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ARCHAEOLOGICAL AND ARCHAEOMETRIC APPROACHES TO THE STUDY OF BYZANTINE POTTERY FROM CRETE

By Eleni Nodarou and Natalia Poulou-Papadimitriou

Recent excavations of Byzantine sites on Crete and their subsequent publications, as well as a plethora of specialized studies, reflect a renewed interest in the Byzantine pottery from the island. When these studies are combined with archaeometric analyses they offer more synthetic approaches and interesting interpretations. The excavation of well-stratified sites and the study of other classes of material such as the lead seals and the coins have contributed greatly to a more secure dating of the pottery and a better understanding of the economic and trade activities of the various sites in Crete during the Byzantine period. In light of these developments, a 2-day scholarly meeting on the study of Byzantine pottery from Crete was held in Pacheia Ammos, combining new data, theoretical approaches, and a hands-on practical on pottery and ceramics petrography (Figure 1).

Figure 1. Workshop participants hope to meet again for another session next year.

The meeting was organized by Associate Prof. Natalia Poulou-Papadimitriou (Aristotle University of Thessaloniki) and Dr. Eleni Nodarou (INSTAP-SCEC). The response to our call for participation and presentation of new material was overwhelming: forty pottery specialists from all the Byzantine Ephoreias of Crete and from foreign schools came to Pacheia Ammos. The first afternoon was devoted to presentations of new material. For this purpose we used the renovated Customs' building at Pacheia Ammos, kindly provided by the president of the village, Mr. G. Rapanis (Figure 2). The Director of the INSTAP Study Center, Dr. Thomas Brogan welcomed the participants and N. Poulou-Papadimitriou gave an overview of the study of Byzantine pottery of Crete (Figure 3). She stressed the importance of the transitional period, i.e. the 7th to the 9th centuries, and discussed the problem of identification of pottery dating at the period of the Arab occupation. E. Nodarou presented the EU-funded program "Pythagoras II" which was devoted to the study of four Byzantine sites on Crete (Pseira, Gortyn, Itanos, and Eleutherna) and involved c. 500 thin sections. Two papers were devoted to the recently excavations at Priniatikos Pyrgos: Dr. Vera Klontza-Jaklova (Masaryk University) presented a thorough analysis of the stratigraphy stressing the presence of local and imported wares as well as the coins found during the excavation indicating the importance of the site from the Early Byzantine to the 12th century. Dr. Elli

Figure 2. The audience in the old Customs Building at Pacheia Ammos.

Figure 3. Dr. Thomas Brogan welcoming the participants and Assoc. Prof. Natalia Poulou-Papadimitriou.

Tzavella (University of Leiden) focused on the amphorae of the transitional period (the 7th to the 9th centuries): she discussed locally produced and imported shapes and presented corroborating evidence for their dating, namely a milliaresion of Leo III and a lead seal of the 8th century. The coffee break by the sea was refreshing before Assistant Prof. Maria Xanthopoulou (Univ. of the Peloponnese) presented aspects of the Byzantine pottery from Itanos with special reference to local and imported wares of the end of the 7th to the 8th century. Prof. Isabella Baldini (Univ. of Bologna), with the assistance of Dr. George Brokalakis, discussed the study of material from the Episcopal church of Mitropolis stressing continuity of the activities until the end of the 8th century. Last but not least, the Director of the 13th Ephorate of Byzantine Antiquities, Dr. Vasiliki Sythiakaki, in collaboration with the archeologist N. Vasilakis, presented the finds from the ongoing excavation of a Byzantine cemetery at Hersonisos. The evening closed tastefully with traditional Cretan flavors at Monastiraki.

The second day was devoted to the pottery. The participants had the opportunity to examine selected Early Byzantine pottery from the island of Pseira and a few objects from Mochlos (Figure 4). N. Poulou guided them through the labyrinth of typology and chronology and discussed possible imports and trade routes. Then E. Nodarou presented the results of the petrographic analyses on the Byzantine pottery across Crete and the participants acquainted themselves with the petrographic microscope. The meeting ended with a glass of raki and the wish to meet again next year somewhere else in Crete.

Figure 4. Hands-on pottery practical at the SCEC.

EXCAVATION OF THE EARLY IRON AGE SETTLEMENT AT AZORIA

By Donald C. Haggis and Margaret S. Mook

Figure 1. B3500: Sondage from the east, showing Archaic cobble fill and spine wall construction.

A goal of the Azoria Project has been to recover and document the remains of a city occupied during the 7th through early 5th centuries B.C., encompassing a period that remains a mysterious gap in the archaeological record, characterized rhetorically and dramatically in the literature as a "period of silence," or "second Dark Age." While recent scholarship has finally shifted its emphasis from historical explanations to account for the apparent lacuna in the 6th century to archaeological questions of systemic discontinuities in material patterns, work at Azoria set out to reassess evidence for sociopolitical change on the island, the character and duration of Early Iron Age (EIA) occupation, and the meaning of stratigraphic discontinuities at the end of the period. The main research questions of the Azoria Project center on how the Early Iron Age cultural landscape changed at the end of the period, after an apparently protracted phase of stable development, ultimately affecting the form of the Archaic settlement. In a sense, work at Azoria represents a study of Iron Age settlement structure in the Kavousi region, examining stratigraphic discontinuities as the basis for reconstructing changing regional sociopolitical structures. Although our approach involves the examination of new configurations of houses and communal buildings—the archaeological evidence for changes in social and economic behavior in the latter 7th century B.C.— to understand the implications of culture change, requires exploration of the Early Iron Age occupational sequences.

Figure 2. B800: Late Minoan IIIC Building from the south.

Excavations at Azoria were reopened in 2013 for the purpose of studying the transition from the Early Iron Age to Archaic periods; the chronology and character of a significant horizon of rebuilding on the site at the end of the period; and the pattern of the Early Iron Age activity on the site and in the region. While there is evidence for Final Neolithic and Early Minoan III occupation at Azoria, previous work in 2002–2006 demonstrated an initial foundation date for the settlement in Late Minoan IIIC, and continuous occupation through the Early Iron Age and Orientalizing (O) periods. Excavations have succeeded in exposing parts of the Late Minoan (LM) IIIC and Late Geometric (LG) settlement, stratified occupation layers underlying Archaic buildings across the southwest slope of the South Acropolis. Although Archaic foundation deposits typically contain EIA material, indicating that most of the area of the peaks and upper slopes of the site were occupied in these periods, it remained to explore the extent, structure, and chronology of these various occupation phases. This stratigraphic work forms the focus of the current stage of excavation at Azoria.

The task has not been easy. In terms of spatial extent, both excavation and survey have demonstrated that in LM IIIC the site was substantial, encompassing an area of about 6.0–9.0 ha—indeed considerably larger than the neighboring EIA villages of Vronda and Kastro, which probably did not exceed a hectare in size. What we normally find in stratigraphic soundings conducted so far is that the Archaic builders in the latter half of the 7th century dug aggressively into the hillsides in efforts to modify the terrain, effectively destroying or otherwise burying EIA and Orientalizing (O) buildings. That is to say, the early Archaic period is characterized by a significant cultural change and stratigraphic horizon—a dynamic restructuring of the landscape, marking a transformative phase transition in the history of the settlement. Terraces were substantially reconfigured and new foundations consist of massive spine walls and deep and densely-packed deposits of cobble-sized stones, normally over a meter deep, and containing LM IIIC–EO pottery. We excavated a number of such structured cobble fill deposits in 2013, in efforts to understand technical aspects of planning and constructing the Archaic settlement, as well as to determine the precise date of this stratigraphic horizon—which we correlate to a site-wide phase of constructing new houses and civic buildings (Figure 1).

Such foundation deposits also encapsulate the remains of earlier buildings, building phases, and sequences of occupation. One such structure was exposed in a sondage in B800, on the upper southwest slope, at the western edge of the agora—in the space behind the east wall of the Archaic Service Building (B1500-B700). The expansion of this sounding in 2013 revealed the dense cobble fill, with the expected range in dates from LM IIIC to the 7th century, as well as a well-preserved LM IIIC building (Figure 2). The limits of the structure on the south were not reached in 2013, but the excellent preservation of the walls and stratigraphy suggests the continuation of the building along the terrace in this direction. As excavated, the building is substantial, some 4.0 m long (north-south) and 2.0 m wide. On the interior, underneath the cobble fill level, a layer of roofing material and wall collapse was exposed sealing a hard-packed clay floor surface.

The walls are well preserved, notwithstanding the modification of this terrace during the Archaic building phase. The foundations stand to about five courses of small to large boulders (ca. 1.20–1.50 m in preserved height; 0.60–0.80 m in width). There is a stone platform or stand in the northeast corner—a single large stone with a slight depression contained a concentration of pebbles, and next to it, a stone pot lid. There were also patches of ash and discolored clay that indicated burning on the floor in front of the stand. Traces of ash were found as well in the middle of the room, along with fragments of an LM IIIC tripod cookpot and cooking tray.

The deep Archaic cobble fill extended behind the walls of the building on the north and east, effectively concealing but also preserving the integrity of the foundations. The unusual depth and condition of the occupation debris in the room suggest little later EIA use of the structure. This could mean that either that the building was abandoned and left exposed into the 7th century, up to the time of the filling of the terrace during the construction of spine walls, or more likely, that the Archaic builders excavated down to the building, disturbing later phases of use, but choosing to leave its earliest architecture intact. The presence of Late Geomteric (LG) and Early Orientalizing (EO) material in the

cobble fill layer confirms the existence of later occupation phases that were likely destroyed during the reconstruction of the terrace at the end of the 7th century.

It has been challenging to sort out the spatial extent and structure of PG-EO phases at Azoria. In 2006, for example, on the southwest slope, we recovered an LM IIIC tholos tomb underlying an Archaic street. The tomb contained several intact Protogeometric burials belonging to its final use phase. Our initial assumption was that this tomb, and thus an extra-mural cemetery, should mark the furthest western limits of the EIA settlement, though this would suggest a settlement size considerably more contracted than that indicated by the distribution of visible LM IIIC surface pottery. Immediately west and downslope of the tomb, however, excavation also exposed the southeast corner of a large LG-EO building, clearly a substantial structure, using boulders in the foundations of its east and south walls. This monumental construction demonstrated conclusively that the PG tholos, certainly visible throughout the 8th and 7th centuries, did not mark the western edge of the LG settlement. Its presence within the settlement has confounded our assumptions of the structure of the site in the period.

Moreover, on the same terrace, lying to the north of the PG tomb along the same contour, is yet another substantial EIA building. In 2006, we revealed the south façade of two rooms of this structure, called in earlier reports the "EIA-O Building." The walls and main rooms clearly extended northward under an unexcavated modern agricultural terrace, and an exploratory excavation at the base of the wall in the building's south room exposed a neat sequence of LG–EO occupation levels overlying an even earlier clay surface. This EIA-O building, apparently of unusual size, preservation, and duration of use, was the main focus of our stratigraphic excavation in 2013.

In 2013, we exposed the basic form and LG–EO phases of the building (Figure 3). It consisted of five rooms: a southernmost room (B3900) was evidently the entrance—perhaps a vestibule or prothalamos—which we had partially uncovered in 2006. In the 7th century, this room was remodeled, narrowed on its east side by a diagonal wall, and a stair was inserted in the room's southeast corner, providing access to a raised courtyard space on the east, providing access to a long east room in B4000. A well-built doorway connected this south room to the building's main room (B4100), which was a single hall with a central hearth

Figure 3. EIA-O Building (B4400, 4100; 4000) from the northwest.

Figure 4. B4100: EIA-O Building from the south

Figure 5. B4000: View of room from the south

in its earlier phase (LG), and then subdivided into two rooms in its later phase (EO). The back or northern room of the building (B4400) was built up against a bedrock outcrop and accessible from the main room through a doorway at the east end of the dividing wall. Finally, a fifth room, the east room (B4000), was a narrow elongated hall, apparently added onto the building in the 7th century phase, though it could have an earlier foundation. It was accessible through a doorway and courtyard at its southern end, mentioned above, and thus communicated with the main rooms from the outside of the building on the south. A potter's kiln was constructed within the northern end of this east room.

The EIA-O Building is unusually large, carefully constructed, and enjoyed a long use life without significant modification until its 7th century phase. It is about 10.0 m long and 8.0 m wide in its internal dimensions. It was subdivided into two rooms in its earliest phase (B4100 on the south and B4400 on the north), and four rooms in the 7th century. The main room (B4100) of the building had complex stratigraphy. A deep layer of stone debris and very dark soil, containing a large amount of pottery and animal bones, covered most of the area of B4100. This dark soil appears to be the remains of an Archaic-period dump, perhaps accumulating over a long period of time in the course of the 6th and 5th centuries while the adjacent terrace to the east (B4000) had a street running along the contour above the building and directly over the narrow room in B4000. The presence of this Archaic dump within the exposed walls of an abandoned EIA building is unusual on the site—normally the architecture of such early structures is carefully concealed, buried by cobble fill, as in the case of the LM IIIC building in B800 mentioned above.

Below this dump layer, we discovered a remarkably uniform deposit of cobbles, about 30 cm deep—in size, shape, and distribution, looking very much like the Archaic cobble fill we normally find in foundation deposits across the site. This stone fill extended across the full extent of the internal space of the building, also forming the foundation for a small buttressing wall or screen wall in the southeast corner of the main room, evidently installed to support the south segment of the room's east wall, which had at some point slipped to the west, perhaps bowing under the weight of the fill and packing for the Archaic street in on the east. It appears as if the layer of cobble fill was originally deposited as part of a filling episode, perhaps for the foundations of an Archaic building project, but then abandoned, and left exposed to collect the dumped debris.

Below this cobble layer, a 10–20 cm stratum of occupation debris was found distributed across a narrow patch of a clay floor surface in the eastern side of the room. This floor, representing the latest use phase of the room, was extant for some 2.0 m on the south (in the southeast corner of the room, narrowing to about one meter from the east wall). Because of erosion, the surface does not survive across the full spatial extent of the room, but enough of it was recovered along the east side to indicate that it was part of a significant renovation phase in which the floor level of the room was elevated, and subdivided into two rooms by means of a cross wall and connecting doorway on the east. The renovation of the room and surface belongs to the Early Orientalizing period.

The material exposed underneath this 7th c. floor level consisted of a deep stratum of floor packing, dense stone debris, and roofing clay, covering another earlier clay floor surface—this floor represents the earliest occupation phase so far recovered in the building. The floor is remarkably even and well-consolidated, and though there are patches of burning, they are probably

indications of cooking activities. The surface is preserved across the entire area of the room, underlying the later cross-wall segments, though it is best preserved in the south. In the center of the room there was a hearth of burned clay, roughly rectangular in dimensions (ca. 1.0 x 0.5 m), though partially obscured by the later cross wall. To the southeast of the hearth is a stone post support (Figure 4).

This LG-EO room was an impressive space nearly square in shape, 6.50 m long (north-south, interior dimensions) and 6.0 m wide (east-west) with the hearth centered in the east-west axis, about 3.80 m from the south wall, so slightly north of center on the north-south axis. Almost 40 square meters in area, the room was substantial, with a well-fashioned doorway leading south into the vestibule (B3900), which served as the prothalamos or front room of the building. A doorway in the north (about 1 meter wide) led over a threshold block into B4400, the north room of the building, which apparently used the same floor level continuously through two major phases of occupation with little significant change. The floor of the northern room is well preserved across the central and eastern parts of the room. The room is 2.70 m wide (north-south), and extant to some 5.0 m east-west. The absence of a stratigraphically distinctive floor surface, at the level of the later floor in the adjacent rooms to the south, along with the stepped transition through the doorway, suggests that the room's floor continued in use, with some evident resurfacing through various periods of occupation.

The east room of the building (B4000) is a long hall-like space, bordering the entire east side (Figure 5). It represents a modification of the EIA-O building in 7th century. In this phase, the south room or vestibule in B3900 was truncated, its southeast corner removed, and a diagonal wall, put in its place, narrowing the space, but expanding the area on the east side, whose ground level was raised to provide access to the east room of the building. This east room is 9.20 m long (north-south) and about 1.80–2.0 m wide, with the space widening slightly at its southern end. Narrowing at its northern end (to about 1.5 meters), the room contained the chamber of a potter's kiln (Figure 6). The kiln occupies about 3.5 m of the northern end of the room, marked on the south by an aperture to the stoking chamber and stepped access to the door of firing chamber, which is no longer preserved. The stratigraphy of the room is complex and important in evaluating and dating the transition from Early Orientalizing to Archaic periods.

In the 6th and early 5th centuries, the entire area of this room was systematically filled in and covered by a street running along the contour of the southwest slope above the Southwest Buildings and immediately below the Service Building (Figure 7). We orig-

Figure 6. B4000: Potter's kiln from the southeast.

Figure 7. B4000: Archaic street and cobble packing from the south.

inally exposed part of this street in the adjacent trench (B3000) to the south in 2006. We continued excavation to the north in efforts to expose the full extent of the street surface running below the Service Building. Excavation in 2013 revealed the upper surface of the street, a packing or resurfacing level, and underneath, an earlier street level. Underlying the earliest street and packing, was a 30 cm-deep layer of Archaic cobble fill (Figure 7). Occupation debris underlying the cobble fill consists of the abandonment-phase deposition within the 7th century room. Roofing material, occupation debris, and wall collapse, mixed with localized indications of burning, were found throughout the room. A number of whole vessels were found on the floor along the east side—including a small cookpot, two short necked cups, a hydria, a coarse plain krater with an inscription, and an aryballos.

The stratigraphy of the area over the kiln, in the north part of the room was a bit different. While the Archaic street extended over this area, stepping up slightly with a single-course step in the street, the cobble fill consisted of densely packed large cobbles and small boulders, overlying a thick layer of greenish gray phyllite clay—similar in consistency to roofing material, but possibly serving as leveling fill raked across the area and used as bedding for the cobble fill.

Excavation underneath the cobble fill exposed the kiln's stoking chamber, which contained a mixture of ash, and ashy and burned soil (Figure 6). The kiln's clay floor—that is the actual floor of the firing chamber—and wall lining do not survive, though small patches of red clay are visible on the north and east walls, and adhering to the central pillar or post, while fragments of the floor itself were found within the stoking chamber. The base of the central pedestal consists of two boulders, standing about 0.5 m high, though the floor of the stoking chamber was not reached in 2013. The kiln's north and east walls stand to a preserved height of about 1.5 m. The east wall of room B4000 has a regular and well-constructed face, though a change of construction is visible at the point of the kiln's entrance. Here the east wall abuts two large boulders, apparently stacked, and protruding into the space of the kiln's chamber, and the even coursing is discontinued at this juncture—forming a distinctive curve around the back of the building and extending along the north to form the wall of the firing chamber.

The stones lining the stoking chamber and the walls of the firing chamber are burned, in some cases calcined, and stained with a black and gray powdery ash. Though the floor of the kiln does not survive, fragments were found within the stoking chamber. Its position can be estimated by a line of ash, which corresponds to the top of the step at the entrance. Fragments of both wasters and pisé lining of the walls and floor have been recovered from the stoking chamber and adjacent contexts.

The function of the EIA-O Building is not certain, and an analysis and interpretation of the structure must await a complete study of the ceramic, faunal, and plant assemblages from the various phases of use, as well as further excavation within the building itself. It is clear, however, that the earliest floor surface recovered was used continuously from LG into EO, and in a transitional phase in the 7th century the rooms were largely cleared of their contents, perhaps recycled and moved to other areas of the site before abandonment. Only the east room (B4000) preserves an assemblage of mostly complete vessels, evidently buried at the time of the construction of the first street at the end of the 7th century. Why the rest of the building remained only partially filled-in, with its architecture left mostly exposed, is not yet clear and will require further consideration. The taphonomy of the building however represents a marked departure from patterns observed elsewhere on the site, where EIA structures appear to have been destroyed or completely concealed by Archaic filling and building operations.

The large size of the EIA-O Building, its complex plan, regularity of construction, and integration of a pottery kiln within the building are unusual features for normal domestic space, as is its close proximity to the LM IIIC-PG tholos tomb, lying a few meters to the south of the entrance. Moreover, excavation in 2006, in the courtyard and doorway of the east room, discovered a substantial hearth or pyre deposit—a dump of burned animal bone and fine drinking wares, representing multiple periods of use (EIA-EO) and suggesting accumulated debris from ritual, drinking, and dining episodes. Thus the evidence, while not conclusive, presents characteristics of a special-function building used for dining and drinking, over extended period during the Early Iron Age, and left mostly intact during the rebuilding of the site at the end of the 7th century. As we have emphasized in earlier reports, the plan and dimensions of the main structure are not inconsistent with the form of known Early Iron Age hearth temples.

A new phase of excavation at Azoria, begun in 2013, has allowed us to begin piecing together a picture of the Early Iron Age town underlying the 6th-century settlement, and new evidence for reconstructing details of culture change in the transition from Early Iron Age to the Archaic period. The site has produced not only a palimpsest of these earlier occupational levels, but clear indications of continuous occupation for several centuries until an abrupt phase transition in the late 7th century transformed the Early Iron Age topography and cultural landscape. For the most part, the Archaic builders sought to bury these earlier settlement remains—the Archaic street constructed along the southwest slope is a remarkable example of this process: the east room of the EIA-O Building was completely filled in preserving but also concealing its contents and architecture. In general the placement of Archaic buildings seem to have avoided using EIA walls for their foundations, and never does the orientation of the earlier architecture seem to predict or guide the structuring of space in the late 7th and 6th centuries. While some buildings were destroyed in the process of rebuilding the settlement, for the most part it appears as if the earlier structures and occupation debris were contained or integrated into the Archaic foundations, as if intentionally preserved but effectively concealed by the new urban plan.

This dynamic alteration of the landscape at the end of the 7th century involved a deliberate manipulation of the artifacts and features of the Early Iron Age settlement. We have demonstrated elsewhere that this physical engagement with the earlier settlement involved recovering and removing earlier objects, such as pottery, figurines, iron slag, and other artifacts from their original context, and then relocating and reintegrating these things into the buildings of the Archaic city. The construction of the Archaic city required not only new buildings and a new settlement form and structure, but an active and dynamic engagement with the past—the places and buildings—which involved a series of conscious decisions to retranscribe the deeply stratified Early Iron Age settlement into the Archaic landscape. The Archaic city was in a sense not merely superimposed on earlier structures, but its creation was an active negotiation with the past, in many ways, a recognition, reaffirmation, and recreation of the EIA systemic contexts of households and communal places that find new forms in the Archaic city center.

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ANALYSIS OF GRANODIORITE POTTERY OF THE VROKASTRO AREA FROM THE FINAL NEOLITHIC PERIOD TO MODERN TIMES

By Eleni Nodarou

This project concerns the analysis of granodiorite pottery found during the intensive survey of the Vrokastro area carried out by B.J. Hayden and J.A. Moody (Hayden 2004; Moody 2005). This analysis constitutes the second stage of a larger project on granitic/dioritic raw materials and archaeological artifacts in the area of the Mirabello Bay. The first part of the project involved an extensive survey and sampling of the geological formations outcropping in the area and comparison with the stone implements. The preliminary results of this research have been published by Dierckx and Tsikouras (2007).

The framework to the project

In an area like Crete, "provenancing" the pottery is rather problematic due to the repetitive character of the geology and the existence of similar geological formations across the island. The area of Mirabello constitutes an interesting exception; it is the "homeland" of a macroscopically distinct pottery fabric consisting of a red- or buff-firing clay paste and characteristic black and white non plastic inclusions which look like grains of "salt and pepper" (Haggis and Mook 1993; Haggis 2005, 169). This composition represents the acid igneous rock outcroppings in the area of Mirabello, i.e. granite, diorite, granite-diorite, hence the name "Mirabello fabric." These outcrops are encountered only in this part of East Crete. The clay paste is fairly characteristic macroscopically and microscopically, and it has been relatively easy to identify grano-diorite pottery when encountered in an assemblage, leaving no doubt as to its origin. Since provenance is not the issue, the aims of our project are a) to identify the compositional variation within the grano-diorite fabric, b) to define the technological aspects of its production within the area of the Mirabello, and c) to investigate variation in time.

Pottery analysis

The analyses carried out over the years identified two main recipes, one for cooking wares, the other mainly for medium-sized transport and storage vessels. The former is characterized by a red-firing clay and white angular inclusions consisting of granite fragments. The latter is characterized by a dark red firing matrix in which the non-plastic inclusions have been added as temper; they consist mainly of diorite fragments with less granite (see Georgotas below for comparison with experimental briquettes). A rather prominent component is also the red clay

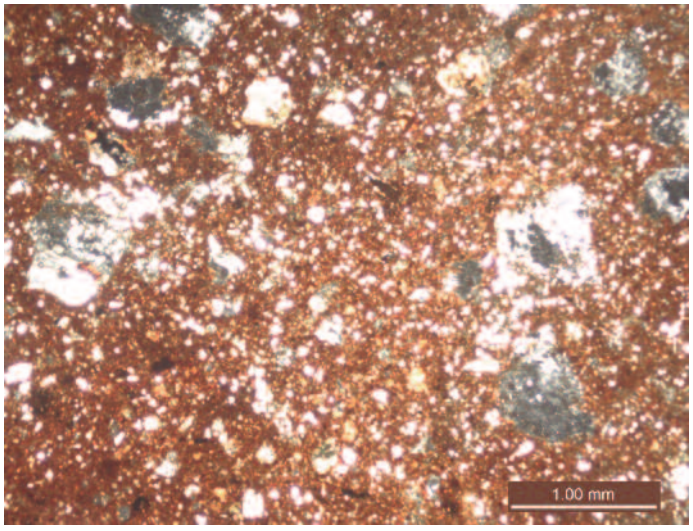

Figure 1. Cooking fabric with weathered granodiorite.

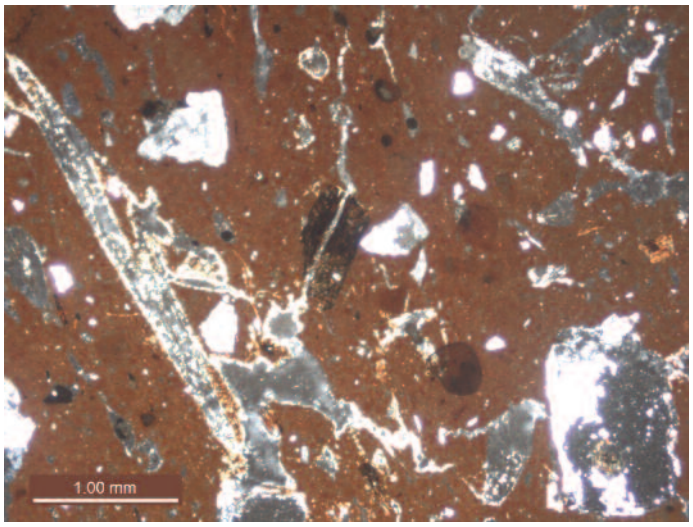

Figure 2. Pithos fabric with characteristic voids indicative of tempering with organic matter.

pellets occurring regularly in this fabric.The detailed macroscopic study of the granodiorite pottery from the Vrokastro survey was followed by extensive sampling and petrographic analysis in order to identify potential differentiation and change in the clay recipes used for the manufacture of this pottery from the Final Neolithic to modern times. Special emphasis was given to the pottery of the historical periods since the presence of the granodiorite fabric(s) has been only sporadically mentioned.

The analysis demonstrated that there are differences in the nature of the raw materials, the mineralogical composition and the granulometry of the granodiorite fabrics (Nodarou and Moody 2014). This variation relates in some cases to the chronology of the vessels, in others to their function. Two examples of characteristic recipes are the presence of a very weathered type of granite in the pottery of the MM I–II period (not encountered in other periods) (Figure 1) and the use of organic tempering for the manufacture of pithoi in the LM IIIC period (Figure 2). The petrographic work was complemented by scanning electron microscopy in order to investigate firing temperatures over time. Finally, the extensive sampling of clays and tempering materials from the broader area of the Mirabello provided further insights on the exploitation of the area's resources and the recipes for pottery manufacture over time (see Georgotas below). Overall, the combined study of stone artifacts and pottery and the analysis of raw materials are expected to shed new light in the production of material culture over millennia in this part of East Crete.

RAW MATERIALS—HUNTING AND EXPERIMENTAL RESEARCH ON MINOAN CERAMIC TECHNOLOGY: A VIEW FROM THE MIRABELLO

By Anastasios Georgotas

Introduction

This article presents the preliminary results of the experimental research which took place as part of the annual petrography internship program funded by the Institute for Aegean Prehistory. It forms part of a broader project on the raw materials of the Vrokastro area carried out by J. Moody, E. Nodarou, H. Dierckx, and B. Tsikouras (see Nodarou above) and part of the results will be included in the author's Master's thesis at the University of Athens entitled "The Mirabello area as a ceramic production centre in the Minoan Period: the evidence from raw material sampling."

The project

The provenance of the pottery fabric(s) with granitic-dioritic inclusions had been established with certainty in the area of the Mirabello Bay (see Nodarou, above). For the next step we attempted to recreate the manufacturing process and simulate the recipes used by Minoan potters. This was made possible through the manufacture of experimental material in the form of clay briquettes and their comparison to the ancient material collected on the Vrokastro survey (Moody 2005; Nodarou and Moody 2014). The aim of the experiment was to investigate the resources of the area in terms of clay deposits and tempering materials and provide additional information about the technology used for Minoan pottery production.

Methodology

The first part of the experiment involved the collection of raw materials near sites in the area between Gournia and Kalo Chorio

Figure 1. A total of forty clay briquettes were manufactured at the W.A. MacDonald Laboratory of Petrography at the INSTAP Study Center for East Crete.

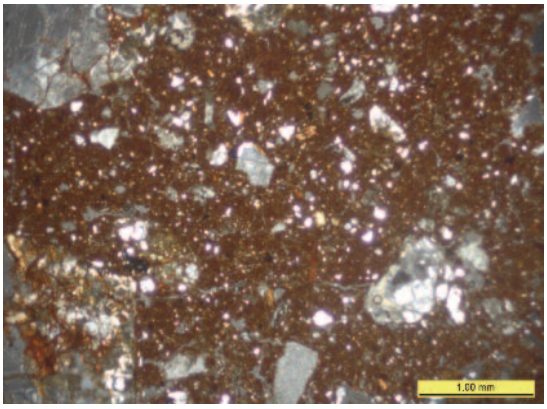

Figure 2a. Microscopic view of experimental sample CS13/24.

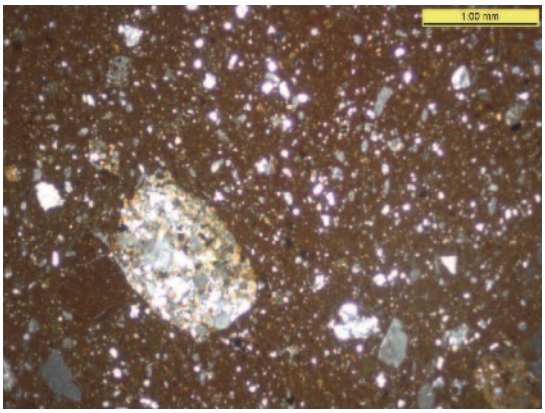

Figure 2b. Microscopic view of archaeological sample VSP 07/355.

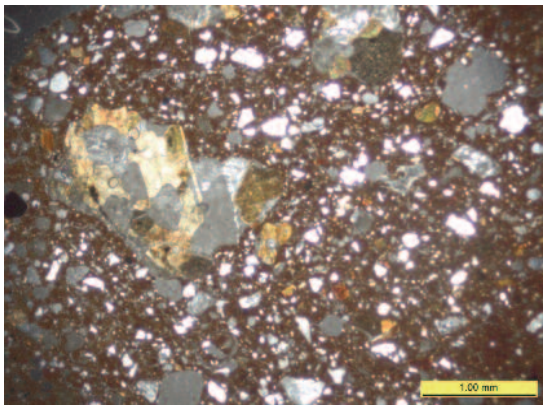

Figure 3a. Microscopic view of experimental sample CS13/26.

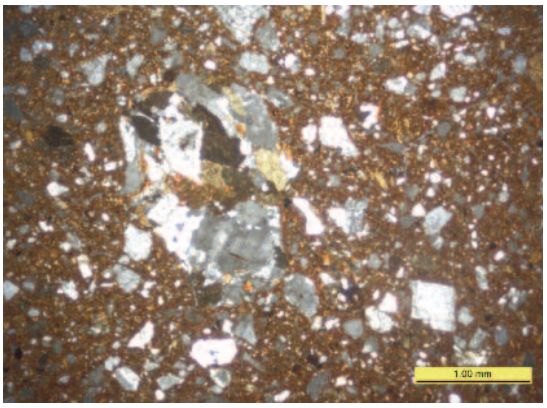

Figure 3b. Microscopic view of archaeological sample VSP 07/150.

where the deposits consisting of granite and/or diorite are located (I.G.S.R. 1959). The sampling involved sediments consisting of white and yellow marl, as well as red sediments, all used as base clays, whereas samples from granitic and dioritic rocks were also collected and used as tempering material. The raw materials were collected near the sites of Pachia Ammos, Gournia, Frouzi and Kalo Chorio. The sampling was supplemented with materials collected during earlier expeditions by E. Nodarou and B.J. Hayden near the sites of Nisi Panteleimon, Ioanni Miti, and Kritsa.

Apart from the raw materials collected directly in the field, additional samples were provided by the team excavating the site of Gournia. These samples were taken from areas of the site that the excavators suggest are connected with pottery manufacture and were included in the experiment in order to test the excavators' hypothesis.

The sampled material was then used to manufacture and fire clay briquettes. The rationale was to create as many different recipes as possible, using all different kinds of clay, pure or tempered with the granitic and dioritic rock material. Forty samples (Figure 1) were produced using the simple procedure of grinding the raw materials with pestle and mortar and when necessary passing them through a 2mm sieve. The clay briquettes were then fired at 950˚C. The final step involved the manufacture of the thin sections at the W.A. MacDonald Laboratory of Petrography of the Study Center.

The results

The experiment provided interesting results, with successful simulation of several of the clay recipes seen in the Vrokastro survey material. The most prominent examples correspond to the two main fabrics, i.e. the cooking fabric with coarse granite fragments and the jar fabric with granite-diorite inclusions (see Nodarou, above), which were used from the Early Bronze Age to the Early Iron Age periods.

Illustrated here are two characteristic examples of successful fabric replications. The first is a jar from Vrokastro dating to the Roman period (Figure 2a) that is identical to an experimental briquette manufactured using a mixture of red clay from Nisi Panteleimon and a marl from Afentis Christos and tempered with granodiorite collected at Frouzi at a 3:1 ratio (Figure 2b). The second is a Neopalatial cooking pot from the survey (Figure 3a) which has a fabric that is very close to the experimental briquette manufactured with a red clay from the Ioanni Miti and granodiorite from Kritsa at a 3:1 ratio (Figure 3b).

With regard to the samples from the excavation at Gournia, the petrographic study showed that their composition and texture are

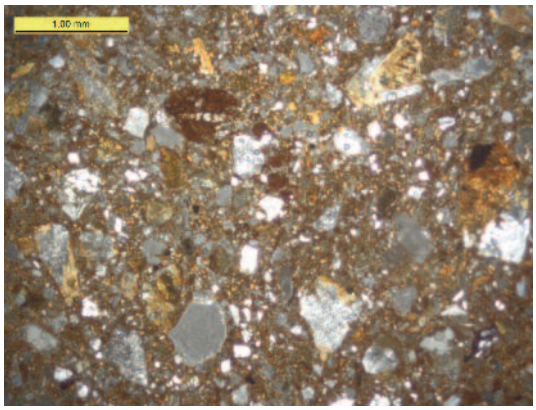

Figure 4a. Microscopic view of experimental sample CS13/30 made from clay collected at the site of Gournia.

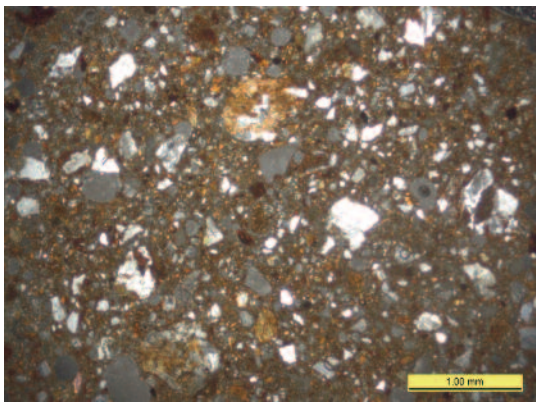

Figure 4b. Comparison with experimental sample CS13/28.

quite similar to those of the experimental samples made from clay mixed with grano – dioritic materials (Figures 4a and b). The result is interesting, but will require closer examination in association with the excavation data in order to determine whether it is natural sediment or prepared clay paste suitable for pottery manufacture.

The preliminary results of this project are promising and show that experimental work can shed light on the technology behind pottery manufacture, in terms of clay mixing, tempering materials, and firing temperatures. Moreover, the collaboration with the Gournia excavation team demonstrated the potential benefit of a petrographic/geo-archaeological approach on questions related to the use of space and technology. The encouraging results of this first campaign have opened the way for a more systematic study of the ancient clay recipes. The continuation of the work is hoped to provide an important dating tool for survey pottery and a better understanding of how pottery workshops operated in the area of the Mirabello for millennia.

ACKNOWLEDGEMENTS

I would like to thank the Institute for Aegean Prehistory for the opportunity to perform petrography at the Study Center. I owe special thanks to Dr. Eleni Nodarou for her guidance during this project and to Dr. Jennifer Moody for making the material from Vrokastro available. Dr. Thomas Brogan, Director of the INSTAP Study Center for East Crete, and the Study Center staff are gratefully acknowledged for their enthusiasm and support during my internship. Many thanks are also due to the potter Mr. Dimitris Limperidis who kindly offered to fire our briquettes. Last but not least, I would like to offer many thanks to Profs. Heidi Dierckx, Anne Chapin, and Asst. Prof. Yiannis Papadatos for providing invaluable information and assistance.

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A TEMENOS OF OLIVE TREES AT MOCHLOS

By Jeffrey S. Soles and Costis Davaras

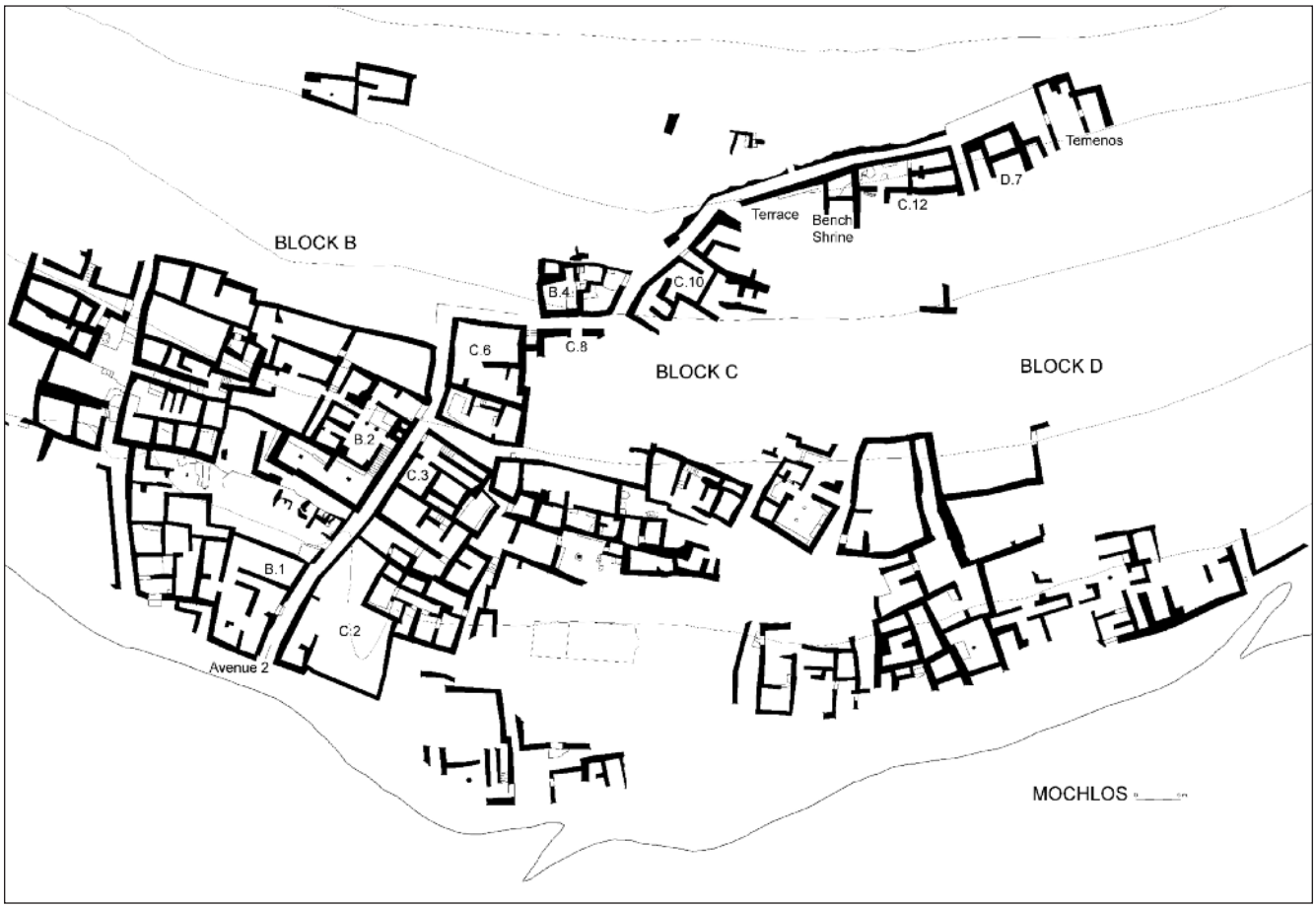

Figure 1. Plan of Neopalatial Mochlos (Drawing by Doug Faulmann).

One of the goals of the 2012 excavation at Mochlos was to discover the destination of the long road that runs through the Neopalatial town separating the houses in Block B from those in Block C (Figure 1). Richard Seager excavated the southernmost part of the street where it begins at the modern coast and runs between Houses B.1 and C.2 (both of which he also excavated), a distance of c. 20 m. He also exposed a smaller part higher up the hill between Building B.2 (which he did not excavate) and House C.6 (most of which he excavated). He does not publish any information about the street, however, and only refers to it in passing (Seager 1909, 286). An aerial photograph taken by J. Wilson and Eleanor Emlen Myers in 1981 shows how far he got (Soles 1992, 191, fig. 25.7).

The current Greek-American excavation has been uncovering more of the road, a little bit every excavation season since the project began in 1989. It is the longest road in the town and probably the most important since it led to major ceremonial areas as well as a number of prosperous houses. It was certainly the most heavily travelled since its cobble stones and bedrock surfaces are worn smooth from the passage of many Minoan feet. Laid out at the beginning of the Middle Minoan III period, c. 1700 BC, it remained in use to the end of the Late Minoan IB period, c. 1430 BC, approximately 270 years, and shows several signs of repair when new cobble stones were placed on top of old cobble stones. It runs from the coast to the north for c. 45 m, past the entrance to the town's main ceremonial center, Building B.2 (Soles and

Davaras 1996, 184–194), and the entrance to the House of the Metal Merchant (Soles 2011). It then makes a sharp turn at a 90 degree angle to the east and runs c. 20 m past an unexcavated house before turning to the northeast. Here the road runs for c. 15 m past the entrances to House B.4 and C.10 before turning again to the northeast at a 10 degree angle where it runs another 25 m past a roadside terrace where people might sit and rest on a long bench, then past a Bench Shrine where a clay foot once sat, and past still another house, C.12. Here it meets another street, probably Avenue 3, which ran up the hill in a north-south direction between Blocks C and D. At this intersection, four steps continue the line of Avenue 2 to the east and lead up to an open pavement and onto a large, flat bedrock surface, at the far end of which stands a wall with a narrow door.

This door was the destination of both streets, and the streets served as processional ways as well as ordinary roads. The door opened onto a paved terrace that was open to the sky; it led from one open space to another open space which was flanked by screen walls on the west and south and by rooms on the north and east (Figure 2). Fragmentary mudbrick survived alongside one of these walls indicating that the terrace's walls were constructed with mudbrick above rubble foundations. The terrace pavement was supported on bedrock to the north but projected out to the south where it rested on earth fill c. 1 m deep. Several of its paving stones were marked with kernoi, i.e. small circular depressions thought to be used for offerings. The adjacent rooms were empty, but broken pithoi lay all over the terrace immediately beneath the deep slope wash or sheet erosion that covers the south slope of the island. Five or six could be identified, only one with a base, and four have been restored. No wall collapse or upper story material lay above them. There was a very small amount of wood charcoal on the terrace and some signs of burning in the area, including the mudbrick. Accordingly, the excavation took a large soil sample from the floor of the terrace and from the soil that remained inside the pithoi. It was floated over the past winter and this spring Evi Margaritis examined the flot from the flotation and found carbonized olive leaves, including several spectacularly preserved leaves still preserving their central veins (Figure 3). Olive trees are grown from cuttings and must be carefully cultivated in pots before transplanting. They can be seen all over Greece today in pots and pithoi at various stages of growth, and this is apparently what was happening in the temenos. They were growing in the pithoi, which were set out in the open on the paved terrace floor. There was nowhere else they could be growing.

The temenos is a unique architectural space, reminiscent of a peak sanctuary in its open and closed spaces more than anything

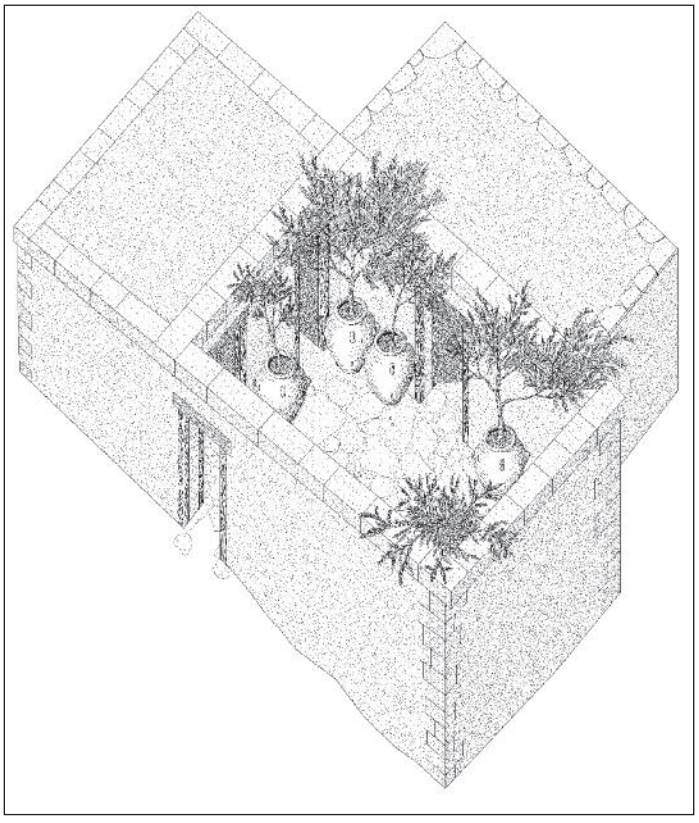

Figure 2. Reconstruction of Mochlos Temenos (Drawing by Doug Faulmann).

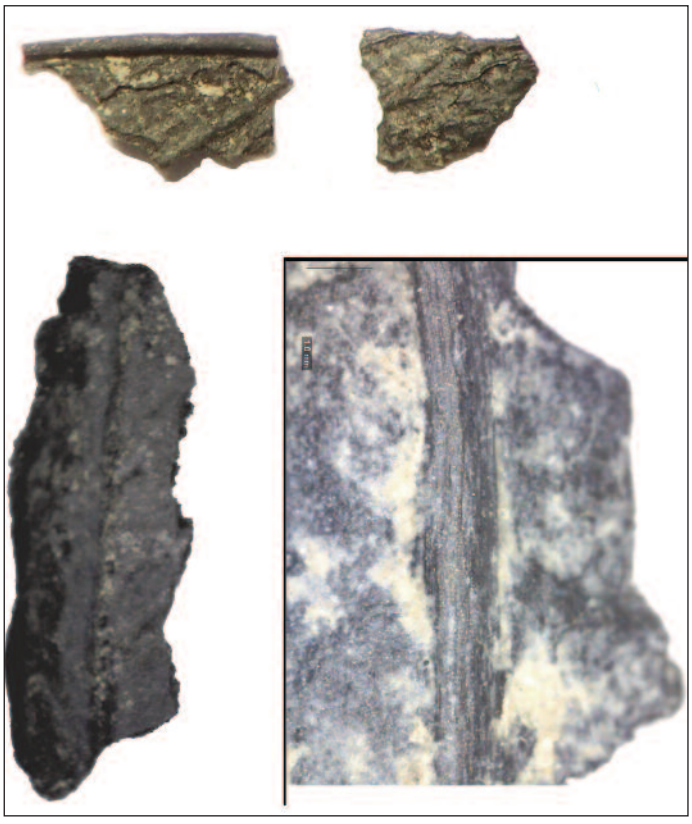

Figure 3. Olive Leaves from the Mochlos Temenos (Photo by Evi Margaritis).

Figure 4. Gold Signet Ring in Berlin, Staatliche Museen Preussischer Kulturbesitz, Inv. No. 30219, 512.

one would find in a settlement area. Such an area is pictured however on three signet rings, two from Knossos now in Herakleion and Oxford (Platon and Pini 1984, 18; Hughes-Brock and Boardman 2009, 458–459) and one from northern Greece now in Berlin (Figure 4; Pini 1988, 41). In each case the temenos is shown surrounded by a screen wall with a projecting cornice and trees, probably olives, growing within (although Evans identified the trees on the Oxford ring as figs in his Mycenaean Tree and Pillar Cult, 4–6). In the Oxford and Berlin rings a narrow doorway is also depicted opening into the temenos, but the wide or double cornice at the top of the temenos wall is its most distinctive architectural feature and it is likely that other temene can be identified as a result, most notably the structure that appears to one side of the famous gold ring that Seager found with the goddess sailing on a seahorse-shaped ship with a sacred olive tree (Seager 1912, fig. 52). The signet rings clearly indicate that one function of the temenos was to accommodate trees and the Mochlos finds reveal that some of these, if not all, were olive trees. Many other Minoan signet rings show the veneration of olive trees and in some cases these scenes may well be set inside a temenos. In later Greek periods, the temenos formed a grove of sacred trees, the ἄλσος described by Homer (Od. 6. 291) and other ancient authors and documented by Pausanias in many places. These groves are the homes of gods and heroes in Greek religion and the signet rings indicate that they were also in Minoan religion.

A female figure stands outside the temenos in each of the rings. Her costume and ample breasts suggest that we should recognize her as the Minoan goddess. In the Berlin ring a man greets her with outstretched arm and addresses her. He is the same figure who appears on the lid of the ivory pyxis recently discovered at Mochlos (Soles and Davaras 2010) where he introduces three figures to the goddess who sits on a throne beneath an olive tree. He serves as an intermediary between man and god and should therefore be identified as a hero or ancestor figure whose function is to do just that. The temenos appears to be home to both. It was a natural target therefore for invading hoards of non-believers who set fire to the trees and smashed their containers sometime around 1430 BC.

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PROJECTS, STAFF, FACILITY IMPROVEMENT, AND OUTREACH AT THE INSTAP STUDY CENTER FOR EAST CRETE IN 2013

By Thomas Brogan and Eleanor Huffman

By every measure the 2013 summer was the busiest ever at the INSTAP Study Center for East Crete. There were many highlights but we will begin with work in Pacheia Ammos. From the beginning of June, we supported major excavations at Azoria and Gournia, as well as a large team studying the finds from Mochlos. By July these teams involved more than 200 members while individual scholars were also in residence. To meet this challenge, we introduced several important changes to the staff and facility. The INSTAP Publication Team welcomed faunal specialist Dr. Demetra Mylona and artist Dr. Lily Bonga who recently completed her dissertation on Late Neolithic pottery. In the summer, the William D.E. Coulson Conservation Laboratory received help on all levels, including junior conservators Anna Tsoupra and Theocharis Katrakazis (both TEI Athens graduates), Konstantina Chatzivasili from Cyprus, conservation intern Gillian Porteous, conservation students from TEI Athens, and several student assistants from the Gournia staff. In October, we hosted our first visiting conservator, Cymbeline Storey, who came all the way from Scotland.

No less important, we expanded the physical plant. Two new covered pottery and bone washing stations were installed in the lower court with mobile drying rack towers, each of which holds 10–12 drying screens for pottery or heavy residue from the water sieves. The soil flotation system was also completely redesigned to supply three water sieve barrels via a 15 ton recycling system that produces 3–5 tons of water per hour and is 80–90% efficient. This upgrade is extremely important given current use—more than 4000 soil samples per year—and Crete's chronic water shortage. The result is already noticeable on the reduced water bill. To accommodate as many as 6 simultaneous pottery studies, we added 30 new tables and worked under our newly shaded lower grape trellis. Finally, for teams working in the field, we are now providing 30 dry sieving machines which were used by 12 excavations on Crete and the mainland in the last 12 months.

The Study Center also takes pride in providing a venue for presentations to the wider scholarly community. This summer we hosted lectures by Pietro Millitello on Neopalatial Craft at Haghia Triada and Phaistos, Adamantia Vasilogamvrou on the

The William D.E. Coulson Conservation Laboratory at the height of summer activity.

The Azoria Project utilized the Central Courtyard as a location for sorting and bar-coding bone.

The Gournia Project sorted pottery under the shady grape trellis

Space-efficient drying rack towers were accommodated in the lower court.

LH III palatial complex at Haghios Vasileos in Lakonia, and on new technologies (bar-coding by Flint Dibble and photogrammetry by Costas Papadopoulos). Finally, the Study Center hosted a two-day workshop, "Archaeological and Archaeometric Approaches to the Study of Byzantine Pottery from Crete," organized by Natalia Poulou and Eleni Nodarou.

The 2013 Richard Seager Fellow at the INSTAP Study Center for East Crete

By Florence Liard

Hello! My name is Florence Liard and I am the Richard Seager Fellow for the year 2013. I will be working at the INSTAP Study Center for East Crete from mid-September to early December. I am currently writing a Dissertation for the Université Catholique de Louvain where Jan Driessen is the Chair of my Committee. I am also a member of the AegIS research group. My Dissertation focuses on potting technologies, workshop organization, ceramic distribution networks and consumption practices in the region of Malia and Sissi during the Final Palatial (LM II–LM IIIA2 early) and Postpalatial (LM IIIA2/B–LM IIIC) periods. I am concentrating on a petrographic examination of the ceramic fabrics, and exploring the possible meanings of the data in correlation with the macroscopic characteristic of the pastes, ceramic typology, and the archaeological and taphonomic context of the deposits.

The main part of my work at the Center consists of a comparative analysis of my own petrographic collection with Late Bronze Age ceramics that have been sampled on diverse sites of Crete: Chrysokamino, Mochlos, Petras in eastern Crete, Karphi in the Pediada, and Chamalevri in western Crete. My aim is to more clearly define the specificity of the Maliote ceramic productions in terms of mineralogy of the clays and inclusions, and to position it within the broader context of the potters' activity in Crete at the end of the Bronze Age. I would like to detect the existence (or absence) of specific choices made by potters at Sissi and Malia, and to study in which way these options may relate to a technical know-how that is observed in other regions of the island. Such a comparative analysis on the polarizing microscope also contributes to our understanding of the exchange networks of ceramic finished products, owing to the

fair amount of non-local samples that I have identified at Sissi and Malia so far. My research at the Study Center's library is also helping my perception of the typological characteristics of the pottery on both sites during the post–LMIB period.

The data I am gathering at the Study Center enables me to grasp some new insights into the social structures, cultural trends, and collective symbols of the Late Bronze Age communities of Crete. Indeed, the post–LMIB period displays a concentrated series of unprecedented social disruptions and upheavals that make this period particularly fascinating for the archaeologist. When Mycenaean populations settle on the island during LM II, they deeply transform the sociopolitical frameworks that prevailed during the earlier Bronze Age. The indigenous population suddenly evolved from a multi-palatial and 'corporate' structure to an apparently hierarchical organization with Knossos being the main center of administration and political power (LM II–LM IIIA2 early). This then led to a strongly decentralized system which may, however, have seen the maintenance of well-rooted technical choices, social practices, and long-distance exchange networks in LM IIIA2/B–LM IIIC.

The petrographic characteristics I have recorded at Sissi and Malia and their careful comparison to pottery production and consumption patterns on other sites of Crete are expected to bring new evidence of a Cretan political landscape that is certainly more fragmented and decentralized than it previously was. That also includes, however, collective practices, social identities and symbolic references that remain more or less the same toward the advent of a Greek Iron Age world.

Florence visits the site of Eretria in July of 2012.

Applying for the Study Center's Richard Seager Fellowship

The INSTAP Study Center for East Crete's Richard Seager Fellowship is intended for scholars in the field of the Aegean Bronze Age/Early Iron Age who are working to complete their PhD Dissertations. Each year one recipient will recieve $4,000 for work to be done at the Study Center in Pacheia Ammos, Crete. Applicants should email Elizabeth Shank for the application and guidelines at **elizabethshank@hotmail.com**. Applications will be due on February 1 of each year, and the recipient will be announced by March 15th.

INSTAP ACADEMIC PRESS

Presents 6 Books Hot Off the Press in 2013 and Forthcoming in 2014

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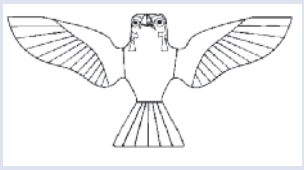
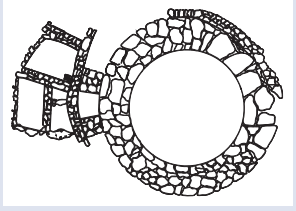
Aphrodite's Kephali: An Early Minoan I Defensive Site in Eastern Crete (*Prehistory Monographs* 41), by Philip P. Betancourt. Hardback: 272 pp., 30 tables, 97 B/W figs., ISBN 978-1-931534-71-0, $70.00/£46.00.

The Neolithic Settlement of Knossos in Crete: New Evidence for the Early Occupation of Crete and the Aegean Islands (*Prehistory Monographs* 42), edited by Nikos Efstratiou, Alexandra Karetsou, and Maria Ntinou. Hardback: 246 pp., 44 tables and 82 figs. in text, ISBN 978-1-931534-72-7, $80.00/£55.00.



AMILLA: The Quest for Excellence. Studies Presented to Guenter Kopcke in Celebration of His 75th Birthday (*Prehistory Monographs* 43), edited by Robert B. Koehl. Hardback: 468 pp., 11 tables and 235 figs. in text, ISBN 978-1-931534-73-4, $80.00/£55.00.



Mortuary Behavior and Social Trajectories in Pre- and Protopalatial Crete (*Prehistory Monographs* 44), by Borja Legarra Herrero. Hardback: est. 464 pp., 8 tables, 141 B/W figs., ISBN 978-1-931534-74-1, $80.00/£50.00. Expected Winter 2014.

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Fundraising Drive for the William D.E. Coulson Conservation Laboratory

The INSTAP Study Center for East Crete would like to encourage specific donations for the following items for the William D.E. Coulson Conservation Laboratory.

An Olympus SZ40 microscope. Cost for a lightly used model: $600

Microscopes are used in the conservation laboratory for cleaning small finds such as seal stones and objects of metal and ivory and can also be used for materials identification. They are borrowed by specialists looking at, for example, archaeobotanical material or use-wear on stone tools. The William D.E. Coulson Conservation Laboratory has two working microscopes and would greatly benefit from a third that would be shared by all conservators during the busy summer season.

An Airbrasive Unit, SS White, Model K. Cost: $3750.00

An Airbrasive Unit is a very versatile cleaning tool which uses compressed air and various grades of abrasive powder to clean artifacts quickly and with great precision. Powder can be varied from very soft (powdered walnut shell) to very abrasive (aluminium oxides). This is a standard piece of equipment in an archaeological conservation laboratory and is used, for example, to remove insoluble accretions on ceramic or stone artifacts and upper corrosion layers on metals.

All donations are tax deductible to the full extent of the law. Please send checks made out to the INSTAP Study Center for East Crete to:

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The 2014 Richard Seager Fellowship

The Richard Seager Doctoral Fellowship was founded in 2009 with the goal of enabling doctoral candidates to use the Study Center's facilities to help bring recipients' dissertations closer to completion. Since then, four awards have been granted, resulting in numerous articles and two finished dissertations. With your help we can reach our goal of $4,000 and provide this fellowship to a qualified candidate for 2014. If you would like to help fund the 2014 fellowship, please make a check payable to the INSTAP Study Center for East Crete and mail it to the address printed below. Please write "Seager Fellowship" in the memo portion of your check. If you would like to make a donation in Euros through direct deposit, please contact Eleanor Huffman at eleanorhuffman@instapstudycenter.net.

INSTAP Study Center for East Crete
Attn. Elizabeth Shank
2133 Arch Street, Suite 300
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Donations Welcome for the Library of the INSTAP Study Center for East Crete!

The Library of the Study Center is happy to accept donations of books, offprints, or money, all of which will be used to expand our collection. Please contact Stavroula Flouri at sceclibrary@gmail.com if you have any questions.

Entrance to the Study Center.

Report from a Visiting Conservator at the William D.E. Coulson Conservation Laboratory

My name is Cymbeline Storey and I am a conservator based in Edinburgh, Scotland. In October, I completed a three-week placement in the William D.E. Coulson Conservation Laboratory at the INSTAP Study Center for East Crete to develop my ceramics conservation skills and learn about archaeological conservation in Crete. I conserved several ceramic pieces from Gournia, including the "small" pithos pictured. I also had the opportunity to visit the site and see from where the pithos was excavated. I wish to thank the staff at the Study Center, particularly Senior Conservator Kathy Hall, for sharing their time and expertise. One of the things I love about conservation is that it is a constant learning process, and I have come away from the Study Center with new skills and techniques that I will be able to apply to my work in the future.

Cymbeline Storey hard at work in the William D.E. Coulson Conservation Laboratory

Deanna Aubert and Tristan Carter on their wedding day on Mochlos Island.

Congratulations!

All of us at the Study Center would like to congratulate Deanna Aubert and Tristan Carter, members of our Study Center "family," who were married on Mochlos Island on June 29, 2013. Their reception was held at Ta Kochilia Taverna, whose landlord Yiorgos Frangiadakis, along with Jeff Soles and Tom Brogan, provided the surprise fireworks over the island. The ensemble then danced until the wee hours of the morning to Cretan lyre music and the hosts' own playlist. We wish Tristan and Deanna many years of happiness together!

INSTAP Study Center for East Crete

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Kentro Staff

Elizabeth Shank, *Editor*
Ariel Pearce-Chalikias, *Production*

Two of Our Special Friends...

We would like to wish a fond farewell to our faithful volunteers for the past 10 years, Rita Roberts and John Lewis, who have gone into retirement for the second time. We hope to see them at lectures and as library users in the future. Their service to the Study Center is appreciated by all!

Crete

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Eleanor J. Huffman, *Assistant to the Director*
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Kathy Hall, *Senior Conservator*
Demetra Mylona, *Faunal Analyst*
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Doug Faulmann, *Chief Artist*
Lily Bonga, *Artist*
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