The Development of Integrated Regional Economies in the Early Bronze Age Levant: new evidence from "Combed-Ware" jars.

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This paper uses new petrographic and geochemical data (ICP-AES and MS analyses) taken from samples of combed-ware jars occurring at sites on Lebanese coast, the Biqa‘ valley, the Orontes valley around Homs and the North Jordan Valley to investigate the production and distribution of these vessels in the Levant during the Early Bronze Age. The evidence points to the existence of integrated regional interaction zones that can be identified through specific modes of craft production and the associated distribution networks. The new evidence sheds light on the development of a nucleated settlement landscape, and the economic, social, and political changes that this implies, in the Central Levant and Western Syria during the first half of the 3rd millennium BC, Early Bronze Age.

Keywords: Early Bronze Age; Central Levant; Lebanon; ceramics; petrography; Combed-ware

Introduction

This article seeks to improve our understanding of the phenomenon of EBA “Combed-Ware” jars. This is a group of material the definition of which remains unsatisfactory and the discussion of which has been bedevilled by contradictory and confusing terminology. Despite these problems, detailed by Thalmann and Sowada (2014: 355-58), we have retained the term “Combed-Ware” for reasons which we explain below.

We examine examples from a geographically extensive ceramic assemblage, and seek to integrate petrographic and geochemical data with evidence pertaining to vessel type, colour and combing patterns to see whether more nuanced chronological and regional patterns in manufacture and distribution can be identified. The archaeometric data including a petrographic and geochemical database created using ICP – AES and MS analysis, for the first time includes samples from sites across the central Levant providing a large and geographically extensive dataset. Additionally, a detailed digital dataset containing hundreds of images of the samples and thin-sections and the geochemical data will be provided in accompanying online appendices (see supplementary info). The addition of archaeometric data to traditional macroscopic analyses on such a large scale enhances our understanding of the significance and function of Levantine Combed-Ware during the EBA in the following areas:

(1) Technology

Improved grasp of aspects of production, including materials selection, technology, and standardization which gives a more specific understanding of the intended function and role of these vessels. As we make use of a geographically extensive dataset, any long-term patterns of materials usage and treatment in a given area can be identified, illuminating geographically distinct traditions within the study area.

(2) Provenance

The petrography and geochemistry will help to identify the locus of production, or the probability of origin within the same production source, even where the specific geographical location cannot be identified. This should provide valuable evidence concerning the basis upon which these vessels were produced, and the extent to which this may have changed over time and space. This data will also help us to assess the extent to which macroscopic aspects, such as colour, or combing patterns, were regionally distinct.

(3) Distribution

Our analysis will allow an assessment of the degree to which material recovered from individual sites, regions, or periods is chemically and petrographically distinctive, and thus provide data on the extent to which vessels were circulating beyond their probable loci of production. This should provide information on the scale and intensity of possible inter-site and inter-regional interaction as evidenced by the movement of commodities, and so flag the existence, or otherwise, of centralised production with associated distribution networks. This data will help us better understand the degree of integration between sites and regions, and so the nature of the economic and political landscape of the EB central Levant.

Figure 1 Map of sites mentioned in text

Levantine Combed-Ware: The State of the Evidence and current interpretations

While the typology of Levantine Combed-Ware, and the history of research has received several recent treatments (Sowada 2009; Thalmann and Sowada 2014 with further references), to which the reader is referred for details, it is useful to define the phenomenon, and outline key aspect of interpretation.

What is Combed-Ware?

We have retained the term "Combed-Ware" jars because it provides a convenient way to refer to a distinctive category of ceramics that is well-known to archaeologists working on the EBA Levant. "Combed-Ware" generally refers to large and medium-sized jars, with flat-bases and ovoid bodies, often, but not always, with two loop handles attached to the body, and that bear combed decoration on the exterior surface. These vessels are widely associated with the bulk storage and transport of commodities during the EBA, and were integral to, perhaps even emblematic of (Greenberg 2011) the development of inter-regional commodity-based exchange economies in the East Mediterranean during the third millennium BC (Marcus 2002; Bevan 2014: 388-91; Knapp and Demesticha 2016: 44-46).

Combing also occurs on handled vats. The vessels can be combed on the outside and often partially or wholly on the inside and usually bear one or a combination of vertical, horizontal, or oblique combing on the exterior wall of the vessel. This material is characteristic of the ceramic assemblages occurring at sites in the central Levant during the Early Bronze Age II-III (for chronology see Table 2). The striking decoration makes this among the most easily recognizable category of ceramics from excavations and surveys conducted in the area. Other categories of vessel from this period are rarely combed, although in coastal Lebanon cooking pots often bear combed decoration (Doumet-Serhal 2006; Badreshany and Genz 2009) (Fig. 3).

While Thalmann and Sowada (2014) deem Levantine Combed-Ware as an ill-defined category, that is too broad for use, the decoration is so distinctive, that it is difficult to deny that the vessels would have been as ‘discernable’ as a group to their past users as they are to present-day archaeologists. Thalmann and Sowada (2014: 60) note that “combing was integrated into the manufacturing process of large and medium-sized vessels” which suggest to us that this form of decoration carried a meaning that was well-understood in the past. Because most vessels bearing combed decoration were medium-large jars, the Combed-Ware in general has attained an association with the storage and transport of commodities such as olive oil and wine, and it is likely that the vessels were important to local economies. (Badreshany 2013; Greenberg 2003; Knapp and Desmesticha 2017: 44-46; Thalmann and Sowada 2014:

358-60). In fact, Greenberg (2011: 239) sees them as representing "incipient commoditization" in that they would have embodied the particular socio-cultural values related to the storage and exchange of oil and wine.

Seal impressions, which will be treated in more detail below, are found in combination with combing, but also on vessels with pattern burnished surfaces (Doumet-Serhal 2006: 48-49; Saghieh 1983:173). Differences in colour, firing, and the materials used create a variety of 'fabrics' (see below for definition) which may prove more useful for the definitions of ceramic categories than the actual combing. The term 'Metallic Ware' is often used as a catchall to describe these fabrics (e.g. Knapp and Demesticha 2017: 45), but it is by no means certain that all authors are using the term in the same way. In fact, our petrographic analysis reveals that Combed-Ware vessels come in a number of colours, patterns, and are fired in different conditions – not all were highly fired – making their categorization very difficult. In turn, vessels that are typologically similar occur that bear pattern burnished surface treatment and lack combing (Badreshany *et al*. 2005; Doumet-Serhal 2006; Greenberg and Porat 1996; Thalmann 2016) and it is not clear if these should be viewed as conceptually different from Combed-Wares. Fortunately, the petrographic data provides a useful starting point on the way to categorizing these vessels based on raw material selection.

In fact, as Greenberg (2014) has reminded us, while the presence of these vessels in Egyptian tombs has highlighted their role in maritime transport, the vessels were originally developed in order to facilitate a terrestrial rather than a maritime economy, and their design was focused upon qualities required of storage vessels, that would have been subject to regular handling and transport over short distances, rather than upon those design elements of most benefit to maritime transport containers. It is vital therefore that interpretation takes account of the differences between the social and economic contexts within which these vessels first appeared in the late 4th millennium BC, and circumstances under which they become prominent during the 3rd millennium BC.

Combed-Ware: the problems

We can now summarize the main areas of confusion and complexity. One problem is that the term “Combed-Ware” has been applied quite loosely, and it is now clear that in some cases the term has been used in a way that encompasses a variety of regional traditions and typological classes (e.g. Esse 1991; Braidwood and Braidwood 1960). In some cases, terms like “Metallic Ware”, which scholars such as Greenberg and Porat (1996) use quite specifically to denote highly fired vessels found at sites in northern Palestine and Transjordan made of shale-derived clays, *some* of which bear combed decoration, is applied more loosely, or used almost interchangeably with all EBA combed vessels. In our view the rather loose and confused use of terms has made it quite difficult to define a distinct unit of analysis. One of the aims of this paper is to ascertain to what extent vessels bearing combed decoration can be said to constitute a distinct unit of production and usage. However, to jump ahead briefly, the wide distribution of these vessels (see below), would seem to argue against any single point of origin, and if this is indeed the case then also against the existence of a single “Combed-Ware” fabric.

To give a brief taste of the complexity of the situation, consider the following. We do not currently know to what extent all “Combed-Ware” was related, or whether it can reasonably be taken to constitute a single object of study. To take a familiar example, the jars and vats produced in what Greenberg and Porat (1996) term North Canaanite Metallic Ware (NCMW) bear combing, but other vessel classes made in the same fabric such as bowls and jugs do not. While, in more southerly regions of Palestine, jars with surface combing occur during EB III, EB II-III occupations at sites in central Palestine and Transjordan such as Tel Yarmouth and Batrawi have produced far fewer combed jars than those in the north (Esse 1991; Miroschedji 2000; Sala 2016: 129). Thus we can see that the use of combed decoration spans at least 600 years (probably more in some locations), during which regional economic organization and its political underpinnings must have changed considerably. Moreover, combed jars were not adopted universally across the Levant, and their production appears to cross-cut units of manufacture. Clearly there were circumstances under which combed jars were appropriate for storage and transport, and others when they were not.

How to move forward?

Until recently, one of the problems in dealing with combed vessels has been that despite the extensive consideration of examples from Palestine, and to a lesser extent from sites in Syria, both the quantity and quality of the evidence from EBA Lebanon, a key region for Combed-Ware production, has been limited. Quite simply, this has left a black-hole in the middle of the discussion. This situation is slowly being remedied by fieldwork undertaken in recent years at sites on the Lebanese coast such as Sidon, Tell Faddous Kafarabida, Tell Koubba and Tell Arqa (Doumet Serhal 2006; Genz et al. 2009, 2011, 2016 with references; Thalmann 2006; 2009; 2016) (Fig. 1). The situation for upland Lebanon and the Biq'a Valley, however, remains problematic.

A recent overview by Thalmann and Sowada (2014) is the most successful attempt to date to categorize and understand the function of these vessels. They point out that most studies of these vessels have been conducted on fragments rather than the relatively rare complete, or near-complete, vessels. They rightly argue that any categorization aimed at understanding the Combed-Ware tradition and how it changes over time necessitates the consideration of largely-complete examples because the combing patterns are firmly entangled within the broader *chaîne opératoire* associated with the manufacture if these vessels (Thalmann and Sowada 2014: 360). In our view, any complete study of the vesssels' c*haîne opératoire* should also include a consideration of raw materials and the resulting vessel fabrics.

The first stage in understanding the Lebanese data then, is to examine the nature and extent of the variability of several key aspects of these vessels.

- The vessel forms – the range of vessels to which combing is applied;
- The mode of execution of combing and its location on the vessel;
- Mode of production and distribution, as evidence by fabrics and manufacturing techniques
- Spatial pattering;
- Temporal patterning

While the current dataset does not allow us to examine each of the above aspects in the same depth, we offer the first systematic, interregional archaeometric investigation of Combed-Ware vessels. The study expands on previous work to significantly enhance the existing archaeometric datasets associated with related material (Greenberg and Iserlis 2014: Greenberg and Porat 1996; Griffiths 2006; Sowada 2009: 175-179), through the addition of unpublished typological, petrographic, and bulk chemical data (ICP –AES and MS) from sites in coastal Lebanon and the Biqa‘ valley, and for comparison smaller numbers of samples from the Homs region of Syria, and the Jordan Valley. We intend that the integration of the archaeometric and typological data will provide a deeper understanding of the production and distribution of Combed-Ware jars over time, and provide a means through which to ask questions about the development of regional interaction spheres, distribution networks, and on the role of commodity storage and transport in shaping the development of the settlement, economic and political landscape in the Central Levant and Western Syria during the Early Bronze Age

The forms of Combed-Ware vessels from the Northern Levant

The range of vessel shapes associated with Combed-Ware has been discussed in detail elsewhere and will not be repeated here. The relevant references for examples from Lebanon and coastal Syria are provided below. In brief, we are dealing with a limited repertory focused on handled and handless jars and pithoi intended for the storage and transport of goods, along with vats for the processing of commodities, and, distinctive to the Lebanese coast, holemouth cooking pots (Table 1 and Fig. 2**)**. The 2016 and 2017 excavation seasons at Tell Koubba II, north of Batroun, produced a large number of complete or mostly complete combed jars and vats (Fig. 4). These are currently under analysis, and should make a substantial contribution to our understanding of the material. However, it is worth stating that work to date reinforces current ideas on the shape and capacity of combed vessels, in that no substantially new forms were identified among restorable sherd material.

Figure 2 Typical Early Bronze Age II and III jar and vat rim and base types from Lebanon that typically exhibit combing.

Number	Description
1	Vat, EB III, Tell Koubba II, Lebanese Coast
2	Jar, EB III, Tell Koubba II, Lebanese Coast
3	Jar, EB II-III, Tell Madjdalūn, Biq'a
4	Jar (Vertical Combing), EB II-III, Tell Aswad, Biq'a
5	Jar, EB II-III, ᶜAyn al-Fawqā, Biq'a
6	Vat, EB III, Tell Koubba II, Lebanese Coast
7	Jar, EB III, Tell Koubba II, Lebanese Coast
8	Jar, EB III, Tell Koubba II, Lebanese Coast
9	Jar, EB III, Tell Koubba II, Lebanese Coast
10	Jar, EB III, Tell Koubba II, Lebanese Coast
11	Jar or Vat Sherd (Diagonal Combing), EB II-III, ᶜAyn al-Fawqā, Biq'a
12	Jar Base (Horizontal Combing), Vat Sherd, EB II-III, Tell Dalhamīya, Biq'a
13	Jar or Vat Sherd (Vertical and Horizontal Combing), EB II-III, Tell Aswad, Biq'a
14	Jar (Pattern Burnish), EB II-III, Tell Aswad, Biq'a
15	Jar or Vat Sherd (Vertical and Horizontal Combing), EB II-III, ᶜAyn al-Fawqā, Biq'a
16	Jar Base (Vertical Combing), EB II-III, ᶜAyn al-Fawqā, Biq'a

Table 1 Description of vessels on Fig. 2

Figure 3 EB III Combed holemouth cooking pot from Tell Koubba II, Northern Lebanese Coast

Figure 4 EB III Combed Vat *in situ* from Tell Koubba II, Northern Lebanese Coast

Combing as a decorative technique: distribution at sites in Syria and Lebanon

Vessels bearing combed decoration have been found throughout both the northern and southern Levant. Their distribution extends from the ‘Amuq/lower Orontes to the Shephelah of Palestine (Thalmann and Sowada 2014: 356–358). Although examples have been found at sites in inland west Syria such as Ebla (Mazzoni 1987: 150), Acharneh (Boileau 2006), Hama (Fugmann 1958: fig. 58: 3F183), and Tell Nebi Mend (Kennedy 2015: 178–179), the bulk of the excavated Combed-Ware assemblage from the region has been identified at sites on or close to the coast. Numerous sites in the Biq’a have also produced Combed-Wares (Badreshany 2013; Marfoe 1998), although these assemblages arise from surface collections and are less easy to date. In the southern Levant, Combed-Ware has been identified both on the coast and in the inland zone, with various quantities of this ware identified at sites such as, Tell Yarmouth (de Miroschedji 2000: 321), Tell Dan (Greenberg 2000: fig. 11.7: 7–8), Hazor (Greenberg and Porat 1996: 12) and Khirbet ez–Zeraqoun (Genz 2002: Taf. 113). However, with the exception of Khirbet ez–Zeraqoun, instances of this ware are less common east of the Jordan River, than they are to its west, while combing is more commonly present at sites in northern Palestine than in the south where it is concentrated in EB III (Esse 1991: 10; Greenberg and Porat 1996: 11; Thalmann and Sowada 2014: 360). Examples from southern Palestine are rather different being usually of EB III date and many bear a white exterior coating recently confirmed as lime plaster (Eliyahu-behar *et al*. 2016). In addition to the Levant, Combed-Ware vessels have also been identified in Egypt, with instances recovered from contexts at Abydos, Giza, Saqqara, Dashur, and Abusir ranging between the

First and Sixth Dynasties (Sowada 2009: 155–156: Thalmann and Sowada 2014: 369–370).

As there has already been discussion of combing patterns observed in the Southern Levant (e.g. Esse 1991, Sowada 2009) we will summarize here the range of combing patterns and colours found at sites in the northern Levant, to draw-out any regional patterning (Fig. 5, 6 and 7). The sites discussed below, are simply those where Combed-Ware appears to form a major component of the assemblage, as EBA sites in the region which have produced a few sherds from combed-ware vessels are far too numerous to detail individually.

Syria

Ras Shamra/Ugarit and Sianu

The 30 ha site of Ras Shamra (ancient Ugarit) lies on the northern coastal plain of Syria. Unfortunately, due to the depth of occupation, our understanding of the pre–second millennium BC sequence remains limited, with our main insight gleaned through a series of soundings conducted between 1955 and 1976 (de Contenson 1992). At Ras Shamra examples of Combed-Ware first appear in EB III levels (Niveau IIIB), contemporaneous with the appearance of Red–Black Burnished Ware/Khirbet Kerak Ware (Schaeffer 1962: 204). Examples of Combed-Ware from the site were marked by a large piriform shape with a flat base, often with out–flaring and everted rims. Fabric colour generally ranged from grey to a yellowish–buff (Schaeffer 1962: 204). A number of decorative schemas can be identified from the published evidence; evenly spaced horizontal registers of fine vertical combing (Schaeffer 1962: fig. 16: A and D); fine to medium horizontal combing with registers of oblique (diagonal) and vertical combing (Schaeffer 1962: fig. 16: C); bands of horizontal and oblique (diagonal) combing (Schaeffer 1969: fig. 24: 6) and simple vertical combing (Schaeffer 1969: pl. IV: 2). The presence of combed jars and vats, in association with what appears to have been an olive press, is also worth noting (Courtois 1962: 422-3, Figs. 12, 18-19).

Al-Maqdissi (2006) reports a similar repertoire of combed pottery at Tell Sianu beginning in the EB III (Niveau 13), though the presence of pattern burnish and platter bowls alongside it might (if comparison with Lebanon are appropriate –see Jean this volume) suggest the presence of some residual EB II material. Another difference is the presence, as at Tell Arqa of very fine horizontal combing, which is found on vessels in layers clearly dated to the EB IV. Arqa and Sianu are so far the only two sites where Combed-Ware has been confirmed as continuing into EB IV. Future work might produce examples from Ugarit and or perhaps coastal sites located between Arqa and Sianu.

Tell Nebi Mend/Qadesh region

Located in the upper Orontes, 30 km south–west of Homs, at the south–eastern edge of Homs–Tripoli Gap, lies the 10 ha site of Tell Nebi Mend (ancient Qadesh). Excavations in Trench I revealed a corpus of some 113 Combed-Ware sherds. Instances of this tradition were identified throughout the third and early second millennia BC sequence, with the 66% of corpus recovered from Phases Q, P and O, dating from the EB III through to the EB III–IV transition. The remaining 34% of the assemblage was recovered from EB IVA (Phase N; 17%), EB IVB (Phase M; 7%) and MB I (Phases L and K; 9%) contexts. The examples from Phases M through K can most probably be considered residual, as ceramic residuality at Tell Nebi Mend is estimated at between 10–15% of each phase assemblage (Kennedy 2015: 75–76). Unfortunately, no complete Combed-Ware vessels were recovered, complicating broader discussions of the typological features of the TNM corpus. Despite this, the TNM Combed-Ware corpus was marked by a wide variety of fabric colours, with examples rendered in orangey–buff, pink, reddish–brown and grey hues. Fabrics ranged from medium to coarse, with mineral grits and occasional vegetal inclusions.

A variety of decorative schemas mark the TNM corpus, with examples occasionally slipped, self–slipped, and washed with combed decoration; other instances were un–slipped with combing. The combing patterns utilised ranged from simple horizontal, vertical or oblique (diagonal) combing; to more complex designs, such as alternate, evenly spaced registers of horizontal and vertical combing, alternate registers of horizontal and oblique (diagonal) combing, "herringbone" combing, and registers of horizontal and "serrated" combing. Combing is predominantly fine, although coarser combed examples are present throughout the corpus. Typologically, the TNM decorative schemas find their best parallels immediately to the west at Tell Arqa (Thalmann 2006: pls 50–53). Nebi Mend is not unique among sites in the Upper Orontes. Combed-Ware sherds similar to those observed at the site were recovered from surface collections undertaken at SHR 81 and 94, two sites located close to the river north of Homs, (Philip and Bradbury 2016: 385, Table 1) (Fig. 1).

Jean (this volume) and Thalmann (2006: 116, 124) report the presence of a distinctive type of jar at Arqa which occurs in a siliceous fabric, and which in terms of both form and paste, resembles vessels from Nebi Mend), indicating direct connections between the two areas. Likewise, the presence of combed-ware during the EBIV at Nebi Mend, a time when it has disappeared from much of the Levant, but is still found in abundance at Arqa and on the Syrian coast, further evidences connections. A program of analysis is currently underway to confirm the provenance of the Combed-Ware jars at Nebi Mend and the Syrian type vessels at Arqa and the nature of the links between the two areas.

Lebanon

Tell Arqa

The 7 ha site of Tell Arqa is strategically located on the Akkar Plain at the western end of the Homs–Tripoli Gap. The settlement is believed to have encompassed both an upper and lower city, with the lower city positioned south of the main mound (Thalmann 2006: 7). Extensive 3rd millennium BC deposits have been identified throughout the settlement, with significant quantities of Combed-Ware recovered. Examples of this tradition were found between Level 19B (EB II) and Level 15 (EB IVB) (Köhler and Thalmann 2014: 190). In contrast to TNM and other Lebanese coastal sites, a number of whole and constructible vessels were recovered. These consist of ovoid, loop–handle jars, ovoid or globular handle–less jars, and vats/basins (Thalmann 2006: 125–128; pls 50–53; 67–75). A range of decorative modes are present within the Tell Arqa assemblage. These include simple vertical, horizontal, oblique (diagonal) and cross combing; alternate registers of horizontal and oblique (diagonal) combing; registers of horizontal and "serrated" combing; and "herringbone", combing both with and without registers of horizontal combing (Thalmann 2008: fig. 2: 9–12). Köhler and Thalmann (2014: 190) note that the earliest examples of this tradition were marked by vertical, horizontal, oblique (diagonal) and cross–combed designs, with these replaced at ca. 2500/2450 BC by horizontal combing. Also appearing after ca. 2500/2450 BC (Levels 16 and 15) are horizontally combed vessels with incised and appliqué decoration, the latter includes geometric and botanical motifs, such as stars, branches and palm fronds (Thalmann

2006: pls 72: 4; 73: 1–3; 74–75).

Anfeh

The site of Anfeh, located on the coast south of Tripoli, produced a small and highly weathered assemblage of EB II-III combed vessels (Charaf 2016). The poor preservation of the vessels makes characterizing patterns difficult, but clear parallels can be observed with the closest sites - Tell Arqa, Koubba II, Fadous-Kfarabida, and Byblos. Common patterns include horizontal thick combing, horizontal thin combing, pattern combing, horizontal and vertical combing. As at other sites, sherds seem to be combed on the inner and outer surface. The fabrics are calcareous and mostly red in colour, though a few pink and grey sherds were noted (Charaf 2016: 203).

Tell Koubba II

Tell Koubba II is situated on a fertile coastal plain to the north of the Nahr al–Jawz, approximately 15 km north of Byblos. Soundings began at the site in 2016 under the auspices of Durham University and the American University of Beirut. During the course of the 2016 season a large stone building was partially uncovered, within the debris of which were significant quantities of Combed-Ware. The Combed-Ware vessels ranged from medium to coarse and were rendered in a variety of fabric colours such as pinkish–orange, orange, grey, red, and reddish–brown, often with a grey or blue–grey core. Forms ranged from simple, rolled rim jars to large, loop–handle vats (Fig. 2). A variety of decorative schemas were present within the Tell Koubba II Combed-Ware assemblage. These ranged from fine to coarse and include; simple horizontal, vertical and oblique (diagonal) combing; as well as more complex designs, such as arrangement in registers, horizontal combing interspersed with alternate bands of oblique (diagonal) combing; horizontal combing with vertical wavy–bands and appliqué decoration; registers of horizontal combing with bands of vertical combing; "herringbone" combing; horizontal and "serrated" combing; and horizontal combing with applied rope decoration at the neck–should juncture. Recent radiometric evidence places the main architectural phases in the second quarter of the 3rd millennium BC, i.e. EB III (Philip *et al forthcoming).*

Fadous–Kfarabida

Fadous–Kfarabida is located approximately 15 km north of Byblos on what is a very narrow section of the coastal plain. Excavations have revealed a sequence of occupation spanning from the EB I through to the early Middle Bronze Age (Genz 2014: 69), with EB III deposits particularly well-preserved. Instances of Combed-Ware have been found throughout the EBA sequence, with Ware *"f"* characterised by hard fired fabrics, ranging in hue between reddish and reddish–brown, often with a grey core (Badreshany and Genz 2009: 57). Characteristic forms include, short–necked, rolled–rimmed jars (Badreshany *et al.* 2005 7: 9), tall narrow–neck jars with everted rims (Genz *et al.* 2009: pl. 1: 9) and deep bowls/vats (Badreshany and Genz 2009: fig. 4: 1). Decoration consisted of fine to coarse horizontal combing (Badreshany *et al.* 2005: pls 5: 6–8; 6: 5–10; 7: 1, 4, 6, 9–10; 12: 4–6); as well as both vertical and horizontal "herringbone" combing (Genz 2014: figs 9: 9); cross combing; registers of horizontal and oblique combing (Genz *et al.* 2009: pl. 1: 9); horizontal combing with registers of short vertical combing (Genz 2014: figs 8: 7); and horizontal combing with appliqué decoration (Genz *et al.*2010: fig. 15).

Byblos

Byblos is located on a promontory approximately 35 km north of Beirut. Excavations during the first half of the 20th Century AD revealed extensive EBA deposits.

Inasmuch as it is possible to tell from the publications, Combed-Ware occurs throughout the 3rd millennium sequence, with examples generally marked by an orange, grey or reddish hue, often with a grey or blue–grey core. Fabrics ranged from medium to coarse, with examples occasionally distinguished by a brownish–orange slip, or orange self–slip. Characteristic forms include, large ovoid handle–less jars, globular jars with loop–handles, and vats/basins (Thalmann 2008: fig. 4: 2). Decorative schemas varied considerably from fine to coarse, with examples marked by simple decorative forms, such as horizontal, vertical, oblique (diagonal) and cross combing; as well as more complex designs, such as registers of vertical and "herringbone" combing (Thalmann 2008: fig. 2: 1); registers of vertical combing (Thalmann 2008: fig. 2: 2); registers of horizontal and oblique (diagonal) combing; cross combing, with "herringbone" and vertical wavy–band combing; cross combing, "herringbone" and zigzag combing (Saghieh 1983: pl. XLI: 10585 and 15979) and horizontal or vertical combing with incised botanical motifs (Saghieh 1983: pl. XLI: d).

Beirut

A small extent of Early Bronze Age remains were excavated on the ancient tell of Beirut in the 1990s (Badre 1997). A Combed-Ware assemblage of Jars and Vats typical of the EB III was uncovered. The pottery is described as mostly being composed of a thick orange fabric and various dark and light shades are observed in one photograph of the sherds. The fabrics are described as tempered with limestone and hematite grits (Badre 1997: 16). The hematite grits, may well be iron rich shales (see discussion below), though no images were available to confirm. The combing is found in typical patterns for other sites of the coastal area, including impressed rope patterns, horizontal and oblique, horizontal and vertical, and horizontal or vertical combing.

Bechemoun and Nahr Damour

These sites are located on the central Lebanese coast to the south of Beirut. Both were visited by Copeland and Wescombe (1965). The EB site of Bechemoun is located in the foothills (roughly 200-300 m asl) to the southwest of Beirut international airport, reportedly on the western terraces of a hill named *Qalaa' Tahun-el-Haoua.* Copeland and Wescombe report a wide range of materials from the site matching the description of typical Combed-Wares. The vessels were mostly Grey and Red in colour though, some pink examples were noted. The collection, housed in the Prehistoric Museum of the Université Saint-Joseph, however, consisted mainly of seal impressed sherds which were sampled as part of this study for petrographic and geochemical analysis. One combed and pattern burnished example was among the materials.

The site of Damour is located further south about 2km inland from the coast on a bend of the river Damour. The material was also collected by Copland and Wescombe (1965) and is housed Prehistoric Museum of the Université Saint-Joseph. As with Bechemoun the sherds were mostly Grey and Red. A number of combing patterns were noted including thin horizontal, thin horizontal and vertical, thin horizontal and vertical or oblique. Herring bone patterns were also noted. All of the pottery analysed originating from both Bchemoun and Nahr Damour, was composed of shale derived fabrics.

Sidon

Located on the coast 40 km south of Beirut is the site of Sidon, which has been under excavation since 1998, under the direction of Claude Doumet–Serhal on behalf of the

British Museum (Doumet–Serhal 2006: 2). Excavations concentrated on the “College site”, revealing an extensive MB I cemetery as well as a large EBA settlement. At present six strata are assigned to the first three quarters of the 3rd millennium BC (Doumet–Serhal 2006: 58–60). Combed-Ware vessels have been found throughout the sequence between Strata 1 and 6 (Doumet–Serhal 2006: 41). However, instances appear to have increased steadily from Stratum 2 onwards, with this ware accounting for approximately 60% of the decorated body sherd assemblage (Doumet–Serhal 2006: 42), while during the subsequent Strata 3–6, Combed-Ware accounts for between 80 and 90% of the decorated body sherd assemblage (Doumet–Serhal 2006: 45–51). Reddish and pink pastes marked the Combed-Ware assemblage of Sidon. Decorative schemas ranged from simple horizontal, vertical and obliquely (diagonal) combing (Doumet–Serhal 2006: pls 87–90), to more complex designs such as cross–combing (Doumet–Serhal 2006: pl. 41: 11), alternate registers of horizontal and vertical or oblique (diagonal) combing (Doumet–Serhal 2006: pl. 86: 1) and occasionally “herringbone” combing appear (Doumet–Serhal 2006: pls 85: 1; 96: 8).

Tyre

Tyre is located 80 km south of Beirut. Excavations have concentrated on the “Crusader Church” area, where soundings revealed an occupational sequence spanning the EB II through to the Roman Period. Combed-Ware vessels have also been found between Strata XXVII and XXI. Unfortunately, little information is available concerning the typology and frequency of these vessels. However, on the basis of the published examples it would appear that instances were marked by a reddish to pink paste with horizontal combing and small registers of oblique (diagonal) combing (Bikai 1978: pl. XX: 22).

Lebanese Mountains

The site of Yanouh in the mountains to the east of Byblos (Pieri and Rousset 2001) represents the only publication to document Combed-Ware in at sites in the Lebanese mountains. The combing patterns are not different from those found on the coast and come in a similar range of colours. The data is fragmentary, but combing patterns could be observed consisting of thick and fine horizontal, vertical, horizontal registers with vertical, and oblique combing (diagonal) and pattern combing of fine horizontal combing of EB III date. It is almost certainly the case that the absence of EBA data for the sites in the mountains is simply because of the lack of systematic archaeological surveys. The authors have observed EB pottery in the foothills at sites to the East of Koubba II and in the mountains to the East of Sidon. If these chance finds are any indicator, new survey and excavation projects in the Lebanese mountains are likely to demonstrate that Combed-Ware was very widely distributed there.

The Biqa'

Combed-Ware is also prevalent throughout the Biqa‘, with at least 17 sites revealing instances of this ware. At Tell Aswad in the southern Biqa‘ (Badreshany 2013: 169), Combed-Ware vessels are marked by an orangey–buff to brownish–orange hue. The extant sherds suggest that a predominance of horizontal, vertical and oblique (diagonal) combing, as well as cross combing and “herringbone” combing (Badreshany 2013: 265). These decorative schemas are paralleled throughout the wider Biqa‘, at sites such as Tell Serhan, Tell Makne, Tell Ayn Cherif, Tell Nebi Fouar, Bar Elias, Tell Hachba, Tell Deir Zanun, Tell Majdaloun and ‘Ayn al–Fawqā. In addition, other sites such as Ayn al-Khanzira, and Tell Haql el–Khirbe have revealed instances of these patterns, as well as more complex designs such as registers of horizontal, oblique (diagonal), and vertical combing, and horizontal and oblique (diagonal) "serrated" designs, such as at Tell Delhamiye. Vessels from the aforementioned sites were also marked by yellowish–brown–buff, brown, pinkish–brown and reddish–brown hues, with fabrics ranging from medium to coarse.

The evidence above argues against the existence of obvious regional stylistic variation in the execution of combing. Rather most styles can be identified at a number of different sites, while most sites produce evidence for a number of different combing styles.

Chronological Development of Combing Patterns

A growing body of radiometric dates combined with recent Bayesian modelling has revised the chronology of the EBA Levant, EB II-III with the EB II–III now dated ca. 3050/3000–2500/2450 cal. BC (Regev *et al.* 2012; Höflmayer et al. 2014). In the southern Levant, EB II is now seen as a relatively short lived period with a maximum span of around 150 years (ca. 3050/3000-2900 cal BC). In Lebanon too, Combed-Ware first appears during EB II, alongside pattern burnished surface treatment, although it continues to occur in quantity during EB III. At Tell Arqa in northern Lebanon, however, the EB II/III transition is placed around 2800 BC (Thalmann 2016: Fig. 2), a date that is broadly in-line with that for the phase II/III transition at Faddous-Kfarabida (Höflmayer et al 2014: 537), so rather later than in the south. Moreover, as we do not yet know when EB II begins in Lebanon, it is possible that developments there followed a different path from that taken by the contemporary southern Levant. The tradition seems to end in much of the Levant towards the end of EB III (ca. 2500/2450 cal BC) (Sowada 2009, Greenberg and Porat 1996), including most of Lebanon as evidenced by recent work by the authors at Tell Koubba II, at Fadous-Kfarabida underpinned by c14 dates (Höflmayer et al. 2014, Genz 2014 and in the Biq'a (Badreshany 2013). Evidence from two sites, Arqa and Sianu, reveals that the tradition continues into the EB IV in north Lebanon and coastal Syria (Jean this volume; Kennedy 2015: 178–179; Mazzoni 2002: 77–78; Thalmann and Sowada 2014; Thalmann 2006: 125–128).

EB II	3050/3000-2800 cal. BC
EB III	2800-2500/2450 cal BC
EB IVA (Combed-Ware only continues in north)	2500/2450- ca. 2250 cal BC

Table 2 Absolute dates associated with the EB II-IV as determined by C14 dates in Lebanon

So far, few chronological or regional developmental patterns have been recognized in terms of ware or decoration, and most agree that Combed-Wares generally become more frequent during EB III and decline in frequency moving into EB IV. Thalmann and Sowada (2014: 368) notice that at Arqa vertical combing mostly disappears from vessels after 2600 BC with only very regular fine horizontal combing occurring, a change that they associate with the introduction of wheel-coiling.

If regional or chronological combing patterns exist, they will be difficult to identify as the analysis of restorable vessels has shown that combing can be applied in multiple directions and thicknesses across different parts of the same vessel. Some restorable vessels for example are found with horizontal combing on the lower part to help join coils and vertical or oblique patterns on the shoulder to help regularize shape (Thalmann and Sowada 2014: 363 fig 4). The vast majority of evidence for combing, unfortunately takes the form of sherd material, making it difficult to build a coherent picture.

The Interpretation of Combing

No-one has yet laid out a convincing explanation for the wish to apply combing to the exterior of these vessels. Quite similar vessels are found both without decoration, and with a pattern burnished exterior and it is not clear if combed vessels differed from these functionally or conceptually. Through detailed studies of the few complete vessels available, it has been argued that combing played a role, in the construction of large vessels, in particular by masking the joins between the coils of clay used in their formation (Greenberg and Porat 1996: 10; Thalmann and Sowada 2014: 367-9). However, given the spatial and temporal extent of combing, it is quite possible that its significance varied, and that (for example) the potters in their workshops, and those receiving jars full of valuable liquid products may have understood combing in a different way, with ideas around the ‘branding’ of products (Wengrow 2008) likely to have been influential in the latter case. We believe, however, that an investigation of the archaeometric dimension of combed vessels over space and time, can shed light on the development of combing as a practice, and perhaps provide further clues as to its meaning.

Somewhat surprisingly the origins and meaning of the decoration has rarely been considered (see Sowada 2009 for a recent summary of views). Some have suggested that basketry provided the initial inspiration for both combing and pattern burnishing (Thalmann and Sowada 2014: 367; Bunimovitz and Greenberg 2004: 21 Prausnitz 1954), as pattern-combing consisting of wide oblique or vertical combing over narrow horizontal bands which seems to mimick basketry patterns occurs from time to time. Baskets lined with materials to make them impermeable to liquids are well-known from the archaeological record of the region from the Neolithic (Nieuwenhuyse and Campbell 2017), showing that the link between containers made in organic materials and in ceramic has a long history.

However, despite the availability of a great deal of ceramic evidence, indicators of a clear technological evolution of Combed-Ware from basketry are missing, as are types demonstrating a clear progression from organic to more stylized impressions. Further, it should also be noted, that while combing appears in many parts of the Levant in EB II, the apogee of combing in the Southern and Northern Levant is reached during EB III (Sowada 2009 with detailed references), thus combed becomes most popular 200-300 years after it appears by which point that the patterns are highly stylized.

Some have suggested a purely functional purpose for the combing and a role in reducing porosity by helping slips adhere, thus making a more effective liquid container (Stager 1992: 37; Dever and Richard 1977: 10). McGovern (1997: 75) saw the applications of such surface treatments as having an added benefit for the preservation of wine. These explanations are unlikely, as Esse (1991: 114) pointed out, because the vast majority of Combed-Ware vessels lack slip; they are well-fired and do not need additional treatment, a point reinforced by the petrographic analyses. Despite reports of ‘white slipped’ Combed-Ware vessels from the northern Lebanese coast, (Hennessey 1967) no vessels of this type were noted in our sample. Combed-ware vessels bearing what has been described as a ‘white-slip’ are known from southern Palestine (Esse 1991: 110; Greenberg and Porat 1996: 10) but this has recently been identified convincingly as a lime plaster coating (Eliyahu-behar *et al.* 2016), and represents a distinct local tradition that will not be treated here. Further, the present authors observed quite different combing patterns on a set of vats found within a single room at Tell Koubba showing that varied styles were contemporary (Fig. 4). It seem unlikely therefore that combing patterns had a relationship to a specific function.

Both Greenberg and Porat (1996: 10) and Thalmann and Sowada (2014: 360) have shown that one purpose of the combing patterns is to help join coils or regularize curves in the vessel profile, especially on larger vessels. Additionally, the evidence from Arqa suggests that combing patterns do change over time, in-line with technological developments in ceramic production. For example, with the increasing use of Rotational Kinetic Energy by potters, who began working with a swiftly rotating device from ca. 2600 BC onwards (EB IV), the coils were joined with the aid of the wheel. From this point onwards, combing is usually horizontal and fine in nature, and would have served more as a visual cue than as part of the technical process – perhaps echoing an earlier connection with ‘brand marking’ (Wengrow 2008). By this point, however, Levantine Combed-Ware had disappeared from much of the region and is only confirmed as continuing at Arqa and Siannu (Jean this volume, Thalmann 2016, Thalmann and Sowada 2014), so the practice might be limited. Sadly, deficiencies in the record renders it hard to assess whether these developments were also reflected at the key site of Byblos.

A brief note on Wares and Fabrics

Levantine Combed-Ware, as implied by the name, is often considered a 'Ware' tradition. The problematic nature of applying the term 'ware' to all combed material has been reviewed by Thalmann and Sowada (2014: 356). In fact, the use within archaeology of what are often ill-defined and overly-generalised 'wares' as basic organizational units of ceramic data (units which are often deployed freely by researchers who may have little first-hand experience with the material in question), is a problem across many categories of Near Eastern ceramics. As Philip and Baird (2000: 18) pointed-out, this can lead to the creation of ceramic categories in the wider archaeological literature, the existence of which is not really warranted by the evidence. The continuing deployment of these convenient (but dubious) categories within wider discussions can hinder the development of nuanced explanatory models. When viewed in this light, the wide spatial and temporal extent, and stylistic variability outlined above, would appear to render Combed-Ware a natural contender for just this kind of confusion. We will return to this issue when we discuss the new archaeometric evidence. However, it is clear even from basic macroscopic analysis, that Levantine Combed-Ware as currently understood falls into two broad categories of material.

The first group consists of fabrics derived mostly from shale sources (Fig. 5 and 6**)** (Badreshany 2013; Badreshany and Genz 2009; Griffiths 2006; Greenberg and Porat 1996); these are referred to henceforth as 'shale derived fabrics'. The main component of these fabrics is fragments of shale (more generally referred to as Argillaceous Rock Fragments (ARFs) after Whitbread ([1995]). These clay sources are naturally low in calcareous materials, but there are sub categories that can contain a proportion of calcareous material. The shale derived fabrics are often, though not always, highly fired. The material that Greenberg and Porat (1996) define as 'North Canannite Metallic Ware' (NCMW), and which has been identified (on petrographic grounds) at a number of EB II sites in northern Palestine, and the origin of which has been ascribed to a specialist producers using the shale-rich cretaceous outcrops at the southern end of the Anti-Lebanon range, sits within this tradition. However, in northern Palestine, NCMW is not restricted to jar forms but is also used for the production of a range of vessel classes including jugs and platter bowls (Greenberg and Porat 1996), indicating that while it shows a particular association with seal impressed jars (Greenberg 2001), the jars are simply one component within a wider manufacturing tradition.

The second broad category of fabric found on combed vessels, in Lebanon in particular, is calcareous in nature, and often contains a large amount of quartz. The calcareous fabrics are more varied and regionally distinct, when compared to the shale derived fabric. This no doubt reflects the fact that there are more potential sources of calcareous than of shale-rich clays (see below). Calcareous fabrics appear in EB II in many parts of the study area (Jean this volume, Badreshany 2013; Badreshany and Genz 2009; Griffiths 2006; Sowada 2009), though is difficult to assess patterns of change through EB II and III. This is partly because EB II remains poorly understood in Lebanon, but also because the vessels are more varied, suggesting a mode of production that is more dispersed than that posited for shale-wares. During the EB III, most of the Combed-Ware vessels are calcareous in nature (see below).

Shale derived fabrics seem to display similar characteristics across the Levant and geochemical evidence presented below strongly suggests a production using a limited number of clay sources, though more work needs to be done making direct comparisons between northern and southern Levantine examples to strengthen this assertion. Chronologically, in most of the areas under consideration this fabric seems to be mainly restricted to the EB II. This is based on evidence from sites with good stratigraphic sequences in northern Palestine, and Tell Arqa in Lebanon (Jean, this volume; Greenberg and Porat 1996). Examples analysed as part of this study do come from clear early EB III strata at Tell Koubba II and at Tell Fadous-Kfarabida, however, as they appear as small sherds, they could be residual in those contexts. Thus, Combed-Ware vessels made from shale fabrics seem to be common between roughly 3050-2800 cal BC and seem to have disappeared from the archaeological record of the area by 2700 cal BC at the latest, when mostly jugs are still found at Koubba and Arqa made in this ware.

New Petrographic and Geochemical Data

Previous Archaeometric studies

Only a few substantial archaeometric studies have been conducted on Levantine EB Combed-Ware from the Levant. Some examples were included in Esse and Hopke’s (1986) Neutron Activation Analysis of more than 500 EBA vessels, from Palestine and Egypt, although the programme investigated only three sherds from Lebanon. There were also deficiencies in the analytical programme, including problems in the identification of individual samples, insufficient attention to the definition of vessel fabrics prior to geochemical analysis (we have indicated above that combed jars were made in multiple fabrics), and the fact that the geochemical data upon which the conclusions were based remain unpublished (Sowada 2009: 173). Greenberg and Porat (1996) examined vessels of the so-called North Canaanite Metallic Ware tradition at a number of sites in northern Palestine, through petrography, a limited use of the electron microprobe and X-ray diffraction, suggesting a single origin in the shale-rich cretaceous clays found at the southern end of the Anti-Lebanon range. Beck (1985) had previously studied Early Bronze Age ware bowls from Tell Aphek that were described as 'metallic', but these are quite different in composition to the north Palestinian material (Greenberg and Porat 1996: 18). These points underline the terminological confusion that the loose usage of terms such as 'Metallic Ware' and 'Combed-Ware' can cause.

Sowada (2009: 175-82, Appendix II) conducted an analytical programme using PIXE-PIGME that examined eight samples of combed jars from Egypt and 25 sherds from combed vessels from the Levant. This produced three main groups, although the lack of petrographic analysis and the fact that the geochemical data is not provided, limits the inferences that can be drawn. Broadly, however, Cluster A included sherds from Byblos and 4th Dynasty tombs at Giza, arguing for a Lebanese component to Egyptian imports from the Levant during the Old Kingdom. The members of Cluster B, were made from clays that were richer in Fe, and some examples may be related in to the shale-rich fabrics. The samples came from Byblos and sites across Palestine, while those from Giza appeared to form a tight but slightly separate group (Sowada 2009: App. II, Chart I). In our view, Cluster B is likely to include sherds in several different fabrics. Cluster C consists of material in calcareous clays from sites in northern Palestine, but includes none of the sherds from Egypt. On the basis of our review of the existing data, we would argue that clarity will only be obtained following the consistent application of petrographic and geochemical analysis in combination, and on a large-scale.

In the northern Levant, ceramic petrography was used to study Early Bronze Age ceramics, including sherds from combed vessels from Sidon (Griffiths 2006), Tell Fadous-Kfarabida (Badreshany and Genz 2009) and sites in the Biq'a (Badreshany 2013). Petrography has also been used to examine combed vessel sherds recovered from Tell 'Acharneh in the Middle Orontes Valley (Boileau 2006).

Part of the problem, in our view, is that because many of the complete examples of EBA Levantine combed vessels were recovered from tomb contexts in Egypt, what is in fact relatively small proportion of the total corpus of such material has played a disproportionate role in shaping the both terminology (the confusing term 'Abydos ware' is a case in point), and the core research questions. Thus, while a number of bulk chemical and petrographic studies have been undertaken on Combed-Ware jars uncovered in tombs in Egypt, that are presumed to have originated in the Levant, (Hartung 2002, Hartung *et al* 2015; Köhler and Ownby 2011; Ownby 2014; Pape 2001), these studies were constrained by a limited scholarly understanding of the nature and petrography of EBA ceramics from the north/central Levant. In contrast, light that we may shed on the nature of EBA trade connections between the Egypt and the Levant, is a by-product of an effort to understand the production and distribution of this material within the Levant.

Accordingly, the present study is the first to take a regional archaeometric perspective through the examination of samples from ceramic vessels originating at multiple sites in central Levant. To this end, 113 samples mostly dating to the EB II and III were investigated by thin–section petrography and a subset of ninety-four of these further analysed using ICP –AES and –MS to examine their geochemistry (Table 1, Supplementary Materials). Extensive photomicrographs images of every thin-section examined and the geochemical data are provided in accompanying online appendices (see supplementary material)

Sample Number	**Site**	**Region**	**Date**	**Type**	**Colour**	**Combing**	**Petro-fabric**	**ICP Group**
Koubba_II_4004-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Burnished	Orange, Black Oblique Wash	None	1A	A
AF1	ᶜAyn al-Fawqā	Biq'a Valley	EB II-III	Jar Base Flat Combed	Orange	Thin Vertical	1B	B
AF10	ᶜAyn al-Fawqā	Biq'a Valley	EB II	Jar Body Sherd	Orange, Red Slip Drip Pattern	None	1B	B
AF11	ᶜAyn al-Fawqā	Biq'a Valley	EB II-III	Platter Bowl	Orange	None	1B	B
AF8	ᶜAyn al-Fawqā	Biq'a Valley	EB II-III	Jar Small Flat Base	Pink	None	1B	B
AK4	ᶜAyn al-Khanzīra	Biq'a Valley	EB II-III	Platter Bowl	Pink	None	1B	B
AK7	ᶜAyn al-Khanzīra	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Grey	Thick Vertical	1B	A
Bchemoun1	Bchemoun	Lebanese Coast	EB II-III?	Jar Rim	Reddish Brown	None	1B	A
BE4	Barr Elyās	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Pink	Thin Horizontal and Oblique	1B	A

Byblos12	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Grey	Thick Horizontal or Vertical	1B	C
Byblos15	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Pink	Thick Horizontal and Oblique	1B	A
DZ1	Dayr Zanūn	Biq'a Valley	EB II-III	Platter Bowl	Orange, Thin Red Slip	None	1B	Outlier
DZ2	Dayr Zanūn	Biq'a Valley	EB II-III	Platter Bowl	Red slipped	None	1B	B
FAD10.305/295.56	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Pithos Combed	Orange	Thick Horizontal or Vertical	1B	C
HK1	Ḥaql al-Khirba	Biq'a Valley	EB II-III	Platter Bowl	Pink	None	1B	Outlier
Koubba_II_3001-1	Koubba II	Lebanese Coast	EB III	Jar Rim	Orange Pink	Thin Horizontal	1B	A
Nahr Damour2	Nahr Damour	Lebanese Coast	EB II-III?	Bowl Rim Red Slipped	Red	None	1B	C
Nahr Damour3	Nahr Damour	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Grey	Thin Horizontal	1B	A
Nahr Damour6	Nahr Damour	Lebanese Coast	EB II-III	Jar Body Sherd Incised	Grey	Herring Bone Incised	1B	A
P.8039	Site 81 (Homs Regional Survey)	Northern Homs Region	EB II-III	Jar Body Sherd Combed	Brownish Orange	Thick Horizontal and Oblique	1B	Not Analysed
TDL2	Dalhamīya	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Pink	Thick horizontal and oblique	1B	B
TM1	Madjdalūn	Biq'a Valley	EB II-	Jar Rim	Orange	None	1B	B

			III					
TMK1	Maqna II	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Reddish-Brown	Thick horizontal and Four Prong Oblique	1B	B
TMK4	Maqna II	Biq'a Valley	EB II-III	Jar Rim	Pink	None	1B	B
ZerFn034-2	Zeraqoun	Lebanese Coast	EB II	Bowl Type A5.1	Pinkish Brown	None	1B	C? (See text)
A4	Aswad 4	Biq'a Valley	EB II-III	Jar Rim	Pink	Thin Sparse Vertical	1C	B
FAD09.290/ 295.270.2	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Jar Body Sherd Combed	Orange	Thick Horizontal	1C	C
TH1	Ḥaschba	Biq'a Valley	EB II-III	Platter Bowl	Red Slipped	None	1C	Outlier
AbuKharas 51322L651 A	Abou Kharaz	Jordan Valley	EB II	Jar Body sherd	Orange	Thin vertical	1D	A
AbuKharas 5L322H651 B	Abou Kharaz	Jordan Valley	EB II	Pithos Rim	Brown	None	1D	A
AbuKharas 5L322N641	Abou Kharaz	Jordan Valley	EB II	Jar Body sherd	Brown	None	1D	A
Abukharas B9L220N848	Abou Kharaz	Jordan Valley	EB I/II transition	Jar Body Sherd	Orange, Brown wash	None	1D	Outlier
AC3	ᶜAyn Scharīf	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Reddish-Brown	Thick Vertical or Horizontal and Oblique	1D	A
AF2	ᶜAyn Scharīf	Biq'a Valley	EB II-III	Jar Base Flat Combed	Orange-Brown	Thick Oblique (three pronged	1D	A

						comb)		
AF24	^{c}Ayn Scharīf	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Orange	Thick Horizontal and Oblique	1D	Outlier
Bchemoun3	Bchemoun	Lebanese Coast	EB II-III	Seal Impressed Sherd (Net)	Reddish Pink	None	1D	A
Bchemoun4	Bchemoun	Lebanese Coast	EB II-III	Seal Impressed Sherd (Net)	Reddish Pink	None	1D	A
Bchemoun5	Bchemoun	Lebanese Coast	EB II-III	Seal Impressed Sherd (Glyph)	Reddish Pink	None	1D	A
Bchemoun6	Bchemoun	Lebanese Coast	EB II-III	Jar Sherd	Orange Pink	Pattern Burnish	1D	A
Bchemoun7	Bchemoun	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Grey	Thin Oblique Two Directions	1D	A
Byblos17	Byblos	Lebanese Coast	EB II-III	Platter Bowl Combed/Incised	Brownish-Pink	Very Thin Horizontal	1D	Outlier
Byblos19	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd	Brownish-Pink	None	1D	Outlier
Byblos20	Byblos	Lebanese Coast	EB II-III	Platter Bowl Rim	Pink	none	1D	Outlier
FAD07.0.1	Fadous-Kfarabida	Lebanese Coast	EB II?	Seal Impressed Sherd (Net)	Orange Pink	None	1D	A
FAD09.285/ 295.313	Fadous-Kfarabida	Lebanese Coast	EB II (Phase II)	Seal Impressed Sherd (Net)	Orange	None	1D	A

FAD10.300/ 295.40	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Seal Impressed Sherd (Net)	Orange Pink	None	1D	A
FAD14.310/ 295.750	Fadous-Kfarabida	Lebanese Coast	EB III	Seal Impressed Sherd (Net)	Orange Pink	None	1D	A
Koubba I 093	Koubba I	Lebanese Coast	EB II	Jar Rim	Orange	None	1D	Outlier
Koubba I 114	Koubba I	Lebanese Coast	EB II	Platter Bowl Rim Burnished Black wash	Orange	None	1D	A
Koubba I 79-47	Koubba I	Lebanese Coast	EB II	Platter Bowl Rim Burnished	Burnish	none	1D	A
Koubba_II_ 1004-1	Koubba II	Lebanese Coast	EB III	Seal Impressed Sherd (Net)	Orange	None	1D	A
Koubba_II_ 2006-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	Thin Oblique Two Directions	1D	A
Nahr Damour4	Nahr Damour	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Grey	Thick Horizontal and Vertical	1D	A
Nahr Damour5	Nahr Damour	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Orange Pink	Thin Horizontal or Vertical and Oblique	1D	A
NF26	Nab^{c} al-Fā^{c}ūr	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Reddish-Brown	Thick Horizontal	1D	A

TH3	Ḥaschba	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Reddish-Brown	Thick Horizontal and Oblique in Multiple Directions	1D	A
TS4	as-Sirḥān	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Brown	Thick Pattern	1D	A
ZerIh6FN069-1	Zeraqoun	Northern Jordan	EB II	Pithos Rim	Orange pink	None	1D	A
ZerIM2FN027-2	Zeraqoun	Northern Jordan	EB II	Pithos Rim	Orange	None	1D	Outlier
ZerIM2FN034-6	Zeraqoun	Northern Jordan	EB II	Jar Rim Sherd	Orange Pink	Thin horizontal	1D	A
Bchemoun2	Bchemoun	Lebanese Coast	EB II-III?	Bowl Slipped	Red	None	1E	A
Byblos21	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Orange-Pink	Thick Horizontal and Vertical	1E	A
Byblos27	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Orange	Thin Horizontal and Oblique	1E	Outlier
P.8013	Site 94 (Homs Regional Survey)	Northern Homs Region	EB II-III	Jar Body Sherd Combed	Brown	Thick Horizontal and Oblique (incised)	1E	Not Analysed
Zer93-260	Zeraqoun	Northern Jordan	EB II	Pithos Rim	Orange	None	1E	Outlier
A5	Aswad 5	Biq'a Valley	EB II-III	Jar	Pink	Thick Vertical and Oblique Wiping	1F	Outlier

Byblos23	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Grey	Vertical Pattern Burnish	1F	Outlier
TS3	as-Sirḥān	Biq'a Valley	EB II-III	Jar Body Sherd Combed	Pink	Thick Horizontal or Vertical	1F	Outlier
Byblos11	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Grey	Thin Horizontal and Oblique	2A	F
Byblos13	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Reddish Brown	Thick Horizontal and Vertical	2A	F
Byblos14	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd	Orange Red	None	2A	Not Analysed
Byblos16	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Pink	Thick horizontal and Oblique	2A	F
Byblos25	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Pinkish Brown	Thin horizontal	2A	F
FAD09.285/295.222.1	Fadous-Kfarabida	Lebanese Coast	EB III (Phase III)	Jar Body Sherd Combed	Orange Brown	Thick Horizontal	2A	E
FAD16.315/345.56	Fadous-Kfarabida	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange Brown	Not Visable	2A	F
Koubba II 1005-2	Koubba II	Lebanese Coast	EB III	Pithos Rim	Reddish Orange	None	2A	Not Analysed
Koubba II 3006-1	Koubba II	Lebanese Coast	EB III	Jar body sherd combed	Orange	Thick Horizontal and Vertical	2A	Not Analysed
Koubba II 3012-1	Koubba II	Lebanese Coast	EB III	Jar body sherd combed	Orange	Thick Horizontal and Vertical	2A	Not Analysed

Byblos22	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd	Orange	None	2B	D
FAD08.285/ 295.178.1	Fadous-Kfarabida	Lebanese Coast	EB III (Phase III)	Jar Body Sherd Combed	Orange Brown	Thick Horizontal	2B	E
FAD10.295/ 295.146	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Seal Impressed Sherd (Net)	Orange	None	2B	D
FAD11.295/ 300.38.20	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Jar Body Sherd Combed	Oranage Brown	Thick Vertical	2B	D
FAD16.315/ 345.38	Fadous-Kfarabida	Lebanese Coast	EB II-III	Jar Body Sherd	Oranage Brown	None	2B	D
Koubba II 49	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange Reddish	Thick Horizontal	2B	Not Analysed
Koubba II 53	Koubba II	Lebanese Coast	EB III	Jar/Vat Body Sherd Combed	Brownish Pink	Thick Horizontal	2B	Not Analysed
Koubba_II_ 3002-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	Thick Horizontal and Vertical	2B	D
x651	Nebi Mend	Biq'a Valley (Syria)	Early EB III	Jar Body Sherd Combed	Brownish Orange	Thick Horizontal and Oblique	2B	Not Analysed
x652	Nebi Mend	Biq'a Valley (Syria)	Terminal EB III/Early EB IV	Jar Body Sherd Combed	Brownish Orange	Thin Horizontal and vertical	2B	Not Analysed
Byblos18	Byblos	Lebanese Coast	EB II-III	Jar Base	Grey	None	2C	H
Byblos26	Byblos	Lebanese Coast	EB II-III	Jar Body Sherd Combed	Orange	Thin Horizontal and Vertical	2C	H

FAD10.305/ 295.38.10	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Jar Body Sherd Combed	Orange	Thick Horizontal	2C	E
Koubba II 3004-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	Thick Oblique (two directions) and Horizontal	2C	Not Analysed
Koubba II 4005 sample 1	Koubba II	Lebanese Coast	EB III	Vat Combed	Orange Reddish	Thick Horizontal	2C	Not Analysed
Koubba II 4005 sample 2	Koubba II	Lebanese Coast	EB III	Vat Combed	Orange Reddish	Thick Horizontal	2C	Not Analysed
Koubba II 4007	Koubba II	Lebanese Coast	EB III	Vat Combed	Orange Reddish	Thick Diagonal Two Directons, Thick Horizontal Bands	2C	Not Analysed
Koubba II 90	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Brownish Pink	Thick Horizontal and Vertical	2C	Not Analysed
Koubba_II_ 1002-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Grey	Thick Horizontal and Oblique	2C	H
Koubba_II_ 1012-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	Thick Vertical	2C	G
Koubba_II_ 2007-3	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange Pink	Thick horizontal and Vertical	2C	D
Koubba_II_ 2007-4	Koubba II	Lebanese Coast	EB III	Jar Body Sherd	Reddish Pink	Think Horizont	2C	D

				Combed		al and Vertical and Oblique		
Koubba_II_ 4002-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Pink	Thick Oblique and Horizontal	2C	G
KoubbaI 6	Koubba I	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange Brown	Thin Horizontal and Vertical	2C	H
Byblos24	Byblos	Lebanese Coast	EB II-III	Jar Base	Pink	Faint Thin-Horizontal	2D	E
Koubba II 1005-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	None	2D	Not Analysed
Koubba II 2006-2	Koubba II	Lebanese Coast	EB III	Jar body sherd combed	Orange	Thick Horizontal or Vertical and oblique	2D	Not Analysed
Koubba_II_ 2007-2	Koubba II	Lebanese Coast	EB III	Pithos Rim	Orange pink	None	2D	E
FAD08.305/ 295.33	Fadous-Kfarabida	Lebanese Coast	EB III (Phase IV)	Jar Body Sherd	Orange	None	2E	Not Analysed
Koubba II 4002-1.1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	Thick Horizontal and oblique	2E	Not Analysed
Koubba_II_ 2007-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Grey Brown	Thick Vertical	2E	G
Koubba_II_ 2022-1	Koubba II	Lebanese Coast	EB III	Jar Body Sherd	Grey	Thick Horizont	2E	G

				Combed		al and Oblique		
Koubba_II_ 3012-2	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Orange	Thick horizont al and Vertical	2E	Outlier
Koubba_II_ 37	Koubba II	Lebanese Coast	EB III	Jar Body Sherd Combed	Reddish Orange	Thick Horizont al	2E	G
FAD09.290/ 295.285.4	Fadous-Kfarabida	Lebanese Coast	MB I (Phase VI)	Jar Shoulder	Orange Brown	Wavy Combin g	2F	Outlier

Table 3. List and Description of samples analysed as part of this study.

The archaeometric analyses was undertaken with the aim of gaining a deeper understanding of aspects of Combed-Ware vessel production and distribution. Specifically, the goals of the analyses were to better inform our understanding of raw material preferences, manufacturing processes, firing temperature, degree of standardisation, and vessel provenance and distribution, and to ascertain the degree to which production may have been centralized, as suggested by Greenberg and Porat (1996). We were also interested to explore the way in which these attributes change through the Early Bronze Age.

Sample Selection and Analytical Methods

Several studies (Badreshany and Genz 2009; Greenberg and Porat 1996; Jean this volume) have observed that Combed-Ware jars often appear to share a fabric with other ceramic types. Accordingly, in addition to samples from Combed-Ware jars and vats, a range of sherds from platter bowls, and non-combed jars, and vats was included in this study to understand the wider context of the production of these vessels and to assess the similarity, in terms of materials used, across multiple typological classes. In order to detect potential space-time variations in production, the analysis included specimens from as wide a range of sites and chronological units as we could access for sampling. These included both stratified contexts from excavated sites, but also material from surface collections, where this would extend the sample spatially to cover areas such as the Biq'a Valley for which stratified material is not available. (See Table 3 for list of sites and regions). The stratified samples come from: the Lebanese littoral - Fadous-Kfarabida (Badreshany *et al*. 2007), Tell Koubba (AUB-Durham University excavations 2016-17), the Upper Orontes Valley - Tell Nebi Mend (Kennedy 2015a), and northern Jordan - Tell Abu al-Kharaz (Fischer 2008) and Khirbet az-Zeraqon (Genz 2002). Samples analysed from surface pick-up included material from collections made by Copeland and Wescombe (1965 and 1966) from the Biq'a valley and Lebanese coast, and from sites in the Orontes valley examined by the regional survey Settlement and Landscape Development in the Homs Region, Syria (SHR); for a recent overview of the latter see Philip and Bradbury (2016).

Table 3 provides the relevant sample details, including find context, vessel form, decoration, phase, and petrofabric. The core sample includes 66 fragments of confirmed or possible combed jars, pithoi or vats; three combed samples are confirmed as coming from vats. In addition, 22 plain (non-combed) or burnished jars, ten platter bowls, and three smaller bowls were also analysed along with nine samples taken from jars bearing seal impressions. The latter were only preserved as small fragments with no visible decoration, so it not clear whether the jar body was plain or decorated with combing or burnish. The samples of non-combed vessels were included to understand their relationship to Combed-Ware production and assess whether the production of Combed-Ware differed from that of other contemporary forms. A sample of a jar from Fadous-Kfarabida of MB I date was included as a geochemical control, to investigate the degree of chemical variability between vessels from a single site, produced using similar materials, but at different times and potentially by a different workshop.

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), Whitbread (1995) 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 (Roduit 2007; www.jmicrovision.com). Tiled images of an area measuring 1 cm^2 on each thin–section were produced for this purpose. Some samples were analysed using Hitachi TM3000 Scanning Electron Miscoscope (SEM) fitted with a SwiftED3000 Energy Dispersive X-ray Spectrometer (EDS). The accelerating voltage was set to 15 kV and the probe current was set to 700 pA. The bulk compositional analysis was generated by the SwiftED software using standardless matrix corrections and is semi-quantitative.

Ninety–Four samples were analysed 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: 168–183) – or from different clay sources. As the signature can vary even within the same clay outcrop, very close signatures suggest production from a geographically and, potentially, temporally proximate batch of materials and, thus, suggests the same production location and broad contemporaneity.

Following the methodology employed by Hughes (2005) and Allen (1999), powders were obtained from the profile of each sherd using a 12-volt dental drill fitted with a 2 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 analysed by ICP–AES and ICP–MS at the Department of Earth Sciences, Durham University. The analysis measured for 39 elements (Table 1 in Supplementary materials). The major elements, analysed by ICP–AES as weight percentage oxide, include Al2O3, Fe2O3, MgO, CaO, Na2O, K2O, TiO2, P2O5 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 principal components analysis (PCA) (Orton and Hughes 2013: 176–180) was conducted using SPSS v.22 to plot the similarity of the ‘chemical fingerprint’ of each sample (Figures 8 and 9). Several elements were removed from multivariate statistical analyses, as various processes can affect them during deposition and sample preparation, including CaO, P_2O5, Co, Ba, and Zr. As the thin–section analysis had already indicated that two closely related clay types were used for the production of most of these vessels, the geochemical analysis focused primarily on the rare earth elements (henceforth REE). These are ideal for geochemical fingerprinting in clays as they are largely immobile during low–grade metamorphism, weathering, and hydrothermal alteration (Rollinson 2003; Degryse and Braekmans 2014: 195). As such, REE values, more than other elements, are a good indicator of the original composition of the parent rock, even though REEs are generally enriched in argillaceous sediments, such as those used to make ceramics, relative to most types of rocks (Kabata-Pendias and Pendias 2001: 188; Aide and Aide 2012: 3). 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 + heavy REE totals and ratios were normalised using the values for chondritic meteorites as presented in Rollinson (1993).

Results of the Petrographic analysis

The petrographic analysis shows that two broad groups of petrofabrics were used consistently to produce the vast majority of the samples. The single largest group of samples was made utilising fabrics rich in argillaceous rock fragments (mostly shale). A smaller proportion of the samples were from vessels produced using coarse or fine calcareous fabrics. Though shale fabrics are more numerous among the samples selected for this study, and perhaps in EB II generally as suggested by both Greenberg and Porat for northern Palestine (1996) and at Tell Arqa Jean (this volume), calcareous fabrics are more common across much of the Central Levant during EB III (Jean, this volume, Badreshany and Genz 2009: 64 table 5, Greenberg 2000; Greenberg and Iserlis 2014:88-91; Griffiths 2006: 63). Within these two major fabric groups, several clay preparations and tempering practices (sub-fabrics) were identified.

Fabric group 1: The Shale Fabrics

The fabric group ‘shale fabrics’ (Fig. 5 and 6**)**, consists of a clay–rich matrix with a fine texture. The groundmass is mostly well-sintered, sometimes vitrified, and optically inactive. Elongate channel voids occur. The samples belonging to this petrofabric are composed of closely related materials but can be divided into six subfabrics depending on the frequency and grain size of either one, or a combination of, quartz and calcareous rocks. All samples belonging to this fabric contained fine-grained moderate to coarse sand sized shales (ARFs), which occurred moderately in the samples 10-25%. They were most commonly highly rounded and elongate, often containing silt to fine sand-sized quartz grains and sometimes carbonates and Fe-Ti oxide phases. They are most commonly Fe rich, but contain variable amounts of Fe. SEM-EDS analysis on a number of these samples indicated that an iron content of 5-10% is frequent. A lesser fraction of non-iron bearing shales, probably composed of kaolinite, can be found in some samples. These fragments can be identified as they are white even in partially oxidized or reduced zones. Overall, these shales are poorly compacted and poorly lithified, as further indicated by splitting that takes place along the long axis of many of the elongated ARFs. The elongated shales often show a preferred orientation. Well-rounded grains of quartz that were found in both spherical and more elongated shapes occurred occasionally to moderately in the shales.

Within the matrix of the samples, quartz most commonly occurs in silt to medium sand sized grains that are anhedral, although some larger grains do occur. Many samples contained larger fragments of quartz-rich sandstones. Pieces of micritic lime mudstone and siltstones occur in varying amounts but are generally rare (1-5%); they occur in medium or coarse sand sized grains. Some finer rounded grains of fine sand sized calcite occurred in trace amounts. Highly weathered basalts occurred rarely in a few samples from the Biq'a. Rounded anhedral grains of microcline also occurred in trace amounts in some samples, as did rounded grains of zircon and tourmaline.

Subfabrics of the Shale Fabrics

A number of subfabrics of this group could be distinguished (Figs. 5 and 6) although only two of these, 1B and 1D, contained a significant number of samples. Subfabric 1A only contained 1 sample, presenting a highly sintered fabric composed almost entirely of shale with very little quartz or calcareous material. Twenty-three samples belonged to subfabric 1B, which was distinguished by the presence of some fine to moderate sand-sized quartz (1-3%) and infrequent medium sand-sized limestone (<1%). The shales in these samples are mostly clay rich, rarely containing quartz or carbonate material. Three samples belonged to Fabric 1C, which is differentiated from 1B by the presence of medium and coarse sand sized limestone fragments (1-3%). Subfabric 1D, the most common, contained thirty-two samples. 1D is differentiated from the other samples of this group by the presence of frequent silty to fine sand-sized, sub-angular quartz grains (15-20%); infrequent medium sand-sized limestone also occurs (<1%). The shale fragments of this group often contain quartz similar in composition and concentration to the matrix. Eight of the nine seal impressed sherds that were examined, were made using this fabric. Five samples belonged to subfabric 1E and three samples belonged to 1F. These subfabrics differ from 1D in that they contain medium (1E) and coarse sand sized (1F) limestone fragments (1-3%); limestone is more frequent in 1F than in 1E. In northern Palestine, cylinder-seal impressed sherds are made predominantly of shale-derived fabrics

(Greenberg 2001: 185). If the same pattern holds in Lebanon, (which is what our petrographic analysis suggests), then on the basis of the stratified evidence from Tell Arqa (Jean this volume) like the use of shale fabrics and the production platter bowls, the production of seal-impressed jars should be concentrated chronologically in EB II. Other vessel types, however, occur in both shale and calcareous fabrics.

Figure 5 Images and Photomicrographs of the samples of shale derived fabric 1A-E in Plane Polarized Light (PPL) and Cross Polars (XPL). Field of View is 2 x 2 mm for each photomicrograph. Ceramic sherds are 1:4 scale.

Figure 6 Images and Photomicrographs of the samples of shale derived fabric 1F and calcareous fabrics 2A-D in Plane Polarized Light (PPL) and Cross Polars (XPL). Field of View is 2 x 2 mm for each photomicrograph. Ceramic sherds are 1:4 scale.

Figure 7 Images and Photomicrographs of the samples of calcareous fabrics 2E and F in Plane Polarized Light (PPL) and Cross Polars (XPL). Field of View is 2 x 2 mm for each photomicrograph. The sherd Tell Koubba II 2007-1 is in 1:4 scale and the sherd FAD09.290/295.285.4 is in 1:9 scale.

Fabric Group 2: The Calcareous Fabrics

As with the shale fabrics, the samples belonging to the calcareous fabric were mostly composed of a similar suite of non–plastic inclusions, but six sub–fabrics (A-F) could be differentiated by an increasing degree of coarseness, and variations in quartz and calcareous minerals (Fig. 6 and 7).

All samples of this fabric are composed of a clay-rich groundmass rich in microcrystalline calcite that in most cases has an optically active crystalic b–fabric. Less commonly a highly sintered optically inactive fabric is noted, indicating a relatively high firing temperature.

The samples are composed of a clay-rich matrix with elongate and channel voids which occur rarely. The aplastic inclusions are always poorly sorted but can exhibit a bimodal distribution. The grains exhibit a high to moderate sphericity. Larger grains are sometimes subangular. Rarely grains occur that are elongated. Pieces of carbonate rock, micritic mudstone (dunham classification) or fossiliferous chalks occur occasionally to moderately (10-20%) in the samples. Rounded to subangular fine to coarse sand sized grains of quartz with a moderate to high sphericity occurred occasionally to moderately in the samples (10-20%). Quartz most commonly occurs in fine to medium sand sized grains that are anhedral. Most carbonate rocks found among the samples contain some fossils. They occur in fine to coarse sand sized grains. Rarely, examples are found that are silty in texture. Medium to Coarse sand-sized grains of cryptocrystalline rocks, including chert, and discrete bodies dominated by phyllosilicates (in some cases kaolinites as determined by EDS) occurred rarely. Sandstones and rounded grains of fine sand sized calcite occur rarely. Silt to medium sand sized planktonic foraminifera are found occasionally (1-3%) in the clay matrix and appear similar to those found in pieces of fossiliferous limestone (chalk). The fossils often contain sparites. The overwhelming majority of microfossils in the samples represent various species of the Genus *Globigerina* (Fig. 8). Expertise is currently being sought to help identify the commonly occurring species. Individual grains of dolomite occurred rarely in some samples. Trace amounts of microcline are noted. Fine-grained moderate to coarse sand sized shales and other discrete iron oxide bodies occurred rarely in the samples. They were most commonly elongate and highly rounded. They often contain coarse silt sized quartz and carbonate grains. Trace medium sand-sized Fe-Mn bodies (as determined by EDS) with pisolithic textures occurred in some samples. Finally, trace amounts of silt-sized grains of zircon occurred in some samples.

Figure 8 SEM micrograph of microfossils in the genus *Globigerina* in a chalk fragment. Koubba II 3002-1

Subfabrics of the Calcareous Fabrics

The lines dividing the sub–fabrics (A-F) are less clear than those of the shale fabrics and they should be seen more as points along a continuum, rather than as distinct classes. These sub–fabrics overlap chronologically and crosscut vessel typology. The samples of calcareous fabric were more evenly distributed across the sub-fabrics than were the shale dominated examples; this suggests that the former represent more diverse production modes.

Ten samples belonged to subfabric 2A, distinguished by the presence of sub to well-rounded, moderate to coarse sand-sized quartz (10-15%), and moderately occurring sub to well-rounded medium to coarse sand-sized limestone (10-15%). The limestone is generally not fossiliferous. Ten samples belonged to subfabric 2B which differs from 2A by exhibiting fossiliferous limestones (sometimes chalk). The single seal impressed sherd that occurred in a calcareous fabric belongs to subfabric 2B. Fourteen samples belonged to 2C which is composed of fossiliferous limestone as 2B, but is finer grained, containing fine to medium sand sized quartz (10-20%). Only four samples belonged to subfabric 2D. 2D, like 2C, is composed of fine to medium sand sized quartz (10-15%), but contains fewer limestone grains (1-9%) and these are generally not fossiliferous. Six samples belong to subfabric 2E which, like 2C and 2D contains fine to medium size quartz. 2E, however, mostly presented medium to coarse sand sized sub-angular to angular euhedral grains of calcite (10-20%). One sample from the 2E fabric (3012-2) contained large grains of quartz as in 2A and 2B, and less calcite (3-5%). The samples were generally fossiliferous and contained a few fossiliferous limestone grains. Lastly, only one sample (FAD09.290/295.285.4) belonged to 2F. Subfabric 2F appears similar to subfabric 2D but contains coarse sand-sized grains of basalt (1-3%) and medium to coarse sand sized grains of chert. The basalt indicates the samples were probably not produced on the north Lebanese coast, anywhere south of Tripoli. In fact, FAD09.290/295.285.4 is a Middle Bronze Age jar with wavy line decoration. The fact that the fabric of this MBA sample differs markedly from all of the EBA fabrics that we observed from sites in this area, is intriguing. While we present here only a single sample, the analyses of additional Middle Bronze Age ceramics from Fadous-Kfarabida, which is planned for the near future, will help clarify to what extent there were significant changes in ceramic production and exchange between the Early Bronze Age and the Middle Bronze Age on the Lebanese coast.

Results of the Geochemistry

As would be expected, the samples from the shale derived and calcareous fabrics groups, exhibited significant chemical differences. This required separate PCA's to be run for each group. Three components were extracted in each PCA cumulatively explaining 82.4% of the variation in the dataset for the shale fabrics (Fig. 9) and 79.3% of the variation in the dataset for the calcareous fabrics (Fig. 10). The loading plots associated with the both PCA analyses showed that the REE had the most impact on the variability between samples of both groups.

The results of the ICP analysis generally reinforced the petrography and in some cases provided data that allowed for the identification of subgroups that were not distinguishable using optical mineralogy alone. The geochemical results for both the shale and calcareous petrofabrics show that a significant number of samples belong to large groups composed of ceramics from multiple sites and areas, which should indicate centralised production modes and wide distribution. A proportion of the samples analysed fall into geographically related groups, indicating the simultaneous presence of regional modes of production and distribution. For the most part, neither temporal, stylistic nor decorative groupings could be distinguished conclusively with regard to the shale and calcareous wares. The exceptions were the seal impressed sherds, which almost exclusively belong to the shale petrofabric 1D, though one sample from Tell Fadous-Kfarabida was made using a calcareous fabric (2B).

A close examination of the results combined with a two-step cluster analysis allowed for the delineation of three distinct shale geochemical groups and five distinct calcareous chemical groups. The shale samples were enriched in REE relative to the calcareous samples, which is to be expected as shale tends to contain higher levels of REE compared to limestone (Kabata-Pendias and Pendias 2001: 188). The shale samples tend to exhibit higher LREE to HREE ratios than do the calcareous samples. This indicates a greater degree of fractionation for the HREE fraction in former. Lastly, the shale samples are relatively enriched in aluminium compared to the calcareous samples perhaps indicating that the former are more clay rich or composed of different types of clays than the latter.

Geochemistry of the Shale Fabrics

The first and largest geochemical group (group A) is composed of combed and uncombed jars, pithoi, and platter bowls from sites on the Lebanese coast, Biq'a, and Jordan Valley. This group also included all of the seal impressed sherds, except the one sample made in a calcareous fabric. These samples belonged mostly to the subfabric 1D dated to both the EB II and III. Subfabric 1D, characterised by frequent silty to fine sand-sized quartz, represents an idiosyncratic petrofabric and, as the results indicate, a unique geochemical signature. The petrography and geochemistry indicate the material used to produce the group A samples is likely to have shared a geographic origin. The chemistry of the Group A vessels is characterised by a general enrichment in Fe and the REE relative to other samples. The ratio of LREE to HREE is always below 3.5 indicating less fractionation of the HREE relative to samples from group B.

The group B samples, also encompassed jars, uncombed, and platter bowls but in this case are mostly from the Biq’a dating to the EB II-III. The samples almost all belong to the 1B petrofabric. These samples can be distinguished from others by low levels of calcium (<5.00 wt%) and mostly lower levels of REE compared to the samples from other shale derived groups. Though the samples from this group appear quite scattered on the PCA, the all demonstrate quite high ratios of LREE to HREE (> 3.5), indicating a greater degree of fractionation of HREE compared to the samples from other groups.

The group C samples are composed of combed jars and pithoi, and two bowls dating to the late EB II and III. The samples originated mainly from the northern Lebanese Coast, with one sample from the central Lebanese coast and one from the Jordan Valley. The samples almost all belong to the 1B petrofabric, with one belonging to the 1C petrofabric. These samples can be distinguished from groups A and B by fairly high levels of aluminium, iron, and magnesium. Additionally, the samples of group C mostly exhibit lower levels of REE compared to group A examples, although they have similar LREE/HREE ratios (<3.5). The one sample from the Jordan Valley, Zeraqon Fn034-2, has a slightly different fingerprint from the other samples. While, Fn034-2 has a similar REE pattern to the other samples from group C, the major elements are significantly different. Whether Fn034-2 shares a geographical origin with the other group C samples, is unclear at present. The analysis of more samples from Zeraqon planned for the near future may elucidate further the relationship between shale derived samples from the Lebanese coast and the Jordan Valley belonging to this chemical group.

The remaining shale derived samples should be seen as outliers, that, while certainly related to the other samples, do not easily fit into the main groupings. The samples on the right of the graph are enriched in REE relative to those on the left. The samples from the Lebanese coast, Jordan valley, and a few from the Biq'a fit the LREE to HREE ratio of the main group (A). Most of the samples from the Biq'a, however, fit the LREE to HREE ratio of those from group B. Three samples, one from the Koubba on the Lebanese coast (093) and two samples some from Zeraqon (M2Fn027-2) and Abu Kharaz (B9L220N848) in the Jordan Valley are a closer fit with the LREE the HREE ratios exhibited in group B.

Figure 9. Plot of the factor scores generated from the principle components analysis of the chemical data generated by ICP-AES and -MS for shale fabrics sorted by petrofabric and region. Factor 1 explains 67.6% of the variation and factor 2 explains 14.8%.

Geochemistry of the Calcareous Fabrics

Although the calcareous samples available for study originate from one area, the Lebanese coast, they showed more chemical variability than the shale derived fabrics, forming five distinct geochemical groups (D-H). The first and largest group, group D, contains samples of combed and uncombed jars, from Byblos, Fadous-Kfarabida, and Koubba. This group also included the one net-pattern seal impression in a calcareous fabric. These samples belonged mostly to the subfabric 2B, examples of which are generally coarse and composed of chalk. The samples dated mostly to the EB III. The chemistry of the Group D vessels is characterised by a relative enrichment in metals such as iron and titanium and a moderately high level of REE compared to other calcareous samples. The ratio of LREE to HREE in most of the calcareous samples is below 3.0 indicating less fractionation of the HREE in comparison with shale examples. The seal-impressed sherd shows a slightly different chemical pattern as it is enriched in REE relative to the other group D samples, and could be made of different, but geologically related, materials, or have a different preparation not apparent in this thin-section. The chemical differences are not easily explained given the available evidence, and it seems possible that the seal-impressed vessel stems from a production that though related, was perhaps distinct from the others.

Group E, contains samples of combed jars and one pithos, from Byblos, Fadous-Kfarabida, and Koubba. These samples belonged a mix of fabrics 2A, 2B, 2C, and 2D dated mostly to the EB III. They differ from the group D samples by being lower in Iron and other metals, though the REE values and ratios are very similar to group D samples. Group F, is composed of four samples from Byblos and one from Fadous-Kfarabida, all combed jars. These samples belonged exclusively to fabric 2A, and are mostly of an uncertain EB II-III date. The Group F samples exhibit a similar pattern of the major elements to those of group D, but are much less enriched in REE. Samples of the 2A petrofabric are composed mostly of micritic limestones rather than chalk. Limestones are known to be lower in REE overall (Rollinson 1993: 145) compared to chalk, which might explain the lower values in the group F samples compared to those of groups D and E. Group G, is composed entirely of EB III combed jar or vat samples from Koubba II belonging to the 2C and 2E petrofabric. The 2E petrofabric is calcite tempered, perhaps providing some explanation for the chemical differences found in this group. Group G samples are lower in aluminium, magnesium and iron relative to other groups, although they show similar REE values to the group F samples. The group H samples are composed entirely of EB II-III combed jar or vat samples from Byblos and Koubba belonging to the 2C petrofabric. The samples in this group are the highest in aluminium and a number of other elements including iron, titanium, and, manganese. The group H samples are enriched in REE relative to those from other groups. The 2C petrofabric is finer grained than the other petrofabrics, which along with the high aluminium values indicate that the samples are relatively clay rich which might explain the higher REE values. The LREE to HREE ratios, however are similar to all of the other samples perhaps reflecting the use of similar materials for samples from all of the calcareous geochemical groups.

One sample from Fadous-Kfarabida (FAD09.290/295.285.4) was a chemical outlier with by far the lowest overall REE values. This sample is a jar with a wavy coming pattern dating to the MB I. This sample was the lone example belonging to the 2F petrofabric and contained grains of basalt, indicating it was probably imported to the area, thus explaining why it produced a different geochemical fingerprint. The strong chemical variation between this sample and those from the Lebanese coast highlights the closely related nature of the calcareous samples from the area in terms of chemistry and material preferences. Though the analysis indicated that there are differences between the groups outlined above, they are relatively minor.

Figure 10. Plot of the factor scores generated from the principle components analysis of the chemical data generated by ICP-AES and -MS for calcareous fabrics sorted by petrofabric and site. Factor 1 explains 63.6% of the variation and factor 2 explains 15.7%.

Review of the Evidence

The petrographic analyses demonstrates that the potters of the EB II and III in the central Levant, over a period of perhaps hundreds of years, consistently utilised closely relate recipes of clays, to create fine-ware platter bowls and combed, uncombed, and seal-impressed jars, vats and pithoi.

Two broad groups of EB II-III fabrics have been identified from several sites in North Lebanon, one shale-rich, the other calcareous. At Tell Arqa, the shale-rich petrographic Groups 5 and 6 were restricted to Phase T (EB II) and were largely replaced by calcareous fabrics in EB III (Jean this volume). At Tell Koubba the shale-rich ceramics come from pit fills in Area I and include forms such as platter bowls, that at Arqa are restricted to EB II (Thalmann 2016: 34, Pl. 1-2). In contrast, this vessel form is very rare among the assemblage from Koubba II which is located ca. 400 m to the east, and which shows many features in common with the published EB III pottery from Tell Faddous-Kfarabida, and among which calcareous fabrics predominate[1]. In the Biq'a, where the evidence is mainly derived from surface finds, calcareous fabrics seem to be used infrequently to make combed or uncombed jars, pithoi, and vats (Badreshany 2013: 526-527), and it is possible that the shale fabrics were in use throughout the EB II and III. That said, this picture may change with the excavation of well-stratified material.

Turning to the wider region, shale vessels comprise between 85% of the total EB II assemblage at Tell Dan (Greenberg and Porat 1996: 11) to perhaps 40-60% in the Biq'a and the Lebanese coast (Badreshany 2013: 528; Doumet-Serhal 2006: 61-63). although not all of these belong to a single petrofabric. At Arqa, the majority of

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[1] The material from Koubba is currently under study and will be presented in detail in a forthcoming issue of BAAL.

EB II vessels are produced in shale (Jean, this volume).

Secondly, during neither phase of production were the shale or calcareous fabrics uniquely associated with jars. Rather at both Koubba and Arqa (Jean his volume), they were used for the production of a wide range of vessel forms (with the exception of cooking pots), confirming that combed jars were simply one component within a larger ceramic industry.

While there were some typological changes between the EB II and EB III assemblages, such as the disappearance of platter bowls at Arqa (Thalmann 2016: 45) and Koubba (Philip *et al*. forthcoming), these were relatively modest. A recent analysis of the technology of the EB II-III pottery from Tell Arqa (Roux and Thalmann 2016: 117-118), argues for marked continuity between the two periods in terms of the preferred *chaînes opératoires*, a characterisation that is broadly confirmed by the unpublished data from Koubba. This suggests that we are dealing with a shift in the locus of production, or the choice of clay-sources, rather than a wholesale replacement of one ceramic tradition by another.

A combination of petrography and geochemistry has revealed that both the shale and calcareous industries involved a number of chemically-distinct clays. This view is also supported by the evidence from Tell Arqa (Jean, this volume). Thus there are grounds to believe that in both cases, multiple clay sources, and probably multiple production centres, were involved.

Nature and Distribution of shale-rich outcrops

Figure 14 geological map

The geographic origin of the vessels made of the shale derived fabric, an idiosyncrasy of the Early Bronze Age, has been much discussed (Badreshany 2013: 495-96;

Greenberg and Porat 1996; Griffiths 2006). Shales of the type that dominate in petrofabric 1 are only found in large quantities in Lower Cretaceous outcrops associated with basal sandstones in the central Levant (C_1 of Dubertret – see Fig. 11). Lower Cretaceous shales are widely distributed in the Lebanon and Anti-Lebanon mountains, and in surrounding areas, making the provenance of the shale derived petrofabrics difficult to assess without concentrated field work. The 1D fabric, with its distinctive quartz profile, might be linked with a particular location, although the political situation at present makes geoprospection in some of the areas where these shales outcrop difficult. Significantly, the shale outcrops are often located quite some distance from the known areas of major settlement, such as the Lebanese coast and Biq'a Valley. On the coast, the area around Beirut is the only place, where shales of this type were available in significant quantities, though this is hard to confirm, given the extent of recent urbanisation in the area (see Attieyh 1986 for locations of shales in the mountains surrounding Beirut). In the Biq'a, the only outcrop near major concentrations of settlement along the valley floor is close to the town of Zahla in the central valley. Lastly, shale outcrops are found in the southern extent of the Anti-Lebanon range, north of Tel Dan.

The shale outcrops and their utility for modern ceramic production was studied in detail by Atiyyah (1986), who showed that those in Lebanon dated to the Upper Jurassic and Lower Cretaceous, are found near each other, and in similar facies stratigraphically, as they were formed under similar conditions. Shales dating to the Lower Cretaceous, however, are more common than those dating to the Jurassic. The study also showed many variations in these outcrops, including differences in the overall calcareous content. These variations are, in some cases, found in close geographical proximity, which could account for the differences in calcareous content found in the different shale petrofabrics. While clay mixing or tempering practices cannot be discounted as the cause of these differences, Atiyyah's work shows that they could possibly be explained by the natural composition of the shales.

The shale outcrops also differ in clay mineral content and level of lithification. Most of the shales are a mixture of at least two different types of clay minerals, and it is more accurate to refer to a dominant clay mineral when describing them. Atiyyah found that the majority of the Lower Cretaceous shales were mixtures of illites and kaolinite. The representation of each mineral varied from roughly 30% to 70% depending on the sample. The colour of the shales is related to their composition, with illite-rich shales brown in colour and Kaolinite-rich shales greyish (Atiyyah 1986: 67-70). In addition, many shales are poorly compacted and so easily extracted for use in the modern ceramics industry. Poorly compacted shales were specifically noted as the raw material used to produce the shale-rich Fabric Group 1, as defined at Sidon (Griffiths 2006: 283). This suggests that ancient potters would have been able to identify, select and extract shales known to have desirable properties.

Technologically, the use of a shale, (especially the 1D fabric with its silt and fine-sand sized quartz rich fabric) would have been ideal for the creation of a hard and durable vessel. The Lower Cretaceous shale-derived fabrics, especially those with a higher kaolinite content, would shrink less on drying, lowering the danger of mechanical damage after the formation of a vessel, and ensuring that vessels would dry and fire to a consistent and predictable size. In addition, shale-derived fabrics, unlike the calcareous fabrics, would behave similarly during and after firing regardless of temperature and relative humidity, because alterations due to the decarbonation/rehydration reaction would not take place due to the general lack of

$CaCO_3$ (Shoval 1988; Badreshany 2013: 551). Clays that would provide these properties would be attractive to potters in larger-scale modes of production.

Based on the vitrification of the groundmass in a few samples, it is possible to suggest that the firing temperature exceeded $800^{o}C$ in some cases (Quinn 2013:191). However, many samples exhibited an optically active groundmass, typically consistent with a lower firing temperature (Quinn 2013: 190). Thus while the samples were mostly well–fired, only a small proportion were fired to high temperatures. The shale derived wares examined here, were not always highly-fired and did not always make a distinctive 'ping' when struck, indicating the term 'Metallic Ware' may not be appropriate to describe the shale derived phenomenon as a whole.

Implications for Archaeology

Vessels made of this clay could, in theory, have been produced in a number of locations, a point that is consistent with the variability shown by our geochemical and petrographic data. It seems clear from the geochemistry, however, that at least some variants were produced using a particular outcrop, the location of which remains uncertain. Future geoprospection should first be targeted on areas where these outcrops are located close to known areas of dense settlement as these areas may be the most efficient location from a logistical standpoint for the location of a large-scale production or clay-mining operation, that was designed to supply vessels to Early Bronze Age population centres.

From the perspective of the shale-rich wares, several key points emerge from the evidence presented above.

(1) There is a difference between they clays that predominate among ceramic assemblages from sites in the Biq'a Valley (Petrographic Group 1B, Geochemical

Group B is thus far only confirmed at sites in in the Biq'a) and those from sites in coastal Lebanon, and the Jordan valley (Petrographic Group 1D, Geochemical Group A).

(2) All but one of the sherds bearing seal impressions were assigned to the 1D fabric with its distinctive fine quartz composition, and formed a single geochemical group. Given the strong association between seal-impressed jars and the 'North Canaanite Metallic Ware' as identified at sites in northern Palestine and Jordan (Flender 2000; Greenberg 2001), we might suspect that this group represents a particular clay source that was closely involved in supplying pottery to sites in that area, and to the Lebanese coast. The situation could be clarified by geochemical analysis of examples of NCMW material from Palestine and putative clay sources. It is worth noting, however, that none of the shale ware samples from the sites on the Lebanese coast produced a good chemical fit for the REE profile of group B vessels from the Biq'a valley.

(3) The presence of a several different petrographic groups among the shale wares, a phenomenon also noted at Sidon (Griffiths 2006: 283-286), suggests either the use of multiple of clay sources, or a degree of mixing by potters of their raw material. This being the case, we might suspect that the examination of a larger sample of ceramics, drawn from a wider range of sites, would demonstrate that the production and distribution of shale-wares is considerably more complex than has hitherto been believed.

Greenberg and Porat (1996), argued that the spatial patterning of what they termed NCMW vessels across northern Palestine and Jordan could be best explained as the results of production at, and distribution from a single location at the southern end of the Anti-Lebanon range. This idea gained support from the fact that these hard-fired, thin-walled vessels were both robust and relatively light, and thus well-suited to transportation. However, the petrographic and geochemical data presented above , and in particular the presence of shale-rich pottery at sites in the Biq'a that is distinct from that occurring in North Jordan and on the Lebanese coast, points to the existence of multiple production centres.

Secondly, the transport of vessels might have been feasible across the limited area of northern Palestine / Jordan defined by Greenberg and Porat (1996), which extended no more than 70 km from their posited production centre at the southern end of the Anti-Lebanon range. However, it is less clear how such a model could explain the presence of shale-rich ceramics, that are petrographically and geochemically similar, at sites in the north Jordan Valley, the north Jordan plateau and northern Lebanon (a distance of around 200 km), as this would have necessitated the transport of large quantities of finished pottery across some very challenging topography.

The alternative is to suggest that it was not the vessels but the clay that was transported, and that we are dealing with itinerant potters (see Alden and Minc [2016] for a recent treatment of the practice in a Near Eastern context). Water makes-up around 25-30% of the weight of moist clay, while the movement of dry, powdery clay in sacks or baskets is not in itself difficult. In terms of transport, the donkey had been domesticated by EB I (Milevski 2011: 177-197, 2013: 200), and there are examples of donkeys carrying what appear to be baskets, from EBA contexts at sites producing shale-rich pottery such as Khirbet ez-Zeraqon (Ajlouny *et al.* 2012, Cat. Nos. 1.3) and Tell Dan (Greenberg and Porat 1996: Fig. 4.3). In the latter case the figurine was itself made in NCMW. Given its load capacity of around 60-65kg, a typical donkey could have carried enough dry clay to produce around 90 kg of moist clay if water was added at the point of use, a quantity sufficient to produce at least 10-15 jars 60-80 cm high, with a capacity of 30-40 litres – more if local clay or a higher amount of temper were added as is suggested by this study. We therefore suggest that it was not finished vessels that moved across the landscape, but potters and their shale-rich clay.

This view is supported by several pieces of evidence:

(1) The use of a high-fired, hard fabric which permitted vessels to be strong while thin-walled and thus light, has been used as an argument in favour of the transportation of vessels (Greenberg and Porat 1996: 10). However, this construction would also have served to reduce the amount of clay required to produce each pot, thus allowing potters to use their clay in the most economical manner, an obvious concern for potters travelling with their raw material. A comparison between NCMW vessels from Palestine, with the products of the contemporary local ceramic industry at sites like Khirbet Kerak, which are made in softer fabrics with thicker-walls, (Greenberg and Iserlis 2014: 63-66) underscores this contrast.

(2) The high level of standardization seen in the shale-rich vessels, and the limited range of surface decoration either burnishing or combing (Roux and Thalmann 2015: 102, Table 2; Jean this volume) – might simply reflect a desire by itinerant potters to minimize the effort that would otherwise have been spent sourcing, preparing and applying pigments. From an 'economy of effort' standpoint, a form of surface treatment that is applied directly to the vessel surface, with no need for additional materials, makes sense. Minimizing such additional work would have allowed the potters to concentrate their on-site time on the essential tasks of clay preparation, vessel formation and firing. Once again, the comparison with the locally-made ceramics identified at sites

like Khirbet Kerak, which often bore red slip with the addition of radial burnish on the interior of open vessels (Greenberg and Iserlis 2014: 63-66), is enlightening. The use of combing on jars might seem to contradict this, but this would have been a relatively quick process, that also rendered the vessels highly distinctive. Moreover, the appearance of combing on both jars and vats, might point to a close connection between this surface treatment and vessels associated with the production and storage of high-value agricultural products.

(3) The presence of a number of over-fired and misshapen sherds among the shale-rich pottery recovered from Tell Koubba I (this material is currently under study by Dr Michel de-Vreeze), where there is no nearby shale source, also points in the direction of the transportation of clay and local firing as it would have made little sense to transport second-rate vessels over long distances.

(4) Finally, the existence of shale-rich fabrics that are relatively ‘pure’ and others that contained a range of inclusions, such as quartz and limestone, as demonstrated among the samples examined here, at Tell Arqa (Jean this volume) and Sidon (Griffiths 2006), might indicate that in some cases locally-sourced material was added to non-local shale-rich clay, presumably to make the raw material go further. It seems reasonable to assume that the specialist potters would have had a good understanding of the materials available in different localities, and in what quantities these could be added to shale-rich clay without impacting too much on product quality.

In our view, the remarkable characteristics of the shale-rich wares identified at sites in coastal Lebanon can be best explained as the result of production by mobile potters who brought a supply of clay with them. We therefore suggest that the wide distribution of these wares, including their presence at sites located at some distance from suitable clay sources, indicates the operation of a network of itinerant potters, travelling with donkeys carrying baskets of dry clay. It is possible that clay was but one element that was transported through developing upland-lowland transport networks. We would also suggest that the potters were based within easy reach of the shale outcrops and had developed their skills within communities in that region. However, as shale-rich clays outcrop at a number of locations throughout the Lebanese mountains (Fig. 11) and in areas where there has been little archaeological fieldwork so far, it is not currently possible to be more precise.

Aspects of vessel production such as the high degree of standardization, the relatively limited range of forms, and lack of attention to decoration has been viewed as one component within a new urban 'package' characteristic of EB II communities in the southern Levant (Greenberg 2011: 238; Greenberg and Paz 2014: 24-39; Paz and Greenberg 2016: 200) to which concepts such as simplicity and uniformity were integral. However, it is possible that in the case of the pottery at least, we are seeing less a collective ideology, than the practical requirements of itinerant potters.

The close connection between seal impressed vessels and shale-rich fabrics noted from sites in Palestine (Greenberg 2001) has now been extended to coastal regions of Lebanon. As sealing took place prior to firing it was clearly an element of the manufacturing process. As only a minority of such jars were marked by a seal impression (Genz 2002; Greenberg 2001: 193), there has been considerable speculation as to what the information impressions were intended to convey (Flender 2000; Greenberg 2001; Thalmann 2014). However, if the jars were produced by mobile potters working close to the markets, rather than in fixed workshops, a different set of considerations emerges. For example, given that the vessels concerned were mainly intended for the *in-situ* storage of valuable commodities, it may not have been necessary to mark every vessel formed within a single episode of production. Thus, the application of a seal to one vessel within a batch, may have been sufficient to serve as some kind of 'brand indicator', that is a mark that could convey not just ownership but also notions of authenticity and quality control (Wengrow 2008). The presence of cylinder seals at EB III Faddous-Kfarabida (although not of the kind used to mark pottery), confirms that sealing was a concept familiar in the region during the EBA (Genz *et al*. 2011: 158-161; Genz *et al*. 2016: 86, Fig. 8). An alternative is that the seals were in some way associated with the needs of the customers for whom these vessels were made,. In that case the argument that jars bearing seal impressions might have been accorded some treatment that marked them out as suitable for a specific (not necessarily mundane) purpose is also worth considering (Greenberg 2001: 193; Thalmann 2014). This would be make particular sense if vessels were produced, not at distant locations, but close to the point of purchase, allowing a seal to be applied in direct response to the requirements of individual buyers.

Figure 11 General Geological Map of Lebanon after (Dubertret 1955, scale: 1/200000)

Calcareous Wares - discussion

The characteristics of the majority of the calcareous fabrics are consistent with clays formed on the Jurassic to Upper Cretaceous Limestones and chalks found in northern Lebanon, the (N_2) formation as described by Dubertret (1955 1975) and Nader *et al.*(2006). These outcrop extensively to the north and east of Byblos, Fadous-Kfarabida, and Koubba. It is therefore reasonable to suggest the Early Bronze Age

Combed-Ware vessels made of calcareous fabrics were produced somewhere in the area containing these three sites. A study by Nader *et al.* (2006) of the Cenomanian platform carbonates in the area surrounding Byblos showed that they are composed of micritic and biolcastic limestones identical to those observed in thin-section. These limestones, unfortunately, are among the most common in the Lebanon and outcrop widely making it difficult to suggest a more precise locus for the clays used to create these vessels. Areas of Byblos and Koubba are closer to major chalk outcrops (M2 or $C4_d$ or C6 formation of Dubertret), which can be expected to contain a greater number of foraminifera (Dubertret 1955 and 1967 and Badreshany and Genz 2009), than Fadous-Kfarabida. Still, materials consistent with those observed in thin-section could occur, in theory, in the vicinity of all three sites and it is not possible to pinpoint a production area within this subregion. A programme of geoprospection planned in the near future should help isolate clay outcrops that are close petrographically and, perhaps of more value, geochemical matches. The addition of vessels from other areas, such as Arqa and its hinterland, might help further to pinpoint source areas.

The calcareous fabrics are also spread throughout the study area in what might comprise an interaction zone, comparable to that documented for the Biq'a on the basis of shale wares. Most of the geochemical groups identified within the calcareous fabrics included samples of pottery collected at more than one site, indicating that pottery was widely distributed within the subregion and perhaps produced using centralised modes. These fabrics were produced using raw materials consistent with those available on the northern Lebanese coast, and are likely to represent a local coastal industry. The full extent of the distribution of these coastal calcareous fabrics remains unclear, because for this samples were available only from Byblos, Fadous-

Kfarabida, and Koubba. A project is currently underway to extend the study northward to include to material from Tell Arqa and Anfeh (Badreshany, Jean, and Philip *in prep),* which will help better define the northern extent of EB II-III economic interaction spheres on the Lebanese coast. While the location of the production centres remains uncertain, the movement of ceramics between these the three sites, located 15-20 km apart, provides physical evidence for a high degree of economic integration within the this part of the coastal plain during the EB III. This evidence appears consistent with the posited EBA polity centred on 'Byblos', and of which sites like Fadous-Kfarabida, and perhaps also Koubba were secondary centres. (Genz 2016: 112)

Levantine Combed-Ware in its regional context: putting together the pieces

Ceramic change and the political economy

Our analysis has demonstrated the existence at sites in Lebanon of two broad ceramic fabrics during the EB II and III. The earlier (broadly EB II) of these consists of shale-rich pottery. Within this we have identified two main petrographic and geochemical groups. One of these is centred upon sites in the Biqa‘ Valley and the other has a wider distribution appearing at sites ranging from northern Palestine /Transjordan to the coast of northern Lebanon. We argue that the second of these groups in particular is more likely to reflect the movement of potters and their clays than the large-scale transport of finished vessels as envisaged by Greenberg and Porat (1996). The evidence indicates that the tradition of vessels produced in shale-rich fabrics was largely replaced during EB III on the Lebanese coast (the situation in the Biq'a remains unclear), by vessels produced using locally-available calcareous clays (some Jugs that continue to be made in shale are the only known exception). The commonalities between the *chaîne opératoires* used in the EB II shale and EB III calcareous ceramic industries, that are documented at Arqa (Roux and Thalmann 2016) and broadly confirmed by the evidence from Koubba, (Badreshany *et al*. in prep.), would suggest that we are seeing less a major technological change, than a shift in the control of ceramic production, in which the manufacturing methods associated with the shale tradition were subsequently applied to clays available close to the coast. This we interpret as evidence for a shift in the control of ceramic production, away from mobile specialists with connections to upland areas, and towards potters with a similar technical background, but who utilised clays available in the coastal plain, and perhaps resided locally.

Given the connection between vessels such as combed storage jars and vats with products of economic value, such as olive oil, we see this as reflecting the desire of emerging coastal polities such as Byblos to bring the production and distribution of the ceramic containers, that served as the hardware of the local economy, under local control. Such a change might well mark the capture of ceramic production and distribution by an emerging regional political economy.

The timing of this change around the EB II/III transition (around 2800 BC), is broadly coincident with wider political and economic change, such as the emergence of local harbour centres such as Byblos, with its evident connections with Old Kingdom Egypt, and perhaps with the development of a tributary relationship between the site, and smaller sites on the coast as was recently argued by Genz (2016) for the case of Faddous-Kfarabida.

Comparison to Palestine

While sites in northern Palestine also show a shift from an EB II industry dominated by non-local shale-fabrics, to the local production of calcareous wares in EB III the situation differs from that in Lebanon. At sites in northern Palestine, the EB II NCMW industry was initially augmented, and subsequently replaced by a local ceramic industry, but without radical change to either the main forms produced, or the methods of production (Greenberg and Iserlis 2014: 59-60, 63-70). However, the local calcareous industry differs in several respects from the shale production with the locally-made vessels having thicker-walls, being fired at a lower temperature and having more emphasis on the use of red paint and burnish as surface treatments, thus moving away from notions of speed, standardisation and efficiency (Greenberg 2000; Greenberg and Iserlis 2014: 59-60) In Lebanon, the EB III calcareous industry retains many of the features of the earlier shale industry, suggesting that external circumstances, in particular the emergence of a distinct coastal political economy, militated against a decline in quality and standards of the kind seen in the southern Levant.

The contrast might neatly encapsulate the difference between the EB III in Lebanon and in northern Palestine. In the first case, we see an expanding economy with strong links to Egypt, underpinned by a developing tributary relationship between Byblos and smaller centres such as Koubba and Faddous-Kfarabida, the productivity of which was actively managed by the centre. The production and movement of ceramic containers was essential to this situation suggesting that many aspects of the pre-existing shale production were simply carried over a locally-controlled EB III ceramic industry. In contrast, in the southern Levant, the EB III is now understood as an episode of decline, characterized by a limited number of large fortified settlements, some occupied only sporadically, with the few sedentary villages to providing a little in the way of an agricultural hinterland, and whose leaders were focused mainly on internal rather than external interaction (Greenberg 2017). These characterisations are consistent with the differing patterns of ceramic change evident in the two regions through EB II and EB III.

Recently published pollen data from Tell Sukas on the Syrian coast (Sorrel and Mathis 2016: 866, Fig. 5) indicate a significant increase in *Olea* around 4600 cal. BP (2650 cal. BC). This would appear to indicate an intensification of olive horticulture in coastal Syria, that is broadly contemporary with the production of combed jars in calcareous fabrics in Lebanon, a development that we see as reflecting the growing control of polities in the coastal plan over the production of economically significant ceramic containers. A marked increase in *Olea* pollen during the early third millennium cal. BC was observed in a core from the Ghab region of the Orontes Valley (Yasuda *et al*. 2000: 133, Fig. 7); this may be related to the appearance of combed jars at sites such as Tell Mardikh and Tell Acharneh that was noted above. This ‘northern’ situation forms an interesting contrast to the apparent decline in the frequency in *Olea* between the later 4th and the 3rd millennia cal. BC that is apparent in a core taken from Lake Tiberias (Langgut *et al*. 2016: 126-7, Fig. 2), and which should reflect economic practices in the North Jordan Valley at that time. These differences may well be indicative of two regions – the coastal and inland regions of both Lebanon and western Syria on the one hand, and the North Jordan Valley on the other – that were differently engaged with the wider regional economy during the first half of the 3rd millennium BC.

Future Work

We have documented a considerable degree of commonality among ceramic vessels occurring at sites in the coastal plain from Byblos northwards. The next question is to ascertain the northern limits of this programme – through additional work on material from Anfeh and Arqa, and of course to explore the extent to which sites in the south such as Beirut and Sidon, were involved in these ceramic systems. Further work is required on material from the Biq'a, which in this case was restricted to sherds from surface collections, and which makes it hard to establish good chronological control. To make a very basic point, we now know that platter bowls drop out of the ceramic repertory at sites in northern Lebanon after EB II (Thalmann 2016; Jean this volume, Badreshany *et al*. in prep.), while they continue as an important element in ceramic assemblages in the Southern Levant. At present the lack of stratified assemblages from the Biq'a means that we do not know where the region sits within these divisions, nor what exactly the predominance of shale-rich over calcareous pottery present within current surface collections from sites in the Biq'a is telling us. This could indicate a sharp decline in settlement there after EB II, or it may be that production of the geochemically and petrographically distinctive group of shale-ware ceramics identified in the Biqa' continued rather further into EB III that was the case elsewhere in the central Levant, or it may simply reflect a bias in the material that is available from current surface collections.

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