A View from the North: Black Wheelmade Ware in Lebanon

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Abstract

Ever since its first discovery at Megiddo in the 1930s, Black Wheelmade ware has sparked the interest of researchers, especially regarding its origin. Most of the research so far has focused on northern Palestine. Lebanon has occasionally been mentioned as a possible region of manufacture, but so far without providing any detailed evidence. In this article, we discuss the occurrence of Black Wheelmade ware in Lebanon and provide the results of the first petrographic and geochemical data from this region.

Introduction

In the Southern Levant, the transition from the Early Bronze Age III to the Early Bronze Age IV, now dated around 2500 BCE according to recent radiocarbon dates (Regev *et al*. 2012; Höflmayer *et al*. 2014), is accompanied by marked changes. Almost all urban settlements of the Early Bronze Age II-III disappear in the Early Bronze Age IV or shrink to the size of villages (Mazar 1990; Palumbo 1990; Dever 1995; Mazar 2006), with the exception of Khirbet Iskander in Southern Jordan, explored by S. Richard and her collaborators since 1980 (Richard *et al*. 2010). Marked changes are also noticeable in the ceramic repertoire. Large platters as well as jars and pithoi with combed surfaces dominate the Early Bronze Age II-III assemblages, while drinking vessels are hardly attested (Genz 2002; Bunimovitz and Greenberg 2004). In the Early

Bronze Age IV, however, platters and combed jars completely disappear, whereas a variety of chalices, goblets, teapots and other types related to drinking customs abound (Bunimovitz and Greenberg 2004; Bunimovitz and Greenberg 2006; D'Andrea 2014; Whelton and Cooper 2014). Especially in the pottery, a marked regionalism is noticeable, which has led to the definition of various pottery families (Amiran 1970: 79-89; Dever 1980; D'Andrea 2014). Marked Syrian influences in the pottery repertoire were noticed from early on (Guy and Engberg 1938; Amiran 1970: 83; Bunimovitz and Greenberg 2004; Whelton and Cooper 2014; D'Andrea and Vacca 2015).

In the Northern Levant, on the other hand, there is a much stronger evidence for continuity between the Early Bronze Age III and IV, both in terms of settlement patterns and ceramic production (Genz 2012: 621; Thalmann and Sowada 2014: 358).

Black Wheelmade Ware: Definition and History of Research

The term "Black Wheelmade Ware" was coined only recently by R. Greenberg (Greenberg *et al.* 1998: 23; Greenberg 2002: 53), whereas formerly it was known as the "Megiddo Group" (Amiran 1970: 81-2). Dever subsumed this pottery under his families N and NC (Dever 1980: 46-47). This pottery was first identified in Megiddo in the 1930s (Guy and Engberg 1938), but since then has been found at various sites in the Jezreel Valley, Galilee and the Hula Valley in Palestine, as well as in Lebanon in the Bekaa and along the coast, as well as in Southern Syria (D'Andrea 2014: fig. 5.3; Bechar 2015: fig. 14).

This ware is characterized by a rather limited repertoire: teapots, goblets, and small flasks dominate the assemblages, whereas jars are only rarely attested (D'Andrea 2014: 153-69; Bechar 2015). The fabric is generally dark grey to black, but reddish hues are attested as well (D'Andrea 2014: 153; Bechar 2015: 39). Most vessels show white painted decoration in their upper parts, mainly simple horizontal bands, but wavy lines framed by horizontal bands are also attested. Reserved painting, in which parts of the white paint are removed with a pointed instrument to expose the dark surface of the vessels, is mainly attested in Southern Syria. Another characteristic is the rather high firing temperature perhaps approaching 800 or 850ºC (Bechar 2015: 40; but see also below).

Contrary to earlier assumptions that this pottery was wheelmade (Guy and Engberg 1938: 148-49; Greenberg 2002: 53), a recent detailed study of the manufacturing technique revealed that the vessels are only wheel coiled (Bechar 2015: 39-40). Concerning the proper definition of the ware, still some discrepancies can be noted. Whereas D'Andrea (2014: 158-59) distinguishes a "western" group, encompassing the finds from Northern Palestine and Lebanon, from an "eastern" group which is found in Southern Syria, Whelton and Cooper (2014: 335) only see the examples from Southern Syria as "related," Bechar (2015: 43-7), however, counts all of these as Black Wheelmade ware.

Earlier researchers generally traced the origin of the Black Wheelmade ware to the Middle Orontes Valley (Guy and Engberg 1938: 148; Dever 1980: 50-2) and regarded the vessels attested in the Southern Levant as imports. Already in 1978, Tadmor (1978: 10) cautiously suggested a local origin for the Black Wheelmade ware from Qedesh in the northern Hula

Valley. The first petrographic analyses of Black Wheelmade ware were conducted on material from Tel Naama (Greenberg *et al.* 1998: 23), which suggested Lower Cretaceous clay as the raw material. Such clays are attested in the Upper Hula Valley and the Lebanese Bekaa. A Lower Cretaceous origin of the clay was excluded in a more recent petrographic study (Bechar 2015: 42-3; see also Cohen-Weinberger 2016). In both studies, few details were published in support of these conclusions, so they should be treated with caution. The production location (or locations) of the Black Wheelmade ware remains poorly understood.

The most recent studies of the distribution of the Black Wheelmade ware (D'Andrea 2014: 157-58 and Fig. 5.3; Bechar 2015) have shown that its distribution encompasses Northern Palestine, Lebanon, and Southern Syria, with Tell Hizzin in the Lebanese Bekaa and Yabroud in Southern Syria so far representing the northernmost extension of the distribution (but see below for new finds from Tell Fadous-Kfarabida and Tell Arqa). However, it is not attested in the Orontes Valley; thus, an import from that region can be excluded. The Lebanese Bekaa remains one of the potential areas of origin of this ware, but except for a few general statements in passing, this option has not yet been seriously investigated. In this contribution, we will review the evidence for Black Wheelmade ware in Lebanon and present the first petrographic investigations for this ware in Lebanon.

Black Wheelmade Ware in Lebanon

The distribution of Black Wheelmade ware in Lebanon has recently conveniently been summed up by D'Andrea (2014: 157 and Fig. 5.3) and Bechar (2015: 43-6). It has to be kept in mind, however, that the state of research regarding the Early Bronze Age IV in Lebanon is scanty at

best (for a recent summary, see Genz 2010). Black Wheelmade ware is represented at six sites in Lebanon: Tell Hizzin and Rafid are situated in the Bekaa, while Tyre, Byblos, and Tell Fadous-Kfarabida are located on the coast. Tell Arqa, located in the Akkar plain, produced one sherd of Black Wheelmade ware (Figure 1).

Tell Hizzin is located in the Bekaa Plain, 11 km southwest of Baalbek. Although excavated by Emir Maurice Chéhab already in 1949 and 1950, the results remained unpublished except for a few short notes (Chéhab 1949-1950: 109; Chéhab 1983: 167; Marfoe 1995: 241). In spring of 2007, a team from the Department of History and Archaeology of the American University of Beirut started cataloguing the material located in the National Museum of Beirut for a future publication of the results of this rather important site (see Genz and Sader 2008a; Genz 2010: 209-10 for preliminary assessments).

The discovery of a number of Early Bronze Age IV vessels came as a complete surprise, as this period was never mentioned for Tell Hizzin before (Marfoe 1995: 241). So far, this period only seems to be represented by tombs. There are at least eight tombs, which have produced Early Bronze Age IV pottery. Unfortunately, no information as to the location, layout and number of interments is available, as except for the material stored at the National Museum in Beirut and several photographs taken during the excavation no documentation is available. None of the old excavation photographs provides any information concerning the tombs of this period. As all of the tombs, which contained Early Bronze Age IV pottery, have produced later material as well, it may be speculated that they were cave tombs which could be entered and reused in later periods. However, no proof for this assumption is available.

The material consists of pottery types such as goblets, teapots, bottles, and amphoriskoi. Remarkable is the high percentage of vessels of Black Wheelmade Ware (Figure 2:1-4). Of the 20 Early Bronze Age IV vessels available from the site, nine (two goblets, five teapots, and two bottles) are in Black Wheelmade ware (Genz and Sader 2008a: 187 and Pl. I). A few sherds represent further Black Wheelmade ware vessels, but as body sherds generally do not seem to have been kept, the actual percentage of Black Wheelmade ware at the site remains unknown. There is no evidence for Early Bronze Age IV habitation layers at Tell Hizzin, as all evidence for domestic activities such as cooking vessels is missing completely.

At Rafid, located in the Wadi at-Taym southeast of Kamid el-Loz, an Early Bronze Age IV chamber tomb was discovered during construction work in 1966 and excavated in 1967 (Mansfeld 1970; Prag 1974: 115; Marfoe 1995: 190-1). Unfortunately, in the meantime, the tomb had been robbed, so that mainly the material rescued in 1966 is preserved. The subterranean chamber, which measures ca. 3.00 x 1.50 m, was covered by one monumental stone slab of 3.40 x 2.30 m. The height of the chamber is 1.1 – 1.2 m. The location of the entrance remains unclear due to damage during the discovery. The chamber was probably covered by a stone tumulus. The finds consist of 13 ceramic vessels, all wheelmade, one dagger, one toggle pin, one awl or needle, as well as several stone beads and pendants and one carnelian bead. The number of interments remains unclear. Black Wheelmade ware is represented by four vessels, three goblets and one bottle (Mansfeld 1970: 123-24 and Taf. 38: 5 + 7; Taf. 39: 7-8). Interestingly, white painted decoration is not mentioned in the published descriptions.

In the deep sounding in the Old City of Tyre conducted by P. Bikai from 1973 to 1974, levels XX and XIX can be attributed to the Early Bronze Age IV according to typical pottery such as teapots, amphoriskoi, and envelope ledge handles (Bikai 1978: 6 and Pls. LIV-LVI). Unfortunately, no architectural remains were encountered in the rather limited sounding. Black Wheelmade ware seems to be restricted to Stratum XX. No quantitative information on the pottery is available, but out of the 17 published sherds and vessels from this stratum, four can be attributed to Black Wheelmade ware. Three of them belong to teapots, while the fourth one is just a body sherd (Bikai 1978: Pl. LVI:10-13).

Byblos is certainly one of the most fascinating archaeological sites in Lebanon. Unfortunately, the inadequate excavation and recording techniques employed by the early excavators have led to great controversies on the exact dating of buildings and objects uncovered there. According to M. Dunand, the Early Bronze Age III settlement ended in a great conflagration, which he attributes to the invading Amorites (Dunand 1952: 86-90; see Genz 2010: 207 for further comments). Unfortunately, the final publication of the third millennium material is still lacking, but according to the studies of the third millennium levels at Byblos undertaken by M. Saghieh, the site continued to show urban structures during the Early Bronze Age IV, such as religious and probably public buildings (Saghieh 1983: 93-8). J.P. Thalmann (2008) has recently published a comparison of the Early Bronze Age IV pottery from Tell Arqa and Byblos. Black Wheelmade Ware is represented by only one teapot from squares 16-17/23 (Dunand 1954: 117 and fig. 114:7585; for comments on the findspot, see Saghieh 1983: 72 and 95).

Situated 12 km north of Byblos directly on the coast, the recently discovered site of Tell Fadous-Kfarabida has so far only produced scanty evidence of Early Bronze Age IV habitation. Early Bronze Age IV pottery was mainly found in topsoil contexts and a few pits (Genz and Sader 2008b: 154 and Pl. 4; Genz *et al*. 2009: 78 and Pl. 3; Genz *et al*. 2010: 247 and Pl. I0). Some rooms of the Early Bronze Age III Building 4 seem to have been reused by squatters in the Early Bronze Age IV. From a fill in Room 3 in this building comes a sherd of a Black Wheelmade ware goblet (Figure 2:5). The Early Bronze Age IV pottery from Tell Fadous-Kfarabida finds its best comparisons in the material from Stratum 15 at Tell Arqa (Thalmann 2006: 19-32).

Tell Arqa, located on the southern edge of the Akkar Plain in Northern Lebanon, has yielded abundant evidence for the Early Bronze Age IV (Thalmann 2006; Thalmann 2010). Noteworthy is the urban layout with multi-room buildings up to three stories in height, separated by narrow streets. Among the large number of Early Bronze Age IV vessels, only one sherd of Black Wheelmade ware is attested from the beginning of Stratum 15, the late Early Bronze Age IV phase. While no spout is preserved, according to the short neck and the globular body it most likely represents the upper half of a teapot with three horizontal bands in white paint (Figure 2:6) and a potmark incised before firing on the shoulder. Still unpublished radiocarbon dates place the absolute dating for Stratum 15 between 2250 ± 50 and 2000 BCE.

Further Early Bronze Age IV sites, such as the dolmens around Mengez in the Akkar Plain (Tallon 1964; Steimer-Herbet 2000), the al-Hourriye cave in the Qadisha Valley (Beayno *et al.* 2002), Baalbek in the Bekaa (Van Ess *et al.* 2008: 110-1 and Pl. 2:9), and the so-far unpublished

early Bronze Age IV tombs in the hinterland of Sidon at Bna'foul (Saidah 1967: 171), Chhim (Saidah 1967: 171), Sarafand (Dahr el-Zaatar) (Saidah 1967: 171; Prag 1974: 115), and Wadi el-Leymoun (Copeland and Wescombe 1966: 161; Saidah 1967: 171) have not yet produced any evidence of Black Wheelmade ware.

Petrographic and chemical characterization of Black Wheelmade ware sherds from Lebanon

The Archaeometric analysis of the samples of Black Wheelmade ware (Table 1**)** was undertaken by ceramic petrography and by Inductively Coupled Plasma-Atomic Emission Spectroscopy and - Mass Spectrometry (ICP -AES and -MS) (Table 2) with the aim of reinforcing the conclusions of their typological/macroscopic study along three specific lines of enquiry. The goals of these analyses are as follows:

1) To better inform our understanding of raw material preferences, manufacturing processes, firing temperature, degrees of standardization and the degree of the centralization of production of these vessels.
2) To understand the degree of petrographic and geochemical similarity between Black Wheelmade ware samples throughout its known distribution area in Lebanon and northern Palestine. A high degree of similarity of Black Wheelmade ware would indicate products of a uniform and centralized production as suspected by some authors (Bechar 2015: 53). Conversely, a low degree of similarity would indicate dispersed and variable production modes. If the latter is true, this study seeks to identify any differences between vessels found on the Lebanese coast, in the Bekaa valley, and in Northern Palestine.

3) Lastly, an attempt will be made to identify the production location(s) of the Black Wheelmade ware vessels.

It must be stated that the limited occurrence of the Black Wheelmade ware in Lebanon means this study is based on only six samples – too few for statistical significance. In order to overcome the limited nature of the dataset and provide greater context, a comparative analysis will be conducted using all published petrographic examples of Black Wheelmade ware. Additionally, the geochemical information will be joined with a published database of contemporary goblets, bowls and jars from Tell Nebi Mend, Qatna, and the Homs Regional Survey, which are very similar in terms of typology, fabric, and technology to the Black Wheelmade ware (Kennedy *et al*., in press*;* Kennedy 2015; Philip *et al*. 2002; Philip *et al*. 2005; Philip and Bradbury 2010; Maritan *et al.* 2005).

The aim of a comparison with the Homs area assemblages is to investigate whether the production and technology of the Black Wheelmade ware is closely related to the "Caliciform" tradition of that area in particular, as recently suggested by Kennedy *et al*. (in press). If so, it could be posited that the Black Wheelmade ware vessels were strongly linked conceptually and functionally with forms in contemporary assemblages found in the Homs area; if not, this may indicate that these vessels filled an alternative, but highly specialized role with Early Bronze Age IV societies in Lebanon and Northern Palestine.

Analytical Methods

The samples were first studied in transmitted light using a Leitz petrographic microscope. Light micrographs were taken with a Leica EC3 digital camera mounted on the microscope.

The thin–sections were described using terminology and values proposed by Stoops (2003), Quinn (2013), and Klein and Philpotts (2013). The measurement and quantification of the aplastic fraction of each sample and grain measurements were completed using the digital image analysis software, Jmicrovision (Rodit 2007; www.jmicrovision.com). Tiled images of an area on each thin-section measuring one cm^2 were produced for this purpose.

Five samples were analyzed by ICP -AES and -MS. Chemical analysis using ICP, yields the inorganic elemental composition of each sample, providing a chemical signature that can be used to determine whether different ceramics were made using clays from the same outcrop which can imply a shared production location (Orton and Hughes 2013: 168-83) or, conversely, the use of different clay sources. As the chemical signature can vary even within the same clay outcrop, very close signatures suggests production from a geographically and, potentially, temporally proximate batch of materials and, thus, likely the same production location and a similar date.

Following the methodology employed by Hughes (2005), powders were obtained from the profile of each sherd using a 12-volt dental drill fitted with a two mm diameter solid tungsten carbide bit. The samples were prepared at the Durham Archaeomaterials Research Centre (DARC). The powders were acid digested using hydrofluoric acid and analyzed by ICP-AES and ICP-MS at the Department of Earth Sciences, Durham University. The analysis measured for 39 elements (Table 2). The major elements, analyzed by ICP–AES as weight percentage oxide, include Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, and MnO. The minor and trace elements analysed by ICP–MS as parts per million (ppm) include Co, Cr, Cu, Ni, Sc, Sr, V, Zn, Rb, Y, Zr, Nb, Cs, Ba, Pb, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.

A principle components analysis (PCA) (Orton and Hughes 2013: 176-80) incorporating the remaining elements was conducted using SPSS v.22 to plot the similarity of the "chemical fingerprint" of each sample (Figure 5). A number of elements were removed from multivariate statistical analyses as various processes can affect them during deposition and sample preparation, including CaO, P_2O_5, Co, Ba, and Zr. As the thin-section analysis indicated that closely related clay sources were used for the production of these vessels, the geochemical analysis focused primarily on the rare earth elements (henceforth REE). REE are ideal for geochemical fingerprinting in clays, as they are largely immobile during low-grade metamorphism, weathering, and hydrothermal alteration (Rollinson 1993). As such, REE values, more than other elements, are a good indicator of the original composition of the parent rock. Moreover, recent studies show that there is no fractionation of these elements as a result of the firing process (Finlay *et al.* 2012: 2389). The REE values used for the light REE and heavy REE sums and ratios were normalized using the values for chondritic meteorites as presented in Rollinson 1993 (Table 2).

Results of the Petrography

The petrographic analysis shows that a related set of petrofabrics and preparations, utilizing mostly fine-grained quartz-rich calcareous fabrics, was used for the Early Bronze Age IV Black Wheelmade ware from Lebanon. In contrast, on-going work (Badreshany *et al*., in press), shows that unrelated coarser calcareous and shale derived fabrics dominated in the area during the Early Bronze Age II-III and into the Early Bronze Age IV at Arqa (Jean in press*)*. Likewise, Cohen-Weinberger (2016: 22), in an analysis of Black Wheelmade ware from Northern Palestine, indicated that a comparison with thousands of samples from the IAA collection

provided no clear parallels with earlier material from northern Palestine. Thus, Black Wheelmade ware shows a lack of continuity with the traditions common in earlier periods within its known distribution area. The disconnect in production modes betrays significant functional and, perhaps, conceptual divisions between the early and late third millennium BCE ceramic repertoires in Lebanon and Northern Palestine supporting ideas first put forth by Bunimovitz and Greenberg that the Black Wheelmade ware represented the emulation by local populations of the contemporary Syrian drinking customs (Bunimovitz and Greenberg 2004; Bunimovitz and Greenberg 2006).

Similar to the dominant fabrics in the area of Nebi Mend and the Homs Regional Survey during the Early Bronze Age IV, the Black Wheelmade ware can be described broadly as "Quartz-Calcareous" Fabrics. They consist of a clay-rich matrix with a fine texture. The ground mass is dark reddish-brown to brown-black in ppl, indicating firing, at least at some stage, in a reducing atmosphere. The ground mass is rich in microcrystalline calcite and in some cases an optically active crystalic b-fabric is observed. The ground mass is sometimes well-sintered and elongate channel voids can occur.

The samples are composed of a similar suite of non-plastic inclusions, but two subfabrics, A and B, can be differentiated according to their coarseness (Figures 3 and 4**)**. Subfabric A, consisting of the samples from Arqa and Fadous-Kfarabida, along with Hizzin samples 4 and 5, is fine grained, whereas subfabric B consisting of Hizzin samples 1, 2, and 3 is much coarser. Subfabric A consists of at least one teapot (Arqa) and one goblet (Fadous-Kfarabida), showing that the fabric crosscuts larger and smaller types. The typology of the Hizzin samples is problematic as permission was granted only to sample body sherds. The thickness and curvature

of these sherds, however, strongly suggests they are larger vessels, probably jars or teapots. Subfabric B, the coarser of the two fabrics, therefore, is only found on larger vessels so far, though with such a small dataset solid conclusions about how this subfabric relates to Black Wheelmade ware typology cannot yet be drawn. Additionally, the chronological relationship of these two subfabrics remains unclear, though the sample from Arqa belonging to subfabric A is found in stratum 15 at Arqa (probably dating between 2250-2100 BCE). Due to a lack of stratified data, it remains unclear if the coarser subfabric B is earlier, contemporary, or later than subfabric A.

The aplastic inclusions in the samples are generally subangular to subhedral. Less commonly rounded spherical and elongate grains are noted. Equant grains of fine to medium sand sized quartz occurred most commonly. Some samples contained silt sized grains of quartz commonly. The grains were sometimes well rounded but most often subangular to subhedral. Pieces of fine to coarse sand sized grains of degraded micritic lime mudstone occur in the samples to varying degrees. Grains of fine sand sized calcite occurred rarely. The samples are generally low in calcium (between ca. 2.5-7.0%), as indicated by the ICP analysis (see below). Rarely, rounded red optically active fine sand sized grains occurred, which were in high relief. These bodies are clay rich and are likely glauconite chlorite, or some form of iddingsite. Iddingsite seems less likely, however, as no evidence of igneous rocks were otherwise noted in the samples.

Subfabric A denotes the finest grained fabrics, where the total aplastic inclusions made up 10–12 % of the sample. The average size of the inclusions rarely exceeds that of fine sand (under 150 microns) and silt sized grains of quartz are noted commonly. The samples belonging to subfabric B are similar in composition to those of A but are much coarser. Aplastic inclusions make up 15-20% of the samples belonging to fabric B. Additionally, the inclusions have a larger

average size with a number of medium sand sized quartz fragments measuring 300-500 microns observed. The samples belonging to this subfabric contain comparatively less limestone relative to those of subfabric A. Lastly, in one of the samples of subfabric B a few argillaceous rock fragments surrounded by shrinkage voids (perhaps shale) were observed.

Results of the Geochemistry

The results of ICP analysis reinforced the petrography, showing two clear groups corresponding to subfabrics A and B. For the PCA (**Figure 5)**, three components were extracted cumulatively explaining 83.8% of the variation in the dataset. The loading plots associated with the PCA analysis showed that the REE had the most impact on the variability between samples.
The PCA charts show the subfabrics A and B form two individual chemical groupings. Though distinct, the ratios of LREE/HREE and total REE data are comparable for both of the Black Wheelmade ware subfabrics, indicating these groups are broadly related and probably composed of clay materials derived from a related geology.

The PCA and REE data indicate that the Black Wheelmade ware subfabrics are distinct from the Tell Nebi Mend, Qatna, and Homs Regional Survey ceramics, though composed of related materials, especially in the case of subfabric A. Compared to the wider dataset from the Homs area, the Black Wheelmade ware samples generally show ratios of LREE/HREE on the higher end of the range. Likewise, these samples are higher in total REE, especially those from subfabric B, which have the highest values of all samples in the combined database. Still, the REE values and ratios for the Black Wheelmade ware are broadly in line with those to those published for the Tell Nebi Mend/Homs area Early Bronze Age IV grey and buff ware ceramics

(Kennedy *et al*., in press), indicating that Black Wheelmade ware is perhaps made using similar types of clay to the Tell Nebi Mend/Homs area ceramics, but mined from a different outcrop. The Black Wheelmade ware is also characterized by relatively low calcium values (ca. 2.5-7.0%) compared to most of the samples in the Homs area database and for values reported from Early Bronze Age II-III calcareous fabrics from Lebanon (Badreshany *et al*., in press).

The results of the petrographic and geochemical analyses suggest that Black Wheelmade ware was made from at least two distinct but closely related sets of materials. The vessels are similarly distinct from contemporary Tell Nebi Mend/Homs area Early Bronze Age IV grey and buff ware ceramics. Materials and preparations preferred for both the production of Black Wheelmade ware and the Tell Nebi Mend/Homs area Early Bronze Age IV grey and buff wares ceramics, however, indicate that they stem from related traditions of craft production and utilize shared technologies.

Provenance, Comparative Petrography and Technological Considerations

The petrographic and geochemical analyses demonstrate that Black Wheelmade ware was made using centralized production modes utilizing a fine quartz-rich calcareous clay. The samples, drawn from a wide geographical area, fell entirely within one of two petrographic and chemical groupings. Caution must be exercised with any interpretation because of the small size of the dataset, though it is worth noting that these findings are in agreement with the typological and petrographic data presented by other authors (Kennedy *et al*., in press*;* Bechar 2015; Cohen-Weinberger 2016), which are based on much larger datasets. All of the currently published data points to a tradition centered on a few workshops in an as of yet undefined area or areas (see

below). The data from this study shows clear overlap between samples from the Lebanese coast and Bekaa (for fabric A) indicating the Black Wheelmade ware were distributed widely, some distance from their place of origin.

As noted by other authors (Bechar 2015; Cohen-Weinberger 2016), the well-refined nature of the clay makes identifying a provenance of the Black Wheelmade ware quite difficult. As will be explained further below, the samples are consistent with a wide range sedimentary rock sources found commonly in Lebanon and in Northern Palestine. The samples share a particular affinity with the Homs area samples which suggests they were similarly made of clay formed from Miocene/Pliocene calcareous marls (Kennedy *et al.*, in press; see Ponikarov 1967: 147-8 for a description of these deposits), though without geoprospection and more data it is not possible to confirm that the Black Wheelmade ware samples were produced using clays formed on these rock types.

This study shows the potential of geochemical analyses to further group samples beyond what is possible with petrography alone, which could contribute substantially to our understanding of the provenance of these vessels, but the dataset is currently restricted to five samples analyzed as part of this study. Given the well-refined nature of the samples, a much larger geochemical dataset and a program of geoprospection will be needed before a convincing assessment of the provenance of Black Wheelmade ware can be made. Here, all of the known data will be organized and examined, which will serve to definitely exclude some areas as possible locations for workshops and identify others as potential areas to focus future work for sample collection and geoprospection.

Black Wheelmade ware is found exclusively in Lebanon, southern Syria and Northern Palestine; therefore, potential production location(s) are very likely located somewhere in these areas. The Black Wheelmade ware is most closely related to contemporary assemblages in the Homs area in terms of typology, technology, and materials selection (as defined by the petrography), especially when compared to earlier Early Bronze Age II-III pottery from Lebanon and Northern Palestine. The evidence indicates that both assemblages stem from shared knowledge networks between the two assemblages, which suggests geographical proximity. A production location, therefore, should perhaps be sought in areas adjacent to the Homs area, where similar clay materials to those used to produce pottery in the Homs Region could be found. The sharing of technology and knowhow would be facilitated by such a geographical situation, partially accounting for the uniformity of paste preparation and shared elements of ceramic style across the two traditions. Such areas exist in the northern and central Bekaa, where Miocene/Pliocene conglomerates, very similar to those around Nebi Mend (Figure 6**)**, outcrop extensively and near Tell Arqa in the Akkar where more limited outcrops of these rocks can be found (Dubertret 1955; Ponikarov *et al.* 1963).

The above assessment is circumstantial, and it is certainly possible the Black Wheelmade ware originated in areas not adjacent to the Homs region and using materials formed on different types of outcrops. The available data, especially the geochemistry, does however indicate the use of sources for making Black Wheelmade ware similar to those selected for the contemporary assemblage of the Homs Area, in part through broad similarities in fabrics between the samples of both areas and in part through the exclusion of certain geographical

locations and geological outcrops.

Firstly, in the petrographic analyses no definite sign of igneous rocks and very few shales were identified in the samples, indicating the clays were not formed on or very near the basalt sources found in the region or the Lower Cretaceous shale outcrops common in parts of Lebanon and Northern Palestine. Additionally, microfossils were not noted in the samples. Microfossils of various kinds are common in clays derived from sedimentary rock outcrops in Lebanon and Northern Palestine (Dubertret 1955; Walley 1998), and are frequently observed in archaeological ceramics from the area (Badreshany *et al*., in press; Badreshany 2013; Badreshany and Genz 2009; Griffiths 2006; Goren *et al*. 2004). Areas adjacent to highly fossiliferous outcrops can, therefore, also be excluded. The primary fossil bearing outcrops in Lebanon are some limestones of Cretaceous age and, especially, foraminiferous chalks from the upper cretaceous and Paleogene age. Geological maps suggest that most of southern costal Lebanon can probably be excluded as a possible production area as along with many parts of the Southern Bekaa (Dubertret 1955), as fossiliferous chalk outcrops are very common in these areas. A large-scale petrographic analysis by Badreshany (2013) showed that areas of the southern and northern Bekaa usually did not produce microfossils, whereas parts of the central Bekaa (north of Zahle and south of the source of the Litani river) did so with some frequency (though not exclusively). Petrographic analyses conducted on assemblages from the north of Lebanon (Badreshany *et al*., in press; Jean in press; Badreshany and Genz 2009), again show microfossils are common in the ancient pottery of the areas, though ceramics without fossils are also frequent.

Another factor excluding some areas as production locations for the Black Wheelmade ware is the nature of the quartz grains observed in the samples. The quartz grains found in the samples are generally subangular, likely indicating transportation by wind (aeolian) (Singer 2007). The clays and/or sands used as tempering materials are, thus, likely not derived from well-transported fluvial or coastal sources. Aeolian angular grains can be expected throughout the study area, but it is worth noting that well rounded and subrounded quartz grains are normally found with some frequency in known coastal Early Bronze Age II-III calcareous fabrics (Badreshany *et al*., in press; Badreshany and Genz 2009). With this evidence in mind, it can be cautiously suggested that the Black Wheelmade wares were made using materials from inland sources that were not transported to a great degree by rivers, though more data is needed to confirm this. The fabrics found at Nebi Mend and in the greater Homs region exhibit quartz grains exhibiting a similar angularity profile to those found in the Black Wheelmade ware fabrics.

The results of the geochemistry of the Black Wheelmade ware similarly show they are made with materials that represent a complete break with the calcareous sources used in northern and central coastal Lebanon during the Early Bronze Age II-III for potting. Despite observing some calcareous material in thin-sections of the Black Wheelmade ware, the geochemistry shows they are much lower in calcium than samples dating to the Early Bronze Age II-III from northern coastal Lebanon. Low calcium values are generally reported for shale tempered fabrics from the Bekaa, even when compared to coastal shale fabrics (Badreshany *et al*., in press), as well as for few samples from the Homs Region (Kennedy *et al*., in press: Table 5). The comparatively low calcium values for Black Wheelmade ware and samples from the Bekaa

could suggest a geographical link between the two fabrics, but again more work will be needed to confirm this.

The REE values of the Black Wheelmade ware are generally much higher in both total value and in LREE/HREE ratios than values reported costal vessels. The Black Wheelmade ware values are a good fit with some values reported for contemporary quartz-calcareous vessels from the Homs Region. The REE values and LREE/HREE ratios for the Black Wheelmade ware generally show values higher than those reported for coastal calcareous fabrics and lower values than reported for shale wares in the Bekaa. The REE data further suggests a break with northern coastal Lebanese fabrics dating to the Early Bronze Age II-III and some general relationship with quartz-calcareous fabrics from the Homs Area.

The petrographic and geochemical evidence presented above, though limited, suggests that the Black Wheelmade ware analyzed in this study was likely not produced on or in the region of the Lebanese coast. The sample from Fadous-Kfarabida, therefore, probably originated some distance from the site. In central and northern Lebanon, Tell Arqa is the only site that has so far shown clear evidence of a continuous ceramic tradition spanning the Early Bronze Age III and IV (Thalmann and Sowada 2014; Jean in press). The site is also located near appropriate clay sources as defined earlier. These two factors could make the region of Arqa a good candidate for the production area of the Black Wheelmade ware; however, there are two factors which also speak against the Arqa as a source area. First, the petrography of the Early Bronze Age IV ceramics from Arqa showed they have different characteristics to the Black Wheelmade ware samples (Jean in press). Second, only one sample is known from the well-investigated Early Bronze Age IV layers and the extensive pottery assemblage yielded from them (Thalmann

2006). If Black Wheelmade ware was produced at or near Arqa, a larger number of examples would be expected. Samples from Tell Arqa dating to the Early Bronze Age IV have been submitted for geochemistry and the results, when available, will provide help better understanding of how the chemistry of the broader Early Bronze Age IV ceramic assemblage of Arqa relate to that of the Black Wheelmade ware.

Although limited, the available evidence, including Cohen-Weinbergers (2016) assessment that no matches for these Black Wheelmade ware petrofabrics could be made for northern Palestine, suggests that the areas of the northern and southern Bekaa and the Wadi et-Taym would be the most logical place to focus geoprospection efforts with the aim of identifying possible source areas for the Black Wheelmade ware. The proximity of the Northern Bekaa to the similar traditions found in the Homs region, perhaps makes that region a particularly good place to conduct investigations for at least one of the source areas for the Black Wheelmade ware.
The usage and preparation of clays for making Black Wheelmade ware finds close parallels with the pottery of Tell Nebi Mend confirming the close conceptual link between the two traditions as suggested by Kennedy *et al*. (in press). Technologically, the use of a quartz rich fabric would have contributed to the creation of a hard and durable vessel. The samples of subfabric A are so fine it seems likely they were levigated (see Maritan *et al*. 2005 for comparative Middle Bronze Age examples of levigated fabrics). Additionally, the use of low calcium clay sources would have allowed for relatively high firing temperatures while avoiding the negative impacts of the decarbonation of calcium carbonate, including spalling and vessel failure, which are often encountered during the high temperature firing of more calcareous clays (Rice 2005: 98). The high temperatures would have further contributed to the creation of hard and durable vessels.

Bechar suggested firing temperatures of above 850°C (2015: 40) for Black Wheelmade ware vessels, though provided no supporting evidence. Consistently and accurately estimating the firing temperature of the samples in this dataset based on their petrographic characteristics proved difficult due to their relatively fine grain size, homogeneity, and composition. The samples were mostly composed of quartz, a mineral of little use for the visual assessment of firing temperature (Maggetti 1982). X-ray diffraction, though commonly used to estimate firing temperature in ceramics, could not be used in this study due to the limited amount of sample available. Based on the vitrification of the groundmass in a few samples, it is possible to suggest the firing temperature exceeded 800°C in some cases (Quinn 2013:191). The samples analyzed in this study were relatively well-fired. The oxidized profiles and reduce surfaces commonly exhibited on Black Wheelmade ware vessels indicate a multistage firing in both oxidizing and reducing atmospheres, strongly suggesting the use of built kilns. A larger dataset and more work will be needed to understand exactly how the Black Wheelmade ware samples were fired and to provides insights into the adoption and development of their associated firing regime.

The potters of the Black Wheelmade ware made consistent use of specific and carefully prepared materials that could be fired to relatively high temperatures in purpose built structures to produce attractive and hardwearing vessels, indicting they were experienced craftsman possessing a good deal of knowhow.

The petrographic and geochemical analyses supports the ideas of Kennedy *et al*. (in press) that the Black Wheelmade ware tradition, with its typological and technological similarities to the upper Orontes horizon of the Homs area, can be described specifically as an emulation of the

Upper Orontes goblet tradition. The Black Wheelmade ware tradition, though part of the broader ceramic trends of the 'Caliciform' heartland further to the north, is more closely related to those traditions. The ceramic parallels perhaps betray in the Bekaa a shift after the end of the Early Bronze Age III from high levels of socio-economic integration with Lebanese coastal areas toward the development of close links with areas further to the north in the Orontes Valley. The close ceramic parallels with the Homs region seem to continue on into the Middle Bronze Age (Genz 2008) perhaps suggesting the continuation of strong socio-economic ties between the Bekaa and areas further north.

Conclusion

Although the number of Black Wheelmade ware vessels currently known from Lebanon is much smaller than the material available from the Jezreel Valley, Galilee and especially the Hula Valley, the much lower number of excavations in Lebanon relating to this period definitely has to be taken into account.

Regarding the typology, almost all types attested farther south are present in Lebanon as well, even in similar percentages. Goblets and teapots are dominant, while bottles are much rarer. No jars are attested yet, but even in the Southern Levant these are only attested by very few examples.

As for the chronological position of the Black Wheelmade ware, the evidence from Lebanon adds some crucial information, as at least some of the material derives from well-stratified sequences. D'Andrea (2014: 165-66; see also Bechar 2015: 53) has recently proposed a dating

of the Black Wheelmade ware to the Early Bronze Age IVB, mainly based on typological arguments in comparison to western Syrian assemblages. The most important evidence to confirm such a dating comes from Tell Arqa. At this site, an uninterrupted sequence from the Early to the Middle Bronze Age is attested (Thalmann 2006). The Early Bronze Age IV is represented by Strata 16 and 15, that is, the Early Bronze Age IVA and B respectively. The Black Wheelmade ware sherd of probably a teapot derives from Stratum 15, that is, the Early Bronze Age IVB.

Based on the evidence from Tell Arqa, the Early Bronze Age IV material from Tell Fadous-Kfarabida can be paralleled with Stratum 15. As the Early Bronze Age IVA does not seem to be present at the site, the unstratified Black Wheelmade ware sherd can be attributed with certainty to the Early Bronze Age IVB.

The situation in Tyre is unfortunately less clear. Stratum XXI should be assigned to the Early Bronze Age III according to the pottery (Bikai 1978: 69-70). If one accepts the proposed dating of Strata XX and XIX to the Early Bronze Age IVB – again based on the pottery (Bikai 1978: 70) – then a hiatus spanning the duration of the Early Bronze Age IVA has to be postulated. Unfortunately, no indication for such a hiatus in the stratigraphic record is mentioned (Bikai 1978: 5-6).

The finds from Byblos, Tell Hizzin, and Rafid do not provide any information regarding the chronology of the Black Wheelmade ware.

Despite the low number of finds, a clear pattern of the distribution of Black Wheelmade ware in Lebanon is discernable. This ware is well represented in the Bekaa and in Southern Lebanon, whereas it only sporadically appears along the Northern coast (Figure 1).

One of the most important problems is the location of the production area(s) of Black Wheelmade ware. Due to the limited number of samples available for this study, the production area(s) still cannot be precisely located. Yet, with the results of both the petrographic and the geochemical studies, several areas can be excluded. This is likely the case for the coastal plain of Lebanon and the southern Bekaa. While the Akkar Plain has limited outcrops of Miocene/Pliocene conglomerates, the scarcity of Black Wheelmade ware at Tell Arqa makes a production in this region highly unlikely. The geology of the central and northern Bekaa, on the other hand, matches the composition of the Black Wheelmade ware. The evidence from Tell Hizzin and Rafid furthermore shows that Black Wheelmade ware is well represented in these regions. A production around Tell Nebi Mend or farther north in the Orontes Valley – while possible from a geological point of view – is highly unlikely given the absence of Black Wheelmade ware in this area. Yet typologically Black Wheelmade ware was inspired by pottery from this region. The long-standing tradition of grey, hard-textured wares in the Upper Orontes Valley, reaching back to at least the Early Bronze Age IVA (D'Andrea 2017), further strengthens the possibility that Black Wheelmade ware originated from an area in the immediate vicinity of this area. Thus, there is a strong possibility that Black Wheelmade ware may have been produced at one or several sites in the central and northern Bekaa. As this area is not well researched, especially for the Bronze Age, more work is definitely needed to confirm (or refute) this theory.

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Sample number	Site	Date	Type	Fabric	ICP Data
Arqa02/112.001	Arqa	Arqa phase P	Jar	A	Yes
Hizzin1	Tell Hizzin		Large Vessel	B	Yes
Hizzin2	Tell Hizzin		Large Vessel	B	Yes
Hizzin3	Tell Hizzin		Large Vessel	B	Yes
Hizzin4	Tell Hizzin		Large Vessel	A	Yes
Hizzin5	Tell Hizzin		Large Vessel	A	Yes
FadousFAD10.305/295.63.3	Tell Fadous-Kfarabida	Phase V	Goblet	A	No

Table 1. List of samples analyzed for petrography.

Sample number	Al2O3	CaO	Fe2O3	K2O	MgO	Na2O	P2O5	Sc	Ti	V
Arqa02/112.001	15.768	3.865	8.542	2.291	4.261	0.253	0.095	19.71	1.33	159.50
Hizzin1	19.793	2.517	9.336	0.941	1.912	0.138	0.119	23.71	3.07	199.90

Hizzin2	19.103	7.024	9.758	1.027	1.296	0.151	0.172	22.14	2.00	183.40
Hizzin3	18.300	5.949	9.286	0.978	1.003	0.144	0.165	23.78	2.17	191.70
Hizzin4	14.341	5.603	7.556	1.956	5.159	0.283	0.172	18.32	1.22	164.00
Hizzin5	14.965	3.557	8.399	1.874	5.123	0.254	0.164	19.69	1.35	151.00

Table 2. ICP-AES and MS values for the six analysed sample and LREE to HREE Ratios and Sums.

Sample number	**Cr**	**Mn**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**Rb**	**Sr**	**Y**	**Zr**
Arqa02/112.001	199.60	0.15	33.56	141.80	24.41	122.20	22.45	92.68	108.40	31.31	153.80
Hizzin1	253.20	0.08	28.97	100.80	27.97	156.30	32.43	43.06	87.11	50.45	368.30
Hizzin2	241.90	0.19	30.85	103.30	22.30	123.20	27.12	46.79	142.10	45.32	245.20
Hizzin3	203.40	0.19	32.90	107.20	23.66	123.30	29.06	49.74	153.80	47.04	257.60
Hizzin4	197.40	0.15	37.21	143.70	23.93	121.10	20.89	80.95	120.80	29.13	152.20
Hizzin5	202.30	0.15	35.16	157.20	22.03	142.80	22.63	77.20	105.10	27.34	150.00

Table 2. ICP-AES and MS values for the six analysed sample and LREE to HREE Ratios and Sums.

Sample number	**Nb**	**Cs**	**Ba**	**La**	**Ce**	**Pr**	**Nd**	**Sm**	**Eu**	**Gd**	**Tb**
Arqa02/112.001	29.61	4.85	398.20	43.45	100.80	10.72	40.40	7.53	1.58	6.25	0.98
Hizzin1	76.06	2.58	98.34	65.35	123.30	15.54	59.88	11.39	2.65	10.12	1.61
Hizzin2	51.40	2.92	143.20	57.83	117.10	14.34	55.74	10.73	2.47	9.58	1.47
Hizzin3	55.14	3.10	152.60	61.86	127.10	15.38	59.78	11.39	2.65	10.15	1.55
Hizzin4	28.14	4.31	383.30	38.65	105.60	9.60	36.39	6.99	1.53	6.09	0.97
Hizzin5	30.57	4.18	361.00	44.19	106.20	11.05	41.93	7.84	1.66	6.55	1.01

Table 2. ICP-AES and MS values for the six analysed sample and LREE to HREE Ratios and Sums.

Sample number	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Hf**	**Ta**	**Pb**	**Th**	**U**	LREE/ HREE	LREE+ HREE
Arqa02/112.001	5.56	1.12	3.06	0.50	3.08	0.48	4.26	1.90	21.34	13.21	2.57	1.74	98.03
Hizzin1	9.09	1.80	4.76	0.78	4.56	0.71	9.54	4.73	22.88	14.56	2.92	1.90	144.49
Hizzin2	8.10	1.54	4.00	0.65	3.82	0.59	6.59	3.26	20.29	14.69	2.25	2.16	128.82
Hizzin3	8.46	1.63	4.20	0.69	3.99	0.62	7.01	3.57	22.20	16.17	2.37	2.14	137.88
Hizzin4	5.49	1.07	2.85	0.48	2.90	0.45	4.25	1.86	22.85	12.17	2.63	1.57	94.16
Hizzin5	5.44	1.04	2.73	0.46	2.75	0.43	4.34	2.04	23.47	13.52	2.42	1.73	101.68

Table 2. ICP-AES and MS values for the six analysed sample and LREE to HREE Ratios and Sums.

Table 2. ICP-AES and MS values for the six analyzed samples and LREE to HREE ratios and sums.

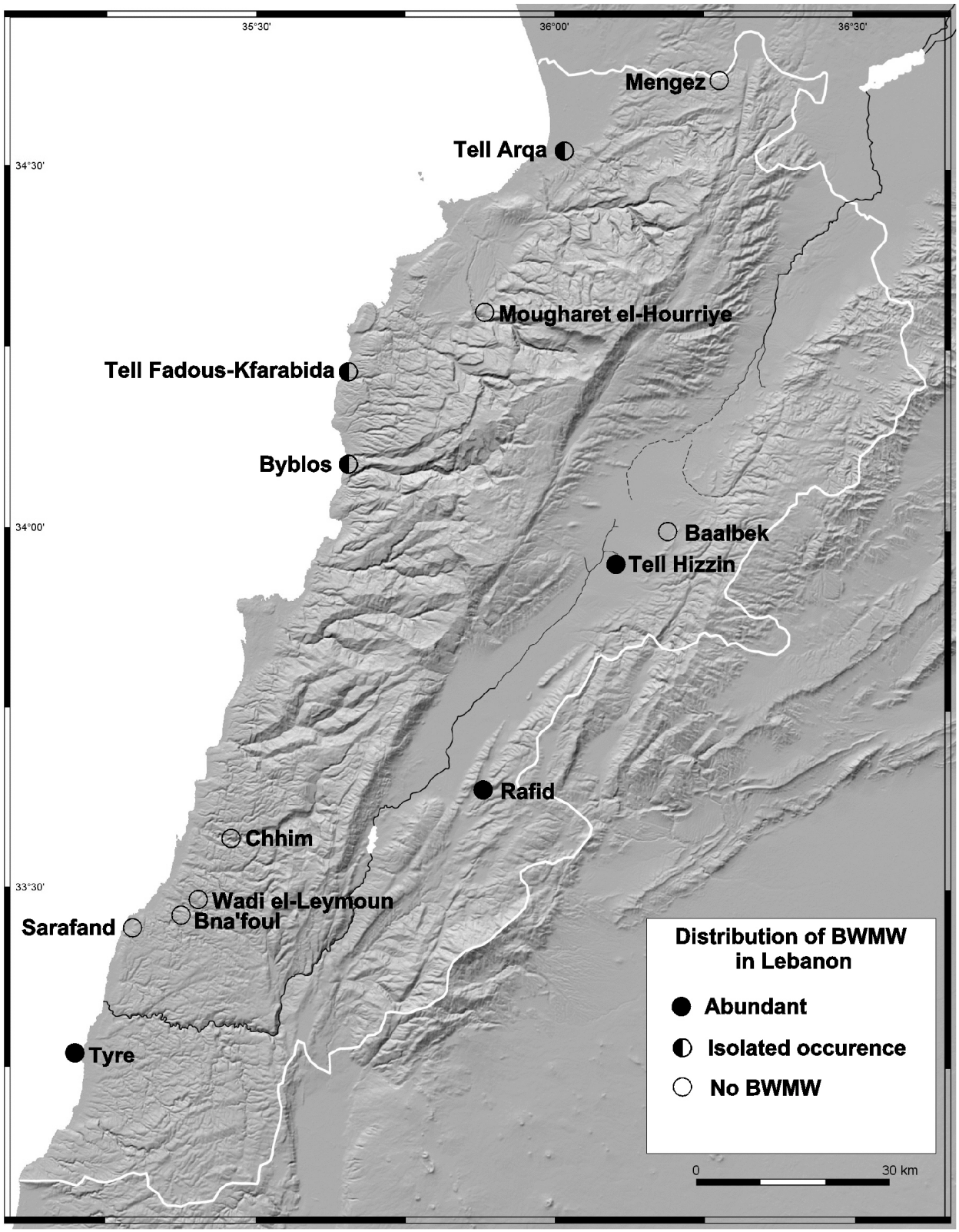


Figure 1. Distribution of Black Wheelmade ware in Lebanon.

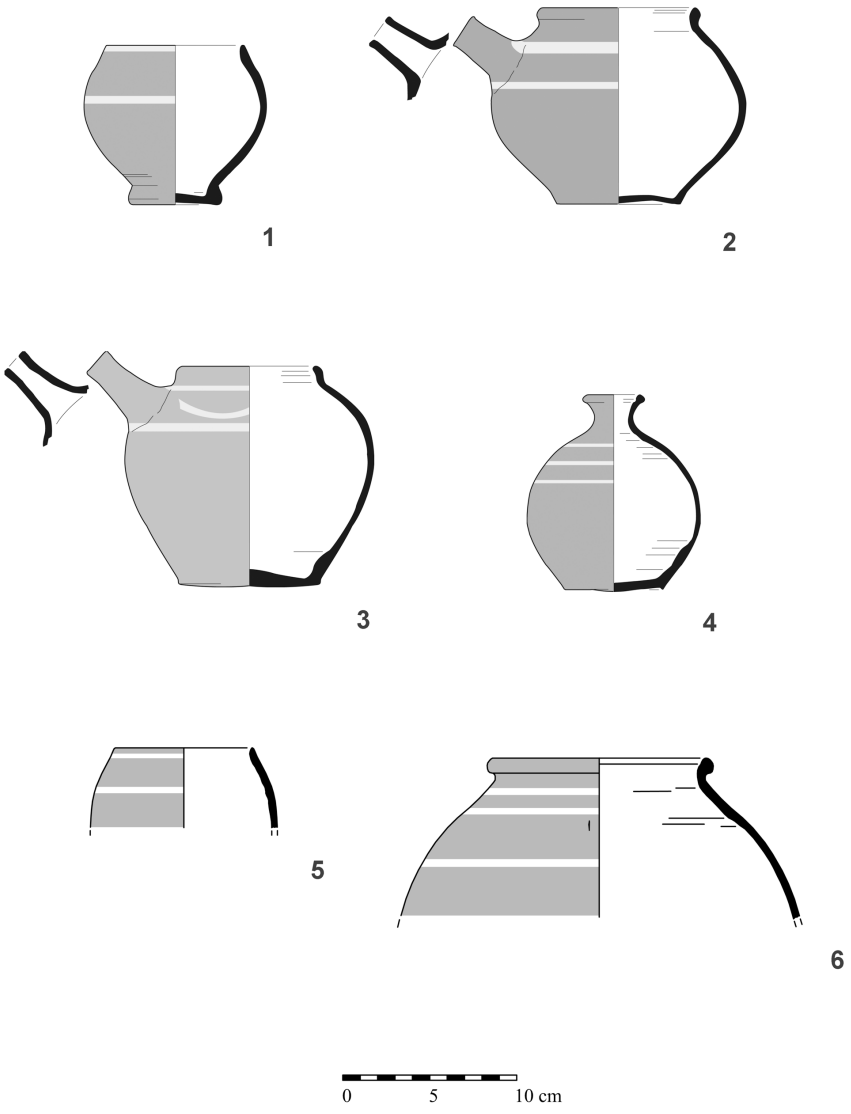


Figure 2. Black Wheelmade ware vessels from various sites in Lebanon. 1-4: Tell Hizzin (Registration numbers 51578, 51690, 51691, 51895), 5: Tell Fadous-Kfarabida

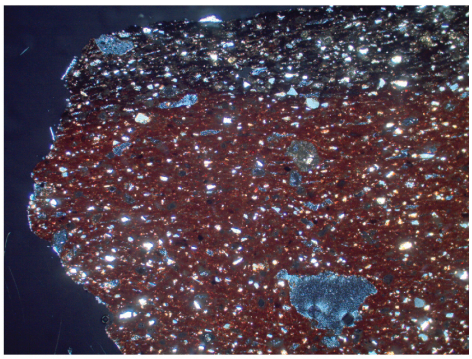
(FAD10.305/295.63.3), 6: Tell Arqa (02/112.001).

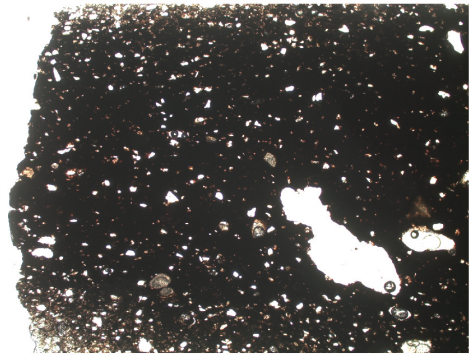
FABRIC A

PPL

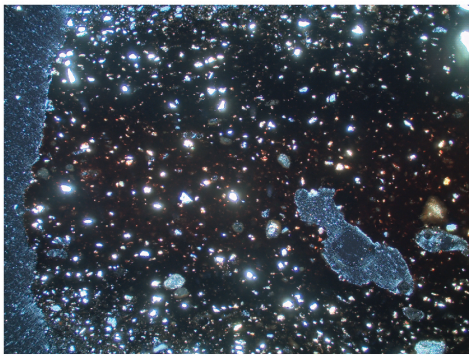
XPL

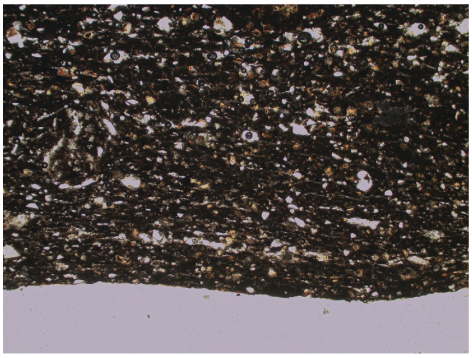
Arqa
02/112.001



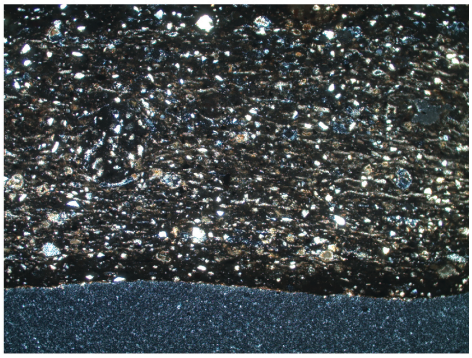


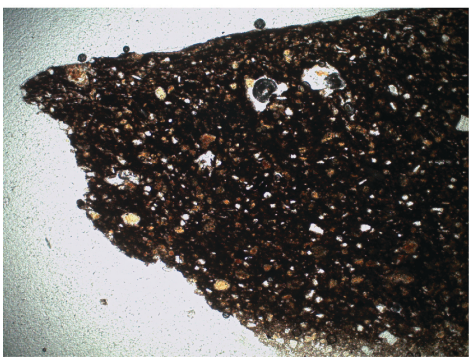
Fadous
FAD10.305/295.63.3





Hizzin 4





Hizzin 5

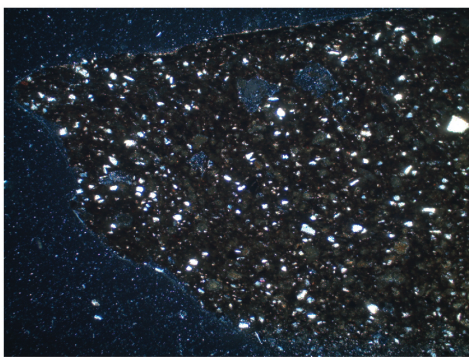


Figure 3. Photomicrographs of the samples of Fabric A in Plane Polarized Light (PPL) and Cross Polars (XPL). Field of View is 2 x 2 mm for each photomicrograph.

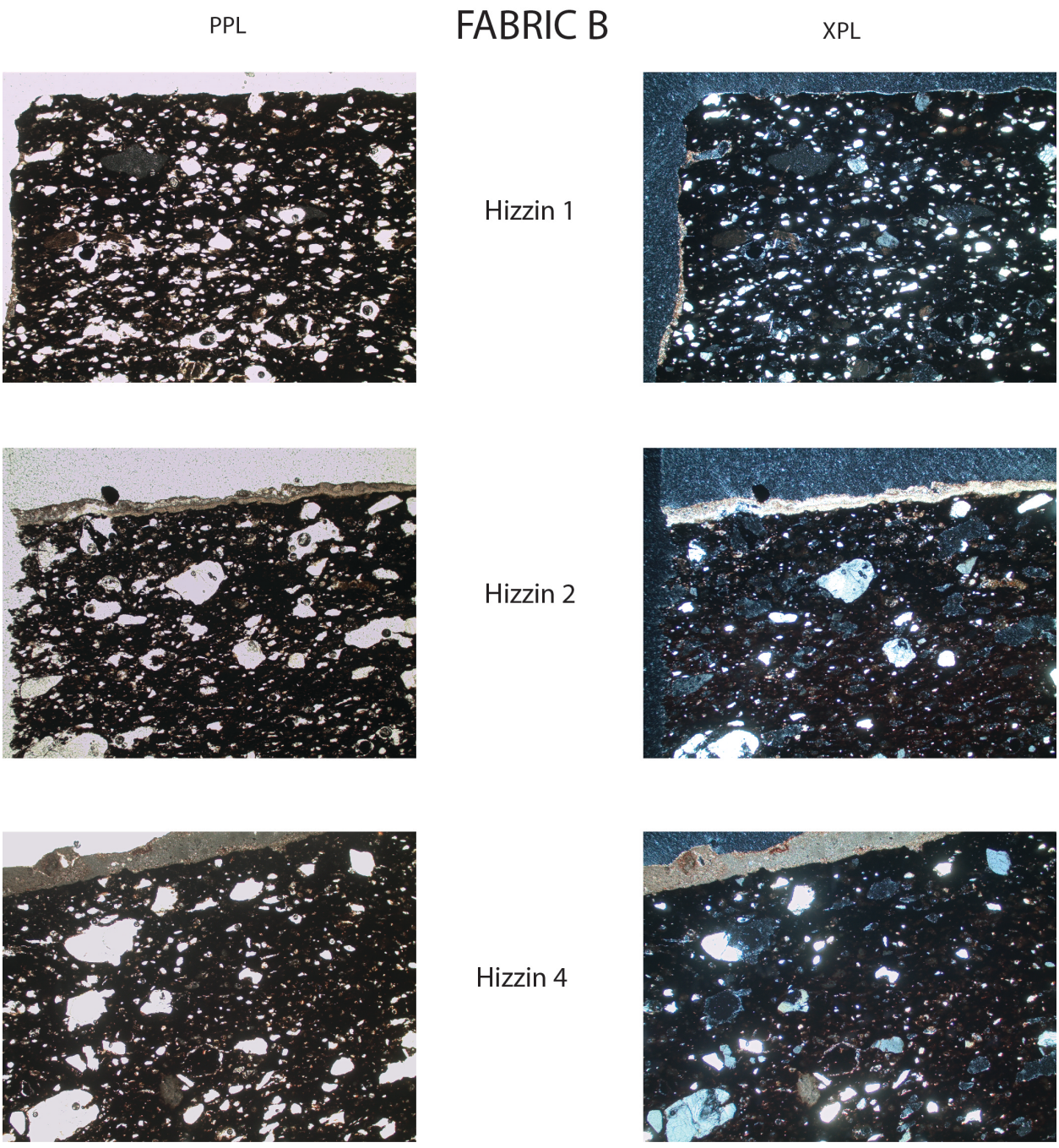


Figure 4. Photomicrographs of the samples of Fabric B in Plane Polarized Light (PPL) and Cross Polars (XPL). Field of View is 2 x 2 mm for each photomicrograph

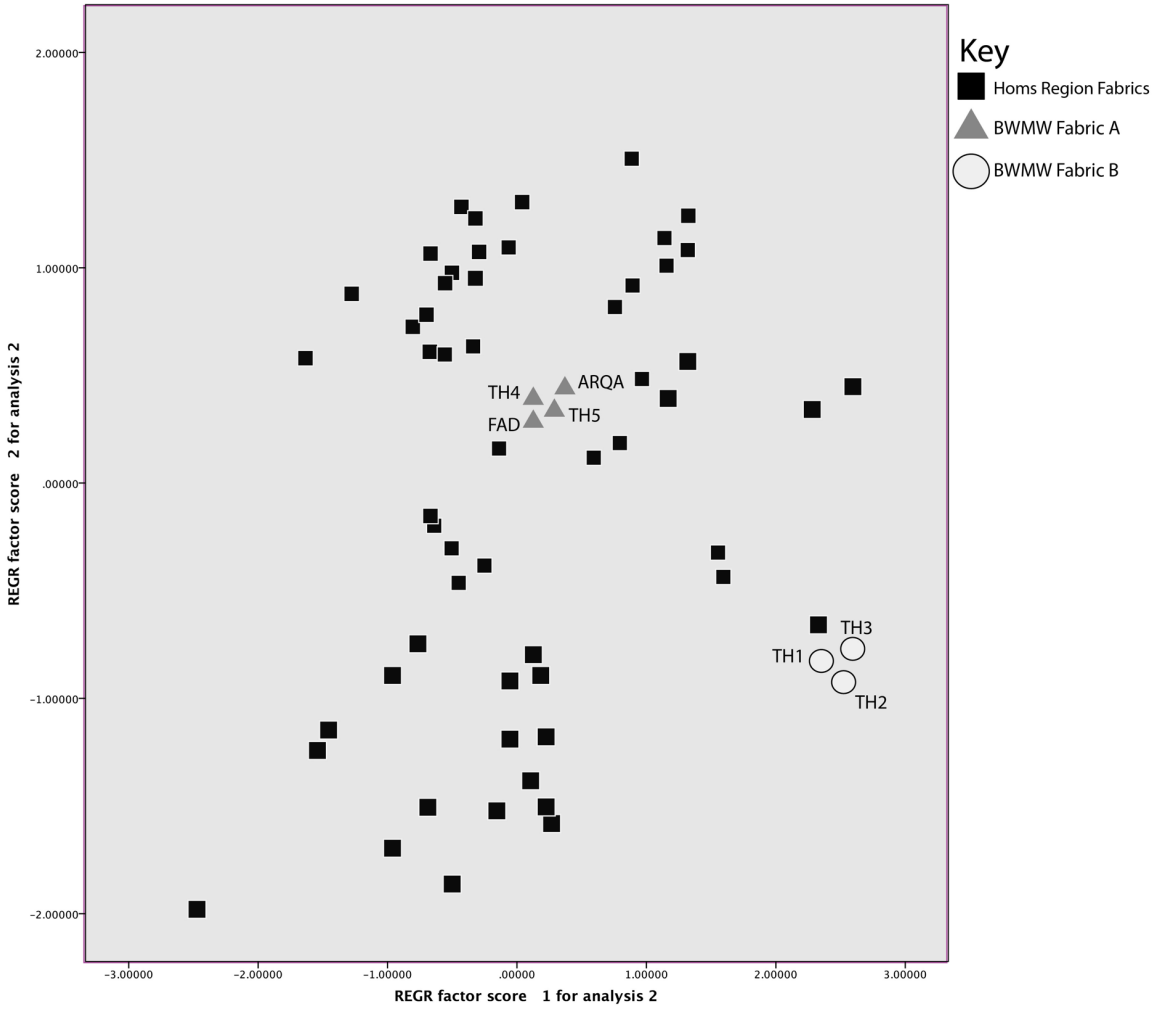


Figure 5. Plot of the factor scores generated from the principle components analysis of the chemical data generated by ICP-AES and MS sorted by Fabric. The samples of Black Wheelmade Ware were plotted against samples from the Homs Region.

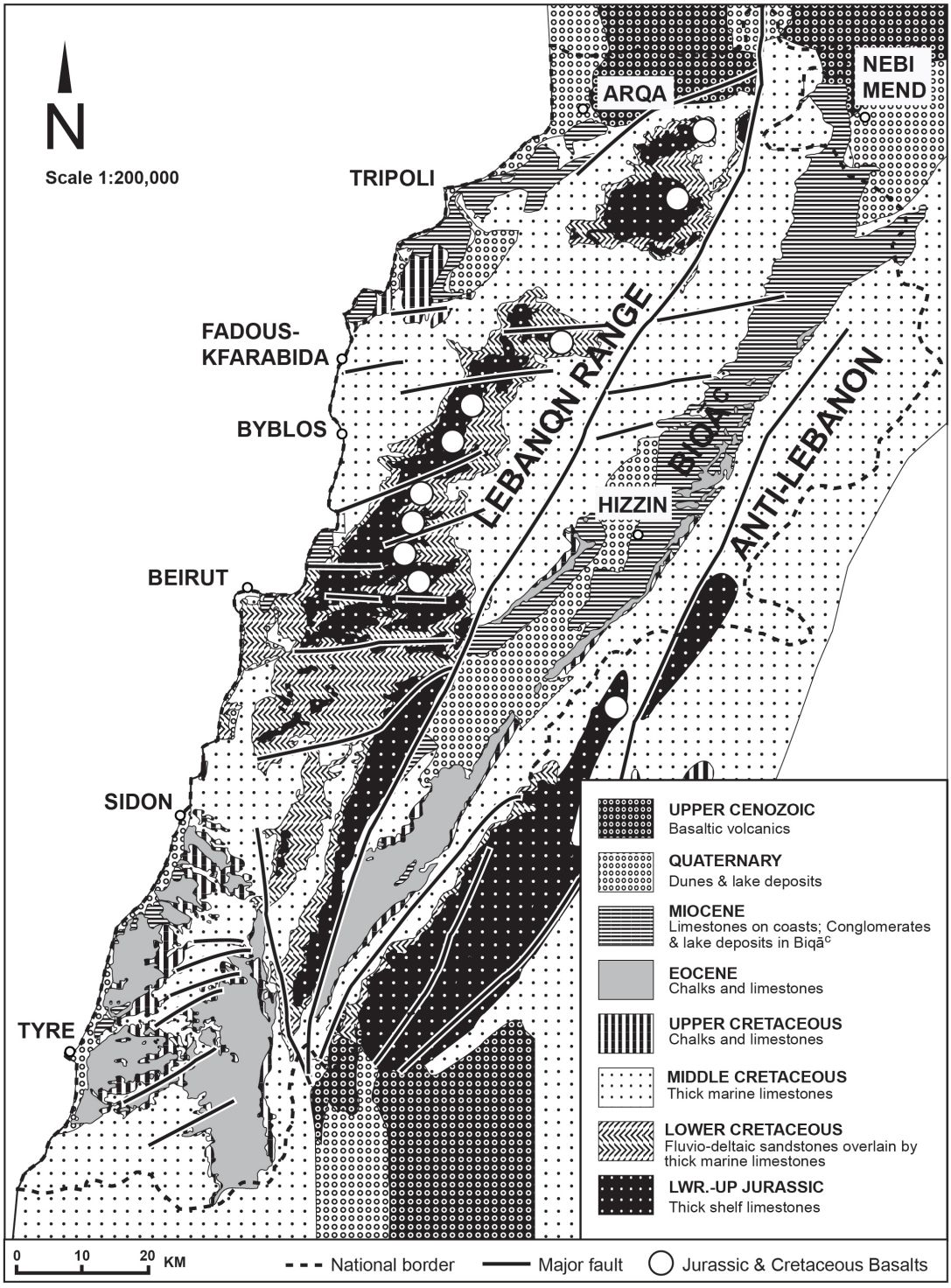


Figure 6. General Geological Map of Lebanon (scale 1:200000) after Dubertret 1955. Key sites are shown on the map.