UNIVERSITY OF CALIFORNIA, SAN DIEGO

Production of Ritual Material Culture in the Pre-Pottery Neolithic Period in Jordan: Some Methods for Analytical Investigation

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by

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Chair

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ABSTRACT OF THE THESIS

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The Neolithic period in Jordan has come under increasing study since the accidental discovery of ‘Ain Ghazal in the late 1970s, which not only showed that large settlements were present in marginal areas, but proved to be the type site of a sub-period previously unknown in the archaeological record. As more sites are discovered and excavated, prior entrenched notions of site interactions, demographic and settlement change, ritual, and other aspects of social organization have been questioned. The discovery of both large, densely occupied “mega-sites” and smaller, perhaps more specialized, peripheral sites which were apparently totally independent of the larger sites in the Pre-Pottery Neolithic has led to the idea of a polycentric evolution of Neolithic

ideas and lifeways. However, while most researchers believe that these sites were self-sufficient, this does not preclude their interaction with other sites. In this thesis, potential ritual remains from Tel Tifdan, one of these small peripheral sites in Southern Jordan, are analyzed using chemical analyses to determine whether evidence of ritual trade with nearby or distant sites can be ascertained. X-Ray Fluorescence (XRF) and Fourier-Transform Infrared (FTIR) spectroscopy are employed to determine whether the clay from a sample of figurines from the site was sourced locally. The results are inconclusive as far as location of clay sources, but theoretically could be solidified with analysis using different chemical methods.

Introduction

Chemical Sourcing of Clays and Ceramics

A large body of work on petrographic and chemical sourcing of archaeological ceramics has been in the works for years. Finding the source of raw materials for ceramic artifacts can tell us many things about the artifact itself and how it came to be where it was before being buried. For one thing, knowing whether ceramics were made far away and then brought to a site, or whether they were made locally from local materials in a local style (or from local materials in a style copied from elsewhere, or vice versa) can tell us about trade, craft specialization, modes of production and consumption, and even, arguably, identity.

However, sourcing of ceramics can be quite difficult. While clay is a very "local" substance in that clays from one area tend to be very different from clays from another, they are often so altered by the ceramic-making process that identifying "local" can be more difficult than expected. For example, petrographic analysis uses the small inclusions (stones, sand, etc) that are native to an area to decide whether the fabric of the sherd was made locally. However, refining processes during pottery production can remove much of this material, making the fabric harder to source. This technique also requires extensive knowledge of local geology.

Another problem with clays is that while different types of clay (the three major types are illite, smectite, and kaolinite, and each has various subdivisions which are variously more or less important to archaeological characterization) are, in theory, readily identifiable with infrared spectroscopy, they are only very rarely found in their pure form.

The tininess of clay crystals combined with the fact that they are almost always found in mixtures with one another (Weiner 2010) makes them, in practice, very difficult to distinguish from one another with FTIR. However, some progress has been made in comparing FTIR spectra to X-Ray Diffraction (XRD) spectra (De Benedetto, et al. 2002) primarily in an effort to mitigate the high cost and sample preparation time of XRD. De Benedetto (2002) compared the results of two provenance studies on the same group of pottery sherds, one by FTIR and one by XRD, and found that the results from both were highly similar.

In addition to the difficulties caused by refining in the production process, diagenesis can also make chemical analysis difficult. Diagenesis of ceramics has been little attended to before now because it has long been a basic assumption in archaeology that ceramics did not undergo diagenesis, but recent studies have shown that it affects ceramics just as it affects all other material objects (Weiner 2010). Ceramic, just like bone, charcoal, plaster, and anything else that can be preserved in the archaeological record, changes over time and is affected by groundwater percolation, soil composition, and even the presence of other artifacts, and thus its chemical and mineral makeup and how they have been diagenetically altered must be taken into account when analyzing them. The processes are not nearly as well understood for ceramic as they are for bone or organic material, however, and little has been published on the subject so at this stage they are not included in this analysis. FTIR and XRF together may provide a plausible method for sourcing clay artifacts, although the technique is still not widely used, and is inconclusive in this study.

Clay in the Neolithic

Until recently, chemical study of Neolithic artifacts from the Near East has been rare and case studies are difficult to find. Most work on clays has been done on ceramic vessels, and not on baked or unbaked clay objects that are not used for cooking, storage, serving, etc. Most of the analysis that has been done has focused on art-historical or "ritual" features of artifacts, and few provenience studies have been undertaken. (Exceptions, such as studies of lime plaster (Goren and Goring-Morris 2008) and dietary studies (Richards, et al. 2003) do exist, but they are less prevalent than for later periods or the Neolithic in Europe.) The assumption has generally been of a long-lived cult of fertility and ancestor worship associated with the advent of agriculture and sedentism (e.g. Cauvin and Watkins 2000). However, it is important to find out whether supposed "ritual" artifacts may have been mass-produced, traded, and/or used for purposes other than those that modern archaeologists would term "ritual" (see Voigt 2002: for discussion of other possible categories that figurines may have been classified in, such as children's toys.) This preliminary study attempts to address this problem by characterizing a group of clay artifacts (broken figurines). As these objects may have functioned in the realm of ritual during the PPN, they can provide a small window on early south Levantine ritual practice. Using ethnographic and ethno-historical data (e.g. Holl and Levy 1993; Voigt 2002) can help to interpret what may have been going on in the archaeological record.

Background and History of Research

The Neolithic in the Levant

Until the last three decades, the Neolithic period of the southern Levant was largely *terra incognita* compared with the same period in the Northern Levant. Anatolia, Syria, Lebanon, and the Zagros mountains were intensively studied before the 1980s (e.g. Braidwood 1975; Mellaart 1975) and much of the early interpretation of Neolithic lifeways and ritual comes from the northern sites, as well as the handful of sites from the Southern Levant. For example, Israel and the Palestinian Territories (with major exceptions such as Jericho (e.g. Kenyon 1954) and Munhatta (Perrot 1964)), Jordan (with the exception of Beidha, (Kirkbride 1966)), and the Sinai and Arabian peninsulas were initially much less intensely covered by scholars studying the earliest settled peoples. However, since the 1980s the pace of Neolithic research in Israel and Jordan has accelerated rapidly (e.g. Garfinkel 1987; Garfinkel and Ben-Shlomo 2009; Kuijt and Goring-Morris 2002; Rollefson 2008b), and the knowledge gained in the past three decades is both diverse and surprising.

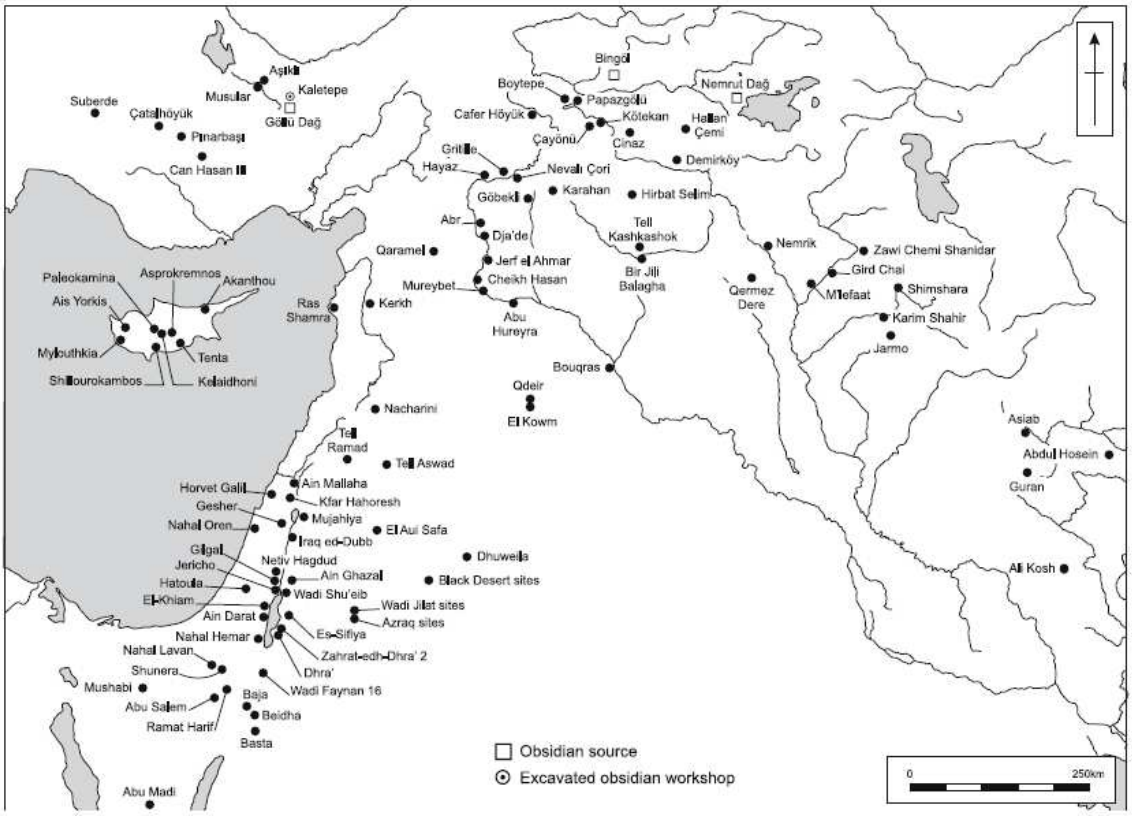

Figure 1 - Map of Selected Neolithic Sites in West Asia (Asouti 2006)

Until fairly recently many researchers still regularly used uncalibrated ^{14}C dates while some switched to calibrated dates, causing confusion in the dating schemes. It seems that calibrated dates were considered somehow untrustworthy, or even dishonest, and were at first avoided (e.g. Bar-Yosef 1989). Dates were given in radiocarbon years rather than calendar years, a practice that has grown less common over the last two decades with various techniques of anchoring, such as calibration curves based on dendrochronology, atmospheric calibration, uranium-thorium coral dating, and/or lake coring, and statistical analysis of multiple dates from a single stratigraphic sequence (e.g. Bronk Ramsey 1995; Bronk Ramsey 2009). Textbooks have in some cases been revised

with these calibrated dates (e.g. Rollefson 2008b), making them easier to understand, and will be referred to as dates "cal BP". Publications older than twenty years, of course, still contain the original dating schemes and as these have not been calibrated, they will be referred to as simply "BP." It should be noted, however, that calendrical anchoring is not easy in the case of the Neolithic. (No period is truly *easy* – but some periods and locations pose particular problems, such as the Neolithic and Iron Age of the Levant.) For example, one of the most reliable methods, dendrochronology, is largely unavailable to scholars attempting to calibrate the radiocarbon curves relevant to this period; wood from this period in the Levant is rarely available, and it is only possible to construct "floating chronologies" based on such limited tree-ring sequences. There are also plateaus in the atmospheric curves for this period (Aurenche, et al. 2001), and the older the date, the more the ^{14}C and calibration dates are likely to diverge (Stuiver, et al. 1998), thus making statistical calibration even more important for accuracy. For the PPNB (see Background section below), the main focus of this paper, the calibration is fairly well-accepted. Part of the reason for this may be that, unlike historical periods in which the difference of a generation matters greatly, in time-spans this far back the resolution is already rather blurry, and at least at this point, tightening the focus on radiocarbon dates is not the highest priority.

Table 1 - Relevant Dates of Periods and Sub-Periods (following Twiss 2007)

Period	Subperiod	RC Years BP	Calibrated Years BP	Years BC	Millennium (Calibrated BP)	Length (calendar years)
PPNA	-	10,200-9400	11,700-10,500	9700-8500	Mid-12th-mid-11th	~1200 y
PPNB	-	9500-7900	10,500-8700	8500-6700	Mid-11th-mid-7th	~1850y
-	EPPNB	9500-9300	10,500-10,100	8500-8100	Mid-11th	~400y
-	MPPNB	9300-8300	10,100-9250	8100-7250	Late 11th-late 10th	~850y
-	LPPNB	8300-7900	9250-8700	7250-6700	Late 10th-Mid-9th	~550 y
PPNC	-	7900-7500	8600-8250	6600-6250	Mid-late-9th	~350y
PN	-	7500-6000?	8250-7300?	6250-5300?	Late 9th - late 8th	~950 y

The earliest period of the Neolithic, the Pre-Pottery Neolithic A (PPNA: c.11,700-10,500 cal BP) is still not well known, although it is beginning to look both more complex and more researchable than was previously thought. In this period it appears that people were in many places still partially nomadic, relying on a sort of proto-agriculture for part of the year and hunting and foraging for the other part (Bar-Yosef and Belfer-Cohen 1989b). Even the "proto-agriculture" claim is highly debated (Zeder 2011), and pinning down the date of domestication for many species is one of the most important study subjects in this period. It is not easy to define morphological domestication in either plants or animals, and often the state of preservation makes it even harder. Domestication of both animals and plants was in its infancy during this time, and few if any species show their later sedentary forms, as long periods of intensive management seem to precede morphological change by many years (Zeder 2011). Settlements in the PPNA generally consist of simply constructed, dirt-and-gravel-floored structures (Kuijt and Goring-Morris 2002), much like the temporary or semi-sedentary structures from the preceding Natufian period (Bar-Yosef and Belfer-Cohen 1989b). The Natufian period saw the earliest experiments with sedentism and a proliferation of foraging and hunting strategies and toolkits that has not been equaled before or since (Bar-Yosef 1998). A major difference between the Natufian and the PPNA is that in this period there begins to be evidence of larger settlements and ritual activity, in the Southern Levant (Finlayson, et al. 2011; Mithen, et al. 2000) and especially in Anatolia and northern Syria, such as the spectacular remains at sites like Göbekli Tepe (Schmidt 2000). While many sites are ephemeral or small and possibly only seasonally occupied,

sites like Göbekli Tepe may have been regional ritual centers, although this is hotly debated (Banning 2011). Houses were usually circular or oval and often semi-subterranean, with a central hearth and grinding slab for food preparation (e.g. Finlayson, Mithen, Najjar, Smith, Maričević, Pankhurst and Yeomans 2011; Kirkbride 1966). Burials in this period are numerous and generally, in the case of adults, are side-lying, flexed, and often missing the skull. Occasionally caches of these removed skulls are found. Children's skulls were not typically removed (Kuijt and Goring-Morris 2002; Twiss 2007). Jericho, in the modern West Bank, exhibits these features, but has one major difference yet to be seen anywhere else – while it generally conforms to the PPNA model, the major departure there is the circular tower, 8.5 meters high and 9m wide, with twelve adult burials stuffed into the stairway (Kenyon 1957). Their heads were never removed, despite the general practice of the period. Infant burials are occasionally found under foundation walls at many sites, indicating some kind of ritual surrounding house-building. These practices of skull removal and infant building "offerings", along with the female and phallic figurines sometimes found at sites of this period, have led some past researchers to believe that the religion of this period consisted of either ancestor worship, goddess/fertility worship, or both (Twiss 2007), but now some scholars think that perhaps this is either simplistic or incomplete and that perhaps a different set of ideas and mechanisms is at work – that of promoting social harmony through shared ritual (Kuijt 1996; Kuijt 2002).

The Early Pre-Pottery Neolithic (EPPNB) is hardly known at all in the Southern Levant. In fact, some question whether the EPPNB is a valid temporal construction at all (Kuijt 2003; Kuijt and Chesson 2005; Kuijt and Goring-Morris 2002). So few sites are

known from this period that not only it is not clear if morphological domestication of plants and animals can be attested this early or not, it isn't even clear if these sites represent a truly separate archaeological phenomenon warranting its own temporal division. This period and the late PPNA fall within the aforementioned plateau in the calibration curve for the early Neolithic (Westaway, et al. 2004; Yizhaq, et al. 2005) It is not known in any detail whether people in the southern Levant were largely sedentary, largely nomadic, or a combination of both. In any case, sites with strata reliably dated to the EPPNB are exceedingly hard to come by. It is possible that the shift seen in the MPPNB (see below) from hunted gazelle to hunted/penned wild goat had already begun in this period, considering how developed it already is in the following thousand years. The designation of this period may be based on an assumption that it *must* exist, because the development of animal domestication in the MPPNB seems to be quite sudden if there is no "period" intervening between the PPNA and MPPNB; however, there are new studies that indicate that this jump from wild to domesticated may be what really did happen (Zeder 2011), obviating the need for inserting an entire sub-period to account for what seems to be missing time in the domestication sequence.. The perceived impossibility of this jump may account for the perceived structural necessity of the EPPNB – there is a sudden jump from almost no domestication to very widespread and advanced domestication of plants and animals and in sedentism, with no intermediate stages to give information about how this was achieved. Thus, archaeologists have effectively inserted a period into the chronological structure as a sort of placeholder for expected future excavations to fill. However, the apparent problem here may not be a problem at all; Melinda Zeder (2011) gives an interesting update on the state knowledge

about early domestication, and this difficulty may be explained by an increased intensity in exploitation of wild plants early in the Neolithic, meaning that morphological domestication may not be the leading edge of domestication, as was previously thought. Intense exploitation may have led to rapid morphological domestication – a process that may have happened so quickly that the resolution of the archaeological record may not preserve a clear or consistent record of it. This would account for the "invisibility" of domestication between the PPNA and MPPNB, and absolve archaeologists of the need for the EPPNB solely on the basis of missing morphological domesticates. Supporting this directly is the site of Zahrat adh-'Dhra in the Dead Sea Plain of Jordan (Westaway, Sayej, Meadows and Edwards 2004). The site dates perfectly to the proposed EPPNB by radiometric methods, but is entirely PPNA in the character of its flaked stone industry and architecture, and exhibits intensive exploitation of pre-domesticated plant remains. New work at other PPNA/EPPNB sites appears to exhibit a similar pattern, so we may soon see a major adjustment in the chronology of the early Neolithic.

The Middle Pre-Pottery Neolithic (MPPNB) is justifiably well known. Many sites have occupations during this period, and some of the most well-known finds in the Near East come from them. The plaster statues of □Ain Ghazal, the plastered skulls of □Ain Ghazal and Jericho, the hoard from Nahal Hemar cave, and the elaborate burials of Kfar Hahoresh are some of the best known, but other sites such as Ghwair I, Yiftahel, Wadi Shu'eib and Beidha are equally important (Bar-Yosef and Alon 1988; Garfinkel 1987; Horwitz and Goring-Morris 2004; Kirkbride 1966; Rollefson 1983; Rollefson 1984; Simmons, et al. 1988; Simmons and Najjar 2006; Simmons, et al. 2001). These sites exhibit incipient morphological domestication of both plants and animals, and were

occupied year-round. The population seems to have increased rapidly during this period, probably due to the increase in available nutrition through tighter control of plant and animal reproduction. How this came to be is uncertain (see EPPNB), but domestication seems to be in full swing by the MPPNB. There is ample evidence of "ritual" behavior, and possible ancestor worship: plastered skulls decorated with facial features have commonly been found buried carefully under house floors, as have decapitated burials, infant burials, and buried animal and human figurines and statues. These last may be involved in a practice of retiring ritual objects when they are perceived to have lost their power (Rollefson 2008a; Voigt 2002). The practice of skull removal seen in the PPNA was clearly continued, but with considerable added complexity (Goren, et al. 2001). Hunting was still in wide practice, and in combination with early versions of agriculture and penning of wild ancestors of later-domesticated animals such as goats provided a hugely varied diet. Pollen analysis indicates that toward the end of this period oak and pistachio forests which had previously covered large areas of the Jordanian Plateau almost completely disappeared, possibly due in large part to their heavy exploitation by the inhabitants of the area. Aside from their use as supports for roofs, they were probably also used in great volume to make fires for the production of lime plaster (Goren and Goring-Morris 2008; Rollefson and Kohler-Rollefson 1989), a new and rapidly adopted and expanded technology.

At □Ain Ghazal in the highland forest (which may have been mostly gone by the end of the MPPNB; see Rollefson and Kohler-Rollefson 1989), early MPPNB houses tended to be expansive and open, using huge trees as supports for possible upper stories. By the end of the MPPNB these change from wooden supports to stone "piers", which

meant that the open plan became more closed inside, although the size of the houses did not decrease. Pier houses became common across the southern Levant (Banning and Byrd 1988), although there was significant variation in house style from site to site, and circular houses remained common as well (e.g. Kaliszan, et al. 2001; Simmons, Rollefson, Kafafi, Mandel, Maysoon, Jason, Köhler-Rollefson and Durand 2001). Their floors and walls were generally coated with thick plaster, usually painted red or pink, and the plaster was reapplied frequently. The houses themselves were frequently modified. At Beidha houses stuck to the semi-subterranean honeycomb style commonly seen in PPNA settlements, although now they used a rectilinear plan rather than curvilinear. The reasons for this are unclear, but are an interesting case for study. Some think it may give us a window onto social organization – for example, that these larger, more complex, rectilinear houses may signify a shift from houses for nuclear families to extended families, and that these were planned for accordingly (Flannery 2002) although there is the potential that engineering questions may have dictated more of the shift than did social organization. Site size varies enough in this period (from about 1.5 hectares in the more marginal climatic zones such as the Rift Valley, up to 12ha in more favored areas, particularly the Mediterranean zone) for researchers to debate whether there was some type of settlement hierarchy, although there is little agreement about whether it was a ritual or economic hierarchy – or whether it existed at all (Gebel 2004a; Kuijt and Goring-Morris 2002). This debate becomes amplified in the LPPNB with the advent of the "mega-site" phenomenon (see below.)

Finds from all the sub-periods of the Neolithic tend to be of only a few types; lithics, plaster, bone, and sometimes clay. However, a rare and exciting find at Nahal

Hemar cave in Israel gives a window onto what a large proportion of material remains from the Neolithic has become invisible to archaeologists. Preserved in a (unfortunately badly looted) cave at the southern edge of the Judean desert southwest of the Dead Sea were beautiful examples of basketry, woven headdresses, and other textiles, together with decorated skulls and figurines (Bar-Yosef and Alon 1988). The skulls here are unique in style and treatment, attesting to the cultural variation among the various sites. The cache has been radiocarbon dated to the late MPPNB (uncal. BP Hedges, et al. 1987).

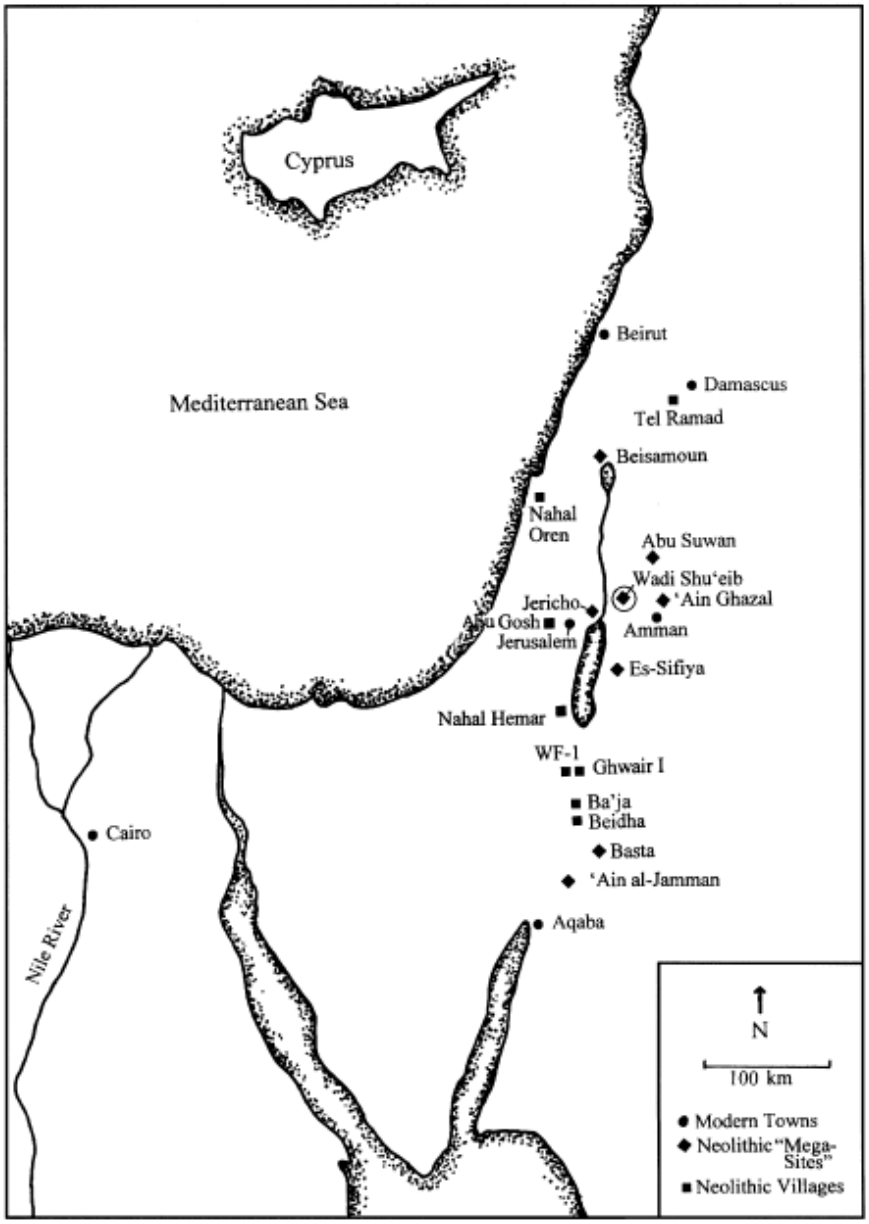

Figure 2 - Map of Jordanian Neolithic Sites (Simmons, Rollefson, Kafafi, Mandel, Maysoon, Jason, Köhler-Rollefson and Durand 2001)

Until the mid-1980s it was thought, based on evidence from the northern Levant (Syria and Anatolia) and Jericho (in what is now the West Bank) that the entire Southern Levant was abandoned at the end of the Late PPNB (e.g.Mellaart 1975; Nissen 1993),

and that the entire population either moved north or became nomadic pastoralists. It should be remembered that there are ephemeral hunting camps throughout all of these periods and the near-invisibility of nomadic people in the archaeological record does not mean that there *were* no people. (Confusing the issue is the fact that "pastoral nomadism," in which people move seasonally with their herds and carry their belongings with them, and "transhumant agro-pastoralism" in which people take their herds out from a permanent, sedentary base, are often used as interchangeable terms (Rosen 2007)). However, beginning in the early 1980s with the accidental discovery of 'Ain Ghazal by a highway-grading project, it is now thought that the eastern rim of the Rift Valley remained a viable farming region, and in some cases even increased in population density and complexity . In fact, Ain Ghazal (and other more recently discovered sites (e.g. Banning, et al. 1994)) exhibit occupational continuity through the end of the Pre-Pottery Neolithic, the Pottery Neolithic, and in some cases even into the Chalcolithic period (Rollefson 1989b). Rather than a shift to the north, it seems there was a strong shift to the east, from the Mediterranean zones to the eastern side of the Rift Valley. To some researchers, it seems likely that this shift in settlement pattern was due in large part to overexploitation of the land surrounding earlier sites by hunters, pastoralists, and farmers, and possibly in some cases to a climatic shift toward cooler and dryer weather (e.g. Rollefson 1989b; Rollefson and Kohler-Rollefson 1989). The evidence for this climatic shift is patchy, and probably glosses over major variation in microclimates, just as Jordan today contains microclimatic variation. Each site will almost certainly show differences in food production/procurement strategy, but this does not necessarily negate the entire idea of an eastward population shift. A site located in a more favorable environmental

area may be expected to last longer, and local changes as well as regional ones will affect each site differently. Indeed, it seems that rather than a LPPNB shift to either total pastoral nomadism and/or a move northward, many people from the major earlier (MPPNB) sites such as Jericho and Abu Ghosh moved eastward across the Arabah Valley to sites such as □Ain Ghazal, Basta, and Ba'ja in the Transjordanian highlands, causing these sites to grow to such proportions that archaeologists, following Rollefson (Rollefson 1989a), call them "megasites." So far there are only a few of these, but as most or all of them were buried under deep accumulations of soil and rubble and discovered only by accident (Gebel 2006), in theory there could be many more undiscovered sites, especially around springs and oases. Many of them are also constructed vertically on steep, terraced slopes with little arable land, lending some credence to the hypothesis that the area available for farming was decreasing (Gebel 2006). As some researchers disagree with the interpretation of environmental change as the prime mover for the aggregation of populations into these mega-sites (e.g. Gebel 2004a), learning more about this period by finding and excavating more sites both large and small is an important future direction.

These megasites lasted for about a thousand years and then they, too, were often abandoned or decreased dramatically in year-round population. The faunal, climatic, architectural, and lithic assemblages point to a dramatic shift to part-time pastoral nomadism (although, as mentioned above, this interpretation is somewhat problematic) in the face of disastrously depleted forests, soils, and water access. By this time goats and sheep were largely domesticated, and facilitated a reliance on pastoralism rather than the farming and hunting strategies observed earlier. At □Ain Ghazal the environmental shift

begins in the MPPNB, especially regarding the use of trees for building and the hunting of wild animals (Rollefson and Kohler-Rollefson 1989), but doesn't become truly disastrous until the end of the LPPNB or even PPNC – one of the few sites so far known where the people held out so long against abandonment.

The PPNC is still not well known, and in fact has only been known as a period at all for about twenty years. The first indication of its existence was at □Ain Ghazal (Rollefson, et al. 1991; Rollefson and Simmons 1988), and is seen in a clear shift in lithic types and architectural styles. Instead of either a break in occupation or direct continuity from the LPPNB to the Pottery Neolithic, there is an intermediate period with previously unknown artifact and architectural styles. It also seems now that perhaps some previously excavated sites may have had PPNC occupations that were not recognized at the time, and if someone has the time, inclination and expertise, it may be that some older excavations warrant a thorough reassessment of their assemblages (Rollefson 2008b). The PPNC is characterized by an almost total shift to farming tools and away from hunting implements, although these tools are quite different stylistically from the farming tools present at earlier, agriculture-intensive sites and periods. In addition, the domestic architecture changes significantly: instead of the large open post-houses seen in the MPPNB or the combinations of honeycomb houses seen in the LPPNB, there are two types of houses, in different areas of the sites. One is the small, one-room house that seems to have been occupied year-round; the other is the "corridor house", with a single long corridor with several small storage-type rooms opening off to either side, and which may have been used as storage for pastoral-nomadic families who were only present for part of the year and otherwise were away with their flocks (Rollefson and Kohler-

Rollefson 1989; but see Rosen 2007: for problems mentioned above with this terminology and category in general.).

The Research Area

Located ca. 50 km southeast of the Dead Sea, the Faynan region of Southern Jordan is most famous for its copper ores. In later periods, especially the Early Bronze Age (Levy, et al. 2002), Iron Age (Levy, et al. 2012), and Roman periods (Pyatt, et al. 2000), it was known as both a place of rich metal deposits and, sometimes, misery. This was particularly true under the Romans, when Christians' death sentences were sometimes to be worked to death in the mining camps there (e.g. Perry, et al. 2011), although people have lived in Faynan and exploited the copper there for millennia. In the Neolithic period, Faynan had demonstrable contact with sites throughout Transjordan. For example, some of the plaster statues from MPPNB Ain Ghazal had green "makeup" drawn around their eyes. The powdered copper used as pigment in this makeup almost certainly came from Faynan (Hauptmann 2007:258), as do a large number of copper ore beads. At Beidha, 40km southeast of Faynan on the Jordanian plateau, a solid roll of this same powdered copper indicates how this makeup may have been stored and applied. Hauptmann thinks it was probably mixed with some type of adhesive and applied in stick form (ibid. 260). Green coatings on wooden and plaster beads from the cave of Nahal Hemar also have been tentatively identified as originating from Faynan ores (Wright and Garrard 2003). It is interesting that the bead-making operations at Tel Tifdan (see below) may have had little to do with these particular interactions, or at least the evidence is sparse. The first reason is that all three of these

sites (Nahal Hemar, Beidha, and this particular context at Ain Ghazal,) are likely to date from the MPPNB (although Ghwair I is confusing; its material culture appears to be solidly LPPNB, but all of the ^{14}C dates indicate an MPPNB settlement (Gebel 2006; Simmons and Najjar 2006)). While it is entirely likely that there is an MPPNB occupation at Tel Tifdan, it is far from conclusively known (Levy In Prep). The more likely source of these particular ores, at least until Tel Tifdan is further excavated and we can tell whether it was occupied in the MPPNB, is Ghwair 1 at the head of the wadi.. The second reason is that Faynan ores are generally too soft to be made into beads – they are easily crushed, and thus lend themselves better to the manufacture of cosmetics. So, while beads seem to have been an important aspect of the economy at Tel Tifdan, it is not yet known whether these beads were traded with neighbors.

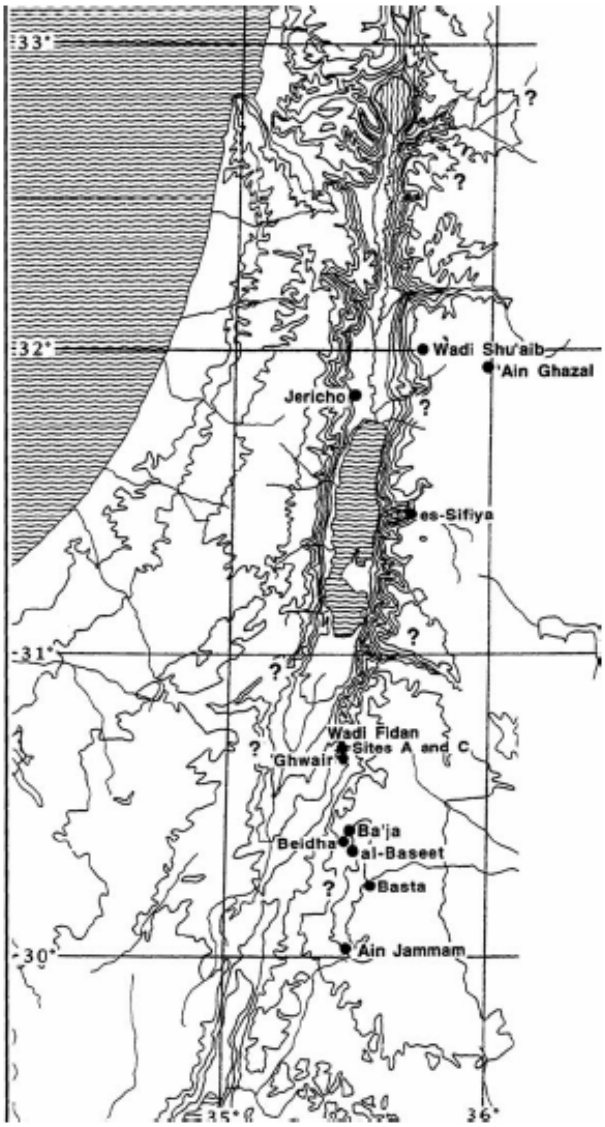

Figure 3 - Map of MPPNB-LPPNB sites in Jordan. Tel Tifdan is here referred to as Wadi Fidan A. (Gebel 2006)

It is entirely likely that trade with other settlements continued after the MPPNB – it is also entirely possible that some of the ores discovered in various contexts at other sites date to the LPPNB and not the MPPNB at all, which would make sense if they were coming from Tel Tifdan (and even Ghwair I, since the material culture there appears to be LPPNB, despite the ^{14}C dates.) However, sub-period dating is often glossed over in many of the chemical and mineralogical reports. Thus, many of the scientists who

publish on the provenance of raw materials refer only to the "PPNB", which is a period that lasted about two thousand years, making the assessment of real contemporaneity very difficult. It is frequently difficult to tease out any information on which sub-period any particular find can be dated to, unless it has also been published in detail by the excavator.

The Site

Tel Tifdan (also referred to in many publications as Wadi Fidan 1, Wadi Fidan 001, Wadi Fidan A or WFD001, but hereafter Tel Tifdan) is a small (~3 ha) inselberg located at the mouth of Wadi Fidan, just past where it empties into the Wadi Arabah. It overlooks the Wadi Arabah on three sides, and looks up the Wadi Fidan/Faynan to the east. In antiquity the site was probably significantly larger than it is today. There was at some point a lower shelf around the northern and western edges of the site, which contained cultural remains that were potentially contemporaneous to the upper site. However, this shelf has since been almost entirely washed away by flooding.

In 1989 a small sounding was conducted which produced four radiocarbon dates indicating a PPNB settlement (Adams 1991), and in 1999 a major excavation based on geophysical surveys (Witten, et al. 2000) was carried out by T.E. Levy and M. Najjar which exposed at least three settlement phases stretching from the LPPNB through (possibly) the PPNC. There may also be earlier occupations (most likely MPPNB) under the LPPNB strata, but this is largely conjecture, as the lowest levels of the site were exposed only over a very tiny area (Levy In Prep).

Aside from a huge number of stone beads, borers, and blank-straighteners, which have led the excavators to think that Tel Tifdan was perhaps a specialized bead-production site (Levy In Prep), one of the most striking assemblages from Tel Tifdan is the figurines. Figurines are not particularly common at most other LPPNB sites (with one or two important exceptions, such as Wadi Shu'eib (Simmons, Rollefson, Kafafi, Mandel, Maysoon, Jason, Köhler-Rollefson and Durand 2001)), but at Tel Tifdan they make up a huge portion of the finds. Animals, humans, animals pierced by flint blades, and small "tokens" (which may have some economic significance; see for example McAdam 1997; Schmandt-Besserat 1992) were found in concentrations in several areas of the site. Only the figurines from Stratum IIb (see map in Figure 7) have been spatially analyzed, although mapping, cataloging, and typing the rest of the figurines (of which there are not many – the majority were found in this stratum) is another future project.

Figure 4 - Cow figurine with possible piercing (flint is missing.) It also appears to have an impression from a "rope", perhaps a halter, which has since rotted away. Courtesy T.E. Levy. Photo by Aaron Gidding.

Figure 5 - Headless animal figurine with "sacrificial" flint. Courtesy T.E. Levy. Photo by Aaron Gidding.

Figure 6 - Clay "token." Many of these were found at the site, and at others. Usually they are pointed at the top; this one is broken. Courtesy T.E. Levy. Photo by Aaron Gidding.

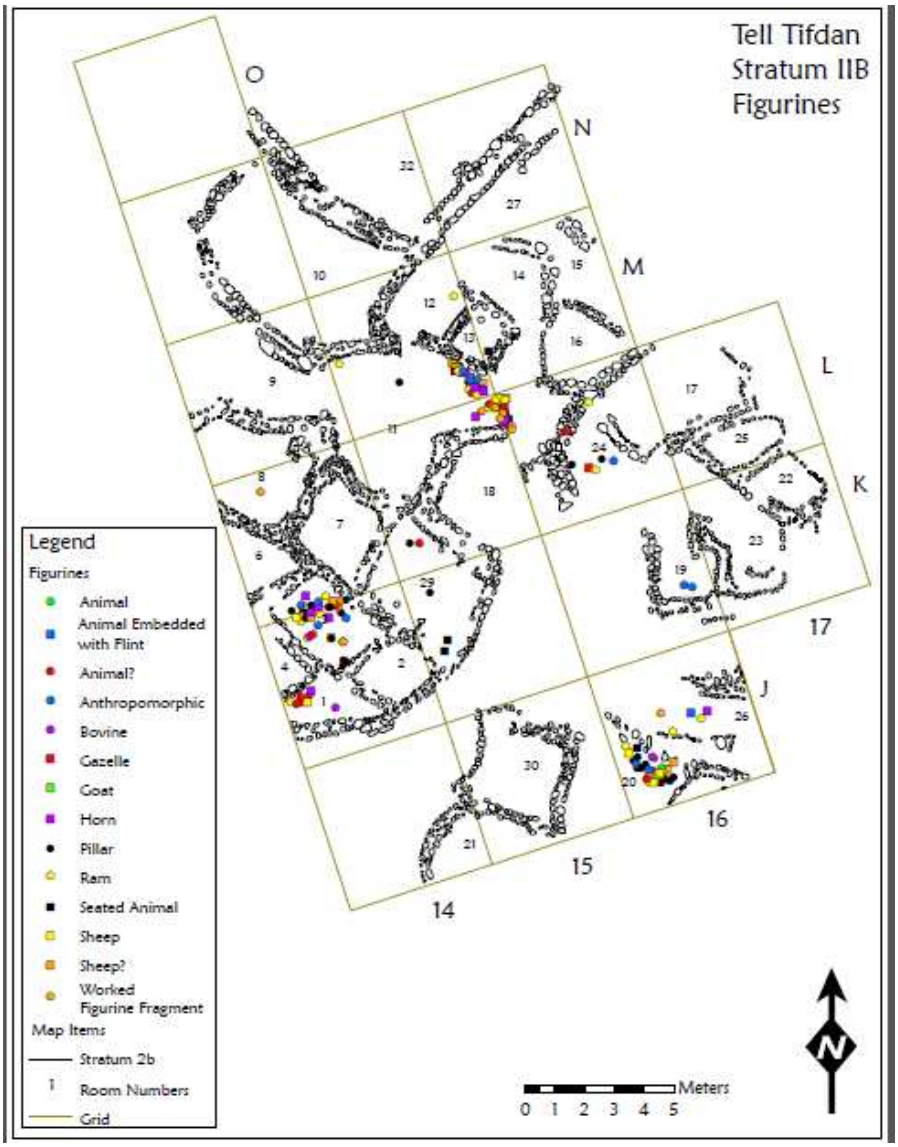

Figure 7 - Location of Figurines in Stratum IIb. Courtesy T.E. Levy. Map by Ian Jones.

There were several wall niches in buildings, some of which contained bones, possibly from infants. Unlike many other sites of this period where rooms are coated in lime plaster, rooms at Tel Tifdan tended to be plastered with mud brick or chalky mud plaster.

Methods and Materials

As the assemblage of complete figurines from Tel Tifdan is stored in the yet-unopened new Jordan Museum in Amman, at the time of this study (the fall/winter of 2011/12) it was not possible to obtain access to any unbroken figurines from the site. However, I did have access to a large subset of the figurine assemblage from the 1999 season; these were the broken, incomplete, or uncategorized portion of the sample. Of these, thirty were randomly selected for chemical analysis. They come from both areas of the excavation and a variety of loci, although most of these were from Stratum IIb in Area M (see Figure 7.) Additionally, five sediment samples were taken by the author in November, 2011 from locations surrounding the mound. Again due to the constraints of the collection timing, these samples were taken in the immediate vicinity of the site mound; however, if further analysis is conducted in the future it will be important to take samples from a variety of geomorphological features in the Wadi Fidan system including around the two major springs on the wadi: □Ain Fidan (ca.3km upstream) and □Ain Ghwair (ca. 14km upstream), as these are likely sources of clay in the Neolithic. There is also an oasis, now dry, very close to Tel Tifdan on the southern bank of the Wadi Fidan, within sight of the village. Depending on when it went dry and what kind of soil is still present there, this too could be a testable source of clay for figurines.

For FTIR analysis, a ~30µg sample was scraped from each figurine with a scalpel, ground with a ~60µg scoop of KBr powder, and pressed at ~2 tons pressure into a 7mm pellet. These pellets, after scanning, were saved in plastic cases for transport back to the US.

The scans were done with a Nicolet iS5 Portable Fourier-Transform Infrared Spectrometer. Each scan was conducted for 50 seconds, which is the default (unchangeable) setting for the spectrometer. A background scan was taken on an empty chamber to correct for the presence of water vapor in the absorption peaks. After 60 minutes the background scan expires and must be taken again before any additional scans can be done.

For XRF, each figurine was scanned whole, as many are too small to remove samples large enough for analysis in order to grind (and thus homogenize) them. Each was scanned on multiple surfaces, and if possible on a fresh break, as low-energy XRF scans (the "no filter" setting below) only penetrate the surface of clay (~.5mm) and thus could give false results if the area scanned included only the dirt that the figurine has been buried in. (Higher-energy scans, such as the "green filter" scans mentioned below can penetrate up to 3mm so this is more of a problem with low-energy scans.) As the purpose of the scanning is to find out whether the clay itself is local, scanning only the surface dirt would almost certainly give a (potentially false) positive answer to the question of locality. However, breaking or pulverizing figurines in order to scan their insides is generally frowned upon. Some figurines have coatings or deposits that are clearly of material other than the body of the figurine; these were avoided if at all possible. Most of the samples collected during excavation actually consist of multiple figurines, so if one piece in a group was extremely crusted or coated with mineral deposits, a different figurine was chosen to scan. Each figurine was scanned on three surfaces (surfaces which appeared to be without accumulated mineral deposits, when possible) for 60 seconds per scan (see Table **2**). Each set of three scans was done with a

"green" filter (containing 12mg Al, 1mg Ti, and 6mg Cu) and no vacuum at 40kV and 4.5 μa. This setting excites elements larger than Fe and the filter hides some of the lighter metals.

To check whether the readings were consistent between and within each figurine, each set of scans for each artifact was calibrated separately to find a rough ppm estimate for each element detected, to see whether the differences between scans was greater than the difference between figurines. This analysis showed that the clay used in the figurines was surprisingly homogenous and uniform, and could be used to give (rough) parts-per-million estimates of some characteristic elements .

The machine used is a Bruker P-XRF Tracer III-V. One important characteristic of the Bruker Portable XRF (all models) is that it requires no calibration (Bruce Kaiser, personal communication) – in fact, the end-user is entirely unable to calibrate the machine. Bruker provides a standard sample for calibration – if the spectrum obtained from this sample does not match the calibration spectrum, the machine must be sent back to Bruker for repair or replacement. The process by which Bruker made their machine able to hold a calibration despite travel etc. is proprietary, and is not published (hence, not available for citation.

Results

Upon examination, it appears fairly clear that the sediment samples taken in the immediate vicinity of the mound are probably not, in fact, pure clay, and some contain more clay than others. There are three families of clay commonly found in archaeological sites: the illite, smectite (usually represented by montmorillonite clay), and kaolinite groups. Montmorillonite has characteristic peaks at wavenumbers 3,625 and 3,427 (Weiner 2010: 300-305). These are visible in the red spectrum in Figure 10, but they are shifted fairly significantly lower than normal. Peak shifting is a complex phenomenon and is more common in some types of compounds than others, but is usually due to two main issues: the small size of crystals, which tends to make them disordered and thus somewhat structurally "unruly", and the presence of ionic inclusions visible to infrared scanning. Both of these occur in clay, and when combined with the fact that clay is rarely of one "pure" type, peak maxima can shift fairly significantly (Weiner 2010: 279). All of the samples have a small peak around 1,630, another characteristic indicator of clays, although some of them are shifted and one appears only as a shoulder on a peak from a non-clay compound. A large single peak or doublet at 1,030 also indicates clay, and is present in all of the spectra.

In sum, the sample spectra appear to have varying levels of clay inclusions, but separating clay crystals from other sediments is not easy, as clay is very fine and "sticky", that is, it adheres tightly to other sediments and compounds that it comes into contact with. Without using a sonicator and/or centrifuge, it would likely be impossible to separate the clay from the other sediments, and even then the possibility is not

guaranteed. Thus, it will probably be more productive in the future to gather samples from directly around the springs mentioned above or other known clay sources in Faynan, as it seems fairly likely that these locations will have a more representative set of inclusions than samples taken from the wadi bottom and sides. Especially when erosion over the last 10,000 years is taken into account (see Tel Tifdan summary for how much of the site has been eroded over that time) the composition of sediments and clays in the immediate wadi surrounding the tell is likely to be different enough that samples from known clay sources will be more reliable.

Table 2 - List of Samples Scanned

Sample #	Source/ Site	Area	Green Filter, 60 sec high voltage
1	North	Wadi	3 scans, shaken each time (not crushed)
2	Northwest	Wadi	3 scans, shaken each time (not crushed)
3	Northeast	Wadi	3 scans, shaken each time (not crushed)
4	East	Wadi	3 scans, shaken each time (not crushed)
5	Southwest	Wadi	3 scans, shaken each time (not crushed)
6	WF001	M	3 scans
7	WF001	M	3 scans
8	WF001	M	3 scans
9	WF001	M	3 scans on small fingerprint piece
10	WF001	J	3 scans
11	WF001	M	3 scans on flat-bottomed animal
12	WF001	M	3 scans on longest piece
13	WF001	M	3 scans on folded piece
14	WF001	M	3 scans on "ram" head
15	WF001	M	3 scans on long piece that looks like teeth
16	WF001	M	3 scans on incised token
17	WF001	M	3 scans on token fragment
18	WF001	J	3 scans
19	WF001	M	3 scans on headless animal/token
20	WF001	M	3 scans on one token
21	WF001	M	3 scans on red, smoother piece
22	WF001	M	3 scans on large red fragment
23	WF001	M	3 scans on shapeless blob
24	WF001	M	3 scans on black "bracelet" fragment with finger marks
25	WF001	M	3 scans
26	WF001	J	3 scans
27	WF001	J	3 scans on thin piece
28	WF001	M	3 scans on larger piece
29	WF001	M	3 scans on flattened triangle
30	WF001	J	3 scans on med piece with gouge
31	WF001	M	3 scans on med token
32	WF001	M	3 scans on token fragment
33	WF001	J	3 scans on random blob

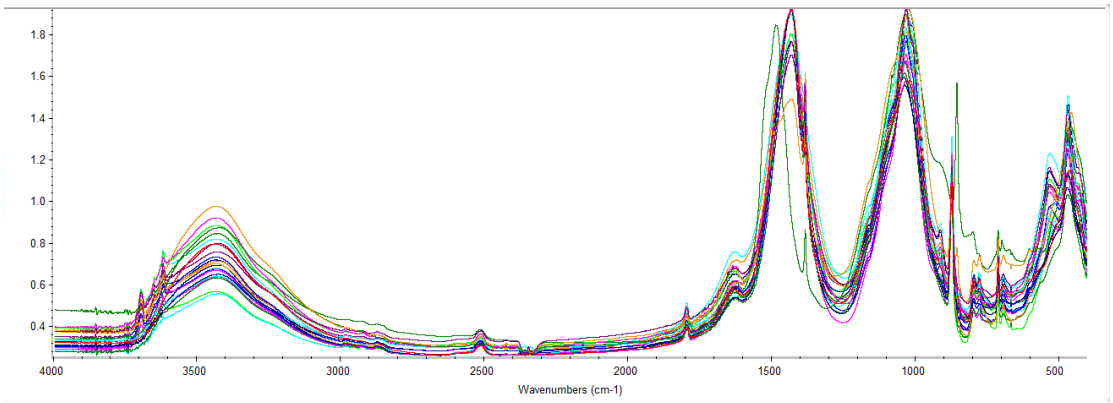

Figure 8 - FTIR Scans of figurines (Samples 5, 6, 10, 12, 13-24, 27-33)

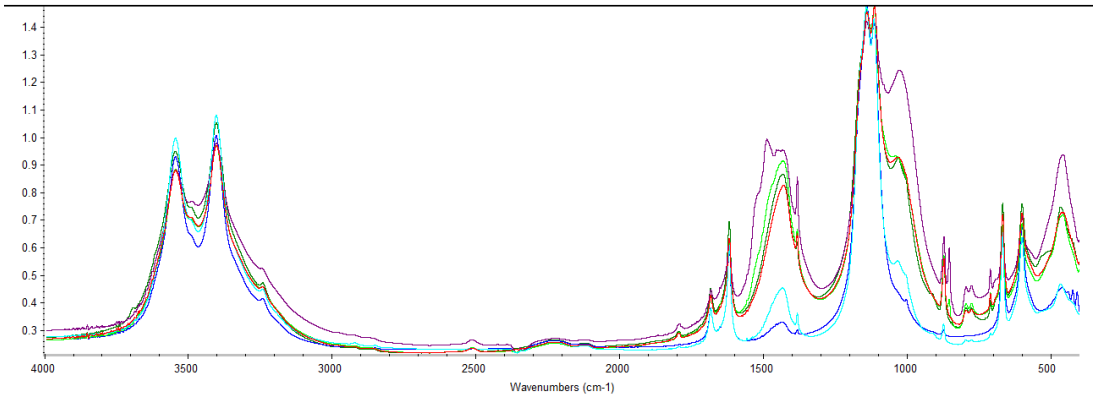

Figure 9 - FTIR Scans of figurines (Samples 7, 8, 9, 11, 25, 26.) It is clear when compared to the scans in Figure 8 above that the peaks in the 3000-4000 cm^{-1} range are quite different in this set of samples, and there is a lot of noise in the 1500-400 cm^{-1} range.

Table 3 - PPM analysis of figurines showing their general homogeneous makeup and their suitability for trace element analysis with XRF.

	MnKa 1	FeKa 1	ZnKa 1	GaKa 1	ThLa 1	RbKa 1	SrKa 1	Y Ka1	ZrKa 1	NbKa 1
WF1_East_40_29_60_1	215	12195	68	16	3	33	616	33	199	13
WF1_East_40_29_60_2	263	12586	69	12	13	41	632	18	192	21
WF1_East_40_29_60_3	450	12715	111	16	8	30	651	24	184	10
WF1_J_J14_244_11583_token_green_40_29_60_1	1530	26155	156	12	15	41	930	30	189	25

Table 3 - PPM analysis of figurines showing their general homogeneous makeup and their suitability for trace element analysis with XRF. (Continued)

WF1_J_J14_244_11583_token_green_40_29_60_2	1468	23788	126	11	7	43	981	36	188	24
WF1_J_J14_244_11583_token_green_40_29_60_3	679	27561	140	3	6	44	975	36	190	29
WF1_J_J14_244_11583_token_green_40_4_300_1	3288	25089	138	8	14	42	999	31	179	15
WF1_J_J14_244_11583_token_green_40_4_300_2	625	25805	152	12	7	55	928	33	195	19
WF1_J_J14_244_11583_token_green_40_4_300_3	1266	24788	126	10	11	45	880	38	176	22
WF1_J_J16_255_11757_blob_green_40_29_60_1	399	13449	129	20	11	50	792	32	198	15
WF1_J_J16_255_11757_blob_green_40_29_60_2	499	21321	138	11	10	51	864	38	210	29
WF1_J_J16_255_11757_blob_green_40_29_60_3	693	11230	91	16	6	48	676	31	186	18
WF1_J_J16_255_11757_med piece with gouge_green_40_29_60_1	418	18019	122	16	11	54	730	35	244	28
WF1_J_J16_255_11757_med piece with gouge_green_40_29_60_2	588	16391	121	16	5	44	730	37	203	21
WF1_J_J16_255_11757_med piece with gouge_green_40_29_60_3	426	14777	89	10	7	52	741	31	220	24
WF1_J_J16_255_11757_med piece with gouge_green_40_4_300_1	934	14955	121	17	10	36	735	33	212	23
WF1_J_J16_255_11757_med piece with gouge_green_40_4_300_2	506	16601	131	6	10	44	794	40	215	13
WF1_J_J16_255_11757_med piece with gouge_green_40_4_300_3	756	22795	138	7	12	49	726	35	270	25
WF1_J_J16_255_11925_token_green_40_29_60_1	615	16927	119	18	5	45	765	24	189	19
WF1_J_J16_255_11925_token_green_40_29_60_2	1355	19053	107	10	10	56	872	30	185	27
WF1_J_J16_255_11925_token_green_40_29_60_3	2879	16141	160	18	9	38	747	35	195	18
WF1_J_J16_255_11925_token_green_40_4_300_1	926	17578	107	13	17	50	798	38	200	30
WF1_J_J16_255_11925_token_green_40_4_300_2	791	16092	111	17	7	41	713	25	178	22
WF1_J_J16_255_11925_token_green_40_4_300_3	1315	17868	95	11	3	57	873	38	216	25
WF1_J_J16_255_11926_small lump_green_40_4_60_1	498	21901	134	10	7	53	768	38	222	26
WF1_J_J16_255_11926_small lump_green_40_4_60_2	242	17806	125	13	7	47	732	29	206	18
WF1_J_J16_255_11926_small lump_green_40_4_60_3	731	36528	262	10	18	63	1070	39	330	32
WF1_J_K17_205_12030_black triangular rod_green_40_29_60_1	3674	25824	144	10	10	56	905	40	187	29
WF1_J_K17_205_12030_black triangular rod_green_40_29_60_2	2451	21917	142	11	10	48	839	28	184	25
WF1_J_K17_205_12030_black triangular rod_green_40_29_60_3	660	27412	139	9	13	62	863	44	232	16
WF1_J_K17_205_12030_black triangular rod_green_40_4_300_1	2698	22542	145	9	9	45	790	32	200	19
WF1_J_K17_205_12030_black triangular rod_green_40_4_300_2	220	28352	164	12	8	57	880	37	217	28
WF1_J_K17_205_12030_black triangular rod_green_40_4_300_3	645	29074	144	8	7	39	933	47	226	32
WF1_M_K14_16_10126_black rod_green_40_29_60_1	1830	9338	85	18	14	37	700	24	177	27
WF1_M_K14_16_10126_black rod_green_40_29_60_2	447	9316	115	23	12	52	754	30	175	19
WF1_M_K14_16_10126_black rod_green_40_29_60_3	471	7397	103	17	20	41	829	29	171	20
WF1_M_K14_16_10126_black rod_green_40_4_300_1	340	5942	97	19	4	43	724	35	172	26
WF1_M_K14_16_10126_black rod_green_40_4_300_2	681	16451	98	14	10	29	702	23	137	12
WF1_M_K14_16_10126_black rod_green_40_4_300_3	524	10889	51	15	16	43	933	30	164	20
WF1_M_K14_16_10137_black bracelet with finger marks_green_40_29_60_1	588	12714	99	18	15	46	795	35	206	16
WF1_M_K14_16_10137_black bracelet with finger marks_green_40_29_60_2	421	11959	117	18	11	38	772	28	176	18
WF1_M_K14_16_10137_black bracelet with finger marks_green_40_29_60_3	353	14673	139	18	13	48	821	29	206	26
WF1_M_K14-L14_37_10027_token_green_40_29_60_1	304	16498	162	20	9	53	900	32	180	17

Table 3 - PPM analysis of figurines showing their general homogeneous makeup and their suitability for trace element analysis with XRF. (Continued)

WF1_M_K14-L14_37_10027_token_green_40_29_60_2	360	17366	140	14	6	32	762	26	155	21
WF1_M_K14-L14_37_10027_token_green_40_29_60_3	371	17203	125	10	4	38	826	30	149	20
WF1_M_K14-L14_37_10027_triangle_green_40_29_60_1	278	19278	133	17	7	39	957	33	148	17
WF1_M_K14-L14_37_10027_triangle_green_40_29_60_2	295	14643	135	22	16	45	947	33	149	21
WF1_M_K14-L14_37_10027_triangle_green_40_29_60_3	689	18189	127	18	12	39	1039	32	176	23
WF1_M_K14-L14_37_10027_triangle_green_40_4_300_1	218	14585	111	8	10	40	916	37	165	24
WF1_M_K14-L14_37_10027_triangle_green_40_4_300_2	500	20034	121	12	15	40	1071	34	182	20
WF1_M_K14-L14_37_10027_triangle_green_40_4_300_3	415	21147	91	3	1	43	1001	34	133	21
WF1_M_K14-L14_37_10206_longest piece_green_40_29_60_1	556	15335	142	9	8	46	1683	29	234	20
WF1_M_K14-L14_37_10206_longest piece_green_40_29_60_2	355	18020	96	13	14	38	1574	41	264	20
WF1_M_K14-L14_37_10206_longest piece_green_40_29_60_3	324	18957	155	19	9	47	1624	32	263	19
WF1_M_K14-L14_37_10206_longest piece_green_40_4_300_1	478	17990	109	15	8	40	1533	38	248	20
WF1_M_K14-L14_37_10206_longest piece_green_40_4_300_2	702	19517	148	18	0	52	1778	31	227	22
WF1_M_K14-L14_37_10206_longest piece_green_40_4_300_3	470	11769	72	5	11	19	1137	20	160	16
WF1_M_K14-L14_37_10206_looks like teeth_green_40_29_60_1	382	12481	78	15	2	31	854	32	187	21
WF1_M_K14-L14_37_10206_looks like teeth_green_40_29_60_2	204	14083	84	12	9	33	888	26	169	25
WF1_M_K14-L14_37_10206_looks like teeth_green_40_29_60_3	447	14723	92	16	16	28	850	33	188	18
WF1_M_K14-L14_37_10227_animal_green_40_29_60_1	1171	14825	125	16	15	27	1390	38	160	22
WF1_M_K14-L14_37_10227_animal_green_40_29_60_2	577	15024	121	20	10	35	1068	28	155	16
WF1_M_K14-L14_37_10227_animal_green_40_29_60_3	1007	17477	138	20	7	31	1124	37	131	25
WF1_M_K14-L14_37_10227_animal_green_40_4_300	333	14982	153	22	10	37	923	28	152	20
WF1_M_K14-L14_37_10227_animal_green_40_4_300_2	575	18528	156	21	3	37	1243	30	147	26
WF1_M_K14-L14_37_10227_animal_green_40_4_300_3	905	14418	111	19	8	37	1068	37	127	16
WF1_M_K14-L14_37_10227_animal_green_40_4_300_4	481	16197	144	22	14	43	1079	24	121	23
WF1_M_K14-L14_37_10227_animal_green_40_4_300_5	326	14040	111	20	18	43	1399	26	143	29
WF1_M_K14-L14_37_10227_small fingerprints_40_29_60_1	156	12946	81	8	13	35	855	38	170	14
WF1_M_K14-L14_37_10227_small fingerprints_40_29_60_2	468	12239	110	12	12	37	847	22	168	19
WF1_M_K14-L14_37_10227_small fingerprints_40_29_60_3	454	15449	134	7	15	38	832	32	166	20
WF1_M_K14-L14_37_10266_token_green_40_4_300_1	423	9594	135	24	13	30	493	17	102	21
WF1_M_K14-L14_37_10266_token_green_40_4_300_2	344	8580	123	13	1	29	744	25	137	23
WF1_M_K14-L14_37_10266_token_green_40_4_300_3	325	12042	134	25	7	46	870	36	153	23
WF1_M_K14-L14_37_10266_token_green_40_4_60_1	163	12097	107	18	12	40	826	32	162	19
WF1_M_K14-L14_37_10266_token_green_40_4_60_2	679	12308	95	19	22	39	844	32	162	24
WF1_M_K14-L14_37_10266_token_green_40_4_60_3	395	6274	72	10	2	41	677	25	139	26
WF1_M_K14-L14_37_10306_folded_green_40_29_60_1	593	21622	120	13	17	46	1069	26	133	25
WF1_M_K14-L14_37_10306_folded_green_40_29_60_2	589	16643	155	21	12	38	1227	39	135	25
WF1_M_K14-L14_37_10306_folded_green_40_29_60_3	258	19719	104	11	7	47	1599	38	153	22
WF1_M_K14-L14_37_10306_folded_green_40_4_300_1	451	17401	112	17	7	39	1324	32	167	18
WF1_M_K14-L14_37_10306_folded_green_40_4_300_2	274	15888	133	19	12	26	977	31	129	18
WF1_M_K14-L14_37_10306_folded_green_40_4_300_3	140	12784	43	8	4	46	943	28	144	17

Table 3 - PPM analysis of figurines showing their general homogeneous makeup and their suitability for trace element analysis with XRF. (Continued)

WF1_M_K14-L14_37_10308_token_green_40_29_60_1	840	12132	71	13	7	35	811	31	175	21
WF1_M_K14-L14_37_10308_token_green_40_29_60_2	529	16682	79	13	14	39	993	29	188	21
WF1_M_K14-L14_37_10308_token_green_40_29_60_3	647	17190	146	20	14	37	997	38	219	18
WF1_M_K14-L14_43_10325_animal head_green_40_29_60_1	405	21407	141	14	6	38	1000	36	155	21
WF1_M_K14-L14_43_10325_animal head_green_40_29_60_2	627	24688	157	12	12	54	954	33	168	21
WF1_M_K14-L14_43_10325_animal head_green_40_29_60_3	361	23754	116	10	16	57	1123	42	170	19
WF1_M_K14-L14_43_none_nondescript_green_40_29_60_1	449	9314	109	15	12	40	760	31	216	24
WF1_M_K14-L14_43_none_nondescript_green_40_29_60_2	264	9331	87	10	14	45	780	30	182	20
WF1_M_K14-L14_43_none_nondescript_green_40_29_60_3	197	8054	74	10	9	37	724	22	212	24
WF1_M_K14-L14_43_none_nondescript_green_40_4_300_1	285	9122	68	16	7	44	725	20	196	28
WF1_M_K14-L14_43_none_nondescript_green_40_4_300_2	539	11189	84	17	0	44	827	33	208	18
WF1_M_K14-L14_43_none_nondescript_green_40_4_300_3	225	10586	75	6	-2	32	788	23	178	22
WF1_M_K14-L14_unknown_10325_med token_green_40_29_60_1	218	16698	108	17	4	39	893	24	156	18
WF1_M_K14-L14_unknown_10325_med token_green_40_29_60_2	467	24701	105	-1	22	42	923	34	165	21
WF1_M_K14-L14_unknown_10325_med token_green_40_29_60_3	644	22601	126	13	-1	48	888	19	148	21
WF1_M_K14-L14_unknown_10325_med token_green_40_4_300_1	519	21502	101	5	13	42	1008	25	151	18
WF1_M_K14-L14_unknown_10325_med token_green_40_4_300_2	316	21354	122	14	17	50	983	32	150	21
WF1_M_K14-L14_unknown_10325_med token_green_40_4_300_3	164	24573	139	13	5	44	1034	30	171	20
WF1_M_L14_37_10243_token_green_40_29_60_1	232	13754	108	14	13	34	951	38	180	18
WF1_M_L14_37_10243_token_green_40_29_60_2	292	15661	123	20	7	44	902	39	166	21
WF1_M_L14_37_10243_token_green_40_29_60_3	274	11309	88	18	3	26	785	33	138	13
WF1_M_L14_37_10243_token_green_40_4_300_1	236	11132	88	15	9	34	862	23	155	29
WF1_M_L14_37_10243_token_green_40_4_300_2	221	16577	117	14	15	40	1000	35	152	21
WF1_M_L14_37_10243_token_green_40_4_300_3	257	14012	126	21	3	42	917	30	189	20
WF1_M_L15_57_10699_headless animal or token_green_40_29_60_1	345	17549	151	20	10	46	819	33	202	19
WF1_M_L15_57_10699_headless animal or token_green_40_29_60_2	334	13263	90	6	9	55	784	25	183	15
WF1_M_L15_57_10699_headless animal or token_green_40_29_60_3	432	13577	123	20	15	44	772	34	236	23
WF1_M_L15_57_10699_headless animal or token_green_40_4_300_1	308	13331	94	10	8	50	829	27	187	30
WF1_M_L15_57_10699_headless animal or token_green_40_4_300_2	492	17934	149	19	10	39	856	22	181	21
WF1_M_L15_57_10699_headless animal or token_green_40_4_300_3	408	15543	89	14	16	35	873	35	184	20
WF1_M_L15_57_10715_blob_green_40_29_60_1	607	16290	102	16	5	38	719	29	183	23
WF1_M_L15_57_10715_blob_green_40_29_60_2	349	20561	89	-1	11	48	674	36	173	26
WF1_M_L15_57_10715_blob_green_40_29_60_3	160	18472	149	13	19	44	717	30	165	33
WF1_M_M15_50_10524_token_green_40_29_60_1	326	13038	115	14	9	50	708	26	215	23
WF1_M_M15_50_10524_token_green_40_29_60_2	513	13699	118	15	10	37	662	32	260	19
WF1_M_M15_50_10524_token_green_40_29_60_3	1418	17979	123	10	8	45	728	29	253	22
WF1_M_M15_50_10524_token_green_40_4_300_1	298	17518	143	21	8	42	691	45	247	23
WF1_M_M15_50_10524_token_green_40_4_300_2	253	18379	109	16	10	53	693	26	226	26
WF1_M_M15_50_10524_token_green_40_4_300_3	913	22474	141	14	2	54	873	49	228	27
WF1_M_M15_51_10572_incised_green_40_29_60_1	1260	25204	95	6	9	53	629	36	203	22

Table 3 - PPM analysis of figurines showing their general homogeneous makeup and their suitability for trace element analysis with XRF. (Continued)

WF1_M_M15_51_10572_incised_green_40_29_60_2	716	26960	117	7	23	55	766	33	209	23
WF1_M_M15_51_10572_incised_green_40_29_60_3	560	21541	104	5	12	46	760	38	208	27
WF1_M_M15-M16_80_none_headless flat-bottom animal_green_40_29_60_1	582	17515	136	19	17	47	731	35	207	24
WF1_M_M15-M16_80_none_headless flat-bottom animal_green_40_29_60_2	250	21393	135	9	9	40	620	32	209	27
WF1_M_M15-M16_80_none_headless flat-bottom animal_green_40_29_60_3	580	14784	99	4	11	45	641	32	180	24
WF1_M_M15-M16_80_none_headless flat-bottom animal_green_40_4_300_1	740	16459	142	15	9	45	573	30	173	30
WF1_M_M15-M16_80_none_headless flat-bottom animal_green_40_4_300_2	684	23160	127	11	3	51	792	30	191	21
WF1_M_M15-M16_80_none_headless flat-bottom animal_green_40_4_300_3	1481	19995	147	14	11	47	708	31	200	26
WF1_M_M15-M16-L15-L16_80_20293_headless animal_green_40_29_60_1	449	15288	82	0	14	43	650	24	181	23
WF1_M_M15-M16-L15-L16_80_20293_headless animal_green_40_29_60_2	229	18613	115	14	11	42	690	38	180	20
WF1_M_M15-M16-L15-L16_80_20293_headless animal_green_40_29_60_3	138	19063	112	15	13	51	674	34	186	21
WF1_M_M15-M16-L15-L16_80_20293_headless animal_green_40_4_300_1	516	17862	107	10	9	45	562	30	177	16
WF1_M_M15-M16-L15-L16_80_20293_headless animal_green_40_4_300_2	608	16938	123	18	7	53	666	21	170	19
WF1_M_M15-M16-L15-L16_80_20293_headless animal_green_40_4_300_3	1612	19750	133	12	6	53	768	22	193	31
WF1_M_none_29_10194_fingerprints_green_40_29_60_1	447	16156	158	21	5	32	927	30	193	25
WF1_M_none_29_10194_fingerprints_green_40_29_60_2	204	12278	102	20	5	35	849	34	199	16
WF1_M_none_29_10194_fingerprints_green_40_29_60_3	498	11491	97	18	9	25	714	36	173	13
WF1_M_none_29_10194_fingerprints_green_40_4_300_1	165	11725	92	17	8	21	739	33	158	15
WF1_M_none_29_10194_fingerprints_green_40_4_300_2	273	8680	106	19	6	33	653	20	195	20
WF1_M_none_29_10194_fingerprints_green_40_4_300_3	450	10410	87	14	18	36	820	24	220	19
WF1_North_40_29_60_1	543	22026	144	16	6	39	942	33	348	18
WF1_North_40_29_60_2	216	19743	97	13	15	61	886	23	215	26
WF1_North_40_29_60_3	280	19844	143	17	2	41	843	27	200	19
WF1_Northeast_40_29_60_1	494	20836	125	12	11	34	1814	31	185	24
WF1_Northeast_40_29_60_2	314	21003	146	15	6	35	1729	34	202	18
WF1_Northeast_40_29_60_3	638	21164	114	12	2	48	1952	38	228	18
WF1_Northwest_40_29_60_1	515	8194	56	2	-3	21	199	10	145	11
WF1_Northwest_40_29_60_2	325	7235	71	15	2	16	224	20	155	12
WF1_Northwest_40_29_60_3	242	7750	39	16	12	19	239	15	138	13
WF1_Southwest_40_29_60_1	28	13035	100	14	-2	32	879	30	254	13
WF1_Southwest_40_29_60_2	295	12969	77	-4	9	30	790	30	224	18
WF1_Southwest_40_29_60_3	514	12287	75	7	11	22	616	20	207	18

From the XRF ppm analysis, it seems apparent that the clay is largely homogenous. That is not to say that it is pure clay; the FTIR clearly shows that it is not (Figure 10.) However, XRF depends more on homogenous grain size and homogenous makeup within the

sample, as opposed to homogeneity of minerals. The reason for this is that the x-ray beam is small, and in this study does not penetrate deeply into the sample. Thus, even if many elements are present, if they are all likely to be in the beam of the x-ray at the same time, the sample is homogenous enough for analysis. According to Table **3** above, most of the samples are homogenous enough to be used in XRF analysis. This means that, while the elements detected by the green-filter scans are nearly ubiquitous in clay, with additional scans and equipment, we may be able to source the clay more securely. A vacuum pump and a filter that allows for the detection of lighter trace elements which sometimes provide a signature signal may allow for true provenience work to be done.

Discussion

Interpreting the meaning, use, and function of figurines is difficult at best. On the one hand, archaeologists rarely record detailed contextual information unless a find is truly spectacular (an adjective which is, of course, subjective and open to the whims of the investigator.) On the other hand, interpretation has, so far, tended to be in a rather Orientalist vein (sensu Said 1979). The idea of The Religion of the Prehistoric Near East (the exact nomenclature is less important than the overall concept here) as a monolithic, unchanging entity from the Neolithic to the advent of the Judeo-Christian tradition in the Iron Age is key archaeological conceit for some archaeologists working in earlier eras and who were the first to interpret ritual finds from the Neolithic (e.g. Cauvin and Watkins 2000; Cauvin 2002; Kenyon 1979). The key idea is that of essentializing an entire culture, specifically in opposition to the Modern West. While Said originally applied his analysis to historical periods and especially to the colonial and post-colonial world since the 16th century AD, it can easily be extrapolated to deal with many archaeologists' interpretations of ancient culture. This is especially true since it is certainly the case that this colonial period is precisely what made modern archaeological work possible, and has greatly influenced the work and interpretations of many, if not most, archaeologists. For example, Cauvin's interpretation is that the religion of the Neolithic Near East was a dualist entity focused on The Woman and The Bull (Cauvin and Watkins 2000). Cauvin estimates that once the religion of sedentary farmers took hold, it remained largely unchanged until the advent of the monotheistic religions of the Iron Age (i.e. the Judeo-Christian tradition (Cauvin 2002).) He uses information from a

span of at least 3,000 years (perhaps closer to 8,000 when he discusses the continuation of this cult into the Classical periods) and from sites that span the area from Southern Jordan to Central Anatolia. Indeed, some of his interpretations are based on data that extend all the way into the Classical periods (i.e. Hellenistic and Roman), and frequently his information for each part of the religion comes from a different site. This is rather like an archaeologist in the year 15,012 AD assuming that people across the Middle East (or whatever it comes to be called then) practiced a polytheistic religion based on three gods called Jesus, Moses, and Mohammad. A potentially reasonable interpretation, given the types of evidence they might be expected to find, and containing an amount of truth, but also vastly simplistic and general, not to mention rather inaccurate. Of course, new information is constantly coming to light, which means that our interpretations should constantly be changing as well. While it may not be possible to ever get at the minutiae of ritual or belief in the Neolithic, it is still the responsibility of archaeologists and anthropologists to keep trying, and not rest on received wisdom for our interpretations.

This is not to say that there is *no* basis for Cauvin's interpretation. Indeed, woman figurines and bull figurines are common at more than one site and in more than one period – but so are many other types, such as goats and gazelles (Meskell 2008; Rollefson 2008a). It is probable that sites were not isolated, and in fact it is fairly certain that they must have had contact with one another. How extensive that contact was is difficult to ascertain; many items that could have been traded do not preserve in the archaeological record, and the evidence of trade, while firm, is rare. There are of course continuities both regionally and supra-regionally, but there is also extensive evidence for regional difference (Simmons and Najjar 2004). This means that to see a pan-Neolithic

religion, spanning thousands of square kilometers and thousands of years, is almost certainly an oversimplification, especially since there is not always evidence of both types of figurines (or either type, necessarily) at every site. Indeed, ethnographic studies of the use of figurines demonstrate that their uses, meanings, and functions are widely varied, even within a small geographical area (Voigt 2002). It is difficult to accept on meager data that the people of Wadi Faynan 16 practiced the same religion (or cult, or embedded ritual – "religion" is itself a problematic category in contexts other than the post-Enlightenment West) as those at Çatal Höyük three thousand years and four thousand kilometers away. Perhaps it was similar or related, but we can't assume that.

Indeed, the entire idea of a Mediterranean (or even pan-Levantine) interaction sphere has also been questioned (Asouti 2006), in the sense that since we know so much more now than we did in the early 1980s, we should entirely reassess our interpretations of the interactions of these societies, whether in the realm of economic exchange, ritual, or social structure. While the concept of the Levantine PPNB Interaction Sphere (Bar-Yosef and Belfer-Cohen 1989a) is generally applied to economic trade, it may make sense to think of it as including ideas as well; the general concept is quite vague, and as it refers to trade only in the most general terms without suggesting the types of items that might be traded, extending it to ideas is no great stretch. At any rate, the fact that one can apply it to almost anything, from obsidian to marriage practices, may mean that eventually it will have to be refined and particularized. General, overarching, and essentializing narratives are gradually being replaced with complex, regional, and data-based ones. Hans Gebel, for instance, believes that there were many Neolithics, and that they evolved polycentrically, if not independently (Gebel 2004b), which is an interesting

place to start from, as it allows researchers to focus on a smaller area and then synthesize from the local, rather than from the pan-regional.

Thus, until evidence is found that more directly links these distant sites and peoples, it is probably more accurate to interpret figurines in their local contexts, perhaps including nearby sites that either demonstrably did or easily could have had contact with one another. A good local analysis of form, deposition, and use-wear has been done by Mary Voigt (2002) on figurines from Çatal Höyük, Hajji Firuz, and Gritille Höyük. She analyzed the shape, type, and material of each figurine, where and how it was deposited and what else, if anything, was deposited with it, and which parts were broken. She then combined each of these factors in a statistical analysis to see if any of them correlated with one another, and then compared these to analyses of figurines in the ethnographic record. It does seem that different types of figurines may have been used for different purposes and in different settings; for example, some of them may have been children's toys. It is far from clear whether this particular interpretation can be applied to sites in the Southern Levant; certainly, it shouldn't be done uncritically or without studying the south Levantine figurines themselves. But if enough smaller studies like these are done, perhaps the larger patterns, if there are any, will become apparent.

In this light and on this scale, □Ain Ghazal seemed to have had at least trading contact in the MPPNB with the Faynan region (probably Ghwair 1, if the radiocarbon dates are followed rather than the material culture), and in the LPPNB, those living at Ba'ja, Basta, and es-Sifiya could all easily have been in contact with the people at Tel Tifdan. Indeed, the similarities between the assemblages at many of these sites are quite close. For example, both □Ain Ghazal and Tel Tifdan contain pierced bovine figurines (Levy In

Prep; Rollefson 2008a) – figurines that appear to represent cattle and which have had a small flint "blade" stuck through them. Shkarat Msaied seems to have been a bead-production workshop, much like Tel Tifdan (Jensen 2004; Levy In Prep). Other similarities may become apparent as more site reports and assemblage studies are published.

Conclusions

There is every possibility that ritual in the Neolithic was highly local, but that contact between and within regions lent some influence or continuity to various local practices so that they show echoes of one another across vast distances. While much has been written on Neolithic ritual, little of it looks closely at individual sites or even individual regions. That is beginning to change, but so much new information has come to light in such a short time, and so much remains to be excavated, that researchers can barely keep up with preliminary reports, let alone detailed analyses of single data sets. That said, there is so much speculation about the beliefs of Neolithic peoples that settling down to a close, detailed, and sober analysis may do much to alleviate the essentializing Orientalist interpretations left over from previous generations.

While the XRF scans of the clay figurines from Tel Tifdan appear to be at least somewhat homogenous, meaning that they are amenable to XRF trace element analysis, the fact that trace element analysis could not actually be done with XRF leaves much open to question. In order to finish the study of provenience, a second set of scans should be done on the figurines, with no filter and in a vacuum at 40kV and 3microamps; this low-energy setting detects lighter elements (Fe and lower) which are often present as trace minerals in clays. These elements, in particular, can help to source clays. However, since the figurines are currently residing in Amman, Jordan, this analysis will have to be done at a later date. It would also be preferable to include the complete figurines now

residing in the museum in this analysis, and, time permitting, to include all of the broken figurines from which the original sample was taken.

In addition, an analysis similar to Voigt's (2002) would be most helpful in establishing what the figurines may have been used for. While it is of course possible and even likely that they were used for ritual purposes, there is always the possibility that they were not. This may be difficult to determine, especially given the ambiguous nature of both figurines and archaeological excavation, but nevertheless it should be attempted.

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