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POST-COLLAPSE: THE RE-EMERGENCE OF POLITY IN IRON AGE BOĞAZKÖY, CENTRAL ANATOLIA

Summary. *How communities reorganize after collapse is drawing increasing attention across a wide spectrum of disciplines. Iron Age Boğazköy provides an archaeological case study of urban and political regeneration after the widespread collapse of eastern Mediterranean Late Bronze Age empires in the early twelfth century BC. Recent work at Boğazköy has significantly expanded our understanding of long-term occupation in north central Anatolia. This work counters previous suggestions that Boğazköy was abandoned after the collapse of the Hittite Empire during the Early Iron Age. In this paper, we focus on the Iron Age occupations at the site to show how growth in the scale and complexity of ceramic production and trade during this period provides another line of evidence for economic and political re-emergence. Based on the increasing diversity of non-local ceramics and ceramic emulations during the Iron Age, we suggest that only in the Late Iron Age, 500–700 years after Hittite collapse, did Boğazköy re-emerge as a significant polity in central Anatolia.*

INTRODUCTION

Over the last two decades, archaeologists have shifted their attention from the origins of complex societies and urbanism to their demise and regeneration (Schwartz and Nichols 2006; Yoffee and Cowgill 1988). Recent cross-cultural comparisons of societal collapse show several patterns in the extent to which new phases of complexity emerge (e.g. Morris 2006; Sims 2006). Historical factors relating to prior power structures, spatial factors relating to territorial marginality vs. centrality, and exogenous factors relating to long-distance trade all play a role in whether or not complex polities re-emerge within the homeland of earlier states. In this paper, we focus on one of these variables, the role of production and long-distance trade, to evaluate the re-emergence of complexity in the previous core of the Hittite Empire – Boğazköy.

The collapse of Late Bronze Age (LBA) empires in the early twelfth century BC is characterized by the disruption of urban centres, trade and political relationships across Anatolia. The subsequent Early Iron Age (EIA) period is often seen as a 'Dark Age'. The disruptions of the LBA and EIA throughout Anatolia and the Levant are typically related to migration and invasion,

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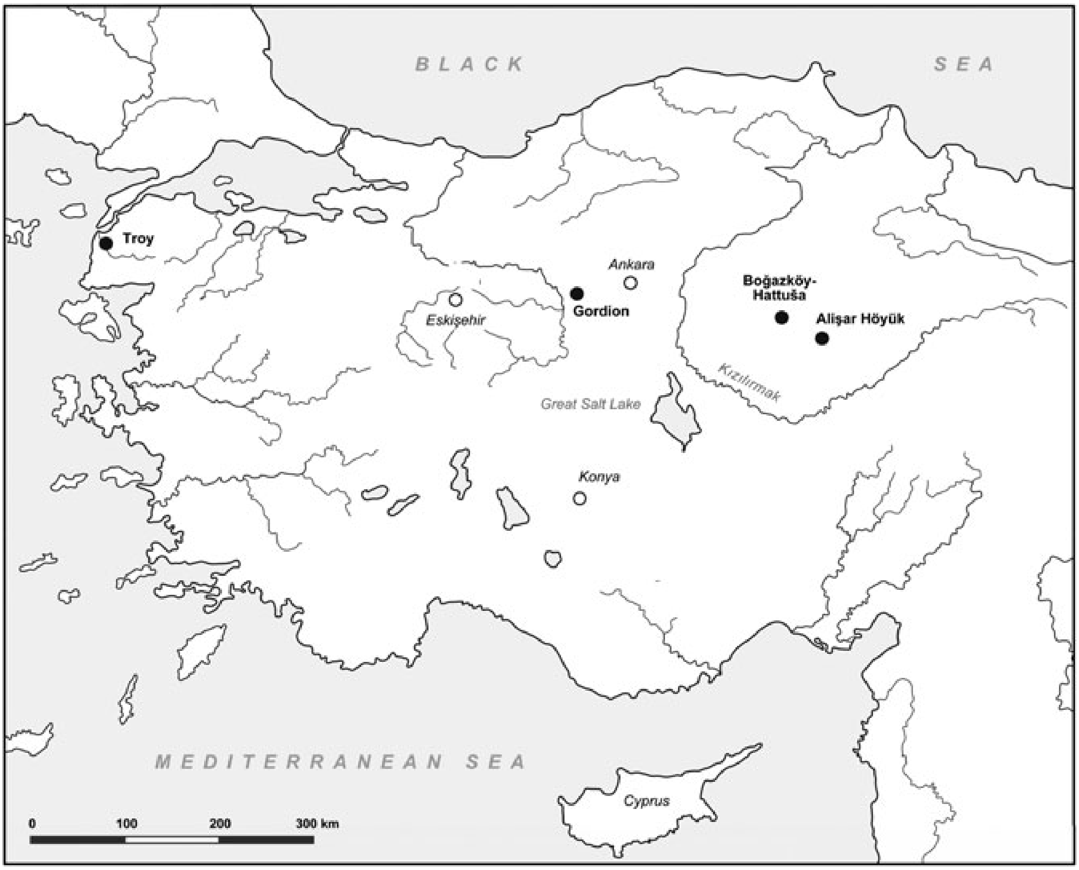


Figure 1
Map of central and western Anatolia showing sites discussed in the text (with location of Boğazköy, Gordion, Kızılırmak, Eskişehir region, Konya and Great Salt Lake). Open circles are modern towns.

as well as to internal processes of consolidation and realignment (Joffe 2002; Sams 1995; Voigt and Henrickson 2000). However, evidence of the emergence of Iron Age polities at the end of the EIA and in the Middle Iron Age (MIA) remains highly fragmentary and poorly understood, a situation compounded by the relative rarity of EIA sites (Genz 2003).

For Anatolia, recent work at Boğazköy has produced a sequence of Iron Age occupation that provides insights into the dynamics of these cultural and political changes (Fig. 1). While the Iron Age in central Anatolia has been dominated by the study of Gordion and Phrygia, the Boğazköy sequence represents one of the few relatively coherent and well-dated Iron Age sequences in central Anatolia. Boğazköy, therefore, provides us with not only a consistent view on economic and political dynamics from Empire collapse through to political re-emergence, but also a comparative case for understanding the range of polities that emerged across central Anatolia as the nature and scale of political and economic interaction dramatically changed in the first millennium BC.

In 2000, we began a project to characterize geochemically the range of fabrics identified at Boğazköy, now part of a larger project to assess the production and exchange of Iron Age ceramics across central Anatolia (http://aia.une.edu.au). In this paper, we present the results of a Neutron Activation Analysis (NAA) analysis of EIA, MIA and Late Iron Age (LIA) ceramics from Boğazköy. These data allow us to identify changes in local vs. exotic ceramic production, and to address the emergence of a new political and economic organization at Boğazköy during the Iron Age.

BACKGROUND

The Iron Age in central Anatolia

Following the collapse of the Hittite Empire, the scale and nature of political and economic organization in local Anatolian societies altered. A key question is the extent of cultural continuity vs. population disruption in the early EIA. Subsequently, in some regions, new polities rapidly developed, with new types of political and economic organization (e.g. Neo-Hittite polities, Phrygia and Lydia). We adopt the term 'polity' for two reasons: the lack of data for characterizing the political entities discussed here, and the problematic nature of terms such as 'chiefdom' and 'state'. The term 'polity' is used here to refer to a generalized political entity that encompasses both 'chiefdom' and 'state' scale societies. Polity can also refer to politically autonomous entities in a larger interacting sphere, which includes multiple autonomous competing units (Renfrew 1986), a definition that seems to match the admittedly limited data for the Iron Age political landscape of central Anatolia.

For the EIA, only three excavations in central Anatolia have recovered architectural remains (Gordion, Kaman-Kalehöyük and Boğazköy), and in all of these, domestic architecture is dominant (often semi-subterranean), apparently following without a break in occupation from the LBA. Comparisons of EIA ceramics from these sites, and from others without architecture or less securely dated (Porsuk, Çadır Höyük, etc.), suggest that the EIA was a period of regional political fragmentation, with diverse trajectories of change (Genz 2003). Some of these sites show continuity with LBA traditions, while others do not. Most polities appear to be strongly influenced by their immediate geopolitical sphere. Ceramics are used here as a measure of social, political and economic interaction. To the south, for example, ceramics reflect interaction with the Mediterranean littoral (Crespin 1999; Hansen and Postgate 1999), while to the west, influences from western Anatolia seem to predominate (Voigt and Henrickson 2000). At Boğazköy, EIA ceramics initially reveal some continuity with the LBA; however, Hittite forms and the use of wheel technologies disappear quite rapidly. There is also a change in decoration (increase in painted motifs; Genz 2003; 2004a). At Gordion, Voigt and Henrickson (2000) argue, based on changes in ceramics, foodways and architecture, for a series of peaceful in-migrations of populations in the EIA. In contrast, at Boğazköy, Genz (2003) sees internal breakdown and reconfiguration instead of in-migration.

By the end of the EIA, the polity of Phrygia had developed in the west. During the MIA, it consolidated and expanded (Sams 1995). The actual scale and extent of Phrygian political control are unclear; however, a Phrygian material 'signature' is evident throughout western and central Anatolia (e.g. stepped altars, ceramic styles, inscriptions; Bahar 1999; DeVries 1988). A general feature of the MIA is the florescence of more widespread interaction and the establishment of regional scale polities (Gates 1999; Grave *et al.* 2008; Sams 1995; Voigt and

Henrickson 2000) that are significant enough to cause problems for the Neo-Assyrians (Sams 1995). Lydian, Persian and Greek invasions of central Anatolia from the sixth century onward further reshaped the political and economic landscape in the second half of the first millennium BC. These invasions differentially affected the political and economic situations at inland sites. For example, in the LIA at Boğazköy, large-scale buildings are again evident (Genz 2006a; Neve 1974), suggesting an increase in regional power at the same time that sites like Gordion appear to lose political hegemony. Nevertheless, while political power fluctuated between centres in central Anatolia, overall economic interaction and exchange intensified.

Extant evidence for these large-scale changes allows a generalized picture of the political and economic landscape. To address, more specifically, the issue of how political and economic institutions were recast after the Hittite collapse requires data with higher spatial and chronological resolution (see contributions in Fischer *et al*. 2003).

The Iron Age at Boğazköy

The archaeological remains at Boğazköy (Fig. 2) comprise one of the most complete and extended occupation sequences in central Anatolia. These include the earliest evidence of Chalcolithic occupation in the region (Büyükkaya), a late Early Bronze Age regional centre, a Middle Bronze Age trade colony (Karum Hattuš), the LBA capital (Hittite Hattuša) of an empire that eventually extended across much of Anatolia, and an Iron Age regional centre, developing after the collapse of the Hittite Empire (Seeher 2005, 156–76).

It can be assumed that the changing political and socio-economic position of the site over time also influenced the quantity and variety of imports. Yet surprisingly few studies have investigated the role of imports at Boğazköy from an archaeological point of view (Genz 2006c; in press). Everyday artefacts, such as ceramics, offer a much better opportunity to study the contacts that occupants of the site may have had with neighbouring or even more distant regions. Ceramics from Boğazköy have long been studied typologically and stylistically (Bossert 2000; Fischer 1963; Genz 2004a; 2006b; Müller-Karpe 1988; Orthmann 1963; Parzinger and Sanz 1992; Schoop 2003; 2005; 2006). However, with few exceptions (Bossert 2000, 145–51; Genz 2004b; Eriksson 1993; Kozal 2003; Mielke 2007), ceramic imports have received comparatively little attention. There are several reasons for this: first of all, for many regions and periods in central Anatolia the typological development of pottery is still poorly understood. Secondly, for certain periods such as the Hittite period, the uniformity and standardization of ceramics across central Anatolia (Gates 2001) hamper the identification of imports by typological and stylistic means alone.

Fortunately, in the case of ceramics, various methods of elemental and geographic analysis provided by the geosciences can differentiate local from non-local wares and – where reference data are available – their provenience.

Archaeological context

The Iron Age settlement Research over the last decade at Boğazköy has substantially improved our understanding of the Iron Age sequence (Table 1). The discovery of the EIA occupation on Büyükkaya closed the gap that previously was believed to have existed after the collapse of the Hittite Empire (Genz 2004a, 7–10). Furthermore, excavations undertaken on the Büyükkale Northwest Slope provided new material from LIA contexts, which helped with the interpretation

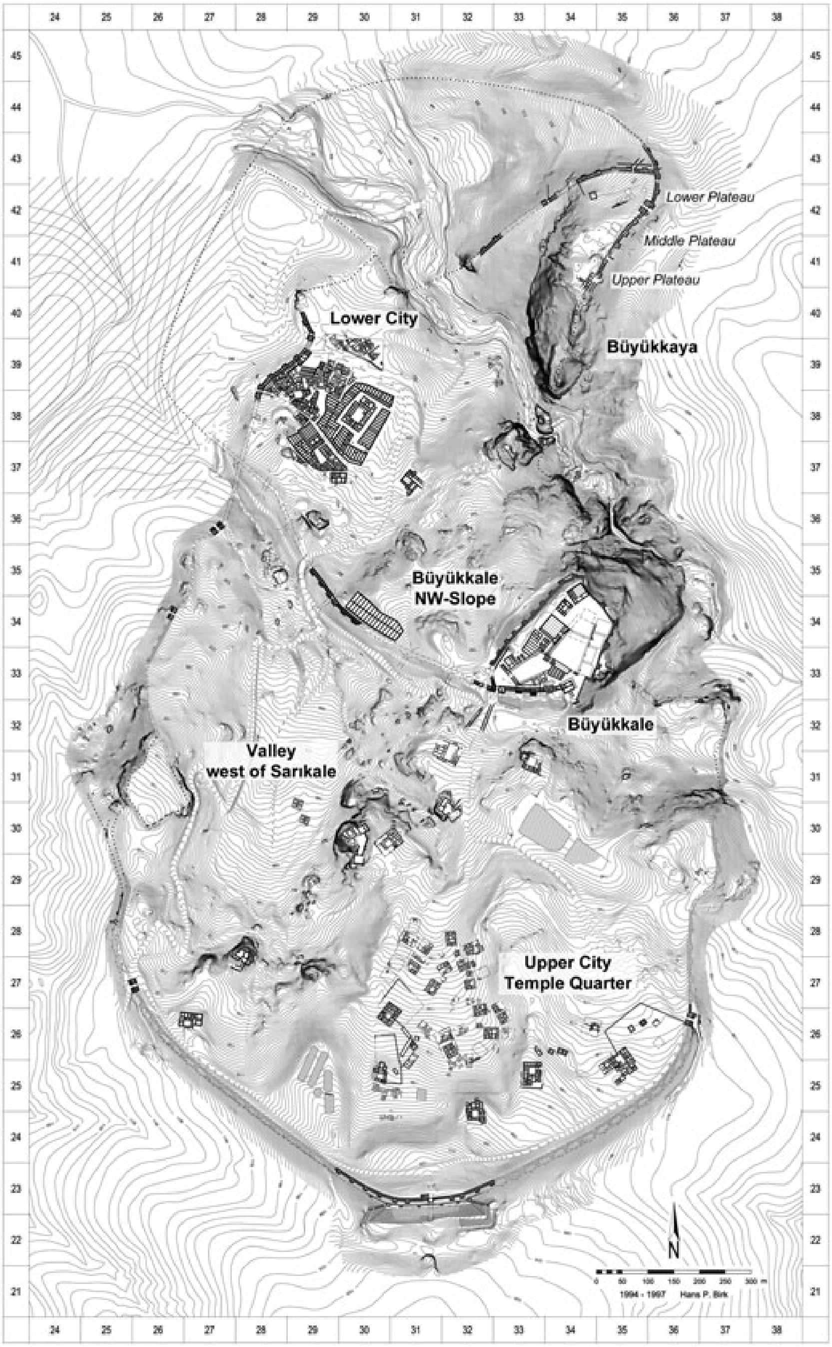


Figure 2
Map of Boğazköy with location of areas discussed in text (Büyükkaya, Sarıkale, Lower City, ‘Temple Quarter’ in the Upper City, Upper Plateau and Büyükkale).

TABLE 1
Definition and dating of Iron Age phases at Boğazköy

Local Designation	Dating (abs.)	Dating (rel.)
Dark Age	12th–10th centuries BC	Early Iron Age
Büyükkaya Stage	9th century BC	Middle Iron Age
Büyükkale II-Stage	9th–8th centuries BC	Middle Iron Age
Büyükkale I-Stage	7th–6th centuries BC	Late Iron Age

of the occupational history and ceramic development of the later parts of the Iron Age (Genz 2006b, 98–107). As a result, Iron Age occupation at Boğazköy now appears both longer and larger than previously thought.

Contrary to a long-held assumption, the site continued to be inhabited after the collapse of the Hittite Empire. However, during the EIA (twelfth to tenth centuries BC) occupation was reduced to a small hamlet located on the hill of Büyükkaya (Genz 2004a, 7–10). Other parts of the site also show traces of EIA occupation, sometimes in the ruins of former Hittite buildings (Genz 2003).

During the MIA and LIA (ninth to sixth centuries BC) the site recovered and developed into a small regional centre (Neve 1974; 1982, 142–70). The end of the Iron Age occupation cannot currently be dated accurately, but certainly previous assumptions that the site was destroyed at the beginning of the Achaemenid period are unfounded (Genz 2006b, 131–3). A short continuation of occupation into the Achaemenid period remains at least a possibility.

The Iron Age pottery As the main focus of the excavations undertaken at Boğazköy lay in the Hittite period, the overlying Iron Age remains received considerably less attention. In 1935, Bittel published the first study of the Iron Age pottery from the site. He distinguished two Iron Age phases, each with characteristic pottery (Bittel and Güterbock 1935, 54–8). The earlier phase, termed Büyükkale II, was characterized mainly by pottery painted with matte, dark colours, whereas the following Büyükkale I period was characterized by polychrome painting with shiny colours (Table 1). Unfortunately, the final publication of the Iron Age pottery from the early excavations was considerably delayed. Even this publication (Bossert 2000) left many questions unanswered. The Iron Age occupational sequence at Boğazköy was not completely represented in this material, many of the published items came from poorly stratified contexts, and no quantitative information was provided. New research undertaken since 1994 has enabled us to fill some of these gaps (Genz 2004a; 2006a; 2006b).

In contrast to the pottery of the Hittite period, EIA pottery (twelfth to tenth centuries BC) is generally handmade (Genz 2003, 179; Genz 2004a, 24–6). In the earliest phases of the EIA wheel-made pottery is still being produced (*c*.30 per cent of assemblage), but disappears quickly, possibly after one generation. No special fabrics seem to have been used; only a general distinction between a cooking pot fabric, characterized by a rather soft firing under reducing conditions (Fig. 3, nos. 1 and 2), and a 'common' fabric (buff or reddish-brown with various mineral inclusions and well fired) is possible. Shapes are restricted to utilitarian forms such as bowls, cooking pots, jugs and jars. In contrast to the preceding Hittite pottery, the vessels generally show labour-intensive surface treatments such as burnishing. About 4 per cent are red-painted decoration, showing mainly geometric motifs (Fig. 3, no. 3). Incised decoration on

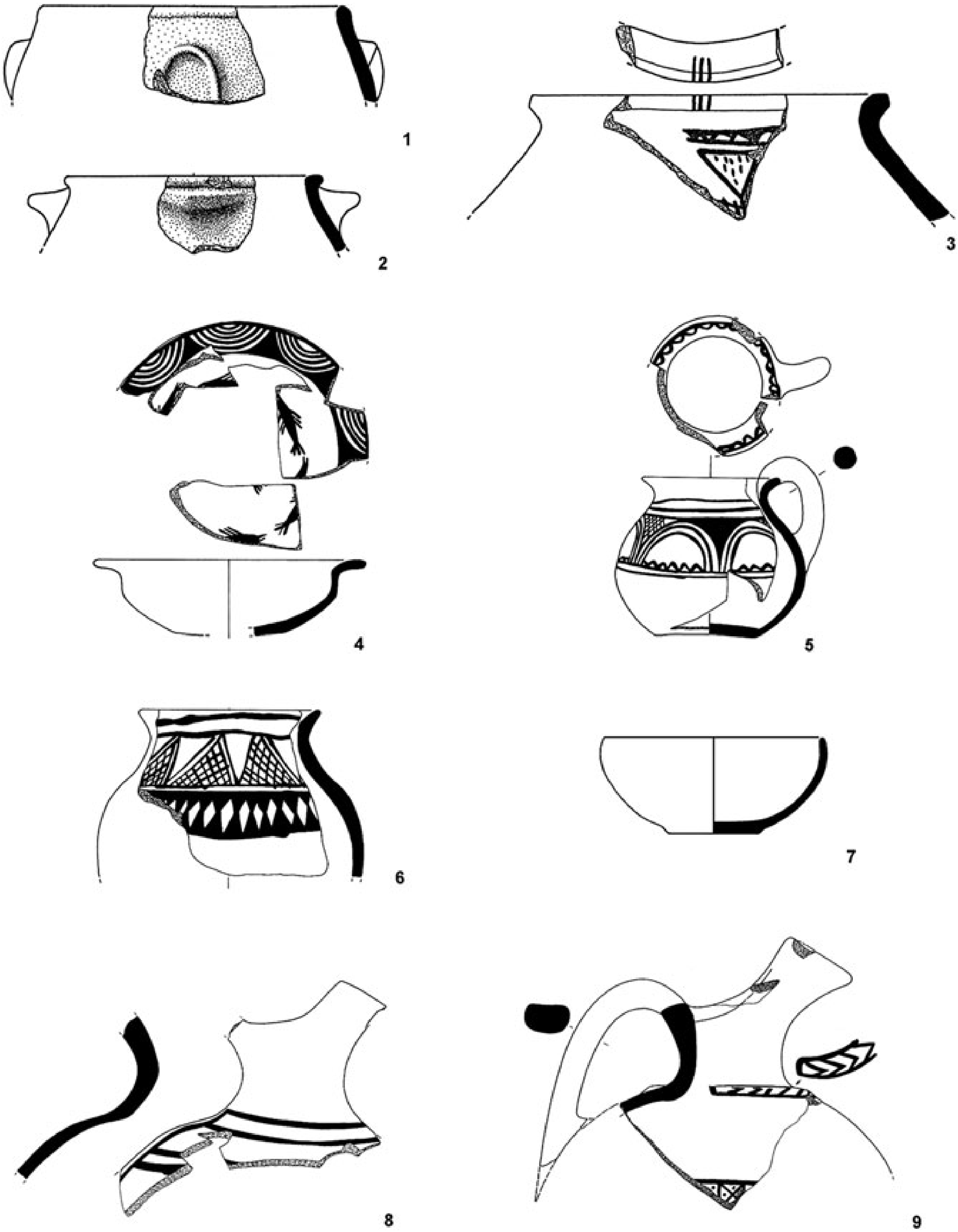


Figure 3
Iron Age pottery from Büyükkaya and the Northwest Slope. Nos. 1–3 EIA pottery from Büyükkaya; nos. 4–6 MIA pottery from Büyükkaya; nos. 7–9 LIA pottery from the Northwest Slope. Scale 1 : 4.

the other hand, frequently encountered at sites farther to the west such as Gordion and Troy, is remarkably rare in Boğazköy. The EIA ceramic assemblage appears to represent local household production (Genz 2003, 179–81; Genz 2004a, 24–8). In general, the EIA in central Anatolia seems to be characterized by small ceramic zones with little interaction between them (Genz 2003).

In the MIA (from the early ninth century BC to the late eighth century BC), use of the potters' wheel reappears. Central Anatolia now seems to be divided into two different ceramic zones. Monochrome grey wares characterize the western part, exemplified by the Gordion assemblage of this period (Henrickson 1993, 124–5; Henrickson 1994, 110–11; Sams 1994). In eastern sites such as Boğazköy, on the other hand, painted pottery with matte dark paint predominates with geometric as well as animal motifs (Fig. 3, nos. 4–6; Bossert 2000; Genz 2004a, 29–35). The border between these two ceramic zones seems to have run along a roughly north–south line from Konya via the area of the Salt Lake (*Tuz Gölü*) and then following the course of the Kızılırmak northwards. Still, both zones were not completely isolated from each other, as painted pottery of the so-called silhouette style, a typical feature of the eastern zone, is found at Gordion (Sams 1994, 163), and grey wares slowly make their appearance in the region of the Kızılırmak bend from the eighth century BC onwards (Summers 1994; Genz 2004a, 35). Here geochemical fingerprinting can help differentiate between production areas, and between genuine imports and local copies of foreign wares.

The LIA, probably beginning around the turn of the eighth to the seventh century BC, is characterized by marked changes in the pottery (Genz 2006b, 107–22). Imported pottery types, including Greek and western Anatolian wares, appear widely across central Anatolia in the LIA (Bossert 2000, 145–51; DeVries 1996; 2005; Schaus 1992). In the eastern part of central Anatolia, matte-painted decoration disappears, and is replaced by decoration in lustrous paint, often polychrome (Fig. 3, nos. 8 and 9). In general, painted decoration becomes less popular, while grey or black burnished pottery (Fig. 3, no. 7) of the western tradition (comprising 10 per cent of the LIA pottery assemblages at Boğazköy), and red burnished pottery (<5 per cent of the assemblage) increase (Bossert 2000, 27–8; Genz 2006b, 122). Motifs are mainly geometric but a few are figurative. Forms include hemispherical or carinated bowls, beaked or trefoil-mouth jugs, large two-handled crater-like vessels, globular jugs and faceted jars. Evidence for long-distance contacts during the LIA is provided by a few finds of west Anatolian, Greek and Cypriot imports at Boğazköy (Bossert 2000, 145–51; Genz 2006b, 119). The proportion of painted vs. grey wares is geographically variable. At Gordion, grey wares dominate, while at Boğazköy painted wares are more common in the LIA. This raises a question about whether the grey wares are imported at Boğazköy (and conversely whether painted wares are imported at Gordion), or are locally produced and emulated.

ANALYTICAL METHODOLOGY

Both ceramic and sediment samples were analysed for this study. Unique geological units in the immediate catchment were identified. Sediments from each were sampled to define the geochemical range which would bracket local clays, rather than attempt the far more problematic identification of relevant clay sources. In addition, stream deposits, both adjacent to the site and just to the north-west, were sampled (Fig. 4).

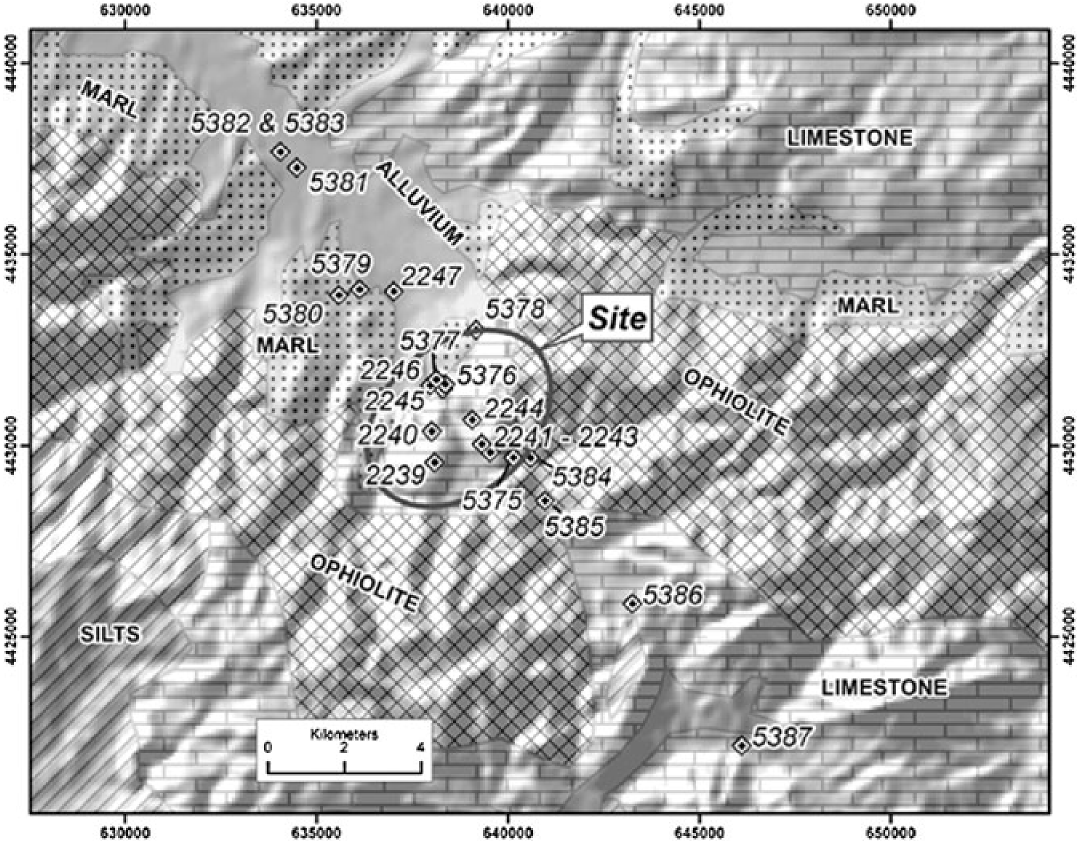


Figure 4
Map of sediment sample locations and regional geology.

Sediment sample context

The regional geology is dominated by large ophiolitic masses, with associated basalts, limestones and green schists. Extensive intrusion and hydrothermal activity have concentrated minerals in parts of sections, while depleting the larger volumes. North-west of the site, Tertiary fans of reworked green schists and other local lithologies, interbedded with marls, lie adjacent to the wide river floodplain. The floodplain has aggraded several metres since earliest settlement. The main hilltop site is underlain primarily by limestone, but the regional geology is heavily deformed, and diverse rock types have been forced next to each other. Much of the sediment on the site appears to be imported – probably as fill or as mud brick – from nearby lowlands. Sample locations within this geology are shown in Figure 4.

Ceramic sample (Table 2)

Samples from Iron Age contexts at Boğazköy were submitted for NAA (n = 77). Within the Iron Age sample LIA is dominant (EIA: n = 13; MIA: n = 19; LIA: n = 45; Table 2). Part of

TABLE 2
Catalogue of sample population organized by compositional group giving sample ID, origin, NAA group (BK#), provenience, visual ware type, sample description, period, form and date

AIA#	INAA#	Site	Provenience	Description	Period Attributed	Publication
3831	1	Büyükkaya	353/420.256.5	Jug, CW	EIA Middle Phase	Genz 2004a, Taf. 15:5
3834	1	Büyükkaya	352/420.272.64	Bowl, CW	EIA Middle Phase	Genz 2004a, Taf. 7:9
3832	2	Büyükkaya	352/420.330	Body sherd, CW	EIA Middle Phase	
3833	2	Büyükkaya	352/420.330	Body sherd, CW	EIA Middle Phase	
3835	2	Büyükkaya	352/420.272.21	Body sherd, RP	EIA Middle Phase	
3839	2.1	Büyükkaya	353/421.158.6	Pot, CPW	EIA Late Phase	Genz 2004a, Taf. 24:2
3843	2.1	Büyükkaya	352/421.207.1	Jug, impressed decoration	EIA Middle Phase	Genz 2004a, Taf. 17:3
3841	2.2	Büyükkaya	352/420.330	Body sherd, CPW	EIA Middle Phase	
3842	2.2	Büyükkaya	352/420.330	Body sherd, CPW	EIA Middle Phase	
3838	3	Büyükkaya	352-3/420-1.90.103	Body sherd, RP	EIA Late Phase	
3840	3	Büyükkaya	352-3/421.144.4	Pot, CPW	EIA	Genz 2004a, Taf. 29:1
3844	1	Büyükkaya	346-7/413-4.611	Bowl, CW, MP	MIA, Büyükkale II-stage	Genz 2004a, Taf. 37:5
3847	1	Büyükkaya	357/431.77.1	Jug, CW	MIA	Genz 2004a, Taf. 64:6
3850	1	Büyükkaya	348/415.391.2	CW, bichrome	MIA, Büyükkale II-stage	
3851	1	Büyükkaya	345-6/413-4.198.2	CW, bichrome	MIA, Büyükkale II-stage	
3852	1	Büyükkaya	347/412.1.12	CW, bichrome	MIA, Büyükkale II-stage	
3862	1	Büyükkaya	355/430.68.2	Pot, CPW	MIA	Genz 2004a, Taf. 53:13
3864	1.5	Büyükkaya	356/432.10.1	Pot, CPW	MIA	Genz 2004a, Taf. 52:9
3861	1.9	Büyükkaya	345/413.285.1	Pot, CPW	MIA	Genz 2004a, Taf. 52:8
3845	2	Büyükkaya	355/426.40.2	Jar, MP (Alishar IV)	MIA, Büyükkale II-stage	Genz 2004a, Taf. 66:10
3849	2	Büyükkaya	346-7/413.759.5	CW, WS, MP	MIA, Büyükkale II-stage	
3853	2	Büyükkaya	355/428.1.6	CW, bichrome	MIA, Büyükkale II-stage	
3854	2	Büyükkaya	346/413.225.6	GW	MIA, Büyükkale II-stage	
3855	2	Büyükkaya	346-7/413.840.2	GW	MIA, Büyükkale II-stage	
3856	2	Büyükkaya	347/411.1.8	GW	MIA, Büyükkale II-stage	
3858	2.2	Büyükkaya	346/414.19.2	WW	MIA, Büyükkale II-stage	
3863	3	Büyükkaya	356/430.88.1	Pot, CPW	MIA	Genz 2004a, Taf. 52:11
3859	6	Büyükkaya	346/413.676.9	WW	MIA, Büyükkale II-stage	
3860	6	Büyükkaya	345/414.30.8	WW	MIA, Büyükkale II-stage	
1172	1	NW-Slope	309/342.17.1	Jug, CW	LIA	Genz 2006b, fig. 16:4
1185	1	NW-Slope	309/342.4.1		LIA	
1191	1	NW-Slope	309/342.50.1	Jug, GW	LIA	Genz 2006b, fig. 17:3
1193	1	NW-Slope	308/343.36.2	Jug, CW	LIA	Genz 2006b, fig. 17:5
1203	1	NW-Slope	308/342.16.1	Jug, CW	LIA	Genz 2006b, fig. 18:2
1204	1	NW-Slope	309/343.152.7	Crater, CW	LIA	Genz 2006b, fig. 19:6
1206	1	NW-Slope	310/343.31	Body sherd, BPW	LIA	
1211	1	NW-Slope	309/342.30.8	Crater, CW	LIA	Genz 2006b, fig. 19:5
1213	1	NW-Slope	309/343.80.1		LIA	
1170	1.5	Eastern Ponds	341/299.34.14	Jar, CW, RS	LIA	Genz 2006a, fig. 7:8
1173	1.5	NW-Slope	311/342.41.1	Beaker, BPW	LIA	Genz 2006b, fig. 15:8
1174	1.5	Eastern Ponds	341/299.34.6	Jar, CW, RS	LIA	Genz 2006a, fig. 8:3
1175	1.5	NW-Slope	309/343.6.1	Bowl, CW	LIA	Genz 2006b, fig. 10:8

1179	1.5	NW-Slope	309/342.37.2	Jar, CW, RS	LIA	Genz 2006b, fig. 14:2
1186	1.5	NW-Slope	308/346.25.1	Body sherd, CW, polychrome	LIA	Genz 2006b, fig. 24:21
1187	1.5	NW-Slope	309/343.29.2	Bowl, CW	LIA	Genz 2006b, fig. 12:6
1198	1.5	NW-Slope	311/342.13.2	Crater, CW	LIA	Genz 2006b, fig. 20:2
1201	1.5	NW-Slope	309/342.30.4	Jug, CW	LIA	Genz 2006b, fig. 18:3
1202	1.5	NW-Slope	308/343.62.1	Crater, CW	LIA	Genz 2006b, fig. 20:1
1207	1.5	NW-Slope	309/342.30	Body sherd, GW	LIA	
1209	1.5	NW-Slope	309/342.78.1	Jug, CW	LIA	Genz 2006b, fig. 16:5
1212	1.5	NW-Slope	310/343.26.1	Jug, CW	LIA	Genz 2006b, fig. 16:6
1208	1.9	NW-Slope	311/342.13.1	Pot, CPW	LIA	Genz 2006b, fig. 15:1
1184	2	NW-Slope	309/343.159.2	Jug, GW	LIA	Genz 2006b, fig. 17:1
1192	2	NW-Slope	309/343.106	Body sherd, RS	LIA	
1196	2	NW-Slope	308/342.11	Body sherd, RS	LIA	
1197	2	NW-Slope	309/342.37.3	Bowl, GW	LIA	Genz 2006b, fig. 9:12
1199	2	NW-Slope	310/344.9.1	Crater, CW, polychrome	LIA	Genz 2006b, fig. 21:5
1205	2	NW-Slope	309/343.53.6	Jug, CW	LIA	Genz 2006b, fig. 18:1
1188	3	NW-Slope	308/342.22.3	Body sherd, CW, polychrome	LIA	Genz 2006b, fig. 24:4
1183	4	Eastern Ponds	341/299.34.10	Pot, CPW	LIA	Genz 2006a, fig. 7:6
1168	5				LIA	
1176	5	NW-Slope	309/342.55.1	Bowl, BPW	LIA	Genz 2006b, fig. 9:6
1178	5	NW-Slope	309/343.213.2	Jug, BPW	LIA	Genz 2006b, fig. 17:2
1189	5	NW-Slope	310/343.22	Body sherd, BPW	LIA	
1194	5	NW-Slope	310/343.30	Body sherd, BPW	LIA	
1210	5	NW-Slope	309/343.159.1	Bowl, BPW	LIA	Genz 2006b, fig. 9:12
1171	5.5	Eastern Ponds	341/299.20.1	Jug, CW	LIA	Genz 2006a, fig. 9:2
1182	5.5	Eastern Ponds	341/299.28.4	Jug, CW, WS	LIA	Genz 2006a, fig. 9:1
1200	5.5	NW-Slope	309/343.29.1		LIA	
Outliers						
3836		Büyükkaya	352/420.382.39	Crater, RP	EIA Middle Phase	Genz 2004a, Taf. 19:6
3837		Büyükkaya	353/420.78.222	Body sherd, RP	EIA Late Phase	
3846		Büyükkaya	355/428.82.2	CW, MP	MIA	
3857		Büyükkaya	346/413.140.5	GW	MIA, Büyükkale II-stage	
1169		Eastern Ponds	341/299.34.7	Pot, CPW	LIA	Genz 2006a, fig. 8:1
1177		NW-Slope	309/342.62.1	Pot, CPW	LIA	Genz 2006b, fig. 15:2
1180		NW-Slope	311/344.28.3	Body sherd, polychrome	LIA	Genz 2006b, fig. 24:9
1181		NW-Slope	310/343.30	Body sherd, BPW	LIA	
1195		NW-Slope	309/343.3	Body sherd, CW	LIA	

Abbreviations

BPW	Black Polished Ware	MIA	Middle Iron Age
CPW	Cooking Pot Ware	MP	Matte Painted
CW	Common Ware	RP	Red Painted
EIA	Early Iron Age	RS	Red Slipped
GW	Grey Ware	WS	White Slipped
LIA	Late Iron Age	WW	White Ware

our methodology involves comparison of compositional groups across periods to determine relative shifts in production/consumption patterns. The disparate sample sizes in each period undoubtedly affect the representation of analytic groups, with compositional diversity (i.e. number of groups) likely to increase with larger sample sizes (Rhode 1988). Two complementary expectations can be derived from the sample size = compositional diversity equation: a) the larger an individual group the more likely it is to be represented across periods; b) small groups are more likely to be seen in larger samples.

Both the sediments and the ceramic samples were analysed by (Instrumental) Neutron Activation Analysis (NAA). Sample size was 1 gram. Of the 31 elements measured, 26 were retained for statistical analysis (Table 3).

The NAA geochemical results were analysed through a combination of multivariate techniques, Principle Components Analysis (PCA) and Canonical Variate Analysis (CVA), used iteratively. A more detailed discussion of this procedure is presented elsewhere (Grave *et al.* 2008).

Definition of terms

In a study of this type, descriptive terms have contextually specific meanings. Here we define our key terms to avoid confusion.

Fabric: an analytic or visual category referring to a distinct combination of clay/minerals used for pottery production. Our working assumption is that it relates to a geographically distinct region of production.

Ware: a visual category referring to a specific typological or decorative vessel type. It is not used to imply any geographically distinct properties.

Group: a quantitative analytic category based on level of elemental compositional coherence to describe samples that are statistically indistinguishable. This is used as the overarching category for both *fabrics* and *wares*. In general, a *fabric* and *group* should agree whereas a *ware* may occur in several *groups* and *fabrics.*

For interpreting these groups, we have several working hypotheses: 1) in a given dataset, the largest group is most likely to represent locally produced ceramics, 2) conversely, smaller groups are more likely to be imported ceramics, and 3) subset groups within larger groups are most likely to reflect local resource variations and/or technological differences in production, or post-depositional alteration. However, multivariate distance alone is not the same as absolute geographic distance: similar sample chemistries can occur over a large geographical region, while distinct chemistries can occur in relatively close geographic proximity.

Multivariate alignment of sediments to ceramics

One basis for our sediment comparator approach is that the sediments approximate the elemental profile of the local ceramic signature. However, sediments are not the same as clays; minimally, they will have a coarser rock component and a distinct, catchment-specific elemental profile. The compositional differences between ceramic and sediment profiles can be expressed as the percentage difference between elemental averages. For the Boğazköy NAA datasets, this factor differs for each element and is non-linear (Fig. 5). The majority of elements are more concentrated in the ceramics but are not equally weighted and some (Co, Na, Cr) are more concentrated in the sediments. To accommodate this non-linearity we adopt an alignment

TABLE 3

NAA results for three standard reference materials (SRM 697, 2711 and 1633b) produced by the National Institute for Standards and Technology, Washington D.C. Experimental measurements for five replicates of each standard analysed within the Boğazköy ceramic sample presented in this paper. Results are given as mean values with % coefficient of variation (C.V.) alongside certified/published values for each element and the deviation of the experimental mean from the certified/published values (% recovery). Elements reported as parts per million (ppm) unless otherwise indicated

	SRM 2711 (n = 5)				SRM 679 (n = 5)				**SRM 1633b (n = 5)**			
ppm	Avg.	C.V.	Cert/pub	% Recovery	Avg.	C.V.	Cert/pub	% Recovery	Avg.	C.V.	Cert/pub	% Recovery
As	101.20	1.77	–	–	9.20	4.86	–	–	132.60	1.14	136.2	97.36
Ba	680.00	6.33	726	93.66	398.00	10.42	432.2	92.09	678.00	3.67	709	95.63
Ca%	2.84	4.72	2.88	114.58	0.14	223.61	0.16	–	1.84	6.20	1.51	121.85
Ce	71.20	2.70	69	103.19	101.20	2.56	105	96.38	181.00	1.41	190	95.26
Co	10.00	0.00	10	100.00	26.00	2.72	26	100.00	49.04	1.59	50	98.08
Cr	46.80	3.51	47	99.57	105.40	2.47	109.7	96.08	203.80	0.73	198.2	102.83
Cs	6.20	6.25	6.1	101.64	9.48	5.24	9.6	98.75	10.40	5.27	11	94.55
Eu	1.02	4.38	1.1	92.73	1.74	3.15	1.9	91.58	3.96	3.39	4.1	96.59
Fe%	2.89	1.79	2.89	99.86	9.09	1.47	9.05	100.44	7.92	1.11	7.78	101.83
Hf	7.60	5.66	7.3	104.11	4.20	6.73	4.6	91.30	6.64	4.07	6.8	97.65
K%	2.66	15.86	2.45	108.57	2.52	9.47	2.433	103.58	1.80	16.20	1.95	92.31
La	37.14	1.26	40	92.85	50.32	1.59	–	–	88.80	1.08	94	94.47
Lu	0.44	5.79	–	–	0.53	3.13	–	–	1.03	1.07	1.2	85.67
Na%	1.10	0.00	1.14	96.49	0.13	3.39	0.1304	101.23	0.20	2.21	0.201	100.50
Ni	–	–	20.60	–	–	–	–	–	–	–	–	–
Nd	30.20	11.33	31	97.42	43.40	6.01	–	–	71.80	5.52	85	84.47
Rb	99.40	0.90	110	90.36	166.00	3.30	190	87.37	132.00	6.34	140	94.29
Sb	19.54	1.47	–	–	0.78	5.73	–	–	5.16	2.21	6	86.00
Sc	9.12	0.87	9	101.33	22.50	1.09	22.5	100.00	40.92	1.29	41	99.80
Sm	5.99	1.57	5.9	101.59	9.16	1.54	–	–	18.64	0.48	20	90.50
Ta	1.60	40.75	2.47	64.78	1.76	23.97	–	–	2.54	13.81	1.8	141.11
Tb	0.90	20.79	–	–	1.04	66.13	–	–	2.84	4.72	2.6	109.23
Th	13.80	3.24	14	98.57	14.20	3.15	14	101.43	25.72	0.75	25.7	100.08
U	2.36	22.34	2.6	90.77	2.46	17.63	–	–	9.14	2.52	8.79	103.98
Yb	2.70	2.62	2.7	100.00	3.30	4.29	–	–	7.00	1.18	7.6	92.08
Zn	338.00	3.86	350.4	96.46	106.60	9.74	150	71.07	156.00	11.64	210	74.29

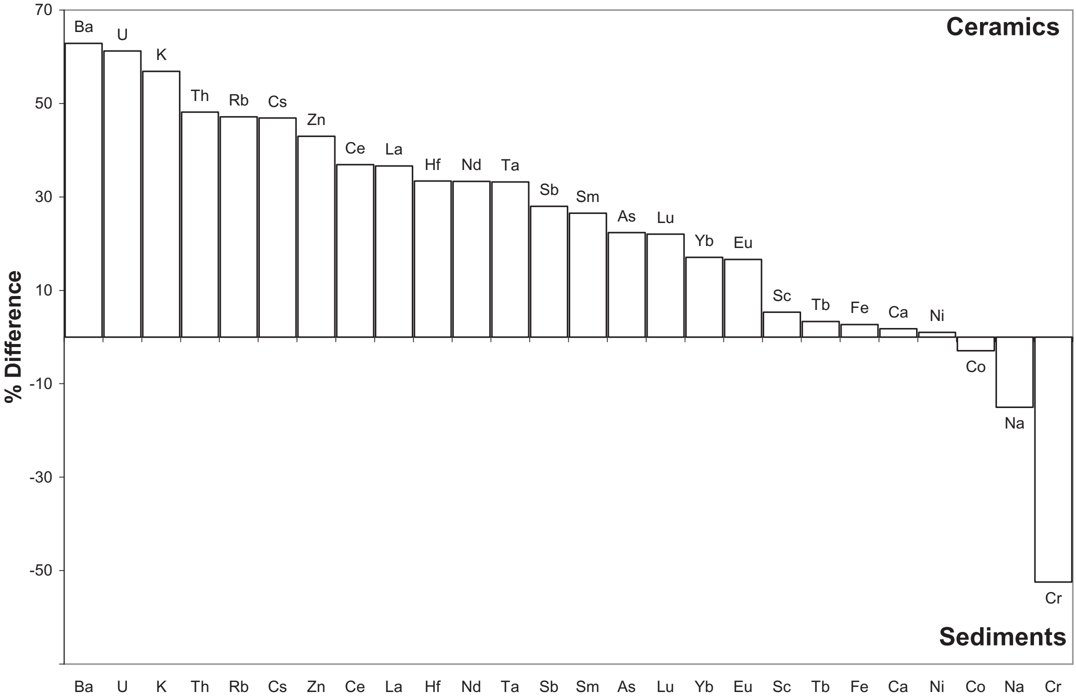


Figure 5
Histogram of differences in per cent between the elemental means for total ceramic population and the total sediment population. (The maximum value is defined as 100 per cent, and percentages are calculated in relation to this maximum value.)

approach where the multivariate sediment mean is made equivalent to the multivariate ceramic mean:[†]

$$= \left(\text{Ceramic}_{\text{avg}} / \text{Sediment}_{\text{avg}}\right) * \text{Sediment}_{\text{sample}}$$

This correction technique, effectively aligning both datasets in multivariate space, retains both the non-linearity inherent in the correction and the compositional structure of the sediment data. It facilitates matching likely sediment sources for local ceramics but does not distort basic differences between sediment and ceramic groups.

RESULTS

To avoid confusion between results for different sites currently studied in the Anatolian Iron Age project we adopt a site-specific nomenclature in labelling compositional groups. For Boğazköy, groups are assigned the prefix BK.

[†] Where $\text{Ceramic}_{\text{avg}}$ is the average of all of the dataset's value for an individual element, and $\text{Sediment}_{\text{avg}}$ is the average of all of the sediment dataset's values for the same element. $\text{Sediment}_{\text{sample}}$ is the value of a single sample for the same element.

To facilitate cross-period comparison, group membership within each period is converted to percentages so that the total sample for a given period sums to 100 per cent. As would be expected, comparatively large groups like BK 1 and 2 are more or less evenly distributed (approximating 1 standard deviation) across periods. However, one of the largest (1.5) is disproportionately represented in the LIA. Conversely, while overall the EIA sample is the smallest, BK 2.1, 2.2 and 3 are disproportionately represented in this period. These patterns run counter to expectations of the sample size = compositional diversity equation. We conclude that while the sample sizes for each period are disparate, the distribution of compositional groups appears to be archaeologically meaningful rather than a sampling artefact.

Through multivariate analyses of the NAA data we identify 12 discrete compositional groups (Tables 4 and 5; Figs. 6 and 7). These groups include both sediment samples and ceramic samples. The group numbering reflects group location in multivariate space, and proximity or geochemical similarity (i.e. BK 2.1 is most similar to BK 2.2).

Sediments

All of the sediment samples, except two (5378 and 5388) fall into ceramic groups BK 1, 1.5, 2, 3 and 4, indicating that these ceramic groups represent a diverse range of locally available sources (Table 5). BK 4.5 encompasses two sediment samples that do not match any ceramic groups. Samples associated with BK 2 and BK 4 were collected either on or very near the site, along the modern Yozgat road. BK 2 is basaltic or from adjacent hydrothermally affected rocks. BK 3 represents transported sediment, including green schist-derived fan materials, and alluvial samples both adjacent to the site and further down the drainage. BK 4 represents weathered samples derived from basaltic and marble sources (Fig. 4). BK 2.1 is relatively calcium enriched (Fig. 7).

The sediments sampled generally match our assumptions relating to local group ubiquity. The most abundant groups (BK 1, 1.5 and 2) were present, if not all common, in the sediments sampled, and therefore were likely produced locally. Two additional ceramic groups (3 and 4), while small, also have sediment matches. Due to their overall geochemical similarity, we also assume that BK 1.9, 2.1 and 2.2 are likely to be technologically differentiated local sediments. BK 5, 5.5 and 6, without sediment matches and more distant in multivariate space from the remaining groups, are considered non-local.

Ceramics

Having defined a series of geochemical groups in our sample we now turn to the question of their archaeological significance. Previous work in Anatolia has highlighted the difficulties in spatially locating compositional groups (e.g. Grave *et al*. 2005). For example, one group might include samples from multiple distant locales if the geochemistry is very similar (local and non-local). We would emphasize that simple relationships between geochemical groups and spatial location may well not hold here; these patterns need to be carefully evaluated and, if necessary, further investigated with higher resolution isotopic techniques.

The EIA (n = 13) samples are distributed relatively equally amongst five NAA groups with two outliers. BK 2 is slightly more abundant than the other four groups (Fig. 8; Table 6). BK 2.1, all coarse ware, is used only in this period, suggesting that this local source falls out of favour relatively quickly and may relate to the unsuitability of this source for the technological demands of the potters' wheel. Two red decorated sherds are present, one each in BK 2 and 3.

TABLE 4

NAA results: summary statistics for the ceramic compositional groups discussed in the text showing mean values and per cent standard deviation. All elements reported as parts per million (ppm)

	BK 1 (n = 17)		BK 1.5 (n = 14)		BK 1.9 (n = 2)		BK 2 (n = 15)		BK 2.1 (n = 2)		BK 2.2 (n = 3)	
	Avg.	C.V.	Avg.	C.V.	Avg.	C.V.	Avg.	C.V.	Avg.	C.V.	Avg.	C.V.
As	11.35	38.89	8.64	53.43	7.50	9.43	25.00	86.14	19.00	52.10	23.00	71.84
Ba	548.82	24.85	551.43	22.93	770.00	60.61	754.67	27.50	550.00	5.14	640.00	62.42
Ca%	4.88	26.55	3.66	29.87	5.15	20.60	4.86	55.63	8.10	5.24	9.83	19.62
Ce	53.76	19.77	55.36	14.87	44.00	3.21	76.47	13.13	44.50	4.77	37.67	1.53
Co	29.53	14.22	39.79	11.20	36.50	1.94	19.67	18.30	26.50	2.67	23.00	8.70
Cr	253.65	31.41	397.00	13.39	312.50	6.56	167.07	28.94	331.00	2.14	292.67	25.70
Cs	4.29	21.56	5.09	24.09	1.90	7.44	6.45	21.37	2.45	2.89	2.50	24.00
Eu	1.23	14.22	1.38	9.08	1.35	5.24	1.28	12.94	0.98	18.13	0.93	0.62
Fe%	5.66	5.36	6.64	8.97	6.83	2.48	4.67	11.52	4.39	2.74	3.95	3.65
Hf	4.00	16.84	4.20	13.50	3.95	1.79	5.15	12.76	3.35	2.11	2.77	4.17
K%	2.25	23.50	2.26	25.23	1.70	0.00	3.51	17.89	2.40	0.00	2.13	7.16
La	27.45	19.68	27.86	12.46	23.35	9.39	39.21	13.16	23.85	0.30	20.60	3.36
Lu	0.37	12.68	0.35	9.85	0.41	8.73	0.41	9.80	0.37	1.94	0.30	5.77
Na%	0.81	22.57	1.02	19.70	1.30	20.20	0.53	46.96	0.54	2.62	0.53	6.80
Nd	26.29	18.47	25.50	11.89	21.00	0.00	34.07	12.48	23.00	12.30	22.67	13.48
Ni	110.59	79.89	280.71	26.78	225.00	47.14	28.00	210.04	165.00	4.29	146.67	3.94
Rb	81.29	18.95	87.21	22.45	43.00	3.29	111.60	18.09	55.00	15.43	55.33	8.15
Sb	0.71	28.05	0.66	33.61	0.60	0.00	0.69	38.73	0.55	12.86	0.43	13.32
Sc	20.98	8.68	23.45	9.15	24.80	0.57	18.16	11.46	16.65	0.42	14.50	4.31
Sm	5.04	14.79	5.25	9.43	5.01	0.85	6.01	10.46	4.38	1.45	3.76	2.61
Ta	1.21	40.20	1.66	23.64	1.01	140.01	1.51	39.74	0.90	15.71	0.77	7.53
Tb	0.70	44.36	0.53	68.58	0.90	0.00	0.77	32.64	0.70	20.20	0.53	10.83
Th	8.33	21.99	7.92	22.33	5.85	10.88	12.93	12.21	6.75	7.33	5.73	7.86
U	1.72	29.99	1.27	54.51	0.85	58.23	2.89	20.07	1.20	23.57	1.37	8.45
Yb	2.45	10.70	2.39	14.52	2.65	8.00	2.71	9.92	2.10	0.00	1.87	3.09
Zn	127.65	12.55	136.43	11.36	170.00	41.59	117.33	20.06	115.00	6.15	107.33	18.66

	BK 3 (n = 4)		BK 4 (n = 1)	BK 5 (n = 6)		BK 5.5 (n = 3)		BK 6 (n = 2)	
	Avg.	C.V.		Avg.	C.V.	Avg.	C.V.	Avg.	C.V.
As	16.00	69.41	7.00	12.50	18.76	6.67	8.66	12.00	11.79
Ba	497.50	8.27	600.00	711.67	15.38	510.00	18.70	675.00	30.38
Ca%	4.25	46.76	4.50	1.88	13.19	3.03	30.45	18.50	3.82
Ce	48.00	13.92	26.00	79.00	4.94	62.67	8.03	26.50	2.67
Co	36.00	12.21	44.00	59.95	4.32	59.73	0.63	12.00	0.00
Cr	722.00	44.48	208.00	447.33	6.70	1158.00	15.86	93.50	5.29
Cs	3.75	22.47	1.20	7.78	13.14	3.47	3.33	2.30	30.74
Eu	0.99	13.71	1.20	1.40	7.82	1.30	7.69	0.66	4.29
Fe%	5.24	8.54	7.24	6.88	2.39	6.76	2.44	2.89	3.43
Hf	3.35	6.21	2.40	5.00	5.66	4.63	4.98	2.35	3.01
K%	2.33	27.06	0.60	3.35	12.20	2.07	19.56	1.40	10.10
La	24.70	6.66	12.90	39.28	5.98	31.30	5.14	13.00	1.09
Lu	0.33	7.32	0.29	0.44	5.95	0.38	5.53	0.23	3.14
Na%	0.69	45.85	1.98	0.55	9.62	0.64	7.81	0.20	14.14
Nd	26.00	12.95	19.00	33.00	5.75	27.33	9.21	19.00	7.44
Ni	367.50	27.87	–	530.00	5.72	650.00	15.15	–	–
Rb	70.00	28.81	26.00	120.00	10.54	74.33	15.00	30.50	11.59
Sb	0.53	18.24	0.50	0.83	14.53	0.57	20.38	0.40	0.00
Sc	18.10	3.85	36.10	23.68	3.80	22.30	2.80	11.40	2.48
Sm	4.60	4.54	3.41	6.26	3.12	5.49	5.96	2.63	1.08
Ta	1.05	9.52	0.70	1.68	14.75	1.40	7.14	0.31	136.78
Tb	0.70	11.66	0.01	0.80	50.02	0.90	40.06	0.35	20.20
Th	7.25	22.23	3.50	12.83	5.87	9.43	10.40	4.35	1.63
U	1.48	40.06	–	1.87	18.45	0.97	85.86	1.15	6.15
Yb	2.10	8.69	2.00	2.82	3.49	2.40	8.33	1.40	10.10
Zn	112.50	8.51	110.00	123.33	12.21	116.67	4.95	66.50	1.06

TABLE 5

Sediment samples, NAA group (BK#), sample description and UTM location. Sediment NAA results are corrected using the multivariate alignment factor (described in text)

AIA	BK #	Description	UTM E	UTM N
5386	1	shaly bank in limestone terrain; 6 km SE	643250	4425869
2246	1.1	clay-rich sediment; below Chalcolithic site at Büyükkale	638127	4431720
2239	2	light-coloured volcanic soil; 400 m S of Sphinx gate	638079	4429566
2243	2	hydrothermally enriched soil; limonite present, adjacent to 2242; 2 km S Yozgat road	639312	4430051
5376	2	reworked excavation material; Büyükkale	638295	4431464
5377	2	basalt-based IA fill; Büyükkale	638358	4431593
5384	2	red clay residuum in ophiolitic mass; 3 km S Yozgat road	640582	4429682
2245	3	brown stream silt 1 m down in 2 m overbank section canyon stream below Kale 600 m W	637967	4431569
2247	3	brown silt from stream draining site, 0.5 m down 2 m bank; 3 km NW	637017	4434022
5379	3	fines from small-stream gravel draining green schist fan; 4 km NW	636124	4434079
5380	3	soil in reworked green schist fan; adjacent to 5379	635584	4433926
5381	3	grey sediment 2 m down bank in 'marl' fan; 8 km NW	634484	4437266
5382	3	red sediment 4 m down same bank as 5381	634484	4437266
5383	3	floodplain of river; 8 km NW	634055	4437681
5387	3	clayey stream floodplain above site;16 km SE on Yozgat road	646103	4422143
2241	4	weathered marble near intrusions; across valley from King's gate 1.5 km SE on Yozgat road	639532	4429831
5385	4	weathered mafic mass in carbonate terrane 3 km SE on Yozgat road	640963	4428563
2240	4.5	'tank fill', mixed lithology in clasts; within site, drainage from upper temple area/Upper Town	638009	4430364
2244	4.5	surface of basaltic lahar within carbonate terrane Yozgat road	639066	4430662
outliers				
2242		dark version of terra rossa soil – some basaltic contribution, Yazılıkaya-Yozgat road	639312	4430051
5375		raw green schist on access road from Yozgat: 5 Y 5/2	640137	4429698
5378		ophiolite-based soil below Chalcolithic site W of Büyükkaya: 2.5 YR 3/2 wet clay, spring pond	639164	4433016
5388		leached basalt in deep section; sandy 10 YR 6/4	647886	4415913

AIA	BK#	As	Ba	Ca%	Ce	Co	Cr	Cs	Eu	Fe%	Hf	K%	La	Lu	Na	Nd	Ni	Rb	Sb	Sc	Sm	Ta	Tb	Th	U	Yb	Zn
5386	1	15.46	565.67	6.01	69.76	25.25	202.73	5.27	1.56	5.59	5.41	3.01	37.40	0.41	0.96	34.50	161.62	105.93	0.69	20.49	6.33	1.50	1.03	10.61	2.06	2.53	131.53
2246	1.1	10.30	861.97	3.97	69.76	34.97	655.42	5.84	1.32	5.15	4.81	2.55	36.14	0.36	0.58	27.00	333.35	107.82	0.69	17.22	5.95	1.50	0.72	11.96	0.00	2.65	152.57
2239	2	11.59	1077.46	1.93	72.93	25.25	190.92	5.84	1.20	4.46	5.56	2.32	37.24	0.37	0.85	21.00	–	109.71	1.25	15.95	5.37	1.35	0.93	14.85	3.09	2.41	131.53
2243	2	16.74	430.98	8.35	68.17	28.17	218.47	7.34	1.32	5.32	4.96	1.62	46.08	0.45	0.35	30.00	151.52	88.91	1.39	18.17	6.72	1.05	0.72	12.73	3.35	3.02	147.31
5376	2	12.88	808.10	5.29	71.34	22.34	114.16	6.40	1.14	4.50	4.81	3.71	36.77	0.41	0.65	33.00	121.22	145.65	0.69	15.85	5.81	1.80	0.00	13.89	3.61	2.53	149.07
5377	2	94.03	700.35	2.85	101.46	22.34	91.85	11.30	1.32	4.90	6.91	5.10	50.34	0.47	0.57	39.00	–	164.57	1.53	16.48	7.28	1.20	0.83	19.29	5.16	3.02	113.99
5384	2	5.15	592.60	0.81	88.78	19.43	39.50	12.24	0.90	3.54	4.06	5.33	39.14	0.41	0.50	36.00	–	189.16	0.97	13.84	5.69	1.65	0.72	17.75	2.84	2.53	140.30
2245	3	6.44	565.67	5.19	50.73	44.68	467.78	3.58	1.07	5.79	3.91	2.32	25.57	0.28	0.66	22.50	424.26	56.75	0.56	20.92	4.76	2.25	0.62	6.17	–	2.05	149.07
2247	3	6.44	484.86	5.40	45.98	43.71	702.00	3.01	1.20	5.85	3.15	1.86	24.30	0.30	0.71	22.50	535.38	56.75	0.42	19.86	4.45	1.05	0.72	5.40	–	1.93	126.27
5379	3	3.86	619.54	5.90	47.56	46.62	1089.09	1.88	1.32	6.30	3.61	1.62	25.41	0.26	0.76	25.50	353.55	35.94	0.42	22.29	4.97	1.20	0.72	4.63	–	1.69	80.67
5380	3	5.15	915.84	4.38	55.49	36.91	441.54	3.77	1.20	4.81	3.76	1.86	28.88	0.32	0.46	28.50	383.86	71.88	0.42	15.95	4.75	1.05	0.52	8.10	1.55	1.93	87.69
5381	3	28.34	404.05	0.71	87.20	29.14	297.86	5.08	0.97	6.07	4.81	3.01	34.56	0.22	0.53	31.50	202.03	107.82	0.69	20.39	4.75	1.95	0.00	11.77	3.09	1.33	85.93
5382	3	24.47	1050.52	3.26	63.42	28.17	304.42	4.14	1.44	5.41	3.91	2.09	31.88	0.32	0.56	33.00	202.03	88.91	0.56	18.38	5.35	1.65	0.83	9.07	4.90	2.05	91.19
5383	3	7.73	673.41	4.07	57.07	46.62	846.34	3.95	1.44	5.92	3.76	2.32	28.72	0.30	0.68	31.50	505.07	62.42	0.56	19.65	4.87	2.10	0.62	8.49	–	1.93	94.70
5387	3	6.44	484.86	4.99	55.49	44.68	436.95	5.46	1.20	5.92	3.61	2.55	29.67	0.33	0.71	34.50	494.97	102.15	0.42	20.92	5.08	1.20	0.72	8.29	3.61	2.17	105.22
2241	4	5.15	148.15	10.18	31.71	32.05	154.18	1.13	1.32	6.45	3.15	–	15.78	0.37	0.65	19.50	–	–	0.28	23.56	4.29	1.35	0.52	2.31	–	2.77	133.28
5385	4	2.58	261.28	8.14	12.68	35.94	132.53	0.94	1.20	6.53	2.10	2.55	5.68	0.38	1.48	18.00	–	45.40	0.00	32.11	2.88	0.00	0.62	–	–	2.53	91.19
2240	4.5	6.44	430.98	3.87	39.63	34.97	158.11	2.64	1.32	7.37	4.51	3.25	20.20	0.56	1.39	19.50	–	56.75	0.56	31.80	5.37	1.65	0.93	5.98	–	3.74	175.37
2244	4.5	6.44	673.41	8.86	28.54	32.05	59.90	2.45	1.14	7.27	3.45	1.39	15.78	0.53	1.16	19.50	–	41.62	0.42	28.31	4.57	0.00	1.03	3.67	–	3.50	157.83
M.V. fit factor		1.29	2.69	1.02	1.59	0.97	0.66	1.88	1.20	1.03	1.50	2.32	1.58	1.28	0.87	1.50	1.01	1.89	1.39	1.06	1.36	1.50	1.03	1.93	2.58	1.21	1.75

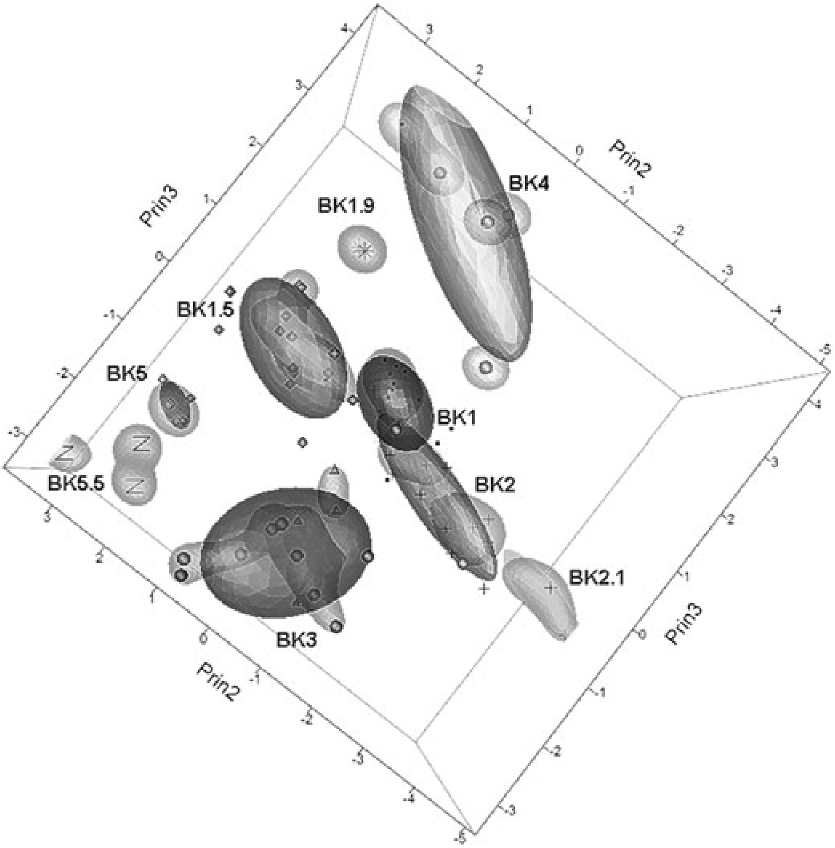


Figure 6
Principal Components Analysis point projection of first three components showing relationships between ceramic groups and sediments. This plot does not include outlying groups BK 4.5 (sediments) or BK 6 (ceramics).

All of the groups attested in the EIA are of local origin, supporting the view gained by the typological analysis that we are dealing with rather localized household production. Even the jug, which due to its unusual shape and incised decoration (Genz 2004a, Taf. 17:3) has been suggested to originate farther to the west in the Gordion region, is made of clay belonging to the local BK 2.1. Possibly this jug and other vessels of the same kind were either made by immigrants from the west in their traditional style or emulated, suggesting a certain mobility of people and/or ideas in the EIA.

The MIA samples (n = 20; two are outliers) include not only more NAA groups (seven), but also a different use of local resources (Fig. 8). BK 1.5 and 1.9 are first found in the MIA, possibly representing technological variations of BK 1, or an adjacent source area. BK 1.5 is enriched in a variety of elements including nickel and zinc, while BK 1.9 is sodium (relatively) enriched (Fig. 7). Both examples are from cooking pots. During the MIA, white wares first appear in a non-local group as well as in a local group emulation (BK 2.2 and 6; Table 6).

The majority of vessels in the MIA were made of local raw materials. The only non-local group (BK 6) consists of a very fine whitish clay. Unfortunately due to the extremely fine nature

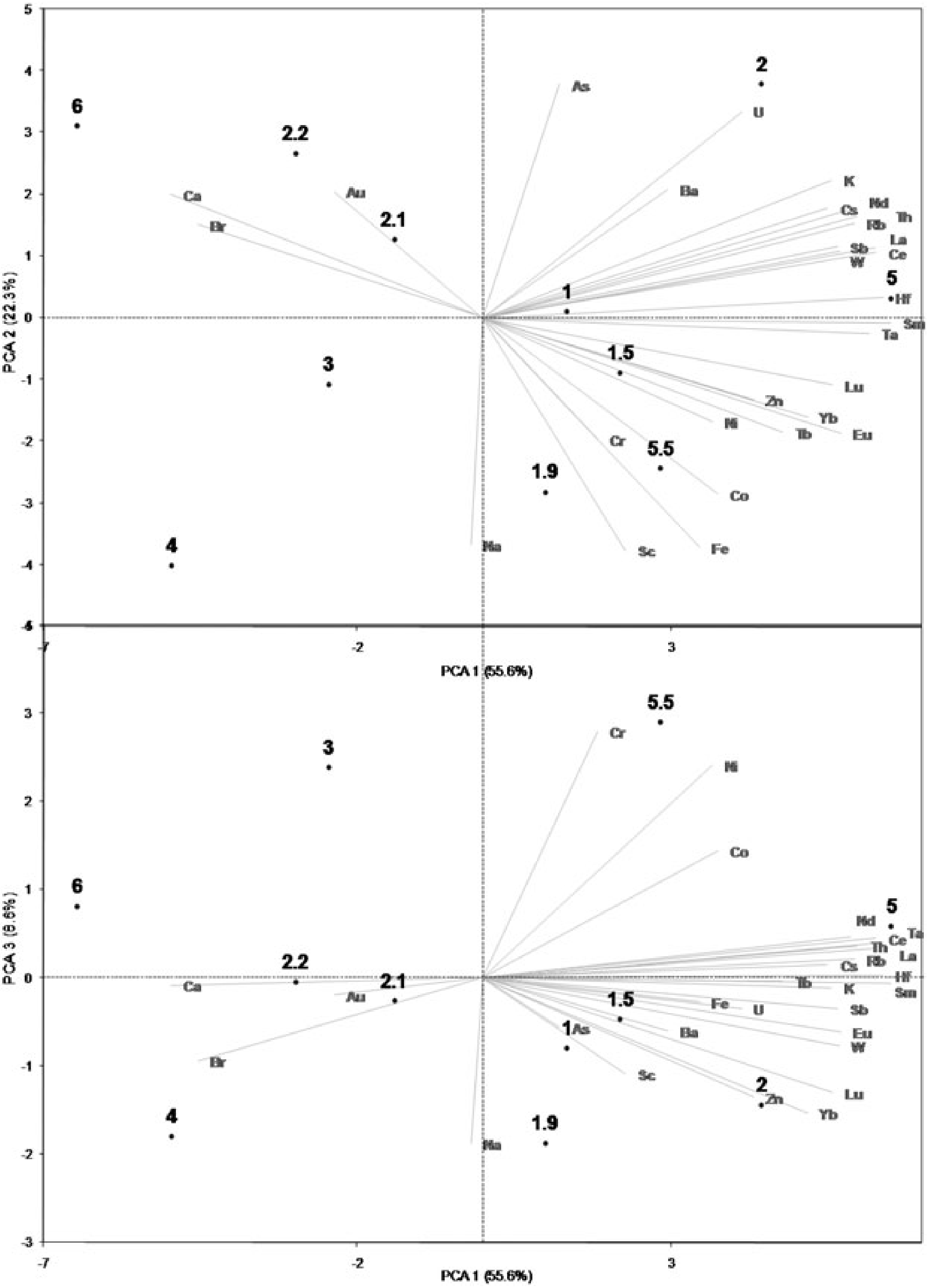
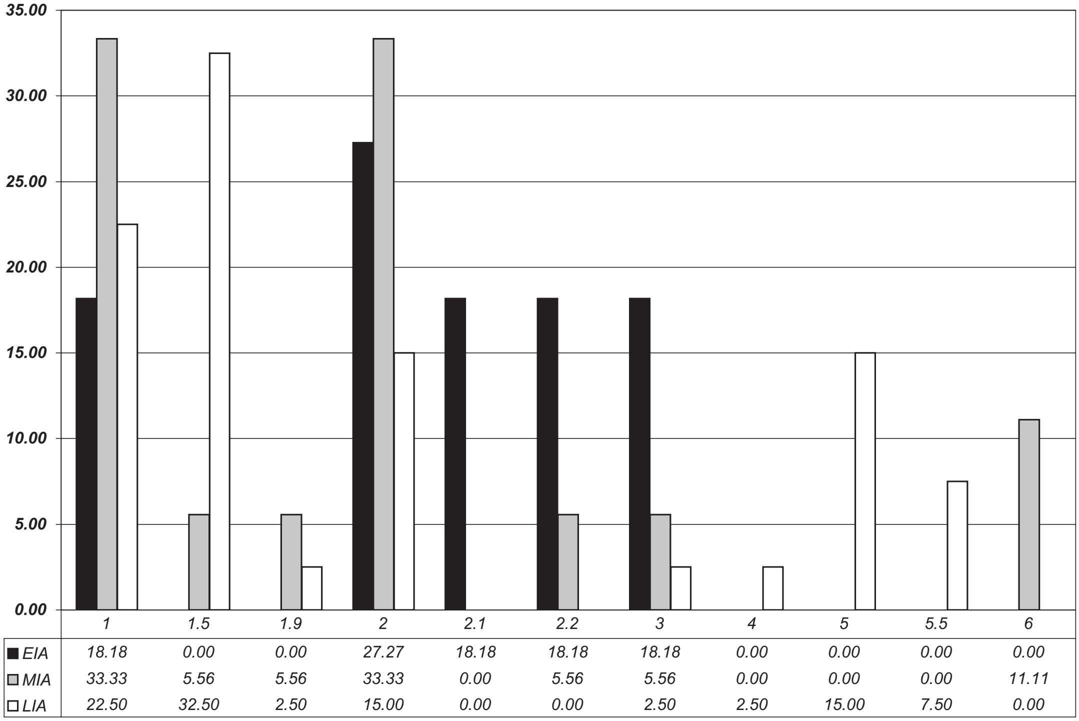


Figure 7
Scatterplot of the first two components of a PCA showing relationship between group means and elements.



	1	1.5	1.9	2	2.1	2.2	3	4	5	5.5	6
■ EIA	18.18	0.00	0.00	27.27	18.18	18.18	18.18	0.00	0.00	0.00	0.00
▨ MIA	33.33	5.56	5.56	33.33	0.00	5.56	5.56	0.00	0.00	0.00	11.11
□ LIA	22.50	32.50	2.50	15.00	0.00	0.00	2.50	2.50	15.00	7.50	0.00

Figure 8
Percentage histogram of NAA groups summed by period (showing relative abundance of these groups).

TABLE 6
Iron Age wares by compositional group (BK#) and sub-phase (raw counts). Note that sherd counts in this table are less than total counts, as ware type for some sherds was not identified

		INAA Groups										
		1	1.5	1.9	2	2.1	2.2	3	4	5	5.5	6
EIA	Coarse					2	2	1				
	Common	2			2							
	Decorated red				1			1				
MIA	Common	1										
	Cooking pot	1	1	1				1				
	Bichrome	3			1							
	Decorated other	1			2							
	Grey				3							
	White						1					2
LIA	Common	7	8		3						3	
	Cooking pot			1					1			
	Decorated other		1					1				
	Decorated red		2		2							
	Grey	1	1		1							
	Black polished	1	1							6		

of the white ware vessels only small sherds are preserved, but the rim types suggest predominantly drinking or serving vessels such as bowls, cups and small jugs. The generally elaborate painted decoration also suggests that we are dealing with a luxury table ware.

The LIA (n = 45) presents the greatest diversity of any period, with eight of the 11 NAA groups represented (and five outliers). Just over 20 per cent of the LIA sample comes from exotic sources. BK 1.5, which first appeared in the MIA, becomes the most abundant local ware, and is now used to make a wide variety of common and decorated wares (every form except cooking pots; Fig. 8; Table 6). BK 1, 2 and 3 all drop off from the MIA. BK 1.9, as in the MIA, is still associated with cooking pots, with an additional local clay source used for cooking pots in the LIA (BK 4). Three groups are found only in the LIA (BK 4, 5, 5.5), suggesting both a shift in local sources (BK 4) and a substantial increase in regional interaction (based on abundance). Neither the import nor the emulation of exotic white wares continues from the MIA. However, as noted above, new styles, like polychrome decoration, are first seen in the LIA.

Just as in the MIA, the LIA exotic groups (BK 5 and 5.5) seem to be restricted to luxury table wares. BK 5 consists exclusively of vessels of the so-called black polished ware. The types most commonly attested in this ware at Boğazköy are bowls, beakers and small jugs, while the other exotic BK 5.5 consists of larger spouted jugs, which most likely have to be interpreted as serving vessels for drinks such as beer or wine.

One other pattern changes from MIA to the LIA. In the MIA, common ware is restricted to BK 1 and grey ware to BK 2, while in the LIA both common wares and grey wares are made from three different local groups (BK 1, 1.5 and 2). This would seem to suggest multiple workshops with specialized production.

Imports and emulations

Several patterns are of particular interest from the perspective of imports and specialization. First, black polished ware, best known from Gordion (Henrickson *et al.* 2002), belongs mainly to a single source (BK 5), and both this group and local emulations occur only in the LIA. The unique and uniform nature of this group, and its local emulations, suggest it represents specialized exchange. Secondly, the presence of a group of ‘common’ wares, all spouted jugs, that also appear to be non-local (LIA BK 5.5), also suggests a second quite different type of specialized exchange.

In addition to black polished ware, several other types appear to be emulations. For example, grey wares, often thought to be imported from the west, where they are more common, occur only in local fabrics during the MIA and LIA. Emulation is also evident for most of the decorated wares (e.g. bichromes, red slipped and polychromes) that are made in local fabrics.

DISCUSSION

The different phases of the Iron Age present quite distinct NAA group distributions. During the EIA all geochemical groups were produced locally, and are relatively evenly distributed across five different compositions. This pattern is consistent with localized household-scale production and the small scale of social, economic and political organization after the collapse of the Hittite Empire at the end of the LBA.

In the MIA, the distribution and content of local groups shift and the first imported wares occur (‘white ware’). The increasing diversity in the MIA, in wares and styles, seems to support a change from EIA hamlet to MIA regional centre, showing some evidence of specialization in pottery production (BK 1 and 2 dominate local production). This is confirmed technologically by the reintroduction of the potters' wheel (Genz 2004a, 30). The introduction of imported white ware also suggests greater interaction at this time.

However, it is in the LIA that imports increase noticeably, suggesting a rapid expansion in external relationships. The increased range of imports relative to previous periods indicates that this community is operating in a new and very different type of Anatolian economy. While it was suggested that by the MIA the site was a regional centre, these analyses indicate that it is only in the LIA that its larger regional interaction increases. This development parallels the appearance of more impressive architecture such as fortifications and much larger buildings at the site (Neve 1982, 147–70; Genz 2006b, 103–7). While the NAA sample reported here is relatively small, the overall trajectory of change in local vs. non-local production, as well as the increase in emulation of non-local ceramic styles, suggests a fairly rapid development of a successful regional political and economic centre interacting with groups hundreds of kilometres away. Whether Boğazköy is a focal or secondary centre of this emerging polity is not yet clear.

It is interesting to note that in the MIA and LIA no imported transport vessels have been found at Boğazköy. Trade goods (contained in ceramic vessels) thus seem to have been limited. Instead, in both periods, the exotic wares consist of luxury table vessels, which seem to have been used as status symbols by the local elite. An emerging elite at Boğazköy is also attested in the cemetery in the Lower City, dating to the later MIA and the beginning of the LIA (Genz in preparation). Some of the cremation tombs in this cemetery contain moderately wealthy graves, with objects such as silver jewellery (Boehmer 1979, Taf. XVV:3561, 3564 and 3565), metal vessels (Boehmer 1979, Taf. IV:2555 and 2556) and elaborate fibulae also attested in the much richer tumuli at Gordion (Boehmer 1979, Taf. III:83A). The exotic pottery groups from Boğazköy support the picture of a trade network which, while slowly expanding from the MIA to the LIA, was comparatively modest in its extension and the quantity of goods transported. It primarily seems to have served to supply local elites with high-quality table wares. Compared to the rich array of imported vessels retrieved from the tumuli at Gordion, which include Greek ceramic imports and Near Eastern glass vessels, the evidence from Boğazköy is restricted in quality and quantity, thus demonstrating that the site had a more limited economic and political importance.

This trajectory of post-collapse recovery is quite different from that of Iron Age Gordion, where the Phrygian polity that emerged in the EIA lost regional political control by the LIA (Voigt and Henrickson 2000; Voigt and Young 1999) with Lydian and Persian invasions. Arguably, Gordion may have remained an important regional political centre, if not under Phrygian control. Gordion appears quite affluent in the LIA (based on tumuli assemblages and the extent of Late Phrygian settlement). No major building is known from the Citadel Mound in this phase. Boğazköy, following a different course, emerges as a regional centre (if short lived), based on the trade ceramic evidence presented here. The expansion of large-scale architecture in this period suggests that it may well have been a significant political centre as well. The timing of these developments at Boğazköy also corresponds with the waning political influence of Phrygia at this time.

The re-emergence of complex societies in central Anatolia in the Iron Age clearly followed quite different paths in different regions. The location of Gordion, on the periphery of the Hittite Empire and yet clearly integrated into its exchange and economic sphere, may have been a significant factor in its subsequent emergence as a major regional power in the EIA. Other factors, including increased interaction with the west and possibly in-migration, undoubtedly played a role as well.

At Boğazköy, in the heart of the Hittite Empire, the re-emergence of complexity was much slower and smaller in scale. The nature of Hittite power clearly did not provide easy paths for subsequent leaders to reinvent political control, which seems only to have re-emerged more than 500 years later in the LIA. Unlike Mesopotamia and Egypt, local Anatolian elites did not find ways to make use of earlier hegemonic ideologies, but adopted quite different ways of creating regionally based power in the Iron Age.

Other variables were likely to have impaired Boğazköy's political re-emergence. The relocation of the capital to the south in the Late Empire period was undoubtedly a key factor. Recent studies of the faunal material from the Iron Age also suggest that EIA domesticates were smaller, and that the cattle were used for heavy labour and slaughtered at older ages (von den Driesch and Pöllath 2003, 298). This could represent local environmental degradation (smaller body size), and perhaps a shift to ploughing heavier lowland soils as the hill slopes were eroded. Without political control over trade routes or a political centre, Boğazköy was also no longer a key stopping point or magnet for long-distance trade. When its long-distance trade re-emerges in the LIA, it is clearly interacting within a new, complex political and economic landscape.

CONCLUSION

NAA analyses of ceramics from Boğazköy have clarified a range of both methodological and substantive issues. In addition to addressing questions of local vs. non-local production, NAA has provided a means to assess both the diversity of geochemical groups over time and the scale and density of regional/long-distance interaction as an independent measure of social and economic dynamics and standardization. Combining all three ceramic measures (style, function and composition) enables more robust interpretations of exchange, use and production. In this case, while the long-distance trade clearly played a role by the LIA in Boğazköy, the limited range of imports of mainly luxury table wares suggests it was not a critical variable in the re-emergence of the LIA regional centre. Future integration of these data with those from other sites and catchments in Anatolia should provide a more robust sense of the sources and scales of exchange across the region.

The Iron Age in central Anatolia provides a unique opportunity to understand how societies reformulate themselves politically and economically after the political collapse of a large empire. In most other regions, successive states reshaped new and often larger empires (China, Mesopotamia, Egypt), while in Anatolia the re-emergence of a local empire did not happen until the second millennium AD. Comparisons of regional patterns, like those at Gordion, Sardis and Boğazköy, should make it possible to identify the interplay of variables that shaped the emergence of new political and economic forms. As our information about Iron Age sequences improves at sites around central and western Anatolia, there will be a possibility of constructing larger-scale landscapes of political and economic interaction and re-emergent patterns of complexity.

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