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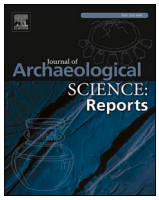

Pottery traditions in Kydonia: Preliminary results from the petrographic analysis of three pottery assemblages in Chania

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ABSTRACT

Chania, or Minoan Kydonia according to the Linear B tablets, has been an important Minoan settlement throughout the Bronze Age. Systematic and rescue excavations on the hill of Kastelli since the 1970 s has revealed the presence of a major palatial centre of the Late Minoan III (LM IIIA1-B1) period that kept thriving even after the collapse of the Minoan palatial system. This paper deals with the combined analysis of three assemblages from Chania covering all phases of the Postpalatial period (LM IIIA1 to LM IIIB2). The petrographic analysis of an array of coarse and fine wares allowed the in-depth investigation of pottery production throughout the LM III period and the establishment of the main pottery recipes. Issues of provenance and technology of manufacture are investigated with emphasis on the use of different types of raw materials for the production of coarse wares used for domestic purposes as well as semi-fine and fine wares used for transportation and consumption of staples and liquids. With an approach incorporating pottery from different contexts and different chronological horizons of the LM III period this paper examines continuity and discontinuity in the use of fabrics and clay recipes in time and at a micro-regional level. Last but not least, the technological characteristics of the renowned 'Kydonian workshop' are examined.

1. Introduction

The settlement of Chania, or Kydonia according to the Linear B tablets, is situated on the north coast of west Crete on the low hill of Kastelli overlooking the Venetian harbour (Andreadaki-Vlazaki 2011a) (Fig. 1).

Habitation on the hill dates since the Final Neolithic but the settlement became an important palatial center in the Neopalatial period (MM III - LM I; for abbreviations and absolute chronologies, cf. Table 1), as reflected among others in the 'Master Impression' from the Greek-Swedish excavation at the Hagia Aikaterini Square (Andreadaki-Vlazaki 2011b, 41). A series of destructions at the end of the LM IB period opened the way for the preeminence of Knossos as the dominant centre during the LM IIIA period followed by the resurgence of a few second-order regional centres, among which Chania in west Crete and Hagia Triada in south-central Crete (Preston 2010, 313-314). The emergence of Kydonia in the LM III period is further substantiated by the discovery of the 'Warrior Graves' cemetery, one of the very few on the island dating to the LM II/III period; the excavation of the tombs produced important metal finds but also an array of ceramic vessels (Andreadaki-Vlazaki and Protopapadaki 2011). The settlement of Chania continued to thrive and increased its influence in the later phase of the Bronze Age (LM IIIB), when other regional centres had declined. This is evidenced by the recent finds from the rescue excavation on Katre Street with ritual deposits and a human sacrifice (Andreadaki-Vlazaki 2022) as well as in the significant increase in the number of imports. The settlements have close contacts with other parts of the island, Knossos in particular, but also the Mesara and sites in east Crete, as well as off-island contacts with Kythera, the Mainland, and Cyprus, to name just a few (Hallager 2017, 47-49). According to the material evidence, Kydonia played a central role in the long-distance trade of the southern Aegean and the east Mediterranean throughout the Late Bronze period (Andreadaki-Vlazaki 2015, 28; Hallager 2010, 156; 2017, 47–49).

2. Aims of the study and methodology

This paper focuses on three ceramic assemblages (for the relevant contexts cf. Table 2) covering all phases of the Final Palatial and Post-palatial periods (LM IIIA1 to LM IIIB2) (Table 1); the material analysed derives from two different contexts of the settlement on the hill of Kastelli, the Greek-Swedish excavation at the Hagia Aikaterini Square (Hallager and Hallager 2003; 2011; 2016) and the rescue excavation of

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the Lionaki-Vlamaki plot (Tzedakis and Kanta 1978; Andreadaki-Vlazaki 2011a, 44-49 also for previous bibliography) (Fig. 2a,b). The third assemblage comes from the 'Warrior Graves' cemetery and more specifically from the sealed ceremonial depositions found in the backfilling of the dromoi of the chamber tombs (Andreadaki-Vlazaki and Protopapadaki 2011).

All three assemblages produced similar types of pottery in terms of fabrics, shapes and wares. On the basis of the macroscopic study, a total of 302 representative samples were selected for petrographic analysis (Table 2). This approach allowed the in-depth investigation of pottery production throughout the LM III period with emphasis on characteristic wares, such as the so-called Kydonian workshop, whose products are found in many sites across the eastern Mediterranean; issues of continuity and discontinuity in the use of fabrics and the technology of manufacture in time and at a micro-regional level are investigated and, finally, the results from Chania are discussed on an island-wide perspective. The present study focuses exclusively on the petrographic analysis of the pottery as the typological and stylistic study have been extensively discussed elsewhere (Hallager 2003, 197-265; 2011, 273–380; 2016, 208–289; Tzedakis and Kanta 1978). The petrographic analysis was carried out at the W.A. MacDonald laboratory of the INSTAP Study Center for East Crete using a Leica DMLP polarising microscope. The samples were grouped into petrographic fabrics according to their mineralogical composition and texture.

3. Geology of the study area

The geology of Chania is characterised by three different units, all connected with raw materials suitable for pottery manufacture: the red clays are associated with alluvial deposits from the Phyllite-Quartzite series, consisting mainly of phyllites, mica schists and quartzites, occasionally mixed with carbonates (e.g. Kilias et al., 1994; Seidel and Stockhert, 2003: 6-7), as well as with the Plattenkalk Unit, comprising dolomitic and siliciclastic rocks, and pelagic platy chert-limestones (e.g. Kilias et al., 1994). These units lie in most parts on top of Neogene marls belonging to eleven different formations (Freudenthal, 1969).

4. Analytical results

Petrographic analysis identified four fabric categories (Classes A-D) that are considered to be locally produced, representing four ceramic

Table 1
Relative and absolute chronology for Bronze Age Crete (after Manning 2010, 24, table 2.2).

Relative Chronology	Absolute Chronology
Early Minoan (EM)	3100–2100/50 BC
Middle Minoan (MM)	2100/50–1700/1625 BCE
Late Minoan I (LMI)	1700/1625–1470/60 BC
Late Minoan II (LMII)	1470/60–1420/10 BC
Late Minoan IIIA1 (LMIIIA1)	1420/10–1390/70 BC
Late Minoan IIIA2 (LMIIIA2)	1390/70–1330/15 BC
Late Minoan IIIB (LMIIIB)	1330/15–1200/1190 BCE

Table 2
The sampled material per context.

Greek-Swedish excavation, 138 samples	**Warrior Graves' cemetery (Andreadaki-Vlazaki and Protopapadaki 2011), 11 samples**	**Lionaki-Vlamaki excavation (Tzedakis and Kanta 1978), 153 samples**
13-Pit L (Hallager and Hallager 2016, 120-139), 32 samples	Grave 4, 2 samples	AII Layer 5, Pit (12.11.1966 & 22.11.1966), 10 samples
20-Pit L (Hallager and Hallager 2011, 224-229), 31 samples	Grave 5, 1 sample	Trench B, Layer 12 (28.09.1966), 13 samples
19-Pit Q (Hallager and Hallager 2011, 144-150), 39 samples	Grave 8, 2 samples	AII Layer 5 (22.11.1966), 126 samples
20/22-Pit B (Hallager and Hallager 2003, 114-122, 141-146), 36 samples	Grave 10, 1 sample	AII Layer 5, part of floor, 1 sample
	Grave 13, 5 samples	AII Layer 5, above floor, 1 sample AIII below wall (14.11.1966), 1 sample Trench B, Layer 5 (12.11.1966), 1 sample

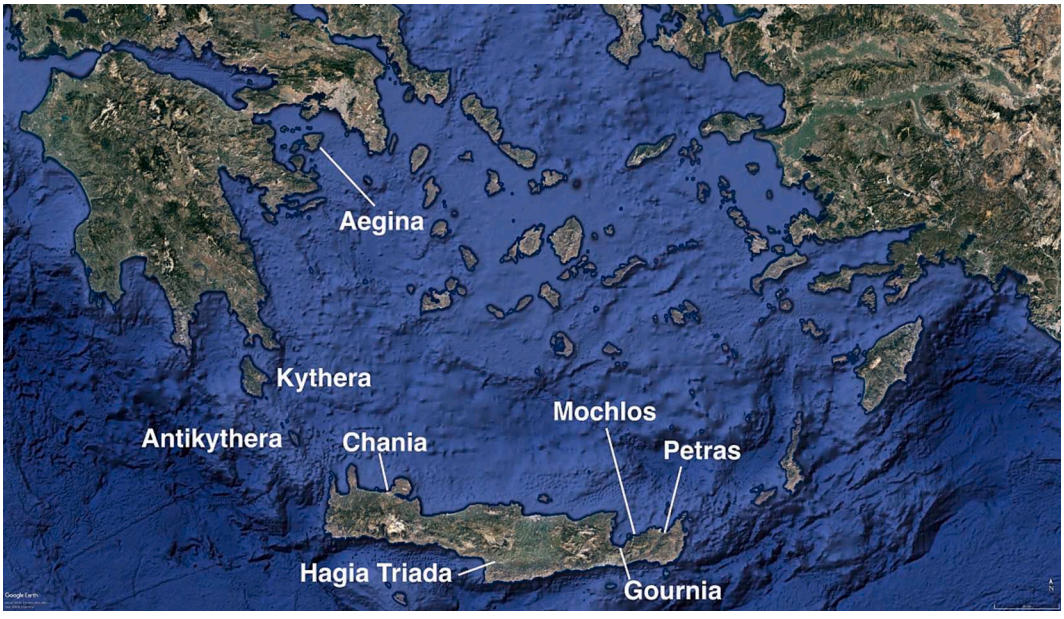

Fig. 1. Map of Crete and the southern Aegean with the sites mentioned in the text (modified after Google earth, no scale).

Fig. 2. Map of Chania showing the location of the three excavations mentioned in the text: α) the Warrior graves cemetery in the modern town and the hill of Kastelli, b) the two settlement sites on the hill of Kastelli (modified after Google earth, no scale).

traditions co-existing in the settlement and the cemetery as well as a few imports.

4.1. Local pottery

CLASS A comprises the red fabrics. In this class the fabrics range from coarse/semi-coarse to semi-fine and fine. There are several sub-categories mainly due to differences in granulometry and density of the non-plastic inclusions (Fig. 3a,b). Overall these fabrics are characterized by the presence of mono- and poly-crystalline quartz as well as low- to medium-grade metamorphic rock fragments, namely phyllites, quartzites and schists in varying quantities. The secondary components include chert, carbonates, and clay pellets. This mineralogical composition is compatible with the Phyllite-Quartzite Series outcropping in the southern part of the Chania plain, around 8 km to the south of Kydonia. In this class the shape repertoire includes coarse domestic vessels such as cooking wares and pithoi to semi-fine transport amphorae and stirrup jars, and finer drinking and serving shapes.

CLASS B includes the coarse sand-tempered fabric (Fig. 3c). It is also a red non-calcareous fabric but it differs because of the presence of well-sorted very coarse inclusions set in an extremely fine and clayey matrix. The inclusions comprise low- to medium-grade metamorphic rock fragments, i.e. quartzite, phyllite and schist. Unlike Class A, mono-crystalline quartz is less prominent in the coarse fraction. The mineralogical composition of Class B is also compatible with the Phyllite-Quartzite Series of west Crete. The texture of this fabric group indicates that sand was added as temper in the clay mix by the potter. The shape repertoire includes cooking wares, domestic vessels and pithoi, and a few amphorae.

CLASS C comprises coarse to fine fabrics manufactured with calcareous clays**.** There are two subgroups: C1 is characterized by clay mixing of a red clay and a Neogene marl, as indicated by the regular

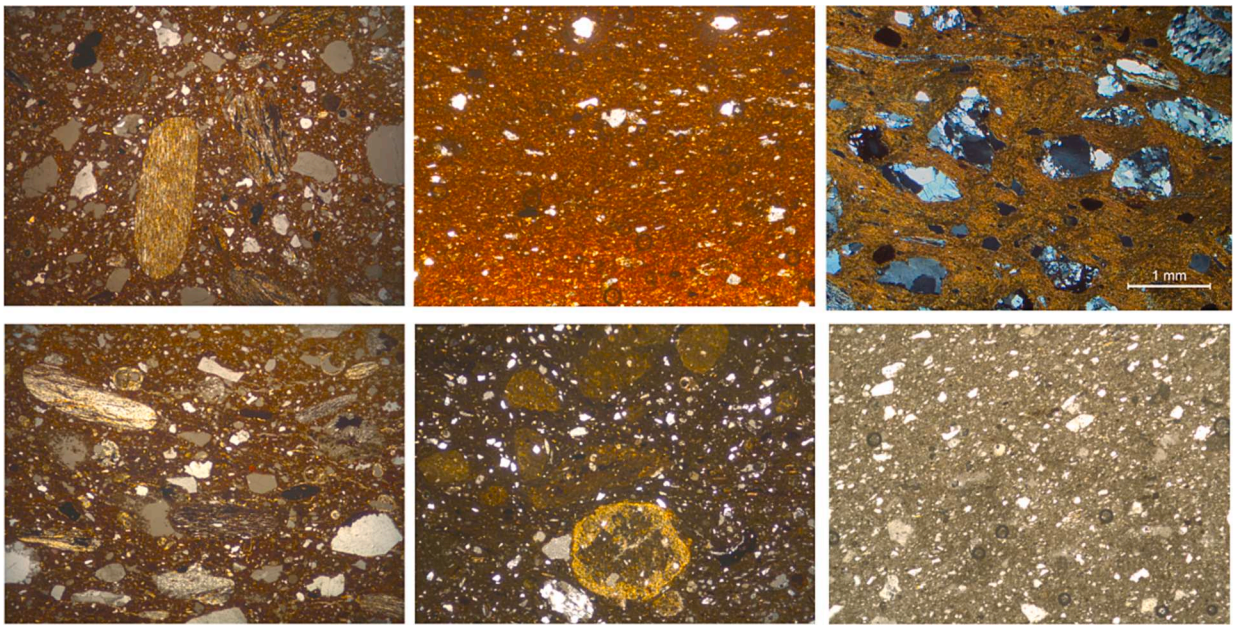

Fig. 3. Photomicrographs of the local fabrics, XP (x25), FoV: 6 mm; a) Class A: red metamorphic fabric (coarse), b) Class A: red metamorphic fabric (fine), c) Class B, coarse sand-tempered fabric, d) Class C, coarse calcareous fabric with metamorphic rocks and clay pellets, e) Class C, semi-fine calcareous fabric, f) Class D, the fabric of the Kydonian workshop.

presence of clay striations and clay pellets (Fig. 3d). The non-plastic inclusions consist of monocrystalline quartz, biotite mica, very few low-grade metamorphic rock fragments, namely phyllite and quartzite, and rarely micritic limestone. The red clay component is compositionally and texturally similar to that seen in the red fabrics of Class A and, therefore, is compatible with the Phyllite-Quartzite series of Chania. The marl component could derive from the Neogene marls on top of which Chania is situated and contains microfossils and, in some cases, micritic limestone. Subgroup *C*2 is characterized by an exclusively calcareous clay (Fig. 3e). The main non-plastic inclusions are small fragments of monocrystalline quartz, and very few to absent microfossils, polycrystalline quartz and phyllite fragments. In terms of shapes, Class C1 comprises all sorts of storage and transport vessels, stirrup jars and finer drinking and serving shapes. Class *C*2 only includes fine drinking and serving vessels and it is not used in the production of coarse wares. In Class C there are no cooking wares as vessels with high calcium content cannot withstand repetitive exposure to heat.

CLASS D comprises a single fabric group which represents a characteristic pottery style that stands out from the rest of the ceramic assemblage in terms of typology and composition. It is the buff, almost white-firing fine pottery known as the Kydonian workshop (Tzedakis 1969). Petrographically it is also distinctive: a rather fine gray greenish siliceous fabric characterised by the densely packed fragments of quartz (Fig. 3f). The shape repertoire includes drinking and serving vessels, some with dark-on-light decoration, others plain. There are cups, goblets, kylikes, bowls, ladles, jugs, and kraters, as well as small stirrup jars. It is worth mentioning that the Kydonian workshop does not produce conical cups; these common and easy to make, occasionally single-use, drinking vessels occur equally in the red fabrics of Class A as well as in the calcareous fabrics of Class C, but not in the fine high quality kydonian fabric. A possible explanation for this exclusion might be that the shape repertoire of the Kydonian workshop only included more prestigious types, or sets of vessels, decorated or plain, and conical cups were not part of these assemblages.

4.2. Imported pottery

Stylistic and petrographic analyses of the ceramic material identified several on– and off-island imports (Table 3). The great majority of the Cretan imports are characterised by a fine calcareous fabric, with non-plastic inclusions consisting of a mixture of high (biotite gneiss) and medium grade (quartzite and phyllite) metamorphics as well as rare volcanic (basalt) and sedimentary (siltstone) rock fragments. This mineralogical composition reflects the Ophiolite series and the Flysch mélange (Fig. 4a) of south-central Crete whereas parallels for this fabric indicate an origin in the plain of the Mesara and most likely the broader area of Hagia Triada (cf. Day et al. 2011, 528; Nodarou 2015, 347, 356) in south-central Crete. The vessels are all transport jars and date from LMIIIA1 to LMIIIB2.

A stirrup jar of LM IIIA2 date represents a rather rare import in west Crete: it is made with a fabric containing granodiorite (Fig. 4b) that is connected with the area of Gournia/Kalo Chorio in the northern part of the Ierapetra isthmus and the bay of Mirabello (e.g. Day et al. 2005; Nodarou 2007; 2010; Nodarou and Moody 2014).

With regard to the off-island imports, the most numerous fabric group is characterised by mica-rich metamorphic rock fragments set in a red, micaceous groundmass (Fig. 4c) (Fouriki 2021). The mineralogical composition as well as the published parallels leave no doubt as to the connection of this fabric with the island of Kythera (Broodbank and Kiriatzi 2007, 249; Kiriatzi 2003, 125). The vessels represented comprise all kinds of medium-sized closed and open containers and a single tripod cooking pot (Fouriki 2020); they cover all phases of the Final Palatial and Postpalatial period.

The calcareous mudstone-tempered fabric (Fig. 4e) is characterised by angular mudstone fragments, some are radiolarian, as well as a few chert and quartz fragments. Although the mineralogy is not distinctive of origin it originates most likely from Kythera as indicated by the published parallels (for parallels from Kythera: Kiriatzi 2003, 125; from Antikythera: Pentedeka et al. 2010, 34-39). This fabric is more shape- and date-specific than the micaceous fabric from Kythera: it is encountered only in amphorae and closed containers, and the vessels represented belong to the LM IIIB period (Fouriki 2021).

Lastly, two tripod cooking pots of LMIIIB1 date are made with a fabric consisting of andesite and its constituent minerals (Fig. 4f). The mineralogical composition is compatible with the geology of the island of Aegina (cf. Gauss and Kiriatzi 2011, 9; 94–95). The identification of Aeginitan imports in Chania is of great importance since this is the first time that the presence of pottery from Aegina is attested (petrographically) in a Minoan assemblage from Crete (Fouriki 2020; 2021).

Table 3
The imported pottery: fabrics, shapes, and suggested origin.

Fabric	Vessel shape/nr of samples	Suggested origin
Ophiolitic	Closed vessel (4) Amphora (1) Stirrup jar (1)	South-central Crete (Mesara)
Granitic-dioritic	Stirrup jar (1)	East Crete (Mirabello)
Mica-schist	Jug (3) Open vessel/basin (3) Tripod cooking pot (1) Closed vessel (1)	Kythera
Mudstone-tempered	Amphora (1) Closed vessel (1)	
Andesitic	Tripod cooking pot (2)	Aegina

5. Discussion

The petrographic analysis of the three ceramic assemblages revealed some interesting trends for the pottery from Chania. Regarding the vessel-function relationship, the red non-calcareous fabrics (Classes A and B) are used in the manufacture of large-sized, coarse vessels, equally for cooking and storage/transport purposes. Special reference should be made to the cooking ware: the stylistic study identified three different shapes, the tripod cooking pot, the cooking dish and the cooking tray, all made in both the red non-calcareous and the sand tempered fabric. The most obvious interpretation is that the two fabrics represent different workshops using each their own recipe for the production of the same array of cooking wares, although we cannot exclude the possibility that a workshop could have used both fabrics at the same time.

The use of red non-calcareous recipes (Classes A and B, the coarse variants) for cooking wares is easily explained by the natural properties of the red clays: Müller, Hein and co-workers (Hein et al. 2009; Müller et al. 2009, 2013) have arguably shown that the thermal conductivity of the red clays is much higher than that of the calcareous raw materials. Moreover, the red sediments of Chania are naturally rich in coarse inclusions that improve the thermal shock resistance of the cooking pots that have to withstand repetitive contact with fire.

On the other hand, the medium- and small-sized, fine and semi-fine pots used for storage, transport, serving and drinking purposes are equally encountered in three different classes: ca. 1/3 in red non-calcareous fabrics (Class A, the fine and semi-fine variants), 1/3 in calcareous fabrics (Class C) and 1/3 in the fabric of the so-called Kydonian workshop (Class D). The latter stands out and is easily identifiable stylistically and technologically due to the characteristic whitish surface and the gray-greenish siliceous fabric that is not encountered in any other type of fine pottery. It seems evident, therefore, that there is a standardized way of manufacture of this very fine pottery followed by a single or only a few centers of production.

The second of the questions set in the beginning was about possible continuity and discontinuity from the LM IIIA to the LM IIIB period. The analysis showed that, although the typology and the decorative styles slightly change, there is strong continuity in the clay recipes, which is

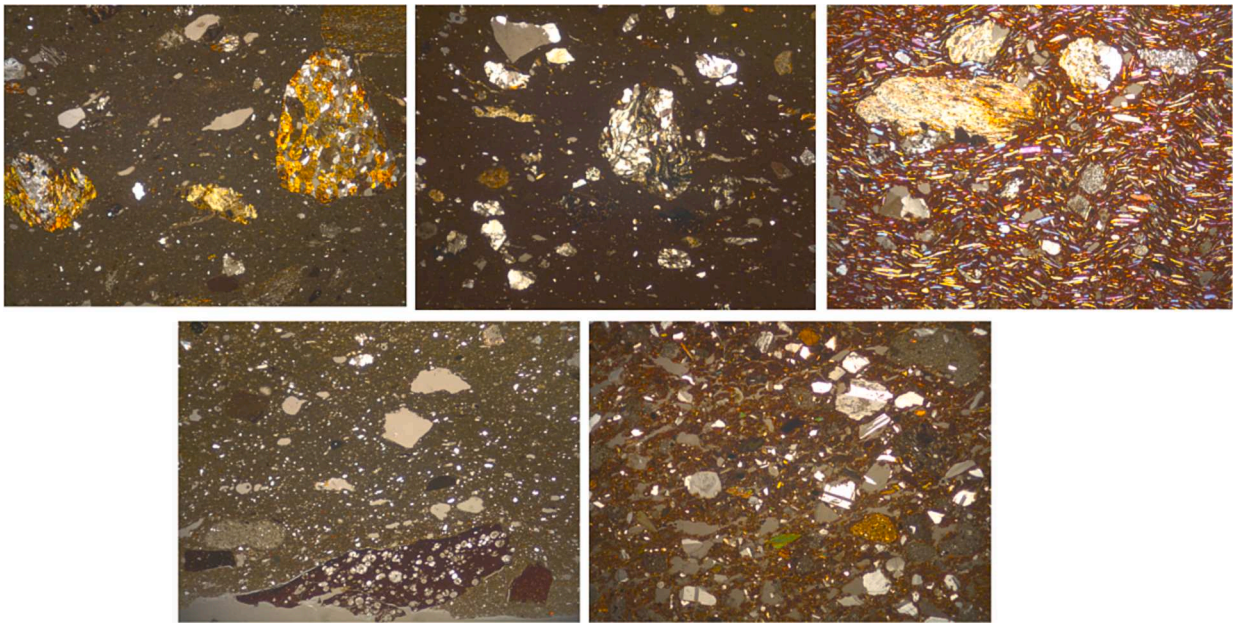

Fig. 4. Photomicrographs of the imported fabrics, XP (x25), FoV: 6 mm; a) Ophiolitic fabric, import from the Mesara, b) Granitic-dioritic fabric, import from east Crete, c) Mica-rich fabric, import from Kythera, d) Mudstone-tempered fabric, import from Kythera, e) Andesitic fabric, import from Aegina.

most likely due to the availability and the natural properties of the local raw materials. Imports (especially the micaceous pottery from Kythera) are common throughout the LM III period but seem to get intensified in the LM IIIB, as indicated by the presence of the Aeginitan cooking pots in the assemblage.

With regard to pottery consumption within Chania the local fabrics are encountered in all three assemblages, in the settlement as well as in the cemetery. For the imports the pattern is different: closed vessels (especially stirrup jars) from south-central Crete as well as all sorts of shapes from Kythera are found only in the contexts of the settlement whereas the rare imports from east Crete and Aegina derive from the Greek-Swedish excavation. This pattern should be treated with caution and is subject to change because the ceramic material from the Lionaki-Vlamaki plot and the pottery from inside the shaft cemetery are still under study.

When the data from Chania is compared to what is known from other areas of Crete (mainly east Crete where there is more analytical data available), it appears that there are common choices in the clays used for vessels of different function: the pattern of cooking wares being manufactured with non-calcareous and storage/transport containers manufactured with calcareous clayey materials is common across the island and this relates to the natural properties of the clays. The manufacture of fine vessels using calcareous marly clays is another common characteristic also due to the natural properties of the clays and the fact that the decoration stands out better when applied on a buff background.

The main difference between Chania and other sites on Crete is the presence of the Kydonian workshop; nowhere else in Crete is there a workshop producing such characteristic fine pottery in the LM III period. The whitish surface is easily recognizable macroscopically when found as an import even on undecorated vessels. In the LM III period the products of the Kydonian workshop witnessed a wide distribution not only in Crete but also in the Cyclades, the Greek mainland, Sardinia, Cyprus, Canaan, Syria and Egypt (Andreadaki-Vlazaki 2015, 28; Hallager 2010, 156; 2017, 47–49).

The last comment concerns the broader role of Chania in the trade networks of the period. The material evidence from the settlement as witnessed in the plethora of imports as well as the chaniote imports elsewhere confirm the nodal position of Chania in intra- and inter-island trade routes. Transport vessels from south-central Crete at Chania and the wide distribution of Kydonian pottery in the centres of the Mesara (Hallager 2010, 157, fig. 11.2) reflect regular contacts between the two areas. Contacts with east Crete are more unilateral with east Cretan pottery being very rare at Chania and the products of the Kydonian workshop being common in the east (e.g. Langohr 2017, 226-227). It appears that Chania mainly exported the fine high quality and craftsmanship pottery of the Kydonian workshop and received coarse transport jars for their content.

As to the off-island imports, Kythera seems to be the site *par excellence* with which Chania maintains regular contacts: two fabrics originating form Kythera have been identified and they are encountered in significant numbers and all classes of pottery. The presence of Aeginitan cooking pots, although rare, indicates a trade route extending from Chania through Kythera along the east coast of Peloponnese to the Saronic gulf. This picture stands in contrast to what is known from east Crete where major sites such as Mochlos and Petras receive pottery from areas in the southeast Aegean, such as Kos (Morrison et al. 2022). This difference reflects the complexity of trade networks during the LM III period and the amount of work needed in order to trace and understand them.

CRediT authorship contribution statement

Stavroula Fouriki: Conceptualization, Methodology, Writing – review & editing. **Eleni Nodarou:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

I have included photos of my samples which form the data source.

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