April, 1993

The Kavousi Coarse Wares: A Bronze Age Chronology for Survey in the Mirabello Area, East Crete

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Abstract

This paper presents the results of the Kavousi-Thriphti Survey coarse-ware study. It is argued that coarse utilitarian pottery can be used for dating sites in archaeological survey, and further, that coarse pottery on the surface of any site with a domestic or storage function may represent a wider, and thus more accurate, chronological range than the associated fine wares. Detailed descriptions of 18 coarse fabric types identified in the survey region are presented. Thirteen of these fabrics were determined to be chronologically diagnostic. These fabric types, with their proposed chronological ranges and proveniences, provide sufficient data to begin analyzing the distribution of coarse ceramics in the protopalatial and neopalatial periods. The results lay the groundwork for more detailed petrographic analyses and provenience studies of coarse wares in the Bay of Mirabello.*

INTRODUCTION

Coarse utilitarian pottery, such as cooking pots, pithoi (storage jars), amphorae, jugs, trays, and bowls, constitutes at least 50–70% of the typical Aegean pottery assemblage in any given excavation context; it is the most prevalent type of pottery recovered in surveys of Minoan sites.[1] New approaches to pottery, such as ceramic petrology[2] and ethnography,[3] are increasing our awareness of the potential of coarse-

* This study was originally presented as a paper at the 93rd Annual Meeting of the Archaeological Institute of America: *AJA* 96 (1992) 334–35 (abstract). The Kavousi-Thriphti Survey (KTS) is a component of the Kavousi Project under the general directorship of W.D.E. Coulson, L.P. Day, and G.C. Gesell. Permission for survey was granted by the Greek Ministry of Culture and the *KD'* Ephoreia of Prehistoric and Classical Antiquities; the authors thank Metaxia Tsipopoulou, Costis Davaras, and Nikos Papadakis of the Archaeological Service of East Crete for their permission and support. The fieldwork was supported by a Fulbright Collaborative Research Grant, University of Minnesota Doctoral Dissertation Fellowships, the Doreen C. Spitzer Fellowship of the American School of Classical Studies at Athens, a Wenner-Gren Predoctoral Grant-in-Aid, and the Olivia James Traveling Fellowship of the Archaeological Institute of America. We would like to thank Philip Betancourt, Harriet Blitzer, Jack Davis, Leslie Day, Geraldine Gesell, and Vance Watrous for reading drafts of this paper and for their useful comments and criticisms. For much helpful discussion and input during the fieldwork and preparation of this paper we would like to acknowledge Jennifer Moody, Barbara Hayden, Gerald Cadogan, Jeffrey Soles, Jean-Claude Poursat, Lee Ann Turner, Sarah Vaughan, and the members of the American School of Classical Studies' Ceramic Study Group directed by Carol Zerner. We are especially grateful to Peter Day of the University of Cambridge for reading drafts of this paper and for access to his comprehensive data and conclusions regarding ancient and modern ceramic production and exchange in the Gournia and Mirabello areas.

The following abbreviations are used:

Betancourt	P.P. Betancourt et al., *East Cretan White-on-Dark Ware. Studies on a Handmade Pottery of the Early to Middle Minoan Periods* (Philadelphia 1984).
Day	P.M. Day, *A Petrographic Approach to the Study of Pottery in Neopalatial East Crete* (Diss. Univ. of Cambridge 1991).
Moody 1985	J.A. Moody, "The Development of a Bronze Age Coarse Ware Chronology for the Khania Region of West Crete," *TUAS* 10 (1985) 51–65.
Moody 1987	J.A. Moody, *The Environmental and Cultural Prehistory of the Khania Region of West Crete* (Diss. Univ. of Minnesota 1987).
Riley	J.A. Riley, "The Contribution of Ceramic Petrology to Our Understanding of Minoan Society," in O. Krzyszkowska and L. Nixon eds., *Minoan Society. Proceedings of the Cambridge Colloquium, 1981* (Bristol 1983) 283–92.
Schiffer	M.B. Schiffer, *Formation Processes of the Archaeological Record* (Albuquerque 1987).
Warren	P. Warren, *Myrtos, An Early Bronze Age Settlement in Crete* (Oxford 1972).
Watrous	L.V. Watrous, *Lasithi, A History of Settlement on a Highland Plain in Crete* (*Hesperia* Suppl. 18, Princeton 1982).

[1] P.P. Betancourt (personal communication) suggests 50–70% as the average proportion of coarse wares in any given excavation assemblage at Pseira. In surface survey, however, this percentage is ca. 90% of the total pottery recovered from any given Bronze Age site.

[2] See, e.g., Riley; P.M. Day, "Ceramic Analysis and Pottery Systems: The Case of Minoan Crete," in R.E. Jones and H.W. Catling eds., *New Aspects of Archaeological Science in Greece* (*Fitch Laboratory Occasional Paper* 3, Athens 1988) 39–45; and P.M. Day, "The Production and Distribution of Storage Jars in Neopalatial Crete," in E.B. French and K.A. Wardle eds., *Problems in Greek Prehistory* (Bristol 1988) 499–508.

[3] For example, P.M. Day, "Technology and Ethnography in Petrographic Studies of Ceramics," in I. Maniatis ed., *Archaeometry: Proceedings of the 25th International Symposium* (Amsterdam 1989) 139–47. See also P.P. Betancourt, "Ethnology and the Interpretation of the Archaeological Record," in Betancourt 159–63.

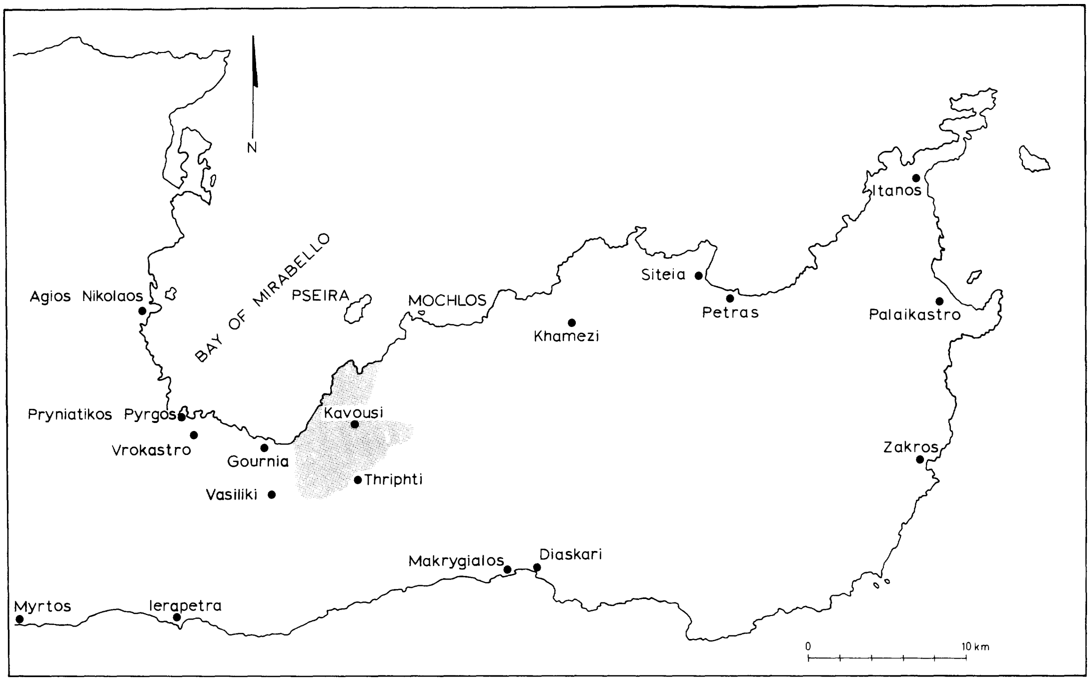

Fig. 1. Map of East Crete showing Kavousi-Thriphti Survey zone

ware studies in providing chronological and provenience data as well as cultural and technological information. Nevertheless, many surveys and excavations in Greece still consider coarse ware an unreliable indicator of chronology and, at best, a necessary burden of storage, study, and publication.[4]

Intensive archaeological survey in the area of Kavousi, in eastern Crete (the Kavousi-Thriphti Survey, hereafter KTS),[5] has shown the feasibility, and indeed the necessity, of using coarse ware as a means of dating Minoan sites in archaeological survey.[6] Diachronic changes in coarse-ware fabrics have been documented from Early Minoan (EM) II to the Late Minoan (LM) IIIC period and concurrent excavations at Vronda, Kastro, Mochlos, and Pseira, and further afield, at Myrtos Pyrgos and Mallia, have provided stratified comparanda for determining the chronological ranges of the coarse-fabric types.[7] While this coarse-fabric typology is not comprehensive for all pottery shapes in all periods of the Bronze Age in the Mirabello and Lasithi areas, it may serve as a foundation for more detailed coarse-pottery studies, petro-

[4] Moody (Moody 1987, ch. 5, and Moody 1985) designed a coarse-ware chronology for survey in Khania and both explored the methodological concerns of such studies and proved their practical application. J.A. Riley, in "Pottery Analysis and the Reconstruction of Ancient Exchange Systems," in S.E. van der Leeuw and A.C. Pritchard eds., *The Many Dimensions of Pottery* (Amsterdam 1984) 59, states, "Coarse wares, which typically comprise ninety percent of a characteristic classical pottery assemblage, have until recently generally been routinely discarded, and, in consequence, rarely studied."

[5] D.C. Haggis, *The Kavousi-Thriphti Survey: An Analysis of Settlement Patterns in an Area of Eastern Crete in the Bronze Age and Early Iron Age* (Diss. Univ. of Minnesota 1992).

[6] For the Kavousi Project, see G. Gesell, L. Day, and W. Coulson, "Excavations and Survey at Kavousi, 1978–1981," *Hesperia* 52 (1983) 389–420 and most recently, G.C. Gesell, W.D.E. Coulson, and L.P. Day, "Excavations at Kavousi Crete, 1988," *Hesperia* 60 (1991) 145–78.

[7] The definition of "coarse ware," or "coarse fabric," versus "fine ware," is often arbitrary and largely impressionistic; the KTS definition of coarse ware is no exception. While an inclusion density of "greater than 10%" may serve as a rough criterion, it has little meaning or explanatory force to someone who has not studied coarse wares in detail. The differentiation between coarse and fine ware is usually dependent on the size and density of the temper or inclusions, and is a relative concept within any given pottery assemblage. In the KTS, "coarse ware" usually means large, thick-walled, utilitarian pottery (most often cooking or storage vessels) made with distinctly visible rock and mineral inclusions present in or added to the clay. The fabric descriptions below describe the range and size of coarse inclusion types. For Minoan pottery, see most recently the glossary and discussion in P.P. Betancourt, *Kommos* II: *The Final Neolithic through Middle Minoan III Pottery* (Princeton 1990) 3–8.

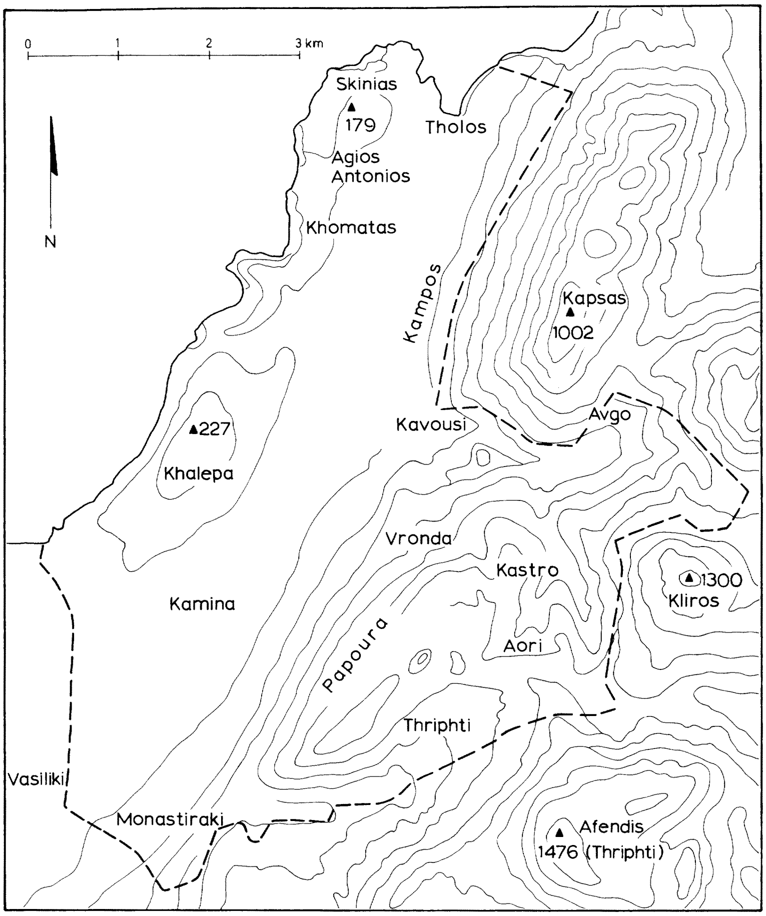

Fig. 2. Map of Kavousi-Thriphti Survey zone

graphic analyses, and provenience studies at excavation sites around the Bay of Mirabello.[8] The aim of this study is to illustrate the potential for discerning variation in coarse-ware fabrics by the visual analysis of large samples in the field during survey, *without* the aid of detailed ceramic petrography (thin-sectioning and laboratory study) in order to determine chronological and regional variability. The purpose of this paper is to explain the method and results of the KTS coarse-fabric study, to present the chronologically diagnostic coarse-fabric types, and to suggest patterns of their distribution for the Kavousi area, the north Isthmus of Ierapetra, and the eastern Bay of Mirabello in the Bronze Age. The north Isthmus of Ierapetra (fig. 1), and the Kavousi area in particular (fig. 2), are geologically and topographically diverse regions situated at a crucial geophysical transition, a veritable crossroads by sea and land between east and central Crete. This situation provides an environment suitable for testing regional variation in ceramic production, distribution, and exchange in Bronze Age Crete.

[8] Multidisciplinary studies of Minoan pottery in the north Isthmus of Ierapetra, which recognized and proved the potential for ethnographic and petrological studies, were initiated by Philip Betancourt; see P.P. Betancourt et al., *Vasilike Ware: An Early Bronze Age Pottery Style in Crete* (Göteborg 1979), and Betancourt. For ethnographic work in the isthmus area see H. Blitzer, "Traditional Pottery Production in Kentri, Crete: Workshops, Materials, Techniques, and Trade," in Betancourt 143–57. P. Day has completed an extensive petrological and ethnoarchaeological study of pottery production and exchange in eastern Crete for the LM I period (Day). The neopalatial production regions defined by Day are Gournia/Kalo Khorio–Mochlos with two centers (included is the Kavousi area), Achladia, Petras (Siteia), Palaikastro, Zakros, and Makrygialos. While a few of the coarse-fabric types defined in the KTS have already been sampled, studied, and identified by Day in the context of his broader study of eastern Crete, the correlation of Day's fabric types with Kavousi wares must await publication of Day's thesis and the Kavousi-Thriphti Survey, both of which are currently in preparation.

KAVOUSI AND ENVIRONS

The modern *koinoteta* or community of Kavousi is situated on the eastern edge of the Bay of Mirabello in northeastern Crete. The area includes the northeastern corner of the Isthmus of Ierapetra and the northwestern edge of the Siteia Mountains (figs. 1–2). The island of Pseira lies 2.5 km off the coast to the north of the study area; Mochlos is about 8 km to the northeast, Middle Minoan (MM) Khamezi is 18 km to the east, the EM site of Vasiliki is some 6 km to the southwest, and other important Bronze Age sites such as Gournia and Pryniatikos Pyrgos lie to the west along the Bay of Mirabello. The survey zone, which consists of the entire modern Kavousi district, is some 33 km^2 in size. The lowlands are made up of level plains and a strip of coastal hills (138–227 masl), which are alternating outcrops of gray crystalline limestone, dolomite, and phyllite. These hills, Skinias, Khomatas, and Khalepa, run roughly north–south and border the eastern edge of the Bay of Mirabello. Between these hills and Mt. Kapsas is the Kavousi plain or "Kampos," which is composed of the fields of Tholos and Kampos. At the northern edge of the plain is the small alluviated bay of Tholos. While it is used today as a small harbor for fishing boats, in the Bronze Age it was an important port and probably a significant link between the north isthmus and the island of Pseira. In the southernmost plain, southwest of the modern village, are the fields of Kamina, which are a mixed terra rosa colluvial and alluvial formation, bordered on the east by the high cliffs and talus slope of the Thriphti range, and on the west by the southernmost of the coastal hills, Khalepa. The village of Kavousi sits on a stable alluvial deposit rising above and south of the Kampos plain at the confluence of the two main drainage basins in the Kavousi Mountains: the Thriphti watershed to the south, and the Avgo watershed to the east. Intensive archaeological survey was conducted in the Kavousi district for a period of three years (1988–1990) to establish the history of settlement in the Bronze Age and Iron Age, and to provide a broad chronological and environmental context for concurrent excavations at Vronda and Kastro.

METHODOLOGY

Viability and Significance of the Coarse-Ware Sample

A study of the KTS coarse pottery was implemented for several reasons. First, it was desirable to make a complete record of the artifacts present on the surface of sites recovered in the survey, and it became obvious, after the first field season in 1988, that a substantial number of sites had no visible fine diagnostic pottery.[9] Second, the great variety of observable differences in coarse fabrics suggested that the enormous volume of coarse pottery in each survey sample might be a useful source of chronological information, if periodicity of types could be established. The apparent abundance of coarse wares and the relative paucity of fine wares on the surface of Bronze Age Cretan sites raise some doubt as to the accuracy of site chronology derived exclusively from the fine wares in a survey sample. This disparity in the quantities of coarse and fine wares recovered in survey might also suggest the potential of the former category in providing a chronologically representative assemblage of surface pottery. A number of factors are likely to be the cause of the ubiquitous nature of Minoan storage, cooking, and pouring vessels and other multipurpose coarse-ware pots: 1) site function (most Bronze Age sites served some domestic or storage function); 2) cultural processes (the factors involved in the deposition of cultural material at a site as waste or during abandonment); and 3) natural formation processes (e.g., erosion and sedimentation, vegetation). It is arguable that the size, function, and origin of a vessel are important variables in the depositional process and can directly affect the appearance of that vessel type on the site surface. The abundance of coarse wares is a discernible phenomenon in the landscape but the reasons for claiming their chronological representativeness require explanation.

Indeed, conservatism in shape, sources of raw materials, and production techniques has often precluded the use of coarse wares as indicators of date. This is especially true in the context of excavation at Minoan sites, where, more often than not, a substantial fine diagnostic assemblage exists with a long-established relative chronology. On the surface of sites, however, the good diagnostic range of fine wares may be lacking, and here the excavator's ambivalence to the stratified coarse-ware sample has limited the potential use of coarse wares in dating sites in survey. The characteristics of the coarse pottery itself, its use and distribution, may account for its visibility in the landscape and thus its potential value for providing a considerable amount of information on the date and function of a site. Ground surface conditions notwithstanding, the main factors causing the abundance of

[9] See Moody 1985, 51, on the paucity of fine diagnostic sherds in survey samples in Khania; see also Moody 1987, ch. 5.

coarse wares are depositional in nature: the size, transport cost, and replacement cost of the vessel, and the circumstances of site abandonment.[10]

Clay tripod cooking pots, for example, have been used as broad chronological indicators in surface surveys in Crete.[11] Several factors may account for this: tripods are well represented on the surface of Bronze Age and Iron Age sites in Crete, they exhibit general changes in form over time, and have unmistakably diagnostic rims and feet.[12] Furthermore, tripods are plentiful on survey sites for several reasons: first, they are the most common cooking vessel from the Early Minoan through Geometric periods. Second, they are often relatively large and unwieldy, causing difficulties in long-distance transport, which, in turn, might result in a greater number of these vessels being left behind when a site is abandoned (and perhaps reused if the site is reoccupied). Finally, their most distinctive feature, the foot, is a solid separable unit and obvious on the site surface because of the plurality of feet per vessel. Thus, in addition to their distinctive form, the main features of tripods that account for their abundance or obtrusiveness are their size, function, and potential reuse and replaceability.

Like the tripods, other large storage, transport, and cooking pots are dominant in survey collections and potentially datable. These large vessels are often (in the KTS area) locally made, and therefore the replacement cost is low in comparison to imported or even locally made fine vessels. Storage containers such as basins and pithoi are bulky and cumbersome for individuals to transport over long distances, whereas fine cups, bowls, and jars are usually smaller in size and light,[13] and are thus probably more likely to be removed when a site is abandoned. In addition, a small fine vessel is more easily broken and irreparable, and therefore less likely to be reused if a site is reinhabited. Finally, regardless of the rate of abandonment, artifact portability (dependent on size, weight, and replaceability) is a primary factor in artifact deposition. For example, survey conducted in the abandoned modern settlements in the Kavousi district has shown that in instances even where abandonment was gradual (and to a new settlement nearby), the pottery assemblage left behind consisted entirely of large, sturdy, potentially reusable vessels such as the shallow basin or *tsikali*, pithoi, and water vessels (*stamnoi*); pithos fragments or whole pithoi were the most prevalent.[14]

Relevant to the obtrusiveness of the coarse-ware sample is the "size-effect hypothesis," which was initially suggested by House and Schiffer in 1975[15] and then successfully tested by Baker at a site along the White River in the Ozark uplands of Arkansas.[16] It states that "the proportionate occurrence of larger artifacts . . . from the surface . . . is greater than the occurrence of these items within the entire [excavated] site." As suggested above, artifact portability and reuse potential are probably crucial factors in the human depositional process at abandoned sites of many periods of occupation. Baker's "size-effect" theory might provide a further dimension to the apparent proportions or variability of coarse and fine wares in survey. He suggests that certain categories of objects, the larger and potentially reusable artifacts, are less likely to be affected by erosion and sedimentation and more likely to be selected and reused by subsequent inhabitants of the site; thus, they are less likely to be obscured by later phases of habitation or natural processes after abandonment. While Baker's hypoth-

[10] Schiffer 90–98 outlines the factors that affect what he calls "*de facto* refuse deposition," the process by which cultural material is left behind when a site is abandoned. The depositional factors are rate and season of abandonment, means of transport, distance to the next settlement, function of the next settlement, size of the emigrating population, size and weight of the artifacts, their replacement cost, and remaining use life and functions (Schiffer 90–91).

[11] S. Hood, G. Cadogan, and P. Warren, "Travels in Crete, 1962," *BSA* 59 (1964) 52; see also Watrous 68. Jack Davis informs us (personal communication) that tripods are also prevalent on Minoanized islands in the Cyclades.

[12] P.P. Betancourt, *Cooking Vessels from Minoan Kommos: A Preliminary Report* (Los Angeles 1980).

[13] H. Blitzer, however, has shown that the Koroni pithoi were traded and transported over long distances ("*Koroneika*: Storage Jar Production and Trade in the Traditional Aegean," *Hesperia* 59 [1990] 675–711); see also Day 27 and 176 on the transport of LM I storage jars. It should be emphasized, however, that the movement of large coarse-ware vessels in an elaborate trade network is not the same process as removing vessels from a site during abandonment; in the latter case, potential artifact portability is the essential factor in the depositional process at the abandoned site.

[14] The ethnoarchaeological study of the pre-World War II settlements in the area of the modern village of Kavousi, including discussion of the associated pottery assemblages, will be published elsewhere.

Schiffer 95 suggests that "all other variables being constant, curate probabilities vary directly with artifact portability." By "curate probabilities," Schiffer means the likelihood an object is kept or removed during site abandonment.

[15] J.H. House and M.B. Schiffer, "Significance of the Archaeological Resources of the Cache River Basin," in J.H. House and M.B. Schiffer eds., *The Cache River Archaeological Project* (*Arkansas Archaeological Survey, Research Series* 8, 1975) 174.

[16] C.M. Baker, "The Size Effect: An Explanation of Variability in Surface Artifact Assemblage Content," *AmerAnt* 43 (1978) 288–93.

esis is proven to apply to stone tools in his locale of study, we believe that the same process might be applicable to classes of pottery such as coarse ware, which consists of large, sturdy, multipurpose, potentially reusable objects.

The theory has two ramifications for site sampling, particularly of Bronze Age multiperiod sites within the survey area: first, large coarse-ware vessels may be well represented diachronically; fragments of coarse pots from every period of the site's use are more likely to be apparent on the surface than fragments of fine ware. Therefore, coarse pottery may provide a sizable assemblage truly representative of all periods of activity, if the fabrics can be defined and dated.[17] Second, because of the high relative proportions of these artifacts, sampling units in the survey must be defined to avoid concentrations of sherds from the same vessel, which would overrepresent any given fabric. In the Kavousi-Thriphti Survey, narrow rectangular units, or transects, radiating out from the site's center proved to be a more effective sampling strategy than random squares or circles, both in terms of time spent per site, and in obtaining a sample of coarse fabrics and shapes across the entire surface that was representative of all occupational phases. Small sample squares would have provided more accurate provenience information but would have required more time and resources since, to avoid a biased sample, a multiplicity of units would have had to be located and recorded separately.

The purpose of the on-site survey was to determine the size, sherd density, and chronology of the site, and to recover a representative sample of coarse-ware fabrics from the site's surface. Thus, sampling units were long, rectangular transects or swaths, 2 m wide, extending from the notional center of the site along cardinal radii.[18] Sherds were counted in 2 × 5 m units along the radii, and all sherds, stone tools, and other artifacts were collected and recorded, irrespective of specific location. Although provenance information is lost by such a method,[19] it proved a fast and effective means for assessing the frequency of coarse-ware fabrics across the site. All sherds for each transect were collected, sorted, and recorded, and a grab sample of fine ware and diagnostic coarse ware from each of the four quadrants (formed by the bisecting radii) was made. Total counts of each coarse-fabric type from each of the transects provided relative percentages to be compared to adjacent transects and values for other sites. The occupational phases for any site were determined by the range of diagnostic fine wares from the quadrants and transects, and the datable coarse-fabric types identified in the transects.

Fabric Typology

The range of fabric types in the KTS was determined while fieldwalking and during the preliminary recording of loci. In the preliminary recording of a site, sample coarse wares were gathered and grouped by fabrics that appeared similar to the naked eye. Types were differentiated primarily by surface and core color and visible rock and mineral inclusions. Samples of each coarse fabric were collected and studied to determine whether the type was valid, that is, different from the others. This method initially provided 14 basic coarse-fabric types. The list was augmented during final site recording, bringing the total to 18 Bronze Age fabrics.

The coarse-ware typology and chronology, while initially established by the correlation of datable fine pottery and coarse fabrics in the survey, were corroborated by the comparative analysis of solidly dated and well-stratified excavation deposits at Mochlos and Pseira, and preliminarily studied deposits from Vronda Kavousi. In addition, isolated but firmly dated pottery deposits from Myrtos Pyrgos (periods II and III) and *Quartier Mu* at Mallia, while not examined systematically or quantified, offered interesting comparative material.[20] Surface pottery from known or excavated sites such as Khamezi, Gournia, Vasiliki, Mallia, Myrtos Pyrgos, and the Vrokastro area supplemented the data.[21] The stratified pottery

[17] The "size-effect" theory provides a possible explanation for the paucity of fine ware on the surface of some Bronze Age sites as it might explain the abundance of visible coarse wares. Furthermore, Moody rightly points out that even one sherd of a chronologically diagnostic coarse fabric, or "index fabric," should carry the same weight as a fine diagnostic sherd and thus indicate activity at that site in the period suggested by the fabric (Moody 1987, ch. 5, 4, and Moody 1985, 52).

[18] By "notional center," we mean where we believed the approximate center of the site to be after preliminary reconnaissance.

[19] S. Plog, F. Plog, and W. Wait, "Decision Making in Modern Surveys," in M.B. Schiffer ed., *Advances in Archaeological Method and Theory* 1 (New York 1978) 407.

[20] Middle Minoan pottery deposits from Pyrgos and Mallia were superficially examined for fabrics corresponding to the KTS types, which helped to confirm the chronological range of the survey material.

[21] Coarse fabrics were observed on the site surface at Khamezi, Gournia, and Vasiliki (fig. 2); the authors thank Gerald Cadogan for permitting the examination of coarse wares from Pyrgos II and III at Myrtos (fig. 2), J.-C. Poursat for allowing the examination of pottery from *Quartier Mu*, Mallia, and Sylvie Müller for showing us survey pottery from the Mallia plain. While no surface pottery from Myrtos Phournou Koriphi was examined, Warren's publication of the fabric types provides much uesful comparative information (Warren 94–96).

from Vronda consisted of 19 pails, mostly destruction or habitation debris, dated to LM IIIC and five pails dated to MM II.[22] Current excavations at Pseira, Mochlos, and Myrtos Pyrgos substantiated the EM, MM–LM I, and LM IIIA–B ranges.[23] Six pails were studied from Pseira (LM I and LM III)[24] and eight from Mochlos (EM II, MM III, LM I, and LM III).[25] The deposits and pails within the deposits form biased samples chosen according to stratigraphic integrity. That is, we chose pails dated firmly on the basis of fine ware, and whose stratigraphic location suggested habitation or destruction debris directly on or near a floor or living surface. Since it is generally assumed that any given LM I deposit on a multi-period site may contain a substantial amount of earlier pottery (EM and MM), we avoided external living areas, slopewash debris, and floor packing and fill deposits, where a variety of periods might be represented, thereby confusing the relative percentages of coarse wares.[26] Thus, it is the exclusive appearance or dominance of certain fabric types in well-stratified and dated deposits that is the basis for the attributed chronological range.

THE COARSE-WARE FABRICS

The aim of the KTS coarse-ware study was to define fabric types whose differentiating features were readily apparent to the naked eye, and thus could be easily identified and quantified in the field during survey. In the case of the KTS coarse wares, macroscopic visual observations allowed different fabric types to be easily and unambiguously identified. For this reason, the application of scientific techniques, such as petrographic analysis, in the initial study of the Kavousi coarse fabrics was not necessary. Concerning the role of scientific methods in the study of pottery, Peacock has observed:

> The existence of scientific techniques does not mean that the traditional archaeological method of visual comparison is invalid: there is still a great scope and need for studies of this type. If the origin, type or ware can be unambiguously identified, the application of complex and often expensive techniques cannot be justified. At a later date more refined questions may arise and analytical work can then be carried out if it is likely to provide answers. The second point, following from this, is that the simplest methods should be used first.[27]

The purpose of petrographic analysis is to aid the researcher in defining rock and mineral inclusions, types of clays, methods of manufacture, and ultimately the provenience of the materials of composition. The provenience of a pot and its mineral components is only established after considerable fieldwork and laboratory study, which might determine the sources of raw materials over a broad area.[28] Thus, the role of scientific analysis in ceramic studies pertains primarily to questions of composition and origin. The chronology and place of production are established archaeologically (that is stratigraphically). Thus, the purpose of the KTS fabric study was not to identify scientifically all the geological components of the pottery, but to define purely visual criteria for identifying fabrics with chronologically significant features.

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[22] The dates and disposition of the Middle Minoan deposits from Vronda have been only preliminarily studied; the deposits may comprise foundation material for LM IIIC buildings (see L.P. Day, W.D.E. Coulson, and G.C. Gesell, "Kavousi, 1983–1984: The Settlement at Vronda," *Hesperia* 55 [1986] 364–65). L.P. Day has pointed out (personal communication) that the LM IIIC coarse wares in the KTS may represent only a sample, perhaps even a minimum, of the actual number of coarse-ware types in use in the period at Vronda.

The following 19 pails of LM IIIC pottery from Vronda were studied: 5807.1, 5807.2, 5815.1, 5817.1, 5352.1, 5354.2, 5357.1, 5357.2, 5357.3, 5358.1, 5358.2, 5358.3, 5361.1, 5361.2, 5362.1, 5362.2, 5362.3, 5362.4, and 5363.1.

The five lots of MM pottery analyzed from Vronda include locus 902, level 2, pails 2 and 4 (combined); locus 902, level 4, pails 12 and 14 (combined); locus 902, level 3, pail 8; locus 903, level 3, pails 13 and 14 (combined); and locus 2801, level 1, pail 4.

[23] The authors thank Philip Betancourt and Jeffrey Soles for permitting the study of coarse pottery from Pseira and Mochlos; and Barbara Hayden and Jennifer Moody for allowing the examination of the Vrokastro survey finds.

[24] The six lots of pottery examined from Pseira came from building BS/BV, room 3, level 6 (LM IB); building DA, room 1, level 4 (LM IIIA2); building DA, room 1, level 3 (LM IIIA2); building DA, room 3, level 3 (LM IIIA2); building DA, room 2, level 3 (LM IIIA2); and building BS, room 16, level 3 (LM I).

[25] The eight pottery lots studied from Mochlos consisted of area E3, pail 1817/2817.2 (MM III); area E4, pail 5905/4905.2 (LM IIIA2–B); area E3, pail 5722.C (LM IB); area F4, pail 9213/9162.1 (LMIII); area E3, pail 4913.9 (EM II); area F3, pail 10062.1 (EM II–III); area F3, pail 10061.3 (EM II–III); and area F3, pail 10061.1–2 (EM II–III).

[26] An LM IA floor, for example, built directly on top of MM IIB destruction debris or fill, may include a substantial amount or even a majority of MM I–II fine and coarse wares. Thus, samples chosen from Pseira and Mochlos were judged to be "closed" or largely "uncontaminated" by earlier material.

[27] D.P.S. Peacock, "Ceramics in Roman and Medieval Archaeology," in D.P.S. Peacock ed., *Pottery and Early Commerce: Characterization and Trade in Roman and Later Ceramics* (London 1977) 25.

[28] In the area of the north isthmus, extensive fieldwork of this type has been conducted; see Betancourt and Day.

Table 1. Percentages of Inclusions in Coarse-Ware Fabric Types

Fabric Type	Date	Phyllite Series	Misc. White	Granitic-Dioritic Series	Gold Mica (Biotite)	Silver Mica Schist	Meta-morphosed Limestone	Other Carbonates	Misc. Gray	Other
I	MM III–LM IB	10–20%	<1%	—	—	—	—	—	—	—
II	EM I–II	—	25%	<1%	<1%	—	—	—	—	—
III	MM I–II	—	<1%	10–15%	<1%	—	—	—	—	—
IV	MM I–II, LM III	10–20%	5%	—	—	—	—	—	—	—
V	?	20%	1%	—	<1%	<1%	—	<1%	—	—
VI	MM I–II	—	30%	5%	3%	—	—	—	—	—
VII	?	—	—	—	<1%	<1%	—	—	—	25%
IX	EM I–II	—	—	—	≤1%	—	25%	—	<1%	—
X	LM IIIC	25%	1%	—	—	—	—	—	—	—
XI	LM III	10–15%	<1%	—	—	—	—	—	—	—
XIII	LM III	20–25%	0–1%	—	—	—	—	—	—	—
XIV	?	2%	7%	1%	—	—	—	—	—	<1%
XV	LM III	—	—	15%	—	—	—	—	<1%	—
XVI	LM IIIC	—	5%	—	—	10–25%	—	—	—	—
XVIII	?	—	15%	—	<1%	—	—	—	—	1%
XIX	?	5%	6%	—	—	—	—	<1%	—	<1%
XX	MM I–II	15%	1%	<1%	0–1%	—	—	<1%	—	—
XXI	MM I–II	—	25%	≤1%	<1%	—	—	—	—	—

The 18 coarse Bronze Age fabrics identified in the field at Mirabello are described below, and the 13 determined to be chronologically significant within the survey sample are discussed in detail.[29] In addition to color, surface treatment, and the use of organic temper (chaff),[30] the fabrics are distinguished by the types and relative quantities of rock and mineral inclusions. The descriptions of the fabric types are based on visual observations made with a 10× hand lens. The percentages of visible constituents (table 1) represent averages observed on a clean surface and fresh break of several specimens of each fabric type. These were estimated with the help of visual percentage estimation charts and represent rough approximations of the percentage of the surface occupied by each class of inclusion.[31] The percentages are translated in the descriptions as follows: <1% rare, 1–3% sparse, 3–5% common, 5–10% frequent, 10–20% abundant, 20–30% very abundant. A standard geological comparison chart was used to evaluate inclusion shapes for roundness and two-dimensionality.[32] White to light gray inclusions were tested with hydrochloric acid (HCl) and those that reacted by "fizzing" were identified as carbonates. Fabric, surface, and core colors are described with reference to the Munsell Soil Color Charts; the Munsell notations and color names are given in parentheses. Additional information on the color range for each fabric is given by our

[29] The original fabric type numbers established for the KTS have been maintained because the typology is currently being used by the Kavousi Project Excavation. Several types, which were initially given numbers during the survey and preliminary recording of sites, were later found not to be distinct, but only variants of other fabric types. Color differences from differential firing and transformations in appearance caused by extreme wear accounted for redundant type assignations. The gaps in the sequential numbering of the fabrics represent types that have been collapsed: type XII is equivalent to type XVI, type XVII is identical to type XV, and type VIII is the same as type I. Some types are omitted from discussion here because they were not chronologically distinctive within the survey sample. These fabrics are nonetheless described, as they might prove to be significant and more prevalent in the future, with the further study of more excavation samples.

[30] By "chaff" or "chaff voids," we mean generally unidentified impressions left in the clay after firing that resemble cut straw, hay, grass, or some other organic material or plant debris, perhaps added intentionally or as the remnant of dung. These voids were clearly produced by organic material that burned out of the clay during firing of the vessels. They usually measure no more than 0.5 mm in width and range from 1.0 to 5.0 mm in length, but are most often 1.5–3.0 mm long.

[31] The charts used are those of R.D. Terry and G.V. Chilingar, *Journal of Sedimentary Petrology* 25 (1955) 229–34.

[32] For example, the roundness scale of M. Powers, *Journal of Sedimentary Petrology* 23 (1953) fig. 1, or those after P. Bullock, N. Fedoroff, A. Jongerius, G.J. Stoops, and T. Tursina, *Handbook for Soil Thin Section Description* (Wolverhampton 1985).

impressionistic description, which we believe is more useful and vivid than the redundant and sometimes incomprehensible Munsell descriptions.[33] The descriptions are based on the visual appearance of the fabrics, and are intended as a guide for identification of the various fabric types by others working in the Mirabello area.[34]

Fabric Descriptions

Type I: MM III–LM IB (fig. 3)

This fabric[35] varies in color from reddish-brown to reddish-orange (2.5YR 4/6 red to 5YR 5/6 yellowish-red). It frequently has a pinkish-gray to dark reddish-brown or yellowish-gray core with diffuse edges (2.5YR 5/2 weak red to 2.5YR 3/6 dark red or 2.5Y 5/2 grayish-brown). Red to gray or brown, foliated inclusions are abundant. They are subangular, equidimensional or elongate, and microscopic to 5.5 mm in size. They belong to the phyllite series. These large, densely packed phyllites are the most apparent inclusions in this fabric. White to very light gray, angular to subangular, elongate inclusions are 0.3–2.5 mm in size. They are rare, and only sometimes visible. The surface texture is smooth and hard, with the inclusions well embedded into the body. The rarity of white inclusions in type I distinguishes it from type IV.

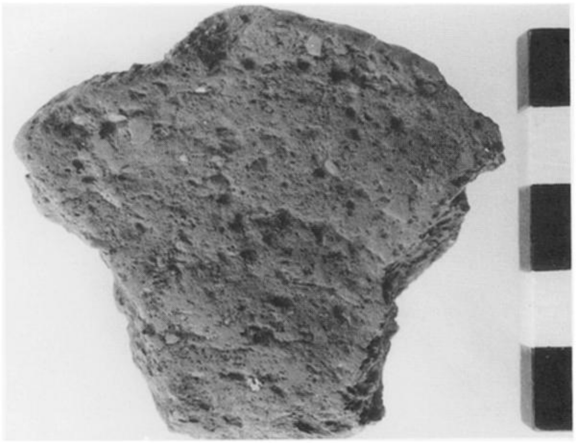

Fig. 3. Fabric type I

Type II: EM I–II (fig. 4)

The fabric ranges from reddish-brown to tan in color (5YR 4/6 yellowish-red to 10YR 5/4 yellowish-brown), sometimes with a gray to yellowish-gray core with diffuse edges (2.5Y 5/2 grayish-brown to 2.5Y 5/4 light olive brown). White to very light gray, angular to subrounded, equidimensional inclusions are microscopic to 3.0 mm in size. These inclusions are very abundant, and generally appear as densely packed white grits. Black-and-white inclusions with a distinctive "salt and pepper" appearance are rare, but always apparent. These are angular, equidimensional rock fragments, 0.5–1.0 mm in size, which come from the granitic-dioritic series. Rare gold mica particles are 0.2–1.0 mm in size. These are identified as biotite and are not always visible without a hand lens. The surfaces of type II have a distinctive rough and sandy texture. This fabric is very similar to type VI but can be distinguished from it by the smaller quantity of the black-and-white granitic-dioritic inclusions.

Fig. 4. Fabric type II

Type III: MM I–II (fig. 5)

The color of this fabric ranges from light orange to buff (7.5YR 6/6 reddish-yellow to 10YR 6/6 brownish-yellow), with a pink to orangish-brown core with diffuse edges (2.5YR 5/6 red to 5YR 5/6 yellowish-red).

[33] We feel that terms like black, buff, light brown, or tan suggest colors more clearly than "very dark grey," "very pale brown," "yellowish-brown," or "light yellowish-brown," on the 10YR chart. Similarly, we think "dusky red," "reddish-brown," and "light red," are less clearly descriptive than terms like brown, purple, or orange on the 2.5YR chart. Moody 1987, ch. 5, 2 also questions the usefulness of strict adherence to the Munsell color names.

[34] The authors would like to thank Peter Day of the University of Cambridge and Sarah Vaughan of the Wiener Laboratory, American School of Classical Studies at Athens, for discussing the fabric types with us and making suggestions for the descriptions. These identifications are preliminary, and in some cases necessarily general. Petrographic and chemical analysis will be conducted on many of the samples as part of a broader analysis of Mirabello coarse wares in the future, and will provide more accurate and comprehensive data.

[35] This is equivalent to the most common phyllite-tempered fabric occurring at Pseira in LM I (P.P. Betancourt and C. Floyd, personal communication).

Black-and-white granitic-dioritic inclusions are 0.3–3.5 mm in size and abundant. These are the most obvious inclusions in type III, and often protrude beyond the surfaces, giving them a rough texture and a "salt and pepper" appearance. Discrete white to very light gray, angular to subangular, elongate inclusions are 0.3–1.0 mm in size. They are rare and not always apparent. "Gold mica" particles (biotite), microscopic to 0.3 mm in size, are also rare and frequently not visible. There are occasional voids in the core, which seem to be the result of incomplete wedging of the clay during production.

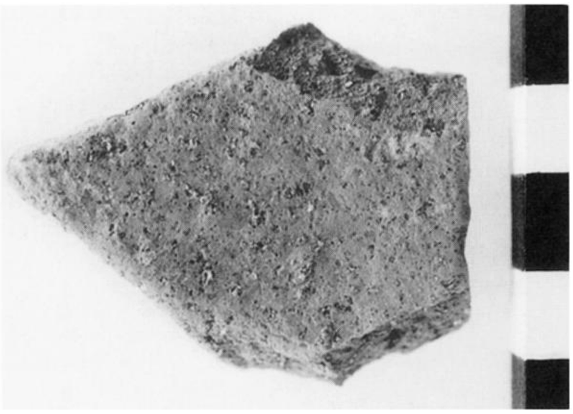

Fig. 5. Fabric type III

Type IV: MM I–II, LM III (fig. 6)

The fabric color varies from reddish-brown to reddish-orange (2.5YR 4/6 red to 5YR 5/6 yellowish-red), sometimes with a dark brown to gray core (5YR 3/4 dark reddish-brown to 10YR 5/1 gray). Red to gray or brown foliated inclusions, subangular and mostly equidimensional but also elongate, are 0.3–6.5 mm in size. They belong to the phyllite series and are abundant. These phyllites are densely packed and are the most obtrusive inclusion type in this fabric. White to very light gray, angular to subangular, equidimensional inclusions are 0.4–3.0 mm in size. They are common to frequent in the fabric, and always apparent. It is the greater quantity of white to light gray inclusions that distinguishes this fabric from type I. The surfaces are sometimes smooth, but frequently rough, with the inclusions protruding.

Type V: Uncertain date

This fabric ranges from tan to pinkish-buff in color (7.5YR 6/6 reddish-yellow to 10YR 6/6 brownish-yellow), sometimes with a pinkish-gray core (2.5YR 5/2–4/2 weak red). Red to gray foliated, subrounded to

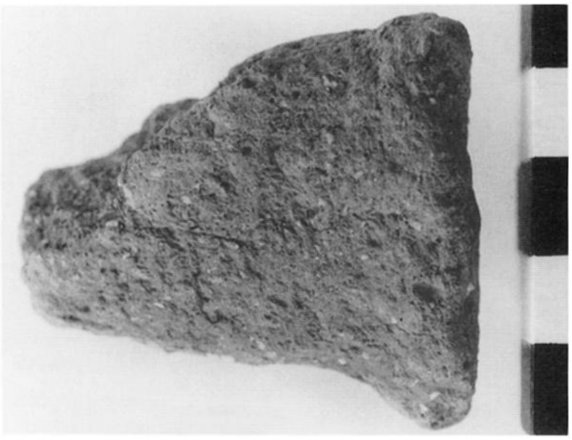

Fig. 6. Fabric type IV

rounded, elongate inclusions are 0.5–4.0 mm in size. These inclusions belong to the phyllite series and are abundant on the surfaces but sparse within the paste. In any sample, approximately half of these phyllites have harder surfaces than the others and are less obviously foliated. Dull orangish-red inclusions are subangular, equidimensional, and 0.5–2.5 mm in size. They are siltstones, also from the phyllite series, sometimes foliated, and rare to sparse. White to very light gray, angular to subangular, equidimensional inclusions are microscopic to 3.0 mm in size. They are sparse. Off-white, subrounded, equidimensional inclusions, microscopic to 3.5 mm in size, are rare. These are carbonates and have a distinctive chalky appearance. Gold mica (biotite) and silver mica particles are rare but always present. Many of the inclusions in type V have a rounded, water-worn appearance. The surfaces have a slightly sandy texture.

Type VI: MM I–II (fig. 7)

This fabric[36] is dark reddish-brown in color (5YR 4/4 reddish-brown), and may have a dark brown core with diffuse edges (7.5YR 3/2 dark brown). White to light gray, angular to subangular, equidimensional inclusions are microscopic to 4.0 mm in size (although most are 0.5 mm and smaller). They are very abundant, and appear as densely packed, white grits. Black-and-white granitic-dioritic inclusions, 0.5–2.5 mm in size, are common to frequent, and always obvious. Gold mica particles (biotite), microscopic to 1.0 mm in size, are also common. The surface texture is distinctly sandy. Although extremely similar to type II in appearance, type VI can be distinguished by the greater quantity of black-and-white granitic-dioritic inclusions.

[36] This is possibly Day's fabric type 1 or 2 (Day 91–94), which he calls "Mirabello Fabric." It is equivalent to Pseira "Mirabello Cooking Fabric" (P.P. Betancourt and C. Floyd, personal communication).

Fig. 7. Fabric type VI

Type VII: Uncertain date

This fabric ranges from light orange to pinkish-buff in color (7.5YR 6/6 reddish-yellow to 7.5YR 6/4 light brown), sometimes with a pinkish-buff core (5YR 6/4 light reddish-brown). Gray and red, subangular to subrounded, elongate or equidimensional inclusions, microscopic to 5.0 mm in size, are very abundant. Some have a dull, rough appearance and others are smooth and shiny; they are very hard and friable. These large chunky inclusions are very obvious on the surfaces and frequently protrude. Gold mica (biotite) and silver mica schist particles are rare and frequently not apparent on the surface.

Type VIII (= Type I)

Type VIII is the same fabric as type I. It was initially assigned a separate number because the fabric was incompletely oxidized, giving it a distinctive appearance with thin reddish-orange surfaces and a thick gray core. Further study, however, indicated that the fabric and inclusions were not distinguishable from those of type I and that this difference in firing was not consistent enough to warrant a separate designation.

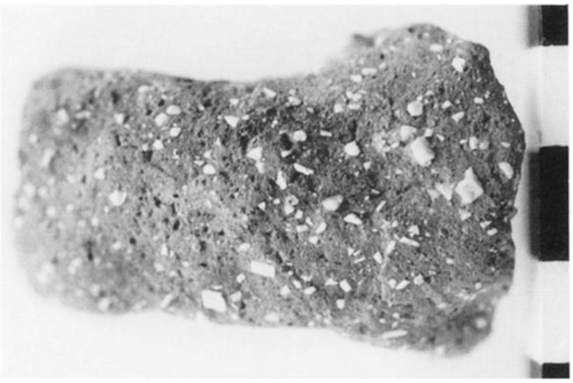

Fig. 8. Fabric type IX

Type IX: EM I–II (fig. 8)

The fabric[37] varies from reddish-brown to brownish-orange in color (5YR 4/4 reddish-brown to 5YR 5/6 yellowish-red) and can have a well-defined dark brown to gray core (10YR 3/3 dark brown to 10YR 5/1 gray). The distinctive inclusions are white, occasionally very light gray, very angular, elongate or equidimensional, 0.2–2.5 mm in size, and very abundant. They are metamorphosed limestone[38] and appear as densely distributed, very angular chunks of white marble. Gray rock fragments, subangular to subrounded, equidimensional, and 0.5–2.0 mm in size, are rare. Gold mica particles (biotite) are rare to sparse and only sometimes visible; they range in size from microscopic to 1.0 mm. If the surfaces of the vessel are unburnished, they have a rough texture because the marble inclusions protrude well beyond the surfaces. Chaff voids are visible both on the surfaces and throughout the paste.

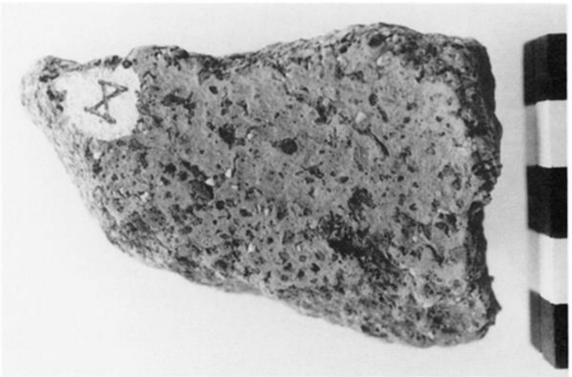

Fig. 9. Fabric type X

Type X: LM IIIC (fig. 9)

This fabric type has a distinctive slip (occurring on both the interior and exterior of open vessels), which ranges in color from buff to light yellow (7.5YR 7/6 reddish-yellow to 10YR 8/6 yellow). The fabric is light orange (5YR 6/6 reddish-yellow), and sometimes has

[37] Type IX is remarkably similar to the description of an EM IB fabric from a deposit in the West Court House at Knossos; see D. Wilson, "Pottery and Architecture from the EM IIA West Court House," *BSA* 80 (1985) 363. Warren's "fabric type 8" at Myrtos (Warren 95) is probably an identical or similar marble-tempered ware.

P.M. Day (personal communication) suggests that the source of the metamorphosed limestone (marble) inclusions in fabric type IX is around the granitic-dioritic intrusions of the Gournia region. See also M.K. Durkin and C.J. Lister, "The Rods of Digenis: An Ancient Marble Quarry in Eastern Crete," *BSA* 78 (1983) 90–91, on the Gournia marble.

[38] These carbonates were specifically identified as metamorphosed limestone by Sarah Vaughan and Peter Day.

a dark pink core with diffuse edges (10R 5/6 red). Red and gray foliated inclusions, subangular, equidimensional or sometimes elongate, are 0.2–4.0 mm in size. They are very abundant and belong to the phyllite series. White to very light gray, angular to subangular, but occasionally subrounded, equidimensional or elongate inclusions, 0.3–2.0 mm in size, are sparse. Chaff voids occur on the surfaces and in the paste in small numbers. Voids are sometimes obvious in the center of the core, and appear to result from incomplete wedging of the clay during production. The surfaces are smooth and the slip partially covers the inclusions.

Type XI: LM III

Fabric type XI is a finer version of type X, with the same inclusions occurring in lesser quantities and generally smaller sizes. Chaff voids rarely are present on the surfaces of type XI.

Type XII (= Type XVI)

Type XII is the same fabric as type XVI. As was the case with type VIII, the fabric appeared to be different because it was incompletely oxidized, with dark tan surfaces and dark grayish-brown core. Other features of the fabric, and the inclusions in particular, are identical to those of type XVI. The sherds identified as type XII, however, were found on the surface of a single site—one that had suffered from a severe brushfire only two years prior to the site recording.

Fig. 10. Fabric type XIII

Type XIII: LM III (fig. 10)

The fabric is dark pink to pinkish-orange in color (2.5YR 6/6 light red to 5YR 6/6 reddish-yellow), and frequently has a thick buff slip (10YR 7/4 very pale brown) that covers the inclusions and creates a smooth surface. Red to purple, foliated inclusions, angular to subrounded, mostly equidimensional but sometimes elongate, are 0.2–7.0 mm in size. These very abundant inclusions are mudstones or siltstones from the phyllite series. White to very light gray, subangular, equidimensional inclusions, 1.0–2.0 mm in size, occur rarely. Clay lumps are also present. It is the densely concentrated, large, red or purple phyllites that are obvious.

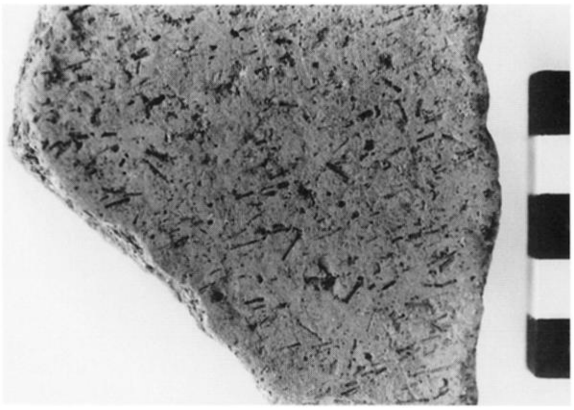

Fig. 11. Fabric type XV: sherd surface showing chaff voids

Type XIV: Uncertain date

This fabric is tan in color (2.5Y 6/4 light yellowish-brown), sometimes with a primary gray core (10YR 6/2 light brownish-gray) and a secondary pink core with diffuse edges surrounding it (5YR 6/4 light reddish-brown). White to light bluish-gray inclusions are frequent. They are angular to subrounded, equidimensional, and microscopic to 2.0 mm in size. Gray to red, subangular to subrounded, equidimensional inclusions are 0.5–4.0 mm in size. These inclusions are sparse, and come from the phyllite series. Black-and-white, subangular, equidimensional inclusions are 2.0 mm in size. These inclusions come from the granitic-dioritic series, and although they are sparse in the fabric, they are always apparent because of their consistently large size. Black-and-red, subangular, equidimensional inclusions are 0.5–1.0 mm in size, and are rare. The surfaces are rough and sandy, and the fabric has a brittle texture. Voids on the surface appear to be the result of dislodged inclusions.

Type XV: LM III (figs. 11–12)

The surface color of this fabric is usually buff, although light greenish-gray examples were also found, perhaps the result of incomplete oxidation during production or secondary burning (7.5YR 7/6 reddish-yellow or 2.5Y 7/2 light gray). The former is associated with a thick pinkish-brown core, while the core of the latter is greenish-gray (5YR 5/4 reddish-brown and 2.5Y 6/2 light brownish-gray). Black-and-white, subangular, equidimensional inclusions range in size from 0.1 to 2.5 mm. They are abundant and come from the granitic-dioritic series. Within type XV, however, these densely packed inclusions are mostly white in color (granitic). Gray, angular, equidimensional or elongate inclusions, 0.5–2.5 mm in

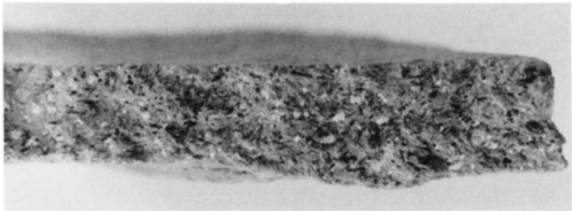

Fig. 12. Fabric type XV: section

size, also occur, but are rare. Clay lumps are also visible. The inclusions are rarely visible on the vessel surfaces, which are soft and smooth (fig. 11). Many chaff voids are present on both the surfaces and in the paste (figs. 11–12).

Although similar to fabric type III, type XV can be distinguished from it by its prominent chaff voids, the primarily white granitic-dioritic inclusions, and by the paucity of inclusions apparent on the surfaces.

Type XVI: LM IIIC (fig. 13)

This fabric varies from red to reddish-orange in color (10R 4/6 red to 2.5YR 5/8 red). Silver mica schists are abundant to very abundant and give this fabric its characteristic glittery appearance. They range in size from 0.1 to 5.5 mm, although few are larger than 2.5 mm. White to very light gray, angular, elongate inclusions, 0.3–2.5 mm in size, are common. Chaff voids occur in the paste and occasionally are visible on the surfaces. The surface texture can be rough and sometimes gritty.

Fig. 13. Fabric type XVI

Type XVII (= Type XV)

Type XVII is the same fabric as type XV. This type was initially identified as distinct from type XV because chaff voids were not visible on the surfaces. Further study of the samples indicated that the chaff voids were indeed present within the paste, but were not apparent on the surfaces because they were severely worn.

Type XVIII: Uncertain date

The color of this fabric is brown (7.5YR 5/4 brown), with a dark brown to black core (10YR 4/2 dark grayish-brown to 10YR 2/1 black). White to light gray, angular to subangular, equidimensional inclusions are abundant. They are 0.3–2.0 mm in size and are the most apparent inclusions on the vessel surfaces, often protruding. Dark gray to black, subangular to subrounded, equidimensional inclusions are microscopic to 0.5 mm in size. They are sparse and look carbonized. Rare gold mica particles (biotite), microscopic to 0.9 mm in size, are not always apparent. The surfaces are rough and chaff voids occur on both the surfaces and in the paste.

Type XIX: Uncertain date

This fabric has a distinctive creamy white surface (10YR 8/2 white), possibly a wash.[39] The color of the fabric is pink (5YR 7/3 pink), with a primary dark gray core (10YR 5/1 gray) and a secondary reddish-orange core surrounding it (5YR 5/6 yellowish-red). Red to gray, foliated, subrounded, equidimensional inclusions are 1.0–5.0 mm in size. These belong to the phyllite series and are common. Off-white carbonate inclusions with a chalky appearance are rounded to subrounded, and equidimensional. They range from 0.4 to 2.5 mm in size and are rare. White to pinkish-gray, angular, equidimensional or elongate inclusions are 0.3–2.0 mm in size, and are frequent. Black microscopic inclusions are rare and appear as black grits. The surfaces are smooth, with the inclusions well embedded into the fabric. Chaff voids are visible on the surfaces and infrequently in the paste.

Type XX: MM I–II (fig. 14)

This fabric is buff (7.5YR 7/6 reddish-yellow), with a buff slip (between 7.5YR 7/4 pink and 10YR 7/4 very pale brown). Red to brown, foliated, equidimensional inclusions from the phyllite series are abundant and 0.1–4.0 mm in size. White to light gray inclusions, microscopic to 2.0 mm in size, angular to subangular and equidimensional, are sparse. Off-white inclusions, which are subrounded to rounded and equidi-

[39] Microscopic examination of this fabric indicated that the creamy white exterior was not a deliberately applied layer. It may be a whitening of the surface caused by the presence of salt in the clay. For explanation of this characteristic see F.R. Matson, "Physical Characteristics of the Fabric, Slip, and Paint," in Betancourt 53.

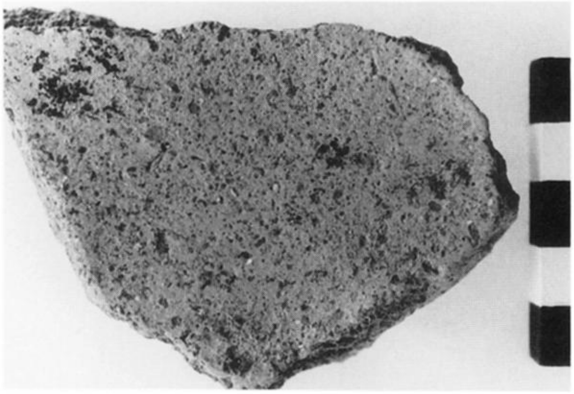

Fig. 14. Fabric type XX: unslipped surface

mensional, have a chalky texture and are carbonates. They are 0.5–1.5 mm in size and rare. Black-and-white, angular, equidimensional rock fragments, 0.5–2.0 mm in size, are also rare and probably from the granitic-dioritic series. Gold mica particles (biotite) are sometimes visible. Slipped surfaces are smooth and the slip obscures nearly all of the inclusions. Unslipped surfaces (interiors of closed vessels) are slightly sandy, with the red to brown phyllite and white inclusions most apparent. The black-and-white granodiorites are not always obvious.

Type XXI: MM I–II (figs. 15–16)

The fabric is pinkish-tan in color (5YR 5/4 reddish-brown), with a buff slip (between 7.5YR 7/4 pink and 10YR 7/4 very pale brown). White, angular, equidimensional inclusions are very abundant, and range from microscopic to 3.0 mm in size. Black-and-white, angular, equidimensional rock fragments from the granitic-dioritic series, 0.3–2.5 mm in size, are rare to sparse. Gold mica particles (biotite), microscopic to 0.4 mm in size, are also rare. Slipped surfaces are smooth (fig. 15), while unslipped surfaces (interiors of closed vessels) have a rough and sandy texture (fig. 16). There are many chaff voids on both the surfaces and in the paste, where they are particularly numerous. This fabric can be distinguished from type XX by its greater quantity of white sandy inclusions and gold mica, and by the absence of phyllites. The black-and-white granodiorites are also more apparent in type XXI than in type XX.

Fig. 15. Fabric type XXI: sherd surface showing slip and chaff voids

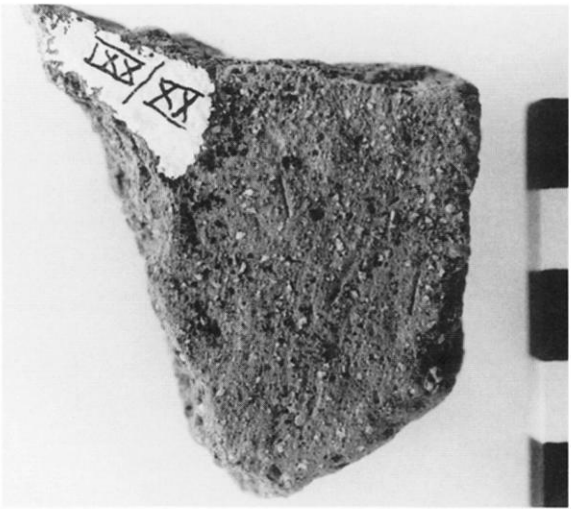

Fig. 16. Fabric type XXI: worn unslipped surface

DISCUSSION

Inclusions in the pottery may be naturally occurring in the clays and soils used by the potter, or they may be intentionally added to serve as aplastic tempering materials during preparation of the clay. Voids that suggest that chaff, dung, or some other organic material was used as a tempering material are apparent in fabric types IX, X, XI, XV, XVI, XVIII, XIX, and XXI; they were found in especially large quantities in type XV. The rather regular size and angular shape of the metamorphosed limestone inclusions in fabric type IX may indicate crushing by the potter for use as temper.

The large quantities and sizes of the phyllite inclusions in fabric types I, IV, X, and XIII suggest that they were intentionally added as temper, either separately or in conjunction with clay mixing. These four fabrics were used to produce pithoi, and the large phyllite inclusions would have strengthened the clay body, helping to support the tall, thick walls of these vessels before firing. Fabric types I and IV are most commonly found in tripod cooking pots, sometimes quite large ones, and the phyllite inclusions may additionally have enhanced the properties of the fabric

Table 2. Fabric Types and Associated Vessel Shapes Identified in the Kavousi-Thriphti Survey, Arranged in Chronological Order

Fabric Type	Date	Associated Vessel Shapes
II	EM I–II	tripod cooking pots, basins, bowls, trays, plates (cooking dishes)
IX	EM I–II	tripod cooking pots
III	MM I–II	jars, pithoid jars, pithoi, basins, oval-mouthed amphorae, amphorae, larnakes
VI	MM I–II	tripod cooking pots, basins, trays, scuttles, cooking dishes, oval-mouthed amphorae
XX/XXI	MM I–II	jars, basins, jugs, amphorae
IV	MM I–II	tripod cooking pots, basins, pithoi, oval-mouthed amphorae
I	MM III–LM IB	tripod cooking pots, cooking dishes, pithoi, jugs, conical cups, basins
XI	LM III	basins, pyxides, jugs, jars, amphorae, kylikes, craters, fenestrated stands
XIII	LM III	pithoi, basins
XV	LM III	jars, pithoid jars
X	LM IIIC	pithoi
XVI	LM IIIC	tripod cooking pots, pithoi, jars
IV	LM III	tripod cooking pots, pithoi, pithoid jars, basins, cooking dishes, kalathoi, scuttles, conical cups

for this specialized function.[40] Since most cooking pots produced from MM through LM IIIC were made with these phyllite-tempered fabrics, this is likely to be the case.

That inclusion size was intentionally controlled by the potter is illustrated by fabric types X and XI, which are distinguished only by the size and density of the inclusions. The much coarser type X was used only for producing pithoi, while the finer type XI is found in a variety of smaller shapes.

Many of these fabrics have limited periods of use and thus are chronologically diagnostic. The range of use for the coarse-ware types is, of course, broad within each period, but may be refined further with more detailed studies of a wider sample of well-stratified excavation pottery. For the purposes of survey, however, wide chronological ranges such as EM, MM I–II, MM III–LM I, LM IIIA–B, and LM IIIC, provide ample and adequate information for interpreting broad diachronic changes in settlement patterns.

The graphs (see below, figs. 17, 19, 21, 22, 24, 25, and 27) illustrate similarities in the occurrence of fabric types at KTS sites of one primary period, on the one hand, and stratified excavation deposits from Vronda, Mochlos, and Pseira, on the other. The survey sites included here are those whose date was established exclusively on the basis of diagnostic fine wares. The actual percentages of the coarse wares, while important, are less significant than the exclusive occurrence of specific fabric types in certain periods. Additionally, "negative evidence"—the absence of a fabric type or types on any given site or in any excavation deposit—is equally important in determining the chronological range of the fabrics.

The shape charts (see below, figs. 18, 20, 23, and 26) illustrate only the range of vessel types in each period that have been identified by the KTS (see also table 2). Thus, the actual number of shapes in each fabric may be greater than those illustrated in the charts and certainly the spectrum of shapes for each period is much wider. The comprehensive correlation of shape, surface treatment, fabric, and vessel function is impossible in the study of survey data and should properly be the aim of excavation.[41]

Early Minoan

Fabric types II and IX are exclusive to EM, and their presence on a survey site or in an excavation context indicates EM activity. Fabric percentages from pottery examined at Mochlos and from KTS locus 58 illustrate their prevalence during this period (fig. 17).[42] Type II is used primarily for tripod cooking pots, but also for basins, bowls, trays, and plates, or "cooking dishes,"[43] and type IX is probably a cooking

[40] See Riley 289, on the presence of phyllite inclusions in Knossian cooking fabrics.

[41] See Moody 1985, 53.

[42] The "other" category on this Mochlos graph (fig. 17a) represents a semi-coarse, black-burnished, phyllite-tempered ware that was not given a type number in the survey because it appeared as a much finer fabric; this "black-burnished ware" was considered generally diagnostic for FN–EM II.

[43] The term "cooking dish," or "baking plate," refers to large coarse vessels with an often enormous diameter. According to Betancourt (supra n. 12) 3, they are distinguished from trays by their thin rounded bottom; "trays" have thick flat bottoms and may be supported by feet. The term "plate" is used by Warren (161).

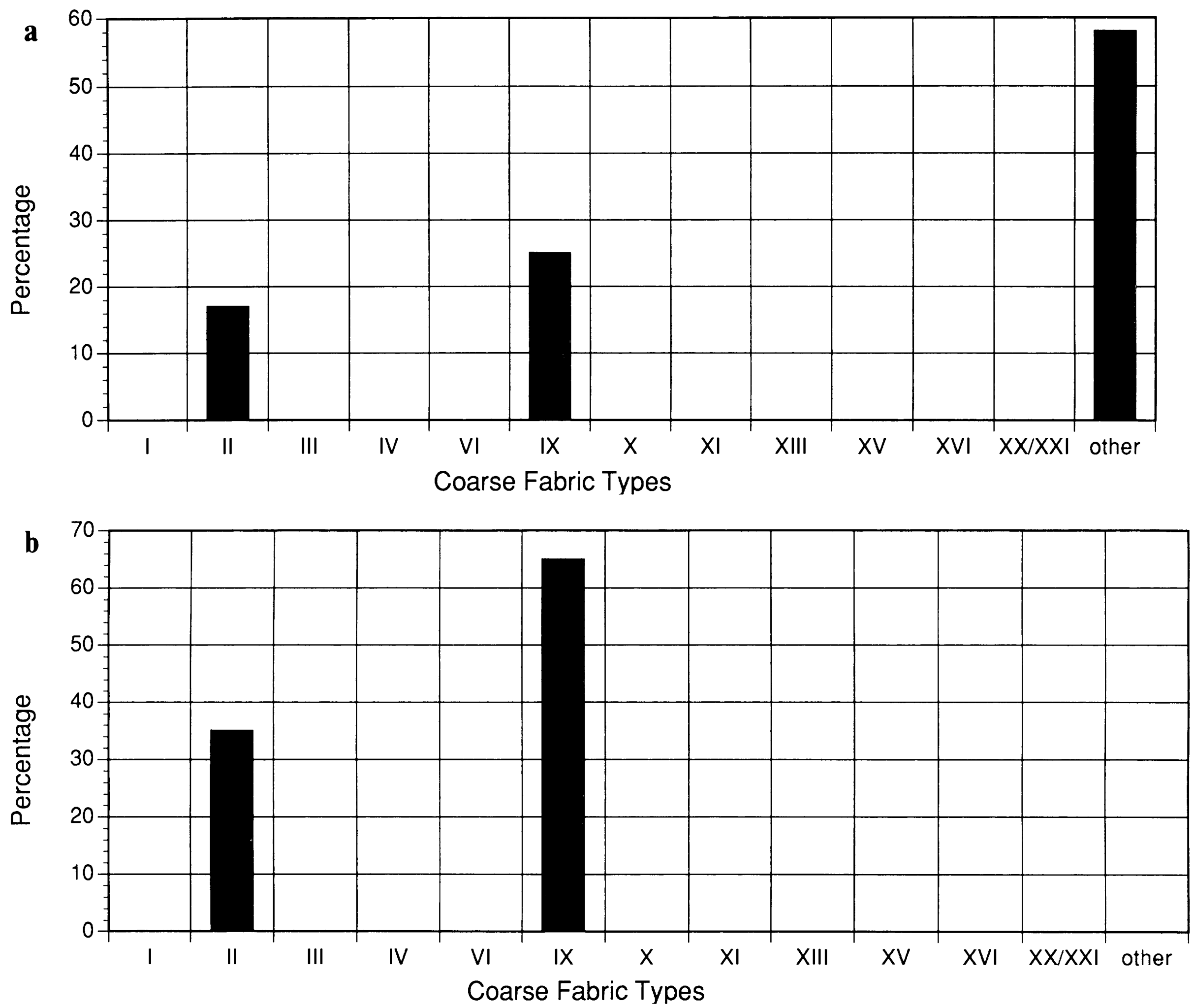

Fig. 17. Percentages of Early Minoan coarse fabrics at a) Mochlos (area F3, trench 10,000) and b) KTS locus 58

pot fabric (fig. 18).[44] These fabrics have been identified on Neolithic–EM II KTS sites and in excavation deposits at Mochlos dated to EM II. Thus, their specific range within the EM sequence is not at all clear, but certainly they are the principal wares in EM II.

Middle Minoan

In MM the number of coarse fabrics in use and the range of shapes increase. Exclusive to MM I–II are fabric types III, VI, and XX/XXI.[45] Type IV is also common in MM. Fabric percentages from Vronda and KTS locus 51 establish that these are the only coarse fabrics found in an MM I–II context at Kavousi (fig. 19).[46] Vessels made in fabric type III include jars, pithoid jars (large transport and storage jars), pithoi, basins, oval-mouthed amphorae, and larnakes. Type VI is used for tripod cooking pots and basins, as well as for trays, scuttles or braziers,[47] cooking dishes, and

[44] S.J. Vaughan (personal communication and "Macroscopic and Petrographic Studies of Early Cycladic Wares from Markiani on Amorgos," in L. Marangou, A.C. Renfrew, and C. Doumas eds., *An Early Fortified Settlement on Amorgos* [in press] 4–11) has identified three different "Marble Ware" fabrics current on the islands of Amorgos, Naxos, Keros, and Siphnos in Early Cycladic, which are very similar to KTS fabric type IX, and may suggest a widespread Aegean ceramic technology for the production of this type of fabric. For other marble-tempered wares on Crete, see supra n. 37.

[45] Types XX and XXI were not distinguished in the field during site sampling, and so are grouped together in the discussion.

[46] Coarse ware from an MM I–II cemetery rescue excavation at Kalo Khorio-Istron, conducted by the authors, also confirms that these types are diagnostic for this period.

[47] The term "brazier" is commonly accepted for a variety of Minoan clay vessels, which may have had a number of purposes associated with coals or burnt material; see P.P. Betancourt, *Minoan Pottery* (Princeton 1985) 110, 161. Given

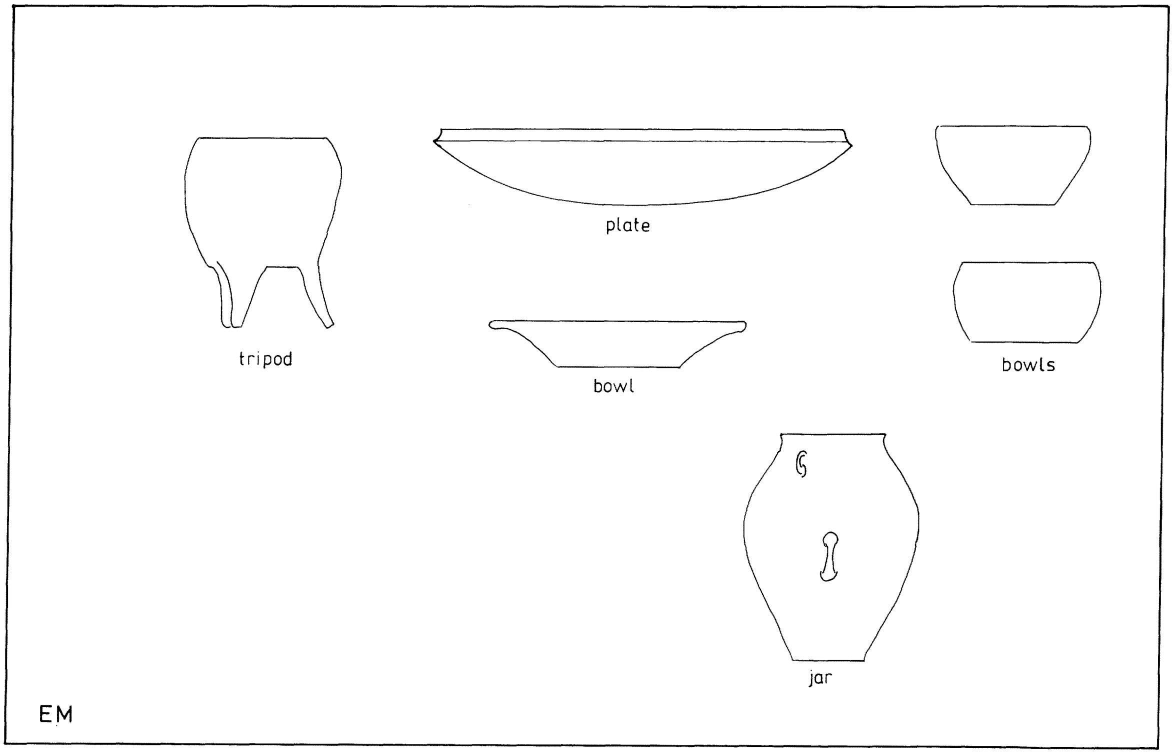

Fig. 18. Early Minoan coarse-ware shapes represented in KTS samples (not to scale)

oval-mouthed amphorae (fig. 20). Drip-decorated jars are the most common shape made of fabrics XX/XXI, but other jars, basins, jugs, and amphorae are also found in these fabrics. In MM, type IV is most frequently used for tripod cooking pots, and occasionally for basins, pithoi, and oval-mouthed amphorae.

Middle Minoan III–Late Minoan I

Fabric type I is the most prevalent coarse-ware fabric by far in MM III–LM I, and occurs only rarely in LM IIIA–C. The predominance of type I, especially as a tripod fabric, in MM III–LM I contexts is apparent in the high percentages of this fabric found at Pseira, Mochlos, and KTS locus 50 (fig. 21). The presence of large quantities of this phyllite fabric in any KTS assemblage is indicative of LM I activity; its complete absence on single-period survey sites and in excavation contexts of Early and Middle Minoan date (figs. 17, 19) further supports its LM I date. The fabric continues to be used on a very small scale in LM III, when it is largely replaced by type IV, which again becomes the basic cooking pot fabric (fig. 22). Tripod cooking pots are the most common vessel found in fabric type I, but pithoi, jugs, conical cups, and basins are also produced (fig. 23).

Late Minoan III

The frequent use of fabric type IV is resumed in LM III, as suggested by pottery from KTS locus 3, Mochlos, and Pseira (fig. 22), and it is also the most common tripod cooking pot, cooking dish, and tray fabric in LM IIIC. Types X–XVI are LM IIIC fabrics,[48] although types XI and XIII are found at Pseira in small quantities, and types XI and XV occur at Mochlos in well-stratified "reoccupation phases" in LM IIIA2–B contexts (fig. 22a–b). This pattern suggests that these three fabrics are first introduced earlier in LM III, but are most fully exploited in LM IIIC, when they are persistently well represented. Important for the purposes of surface survey is the complete absence of LM IIIC fabrics in LM I assemblages.

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the confusion in nomenclature for objects that might have been lamps, incense-burners, braziers, scoops, or chafing pans, we agree with Alexiou and Georgiou and prefer the more general term "scuttle" for the object illustrated in fig. 11; see H. Georgiou, *Keos* VI. *Ayia Irini: Specialized Domestic and Industrial Pottery* (Mainz 1986) 28, and "Minoan Fireboxes: A Study of Form and Function," *SMEA* 21 (1980) 126.

[48] Only one sherd of fabric type XIV was recovered in the KTS.

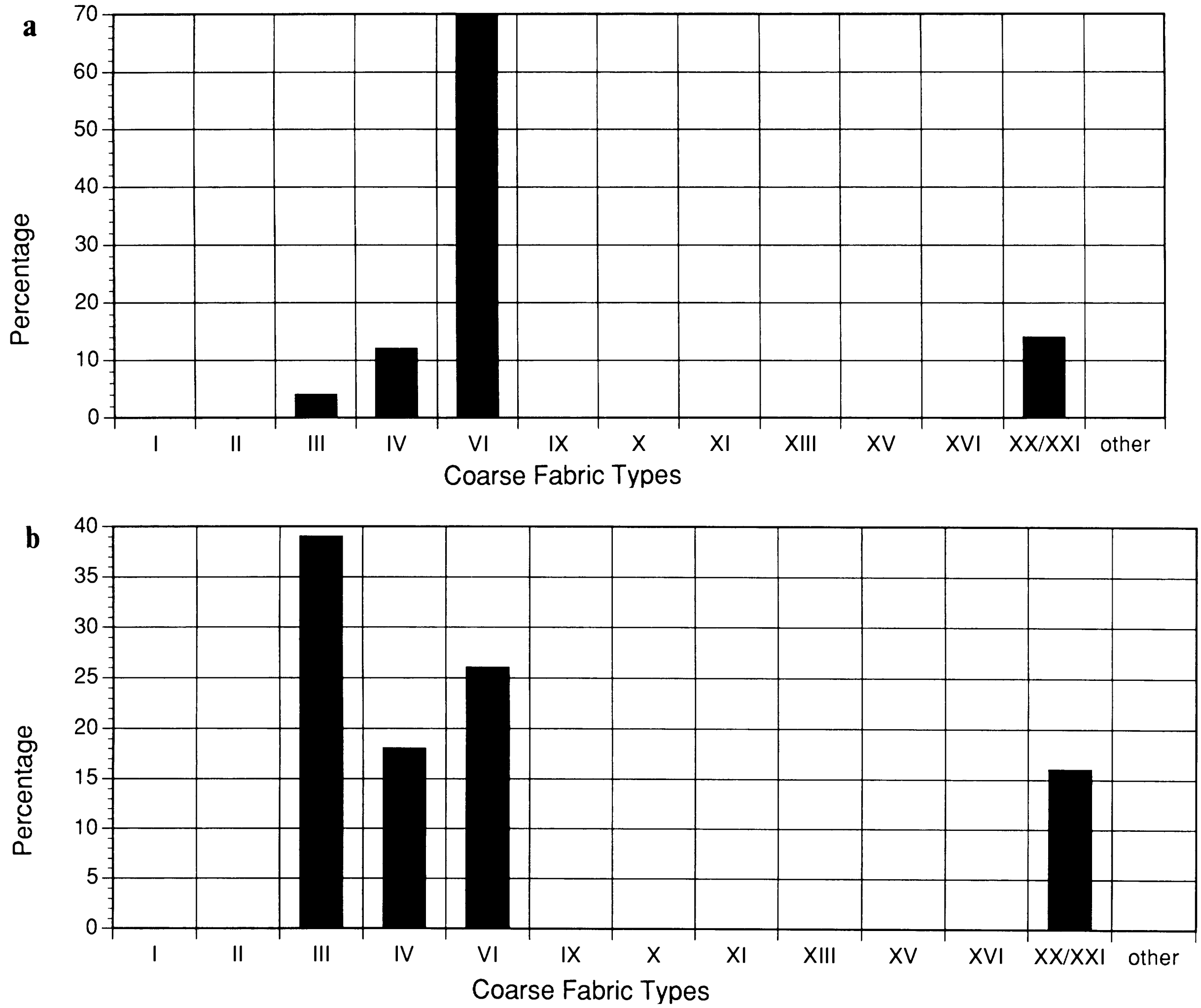

Fig. 19. Percentages of Middle Minoan coarse fabrics at a) Vronda (locus 903, level 3) and b) KTS locus 51

Fabric percentages from KTS loci 76 and 96 and Vronda further demonstrate that XI, XIII, and XV are the principal types that occur in pure LM IIIC contexts (figs. 24–25).[49] In LM IIIC, as in MM, many coarse fabrics are in use with an accompanying broad range of vessel shapes. Type X is a common pithos fabric, while its finer variant, type XI, is used for a broad variety of shapes, including basins, pyxides, jugs, jars, amphorae, kylikes, craters, and fenestrated stands (fig. 26). Type XIII is used primarily for pithoi, but basins are also made with this fabric. Jars and pithoid jars are found in type XV.[50] Fabric type XVI is used for tripod cooking pots, pithoi, and jars, as well as small vessels. In LM IIIC, type IV is used not only for tripod cooking pots, but also for pithoi, deep basins, shallow cooking dishes, kalathoi, pithoid jars, scuttles, and conical cups (fig. 26).

Dating Sites in Survey

Moody, who first developed a coarse-ware chronology for survey in the Khania area of western Crete, used a "suite wares" approach to site dating.[51] The underlying assumption of this method is that the chronology of a site may be determined by the appearance of "index fabrics" (fabrics limited to a specific and narrow period such as MM I–II or MM

[49] The authors thank Lee Ann Turner for providing coarse-ware statistics from this area of Vronda, which she is studying for final publication, and Leslie Day for permission to publish this data.

[50] Day 99 notes that the granitic-dioritic fabrics appear at Iron Age sites on the southern and eastern edge of the Bay of Mirabello.

[51] Moody 1985, 51–52; Moody 1987, ch. 5, 4–6 and table 5.2.

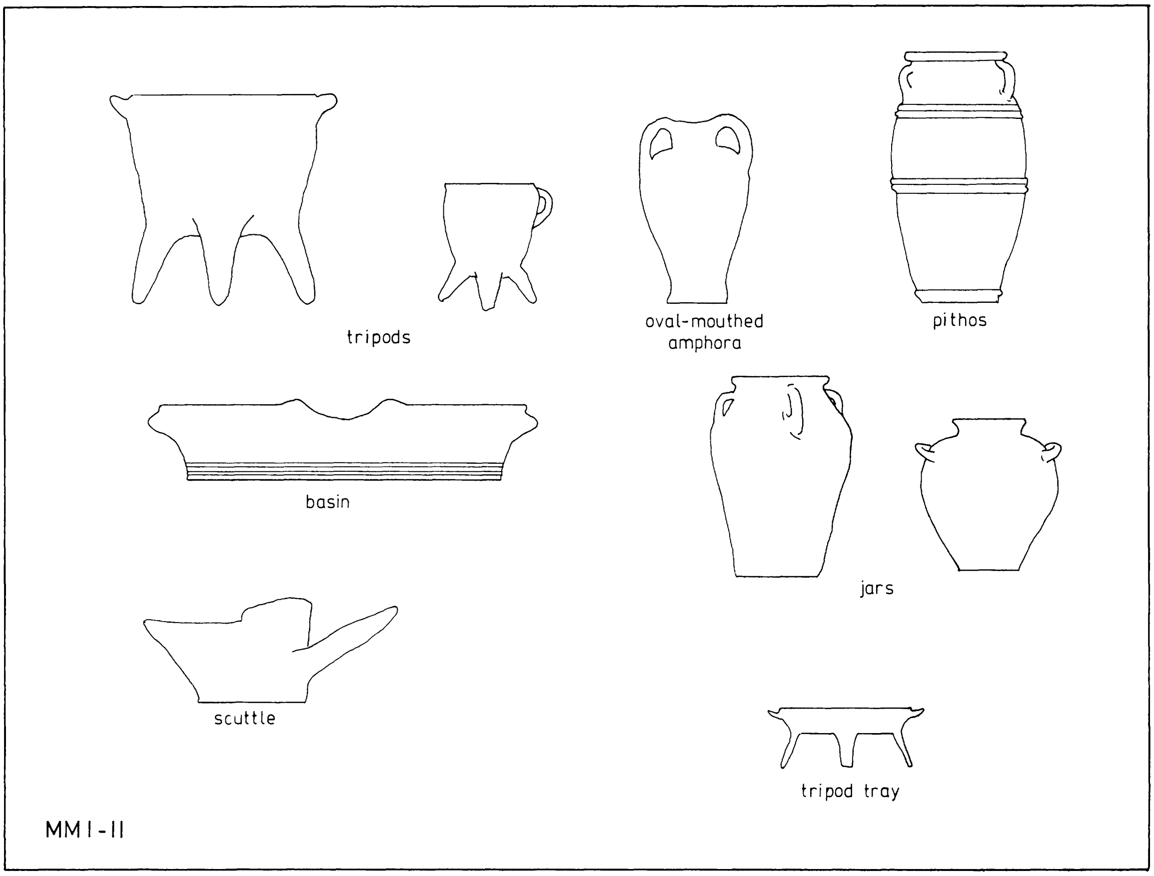

Fig. 20. Middle Minoan coarse-ware shapes represented in KTS samples (not to scale)

III/LM I), and the presence of a certain number of other fabrics with wider or overlapping chronological ranges. Presumably, the occurrence and combination of fabrics on the site suggest a particular "suite" of wares common in or specific to a particular range of occupational phases. For example, a site dated by Moody to "MM I–LM I" has a particular suite of seven coarse-ware fabrics. Two fabric types, "wares II and III," span the MM I–LM I phases, and two index wares, "VI and VII," are dated MM I–II; other types on the site show an overlapping range: "ware I" is EM I–LM I, another, "ware IV," is MM III–LM III, and a third, "ware V," is EM I–MM II. Thus, in the absence of an index ware for LM I, it seems likely that the site in Moody's example was inhabited from MM I to LM I; indeed the greatest overlap in date and concentration of wares falls within this MM I–LM I period. It is not entirely clear, however, whether this particular suite of MM I–LM I is consistently present on all sites in the survey dated as such, or why the presence of wares I, IV, and V might not indicate that occupation began as early as EM I and continued as late as LM III. With the lack of illustrated suites for each site, it is admittedly difficult to judge the meaning of the non-index fabrics in Moody's chronology, or the veracity of the suite diagram.

The purpose of the KTS study was to build upon Moody's work by isolating a number of index fabrics for the Kavousi area, that is, types with very specific and limited chronological ranges that might be verified by stratigraphic provenience. While Moody's seriation of types and rendering of suites are justified by the study of 8,000 kg of pottery from excavations at Stylos, Samonas, Kastelli, Nerokourou, and Debla, there is little indication of the stratigraphic integrity of the deposits studied.[52] The number of deposits examined does not, in itself, suggest a reliable verification of the periodicity of index wares or suites of wares. Stratigraphic control is, we believe, the critical issue in defining the existence or use of certain fabrics in certain periods. Every excavator of a multi-period site has experienced or can easily imagine the innu-

[52] Moody 1987, ch. 5, 4–5.

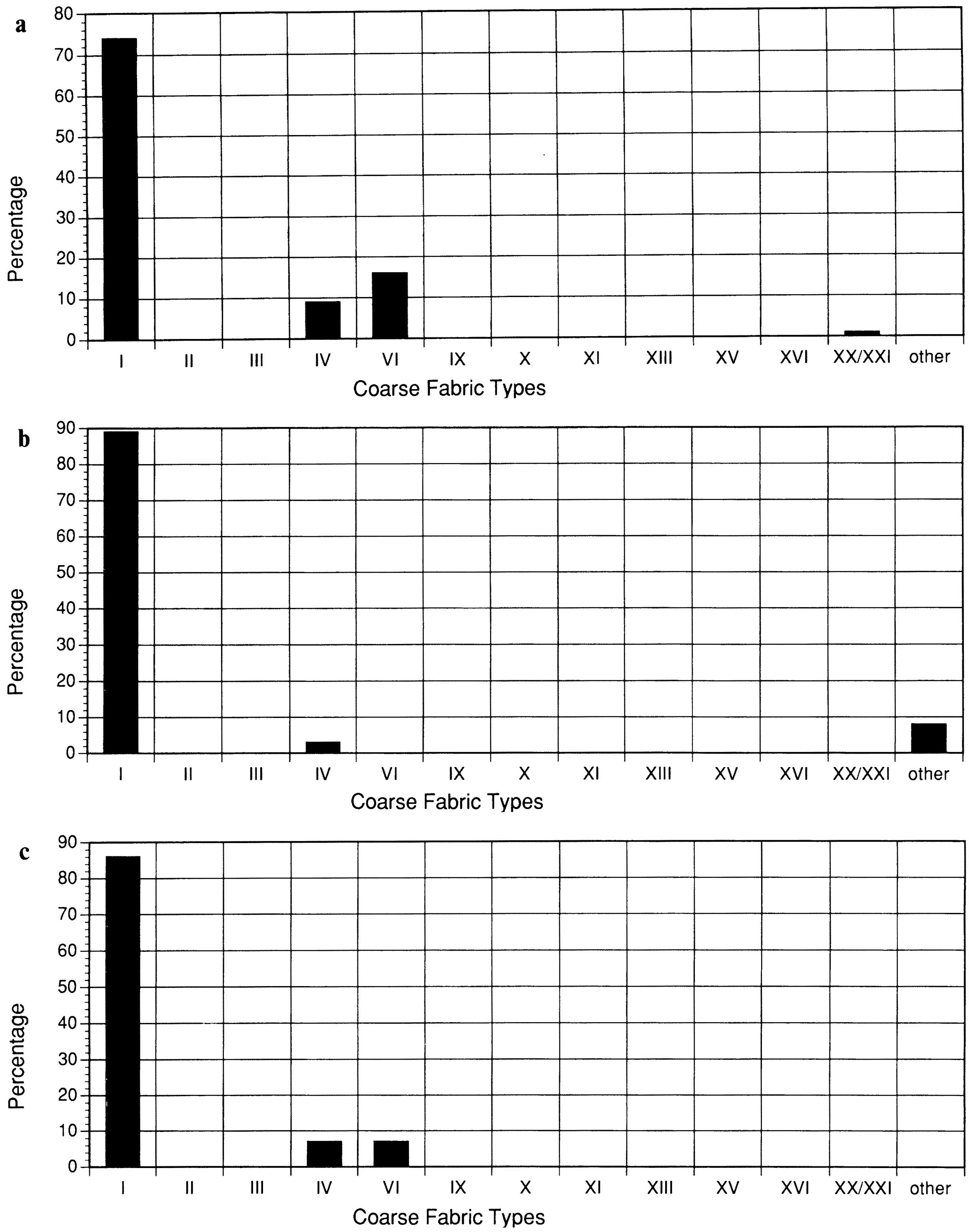

Fig. 21. Comparison of relative percentages of coarse fabrics in Late Minoan I at a) Pseira (building BS/BV, room 3, level 6), b) Mochlos (area E3, trench 5700), and c) KTS locus 50

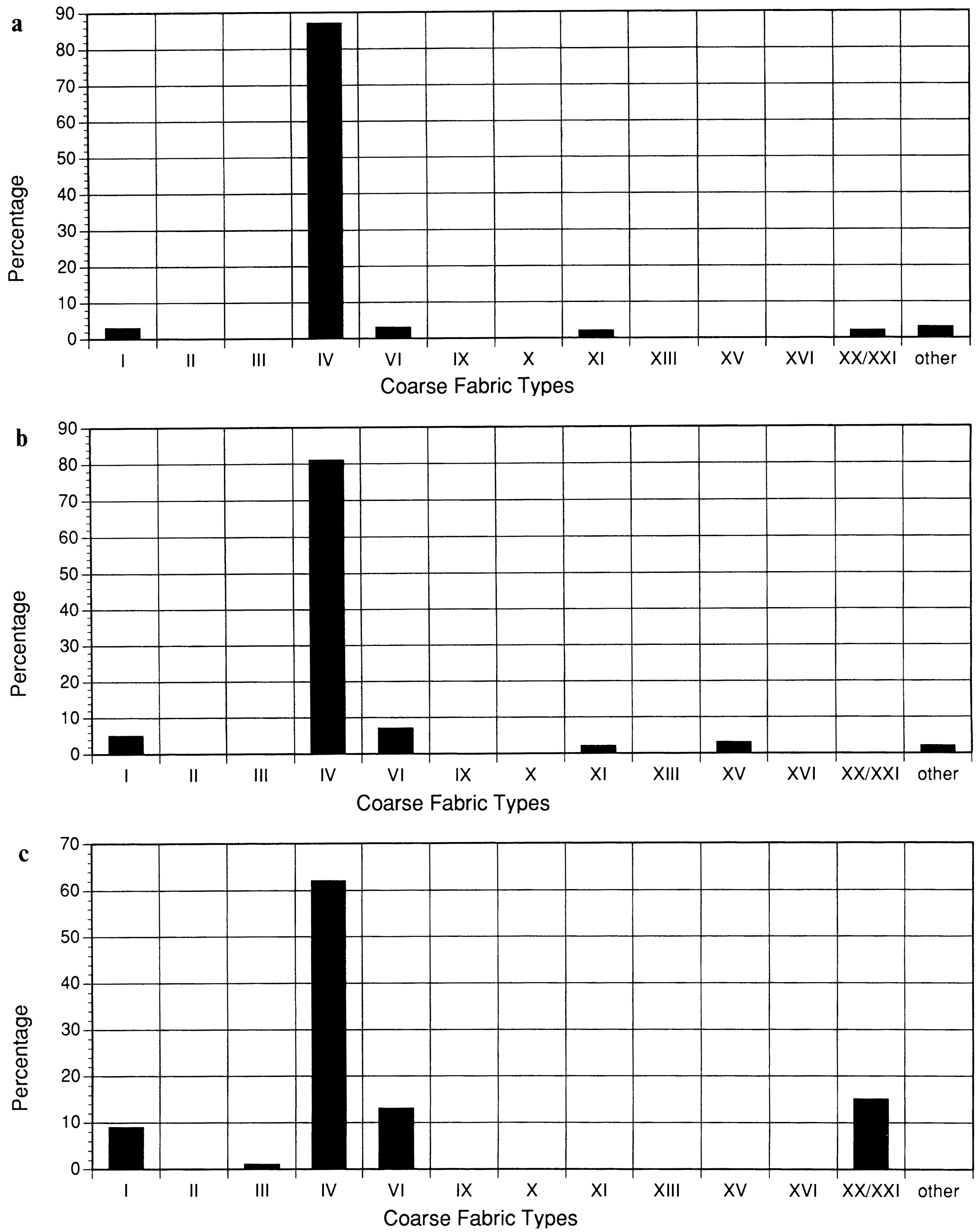

Fig. 22. Comparison of relative percentages of coarse fabrics in Late Minoan III at a) Pseira (building DA, room 2, level 3), b) Mochlos (area F4, trench 9200/9100), and c) KTS locus 3

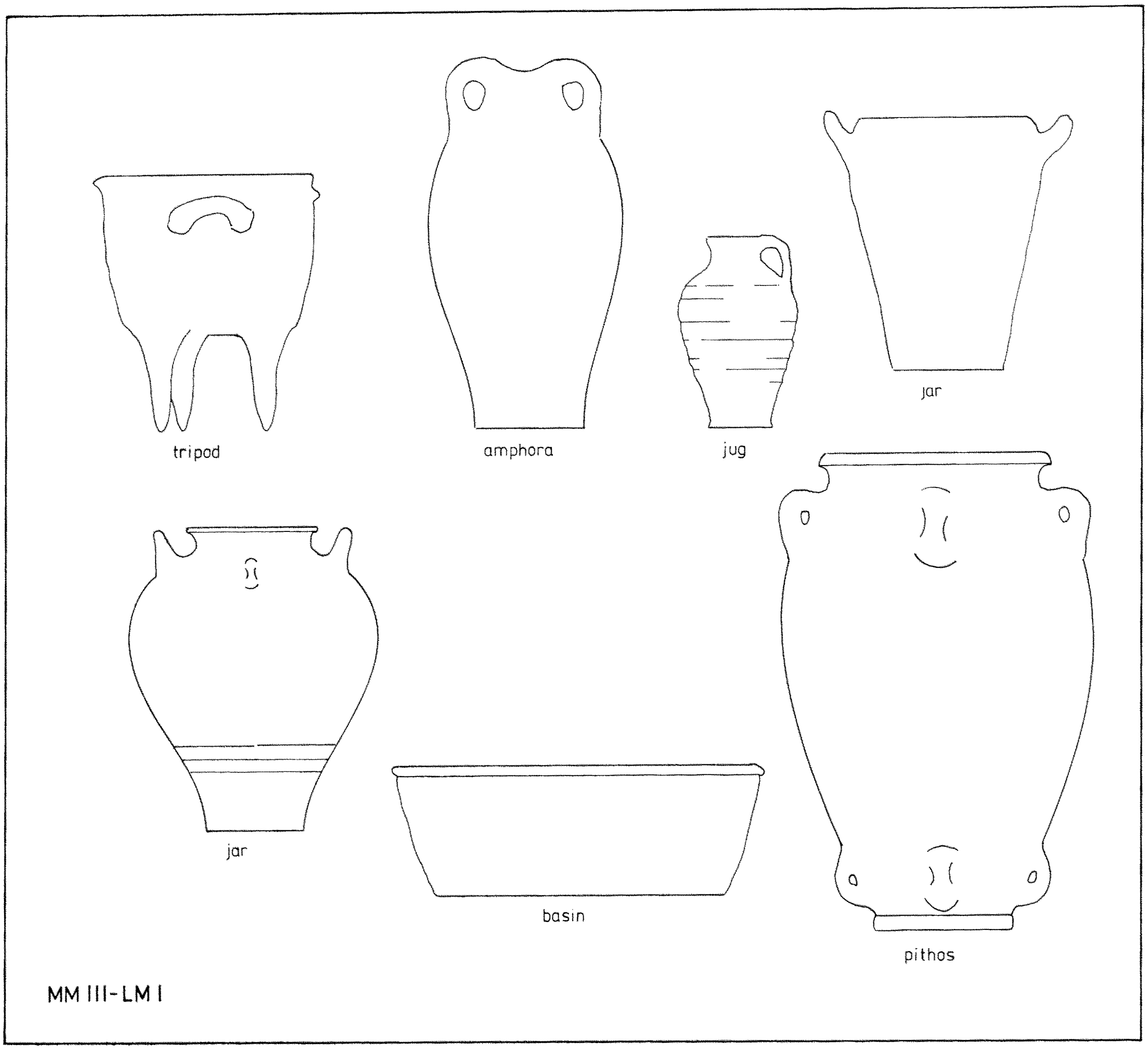

Fig. 23. Middle Minoan III–Late Minoan I coarse-ware shapes identified in KTS samples (not to scale)

merable situations that might account for the presence of earlier pottery in an uncontaminated deposit dated by the latest sherd. Formation processes, the location and nature of the deposit, stratigraphic situation, and not least of all, the method of excavation are all factors affecting the relative percentages of datable pottery or even suites of wares in closed deposits or habitation levels on a multi-period site. Indeed, the assessment of the integrity of excavation deposits rests with the excavator. A detailed study and description of all stratified habitation deposits from a site, including quantified proportions of datable fine-ware sherds along with a breakdown of coarse-fabric types, would be useful in determining both index wares and possible suites of fabrics for any given phase. The assumption here is that a floor deposit of LM I date, with proportionately greater amounts of EM or MM pottery, would also have proportionately greater amounts of pre-LM I coarse-ware fabrics. The aim should be to identify a series of period-specific fabrics or what Moody calls index wares. The suite approach, while theoretically valid, is hard to visualize, since a suite of coarse and fine pottery from a stratigraphic context in excavation may not be identical to the suite of wares on the site surface, even if the presence or absence of index wares is used to justify the dates assigned to the site. While index wares might be verified by any excavation context in the region of survey, the veracity of suites can only be tested by subsurface examination of sites at which a particular suite occurs.

In the KTS, the occurrence of any period-specific fabric (types II, III, VI, IX, X, XI, XIII, XV, XVI, and XX/XXI) in a surface sample indicated activity on the site in that period. Further, given the sampling strategy employed, it is very likely that all periods of activity are represented in the coarse wares collected from each multi-period site. Therefore, the relative percentages of each fabric type (figs. 17, 19, 21, 22, 24, and 25) are not important, in themselves, for

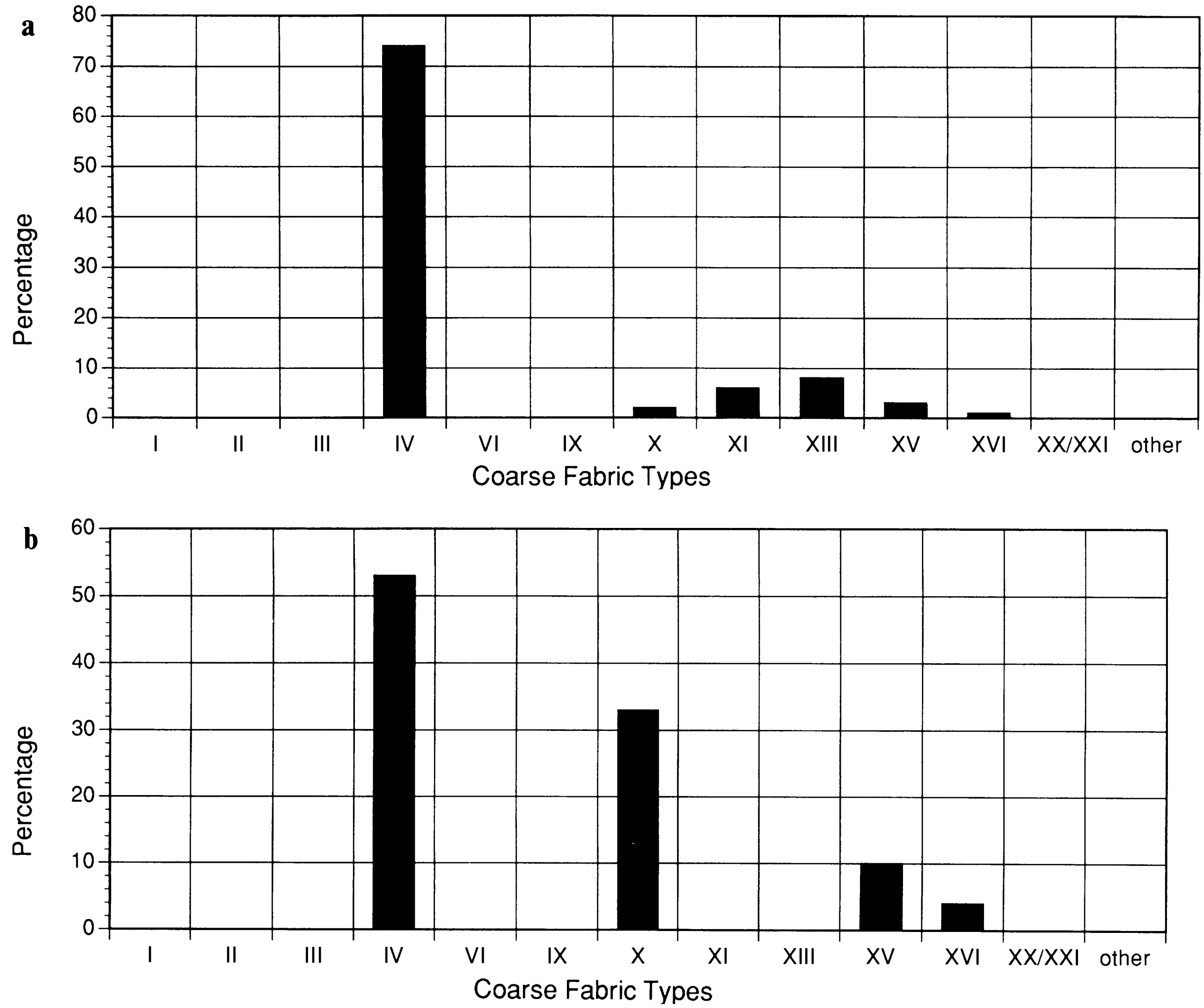

Fig. 24. Percentages of Late Minoan IIIC coarse fabrics at a) Vronda (building K, area 6, locus 5358) and b) KTS locus 96

establishing the representative dates for survey distribution maps, but they may be, nonetheless, significant in interpreting site function and the extent, importance, or intensity of habitation in specific periods.[53]

For example, KTS locus 50 is an LM I site (fig. 27a). Fabric type I is characteristically predominant. MM I–II occupation is suggested by traces of fabric types IV and VI. For all intents and purposes (especially those of regional survey), locus 50 is a multi-period site, founded in Middle Minoan with continued habitation in MM III–LM I. By way of contrast, another multi-period site is KTS locus 16 (fig. 27b), which shows substantial evidence for continuous activity from EM to LM I. A comparison of the graphs (fig. 27) of loci 50 and 16 shows vastly different *relative* percentages of the various coarse-ware fabrics, which may be explained by the different functions of the two sites.

Locus 50 is an LM I farmhouse or "country house," which is a phenomenon of the neopalatial period.[54] The low levels of fabric types IV and VI suggest only

[53] We disagree with Moody (Moody 1985, 52), who argues that "surface altering processes differ so greatly from site to site, even within a single region, that generalizations about when surface scatters are representative of activity intensity per occupational phase and when they are not are difficult or impossible to make."

[54] These LM I rural houses or "country houses" (villas, megalithic farmsteads) have been identified in Lasithi and throughout Crete; see, e.g., Watrous 14. Their chief characteristics and chronological range have been defined by Hood and Cadogan: S. Hood, "The 'Country House' and Minoan Society," in O. Krzyszkowska and L. Nixon eds., *Minoan Society* (Bristol 1983) 129–35; G. Cadogan, "Was There a Minoan Landed Gentry?" *BICS* 18 (1971) 145–48. On the chronology and site hierarchy in LM I see L. Nixon, "Neo-Palatial Outlying Settlements," in R. Hägg and N. Marinatos eds., *The Function of the Minoan Palaces: Proceedings of the Fourth International Symposium at the Swedish Institute in Athens* (Stockholm 1987) 95–99.

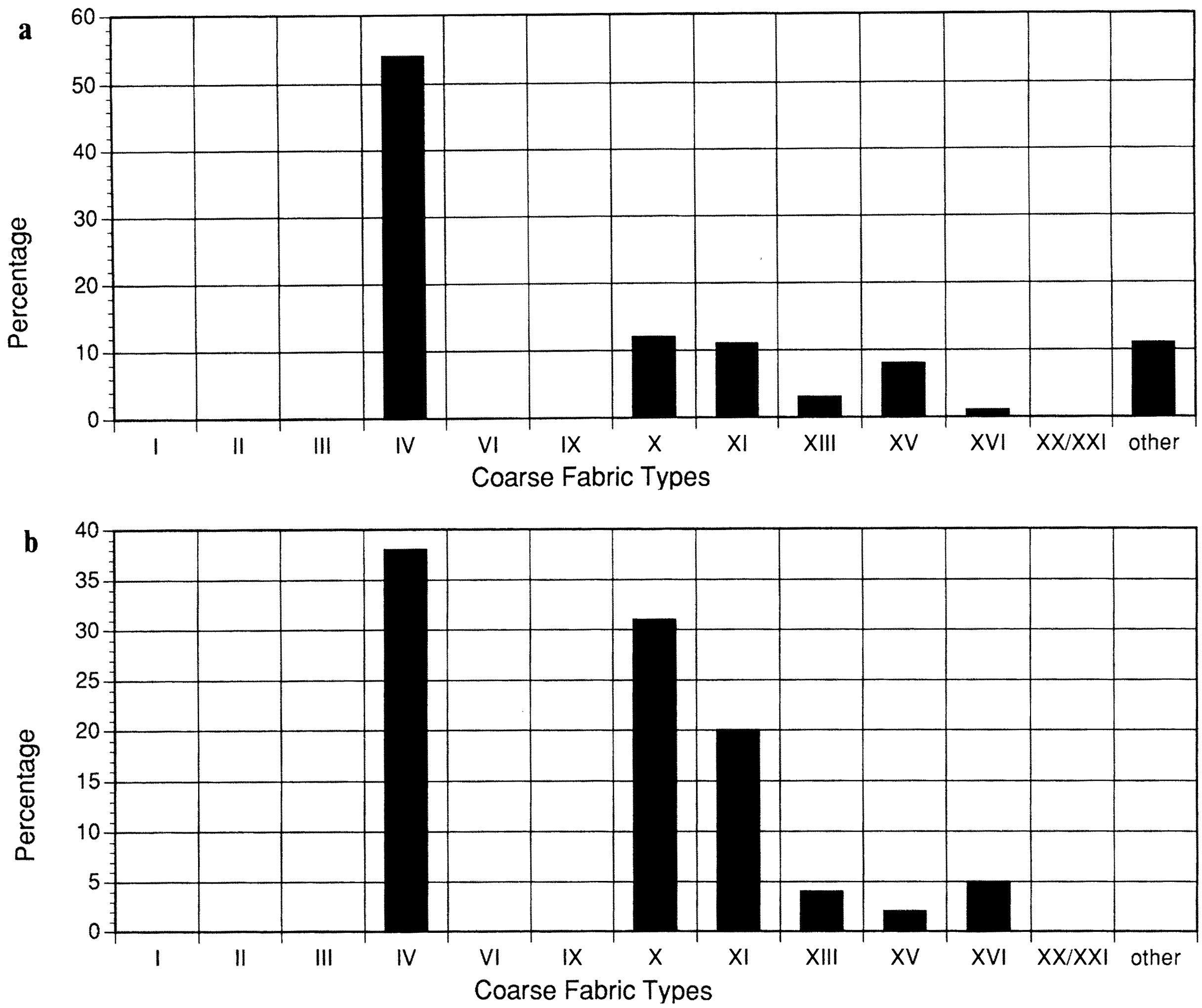

Fig. 25. Percentages of Late Minoan IIIC coarse fabrics at a) Vronda (building K, area 6, locus 5361) and b) KTS locus 76

minimal or perhaps even temporary use or short-term activity in MM I–II. The overabundance of fabric type I (and associated fine wares) is a sure indication of the singular importance of the site in LM I, with the foundation of the house in the neopalatial period. Locus 16, on the other hand, is Tholos (fig. 2), a site of special significance as a port facility throughout the Bronze Age. While its main period of use was MM III–LM IB, it was an active port in MM I–II, and was founded surely by EM II. The relatively high levels of the MM and LM I fabric types, and the relatively equal percentages of fabric types I and IV, suggest the *continuous* trajectory of development and importance of this harbor site throughout the Bronze Age.

CONCLUSIONS

The Survey

The ultimate purpose of the sampling strategy for the survey was to record the chronology, size, and artifact density of predetermined sites. Coarse wares offered the means to date sites that lacked an adequate fine diagnostic sherd sample. Furthermore, the wide chronological range of coarse sherds studied provides insights into coarse ceramic production and exchange in the Kavousi area, and suggests patterns that might be elucidated by future petrological analysis, including more detailed provenience studies of clay and inclusion sources in the isthmus and Lasithi-Mirabello regions.

Within the KTS survey zone, 109 loci or sites were identified, 93 of which produced surface artifacts that were used to determine the sites' chronology and function. Of these 93 loci, 68% contained fine pottery on the surface, which could be used to define a period or periods of use. The remaining 32% of the sites, however, produced no chronologically diagnostic fine-ware pottery, but a sizable sample of coarse utilitarian pottery. The design and implementation of a coarse-fabric typology proved to be a means of establishing a range of dates for this 32%—some 30 sites—for which no date could be assigned otherwise. More-

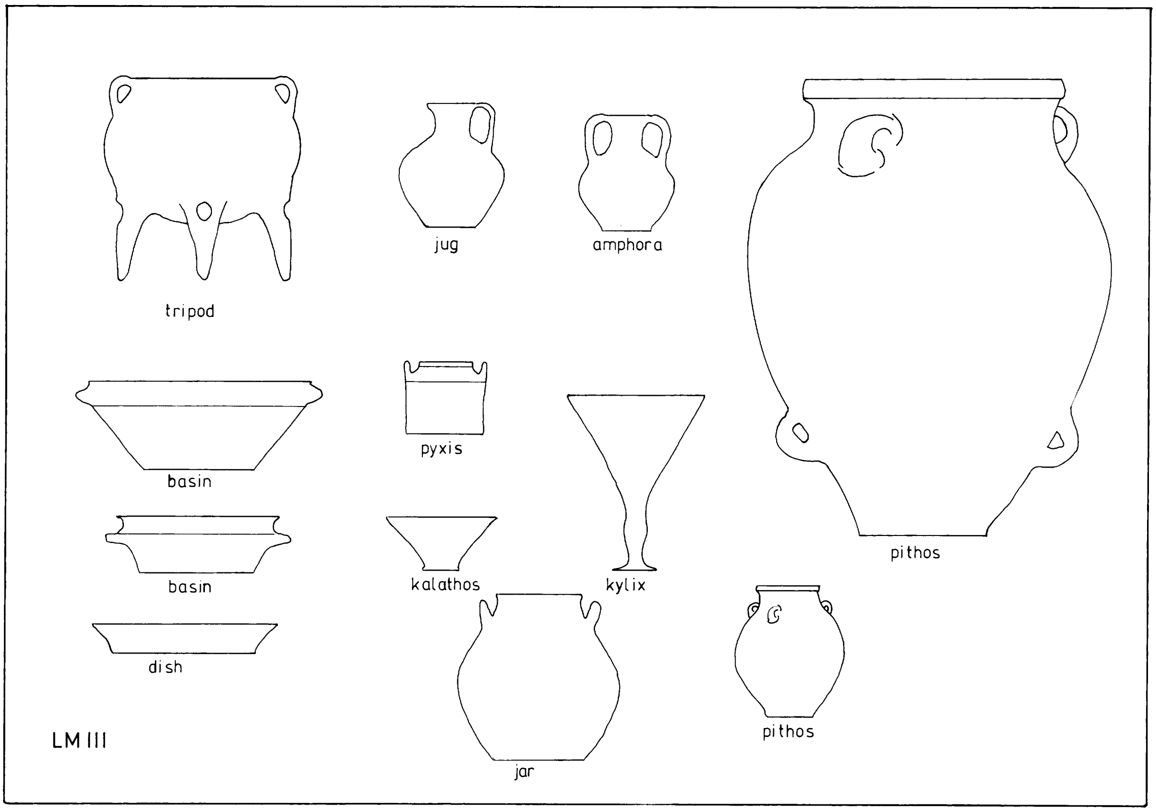

Fig. 26. Late Minoan III coarse-ware shapes identified in KTS samples (not to scale)

over, after we established that coarse fabrics were chronologically variable and period-specific for the Kavousi area, we realized that only 18% of the sites produced a fine-ware chronological range analogous to the range suggested by the coarse ware. Thus, the fine pottery at 50% of the sites in the survey, while diagnostic for one or more periods, was not at all representative of the actual range of dates for activity at those sites. The implications of these results for Bronze Age survey in Greece are far-reaching. Although a number of variables affect the obtrusiveness of fine diagnostic pottery on a site surface—such as depositional processes, surface conditions, surface visibility, natural formation processes, and, not least of all, the sampling method employed—it must be admitted that coarse utilitarian pottery might exhibit a wider chronological range than fine ware on the surface of a site that has any kind of domestic or storage function. Furthermore, if one dates Bronze Age survey sites on the basis of *only* the fine diagnostic pottery in the sample, a range of dates for a large number of sites (as many as 82% of loci at KTS) may be absent from the data.

Thus, the study of the KTS coarse wares has shown the effective use of fabric analysis in discerning temporal differences in coarse ceramics, which in turn permitted the dating of sites that contained little or no fine pottery on the surface. Furthermore, the diverse topography and heterogeneous geology of the Mirabello and north isthmus areas provide a landscape suitable for the study of Minoan coarse wares,[55] a class of pottery that Riley has called "the lowest common denominator of movement and interaction."[56]

Coarse Ceramic Distribution in the Protopalatial and Neopalatial Periods

Although no systematic petrographic analysis of the KTS wares has been conducted, the variable range of fabric types and diversity in known rock inclusions have provided data sufficient to begin to analyze the movement of specific coarse vessels in the Mirabello area. Two common inclusions in Minoan coarse pottery (which very rarely occur together in any fabric) dominate the assemblages in the north isthmus and Kavousi areas, and are regionally distinct in their

[55] Moody 1985, 55, has argued that the potential of coarse ceramic studies to document intra- and extraregional interaction is contingent on the homogeneity or heterogeneity of the geological environment.

[56] Riley 289.

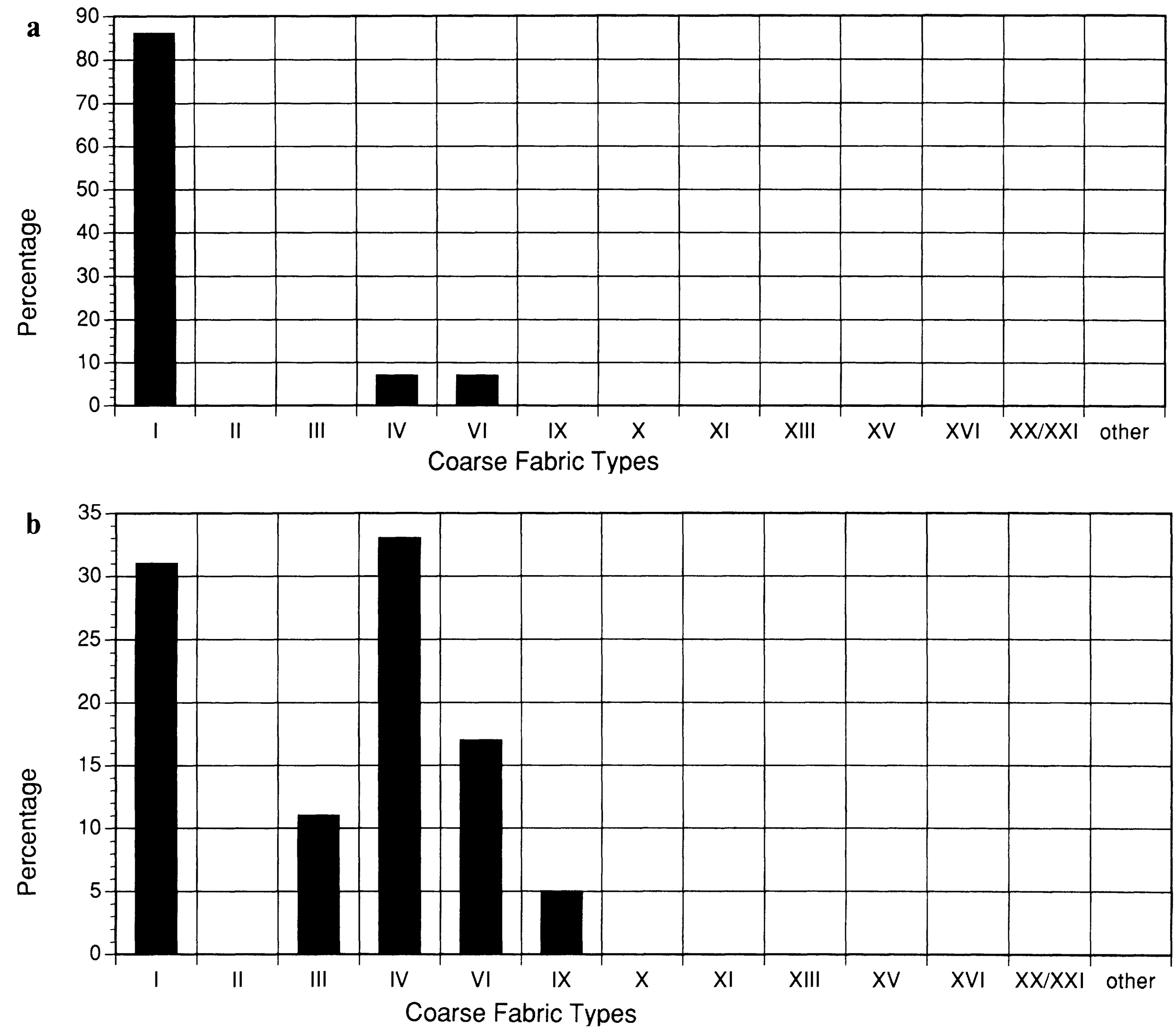

Fig. 27. Comparison of relative percentages of coarse fabrics at a) KTS locus 50 and b) KTS locus 16

bedrock geology. Phyllite, by far the most common inclusion in cooking, transport, and storage vessels, is a significant part of the geology of the Kavousi area and the northeast isthmus, but present in only negligible quantities in the Gournia area of the northwest isthmus.[57] The second inclusion, which is common in an equally wide range of utilitarian vessels, is from the granitic-dioritic series and is "indigenous" or local to the area around Gournia and the northwest isthmus; it is unknown in the area of Kavousi and the western Siteia Mountains.[58] These two distinctly different and regionally isolated rocks appear as inclu-

[57] Day 172 identifies siltstone and phyllite fabrics derived from the phyllite-quartzite series in the Bay of Mochlos. The phyllite-quartzite series around Mochlos extends to the western edge of the Bay of Mirabello and includes the area of Kavousi; see Day 102.

[58] Granitic-dioritic outcrops are local to the southern edge of the Bay of Mirabello; see J. Papastamatiou, D. Vetoulis, A. Tataris, J. Bornovas, G. Christodoulou, and G. Katsikatsos, "Geological Map of Greece: Ierapetra," *Institute for Geology and Subsurface Research* (Army Geographical Service, Athens 1959). Most recently, Day (91, 99, 172) has suggested a location limited to the area between Kalo Khorio (Pryniatikos Pyrgos) and Gournia. Moody first observed the granite-diorite rocks as the primary inclusions in Gournia and Vrokastro coarse ware. The constituents of this rock inclusion were identified by Betancourt and Myer in G.H. Myer, "Ceramic Petrography," in Betancourt 60–66. The term "granodiorite" was coined by Moody and is now used by researchers in the Bay of Mirabello; see B.J. Hayden, J.A. Moody, and O. Rackham, "The Vrokastro Survey Project, 1986–1989: Research Design and Preliminary Results," *Hesperia* 61 (1992) 310. On Day's suggestion we have used in this paper the correct term "granitic-dioritic" for inclusions that appear to be undivided granite-diorite rocks.

Table 3. Relative Percentages of Coarse Wares Containing Granitic-Dioritic and Phyllite Inclusions from the Kavousi-Thriphti Survey

Period	Granitic-Dioritic Fabrics	Phyllite Fabrics
EM I–II	34%	—
MM I–II	81%	19%
MM III–LM I	4%	96%
LM IIIA–B	29%	70%
LM IIIC	4%	82%

Table 4. Relative Percentages of Coarse Wares Containing Granitic-Dioritic and Phyllite Inclusions from Excavation Contexts

Period	Granitic-Dioritic Fabrics	Phyllite Fabrics
EM I–II	16%	29%
MM I–II	77%	23%
MM III–LM I	6%	86%
LM IIIA–B	9%	90%
LM IIIC	6%	82%

sions in Kavousi coarse wares in different frequencies in different periods, suggesting significant diachronic changes in patterns of interaction throughout the Bronze Age among Kavousi, Gournia, and sites in the north isthmus (tables 3–4).[59]

A comparison of MM I–II and MM III–LM I coarse wares from Kavousi and the northeast Bay of Mirabello serves to illustrate changes in production, distribution, and exchange systems in the transition from the protopalatial to neopalatial period. In MM I–II (fig. 19), a plethora of new ceramic fabrics appears in the Kavousi area, containing granitic-dioritic inclusions. These fabrics, types III, VI, and XX/XXI, date exclusively to MM I–II and supplement the local Kavousi phyllite ware (type IV). The wide variety of vessels represented (table 2; fig. 20) and their appearance in the Kavousi area exclusively in MM suggest a wide range of specialized coarse ceramic production in the Gournia area, perhaps at Gournia itself, in the protopalatial period.[60] Given the limited geographic area containing the source for the granitic-dioritic inclusions and the growth of settlement in the Gournia area in MM I–II,[61] it is likely that Gournia or a nearby ancillary center was producing ceramic vessels of all kinds and exporting pots directly to the Kavousi area.

In MM III–LM I (fig. 21), the pattern changes drastically;[62] granitic-dioritic inclusions are no longer present, and the local phyllite fabric, type I, becomes by far the most prevalent type, indicating a marked reduction in the movement of coarse ceramic vessels between the Gournia and Kavousi areas in the neopalatial period.[63]

If, as Riley states, the movement of coarse wares reflects inter- and intraregional interaction in Minoan Crete, it must be concluded that the Middle Minoan period at Gournia, Kavousi, Mirabello, and the Isthmus of Ierapetra is the time of most extensive local distribution of coarse-ware vessels and perhaps their contents. Moreover, the prevalence of the granitic-dioritic fabrics (especially for tripod cooking pots, oval-mouthed amphorae, and large storage jars), also found as far west as Mallia, as far east as Khamezi, and as far south as Myrtos Pyrgos, may indicate an incipient regional exchange system in MM I–II.[64] The centralized producer and head of this distribution

[59] The percentages in table 3 represent combined averages for coarse wares from KTS single-period sites (as determined on the basis of diagnostic fine wares); table 4 represents combined averages for coarse wares from the excavated pottery lots studied from Vronda, Mochlos, and Pseira. The percentages are simply an indication of *general trends* in the use of these inclusions in different periods.

[60] Day (173, 219–20) suggests a coastal trade of large storage jars from a local production center in the Gournia/Kalo Khorio area.

[61] On Gournia in MM I–II, see J. Soles, "The Early Gournia Town," *AJA* 83 (1979) 151.

[62] MM IIIA is marked, all over Crete, by significant changes in pottery production; in general, the pottery is characterized by a "recession" or "degeneration" from the preceding MM IIB period; see J.D.S. Pendlebury, *The Archaeology of Crete* (London 1939) 158; M. Popham, "Late Minoan Pottery: A Summary," *BSA* 62 (1967) 337; S. Hood, *The Minoans* (London 1971) 43; and Betancourt (supra n. 47) 103.

[63] B. Hayden and J. Moody (personal communication) and Day argue that fabrics with granitic-dioritic inclusions continue to be produced in LM I in the Gournia/Kalo Khorio area; see B.J. Hayden et al. (supra n. 58) 310. It is interesting that these wares essentially disappear at neighboring Kavousi in LM I.

[64] The fine wares from Myrtos Pyrgos and *Quartier Mu* at Mallia are remarkably similar, with shapes and decorations that are regionally distinctive; see G. Cadogan, "Lasithi in the Old Palace Period," *BICS* 37 (1990) 172–74. Cadogan and Poursat have both suggested a sphere of influence for Mallia in MM (based on the distribution of Khamezi pots and carpenter's hoards) extending as far south as Pyrgos and as far east as Khamezi, thus including the entire region of Mirabello and the north isthmus; see J.-C. Poursat, "Town and Palace at Malia in the Protopalatial Period," in Hägg and Marinatos eds. (supra n. 54) 75; Cadogan, most recently, has outlined the area and characteristics of what might be called a "Lasithi State" in Middle Minoan (G. Cadogan, "The Middle Minoan Pottery of Pyrgos and the Lasithi Region," in *The Proceedings of the Seventh International Cretological Congress*, forthcoming).

system may conceivably have been the town of Gournia. In the neopalatial period, on the other hand, the abundance of the phyllite-tempered fabric (our type I) at KTS, Mochlos, and Pseira (fig. 21) suggests a decentralized pattern of coarse-ware production and distribution in which a wider range of coarse utilitarian vessels were locally made in each area; the typical Gournia pots were perhaps no longer reaching Kavousi in significant quantities, but probably traveling to more distant ports.[65]

This decentralization of coarse-ware production accords well with the increasing decentralization of economy and administration in the neopalatial period. While large-scale manufacture of pottery is certainly a characteristic of the protopalatial centers of Crete, a distinct pattern of decentralized mass-production in LM I is emerging from the archaeological record of the Mirabello area.[66] Indeed, the KTS has shown that it is not until the LM I period at Kavousi that the first large nucleated centers developed that could have been serious trade or production competitors of Gournia. These sites of Agios Antonios and Tholos (fig. 2) are the first significant signs of centralization of economic and settlement activity after the long Middle Minoan period of dispersed farmsteads and small hamlets.[67] Thus, the changing pattern of coarse-ware distribution might be symptomatic of changes in socioeconomic organization, production and exchange systems, and settlement patterns, with the appearance of the new palaces in MM III/LM IA. It is possible that fine wares and non-ceramic luxury items and materials replaced the coarse vessels (and whatever they might have carried) as the primary exchange items, at least between these neighboring areas in the north isthmus.[68] The disappearance of the Gournia fabrics in the Kavousi area by LM IA, and the appearance and widespread use of the local phyllite fabric type I, surely point to some kind of economic change at the beginning of the neopalatial period. This change in MM III/LM I caused or accompanied the breakdown or dissolution of the protopalatial pattern of intraregional distribution and must have involved a significant reorganization of palatial and inter-palatial economics and communication.[69]

The results and conclusions presented here are preliminary. The study of the Kavousi area coarse wares has shown the importance of this much-overlooked category of pottery in determining site chronology and patterns of artifact distribution in the landscape. Comparative coarse-ware chronologies from other surveys in other regions of Crete will be

[65] Day's identification of LM I storage jars, in local Gournia/Kalo Khorio fabrics, at distant coastal sites such as Petras, Palaikastro, Makrygialos (Plakakia), and Diaskari, does not preclude the fact that fabrics with granitic-dioritic inclusions seem to drop off significantly (if not entirely) in LM I at Kavousi (see Day 27 and 176). It appears that the movement of coarse ceramic vessels between these neighboring areas of Kavousi and Gournia was more common in MM I–II than in LM I.

[66] For changes in the economics of Bronze Age pottery production, see J.L. Davis and H.B. Lewis, "Mechanization of Pottery Production: A Case Study from the Cycladic Islands," in A.B. Knapp and T. Stech eds., *Prehistoric Production and Exchange: The Aegean and Eastern Mediterranean* (Los Angeles 1985) 79, 89–90. Davis and Lewis suggest that "pottery degeneration" such as that observed in MM III Crete might be the result of the competition caused by the decentralization and proliferation of mechanized mass-production centers. Competition might explain the changes in coarse wares in MM III in the north isthmus area; that is, local production and trade centers around the Bay of Mirabello were, by MM III/LM IA, competing with and undercutting the market established by the old MM I–II regional production center at Gournia. The authors thank Leslie Day for suggesting the parallels between decentralization of palatial power and pottery production.

[67] D.C. Haggis, "Archaeological Survey at Kavousi, Crete: Settlement Development in Middle Minoan and Late Minoan I," forthcoming in *Proceedings* (supra n. 64). For Agios Antonios in MM III–LM I, see P. Warren, "The Place of Crete in the Thalassocracy of Minos," in R. Hägg and N. Marinatos eds., *The Minoan Thalassocracy: Myth and Reality* (Stockholm 1984) 40–41; and J.S. Soles, "The Gournia Palace," *AJA* 95 (1991) 75–76.

[68] On LM I fine-ware production at Gournia, see W.-D. Niemeier, "The Master of the Gournia Octopus Stirrup Jar and a Late Minoan IA Pottery Workshop at Gournia Exporting to Thera," *TUAS* 4 (1979) 18–26; J. Silverman, "The LM IB Painted Pottery of Eastern Crete," *TUAS* 3 (1978) 31–35; Betancourt (supra n. 47) 133–39. J. Davis (personal communication) has suggested that given the regional competition in coarse-ware production, a shift in production emphasis from utilitarian coarse ware to luxury ceramics, such as fine wares, at LM I Gournia, may have been economically advantageous since the smaller, expensive objects would yield a greater return per bulk weight when transported overland.

[69] P.P. Betancourt and E.S. Banou, "Pseira and Minoan Sea-Trade," *Aegaeum* 7 (1991) 107–109, have shown the importance of Pseira in LM I as a significant trading station in the Bay of Mirabello, and suggest that the island's role might be a result of changing economic and political conditions in the neopalatial period.

crucial in determining regional and interregional patterns of distribution and exchange.[70] The basis of such chronologies of course must be the petrographic analysis of material from excavation contexts. Fortunately, in eastern Crete, recent and current projects at Pseira, Mochlos, Kavousi Vronda and Kastro, Ayia Photia and Petras Siteia, Palaikastro, and Mallia show the potential for such comparative research. If theories and models of palatial economics and inter-palatial communication are to be developed, substantiated, or discarded, future excavation and research strategies should exploit the full range of archaeological material at their disposal. A substantial part of this material and indeed a potentially vital source of information is coarse utilitarian pottery.

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[70] P. Halstead and J. O'Shea, "A Friend in Need is a Friend Indeed: Social Storage and the Origins of Social Ranking," in C. Renfrew and S. Shennan eds., *Ranking, Resource and Exchange* (Cambridge 1982) 94, have suggested that "tokens," such as pottery, "are often durable and so survive archaeologically, while they tend to be highly visible by virtue of their raw material and workmanship. Their provenance can frequently be determined by compositional analysis, and, because of their role in social storage, they may, up to a point, stand proxy for the movement of foodstuffs, which do not survive archaeologically."