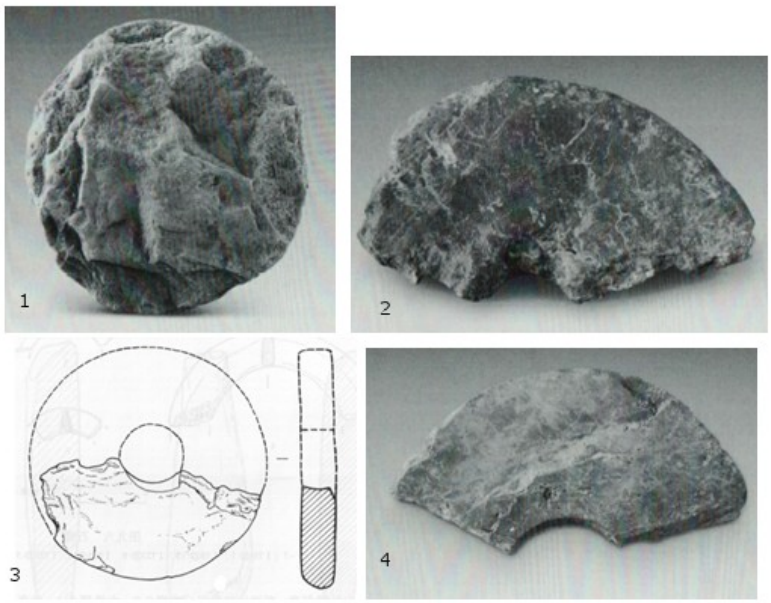


Figure III-11: Worked stone material (*panzhuangqi*) and *bi* disks
1. IT15⑫:30; 2-3. IIT43⑪:123; 4. IIT54⑩:35 (not to scale).

These other production activities, including spinning and lithic- and bone-tool working, may or may not directly relate to pottery production. But together they were organized in a specialized way, in which different crafts formed their own divisions of labor in production, yet

were complementary or intersecting with each other. In the example of Shi'erqiao, potteries were associated with food preparation, textile production, and perhaps, also in agreement with subsistence and other production activities, in scheduling. The relationship between bone or lithic tools and subsistence economies, such as agriculture and fishing, is even more evident. These various types of production, organized in the household or community level, need to be considered in a larger framework and in accordance with public activities, as labor and other forms of resources might have to be shared among these activities, as some scholars have argued (Hagstrum 2001; H. Miller 2007).

Though the public spaces and scenes in which ancient people lived might be hard to reconstruct, such an attempt would be beneficial when considering production activities in an integral manner. In particular, the Shi'erqiao site is famous for its well-preserved wooden constructions built at the end of the second millennium BC (beneath the twelfth layer of the stratigraphy). A considerable quantity of logs and bamboos in varied sizes has been recovered from the site that was near the ancient river course. The building clusters were constructed to be *ganlan* style (or stilts) common to the Chengdu Plain, like those in Pixian (Chengdu and Pi Xian 2001:32). However, such constructions, scattered over 1,300 m^2 and still beyond current excavation scope, have not been found on such a large scale and in such detail before. Not only have the constituents been preserved, but their relative positions and joint ways can also be clearly inspected. According to the scattered constituents and post-hole patterns, one of the wooden buildings (F1) was likely a 175-square-meter long-house (Sichuan and Chengdu 2009:20). This, however, might only have been a small part of the building cluster. It is found that tongue-and-groove joint techniques had been mastered for the woodwork. Archaeologists believe that the buildings were well planed and worked so that they not only were symmetrical in

their own internal parts with several partitions inside, but also formed a spatial pattern, in which different buildings seem to correspond to each other (Sichuan and Chengdu 2009:37). Though the use of the constructions cannot be certain at present, the excavators suggest that they might be palace buildings. I hold this assumption in abeyance, but I do suspect that some of the constructions were resided in by kinship related families or were linked to public activities. To procure, work, and erect the large logs would have required considerable labor and to carry out such tasks, they would have to organize and mobilize the public. Nevertheless, such task-oriented organization was probably only maintained for short time periods that did not necessarily require workers to give up autonomy.

The lifted constructions, the slight displacement of the constituents from their original grids, and the presence of the ancient river course and river sands in the stratigraphy probably suggest that the locus was subject to floods. These flood-like traces may also be found in many loci including those discussed in the following.

3.1.2. Zhihuijie 指揮街

Located in the southeast of the Shi'erqiao site, this locus has been recognized as a secondary-deposit site most probably created by ancient flooding (Sichuan and Chengdu 1987; Sun Hua 1996). The lower stratigraphy (i.e., the 5Bth and 6th layers) yielded mixed types of vessel sherds from the early Shi'erqiao to the early Warring States period (5th century BC) (Sun Hua 1996:131). Such a long span of time is inferred from the vessel types but is not equivalent to the duration the stratigraphy formed, as Sun Hua has pointed out (1996). Although it is nearly impossible to date each stratum precisely, such a site can be treated as the result of the natural selection on material cultures from various sources.

From identifiable vessel bottoms, we can tell a large part of the vessels are pointed bottoms (about 45.6%) or have ring feet (23.4%). Flat-based vessels make up the third largest group and round-bottomed wares are rare (only about 3.4%). The pointed-bottom vessels are equipped with different features that have been attributed to varied periods. Taking *jiandi guan,* for example, Figure III-12 demonstrates that they are very diverse in shape and they could in fact be characteristic of different periods. The double-bellied jars (Figure III-12.2), for instance, only appear in Warring States burials (5^{th}-3^{rd} centuries BC) but not other periods. Examples like Figure III-12.4 illustrate that the ring-footed tureens might originally have been pointed bottoms before being transformed by attaching ring feet.

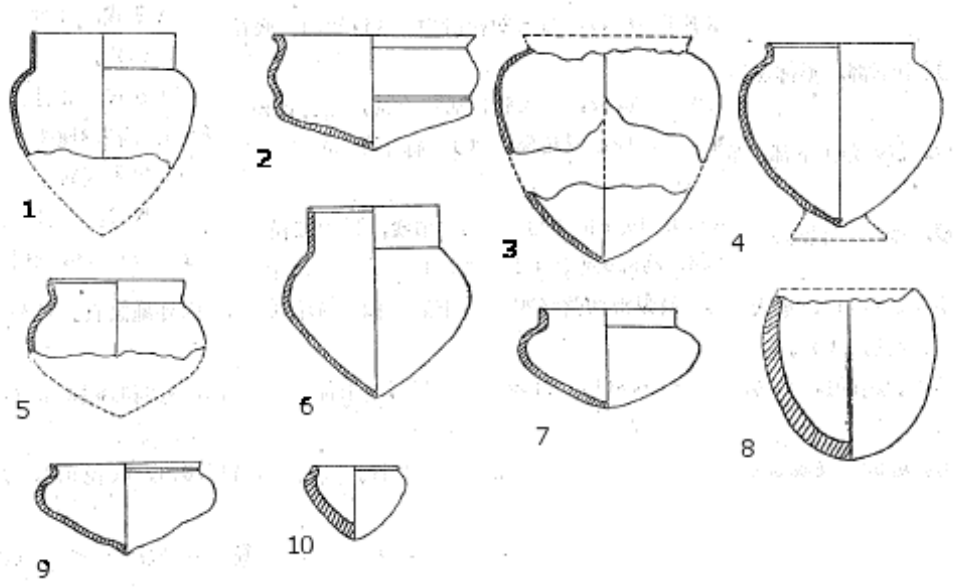


Figure III-12: Different varieties of pointed-bottom jars found in Zhihuijie (Sichuan and Chengdu 1987:183) (not to scale).

Because vessels from different periods are mixed together here, to refer to other sites, stratigraphy, and/or contexts becomes crucial for classifying the cultural contents of the site. Note, for instance, that the locus yielded vessels comparable to the first phase of Shi'erqiao, including small-flat-based jars, high-stemmed bowls, vessel-cover buttons, pointed-bottom vessels, and *he* tripodal spouted pitchers (Sun Hua 1996:131). The turtle shells used in

divinations were drilled into two styles: round holes that prevailed during early Shi'erqiao and rectangular holes that were characteristic of a later phase of Shi'erqiao, namely Xinyicun (Figure III-13). Besides the vessel assemblage similar to that of early Shi'erqiao, the second group of vessels of Zhihuijie contains mostly the varieties of the first group and can be generally found in other loci like Fuqin Xiaoqu, according to Sun Hua (1996:132; see also Wang Yi 1999:5). There remains the third group of vessels. However, the temporal gap between this group and the previous two is evident. For example, the double-bellied *jiandi guan*, round-bottom vessels and *ding* 鼎 tripods only appear during the Warring States period.

Pottery decorations are also diverse in Zhihuijie. For example, different varieties of multi-layered rhombic marks (*chonglingwen* 重菱紋) (Figure III-14) were often applied to coil the vessels for one to several circuits or were randomly impressed on vessel surfaces block by block. Similar designs were widely adopted in the Chengdu Plain from the Shi'erqiao period on. They can also be found in eastern Sichuan, western Hubei, and southern and middle Shaanxi[22], especially during the turn of the first millennium BC. In Zhihuijie, painted pottery (T3⑤:45) and lacquered pottery were present too. In both situations, pottery was painted or lacquered to be red on black. The painting is used to decorate the vessel rim and designed in the same way as the bronzes were (Figure III-15). Similar painting designs have been uncovered from Xinyicun, as discussed later. Besides painted pottery, black slips seem to be applied very often, as noted by the excavators. Sometimes only the inner surfaces were slipped (Sichuan and Chengdu 1987:180). Vessel types like *jiandi zhan* were always slipped on both sides. They also account

[22] Such as Zhangjiapo 張家坡 site in Chang'an 長安 (Zhongguoo 1999:110 fig. 85) and Yijiabao 壹家堡 site in Fufeng 扶風 (Beijing 1994:358).The connections between these sites and Chengdu Plain, however, are obscure. They are not discussed in this study.

for the majority of all vessels (67)[23] from this site. As slipping would significantly improve the permeability of vessels, making them more effective to hold liquids but still heat-shock resistant, this surface treatment probably had a functional purpose. It seems that the *jiandi zhan* of this site are close to each other not only in dimensions but also their production manner.

This site resembles Xinyicun in many respects, including the likely formation process of the deposits and the diversity of its remains. Further details will be discussed in the Xinyicun section.

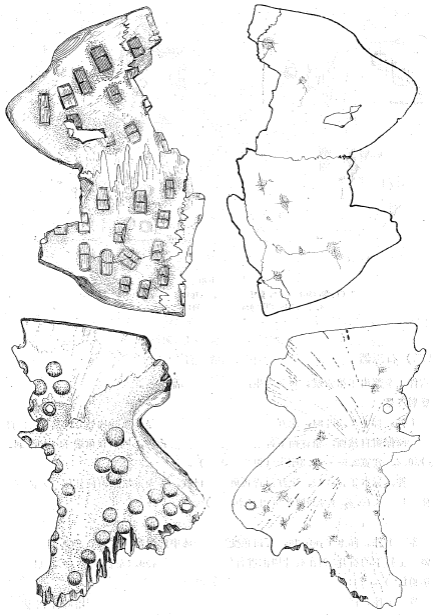


Figure III-13: Different styles of oracle-bone drilling holes found in Zhihuijie
Upper: T2⑥:48; below: T2⑥:32 (Resized to about 1/4) (Sichuan and Chengdu 1987:196).

[23] Not counting in the so-called *jiandi pan* 尖底盘 (pointed-bottom trays) that are of wider rim diameters than usual *jiandi zhan*.

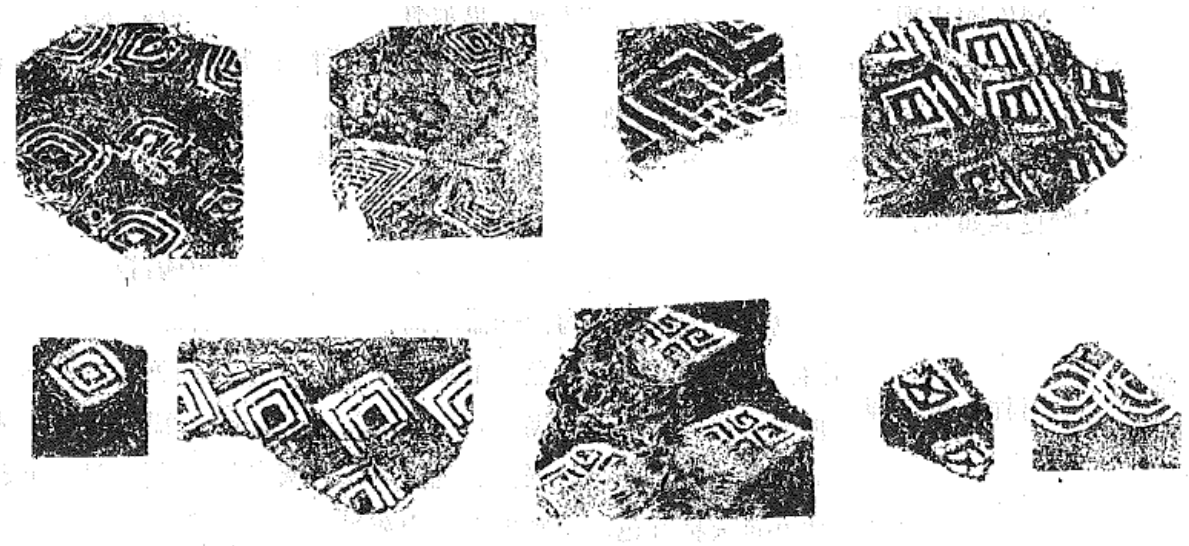


Figure III-14: Different variations of *chonglingwen* found in Zhihuijie (Sichuan and Chengdu 1987:179).

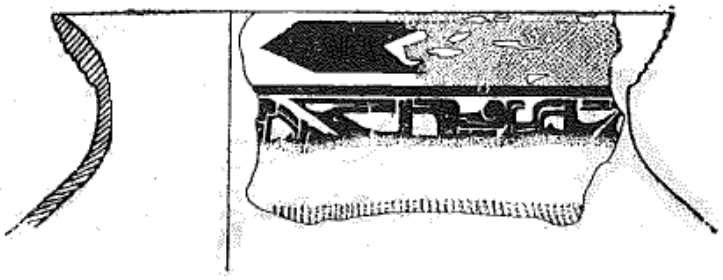


Figure III-15: Painted pottery found in Zhihuijie (T3⑤:45) (Sichuan and Chengdu 1987:180).

3.1.3. Fangchijie 方池街

The site is near the heart of modern Chengdu City. Like Zhihuijie, as a secondary deposit, the lowest stratum (the fifth layer) has mixed remains from different periods, from the Neolithic to the Bronze Ages (till the Western Zhou in the first millennium BC) (Chengdu Bowuguan and Chengdu 2003). The public project of stone embankment extending between the fifth and 4bth layers is believed to be a water-repellent facility, which suggests that the locus was subject to floods (Wang Yi 1991a, b). The fifth layer has yielded abundant stone tools and a small number of bone tools along with potteries. Among the stone tools, many stone disks (*panzhuangqi,* as

shown in Figure III-11.1) were discovered in Fangchijie (108).They were perhaps semi-finished products waiting for further processes. Except *huang* pendants, most stone tools were daily-use equipment, lacking delicate ornaments. The bone tools also appear in simple forms, such as needles and chisels, most likely for daily-use purposes too. However, oracle bones with different styles of drilling holes are present and sometimes coexist on the same piece of turtle shell. For instance, in 85CFT245, both round and oval-shaped holes are juxtaposed. The round hole has been burnt and shown omen fissures whereas the oval hole has not been used for divination and was left unburned. These differences reveal that both drilling and divination can be conducted in different batches on the same bone (Chengdu Bowuguan and Chengdu 2003:303).

In the early phase of the cultural deposits, remains of high-stemmed mounted bowls account for the majority of potteries. Pointed-bottom vessels only became more abundant from the fourth layer (including two sub-strata 4b and 4a) in about the eighth through fifth centuries BC. One of the *jiandi bei* found here is in the same style as those most popular in Jinsha. The vessels are nearly standardized in both dimensions and clay quality. From the photograph in the excavation report, we can see the *jiandi bei* is slightly smudged in the lower body, probably indicating several pieces of similar items were sleeve-connected during firing. The same has been found in other sites, such as Zhen'an 鎮安, Fuling 涪陵, and will be touched upon again in the eastern Sichuan section.

From the same layer (4b), a stone figure of a human kneeling with two hands tied behind its back has been recovered. Its hair style and position are close to those found in Sanxingdui[24] and the Jinsha sacrificial zone (Chen Xiandan 1989:216; 2010:48; Wu Hung 2003[1997]:295) (Figure III-16). So far, 12 similar stone human figures have been found in Jinsha-Meiyuan along

[24] According to Chen Xiandan (2010:47), one of the chief excavators, another stone figure in the similar style was found from the 1984 Xiquankan 西泉坎 locus, close to the likely stone-tool workshop.

with other animal sculptures and ornaments. They were usually painted and covered with cinnabar.

Besides these stone human figurines and *jiandi bei* that demonstrated the similarity between this site and Jinsha, Fangchijie also contains artifacts closer to those of Xinyicun, such as *jiandi zhan, fu* cauldrons with round bottoms[25], and ring-footed, mounted bowls, which were produced in later styles. These items, especially *jiandi zhan* and ring-footed *dou*, are the most numerous grave goods found at the 1995 Xinyicun locus, where the burial M1 has been dated to the Warring States period (5th-3rd centuries BC) (Chengdu 2004e) (Figure III-17). The same style of ring-footed *dou* can also be found in western Hubei[26]. This mix of Shi'erqiao- and Xinyicun-period items also illustrates the complex deposition process of the site.

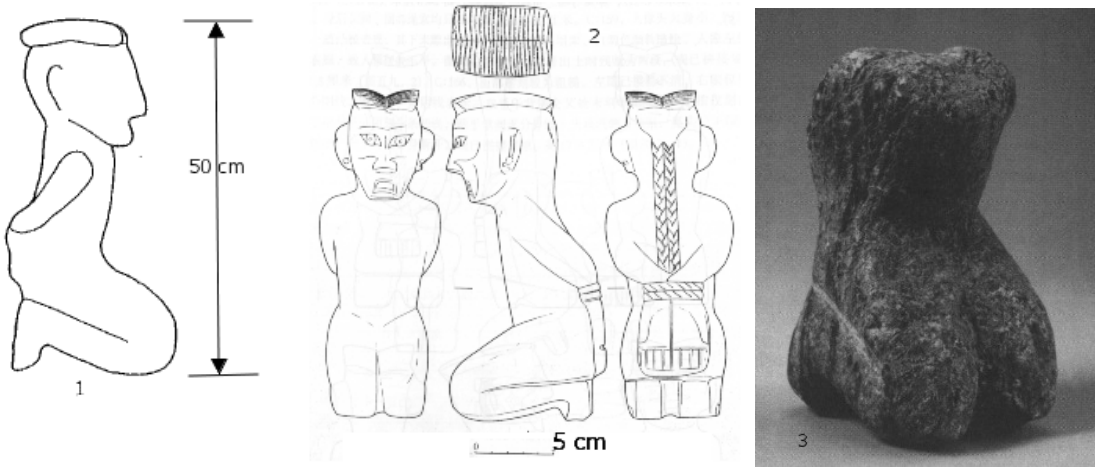


Figure III-16: Stone kneeling human figures discovered in Fangchijie (no.1), Meiyuan (no.2), and Sanxingdui (no.3) 1. (84CFT12) (Chengdu Bowuguan and Chengdu 2003: 307 fig. 4); 2. (C:716) (Chengdu 2004d:159 fig. 58); 3. Sanxingdui (86T1313⑧, head missing) (Chen Xiandan 2010:48).

[25] A *ding* tripod seem to have been transformed from *fu,* by simply attached vessel feet (Figure III-17.5).In fact, the same type of tripods is recognized as "*fu* with three feet" (*sanzufu* 三足釜) by the excavators of the Qingyanggong site (Sichuan 1959:412). Although a *fu* is discovered from the same stratum of the kneeling human figure, it is probably misplaced from the upper stratum (4a), from which other *fu* were unearthed.
[26] For example, the Quxikou 曲溪口 site in Zigui (Yichang 2003:317).

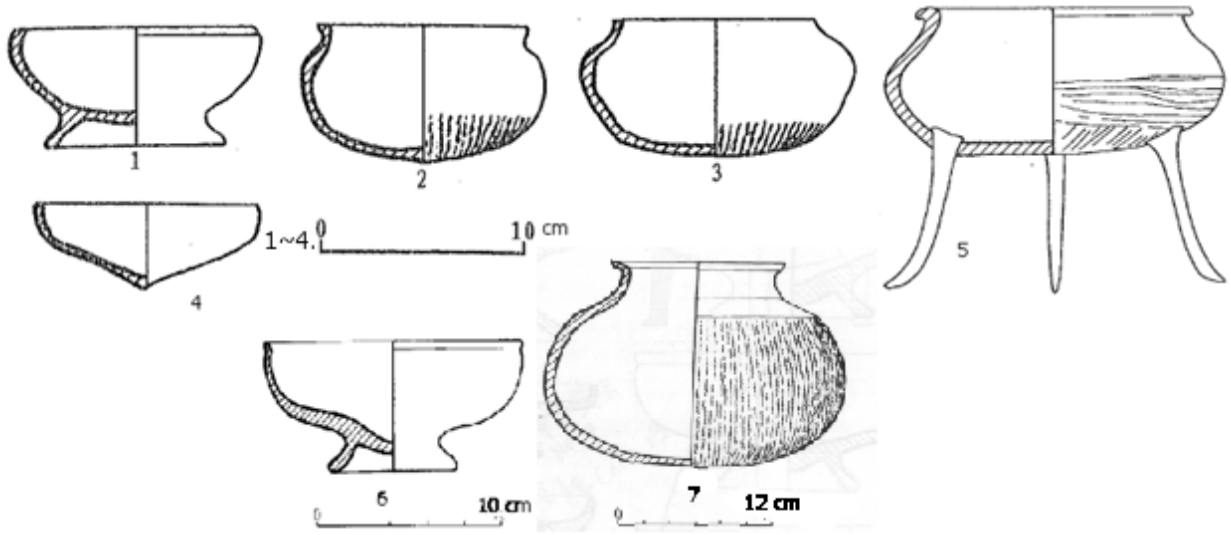


Figure III-17: A comparison of vessels discovered in Fangchijie (no.1-5) and Xinyicun (no.6-7)
1. ring-footed, mounted bowl (85CFT8③B30); 2-3. *fu* cauldrons (85CFZT8③B11, 85CFZT8③B7); 4. *jiandi zhan* (85CFZT8③A); 5. *ding* tripod (85CF②111) (Chengdu Bowuguan and Chengdu 2003:307 fig. 9, 313 fig. 12); 6. ring-footed, mounted bowl (M1:25); 7. *fu* cauldron (M1:79) (Chengdu 2004e:203 fig. 31, 204 fig. 32).

3.1.4. Minjiang Xiaoqu 岷江小區

The Minjiang Xiaoqu site had been inhabited since the late Baodun period yet only a small number of remains have been found. The excavators recognize the possibility that the Baodun pits found from this locus were related to the cemetery found in Shijiefang 十街坊 as these two loci are only distant from each other by 1 km. They together probably represent the earliest inhabitation of the Chengdu Plain known as yet (Chengdu 2001b, 2001c:187).

During the Shi'erqiao period, the locus was comprised of four buildings, five graves, more than 50 pits and a kiln (Y1). From the kiln, more than ten pieces of complete *jiandi bei*, *jiandi zhan,* vessel seats, and small-mouthed jars as well as a large amount of potsherds have been unearth (Chengdu 2001c:187). These complete vessels found in the kiln, which are similar to those found in Shi'erqiao and Jinsha, provide information about locally manufactured products. The same vessel types were also unearthed from the numerous pits, among which pointed-bottom vessels account for the majority. The volume, assemblage, and spatial relations between

features indicate the production life and likely consumption scale of the community, although only a small part of the inhabitation has been recovered (about 672 of 7,000 m^2).

The building remains, in turn, include stilt-house and wattle-and-daub styles, one of which (F1) is a complex of multiple rooms, reaching more than 23 m long. Most of the pits and features seem concentrated around this large house. A small number of bronzes, including a *zun* vessel, have also been recovered from the pits. It has been proposed that from this sketch of production, the *zun* was a local imitation of Central-Plain products.

3.1.5. Shuiguanyin 水觀音 in Xinfan 新繁

The site is north to the Shi'erqiao type site by 22 km, and was discovered and excavated in the late 1950s (Deng Boqing 1959; Wang and Jiang 2006[1958]). It was probably occupied between *ca.* 1150-900 BC. A large number of ceramics, including *jiandi bei*, *jiandi zhan*, a vessel stand, high-stemmed-*dou*-like vessels (*douxingqi* 豆形器), a *gui* 鬶 tripod, and round-bottom jars, were uncovered along with polished stone tools and bronze weapons. Potteries such as vessel covers with kneaded buttons, pointed-bottom saucers and cups, ring-footed jars, and jars with trumpet-shaped mouths are notably similar to those found in Sanxingdui and Shi'erqiao. Analogous vessels have also been recovered from Baimashi 白馬石 in Ziyang 紫陽, Shaanxi (Sun Bingjun 1994:381) (Figure III-18), suggesting the connection between southern Shaanxi and the Chengdu Plain.

As noted by the excavators, potteries of Shuiguanyin were made with potter's wheels and sometimes by molds. For coarse wares, powder from clamshells might have been used as temper materials (Deng Boqing 1959:405). These features contain information about the production tradition in the Chengdu Plain and deserve further comparisons with other sites like those in the Three Gorges area. Information related to the functions of the potteries may also be gleaned from

their relative positions. For instance, a pointed-bottom cup was found inside a larger jar in situ (Sun Bingjun 1994:381). The excavators thus suggest that the cup likely functioned as a dipper for the liquid contained in the larger jar. This is only one possibility, however. The likely functions of the vessels and their relations to clay fabrications will be revisited in the next chapter.

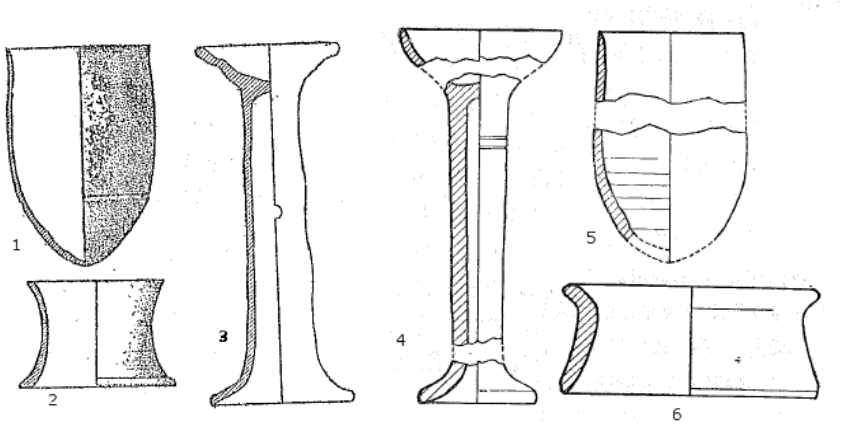


Figure III-18: A comparison of potteries discovered in Shuiguanyin (no.1-3) and Baimashi (no.4-6)
1. pointed-bottom cup (T8.3:1); 2. vessel stand (T7.3:8); 3. high-stemmed *dou* (T41.3:1) (Deng Boqing 1959:406);
4. high-stemmed *dou* (T21④:6); 5. pointed-bottom cup (T21④:36); 6. vessel stand (T0④:8) (Sun Bingjun 1994:381-382)
(not to scale).

In addition to these cultural deposits, the site also yielded a number of graves, which have been periodized. Whereas the earlier burials only contain limited numbers of potteries and were poorly preserved, the later graves were equipped with richer goods in ceramics, small pieces of bronze weapons, and stone tools. Two burial pits were even outlined by pottery jars (Figure III-19). Among these potteries, the globular, round-bottom jars with inflated shoulders, long necks, and tiny handling loops (Figure III-20) are largely similar to those found in the Jinsha core area[27]. Similar vessels have also recently been found in Songjiaheba 宋家河壩 in Pixian (Chengdu 2009b:131). Moreover, the counterpart of another kind of globular jar with a slightly

[27] Such as Wanbo Didian 萬博地點 as illustrated in Figure III-20, and several other samples from Lanyuan and Languang 藍光 loci by personal observation in the Beihu storehouse in 2011.

flatter belly has been discovered in Baoshan 寶山, Shaanxi[28] although samples of Shuiguanyin have shorter necks (Figure III-21). The accompanying bronze weapons in turn are similar to the finds of the Zhuwajie hoards in Pengzhou and sites in Shaanxi[29] (Sichuan et al. 1981; Shen and Huang 1987:30; Li Boqian 1987[1983]:35; Chen Fang-mei 1992:277-278; Falkenhausen 2003b:338-340), which will be discussed below. These similarities again suggest the connection between the region and Shaanxi and also reveal that the burials were interred no earlier than early Western Zhou (*ca.* 1000-900 BC).

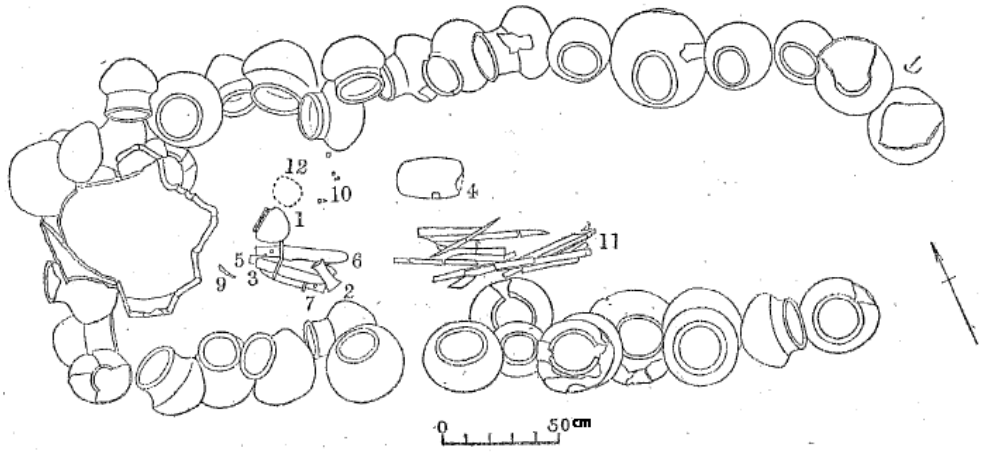


Figure III-19: Burial (M1) of Shuiguanyin
(Deng Boqing 1959:408).

[28] Where comparable vessels are called flat-bellied pots (*bianfu hu* 扁腹壺) (e.g. SH20:21) (Xibei Daxue 2002:55; Huang Shangming 2007:318). The Jinsha core area also yielded similar items to samples of Baoshan but with only one loop (saw in the Beihu storehouse in 2011).
[29] E.g., Chenggu in southern Shaanxi and Yu-state cemeteries in the middle Shaanxi.

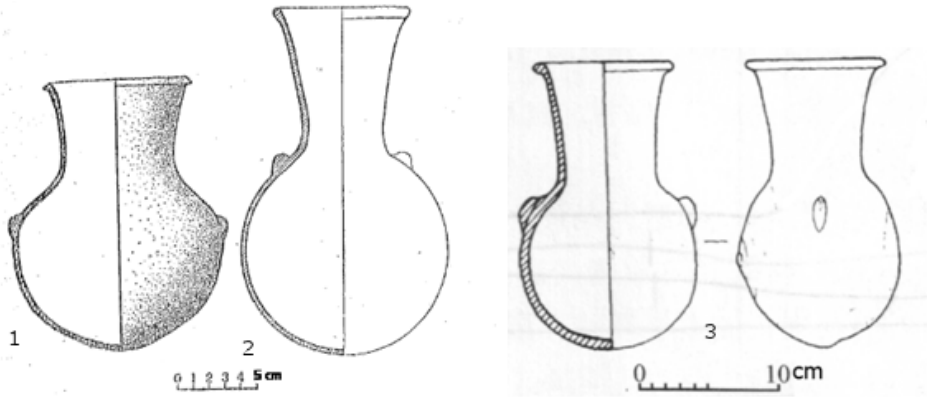


Figure III-20: Long-necked, globular jars discovered in the tombs of Shuiguanyin (no.1-2) and the pit of Jinsha-Wanbo Didian locus (no.3)
1: M1:38; 2: M2:7 (Deng Boqing 1959:409); 3: H844:3 (Chengdu 2004c:72)

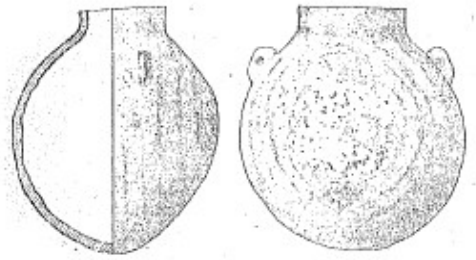


Figure III-21: Short-necked globular jars (*bianfu hu*) discovered in Shuiguanyin (acquired from surface collection, not to scale) (Deng Boqing 1959:407).

3.1.6. Zhengyincun 正因村 in Xindu 新都

Xindu is 16 km north of Chengdu City and located between Chengdu and Guanghan, where Sanxingdui is situated. The site is also close to the Shuiguanyin site in Xinfan. In 2001 and 2003, two campaigns of excavation were conducted at two loci next to each other, south and east of the Southwest Petroleum University, respectively, and date the sites to *ca.* 1200-900 BC.

The 2001 locus yielded remains comparable to those in early Shi'erqiao (Chengdu and Xindu 2003). From the 74 pits and two trenches, ceramic sherds of known vessel types, such as *xiaopingdi guan*, *jiandi bei*, vessel covers with kneaded buttons, ring-footed jars or tureens, *pen* basins, *he* tripodal spouted pitchers, and high-stemmed, mounted bowls (*gaobing dou*), were

recovered. In the pits that yielded sherds, thick layers of ash and burnt soils were often present. Animal remains were also occasionally present. This context reveals not only the depositional conditions of the ash pits and related activities (e.g., cooking, offering sacrifice, and so on) but the likely scenario in which the vessels were used.

In their early phase[30], collared *jiandi bei* (Figure III-22.1) are close to those seen in eastern Sichuan and further east, at sites such as Xianglushi, but were then less popular in the Chengdu Plain. The more popular style of pointed-bottom cups in the Chengdu Plain, artillery-shell-style *jiandi bei*, was recovered from the second phase (Figure III-22.2). The coexistence of two types of *jiandi bei* is only found during the early Shi'erqiao.

The decorations of pottery vessels from Zhengyincun seem diverse, some of which may be unique to the site. Besides normal cord marks, punctuations, and appliqué, multi-layered rhombic marks widely distributed in the Sichuan Basin were also found here (Figure III-23.1) but in a somewhat different style. That is, instead of zonally distributed around the shoulder, the rhombic decorations in this case have served as the background design, filling up the vessel surface, which is closer to the so-called "*yunleiwen* 雲雷紋" regularly used to decorate bronzes and also adopted in Sanxingdui ceramics[31]. In addition to variations in some common decorations, rarer designs, such as incised fish in Figure III-23.2, were found. A purported paddle is found to bear a symbol unknown to other places (Figure III-24), if not reminiscent of the eye motifs of Sanxingdui. A hollow ceramic turtle (Figure III-25), moreover, seems to be a new subject for pottery animals not seen in Sanxingdui, where pigs, roosters, and birds were the most popular themes.

[30] Including the sixth layer and the pits under this stratum.
[31] E.g., BbT5①:22 (Sichuan et al. 1987a:243 fig. 14.26).

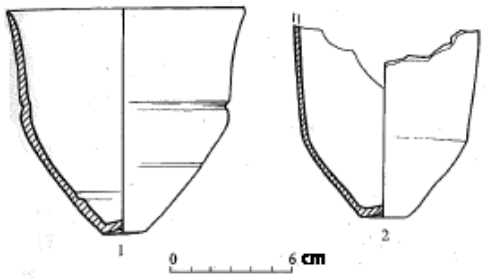


Figure III-22: *Jiandi bei* of Zhengyincun
1. the first phase (H69:27); and 2. the second phase (IIIT1503⑤:2) (Chengdu and Xindu 2003:69).

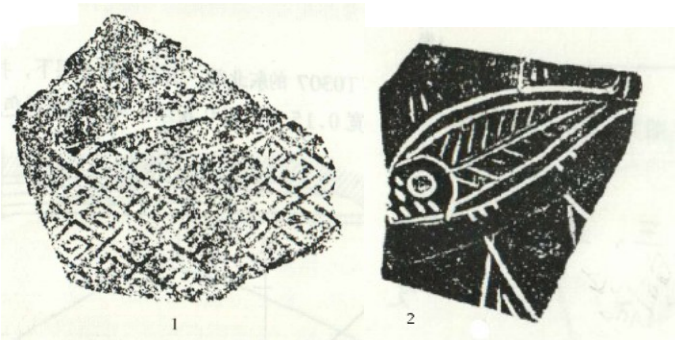


Figure III-23: Decorations on Zhengyincun pots
1: H19③:82; 2. IVT0307⑤:3 (Chengdu and Xindu 2003:62).

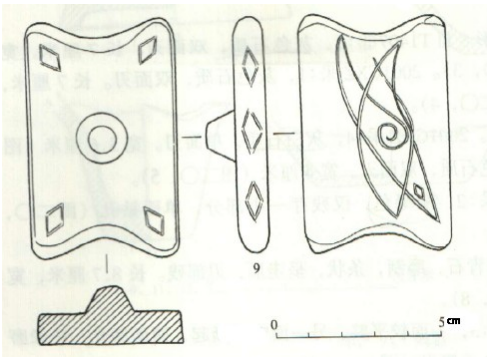


Figure III-24: Pottery paddle (?) discovered in Zhengyincun
(H34:1) (Chengdu and Xindu 2003:76).

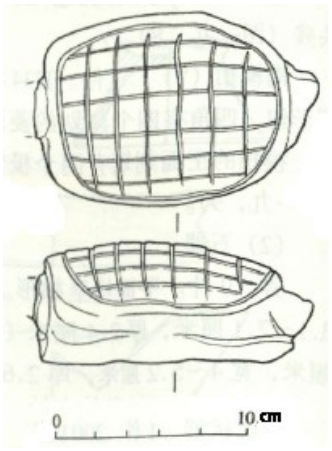


Figure III-25: Pottery turtle (missing head) discovered in Zhengyincun (IIIT0310⑥:2) (Chengdu and Xindu 2003:76).

The test excavation of 2003 was only of a small scale, about 250 m^2 (Chengdu and Xindu 2005). The stratigraphy and post-depositional conditions of the new locus are parallel to those of the 2001 locus in many respects. Like the 2001 locus, the pits here were often filled with burnt soils and ashes and yielded potteries similar to those in Sanxingdui and Shi'erqiao. However, in comparison with the 2001 locus, the 2003 locus yielded more earlier-phase remains and fewer Shi'erqiao equivalents. For example, vessel feet with crescent and openwork decorations that prevailed in Sanxingdui are exclusive to the 2003 locus, not the 2001 locus. Moreover, cord-marked decorated-rim jars (*shengwen huabian guan*) that can be sourced back to the Baodun period are also only present in the 2003 locus. On the other hand, pointed-bottom vessels that have distinguished the Shi'erqiao Culture and can be easily found in the 2001 locus, as noted above, are hardly seen in the 2003 locus. Based on this subtle difference, the excavators speculated that the inhabitation period of the 2003 locus was slightly earlier than that of 2001 locus (Chengdu and Xindu 2005:135), even though they are very close and may be viewed as different parts of a larger settlement.

The only burial found here is in the shaft-earthen-pit style and contains no mortuary goods besides a layer of board at the bottom of the pit (Chengdu and Xindu 2005:123, 126). A similar burial custom has been found in Jinsha cemeteries and the Xinyicun site, which I discuss in the following.

3.1.7. Shaxi 沙溪 in Ya'an 雅安

This site is 160 km from Chengdu, on the southwest bank of the Sichuan Basin. Because the site was partially destroyed by later farming, its remains and features are largely scattered. Although post holes of houses have been discovered at the site, their number, arrangement, and structures are unclear. Like other mountainous margins of the basin, such as Hanyuan, microlithics prevailed in the area coexisting with larger ground and chipped stones. They are normally made of obsidian, flints, and rhyolite and can be dated back to 3100±70 years BP (Li Yongxian 1996:8). It seems that though such microlithic techniques lasted long in the Sichuan mountain areas, none of comparable items has been found in the Chengdu Plain. Perhaps accommodated to the local ecology and subsistence activities (Flad and Chen 2006:246, 253), stone technologies of these mountainous settlements were highly developed, producing diverse stone tools. The kinds of rocks exploited to make stone tools, according to the excavation report, including various plutonic, volcanic, sedimentary, and metamorphic rocks, also demonstrate and reflect the geological conditions of the western mountain areas of the Sichuan Basin.

Among these stone tools, the presence of a large number of shouldered axes (74) is characteristic of the region. As the excavators have noted, this type of stone tool perhaps influenced the appearance and shape of bronze *fu* 斧 or *yue* 鉞 axes discovered in Sichuan, such as those in the Zhuwajie hoards and tombs of the Warring States period (5th-3rd centuries BC) (Figure III-26) (Sichuan et al. 1996:333-334).

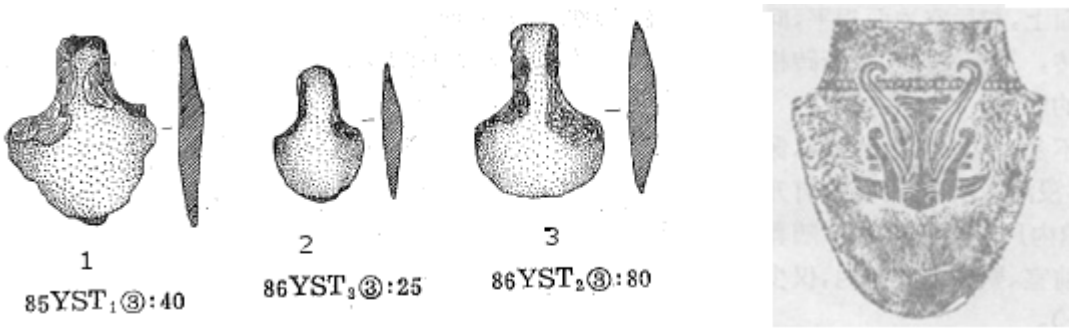


Figure III-26: Shouldered stone axes found in Shaxi (no.1-3) and bronze axe in Zhuwajie (Sichuan et al. 1981:499; Sichuan et al. 1996:309).

Although the stone-tool tradition of Shaxi was different from the plain area, pottery types common to the Chengdu Plain are present in Shaxi accompanying the stone tools. They include small-flat-bottom (60%) and pointed-bottom (34%) vessels, ring-footed *dou* with or without high stems, vats, small rounded bowls (*bo* 鉢), vessel covers, vessel stands, basins, and spindle whorls (Sichuan et al. 1990). Among them, *jiandi bei* are the commonest (31) and, like Shi'erqiao, both artillery-shell-shaped (*paodanxing*) *jiandi bei* and collared *jiandi bei* with carinated shoulders are present (Figure III-27.10-12). A portion of small, flat-bottomed jars (*xiaopingdi guan*) are also similar to those found in Sanxingdui and early Shi'erqiao (Figure III-27.13).

One spot of the locus has been identified as a cooking area because it was filled with charcoal, ash, stone tools, and potsherds. In particular, five vessel stands were unearthed from the ash pit, demonstrating how the objects could be used in cooking (Figure III-27.1-5). Except the vessel stands, other potteries appearing in the same pit are otherwise broken. On the other hand, undamaged pointed-bottom vessels, often associated with vessel stands, were uncovered from other pits. From the six recovered pieces, although their appearances are not identical, their dimensions and especially the width of their openings are very close (Figure III-27.6-9). Because such finds are still small in number, it is difficult to generalize about patterns from the current vessels. However, it is clear that the production techniques and clay choices of the Shaxi

ceramics are comparable to other sites of the Chengdu Plain during the early Shi'erqiao period. It seems that whereas the settlement dwellers developed specific stone tool assemblages in response to their environments, they received and adopted certain influences, mainly the pottery assemblage, from the Chengdu Plain. This makes Ya'an a part of the cultural sphere centered on the plain.

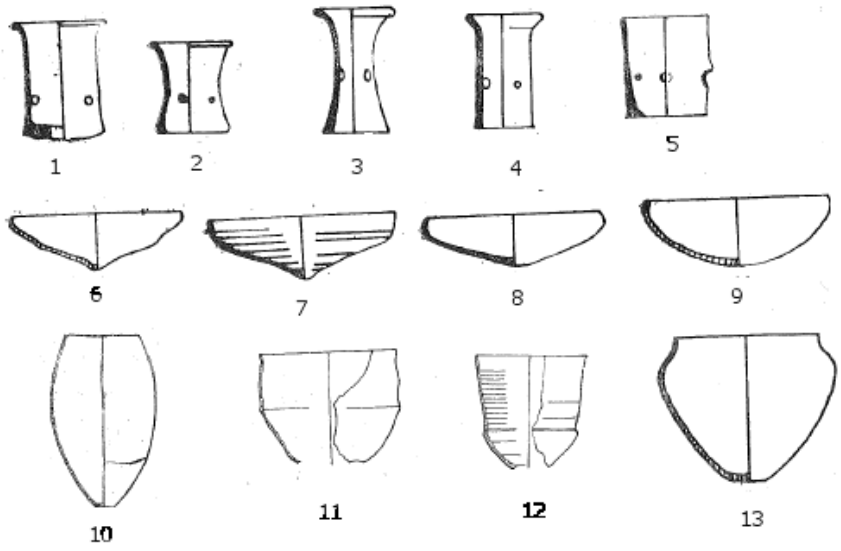


Figure III-27: Characteristic vessel types of Shaxi, Ya'an
1-5. vessel stands (85YST1Z1:3, 85YST1Z1:2, 85YST1Z1:4, 85YST1Z1:5, 85YST1Z1:1); 6-9. *jiandi zhan* (86YST1H6:8, 85YS*:101, 86YST1H6:5, 86YST1H7:1); 10-12. *jiandi bei* (85YS*:43, 86YS*:42, 86YST5③:4); 13. *xiaopingdi guan* (86YST5③:7) (Sichuan et al. 1990:299 fig. 8, 300 fig. 9).

3.1.8. Maiping 麥坪 and Majiashan 麻家山 sites in Hanyuan 漢源

Located in the southwest of Ya'an, Hanyuan is about 310 km distant from Chengdu City (Figure III-28) and built upon a delta within its southwest mountain areas. The region has been inhabited since the Paleolithic and later known for the Fulin 富林 culture, which featured microlithic tools (Sichuan et al. 2008). The microlithic tradition has made the drainage of the Dadu River appear to be very special and it continued to prevail through the Neolithic and Bronze Ages. During the Neolithic period, sites of the region were productive. Besides the far affinity to the Chengdu

Plain, remains found in this region demonstrate diverse characteristics and are closely related to the archaeological cultures of the Upper Lancang 瀾滄 (Mekong) River and the Gansu-Qinghai region. For instance, Maiping is similar to Karuo 卡若 in Changdu 昌都 in their stone tools. The painted pottery collected from Shizishan 獅子山 is close to those of Majiayao in Gansu-Qinghai, on the other hand (Sichuan et al. 2008).

The Bronze Age remains, including high-stemmed mounted bowls (*gaobing dou*), short-stemmed, mounted bowls with ring-feet (*aiquanzu dou* 矮圈足豆), vessel covers, pointed-bottom jars, and vessel stands, show a resemblance to Sanxingdui and Shi'erqiao. In a grave of Maiping (M3), not only does the burial type resemble that of the Chengdu Plain, but within the grave pit, pointed-bottom vessels were also placed close to the head of the dead, similar to the customs of the plain. The difference is perhaps that the grave contains many more vessel stands (22) and bronze weapons than its counterparts in the city center. According to the excavators, these potteries were poorly made, with kneading traces on their surfaces. Similar vessels and stands also appeared in the pits and were made even thicker.

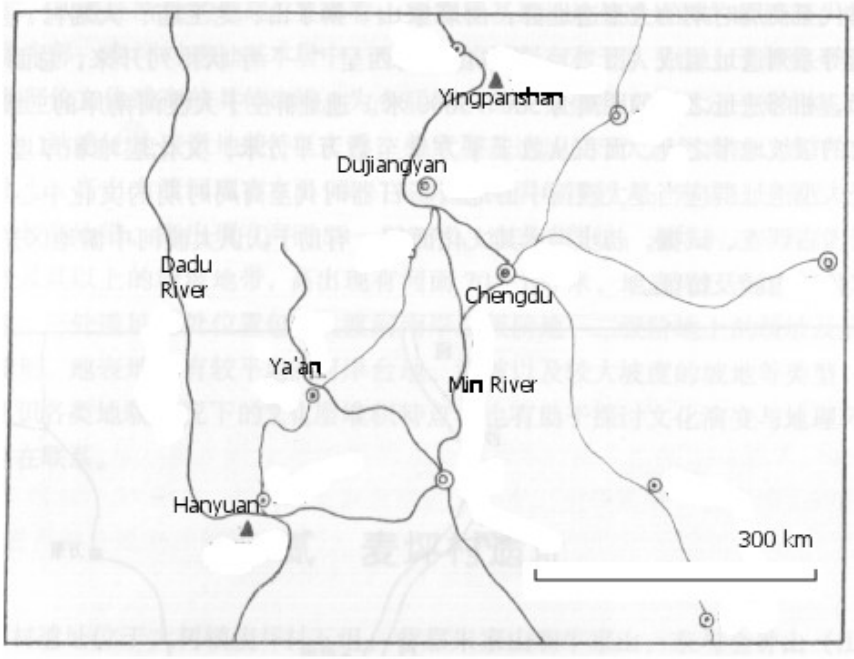


Figure III-28: The locations of Ya'an and Hanyuan in relation to Chengdu City (Daduhe 2003:307).

Another site, Majiashan, was prosperous during the Shi'erqiao period and contains kilns and pits in the locus. It yielded microlithic tools and pottery vessels with ring feet, pointed bottoms, and flat bottoms (Daduhe 2003). The long- and short-stemmed bowls seen in Maiping were also popular here. Although most of the pointed-bottom vessels are broken such that the upper parts of *jiandi bei* and *jiandi guan* are often missing and barely recognizable, we can tell from their bottoms that the vessels were made in different sizes and of different thicknesses. All were, however, made from fine clays. From the few complete *jiandi bei* recovered from Pingyangcun 平陽村 cemetery[32] (Sichuan et al. 2008:13), many are surprisingly similar to the collared *jiandi bei* found in the Chengdu Plain, eastern Sichuan, and western Hubei (Figure III-29) not only in shape but tin clay texture. Though archaeologists have suggested this vessel type originated in eastern Sichuan, its occurrence on the western margins of the basin probably reflects a Chengdu-

[32] Where the vessels are called as *xiaopingdi bei* 小平底杯 (small, flat-bottom cups).

Plain influence, which might be a redistribution center for the vessel type. Because of these similar pottery vessels, the sites in the Middle Dadu River may help outline an influential scope of the Shi'erqiao culture, in which Hanyuan is located on the most southwestern edge, known to us so far. This, however, does not mean that the sites can completely be fit into the Chengdu-based culture. Their diverse remains simultaneously reveal other possibilities that connect them with other directions.

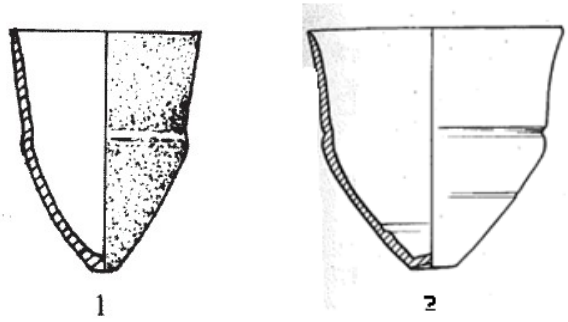


Figure III-29: A comparison of pointed-bottom cups discovered in Pingyangcun (no.1) and Zhengyincun (no.2) 1. 90SZPM1:5 (Sichuan et al. 2008:13); 2. (H69:27) (Chengdu and Xindu 2003:69) (not to scale).

3.1.9. Zhuwajie 竹瓦街 hoards in Pengzhou 彭州

Two hoards of bronzes within a 25 m distance were discovered in 1959 and 1980 from Zhuwajie, Pengzhou, which is also close to the Sanxingdui and Shuiguanyin sites. The two hoards seem to have been deposited in a one-time event and both of them were made up of large vats. In the 1980 hoard, 15 weapons were placed within two *lei* vessels and these two *lei* along with the other two, in turn, were placed in an even bigger vat over 120 cm in height. The vat is decorated with multi-layered rhombic marks (*chonglingwen*) on its upper body, a decoration style popular in Shi'erqiao and Xinyicun ceramics. Two hoards together yielded 12 bronze vessels and 25 pieces of weapons and tools (Wang Jiayou 1961; Sichuan Bowuguan et al. 1981). They were carefully laid. The bronze vessels include nine *lei* and one *zun* amphora-shaped vessels, and two *zhi* 觶 goblets. As some vessels are not in local styles but similar to those from Shang or Zhou

territories in North China, their place(s) of production and the reason they were brought to Sichuan have raised much speculation (e.g., Feng Hanji 1980; Xu Zhongshu 1998[1962]; Falkenhausen 2003b; Shi Jinsong 2003:206-211). In short, though *zun* and *zhi* that bear inscriptions[33] and Shang or Zhou designs are assumed to be the products of the Central Plains, perhaps brought to Sichuan as diplomatic gifts (Xu Zhongshu 1998[1962]) or war booty (Feng Hanji 1980:41), the other vessels are thought to be local imitations of Zhou products (e.g. Feng Hanji 1980) or imports from the Zhou core (e.g., Falkenhausen 2003b). Scholars who believe the vessels are local imitations maintain that although Sichuan craftsmen attempted to imitate the motifs and shapes of Central-Plain products, they did not faithfully reconstruct the Shang-Zhou objects but rather modified them according to local interests such that the imitations have some extra decorations. On the other hand, other scholars have argued that the seemingly over-decorated designs and motifs are not unusual in North China. The parallels between the *lei* vessels of Zhuwajie and those in the Middle Yangzi, Yu 弓魚-state cemeteries and Hejiacun 賀家村 (both in Shaanxi), and Inner Mongolia are especially notable (e.g., Jiang and Li 2002:186-194; Falkenhausen 2003b). The assemblage had continued and highlights the southern interest of *lei* and *zun* amphorae as well as animal motifs with dynamic visual effects, as many examples have been found in Sanxingdui and elsewhere in the Middle Yangzi (Rawson 1991:89; Falkenhausen 2001:179-181; 2003b:325-327). The nearly exclusive preference for *lei* and *zun* has distinguished areas outside the Central Plains where such amphorae only account for a small part of the ritual bronze paraphernalia (Sun Hua 2000:232).

The modification of Central-Plains canonical equipments to fit local ritualistic needs is perhaps also exemplified by such contexts as Zhuwajie hoard no. 1, in which *lei* of varied sizes

[33] Which were common in the Central Plains but not in Sichuan during that time.

are present. Some scholars have argued that the *lei* were arranged in a special manner for a ritualistic activity, in which the largest *lei* was situated in the middle with gradually reduced ones symmetrically standing on both sides (Feng Hanji 1980; Sun Hua 2000:232) (Appendix III-Figure 21). It is believed that such an arrangement imitated the use of ritual bronzes in Zhou ceremonies (see also Cao Wei 2004:98-101).

Besides vessels, the category of bronze weapons is mostly made up of daggers of various types. They are, however, distinctive to the region and are thought to be local products. Because similar items have been repeatedly unearthed from Sichuan, researchers have commonly recognized the weapons as "Ba-Shu-style" or simply "Shu-style" weapons[34]. They are normally composed of cruciform dagger-axes, triangular *kui* 戣 dagger-axes (or *sanjiaoyuan ge* 三角援戈), *fu* or *yue* axes, willow leaf-shaped swords or daggers, spearheads, arrowheads, and *ji* 戟 halberds (Appendix III-Figure 22). Although the majority of them appear in the Warring-States period (or the Qingyanggong period in 5th-3rd centuries BC), a willow leaf-shaped sword from early Shi'erqiao (IT4⑫:5) (Sichuan and Chengdu 2009:117), though only appear alone, probably illustrates the earliest example of such items. Slightly later on, the tomb of Shuiguanyin also yielded cruciform dagger-axes. Because of these early and primitive samples, some authors argue that "Shu-style" weapons came from the Chengdu Plain (see Jiang Zhanghua 1992). Nevertheless, similar weapon form can be found in North China during the middle Shang[35] (Henan 1981), a period much earlier than the deposition of Shuiguanyin. Other weapon types, such as triangular *kui* dagger-axes, have also been frequently found in the Late Shang capital[36]

[34] Because the weapon types have been largely discovered from Sichuan, which has traditionally been considered the inhabitation of the Ba and Shu ethnic groups.
[35] That is, during the Erligang period in the mid-first millennium BC (see also Falkenhausen 2003b:340).
[36] I.e., Yinxu 殷墟 in Anyang 安陽. Some scholars believe that the weapon types, distributed in both the Yellow River and Sichuan basins, can be sourced back to the same prototypes from the Northwest (e.g., Chen Fang-mei 1992:276-278).

(Thorp 2006:169), the Upper Han River Basin (e.g. Zhao Congcang 2006), and the cemeteries of the Western Zhou[37], though in a smaller number and proportion than in Sichuan. Although the weapon types often appear together, they were not necessarily developed at the same time or the same place and may not have formed a fix assemblage until the Qingyanggong phase. Regardless of their places of origin, after the weapons became popular in Sichuan, craftsmen decorated them in ways very characteristic of the region, using vivid animal figures or their transformations, among which tigers, reptiles, and birds are the most prominent. During the Qingyanggong period, the so-called "Ba-Shu characters"[38] were also added to the decoration themes.

3.1.10.Xinyicun 新一村

The Xinyicun site is situated between the Shi'erqiao type site and the Xijiao 西郊 River, where Xinyicun is east of Shi'erqiao by only 100 meters and distant from Jinsha site cluster by five kilometers. The site was firstly excavated in 1995 and excavation was recently extended to the south in 2010. Counted as a continuum of Shi'erqiao, the main deposits of the Xinyicun locus (i.e., from the ninth layer to the surface) have diverged from the earlier phase of Shi'erqiao in general pottery assemblages. Archaeologists have singled out this latter phase as the Xinyicun culture (*ca.* 900-500 BC) (Sun Hua 2000; Chengdu 2004e). The eighth layer in particular has yielded rich remains, which are recognized by the excavators as being deposited during a period roughly contemporary with the late Western Zhou in the Central Plain in the eighth century BC (Chengdu 2004e:208).

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[37] Such as Yu-state cemeteries in Baoji (Shaanxi) (Lu and Hu 1988, for example p.115), Baicaopo 白草坡 cemetery in Lingtai 靈台 (Gansu) (Gansu 1977:111), and Zhangjiapo cemetery in Chang'an (Shaanxi) (Zhongguo 1962, pl. 69). Besides *kui* dagger-axes, these cemeteries also yielded cruciform dagger-axes and willow leaf-shaped daggers (e.g. Zhongguo 1962:118, pl. 68; Gansu 1977:111) (Appendix III-Figure 23, 24). It is worth noting that in the residential area of Zhangjiapo, *chonglingwen* was applied to decorate potteries, like Chengdu Plain (Zhongguo 1962:96; Zhongguo 1999:110, see n. 22).

[38] Some scholars (e.g., Li Xueqin 1995) believe that the characters represent an early writing system of Ba and Shu whereas some other scholars (e.g., Sun Hua 1984) consider them as patterned graphs without semantic meanings.

From this Xinyicun locus, characteristic pottery assemblage of early Shi'erqiao, such as jars with small, flat bases (*xiaopingdi guan*), collared *jiandi bei* (i.e., those like Figure III-29.2), and bird-head-shaped dipper handles became unusual. Even the artillery-shell-shaped (*paodanxing*) *jiandi bei* have rarely been discovered and the so-called *jiandi guan* do not really resemble those in the previous phase. The overall aesthetic standards of pottery seem to have shifted such that the derivative vessel types from the vanishing ones also faded out accordingly. For instance, during the time when *xiaopingdi guan* disappeared, ring-footed tureens (*guixingqi*) that were transformed from *xiaopingdi guan* by attaching ring feet also changed their shape. That said, although ring-footed jars were still favored, the upper bodies of *guixingqi* had been greatly reshaped. They are not like *xiaopingdi guan* anymore. Meanwhile, round-bottom *fu* cauldrons, normally decorated with cord marks on their bellies and bottoms (Figure III-30.12), became popular during the Xinyicun phase. This vessel type believed to have been introduced from eastern Sichuan had only been sparingly found in the Chengdu Plain. It was when pointed-bottom vessels gradually disappear that round-bottom wares become more common, replacing them as the most popular vessel types in the plain (e.g., Sun Hua 1996:125).

On the other hand, *jiandi zhan* were still prevalent but seem to have changed slightly in shape. Their appearance, however, becomes more unified with smoother outlines at this stage. *Jiandi zhan* had been one of the most lasting and stable vessel types. Other popular vessels continuing from the Shi'erqiao period include jars with inverted rims and broadened shoulders (*liankou guangjian guan* 斂口廣肩罐, many of which were decorated with *chonglingwen* on the shoulders), *pen* basins, and jars with trumpet-shaped mouths. The styles of vessel covers and spindle whorls do not seem to have changed significant during this time either. Typical vessel types of this phase are illustrated in Figure III-30.

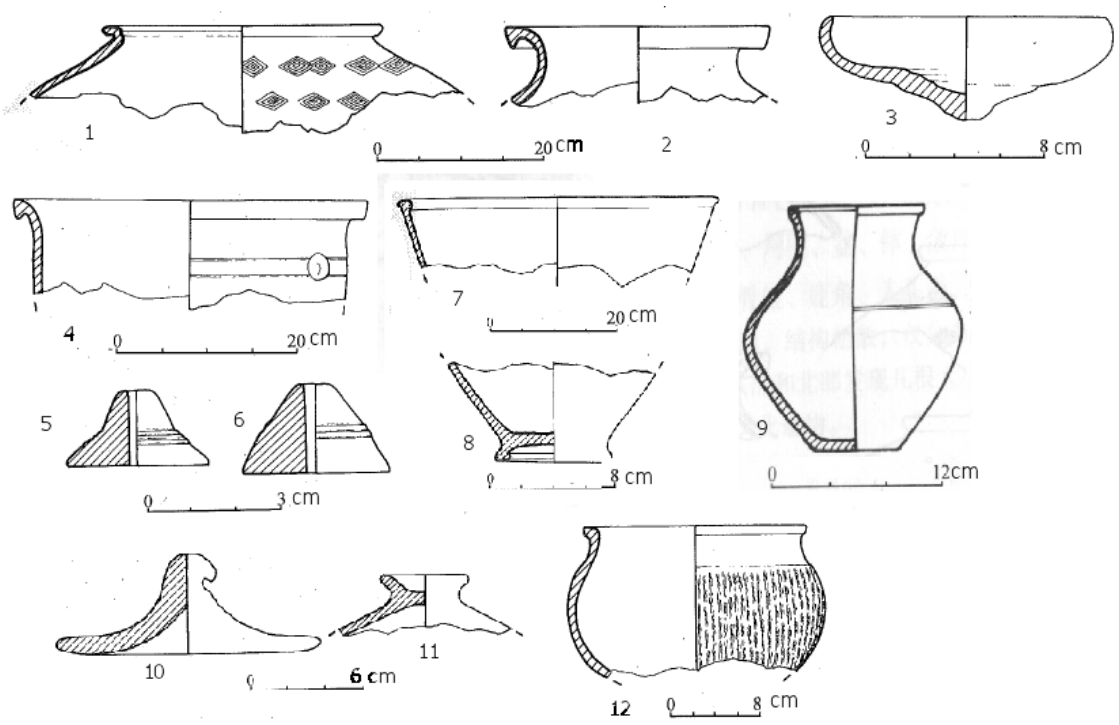


Figure III-30: Characteristic ceramic types of Xinyicun
1. jar with inverted rims and wide shoulders (*liankou guangjian guan*) (T102⑧:41); 2. w*eng* urn (T301⑧:34); 3. *jiandi zhan* (T101⑧:12); 4. *pen* basin (T101⑧:30); 5-6. spindle whorls (T301⑧:7, T301⑧:6); 7-8. ring-footed tureens (T102⑧:29, T301⑧:28); 9. jar with trumpet-shaped mouth (*labakou guan*) (T301⑧:17); 10-11. vessel covers (T201⑧:3, T301⑧:33); 12. *fu* cauldron (H7:3) (Chengdu 2004e:175-180, 200).

The only burial (M1) found in this locus is a secondary burial interred in a shaft-earthen pit with a layer of wooden board at the bottom (Chengdu 2004e:199). Cinnabar was applied to both the dead and the board, which was a common treatment for burials and ritualistic items, endowing the bodies or objects with sacredness. The grave goods consist largely of ceramic ring-footed, mounted bowls, as seen in the Fangchijie tomb (Figure III-17.6), along with a few other pottery types and bronze vessels and weapons (Appendix III-Figure 25). They constitute the most diverse and largest number of grave goods[39], by which the excavators dated the tomb to the middle Warring States period (5th-3rd centuries BC) (Chengdu 2004e:207), and the burial has become one of the references used in dating similar tombs (Wang Yi et al. 1999:6). Although no

[39] 73 pieces of potteries and 17 pieces of bronzes in total.

jiandi zhan has been found in this Xinyicun tomb, unlike other Warring Sates tombs, the upper bodies of the numerous *dou* are sometimes reminiscent of *jiandi zhan*. As the two vessel types, *jiandi zhan* and *dou*, were often alternatively interred as grave goods, they probably had a similar function or meaning in the burial contexts. A part of the *dou,* however, are equipped with deeper and rounder bellies, making their upper parts resemble *fu* cauldrons. This may denote the growing prevalence of vessels manufactured with round bottoms.

Immediately south to the 1995 Xinyicun site, a new locus was excavated during 2010-2011[40]. A major part of the 2010-11 locus is a secondary deposit, in which remains from different periods are mixed together. For instance, cord-marked decorated-rim jars (*shengwen huabian guan*) and long-necked jars with trumpet-shaped mouths (*labakou gaoling guan*) from the Baodun period and bird-head-shaped dipper handles characteristic of Sanxingdui were jumbled together in the eighth and ninth layers of the stratigraphy. Nevertheless, through comparisons with other sites, particularly Sanxingdui, Shi'erqiao, and the 1995 Xinyicun locus, we are able to classify objects from different periods and strata. In addition, the new locus has a richer deposit through the ninth to twelfth layers, which provides information about the transition from Shi'erqiao to Xinyicun.

Because the pit TN05W03 of the new locus was less disturbed and is comparatively clear in stratigraphy information, I have used it as the sample pit in this study and collected ceramics from the ninth layer. Based on these samples, I have conducted several metric measures and compositional analyses, the results of which I discuss in the next chapter. Before characterizing the samples based on these results, I have also sorted the potsherds by color, vessel type, and decoration. It turns out that over 92% of the potsherds are coarse wares without any decoration and more than half of the total ceramic samples (58%) have black surfaces, including slipped or

[40] This extends the original excavation area from 396 m^2 to be 2296 m^2.

smudged wares. Less than 0.5% of the ceramics were made in unusual colors, such as white and purplish red. That these colors are rare in the region perhaps implies that their raw clays were uniquely procured or processed. Analyses of these ceramic compositions are discussed in the *data analysis* section of the next chapter. As to the decorations, multi-layered rhombic marks (*chonglingwen*) with several varieties make up more than 20% of the decorated potsherds, the second highest only to cord-marked samples in weight as well as in count (13%). This is probably because *chonglingwen* were often applied to decorate the shoulders of large jars that are thick, sturdy, and frequently found connecting with rims. From the number of rims that have been uncovered, such large jars (most likely *liankou guangjian guan*) must have been produced in a considerable quantity.

In addition to the jars often bearing *chonglingwen*, the pottery assemblage of this recently excavated locus include pointed-bottom saucers (*jiandi zhan*)*, weng* urns, *fu* cauldrons, ring-footed tureens, jars with flat bases in a variety of sizes, high-stemmed *dou*, and spindle whorls. Here, *jiandi zhan* were produced with the aid of potter's wheels such that spiral traces can be clearly viewed and the vessel walls are evenly thin. They are fragile and normally scatted in the pits or common cultural deposits. Only a few complete pieces were unearthed from the tenth layer along with several other vessels. Legs of *li* 鬲 tripods were also occasionally found, illustrating early examples of the vessel type in the Chengdu Plain. These vessels were otherwise thought to prevail in the Middle Yangzi. Like the 1995 locus, this new locality has also yielded tube-shaped pottery objects (*tongxingqi* 筒形器), sometimes with incised marks. The incised designs include arrowheads, crosses, trees, and grids (Figure III-31). However, the function of the objects remains unknown. This assemblage is more or less similar to that of the 1995 locus.

Other special ceramic products are painted and lacquered potsherds that have rarely been found elsewhere in the Chengdu Plain, other than in Zhihuijie (Figure III-15). Like the Zhihuijie sample, the painted or lacquered designs are what used to be applied to bronze vessels (Figure III-32). That is, the same designs have been realized in different media.

The development of lacquerware crafting in the Chengdu Plain is another subject that deserves to be explored but cannot be here. Briefly, though, the craft had become a highly specialized production system at least during the Warring States period. The discovery of well-preserved lacquerware from the early Warring States boat coffins (5th century BC) at Shangyejie 商業街 in modern Chengdu City (Chengdu 2009a) suggests a precedent for the heyday of the craft in the Han Dynasty (202 BC-AD 220). The application of lacquer, however, may happen as early as the Sanxingdui period, although it would have been only primitive at this point. According to the conservation technicians of the sacrificial pits, lacquer was once applied to some Sanxingdui bronze heads as the adhesive substance to attach the items with gold masks (Yang Xiaowu 1992). The excavators also state that a painted-wooden pottery paddle and the lacquer coats of unidentified items have been found in Sanxingdui (Chen Xiandan 2010:49). Like the lacquer widely used later in the region, the adhesive substance employed in Sanxingdui probably came from *Toxicodendron vernicifluum* (the lacquer trees). The same kind of lacquer trees may have also provided the painting material for the Xinyicun lacquered pottery because elements close to urushiol, specific to the lacquer trees, are found in the paint[41]. After close inspection, I discovered at least one layer of black primer paint beneath the red bottom color (Figure III-32, right). I suspect that the crafters had mastered certain processes, including the acquisition of raw lacquer liquid, processing, coloring, painting, and fixative. Although it is hard

[41] Based on results of infrared spectrum analysis and X-ray Fluorescence Spectrometer analysis (XRF) taken in the laboratories of the Peking University, Beijing and personal communication with Yang Yingdong in 2012. The black and red coloring agents may come from iron oxide, cinnabar, and/or carbon.

to image that the same complex working process of lacquerware was adopted in the production of lacquered pottery, considerable time and skill would have been required to finish the potteries. With their bronze-like decorations and delicate surface treatments, the painted and lacquered potteries convey a meaning different from daily commodities. To imitate the decorative designs of bronzes suggests that the potteries were used during special occasions, perhaps as replacements for bronze vessels. The items also reveal the interactions of different categories of craft production.

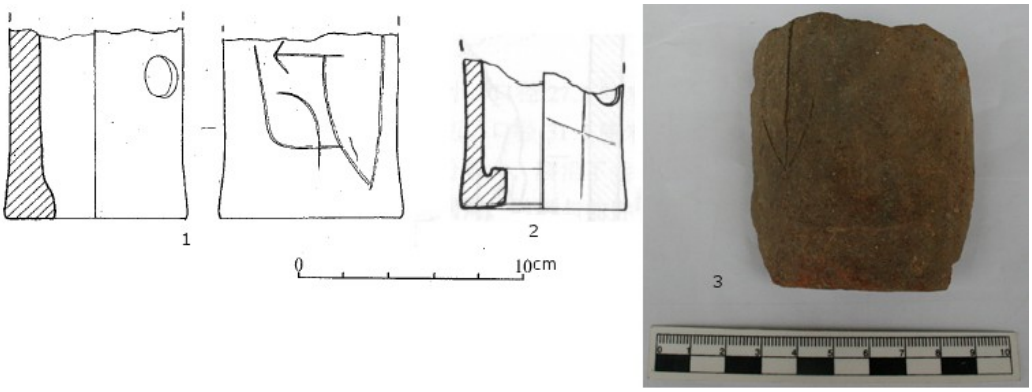


Figure III-31: Incised marks on *tongxingqi* discovered in Xinyicun (Xinyicun 1995 locus: 1. T404⑥:81; 2. T303⑦:70) (Chengdu 2004e:187, 198); and (2010 locus: 3. photo taken by the author).



Figure III-32: Painted and lacquered potsherds discovered in Xinyicun (after Chengdu Institute of archaeology[42]).

The non-routine, ritual life of Xinyicun can also be observed through the remains of oracle bones that have been unearthed from the Chengdu Plain in a significant number since the

[42] See also Zhongguo Wenwubao 2012.5.11 (http://www.kaogu.cn/en/detail.asp?ProductID=3501).

Shi'erqiao period and. The custom seems to have lasted a long time, but the drilling styles changed over time. Earlier, the shape of the holes tended to be circular whereas rectangular holes became popular later. This change in the drilling-hole shape also occurred in the Three Gorges area and on the Jianghan 江漢 Plain in the further east, which is believed to have been influenced by Zhou-style oracle bones in the Central Plains (Jiang Gang 2005). Here in Xinyicun, different styles were mixed (Figure III-33 shows the example of round holes) perhaps due to the disturbance of stratigraphy as we have seen in Zhihuijie. However, the media are not as diverse as those in eastern Sichuan where fish gills and other animal bones or parts as well as turtle plastrons were used. It is possible that this selection use of animals has ecological and ideological implications.

As to other crafts, the stone production of Xinyicun in both loci does not seem very different from Shi'erqiao. They have all yielded a considerable number of *huang* pendants along with semi-finished products. Stone tools and/or weapons, such as axes, adz, and knifes, were also present. A significant difference from previous finds is perhaps that although stone objects like a *cong* tube and a *ge* 戈 dagger[43] were discovered in Xinyicun, they were made in a much rougher way than those that have been found in Jinsha. The lithic materials do not seem delicate either. Perhaps these are semi-finished products or they were used on a different occasion not as solemn as that in Jinsha.

Although the locus and cultural deposits have suffered disturbances from water in some parts, a wooden structure has been preserved in the twelfth layer. This is unmistakably reminiscent of the Shi'erqiao construction mentioned earlier. However, we can tell from the still erected posts (containing logs and bamboo) that the building was arched shape, unlike earlier

[43] The *ge* dagger is incomplete and could be a *zhang* blade, however.

finds. The remaining part of the building is about 31 meters long and 5.2 meters wide at its broadest places. This may only count for a small portion of the original structure. Other building components including likely roof and ground beam have also been discovered. The function of such a large-scaled building requires further consideration.

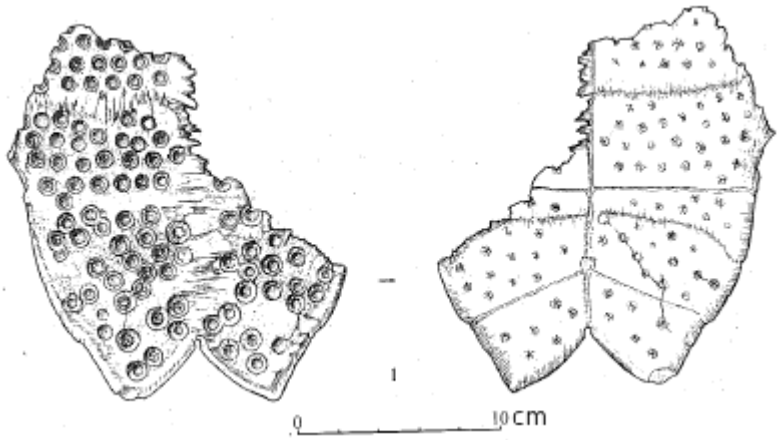


Figure III-33: Oracle bone from Xinyicun with traces of round drilling holes (T303⑦:16) (Chengdu 2004e:190).

In the later stratigraphy contemporary with the Sui and Tang Dynasties (AD 581-907), water wells, kilns and kiln-firing-related tools (e.g., separators between vessels), and porcelain sherds have been largely uncovered, indicating the locus had been intensively used as a pottery production area during the medieval times. While easy access to water and clay resources is often an important concern of pottery production, the locus was probably advantageous in these conditions.

3.1.11.Qingyanggong 青羊宫 and Shangwangjiaguai 上汪家拐

These sites represent the last phase of Bronze-Age Sichuan after the Xinyicun era, continuing through the Qin conquest in 316 BC and until the region was assimilated into the Han Dynasty (202 BC- AD 220). This phase following Xinyicun is also known as the "Ba Shu Culture", but archaeologists have proposed to replace it with "Qingyanggong Culture" or "Shangwangjiaguai

phase" (Sun Hua 2000:281-283; Huang Shangming 2007). The finds of this period are mostly composed of burials [44] but rarely sites of other types. Qingyanggong (Sichuan 1959), Shangwangjiaguai (Chengdu and Sichuan 1992), and Longquancun 龍泉村 (Chengdu and Pengzhou 2006) are among the few exceptions, although their scale is small. During this period, only *jiandi zhan* remained as the lone pointed-bottom vessels. Instead, round-bottom jars and *fu* cauldrons became the major vessel types. *Ding* tripods as found in Fangchijie (Figure III-17.5) also become popular. However, although the number of pointed-bottom vessels had been greatly reduced, in those tombs containing bronze vessels and weapons, they are often the only potteries interred with other bronze items. In these burial contexts, sometimes vessel covers and *jiandi zhan* were alike and were likely interchangeable in real use (Figure III-34). For instance, in a grave (M4) at the Jinjing 金井 cemetery in Jianwei 犍為 County, which is recognized as a late Warring States tomb, a *jiandi zhan* is placed upside down to cover the other piece (Sichuan 1983b:780). One of the tombs (M4) discovered at Sandongqiao 三洞橋, Chengdu (Chengdu 1989:31) also contains two *jiandi zhan* set in the same way (Figure III-34, right). In some other

[44] They include, for example, one tomb from Wuxiandian Jixie Gongye Xuexiao 無線電機械工業學校 (now Chengdu Technological University) (Sichuan 1982), four tombs from Sandongqiao (Chengdu 1989), one tomb from Zhongyi Xueyuan 中醫學院 (Chengdu 1992), several graves from Baihuatan 百花潭 Middle School (Sichuan 1976), 211 graves from Yangzishan 羊子山 terrace (Sichuan 1956), the Shangyejie cemetery (Chengdu 2009), and two tombs from Wenmiao Xijie 文廟西街 (Chengdu 2005e), all in Chengdu; and one Majia 馬家 tomb in Xindu 新都 (Sichuan and Xindu 1981), four Wulong 五龍 tombs in Dayi 大邑 (Sichuan and Dayi 1985), the Chengguan 城關 cemetery in Shifeng 什邡 (Sichuan et al. 2006), a tomb in Hongguang Gongshe 紅光公社, Pixian 郫縣 (Li Fuhua 1976), the Zengjiagou 曾家溝 (Zhao Dianzeng *et al.* 1988), Tongxincun 同心村(Sichuan and Xingjing 1998), and Nanluobacun 南羅壩村 (Xingjing 1994) cemeteries in Xingjing 榮經, the Moutuo 牟托 tombs in Maoxian 茂縣 (Maoxian and Aba 1994), the Xiaotianxi 小田溪 cemetery in Fuling 涪陵 (Sichuan et al. 1998), the tombs in Baolunyuan 寶輪院, Guangyuan 廣元 and Dongsunba 冬筍壩, Baxian 巴縣 (Sichuan 1960). During this period, most of the tombs are in the shaft-earthen-pit style possibly with remains of wooden or boat coffins.

graves[45], where a special type of bronze pointed-bottom vessels[46] with covers (*jiandi cheng* 尖底盛 or *jiandi he* 尖底盒) were found, these vessel covers look exactly like *jiandi zhan*.

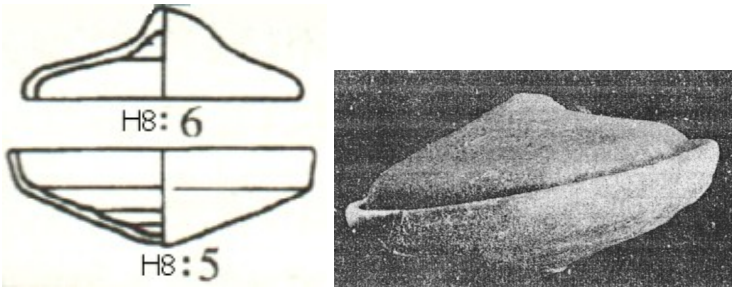


Figure III-34: *Jiandi zhan* (H8:5) and vessel cover (H8:6) found in Shangwangjiaguai (Chengdu and Sichuan 1992:330 fig. 7; Sun Hua 2000:73 fig. 3.4). Samples discovered in Sandongqiao, Chengdu (right) demonstrate how they were used in reality (Chengdu 1989:31 fig. 1).

As briefly mentioned in the Zhuwajie section, in the numerous graves of the Shangwangjiaguai period, a bronze assemblage, including vessels, ornaments, weapons, and tools, were repeatedly found besides potteries. Despite the usual lack of stratigraphy information from excavation contexts, scholars have attempted to determine the periodization of the tombs based on these bronzes as well as the changing pottery vessel styles (e.g., Song Zhimin 1979; Huo and Huang 1991; Jiang and Zhang 1999; Li Mingbin 1999; Sun Hua 2000:83-85; Zhu Ping 2003; Huang Shangming 2007:67-127). Some scholars have also sourced different cultural influences from this bronze assemblage and generalized that besides the cultural elements local to Sichuan, influences from Zhongyuan (the Central Plains) and other regional states, including Qin, Chu, and Yue 越, are often present (e.g., Li Mingbin 1999; Chengdu 2005e). The presence of different cultural elements has prompted scholars to consider the ethnic affiliations of the tomb occupants and ascribe the juxtaposition of multi-cultures to human immigration or communications between the ruling classes (e.g., Duan Yu 1991; Jiang Zhanghua 1996; Sun and

[45] Such as the boat coffin (M1:9) in Mianzhu 綿竹 (Wang Youpeng 1987:23 fig. 2), tomb no. 10 of Baihuatan (Sichuan 1976:42 fig. 7-8), and the tomb in the western suburban of the Chengdu City (Sichuan 1983a:598)
[46] Their ceramic prototype has been found in Zhihuijie, for example (Figure III-12.2).

Sheng 2000[1982]:217-226; Zhu Ping 2003). Scholars also note that among all grave goods, ritual bronzes[47] are particularly susceptible to foreign styles or decorations. Moreover, whenever ritual bronzes are present, they are accompanied by rich numbers of other grave goods (e.g., Huang Shangming 2007:67-127; Jiang Zhanghua 2008). Scholars have inferred that such tombs belonged to some ruling classes or people of higher social status. The presence of foreign ritualistic items also provides information concerning the communications between different social groups in the upper classes, especially with Qin and Chu peoples during this period.

On the other hand, weapons were less monopolized and relatively common in most tombs. The so-called "Ba-Shu style" or "Shu style" weapons, including daggers, axes, halberds, and swords, along with a set of bronze vessels not related to ritual uses[48], were popular in the tombs of the Shangwangjiaguai period. It seems that a local interest in bronze production had been shifted from ritual objects (i.e., *zun* and *lei* vessels and human figures) to weapons from Sanxingdui and Shi'erqiao periods on (Jiang Zhanghua 2008). This shift in bronze categories is perhaps related to changes in the social structure over time and the frequent warfare accompanying the persistent contact between different polities and social groups.

3.2. Jinsha 金沙 site cluster

The Jinsha site cluster is thought to belong to the Shi'erqiao Culture, which is only five kilometers away and yielded similar material cultures, particularly in pottery assemblages. In addition, both of the two site clusters prospered during the same period at the end of the second millennium BC (Zhu Zhangyi et al. 2002; Jiang Zhanghua 2010). The site cluster is composed of several loci, as shown in Figure III-36. This number is continually growing along with urban

[47] Including bronze vessels, such as *ding* tripods, *dou* ring-footed mounted bowls, *dui* 敦 grain-offering vessels, *pan* 盤 basins, *yi* 匜 water-pouring vessels, *yan* 甗 steamers, *jian* 鑑 water basins, *fou* 缶 jars, *lei* water containers, and *hu* 壺 liquid containers, bronzes mirrors, and bronze music instruments.

[48] Especially single-eared *mou* 鍪 vessels and double-eared *fu* cauldrons, both are with round bottoms.

construction. In addition to the core area near the modern city center, sites have been discovered in the northwestern suburbs of the city one after another in recent years. In some loci, such as Zhixin Jinshayuan 置信金沙園 I (Chengdu 2004b), Jingpinfang (Chengdu 2006b), Gandao Huangzhong A- and B-lines (Chengdu 2004a; 2005a), and the sites in the suburbs, inhabitation occurred as early as the late Baodun period (Baodun III or IV). It is clear that the modern city center was not a wasteland in Neolithic times as we formerly thought. In Zhixin Jinshayuan, for instance, the house foundations, pits, burials, and pottery kiln equipped the place with more than basic vital functions during the Baodun period (sixth and fifth layers), though the scale of the settlement was very small[49].

Before the discovery of Jinsha in 1995[50], the "Sanxingdui Civilization" was considered 'lost' as comparable ritual remains and luxury goods had never been found again in later times even though daily-life-oriented settlements and large communities are not absent from the Chengdu Plain (e.g., Shi'erqiao site cluster). The large number of precious goods found in Meiyuan (Chengdu 2004d) quieted the dispute for a while but raised other questions about the nature of the settlement and its external connections. One of such questions is that although small-scaled pottery kilns have been found from time to time, the working spaces of the other objects (i.e., jades, bronzes, and gold) are still unclear.

Aside from this uncertainty, in comparison with Sanxingdui, Jinsha seems more diverse in the functions of the settlement according to the spatial divisions. The rich finds from Jinsha also augment and complement the Shi'erqiao site. On one hand, Jinsha is recognized as the largest site and perhaps the one yielding the maximum amount of luxury goods among all of the Shi'erqiao sites. Archaeologists have therefore considered Jinsha the political and religious

[49] The inhabitation was seemingly abandoned after the Baodun period until it was reoccupied during the Shi'erqiao period (Zhou Zhiqing 2010:167).
[50] The site was known as Huangzhongcun 黃忠村 before 2001.

center after Sanxingdui. On the other hand, as the Jinsha site cluster includes several loci, whose area reaches five square kilometers in total[51], the spatial division and organization of the site cluster *per se* could serve as a valuable case study in intra-site relationships.

As the materials of the site have not been completely digested and data not fully published, some loci are less well known than the others. Loci relevant to this study have been chosen to offer further detail in the following.

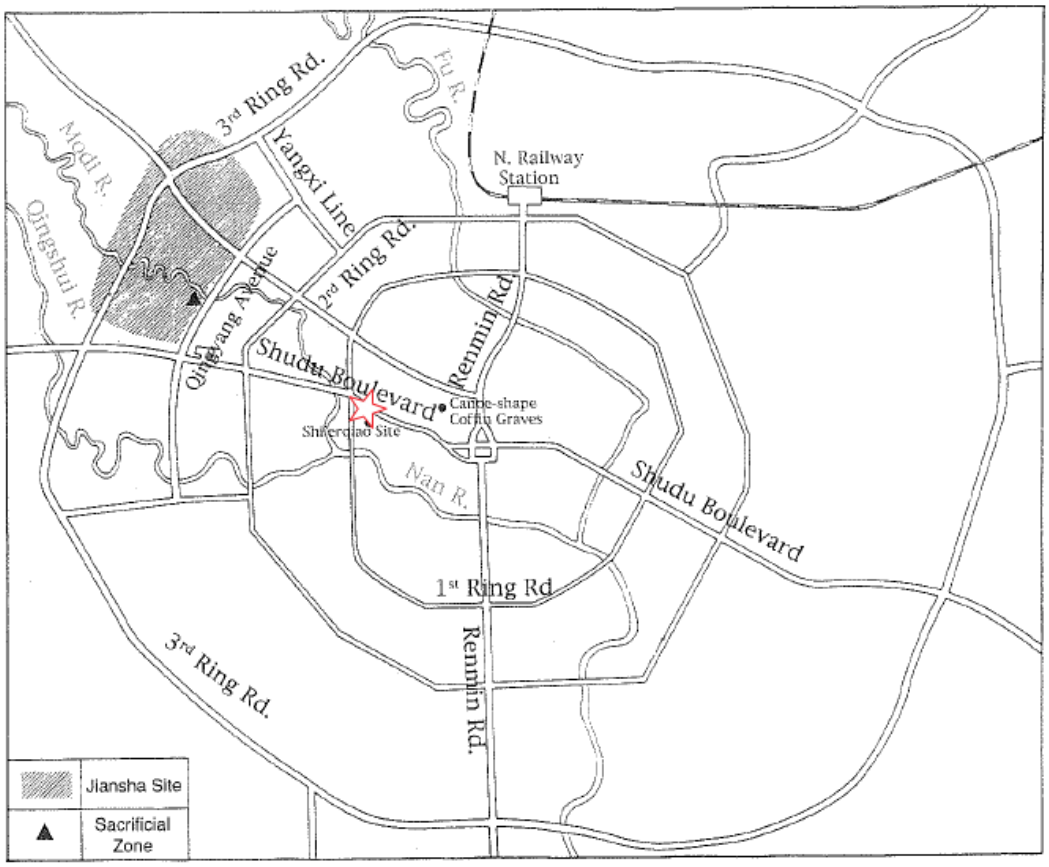


Figure III-35: Location of Jinsha site in relation to the Shi'erqiao site (after Chengdu 2006e:6).

[51] Only the area that has been excavated is accounted. There remains a large area untouched under modern constructions or roads.

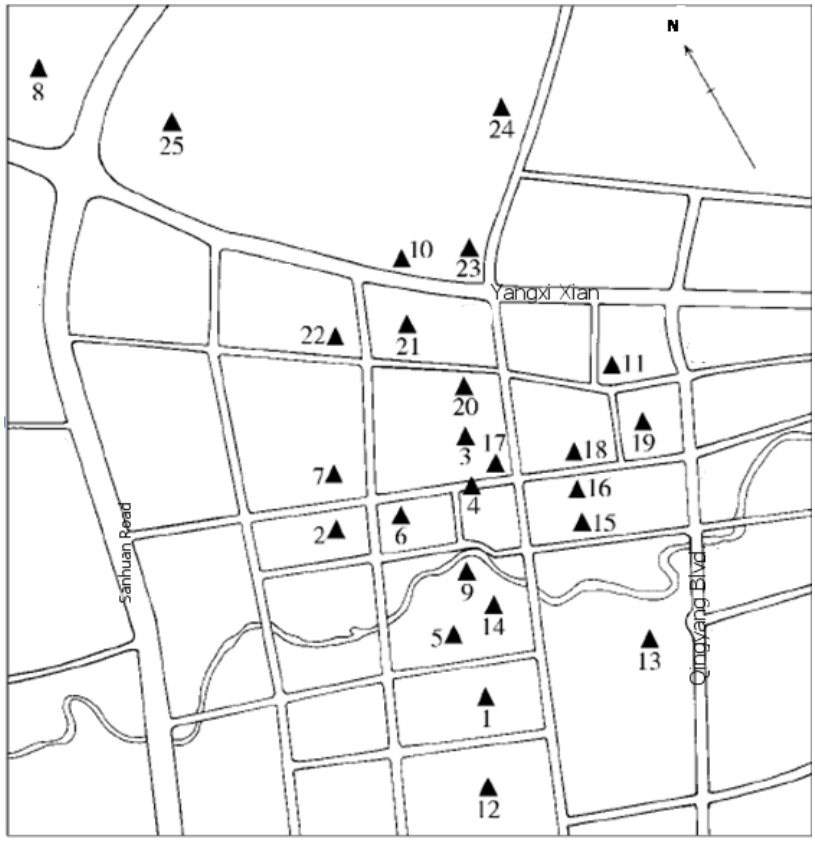


Figure III-36: Loci that have been excavated from the Jinsha site cluster

1. Lanyuan 蘭苑
2. Boyatingyun 博雅庭韻
3. S. Furongyuan 芙蓉苑南
4. Gandao Huangzhong A-line 幹道黃忠 A 線 (Huangzhong Road, Line A)
5. Renfang 人防
6. Guoji Huayuan 國際花園
7. Chunyu Huajian 春雨花間
8. Jingpinfang 精品房
9. Shufeng Huayuan II 蜀風花園二期
10. Xicheng Tianxia 西城天下
11. Sanhe Huayuan 三合花園
12. Hanlong 漢隆
13. Meiyuan 梅苑 (including the "sacrificial area")
14. Yansha Tingyuan 燕莎庭院
15. Jiangwangfu 將王府
16. Jinyu 金煜
17. Jinniuqu Jiaotongju 金牛區交通局
18. Gangzheng 罡正 cemetery
19. Huangzhong Xiaoqu 黃忠小區
20. N. Furongyuan 芙蓉苑北
21. Jindu Huayuan 金都花園
22. Yudu Huayuan 御都花園
23. Yangxi Xian Zonghelou 羊西線綜合樓
24. Jingangwan 金港灣
25. Jiazai Huilang 家在迴廊

3.2.1. Meiyuan 梅苑

Of all of the loci in Jinsha, the so-called Meiyuan sacrificial area is 3,625 m^2 large and immediately located in the south bank of the Modi 摸底 River. The area has yielded more than five thousand pieces of precious bronze and gold objects and piles of ivories, oracle bones, pig buck-teeth, and antlers, which appear to be related to religious activities (Chengdu and Beijing 2002; Chengdu 2004d; 2006e; Zhu Zhangyi et al. 2004). Abundant potteries and ornaments made of polished stones were also recovered in this location. The products embrace both large- and small-sized objects. The turtle carapaces and plastrons[52] used for divination, for instance, are exceptionally large. In fact, the use of carapaces in divination is rarely seen elsewhere. The bronze human figurine (C:17, Appendix III-Figure 26) and stone human-head sculpture (C:167, Appendix III-Figure 27), on the other hand, are much smaller[53] than their Sanxingdui parallels. Aside from size, these various items are similar to Sanxingdui samples in many respects. It is these unpractical but precious objects that suggest Jinsha was the ritual center of the Shi'erqiao period. Some archaeologists even speculate that the area, full of ancient river courses, had been used for water-related rites for a long while, from the earliest phase of Shi'erqiao to the Xinyicun phase (e.g., Zhou Zhiqing 2010). Yet archaeologists have also questioned that, without having discovered a wall, moat, or public square, the nature of the Jinsha settlement might diverge from that of Sanxingdui (Jiang Zhanghua 2010:47; Zhou Zhiqing 2010:172). While the use of these features as diagnoses for a political center is not without its problems, I suggest the Jinsha case provides us with a chance to rethink the possible forms of power control and social organization.

With the large number of craft remains, many of which would have required great skill and complex processes, to recognize the production processes and how different crafts were

[52] A plastron found in 2001 reaches 59 cm.
[53] C:17 is only 14.6- 19.6 cm high and C:167 about 2.3 x 3.4 cm.

organized may help us understand the social organization of this settlement. It has been calculated by the excavators that aside from the pottery and bone tools, gold objects take up 5.2%, bronze 28.1%, and lithic 66.6% of the 4,065 pieces in total (Chengdu 2006d:13). The enthusiasm for jades in Jinsha and the similar remains are reminiscent of the Liangzhu Culture (*ca.* 3200-1900 BC) in the Lower Yangzi valley. Their intricate connection is especially exemplified by a Liangzhu *cong* tube[54] present in Meiyuan (C:61, Appendix III-Figure 28). Aside from imports like the Liangzhu sample, geologists have searched the raw materials of Jinsha's lithic objects in the surrounding mountain areas and found they matched, as briefly mentioned above (Yang Yongfu et al. 2002:194). Although production tools or facilities for lithics have rarely been identified, the large number of semi-finished products of stone ornaments suggests production-related activities nearby. These worked and semi-finished articles are also one of the places that we may observe the craftsmanship of the ancient Chengdu Plain and the devotion of social resources, wealth, and labour to ritualistic or non-routine items. For such items, fine stones were carefully polished and carved. The workmanship required to process these objects was exquisite. For instance, from an unfinished *zhang* blade, it can be observed that the jade material was first trimmed as a thick piece and then sliced off the middle to turn the object into two symmetric pieces (Figure III-37). The parabolic curves indicate that the jade was processed with sandline cutting. Other techniques and tools, such as drilling from two ends and stone-wheel cutters (e.g., C:2), were also involved in cutting *bi* disks and *cong* tubes. As to surface carving, techniques like intaglio, bas-relief, openwork, and inlay can all be found applied to jade items, besides polishing and burnishing, and were sometimes used in combination (e.g., C:7, a jade axe).

[54] With a distinguishable microstructure. The style and motif support the object as a Liangzhu import that prevailed during around 2200-1900 BC (Falkenhausen 2003a:201).

Like many lithics whose prototypes can be sourced to Sanxingdui and then perhaps other regions[55], bronzes items of reduced sizes found in Jinsha claim equally strong connection to this preceding site. Sometimes, objects originally made in bronze were realized in jade, or vice versa. Whether the transformation in materials as well as sizes is related to the change of casting technologies or bronze resources has raised much speculation. Some scholars have conducted provenances studies to trace the raw materials (e.g., Jin Zhengyao et al. 1995; Peng 1996; Jin Zhengyao et al. 2004; Xiao Lin et al. 2004). From these studies, it can be generalized that the Jinsha people broadened their scope of resource procurement in excess of the exploitation of Sanxingdui. However, no conclusion has been reached that certifies any concrete deposit for the raw materials. It is also curious that no trace of production-related features or facilities for bronzes has been discovered in the current excavation area given the correspondingly large number of items.

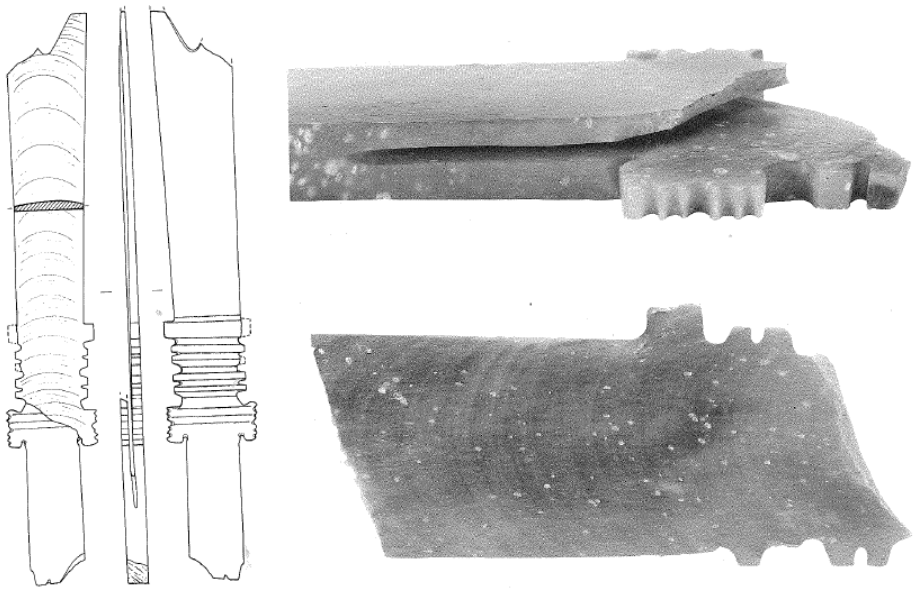


Figure III-37: An unfinished jade *zhang* blade showing processing workmanship (C:82) (Chengdu 2006e:72).

[55] Some ritual items such as *cong* tubes, *zhang* blades, and *bi* disks are widely distributed in China proper (Deng Cong 1994, 1998).

3.2.2. Sanhe Huayuan 三合花園, Huangzongcun 黃忠村

Sanhe Huayuan is among the earliest loci discovered in the Jinsha site. It is distant only 800 meters from Meiyuan with the Modi River lying between them. While Meiyuan was possibly a locality holding sacrificial or ritual activities, the nature of Sanhe Huayuan seems completely different. It is composed of 17 building remains, 17 kilns, 13 graves, and hundreds of pits (Chengdu 2001a). The largest building (F6) is more than 430 m^2 large and appears to be a complex of five rooms, each of which is more than 25 meters long (a bird's eye view of F6 is illustrated in Appendix III-Figure 29) (Chengdu 2001a, 2006e; Zhu Zhangyi et al. 2002). There remain four other constructions exceeding 150 m^2 large. Located among these large buildings are the 17 kilns. Although the kilns are small (about 2 m long and 0.4 m deep, Figure III-38), and only slightly larger than those found in other loci, they reveal first-hand information about firing conditions. Furthermore, the firing chambers often contained a large number of pottery sherds, including those of pointed-bottom saucers and cups (e.g., Y3). Yet these broken sherds (or kiln wasters) that were used to separate vessels from direct contact with fire could have been recycled from broken pots. Kilns like these have been found in a number of loci, such as Gandao Huangzhong B-line (Chengdu 2004a:53), Lanyuan (Chengdu 2003a), Guoji Huayuan (Chengdu 2006c), and Chunyu Huajian (Chengdu 2006a).

The construction of these large buildings are similar to the techniques often used in the Chengdu Plain since the Baodun period, but the buildings differ in their size and number of large posts. They were wattle-and-daub walled with logs and bamboos setting the grids (e.g., every 1.4-1.5 m for one larger post, as seen in F6). Ceramic sherds, including those of pointed-bottom saucers and cups, ring-footed tureens, and long-necked jars, were sometimes scattered in the foundation grooves. Scholars like Jiang Zhanghua (2010:46) believe that the function of the

buildings was related to public activities instead of household residences and suggest these were similar to a contemporaneous construction in Fengchu 鳳雛 village, Shaanxi, which thought to be an ancestral temple of the ruling house of the Zhou Dynasty (the late second to first millennia BC). These large building clusters along with the artifacts unearthed from Meiyuan have particularly fueled archaeologists' interest in considering Jinsha a center of political and economic importance. Though this speculation must await verification, it does seem that the community was specifically organized from the layout of houses, working spaces, and cemeteries. Meanwhile, as the kilns of Sanhe Huayuan are found in a cluster and strewn among the buildings, their spatial arrangement has yielded useful information about the organization of pottery production.

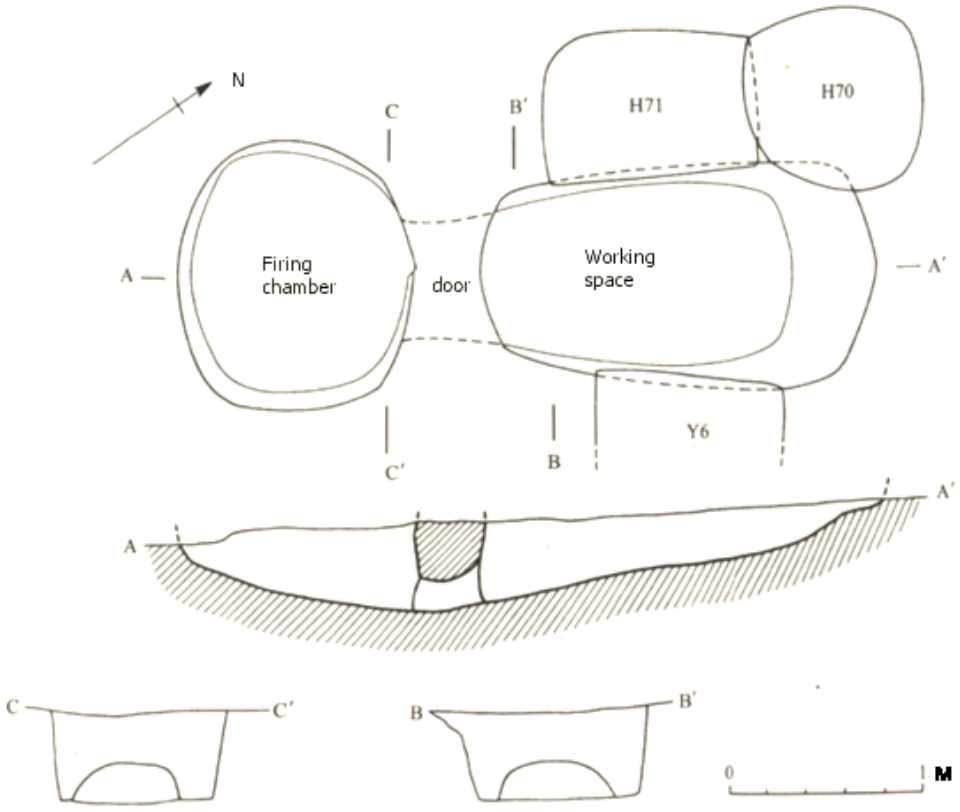


Figure III-38: One of the kilns (Y3) found in Sanhe Huayuan (Chengdu 2001a:170 fig. 6).

Whereas large building foundations were discovered in Sanhe Huayuan, small-scaled ones constructed in the same way have been unearthed from such loci as S. Furongyuan (Chengdu 2005f). The two loci are indeed only distant from each other by several hundred meters with the Gangzheng cemetery in the middle. In S. Furongyuan, many features related to residential areas, including the seven housing bases, 176 pits, and a water-well, have been recovered. Many of the potteries, especially the *jiandi bei* and *jiandi zhan,* found in this likely scene of daily life are close to those of Sanhe Huayuan. Perhaps such potteries were distributed from the same workshop(s). The different scales of construction and types of features between S. Furongyuan and Sanhe Huayuan remind us nonetheless of their differences for vital functions. Probably the two loci and other neighboring areas as well were complementary and met various social needs.

3.2.3. Lanyuan 蘭苑, Shufeng Huayuan 蜀風花園, *Boyatingyun 博雅庭韻*[56]*, and Xinghelu Xiyanxian 星河路西延線*

Other loci, such as Lanyuan and Boyatingyun, have been recognized as residential areas, although other features are also present. These places are often accompanied by kilns, pits and occasionally burials. In Lanyuan, 17 wattle-and-daub houses have been recovered along with three kilns, 461 pits, and more than 100 graves (Chengdu 2003a). Unlike the building remains of Sanhe Huayuan, a normal structure found in Lanyuan is only about 20 m^2 large. Nevertheless, these were constructed by the same manner as their larger counterparts. This locus is east of the sacrificial area of Meiyuan by only 30 meters and located in the south bank of the Modi River, like Meiyuan. Because the most commonly seen vessels in this locus are small flat-bottom jars (*xiaopingdi guan*) and pointed-bottom cups (*jiandi bei*), both of which were popular in the early but not the late Bronze Age, the locus was probably used at an earlier time than other Jinsha

[56] Also known as Wanbo Didian.

loci[57]. Although the locus has also yielded items made of rare materials, like Meiyuan, the quantity of these items is much small and the quality of the lithics and bronzes less delicate. They were mainly small weapons and implements, such as axes and adzes, and are present in the graves. The cemetery seems to have been well planned such that burials hardly overlapped with each other and were oriented in roughly the same direction (NW-SE). During this period, it is normal for burials to contain only a few or no grave goods. If grave goods are present, they are most likely non-decorated potteries, including pointed-bottom vessels. Pointed-bottom vessels can also be found in the kilns and pits, sometimes in a bundle (e.g., H305). A few pits seem to have been deliberately dug, judging from their trimmed margins, in which diverse vessel types in good preservation conditions were juxtaposed. Pits like these have prompted archaeologists to speculate that they were used as caches to preserve pottery vessels (Chengdu 2003a).

In the locus of Boyatingyun, 353 pits and a cemetery containing 60 burials were recovered (Chengdu 2004c). The cemetery mixed primary and secondary burials, both of which are in the shaft-earthen-pit style (Figure III-39). Pits are hardly deeper than 0.5 m and barely accommodated. Only a few burials were built with a second tier. Also, a few of them (3) have a layer of board beneath the dead. The excavators suspect that the burials with boards might be the prototype of boat coffins popular in late Bronze Age (see also Chengdu 2004c:94; Jiang Zhanghua 2010:38). In either case, the graves of Boyatingyun do not contain particular grave goods or show a difference in the treatment of bodies. In burials containing grave goods, they typically include small jars, pointed-bottom vessels, and spindle whorls in any combination. Spindle whorls sometimes bear special decorations. Interestingly, nearly all of the dead are set

[57] Jiang Zhanghua (2010:45-6) has proposed a periodization scheme for several Jinsha loci (Appendix III-Table 2). He also noted that the Jinsha settlement had not well developed during its first phase (contemporary with Shi'erqiao thirteenth –twelfth layers). It then reached the heyday during phases II-IV (contemporary with the period between Shi'erqiao/Xinyicun twelfth and eighth layers), during which the settlement became more concentrated around the sacrificial area.

with their hands crossed in front of their bellies or chests. This custom was also adopted in children and even secondary burials and probably lasted for a long period, as seen in the Spring-and-Autumn (8^{th} -5^{th} centuries BC) burials in Guoji Huayuan (Chengdu 2006c) and Warring-States (5^{th}-3^{rd} centuries BC) burials in the Renfang cemetery (Chengdu 2005g), for instance. Besides graves, there are small quantities of stone implements and jades discovered in pits or around them. For example, like Lanyuan, Boyatingyun also yielded an unusual stone *yue* ax (T4939⑤:1).

The division of spatial utilization within the Jinsha site cluster is even clearly displayed in Shufeng Huayuan (Chengdu 2003b) and Gangzheng (unpublished), where the land use for cemeteries is nearly exclusive, intensive and on a larger scale[58]. Slightly north of Lanyuan, Shufeng Huayuan is composed of 15 burials, all of which were made in shaft-earthen pits and aligned to the northwest-southeast axis. These characteristics conform to Lanyuan burials. Five of the 15 graves are found to have grave goods, all of which contain pointed-bottom vessels, either *jiandi bei, -guan*, or *-zhan*. It is worth noting that while pointed-bottom vessels are often used as grave goods, they are often present singly with or without the companion of other types of pottery or stone tools. This was a common custom since the Shi'erqiao period and followed in later times. Because the dead have not been accordingly identified for their gender, age, and so on, and differences in the grave types or goods are not evident, social differences are at best only vague in these cemeteries.

The identification done on the occupants of the burials in Xinghelu Xiyanxian, another cemetery recently excavated, reveal more details (Chengdu and Xindu 2010). The 24 burials of the Shi'erqiao period yielded *jiandi zhan* and *xiaopingdi guan* in small quantities, with very few

[58] About 37,000 m^2, according to the test excavation. However, only a very small part of it has been excavated.

other grave goods. From the burials whose occupants' gender and age can be identified, no difference in grave goods has been noted of in their statuses. As seen in Boyatingyun, the dead found in Xinghelu Xiyanxian and Gangzheng were interred in the same position, in which their hands were crossed in front of their bellies or chests. The potteries in turn were placed beside their upper bodies. Besides these earlier burials, the Xinghelu Xiyanxian also contains 24 graves of the late Xinyicun or Shangwangjiaguai phase, in which *jiandi zhan* were persistedly present as grave goods along with a new burial assemblage, including round-bottom *fu* cauldrons, *pen* basins, ring-footed, mounted bowls, *he* 盒 boxes, *hu* flasks, and sometimes "Ba-Shu-style" bronze weapons as well. Again, potteries and bronze weapons are present for both male and female occupants (for example, M2732 displays a female occupant accompanied by bronze weapons).

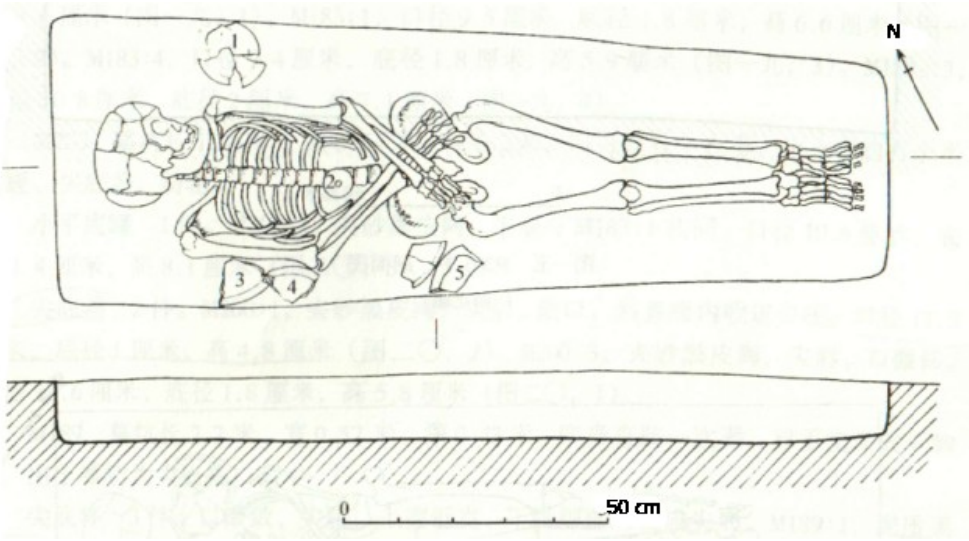


Figure III-39: A burial (M197) discovered in Boyatingyun
Containing pottery vessels: 1, 3-4. *xiaopingdi guan*; 2. spindle whorl; 5. *jiandi zhan* (Chengdu 2004c:73).

3.2.4. Peripheral sites, northwest of Chengdu City

Whereas the above site cluster has been recognized as the Jinsha core, a few peripheral sites are scattered between Pixian and the Jinsha core along the Modi River, which also runs through the

Jinsha core area. Most of these peripheral sites are today in the Gaoxin Xiqu 高新西區 District or Pixian County northwest of modern Chengdu city, including Wan'an Yaoye Baozhuangchang 萬安藥業包裝廠 (Chengdu 2005c), Datang Dianxin 大唐電信 II (Chengdu 2005b), Guoteng 國騰 II (Chengdu 2005d), Zhonghai Guoji Shequ 中海國際社區 (Chengdu 2007a; 2007b), Putian Dianlan 普天電纜 (Chengdu 2008c), Dianzi Keji Daxue Qingshuihe Xiaoqu 電子科技大學清水河校區 (University of Electronic Science and Technology of China at Qingshuihe, or UESTC) (Chengdu 2008a; 2008b), Futong Guanglan Tongxin Youxian Gongsi 富通光纜通信有限公司 (Chengdu 2010a), Languang Luse Yinpin 藍光綠色飲品 II (Chengdu 2010b), and Sichuan Ruyang Shiye Fazhan Youxian Gongsi 四川如陽實業發展有限公司 (Chengdu 2010c). This list is not exhaustive and keeps growing along with urban construction due to city expansion. The majority of the localities have been inhabited since the Baodun period and continued to be employed as cultivated lands until modern times, such that these sites are composed mainly of pits. Other types of features have only occasionally been discovered. For example, three kilns were unearthed in Putian Dianlan, in which the kiln structures are similar to those from Jinsha. At the site, vessel types characteristic of the early Shi'erqiao period, such as vessel covers with kneaded buttons, pointed-bottom vessels, and jars with small, flat bases (*xiaopingdi guan*), have also been found accompanying the kilns (Chengdu 2008c).

It is normal to find in these sites the strata yielding vessel types typical of Shi'erqiao deposited atop the strata containing remains of the late Baodun period. Some scholars have noted that these sites were not only linearly distributed along the Modi River but that Baodun remains are also more frequently discovered in the western end (i.e., close to Pixian) (e.g., Chengdu 2010c:205). Conversely, the eastern end, wherever close to Chengdu City, contains more

Shi'erqiao remains. Whether this uneven distribution implies the expansion direction of the Baodun culture or even its center shift from northwestern Chengdu Plain to the modern city center deserves further exploration.

3.3. Other perspectives of the ancient environment-- faunal and floral resources of the Chengdu Plain

Whereas the deposition environment of the Chengdu Plain before the construction of the Dujiangyan irrigation project (256 BC) is often referred to as a floodplain, recent archaeometric work has identified diverse faunal and floral resources in pre-Qin times. According to studies of the zoo-ecology of the Chengdu Plain (e.g., Sichuan and Chengdu 1987:205-06; He Kunyu et al. 2006; Shichuan and Chengdu 2009:206-220; He Kunyu 2011:82), archaeologists suggest that the region was abundant in both wild animals (e.g., birds, muntjacs, monkeys, deer, and freshwater fish and turtles) and domestic animals (e.g., pigs, dogs, oxen, and chicken) before the end of the second millennium BC. Remains of pigs or boars are particularly plentiful in such loci as Shi'erqiao and Xinyicun, whose tusks were also been used in ritual scenes. The likely sacrificial occasions, such as Meiyuan, reveal the ritualistic importance of some animals, including turtles, elephants, rhinoceros, and pigs. Plastrons of tortoises, for instance, are often preserved as divinatory objects in the Chengdu Plain where the custom had been practiced since the Shi'erqiao period.

As to the economic and subsistence values of faunal resources, from the sampled twelfth layer of Shi'erqiao, researchers discovered that more than 60% of the meat resources of ancient Chengdu Plain came from domestic animals, among which pigs provided up to 58%-63% of the total weight of the meat consumed, excluding aquatics (Sichuan and Chengdu 2009:219). Other than pigs, remains of deer also overwhelm the other finds in the region. On the other hand,

aquatic remains were not abundant during early excavations. However, this poverty could be the result of the excavation method, by which sieves of fine mesh were not thoroughly adopted in earlier excavations. A variety of fresh-water fishes and turtles should not have been scarce as river resources were fairly accessible. Given the rich remains of fishing-related instruments, such as net sinkers and finishing hooks, I suspect fishing was an important subsistence activity in the ancient Chengdu Plain.

Among those animals whose remains are preserved in the sites, some species such as rhinoceros, elephants, and testudines are now extinct in the region. The differential use and preservation of animal parts make it difficult to determine whether these animal parts were imported products or indeed came from indigenous animals that are extinct now. For example, large amounts of ivory are present in both Sanxingdui and Jinsha sacrificial contexts. Remains of the other parts of elephant bodies, however, are rare. This disproportion leads to divergent opinions about whether the environment of that time was favorable for the species. If these animal species lived in the region during the Bronze Age, the region might have experienced climate change or perhaps overhunting by humans from then on, both of which caused the deterioration of the environment. However, if the remains were imported from the warmer, distant south, the exchange networks of Sanxingdui and Jinsha must have been widely extended and this also signals that the sites were once important trade centers for these foreign items. The ritualistic needs of Sanxingdui and Jinsha constituted large consumption markets of particular animal parts.

Although these animal remains should not be taken as a definitive indication of the climate or eco-system of the time, they do provide useful information for reconstructing environments and ancient people's subsistence and, if compared over time, they should also help us to figure

out the fluctuation of local climates. For instance, from the identification and classification of animal bones of the Shi'erqiao site, researchers have shown how animal bones were modified and used (Sichuan and Chengdu 2009:206). It seems that the long bones of sambars and antlers were the most often used parts to make bone tools. A large quantity of worked bones and remnants were left in the site. Looking at the cutting sections, which are often very straight and sharp, it is possible to guess that the bones and antlers were cut by metal tools. In fact, small bronze tools, such as chisels and cutting tools, were occasionally found in these sites. In other nearby loci, such as Xinyicun, the use of animals for food is evident from the repeatedly found modification traces on bones. Modification marks, such as cuts, scrapes, impacts, chops, and burning (Reitz and Wing 1999:128-134), are frequently seen on animal shafts, scapulae, crania, and antlers to remove skin, meat, or marrow, some of which may have involved metal tools, too. Sometimes, canines (e.g. IT15⑫:4) from small carnivorous animals were worked and had holes drilled in them to become ornaments.

While the establishment of a database in faunal species specific to Southwestern China is still at its initial stage and requires continuous data accumulation, efforts to study pollen remains have almost become routine in Sichuan and other parts of China in recent years. Based on recent investigations into the pollen remains of different periods in the Chengdu Plain, especially the Guanghan area where the Sanxingdui Culture centered (Fu Shun et al. 2003; Fu Shun et al. 2005; Liu Xingshi 2005), researchers have suggested that the region did not have generally stable climates. It gradually became warmer in *ca.* 10 ka BP[59], when pine forests were slowly replaced by broad-leaved trees. Between 6-3 ka BP, the plentiful evergreens, ferns, and algae pollen indicate a more humid climate. Finally, pine trees and grasses became dominant during 3-2.8 ka

[59] This also marks the deglacial warming during the transition from the Pleistocene to the Holocene.

BP, perhaps because the weather became cooler again. Liu Xingshi et al. (1983; 1998; Liu Xingshi et al. 2005; Fu Shun et al. 2003; Fu Shun et al. 2005) continue to conclude that Sanxingdui suffered from intermittent floods during an otherwise very arid period. Such sudden events also led to the decline of the settlement.

Another study on the Holocene stratigraphy of the Chengdu Plain where organic materials were rich in soils reveals that the area was dominated by deposits caused by floods and had intermittent swamps (Sichuan and Chengdu 2009:220-234). Pollen recovered from the fifteenth[60] to the ninth layers in Shi'erqiao is particularly abundant, from which local vegetation and climates might be inferred. For instance, from the fifteenth to the fourteenth layers, the proportions of woody plants were greatly reduced as ferns dramatically increased (Figure III-40). In addition, although the proportion of pines increased in the fourteenth layer, it was in fact derived from an even larger reduction in the proportion of broad-leaved tree pollen (from 41.8% to 5.3%) (Figure III-41). This perhaps suggests a retreat of vegetation, gradually turning the area into the margins of open forests. From the thirteenth layer on, the amounts of herbages, mostly composed of the grass family, generally grew. This might be related to the development of agriculture in the region (Sichuan and Chengdu 2009:225, 229). However, it should be noted that, like the distributions of faunal remains, the consideration of a more comprehensive ecological system other than the change of temperature and rainfall is still required to interpret floral data. The flexible adaptation and individual characteristics of animal and plant families are also relevant. For example, the agents needed to transport pollen (e.g., wind, water), the differential

[60] Although archaeological excavation stopped at the thirteenth layers, archaeologists continued to retrieve soil samples beneath.

yields of pollen between species[61], and the change in wind directions, are all factors that could cause errors in data interpretation and require careful consideration.

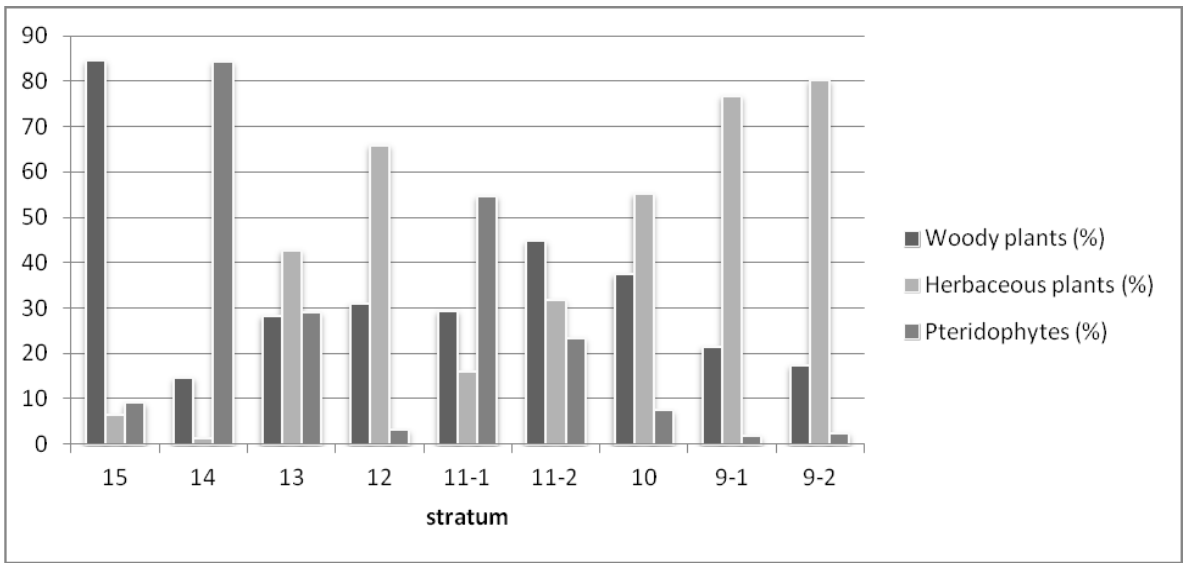


Figure III-40: Percentages of woody plants, herbage, and pteridophytes that make up the pollen in the strata of the Shi'erqiao site
(drawn from Sichuan and Chengdu 2009:230 table 16; note that 11-1 is earlier than 11-2 in stratigraphy).

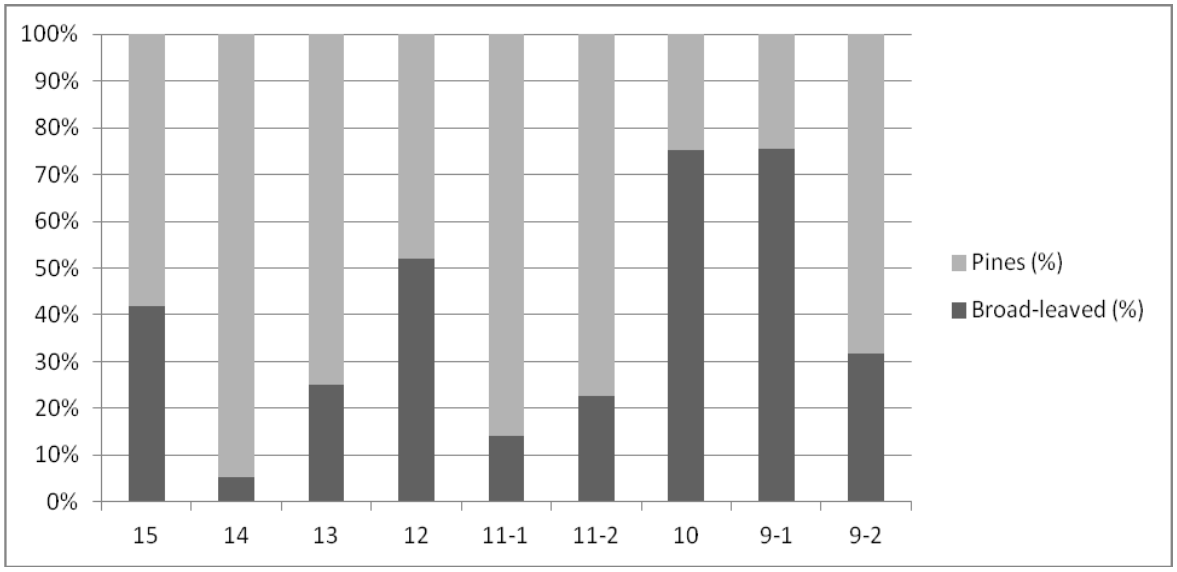


Figure III-41: Percentages of pines and broad-leaved tress that make up the woody plants in Figure III-40 (drawn from Sichuan and Chengdu 2009:230 table 16).

[61] For example, broad-leaved trees yield less pollen than pine trees.

4. Relevant archaeological sites and finds to the Chengdu Plain

4.1. Chongqing -Three Gorges

In this section, I discusses the sites in the Yangzi River valleys between Chongqing and the Three Gorges (Sanxia 三峽). As the Yangzi River flows from west to east, a number of its tributaries converge toward the Yangzi from the north and form river terraces as well as sandbars at the confluence, at which most archaeological sites have been discovered. They belong to the modern administrative regions of Fuling 涪陵, Fengdu 豐都, Zhongxian 忠縣, Wanxian 萬縣 (Wanzhou 萬州), Yunyang 雲陽, Fengjie 奉節, and Wushan 巫山. Through a number of surveys and test excavations, several Paleolithic sites have been recovered from these areas and yielded rich data in stone-tool traditions. Neolithic cultures, such as Weijialiangzi culture (*ca.* 2700-2000 BC) (Zhongguo 1996), Laoguanmiao 老關廟 culture[62] (Zhao and Wang 1996; Jilin and Sichuan 1998), and Shaopengzui culture (*ca.* 4300-1800 BC) (see in the following), even flourished, and their many features and cultural elements were followed by or continued to influence other cultures over time. As the Yangzi River connects the Chengdu Plain and eastern Sichuan, scholars have observed that these riverside settlements had varying degrees of interaction over time (e.g., Sun Hua 2000; Jiang and Yan 2003).

Furthermore, the region is considered the inhabitation of the Ba 巴 ethnic groups and the Ba State during the Warring States period (5th-3rd centuries BC). Its changing relations with western Sichuan, which is traditionally thought of as the kingdom of the Shu 蜀 people, and its potentially intermediary role in connecting western Sichuan to other regions have raised much

[62] According to the excavators, the Lower Laoguanmiao is no later than the Xia-Shang period (*ca.* 2100-1050 BC) and the Upper Laoguanmiao is slightly later (Zhao and Wang 1996).

speculation. The relevant sites after the Neolithic Age that show certain likeness with the Chengdu Plain in material cultures are introduced in the following, from west to east.

4.1.1. Linshi 藺市, Zhen'an 鎮安, and Shituo 石沱 in Fuling 涪陵

1) Linshi

Linshi is located on the south bank of a turning point of the Yangzi River. Excavations conducted at the site have yielded remains from the late Neolithic and Bronze Ages, among which were vessel types comparable to those of the Chengdu Plain (Chongqing and Fuling 2003; Chongqing and Chongqing 2006). For example, water-wave-like incisions and trumpet-shaped vessel mouths that could be parts belonging to round-shouldered flasks with trumpet-shaped mouths (*labakou yuanjian hu* 喇叭口圓肩壺) are close to Baodun samples. However, the clay sources drawn by Linshi potters differ. That is, though the water-wave incisions were often impressed on ashen fine wares in Baodun, the same decoration was applied to brownish coarse wares in Linshi (Chongqing and Chongqing 2006:806). This exemplifies the divergence in two groups of potters while realizing the same artistic expression, which was probably conditioned by natural resources and technological choice.

Later, during the Sanxingdui and Shi'erqiao periods, potteries similar to the Chengdu Plain were often found. For instance, a closed-spouted pitchers with pouch-shaped feet (*daizu fengkou he*) (IT0803⑥:10) is similar to its counterparts in Sanxingdui or early Shi'erqiao (Chongqing and Chongqing 2006:799 fig. 11.1). Even the handle of the vessel is decorated with the same vertical marks (Appendix III-Figure 30.1). *Xiaopingdi guan,* especially those with blocks of cord marks on their shoulders, are also close to Sanxingdui samples. Other vessels, such as the pointed-bottom cups, high-stemmed, mounted bowls, ring-footed tureens, and vessel covers with kneaded buttons are all reminiscent of the vessel types in Shi'erqiao. On the other hand, besides

primitive artillery-shell-shaped *jiandi bei*, horn-shaped *jiandi bei* (*yangjiaobei* 羊角杯 or *jiaozhuang jiandibei* 角狀尖底杯) are present in the site, although the latter are absent from the Chengdu Plain.

During the Warring States period, three tombs were found to have mixed local and Chu traditions in the Middle Yangzi (Chongqing and Fuling 2003:822-827). The Chu-style items include both potteries and bronzes. Usually common Ba-Shu style weapons are however absent.

2) Zhen'an

Zhen'an is located on the northern bank of the Yangzi River, west of Linshi by 7 km and Fuling by 24 km. After several campaigns of excavation, a number of features, including graves, pits, and trenches, were recovered (Beijing and Chongqing 2003b, 2006; Beijing et al. 2007). Based on the remains obtained from these excavations, the excavators proposed that the first and second phases of the site are contemporary with the Shi'erqiao Culture of the Chengdu Plain. In particular, the collared *jiandi bei* from the first phase of Zhen'an (e.g., H8:6) are similar to those found in Shi'erqiao and Zhengyincun. This vessel type was in fact widely distributed in the eastern Sichuan Basin and western Hubei, such as Xianglushi, which I discuss in the following. Vessel covers with kneaded buttons (e.g., H8:4) can also be sourced back to the Sanxingdui period (Appendix III-Figure 31).

From the second phase, the parallel between Zhen'an and the Chengdu Plain is even more apparent, as remains such as pointed-bottom vessels are very rich from this period. Other than artillery-shell-shaped *jiandi bei,* which were popular in the Shi'erqiao and Jinsha site clusters, the site also yielded *jiandi zhan,* high-stemmed mounted bowls, and ring-footed tureens close to Shi'erqiao samples. The excavators note that the bottoms and upper parts of the *jiandi bei* were first made separately and later joined together with the help of a potter's wheel (Beijing and

Chongqing 2003b:867). The excavators also discovered that the incised marks often seen at the bottoms of pointed-bottom vessels were actually caused by stationary barriers that fixed the pots to the potter's wheel (Beijing et al. 2007:1937). In addition, as noted earlier in Fangchijie, from samples such as G1:11[63], whose upper parts are often grey and lower part as well as inner surfaces black or smudged, it is likely that multiple cups were sleeve-connected during firing, as the excavators noted (Beijing and Chongqing 2003b:868). Actual examples of vessels stacked during firing have been discovered in Shaopengzui and Wazhadi 瓦渣地 (Figure III-43) (Sun and Zeng 2006[1999]:304).

Besides artillery-shell-shaped *jiandi bei*, slenderer horn-shaped *jiandi bei* (*yangjiaobei*) are also present. The two different varieties of *jiandi bei* are denoted as A and B subtypes in Sun and Zeng's typology (2006[1999]:296) (Figure III-42). Although their shapes might be close to each other, the two varieties of *jiandi bei* differ in clay quality as well as volume. Whereas the texture of artillery-shell-shaped *jiandi bei* is often very fine and more delicately produced, horn-shaped *jiandi bei* are made as oxidized, coarse wares. Even though both could be fired in a batch, horn-shaped *jiandi bei* seem to approximate mass production as the large quantities of sherds featuring sketchy production have been found in some localities, especially the site cluster in Zhongxian, which I discuss in the following. Such divergence in clay textures and production manners probably suggests their distinct usage.

[63] Although G1 is a feature ascribed to the third phase, it has yielded many remains left from the second phase, including *jiandi bei* and *jiandi zhan* (Beijing and Chongqing 2003:883).

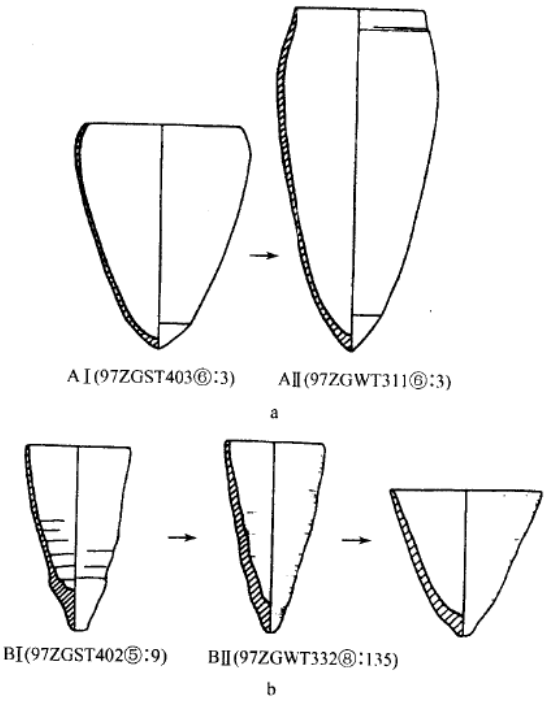


Figure III-42: Form development of pointed-bottom cups (after Sun and Zeng 2006[1999]:296 fig. 5).

Like pointed-bottom cups (*jiandi bei*) characteristic of Zhen'an, pointed-bottom saucers (*jiandi zhan*) (e.g., T0603⑥:2), is also similar to their counterparts in western Sichuan but perhaps differ in clay texture. That is, while *jiandi zhan* of the Chengdu Plain were mostly made to be coarse or finely coarse and only occasionally as delicate as *jiandi bei*, samples of Zhen'an, on the other hand, tend to be in a similar fine clay texture and color with *jiandi bei*. This difference may again be related to the specific clay-procuring and pottery-making traditions. As the excavators discovered, fine wares had been fairly prevalent during the first two phases of Zhen'an, in which they account for 72%-80% of the total potteries (Beijing and Chongqing 2003b:856). Following this technological tradition, it is not surprising that many vessel types were fine or nearly fine wares even though their counterparts in other regions were likely coarse wares. Whether different clay textures are associated with the usage of vessels is a topic that I discuss in Chapter IV. Here, though, it is difficult to know why the pottery color changed

between the first and second phases of the site, during which the potteries changed from red with black slips to grayish. Such change is likely related to different firing atmospheres, clay sources, and/or colorants, driven by a preference for certain colors. The definitive reason is uncertain, however, if no other evidence is provided.

Like Linshi, a number of tombs from the Warring States period have been discovered at the site. Also like the Linshi graves, bronze weapons and vessels were not common here. When they are present, they hardly constitute a complete assemblage either. Instead, round-bottom jars or *fu* cauldrons and ring-footed, mounted bowls are the major grave equipments. These grave goods have been widely compared with those not only in western Sichuan and Chu but also in Qin in northern China, which later conquered the region in 316 BC (Beijing and Chongqing 2006:775-777).

3) Shituo

The site is in the other side of the Yangzi River of Zhen'an. Like the early phases of Zhen'an, potters of Shituo tended to produce fine wares rather than coarse wares. The two close sites probably shared the same clay resources. However, although Shituo was inhabited as early as Zhen'an, the yielded pottery remains of two locations are not completely alike, except for a few vessel types (Beijing and Chongqing 2001; Beijing and Fuling 2003; Beijing et al. 2007). These exceptions are high-stemmed mounted bowls, long-necked jars, and horn-shaped *jiandi bei.* The former two are also close to western Sichuan samples. Beyond these, although pointed-bottom vessels, particularly *jiandi zhan*-like vessels*,* were more abundant in Shituo, they are not in the same styles as typical *jiandi zhan* in the Chengdu Plain or other sites in eastern Sichuan. In Shituo, these pointed-bottom vessels have deeper and rounder bellies than usual and sometimes have longer necks. The excavators of Sihtuo concluded that this difference is because the site

was inhabited slightly earlier than Zhen'an. No clear indicator of chronology can confirm this inference however. I suspect that whereas *jiandi zhan* had long prevailed in other places without much change, some specific local needs to Shituo may have driven the modification in vessel shapes.

4.1.2. Ganjinggou 贛井溝 site cluster in Zhongxian 忠縣

Located around the confluence of the Ganjing and Yangzi Rivers, the Ganjinggou site cluster is composed of Shaopengzui, Dujiayuanzi 杜家院子 (Chengdu and Chongqing 2003a), Luojiaqiao 羅家橋 (Chengdu and Chongqing 2003b; 2003c), Banbianjie 半邊街 (or Yaijiao 崖腳)[64], and Wazhadi sites (Wang Xin 1996; Sun Hua 2000:119; Beijing Daxue et al. 2001; 2003; 2006). Although Zhongba 中壩 is not clustered with the other sites, it is distant from the confluence of the two rivers by only about 6 km and is thus discussed under the same title (Appendix III-Figure 32). Around the confluence of two active rivers, these localities have been greatly impacted by river erosion and flooding alluvium. Stratigraphy in such loci as Wazhadi and Zhongba have especially reflected the traces of flood disturbance. Those strata that were formerly recognized as sterile soils may turn out to be intermittent flooding alluvium covering and hiding earlier deposits. The chronology and periodization of certain sites and cultures, such as Shaopengzui, also need to be reconsidered (Wang Chuanping et al. 2006:ii).

The site cluster has been inhabited since the Neolithic Age and continued to be exploited throughout historical times. Though these sites were close to each other, they were also somewhat isolated given the natural landscapes (e.g., river terraces and sandbars). Among them, Shaopengzui is the most lasting and representative site. It has also better preserved the Neolithic

[64] Because the nature of Dujiayuanzi is close to that of Wazhadi and Luojiaqiao, and Banbianjie mainly features cemeteries contemporary with the Warring-States and even later periods, Dujiayuanzi and Banbianjie are not discussed here.

cultural elements indigenous to the area before increased regional interactions brought other feathered ingredients to the area. Some scholars suggest that, during the Neolithic period, Shaopengzui along with a number of other sites in the region, including Zhongba in Zhongxian, Laoguanmiao in Fengjie, Yuxiping 玉溪坪 in Fengdu, and upper Daxi 大溪 in Wushan 巫山, all broadly belong to a Shaopengzui Culture (Jiang and Yan 2003). It should however be noted that the included settlements were not necessarily prosperous during the same periods of time[65].

1) Shaopengzui

As one of the earliest sites discovered in the Three-Gorges area, Shaopengzui has yielded rich remains of Neolithic and Bronze Ages after several surveys and excavations since the 1950s (Beijing et al. 2001; Beijing et al. 2003; Beijing et al. 2006). The Neolithic Shaopengzui seems distinct from the Chengdu Plain but related to the Daxi Culture (*ca.* 4300-3000 BC) prevailing in the Middle Yangzi in an earlier time than Baodun (Sun Hua 2000:323; Zou and Bai 2003). Nevertheless, such early Daxi influence was short-lived and did not seem to incorporate Shaopengzui into the Middle Yangzi tradition. Instead, the region became more and more similar to the Chengdu Plain during its major period in and after late Neolithic Age. For instance, both Baodun and Shaopengzui yielded beakers or vats with cord marks and horizontal appliqué. It has been noted that similar vessels were popular in the middle Yangzi and eastern Sichuan (Flad and Chen 2006:242 fig. 7, 244 fig. 9) (Appendix III-Figure 33). Also, like the Baodun Culture, the pottery quality of Shaopengzui once declined in both clay texture (i.e., transforming from fine- to coarse-clay dominated) and decorations. This roughly synchronic 'decline' is curious and demands a wide range of examinations in environmental and social change.

[65] Shaopengzui lasted a long time (*ca.* 4300-1800 BC). During its earlier phases (I and II), the Yuxiping site is thought to be a more representative site and the Yuxiping culture has been proposed by some scholars to replace the broader designation. In such scheme, the Shaopengzui culture represents its original third phase (Wang Chuanping *et al.* 2006:iii).

Whereas the similarity between the two cultures, Shaopengzui and Baodun, is traceable, they demonstrate some difference in pottery assemblages. In addition to the difference in a part of the vessel types, Sun Hua (2000:321) argues that the ceramic colors are often distinct between the western and eastern Neolithic Sichuan Basin. Although this dominance of certain colors was likely caused by the respective local clay sources, as color and vessel type are sometimes associated and mutually influenced, this observation may still provide a parameter for understanding cultural differences and similarities.

During the period contemporary with Sanxingdui and Shi'erqiao, Shaopengzui yielded vessel types including jars with inverted-rims (*liankou guan*), jars with small, flat bases (*xiaopingdi guan*), long-necked jars, pointed-bottom saucers and cups, high-stemmed mounted bowls (*gaobing dou*), vessel covers, jars with decorated rims (*huabiankou guan*), round-bottom jars with decorated rims (*huabian huandi guan* 花邊圜底罐), and horn-shaped, pointed-bottom cups (*jiaozhuang jiandibei*) (Figure III-43). Among them, except for *huabian huandi guan* and *jiaozhuang jiandibei*, which were not seen in the Chengdu Plain and probably denote the most evident difference between western and eastern Sichuan, pottery vessels of the wide Chongqing-Three Gorges area are similar to those of late Sanxingdui and early Shi'erqiao. Particularly, *xiaopingdi guan,* high-stemmed mounted bowls, vessel covers, and *jiandi zhan* from Shaopengzui have made the site look similar to its western counterparts. The vessel styles of the two areas are so close that scholars like Jiang Zhanghua consider Shaopengzui a regional phase of the Shi'erqiao culture (Beijing et al. 2003). Jiang proposes that eastern Sichuan was greatly influenced by the Sanxingdui Culture when the latter expanded eastward. The eastern Sichuan was incorporated into the cultural sphere of Sanxingdui and this intensive communication continued into the Shi'erqiao period (see also Sun Hua 2000; Jiang Zhanghua 2007).

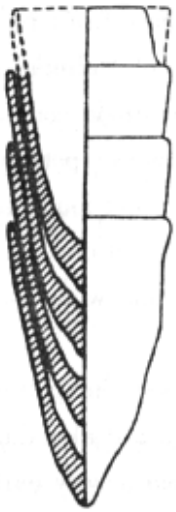


Figure III-43: Stacked horn-shaped, pointed-bottom cups discovered in Shaopengzui (after Sun and Zeng 2006[1999]:304 fig. 7).

From the stratigraphy of Shaopengzui and other nearby sites, the period of *xiaopingdi guan* and high-stemmed mounted bowls is earlier than the time *jiaozhuang jiandibei* and *jiandi zhan* becoming abundant. The deposits of *jiaozhuang jiandibei* and *jiandi zhan* are, in turn, earlier than that of *huabian huandi guan.* Successively, *jiaozhuang jiandibei* and *huabian huandi guan* have become the most popular vessel types and their deposits are very intensive and thick in the strata, with only few other potteries coexisting (Sun and Zeng 2006[1999]:290).

The Wazhadi locus features the later phase of Shaopengzui as a thick layer of *huabian huandi guan* has been discovered from the upper stratigraphy (the fourth and fifth layers) atop the ones containing a small quantity of Neolithic remains (the eighth and ninth layers)[66]. Besides *huabian huandi guan,* the upper stratigraphy only yielded *jiaozhuang jiandibei* and *jiandi zhan* but nothing else[67]. The vessel types are limited and monotonous. A well preserved kiln yielded hundreds of *jiaozhuang jiandibei* demonstrating the intensive and large firing batch of the items. The considerable number of potsherds and presence of kilns indicate that the locus was a pottery

[66] Layers of alluvium (the sixth and third layers) seem to have broken the cultural deposits.
[67] This is probably the only locus and strata in which two types of vessels, *jiaozhuang jiandibei* and *huabian huandi guan,* coexist (Sun and Zeng 2006[1999]:290).

production locality supplying the Ganjinggou site cluster (Sun Hua 2000:120). A tomb (97ZGWM1) equipped with a simple set of "Ba-Shu-style" bronze weapons was later on interred upon the layer with production signs. According to Sun Hua (2000:121), such weapons are archaic Ba-Shu weapons and thus date the tomb earlier than the Warring States period (or the Qingyangong phase in the Chengdu Plain). Sun also proposes that when the influence of the Chengdu Plain receded from eastern Sichuan after the Shi'erqiao period, the divergence between the western and eastern Sichuan Basin became evident, and the latter should no longer be treated as a regional phase of the newly-developed culture of the Chengdu Plain, namely the Xinyicun. Under this situation, he uses the "Wazhadi Culture" to refer to and generalize the culture prevailing in eastern Sichuan from about 900-600 BC.

Unlike the Wazhadi tomb, the graves found in another nearby locus, Banbianjie, were buried in an even later period. Several of them are recognized by scholars as Chu-style tombs introduced from the Middle Yangzi with the westward expansion of the Chu State (Sun Hua 2000:121; Wang and Zou 2003:vii; Zhu Ping 2003:182), indicating increasingly complex interactions between multiple populations in the area during the late Bronze Age.

2) Zhongba, Zhongxian

The main cultural deposit is located upstream on a sandbar island in the Ganjing River. Archaeologists such as Wang Xin (1996:35) recognize that the earliest Neolithic phase in Zhongba is close to the early Shaopengzui in pottery production and should be thought of as a part of the Shaopenezui culture. This earliest phase is followed by the deposits of Liaoguanmiao and then Sanxingdui. The clear overlying sequence in stratigraphy provides information for the chronological relations between these archaeological cultures (Sichuan et al. 2003). The ^{14}C

dating from Zhongba (Sichuan et al. 2007) has also become an important reference for the other sites in the region.

After a long period of intensive accumulation, the cultural deposits have reached a depth of more than 10 m in Zhongba. Among the pottery deposits, the site yielded vessel types specific to eastern Sichuan such as cord-marked decorated-rim jars (*shengwen huabian guan*) and pressed-marked-lip jars (*anwochun guan* 按窝唇罐), although jars with small, flat bases (*xiaopingdi guan*) found here are similar to Sanxingdui samples. The various pointed-bottom cups (*jiandi bei*) prevalent concurrently are especially noteworthy. Not only are the shapes unfixed but their clay texture also varies between fine and coarse (Sichuan et al. 2003:639 fig. 33). Their color sometimes is red but sometimes yellowish or grayish. Moreover, these fluid properties of manufacturing occurred with every variety of *jiandi bei* (mainly horned *jiandi bei* and artillery-shell-shaped *jiandi bei*) and probably reflect the local production conditions.

Pointed-bottom vessels are among the major vessel types and they endured for a long period of time. Unlike the *jiandi bei* with local characteristics, the style of *jiandi zhan* in Zhongba is very close to their counterparts in the Chengdu Plain. And, as with the Chengdu Plain, they were sometimes used as grave goods here. However, they do not exceed round-bottom jars (*huandi gua*n) in number. During a later period, after the Shi'erqiao, round-bottomed jars account for up to 95% of the total potteries and they are even more intensive than soil (Sichuan et al. 2001:568). Many of the round-bottom vessels were made with decorated rims and cord marks, but appear sketchy and coarse. They often bear smoked traces on their bottoms. It seems that these round-bottomed jars are vessels frequently discarded and their sherds were reused to pave roads and floors.

A large numbers of floor features have been discovered besides pits since the Shi'erqiao period. As the excavators noted, the inner spatial arrangements of these features, based on the distribution of floors and postholes, were probably uninhabitable, and related instead to production activities (Sichuan et al. 2001:608). This is likely, especially when some features that had originally been thought of burial pits have more recently been associated with salt production. Because of the chemical remnants on the surface of these pits, scholars have suggested that they were brine storage troughs instead of burials (e.g., Sichuan et al. 2007:1016-7; Flad 2011:66). Furthermore, these troughs and floors are closely connected together. Contained in rectangular troughs, *huabian huandi gua*n were sometimes found. These features and remains, together, probably constituted a salt production scene.

4.1.3. Zhongbazi 中壩子 and Maliutuo 麻柳沱 in Wanzhou 萬州

1) Zhongbazi

Located on the river terrace, this site has yielded features of the earliest known paddy fields in the Three Gorges area, which is about the late second millennium BC. Human footprints and cattle hoof prints were also discovered with the ancient paddy field (Xibei and Wanzhou 2001). The large number of stone tools is probably related to farming activities. From the same layers of the stratigraphy, potteries close to Sanxingdui, such as *xiaopingdi guan, gui* tripods, *gu* goblets, high-stemmed mounted bowls, and bird-head-shaped dipper handles, are also often present. Among them, *gui* and *gu* are generally believed to have originated in the Central Plains.

The parallel between this area and the Chengdu Plain can also be observed in its burial custom. Like its counterparts in Jinsha (Figure III-39), one of the Zhongbazhi burials contains a male occupant with his hands crossed on his abdomen. Beside the dead are the grave goods, including *xiaopingdi guan* and stone tools. Graves with *xiaopingdi guan* and stone tools are not

uncommon in this region; we will see this combination again in the tomb at Lijiaba, Yunyang. *Xiaopingdi guan* of the same style as the Chengdu Plain were also popular in other neighboring sites, such as Maliutuo (Chonging and Fudan 2006) and Suheping 蘇和坪 (Chongqing and Wanzhou 2006; Chongqing et al. 2007). However, the burial styles and customs of Zhongbazi should not be attributed to a single source, because they seem to belong to a complexly mix of different traditions. The vat coffins popular in the Qujialing 屈家嶺 (*ca.* 3000-2500 BC) and Shijiahe (*ca.* 2500-1900 BC) cultures in the middle Yangzi were also used in Zhongbazi, especially to inter children. The vats with trumpet mouths *per se* are similar to the samples from Shijiahe. The excavators additionally recognize other vessel types, such as ring-footed cups and jars with dish-shaped mouths, related to the cultures of the Jianghan Plain (Xibei and Wanzhou 2001; Xibei 2006). Later tombs of the Warring States period containing pottery jars, ring-footed, mounted bowls, and sometimes bronze items again denote the relationship between this area and the Chengdu Plain. The ring-footed *dou* are close to those uncovered in Xinyicun and Chengguan (Shifang) tombs, for example, though they often bear incised symbols (Xibei and Wanzhou 2003:596 fig. 9) rarely seen in the Chengdu Plain. Remains of animal bones are sometimes found in these mounted bowls (e.g., M17:10). Though bronze items were also found in the tombs, they diverge from the usual "Ba-Shu style" assemblage. Instead, they were introduced from some other source, most likely the Chu culture.

2) Maliutuo

Maliutuo is close to the confluence of the Qinghegou 清河溝 and Yangzi rivers and only distant from Zhongxian by about 40 km. The site is rich in the cultural deposits of the Neolithic and Bronze Ages (Chongqing et al. 2003; Chongqing and Fudan 2006). Since the Neolithic Age, potters had produced potteries of high quality that were often very thin. The assemblage from the

early Bronze Age includes *xiaopingdi guan, jiandi bei, jiandi zhan,* and high-stemmed mounted bowls and cups (or lamp-shaped *dengxingqi* 燈形器). Although such an assemblage sounds familiar, none of these items are exactly like those in the Chengdu Plain. During the late Bronze Age, besides the enduring *jiandi zhan,* round-bottom jars (*huandi guan*), horned-shaped *jiandi bei,* and ring-footed, mounted bowls became the major vessel types. In comparison with the previous phase, vessels from this period, instead, resemble more those discovered in the Chengdu Plain. For instance, *jiandi zhan* with straight mouths and shallow bellies are similar to the usual grave goods found in the Chengdu Plain during the Qingyanggong period (Chongqing and Fudan 2006:511). Ring-footed *dou* are also more regularized. During the same period, painted potteries imitating the decoration of ritual bronzes appeared in Maliutuo (Chongqing and Fudan 2006:512). This is also the period during which pottery imitations of ritual bronzes (e.g., *lei* and *hu* containers) are mostly found, especially in grave goods like those discovered in the Chengguan cemetery in Shifang, Banbianjie cemetery in Zhongxian and Lijiaba 李家壩 and Matuo 馬沱 cemeteries in Yunyang. On the other hand, although bronze vessels were present in the cemeteries of the region, only stone models that were used to produce small bronze items, such as arrowheads, daggers, and fish hooks, were discovered.

The presence of fish hooks and approximately 1,000 pieces of stone net sinkers[68] reveals that fishing was an important subsistence activity to the settlement. Moreover, divination had been performed on both turtle plastrons and fish gills[69]. Whereas the use of fish gills in divination was characteristic of the Middle Yangzi, like the Xianglushi site, this usage has not been discovered in western Sichuan.

[68] According to the experimental archaeology undertaken by the excavators, the processing of these stone net sinkers, which were taken from river cobbles, would have required metal tools (Chongqing et al. 2003:557-8).
[69] Which scientists identified as belonging to *Acipenser sinensis* (Chinese sturgeon) (Chongqing and Fudan 2006:514).

4.1.4. Lijiaba 李家壩 in Yunyang 雲陽

This site is located near the confluence of the Pengxihe 澎溪河 and Yangzi rivers and has been well preserved; the cultural deposits have lasted for a long period since the early Bronze Age. The site yielded a pottery assemblage comparable to that of Sanxingdui and Shi'erqiao. Potteries close to the Chengdu Plain, including *xiaopingdi guan, jiandi zhan, jiandi bei,* vessel stand, vessel covers, high-stemmed mounted bowls, long-necked jars, and net sinkers, are rich in the lowest stratigraphy (Sichuan and Yunyang 2001a, 2003a). A tomb (M12) interred during the same period was found equipped with waist pit (*yaokeng* 腰坑) beneath the dead, containing *xiaopingdi guan* and five pieces of stone tools (an axe, adzes, and a chisel). The other graves goods include a high-stemmed *dou* and two pieces of stone tools that were scattered around the dead (Sichuan and Yunyang 2001a:217). In addition to these potteries, jars with decorated rims (*huabian kouyan guan*) characteristic of eastern Sichuan have also been uncovered in a large number from the same strata. It is worth noting that around several postholes, believed to belong to a raised house (F9) by the excavators, traces of water pipes perhaps formed by bamboos were discovered.

A part of the site (area II) was turned into a cemetery in the early Warring States period, yielding a new assemblage, including "Ba-Shu-style" weapons (Sichuan and Yunyang 2001b, 2003b). Like the Chengdu Plain, *xiaopingdi guan* and high-stemmed *dou* were no longer been found at this stage and there were only few pointed-bottom vessels. This development and change in Lijiaba coincides with the Chengdu Plain. Moreover, like other contemporaneous tombs in Sichuan, cultural elements of the Chu and Yue were introduced to Yunyang tombs in the Warring States period. However, it seems that these "foreign elements" only became popular during the second-phase, based on the periodization of the tombs attempted by the excavators. At

that point, Chu-style objects, including bronze *dui* 敦 grain-offering vessels, *he* boxes, *hu* 壺 liquid containers, *ding* tripods, and sometimes their pottery imitations, were added to the usual "Ba-Shu-style" weapons and potteries.

4.1.5. Xinpu 新浦 in Fengjie 奉節

Xinpu is located on the south bank of the Yangzi River and west of Fengjie by about 20 km. Based on the remains obtained from several excavations, the excavators have divided the site into two phases contemporary with the Shang-Zhou period (Jilin and Fengjie 2001, 2003; Jiang Zhanghua 2007:397; Jilin and Chongqing 2007; Jilin et al. 2007). The first phase yielded vessel types, such as pointed-bottom cups, vessel covers, high-stemmed mounted bowls, and long-necked jars, comparable to the Chengdu Plain. The collared *jiandi bei* (Figure III-44) discovered here can be considered as a subset of those found in western Hubei (i.e., Xianglushi and Lujiahe 路家河). Similar vessels have also been found in Sanxingdui and early Shi'erqiao. The vessels seem to have been finished by fast wheels with obvious traces left on the surfaces. In addition to the often seen cord-marked decorations and punctations with tiny circles, multi-layered rhombic (*chonglingwen*[70]) decorated vessels are particularly reminiscent of the Shi'erqiao and Xinyicun.

The second phase, on the other hand, yielded vessels not seen in Shi'erqiao, though occasionally in Xinyicun. These vessels include *li* tripods and round-bottom jars with decorated rims (*huabian huandi guan*) that seem to belong to a much later period[71]. The connections of the area with western Sichuan seem only weak during this phase. Instead, the *li* tripods are thought to denote the influence of the Chu Culture from the east (Jilin and Fengjie 2001:177). Like

[70] The decorations are called *leiwen* 雷紋 here. Many archaeologists believe such decorations originally came from the Central Plains (Jilin and Fengjie 2001:177).
[71] According to archaeologists (e.g., Jiang Zhanghua 2007:398), *huabian huandi guan* only became popular after the eighth century BC.

Maliutuo, small pieces of bronzes made by stone models probably denote the local bronze production in this area.

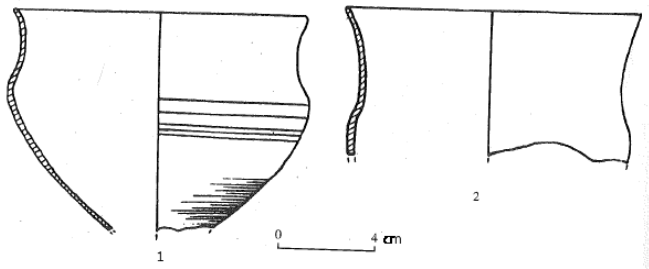


Figure III-44: Collared jiandi bei
(left: T3295:25; right: T3295:24) discovered in Xinpu (Jilin and Fengjie 2001:170).

4.1.6. Tiaoshi 跳石 and Shuangyantang 雙堰塘 in Wushan 巫山

It seems that the Wushan area had exchanged pottery-making ideas with the Chengdu Plain since the Neolithic period in about 2700-2000 BC. The most popular deep-bellied jars (*shenfu guan* 深腹罐) with their rims decorated with cord marks discovered in Weijialiangzi (Wu and Cong 1996; Zhongguo 1996) and Suolong 鎖龍 (Chengdu and Wushan 2001; Chengdu and Chengdu 2003) find their counterparts in the Baodun-period walled sites in the Chengdu Plain. Flared-rim jars (*chikou guan* 侈口罐), cylindrical jars (*tongxing guan* 筒形罐), and water-wave incisions (Appendix III-Figure 34) often seen in Baodun as well as in a number of Neolithic sites in eastern Sichuan were also uncovered in the Wushan area. In this area, Tiaoshi and Shuangyantang are especially rich in the remains of the Neolithic and Bronze ages and comparable to the western Sichuan in many dimensions.

1) Tiaoshi

The site is close to the confluence of the Daning 大寧 and Yangzi rivers and also close to the type sites of Weijialiangzi and Daxi (Nanjing and Wushan 2001). It had been a cemetery during late Neolithics (Nanjing et al. 2003). According to some scholars, different cultural sources,

including the Lower Laoguanmiao, Weijialiangzi, and Baimiao 白廟, influenced Tiaoshi during the Neolithic period in the third millennium BC (Wang and Zou 2003). However, although Baimiao (Guojia 1998:458 fig. 12.17-19) and Taioshi (Nanjing et al. 2003:34 fig. 8 and 9) yielded the same vessel types, such as deep-bellied jars with large mouths, these vessels were differently tempered in the two locations. That is, whereas charcoal and clams[72] are often contained in the sherds of Tiaoshi, the potters of Baimiao tempered the same types of vessels with river sand. This divergence probably indicates potters' different knowledge of and avenues for forming vessels. Besides this difference, red clays seem to have been widely adopted across this region, from Fuling to Daxi. As the excavators noted, red wares dominate the potteries of Tiaoshi during both the late Neolithic (63.5%) and the following times at the turn of the first millennium BC (57.9%) (Nanjing et al. 2003:32, 43). It is also worth noting that fine wares account for about 70% of the pottery in these periods.

Although graves have only occasionally been discovered during the first millennium BC, they display the same burial customs as the Chengdu Plain, in which the dead were interred with their hands crossed atop their abdomens. Ring-footed, mounted bowls of the same style as those in the Xinyicun tomb were also found from the same stratigraphy.

2) Shuangyantang

Located in the drainage of the Daning River, the site once reached a scope of approximately 100,000 m^2 large according to several surveys and excavations (Zhongguo and Wushan 2001, 2003, 2006). The sites in the Wushan area have much in common in their material cultures. That is, the sites share the same pottery assemblage, based on which it can be seen that sites of the

[72] To include charcoal and clam as temper materials had been a tradition of the Daxi culture and can be found in sites like Guanmiaoshan, Zhongbaodao, and Honghuatao (Li Wenjie 1996:129). Similar tempering manner can also been found in the Chengdu Plain in Shuiguanyin (Sichuan et al. 1959:405) and Xinyicun (personal observation, data illustrated in the next chapter), for instance.

area were concurrently influenced by the western Sichuan and the Middle Yangzi. For instance, *li* tripods, ring-footed, mounted bowls, and *yu* 盂 containers[73], thought to be related to the Chu culture in the Middle Yangzi (Appendix III-Figure 36), are present in Shuangyantang, Tiaoshi, and Lanjiazhai 藍家寨. Potteries and decoration designs popular in Xinyicun, including *jiandi zhan*, ring-footed tureens, vessel covers, spindle whorls, multi-layered-rhombic marks (*chonglingwen*), and impressed marks with two circuits of strips and round buttons (Figure III-45), have also been discovered in Shuangyantang. These Chu-style and Chengdu-Plain vessel types coexisted with ceramics from a local tradition but appear in smaller quantities. Ceramics characteristic of the local tradition in turn include round-bottomed jars with or without decorated rims and *jiandi bei* in both artillery-shell and horned shapes.

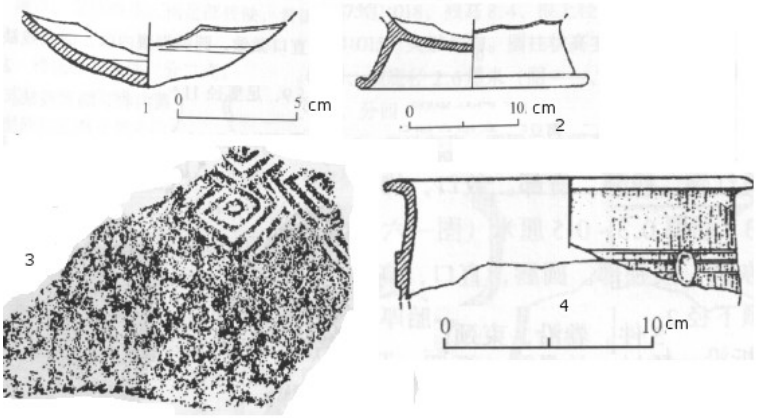


Figure III-45: Pottery types and decorations discovered in Shuangyantang
Showing likeness to Xinyicun on the Chengdu Plain (also see Appendix III-Figure 35).
1. *jiandi zhan* (T112②:19); 2. ring-footed jars (*guixingqi*) (T326④:011); 3. multi-layered-rhombic marks (*chonglingwen*) (T409⑤:p1); 4. impressed strips with round buttons (T113③:9) (Zhongguo and Wushan 2001:48 fig. 13, 50 fig. 14, 54 fig. 17; 2006:90 fig. 12).

Most of the above vessels are likely local products: features related to kilns have been discovered, one of which contains more than 700 pieces of potsherds, including the most popular round-bottomed jars, *jiandi zhan, jiandi bei,* ring-footed tureens, *pen* basins, *weng* vats, *dou*

[73] Broad-mouthed jars to hold liquids.

mounted bowls, and *li* tripods. The clay nature and ceramic assemblage of these kiln yields basically coincide with those found in cultural deposits. From pits, tens of thousands of potsherds have been uncovered. In addition, the remains of bamboo charcoal are present in the kiln and most pits, suggesting that bamboo was an important source of fuel. The excavators also note that bronze slag and raw copper minerals were uncovered from the site, revealing the development of bronze production in the area, though perhaps not on a large scale. Small bronze items, such as fish hooks, arrowheads, and chisels, are perhaps the products of local bronze crafters.

While the site has connections with both western Sichuan and the eastern Three-Gorges area, a Shang-style bronze *zun* vessel (Dongba B010) was discovered near Shuangyantang[74] (Sichuan et al. 1998:9 fig. 10-11). Although it is a stray find, it resembles those products found in Sanxingdui sacrificial pits[75], the middle Yangzi region, and the Upper Han valley (Bagley 1990:66; Jiang and Li 2002:135; Falkenhausen 2003:214-215), whose foundries have been recognized by scholars as being equipped with the regional characteristics of South China, branching out from Shang since the Erligang period (*ca.* 1500-1300 BC) (Kane 1974-1975; Bagley 1992, 1999). Its ornamentation, including three-dimensional birds and bovine heads situated on the vessel's shoulders, also resembles the Sanxingdui finds.

Although only a scatter of oracle bones have been discovered in Shuangyantang (4), the turtle shells show both round and rectangular drilling styles like the Zhihuijie samples in Figure III-13 and will also be discussed in the Xianglushi section.

[74] From Dachang 大昌, Wushan.
[75] Especially the subtype IV from pit no. 2.

4.1.7. Chaotianzui 朝天嘴 in Zigui 秭歸 and Zhongbaodao 中堡島 in Yichang 宜昌

1) Chaotianzui

This site has yielded rich Neolithic remains, which have been divided into two phases by the excavators (Guojia 2001:15). It is noted that the two phases have different pottery-making technologies even though their vessel types are largely the same. Since the second phase, the forming technique changed from the piecing method or strip-sticking (Shepard 1956:394), which is to overlap clay patches upon molds (*nipian tiezhufa* 泥片貼築法[76]), to the coiling method. The former, strip-sticking, was in fact characteristic of the Chengbeixi 城背溪 culture (*ca.* 6000-5000 BC) (Li Wenjie 1996:119-125; Hubei 2001; Changjiang 2002:112) and is also seen in Lujiahe to the east of Three-Gorges area, which I discuss in the following.

In addition to forming techniques, the tempering habits also seem to have changed from the concurrent usage of sand, powdered clam ashes, and organics to almost sand alone. Different tempering behaviors probably have their functional implications. For example, while the use of sand and clam ashes would have supported vessel bodies and is often found in cooking vessels, such as jars and *fu* cauldrons, which often bear firing clouds, plant organics were incorporated in fine serving wares, producing black and less penetrable vessels (Guojia 2001:20). Aside from these differences, like the Wushan area, red and brownish wares prevailed in the first phase and continued to dominate during the second phase. They are sometimes slipped with red or black coats. Some vessels, especially the rims and/or upper bodies of jars, basins, and flasks, were further painted with black strips or mesh lines. Thoroughly black potteries, however, account for only a small number. Though there were no *li* tripods, the site yielded a considerable number of *fu* cauldrons and vessel supports (*zhizuo* 支座), which had been popular since the Daxi culture

[76] Or *nipian pinjiefa* 泥片拼接法.

(*ca.* 4300-3000 BC). If we combine the *fu* and *zhizuo*, they become divisible *li* and can function in the same way. Such a combination of round-bottom vessels and supports seem very common in sites related to the Daxi culture in the Xilingxia 西陵峡 gorge, the easternmost one of the Three Gorges, and in the surrounding areas, such as Zhongbaodao in Yichang and Liulinxi 柳林溪 in Zigui (Guowuyuan 2003).

Following the Neolithic times, reduced atmospheres were preferred and black-surfaced potteries became dominate. During this period, contemporary with Erlitou and Shang, the site yielded many *xiaopingdi guan,* high-stemmed mounted bowls, and vessel covers close to Sanxingdui and early Shi'erqiao (Guojia 2001:68) (Figure III-46.1-3). The site was also equipped with beakers and vats with large mouths and appliqué similar to the samples found in eastern sites such as Lujiahe and Jingnansi (Figure III-46.6-7). The presence of *gui* tripods and closed-spouted pitchers with pouch-shaped feet (*daizu fengkou he*) in Jingnansi, Maoxitao 毛溪套, Chaotianzui, and Zhongbaodao, for instance, perhaps demonstrate the dual connections of the site to the Yellow River basin and the Sanxingdui in western Sichuan. Some scholars have proposed that the Erlitou culture of the Yellow River once influenced Sanxingdui via this Middle Yangzi area (Jiang and Li 2002:87; Jiang and Yan 2003:79).

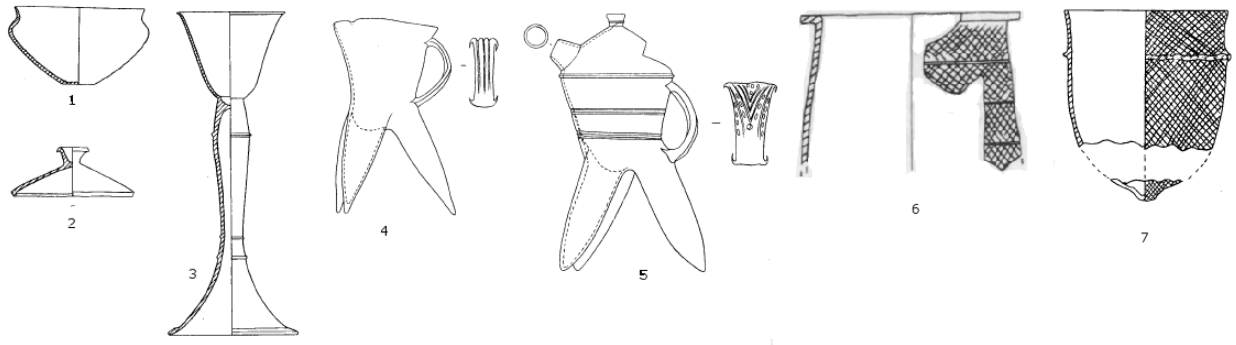


Figure III-46: Vessel types discovered in Chaotianzui, contemporary with Erlitou and Shang
1. *xiaopingdi guan* (T7⑥:16); 2. vessel cover (T7⑥:6); 3. high-stemmed mounted bowl (*gaobing dou*) or lamp-shaped vessels (*dengxingqi*) (T6⑥:21); 4. *gui* tripod (T7⑥:4); 5. closed-spouted pitchers with pouch-shaped feet (*daizu fengkou he)* (T7⑥:9); 6. flat-rimmed beaker-shaped vessel (*pingyan zunxing qi*) (T6⑥:88); 7. large-mouthed vat (T7⑥:93) (Guojia 2001:68 fig. 34, 70 fig. 35, 71 fig. 36, 72 fig. 37, 74 fig. 38).

2) Zhongbaodao

Although assigned to different administrative regions, Zhongbaodao is only distant from Chaotianzui by 6 km (see Appendix III-Figure 37 for archaeological sites located in between the Miaohe-Nantuo valley). The pottery types from these neighboring sites are also alike. The Zhongbaodao site has yielded especially rich remains from the Neolithic Age, including large quantities of relics related to daily life and a few graves. In comparison with Chaotianzui, Zhongbaodao was more unambiguously influenced by the Daxi culture in its vessel types and decorations during the early Neolithic times (phase I-III). Painted vessels were largely discovered in the Neolithic deposits. Ceramics were slipped with red coats and then painted with black designs. The pottery color then changed to black/grayish and the forming techniques changed to throw potteries (fast wheel) after the third phase. The excavators have argued that this change was caused by the cultural realignment, in which the Daxi influence subsided, and the Qujialing culture became influential in Zhongbaodao (Guojia 2001:285).

Besides the highly developed stone tools industry, both Chaotianzui and Zhongbaodao have yielded large numbers of fish bone remains along with bronze fishhooks throughout the stratigraphy and pits. Sometimes, the deposits of fish bones can reach 10-cm thick (e.g., H234).

Following the Neolithic phase, deep-bellied jars, large-mouthed vats, and long-necked jars that had been popular in the Three Gorges also prevailed in Zhongbaodao. Horned-shaped and collared *jiandi bei* were also occasionally found. These vessel types seem locally developed and coexisted with those featured in the Chengdu Plain. Like Chaotianzui, Zhongbaodao has yielded *xiaopingdi guan,* high-stemmed mounted bowls, *gui* or *he* tripodal spouted pitchers, and vessel covers comparable to the Chengdu Plain. As briefly mentioned above, collared *jiandi bei* are a type of pointed-bottom cups discovered in the Chengdu Plain during the early Shi'erqiao period (e.g., Figure III-22.1). However, they were in fact more common in the Middle Yangzi area like Zhongbaodao. They are often called *zun*-beaker-like cups (*zunxingbei* 尊形杯) in this area for their trumpet-shaped mouths. If they have stems and ring foots, as in Figure III-47.3-4, they do look like a pottery *zun* sample, also from Zhongbaodao (Figure III-47.5). This transformation, by attaching ring feet or supports to certain vessels that were originally equipped with small or round bases, is frequently seen in all areas.

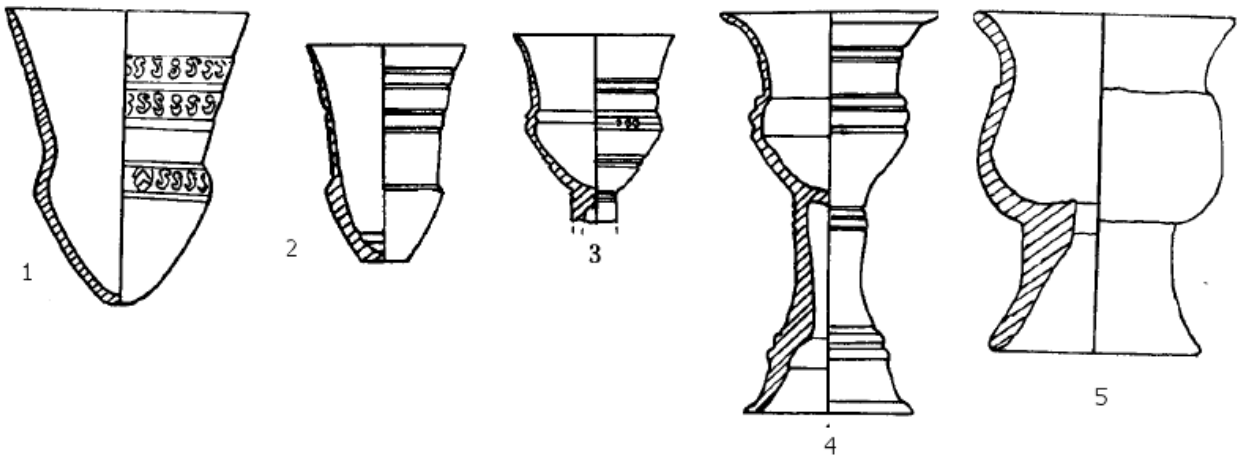


Figure III-47: Collared *jiandi bei* discovered in Xianglushi (no.1) and Zhongbaodao (no.2-5)
1. (Wang Shancai et al. 2004:244 fig. 184); 2. (T7⑦:44) (Guojia 2001:257 fig. 105); 3-4. stemmed "*dou*" transformed from collared, trumpet-mouthed *jiandi bei* (TT8⑧:60; M114:1) (3. stem missing) (Guojia 2001:253 fig. 103); 5. pottery "*zunxingqi*" similar to stemmed "*dou*" (T0206⑪:166) (Guojia 2001:36 fig. 36) (not to scale).

4.1.8. Lujiahe 路家河 in Yichang 宜昌

In the easternmost end of the Three Gorges area (the Xiling Gorge), a series of sites have been discovered from the valley around Yichang, where the Yangzi River flows eastward to the Jianghan Plain. The cultural deposits reveal that the Lujiahe site had been inhabited from the Chengbeixi period in around 5700 BC (Hubei 2001; Changjiang 2002:112). However, the excavators note that cultural remains only became rich from the second phase in about 1500-1300 BC, which they call the Lujiahe culture[77]. Before that time, the area was a contact zone for the integration of different regional cultures, including those from the Central Plains (the Erlitou culture), the Chengdu Plain (the Baodun culture), southern Shaanxi[78], and the Three Gorges area[79] itself (Changjiang 2002:115). Aside from round-bottom *fu* caldrons and collared *jiandi*

[77] As the Lujiahe site has been best studied and is recognized as the most lasting site yielding the richest remains, Lin Chun (2003) has defined Lujiahe as the type site and used the term Lujiahe Culture to generalize the neighboring areas that have yielded similar pottery assemblages. This refers to a period roughly contemporary with the Shang in the Central Plains and the Sanxingdui in the Chengdu Plain.
[78] Such as Baoshan elements.
[79] Such as the Weijialiangzi culture (Zhongguo 1996), Laoguanmiao culture (Zhao and Wang 1996; Jilin and Sichuan 1998), and Shaopengzui culture.

bei[80] that had long served as cooking and perhaps serving vessels in the large Middle Yangzi basin, jars like both *xiaopingdi guan* and *jiandi zhan,* vessel covers, ring-footed tureens, high-stemmed, mounted bowls or lamp-shaped vessels (*dengxingqi*), and bird-head-shaped dipper handles were introduced from the Chengdu Plain probably via intermediaries, signifying a western influence (Figure III-48). A trend worth noting is that the clay texture of collared *jiandi bei* became finer over time and their bottoms were transformed from slightly round to sharper. The excavators also deduced that the function of these vessels changed from cooking to serving wares (Changjiang 2002:120), which is a reasonable conjecture according to the evolution of clay texture and vessel shape. Moreover, at least from the second phase, various decorations had been applied to vessels. These include multi-layered rhombic marks (*chonglingwen*) that had been popular in the Chengdu Plain and many other marks. Not only were *fu* mostly decorated by cord marks and large vats by appliqué to assist their forming processes but many fine wares like *jiandi bei* and a few hard pottery were also impressed or incised with various marks (Appendix III-Figure 38).

[80] Called *gufubei* 鼓腹杯 (inflated-bellied cups) by the excavators.

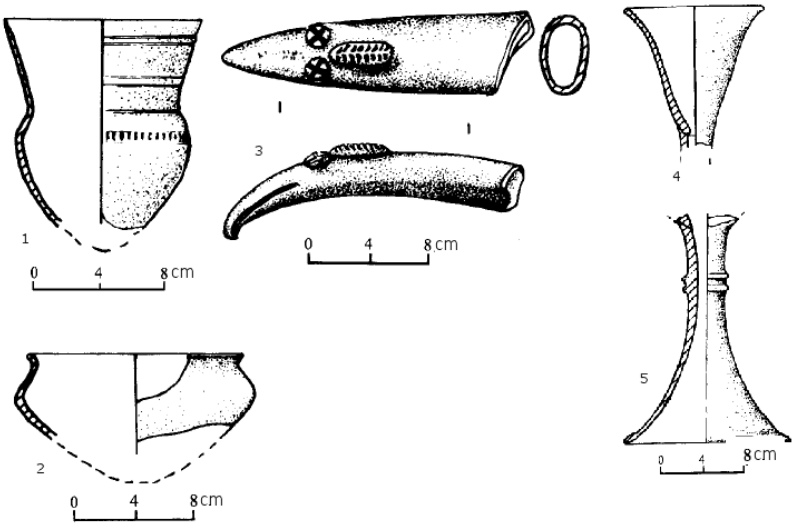


Figure III-48: Vessel types of Lujiahe showing an affinity to the Chengdu Plain and eastern Sichuan
1. collared *jiandi bei* (T5⑤:8); 2. pointed-bottom jar (T8⑤:20); 3. bird-head-shaped dipper handle (collected:48); 4&5: upper cup and handle of lamp-shaped vessel (*dengxingqi*) (T84:16, collected:161) (Changjiang 2002: 45, 60-61, 65).

Unlike other contemporaneous societies that had largely adopted the potter's wheel, the potters of Lujiahe, for a long period, followed the tradition of the Chengbeixi culture to form their vessels by mosaicking and overlapping clay patches, starting from the rims down to the bodies before finally joining the bottoms (*nipian pinjiefa*) (Li and Huang 2001:296-297; Lin Chun 2002). Such method may have limited vessel shapes and was especially distinctive in making *fu* caldrons (Appendix III-Figure 40) (Lin Chun 2003:155). Perhaps because of this frequently used forming technique, around 70% of the potteries from the site are composed of round-bottom pots (Changjiang 2002:20).There is only a moderate number of other vessel types, especially fine wares like *jiandi bei,* that were formed by throwing technique with the potter's wheel. And, an even smaller number of vessels like the handles of high-stemmed *dou* were produced by hand-model building. The employment of the latter two techniques in associated vessel types is in fact close to the forming methods developed in the Chengdu Plain. Related issues will be further discussed in the next chapter.

From the pits of Lujiahe, potsherds and ash from plant fuel were often found with fish and other kinds of animal bones, particularly deer. Like the Chengdu Plain, deer were the most populous medium-sized mammals in the area, providing the major game sources. However, such sources did not seem to match fishing, as bronze fishhooks and stone or pottery net sinkers as well as a large number of fish bones have been uncovered at the site (Changjiang 2002:7). This subsistence style seems to have been very common among the sites in the Three Gorges area, as we saw in other sites above.

4.1.9. Xianglushi 香爐石 in Changyang 長陽 (ca. 2000-1000 BC)

This site is located in the middle Qingjing 清江 River and the Xiling Gorge. Scholars have proposed the drainage as the major homeland of the Ba people in contrast with the Shu ethnic group centered on the Chengdu Plain (e.g., Wang Shancai 2001, 2007; Wang Shancai et al. 2004; Bai Jiujiang 2009). Xianglushi is one of the earliest sites that yielded collared *jiandi bei* with trumpet-shaped mouths and inflated shoulders (Figure III-49). This vessel type together with high- or short-stemmed mounted bowls were widely distributed in the settlements along with the Yangzi River as well as the Chengdu Plain. Besides these vessels, the site also yielded cord-marked *fu* cauldrons with round bottoms and jars with decorated rims characteristic of the region. In particular, approximate 3,000 pieces of *fu* cauldrons have been recovered from the site, accounting for three-fourths of all ceramic vessels (Wang Shancai 2001:24). This quantity makes Xianglushi the most productive site in the region for the production of *fu*, which had constituted the main cooking vessels in related sites. Other types of cooking wares seem only minor and *li* tripods were only introduced from the east at a later time.

The excavators believe that the site was less influenced by North China than Jingnansi might be. Even though the site contains some vessel types thought to be related to Shang in the

Central Plains, such as *gui* and *he* tripodal spouted pitchers, *gu* goblets, *zun* beakers with large mouths, and ring-footed tureens, Wang Shancai (2001:27), the chief excavator of the site rightly cautions that these vessels might not necessarily have originated in the Yellow River basins, but probably came from local sources.



Figure III-49: Collared *jiandi bei* from Xianglushi popular in eastern Sichuan and western Hubei (left: from the 4th layer, 16.6 cm high and 14 cm for the rim diameter; right: from the 6th layer, 11.5 cm high and 11 cm for the rim diameter) (Wang Shancai 2007: color pl. 22).

In addition to pottery production, the inhabitants of Xianglushi seem especially skilled at processing animal bones, and had made various bone tools, ornaments, and ritual items. For instance, a large bone ladle 26.6 cm long was found in a grave, demonstrating the superb skills of the maker (Appendix III-Figure 41). From another grave the possibly largest oracle bone (42 cm long) known as yet among all archaeological cultures was also recovered (Appendix III-Figure 42). It is taken from a cattle scapula. Finely made bone tools, including needles, awls, wheel-shaped tools, hairpins, scarpers, arrowheads, saws, and so on, were also unearthed in large numbers. Like the Chengdu Plain, animal spices such as Sumatran rhinoceros (*Dicerorhinus sumatrensis*) extinct in the region today might show certain changes in the environment and human-nature relations (Chen Quanjia et al. 2004).

Like the other sites of the Three Gorges area, the divination custom performed by drilling and/or burning animal shells and bones was conducted in Xianglushi. Both the graves and cultural deposits contained related items. In fact, the site has yielded the greatest quantity of oracle bones and included diverse media. Not only were turtle shells and cattle scapulae frequently used in the divination exercises, which is a tradition that can probably be sourced back to the Yellow River basins, but a significant number of fish gills were employed for the same purpose. The use of fish gills in divination seems to have only prevailed in the Three Gorges area, probably due to its rich fishery resources[81] and preserved conditions. The environments of the Three Gorges area would have encouraged people to rely on fishing and hunting in a relatively exclusive manner and much less on farming. Even though fish gills are comparatively fragile and perishable, their use in divination patently exceeded turtle plastrons and castle scapulae in number especially in the fourth phase of Xianglushi, roughly contemporary with the Western Zhou period at the turn of the first millennium BC (Jiang Gang 2005:61) (Figure III-50). Other sites like Shimenzui 石門嘴 in Zigui (Wang Lixin et al. 2004) had a similar phenomenon. Furthermore, as I briefly noted in the Xinyicun section, there was a general tendency in both western and eastern Sichuan that rectangular holes replaced circles or ovals as the favored drilling style during the Western Zhou period, although round holes can still be found occasionally. Though the variations in media reveal that the divination custom was strategically adopted by different regions according to their natural resources, the interactive regions generally followed a certain trend over time (Appendix III-Figure 44).

[81] The richness in fishery resources of the area is evident from the large number of net sinkers and fishhooks discovered at the site (Appendix III- fig. 43). Most of the pottery net sinkers are in a spindle shape and can be found throughout the stratigraphy. The same spindle-shaped net sinkers are widely distributed, including over the Chengdu Plain, but not usually in as large a number as those in Xianglushi.

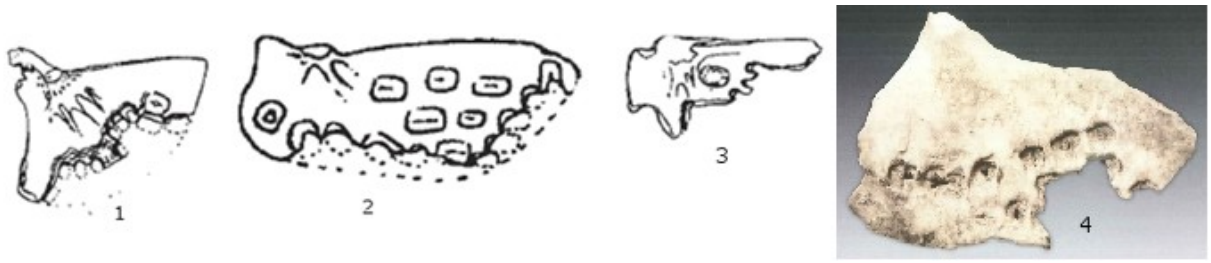


Figure III-50: Fish gills used for divination discovered in Xianglushi
1. T10③c:222; 2. T10④:201; 3. T9⑤:154; 4. T10④:205 (no to scale) (after Jiang Gang 2005:60).

4.2. Sites east of the Three Gorges Area

This region has been referred to as the Middle Yangzi River valley and covers modern Hubei, northern Hunan, and southern Henan Provinces. The region has been paid close attention as one of the earliest regions to develop rice farming[82] and walled settlements in the East Asian continent (Yan Wenming 1990; Zhang Xuqiu 1996; Liu Deyin 2004; Yasuda 2007; Zhang and Liu 2008). It is noted that since the Pengtoushan 彭頭山 period (*ca.* 7000-5500 BC), rice husks, which might also have provided the fuels for pottery firing, had often been mixed in with tempers during forming (Yan Wenming 1990:29; Li Wenjie 1996:144; Li and Huang 2001). This might suggest a seasonal scheduling relationship between agriculture and pottery making.

Since the Longshanoid period in the late third millennium BC, the region where the Shijiahe Culture flourished played a role in influencing and transmitting cultural elements from the eastern end to the Sichuan Basin. As the largest walled settlement known to date, the wall-construction technique of Shijiahe is thought to have inspired the Baodun walled-settlement clusters mentioned above. The iconography of the regional culture may also on one occasion have affected the aesthetic designs of Sanxingdui imagery as well as other neighboring areas (Falkenhausen 2003a:192-199).

[82] Early evidence about rice cultivation can be found in the Pengtoushan site in the Liyang 澧陽 Plain. As pointed out by Yan Wenming (1990:29), other early sites that have yielded traces of rice husks include Lijiacun 李家村 and Hejiawan 何家灣 in the Upper Han River basin of the Laoguantai 老官台 period (*ca.* 6000-5000 BC).

4.2.1. Jingnansi 荊南寺 in Jingzhou 荊州

Located in the southwestern Jianghan Plain, the area exemplified by Jingnansi or the Jingzhou Gucheng 荊州古城[83] is an important nexus of communication with the Central Plains to the north (via Han River and its branches) and the Three Gorges area to the west (via Yangzi River). Not only has the area witnessed a series of Neolithic cultures, like the Daxi (*ca.* 4300-3000 BC), Qujialing (*ca.* 3000-2500 BC), and Shijiahe (*ca.* 2500-1900 BC), but the remains of the early Bronze Shang have also been preserved here, as a result of the southward extension of Erlitou (He Nu 1994; Jingzhou 2009). Because the cultural deposits of the Bronze Age in about 1700-1300 BC feature in this site, the discussion is only concentrated on this era. During this period, the area seems to represent the easternmost point to which cultural elements from the Sanxingdui reached (Sun Hua 2000:14).

The Jingnansi site is mostly composed of pits, from which significant numbers of potsherds and burnt animal bones were yielded. Characteristic vessel types of the Middle Yangzi area, such as *li* and *ding* tripods and *fu* cauldrons, were largely recovered from the site. These vessel types, mainly used for cooking, along with a few other types of jars embody the largest variety of decoration marks for the entire pottery assemblage, including cord-marks, rice-shaped marks, grid stamps, appliqué, shell-shaped buttons, net marks, punctuations, square spiral marks (*yunleiwen*), and multi-layered rhombic marks (*chonglingwen*) (Jingzhou 2009:62). These decorations individually are not unusual in either the upper or middle Yangzi valleys or the neighboring areas, but they differ in frequency and in decoration-to-vessel type collocations. For instance, to apply *chonglingwen* on hard potteries is a distinctive collocation, but it has not been discovered in western Sichuan. *Chonglingwen* with several varieties, which are the most

[83] The modern Jiangling 江陵 City in Hubei Province.

changeable and frequently found in the Chengdu Plain, are complicatedly constructed and have nothing to do with the function of the vessels. The occurrence of these similar designs across regions, including the large Sichuan Basin and southern Shaanxi, must not be a chance happening. While *chonglingwen* are thought of by some scholars as being related to *yunleiwen*, a few pieces of Jingnansi proto-porcelain applied both designs concurrently (Figure III-51). Based on provenience studies, most researchers agree that these proto-porcelain vessels were imported from the area known as the Wucheng 吳城 Culture (*ca.* 1500-1000 BC) southeast of the Jianghan Plain (He Nu et al. 1999; Chen Tiemei et al. 2003), suggesting another tie to the region and a potential network for proto-porcelain exchange.

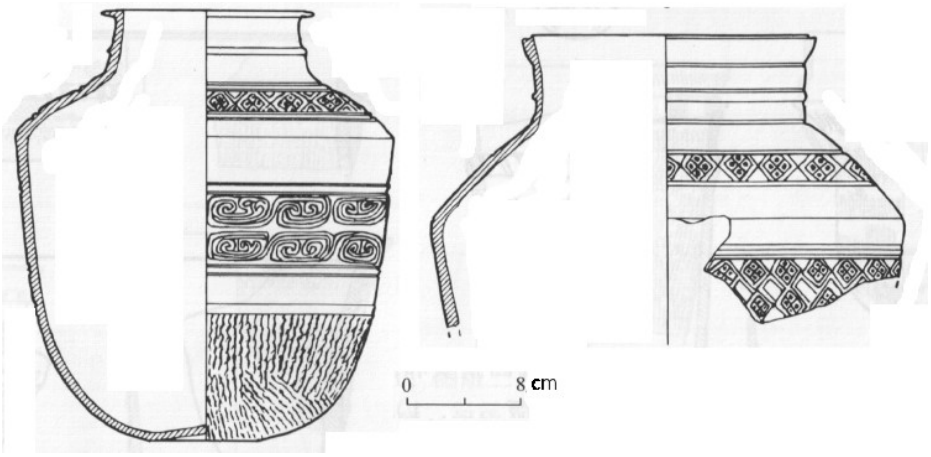


Figure III-51: *Chonglingwen* and *yunleiwen* (the shoulder and upper body) occurring on the proto-porcelain of Jingnansi (left: T1④C:1; right: H214:1) (Jingzhou 2009:110).

Among the cooking vessels, *li* tripods are similar to those of the Yellow River valleys, where the seriation and periodization of this vessel type has long been studied (Su Bingqi 1984) and often invoked as a chronological reference by scholars (Jingzhou 2009). On the other hand, *ding* tripods were transformed from *fu* cauldrons or *pen* basins by adding feet onto the bodies of the vessels. Besides these tripods, *xiaopingdi guan,* representative of Sanxingdui and early Shi'erqiao, are also recognized by the excavators as another type of cooking vessel during the

early phases of Jingnansi. They are named as *tujian guan* 凸肩罐 (jars with protruding shoulders) by some researchers to contrast with *tujian bei* 凸肩杯 (cups with protruding shoulders), which is an alias of collared *jiandi bei*[84] widely distributed in eastern Sichuan and western Hubei. The parallels in vessel types and decorations between Jingnansi and western Sichuan are illustrated in Figure III-52. This subset of vessel types also exemplifies the "D group" pottery assemblage characterized by He Nu (1994:87, see also Appendix III-Figure 45), which is mainly composed of small drinking and serving wares. According to He's characterization, the five categories of potteries represent their respective connections with varied neighboring areas. The "D group" in this case denotes the connection with the Chengdu Plain. It seems to be functionally complementary to other groups, which are otherwise large cooking, steaming, and storage vessels (He Nu 1999:89). He Nu et al. further speculate that the "D group" might have been imported from Zhongbaodao, which had produced a wider range of Chengdu Plain-style vessels. Perhaps because of the importation, those vessels show different features from other local products in their chemical compositions in the neutron activation analysis (He Nu et al. 1999:89-90). The assemblage, however, was short-lived and because Jingnansi was soon overwhelmed by the influence from the Central Plains in the later phases. The reinforcement of cultural influence in one direction (i.e., the Central Plains) may lead to the cessation or regression of other exchange relations.

[84] Also known as *gaoling jiandi guan* 高领尖底罐 (long-necked, pointed-bottom cups) in other sites such as Chaotianzui (Sun Hua 2000:15). The names of the vessels are often inconsistent among different archaeological institutes.

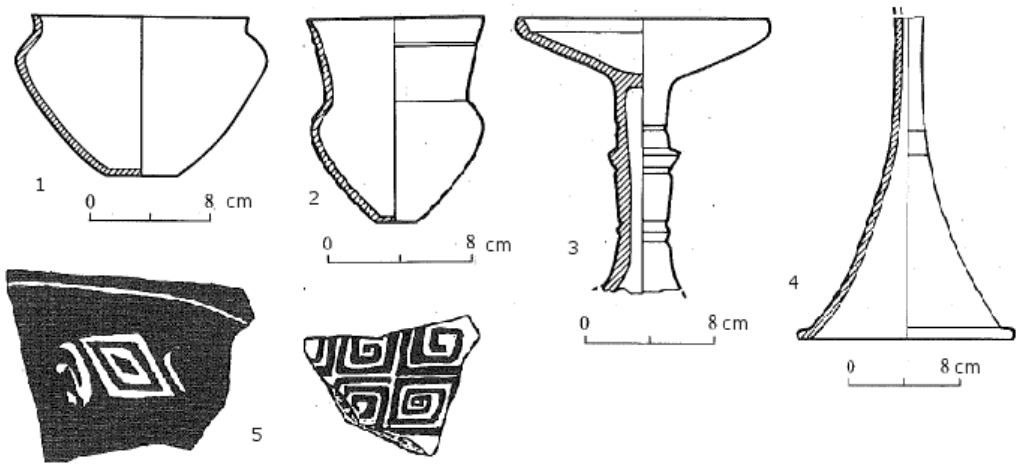


Figure III-52: Vessel types and decorations of Jingnansi similar to the Chengdu Plain
1. *xiaopingdi guan* (H211:2); 2. collared *jiandi bei* (H3:1); 3 high-stemmed *dou* (H36①:22); 4. ring foot of a high-stemmed *dou* or *dengxingqi* (H36②:6); 5. *chonglingwen* (T33④A and T42④A) (Jingzhou 2009:97, 128, 131, 138, 143).

4.3. Shaanxi

4.3.1. Hanzhong 漢中 Basin, the Upper Han River (late second millennium BC)

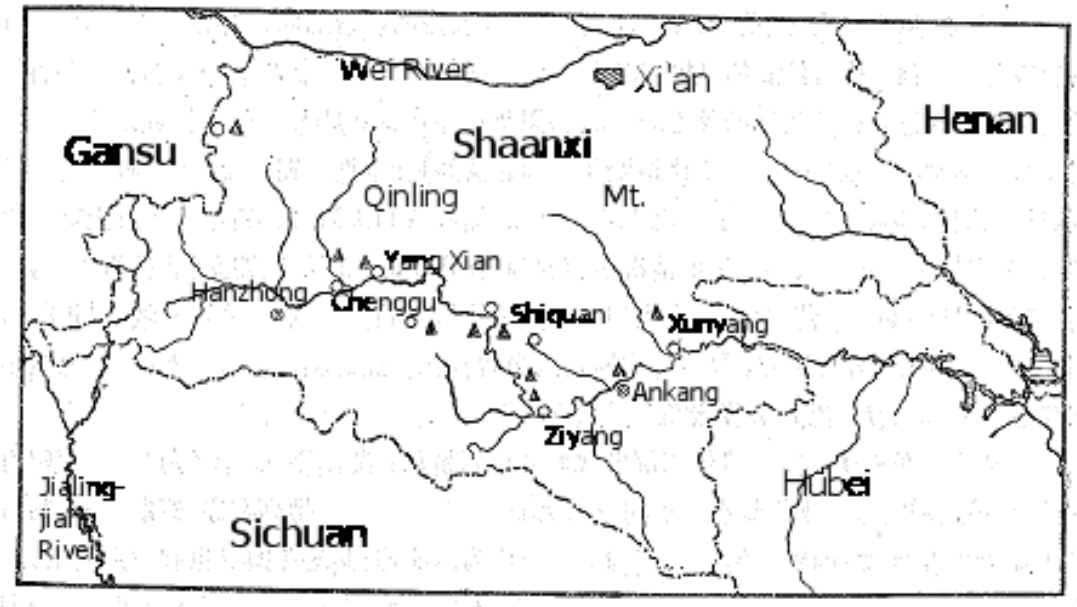


Figure III-53: Sites of the Hanzhong Basin
(After Wang and Sun 1992:237).

This region includes archaeological sites in the modern Chenggu 城固, Yangxian 洋縣, Shiquan 石泉, Ziyang 紫陽, Ankang 安康, and Xunyang 旬陽 counties. Immediately south of the

Qinling 秦嶺 Mountains, the area has been traditionally known as the Upper Han River or the Hanzhong Basin. Whereas the Han River and its branches have conveniently connected this region to the Middle Yangzi area, the Jialing 嘉陵 River traversing the Bashan 巴山 Mountains in northern Sichuan provides a channel for Hanzhong to communicate with the Sichuan Basin (Figure III-53). Having yielded hundreds of bronze vessels, masks, ornaments, weapons, and ceremonial weaponry that highly resemble those of the Sichuan Basin, the Hanzhong region is closely related to the cultural sphere of the Sichuan Basin during the pre-Qin times (Li Boqian 1987[1983]; Wang and Sun 1992; Sun Bingjun 1994:385-386; Falkenhausen 2011; Sun Hua 2011). For instance, with few metal specimens, forked *zhang* blades are distinguishing lithic ceremonial objects of Sanxingdui and Jinsha. These objects have parallels from the Fanba 范壩 hoard in Yangxian but are made in bronze (Zhao Congcang 2006:171; Falkenhausen 2011:530). The occurrence of "Ba-Shu style" weapons in the several localities of the Hanzhong Basin (Appendix III-Figure 46) further endorses the impression that the region was culturally connected with Sichuan and might have played a role in transmitting Sichuan elements to other regions, such as the Wei River valley north of Hanzhong[85] (Wang and Sun 1992:244-245; see also Falkenhausen 2011:531), and vice versa.

The comparability between two regions, Sichuan and Hanzhong, is also reflected in the pottery assemblages that can be dated back to a much earlier period than the bronze assemblages. For example, the Baoshan site in Chenggu had yielded items similar to those of the Baodun Culture since the Neolithic period, as noted by the excavators. The wide-lipped beakers with carinated bellies (*kuanyan zhefu zun* 寬沿折腹尊) and wide-lipped vats with large mouths (*kuanyan dakou gang* 寬沿大口缸) uncovered from Baoshan are similar to the Baodun vessels

[85] E.g., the Yu-state cemeteries in Baoji (Lu and Hu 1988) and the Laoniupo 老牛坡 site in Xi'an (Liu Shie 2002).

in many respects (Appendix III-Figure 47) (Xibei 2002:17-18). From Sanxingdui II on, the similarity between these two regions is even more noticeable. Other than the parallels between Baimashi and Shuiguanyin illustrated in the Shuiguanyin section above (Figure III-18), *jiandi zhan*[86], *jiandi bei*[87], high-stemmed *dou*, globular jars (*bianfu hu* 扁腹壺), long-necked jars, vessel covers, and jars with small bases from Baoshan can find their counterparts in Sanxingdui, Shi'erqiao, Jinsha, and Shuiguanyin (Figure III-54) (Xibei 2002). Other new vessel types were transformed from the established ones simply by attaching ring feet or supports, a way also conducted in the Chengdu Plain and Jianghan Plain. These two parts, vessel bodies and feet, were usually made separately during forming before being joined together. Besides vessel shapes, motifs such as eye- and bird-shaped decoration marks occurring on pottery jars are reminiscent of Sanxingdui and Jinsha, although they appear in different media (Figure III-55). These manifold resemblances make the Hanzhong Basin look like an extension of Sichuan. Sites such as Baimashi are thought to be a regional phase of the bronze culture centered on the Sichuan Basin (Wang and Sun 1992:246).

[86] Called *xiaodi bo* 小底鉢 (bowls with small bases) here (Xibei 2002, pl. 47.1-4).
[87] Here called *xiaodi zunxing bei* 小底尊形杯 (*zun*-shaped cups with small bases) (Xibei 2002, pl.21-29).

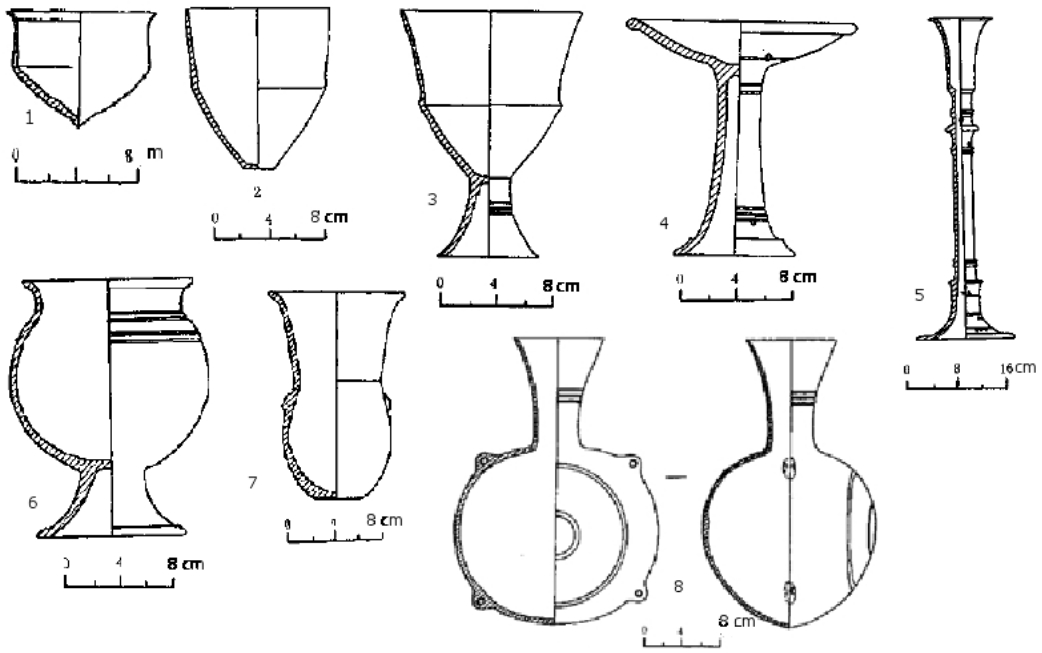


Figure III-54: Vessel types of Baoshan, Chenggu
1. *jiandi zhan* (*xiaodi bo*) (SH3:8); 2. *jiandi bei* (*xiaodi zunxing bei*) (SH38:6); 3. ring-footed cup (SH8:34); 4. stemmed mounted bowl (SH6:4); 5. *dou*-shaped object (*douxingqi*) (SH8:28); 6. ring-footed tureen (M7:1); 7. long-necked jar (SH48:5); 8. globular jar (*bianfu hu*) (SH20:21) (Xibei 2002:29, 33, 38, 69, 77, 90, 119).

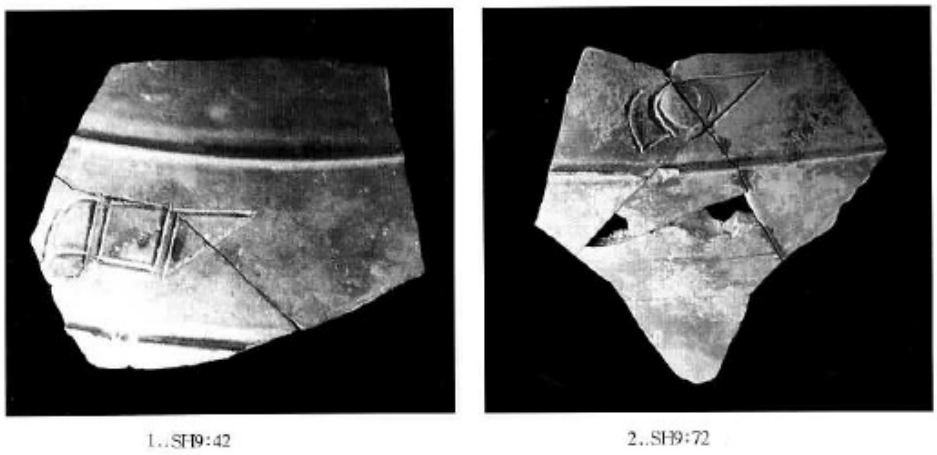


Figure III-55: Eye motifs discovered in Baoshan, Chenggu
(Xibei 2002, pl. 50-1 &2).

However, the Hanzhong Basin has also yielded pottery types not seen in Sanxingdui or Shi'erqiao, or that were only introduced to the Chengdu Plain in the later times. For example, pottery *li* and *ding* tripods and *fu* caldrons, frequently found in Hanzhong, were absent from the

Chengdu Plain before or during the Shi'erqiao period. As the Hanzhong basin had been a convergent and transitional region that received influence from different directions, owing to its location and convenient river transportation, a part of its material culture is traceable to the Shang core in the Central Plains and its secondary culture in the Wei 渭 River valley[88] (Falkenhausen 2011:521), besides Sichuan and the Middle Yangzi. It is also possible some material cultures were introduced to Sichuan from the Middle Yangzi area or the Central Plains via the Hanzhong. Due to these different sources and connections, the excavators at Baoshan have generally divided the potteries into three assemblages: the first group (constituting 62.57% of the whole collection) was presumably developed by an aboriginal culture; the second group (29.15%) was produced under the influence of the Chengdu Plain; and the remainder (5.70%) shows affinities to the Central Plains (Xibei 2002). The partial overlaps between the Hanzhong Basin and these various regions as well as its other neighbors in the western side demonstrate that while the Hanzhong had recurrent information and/or material exchange with its various connecting areas and groups, the adoption of cultural elements was often selective and underwent local transformation.

4.3.2. Yu 弇state cemeteries in Baoji 寶雞, Shaanxi

The cultural deposits of the ancient Yu state, subordinate to the Zhou court, are distributed in several loci across the Wei River, among which Rujiazhuang 茹家莊, Zhuyuangou 竹園溝, and Zhifangtou 紙坊頭 cemeteries along with a few residential areas are better preserved. They are the clan cemeteries of the Yu ruling class employed during the Western Zhou period in *ca.* 1000-

[88] Where is thought to be one of the birthplaces of the Zhou people, who conquered Shang in the late second millennium BC (ref. Zou Heng 1979; 2001[1980]:289).

850 BC and where several generations[89] of the rulers of the Yu state along with their sacrificial wives, servants, and chariots were buried. Based on the grave goods, especially the bronze vessels bearing inscriptions, scholars suggest that the chronological sequence should be Zhifangtou, Zhuyuangou, and then Rujiazhuang (Lu and Hu 1988:415). Together they span a period contemporary with that between Shi'erqiao, Jinsha, and Xinyicun in the Chengdu Plain.

Located on the northern bank of the Wei River, Zhifangtou was used as a cemetery during the heyday of the Yu state (Lu and Hu 1988:415). During this epoch, the sphere of the state may once reach the south of the Qinling Mountains where it came into contact with the politics of the Upper Han River. It is probably via these intermediaries that the Wei River valley formed certain connections with the Sichuan Basin and exchanged products and/or manufacturing ideas during later periods. Sun Hua (2000:111) notes that the long-bellied, cord-marked jars with everted rims and rolled lips (*changfu guan* 長腹罐) recovered from Xinyicun have their parallels in all three of the Yu cemeteries, among which Zhifangtou's products are especially close to those of Xinyicun (see Lu and Hu 1988:40). The jars from Zhifangtou often came with *jiandi zhan*-like lids, which were also popular in the Chengdu Plain (Appendix III-Figure 48). The jars and lids of Zhifangtou were among the limited ceramic types found in a ruler's tomb[90] together with bronze vessels and a piece of proto-porcelain jar.

While the highly-ranked noble tombs feature a variety of ritual bronzes traditional to the Western Zhou and had their quantities conform with the principle of the Western Zhou court[91], bronze pointed-bottom jars, flat-based jars, square trays, dippers with bent handles, and

[89] Some tombs are thought to have belonged to the rulers by the excavators, though the real number is uncertain. The excavators suggest, however, that the cemeteries were in continuous use for four generations (Lu and Hu 1988:416).
[90] Believed to be the first generation of the Yu rulers.
[91] That is, the number of ritual bronzes, especially round *ding* tripods, must conform to the official rank of the dead. For example, a ruler's tomb at Rujiazhuang (BRM1) contains five round *ding* tripods and four ring-footed *gui* vessels. Other minor officials do not seemingly exceed these numbers.

sometimes plus combs additionally form a special assemblage of grave goods that have been frequently discovered from important tombs with other traditional ritual vessels (Appendix III-Figure 49). Moreover, when present, this special assemblage was placed at the same conspicuous positions with traditional ritual vessels or within the inner coffins close to the heads of the dead, implying that these special items were important grave goods and perhaps constituted a part of the ritual paraphernalia (Lu and Hu 1988:451). In contrast with traditional ritual vessels, the use of this special bronze assemblage containing pointed-bottom jars seemed to be an innovation of the regional culture, but one not seen elsewhere. The individual vessel types in this new assemblage are not unprecedented, however. They are bronze copies of originally ceramic vessels, but they might have been produced in a smaller size not intended for real use. While high-ranking tombs may contain both bronze and ceramic assemblages, lower-ranking tombs yielded only ceramic one.

Among these vessels, pointed-bottom jars (Figure III-56) are reminiscent of the *jiandi guan* of the Chengdu Plain. In addition to the bronze *jiandi guan,* 13 of the 22 tombs at Zhuyuangou yielded one to two pieces of pottery *jiandi guan,* and were placed in the same spots as their bronze counterparts in the graves, perhaps playing a similarly important role (Lu and Hu 1988:91). By contrast, as many as 18 pieces of flat-based jars were interred in a single grave. They were, however, produced in a coarser manner and placed in less important places (Lu and Hu 1988:92). This preferential use of *jiandi guan* reminiscent of the Chengdu Plain, where one of the most remarkable uses for pointed-bottom vessels, in particular *jiandi zhan,* was to present them as funerary objects, often in a single piece. However, even though such a funerary custom began in Sichuan, no bronze copy of *jiandi guan* or *jiandi zhan* has been found in Sichuan in the

same context[92]. There seems a certain social practice in the Yu state that created this social need of bronze *jiandi guan*. The two kinds of materials, ceramics and bronzes, though have different economic values, were probably interchangeable in their social meaning under certain conditions. While a pottery imitation of a bronze *lei* vessel (BZM7:28) was also unearthed from Zhuyuangou (Appendix III-Figure 50), it reveals not only a social need to transfer the same design to different media, but also the proficiency in techniques needed to realize such imitations. Items like this have also witnessed the interactions between different production systems.

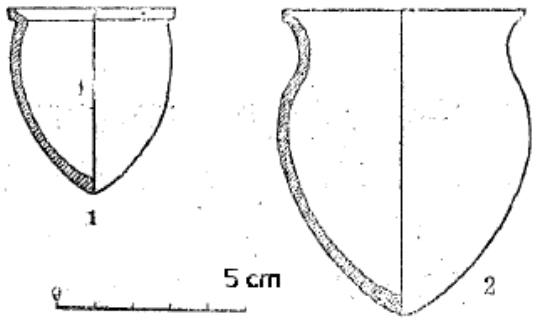


Figure III-56: Bronze *jiandi guan* unearthed from Zhuyuangou Tomb No. 13 (BZM13:107, 71) (Lu and Hu 1988:79).



Figure III-57: Ring-footed tureens discovered in Zhuyuangou (left) and Shuiguanyin (right)
Left: BZM7:38 (Lu and Hu 1988:127, 453);
right: T4.3:1 (Deng Boqing 1959:406), where it is identified as *dou*-like vessel (*douxingqi*)[93] (not to scale).

[92] Only a deeper type of pointed-bottom container (*jiandi cheng* or *jiandi he*) was made in bronze in a much later period. They were discovered in the Qingyanggong-period tombs of the Chengdu Plain such as the boat coffin of Mianzhu (Wang Youpeng 1987).
[93] More frequently called *guixingqi* in the Shi'erqiao culture.

Like Zhuyuangou, Rujiazhuang has also yielded rich pottery vessels from almost every grave. In some cases, the graves were surrounded by a variety of ceramic jars similar in arrangement to the burial in Shuiguanyin (M1, Figure III-21). Moreover, a considerable number of pointed-bottom vessels, including *jiandi guan* and *jiandi zhan,* were unearthed from the residential area of nearby Rujiazhuang, suggesting the vessels were practically used in day-to-day life. Nearly all of them were made as thin, fine wares (Appendix III-Figure 51, 52) and they together account for 30% of the potsherds at the site (Lu and Hu 1988:7). In actual use, ring feet might have been attached to them, a design popular in Shi'erqiao, Shuiguanyin, and other Chengdu Plain sites (Figure III-57). The existence of pointed-bottom vessels also makes the Yu-state area distinct from other Zhou sites, but it appears to have been influenced by its neighbors in the Upper Han River, even though the Yu state was close to the Zhou court culturally and politically.

As we have seen, the Upper Han River especially overlapped with the Sichuan region in pointed-bottom pottery vessels and bronze items. Similarly, the Wei River area and the Chengdu Plain mutually influenced each other in many dimensions, but not only in respect to pottery types. For instance, scholars have drawn attention to the parallels shown in the Rujiazhuang bronze figures[94] and Sanxingdui sample in their similarly exaggerated gestures, although they were differently designed in dresses and made in different sizes (Sun Hua 2000:189: Falkenhausen 2003a:221-2) (Appendix III-Figure 53). The other direction of influence between the Wei River area and the Chengdu Plain is further demonstrated by the "Zhou-style" ritual bronzes contained in the Zhuwajie hoards, which have been recognized as being closely related to the products of the Yu-state cemeteries. A *zhi* goblet discovered from Zhuwajie hoard no. 1, for example, coincides with that of Zhuyuangou (BZM13:6) in not only appearance but inscriptions (Lu and

[94] Recovered from Tombs no. 1B and 2, which are thought to be the tombs of a ruler and his wife, respectively.

Hu 1988:457), although the inscriptions present in Sichuan did not necessarily function in the same way as those in the Zhou tradition (Falkenhausen 2003b:324). It is possible that these vessels came from the same workshop somewhere in the Zhou territories, if not in the Yu state.

Also illustrated by the Zhuwajie hoards are the parallel "Ba-Shu style" weapons found in both the Yu-state cemeteries and the Chengdu Plain. According to the excavators of the Yu state cemeteries, the quantities of bronze weapons in the graves were correlated with the official ranking of the dead (Lu and Hu 1988:431). The interred weapons may be real ones that had been used during the lifetime of the dead or symbolic ones specially produced as (miniature) funerary objects. Among them, *ge* dagger-axes, including cruciform dagger-axes and triangular *kui* dagger-axes, are the most distinctive and account for the majority. The shapes of and motifs (often tigers) on these items resemble samples from the Zhuwajie hoards, the tomb of the 1995 Xinyicun locus, and the many Qingyanggong-period tombs of Chengdu. Similar assemblages have been discovered from the Upper Han River Basin, as previously demonstrated (Appendix Appendix III-Figure 46 54, 55). From Appendix III-Figure 54 and 55, for instance, we can find willow leaf-shaped swords that were characteristic of Sichuan were also discovered in Zhuyuangou and Rujiazhuang tombs (e.g. BZM13:99). However, in the Yu-state contexts, the swords were normally placed beside the waists of the dead, simulating how they would be worn. Moreover, although similar items have been widely recovered from the early Western Zhou tombs[95], the swords are most concentrated in the Yu-state cemeteries and are significantly associated with high-ranking male nobles (Sun Yan 2006:115). Such differences in the way of using willow leaf-shaped swords seem to distinguish the Yu-state cemeteries from other areas.

[95] With their wide distribution, arguments about possible sources for the sword types as well as other so-called "Ba-Shu-style" weapons have never settled (Tung Enzheng 1977; Chen Fang-mei 1992; Jiang Zhanghua 1992; Sun Yan 2006; Duan Yu 2009).

The Wei River region, though far from the Chengdu Plain, seems similar to the Xinyicun site and Zhuwajie hoards in many aspects, in which communications might have been directed though the Upper Han River. The Wei River valley may in turn become another intermediary that connects Sichuan and other regions even further afar, such as the Zhou territories east or north of the Yu state.

5. Discussion

In this chapter, I have isolated the Sichuan Basin as a distinct geographical region and inspected its natural and cultural environments. My purpose was to investigate the contents of the bronze cultures of the Chengdu Plain, especially during the Shi'erqiao period, and to show how different factors affected the development and distribution of these cultures. I then reviewed the material cultures of the Shi'erqiao: their origins, production techniques, and scopes of circulation. By juxtaposing multiple types of the material cultures from related archaeological sites and cultures, I explored their commonalities and shared cultural spheres. In addition to synchronous investigation, I have also conducted diachronic comparisons whenever relevant. To make clear how these sites and their material cultures were linked, I organize the sites and artifact types in maps and tables (Figure III-58-Figure III-60, Table III-1-Table III-3) by period so that we can visualize their spatial relationships and the distribution of artifact types during each period.

5.1. The influence of natural environments

To explore the factors contributing to the development of the bronze cultures of the Chengdu Plain, I first went over its geological and paleoclimatic conditions, both of which have played important roles in the processes of soil formation and affecting clay conditions. These natural factors are of concern because they not only directly affect the distribution and properties of clay sources and thus the development of pottery production, but they also set a basis for people to

maintain their specific subsistence and social needs. To this end, I have reviewed past studies on the geological conditions of the likely sources responsible for the lithic and ceramics products of the Sanxingdui and Shi'erqiao and briefly discussed their characteristics. This survey allows us to quickly grasp the properties of local products and how ancient crafters might have interacted with their environments. This information will also serve as a point of comparison in the next chapter, in which I examine further the properties of clays and production techniques.

I then discussed the faunal and floral remains from the Shi'erqiao stratigraphy. In doing so, I hoped to understand the ecological system of the Shi'erqiao and how it might have shaped the subsistence and economy of the settlement, including the craft systems of different types of material cultures. By examining the disturbed loci and breaks in cultural deposits likely caused by floods, I also attempted to search for the distributional pattern of the archaeological sites corresponding to the river orientations and the spatial relations within the site clusters. However, this consideration of environments is not mere environmental determinism—I do not ascribe the decline of a society or production system to a single climatic event—but, rather, I consider ecological variations as turning points at which people undertook responses to a crisis with varied strategies. I also hope to distinguish nature from other social or cultural factors before we apply the latter to explain social change.

The comparisons between sites and over time in this chapter show that while some pottery assemblages prevailed across different areas, potters nonetheless needed to orient their products to local clay resources and production traditions. For example, in contrast with the coarse, black-slipped *jiandi zhan* in the Chengdu Plain, the same vessel type tends to be in fine, red clay in the Three Gorges Area. Both respective soil conditions (i.e., their chemical compositions) in different regions and potters' deliberate choices of raw materials, including clays and tempers,

might cause this difference in color and clay texture. To discern the reason for this would require us to examine the natural environments and the social values of certain raw materials. The former can be fulfilled through inspecting the variations in regional clay resources, and the latter can be searched in local production traditions. However, it is worth noting that while natural factors played a role in affecting craft performance, including constraining the choices of the crafters and affecting their aesthetic view, such influence might gradually become a part of a production tradition, thus making natural and artificial factors indiscernible. With this consideration in mind, I have evaluated the ecology and regional economies of not only the Chengdu Plain but also several other areas, where commonalities and shared cultural values between localities are sought.

On the other hand, in response to the regional ecology, we may find that within the same archaeological culture, different sections or subgroups adopted different strategies according to their respective circumstances, and yet still maintained frequent interactions and shared certain cultural values. For instance, although the Three Gorges area and Jianghan Plain have different natural environments, which led them to develop different subsistence economies, these two regions nonetheless developed generally common features in pottery production that have made both of them part of the Daxi culture (Zou and Bai 2003:49). Similarly, whereas the oracle-bone divination custom was widely adopted in the Upper-Middle Yangzi River valleys, sites in the Middle Yangzi display greater flexibility in selecting divination media. The selection use of other animals reveals the local faunal resources. That said, shared customs have been differently adapted to local environments.

5.2. Material culture and cultural influence

Second, by examining the shared pottery assemblages discovered from the geographically connected regions, I showed how different cultures might influence each other and how they incorporate outside elements. Although this study is centered on the Shi'erqiao culture of the Chengdu Plain, its social development and tradition had an earlier ground and needs us to source back to the preceding archaeological cultures, namely the Baodun and Sanxingdui. Whereas the societies of the Chengdu Plain noticeably increased complexity during the Baodun period in late Neolithics, the Sanxingdui culture, in particular, influenced the development of the Shi'erqiao material cultures and probably the ritual life as well. The Shi'erqiao culture, in turn, founded the social setting of the region in the succeeding periods in which, though transformation sometimes occurred, continuity between cultures is clear. This continuity can be seen in the bronze, pottery, lithic, and bone assemblages. These cultures together form a comparison basis for clarifying the distributions and changes of cultural spheres in space and over time.

Comparisons between the number of site clusters within the plain and between the plain and surrounding regions suggest the overlaps and connections in various types of material cultures. In particular, these sites shared assemblages of artifacts and decorations, including (1) flat-based or ring-footed beakers with everted-rims (*kuanyan pingdi zun* or *changkou quanzu zun*), long-necked jars with trumpet-shaped mouths (*labakou gaoling guan*), jars with decorated rims (*huabian kouyan guan*), and water-wave marks in the late Neolithic Age (or the Baodun period) (Figure III-58, Table III-1); (2) jars with small flat bases (*xiaopingdi guan*), *he* tripodal spouted pitchers, bird-head-shaped dipper handles, pointed-bottom vessels, vessel covers with kneaded buttons, stemmed bowls with shallow dishes, high-stemmed mounted bowls (*douxingqi*) or lamp-shaped vessels (*dengxingqi*), ring-footed *dou*, and animal motifs (e.g., bird, fish, and tiger)

in the early Bronze Age (or Sanxingdui II-early Shi'erqiao period) (Figure III-59, Table III-2); (3) and ring-footed tureens, jars with inverted rims (*liankao guan*), multi-layered rhombic marks, round-bottom jars, and the "Ba-Shu-style" weapons in later periods (or the Xinyicun period) (Figure III-60, Table III-3). These vessel types are the characteristic assemblages that repeatedly appear in the Chengdu Plain and neighboring regions during the late Neolithic and Bronze Ages. They together form the principle axis that links different social groups. Though I only list the pottery types that were characteristic of the Chengdu Plain, sites in eastern Sichuan and northern Sichuan produced a number of other vessel types in addition to Chengdu Plain-assemblages. These other vessel types were not common or only reached the Chengdu Plain in later times. For example, round-bottomed jars often seen in the middle Yangzi since Neolithics only reached the Chengdu Plain during the Xinyicun period. It is worth noting that there remain some sites in the maps not reported to have produced the same types. These sites, however, were only tentatively surveyed and ask for systematic investigation in the future to understand their relationship with the Chengdu Plain.

Sometimes, the parallels between two localities are revealed by shared customs, such as oracle-bone divination and burial treatments. It is via these material objects, manufacturing techniques, artistic designs, and customs that relationships between the various sites can be assessed. It turns out that the degree of overlap, the aspects of resemblance, the mechanisms underlying the connections, and the relationships between the involved parties vary in each pair of comparisons. For instance, settlements on the Chengdu Plain produced more artillery shell-shaped *jiandi bei* and fewer collared *jiandi bei*, while the latter were more commonly shared among the settlements in eastern Sichuan. Western and eastern Sichuan favored different

varieties of vessels and show their respective, internal coherence in this respect, although they were aware of and capable of producing other varieties.

The scope of the cultural influence from the Chengdu Plain changed over time as well. In some cases, detectable communications between two loci were lasting, but in others they were only stray or circuitous. For instance, in spite of the spatial and temporal distance between Sanxingdui (*ca.* 1800-1200 BC) and Shijiahe (*ca.* 2500-1900 BC) in the Middle Yangzi and Liangzhu (*ca.* 3200-1900 BC) in the Lower Yangzi, the material and information flows between these regions are discernible and can be sourced back to late Neolithics as the cultural elements of Shijiahe and Liangzhu have been preserved in Sanxingdui and Jinsha (Falkenhausen 2003a:192-203; Jiang Zhanghua 2007:400). Also, some scholars speculate that during the formation period of the Sanxingdui culture, it was via the Middle Yangzi that the influence of the Erlitou culture, the first grown bronze culture centered at the Yellow River basin, reached western Sichuan, introducing pottery vessel types like *he* tripodal spouted pitchers and high-stemmed *dou* (Sun Hua 2000:154; Jiang and Yan 2003:79-81) and perhaps metallurgical technologies (Sun Hua 2000:39; 2003:73). The exchange flows continued in the succeeding periods while the full-blown Sanxingdui extended its influence to eastern Sichuan such that the characteristic ceramic assemblages of the Chengdu Plain (especially of Sanxingdui and Shi'erqiao) have been often discovered in the Sichuan Basin, as illustrated in Figure III-59. These discoveries have suggested a scenario in which eastern Sichuan and western Hubei were greatly influenced by the Chengdu Plain and even incorporated into the cultural sphere of the Sanxingdui, and later, the Shi'erqiao (Sun Hua 2000:39-40; Jiang and Yan 2003; Jiang Zhanghua 2007:399).

During the later period of Sanxingdui, while the bronze vessels were discovered from the sacrificial pits, many have speculated about the possible sources or prototypes for the artifacts. Their styles seem similar but somewhat different from Shang bronzes in North China. The counterparts are distributed in the Huai 淮 River, the Three Gorges area, the Middle Yangzi, and the Upper Han River. Despite the uncertainty of the foundry's origin, to transmit such products and/or complex manufacturing knowledge needed would have required direct or indirect interactions between involved social groups and intermediaries, prompting them to face certain cultural collisions and reconciliations.

However, temporal gaps and lags between cultural transmissions might have occurred because a large geographic territory was involved. The reinterpretation and selective use of foreign cultural elements might have also been inevitable. The adoption of foreign products or manufacturing ideas in the Chengdu Plain, such as ritual bronzes and jades, unavoidably transformed the social meanings of the artifacts while they were used in a different way or context. For instance, when the ritual items were brought to the areas peripheral to the Shang and Zhou courts, the local patrons accommodated the artifacts to a new cultural system according to their own social needs and local interests. In the Sanxingdui sacrifice pits, we not only found that ritual bronzes were interred in a distinct manner from their counterparts in other regions, but also that they were used together with many items unique to the Chengdu Plain. They together signal the values of Sanxingdui inhabitants about how a ritual assemblage should be formalized in their social settings. Likewise, when the Sanxingdui life-sized statue might serve as a template reproduced in Rujiazhuang, as mentioned in the Yu-state section, the gap in time and space between the two cultures and the difference in the contexts in which the figures were used are

apparent. It would be risky to assume that the same cultural meaning was held in the samples of the two cultures, as scholars have cautioned (Rawson 1996:70; Falkenhausen 2003a:222).

In some areas, where multiple cultural encounters might have occurred, the overwhelming influence coming from a certain culture might have crowded out the others. After the "subsidence" of the Sanxingdui sphere, the Jianghan Plain and eastern end of Three Gorges area were overwhelmed by the influence from the Yellow River basin and later by the "proto-Chu culture". The influence power of western Sichuan seems gradually to have regressed from the east but expanded in the north to the Upper Han River and Wei River in Shaanxi during the Shi'erqiao and Xinyicun periods, according to Sun (2000:34-40). Sites, such as Jingnansi, which produced Chengdu Plain assemblages earlier and might have been the easternmost boundary of the Sanxingdui sphere, did not circulate the same vessel types after early Shi'erqiao. By contrast, settlements in the north of the Hanzhong Basin (e.g., Baoji) that did not have apparent connection with the Chengdu Plain before the Shi'erqiao period began to circulate material cultures from the Chengdu Plain. This recognition of cultural spheres, clearest in a comparison of the two periods—Sanxingdui and Xinyicun in their eastern and northern bounds (Figure III-61), has mostly, but not solely, been based on the pottery assemblages, which in turn are largely composed of vessels of everyday life, suggesting the presence or absence of intensive interactions among the general public.

Other types of material cultures, like bronzes and lithics, although they have been cited as additional evidence to suggest the connection between settlements, have in previous studies not been treated in the same way as pottery assemblages in considerations of the distribution of an archaeological culture or as carefully discerned for their social functions. This is partially because non-daily items often involved rare raw materials and/or complex manufacturing skills,

making them expensive to modify frequently and therefore less sensitive to local variations. For instance, after comparing the graves of the Qingyanggong period in the large Sichuan region, Jiang Zhanghua (1999:34) concludes that bronzes (a few bronze vessel types plus the "Ba-Shu-style" weapons) of the same periods are nearly consistent everywhere, whereas funeral potteries (mostly *fu* cauldrons and ring-footed *dou*) tend to be sensitive to local variations. The argument that different types of material culture can form divergent circulation spheres is shown in examples like this.

The ritual bronzes and lithics from Sanxingdui and Jinsha, the bronze weapons from Shuiguanyin graves, the ritual bronzes and weapons from Zhuwajie hoards, and the "Ba-Shu-style" weapons and the bronze vessels in the tombs of the Qingyanggong phase are added to the discussion here, for they provide us with the opportunity to think about the plurality and disconformity of cultural spheres, although they have not yet been fully comprehended and may exceed the scope of this study. While raising this argument, I also hope to clarify that even if a cultural sphere can be recognized, it should not be taken for granted that all the resemblances were directed from a single place or caused by the same reason. Instead, the communication flows perhaps involved artifacts of multiple origins and made in different media. The assemblages are not unchangeable packages either. For instance, as briefly mentioned above, although the "Ba-Shu-style" weapons were characteristic of Sichuan and lasted in the region for a long time, the weapons subsumed under that style (e.g., cruciform dagger-axes, triangular daggers, willow leaf-shaped swords, *fu* or *yue* axes, and spearheads) probably have prototypes from more than one source, like the Upper Han River basin, Baoji, Gansu, and northwest China (e.g., Lu and Hu 1988:431-446; Zhang Tian'en 1998). However, with mutual influence or indirect exchange via multiple intermediaries, to identify the sources responsible for the

resemblances is not always possible. The currently defined weapon assemblage was not necessarily invented or brought to Sichuan in a package but was more likely selectively adopted, transformed, and combined over time such that, in early graves like the Shuiguanyin burials, only a portion of the weapon types were present. It is only because the specific social circumstances of Sichuan during the Qingyanggong phase made it feasible that interring such weapon assemblage with the dead became a popular and distinctive funeral custom.

Similarly, although the collocations of particular decorations and vessel types are often patterned in one culture, the same collocations do not necessarily transmit to other places as a package. For instance, whereas the collocation of multi-layered rhombic marks (*chonglingwen*) or square spiral marks (*yunleiwen*) and jars with inverted-rims (*liankao guan*) has been frequently discovered in Shi'erqiao and Xinyicun, such collocation is absent from other sites down the Yangzi River even though the decorations *per se* are widely distributed. Instead, similar decoration marks are often associated with proto-porcelain in Jingnansi and Wucheng in southeast China. Another example is collared *jiandi bei*, which when they were introduced to the Chengdu Plain during the early Shi'erqiao, the "s-shaped" marks often associated with the vessel type in the Middle Yangzi and eastern Sichuan (e.g., Lujiahe, Shimenzui, and Xianglushi, as shown in Figure III-47.1) were not brought to the Chengdu Plain concurrently. This selective adoption of artifacts and the realization of the same designs in different media and details make it clear that while the formation of a cultural sphere has certain backgrounds and conditions, the social segments involved have certain agency to determine how various artifacts are perceived and used.

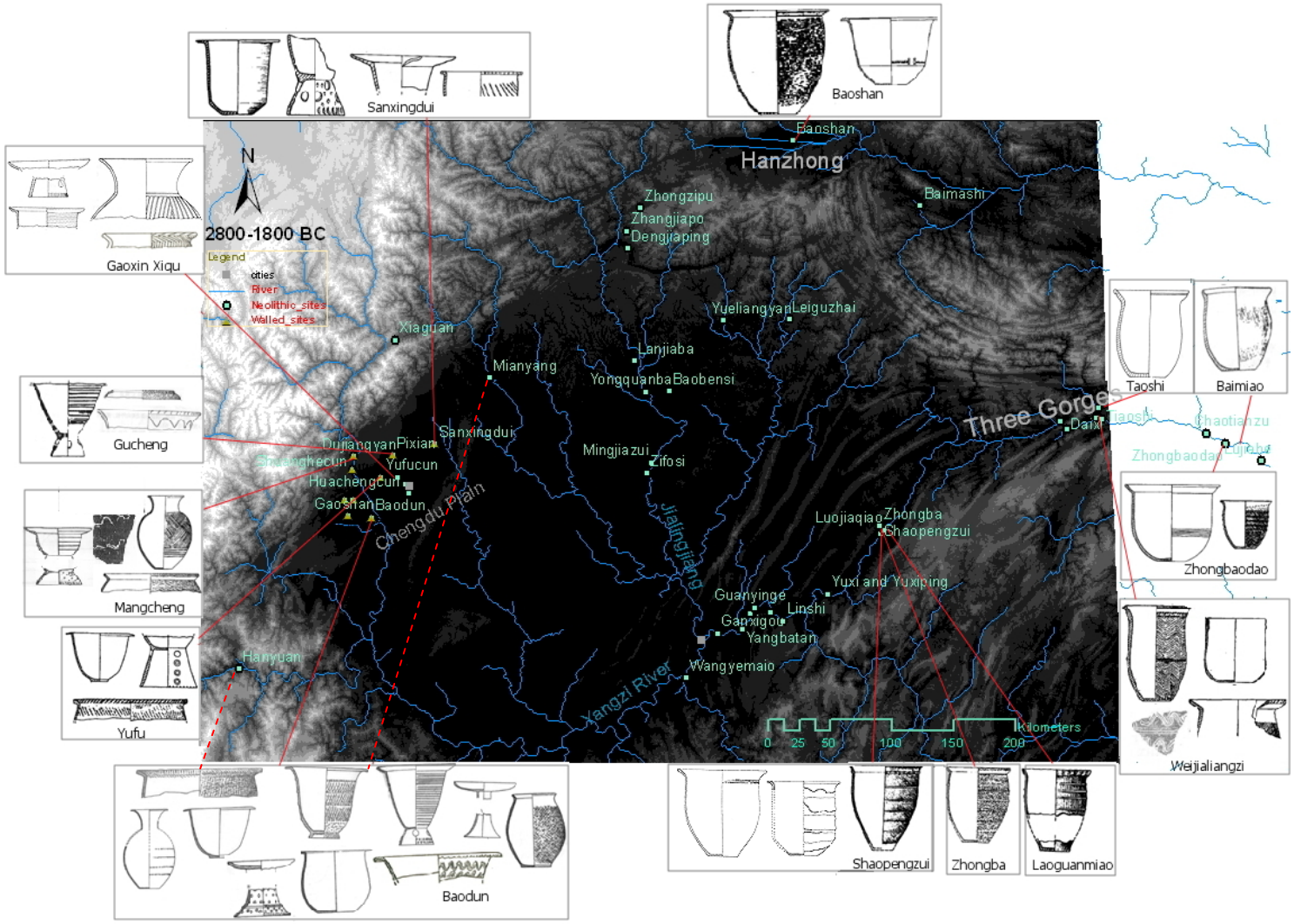


Figure III-58: Archaeological sites sharing material cultures of the Chengdu Plain, *ca.* 2800-1800 BC

The Baodun site (below left) produced the most various pottery types, many of which also featured in other sites on the Chengdu Plain. Some vessel types can be found in eastern and northern Sichuan. These characteristic sites are linked, via red lines, with the pottery types found at the sites (enclosed in corresponding boxes). Other sites (marked with dash lines) are reported to have similar findings, but not illustrated in reports. (Only pottery types characteristic of the Chengdu Plain are listed.)

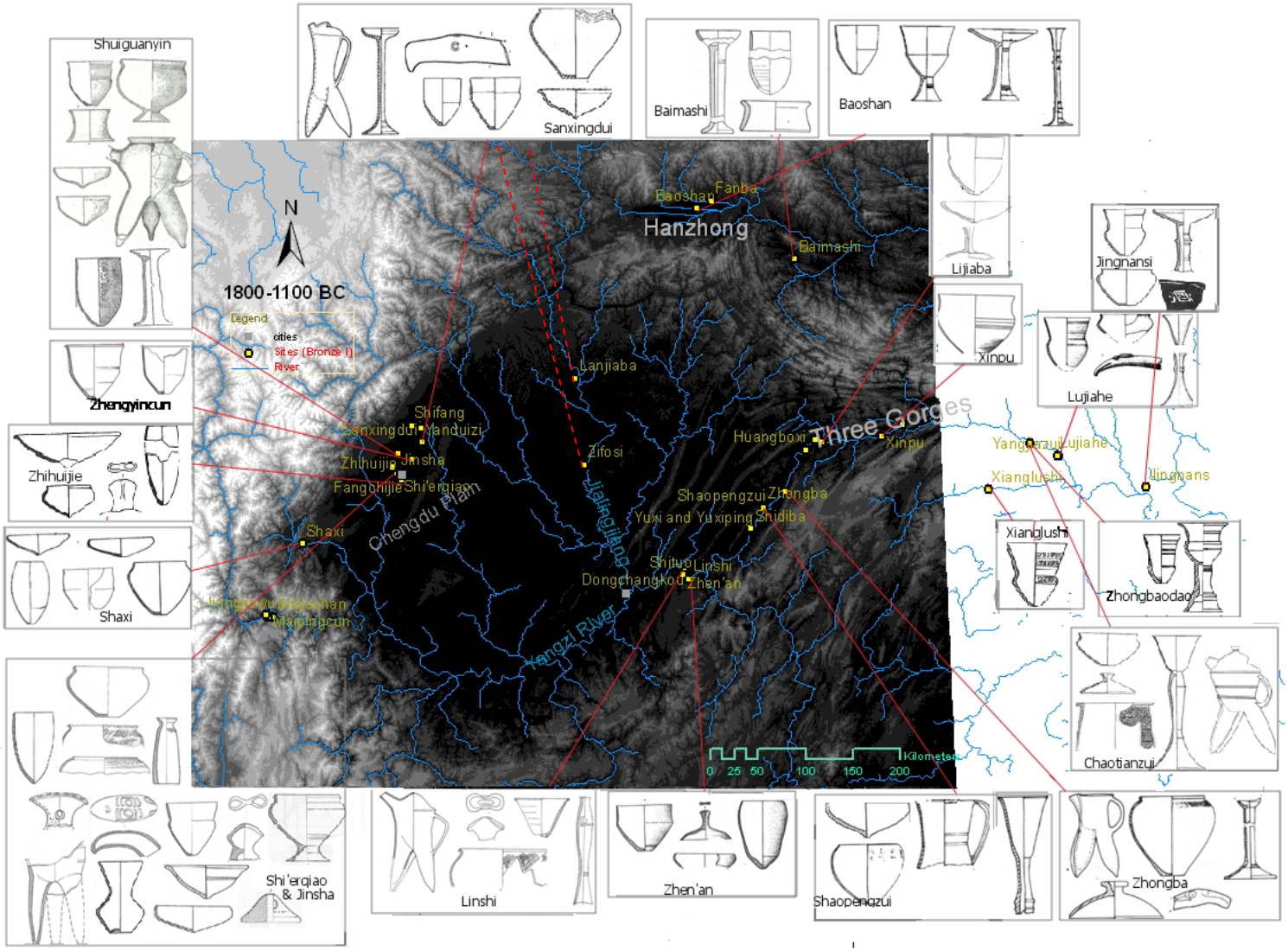


Figure III-59: Archaeological sites sharing material cultures of the Chengdu Plain, *ca.* 1800-1100 BC
The Sanxingdui (above left) and Shi'erqiao (below left) sites produced the most various pottery types, many of which also featured in other sites on the Chengdu Plain. Some vessel types can also be found in eastern and northern Sichuan. These characteristic sites are linked, via red lines, with the pottery types found at the sites (enclosed in corresponding boxes). Other sites (marked with dash lines) are reported to have similar findings, but have not been systematically investigated. (Only pottery types characteristic of the Chengdu Plain are listed.)

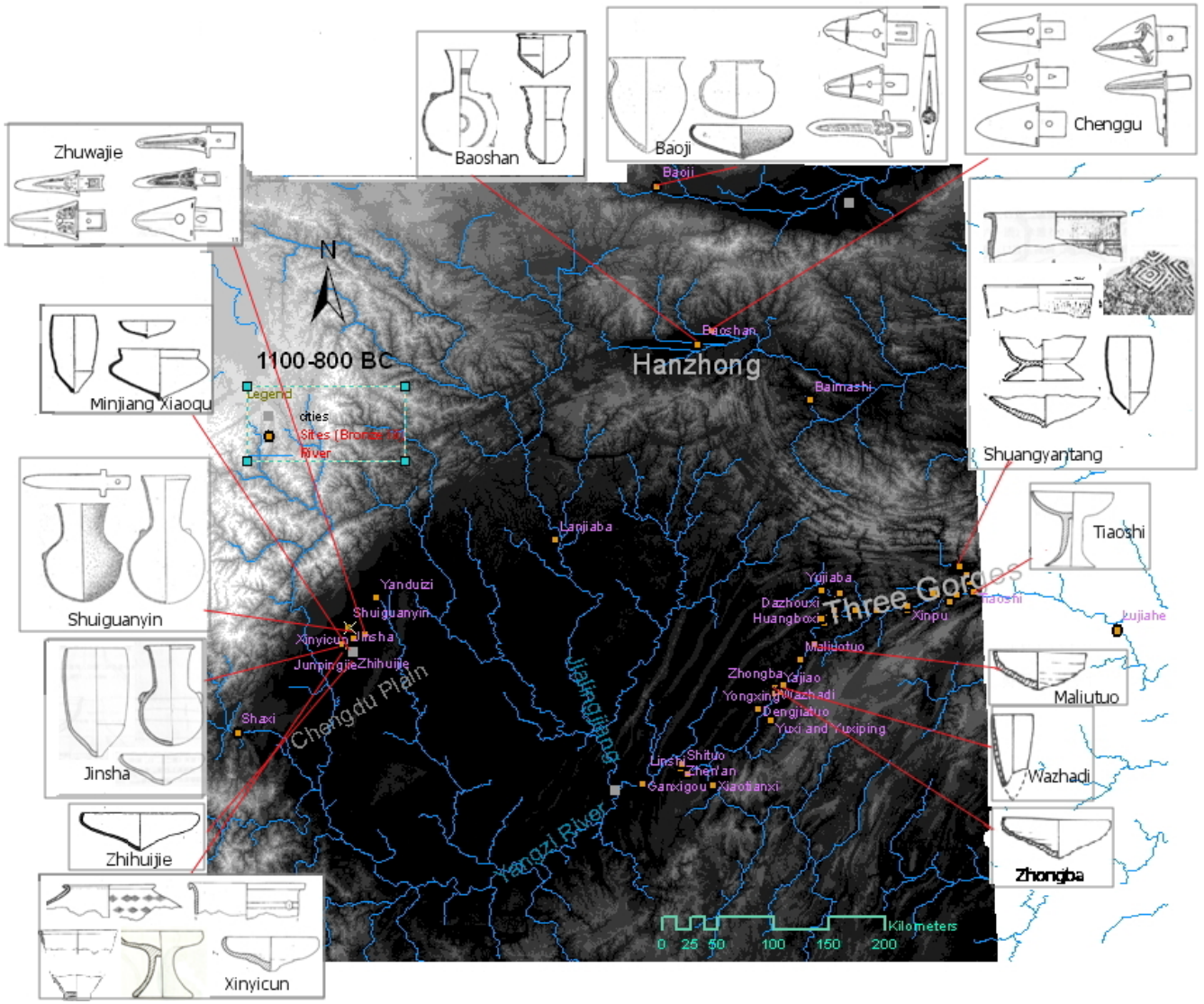


Figure III-60: Archaeological sites sharing material cultures of the Chengdu Plain, *ca.* 1100-800 BC

The listed pottery and weapon types not only were common in the Chengdu Plain (left), but can also be found in eastern and northern Sichuan. However, in comparison with previous stages, some sites (e.g., Jingnansi) in the east of the Three Gorges detached from the sphere of the Chengdu Plain. By contrast, some types were introduced to sites farther north of the Sichuan Basin, such as Baoji.

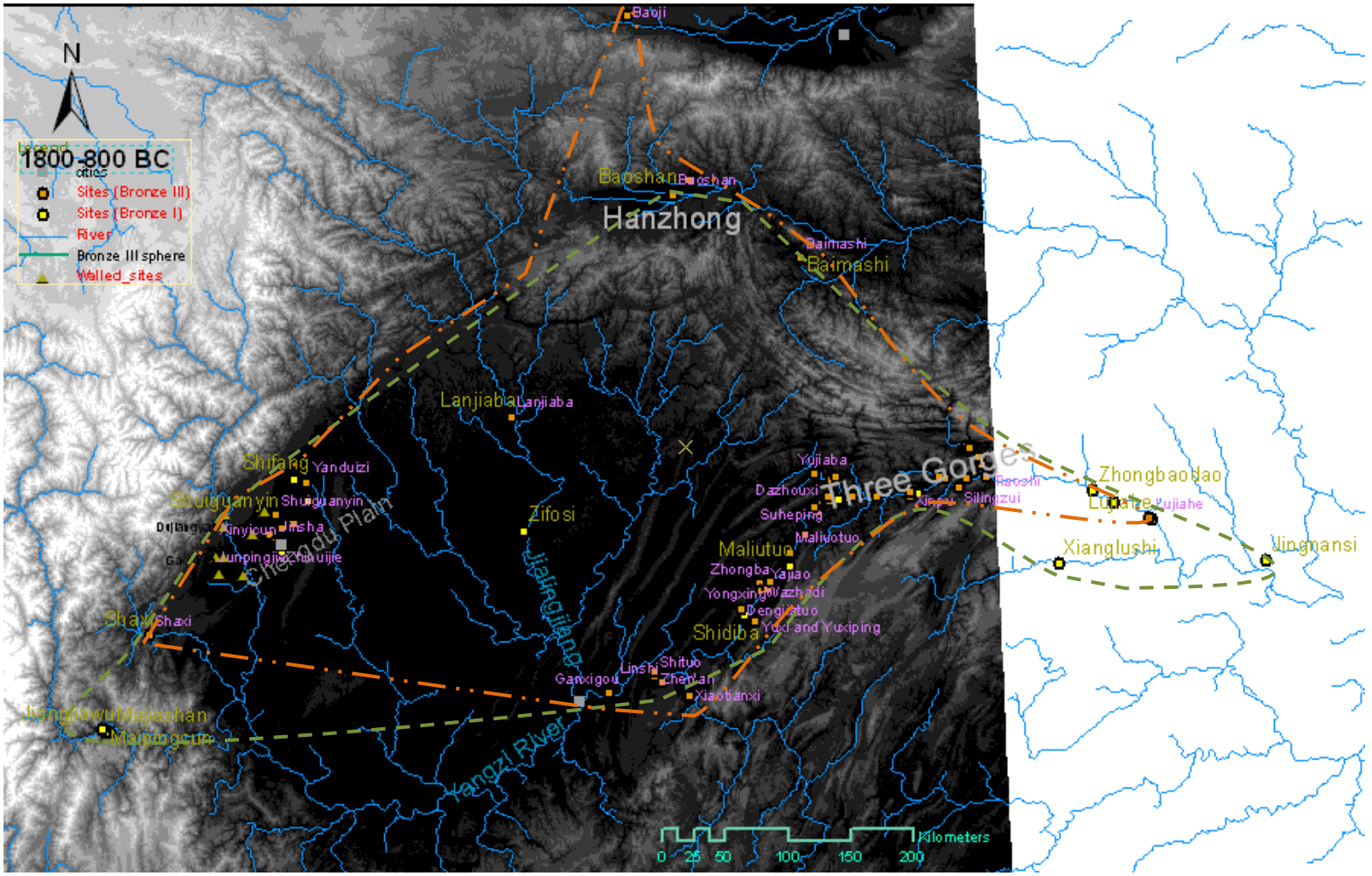
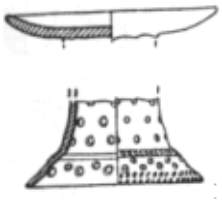
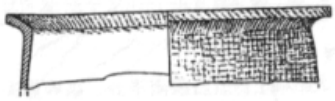
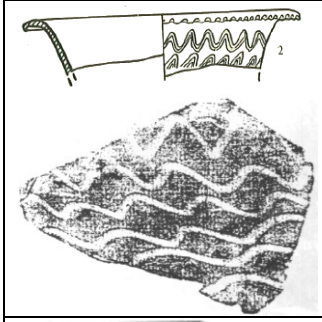
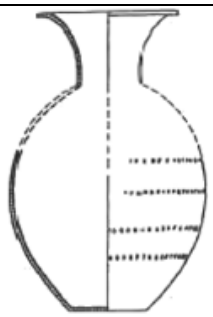
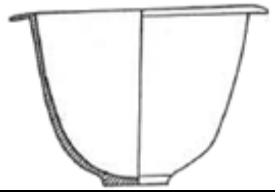
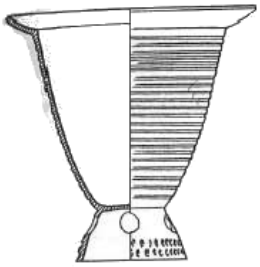
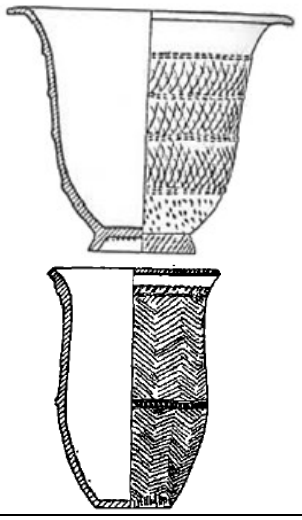


Figure III-61: A comparison of the distributions of Chengdu Plain assemblages between two periods: Sanxingdui (green dash line) and Xinyicun (red long dash dot line)

Time Period: Neolithic Age (2800-1800, Baodun period)		
Type of pottery or decoration		Site where found
	*loukong quanzu dou* (mounted bowl with openwork ring foot)	Baodun (C)*, Sanxingdui (C), Mangcheng (C), Yufu (C), Gaoxin Xiqu (UESTC, Zhonghai, etc.) (C), Huachengcun (C) Jinsha (Zhixin Jinshayuan I) (C) Laoguanmiao (E)
	*shengwen huabian guan* (cord-marked jars with decorated rims)	Baodun (C), Sanxingdui (C), Mangcheng (C), Yufu (C), Gucheng (C), Qingjiangcun (C), Gaoxin Xiqu (UESTC, Ruyang, Zhonghai, etc.) (C), Shijiefang (C) Huachengcun (C), Suolong (E), Weijialiangzi (E)
	water-wave mark	Baodun (C), Mangcheng (C), Gucheng (C), Gaoxin Xiqu (Gewei) (C), Linshi (M), Zhongba (E), Weijialiangzi (E)
	*kuanyan pingdi zun* (wide-lipped, flat-bottomed beakers)	Baodun (C), Sanxingdui (C), Mangcheng (C), Qingjiangcun (C), Shaopengzui (E), Dujiayuanzi (E), Taoshi (E), Weijialiangzi (E), Baimiao (E), Baoshan (N)

	*labakou gaoling guan* (long-necked jars with trumpet-shaped mouths)	Baodun (C), Sanxingdui (C), Mangcheng (C), Gucheng (C), Gaoxin Xiqu (Zhonghai, UESTC, Gewei) (C), Linshi (M), Zhongba (E) Dujiayuanzi (E) Miaoping (E)
	*changkou quanzu zun* (ring-footed beakers with everted rims)	Baodun (C), Yufu (C), Gucheng (C)
	*pankou quanzu zun* (ring-footed beakers with dish-shaped mouths)	Baodun (C), Sanxingdui (C), Mangcheng (C), Gucheng (C), Shijiefang (C), Huachengcun (C), Gaoxin Xiqu (Zhonghai, Gewei, Hangkonggang) (C), Jinsha (Zhixin Jinshayuan I) (C)
	*zun* beakers or *shenfu guan* (deep-bellied jars) with horizontal appliqué	Baodun (C), Gaoxin Xiqu (Zhonghai) (C), Laoguanmiao (E), Zhongba (E), Shaopengzui (E), Weijialiangzi (E), Suolong (E), Taoshi (E), Zhongbaodao (E) Miaoping (E)

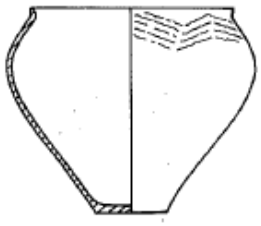
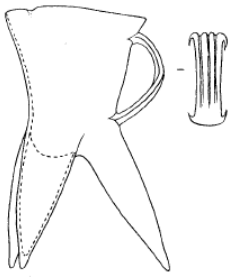
*C= sites on the Chengdu Plain and western Sichuan mountain areas

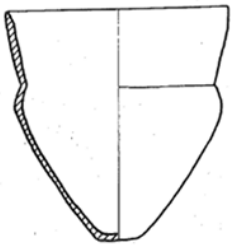
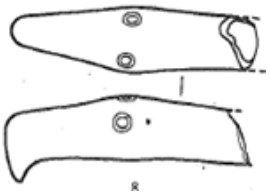
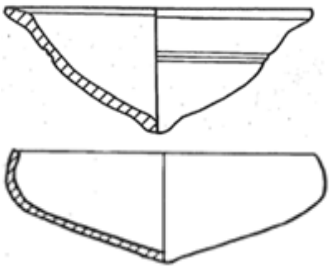
M= sites around Chongqing City

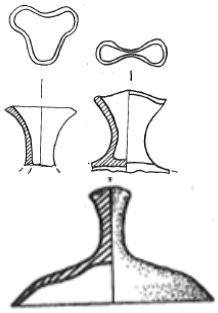
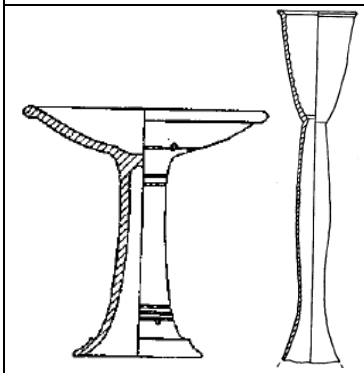
E= sites in eastern Sichuan and east of Sichuan, in the Three Gorges Area

N= sites in the north of Sichuan

Table III-1: Pottery types characteristic of the Chengdu Plain, *ca*. 2800-1800 BC

Time Period: Bronze Age I (18000-1100 BC, Sanxingdui II-early Shi'erqiao)		
Type of pottery or decoration		Site where found
	*xiaopingdi guan* (jars with small, flat bases)	Sanxingdui (C), Shi'erqiao (C), Jinsha (Meiyuan, Lanyuan, Xinghelu Xiyanxian, etc.) (C), Gaoxin Xiqu (Languang, etc.) (C), Xinyicun (C), Zhengyincun (C), Shaxi (C), Hanyuan (Maiping) (C), Linshi (M), Shaopengzui (E), Zhongba (E), Zhongbazi (E), Maliutuo (E), Suheping (E), Lijiaba (E), Chaotianzui (E), Zhongbaodao (E), Lujiahe (E), Jingnansi (E)
	*daizu fengkou he* (closed-spouted pitchers with pouch-shaped feet)	Sanxingdui (C), Shi'erqiao (C), Zhengyincun (C), Gaoxin Xiqu (Languang, etc.) (C), Linshi (M), Maoxitao (E), Xianglushi (E), Chaotianzui (E), Zhongbaodao (E), Jingnansi (E)
	*gui* tripods	Sanxingdui (C), Jinsha (Lanyuan, Wanbo, etc.) (C), Shuiguanyin (C), Zhongba (E), Zhongbazi (E), Maoxitao (E), Xianglushi (E),

		Chaotianzui (E), Zhongbaodao (E), Jingnansi (E)
	*you-ling jiandi bei* (collared pointed-bottom cup)	Sanxingdui (C), Shi'erqiao (C), Shuiguanyin (C), Hanyuan (Pingyangcun) (C), Zhengyincun (C), Shaxi (C), Zhen'an (M), Lijiaba (E), Xinpu (E), Xianglushi (E), Zhongbaodao (E), Lujiahe (E), Changfutuo (E), Jingnansi (E), Baoshan (N)
	*niaotouxing shaobing* (bird-head-shaped dipper handle)	Sanxingdui (C), Shi'erqiao (C), Jinsha (C), Zhongba (E), Zhongbazi (E), Lujiahe (E)
	*jiandi zhan* (pointed-bottom saucer)	Sanxingdui (C), Shi'erqiao (C), Jinsha (Lanyuan, Shufeng Huayuan II, Huangzhongcun, etc.) (C), Shuiguanyin (C), Minjiang Xiaoqu (C), Qingjiangcun (C), Zhen'an (M), Shaopengzui (E), Zhongba (E), Maliutuo (E), Lijiaba (E), Laoguanmiao (E), Baoshan (N)

	artillery shell-shaped *jiandi bei* (pointed-bottom cup)	Shi'erqiao (C), Jinsha (Huangzhongcun, Lanyuan, Shufeng Huayuan II, etc.) (C), Minjiang Xiaoqu (C), Shuiguanyin (C), Qingjiangcun (C), Zhengyincun (C), Shaxi (C), Linshi (M), Zhen'an (M), Shaopengzui (E), Maliutuo (E), Lijiaba (E), Baimashi (N)
	*qizuo* (vessel stand)	Sanxingdui (C), Shi'erqiao (C), Jinsha (Meiyuan) (C), Shuiguanyin (C), Shaxi (C), Hanyuan (Maiping) (C), Lijiaba (E), Baimashi (N)
	*qigai* (vessel cover)	Sanxingdui (C), Shi'erqiao (C), Jinsha (Huangzhongcun, Lanyuan, Wanbo, etc.) (C), Gaoxin Xiqu (Putian) (C), Zhengyincun (C), Qingjiangcun (C), Shaxi (C), Hanyuan (Maiping) (C), Linshi (M), Zhen'an (M)
	*gaobing dou* (high-stemmed mounted bowls)	Sanxingdui (C), Shi'erqiao (C), Jinsha (Lanyuan, etc.) (C) Zhengyincun (C), Shuiguanyin (C), Gaoxin Xiqu (Zhonghai, Futong, Languang, etc.) (C), Qingjiangcun (C), Shaxi (C), Hanyuan (Maiping) (C), Linshi (M),

		Shituo (M), Shaopengzui (E), Zhongba (E), Maliutuo (E), Zhongbazi (E), Lijiaba (E), Xinpu (E), Chaotianzui (E), Zhongbaodao (E), Lujiahe (E), Changfutuo (E), Jingnansi (E), Baimashi (N), Baoshan (N)
	*guixingqi* (ring-footed tureens)	Shi'erqiao (C), Jinsha (Sanhe Huayuan II, Lanyuan, Xinghelu Xiyanxian, Huangzhongcun, etc.) (C), Minjiang Xiaoqu (C), Zhengyincun (C), Linshi (M), Zhen'an (M), Lujiahe (E), Xianglushi (E), Baoshan (N)
	*chonglingwen* (multi-layered rhombic marks)	Sanxingdui (C), Shi'erqiao (C), Jinsha (Wanbo, S. Furongyuan etc.) (C), Lijiaba (E), Xinpu (E), Lujiahe (E), Changfutuo (E), Jingnansi (E)

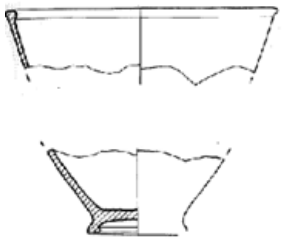
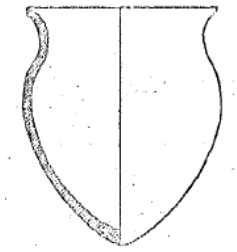
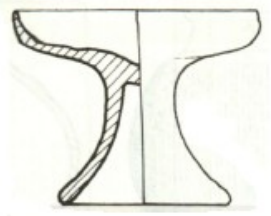
*C= sites on the Chengdu Plain and western Sichuan mountain areas

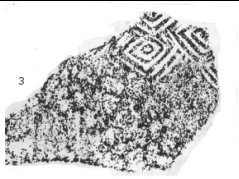
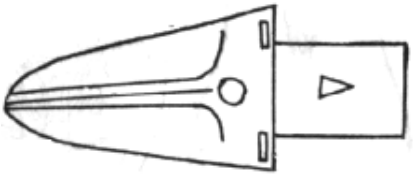
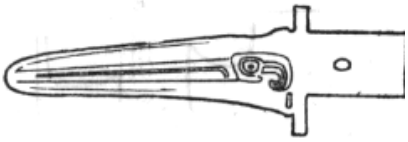
M= sites around Chongqing City

E= sites in eastern Sichuan and east of Sichuan, in the Three Gorges Area

N= sites in the north of Sichuan

Table III-2: Pottery types characteristic of the Chengdu Plain, *ca*. 1800-1100 BC

Time Period: Bronze Age II (1100-800 BC, Xinyicun)		
Type of pottery or metal weapon		Site where found (mentioned in the text)
	*jiandi zhan* (pointed-bottom saucer)	Xinyicun (C), Jinsha (Shufeng Huayuan II, Boyatingyun, Xicheng Tianxia, etc.) (C), Gaoxin Xiqu (Datang, Wan'an) (C), Zhihuijie (C), Fangchijie (C), Qingjiangcun (C), Shaxi (C), Zhongba (E), Maliutuo (E), Shuangyantang (E), Baoji (Rujiazhuang) (N)
	*guixingqi* (ring-footed tureens)	Xinyicun (C), Jinsha (Xicheng Tianxia) (C), Gaoxin Xiqu (Datang) (C), Zhihuijie (C), Qingjiangcun (C), Hanyuan (Majiashan) (C), Maliutuo (E), Shuangyantang (E), Taoshi (E), Lanjiazhai (E), Xianglushi (E)
	*jiandi guan* (pointed-bottom jars)	Jinsha (Xicheng Tianxia) (C), Hanyuan (Maipingcun) (C), Baoji (Rujiazhuang) (N)
	*dou* mounted bowls	Xinyicun (C), Jinsha (C), Hanyuan (Maiping, Majiashan) (C), Maliutuo (E), Shuangyantang (E), Zhongbazi (E), Lijiaba (E), Taoshi (E), Jingnansi (E)

	*chonglingwen* (multi-layered rhombic marks)	Xinyicun (C), Gaoxin Xiqu (Datang, Wan'an) (C), Zhihuijie (C), Zhuwajie (C), Shuangyantang (E), Zhangjiapo (N), Yijiabao (N)
	triangular *kui* dagger-axes (or *sanjiaoyuan ge*)	Jinsha (Xinghelu Xiyanxian) (C), Zhuwajie (C), Wazhadi (E), Chenggu (N), Baoji (Zhuyuangou and Rujiazhuang) (N), Lingtai (Baicaopo) (N)
	cruciform dagger-axes	Shuiguanyin (C), Zhuwajie (C), Baoji (Zhuyuangou) (N), Lingtai (Baicaopo) (N), Chang'an (Zhangjiapo) (N)

*C= sites on the Chengdu Plain and western Sichuan mountain areas

M= sites around Chongqing City

E= sites in eastern Sichuan and east of Sichuan, in the Three Gorges Area

N= sites in the north of Sichuan

Table III-3: Pottery and weapon types characteristic of the Chengdu Plain, *ca*.1100-800 BC

IV. Pottery production in the ancient Chengdu Plain

1. Introduction

In this chapter, I examine datasets principally from three site clusters in the Chengdu Plain of the Bronze Age to offer an account of production technologies and related issues, such as craft organization and the division of labor. The site clusters are Sanxingdui, Jinsha, and Shi'erqiao, all overlapping in chronology. Data from other sites are occasionally used for comparison. Though these sites were occupied for a long period of time, nearly throughout the entire Bronze Age, my datasets are mainly drawn from the early to middle Bronze Age (*ca*. 1300-800 BC). This period is represented by the late Sanxingdui, the Shi'erqiao, and the early Xinyicun cultures. The Shi'erqiao Culture, as introduced in Chapter III-3.1, refers to the lower strata of the Shi'erqiao type site (layers 12-10) and other contemporaneous cultural strata of the Chengdu Plain, such as the lower part of the Xinyicun site (layer 9 and below) and some loci of the Jinsha-site cluster.

The samples collected from these sites are composed of pottery vessels and potsherds of different types. Several tests, including metric measurements of the vessels' dimensions, mineralogical and chemical analyses of the potsherds' composition, and thermal analysis, are designed to compare and characterize these ceramic samples to assess their differences and how they were produced. My goal is to compare the production organizations and their relationships to other social divisions among these site clusters. I focus mainly on pointed-bottom vessels, but I also consider other vessel types whenever the comparison is meaningful. This examination of ceramic samples allows me to provide a basis for inferring the scale and organization of pottery production.

I argued in the previous chapter that craft production in ancient times was sensitive to the supply of raw materials and to a certain degree was restricted by natural settings and resources. To understand the effects that natural conditions might have, I first explore the available resources to potters and how this related to the spatial concentration and ceramic variability among different sites and regions. According to Li Wenjie (1996:330-42; see also Xu Zhiyong 2004:104), a specialist in experimental archaeology, raw clays used in pottery production before Han China (before 202 BC) can be divided into four categories[96], depending on the presence, quantities, and proportions of silica (SiO_2), alumina (Al_2O_3), and fluxes in clay bodies. As a result, we need to consider further how people in the region under study perceived their particular clay resources, passed on knowledge about the raw materials, and transformed them into cultural objects. We should also ask if and how the raw materials were modified to fit the interests of producers and users.

This inquiry about the use of clay resources forces us to understand the geological background of the study area. The relationships among the soil formation, its distribution, and sources of clay, however, involve complex weather and environmental factors that are beyond the scope of this discussion. Briefly, from modern geological and hydrological surveys, in the Chengdu Plain, where, in ancient times as today, surface soils were carried from the near mountains through the transportation of intertwining rivers, the main sources of raw materials for pottery were igneous rocks, weathered and metamorphosed to varying degrees. With this natural material, briefly mentioned in Chapter III-2.1, pottery manufacturing had been mastered and reached its peak no later than the late Neolithic Age, from the late third to the early second millennia BC. This is exemplified by ceramics from the early phases of the Baodun site and the

[96] They are, 1) low SiO_2, low Al_2O_3, and high fluxes; 2) low SiO_2, low Al_2O_3, and high MgO; 3) low SiO_2, high Al_2O_3, and low fluxes (this category is also known as kaolin); and 4) high SiO_2 and low fluxes (also known as chinastone).

first phase of the Sanxingdui site (Sun Hua 2000:50), both of which are part of early Baodun Culture (Sun and Chen 1999). According to the excavators (Chengdu et al. 2000:107), fine-textured pottery accounted for 60 to 65% of all ceramics in the first two phases of the Baodun period. Ceramic quality then 'downgraded' during the last phase of the Baodun site and roughly during the transition from the late Neolithic Age to the Bronze Age in the Sanxingdui site. To explain this change in quality, researchers tend to search for clues from possible social changes of the same period. Inquiries like this, however, need to be grounded in an understanding of production technologies and only then can other factors that might have influenced material expressions be advanced. It is therefore production technologies that constitute the theme of this chapter as the basis to promote more in-depth thinking.

For instance, the proportion of fine and coarse wares, which Chinese scholars have generally used as an index to suggest the level of production technology, can be a result of many factors, including available resources and manufacturing techniques, the intended function and use of the ceramics, and the nature of the sites, which can all play a role in affecting technological choices and the composition of vessel assemblages. For example, coarse wares, if properly tempered, are more heat resistant than fine wares and are therefore more suitable for cooking, whereas finer wares might predominantly have been used for serving and storage. In cases like this, technical preferences apparently have functional implications. Moreover, because coarse wares can be fired under lower temperatures and finished in a more speedy and economical manner than fine wares, a shortage of fuel, a scarcity of clay, or an urgent need for products could have caused ceramicists to prefer coarse wares. Both examples suggest little about technological levels, but rather attest to the fact that certain properties of the objects were adopted for utilitarian reasons. That said, the seeming 'downgrading' of ceramic quality is not

necessarily a regression in production techniques or social deterioration, but might be the result of technological choices, natural limitations, or economic considerations. Before reaching a conclusion, we need to take all of these factors into account and carefully examine the properties of the products that were produced. As a result, I avoid hastily connecting superficial ceramic features with specific technological levels of achievement, preferring instead to conduct detailed analyses from a variety of perspectives.

Since the discovery of Jinsha-Meiyuan (more details in Chapter III-3.2), scholars have proposed that the economic, political, and/or ritual centers had shifted from Sanxingdui to Jinsha after the decline of Sanxingdui. The process by which the population moved to this new settlement, however, remains a mystery. Though large buildings were uncovered from both the Shi'erqiao and Jinsha sites, surrounded by other sites or loci, the relations between these loci are pregnant with meaning. Also, because the material cultures of Sanxingdui, Shi'erqiao, and Jinsha share so much in common, particularly the continuity of some vessel types, I believe that examining craft production is an effective way to explore the uncertain relations among these settlements, whether they were successive political centers or actually featured different social divisions.

In this chapter, I compare in particular the same vessel types from different sites of the Chengdu Plain so as to see how this comparison might tell us about the differences in the organization of production among the settlements under study. The selection of data has been based on a long thought-provoking, but little understood, inquiry into the relationship between production organization and social organization. As their connection might not be direct or immediately visible, long-term observation from a various geographic range, from a single locus within a settlement to regional wide, is required. This inspection will help us to clarify how

production organization varied with settlements and through time and whether these variations and changes were related to a broader system change. Therefore, the comparison conducted is both synchronic, with multiple sites, and diachronic, subdivided into several time-slices. To compare sites and samples with a spatial and temporal control, the pottery samples drawn for analysis were limited to a few vessel types and focus was placed on the pointed-bottom vessels that prevailed in the Chengdu Plain during the early to middle Bronze Age.

2. Datasets—vessel types

2.1. Pointed-bottom saucers (*jiandi zhan*)

Among the artifacts found in abundance in Sanxingdui and that continued to be produced in early Shi'erqiao, jars with small, flat bases (*xiaopingdi guan*) were notably made in a standardized size. Although scholars have not systemically evaluated such standardization, potters must have shared an ideal type. Slightly later on, other vessel types, such as the pointed-bottom vessels briefly mentioned in my previous chapter, were also produced in a regular way and became a trademark of the Chengdu Plain that were also widely distributed in other regions. In particular, *jiandi zhan* and possible vessel stands for pointed-bottom vessels are the very few ceramics found in the Sanxingdui sacrifice pit K1 along with other precious goods made in other materials. Except for other piecemeal finds[97], the *jiandi zhan* found in the K1 appear to be the beginnings of a type of vessel that later came to prevail in the Sichuan Basin until the end of the Bronze Age. The increasing prevalence of *jiandi zhan,* as well as other types of pointed-bottom vessels, also denotes the coming of the Shi'erqiao period.

Scholars note that, during the Shi'erqiao period, pointed-bottom vessels were the most distinctive constituents of the pottery assemblage and can be used to trace cultural ties among social groups.

[97] Such as the Yufucun site (Chengdu 2001d:50).

The A group of *jiandi zhan* found in the Sanxingdui sacrificial pit (Figure IV-1) continued to be used in early Shi'erqiao (Figure IV-2). Nevertheless, unlike the *jiandi zhan* in the sacrificial pit in which the ceramics were most likely treated as ritual items, most *jiandi zhan* from the Shi'erqiao and later periods appear solely in graves or were scattered in pits as well as unfeatured strata. They were not found in a group. Since the Shi'erqiao, the uses for such vessels seem to have become even broader over time. Later in the Xinyicun phase (*ca.* 1000 BC), *jiandi zhan* even became routine burial goods.

The use of pointed-bottom vessels as grave goods was particularly conspicuous in the later period (i.e., the Warring States period after *ca.* 600 BC). However, because burials have dominated the archaeological findings from this period in the Chengdu Plain, we do not clearly know how the vessels were used in other contexts. It is only known that in many wealthy graves, such as the boat-coffins at the Shangyejie site in Chengdu City (5th century BC), a few pottery vessels are present along with bronze weapons and tools, lacquered wooden implements, and other precious goods (Chengdu 2009a:26, fig. 16:5). Other, probably contemporaneous, graves or cemeteries[98] also yielded *jiandi zhan* in a similar shape—those with straight openings and shallow bellies. The usual appearances of *jiandi zhan* from different periods are shown in Figure IV-3. Some have noted that the vessels that were prevalent in earlier periods, such as *xiaopingdi guan, jiandi bei*, and *jiandi guan* seem to have disappeared after the Xinyicun phase. The then lone pointed-bottom vessel type, *jiandi zhan*, also became less carefully made. The *jiandi zhan* found at Shangyejie were formed by coiling and smoothed by slowly rotating turntables in such a way that the clay strips can be clearly identified. This rougher way of making the vessels is

[98] E.g. Chengguan cemetery at Shifeng (Sichuan et al. 2006), Zhongyi Xueyuan (Chengdu 1992), Sandongqiao (Chengdu 1989), and Wuxiandian Jixie Gongye Xuexiao (Sichuan 1982) at Chengdu, and Wulong at Dayi (Sichuan and Dayi 1985). Among them, the pointed-bottom vessels found in Wulong, Dayi were piled up and covered on the top of other ceramic bowls. The excavators believe that they are vessel covers though they look like normal *jiandi zhan* (Sichuan and Dayi 1985:35).

perhaps because their functions had changed—they were only present as routine burial items and probably did not have practical uses. It is unclear whether other vessel types absent from such burials really disappeared during this period: few sites[99] have been found other than cemeteries. It is equally uncertain whether *jiandi zhan* bore some special meaning so that they continued to survive as burial goods.

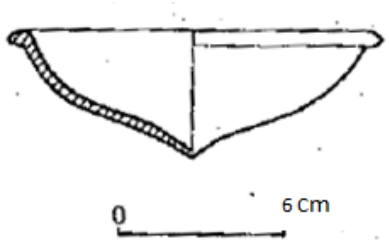


Figure IV-1: The "A type" *jiandi zhan* from Sanxingdui sacrifice pit K1 (K1:334) (Sichuan 1999:146, 148).

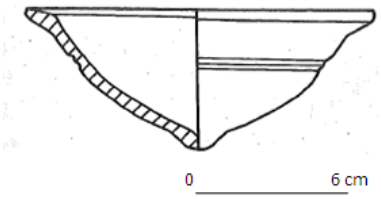


Figure IV-2: *Jiandi zhan* found in the Shi'erqiao site (IT2□:4) (Sichuan and Chengdu 2009:79).

[99] E.g., Shangwangjiaguai (Chengdu and Sichuan Daxue 1992) and Qingyanggong (Jiang and Lu 1959) in the Chengdu City. The *jiandi zhan* found in these sites are similar to those found in the cemeteries in note 98.

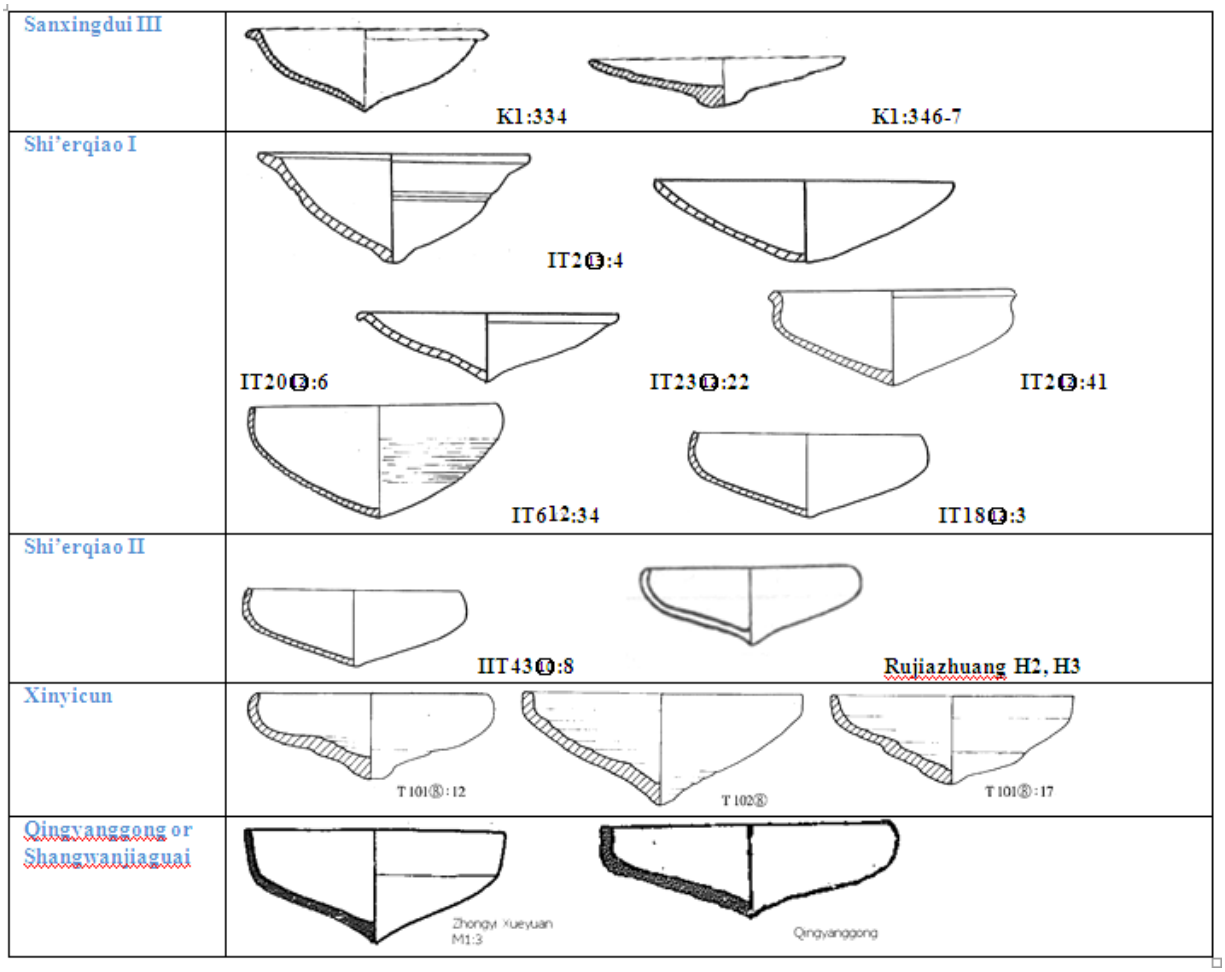


Figure IV-3: *Jiandi zhan* of different periods
(not to scale) (Sichuan 1999; Sun Hua 2000:84, 131; Chengdu 2004e:177; Sichuan and Chengdu 2009).
In the earlier period of the development of *jiandi zhan* (i.e., Shi'erqiao phase I), it seems that the vessels had not been standardized and were more diverse in the shape of their openings.

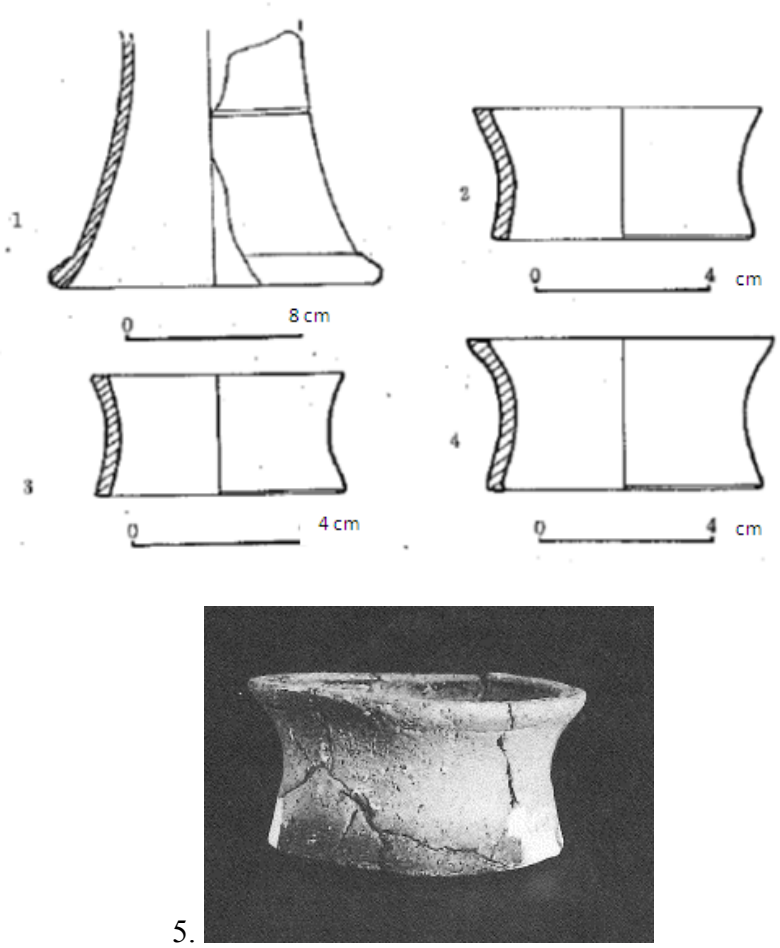


Figure IV-4: Ceramic vessel stands from Sanxingdui sacrifice pit K1 (1. K1: 38; 2. K1:125; 3. K1:325; 4-5. K1:50) (Sichuan 1999:151-2).

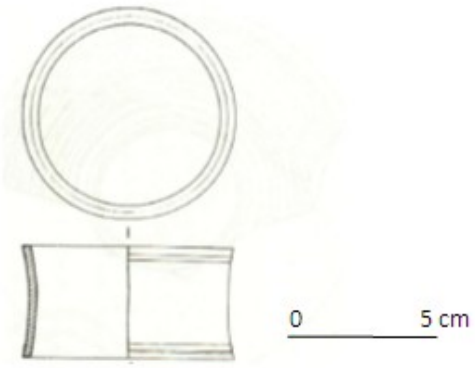


Figure IV-5: Tube-shaped object made in lithics from Jinsha-Meiyuan (C:172) (Chengdu 2004d:147, fig. 47:4).

Because pointed bottoms would have made it difficult to make these vessels stand on their bases, scholars have often speculated about their functions and their relationship to other vessels. Some have convincingly proposed that a type of waisted, tube-shaped ceramics (Figure IV-4) served as stands for pointed-bottom vessels because, according to past excavations, if tube-shaped ceramics are found in certain contexts, archaeologists can normally find pointed-bottom vessels, particularly *jiandi zhan*, nearby and the two types of vessels can be collocated in use. Items of similar shape have been recovered from eastern Sichuan[100] and the Upper Han River Basin[101] as well as the Chengdu Plain (Deng Boqing 1959:406, fig. 3:8; Wang and Sun 1992; Sichuan 1999:151-2; Chengdu and Xindu 2003:74, fig. 18:13; Sichuan and Chengdu 2009:107). However, although they have been widely discovered, these supposed stands are much fewer in number than pointed-bottom vessels. I suspect that one stand might have been shared by multiple *jiandi zhan* and thus such stands were less frequently produced. If this is true, then many *jiandi zhan* needed to be made in a restricted range of sizes so that they could be used with a single stand.

In some rare situations, "vessel stands" have been found without the companion of pointed-bottom vessels. In Sanxingdui-Cangbaobao 倉包包 and Jinsha-Meiyuan[102], for instance, items of a similar appearance to the pottery stands, but made of well polished jade (tremolite) with impressed lines, have been found (Figure IV-5) (Sichuan and Guanghan 1998:83; Chengdu and Beijing 2002-91; Chengdu 2004d). These sites, especially Jinsha-Meiyuan, have yielded many other precious items that scholars believe were used ritually. In Meiyuan, whereas other lithic ornaments and instruments do not show apparent signs of wear, the tube-shaped object seems to

[100] Such as Shaopengzui (III) (Sun Hua 2000:18).
[101] Such as Baimashi, Ziyang (Sun Bingjun 1994:382).
[102] Where the object is termed "*tongxing qi* 筒形器" (cylindrical object) or "*guxing qi* 箍形器" (hoop-shaped object). The ambiguous names show researchers' uncertainty about the function of the object.

have been moderately worn. However, no pointed-bottom vessel made in the same material was discovered in the same context and the real use of the tube-shaped object is uncertain. It is likely that, according to its precious material and careful treatment as well as the other accompanying remains, this tube-shaped object was still associated with ritualistic activities and had different meaning or significance from common vessel stands. Such "homo-morphic" items made in distinct materials are also reminiscent of the less frequently found bronze pointed-bottom boxes (*jiandi he*) and their *jiandi zhan*-like covers from Shangwangjiaguai phase[103] of the Chengdu Plain.

Besides the diverse and changing contexts in which they were used, the *jiandi zhan* shape, characterized by its rim, shoulder, and body depth, also seems to have been gradually transformed from Sanxingdui onward. Some scholars have noted that the rims of *jiandi zhan* changed from everted to inverted as their bodies became more and more shallow towards the end of the Bronze Age (Sun Hua 1996; 2000:110; Chengdu 2004e:208). Some have also searched the 'evolutionary trends' for other types of pointed-bottom vessels. Within these trends, they frequently claim that pointed-bottom vessels, particularly *jiandi zhan*, 'evolved' over time and can serve as time or seriation markers to determine the period of the stratum in which they were found (e.g., Song Zhimin 2005; Jiang Zhanghua 2010). For instance, Song Zhimin noted that, in the Jinsha site, the bottoms of *jiandi zhan* tend to be very rugged with redundant clays attached, making them impossible to stand. In his opinion (Song Zhimin 2005:29), this sketchy manufacturing fashion suggests that these vessels were produced in large batches and carelessly finished. The crude production also denotes the decline of the vessel type, according to him. Nevertheless, there are other possibilities worth considering. For example, it is possible that this

[103] For example, the burials in Mianzhu County (Wang Youpeng 1987) and Baihuatan, Chengdu (Sichuan 1976) (see section Chapter III 3.1.11).

difference in appearance is simply a normal variation as a result of discrete workshop traditions. It is also likely that this difference was a response to the different needs of their users or different occasions. For instance, an inverted opening may be good for retaining heat but not for pouring liquids. To clarify the possible reasons, further investigation is needed on the vessels' manufacturing processes and social contexts.

2.2. Pointed-bottom cups (*jiandi bei*) and pointed-bottom jars (*jiandi guan*)

Unlike the *jiandi zhan* that are first seen in the Sanxingdui sacrifice pit and are rarely absent in the following phases of the Bronze Age, *jiandi bei* and *jiandi guan* are believed to have originated from western Hubei and were introduced to the Chengdu Plain during the early Shi'erqiao period via the Three Gorges area, as discussed in the previous chapter (Sun Hua 2000:14; Jiang Zhanghua 2007:400). The pointed-bottom cups with protruding shoulders (*tujian bei*), or collared *jiandi bei*, discovered in the Jingnansi site can be dated back to a period much earlier than the deposits of the Sanxingdui sacrifice pits[104]. A similar type of cup also continued to be used in such areas as Xianglushi, in western Hubei (Wang Shancai 2001), and Zhen'an (type I), in between western Hubei and the Chengdu Plain (Beijing and Chongqing 2003) (Figure IV-6). Their counterparts in the Chengdu Plain, however, can only be found during the early Shi'erqiao period, such as Sanxingdui (phase IV) (Sichuan 1999:426), Shi'erqiao (type Aa) (Sichuan and Chengdu 2009) and Zhengyincun at Xindu (type I) (Chengdu and Xindu 2003). From the early Shi'erqiao on, different versions of *jiandi bei* became popular. They are taller and more slender (Figure IV-7, 2-4). Among these varieties, *jiandi bei* like no. 2 and 3 in the Figure IV-7, sometimes described as artillery-shell shaped, were most prevalent in the Chengdu Plain. Samples like no. 4 of Figure IV-7 are most often seen in the Three Gorges area during the

[104] Such cups and jars were found from the second phase of Jingnansi, which is contemporary with the early second-phase of Sanxingdui. On the other hand, the deposits of two sacrificial pits probably took place at the end of the third phase or the beginning of the fourth phase of Sanxingdui.

Shi'erqiao period and later. Though with different shapes, it is difficult, if not impossible, however, to offer a chronological sequence simply by their appearances[105], which could be a result of both temporal and spatial factors. Instead, because the divergence within the overall *jiandi bei* group is clear, I suggest considering different groups separately as different types for the current stage. Here, only the variety of Figure IV-7 no. 2 and 3 will be included in the data analyses. They might have functioned as dippers, as attested by one example (Sun Bingjun 1994:381). However, this may not be the only function of *jiandi bei*.

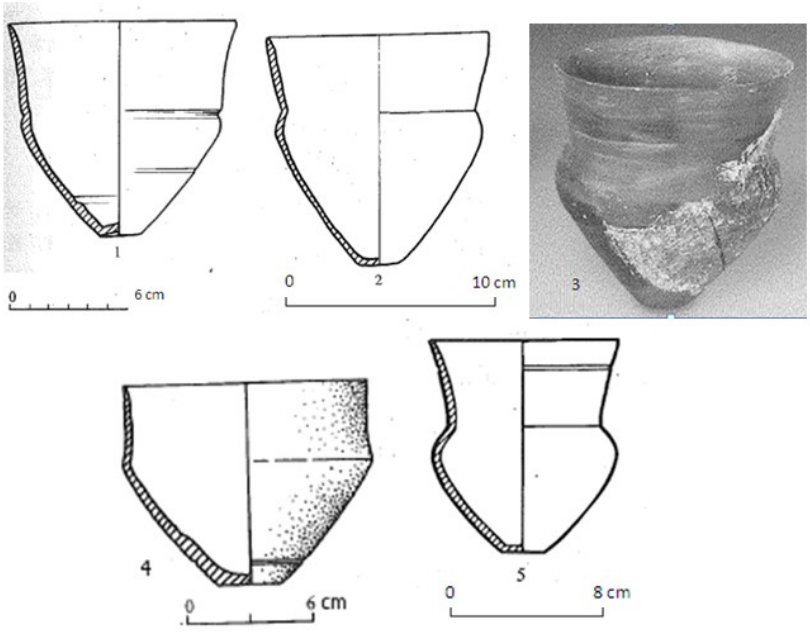


Figure IV-6: A comparison of collared *jiandi bei* from several places
1. Zhengyincun (H69:27) (Chengdu and Xindu 2003:69, fig. 15:1); 2. Shi'erqiao (IIT5013:6) (Sichuan and Chengdu 2009:73, fig. 49:2); 3. Xianglushi (rim dia.: 11cm, height: 11.5 cm); 4. Zhen'an, Fuling (H8:6) (Beijing and Chongqing 2003:863, fig. 9:6); 5. Jingnansi (H3:1) (Jinzhou 2009:128).

[105] An attempt has been made by Sun Hua and Zeng Xianlong (2006 [1999]:296, fig. 5).

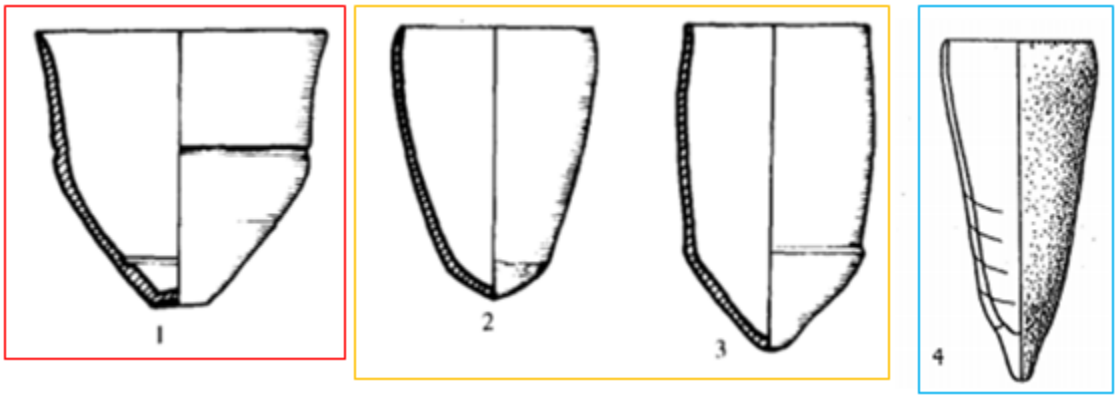


Figure IV-7: Different varieties of *jiandi bei*
from 1. Zhengyincun (H69:27); 2. Minjiang Xiaoqu (H14:8); 3. Jinsha-Lanyuan (H305:7); 4. horn-shaped, pointed-bottom cups (*jiaozhuang jiandibei*) from Shaopengzui (99ZGST115⑦:2) (Beijing et al. 2006:633) (not to scale).

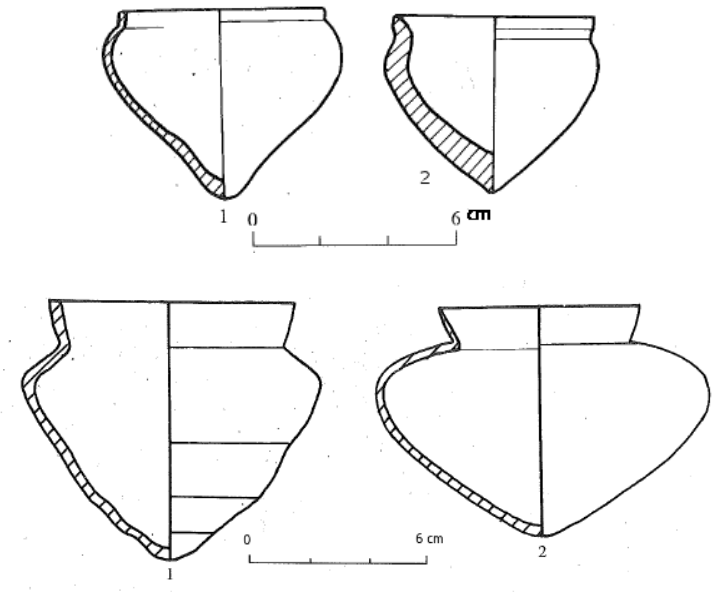


Figure IV-8: *Jiandi bei* and *jiandi guan* found in Shi'erqiao
Above: 1. I-collected:8; 2. IIT29㘝:108.
Below: 1. IIT30㘝:5; 2. IIT50㘝:14 (Sichuan and Chengdu 2009: 46, 77).

Although not every variety of so-called *jiandi bei* was taken for analysis, it is worth noting that pointed-bottom cups with protruding shoulders are similar to another type of pointed-bottom vessel, the *jiandi guan* (Figure IV-8 shows a subtype of the so-called *jiandi bei* [the top row] versus the typical *jiandi guan* [the bottom row] in the Shi'erqiao). If their bottoms are not very sharp, they also look similar to the *xiaopingdi guan* that prevailed during the Sanxingdui period,

as some scholars have noted (e.g., Song Zhimin 1998:44). The nomenclature is often confusing and not consistent among different excavation teams. Because so many varieties of pointed-bottom vessels appear in Shi'erqiao, we might conjecture that the site was a significant source for, or convergence of, pointed-bottom vessels. It is likely that the vessels had to be transformed, more or less, to meet local needs and to fulfill different tasks. This also suggests that our current vessel types are not necessarily as well divided as archaeologists might think.

In the excavators' view, vessels like Figure IV-8 top row are classified as *jiandi bei* but not *jiandi guan* largely because their clay matrix is as 'fine' as normal *jiandi bei* (Sichuan and Chengdu 2009:76). Clay matrix is certainly an important criterion in determining vessel's type. Nevertheless, we need to consider the fact that clay matrix *per se* might not be always clearly divided into the two categories, revealing only fine and coarse models, especially if solely based on macrographic analysis. Moreover, we should not stop at the inspection of the clay matrix without further inferring the underlying reasons why potters adopted specific materials. For instance, if we also look to how these vessels were used, *jiandi guan* from the Yu-state cemeteries in Baoji, Shaanxi from about the turn of the first millennium BC (Lu and Hu 1988) show us that this type of vessels can also be made for use as precious grave goods. Like their counterparts *jiandi zhan* in the Chengdu Plain, high-class graves in the Yu-state cemeteries usually contain a piece of *jiandi guan,* placed close to the head of the dead person, together with other bronzes. In these contexts, *jiandi guan* were carefully made as fine wares with polished surfaces. In some cases, such as the tomb no. 13 of Zhuyuangou, bronze versions of this vessel type are also present (Figure IV-9), accompanied by more than 200 bronze, jade, and bone articles (Lu and Hu 1988:48). The coexistence of pottery and bronze *jiandi guan,* along with other elaborate items, suggests that this vessel type probably had symbolic functions and features

and was used in ritualistic activities. In this sense, *jiandi guan* might be close to *jiandi zhan*, when they were used in the ritual or burial settings of the Chengdu Plain. On the other hand, both *jiandi guan* and *jiandi zhan* were discovered in the residential area of Rujiazhuang (Lu and Hu 1988:8-9). They were all finely-fabricated and made in the grey color.

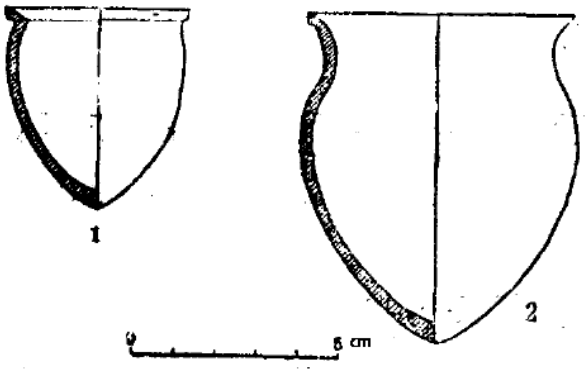


Figure IV-9: Bronze *jiandi guan* from Zhuyuangou, Baoji (1. BZM13:107; 2. BZM13:71) (Lu and Hu 1988:79, fig. 63).

Despite their similarities, I do not suggest that there was 'consanguinity' among *jiandi bei, jiandi guan, xiaopingdi guan*, and *jiandi zhan*, because their designs are fairly simple and they could have been fashioned for any number of ends. Their shape, for instance, could have been adjusted to meet certain tasks or user requests. It is also possible that while several vessel types coexist, they might have influenced each other, causing an 'interaction' across vessel types. Although the texture of the clay bodies can often be an effective indicator of different vessel types, this characteristic does not fully explain the relationships among these various vessel types. A further examination on the functions of vessels may provide useful information to justify the classification of pointed-bottom vessels into different types. Until undertaking such a task, I will continue to refer to *jiandi bei, jiandi zhan,* and *jiandi guan* by their most common features and shapes.

These pointed-bottom vessels appear to have been locally produced. In the Chengdu Plain, for instance, raw clays and production requirements were fairly accessible. While the plain has long been a place occupied by large populations, to have production workshops set close to the 'consumption market' would have greatly reduced transportation costs. This may be especially true for fragile items like ceramics. Furthermore, considering the spatial distribution of kilns in relation to residential areas, we can assume that pottery was produced on site and that the products found their most intensive use nearby. On the other hand, sites like Sanxingdui and Jinsha-Meiyuan are unusual for their ritualistic aspects. As extensive wealth and effort are often devoted to religious activities and items often accrue special meaning during such ceremonies, some attendees might have acquired rare and precious items or intangible knowledge from distance locations. When production knowledge is transmissible, the same types of objects could be produced in various places, using individual and local raw materials and with a concern for details. This is illustrated by the forked jade blades found in many regions of East Asia (Appendix III-Figure 12) (Deng Cong 1994; Chengdu 2006d:18).

If real objects are exchanged, foreign goods can possibly be identified from their non-local raw materials. A way to test this hypothesis is to examine how diverse or unusual the raw materials of certain vessel types are and how different workshops have fulfilled the manufacturing details. In addition, even though the final products were of similar appearances and sizes, the working processes and firing control on the raw clay might be different and so might be their uses. For example, whereas *jiandi zhan* are often made up of coarse wares, fine clays are occasionally exploited to produce vessels with similar appearances, as in the few cases in Jinsha-Lanyuan and Rujiazhuang in Shaanxi. In fact, white *jiandi zhan* made in a very fine texture are found in sites such as Sanxingdui and Xinyicun. It is uncertain whether these

specially treated vessels had different meanings or served different functions from coarse ones. As sources of white clays have not been thoroughly surveyed and documented in the region, it is difficult to locate the origins of the raw materials. However, the analyses undertaken here may provide some information about differences and similarities between these unusual items and the others in the way they were fabricated. Moreover, although we might not be able to ascertain the provenances of the vessels, a chemical element analysis should provide a basis for a broader understanding and comparison of individual clay properties.

The various properties of these vessels and their distributions suggest the production traditions and perhaps cultural ties or exchange relationships between them. It is also these vessels and their uses that provide a field for observing how production was organized and related to other social activities and how material things were given, altered, or removed of their social meanings.

3. Data analysis

The pottery vessels were analyzed in three stages. First, samples were drawn from roughly contemporaneous localities—the Sanxingdui [106], Shi'erqiao, and Jinsha site clusters that constituted the early-middle Sichuan Bronze Age—to identify representative and curious samples for further testing. Second, the degree of standardization for individual vessel types across sites was assessed to recognize potential workshops or working groups and to infer the underlying organization of production. Third, a series of tests on the physical and chemical properties of the samples was undertaken to compare manufacturing technologies and the use and reception of raw materials between sites. At this stage, ceramics sherds that were most likely

[106] Mostly from the third and fourth phases. From excavations in recent years, it has been shown that the settlement continued to be occupied for a longer period of time than previously thought, beyond the fourth phase until at least the flourishing period of Jinsha (personal conservation with Lei Yu 2011).

local products, like kiln wasters[107], were examined as control data. A number of non-pointed-bottom vessel types were also compared to see if there was detectable production division or difference among the vessel types. These different methods offer complementary perspectives, allowing us to understand the properties of the raw materials, the working processes, and the level of standardized among final products, which in turn can be a key to assessing the similarity in production technologies and organizations between settlements.

Besides synchronic comparisons, samples from different phases were obtained in order to examine how vessels, particularly pointed-bottom vessels, changed over time in the archaeological cultures of the Chengdu Plain. The TN05W03 pit of the Shi'erqiao-Xinyicun 2010-11 locus was used as a sample pit due to its diverse artifacts and comparatively clear strata. The ninth level of this locus is important: it is the missing level in the past excavation of Xinyicun[108] and its discovery bridges the Shi'erqiao and Xinyicun phases. However, because most ceramics from this sample level are fragmentary and nearly unrecoverable, it is impractical to measure the dimensions of the vessels. Instead, samples from this pit are mainly used in the tests of mineralogical and chemical compositions. The overall goal of these analyses is to investigate how ceramic products can be meaningfully characterized, diachronically or synchronically, and how production activities might have been organized within and across settlements.

[107] These are broken vessels found inside or in the vicinity of kilns in the archaeological investigation. According to ethnographic observations, these broken sherds normally serve as separators to avoid the direct influence of fire on pottery and sometimes produce the effect of a reducing atmosphere (see for example Sinopoli 1991:33). In some cases, kiln wasters have been used to help the identification of production locations (e.g., B. Stark 1985).

[108] In the past excavation, only a thin deposition of the ninth layer with very few remains has been discovered (Chengdu 2004e:174).

3.1. Physical features by visual examination and metric measurements

In earlier research, Costin and Hagstrum (1995) suggest a number of indicators, such as decoration, function, style, dimensional and color consistency, wall thickness, and firing control, as ways to evaluate the manufacturing technologies of pottery and to classify the production of specific ceramics into certain types of specialization. In a similar manner, the following is a series of observations on the appearances and physical features of the ceramic samples from which useful information about production techniques may be acquired.

3.1.1. Building/forming techniques

From my observation of substantial ceramic samples, including those seen in the field and in storehouses, it seems that many pointed-bottom vessels, especially *jiandi bei* from the Jinsha site cluster and *jiandi zhan* from Shi'erqiao-Xinyicun, were thrown vessels formed by using fast wheels (Rye 1981:74-80). Vessels produced this way are usually very thin (they can be less than 0.2 centimeter), symmetrical, even, and nearly consistent in thickness throughout the walls. Spiral patterns can often be found around the vessels' inner or outside surfaces, or both. As fast wheels can be an efficient way to produce standardized products, these vessels often have a regular-round shape and have similar rim dimensions. It is worth noting that the presence of costly and non-transient facilities, such as wheels and stationary kilns, reveals the scale and intensity of production. With these facilities, the production activities would have also become more fixed in certain locations.

Besides throwing, many pottery vessels were produced by coiling, followed by burnishing, scraping, or further shaping by using slowly rotating turntables (or slow wheels). In this way, fingerprints are occasionally found on the interior walls of some coarse wares despite the smoothing processes. Other vessels, such as jars with handles or ring feet, were made piece by

piece and assembled later. For example, a high-stemmed, mounted bowl with ring foot (*dou*) was made by combining the three parts—ring foot, stem, and tray or bowl. Because of this mode of assembly, these vessels' bodies have certain fragile faces and were often broken into pieces for this reason (e.g., Vandiver 1988:144). Consequently, ring feet, vessel bases, handles, vessel cover buttons, and the upper trays or cups are often found detached from each other in excavations. These individual parts also constitute the most frequently seen objects aside from unrecognizable fragments at the sites. As a result, we find that many mounted saucers or bowls were originally built to be pointed-bottomed like *jiandi zhan,* yet after breakdown, they bear joint traces on their lower bellies. The joint traces suggest that the vessel parts would have been attached to stemmed handles or ring feet to become *dou* or other similar vessels.

As observed in Chapter III-4.3.2, the upper bodies of ring-footed vessels often look like other frequently found vessels that have small bases or pointed bottoms, such as *xiaopingdi guan* or *jiandi guan*. For instance, in Shi'erqiao, the appearance of the upper part of a *dou* does resemble *jiandi zhan* (Figure IV-10) and its ring foot is like a vessel stand. A *dou* with a stem and ringed foot is in many ways like a fixed version of the combination of a *jiandi zhan* with a stand. In the middle Yangzi basins, beaker-like cups (*zunxingbei*) also resemble *jiandi bei* joined with ring feet; another popular transformation was to attach three feet to a round-bottom vessel to become a *li* tripod. These observations on how vessels were assembled not only suggest their forming techniques and the possible division of labor in pottery production, but also offer a sign of the functions or uses of these vessels. The co-variation of the upper part of *dou* and *jiandi zhan* also informs how different types of vessels might have transformed concurrently. Although the function of *jiandi zhan* is still obscure, the joint way of *dou* and the pointed bottoms of their upper trays, which were supposed to be invisible after assemblage, perhaps provide a clue. It is

possible that, like the probable functions of *dou*[109], *jiandi zhan* were used for serving food, at least on some occasions. When we examine their physical properties next, we can review this conjecture.

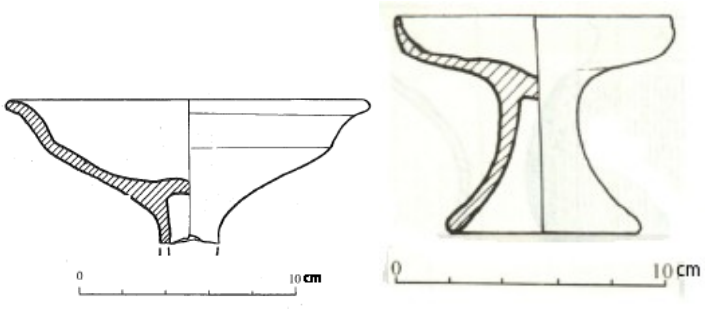


Figure IV-10: Mounted bowls (*dou*) from Shi'erqiao (left) and Xinyicun (right)
Left: IT15▫:43, stem missing (Sichuan and Chengdu 2009:95). Right: M1:62 (Chengdu 2004e: 204).
Their upper parts are similar to the then popular *jiandi zhan.*

3.1.2. Clay and tempering

As clay has different meanings in varied contexts[110], before discussing clay and temper, I hope to clarify several concepts relevant to this study. For pottery producers, "clay" is a soil substance dug out of the ground that may feature a combination of clay and non-clay minerals (e.g., quartz and feldspar), rock fragments, and organic matter (Pollard and Heron 2008:112). Chemically, although almost all clays are composed of alumina, silica, and water, their relative percentages can vary greatly. These variations also lead to different categories of clays (Rice 1987:40-50). "Temper", on the other hand, is a non-plastic material that is *deliberately* added to the clay by potters to enhance its workability. In this sense, temper can be sand, calcium carbonates, crushed rocks, organic matters, and grogs (fragments of other broken pottery) (Reedy 2008:146).

[109] Similar mounted bowls are believed to have been food-serving vessels in the Yellow River basins. According to *Zhou li* 周禮 (Tianguan: Hairen), one of the three ritual compendia about the Zhou Dynasty yet complied in the later time (4th and 3rd centuries BC), [bronze] *dou* were used to serve soy sauce pickles or meat sauce. Although it is questionable if their counterparts were used in the same way in other regions (their nomenclature seems to have implied so), the textures and shapes of the pottery *dou* discovered in Sichuan made them unsuitable for the tasks of cooking or storage.

[110] For example, it can refer to fine-grained earth (<0.002mm); a specific group of minerals; and rocks and soils that are mainly constituted by clay minerals (more thorough definitions given in Rice 1987:36-53).

The nature and workability of clays can be modified not only by adding tempering materials, but also by the uses of fluxes and colorants. Some matters (e.g., FeO and Fe_2O_3) may have multiple effects. For instance, when the non-plastic material content is high (e.g., if silica is over 60%), the plasticity of the clay becomes poor, making it less easy to shape. The non-plastic material, however, facilitates the drive-out of moisture from the clay body and helps to control shrinkage during drying and firing (Shepard 1956:25). For the same clay group, other factors, such as the sorting, shape, and particle size of the clay compositions and the atmospheric temperature, also cause difference in plasticity (Rice 1987:58). Furthermore, it is noted that while both clay minerals and impurities may contribute to the volume of silica, the source of alumina in ceramics mainly comes from the clay minerals themselves, but not from other inclusions. If the alumina is relatively high (i.e., over 20%), the clay will be refractory, unless fluxes are added, because the fusing point of alumina is over 2,000 degrees Celsius. Table IV-1 shows the properties and functions of some common chemical matters derived from clay minerals and other inclusions. Nonetheless, as Rice (1987:53) stresses, it is not the compositions, themselves, but the properties they confer that are of interest.

On the one hand, it seems that with a limited ability to modify available clays, potters were largely constrained by the natural properties of clay soils in the very early period. Pamela Vandiver (1988) has argued that the nature of clays greatly influenced the construction methods of pottery vessels in Neolithic times. For instance, unlike the clays of the Near East, the clays of China are less plastic and only have a minor degree of shrinkage during drying. Ancient Chinese potters thus tended to construct vessels by way of coiling because this was a better manner for them to shape the clays. This speculation only explains situations in which potters had limited

knowledge and technological choices, though. Nonetheless, it suggests how the nature of the environment played a role, if not the determining role, in influencing technological developments.

It should also be noted that though the choices of these materials are constrained by natural conditions and the intended functions of products, there are ceramics not fitting our sense of optimum utility that were made in the ways largely following cultural practices (e.g., Rice 1987:116; Tite 1999). For instance, although coarse wares that were elaborately decorated or painted were not economically feasible, we sometimes nonetheless find such products in archaeological contexts. To explain these 'anomalies', both practical and ideological factors need to be taken into account.

SiO_2	The plasticity decreases when the volume increases.
Al_2O_3	When abundant, clays become refractory and hard to fuse.
K_2O, Na_2O, CaO, MgO	Flux: may lower the fusing point of the clay and help decrease the finishing temperature. If containing too much flux, the clay body will be subject to deformation.
FeO, Fe_2O_3, MnO, TiO_2	Colorants: the color will become darker when the quantity content increases. FeO and Fe_2O_3 can serve as flux as well.

Table IV-1: Compositions commonly found in ceramics and their functions (Li Wenjie 1996:329; Chen Tiemei 2008-56).

Through studying ethnographic cases, Dean Arnold (1985:38, 52; 1991:338) suggests that potters devoted different energies to the acquisition of the different materials needed to produce pottery. For instance, whereas people sometimes traded slip and mineral pigments over hundreds of kilometers from their place of provenience, potters tended to find affordable sources of clays and tempers close to their residential or working areas. Arnold found that in about 85% of the cases, potters exploited clays and tempers in a range not beyond seven kilometers from their living spaces. Such territories can be thought of as the "catchment" areas for clay and temper sources. However, as noted above, many factors, such as clay color, other than distance, might affect the selection of 'suitable' sources. In such a situation, potters would rather go farther afield

for ideal clay sources, and ideologically favorable clay sources may become sacred and access to them was limited. It is noted by anthropologists (see Rice 1987:115 for example) that the process of procuring clays *per se* was part ritual. Briefly, the adoption of clay and temper in making pottery vessels was affected not only by the environmental and technological factors, but also by the economic, political, cultural, and ideological conditions. These are also the "situational factors" that may influence the preference of primary materials, according to Tite (1999:213).

In my study sites, it has been generally found that *jiandi bei* were made as fine wares whereas *jiandi zhan* and *jiandi guan* were coarser with visible inclusions in their cross-sections and even in their surfaces. For example, in the material from the 2010-11 excavation at the Xinyicun site, pointed-bottom vessels contribute about 2% of the total weight of the ceramic samples[111]. Among these pointed-bottom vessels, all *jiandi bei*[112] were fine wares, and more than 99.8% of *jiandi zhan*[113] and 100% of *jiandi guan*[114] were coarse wares. Although this is not a strict rule and there are sometimes confusing cases in which the vessels' shapes do not correspond to the expected categories of clay matrices or the vessels cannot be characterized into single types simply by their appearances, clay types and vessel shapes are still highly allied. In other words, clay matrices and their tactile qualities remain a working principle for suggesting vessel types. The difference existing in the proportions of clays to non-plastic inclusions reveals potters' different reception and selective use of raw clays for different vessel types. The associations between certain types of clays and vessel types may also suggest their divergent functions, such as cooking and serving, given the known relationship between the clay-temper recipes and vessel strength (i.e., thermal shock resistance). As many scholars have noted (e.g.,

[111] Including *jiandi zhan*, *jiandi bei*, *jiandi guan*, small, basinwide-mouthed jar with pointed bottoms (*jiandi yu* 尖底盂), and those vessels that were of pointed bottoms but attached with ring feet.
[112] 441 pieces of sherd, weighing to 3006 g.
[113] 1020 pieces of sherd, weighing to 18930.5 g.
[114] 50 pieces of sherd, weighing to 708 g.

Bronitsky 1989; Feathers 1989; Kilikoglou et al. 1995), ancient potters might have acquired this kind of knowledge through trial and error. For instance, the addition of tempers, their kinds, volume, morphology, and proportion are believed to be crucial in heating activities. Whereas vessel forms and clay matrices appear to have certain associations in our case, to examine the physical properties and microstructure of pots should offer extra information to clarify such associations. Further details will be discussed in the mineralogical section.

3.1.3. Color

The color of pottery is determined by various factors, most importantly the compositions of clays, surface treatments, and firing conditions. The compositions can in turn be affected by the amount, distribution, and state of impurities (e.g., iron and organic matters) in raw clays (Bishop et al. 1982:277; Rice 1987:333-336). For example, the presence of iron in clays, if fully oxidized during firing (i.e., becoming hematite [Fe_2O_3]), will cause to a reddish or brownish color. The same combination of oxygen and iron may, however, form a different chemical state of the iron, magnetite (Fe_3O_4), and make the pottery become dark or black. Similarly, the hue would change from yellow to red depending on the degree limonite is dehydrated to hematite (Rice 1987:333, 335). The burning of the organic matters included in clays, on the other hand, may cause the pots to become dark or black, depending on how much residual carbonaceous material is not burnt out of the clay matrix. Other elements such as feldspar, which is very common in soils and often serves as natural flux, can also influence the color of pottery during firing.

Moreover, vessels' colors are determined not only by the composition, but also by the firing processes, including the maximum temperature, duration, and atmosphere (Rice 1987:80), which in turn are related to the structure of firing devices and associated controlling techniques. For example, although oxidizing atmospheres are known to be responsible for a brownish color and

reducing atmospheres for a grayish color, the atmospheres actually alternate at the various stages of the firing process. This atmosphere change may be especially frequent when open-air or bonfire firings are employed or when kiln structures are simple, in which the temperature fluctuates more frequently (Rice 1987:81; Sasaki Mikio 2000:186). There must have been a long trial-and-error process in the history of pottery production. Because the control of color is both a cultural and technical issue, it is important to take it into consideration in order to make inferences about manufacturing technologies and the cultural dimensions that might influence them. For example, reducing atmospheres, in which oxygen is cut off, are not exclusive to kiln firing. The atmospheres can be achieved by controlling the fuel supply in open firing or bonfires too (Shepard 1956:217). In most situations, bonfires are a more accessible and economical option. However, because kiln firing offers a more stable and sustainable environment for preferred atmospheres and temperature (Varndell and Freestone 1997) and thus helps to achieve the intended colors, it is favored over open fires when the quality and color of pots are considered crucial.

As a series of oxidizing and reducing atmospheres take turns during firing (Tite 1999:217; Sasaki Mikio 2000), a gradation of color change may appear from the core to the surfaces of a pot. For instance, Owen Rye (1981:116; see also Orton et al. 1993:134) deduced from the observations of pottery cross-sections that if vessels are cooled down and refired a couple of times, this may result in double cores and several layers or gradations of colors between the cores and surfaces. In this fashion, the speed of cooling also matters: rapid cooling is responsible for sharp core margins while slow cooling produces diffuse margins. Rice (1987:345) has also generalized the relations between the range of variations in color and firing conditions. For instance, when the ceramic core and surfaces are all in light grey, this probably indicates an

incompletely oxidized or reducing firing, and if the surfaces are in dark grey or black, the sample may have been smudged. Because different firing conditions can sometimes lead to similar effects, to refire the samples is a method to clarify the firing technologies.

With our studied ceramics, it seems that different vessel types, sites, and periods all have their favored colors. Here I use the *Munsell Soil Color Book* and the descriptions of ceramic color in related archaeological reports to record and assess the color of samples. It has been noted that the Jinsha site cluster has tended to yield yellowish-grey wares whereas most sherds from the 2010-11 Xinyicun site have black surfaces. Upon closer inspection, I often find sherds with a light grey color in the core surrounded by a red-brown clay matrix (for example, Figure IV-11). This is probably due to the abundance of iron in the clays and because the pots were fired in incomplete oxidation. In addition, organics might be present that produced the grey core. Another group of coarse wares in Xinyicun have red to brown cores with or without black coating, perhaps indicating oxidization followed by reducing atmospheres. The dark to black color underneath the surfaces is possibly the result of the remnant of carbonaceous material from organic matters that were not completely removed during firing. To assess whether the organic matter has been completely oxidized and removed and whether the color of iron has been well developed requires refiring and further tests on the chemical states of the samples.



Figure IV-11: The cross section of a sherd from Shi'erqiao-Xinyicun (2010-11 locus)

Furthermore, it has also been noted that in some samples from the 2010-11 Xinyicun site, dense carbon is deposited on the surfaces causing a smudging effect. Such permanently darkened surfaces can usually be achieved by covering a layer with an organic substance, such as sawdust or rice chaff, after the pots have been fired to their maximum heat (Shepard 1956:88; Schiffer et al. 1994; Li Wenjie 1996:143-48; Longacre et al. 2000). For instance, Li Wenjie (1996) observes that rice chaff was widely used as tempers in the pottery of the Daxi Culture in the Middle Yangzi. He further speculates that such material was also likely to be employed as fuel that produced smoke and isolated pot surfaces from oxygen. Surfaces treated in this way can be very lustrous and of an almost metallic shine, which might have been appreciated by ancient people. An observation in the Philippines has suggested such an example in which people favor smudged pottery (Longacre et al. 2000). Smudged pottery also performs better in water permeability because the pores of the vessel walls are filled with carbonaceous matters. Another benefit is that such vessels may have higher abrasion resistance than slipped or polished vessels (see also Skibo et al. 1997:311). Other surface treatments I have found in my studied samples include the

application of mud water on the vessel surfaces to cause black or yellowish-gray slips or burnish effects on both sides. In the case of slipping, layers of 'crusts' can usually be observed from the cross sections. However, burnishing or painting may sometimes produce a similar complexion. Further comparisons in compositions between the clay body and surfaces would be helpful to distinguish between burnishing, slipping, and painting.

It should be stressed that although this discussion of ceramic color may concentrate on technological and material conditions, especially the nature of the clay and the control of firing, preference for certain colors can be derived from aesthetic and psychological reasons. These cultural inclinations can in turn affect technological choices in an active manner instead of simply being constrained by given conditions. Ritual and other visual-effect requirements, for instance, can confine the choices of color, which would then influence the recognition and adoption of 'appropriate' raw materials and technologies. Pottery color can therefore be approached from different angles. In addition, other factors such as the use (e.g., washing and deposition of carbon or soot during cooking) and post-depositional environments (e.g., leaching of soil water and alteration or deposition of other minerals or organic matters in the soil) may to a certain degree affect the original color of pots (Shepard 1956:103; see also Giardino et al. 1998:477). Before inferring manufacturing technologies and the properties of raw material from pottery color, we need to take these factors into consideration. If aided by analyses of chemical compositions of the pottery and the surrounding soil, we might be able to clarify the roles of these different factors.

3.1.4. Measures of dimension, performance characteristics

At this stage, I measured identifiable vessels by their outward forms. The measures include the shape and dimensions that describe the features of a vessel as comprehensively as possible.

Characteristics like these can be critical for inferring the functions of pottery vessels such as their use in boiling, cooking, serving, food preparation, and storage, because the required or desired performance characteristics would have confined the design of vessels (D. Miller 1985:51; Skibo et al. 1997; Schiffer 2011:26). That is, while the forming of ceramics was unavoidably constrained by raw materials and technological conditions, demands and feedbacks from users, customers, or consumers also played a role in determining the design of wares. Users' considerations may involve whether the vessels can be easily stabilized, handled and lifted up; whether they are efficient in raising and retaining heat or in cooling; and whether their contents can be smoothly added, manipulated, and removed (Skibo et al. 1997; Tite 1999:211; Schiffer 2011:27). These performance characteristics finally are translated into utility, permeability, strength, toughness, thermal shock, spalling resistance, and so on in terms of physical properties of the vessels when they are brought under study even though ancient potters did not use the same descriptive language. Sometimes, the 'function' may not be very practical or immediately understood. For example, in some cases, certain visual and acoustic effects are demanded by users who might then customize the material of the clay body and surface treatment (e.g., Longacre et al. 2000:274). It is also very likely that surface treatments or decorations in highly visible places versus those that are less visible might signal different functions or have different communication targets (Wobst 1977; David et al. 1988).

Here, for samples of pointed-bottom vessels, (1) the rim radius and the maximum circumferences (if not same with the rim radius), (2) maximum height, (3) inner depth, (4) the length from rim to neck or shoulder, and (5) wall thickness are measured (Figure IV-13). These measurements have been carried out on the vessels from some loci of the Jinsha site cluster. Comparative data from Sanxingdui, Shi'erqiao, and Xinyicun, as well as several other loci of

Jinsha from which real objects are not accessible, are supplemented by excavation reports. To make vessels of different sizes comparable, the ratio of a pair of measurements (e.g., rim radius vs. height) is calculated too. As some scholars have argued, the selection of variables aims to discover the inner order or structure of the data but not to impose researchers' own order (Whallon 1982:127). After checking volumes of data, I suggest that while the vessel shape and size seem generally regular within one locus, the rim shape is comparatively sensitive to spatial or temporal change and can be relevant to a vessel's function. Its change, indeed, has been treated as a time marker by some scholars. The height of pointed-bottom vessels is also assumed to be relevant because it has largely determined the volume of the vessels given the other measurements are less changeable. The variation of volume may contain information about the function of the vessels, which is another dimension deserving further consideration. I found that a large part of the vessels have extra lumps at the bottom, whereas the remaining part tends to be flat, even though very small and unstable (Figure IV-12). The different shapes of the bottoms that would have influenced the vessel height seem to have been made on purpose during forming for unknown reasons and might be culturally meaningful. Also, because the measurements of the rim diameter and the height of recoverable pots have nearly become routine in today's archaeological work and yielded relatively consistent data, these two vessel dimensions were therefore specially chosen to test their variations and differences among sites and periods. The resulting datasets are listed as Appendix IV-Table 1 in chronological order.

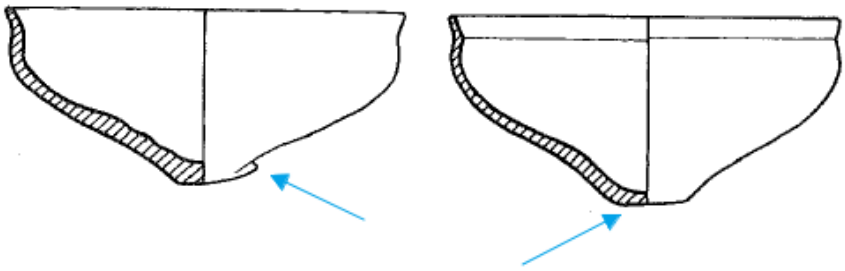


Figure IV-12: Different finishing styles of pointed bottoms (both from Jinsha-Lanyuan).

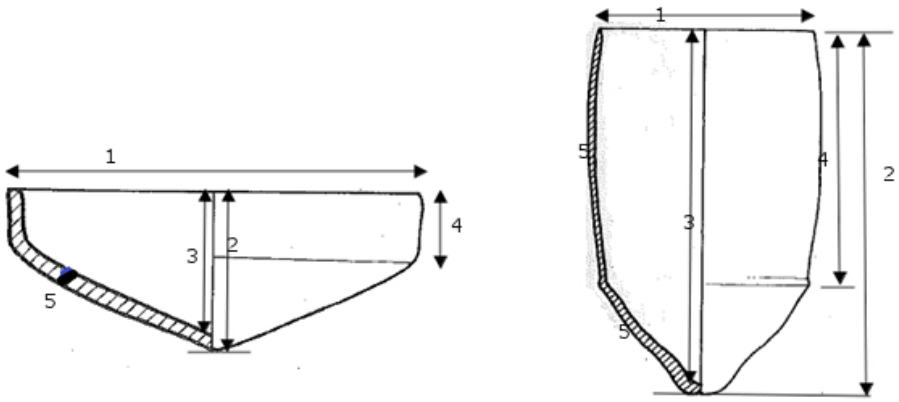


Figure IV-13: Measurements made on pointed-bottom vessels

A. Scatterplots

The measurements were then used for comparing, grouping, testing the degree of standardization, and inspecting change of style over time. For example, *jiandi zhan* from the Sanxingdui sacrificial pit K1can be divided into two sub-groups by their rim radius and height (Figure IV-14). From the scatter plots and also from the means and standard deviations, it is found that *jiandi zhan* from Sanxingdui are comparatively concentrated on two sets of values in both rim radius and vessel height by which the two concentrations can be seen clearly. This division suggests that we should consider two groups separately before applying statistics to compare the inner and cross group variance. The average rim radius of Sanxingdui-A group (6.53 cm) is,

indeed, very close to that of Shi'erqiao (6.52 cm for level 12-13) and the several Jinsha loci (6.70 cm for Meiyuan, for example), suggesting the "A group" is more comparable to other datasets in this case than the "B group." From Figure IV-15, samples from other periods clearly cluster together with the "A group." The "B group" seems to have disappeared in the subsequent periods, on the other hand. Another possibility is that excavators no longer treated this exceptional type of vessels as *jiandi zhan* but categorized them as a different type, possibly vessel covers. In either case, the concentrations of Sanxingdui *jiandi zhan* do demonstrate that rim radius and height are strongly controlled during the production of the vessels. The two variables are very likely to be culturally meaningful and are suitable for suggesting vessel types. Beside Figure IV-15 that compares data distributions for different periods of time, Figure IV-16-Figure IV-19 illustrates the datasets inside the Shi'erqiao and Jinsha site clusters chronologically. Comparing Figure IV-17and Figure IV-19, both the mean rim dimension and mean height of Shi'erqiao samples vary more greatly over time. In Shi'erqiao, whereas the samples from Early Western Zhou are more concentrated, those from Late Western Zhou tend to be larger in size (Figure IV-16). The two variables, height and rim radius, seem to co-vary in this case. On the other hand, Jinsha samples do not change their sizes significantly over time. The magnitude of change in height, however, is greater than that in rim dimension such that when vessels became shorter from the Shang-Zhou period to the Early Western Zhou period, their rim dimension only change imperceptibly (Figure IV-20). Whether these changes are significant are further tested in the ANOVA section. In the following, I also test how the dimensions (represented by rim radius and vessel height) of the samples have varied over space and with contexts.

Figure IV-21 shows data distributions during each slice of time. Although loci other than Sanxingdui do not show apparent multi-modes, the graphs suggest some possible clustering

phenomena and outliers.[115] For instance, though overlapping each other, datasets from Shi'erqiao and Jinsha site clusters show distinct tendencies during both the Shang-Zhou and Early Western Zhou periods. The Shi'erqiao samples seem to in smaller sizes. Applying K-means cluster analysis (where k=2) for each period, it shows that samples from Jinsha-Boyatingyun all cluster in one group and Shi'erqiao (including Minjing Xiaoqu) largely in the other. Samples from other loci are mostly distributed across the two groups (Table IV-3 shows a result of k-means analysis, with time = Shang-Zhou, for instance). When time = Early Western Zhou, both Figure IV-21 and the result of k-means analysis suggest that all Shi'erqiao samples cluster in one group whereas Jinsha samples cross two groups. Different loci of Jinsha seem to have their individual clustering patterns. For instance, during the Shang-Zhou period (Table IV-3), nearly all samples from Jinsha-Boyatingyun belong to group 2. During the early Western Zhou period (Table IV-4), all samples from Huangzhong Road Line A and B and from Boyatingyun cluster together with those from Shi'erqiao, contrasting with the group constituted by Xinghe samples.

To further clarify the data distributional pattern inside Jinsha, we tested the Jinsha loci exclusively. During the Shang-Zhou period (Figure IV-22), no subgroup can be affirmed. If subgroups do exist, that means all loci yielded products with two or more subtypes. During the early Western Zhou period (Figure IV-23), samples can be divided into two group more clearly at vessel height = 5.20 cm, in which Xinghe and Huangzhongcun[116] belong to group 1; and Boyatingyun and Huangzhong Road Line A and B belong to group 2. This clear separation suggests that the vessel height from the Jinsha site cluster is bimodal. Potters of some loci tended

[115] Some loci, such as Jinsha-Huanagzhong Road-- A and B lines (Chengdu 2004b; 2005a), yielded *jiandi zhan* of more diverse shapes and sizes. The sample numbers, however, are too small to suggest evident modes and thus the *jiandi zhan* from these loci were still taken as a whole without further subdivision. Outliers that are abnormal in not only sizes but also other features were removed in these cases.

[116] Huangzhongcun has one sample located in a different group (2). This sample will be excluded in the computation of *Coefficients of Variation*.

to produced higher *jiandi zhan* (group 1) while those of some other loci tended to produce shorter ones (group 2). Among them, all of the Boyatingyun samples come from tombs whereas other samples are mostly from archaeologically deposited ash pits or the testing pits that were created during excavations.

To examine how this separation is related to contexts, I compare the data distributions in different contexts. It seems that samples from the Shang-Zhou period (Figure IV-24-above) do not show difference in the several contexts. However, during the Early Western Zhou period, samples from testing pits and tombs tend to small in size (Figure IV-24-below).

The measurements from different sites and periods along with their *Coefficients of Variation* (*CVs*)[117] are summarized in the Table IV-6. Next, I focus on whether vessel sizes are more standardized and thus have smaller variability in some loci than others and whether time, in addition to location, affected the variability. It is also relevant to determine whether the differently distributed vessel sizes across loci and time phases were due to different production customs or organizational ways, or whether this was simply a result of random variation.

[117] *Coefficients of Variation* (*CV*), which is calculated by $cv = \frac{\text{Std.} \times 100}{\text{Mean}}$ (%), is often used as a measure to evaluate the degree of standardization in a group of samples (e.g.,, Longacre et al. 1988; Costin and Hagstrum 1995). Eerkens and Bettinger (2001:493-4) measure the highest degree of standardization that humans can achieve without any aid of instruments versus the lowest degree when production is random and no standardization is attempted. They translate these upper and lower bounds into *CV* and find this coefficient reliable to compare between different categories of artifacts.

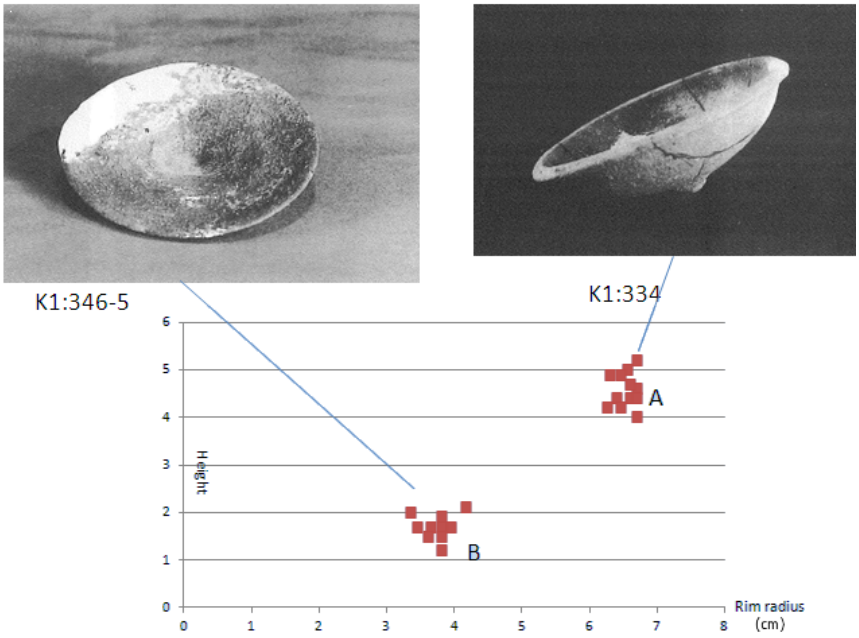


Figure IV-14: Two groups of *jiandi zhan* in the Sanxingdui sacrificial pit K1, separated by rim radius versus vessel height

	Site	Number of Samples	Mean (cm)	Std. Deviation	Coefficient of Variation
Rim_radius	Sanxingdui A	12	6.53	0.16	2.5%
	Sanxingdui B	10	3.74	0.23	6.1%

	Site	Number of Samples	Mean(cm)	Std. Deviation	Coefficient of Variation
height	Sanxingdui A	12	4.58	0.37	8.1%
	Sanxingdui B	10	1.70	0.26	15.4%

Table IV-2: Descriptive statistics of the A and B groups of Sanxingdui *jiandi zhan* in Figure IV-14

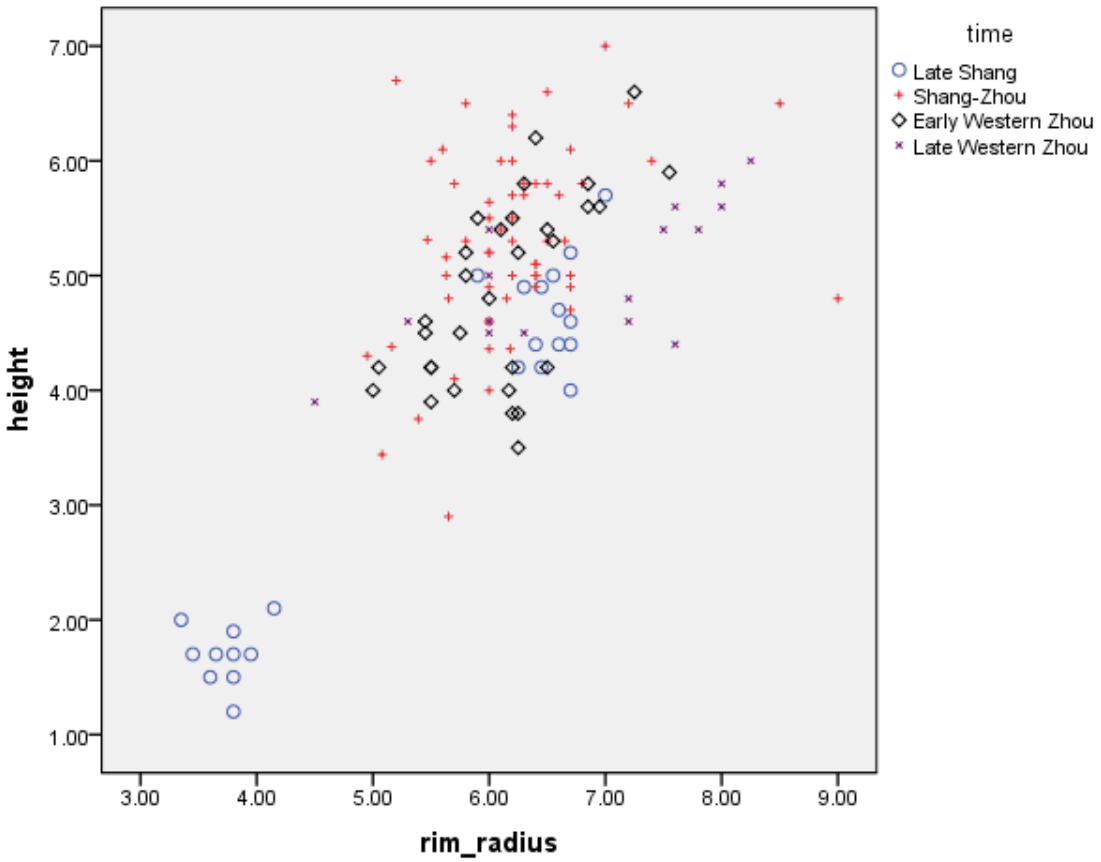


Figure IV-15: Mixing samples from all locations of the Chengdu Plain, marked by periods of time

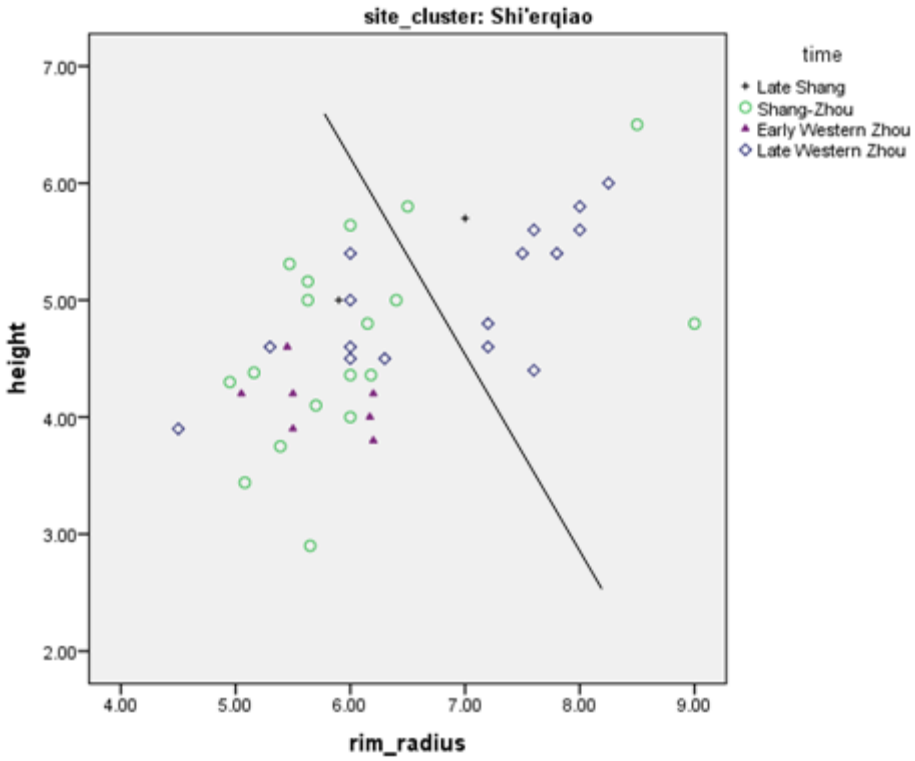


Figure IV-16: Samples from the Shi'erqiao site cluster, marked by periods of time A line shows a potential clustering from k-means analysis (k=2).

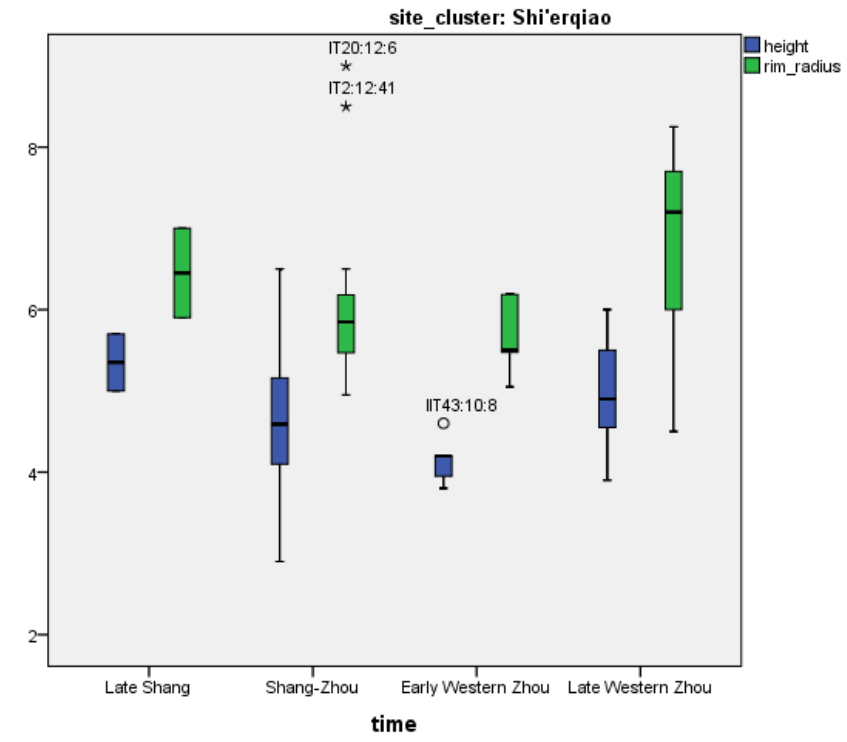


Figure IV-17: Boxplots of rim radius and height changing over time (samples from the Shi'erqiao site cluster).

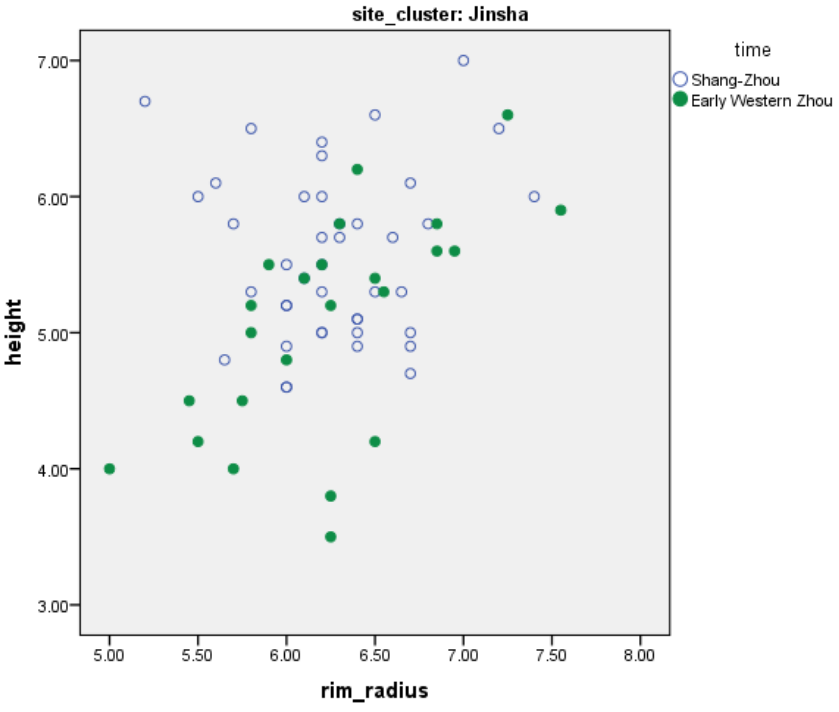


Figure IV-18: Samples from the Jinsha site cluster, marked by periods of time

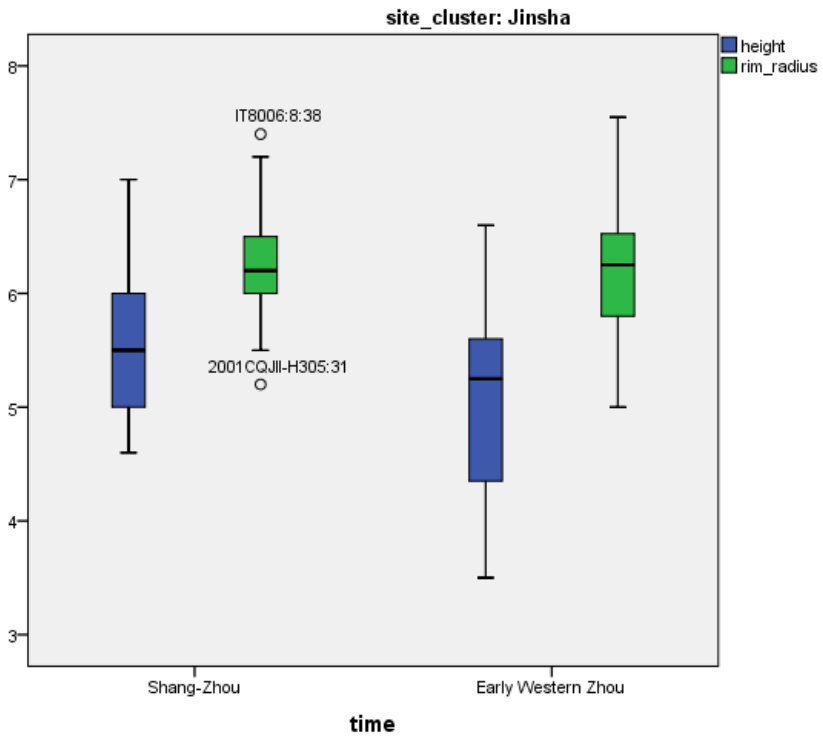


Figure IV-19: Boxplots of rim radius and height changing over time (samples from the Jinsha site cluster).

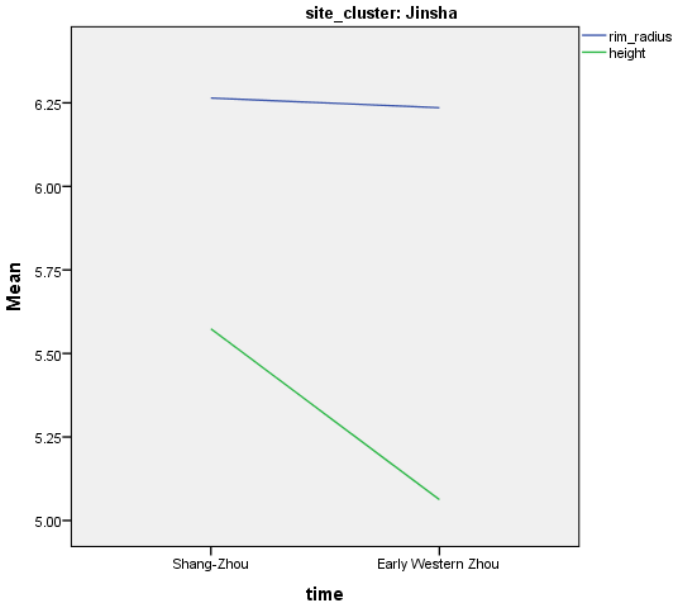
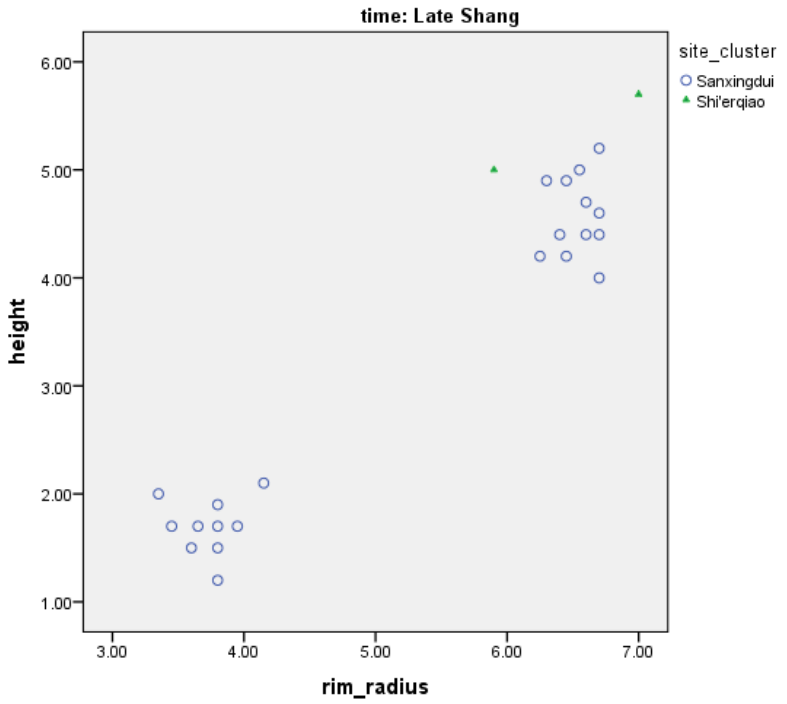
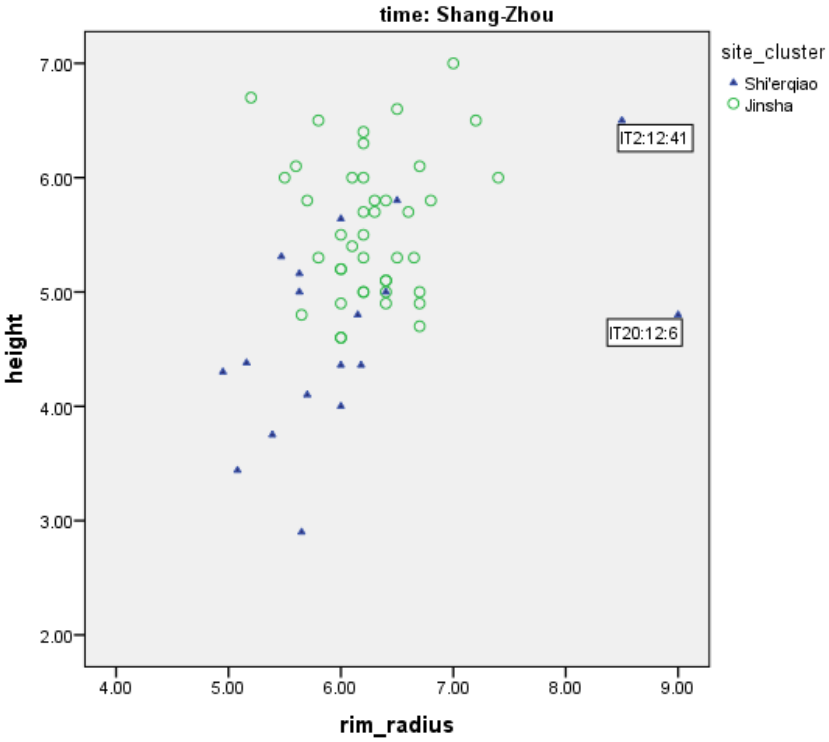


Figure IV-20: Mean values of radius and height changing over time (from the Jinsha site cluster).


time: Late Shang
site_cluster
Sanxingdui
Shi'erqiao
height
rim_radius
6.00
5.00
4.00
3.00
2.00
1.00
3.00
4.00
5.00
6.00
7.00


time: Shang-Zhou
site_cluster
Shi'erqiao
Jinsha
IT2:12:41
IT20:12:6
height
rim_radius
7.00
6.00
5.00
4.00
3.00
2.00
4.00
5.00
6.00
7.00
8.00
9.00

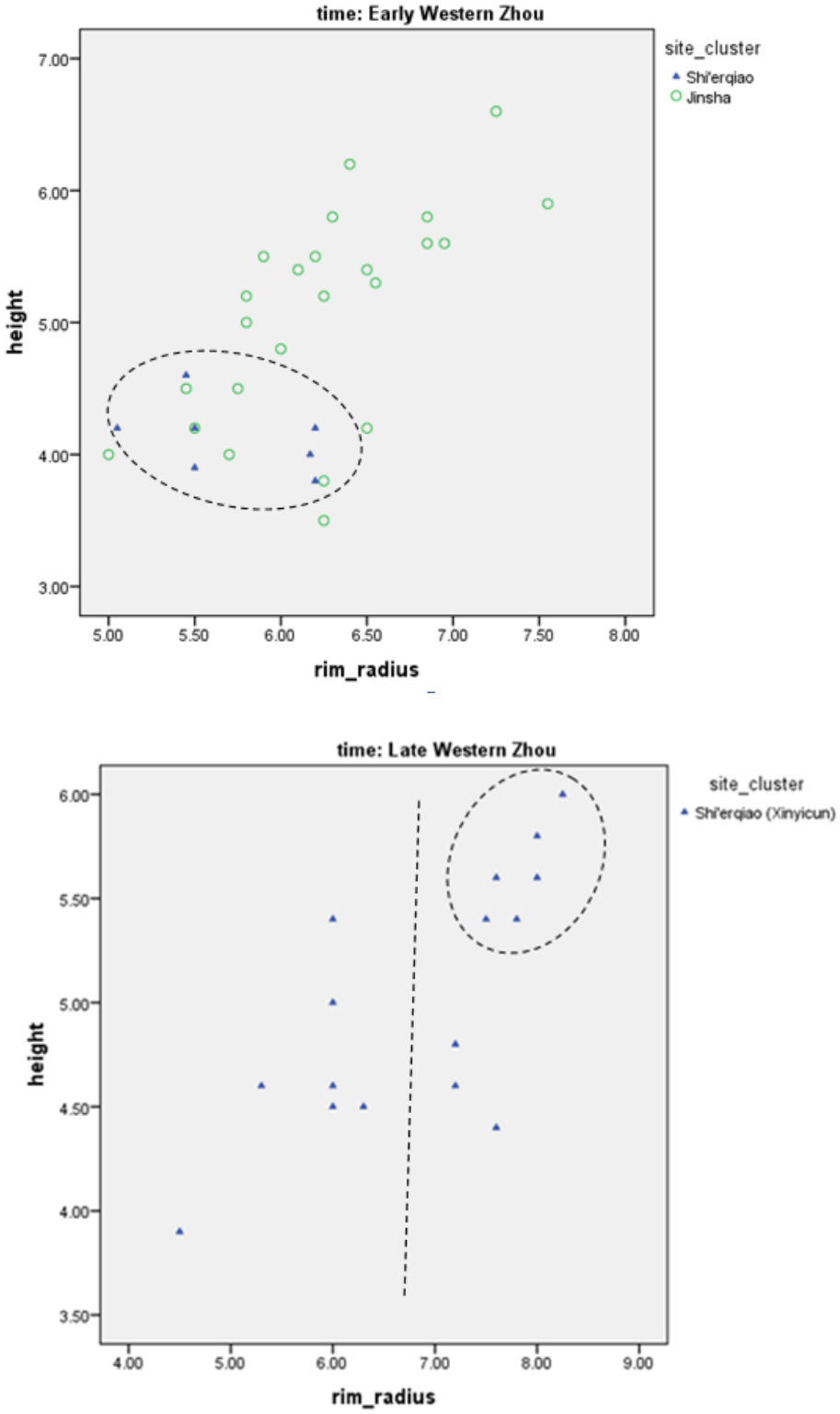


Figure IV-21: The distributions of *jiandi zhan* against rim radius and height in different periods Showing some 'outliers' and clustering phenomena, marked by site clusters (unit: cm)

Cluster Membership (time = Shang-Zhou)

Case Number	locus	Cluster	Distance
25	Shi'erqiao	1	1.821
26	Shi'erqiao	1	1.095
27	Shi'erqiao	2	2.115
28	Shi'erqiao	2	2.784
29	Shi'erqiao	2	.145
30	Shi'erqiao	1	.652
31	Shi'erqiao	1	.527
32	Shi'erqiao	1	.208
33	Shi'erqiao	1	.693
34	Jinsha-Meiyuan	1	.096
35	Jinsha-Meiyuan	2	.667
36	Jinsha-Meiyuan	1	.383
37	Jinsha-Meiyuan	1	.728
38	Jinsha-Meiyuan	2	.367
39	Jinsha-Meiyuan	2	.928
40	Jinsha-Meiyuan	1	.527
41	Jinsha-Meiyuan	1	.476
42	Jinsha-Meiyuan	1	.508
44	Jinsha-Meiyuan	1	.790
45	Jinsha-Meiyuan	2	1.190
46	Jinsha-Meiyuan	2	.942
47	Jinsha-Lanyuan	2	.354
48	Jinsha-Lanyuan	1	.591
49	Jinsha-Lanyuan	1	.096
50	Jinsha-Lanyuan	2	.529
52	Jinsha-Lanyuan	1	.757
53	Jinsha-Lanyuan	2	.267
54	Jinsha-Lanyuan	1	.210
55	Jinsha-Lanyuan	1	.649
56	Jinsha-Lanyuan	2	.277
57	Jinsha-Lanyuan	1	.383

58	Jinsha-Lanyuan	2	.511
59	Jinsha-Lanyuan	2	.152
60	Jinsha-Lanyuan	1	.632
61	Jinsha-Lanyuan	2	.445
62	Jinsha-Lanyuan	1	.508
63	Jinsha-Lanyuan	2	1.472
64	Jinsha-Lanyuan	2	.636
65	Jinsha-Lanyuan	1	.591
66	Jinsha-Lanyuan	2	.875
67	Jinsha-Huangzhongcun	2	.365
68	Jinsha-Huangzhongcun	2	.641
69	Shi'erqiao-Minjiang Xiaoqu	1	.392
70	Shi'erqiao-Minjiang Xiaoqu	2	.549
71	Shi'erqiao-Minjiang Xiaoqu	1	.333
72	Shi'erqiao-Minjiang Xiaoqu	1	.870
73	Shi'erqiao-Minjiang Xiaoqu	1	1.538
74	Shi'erqiao-Minjiang Xiaoqu	1	.796
75	Shi'erqiao-Minjiang Xiaoqu	1	1.108
76	Shi'erqiao-Minjiang Xiaoqu	1	.580
77	Shi'erqiao-Minjiang Xiaoqu	1	.460
78	Jinsha-Boyatingyun	1	.340
79	Jinsha-Boyatingyun	2	.212
80	Jinsha-Boyatingyun	2	.288
81	Jinsha-Boyatingyun	2	.649
82	Jinsha-Boyatingyun	2	.962
83	Jinsha-Boyatingyun	2	.773
84	Jinsha-Boyatingyun	2	.866
85	Jinsha-Boyatingyun	2	.662
86	Jinsha-Boyatingyun	2	.289

Table IV-3: The result of K-means cluster analysis shows how data are clustered for different loci during the Shang-Zhou period

Cluster Membership (time = Early Western Zhou)

Case Number	locus	Cluster	Distance
87	Jinsha-Xinghe	2	.245
89	Jinsha-Xinghe	2	.573
90	Jinsha-Xinghe	2	.856
91	Jinsha-Xinghe	2	.648
92	Jinsha-Xinghe	2	.525
93	Jinsha-Xinghe	2	.280
94	Jinsha-Xinghe	2	.355
95	Jinsha-Xinghe	2	.420
97	Shi'erqiao	1	.519
98	Shi'erqiao	1	.731
99	Shi'erqiao	1	.281
100	Shi'erqiao	1	.419
101	Shi'erqiao	1	.438
102	Shi'erqiao	1	.580
103	Shi'erqiao	1	.411
104	Jinsha-Huangzhongcun	2	.496
105	Jinsha-Huangzhongcun	2	.362
106	Jinsha-Huangzhongcun	1	.446
107	Jinsha-Huangzhongcun	2	.321
108	Jinsha-Huangzhongcun	2	.343
109	Jinsha-Huangzhongcun	2	1.050
110	Jinsha-Huangzhongcun	2	1.196
111	Jinsha-Huangzhong Road Line A and B	1	.639
112	Jinsha-Huangzhong Road Line A and B	1	.281
113	Jinsha-Huangzhong Road Line A and B	1	.617
114	Jinsha-Huangzhong Road Line A and B	1	.719

116	Jinsha-Huangzhong Road Line A and B	1	.843
120	Jinsha-Meiyuan	1	.800
121	Jinsha-Boyatingyun	1	.216
122	Jinsha-Boyatingyun	1	.806
123	Jinsha-Boyatingyun	1	.302

Table IV-4: The result of K-means cluster analysis shows how data are clustered for different loci during the early Western Zhou period

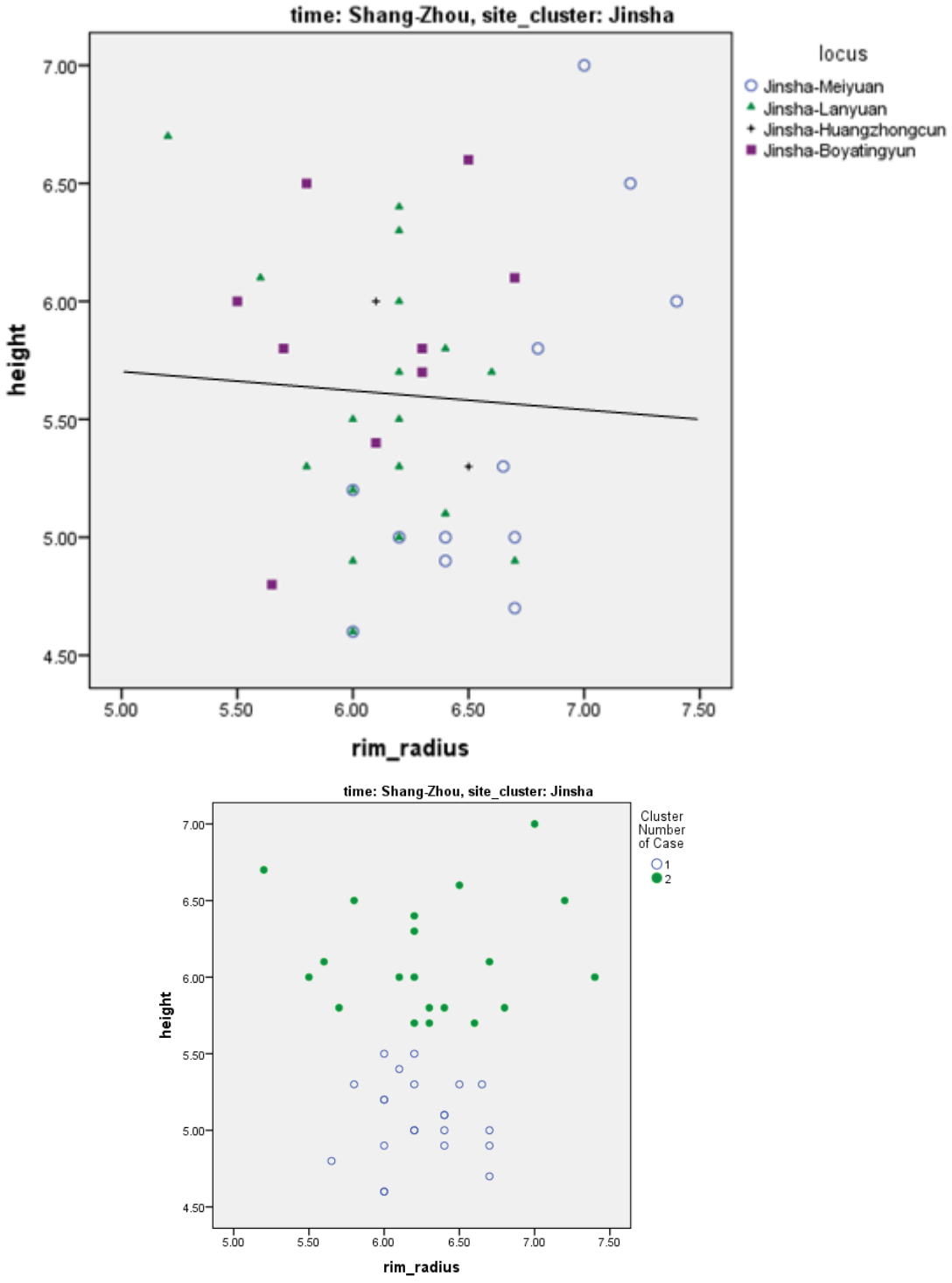


Figure IV-22: The distributions of *jiandi zhan* against rim radius and height from the Jinsha site cluster during the Shang-Zhou period
Above: marked by locus. The separation lines are drawn according to the results of k-means analysis, with k=2 (below). Note that all loci produced both kinds of products.

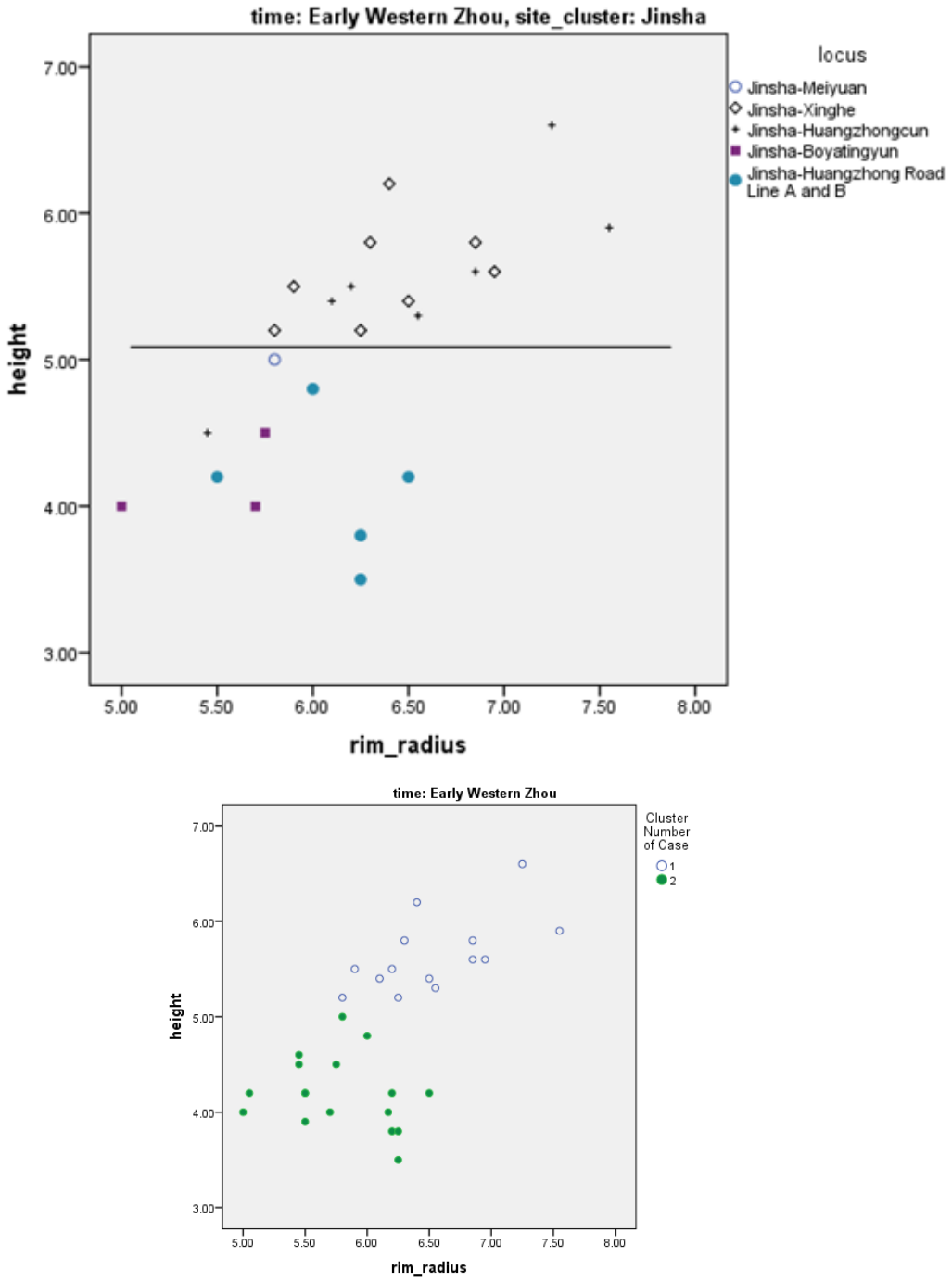


Figure IV-23: The distributions of *jiandi zhan* against rim radius and height from the Jinsha site cluster during the Early Western Zhou period
Above: marked by locus. The separation lines are drawn according to the results of k-means analysis, with k=2 (below).

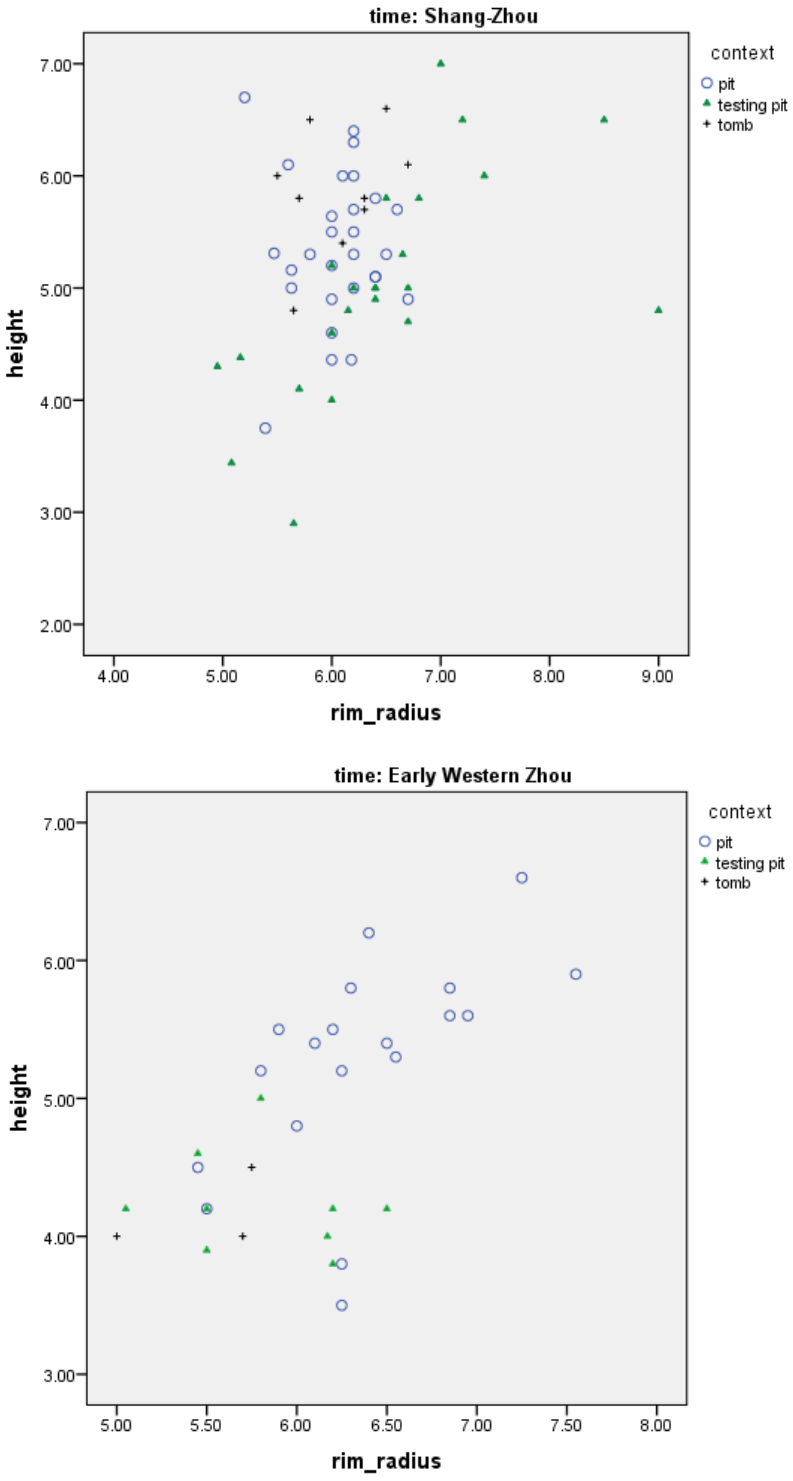


Figure IV-24: Comparing the sizes of *jiandi zhan* in different contexts
Above: during the Shang-Zhou period. Below: during the Early Western Zhou period.

Rim radius of *jiandi zhan*

time	Locus	N	Mean (cm)	Std. Deviation	Coefficient of Variation (CV)
Late Shang	Sanxingdui A	12	6.53	0.16	2.5%
(*ca.* 1300-1200 BC)	Sanxingdui B	10	3.74	0.23	6.1%
	Shi'erqiao I	2	6.45	0.78	12.1%
	Total	24	5.36	1.42	26.5%
Shang-Zhou	Shi'erqiao II	9	6.54	1.34	20.5%
(*ca.* 1200-1000 BC)	Jinsha-Meiyuan	12	6.62	0.44	6.7%
	Jinsha-Lanyuan	19	6.13	0.34	5.6%
	Jinsha-Huangzhongcun	2	6.30	0.28	4.5%
	Shi'erqiao-Minjiang Xiaoqu	9	5.62	0.38	6.8%
	Jinsha-Boyatingyun	9	6.06	0.42	6.9%
	Total	60	6.21	0.69	11.1%
Early Western Zhou	Shi'erqiao III	7	5.72	0.46	8.1%
(*ca.* 1000-900 BC)	Jinsha-Meiyuan	1	5.80		
	Jinsha-Xinghe	8	6.37	0.41	6.4%
	Jinsha-Huangzhongcun	6	6.75	0.58	8.6%
	Jinsha-Boyatingyun	3	5.48	0.42	7.6%
	Jinsha-Huangzhong Road Line A and B	5	6.10	0.38	6.2%
	Total	30	6.12	0.60	9.8%
Late Western Zhou	Shi'erqiao-Xinyicun	16	6.83	1.11	16.2%
(*ca.* 900-800 BC)	Total	16	6.83	1.11	16.2%
Total (by locus)	Sanxingdui A	12	6.53	0.16	2.5%
	Sanxingdui B	10	3.74	0.23	6.1%
	Shi'erqiao	18	6.21	1.06	17.0%
	Jinsha-Meiyuan	13	6.56	0.48	7.4%
	Jinsha-Lanyuan	19	6.13	0.34	5.6%
	Jinsha-Xinghe	8	6.37	0.41	6.4%
	Jinsha-Huangzhongcun	8	6.64	0.54	8.1%
	Shi'erqiao-Minjiang Xiaoqu	9	5.62	0.38	6.8%
	Jinsha-Boyatingyun	12	5.92	0.48	8.1%
	Shi'erqiao-Xinyicun	16	6.83	1.11	16.2%
	Jinsha-Huangzhong Road Line A and B	5	6.10	0.38	6.2%
	Total	130	6.30	0.73	11.6%

Table IV-5: Summary of the rim radius of the *jiandi zhan* from four chronological phases and three site clusters

Height of *jiandi zhan*

time	Locus	N	Mean (cm)	Std. Deviation	Coefficient of Variation (CV)
Late Shang	Sanxingdui A	12	4.58	0.37	8.1%
	Sanxingdui B	10	1.7	0.26	15.4%
	Shi'erqiao I	2	5.35	0.49	9.3%
	Total	24	3.44	1.55	45.1%
Shang-Zhou	Shi'erqiao II	9	4.69	1.05	22.4%
	Jinsha-Meiyuan	12	5.42	0.75	13.9%
	Jinsha-Lanyuan	19	5.53	0.57	10.4%
	Jinsha-Huangzhongcun	2	5.65	0.49	8.8%
	Shi'erqiao-Minjiang Xiaoqu	9	4.60	0.73	15.9%
	Jinsha-Boyatingyun	9	5.86	0.55	9.4%
	Total	60	5.30	0.82	15.5%
Early Western Zhou	Shi'erqiao III	7	4.13	0.26	6.4%
	Jinsha-Meiyuan	1	5.00		
	Jinsha-Xinghe	8	5.59	0.34	6.1%
	Jinsha-Huangzhongcun	6	5.72	0.48	8.4%
	Jinsha-Boyatingyun	3	4.17	0.29	6.9%
	Jinsha-Huangzhong Road Line A and B	5	4.10	0.49	11.9%
	Total	30	4.85	0.82	17.0%
Late Western Zhou	Shi'erqiao-Xinyicun	16	5.01	0.60	12.0%
	Total	16	5.01	0.60	12.0%
Total (by locus)	Sanxingdui A	12	4.58	0.37	8.1%
	Sanxingdui B	10	1.7	0.26	15.4%
	Shi'erqiao	18	4.54	0.85	18.6%
	Jinsha-Meiyuan	13	5.38	0.73	13.5%
	Jinsha-Lanyuan	19	5.53	0.57	10.4%
	Jinsha-Xinghe	8	5.59	0.34	6.1%
	Jinsha-Huangzhongcun	8	5.70	0.45	7.9%
	Shi'erqiao-Minjiang Xiaoqu	9	4.60	0.73	15.9%
	Jinsha-Boyatingyun	12	5.43	0.90	16.6%
	Shi'erqiao-Xinyicun	16	5.01	0.60	12.0%
	Jinsha-Huangzhong Road Line A and B	5	4.10	0.49	11.9%
	Total	130	5.07	0.79	15.6%

Table IV-6: Summary of the height of the *jiandi zhan* from four chronological phases and three site clusters

B. *Coefficient of Variation* (*CV*)

From Table IV-6, the A-group *jiandi zhan* from Sanxingdui (*CV*=2.5%) is the most standardized in regard to rim radiuses. On the other hand, vessel height is least variable in Jinsha-Xinghe (*CV*=6.1%). Generally, the values of rim radius vary in a narrower range than vessel height, which might be a result of the use of potter's wheels. Other concerns about practical use might have also limited the variation in rim dimension. From the tables, it was found that most of the values of the *Coefficients of Variation* in our study are relatively small compared to other datasets obtained from archaeological excavations or ethnographic observations. For instance, Eerkens and Bettinger (2001:499) juxtaposed a number of studies in the attributes of material cultures with their CV distributions (Table IV-7). Among them, Weber Fraction represents the critical value of *CV* producers can achieve without the aid of any ruler or mold. William Longacre (1999), from ethnographic study, also shows that the range of *CV*, while specialized potters attempt standardized products, is between 2% and 6% (Table IV-7).

Data Set	Avg. CV (%)	Range of CV (%)	Source
Machine-Produced Items	.1	.1 – .2	Eerkens 2000
Weber Fraction	1.6	1.6 – 1.7	Ogle 1950
Pots by specialized potters	4	2 – 6	Longacre 1999
Cut–outs from mental image	5	2.5 – 8	Eerkens n.d.
Duna Are Kou	10	8 – 11	White and Thomas 1972
Chaco Canyon Manos	17	8 – 35	Cameron 1997
English Mesolithic Microliths	19	5 – 39	Eerkens 1997, 1998
Great Basin projectile points	22	6 – 55	Bettinger and Eerkens 1997
Owens Valley Handstones	22	10 –32	This article
Random Uniform Data	58	50 – 65	This article
Stylistic elements on SW pots	66	46 – 84	Kantner 1999
Safety pin brooch attributes	74	25 – 113	Doran and Hodson 1975:224

Table IV-7: Average CV and the range of CV for the datasets from various studies (after Eerkens and Bettinger 2001:499, Table 1, highlight added).

C. ANOVA

To further compare whether, during different periods of time, the variability of rim radius and height across groups (loci) is significantly greater than that inside a group, I employed the

analysis of variance (ANOVA) to compare the means of more than two groups (Table IV-8 illustrates the concept of ANOVA). Before the ANOVA was computed, a test on the correlation of the two variables shows that changes in *height* and *rim radius* are associated (Pearson correlation R^2=0.496, p=.000)[118]. Therefore, both of them were taken as dependent variants in the Factorial Multivariate-ANOVA (Factorial MANOVA)[119]. From the Multivariate Tests of ANOVA, it was found that both the main effects of *locus* and *time* and their interaction effect (time*locus) are significant (Table IV-9). Moreover, from Tests of Between-Subjects Effects, the interaction effect of the two factors (time*locus) is significant for height ($F_{(3,114)}$=3.129, p=.028), but not significant for rim radius ($F_{(3,114)}$=1. 517, p=.214) (Table IV-10). Therefore, the effects of locus and time do not have to be examined in combination for rim radius. For vessel height, I consider the effect of locus during each period (simple main effect of locus) and the effect of time in each locus (simple main effect of time) separately (Figure IV-25 illustrates the decision tree model).

Source of variation	Sum of Squares (SS)	Degree of freedom (*df*)	MS	F
Between group	SS_b	k-1	SS_b / df_b	MS_b / MS_w
Within group (error)	SS_w	N-k	SS_w / df_w	
Total	SS_t	N-1		

* Where N= number of samples; and k= number of groups;
SS_b = sum of squares of the difference between each group mean and the grand mean;
SS_w = sum of squares of the difference between each sample value and the group mean;
SS_t = sum of squares of the difference between each sample value and the grand mean; $SS_t = SS_b + SS_w$.

Table IV-8: Concept of one-way ANOVA and the *F* ratio

[118] Pearson's $r = \frac{\text{covariance of two variables}}{\text{stad.deviation of two variables}}$.
[119] A variety of ANOVA that analyzes multiple correlative variants and one or more affecting factors simultaneously.

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.987	4378.226[b]	2.000	113.000	.000	.987	8756.452	1.000
	Wilks' Lambda	.013	4378.226[b]	2.000	113.000	.000	.987	8756.452	1.000
	Hotelling's Trace	77.491	4378.226[b]	2.000	113.000	.000	.987	8756.452	1.000
	Roy's Largest Root	77.491	4378.226[b]	2.000	113.000	.000	.987	8756.452	1.000
locus	Pillai's Trace	.881	9.979	18.000	228.000	.000	.441	179.617	1.000
	Wilks' Lambda	.258	12.143[b]	18.000	226.000	.000	.492	218.575	1.000
	Hotelling's Trace	2.329	14.491	18.000	224.000	.000	.538	260.845	1.000
	Roy's Largest Root	2.067	26.188[c]	9.000	114.000	.000	.674	235.689	1.000
time	Pillai's Trace	.102	3.072	4.000	228.000	.017	.051	12.287	.804
	Wilks' Lambda	.898	3.121[b]	4.000	226.000	.016	.052	12.485	.811
	Hotelling's Trace	.113	3.169	4.000	224.000	.015	.054	12.678	.817
	Roy's Largest Root	.110	6.276[c]	2.000	114.000	.003	.099	12.551	.889
locus * time	Pillai's Trace	.117	2.360	6.000	228.000	.031	.058	14.158	.805
	Wilks' Lambda	.886	2.349[b]	6.000	226.000	.032	.059	14.094	.803
	Hotelling's Trace	.125	2.338	6.000	224.000	.033	.059	14.029	.801
	Roy's Largest Root	.086	3.283[c]	3.000	114.000	.023	.080	9.848	.738

a. Design: Intercept + locus + time + locus * time

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

Table IV-9: Multivariate tests from the MANOVA analysis for time, locus, and their interaction

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	rim_radius	79.437[a]	15	5.296	13.080	.000	.632	196.197	1.000
	height	141.481[b]	15	9.432	27.458	.000	.783	411.872	1.000
Intercept	rim_radius	2950.863	1	2950.863	7288.128	.000	.985	7288.128	1.000
	height	1793.669	1	1793.669	5221.644	.000	.979	5221.644	1.000
locus	rim_radius	51.154	9	5.684	14.038	.000	.526	126.343	1.000
	height	74.427	9	8.270	24.074	.000	.655	216.669	1.000
time	rim_radius	1.437	2	.719	1.775	.174	.030	3.549	.365
	height	4.276	2	2.138	6.224	.003	.098	12.448	.887
locus * time	rim_radius	1.843	3	.614	1.517	.214	.038	4.551	.392
	height	3.225	3	1.075	3.129	.028	.076	9.388	.715
Error	rim_radius	46.157	114	.405					
	height	39.160	114	.344					
Total	rim_radius	4983.168	130						
	height	3197.961	130						
Corrected Total	rim_radius	125.594	129						
	height	180.640	129						

a. R Squared = .632 (Adjusted R Squared = .584)

b. R Squared = .783 (Adjusted R Squared = .755)

c. Computed using alpha = .05

Table IV-10: Tests of Between-Subjects Effects from the MANOVA analysis for time, locus, and their interaction

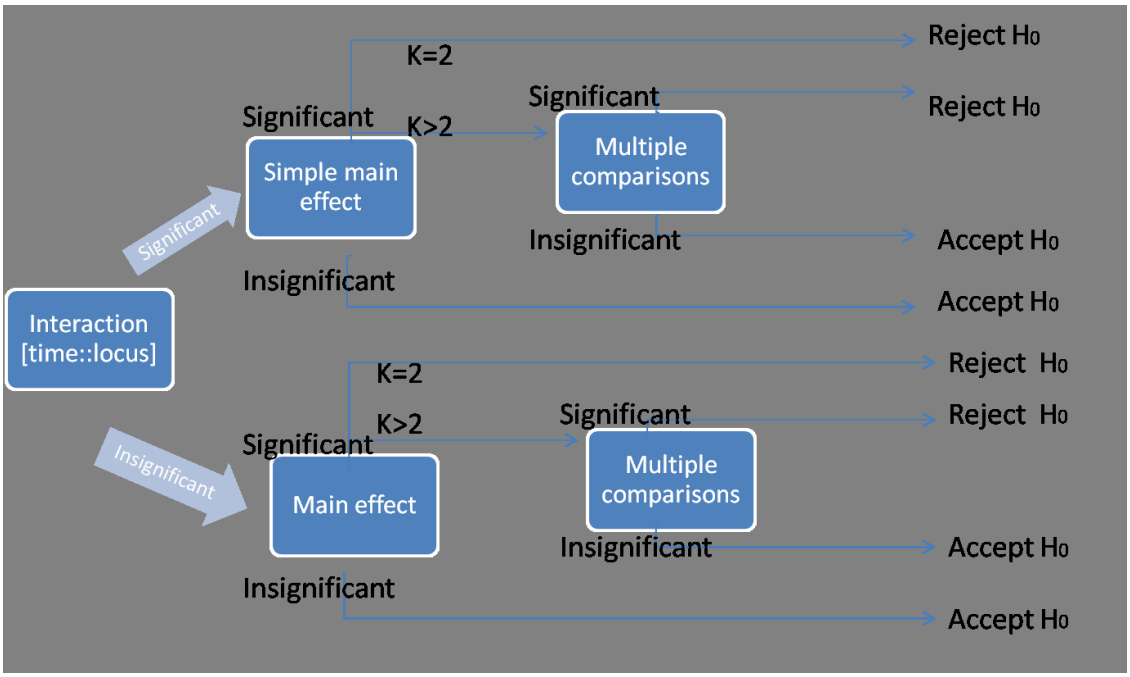


Figure IV-25: Decision tree of the two-way ANOVA analysis
Including two factors and their interaction effect (redrawn from Qiu Haozheng 2010:9-7).

The following are the steps used to test the two factors:

1) To test if *time* is a significant factor influencing the change in rim radius:

   - The null hypothesis is that the means of the rim radiuses of *jiandi zhan* do not differ during different periods of time.

From the Between-Subjects-Effects tests of Factorial MANOVA, the main effect of time on rim radius is significant ($F_{(2,114)}$=3.137, p=.047). The null hypothesis is rejected. To learn how the levels of the factor differ, posteriori comparisons (Post Hoc) were undertaken.

Based on observed means, the Post Hoc tests compare the multi-group difference. The result shows that, except between Shang-Zhou and Early Western Zhou, the mean rim radius is significantly different between the other pairs of datasets at the significance level of 0.0083[120] (confidence interval =99.167%) (Table IV-11). The homogeneous subsets are suggested in Table

[120] To control cumulative Type I error, let alpha = 0.05 / [(number of group-1) * number of variants].

IV-12. Figure IV-26 shows the error bar charts of mean rim radius changing over time. The mean values of Shang-Zhou and Early Western Zhou and their standard error are similarly distributed.

Apparently, mixing the two groups of Sanxingdui *jiandi zhan* has made the overall variance of Late Shang very large. If we take Sanxingdui B group as a distinct type and exclude it from the current test, the main effect of time on rim radius becomes insignificant ($F_{(2,108)}$=2.926, p=.058). Figure IV-27 allows us to compare the mean values visually. However, the Post Hoc tests suggest that the mean rim radius of the Late Western Zhou is significantly different from those of Shang-Zhou and Early Western Zhou (Table IV-13).

Multiple Comparisons

Dependent Variable				Mean Difference (I-J)	Std. Error	Sig.
rim_radius	LSD	Late Shang	Shang-Zhou	-.8477*	.15368	.000
			Early Western Zhou	-.7819*	.17426	.000
			Late Western Zhou	-1.4677*	.20537	.000
		Shang-Zhou	Late Shang	.8477*	.15368	.000
			Early Western Zhou	.0658	.14228	.644
			Late Western Zhou	-.6200*	.17903	.001
		Early Western Zhou	Late Shang	.7819*	.17426	.000
			Shang-Zhou	-.0658	.14228	.644
			Late Western Zhou	-.6858*	.19698	.001
		Late Western Zhou	Late Shang	1.4677*	.20537	.000
			Shang-Zhou	.6200*	.17903	.001
			Early Western Zhou	.6858*	.19698	.001

Based on observed means.
The error term is Mean Square(Error) = .344.
*. The mean difference is significant at the .0083 level.

Table IV-11: Results of multiple comparisons on mean rim radius over time
The star marks denote significant between-group differences.

rim_radius

time		N	Subset 1	Subset 2	Subset 3
Scheffe[a,b]	Late Shang	24	5.3604		
	Early Western Zhou	30		6.1423	
	Shang-Zhou	60		6.2082	6.2082
	Late Western Zhou	16			6.8281
	Sig.		1.000	.987	.009

Means for groups in homogeneous subsets are displayed.
The error term is Mean Square(Error) = .410.
a. Uses Harmonic Mean Sample Size = 25.946.
b. Alpha = .0083.

Table IV-12: Homogeneous subsets based on observed means

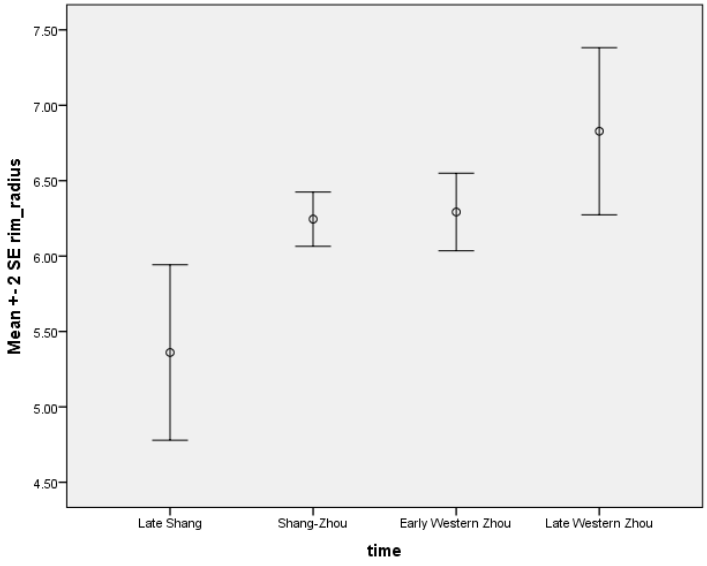


Figure IV-26: Error bars of mean rim radius over time

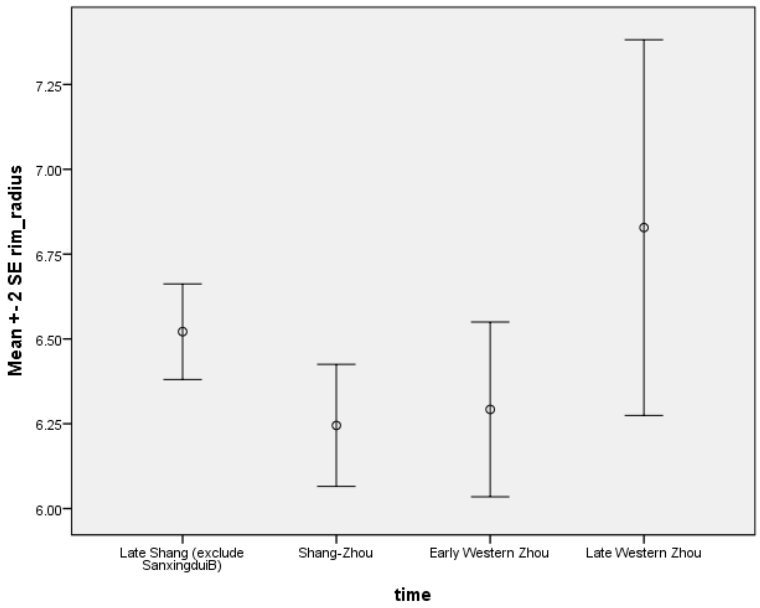


Figure IV-27: Error bars of mean rim radius over time
Sanxingdui group B is excluded from the Late Shang samples.

Multiple Comparisons

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.
rim_radius	Late Shang	Shang-Zhou	.3133	.19686	.114
		Early Western Zhou	.3791	.21467	.080
		Late Western Zhou	-.3067	.24273	.209
	Shang-Zhou	Late Shang	-.3133	.19686	.114
		Early Western Zhou	.0658	.14831	.658
		Late Western Zhou	-.6200*	.18662	.001
	Early Western Zhou	Late Shang	-.3791	.21467	.080
		Shang-Zhou	-.0658	.14831	.658
		Late Western Zhou	-.6858*	.20532	.001
	Late Western Zhou	Late Shang	.3067	.24273	.209
		Shang-Zhou	.6200*	.18662	.001
		Early Western Zhou	.6858*	.20532	.001

LSD algorithm is used.
Based on observed means.
The error term is Mean Square(Error) = .387.
*. The mean difference is significant at the .0083 level.

Table IV-13: Results of multiple comparisons on mean rim radius over time (Sanxingdui group B excluded)
The star marks denote significant between-group differences.

2) To test if *locus* is a significant factor influencing the change in rim radius:

- The null hypothesis is that the means of the rim radiuses of *jiandi zhan* are the same in different loci.

From the Between-Subjects-Effects tests of Factorial MANOVA, mean rim radius is significantly different across loci ($F_{(9,117)}$=14.964, p=.000) and thus the null hypothesis is rejected. Post Hoc tests were then undertaken to test which pairs of loci may statistically differ in the mean values of rim radius.

Based on observed means, the Post Hoc tests compare the multi-group difference at the significance level of .0025 (confidence interval =99.75%). The result shows that SanxingduiB statistically differs from all of the other loci in their mean values of rim radius. In addition,

Shi'erqiao-Minjiang Xiaoqu differs from SanxingduiA, Jinsha-Meiyuan, Jinsha-Huangzhongcun, and Shi'erqiao III-Xinyicun. Shi'erqiao III-Xinyicun differs from Jinsha-Lanyuan and Jinsha-Boyatingyun significantly besides Minjiang Xiaoqu (Table IV-14). Figure IV-28 shows the variation of mean rim radii over space. Some of the loci, such as SanxingduiB, Minjiang Xiaoqu, and Jinsha-Boyatingyun, tend to yield *jiandi zhan* of smaller rim radius. These comparisons only take the effects of *locus* into account and thus mix loci from different periods. To further separate loci by time, we take the third step.

Multiple Comparisons

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.
Rim_radius	SanxingduiA	Shi'erqiao	.3211	.23870	.181
		Jinsha-Meiyuan	-.0244	.25641	.924
		Jinsha-Lanyuan	.4018	.23618	.092
		Jinsha-Xinghe	.1646	.29235	.575
		Jinsha-Huangzhongcun	-.1042	.29235	.722
		Shi'erqiao-Minjiang Xiaoqu	.9178*	.28244	.002
		Jinsha-Boyatingyun	.6167	.26149	.020
		Shi'erqiao III-Xinyicun	-.2948	.24460	.231
		Jinsha-Huangzhong Road Line A and B	.4333	.34094	.206
		SanxingduiB	2.7983*	.27425	.000
	Shi'erqiao	SanxingduiA	-.3211	.23870	.181
		Jinsha-Meiyuan	-.3455	.23313	.141
		Jinsha-Lanyuan	.0806	.21068	.703
		Jinsha-Xinghe	-.1565	.27216	.566
		Jinsha-Huangzhongcun	-.4253	.27216	.121
		Shi'erqiao-Minjiang Xiaoqu	.5967	.26149	.024
		Jinsha-Boyatingyun	.2956	.23870	.218
		Shi'erqiao III-Xinyicun	-.6159	.22007	.006
		Jinsha-Huangzhong Road Line A and B	.1122	.32379	.730
		SanxingduiB	2.4772*	.25262	.000
	Jinsha-Meiyuan	SanxingduiA	.0244	.25641	.924
		Shi'erqiao	.3455	.23313	.141
		Jinsha-Lanyuan	.4261	.23054	.067

	Jinsha-Xinghe	.1889	.28782	.513
	Jinsha-Huangzhongcun	-.0798	.28782	.782
	Shi'erqiao-Minjiang Xiaoqu	.9421*	.27774	.001
	Jinsha-Boyatingyun	.6410	.25641	.014
	Shi'erqiao III-Xinyicun	-.2704	.23916	.260
	Jinsha-Huangzhong Road Line A and B	.4577	.33706	.177
	SanxingduiB	2.8227*	.26941	.000
Jinsha-Lanyuan	SanxingduiA	-.4018	.23618	.092
	Shi'erqiao	-.0806	.21068	.703
	Jinsha-Meiyuan	-.4261	.23054	.067
	Jinsha-Xinghe	-.2372	.26995	.381
	Jinsha-Huangzhongcun	-.5059	.26995	.063
	Shi'erqiao-Minjiang Xiaoqu	.5160	.25918	.049
	Jinsha-Boyatingyun	.2149	.23618	.365
	Shi'erqiao III-Xinyicun	-.6965*	.21733	.002
	Jinsha-Huangzhong Road Line A and B	.0316	.32194	.922
	SanxingduiB	2.3966*	.25024	.000
Jinsha-Xinghe	SanxingduiA	-.1646	.29235	.575
	Shi'erqiao	.1565	.27216	.566
	Jinsha-Meiyuan	-.1889	.28782	.513
	Jinsha-Lanyuan	.2372	.26995	.381
	Jinsha-Huangzhongcun	-.2688	.32026	.403
	Shi'erqiao-Minjiang Xiaoqu	.7532	.31123	.017
	Jinsha-Boyatingyun	.4521	.29235	.125
	Shi'erqiao III-Xinyicun	-.4594	.27735	.100
	Jinsha-Huangzhong Road Line A and B	.2688	.36515	.463
	SanxingduiB	2.6338*	.30382	.000
Jinsha-Huangzhongcun	SanxingduiA	.1042	.29235	.722
	Shi'erqiao	.4253	.27216	.121
	Jinsha-Meiyuan	.0798	.28782	.782
	Jinsha-Lanyuan	.5059	.26995	.063
	Jinsha-Xinghe	.2688	.32026	.403
	Shi'erqiao-Minjiang Xiaoqu	1.0219*	.31123	.001
	Jinsha-Boyatingyun	.7208	.29235	.015
	Shi'erqiao III-Xinyicun	-.1906	.27735	.493
	Jinsha-Huangzhong Road Line A and B	.5375	.36515	.144
	SanxingduiB	2.9025*	.30382	.000
Shi'erqiao-Minjiang Xiaoqu	SanxingduiA	-.9178*	.28244	.002
	Shi'erqiao	-.5967	.26149	.024

	Jinsha-Meiyuan	-.9421*	.27774	.001
	Jinsha-Lanyuan	-.5160	.25918	.049
	Jinsha-Xinghe	-.7532	.31123	.017
	Jinsha-Huangzhongcun	-1.0219*	.31123	.001
	Jinsha-Boyatingyun	-.3011	.28244	.289
	Shi'erqiao III-Xinyicun	-1.2126*	.26688	.000
	Jinsha-Huangzhong Road Line A and B	-.4844	.35726	.178
	SanxingduiB	1.8806*	.29429	.000
Jinsha-Boyatingyun	SanxingduiA	-.6167	.26149	.020
	Shi'erqiao	-.2956	.23870	.218
	Jinsha-Meiyuan	-.6410	.25641	.014
	Jinsha-Lanyuan	-.2149	.23618	.365
	Jinsha-Xinghe	-.4521	.29235	.125
	Jinsha-Huangzhongcun	-.7208	.29235	.015
	Shi'erqiao-Minjiang Xiaoqu	.3011	.28244	.289
	Shi'erqiao III-Xinyicun	-.9115*	.24460	.000
	Jinsha-Huangzhong Road Line A and B	-.1833	.34094	.592
	SanxingduiB	2.1817*	.27425	.000
Shi'erqiao III-Xinyicun	SanxingduiA	.2948	.24460	.231
	Shi'erqiao	.6159	.22007	.006
	Jinsha-Meiyuan	.2704	.23916	.260
	Jinsha-Lanyuan	.6965*	.21733	.002
	Jinsha-Xinghe	.4594	.27735	.100
	Jinsha-Huangzhongcun	.1906	.27735	.493
	Shi'erqiao-Minjiang Xiaoqu	1.2126*	.26688	.000
	Jinsha-Boyatingyun	.9115*	.24460	.000
	Jinsha-Huangzhong Road Line A and B	.7281	.32816	.028
	SanxingduiB	3.0931*	.25820	.000
Jinsha-Huangzhong Road Line A and B	SanxingduiA	-.4333	.34094	.206
	Shi'erqiao	-.1122	.32379	.730
	Jinsha-Meiyuan	-.4577	.33706	.177
	Jinsha-Lanyuan	-.0316	.32194	.922
	Jinsha-Xinghe	-.2688	.36515	.463
	Jinsha-Huangzhongcun	-.5375	.36515	.144
	Shi'erqiao-Minjiang Xiaoqu	.4844	.35726	.178
	Jinsha-Boyatingyun	.1833	.34094	.592
	Shi'erqiao III-Xinyicun	-.7281	.32816	.028
	SanxingduiB	2.3650*	.35082	.000
SanxingduiB	SanxingduiA	-2.7983*	.27425	.000
	Shi'erqiao	-2.4772*	.25262	.000

	Jinsha-Meiyuan	-2.8227*	.26941	.000
	Jinsha-Lanyuan	-2.3966*	.25024	.000
	Jinsha-Xinghe	-2.6338*	.30382	.000
	Jinsha-Huangzhongcun	-2.9025*	.30382	.000
	Shi'erqiao-Minjiang Xiaoqu	-1.8806*	.29429	.000
	Jinsha-Boyatingyun	-2.1817*	.27425	.000
	Shi'erqiao III-Xinyicun	-3.0931*	.25820	.000
	Jinsha-Huangzhong Road Line A and B	-2.3650*	.35082	.000

LSD algorithm is used.
Based on observed means.
The error term is Mean Square(Error) = .362.
*. The mean difference is significant at the .0025 level.

Table IV-14: Results of multiple comparisons on mean rim radius by locus (significant between-group differences highlighted).

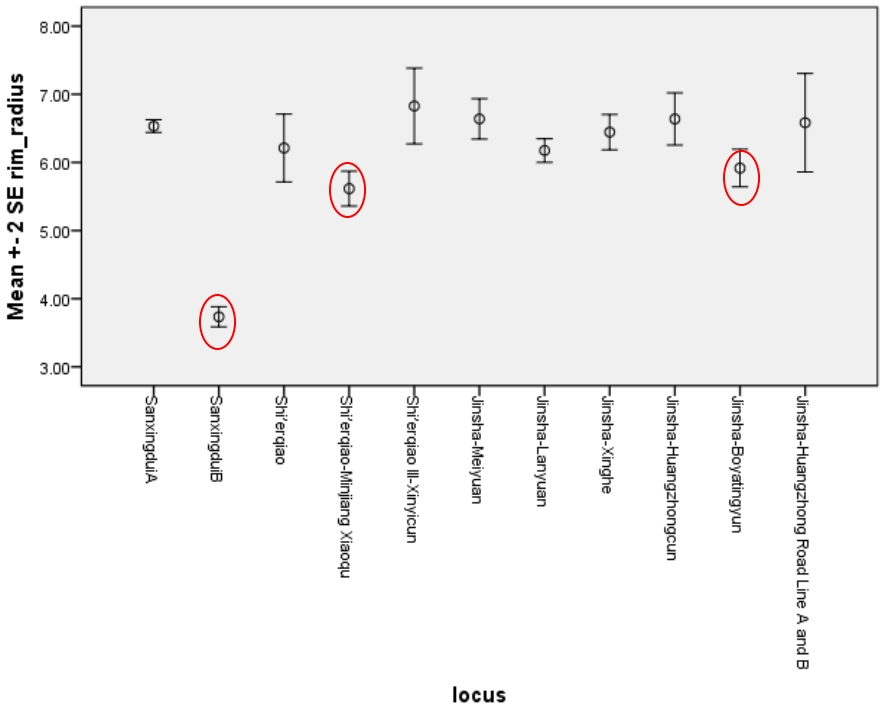


Figure IV-28: Error bars of mean rim radius over space

3) To test if the mean values of height significant differ between loci during a certain period of time:

   - The null hypothesis is that the means of the heights of *jiandi zhan* are the same in different loci during a certain period of time.

Before conducting One-Way ANOVA that uses *locus* as the only factor, we need to spilt data by time and compare any pair of loci for each period of time. The result of the Post Hoc comparison is illustrated as Table IV-15. From the multiple comparisons, it is suggested that the mean value of height of SanxingduiB is significantly different from those of SanxingduiA and Shi'erqiao (13^{th} layer) during the Late Shang period.

During the Shang-Zhou period, Jinsha-Boyatingyun differs from Shi'erqiao (12^{th} layer) and Shi'erqiao-Minjiang Xiaoqu. Shi'erqiao-Minjiang Xiaoqu also differs from Jinsha-Lanyuan.

During the Early Western Zhou period, Jinsha-Huangzhongcun differs from Shi'erqiao (10^{th}-11^{th} layers), Jinsha-Boyatingyun, and Jinsha-Huangzhong Road Line A and B. Jinsha-Xinghe differs from Shi'erqiao, Jinsha-Boyatingyun, and Jinsha-Huangzhong Road Line A and B.

The Late Western Zhou period only includes one locus and thus is not subject to comparison. Except this, the null hypothesis is rejected. The variations of mean heights over space during particular periods are shown in Figure IV-29-Figure IV-31.

Moreover, from the same table, we can also find that, during the Late Shang period, SanxingduiB is significantly different from SanxingduiA and Shi'erqiao in their mean values of rim radius. During the Shang-Zhou period, Jinsha-Meiyuan is significantly different from Shi'erqiao-Minjiang Xiaoqu in their rim-radius means. These comparisons have considered both the *locus* and *time* factors (Figure IV-32-Figure IV-34).

Multiple Comparisons

time				Mean Difference (I-J)	Std. Error	Sig.
Late Shang	height	SanxingduiA	Shi'erqiao	-.77500	.25644	.006
			SanxingduiB	2.87500*	.14377	.000
		Shi'erqiao	SanxingduiA	.77500	.25644	.006

			SanxingduiB	3.65000*	.26008	.000
		SanxingduiB	SanxingduiA	-2.87500*	.14377	.000
			Shi'erqiao	-3.65000*	.26008	.000
	rim_radius	SanxingduiA	Shi'erqiao	.08333	.19592	.675
			SanxingduiB	2.79833*	.10984	.000
		Shi'erqiao	SanxingduiA	-.08333	.19592	.675
			SanxingduiB	2.71500*	.19870	.000
		SanxingduiB	SanxingduiA	-2.79833*	.10984	.000
			Shi'erqiao	-2.71500*	.19870	.000
Shang-Zhou	height	Shi'erqiao	Jinsha-Meiyuan	-.72778	.31676	.025
			Jinsha-Lanyuan	-.84269	.29068	.005
			Jinsha-Huangzhongcun	-.96111	.56155	.093
			Shi'erqiao-Minjiang Xiaoqu	.08889	.33863	.794
			Jinsha-Boyatingyun	-1.16667*	.33863	.001
		Jinsha-Meiyuan	Shi'erqiao	.72778	.31676	.025
			Jinsha-Lanyuan	-.11491	.26488	.666
			Jinsha-Huangzhongcun	-.23333	.54864	.672
			Shi'erqiao-Minjiang Xiaoqu	.81667	.31676	.013
			Jinsha-Boyatingyun	-.43889	.31676	.172
		Jinsha-Lanyuan	Shi'erqiao	.84269	.29068	.005
			Jinsha-Meiyuan	.11491	.26488	.666
			Jinsha-Huangzhongcun	-.11842	.53401	.825
			Shi'erqiao-Minjiang Xiaoqu	.93158*	.29068	.002
			Jinsha-Boyatingyun	-.32398	.29068	.270
		Jinsha-Huangzhongcun	Shi'erqiao	.96111	.56155	.093
			Jinsha-Meiyuan	.23333	.54864	.672
			Jinsha-Lanyuan	.11842	.53401	.825
			Shi'erqiao-Minjiang Xiaoqu	1.05000	.56155	.067
			Jinsha-Boyatingyun	-.20556	.56155	.716
		Shi'erqiao-Minjiang Xiaoqu	Shi'erqiao	-.08889	.33863	.794
			Jinsha-Meiyuan	-.81667	.31676	.013
			Jinsha-Lanyuan	-.93158*	.29068	.002
			Jinsha-Huangzhongcun	-1.05000	.56155	.067

		Jinsha-Boyatingyun	-1.25556*	.33863	.000
	Jinsha-Boyatingyun	Shi'erqiao	1.16667*	.33863	.001
		Jinsha-Meiyuan	.43889	.31676	.172
		Jinsha-Lanyuan	.32398	.29068	.270
		Jinsha-Huangzhongcun	.20556	.56155	.716
		Shi'erqiao-Minjiang Xiaoqu	1.25556*	.33863	.000
rim_radius	Shi'erqiao	Jinsha-Meiyuan	-.16496	.27871	.556
		Jinsha-Lanyuan	.36389	.25798	.164
		Jinsha-Huangzhongcun	.23889	.50244	.636
		Shi'erqiao-Minjiang Xiaoqu	.92333	.30299	.004
		Jinsha-Boyatingyun	.47778	.30299	.120
	Jinsha-Meiyuan	Shi'erqiao	.16496	.27871	.556
		Jinsha-Lanyuan	.52885	.22898	.025
		Jinsha-Huangzhongcun	.40385	.48819	.412
		Shi'erqiao-Minjiang Xiaoqu	1.08829*	.27871	.000
		Jinsha-Boyatingyun	.64274	.27871	.025
	Jinsha-Lanyuan	Shi'erqiao	-.36389	.25798	.164
		Jinsha-Meiyuan	-.52885	.22898	.025
		Jinsha-Huangzhongcun	-.12500	.47666	.794
		Shi'erqiao-Minjiang Xiaoqu	.55944	.25798	.034
		Jinsha-Boyatingyun	.11389	.25798	.661
	Jinsha-Huangzhongcun	Shi'erqiao	-.23889	.50244	.636
		Jinsha-Meiyuan	-.40385	.48819	.412
		Jinsha-Lanyuan	.12500	.47666	.794
		Shi'erqiao-Minjiang Xiaoqu	.68444	.50244	.179
		Jinsha-Boyatingyun	.23889	.50244	.636
	Shi'erqiao-Minjiang Xiaoqu	Shi'erqiao	-.92333	.30299	.004
		Jinsha-Meiyuan	-1.08829*	.27871	.000
		Jinsha-Lanyuan	-.55944	.25798	.034
		Jinsha-Huangzhongcun	-.68444	.50244	.179
		Jinsha-Boyatingyun	-.44556	.30299	.147

		Jinsha-Boyatingyun	Shi'erqiao	-.47778	.30299	.120
			Jinsha-Meiyuan	-.64274	.27871	.025
			Jinsha-Lanyuan	-.11389	.25798	.661
			Jinsha-Huangzhongcun	-.23889	.50244	.636
			Shi'erqiao-Minjiang Xiaoqu	.44556	.30299	.147
Early Western Zhou	height	Shi'erqiao	Jinsha-Huangzhongcun	-1.58810*	.21240	.000
			Jinsha-Boyatingyun	-.03810	.26345	.886
			Jinsha-Xinghe	-1.45893*	.19759	.000
			Jinsha-Huangzhong Road Line A and B	.02857	.22354	.899
		Jinsha-Huangzhongcun	Shi'erqiao	1.58810*	.21240	.000
			Jinsha-Boyatingyun	1.55000*	.26996	.000
			Jinsha-Xinghe	.12917	.20618	.537
			Jinsha-Huangzhong Road Line A and B	1.61667*	.23118	.000
		Jinsha-Boyatingyun	Shi'erqiao	.03810	.26345	.886
			Jinsha-Huangzhongcun	-1.55000*	.26996	.000
			Jinsha-Xinghe	-1.42083*	.25846	.000
			Jinsha-Huangzhong Road Line A and B	.06667	.27881	.813
		Jinsha-Xinghe	Shi'erqiao	1.45893*	.19759	.000
			Jinsha-Huangzhongcun	-.12917	.20618	.537
			Jinsha-Boyatingyun	1.42083*	.25846	.000
			Jinsha-Huangzhong Road Line A and B	1.48750*	.21764	.000
		Jinsha-Huangzhong Road Line A and B	Shi'erqiao	-.02857	.22354	.899
			Jinsha-Huangzhongcun	-1.61667*	.23118	.000
			Jinsha-Boyatingyun	-.06667	.27881	.813
			Jinsha-Xinghe	-1.48750*	.21764	.000
	rim_radius	Shi'erqiao	Jinsha-Huangzhongcun	-1.02571	.38250	.012
			Jinsha-Boyatingyun	.24095	.47444	.615
			Jinsha-Xinghe	-.72071	.33882	.042

		Jinsha-Huangzhong Road Line A and B	-.85905	.34648	.019
	Jinsha-Huangzhongcun	Shi'erqiao	1.02571	.38250	.012
		Jinsha-Boyatingyun	1.26667	.48615	.014
		Jinsha-Xinghe	.30500	.35504	.397
		Jinsha-Huangzhong Road Line A and B	.16667	.36236	.649
	Jinsha-Boyatingyun	Shi'erqiao	-.24095	.47444	.615
		Jinsha-Huangzhongcun	-1.26667	.48615	.014
		Jinsha-Xinghe	-.96167	.45258	.042
		Jinsha-Huangzhong Road Line A and B	-1.10000	.45835	.023
	Jinsha-Xinghe	Shi'erqiao	.72071	.33882	.042
		Jinsha-Huangzhongcun	-.30500	.35504	.397
		Jinsha-Boyatingyun	.96167	.45258	.042
		Jinsha-Huangzhong Road Line A and B	-.13833	.31590	.665
	Jinsha-Huangzhong Road Line A and B	Shi'erqiao	.85905	.34648	.019
		Jinsha-Huangzhongcun	-.16667	.36236	.649
		Jinsha-Boyatingyun	1.10000	.45835	.023
		Jinsha-Xinghe	.13833	.31590	.665

LSD algorithm is used.

*. The mean difference is significant at the 0.0025 level.

Table IV-15: Results of multiple comparisons on mean height and mean rim radius by locus (significant between-group differences highlighted).

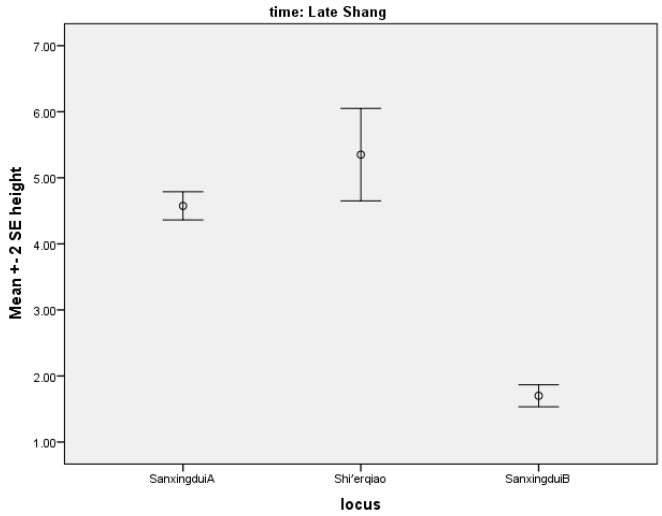


Figure IV-29: Error bars of the variation of mean heights over space, during the Late Shang period

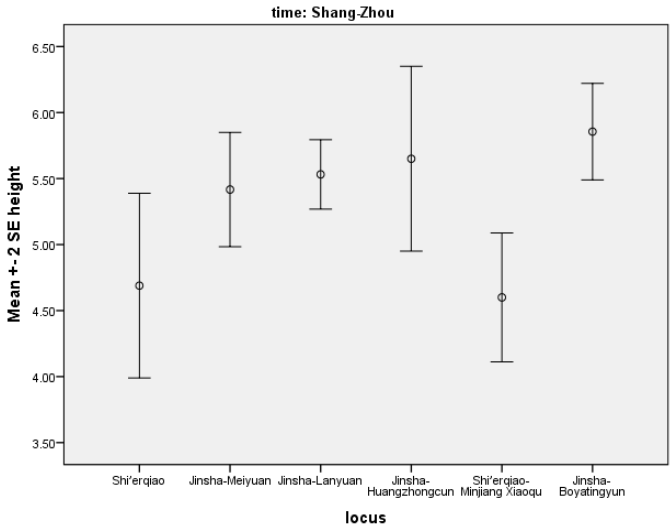


Figure IV-30: Error bars of the variation of mean heights over space, during the Shang-Zhou period

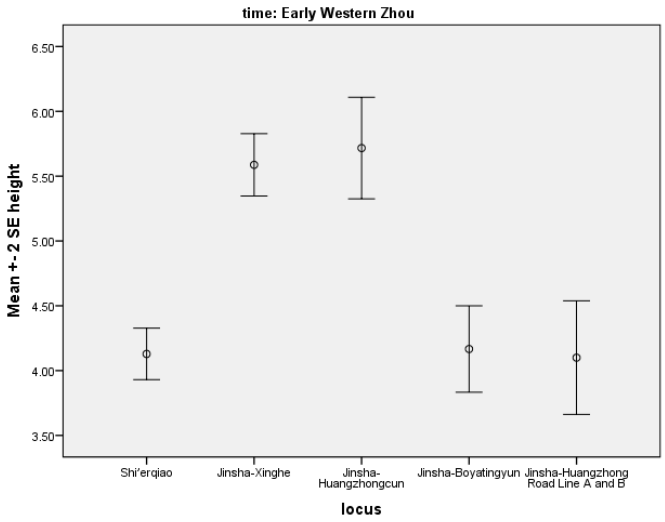


Figure IV-31: Error bars of the variation of mean heights over space, during the Early Western Zhou period

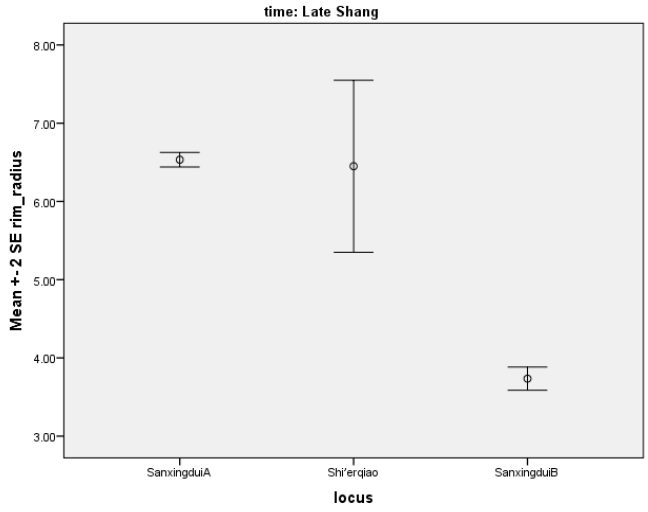


Figure IV-32: Error bars of the variation of mean rim radii over space, during the Late Shang period

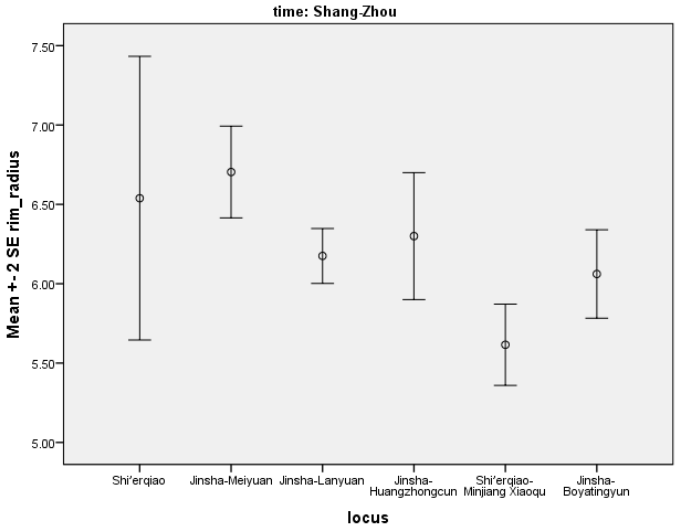


Figure IV-33: Error bars of the variation of mean rim radii over space, during the Shang-Zhou period

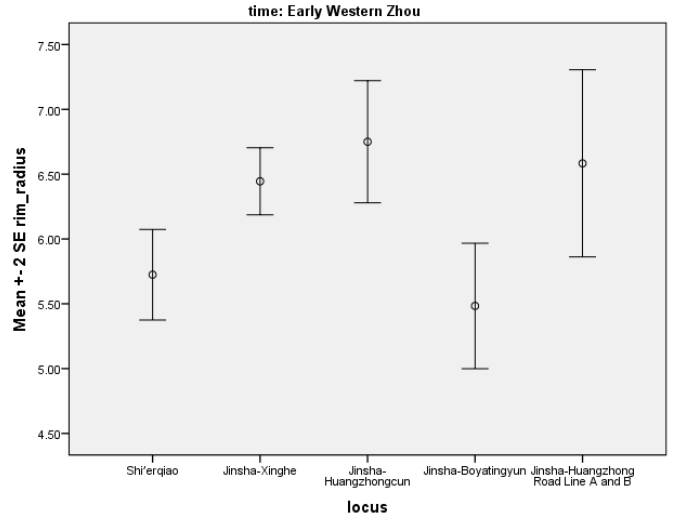


Figure IV-34: Error bars of the variation of mean rim radii over space, during the Early Western Zhou period

4) A test is also conducted to see if, within a certain locus, the mean values of height significantly vary with time. Different from the One-Way ANOVA taken in step 3), this time we need to split data by *locus* and use *time* as the only factor to compare any pair of time phases for a certain locus. However, among all sites, only Shi'erqiao contains samples for more three time phases (i.e., k>2 in the decision tree of ANOVA in Figure IV-25). The vessel

height gradually became smaller but is not statistically significant (Figure IV-35). The One-Way ANOVA analysis for Shi'erqiao shows that no between-group difference is significant (Table IV-16).

Multiple Comparisons

site_cluster				Mean Difference (I-J)	Std. Error	Sig.
Shi'erqiao	rim_radius	Late Shang	Shang-Zhou	.37278	.75200	.623
			Early Western Zhou	.72571	.80893	.375
			Late Western Zhou	-.37812	.75668	.620
		Shang-Zhou	Late Shang	-.37278	.75200	.623
			Early Western Zhou	.35294	.44940	.437
			Late Western Zhou	-.75090	.34665	.036
		Early Western Zhou	Late Shang	-.72571	.80893	.375
			Shang-Zhou	-.35294	.44940	.437
			Late Western Zhou	-1.10384	.45720	.021
		Late Western Zhou	Late Shang	.37812	.75668	.620
			Shang-Zhou	.75090	.34665	.036
			Early Western Zhou	1.10384	.45720	.021
	height	Late Shang	Shang-Zhou	.70556	.52330	.185
			Early Western Zhou	1.22143	.56292	.036
			Late Western Zhou	.34375	.52657	.518
		Shang-Zhou	Late Shang	-.70556	.52330	.185
			Early Western Zhou	.51587	.31273	.107
			Late Western Zhou	-.36181	.24123	.142
		Early Western Zhou	Late Shang	-1.22143	.56292	.036
			Shang-Zhou	-.51587	.31273	.107
			Late Western Zhou	-.87768	.31816	.009
		Late Western Zhou	Late Shang	-.34375	.52657	.518
			Shang-Zhou	.36181	.24123	.142
			Early Western Zhou	.87768	.31816	.009

LSD algorithm is used.

*. The mean difference is significant at the 0.0083 level.

Table IV-16: Results of multiple comparisons on mean height and mean rim radius of Shi'erqiao samples by time

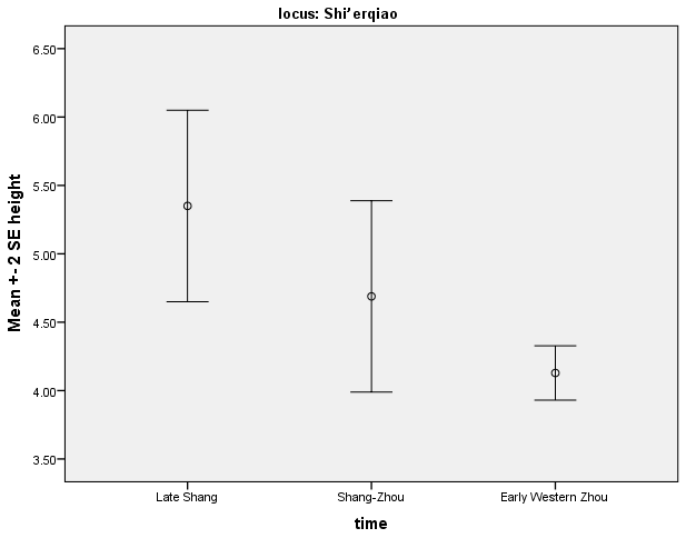


Figure IV-35: Error bars of the variation of mean heights over time, at Shi'erqiao

This testing on the variation of rim radius and vessel height, which are related to vessel shapes and sizes, demonstrated patterning in the variability and standardization of pottery through time and space. It also compared the within-group and between-group differences. It was found that the variances in rim radius and height are divergent during different time phases. During the Late Shang period, pots from Sanxingdui, particularly the A group, are highly standardized in rim radius, The small variances of Sanxingdui vessels can be represented by their small *CVs* (2.5% and 6.1%) in rim radius and the comparatively condensed error bars in the graphs (e.g., Figure IV-28 and Figure IV-32). It is possible that these highly standardized products were produced in a batch to fulfill the need of the special event responsible for the deposition of the sacrifice pit K1. For all of the later groups, no single locus or context seems to have achieved the same control level in rim radius, even Jinsha-Meiyuan, another site thought to be a ritual center. There is no evidence supporting the idea that *jiandi zhan* had become more and more standardized through time either. During the Shang-Zhou period, the variance of Shi'erqiao samples is very large in both rim radius and height (*CV*=20.5% and 22.4%, respectively).

Moreover, a Shi'erqiao locus—Minjiang Xiaoqu produced smaller *jiandi zhan* that were narrower and shorter than those discovered from other contemporaneous sites. The contemporaneous Jinsha loci tended to produce large *jiandi zhan* whose rim radii are controlled within a small range of variation (<7%). During the Early Western Zhou period, the Shi'erqiao *jiandi zhan* further became smaller comparing to previous phases. On the other hand, some of the Jinsha loci, such as Jinsha-Boyatingyun and Jinsha-Huangzhong Road Line A and B, began to yield shorter *jiandi zhan* while the other loci, such as Jinsha-Huangzhongcun and Jinsha-Xinghe, continued to yield wider and taller products. The two categories of vessel heights were separately produced at different locations of Jinsha but this distinction does not seem to be related to the contexts from which the vessels were discovered. Besides this grouping, generally, variances of height tend to be larger than those of rim radius in most situations. This greater variance in vessel height is a result of both the effects of time and location and their interaction effects.

From the perspective of space, the two closely located loci, Shi'erqiao II and Xinyicun (*CV* =20.5% and 16.2%, respectively), both have high variability in rim radius. The variability of the former is larger than other contemporaneous loci of the Jinsha site cluster and even than their combination (*CV* = 7.8%). The less standardized vessel dimensions in Shi'erqiao and Xinyicun suggests that pottery production in these loci was conducted in a loose way and there was less control over the vessel sizes. Another possibility is that the loci had a wider source of pots coming from other settlements and thus the vessel sizes appear to be multi-modal. This could be true for the case of Xinyicun while part of the stratigraphy of the locus is a secondary deposit, possibly disturbed and transported by river. From the distribution of data against rim radius versus height in the scatter plot (Figure IV-21), there might also be multimodality in the

Xinyicun samples. To clarify the possible reason for this requires further comparisons of other properties.

It is also worth noting that though *jiandi zhan* of the Jinsha site cluster overall had reduced variability, the location Huangzhongcun from the Early Western Zhou, where the heaviest concentration of kilns has been found[121], does not feature the smallest variability in vessel dimensions. The clustering of pottery workshops and expanded production scale do not seem to have enhanced the degree of standardization of *jiandi zhan*. Nor did the Meiyuan sacrificial area reach a comparable degree of standardization to Sanxingdui. Conversely, it is the loci, Lanyuan and Huangzhong Road Line A and B, in which a few dispersed, small-scaled kilns mixed with large numbers of pits and burials, that feature the least variability.

Other than vessel size, standardization may occur across other attributes of pottery, such as color, firing temperatures and atmospheres, surface treatments, the sources of raw clays and their modification, the contexts in which the potteries were used, pottery quantity and usage in these contexts, and so on (e.g., Rice et al. 1981). Various tests on physical and chemical properties of ceramics as well as metric measurements are therefore needed to assess the differences and similarities between vessels and to evaluate the manufacturing techniques used by potters.

Other performance characteristics, such as surface abrasion resistance and use alteration, are also of concern and deserve scrutiny. These include surface attrition, organic residues, and carbon deposits, as James Skibo (1992) notes. According to past studies of the relations between such alternation and use, the deposition areas of soot and carbon as well as the abrasion pattern on a vessel can help identify its distance from the fire and the use activities of the vessel. It is suggested that, for instance, linear scratches found on the mid-exterior side is probably caused by washing, whereas abrasion traces on the interior side could be related to stirring (Rice 1987:234;

[121] 17 small-scaled kilns scattered around 17 large buildings.

Skibo 1992:123, 142). Organic residues are also useful for researchers as a way to recognize the cooking subjects (i.e., whether the fatty acids are derived from vegetables oils, animal fats, or fish oils) (Tite 1999:209).

Under similar examination, our samples of pointed-bottom vessels do not display any apparent abrasion or use wear on the surfaces of their exterior sides. Nor do they have traces indicating that they had once been situated over fire for some span of time. The finely coarse or coarse clay of *jiandi zhan* and *jiandi guan* and their slipping on both sides may, however, make them suitable for moderate firing and still be able to hold liquids effectively. On one hand, the pointed bottoms make the vessels unstable when situated on the ground. This is especially true when some of the bottoms were only roughly finished with redundant mud lumps. On the other hand, some of the others have small yet flat bottoms allowing them to stand, though somewhat unstably (Figure IV-12). In the latter case, the bottoms or the edges tend to be unslipped or have their slips abraded off. They might sit directly on the ground without vessel stands. Scrapes of slips, scratches, chips and pits accompanied by the removal of tempers are occasionally present in the interior side of *jiandi zhan*, especially in the upper bodies—the rims and extrusive collars. These could be caused by the hits of ladles or the like. Yet, they do not seem to form an attrition pattern that would otherwise have suggested frequent abrasion during cooking (i.e., caused by stirring contents) (Skibo 1992:115). The interior walls have soot deposited in a few cases. This wear from use and carbon or soot deposition are hardly seen in fine-grained *jiandi bei*, however, and both *jiandi bei* and *jiandi zhan* lack fireclouds or patterned grooves. Finely fabricated *jiandi zhan* were occasionally discovered from Jinsha, yet their dimensions and the contexts in which they were found do not show difference from coarse *jiandi zhan*. This mostly random wear and alternation, combined with the shapes and volumes of the vessels (*ca.* 600-850 milliliters for

jiandi bei[122] and *ca.* 250-450 milliliters for *jiandi zhan*[123]), suggests that the vessels were used for serving or light warming rather than heavy cooking. As mentioned above, one use of *jiandi bei* was probably as liquid dippers, as suggested by an archaeological find. It is also possible that the vessels were made at such a high temperature that they were not as susceptible to use and cleaning abrasion as common, low-fired pottery (Skibo et al. 1997:312). Further examinations with microscopes and in firing temperature will be required to confirm these speculations.

3.2. Mineralogical analyses

In addition to examining complete or recognizable vessels, more than two hundred ceramic sherds from Sanxingdui[124] (28), Jinsha[125] (145), Shi'erqiao-Xinyicun (68), and the Wang Jian tomb[126] (12) were cut into cross sections that are suitable for examination under magnifiers. The textures, joints, building techniques, surface treatments, clay nature, firing conditions, colors, and so on are observed. Based on initial observations, I chose representative samples for further analyses. These include mineralogical analyses in the following.

Mineralogical analyses, with the aid of special instruments and a preliminary knowledge of the background geological environments that were discussed in Chapter III, provide information for identifying the constituent minerals, their structure, and orientations in details that cannot otherwise be achieved through visual examination. This information in turn is useful for inferring the selection of clay materials, forming techniques, and tempering behaviors.

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[122] Given the rim radius is 4.5 cm and the height is 12-15 cm on average.
[123] Given the rim radius is 6 cm, the base radius is 1 cm, and the height is 4-6 cm on average.
[124] All samples are from the 1999 excavation at Yueliangwan.
[125] Except the kiln wasters that are from the Yangguang Xiaoqu locus, all samples are from the Meiyuan sacrificial area.
[126] The site is named after the Former Shu emperor Wang Jian (AD 847-918), who built his kingdom (AD 907-967) in Sichuan. Although the site is famous for the emperor's tomb, underneath it, the earlier strata yielded *jiandi zhan* from the Warring States period comparable to the late Shi'erqiao-Xinyicun (*Archaeological discoveries of Chengdu 2009*, forthcoming).

Two such methods undertaken here are petrographic analysis and X-ray diffraction analysis. They will be discussed below and the samples examined in these analyses are listed in Table IV-17 with more details in the Appendix IV-Table 2. Briefly, samples are drawn from the localities of Sanxingdui, Jinsha (including kiln wasters), and Shi'erqiao-Xinyicun (the 2010-11 locus) with time phases shifting from the Early to the Middle Bronze Age. While the metric measurements in section 3.1.4 were designed to determine metric patterning in pointed-bottom vessels, mineralogical tests here and chemical analysis in the next section additionally include sherds from other vessel types such as *xiaopingdi guan.* A few kiln wasters were also taken as control data to provide information on local products and other types of vessels.

Analysis	*Samples*
XRD	Sanxingdui (Bronze II = early Western Zhou): SXD-001f, SXD-002f, SXD-003f. Jinsha-Meiyuan (Bronze II): Jin-001f, Jin-002f, Jin-003d. Shi'erqiao-Xinyicun (Bronze III = late Western Zhou):12-001d, 12-002d, 12-003d, 12-004d, 12-005d, 12-006d, 12-007d, 12-008dj, 12-009d, 12-010d, 12-011d, 12-012d, 12-013d, 12-014d, 12-015d, 12-016d, 12-017d, 12-018d, 12-019c, 12-020j, 12-021j, 12-022t, 12-023t, 12-024f, 12-025f. Jinsha-Meiyuan (Bronze III): Jin-004d, Jin-005d, Jin-006d, Jin-007c, Jin-008c, Jin-009d, Jin-010f. Jinsha-kiln[127] (Bronze III): Y55-01rf, Y55-002rf, Y64-02rf, Y51-01f, Y71-01f.
Petrography	Including the samples from XRD plus: Shi'erqiao-Xinyicun (Bronze III): 12-026f, 12-027f, 12-028f, 12-029t, 12-030c, 12-031, 12-032c, 12-033c.

Table IV-17: Samples used in the mineralogical analyses

3.2.1. X-ray powder diffraction analysis (XRD)

XRD is designed to identify individual minerals in pottery and gives information about the crystalline substances, as each mineral has its own unique atomic lattice arrangement

[127] From the Yangguang Xiaoqu locus, unpublished.

(Weymouth 1973:339; Rice 1987:382). When X-rays with certain wavelengths scan through powdered samples, the lattice planes of samples will diffract the wavelengths. Each diffracted beam can then be measured and compared to the reference values to identify the crystal. These crystalline substances can be either deliberately added tempers or non-plastic inclusions originally present in the clay. The XRD analysis does not help to differentiate tempers from other non-plastic inclusions, though, unless further examination, such as petrographic analysis or scanning electron microscope (SEM), is undertaken. The precise quantities of the detected minerals cannot be determined either. Only the relative contents can be discovered. Despite these uncertainties, the test allows us to identify mineral phases and their relative abundance in a quick manner. It is also beneficial to the identification of minerals that may otherwise be too small or obscure to be missed under microscopes. With mutual reference, XRD and petrographic analysis can be complementary methods to confirm the existence of certain minerals.

In this process, 42 samples of sherds (Table IV-17) were milled into fine powder by using an agate mortar and pestle after the samples have been cleaned by an ultrasonic instrument and air-dried, which is designed to remove surface precipitation and contamination from postdepositional environments and excavation handling. Some samples were also scraped off the slips or the surface layers. The powder was then scanned under X-ray at a scattering angel of 2θ =3 to 60 degrees[128]. Through the diffraction of the X-ray at certain angles, the existence of particular minerals can be detected. For example, if quartz is present, a series of peaks are expected to appear at around 2θ =21, 27, 39, 41, and 50 degrees with varied intensity.

The testing result shows that most samples have similar mineral phases. All contain quartz as the primary phases accompanied with a variety of mica and feldspars, including alkali feldspar

[128] This was performed by using Rigaku DMAX II/C with copper source radiation (wavelength $CuK\alpha_1$=1.54056 nm) that scan with a rate of 2^{O}/min. The accuracy is within 0.02 degree. The examination was conducted in the Archaeometric Laboratory of the Academia Sinica, Taipei, Taiwan.

(e.g., orthoclase, sanidine, and microcline) and plagioclase (e.g., albite, andesine, and anorthite). A few also include mineral phases of illite, chlorite[129], calcite and/or aragonite. According to the presence and absence of certain principal mineral phases, samples are grouped as Table IV-18 below and Appendix IV-Table 3. Appendix IV-Figure 1-5 also illustrate the XRD spectra of representative samples that are drawn based on the testing results of the two-theta degrees against their corresponding intensity. The grouping has sometimes violated the preliminary characterization of 'fine' and 'coarse' wares based on cross-section specimens and suggested further divisions within each vessel type and site. On the one hand, it conforms to our expectation that fine wares tend to include fewer 'impurities'. In fact, only limited kinds of mineral phases other than quartz and muscovite have been detected with low density in 'fine-wares' samples (e.g., Jin-001f and Y51-01f). In these 'fine-ware' samples, peaks occur at $2\theta \approx 28$ degree, which may indicate the presence of such minerals as muscovite, anorthite, and albite. They are, however, normally in lower density than those seen in coarse-ware samples.

It should be noted that, however, the XRD analysis can only document the kinds of contained minerals but not their size, shape, sorting or distribution in the clays. It is highly possible that fine and coarse wares may contain the same kinds of minerals if the clay resources are the same. The levigation and tempering processes employed to produce fine or coarse wares may have changed the quantities of the inclusions but do not seem to have changed the kinds of contained minerals significantly[130]. This also suggests the closeness between the plastic bodies and tempers in these cases. Though coarse wares do not notably diverge from fine wares in mineral compositions, their texture—the mineral size, angularity, and orientation—making them

[129] Both illite and chlorite could be associated with the rich mica substances in the samples.
[130] For fine wares, clays were levigated to remove impurities, plant roots, and so on before a small amount of ash, grinded silt, or sand were added in to fortify the clay bodies, which would or would not introduce other varieties of minerals and rocks. If these deliberately added tempers were adopted from nearby loci, it is likely that the tempers would still be close to the natural inclusions in the clays.

felt 'coarse'. The difference between textures in turn is centered on how raw clays have been processed. The forming techniques may be better studied by petrographic analysis (discussed below).

The grouping here is a preliminary characterization based on the mineral phases detected in the samples. The characterization does not always conform to the distinction of vessel types and sometimes mix samples from different periods and loci, suggesting that these closely situated loci were similarly influenced by a larger geological setting during different periods. Although not all mineral phases are detectable due to the noises or blocks caused by dominant minerals (e.g., quartz), and although the precise volumes of the minerals are unknown, the method is useful in reflecting the variations among samples. Identifying the disappearance and appearance of certain minerals, such as calcite[131] and mullite[132], also helps us to understand the rough firing temperatures of the ceramic samples (e.g., Rice 1987:100). In the following, data from petrographic analysis and firing-temperature tests will be further integrated and cross-referenced.

Samples	Mineral phases obtained from the XRD analysis
12-001d	**a. Quartz, Alkali-feldspar[133], Plagioclase[134], Carbonate group[135], Silimanite, Magnetite/Humite**
12-002d	**b. Quartz, Mica[136], Alkali-feldspar, Plagioclase, Pyroxene group[137], Illite, Montmorillinite**
12-003d, 12-008dj, 12-018d, Jin-006d, Jin-009d	**c. Quartz, Mica, Alkali-feldspar, Pyroxene, Magnetite/Humite**
12-004d, SXD-001f	**d. Quartz, Mica, Alkali-feldspar, Plagioclase, Carbonate group, Pyroxene, Montmorillinite**
12-005d, 12-007d, SXD-003f	**e. Quartz, Mica, Alkali-feldspar, Plagioclase, Carbonate group, Pyroxene, Magnetite/Humite**

[131] Decomposes at around 870℃.
[132] Forms at around 1050℃.
[133] Such as sanidine, microcline, or orthoclase.
[134] Such as albite, anorthite, labradorite, or bytownite.
[135] Such as calcite, aragonite dolomite, or siderite.
[136] Such as muscovite, biotite, or phlogopite.
[137] Such as enstatite, augite, clinoenstatite, diopside, or pigeonite.

12-006d, 12-019c	**f. Quartz, Alkali-feldspar, Plagioclase, Pyroxene, Montmorillinite, Magnetite/Humite**
12-009d, 12-012d, 12-021j, Jin-010f, Y55-01rf	**g. Quartz, Mica, Alkali-feldspar, Plagioclase, Pyroxene, Montmorillinite, Magnetite/Humite**
12-010d, 12-011d, 12-015d, 12-016d, 12-022t, Jin-002f, Jin-008c, Y71-01f	**h. Quartz, Mica, Alkali-feldspar, Pyroxene, Montmorillinite, Magnetite/Humite**
12-013d, Jin-004d	**i. Quartz, Mica, Alkali-feldspar, Pyroxene**
12-014d, Y64-02rf, SXD-002f	**j. Quartz, Mica, Alkali-feldspar, Plagioclase, Pyroxene, Magnetite/Humite**
12-017d, 12-025f	**k. Quartz, Mica, Alkali-feldspar, Pyroxene, Illite, Montmorillinite, Magnetite/Humite**
12-020j	**l. Quartz, Mica, Alkali-feldspar, Carbonate group, Pyroxene, Magnetite/Humite**
12-023t, Jin-003d	**m. Quartz, Alkali-feldspar, Carbonate group, Pyroxene, Montmorillinite, Magnetite/Humite**
12-024f	**n. Quartz, Mica, Alkali-feldspar, Pyroxene, Montmorillinite**
Jin-001f, Y51-01f	**o. Quartz, Mica, Alkali-feldspar**
Jin-005d	**p. Quartz, Mica, Alkali-feldspar, Plagioclase, Pyroxene, Montmorillinite**
Jin-007c	**q. Quartz, Mica, Alkali-feldspar, Plagioclase, Carbonate group, Pyroxene, Illite, Montmorillinite, Magnetite/Humite**

Table IV-18: Result of the XRD tests and the characterization of samples

3.2.2. Petrographic analysis

In the above, cross-section specimens and XRD characterization provide preliminary information about the textures and mineral compositions of the clays. To further understand the ways ancient potters processed their raw materials and to distinguish deliberately added tempers from nonplastics, I conducted a petrographic analysis. Petrographic analysis is used to examine the texture and structure of the minerals constituting ceramics through polarized microscopes (Peacock 1967, 1970; Kerr 1977:13-50; Rice 1987:372; Gribble and Hall 1993:1-34; Rapp and Hill 1998:149). Based on the crystal symmetry and optical characters of minerals, not only can individual minerals be recognized, but their abundance, the fabric features, the association and combined ways between minerals, the orientations formed by grains and cracks, and the mineral alternation or recrystallization can all be studied. These features in turn can indicate manufacturing techniques, technological choices, and even the uses of the vessels. The method has been thought useful in offering information about production traditions, given the assumption that potters of the same production traditions tend to adopt the same clay and temper

sources and develop or maintain similar tempering behaviors (Rapp and Hill 1998:151). For this reason, the characteristics of mineral inclusions have been taken into account and serve as the indices alongside the outward appearances for standardization and characterization of ceramics (e.g., Blackman et al. 1993; Rapp and Hill 1998; Reedy 2008; Quinn 2009).

In this analysis, 50 vessel shards (Table IV-17), 42 of which are the same with those examined in the XRD analysis, were taken for petrographic observation (Appendix IV-Table 2). Samples are prepared in slices of thin sections, each of which is thirty microns thick (or 0.03 mm). They are then observed under two polarized microscopes, Leica DM2500 and Olympus BX51, with both plain- and crossed-polarized light built in. With the optical characteristics of minerals (e.g., Kerr 1977; Nesse 2009) exhibiting under the microscopes, grains larger than silt size (*ca.* 0.0625 mm) can be identified. From past studies in archaeological and ethnographic materials, researchers have suggested that particles larger than 60 μm (or 0.06 mm) should be thought of as deliberately added tempering materials (e.g., Tite 1999:195). Although not an absolute standard, this rule serves a rough reference point. Other factors such as the shape of the inclusions and the conditions of the clay matrix are also taken into account. That is, in addition to the identification of minerals and the varieties of rock fragments (i.e., igneous, sedimentary, or metamorphic rocks), particle size along with their intensity, sorting, roundness, and sphericity have been assessed as these are relevant to the tempering practices and allow us to distinguish tempers from natural inclusions. Also, as far as forming techniques are concerned, the orientation and alignment of inclusions and voids, fissures, or cracks are also considered. As a result, each sample is described with a number of variables, such as the presence/absence of particular minerals, grades of roundness, sphericity, and sorting, the types of contained rock fragments, and so on. Variables used to denote samples are listed and explained in the Appendix IV-Table 4.

These samples are then classified based on their properties: clay texture, color, porosity, kinds of temper, grain size and sorting, and relative proportions of large inclusions (Appendix IV-Table 5).

The clay structure ranges from very fine, containing only small volumes of silty sands, to very coarse, loosely bonding many large inclusions that were poorly sorted. From an observation of thin sections, I found that all of the samples contain more or less angular inclusions other than the small grains (e.g., quartz, feldspars, and mica) originally existing in the groundmass of the clays. Except in a few cases, such as a thick, pointed-bottom small cup (*jiandi yu* 尖底盂) and several *xiaopingdi guan* from Xinyicun (12-023t, 12-025f, and 12-027f), nearly all of the coarse wares from the different loci share a similar clay matrix and only vary in the amount of large inclusions. These samples constitute the first group with a number of subgroups.

In group 1, the clay matrix is rich in mica and in lamination structure with elongated voids or fissures. It is also found that a large part of the samples in this group are fired in oxidized atmospheres and rich in hematite in the paste. The large inclusions are sub-angular or angular with varied degrees of sphericity and are poorly sorted. They are normally made up of quartz, feldspars, mica, rock fragments, opaque nodules, and iron and earth lumps and are distributed throughout the clay bodies. The commonly seen iron and clay lumps tend to be rounder. These lumps seem to have been accidentally introduced during the process of forming and/or tempering. Most rock fragments, in turn, are micaceous sandstone or its metamorphism and schist, although igneous rocks are also frequently seen. Limestone or marble can occasionally be recognized. The proportion of large inclusions tends to be high in this group and their poor sorting perhaps indicates less effort in selecting and processing the temper materials which might be locally acquired. Meanwhile, grogs of similar constituents as the clay matrix are present in a number of

cases and appear sub-rounded to sub-angular. The similarity between temper and paste would have enhanced the heat resistance of the ceramics as the heat expansion of the two parts is consistent. Moreover, the elongated grains and fissures are often oriented to a certain direction, suggesting either vertical smoothing from the vessel bottoms to the lips (or the opposite direction) or horizontal smoothing, especially if a potter's wheel was adopted, during and after forming. This process of smoothing has often caused the additives to drift outward the vessel surfaces. Fissures may also appear and surround large inclusions during smoothing. It is also possible that some fissures which look like long, thin channels were caused by organic fibers that had been burnt away during firing.

A few subgroups or 'outliers' exist under this general heading. The clay and additive types of the subgroups are generally alike but they only differ in minor aspects. For example, group 1.b differs from group 1.a in containing calcite or other carbonate-rich rocks. Group 1.c accounts for samples that were largely affected by reduced atmospheres and appear to be dark grey in their cores. Amphibole is often seen in this group. Both groups 1.d and 1.h contain many "medium-sized" inclusions (*ca.* 0.3 mm). 1.h further differs from 1.d in having fewer large grains (only less than 3%) and cracks. As seen in the Figure IV-36, the "medium-sized" grains and cracks in 1.h are very abundant. Groups 1.f and 1.g are samples of the same mineral and rock compositions as other subgroups though they contain fewer (*ca.* 5%) large inclusions and voids. Their overall texture is therefore finer and more compact than other subgroups. Samples from these groups (1.f and 1.g) suggest that they were made more carefully. The abundant white or transparent minerals make them look reflective. 1.g differs from 1.f in that 1.g does not contain as much reflective minerals as 1.f. In addition, 1.g is more grayish in color. The features of each subgroup are summarized in the Table IV-19. Figure IV-36 shows the overview

photomicrographs of the representative samples from each group, by which clay matrices of different groups are juxtaposed for comparisons. Detailed pictures with featured minerals or rocks are illustrated in the Appendix IV-Figure 6-29.

Group 2 consists of not only fine wares but also a few samples that were categorized as "coarse wares" in the observation of hand specimens. The clay matrix is still full of small quartz, feldspars and needle-shaped or blanket-like mica minerals. However, these samples differ from group 1 mainly in the amount of large inclusions (often less than 1%). Moreover, the clay matrix is often very well sorted, making it appear homogeneous. The only few larger grains are usually angular and evenly distributed, among which quartz, feldspar, and metamorphic rocks are the most common. Unlike group 1, more opaque nodules and less iron lumps are contained in the clays of group 2. It is possible that the clays were levigated before tempers were added and that the tempers seem to have been carefully processed such that they are all in the similar size. Although only containing small amounts of temper material, the kinds of these larger inclusions are similar to the recognizable small grains in the clay matrix. Whereas the clay matrix itself is of a very fine texture and well sorted, some samples contain grogs from fragments of coarse wares (e.g., Jin-001f). The careful processing of the clay matrix and lack of extra large inclusions make the clay more condensed and less porous. It is also usual that vessels of this group were slipped and fired under an atmosphere that multiple color zones formed from the outside surfaces to the cores (e.g., light brown to dark grey). Without many voids, orientations can still be seen among the small grains in the paste. Calcite seems absent in this group.

Group 3 consists of only two samples. They contain less than 5% of large inclusions and are made of a very fine clay matrix like the samples in group 2. They differ from group 2 in that they are white or pale color not simply because of reduced firing but mostly due to their special clays.

Indices of forming technique such as porosity and void/grain orientation, however, are similar to those of other fine wares in group 2. Because the observable additives are limited, how the clay differs from that of group 2 requires further examination of it chemical compositions and will be discussed again in the next section.

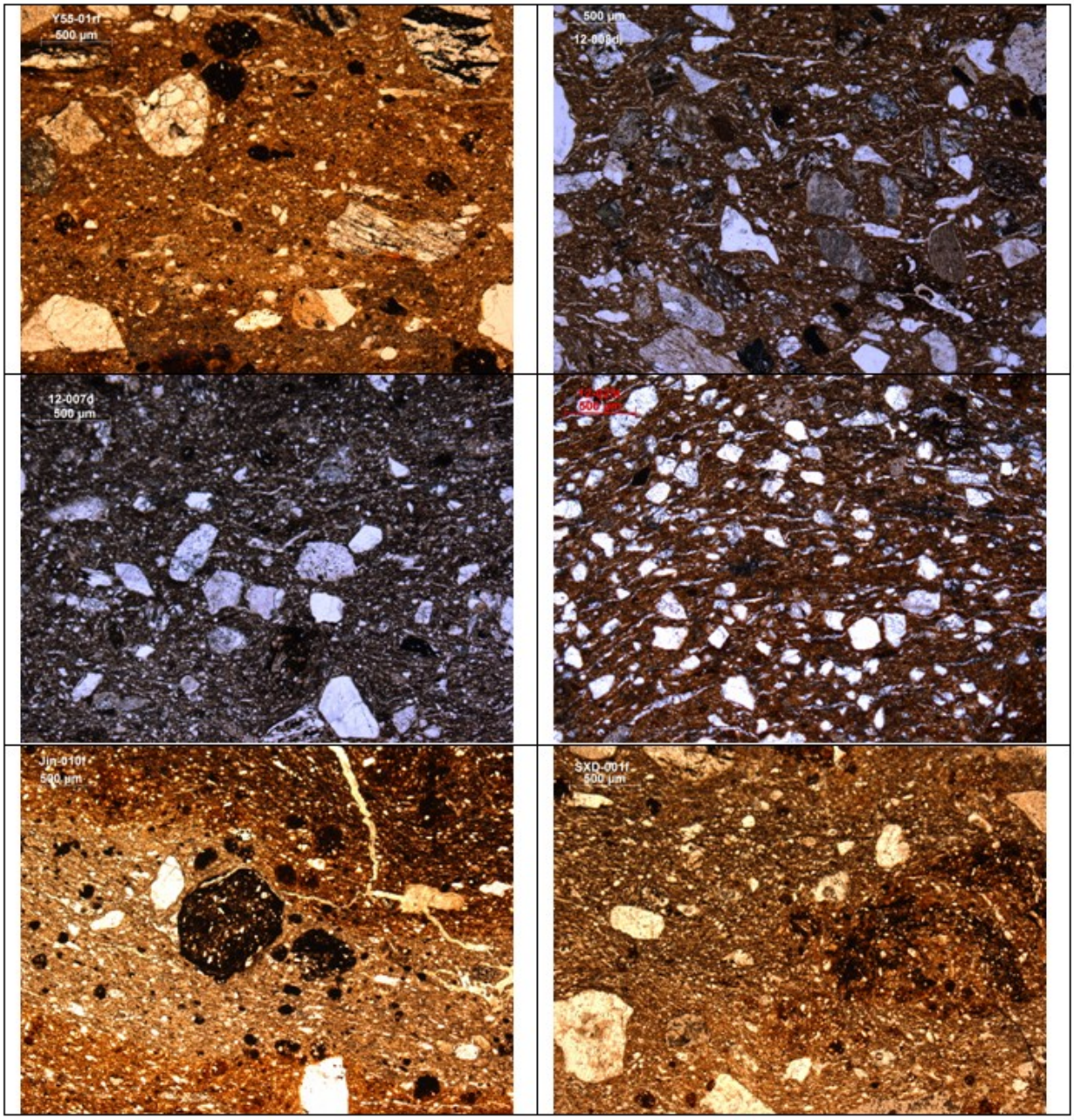
In group 4, samples contain large inclusions varying in a wide range between 1% and 20%. Two subgroups 4.a and 4.b are divided based on the proportions of inclusions and porosity. In this group, the texture of the clay matrix might be close to the samples from group 2, but contains much more small and medium-sized (*ca.* 0.1-0.4 mm) grains in the background. It is however finer than common coarse wares in group 1 and more or less lies in between coarse and fine wares. Except 12-022t, grain- or void-alignments may occasionally occur but are not as obvious as the samples in other groups. Another common feature shared by these samples, but differentiates them from other groups, is the abundance of opaque minerals. The amount of opaque minerals they contain apparently exceeds the samples from group 2. They lack for iron and earth lumps, however.

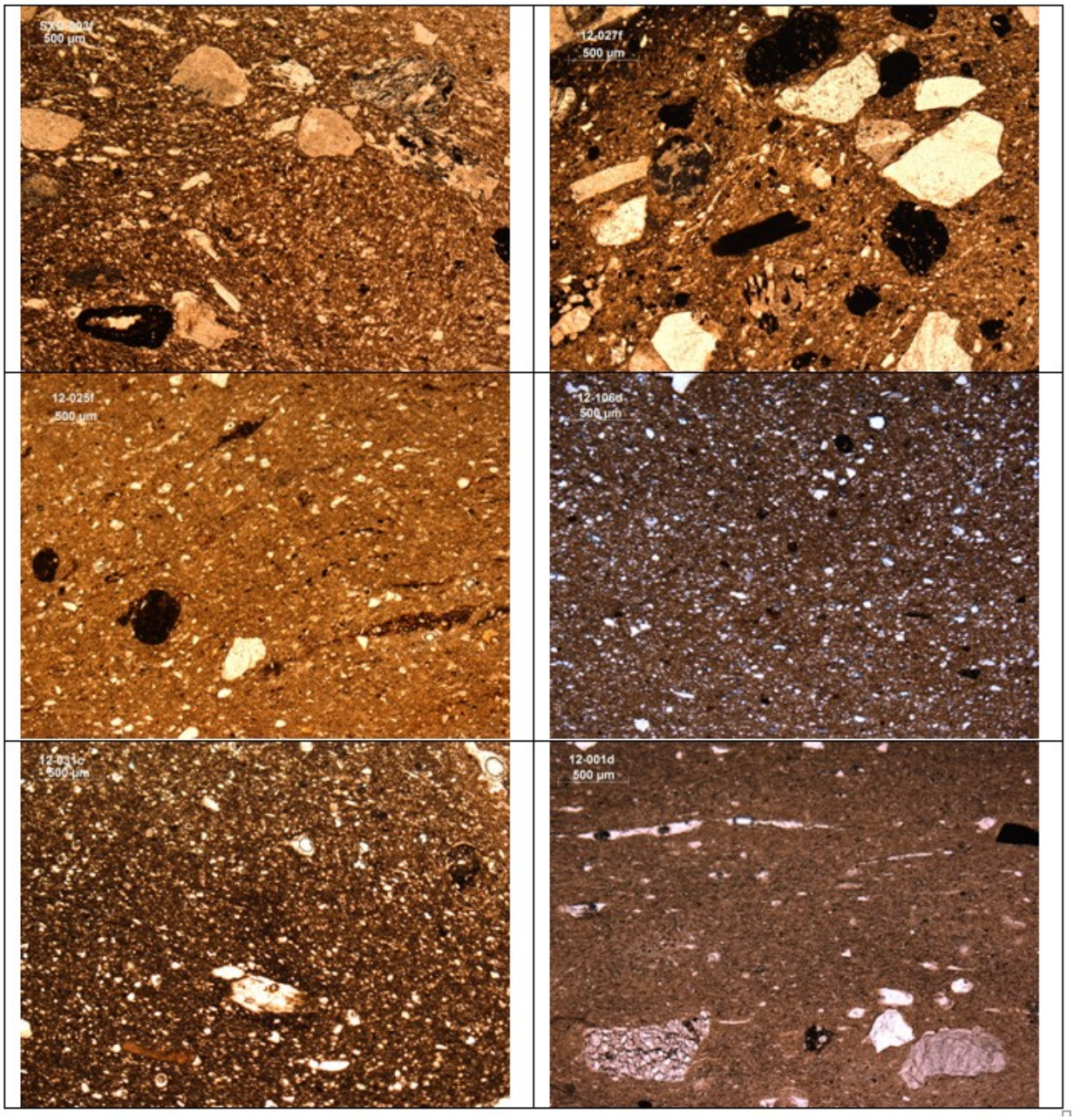
Fabric types	Samples	Features
1.a	12-012d, 12-020j, 12-026f, 12-028f, Jin-002f, Jin-004d, Jin-005d, Y64-02rf, Y55-01rf	The texture is from coarse to very coarse, filled with cracks, voids and large inclusions. The distribution of grain size is roughly bimodal, in which larger grains are about 0.5~0.8 mm long on average and small grains in the groundmass less than 0.06 mm. The large inclusions usually account for 10-15% of the paste and can sometimes reach 25% in a few cases. The large inclusions are often composed of quartz, feldspars (more frequently as alkali-feldspars although plagioclase is not rare), and mica schist. Pyroxene and amphiboles are occasionally found. Both igneous and metamorphic rocks can be identified in this group. Metamorphic rocks, such as mica schist and transformed, bending biotite, are very common. Metamorphic gneiss is also present (Appendix IV-Figure 6). Sedimentary rock structure can sometimes be identified. Besides these common minerals and rock fragments, clay lumps and iron oxides are present in all cases in this group. They could be accidentally introduced together with clay or during tempering.
1.b	12-002d, 12-003d, 12-005d, 12-008dj, 12-009d, 12-010d, 12-011d, 12-013d, 12-014d, 12-021j, 12-024f, Jin-003d, Jin-006d, Jin-009d	The inclusions are very angular accompanied with many cracks. The clay matrix and types of inclusions are same with subgroup 1.a but samples contain calcite or limestone. Some samples (e.g., 12-008dj) are especially rich in calcite. Metamorphic rock fragments such as mica schist and gneiss are common (Appendix IV-Figure 8, 9). Igneous (e.g., diorite and granite) and sedimentary rocks (e.g., limestone) are also present (Appendix IV-Figure 10, 11). Amphibole and pyroxene are occasionally found (perhaps associated with diorite) (Appendix IV-Figure 12-14).
1.c	12-004d, 12-006d, 12-007d	The fabrication is same with subgroup 1.a except that samples were fired mainly under reduced atmospheres. Amphibole can be identified (solely or contained in plutonic rocks) from this group. Igneous and metamorphic rocks are frequently seen (Appendix IV-Figure 15, 16).
1.d	12-023t	Texture is finer than subgroups 1.a-1.c with better sorting, smaller inclusions, and higher sphericity. There are still many cracks. Similar kinds of minerals and rock fragments as seen in other subgroups but appear smaller (*ca.* 0.3 mm). These "medium-sized" grains are evenly distributed. The groundmass is also close to other subgroups but strongly oxidized.

1.e	Jin-010f	Texture is finer than subgroups 1.a-1.c with fewer voids. Having the same clay matrix as subgroup 1.a but the proportion of the temper differs from other samples—large, angular rock fragments, including sedimentary, igneous, and metamorphic rocks, are more abundant than individual minerals (Appendix IV-Figure 17). Oxidized outside and grey in the core, both of which contain many iron oxides. The separation of different color zones is sharp (Appendix IV-Figure 18).
1.f	SXD-001f, SXD-002f	Made of the same type of clay and temper as the other subgroups but with finer texture than subgroups 1.a-1.c—containing less voids and cracks. Large particles account for only about 5% of the clay bodies. Iron oxides are still rich. Diopside seems more abundant in this subgroup, making the samples slightly reflective.
1.g	SXD-003f	Made of the same type of clay and temper as the other subgroups but with finer texture than subgroups 1.a-1.c. The groundmass is close to 1.f but contains less diopside-like minerals. Besides, the orientation of small grains is more obvious. Although the sample was fired to be grey color, it contains oxidized grogs. The sample contains only about 5% large particles. Metamorphic and volcanic rocks are still abundant (Appendix IV-Figure 20).
1.h	12-025f	The aligning pattern of the clay minerals is clear (parallel to the walls). Many medium-sized (*ca.* 0.3 mm) quartz and sanidine are present in the background. The sample contains only a limited number of large grains (1-3%) and only metaphoric rocks are seen. However, iron lumps can be very large.
1.i	12-027f	Containing abundant opaque nodules. Most quartz and feldspars are in the medium size and the sample contains a high proportion of these inclusions (15-20%), which are very poorly sorted.
2.a	12-015d, 12-016d, 12-033c, Jin-001f, Jin-007c, Y51-01f, Y71-01f	The texture of the samples in group 2 is generally very fine, containing much fewer large particles (usually less than 1%).The small inclusions are angular or sub-angular and mainly composed of quartz, sanidine, and mica. They are well sorted. Small pyroxene and amphiboles may occasionally be found. Clay minerals are well aligned. Voids and cracks are reduced and less visible in this group. Most of the samples are not rich in hematite in the paste. However, many of them still contain iron earth lumps (Appendix IV-Figure 21). Tempers may also include grogs of similar constituents with the clay matrix. If samples were slipped, the slip layers produced a clear separation from the cores. The contents and kinds of rock fragments are limited. Metamorphic rocks are probably the most often seen

		(Appendix IV-Figure 22).
2.b	Jin-008c, 12-030c, 12-031c, 12-032c	This subgroup is slightly coarser than group 2.a. The paste of the samples is full of small-sized grains (*ca.* 0.1 mm). These grains and clay minerals are aligned and in good to very good sorting. Large inclusions more than 0.3 mm are occasionally present but only rare. Iron earth lumps are not as common as other groups. Grogs are not seen. The amounts and kinds of rock fragments are limited.
3.a	12-001d, 12-029t	The clay matrix is reduced, light grey to white color. Samples are finely woven with very few voids. Clay minerals in the groundmass are in well sorted. More large inclusions are present in this group than in other fine wares but are still very few (1-3%). The types of minerals and rocks are limited. Volcanic rock fragments can be identified. Transformed quartz is also present (Appendix IV-Figure 23, 24).
4.a	12-017d, 12-018d 12-019c	Containing abundant opaque nodules and small-sized grains (*ca.* 0.1-0.3 mm), larger than clay minerals. The clay minerals and small inclusions are strongly aligned. The proportions of large particles are low, less than 5%. The texture is from medium to good and porosity from medium to low. Samples' texture is coarser than group 2 but still notably finer than group 1. Particles are well sorted. The amounts and kinds of rock fragments are often limited. Metamorphic and volcanic rocks can be identified (Appendix IV-Figure 25-26). Amphibole is occasionally present (Appendix IV-Figure 28).
4.b	12-022t	Like 4.a, the contained grains are in small to moderate sizes but the sample has much more inclusions and cracks or fissures than 4.a (*ca.* 20%). The inclusions and fissures are well aligned. The sample is coarse than 4.a but the sorting is still better than group 1. Large clay lumps are occasionally found (Appendix IV-Figure 29).

Table IV-19: Fabric details and classification of the pottery samples according to petrographic analysis


Y55-01f
500 μm
500 μm
12-007d
500 μm
500 μm
Jin-010f
500 μm
SXD-001f
500 μm


500 µm
12-027f
500 µm
12-025f
500 µm
12-106d
500 µm
12-001d
500 µm

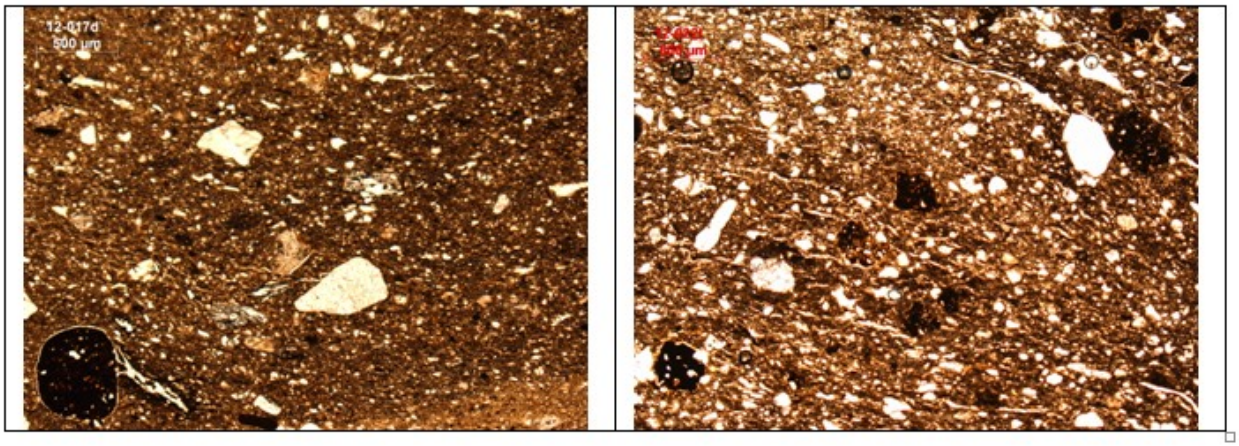


Figure IV-36: Photomicrographs of each group, an overview
(all taken in 5x magnification and under plain-polarized light)

Through this observation of the petrographic structure, production technology such as the selection and processing of raw clays and temper materials can be scrutinized. The forming techniques and firing conditions may also be inferred through the presence or absence of certain minerals as well as the color of the clay matrix. Moreover, we may compare data regarding ceramic compositions with the local geological background to estimate if the clay and temper sources were locally available. A study on the paleoenvironment of the Jinsha site indicates that the bedrock of the area is composed of sedimentary rocks with granite and quartzite (Fu Shun et al 2006:71). The clayey silt covering at the top of it often contains iron nodules. This has conformed to our inspection of the clay matrix of the ceramic samples. After careful examination, I suggest that all of the potsherds brought for petrographic analysis are clearly tempered. Not only were the raw clays of the so-called "fine wares" thoroughly levigated and then deliberately added well-processed and sorted tempers, but the coarser wares were also commonly tempered and smoothed though in a less careful way. The examination shows that the tempers were normally prepared in such a manner that sands and broken ceramics (grogs) were crushed to be angular and in roughly the same size to the naked eye. The inclusions consist of igneous and

metamorphic rock fragments along with common minerals. It is not difficult to find similar rock types in Chengdu and nearby areas and possibly upstream mountains. Their existence supported the plastic clays from shrinkage and collapse during drying and firing (Rye 1976). Furthermore, the potters were able to select silt-sand additives essentially similar to the plastic clays, such as grogs, or additives that enhance certain properties of the clays, such as shell, mica, and granodiorite. These deliberately added additives would have protected pots from successive reheating and cooling during cooking (Knight et al. 2003:119). They might have also increased the hardness and/or artistry of the vessels. As the acquisition of tempering knowledge often requires a long accumulation of experiences, the presence of grogs, shell fragments, and other characteristic materials together with the careful processing may suggest the presence of experienced crafters that were aware of the associations between the tempering material and the resultant performance of vessels and were able to make the technological choices.

Because the kinds of minerals and rock fragments serving as temper materials in the samples under study are somewhat similar to those contained in the stone tools and ornaments from Sanxingdui and Jinsha (Su Yongjiang 1996; Sichuan 1999:500-521; Yang Yongfu et al. 2002), it is possible that the materials were not difficult to access in the Chengdu Plain. The varieties of rock also reflect that the plain was the lowland to which soils were brought from nearby mountain areas. On one hand, most of the potsherds under study demonstrate similarity in the source(s) of both plastic and non-plastic materials and were formed and smoothed in a similar manner. On the other hand, levigation and tempering behaviors were not equally performed on these potsherds. The divergent processing of raw materials and additives leads to the variation in the samples' texture from the porosity of the clay matrix to the grain size,

distribution, and amount of tempers. Pots might also have been fired in varied conditions and temperatures, making the groundmass appear to be different in the paste color.

The similarities cross the separation of vessel types and divisions of sites suggest that different production units, whether they were individual households or workshops, were influenced by large environmental resources. The distinction between Shi'erqiao-Xinyicun or Jinsha samples and Sanxingdui, however, suggests that the corresponding production units also developed and were affected by their local manufacturing customs.

3.3. Chemical analysis— X-ray fluorescence (XRF)

In addition to mineralogical studies, chemical analyses also provide valuable information to access production technologies. Like other scientific studies on ancient ceramics with modern instruments, although ancient potters might not have used the same knowledge system to classify the composition and structure of the raw materials as we do today, the properties of clays may still have been relatively clear to potters who chose their raw clays through experience. In this manner, distinctive chemical formulae may be translated into the diverse visual, tangible, and acoustic effects that potters expected to achieve. This propensity for certain effects that needed to be realized through particular clay usage was influenced by the crafters' habits and traditions. Different formula may therefore suggest varied working groups that tied to their individual manufacturing traditions and goals.

As to the methodology of chemical analyses, it is often assumed that ceramics made from the same clay source would behave similarly in chemical analyses and that the variation within clays from the same source should be less significant than that of different provenances. Nevertheless, since the late 1980s such an assumption has asked for reconsideration (e.g., Neff et al. 1989; Bishop et al. 1990; Pollard and Heron 2008:100). Because many environmental factors,

potters' practices (e.g., tempering and firing), and laboratory conditions can influence the visibility of original chemical compositions and the precision/accuracy of analytical results, operations and results need to be carefully undertaken and interpreted. It is also worth noting that different methods of chemical analysis, due to their sensitivity to specific groups of chemical elements, provide information in different dimensions (Chen and Wang 2003). For instance, while inductively coupled plasma-mass spectrometry (ICP-MS) can efficiently provide data for more than 50 chemical elements, including many trace elements useful in ceramic studies, the method cannot satisfactorily detect Si and Ca that are common in clays (Speakman and Neff 2002:138; Wu Jun 2009:17). Moreover, the preparation of specimens for this analysis is complicated and costly. However, due to its sensitivity to trace elements, the method is favored when pottery provenances are of concern. XRF, on the other hand, performs better in main and minor elements. It is less expensive and easier to prepare at the cost of reduced sensitivity comparing to ICP-MS and instrumental neutron activation analysis (INAA).

In this test[138], 68 samples from different sites were examined for their main, minor, and trace elements. That is,

1) main and minor elements: Na, Mg, Al, Si, P, K, Ca, Ti, Mn[139], and Fe (all in oxide forms), measured in percentage; and
2) trace elements: Rb, Sr, Zr, Cu, Zn, V, and Mn, measured in parts per million.

The specimens are from:

a. the Sanxingdui site cluster (16 samples, covering from time phase 0 to phase 2),

[138] Analysis was conducted in the archaeometric laboratory of Peking University, China. An EDXRF (energy-dispersive XRF) instrument XGT-7000 X-ray Analytical Microscope was employed (more configurations at: http://www.horiba.com/scientific/products/x-ray-fluorescence-analysis/micro-xrf-analyzer/details/xgt-7000-x-ray-analytical-microscope-488/). The general working principle of XRF is discussed in Pollard and Heron's chapter (2008:38-45).

[139] Some elements like Mn can be treated as major/minor element or trace elements, depending on their volume.

b. the Jinsha kiln cluster (7 samples, all from time phase 3),

c. the 2010-11 Xinyicun site (41 samples, all from time phase 3), and

d. the Wang Jian tomb site (4 samples, all from time phase 4).

In this analysis,

Time phase 0 (Bronze 0) refers to the period earlier than late Shang (before *ca.* 1300 BC);

Time phase 1 (Bronze I) contemporary with late Shang-Zhou (*ca.* 1300-1000 BC);

Time phase 2 (Bronze II) contemporary with early Western Zhou (*ca.* 1000-900 BC);

Time phase 3 (Bronze III) contemporary with late Western Zhou (*ca.* 900-800 BC); and

Time phase 4 (Bronze IV) contemporary with Eastern Zhou (after *ca.* 800 BC).

Samples were extracted from several types of pointed-bottom vessels (*jiandi zhan, jiandi bei*, *jiandi yu*, and *jiandi guan*), *xiaopingdi guan*, and kiln wasters from the Jinsha-Sanhe Huayuan site. Several interesting samples, though of unknown vessel types, were also included because of their special properties (e.g., clay color, painting, or carbon deposition). Their presence may perhaps provide further contrast between different clay and temper sources. They were cleaned, dried, and cut to expose the flat, fresh cross-sections before being examined. With the built-in optical camera, X-rays, produced by the X-ray tube (1.2 mm in diameter), can irradiate the samples at a carefully chosen range and switch between samples quickly. Considering the inhomogeneity of some samples, several of them were shot more than once and the average values of the measured elements were selected. The purpose is to compare pottery recipes of different vessel and clay types from sites of the Chengdu Plain, around which the clay sources are assumed to be close or only have minor variations, which is suggested by the mineralogical analyses. The comparison among these sites is also aimed to inspect if inconsistency in

manufacturing behaviors between the settlements or periods is significant. The results can be used to further support or contradict the above analyses.

Although the focus has been placed on time phase 3, a few cases from different time periods are also added to inspect how production behaviors might have changed over time. With this consideration, the Wang Jian tomb site, which is only 1.2 km distant from the Shi'erqiao and 3.2 km from the Jinsha site clusters, provides later data following the Xinyicun phase, while partial samples from Sanxingdui offer an earlier reference. As a result, a matrix of observations and variables were acquired (Appendix IV-Table 7and 8).

Each variable (element) calculates the mean, distribution, standard deviation, and so on at first (Table IV-20). Through observing the histograms, some variables such as NaO, P_2O_5, Mn (or MnO), and Cu are manifestly skewed, indicating possible outliers or errors in measurements. I then used multivariate analyses to cross-examine the latent patterns of the data and found that these variables seem unsuitable in describing the covariance of the cases. These elements were therefore removed from our consideration about grouping data.

It should be stressed that although the XRF is able to detect numerous compositional elements, not all of them are useful in suggesting grouping. Careless use of variables without judgment could not only mask the patterns but generate misleading results. For instance, some elements only play an unimportant role in accounting for the variations of items and some elements are in fact correlated to each other (Chen and Wang 2003). This may especially be true when elements, like the major and minor elements in our studied cases, are displayed in the form of proportions, by which they are naturally inter-correlated (Baxter 1994:14; Shennan 1997:298). Failing to take care of the relations between variables will cause a problem by giving certain variables too much weight during data evaluation. An inspection of variable-variable and

variable-observation relations is thus a requirement before any interpretation can be made. Such inspection should also help us choose representative variables whose variances can effectively account for the observations.

	Mean	Median	Std. Deviation	Variance	Skewness	Kurtosis	Minimum	Maximum
Na2O	0.67	0.68	0.12	0.02	-4.85	25.10	0.00	0.77
MgO	1.28	1.29	0.38	0.14	0.43	0.37	0.37	2.25
Al2O3	20.32	20.30	1.89	3.59	0.92	1.85	16.07	26.62
SiO2	62.46	62.48	3.74	14.02	0.11	-0.17	54.22	71.97
P2O5	1.78	1.34	1.57	2.46	1.07	0.70	0.00	6.37
K2O	2.77	2.74	0.46	0.21	0.02	-0.49	1.81	3.78
CaO	1.85	1.85	0.69	0.47	0.45	1.21	0.32	4.23
TiO2	0.76	0.75	0.12	0.01	0.53	0.25	0.55	1.11
MnO	0.10	0.06	0.16	0.03	5.24	33.38	0.01	1.18
Fe2O3	8.01	8.35	2.11	4.45	0.07	0.80	2.58	13.87
Rb	117	114	31	962	0	-1	59	197
Sr	192	176	84	7012	1	0	65	404
Zr	292	277	112	12513	1	3	89	736
Cu	87	45	180	32512	5	26	8	1130
Zn	105	95	50	2468	1	2	35	293
V	93	88	33	1097	0	0	27	175
Mn	524	231	1122	1259421	6	40	-22	8562

Table IV-20: Statistics of individual element from the XRF analysis

Both principle component analysis (PCA) and factor analysis (FA) involve a process of recognizing the correlations between variables while aiming to simplify the complexity by suggesting a new set of variables in a reduced number to represent the original ones. The new extracted variables are able to show the correlation effects between variables and compress the dimensions of the data matrix into two or three (Shennan 1997:265-307). Here, factor analysis is employed to calculate the communalities of variables, which represent how much a variable has in common with the others and how much it contributes to the newly generated factors. The major/minor and trace elements are divided into two parts during analysis as they are suitable for inquiring into different dimensions of pottery manufacturing—the major/minor elements may

offer information about levigating/tempering practices and the trace elements for the provenances of the clays, for instance. The analytical strategies are accounted for in the following.

1) Factor analysis on trace elements

First, factor extraction is applied to trace elements, most of which are correlative. The KMO and Bartlett's test (KMO=.795, p=.000) that measures the correlations among variables suggests that the case is suitable for factor analysis. Two factors are extracted in this process (initial Eigenvalues >1), in which Rb, Zr, V, Cu, Sr, and Zn correlate to factor one, and Mn correlates to factor two after "oblimin rotation"[140]. The two factors together account for 58.8% of the variance when the extraction method—Principal Component Analysis—is chosen (Table IV-21). The two factors are then used to produce scattergrams, by which the distributions of observations by clay texture, period of time, site location, and vessel type are demonstrated, respectively (Figure IV-37-Figure IV-40). We may then inspect the latent patterns from the scattergrams.

The results show that fine and coarse wares do not actually differ from each other in trace element compositions. Different vessel types, sites, and periods of time also largely overlap in trace-element distributions, although samples from Xinyicun are more dispersed and those from Jinsha (all kiln wasters) are relatively concentrated. Samples from Sanxingdui appear to differ in trace elements between Early Shang and Early Western Zhou. Whether the potters shifted their clay sources during different periods requires more sampling from other periods than Early Western Zhou. A few cases, particularly a sample from Xinyicun (no.10:12-042rp), are distant from the others. The special item is a red slipped sherd. It possibly comes from a nonlocal pot. However, this does not mean that all the seeming outliers have different clay sources or should

[140] After factors have been extracted, rotation is applied to the variables-factors matrix to manifest the relations between variables. The same operations were adopted during the factor analysis for major/minor elements.

be differently grouped. To suggest this, other tests or comparisons are required. For instance, if we look back to the mineralogical section (Table IV-18 and Table IV-19), no. 3 is not evidently distinct from other samples in mineralogical compositions.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3.059	43.707	43.707	3.059	43.707	43.707	3.051
2	1.057	15.093	58.800	1.057	15.093	58.800	1.202
3	.966	13.797	72.597				
4	.840	11.999	84.596				
5	.440	6.280	90.876				
6	.339	4.836	95.712				
7	.300	4.288	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table IV-21: Two factors are extracted from factor analysis

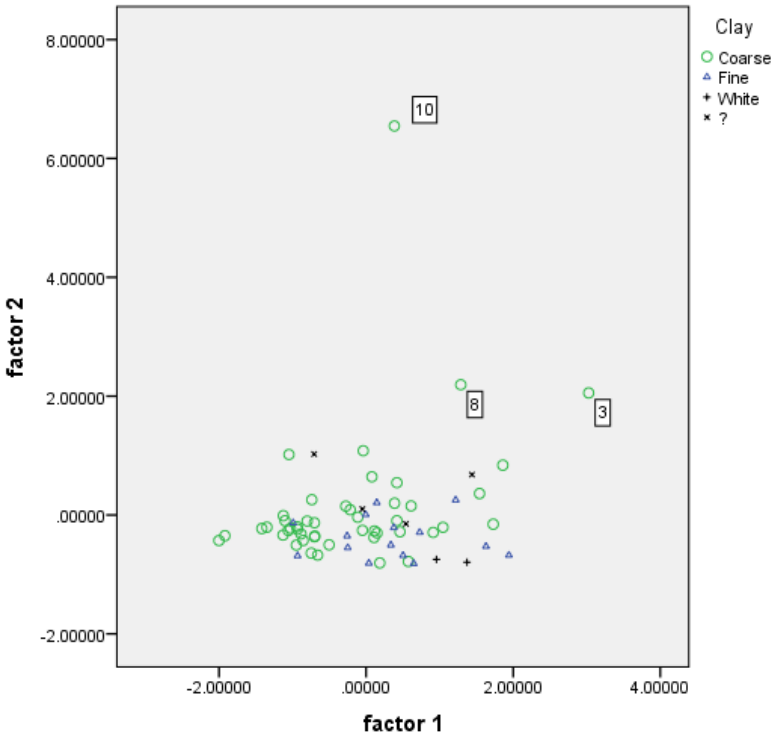


Figure IV-37: Scattergram of samples denoted by clay texture
The x-axis and y-axis are factors produced by factor analysis on trace elements. Some deviations are labeled.

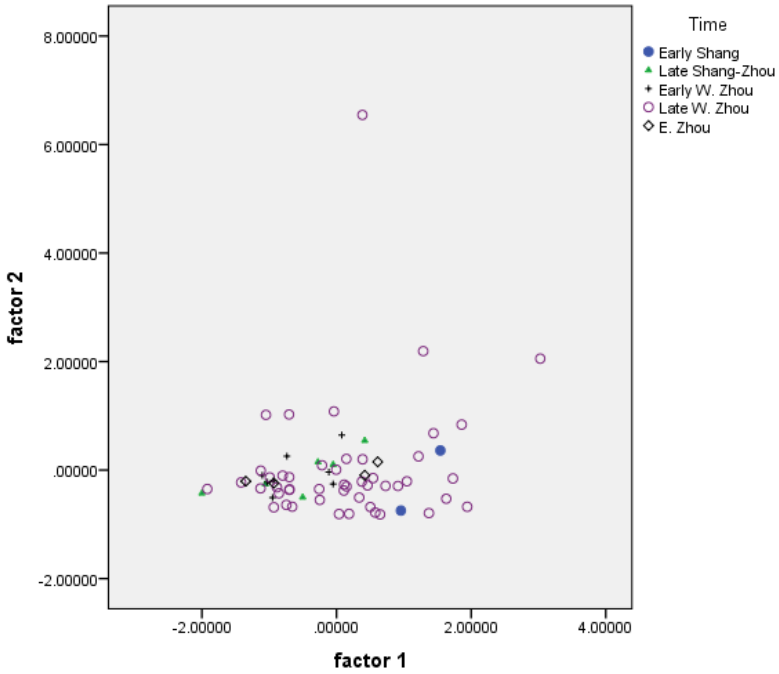


Figure IV-38: Scattergram of samples against the factors derived from factor analysis, denoted by period

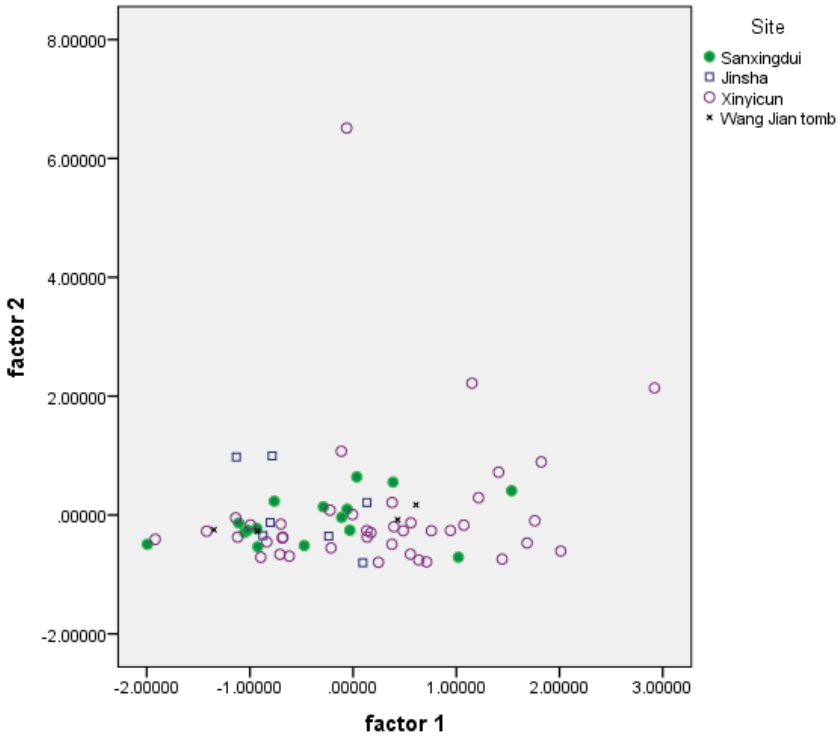


Figure IV-39: Scattergram of samples, marked by site

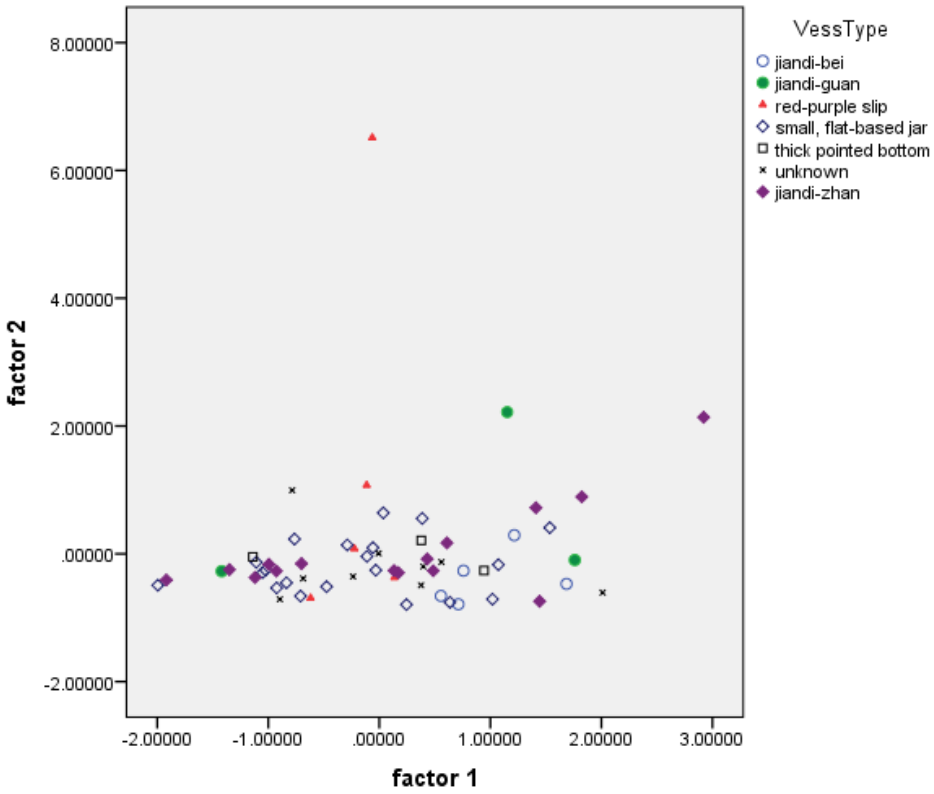


Figure IV-40: Scattergram of samples, marked by vessel type

2) Factor analysis on major and minor elements

The same factor-extraction process is applied to the major and minor elements. However, the KMO and Bartlett's test (<.5) suggests that the case is not suitable for factor analysis. This is probably because the *communalities* of some variables are too high or too low. For instance, the variances of SiO_2 and CaO overwhelm those of the others. By contrast, TiO_2 and MgO have only small *communalities*, indicating they share little commonality with the other variables. These variables are removed while I redo the factor analysis on the remaining variables (elements). The KMO becomes .563 (p=.000) and three factors are extracted (Table IV-22). They cumulatively account for more than 72% of the total variance. These three factors are then used for examining the distributions of samples by clay texture, time phase, site location, and vessel type, respectively. To visually inspect how samples distribute against these three factors, 3-D scatterplots with different angels of rotation are inspected through the statistic software. It seems that different clay textures, sites, and time phases can be separated by using the three factors (Figure IV-41 shows the rough clusters for clay textures, for instance). To further check if working groups from different locations and periods of time tended to develop their specific clay 'recipes' and if the separation of clay textures reflect the distinct processing of fine and coarse clays, I then map them onto two dimensional scattergrams.

Pattern Matrix[a]

	Component		
	1	2	3
Fe2O3	.867	.118	-.193
Na2O	-.671	-.205	-.335
K2O	.103	.750	
P2O5	.603	-.687	
MnO	.350	.643	-.136
TiO2		-.157	.789
Al2O3		.154	.681

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 4 iterations.

Table IV-22: Three components are extracted by using Principal Component Analysis

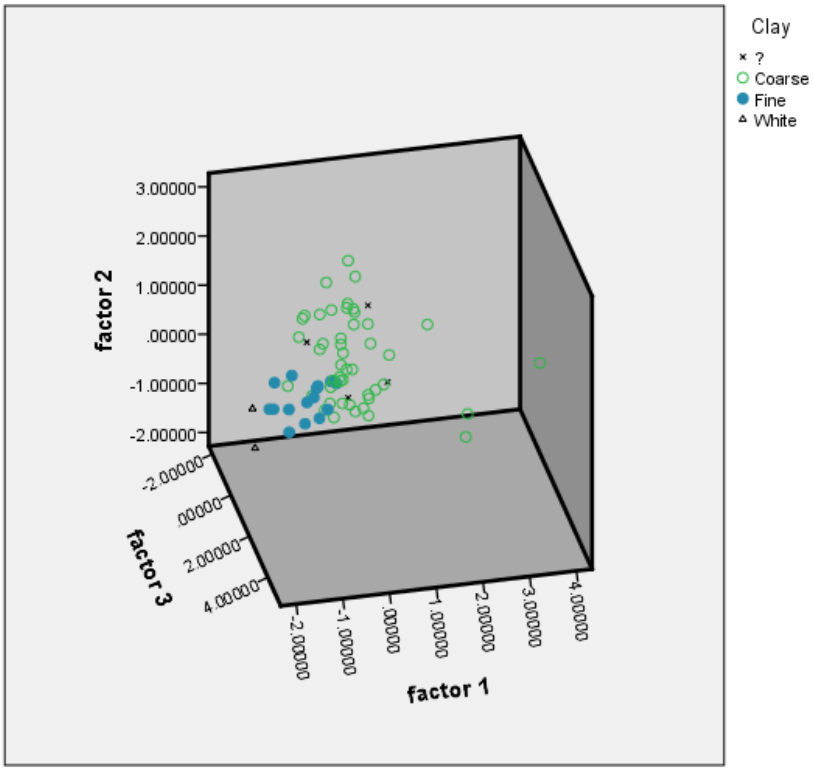


Figure IV-41: Data distribution against the three factors extracted from factor analysis, marked by clay texture

3) Mapping factors "1 vs. 2", "2 vs. 3", and "1 vs. 3" of major/minor elements in two-dimensional space

As the transformation of three-dimensional figures to two-dimensional space can be obscure, it is useful to examine the distributions against two of the three factors in turn. After inspecting each of these combinations, it was found that samples from different sites, although they somewhat overlap, form individual groups in data distributions against factor 1 versus 2 (Figure IV-42). Grouping phenomena also appear in the samples from different time phases (mainly between Early Western Zhou and other phases) (Figure IV-43). Again, as with the divergence seen in trace elements, Sanxingdui samples from Early Shang differ from its later samples from Early Western Zhou, but are instead closer to the Xinyicun samples. From the clay textures, fine wares and white wares also differ from coarse wares in their major and minor elements (Figure IV-44). As their trace elements remain similar, the levigation and tempering processes could have led to the change in major and minor elements.

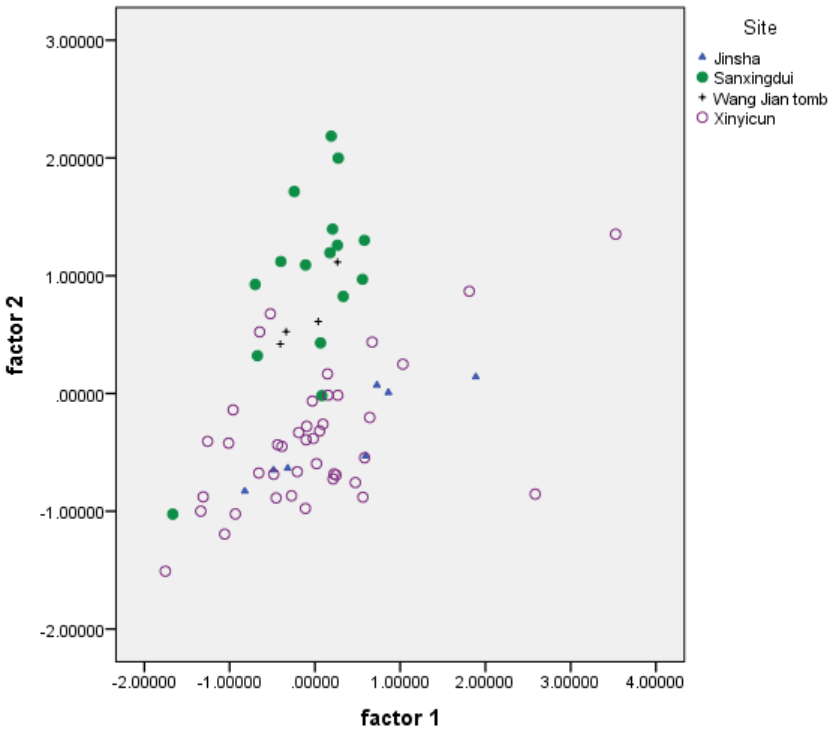


Figure IV-42: Data distributional tendencies from different site

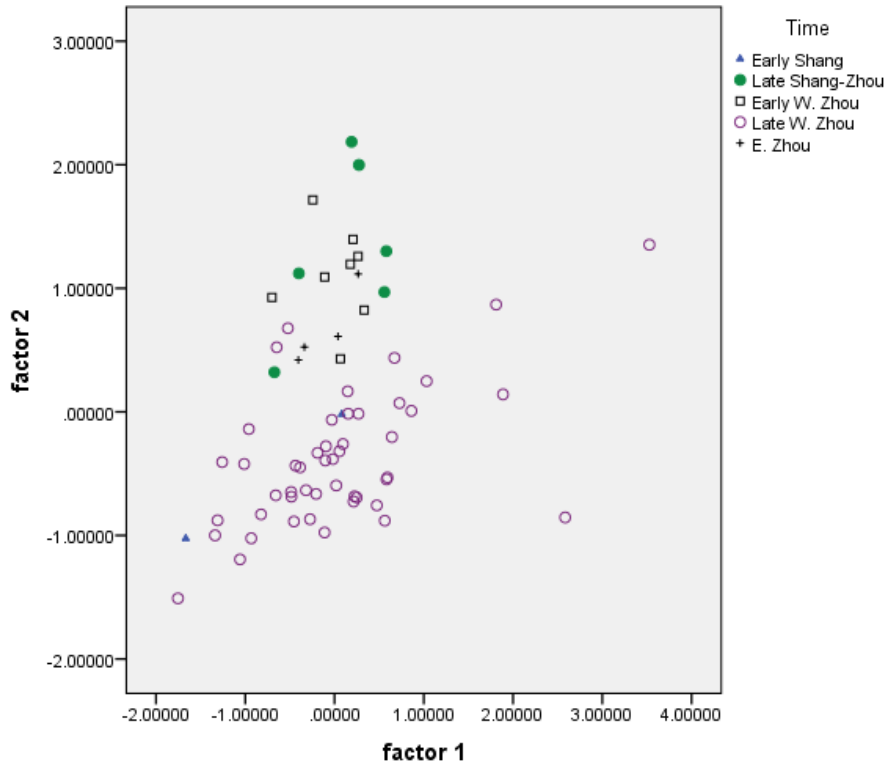


Figure IV-43: Distributional tendencies of samples from different time phases

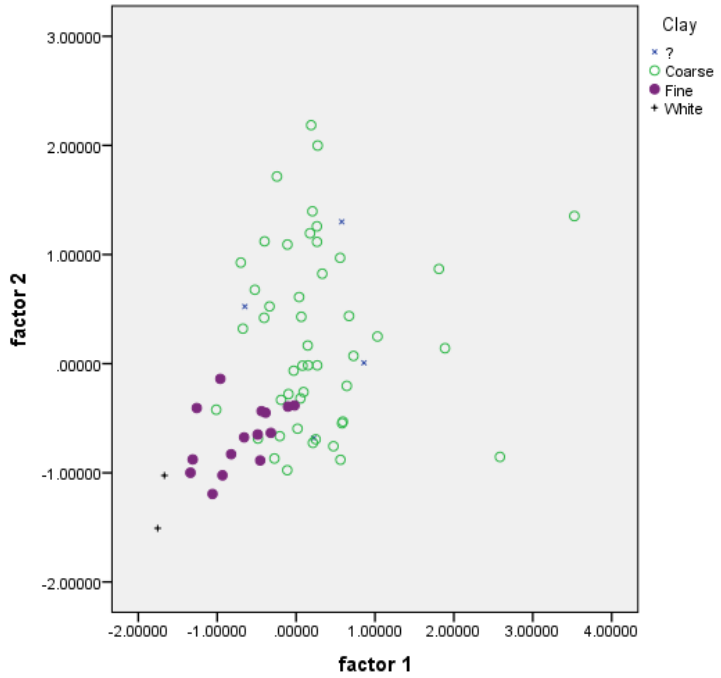


Figure IV-44: Data distributional tendencies marked by clay textures

4) Choosing representative elements

Though factor 1 and factor 2 together suggest distributional patterns for the samples, as above, in which samples from some sites and time phases and those of fine clay textures can be roughly differentiated, it is useful if we know more specifically which elements contribute the most to these differentiations among samples. Such information might reflect potters' knowledge of the properties of the elements and helps to distinguish technological choices from random adoption of available raw materials. The use of certain materials might be culturally meaningful.

During the processes of factor analysis, I noted that a few variables, such as SiO_2, Al_2O_3, and Fe_2O_3, are particularly influential to the variance of the pottery samples under study. In addition, as stated at the beginning of this chapter, researchers like Li Wenjie (1996:330-42) have proposed that, based on the proportions of silica (SiO_2), alumina (Al_2O_3), and fluxes, Chinese pottery of various regions can be roughly characterized. According to Li, ceramics from

South China have tended to contain more and more silica but decreased in the volume of fluxes (e.g., CaO, MgO, and Fe_2O_3) over time. This modification in recipes happened at the same time accompanied by an increase in firing temperature (see also Wu Jun 2009:7).

Building on Li's research, it appears that most clay sources of the Chengdu Plain, from which our studied samples are thought to have been produced, fall into the category of high silica, high alumina, high ferric oxide, and easy fusion. Similar clays and ceramic products have been found common in the Middle Yangzi basins (e.g., the Guanmiaoshan 關廟山 site of the Daxi Culture) and northern China (e.g., Taosi 陶寺 --Miaodigou 廟底溝 II) (Li Wenjie 1996:332). This, however, is only a general categorization which does not account for local variations. For instance, the 'outliers' in the studied samples here, the white sherds from Xinyicun (no. 4) and Sanxingdui (no. 44), lie in between the high-alumina category and high-silica category. The former is recognized as refractory clays[141] and the latter traditionally termed "chinastone". Their white or light color is a result of an absence of iron, which, if present at a certain volume, should be an important colorant during firing. That is, the volume and proportion of alumina and ferric oxide in ceramics are significant in determining the firing temperatures and colors of products. In order to control temperatures and colors, potters needed to understand these associations. The change in recipes over time may therefore reflect the changing manufacturing technologies, selection of clays, and/or preference of users. With these concerns, SiO_2, Al_2O_3, and Fe_2O_3 are specially singled out for further examination here.

From the scatterplots of samples against silica versus alumina (Figure IV-45), we can see that, although ceramics from Sanxingdui tend to have lower silica in comparison with Xinyicun samples, the distinction among the samples in these two elements is not obvious. However, from

[141] Usually are high in alumina (Al_2O_3>20%) and low in alkali (Na_2O+K_2O<3%) as alkali can serve as flux (Tite 1999:185).

the same figure, the kiln wasters were commonly produced by high-alumina clays. The high percentage of alumina probably made these sherds refractory if they were designed to be refired more than once. The thermal testing that will be discussed in the following also suggests that the firing temperature of these samples tended to be high (at or above 900˚C). This shared property among kiln wasters reveals that the potters were equipped with the skill to make and choose suitable ceramic tools.

From the perspective of clay texture, the tendency that a high proportion of "fine wares" contain rich silica is clear (Figure IV-46). The high ratio of silica to flux (formulated as R_xO_y)[142], separates fine wares from coarse wares (Figure IV-47). This seems to suggest different processes for raw material for fine and coarse wares and reveal the design to fire them to different temperatures. In addition, the variance of samples in silica is negatively correlated to that in flux, particularly ferric oxide (Fe_2O_3). Over 64% of the variance in the content of ferric oxide is related to the variance in silica (Figure IV-48). The two white sherds, which have relatively low iron and high silica, unambiguously occupy one of the extremes of the regression line. Moreover, Jinsha and Xinyicun seem to have similar proportions of Fe_2O_3 and SiO_2 whereas the clays of Sanxingdui tend to be high in Fe_2O_3 and low in SiO_2 (Figure IV-49). This might explain why Sanxingdui ceramics look different from the samples from the other two sites in color. Our earlier investigation on petrographic structure also suggests that the samples from Jinsha and Xinyicun, even from different periods of time, can often be classified into the same groups, revealing that they are closer in clay matrices and are together distant from Sanxingdui samples. If taking vessel types into consideration, the negative correlation between silica and ferric oxide is especially explicit in *jiandi zhan* (R^2=0.79) (Figure IV-50). *Xiaopingdi guan* and *jiandi bei* seem to behave differently in their silica versus ferric oxide distributions. It is possible that this

[142] Flux = Na2O + MgO + K_2O + CaO + TiO_2 + Fe_2O_3.

correlation between the two factors is derived from certain levigation practices and the special care of different vessel types.

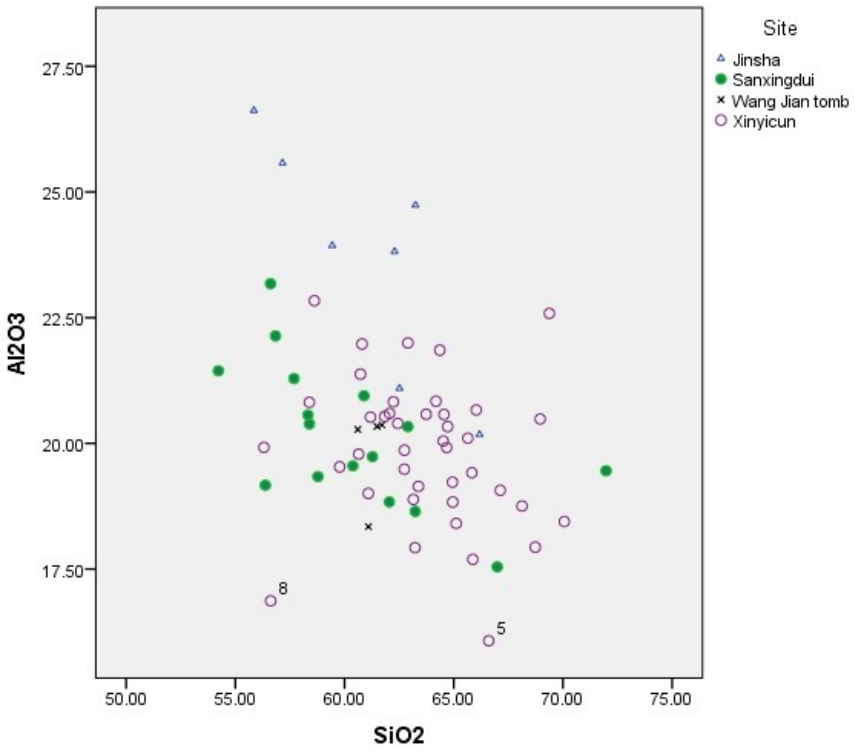


Figure IV-45: Scattergram of samples against silica versus alumina, marked by site

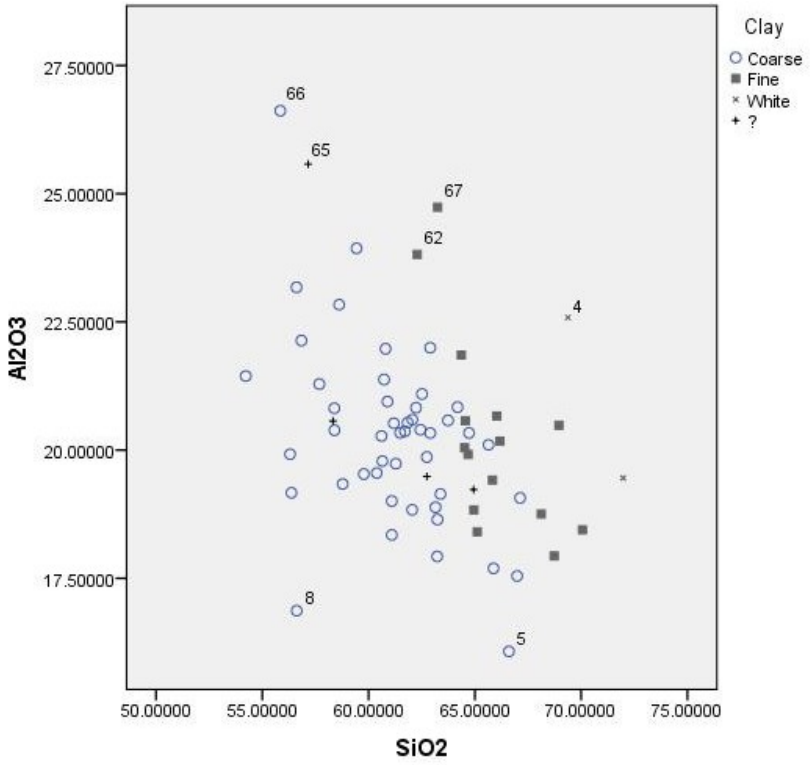


Figure IV-46: Scattergram of samples against silica versus alumina, marked by clay texture

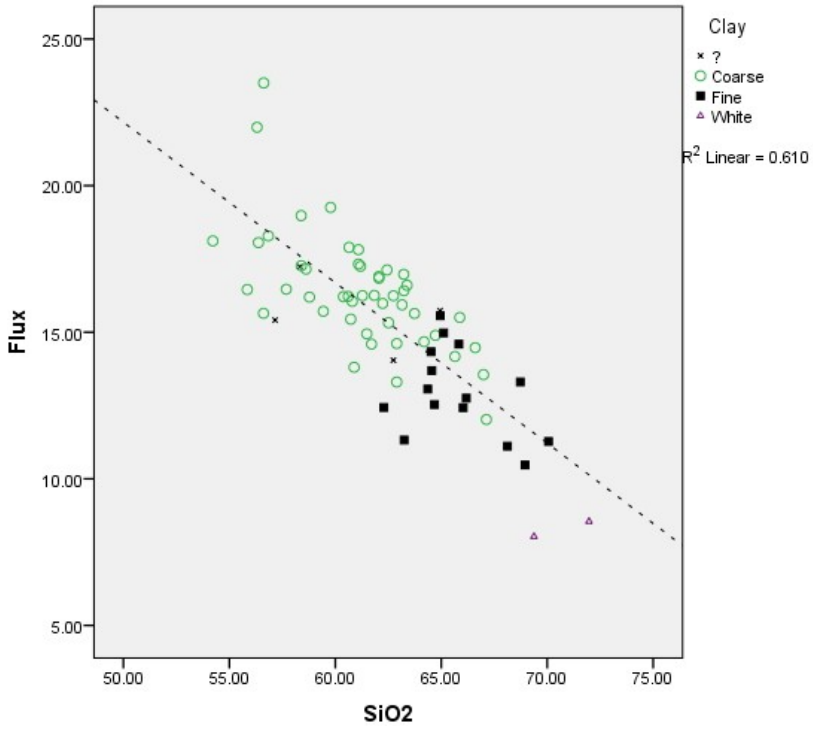


Figure IV-47: Scattergram of samples against silica versus flux, marked by clay texture

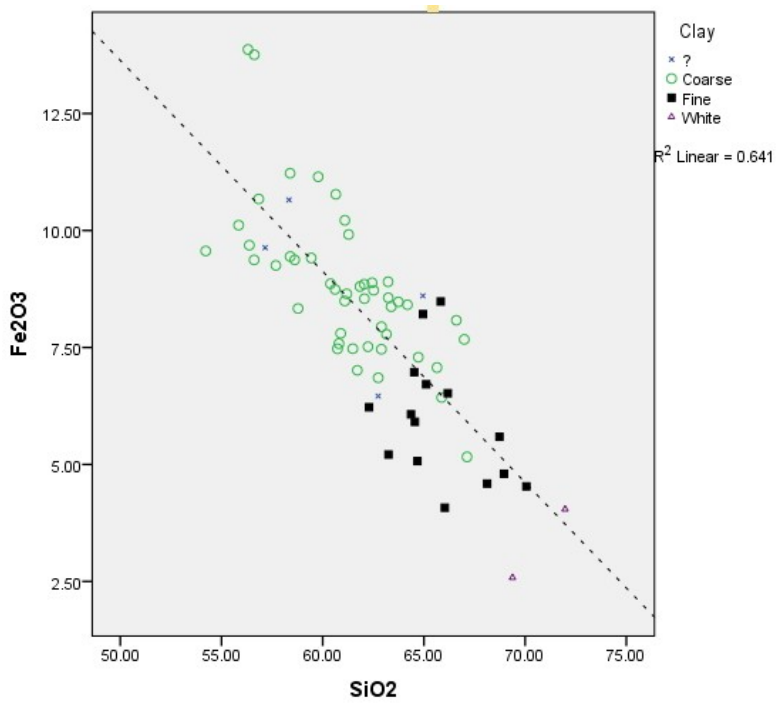


Figure IV-48: Scattergram of samples against silica versus ferric oxide, marked by clay texture

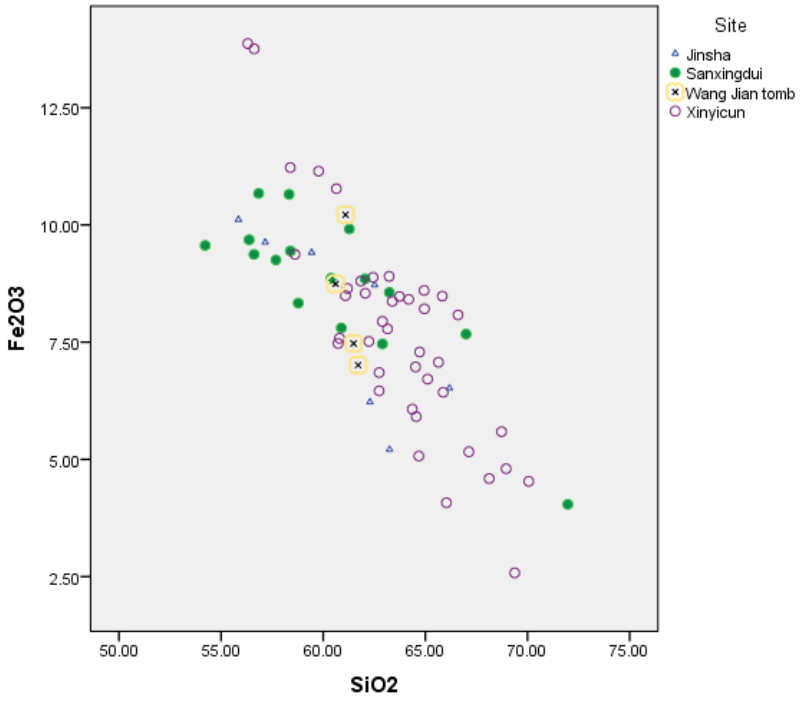


Figure IV-49: Scattergram of samples against silica versus ferric oxide, marked by site

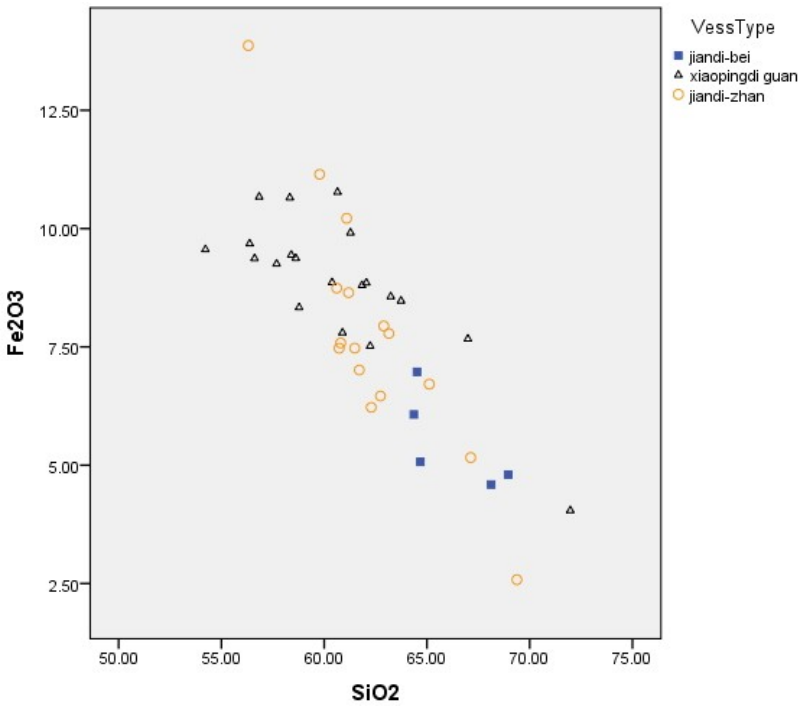


Figure IV-50: Scattergram of samples against silica versus ferric oxide, marked by vessel types (only the major vessel types are shown).

In short, ceramics of the Chengdu Plain did not change significantly in the compositions of *trace elements* during different time phases. Samples from different site clusters or vessel types do not differ from each other, either. The inter-site variation does not seem to exceed that within a site. Although samples from Sanxingdui, especially from the Early Western Zhou period, appear to be more concentrated at a certain range in trace elements, suggesting that their clay resources be more uniform, an earlier, different source might exist and more samples are needed to confirm this. It is equally hard to determine if the dispersion in trace elements found in Xinyicun samples was due to the inherent variation of a single clay resource or the fact that multiple resources were exploited. If it is the latter, it seems unlikely that potters meant to use different sources of clays to produce different vessel types, because the variation within any one vessel type is no less than that across different types. To the contrary, instead of changing clay sources by site or vessel type, it is more possible that potters would alter the working properties

of the clay by means of levigating it and/or adding tempers given this knowledge was well known to potters. To do this may transform the concentrations of *main and minor elements*, which probably also explains the distinctness of the "fine wares" and kiln wasters for they had different uses. Similarly, if potters expected to have different physical properties for fine versus coarse wares, such as hardness and heat resistance, they might have modified raw clays, leading to some certain degree of differentiation in main and minor element concentrations. The factors extracted from FA on main and minor elements have distinguished fine wares from coarse wares and their grouping becomes even clear when we check the scatterplots of samples against silica versus alumina and against silica versus flux.

3.4. Thermal analysis

As mentioned briefly in the section on color, firing processes, including maximum temperature, duration, and atmosphere, are important factors, like the composition of the raw clays, that would greatly affect the sintering and appearance of ceramic products. The pottery color, hardness, porosity, shrinkage (Rice 1987:81) and the subsequent performance are all related to the firing technology. The subject thus deserves a careful consideration along with other manufacturing processes when we discuss the technological level of a social group. In particular, the improvement and control of firing temperatures was thought a great leap in production technology in early periods of pottery making. The firing temperature is important in two respects. That is, the control of firing in a particular range of temperature both clarifies the intentions of potters and signals affordable production techniques (Sasaki 2000:133). Such master control, especially at high temperatures, would have required a long accumulation of practice and experience and may signal a certain degree of specialization due to the investment of time and devices, especially permanent facilities. It is also proposed that the study of firing

temperature offers hints to the functions of pottery (Sasaki 2000:133). For example, high firing temperatures, if exceeding the point of vetrification and thus diminishing vessel pores, would make the vessel more ideal for storing or serving liquids instead of cooking. Cooking vessels, on one hand, as they would be reheated after the initial firing, are required to have different thermal properties that equip them with better heat conductivity and resistance to heat shocks during repeated expansion and contraction (Rice 1987:363). On the other hand, with the technical and resource limitations of ancient times, the high wastage of cooking vessels often leads them to be produced in a clumsy way (Ozawa 2000:182). Due to these functional reasons, different vessel types serving varied purposes might not only be fabricated in separate ways, but are also often associated with specific sizes, shapes, surface treatments, and firing conditions (Rice 1987:368). These associations have also become a part of their respective production customs.

For instance, during the Baodun and Sanxingdui periods, it is normal to find that "coarse wares", such as *xiaopingdi guan* and ring-footed *zun* beakers, were fired under an oxidizing atmosphere, whereas pots in finer textures, such as *jiandi bei*, *hu* flasks, and high-stemmed mounted bowls (*dou*), were largely exposed to a reducing atmosphere during firing. The fine wares are also believed to have been fired under higher temperatures than coarse wares. The repeated association between vessel types and textures and between types and firing atmospheres, temperatures, and colors suggests that the potters were well aware of the techniques for controlling the firing process. Specific knowledge about firing control might have also informed the specialization or division of labor in producing different categories of pottery. To search for patterns about the associations between vessels and firing conditions is therefore an avenue to learn about the organization of manufacturing.

For Bronze Age Chengdu, kilns found so far are normally constructed in a simple way, comprising a firebox and a firing chamber built as a close fornix (Figure IV-51). A working platform was also frequently present right in front of the door of the kiln. Even if the structure might be simple, in such a kiln it was possible to raise the firing temperature to about 1000 degrees Celsius and maintain both the temperature and atmosphere in a steadier manner for a better-controlled duration than in open fires. In some cases, complete or broken products may be found inside or around the kilns. For example, more than ten pieces of complete *jiandi bei*, *jiandi zhan,* small-mouthed jars, and possible vessel seats as well as a large amount of potsherds have been recovered from a small kiln at Shi'erqiao-Minjiang Xiaoqu (Chengdu 2001c:187) together with four building bases, pits, and graves, as noted in Chapter III. The presence of these products in the identifiable production area not only verifies that they are local products but also provides direct information about their firing context, including the rough quantity and product types fired in a batch. Similar products, though not directly from kilns, have constituted the major part of the testing samples in the thermal analyses. Kiln wasters from similar constructions are also employed like everywhere in this study to serve as comparative references at various manufacturing stages. They are of particular interest with inquiries into firing behaviors: the potsherds may provide direct information about firing and refiring processes. Here four samples are drawn from kiln wasters. Thirty-one samples from Shi'erqiao-Xinyicun (the 2010-11 locus), nine from Jinsha site cluster, and three from Sanxingdui site cluster are also taken for thermal analyses. They together make up 47 samples (Appendix IV-Table 2 and 9).

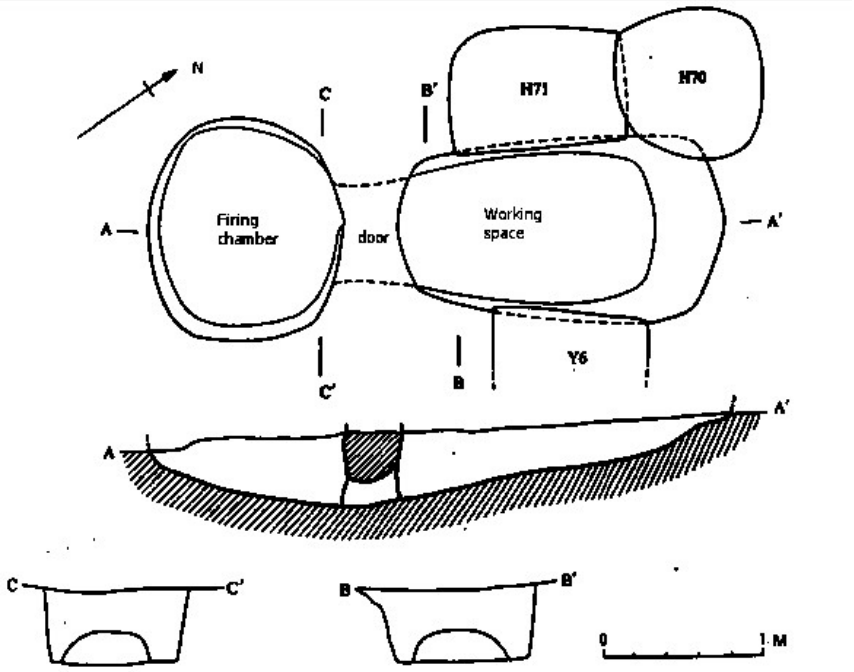


Figure IV-51: Structure of kiln from the Shi'erqiao period (Chengdu 2001a:170, fig. 6).

As noted by Rice (1987:426-7), there are multiple methods and analytical techniques to estimate the firing temperature of ceramics. These estimations include the observation of pottery color and the phase transformation of included minerals that have been briefly mentioned earlier. Here thermal analyses are achieved through thermogravimetric and firing-temperature tests. A dilatometer NETZSCH DIL 402 PC[143] is employed to test the firing temperature. The idea is to 'refire' the ceramic samples progressively to a certain temperature, maintaining them at the maximum temperature for a period of time, thus producing an environment imitating a kiln firing. The goal is to simulate the process of dehydration, chemical combinations, decomposition, and transformations of minerals that would cause changes in the volumes of the samples during firing (Shepard 1956:19-20; Rice 1987:386). In this experiment, samples are fired from 45 to 1100

[143] More specifications and features can be found at http://www.netzsch-thermal-analysis.com/en/products/detail/pid,15.html. The experiment was also conducted with a simultaneous thermogravimetric/differential scanning calorimeter (TA Instruments Q600 SDT) to measure changes in sample weight during refiring.

degrees Celsius at a speed 10.0 K/min. During this process, the expansion and shrinkage of the samples were traced and recorded. When the sample begins to substantially shrink (i.e., the maximum decrease in the sample length, as shown in Appendix IV-Figure 30), this suggests a turning-point temperature at which the ceramic was fired. With this refiring process, it is noted that most of the samples under study were fired roughly at 900-950 degrees Celsius regardless of sites (Figure IV-52). Due to the limited number of samples from Sanxingdui and Jinsha, there is no sufficient evidence supporting a significant difference in the firing temperature across sites. However, regarding vessel types, the result shows that *jiandi bei* can be produced at a wide range of temperatures and that *jiandi zhan* are not necessarily inferior to *jiandi bei* in firing temperatures, although *jiandi bei* and kiln wasters still tended to be fired in higher temperatures (Figure IV-53). The estimated average temperatures of *xiaopingdi guan*, *jiandi zhan,* and *jiandi bei* are 888, 891, and 928 degrees Celsius respectively. While *jiandi bei* are largely made in "fine wares" and *jiandi zhan* can be in both types of textures but are largely "coarse wares", this inspection in type difference also conforms to the differentiation in clay textures. As the distributions displayed in the Figure IV-54 show, fine wares were normally fired at higher temperatures than coarse wares.

Regarding colors, both surface and inner colors are considered because they are sometimes inconsistent. Most black-slipped ceramics, for example, have brownish cores. These inconsistencies in color (and their boundaries) cannot be solely attributed to the firing temperature but are complicatedly associated with the changing atmospheres, as noted in the color section. Both grayish and brownish colors can be produced under different temperatures. However, Figure IV-55 illustrates that grayish wares are indicative of a higher firing temperature

in average especially when they are well fired throughout; that is, grayish both on their surfaces and in their cores. This often occurs to vessels like *jiandi bei*.

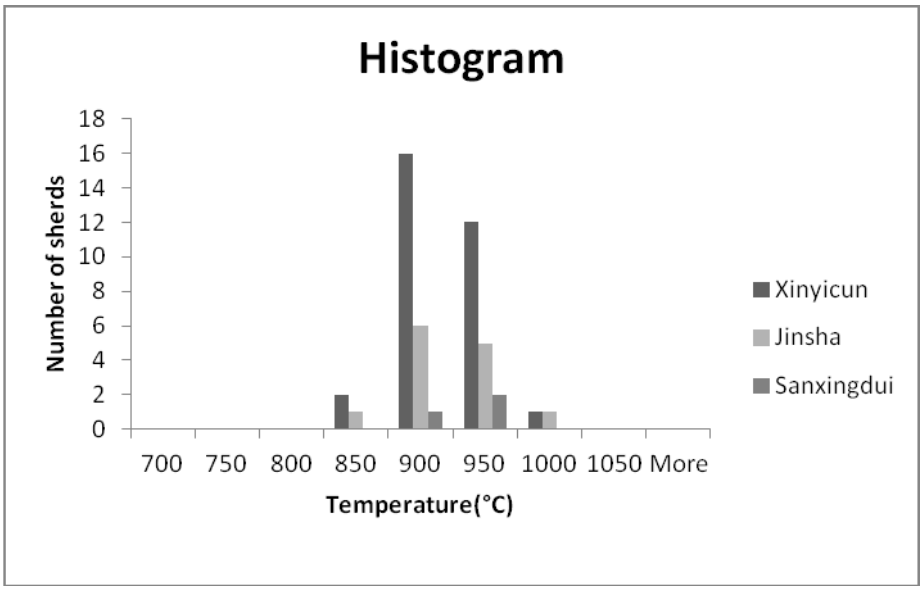


Figure IV-52: Histogram of firing temperatures and respective frequency for three site clusters

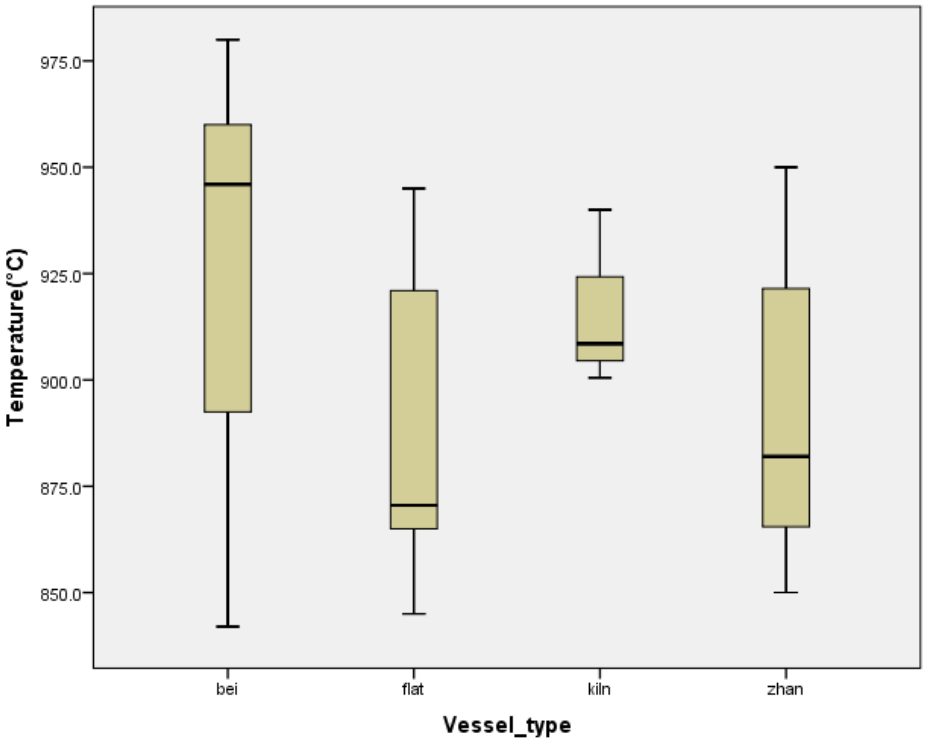


Figure IV-53: Boxplot of firing temperature, by vessel types

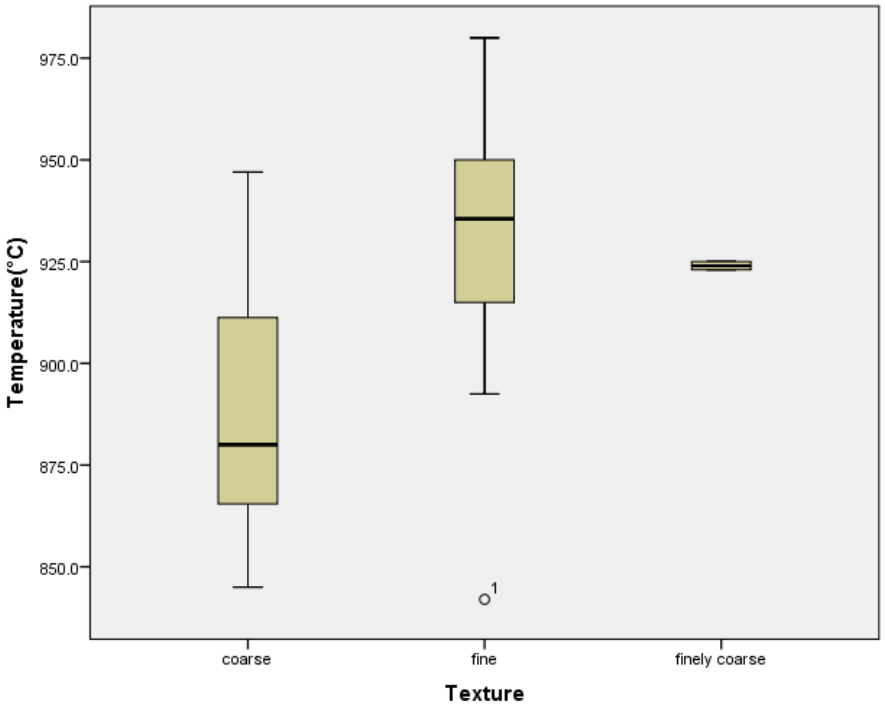


Figure IV-54: Boxplot of firing temperature, by clay textures

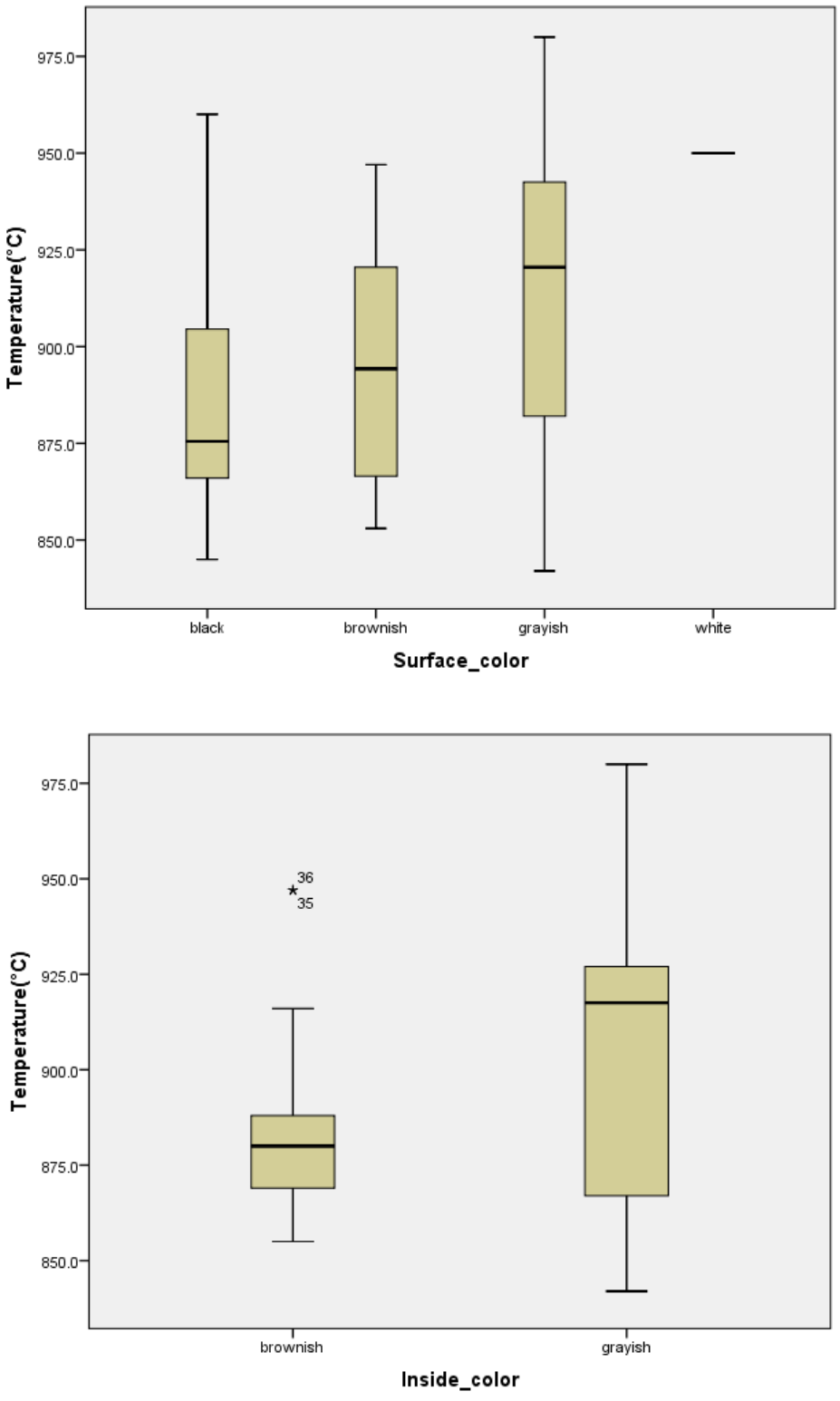


Figure IV-55: Boxplots of firing temperature, by surface color (above) and core color (below)

4. Discussion

In this chapter, I described and discussed the sample entities, analytical methods and facilities, implementation processes, and the results of several tests. The analytical methods include the metric measurement of vessel dimensions, mineralogical and chemical analyses of the compositions of potsherds, and thermal analyses of the firing temperature. As noted earlier, the study's subjects, *jiandi zhan*, are widely distributed in both geographical settings and use contexts and remained popular for a long period of time. Knowledge about the material properties of the vessel type was further added in this chapter. From these properties, manufacturing techniques (e.g., forming, shaping, and firing) and possible functions or uses for the vessels, the spatial relations of the working areas to other features and to the natural resources, and the production organizations were also considered.

4.1. Discovering patterns and classification

Through a series of examinations, I detected the patterns of the potsherd samples and classified them based on several criteria, including clay textures, colors, shapes, production sites and periods, mineralogical constituents, chemical compositions, and firing temperatures. Many of these properties are correlated and can be used for cross-checking. This characterization aims to manifest undiscovered patterns that are covered up by various sources of variability during pottery making. It sometimes conforms but sometimes conflicts with the traditional definition of pottery types. Among them, clay texture, color, and vessel shape have long been used to describe ceramic remains and have served as bases for defining type-variety in Chinese archaeology. For example, clay textures have been one of the criteria to separate *jiandi zhan, jiandi bei,* and *jiandi guan,* besides their morphological forms. The shape of the openings of *jiandi zhan* has also been proposed as an indicative characteristic to suggest different varieties and periods of manufacture.

Scholars propose that the rim shape of *jiandi zhan* evolved from overt to verticle and then to inverted (e.g., Sun Hua 2000; Jiang Zhanghua 2010). However, little has been mentioned about how rim dimension, vessel height, or volume changed through time. Although these attirbutes may provide information on manufacturing techniques, customs, and controls, changes in these trait values and their patterns may not be easy to detect. The metric measurement in rim radius conducted here cannot reflect the varying tendency in rim shape. Nonetheless, through multiple comparisons, some patterns become clearer.

First, it was found that the rim size only significantly changed in the Late Western Zhou period, represented by the Xinyicun phase, but otherwise varied in an insignificant degree through time. That said, even though the shape of the rims might have changed over time as scholars have suggested, the rim radius did not change accordingly. On the other hand, the mean values of rim radius are not the same among various locations, yet the variations are insignificant except Minjiang Xiaoqu, where potters tended to produce smaller *jiandi zhan*. It was also found that the rim size of Sanxingdui A group and the Shi'erqiao and Jinsha site clusters were restricted within a range—a truncated or isochrestic trait[144] that is not related to the function of the vessels (Read 2007:280-81). Among the three site clusters, only the Jinsha samples, including those from the Shang-Zhou and Early Western Zhou periods, form a normal and unimodal distribution. It is possible that there was a shared mental template or cultural value about *jiandi zhan* transcending time and cross space in Jinsha. However, rim dimension was not a normative trait under a restrict control in Sanxingdui and Shi'erqiao such that their rim size fluctuated within a range, though the two sites had different ranges of variances. Perhaps the limited ranges were set by production instruments, such as potter's wheels. In Jinsha, on the other hand, rim dimension

[144] Artisans may choose to fulfill their tasks from equally valid options that are potentially available to them (See Sackett 1982:72; 1990:32).

seem to have become an isochrestic trait that probably formed by a shared norm or custom (Read 2007:282).

Second, also from the metric measurements, although the variance of vessel height is generally greater than that of rim dimension, it is more characteristic of locations and time phases. The mean values of height not only varied through time but also over space. Furthermore, the intra-site variations sometimes exceed inter-site differences, especially during the Early Western Zhou period. For instance, unlike the Shan-Zhou period, during which Jinsha in chorus produced *jiandi zhan* taller than the Shi'erqiao site cluster, some loci of Jinsha turned to produce short *jiandi zhan* that were closer to Shi'erqiao products but divergent from other Jinsha loci during the Early Western Zhou period. In other words, the frequency distribution of height forms bimodal for Jinsha during this period. It seems that Jinsha people had two ideal values for their vessel height among different working groups. Some loci, such as Boyatingyun, might have changed their production strategy from producing taller *jiandi zhan* to shorter ones through time. This convergence of two trait values specific to different loci is less related to functions or the contexts from which the vessels were discovered because both taller and shorted products have been found in residential areas and burials. The trait was possibly an idiosyncrasy of the different working groups in Jinsha. During the same periods, from the Shang-Zhou to the Early Western Zhou periods, Shi'erqiao, like Boyatingyun, also reveal a tendency to produce short *jiandi zhan*. However, during the Late Western Zhou period, the Shi'erqiao-Xinyicun locus, again, turned to produced taller *jiandi zhan* than the Shi'erqiao loci from the previous phases, which makes Xinyicun more similar to other Jinsha loci that also made tall *jiandi zhan.* Such similarity between Xinyicun and Jinsha can also be found in the chemical and mineralogical analyses in

which samples from Jinsha-Meiyuan II, contemporaries with Xinyicun, were often categorized into the same groups with Xinyicun.

From the perspective of functions, pointed- and rounded-bottom vessels are efficient in heating but cannot stand steadily. Both of them need to be used with vessel stands or supports. Judging from the fewer number of vessel stands in most contexts, the stands were probably recyclable and were only needed when pointed-bottom vessels served practical functions, such as to offer food. In burial contexts, for instance, vessel stands are often absent. Usage like this also suggests the symbolic meanings of *jiandi zhan*. To the contrary, the collocation occurrences of *jiandi zhan,* vessel stands and likely vessel covers in the case of Sanxingdui pit K1and their non-casual manufacturing indicate that they had certain real functions in performance, probably constituting a part of the ritual paraphernalia before they were interred. Furthermore, as the bimodal phenomenon found in Sanxingdui '*jiandi zhan'* is clear, although both groups have been given the same name, we need to consider the possibility that they belong to two types of vessels and even served different functions[145]. The collocation use of *jiandi zhan,* vessel stands, and possibly also vessel covers, while was not a one-to-one match, might have required the vessels to be produced in somewhat fixed sizes.

The small variance of Sanxingdui products, especially group A, make them special. The variation in rim radius of this group (*CV*=2.5%) is close to the limit that human sensory systems can perceive because humans are normally unable to discriminate differences in metric measurements less than *CV*=2-3% (Eerkens and Bettinger 2000, 2001). From Table IV-7, we may infer that the high level of standardization of the A group was probably achieved by a single artisan that worked very proficiently. Even a specialist may not always attain this aim without

[145] Similar items to group B were found to have served as vessel covers of *jiandi zhan* from later periods, such as the case in a Warring-States tomb in Sandongqiao, Chengdu (Chengdu 1989).

the aid of rulers. Perhaps because the special occasions—sacrifice, the so far earliest appearance of *jiandi zhan* was made effort to achieve a certain goal. On the other hand, the variation of the B group (*CV*=6.1%), though is not very large, is perceptible. We are not clear how many potters were responsible for the manufacturing of group B but clearly, it was not under the same strict control and not as uniform as group A. It is likely that group B was not the main focus of the occasion.

As production scale and organization might affect the degree of standardization of products, I also paid special attention to the relationship between the variability of *jiandi zhan* and the contexts from which the vessels were discovered. It was found that while samples from various loci have different variability, sample discovered from graves, such as Boyatingyun, were not more changeable than those from pits or around kilns. This may suggest that the production of *jiandi zhan* was undertaken on a batch-by-batch basis in local kilns when occasions needed instead of being in the manner of mass production. Even though many kilns were concentrated in such locus as Huangzhongcun, their products did not demonstrate unusually high degree of standardization. There seems to be no single plan responsible for production control and the specific local concerns resulted in various varieties when potters made the same types of vessels. The vessels were less likely produced in a production center and then distributed to the other parts of the settlement and more likely produced in individual residential units. The similarities among different loci and the generally small variations (*CV* less than 7%) in individual loci might be based on intensive communication and mutual learning among potters in these spatially close communities.

If we go beyond metric measurement and move to the material properties and technological features of the vessels, the recurrent behaviors of potters in making pottery may add information

to the identification of vessel types. Both the mineralogical analysis and the trace elements of XRF show that potters of the three site clusters largely adopted the same clay sources that were probably local to the Chengdu Plain unless that Shi'erqiao-Xinyicun seemingly adopted a wider range of sources. However, from their different levigation and tempering customs, technological choices in forming, and the control of firing to a specific range of temperature and atmosphere, not only may the association between desired functions and techniques become clearer, but certain culturally meaningful traits may also emerge (Shepard 1956:310-11; Rye 1976:107-8). For instance, our petrographic analysis suggests that similar tempering behaviors were practiced in Jinsha sacrificial area (Meiyuan II) and Xinyicun. The contemporaneous kiln wasters from Jinsha-Yangguan Xiaoqu that were fired under higher temperatures can also find similarly composed counterparts in Xinyicun. Again, the inter-site differences do not exceed intra-site differences between Jinsha and Xinyicun and the distributional range of Jinsha dataset makes it more like a subset of that of Xinyicun. The two site clusters reveal certain cultural consistency. Contrarily, Sanxingdui can be separated from the other two locations more easily based on their petrographic structures as well as major/minor chemical elements. Not only are the color and texture of Sanxingdui sherds distinct but the sorting and kinds of their tempering materials are different (e.g., containing more reflective minerals). Furthermore, Sanxingdui samples were made in a more careful way and fired under higher temperatures. The XRF test on major and minor elements also shows similar patterns to the results of the mineralogical analyses in which potters from different time phases and loci seem to have developed specific recipes in tempers. This probably reveals the existence of local traditions.

The possible scenario is that most of the raw materials, including clays and tempers, were acquired locally from mixed igneous, metamorphic, and sedimentary rocks as well as

polycrystalline quartz in the riverbeds. Although several groups of clay matrix and fabrication are distinguishable in our mineralogical analysis, the clay and temper sources basically conform to the larger environmental setting. Meanwhile, a few 'outliers' in the trace element analysis, such as the red-purple-slipped ceramics from Xinyicun, reveal unusual chemical characteristics. More similar samples, though, are required to determine whether they are really nonlocal products. The major difference among different groups of vessels is most likely derived from the processing of clays, in which clays were levigated to a different degree before tempering materials were added to enhance the workability and physical mechanism of the clays. This processing of clays and tempers tended to vary with site locations and working groups, especially between Sanxingdui and the other two site locations, even though for making the same types of vessels. Such grouping by the chemical and physical properties of the vessels, other than the ones based on metric dimensions, provides another way to detect different varieties of a vessel type, particularly *jiandi zhan*.

These together suggest that the ancient Chengdu Plain was covered by a large manufacturing tradition with several local variations. It is possible that the different locations and working groups that might be individual settlements or communities in the ancient time had different local traditions and practices to satisfy their concerns of ceramic properties, such as color and height. Some settlements, such as Xinyicun and Jinsha, were probably close enough to share manufacturing knowledge and customs, which made their recipes largely overlapped when producing the same categories of vessels.

4.2. Analytical methods and future work

It is clear that each of these analytical methods and techniques has its uses and limits. For instance, it has been be cautioned that chemical analysis lumps all elements present in clays and

tempers (e.g., Rice 1987:313-14). A given concentration of a certain chemical element is a sum of its oxides and compounds existing in varied minerals. For example, high calcium in ceramics can be derived from the abundance of calcite common in the clay or the presence of shells in the temper. In addition, many clay and temper sources, particularly when sedimentary rocks are involved, are indeed alike and hardly distinguishable. To group ceramics uncritically by their chemical compositions can be misleading in such situations. However, while it is important that we are clear about the limits of these methods so as not to over-interpret the results derived from experiments, it is useful to employ these methods complementarily. For example, though mineralogical analysis is useful in identifying crafting techniques as well as mineral compositions and their structure, the method is only adequate to low- to mid-fired pottery. On the other hand, thermal expansion analysis is better for pottery fired at medium-high temperatures (over 800 degrees Celsius) and can assess the firing temperatures more preciously. To avoid hasty characterization, I therefore cross-referenced the results from various analyses. With the inspections of different dimensions (i.e., vessel types, clay textures, sites, periods of time), I avoid group samples solely because they have similar appearances or compositions but to discover the patterns existing in these dimensions and make inferences from the patterns.

These methods together provide a basis for assessing raw materials, manufacturing processes, use wear and likely residues, and post-depositional environments. To make sense of the results, one nevertheless needs to take social contexts and cultural meanings into account whenever possible. That is, experiment results and cultural setting can be mutually validated. It should also be stressed that it is the conferred properties rather than the data or numbers these methods provide that help us approximate the manufacturing of ancient crafts (Rice 1987:53).

The series of examinations and experiments I have taken in this thesis is essentially designed to provide an understanding of the *chaîne opératoire* of pottery production, including the transformational sequence ”which brings a primary material from its natural state to a fabricated state” (Cresswell 1976:6) until it is finally discarded. This series of operations involves not only technological sequences but also cultural processes and choices (Read 2007:188-9; Berg 2011:57). As Rye (1976:106) has observed, “[E]ach pottery vessel reflects decisions made about materials and techniques as well as cultural choices.” These factors would have influenced production in a combined manner. Our analyses aimed to reveal the dimensions or processes in which the variations occurred, such as tempering practices, because these production traditions and practices might signal the way by which social groups interacted with each other and help us to infer the organizations responsible for such production. How this was related to social organization and how local communications contributed to the formation of a larger production tradition or even cultural code will be further explored in the next chapter.

The practical use of pointed-bottom pottery vessels on various occasions and their associated meanings is an important but less explored question. To better understand this, their practical uses should provide the basic information for further inferring social meanings. My next step will be to include organic residue analysis as part of a future excavation project. The challenge, however, is that because of chemical alteration and microbiological degradation of organic products, the lipids left are not always identifiable to the point of species (Tite 1999:209). It is also often difficult to discover complete vessels or ideal parts for the extraction of organic residue. This requires special care in the sampling processes. Samples and nearby soils need to be taken care of and preserved in a special way such that attached residues can be scraped off or

extracted before the artifacts are brought in to be cleaned. This further study will also include ceramic samples from other relevant sites to broaden the spectrum of comparison.

Second, ethnoarchaeological studies show that potters may be willing to trek far or pay higher expense to exchange for some highly-appraised tempers (Arnold 1985, 1991). For instance, they may use mica to enhance the reflectivity of the ceramics (Peuramaki-Brown 2009) or add granodiorite to increase vessels' wearability or hardness (Knight et al. 2003). From the petrographic analysis, I have identified abundant metaphoric rocks, particularly micaceous schist and gneiss, that were added to the clay matrix. To discover how these temper substances might be valued in the ancient Chengdu Plain, I suggest to examining other lithic materials from the same contexts and recognize related temper sources in surrounding environments so as to discriminate whether the presence of the temper substances was a result of a natural or cultural choice.

Third, as the Shi'erqiao and Jinsha sites contains diverse loci of production and contexts of use, how the two traits of the vessels—rim radius and height—reveal different modes of cultural control over production among these loci deserves further consideration. Given the testing results that the Shi'erqiao locus once yielded short *jiandi zhan* similar to some loci of Jinsha (e.g., Boyatingyun) and later, the Shi'erqiao-Xinyicun locus, where tall *jiandi zhan* were discovered, yielded products similar to the other group of Jinsha loci (e.g., Meiyuan II), it seems that Shi'erqiao and at least part of Jinsha maintained close relationships. Nonetheless, because the mean values of the testing traits shifted through time for some loci and because different properties of ceramic samples have not been thoroughly examined, the relationships between the working groups inside Jinsha have not been clearly known yet. More samples from the two site

clusters of different time phases, especially the Early and Late Western Zhou periods, are needed for further testing and comparisons.

V. Craft production and economies in the ancient Chengdu Plain

1. Introduction

In the last two chapters, I examined the distributions of the pottery assemblage, especially pointed-bottom vessels, during the Bronze Age in the Chengdu Plain at various sites and in different cultures; I also examined manufacturing technologies and provided mineralogical and chemical analysis. These findings are the basis for further discussion of several issues.

(1) Pottery production, including the procurement of raw materials, manufacturing knowledge and skills, and the use and distribution of the end products, was seemingly not restricted to the hands of the few. Instead, raw materials were generally available in the Chengdu Plain; and vessel types, were made freely in local contexts and were subject to local variations in tempering, metric dimensions, and firing conditions.

(2) Even though production groups were often dispersed and connected to individual residential areas, the interactions among these groups are evident from their general conformity to the same vessel types.

(3) Although we only tested clay materials for the Chengdu Plain, wherein the site clusters (i.e., Sanxingdui, Shi'erqiao, and Jinsha) belonged to the same geological environment, from excavation reports, we call tell that different geological regions also tended to use their readily available material (i.e., clays) when producing similar vessels. As a result, morphologically and stylistically similar potteries were made in distinct clays and sometimes differently fabricated (e.g., coarse vs. fine wares). For instance, the Upper Han Basin yielded numerous fine *jiandi guan* and *jiandi zhan* in both burial and residential contexts. These vessel types were typically made in coarse wares in the Chengdu Plain.

(4) *Jiandi zhan* from several settlements on the Chengdu Plain, especially Sanxingdui and Jinsha, display high degrees of standardization in metric dimensions and colors. On the other hand, in other places like eastern Sichuan, where *jiandi zhan* were less popular, though they are still found in significant numbers, the vessels are less standardized in appearance. That said, although similar to their counterparts in western Sichuan, they were subject to different production or cultural controls and consumption needs.

(5) The use of *jiandi zhan* has been notable in several contexts, such as daily life, ritual settings, and burials. In these various contexts, although the ceramic assemblages are differently composed, *jiandi zhan* do not change significantly in their metric dimensions. In sacrificial events, *jiandi zhan* were sometimes made as fine wares and accompanied by vessel stands and covers as well as other luxury items. In burial contexts, *jiandi zhan* often appeared alone as the only grave good. The distinct social functions and values of the objects are worth further consideration.

(6) In our case study, the change in pottery did not directly coincide with widely perceived social changes. Nor did changes in different material cultures or vessel types occur synchronously. We should think of the appearance and disappearance of different kinds of pointed-bottom vessels as isolated events.

(7) Following this observation, the spread of a certain material culture or innovation should not be treated as the proxy for cultural diffusion nor should it be used to mark a single cultural boundary, because the adoption of innovations was often selective and strategic. However, as *jiandi zhan* became the most representative vessel type during the Bronze Age, the adoption of *jiandi zhan* has properly marked the incorporation processes of some outlier regions (e.g.,

southwestern mountain areas of the Chengdu Plain) to the Chengdu Plain. Certain sets of social relations and interactions can also be traced through the circulation of *jiandi zhan*.

2. Production environments and traditions

2.1. "Ceramic ecology" and technological choices

Like cultural ecology, ceramic ecology considers the making of pottery as a process influenced by the interplay between artisans' cultural and natural environments (Matson 1965; Arnold et al. 1975). The proponents of cultural ecology argue that we should not persist in looking for the origin or diffusion of a technique, but should, instead, focus on how the technique was differently used, and this in turn was a product of different social arrangements, which deserve greater consideration (Steward 1955:36, 38, quoted in Matson 1965:203). In this sense, Rice (1976, 1984:50) has argued that the identification of ceramic ecology should include the detection of ceramic resources, environmental factors, the behavioral patterns of artisans, and the use, discarding, and influence of ceramic production on other cultural dimensions.

With respect to natural conditions, the geographic and geological conditions of the Chengdu Plain reveal that the soil resources basically conform with the mineralogical compositions of lithic and pottery products from several large settlements in the region. Climates that could have affected the soil formation and the supply of food and fuels changed from time to time, whose effects on faunal and floral evidence have been examined. This kind of data not only provides information about the ecosystem, but also allows us to investigate how the distributions of the resources might have influenced the location and structure of settlements, especially the basic units constituting working groups—households, and the division of labor. With respect to human behaviors and cultural dimensions, I have also attempted to compare features of products and to

infer the *habitus* responsible for production activities in different social settings under controlled ecological conditions.

2.1.1. The location of pottery production and its interactions with other activities

Because kiln structures with wasters or furniture are often discovered in the Chengdu Plain in connection with residential structures, I speculate that production loci set up in this way benefited from a direct supply of labor and accessibility to consumers, both of which were likely belong to the same community. For instance, given the Jinsha site can be divided into a number of loci with diverse functions (e.g., sacrificial area and cemetery) as well as residential communities, kilns were dispersed in many loci, often clustering around individual residential areas. A community was often equipped with a few simple kilns. Open firing might have also existed but left fewer traces because it tended not to be as fixed in location as kiln firing. Only in rare situations, such as the Sanhe Huayuan locus where 17 kilns aggregated with 17 building foundations have been found, were kiln structures set closely on a large scale. Because some of the buildings in Sanhe Huayuan appear to be large, containing multiple rooms, and also because of its proximity to the sacrificial area (i.e., Meiyuan), several scholars have speculated about the use of the building clusters, which might have functioned as palaces, temples, or places for public gatherings. Nonetheless, such speculations have rested on the assumption that a ruling class existed and that the site was a political center, neither of which is certain based on our current data. Not only were the kilns very simple like those in other loci, but their products, which include pointed-bottom vessels formed by coiling technique and/or finished by potter's wheels, also appear to be very usual. It is possible that the aggregation of working units and the nucleation of workshops formed to meet the needs of a large population near the core area and thereby gained the benefit of marginal costs in the distribution of their products as well as in the

gathering of their raw materials. That is, the intensification of the residents and the economic considerations following the settlement arrangement might have affected the selection of the locations for craft production. We need therefore to consider these possible factors more comprehensively.

A few studies of the paleoenvironment of the Chengdu Plain suggest that agriculture developed in the region by the late Neolithic Age (the Baodun period) at the latest (Fu Shun et al. 2006; Sichuan and Chengdu 2009; Jiang Ming et al. 2011). Judging from the floral remains of the Jinsha site, rice dominated crop production, followed by millet during the Shi'erqiao period (Jiang Ming et al. 2011). The faunal data from the Shi'erqiao site also shows that domestic animals, especially pigs, as well as agricultural products, provided the core food resource for the ancient people of the Chengdu Plain. The development and intensification of agriculture not only provided a stable supply of food surplus to support the growing population, but also required special care and an extra devotion of energy. Such activities therefore influenced the scheduling and rhythm of other subsistence and production activities. For instance, pottery production, which is ideally conducted during the dry and warm seasons, was likely undertaken during slack periods and became seasonally specialized. Despite its seemingly small scale and its coexistence with other activities, this does not mean pottery production in the Chengdu Plain was marginal, as some scholars have suggested for other regions (e.g. D. Arnold 1975). Instead, because both the dry and fallow seasons of the Sichuan Basin occur in winter, this would have allowed a coordinated relationship between agricultural and pottery production activities.

It is also found that, in a normal cluster of households or a settlement, there were several classes of production, including pottery, textile, lithic, and bone production, which often appeared alongside one another. This coexistence was seemingly driven by the daily needs of the

residents and perhaps does not follow the "optimal" principle of labor or energy management. Different raw materials had to be gathered and transferred to a single location, and people might have conducted a range of activities without an elaborate division of labor.

In regions such as the Middle Yangzi River basins, which is recognized as one the earliest regions to develop paddy rice, agricultural products seemingly influenced other activities in a more profound way. The use of residual products from paddy rice as tempers and fuel in this region possibly denotes a seasonal relationship between agricultural activities and pottery production. Scholars have noted that, in these regions, rice husks were often used in pottery as tempers (Li Wenjie 1996; Li and Huang 2001; Yu Weijie 2010). Such tempers sped the drying of the potteries in humid climates and helped to reduce their weight (Yu Weijie 2010:130). Because of these advantages, rice husks were frequently used in serving and storing wares though less so in cooking wares, given their fragility during heavy use (Li Wenjie 1996). This also shows that the selection of raw materials and the forming techniques used are related to and perhaps impose constraints on vessels' shapes and functions. For instance, the strip-sticking technique is often associated with round-bottom vessels. On the other hand, different ecological zones in western and eastern Sichuan created different needs for and concerns about pottery products, such as the coordination of particular subsistence activities, including fishing and salt production. The particular pottery technology that the society seems unintentionally to have maintained was actually a component other than the products themselves (i.e., pottery vessels) that united the culture and isolated it from others.

Tempering behaviors are one part of such technological choices that can become important indicators of pottery production traditions because there was usually more than one type of temper available to potters that could achieve the same effect. Their selection might therefore

have implications beyond technological concerns (D. Arnold 2008:192). That is, the selection of tempers was not only linked to natural resources but also to different social or production groups, which often formed their own habits and traditions through a long period of practice. When natural resources allow, different production groups sometimes develop distinct tempering behaviors even within the same ecological zones. This is clear in the differences between Sanxingdui and Shi'erqiao/Jinsha, where potters generally adopted similar plastic materials but had different temper types and processes. That is, Sanxingdui potters used a temper recipe with better sorting different from that in Shi'erqiao and Jinsha, and employed a more careful forming technique. The differences were possibly a technological choice driven by cultural factors but were less likely due to geographical distance or geological conditions, because tempers from both groups were available in the Chengdu Plain. In my view, this divergence was a result of production traditions that were shaped through time.

In addition, from ethnographic observations, the desire for special tempers and surface treatment materials, including pigments and slips, might have prompted potters to invest more costs or energy in acquiring the materials. In such situations, tempers could be acquired afar. They were endowed cultural meanings that could be used to denote specific types of vessels or even social groups, as the procurement, processing, and transportation of tempers became more specialized (D. Arnold 1985, 1991, 2008).

2.2. Standardization and the formation of cultural code

Variations in pottery production across sites, such as tempering variability, were mainly the result of traditions or the accumulation of cultural choices and idiosyncrasy. As some scholars have argued, variation is reduced as the number of artisans decreases. The number of producers should thus be one criterion of specialization. This is based on the assumption that intra-person

variation is smaller than inter-personal variation and that the producers intend to produce consistent products for functional or cultural profits. This phenomenon should be visible in various dimensions and stages of production, including raw-material processing and forming. For instance, Sanxingdui potter(s) achieved notably little variability while producing *jiandi zhan* for its sacrificial event. The degree of standardization measured in vessels' rims suggests that they were likely made by one artisan who intended uniformity across his or her products. Moreover, other characteristic vessels, especially *xiaopingdi guan*, were also made with standardized outward appearances. Not only do their sizes and shapes appear standardized, but their preparation of tempers was also more uniform than that of Xinyicun, as suggested by the results of the XRF test. In contrast to Sanxingdui, the temper recipes in Xinyicun, which are the most diverse in this case study, were probably prepared by a number of people who might or might not have been the potters themselves.

Besides the number of artisans, standardization and internal variation can still be the result of a range of activities and causes (e.g., Blackman et al. 1993; Kreiter 2009:113). It is possible for a full-time specialist to reach a higher level of standardization than those who only devote their time in part to production (Longacre et al. 1988; Tite 1999:193). In such a situation, although specialization and standardization are two distinct concepts, they are nevertheless related. It is also possible that some forms of production organization might have led more easily to standardization than others (Costin and Hagstrum 1995:624), probably thanks to their convenience for the management class in supervising production or for potters themselves when interacting with one another and when sharing information. Because different forms of production organization were seemingly associated with varied degrees of standardization with the sites we study and also because the vessel types brought for analysis do normally not require

to be finished with high artistic skills, I therefore agree with some scholars' opinion to use degrees of standardization as one indicator of specialization and as an index to differences or changes in production organization (Rice 1981, 1991).

After a series of examinations, it is clear that *jiandi zhan* found in the several sites in the Chengdu Plain had reached a high degree of standardization or a certain consensus in outward metric dimensions, volume, raw material, and manufacturing technology from as early as the late Sanxingdui, though the level of standardization from site to site. For a single deposit, such as the Sanxingdui sacrificial pit, the degree of standardization, if compared with other specialization cases supplied by ethnographic observation, confirms the existence of pottery specialists (Longacre et al. 1988; Kvamme et al. 1996; Longacre 1999; Eerkens and Bettinger 2001). Furthermore, within the sites, where *jiandi zhan* can be found in multiple contexts, such as burials, middens, and sacrificial areas, the products do not display significant differences. Such standardization can be further supplied by other peripheral products normally used together with *jiandi zhan*, such as vessel stands and covers, which have also been found in similar sizes.

In such a comparison, the several closely situated communities in Jinsha with their concentration of residence and production loci contrast with the otherwise dispersed Shi'erqiao settlements. The clusters of the Jinsha site, though each community might produce its own pottery, generally produced *jiandi zhan* with less variation than other Shi'erqiao loci. Whereas the values of rim radius range within an interval without any clear mode (i.e., truncated trait) for Shi'erqiao products, Jinsha products formed a normal distribution and clustered around their mean value (i.e., isochrestic trait). Furthermore, vessel heights that vary within a large range among the *jiandi zhan* from other sites form bi-modes among the Jinsha products. These modes may reveal the ideal trait values and templates among Jinsha potters which were perhaps the

result of common consensus or cultural control. The convergence values observed in Jinsha seem to suggest a relationship between the spatial arrangement of communities and their communications about production tendencies. If we attribute this difference in variability to the distribution of production loci in the cluster at the Jinsha site, it becomes clear that the production was organized in a large compound in which potters had greater opportunities to observe or compete with their peers. It is likely that the production standards in this group of workshops were a result of artisans' working experiences, as well as the collective acknowledge of and expectations about the products inside the social group. Such consensuses might not only be developed and function within a crafting system, but might also be adjusted according to customer feedback, which fashions cultural constraints as well as a system of economic control (Sinopoli 1991:169).

From ethnographic observation, we know that manufacturing techniques are often transmitted through hands-on instruction and require potters to memorize bodily movements and gestures (Leroi-Gourhan 1993). In other words, such skills are learnt in a routine manner. These repetitive practices constitute the *habitus* and historic traditions particular to the group (Bourdieu 1977, 1990; Hegmon 1998). Although artisans may not be fully aware of the entire production plan or the social effects of their products, they are the consumers of products from previous working stages, such as processed tempers, and had themselves the power to control their products as both producers and consumers at the same time. Here, although I divide the working processes of pottery production into multiple parts, I do not refer to pottery production on the ancient Chengdu Plain as a category of prescriptive technology (Franklin 1992:12), in which the presence of an administrative or supervising class is assumed, because the dispersed production and demands did not support mass production in the modern sense. Instead, the working process

might be constituted by a restricted number of specialists or artisans encompassed within the same cultural or regional atmospheres wherein they learned cultural norms. Some tools, such as potter's wheels, paddles, and pattern plates, might additionally help to create standardized, patterned decorations and marks. In such a social context, although *jiandi bei* and *jiandi guan* might have originally come from eastern Sichuan Basin or western Hubei (Jiang Zhanghua 2007:400), they entered and became a part of the cultural code of the Chengdu Plain in which the several vessel types constituting the assemblage perhaps interacted with each other as well as with feedback from local users. Skillful potters, though were not omniscient, did not always act according to a set plan, and their pottery in turn exhibits variations (Giddens 1986:536; Dobres 2000:137). During the recursive making of decisions and choices, they sometimes transform or create new norms in the process of interacting with their material environments, social settings, peers, and consumers.

Furthermore, the existence of this agreement might not necessarily have united the social groups into an identical "culture". It seems that while there might have been a set of cultural codes or institutions which actors were expected to obey, these institutions *per se* were not without flexibility and people might have more than one choice of cultural norms. From the example of pointed-bottom vessels, although the vessels were often highly standardized within a locus or a site, potters still enjoyed a certain freedom in production, such that many vessels do not follow a strict norm in dimensions but exhibit certain "fluctuations".

2.3. Categorization

Though variable values have been estimated statistically here, the goal is to discover the emic categories or classification instead of inventing our own optimal clusters. Because the ancient social conditions and cultural order underlying such material expressions are really what we

hope to understand, our effort should be directed to approach the mental processes of artisans with prior knowledge of their classes. Such classes that were usually possessed the same language labels among a social group (e.g., the villagers) are *types* we aim to recognize but have been lost in the archaeological contexts. Nevertheless, both ancient people and modern analysts have imposed their own order on the materials, either when people made/used objects or when the objects were studied. An 'emic classification' can be differently and strategically expressed and interpreted by producers and users for certain conditions and specific duration (D. Miller 1985:10), in which we might also detect flexibility in technical choices and decision making. In other words, the material categories we may discover are only one of the many ways to represent a given cultural world, or they are simply an instantiation of a template. From this viewpoint, no material expression of a category is a pure, holistic reflection of a cultural template. Instead, we may hope at best to search for material categories, which were social products of a particular space and time, to infer the embodied social distinctions that might not be directly accessible otherwise.

With this purpose in mind, after checking the variables that represent vessel dimensions, I found that vessel rim radius and height most clearly reveal the artisans' concerns when shaping and sizing the pottery (Read 2007:37). Although they are quantitative variables, their frequency distributions show potters' intentions in making distinguishable vessels types or varieties. Also, for identifying variables relevant to the categorization of the ceramics under study, I employed factor analysis to reduce the redundancy of chemical variables (elements), and additionally identified such chemical elements as silica, ferric oxide, alumina, and flux[146] as meaningful factors. Moreover, tempering categories are also culturally relevant and characteristic of local production. In other words, as some materials and technologies were of cultural significance and

[146] In Chapter IV, a combination of Na_2O, MgO, K_2O, CaO, TiO_2, and Fe_2O_3 is adopted.

related to social differentiation (Nicklin 1971), the methods we choose to measure them need to reflect such distinctions in some aspects so that we may illuminate the categorizations of producers and users (Rice 1987, Read 2007). These attributes were adopted intentionally or unintentionally by their makers and users to create differences during the various stages of the production process. However, a distinction in one dimension may cut cross that in another. For instance, different tempers may be used to produce vessels of the same shape, and vice versa. Thus, to study such material categories and distinctions from different aspects allows us to trace and compare not only the different environmental adaptations and technological choices, but also diversely constructed social distinctions and relations.

2.3.1. Types, varieties, and assemblages

Both the rim radius and height of the vessels varied within a certain range that was probably constrained by certain outside conditions; together they form a morphological range of *jiandi zhan,* which distinguishes this vessel type from others. For instance, *jiandi zhan* found in the Sanxingdui sacrificial pit were divided into two types based on their morphological differences, which are clearly demonstrated by their frequency distributions against height and rim diameter. The division of vessel forms into two radically different clusters without overlap—the large-deep versus small-shallow pointed-bottom vessels— might suggest their different functions or uses. Such divergence in shapes therefore provides a basis for the definition of a type, depending on how we understand the relationship between function and type (D. Miller 1985:53). Although functional traits, such as the sharpness of the edge of a knife, are supposedly culturally independent, the needs for some functions are not necessarily universal; instead, a need can be culturally constructed or stressed (Appadurai 1986; D. Miller 1995) and is related to the microenvironment. Moreover, when a functional need can be met in more than one ways, due to

certain constraints or choices, the morphological designs of artifacts might not always represent the optimal execution from the perspective of function. Cooking and eating vessels, for example, often point to cultural idiosyncrasies even though they are required to meet such concerns as heating efficiency and preservation. These vessels are also an area revealing cultural and social identity which shaped the conventions of vessel use, whose practice reproduces the family structure (Ralph 2006). *Li* tripods that were prevalent in the Yellow River and Middle Yangzi River basins, for instance, are absent in the Upper Yangzi River. Even in the regions where the vessels were used, they were differently valued, according to their frequency of occurrence in the assemblages. The replacement of small, flat bottoms by pointed bottoms, and then by rounded bottoms in eating vessels of the Chengdu Plain is another example, in which the replacement might not fully owe to a functional reason but might be related to certain social changes since all three types of vessels can perform the same tasks equally well. Perhaps the functional criteria or minimal limits of these vessels need to be detected in different aspects, such as material properties (e.g., refractoriness and permeability), beyond morphology. It is possible that, if the relationships between the diversity of eating vessels and foodways hold, the change in vessel types and even the assemblages may imply a change in food or eating habits.

If we further observe individual metric dimensions and seek out properties that are culturally important, whether the variables of interest form convergent values might provide information about artisans' preferences or restrictions, which are useful in defining types or varieties. Rim diameters, for instance, are often determined during the forming stage of manufacturing, such as throwing on the wheel. It seems that their variations were restricted within a certain range and were not culturally meaningful in the *jiandi zhan* from Sanxingdui and Shi'erqiao site clusters. The Jinsha site, on the other hand, formed a nearly normal distribution in

the values of the rim radii of *jiandi zhan*. In addition, two different heights of *jiandi zhan* were manufactured in Jinsha during the early Western Zhou period (*ca.* 1000-900 BC), probably indicating the trait was under the stricter control of two sets of norms. Two varieties of *jiandi zhan* were derived on this basis. What the relationships were among the loci that yielded high and short *jiandi zhan* requires further exploration. The trait, however, bore certain meanings, perhaps suggesting distinctions among residential groups, while both varieties were used in a similar manner, as found in the remains associated with daily life and burials.

Sometimes, it is the ratio of two metric measurements that forms a normal distribution and suggests that potters shared a concept about the shape of a certain vessel type. For instance, although the Sanxingdui *jiandi zhan* can be subdivided into two groups by rim radius and height, none of the groups shows modal values in their individual dimensions, though they do in their ratios. This preference for certain ratios also witnesses the fact that the value of one dimension often affects that of another.

Aside from pointed-bottom vessels, during the Bronze Age, characteristic pottery types of the Chengdu Plain also include ring-footed tureens, mounted bowls with ring feet (*gaobing dou* or *aiquanzu dou*), *he* tripodal spouted pitchers, jars with small and flat bases (*xiaopingdi guan*), long-necked jars[147], vessel covers and stands, spindle whorls, and later Ba-Shu-style weapons, as seen in Chapter III. All of these ceramic types, though they are perhaps not as numerous as pointed-bottom vessels, were frequently found at the sites throughout this large space, and some types were maintained across different periods of time. To investigate the social functions of the vessels carries the implication of cultural influence, because the distribution of the same pottery vessels may reveal a relatedness in lifestyles, foodways, religious cults, or burial practices across

[147] Pottery vessels categorized as high-stemmed dishes, *ping* vases, tripod *he*, and small, flat-bottom jars are close to those of Sanxingdui; on the other hand, pointed-bottom pottery vessels, ring-rooted jars, and long-necked jars are close to those from the Shi'erqiao sites.

the region, while the selective use of vessel types from the assemblage suggests varying perceptions of other cultures. When appearing alone, the objects might be thought of as fortuitous. This is exemplified by some of the ritual bronzes scattered in the Sichuan region, whose foundries can rarely be identified. Most of the pottery assemblage or their forms, however, were introduced to other areas outside the Chengdu Plain under certain forms of cultural or economic exchange. After adopted, vessel types were perhaps transformed to meet local needs with readily available materials. Furthermore, besides vessel types, some decorations, motifs, and subjects which were common among Baodun or Sanxingdui artifacts continued to be used in the later phases in and beyond the Chengdu Plain with more or less transformation, showing certain connections and common grounds in life and aesthetic experiences among the involved settlements. By comparing the technological, aesthetic, and social specialties among these related settlements, synchronically or diachronically, we are provided with an important avenue to understand possibly shared cultural values.

2.3.2. Stylistic frontiers and social relations

It is worth noting that interactions between social groups, while helping to spread certain cultural values, may decrease social distance in one respect but increase it in another. Styles of products that are not directly related to the performance of tasks, for instance, have often been thought to create boundaries while also serving as an avenue for communication. Despite framing or influencing how people interact with each other, they provide a tool for group members who seek social change, whether through individualization or affiliation (Wobst 2000). The borrowing of foreign-stylistic ceramics in displaying personal wealth and status is also a strategy for internal social mobility. As Stanish (1989:91) has argued, non-domestic contexts, including ceremonial, elite activity areas, and burials, may not necessarily reflect the ethnicity of a working

population. The information carried by artifacts found in these contexts is possibly nonlocal. Furthermore, because valuable items are more likely to be curated, reused, or scavenged, they are less frequent in common deposits (Schiffer et al. 1981; Hayden and Cannon 1983; Smith 1987:324). For example, although the Shang and Zhou cultures were distinctive in their pottery assemblages, the designs of Shang bronze deeply influenced the Zhou style especially before the Middle Zhou in the first millennium BC (Yue Hongbin 2006:329). Such influence and borrowing were hardly comprehensive or systematic in every dimension, however. The characteristic collocations of decorative designs and vessel types and the different compositions of ritual vessel assemblages, besides the daily potteries, distinguish the Shang and Zhou people. The adoption of Shang or Zhou ritual bronzes outside their territories in such regions as the Chengdu Plain also exemplifies the use of nonlocal styles and items that were transformed for ceremonial events. The borrowing might not be direct, but via the peripheries of the Shang and Zhou courts, such as the Upper Han River and the Middle Yangzi River basins.

The use of such nonlocal designs for special occasions created both a link and a division between social groups. For instance, in ritual contexts, like Sanxingdui, there was limited stylistic variability among pottery artifacts. It is possible that social unification was sought through the homogeneity of artifacts in such occasions (Nelson et al. 2011). Events like this would also have created both a template for social positioning and a chance for status mobility. Because categorization is a repetitive process to relocate the position of things to the category they were thought to belong, both the inherent (material) values and social values of things can be used by their owners to articulate and improve their social conditions. In such situations, artifacts acquire particular cultural values in certain cultural settings, and again provide another source to create social relations. Like the mutual adoption of certain pottery vessel types between

the Chengdu Plain and eastern Sichuan, in which foreign vessels were "localized" in domestic contexts, the introduced items had to be decontextualized and recontextualized even though they might have been used for similar activities (e.g., rituals or ceremonies).

To explore the categorization of artifacts, we therefore need to investigate the diverse aspects of their social lives and how the same artifacts took on different expressions on various occasions. This includes contrasting secular and non-secular vessels and distinguishing between gifts and commodities (D. Miller 1995), through which we can understand which social meanings were attached to objects in different contexts. For artifacts like *jiandi zhan* that can be used in multiple ways and have appeared in various contexts, it is difficult to determine their social roles because the social values and meanings of the vessels may have varied accordingly. Whether they were prestige goods is unclear or changeable. It is very possible that such vessels cut across the distinction between prestige goods and subsistence commodities. In the Sanxingdui sacrificial pit, where *jiandi zhan* were buried with other luxury and prestige goods—bronzes, gold, and jades—the pottery probably bore certain cultural and moral values beyond practical usage. In such cases, the value of the vessels was not determined by the labor or time devoted to their production; value, instead, needs to be sought culturally and socially (Clark 2007:26). Whether the interment of ritual objects means the end of their cultural values along with their attendant social relationships and keeps them from being re-accessed or, contrarily, signifies and enforces the prestige of the ruling or religious authority is perhaps related to current debates about the decline of Sanxingdui. Such associations among certain crafting objects, their cultural values, and social relationships, even though we know what they are, may not necessarily have endured during later periods in the Chengdu Plain, especially when the objects'

usage did not remain the same. That is, later, *jiandi zhan* are more common in other contexts—in daily life and graves, as we saw during the Shi'erqiao and later periods.

In a similar way, the discontinuity of *jiandi zhan* production after the Qingyanggong phase was not the product of 'technological loss' or due to the lack of raw material but, rather, was related to the broader social conditions, during which external (e.g., the introduction and widespread of the production and use of round-bottom vessels) and internal factors (e.g., vessel stands became permanently fixed to the vessels) might both have played a role.

2.3.3. Interplay of different types of artifacts

To investigate the categorization of potteries, we should also take into account the interplay among different types of ceramics, where fuzzy categories (D. Miller 1985) are initially assigned. How pottery production interacted with other classes of production, as well as with subsistence economies is also worth noting. In many cases (e.g., D. Miller 1985:48), the presence of potters and workshops is related above all to the demographic factors and the decisions made about the locations of workshops often needed to adjust to day-to-day life. In such situations, workshops were often associated with residential areas, in which production was most likely undertaken to fulfill the practical needs of the communities. For instance, from the Shi'erqiao settlements, several vessel types similar in functions and volumes, such as the various types of pointed-bottom vessels and *dou* mounted bowls, were probably used as a set of foodwares. Potters did not invest all of their energies in producing a single vessel type, but made several types in single a batch. This can be observed from the usual mix of pottery products found in kilns. A number of kilns, including those from the Shi'erqiao and Jinsha site clusters, were not used for the specialized firing of certain vessel types, as might be expected. These kilns were but employed for different types and clay textures of vessels, which seem intentionally to have been mixed in a

given batch. From the examination of petrography, it is also clear that different vessel types, including *jiandi zhan,* even though might have special social values according to their contexts of use, did not separate raw clays or tempers within a locus. It is quite possible that the same vessel types served more than one end and that different tasks could be fulfilled by several types of vessels. The mixed production for different pottery vessel types reflects the consumption needs of perhaps households or the community where the vessels were used and were sensitive to practical problems. The mutual influence among vessel types often shows transitional features in their composed materials, volumes, and shapes, which also further add to the fuzziness of the categorization.

It is also likely that in a society like the Shi'erqiao settlements, more than one type of production organization coexisted for the same or different categories of crafts. As Kenneth Hirth (2009) points out, for understanding small-scale specialization, such as in household production, it is not the time devoted to production but the economic strategies that are important. It is possible that producers may have worked on a range of materials complementarily or sequentially and were not product or material specialized. The diversification of craft production, though without high yield, allowed residents to manage risk (Hirth 2009). The conjunction of different categories of production conducted within households or domestic groups also denotes the interplay among these crafts. For instance, pottery making provided molds for bronze production and spindle whorls for textile production. Front-end products might influence production of the back-end, and could also be customized according to its needs. With the relationship between supply and demand, the specialization or intensification of one production activity may result in the intensity of another production method. From the diverse production tools, semi-finished products, and debris seen in the settlements under study, different types of

craft production, including bones, lithics, and bronzes, were seemingly aggregated at the sites and formed some units of symbiosis. They together also formed a network of artifacts important for subsistence economies besides direct food production. Moreover, the craft products also cover non-utilitarian items, including semiprecious ornaments. The symbolic impressions bore on pottery spinning whorls, for instance, transformed the production tools into ones with special meanings that pertained to the weavers or their affiliated social groups. Although the scope of ceramic circulation and other types of exchange might be different, they were nonetheless related to and influenced one another through overlapping household laborers and consumers.

The interplay between different types of production may also be observed in the pottery and bronze imitations of the other materials discovered in the region, although it is sometimes difficult to determine which of the materials represents the prototype (Trachsler 1965). Many of these imitations were used in the contexts of burial and both bronze imitations of pottery (e.g., *jiandi guan* and *jiandi cheng*) and pottery imitations of bronze ritual vessels (e.g., *lei* and *hu* liquid containers) can be found in the Baoji cemeteries and the Chengdu Plain, especially during the Qingyanggong period. To imitate of higher-appraised prototypes with readier materials might especially involve economic concerns and the pursuit of certain social roles (i.e., identity or status).

3. Production organization and political complexity

From the above, different categories of artifacts executed by various material cultures may form complementary data and can be used for crosschecking one another. They were not only products produced by artisans but the social products of a collective recognition about how things should look like and how they should be used. As a part of the cultural assemblage, technological differences may also be associated with social differentiation in other respects,

such as food and dress, each of which maintains specific sets of social and power relations. Thus, the study of material distinctions and their formation during production may allow us to infer distinctions in other dimensions and how they were collectively or uniquely associated with social change.

3.1. Production organization—household production and domestic economies

Through examining pottery products from the three site clusters under study, it is clear that different modes of production organization would have been responsible for the product characteristics specific to the sites, even though they produced the same vessel types. *Jiandi zhan* from Sanxingdui, as discussed above, reveal that their pottery production was constituted by a limited number of artisans working for special occasions, through which highly standardized vessels were made. On the other hand, in Shi'erqiao and Jinsha, the kiln clusters found in Sanhe Huayuan (Chengdu 2001d:171) and single kilns in several other loci are not only associated with large buildings that were likely public spaces shared by community members or long houses shared by households, but also nearby burial grounds. Such spatial relationships may have implications for the scale of production organization.

If we consider the parameters proposed by Costin (1991; 2000:378; Costin and Hagstrum 1995:620): the spatial organization of Jinsha contrasting with those of other Shi'erqiao settlements suggests the existence of both nucleated and dispersed modes for producers. In domestic economies like the Shi'erqiao settlement, households would have accounted for the basic production unit, in which a small group of possibly kindred producers made crafts together. On the other hand, Jinsha-Sanhe Huayuan has demonstrated the existence of a nucleated and workshop mode of production unit, in which cooperative producers may or may not have been relatives (Costin 1991:7, 15), even if the real size of the involved labor is unclear. The

production area is specialized (Rice 1991) and the products implied certain control. This inferred scale and system of control can be of economic, political, and/or social importance, as Costin figures out (2000). It is possible that the specialization was driven by collective needs derived from the increase of population density and spatial expansion of the Jinsha core. The adjacent residential and ceremonial areas (Lanyuan and Meiyuan, etc.) might have produced extensive market demands for craft products. The number of specialists could reflect the size of the consumption population (Earle 1981:230), and vice versa, which in turn is related to population density, the consumption rate for items, and the distance between producers and consumers.

Daniel Miller's case study of Dangwara in central India shows that the division of labor in pottery production in a household is normally distribution between a potter and a painter, who are often a married couple, working simultaneously at some stages, and especially during firing (D. Miller 1985:79). A similar household division of labor has also been found in other ethnographic studies. In these cases, the social status of potters in a village is usually tied to the local birth rate and mortality, which affect the supply of potters. When there is a dearth of potters, villagers might invite potters from other villages through the expense of lands and houses, which encourages the mobility of potters between different village traditions and thus the mobility of the techniques of pottery production itself. By inviting new potters from other traditions in this manner, together with intermarriage among different villages, promotes technical communications among neighboring settlements and a certain level of convergence across a larger region.

On the other hand, temper usage and forming techniques are often the most conservative aspects of pottery making in some societies, even in the face of social change (D. Arnold 2004; seen in Gibson, ed. 2006:113). Sometimes, the kinds of tempers are explicitly raised by villagers

to distinguish certain vessel types from others, giving them special meanings (D. Miller 1985). The use of certain tempers also often characterizes a regional tradition. For instance, grogs were usually used as tempers in the Xindian 辛店 culture in the Gansu-Qinghai region during the Western Zhou period, whereas rice chaff and clams are often present in Daxi pottery in the Middle Yangzi. Both of the regions are adjacent to the Sichuan Basin and similarly tempered ceramics can occasionally be found in samples from the Chengdu Plain during the Shi'erqiao period, although sand tempers still dominated. The presence of these "foreign-style tempers" might be the result of the exchange of real objects or technical aspects of production among these regions.

3.1.1. Production units and scale

From the remains found in kilns, it is known that several different kinds of products may be mixed for firing in a batch. How the division of labor was undertaken to make different types of pottery is unclear. From ethnographic observation, however, even though potters were able to make all kinds of vessels, they tended to choose limited, particular types that they were probably more skilled at making (van der Leeuw 1984:756). If a kiln from the Shi'erqiao period could be loaded with at least ten moderate-sized pots for one batch of firing, which can be estimated using the findings from Minjiang Xiaoqu, and the kiln can be used repeatedly, then the products of a single kiln is better able to meet the needs of a household and even satisfy the requirements of a cluster of households or a community. Some researchers have recognized this consumption of products by nondependents beyond households as product specialization (see Flad and Hruby 2007:4).

Moreover, as several types of craft production are often juxtaposed and complement each other in these settlements, the producers were not necessarily fully devoted to producing one

particular category of items, but possibly undertook multiple tasks and even made more than one type of craft at different times. It is likely that autonomy and self-efficiency were maintained at the community level, as household specialists were hardly completely self-sufficient (Hagstrum 2001). In some settlements, like those in the outlying mountains of the Chengdu Plain, most pottery vessels were constructed using simple structures and decorations, forming only a moderate degree of standardization. Potters in such a scenario might not have devoted all of their time to pottery production, though they seemingly chose to produce a limited range of vessel types. The dispersed distribution and small numbers of production facilities suggest that production operated on a small scale to fulfill local needs. Even though some categories of craft products, such as lithic production, were produced in great numbers, their production loci do not seem to have been independent of residential areas. The volumes and skill levels of products should not be taken for granted as indicators of production scale, as Feinman and Nicholas have warned (2000).

The generally dispersed production mode in the Shi'erqiao loci provide an example in contrast to the Jinsha core, where production was organized through community specialization or nucleated workshops (per the definition of Costin and Hagstrum 1995:624). As Hagstrum has shown, household specialists possibly worked in aggregate at the community level to produce ritually important items or to fulfill obligations for institutional projects (Spielmann 1998; Hagstrum 2001:50-2). By clustering together, artisans created an environment to work together or competitively, making their production more efficient and products more uniform or delicate. Such an environment has also created opportunities for some artisans to imitate superior ones. In this fashion, a certain degree of standardization was achieved through repetitive practice, imitation, the sharing of knowledge, and continuous readjustment to cultural templates. It is also

possible that a part of the craft production may have been supported by institutions for ceremonies or mortuary events and was thus closer to nucleated corvée or retainers workshops, in which crafters were recruited by the a certain society or institution for specific events. From this point of view, the Sanxingdui and Jinsha production groups are best thought of as "embedded specialized" units (Ames 1995; Saitta 1997; Janusek 1999; Inomata 2001).

At this stage, however, the dependency between the production center and consumption peripheries might not have been fixed, though the influence of workshops and their characteristic products spread to remote districts. The exchange flow might have been intermittent. It is common to find single or a small number of kilns of the same type in many loci. Under moderate technical requirements, settlements apart from each other apparently built their own kilns to produce pottery in a cost-effective way. Multiple types of kilns and production modes might have coexisted to serve different purposes or consumption groups. Less delicate pots could still have been made in households by non-specialists or part-time producers, in which impermanent facilities, such as bonfires, might have been employed though they would have left little if any archaeological evidence.

In other words, it is still a leap to assume the existence of centralized, instituted control over production even though nucleated workshops, craft specialization, and standardization are evident. It has been shown from other case studies that workshops for different crafts were concentrated in spaces thanks to similar manufacturing processes and production needs, such as water resources, fuels, specific raw materials, supplies of labor, and markets (H. Miller 2007:37), but were not forced by political management. The population structure and their relationships may also influence the distribution of the workshops in a community. In the transition from spatially flexible to spatially restrictive production (P. Arnold 1991), the less moveable

instruments and permanent facilities (e.g., pottery kilns) are able to satisfy greater demands than open firing though production activities are restricted to a certain range of space. Moreover, the long, continuous occupation of the same locations with sedentary life, agricultural activities, funeral practices, and animal domestication reveal that households could grow to a large size, making production systems and the transmission of cultural knowledge and property more complex. From this point of view, the large buildings found in Shi'erqiao, for example, are not necessarily palace or elite residential spaces, as some scholars have suggested, but could have been realms for larger households that gathered several nuclear families who cooperated economically. Even if these were civic structures, it cannot be taken for granted that the embedded production loci were under the control of higher non-producing classes, especially when there is no evidence to support differentiations in social status. Precious items were largely interred or deposited in ritual related occasions, but no concentration of personal wealth can be clearly identified in private spaces, such as households and graves.

In order to speculate about the economic background of households, ceramic expressions have been used as an indicator of differentiation. For instance, scholars have proposed using the quantity of serving wares to estimate the size of a household and settlement (M. Smith 1987:323). This is because the wealthy of a household perhaps influenced the quantity and diversity of foods, such that eating and serving vessels might have been more diverse in wealthier households. On the other hand, this pattern might be aggrandized or confused by such events as feasting. It has been observed that when serving public events, the quantity, diversity, and even the size of the vessels were often enlarged to meet serving needs though the vessel types and styles remained the same (e.g., D. Miller 1985; Blitz 1993; Ralph 2006). Possibly, the extra-large pointed-bottom

vessels, tripodal spouted pitchers (*he*), and high-stemmed mounted bowls (*gaobing dou*) found in the Jinsha core were produced for similarly customized functions.

3.2. Social relations and power relations

The domestic working groups do not seem mysterious when broken down into the level of autonomous villages. Their "economies", however, were not isolated but need to be considered together with other social groups and connecting social relations (Sahlins 1972), by which they constitute a complex exchange web. There is evidence from the explosion of archaeological sites and pottery sherds that the Chengdu Plain has been populated since at least the Neolithic Age and that populations grew further during the Bronze Age. Mapping the level of political integration, as defined by Murdock and Provost (1973), the societies of Chengdu Plain during the Bronze Age, revealed by settlements like Jinsha, are probably best described as stateless but nonetheless possessed organized, autonomous units of local communities. It is evident that the nucleation of workshops in Jinsha was accompanied by the formation of specialist functions for various loci. Meanwhile, in addition to the peripheral areas in today's Gaoxin Xiqu District that have been occupied since the Neolithic Age, recent excavations in Jinsha show that the settlement expanded to locations originally marginal to the Jinsha core area. It is likely that something urbanization gradually developed in these settlements. From the expansion of the settlements and the concentration of workshops in certain loci, we can observe both the nucleation and decentralization of working modes.

Moreover, not only can the settlements in the Chengdu Plain be generally recognized as member of the Shi'erqiao culture, but it is also clear that the western mountainous areas of the plain as well as the Middle Yangzi valleys and the Upper Han Basin adopted potteries characteristic of Shi'erqiao. These adoptions were selective and were incorporated with their

native pottery traditions. Such selections, though not identical in all places, almost always involved pointed-bottom vessels. As they had different impacts on local cultures, the diverse cultural exchanges might have denoted distinctive meanings for different places. The seemingly asymmetric influence from the plain to the western mountainous areas, for example, probably signals the incorporation of the peripheral areas into the cultural core though the ostensible peripheries did not give up their agency. This process was not the same as the cultural exchanges between the Chengdu Plain and the eastern and northern regions. Furthermore, it is clear that, even in areas sharing the same cultural knowledge and producing similar vessel types, different sites diverged in their technological choices which were adjusted to local microenvironments and social needs. It seems that from the distribution of the Shi'erqiao assemblage, the cultural sphere that had formed since the Sanxingdui period continued on, was altered, and was re-integrated.

3.2.1. Inequality and heterarchy

As no evidence supports the presence of a single elite control over the production or the distribution of products, it can only be speculated that cultural influence and exchange followed material exchange and intensive contact among social groups. That said, large-scale craft production is not necessarily attached to an administrative stratum, so that assume this one would need to combine conjecture with other lines of evidence, such as certain forms of social inequality. Some forms of inequality may exist in different segments of social life, such as religious activities, feasting, or other public projects. For instance, the separation of ritual occasions and cemeteries from the main residential areas in Sanxingdui and Jinsha, though not distant, is recognizable, indicating that some distinction between sacred and secular life was known. Different activities can together result in the customization of paraphernalia while fulfilling the practical needs and legitimating the cultural significance of the events. This,

however, does not necessitate emergence of permanent power relations. Current evidence may not be sufficient to allow us to comprehend the power relations in the Chengdu Plain during this early period. However, if taking into account the burials found in the Chengdu Plain, especially those close to the loci that have been thought of as political and/or religious centers, such as the Rensheng cemetery next to Sanxingdui and the several cemeteries in Jinsha, where more than 2,000 burials have been recovered, we find that occupants were only simply treated and that the pits were small, shallow, and nearly all of the same size. Neither do they show notable differences in grave goods. In addition, many burial grounds were connected with or scattered around residential areas and were taken over by other features after a short duration of usage for burials (Jiang Zhanghua 2010:46). It is difficult to suggest from this line of evidence that any form of hereditary social rank had taken place. Perhaps this suggests that a large-scale and complex society was organized in a heterarchical, noncentralized way or based on acquired achievements. Though we cannot be certain at this stage, it is still reasonable to argue from current evidence that craft production contributed to the development of an extensive social network during the early Bronze Age.

It is clear that production in the Chengdu Plain during this time was organized in an integrated and yet loose manner. With this mode of organization, potters had a certain degree of freedom while still adhering to social norms or customs in making their products, whether the products were designed to serve daily or funeral purposes. The norms were followed more strictly in populous areas, where demands were larger and potters were thus more likely to devote more time to production, but products were otherwise produced in a more random manner in less populated areas. It was only on special occasions, such as the ritual events in Sanxingdui, that production was undertaken by a very limited number of artisans achieving a higher standard

than usual. It seems that wealth and surplus were preserved in the community and used in special ceremonies, but they were not in the hands of specific individuals or groups. The economic function of ritualistic institutes and ceremonial activities that have often been overlooked probably created not only the needs for precious items (Friedman 1975), but also those for new techniques and specialists.

On the other hand, it has been noted that since the late Neolithic Age labor was seemingly mobilized and organized on a large scale in public projects to build walls, moats, large structures, ritual paraphernalia, and water- repellent devices. The organization of production, ritual activities, and feasts and the importation and use of foreign artifacts might also have gathered people and been used as strategies of aggrandizement. Questions like "who was *empowered* to make decisions about resource procurement and use, technology…, and the distribution of finished goods?" (Costin 2000:378, emphasis added) have presumed the existence of a powerful control over production processes. Nonetheless, such inquiries have not accounted for collaborative activities in which everyone shares the same benefits, such as the exploitation of new mines. It is likely that social prestige in such situations was shared among attendant people. In addition, in a society, in which the combination of cultural elements is not patterned such that they can be combined and recombined in various ways (Levy 1995), the society likely witnessed greater room for negotiation and reorganization.

3.2.2. Exchange and tension between social segments

Although contact with other regional cultures might have greatly influenced the development of societies centered on the Chengdu Plain, I argue that we should not rely on these external stimuli as the main impetus behind the sociopolitical process of the Chengdu Plain. External stimuli do not satisfactorily explain the development of Bronze Sichuan, because we lack information about

how an innovation was adopted by the societies. Given the larger political and economic forces, scholars have also often overlooked how small-scale household production contributed and responded when facing these forces (D. Miller 1987). To compensate for this lack of information, I suggest comparing different coexisting cultures as well as social segments about their decision-making strategies, interests, and conflicts, when they adopted a new technology associated with techniques and/or products.

In places like the Central Plains, where the Shang and Zhou courts were situated, ritual bronzes were instruments of and proxies for political power and were used to legitimate the political authority (Chang 1983, 1986). The "horizontal relations" of contemporaneous clan members or polities might be translated into the "vertical relations" of lineage (Friedman 1975:49). Similar ritual vessels or their manufacturing techniques were, however, cut off from other paraphernalia and their original contexts of use, as well as cultural meanings, when they were brought into the Chengdu Plain. The artifacts thus acquired an opportunity to be reinterpreted by local societies and impacted local social groups in varied degrees, depending on their relationship to the ritual events. The different strategies employed by social groups during the exchange of such items might also delineate some economic entities that are otherwise difficult to detect.

The tension that existed in the exchange of different materials or cultures and the resulting renegotiation of social relations from such exchanges are especially visible in regions where multiple production traditions coexist due to population movements. In areas of cultural encounter, such as the Middle Yangzi River and the Upper Han River, their pottery assemblages often contain vessels from a variety of regions. For instance, in Jingnansi, east of Sichuan, people selectively adopted vessels from their neighboring regions, including the Central Plains

and the Chengdu Plain via the Three Gorge Area (He Nu 1994, Appendix III-Figure 45). Although scholars have often attributed the coexistence of different regional variants to the presence of different production groups, each of which was responsible for a variant (e.g., Costin 1991:41), the coexistence of such groups might not be necessary in an area with high rate of exchange. The excavators of Jingnansi have suggested that the different categories of potteries adopted in this settlement, which were functionally complementary, had different sources. They probably had distinct meanings for and importance to local people. For example, the Chengdu Plain-style vessels found here, which were mainly composed of fine drinking and eating vessels, were seemingly attached to higher value than local potteries, even though local potters were not incapable of producing fine wares. Nonetheless, the presence of the material-culture elements originating in the Chengdu Plain was not lasting and was soon replaced by an influx of objects from other regional cultures. This withdrawal was perhaps due to the occurrence of certain social change on the Chengdu Plain. Nonetheless, it is also possible that the social conditions of Jingnansi *per se*, in which the vessels were once demanded, no longer existed. As the pace of social change might be inconsistent in different social aspects, different consumption patterns might change in a non-synchronous manner, resulting in tension in social relations and perhaps the struggle for cultural identity. As a result, when such societies as Jingnansi realigned to other cultural sources, notably the Central Plains, as observed in their material cultures, their transformation should not be thought of as fissureless or well-integrated.

With the distribution of Chengdu Plain-style products that have been found across the whole basin and beyond, it is also clear that craft production at the domestic level and products for daily use might also have been involved in long-distance exchange. Such exchange, however, might not come with real objects but, instead, with templates—vessel types. The exchange of

manufacturing ideas might have required many intermediaries and numberless communications, even with areas that would have been peripheries between production cores. The articulation of domestic economies, via communications among social groups, may become large exchange networks, as Feinman and Nicholas (2000) have noted in Mesoamerica. This articulation, in my view, not only accounted for the intensification and complication of regional economies, but would also have witnessed the processes of social complexity.

4. Conclusion

To understand craft production we must first understand a series of processes of materialization and circulation; the study is not confined to techniques or objects *per se*. Our concern here is mainly the social distinctions reflected in material categorization and the cultural influences of the products. In a similar sense, the introduction of the concept of ecology does not limit this study to natural environments and resources, but includes social and cultural conditions that influenced craft production. Forms of social organization and different settlement arrangements, for instance, often influenced the distributional modes of workshops or working groups. These may also have fashioned how different categories of craft production played off one another. In the Jinsha core and sacrificial loci, the production units were closely clustered and the products broadly achieved a higher degree of standardization. On the other hand, most other working groups of ceramics were dispersed and yielded diverse products to meet local communal needs and, at the same time, to reduce the risk of monotony. It would be, nonetheless, misleading to assume that such working groups, as in the latter situation, only worked marginally and as a complement to subsistence activities. Nor did nucleated workshops or factories have a monopoly on large-scale production. In workshops responsible for the production of pointed-bottom vessels as well as other associated pottery, for instance, the intensification of craft production appeared,

despite the absence of craft specialization. Instead, artisans conducted several types of craft activity in complementary or intersecting manners to diversify their products. The diversification and intensification of production activities would have required the coordination and scheduling of crafters. The intensive communications among various working groups would have also promoted the formation of cultural norms and isochrestic traits whose model values were not related to functional reasons, but were fashioned by common consensus and transmitted by the potters' practices and bodily movements. This embodiment of production knowledge and repetitive practices also increased the degree of standardization.

Categorization or classification, by which things were assigned to given categories in mind, was tacitly conducted by and affected potters and users during each stage of production and through various scales, from clay sources to the combinational use of artifacts for certain contexts. Such association of things with certain meanings reflects not only the underlying cultural order, but also producers' or consumers' experiences and interpretations of it. To have similar categorization may therefore reveal that people shared cultural values to a certain degree. For instance, the ceramic assemblage containing *xiaopingdi guan* and *jiandi zhan* probably delineated the cultural sphere centered on the Chengdu Plain and thus can be treated as a key for tracing the expansion of Sanxingdui and Shi'erqiao. In particular, from the Shi'erqiao period on, the *jiandi zhan* vessel type appeared as a cultural code or template that cannot simply be understood through the lens of functionality. To the contrary, such vessels informed certain shared customs among social groups and that their cultural significance was widely recognized and received in different social contexts. As they were used in both daily-life and burial contexts, the division between the living and the dead was not situated on the typology of the vessels, but in how they were used and associated with other artifacts. Potters as social actors were engaged

not only in the practice of production, but also in the realization and transmission of cultural knowledge. This prior knowledge, on one hand, would have limited artisans' personal reception and experience, such that they produced products largely following templates. On the other hand, artisans possessed a certain degree of flexibility and acquired power from knowledge in interpretation and decision making in the various stages of production. They were thus able to devise or bring in innovations. As both representatives and inventors, artisans not only digested a system of cultural knowledge within a web of social relations, but also reflected the distinctions and disjunctions within a society. They were, however, rarely omniscient or omnipotent in production systems and projects. Their mix of free will and cultural knowledge made them a dynamic part of social organization, which in turn was jointly shaped by *habitus* and the daily practice of the inhabitants. Multiple crafting for exchange might also have expanded the social relations of producers and consumers, adding sources and perhaps conflicts for their cultural knowledge.

The distribution of manufacturing loci in relation to residential units suggests that several categories of production were likely undertaken in the communities, where supply and consumption were community wide, as the usual economic mode of the Chengdu Plain. Such production can, however, work in the conjunction of varied modes, dispersedly or aggregately, for a large spectrum of artifacts. Here, the society of the Chengdu Plain may or may not fit Service's (1962) terminology of society types. The concept of chiefdom or state does not help us understand social complexity. Nor can it reflect the differential situations and strategies in individual settlements. I suggest that, though craft production was organized in various ways, cross-cutting different categories, there is no irrefutable evidence that supports the presence of a centralized control or leadership over production activities, as scholars previously thought. The

values of the artifacts in the realm of political economy were not fixed, either, because the use and circulation of products do not seem to have been restricted. Although, in certain instances, artifacts that had acquired importance in preceding events were used to legitimate the occasions at that moment and invested them with cultural significance, such translation between artifacts and events had little effect on permanent power, because the interpretation of artifacts' meanings was not monopolized.

In the Chengdu Plain and its neighboring regions, where multiple economic and cultural lifestyles frequently encountered one another, social groups and segments might have had different strategies and responses to innovations and social change. To study the social groups covered by the totality of the societies, particularly the basic division of labor in production (e.g., households), is to discover the fragmentation of the totality (Yates 1989) derived from the individual interests of these groups. It is also to discover how the fragments were incorporated into a system through the articulation of practices and communications. The seemingly random and unorganized local communications made during decision making contain information about not only technological choices, but also categorization, in which both humans and things may be objectified and the relationships among humans and between humans and objects are subject to change according to social contexts. This fabrication of communications in various social conditions and its integration also deepened the society's economic and social complexity.

VI. Conclusions

1. Findings and significance

By applying the concept of domestic economies, my dissertation aims to answer a central question: How were production and related activities efficiently organized without the presence of a central control? This question is also related to how complexity is constructed from the accumulation of seemingly simple communications and social relations. From the analyses and discussion presented in my earlier chapters, it is clear that pottery production on the Chengdu Plain played multiple roles and was a multifaceted element of ancient people's social life from at least the Late Neolithic Age. This study has also reflected on several important social and economic issues.

On one hand, the production of pottery was shaped by both natural settings and social structures, such as local soils, fuel resources, and settlement patterns. On the other hand, the manufacturing and use of certain types of ceramics were especially sensitive to individual social needs and consumers' feedback and were proactively customized. In such situations, although the manufacturing of ceramics largely followed prototypes, such ceramics varied in detail or were fulfilled in different fashions. These phenomena tell us about not only the cultural values shared across several social groups, but also the elements of social idiosyncrasy. By comparing the similarities and differences among loci and sites that produced the same vessel types, I have also discovered that these production loci possessed various degrees of cultural control over their products, depending on how the working groups were organized, the purposes for which the products were used, and the meanings that they bore. In other words, under the same cultural sphere, different local varieties, though maintained a similar template, were uniquely fulfilled to supply individual concerns.

On some occasions, as with the pottery found in the Sanxingdui sacrifice pit K1, pointed-bottom saucers can be further subdivided by size. Subgroups so divided possess distinct levels of standardization. Group A, for instance, has a nearly uniform appearance (coefficient of variation = 2.6% in rim diameter), but group B is not only less standardized than group A, but also less standardized than other production loci in the region. The two groups were apparently not under the same production control and likely bore different importance. Because production does seem to have been supervised by an institutionalized power, the high degree of standardization in Group A was probably the result of a very small number of artisans working with repetitive practices and bodily movements while following a certain cultural template. Anthropological studies have documented situations in which cultural knowledge was similarly transmitted through repetitive practices (e.g., Herzfeld 2004). Such a template, though, could have been widely shared among the settlements in the region through frequent communication. Such repetitive practices tacitly shaped *habitus*, which in turn regulated production and directed the formation of production traditions. Production traditions formed in this way might also influence people's construction of cultural knowledge, lifeways, social needs, and social relations.

My own view is that the working groups responsible for the pottery assemblage characteristic of the Chengdu Plain were loosely organized at co-residential households or at the community level with little or no elite or political intervention, even when products served purposes other than daily use. Nonetheless, such a mode of production still reached a high degree of standardization in metric dimensions and forming techniques. From the different degrees of nucleation in the production loci (e.g., workshops, production instruments, etc.) and their spatial relation to the residential areas, I also found that mixed modes of production likely coexisted and that each had its own flow of communication. How production organizations were constituted

was then largely determined by population density, spatial arrangements of residential units, and the social relations among the inhabitants. How easy artisans could communicate one another and had access to public opinion would have in turn affected the formation and the sphere of the influence of consensus.

It is also clear that multiple crafts that were practiced by the same (multicrafting) or different (multicraft production) groups in the same or adjacent spaces (Shimada 2007) were common in almost all of the settlements we encountered. Different production techniques and behaviors had greater opportunities of influencing one another in these shared working spaces. In the situation of multicrafting, instead of being full-time specialists, artisans chose to devote themselves to more than one kind of production activity to enhance their environmental adaptability or economic profits. It is possible that different crafts were undertaken in concert with each other and with the scheduling of central subsistence activities. This coordination and organization of various activities reveals not only the scale of the economy for maintaining self-sufficiency, but also the complexity of local communications. To contrast this mode of domestic economy with production organizations controlled by central power is important, because non-centralized, domestic economy-model does not take complex divisions of labor as a given or as an inevitable result. Instead, this model offers a field in which to observe how complexity might emerge from the integration of seemingly unorganized communications at the local level.

2. Summaries of chapters

In Chapter I, I introduced the history of pottery production in the Chengdu Plain during the Late Neolithic Age and the Bronze Age, against the background of population growth, the formation and rise of large settlements, and the broadening of exchange spheres. This background along with the development of agriculture might have freed up extra labor and produced a surplus for

craft specialization. Specialization, in turn, further promoted exchange and, associatively, the creation of social relations because exchange *per se* was a means to extend social relations as well as a result of such an extension. With these basics and the archaeological data I inspected, I raised several research questions regarding the relationship between craft production and social relations. I also briefly introduced the theoretical models and methods I consider most useful for my case study. They provided the basis for accounting for possible sources of production control, cultural values, and the economic modes that best describe craft production on the ancient Chengdu Plain. This introduction also addresses my primary goal: to understand how different sets of social relations emerged and changed through the circulation of craft products, and to understand how the social meanings of things might change accordingly.

In Chapter II, I set up a theoretical framework to help explain the economic modes and strategies of the ancient Chengdu Plain, whose pottery production I addressed in the succeeding chapters. I first reviewed theories and case studies related to craft production and social complexity, and studied their effectiveness in accounting for the phenomena of the Chengdu Plain and the questions posed at the outset of this dissertation. Production and technologies were here considered social products that could have cultural importance depending on how social actors used them. By reviewing such concepts as standardization and specialization, I was able to argue that these phenomena might have been differently developed over multiple stages of production for which they might have bore specific meanings. Such a view requires us to examine crafts from a different aspect, and to consider their corresponding production control or technological choices. I also explained why some of the theories that scholars have relied on in the past are inadequate in this particular situation. I proposed to investigate household and domestic economies and the spatial relations in production loci, through which the basic

organization of production, mechanisms for regulating production, and related social and power relations could be expounded. From the complex distributional networks of artifacts that are illustrated in Chapter III, it is clear that household production or the division of labor at the community level can contain complex social relations and can have far-reaching effects. Production organized at this scale can still be high-yielding and can feature in the supra-community consumption. In the end, I suggested that multiple sets of relationship among social segments can be constructed and subject to negotiation during the circulation of diverse crafts.

I began Chapter III by reviewing the natural and cultural backgrounds of the Chengdu Plain and, in particular, resources related to pottery production and the factors affecting its organization. The soil types, mineral composition of lithic products, and ceramic vessels were crosschecked, which also set the basis for Chapter IV, where I examined in detail the properties of certain vessel types. The discussion of sites related to the Chengdu Plain focused on their material cultures during the Bronze Age. I decided to compare the distribution of an assemblage of artifacts characteristic of the Chengdu Plain in different periods and regions, including the Three Gorge Area in the eastern Sichuan, the Middle Yangzi basins, and the Upper Han River basins. This comparison demonstrates that the sites under discussion maintained various degrees of cultural and material exchange during different periods. The circulation of the assemblage and some items in particular also suggests how the cultural sphere of the Chengdu Plain changed over time. In addition, though the adoption of foreign goods was selective, it also denotes these societies' different attitudes towards and responses to other material cultures, according to their respective circumstances and needs. I argued that the “scopes” of certain cultural values not only were related to the influence of the societies from which the cultural values originated, but were also determined by whether the new culture values were compatible with the circumstances of

the accepting social groups. The production of the same vessel type (e.g., *jiandi zhan*) with different clays and/or tempers and the practice of similar custom (e.g., oracle-bone divination) on different media are such two examples. This adoption and adaptation of foreign material and nonmaterial things to local production systems, even if their origins were not always certain, also provided social actors with the opportunity to reinterpret these things.

In Chapter IV, I illustrated that the development of production traditions and cultural idiosyncrasy can be inspected from the different properties of artifacts and from their various stages of production, each of which might be under different degrees of production control. It was found that, by comparing ceramic vessels from the Sanxingdui, Shi'erqiao, and Jinsha site clusters, some vessel traits, such as vessel shapes and clay types, were subject to greater cultural control or more closely related to the larger ecology, and their values were received across the region. Some, such as tempering recipes and the local metric dimensions of vessels, on the other hand, were sensitive to microenvironments and artisans' practices, and thus their values tended to be settlement or even locus specific. This observation coincides with many archaeological and ethnological data that the selection of tempers and their processing are often culturally idiosyncratic. In examining natural environments in Chapter III, I also found that certain clays and tempers were equipped with special social values and were preferred by local potters regardless of their face value. In this chapter, I further compared several properties of ceramic samples to see if the property values differ in correspondence to different origins of production loci, periods, clay textures, contexts of use, or vessel types. I conducted color and metric measurements and employed a series of mineralogical, chemical, and thermal analytical methods to acquire data for these properties. These comparisons also allow us to assess the degree of standardization of vessels of different groups, and the production control or technological

choices made at different stages of the manufacturing processes. Together they suggest that the Shi'erqiao and Jinsha site clusters were under closer production tradition. We also found that some traits, such as vessel height, though unrelated to functionality, were produced following more than one set of norms in the Jinsha site cluster. The same trait was otherwise only roughly restricted to a range of values at other sites.

In Chapter V, I combined my case study and the related archaeological data with the framework laid out in Chapter II. I first explained how vessel type and variety could be better defined for our datasets with reference to classifications from the several properties and manufacturing stages that were examined in Chapter IV. I then reviewed the formation of production traditions and cultural codes I had observed in the several settlements of the Chengdu Plain. I suggested that the organization of production in these settlements has been affected by a number of factors, including population density, settlement patterns, and contexts of use. Even if comprehensively understood as domestic economies, the mode of production organization can vary with these factors. These variations reflect the larger social structures and social needs and may themselves produce different social effects and involve communications of diverse degrees of complexity. In closing, I highlighted the processes through which artifacts were used to create social relations, including a sense of belonging or individualization, and the processes in which artifacts and events formed a cycle of a legitimation. Though the adoption of foreign cultures was often selective and strategic, I also illustrated that, although the connection might not be immediately visible, people's changing attitudes toward foreign items over time might reflect transformations in social conditions.

3. Implications and future work

From this series of investigations, it should now be clear that the spatial proximity of settlements and working groups has influenced information sharing, the formation of conformity in production, and the transmission of cultural values. We should not, however, credit such conformity to the management of a supervisory class or a centralized control, because no social rank was evidently in charge of the production and circulation of the products in our case study. This recognition should remind us to take other lines of evidence into account. This study, for instance, did so in two ways: by emphasizing the importance of environmental changes and their impact on local ecological systems, and by studying the spatial relations of production features. The Jinsha site cluster, along with its peripheral sites, where archaeological excavation has not been completed and settlement patterns have not fully been explored, might provide especially useful information about craft production in relation to other dimensions of social life, and requires further attention.

Because social relations can be constructed in diverse ways and often intersect with each other, my investigation could also be expanded to the study of other crafts and their production that involve different scales of economy. That is, although I have focused on household and domestic economies and considered them the basic division of labor for constructing larger economic units, I also recognize the importance and potential of an investigation into economies of different scales. In doing so, we will be able to add to the spectrum about how production activities could be organized, along with their social effects and contribution to sociopolitical processes. To compare the circulation of different categories of crafts may also contribute to our understanding of the thorny issue of self-identity, as pervading cultural codes may provide sources for constructing social identity. Social identity constructed through production traditions

can be constant and influential in other social dimensions, but may, nevertheless, cut across and even conflict with the affiliations formed by other circulations of material and nonmaterial things. This construction is thus dynamic and open to renegotiation.

The concept of technological choice and *habitus* help us not to overlook the agency of both artisans and consumers, and allow us to examine the formation of regularity and cultural norms in production. In the future, my research will continue to pay close attention to the multifaceted social relations and interactions that might influence people's decision making. I will study how production traditions affect material expressions, and how unspoken norms might have regulated people's practices and social actors' intentions but meanwhile, did not eliminate their creativity. For the latter, the study of production traditions, in which different groups of people with divergent concerns and interests collectively define what "suitable techniques" should look like, and further create social needs for the techniques, may best reflect the tacit organizational rules that are otherwise difficult to detect.

Appendix I— Chinese glossary

Ankang 安康
anwochun guan 按窩唇罐
Ba 巴 (ethnic group)
Ba 巴 Mountain
Baimashi 白馬石
Baimiao 白廟
Banbianjie 半邊街
Baodun 寶墩
Baoji 寶雞
Baoshan 寶山
ben 錛 adzes
bi 璧 disks
bianfu hu 扁腹壺 (globular jars)
bo 缽 round bowls
Cangbaobao 倉包包
Changdu 昌都
changfu guan 長腹罐 (long-bellied jars)
changkou quanzu zun 敞口圈足尊 (ring-footed beakers with everted-rims)
Changyang 長陽
Chaotianzui 朝天嘴
Chengbeixi 城背溪 Culture
Chengdu 成都
Chenggu 城固
chikou guan 侈口罐 (flared-rim jars)
chonglingwen 重菱紋 (multi-layered rhombic marks)
Chongzhou 崇州
Chu 楚 (Culture or State)
Dachang 大昌
Dadu 大渡 River
Daning 大寧 River
Daxi 大溪
dengxinqqi 燈形器 (lamp-shaped vessels)

ding 鼎 tripods
dou 豆 (mounted bowls with ring feet)
    aiquanzu dou 矮圈足豆(short-stemmed mounted bowls)
    douxingqi 豆形器 (*dou*-like vessels)
    gaobing dou 高柄豆 (high-stemmed mounted bowls)
    qianpan gaobing dou 淺盤高柄豆 (high-stemmed, mounted saucers with ring feet)
Dujiangyan 都江堰
Dujiayuanzi 杜家院子
Erlitou 二里頭 culture (*ca.* 1900-1500 BC)
Fanba 范壩
Fangchijie 方池街
fangkong bi 方孔璧 (square-holed objects)
fanglun 紡輪 (spindle whorls)
Fengchu 鳳雛
Fengdu 豐都
Fengjie 奉節
fu 斧 axes
fu 釜 cauldrons
Fufeng 扶風
fujiaduiwen 附加堆文 (appliqué)
Fulin 富林
Fuling 涪陵
Funan 阜南
Fuqin Xiaoqu 撫琴小區
Ganjinggou 甘井溝
ganlan 干欄 (stilts)
gaoling guan 高領罐 (long-necked jars)
gu 觚 goblets
guxing qi 箍形器
Guanmiaoshan 關廟山
Gucheng 古城
gufu bei 鼓腹杯 (inflated-bellied cups)
gui 鬶 tripods
guixingqi 簋形器 ring-footed tureens or jars
Hanyuan 漢源
he 盉 tripodal spouted pitchers

daizu fengkou he 袋足封口盉 (closed-spouted pitchers with pouch-shaped feet)

Hejiacun 賀家村

hu 壺 flasks

huabian kouyan guan 花邊口沿罐 (jars with decorated rims)

huabian huandi guan 花邊圜底罐 (round-bottomed jars with decorated rims)

shengwen huabian guan 繩文花邊罐 (cord-marked jars with decorated rims)

Huachengcun 化成村

Huai 淮 River

huan 環 rings

huang 璜 pendants

ji 戟 halberd

Jialing 嘉陵 River

jiandi qi 尖底器 (all kinds of vessels with pointed bottoms)

jiandi bei 尖底杯 (pointed-bottom cups)

jiaozhuang jiandibei 角狀尖底杯 or *y*angjiaobei 羊角杯 (horn-shaped, pointed-bottom cups)

paodanxing jiand-ibei 砲彈形尖底杯 (artillery-shell-shaped, pointed-bottom cups)

jiandi cheng 尖底盛 or *jiandi he* 尖底盒 (pointed-bottom boxes)

jiandi guan 尖底罐 (pointed-bottom jars)

jiandi yu 尖底盂 (small, basinwide-mouthed jar with pointed bottoms)

jiandi zhan 尖底盞 (pointed-bottom saucers)

Jianghan 江漢 Plain

Jiangling 江陵

Jianwei 犍為

Jingpinfang 精品房

Jinjing 金井

Jinnansi 荊南寺

Jinsha 金沙

Junpingjie 君平街

Karuo 卡若

kuanyan dakou gang 寬沿大口缸 (wide-lipped vats with large mouths)

kuanyan pingdi zun 寬沿平底尊 (wide-lipped, flat-bottomed beakers)

kui 戣 triangular dagger-axes (= *sanjiaoyuan ge* 三角援戈)

labakou gaoling guan 喇叭口高領罐 (long-necked jars with trumpet-shaped mouths)

labakou guan 喇叭口罐 (jars with trumpet-shaped mouths)

labakou yuanjian hu 喇叭口圓肩壺 (round-shouldered flasks with trumpet-shaped mouths)

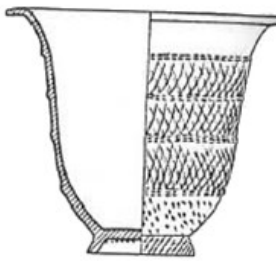
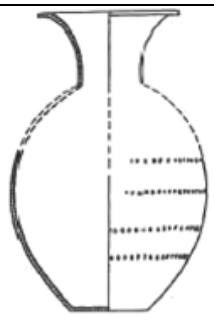
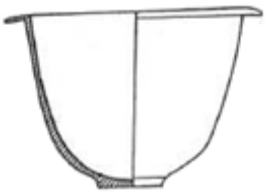
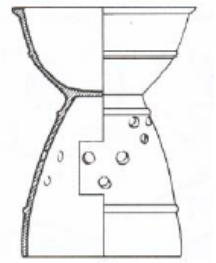
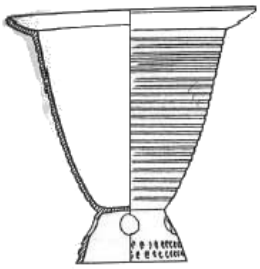
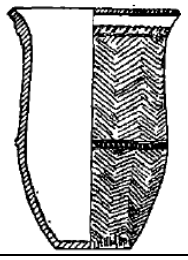
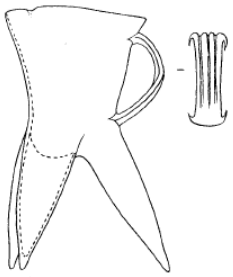
Lancang 瀾滄 River (also known as Mekong River)
Langzhong 閬中
Lanjiazhai 藍家寨
Lanyuan 蘭苑
Laoguanmiao 老關廟
li 鬲 tripods
Liangzhu 良渚
liankou guan 斂口罐 (jars with inverted rims)
Lijiaba 李家壩
Linshi 藺市
Liulinxi 柳林溪
Longmen 龍門 Mountains
Longquan 龍泉 Mountains
Longquancun 龍泉村
Longxi 龍溪
Lujiahe 路家河
Luojiaqiao 羅家橋
Maiping 麥坪
Majiashan 麻家山
Majiayao 馬家窯
Maliutuo 麻柳沱
Mangcheng 芒城
Maoxitao 毛溪套
Meiyuan 梅苑
Mianzhu 綿竹
Miaodigou 廟底溝
Miaopu 苗圃
Min 岷 River
Minjiang Xiaoqu 岷江小區
Minshan Fandian 岷山飯店
Modi 摸底 River
muguniqiang 木骨泥牆 (wattle and daub)
niaotouxing shaobing 鳥頭形杓柄 (bird-head-shaped dipper handle)
nipian pinjiefa 泥片拼接法 or *nipian tiezhufa* 泥片貼築法
pingyan zunxing qi 平沿尊形器 (flat-rimmed beaker-shaped vessels)
pankou quanzu zun 盤口圈足尊 (ring-footed beakers with dish-shaped mouths)

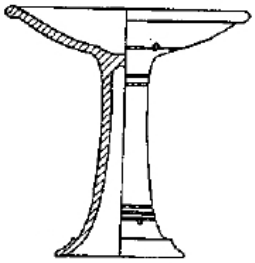
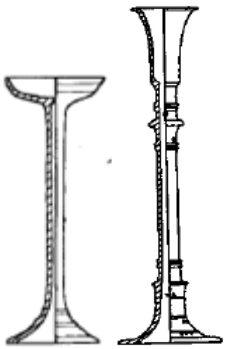
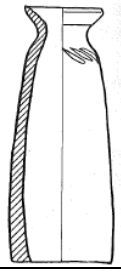
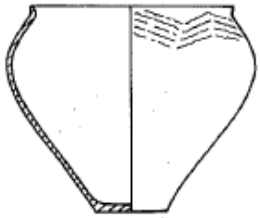
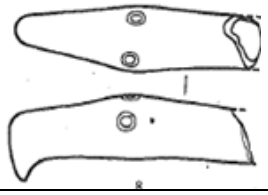
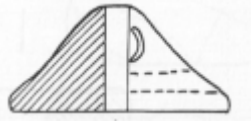
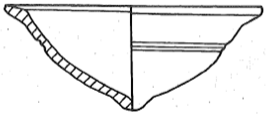
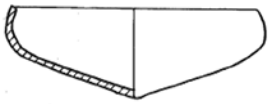
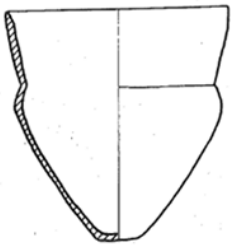
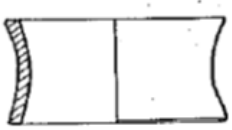
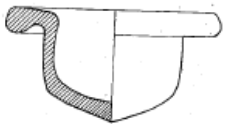
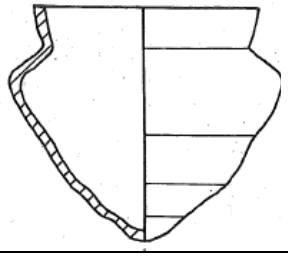
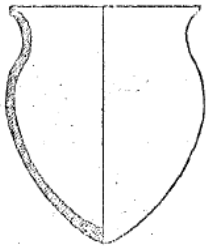
panzhuangqi 盤狀器
pen 盆 basins
Pengzhou 彭州
Pi 郫 River
ping 瓶 vases
Pingshang 坪上
Pingyangcun 平陽村
Pixian 郫縣
qigai 器蓋 (vessel cover)
Qin 秦 State
Qingjiangcun 清江村
Qingyanggong 青羊宮
Qinling 秦嶺 Mountains
Qionglai 邛崍 Mountains
Qishan 岐山
qizuo 器座 (vessel stand)
quanzu pan 圈足盤 (ring-footed dishes)
Rensheng 仁勝
Rujiazhuang 茹家莊
Sandongqiao 三洞橋
Sanhe Huayuan 三合花園
Sanxia 三峽 (Three Gorges)
Sanxingdui 三星堆
Shangwangjiaguai 上汪家拐
Shangyejie 商業街
Shaopengzui 哨棚嘴
Shaxi 沙溪
shenfu guan 深腹罐 (deep-bellied jars)
shengwen huabian guan 繩紋花邊罐 (cord-marked decorated-rim jars)
Shi'erqiao 十二橋
Shijiahe 石家河
Shijiefang 十街坊
Shimenzui 石門嘴
Shiquan 石泉
Shizishan 獅子山
Shu 蜀 (ethnic group)

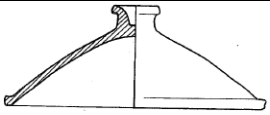
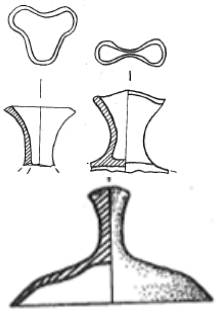
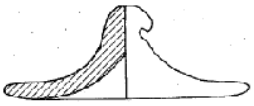
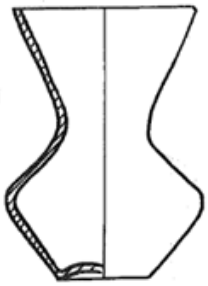
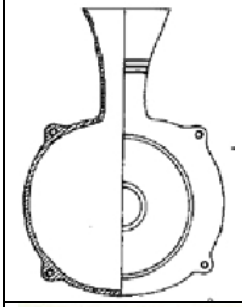
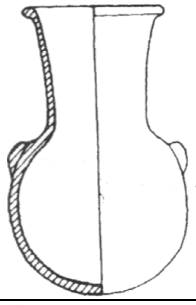
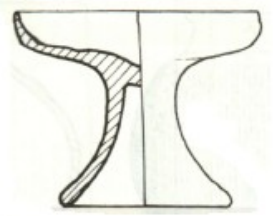
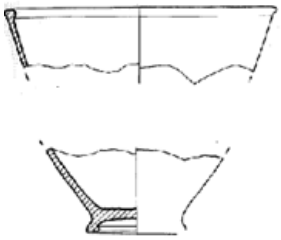
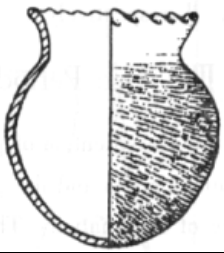
Shuanghe 雙河
Shuangyantang 雙堰塘
Shufeng Huayuan 蜀風花園
Shuiguanyin 水觀音
Songjiaheba 宋家河壩
Suheping 蘇和坪
Suolong 鎖龍
Taoping 桃坪
Taosi 陶寺
Tiaoshi 跳石
tongxingqi 筒形器
tongxing guan 筒形罐 (cylindrical jarlets)
tujian bei 凸肩杯 (cups with protruding shoulders)
tujian guan 凸肩罐 (jars with protruding shoulders)
Tuo 沱 River
Wanxian 萬縣 (Wanzhou 萬州)
Wazhadi 瓦渣地
Weijialiangzi 魏家梁子
Wenchuan 汶川
weng 甕 urns
Wenjiang 溫江
Wucheng 吳城
Wushan 巫山
Xianglushi 香爐石
xiaopingdi guan 小平底罐 (jars with small, flat bases)
Xijiao 西郊 River
Xilingxia 西陵峽
Xindian 辛店
Xinfan 新繁
Xunyang 旬陽
Xindu 新都
Xinjin 新津
Xinpu 新鋪 (浦)
Xinyicun 新一村
Ya'an 雅安
Yaijiao 崖腳

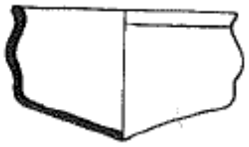
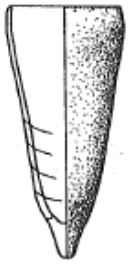
yan 甗
Yangxian 洋縣
Yangzishan Tutai 羊子山土台
Yazi 鴨子 River
Yibin 宜賓
Yichang 宜昌
Yijiabao 壹家堡
Yinxu 殷墟
yuan 瑗 rings
Yue 越 State
Yueyang 岳陽
Yufu 魚鳧
yunleiwen 雲雷紋
Yunyang 雲陽
Yuxiping 玉溪坪
Zaoyang 棗陽
zhang 璋 blade
Zhangjiapo 張家坡
zhejian guan 折肩罐 (jars with carinated shoulders)
Zhen'an 鎮安
Zhengyincun 正因村
zhi 觶 goblet
Zhifangtou 紙坊頭
Zhihuijie 指揮街
zhizuo 支座 (vessel supports)
Zhongbaodao 中堡島
Zhongbazi 中壩子
Zhongxian 忠縣 County
Zhongyuan 中原
Zhouli 周禮 (The Rites of Zhou)
Zhuwajie 竹瓦街
Zhuyuangou 竹園溝
Ziyang 紫陽
Zizhu 紫竹
zun 尊 beakers (liquid serving vessels with trumpet-shaped mouths)
    zunxingbei 尊形杯 (*zun*-beaker-like cups)

Appendix II—Reference list of pottery

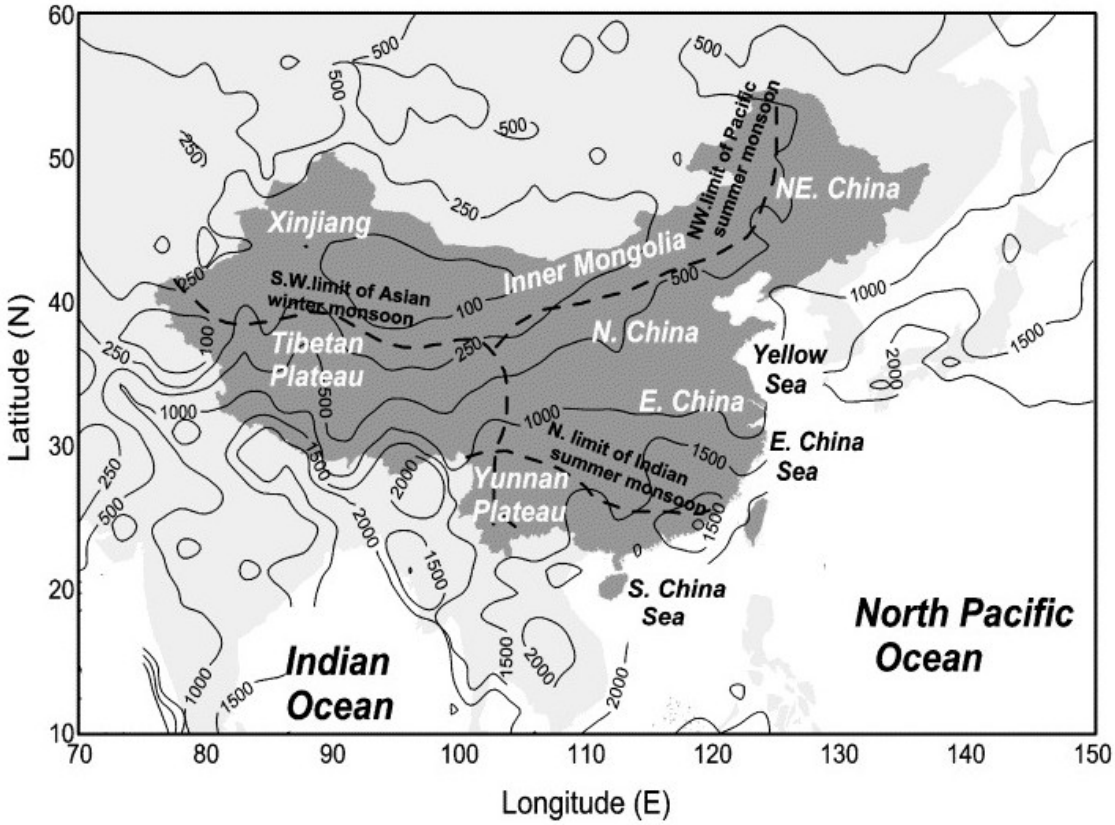
	*changkou quanzu zun* ring-footed beakers with everted-rims		*labakou gaoling guan* long-necked jars with trumpet-shaped mouths
	*changkou quanzu zun* ring-footed beakers with everted rims		*kuanyan pingdi zun* wide-lipped, flat-bottomed beakers
	*(loukong) quanzu dou* mounted bowl with openwork ring foot		*pankou quanzu zun* ring-footed beakers with dish-shaped mouths
	*quanzu pan* ring-footed dishes		*shenfu guan* deep-bellied jars
	*daizu fengkou he* closed-spouted pitchers with pouch-shaped feet		*gui* tripods

 *gaobing dou* high-stemmed mounted bowls	 *gaobing dou* high-stemmed mounted bowls or *dengxinqqi* lamp-shaped vessels
 *Ping* vases	 *xiaopingdi guan* jars with small, flat bases
 *niaotouxing shaobing* bird-head-shaped dipper handle	 *fanglun* spindle whorls
 *jiandi zhan* pointed-bottom saucer	 *jiandi zhan* pointed-bottom saucer
 *you-ling jiandi bei* collared pointed-bottom cup	 *jiandi bei* pointed-bottom cup
 *qi zuo* vessel stand	 *jiandi yu* small, basinwide-mouthed jar with pointed bottoms
 *jiandi guan* pointed-bottom jars	 *jiandi guan* pointed-bottom jars

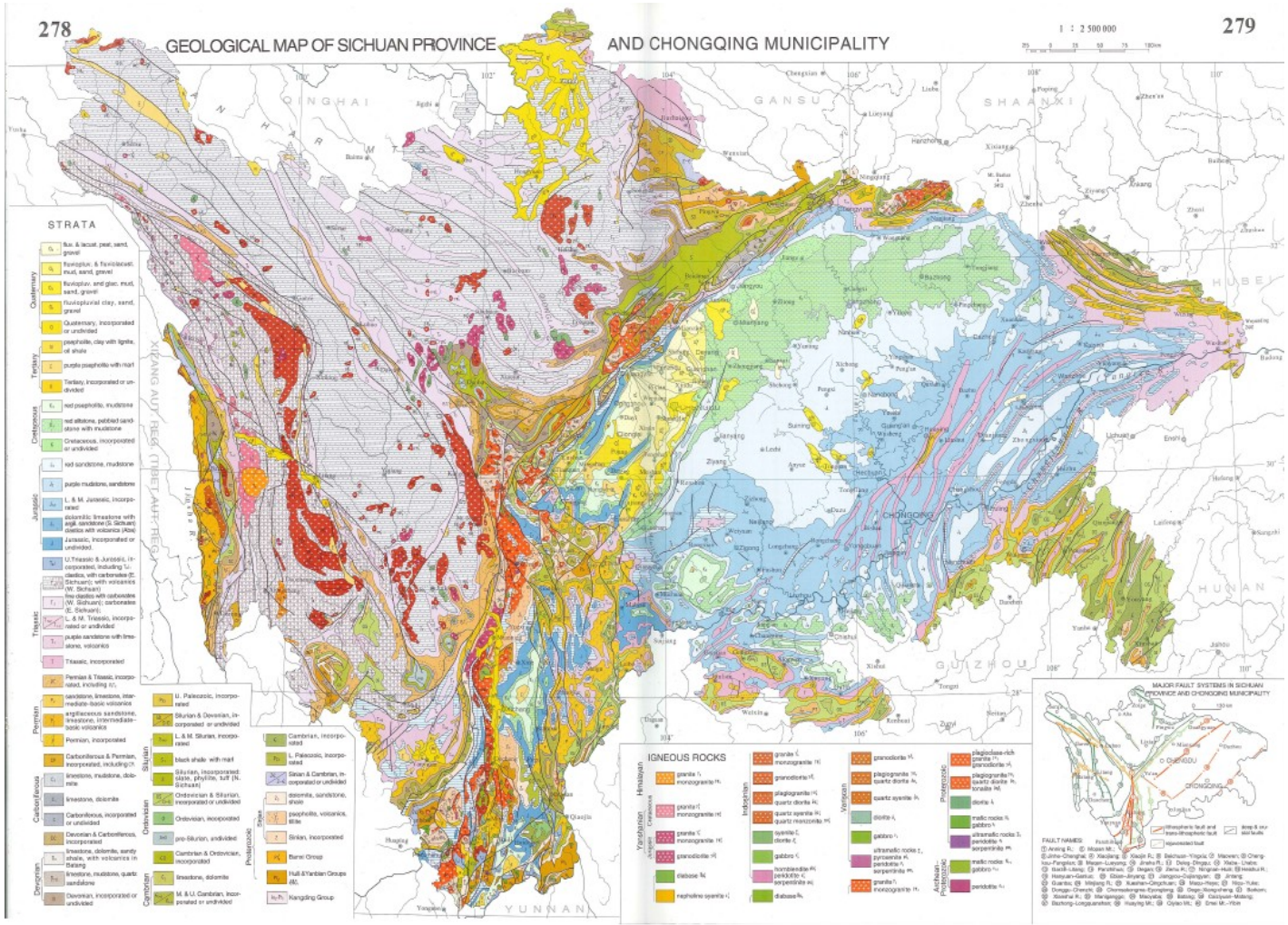
 qigai vessel cover	 qigai vessel cover
 qigai vessel cover	 qigai vessel cover
 *liankou guan* jars with inverted rims	 *guixingqi* ring-footed tureens
 *bianfu hu* globular jars	 *bianfu hu* globular jars
 *dou* mounted bowls	 *guixingqi* (ring-footed tureens)
 *huandi guan* round-bottomed jars	 *huabian huandi guan* round-bottomed jars with decorated rims

	*jiandi cheng* or *jiandi he* pointed-bottom boxes
	*jiaozhuang jiandibei* horn-shaped, pointed-bottom cups

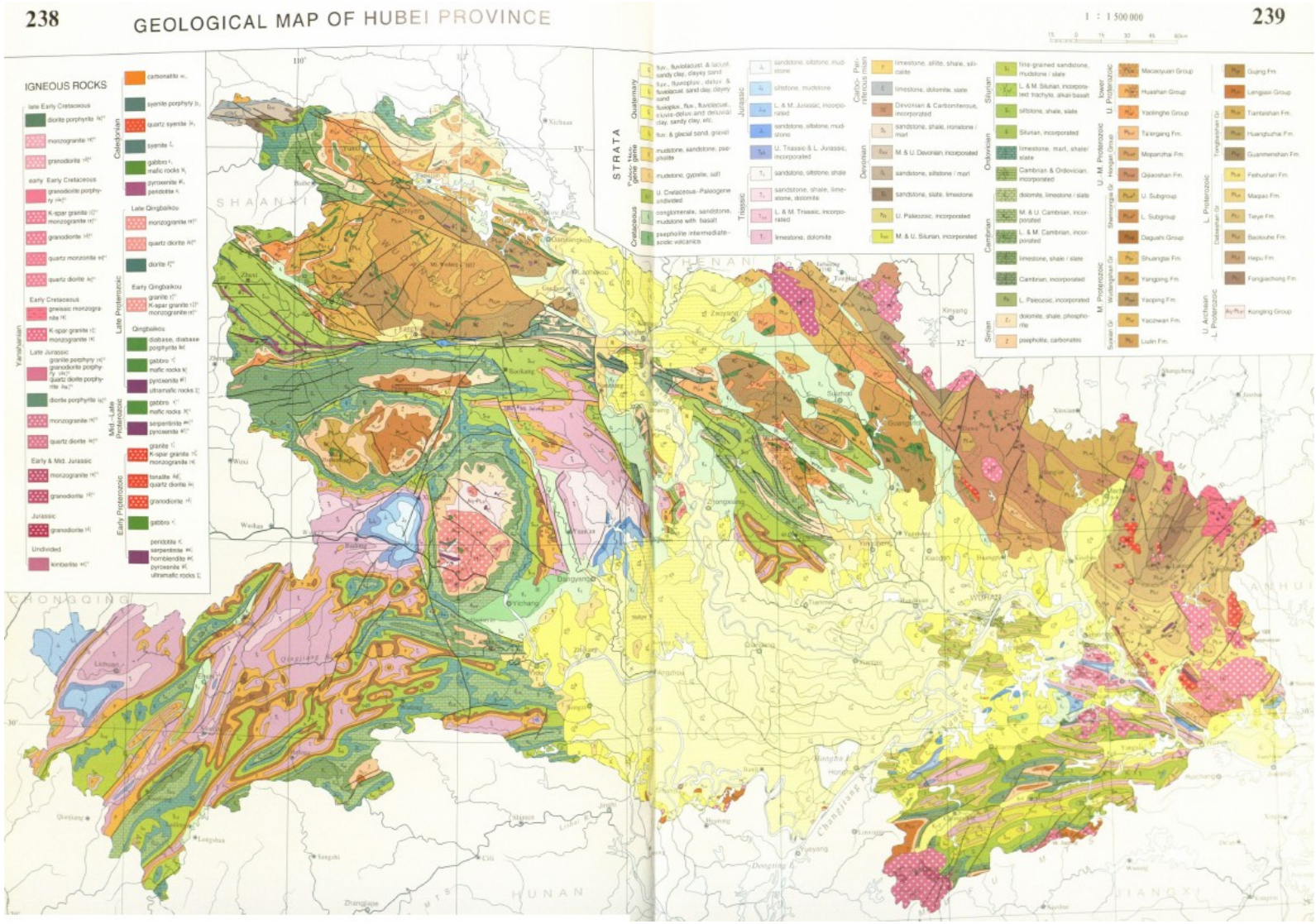
Appendix III—Related sites and artifacts



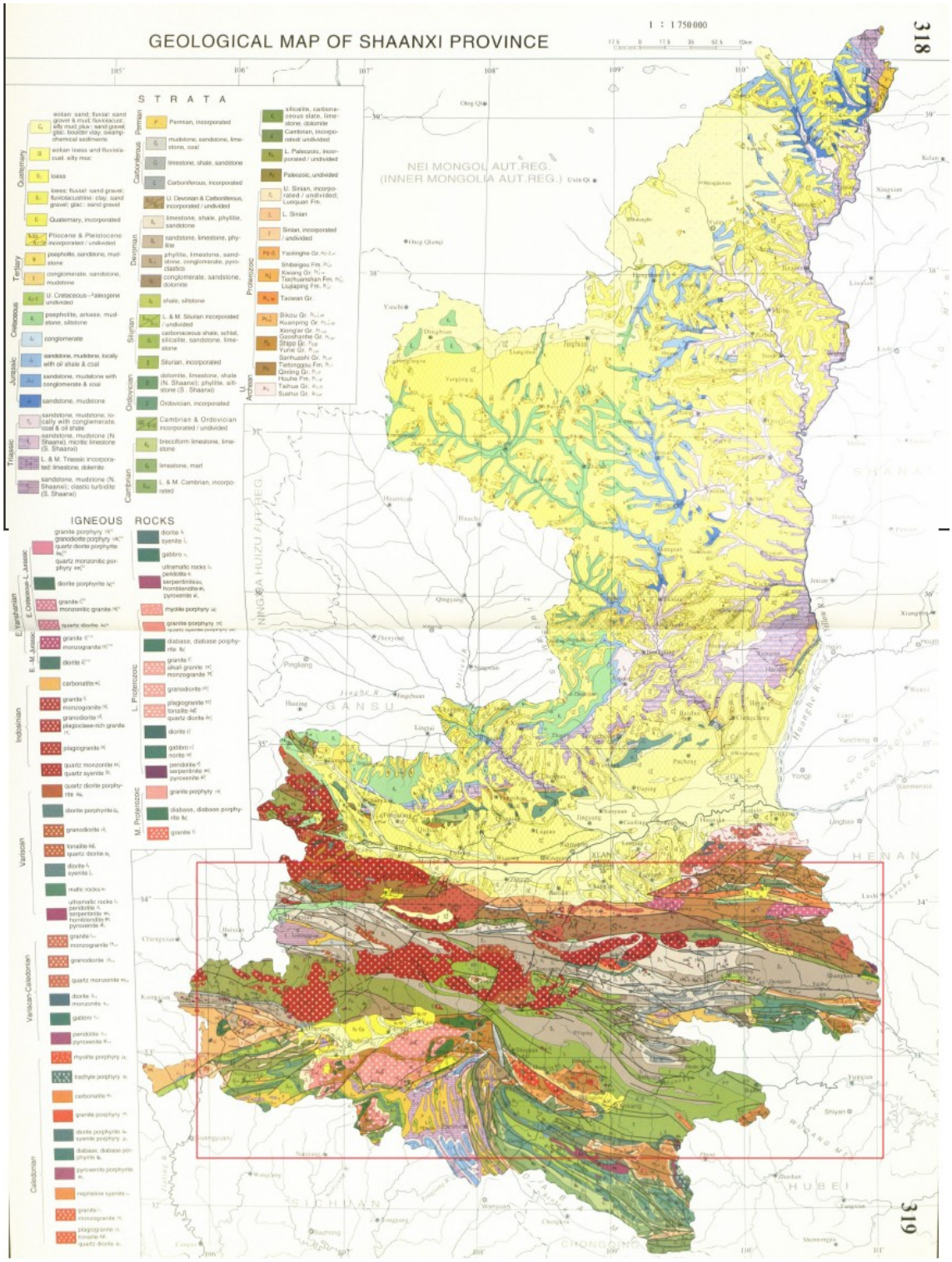
Appendix III-Figure 1: The annual precipitation of China (in mm)
With three dashed lines representing rough boundaries of the northern limit of the Indian Monsoon in summer, the northwestern limit of the Pacific Monsoon in summer, and the southwestern limit of the Asian winter monsoon in winter, respectively (after Ren et al. 1979).



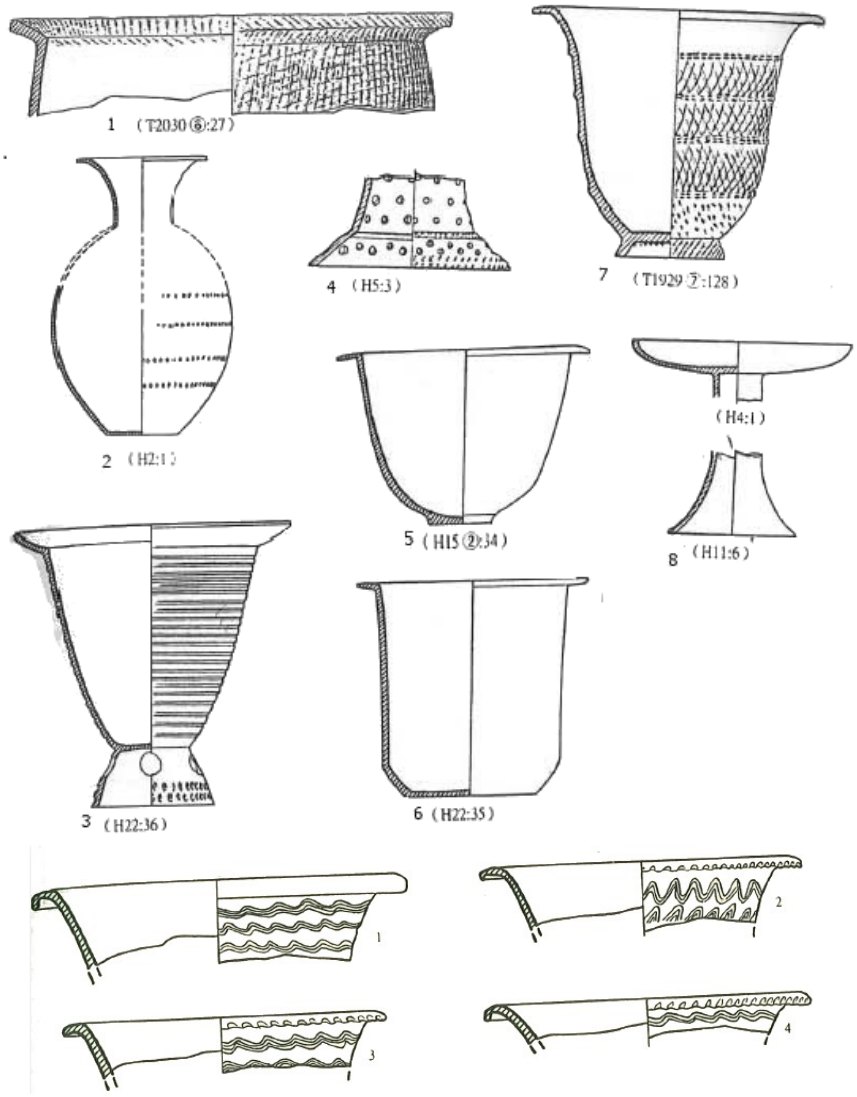
Appendix III-Figure 2: Geological map of Sichuan (Zhongguo Dizhi Tuji 2002).



Appendix III-Figure 3: Geological map of Hubei Province (Zhongguo Dizhi Tuji 2002).

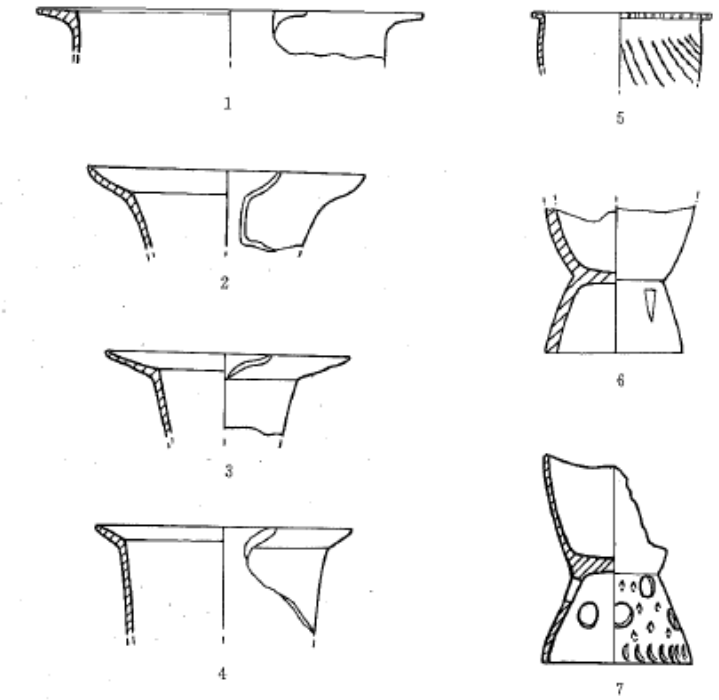


Appendix III-Figure 4: Geological map of the Hanzhong Basin in southern Shaanxi (in box) (Zhongguo Dizhi Tuji 2002).



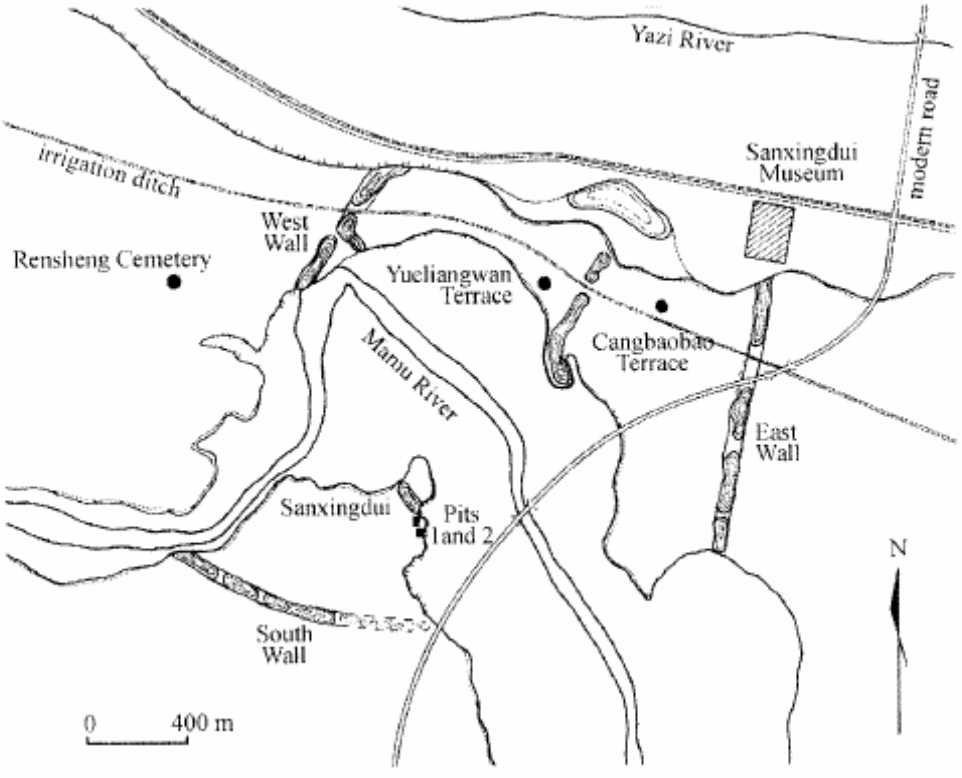
Appendix III-Figure 5: Vessel types and decorations characteristic of the Baodun Culture (not to scale) (after Chengdu et al. 2000: 57 fig. 40, 108-113).

1. decorated-rim jars *(shengwen huabian guan*)
2. long-necked jars with trumpet-shaped mouths (*labakou gaoling guan*)
3. ring-footed beakers with dish-shaped mouths (*pankou quanzu zun*)
4. openwork ring foot (*loukong quanzu zun*)
5. & 7. ring-footed beakers with everted rims (*changkou quanzu zun*)
6. wide-lipped, flat-bottomed beakers (*kuanyan pingdi zun*)
8. high-stemmed, mounted saucers with ring foot (*qianpan gaobing dou*)

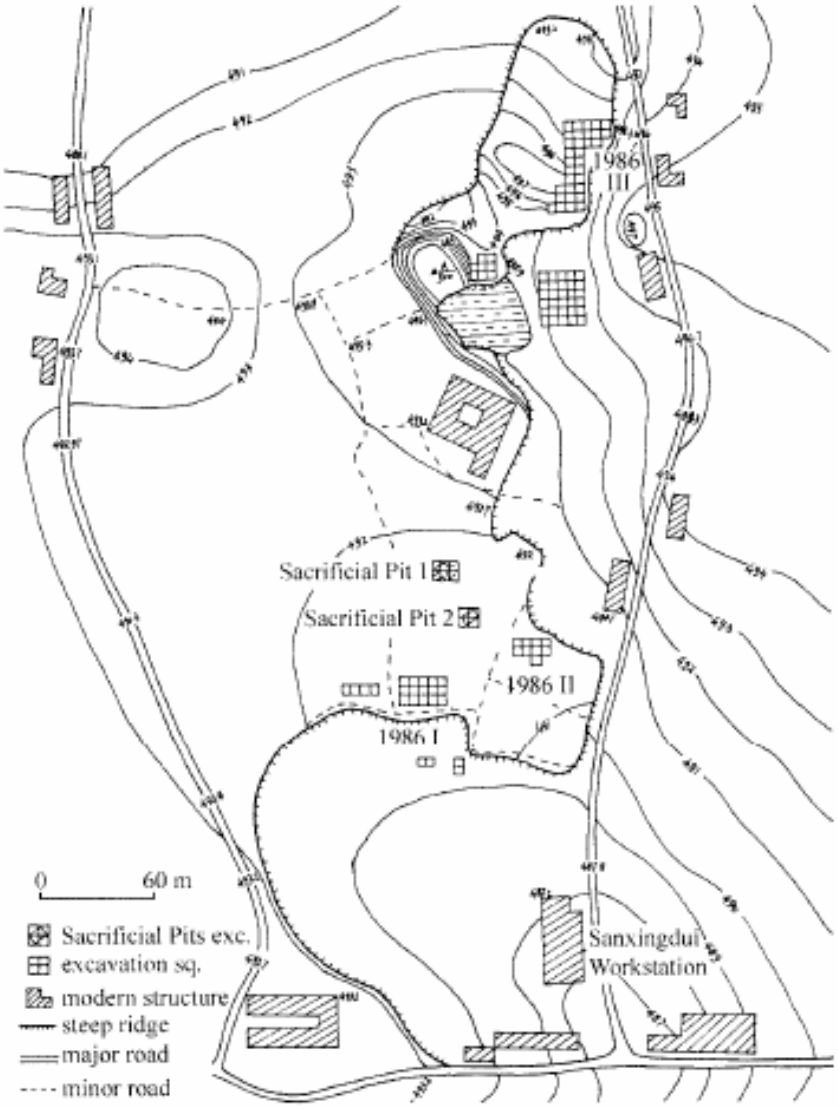


Appendix III-Figure 6: Vessel types characteristic of the Sanxingdui Culture (phase I) (not to scale) (after Sichuan 1999:425 fig. 225).

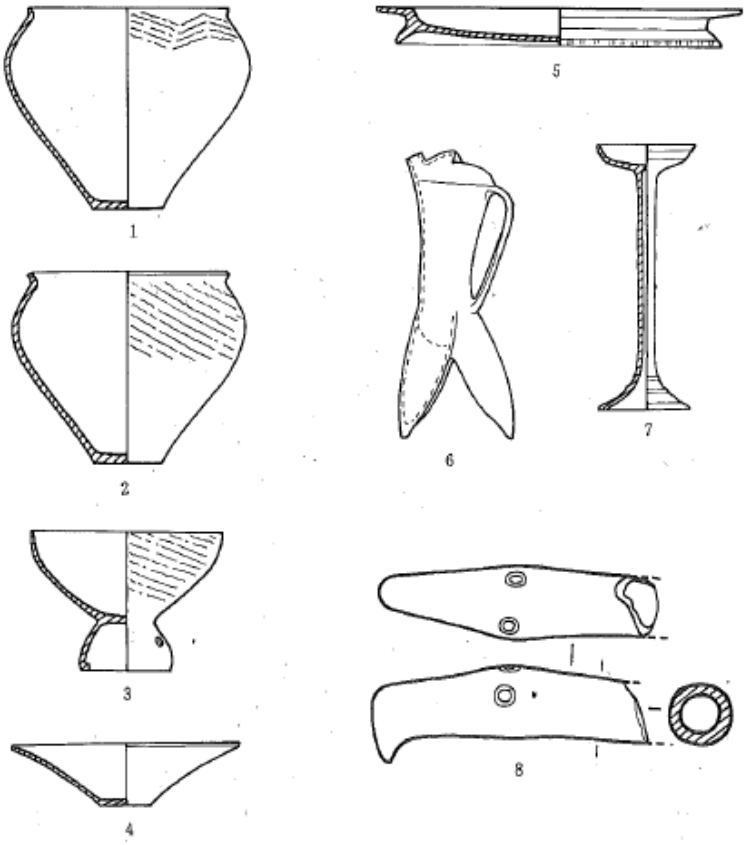
1. wide, flat-rim beaker (*kuan pingyanqi*)
2-4. folded-rim vessels (*zheyanqi*)
5. sawtooth decorated-rim vessel (*juchixing kouyanqi*)
6-7. ring-footed mounted bowls (*quanzu dou*)



Appendix III-Figure 7: The walled site of Sanxingdui with several loci that have been excavated (after Xu 2003:150 fig. 1).

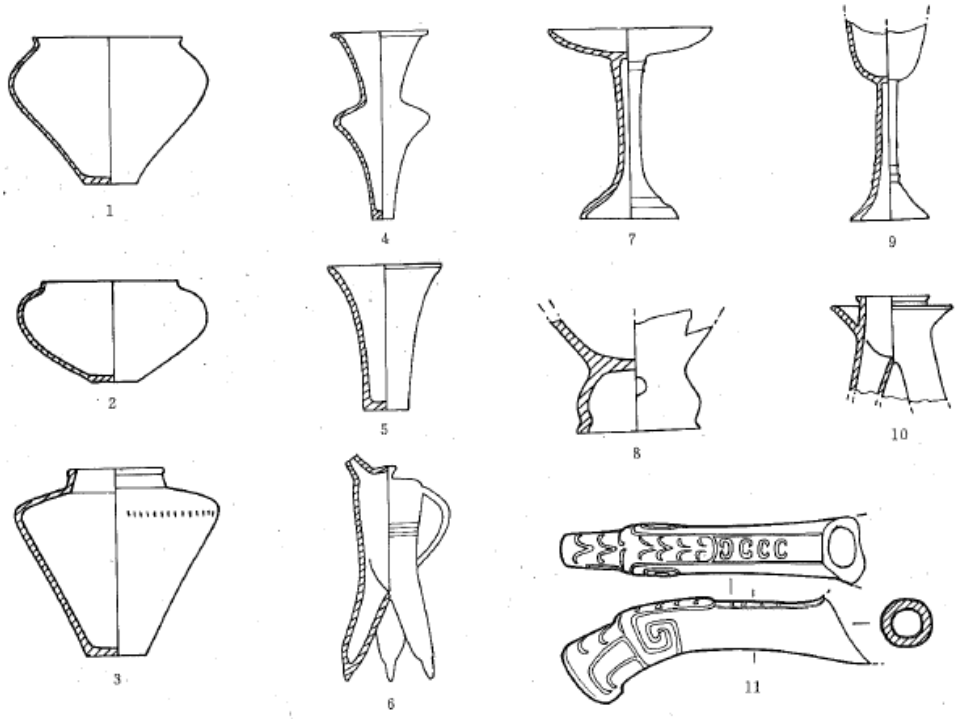


Appendix III-Figure 8: Excavation loci at Sanxingdui between 1980-1986 (after Xu 2003:154 fig. 2).



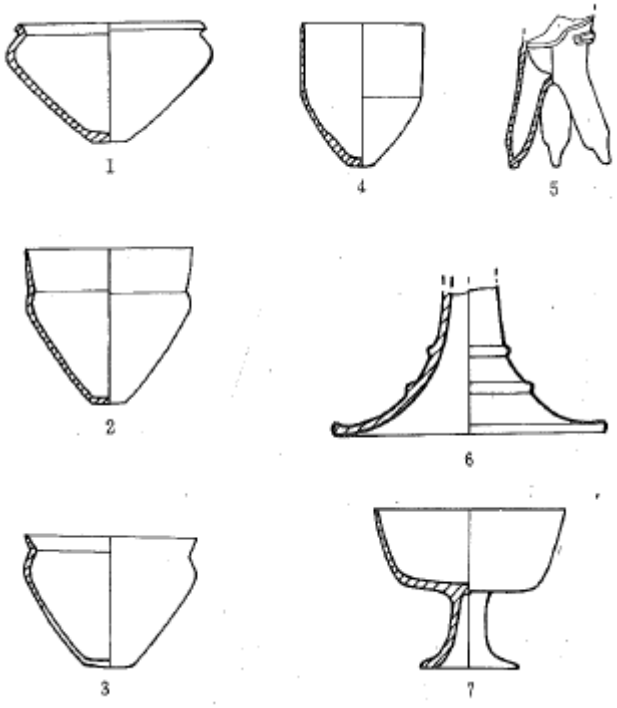
Appendix III-Figure 9: Vessel types characteristic of the Sanxingdui Culture (phase II) (not to scale) (Sichuan 1999:425 fig. 226).

1&2. jar with small, flat base (*xiaopingdi guan*)*;*
3. ring-footed mounted bowl *(quanzu dou);*
4. dish with flat base *(pingdi pan*);
5. ring-footed tray *(quanzu pan*);
6. *he* tripodal spouted pitchers (*daizu fengkou he*)
7. high-stemmed mounted bowl *(gaobing dou);*
8. bird-head-shaped dipper handle (*niaotouxing shaobing*)



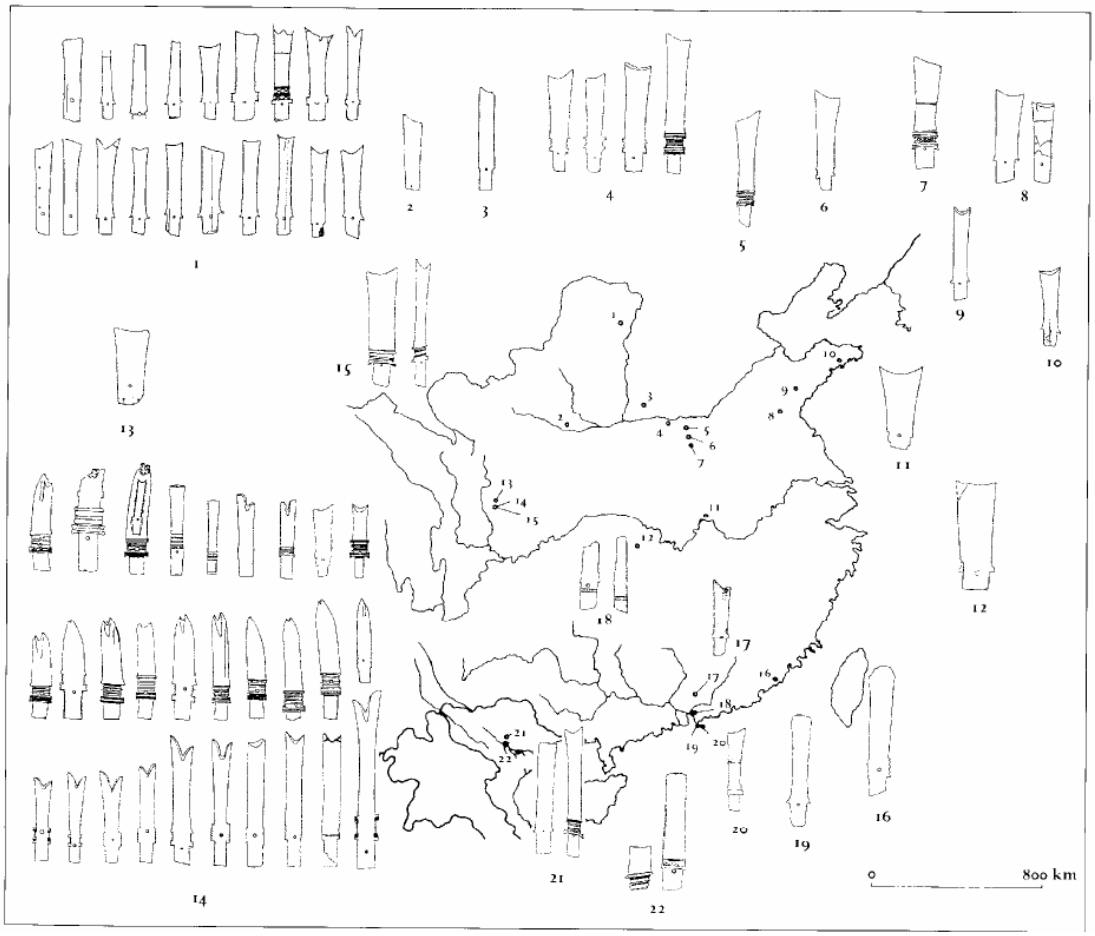
Appendix III-Figure 10: Vessel types characteristic of the Sanxingdui Culture (phase III) (not to scale) (Sichuan 1999:426 fig. 227).

1&2. jar with small, flat base (*xiaopingdi guan*)
3. long-necked *weng* urn
4. *zun*-beaker-like vessel (*zunxingqi*)
5. *gu* goblet
6. *he* tripodal spouted pitcher
7&9. high-stemmed mounted bowl (*gaobing dou*)
8. ring-footed mounted bowl (*quanzu dou*)
10. *yan*-steamer-like vessel (*yanxingqi*)
11. bird-head-shaped dipper handle (*niaotouxing shaobing*)

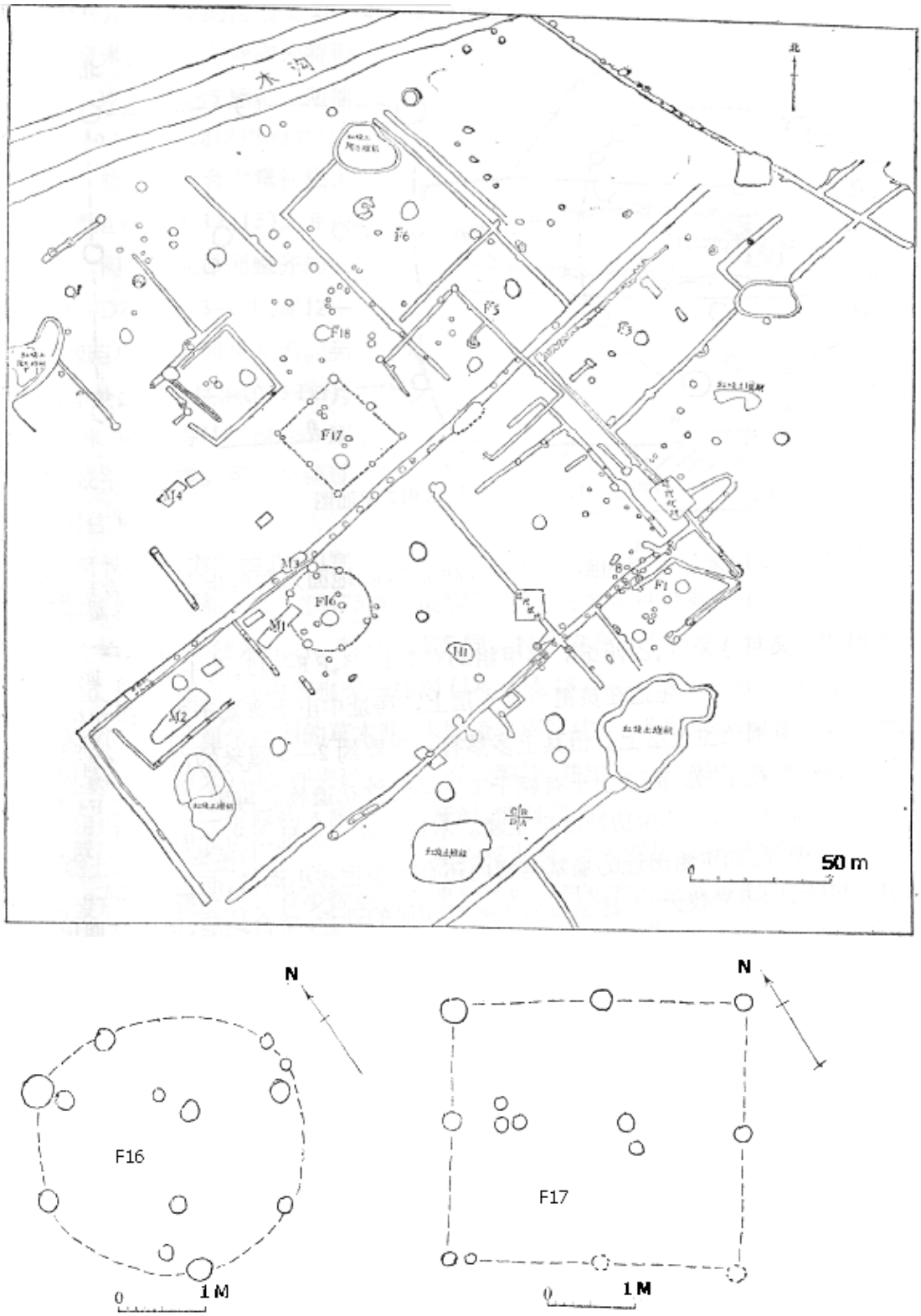


Appendix III-Figure 11: Vessel types characteristic of the Sanxingdui Culture (phase IV) (not to scale) (Sichuan 1999: 426 fig. 228).

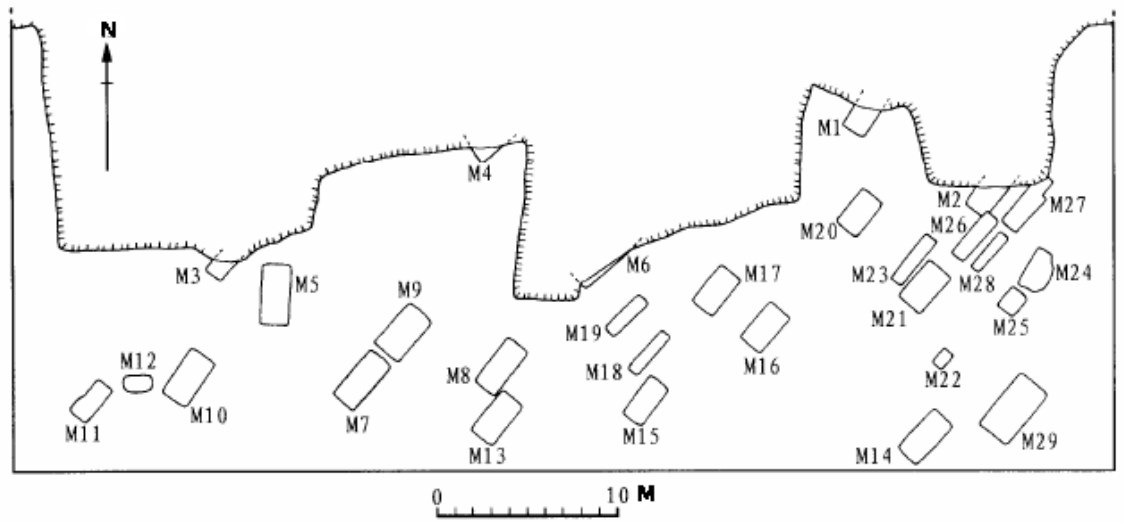
1. jar with small, flat base (*xiaopingdi guan*)
2-4. pointed-bottom cups (*jiandi bei*)
5. *he* tripodal spouted pitcher
6&7. high-stemmed mounted bowls



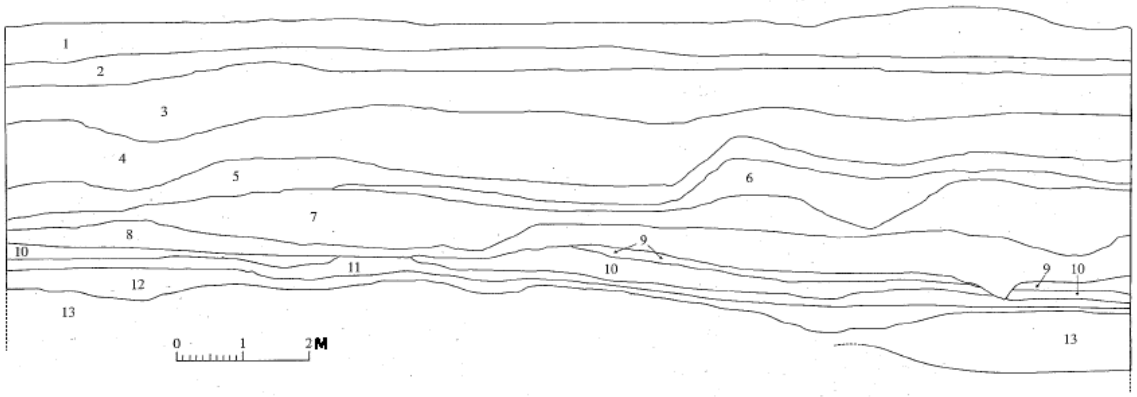
Appendix III-Figure 12: Distribution map of forked jade *zhang* blades With the Chengdu Plain represented by points 13-15 (After Deng Cong 1994).



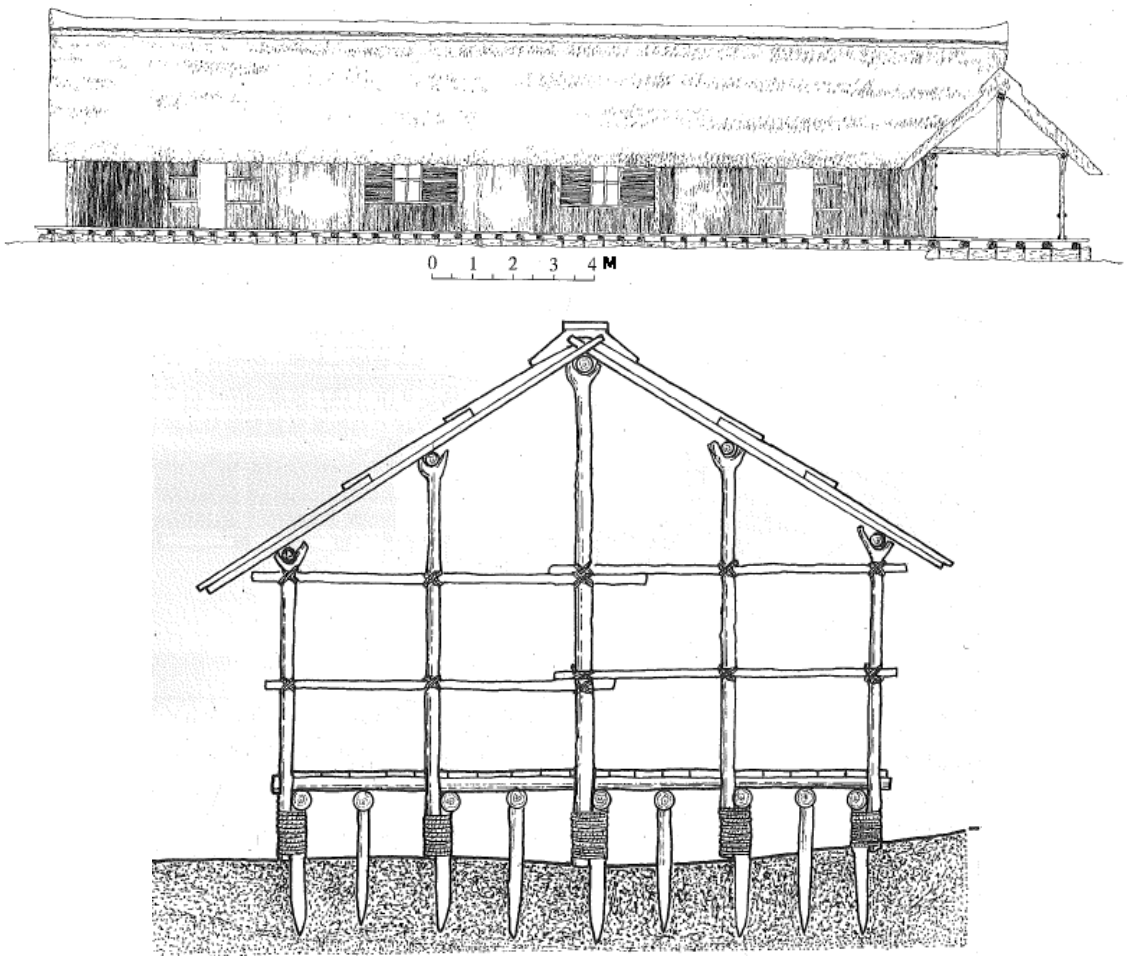
Appendix III-Figure 13: House foundations at Sanxingdui discovered during 1980-81 Showing both round and rectangular houses (Sichuan et al. 1987:233-234).



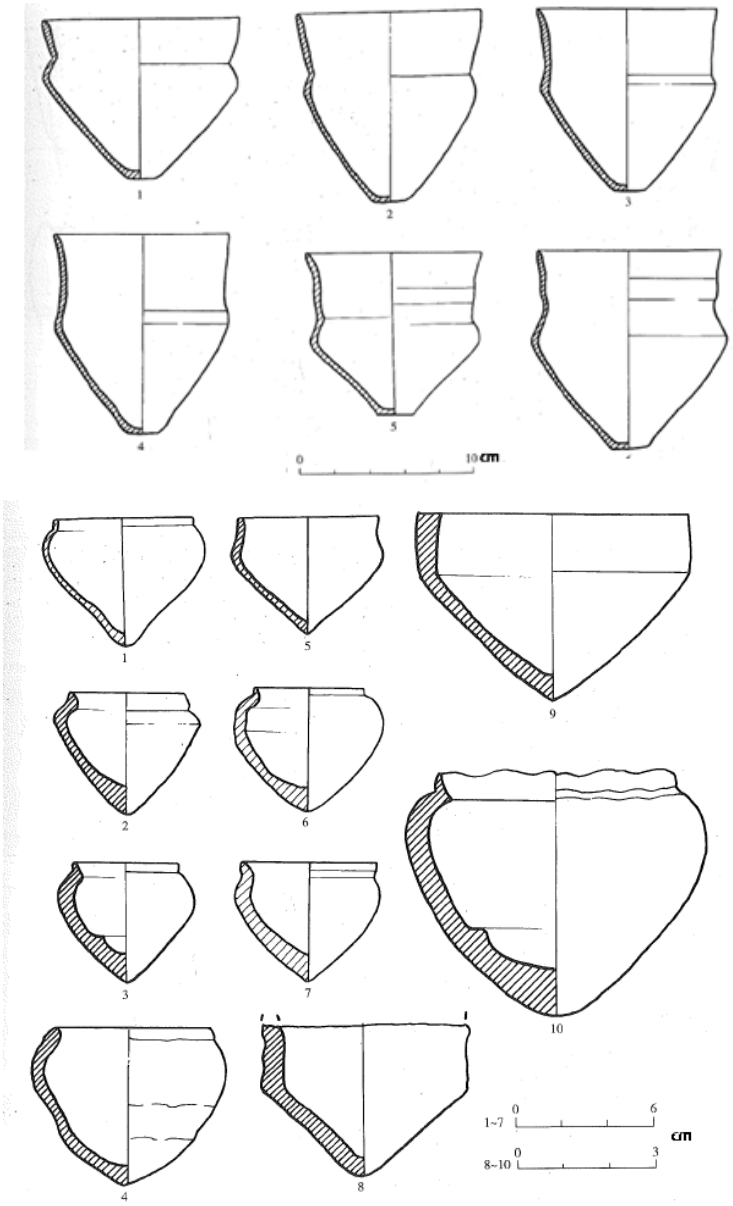
Appendix III-Figure 14: Rensheng cemetery
(after Sanxingdui Yizhi Gongzuozhan 2004:15 fig. 2).



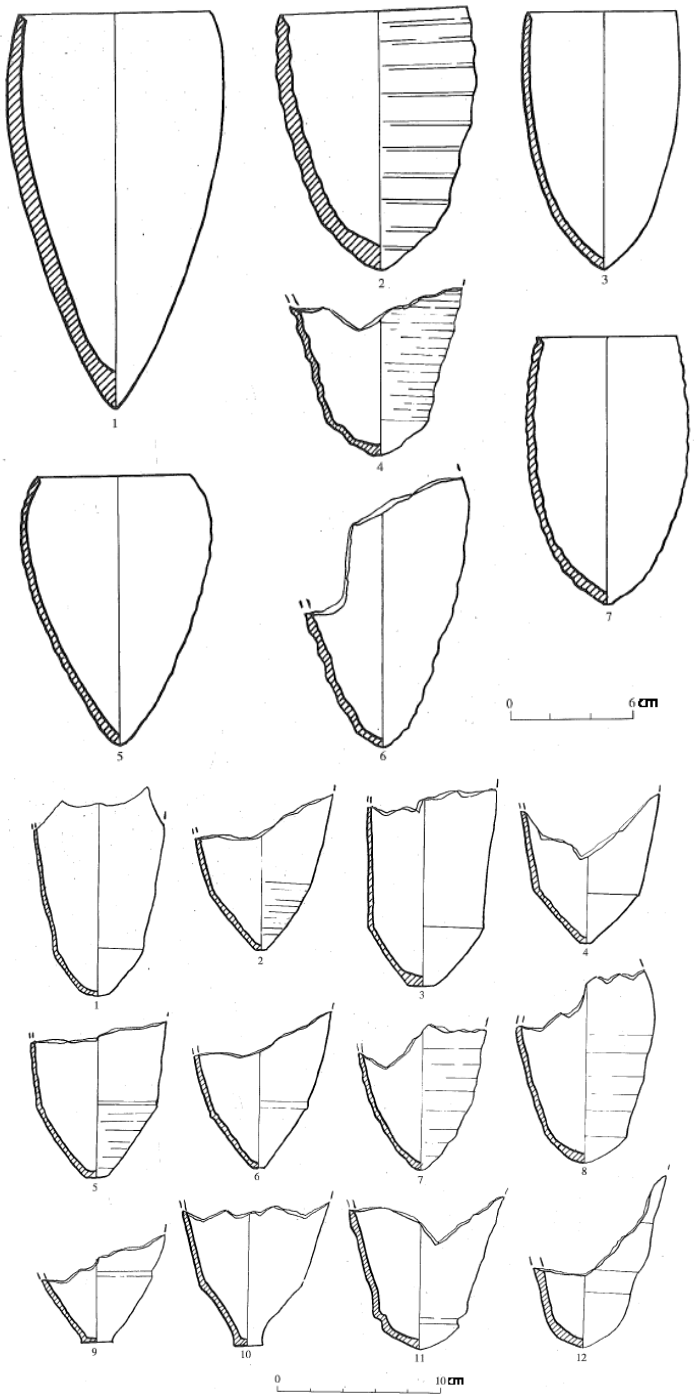
Appendix III-Figure 15: Profile of the western wall at the Shi'erqiao site (IIT30, 40, and 50) (Sichuan and Chengdu 2009:15).



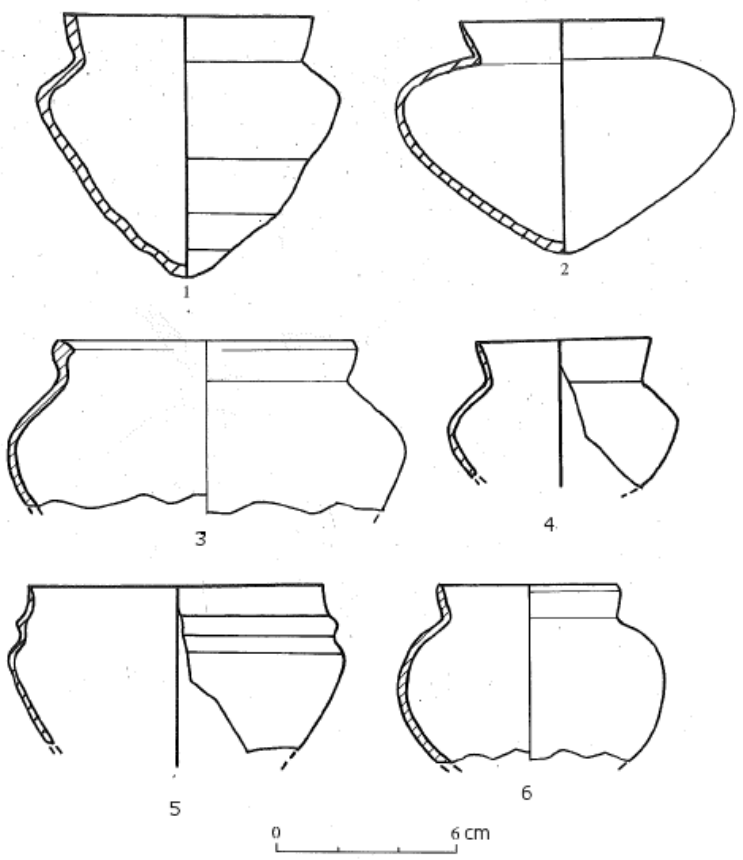
Appendix III-Figure 16: Reconstruction of Building F1 at Shi'erqiao (Sichuan and Chengdu 2009:35-36).



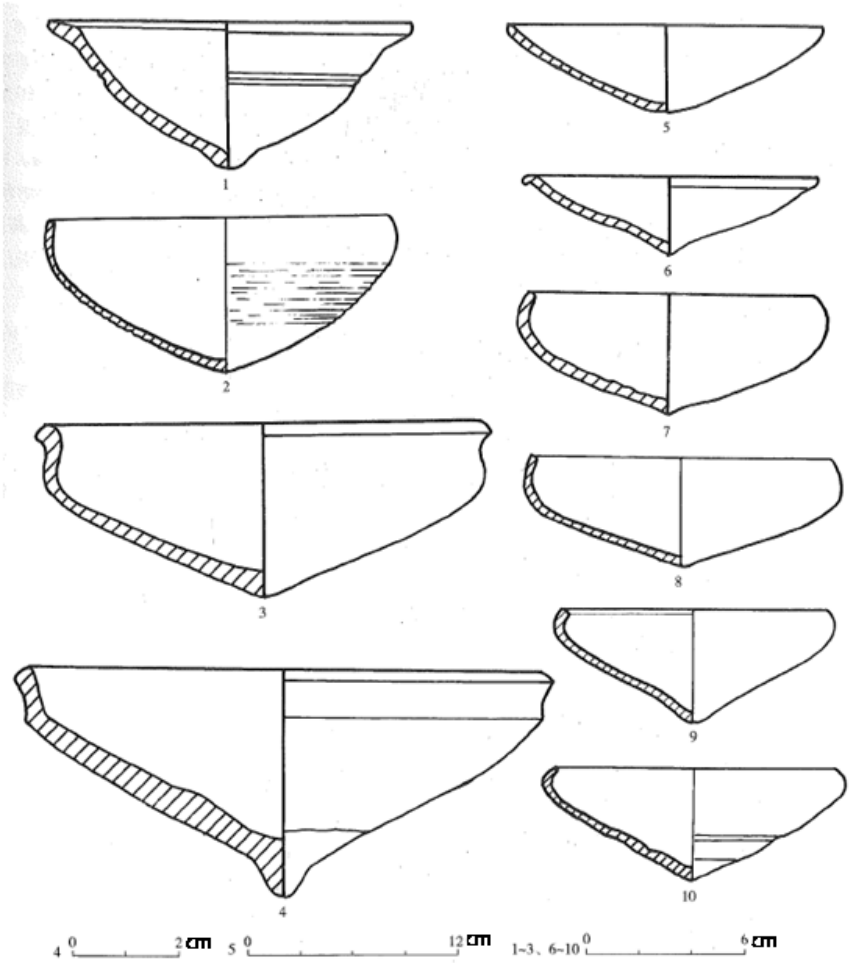
Appendix III-Figure 17: Pointed-bottom cups (*jiandi bei*) from Shi'erqiao—collared (Sichuan and Chengdu 2009:73, 77).



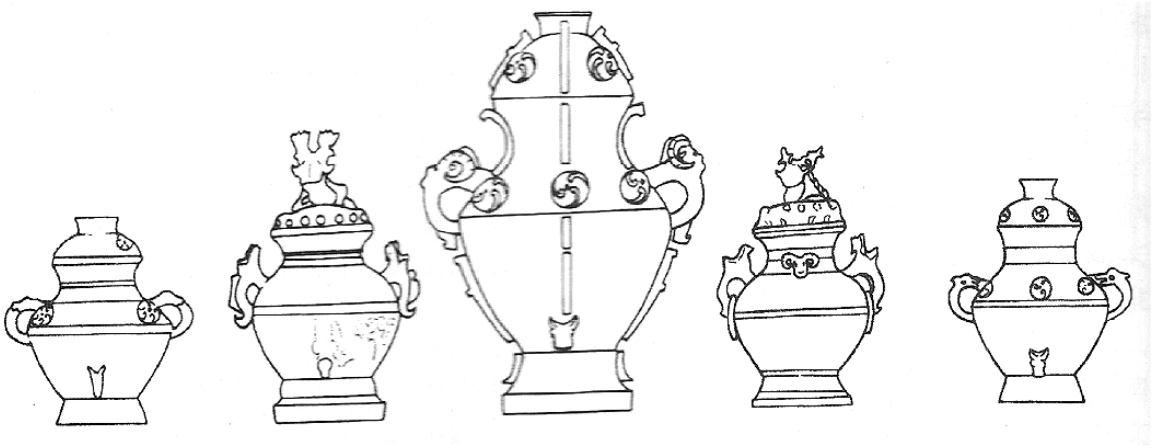
Appendix III-Figure 18: Pointed-bottom cups from Shi'erqiao — artillery-shell-shaped (*paodanxing jiandi bei*) (Sichuan and Chengdu 2009:74, 75).



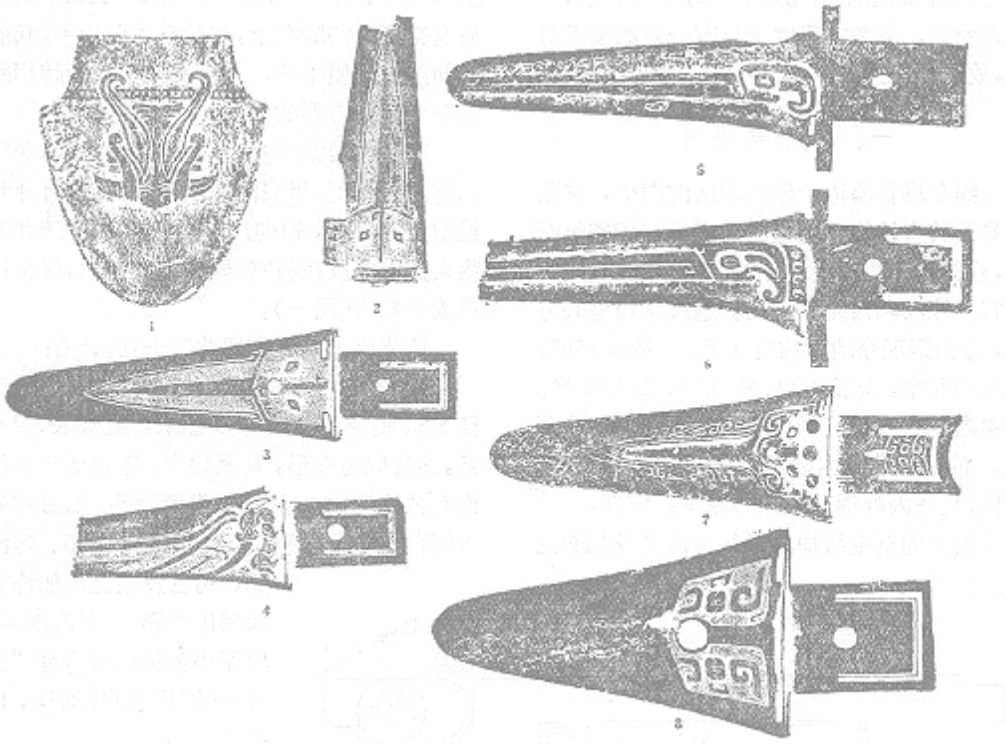
Appendix III-Figure 19: Pointed-bottom jars (*jiandi guan*) found in Shi'erqiao (Sichuan and Chengdu 2009:46).



Appendix III-Figure 20: Pointed-bottom saucers (*jiandi –zhan*) found in Shi'erqiao (Shichuan and Chengdu 2009:79 fig. 55).

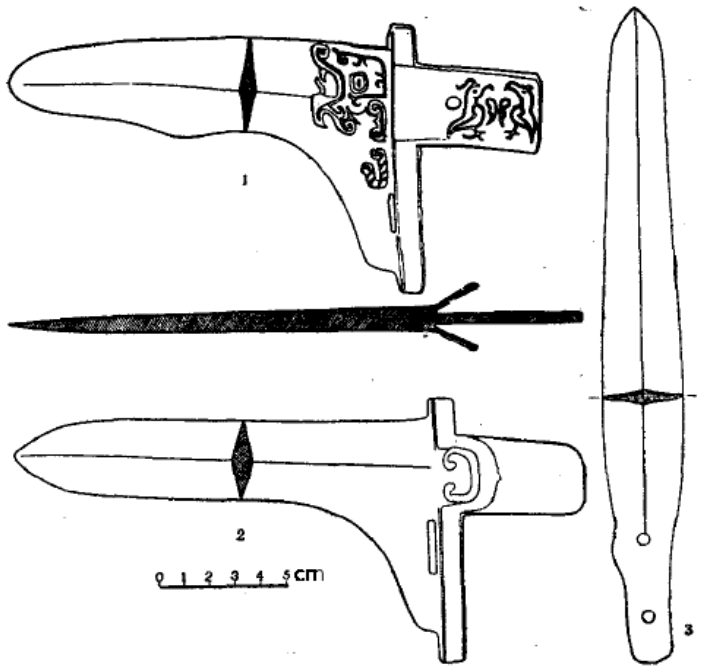


Appendix III-Figure 21: *Lei* aligned by size ("*lielei*")–from Zhuwajie hoard no. 1 (after Sun Hua 2000:232).

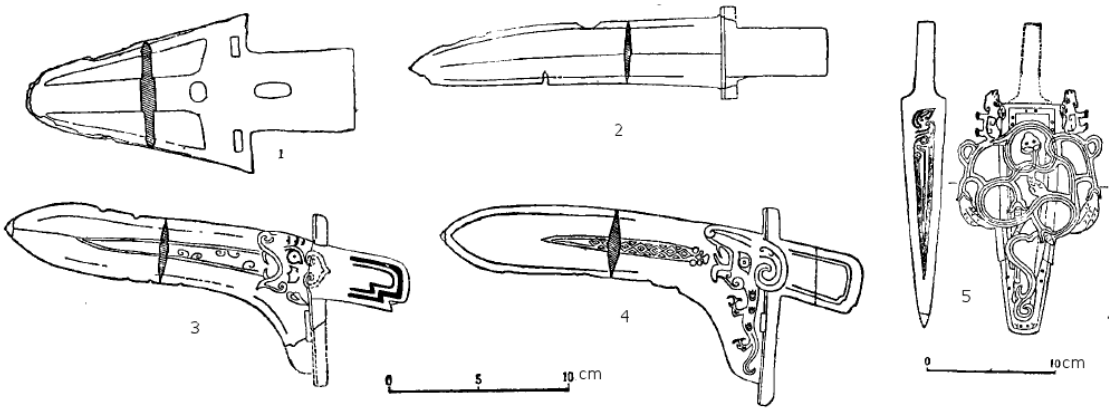


Appendix III-Figure 22: Bronze axe and daggers discovered in Zhuwajie hoard no. 2 (not to scale) (Sichuan et al. 1981:499).

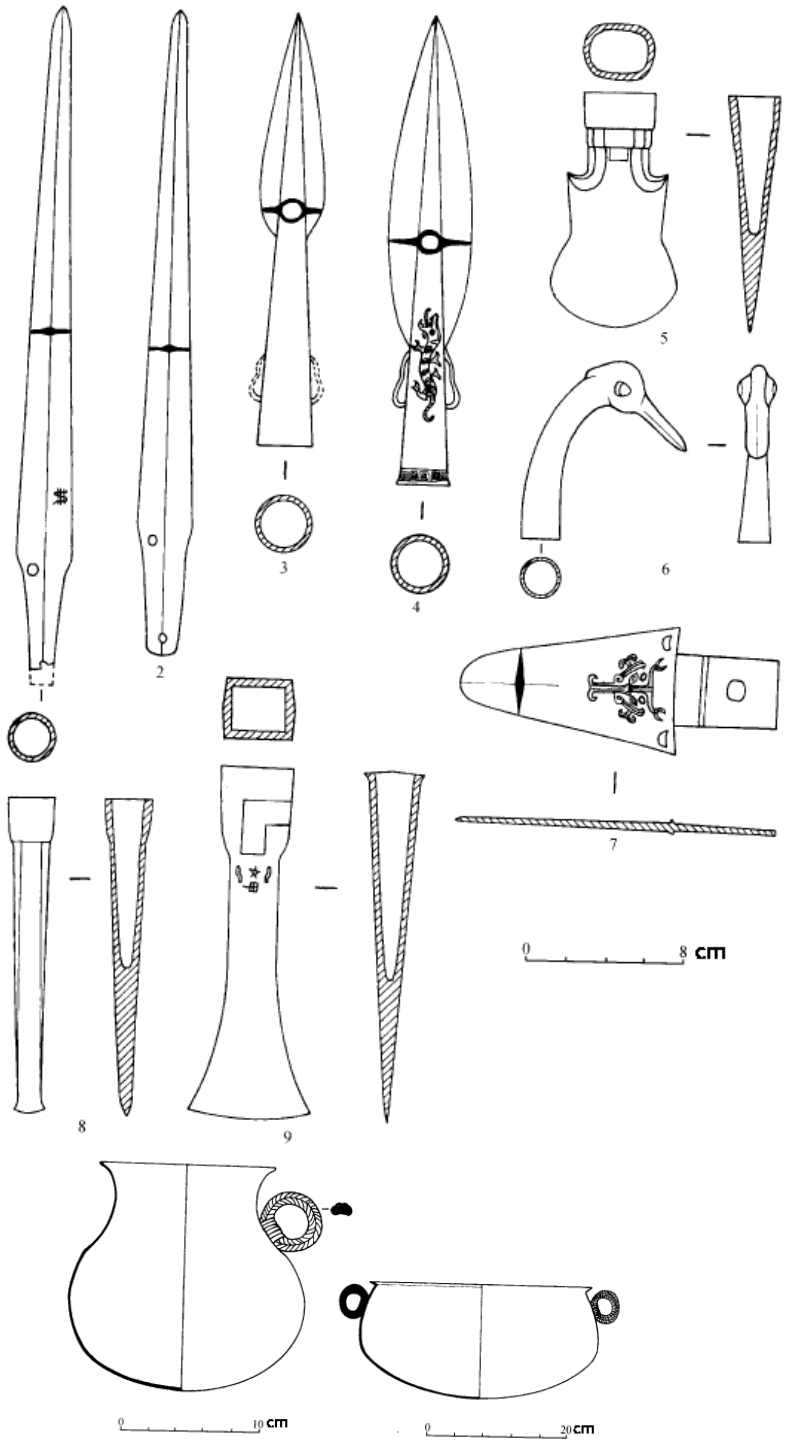
1. *yue* axe (no.14)
2-3. *ji* halberd (no. 6)
4. *ji* (no. 10)
5-8. *ge* dagger-axes (no.5, 19, 16, 17)



Appendix III-Figure 23: Bronze daggers from the Western Zhou cemetery at Zhangjiapo in Chang'an, Shaanxi
1. K12:5; 2. 218:55; 3. 206:4 (Zhongguo 1962:118).
No.1 dagger bears the tiger motif often seen on Sichuan samples.



Appendix III-Figure 24: Bronze daggers from the Western Zhou cemetery at Baicaopo in Lingtai, Gansu
1. triangular *kui* dagger-axes (7:2); 2. cruciform dagger-axes (1:25); 3. dagger-axe, decorated with a tiger head (1:54); 4. dagger-axe, decorated with a tiger (2:12); 5. willow leaf-shaped dagger and sheath (2:35) (Gansu 1977:111, 113, 115).

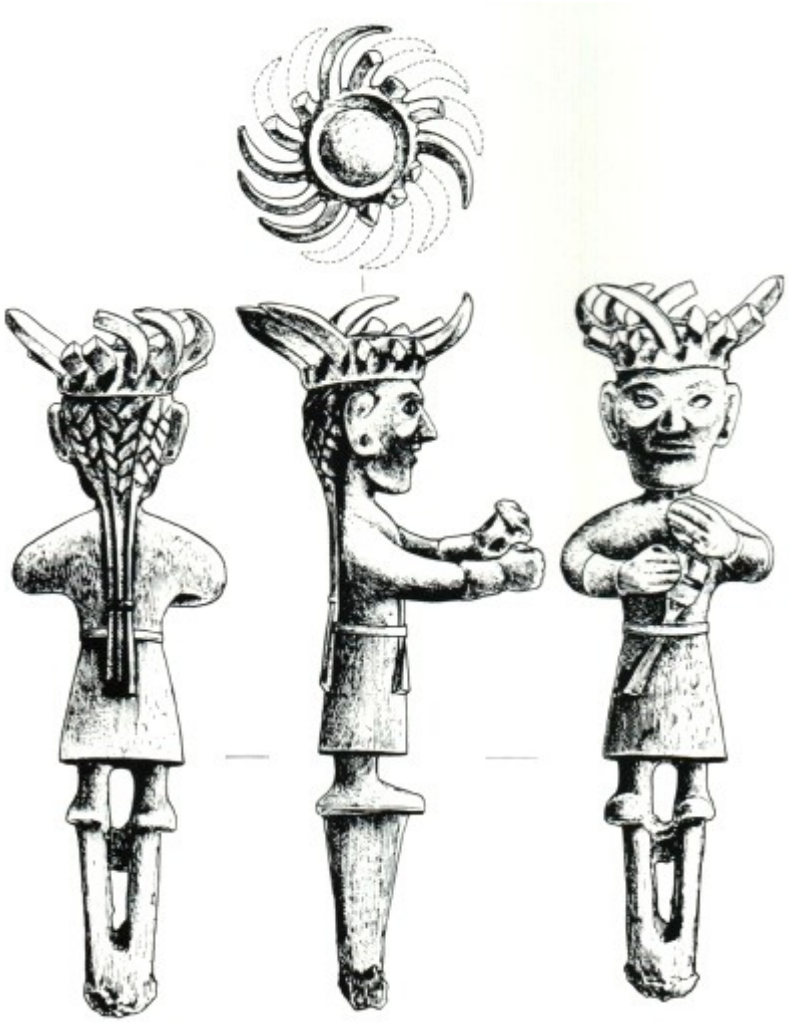


Appendix III-Figure 25: Bronze items from Xinyicun M1
(Chengdu 2004e:205, 206).
The weapons are often found in the Warring States tombs in the Sichuan region. Some bear the "Ba Shu characters".

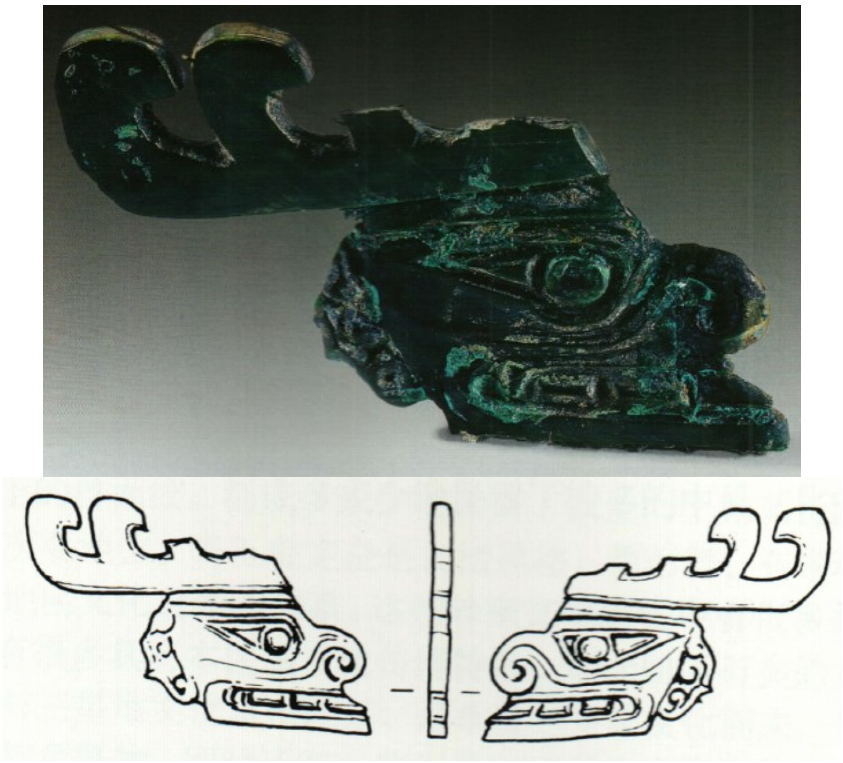
Locus	Phase I*	Phase II	Phase III	Phase IV	Phase V	Phase VI
Chunyu Huajian 春雨花間	1					
Jingpinfang 精品房	1					
Shufeng Huayuan 蜀風花園 II	1	2				
Boyatingyun 博雅庭韻	1	2	3	4		
Lanyuan 蘭苑	1	2				
S. Furongyuan 芙蓉苑南		1		2		
Guoji Huayuan 國際花園		1	2	3		4
Sanhe Huayuan 三合花園		1	2			
Xicheng Tianxia 西城天下			1			
Gandao Huangzhong A line 幹道黃忠 A 線				1		
Renfang 人防				1	2	

Appendix III-Table 1: Periodization of Jinsha loci (not including Neolithic remains) (after Jiang Zhanghua 2010:45).

*Phase I = Shi'erqiao thirteenth –twelfth layers (late Shang);
Phase II = the transition between Shang and Zhou;
Phase III = Shi'erqiao eleventh-tenth layers (early Western Zhou);
Phase IV = Xinyicun eighth layer (late Western Zhou);
Phase V-VI = Springs and Autumns.



Appendix III-Figure 26: A bronze figurine discovered at Jinsha-Meiyuan (C:17) (height: 14.6 cm) (Chengdu and Beijing 2002:43).



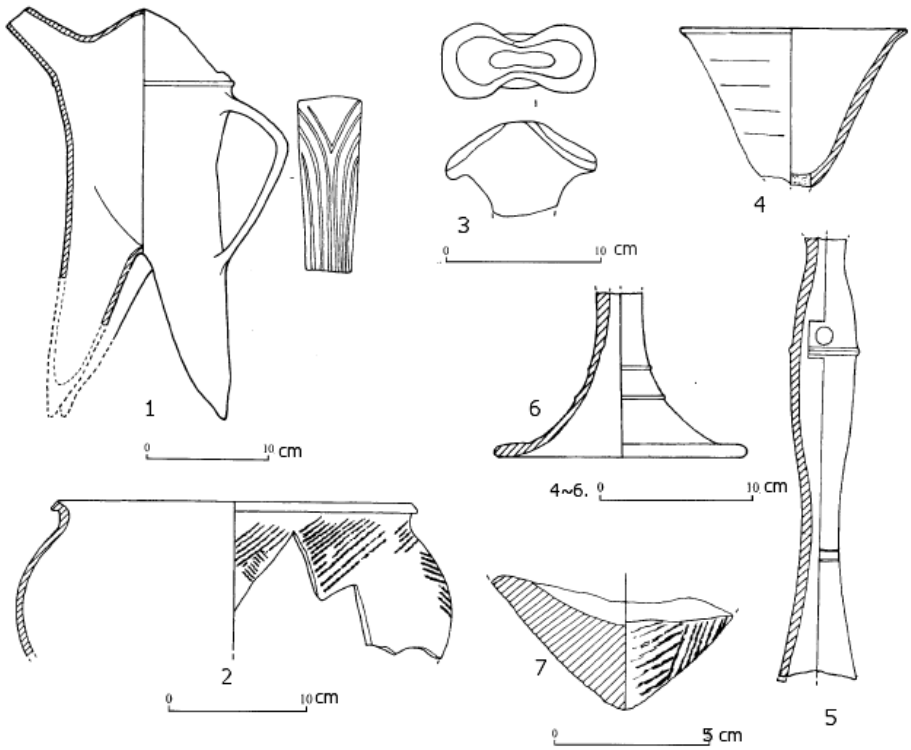
Appendix III-Figure 27: A lithic human head (C:167) discovered at Jinsha-Meiyuan (width: 3.44 cm; height: 2.3 cm) (Chengdu and Beijing 2002:80, 81).



Appendix III-Figure 28: A ten-tiered Liangzhu *cong* tube (C:61) found in Jinsha-Meiyuan (Chengdu and Beijing 2002:83).

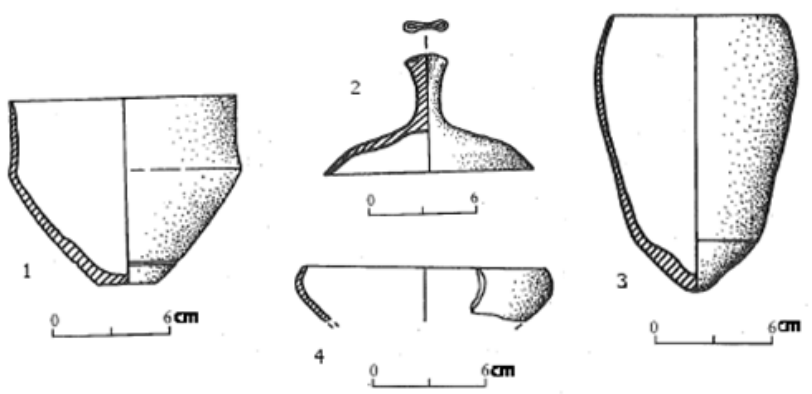


Appendix III-Figure 29: Traces of buildings at Sanhe Huayuan
The lower part of the image shows the largest building (F6) with five rooms inside (Chengdu 2006e:9).



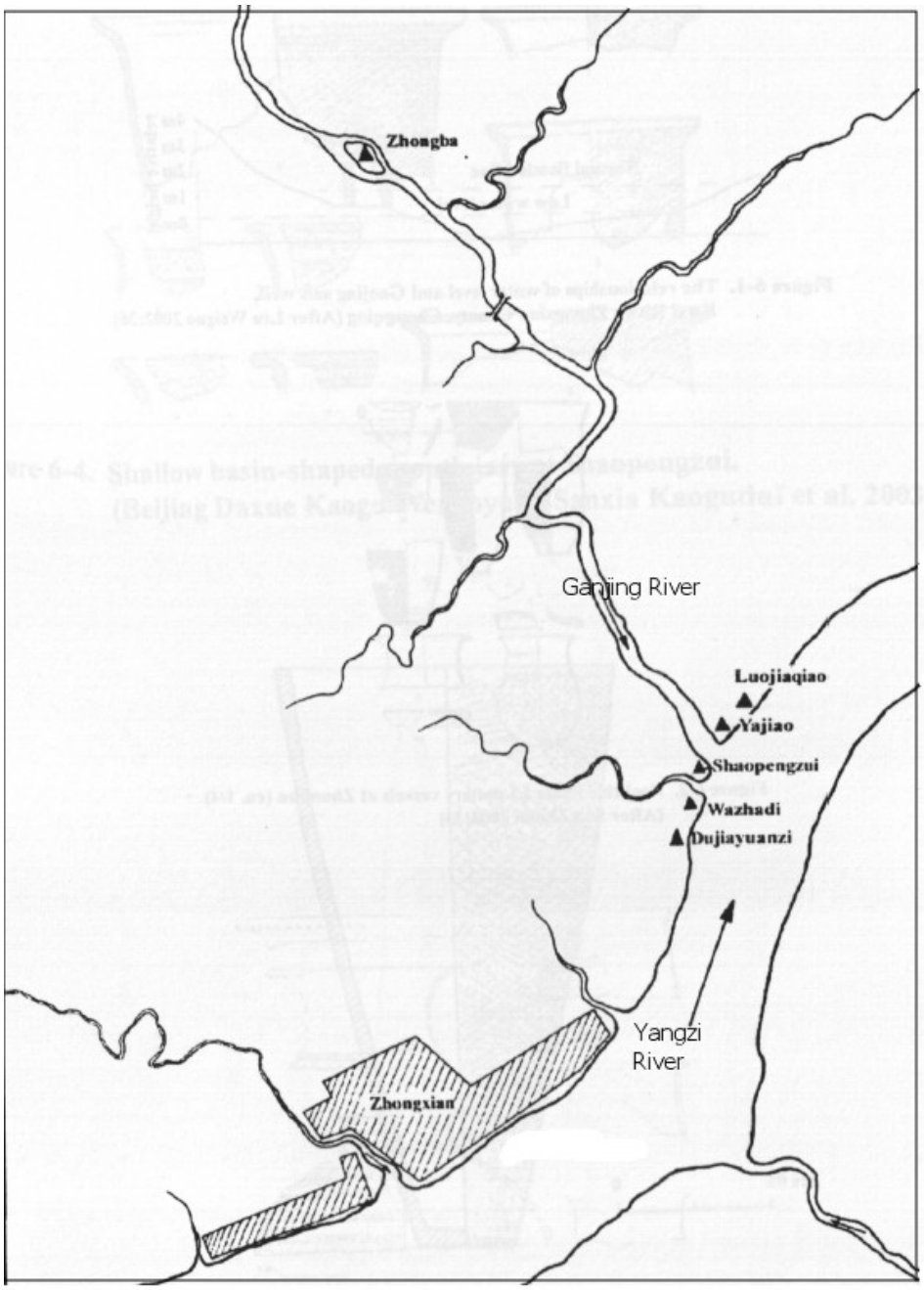
Appendix III-Figure 30: Pottery types discovered in Linshi, Fuling, showing their similarity to Sanxingdui and early Shi'erqiao
(Chongqing and Chongqing 2006:793, 799, 801, 803).

1. closed-spouted pitcher with pouch-shaped feet (*daizu fengkou he*) (IT0803⑥:10)
2. jar with small, flat base (*xiaopingdi guan*) (IT0802⑥:19)
3. kneaded vessel-cover button (IT0803④:26)
4-6. parts of high-stemmed mounted bowls (IT0803⑦:16, IT0803⑤:19, IT0802③:5)
7. pointed bottom (IT0802⑤:17)

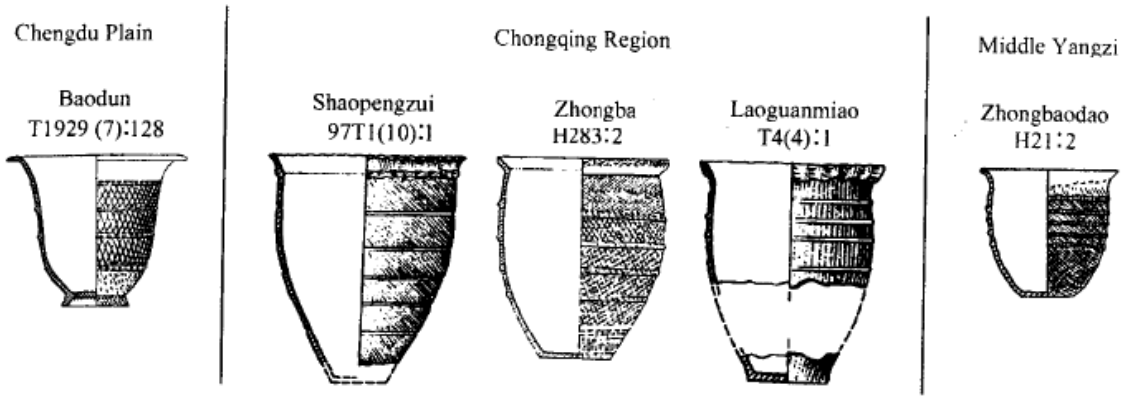


Appendix III-Figure 31: Vessel types discovered in Zhen'an, Fuling, showing their similarity to Sanxingdui and Shi'erqiao
(Beijing and Chongqing 2003:863, 869, 870).

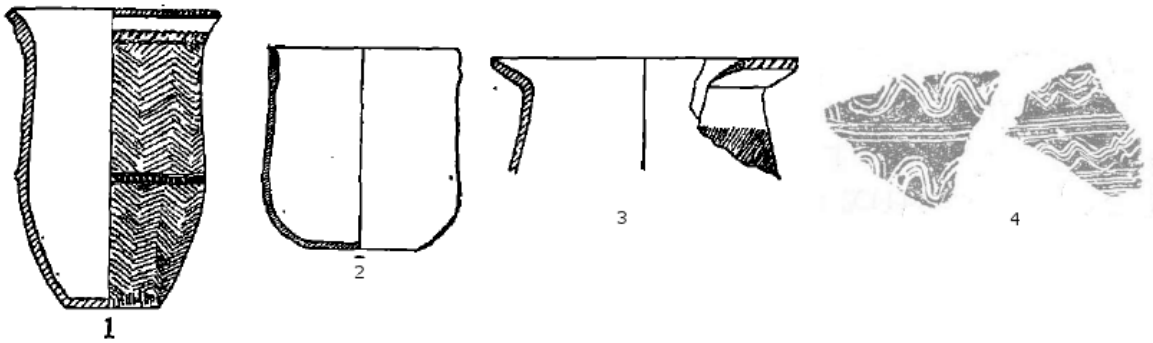
1. collared pointed-bottom cup (H8:6)
2. vessel cover with kneaded button (H8:4)
3. artillery-shell-shaped pointed-bottom cup (G1:11)
4. pointed-bottom saucers (T0603⑥:2)



Appendix III-Figure 32: Ganjinggou site cluster
(After Beijing et al. 2001:611; Pochan Chen 2004:319).

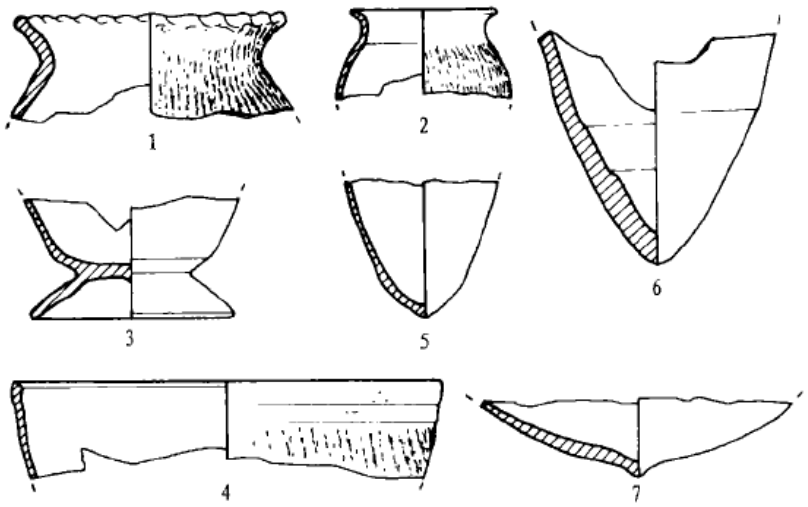


Appendix III-Figure 33: Beakers with cord marks and horizontal appliqué (after Flad and Chen 2006: 244 fig. 9).



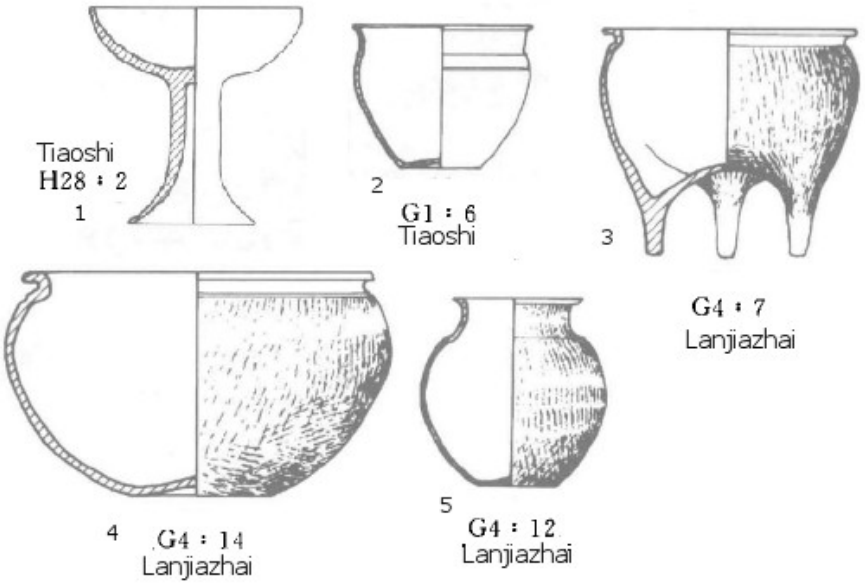
Appendix III-Figure 34: Vessels from Weijialiangzi, Wushan (Wu and Cong 1996:21 fig. 1; Zhongguo 1996:9 fig. 12).

1. deep-bellied jar (*shenfu guan*) (T3⑤:38)
2. cylindrical jar (*tongxing guan*) (T3④:91)
3. flared-rim jar (*chikou guan*) (T3④:102)
4. water-wave incisions (T4④:214; T3④:215



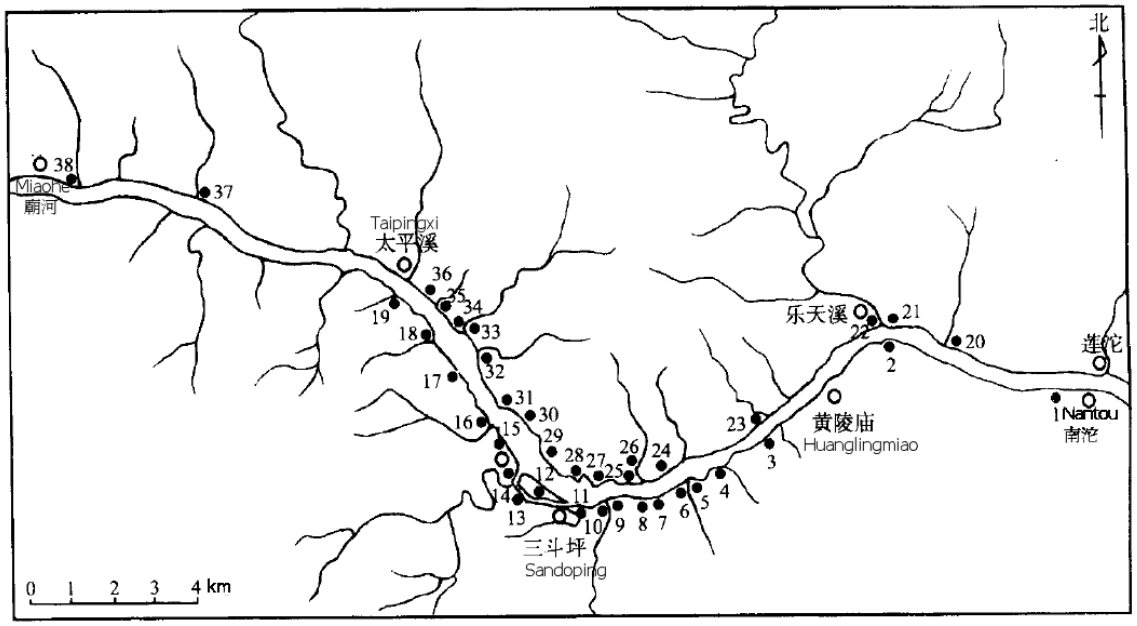
Appendix III-Figure 35: Vessels types discovered in Shuangyantang (not to scale) (Jiang Zhanghua 2007:397 fig.7).

1. jar with decorated rim (*huabian kouyan guan*)
2. upper body of likely round-bottom jar
3-4. ring-footed tureens (*guixingqi*)
5-6. pointed-bottom cups
7. pointed-bottom saucer



Appendix III-Figure 36: Chu-style vessels discovered in the Wushan area (not to scale) (Jiang Zhanghua 2007:398 fig. 8).

1. ring-footed mounted bowl
2. *pen* basin
3. *li* tripod
4. *yu* container
5. long-necked jars

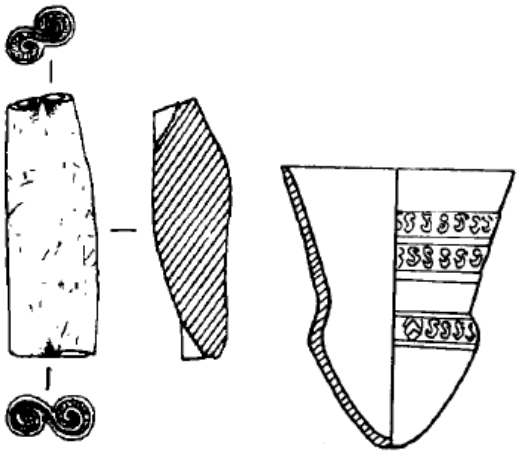


Appendix III-Figure 37: Archaeological sites located between Miaohe and Nantuo (Miao-Nan valley) in the Three Gorges area
(Changjiang 2002:7 fig. 2). Some important sites are listed as:

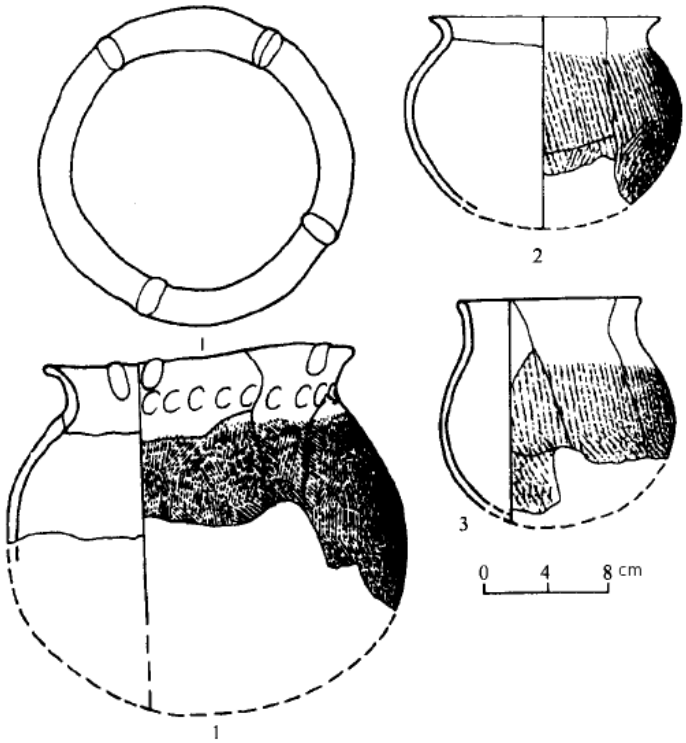
4. Yangjiawan 楊家灣
7. Baimiao 白廟
11. Sandouping 三斗坪
12. Zhongbaodao 中堡島
16. Changfutuo 長府沱
17. Chaotianzui 朝天嘴
20. Xia'an 下岸
22. Yangjiazui 楊家嘴
30. Zhuqituo 朱其沱
32. Lujiahe 路家河
35. Xiaoxikou 小溪口
38. Liulinxi 柳林溪



Appendix III-Figure 38: Decorations on the pottery vessels from Lujiahe II (Changjiang 2002:23-27).



Appendix III-Figure 39: Pottery stamp discovered in Shimenzui, Zigui (left) and *jiandi bei* decorated in this way (right) from Xianglushi
Left: T121④:2; right: T24④:58 (not to scale) (Wang Lixin et al. 2004: 244 fig. 184, 425 fig. 8).



Appendix III-Figure 40: Clay-chip mosaic forming method (*nipian pinjiefa*) used in Chengbeixi and Daxi pots 1. T⑤3:39; 2. T8④:6; 3.T5⑤:34 (Changjiang 2002:131).



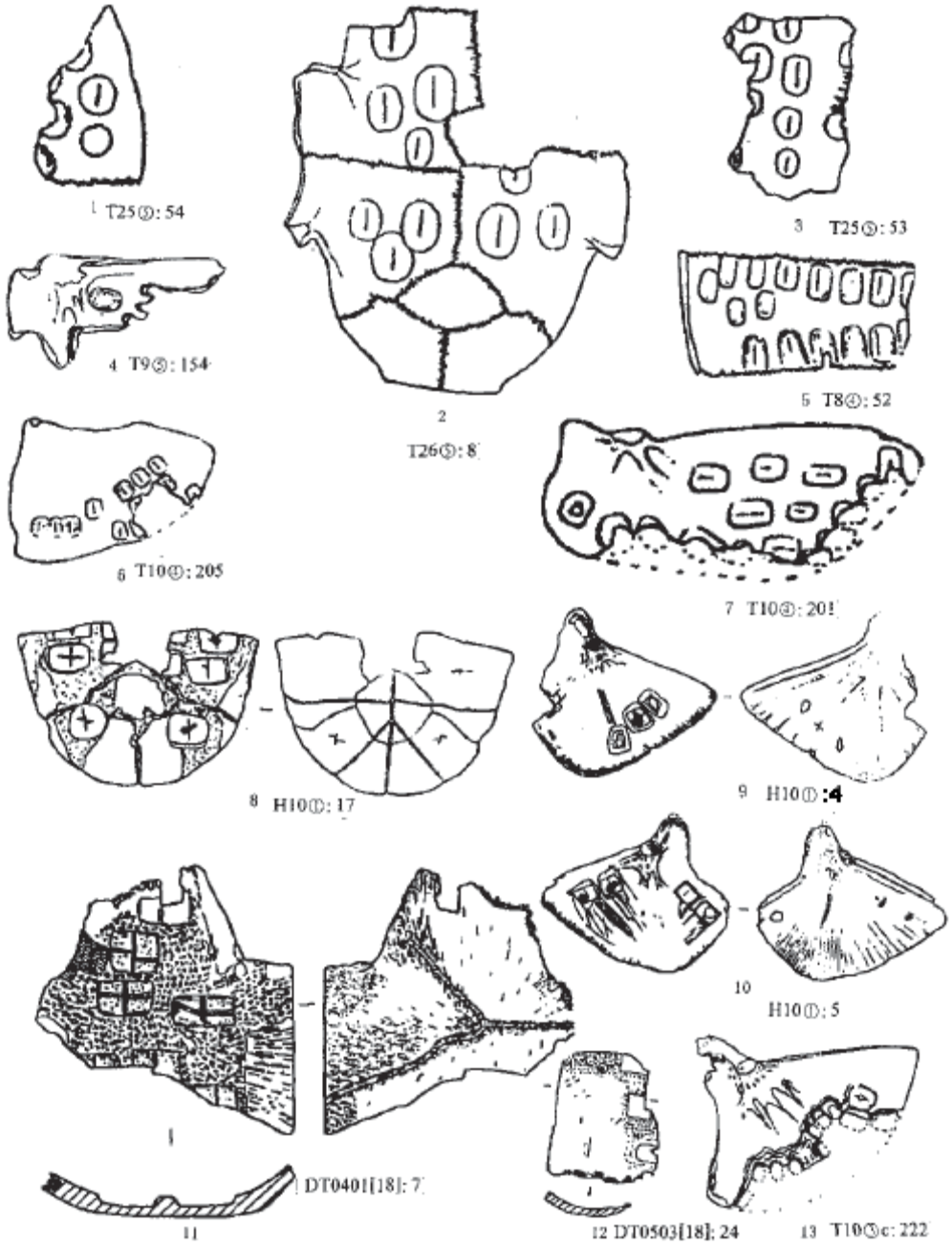
Appendix III-Figure 41: Bone ladle discovered in Xianglushi (after Wang Shancai 2007, color pl. 24)



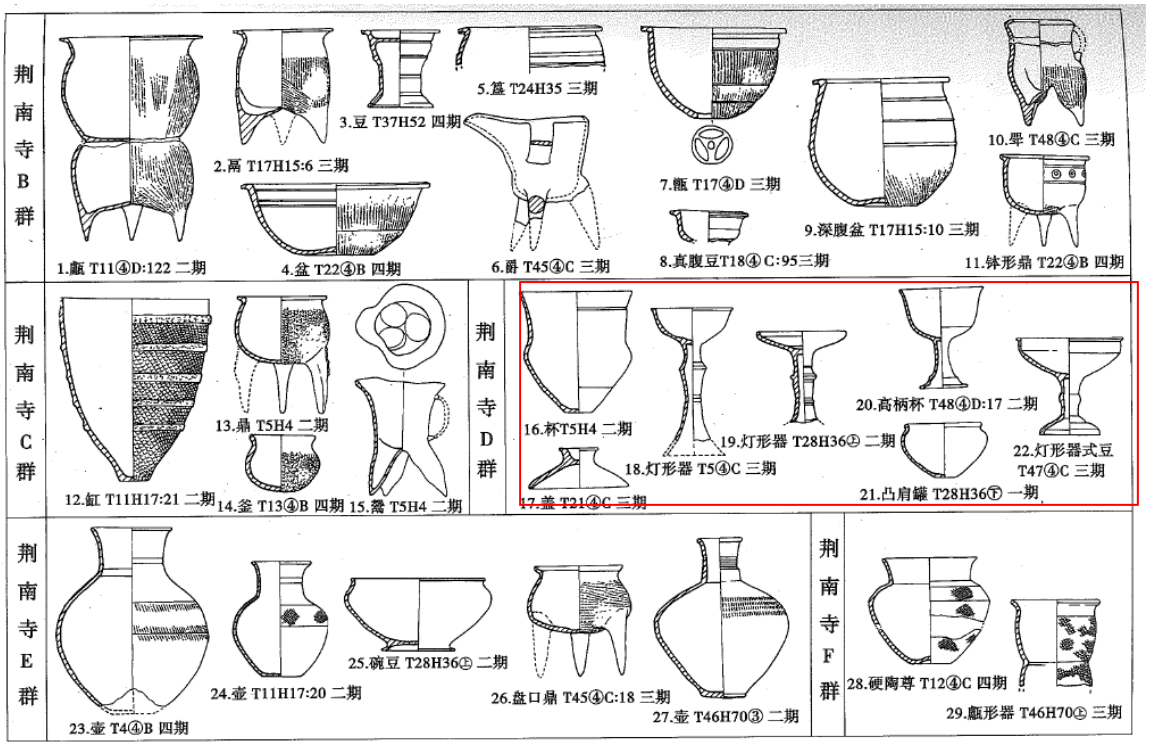
Appendix III-Figure 42: Cattle scapula discovered in Xianglushi (6th layer)
The largest oracle bone known so far (after Wang Shancai 2007, color pl. 31-below).



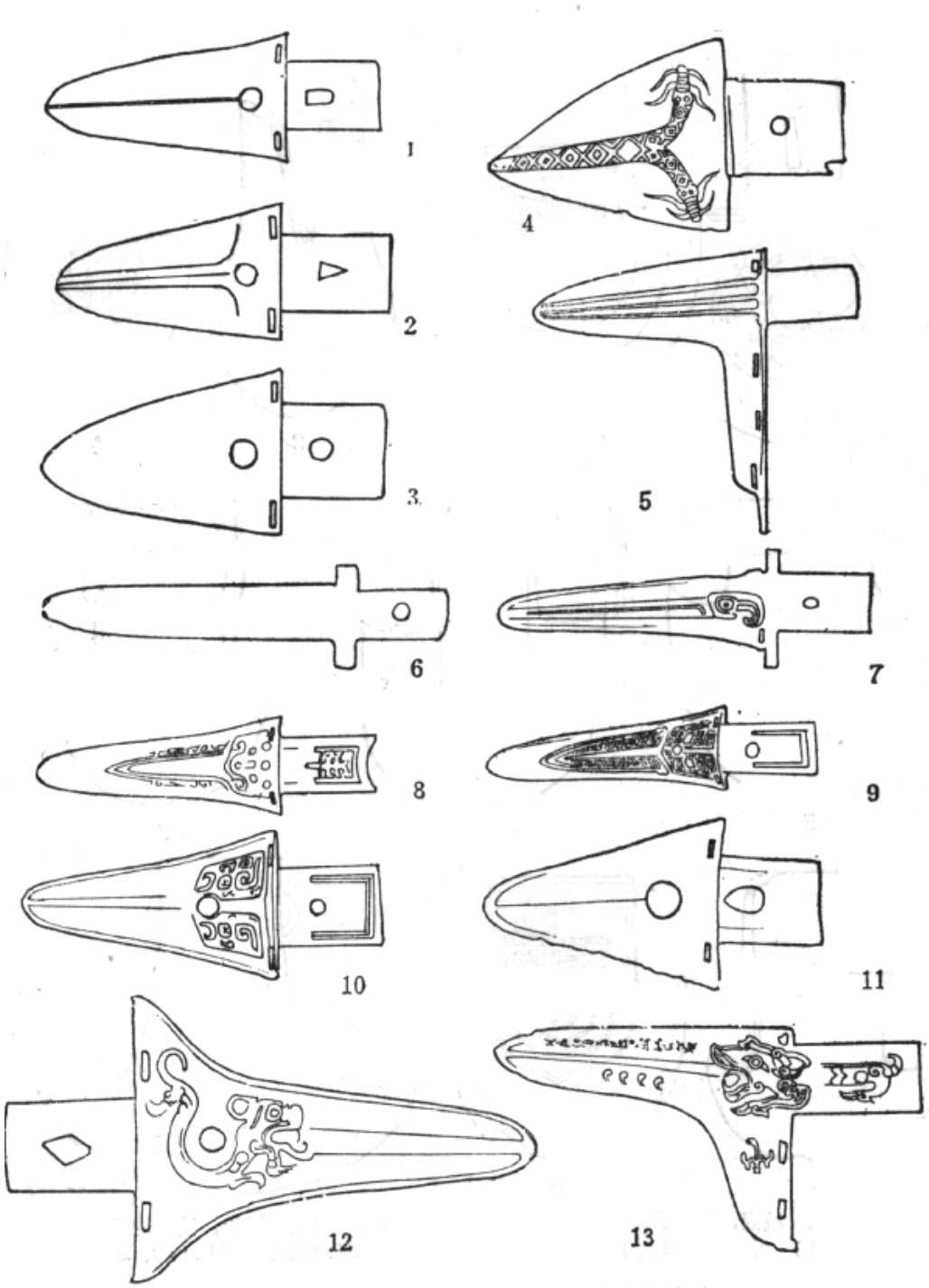
Appendix III-Figure 43: A large number of net sinkers discovered in Xianglushi (after Wang Shancai 2007, color pl. 38).



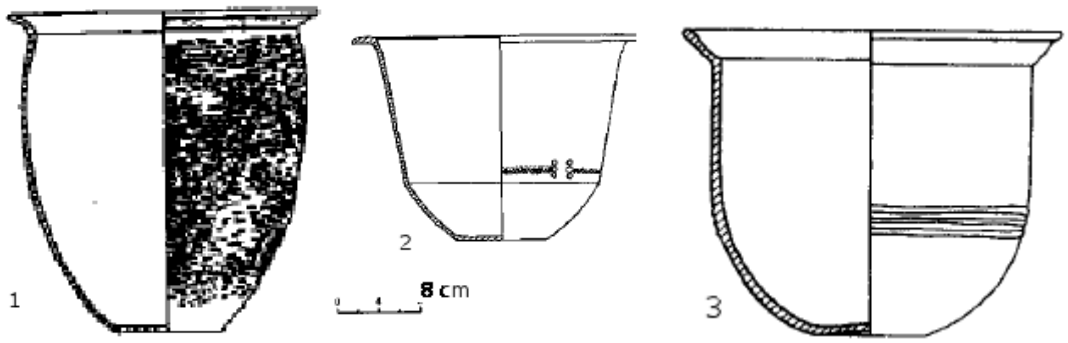
Appendix III-Figure 44: Different drilling styles on oracle bones found in the Middle Yangzi
1-7& 13. Xianglushi; 8-10. Shimenzui; 11-12. Zhongba (Jiang Gang 2005:60).



Appendix III-Figure 45: Five pottery assemblages (B-F) characteristic of Jingnansi (after He Nu 1994:87).
The D group shows similarity to Chengdu Plain vessels.

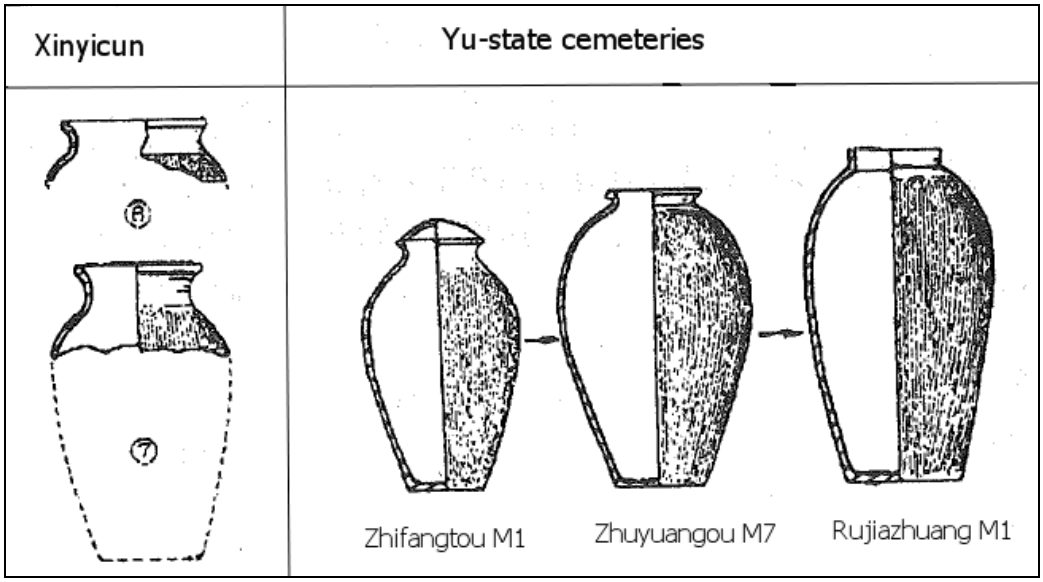


Appendix III-Figure 46: *Ge* dagger-axes discovered in a wide region
1-5. Chenggu; 6. Shuiguanyin, Xinfan; 7-11. Zhuwajie, Pengzhou; 12 Chengdu; 13. Hongguang Gongshe, Pixian (not to scale) (after Lu and Hu 1988:437).

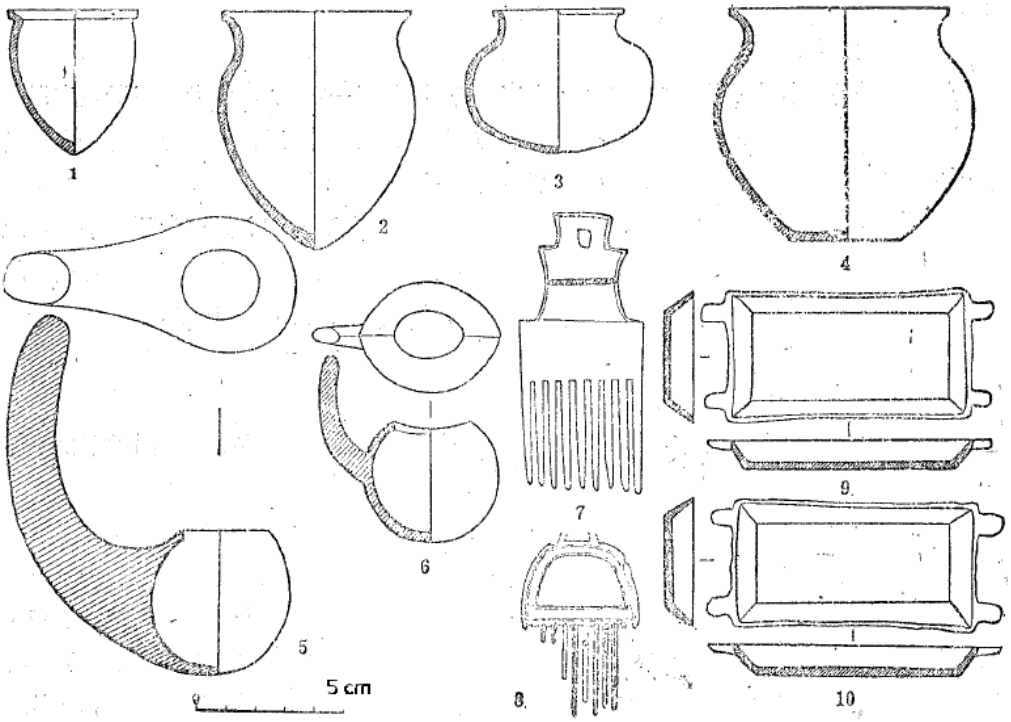


Appendix III-Figure 47: Jars discovered in Baoshan (no.1-2)
Showing similarity to Baodun vessels (see in Appendix III-Figure 5) and Zhongbaodao (no. 3).

1. wide-lipped vats with large mouths (*kuanyan dakou gang*) (SH28:27)
2. wide-lipped beakers with carinated bellies (*kuanyan zhefu zun*) (Xibei 2002:17-18)
3. (H67:10) (Guojia 2001:227 fig. 88).

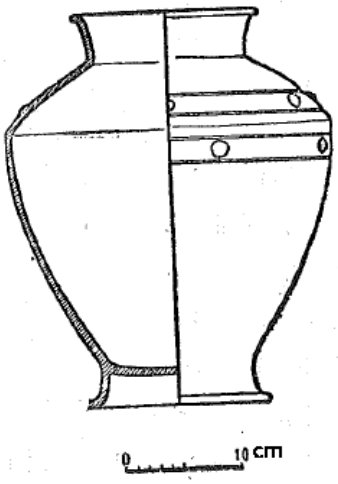


Appendix III-Figure 48: Long-bellied jars (*changfu guan*) discovered in Xinyicun and the Yu-state cemeteries (after Sun Hua 2000:111).

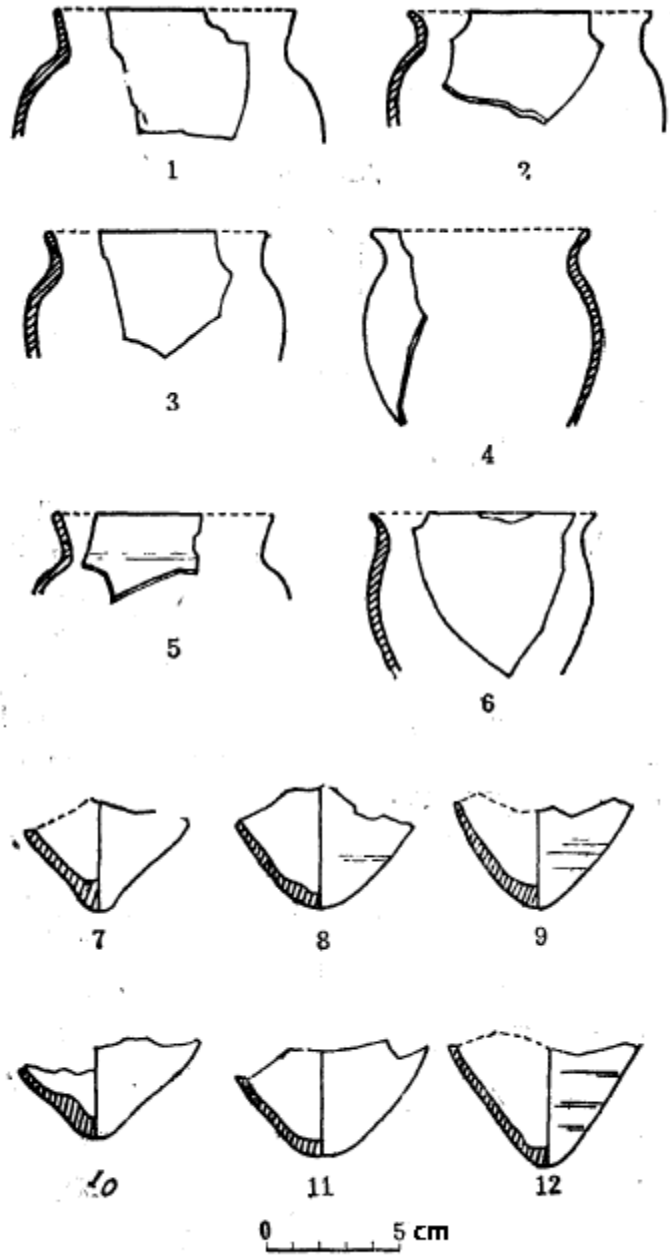


Appendix III-Figure 49: Bronzes discovered in Zhuyuangou Tomb No. 13 (after Lu and Hu 1988:79).

1-2. pointed-bottom jars (BZM13:107, 71)
3-4. flat-based or round-bottom jars (BZM13:108, 70)
5-6. bent-handled dippers (BZM13:109, 69)
7-8. combs (BZM13:67, 117)
9-10. trays (BZM13:110, 68)

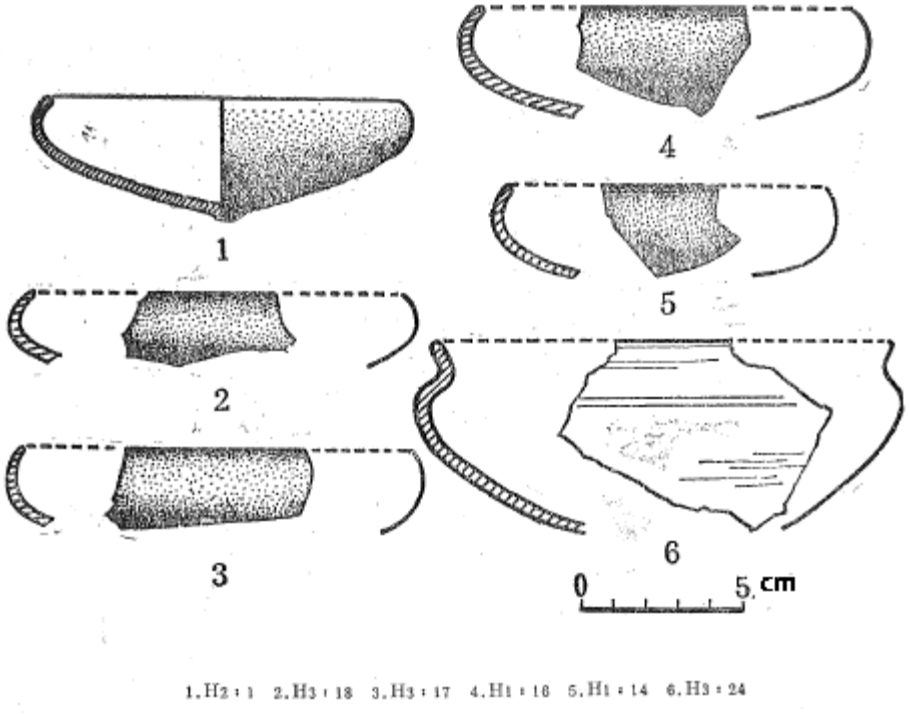


Appendix III-Figure 50: Pottery imitation of a bronze *lei* vessel from Zhuyuangou (BZM7:28) (Lu and Hu 1988:128).



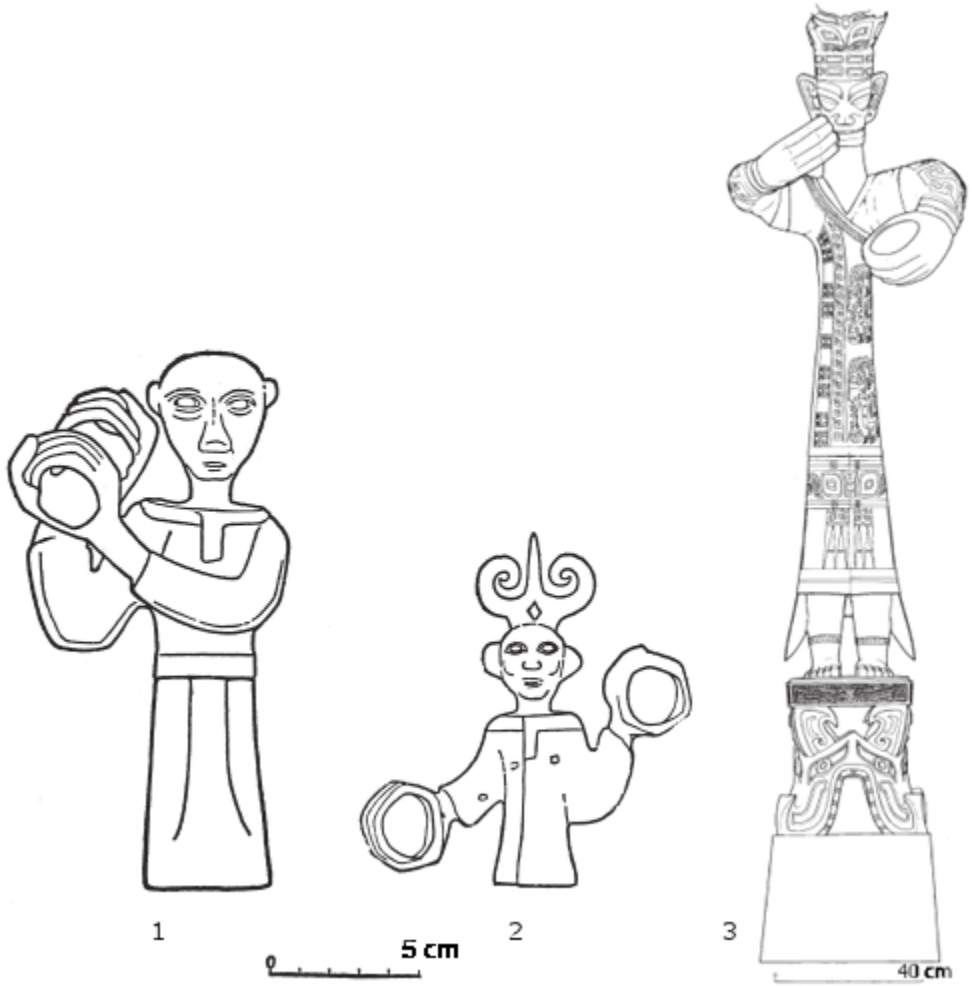
1. H3 : 12 2. H3 : 14 3. H3 : 15 4. H1 : 8 5. H1 : 9 6. H3 : 11 7. H3 : 9 8. H2 : 9 9. H3 : 16 10. H1 : 10 11. H2 : 10 12. H1 : 19

Appendix III-Figure 51: Pointed-bottom jars discovered in Rujiazhuang (Lu and Hu 1988:8).

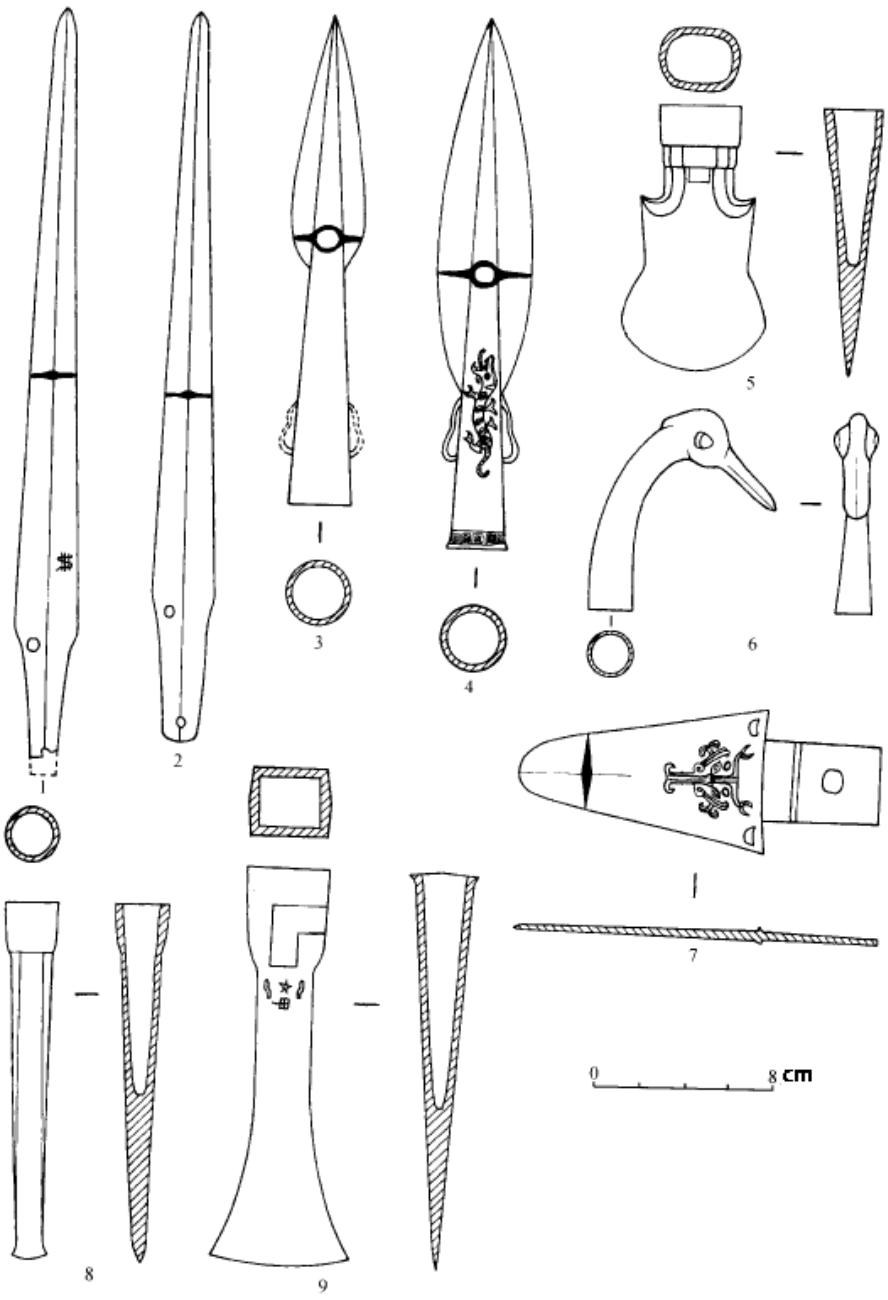


1. H2 : 1 2. H3 : 18 3. H3 : 17 4. H1 : 18 5. H1 : 14 6. H3 : 24

Appendix III-Figure 52: Pointed-bottom saucers from Rujiazhuang (Called as *jiandi bo*) at this site (Lu and Hu 1988:9).

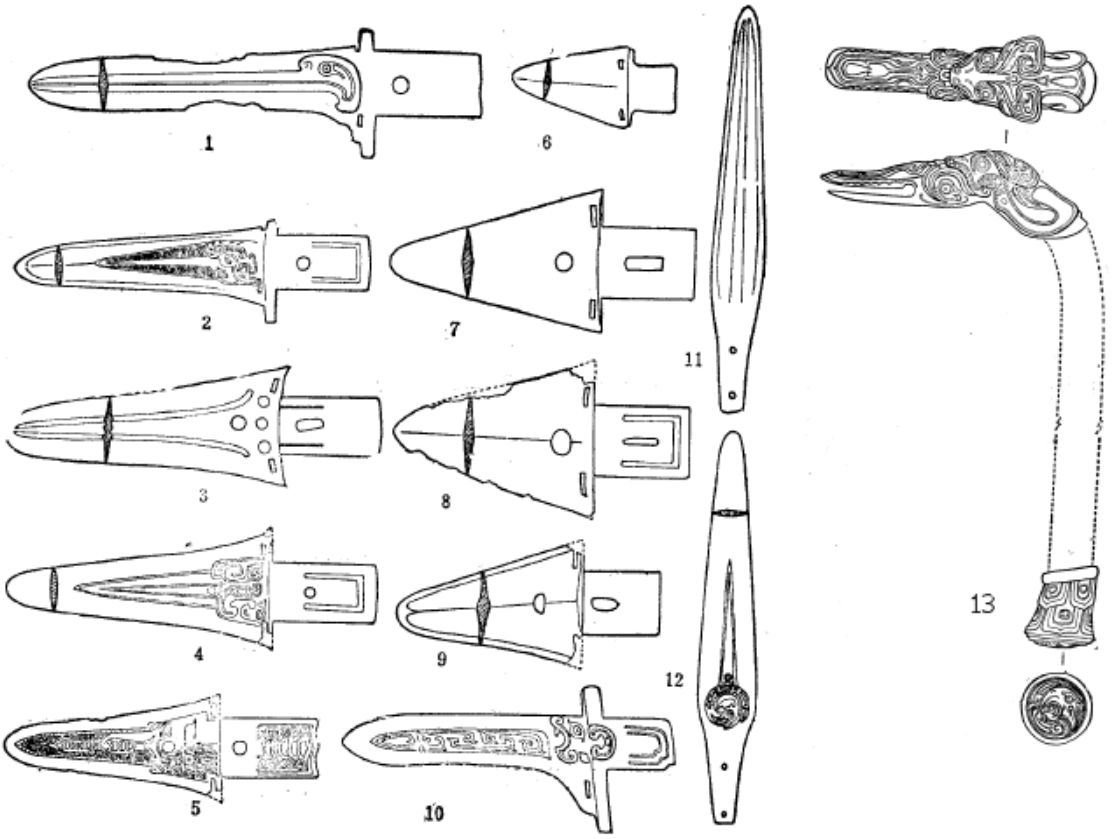


Appendix III-Figure 53: Two small figures from Rujiazhuang and the life-sized standing figure from Sanxingdui pit no. 2 1. BRM1B:67; 2. BRM2:22 (after Falkenhausen 2003:221 fig. 19) 3. (after Sichuan 1999:162 fig. 82).



Appendix III-Figure 54: Bronzes excavated from Xinyicun M1 (Chengdu Shi 2004e:206).

1-2. willow leaf-shaped swords (M1:14, M1:15)
3-4. Spearheads (M1:4, M1:5)
5. *fu* or *yue* axe (M1:10)
6. duck-head-shaped object (M1:11)
7. triangular *kui dagger-axe* (M1:13)
8. chisel (M1:8)
9. *fu* axe (M1:12)



Appendix III-Figure 55: Bronze weapons excavated from Zhuyuangou
(Lu and Hu 1988:114 fig. 91, 432 fig. 276)

1-2, 10. cruciform dagger-axes (BZM18:30; BZM13:168; BZM19:60)

3-9. triangular *kui dagger-axe*s (BZM4:106; BZM4:105; BZM7:146; BZM18:31 BZM3:3; BZM8:16; BZM7:186)

11-12. willow leaf-shaped swords (BZM7:147; BZM20:35)

13. duck-head-shaped object (BZM7:19) (not to scale).

Appendix IV—Data analysis samples

Time 1: Late Shang (ca. 1300-1200 BC)

Cat. #	site name	sample id	level	vessel type	rim radius	height	depth	color (outside surface)	color (inside surface)	texture
1	Sanxingdui	K1:320	6+	jiandi zhan	6.7	5.2	4.5	yellow-brown	black-brown	coarse
2	Sanxingdui	K1:346-5	6+	jiandi zhan	3.8	1.7		black-brown		coarse
3	Sanxingdui	K1:334	6+	jiandi zhan	6.7	4.6	4.2	black-brown	yellow-brown	coarse
4	Sanxingdui	K1:346-10	6+	jiandi zhan	3.65	1.7		yellow-orange		coarse
5	Sanxingdui	K1:342	6+	jiandi zhan	6.55	5	4.2	black-brown		coarse
6	Sanxingdui	K1:339	6+	jiandi zhan	6.6	4.4	3.8	black-brown		coarse
7	Sanxingdui	K1:331	6+	jiandi zhan	6.6	4.7	3.9	black-brown		coarse
8	Sanxingdui	K1:333	6+	jiandi zhan	6.7	4.4	4	black-brown		coarse
9	Sanxingdui	K1:332	6+	jiandi zhan	6.7	4	3.6	black-brown		coarse
10	Sanxingdui	K1:338	6+	jiandi zhan	6.45	4.9	4.5	black-brown		coarse
11	Sanxingdui	K1:54	6+	jiandi zhan	6.4	4.4	3.9	black-brown		coarse
12	Sanxingdui	K1:34	6+	jiandi zhan	6.25	4.2	3.9	black-brown		coarse
13	Sanxingdui	K1:329	6+	jiandi zhan	6.3	4.9	3.9	black-brown		coarse
14	Sanxingdui	K1:24	6+	jiandi zhan	6.45	4.2	3.7	red-brown		coarse
15	Sanxingdui	K1:346-7	6+	jiandi zhan	3.8	1.5		black-brown		coarse
16	Sanxingdui	K1:346-8	6+	jiandi zhan	3.8	1.2		black-brown		coarse
17	Sanxingdui	K1:346-2	6+	jiandi zhan	4.15	2.1		black-brown		coarse
18	Sanxingdui	K1:346-1	6+	jiandi zhan	3.45	1.7		brown		coarse
19	Sanxingdui	K1:346-3	6+	jiandi zhan	3.35	2		brown		coarse
20	Sanxingdui	K1:346-4	6+	jiandi zhan	3.6	1.5		grey-brown		coarse
21	Sanxingdui	K1:346-6	6+	jiandi zhan	3.8	1.9		brown		coarse
22	Sanxingdui	K1:346-9	6+	jiandi zhan	3.95	1.7		black-brown		coarse
23	Shi'erqiao	IT2:13:4	13	jiandi zhan	7	5.7		grey-black	brown	coarse
24	Shi'erqiao	IT1:13:52	13	jiandi zhan	5.9	5		grey-black	brown	coarse

*** X+ = below the Xth layer in the strata**

Time 2: Shang-Zhou (ca. 1200-1000 BC)

Cat. #	site name	sample id	level	vessel type	rim radius	height	depth	color (outside surface)	color (inside surface)	core	texture
1	Shi'erqiao	IT23:12:22	12	jiandi zhan	5.65	2.9		grey		brown	coarse
2	Shi'erqiao	IT12:12:3	12	jiandi zhan	4.95	4.3		grey			coarse
3	Shi'erqiao	IT2:12:41	12	jiandi zhan	8.5	6.5		grey		brown	coarse
4	Shi'erqiao	IT20:12:6	12	jiandi zhan	9	4.8		grey			coarse
5	Shi'erqiao	IT6:12:34	12	jiandi zhan	6.5	5.8		brown			coarse
6	Shi'erqiao	IT18:12:3	12	jiandi zhan	5.7	4.1		grey			coarse
7	Shi'erqiao	IT1:12:21	12	jiandi zhan	6.4	5		grey			coarse
8	Shi'erqiao	IIT39:12:30	12	jiandi zhan	6.15	4.8		grey			coarse
9	Shi'erqiao	IT9:12:13	12	jiandi zhan	6	4		brown			coarse
10	Meiyuan	IT8206:8:3	8	jiandi zhan	6	4.6		2.5Y 6/2	2.5Y 7/4		coarse
11	Meiyuan	IT8106:9:80	9	jiandi zhan	6.65	5.3		2.5Y 6/4	2.5Y 6/4	10YR 5/1	coarse
12	Meiyuan	IT8026:10	10	jiandi zhan	6.2	5		2.5Y 6/4, 2.5Y 6/3	2.5Y 6/4, 2.5Y 6/3		fine
13	Meiyuan	IT8007:8B:15	8B	jiandi zhan	6.7	4.7		2.5Y 6/1	2.5Y 4/1		
14	Meiyuan	IT8006:8B:2	8B	jiandi zhan	6.8	5.8		2.5Y 6/1	2.5Y 5/2		
15	Meiyuan	IT8007:8B:43	8B	jiandi zhan	7.2	6.5				2.5Y 5/3	coarse
16	Meiyuan	IT8007:8B:41	8B	jiandi zhan	6.4	5		2.5Y 7/1	2.5Y 6/1, 2.5Y 7/1		coarse
17	Meiyuan	IT8007:8B:16	8B	jiandi zhan	6.4	4.9		2.5Y 5/1	2.5Y 5/1	2.5Y 5/2	coarse
18	Meiyuan	IT8007:8B:38	8B	jiandi zhan	6	5.2		2.5Y 6/1	2.5Y 6/1,		coarse
19	Meiyuan	IT8007:8B:23	8B	jiandi zhan	6.7	5		2.5Y 6/2	2.5Y 6/2	2.5Y 5/1	coarse
20	Meiyuan	IT8006:8:23	8	jiandi zhan	7	7		2.5Y 5/1	2.5Y 6/3		coarse
21	Meiyuan	IT8006:8:38	8	jiandi zhan	7.4	6		2.5Y 5/1	2.5Y 4/1	2.5Y 5/2	coarse

22	Lanyuan	2001CQJII-H305:21	4-H305-M65	jiandi zhan	6.2	5.7		2.5Y 5/1	2.5Y 6/2		coarse
23	Lanyuan	2001CQJII-H305:30	4-H305-M65	jiandi zhan	6.4	5.1		2.5Y 5/1	2.5Y 5/2	7.5YR 5/4	coarse
24	Lanyuan	2001CQJII-H305:23	4-H305-M65	jiandi zhan	6	4.6		2.5Y 5/1	2.5Y 5/1	brown	coarse
25	Lanyuan	2001CQJII-H305:20	4-H305-M65	jiandi zhan	6.2	6.4	5.6	2.5Y 5/2	2.5Y 6/1	brown	coarse
26	Lanyuan	2001CQJII-H305:22	4-H305-M65	jiandi zhan	6.7	4.9		2.5Y 5/1	2.5Y 5/1	slightly darker	fine
27	Lanyuan	2001CQJII-H305:11	4-H305-M65	jiandi zhan	6.2	6		2.5Y 6/3	2.5Y 6/1		fine
28	Lanyuan	2001CQJII-H305:17	4-H305-M65	jiandi zhan	6	4.9		2.5Y 6/1	2.5Y 5/1		coarse
29	Lanyuan	2001CQJII-H305:18	4-H305-M65	jiandi zhan	6.2	5.3		2.5Y 7/1	2.5Y 7/1	2.5Y 7/2	fine
30	Lanyuan	2001CQJII-H305:4	4-H305-M65	jiandi zhan	6.6	5.7		2.5Y 5/1	2.5Y 5/1		coarse
31	Lanyuan	2001CQJII-H305:8	4-H305-M65	jiandi zhan	6.2	5		2.5Y 5/1	2.5Y 5/1	2.5Y 6/2	coarse
32	Lanyuan	2001CQJII-H305:9	4-H305-M65	jiandi zhan	6.2	5.5		2.5Y 7/2, 2.5Y 6/1	2.5Y 6/2, 2.5Y 7/4		coarse
33	Lanyuan	2001CQJII-H305:10	4-H305-M65	jiandi zhan	6.4	5.8		2.5Y 7/2	2.5Y 8/2	2.5Y 5/1	fine
34	Lanyuan	2001CQJII-H305:4	4-H305-M65	jiandi zhan	5.8	5.3		2.5Y 5/1	2.5Y 4/1		coarse
35	Lanyuan	2001CQJII-H305:1-1	4-H305-M65	jiandi zhan	6.2	6.3		light grey			fine
36	Lanyuan	2001CQJII-H305:1-2	4-H305-M65	jiandi zhan	6	5.2		grey-brown			coarse

37	Lanyuan	2001CQJII-H305:31	4-H305-M65	jiandi zhan	5.2	6.7		grey-brown			coarse
38	Lanyuan	2001CQJII-H305:25	4-H305-M65	jiandi zhan	6	5.5		grey-brown			coarse
39	Lanyuan	2001CQJII-H305:26	4-H305-M65	jiandi zhan	6.4	5.1		grey-brown			coarse
40	Lanyuan	2001CQJII-H305:12	4-H305-M65	jiandi zhan	5.6	6.1		grey-brown			fine
41	Huangzhongcun	H150:11	6-H-7	jiandi zhan	6.1	6			black		?
42	Huangzhongcun	H150:1	6-H-7	jiandi zhan	6.5	5.3			black		?
43	Boya Tingyun	M200:1	6+	jiandi zhan	5.65	4.8					coarse
44	Boya Tingyun	M200:3	6+	jiandi zhan	6.3	5.8					coarse
45	Boya Tingyun	M193:1	6+	jiandi zhan	6.3	5.7					
46	Boya Tingyun	M193:2	6+	jiandi zhan	6.1	5.4					
47	Boya Tingyun	M185:1	6+	jiandi zhan	5.5	6					
48	Boya Tingyun	M191:1	6+	jiandi zhan	5.7	5.8					
49	Boya Tingyun	M202:1	6+	jiandi zhan	5.8	6.5					
50	Boya Tingyun	M201:1	6+	jiandi zhan	6.5	6.6					fine
51	Boya Tingyun	M206:1	6+	jiandi zhan	6.7	6.1					coarse

52	Minjiang Xiaoqu	H10:1	5-4	jiandi zhan	6.18	4.36	4.00				
53	Minjiang Xiaoqu	H14:7	5-4	jiandi zhan	6.00	5.64					
54	Minjiang Xiaoqu	H6:2:9	5-4	jiandi zhan	6.00	4.36					
55	Minjiang Xiaoqu	T1919:5:1	5	jiandi zhan	5.16	4.38					
56	Minjiang Xiaoqu	T2319:5:1	5	jiandi zhan	5.08	3.44					
57	Minjiang Xiaoqu	H49:4	5-4	jiandi zhan	5.47	5.31					
58	Minjiang Xiaoqu	H6:2:3	5-4	jiandi zhan	5.39	3.75					
59	Minjiang Xiaoqu	H7:1	5-4	jiandi zhan	5.63	5.16					
60	Minjiang Xiaoqu	H15:1	5-4	jiandi zhan	5.63	5.00					

Time 3: Early Western Zhou (ca. 1000-900 BC)

1	Shi'erqiao	IIT43:10:8	10	jiandi zhan	5.45	4.6					coarse
2	Shi'erqiao	IIT30:10:2	10	jiandi zhan	5.05	4.2					coarse
3	Shi'erqiao	IIT43:10:9	10	jiandi zhan	5.50	4.2					
4	Shi'erqiao	IIT40:11:16	11	jiandi zhan	6.20	4.2					coarse
5	Shi'erqiao	IIT40:11:17	11	jiandi zhan	6.17	4					coarse
6	Shi'erqiao	IIT50:10:1	10	jiandi zhan	6.20	3.8					coarse
7	Shi'erqiao	IIT61:10:27	10	jiandi zhan	5.50	3.9					coarse
8	Meiyuan	IT8106:7:76	7	jiandi zhan	5.80	5		2.5Y 6/2	10YR 6/4		fine coarse
9	Xinhe	H7103:1	6-H-7	jiandi zhan	6.5	5.4					coarse
10	Xinhe	H6793:1	5-H-6	jiandi zhan	6.4	6.2					fine
11	Xinhe	H6793:2	5-H-6	jiandi zhan	5.8	5.2					coarse
12	Xinhe	H7094:4	5-H-6	jiandi zhan	5.9	5.5					coarse
13	Xinhe	H7094:10	5-H-6	jiandi zhan	6.25	5.2					coarse
14	Xinhe	H7096:1	5-H-6	jiandi zhan	6.3	5.8					coarse
15	Xinhe	H7096:2	5-H-6	jiandi zhan	6.85	5.8					coarse
16	Xinhe	H7096:3	5-H-6	jiandi zhan	6.95	5.6					
17	Huangzhongcu	H128:11	4B+	jiandi zhan	6.10	5.4			grey		coarse
18	Huangzhongcu	H128:12	4B+	jiandi zhan	6.20	5.5					fine
19	Huangzhongcu	H128:3	4B+	jiandi zhan	5.45	4.5					coarse
20	Huangzhongcu	H128:8	4B+	jiandi zhan	6.35	7.7			grey		coarse
21	Huangzhongcu	H158:14	5A+	jiandi zhan	6.85	5.6		black	grey		coarse
22	Huangzhongcu	H158:4	5A+	jiandi zhan	6.55	5.3		black	grey		coarse
23	Huangzhongcu	H158:23	5A+	jiandi zhan	7.55	5.9		black	grey		coarse
24	Huangzhongcu	H158:18	5A+	jiandi zhan	7.25	6.6		black	grey		coarse
25	Huangzhongcu n B	H515:2	5-H-6	jiandi zhan	6.00	4.8					coarse

26	Huangzhongcun B	H519:1	5-H-6	jiandi zhan	5.50	4.2					coarse
27	Huangzhongcun B	H519:2	5-H-6	jiandi zhan	6.25	3.8					coarse
28	Huangzhongcun B	IT6979:5:1	5	jiandi zhan	6.50	4.2					coarse
29	Huangzhongcun B	H519:3	5-H-6	jiandi zhan	6.25	3.5					coarse
30	Boya Tingyun	M207:2	6+	jiandi zhan	5.7	4					coarse
31	Boya Tingyun	M463:1	6+	jiandi zhan	5	4					
32	Boya Tingyun	M462:1	6+	jiandi zhan	5.75	4.5					

Time 4: Late Western Zhou (ca. 900-800 BC)

1	Xinyicun	T303:7:26	7	jiandi zhan	8	5.6					coarse
2	Xinyicun	T303:7:35	7	jiandi zhan	7.5	5.4					coarse
3	Xinyicun	T104:7:17	7	jiandi zhan	7.8	5.4					coarse
4	Xinyicun	T303:7:15	7	jiandi zhan	6	5.4					coarse
5	Xinyicun	T101:7:32	7	jiandi zhan	7.6	5.6					coarse
6	Xinyicun	T404:6:48	6	jiandi zhan	8	5.8					coarse
7	Xinyicun	T404:6:40	6	jiandi zhan	7.6	4.4					coarse
8	Xinyicun	T104:6:8	6	jiandi zhan	7.2	4.6					coarse
9	Xinyicun	T104:6:9	6	jiandi zhan	7.2	4.8					coarse
10	Xinyicun	T404:6:9	6	jiandi zhan	4.5	3.9					coarse
11	Xinyicun	T404:6:39	6	jiandi zhan	8.25	6					coarse
12	Xinyicun	T404:6:49	6	jiandi zhan	6	5					coarse
13	Xinyicun	T404:6:21	6	jiandi zhan	6	4.6					coarse
14	Xinyicun	T104:6:15	6	jiandi zhan	5.3	4.6					coarse
15	Xinyicun	T404:6:15	6	jiandi zhan	6	4.5					coarse
16	Xinyicun	T404:6:28	6	jiandi zhan	6.3	4.5					coarse

Appendix IV-Table 1: Pointed-bottom saucer (*jiandi zhan*) samples used in metric measurement

Sample id	Site	Original id	Period*	Vessel type	Analysis undertaken	Thin-section slicing pt.	Appearance
12-001d	Shi'erqiao-Xinyicun	2010TN05W03:9:1	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	close to bottom	1. White; 2. rim and wall; 3. thin
12-002d	Shi'erqiao-Xinyicun	2010TN05W03:9:2	Bronze Age III	zhan	XRD, Petro, TGA/DSC	wall	1. Black outside, rust in the core; 2. only have the rim with round lip; 3. about 0.7 cm thick; 4. a band (ca. 1cm wide) around the neck
12-003d	Shi'erqiao-Xinyicun	2010TN05W03:9:3	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim	1. Black; 2. thin inverted rim, short neck; 3. the rim is about 0.5 cm wide and the neck about 1 cm wide
12-004d	Shi'erqiao-Xinyicun	2010TN05W03:9:4	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim	1. Orange-red on the outside surface (slipped), yellow-grey on the inside surface, and black on the core; 2. very short neck (ca. 0.5 cm wide); 3. wheel trace
12-005d	Shi'erqiao-Xinyicun	2010TN05W03:9:5	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim	1. Rust color; 2. very thin; 3. neck ca. 0.9 cm wide
12-006d	Shi'erqiao-Xinyicun	2010TN05W03:9:6	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	rim and wall	1. Brick red, black in the core; 2. only rim with round lip; 3. about 0.3 cm thick
12-007d	Shi'erqiao-Xinyicun	2010TN05W03:9:7	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	bottom	1. Yellow-grey on the surfaces, grey in the core; 2. base with wheel trace;

							3. ca. 0.4 cm thick
12-008dj	Shi'erqiao-Xinyicun	2010TN05W03:9:8	Bronze Age III	zhan or guan	XRD, XRF, Petro, TGA/DSC	rim-wall	1. Yellow-grey on the surfaces, grey in the core; 2. thick, small in rim diameter, shape close to jiandi yu
12-009d	Shi'erqiao-Xinyicun	2010TN05W03:9:9	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	rim-wall	1. Yellow-grey on the surfaces, rust color in the core; 2. inverted rim, straight and short neck (ca. 0.8 cm)
12-010d	Shi'erqiao-Xinyicun	2010TN05W03:9:10	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	rim-wall	1. Yellow-grey on the surfaces, black in the core; 2. round lip, ca. 0.5 cm thick; 3. wheel trace; 4. containing many visible white grains
12-011d	Shi'erqiao-Xinyicun	2010TN05W03:9:11	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	rim	1. Black on the surfaces, grey in the core; 2. thin--only ca. 0.25 cm; 3. containing many visible white grains
12-012d	Shi'erqiao-Xinyicun	2010TN05W03:9:12	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	rim, shoulder, wall	1. Rust color; 2. sharp lip and evert rim; 3. ca. 1.3 cm wide neck; 4. 0.35 cm thick
12-013d	Shi'erqiao-Xinyicun	2010TN05W03:9:13	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	rim, wall	1. Black on the surfaces, rust color in the core; 2. straight short neck (ca. 0.9 cm); 3. ca. 0.3 cm thick
12-014d	Shi'erqiao-Xinyicun	2010TN05W03:9:14	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim, wall	1. Black on the surfaces, rust color in the core; 2. straight neck (ca. 1.4 cm); 3. ca. 0.3 cm thick
12-015d	Shi'erqiao-	2010TN05W03:9:15	Bronze Age	zhan	XRD, Petro,	rim and	1. Black slip→yellow-

	Xinyicun		III		TGA/DSC	wall	grey→black in the core; 2. round lip, round shoulder; 3. ca. 0.5 cm thick
12-016d	Shi'erqiao-Xinyicun	2010TN05W03:9:16	Bronze Age III	zhan	XRD, Petro, TGA/DSC	wall and bottom	1. Yellow-black; 2. extra lump at bottom; 3. wheel trace
12-017d	Shi'erqiao-Xinyicun	2010TN05W03:9:17	Bronze Age III	zhan	XRD, XRF, Petro, TGA/DSC	wall and bottom	1. black throughout; 2. extra lump at bottom; 3. wheel trace
12-018d	Shi'erqiao-Xinyicun	2010TN05W03:9:18	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim and wall	1. Brown on the surfaces, black in the core; 2. sharp lip and evert rim; 3. 0.3 cm thick; thin
12-019c	Shi'erqiao-Xinyicun	2010TN05W03:9:19	Bronze Age III	zhan	XRD, XRF, Petro	wall	1. Light grey on the surfaces, dark grey in the core
12-020j	Shi'erqiao-Xinyicun	2010TN05W03:9:20	Bronze Age III	guan	XRD, XRF, Petro, TGA/DSC	wall	1. Black throughout the whole body; 2. thin with wheel trace
12-021j	Shi'erqiao-Xinyicun	2010TN05W03:9:21	Bronze Age III	guan	XRD, XRF, Petro, TGA/DSC	wall	1. Black on the surfaces rust/grey in the core; 2. the core is in different colors
12-022t	Shi'erqiao-Xinyicun	2010TN05W03:9:22	Bronze Age III	unknown thick pointed bottom	XRD, XRF, Petro, TGA/DSC	bottom	1. Yellow-grey on the surfaces, grey in the core; 2. very even; 3. ca. 1.2 cm thick at the bottom, wheel trace
12-023t	Shi'erqiao-Xinyicun	2010TN05W03:9:23	Bronze Age III	unknown thick pointed bottom	XRD, XRF, Petro, TGA/DSC	bottom	1. Brick red on the surfaces, rust color in the core; 2. the distribution and size of grains are very even; 3. fragile

12-024f	Shi'erqiao-Xinyicun	2010TN05W03:9:24	Bronze Age III	small flat-based jar	XRD, XRF, Petro, TGA/DSC	wall	1. Black on the surfaces, brown in the core; 2. wheel trace at the lower part; 3. contains many bright white grains
12-025f	Shi'erqiao-Xinyicun	2010TN05W03:9:25	Bronze Age III	small flat-based jar	XRD, XRF, Petro	wall	1. Slightly different colors on the surfaces and the core
12-026f	Shi'erqiao-Xinyicun	2010TN05W03:9:26	Bronze Age III	small flat-based jar	XRF, Petro, TGA/DSC	rim and wall	1. Brown-black on the surfaces, darker in the core; 2. visible white grains; 3. bulging shoulder
12-027f	Shi'erqiao-Xinyicun	2010TN05W03:9:27	Bronze Age III	small flat-based jar	XRF, Petro, TGA/DSC	rim and bottom	
12-028f	Shi'erqiao-Xinyicun	2010TN05W03:9:28	Bronze Age III	small flat-based jar	XRF, Petro, TGA/DSC		
12-029t	Shi'erqiao-Xinyicun	2010TN05W03:9:44	Bronze Age III	unknown thick pointed bottom	XRF, Petro, TGA/DSC		1. Grey throughout the whole body; 2. containing many large black grains; 3. thick
12-030c	Shi'erqiao-Xinyicun	2010TN05W03:9:45	Bronze Age III	bei	XRF (12-034u), Petro, TGA/DSC	close to the bottom	1. Grey on the surfaces, brown in the core
12-031c	Shi'erqiao-Xinyicun	2010TN05W03:9:31	Bronze Age III	bei	XRF, Petro, TGA/DSC	wall	1. Surface smoothing or slipping
12-032c	Shi'erqiao-Xinyicun	2010TN05W03:9:32	Bronze Age III	bei	XRF, Petro, TGA/DSC	bottom	1. Black throughout the whole body; 2. extra lump at bottom with trim trace

12-033c	Shi'erqiao-Xinyicun	2010TN05W03:9:33	Bronze Age III	bei	XRF, Petro, TGA/DSC	wall	1. Surface smoothing or slipping; 2. color is not even
12-034u	Shi'erqiao-Xinyicun	2010TN05W03:9:30	Bronze Age III	unknown	XRF		1. Part of the wall, grey; 2. with grid cord marking
12-035u	Shi'erqiao-Xinyicun	2010TN05W03:9:31	Bronze Age III	unknown	XRF		1. Part of the wall, from the core to the surfaces: black-->rust--> red-grey skin; 2. with visible red, dark grains; 3. decorated with impressed lines
12-036u	Shi'erqiao-Xinyicun	2010TN05W03:9:32	Bronze Age III	unknown	XRF		1. Part of the wall, yellow-grey on the surfaces, grey in the core; 2. thin, decorated with impressed lines; 3. with wheel trace
12-037rp	Shi'erqiao-Xinyicun	2010TN05W03:9:33	Bronze Age III	unknown	XRF		1. Part of the wall, purple-red throughout; 2. containing many white grains
12-038u	Shi'erqiao-Xinyicun	2010TN05W03:9:38	Bronze Age III	unknown	XRF		1. Part of the wall, black; 2. with wheel trace
12-039u	Shi'erqiao-Xinyicun	2010TN05W03:9:39	Bronze Age III	unknown	XRF		1. Part of the wall, dark grey in the core surrounded by light grey and black skin
12-040t	Shi'erqiao-Xinyicun	2010TN05W03:9:40	Bronze Age III	unknown thick pointed bottom	XRF		1. Only bottom remains, yellow-grey on the surfaces, brown in the core; 2. smudged from inside
12-041rp	Shi'erqiao-Xinyicun	2010TN05W03:9:34	Bronze Age III	unknown	XRF		1. Part of the wall, purple-red on the surface, grey in the core; 2. containing many bright grains
12-042rp	Shi'erqiao-Xinyicun	2010TN05W03:9:35	Bronze Age III	unknown	XRF		1. Part of the wall, purple-red on the surface, black in the

							core; 2. containing many bright and white grains
12-043rp	Shi'erqiao-Xinyicun	2010TN05W03:9:36	Bronze Age III	unknown	XRF		1. Part of the wall, purple-red on the surfaces, grey in the core, polished
12-044sh	Shi'erqiao-Xinyicun	2010TN05W03:9:37	Bronze Age III	unknown	XRF		1. Part of the wall, containing spiral shell in the paste; 2. yellow-grey throughout
12-045dc	Shi'erqiao-Xinyicun	2010TN05W03:9:29	Bronze Age III	zhan-like cover	XRF		1. Black on the surfaces, brown in the core; 2. thin and small, shallower than jiandi zhan 3. contains many bright white grains
12-046roy	Shi'erqiao-Xinyicun	2010TN05W03:9:41	Bronze Age III	unknown	XRF		1. Brick red throughout
12-068d	Shi'erqiao-Xinyicun	2010TN05W03:9:68	Bronze Age III	zhan	XRF		
Jin-001f	Jinsha	H2316:68	Bronze Age II	small flat-based jar	XRD, Petro	wall, base	1. From sacrificial area II; 2. coarse; 3. yellow-grey
Jin-002f	Jinsha	H2309:22	Bronze Age II	small flat-based jar	XRD, Petro, TGA/DSC		1. From sacrificial area II; 2. coarse; 3 black-brown
Jin-003d	Jinsha	H2296:37	Bronze Age II	zhan	XRD, Petro, TGA/DSC		1. From sacrificial area II; 2. coarse; 3. black-brown
Jin-004d	Jinsha	IT7711:7:139	Bronze Age III	zhan	XRD, Petro, TGA/DSC		1. Coarse; 2. black-brown; 3. from sacrificial area I
Jin-005d	Jinsha	IT7711:7:245	Bronze Age III	zhan	XRD, Petro, TGA/DSC		1. Coarse; 2. grey-brown; 3. from sacrificial area I

Jin-006d	Jinsha	IT6513:10:552	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim	1. Coarse; 2. black-brown; 3. from sacrificial area I
Jin-007c	Jinsha	IT6513:10:1813	Bronze Age III	bei	XRD, Petro, TGA/DSC	wall	1. Fine; 2. grey-black; 3. from sacrificial area I
Jin-008c	Jinsha	IT7211-7212:14:76	Bronze Age II	bei	XRD, Petro, TGA/DSC	wall	1. From sacrificial area I? 2. fine; 3. grey-black
Jin-009d	Jinsha	L27:1	Bronze Age III	zhan	XRD, Petro, TGA/DSC	rim	1. From sacrificial area II
Jin-010f	Jinsha	L58-8:1	Bronze Age I	small flat-based jar	XRD, Petro, TGA/DSC		1. From sacrificial area II; 2. coarse; 3. grey-black
Y55-01rf	Jinsha	Y55:1	Bronze Age III	ring foot, kiln waster	XRD, XRF (Y55-001rf), Petro, TGA/DSC		1. Yellow-grey on the surfaces, grey-brown in the core; 2. from Yangguang II loci; 3. coarse
Y55-002rf	Jinsha	Y55:2	Bronze Age III	ring foot, kiln waster	XRF		1. Sharp division between surfaces and the core; 2. yellow-grey on the surfaces, dark grey in the core; 3. paste looks fine, containing silty white grains; 4. from Yangguang II loci
Y64-02rf	Jinsha	Y64:2	Bronze Age III	ring foot, kiln waster	XRD, XRF, Petro, TGA/DSC		1. Brown on the surfaces, yellow-grey in the core; 2. coarse, containing black grains in sand size; 3. from Yangguang II loci
Y51-01f	Jinsha	Y51:1	Bronze Age III	small flat-based jar, kiln	XRD, Petro, TGA/DSC	wall and base	1. Thin ; 2. dark grey-black with yellow-grey skin; 3. with large white grains;

				waster			4. from Yangguang II loci
Y71-01f	Jinsha	Y71:4	Bronze Age III	small flat-based jar, kiln waster	XRD, XRF, Petro, TGA/DSC	wall	1. Small, flat base but also could be the bottom of jiandi bei; 2. fine; 3. from Yangguang II loci
Y71-002u	Jinsha	Y71:2	Bronze Age III	kiln waster	XRF		From Yangguang II loci
Y71-003rf	Jinsha	Y71:3	Bronze Age III	ring foot, kiln waster	XRF		From Yangguang II loci
Y12-002u	Jinsha	Y12:2	Bronze Age III	kiln waster	XRF		From Yangguang II loci
SXD-001f	Sanxingdui	99GSZYT004:5:1	Bronze Age II	small flat-based jar	XRD, XRF, Petro, TGA/DSC		1. Coarse; 2. grey in the core, with black skin; 3. overt, flat lip, inflating shoulder; 4. visible white grains
SXD-002f	Sanxingdui	99GSZYT004:5:2	Bronze Age II	small flat-based jar	XRD, XRF, Petro, TGA/DSC		1. Coarse; 2. grey throughout the whole body with black skin; 3. flat lip, straight opening, inflating shoulder; 3. visible white grains
SXD-003f	Sanxingdui	99GSZYT004:5:3	Bronze Age II	small flat-based jar	XRD, XRF, Petro, TGA/DSC		1. Coarse; 2. yellow-grey on the outside surface, black inside surface; 3. cord marking on the collar; 3. flat lip, straight opening, inflating shoulder; 4. visible white grains

SXD-004f	Sanxingdui	99GSZYT004:8:2	Bronze Age I	small flat-based jar	XRF	1. Coarse; thin; 2. yellow-grey on the surfaces, brown in the core; 3. decorated with rice shape under the neck; 5. square, overt lip; 6. containing large white, black grains
SXD-005f	Sanxingdui	99GSZYT004:8:3	Bronze Age I	small flat-based jar	XRF	1. Brown with black skin; 2. overt lip; inflated shoulder
SXD-006f	Sanxingdui	99GSZYT004:8:1	Bronze Age I	small flat-based jar	XRF	1. Coarse but applied clay liquid to the mouth and inside surface; 2. yellow-grey on the surfaces, dark grey in the core; 3. wave-shaped rim, impressed from the side; 3. protruding shoulder; 4. visible white and black grains on the surface
SXD-008f	Sanxingdui	99GSZYT004:9:3	Bronze Age I	small flat-based jar	XRF	1. Coarse; 2. yellow-grey on the surfaces, brown in the core; slightly smudged 3. square lip and round shoulder; 4. visible white inclusions on the inside surface
SXD-009f	Sanxingdui	99GSZYT004:7:1	Bronze Age I	small flat-based jar	XRF	1. Coarse; very thin; 2. rust outside, grey in the core with visible grains; 3. overt rim, square lip, inflating shoulder;

SXD-010f	Sanxingdui	99GSZYT004:6:8	Bronze Age II	small flat-based jar	XRF		1. Coarse; 2. yellow-grey outside, dark grey in the core; 3. with visible white grains
SXD-011f	Sanxingdui	99GSZYT004:6:7	Bronze Age II	small flat-based jar	XRF		1. Coarse; 2. black outside, grey in the core; 3. obvious wheel traces
SXD-012f	Sanxingdui	99GSZYT004:6:4	Bronze Age II	small flat-based jar	XRF		1. Coarse; 2. yellow-grey; 3. sharp lip, straight opening, inflating shoulder; 4. very thin
SXD-013cr	Sanxingdui	99GSZYT004:6:3	Bronze Age II	crucible	XRF		1. Coarse; 2. orange color on the outside surface, brick-red on the inside surface and brown in the core; 3. with cord marks on the orange side
SXD-014oj	Sanxingdui	99GSZYT102:12:1	Bronze Age 0	overt-rim jar	XRF	Original no. 124	1. Fine; 2. grey-white
SXD-015f	Sanxingdui	99GSZYT102:10:1	Bronze Age 0	small flat-based jar	XRF		1. Coarse; thin; 2. yellow-grey on the outside surface, brown inside surface, grey in the core; 3. white grains distributed along with wheel traces;
SXD-016f	Sanxingdui	99GSZYT004:9:2	Bronze Age I	small flat-based jar	XRF		1. Coarse; 2. yellow-grey; 3. sharp lip; 4. mud water applied on the inside surface of the rim; 5. visible white and dark grains
SXD-017f	Sanxingdui	99GSZYT004:6:6	Bronze Age II	small	XRF		1. Coarse; thin;

				flat-based jar			2.yellow-grey on the surfaces, grey in the core; 3. sharp lip, straight opening, inflating shoulder;
Wan-58d	Wang Jian Tomb	09CJXT2:5:129	Bronze Age IV	zhan	XRF		1. Coarse; 2. black on the outside surface, yellow-grey inside surface, and dark grey in the core; 3. corn-shaped bottom
Wan-59d	Wang Jian Tomb	09CJXT1:6:64	Bronze Age IV	zhan	XRF		1. Coarse; 2. black on the surfaces, brown in the core; 3. visible white and red grains in the paste; 4. extra lump at bottom, deep--can be jiandi jar
Wan-60d	Wang Jian Tomb	09CJXT1:6:3	Bronze Age IV	zhan	XRF		1. Coarse; 2. yellow-grey on the outside surface, rust inside surface, and grey in the core; 3. round lip, short neck, shallow; 4. with wheel trace at the bottom
Wan-61d	Wang Jian Tomb	09CJXH1:249	Bronze Age IV	zhan	XRF		1. Coarse; 2. brick-red on the surfaces, brown in the core; 3. extra lump at bottom, thick and with wheel trace

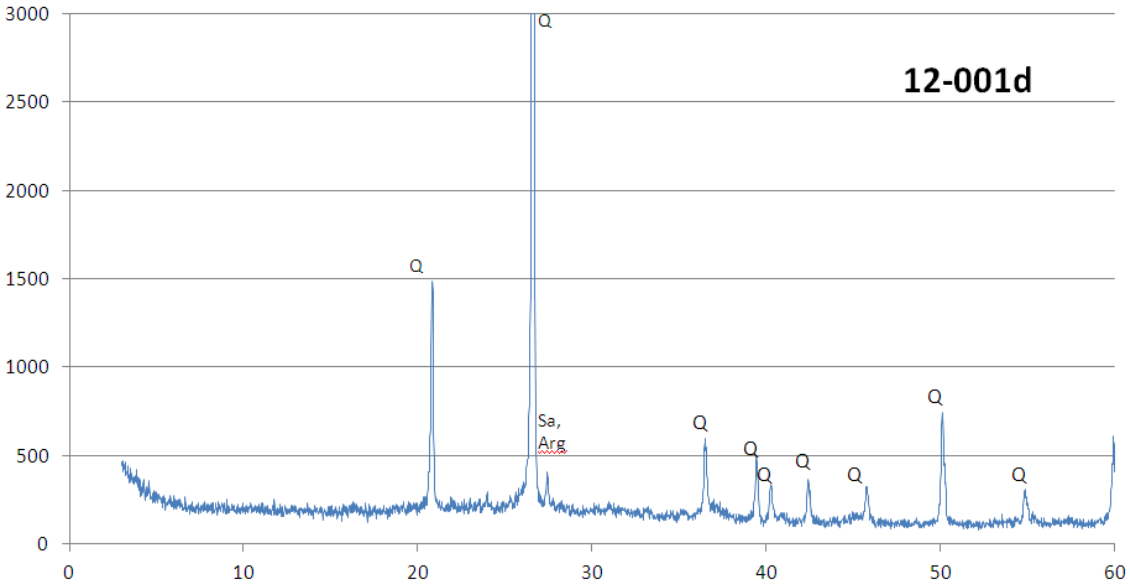
***Note about 'Age': Bronze 0= earlier than Late Shang (--1300 BC); Bronze I= late Shang-Zhou (1300-1000 BC); Bronze II= early Western Zhou (1000-900 BC); Bronze III= late Western Zhou (900-800 BC); Bronze IV= Eastern Zhou (800 BC--)**

Appendix IV-Table 2: Samples used in XRD, XRF, petrographic and/or TGA/DSC (thermal) examinations

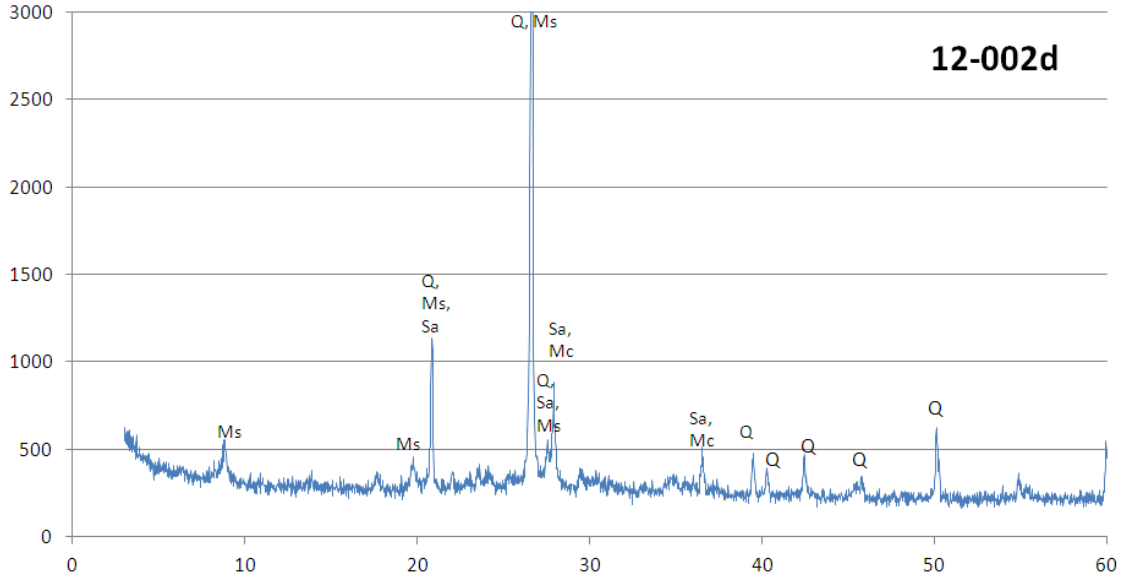
Sample	Quartz	Mica	Alkali-feldspars	Plagio-clase	Calcite/ Aragonite/ Dolomite/ Siderite	Pyroxene	Illite	Mont-morillonite	Magnetite/ Humite
Jin-001f	1	1	1	0	0	0	0	0	0
Y51-01f	1	1	1	0	0	0	0	0	0
12-013d	1	1	1	0	0	1	0	0	0
Jin-004d	1	1	1	0	0	1	0	0	0
12-003d	1	1	1	0	0	1	0	0	1
12-008dj	1	1	1	0	0	1	0	0	1
12-018d	1	1	1	0	0	1	0	0	1
Jin-006d	1	1	1	0	0	1	0	0	1
Jin-009d	1	1	1	0	0	1	0	0	1
12-024f	1	1	1	0	0	1	0	1	0
12-010d	1	1	1	0	0	1	0	1	1
12-011d	1	1	1	0	0	1	0	1	1
12-015d	1	1	1	0	0	1	0	1	1
12-016d	1	1	1	0	0	1	0	1	1
12-022t	1	1	1	0	0	1	0	1	1
Jin-002f	1	1	1	0	0	1	0	1	1
Jin-008c	1	1	1	0	0	1	0	1	1
Y71-01f	1	1	1	0	0	1	0	1	1
12-017d	1	1	1	0	0	1	1	1	1
12-025f	1	1	1	0	0	1	1	1	1
12-020j	1	1	1	0	1	1	0	0	1
12-023t	1	1	1	0	1	1	0	1	1
Jin-003d	1	1	1	0	1	1	0	1	1
12-014d	1	1	1	1	0	1	0	0	1
Y64-02rf	1	1	1	1	0	1	0	0	1
SXD-002f	1	1	1	1	0	1	0	0	1
Jin-005d	1	1	1	1	0	1	0	1	0
12-009d	1	1	1	1	0	1	0	1	1

12-012d	1	1	1	1	0	1	0	1	1
12-021j	1	1	1	1	0	1	0	1	1
Jin-010f	1	1	1	1	0	1	0	1	1
Y55-01rf	1	1	1	1	0	1	0	1	1
12-002d	1	1	1	1	0	1	1	1	0
12-001d	1	1	1	1	1	0	0	0	1
12-005d	1	1	1	1	1	1	0	0	1
12-007d	1	1	1	1	1	1	0	0	1
SXD-003f	1	1	1	1	1	1	0	0	1
12-004d	1	1	1	1	1	1	0	1	0
SXD-001f	1	1	1	1	1	1	0	1	0
12-006d	1	1	1	1	1	1	0	1	1
12-019c	1	1	1	1	1	1	0	1	1
Jin-007c	1	1	1	1	1	1	1	1	1

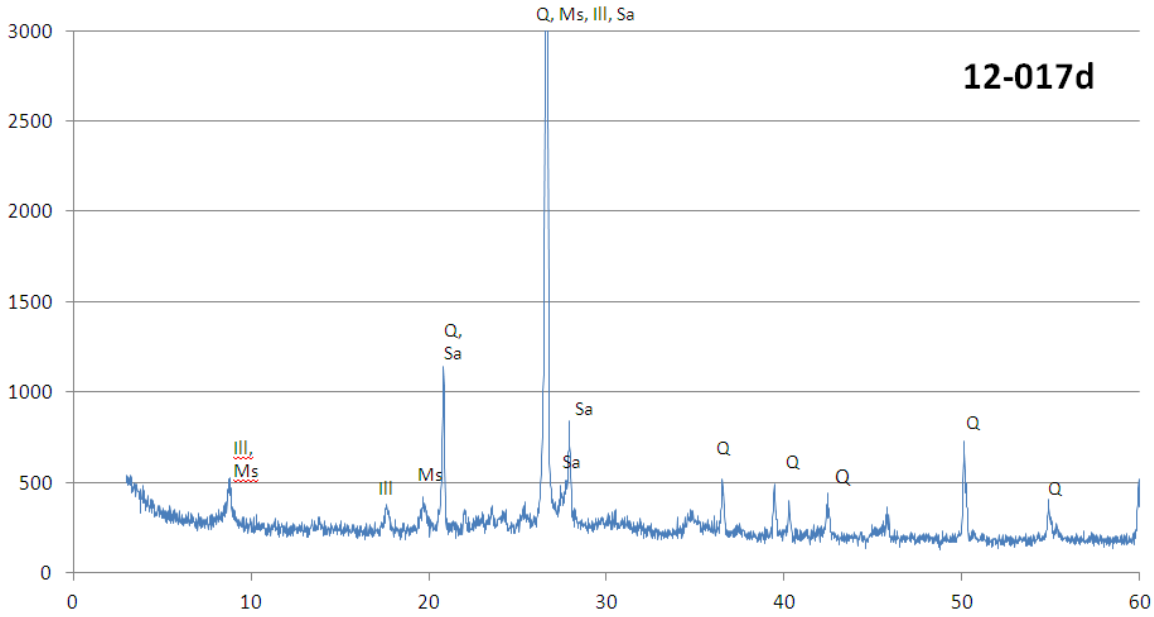
Appendix IV-Table 3: The presence/absence of specific minerals for each sample, recognized by XRD (Samples are grouped by these properties.)



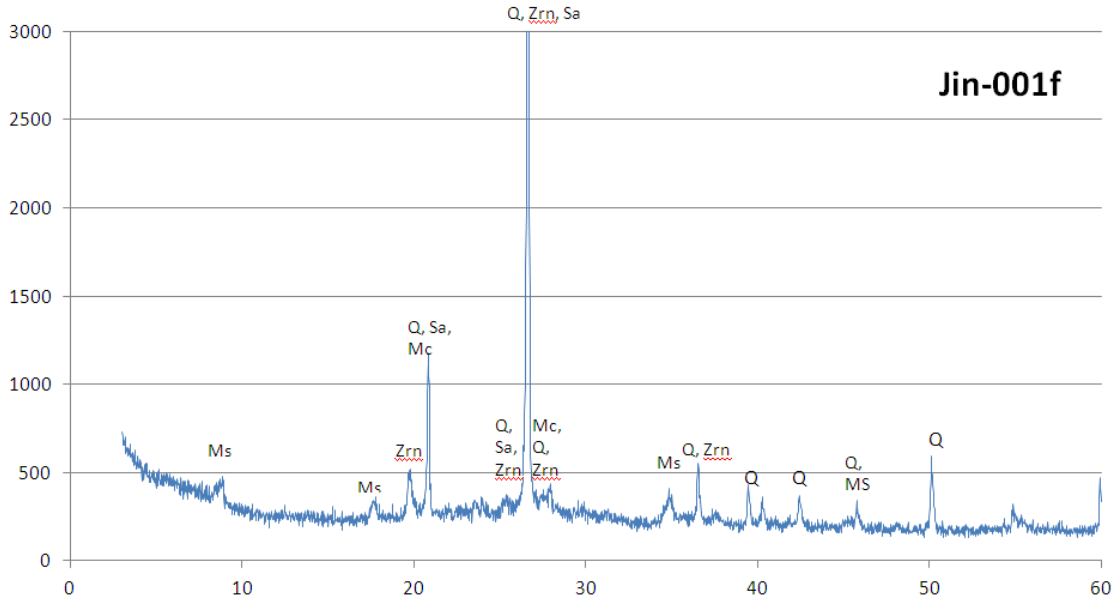
Appendix IV-Figure 1: XRD spectrum of 12-001d (a *jiandi zhan* from Shi'erqiao)
Q=quartz; Sa=Sanidine; Arg=Aragonite



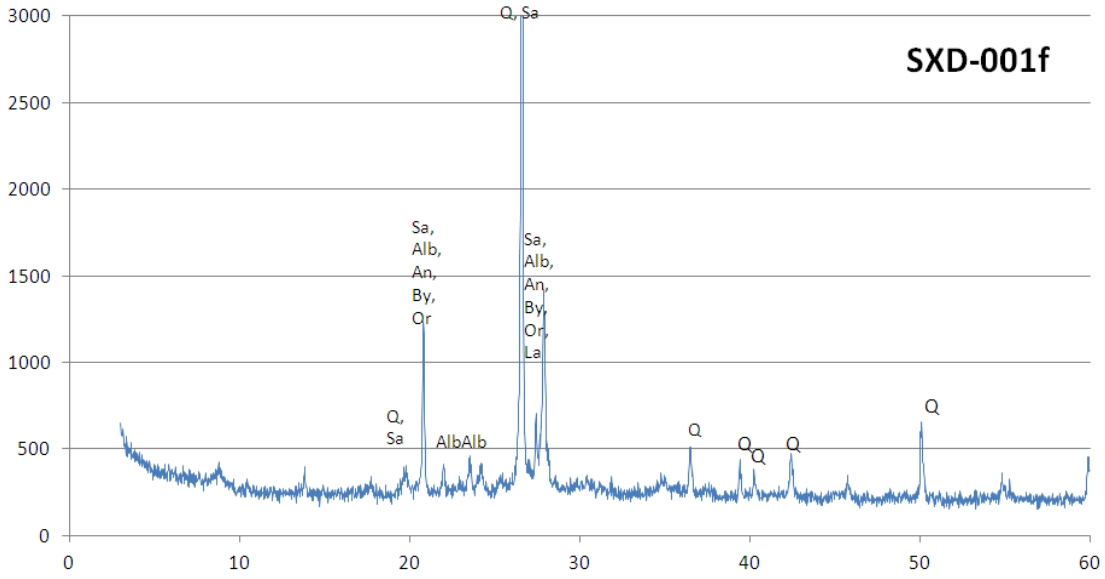
Appendix IV-Figure 2: XRD spectrum of 12-002d (a *jiandi zhan* from Shi'erqiao)
Q=quartz; Sa=Sanidine; Ms=muscovite; Mc=microcline



Appendix IV-Figure 3: XRD spectrum of 12-017d (a *jiandi zhan* from Shi'erqiao)
Q=quartz; Sa=Sanidine; Ill=illite; Ms=muscovite



Appendix IV-Figure 4: XRD spectrum of Jin-001f (a *xiaopingdi guan* from Jinsha)
Q=quartz; Ms=muscovite; Zrn=Zircon; Sa=Sanidine



Appendix IV-Figure 5: XRD spectrum of SXD-001f (a *xiaopingdi guan* from Sanxingdui)
Q=quartz; Sa=Sanidine; Or= orthoclase; Alb=albite; An= anorthite; La= labradorite; By= Bytownite

Variable	Value	Meaning
texture	1	very fine
	2	fine
	3	medium
	4	coarse
	5	very coarse
others	1	Yes
	2	No
type of rock fragment	i (v or p)	Igneous rock (volcanic or plutonic rocks)
	S	Sedimentary rock
	M	Metamorphic rock
roundness	1	Angular
	2	Medium
	3	Round
	4	Mix
sphericity	1	Low
	2	Medium
	3	high
	4	mix
sorting	1	very good
	2	good
	3	medium
	4	poor
	5	very poor
vessel type	1	jiandi zhan
	2	jiandi bei
	3	jiandi guan
	4	xiaopingdi guan
	5	kiln wasters
	6	unknown pointed-bottom vessels
micas	1	muscovite
	2	biotite
	3	cannot determine
porosity	1	low
	2	medium
	3	high

Appendix IV-Table 4: Variables and values representing in the recording of petrographic analysis (used in the following two tables)

sample	vessel type	rock frag. type	texture	inclusion orientation	void/fissure orientation	quartz	alkali-feldspars	plagioclase	pyroxenes	amphiboles	micas	calcite/ marble/ limestone
12-012d	1	m, i, s	4	1	1	1	1	0	1	0	1, 2	0
12-020j	3	m, i, s	5	1	1	1	1	1	1	1	1, 2	0
12-026f	4	m, s	4	0	0	1	1	1	0	1	1, 2	0
12-028f	4	m, i, s	4	0	1	1	1	1	1	0	1, 2	0
Jin-002f	4	m, i, s	4	1	1	1	1	1	1	0	1, 2	0
Jin-004d	1	m, i	4	0	1	1	1	0	1	0	1, 2	0
Jin-005d	1	m, i	4	1	1	1	1	1	1	0	1, 2	0
Y64-02rf	5	m, i, s	4	0	0	1	1	1	1	0	1, 2	0
Y55-01rf	5	m, l (p), s	4	0	1	1	1	1	1	0	1, 2	0
12-002d	1	m, i, s	4	1	1	1	1	1	1	1	3	1
12-003d	1	m, i, s	4	1	1	1	1	0	1	1	1, 2	1
12-005d	1	m, i	4	0	1	1	1	1	1	0	1, 2	1
12-008dj	1 or 3	m, l, s	5	0	1	1	1	1	?	1	1, 2	1
12-009d	1	m, i	5	0	1	1	1	1	0	0	1, 2	1
12-010d	1	m, i, s	4	1	1	1	1	1	1	1	1, 2	1
12-011d	1	m, i	5	0	1	1	1	1	0	?	1, 2	1
12-013d	1	m, i, s	5	1	1	1	1	1	1	0	1, 2	1
12-014d	1	m, i	5	0	1	1	1	?	1	0	1, 2	1
12-021j	3	m, i, s	5	1	1	1	1	1	1	1	1, 2	1
12-024f	4	m, i, s	3	0	0	1	1	1	1	?	1, 2	1
Jin-003d	1	m, i, s	4	0	1	1	1	1	1	1	1, 2	1

sample	vessel type	rock frag. type	texture	inclusion orientation	void/fissure orientation	quartz	alkali-feldspars	plagioclase	pyroxenes	amphiboles	micas	calcite/ marble/ limestone
Jin-006d	1	m, i, s	5	0	1	1	1	1	0	1	1, 2	1
Jin-009d	1	m, i, s	4	1	1	1	1	1	1	1	1, 2	1
12-004d	1	m, i, s	4	1	1	1	1	1	0	0	1, 2	0
12-006d	1	m, i, s	4	1	1	1	1	1	0	1	1, 2	1
12-007d	1	m, I (p), s	4	0	1	1	1	1	1	1	1, 2	1
12-023t	6	m, i, s	3	0	1	1	1	1	0	0	1	1
Jin-010f	4	m, i, s	3	1	1	1	1	1	1	1	1, 2	0
SXD-001f	4	m, i, s	4	1	1	1	1	1	1	0	1, 2	0
SXD-002f	4	m, i, s	3	0	1	1	1	1	1	0	2	1
SXD-003f	4	m, i	3	1	1	1	1	1	0	1	1, 2	1
12-025f	4	m	2	1	1	1	1	0	0	0	1, 2	0
12-027f	4	m, i, s	4	0	1	1	1	1	1	1	1, 2	1
12-015d	1	m, i	1	1	1	1	1	0	0	?	1	0
12-016d	1	m, i	1	1	0	1	1	1	0	1	1	0
12-033c	2	m	1	1	1	1	1	0	1	0	1, 2	0

sample	vessel type	rock frag. type	texture	inclusion orientation	void/fissure orientation	quartz	alkali-feldspars	plagioclase	pyroxenes	amphiboles	micas	calcite/ marble/ limestone
Jin-001f	4	m, i	1	0	0	1	1	0	0	1	1, 2	0
Jin-007c	2	m	1	1	0	1	0	0	0	0	1, 2	0
Y51-01f	5	i	1	1	0	1	0	0	1	0	1, 2	0
Y71-01f	5	m	1	1	0	1	1	0	0	0	1	0
Jin-008c	2	m	1	1	0	1	0	1	0	0	1	0
12-030c	2	m	1	1	0	1	0	1	0	1	1	0
12-031c	2	m, i	1	1	0	1	0	0	0	0	1	0
12-032c	2	s	1	1	0	1	0	1	0	0	1	0
12-001d	1	m, I (v), s	1	1	1	1	1	1	0	0	0	0
12-029t	6	m, i, s	1	0	1	1	1	1	0	0	0	0
12-017d	1	m, i, s	2	1	0	1	1	1	0	1	1, 2	0
12-018d	1	m	2	1	0	1	1	0	1	0	1, 2	0
12-019c	2	m	2	1	0	1	1	0	0	1	1	0
12-022t	6	m	2	1	1	1	1	1	0	0	1, 2	0

Appendix IV-Table 5: Petrographic properties of ceramic samples
(Samples are grouped based on their closeness in these properties.)

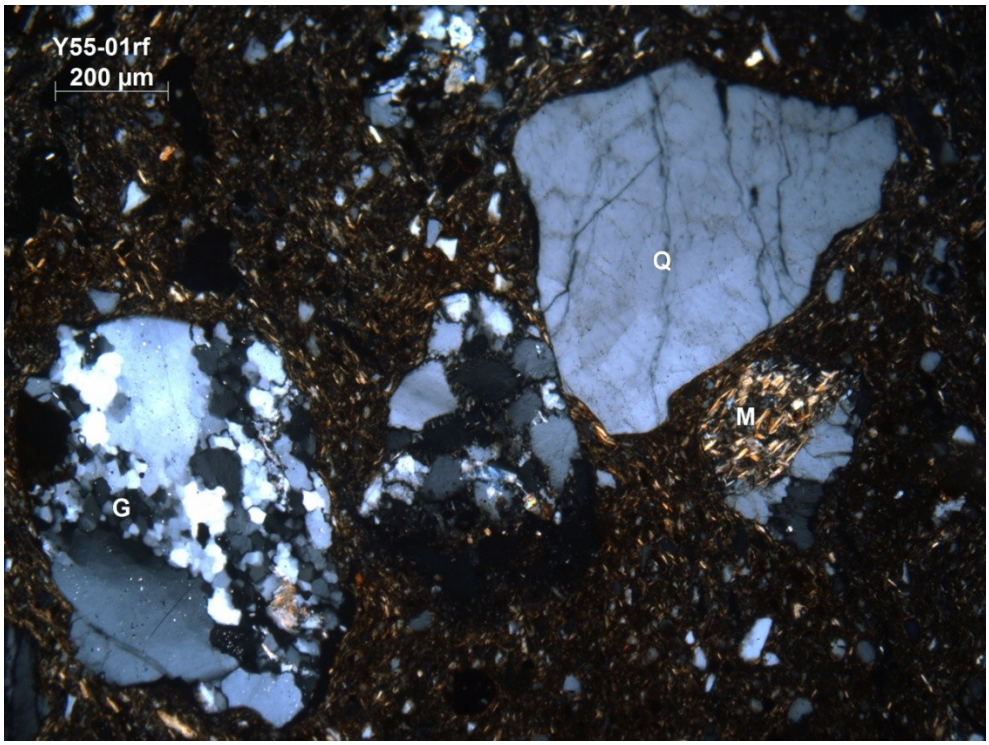
sample	rock fragments	iron earth	argillaceous clasts or grogs	opaque minerals	particles larger than 60 μm	roundness	sphericity	sorting	porosity	hematite rich in the paste	note
12-012d	1	1	1	1	10-15%	1	4	5	2	1	
12-020j	1	1	0	1	10%	1	4	5	3	1	
12-026f	1	1	1	1	10%	4	4	4	2	1	
12-028f	1	1	0	1	10-15%	4	4	4	3	1	
Jin-002f	1	1	0	1	10-15%	4	4	4	3	1	black temper in sedimentary rocks, seeming to be organic matters
Jin-004d	1	1	1	1	10%	1	1	4	3	1	many voids and bubbles
Jin-005d	1	1	0	1	10%	1	4	4	3	1	special, circular temper
Y64-02rf	1	1	0	1	10%	1	1	4	3	1	special, 'soft' temper
Y55-01rf	1	1	1	1	15-20%	4	4	3	3	1	diverse rock fragments: granite
12-002d	1	1	1	1	10-15%	1	4	4	3	1	
12-003d	1	1	1	0	10-15%	1	4	4	2	1	limestone
12-005d	1	1	1	1	10%	1	1	4	2	1	
12-008dj	1	1	1	1	20-25%	1	4	5	3	1	diorite; limestone, myrmekitic structure, perthite
12-009d	1	1	1	1	25%	1	4	5	3	1	
12-010d	1	1	1	1	10-15%	1	4	4	3	1	
12-011d	1	1	1	1	10-15%	1	4	5	3	1	
12-013d	1	1	1	1	15-20%	4	4	5	3	1	
12-014d	1	1	1	1	15-20%	1	4	5	3	1	

sample	rock fragments	iron earth	argillaceous clasts or grogs	opaque minerals	particles larger than 60 µm	roundness	sphericity	sorting	porosity	hematite rich in the paste	note
12-021j	1	1	1	1	20%	1	4	5	3	1	
12-024f	1	1	0	1	10%	4	4	4	2	1	has 'fiber-like' inclusion; more sandstone
Jin-003d	1	1	1	1	10%	1	3	5	3	1	big black nodule
Jin-006d	1	1	0	1	15%	1	4	4	3	1	
Jin-009d	1	1	1	1	15%	1	4	3	3	1	
12-004d	1	1	0	1	15-20%	1	4	4	3	0	slipped
12-006d	1	1	0	1	15-20%	1	4	4	3	0	
12-007d	1	1	0	1	15-20%	1	4	4	3	0	
12-023t	1	1	1	1	10-15%	1	3	3	2	1	dominated by middle size tempers, evenly distributed and in good sorting in this size; clay matrix close to group 1.1 but strong oxidized
Jin-010f	1	1	1	1	5%	4	3	4	2	1	diverse rock fragments; rust outside and grey in the core both of which contain many hematite nodules; temper differing from other samples

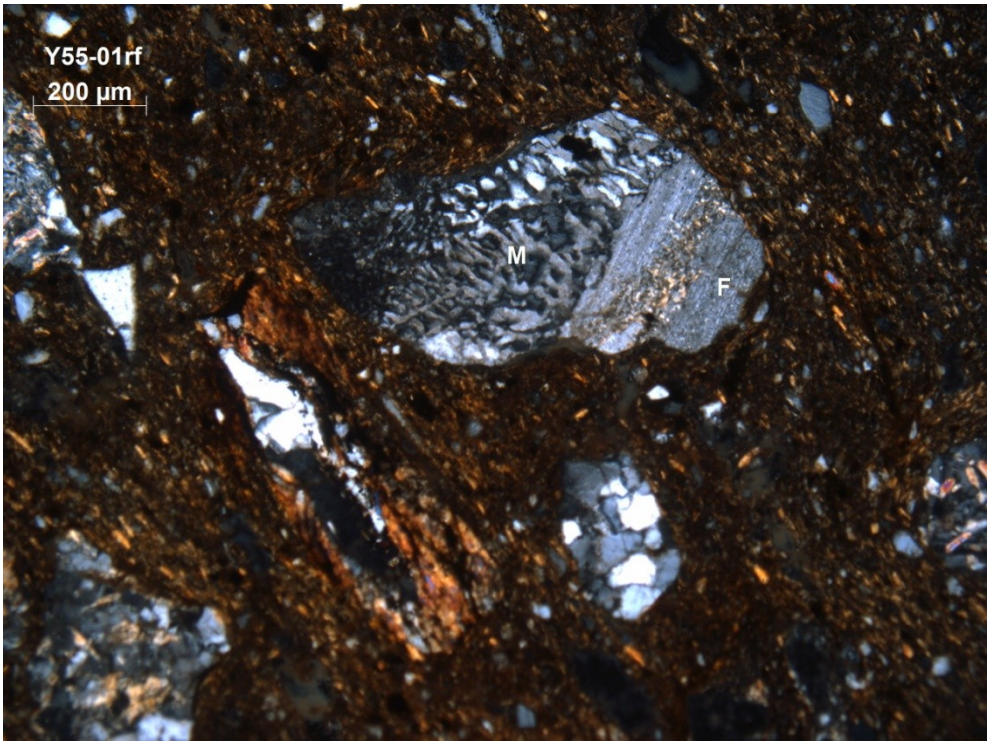
sample	rock fragments	iron earth	argillaceous clasts or grogs	opaque minerals	particles larger than 60 μm	roundness	sphericity	sorting	porosity	hematite rich in the paste	note
SXD-001f	1	1	1	1	5%	1	4	4	3	1	large clay lump; diopside everywhere
SXD-002f	1	1	1	1	5%	1	2	3	2	1	slip; diopside everywhere
SXD-003f	1	1	1	1	5%	1	3	4	2	0	clay lumps in the oxidized layer
12-025f	1	0	0	1	1-3%	1	4	2	1	0	the orientation of clay minerals is very apparent; many middle size quartz (sanidine) in the background; only contains a few large grains but have a large iron lump
12-027f	1	1	1	1	15-20%	4	4	5	2	0	many black nodules; quartz larger than the usual size (middle size)
12-015d	1	1	1	1	1-3%	1	1	2	2	0	banded hematite in the paste
12-016d	1	1	1	1	1-3%	1	4	1	1	0	
12-033c	1	1	0	1	<1%	4	3	2	1	0	
Jin-001f	1	1	1	1	<1%	1	1	2	1	0	slipped; clay lumps or grogs
Jin-007c	1	1	0	1	1-3%	1	1	2	1	0	slipped

Y51-01f	1	1	0	1	< 1%	1	3	1	1	0	
Y71-01f	1	1	0	1	< 1%	1	3	1	1	0	only very little larger inclusions (quartz); clear separation b/w slip and core; more dark nodules than white grains; banded hematite in the paste
Jin-008c	1	1	0	1	< 1%	3	3	1	1	0	
12-030c	1	0	0	1	< 1%	1	3	1	1	0	
12-031c	1	0	0	1	< 1%	1	3	1	1	0	
12-032c	1	0	0	1	1%	1	3	1	1	0	
12-001d	0	0	0	0	3-5%	1	3	1	1	0	
12-029t	0	0	0	0	1-3%	4	3	1	1	0	
12-017d	1	1	1	1	5-10%	1	4	2	1	0	abundant opaque minerals; close to 12-015d but contain more small grains in the background
12-018d	1	0	0	1	1%	4	3	1	1	0	abundant opaque minerals; many black 'air bubbles'
12-019c	1	1	0	1	1%	4	3	1	1	0	abundant opaque minerals; many black 'air bubbles'
12-022t	1	1	1	1	20%	4	4	2	2	0	abundant opaque minerals

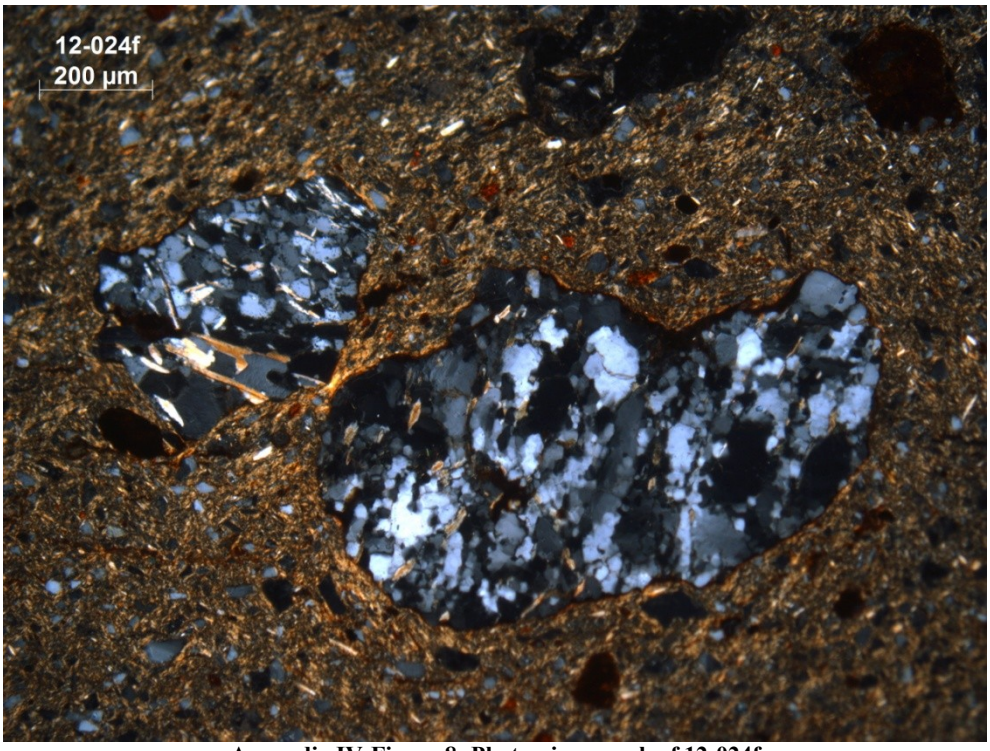
Appendix IV-Table 6: Petrographic properties of ceramic samples (continued)
(Samples are grouped based on their closeness in these properties.)



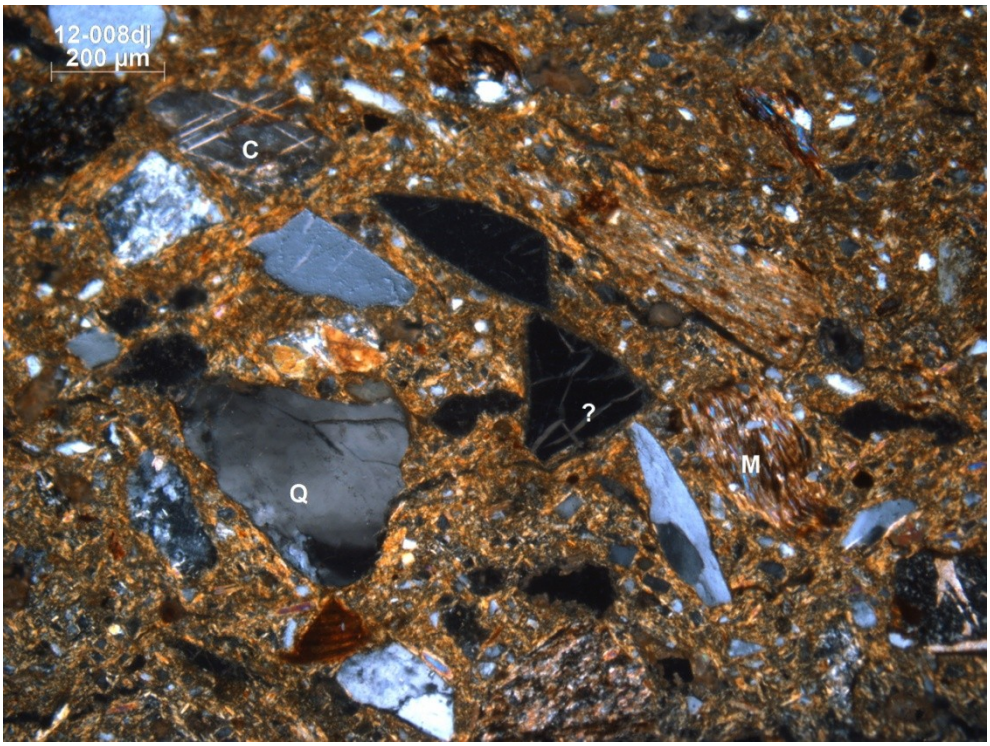
Appendix IV-Figure 6: Photomicrograph of Y55-01rf
G=igneous rock with little metamorphic gneiss; M=mica schist; Q=quartz (taken in 10x crossed-polarized light)



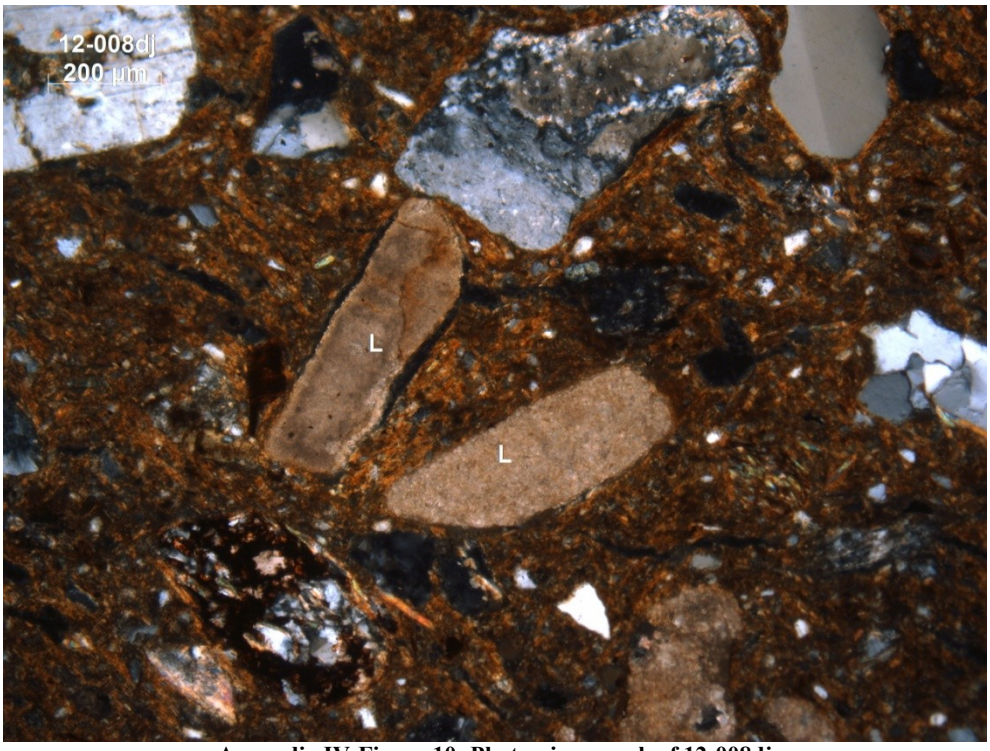
Appendix IV-Figure 7: Photomicrograph of Y55-01rf
M=quartz and feldspar myrmekite (rod-like inclusions of quartz inside a plagioclase grain);
F=feldspar with muscovite inside (taken in 10x crossed-polarized light).



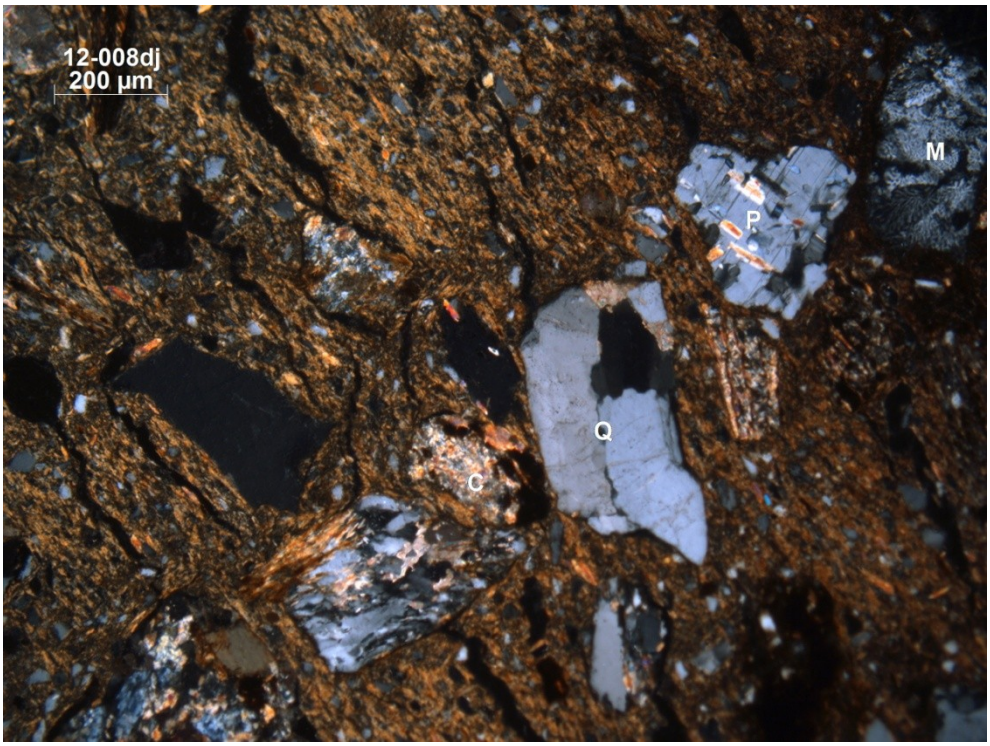
Appendix IV-Figure 8: Photomicrograph of 12-024f
Left: mica schist; right: gneiss (both are metamorphic rocks) (taken in 10x crossed-polarized light).



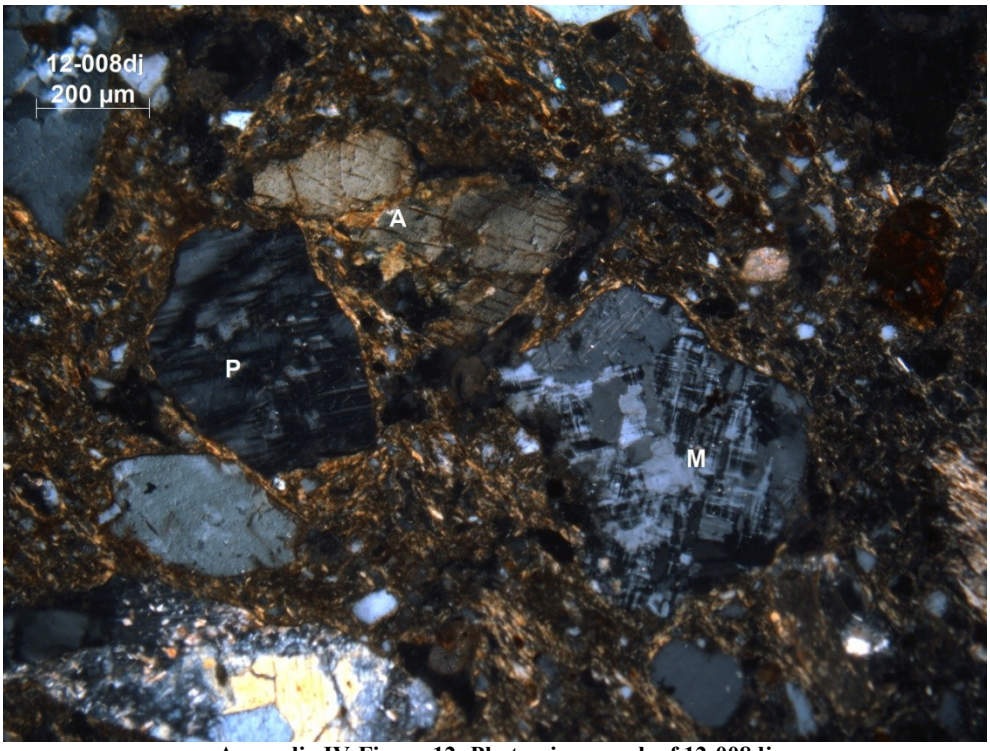
Appendix IV-Figure 9: Photomicrograph of 12-008dj
Q=quartz; C=calcite; ?= black glasses with fractures?; M= mica schist (taken in 10x crossed-polarized light).



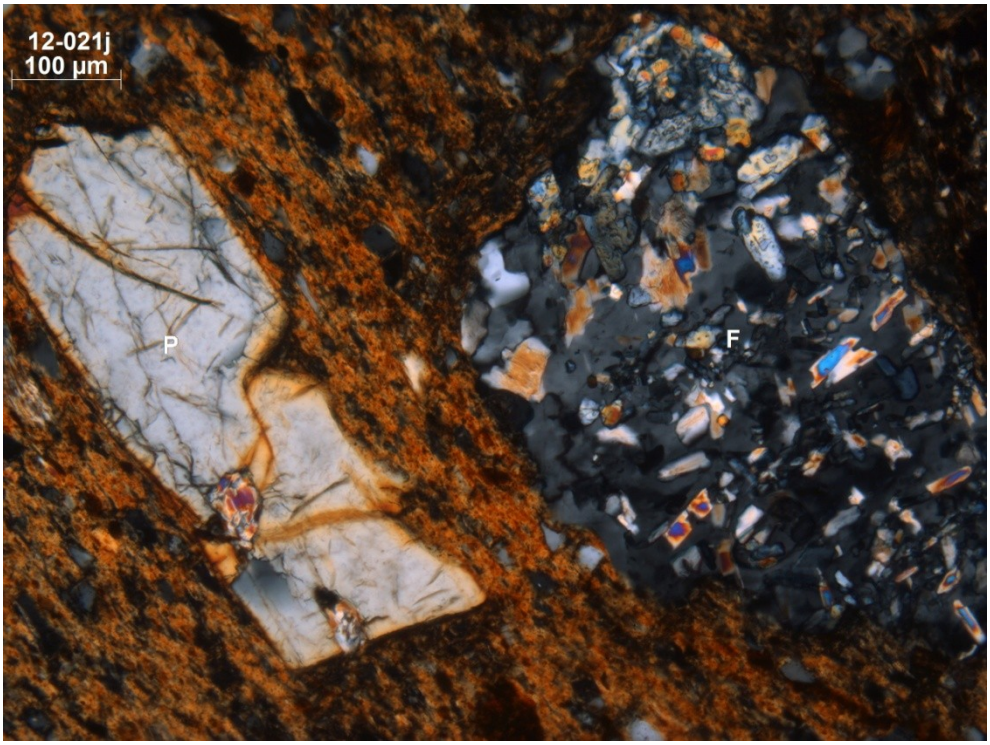
Appendix IV-Figure 10: Photomicrograph of 12-008dj
L= micritic limestone (very fine grains) (taken in 10x crossed-polarized light).



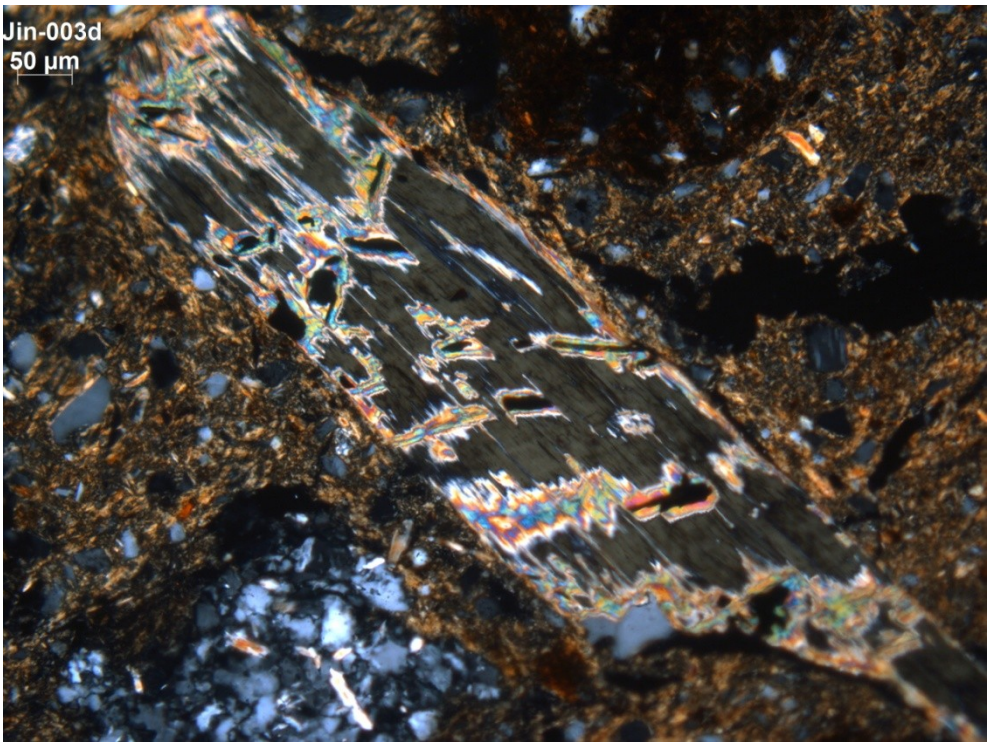
Appendix IV-Figure 11: Photomicrograph of 12-008dj
M=quartz and feldspar myrmekitic intergrowth (usually occurs in granite);
P=plagioclase; Q=quartz; C=calcite (taken in 10x crossed-polarized light).



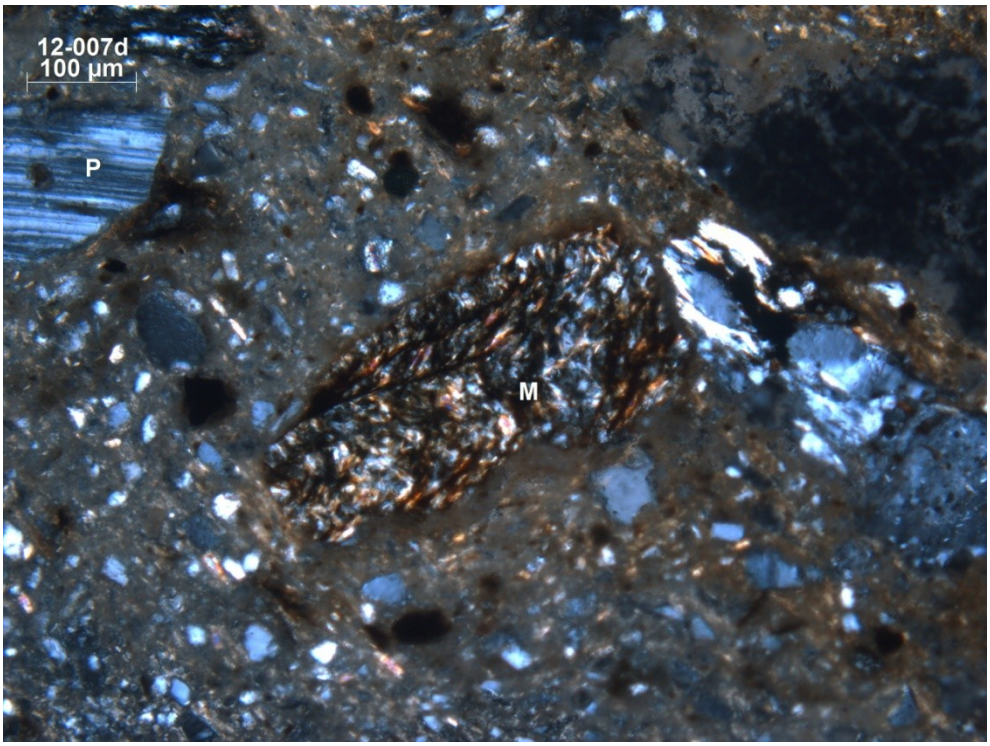
Appendix IV-Figure 12: Photomicrograph of 12-008dj
M=microcline; A=amphibole (in the diorite?); P=perthite (taken in 10x crossed-polarized light).



Appendix IV-Figure 13: Photomicrograph of 12-021j
P=pyroxene; F=feldspar (taken in 20x crossed-polarized light).



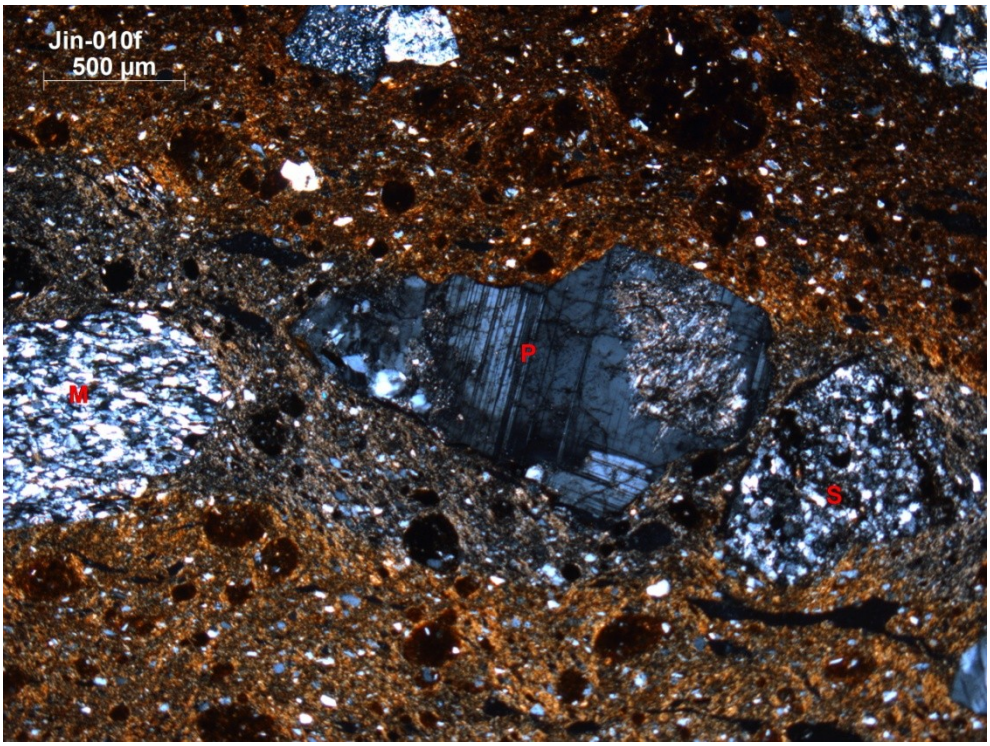
Appendix IV-Figure 14: Photomicrograph of Jin-003d
Transformed amphibole (taken in 20x crossed-polarized light).



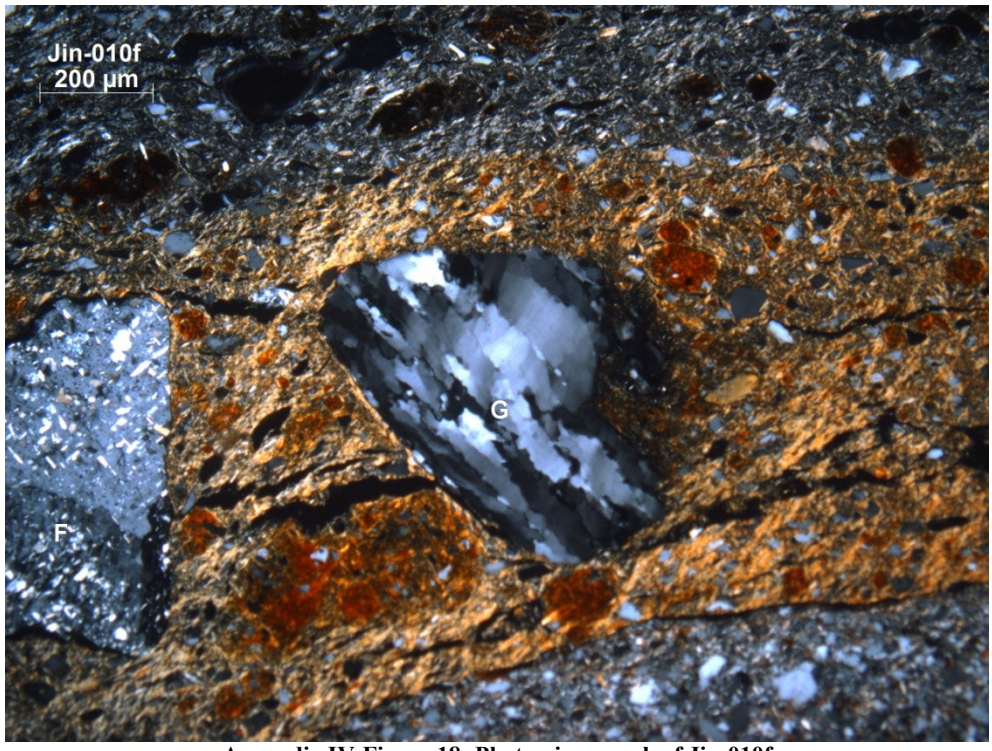
Appendix IV-Figure 15: Photomicrograph of 12-007d
M= mica (with crenulation cleavage: two phases of deformation); P=plagioclase (taken in 20x crossed-polarized light).



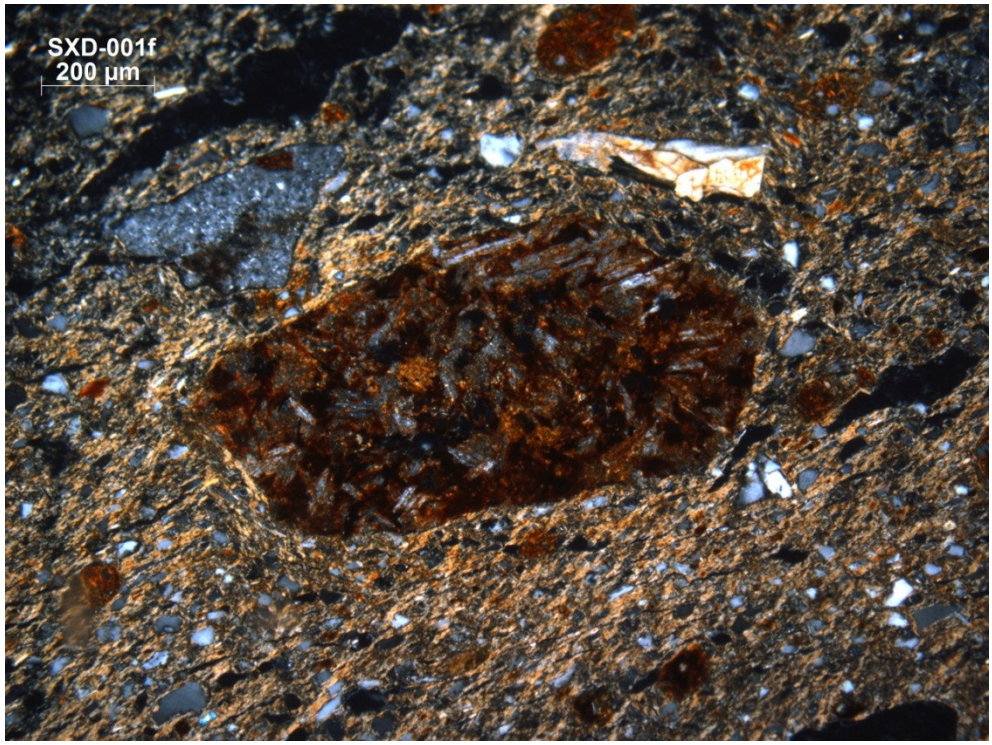
Appendix IV-Figure 16: Photomicrograph of 12-007d
Igneous rock containing amphibole (A), feldspar (F), and biotite (B) (taken in 20x crossed-polarized light).



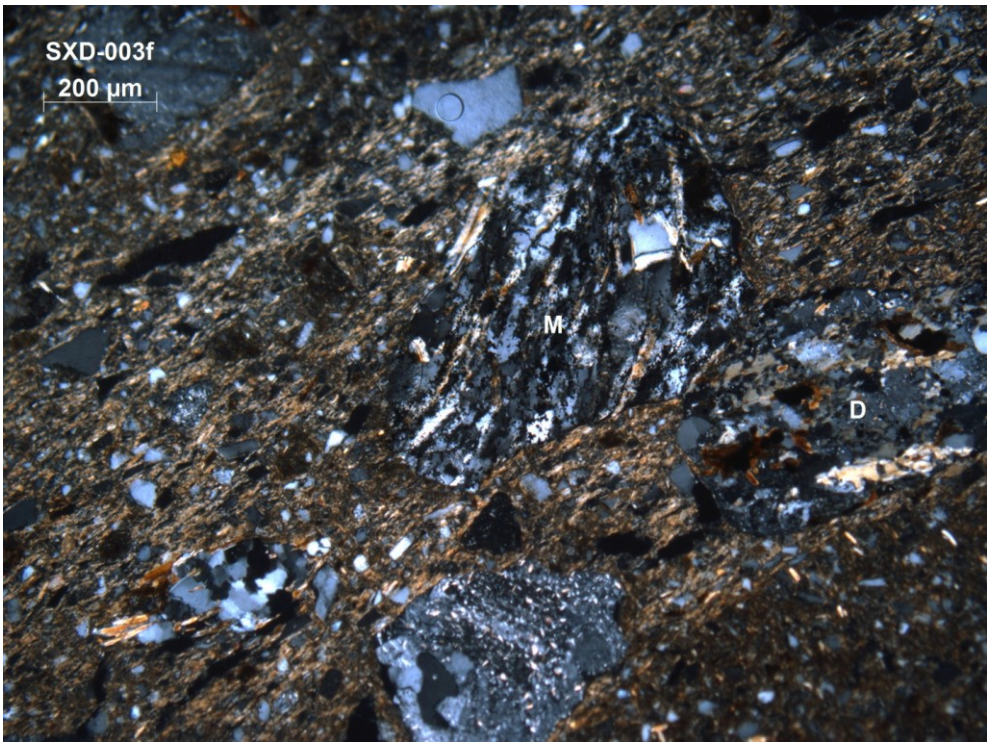
Appendix IV-Figure 17: Photomicrograph of Jin-010f
P=plagioclase; M=mica schist; S=weathering sandstone (taken in 5x crossed-polarized light).



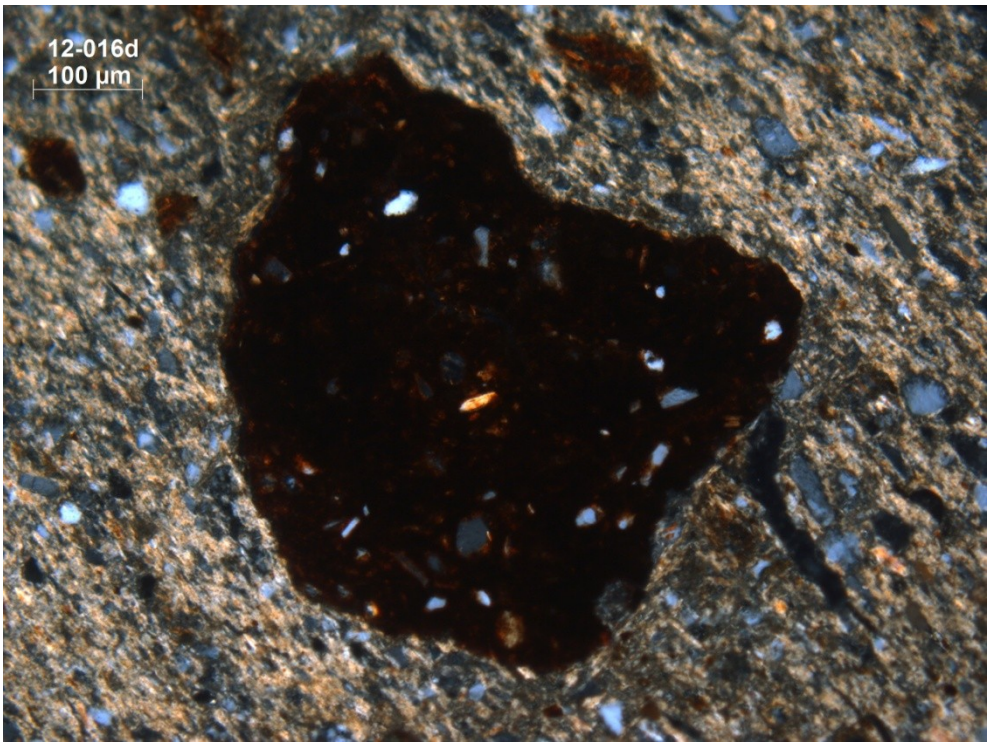
Appendix IV-Figure 18: Photomicrograph of Jin-010f
The difference in color between surfaces and the core is sharp.
F=feldspar; G=gneiss (taken in 10x crossed-polarized light).



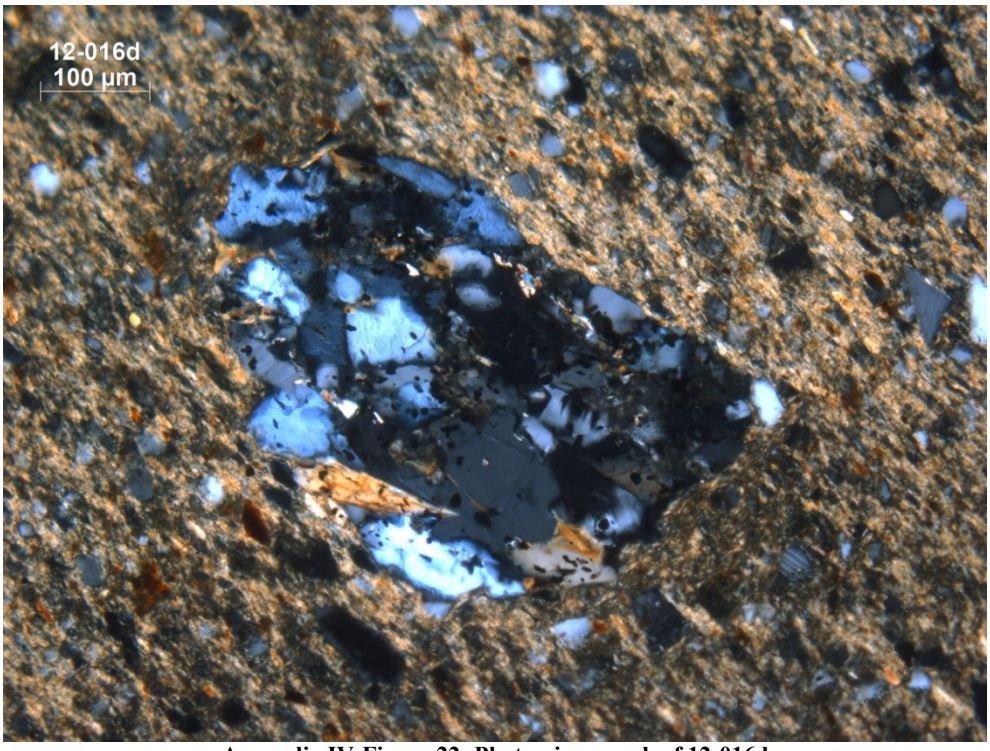
Appendix IV-Figure 19: Photomicrograph of SXD-001f
Weathering volcanic rock with elongated plagioclase, rich in iron (taken in 10x crossed-polarized light).



Appendix IV-Figure 20: Photomicrograph of SXD-003f
M=mica schist; D=diorite (with elongated amphibole and biotite) (taken in 10x crossed-polarized light).



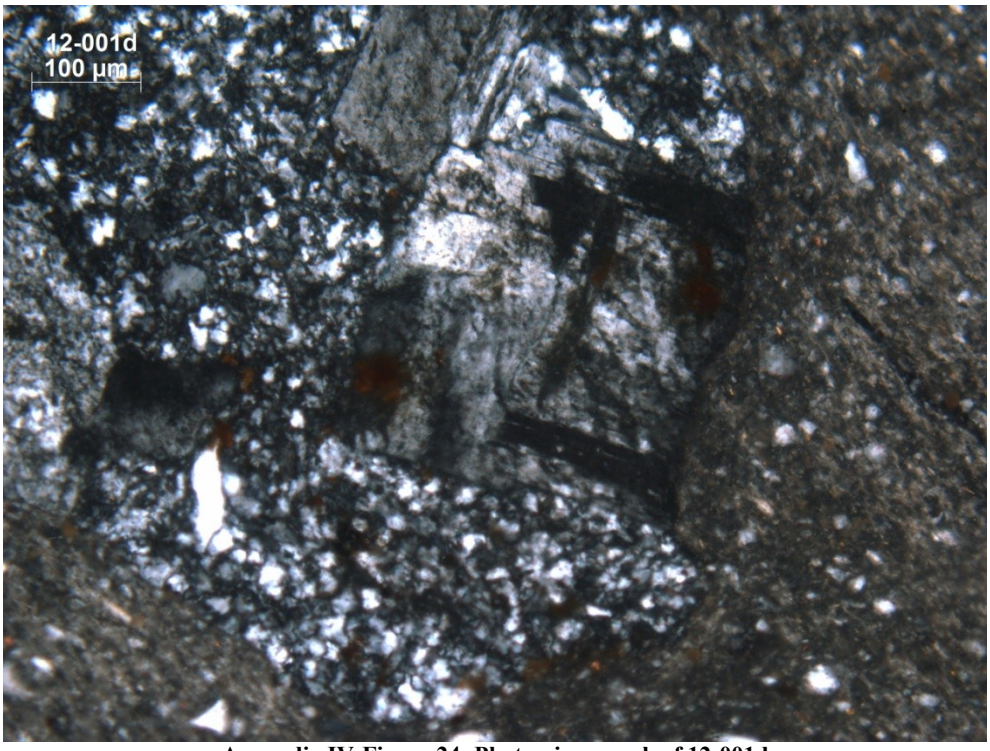
Appendix IV-Figure 21: Photomicrograph of 12-016d
Iron oxide (taken in 20x crossed-polarized light).



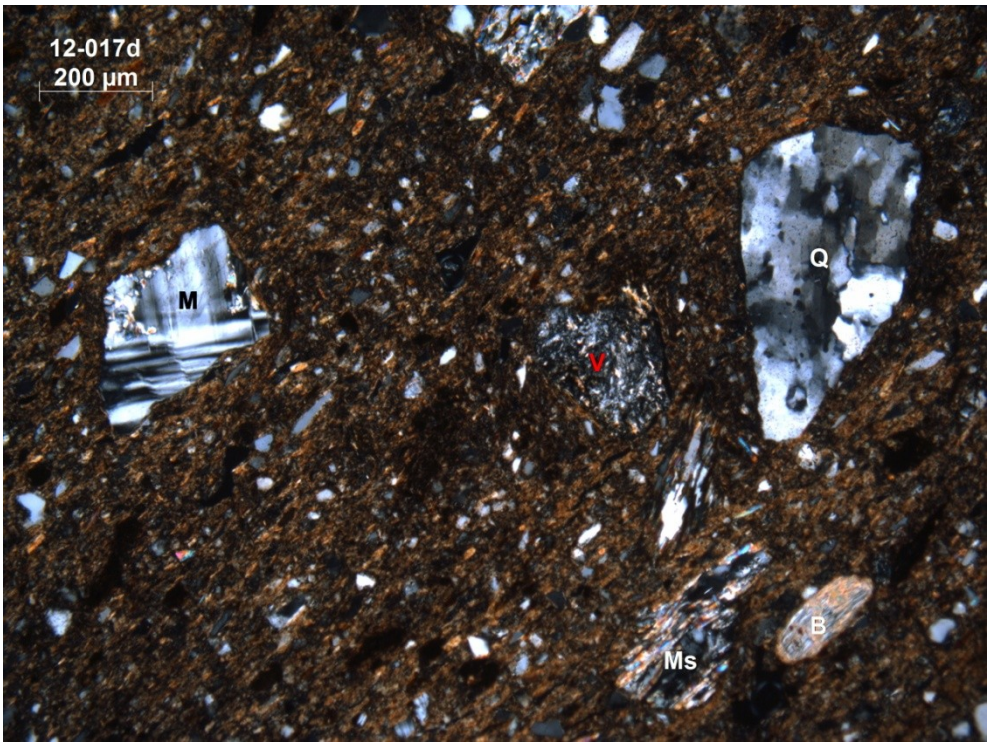
Appendix IV-Figure 22: Photomicrograph of 12-016d
Metamorphic rock containing quartz, feldspars, and possibly amphibole (taken in 20x crossed-polarized light).



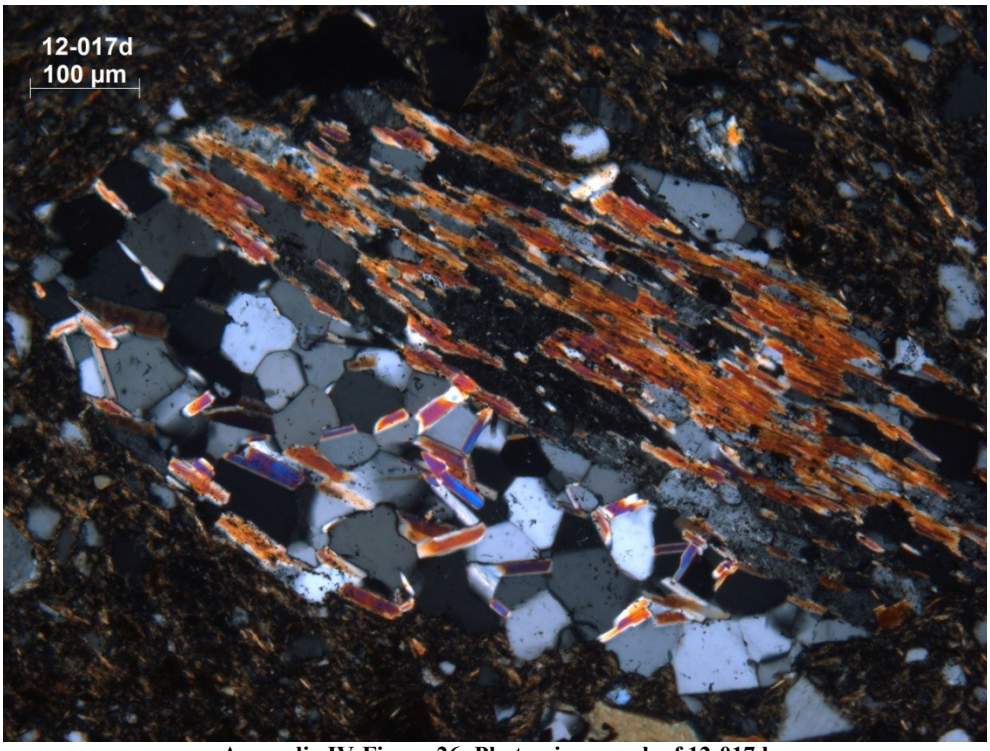
Appendix IV-Figure 23: Photomicrograph of 12-001d
Transformed quartz in chalcedonic intergrowths (a cryptocrystalline form of silica) (taken in 20x crossed-polarized light).



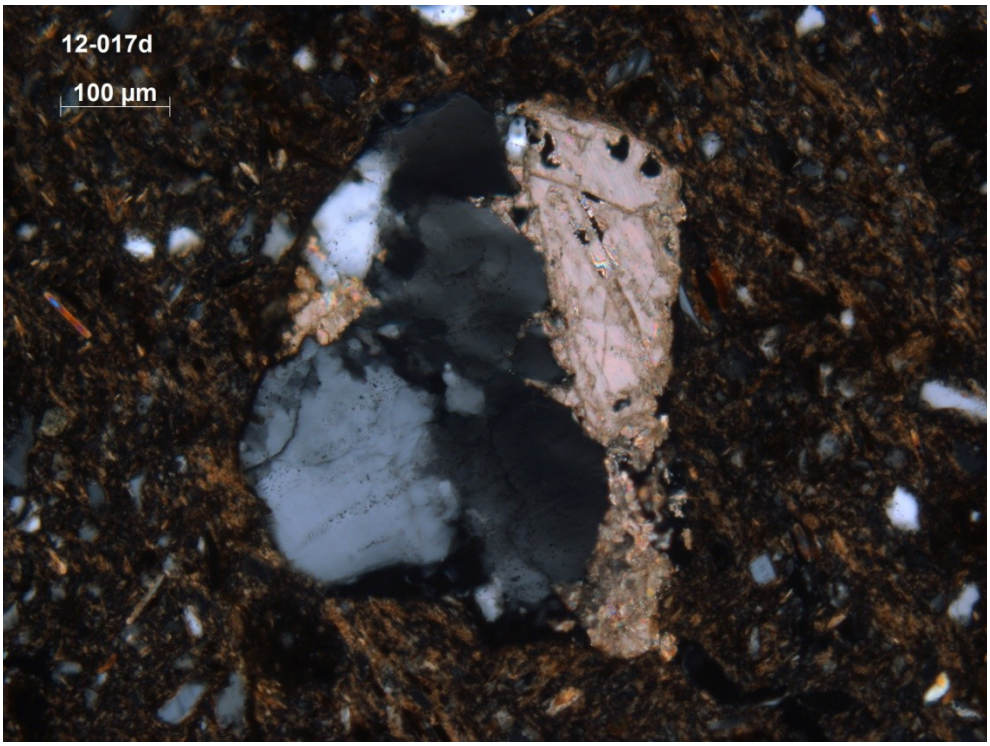
Appendix IV-Figure 24: Photomicrograph of 12-001d
Volcanic rock with feldspar inclusions (taken in 20x crossed-polarized light).



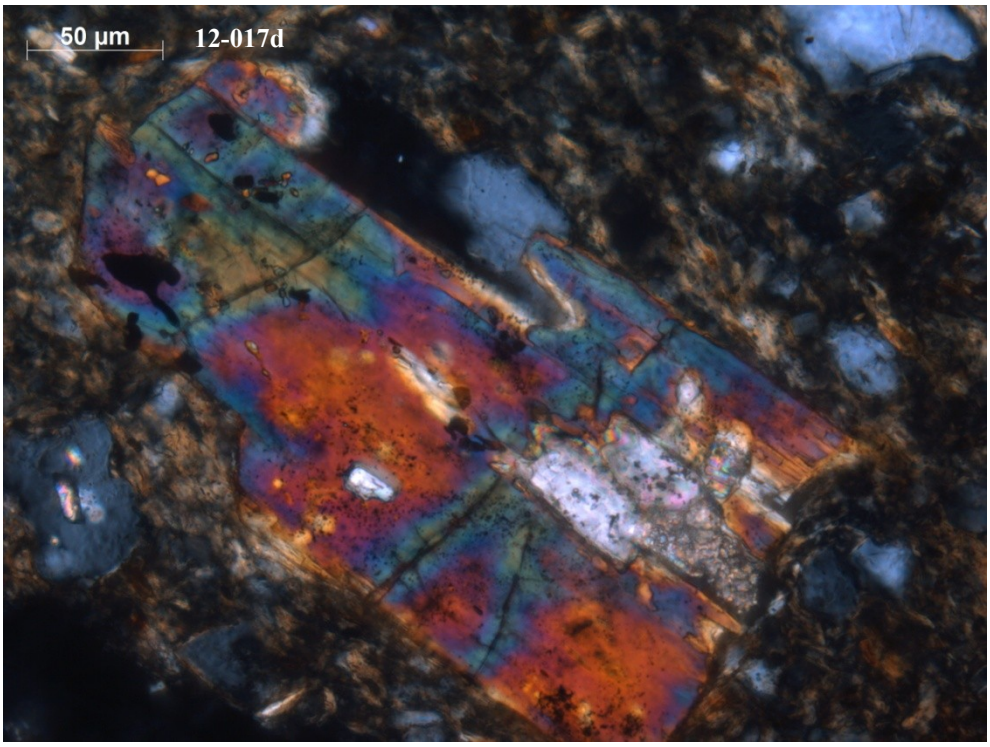
Appendix IV-Figure 25: Photomicrograph of 12-017d
Q=quartz; B=biotite; Ms=mica schist; V=volcanic rock; M=microcline (taken in 10x crossed-polarized light).



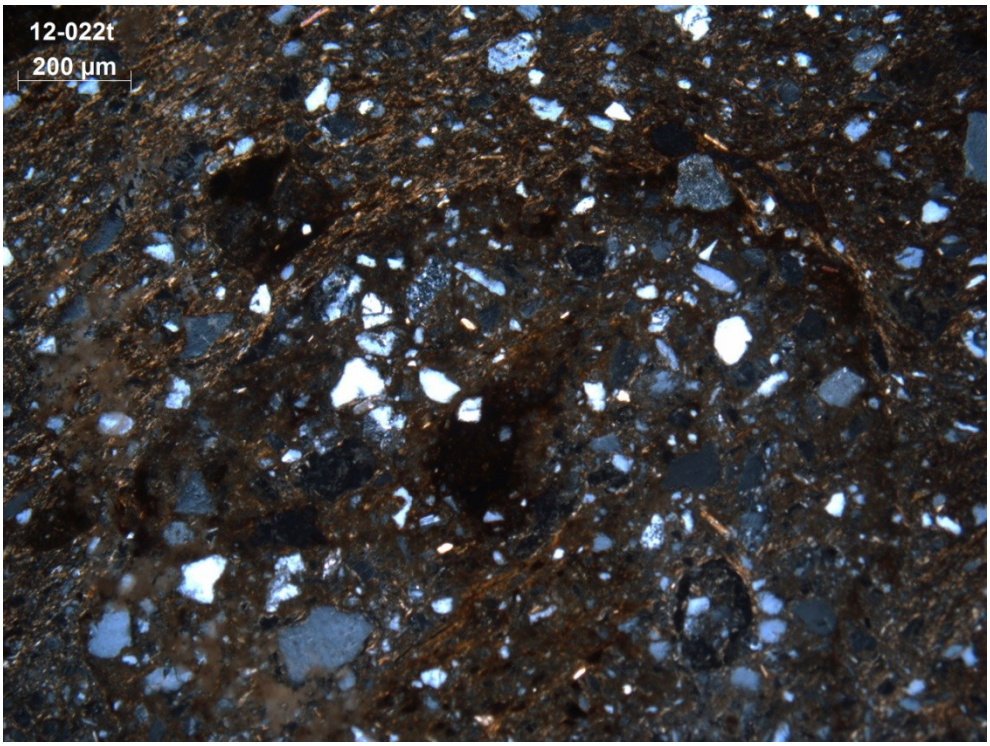
Appendix IV-Figure 26: Photomicrograph of 12-017d
Two ways of arrangements of mica in mica schist (taken in 20x crossed-polarized light).



Appendix IV-Figure 27: Photomicrograph of 12-017d
Quartz with calcite (taken in 20x crossed-polarized light).



Appendix IV-Figure 28: Photomicrograph of 12-017d Amphibole (taken in 50x crossed-polarized light).



Appendix IV-Figure 29: Photomicrograph of 12-022t Clay lump in the middle: the constitution of the clay lump is the same as the groundmass but lack for orientation (taken in 10x crossed-polarized light).

SpectrumLabel	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3
12-033c	0.68	1.25	21.85	64.36	0.64	3.09	1.11	0.86	0.08	6.07
12-011d	0.66	1.44	21.98	60.8	1	3.51	1.98	0.88	0.16	7.58
12-007d	0.67	1.56	20.52	61.19	0.75	3.13	2.2	1.04	0.29	8.65
12-001d	0.71	1	22.58	69.37	0	2.59	0.33	0.82	0.01	2.58
12-022t	0.77	0.69	16.07	66.6	2.77	1.96	2.3	0.67	0.08	8.08
12-014d, 12-029t	0.72	1.8	19.23	64.94	0	3	0.77	0.84	0.1	8.6
12-031c	0.71	1	20.48	68.95	0.07	2.01	1.06	0.89	0.01	4.8
12-020j	0?	1.1	16.87	56.62	2.59	3.51	4.23	0.9	0.42	13.76
12-041rp	0.69	1.39	20.4	62.44	0	3.78	1.75	0.63	0.05	8.88
12-042rp	0.66	1.6	20.82	58.39	0.64	3.45	1.34	0.7	1.18	11.22
12-027f	0.7	0.79	20.58	63.74	0	3.11	1.45	1.11	0.06	8.47
12-006d	0.67	1.5	22	62.9	0.44	2.21	1.6	0.69	0.07	7.94
12-025f	0.64	1.05	22.84	58.62	1.35	3.58	1.82	0.69	0.02	9.37
12-034u	0.7	2.08	18.83	64.95	0.58	2.73	1.22	0.62	0.06	8.21
12-068d	0.68	0.97	19.49	62.74	3.69	2.73	2.46	0.74	0.04	6.46
12-023t	0.68	1.28	20.84	64.19	0.24	2.08	1.55	0.67	0.08	8.41
12-037rp	0.71	1.3	20.33	64.72	0	3.3	1.61	0.68	0.04	7.29
12-044sh	0.7	1.44	19.14	63.38	0.8	2.84	2.66	0.59	0.06	8.37
12-045dc	0.71	1.22	17.93	63.23	1.79	2.77	2.74	0.63	0.08	8.9
12-039u	0.75	1.22	18.45	70.06	0.18	2.3	1.66	0.81	0.04	4.53
12-043rp	0.69	1.41	20.6	62.06	0.33	3.4	2.13	0.67	0.17	8.54
12-030c	0.7	1.14	19.92	64.68	2.8	2.89	1.83	0.9	0.07	5.07
12-038u	0.71	1.29	20.57	64.55	1.13	3.01	2.14	0.63	0.04	5.91
12-046roy	0.71	1.57	20.1	65.64	0.02	2.86	1.35	0.61	0.08	7.07
12-024f	0.69	0.93	19.79	60.65	1.66	2.79	2.03	0.68	0.02	10.77
12-019c	0.73	0.89	18.75	68.12	1.92	2.48	1.68	0.74	0.07	4.59
12-010d	0.67	1.51	19.53	59.78	1.32	2.99	2.29	0.66	0.13	11.15
12-028f	0.68	1.01	20.54	61.84	1.33	2.74	2.24	0.78	0.05	8.8
12-026f	0.67	1.57	20.83	62.23	0.92	3.37	2.21	0.66	0.05	7.52
12-021j	0.7	1.22	19.86	62.74	1.12	3.46	3.21	0.81	0.04	6.85
12-036u	0.76	1.37	17.94	68.73	0	2.7	1.96	0.92	0.02	5.59
12-032c	0.71	0.85	20.05	64.52	1.07	2.82	2.24	0.74	0.02	6.97
12-006d	0.71	1.08	19.07	67.13	1.7	2.58	1.69	0.8	0.07	5.16
12-013d	0.65	1.51	19.92	56.31	1.67	2.9	2.44	0.63	0.12	13.87
12-009d	0.67	0.97	21.38	60.73	2.34	3.23	2.36	0.74	0.1	7.47
12-040t	0.68	2.11	19.01	61.09	1.99	3.3	2.47	0.76	0.09	8.49
12-012d	0.71	0.91	18.89	63.15	1.93	3.52	2.31	0.7	0.1	7.78
12-017d	0.72	1.43	18.41	65.11	1.41	3.01	2.37	0.74	0.1	6.71
12-008dj	0.73	1.71	17.69	65.87	0.83	2.95	3.13	0.55	0.1	6.43
12-035u	0.72	1.35	19.42	65.83	0.13	2.37	0.99	0.68	0.04	8.48
12-painted-clay	0.7	1.4	20.67	66.03	0.85	3.38	2.11	0.78	0.03	4.08
SXD-001f	0.67	2.19	18.84	62.05	2.16	2.5	1.91	0.77	0.05	8.85
SXD-004f	0.76	1.31	17.55	66.99	1.9	1.91	1.26	0.64	0.02	7.67

SXD-014oj	0.77	0.65	19.46	71.97	0	1.9	0.32	0.86	0.02	4.04
SXD-015f	0.71	1.5	18.65	63.24	1.66	3.07	1.57	1	0.02	8.56
SXD-008f	0.63	1.68	19.17	56.37	6.37	2.5	2.72	0.84	0.04	9.68
SXD-010f	0.67	1.37	19.74	61.28	2.65	2.28	1.16	0.85	0.09	9.91
SXD-009f	0.66	0.79	20.95	60.89	4.34	2.38	1.43	0.74	0.01	7.8
SXD-003f	0.65	2.04	19.34	58.78	5.62	2.32	2.07	0.78	0.06	8.33
SXD-013cr	0.69	1.57	20.33	62.9	3.46	1.81	1.24	0.55	0.01	7.46
SXD-006f	0.61	2.25	21.44	54.22	6.18	2.7	2.2	0.79	0.04	9.56
SXD-012f	0.66	1.31	20.39	58.39	3.8	2.16	2.81	0.88	0.13	9.44
SXD-011f	0.61	1.22	23.17	56.61	4.54	2.52	1.12	0.8	0.02	9.37
SXD-002f	0.69	1.23	19.55	60.38	3.84	2.4	2.19	0.84	0.02	8.86
SXD-016f	0.64	1.86	22.14	56.84	2.71	2.34	1.86	0.91	0.03	10.67
SXD-005f	0.65	0.83	20.57	58.33	3.86	2.71	1.6	0.79	0.01	10.65
SXD-017f	0.63	1.24	21.29	57.68	4.54	2.88	1.6	0.86	0.03	9.25
Wan-59d	0.67	1.1	20.37	61.71	3.25	2.71	2.46	0.64	0.08	7.01
Wan-58d	0.67	1.47	20.28	60.61	2.86	2.63	1.99	0.72	0.04	8.74
Wan-60d	0.71	0.84	18.35	61.09	3.19	2.22	2.75	0.6	0.06	10.22
Wan-61d	0.67	1.32	20.34	61.48	3.21	2.66	2.13	0.69	0.04	7.47
Y71-001d (Y71-01f)	0.66	0.83	23.82	62.29	1.25	2.79	1.04	0.89	0.22	6.22
Y71-002u	0.72	1.06	20.18	66.18	0.75	2.63	1	0.82	0.14	6.52
Y71-003rf	0.69	1.28	21.09	62.51	0.66	2.74	1.26	0.63	0.41	8.72
Y12-002u	0.61	0.37	25.58	57.16	1.48	2.56	1.51	0.73	0.36	9.63
Y55-001rf	0.58	0.97	26.62	55.85	1.06	2.79	1.24	0.76	0.02	10.11
Y55-002rf	0.63	0.84	24.74	63.25	0.65	2.59	1.14	0.91	0.04	5.21
Y64-002rf	0	1.3	23.93	59.43	0.79	3.2	1.05	0.75	0.13	9.41

Appendix IV-Table 7: Major and minor elements of samples (in wt%)

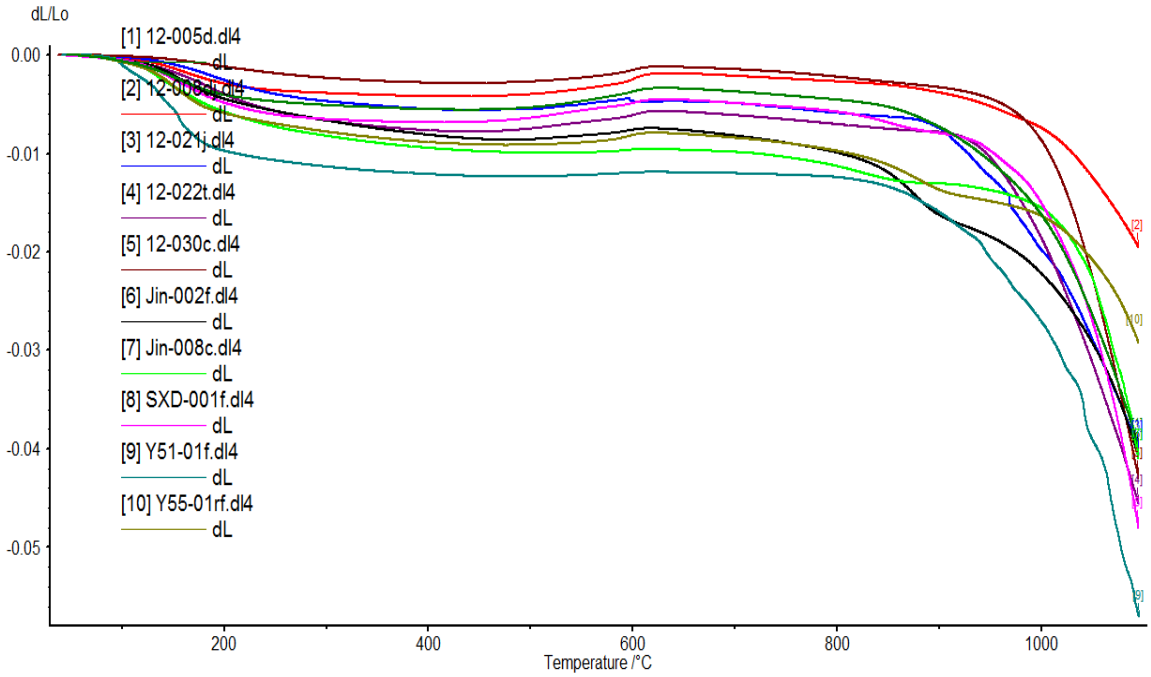
Spectrum Label	Rb	Sr	Zr	Cu	Zn	V	Mn
12-033c	197	174	397	45	143	153	627
12-011d	152	365	434	151	133	175	1381
12-007d	154	292	736	215	293	141	2031
12-001d	178	70	318	29	224	145	8
12-022t	85	186	201	10	74	48	288
12-014d, 12-029t	154	105	350	151	176	74	378
12-031c	137	117	339	80	128	137	0
12-020j	130	320	325	1004	131	108	2356
12-041rp	156	266	286	32	66	78	225
12-042rp	105	216	327	25	178	87	8562
12-027f	150	150	387	53	74	125	302
12-006d	83	116	240	13	66	56	222
12-025f	124	109	206	58	88	53	0
12-034u	140	119	292	9	168	98	398
zhan--fine 68??	145	384	384	36	216	110	221
12-023t	131	124	531	74	110	125	651
12-037rp	127	135	215	22	63	69	134
12-044sh	111	138	188	63	82	75	310
12-045dc	114	152	266	85	61	55	265
12-039u	125	173	348	62	95	119	208
12-043rp	104	376	268	25	98	83	1097
12-030c	138	292	443	69	148	127	493
12-038u	114	230	279	26	125	87	214
12-046roy	112	152	231	32	144	82	493
12-024f	79	191	213	18	56	91	0
12-019c	151	209	341	53	107	126	507
12-010d	98	139	254	32	77	73	525
12-028f	147	118	281	336	56	109	259
12-026f	172	284	315	161	126	116	237
12-021j	146	229	333	1130	103	166	171
12-036u	176	157	490	78	194	158	0
12-032c	140	225	443	77	58	103	6
12-006d	139	249	346	34	78	116	403
12-013d	71	84	89	15	42	39	337
12-009d	144	194	266	65	82	104	552
12-040t	117	202	319	56	141	112	618

12-012d	171	221	273	121	65	69	592
12-017d	86	141	275	54	74	46	273
12-008dj	73	143	131	89	35	70	418
12-035u	99	65	260	38	67	64	122
12-painted-clay	118	188	268	94	62	95	106
SXD-001f	76	178	187	12	70	76	150
SXD-004f	59	95	136	17	44	27	0
SXD-014oj	104	96	540	50	128	155	0
SXD-015f	150	318	480	56	221	98	0
SXD-008f	118	404	363	102	112	75	187
SXD-010f	62	117	198	21	94	77	293
SXD-009f	104	185	254	23	71	86	0
SXD-003f	90	256	284	13	96	37	176
SXD-013cr	91	153	256	124	89	37	0
SXD-006f	86	242	184	39	139	103	122
SXD-012f	107	391	261	9	91	98	606
SXD-011f	92	127	131	34	91	82	0
SXD-002f	101	205	204	53	129	119	0
SXD-016f	71	135	153	14	107	76	0
SXD-005f	96	264	281	45	132	89	0
SXD-017f	102	255	323	12	102	83	84
Wan-59d	133	247	368	24	143	98	426
Wan-58d	141	315	249	41	102	111	206
Wan-60d	78	181	128	15	63	57	126
Wan-61d	96	233	220	8	49	58	89
Y71-001d (Y71-01f)	117	109	291	46	96	134	1441
Y71-002u	110	121	328	37	44	111	810
Y71-003rf	90	101	143	26	105	64	1936
Y12-002u	91	102	262	56	79	79	2169
Y55-001rf	82	155	167	31	100	80	-22
Y55-002rf	126	131	378	105	50	104	166
Y64-002rf	110	149	194	50	63	70	703

Appendix IV-Table 8: Trace elements of samples (in ppm)

site	id	Temperature (˚C)
Xinyicun	12-001d	950
Xinyicun	12-002d	869
Xinyicun	12-003d	860
Xinyicun	12-004d	947
Xinyicun	12-005d	863
Xinyicun	12-006d	853
Xinyicun	12-007d	927
Xinyicun	12-008dj	880
Xinyicun	12-009d	870
Xinyicun	12-010d	855
Xinyicun	12-011d	882
Xinyicun	12-012d	916
Xinyicun	12-013d	868
Xinyicun	12-014d	855
Xinyicun	12-015d	926
Xinyicun	12-016d	920
Xinyicun	12-017d	923
Xinyicun	12-018d	925
Xinyicun	12-020j	867
Xinyicun	12-021j	884
Xinyicun	12-022t	921
Xinyicun	12-023t	888
Xinyicun	12-024f	870
Xinyicun	12-026f	845
Xinyicun	12-027f	865
Xinyicun	12-028f	865
Xinyicun	12-029t	915
Xinyicun	12-030c	947
Xinyicun	12-031c	842
Xinyicun	12-032c	960
Xinyicun	12-033c	945
Jinsha	Jinsha-002f	871
Jinsha	Jinsha-003d	914
Jinsha	Jinsha-004d	885
Jinsha	Jinsha-005d	884
Jinsha	Jinsha-006d	880
Jinsha	Jinsha-007c	892.5
Jinsha	Jinsha-008c	980
Jinsha	Jinsha-009d	850
Jinsha	Jinsha-010f	921
Jinsha	Y71-01f	908.5
Jinsha	Y51-01f	866
Jinsha	Y55-01rf	940
Jinsha	Y64-02rf	900.5
Sanxingdui	SXD-001f	936
Sanxingdui	SXD-002f	895
Sanxingdui	SXD-003f	945

Appendix IV-Table 9: Estimations of the firing temperatures by using dilatometer



Appendix IV-Figure 30: The change of sample volumes during refiring
Note that most samples encounter substantial shrinkage at around 1000˚C.

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