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3 A Burning Issue: Firing Temperatures and the Production of Late Bronze Age Pottery from
4 Tarsus-Gözlükule, Turkey

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14
15 Abstract

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17 Although ceramic pyrotechnology is a critical component of pottery production, archaeometric
18 studies rarely integrate firing practices into discussions of the organization of pottery
19 manufacture. The primary obstacles to such studies are the limited range and accuracy of many
20 analytical methods, small sample populations, and observed variation within a single firing. We
21 posit in this study that a robust sampling strategy paired with magnetic susceptibility, which has
22 been shown to be an accurate means of estimating maximum firing temperatures, can identify
23 patterns in ceramic pyrotechnology explainable in terms of production strategy. In our case study
24 we analyze Late Bronze IIA pottery from Tarsus-Gözlükule in southern Turkey. The data
25 indicate that the potters consistently fired their pottery to two different maximum temperatures. It
26 is suggested that these two maximum temperatures may have been the result of either the use of
27 two different firing structures or the seasonal exploitation of different fuels.

28
29 Keywords

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31 Pottery; Magnetic Susceptibility; Firing Temperature; Turkey; Hittite

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33 1. Introduction

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35 The firing of a pot, like the collection of raw materials and the shaping of a vessel, is an essential
36 step in pottery production. However, when scholars consider ceramic pyrotechnology, their
37 tendency has been to focus on the analytical methods used to estimate a firing temperature rather
38 than how firing practices may relate to the organization of pottery production (D.E. Arnold 2008,
39 281; Tite 1995, 37; as exceptions see Buxeda i Garrigós et al. 2001; 2003). Three key factors
40 have limited the ability to bridge this gap between scientific method and archaeological
41 interpretation. First, most analytical methods used to reconstruct firing atmospheres have low
42 levels of precision over a limited temperature range. Second, the sample population is often
43 small, can span hundreds or even thousands of years, and may include pots produced in different
44 contexts. Finally, ethnographic studies and experimental archaeology have recorded significant
45 variation in temperature within a single firing structure, raising questions about the extent to
46 which firing temperature can be applied to reconstructions of firing atmospheres (Gosselain

1992; Livingstone Smith 2001; Thér 2014; Thér and Gregor 2011). As a result of these three limitations, when the discussion moves beyond analytical method to pottery production, the contribution of ceramic pyrotechnology is often restricted to distinctions between firing done in open pits or bonfires and those performed in built kilns (for a critique see Livingstone Smith 2001). While such distinctions are certainly important for understanding developments in pottery production over the long course of human history, the current study demonstrates that ceramic pyrotechnology holds the potential for gaining further insights into production.

This paper presents the results of magnetic susceptibility, a relatively new and accurate method for estimating the maximum firing temperature (Rasmussen et al. 2012), applied to pottery produced from the same clays around the site of Tarsus-Gözlükule in southern Turkey in a single archaeological period, the Late Bronze IIA (LB IIA) (c.1425-1200 BCE). Given the documented variation in the firing of a single kiln, the application of controlled variables – in this case chronological, cultural, and compositional – is critical for interpreting observed patterns in the dataset. The accuracy of the analytical method and controlled variables of the sample population allow for new insights into the production of this pottery. The data suggest that the potters employed two different firing atmospheres, one of which consistently achieved a maximum firing temperature of 740°C and a second that had an average maximum firing temperature of between 800°C and 830°C. We propose two possible explanations for these different practices. It may be that the potters employed two different firing structures in the LB IIA, or that the potters employed different fuels, the availability of which would have been tied to the seasonal rhythms of the local agro-pastoral cycle.

2. Pyrotechnology, the Weakest Link in the *Chaîne Opératoire*

The most basic steps in the production of pottery include the collection and preparation of raw materials, the forming of the vessel, and the firing. Of these steps, the firing can be the riskiest and require the most skill (D.E. Arnold 2008, 288-301). A number of variables such as a sudden rain or a shift in winds have the potential to destroy the entire load of pottery (D.E. Arnold 2015, 250-72; P.J. Arnold 1990; Ionas 2000, 175; Rye and Evans 1976, 30-6). In addition, firing requires a large investment in fuel and the construction of a firing structure, often the potters' greatest investment (D.E. Arnold 2008, 286). Taking into account both risk and cost, potters fire their wares within specific environmental, technological, and cultural contexts (Pool 2000; Sillar 2000). These contexts contribute to the creation of the firing atmosphere, which is defined as a combination of the maximum firing temperature, heating rate, and duration of exposure to the maximum temperature (Livingstone Smith 2001, 991-2). It stands to reason that different contexts give rise to different firing atmospheres, and, conversely, that demonstrable variations in firing atmospheres are suggestive of pottery having been fired within different contexts.

The difficulties of reconstructing the firing atmosphere present a significant obstacle to the study of ceramic pyrotechnology. Excavated firing structures are quite rare, and thus most analyses are restricted to estimating the maximum firing temperature from the ceramics. Such analysis depends on the assumption that after a pot has been fired and cooled, its physical, mineralogical, and chemical properties remain relatively unchanged until it is refired at a temperature that exceeded the original firing. Previous studies have employed a variety of analytical methods combined with incremental increases in the refiring of sherds to identify the point at which

physical changes occur. As time is a factor in these changes, the maximum firing temperature calculated through refiring is relative to other samples run under the same conditions and does not necessarily represent the original firing temperature (Tite 1969; 1995). Popular methods for estimating the maximum firing temperature include petrography, x-ray diffraction (XRD), scanning electron microscopy (SEM), color coordinates, Mössbauer spectroscopy, and thermal expansion (Maggetti 1982; Maniatis and Tite 1981; Maniatis et al. 1982; Mirti 1998; Roberts 1963; Tite 1969; Wagner and Wagner 2004; Zhu et al. 2014). These methods are limited in both their accuracy and range, often reducing data to being fired either above or below a single temperature established from *a priori* assumptions about firing structures (i.e. Chatfield 2010; for further discussion of methods see Rice 2015, 376-87; Tite 1995; 2008). Magnetic susceptibility, a method recently developed by Rasmussen et al. (2012), is more accurate over a wider range than previous tests. Moreover, magnetic susceptibility is a relatively quick procedure, allowing for the generation of larger datasets.

Both Gosselain (1992) and Livingstone Smith (2001) have raised questions about the usefulness of maximum firing temperature as a metric for identifying different firing structures. Gosselain's (1992, 252) study found that the maximum temperature of a single firing can vary from 150°C to 550°C depending on the location of the reading within the firing structure, and Livingstone Smith (2001, table 1) arrived at similar results. Experimental tests conducted in a variety of archaeologically attested firing structures have reproduced these observations (Thér 2014, table 2; Thér and Gregor 2011, fig. 5). A significant implication of these studies is that two sherds produced in firing structures known through ethnographic observation to be different may yield similar maximum firing temperatures, and, therefore, the maximum firing temperature is of limited utility when attempting to differentiate between bonfires, single-chamber kilns, and double-chamber kilns.

Figure 1. Map of southern Turkey with relevant LB IIA sites.

While it may not be possible to reconstruct specific firing structures from maximum firing temperatures, these data can nevertheless be used to gain valuable insight into pottery production. Measurements taken from multiple vessels produced in a common context can be graphed as a histogram that illustrates the range and average maximum firing temperature specific to the context in which the vessels were produced. To this end, we used magnetic susceptibility to estimate the maximum firing temperatures for 62 Monochrome Ware (MW) sherds locally produced in the vicinity of Tarsus-Gözlükule during the LB IIA (Fig. 1). By analyzing sherds from the same period, ware, and raw materials we sought to control, to as great an extent as archaeologically possible, the likelihood that the pottery included in this study was the product of the same environmental, technological, and cultural contexts. When situated within the broader archaeological record of Tarsus-Gözlükule, this histogram sheds new light on the production of pottery that cannot be gleaned from other forms of analysis.

3. Archaeological Background

Goldman (1956) excavated the LB IIA level at Tarsus-Gözlükule in the 1930s and 1940s. Because her excavations pre-dated the widespread use of radiocarbon dating, absolute dates depend on regional chronologies. In her LB IIA level, Goldman documented several monumental buildings, the implementation of Luwian hieroglyphic seals, and the introduction of new ceramic shapes. All three notable changes have their origins in the heartland of the Hittite Empire, and it is generally thought that the Hittites introduced these changes (Gates 2001; Glatz 2009; Postgate 2007). When and how the Hittites introduced these changes remains uncertain. The historical record indicates that the Hittites exercised political influence over Cilicia by the reign of Tudhaliya I, who ruled at the end of the fifteenth century (Beal, 1986; Wilhelm, 1988), and radiometric data from Kilise Tepe and Kinet Höyük clearly demonstrate that similar shifts in the material culture occurred by the second half of the fifteenth century if not sooner (Bouthillier et al. 2014; Collon et al., 2010, 172-174; Gates, 2006, fn. 7, fn. 13; Hansen and Postgate, 2007; Kuniholm et al., 2007, 622). The subsequent Late Bronze IIB (LB IIB) at Tarsus-Gözlükule included Late Helladic IIIC pottery, which dates to the start of the twelfth century (Kaniewski et al. 2011), providing a *terminus ante quem* for the end of the LB IIA. In terms of absolute years, this span of time is at least two centuries. However, from an archaeological perspective, the LB IIA cannot be further divided, and, therefore, material from the LB IIA at Tarsus-Gözlükule is regarded as contemporary.

The single most common ware from the LB IIA was MW, characterized by a buff, undecorated exterior (Fig. 2). This utilitarian ware included open and closed vessels that would have been used for storage, transportation, and the consumption of food. The repertoire of shapes and method of producing MW are rare in the preceding stratigraphic levels at Tarsus-Gözlükule but well known from the Hittite heartland of Central Anatolia. The proliferation of MW in the LB IIA is, therefore, regarded as a Hittite-style of pottery that was introduced as part of the larger economic and administrative integration of Cilicia into the empire (Gates 2001; Glatz 2009; Postgate 2007).

Previous studies have addressed the pyrotechnology of Hittite-style pottery. As part of a larger geochemical study of pottery from Gordion, Henrickson and Blackman (1996) fired local clays at 650°C and 850°C and found that a measurable chemical difference existed between a handful

Figure 2. The most commonly occurring open (A) and closed (B) MW shapes from LB IIA Tarsus-Gözlükule. Figure 2A: basin (1), carinated bowls (2-3), hemispherical bowl (4), miniature bowl (5), tub (6), plates (7-9), shallow bowls (10-12). Figure 2B: small-rim jars (1-2), lid (3), medium-rim jars (4-5), jar with basket handle (6), large-rim jars (7-8), miniature jar (9).

Figure 3. Results of principal component analysis conducted on the NAA data from clay deposits near the Berdan River (n=5) and pottery from Kilise Tepe (n=121), Kinet Höyük (n=47), and Tarsus-Gözlükule (n=140). The ellipse represents a 90% confidence level for membership in the Tarsus-Gözlükule geochemical group. Only the samples from Tarsus-Gözlükule that were included in the magnetic susceptibility test are plotted in the graph.

of the higher and lower fired clays. Similar chemical differences separated the cooking pottery from serving and storage vessels, leading the authors to conclude that the Hittite-period potters at Gordion fired cooking pottery at a lower temperature. A second study examined a total of 19 sherds from the Hittite sites of Boğazköy, Alaca Höyük, Ortaköy, and Kuşaklı (Ertem and Demirci 1999; Ertem et al. 1998). Through a combination of petrography, XRD, and SEM the researchers determined that the samples from Boğazköy, Alaca Höyük, and Ortaköy were not fired beyond 700-900°C while the pottery from Kuşaklı appears to have been fired above 900°C.

The Archaeometry Laboratory at the University of Missouri Research Reactor (MURR) applied neutron activation analysis (NAA) to the MW as well as other pottery from the LB IIA level at Tarsus-Gözlükule according to established laboratory protocol (Glascock and Neff 2003; Glascock et al. 2004; Karacic et al. 2016). Previous studies conducted NAA on contemporary pottery from Kilise Tepe and Kinet Höyük (Grave et al. 2008; Hodos et al. 2005; Knappett and Kilikoglou 2007). In addition, these studies published NAA results from geological samples collected from the Berdan River, which ran past Tarsus-Gözlükule, and several other sources in the region. A comparison of the data collected by MURR with contemporary pottery from Kilise Tepe and Kinet Höyük determined that the pottery from Tarsus-Gözlükule share an unique geochemical signature, and this signature compares favorably with samples collected from the Berdan River (Fig. 3) (Karacic et al. 2016). A more detailed analysis of the NAA data further divided the Tarsus-Gözlükule pottery into subgroups alpha, beta, and gamma (Fig. 4). These subgroups have been interpreted as the product of at least three contemporary potters' workshops that were all located in the vicinity of Tarsus-Gözlükule (Karacic et al. 2016).

Figure 4. Results of principal component analysis conducted on LB IIA pottery from Tarsus-Gözlükule (n=140). The ellipses represent 90% confidence levels for membership in the subgroups alpha, beta, and gamma as determined for the larger corpus of 140 LB IIA sherds from Tarsus-Gözlükule (Karacic et al. 2016). Only those sherds included in the magnetic susceptibility tests are plotted in the graph.

4. Sampling Strategy and Method

The samples (n=62) included in this study were MW sherds from the LB IIA level at Tarsus-Gözlükule identified by NAA to have been locally produced. The samples were taken from all three subgroups ($\alpha = 19$, $\beta = 11$, $\gamma = 17$) as well as pottery that was locally produced but could not be assigned to a specific sub-group (n=15). Sampling was conducted according to subgroup in order to determine if there was a correlation between the raw materials selected for pottery production and the maximum firing temperature. Samples were also selected with vessel shape in mind, because it may have been the case that potters fired certain shapes differently from others. A number of sherds included in the NAA study showed traces of later firing due to use as a cooking pot or as a consequence of post-depositional processes. These sherds were excluded from the analysis because such exposure to later firings may have altered the mineralogy.

Figure 5. Examples of the experimental data. Two samples from different locations on the same vessel (A, B) were analyzed to see if there was noticeable variation across the surface of the vessel. One sherd was cut in such a way that the surface was removed and the core was analyzed (C) in order to determine if the maximum firing temperature differed from a complete section of the same sherd (D).

The magnetic susceptibility tests followed a methodology adopted from Rasmussen et al. (2012) in order to reconstruct the maximum firing temperature of each sherd. The premise for this analysis is as follows: magnetic susceptibility, as a bulk mineral characteristic of the pottery, remains relatively constant after the ancient firing of the pot, whereas re-firing beyond this point

leads to a change in magnetic susceptibility. By re-firing pottery at set intervals and measuring magnetic susceptibility between each re-firing, it is possible to identify the temperature at which the magnetic susceptibility changes, and from this change deduce the maximum firing temperature. Rasmussen et al. (2012) demonstrated that such a method can estimate firing temperatures with an uncertainty (1σ) of $\pm 25.8^\circ\text{C}$ from 400°C to 1000°C .

In the current study, a sample was cut through the section of each sherd in such a way that the sample included the interior, exterior, and core. Then magnetic susceptibility was measured in triplicate and averaged. The samples were then fired in a furnace under normal atmospheric conditions at 30°C intervals from 320°C to 1100°C . The firing duration decreased as the temperature increased in accordance with Rasmussen et al. (2012). After each firing, the magnetic susceptibility was measured in triplicate and averaged. Both the magnetic susceptibility data and the first derivative squared of this data were then plotted as a function of temperature, and the maximum firing temperature was identified as the first point where there was a significant change in the magnetic susceptibility.

In order to test whether two samples from the same pot provided different estimates for the maximum firing temperature, multiple samples from different parts of the same vessel were measured. In addition, we tested whether the maximum firing temperature differed between the surface and core of a sherd. To do this, we separated the exterior of a sherd from the incompletely oxidized core and compared the results of the core with a complete sample taken from this sherd. For both tests we found that there was no significant variation in the maximum firing temperatures (Fig. 5).

5. Results

The LB IIA pottery from Tarsus-Gözlükule was fired to an average temperature of 782.6°C with the lowest temperature at 590°C and the highest 920°C . A histogram of the data reveals bimodal distribution with peaks at 740°C and 800°C to 830°C (Fig. 6a).

The difference between peaks exceeds the estimated uncertainty of the experimental method. There is no mineralogical explanation for why changes in magnetic susceptibility would be more likely to occur at 740°C and 800°C to 830°C than at 770°C , as typical rock-forming minerals have temperature dependent changes in susceptibility at temperatures below 700°C . As previously mentioned, the range of maximum temperatures within a single firing structure can vary by over 100°C . The diffusion of heat within a firing structure can be assumed to follow a normal distribution of maximum temperatures. In other words, certain parts of the structure will be very hot and others relatively cool while the majority of the space is close to a mean temperature. Expanding upon this assumption, a histogram of the maximum firing temperature of sherds produced in the same firing atmosphere would therefore follow a normal distribution. In the case of the data from Tarsus-Gözlükule, the Shapiro-Wilk test, a statistical method employed to test for normal distribution (Hally 1984), permits rejection of the null hypothesis of sample normality for the local MW vessels ($p=0.0182$).

It is not possible to explain the peaks at 740°C and 800°C to 830°C as the result of two potters' workshops each using a different firing methods because both alpha and beta produce the same

bimodal distribution (Fig. 6b, c). Likewise, the bimodal patterns for both open and closed vessels suggest that the potters did not fire open vessels at one temperature and closed vessels at another (Fig. 6e, f). Gamma is the notable exception: there is no peak at 800°C to 830°C; gamma has the highest standard deviation; and the lowest and highest estimated temperatures belong to this subgroup (Fig. 6d). This greater range would suggest that gamma was the product of a ceramic workshop that was less consistent in its firing practices than alpha and beta, both of which regularly achieved maximum firing temperatures at 740°C and 800°C to 830°C.

Figure 6. Histograms of the maximum firing temperatures. The Shapiro-Wilk test calculated the probability (p) that the data conformed to a normal distribution.

6. Discussion

These results raise the following question: what might account for a bimodal distribution in the histogram? As previously mentioned there are many variables that may influence the firing

temperature of pottery. Weather, particularly strong winds, and rain can have an impact on the kiln temperature (P.J. Arnold 1990; Ionas 2000, 175). However, if weather was the contributing factor, then the firing temperature would be expected to follow a normal distribution as temperatures fluctuated between seasonal highs and lows.

Another possible explanation is that alpha and beta, but not gamma, employed two firing structures. This would account for the bimodal distribution of the data; one firing structure would have consistently achieved a temperature of 740°C and the other a temperature of 800°C to 830°C. Contemporary firing structures are known from Central Anatolia at the sites of Boğazköy and Kuşaklı as well as the Syrian and Levantine sites of Alalakh, Qatna, and Tell Sabi Abyad (Al-Maqdissi 2002; Dardeniz forthcoming; Duistermaat 2008; Mielke 2006, 173-4; Müller-Karpe 1988, 7-12). Although not all of the firing structures are well preserved, the evidence indicates that Late Bronze Age potters employed updraft kilns, often with evidence for a firebox. Excavations at Alalakh have determined that within a single workshop there can exist variation in both the size and organization of internal chambers for the kilns (Yener and Yazıcıoğlu 2010, 16-9), both factors that would have influenced the maximum firing temperature. These observations leave open the possibility that the potters at Tarsus-Gözlükule may have used two different kilns. Dean Arnold (2008, 301) observed that potters from Mexico employed smaller updraft kilns to meet small orders and larger beehive-shaped kilns for big orders, and it may be that the potters from Tarsus-Gözlükule followed a similar practice. Ethnographies and experimental archaeology have demonstrated that maximum firing temperature is not a suitable variable for identifying the type of firing structure used to produce pottery (Gosselain 1992; Livingstone Smith 2001; Thér 2014; Thér and Gregor 2011). Therefore, if this bimodal distribution does in fact represent the use of two different firing structures during the LB IIA at Tarsus-Gözlükule, then the exact differences between the two structures must remain within the realm of speculation until excavations recover the kilns themselves.

Fuel is also known to impact the maximum firing temperature. Ethnographies record potters using a wide range of fuels, each of which has a different firing characteristic (Gosselain 1992; Livingstone Smith 2001). Paleobotanical data for the LB IIA at Tarsus-Gözlükule are not available, but it is possible to infer the presence of certain fuels from the archaeological record. Excavations uncovered a sickle in the East Building, clear evidence for the harvesting of grain (Goldman 1956, 281-2). Within this same building, excavations uncovered a trough that suggests animals were kept (Goldman 1956, 53-4), and where there are animals there is dung. Both chaff from the harvesting of wheat and dung are viable fuel sources for firing pottery (Nicklin 1979, 446; Sillar 2000; Van der Veen 1999). Though there is no reason to link the East Building, which is typically interpreted as the residence of a prominent individual (Goldman 1956, 56), with the production of pottery, it is possible to extrapolate from this evidence two dimensions of the local economy that may have provided fuel for potters: the harvest and animal husbandry.

Assuming that the potters maintained workshops in the vicinity of Tarsus-Gözlükule year-round, then it may have been the case that the use of these two fuel sources was seasonally dependent. In a report by British Naval Staff Intelligence (1919, 39-46) on pre-mechanized farming in Cilicia at the start of the twentieth century, it was observed that herds of animals were taken from the plains up to the foothills of the Taurus Mountains from June until September, and it was at the start of this migration into the hills in the months of June and July that wheat was harvested.

Yakar (2001) has argued for a similar pattern of subsistence – a combination of farming and animal husbandry with herds being taken into the mountains during the summer months – for Cilicia in both the Ottoman Period and the Late Bronze Age. Such a subsistence pattern would have provided the potters with dung in the winter and agricultural waste in the summer.

It is not uncommon for potters to be closely tied to agro-pastoral subsistence strategies. For example, modern potters from Cyprus regard their trade as supplementary to farming (Ionas 2000, 210). In his study of these Cypriot potters, Ionas (2000, 211) writes, “Since all those possessing skills in the countryside were first and foremost farmers, they had to follow the annual calendar imposed by nature on agriculture, a calendar which conditioned the life of the family as much as that of the village.” Dean Arnold (2008, 37), in his study of pottery production in Mexico from the 1960s to the present day, recorded a similar symbiotic relationship between farming and pottery production. He observed that potters often practiced farming as a way to buffer against the unpredictable demand for pottery, and he noted that agricultural waste provided the potter with fuel. When animal husbandry is a significant component of the local subsistence strategy, then potters also make use of dung. In his discussion of pottery production in the Andes, Sillar (2000) determined that potters preferred to use dung when firing their pottery because animal husbandry, which was practiced by many of the potters and embedded within their social and economic practices, made dung a less expensive alternative to wood. A study conducted among agro-pastoral families in Uzbekistan found that both dung and wood were used as fuels for domestic cooking. Dung was regarded as a fuel for the winter when the herds were kept near the villages. Wood seems to have been preferred in the summer months; at this time herds were taken to grazing grounds at higher elevations far from the villages (Gur-Arieh et al. 2013, 4338). Though notions of hygiene were noted as having an impact on the selection of wood over dung, it was generally concluded that availability, rather than the performance of one fuel over the other, determined fuel selection (Gur-Arieh et al. 2013, 4344-5).

It may be the case that similar opportunism informed the decisions of the potters in the vicinity of Tarsus-Gözlükule. Given the likely agro-pastoral subsistence pattern practiced in the plain of Cilicia and the embedded nature of pottery production within such practices, we propose as one explanation for the two different firing peaks that the majority of potters used dung in the winters and then a second fuel source, possibly agricultural waste, in the summers. It may be that subgroup gamma was only produced during part of the year or that this group of potters had regular access to a single type of fuel. The combustible properties of dung vary widely depending on the animal that produced the dung as well as its preparation – how it is dried, possible additives, and storage (Sillar 2000, 48-9). As a result, it is not yet possible to associate the 740°C and 800°C to 830°C peaks with specific fuel types. It may be the case that as current excavations recover paleobotanical data, re-firing tests with different fuels can shed further light on this question.

7. Conclusions

The production of MW has played a role in larger discussions of Hittite imperial administration within their provinces. Central to this discourse is the assumption that MW was highly standardized and the result of mass production, which, in turn, has been viewed as a byproduct of integration into the Hittite Empire (e.g. Gates 2001; Postgate 2007). This interpretation depends

largely on qualitative evaluations of the material as homogenous and lacking in aesthetic value, a point highlighted by the fact that this pottery is also referred to as ‘drab ware’ (Schoop 2011). However, when statistical analysis has been conducted on Hittite-style pottery evidence for standardization appears to be lacking (Glatz et al. 2011), and detailed studies of the organization of pottery production have identified more heterogeneity than can be accommodated within models of mass production (Glatz 2012; Karacic et al. 2016; for additional critique see Glatz 2015).

Previous studies of Hittite-style pottery have demonstrated that potters used different firing temperatures to produce certain types of vessels (Henrickson and Blackman 1996) and that pyrotechnologies can vary by site (Ertem and Demirci 1999; Ertem et al. 1998). The study of the MW pottery from Tarsus-Gözlükule contributes further to the increasing evidence for heterogeneity in the production of pottery in the Hittite Empire. A histogram of maximum firing temperatures for LB IIA pottery from Tarsus-Gözlükule determined that the potters consistently achieved two different maximum firing temperatures. When this data is divided among geochemical subgroups, previously interpreted as contemporary and local workshops (Karacic et al. 2016), one of the subgroups reveals a wide range of maximum firing temperatures while the other two confirm that two different maximum firing temperatures were employed. It remains beyond the ability of the data to explain what caused this difference, but we have proposed two likely scenarios. It may be that the pottery workshops used two different kilns. Alternatively, the potters may have employed two different types of fuel, the selection of which was embedded within larger economic and social practices. These results emphasize that heterogeneity within the production of Hittite-style pottery must be sought at the local level, in this case in technological variety and the embeddedness of potters within agro-pastoral subsistence strategies.

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