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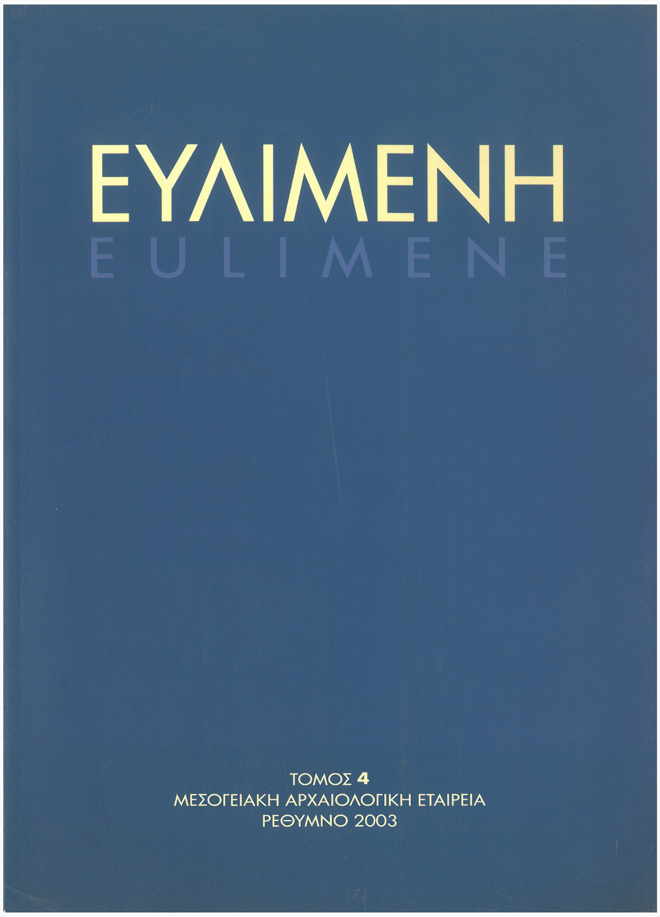

A petrographic and chemical study of East Greek and other archaic transport amphorae

Christina de Domingo, Alan W. Johnston

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ΕΥΛΙΜΕΝΗ

ΜΕΛΕΤΕΣ ΣΤΗΝ ΚΛΑΣΙΚΗ ΑΡΧΑΙΟΛΟΓΙΑ,
ΤΗΝ ΕΠΙΓΡΑΦΙΚΗ, ΤΗ ΝΟΜΙΣΜΑΤΙΚΗ ΚΑΙ ΤΗΝ ΠΑΠΥΡΟΛΟΓΙΑ

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Circiter tertia parte ponderis (Vitruve 2, 5), the existence of an hydraulic lime in the Roman architecture. In his treaty on architecture, Vitruve (2, 5) explains how to make lime from a particular limestone. In 2, 5, 3, he indicates that during lime calcination, the limestone lost a third of its weight [*circiter tertia parte ponderis*]. One deducts that the original limestone contains 20% of silicates and the lime thus obtained is of medium hydraulicity. Vitruve recommends for the construction of walls to use a lime made from a compact and rather hard siliceous limestone [*ex spisso et duriore*], what implies the hydraulic character required for such an usage. For coatings [*in tectoriis*], the lime hardens by air and is made from porous stone [*ex fistuloso*].

Christina de Domingo and Alan Johnston, A pertrographic and chemical study of east Greek and other archaic transport amphorae, ΕΥΛΙΜΕΝΗ 4 (2003), 27-60

Πετρογραφική και χημική μελέτη διαφόρων τύπων ελληνικών αρχαϊκών αμφορέων. Παρουσιάζονται τα αποτελέσματα μιας σειράς πετρογραφικών αναλύσεων διαφόρων τύπων αρχαϊκών ελληνικών αμφορέων, παράλληλα με κάποιες χημικές αναλύσεις. Σκοπός είναι να ελεγχθεί η πετρογραφική σύσταση των αγγείων συγκριτικά με την τυπολογία που έχει ήδη αναπτυχθεί από μη-συστηματικές μελέτες. Τα αποτελέσματα στηρίζουν σε σημαντικό βαθμό τις προηγούμενες έρευνες, και παράλληλα καταδεικνύουν ορισμένες ενδιαφέρουσες περιοχές για μελλοντική έρευνα, ειδικά όσον αφορά τους τύπους που αποδίδονται στη Λακωνία, τη Λέσβο και την Κόρινθο.

Dimitris Paleothodoros, The Pithos painter, ΕΥΛΙΜΕΝΗ 4 (2003), 61-76

Ο Ζωγράφος του Πίθου. Ο Ζωγράφος του Πίθου είναι ο χειρότερος αθηναίος αγγειογράφος του ύστερου 6^{ου} αι. π.Χ., του οποίου όμως οι κύλικες γνωρίζουν πολύ μεγάλη διάδοση στην Μεσόγειο. Το αγαπημένο του θέμα, ο συμποσιαστής που φορά σκυθικό σκούφο, απαντά σε όλες τις περιοχές όπου βρίσκουμε αγγεία του ζωγράφου, ιδιαίτερα όμως στην Ανατολή και τη Μαύρη Θάλασσα. Αφήνοντας ανοικτή την πραγματική ταυτότητα του συμποσιαστή, ο ζωγράφος επιτρέπει διαφορετικές ερμηνείες από τους αγοραστές των αγγείων, που ανταποκρίνονται στις τοπικές ιδιαιτερότητες.

Nicholas Victor Sekunda, The stele of Thersagoras of Polyrrhenia from Demetrias, ΕΥΛΙΜΕΝΗ 4 (2003), 77-80

Η στήλη το Θερσαγόρα, ενός Κρητικού από την Πολυρρήνια, η οποία βρέθηκε στην Δημητριάδα, χρονολογείται συμβατικά γύρω στο 200 π.Χ. Ο Θερσαγόρας παριστάνεται με πλήρη στρατιωτική εξάρτηση. Στο παρόν άρθρο υποστηρίζεται ότι ο Θερσαγόρας ανήκε στο συμμαχικό τάγμα που εστάλη από «τους Πολυρρηνίους και τους συμμάχους τους» στον Φίλιππο Ε' της Μακεδονίας το 220 π.Χ. Ο Θερσαγόρας πιθανότατα σκοτώθηκε και τάφηκε στη Δημητριάδα κατά τη διάρκεια της παραμονής του στρατού των Αντιγονιδών εκεί, πριν μεταβεί στην Εύβοια και κατεθυνθεί στη συνέχεια στην Κόρινθο, στις αρχές του 219 π.Χ. Άλλωστε, η στήλη δεν είναι προσεγμένη και αυτό ίσως να υποδηλώνει ότι κατασκευάστηκε βιαστικά, ενώ η κρητική μονάδα προήλαυνε.

Βίλη Αποστολάκου «…ΚΑΙ ΛΑΤΟΣ ΓΑΡ ΕΝΕΓΚΑΤΟ ΤΟΝΔΕ …» ή Λατίων Προσωπογραφία, ΕΥΛΙΜΕΝΗ 4 (2003), 81-133

«…ΚΑΙ ΛΑΤΟΣ ΓΑΡ ΕΝΕΓΚΑΤΟ ΤΟΝΔΕ …» or the prosopography of the Latians. The inscriptions found in Lato, in Agios Nikolaos, the ancient Kamara, and in other areas that according to epigraphic evidence belonged to the territory of Lato are the unique source for the names of the Latoans. Most of the inscriptions are currently kept in the Archaeological Museums of Herakleion and of Agios Nikolaos, some in Museums outside of Crete, while a certain number recorded up to the end of last century, are lost and have not been located yet. The inscriptions in their vast majority have been dated to the 2nd cent. B.C. and moreover to its last quarter.

The names of the Latoans concentrated from seventy-three inscriptions are quoted in alphabetical order. In a total of 279 indexed names, not including twenty-six that are incomplete, we come across of 181 different Latoan names. Of those names at least eighty belong to the Kosmoi, the magistrates elected from the four ruling clans, or the members of the board of Eunomia.

The number of preserved female names, which in their majority come from funerary inscriptions, is strikingly lower than that of males. In a total of thirty-four, apart from four not restored, twenty-five are different female names.

Apart form the Latoans' names and their patronymics, wherever they are mentioned, known information about these persons is given briefly; their status, provided that they possessed public office, their activity, their possible relationship with the other persons of the list and finally the date of the inscriptions in which they are attested.

Παύλος Χρυσοστόμου, Συνεισφορές σε λατρείες θεοτήτων και ηρώων από τη Βοττιαία και την Πιερία της Μακεδονίας, ΕΥΛΙΜΕΝΗ 4 (2003), 135-152

Contributions on the cults of gods and heroes from Bottiea and Pieria in Macedonia. In this paper new pieces of information are presented concerning cults of gods and heroes from Bottiea and Pieria in «Lower Macedonia», the center of the Macedonian Kingdom: on the cults of 1) the Muses in Pella, 2) Aeolus and Graia in Pella, 3) Hermes and Demeter in Kyrros, 4) Eileithyia and Artemis Eileithyia-Lochia in Pydna.

Γεωργία Ζ. Αλεξοπούλου και Δήμητρα Τσαγκάρη, Deux trésors hellénistiques de Psélalonia de Patras, ΕΥΛΙΜΕΝΗ 4 (2003), 153-162

Δύο ελληνιστικοί θησαυροί από τα Ψηλαλώνια Πατρών. Το 1990, οι ανασκαφές της ΣΤ΄ ΕΠΚΑ στα Ψηλαλώνια Πατρών έφεραν στο φως μία σειρά οικοδομημάτων από τα κλασικά ως τα υστερορωμαϊκά χρόνια. Τα πλουσιότερα στρώματα κάλυπταν την ελληνιστική και ρωμαϊκή περίοδο. Σε οικία της ελληνιστικής φάσης, βρέθηκαν δύο «θησαυροί» σε διπλανά δωμάτια, εκ των οποίων ο πρώτος βρέθηκε μέσα σε ηθμωτό αγγείο και περιείχε 57 νομίσματα: 1 αργυρό τριώβολο της Αχαϊκής Συμπολιτείας και 56 χάλκινα (14 του Αντιγόνου Γονατά, 39 του Πτολεμαίου Γ΄ του τύπου 1000 του Σβορώνου και 3 αρκετά φθαρμένα). Ο δεύτερος «θησαυρός», που βρέθηκε μέσα σε άωτο σκυφίδιο, περιείχε 8 νομίσματα, 6 αργυρά (1 δραχμή Χαλκίδος και 5 τριώβολα Αχαϊκής Συμπολιτείας) και 2 χάλκινα (1 Πτολεμαίου Γ΄ και 1 αρκετά φθαρμένο). Οι δύο αυτοί «θησαυροί», με ίδιο αλλά αντίστροφης αναλογίας περιεχόμενο και χρονολογία απόκρυψης την περίοδο 165-147 π.Χ., προστίθενται στον μακρύ κατάλογο των «θησαυρών» που απεκρύβησαν στην Πελοπόννησο και την Δυτική Ελλάδα γενικότερα, μέσα στο κλίμα αναταραχής που επικράτησε μετά τη μάχη της Πύδνας.

Nahum Cohen, A customshouse receipt ΕΥΛΙΜΕΝΗ 4 (2003), 163-165

Απόδειξη πληρωμής ενός φόρου, της ερημοφυλακίας, στην πύλη της Σοκνοπαίου Νήσου του Αρσινοΐτη νομού.

Despina Iosif, Caesar the warrior versus Jesus the peacemaker?, ΕΥΛΙΜΕΝΗ 4 (2003), 167-180

Πολεμοχαρής Καίσαρ εναντίον ειρηνιστή Ιησού; Οι πρώτοι Χριστιανοί ένιωθαν έντονη απέχθεια για τον πόλεμο και τη βία και απέφευγαν συστηματικά να στρατευτούν. Προτιμούσαν να πεθάνουν παρά να προδώσουν τις αρχές τους. Αυτή την εικόνα είχαν σχηματίσει οι Βυζαντινοί για τους Χριστιανούς των τριών πρώτων αιώνων. Η ίδια εικόνα παραμένει αρκετά ισχυρή μέχρι σήμερα. Εξακολουθούμε να αρεσκόμαστε να επικαλούμαστε την «αγνότητα» των πρώτων Χριστιανών. Ενοχοποιούμε τον αυτοκράτορα Κωνσταντίνο ότι τάχα αυτός ευθύνεται για τον ιδεολογικό ξεπεσμό της εκκλησίας και την διεξαγωγή πολέμων από Χριστιανούς.

Η πραγματικότητα θα πρέπει να ήταν πιο πολύπλοκη απ' όσο την φανταζόμαστε. Προσεχτική μελέτη των πηγών αποκαλύπτει ότι υπήρχαν πολλές στάσεις των Χριστιανών απέναντι στη βία, στον πόλεμο και στη στρατιωτική θητεία. Φαίνεται όμως, πως η πλειονότητα των Χριστιανών δεν αντιμετώπιζε ούτε τον πόλεμο, ούτε τη στρατιωτική θητεία με καχυποψία και δεν απέφευγε να καταταγεί. Οι εθνικοί δεν είχαν θορυβηθεί και δεν είχαν λόγο να θορυβηθούν. Οι Χριστιανοί δεν αποτελούσαν απειλή ούτε στη θεωρία, ούτε στην πράξη. Αντίθετα, στήριζαν την πολιτική εξουσία. Μονάχα μια μικρή μερίδα Χριστιανών αντιδρούσε στην ιδέα της διεξαγωγής πολέμων από Χριστιανούς και συμμετοχής Χριστιανών σ' αυτούς. Είτε επειδή διέβλεπε κινδύνους από τις ειδωλολατρικές πρακτικές του ρωμαϊκού στρατού, είτε επειδή θεωρούσε ότι ένας Χριστιανός δεν επιτρέπεται να σκοτώνει, είτε επειδή επιδίωκε να αμφισβητήσει την πολιτική εξουσία.

Chryssa Bourbou, A survey of neoplastic diseases in ancient and medieval Greek populations**,** ΕΥΛΙΜΕΝΗ 4 (2003), 181-188

Επισκόπηση των νεοπλασιών στον αρχαίο και μεσαιωνικό ελληνικό πληθυσμό. Για τη διάγνωση των νεοπλασιών στους αρχαιολογικούς πληθυσμούς βασιζόμαστε σε γραπτές πηγές, απεικονίσεις και ανθρωπολογικά κατάλοιπα. Αν και ελάχιστα έργα τέχνης αναπαριστούν αναμφισβήτητες περιπτώσεις νεοπλασιών, πληθώρα ιατρικών κειμένων, ήδη από την εποχή του Ιπποκράτη και του Γαληνού, αναφέρονται στη συγκεκριμένη παθολογία. Στην εργασία αυτή παρουσιάζονται όλες οι έως τώρα γνωστές ή δημοσιευμένες περιπτώσεις για την Ελλάδα από την αρχαιότητα ως στον ύστερο μεσαίωνα.

Stelios Psaroudakes, Archaeomusicology and Ethnomusicology in dialogue, ΕΥΛΙΜΕΝΗ 4 (2003), 189-200

Αρχαιομουσικολογία και Εθνομουσικολογία. Το συνέδριο στο οποίο παρουσιάστηκε η παρούσα εισήγηση, είχε θέμα του το «διάλογο» ανάμεσα στις επιστήμες αρχαιολογία και ανθρωπολογία. Στο παρόν άρθρο εξετάζεται ένα επί μέρους ζήτημα, το κατά πόσον η εθνομουσικολογία, επιστήμη βαθύτατα επηρεασμένη από την ανθρωπολογία τα τελευταία χρόνια, έχει με τη σειρά της επηρεάσει την έρευνα στο πεδίο της αρχαίας μουσικής, ιδιαίτερα σε εκείνο της ελληνικής. Το συμπέρασμα είναι ότι η εθνομουσικολογία όχι απλώς επηρέασε την αρχαιομουσικολογία, αλλά άλλαξε άρδην την οπτική των επιστημόνων στον τομέα αυτόν σε βαθμό που να μην θεωρείται πλέον δόκιμη η σπουδή ενός αρχαίου μουσικού πολιτισμού χωρίς την εφαρμογή της εθνομουσικολογικής μεθόδου.

A PETROGRAPHIC AND CHEMICAL STUDY OF EAST GREEK AND OTHER ARCHAIC TRANSPORT AMPHORAE

This paper discusses the petrographical and chemical analyses of a small number of sherds of a varied range of transport amphorae of the Archaic period.[1] They are presented as one unit because of their appoximate contemporaneity and their being from similar types of pot. Some of the classes represented here have been studied previously either by chemical or by petrographic techniques, and this contribution aims to add information to that already made public.

Petrographic analysis was undertaken using the Leitz Laborlux 12 Pol polarizing microscope. Chemical characterizations of ceramic powders were carried out using a Pye Unicam SP2900 Atomic Absorption Spectrophotometer after preliminary lithium metaborate fusion and acid dissolution. The chemical data are contained in an appendix (TABLE 2), with summary statistics presented in TABLE 1.

The material studied in this work was provided through AWJ, and comes principally from excavations at Kommos, Miletus, and Incoronata, near Metapontum. The Kommos material is largely from Building Q and consists of sherds typologically assessed as being

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[1] This presentation of the material is an expansion of that published as «Trade between Kommos, Crete and East Greece: a petrographic study of Archaic transport amphorae», *Archaeological Sciences 1995* (ed. Anthony Sinclair *et al.*), Oxford, 1997, 62-68.

We would like to thank I.K. Whitbread for his help and advice throughout this study, and N. Brodie for undertaking chemical analysis of the samples. The Greek Archaeological Service and the Turkish Directorate of Monuments and Museums are in our debt for allowing sampling and subsequent analysis of the material.

The Kommos samples were kindly provided by Professor J.W. Shaw, Director of the excavations conducted by the University of Toronto under the auspices of the American School of Classical Studies at Athens. Those from Miletus were made available by Dr. V. von Graeve, University of Bochum. The samples from Incoronata were generously supplied by Prof. P. Orlandini, and those from Chios by Aris Tsaravopoulos.

The following abbreviations are used: Dupont 1982: P. Dupont, «Amphores commerciales archaiques de la Grèce de l'Est», *PdP* 37 (1982), 193-209.

Dupont 1998: P. Dupont, «Archaic East Greek trade amphoras» in R.M. Cook. and P. Dupont, *East Greek Pottery* (London, 1998), 142-91.

Grace 1971: V.R. Grace, «Samian amphoras», *Hesperia* 30 (1971), 52-93.

Johnston 1993: A.W. Johnston, «Pottery from Archaic building Q at Kommos», *Hesperia* 62 (1993), 339-82.

Jones 1986: R.E. Jones, *Greek and Cypriot Pottery; a Review of Scientific Studies* (Fitch Laboratory Occasional Papers 1, 1986).

Watson 1985: R.G. Watson, *Analysis of Greek stamped amphora handles using Thin Layer X-Ray Fluorescence Spectrometry* (unpublished MA dissertation, University of Bradford, 1985).

Whitbread 1987: I.K. Whitbread, *The application of ceramic petrology to the study of ancient Greek transport amphorae, with special reference to Corinthian amphora production* (unpublished PhD dissertation, University of Southampton, 1987).

Whitbread 1995: I.K. Whitbread, *Greek Transport Amphorae: a petrographic and archaeological study* (Fitch Laboratory Occasional Papers 4, 1995).

from Lesbos, Samos and Chios, together with a group labelled «Lakonian».[2] The Incoronata material is typologically Attic and Corinthian. These typologies have been constructed largely on the basis of shape and, especially in later centuries, stamped impressions. Lack of stamps has certainly been one reason why differences between production centres in the Archaic and Classical periods has been somewhat more hesitantly proposed than for later periods. These problems have been highlighted in recent years by Dupont and Whitbread, and both have employed arguments from scientific analyses to alleviate the difficulties.[3] The results of this study allow some refinement of their preliminary results, significant ones in some cases. Following on from previous work,[4] this study covers classes already investigated, but adds some new ones. Whitbread has demonstrated the profitable use of petrography,[5] and here we feel that its use together with chemical techniques has led to a more comprehensive treatment.

SCIENTIFIC ANALYSIS OF TRANSPORT AMPHORAE

Recently it has been demonstrated that chemical and petrographic techniques can be fruitfully combined with the established use of shape and stamp to indicate provenance of jars.

Most chemical studies have been undertaken to determine provenance through analysis of the clay material. Jones discusses individual methods and the results of a number of projects of chemical analysis.[6] Slusallek, Burmester and Börker (see n. 4) have studied by NAA (neutron activation analysis) some East Greek amphorae; Watson examined amphorae from East Greece, Western Anatolia and Corinth by XRF (X-ray Fluorescence). The NAA analysis incorporated minor and trace elements –potassium, calcium, iron, scandium, cobalt, lanthanum, hafnium and thorium, and by using these Rhodian jars were clearly distinguished from Koan, though there was some difficulty in separating known Knidian from Thasian jars.[7] Watson's study concentrated on major and minor elements, magnesium, aluminium, silicon, potassium, calcium, titanium, chromium, manganese and iron. Cluster analysis was only possible by incorporating the archaeological evidence for provenance, and so by itself was of no help; but discriminate analysis proved more fruitful, especially when the very distinctive Rhodian material was excluded from the plots. Corinthian, Chian and Thasian jars formed individual groups, though there was overlap between Knidian and Koan jars.[8] Watson noted high manganese and aluminium in Corinthian jars, but that he could separate them into two groups, equal to types A and B, by calcium content. Yet when a multiplying factor of 1.7 was applied to the group B, with lower levels of aluminium,

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2 See Johnston 1993, esp. 358-70.

3 Dupont 1998 and Whitbread 1995.

4 Watson 1985, and Dupont 1982; K. Slusallek, A Burmester and C. Börker, «Neutronenaktivierung-analytische Untersuchungen an gestempelten griechischen Amphorenhenkeln: erste Ergebnisse», *Berliner Beiträge zur Archäometrie*, 8 (1983) 261-276.

5 Whitbread 1995.

6 Jones 1986, esp. chapter 2.

7 Whitbread 1995, 48.

8 Watson 1985, 91.

titanium and iron, the groups became indistinguishable, and Watson concluded that the clays of each type were the same, the additional calcium in type B diluting the percentage of other elements. Whitbread has more recently confirmed that the clay of type B is more calcareous.[9]

While each of these studies used slightly different elements, producing varied groupings, the results showed that chemical composition can determine groupings of jars by provenance. Yet it is not always easy to determine sources by these methods; the problem is overlap between basically definable sources, which complicates differentiation. In some instances groupings suggest that a single source used more than one fabric.[10]

Dupont 1982 has studied by XRF amphorae from Ionia (East Greece and central Western Anatolia). His Chian grouping is typologically unitary but with diverse chemical attributes. The coarse fabric and small size (six examples) of his Lesbian material caused problems. And the attribution of material to Samos or Miletus has also been debated of late. In her seminal study of the type, Grace 1971 identified the shape of many Samian jars, and she attributed most with confidence; for others she noted a lack of supporting evidence and her Samian attribution was *faute de mieux*. Dupont denied a Samian origin to some of these, based on chemical data as well as find context, and suggested Miletus as a more likely source; Johnston has also taken this distinction forward, while Martina Seifert has produced more chemical evidence for the discrimination, as yet only provisionally published.[11]

A different approach to the study of amphora fabrics, optical microscopy, has been deployed by Whitbread.[12] He has demonstrated that by identifying inclusions in the clay we can isolate classes with general similarities and also suggest provenances for each fabric. As with chemical analysis this method is naturally applicable to all jars, not just those with stamps. In addition it provides geological and technical reasons for groupings and attributions.

Whitbread studied jars from a wide range of areas–eastern and northern Aegean, southern Greece and East Greece. Material from Samos was fine-grained, and that typologically from Lesbos had metamorphic inclusions. Using petrology he was able to distinguish between some of the classes that could not be clearly separate in the chemical studies of Slusallek et al. (see note 4) and Watson, particularly Thasian and Koan.[13] He also demonstrated the ability of the method to provide geological reasons behind the chemical results, e.g. in showing that the Knidian fabric placed by Watson with Koan was in fact

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[9] Whitbread 1995, 267 discusses the results of tests by Vandiver, in which type B jars were found to contain much higher CaO levels than type A; see P.B. Vandiver and C.G. Koehler, «Structure, processing, properties and style of Corinthian transport amphorae» in W.D. Kingery and E. Lense (ed.), *Technology and Style* (Ceramics and Civilisation 2; Ohio, 1986) 173-215, esp. 208-10. Whitbread notes that this indicates a high proportion of $CaCO_3$, which in turn indicates the use of a more marly clay.

[10] Whitbread 1995, 50.

[11] Dupont 1982, 205-6; Johnston, *AA* 1990, 47-52, and 1993 364-70; M. Seifert *Veröff. Joachim Jungius-Ges.Wiss. Hamburg* 87 (1998), 131-41, esp. 137-8, and forthcoming. Further thoughts by Dupont on the matter are to be found in his paper «La circulation amphorique en mer noire à l'epoque archaique», in Y. Garlan (ed.) *Production et Commerce des Amphores anciennes en Mer noir* (Aix-en-Provence, 1999) 145-153.

[12] Whitbread 1995 gives a detailed explanation of the method of petrographic examination of ceramics, and its application for less fine wares.

[13] Whitbread 1995, 251.

geologically very close to the Koan.[14]

It is recognised that typological analysis and archaeological context must remain important tools in limiting the range of possible provenances that might be thrown up by clay chemistry and geology of included matter.[15]

AMPHORA CLASSES

We first outline a few aspects of the various classes. For those from East Greece there is more, readily accessible, detail from Dupont in Cook and Dupont 1998, esp. 146-186.

Chian

An important contribution to the study of Chian jars came from Virginia Grace, who noted the occasional presence on later jars of a stamp, usually at the base of the handle; the clay is sandy, rich in mica, often grey in the core with a redder surface.[16] Early examples are bobbin-shaped (seventh century), but by the late sixth century have developed a slightly fuller body and a bulge, of increasing prominence, on the neck. The bulge eventually disappears *c.* 450 BC, and by *c.* 425 a new type with straight neck and flat shoulder is introduced. During the Classical and Hellenistic periods the neck tends to lengthen and the body become more angular.[17]

The sherds submitted for examination include one possibly of the early bobbin type, from Kommos, where at least five such pieces, in fragmentary and very worn state, have been excavated; often the characteristic white slip is wholly worn, which could possibly lead to misidentification (and our one sample is visually on the borderline). The fabric is coarse and the surface under the slip is regularly a purplish brown.[18] The remaining samples come from excavations, including that of an assumed fifth century kiln-site, at Chios town itself.[19]

Samian

Identification of the type by Grace started from Classical and Hellenistic material with stamps which reflected types on Samian coins. The shape of complete jars was inferred from their representation on the coins and stamps, and finds of «apparently similar amphorae», notably in cemeteries on Samos led to the identification of a series of actual

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14 *Ibid.*

15 Whitbread 1987, 323; at Whitbread 1995, 245 he notes that even when «similarities in fabrics ... cause problems when determining provenance ... it is possible to provide a relatively short list of the most likely alternative source».

16 V.R. Grace, «Stamped amphora handles found in 1931-2», *Hesperia* 3 (1934) 175-89.

17 Usefully surveyed by V.R. Grace, *Amphoras and the Ancient Wine Trade* (Excavations of the Athenian Agora, Picture Book 6; Princeton, 1979) esp. figs. 44-51. Recent contributions on fifth century types and their (lack of) relevance to the Athenian standards decree are H.B. Mattingly, «Coins and amphoras –Chios, Samos and Thasos in the 5th century B.C.», *JHS* 101 (1981) 78-86, T. Figueira, *The Power of Money* (Philadelphia, 1998) 299-304 and M. Lawall, «Graffti, wine-sellind and reuse of amphoras in the Athenian Agora, ca. 430 to 400 B.C.» *Hesperia* 69 (2000), 3-90, esp. 81-2.

18 Johnston 1993, 363-4 and 373, cat. 145.

19 For the site see A. Tsaravopoulos, *Horos* 4 (1986) 136-9.

jars.[20] Some identifications were perforce based on rather less reliable evidence, and for a number an origin from Miletus has since been proposed.[21]

In the sixth century the Samian amphora of full size has a full body with broad shoulder, a relatively short offset neck and slim handles; the toe is of flaring ring form, with the floor of the body nestling heavily in it.[22] Fifth century jars are represented on coins, with a longer ovoid body.[23]

The material from Kommos represents the early type, the clay fine and reddish, with many small mica particles, though the amount appears to vary. The toe fragments indicate the presence of both the full-bodied type and also more the more conical bodied variety, normally fractional.[24]

Milesian

The type of amphora now recognised to be Milesian (or derivative thereof) has been isolated fairly recently. Identifiable from the seventh into the fifth century, it generally has a full body, offset by a ridge at the physical join with the neck, relatively largely flattened handles and a tall convex lip.[25] Ruban has described the development of the «so-called» Milesian amphora (some previously termed «Samian» or «protothasian») and differentiated different versions over a period of some two hundred years.[26] Dupont has questioned a Milesian origin for the «protothasian» variety, and he also removed some pieces from Grace's «Samian» categories, since chemical analytical evidence suggests a Milesian provenance.[27] Subsequently many more pieces of the type have been found at Miletus itself, and this study is based on such samples. Material from Kommos is not lacking, and most examples there are of dull light brown clay with plentiful and sometimes moderate sized mica inclusions.[28]

Lesbian

In the early 1950s Cook and Grace individually published attributions of jars to Lesbos;[29] they are of reduced fired mica-rich clay, grey to dark grey on the surface, grey to grey-brown in the core (typically Munsell 5YR 4/1). Distinctive features are a turnip body with slight if any foot, tall cylindrical neck and especially round handles ending in a «rat's-

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[20] Grace 1971, esp. 55-67.

[21] P. Hommel «Amphoren» in G. Kleiner, P. Hommel and W. Müller-Wiener, *Panionion und Melie* (*JdI* Ergänzungsheft 23, 1967) 144-9; and see n. 11.

[22] Grace 1971, 71-2.

[23] *Ibid.* 75-6.

[24] Johnston 1993 365-6 (where under «Overview» the cat. nos should read «110, 111» not «109, 110», and under 111, the measurements should read «Pres. H. 0.083; Hf 0.013; Df 0.078»).

[25] See notes 11 and 21 above, and the review by Dupont 1997, 170-7.

[26] V.V. Ruban, «An attempt at classification of so-called Milesian amphoras from the lower Bug area» *Sov.Arch.* 1991, 2, 182-96. See Dupont in Garlan (n. 11).

[27] See note 21 and Dupont 1998, 178-86.

[28] Johnston 1993, 366-8.

[29] J.M. Cook, «Archaeology in Greece, 1952», *JHS* 73 (1953) 108-30, with indication on 124. V.R. Grace, «Wine jars» in C.G. Boulter, «Pottery of the mid-fifth century from a well in the Athenian Agora», *Hesperia* 22 (1953) 101-110, esp. 102-4; here Grace based her report on Cook's series.

tail» on the body.[30] Chronological tendencies are to a longer body with narrower foot and taller neck, with S-curving handles. We do not consider here the red-fired varieties of as yet uncertain chronological and geographical range.[31]

Perhaps ten jars, to judge largely from extant handles, are known from Kommos in the seventh century; represented is a rare variety with pseudo-twisted handles.[32]

Laconian

The Laconian amphora has been studied of late by Paola Pelagatti, citing published examples mainly from Sicily and Etruria.[33] Examples date from the late seventh into the fifth century and were probably made for the export of oil. The shape has some ressemblance to the Attic SOS amphora, especially in the neck-ring, and the clay is generally of a pink-mauve colour. Pelagatti notes the relationship of smaller table amphorae with this transport variety, which can also be wholly painted, but tends to have reserved neck (plus upper shoulder in some cases) and handles; the inside of the neck can be painted, in contrast to the SOS.

The material from Kommos is typologically related, but fits in ill at the start of the development of the assured Laconian series;[34] two varieties of black transport amphora, distinct from the SOS, are clear: type A is of rather red, micaceous clay and has a fascia rather than a ridge below the lip; inside of neck and the inside of the lower body are painted; type B tends to less red, less micaceous clay with a rim profile closer to the SOS, while the inside of the neck is reserved. The attribution of the type by typological criteria is difficult, since later Laconian jars show a mix of characteristics from these two types.

SOS amphorae

There is no need here to repeat the history and characteristics of this type of Attic amphora, with its life from the later eighth century into the second quarter of the sixth, and named after the most common form of decoration painted on the neck.[35] The body is full, on a large, increasingly flaring, foot; handles are round or only slightly flattened and the lip is always substantial, ending up as a tall echinus moulding; a drip-ring below it gradually loses prominence. Local imitations are clear, with a Chalcidian type being best attested, at an early date; it has a glazed inside to the neck, unlike the SOS.[36]

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30 J.M. Cook, «Archaeology in Greece, 1952», *JHS* 73 (1953) 108-30, with indication on 124. V.R. Grace, «Wine jars» in C.G. Boulter, «Pottery of the mid-fifth century from a well in the Athenian Agora», *Hesperia* 22 (1953) 101-110, esp. 102-4; here Grace based her report on Cook's series.

31 Treated by Dupont 1997, who notes the limitations of previous arguments by Clinkenbeard (*Hesperia* 51 (1982) 242-68) regarding chronology and provenance of the variety. See also Johnston, *Hesperia* 69 (2000) 218, no. 108.

32 Johnston 1993, 362-3.

33 P. Pelagatti, «Ceramica laconica in Sicilia e a Lipari», *BdA* suppl. to vol. 75, no. 64, 1990, II, esp. 130-8.

34 Johnston 1993, 358-62.

35 Most typological and compositional aspects are treated by A.W. Johnston and R.E. Jones, «The SOS amphora», *BSA* 52 (1978) 103-41. Recent finds have considerably expanded the corpus and the number of find-spots.

36 Johnston and Jones *ibid.* 111-2; the material remains largely unpublished, apart from a sherd from Chania (*ibid.* 114), M. Andreadaki-Vlasaki in E. Hallager and B. Hallager (edd.), *The Greek-Swedish Excavations*

Here some fragments from the excavations at Incoronata are examined.

Corinthian

Again fragments from Incoronata are examined, from amphoras of type A, the earliest of the two major forms of Corinthian jar, destined almost certainly to carry oil in primary use.[37] The type has been traced from the eighth to the fourth century by Koehler and its clay has been the subject of much work by Whitbread.[38] The fabric tends to pink, but is characterised mainly by the coarseness generated by heavy tempering with stone inclusions

PETROGRAPHIC AND CHEMICAL DISCUSSION

The aim of the petrographic study was (a) to identify fabrics in each typological class, and thereby (b) isolate microscopic features that may be useful in distinguishing between classes that are not readily identifiable by other criteria.

Chemical analysis was employed to validate groupings isolate by typological and petrographic criteria.

Chian

Previous studies have noted varieties in Chian fabric. Whitbread has two groups, with similar assemblages of inclusions but with different size distribution;[39] he notes in the latter group an assemblage of inclusions comparable with that of clay from Armolia used in modern pottery, indicating a feasible provenance for the ancient material. Dupont commented on the diversity of the thirty sherds from Chios which he studied, though they conformed to typological assessments of provenance, and Watson in his study of a small number of handles of typologically Chian amphorae found high levels of Al and low Mg.[40]

The material in this study, one fragment, possibly Chian, of the seventh century from Kommos and later material, some of *c.* 450 from a kiln site on Chios, show diversity in appearance but nonetheless form a single petrographic group. They contain predominantly sedimentary and metasedimentary inclusions with sparse volcanics (PLATE 1 *a*, FIG. 1 *a-b*), and so are very similar to Whitbread's second group of Chian sherds.

However, the chemical results do not correlate with Watson's; Al is not high, nor is Mg consistently low, but very variable. Nonetheless the Chian set form a reasonable coherent chemical group; K15, submitted to the Fitch as «Chian/Samian?» on visual

in the Agia Aikaterini Square, Kastelli, Khania, 1970-1987 I (Stockholm, 1997) 236, 70-P 0216, and a Pithekoussan derivative (see *ibid.* 115, no. 46), G. Buchner and D. Ridgway, *Pithekoussai* I (Rome, 1993) 700 and pl. CXCV, Sp. 2, 3.

37 For type A and A' (we do not here deal with type B) see C. Koehler, «Corinthian developments in the study of trade in the fifth century», *Hesperia* 50 (1981) 449-58. See also n. 9.

38 I.K. Whitbread, «The characterisation of argillaceous inclusions in ceramic thin sections», *Archaeometry* 28 (1986) 79-88 and 1995, 268-93.

39 Whitbread 1995, 143.

40 Dupont 1982, 198; Watson 1985, 86.

criteria,[41] is petrologically unrelated to Samian material, being much closer to Chian fabric, but the chemical analysis distinguished it from Chian, in demonstrating a non-calcareous clay.

While this last sherd is both typologically and scientifically a problem, the rest form a coherent group, matching most previous analyses.

Samian

Dupont, who examined some 150 sherds, none, he records, from a typical Samian amphora, introduced evidence, through XRF analysis, which distinguished Samian in particular from Milesian material.[42] As noted above, typological distinctions between «core» Samian and Milesian have been advanced more recently; Samian fabric is visually akin to Attic, but with more mica (though of small size), and the upper parts at least of Samian jars are of lighter build. Whitbread has published some analyses of samples from Samian amphorae and noted that their geology is consistent with the predominantly metasedimentary geology of the island, though he notes that this differs little from that of the nearby mainland.[43] Analysis of individual clay sources would be needed to further this aspect.

One sherd (K15) of typologically dubious Samian origin is mentioned above; the other two, more definitely Samian on such criteria, are shown to have similar characteristics to those analysed by Whitbread; the inclusion content is very low, at 5-15%, of which most are medium silt-sized metasediments (PLATE 1 *b*, FIG. 2). Therefore the typological attribution is reinforced, and it is clear that petrographically the Samian clay can be distinguished, primarily, but not only, from Chian, Milesian and Lesbian by its fine inclusions.

Milesian

The material studied here, from Miletus (Drawing 1) is of light brown clay with rather coarse mica. Since the material was originally selected for analysis of inorganic traces, no lip fragment was included; therefore it is not readily judged whether any of the sample come from the well-represented type with a much more square lip, termed «cornice rim» by Dupont, rather than from the better known tall-lipped version.[44] We can set beside our results analysis carried out on similar material from Miletus by Dupont, who tested some one hundred sherds from various sites, including Miletus, and demonstrated that some could not be Samian, as argued by Grace, but that analysis and weight of provenance point to Miletus.[45] Martina Seifert has taken chemical analysis of material from Miletus further,[46]

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[41] AWJ adds that in the list submitted to the Fitch laboratory K15 was indeed labelled «Samian/Chiot», but this referred to a stage when the sherd to bear this number had not been finally chosen, rather than being a judgment on the sherd which was eventually allocated.

[42] Dupont 1982, 206-7.

[43] Whitbread 1995, 127.

[44] For «cornice rims» see Dupont 1997 178. The only hint of such a rim in our sherds is the fact that M7 has a handle that appears to be of strap form, not bifid; in the deposit concerned AWJ noted that tall rims have only bifid handles, but according to Martina Seifert (pers. comm.) this observation apparently does not hold throughout the class.

[45] See note **27** above. The «classic» non-Samian example in Grace's treatment of that class is her pl. 15,4.

[46] See note 11 above.

while that carried out by Gautier on decorated wares led Jones to suggest Miletus as an origin for heavily micaceous vases with small plagioclase laths.[47]

The sherds typologically assigned a Milesian origin have a high inclusion content, at 35%, the coarse inclusions predominantly of sedimentary and metasedimentary nature (PLATE 1 *c*, FIG. 3). These sherds were therefore easily separable from all other classes in the programme. The quantity of mica with some plagioclase is consistent with Jones' observations regarding decorated wares. In addition chemical analysis of the same sherds (TABLE 2) indicates a very consistent composition, the high potassium content being particularly noteworthy.

The petrographic features of these sherds fit a provenance in a metasedimentary area with fluviatile sediments, as the region around Miletus.[48] Tight chemical grouping, indicating closely related compositions, is matched with a fabric that is petrographically distinctive.

Distinction between Samian and Milesian sherds

Petrographically too there is a clear distinction between the two sets of fragments; although the mineralology of the inclusions is not much different, the texture of the fabrics differs substantially, as illustrated in PLATE 1 *b* and *c*.

From his data too, Dupont appeared to have little doubt that he could readily distinguish Samian from Milesian; it was this observation which led him to reject Grace's attribution of certain material to Samos, material whose distribution is more heavily weighted to Miletos.[49] The small number of Samian sherds in our study is of course a limiting factor. It would be useful to be able to compare the data sets from Dupont's studies with our own.

Lesbian

Literary references to wine-making on Mytilene would lead us to expect amphora production on the island, with clay being used with inclusions reflecting the local geology, mostly volcanic, of the island.[50] Whitbread anticipated such inclusions in the typical grey ware jars, but his studies have not as yet substantiated this; rather, he found metamorphic material with, in one case, very rare fossil fragments.[51] Such lithology occurs in the east of the island, away from the area of Methymna, where Virgil would place the origin of Lesbian wine, and the volcanic area.

Two main chemical studies have been carried out, by Dupont on Archaic material and

[47] J. Gautier, *Application de la microscopie à l'étude minéralogique et technologique des céramiques grecques* (Paris, 1975) discusses the petrography of the material, and attribution is by Jones 1986, 307. Further important work has recently been carried out by Kirschner and Mommsen and reported in several sections of M. Akurgal, M. Kirschner, H. Mommsen and W-D. Niemeyer, *Töpferzentren der Ostägäis; archäometrische und archäologische Untersuchungen zur mykenischen, geometrischen und archaischen Keramik aus Fundorten in Westkleinasien* (Vienna 2000), *q.v.* for further bibliography.

[48] Jones 1986, 309.

[49] See n. 11 above.

[50] Virgil, *Georg*. 2, 89-90.

[51] Whitbread 1995, 160.

by Clinkenbeard on Classical and Hellenistic.[52] Dupont found homogeneity in his group of six sherds but could not pin-point a source; he suggested petroscopy as being more suitable in view of the very coarse fabric. Clinkenbeard tested sherds from the Athenian Agora, Mytilene town and Methymna, together with modern material from the pottery workshop at Ayiassos on Lesbos. Analysed at the Brookhaven National Labvoratory for a wide range of trace elements, the ancient material was found to differ from the modern. The Mytilene and Methymna sherds could be set together on levels of antimony, and could be provenanced to a volcanic region. The other sherds Clinkenbeard felt to be unrelated to any known areas of production in antiquity, and suggested a source outside the island. Whitbread suggested that before going outside the island the modern source at Mandamados should be investigated.[53] It is closer to Methymna than Ayiassos, in an area of ignimbrites with modern pottery workshops. Jones suggested that one sherd from the Athenian Agora with a very high chromium content may derive from the serpentine band at Mandamados bay.[54]

The petrographic results show the existence of two distinct groups of Lesbian material, volcanic and non-volcanic, in addition to the metamorphic group defined by Whitbread. The sherds in both the first two groups contain volcanic fragments of lava, glass, plagioclase and amphibole and non-volcanic fragments of monocrystalline and polycrystalline quartz and chert. They can be split into two groups by virtue of relative proportions and condition of these inclusions, giving a volcanic group with a bimodal distribution dominated by fresh angular lava, plagioclase and glass (PLATE 2 *a*, FIG. 4 *a*) and a non-volcanic group with a unimodal distribution dominated by monocrystalline quartz and biotite with a few slightly altered sub-rounded volcanic fragments (PLATE 2 *b*, FIG. 4 *b*). The coarse inclusions are generally sub-angular to sub-rounded, and so they were probably collected already broken; as they are quite fresh, it is possible that a stream deposit near the solid parent rock may have been exploited to provide temper.

The elements in common between our study and that of Clinkenbeard are sodium, potassium, chromium, manganese and iron; as there is no apparent disagreement with quantities of these elements the two sets of data can be considered comparable. The high potassium content of the non-volcanic fabrics support the petrographic division of the Kommos sherds into two groups.

The exploitation of the same clay source for both groups of sherds would explain both the similar chemical analysis and the presence of very similar fine material, in this case volcanic. Temper from volcanic rocks in the form of stream deposit could then have been added to some jars only, with the resulting formation of the two groups. In this case we would expect the textural concentration features to be exactly the same in each group in view of the use of a common clay bed; but this is not the case, since in only one, weak, case can such a similarity be argued between examples in each group. So we should assume different clay sources and conclude that the two groups as distinguished petrographically are truly distinct, each manufactured at workshops exploiting clay geologically related to the volcanic rocks of the island; that producing the volcanic fabric may simply have been situated nearer the parent rock, or a local stream, for the volcanic temper.

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52 Clinkenbeard, *loc.cit.* (n. 31) and Dupont 1982, 203.

53 Whitbread 1995, 161.

54 Jones 1986, 740.

Laconian

Whitbread has analysed petrographically sherds representing a variety of Late Bronze Age vessels of Laconian origin.[55] His studies revealed several different fabrics, resulting from technological variation, but he concluded that they were probably all from Laconia. No previous study, petrographic or chemical, of the amphora type has been previously carried out.

Johnston is not convinced of a Laconian origin for the Kommos jars, mainly because of the difficulty in linking the Kommos pieces to the later sequence of Laconian amphorae; though two typological varieties can be isolated, the clay used is not always distinct to the eye.

These two typological groups were not found in either the petrographic or chemical data; both methods produced one main group and a single isolated sherd, indistinguishable typologically from its fellows.[56]

Petrographic analysis revealed the micromass of the main group to be red to very dark brown, with inclusions of metasediments (PLATE 2 *c*, FIG. 5 *a*) which can be found in Laconian sediments. The single sherd K8 bears no resemblance to the main group, and contains metasediments, amphiboles, and volcanic fragments unlikely to be found in Laconian sediments, set in a red micromass with brown patches (PLATE 2 *d*, FIG. 5 *b*). The fragment does bear some typological characteristics which would allow it to be hived off from the rest; see the Catalogue of sherds for further remarks.

Discounting this sherd, the petrographic and chemical similarities in both type A and type B suggest production in the same area, possibly in the same workshop, and that the apparent typological variations may be due to different producers within that restricted environment. The inclusions are found in sediments in Laconia, and a Laconian provenance is therefore feasible. The single sherd suggests that the type was being imitated elsewhere.

SOS amphorae

Attic amphorae of this type are made from a fine clay of buff to orange colour with white and in particular red inclusions, not found in the version made on Euboea.[57] Petrographic studies of the type have not previously been undertaken, though a substantial programme of chemical analysis, using Optical Emission Spectroscopy, was one of the earliest such efforts in the field of Greek archaeology (see n. 35); it involved control groups from the Agora and Kerameikos, as well as a set of samples from Chalkidian material. Diagnostic elements proved to be magnesium, chromium and nickel, all of which were present in greater concentrations in the Athenian than in the Chalkidian pieces.

Five samples were studied petrographically. Four proved very similar, while the fifth displays minor differences in hand specimen and thin section; it contained only 12%

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55 I.K. Whitbread, «Petrographic analysis of Barbarian Ware from the Menelaion, Sparta», *Φιλολάκων: Lakonian Studies in Honour of Hector Catling* (London, 1992) 297-306.

56 Johnston 1993, 359 for the typology. With respect to the odd man out (K8) see the list of samples below.

57 These inclusions are often noted in Attic; see most recently R. Catling, «Exports of Attic protogeometric pottery and their identity», *BSA* 93 (1998) 368.

inclusions, compared with 20-30% in the rest, and in hand specimen lacks the white inclusion of the other sherds. The metasedimentary inclusion assemblages in all the sherds are consistent with those expected from Attica and Euboea, with thin section revealing the red inclusions to be clay concentration features and the white inclusions quartz fragments (PLATE 3 *a*, FIG. 6).[58] The smaller size of the quartz fragments in sample I11 meant that they were not visible in hand specimen.

The analysis above is an interesting test case, since four of the fragments were taken from what was almost certainly the same jar, the «different» sherd from another amphora – ample confirmation of the use of the petrographic technique as a fine tool. Nonetheless, spectrographic analysis clearly shows consistency with production in Attica for all pieces.

Corinthian

While Corinthian jars of type B are the subject of considerable debate regarding provenance, both Corinth and Kerkyra being apparent major producers,[59] our material comes from amphorae of types A and A', the former being red, the latter yellow. They can also be differentiated on the basis of mudstone content and fabric colour. Petrographically, they have a very distinctive appearance, both containing numerous clasts of mudstone and mudstone brecchia. Both show a bimodal grain size distribution when they contain mudstone, suggesting that the coarser material may have been added as a temper, a notion supported by the differences in clast composition by size. Type B displays unimodal distribution of inclusions, dominated by quartz and chert fragments, and no mudstones.[60]

The sherds from Incoronata are all closely related, but in both hand specimen and thin section can be assigned to two groups. When compared with published sections and descriptions of type A jars, there can be seen to be of good consistency.[61] Type A sherds are yellow-brown to grey, type A' greenish-yellow. Both groups display bimodal size distributions with very coarse mudstone inclusions (FIGS 7 *a-b*); mudstones in type A are brown, rarely brecchias, those of A' are mostly red to brown breccias (PLATE 3 *b*). Large channels are found in both fabrics, but those of A' are less numerous than those of A.

Chemical analysis of these sherds showed very similar values of Mg, Ca and Fe to those found by Watson for Corinthian A sherds (see note 60), but provided no evidence of differentiation between A and A'.

The sherds studied petrographically and considered Corinthian thereby are confirmed in that origin from typological considerations.

Polygonal cracks were noted in several areas of the groundmass of sherd I6 of Corinthian A fabric (PLATE 3 *c*). Whitbread (see n. 38) has used this characteristic of

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[58] For such concentration features see Whitbread 1986 (n. 38). This identification runs counter to that published by Johnston and Jones (n. 35) 103.

[59] For previous work on type B jars see in particular M. Farnsworth, I. Perlman and F. Asaro, «Corinth and Corfu: a neutron activation study of their pottery», *AJA* 81 (l977) 455-68, Jones 1986, 713-20 and Whitbread 1995, section 5.

[60] Whitbread 1995, 278. With respect to chemical analysis, Watson found high levels of both manganese and aluminium in types A and B, and noted they could be differentiated on calcium content, which, where high, corresponded with low levels of aluminium, titanium and iron. Vandiver in Vandiver and Koehler (n. 9) 209 proposed two different clay sources because of differing Al_2O_3:SiO_2 ratios, but Whitbread later suggested (1995, 267) that high levels of $CaCO_3$ are more important, possibly the result of using a marly clay.

[61] Whitbread 1986 (n. 38) esp. 84-6, and 1995, 268-73.

mudstone inclusions in Corinthian A and A' jars as a factor in deciding that they were argillaceous rock fragments and not grog, since such cracks do not appear in the clay matrix or clay pellets. In this study polygonal cracking was noted in the matrix of thinly ground Corinthian A and A' sections; thus, as the phenomenon does not seem restricted to mudstone fragments, care should be taken to use it as a principle characteristic in differentiation of argillaceous rock fragments from grog. However, in Whitbread's Corinthian A and A' sections the polygonal cracks do largely occur in the mudstone inclusions. The cause of these cracks in both inclusions and groundmass has not been determined, but is most likely a function of the physical properties of the hard and very fine-grained material in response to the grinding during thin-section preparation.

CONCLUSION

Through petrographic analysis several groups of amphora fabric were identified, some based on previous work, others for the first time. Samian fabric was successfully distinguish from Milesian under the microscope, the Samian being identified with previous data, the Milesian through geological information. Sherds of Lesbian origin were found to have a predominantly volcanic inclusion assemblage, to be anticipated from the island's volcanic geology, but not previously isolated in sections. A Laconian fabric seems to have been confirmed, though with one differentiated imitation. SOS sherds showed a fabric consistent with an Attic origin. Classes identified from previous work were Chian and Corinthian A and A'.

The accompanying chemical analyses showed close correlation with the petrographic results for the main classes of amphora. The clays of the two groups isolated by petrography for Lesbos were chemically indistinguishable, confirming a common source, though blurring such petrographic differences. The close relation of four of the SOS sherds was confirmed by the later report that they were almost certainly from the same jar. No evidence was found to distinguish by either method the two typological types of Laconian amphora submitted for analysis, save for one «rogue» sherd. Samian and Milesian sherds would have been difficult to distinguish by chemical methods alone.

CATALOGUE

A brief archaeological description of the material (with the numbers in this article first, any other catalogue or inventory number after) is followed by the results of thin section examination.

K = Kommos. The material is very largely from Building Q, for which see *Hesperia* 62 (1993), 339-82; unless otherwise stated, sherds are from the Building, but not specifically catalogued in that publication.

K1-5 Lesbian by typological criteria.
K1 cat. 103.
K2 body sherd.

K3 shoulder sherd.

K4 shoulder sherd.

K5 body sherd.

K6 body sherd taken on visual criteria to be from cat. 125, a jar of Milesian type.

K7-14 «Lakonian» A or B by typological criteria.

K7 lip fragment of type B; top of lip glazed, inside very worn.

K8 lip fragment of type B; the inside of the lip is painted rather lower than seems the norm, but the paint does not continue far down the neck (as usual for type A); the clay is more porous (but possibly from post-depositional erosion) and more micaceous than in other pieces.

K9 body fragment, probably of type B. Inside of lip and reserved; stronger red-orange clay.

K10 cat. 88 (type A). Rather purplish-brown clay, as K13 and K14, and indeed K7.

K11 neck fragment, type A. Orange clay, as K12 –perhaps from same amphora.

K12 lip fragment of type A.

K13 ip fragment of type A.

K14 neck fragment, probably of type A since it is painted inside.

Chian?

K15 body sherd, taken to be from cat. 132, «bobbin» amphora; coarse, grey clay, surface lost.

Samian

K16 shoulder/neck fragment.

K17 shoulder/neck fragment.

Chian amphorae

C1-8 material from A. Tsaravopoulos' excavations on Chios, contributed for analysis directly to the Fitch Laboratory. C1-3 are late Archaic rim and neck fragments; C4, 5 and 8 plain wall sherds; C6 and 7 are late Archaic or early Classical feet.

O14 etc. foot and lower wall sherds from the kiln site in Chios town (Drawing 2), contributed by A. Tsaravopoulos via AWJ; of *c*. 450-25 BC. See A. Tsaravopoulos, *loc. cit.* note 19; the numbers are his.

Milesian amphorae

M1-8, range of fragments from probable 494 B.C. destruction debris from Kalabaktepe. Visually the clay of all pieces is similar.

M1 lower wall sherd.

M2 lower wall sherd.

M3 shoulder fragment, with scar of handle attachment.

M4 lower wall fragment.

M5 lower neck fragment (Drawing 1).

M6 lower neck/shoulder fragment (Drawing 1).

M7 neck and handle fragment (Drawing 1).

M8 about half of foot (Drawing 1).

M9 foot fragment (Drawing 1).

I = Incoronata. Sherds from amphorae found in the huts of the settlement.

I2-I5 inv. 123965, Attic SOS amphora, wall fragments. Sb, O, Sa decoration on neck; striped handles. Middle period.

I6-I10 inv. I551-555 Saggio S, Corinthian wall sherds. I5 and 10 have greyer core, red-orange inner and creamy-orange outer surface. I8-9 have a more homogeneous buff-cream biscuit.

I11, no inv., Saggio S, lower wall fragment, seemingly from an Attic SOS amphora (stained inside).

Petrographic description

Chian

K15, C1-C8, 014, 031, 035a, 035b, 65/2, 074a, 81/2

In hand specimen the sherds are yellowish-red to red (Munsell 5YR 5/6 to 2.5YR 4/6) or grey (5YR 6/1). The core is dark reddish grey (5YR 4/2); the fabric is hard (save K15) and rough, with a smooth to uneven fracture. Some of the Tsaravopoulos set have a red band on the rim.

In thin section the micromass is optically very weakly active, and is pale grey-brown, darkish red-brown or nearly black in ppl, and pale-brown, darker red-brown in xpl. Inclusions represent 35% of the fabric, are predomiantly silt to very fine sand (K15 is coarser), subangular or subrounded with medium apparent sphericity, and display a unimodal distribution. Although unimodal, inclusions vary by composition across the size range; the coarse inclusions are dominated by rock fragments of LIMESTONE, SANDSTONE, and SCHIST. Other common inclusions are POLYCRYSTALLINE QUARTZ, ORTHOCLASE, MONOCRYSTALLINE QUARTZ and CHERT. Foraminifera fragments of sparry calcite are occasionally found. Rarely included are volcanic glass, amphibole, siltstone, mudstone, plagioclase, microcline, and grog, which is dark brown to opaque with silty inclusions of monocrystalline quartz and whire mica.

The fine inclusions are mainly MONOCRYSTALLINE QUARTZ or LIMESTONE. Also present are BIOTITE and MUDSTONE (frequently with fan-shaped internal structures), and to lesser levels white mica, chert, amphibole, plagioclase, and rock fragments of quartz-biotite, quartz-biotite-plagioclase, and quartz-muscovite schist. Occasionally epidote and clinopyroxene are seen.

Samian

K16, K17

In hand specimen the sherds have a white to grey core (7.5YR 8/0 to 5YR 5/1), with a reddish yellow rim and surface (5YR 7/6). The fabric is soft, smooth, and with a laminated to smooth fracture. Surfaces are smooth.

The micromass is optically active, and is brown to dark brown in the centre (ppl), grey-brown, orange-brown (xpl), with an orange to brown rim (ppl), orange, rarely brown (xpl).

Inclusions occupy a maximum of 15% of the section and are predominantly medium silt, well sorted, subangular to sub-rounded with low apparent sphericity. They display a unimodal distribution.

MONOCRYSTALLINE QUARTZ is the predominant inclusion, WHITE MICA is common to dominant, and polycrystalline quartz is common. Also present, though in small quantities, are fresh and oxidised flakes of biotite, limestone, plagioclase, chert, amphibole, sandstone and quartz-biotite schist.

Milesian

M1-M9

In hand specimen the sherds are red to reddish yellow (2.5YR 5/6 to 5YR 6/6), with a thin rim on the external surface and a core that is nearer grey. The fabric is hard or soft, and rough, with an even/uneven/laminated fracture. Some surfaces have an apparent creamy slip; all have burial deposits on all exposed surfaces.

The micromass is optically active, ranging fron pale orange-brown to dark orange or red-brown, with rare rims of orange and brown 0.2 to 0.7 mm wide (ppl), and pale orange-brown to dark-, commonly red-, brown (xpl).

Inclusions occupy approximately 35% of the section, are frequently fine to medium sand, commonly medium silt to fine sand, and display a unimodal distribution. They are moderately sorted, subangular to subrounded with medium apparent sphericity. The common to dominant type is MONOCRYSTALLINE QUARTZ, Common are BIOTITE, GLASS, with inclusions of biotite, plagioclase and quartz, and ALKALI FELDSPARS. Rare inclusions are plagioclase, polcrystalline quartz, limestone, oligoclase, siltstone, hornblende, microcline, anorthoclase, calcite, chert, and rock fragments of quartz-biotite, quartz-alkali feldspar and quartz-plagioclase.

Lesbian

Volcanic group fabric (K1, K2, K3, K5)

These sherds are dark grey to pinkish grey (7.5YR 4/0 to 6/2) with a rim, where present, of light brown (7.5YR 6/4). Surface colours are pinkish grey to reddish brown (7.5YR 7/2 to 6/6). The fabric is soft and rough, with an uneven fracture. Surfaces on K3 have a whitish coating. Inclusions are commonly visible –grey, pink, black and yellow.

In this section the micromass is optically inactive or active, and is brown to dark brown, with a mid to very dark orange rim (ppl), and dark brown with a yellow-brown to red rim (xpl).

The inclusions, 15 to 25% of the sections, are predominantly medium silt to very fine sand, subangular to subrounded, and show a unimodal or bimodal distribution. The coarse fraction is dominated by volcanic material: angular, broken PLAGIOCLASE and subangular GLASS and GLASSY TUFF are found in all the sections. A common inclusion was identified as possible MELILITE (grey-white low first order interference colours, poor cleavage indicated by a dark indistinct line, parallel extinction, optically uniaxial negative, possibly length slow; could also be apatite, idiocrase, nepheline). Also present are feldspar, volcanic rock fragments containing fine-grained plagioclase laths, biotite and small round black grains, and monocrystalline quartz. Occasional inclusions of chert, polycrystalline quartz, schist, phyllite, sandstone and clay pellets are also seen.

The fine inclusions are dominated by MONOCRYSTALLINE QUARTZ, yellowish to red-brown CLAY FRAGMENTS and BIOTITE, most of the last oxidized red. PLAGIOCLASE is common in some sections, but generally volcanic rock fragments are few, comprising fine-grained plagioclase laths. Amphibole, limestone, glass polycrystalline glass, zircon, and chert are all present in small quantities.

Non-volcanic group fabric (K4, K6)

In hand specimen these sherds are greyish brown to pink (10YR 5/2 to 7.5YR 7/4), with slightly darker grey cores. The fabric is soft, smooth, with an uneven fracture. K4 has finger marks on the inside, K6 remains of a white exterior coating. A moderate number of inclusions can be seen, of mica and of black and white grains.

In thin section the micromass is optically active and granostriated. In colour it ranges from orange-brown to brown (ppl), and dark brown to very dark brown (xpl). Commonly the orange browns are banded with darker browns along the length of the section.

The inclusions occupy 35% of the sections and are predominantly silt to very fine sand, subangular to rounded with a unimodal distribution. MONOCRYSTALLINE QUARTZ and BIOTITE are the dominant inclusions in both sections. Plagioclase and clay pellets are present in small amounts. Rare inclusions are glass, both fresh and devitrified, siltstone, orthoclase, volcanic rock fragments of dominantly plagioclase laths, amphibole, and chert.

Laconian

Main group (K7, K9-K14)

In hand specimen the sherds are pinkish grey to reddish yellow (7.5YR 6/2 to 6/6) with a core of light grey to white. The fabric is soft or hard, and smooth, with a smooth fracture. Vessel surfaces are worn, with remains of a black coating on the exterior.

In thin section the micromass is found to very weakly optically active, and is brown to dark brown (ppl) and dark reddish brown (xpl).

Inclusions, 15% of the sections, are predominantly medium to coarse silt, and common to few very fine to medium sand, well sorted, and subangular to subrounded with medium apparent sphericity. They display a unimodal distribution. MONOCRYSTALLINE QUARTZ is frequently present, slightly clouded with inclusions. BIOTITE, both fresh and oxidized, is also frequent. POLYCRYSTALLINE QUARTZ, WHITE MICA, and ORTHOCLASE are often present in small quantities, and occasionally plagioclase, oligoclase, quartz-biotite schist, phyllite, chert, and volcanic glass with inclusions.

Unknown provenance (not Laconian)

(K8)

The hand specimen is pink (7.5YR 7/4), soft, rough, with an uneven fracture. Surfaces are worn, with remains of a black coating on the exterior, blackish brown on the interior (see above «Laconian»).

The thin section reveals an optically inactive micromass of dark brown (ppl) and a red framework with brown patches (xpl).

Inclusions occupy 25% of the section, and are predominantly medium silt to very fine sand. They are well sorted, subangular, with medium to low apparent sphericity, and show a unimodal distribution. BIOTITE is dominant, mostly oxidized; these grains appear to give the micromass its red patchy colour. Frequent MONOCRYSTALLINE QUARTZ, PLAGIOCLASE and AMHIBOLE are present. In lesser quantities are polycrystalline quartz, white mica, volcanic material, and volcanic glass with inclusions, probably plagioclase.

SOS amphorae

(I2-5, I11)

In hand specimen the sherds are pink (7.5YR 7/4 to 8/4). The fabric is hard and smooth with an almost conchoidal fracture. Outside surfaces have a horizontally banded black to red-black coating.

In thin section the micromass is very weakly optically active, and is brown (ppl) and orange-brown (xpl).

Inclusions occupy anything from 12% to 30% of the section, and are predominantly medium silt to very fine sand, angular to subrounded with medium apparent sphericity. They display a unimodal distribution. MONOCRYSTALLINE QUARTZ is frequent to predominant, and BIOTITE, both oxidized red flakes and grains, is frequent. A few grains each are present of POLYCRYSTALLINE QUARTZ, a few with biotite inclusions, PLAGIOCLASE, WHITE MICA. Rarely present are metaquartzite, phyllite, sandstone, devitrified glass, orthoclase, enstatite, chlorite, and biotite-chlorite. Clay features account for 4% of the sections, varying from brown to black (ppl) and red-brown to black (xpl). They are predominantly subrounded, half with a high inclusion content related to the section inclusions, the other half inclusion-free.

Corinthian A

(I6, I10)

In hand specimen these sherds have a reddish yellow rim (5YR 6/6) and a pinkish grey core (5YR 6/2). The fabric is hard and harsh with an uneven fracture. Outside surfaces have a whitish pink coating, the interior a pink/pink-orange one.

In thin section the micromass is seen to be very weakly optically active, and is brown to dark brown (ppl) and brown to rusty red with mottled brownish pattern (xpl). Strong polygonal cracking is present in several parts.

Inclusions occupy 20% of the fabric, and are predominantly medium to very coarse sand, and frequent medium silt, predominantly subangular, with medium to low apparent sphericity. They display a bimodal distribution. The coarse fraction is dominated by argillaceous rock fragments, namely brown-grey MUDSTONE (showing polygonal cracking, with up to 10% inclusions of silty monocrystalline quartz and polycrystalline quartz, yellow micas, chert, radiolaria, calcite, plagioclase and biogenics) and MUDSTONE BRECCIA (clast-supported fragments with red, brown and grey very fine sand-sized mudstone clasts, chert and biogenics, occasionally with polygonal cracking). Occasionally the breccia may pass into mudstone within the fragment. Rare inclusions are mudstone temper, radiolarian chert, limestone, prolate grains of micrite, siltstone, and quartz grains in a micritic cement.

Fine inclusions are dominated by MONOCRYSTALLINE QUARTZ with a few flakes of golden micas.

Corinthian A'

(I7, I8, I9)

In hand specimen these sherds are pink (7.5YR 7/4) while the core of I7 is light grey (7.5YR 6/0). The fabric is hard and harsh with an uneven fracture. Outside surfaces of I8 and I9 have a buff slip concealing all clasts, but clasts of I7 are visible; on the interior the clasts of I7 are partly concealed under a pale slip, those of I8 are poorly covered and stand slighly proud, and the large clasts of I9 stand proud.

The micromass is moderately to very strongly optically active, and is yellow-brown or brown (ppl) and golden to yellow-brown or orange-brown (xpl).

Inclusions account for 15% of the sections, and are predominantly very coarse sand and coarse silt, showing a bimodal distribution. The coarse inclusions are angular to subrounded, with medium to low apparent sphericity. The fine inclusions are subangular to subrounded, with medium to low apparent sphericity. The coarse fraction contains frequent to dominant argillaceous rock fragments: MUDSTONE BRECCIA (clast-supported fragments with red, grey and brown mudstones, quartz, yellow anisotropic grains, carbonates, radiolaria, shell fragments, bryozoa, and possible chlorite grains), MUDSTONE (brown to matt grey, with polygonal cracks, constituents quartz and mica) and SILTSTONE. Clay pellets are common, occasionally present are microsparite grains.

The fine fraction contains frequent angular LIMESTONE and rare to frequent MONOCRYSTALLINE QUARTZ. Common inclusions are MICRITE and opaque grains, probably iron oxides. Occasionally there are also siltstone, sandstone, fresh and devitrified glass, and biogenics.

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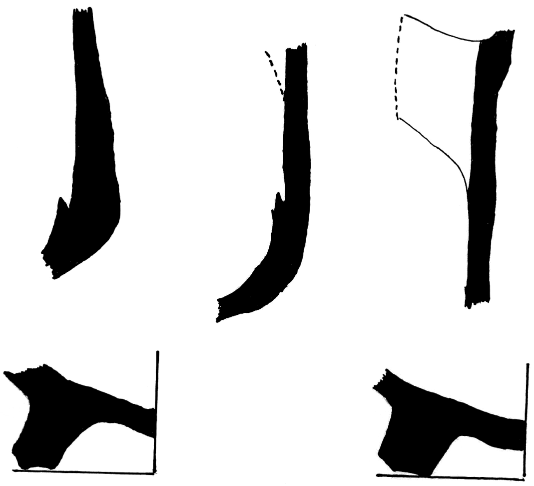
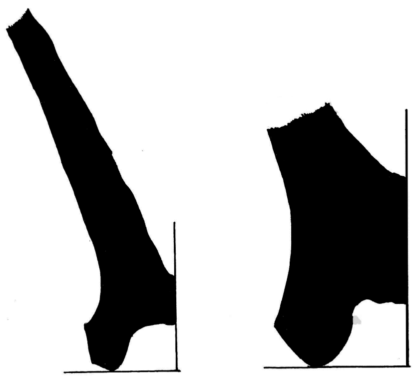
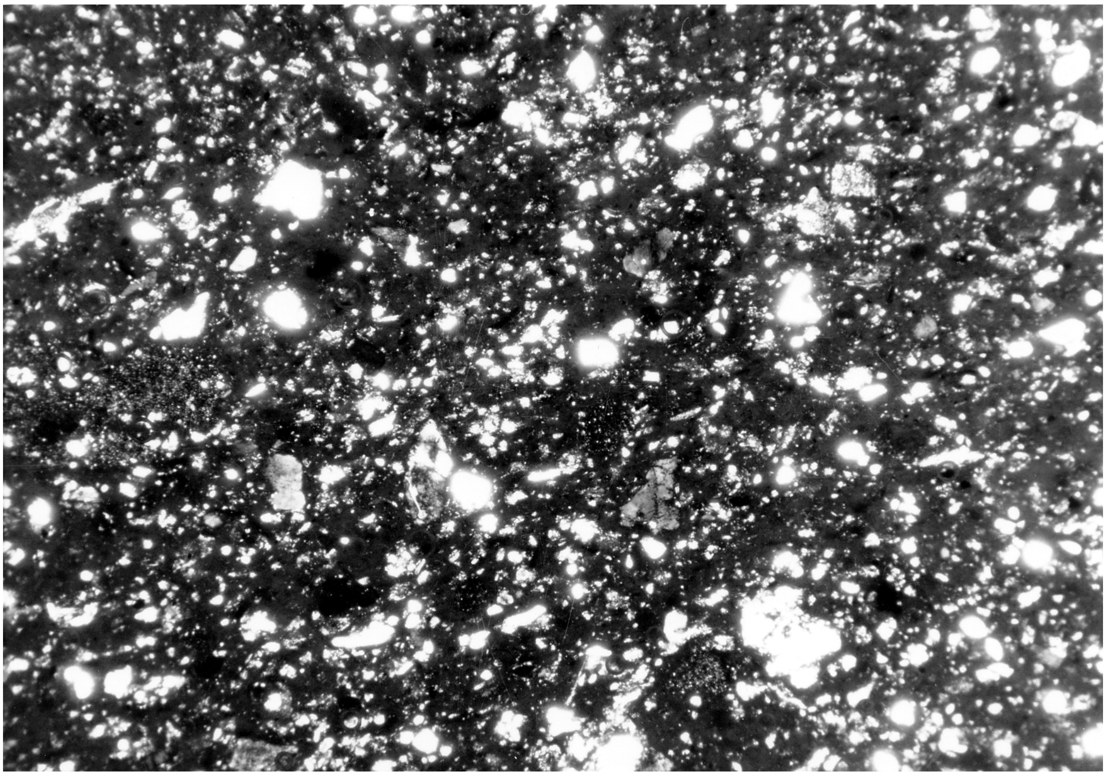


Drawing 1. Profiles of Milesian sherds, M5-M9.

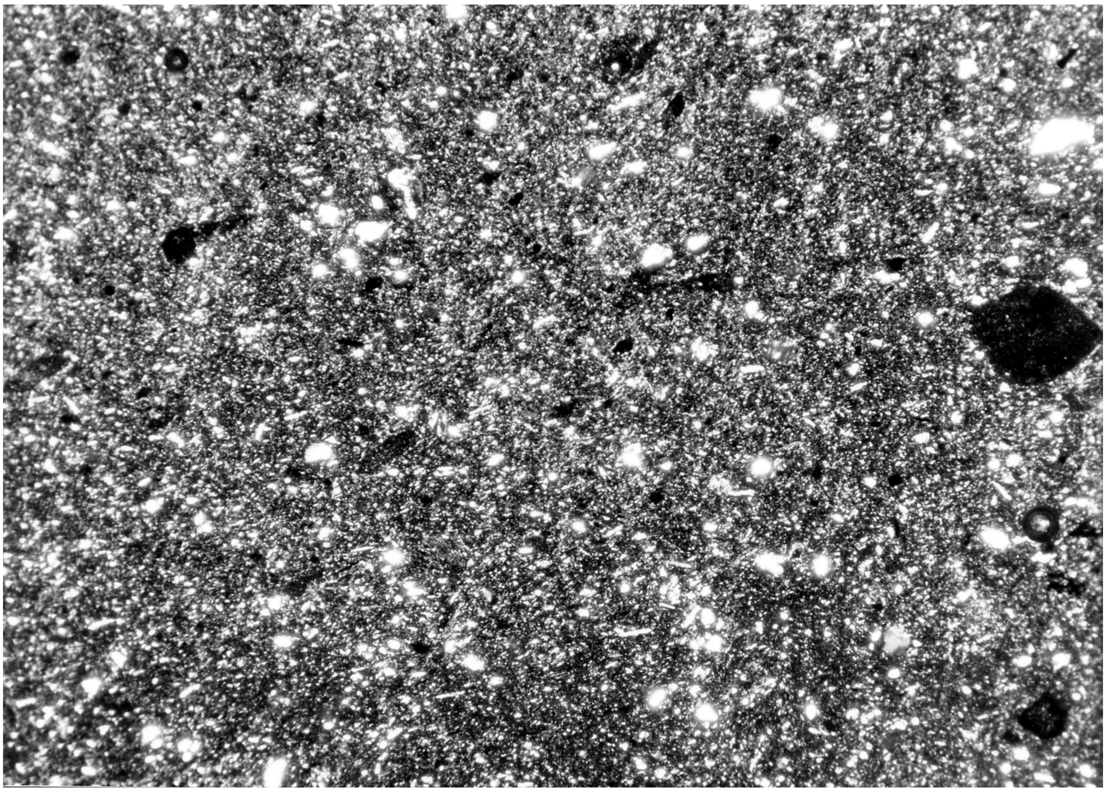


Drawing 2. Profiles of Chian sherds, 035b and 074a.

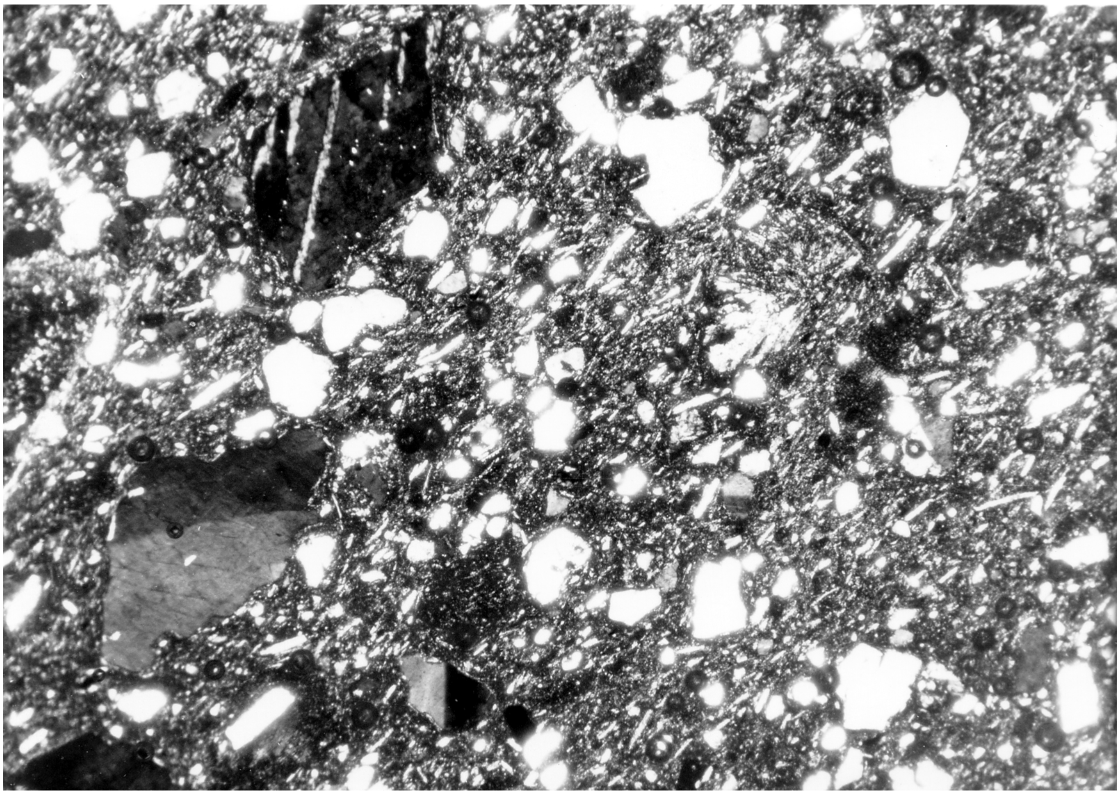
PLATES



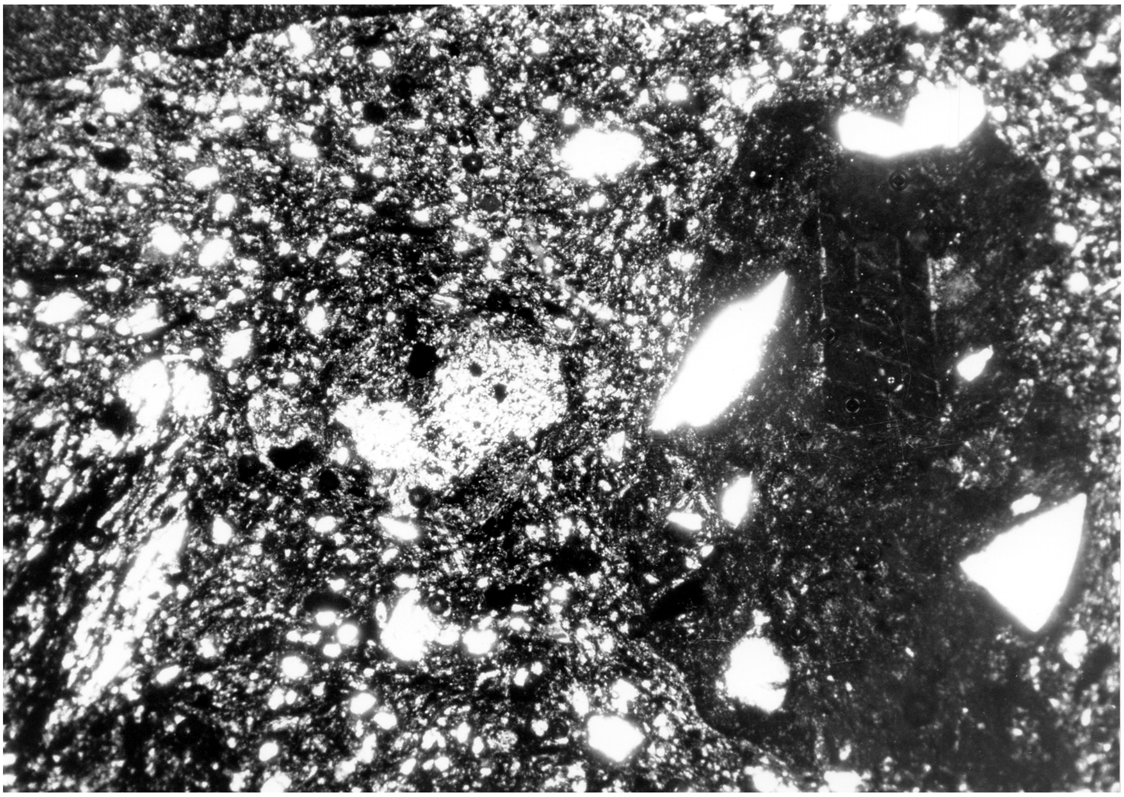
1a) Chian fabric showing sedimentary and metasedimentary inclusions (view xpl, approx. 3.5 mm across).



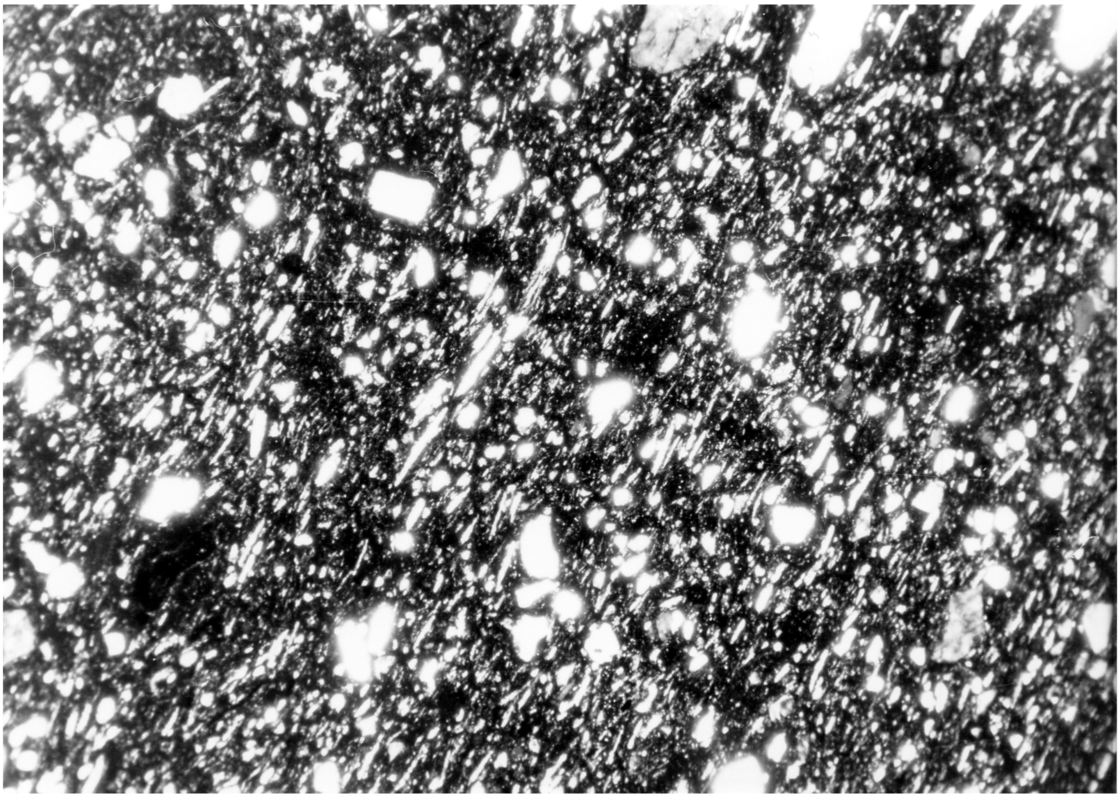
1b) Samian fabric. Silty metasediments (view xpl, 3.5 mm across).



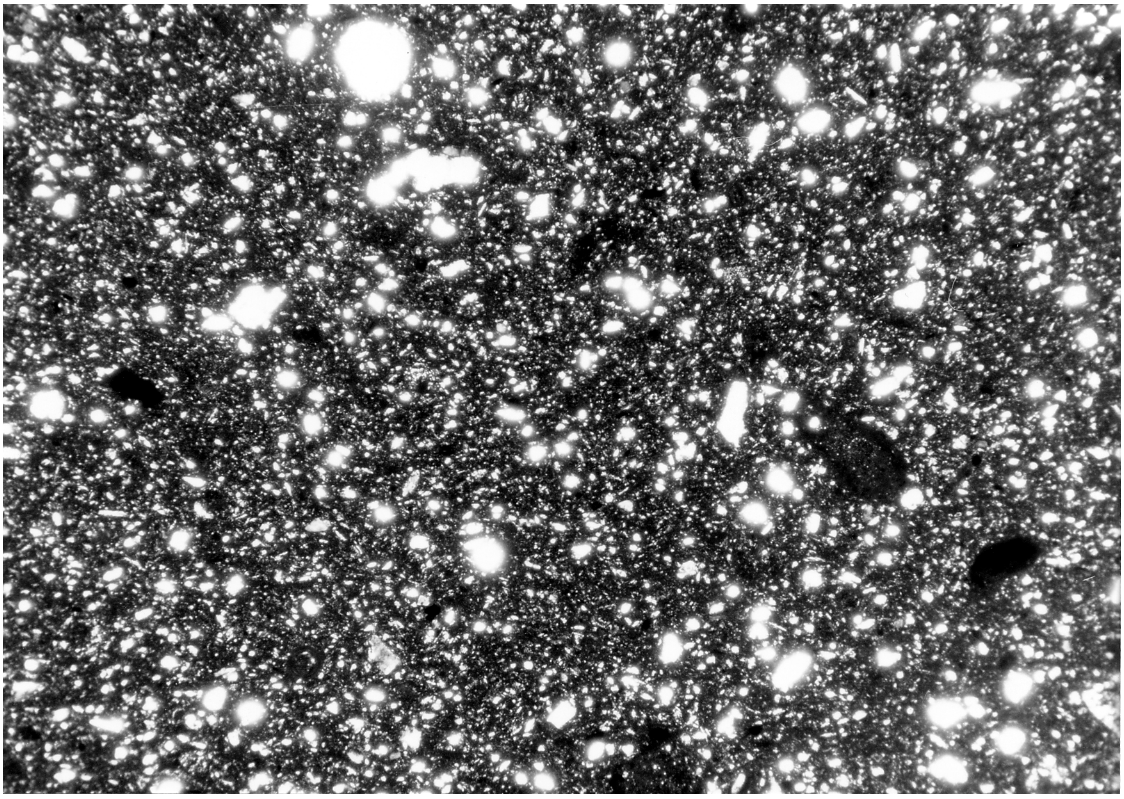
1c) Milesian fabric. Sandy metasediments (view xpl, 3.5 mm across).



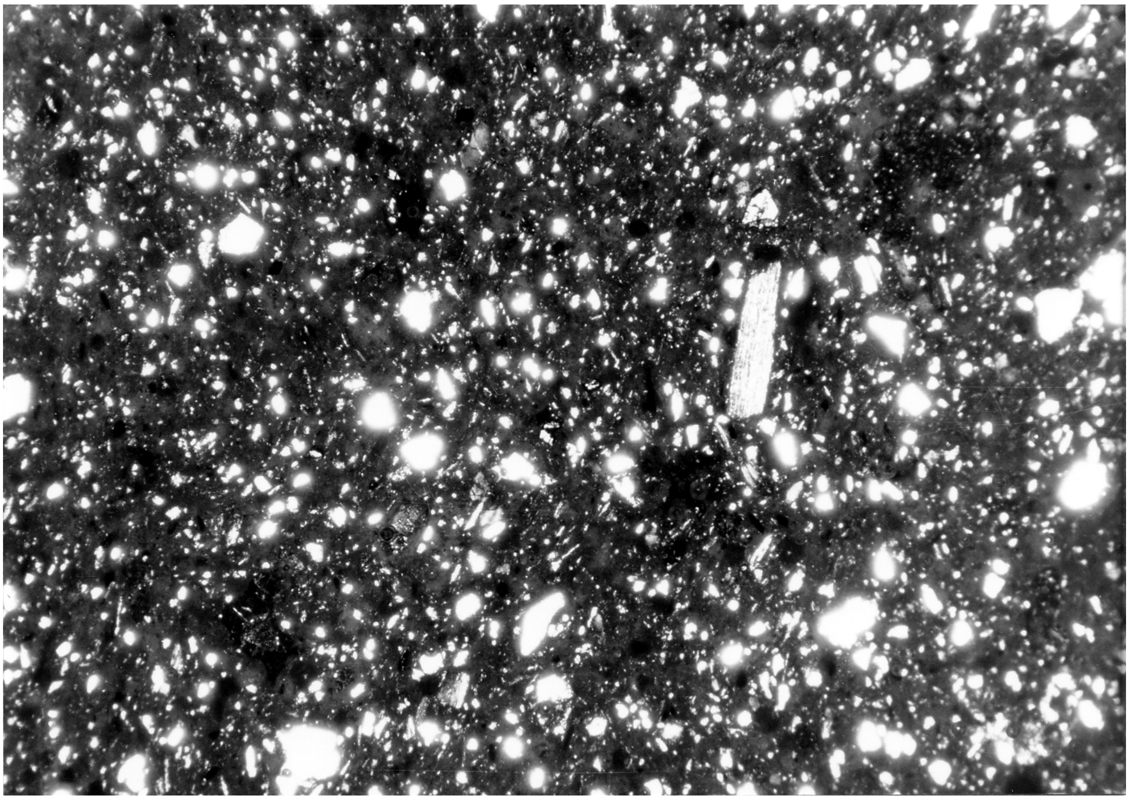
2a) Lesbian volcanic fabric. Large fragment of volcanic glass with feldspar inclusions.



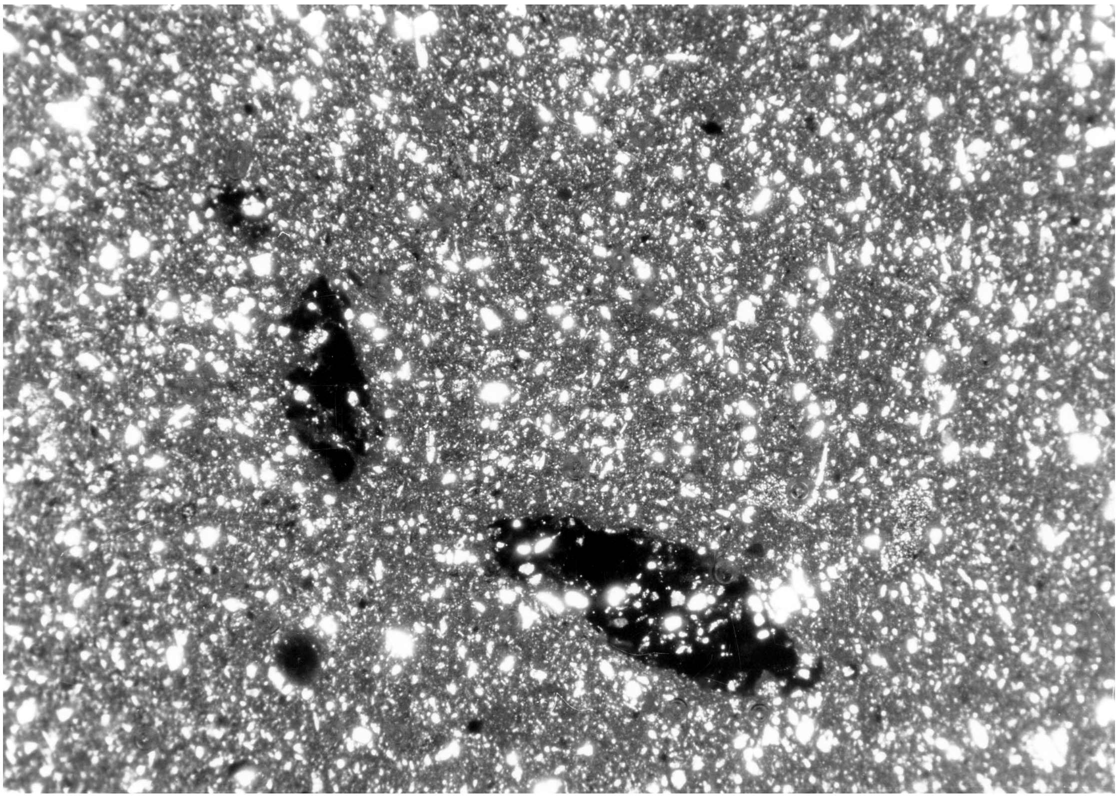
2b) Lesbian non-volcanic fabric. Quartz and biotite inclusions.



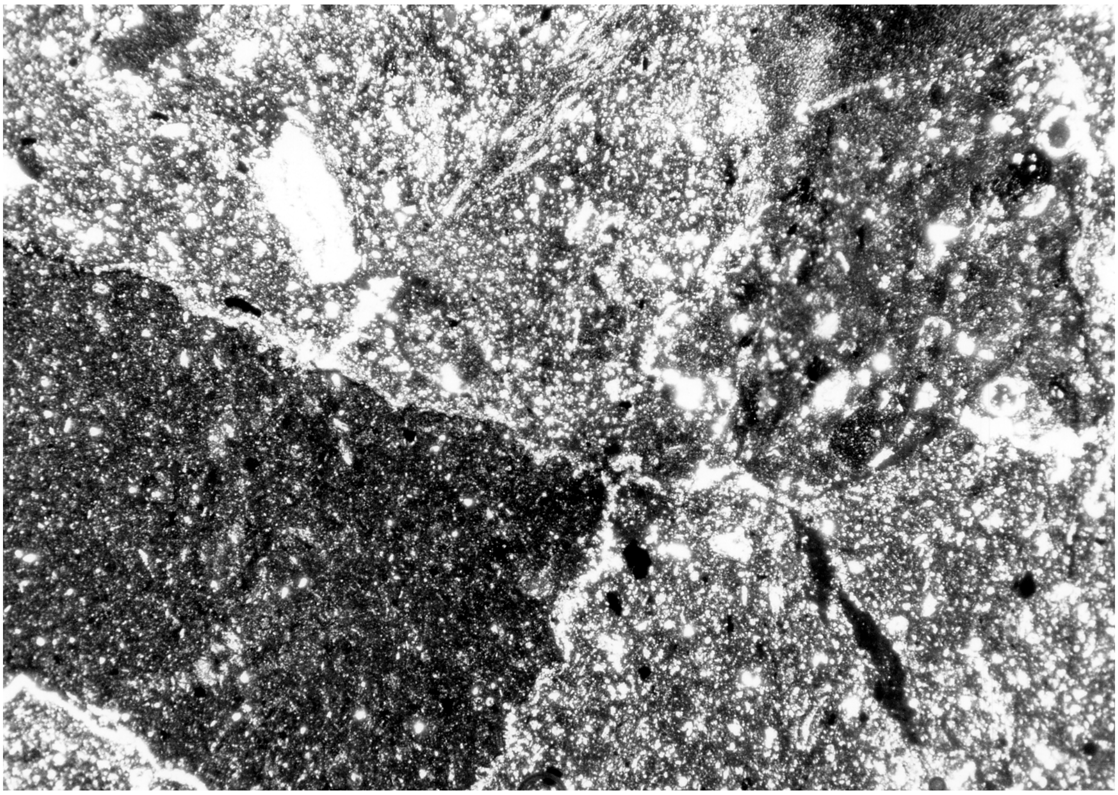
2c) Laconian fabric. Sediments and metasediments.



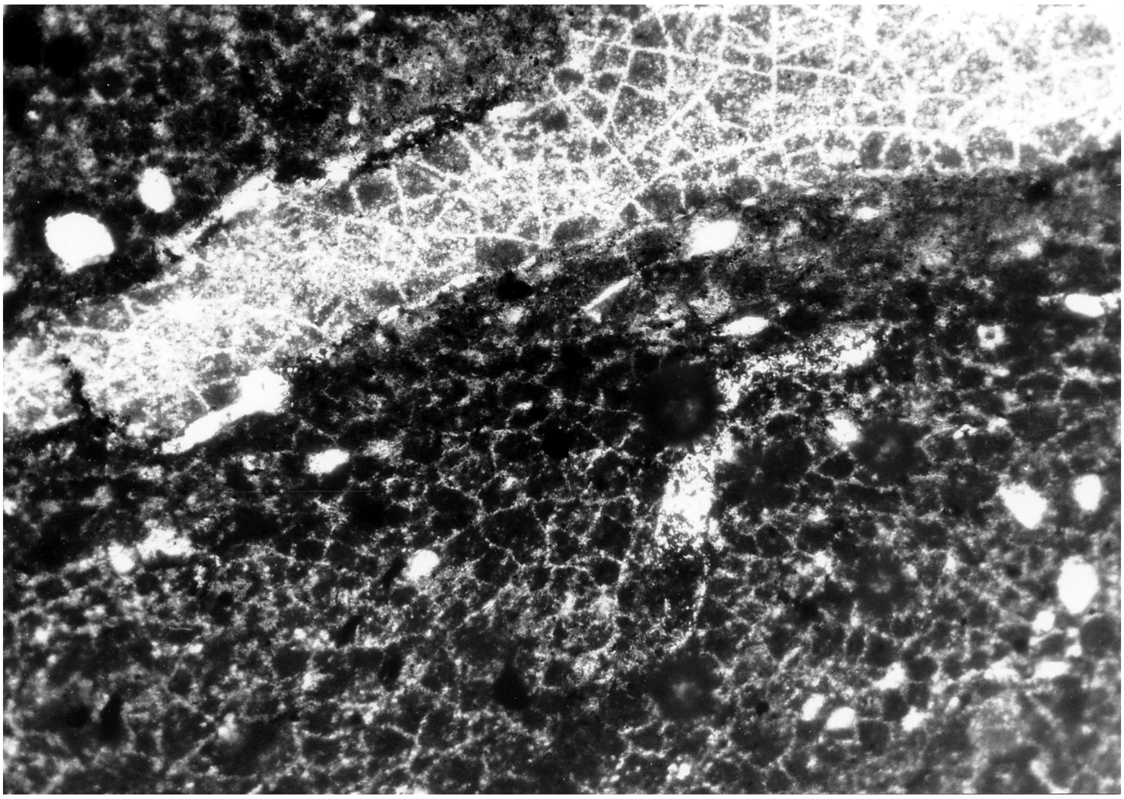
2d) Non-Laconian fabric. Some igneous inclusions in dark micromass. All view xpl, 3.5 mm across.



3a) SOS fabric. Sediments and clay features (view xpl, 3.5 mm across).



3b) Corinthian A' fabric. Large mudstone clasts, one of breccia (view xpl, 3.5 mm across).



3c) Polygonal cracks in mudstone and micromass of Corinthian A sherd (view ppl, 3.5 mm across).

TABLES

Table 1. Summary of chemical data (expressed as % element oxides).

s.d. = standard deviation.
Numbers in brackets indicate number of sherds.
Note: not all classes are represented in this table, only those with sufficient sherds to calculate s.d and mean figures.

		Al	Ca	Mg	Fe	Na	Mn	Cr	Ni	K
Chios (8)	mean	13.6	8.2	5.2	7.0	1.31	0.194	0.069	0.038	1.38
	s.d.	1.0	1.1	0.7	0.6	0.14	0.049	0.004	0.005	0.17
Miletus (9)	mean		6.2	3.8	7.2	1.32	0.102	0.029	0.017	4.33
	s.d.		1.2	0.4	0.5	0.2	0.013	0.004	0.003	0.21
Lesbos volcanic (4)	mean	16.5	3.9	3.3	6.4	1.5	0.112	0.033	0.018	2.79
	s.d.	1.6	1.2	1.5	1.7	0.4	0.033	0.029	0.019	0.11
Laconia (7)	mean	16.9	3.8	2.6	6.g	0.91	0.07	0.037	0.014	2.45
	s.d.	0.7	0.8	0.2	0.7	0.11	0.024	0.006	0.005	0.24
Corinth (5)	mean		8.8	3.3	7.6	0.45	0.14	0.038	0.021	3.04
	s.d.		3.6	0.5	1.0	0.114	0.03	0.005	0.004	0.25

Table 2. Chemical data (expressed as % element oxides).

* = because of instrument failure there are no readings for Al.

Cat.		Al	Ca	Mg	Fe	Na	Mn	Cr	Ni	K
Kl	Lesbos volcanic	16.2	2.4	3.2	6.8	1.95	0.147	0.023	0.01	2.78
K2	Lesbos volcanic	14.8	5.2	1.4	4.0	1.5	0.091	0.009	0.006	2.74
K3	Lesbos volcanic	16.2	4.3	3.6	6.4	1.45	0.133	0.023	0.01	2.7
K4	Lesbos non volcanic	18.8	5.1	3.7	6.4	2.24	0.091	0.023	0.014	5.44
K5	Lesbos volcanic	18.6	3.6	5.0	8.2	1.03	0.077	0.075	0.047	2.95
K6	Lesbos non volcanic	15.5	3.9	2.9	5.7	1.05	0.077	0.023	0.01	3.57
K7	Laconia	16.5	3.2	2.5	8.0	1.01	0.098	0.047	0.022	2.23
K8	not Laconia	16.7	7.3	4.1	7.4	1.43	0.147	0.055	0.026	1.77
K9	Laconia	15.7	3.9	2.6	6.3	0.99	0.064	0.031	0.01	2.7
K10	Laconia	17.9	5.1	2.3	7.4	0.82	0.084	0.038	0.014	2.46
K11	Laconia	16.9	3.1	2.8	6.6	0.76	0.05	0.031	0.01	2.16
K12	Laconia	17.4	3.0	2.9	6.6	0.82	0.05	0.035	0.01	2.42
K13	Laconia	16.5	3.6	2.5	7.2	0.99	0.098	0.044	0.018	2.38
K14	Laconia	17.2	4.7	2.6	6.0	0.99	0.043	0.035	0.014	2.83
K15	Chios	16.5	1.6	2.5	6.9	1.03	0.154	0.052	0.022	2.12
K16	Samos	21.6	3.5	3.1	7.1	0.43	0.064	0.038	0.01	4.2
K17	Samos	20.9	2.9	2.5	7.9	0.29	0.064	0.044	0.014	2.58
C1	Chios	14.5	7.2	5.5	7.5	1.5	0.244	0.073	0.043	1.7
C2	Chios	13.1	7.0	5.0	6.9	1.52	0.189	0.071	0.039	1.54
C3	Chios	15.7	9.9	6.3	8.0	1.28	0.196	0.071	0.043	1.48
C4	Chios	12.9	7.1	4.1	6.8	1.26	0.196	0.064	0.035	1.26
C5	Chios	13.6	9.4	5.4	6.9	1.19	0.154	0.069	0.031	1.35
C6	Chios	12.9	8.2	5.7	6.8	1.3	0.279	0.071	0.035	1.26
C7	Chios	13.3	8.1	5.2	6.9	1.15	0.168	0.067	0.043	1.23
C8	Chios	12.6	8.9	4.6	6.0	1.24	0.126	0.062	0.031	1.23
M1	Miletus	*	4.3	3.3	6.7	1.43	0.082	0.025	0.015	4.25
M2	Miletus	*	7.6	4.1	6.7	1.56	0.12	0.037	0.021	4.21
M3	Miletus	*	4.5	3.5	6.7	1.48	0.093	0.025	0.018	4.17
M4	Miletus	*	6.4	3.9	7.3	I.30	0.088	0.029	0.015	4.73
M5	Miletus	*	6.5	4.2	7.6	1.22	0.109	0.033	0.018	4.17
M6	Miletus	*	7.3	4.4	8.2	1.06	0.109	0.033	0.021	4.09
M7	Miletus	*	7.0	3.4	7.0	1.59	0.115	0.029	0.018	4.33
M8	Miletus	*	5.3	3.7	7.2	1.35	0.099	0.025	0.015	4.53
M9	Miletus	*	6.6	3.9	7.7	0.88	0.099	0.025	0.012	4.49
I2	SOS	*	9.5	5.5	8.5	0.74	0.12	0.08	0.042	2.88
I3	SOS	*	6.3	5.5	8.5	0.79	0.115	0.086	0.045	3.06
I4	SOS	*	7.6	5.8	9.4	0.79	0.142	0.09	0.05	3.23
I5	SOS	*	8.0	5.4	8.3	0.68	0.126	0.084	0.042	3.06
I6	Corinthian A	*	8.6	3.8	9.3	0.64	0.169	0.043	0.026	3.1
I7	Corinthian A'	*	8.1	3.9	7.3	0.38	0.169	0.043	0.024	3.32
I8	Corinthian A'	*	5.2	2.7	7.3	0.36	0.099	0.033	0.018	3.14
I9	Corinthian A'	*	14.7	2.9	6.6	0.46	0.136	0.033	0.018	2.65
I10	Corinthian A	*	7.2	3.3	7.7	0.4	0.126	0.037	0.018	2.97
I11	SOS	*	9.1	4.9	7.9	0.62	0.126	0.076	0.04	2.79

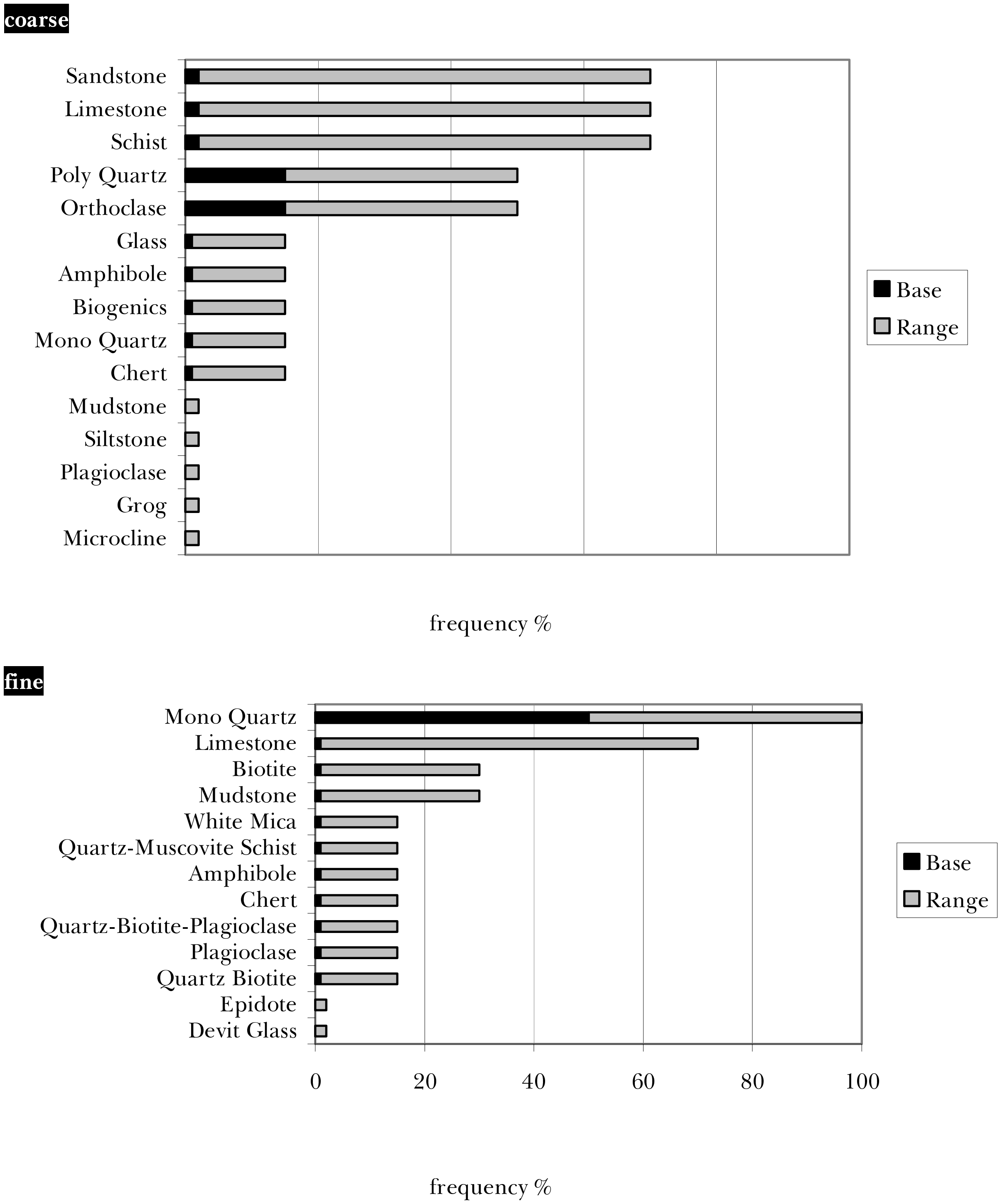


Fig. 1a. Mineral composition, Chian fabric: all sherds.

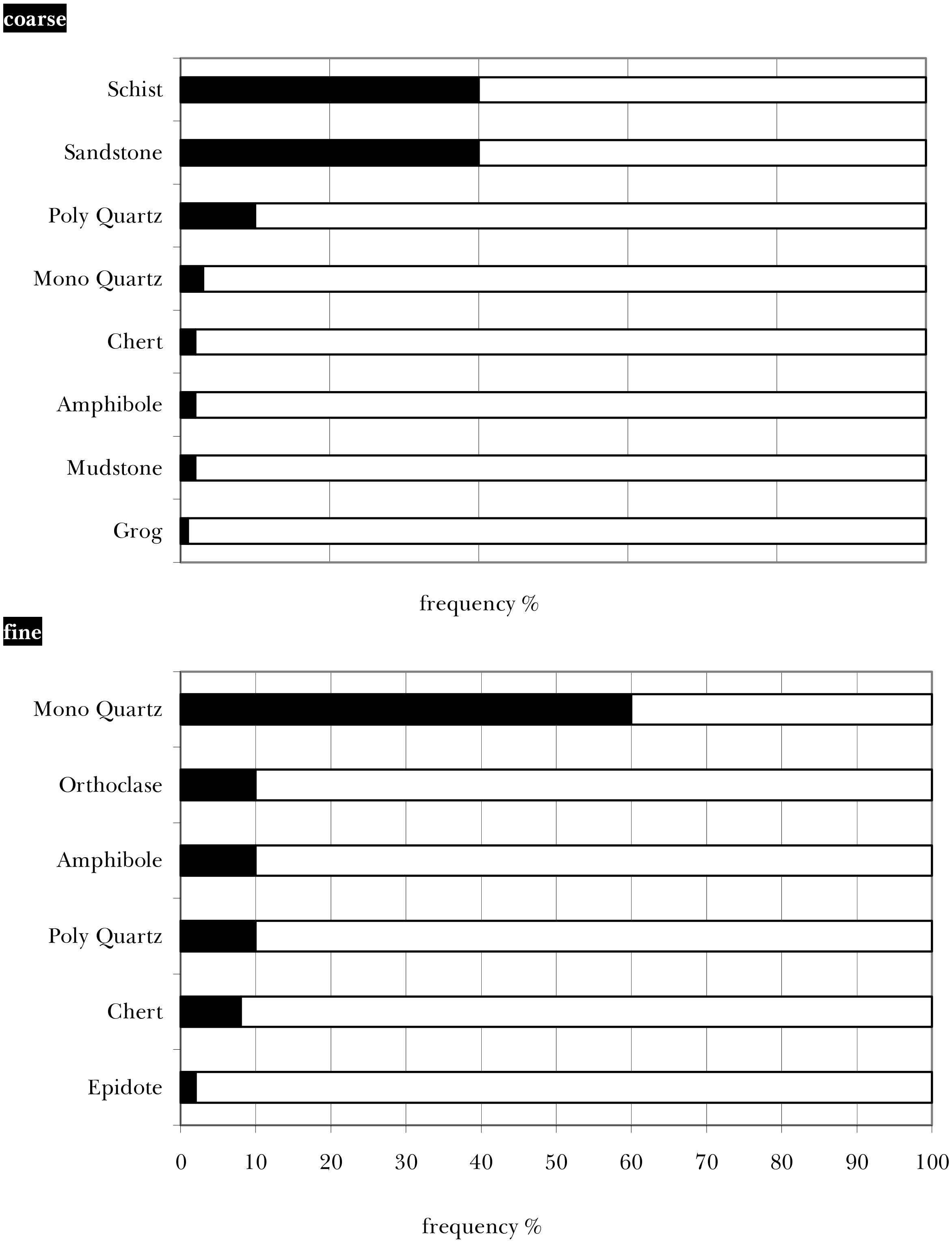


Fig. 1b. Mineral composition, Chian fabric: K15.

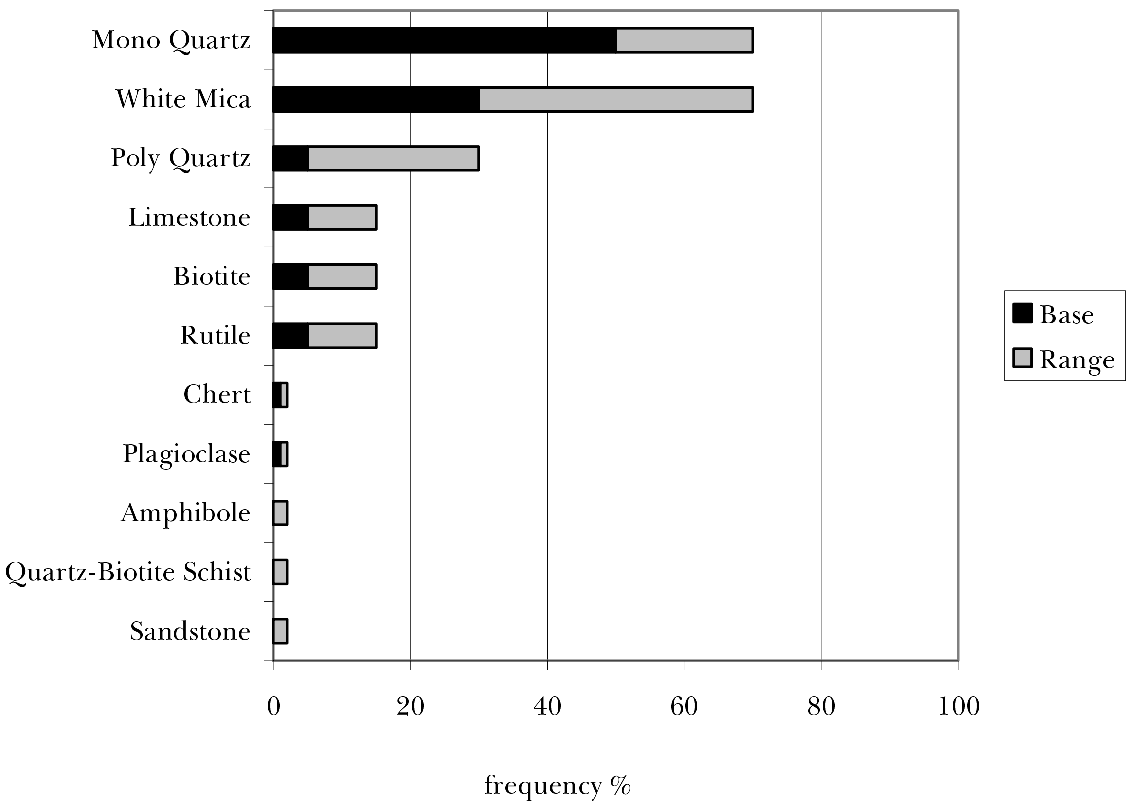


Fig. 2. Mineral composition, Samian fabric: K16, K17.

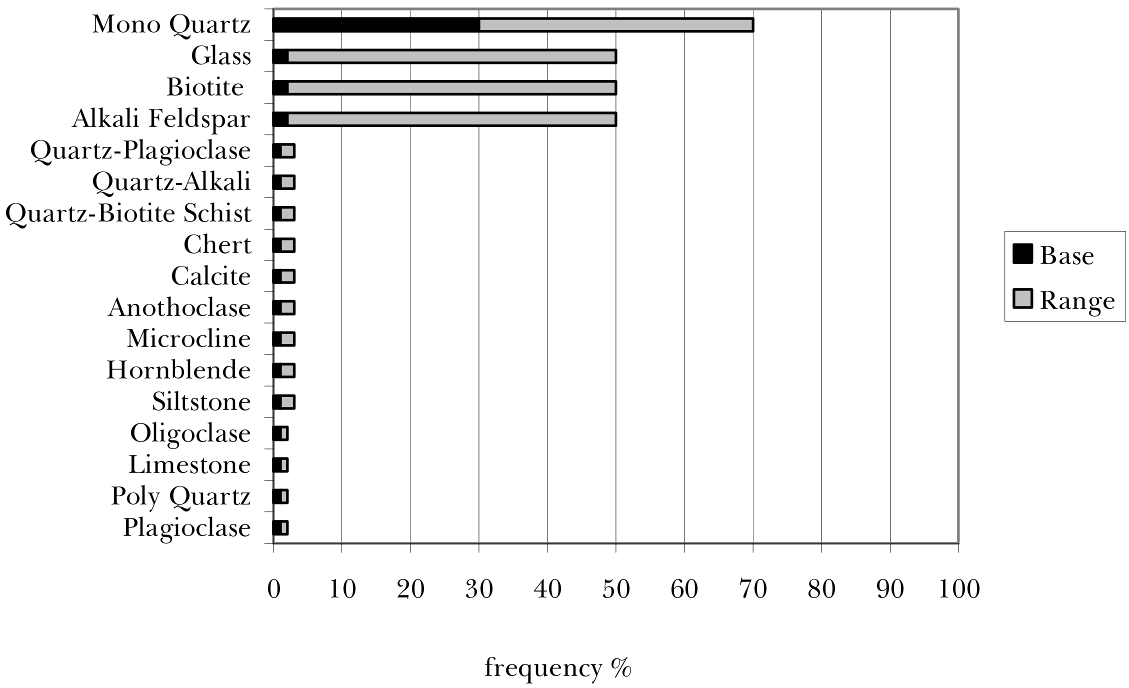


Fig. 3. Mineral composition, Milesian fabric: M1-M9.

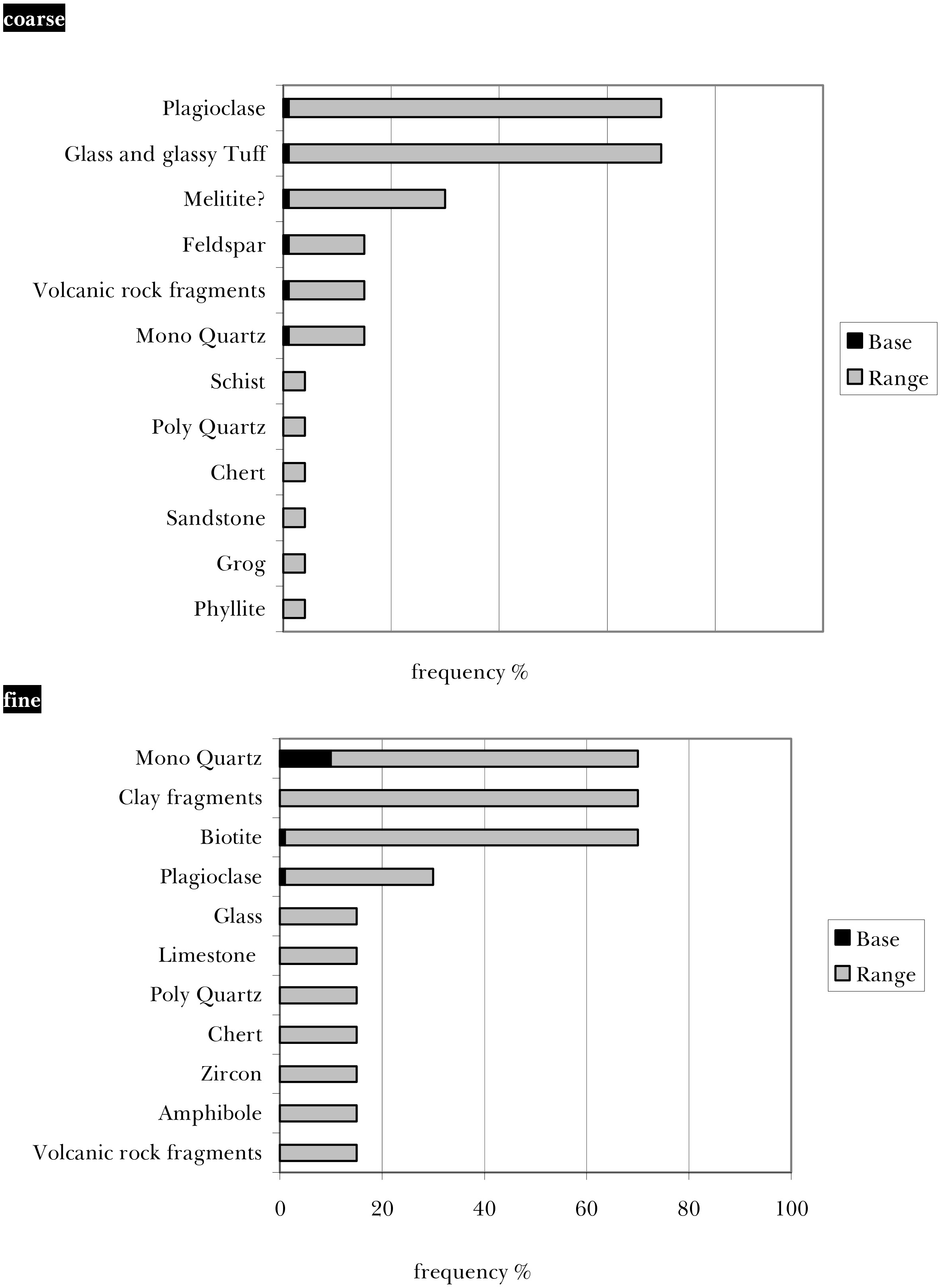


Fig. 4a. Mineral composition, Lesbian volcanic fabric: K1, K2, K3, K5.

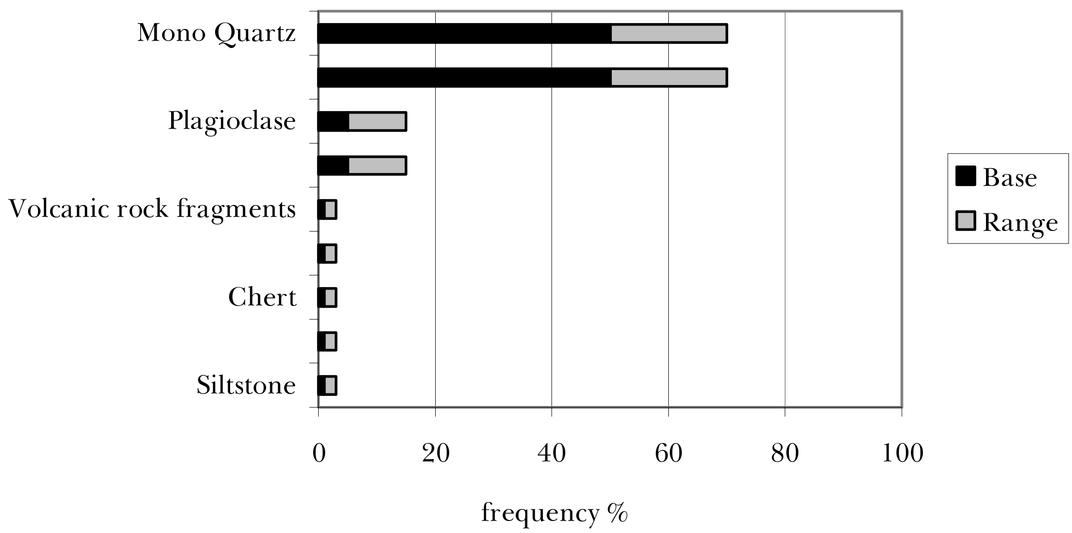


Fig. 4b. Mineral composition, Lesbian non-volcanic fabric: K4, K6.

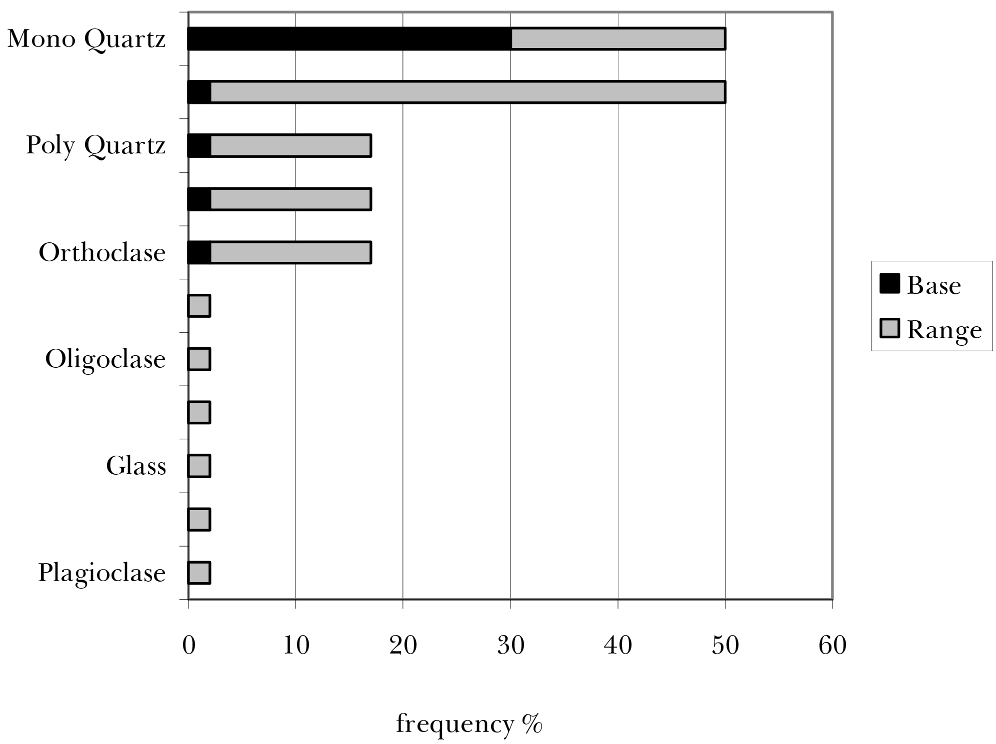


Fig. 5a. Mineral composition, Laconian fabric: K6, K7, K9-K14.

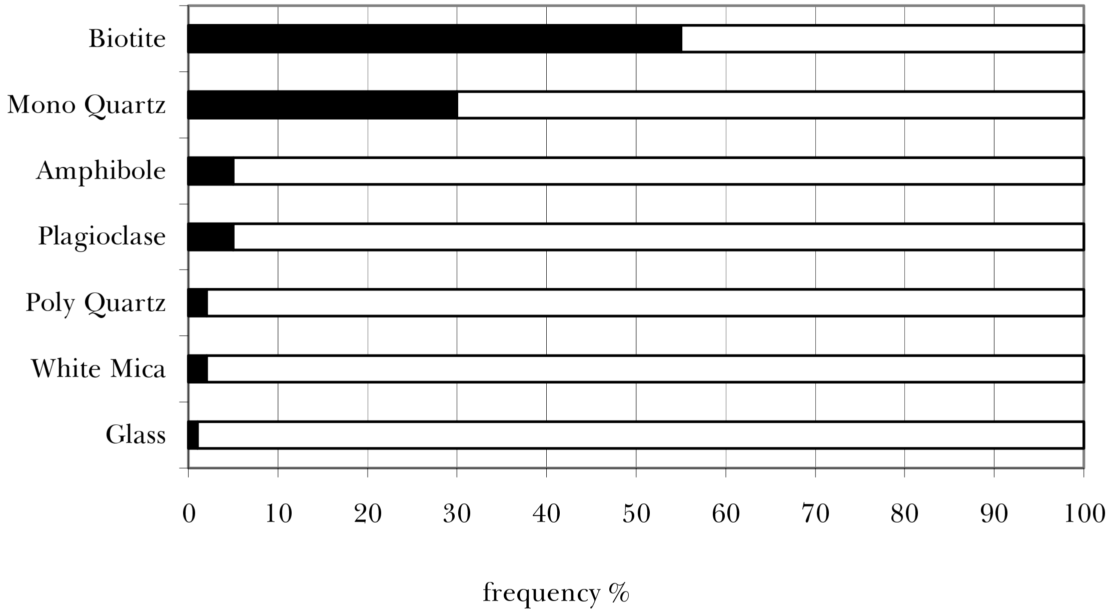


Fig. 5b. Mineral composition, non-Laconian fabric: K8.

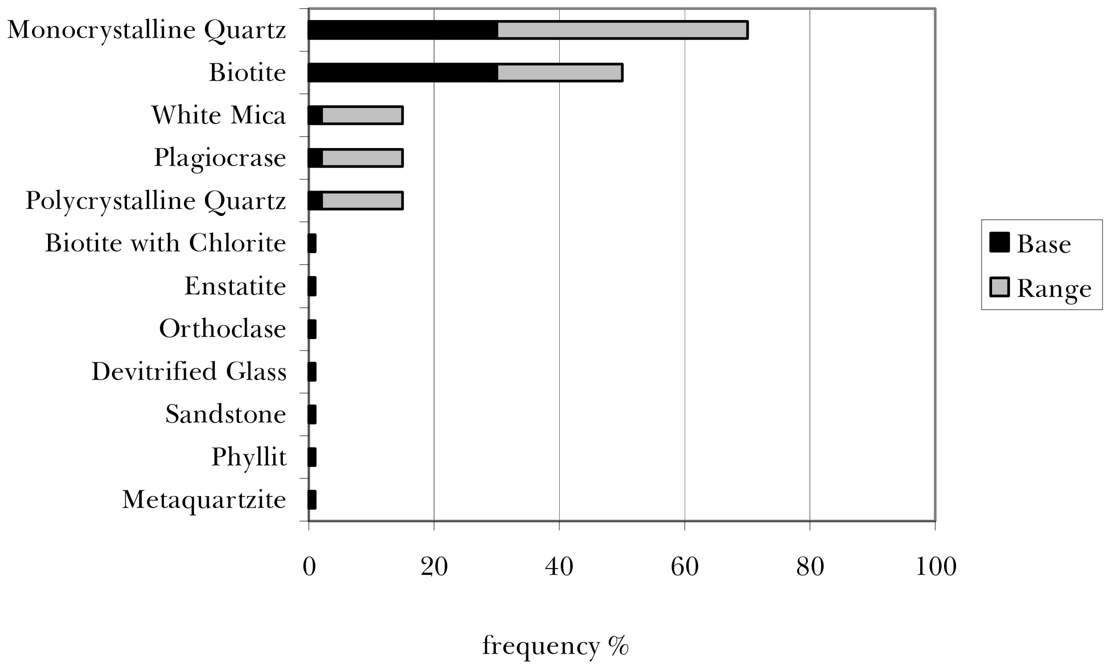


Fig. 6. Mineral composition, Attic SOS fabric: I2-5, I11.

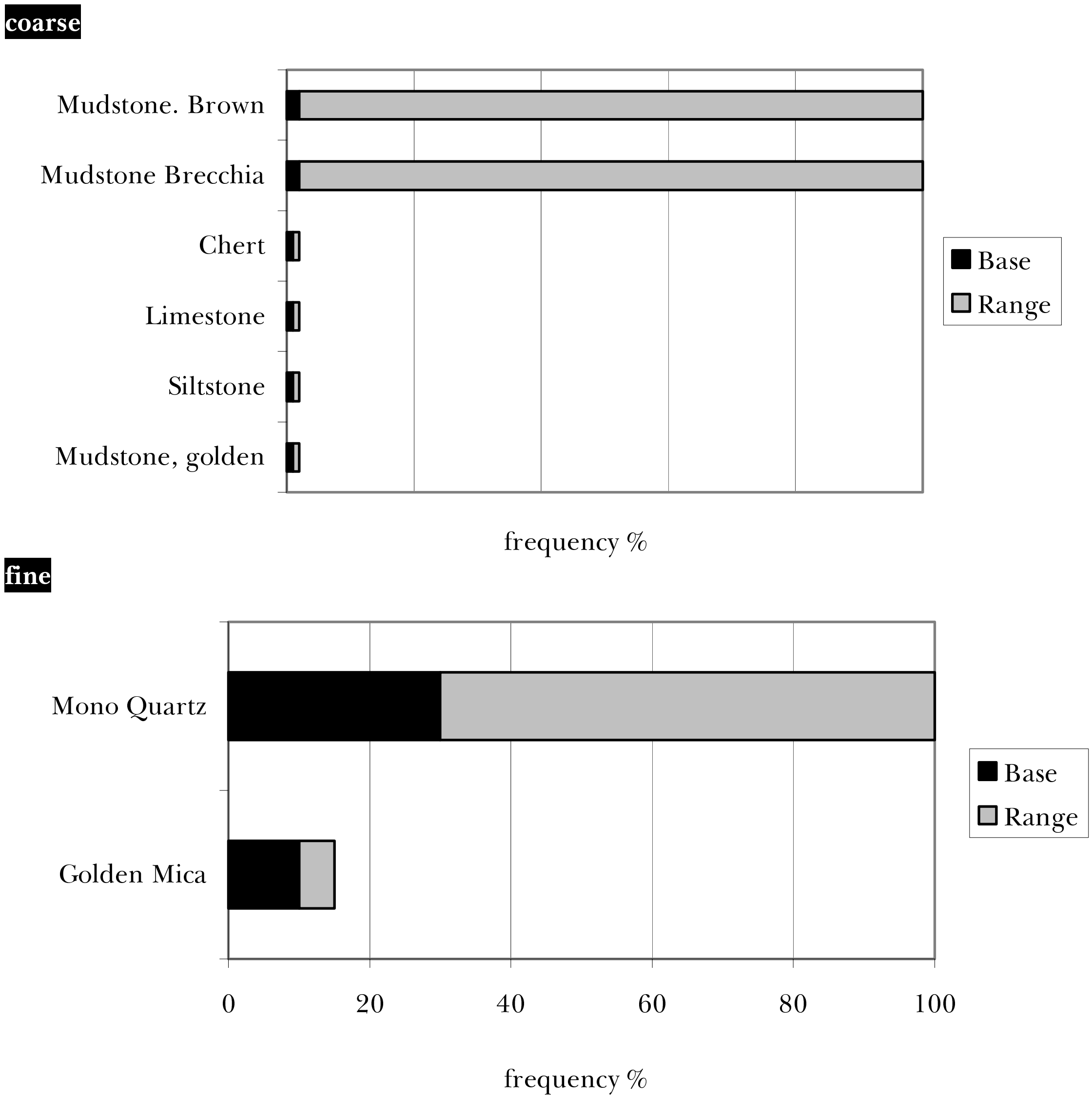


Fig. 7 *a*. Mineral composition, Corinthian A fabric: I6, I10.

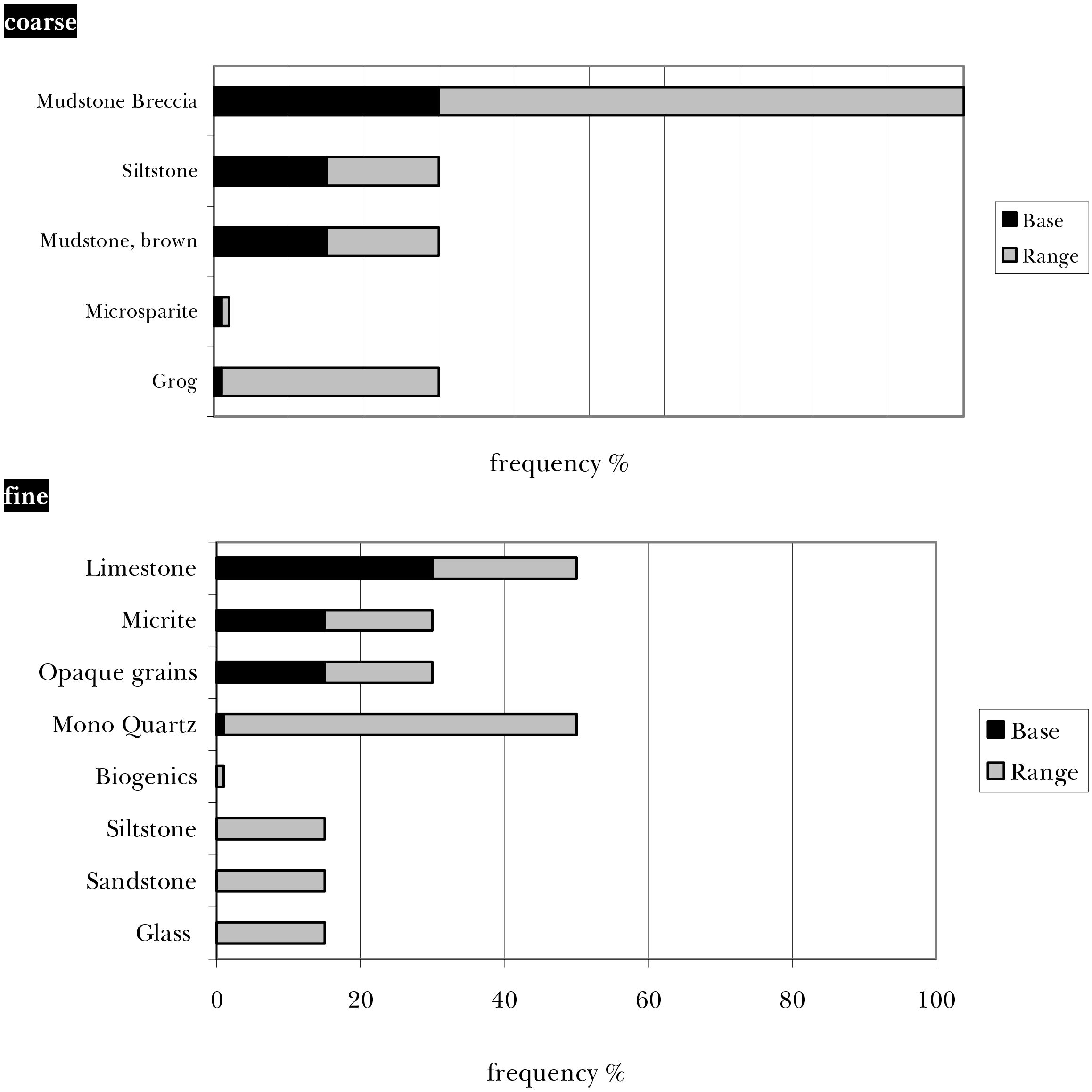


Fig. 7 *b*. Mineral composition, Corinthian A' fabric: I7-I9.