The characterisation of ceramic production from the Central Levant and Egyptian trade in the Pyramid Age

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Keywords: Archaeological science; Geochemistry; petrography; Early Bronze Age Levant; Old Kingdom Egypt; Pottery; Social Complexity; trade

Highlights:

- During the 4th Dynasty of the Old Kingdom (c. 2613–2494 BC), Combed Wares and their contents were produced in the Levant and traded to Egypt
- In Egypt, these vessels were received as high-status objects associated with the palace economy and funerary assemblages of high officials

- A geochemical approach reinforces published petrographic results to show the jars likely originated in Northern Lebanon in the region of the important site of Byblos
- The findings suggest the vessels likely belonged to specialised workshop production made specifically for export to Egypt
- New light is shed on the origin and nature of the relationship between the Egyptian state and the polity of Byblos which endured for millennia

Abstract

A recent petrographic study of ceramic jars from Giza imported into Egypt during the 4th Dynasty of the Pyramid Age (c. 2613–2494 BC) identified the original production zone as the Lebanese coast generally between Beirut and Tripoli, including the region of Byblos. The jars and their contents were imported to Egypt by maritime trade expeditions conducted at the behest of the Egyptian state. This study analyses a selection of these ceramic samples using ICP-AES and -MS for comparison with published data from the region of Byblos. The results not only confirmed the underlying petrography, but together with new evidence from Lebanon suggests the vessels likely belonged to specialised workshop production in the Byblos environs and were made specifically for export to Egypt. The finding sheds new light on the relationship between the Egyptian state and the polity of Byblos in the Early Bronze Age, indicating the presence of standardised local production and commodity procurement mechanisms tailored to the needs of a large trade entity. This relationship in turn delivered

significant prestige and status to local elites in an environment of competitive local peer-polity interactions.

1. Introduction

During the Old Kingdom (c. 2686–2181 BC), the centralised state reached high levels of administrative capacity and control of economic resources. Strategic use of these resources enabled Egypt's kings to mount expeditions for the acquisition of commodities not available locally, such as silver, coniferous trees and aromatic oils. Egyptian texts and archaeological evidence indicate that this activity included mining expeditions for Sinai copper and turquoise, and maritime voyages to distant lands for the exotic products of Africa and Western Asia. That said, compared to later periods, the textual record of such activity is thin, with the result that archaeological data assumes the key role in piecing together the story of Egypt's interactions with its neighbours [1–3, 9-18, 36, 42, 57].

During this time, the Combed Ware jar is regarded as the primary ceramic container of Levantine trade [1–5, 69]. Produced across the northern and southern Levant (Fig. 1), 'Combed Ware' (hereafter 'CW') generally refers to large- and medium-sized jars, with flat bases and ovoid bodies, often, but not always, with two loop or ledge handles attached to the body, and bearing combing on the exterior and sometimes interior surface (Fig. 2a–b). With origins stretching back to c. 3200/3150 BC, it was manufactured with regional variations in size and fabric; in the central and northern Levant it continued in production until the end of the third millennium [4–5]. The type reached its zenith as the dominant imported ceramic container during the Old Kingdom (OK), where they are found mostly in

4th to 6th Dynasty tombs, c. 2613–2181 BC, coeval with the Central Levantine Early Bronze Age (EB) III and IV/Early Central Levant (ECL) 4–5 (c. 2700–2250 BC) (Fig. 3).

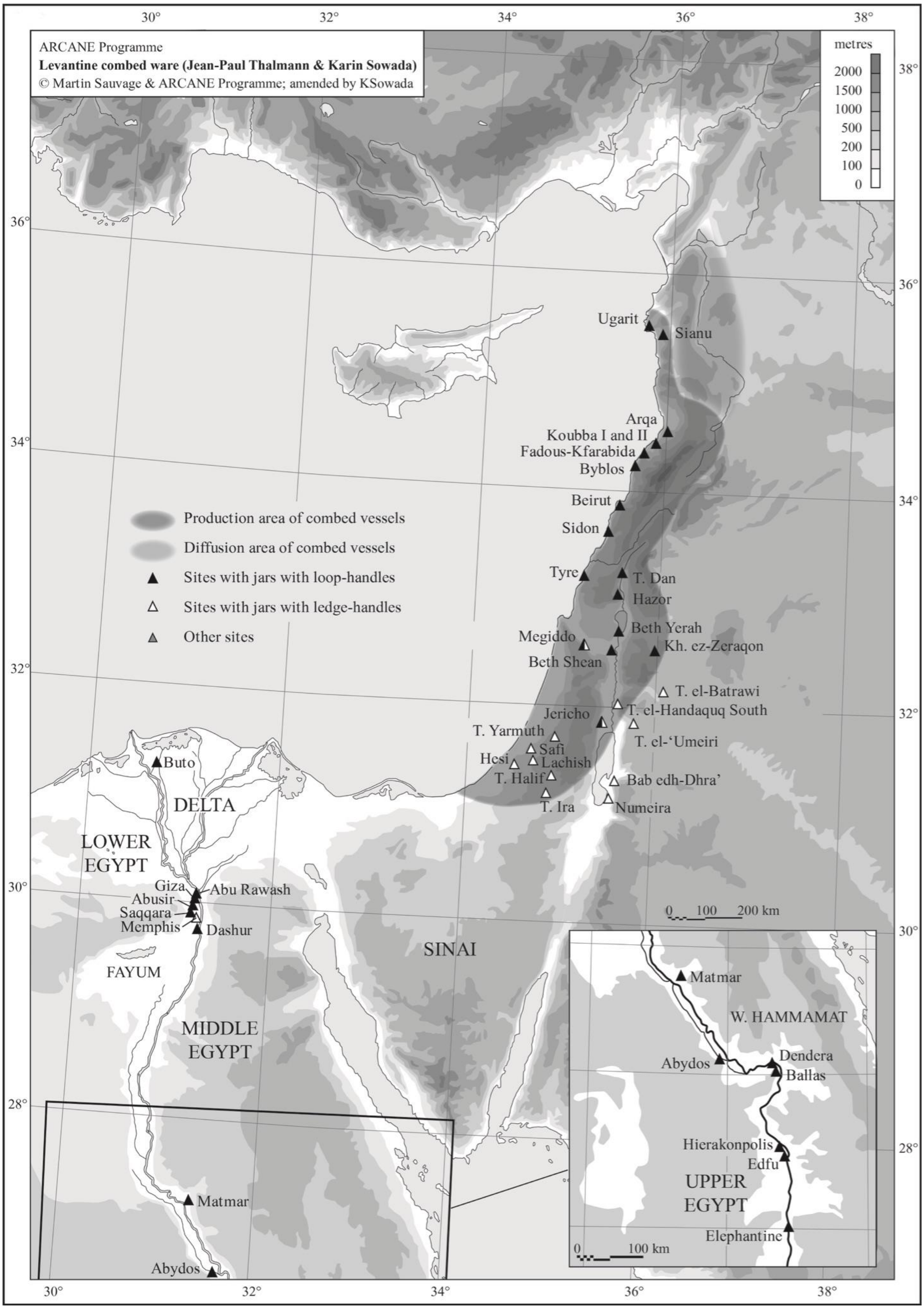

Fig 1. Map of Egypt and the Levant, showing production and diffusion zones of Combed Ware in the third millennium BC (after Thalmann and Sowada 2014 [4]).

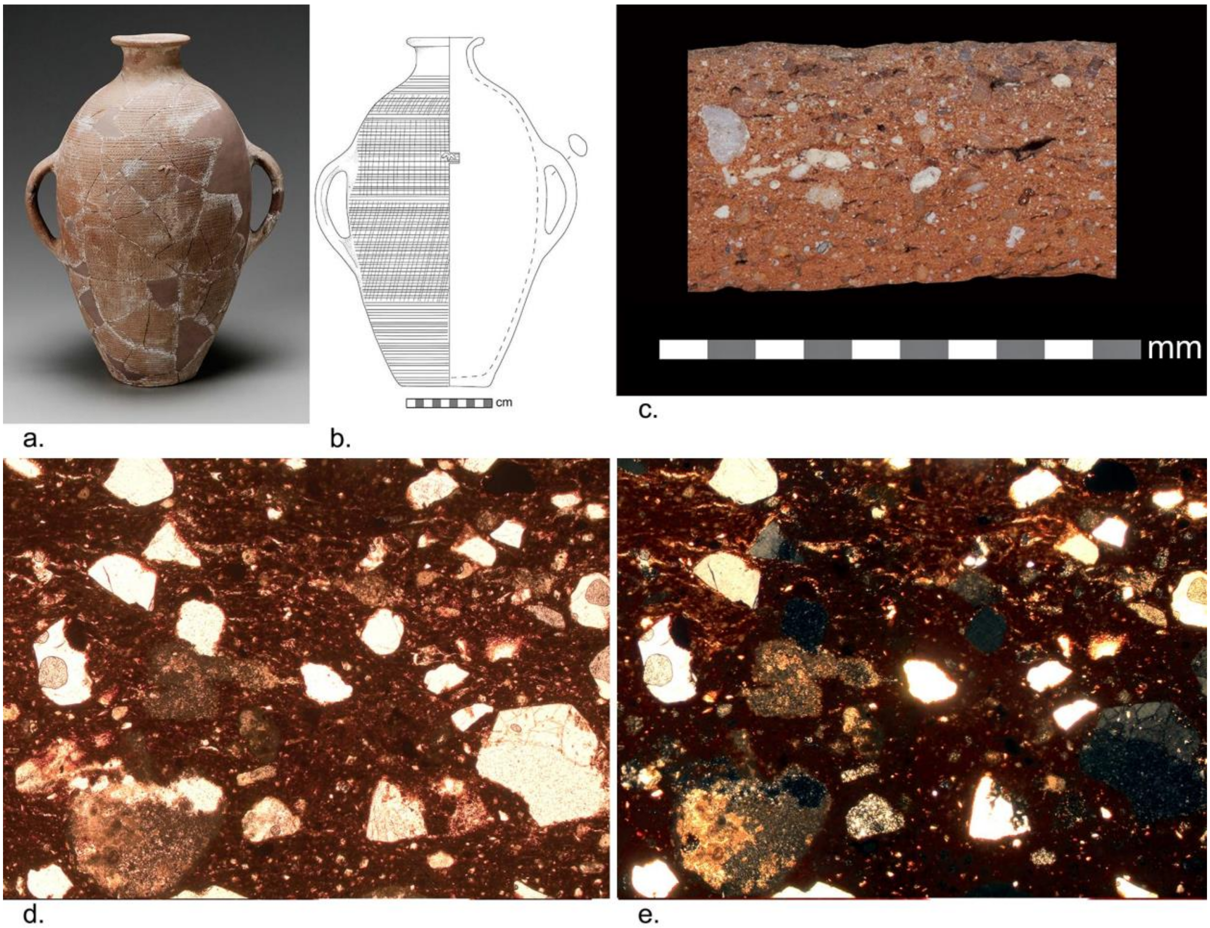

Fig 2. Combed jar MFA 37.1319 from Giza Tomb G 7330 A, mid–late 4th Dynasty. Fabric P200: iron-rich, calcareous with chert. a. MFA 37.1319 (Photo © 2019 Museum of Fine Arts, Boston). b. MFA 37.1319 (drawing K. Sowada). c. Sherd fracture (photograph K. Sowada). d. Thin-section at plane-polarised light (PPL). Field of view 3 mm. e. Thin-section at cross-polarised light (XPL). Field of view 3 mm. Thin-sections show silt and sand-sized quartz grains and limestone fragments.

A recent petrographic study on CW imports found in Egypt of mainly 4th Dynasty date revealed they were highly comparable to contemporary published examples from northern

Lebanon [5, 7–8, 20-21]. These vessels, like those from Lebanon, were produced using calcareous clays tempered with mixtures of quartz, limestone, and calcite (Fig. 2 c-e). The materials can be linked to supply basins dominated by Cretaceous limestones and chalks found in central and northern Lebanon; the C1-C6 formations as described by Dubertret [23, 58] and Nader et al. [70] (Fig. 4). This region includes Byblos, one of the Levant's key sites that has long been acknowledged by scholars as a focal point for Egyptian trade [2–5, 7–18]. A recent study on material from 6th Dynasty Abusir in Egypt, indicates the presence of imported vessels made using a similar clay type, some 350 years later. This suggests the existence of a long, and probably continuous, trade relationship between the two regions [18].

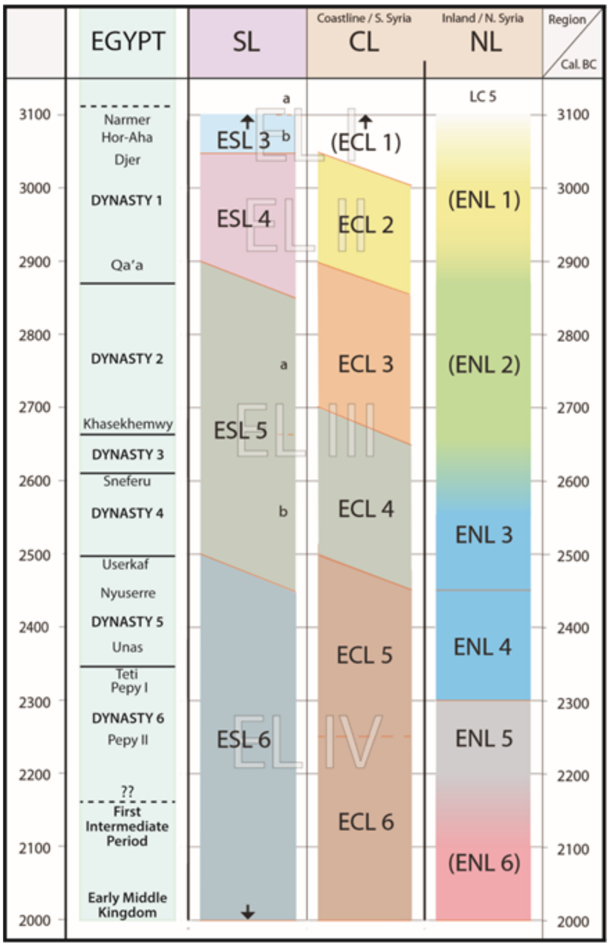

Fig 3. Regionalised chronological synchronisms between Egypt and the Levant in the Early Bronze Age, based on 14C dates for Egypt and the historical chronology alongside periodisations developed by the Associated Regional Chronologies of the Ancient Near East (ARCANE) Project. ‘ESL’ refers to ‘Early Southern Levant’, ‘ECL’ to ‘Early Central Levant’ and ‘ENL’ to ‘Early Northern Levant’. [6, 68: 18]

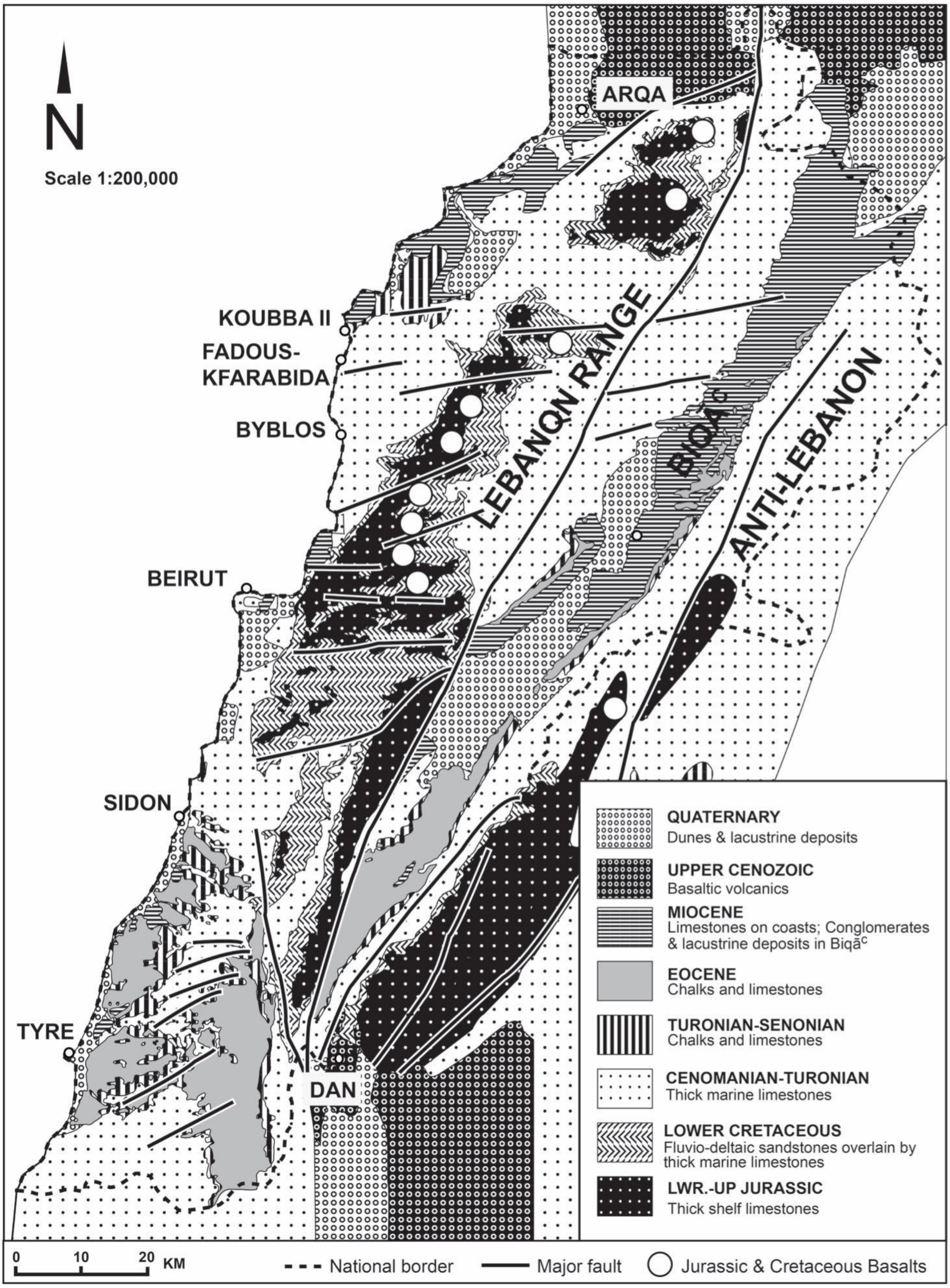

Fig. 4. General geological map of Lebanon (after Dubertret 1955 [23]). Scale: 1/200000.

This paper applies a geochemical approach to a sample of CW vessels found at Giza dating to the 4th Dynasty (c. 2613–2494 BC) with the aim of determining their geographic origin and understanding their production more precisely. To accomplish these aims, the results were plugged into an extensive geochemical database resulting from the analysis of macroscopically and petrographically comparable CW vessels locally produced in two regions of northern Lebanon [5, 21] thought to play a key role in trade at the time. The regions include Byblos and closely linked sites in the surrounding area [5], and another major site further north, Tell Arqa [21]. The results help map the location of specialised ceramic production centres that supplied commodities for the Egyptian state, shedding light on the origins, nature and orientation of this important trading relationship.

2. Materials and methods

Nine samples from Giza examined using thin-section petrography by Sowada et al. [8] were analysed by ICP-AES and -MS at Durham University in 2019. The samples were obtained from jars and a jug held in the Museum of Fine Arts, Boston (MFA), the fruits of excavations conducted by the joint Harvard University-MFA Egyptian Expedition led by Dr George Reisner in the early 20th century [1]. The Museum holds 29 imported jugs and jars from Old Kingdom Giza, representing the largest corpus of such vessels outside Egypt. Curatorial information about each vessel is published in Sowada 2009 [3]. The samples represent near-complete jars from a museum context necessitating a minimally destructive analytical approach. ICP -AES and -MS were chosen here as the methods of analysis because they are capable of providing highly precise and accurate bulk chemical data using small amounts of sample (see below). The samples from Giza are broadly contemporary (Table 1). The results were compared with 27 samples from the region of Byblos, including Byblos itself, Tell Koubba, Tell Fadous-Kfarabida, and 30 samples from Tell Arqa that have been analysed petrographically and via ICP [5, 21] (Table 2). Chronologically, most of these samples are contemporary with those from Giza, however, several later samples from Arqa (EB IV/ECL 5) and several earlier examples from Arqa and Byblos (EB II/ECL 2–3) were added to the analysis to facilitate wider comparison (Table 2).

Petrographic results of the Giza material, based on the analysis of 36 samples, identified three closely related fabrics, designated P200, P201 and P202 in the Egyptian ceramic classification system [8, 22, 31]. All samples were highly comparable to contemporary CW materials published from Lebanon and, therefore, imported from there to Egypt. P200 is the most common fabric, closely paralleled with Fabric 2A and B from the Byblos region [5] and group 2 at Tell Arqa [21] (Table 1). There are a few cases where samples from Lebanon and Giza are nearly identical under the microscope, representing exceptionally strong petrographic matches (Fig 5).

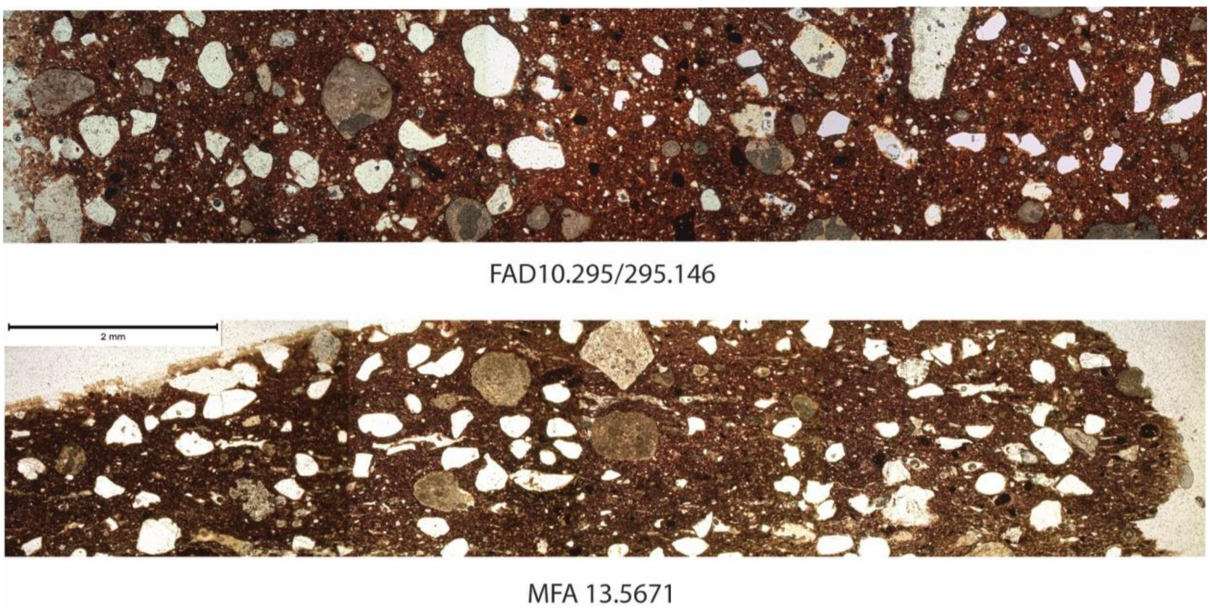

Fig. 5. Thin-section Image (PPL) comparing a sample from Tell Fadous-Kfarabida (FAD10.295/295.146) with one from Giza (MFA 13.5671) , showing that they exhibit a very similar petrofabric. The samples are dominated by sand sized quartz grains and limestone. Scale applies to both images.

Table 1. Giza samples examined using ICP-AES, -MS and petrography.

MFA Registration # **Original Reisner Registration #**	***Petro Sample # (from Sowada et al. 2019)**	**Vessel Type**	**Provenance**	**Date of Context**	**Fabric Type**
MFA 13.5638 Field #13-11-64	1	Combed jar	Tomb G 4240 Owner: Sneferu-Seneb	Early–mid 4th Dynasty c. 2550 BC	Fabric P200
MFA 13.5593 Field # 13-10-29	2	Combed jar	Tomb G 4340 A Owner: name not preserved	4th Dynasty c. 2613–2494 BC	Fabric P201
MFA 37.2729 Field # 38-8-11	3	Combed jar	Tomb G 5020 Owner: Imhetep	Early–mid 4th Dynasty c. 2550 BC	Fabric P202
MFA 13.5639 Field # 13-11-65	7	Combed jar	Tomb G 4240	Early–mid 4th Dynasty c. 2550 BC	Fabric P200

MFA 13.5671 Field # 13-11-106	8	Combed jar	Tomb G 4440 Owner: name not preserved	Early–mid 4th Dynasty c. 2550 BC	Fabric P200 (Fig. 5)
MFA 13.5672 Field # 13-11-107	9	Combed jar	Tomb G 4440	Early–mid 4th Dynasty c. 2550 BC	Fabric P200
MFA 13.5673 Field # 13-11-108	10	Combed jar	Tomb G 4440	Early–mid 4th Dynasty c. 2550 BC	Fabric P200
MFA 37.1319 Field #34-6-17j	11	Combed jar	Tomb G 7330 A Owner: name not preserved	Mid–late 4th Dynasty c. 2550–2494	Fabric P200 (Fig. 2)
MFA 13.5615 Field # 13-10-68	N/A	One-handled jug	Tomb G 4340	4th Dynasty c. 2613–2494 BC	Fabric P200

* Petrography Sample # refers to the numbers allocated to samples published in [8].

100 mg of powder was obtained across the profile of each sherd using a 12-volt dental drill, fitted with a 2mm 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 using protocols established by Ottley et al. (2003) [24]. 0.100 +/- 0.001 g of powder was digested in a 4 ml 40% HF e 1 ml 69% HNO3 solution for 48 h before

evaporating to dryness and redissolving in HNO3 acid, the resulting solution being 3.5% HNO3. This solution then had a Re and Rh internal standard added to compensate for possible calibration drift, matrix suppression and dilution errors. The analysis measured for 43 elements (Table 2). The major elements, analysed by ICP-AES as weight percentage oxide, include Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5 and MnO. The minor and trace elements analysed by ICP-MS as parts per million (ppm) include Co, Cr, Cu, Ni, Sc, Sr, V, Zn, Rb, Y, Zr, Nb, Cs, Ba, Pb, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Pb, Th, and U. Calibration was achieved via the use of in-house standards and international reference materials (W-2, BHVO-1 and AGV-1 standards) as well as a blank and standard sample being run every 10 samples to ascertain instrument calibration stability.

The minimally destructive approach necessitated by the nature and museum context of the objects, meant that only 100 mg of sample was available with the consequence that Loss on Ignition (LOI) could not be determined reliably [59]. A mitigating methodological approach has been adopted to compensate utilising element ratios as described below [60: 8].

Table 2. ICP -AES and -MS results. Values indicated by (%) are given in weight % otherwise values are ppm.

A principal components analysis (PCA) [25 (p 176–180)] was conducted to plot the similarity of the chemical composition of each sample (Fig. 6). The R software package, version 3.5.0 (R Core Team) was used for the analysis and the figures were produced using the package ggplot2 [62]. A Log-ratio transform (base 10) was applied to the raw data [63, 64] before processing. Some elements were removed from multivariate statistical analyses. Zr is not fully digested during sample preparation giving semi-quantitative results. Some elements are likely to be affected in ceramics, post-depositionally (See [91] for an overview), especially in coastal central Levantine contexts. CaO was removed as Lebanon's ground water is high in dissolved Ca [61] and voids infilled with secondary calcite [67: 67] were observed consistently during the analysis of the thin-sections from Lebanon [20]. Variations in CaO were, however, carefully taken into account in particular instances. P_2O_5 and Ba have been omitted as their leaching or enrichment in ceramics has been reported in the literature [71: 11-12] and related bibliography.

As thin-section work already indicated that closely related materials were used, the geochemical analysis focused primarily on 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 [26, 27 (p 195), 28, 66]. As such, REE values, more than other elements, are a good indicator of the original composition of the various inputs within material supply basins, even though REEs are generally enriched in argillaceous sediments relative to most types of rock [29 (p 3), 30 (p 188)]. Moreover, recent studies show that there is no fractionation of these elements from the firing process [26 (p 2389)]. The REE values were normalised using the values for chondritic meteorites as presented in Rollinson [28]. As mentioned above, we adopted an approach focused primarily on element ratios rather than absolute values to mitigate the impact of variations among the samples in volatile organic matter (unknown as LOI could not be determined), known post-depositional impacts, and tempering with quartz, calcite, and sedimentary rocks (see [60] for a recent treatment). The Ratio of Light REE (La, Ce, Pr, Nd, Sm, Eu) to Heavy REE (Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) has been examined as its value is governed by clay protolith(s) [26] and has been shown specifically not to alter significantly through the addition of most tempering materials where these are similar to the original clay protolith(s) [26 (p 2389)]. The value is, therefore, useful for determining whether jars tempered differentially are derived from the same original source rocks. Additionally, Th/Co and La/Sc elemental ratios have been plotted as they are a useful way to evaluate and classify geological inputs into clays [26].

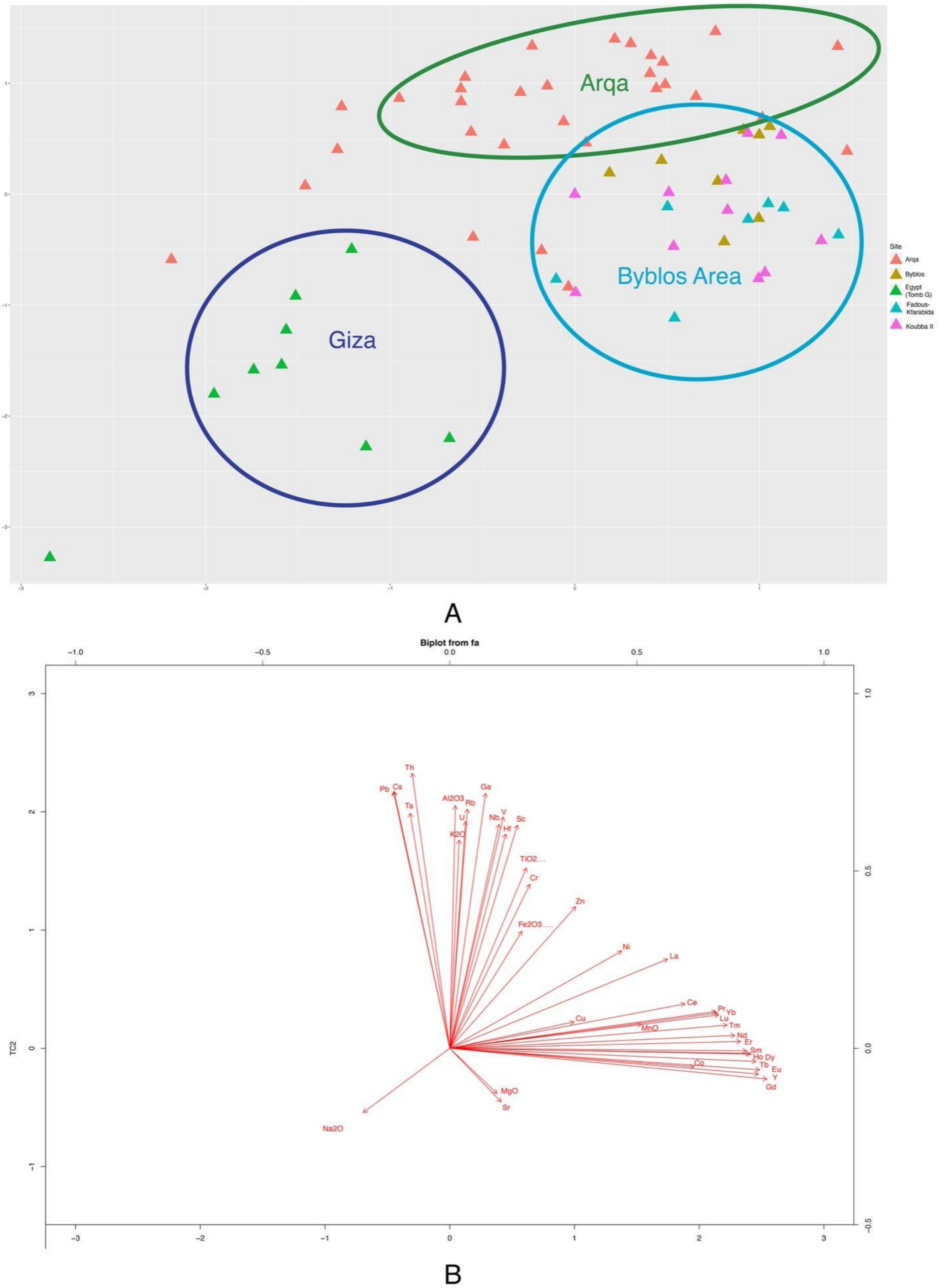

Fig. 6. Plot of the factor scores (A) and loading plot (B) generated from the principal components analysis of the chemical data generated by ICP-AES and -MS for calcareous

fabrics from Lebanon and Giza sorted by site. Factor 1 explains 65.3% of the variation and factor 2 explains 16.3%.

3. Results

The graph of factor scores resulting from the PCA (Fig. 6) demonstrates chemical variability between the samples from Giza, the Byblos region, and Tell Arqa, which clustered into three separate groups. The Giza samples, when compared to those from Lebanon, generally show lower values of Al_2O_3, CaO, and Fe_2O_3. Greater percolation of ground-water in the wetter climate of Lebanon resulting in the observed formation of secondary calcite post-depositionally, mentioned earlier, contributes to generally elevated CaO in Lebanese samples relative to those from Giza. The Giza samples are also relatively deficient in the REE (including Sc and Y), Cr, Ni, and Co. The samples from the Giza tombs and the Byblos region are differentiated from the Tell Arqa samples as the latter are generally elevated in Ti, Th, U, Ta and Nb.

Differences between the Giza and Byblos region samples occur mainly among elements that are enriched in the clay fraction [27, 28]. If we assume two groups derived from the same clay source, the concentrations of Cr, Ni, and Co and the REE (including Sc and Y) would decrease consistently as greater amounts of quartz, calcite or most types of sedimentary rocks are added as temper [60]. Likewise, lower concentrations would be expected with higher relative organic content, or if more secondary calcite was formed during deposition. These factors cannot be controlled for in the present study, reinforcing the advantages of an approach emphasising element ratios to determine shared provenance. Thus, the chemical data indicates that the Giza samples are in general less clay-rich compared to those from the Byblos region and Tell Arqa.

The chondrite-normalised LREE/HREE ratios are plotted in Fig. 7. The majority of the samples exhibit similar values indicating that they derive from similar clay protoliths, reinforcing the petrographic results. The values shown are in line with those expected for sedimentary rock and the sediments derived from them [28, 32 (p 1392)]. Likewise, the Th/Co and La/Sc plots (Fig 8) show good agreement between the majority of the samples, further supporting the notion that they mostly derive from closely related materials.

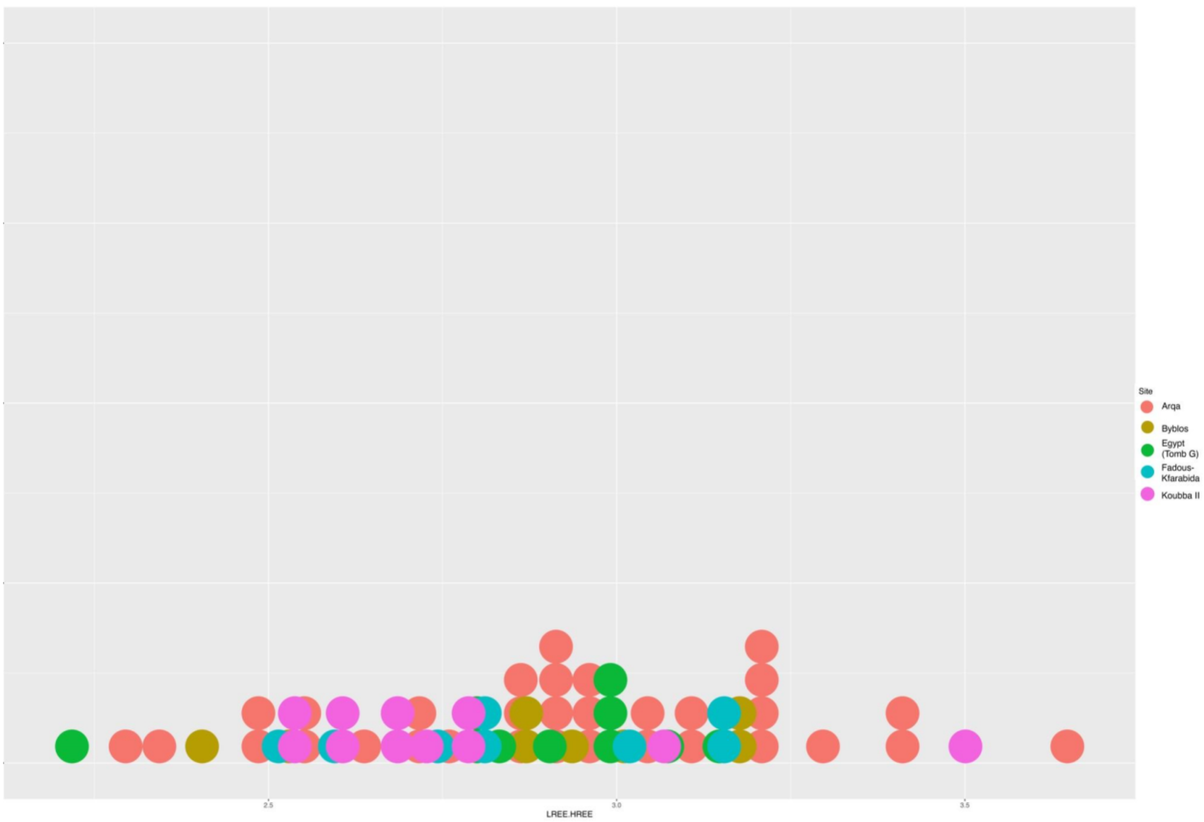

Fig. 7. Distribution of Ratios of ppm LREE to HREE by site. The samples from the Lebanese coast and Giza generally exhibit similar values indicating they are derived from similar clay protoliths.

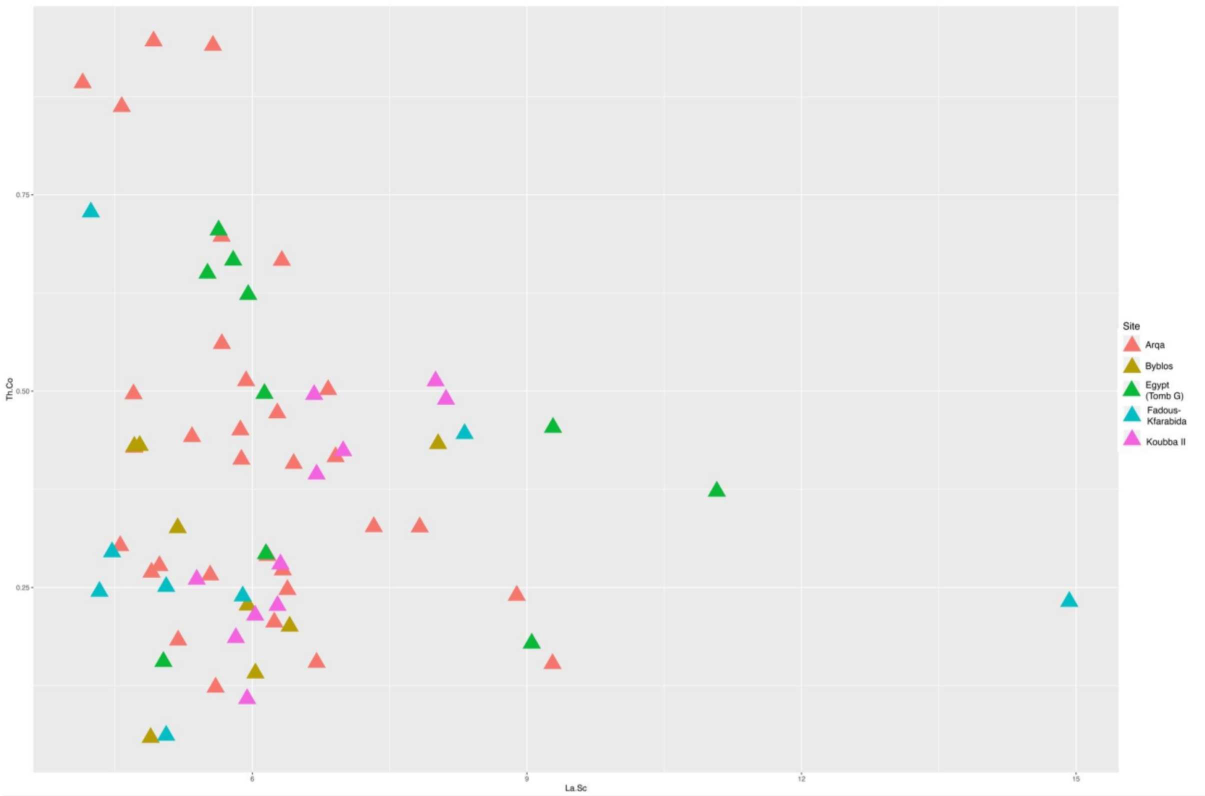

Fig. 8. Plot of Th/Co s and La/Sc ppm ratios. The samples from the Lebanese coast and Giza generally exhibit similar values indicating they all derive from closely related materials.

Despite similar REE values, the samples from Arqa are differentiated from the Giza and Byblos region samples by other aspects of their geochemistry, which suggests differences in the composition of accessory minerals of the former. Samples from Arqa are generally elevated in Nb, Th and U, elements that are associated with heavy minerals such as zircons [27]. Nb, normally depleted in clastic sediments, is particularly elevated in the Arqa samples and is likely associated with titaniferous minerals [33]. Fig. 9 shows that the Nb and Ti concentration in the samples are correlated supporting the association of enriched Nb with a higher amount of titaniferous minerals in the samples from Arqa. Here, caution must be exercised in comparing absolute values due to the uncertainties highlighted earlier. Still, the pattern is quite consistent among the Arqa materials with many showing elevated Ti, Th, U, Ta and Nb, despite similarity with Byblos area samples across other element concentrations. We suggest the elevated levels of Nb in many of the Arqa samples can be explained by the proximity of Arqa to Cenozoic basalt flows (Fig 4) known to be rich in Fe-Ti minerals [34]. Aeolian or fluvial transport from these basalts would serve to increase the concentration of titaniferous minerals in sediments near Arqa exploited for potting relative to otherwise similar sediment types found in the Byblos region. Since Fe-Ti oxides are very resistant to weathering [35] they can be transported into sediments over relatively long distances. These minerals are comparatively small and mostly opaque and, as such, differences would not be easily detectable via standard petrographic analyses without a specialised methodology.

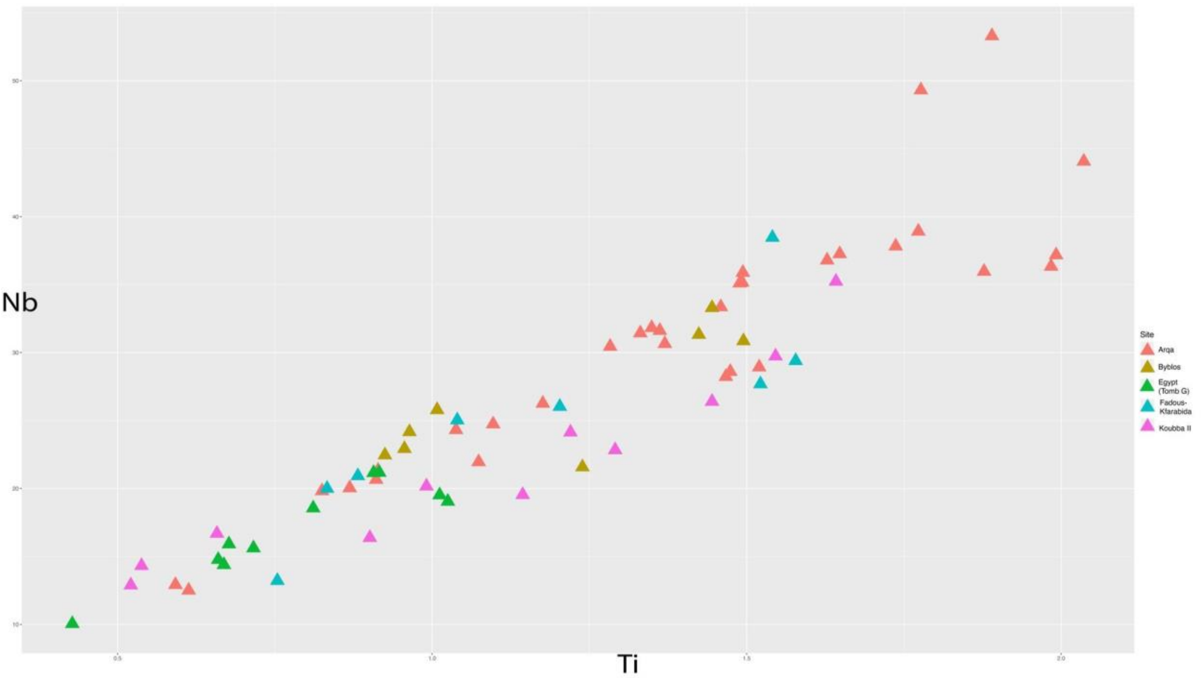

Fig. 9. Plot of Nb and Ti ppm values. The plot shows that the Nb and Ti concentration in the samples are correlated supporting the association of enriched Nb with a higher amount of titaniferous minerals in the samples from Arqa.

4. Discussion

Several studies show that potters of the EB II–III/ECL 2–5 on the central Levantine coast favoured similar materials for CW jar production [5, 19–21 see 65 describing a similar situation in Neolithic Italy)]. This underscores the challenges of associating samples with discrete production locations based on petrography alone, demonstrating the value of incorporating geochemistry (in this case ICP-AES and -MS) to augment petrographic results. In theory, while sampling clay sources analogous to those used by ancient potters could be undertaken, this is impractical owing to the large potential catchment with no guarantee that the clay beds and other resources exploited in the 3rd millennium BC are still extant. Further, extensive processing and preparation by the potters has been observed in thin-section, making direct comparison with raw materials difficult [60] and unlikely to improve provenancing determinations. In the case of Levantine CW, the vast quantities produced means it is highly probable that production, in the main, took place in the region surrounding a site. Therefore, an approach comparing ceramic samples directly and linking them to a shared production is preferable to geoprospection. No evidence from Lebanon for kilns or production sites of the period has yet been unearthed. It is hoped future discoveries will improve our understanding of the context of CW production.

Integration of geochemical data with petrographic evidence is an effective strategy for the creation of discrete groups likely representing closely related productions. The Giza samples showed good agreement with the majority of those from Byblos and Arqa across several elements considered the most useful for determining provenance. Additionally, they exhibited similar LREE/HREE and Th/Co and La/Sc ratios, which can compensate for chemical differences arising from variations in tempering practice. The chemical data presented here indicates, however, that the Giza materials are more closely related to those from the Byblos region than those from Tell Arqa. A number of samples from Arqa were elevated in Ti, Th, U, Ta and Nb distinguishing them from the Byblos region and Giza samples. The Giza samples are not an exact chemical match, but were derived from closely related materials to those used in the production of samples found in the Byblos area, implying they were produced using similar modes.

The results are broadly in line with previous archaeometric studies. A 1986 investigation by Doug Esse and Phil Hopke applied Neutron Activation Analysis (NAA) to 21 samples from Giza [36]. The chemical data on which this work was based was recently re-discovered at the Museum of Fine Arts (Boston) but is of limited value because of the restricted range of elements then used, and the greater precision that can now be achieved using new methods. That said, the resultant hierarchical cluster analysis identified several groups of which the largest clustered with sherds from Byblos [3, 5, 36]. This is almost certainly the dominant Fabric P200 (Figs 2, 5) [8].

A second study using PIXE-PIGME was conducted by Peter Grave in 1999 [3–5]. Like the ICP-AES and -MS results in the present work, the samples from Giza grouped with each other and were slightly separate from samples obtained from Byblos. The results help reinforce the ICP and typological data, and suggest that the 4th Dynasty Giza pottery imports are drawn from a common set of raw materials found in contemporary ceramics from the

Byblos–Tell Fadous Kfarabida–Koubba zone of the central Levant, but as a group may represent a specialist product.

Several possible explanations are proposed for the observed chemical differences, keeping in mind post-depositional factors and variations in organic material are likely contributing to a lesser degree. Firstly, as indicated by the petrographic analysis, the Giza samples are most likely less clay-rich because, on the whole, they contain more and larger temper grains when compared to CW samples from Lebanon [5, 8 and 21], explaining their *lower* absolute REE values, but *comparable* REE ratios. As demonstrated in Fig. 4, however, some samples from Lebanon exhibit highly similar textures to those from Giza, and, correspondingly, are closer chemical matches (e.g. closer values of Ca and Fe).

Secondly, the slight chemical differences between the Giza and Byblos area samples could relate to the use of clays from different beds. The clay beds found in Lebanon are, in the main, mixtures of at least two types of clay minerals, with kaolinite, illite, and montmorillonite represented [37, 38]. The clay resources of Lebanon are, therefore, quite heterogeneous and of varying quality [39]. They are determined by a number of inputs [40] and individual lenses of clay with quite different clay mineral composition and properties may exist in proximity to each other. Particular clay beds could have been reserved or directly targeted for the production of jars intended for Egypt, but there is currently no clear evidence for such practices.

Thirdly, the Giza vessels might be linked to another entrepôt, for which we do not yet have data. In recent years, a few Old Kingdom Egyptian artefacts have been found from excavations at Tyre [46, 47]. One object, a flint knife, was also found at Sidon [48]. Vessels produced elsewhere around Sidon and Tyre should present a different petrographic and chemical signature due to inputs from nearby Eocene marls, which are generally absent from the Byblos area. Petrographic data from Sidon supports this suggestion [19]. Petrographic and geochemical analysis of samples from the regions of Early Bronze Age Beirut, Sidon, and Tyre will be conducted in the future, thus providing further clarity.

Considering the lower capacity and slight petrographic and chemical differences observed for the Giza imports, the totality of the evidence suggests a production that, though closely related and likely linked to the Byblos area, was distinct from local mainstream production. The use of clays and tempering materials low in CaO, would enable higher firing temperatures [41], which along with a coarser quartz tempered fabric, could produce a harder jar. Specialist production could have aimed at creating exceptionally well-made jars intended for elite exchange, use in Egyptian ritual activities and the palace economy, but that could also withstand long-distance sea-transport. Thalmann and Sowada [4], showed that the jars found in 4th and 5th Dynasty Egypt generally had much lower capacities than those of the contemporary Levant, suggesting they represent forms made specifically for export. That these jars were smaller, would have also made them easier to transport to Egypt and/or might reflect the nature of the commodity traded [4: 361]. Specialist production is further attested by a white-slipped one-handled jug MFA 13.5615 (Table 1), made of Fabric P200, which belongs to a suite of imported slipped jugs in Egypt with few parallels in the central Levant [3 (p 72, 73), 71, 72]. Conversely, CW jars intended for local consumption would, principally, be manufactured for everyday use and transport by land and over shorter distances.

The results presented in this paper, compared to analyses undertaken by Badreshany *et al. (2019),* show that smaller sites in the Byblos region, like Koubba and Tell Fadous-Kfarabida, can be linked to trade with Egypt through the presence of chemically comparable CW jars. However, unlike at Byblos and despite significant excavation, Egyptian (or even egyptianising) objects are represented by only two finds at Fadous-Kfarabida [49, 50]. This suggests that trade activities were mediated through individuals at Byblos where the high-status Egyptian objects generally remained. This also compares with the absence of any evidence for direct Egyptian exchange at ECL 4 / EB III sites in the region of Tell Arqa, suggesting that Arqa was not involved in the direct supply of Egyptian royal expeditions at this time. We must, however, consider our small sample size and that only domestic contexts were excavated at Arqa, and leave open the possibility that future work may produce relevant evidence.

It is entirely possible that the Egyptian administration worked closely with local potters at or near Byblos, or co-opted an existing facility to serve its requirements. Production may have been mediated by the presence of Egyptian officials visiting or even resident at Byblos. Archaeologically, this appears to be attested at EB II/ESL 4 (c. 3050–2900/2870 BC) Tel Beth Yerah in the Galilee region, where a locally-made jar was found with an inscription in hieroglyphs bearing the name of a possible Egyptian official [44, 45]. The site is a known originator of ceramic containers found in 1st Dynasty Egyptian tombs [45]. During the Old Kingdom, a year-round or short-term Egyptian presence in the Byblos region around the ancient sailing ‘season’ provides a rationale for the large volume of Egyptian artefacts found there – some even inscribed with non-royal names – although in much-disturbed contexts [3 (p 128–144, 150–153, 218–222), 17].

5. Combed Ware in its Levantine and Egyptian Contexts

In the central Levant, the appearance of large jar forms during the EB II/ECL 1–2 is now viewed as a key component within a new urban 'package', characteristic of the emergence of complexity during that time [5 (p 31), 51 (p 238), 52 (p 24–39)]. The jars are the manifestation of a system of agriculture thought to focus on olive and grape [53, 73], a system which played an increasingly important role in local political economies. This is evidenced in the EB III/ECL 3-5 through an increase in the scale of vessel production, and the use of fabrics consistent with clays accessible in the coastal zone, in contrast to an earlier usage of clays originating in upland locations [5, 21]. Likewise, recent studies show that the jars and their contents were mostly circulated within intensive economic interaction zones presumably congruous with local political structures on this part of the Lebanese coast [5].

Further supporting this notion, the present study has not produced clear evidence for direct trade in CW vessels or the commodities they contained between places like Arqa and Byblos. CW jars were made for the storage and transport of commodities that were widely available to people in the region, rendering unnecessary, save in exceptional cases, the large-scale movement of CW jars between, as opposed to within, the different coastal polities. The increasingly localised production evident in the ceramic industry beginning in the EB III/ECL 3–5 [5] perhaps reflects the ambitions of local elites looking to expand their influence or consolidate power. This process is also visible at settlements, with, for example, the reorganisation of Fadous-Kfarabida in the later EB III/ECL 4 by building over or expanding domestic structures to create new public/monumental architecture [53]. These developments are coeval with the emergence of strong links with Egypt during the 4th Dynasty. Egyptian textual and archaeological evidence reveals that state expeditions to Byblos and other Levantine locations in addition to Byblos continued into the long reign of Pepy II (c. 2278–2184 BC) [9, 18], although for how long cannot be ascertained.

The contrast might neatly encapsulate the difference between the EB III/ECL 2–5 in Lebanon and 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 Fadous-Kfarabida, the productivity of which was actively managed by the centre. While in northern Palestine, the latter part of the EB III – the EB IIIB /ESL 5b – is now understood as an episode of decline, characterised by a limited number of large fortified settlements, some occupied only sporadically, whose leaders were focused mainly on internal rather than external interaction [54, though see De Miroschedji's [69] treatment of southern Palestine for a differing perspective]

Without further archaeological and scientific data from the Levant, details on the social context of the mobilization of CW jars and consumption of their contents are lacking. The balance of evidence shows the development by the 4th Dynasty in the Byblos region of a class of elites, likely looking for new ways to strengthen status, which they found through more intensive interactions with Egyptian counterparts. From the late Predynastic period, the Egyptians found in the region of Byblos (and perhaps other parts of the Syrian and

Lebanese coasts, about which we currently know rather less) forms of socio-economic organisation with which they could articulate to meet their resource needs, forms of organisation absent further south in the Levant [44, 45]. In addition, large-scale maritime journeys to the cedar forests of Lebanon provided an efficient means of bulk commodity procurement, one which could be tightly controlled by the Egyptian state as it extended over a relatively small geographical area, making it more easily managed through the cooperation of local elites. In Egypt, royal expeditions to the Levant came to serve the ideology of kingship through the projection of royal power to distant foreign lands, in addition to underpinning social hierarchies and peer status through access to foreign products [55].

At Byblos, intangible displays of status through feasting and religious ceremonies likely factored into trade relationships. As noted, large flint knives and stone vessels – including a large number of fragmentary prestige types – form the main corpus of Egyptian objects recovered there. In Egypt, these objects are status markers, largely restricted to elite contexts, such as cultic deposits, temple magazines, elite tombs and installations [16 (p 63–75), 49, 56]. At Byblos, the knives come from a number of contexts, but patterns of multiple knives associated with temples or temple courtyards are noted, such as those found around the Ba'alat Gebal temple. The majority of stone vessels were also associated with the Ba'alat Gebal temple or the *Enceinte Sacrée* [3, 11, 12, 14–17], suggesting their preeminence over other the temples of the period at Byblos. Likewise, iconographic and archaeological evidence indicates that in Egypt, the flint knife type was used for the ritual slaughter of cattle [57 (p 20)]. Their presence among Egyptian-made objects at Byblos hints that cattle were an important trade item and that feasting and sacrifice was possibly integral to the interaction of Egyptian emissaries with Byblos elites.

On the Egyptian side, CW jars were primarily acquired for their contents. The nature of the original contents remains to be established and is currently the subject of a multi-proxy scientific research program. Preliminary results reveal significant complexity in the remaining residues, the likely cause of which is multiple episodes of re-use of jars after they were emptied of their original contents in Egypt [8, 18]. The jars themselves were also received in Egypt as high-status objects. Acquired by royal expeditions, they occur in deposits associated with the palace economy and funerary assemblages of high officials. Jars were likely gifted by the palace as rewards and marks of royal favour, and to symbolise the original luxury contents in the hereafter [18]. The multiple levels of meaning inherent in the reception of Combed Ware jars will be assessed in a future study.

6. Conclusion

ICP-AES and -MS results underscore the petrographic data that points to the Byblos area as the manufacturing centre of Combed Ware jars imported to Giza during the 4th Dynasty. The elemental results were very consistent, but notably were not a perfect chemical match with other samples from the region, including material from Byblos itself. This suggests the possibility of another production centre such as Sidon to the south, or more likely, specialised production at Byblos or its environs of jars to meet the trade needs of the Egyptian state. The latter is suggested by the smaller size of the jars and coarser nature of the fabric when compared to those used locally, presumably to create vessels suitable for arduous long-distance trade.

The results have implications for the nature of foreign relations and the mediation of trade relationships. Specialised production indicates close and direct engagement between agents of the Egyptian state and producers at Byblos, a practice also suggested by archaeological and textual evidence in the third millennium. Indeed, it seems likely that the foundation of this centuries-long pattern of direct engagement was established at this early time, forming the basis of later intensive ties and even of later Egyptian literary genres. Future work will build on this study by similarly analysing 5^{th} and 6^{th} Dynasty jars for comparison with contemporary examples from the Lebanese coast with the aim of confirming the Egyptian textual evidence and investigating contemporary links with between Egypt and other parts of the region.

Locally, links with Egypt delivered reciprocal benefit to Byblite elites, who benefited from access to regular trade and status markers in the form of Egyptian prestige goods, in an environment of competitive peer-polity interactions. As this exchange continued into the 23rd century BC, it can be argued that this relationship endured despite clear signs of significant and ultimately devastating upheaval at Byblos and in the surrounding region. This evidence underscores the long-established symbolic importance of Byblos to the Egyptians, a significance that outweighed its short-term economic fortunes.

Acknowledgements

Research for this paper was funded by Australian Research Council Future Fellowship Grant FT170100288 ‘Pyramids, Power and the Dynamics of States in Crisis’ held by Karin Sowada, and the ‘Computational Research on the Ancient Near East’ (CRANE) project (Graham Philip), funded by the Social Sciences and Humanities Research Council of Canada. We are grateful to the Museum of Fine Arts, Boston, notably Dr Rita Freed and Dr Denise Doxey of the Department of Ancient Art, for their continued support for the project, enabling access to samples and study of the archival material. Anthony Dakhoul amended the map in Figure 1. Alice McClymont prepared Figure 2 and Figure 3 was adapted with the assistance of Leonie Donovan.

The ceramic assemblage from Tell Koubba was excavated by a joint project of the American University of Beirut and Durham University directed by Prof Hélène Sader, and authors Badreshany and Philip, with support from the Council for British Research in the Levant, and the Society of Antiquaries of London. The authors gratefully acknowledge the support of the Directorate General of Antiquities of Lebanon who kindly gave permission to export samples for petrographic analysis. We would also like to thank Prof. Hermann Genz for providing comparative material from Tell Fadous-Kfarabida, and the late Dr. Jean-Paul Thalmann for encouraging extended analyses of EBA materials from Tell Arqa. Thanks are also due to Ian Chaplin from the Department of Earth Sciences at Durham University for preparing the samples analysed in this study and Chris Ottley from the Department of Earth Sciences at Durham University for undertaking the geochemical analyses by ICP-AES and-MS.

We would like to thank the two anonymous reviewers for their comments which helped improve the manuscript.

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