IX. Scientific Analysis of Pottery of the 6th to 4th Centuries from Aegina-Kolonna. Local Production and Imports

1. Research Questions. Sample Selection and Description According to Stylistic and Macroscopic Criteria

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1.1. Introduction

The scientific analysis of selected vessels of the 6th to the 4th centuries B.C. from Aegina-Kolonna has been carried out in collaboration with the Fitch Laboratory of the British School at Athens under the direction of Evangelia Kiriatzi. The aims of this project are, on the one hand, the identification and characterisation of local pottery production, and on the other hand, the definition of imports and the investigation of so far unidentifiable fabrics. At present, the pottery production on Aegina in the Archaic and Classical periods has hardly been explored. From the contexts presented in this volume, there are several fabrics of presumed local origin. Furthermore, a number of vessels are supposed to be imported on the basis of stylistic and/or macroscopic criteria. Often these are well known fabrics, like that of the Attic black-glazed pottery, some Corinthian fabrics or the amphorae associated with Chios and Lesbos. In other cases, the places of origin cannot be determined or can only be assumed. The imported pottery comprises mainly tableware or transport vessels, whereas only a very small part of the cooking vessels found at Kolonna seems to be imported.[439]

The selection of the samples CKOL 1–140 (Table 2) was primarily based on groups formed with macroscopically defined fabric characteristics. In other cases, it was mainly the stylistic associations among pots that raised questions of common or different origin. The analysis of several samples from each group aims to cover any internal variation, either in terms of fabric composition or in technology. For the creation of the macroscopic groups (CMG; see Table 1)[440] the following features of the fired unsliped sherd were taken into consideration: quality, hardness and colour of the surface, quality, texture and colour of the fresh break as well as frequency and types of the inclusions on the surface and break as they can be observed with the naked eye or with a hand-lens (10× magnification).[441] The inclusions were described on the basis of common criteria like colour, brightness, size and shape. Geological terms were not used, in order to avoid misidentifications. A macroscopic group was defined when certain characteristics of a fabric could be observed on several samples. The fabrics of individual samples for which no macroscopic group was defined were described in the same way. The scientific analysis of well known fabrics, like that of the Attic black-glazed pottery or certain Corinthian fabrics, is intended particularly to produce new reference data and to compare them with fabrics of

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[439] Similarly Gauss and Kiriatzi 2011, 252 argued for the Middle Bronze age that numerous vessels from different parts of Greece were imported to Kolonna, but among those no cooking vessels.

[440] The short names 'CMG' for the macroscopic groups and 'CKOL' for the samples used in this volume aim to differentiate them from the macroscopic groups 'MG' defined, and the samples 'KOL' analysed, by Gauss and Kiriatzi 2011 for the prehistoric pottery from Kolonna.

[441] The macroscopic description of the fabric (*'Scherbentyp'*; for a definition of this term s. Schneider 1989, 10; Gassner 2003, 26f.; Orton *et al.* 1993, 67; see also above note 16) follows basically the guidelines established by Sanders 1999, 477f.: the feel of the surface is therefore described as smooth/glatt, greasy/seifig, powdery/kreidig, harsh/rau and rough/grob. The hardness is described as very soft/sehr weich, soft/weich, medium-hard/mittelhart, hard/hart and very hard/sehr hart. The appearance of the break is described as smooth/glatt, granular/körnig, hackly/grobkörnig, laminar/schiefrig, conchoidal/facettiert. The frequency of the inclusions is estimated as rare/sehr wenig, few/wenig, frequent/häufig, common/sehr häufig, abundant/reichlich, their size as fine/fein, small/klein, medium/mittelgroß, large/groß, very large/sehr groß. The shape of the inclusions is described as spherical/sphärisch, tabular/mäßig länglich and platy/länglich, their outline as rounded/gerundet, sub-rounded/kantig gerundet and angular/kantig. For the colour values Munsell Soil Color Charts (reprinted edition 1994) was used in natural light.

unidentifiable origin, in order to see similarities or dissimilarities. However, the focus of our analysis lies on the characterisation of the local production. Most of the samples come from well stratified contexts, mostly dated within the 5th century. This offers the opportunity to observe chronological differences in shape as well as in fabric within each group. Furthermore, some additional samples from the so-called Westkomplex in Aegina-Kolonna (Abb. 1) were included in order to comprehend later periods.[442]

Section 1 of this chapter describes the stylistic and macroscopic criteria of the sample selection as well as the research questions. Section 2 presents the results of the petrographic and chemical analysis and discusses them in connection with the research questions raised in section 1. Section 3 summarizes the most important results of both studies. Profile drawings of all the analysed pieces are presented on plates 51–71 in the same sequence as discussed in the following sections. Plates 116–122 show photos of the analysed pieces from the 'Westkomplex'; for photos of the samples found in the other contexts see plates 72–115. Unless otherwise stated all dating is B.C.

Macroscopic group	Samples (CKOL)	Section in text	Presumed origin based on macroscopic and/or stylistic criteria
CMG 1	80–83. 85. 87–93. 96. 98–103. 106–112. 114–127. 129–140 84?	1.2.2	Aegina
CMG 2	27–29	1.2.3	Aegina
CMG 3	23–25. 33–36. 38–42 37? 43?	1.2.4	Aegina
CMG 4	31. 32	1.2.5	Aegina
CMG 5	1–4. 6. 7	1.3.1	Attica
	5. 8–16	1.3.2	'singles'; imports of unidentifiable origin
CMG 6	17–20 26?	1.3.3	Laconia
CMG 7	21. 22	1.3.4	Laconia?
	44–46. 71	1.3.5.1	'singles'; East Aegean
CMG 8	68–70	1.3.5.2	Chios
CMG 9	72–74	1.3.5.3	Lesbos
	75–77	1.3.6	'singles'; imports of unidentifiable origin
CMG 10a	47–49	1.3.7.1	Corinth
CMG 10b	50–53. 61	1.3.7.1	Corinth
CMG 11	not sampled	1.3.7.1	Corinth
CMG 12	60	1.3.7.2	Corinth
CMG 13	54–59	1.3.7.3	imports of unidentifiable origin
CMG 14	64. 65. 67	1.3.8.1	Mende
	62. 63. 66	1.3.8.2	loners; North Aegean
CMG 15	78. 79	1.3.8.3	North Aegean
	30	1.3.9	'single'; import of unidentifiable origin
CMG 16	94	1.3.10.1	Attica
CMG 17	113. 128	1.3.10.2	Attica
CMG 18	95. 97	1.3.10.3	import; Corinth?
	86. 105	1.3.10.4	'singles'; imports of unidentifiable origin
	104	1.3.10.4	import; Asia Minor or southern Levant?

Table 1 Summary table of macroscopic groups, including samples, section in text and presumed origin

[442] For the actual excavations in the so-called Westkomplex see the current preliminary reports since *ÖJh* 72, 2003.

Samples (CKOL)	Date	Class	Shape	Macroscopic Group (CMG)
1	ca. 480/70	fine ware	salt cellar	CMG 5
2	context ca. 480/70	fine ware	bowl	CMG 5
3	context ca. 430/20	fine ware	jug	CMG 5
4	ca. 430/20	fine ware	skyphos	CMG 5
5	context late 3rd/early 4th qu. 5th c.	fine ware	jug	–
6	mid 4th c.	fine ware	skyphos	CMG 5
7	2nd qu. 4th c.	fine ware	kantharos	CMG 5
8	context late 1st/early 2nd qu. 5th c.	fine ware	jug	Grey fabric
9	context late 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
10	context late 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
11	context late 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
12	context late 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
13	context 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
14	context 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
15	context 3rd/early 4th qu. 5th c.	fine ware	jug	Grey fabric
16	context ca. mid/early 3rd qu. 5th c.	fine ware	jug	Grey fabric
17	1st half 5th c.	fine ware	krater	CMG 6
18	ca. 3rd qu. 6th c.	fine ware	jug	CMG 6
19	2nd half 6th c.	fine ware	jug	CMG 6
20	context late 1st/early 2nd qu. 5th c.	fine ware	jug	CMG 6
21	context 3rd/early 4th qu. 5th. c.	fine ware	bowl, one-handle	CMG 7
22	context 3rd/early 4th qu. 5th c.	fine ware	bowl, one-handle	CMG 7
23	context 4th qu. 4th c. or ca. 300	fine ware	kantharos	CMG 3
24	context 4th qu. 4th c. or ca. 300	fine ware	kantharos	CMG 3
25	context 4th qu. 4th c. or ca. 300	fine ware	bowl	CMG 3
26	context late 1st/early 2nd qu. 5th c.	fine ware	jug	CMG 6?
27	ca. 440/30	fine ware	jug	CMG 2
28	context 3rd qu. 5th c.	fine ware	askos	CMG 2
29	ca. 440/30	fine ware	amphoriskos	CMG 2
30	context 3rd/early 4th qu. 5th c.	coarse ware	askos	–
31	context late 1st/early 2nd qu. 5th c.	coarse ware	amphoriskos	CMG 4
32	context late 1st/early 2nd qu. 5th c.	coarse ware	jug or amphoriskos	CMG 4
33	context late 1st/early 2nd qu. 5th c.	coarse ware	jug	CMG 3
34	context 3rd/early 4th qu. 5th c.	coarse ware	askos	CMG 3
35	context 5th c.	coarse ware	mortarium	CMG 3
36	context mid/early 3rd qu. 5th c.	coarse ware	mortarium	CMG 3
37	context late 1st/early 2nd qu. 5th c.	coarse ware	mortarium	CMG 3?
38	context mixed	coarse ware	mortarium	CMG 3
39	context 3rd/early 4th qu. 5th c.	coarse ware	mortarium	CMG 3
40	context late 3rd/early 4th qu. 5th c.	coarse ware	mortarium	CMG 3
41	ca. 4th qu. 4th c.	fine ware	bowl	CMG 3
42	context 1st half 5th c.	coarse ware	jug	CMG 3
43	context 4th qu. 4th c. or ca. 300	fine ware	bowl	CMG 3?
44	context late 3rd/early 4th qu. 5th c.	fine ware	amphoriskos	–
45	context late 3rd/early 4th qu. 5th c.	fine ware	amphoriskos	–
46	3rd qu. 5th c.	fine ware	amphoriskos	–
47	3rd/early 4th qu. 5th c.	fine ware	lekythos	CMG 10a
48	context late 1st/early 2nd qu. 5th c.	fine ware	jug	CMG 10a
49	late 3rd qu. 5th c.	fine ware	bowl, one-handle	CMG 10a
50	context 2nd/early 3rd qu. 5th c.	coarse ware	perirrhanterion	CMG 10b
51	context 2nd/early 3rd qu. 5th c.	coarse ware	perirrhanterion	CMG 10b
52	context 2nd/3rd qu. 5th c.	coarse ware	storage vessel	CMG 10b
53	context ca. 430/20	coarse ware	storage vessel	CMG 10b
54	1st qu. 5th c.	coarse ware	transport amphora	CMG 13

Samples (CKOL)	Date	Class	Shape	Macroscopic Group (CMG)
55	mid/3rd qu. 5th c.	coarse ware	transport amphora	CMG 13
56	mid/3rd qu. 5th c.	coarse ware	transport amphora	CMG 13
57	late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	CMG 13
58	ca. mid 5th c.	coarse ware	transport amphora	CMG 13
59	ca. mid 5th c.	coarse ware	transport amphora	CMG 13
60	late 3rd/4th qu. 5th c.	coarse ware	transport amphora	CMG 12
61	context late 1st/early 2nd qu. 5th c.	coarse ware	transport amphora	CMG 10b
62	context late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	–
63	context late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	–
64	ca. 440/30	coarse ware	transport amphora	CMG 14
65	ca. 440/30	coarse ware	transport amphora	CMG 14
66	context ca. 430/20	coarse ware	transport amphora	–
67	ca. 440/20	coarse ware	transport amphora	CMG 14
68	ca. 450	coarse ware	transport amphora	CMG 8
69	towards 440	coarse ware	transport amphora	CMG 8
70	context ca. 470/60	coarse ware	transport amphora	CMG 8
71	context 3rd qu. 5th c.	coarse ware	transport amphora	–
72	late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	CMG 9
73	late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	CMG 9
74	late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	CMG 9
75	3rd qu. 5th c.	coarse ware	transport amphora	–
76	context 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	–
77	context 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	–
78	context late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	CMG 15
79	context late 3rd/early 4th qu. 5th c.	coarse ware	transport amphora	CMG 15
80	mid/3rd qu. 6th c.	cooking ware	chytra, plain	CMG 1
81	context late 1st/early 2nd qu. 5th c.	cooking ware	chytra, plain	CMG 1
82	context 3rd/early 4th qu. 5th c.	cooking ware	chytra, plain	CMG 1
83	context late 3rd/early 4th qu. 5th c.	cooking ware	chytra, plain	CMG 1
84	context 3rd/early 4th qu. 5th c.	cooking ware	chytra, plain	CMG 1?
85	context late 4th c. to 1st half 2nd c.	cooking ware	chytra lidded	CMG 1
86	context advanced 4th to 3rd c.	cooking ware	chytra lidded	–
87	context 1st half 4th c.	cooking ware	chytra lidded	CMG 1
88	context late 1st/early 2nd qu. 5th c.	cooking ware	jug	CMG 1
89	context 3rd qu. 5th c.	cooking ware	jug	CMG 1
90	context late 1st/early 2nd qu. 5th c.	cooking ware	jug	CMG 1
91	context late 1st/early 2nd qu. 5th c.	cooking ware	jug	CMG 1
92	context late 3rd/early 4th qu. 5th c.	cooking ware	jug	CMG 1
93	context 3rd qu. 5th c.	cooking ware	jug	CMG 1
94	context late 1st/early 2nd qu. 5th c.	cooking ware	hydria	CMG 16
95	context ca. 430/20	cooking ware	jug	CMG 18
96	context 3rd/early 4th qu. 5th c.	cooking ware	jug	CMG 1
97	context 3rd/early 4th qu. 5th c.	cooking ware	jug	CMG 18
98	context late 3rd/early 4th qu. 5th c.	cooking ware	amphoriskos	CMG 1
99	context late 3rd/early 4th qu. 5th c.	cooking ware	amphoriskos	CMG 1
100	context late 3rd/early 4th qu. 5th c.	cooking ware	amphoriskos	CMG 1
101	3rd qu. 5th c.	cooking ware	lopas	CMG 1
102	3rd qu. 5th c.	cooking ware	chytra lidded	CMG 1
103	mid to early 3rd qu. 4th c.	cooking ware	lopas	CMG 1
104	1st half 2nd c.	cooking ware	lopas	–
105	1st third 3rd c.	cooking ware	lopas	–
106	mid to early 3rd qu. 4th c.	cooking ware	lopas	CMG 1
107	context late 1st/early 2nd qu. 5th c.	cooking ware	bowl	CMG 1
108	context 3rd/early 4th qu. 5th c.	cooking ware	bowl	CMG 1

Samples (CKOL)	Date	Class	Shape	Macroscopic Group (CMG)
109	context 2nd half 5th c.	cooking ware	bowl	CMG 1
110	context ca. 430/20	cooking ware	bowl	CMG 1
111	context ca. 460/30	cooking ware	bowl	CMG 1
112	context mixed	cooking ware	bowl	CMG 1
113	context 4th qu. 4th c.	cooking ware	lid	CMG 17
114	context mainly 3rd qu. 5th c.	cooking ware	plate	CMG 1
115	context 3rd/early 4th qu. 5th c.	cooking ware	plate	CMG 1
116	context 2nd half 5th c.	cooking ware	plate	CMG 1
117	context ca. 460/30	cooking ware	plate	CMG 1
118	context mainly 3rd qu. 5th c.	cooking ware	plate	CMG 1
119	context late 3rd/early 4th qu. 5th c.	cooking ware	eschara	CMG 1
120	context late 6th/early 5th c. to 3rd qu. 5th c.	cooking ware	eschara	CMG 1
121	context mainly 3rd qu. 5th c.	cooking ware	eschara	CMG 1
122	5th c.	cooking ware	bowl	CMG 1
123	context ca. 460/30	cooking ware	eschara	CMG 1
124	context 2nd half 5th c.	cooking ware	lid	CMG 1
125	context ca. 430/20	cooking ware	lid	CMG 1
126	context 3rd/early 4th qu. 5th c.	cooking ware	portable hearth	CMG 1
127	context ca. 460/30	cooking ware	storage vessel	CMG 1
128	context mixed	cooking ware	cauldron	CMG 17
129	context 2nd/early 3rd qu. 5th c.	cooking ware	storage vessel	CMG 1
130	context 3rd/early 4th qu. 5th c.	cooking ware	sieve	CMG 1
131	context late 6th/early 5th c. to 3rd qu. 5th c.	cooking ware	portable hearth	CMG 1
132	context advanced 3rd/early 4th qu. 5th c.	cooking ware	portable hearth	CMG 1
133	context ca. 430/20	cooking ware	portable hearth	CMG 1
134	context mainly mid/early 4th qu. 5th c.	cooking ware	grill	CMG 1
135	context ca. 430/20	cooking ware	portable hearth	CMG 1
136	context 2nd/early 3rd qu. 5th c.	cooking ware	lamp	CMG 1
137	context 3rd/early 4th qu. 5th c.	cooking ware	lamp	CMG 1
138	probably 5th c.	cooking ware	lamp	CMG 1
139	context ca. 460/30	cooking ware	lamp	CMG 1
140	2nd half 4th c.	cooking ware	waster	CMG 1

Table 2 Summary table of analysed samples with date, class, shape and macroscopic group

1.2. Pottery of presumed local origin

1.2.1. General remarks on the study of the pottery production on Aegina

While the extensive production and circulation of Aeginetan pottery in prehistoric times are well attested and studied,[443] our knowledge about historical times has up to now been quite scarce.[444] It is generally assumed that in the historical period Aegina did not produce painted fine ware of its own, but exclusively imported it.[445] The large amount of Attic black-glazed pottery that was brought to Aegina without any obvious interruption from the 6th century and throughout the Classical period supports the assumption that the island itself produced very little fine ware or none at all.[446] Furthermore, M. Farnsworth,

[443] KIRIATZI *et al.* 1999; GAUSS and KIRIATZI 2011.

[444] FIGUEIRA 1981, 232f. for example supposes that "Aeginetan pottery was other people's pots sold by Aeginetans", as the written sources do not associate a certain pottery product with Aegina. In contrast J. WEILHARTNER *in this volume, Anhang II* emphasizes that information about potters and workshops is generally hard to find in the ancient literature.

[445] See among others FELTEN 1982a, 19; JAROSCH-REINHOLDT 2009, 81; WALTER-KARYDI 1987; WALTER-KARYDI 1997 as a reply to the suggestion of MORRIS 1984 that Middle Protoattic pottery was produced on Aegina; JENNINGS 1990, 72f. also supposes a local production of painted fine ware.

[446] See also chapter XI.

based on experimental replications, argued that the clays available on Aegina are not appropriate for the production of a glossy slip.[447] The material presented in this volume did not provide evidence for a large-scale local production of pictorial or black-glazed pottery, either.[448]

Ancient sources referring to Aegina as a 'pot-seller' and mentioning 'local clay vessels' have always led to the assumption that a local production of pottery for every day use existed on Aegina.[449] Therefore the few previously undertaken scientific analyses of the local production in the historical periods mainly focused on the so-called cooking pottery.[450] The first petrographic analysis was published in 1964 by M. Farnsworth: in her studies of cooking vessels of the 6th to 4th centuries found at the Athenian Agora, she isolated a characteristic fabric that she distinguished from the Attic products and associated it with Aegina.[451] Farnsworth's attribution to Aegina is, on one hand, based on the written sources mentioned above, while on the other hand, on the known geology of the island, whose southern and central parts consist of volcanic rocks.[452] Following Farnsworth's results, J. Hayes identified Aeginetan cooking pots in Tocra, North Africa.[453] Petrographic and chemical analyses suggested the presence of Aeginetan cooking vessels also in Euesperides in the Cyrenaica[454] and perhaps in Thorikos.[455] Until now, however, almost no cooking pottery has been analysed from Aegina itself.[456]

The contemporary potters of Aegina use primarily fine buff clay.[457] This buff clay was also used, as recent studies demonstrate, in prehistoric times.[458] Previous research however did not find any evidence for the use of this clay in the historical periods.[459]

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447 Farnsworth 1970, 18f.

448 For the sporadic attempts to imitate Attic black glaze see below section IX.1.2.4 and 2.2.3 for **CKOL 23. 24** and section IX.3.

449 For a summary and interpretation of the sources see J. Weilhartner *Anhang II*, especially for the reading χυτρόπωλιν and the interpretation as 'pot-seller' in contrast to a reading χυτρόπολιν and an interpretation as 'town that produces cooking pots' that was sometimes put forth in recent studies. Already H. Thiersch in: Furtwängler 1906, 441 mentions these ancient sources in his discussion about the local coarse wares. For the name χύτρα/χύτρις meaning a clay vessel for everyday use as drinking vessel and cooking pot see J. Weilhartner *Anhang II*.

450 See also Fillieres *et al.* 1983, 55–69 for the analysis of Classical and Hellenistic terracottas from Athens that were assumed to be Aeginetan because of the similarity with clay samples from Mesagros/Aegina. For the terms 'cooking pottery' and 'cooking ware' see below chapter X.1; for an overview on scientific research on Aeginetan ceramics see Gauss and Kiriatzi 2011, 23–27.

451 Farnsworth 1964, 222–224. 226f. no. 2. 11 pl. 66. 67. Her no. 2 is a plain chytra dated to the 6th century: preserved are two joining rim fragments and a non-joining wall fragment presumably from the same vessel; the interior of the wall fragment is carefully scraped (*verstrichen*), and the clearly wheel-made upper part was added later to the body. No. 11 is the rim fragment of a lopas; the rim-shoulder-part is wheel-made, while the interior and exterior surfaces below do not show any tool-marks. The lopas no. 11 was dated by Farnsworth to the late 5th c. and comes according to her notes from a context dated by Sparkes and Talcott 1970, 384 around 425–400 B.C. The two fragments from the Athenian Agora identified by Farnsworth as Aeginetan match according to the macroscopic analysis with our definition of the Aeginetan cooking ware. For Farnsworth's studies of Aeginetan cooking ware see also Jones 1986, 167 and Gauss and Kiriatzi 2011, 23.

452 For the geology of Aegina see section IX.2.2.1.

453 See fn. 935.

454 See fn. 935.

455 In Thorikos De Paepe 1979, 68–71. 86 identified within the coarse ware of the 6th to 4th c. a petrological group (group A) that was clearly not local and whose volcanic inclusions were consistent with the western section of the so-called Cycladic Volcanic Arc extending from Methana, Aegina and Poros to Melos and Thera. Although De Paepe observed that the volcanic inclusions of the pottery from Thorikos have common characteristics with those found in Aeginetan pottery analysed by Farnsworth 1964, he did not consider Aegina as the definite source. Furthermore De Paepe 1979, 79 suggested that not the complete vessels but only raw materials were imported; for that see also Jones 1986, 161–164. 724–727 and Gauss and Kiriatzi 2011, 23. Jones 1986, 725–727 assumes an Aeginetan origin of the majority of the cooking pots from Thorikos.

456 See Jones 1986, 724 for NAA of a chytra and two lopades found in Aegina.

457 According to Farnsworth 1964, 223 this light clay is in an unfired condition very similar to the clay from Corinth and the Argolis; for this see also Jones 1986, 165. 855; Hampe and Winter 1965, 137f.; Farnsworth *et al.* 1977, 459; for the most recent studies about clay deposits in Aegina and about the raw materials used by today's potters see Kiriatzi *et al.* 2011, 71–92.

458 Kiriatzi *et al.* 2011, 131–139.

459 See also the discussion on Hellenistic 'Halsringkannen' made of a fine light and slightly porous fabric; for these jugs an Aeginetan provenience was repeatedly presumed: Thompson 1934, 465 and Braun 1970, 166 for jugs from Athens; Smetana-Scherrer 1982, 85f. no. 675–677 pl. 54 for jugs from Aegina. However, recent scientific analysis has probably excluded an Aeginetan origin of these jugs; for this, see Rotroff 2006, 29–32, especially 31, who considers an origin from the further vicinity of Corinth.

The deposits presented in this volume yielded several vessels of different fabrics for which macroscopic analysis pointed towards a local origin. This applies primarily to unpainted vessels made of a characteristic reddish-brown coarse fabric, our CMG 1, mainly used for cooking pottery and water containers. The percentage of vessels made of this fabric is very high in all deposits, so it was obvious to assume an Aeginetan origin for them from the very beginning. The results of our macroscopic analysis of the local cooking fabric correspond to M. Farnsworth's definition of the Aeginetan cooking pottery. A local origin was also assumed for several vessels of different shapes made of yellowish buff, fine or granular fabrics, our macroscopic groups CMG 2, CMG 3 and CMG 4 that recall local products of the prehistoric and modern period. Altogether, even if the production of pottery made of buff fabrics can be confirmed at least from the late 1st quarter of the 5th century until the late 4th century, it obviously never reached large scale during this period.

1.2.2. Macroscopic Group 1: Red coarse 'cooking' fabric[460]

The following samples were selected to represent the macroscopic group CMG 1: **CKOL 80–83. 85. 87–93. 96. 98–103. 106–112. 114–127. 129–140** and possibly **CKOL 84**. These samples are made of a characteristic reddish-brown to brown[461] granular fabric that was used for the majority of the cooking pottery found at Kolonna. The usually medium-hard surface can be slightly greasy, when burnished or smoothed, or harsh at the unsmoothed undersides or interiors. It usually reveals frequent inclusions, namely frequent small to large flat golden and oblong black glittering inclusions, few and partly very large, white dull inclusions and frequent small to medium-large dark dull inclusions. The granular and rather poorly sorted break has frequent small to large whitish translucent inclusions, few medium-large to large black glittering inclusions, few to frequent large dark dull inclusions and frequent medium-large to large white dull inclusions.[462]

The high percentage of vessels made of this fabric, the range of shapes associated with it and characteristics of the manufacturing techniques have always suggested an Aeginetan origin.[463] It arises that this fabric was mainly used for vessels associated with boiling, frying and heating or with containing liquids. Fire-resistance and water-impermeability therefore seem to be qualities that can be well fulfilled by the Aeginetan cooking fabric.[464]

The samples belong mainly to the decades from the late 1st/early 2nd to the late 3rd/early 4th quarters of the 5th c. and mark the heyday of the local production of cooking vessels.[465] Characteristic shapes of Aeginetan cooking ware of this period are round-bottomed plain chytrai with a vertical handle (**CKOL 80–84** Taf. 51. 75. 84. 100. 106), lidded chytrai (**CKOL 102** Taf. 51. 116), jugs without foot or with a low base (**CKOL 88–93. 96** Taf. 55. 76. 83. 101. 108. 109), amphoriskoi (**CKOL 98–100** Taf. 56. 85), lopades (**CKOL 101** Taf. 52. 100), bowls and round-bottomed pans (**CKOL 107–112. 122** Taf. 52. 53. 76. 101. 116. 117), plates (**CKOL 114–118** Taf. 54. 101. 116), escharai (**CKOL 119–121. 123** Taf. 53. 84. 117), lids (**CKOL 124. 125** Taf. 52. 117), storage bins (**CKOL 127. 129** Taf. 56. 117), sieves (**CKOL 130** Taf. 52. 100), hearths and grills (**CKOL 126. 131–135** Taf. 54. 101. 117. 118) as well as lamps (**CKOL 136–139** Taf. 56. 102. 118).[466] The chytra **CKOL 80** can be dated slightly earlier on the basis of its style, around the mid or third quarter of the 6th c.

460 For the scientific analysis of these samples, see below section IX.2.2.2.

461 Surface mostly 7.5YR 5/3–6 (brown to strong brown) to 5YR 5/4–6 (reddish brown to yellowish red); break mostly 5YR 4/3–5/6 (reddish brown to yellowish red).

462 Already Farnsworth 1964, 222–224. 226f. has mentioned as most significant characteristics of her 'Aeginetan' fabric the existence of fresh biotite, sharp-cornered feldspars and volcanic glass as well as the absence of muscovite and quartz. Whereas Farnsworth 1964, 224 assumed that "the temper in the Aegina cooking ware is not an integral part of the clay itself but is crushed volcanic rock", Kiriatzi *et al.* 2011, 133f. suggest that the fragments of volcanic rock are products of a natural weathering process.

463 For the range of shapes and the manufacturing techniques see below chapter X with a more detailed discussion of the characteristic techniques used during the whole of the 6th and 5th centuries: these are the burnishing (*Streifenpolitur*) of the exterior surface and the scraping (*Verstreichen*) of the interior lower part of the body.

464 For a discussion on the qualities of the Aeginetan cooking ware, on possible advantages of its fabric, production techniques and shapes see below chapter X.1 and Gauss *et al.* forthc.

465 For this see also below chapter X.1.

466 For **CKOL 81. 88. 90. 91. 107** see chapter II.3.8 **Kat. 50. 53. 61. 56. 64**; for **CKOL 83. 92. 98–100. 119** see chapter III.3.5 **Kat. 132. 114. 131. 129. 130. 138**; for **CKOL 82. 96. 101. 108. 115. 126. 130** see chapter VI.2.7 **Kat. 364. 381. 371. 387. 391. 395. 386**; for **CKOL 137** see chapter VI.2.9 **Kat. 404**; for **CKOL 80** see chapter VII.2.6 **Kat. 463**; for **CKOL 89. 93** see chapter VIII.2.2 for **Kat. 478. 474**; for **CKOL 102** see chapter X.4.2.

According to macroscopic analysis the fabric used within that period appears basically homogenous. For certain thicker-walled shapes like escharai or plates the fabric seems to be coarser. A possible chronological development might be traceable with the older chytra **CKOL 80**. This sample has on its surface clearly more and larger black glittering and golden inclusions than the chytrai of the 5th c.[467]

The chytra **CKOL 84** is slightly different in comparison to other contemporary vessels of this macroscopic group; therefore its attribution to CMG 1 was thought to be ambigous. Indeed the existence of golden inclusions at the surface and black glittering ones in the break as well as the vessel shape, its manufacturing technique with the interior of the body being scraped and the upper part being wheel-made, and the burnishing of the exterior surface indicate an Aeginetan origin. The number of these characteristic inclusions, however, is very low, the fabric is unusually dense, the surface very hard fired and the vessel's wall is exceptionally thin. Moreover, impressions of a rounded tool are visible at the interior of the lower body underneath the striation marks, and this is quite an unusual feature on Aeginetan cooking pots.[468] Probably an Aeginetan potter experimented with a different version of the usual cooking-ware fabric and with new techniques to make the vessel's wall harder and denser.

Some of the shapes popular in the 5th century continued to be produced in the 4th century, like lidded chytrai (**CKOL 85. 87. 140** Taf. 51. 52. 113. 116) and lopades (**CKOL 103. 106** Taf. 52. 116).[469] Other features change, as burnishing now becomes very rare (**CKOL 106**). The surface is left simply smoothed without the former slightly greasy layer of fine clay particles, and it is usually very hard fired. The rare presence of golden and black glittering inclusions suggests that the fabric used now is tempered more lightly with volcanic rock (**CKOL 85. 87. 103**).

1.2.3. Macroscopic Group 2: Fine buff fabric[470]

The oinochoe **CKOL 27**, the askos **CKOL 28** and the amphoriskos **CKOL 29** (all Taf. 57. 107), all from the 3rd quarter of the 5th century, are made of a fine yellowish-brown[471] fabric with very few inclusions seen on the powdery, very soft to soft surface: some fine mica (**CKOL 27**), few large golden and black glittering inclusions (**CKOL 29**) and few small reddish-brown and dark dull inclusions (**CKOL 28**). The smooth, dense and sometimes slightly porous break has few fine mica and few small brick-red inclusions. Additionally, few small white inclusions (**CKOL 29**) and rare small dark dull ones (**CKOL 28**) were identified. A Corinthian origin for these three vessels can be excluded with some certainty due to the soft quality of the fabric and the golden and black glittering inclusions of **CKOL 27** and **CKOL 29**. It therefore seems likely to assume that **CKOL 27–29** are local products, showing also stylistic elements associated both with the Attic as well as the Corinthian potters' traditions.[472]

1.2.4. Macroscopic Group 3: Buff, slightly porous medium-coarse fabric[473]

The macroscopic group 3 comprises unpainted, banded or solidly painted vessels of different shapes, made of a yellowish buff,[474] slightly porous fabric. The close similarities of this fabric with prehistoric vessels of supposed local origin suggest an Aeginetan provenance for CMG 3, too. Differences visible in the macroscopic analysis of some of these samples (**CKOL 37. 43**), however, might point to variations in the composition of this fabric or even to a different origin.

The fabric of **CKOL 23–25. 33–36. 38–42** appears quite homogeneous in the macroscopic analysis: the slightly powdery, soft to medium-hard surface is characterized by rare to few fine mica, rare large white dull, few to frequent small to large dark dull and, with the exception of **CKOL 33. 38**, also rare to few small to large golden and black glittering inclusions.

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[467] This is also true for the chytra **Kat. 464** (Taf. 43. 106) that is approximately contemporary with **Kat. 463/CKOL 80**, for the chytra **Kat. 485** (Taf. 48. 111) from ca. 1st half 7th c. and for the jug **Kat. 486** (Taf. 48. 112) from ca. 2nd half 6th c.

[468] See also chapter X.3.2.

[469] For lidded chytrai and lopades from the waster **FG 308/ CKOL 140** see below *Anhang* I.2; for **CKOL 85. 87** see below chapter X.4.2; for **CKOL 106** see below chapter X.4.3.

[470] For the scientific analysis of these samples see below section IX.2.2.3.

[471] Surface 2.5Y 7/3 (pale yellow) to 10YR 7/3–4 (very pale brown), rarely 7.5YR 7/6 (reddish yellow); break 2.5Y 7/3 (pale yellow) to 10YR 6/6 (brownish yellow) and 7/4 (very pale brown).

[472] For **CKOL 27–29** see chapter VIII.2.1 **Kat. 471–473**.

[473] For the scientific analysis of these samples see below section IX.2.2.3.

[474] Surface mainly 5Y 8/2–3, 2.5Y 7/3 and 2.5Y 8/2–3 (pale yellow) and rarely 5Y 7/2 (light grey); break mainly 2.5Y 8/2–4, 5Y 7/3–4 and 5Y 8/3–4 (pale yellow) and rarely with reddish overtones 7.5YR 7/6 (reddish yellow).

The surface of **CKOL 40** reveals also rare medium-large whitish translucent inclusions. At the slightly granular and porous break rare to frequent small to large black dull inclusions and rare to few large to very large white dull inclusions are visible, while also observed are, in the case of **CKOL 35. 36. 40. 42**, frequent small reddish inclusions, and of **CKOL 35** rare large whitish translucent inclusions. This fabric is found in the 1st and 2nd half of the 5th c. mainly with different closed shapes (**CKOL 33** Taf. 58. 73.[475] **CKOL 34** Taf. 57. 99.[476] **CKOL 42** Taf. 57. 119) and mortaria (**CKOL 35. 36. 38–40** Taf. 58. 99. 119), and in the later 4th c. with drinking vessels (**CKOL 23–25. 41** Taf. 59. 119). The two kantharoi **CKOL 23. 24** are especially interesting as their black slip, which adheres badly, seems to imitate black glaze.[477] Together with the bowls **CKOL 25. 41**, they may suggest that local potters in the last quarter of the 4th or in the early 3rd century tried to slip vessels made of buff, slightly porous fabric.[478] The samples also, if proven to be Aeginetan, clearly show that the quality of raw materials available on Aegina for ceramic bodies was not appropriate to hold glazes.

The homogeneity in fabric of the mortaria **CKOL 35. 36. 38–40** (Taf. 58. 99. 119) is complemented by homogeneity in shape:[479] the thick rounded rim is demarcated from the wall only by a deep horizontal groove at the exterior. The straight exterior of the wide low ring foot or simple disc foot meets the wall in an angle. The shallow massive bowls seem to be mold-made.[480] The flat spout is made separately (**CKOL 40**). As known from other examples, the handles are usually cylindrical and ribbed. Surfaces are smoothed, and there is no grit applied to the interior of our samples.[481] At Kolonna such mortaria are presently found exclusively in deposits of the 2nd half of the 5th century, and here they appear much more often than other types of mortaria.[482] The specific shape is also known from other sites: two higher proportioned and thinner-walled mortaria found in deposits of the last quarter of the 6th and 1st quarter of the 5th c. at the Athenian Agora and in Eretria might be early examples of this type.[483] Close parallels to **CKOL 35. 36. 38–40** come from deposits dating mainly to the 2nd half of the 5th c. and to the 4th c., including examples from Athens,[484]

475 For **CKOL 33** see chapter II.3.5 **Kat. 42**.

476 For **CKOL 34** and generally for unpainted askoi of this shape see chapter VI.2.5 **Kat. 342**.

477 For the context of these vessels dated to the last quarter of the 4th century or around 300 B.C. see Felten *et al.* 2004, 118 with fn. 44 fig. 24. Archetypes for these two vessels might be the so-called Kabirenbecher from Boeotia or the late Classical/early Hellenistic Attic kantharoi that are derived from the 'Kabirenbecher': compare e.g. Heimberg 1982, 27f. 131 no. 126. 127 pl. 8 for glazed examples; Braun and Haevernick 1981, 58 no. 237 pl. 9, 8; 57f. no. 218 pl. 10, 6; 52 no. 189 pl. 11, 4; 51 no. 173 pl. 12, 1; see also Felten *et al.* 2004, 118 fn. 44; Rotroff 1997, 97–99. 103 for the derivation of the Attic Hellenistic kantharos with straight wall from the 'Kabirenbecher' and their influence on the 'baggy'-shaped kantharoi. **CKOL 23. 24** are different in their higher proportions, a more baggy-shaped form and a slimmer and less carefully profiled foot. **CKOL 23. 24** will be discussed in more detail elsewhere; I have to thank R. Smetana for numerous references concerning these two vessels. For practical experiments to create black glaze with Aeginetan clay see Farnsworth 1970, 18f.

478 For **CKOL 25. 41** see shallow and deep Echinus bowls of the last quarter and late 4th c., e.g. Rotroff 1997, 339–341 no. 974. 984. 994. 996 fig. 62. 63.

479 For a discussion of this type of mortarium ('heavy-rim mortaria') see recently Villing and Pemberton 2010, 590–594. 626. For the use and denotation of mortaria see Villing 2006, 34–37; Spataro and Villing 2009, 89; Villing and Pemberton 2010, 557–559. 602–624.

480 For the discussion of the manufacture of mortaria see Villing and Pemberton 2010, 565 with fn. 50.

481 For the absence of grit in every known example of this type see also Villing and Pemberton 2010, 566. 590.

482 For **CKOL 39** see chapter VI.2.5 **Kat. 348**; compare also a fragment found in Aphaia: H. Thiersch in: Furtwängler 1906, 457 no. 248 pl. 124, 3 below.

483 Athens, Agora: Sparkes and Talcott 1970, 222. 369 no. 1895 pl. 90 ("context 520–490"). According to our macroscopic analysis this mortarium might be made of the same fabric as **CKOL 35. 36. 38–40**; for this see also Villing and Pemberton 2010, 593 with fn. 111 fig. 20; Eretria: Huber 2003, Vol. 1, 67f.; Vol. 2, 44 no. V161 pl. 40. 112 ("context 1st qu. 5th c.").

484 Sparkes and Talcott 1970, 370 no. 1912 fig. 16 pl. 91 ("context ca. 450–425"); there the fabric is described as Corinthian 'tile fabric'. Our macroscopic analysis of this piece however showed that it is not made of 'tile fabric' but is in fabric as well as in shape very similar to the examples **CKOL 35. 36. 38–40** from Kolonna; for this see also Villing and Pemberton 2010, 591 with fn. 95; for the 'tile fabric' see fn. 553. Another mortarium of this type from the Athenian Agora has a rim decorated with stamped patterns and with additional grooves; according to our macroscopic analysis it seems also to be made of that buff and slightly porous fabric: Sparkes and Talcott 1970, 370 no. 1913 pl. 91 ("context 5th c."); for this see also Villing and Pemberton 2010, 591 with fn. 103. A mortarium from a context of the 4th qu. 5th c. at the Athenian Kerameikos is in our opinion also closely related in shape and fabric: Knigge 2005, 147 no. 276 pl. 81 fig. 48; for this see also Villing and Pemberton 2010, 591 with fn. 97.

Eretria,[485] Corinth,[486] from a shipwreck sunken close to Alonessos,[487] from Samos[488] and Naukratis.[489] Thus, the distribution points to the appearance of these mortaria mainly in the 2nd half of the 5th c. through the 1st half of the 4th c. and particularly in the wider surrounding of the Saronic Gulf. Some of the examples from the Athenian Agora are classified within the so-called 'sandy class' that includes mortaria of different shapes made of a "very light-weight pale buff clay, the texture approaching that of fine sand stone", and they are considered Corinthian.[490] However, a Corinthian origin of this type seems improbable: the majority of mortaria found in Corinth belong to other types and are made of the characteristic Corinthian 'tile fabric'.[491] The specific shape of **CKOL 35. 36. 38. 40** is rarely represented in Corinth, and the fabric of these samples does not correspond with any of the usual Corinthian fabrics.[492]

The mortarium **CKOL 37** (Taf. 58. 119) from a context of the late 1st/early 2nd quarter of the 5th c. is somewhat different from the samples just mentioned. The shape of the high foot, passing with a concave curve into the wall, as well as the finer and denser texture of the fabric are different from the samples discussed before and speak either for a variation of the same place of production or for a different origin.[493] The bowl **CKOL 43** (Taf. 59. 119) from a context of the late 4th c. also differs from the above discussed samples of CMG 3 by additional frequent, small to large, light red inclusions in the break; possibly this too speaks for a variation in fabric or for another, non-Aeginetan origin.

1.2.5. Macroscopic Group 4: Buff granular fabric[494]

The amphoriskos **CKOL 31** (Taf. 59. 73) and the fragment of another closed vessel **CKOL 32** (Taf. 59. 73), both from a context dated around 480/70, are made of the same buff[495] and granular fabric. Fine particles at the exterior form a slightly greasy medium-hard and, in both cases, burnished surface with frequent inclusions visible, namely few fine mica, frequent small black glittering and large golden inclusions as well as frequent large dark and few large white dull ones. The granular break reveals frequent small dark inclusions and few small white and medium-large black glittering ones. The obvious affinities of this fabric with the assumed local cooking ware CMG 1 as well as the burnishing common in both fabrics speak for an Aeginetan origin also for CMG 4.[496] Vessels of this fabric appear from time to time in contexts of the 5th c., although it never became very popular.

1.3. Pottery of presumed non-Aeginetan origin

1.3.1. Macroscopic Group 5: Fine reddish-yellow 'Attic' fabric[497]

The fabric, the quality of the black glaze and the well studied stylistic development make it quite clear that the plain vessels **CKOL 1–4. 6. 7** (Taf. 60. 72. 77. 120) are products of Attic workshops. The reddish-yel-

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485 I. Metzger in: Reber 1998, 193 no. 324 fig. 237 from a context of the late 5th c. to 3rd qu. 4th c.

486 Villing and Pemberton 2010, 590–594 fig. 21; as far as the context is known, the examples are dated to the 1st half 4th c. or come from deposits of the late 5th to 4th c.

487 Hadjidaki 1996, 577 no. 5 fig. 15; the shipwreck sank in the late 5th c.

488 Tölle-Kastenbein 1974, 120 no. Z128A from the filling of a cistern containing, besides some single sherds from the pre- and early Hellenistic periods, mainly finds from the 1st half of the 2nd c.

489 Villing 2006, 33f. no. 24 fig. 13; this example is different in a handle that is profiled by broad pearls. Villing and Pemberton 2010, 591 fn. 99. 100 mention further examples from Torone, Miletos, Klaros, Cyprus, Butrint, Sicily, southern Italy and Spain.

490 Sparkes and Talcott 1970, 369f. no. 1895. 1913; generally for the 'sandy class' see Sparkes and Talcott 1970, 37. 222. 223. 369f. no. 1895–1898. 1913 pl. 90–92 and Merker 2006, 18; Farnsworth 1970, 12 identified this fabric as Corinthian on the basis of thin-sections and assumed that they are "... molded from white Acrocorinthian clay, a clay much sandier to the feel than the regular clay used for the large pots, but having the regular Acrocorinth inclusions – feldspar, quartz, fine quartzite, fine schist, spotted shale and mica"; see ibidem 11: "... the fired Acrocorinth white clay which is buff with rosy overtones"; for this see also Sparkes and Talcott 1970, 37 with fn. 97; critical of the term 'sandy class' are Villing and Pemberton 2010, 591f.; see also Rotroff 2006, 31 who stresses the similarity of the fabric of the buff-coloured Hellenistic 'Halsringkannen' with that of the mortaria of the 'sandy class'; see above fn. 459 for Rotroff's assumption for an origin of these jugs in the wider surrounding of Corinth.

491 See recently Villing and Pemberton 2010, esp. 564. 602.

492 See also Villing and Pemberton 2010, 590–593. 602 for the examples found at Corinth.

493 Another mortarium of this kind from a context of the 4th quarter 5th c. at the Athenian Agora is supposed to be Attic: Sparkes and Talcott 1970, 371 no. 1919 pl. 91.

494 For the scientific analysis of these samples see below section IX.2.2.3.

495 Surface 2.5Y 7–8/3 (pale yellow); break 7.5YR 6–7/6 (reddish yellow).

496 For **CKOL 31. 32** see chapter II.3.5 **Kat. 39. 41**; see ibidem also for **Kat. 40**.

497 For the scientific analysis of these samples see below section IX.2.3.1.1.

low[498] fabric has a smooth hard surface with few inclusions of fine mica. The break is smooth with no visible or rare small white inclusions. Our samples can be dated by style and context to around 480/70 (**CKOL 1**. **2**),[499] around 430/20 (**CKOL 3**. **4**),[500] to the 2nd quarter of the 4th c. (**CKOL 7**)[501] and ca. mid 4th c. (**CKOL 6**).[502] According to the macroscopic analysis of these samples there is no remarkable change, neither in the character of the fabric, nor in the quality of the black glaze within this period of time.

1.3.2. Grey fabrics with a polished surface of unidentifiable origin[503]

The jugs **CKOL 8–16** (Taf. 60–62. 72. 78. 79. 98. 120) share the same kind of surface treatment and firing method. Due to the firing in a reduced atmosphere the surface has a medium- to dark-grey[504] hue, and the black slip on the exterior has a dull shine by polishing. Beyond these similarities, the macroscopic and stylistic analysis reveals also clear differences between the samples in question that point to a different origin for at least some of them; a common macroscopic group cannot therefore be established. The smooth to slightly greasy, more or less soft surface of all these samples reveals only few inclusions, namely frequent fine mica, rare very large white dull inclusions and in most cases rare large silver mica. The break is smooth, mostly quite dense with few large white dull and sometimes whitish translucent inclusions; it is entirely grey or, as **CKOL 8. 9. 12**, brown to reddish brown. The polished, more or less dense slip is usually smooth and solid respectively in the case of **CKOL 8. 9. 12** greasy and relatively soft. These differences within the samples are reflected only partly also by the vessels' style: the oinochoai **CKOL 9. 10. 11. 13. 14** are similar in the ovoid shape of their body, the flaring ring foot and, when preserved, the handle with a central ridge. All above mentioned samples have a relatively solid shiny slip and an entirely grey break. Sample **CKOL 9** is quite different, as it has a greasy matt-finished surface and a reddish-brown break. **CKOL 8** and **CKOL 12** are quite similar to each other in the appearance of their fabric, in the nature of the smooth exterior with its metallic shine and in the shape with a tapering lower body, a low straight ring foot and the style of the handle; in these points they differ clearly from the other samples of this group. The fabric and the surface treatment of the double handle **CKOL 15** and the horizontally ridged neck-fragment **CKOL 16** are similar to **CKOL 10. 11. 13. 14**, but their shapes are clearly different.

Grey jugs with a polished black slip appear in Kolonna from time to time, even though not in high numbers, in contexts from the late 1st/early 2nd quarter of the 5th century (**CKOL 8**) and mainly in its 3rd to early 4th quarter (**CKOL 9–16**);[505] beyond that, so far no examples were found. The origin of these vessels is unclear; among other aspects the existence of silver inclusions in almost all of these samples suggests that the place of origin is not Aegina.[506] The firing of pottery in a reduced atmosphere and the polishing of its surface have a long tradition especially in the eastern Aegean, but it was presumably known also in other regions like Corinth or the Argolid.[507] But until now it has hardly been possible to associate certain production centres with a certain style of this grey pottery.[508] Several grey vessels of different shape were also found at the Athenian Agora

[498] Surface mostly 5YR 6–7/6 to 7.5/YR 7/6 (reddish yellow); break mostly 5YR 6/6–8 to 7.5YR 6/6 (reddish yellow).

[499] For **CKOL 1** and **CKOL 2** see chapter II.3.1 **Kat. 15. 25**.

[500] For **CKOL 3** and **CKOL 4** see chapter III.3.1 **Kat. 75. 79**.

[501] See Sparkes and Talcott 1970, 282 no. 653. 655 pl. 28 (both "ca. 375"); Robinson 1950, 285–287 no. 501. 505. 506. 509 pl. 187 ("1st quarter 4th c." to "2nd quarter 4th c."); for the style of the stamped decoration see e.g. Smetana-Scherrer 1982, 58 no. 369 pl. 28; 63 no. 417 pl. 32 (both "mid 4th c.").

[502] See e.g. Sparkes and Talcott 1970, 258 no. 325 pl. 15 ("ca. 350"); Kovacsovics 1990, 17f. no. 18, 1 pl. 30, 5 ("context 3rd quarter 4th c."); 60 no. 60, 1 pl. 45, 4 ("context shortly before 350"); Thompson 1940, 133f. fig. 98b ("2nd quarter 4th c.").

[503] For the scientific analysis of these samples see below section IX.2.3.1.4.

[504] Surface mostly 2.5Y 4/1 (dark grey) to 5/1 (grey) to 5/2 (greyish brown); break very different with grey hues like 2.5Y 5–6/1 (grey) to 4/2 (dark greyish brown) and brown hues like 5YR 4/4 (reddish brown) to 7.5YR 5/6 (strong brown).

[505] For **CKOL 8** see chapter II.3.3 **Kat. 34**; for **CKOL 9–12** see chapter III.3.2 **Kat. 89–92**; for **CKOL 13** see chapter VI.2.4 **Kat. 335**.

[506] For the absence of muscovite (silver mica) in the Aeginetan clay see Farnsworth 1964, 223; Jones 1986, 167.

[507] So among others Sparkes and Talcott 1970, 190 with fn. 21. 22; Mitsopoulos-Leon 1991, 78. For the discussion about the so-called grey ware from Aeolia see Lamb 1932, 1–12 esp. 2f.; Bayne 2000; recently Posamentir 2002, 19 with fn. 43; Kerschner 2005, 125–127.

[508] See Williams and Williams 1991, 184 for the find of a waster that proves the production of grey ware in Mytilene.

in contexts of the 5th, but also of the 6th and 4th centuries; they are presumed to be imports, but their exact place of origin could not be determined.[509]

The jugs **CKOL 8–15** from Kolonna are, regarding their shape, so far without exact parallels.[510] The style of some of these vessels, especially **CKOL 9** and **CKOL 11**, is similar to that of contemporary Attic black-glazed jugs with trefoil mouth, even though they miss the tight dynamic outline of these Attic products, and their ovoid body and the often narrow foot appear, in comparison with the Attic ones, slightly old-fashioned.[511] This and the characteristic treatment of the surface suggest that these jugs were produced outside of Athens as imitations of the high-quality Attic black-glazed pottery. The stylistic proximity to Attic vessels and the absence of jugs of this kind among the 'grey ware' from the eastern Aegean point towards an origin rather in a nearby region, perhaps – just hypothetically – in the eastern Peloponnese. Double handles like **CKOL 15** are relatively popular among grey vessels; from Kolonna, only one example is yet attested.[512] **CKOL 16** might actually be an import from the north-eastern Aegean where the characteristic decoration of the neck with horizontal ridges is regularly found on grey polished jugs of the Classical period.[513]

The stylistic proximity of **CKOL 5** (Taf. 60. 80) with some of the grey jugs, especially **CKOL 11**, and the likewise unusual treatment of its surface suggest a connection to this group.[514] **CKOL 5** is not fired in a reduced atmosphere; its light red[515] fabric contains also single silver and large white inclusions. The dull unpolished red slip is thick and does not adhere well. The obvious dependence on shapes of Attic black glaze might suggest another attempt to imitate Attic products, perhaps even the red glaze that is not very frequent in Athens itself.

1.3.3. Macroscopic Group 6: Fine 'Laconian' fabric[516]

The style and the quality of the fabric of the four vessels **CKOL 17–20** speak with some certainty for a Laconian origin.[517] The jugs **CKOL 18. 19** (Taf. 63. 104) date to the 2nd half of the 6th century, the jug-fragment **CKOL 20** (Taf. 63. 72) comes from a context of ca. 480/70, and the crater **CKOL 17** (Taf. 62. 98) belongs to the 1st half of the 5th century. Characteristic for Laconian products are the usually slightly heavy shape, the reddish-brown hue of the fabric, the thick and usually dull glaze that often flakes off in small chips as well as the relatively low weight despite the thick wall.[518] These criteria are fulfilled by our four samples: their brownish to reddish-brown[519] surface is smooth and soft to hard with only few visible inclusions, namely few fine mica and few small to very large white dull inclusions. The smooth, slightly porous break reveals rare fine mica, rare large white dull or whitish translucent inclusions and in sample **CKOL 17** also rare very large red dull inclusions. The glaze of **CKOL 18–20** is thick and dull, and only on the krater **CKOL 17** it is evenly dense and slightly shiny; on all examples it flakes off in small chips. Based on the macroscopic examination, the fabric of the four samples **CKOL 17–20** is quite homogenous. The quality of the glaze shows no big differences between the older vessels of the 2nd half of the 6th century **CKOL 18. 19** and **CKOL 20** of ca. 480/70. It seems justified to assume that the magnificent vessel **CKOL 17** was provided with an especially high-quality glaze.

509 Sparkes and Talcott 1970, 190. 339 no. 1475–1477; 209. 355f. no. 1701–1714. The so-called grey ware is *ibidem* 190 described as follows: "The clay is usually a light gray, but sometimes darker, and the core may have a reddish tinge; it is either well settled or only slightly gritty and mica is rarely perceptible. All the pieces are finished with a black glaze or glaze wash, usually thin and worn ..., and sometimes with brush marks prominent ... Occasionally the finish is a firm glossy black …"; for **CKOL 8–15** compare especially the fragment of the oinochoe Sparkes and Talcott 1970, 355 no. 1703 pl. 79 ("context turn form the 5th to the 4th c.").

510 Sparkes and Talcott 1970, 355 no. 1703 pl. 79 ("context turn of the 5th to the 4th c.") might also be a jug of this kind.

511 Compare e.g. the jugs Sparkes and Talcott 1970, 244 no. 113–118 pl. 6 of the 3rd and 4th qu. 5th c.

512 See e.g. Sparkes and Talcott 1970, 355f. no. 1701–1703. 1705. 1707 fig. 14 pl. 79; Rotroff and Oakley 1992, 26. 118 no. 300 pl. 55; Voigtländer 1982, 87 fig. 43; Naumann and Tuchelt 1963/64, 53 no. 50 fig. 16 pl. 20, 1.

513 See chapter VI.2.4 **Kat. 336** with footnotes.

514 For **CKOL 5** see chapter III.3.3 **Kat. 94**.

515 Surface 7.5YR 6/4 (light brown); break 5YR 6/6 (reddish yellow).

516 For the scientific analysis of these samples see below section IX.2.3.1.2.

517 For **CKOL 18** and **CKOL 19** see chapter VII.2.3 **Kat. 448. 450**; for **CKOL 20** see chapter II.3.2 **Kat. 29**; for **CKOL 17** see chapter VI.2.3 **Kat. 326**; generally for Laconian pottery from Kolonna see chapter XI.

518 See the descriptions of fabric in Boardman and Hayes 1966, 87f.; McPhee 1986, 155; Stibbe 1989, 14; Catling 1996, 35–37; see Catling 1996, 33 regarding the insufficient state of publication of Laconian black-glazed pottery of the Classical period.

519 Surface between 2.5YR 6/6 (light red), 5YR 5/4 (reddish brown) and 7.5YR 5/3 (brown); break between 5YR 5/6 (yellowish red) and 7.5YR 5/4 to 10YR 5/3 (brown).

A Laconian origin is also suggested for the jug **CKOL 26** (Taf. 63. 72), the style of which is difficult to judge.[520] The quality of the thick dull glaze that flakes off in small chips and other characteristics of its fabric are reminiscent of Laconian products, even though the fabric of **CKOL 26** is finer, denser and considerably heavier in comparison to **CKOL 17–20**.

1.3.4. Macroscopic Group 7: Reddish-brown fine fabric of unidentifiable origin[521]

The brown to reddish-brown[522] fabric CMG 7 is so far primarily connected with one-handled footless bowls like **CKOL 21. 22** (Taf. 63. 98). At the smooth hard surface few fine mica and few medium-large white dull inclusions are visible.[523] The smooth and slightly porous break shows frequent small to medium-large white dull inclusions and in the case of **CKOL 21** also few medium-large whitish translucent inclusions. The dull black glaze is unevenly applied on both vessels and their interiors are solidly painted, while at the exterior the glaze ends irregularly slightly above the base. The bowls are, despite their thick walls, relatively light in weight. They have a flat base, a broad horizontal band handle and usually an angular profile.

One-handled bowls of this type are up to now relatively rare and appear only within a geographically limited area. At Kolonna, they are found sporadically, even though not very numerous in contexts of the 2nd half of the 5th century and especially in its late 3rd/early 4th quarter; all the examples found at Kolonna are made of the same fabric, CMG 7.[524] Outside of Aegina only a few examples are known so far from Attica, and interestingly also from contexts of the 2nd half of the 5th c.[525] A consistent development of the shape cannot at present be traced due to the small number of examples.

According to the macroscopic analysis, the fabric of the samples from Kolonna is homogeneous, and their characteristic style points to a common, though so far unidentifiable, origin.[526] However, an Aeginetan origin of these bowls seems as improbable as an origin in Athens or Corinth. Some parallels in the quality of the fabric and the black glaze may indicate a Laconian origin, even if bowls of this shape and style of decoration are so far unknown from Laconia.

1.3.5. Pottery of presumed East Aegean origin

1.3.5.1. Various imports of uncertain, presumably East Aegean origin[527]

The style of the two amphoriskoi **CKOL 44. 45** (Taf. 64. 81), from a context dated to ca. 430/20, and of the approximately contemporary amphoriskos **CKOL 46** (Taf. 64. 99) indicates an East Aegean, probably Ionian origin. The shape and the style of the decoration as well as the macroscopic examination of their fabrics point to different places of origin for the three samples, even though in our present state of knowledge hardly any definite conclusions can be drawn.[528] Recent finds from Klazomenai suggest for **CKOL 46** an origin from this site or this region.

The style of the amphora **CKOL 71** (Taf. 69. 110) found in a context of the 3rd quarter of the 5th century indicates an origin in the region of Samos and Miletus, but a definite attribution of a specific amphora type to one of these two production centres is so far not possible.[529] The surface of **CKOL 71** is powdery and soft with frequent fine mica and few large silver and white dull inclusions; at the slightly granular break, few small red and dull dark inclusions, frequent small whitish translucent and few large white dull ones are visible.

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520 For **CKOL 26** see chapter II.3.2 **Kat. 33**.

521 For the scientific analysis of these samples see below section IX.2.3.1.5.

522 Surface between 5YR 5/4 (reddish brown) and 7.5YR 6/4 (light brown); break 5YR 5/6 (yellowish red).

523 For **CKOL 21. CKOL 22** see chapter VI.2.4 **Kat. 333. 332**.

524 In the same find-context as **CKOL 21. 22** two almost completely preserved examples and a further fragment were found: see chapter VI.2.4 **Kat. 330. 331. 334** (Taf. 32. 98). Most of the pottery from this context dates to the advanced 3rd and early 4th quarter of the 5th century. More examples come from a context of the early 2nd to 3rd quarter 5th c. (chapter IV.2.2 **Kat. 161** Taf. 20. 87) and from so far unpublished contexts in the 'Westkomplex' in Kolonna from ca. mid 5th c. to late 3rd/early 4th quarter 5th c.

525 Athens, Agora: Sparkes and Talcott 1970, 357 no. 1719 pl. 79 ("context ca. 425–400"); Athens, Kerameikos: Knigge 2005, 119 no. 82 fig. 42 pl. 51 ("context before 430"); Thorikos: Mussche 1998, 68 no. 13 fig. 135 ("context 2nd half 5th c.").

526 Margreiter 1988, 39 no. 274. 275 suggests an origin in a provincial Peloponnesian workshop or Aegina.

527 For the scientific analysis of these samples see below section IX.2.3.2.2.

528 For **CKOL 44. 45** see chapter III.3.3 **Kat. 99. 100**; for **CKOL 46** see chapter VI.2.4 **Kat. 337**; generally for East Greek imports in Kolonna see chapter XI.

529 For **CKOL 71** see chapter VIII.2.3 **Kat. 483**; for scientific analysis of Samian amphorae see also Whitbread 1995, 122–133.

1.3.5.2. Macroscopic Group 8: 'Chian' coarse fabric[530]

On the basis of their characteristic shape the three transport amphorae **CKOL 68–70** (Taf. 69. 109. 122) can be definitely assigned an origin in the island of Chios. The morphological development of Chian amphorae with swollen neck is relatively well studied, and their identification is supported by scientific analysis.[531] **CKOL 68–70** belong to the so-called type C2 that was in use from ca. 480 to 440 B.C. The foot fragment **CKOL 70** comes from a context of around 470/60,[532] **CKOL 68** can be dated close to 450,[533] and **CKOL 69** close to 440 B.C.[534] The characteristic inclusions are few to frequent fine mica, few large white dull inclusions, few small to large dull black inclusions at the surface and few to frequent sometimes very large dark dull inclusions in the break.[535] But there exist also differences between the three samples: the surface of **CKOL 68** shows small to large golden and silver inclusions, while that of **CKOL 70** only small silver ones. The surface of **CKOL 68** is slightly harsh and soft, that of **CKOL 69** and **CKOL 70** slightly powdery and hard. At the breaks of **CKOL 69** and **CKOL 70** rare partly large red inclusions are visible.

1.3.5.3. Macroscopic Group 9: 'Lesbian' coarse fabric[536]

An attribution of the amphorae **CKOL 72–74** (Taf. 70. 122) to the island of Lesbos on the basis of their shape and the character of their fabric can hardly be doubted. The three samples from the late 3rd or early 4th quarter of the 5th c. belong to a type identified as Lesbian that is primarily defined by its grey fabric.[537] The morphological development of this amphora type is well known, and its connection with Lesbos is supported by scientific analysis.[538] The shape is characterised by a long cylindrical neck with a fillet below the outward thickened square rim (**CKOL 74**), a heavy rounded handle continuing in a tapering ridge at the shoulder (**CKOL 72**) and a solid toe with a flat base (**CKOL 73**). The grey[539] fabric has a smooth, soft to medium hard surface with common small to very large golden inclusions and few to frequent small dark dull ones. The granular break shows few to frequent fine mica inclusions, few to frequent large to very large whitish translucent inclusions, rare large white dull inclusions and in the case of **CKOL 73** also few large golden inclusions. The homogeneity in the fabric of the three samples confirms the stylistic attribution to one and the same place of production.

1.3.6. Medium-coarse fabrics of presumed different origins (Solokha I class amphorae)[540]

The three amphorae **CKOL 75–77** (Taf. 70. 88. 99) from ca. the 3rd to early 4th quarter of the 5th c. share the characteristic moulding of the heavy triangular rim.[541] Amphorae of this so-called Solokha I class appear from the 5th century onwards.[542] The different fabrics of the known examples speak for a number of different production centres presently identified mainly on the south-eastern Aegean islands like Kos and Rhodos, and at the opposite coast of Asia Minor, in the region of Halikarnassos and the Datça peninsula. The analysed samples **CKOL 75–77** also reveal differences in shape and fabric that point to different, unidentifiable origins. Whereas **CKOL 75** and **CKOL 77** share at least certain similarities in shape and fabric, **CKOL 76** is clearly different in both aspects. According to the macroscopic examination, none of the three amphorae can be connected with any other of our analysed fabric groups.

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530 For the scientific analysis of these samples see below section IX.2.3.2.3.

531 For the development of the shape see Lawall 1995, 89–92 with further references; for scientific analysis see Whitbread 1995, 135–153 esp. 138–144.

532 Compare e.g. Lawall 1995, 356 fig. 25 ("ca. 480").

533 For **CKOL 68** see chapter VIII.2.3 **Kat. 482**.

534 Compare V. Grace in: Boulter 1953, 104 no. 150 pl. 39 ("context ca. 460–440"); see also Lawall 1995, 355 fig. 20 who dates this amphora around 440.

535 Surface 5YR 6–7/6 (reddish yellow) to 7.5YR 6/4 (light brown); break 5YR 5/6 (yellowish red) to 7.5YR 6/6 (reddish yellow).

536 For the scientific analysis of these samples see below section IX.2.3.2.4.

537 Compare e.g. Mylonas 1975, 342 no. H13 pl. 334a ("context late 3rd quarter 5th c."); Rotroff and Oakley 1992, 125 no. 354 pl. 60 ("context ca. 475–425"). **CKOL 73** comes from a context of around 430/20; the context of **CKOL 72** and **CKOL 74** is dated to the 2nd half of the 5th c.

538 For the characterisation and development of Lesbian amphorae see Clinkenbeard 1982; Lawall 1995, 196–204; Whitbread 1995, 154–164.

539 Surface 2.5Y 5/1 (grey) to 5/2 (greyish brown); break 2.5Y 5/2 (greyish brown) and 2.5Y 4/1 (dark grey) at the core.

540 For the scientific analysis of these samples see below section IX.2.3.2.5.

541 For **CKOL 75** see chapter V.2.4 **Kat. 203**, for **CKOL 76. 77** see chapter VI.2.6 **Kat. 360. 359**.

542 See Lawall 1995, 218–233; especially 218 fn. 1 for the term; Lawall 2000, 66; V. Nørskov – J. Lund in: Vaag *et al.* 2002, 60–62.

1.3.7. 'Corinthian' imports

1.3.7.1. Macroscopic Group 10a and 10b: Fine and coarse yellowish-pinkish fabric[543]

Stylistic criteria and the quality of the fabric leave no doubt about the Corinthian origin of the samples **CKOL 47–53. 61**. Banded lekythoi like **CKOL 47** (Taf. 65. 96), thin walled unpainted vessels with a shiny polished surface like **CKOL 48** (Taf. 65. 73), one-handled cups, semi-glazed by dipping on the exterior, like **CKOL 49** (Taf. 65. 120), perirrhanteria like **CKOL 50. 51** (Taf. 65. 120) and transport amphorae of type Corinth A′ like **CKOL 61** (Taf. 66. 121) are characteristic products of Corinthian workshops of the 5th century. The formal development of these types is well known, and their attribution to Corinth is supported by several studies concerning their fabrics and raw materials.[544] The lekythos **CKOL 47** (3rd or early 4th quarter of the 5th century), the jug **CKOL 48**[545] from a context of 480/70 and the semi glazed one-handled bowl **CKOL 49** (advanced 3rd quarter of the 5th century)[546] are made of a fine yellowish, partly pinkish fabric[547] – our macroscopic group 10a – with a hard greasy surface that has almost no inclusions except for single larger white dull ones and very rare fine mica. The smooth dense break has also only single small white and dark dull inclusions and single small light-red ones. Parallels from Corinth confirm that this fabric was preferred for vessels of the above mentioned shapes. One-handled semi-glazed cups were also made of another characteristic Corinthian brownish-yellowish fabric with greenish overtones[548] – our macroscopic group CMG 11 – whose greasy hard to medium-hard surface usually has no visible inclusions and whose smooth dense break shows only occasionally very few small spherical light red ones.[549]

The perirrhanteria **CKOL 50. 51**,[550] the transport amphora type Corinth A′ **CKOL 61**[551] and the two storage vessels **CKOL 52. 53** (Taf. 65. 120) have, like **CKOL 47–49,** a matrix fine and dense in texture and of a yellowish to reddish[552] hue, but, unlike those, many large dark angular and white dull inclusions are added. This coarse fabric is therefore distinguished as macroscopic group 10b. The dark angular tempering material was identified as mudstone that is used in Corinth mainly for big thick-walled vessels like perirrhanteria and amphorae, but also for roof tiles and architectural terracottas.[553] The break of

543 For the scientific analysis of these samples see below section IX.2.3.1.3 and 2.3.2.1.

544 See Farnsworth 1964, 224; Farnsworth 1970; Farnsworth *et al.* 1977, 459–461; Jones 1986, 173–189; Whitbread 1995, 282. 308–344; Whitbread 2003, 6–12; Lawall 1995, 62f. 66; for neutron activation analysis of pottery from Aegina that was identified by style as Corinthian see Farnsworth *et al.* 1977, 459. 467; generally for imports of Corinthian pottery in Kolonna see chapter XI.

545 For **CKOL 47** see chapter VI.2.2 **Kat. 316**; for **CKOL 48** see chapter II.3.4 **Kat. 35**.

546 Compare the two bowls **Kat. 300. 301** (Taf. 29. 96); see also chapter VI.2.2.

547 Surface mostly 2.5Y 7/4 to 8/3 (pale yellow) and 5YR 7/6 (reddish yellow); break mostly 2.5Y 7/4 to 8/3 (pale yellow) and 5YR 6–7/6 (reddish yellow).

548 Surface mostly 2.5Y 7/3–4 and 8/3 (pale yellow) to 10YR 7/3–4 to 8/3–4 (very pale brown); break mostly 2.5Y 6/4 (light yellowish brown) to 2.5Y 7/3–4 (pale yellow).

549 The fabric of our macroscopic Group 11 was not analysed within the scope of this volume; see the two cups **Kat. 300. 302** (Taf. 29. 96) and further vessels made of this fabric: **Kat. 37. 38. 87. 98. 183. 305. 315. 441. 442. 445. 446**; for a characterisation of different types of clay in the region of Corinth see Farnsworth 1970, 11: "… the fired Acrocorinth white clay which is buff with rosy overtones. The clay from the plain is always, on the other hand, creamy with greenish overtones."; see also Whitbread 2003, 6 table 1.1.

550 **CKOL 50. 51** come from a context that contains mainly pottery from the 2nd to the early 3rd quarter 5th c. as well as single finds from the early 5th c. The shape of the rim with the high overhanging ridge, the ridge's profile with two groups of three ridges each and a broad central ridge as well as the colouring fits with the standardised shape of the Corinthian perirrhanterion that appears from around 480/70 onwards through the whole of the 5th century and still in the 4th century without striking changes. The careful shaping of the spool-shaped handle of **CKOL 51** supports the attribution to an early state of the shape's development, a date that is also suggested by the context. For perirrhanteria from Kolonna see Kerschner 1996; generally for this shape see Bentz 1982, 106–108; Iozzo 1987, 356f.; Kerschner 1996, 74f.

551 The fragment **CKOL 61** from a context of the late 1st/early 2nd quarter 5th century belongs to the early variant of the amphora of type Corinth A′ that appears in the 1st half 5th century; their fabric is, in contrast to the later variant, tempered with a lot of mudstone. Generally for this type of amphora see Koehler 1981, 454–456; Lawall 1995, 64–68; for the fabric see especially Whitbread 1986, 270–273. 278.

552 Surface mostly 10YR 7/4 (very pale brown) to 7.5YR 7/6 (reddish yellow); break mostly 10YR 7–8/6 (yellow) to 5YR 6/6–8 (reddish yellow).

553 For the description of this fabric as 'Corinthian tile fabric' see recently Merker 2006, 17f.; for the identification and use of mudstone see Farnsworth 1964, 224; Farnsworth 1970, 10f.; Whitbread 1995, 334f.; esp. Whitbread 2003, 6 with fn. 23. I. Whitbread could demonstrate by petrographical analysis that in Corinth the same characteristic fabric of yellow clay and rough mudstone-temper was used for

these samples is very hackly due to the coarse temper. At the carefully smoothed, hard and greasy interior of the two perirrhanteria no inclusions are visible, whereas the surface of the amphora **CKOL 61** is quite rough due to the abundant temper.

1.3.7.2. Macroscopic Group 12: Coarse reddish-yellowish to grey fabric[554]

The fabric of the amphora type Corinth A **CKOL 60**[555] (Taf. 66. 121) has a very hard rough reddish-yellowish surface and an entirely grey hackly break, both of them with frequent large white dull and dark-red dull angular inclusions.[556] In the 5th and 4th c., this fabric is characteristic for the usually handmade transport amphorae of type Corinth A. Supported by previous scientific analysis, it can be assigned to Corinth with some certainty.[557] Due to its fine matrix, its tempering with mudstone and white dull inclusions as well as the absence of further visible inclusions, CMG 12 appears very similar to CMG 10b. Recent studies, however, showed that the different colouring and the higher degree of hardness have to be ascribed rather to the use of a different clay-mixture than to a different firing-method of the same fabric.[558]

1.3.7.3. Macroscopic Group 13: Buff, slightly porous medium-coarse fabric[559]

The attribution of the third amphora type, type Corinth B, to Corinth is controversial, despite its frequent appearance there.[560] The absence of predecessors among the local pottery and fundamental morphological differences to the types Corinth A and A′ caused doubts as to whether amphorae of type B were at all produced in Corinth. The discovery of wasters in Corfu and scientific analysis prove that at least one production centre of such amphorae is located on this island,[561] whereas a production at Corinth is still uncertain.[562] At Kolonna, amphorae of type B are found quite frequently. The analysed samples **CKOL 54–59** (Taf. 66. 99. 121) belong to the period between the later 1st and the early 4th quarter of the 5th century. The rim fragment **CKOL 54**[563] can be dated to the 1st quarter of the 5th century due to its more rounded exterior outline, whereas the more angular profile of **CKOL 55. 56**[564] points to the period around the middle or in the 3rd quarter of the 5th century. This date is confirmed by the context in which these two fragments were found. The foot of the two fragments **CKOL 58. 59**,[565] dated to

amphorae of type A′/class 1, for roof tiles, for architectonical terracottas, for some terracotta-sculptures, perirrhanteria and different larger vessels. He supposes that for perirrhanteria as well as for terracotta-sculptures two or more different kinds of clay were mixed: Whitbread 1995, 294. 296f. 299f. 305.

554 For the scientific analysis of these samples see below section IX.2.3.2.1.

555 **CKOL 60** belongs to Lawall's variant 2 of type Corinth A (Lawall 1995, 59–61) that was in use during the whole 5th century without striking changes; compare e.g. Koehler 1981, 454 fig. 1d pl. 98h ("ca. mid 5th c."); see also Lawall 1995, 61 with fn. 21 ("mid to 3rd quarter 5th c."). The context of **CKOL 60** cannot be dated before the late 3rd or 4th quarter of the 5th century. **CKOL 60** would therefore be one of the few examples of this type of amphora that were still exported in the later 5th century: see also Koehler 1981, 454.

556 Surface 5YR 7/6 (reddish yellow); break ca. 1forGley 6/N (grey).

557 See Koehler 1979, 1–4. 28f.; Koehler 1981, 452; Jones 1986, 184f.; Whitbread 1995, 268f. 282. 345f.; Lawall 1995, 61–63; for the close relationship of this fabric with the so-called blisterware see Koehler 1979, Appendix I.1; Koehler 1981, 452; Whitbread 2003, 8; for vessels made of blisterware from Kolonna see chapter VI.2.2 **Kat. 318–320**.

558 See Whitbread 2003, 8f.

559 For the scientific analysis of these samples see below section IX.2.3.2.1.

560 For the development of this type of amphora see Koehler 1979, 33–49; Lawall 1995, 68–74; for petrographic analysis of amphora type Corinth B found in Corinth and Corfu see Whitbread 1995, 274–278; ibidem 264–268 for previous analysis of Corinthian amphorae; Whitbread 2003, 9.

561 See also Koehler 1981, 452 with fn. 14; Whitbread 1995, 260f. 281; Lawall 1995, 76.

562 Koehler 1981, 452 suggests a production in Corinth, although she does not exclude a partial production on Corfu. Whitbread 1995, 260f. 278–285. 344–346 views a Corinthian origin of this type of amphora with a critical eye; see also Whitbread 2003, 9 with fn. 50. Lawall 1995, 69. 74–80 persists on Corinth being one of the production centres of this type of amphora.

563 **CKOL 54** was found in a filling layer which contained mainly pottery from the late 6th/early 5th c. and few sherds until the mid of the 5th century. The amphora belongs to the early phase of variant B/2 in Lawall 1995, 70; compare e.g. amphorae from Aphaia: Johnston 1990, 46 no. 88 fig. 5 ("approximately contemporary with the building of the second limestone temple"); from a well at the Athenian Agora closed around 480: Roberts 1986, 67 no. 417 fig. 41; see also Lawall 1995, 72 with fn. 74.

564 **CKOL 55. 56** from contexts of the 3rd/early 4th quarter 5th c. belong to the advanced phase of Lawalls variant B/2: see Lawall 1995, 70. 72f.; compare e.g. amphorae from the mid or the 3rd quarter 5th c.: Koehler 1979, 177–179 no. 228–230 pl. 39.

565 e.g. Koehler 1979, 178 no. 228. 229 pl. 30. 39 ("mid 5th c." and "460–440"); see also Lawall 1995, 354 fig. 15. The context of **CKOL 58. 59** dates to the 2nd to early 3rd quarter 5th c.

around mid 5th century, is clearly set off from the spherical body; these samples are slightly older than the amphora **CKOL 57**[566] which belongs with its small conical and less set off foot already to the turn from the 3rd to the 4th quarter of the 5th century. According to macroscopic criteria, the fabrics of **CKOL 54–59** appear very similar due to their pale[567] colour and their slightly sandy texture. The slightly powdery, soft to medium-hard surface shows only rare to few inclusions, namely very rare medium-large to large black glinting ones, in the case of **CKOL 55. 57** also rare medium-large to large whitish translucent inclusions and in the case of **CKOL 56. 57** rare large white dull ones; **CKOL 56** and **CKOL 58** contain rare fine mica. The break of all the samples is slightly granular and shows only few inclusions, namely rare fine mica, in the case of **CKOL 54–56** also few large dark inclusions and in the case of **CKOL 56** and **CKOL 57** also rare large white dull and light-red ones. The break of the finer fabric of **CKOL 59** looks different with rare medium-large dark, dull white and whitish translucent inclusions and rare very large pinkish ones. According to macroscopic criteria, none of the six samples of type Corinth B amphorae **CKOL 54–59** can be assigned to one of the above mentioned fabrics whose association with Corinth is fairly certain. In fact the buff, slightly sandy consistence and the rare black glittering inclusions of **CKOL 54–59** rather bring to mind other fabric groups represented at Kolonna, like the mortaria **CKOL 35.36.38–40** or the buff vessels **CKOL 23–25. 33. 34. 41. 42**.

1.3.8. Pottery of presumed North Aegean origin

The amphorae **CKOL 62–67. 78. 79** share the same basic shape, but some more or less distinct differences in style and fabric indicate that these are products of different workshop-groups. Amphorae of this kind appear across the North Aegean region in a largely homogeneous style, varying only in details of the shape and in the fabric. For most of these variants it was so far not possible to identify their specific place of production.[568] The homogeneity of shape among amphorae of a relatively wide geographic region, over a certain period of time also accompanied by homogeneity of the marking systems, speaks probably for homogeneous economic structures.[569]

1.3.8.1. Macroscopic Group 14: 'Mendean' coarse fabric[570]

Best known are amphorae from Mende whose morphological development and fabrics are well studied.[571] Such an attribution for the three samples **CKOL 64. 65. 67** (Taf. 67. 110. 121), on the basis of their style and macroscopic criteria, seems quite probable. **CKOL 64** and **CKOL 65** date to around 440 or close to 430.[572] The less elongated foot of **CKOL 67** comes from a context of the late 3rd to early 4th quarter of the 5th century.[573] The light red[574] fabric has a hard and harsh surface with frequent inclusions, namely few fine mica, few to common small to large white and dark dull inclusions, few large golden and few to frequent large silvery ones, in the case of **CKOL 67** also few large black glinting inclusions, in the case of **CKOL 64. 65** also few large whitish translucent ones. The break is granular and reveals frequent inclusions, namely few to frequent fine mica and frequent medium-large to large whitish translucent inclusions. In the case of **CKOL 64. 65** also frequent large white dull inclusions were observed, **CKOL 65** has also rare large red brown inclusions, and few medium-large black glinting ones were detected with **CKOL 67**. The fact that the samples **CKOL 64. 65. 67**, dated between 440 and 420, are made of a hard and fairly coarse fabric supports Lawall's assumption that before ca. 440 Mendean amphorae were made of a finer and less hard fired material than later.[575]

566 For **CKOL 57** see chapter VI.2.6 **Kat. 352**.
567 Surface 2.5Y 7/3 to 8/2 and 5Y 8/2 (pale yellow) to 10YR 7/3 (very pale brown); break mostly 2.5Y 7/4 and 5Y 7–8/3 (pale yellow).
568 For problems of identification of specific production-centres in the northern Aegean see Lawall 1995, 116f. 156; Lawall 1997, 114. 118.
569 See Lawall 1995, 172–175; Lawall 1997, 118. 120–122.
570 For the scientific analysis of these samples see below section IX.2.3.2.6.
571 Lawall 1995, 117–124; Lawall 1997, 115; Lawall 1998, 17–19; for petrographic analysis of Mendean amphorae indicating the use of two different fabrics see Whitbread 1995, 198–209.
572 For **CKOL 64. 65** see chapter VIII.2.3 **Kat. 480. 481**.
573 Compare two slightly older amphorae: Talcott 1935, 514f. no. 88 fig. 17 ("context ca. 440 to 425"); Lawall 1998, 18 fig. 3 ("ca. 450–425"); compare also the probably only slightly younger amphora Papadopoulos and Paspalas 1999, 161 fn. 1 fig. 3 ("around 425 or slightly later").
574 Surface mostly 7.5YR 7/4 (pink); break mostly 7.5YR 6/6 (brownish yellow) to 5YR 7/8 (reddish yellow).
575 Lawall 1995, 118f.

1.3.8.2. Coarse fabrics of presumed various North Aegean origins[576]

CKOL 62, **CKOL 63** and **CKOL 66** (Taf. 67. 68. 86. 121) share the same basic shape characteristics with the typical Mendean amphorae. They differ, however, from those and from each other, more or less distinctly, by their style and fabric. The fact that all these samples come from contexts of around 430/20 offers the possibility to study similarities and differences of morphological details and fabrics among contemporary vessels.[577] The shape and the decoration with two horizontal painted bands of the amphora **CKOL 66** have close parallels in contemporary Mendean amphorae, but the heavy and, according to the macroscopic examination, different fabric suggests an origin in another workshop centre, probably in the wider neighbourhood of Mende.[578] The two amphorae **CKOL 62** and **CKOL 63** have, unlike contemporary Mendean-type amphorae, a clearly more elongated foot that is in the case of **CKOL 62** also more carefully shaped.[579] The differences in style and fabric suggest for each of the two amphorae **CKOL 62** and **CKOL 63** a different origin within the North Aegean region, even though this cannot be specified at the moment.

1.3.8.3. Macroscopic Group 15: Light-red medium-coarse fabric of presumed North Aegean origin[580]

The two amphorae **CKOL 78**. **79** (Taf. 68. 86), both from a context dated to around 430/20, also belong to the North Aegean sphere, but their elongated shape and fabric is quite distinctive from contemporary Mendean products.[581] Therefore, they should be attributed to another, so far not provenanced, North Aegean type. According to macroscopic criteria, the samples **CKOL 78** and **CKOL 79** are made of the same light-red[582] fabric whose slightly powdery soft surface shows frequent inclusions. The surface is characterised by frequent mica, rare to frequent large silver inclusions, frequent large to very large white dull ones, few to frequent small to medium-large dark dull inclusions and in the case of **CKOL 78** also rare large golden ones. At the slightly granular break few to frequent inclusions are visible, namely rare mica, few small to large white dull inclusions, in the case of **CKOL 79** few small whitish translucent inclusions and in the case of **CKOL 78** rare very large dark-red ones.

1.3.9. Buff, slightly porous fabric of uncertain origin[583]

The askos **CKOL 30** (Taf. 70. 100) is made of a light-coloured reddish-yellowish[584] fabric whose slightly greasy and medium-hard surface features frequent fine mica, few small white and black dull inclusions and rare large silver ones. The break is smooth and slightly porous with only a few inclusions visible, namely rare fine mica, few small white, red and dark dull and rare medium-large white inclusions. **CKOL 30** shares several characteristics of shape with the askos **CKOL 34**, but the macroscopic examination clearly suggests different origins. Whereas **CKOL 34** is supposed to be Aeginetan, this can be excluded for **CKOL 30** with some certainty, as this sample has silver inclusions seen both on surface and break. A Corinthian or Attic origin seems likewise not probable based on macroscopic examination.[585]

1.3.10. Imported cooking pottery

1.3.10.1. Macroscopic Group 16: Micaceous 'Attic' 'cooking' fabric[586]

The hydria **CKOL 94** (Taf. 71. 74) from a context dated to around 480/70 is a certain Attic product.[587]

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576 For the scientific analysis of these samples see below section IX.2.3.2.6.

577 For a detailed description of the fabrics of **Kat.144/ CKOL 62. Kat. 145/CKOL 63. CKOL 66** see the relevant sections in the catalogue.

578 Compare e.g. an amphora from ca. 425 or slightly later: Papadopoulos and Paspalas 1999, 161 fn. 1 fig. 3; see also the probably slightly older amphora **CKOL 67** (Taf. 67).

579 For **CKOL 62. 63** see chapter III.3.7 **Kat. 144. 145**.

580 For the scientific analysis of these samples see below section IX.2.3.2.7.

581 For **CKOL 78**. **79** see chapter III.3.7 **Kat. 140. 141**. As mentioned there, the two amphorae show some characteristics of the so-called Solokha II-class, but also differ in certain details. Therefore an immediate relationship should be excluded and does not go beyond a common general affiliation to this North Aegean form group. The Solokha II-class refers to a consistent form, but appears to have been made by different producers in different fabrics and locations, among those obviously the islands of Peparethos and Ikos: see Lawall 1995, 234–239; Hadjidaki 1996, 576; Doulgéri-Intzessiloglou and Garlan 1990, 361–389; Mantzouka 2004, 52–62.

582 Surface 5YR 6–7/6 (reddish yellow); break 5YR 5/6–8 (yellowish red) to 6/8 (reddish yellow).

583 For the scientific analysis of this sample see below section IX.2.2.3.

584 Surface 7.5YR 6/6 (reddish yellow); break 7.5YR 6/6 (reddish yellow) to 2.5Y 4/1 (dark grey).

585 For **CKOL 30** see chapter VI.2.5 **Kat. 343**; for **CKOL 34/ Kat. 342** see there and in this chapter section IX.1.2.4.

586 For the scientific analysis of this sample see below section IX.2.3.3.1.

587 For **CKOL 94** see chapter II.3.6 **Kat. 43** and another example from this context, **Kat. 44**.

It is made of a light-red to light-brown[588] fabric that is very common in Attic pottery from the Late Geometric period until the late 5th century.[589] The smooth medium-hard surface of **CKOL 94** is mainly characterized by frequent small to medium-large silver inclusions, fine mica, large to very large white dull and small dark dull inclusions; the slightly granular break has frequent medium-large white dull and few whitish translucent inclusions. Unlike contemporary Aeginetan closed cooking-vessels, the hydria **CKOL 94** is handmade.

1.3.10.2. Macroscopic Group 17: Reddish-brown 'Attic' 'cooking' fabric[590]

An Attic origin may also be presumed for the lid **CKOL 113** (Taf. 71. 118) and the cauldron **CKOL 128** (Taf. 71. 118), both made of the same reddish-brown[591] granular fabric. The slightly greasy and glossy surface is medium-hard to very hard and has few inclusions, among those frequent fine silver mica and few small to very large silver ones. In the case of **CKOL 128**, also rare medium-large golden inclusions, few medium-large black dull ones and few large white dull inclusions are visible. The granular break reveals common and poorly sorted inclusions, namely frequent mica, common and sometimes very large whitish translucent ones and few large to very large inclusions with a metallic glint. Large lids like **CKOL 113** from a context of the 4th quarter of the 4th century with a horizontally ripped upper side and a high conical knob are well known in Athens from contexts of the late 4th and the 3rd century.[592]

1.3.10.3. Macroscopic Group 18: Dense brown fabric of uncertain, possibly Corinthian origin[593]

The two jug fragments **CKOL 95** (Taf. 71. 118) and **CKOL 97** (Taf. 71. 101) from contexts of the 3rd and early 4th quarter of the 5th century share several features, so that a common origin can be assumed.[594] The nature of their heavy brown[595] fabric and the surface treatment differ clearly from Aeginetan products. The smooth surface has rare fine mica, frequent large white dull inclusions and few large angular dark slightly glinting ones. In the case of **CKOL 97**, there are also rare medium-large golden and frequent small whitish translucent inclusions. The granular break features frequent large to very large white and dark dull inclusions, and in the case of **CKOL 97** also rare fine mica. The exterior of **CKOL 97** is burnished in a way that is unknown in Aegina. Jugs of this kind are so far hardly known. A small number of jugs similar in fabric, style of decoration, and shape were found in Corinth in contexts between mid and early 4th quarter of the 5th century. One might therefore consider a Corinthian origin, even though this has to remain hypothetical as little is known about Corinthian cooking wares.[596]

1.3.10.4. 'Cooking' fabrics of various uncertain origins[597]

The lidded chytra **CKOL 86** and the two lopades **CKOL 104. 105** (all Taf. 71. 118) are imports. All three vessels have a relatively hard, slightly harsh surface. The macroscopic examination points to different, so far unidentifiable, places of production. **CKOL 105**, from a context containing finds from the 5th to the 2nd century, might belong to a lopas with flat bottom and rounded wall; this shape appears in Athens so far only in the 1st third of the 3rd century.[598] **CKOL 86**, from a context of the advanced 4th to 3rd century, can be reconstructed as a very steep-walled, probably bag-shaped vessel. Lopades like **CKOL 104** were found between the Greek mainland and Palestine from the early 2nd to the 1st century and beyond; the shape might have its origin in the coastal region of Asia Minor or the

588 Surface 2.5YR 5/6 (red) to 7.5YR 6/3–4 (light brown); break 2.5YR 5/6 (red) to 5YR 5/6 (yellowish red).

589 For this fabric and the range of shapes associated with it see Klebinder-Gauss and Strack forthc., fabric 'Att1a'; for the abundant presence of muscovite (silver mica) in Attic clays see Farnsworth 1964, 222f. and Sparkes and Talcott 1970, 36.

590 For the scientific analysis of these samples see below section IX.2.3.3.1.

591 Surface 2.5YR 5/6 (red) to 5YR 4/3 (reddish brown); break 2.5YR 4/8 (red) to 7.5YR 4/3 (brown).

592 Compare Sparkes and Talcott 1970, 374 no. 1981 pl. 95 ("context ca. 325–300"); Knigge 2005, 201 no. 695 pl. 121 ("context late 4th c."); 211 no. 804 pl. 129; 222 no. 909 pl. 136; Rotroff 2006, 196f. no. 717–723 'Lid, Form 2' and referring to a supposed Attic origin of most of these examples.

593 For the scientific analysis of these samples see below section IX.2.3.3.2.

594 For **CKOL 97** see chapter VI.2.8 **Kat. 397**.

595 Surface 7.5YR 5/4–6 (brown to strong brown); break 5YR 5/6 (yellowish red) to 7.5YR 4/3 (brown).

596 For this see chapter X.2.

597 For the scientific analysis of these samples see below section IX.2.3.3.2.

598 Rotroff 2006, 180 lopas form 2.

southern Levant.[599] The fabric of **CKOL 104** corresponds to the descriptions of comparable finds from the Athenian Agora; its context and parallels suggest a date in the 1st half of the 2nd century.[600]

2. Understanding Local Products and Exploring Sources of Imports: Petrographic and Chemical Analysis of Classical Pottery from Kolonna, Aegina

Areti Pentedeka – Myrto Georgakopoulou – Evangelia Kiriatzi

The petrographic and chemical analyses conducted on selected vessels of the Archaic and Classical periods from the sanctuary of Apollo at Kolonna aimed to further investigate provenance and pottery technology issues that surfaced from the macroscopic and stylistic examination of the ceramic assemblage under study. The construction of reference databases for the different pottery production centres in antiquity was also of interest. With regard to petrographic data, such reference material exists,[601] and although limited, is constantly enriched.[602] The situation is somewhat different concerning chemical analysis data; the existing published results and ongoing research programmes are not always sufficient to safely characterise the products of the various production centres for these periods. This does not apply for the characterisation of the local Aeginetan production, since an extensive petrographic and chemical database exists, resulting from the analyses of a large number of both pottery and raw materials samples from Aegina, undertaken within the frame of recent research focusing on the pottery production of the Bronze Age settlement of Kolonna.[603]

In this project a total of 140 pottery samples were analysed using petrographic analysis (combined with refiring tests) and chemical analysis (Inductively Coupled Plasma-Optical Emission Spectroscopy). Since the analysis was based on the research questions already discussed in the previous section, the same outline is followed in this section, where the analytical data is presented and discussed.

The results of the scientific analyses are structured with respect to assumed provenance, since one of the major objectives of this research is to distinguish local products vs imports, and to characterise fabric variation in terms of the clay recipe used, in order to shed light on the scale and organisation of local pottery production. Thus, the macroscopically assumed local production is discussed in section IX.2.2, separately from the assumed imports (discussed in section IX.2.3), despite the fact that some of the macroscopically defined groups (CMGs) that were considered to be of possible local origin were proved to be imports on the basis of the analytical evidence. A summary of the results is given in Tables 4a–b and 7a–b, which also serve to facilitate combining macroscopic and analytical groupings.

2.1. Methodology

2.1.1. Petrographic analysis and refiring tests

Petrographic analysis with thin sections is an analytical technique that integrates ideally with macroscopic examination of pottery, as its results can be directly related to the compositional and technological features observed macroscopically. At the same time, it enables the detailed characterisation of the mineralogical composition, which in turn can be combined with more sophisticated analytical approaches, like analysis of the chemical composition, providing information on both provenance and technological issues.

Petrographic examination of the 140 CKOL samples[604] was conducted at the Fitch Laboratory, using a ZEISS AXIOSKOP 40 POL polarising microscope, while microphotographs were taken using a Leica DC300 camera attached to a Leica MZ9.5 stereomi-

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599 For the shape see Rotroff 2006, 183–186 lopas form 4 'canonical form' and form 5; for the fabric *ibidem* 45f. 382 'lopas 5 cooking fabric'.

600 Compare especially Rotroff 2006, 314f. no. 665 ("context ca. 175–150"); no. 669 ("context ca. 150–110"); no. 670 ("context ca. 150–110") fig. 84. 85 pl. 69; Knigge 2005, 245 no. 1097 fig. 67 ("context mainly 2nd half 2nd c. to begin 1st c."); Reber 1998, 189 no. 199 fig. 231 ("context 6th–3rd c."); for this exceptional early piece see also Rotroff 2006, 184 with fn. 44; De Luca and Radt 1999, 45 no. 221 fig. ("context 1st half 2nd c."); compare especially Rotroff 2006, 45 with a definition of the fabrics of the imported pieces found in Athens and with the conclusion that the appearance of this fabric in Athens is restricted to the 2nd century.

601 e.g. Farnsworth 1964, Whitbread 1995.

602 e.g. De Domingo and Johnston 2003.

603 Mommsen *et al.* 2001; Hein *et al.* 2004; Gauss and Kiriatzi 2011.

604 All thin sections were prepared at the Fitch Laboratory, British School at Athens, by Michalis Sakalis.

croscope and appropriate polarising filters. The detailed microscopic descriptions follow the main principles of the descriptive system proposed by I.K. Whitbread[605] with some adjustments. Comparative charts were used in order to estimate a) the c:f:v ratio (coarse fraction to fine fraction to voids),[606] b) the inclusion sorting[607] and c) the inclusion roundness.[608]

Apart from petrographic analysis, all samples were subjected to refiring tests. Chips from all the samples were refired at 1050°C in controlled oxidising conditions using a Naberthem L5/P furnace. Maximum temperature was achieved gradually in 2 hours time and was kept stable for 1 hour. The kiln was turned off and the samples were left to cool overnight. The temperature of 1050°C was considered to be above the firing temperatures of the pottery under study, based on the thin section examination of the optical activity of the groundmass. The refiring of all ceramic samples under the same controlled conditions and at higher temperature than that of the original firing aimed to distinguish different clay paste or slip/paint composition, by eliminating any variation in their colour caused by ancient firing conditions.

In order to further investigate and discuss issues of provenance, a range of other sample sets was also examined for comparative reasons. These include mainly the sample collection for the Bronze Age settlement of Kolonna at Aegina (a total of 396 samples including ancient and modern pottery, rock fragments, loose and clay-rich sediments, and experimental paste samples).[609] Furthermore, additional comparative material was provided from sample sets of a) Corinthian pottery and transport amphorae of various origins, b) Corinth cooking wares, c) the Bronze Age settlement of Eleusis, d) Mendean pottery, e) various types of archaic transport amphorae found, for the most part, at Kommos (Crete),[610] all housed at the Fitch Laboratory, British School at Athens. Moreover, samples from the Athenian Agora collections by M. Farnsworth and M. Lawall were examined,[611] with the kind permission of Dr. S. Fox, Director of the Wiener Laboratory, American School of Classical Studies at Athens, where these collections are kept. Published data were also taken into account, where relevant, and corresponding references are given in the text.

2.1.2. Methodology of chemical analysis

Chemical analysis was carried out using an Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES: Perkin Elmer Plasma 400) at the Fitch Laboratory, British School at Athens. For sample preparation a fragment of ca. 1 cm^3 was removed from each ceramic sherd, cleaned externally with a tungsten carbide drill, powdered in an agate mortar and allowed to dry overnight at ca. 105°C. Fifty mg of powdered sample (exactly weighed) were thoroughly mixed with double the quantity of lithium metaborate flux in a platinum crucible and heated in a muffle furnace to 1100°C. The fused bead was dissolved in 50 ml of a 20 % aqua regia solution (3:1 HCL: HNO_3) and kept in PET vials.

Fifteen elements were measured with the ICP-OES, in three separate methods as follows: MET1 (Mn, Fe, Mg, Si, Al, Ca, Ti), MET2 (Ni, Cr, Zr, Sc, Sr, Ba), and MET3 (Na, K). Prior to analysis each solution was diluted 1:10 times with ultrapure water for MET1 measurements and 1:2 for MET2 and MET3. The instrument was calibrated using two multi-element standards prepared from commercial analytical single element solutions (Alfa Aesar) and a blank, all matrix-matched to the samples. Calibration was repeated approximately every eight samples.

In order to monitor the performance of the instrument, multi-element solutions of known concentration, in the range expected for pottery, were prepared in the same way as the calibration standards and measured regularly among the samples during a run. In addition, one certified reference material (IAEA: SOIL7) and one noncalcareous clay standard from Portol[612] were dissolved, following the same procedure used for the archaeological samples, and one of them was measured at the start and end of each daily run. Based on the results gathered from the analyses of these two materials, estimates of overall precision and accuracy were produced (Table 3).

From the results given in Table 3, it is clear that overall analytical estimates for precision and accuracy

605 Whitbread 1986; 1989; 1995.
606 Bullock *et al.* 1985, fig. 24.
607 Bullock *et al.* 1985, fig. 27.
608 Bullock *et al.* 1985, fig. 31.
609 Gauss and Kiriatzi 2011.
610 Published in Whitbread 1995 (Corinthian pottery and transport ampora); Joyner 2007 (Corinth cooking wares); Cosmopoulos *et al.* 1999 (Eleusis); Moschonissioti *et al.* 2005 (Mende); de Domingo and Johnston 2003 (archaic transport amphorae).
611 Published in Farnsworth 1964 and Lawall 1995, respectively.
612 Tsolakidou *et al.* 2002.

	Precision (% r.s.d.)	Accuracy $100 * (x_m - x_c)/x_c$
Mg	2.3	0.1
Al	3.0	–2.5
Si	4.5	–7.5
Ca	4.2	0.2
Ti	2.3	2.4
Mn	2.1	1.5
Fe	1.2	–3.0
Sc	2.2	1.0
Cr	3.7	7.1
Ni	8.2	8.6
Sr	2.6	5.2
Zr	4.8	–6.1
Ba	2.2	12.5
Na	7.3	1.8
K	4.6	2.0

Table 3 Estimates of overall precision and accuracy for the entire group of samples based on 6 analyses of SOIL7 for MET1 elements, 5 analyses of Portol for MET2, and 7 analyses of Portol for MET3 (r.s.d.: relative standard deviation, x_m: mean, x_c: certified value)

are good and within the range expected for this technique. It should, however, be noted that both precision and accuracy worsen dramatically as concentrations approach the detection limits of the instrument. Based on the measurement of calcium in four Portol samples (certified concentration 0.47%), for example, estimates of precision and accuracy rise to 25 and 55% respectively, while similar calculations for potassium in four runs of Soil 7 (certified concentration 1.21%) give correspondingly 9 and 50%.

Appropriate multivariate statistical techniques were subsequently applied to the data using the Statistica 6.0 software. Initially, all the pottery data were logtransformed and treated using cluster analysis based on the unweighted group average of the squared Euclidean distance. All elements except sodium and potassium were used. The resulting dendrogram is shown in (Taf. 123). Given the nature of the samples, which include finds from diverse origins and possibly frequent 'singles' or small groups, the clustering was not expected to always produce clear and necessarily meaningful groupings. Instead, it was used to investigate and illustrate the chemical relationship between groups proposed by the archaeological and petrographic study, and is used in this way in the following discussion where necessary.

More than half of the analysed samples were considered as possibly local archaeologically and one of the primary aims of the current analytical examination was to examine whether this is supported by their mineralogical and chemical profile. The large suite of samples analysed in the context of the research project on Bronze Age Aeginetan pottery production provide useful comparative materials for this investigation, particularly as they have been analysed using the same analytical protocol.[613] The chemical composition data of assumed local pottery from Classical Kolonna were considered together with those of local Bronze Age fabrics (fabric groups FG1 and FG2), Aeginetan clays, experimental pastes, and modern pottery samples using principal component analysis of the logtransformed data.[614] Again, sodium and potassium contents were not included. The first two principal components are plotted in Taf. 124.

Drawing conclusions on the proposed provenance of samples recognised archaeologically and/or petrographically as imports, based on the chemical analysis results, is not straightforward for several reasons. First, comparative published analyses have been usually undertaken with techniques other than ICP-OES, in most cases discussed here using Neutron Activation Analysis (NAA). The commonly analysed elements are usually few, while the absence of interlaboratory calibration procedures does not allow direct data comparisons. Furthermore, in the context of the current study the number of samples included in each of the assumed as imported groups is always very small making it impossible to estimate fully intra-group chemical variability. For these reasons the chemical data of proposed imports in this study and comparative sets are not considered statistically, but rather qualitatively, discussing in each case whether they could support or not the proposed provenance.

2.2. Understanding local production

As already described, detailed macroscopic examination distinguished four groups (CMG 1–4) as probable local products (see section IX.1.2). Based on the evidence of petrographic and chemical analysis, representative samples of the latter groups were attributed to five fabrics (in some cases including further

[613] Kiriatzi *et al.* 2011.

[614] Description of the comparative samples can be found in Kiriatzi *et al.* 2011 (tables 38, 39, 41, and 49 for chemical data).

Macroscopic Group	Fabric (after petrographic analysis)	Suggested provenance
Local cooking ware		
CMG 1	Red Fabric A: Coarse volcanic (three sub-groups) Red Fabric B: Medium-coarse carbonate & volcanic	Aegina
	Variant (CKOL 112: Carbonate and volcanic with serpentinite)	Aegina?
Local fine ware		
CMG 2 (part), CMG 3 (part)	Buff Fabric A: Fine calcareous	Aegina
CMG 3 (part), CMG 4	Buff Fabric B: Medium carbonate & volcanic	Aegina
CMG 2 (part)	Buff Fabric C: Volcanic glass & pumice	unidentifiable origin
Loners	CKOL 25: Silicate; CKOL 30: Silicate & carbonate; CKOL 37:Chert & silicate	unidentifiable origin

Table 4a Macroscopic groups of assumed local pottery in association with the results of petrographic analysis (cf. Table 1)

		Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba
		%									ppm					
Red F (all) (53 samples)	mean	2.11	2.20	18.8	58.1	1.97	4.82	0.77	0.11	6.83	20	152	79	339	171	492
	r.s.d.	*16*	*13*	*5*	*4*	*15*	*20*	*8*	*22*	*7*	*9*	*34*	*41*	*15*	*14*	*19*
Red F A (39 samples)	mean	2.19	2.13	19.1	58.3	1.91	4.54	0.77	0.11	6.81	20	134	67	334	165	477
	r.s.d.	*13*	*10*	*5*	*4*	*13*	*15*	*8*	*21*	*7*	*10*	*26*	*32*	*13*	*12*	*20*
Red F B (13 samples)	mean	1.91	2.38	18.2	57.4	2.13	5.62	0.78	0.11	6.87	19	186	105	349	187	536
	r.s.d.	*20*	*14*	*5*	*6*	*18*	*21*	*8*	*24*	*5*	*4*	*18*	*27*	*21*	*15*	*16*
BA_FG1 (all) (44 samples)	mean	2.08	1.97	18.2	56.4	2.04	4.97	0.69	0.10	6.58	17	148	75	342	184	547
	r.s.d.	*13*	*16*	*5*	*6*	*13*	*21*	*9*	*28*	*13*	*15*	*30*	*27*	*12*	*11*	*17*
BA_FG1A (28 samples)	mean	1.99	2.02	18.1	56.6	2.09	4.98	0.72	0.11	7.02	18	160	78	323	184	562
	r.s.d.	*13*	*16*	*4*	*6*	*12*	*22*	*7*	*15*	*9*	*12*	*29*	*26*	*9*	*12*	*14*
BA_FG1B (16 samples)	mean	2.25	1.88	18.5	56.0	1.96	4.94	0.65	0.09	5.80	14	128	69	374	182	522
	r.s.d.	*8*	*15*	*6*	*6*	*12*	*20*	*8*	*44*	*10*	*10*	*23*	*29*	*10*	*11*	*21*
Buff F A (8 samples)	mean	1.37	3.41	9.62	43.0	1.71	18.3	0.59	0.06	5.51	15	450	332	442	116	242
	r.s.d.	*40*	*28*	*15*	*14*	*31*	*16*	*13*	*27*	*14*	*22*	*14*	*22*	*18*	*16*	*32*
Buff F B (4 samples)	mean	1.65	5.11	12.8	49.0	1.89	12.5	0.66	0.09	6.89	19	504	453	390	115	271
	r.s.d.	*24*	*12*	*13*	*10*	*34*	*27*	*5*	*4*	*6*	*17*	*7*	*18*	*6*	*5*	*40*
Buff F C (5 samples)	mean	2.03	3.38	13.4	46.9	1.84	15.0	0.64	0.10	5.45	13	180	113	554	162	269
	r.s.d.	*11*	*11*	*3*	*4*	*33*	*5*	*3*	*4*	*3*	*5*	*6*	*6*	*4*	*6*	*6*
BA_FG2Af (36 samples)	mean	1.21	3.80	10.5	52.8	2.06	14.0	0.62	0.07	5.90	15	615	361	371	138	304
	r.s.d.	*18*	*17*	*10*	*11*	*13*	*17*	*8*	*17*	*8*	*9*	*63*	*45*	*19*	*14*	*32*
BA_FG2Am (62 samples)	mean	1.30	3.25	11.1	52.9	2.00	13.7	0.61	0.07	5.77	14	455	288	348	143	321
	r.s.d.	*13*	*17*	*12*	*8*	*10*	*11*	*9*	*17*	*10*	*10*	*31*	*20*	*13*	*13*	*23*
BA_FG2B (30 samples)	mean	1.59	3.14	13.1	52.6	2.12	11.5	0.62	0.09	6.09	15	375	247	369	147	370
	r.s.d.	*14*	*23*	*10*	*7*	*10*	*17*	*12*	*20*	*15*	*13*	*16*	*19*	*15*	*18*	*17*

Table 4b Summary of chemical compositions for the fabric groups of the assumed local pottery with comparative data (shaded) for the identified Bronze Age Aeginetan fabric groups and subgroups (full data in Kiriatzi *et al.* 2011, C 3.2, Tables 41 and 48)

sub-groups), of which only four can be considered as local (Red Fabric A and B, Buff Fabric A and B), while the fifth fabric (Buff Fabric C) along with a number of individual samples (not falling into any fabric and being henceforth referred to as 'singles') are not local products and are considered as imports of unidentifiable origin. The final results of petrographic and chemical analyses are summarised in Tables 4a and b, respectively.

A summary of the geology of Aegina is given in the following section (IX.2.2.1), along with a short description of the clay-rich sediment deposits that are associated with potential raw materials sources for pottery manufacture. The results of petrographic and chemical analysis are presented in the subsequent section (IX.2.2.2 and 3), together with a detailed discussion of the provenance and manufacturing technology of each fabric group, which takes also into account former archaeometric, geological and experimental research on Aeginetan pottery.

2.2.1. The geology of Aegina

The island of Aegina forms one of the volcanic centres of the South Aegean Arc. The basement consists of Mesozoic limestone rock formations of various textures and consistencies, all belonging to an autochthonous series of the Subpelagonian Zone. It is covered by an overthrust series of Upper Cretaceous – Lower Eocene age, consisting of thrust sheets of flysch, Cretaceous limestones and ophiolitic mélange. Deep Pliocene sediment deposits are exposed across the northern part of the island, while the Pliocene-Pleistocene volcanic activity led to the construction of a subaerial volcanic edifice, which characterises today's steep mountainous landscape of central and south Aegina. This volcanic activity can be divided into two main phases; the first, of dacitic composition, dates to the Late Pliocene, while the second, of andesitic composition, dates to the Pleistocene. Limited Pleistocene multi-compositional deposits can be found near the coast or in drainage basins.[615]

Extended raw material sampling conducted in the frame of the Bronze Age Kolonna pottery research[616] identified two types of sediment deposits, where potential sources associated with pottery manufacture could be located. These deposits are considered to present very strong compositional (to some extent also textural) similarities to the raw materials used for the clay paste preparation of the various local pottery wares, be it Bronze Age or post-prehistoric period in date. The deposits can be classified into two broad categories: a) white-yellow clay-rich sediments of Pliocene age, located mainly in the northern lower lands of Aegina and consisting mainly of yellow fossiliferous marly clay formations which contain crystals of volcanic rock mineral constituents, and b) red coarse clay-rich alluvial deposits of the Pleistocene, rather limited and located close to the coast or in small inland basins, locally on slopes or along creeks, and containing abundant volcanic rock fragments and their constituents.[617]

2.2.2. Red Fabrics of presumed local origin (CKOL 80–85. 87–93. 96. 98–103. 106–112. 114–127. 129–140; Taf. 51–56. 75. 76. 83–85. 100–102. 106. 108. 109. 113. 116–118)

These fabrics include all the samples of the macroscopically defined group CMG 1, along with CKOL 84, which were assumed to be probable candidates for local products.

Petrographic Analysis

All samples belong to the same broad group characterised by medium-coarse to coarse fabrics, with red-firing, noncalcareous clay matrix and inclusions primarily associated with acid to intermediate volcanic rocks. The inconsistent presence of carbonate inclusions and textural differences divide this broad fabric group into two subgroups: a) Red Fabric A, being coarse and containing frequent volcanic rock fragments and very rare to absent carbonate inclusions (CKOL 80–84. 88–91. 96. 99–100. 102–103. 106–110. 114–124. 126–127. 129. 131–135. 137), and b) Red Fabric B, being medium-coarse, mainly including individual mineral constituents of volcanic rocks rather than actual rock fragments, as well as carbonate inclusions (micrite and microfossils) (CKOL 85. 87. 92–93. 98. 101. 111. 125. 130. 136. 138–140) (Table 5a).

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix optical activity
Red Fabric A (Coarse volcanic)					
80	mid/3rd qu. 6th c.	chytra, plain	dark red	Red Fabric A	active to moderately active
81	context late 1st/early 2nd qu. 5th c.	chytra, plain	dark red	Red Fabric A	active
82	context 3rd/early 4th qu. 5th c.	chytra, plain	dark red	Red Fabric A	active to moderately active
83	context late 3rd/early 4th qu. 5th c.	chytra, plain	dark red	Red Fabric A	active
84	context 3rd/early 4th qu. 5th c.	chytra, plain	dark red	Red Fabric A	inactive
88	context late 1st/early 2nd qu. 5th c.	jug	dark red	Red Fabric A	active
89	context 3rd qu. 5th c.	jug	dark red	Red Fabric A	active

[615] Dietrich *et al.* 1991; Piper and Piper 2002, 398–400; for a detailed discussion of the geology of Aegina and geological map see Kiriatzi *et al.* 2011, 71–74, fig. 32.

[616] Kiriatzi *et al.* 2011, 74–81, tables 33–39.

[617] For further discussion of potential raw materials sources see Kiriatzi *et al.* 2011, 71–92.

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix optical activity
Red Fabric A (Coarse volcanic)					
90	context late 1st/early 2nd qu. 5th c.	jug	dark red	Red Fabric A	active
91	context late 1st/early 2nd qu. 5th c.	jug	dark red	Red Fabric A	slightly active to inactive
96	context 3rd/early 4th qu. 5th c.	jug	dark red	Red Fabric A	active
99	context late 3rd/early 4th qu. 5th c.	amphoriskos	dark red	Red Fabric A	moderately active
100	context late 3rd/early 4th qu. 5th c.	amphoriskos	dark red	Red Fabric A	active
102	3rd qu. 5th c.	chytra, lidded	dark red	Red Fabric A	active
103	mid to early 3rd qu. 4th c.	lopas	dark red	Red Fabric A	slightly active
106	mid to early 3rd qu. 4th c.	lopas	dark red	Red Fabric A	moderately active to slightly active
107	context late 1st/early 2nd qu. 5th c.	bowl	dark red	Red Fabric A	active
108	context 3rd/early 4th qu. 5th c.	bowl	dark red	Red Fabric A	active to moderately active
109	context 2nd half 5th c.	bowl	dark red	Red Fabric A	active
110	context ca. 430/20	bowl	dark red	Red Fabric A variant 2	active
114	context mainly 3rd qu. 5th c.	plate	dark red	Red Fabric A variant 1	active to moderately active
115	context 3rd/early 4th qu. 5th c.	plate	dark red	Red Fabric A variant 1	active
116	context 2nd half 5th c.	plate	dark red	Red Fabric A variant 2	active
117	context ca. 460/30	plate	dark red	Red Fabric A variant 2	active
118	context mainly 3rd qu. 5th c.	plate	dark red	Red Fabric A	active
119	context late 3rd/early 4th qu. 5th c.	eschara	dark red	Red Fabric A	active
120	context late 6th/early 5th c. to 3rd qu. 5th c.	eschara	dark red	Red Fabric A	active
121	context mainly 3rd qu. 5th c.	eschara	red (layer)	Red Fabric A variant 1	active to moderately active
122	5th c.	bowl	red (layer)	Red Fabric A variant 1	active to moderately active
123	context ca. 460/30	eschara	dark red	Red Fabric A variant 2	active
124	context 2nd half 5th c.	lid	dark red	Red Fabric A variant 2	active
126	context 3rd/early 4th qu. 5th c.	hearth	dark red	Red Fabric A	active to moderately active
127	context ca. 460/30	storage vessel	red (layer)	Red Fabric A variant 1	moderately active to slightly active
129	context 2nd/early 3rd qu. 5th c.	storage vessel	dark red	Red Fabric A variant 1	active to moderately active
131	context late 6th/early 5th c. to 3rd qu. 5th c.	hearth	dark red	Red Fabric A	active to moderately active
132	context advanced 3rd/early 4th qu. 5th c.	hearth	dark red	Red Fabric A	active
133	context ca. 430/20	hearth	dark red	Red Fabric A	active
134	context mainly mid/early 4th qu. 5th c.	grill	dark red	Red Fabric A	inactive
135	context ca. 430/20	hearth	dark red	Red Fabric A variant 1	active to moderately active
137	context 3rd/early 4th qu. 5th c.	lamp	dark red	Red Fabric A	active
Red Fabric B (Medium-coarse carbonate & volcanic)					
85	context late 4th c. to 1st half 2nd c.	chytra, lidded	dark red	Red Fabric B	slightly active to inactive
87	context 1st half 4th c.	chytra, lidded	dark red	Red Fabric B	slightly active
92	context late 3rd/early 4th qu. 5th c.	jug	dark red	Red Fabric B	slightly active to inactive
93	context 3rd qu. 5th c.	jug	dark red	Red Fabric B	active to moderately active
98	context late 3rd/early 4th qu. 5th c.	amphoriskos	dark red	Red Fabric B	active to moderately active
101	3rd qu. 5th c.	lopas	dark red	Red Fabric B	active
111	context ca. 460/30	bowl	dark red	Red Fabric B	active
125	context ca. 430/20	lid	dark red	Red Fabric B	active
130	context 3rd/early 4th qu. 5th c.	sieve	red (layer)	Red Fabric B	active to slightly active
136	context 2nd/early 3rd qu. 5th c.	lamp	dark red	Red Fabric B	active to slightly active
138	probably 5th c.	lamp	dark red	Red Fabric B	active to moderately active
139	context ca. 460/30	lamp	red (layer)	Red Fabric B	active to slightly active
140	2nd half 4th c.	waster	dark red	Red Fabric B	inactive
Red Fabric B Variant (Carbonate & volcanic with serpentinite)					
112	context mixed	bowl	dark red		active

Table 5a Red Fabric pottery samples of presumed local origin and summary of attributes

Red Fabric A has an orange brown to reddish brown micromass in XP with 3–10% voids,[618] while Red Fabric B has an orange brown to dark red micromass in XP with 3–7% voids (10% in CKOL 140 due to vitrification). In Red Fabric A (Taf. 125. CKOL 103), inclusions are common to few, subangular to subrounded, moderately to well sorted, with fine to medium sand mode sizes, maximum grain size reaching very coarse sand.[619] Red Fabric A is characterised by frequent plagioclase and dacite/andesite fragments (predominantly of the hornblende-biotite variety, few pyroxene-hornblende ones), common to few hornblende (frequently oxyhornblende and commonly hornblende with brown to green pleochroism), common to very few biotite, few alkali feldspar (some sanidine present), very few opaques (probably magnetite), very few pyroxenes (predominantly augite), and rare micritic calcite and sponge spicules. It has to be noted that sample CKOL 107 also contains few sedimentary rock fragments (sandstone).

In Red Fabric B (Taf. 125. CKOL 87), inclusions are common, subangular to rounded, moderately sorted (with end members being either well or poorly sorted), with fine sand mode sizes, maximum grain size reaching coarse sand. Red Fabric B is characterised by plagioclase, micritic limestone fragments, dacite / andesite fragments (mainly of hornblende-biotite composition), accompanied by alkali feldspar, amphibole (oxyhornblende and hornblende with brown to green pleochroism), very few biotite laths, opaques (magnetite?), sponge spicules and rare pyroxene grains (augite).

All samples from both subgroups refired dark red,[620] implying the use of similar types of noncalcareous clays, except CKOL 130 and CKOL 139 which refired red, possibly pointing to some variation in the clay recipes used. The optical activity of the groundmass for the majority of the samples for both subgroups suggests original firing temperatures around/below 800°C, in few occasions reaching higher temperatures. All cooking ware shapes seem to be represented in this broad fabric, although the more sturdy shapes like escharai, plates, portable hearths and storage bins are encountered only in Red Fabric A.

The textural and compositional variation between Red Fabric A and Red Fabric B may be associated with consistently different technological choices or could be explained by natural variation within the raw materials collected from a wide area without adherence to strictly standardised criteria. Such variation is further observed in two small clusters of samples falling into Red Fabric A. Samples CKOL 114–115. 121–122. 127. 129. 135 differ from the core group mainly due to the presence of streaks of clay with dense, fine silt-sized silicate inclusions (Taf. 125. CKOL 115). Moreover, their refiring colour is not homogeneous since some samples refired in a lighter hue of red. The above may reflect clay mixing or the use of more than one clay sources, possibly comprising a variation to the basic recipe represented by the majority of Red Fabric A samples. The samples of this variety concern plates, escharae, storage vessels and a portable hearth example, all dated throughout the 5th c. BC. A second set of samples (CKOL 110. 116–117. 123–124) is characterised by the presence of pyroxene or pyroxene-hornblende andesite fragments in higher frequency and much larger sizes (granule to pebbles) in comparison to the core group, resulting in a poorly sorted and considerably coarser fabric (Taf. 125. CKOL 124). This cluster presents the same dark red refiring colour as the core group, pointing to the use of the same type of clay base despite the use of temper of a slightly different composition (possibly pointing to a different source of similar nature), and concerns bowls, plates, escharae and lids dated throughout the 5th c. B.C.

Further variation is demonstrated by CKOL 112, which contains plagioclase, alkali feldspar, micritic limestone and serpentinite fragments, along with few chert and volcanic rock fragments (Taf. 125. CKOL 112). Despite the unique occurence of certain types of inclusions, CKOL 112 bears a fair compositional resemblance to the core group (especially Red Fabric B), as the volcanic rock fragments and their constituents (plagioclase, oxyhornblende) present strong mineralogical similarities to the ones identified in all samples of the core group.

Chemical Analysis

Chemically, the samples in this fabric group form a relatively coherent set, particularly taking into

618 Abbreviations of the polars setting: PPL: plane polarised light; XP: crossed polars.

619 Grain size characterisations follow the Wentworth Sediment Size Scale: boulder: >256mm; cobble: 64–4mm; pebble: 4–2mm; granule: 2–1.0mm; very coarse sand: 1.0–0.5mm; coarse sand: 0.5–0.25mm; medium sand: 0.25–0.125mm; fine sand: 0.125–0.0625mm; very fine sand: 0.0625–0.031mm; coarse silt: 0.031–0.0156mm; medium silt: 0.0156–0.0078mm; fine silt: 0.0078–0.0039mm; clay: <0.0039 mm.

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
Red Fabric A																
80	2.30	1.89	18.1	59.7	1.88	3.97	0.88	0.11	6.43	20	133	114	347	176	440	95.3
81	2.08	1.88	17.8	59.3	2.04	4.16	0.94	0.11	7.01	19	162	73	319	166	363	95.3
82	2.10	2.11	19.1	57.7	2.17	4.80	0.78	0.08	7.01	21	158	95	414	188	759	95.9
83	1.90	1.88	18.9	58.0	1.87	4.55	0.80	0.10	7.48	21	181	85	273	175	446	95.4
84	1.68	2.53	19.1	60.8	1.96	4.87	0.80	0.10	7.55	20	198	120	287	166	513	99.4
88	2.50	1.94	19.3	57.8	1.99	4.02	0.71	0.08	6.79	18	109	62	322	118	340	95.2
89	1.91	1.86	19.1	58.5	2.28	3.09	0.82	0.13	7.60	19	152	85	245	176	345	95.3
90	1.87	2.11	19.2	55.7	1.98	3.19	0.82	0.05	7.71	23	143	87	270	154	304	92.6
91	2.17	2.19	19.0	55.6	1.87	5.18	0.75	0.13	7.53	20	215	80	358	156	615	94.4
96	2.37	1.98	18.4	56.2	2.07	3.86	0.76	0.08	6.98	18	172	94	342	177	560	92.8
99	2.01	2.29	19.1	55.1	1.67	5.28	0.74	0.11	7.23	21	175	87	324	167	513	93.5
100	1.96	2.17	19.2	56.3	2.20	3.46	0.85	0.11	7.47	20	221	100	327	190	623	93.6
102	1.97	1.99	17.8	58.2	2.03	3.68	0.72	0.07	6.53	18	158	63	260	167	394	93.0
103	1.99	2.55	20.2	61.4	2.15	4.45	0.75	0.11	6.81	18	123	50	277	170	447	100.4
106	1.77	2.79	18.4	58.9	2.23	3.90	0.69	0.09	6.85	17	114	67	240	176	448	95.6
107	1.84	1.73	17.0	61.9	2.18	3.82	0.83	0.14	6.68	18	122	70	267	196	373	96.2
108	2.00	2.15	20.2	60.6	1.73	6.07	0.79	0.12	7.06	21	123	53	374	157	401	100.7
109	2.12	1.95	19.0	58.3	2.26	4.83	0.71	0.12	6.77	18	151	63	361	163	654	96.1
110	2.53	2.08	19.2	59.2	1.89	5.59	0.71	0.10	6.31	20	70	35	383	132	478	97.6
114	2.49	2.33	20.2	57.3	1.78	5.26	0.76	0.15	6.55	21	102	70	370	135	556	96.8
115	2.19	2.34	18.6	54.7	1.65	4.91	0.74	0.11	6.27	20	145	93	358	134	400	91.5
116	2.44	2.10	19.1	58.3	2.29	4.11	0.72	0.08	6.27	21	125	57	325	169	401	95.4
117	2.39	2.06	19.2	59.4	2.06	4.43	0.71	0.10	6.09	21	101	54	343	153	445	96.5
118	2.48	1.90	17.4	55.6	2.02	4.37	0.58	0.09	5.54	16	111	43	332	142	489	89.9
119	2.04	2.19	18.5	60.8	1.30	4.19	0.76	0.10	6.21	19	127	55	311	207	463	96.0
120	2.12	1.92	17.3	59.1	2.17	4.00	0.74	0.08	5.92	18	146	70	314	185	451	93.3
121	2.19	2.33	20.6	58.9	1.67	5.06	0.75	0.09	6.91	22	101	44	330	154	459	98.4
122	2.04	2.00	18.8	57.1	1.74	4.48	0.85	0.15	7.53	23	92	48	339	170	634	94.7
123	2.15	2.18	19.6	57.2	1.73	4.76	0.81	0.14	6.81	22	139	88	363	158	531	95.4
124	2.24	1.94	18.9	53.4	1.80	4.16	0.76	0.10	6.51	21	142	62	360	182	409	89.8
126	2.17	2.32	19.1	54.9	1.80	5.00	0.73	0.11	6.66	23	142	48	369	132	400	92.8
127	1.91	2.40	20.1	60.5	1.52	4.51	0.86	0.13	7.23	24	115	54	340	179	466	99.2
129	2.80	2.14	18.4	60.6	2.29	5.65	0.82	0.13	7.06	21	109	45	397	174	511	99.9
131	2.94	2.22	20.9	58.3	1.86	5.07	0.79	0.10	7.18	23	90	50	407	172	597	99.4
132	2.69	2.21	20.0	57.7	1.86	4.76	0.77	0.13	6.88	23	118	47	346	154	444	97.0
133	2.45	2.06	19.2	60.5	1.78	4.26	0.71	0.08	6.23	20	128	69	326	182	441	97.3
134	2.23	2.24	19.9	59.0	1.61	5.79	0.70	0.10	6.47	21	131	45	339	138	513	98.0
135	2.38	2.21	20.5	59.9	1.36	4.99	0.77	0.11	6.85	25	77	39	404	172	491	99.0
137	2.08	1.94	18.9	61.2	1.93	4.71	0.77	0.10	6.56	20	105	52	362	170	486	98.2
Red Fabric B																
85	2.05	2.56	18.8	56.8	2.22	5.92	0.86	0.15	7.39	20	181	93	380	189	554	96.8
87	1.85	2.55	18.7	57.2	1.75	8.17	0.85	0.16	6.95	19	168	89	407	174	560	98.2
92	1.73	2.55	18.9	53.8	1.93	5.66	0.75	0.11	7.43	20	200	113	303	161	432	92.9
93	0.88	3.05	16.1	49.5	3.02	6.06	0.82	0.12	7.16	19	265	171	135	153	293	86.7
98	2.11	2.51	17.5	52.1	2.00	6.55	0.77	0.10	6.64	19	184	107	404	151	515	90.3
101	1.98	2.17	18.9	61.5	2.31	4.21	0.74	0.07	6.75	19	164	76	343	247	534	98.6
111	1.96	1.90	17.6	60.2	2.42	5.71	0.74	0.08	6.61	18	199	82	359	166	614	97.2
125	2.15	2.21	17.1	56.6	2.31	4.44	0.67	0.09	6.24	18	190	124	360	173	599	91.8
130	2.28	2.47	18.9	58.8	2.36	4.28	0.81	0.10	6.92	21	218	127	323	206	596	96.8
136	2.43	2.31	18.1	58.6	2.10	5.69	0.70	0.09	6.47	19	172	122	399	180	592	96.5
138	1.84	2.32	18.1	58.9	1.87	4.91	0.79	0.12	6.84	19	163	96	361	216	509	95.7
139	1.85	1.77	19.0	62.0	1.50	4.40	0.84	0.14	6.85	20	120	61	352	200	566	98.4
140	1.67	2.59	19.0	59.5	1.85	7.11	0.83	0.15	7.11	20	199	111	412	211	601	99.7
Red Fabric B Variant																
112	1.72	2.78	17.1	60.5	2.15	5.15	0.81	0.12	7.28	19	379	191	391	184	527	97.6

Table 5b Results of chemical analyses (ICP-OES) for Red Fabric pottery samples of presumed local origin

account their coarseness. They show low to medium relative standard deviations for all analysed elements, generally not exceeding approximately 20%, with the exception of nickel and chromium, further discussed below (see data for Red Fabric group and subgroups in Table 5b). The dendrogram produced by cluster analysis of all chemical data (Taf. 123), as described in the previous section, is divided into two main clusters (at a linkage distance of 0.9) and 11 loners at the left of the diagram. Apart from CKOL 93 and CKOL 112, all other Red Fabric samples of presumed local origin clustered together in the left of these two main clusters (Taf. 123), confirming their compositional association also indicated by petrographic analysis. Their chemical profile is characterised by high silicon (SiO_2: 50–62%) and aluminium (Al_2O_3: 16–21%) contents and low to medium calcium (CaO: 3–8%). Among the trace elements the broadly low nickel and chromium levels are distinctive (see below). This observation partly explains the higher variation noted in these two elements, as the contents, particularly in the case of nickel, approach the detection limits of the technique (see section IX.2.1.2 on methodology). Hence, the higher relative standard deviation values noted in Table 4b, are to a large extent due to inherent analytical limitations. Also notable are the relatively high scandium (15–25 ppm) and barium (300–760 ppm) contents.

The internal subgroups defined petrographically are not similarly distinguished on the basis of the chemical analysis. Although some of the Red Fabric B samples cluster together (e.g. CKOL 87. 140. 85 and CKOL 130. 136. 125. 98. 92) there is otherwise no direct correspondence with the sub-clusters of the dendrogram (Taf. 123). Similarly, looking at Table 4b, the separation of these samples into Red Fabric A and B samples does not result in tighter groups (i.e. lower relative standard deviations) compared to considering all Red Fabric samples together. Broadly, however, a general tendency for lower calcium, nickel, and chromium contents in the Red Fabric A samples compared to Red Fabric B can be noted, in accordance with their mineralogical differences (see discussion below).

Sample CKOL 93 shows significant differences in its chemical composition both in terms of major/minor as well as trace element composition (Table 5b). More specifically, silicon and aluminium contents are somewhat depressed relative to iron, magnesium, and calcium compared to other members of this fabric group. It shows by far the lowest strontium and barium content of all Red Fabric samples, and, together with CKOL 112, the highest nickel and chromium. The latter two appear to be the main discriminating elements separating CKOL 112 from the other Red Fabric samples.

Discussion of the Analytical Data

On discussing the probably local provenance of these samples, information on the geology of Aegina along with previous analytical work on pottery from the island was taken into account. The latter includes petrographic and chemical analyses of Bronze Age pottery from Kolonna, raw materials from Aegina, experimental mixes, and local traditional pottery of modern times.[621]

This broad fabric group can be considered as local to Aegina and is related to clay-rich Pleistocene sediments in the vicinity of volcanic formations located in central and south Aegina. It strongly resembles the Bronze Age FG1 in terms of composition,[622] the only diverging feature being the consistent presence of sponge spicules in the Classical samples. They are rare, but present, in Red Fabric A and more frequent in Red Fabric B, in association with other carbonates (micrite lumps). The occurrence of sponge spicules could be explained in various ways. One approach would consider this as the result of the intentional addition (of a limited quantity and in varied proportion) of fossiliferous Pliocene sediments found in specific locations of the northern part of Aegina. In this case, the difference between subgroups A and B may reflect the mixing of the same materials in different proportions. An alternative explanation would be the use of raw material sources located in the interface of Pleistocene volcanic sediments and the aforementioned Pliocene sediments, the variation between the two subgroups thus reflecting natural variation in

620 Refiring colour characterisations used in the text correspond to the following range of Munsell Soil Colour Chart values (1975 edition): buff (10YR 8/3 very pale brown, 10YR 8/4 very pale brown, 10YR 7/3 very pale brown, 10YR 7/4 very pale brown, 10YR 7/6 yellow); light red (10YR 6/4 pale red, 10YR 5/6 red, 2.5YR 6/4 light reddish brown, 2.5YR 6/6 light red); light pinkish brown (2.5YR 6/4 light reddish brown); light brown (7.5YR 7/4 pink, 7.5YR 6/6 reddish yellow, 5YR 7/4 pink); brownish red (5YR 5/8 yellowish red); red (2.5YR4/8 red, 2.5YR5/8 red); dark red (2.5YR 4/4 reddish brown, 2.5YR 4/6 red, 2.5YR 3/4 dark reddish brown, 2.5YR 3/6 dark red).

621 Kiriatzi *et al.* 2011.

622 Kiriatzi *et al.* 2011, 93–99.

the composition of a single raw material, whose source is located in the interface zone. Within Red Fabric A, a cluster of samples shows streaks of clay with dense, fine silt-sized silicate inclusions, which may indicate the mixing of a very fine-grained sediment to the coarse volcanic clay base. Furthermore, the presence of distinctively larger grains of volcanic rocks in another cluster of samples within the same subgroup could also be associated with the use of not thoroughly cleaned clay base or the addition of sand grains of a different variety of andesite/dacite (nevertheless, bimodality is not observed).

Although this broad fabric group is very similar compositionally to Bronze Age FG1, texturally it presents some differences, mainly due to the better sorting of its inclusions. This textural difference is probably the result of more systematic cleaning/sieving of the clay. Better sorting has an impact to inclusion frequencies, since the larger grains, which were removed by cleaning, were predominantly the andesite/dacite fragments that are dominant in the Bronze Age FG1, whereas in the Classical pottery samples they follow plagioclase in frequency. The broad definition of two subgroups (Red Fabric A and B), as well as some variation observed within Red Fabric A, may represent technological variation associated with the variable use of the same basic recipe within the same geological setting, possibly by a number of production units. Alternatively, such variation may be related with natural variation in the composition of the similar types of raw materials selected from locations within the same geological zone. In this context, the differences, both mineralogical and chemical, recognised in the variant sample of this group CKOL 112, might be due to a clay mix with Pliocene sediments of the lower levels, which contain serpentinite and chert rock fragments.[623]

The chemical relationship between presumed local pottery of the Classical period discussed in this section and known Aeginetan fabrics and raw materials was investigated using principal component analysis (see methodology section IX.2.1.2) and the first two principal components are plotted in Taf. 124. The chemical association of the Red Fabric samples with the Bronze Age FG1 fabric is clear from this diagram as well as by looking at the relevant data in Table 4b. It is noteworthy that the majority of Classical samples plot more closely between them than the Bronze Age FG1, indicating less chemical variability, and hence more homogeneity in the clay paste preparation. Interestingly, these samples fall in the part of the diagram occupied primarily by the Bronze Age subgroup FG1A, the typical fabric in use for cooking pots during the Middle and Late Bronze. As it has been argued in the context of Aeginetan pottery production during the Bronze Age, the use of this fabric (FG1A) marked a shift in the location of raw material sources in comparison to the earlier periods (FG1B), most possibly from inland locations to a restricted zone south of Kolonna in the vicinity of the Koutalou type dacites.[624] The close resemblance of the Classical Red Fabric with FG1A may reflect the use of the same raw material sources in the vicinity of Kolonna for the production of cooking wares. So, it can be argued that the types, and possibly sources, of raw materials used during the Classical period for cooking wares were similar to the ones exploited in the Middle and Late Bronze Age, although it seems that the preparation of the clay paste may have involved a slightly different procedure.

Petrographic Description

Red Fabric A – core group: coarse volcanic (CKOL 80–4. 88–91. 96. 99–100. 102–103. 106–109. 118–120. 126. 131–134. 137)

Microstructure

There are very few to few voids, frequently mesoplannar voids and commonly mesovughs. Rarely voids have micritic calcite infillings. The c:f related distribution is single to double spaced porphyric related distribution (when coarse-grained, distribution is close- to single-spaced). Frequently voids (predominantly plannar voids) and few inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections, although few display colour differentiation, having a darker coloured core, while uneven distribution of inclusions (concentrations of inclusions) is rarely observed (CKOL 90.

[623] Such clay-rich sediments are located in Vathy but also Kolonna itself; see Kiriatzi *et al.* 2011, 72–74, 78–80 for detailed description and discussion, in particular of AGS42.

[624] Kiriatzi *et al.* 2011, 131–134 and geological map of fig. 32.

102). The micromass is predominantly optically active (to moderately active), reddish brown to brown in PPL (x25), orange brown to reddish brown in XP (x25); in few sections it is slightly active to inactive, reddish brown / brown to dark reddish brown in PPL (x25), dark reddish brown to dark red in XP (x25); rarely inactive, dark brown in PPL (x25), very dark red to inactive in XP (x25).

Inclusions

c:f:$v_{125\mu m}$	35:55:10 to 25:72:3 (coarse samples) 20:77:3 to 15:80:5 (medium-coarse samples)

The inclusions are moderately to well sorted, <1.7mm, mode 0.2mm, sa–sr.[625] Size distribution seems unimodal (to bimodal in CKOL 80. 90. 118. 119).

Fine fraction <125µm

Dominant	FELDSPAR, predominantly plagioclase, few could be sanidine, sa–sr.
Few	AMPHIBOLE, brown (probably hornblende), frequently diamond shaped, sa–sr.
	BIOTITE, laths.
	OPAQUES, sr, black in PPL, black in XP.
Rare	MICROFOSSILS, sponge spicules.

Coarse fraction >125µm

Frequent	PLAGIOCLASE, <0.9mm, mode 0.2mm, sa, mainly andesine with albite, Carlsbad and, rarely, also periclinic twinning, few with zoning, dominantly fresh, few (to commonly) weathered.
	VOLCANIC ROCK FRAGMENTS, <1.7mm, mode 0.25–0.4mm, sa–sr. The rock fragments show hyalophyric to porphyritic texture, are dominantly weathered, and consist mainly of a glassy matrix with plagioclase and brown amphibole and/or pyroxene phenocrysts, biotite flakes and black opaques. Plagioclase, predominantly andesine (some albite also present), have albite and Carlsbad twinning, while few have a cloudy appearance. Brown hornblende (predominantly oxyhornblende) is commonly corroded (with a rim of opaque minerals), few showing brown to green pleochroism, twinning is rarely observed. Biotite flakes/laths are few and usually oxidised. Pyroxene is dominantly clinopyroxene (probably augite, colourless in PPL, sometimes with twinning) while orthopyroxene is common. Glassy groundmass occasionally has perlitic cracks. In general, these fragments could be characterised as dacite or hornblende – biotite andesite, with few examples of pyroxene – hornblende composition. Only in CKOL 90 the volcanic rock fragments contain green, instead of brown, hornblende. Common to few fragments of volcanic glass with minute feldspar crystals, few with perlitic cracks.
Common–few	AMPHIBOLE, <0.65mm, mode 0.2–0.15mm, a–sr, with brown pleochroism (oxyhornblende) or brown to green pleochroism (green amphibole with pleochroism from pale green/green to green/olive green only in CKOL 90), frequently diamond-shaped with typical amphibole cleavage, but also few anhedral, lath-like examples exist. Few are twinned or corroded (with rim of opaque minerals).
Common–very few	BIOTITE, <0.9mm, mode 0.2mm, flakes and laths commonly oxidised.
Few–very few	ALKALI FELDSPAR, <0.8mm, mode 0.2mm, sa–sr, predominantly fresh, very few weathered. Some sanidine might be present, microcline (?) only in CKOL 118.
Very few	QUARTZ, monocrystalline, mode 0.2mm, sa–sr.
	OPAQUES, mode 0.2–0.1mm, sr, predominantly black in PPL, black in XP, rarely orange red in PPL, very dark orange red in XP.
Very few–rare	PYROXENE, <0.8mm, mode 0.2–0.1mm, sa–sr. Predominantly clinopyroxene (augite, colourless in PPL, sometimes with twinning) while orthopyroxenes are common. In

[625] The following abbreviations are used for grain roundness characterisation: a=angular; sa=sub-angular; sr=sub-rounded; r=rounded; wr=well-rounded.

	CKOL 126 a grain 0.7mm is probably a very altered pyroxene (unique example).
Rare	Microfossils, sponge spicules, <0.35mm, mode size falls into the fine fraction.
	Calcite, micritic, <0.8mm, mode 0.35–0.15mm, r–sr (CKOL 82. 84. 89. 119).
Very rare	Sandstone (?), only in CKOL 107 (Few), <1.4mm, mode 0.6mm, sa–sr; consisting of volcanic rock fragments, plagioclase, biotite, brown and green amphibole, rarely quartz (?), in Fe oxides matrix (possibly also rare clay minerals).
	Shale (?), only in CKOL 107 (Few), <0.65mm, mode 0.2–0.15mm, sr, not certain whether actual shale or the product of extensive sericitisation.

Textural Concentration Features

Few – very few (CKOL 80. 83. 88. 89. 90. 102. 119–120. 132. 133), the majority is probably clay pellets. Due to the variability observed, only the commonest types are described.

Dark red (PPL, x50) and red to dark red (XP, x50), <0.8mm, mode 0.3, boundaries clear to diffuse, sr–r, equant shape, (neutral to) high optical density, discordant with the external fabric (CKOL 89. 120).

Red to dark red (PPL, x50) and dark red to very dark red (XP, x50), <0.4mm, mode 0.15mm, boundaries clear to diffuse, sr–r, equant shape, neutral to high optical density, discordant with the external fabric (CKOL 88. 90).

Brown to reddish brown (PPL, x50) and dark red to dark orange red (XP, x50), <1.2mm, mode 0.25–0.4mm, boundaries clear to diffuse, r–sr, equant shape, neutral to high optical density, discordant with the external fabric (silicate inclusions, in one case also biotite) (CKOL 102).

Red Fabric A variant 1 (CKOL 114–115. 121–122. 127. 129. 135)

The above description applies with the following changes:

Porphyric related distribution is single- to double-spaced.
Not homogeneous throughout the section due to areas/streaks that have only fine silt-sized inclusions in dense concentrations (in CKOL 122. 129 this fine silt is evenly or rather evenly distributed in the fine fraction). The micromass is dominantly active to moderately active, presenting the same range of colours as mentioned above.

Fine fraction <125μm c:f:v 25:74:1

Predominant	Alkali feldspar/Quartz, 0.02–0.03mm, sa–sr.
Few	Biotite, 0.02–0.03mm, laths.
	Amphibole, with brown and brown-green pleochroism (probably hornblende), 0.02–0.03mm, sa–sr.
Very few	Opaques, sr, black in PPL, black in XP.

Red Fabric A variant 2 (CKOL 110. 116–117. 123–124)

The above description applies with the following changes:

Porphyric related distribution is close- to single-spaced.
The micromass is optically active, reddish brown in PPL (x25), orange brown in XP (x25).

$c{:}f{:}v_{125\mu m}$ 35:60:5 to 30:65:5
The inclusions are moderately to poorly sorted, <5.2mm, mode 0.2–0.4mm, sa–sr. Size distribution is unimodal.

Frequent	Intermediate volcanic rock fragments, <5.2mm, mode 0.4–0.6mm, sa–sr. The rock fragments show hyalophyric to porphyritic texture, are dominantly weathered, and consist mainly of a glassy matrix with plagioclase and brown amphibole and/or pyroxene phenocrysts, biotite flakes and black opaques (magnetite?). The larger fragments, though, frequently have porphyritic texture with larger feldspar crystals in the groundmass, and have pyroxene phenocrysts (both clinopyroxene and orthopyroxene) commonly accompanied by brown hornblende phenocrysts. Plagioclase and brown hornblende have the same characteristics as in core group samples. Pyroxene can be clinopyroxene (probably augite, colourless in PPL, sometimes with twinning) and/or ortho-

pyroxene (colourless in PPL). Apart from hornblende biotite andesite, which is present with medium to coarse sand sizes, there is also pyroxene – hornblende andesite, in larger quantities than in the core group samples but mainly in grains larger in size, reaching granule or very small pebble sizes. Few fragments of volcanic glass with minute feldspar crystals and/or perlitic cracks.

Red Fabric B: medium-coarse carbonate & volcanic (CKOL 85. 87. 92–93. 98. 101. 111. 125. 130. 136. 138–140)

Microstructure

There are very few to few voids, frequently mesovughs and commonly mesoplannar voids. Few voids have infilling or coating of micritic calcite. The c:f related distribution is single- to double-spaced porphyric related distribution. Voids and inclusions are dominantly randomly orientated.

Groundmass

Rather homogeneous throughout the sections, although frequently colour variation is observed (darker colour in the core, probably due to firing conditions). The micromass is optically active to moderately active, reddish brown to brown in PPL (x25), orange brown to dark brown or dark red in XP (x25); slightly active to inactive, dark brown in PPL (x25), very dark reddish brown to very dark red in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 20:77:3 to 30:63:7

The inclusions are moderately to well sorted (also few samples are moderately to poorly sorted), <0.85mm, (1mm in CKOL 140), mode 0.2mm, sa–r. Size distribution is unimodal.

Frequent–common	Plagioclase, <0.85mm, mode 0.2mm, sa, predominantly andesine (few albite to oligoclase also present) with albite, Carlsbad and, rarely, also periclinic twinning, few with zoning, dominantly fresh, few weathered.
Frequent–few	Calcite, micritic <0.7mm, mode 0.2mm, r–sr, few with isotropic rim (due to vitrification?).
	Volcanic rock fragments, <0.7mm, mode 0.2–0.3mm, sa–sr. The rock fragments show hyalophyric to porphyritic texture, are commonly weathered, and consist mainly of a glassy matrix with plagioclase, brown amphibole and/or pyroxene phenocrysts, biotite laths and opaques. Plagioclase, mostly andesine, have albite and Carlsbad twinning, while few have a cloudy appearance. Pyroxene is dominantly clinopyroxene (probably augite, colourless in PPL, sometimes with twinning) although orthopyroxene is also observed. Brown hornblende (oxyhornblende) is commonly corroded (with rim of opaque minerals), while there are few examples of oxidised biotite laths. Volcanic glass fragments occasionally have perlitic cracks. In general, these fragments could be characterised as dacite or hornblende – biotite andesite, with few examples having pyroxenes as additional constituents.
Common–few	Alkali feldspar, <0.5mm, (1mm in CKOL 140) mode 0.2mm, sa–sr, dominantly fresh, few weathered. Some sanidine might be present.
Few–common	Amphibole, <0.75mm, mode 0.2–0.1mm, a–sr, hornblende with brown or brown to green or green pleochroism, frequently diamond-shaped, but few anhedral, lath-like examples exist. Few are twinned or oxidised.
Very few	Quartz, monocrystalline, mode 0.2mm, sa–sr.
	Biotite, <0.4mm, mode 0.1–0.2mm, laths commonly oxidised.
	Opaques, <0.6mm, mode 0.2–0.1mm, sr, black in PPL, black in XP.
Rare–very few	Microfossils, predominantly sponge spicules, rarely foraminifera, <0.3mm, mode 0.05–0.1mm.
	Pyroxene, <0.3mm, mode 0.15–0.1mm, sa, predominantly clinopyroxene (augite).
Very rare	Mudstone, 0.85mm, sr, radiolarian (CKOL 93).
	Shale (?), 0.4mm, sr (CKOL 93).

	Rock fragment (?), extensively oxidised, 0.85mm, sa (CKOL 98); 0.7mm, sa (CKOL 125).

Textural Concentration Features

Rare (only in CKOL 101)

Pale brown (PPL, x50) and dark brown (XP, x50), 0.65mm, boundaries clear, sr, equant shape, neutral optical density, discordant with the external fabric – clay pellet (?).

Red Fabric B variant (CKOL 112)

Microstructure

Very few voids; mesovughs; single- to double-spaced porphyric related distribution; voids and inclusions rather randomly orientated.

Groundmass

Homogeneous, optically moderately to slightly active, reddish brown in PPL (x25), orange brown in XP (x25).

Inclusions

$c:f:v_{125\mu m}$ 20:75:5

Inclusions are moderately to well sorted, <0.6mm, mode 0.2mm, sr–sa. Size distribution is unimodal.

Common	Plagioclase, <0.5mm, mode 0.2mm, sa–sr.
	Alkali feldspar, <0.4mm, mode 0.2mm, sr–sa.
	Calcite, micritic <0.6mm, mode 0.2mm, r–sr.
	Serpentinite, mode 0.6mm, sr–sa.
Few	Biotite, <0.45mm, mode 0.2–0.15mm, laths or flakes.
	Amphibole, <0.55mm, 0.2mm, a–sr, with brown pleochroism, occasionally corroded.
	Opaques, <0.4mm, mode 0.15–0.2mm, sr, black in PPL and XP or red in PPL and XP.
Very few	Volcanic rock fragments, <0.6mm, mode 0.4mm, sa–sr, fragments with porphyritic texture and phenocrysts of feldspar (dominantly plagioclase, few alkali feldspar), brown amphibole and biotite in a glassy matrix (dacite).
Rare	Pyroxene, 0.2–0.3mm, sa–sr, clinopyroxene (augite).
	Chert, 0.2mm, sr–sa.
Very rare	Microfossils, 0.15mm.
	Quartz, monocrystalline, 0.25mm, sa–sr.

2.2.3. Buff Fabrics of presumed local origin (CKOL 23–25. 27–43; Taf. 57–59. 70. 73. 99. 100. 107. 119)

A number of macroscopic groups (CMG 2, CMG 3, CMG 4) were considered to be possibly of Aeginetan origin, due to their macroscopic similarity with the local buff-firing fabrics of the Bronze Age (especially fabric FG2). Thus, the analyses undertaken had as main objective the examination of this assumption. Sample CKOL 30, buff fabric of uncertain origin, is also discussed here, as it was checked in conjunction with local buff fabrics, aiming to confirm or disprove the, macroscopically assumed, non-local origin.

Petrographic Analysis

Following petrographic analysis, the above samples were classified into three groups, while three of them remained ungrouped. The three groups are: a) Buff Fabric A, a fine calcareous fabric (CKOL 23–24. 27–29. 33. 41–42), b) Buff Fabric B, a medium carbonate and volcanic fabric (CKOL 31–32. 34. 43), and c) Buff Fabric C, a medium-fine fabric containing volcanic glass and pumice fragments (CKOL 35–36. 38–40) (Table 6a).

Buff Fabric A (Taf. 125. CKOL 29) is a fine-grained calcareous fabric, bearing an orange brown to dark yellowish brown micromass in XP with 2–5% voids. Inclusions are few to very few, subangular to rounded, well to very well sorted, with mode sizes up to fine sand, rarely reaching medium-coarse sand. Buff Fabric A is characterised by silicate inclusions, mainly alkali feldspar, microfossils (foraminifera and sponge spicules) and micritic calcite in varying percentages, accompanied by mica (mainly biotite), brown amphi-

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Matrix optical activity
Buff Fabric A (Fine calcareous)					
23	context 4th qu. 4th c. or ca. 300	kantharos	buff	–	moderately active to slightly active
24	context 4th qu. 4th c. or ca. 300	kantharos	light brown	dark red	active
27	ca. 440/30	jug	buff	–	active
28	context 3rd qu. 5th c.	askos	buff	dark purple brown	active
29	ca. 440/30	amphoriskos	buff	–	active
33	context late 1st/early 2nd qu. 5th c.	jug	buff	–	slightly active to inactive
41	ca. 4th qu. 4th c.	bowl	buff	–	moderately active to inactive
42	context 1st half 5th c.	jug	buff	–	moderately active to slightly
Buff Fabric B (Medium carbonate & volcanic)					
31	context late 1st/early 2nd qu. 5th c.	amphoriskos	light red	buff	moderately active to slightly active
32	context late 1st/early 2nd qu. 5th c.	jug or amphoriskos	red (with light red thin layers)	buff	moderately active to slightly active
34	context 3rd/early 4th qu. 5th c.	askos	buff	–	inactive
43	context 4th qu. 4th c. or ca. 300	bowl	buff	dark red	slightly active
Buff Fabric C (Volcanic glass & pumice)					
35	context 5th c.	mortarium	buff	–	slightly active to inactive
36	context mid/early 3rd qu. 5th c.	mortarium	buff	–	moderately active to slightly active
38	context mixed	mortarium	buff	–	slightly active to inactive
39	context 3rd/early 4th qu. 5th c.	mortarium	buff	–	slightly active to inactive
40	context late 3rd/early 4th qu. 5th c.	mortarium	buff	–	slightly active to inactive
Buff Fabric 'single': Silicate fabric					
25	context 4th qu. 4th c. or ca. 300	bowl	buff	–	inactive
Buff Fabric 'single': Silicate & carbonate fabric					
30	context 3rd/early 4th qu. 5th c.	askos	red	–	active
Buff Fabric 'single': Chert & silicate fabric					
37	context late 1st/early 2nd qu. 5th c.	mortarium	buff	–	inactive

Table 6a Buff Fabric pottery samples of presumed local origin and summary of attributes

bole and opaques, with rare volcanic glass and plagioclase fragments and common clay pellets. All samples refired buff, indicating the consistent use of similar types of clays. The optical activity of the groundmass suggests original firing temperatures usually not exceeding 800–850°C. The slip of the glazed samples refired dark red, indicating the use of an iron-rich slip. The glazed and painted vessels indicate the use of the iron reduction technique commonly used in contemporary potting industries in Attica, Laconia or elsewhere.[626] Various pottery categories fall into this fabric group, including black glazed kantharoi, unglazed trefoiled jugs, an amphoriskos and an askos, banded jugs and bowls, i.e. small to medium sized pottery.

Buff Fabric B (Taf. 125. CKOL 31) is a medium-grained fabric and has a dark orange brown to dark yellowish brown micromass in XP, with 2–5% voids. Inclusions are few, subangular to rounded, rather well sorted, with mode sizes up to medium sand, maximum grain size reaching coarse sand. Buff Fabric B is characterised by the presence of plagioclase and alkali feldspar, micritic calcite and andesite rock fragments, accompanied by biotite and oxyhornblende, very few sponge spicules, monocrystalline quartz and opaques, and rare clinopyroxene and chert. The four samples of this group did not refire the same colour: CKOL 31 and CKOL 32, both rather large-sized vessels, refired red or light red with a buff slip, whereas CKOL 34 and CKOL 43, both small-sized vessels, refired buff. The optical activity of the groundmass for all samples suggests original firing temperatures in the range of 850–1050°C.

Buff Fabric C (Taf. 125. CKOL 40) is a medium-grained fabric, bearing a dark yellowish brown micromass in XP, with usually 5% voids. Inclusions are few,

[626] Maniatis *et al.* 1993; see also Jones 1986, 798–805.

subangular to subrounded, well sorted, with mode sizes up to medium sand, maximum grain size reaching very coarse sand. Buff Fabric C contains glass shards (of various types, including pumice), monocrystalline quartz, and alkali feldspar, along with plagioclase, biotite laths, clinopyroxene (augite), volcanic rock fragments, rare micritic calcite and very rare radiolaria, microfossils and shale (?) fragment. All samples of this fabric refired buff, pointing to the consistent use of similar, calcareous, types of clay. The optical activity of the groundmass for all samples suggests original firing temperatures in the range of 850–1050°C.

Chemical Analysis

In terms of chemical composition, the samples of the assumed local buff fabrics all have, as expected, high calcium contents. Among the three fabric groups identified petrographically, Buff Fabric C is by far the most homogeneous, in terms of chemical composition (Taf. 123; Tables 4b. 6b) and is clearly distinguished from the other two on the basis of consistently lower nickel (105–123 ppm) and chromium (170–192 ppm) contents as well as higher zirconium (155–178 ppm). Calcium is high (CaO c. 15%), while aluminium (Al_2O_3 c. 13%) and iron (Fe_2O_3 5.5%) medium/low.

Buff Fabric A and Buff Fabric B, on the other hand, cannot be considered chemically homogeneous groups (note high r.s.d. values in Table 4b). Both are characterised by high calcium, chromium and nickel contents, and low to medium aluminium, while the chemical variability within each one does not allow a meaningful comparison between the two. Buff Fabric A samples form a loosely chemically associated cluster (Taf. 123, with the exception of CKOL 33, primarily distinguished by higher magnesium, iron, and aluminium relative to calcium and higher scandium contents. Further interesting differentiating parameters among the remaining samples in Buff Fabric A are the ratios of chromium to nickel, approximately 1:1 for CKOL 27–29, and 1.5–2:1 for CKOL 23–24, 41–42, as well as silicon to aluminium roughly 4:1 for CKOL 27–29 and 5–6:1 for CKOL 23–24. 41–42. Based on these, samples of Buff Fabric A can be divided into two slightly more coherent chemical subclusters. Within Buff Fabric B samples CKOL 31–32 form a tighter sub-cluster distinct

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
Buff Fabric A																
23	1.49	2.68	8.87	50.9	1.41	19.1	0.62	0.05	5.35	14	586	294	527	136	374	90.5
24	1.27	2.78	8.05	44.8	2.20	15.1	0.54	0.05	4.50	13	486	306	369	118	331	79.3
27	1.11	4.29	9.86	41.5	2.36	15.0	0.58	0.06	5.40	15	399	408	417	106	167	80.1
28	0.92	3.25	10.6	35.6	2.38	20.4	0.56	0.06	6.07	16	455	460	396	84	210	79.8
29	0.72	2.99	8.49	33.4	1.56	22.3	0.49	0.05	4.95	14	418	366	441	102	159	74.9
33	2.52	5.39	12.5	43.0	1.16	14.7	0.75	0.10	7.04	23	412	254	560	136	221	87.2
41	1.32	3.20	9.07	46.1	1.13	20.7	0.61	0.06	5.38	13	420	273	494	116	267	87.5
42	1.57	2.71	9.48	49.0	1.46	19.2	0.59	0.07	5.37	13	426	294	332	128	207	89.5
Buff Fabric B																
31	1.61	5.07	14.3	50.6	2.30	9.95	0.70	0.09	7.30	21	510	491	383	119	386	91.9
32	1.73	5.32	12.9	46.2	2.19	9.50	0.64	0.10	6.95	21	462	550	425	121	332	85.5
34	2.11	5.78	13.6	43.7	0.95	16.5	0.67	0.09	6.92	20	552	407	384	110	140	90.3
43	1.16	4.26	10.4	55.3	2.11	14.2	0.62	0.10	6.37	14	494	365	367	110	226	94.5
Buff Fabric C																
35	2.36	3.87	14.0	48.2	1.34	14.3	0.65	0.09	5.78	13	192	123	543	155	282	90.6
36	1.79	3.03	13.0	46.9	2.77	13.9	0.63	0.10	5.33	12	171	112	534	178	278	87.4
38	1.99	3.64	13.4	49.2	1.28	15.5	0.67	0.10	5.41	14	187	105	532	159	252	91.1
39	1.91	3.20	13.2	46.3	2.07	15.6	0.63	0.10	5.34	13	170	108	578	159	280	88.4
40	2.10	3.14	13.4	43.8	1.73	15.5	0.63	0.10	5.38	12	178	117	580	159	251	85.8
Buff Fabric ‘singles’																
25	1.93	3.27	17.0	50.1	1.76	13.9	0.77	0.09	5.95	17	181	150	316	184	415	94.7
30	1.49	4.47	13.0	55.0	2.89	4.64	0.69	0.10	7.05	25	584	326	272	151	311	89.3
37	1.32	2.04	13.5	57.3	2.21	9.71	0.73	0.08	5.06	13	148	85	298	214	499	92.0

Table 6b Results of chemical analyses (ICP-OES) for Buff Fabric pottery samples of presumed local origin

from the others on the basis of a lower chromium to nickel ratio (Cr:Ni 1:1 for CKOL 31, 32 and 1.4:1 for CKOL 34. 43) and lower calcium content. Moreover CKOL 43 is further distinguished from the other samples with respect to lower contents of iron, magnesium, aluminium, and scandium.

Following the above observations it is clear that Buff Fabric A and Buff Fabric B exhibit several common chemical characteristics, but cannot be considered as a chemically coherent group. This picture may to some extent be due to the small number of samples available, which potentially prohibit a full consideration of the chemical variability within an assumed group.

Discussion of the Analytical Data

In terms of provenance, Buff Fabric A and Buff Fabric B resemble petrographically the Aegina Bronze Age fabrics FG2A (fine) and FG2A (medium), respectively.[627] In particular Buff Fabric B can be considered as local to Aegina, since its inclusions bear strong resemblance to the local Bronze Age FG2A (medium) and are compatible to the geology of the island. Nevertheless, Buff Fabric B presents internal technological differentiations, as attested by the variety of refiring colours obtained (from red/light red to buff) implying the use of non-standardised recipes during clay paste preparation. Moreover, it differs from the Bronze Age FG2A (medium), showing rather bimodal grain-size distribution and presenting more consistent grain sizes, pointing to better controlled cleaning processes during the Classical period.

Buff Fabric A bears a fair resemblance to raw material samples (in particular Pliocene clay AGS5)[628] and is reminiscent of Bronze Age FG2A (fine); it is associated to fine calcareous fossiliferous clays, similar to the Pliocene sediments located in northern Aegina.[629] Mineral and/or rock fragments inclusions are not very diagnostic due to their small size, but they do not appear to be incompatible to local geology.

The broad chemical characteristics of Buff Fabric A and Buff Fabric B are generally compatible with those of the Bronze Age fabric FG2A (fine and medium varieties) and the correspondingly associated local Pliocene clay deposits sampled, particularly with reference to the high calcium, chromium, and nickel contents, diagnostic of the use of the Pliocene deposits on Aegina. A more detailed comparison with the Bronze Age fabric subgroups (see Taf. 124 and Table 4b), as attempted petrographically, is not possible (although see discussion below), first because the Bronze Age fabric subgroups are not as clearly distinct chemically (as petrographically) and second because the samples belonging to the Classical Buff Fabric A and B, are comparatively few and do not form tight chemical groups. Given the chemical heterogeneity of the Classical Buff Fabric pottery samples discussed here, the degree to which their chemical composition relates with that of the Bronze Age fabrics varies. Samples CKOL 23–24, CKOL 41, CKOL 42 show the closest correspondence (Taf. 124). Among the remaining samples differentiating factors compared to the Bronze Age FG2A fabric are the low Cr:Ni ratio of CKOL 27–29 (1:1 compared to 1.7:1 roughly for the BA) as well as the higher calcium, aluminium, magnesium, iron and scandium for CKOL 33–34, and low Cr:Ni ratio and high scandium contents for CKOL 31–32. These differences are at least some of the differentiating reasons responsible for the appearance of these samples at the outskirts or outside the area occupied by Bronze Age FG2A samples in the pca diagram.

Similarly to petrography, however, most of the samples appear closer to the FG2A (fine) samples towards the left side of the pca scatterplot (Taf. 124), and close to many of the analysed local raw materials themselves. This observation is in line with the petrographic conclusion proposing an Aeginetan provenance for these pottery samples, pointing, however, to the use of a different recipe in the Classical period in comparison to the Bronze Age. The wide distribution of the Buff Fabric A and B samples in Taf. 124 is comparable to that noted within the Aeginetan Pliocene clays, supporting the proposal that their compositional variability may be attributed to the exploitation of a number of different Pliocene clay sources across the northern part of the island.

Buff Fabric C contains only mortaria, therefore a specialised use of this fabric could be argued, on the basis of present data. It can be considered rather unique as a fabric group, due to the high frequency of pyroclastic rock fragments, namely volcanic glass shards and pumice. This composition is not entirely incompatible to the geology of Aegina, although it is

627 Kiriatzi *et al.* 2011, 99–102.
628 Kiriatzi *et al.* 2011, 76–80, table 36 and fig. 38 (AGS5).
629 Kiriatzi *et al.* 2011, 79 and fig. 32.

too acidic compared to the rather intermediary character of Aeginetan volcanic formations. Moreover, glass shards and pumice fragments are absent from all fabrics considered to be local, be it of Bronze Age or Classical date, and raw material samples.[630] An origin from Corinth has been proposed for mortaria of this fabric (see section IX.1.2.4), but such an argument cannot be sustained by present analytical data. Among the fabrics considered local to Corinth, Whitbread mentions a variant of Corinth A and A′ amphora fabrics which includes pyroclastic rock fragments; these are classified as devitrified volcanic rock fragments, devitrified volcanic glass and welded shards, i.e. compacted and welded original pumice fragments,[631] all pointing to high pressure and temperature volcanic processes not attested in the Aegina samples.

Although Buff Fabric C samples plot at the outskirts of the area occupied by the Bronze Age FG2 samples (Taf. 124), a closer look at their chemical composition shows significant consistent differences, namely lower nickel and chromium contents and a lower silicon to aluminium ratio, that support the exclusion of a local origin as also suggested by the petrographic results. Recent petrographic and chemical analyses of mortaria found in a number of Mediterranean sites have shown that many different clay recipes were used for their fabrication, with Cyprus being identified as a major production centre and smaller ones located at Miletus, Naukratis and Palestine.[632] The fabrics that characterise the Cypriot products differ significantly from Buff Fabric C, although they share some common technological choices, like the preference for calcium-rich clay and the rather high firing temperatures.[633] To date, a comparable (although not identical) mineralogical composition is reported only for Late Roman Phocaean cookware fabrics (in particular Gruppe B) and raw materials from the vicinity of Phocaea (FOC T1, T2, T4, T5, T8).[634] However, Phocaean cookware Gruppe B is characterised by red-firing colours, is considerably coarser and also contains chert fragments, while the raw material samples, although buff-firing, lack the pumice fragments observed in the related pottery. Nevertheless, central Asia Minor is characterised by extended pyroclastic formations (e.g. in the Çeşme hinterland, the vicinity of Foça and the wider area of the Yunt Dagi mountain);[635] hopefully, future research will clarify whether this area is a candidate for the manufacture of this type or mortars. The chemical data currently available are too few to allow a discussion of provenance on this basis,[636] but the growing interest in the analyses of such vessels ensures that the relevant results accumulated through the present study (summarised in Table 4b) will soon find comparative grounds.

Turning to individual samples, loner CKOL 25 (Taf. 125. CKOL 25) is too fine-grained, containing non-diagnostic inclusions; in general it does not match local fabrics. Equally, loner CKOL 37 (Taf. 126. CKOL 37) comprises a fine-medium fabric, bearing inclusions that point to a metamorphic rather than volcanic environment, being therefore incompatible with local geology. Loner CKOL 30 (Taf. 126. CKOL 30) is a fine-medium silicate fabric, compositionally pointing to a rather metamorphic environment, not compatible to the geology of Aegina and known local fabrics. Stylistically, CKOL 30 is similar to vessels from Corinth or north-eastern Peloponnese; nevertheless, its composition as identified petrographically does not match the geology of Corinth or fabrics considered as local to Corinth.[637] All three samples are also clearly distinct in their chemical composition from the other buff fabric samples discussed here (see Taf. 123–124 and Table 6b).

[630] The pyroclastic fragments observed in local raw materials and locally made pottery are classified as volcanic glass (liquid magma having solidified very fast), characterised by a glassy matrix with minute feldspar crystals and occasional perlitic cracks. The pyroclastic fragments observed in buff fabric C are classified as pumice (highly vesiculated volcanic glass), characterised by vesicular pumiceous texture, and glass shards, consisting of the walls of tiny broken glass bubbles or the junctions of bubbles developed by the vesiculation of magma, typically in cuspate-shaped fragments (Fischer and Schmincke 1984, 96–103). The authors would like to thank Dr. Ruth Siddall (UCL) for confirming the characterisation of this fabric, as well as for clarifying comments and relevant geological references.

[631] Whitbread 1995, 272–273.

[632] Spataro and Villing 2009; Mommsen *et al.* 2006a; Zukerman and Ben-Shlomo 2011.

[633] Spataro and Villing 2009, 98. Michela Spataro and Caroline Cartwright (pers. com. with E. Kiriatzi) confirmed having identified a fabric very similar to buff fabric C among the British Museum samples they have analysed from Miletus and Naukratis, although not yet published.

[634] Sauer 1995, 90, 141.

[635] Şenel 2002.

[636] Spataro and Villing 2009; Mommsen *et al.* 2006a.

[637] Whitbread 1995, 255–346.

Petrographic Description

Buff Fabric A: fine calcareous (CKOL 23–24. 27–29. 33. 41–42)

Microstructure

There are rare to very few voids, dominantly mesovughs and very few to rare mesoplannar voids. Rarely voids have coatings or infillings: in CKOL 33 few voids with coating of micritic calcite, in CKOL 42 rare incomplete infilling orange brown in PPL very dark orange brown in XP. The c:f related distribution is double- to open-spaced porphyric related distribution. Common to few voids and inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections, variation observed a) in the secondary calcite (?) present in CKOL 23. 33. 41, b) in the colour of the groundmass, mainly patches of darker colour in CKOL 28–29. The micromass is optically active, reddish brown to brown in PPL (x25), orange brown (dark yellowish brown in CKOL 41, due to secondary calcite?) in XP (x25); moderately active to slightly active/inactive, brown in PPL (x25), dark yellowish brown to dark orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{10\mu m}$ ca. 3:87:10 to 7:90:3 to 15:80:5

The inclusions are very well to well sorted, <0.5mm (2.6mm in CKOL 24), mode 0.1–0.2mm, sa-r. Size distribution is unimodal.

Predominant–frequent	Feldspar/Quartz, <0.3mm, mode 0.05–0.1mm, sa–sr. Discrimination between very small quartz and feldspar grains is difficult, so exact quantitative estimation of each is not attempted. Feldspar is considered to be alkali feldspar, since no twinning can be detected.
Predominant-few	Microfossils, foraminifera, <0.4mm, mode 0.1mm; sponge spicules <0.15mm.
Frequent	Calcite, <0.5mm, mode 0.08–0.15mm, r–wr, predominantly micritic, few sparitic (Very rare-Absent in CKOL 23. 33. 41).
Few–very few	Mica, mode 0.1mm, commonly oxidised, predominantly biotite laths.
Few-rare	Amphibole, brown (probably oxyhornblende), <0.15mm, mode 0.05–0.08mm, a–sr, diamond-shaped or anhedral, lath-shaped. Commonly twinned or zoned.
Very few	Opaques, <0.2mm, mode 0.05mm, black in PPL and XP, or very dark red in PPL and XP.
Rare–very rare	Volcanic glass/Volcanic rock fragments, <0.9mm, mode 0.2–0.6mm, sa–sr. The fragments are dominantly volcanic glass, while few have small plagioclase phenocrysts (in CKOL 23 also brown amphibole with twinning) in a glassy matrix.
	Plagioclase, <0.5mm, mode 0.05–0.15, sa (CKOL 41–42).

Textural Concentration Features

Few to common

Red to reddish brown (PPL, x50) and orange red to reddish brown (XP, x50), <0.2mm, mode 0.1mm, boundaries clear to diffuse, r, equant (to distorted) shape, neutral to high optical density, concordant with the external fabric – clay pellets (?).

Reddish brown (PPL, x50) and reddish brown (XP, x50), 2.6mm, boundaries clear (partially with a plannar void around it), sa, prolate shape, high optical density, discordant with the external fabric (as inclusions alkali feldspar, quartz, brown amphibole, micritic calcite, volcanic rock fragment) – grog (CKOL 23).

Orange brown (PPL, x50) and dark orange brown (XP, x50), 4mm, boundaries clear (surrounding void), sa, prolate shape, high optical density, concordant with the external fabric – clay pellet (?) (CKOL 24).

Buff Fabric B: medium carbonate & volcanic (CKOL 31–32. 34. 43)

Microstructure

There are very few voids, dominantly mesovughs and commonly mesoplannar voids. Few voids have infilling or coating of micritic calcite (in CKOL 43 red infilling, possibly Fe oxide?). The c:f related distribution is double- to single-spaced porphyric related distribution. Frequently voids (and few inclusions) show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections, variation observed only concerning the presence of secondary calcite (?) in CKOL 31–32. 43. The micromass is optically moderately to slightly active, reddish brown to brown in PPL (x25), dark orange brown to dark yellowish brown in XP (x25); inactive, greyish brown in PPL (x25), very dark olive brown in XP (x25).

Inclusions

c:f:v$_{60\mu m}$ ca. 15:83:2 to 10:85:5

The inclusions are moderately to well sorted (although in CKOL 43 poorly sorted), <1mm (1.2mm in CKOL 43), mode 0.2–0.4mm, sa–r. Size distribution seems to be bimodal.

Frequent-common	PLAGIOCLASE, <0.5mm, mode 0.2mm, sa, mainly andesine with albite, Carlsbad and, rarely, also periclinic twinning, few with zoning, dominantly fresh, few weathered.
	ALKALI FELDSPAR, <0.4mm, mode 0.2mm, sa–sr, dominantly fresh, few weathered.
Frequent–few	CALCITE, <1mm, mode 0.2–0.4mm, r–sa, predominantly micritic, with few sparitic or crystalline examples, in CKOL 32 very few with clinopyroxene inclusions.
Common–few	INTERMEDIATE VOLCANIC ROCK FRAGMENTS, <0.6mm, mode 0.2–0.3mm, sr–sa. The rock fragments show porphyritic texture, are commonly weathered, and consist mainly of a glassy matrix with plagioclase and pyroxene phenocrysts and/or brown amphibole, biotite laths and opaques. Plagioclase, mostly andesine (some albite also present), have albite and Carlsbad twinning, while few have a cloudy appearance. Pyroxene is dominantly clinopyroxene (probably augite, colourless in PPL, sometimes with twinning) while orthopyroxene is common. Brown hornblende (oxyhornblende) commonly has oxidised rims, while there are few examples of oxidised biotite laths. Volcanic glass fragments occasionally have perlitic cracks. In general, these fragments could be characterised as andesite, rather than dacite.
	MICA, <0.9mm, mode 0.2–0.4mm, predominantly biotite laths commonly oxidised.
Few	AMPHIBOLE, <0.4mm, mode 0.2mm, a–sr, with brown pleochroism (oxyhornblende), frequently diamond-shaped, but few anhedral, lath-like examples exist. Few are twinned or oxidised.
Very few	MICROFOSSILS, predominantly sponge spicules, <0.3mm.
	OPAQUES, mode 0.2–0.1mm, sr, black in PPL and XP.
	QUARTZ, monocrystalline, <0.5mm, mode 0.2mm, sr–sa.
Rare–very rare	PYROXENE, predominantly clinopyroxene (augite), mode 0.1mm, sa.
	CHERT (?), 0.4–0.3mm, sa (CKOL 34. 43).

Textural Concentration Features

Only in CKOL 32 (Very few) and CKOL 43 (Dominant).

Orange red (PPL, x50) and dark orange brown (XP, x50), 0.8mm, boundaries sharp (with surrounding void), r, equant shape, high optical density, discordant with the external fabric (silicate inclusions and black opaques, rare brown amphibole) – grog (?) (CKOL 32).

Orange brown (PPL, x50) and black with orange speckles (XP, x50) mode 0.2mm, boundaries clear, r, distorted shape, neutral optical density, discordant with the external fabric – clay pellets (?) (CKOL 32).

Reddish brown to red (PPL, x50) and reddish brown to red (XP, x50), <1.2mm, mode 0.3–0.4mm, boundaries sharp to clear, sr–r, equant and prolate shape, neutral to high optical density, discordant with the external fabric (when with inclusions, silicates; in one occasion with a probable quartz-rich metamorphic rock fragment) – ARF, mudstone (?) (CKOL 43).

Buff Fabric C: volcanic glass & pumice (CKOL 35–36. 38–40)

Microstructure

There are few voids, dominantly mesovughs and frequent mesoplannar voids. Few voids in CKOL 40 have infillings or coatings of micritic calcite. The c:f related distribution is double spaced porphyric related distribution. Voids and/or inclusions show no traces of preferred orientation.

Groundmass

Rather homogeneous throughout the sections, variation observed only in relation to the presence of secondary calcite in all samples, which in some occasions (CKOL 35. 40) is certainly intruding the sherd body, coming from a surface encrustation. The micromass is optically moderately or slightly active to inactive, brown in PPL (x25), dark yellowish brown in XP (x25).

Inclusions

$c:f:v_{60\mu m}$ ca. 10:85:5 to 15:70:15
The inclusions are well sorted, <1.4mm, mode 0.2–0.1mm, sa–sr. Size distribution is unimodal.

Frequent	VOLCANIC GLASS AND PUMICE, <1.4mm, mode 0.5–0.3mm, sa–sr. Fragments consist of various glass shards (cuspate, platy, pumice). Larger grains have a mesh-like texture, with elongated vesicles, possibly depicting flow movement; rarely with small feldspar crystals or more characteristic features of devitrified glass (in CKOL 40); pale brown in PPL, isotropic in XP.
Common	QUARTZ, monocrystalline, <0.4mm, mode 0.1mm, sa–sr.
	ALKALI FELDSPAR, <0.4mm, mode 0.1mm, both fresh and slightly cloudy examples exist.
Few–very few	PLAGIOCLASE, <0.5mm, mode 0.2–0.1mm, sa–sr, with albite and Carlsbad twinning.
	MICA, <0.5mm, mode 0.15mm, predominantly biotite laths and flakes.
Very few	CLINOPYROXENE, <0.6mm, mode 0.1–0.2mm, predominantly colourless and very rarely slightly pleochroic (from pale yellow to pale green) in PPL, frequently with twinning, in CKOL 40 also with zoning, most probably augite.
	OPAQUES, <0.2mm, mode 0.08mm, sr, very dark red in PPL and XP black in PPL and XP.
Very few–rare	VOLCANIC ROCK FRAGMENTS, <0.5mm, mode 0.15–0.3mm, sa–sr. Fragments predominantly consist of a very altered glassy matrix with very small feldspar crystals (dominantly plagioclase), very rarely brown amphibole crystals as well. In CKOL 36 crystallitic texture can be recognised in a fragment containing plagioclase and clinopyroxene crystals.
Rare	CALCITE, micritic, mode 0.15mm, sr–r (CKOL 38). In CKOL 40 a 2.6mm area with micrite is most probably a post-depositional effect (calcite encrustation intruding the sherd body).
Very rare	MICROFOSSILS, radiolaria, 0.08mm (CKOL 38); sponge spicule (?), 0.3mm (CKOL 36).
	SHALE (?), 0.2mm, sr (CKOL 36).

Textural Concentration Features

Rare (CKOL 36)

Red (PPL, x50) and dark red (XP, x50), <0.5mm, mode 0.2mm, boundaries clear, sa–sr, prolate and equant shape, neutral to high optical density, discordant with the external fabric (silicate inclusions) – ARF (?)

'Single' Buff Fabrics

Silicate fabric: CKOL 25

Microstructure

Very few voids, mesovughs, single- to double-spaced porphyric related distribution, no traces of well developed preferred orientation.

Groundmass

Homogeneous, optically inactive, brown in PPL (x25), very dark brown in XP (x25).

Inclusions

$c{:}f{:}v_{10\mu m}$	10:87:3

Inclusions are well sorted, <0.3mm, mode 0.05–0.1mm, sr–sa. Size distribution is unimodal.

Frequent	Quartz/Alkali feldspar, <0.15mm, mode 0.05mm, sr–sa. Due to the small size of the grains no precise discrimination and quantity characterisation are feasible, so both types are considered together.
	Plagioclase, mode 0.08mm, sa–sr, with albite twinning.
Common	Mica, mode 0.05mm, predominantly biotite and few white mica laths.
Very few	Opaques, mode 0.05mm, black in PPL and XP.

Silicate & carbonate fabric: CKOL 30

Microstructure

Very few voids, mesovughs and mesoplannar voids, few with micritic calcite coating, single- to double-spaced porphyric related distribution, no traces of preferred orientation.

Groundmass

External end with colour differentiation (lighter colour, due to uneven firing?), optically active, reddish brown in PPL (x25), orange brown to dark orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{60\mu m}$	15:80:5

Inclusions are moderately sorted, <0.4mm, mode 0.1–0.2mm, sr–sa. Grain-size distribution appears to be unimodal.

Common	Quartz, monocrystalline, <0.3mm, mode 0.15mm, sr–sa, few polycrystalline, mode 0.2mm, sr–sa.
	Alkali feldspar, <0.3mm, mode 0.15mm, sr–sa.
	Chert, <0.25mm, mode 0.15mm, sa–sr, equigranular microquartz.
Very few	Calcite, micritic and/or crystalline, mode 0.1–0.2mm, r/sr–sa.
	Mica, mode 0.15mm, predominantly white mica laths.
	Opaques, mode 0.1mm, sr, PPL black, XP black, or PPL red, XP red.
	Microfossils, shell-like (ostracods?) <0.4mm, mode 0.2mm; radiolaria, 0.1–0.15mm, r.
Very rare	Schist rock fragment, 0.2mm, sa–sr, quartz + white mica.
	Epidote, mode 0.1mm, sa.

Chert & silicate fabric: CKOL 37

Microstructure

Few voids, mesovughs, single-spaced porphyric related distribution, fairly well developed preferred orientation parallel to vessel walls.

Groundmass

Some secondary calcite (?) on external end, optically inactive, brown in PPL (x25), black in XP (x25).

Inclusions

$c{:}f{:}v_{60\mu m}$	20:77:3

Inclusions are well to moderately sorted, <1mm, mode 0.2mm, sa–sr. Grain-size distribution is unimodal.

Frequent	Chert, <0.45mm, mode 0.15mm, sa–sr, equigranular microquartz.
Common	Quartz, monocrystalline, mode 0.1–0.2mm, sr–sa.
	Alkali feldspar, <0.6mm, mode 0.2–0.3mm, sr–sa, rather fresh.

Few	Quartz-rich metamorphic rock fragment, <1mm, mode 0.25–0.4mm, sa–sr.
	Plagioclase, mode 0.3–0.2mm, with albite twinning, frequently zoned.
Very few	Mica, mode 0.1mm, predominantly biotite laths.
	Opaques, mode 0.15mm, black in PPL and XP.
Very few	Calcite, micritic, mode 0.2mm, r–sr.
	Amphibole, mode 0.1–0.15mm, sa, with brown pleochroism.

2.3. Exploring sources of imports

Macroscopic study distinguished fourteen pottery groups (CMG 5–10b, CMG 12–18) and a number of individual pots as probable imports. Representative samples were selected from all the above groups, as well as a selection of individual pots. Based on their analysis, eleven fabrics have been identified, to seven of which a specific provenance can be attributed (e.g. Attica, Corinth, Chios, Lesbos, Mende/Cassandra peninsula) (Table 7a–b). The rest of the fabrics, along with sixteen 'singles', remain of unidentifiable origin. As in the previous section, the results of petrographic and chemical analysis are presented, followed by a detailed discussion on the provenance and manufacturing technology of each fabric group, taking also into consideration all data published to date.

Macroscopic Group	Fabric (after petrographic analysis)	Suggested provenance
Imported tableware		
CMG 5	Fine micaceous fabric	Attica
CMG 6	Fine micaceous & metamorphic fabric with Tcfs	unidentifiable origin
CMG 10a	Very fine	Corinth
Polished jugs with grey fabric	Silicate & carbonate fabric 'Single' fabrics (CKOL 5 Schist & calcite; CKOL 8 Schist & quartz-rich metamorphic; CKOL 11 Quartz & calcite; CKOL 12 Schist & chert; CKOL 15 Silicate & calcite)	unidentifiable origin (CKOL 5 Attica?)
CMG 7	Silicate & carbonate with serpentinite fabric	unidentifiable origin
Imported coarse wares		
Coarse wares		
CMG 10b (part)	Coarse mudstone-tempered fabric	Corinth
Transport amphorae		
CMG 10b (part)	Coarse mudstone-tempered fabric	Corinth
CMG 12	Coarse mudstone-tempered fabric	Corinth
CMG 13	Silicate & chert fabric	(Corfu?)
CKOL 44–46, CKOL 71	'Single' fabrics (CKOL 44 Silicate & carbonate, CKOL 45 Silicate & brown amphibole; CKOL 46 Silicate & micaceous; CKOL 71 Metamorphic & carbonate)	unidentifiable origin
CMG 8	Metamorphic/silicate, carbonate & volcanic fabric	Chios
CMG 9	Feldspars and volcanic fabric	Lesbos?
CKOL 75–77	'Single' fabrics (CKOL 75 Calcareous; CKOL 76 Silicate/metamorphic & carbonate; CKOL 77 Carbonate & silicate/metamorphic)	unidentifiable origin (CKOL 76 Miletos?)
CMG 14, CKOL 62–63, CKOL 66	Silicate/metamorphic & carbonate fabric Variant (CKOL 66) 'Single' fabric (CKOL 63 Metamorphic/silicate)	Mende/Cassandra peninsula (CKOL 62, CKOL 64–64, CKOL 67; CKOL 66?) unidentifiable origin (CKOL 63)
CMG 15	Micaceous, carbonate & silicate with Tcfs fabric	unidentifiable origin
Imported cooking ware		
CMG 16 CMG 17	'Single' fabrics (CKOL 94 Carbonate & metamorphic; CKOL 113 Mica schist & quartz-rich metamorphic; CKOL 128 Quartz-rich metamorphic & shale/phyllite)	Attica
CKOL 86	Silicate & chert fabric	unidentifiable origin
CKOL 95	Carbonate, sedimentary & volcanic fabric	unidentifiable origin
CKOL 97	Carbonate, sedimentary & low metamorphic fabric	unidentifiable origin
CKOL 104	Acid igneous & carbonate fabric	unidentifiable origin
CKOL 105	Carbonate, silicate & chert fabric	unidentifiable origin

Table 7a Macroscopic groups of assumed imported pottery in association with the results of petrographic analysis (cf. Table 1)

		Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba
		%									ppm					
CMG 5 (samples 6)	mean	0.96	5.25	17.2	52.9	2.39	7.51	0.86	0.11	7.71	21	525	367	295	144	442
	r.s.d.	*9*	*14*	*5*	*5*	*17*	*10*	*3*	*9*	*10*	*2*	*5*	*7*	*22*	*6*	*7*
CMG 6 (samples 5)	mean	1.29	2.45	17.3	57.5	2.90	5.25	0.92	0.05	6.58	18	190	114	182	234	374
	r.s.d.	*13*	*5*	*6*	*4*	*9*	*8*	*6*	*10*	*11*	*6*	*9*	*12*	*18*	*6*	*10*
CMG 10a (samples 3)	mean	0.87	3.95	16.5	49.4	2.89	13.8	0.80	0.12	7.97	21	254	216	453	108	444
	r.s.d.	*20*	*2*	*3*	*2*	*6*	*11*	*1*	*16*	*3*	*7*	*7*	*2*	*8*	*6*	*34*
Polished jugs with grey fabric (core group) (samples 5)	mean	1.80	4.06	15.2	54.1	2.63	8.31	0.81	0.12	6.71	15	190	185	301	147	451
	r.s.d.	*14*	*11*	*5*	*3*	*3*	*20*	*4*	*15*	*3*	*13*	*8*	*15*	*17*	*13*	*15*
CMG 7 (samples 2)	mean	1.61	4.67	16.4	58.1	2.69	5.39	0.88	0.12	7.37	21	254	175	214	149	338
	r.s.d.	*9*	*6*	*3*	*3*	*5*	*23*	*0.4*	*2*	*6*	*4*	*1*	*6*	*16*	*0*	*1*
CMG 10b (excl. CKOL 52) (samples 4)	mean	0.90	3.53	14.9	47.6	2.74	14.7	0.72	0.13	7.37	19	241	192	422	100	287
	r.s.d.	*9*	*8*	*5*	*3*	*2*	*7*	*4*	*2*	*7*	*5*	*11*	*11*	*5*	*1*	*8*
CMG 13 (samples 6)	mean	1.56	4.55	12.1	54.9	2.03	12.6	0.67	0.11	6.49	16	455	274	424	128	302
	r.s.d.	*20*	*9*	*1*	*1*	*24*	*6*	*2*	*7*	*1*	*2*	*9*	*3*	*11*	*5*	*13*
CMG 8 (samples 3)	mean	1.67	4.30	11.6	59.0	1.65	8.28	0.65	0.12	6.11	16	429	303	254	114	227
	r.s.d.	*8*	*9*	*6*	*5*	*13*	*33*	*7*	*8*	*5*	*3*	*6*	*6*	*16*	*8*	*2*
CMG 9 (samples 3)	mean	2.07	3.71	16.1	54.5	2.53	5.43	0.69	0.12	6.15	17	144	115	396	146	647
	r.s.d.	*11*	*2*	*3*	*4*	*26*	*22*	*2*	*4*	*2*	*6*	*5*	*9*	*9*	*9*	*13*
CMG 14 and CKOL 62 (samples 4)	mean	1.60	4.52	13.6	57.6	2.38	9.34	0.67	0.12	6.49	16	341	228	267	116	337
	r.s.d.	*12*	*10*	*4*	*6*	*4*	*24*	*4*	*11*	*6*	*6*	*10*	*3*	*16*	*6*	*8*
CMG 15 (samples 2)	mean	1.25	3.47	17.8	54.2	3.09	7.80	0.85	0.07	7.67	19	329	265	193	152	403
	r.s.d.	*3*	*11*	*2*	*1*	*1*	*44*	*2*	*11*	*5*	*0*	*22*	*33*	*6*	*10*	*0*

Table 7b Summary of chemical compositions of the main fabric groups of imported pottery identified by petrography (cf. Tables 1 and 7a)

2.3.1. Tableware

2.3.1.1. Black glazed vessels of presumed Attic origin (CKOL 1–4. 6. 7; Taf. 60. 72. 77. 120)

All samples that were macroscopically characterised as 'Black glazed pottery of Attic origin' (group CMG 5) comprise a fairly homogeneous group both in terms of petrographic and chemical analysis (Tables 8a–b).

Petrographic Analysis

This is a fine-grained fabric, well sorted and micaceous, having a dark red micromass in XP with about 2–3% voids (Taf. 126. CKOL 1). Inclusions are few,

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
1	ca. 480/70	salt cellar	light red	dark purple brown	Fine micaceous fabric	moderately to slightly active
2	context ca. 480/70	bowl	light red	dark purple brown	Fine micaceous fabric	moderately active
3	context ca. 430/20	jug	light red	dark purple brown	Fine micaceous fabric	moderately to slightly active
4	ca. 430/20	skyphos	light red	dark purple brown	Fine micaceous fabric	moderately to slightly active
6	mid 4^{th} c.	skyphos	light red	dark purple brown	Fine micaceous fabric	moderately to slightly active
7	2^{nd} qu. 4^{th} c.	kantharos	light red (lighter than CKOL 1–4.6)	dark purple brown	Fine micaceous fabric	moderately active

Table 8a Black glazed pottery samples of presumed Attic origin (CMG 5) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
1	1.05	5.63	17.3	52.1	2.32	7.46	0.83	0.10	7.81	21	504	353	288	131	414	94.6
2	0.96	6.61	18.7	56.7	1.96	6.69	0.91	0.12	8.79	22	544	389	208	139	427	102.0
3	1.08	4.96	16.6	52.4	3.13	8.79	0.87	0.11	8.00	21	563	397	283	144	440	95.9
4	0.91	4.65	17.3	55.0	2.30	7.17	0.87	0.12	8.06	21	511	381	249	152	429	96.4
6	0.93	4.83	16.4	51.5	2.42	6.97	0.84	0.10	6.84	21	532	347	388	149	498	90.8
7	0.86	4.83	16.6	50.0	2.19	7.96	0.86	0.10	6.77	20	495	337	353	148	445	90.1

Table 8b Results of chemical analyses (ICP-OES) for Black glazed pottery samples of presumed Attic origin (CMG 5)

rounded to subangular, and very well sorted, with grains predominantly falling into the silt and very fine sand classes with very rare fine sand. The predominant constituents are mica (dominantly white mica) and quartz (monocrystalline), accompanied by opaques (possibly Fe oxides), polycrystalline quartz, calcite (in varying quantity from sample to sample), and sporadic plagioclase, chert, quartz-rich metamorphic rock fragments, quartz+biotite rock fragments, brown amphibole and epidote. All samples refired light red (CKOL 7 slightly lighter than the rest), indicating the use of a similar clay type. The glazed slip is visible in the thin sections of samples CKOL 2, CKOL 3 and CKOL 6; it is extremely fine in texture and its thickness is about 0.01mm (varying up to 0.02mm in CKOL 6), while its colour is very dark red in PPL, black to very dark red in XP, and its matrix appears optically inactive to moderately active. The black glazed slip refired dark purple brown, in accordance with the assumed use of an iron-rich material. Its optical activity ranges from moderately active to almost inactive indicating varied degrees of vitrification (initial to advanced, respectively). This evidence, in combination with the optical activity of the groundmass suggests original firing temperatures most possibly in the range of 800–900°C.[638]

Chemical Analysis

Chemically, CMG 5 samples cluster together at the right edge of the dendrogram in Taf. 123. They exhibit high aluminium (Al_2O_3 c. 17 %), iron (Fe_2O_3 c. 8 %) and magnesium (MgO c. 5 %) and medium calcium (CaO c. 7.5 %), while in terms of trace elements notable are the elevated contents in nickel (c. 350 ppm), chromium (c. 500 ppm), and scandium (c. 21 ppm) (Tables 7b and 8b). The only sample slightly deviating, but still in agreement with the rest, is CKOL 2 with higher silicon, magnesium, iron, and aluminium contents and lower calcium. Interestingly, the two later samples, dating to the 4th c. BC (CKOL 6 and CKOL 7), form a very tight subcluster (Taf. 123 and Table 8b), distinct, but clearly related to the rest, with somewhat lower iron and higher strontium.

Discussion of the Analytical Data

The inclusions, although not safely diagnostic, reflect a metamorphic geological environment and are therefore compatible with the geology of Attica, which is characterised by Paleozoic and Mesozoic alternating formations of marbles, gneisses and schists of variable composition.[639] Samples CKOL 1–4 and CKOL 6–7 were compared petrographically with three fine ware samples in M. Farnsworth's collection from the Athenian Agora.[640] Farnsworth's samples AA32, AA45[641] and AA54 are all dated to the 5th c. BC, belong to small-sized pots (e.g. kylix, cup; one of them is also black glazed), and are considered to be typical representatives of Attic fine fabric. They are rather similar to the Kolonna samples, i.e. are equally fine-grained, bear a micaceous matrix and contain rare silicate inclusions. Given the fineness of the fabric and the lack of auxiliary diagnostic features, nothing more can be essentially said apart from the fact that the two sets of samples do not exhibit obvious dissimilarities.

A range of chemical data from analyses of pottery of presumed Attic provenance from different chronological periods has been generated in the past using a variety of techniques.[642] For the reasons out-

638 Analytical and experimental work on the firing temperatures of Attic Black Glaze pottery showed that these fall into the range of 800–950°C (Aloupi 1993, 102).

639 Papadeas 2003.

640 Farnsworth 1964.

641 Published in Farnsworth 1964, 227 as no. 13, pl. 68.13.

642 See discussion and relevant references in Jones 1986, 150–169 as well as more recently Neff and Glascock 2006 (full dataset in http://archaeometry.missouri.edu/datasets/datasets.html), and relevant data in the University of Manchester Archaeometry database from the work by Prag *et al.* in prep. (http://archaeometry.missouri.edu/datasets/uman/index.html)

lined in the methodology section, direct statistical comparison with this data is not possible, but a brief comparative discussion with some of the most relevant data available is undertaken here. In their analyses of ceramics from the Athenian Agora using instrumental neutron activation analysis (INAA) at the Brookhaven National Laboratory, Fillieres *et al.*[643] distinguished two groups to which they attributed an Attica origin: Attic Group A dating to the Classical-Hellenistic period and Attic Group B from the Protogeometric period. Only some of the analysed elements are common to both the Fillieres *et al.* and the present study (Na, K, Mn, Fe, Ca, Cr, Sc, Ba). These show close correspondence, particularly with the Brookhaven National Laboratory Attic Group B, as barium, scandium, and potassium contents appear elevated in Group A compared to the samples analysed here. Further INAA analyses of Hellenistic coarse and fine ware from the Athenian Agora was undertaken more recently by the University of Missouri Research Reactor Center.[644] In addition to the aforementioned, elements analysed in common included Ni, Zr, Al, and Ti. On the basis of all these, the six CMG 5 samples are similar to the Attic fine ware found in the Athenian Agora, the majority of which are associated with the Brookhaven National Laboratory Attica Group A and fewer with Attic Group B. Higher nickel and sodium contents and lower potasssium was, however, noted in the CMG 5 samples. The chemical composition of the CMG 5 samples is also broadly comparable with a group of samples of 7th century BC Attic pottery analysed using ICP-OES (same elements as here excluding zirconium, scandium, and barium) at the Fitch Laboratory.[645] In closing, similarly to the petrographic analyses, the chemical data are in good agreement with other finds of assumed Attic provenance and therefore support the archaeological identification and provide additional evidence for the characterisation of Athenian/Attic products.

Three sub-clusters are noted among the CMG 5 samples in the dendrogram (Taf. 123) as follows: a) CKOL 1, CKOL 3, CKOL 4 (dated to the 5th c. BC), b) CKOL 6 and CKOL 7 (dated to the 4th c. BC), and c) CKOL 2 (dated to the 5th c. BC). Admittedly, the small number of samples analysed does not allow generalisations to be made concerning Attic pottery production. Nevertheless, present data may be pointing towards the use of different fabrics, possibly implying distinct technological choices or exploitation of multiple raw material sources through time (between the 5th c. and 4th c. BC)[646] and/or across space (within Attica). In this respect, it is noteworthy that the two later samples clustered together. Clearly, pottery production in the Attic workshops, as well as raw material diversity in this region, requires substantial further investigation for such trends to emerge.

Petrographic Description

Fine micaceous fabric (CKOL 1–4. 6–7)

Microstructure

The fabric has rare voids (very few in CKOL 7), predominantly mesovughs and rare mesoplanar voids (dominant megaplanar voids only in CKOL 7). Voids do not possess coatings and/or infillings, except CKOL 7 where vughs rarely have complete infillings of sparitic calcite. The c:f related distribution is close- to single-spaced porphyric related distribution. Voids and mica laths show relatively well developed preferred orientation parallel to the vessel walls (in CKOL 6 mica is in some areas at an angle to the vessel walls), while orientation cannot be described with regard to the rest of the inclusions, since they are rounded and of small size.

Groundmass

Rather homogeneous throughout the sections, with the exception of CKOL 4 and CKOL 7, where patches of secondary calcite are observed, noticeable only in XP. Moreover, CKOL 3 and CKOL 4 appear less micaceous than the rest of the samples, but this might be the result of variable orientation of thin-sectioning. The micromass is optically moderately to slightly active, PPL reddish brown (in CKOL 1 and CKOL 6 brown), XP dark red (in CKOL 6 dark brown) (x25).

[643] Fillieres *et al.* 1983.

[644] Neff and Glascock 2006 (full dataset in http://archaeometry.missouri.edu/datasets/datasets.html)

[645] Kartsonaki 2003.

[646] See also suggestions for subdivision of chemical profiles in Attic pottery of different chronological periods in Fillieres *et al.* 1983 and discussion in Jones 1986, 168–169.

Inclusions

$c{:}f{:}v_{10\mu m}$	ca. 7:91:2 to 10:88:2 (10:87:3 in CKOL 7)

Inclusions are very well sorted, <0.175mm (0.4mm in CKOL 3), mode 0.05mm, r–sa. Size distribution is unimodal.

Dominant–common	Mica, <0.12mm, mode 0.05mm, dominantly white mica laths and commonly biotite laths (rarely flakes), occasionally oxidised.
Frequent	Quartz, monocrystalline, <0.15mm, mode 0.05–0.08mm, r–sa. Given the difficulty of discriminating between quartz and feldspar in very small grain sizes, it is likely that a proportion of these inclusions are alkali feldspar.
Very few–few	Opaques, <0.1mm, mode 0.05mm, r–sr, very dark red in PPL and XP, rarely orange red in PPL, isotropic/anomalous birefringence in XP.
Rare–very few	Quartz, polycrystalline, <0.15mm, mode 0.08mm, sr–sa.
Rare	Calcite, predominantly micrite, <0.4mm, mode 0.05, r. In CKOL 3 it is either vitrified (isotropic) or at an initial stage of vitrification (isotropic rim; in CKOL 4 it is Common, rather vitrified, not having a birefringent reaction but not isotropic). Very rarely sparitic, mode 0.2mm, sa–sr (in CKOL 7).
	Plagioclase, 0.05–0.03mm, sa, with albite twinning.
	Chert, 0.06–0.1mm, sr.
Very rare	Quartz-rich metamorphic rock fragments, consisting of quartz and alkali feldspar, 0.16–0.12mm, sr.
	Rock fragments, quartz+biotite, 0.075–0.1mm, sr.
	Brown Amphibole, 0.075–0.175mm, with pleochroism from pale green or light brown to dark brown, sr.
	Epidote, 0.03–0.1mm, sa.

2.3.1.2. Black glazed vessels of presumed Laconian origin (CKOL 17–20. 26; Taf. 62. 63. 72. 98. 104)

Samples of black glazed pottery, dated to the 6th c. and 5th c. BC and macroscopically associated with a possible Laconian origin, (group CMG 6), were also found to comprise a very homogeneous fabric group, both petrographically and chemically (Tables 9a–b).

Petrographic Analysis

The fabric (Taf. 126. CKOL 26) is fine-grained, well sorted and micaceous, with a very dark red micromass in XP and about 2–5% voids. Inclusions are few, rounded to subangular, and well to moderately sorted, with grains predominantly falling into the very fine and fine sand classes with rare medium sand and very rare coarse or very coarse sand. Inclusions consist of frequent mica (dominantly biotite) and common quartz (monocrystalline) and alkali feldspar, accompanied by quartz-rich metamorphic rock fragments (rarely converting to schist), opaques (possibly Fe oxides) and Tcfs, and rare–very rare polycrystalline quartz, plagioclase, chert, microfossils, micritic calcite, biotite-quartz rock fragment, brown amphibole, epidote (?), and serpentinite (?). All samples refired red, indicating the use of a similar clay type.

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
17	1st half 5th c.	krater	red	dark purple brown	Fine micaceous & metamorphic with Tcfs fabric	moderately to slightly active
18	ca. 3rd qu. 6th c.	jug	red	dark purple brown	Fine micaceous & metamorphic with Tcfs fabric	slightly active
19	2nd half 6th c	jug	red	dark purple brown	Fine micaceous & metamorphic with Tcfs fabric	slightly active
20	context late 1st/ early 2nd qu. 5th c.	jug	red	dark purple brown	Fine micaceous & metamorphic with Tcfs fabric	moderately to slightly active
26	context late 1st/ early 2nd qu. 5th c.	jug	red	dark purple brown	Fine micaceous & metamorphic with Tcfs fabric	moderately to slightly active

Table 9a Black glazed pottery samples of presumed Laconian origin (CMG 6) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
17	1.08	2.34	18.1	54.7	3.22	5.63	0.86	0.06	7.43	19	182	113	140	227	397	93.4
18	1.45	2.32	15.4	59.9	2.83	5.46	0.87	0.05	5.96	17	176	114	224	244	330	94.3
19	1.12	2.52	17.3	58.0	2.50	5.26	0.96	0.05	5.76	17	220	108	197	229	392	93.5
20	1.37	2.48	17.9	59.1	2.89	4.56	0.91	0.05	7.19	18	182	135	160	221	340	96.5
26	1.40	2.57	17.7	56.0	3.07	5.35	0.99	0.05	6.57	19	190	98	190	251	408	93.7

Table 9b Results of chemical analyses (ICP-OES) for Black glazed pottery samples of presumed Laconian origin (CMG 6)

The fineness of the clay paste used can either be a natural feature of the raw materials selected or product of levigation or cleaning processes. Whatever the case might be, although this fineness is of high degree, it cannot be compared with that of Black glazed pottery of presumed Attic origin (see above IX.2.3.1.1). The black glazed slip refired dark purple brown, due to its rich-in-iron composition, as in the case of the presumed Attic examples, but it was not preserved in any sample in order to describe it in thin section. The optical activity of the groundmass suggests original firing temperatures most possibly in the range of 800–900°C, similarly to the Attic black glazed pottery.

Chemical Analysis

Chemically, the samples form a relatively tight cluster (Tables 7b and 9b), distinct from the rest, local or imported, appearing to the right side of the left main branch of the dendrogram (Taf. 123). Similarly to local Red Fabrics, with which they are more broadly associated in the dendrogram, the samples have low-medium calcium, nickel, and chromium contents, and high aluminium. They are, however, clearly distinguished from the composition of the local Red Fabrics, on the basis of higher zirconium and potassium, and lower strontium, manganese and sodium contents.

Discussion of the Analytical Data

Although petrographic and chemical analysis support the compositional integrity of this macroscopic group, it is difficult, with present data, to discuss its possible provenance and confirm its presumed Laconian origin. The following comparative sample sets and published results of petrographic analysis were taken into account: a) seven samples from Archaic Laconian type amphorae found in Kommos, Crete, and published by C. de Domingo and A. Johnston (main group),[647] b) three samples of deposit σ from Kastri, Kythera, identified by shape as Laconian kraters (two sherds) and lekane (one sherd) by Alan Johnston,[648], c) Late Helladic I–II pottery from Ayios Stephanos, Laconia, published by I.K. Whitbread and R. Jones (in particular Classes 1~1, 2~1, 2~2),[649] and d) Late Helladic III 'Barbarian Ware' from Menelaion, Laconia, published by I.K. Whitbread (FC 1–4).[650] All sets of samples have many textural and compositional attributes in common, namely they are all fine-grained and well sorted, and are characterised by mica, silicate inclusions of metamorphic origin, Tcfs and sporadic microfossils. Nevertheless, this overall similarity in fabric does not favour any attribution to a specific area of production, although Laconia itself cannot be ruled out;[651] the fineness of the fabric, the undiagnostic inclusions, and the lack of analysed raw materials from any part of Laconia so far hinder the discussion of provenance on the basis of petrographic data.

Chemical data for Laconian pottery of this period are still scarce.[652] Atomic absorption spectroscopy (AAS) data from the analysis of Archaic Laconian type amphorae from Kommos[653] discussed above are in good agreement with the CMG 6 samples. Contemporary pottery from Sparta analysed by Attas *et al.*[654]

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647 De Domingo and Johnston 2003, 37, 43.
648 Johnston *et al.* (forthcoming).
649 Whitbread and Jones 2008, CD-93–98.
650 Whitbread 1992, 298–302.
651 Whitbread and Jones 2008, CD-112–113, De Domingo and Jonston 2003, 37.
652 Laconian pottery of this period is reported to have been analysed using NAA in the study on 'Mainly Black Glaze pottery from Greece' undertaken at Manchester University by J.A. Scott and currently in preparation for publication by A.J.N.W. Prag *et al.* (data in http://archaeometry.missouri.edu/datasets/uman/index.html, although the relevant section does not provide clear archaeological information on the analysed samples). Publication of recognised regional groups must be awaited before any comparisons can be made.
653 De Domingo and Johnston 2003, table 2.
654 Attas *et al.* 1982

using INAA at Brookhaven National Laboratory shows little comparability based on the few common elements, while the results of the present study are also not in good agreement with X-ray fluorescence measurements of a single Archaic amphora sample from Miletus attributed a Laconian origin.[655] Among Late Helladic pottery from Ayios Stephanos analysed with NAA, Group A, considered to be local, shows higher contents of Ca, Cr, and Ni compared to CMG 6.[656] Moreover, the results of ICP-OES analyses of Late Helladic pottery from the Menelaion[657] are markedly different to those of CMG 6, while comparison with NAA data of contemporaneous pottery groups identified as local from the same site,[658] shows discrepancies in some of the few commonly analysed elements, particularly Mn, Na, and Ca. It is, however, noteworthy that analyses, as yet unpublished, from later Archaic and Classical contexts at Menelaion are reported to show a different chemical profile to the Bronze Age ones.[659] With the exception of the Kommos samples, the remaining cases attributed a Laconian origin are not comparable to CMG 6. Clearly, however, for the reasons outlined previously, the incompatibilities do not reject, nor, of course, confirm, a Laconian origin for CMG 6, and provenance attribution of this fabric group remains presently tentative.

Petrographic Description

Fine micaceous & metamorphic fabric with Tcfs (CKOL 17–20. 26)

Microstructure

The fabric has rare to very few voids, predominantly mesovughs. Voids rarely have incomplete coatings and/or infillings of microsparitic calcite (CKOL 18). The c:f related distribution is close- to single-spaced porphyric related distribution. Voids and inclusions (especially mica) show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections, variation observed a) in the presence of secondary calcite in CKOL 18 (patches up to 1.5mm) and CKOL 26, b) in the size and kind of the rare larger inclusions. The micromass is optically moderately to slightly active, reddish brown (brown in CKOL 19) in PPL, very dark red (very dark reddish brown in CKOL 19) in XP (x25).

Inclusions

$c{:}f{:}v_{10\mu m}$ ca. 15:83:2 to 20:75:5

Inclusions are moderately to well sorted, <0.8mm (4.4mm in CKOL 19), mode 0.1–0.2mm, r–sa. Size distribution is unimodal.

Frequent	Mica, <0.15mm, mode 0.05–0.08mm, dominantly biotite laths (some oxidised) and commonly white mica laths (rarely flakes). In CKOL 18 mica is few.
Common–frequent	Quartz, monocrystalline, <0.35mm, mode 0.05–0.1mm, sr–sa.
	Alkali feldspar, <0.4mm, mode 0.05–0.1mm, sr–sa, rather fresh, but weathered examples exist.
Few–very few	Quartz-rich rock fragments/Schist, <4.4mm, mode 0.25mm, sa–sr. When schist fragments, they contain quartz+sericite/white mica ± biotite ± opaques.
	Opaques, <0.2mm, mode 0.05 mm, r–sr, black in PPL and XP, or orange in PPL, isotropic in XP.
Rare	Quartz, polycrystalline, mode 0.2mm, sr–sa.
	Plagioclase, 0.05–0.1mm, sa.
	Chert, 0.25–0.3mm, sa.
	Microfossils, 0.3–0.1mm, foraminifera and ostracods (CKOL 18, CKOL 19, CKOL 20)
Very rare	Calcite, 0.15–0.1mm, sr, vitrified? (CKOL 20).

655 Sample TR-3K/037 in Seifert 2004, 108.
656 French *et al.* 2008, table A3.3.
657 Jones and Tomlinson 2009, table G.2.
658 Jones and Tomlinson 2009, table G.7.
659 Jones and Tomlinson 2009, 162.

ORGANIC RESIDUE (?), 0.2mm, flake (CKOL 20).
AMPHIBOLE, 0.1mm, weak pale brown pleochroism, with cleavage (CKOL 17).
BIOTITE-QUARTZ ROCK FRAGMENT, 0.15mm (CKOL 17), 0.8mm (CKOL 19, possibly alteration product).
EPIDOTE (?), 0.01mm (CKOL 17).
WEATHERED SERPENTINITE (?), 0.05mm (CKOL 26).

Textural Concentration Features

Very few to few

Very dark red to dark reddish brown (PPL, x50) and very dark red to black (XP, x50), <0.4mm, mode 0.25mm, boundaries clear (to merging), sr, equant shape, high optical density, discordant with the external fabric (quartz and rarely mica inclusions) – ARFs or clay pellets (?).

Very dark red to black (PPL, x50) and very dark red to black (XP, x50), <1.4mm, mode 0.2mm, boundaries clear to merging (frequently with surrounding void or a rim – vitrification rim?), sr, prolate to equant shape, high optical density, discordant with the external fabric (silicate inclusions) – clay pellets (?).

Brown (PPL, x50) and dark brown (XP, x50), <2.4mm, mode 0.2–0.3mm, boundaries clear to merging, r, equant to prolate shape, neutral to low optical density, discordant with the external fabric (silicate and mica inclusions for the larger Tcfs, calcite 'dust' for the smaller ones).

2.3.1.3. Plain and painted vessels of presumed Corinthian origin (CKOL 47–49; Taf. 65. 73. 96. 120)

Group CMG 10a consists of plain and painted fine tableware that has been macroscopically attributed a possible Corinthian origin.

Petrographic Analysis

This is a homogeneous, very fine-grained fabric (Table 10a; Taf. 126. CKOL 48). It has a dark orange brown to very dark red micromass in XP with 2–5% voids. Inclusions are very few to few, rounded to subangular, very well to well sorted, of silt size (rarely reaching fine sand). The fabric has dominant mica and silicate inclusions (monocrystalline quartz and alkali feldspar), few micritic calcite and opaques, rare polycrystalline and plagioclase fragments and common to dominant clay pellets. Samples CKOL 47 and CKOL 49 refired buff, indicating the use of different clays, whereas CKOL 48 refired light red. The slip of CKOL 47 (banded oinochoe) refired red, while that of CKOL 49 (semiglazed mug) refired dark purple brown, indicating the use of iron-rich slips in both occasions, but possibly of different composition and/or fired under different conditions. The optical activity of the groundmass suggests original firing temperatures around 850°C.

Chemical Analysis

The three samples have similar chemical compositions (Table 10b), showing medium-high aluminium

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
47	3rd/early 4th qu. 5th c.	lekythos	buff	red	Very fine fabric	moderately to slightly active
48	context late 1st/early 2nd qu. 5th c.	jug	light red	light red	Very fine fabric	moderately to slightly active
49	late 3rd qu. 5th c.	bowl, one-handle	buff	dark purple brown	Very fine fabric	inactive

Table 10a Samples of plain and painted vessels of presumed Corinthian origin (CMG 10a) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
47	0.97	3.87	16.0	49.1	2.73	14.41	0.79	0.13	7.79	19	235	214	437	101	304	95.8
48	0.97	3.96	16.8	50.2	3.09	12.06	0.80	0.10	7.88	21	258	212	495	114	603	95.9
49	0.67	4.02	16.7	48.7	2.86	14.81	0.81	0.12	8.24	22	269	222	427	110	425	97.0

Table 10b Results of chemical analyses (ICP-OES) for samples of plain and painted vessels of presumed Corinthian origin (CMG 10a)

and iron and high calcium contents, with sample CKOL 48 (that refired light red) slightly calcium poorer. Nickel and chromium range around 200 ppm each with a ratio of roughly 1:1 between them, scandium values tend towards the highest of the assemblage, around 20 ppm, while zirconium towards the lowest, around 100 ppm. On the dendrogram (Taf. 123) they cluster together with the majority of samples from group CMG 10b (see below IX.2.3.2.1).

Discussion of the Analytical Data

In order to investigate the presumed Corinthian provenance of this group, samples CKOL 47–49 were compared both petrographically and chemically with different sets of comparative data. Since CMG 10a includes finewares only, it was compared to Corinthian medium-coarse and finewares studied petrographically by I. Whitbread,[660] falling into the petrographic group of Corinth amphorae type A′ FC1 and 2. Samples CKOL 47–49 bear fair resemblance to the finer members of these fabric classes (notably A′ FC2). Given the fineness of the fabric and the lack of helpful diagnostic features, no further comments can be made apart from the lack of obvious dissimilarities between the two sets of samples. It has to be noted, though, that CKOL 47–49 present variation in refiring colour, which is not encountered in Whitbread's samples.[661]

Chemical data from Corinthian pottery can be found in several studies,[662] although the same problems of intercomparability as discussed in the Methodology section IX.2.1.2 apply here as well. Nevertheless, good agreement is seen between common elements in these samples and the Corinth Control Group and Corinthian pottery from Kolonna, established through INAA analyses at the Lawrence Berkeley Laboratory,[663] as well as the black glazed Corinthian pottery analysed with INAA at the Manchester Archaeometry Laboratory.[664] Both the petrographic and the chemical data are therefore in agreement with a Corinthian provenance of samples CKOL 47–49.

Petrographic Description

Very fine fabric (CKOL 47–49)

Microstructure

There are few to very few voids, predominantly mesovughs and very few mesoplannar voids. The c:f related distribution is single- to double-spaced porphyric related distribution. The majority of voids, mica and Tcfs show well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections, variation observed only in the presence of secondary in CKOL 47, CKOL 49. The micromass is optically moderately to slightly active, brown in PPL (x25), orange brown to dark orange brown in XP (x25); inactive, brown in PPL (x25), very dark red to black in XP (x25) (CKOL 49).

Inclusions

$c{:}f{:}v_{10\mu m}$ ca. 5:93:2 to 10:88:2

The inclusions are very well to well sorted, <0.2mm (1.1mm Tcf in CKOL 49), mode 0.1–0.05mm, r–sa. Size distribution is unimodal.

Dominant	Mica, mode 0.03–0.05mm, both biotite and white mica laths. In CKOL 49 mica is rare due to the angle of the section (?).
Common	Quartz/Feldspar, <0.12mm, mode 0.05–0.03mm, sr. Discrimination between very small quartz and feldspar grains is difficult, so exact quantitative estimation of each is not attempted. Feldspar is considered to be alkali feldspar, since no twinning can be detected.

660 Whitbread 1995, 301–304.
661 Whitbread 1995, 301.
662 See also Jones 1986, 173–191, for an account of further earlier analyses of Corinthian pottery.
663 Farnsworth *et al.* 1977, 457, table 1: Columns 4 and 6 respectively.
664 Unpublished study undertaken by J.A. Scott and A.J.N.W. Prag at the University of Manchester. Datasheet (amcor.dat) in the online database at http://archaeometry.missouri.edu/datasets/uman/index.html.

Few–very few	CALCITE, micritic, <0.2mm, mode 0.1mm, r–wr.
	OPAQUES, mode 0.05–0.03mm, sr, very dark red to black in PPL, black in XP, or red to very dark red in PPL, very dark red in XP.
Rare	QUARTZ, polycrystalline, 0.06–0.07mm, sa.
	PLAGIOCLASE, 0.25mm, sa.

Textural Concentration Features

Dominant to common

Orange brown (PPL, x50) and very dark orange brown (XP, x50), <1.1mm, mode 0.1–0.2mm, boundaries clear to merging, r, prolate and distorted shape, neutral optical density, discordant with the external fabric – clay pellets (?) or calcareous marl (?).

Reddish brown (PPL, x50) and dark reddish brown (XP, x50), <0.6mm, mode 0.1mm, boundaries clear to merging, r, equant and distorted shape, neutral to high optical density, discordant with the external fabric – clay pellets (?).

2.3.1.4. Polished jugs with grey fabric of unidentifiable origin (CKOL 8–16, Taf. 60–62. 72. 78–80. 98. 120; CKOL 5, Taf. 60. 80)

Samples CKOL 8–16 and CKOL 5 represent vessels that share morphological features, but could not be classified as a uniform macroscopic group, including monochrome polished jugs, mainly grey and rarely red ones. Petrographic and chemical analysis aimed at exploring the integrity of this group as well as the possibility of a local origin (Tables 11a–b).

Petrographic Analysis

The above samples do not form a compositionally homogeneous cluster. One core subgroup (CKOL 9–10, CKOL 13–14, CKOL 16) can be discerned petrographically and is confirmed chemically, while the remaining samples constitute single cases. The core subgroup has a dark brown to (very) dark yellowish brown micromass in XP with about 3–5% voids (Taf. 126. CKOL 10). Inclusions are few, subrounded to subangular, and well to moderately sorted, with grains being predominantly of fine sand, few medium sand and rarely reaching coarse or very coarse sand size. Inclusions contain dominantly to commonly quartz (predominantly monocrystalline), commonly to frequently calcite (micritic or microsparitic limestone fragments), frequent to few microfossils (ostracods?), along with alkali feldspar (probably orthoclase), mica (biotite and white mica), opaques, and rare to very rare green amphibole, plagioclase,

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
5	context late 3rd/ early 4th qu. 5th c.	jug	brownish red	dark red	Schist & calcite fabric	active
8	context late 1st/ early 2nd qu. 5th c.	jug	very dark red	very dark red	Schist & quartz-rich metamorphic rock fragments fabric	active
9	context late 3rd/ early 4th qu. 5th c.	jug	red	dark red	Silicate & carbonate fabric	moderately active
10	context late 3rd/ early 4th qu. 5th c.	jug	red	dark red	Silicate & carbonate fabric	active
11	context late 3rd/ early 4th qu. 5th c	jug	red	–	Quartz & calcite fabric	active to moderately active
12	context late 3rd/ early 4th qu. 5th c.	jug	dark red	dark red	Schist & chert fabric	active
13	context 3rd/early 4th qu. 5th c.	jug	red	brown/black	Silicate & carbonate fabric	slightly active to inactive
14	context 3rd/ early 4th qu. 5th c.	jug	light red	dark red	Silicate & carbonate fabric	slightly active to inactive
15	context 3rd/ early 4th qu. 5th c.	jug	dark red	dark red	Silicate & calcite fabric	slightly active to inactive
16	context ca. mid/ early 3rd qu. 5th c.	jug	light red	dark red/brown	Silicate & carbonate fabric	slightly active to inactive

Table 11a Samples of polished jugs with grey fabric of unidentifiable origin and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
9	2.20	4.02	16.4	55.1	2.70	7.60	0.85	0.11	6.99	18	210	191	331	161	477	96.0
10	1.87	3.79	15.0	53.8	2.63	7.04	0.78	0.09	6.60	16	192	205	267	155	394	91.6
13	1.77	4.87	15.2	56.5	2.49	6.80	0.83	0.13	6.86	13	189	216	240	131	371	95.5
14	1.57	3.81	14.6	52.6	2.62	9.65	0.79	0.13	6.51	13	169	148	296	123	482	92.3
16	1.60	3.82	14.4	52.4	2.70	10.5	0.79	0.13	6.57	17	190	164	372	163	530	92.9
8	1.72	2.92	20.0	56.5	4.34	1.38	0.88	0.05	8.01	19	262	262	177	188	441	95.7
11	1.61	2.81	13.5	56.5	1.91	8.16	0.87	0.08	5.16	15	197	144	203	187	297	90.6
12	0.82	1.69	15.5	66.7	2.91	2.46	0.70	0.02	6.38	14	251	202	98	217	384	97.1
15	1.36	2.85	18.2	55.9	2.50	3.19	1.01	0.11	7.47	22	206	130	149	178	408	92.6
5	1.11	4.34	15.5	53.4	3.31	4.78	0.80	0.10	7.50	18	456	361	280	142	403	90.9

Table 11b Results of chemical analyses (ICP-OES) for polished jugs with grey fabric

epidote group minerals, chert, and shale (?). The remaining samples comprise 'single' fabrics characterised by silicate, quartz-rich metamorphic and/or schist rock fragments and calcite inclusions. Fine to fine/medium-grained clay was preferred for the manufacture of grey polished jugs (with the exception of CKOL 11, which is medium-coarse). After refiring it became rather obvious that the grey jugs also had a slip, which was not obvious at the original state of the sherds. The slip and, notably, the clay body present considerable variability in the refiring colour, from light to very dark red (this variability is notable even in the core subgroup samples), indicating the use of more than one type of clay and possibly reflecting more than one production centres. The optical activity of the groundmass suggests a wide range of original firing temperatures from 800°C to above 900°C, while the grey core and surface colour suggest well-controlled reducing firing conditions.

Chemical Analysis

The core subgroup samples CKOL 9–10, CKOL 13–14, CKOL 16 cluster together in the dendrogram (Taf. 123), forming, however, a less chemically homogeneous set than noted in other cases (note structure of dendrogram and elevated relative standard deviations in Table 7b). Medium to high magnesium and medium contents of aluminium and calcium were measured, while nickel and chromium average around 200 ppm each on a roughly 1:1 ratio. Among the remaining samples, only CKOL 11 is loosely associated with the core cluster in the dendrogram, but a look at the chemical results (Table 11b) shows that its manganese, magnesium, aluminium, and iron content are depleted compared to the core group. The remaining samples are, similarly to petrography, 'singles' and, with the exception of CKOL 5, appear to the left edge of the dendrogram (Taf. 123).

Discussion of the Analytical Data

Based on evidence provided by both petrographic and chemical analysis, a non-local origin for the polished jugs with grey fabrics should be considered, confirming macroscopic examination. Moreover, samples CKOL 5, CKOL 8–16 were compared with samples of presumed Attic origin from M. Farnsworth's collection from the Athenian Agora since an Attic origin was also considered possible (see Section IX.1.3.2). The Kolonna samples are considerably finer-grained than Farnsworth's 'Attic' group, and they do not present any strong similarity in composition. The core subgroup (CKOL 9–10, CKOL 13–14, CKOL 16) points to a sedimentary and metamorphic environment, in terms of geological characterisation of its inclusions. It is a fine fabric, without any particularly diagnostic features allowing for discussion of a possible geographic origin of this group. Nevertheless, it is worth noting that the samples falling into this fabric constitute a uniform, albeit not very tight, chemical cluster that is distinct from all other imports to Aegina attributed to a known source (e.g. Attic, Laconian, Corinthian etc.). CKOL 5 (Taf. 126. CKOL 5) is to some extent compatible, both petrographically and chemically, to CMG 5, making an Attic origin for this sample probable. The remaining members of the polished jugs group (Taf. 126. CKOL 8; CKOL 11; Taf. 127. CKOL 12. CKOL 15) present notable differences not only to the core subgroup but also to each other, although they all point to a metamorphic geological environment. Thus, it is possible to propose that the polished jugs of the core subgroup (CKOL 9–10, CKOL 13–14, CKOL 16) can be associated with one region (and even one production centre), whereas the rest probably have various origins. So, despite the morphological similarities, composition seems to indicate production at various locations/workshops.

Petrographic Description

Core subgroup: silicate & carbonate fabric (CKOL 9. 10. 13. 14. 16)

Microstructure

The fabric has very few voids, predominantly mesovughs and rare mesoplanar voids. Voids rarely have incomplete coatings and/or infillings of micritic calcite. The c:f related distribution is variable, ranging from close- to double-spaced porphyric related distribution. Voids and some inclusions (especially microfossils) show relatively well developed preferred orientation parallel to vessel walls, while the rest is rather randomly orientated.

Groundmass

Rather homogeneous throughout the sections, variation observed in a) micromass optical activity, ranging from active to inactive across the sections, b) composition (small differences observed in CKOL 9 and CKOL 14; see description), c) the presence of secondary calcite (only in CKOL 16). The micromass is optically active to moderately active, reddish brown to dark brown in PPL, dark yellowish brown to dark orange brown in XP (x25) (CKOL 9, CKOL 10); slightly active to inactive, dark brown in PPL, very dark brown to very dark yellowish brown in XP (x25) (CKOL 13–14, CKOL 16).

Inclusions

$c{:}f{:}v_{60\mu m}$ ca. 10:87:3 to 15:80:5

Inclusions are well to moderately sorted, <1.5mm, mode 0.1–0.25mm, sr–sa. Size distribution is unimodal.

Dominant–common	Quartz, monocrystalline, <0.5mm, mode 0.1mm, sr–sa; few polycrystalline, mode 0.2mm, sr–sa.
Common–frequent	Calcite, micritic and/or sparitic, <1.2mm, mode 0.15mm, r–sr; few crystalline examples also observed. Limestone rarely has quartz inclusions (CKOL 13, CKOL 16), or has reached an initial stage of vitrification (isotropic rim).
Frequent–few	Microfossils, <0.7mm, mode 0.2–0.3mm, shell-like; rare in CKOL 14 and CKOL 16, few with incomplete micritic infilling.
Common–few	Alkali feldspar, <0.2mm, mode 0.1mm, sr–sa, relatively fresh, most probably orthoclase.
Few–very few	Mica, <0.4mm, mode 0.05–0.1mm, dominantly biotite laths and commonly white mica laths (rarely flakes).
Very few	Opaques, <0.2mm, mode 0.05–0.1mm, r–sr, black in PPL and XP.
Rare–very rare	Amphibole, <0.1mm, mode 0.05mm, sa; predominantly laths with pale green-green pleochroism and small extinction angle (brown amphibole in CKOL 9).
Very rare	Plagioclase, mode 0.05mm, sa.
	Epidote group, mode 0.05mm, sa.
	Chert, 0.25mm, sa–sr (CKOL 16).
	Shale (?), 0.55mm, sr–sa (CKOL 14).

Textural Concentration Features

Very few to rare

Red (PPL, x50) and very dark orange brown (XP, x50) (in CKOL 13 red to dark red in PPL, very dark red to black in XP), 0.25–0.2mm, boundaries diffuse, r, equant shape, neutral optical density, discordant with the external fabric (CKOL 10, CKOL 13, CKOL 16).

Very dark brown to black (PPL, x50) and very dark reddish brown (XP, x50), <0.45mm, mode 0.2mm, boundaries clear (frequently with surrounding void), r–sr, equant to prolate shape, neutral to high optical density, discordant with the external fabric (silicate and mica inclusions, rarely also calcite?) (CKOL 9, CKOL 10).

Orange brown (PPL, x50) and black with orange speckles (XP, x50), <0.8mm, mode 0.2–0.4mm (the larger incomplete, with void), boundaries clear, r, distorted shape, neutral optical density, discordant with the external fabric (CKOL 14).

'Single' Fabrics

Schist & calcite fabric: CKOL 5

Microstructure

Rare voids, mesovughs, single-to double-spaced porphyric related distribution, no traces of preferred orientation.

Groundmass

Homogeneous, optically active, reddish brown in PPL (x25), orange brown in XP (x25).

Inclusions

$c:f:v_{60\mu m}$ 15:83:2

Inclusions are moderately sorted, <1mm, mode 0.1–0.2mm, sr–sa. Size distribution is unimodal.

Frequent	QUARTZ, monocrystalline, <0.55mm, mode 0.1mm, sr–sa; few polycrystalline, mode 0.2mm, sr–sa.
	CALCITE, micritic and/or sparitic, <1mm, mode 0.05–0.1mm, r–sr.
Few	SCHIST FRAGMENTS, <0.4mm, mode 0.2mm, sa–sr; two varieties consisting of a) quartz + biotite + white mica schist, occasionally mylonitised and b) fine-grained quartz + biotite schist.
	MICA, <0.3mm, mode 0.1mm, biotite and white mica laths.
Very few	OPAQUES, mode 0.05–0.1mm, black in PPL and XP.

Schist & quartz-rich metamorphic rock fragments fabric: CKOL 8

Microstructure

Very few voids, predominantly mesovughs and rare mesoplannar voids, single- to double-spaced porphyric related distribution. Voids and some inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Homogeneous, optically active, reddish brown in PPL (x25), orange to yellowish brown in XP (x25).

Inclusions

$c:f:v_{60\mu m}$ 10:85:5

Inclusions are well sorted, <0.55mm, mode 0.1–0.2mm, sr–sa. Size distribution is unimodal.

Dominant	QUARTZ, monocrystalline, <0.5mm, mode 0.1mm, sr–sa; few polycrystalline, mode 0.2mm, sr–sa.
Common	QUARTZ-RICH METAMORPHIC ROCK FRAGMENTS, <0.55mm, mode 0.25–0.35mm, sr–sa.
	ALKALI FELDSPAR, mode 0.05–0.1mm, sr–sa.
Few	MICA, <0.4mm, mode 0.05–0.1mm, both biotite and white mica laths.
Rare–very few	EPIDOTE GROUP, <0.2mm, mode 0.1mm, sr.
Rare	OPAQUES, mode 0.05–0.1mm, black in PPL and XP, sr.
	CHLORITE (?), <0.4mm, mode 0.1, sr, green in PPL, occasionally showing very faint pleochroism.
Very rare	PLAGIOCLASE, 0.2mm, sr.

Textural Concentration Features

Rare

Brown (PPL, x50) and dark orange brown (XP, x50), 0.7mm, boundaries diffuse, r, distorted shape, neutral optical density, concordant? with the external fabric (clay pellet?).

Quartz & calcite fabric: CKOL 11

Microstructure

Very few voids, mesovughs, single-spaced porphyric related distribution, voids and some inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Homogeneous, optically active to moderately active, PPL brown (x25), XP yellowish brown (x25).

Inclusions

$c{:}f{:}v_{60\mu m}$ 20:77:3

Inclusions are moderately sorted, <0.9mm, mode 0.15mm, sr–sa. Size distribution is unimodal.

Frequent	Quartz, monocrystalline, mode 0.15mm, sr–sa; few polycrystalline, <0.9mm, mode 0.15mm, sa–sr.
	Calcite, micritic, sparitic and few crystalline examples, <0.35mm, mode 0.15mm, sa–sr.
Few	Mica, <0.3mm, mode 0.1mm, predominantly biotite with brown to green pleochroism and few white mica.
Very few	Alkali feldspar, <0.35mm, mode 0.15mm, sa–sr.
	Opaques, mode 0.05–0.1mm, very dark red in PPL and XP, sr.
Rare	Epidote, mode 0.05–0.1mm, sr.
	Schist fragments, quartz + white mica, mode 0.15mm sr–sa.

Textural Concentration Features

Very few

Dark red (PPL, x50) and very dark red (XP, x50), <0.4mm, mode 0.15mm, boundaries clear to diffuse, sa–sr, prolate and equant shape, high optical density, discordant with the external fabric (silicate inclusions).

Schist & chert fabric: CKOL 12

Microstructure

Rare voids, mesovughs, single- to double-spaced porphyric related distribution, voids and some inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Homogeneous, optically active, brownish red inPPL (x25), orange red in XP (x25).

Inclusions

$c{:}f{:}v_{60\mu m}$ 15:83:2

Inclusions are moderately sorted, <0.4mm, mode 0.1–0.2mm, sr–sa. Size distribution is unimodal.

Frequent	Quartz, monocrystalline, <0.2mm, mode 0.08–0.1mm, sr–sa; few polycrystalline, <0.3mm, mode 0.1mm, sr–sa.
Common	Schist fragments, quartz + white mica, <0.3mm, mode 0.01mm, sr–sa.
	Chert fragments, mode 0.2mm, sr–sa.
Few	Alkali feldspar, <0.2mm, mode 0.1mm, sr.
	Mica, <0.4mm, mode 0.1mm, white mica laths.
	Quartz-rich metamorphic rock fragments, mode 0.25mm, sr–sa.
Very few	Opaques, mode 0.1–0.15mm, black in PPL and XP, or dark red in PPL and XP, sr.
Very rare	Calcite, micritic mode 0.15mm, sr, at initial vitrification stage (isotropic rim).

Silicate & calcite fabric: CKOL 15

Microstructure

Very few voids, mesovughs frequently with coating (clay minerals?), single- to double-spaced porphyric related distribution, voids and some inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Homogeneous (although secondary calcite present at the joint), optically slightly active to inactive, dark brown in PPL (x25), very dark brown to black in XP (x25).

Inclusions

$c:f:v_{60\mu m}$	15:80:5

Inclusions are well to moderately sorted, <0.5mm, mode 0.1mm, sr–sa. Size distribution is unimodal.

Frequent	QUARTZ, monocrystalline, <0.3mm, mode 0.08mm, sr–sa; rare polycrystalline, mode 0.25mm, sr–sa.
	ALKALI FELDSPAR, <0.3mm, mode 0.1mm, sr–sa.
Few	MICA, <0.3mm, mode 0.1mm, biotite and white mica laths.
Very few	CALCITE, micritic mode 0.5mm, r–sr.
	OPAQUES, mode 0.1–0.05mm, black in PPL and XP.
Rare	PLAGIOCLASE, 0.1–0.2mm, sa.
Very rare	CHERT FRAGMENTS, 0.2, sa.
	ROCK FRAGMENT, clinopyroxene + mica + quartz + epidote 0.25mm, sa.

Textural Concentration Features

Few

Dark reddish brown (PPL, x50) and very dark red to black (XP, x50), <0.4mm, mode 0.2mm, boundaries clear to diffuse, sa–sr, prolate and equant shape, neutral to high optical density, discordant with the external fabric (when there are inclusions, these are silicates).

Orange brown (PPL, x50) and black with orange speckles (XP, x50), <0.45mm, mode 0.15mm, boundaries clear, r, distorted shape, neutral optical density, discordant with the external fabric (as in CKOL 14).

2.3.1.5. Reddish-brown fine fabric of unidentifiable origin (CKOL 21. 22; Taf. 63. 98)

Macroscopically defined group CMG 7, characterised by reddish brown fine fabric, includes two one-handled bowls of unidentifiable origin. The two specimens are closely related both petrographically and chemically (Tables 12a–b), and do not appear to be associated with any other compositional group identified within the Kolonna assemblage, local or import, thus providing no evidence against or in support of a Laconian origin suspected on the basis of macroscopic examination (see section IX.1.3.4).

Petrographic Analysis

The fabric of this group is fine/medium-grained, bearing a very dark red micromass in XP with about 2–5% voids (Taf. 127. CKOL 22). Inclusions are few, rounded to subangular, and moderately sorted, with grains predominantly falling into the very fine and fine sand classes with rare medium sand and very rare coarse or very coarse sand. Inclusions consist of frequent to common quartz (monocrystalline) and alkali feldspar, accompanied by micritic calcite and Tcfs, along with few to very few quartz-rich metamorphic rock fragments, mica (biotite and white mica), polycrystalline quartz and opaques (possibly Fe oxides), rare to very rare serpentinite and sandstone fragments, chlorite, chert fragments, plagioclase and brown amphibole. Both samples refired red, indicating the use of a similar clay type. The black glazed slip refired dark purple brown, confirming the use of an iron-rich slip completely reduced in firing. The glazed slip was not preserved in any sample in order to describe it microscopically. The optical activity of the groundmass suggests extensive vitrification and original firing temperatures most possibly in the range of 800–1000°C.

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
21	context 3rd/early 4th qu. 5th. c.	bowl, one-handle	red	dark purple brown	Silicate & carbonate with serpentinite fabric	slightly active
22	context 3rd/early 4th qu. 5th c.	bowl, one-handle	red	dark purple brown	Silicate & carbonate with serpentinite fabric	slightly active

Table 12a Samples of reddish-brown fine fabric of unidentifiable origin (CMG 7) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
21	1.51	4.88	16.8	59.3	2.78	4.51	0.89	0.12	7.68	21	251	183	191	149	341	98.5
22	1.71	4.46	16.0	56.9	2.60	6.27	0.88	0.12	7.06	20	256	167	238	150	335	96.0

Table 12b Results of chemical analyses (ICP-OES) for samples of reddish-brown fine fabric of unidentifiable origin (CMG 7)

Chemical Analysis

The two samples have very similar chemical composition with low-medium calcium, medium aluminium, and relatively high magnesium and iron contents. Scandium content approaches the highest of the assemblage (20 ppm), while nickel and chromium range around 150–250 ppm on a roughly 1:1.5 ratio between them.

Discussion of the Analytical Data

At this stage, not much can be deduced on the provenance of this group. The inclusions point to a metamorphic and sedimentary geological setting, while the samples are not compatible with any of the other material analysed in this project.

Petrographic Description

Silicate & carbonate with serpentinite fabric (CKOL 21–22)

Microstructure

The fabric has very few mesovughs. The c:f related distribution is close- to single-spaced porphyric related distribution. Voids and the majority of inclusions show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections. The micromass is optically slightly active, reddish brown in PPL, very dark red in XP (x25).

Inclusions

$c:f:v_{10\mu m}$ ca. 15:83:2 to 15:80:5

Inclusions are moderately to well sorted, <0.4mm, mode 0.1–0.2mm, r–sa. Size distribution is unimodal.

Common–frequent	QUARTZ, monocrystalline, <0.3mm, mode 0.1mm, sr–sa.
	ALKALI FELDSPAR, <0.7mm, mode 0.05–0.1mm, sr–sa, rather cloudy.
Common-few	CALCITE, micritic <0.4mm, mode 0.2mm, r, frequently with vitrification rim.
Few–very rare	QUARTZ-RICH METAMORPHIC ROCK FRAGMENTS, <0.4mm, mode 0.25mm, sa–sr, consisting of quartz ± alkali feldspar (± white mica ± opaques).
Few–very few	MICA, <0.35mm, mode 0.08mm, biotite laths (oxidised) and white mica laths.
Very few	QUARTZ, polycrystalline, <0.35mm, mode 0.2mm, sr–sa.
	OPAQUES, <0.2mm, mode 0.05 mm, r–sr, black in PPL and XP or red in PPL and XP, rarely orange in PPL, isotropic in XP.
Rare	SERPENTINITE, mode 0.2–0.3mm, r–sr.
	SANDSTONE, mode 0.3mm, sa, mainly quartz and feldspar grains in Fe oxide cement.
Very rare	CHLORITE, mode 0.15–0.2mm, sr, pale green in PPL, anomalous-isotropic in XP (CKOL 22).
	CHERT, 0.3mm, sr (CKOL 22).
	PLAGIOCLASE, 0.1mm, sa (CKOL 22).
	AMPHIBOLE, 0.1mm, brown pleochroism (CKOL 22).

Textural Concentration Features

Common to few

Very dark red to dark reddish brown (PPL, x50) and very dark red to black (XP, x50), <0.4mm, mode 0.2mm, boundaries clear (to merging), r–sr, equant to prolate shape, neutral to high optical density, discordant with the external fabric (when it has inclusions they are quartz) – ARFs or clay pellets (?).

2.3.2. Transport Amphorae

2.3.2.1. Amphorae and coarse wares of presumed Corinthian origin (CKOL 50–61; Taf. 65. 66. 99. 120. 121)

Samples CKOL 50–53, CKOL 61 (CMG 10b), CKOL 60 (CMG 12) and CKOL 54–59 (CMG 13) relate to pottery of presumed Corinthian origin, including coarse wares (CKOL 50–53), Corinthian amphorae type A (CKOL 60) and A′ (CKOL 61), and Corinthian amphorae type B (CKOL 54–59) (Tables 13a–b).

Petrographic Analysis

Samples falling into CMG 10b and CMG 12 constitute a homogeneous fabric, which is medium- to coarse-grained, characterised by mudstone inclusions and strong bimodality (Taf. 127. CKOL 52). It has a very dark red to very dark yellowish brown micromass in XP with 2–5% voids. Inclusions are few to common, angular to subrounded, poorly to very poorly sorted, with mode sizes falling into medium sand, maximum grain size reaching very coarse sand. The fabric is characterised by frequent large mudstone and mudstone breccia fragments, few micritic limestone and siltstone fragments, very few opaques, rare chert and volcanic glass fragments. Samples CKOL 50, CKOL 51, CKOL 53, CKOL 61 refired buff, pointing to the use of similar, calcareous clay types (see also Table 13b), whereas CKOL 52 and CKOL 60 refired red, indicating the use of different clay types. The optical activity of the groundmass suggests original firing temperatures around 800–850°C for CKOL 50, CKOL 52, CKOL 53, CKOL 61 and higher for CKOL 50 and CKOL 60.

Samples belonging to CMG 13 form another fabric, which is rather homogeneous and medium/fine-grained, characterised by silicate inclusions (Taf. 127. CKOL 55). It has a very dark brown to dark yellowish brown micromass in XP with 2–5% voids. Inclusions are few, subangular to subrounded, well sorted, with mode sizes up to medium sand, maximum grain size reaching coarse sand. The fabric contains monocrystalline quartz, alkali feldspar and chert, along with oxidised biotite, opaques, very few polycrystalline quartz, plagioclase and quartz-rich metamorphic rock fragments, and very rare microfossils, serpentinite, schist and sandstone fragments. All samples refired buff, pointing to the use of similar, calcium-rich clays. The optical activity of the groundmass for

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix optical activity
		CMG 10b			
50	context 2nd/early 3rd qu. 5th c.	perirrhanterion	buff	Coarse mudstone-tempered fabric	inactive
51	context 2nd/early 3rd qu. 5th c.	perirrhanterion	buff	Coarse mudstone-tempered fabric	moderately active
52	context 2nd/3rd qu. 5th c.	storage vessel	light red	Coarse mudstone-tempered fabric	moderately active
53	context ca. 430/20	storage vessel	light brown	Coarse mudstone-tempered fabric	moderately active
61	context late 1st/early 2nd qu. 5th c.	transport amphora type Corinth A′	buff	Coarse mudstone-tempered fabric	moderately active
		CMG 12			
60	late 3rd/4th qu. 5th c.	transport amphora type Corinth A	red	Coarse mudstone-tempered fabric	slightly active to inactive
		CMG 13			
54	1st qu. 5th c.	transport amphora type Corinth B	buff	Silicate & chert fabric	inactive
55	mid/3rd qu. 5th c.	transport amphora type Corinth B	buff	Silicate & chert fabric	inactive
56	mid/3rd qu. 5th c.	transport amphora type Corinth B	light brown	Silicate & chert fabric	slightly active to inactive
57	late 3rd/early 4th qu. 5th c.	transport amphora type Corinth B	buff	Silicate & chert fabric	slightly active to inactive
58	ca. mid 5th c.	transport amphora type Corinth B	buff	Silicate & chert fabric	inactive
59	ca. mid 5th c.	transport amphora type Corinth B	buff	Silicate & chert fabric	slightly active to inactive

Table 13a Samples of amphorae and coarse wares of presumed Corinthian origin and summary of attributes

all samples suggests original firing temperatures above 850°C.

Chemical Analysis

With the exception of sample CKOL 52, the remaining CMG 10b specimens form a tight cluster in the dendrogram, also closely associated with CMG 10a. They are calcareous, with relatively low aluminium, and medium to high iron (Table 13b). The zirconium contents are amongst the lowest of the entire assemblage, while scandium and strontium tend towards the highest. Nickel and chromium values range around 200 ppm in a 1:1.2 ratio approximately. The two samples that refired red, CKOL 52 and CKOL 60 (CMG 12), cluster together in the dendrogram and are distinguished from the others by lower calcium contents (as expected from refiring tests), higher silicon and aluminium and lower manganese. Nickel, chromium, and scandium contents are systematically slightly elevated compared to the remaining CMG 10 samples, while strontium levels are comparatively depleted.

CMG 13 samples form a very homogeneous chemical group, clearly distinct from CMG 10b and CMG 12 on the basis of lower ratios of aluminium, calcium and iron to silicon and higher magnesium. Nickel and chromium contents are considerably higher in a ratio of 1:1.5–2, zirconium values are consistently higher and scandium lower.

Discussion of the Analytical Data

In order to verify the Corinthian origin of all these samples, they were compared both petrographically and chemically to different sets of comparative data. Samples CKOL 50, CKOL 51 (perirrhanteria) and CKOL 52, CKOL 53 (storage bins) were compared with Corinthian perirrhanteria falling into Whitbread's Corinth amphorae type A′ FC1.[665] The Kolonna samples were found very similar to the Corinth samples not only petrographically but also in terms of refiring colour (buff, except CKOL 52, which refired red, and strictly speaking falls into the Corinth amphorae type A fabric class). Samples CKOL 60 (amphora type A) and CKOL 61 (amphora type A′) were compared with Corinth samples of amphorae type A and A′ studied by I. Whitbread and found very similar (CKOL 61 especially with Corinth sample LOT78-93-44).[666] Therefore, a Corinthian origin can be convincingly argued for CMG 10b and CMG 12 samples, since they match not only compositionally (mudstone fragments) but also technologically (tempering) with the well established Corinthian potting tradition.

The chemical composition of the CMG 10b samples, with the exception of sample CKOL 52, is very close to CMG 10a as noted earlier and therefore compares well with pottery of Corinthian provenance analysed at Lawrence Berkeley Laboratory and Manchester University.[667] Samples CKOL 52 and CKOL 60

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
CMG 10b																
50	0.92	3.50	14.2	46.0	2.71	13.85	0.68	0.13	7.11	19	267	206	441	99	307	89.1
51	0.95	3.41	14.5	47.7	2.71	14.96	0.70	0.13	7.35	18	230	181	441	99	256	92.5
52	0.79	3.97	17.0	54.0	3.34	8.43	0.72	0.11	7.69	22	272	232	357	105	319	96.0
53	0.78	3.91	15.9	49.4	2.76	13.96	0.75	0.13	8.11	20	258	212	400	102	299	95.7
61	0.93	3.30	14.9	47.1	2.80	16.05	0.73	0.14	6.93	18	208	168	406	98	286	92.8
CMG 12																
60	0.62	3.92	18.4	57.2	3.29	5.70	0.77	0.10	8.12	23	282	236	247	107	386	98.1
CMG 13																
54	1.91	4.89	12.0	55.9	1.55	12.16	0.66	0.10	6.50	15	505	279	381	128	268	95.7
55	1.56	5.17	12.1	54.4	1.84	12.51	0.65	0.12	6.46	16	426	285	418	120	338	94.8
56	1.32	4.30	11.9	54.8	2.63	12.94	0.65	0.11	6.39	16	455	264	477	138	317	95.0
57	1.95	4.13	12.2	55.2	1.47	13.88	0.69	0.11	6.47	16	453	280	358	129	241	96.1
58	1.46	4.45	12.2	55.1	2.15	12.14	0.68	0.11	6.59	16	495	267	470	131	342	95.0
59	1.16	4.35	12.0	54.0	2.51	11.77	0.66	0.11	6.53	16	398	268	441	121	306	93.1

Table 13b Results of chemical analyses (ICP-OES) for amphorae and coarse wares of presumed Corinthian origin

[665] WHITBREAD 1995, 299–300.

[666] WHITBREAD 1995, 268–273. 278–289.

[667] FARNSWORTH *et al.* 1977 (table 1, Columns 4 and 6) and datasheet (amcor.dat) in the Manchester University Archaeometry online database at http://archaeometry.missouri.edu/datasets/uman/index.html.

differ from the rest due to their red refiring colour and their chemical composition. They can be petrographically associated with Whitbread's Corinth amphora type A fabric. The differences noted in the chemical composition of these two samples with the rest of the CMG 10 are to some extent comparable to previously noted deviations between Type A amphorae and Corinthian finewares respectively.[668] CKOL 52 and CKOL 60 are therefore chemically comparable to Type A Amphora samples analysed in the past,[669] although again inherent problems of laboratory intercomparability as well as the small number of such fabrics analysed here, make any conclusions at this stage only tentative.

CMG 13 contains only amphorae type Corinth B, and for that reason was compared with the samples of the same shape studied by I. Whitbread.[670] Comparison resulted in establishing very strong similarities a) to Whitbread's type B FC1 for CKOL 55, CKOL 56, CKOL 58, CKOL 59 and b) to Whitbread's type B FC2 for CKOL 54, CKOL 57, a distinction that is also noted in the clustering of the chemical results. These similarities were not only compositional, but also coincided with the colour acquired after refiring, which in all occasions was buff/pale yellow. Whitbread did not argue for a Corinthian origin for this amphora type and its fabrics;[671] indeed, the chemical composition of the CMG 13 samples differs to that of the Corinthian group. The minerological composition of samples CKOL 54–59 bears no typical 'Aeginetan' inclusion types either, thus an Aeginetan origin for this type of vessels can be definitely excluded. Comparison to the three Corinthian B type amphora samples from Corfu included in I. Whitbread's sample set showed no striking textural similarity, although both sets of samples are characterised by an essentially silicate composition.[672] It has to be noted, though, that there are considerable grain size differences between the Kolonna and Corfu samples, with the latter being coarser, thus these two sets of samples should not be considered as identical but rather as strongly similar in terms of fabric mineralogy. When the chemical composition is examined, Corfu could be proposed as a possible alternative origin for this group of pottery. This preliminary suggestion is based on the comparison of the very few common elements measured in these samples and pottery attributed a Corfu origin by Farnsworth *et al.*, particularly in terms of higher nickel and chromium contents compared to the Corinthian pottery in the same study.[673] Obviously this is presently a very preliminary suggestion, given the scarcity of data from Corfu and the other methodological problems discussed, but worth considering given further evidence.[674]

Petrographic Description

Coarse mudstone-tempered fabric (CKOL 50–53. 60–61)

Microstructure

There are few voids, frequently mesovughs and mesoplannar voids and commonly megavughs and macro to mesoplannar voids. Incomplete coatings of micritic calcite are present only in CKOL 50 and CKOL 61. The c:f related distribution is close- to double-spaced porphyric related distribution. Voids show relatively well developed preferred orientation parallel to vessel walls, while most inclusions are randomly orientated (with the exception of CKOL 50, CKOL 51).

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668 Newton *et al.* 1988; see also discussion in Whitbread 1995, 264–268.

669 Newton *et al.* 1988; Vandiver and Koehler 1986.

670 Whitbread 1995, 274–285. 289–293. 344–346.

671 Whitbread 1995, 281–285; in discussing technological attributes of amphorae types A, A′ and B, he characteristically states "…the tradition of Type B manufacture at Corinth seems to be so alien to A and A′ that it could easily belong to another production centre" (ibid, 284).

672 However, the Kolonna samples have quartz as the main inclusion component, whereas the Corfu samples are characterised by high chert fragment frequency.

673 Farnsworth *et al.* 1977, 461 table 2. The samples show closer correspondence with Roman Ware from Corfu (Column 1). See, however, re-treatment of that data and discussion in Jones 1986, 117–121. 712–720 and also Whitbread 1995, 264–268. Samples of Corinthian Amphorae Type B have also been analysed by Newton *et al.* 1988, but show several differences in composition compared to CMG 13.

674 It should also be noted that the chemical composition of CMG 13 is markedly different to the two Corinthian B amphorae from Miletus analysed using XRF (samples TR-3K/68 and TR-3K/69) and given in Seifert 2004, 111. There are also significant differences between commonly analysed elements of CMG 13 with the four Corinthian B amphorae from Gela in Sicily, analysed with ICP-OES by Barone *et al.* 2004 and attributed a Greek origin (samples CorB6, CorB17, CorB18, CorB19).

Groundmass

Rather homogeneous throughout the sections, variation observed a) in the uneven distribution of inclusions in all samples, b) in streaks of variable colour in CKOL 53, and c) in the sporadic presence of secondary calcite (only in CKOL 51). The micromass is optically moderately to slightly active, reddish brown in PPL (x25), dark orange brown to very dark red in XP (x25); inactive, brown to greyish brown in PPL (x25), very dark brown to very dark yellowish brown in XP (x25).

Inclusions

$c:f:v_{125\mu m}$	ca. 10:75:15 to 20:65:15

The inclusions are poorly to very poorly sorted, <2.8mm, mode 0.4–0.6mm, a–sr. Size distribution is bimodal.

Fine fraction <125µm

Predominant	Quartz/Alkali feldspar, mode 0.05–0.1mm, sa–sr.
Very few–few	Mica, frequently white mica and commonly biotite laths.
	Opaques, mode 0.05–0.1mm, sr, very dark red/black in PPL and XP.
Rare	Quartz, polycrystalline, mode 0.1mm, sa–sr.
Rare–very rare	Microfossils, radiolaria, mode 0.1mm, sr.
	Calcite, micritic, mode 0.1mm, sr (CKOL 51).

Coarse fraction >125µm

Frequent	Mudstone, <2.8mm, mode 0.4–0.6mm, sa–sr. Few fragments have polygonal cracks, while all bear up to 10% inclusions, dominantly chert, commonly radiolaria or quartz.
	Mudstone breccia, <2.4mm, mode 0.4–0.6mm, a–sr. Main constituents are mudstone, chert, radiolarian, micritic calcite, possibly also serpentinite (?). In CKOL 53 a rock fragment preserves the transition from mudstone to mudstone breccia.
Few	Siltstone, <1.6mm, mode 0.4mm, sa–sr.
Very few	Calcite, micritic, <2mm, mode 0.2–0.4mm, frequently with isotropic rime (due to incipient vitrification?).
	Opaques, <0.3mm, mode 0.15mm, sr, very dark red/black in PPL and XP, or black in PPL and XP.
Rare	Chert, mode 0.4–0.6mm, sr–sa.
	Volcanic rock fragments, a) 0.7mm, pyroclastic tuff with spherulites, b) 0.8–0.35mm, devitrified volcanic glass (both types in CKOL 52).
Very rare	Sandstone, 0.6mm, sa (CKOL 51).
	Microfossil (?), 1.2mm, brachiopod shell (?) (CKOL 61).

Textural Concentration Features

Few to very few

Brown (PPL, x50) and very dark orange brown to black (XP, x50), <0.9mm, mode 0.3–0.4mm, boundaries clear, r, equant to distorted shape, neutral to low optical density, discordant with the external fabric – clay pellets (?) (CKOL 50, CKOL 51, CKOL 53, CKOL 60).

Reddish brown (PPL, x50) and very dark red to very dark reddish brown (XP, x50), maximum size unidentifiable because lager grains were always abraded, mode 0.2mm, boundaries clear to diffuse, r–wr, equant shape, neutral to high optical density, discordant with the external fabric – clay pellets (?) (CKOL 50, CKOL 51, CKOL 52, CKOL 53, CKOL 61).

a) Brown (PPL, x50) and dark yellowish brown (XP, x50), boundaries clear to diffuse, r, distorted shape, neutral optical density, discordant with the external fabric (contain more inclusions than the fine fraction, mainly silicates and mica) b) red to reddish brown (PPL, x50) and dark red (XP, x50), boundaries clear to diffuse, r, distorted or prolate shape, neutral optical density, concordant (?) with the external fabric; in both cases description refers to streaks and not grains, <3.4mm, mode 1.2–0.8mm – clay pellets (?) (CKOL 53).

Silicate & chert fabric (CKOL 54–59)

Microstructure

There are very few voids (few in CKOL 54), predominantly mesovughs and few mesoplannar voids. Coatings of micritic calcite are present only in CKOL 59. The c:f related distribution is close- to double-spaced porphyric related distribution. Frequently voids (and few inclusions) show relatively well developed preferred orientation parallel to vessel walls.

Groundmass

Rather homogeneous throughout the sections, variation observed a) in the presence of secondary calcite (in CKOL 54, CKOL 55, CKOL 57, CKOL 59), b) in the uneven distribution of inclusions in CKOL 56, CKOL 58 (some areas devoid of inclusions). The micromass is optically slightly active to inactive, brown to reddish brown in PPL (x25), very dark brown to dark yellowish brown in XP (x25).

Inclusions

$c:f:v_{10\mu m}$ ca. 10:85:5 to 15:83:2

The inclusions are well sorted to very well sorted (for the unimodal samples), <0.8mm, mode 0.2-0.4mm, sr–sa. Size distribution seems to be bimodal in CKOL 55, CKOL 56, CKOL 58, CKOL 59 and unimodal in CKOL 54, CKOL 57.

Fine fraction (particularly for the possibly bimodal samples) <125µm

Predominant	Quartz/Alkali feldspar, mode 0.05mm, sr.
Few–very few	Mica, mainly oxidised biotite laths.
Very few	Opaques, mode 0.1mm, sr, very dark red in PPL, very dark red/black in XP.
	Calcite, micritic (especially in CKOL 56).
	Plagioclase, sa, with albite twinning.
Rare	Epidote (?), 0.05mm (CKOL 54, CKOL 56).
	Brown Amphibole (?), mode 0.05mm (CKOL 56).
	Serpentinite (?), <0.2mm, mode 0.1mm, sr, PPL red, XP red.
	Sphene (?), 0.1mm (CKOL 54).
	Microfossils, radiolaria, 0.1mm (CKOL 56).

Coarse fraction (for all samples) >125µm

Frequent–few	Quartz, monocrystalline, <0.6mm, mode 0.2mm, sa–sr.
	Alkali feldspar, <0.4mm, mode 0.2mm, both fresh and slightly cloudy examples exist, rarely microcline (?) (CKOL 58).
Frequent–very few	Chert, <0.8mm, mode 0.2mm, sa–sr, dominantly equigranular microquartz.
Few–very few	Mica, mode 0.15mm, dominantly oxidised biotite laths, white mica commonly present in CKOL 56, CKOL 58, CKOL 59.
Very few	Opaques, mode 0.15mm, sr, very dark red in PPL, dark red/black in XP, or black in PPL and XP.
Very few–rare	Quartz, polycrystalline, <0.8mm, mode 0.2–0.4mm, sa–sr.
	Plagioclase, <0.4mm, mode 0.15mm, sa–sr.
Rare	Quartz-rich metamorphic rock fragments, <0.8mm, mode 0.3mm, quartz ± alkali feldspar (slightly sericitised in CKOL 59), sa (CKOL 57, CKOL 58, CKOL 59).
Very rare	Microfossils, 0.5–0.3mm, oxidised (CKOL 56, CKOL 58, CKOL 59).
	Schist rock fragment, 0.15mm, sr, quartz + biotite (CKOL 56).
	Sandstone, 0.6mm, sa, quartz in black-coloured cement (siderite cement?) (CKOL 58).

Textural Concentration Features

Rare (CKOL 57, CKOL 58)

Pale brown (PPL, x50) and black (with orange speckles, XP, x50), 0.3–0.2mm, boundaries diffuse, r, equant to distorted shape, neutral optical density, discordant with the external fabric – clay pellets (?) (CKOL 57).

Pale brown (PPL, x50) and very dark brown to dark yellowish brown (XP, x50), 1.3mm, boundaries diffuse, r, equant shape, neutral optical density, discordant with the external fabric (silicate inclusions) – ARF (?) (CKOL 57).

Brown (PPL, x50) and very dark brown (XP, x50), 4.8mm, boundaries diffuse, wr, equant shape, neutral optical density, discordant with the external fabric (devoid of inclusions) – clay pellet (?) (CKOL 58).

2.3.2.2. Amphorae of uncertain, presumed East Aegean origin (CKOL 44–46. 71; Taf. 64. 69. 81. 99. 110)

Samples CKOL 44–46, CKOL 71 represent vessels of presumed East Aegean, probably Ionian, origin. Their shape, decoration style and macroscopic fabric, however, point to different production centres (Tables 14a–b).

Petrographic Analysis

Samples CKOL 44–46 and CKOL 71 do not present compositional homogeneity. Although the major inclusion types of all samples point to a metamorphic/sedimentary geological environment (silicates, quartz-rich metamorphic rock fragments, occasionally chert and limestone fragments), each sample bears features and inclusion types that set it apart from the other three: CKOL 44 (Taf. 127. CKOL 44) contains limestone fragments, CKOL 45 (Taf. 127. CKOL 45) rare serpentinite and amphibole-bearing rock fragments, CKOL 46 (Taf. 127. CKOL 46) is lower fired and rather micaceous, while CKOL 71 (Taf. 127. CKOL 71) contains also schist and limestone fragments along with rare microfossils, serpentinite, sandstone and volcanic glass fragments. CKOL 44 refired light brown, whereas CKOL 45–46 and CKOL 71 refired red, indicating the use of different clay types. The optical activity of the groundmass varies from one sample to another suggesting varied original firing temperatures not exceeding 800–850°C for CKOL 45–46, CKOL 71, and possibly slightly higher for CKOL 44, all in oxidising atmosphere.

Chemical Analysis

The four samples show entirely different chemical compositions in terms of major, minor and trace elements (Table 14b) and, not surprisingly, do not cluster together in the dendrogram of Taf. 123. Sample CKOL 44 has, as expected, high calcium content, while the other three do not, but even between the latter significant variability exists and they cannot be grouped together.

Discussion of Analytical Data

Samples CKOL 44–46 were compared with amphorae samples from Chios (FC2), Samos (FC1), Rhodes (FC1, FC3), Kos (FC3) and Knidos (FC1), while CKOL 71 with amphorae samples from Samos (FC3), all studied by I. Whitbread.[675] Comparison did not turn out to be particularly enlightening, since no

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
44	context late 3rd/ early 4th qu. 5th c.	amphoriskos	light brown	light brown	Silicate & carbonate fabric	moderately to slightly active
45	context late 3rd/ early 4th qu. 5th c.	amphoriskos	red	red	Silicate & brown amphibole fabric	moderately active
46	3rd qu. 5th c.	amphoriskos	red	red	Silicate & micaceous fabric	active
71	context 3rd qu. 5th c.	transport amphora	red	buff	Metamorphic & carbonate fabric	active

Table 14a Amphorae samples of uncertain, presumed East Aegean origin and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
44	1.37	3.57	16.1	53.5	2.72	9.75	0.88	0.16	7.68	17	284	204	283	194	385	95.7
45	0.50	1.40	19.3	66.4	1.48	1.22	0.81	0.08	7.02	22	677	283	142	103	176	98.2
46	0.80	2.06	17.4	66.3	2.81	2.02	0.87	0.08	6.13	17	242	142	130	158	345	98.5
71	1.43	3.02	15.6	54.7	1.89	5.05	0.77	0.08	6.81	20	376	302	236	136	307	89.3

Table 14b Results of chemical analyses (ICP-OES) for amphorae of uncertain, presumed East Aegean origin

675 Whitbread 1995, 53–67 (Rhodes); 68–80 (Knidos); 81–106 (Kos); 122–133 (Samos); 135–155 (Chios).

convincing match could be made for any of the samples, in terms of either composition and/or texture. Although limited common features were observed, in particular between CKOL 44–45 and Koan fabric FC3 (mixed composition subgroup) samples, this similarity points rather to an origin from a similar geological environment than from Kos itself. Recent petrographic analysis conducted on Hellenistic amphorae from Halasarna (Kos)[676] supports this suggestion, since these samples present fair resemblance to Whitbread's Koan fabrics, but very limited to CKOL 44–46 and CKOL 71. Presently the published petrographic data for East Greek amphorae and contemporaneous pottery deriving from the coastal area of Asia Minor is rather limited;[677] nevertheless, a fair mineralogical resemblance between local Milesian fabrics[678] and CKOL 71 seems to exist, since all sets of samples are characterised by a variable micritic and micaceous fabric containing quartz-rich/gneiss-schist fragments, quartz and feldspar, along with volcanic glass fragments and Tcfs. Significant textural differences, especially with regard to inclusions frequency and grain size, do exist though, thus hindering the definite attribution of CKOL 71 to a workshop of Miletus. An origin from the coastal area of Asia Minor remains, however, a plausible suggestion. Given that all four samples appear as chemical loners and in view of the acknowledged methodological problems, comparison for the purpose of provenance attribution with the chemical profiles of groups established by the presently published studies of East Aegean pottery[679] would be premature at this stage. The clearly different chemical composition of the four samples does, nevertheless, suggest a different origin in each case, in accordance with the petrographic data. Overall, the East Greek provenance of these samples cannot be confirmed or refuted on the basis of present results.

Petrographic Description

'Single' Fabrics

Silicate & carbonate fabric: CKOL 44

Microstructure

Very few voids, mesovughs, single- to double-spaced porphyric related distribution, voids and inclusions rather randomly orientated.

Groundmass

Lighter coloured patches observed and possibly also secondary calcite (?), optically moderately to slightly active, brown in PPL (x25), dark reddish brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu}$ 15:83:2

Inclusions are well to moderately sorted, <0.7mm, mode 0.2–0.4mm, sa–sr. Size distribution is unimodal.

Frequent	Calcite, micritic, <0.7mm, mode 0.25mm, r–sr, frequently with isotropic rim (due to vitrification?).
Common	Quartz, monocrystalline, <0.6mm, mode 0.2–0.4mm, sa–sr.
	Quartz, polycrystalline, <0.6mm, mode 0.2mm, sa–sr.
Few	Quartz-rich metamorphic rock fragments, <0.6mm, mode 0.3mm, quartz ± biotite ± opaques, sa–sr.
	Mica, mode 0.15mm, dominantly biotite and few white mica laths.
	Alkali feldspar, mode 0.2–0.15mm, sr–sa.
Very few	Opaques, mode 0.1–0.2mm, sr, red in PPL, isotropic in XP or black in PPL and XP.
	Plagioclase, mode 0.2mm, sa.

676 Hein *et al.* 2008.

677 Seifert 2004; Spataro and Villing 2009.

678 Seifert 2004, 35. 41; Spataro and Villing 2009, 94f.

679 See for example Hein *et al.* 2008; Kerschner *et al.* 2002; Kerschner and Mommsen 2009; Kilikoglou and Glascock 2009; Marketou *et al.* 2006; Mommsen 2002; Mommsen *et al.* 2006a; Mommsen *et al.* 2006b; Seifert 2004; Slusallek *et al.* 1983; Spataro and Villing 2009.

Rare	Chert, 0.3mm, sa.
	Rock fragment, 0.45mm, sa, PPL dark brown, XP isotropic, with quartz (?) inclusions.
	Siliceous rock fragment, 0.5mm, sa, including also radiolaria?
	Epidote, or clinopyroxene (?) 0.15mm, sa.

Silicate & brown amphibole fabric: CKOL 45

Microstructure

Very few voids, mesovughs, close- to single-spaced porphyric related distribution, voids and inclusions rather randomly orientated.

Groundmass

Dark coloured streaks (clay mix?), optically moderately to slightly active, reddish brown in PPL (x25), dark orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 15:83:2

Inclusions are moderately to well sorted, <1.5mm, mode 0.2mm, sa–sr. Size distribution is unimodal.

Frequent	Quartz, polycrystalline, <0.6mm, mode 0.25mm, sa–sr.
Common	Quartz-rich metamorphic rock fragments, <1.5mm, mode 0.3–0.5mm, quartz ± alkali feldspar (microcline?), sa–sr.
Few	Quartz, monocrystalline, <0.4mm, mode 0.15–0.2mm, sa–sr.
Very few	Amphibole, <0.6mm, mode 0.15mm, pleochroism colourless to pale brown, frequently with typical amphibole cleavage and twinning.
	Mica, <0.35mm, mode 0.15mm, predominantly biotite laths.
	Opaques, mode 0.1mm, sr, black in PPL and XP.
Rare	Chert (?), <0.6mm, mode 0.15mm, sr, unequigranular microcrystallic matrix with larger quartz crystals.
	Serpentinite, mode 0.4mm, sr.
	Plagioclase, 0.1–0.2mm, sa.
	Rock fragment, 0.4–0.3mm, quartz + brown amphibole.

Textural Concentration Features

Very few

Brown (PPL, x50) and isotropic (with orange speckles, XP, x50), mode 0.5–0.6mm, boundaries clear, sr, distorted shape, neutral optical density, discordant with the external fabric – carbonate pellets (?)

Silicate & micaceous fabric: CKOL 46

Microstructure

Very few voids, mesovughs, single- to double-spaced porphyric related distribution, voids and inclusions rather randomly orientated.

Groundmass

Homogeneous, optically active, brown in PPL (x25), dark yellowish brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 15:80:5

Inclusions are well sorted, <0.45mm, mode 0.2–0.15mm, sa–sr. Size distribution is unimodal.

Frequent–common	Quartz, monocrystalline, mode 0.15–0.2mm, sa–sr.
	Quartz, polycrystalline, mode 0.25mm, sa–sr.
Common	Quartz-rich metamorphic rock fragments, <0.25mm, mode 0.15–0.2mm, quartz ± white mica ± opaques, sa–sr.

	Mica, <0.25mm, mode 0.1mm, frequent but smaller white mica laths, fewer but larger biotite laths.
Few	Alkali feldspar, <0.3mm, mode 0.15mm, sr–sa, some sericitised.
	Opaques, <0.25mm, mode 0.1mm, sr, very dark red in PPL, black in XP.
Very few	Chert, mode 0.2mm, sr, equigranular microquartz.
Very rare	Plagioclase, 0.25mm, sa.
	Rock fragment, 0.45mm, sandstone (?) consisting of polycrystalline quartz + schist rock fragment of quartz and white mica in an isotropic groundmass.

Metamorphic & carbonate fabric: CKOL 71

Microstructure

Very few voids, mesovughs, single- to double-spaced porphyric related distribution, no traces of preferred orientation.

Groundmass

Homogeneous, optically active, reddish brown in PPL (x25), orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{60\mu m}$ 15:82:3

Inclusions are moderately to well sorted, <1mm, mode 0.2–0.4mm, sa–sr. Size distribution is unimodal.

Frequent	Quartz-rich metamorphic rock/Schist fragments, <1mm, mode 0.2–0.4mm, predominantly mylonitised and consisting of quartz ± white mica ± opaques, rarely fine-grained biotite schist.
Common	Calcite, micritic and/or crystalline, <0.5, mode 0.15–0.2mm, r/sr–sa; in one occasion with quartz inclusions.
	Quartz, monocrystalline, mode 0.15–0.2mm, sr–sa.
Few	Alkali feldspar, <0.3mm, mode 0.2mm, sr–sa.
	Mica, mode 0.1mm, dominantly white mica and commonly biotite laths.
Very few	Opaques, <0.2mm, mode 0.1mm, sr, black in PPL and XP or very dark red in PPL and XP.
Rare	Quartz, polycrystalline, mode 0.2mm, sr–sa.
	Microfossils, mode 0.3–0.2mm, shell-like and cylindrical.
	Serpentinite (?), 0.4–0.2mm, sr, orange red in PPL, orange red in XP.
Very rare	Sandstone, 0.3mm, silicate components in a clay minerals/Fe oxides matrix.
	Volcanic glass, 0.35mm, sr, isotropic grain with minute feldspar crystals.
	Plagioclase, 0.2mm, sa.

Textural Concentration Features

Very rare

Very dark red (both in PPL and XP, x50), 0.45mm, boundaries clear to diffuse, r, equant shape, neutral optical density, discordant with the external fabric – clay pellet.

2.3.2.3. Amphorae of presumed Chian origin (CKOL 68–70; Taf. 69. 109. 122)

Macroscopic Group CMG 8 includes transport amphorae of presumed Chian origin. These samples form a fairly coherent fabric both petrographically and chemically, but present also some differences, mainly in the refiring colour (Tables 15a–b).

Petrographic Analysis

This fairly homogeneous fabric is medium- to coarse-grained, characterised by quartz and quartz-rich metamorphic rock fragments/schist fragments, micritic limestone, mica and volcanic glass fragments. It has orange to yellowish brown micromass in XP with 5% voids (Taf. 128. CKOL 68). Inclusions are common,

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
68	ca. 450	Chian transport amphora	red	buff	Metamorphic/silicate, carbonate & volcanic	moderately active
69	towards 440	Chian transport amphora	light pinkish brown	buff	Metamorphic/silicate, carbonate & volcanic	moderately active
70	context ca. 470/60	Chian transport amphora	light pinkish brown	buff	Metamorphic/silicate, carbonate & volcanic	moderately active

Table 15a Amphorae samples of presumed Chian origin (CMG 8) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
68	1.86	3.80	12.5	63.4	1.95	4.47	0.71	0.10	6.54	16	467	330	204	126	223	95.3
69	1.59	4.65	11.1	56.4	1.44	10.58	0.61	0.12	5.88	15	405	293	302	109	227	92.4
70	1.55	4.44	11.1	57.3	1.56	9.79	0.62	0.12	5.89	16	414	285	255	106	232	92.4

Table 15b Results of chemical analyses (ICP-OES) for amphorae samples of presumed Chian origin (CMG 8)

subangular to subrounded, moderately to well sorted, of fine sand grain size (rarely reaching medium sand). Inclusions consist of common monocrystalline quartz, micritic limestone, alkali feldspar, biotite laths, very few quartz-rich metamorphic rock/schist fragments, volcanic glass, polycrystalline quartz, chert fragments, opaques, and very few plagioclase and possible serpentinite. In terms of refiring colour, CKOL 68 refired red, while CKOL 69 and CKOL 70 refired light pinkish brown, indicating the use of different types of clays. The optical activity of the groundmass for these samples suggests original firing temperatures around 800–850°C, in oxidising atmosphere.

Chemical Analysis

The internal subgrouping noted on the basis of refiring colour is clearly evident in the chemical analyses results that showed high calcium contents for CKOL 69 and CKOL 70, and low-medium for CKOL 68. It should be noted that the higher calcium contents must be attributed in part to the presence of secondary calcite. The two calcareous samples show closer chemical resemblance between them on the basis of most other elements analysed and hence cluster together in the dendrogram of Taf. 123. Still, the number of samples in this macroscopic group is too small to determine the extent of chemical variability and decide whether CKOL 68 could also be associated.

Discussion of the Analytical Data

Samples CKOL 68–70, all belonging to Chian type amphorae, were compared with samples of Chian type amphorae found in Corinth and studied by I. Whitbread.[680] Comparison was carried out only with FC2, which was considered to be local to Chios.[681] On the whole, the two sets of samples present certain similarities, both compositional and textural: a) both sets of samples contain more or less the same types of inclusions, namely quartz, feldspar, limestone, volcanic glass, chert (although the Corinth samples have more white mica than the Kolonna ones, and quartz-plagioclase-white mica rock fragments, that are not observed in the three Kolonna samples, whereas the latter contain more serpentinite than the Corinth samples), b) both sets of samples present the same type of Tcf,[682] c) in both sets of samples (especially the Kolonna ones) odd grains are observed, which look like micritic material with isotropic parts, but it is equally possible they are altered (sericitised?) volcanic glass. Among Whitbread's samples, this is observed mainly in C-37-2028 and LOT-78-93-75. Another set of samples, deriving from Chian amphorae found on an assumed 5th c. BC kiln site on Chios itself and analysed by de Domingo and Johnston,[683] presents strong compositional (same types of main inclusions, including Tcfs) and textural (medium/coarse-grained) affinities to both Whitbread's FC2

680 Whitbread 1995, 135–153.

681 Whitbread's Chios FC1 samples, although bearing considerable compositional similarities, differ in grain size distribution (bimodal) and were not taken into consideration.

682 Whitbread's Tcf 1 as described in Whitbread 1995, 150.

683 de Domingo and Johnston 2003, 33, 41.

and the Kolonna set, further supporting a Chian origin for samples CKOL 68–70.

Chemical data for pottery of Chian origin are still very scanty, while earlier studies showed a range of compositions.[684] Qualitative comparison of this data with the samples analysed here showed no evident association. The Chian amphorae discussed above were also analysed with AAS revealing a chemically coherent group[685] with close chemical characteristics to CMG 8, further confirming the petrographic association noted above. At a glance, significant differences are noted with the results of XRF analyses of Chian amphorae from Miletus (higher contents for all trace elements analysed in common except Sr, some differences also in the contents of most major oxides).[686] Comparison with the probably Chian group ChiB, established through NAA analyses of Archaic finewares,[687] shows some similarities with CMG 8. Again in the case of the latter two studies the absence of interlaboratory calibrations and the small number of samples present a significant impetus in reaching final conclusions based on chemistry. A Chian origin is, however, overall compatible on the basis of data available so far.

Petrographic Description

Metamorphic/silicate, carbonate & volcanic fabric (CKOL 68–70)

Microstructure

The fabric has very few voids, predominantly meso- to macrovughs and few meso- to macroplannar voids (in CKOL 68). Voids, frequently inclusions too, have coatings of micritic calcite, few also have micritic infillings. The c:f related distribution is close- to single-spaced porphyric related distribution. Voids and inclusions are more or less randomly orientated.

Groundmass

Rather homogeneous throughout the sections, variation observed in relation to the secondary calcite present in CKOL 69 and CKOL 70. The micromass is optically moderately active, reddish brown to brown in PPL, orange to yellowish brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ ca. 20:75:5 to 25:70:5

Inclusions are moderately .to well sorted, <0.6mm (2.6mm in CKOL 70), mode 0.2mm, sa–sr. Size distribution is unimodal.

Common	QUARTZ, monocrystalline, <0.45mm, mode 0.15–0.2mm, sa–sr, in one occasion with micrographic texture (CKOL 69).
	CALCITE, micritic, <2.6mm, mode 0.2–0.15mm, sr, vitrified (?).
Common-few	ALKALI FELDSPAR, <0.5mm, mode 0.15–0.2mm, sr–sa, frequently cloudy and/or sericitised.
	MICA, <0.35mm, mode 0.15–0.2mm, predominantly biotite laths, flakes or even aggregates (some might be phlogopite) and few white mica laths.
Very few	QUARTZ, polycrystalline, <0.6mm, mode 0.2mm, sr–sa.
	CHERT, <0.5mm mode 0.2mm, sr–sa, equigranular microquartz, rarely radiolarian.
	QUARTZ-RICH METAMORPHIC ROCK FRAGMENTS/SCHIST, <0.6mm, mode 0.2mm, sa–sr, consisting of quartz ± opaques ± alkali feldspar ± mica ± epidote.
	VOLCANIC ROCK/GLASS FRAGMENTS, <0.6mm, mode 0.4–0.2mm, sr–sa. Frequently volcanic glass (commonly altered/sericitised, rarely devitrified), commonly small feldspar crystals in either glassy or microcrystalline matrix.
	OPAQUES, 0.1–0.2 mm, sr, black in PPL and XP, or very dark red in PPL and XP.
Very few–rare	PLAGIOCLASE, <0.45mm, mode 0.15mm, sa, albite twinning, with oligoclase to andesine composition.
	SERPENTINITE (?), 0.25–0.1mm, sr, orange red in PPL and XP.

684 See discussion in JONES 1986, 282–288.
685 DE DOMINGO and JOHNSTON 2003, table 2.
686 SEIFERT 2004, 110. 112 (samples TR-3K/58, TR-3K/71-/78).
687 KERSCHNER and MOMMSEN 2009, table 2.

Rare — SANDSTONE, 0.7mm, sa, consisting of quartz, plagioclase, epidote/pyroxene (?) grains and biotite laths in a rather carbonate matrix that seems vitrified (isotropic in XP) (CKOL 68). PYROXENE (?), 0.2mm, sa, pleochroism from colourless to pale yellow (CKOL 68).

Textural Concentration Features

Very few to rare

Reddish brown (PPL, x50) and very dark reddish brown (XP, x50), <0.8mm, mode 0.2–0.4mm, boundaries sharp to diffuse, sr, equant shape, high optical density, discordant with the external fabric (silicate inclusions, mica, opaques?) – clay pellets (?).

2.3.2.4. Amphorae of presumed Lesbian origin (CKOL 72–74; Taf. 70. 122)

Group CMG 9 contains transport amphorae of presumed Lesbian origin. The samples studied form a very homogeneous group, both chemically and petrographically (Tables 16a–b).

Petrographic Analysis

This is a medium- to coarse-grained fabric, characterised by feldspars, biotite, green amphibole and volcanic rock fragments (Taf. 128. CKOL 74). It has dark reddish brown to dark yellowish brown micromass in XP with 5–10% voids. Inclusions are common, subangular to subrounded, moderately to poorly sorted, with fine to medium sand mode sizes and maximum grain size reaching very coarse sand. The fabric is characterised by common alkali feldspar, plagioclase and biotite, few green amphibole, volcanic rock fragments and monocrystalline quartz, very few opaques, and rare micritic limestone and various rock fragments consisting of silicates and green amphibole. All samples refired red, pointing to the use of similar clay types. The optical activity of the groundmass for these samples suggests a rather broad range of firing temperatures from 800°C to 1000°C, in reducing/mixed atmosphere.

Chemical Analysis

Chemically, the samples cluster together in the dendrogram, showing low relative standard deviations (<10%) for most analysed elements, when considered as a group (Table 7b). They are characterised by high aluminium and low calcium contents, while among the trace elements nickel and chromium are low-medium and in roughly 1:1.2 ratio, while strontium and barium are comparatively elevated.

Discussion of the Analytical Data

Samples CKOL 72–74 were compared with samples of Lesbian amphorae studied by I. Whitbread[688] and

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix optical activity
72	late 3rd/early 4th qu. 5th c.	Lesbian transport amphora	red	Feldspars & volcanic fabric	moderately active
73	late 3rd/early 4th qu. 5th c.	Lesbian transport amphora	red	Feldspars & volcanic fabric	active to slightly active
74	late 3rd/early 4th qu. 5th c.	Lesbian transport amphora	red	Feldspars & volcanic fabric	moderately active to inactive

Table 16a Amphorae samples of presumed Lesbian origin (CMG 9) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
72	1.81	3.81	16.4	56.2	1.77	4.37	0.69	0.12	6.04	17	145	127	383	136	612	91.2
73	2.15	3.67	15.5	52.3	2.94	5.24	0.67	0.11	6.14	15	137	113	371	141	589	88.8
74	2.25	3.65	16.4	55.0	2.88	6.69	0.70	0.12	6.28	17	150	106	436	161	742	94.0

Table 16b Results of chemical analyses (ICP-OES) for amphorae samples of presumed Lesbian origin (CMG 9)

688 WHITBREAD 1995, 154–164; included are three samples from the Athenian Agora and two from Corinth, none of which is stamped.

de Domingo and Johnston.[689] Due to the small number of samples examined, Whitbread considers his and the preceding analyses inconclusive, but the existing results (in combination with the knowledge of local geology) show that a variation in composition of Lesbian amphorae does exist. The mineralogical composition of Whitbread's samples[690] points to a rather metamorphic environment and can be related to the eastern part of the island. De Domingo and Jonston discriminate two groups, one volcanic (bimodal, with lava and glass fragments) and one non-volcanic (unimodal, with quartz, biotite and altered volcanic inclusions), suggesting the existence of workshops exploiting geologically related, nevertheless different, clay sources associated with the volcanic rocks of the island.[691] The three Kolonna samples equally show a geological composition pointing to a volcanic/pyroclastic environment, possibly like that of central Lesbos (i.e. their mineralogical composition is compatible with Lesbos geology). However, they present differences both in texture (the Kolonna samples comprise a unimodal, medium/coarse fabric) and quantitative participation of the various volcanic type inclusions (feldspars and, in general, mineral constituents are more frequent than volcanic fragments), as well as lower firing temperatures. Based on present evidence it is impossible to make more conclusive suggestions on provenance, but Whitbread's remark on the existence of many production centres on the island, resulting in different fabrics' recipes, should be kept in mind. Similarly meagre are the chemical data for Lesbian pottery,[692] making comparisons and further discussion at this stage premature. Nevertheless, based on the results of petrographic and chemical analyses, it can be convincingly argued that samples CKOL 72–74 form a very coherent compositional group and are most probably products of the same production centre.

Petrographic Description

Feldspars & volcanic fabric (CKOL 72–74)

Microstructure

The fabric has very few to few voids, predominantly meso- to macrovughs and few mesoplannar voids (in CKOL 72). The c:f related distribution is close- to single-spaced porphyric related distribution. Voids and inclusions are more or less randomly orientated.

Groundmass

Rather homogeneous throughout the sections, variation observed in the darker colour the core has in CKOL 73 and CKOL 74. The micromass is optically active to moderately active, brown in PPL, dark yellowish brown in XP (x25), or slightly active to inactive, dark brown in PPL, reddish to dark reddish brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ ca. 20:75:5 to 25:65:10

Inclusions are moderately to poorly sorted, <1.45mm, mode 0.2–0.4mm, sa–sr. Size distribution is unimodal (hints of bimodality in CKOL 73, CKOL 74).

Common — Plagioclase, <1.2mm, mode 0.2mm, sa, albite twinning, with andesine composition, larger grains tend to be sericitised.
Alkali feldspar, <1.45mm, mode 0.2–0.3mm, sr–sa, mainly fresh, but cloudy and/or sericitised grains also exist.

689 de Domingo and Johnston 2003, 35–36, 42–43; included are six samples from Kommos.

690 Inclusions consist of mono- and polycrystallic quartz, white mica, epidote group minerals, plagioclase, and rare brown amphibole, clinopyroxene, volcanic glass and rock fragments, limestone, phyllite, metamorphic/silicate rock fragments.

691 de Domingo and Johnston 2003, 36.

692 Three XRF analyses of Lesbian amphorae are given in Seifert 2004, 106. 108 (samples TR-3K/17, 18, 45), while eight of the Archaic/Classical amphorae analysed with NAA by Clinkenbeard 1982, 268 are considered to be Lesbian. The four volcanic fabrics analysed by De Domingo and Johnston 2003, table 2 are so far compatible with CMG 9. A larger number of samples appears to have been analysed by Dupont 2011, but unfortunately the data are not presented. See also discussion and references to earlier analyses in Jones 1986, 281f.

	Mica, <0.8mm, mode 0.2–0.3mm, predominantly biotite laths and flakes with brown pleochroism (rare/absent white mica).
Few–very few	Amphibole, <0.3mm, mode 0.15mm, a–sa, plechroism from colourless/pale green to pale green/green, frequently with twinning and with typical amphibole cleavage.
	Volcanic rock fragments, <1mm, mode 0.4mm, dominantly alkali feldspar crystals in glassy/microcrystallic matrix, few with plagioclase phenocrysts in microcrystallic matrix. Frequently weathered (cloudy appearance).
	Quartz, monocrystalline, <0.8mm, mode 0.2mm (0.6mm in CKOL 74), sa–sr.
Very few	Opaques, mode 0.15 mm, sr, black in PPL and XP.
Rare	Calcite, micritic, <0.8mm, mode 0.2mm, sr–r.
	Rock fragments, a) green amphibole + alkali feldspar, 0.85mm and 0.45mm, sa–sr (CKOL 73), b) quartz + green amphibole ± alkali feldspar, 0.5–0.4mm, sa–sr (CKOL 74), c) green amphibole + quartz 0,2mm sa–sr (CKOL 72), d) quartz + biotite + plagioclase, 1.2mm, sa (CKOL 73).
Very rare	Organic residue (?), 0.25mm (CKOL 73).
	Sphene (?), 0.2mm sa (CKOL 73).
	Chert (?), 0.5mm sa (CKOL 74).

Textural Concentration Features

Very few (only in CKOL 74)

Brown (PPL, x50) and isotropic (with orange speckles, XP, x50), mode 0.2mm, boundaries clear, sr–r, distorted and equant shape, neutral to low optical density, discordant with the external fabric.

2.3.2.5. Solokha I type amphorae (CKOL 75–77; Taf. 70. 88. 99)

Samples CKOL 75–77 belong to transport amphorae of Solokha I type. They present different medium-coarse fabrics and multiple production centres are assumed to exist for this type of amphora, probably located on the south-eastern Aegean islands or the coastal areas of Asia Minor. Although these samples are characterised by distinct compositional features, they can, however, be potentially associated with similar geological environments.

Petrographic Analysis

Sample CKOL 75 is characterised by calcareous inclusions, in particular microfossils (Taf. 128. CKOL 75), pointing to a sedimentary geological environment, whereas CKOL 76 (Taf. 128. CKOL 76) and CKOL 77 (Taf. 128. CKOL 77) contain inclusions, such as quartz-rich metamorphic/schist and serpentinite rock fragments (the latter only in CKOL 77), that relate to sedimentary and metamorphic environments. The heterogeneity observed petrographically is also seen in colours acquired after refiring: CKOL 75 and CKOL 77 refired buff, pointing to the use of similar calcareous clays (see also Table 17b), while CKOL 76 refired red, implying the use of different clay. The optical activity of the groundmass for these samples suggests original firing temperatures not exceeding 800–850°C for CKOL 75–76, and in the range of 850–1050°C for CKOL 77, all in oxidising atmosphere.

Chemical Analysis

The samples naturally did not cluster together in the dendrogram as their chemical compositions differ significantly. CKOL 75 and CKOL 77 are calcareous with low aluminium, while CKOL 76 is com-

CKOL	Date	Shape	Refiring colour-body	Refiring colour-paint	Fabric	Matrix optical activity
75	3^{rd} qu. 5^{th} c.	Solokha type I transport amphora	buff	dark purple brown	Calcareous fabric	active
76	context 3^{rd}/early 4^{th} qu. 5^{th} c.	Solokha type I transport amphora	red	–	Silicate/metamorphic & carbonate fabric	active
77	context 3^{rd}/early 4^{th} qu. 5^{th} c.	Solokha type I transport amphora	buff	–	Carbonate & silicate/metamorphic fabric	moderately active to slightly active

Table 17a Solokha I type amphorae samples and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
75	0.88	3.12	10.3	41.1	2.55	18.6	0.59	0.05	5.26	14	431	320	410	91	300	82.5
76	1.28	3.58	17.3	50.6	3.31	4.77	0.79	0.14	7.87	21	406	306	124	146	489	89.7
77	1.05	5.45	11.5	45.9	1.98	17.3	0.66	0.13	6.45	16	511	386	313	113	267	90.4

Table 17b Results of chemical analyses (ICP-OES) for Solokha I type amphorae

paratively poor in calcium with correspondingly high aluminium. The predominance of calcareous inclusions in CKOL 75 is reflected in its chemical composition as the ratio of calcium to the other major elements is higher compared to CKOL 77. In terms of trace elements, the three samples show some common features, such as relatively high nickel and chromium, while CKOL 76 is again clearly distinct based on higher scandium, zirconium, and barium and significantly lower strontium content.

Discussion of the Analytical Data

Solokha I type amphorae samples CKOL 75–77 were compared with a number of amphorae samples of presumed East Aegean origin, studied by I. Whitbread, and in particular those from Rhodes (FC1, FC2), Kos (FC3), Samos (FC1) and Knidos (FC1).[693] Comparison did not elucidate the issue of the exact provenance of these amphorae, since no unambiguous and convincing match could be made for any of the three samples, in terms of either composition and/or texture. Only sample CKOL 76 could be argued to generally resemble Samian FC1, due to its micaceous character; nevertheless, Samian FC1 resembles Rhodian FC3, Knidian FC2 and Koan FC4, while Whitbread is not positive on its Samian origin, until assemblages from the opposite coast (Miletus) are also analysed.[694] Indeed, recently published analytical data of Milesian pottery[695] render plausible the suggestion that CKOL 76 could be a product of a workshop at Miletus, since it bears a fair resemblance in mineralogical composition (but not so much in textural attributes) with local Milesian fabrics. For CKOL 77, an Asia Minor provenance is possible, while comparison of CKOL 75 to all published East Greek pottery fabrics still did not favour the attribution to a specific area.

Given that chemically these three samples appear as 'singles', a coherent chemical profile cannot be deduced presently and comparisons for provenance assignment are therefore impossible. All samples contain high concentrations of Cr and Ni, which could be associated with a geological environment characterised by mafic igneous or serpentinite formations. The three different fabrics distinguished petrographically cannot be attributed with certainty to specific raw materials sources or geographic areas. Taking into account the rather limited published analyses of Koan pottery,[696] a Koan provenance does not seem very probable, since both chemical analysis data and petrofrabric descriptions differ significantly when compared to those of samples CKOL 75–77. A Rhodian provenance cannot be ruled out on the basis of our knowledge of this island's geology, at least for CKOL 77, but existing petrographic evidence is not conclusive towards this end; equally plausible is an Asia Minor origin. Therefore, no specific place of production can be sufficiently argued with present evidence for these three samples, perhaps with the exception of CKOL 76 (possibly Miletus). Similarly to before, the small number and heterogeneity in the chemical compositions of these three samples make comparisons with other established Eastern Aegean chemical groups premature.[697]

693 Whitbread 1995, 53–67 (Rhodes); 68–80 (Knidos); 81–106 (Kos); 122–133 (Samos).

694 Whitbread 1995, 129–130.

695 Seifert 2004; Spataro and Villing 2009.

696 Whitbread 1995, 81–106; Hein *et al.* 2008, Slusallek *et al.* 1983.

697 See for example Hein *et al.* 2008; Kerschner *et al.* 2002; Kerschner and Mommsen 2009; Kilikoglou and Glascock 2009; Marketou *et al.* 2006; Mommsen 2002; Mommsen *et al.* 2006a; Mommsen *et al.* 2006b; Seifert 2004; Spataro and Villing 2009.

Petrographic Description

'Single' Fabrics

Calcareous fabric: CKOL 75

Microstructure

Few voids, meso- to macrovughs, double-spaced porphyric related distribution, voids and inclusions rather randomly orientated.

Groundmass

Dark coloured streaks, optically active, brown in PPL (x25), yellowish orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{60\mu m}$	10:80:10

Inclusions are very well sorted, <0.4mm, mode 0.1–0.06mm, sr–sa. Size distribution is unimodal.

Common	MICROFOSSILS, <0.4mm, mode 0.1–0.2mm, foraminifera.
Few	QUARTZ, monocrystalline, mode 0.1–0.06mm, sr–sa.
	ALCALI FELDSPAR, mode 0.15–0.06mm, sr–sa.
	CALCITE, micritic, sparitic and crystalline, <0.15mm, mode 0.06mm, r–sa.
Rare	PLAGIOCLASE, 0.1–0.06mm, sa.

Textural Concentration Features

Frequent
Red (PPL, x50) and dark red (XP, x50), <0.4mm, mode 0.1mm, boundaries diffuse, sr, equant to distorted shape, neutral optical density, discordant with the external fabric – clay pellets (?)

Silicate/metamorphic & carbonate fabric: CKOL 76

Microstructure

Very few voids, mesovughs, single-spaced porphyric related distribution; voids and inclusions rather randomly orientated.

Groundmass

Homogeneous, optically active, brown to reddish brown in PPL (x25), orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$	15:80:5

Inclusions are moderately to well sorted, <0.7mm, mode 0.2–0.15mm, sr–sa. Size distribution is unimodal.

Common	ALCALI FELDSPAR, <0.6mm, mode 0.25mm, sr–sa.
	MICA, mode 0.15mm, both biotite and white mica laths.
Few	QUARTZ, monocrystalline, mode 0.15–0.2mm, sr–sa.
	SCHIST/QUARTZ-RICH METAMORPHIC ROCK FRAGMENTS, <0.4mm, mode 0.2mm, sr–sa, quartz + biotite or white mica ± alkali feldspar.
	CALCITE, micritic and microsparitic, <0.5mm, mode 0.15mm, sr.
Very few–few	OPAQUES, 0.2–0.1mm, sr, dark red in PPL and XP; 0.06–0.1mm, black in PPL and XP.
Very few	QUARTZ, polycrystalline, <0.4mm, mode 0.2mm, sr–sa.
Very rare	PHYLLITE (?), 0.7mm, sr; biotite + green amphibole.

Carbonate & silicate/metamorphic fabric: CKOL 77

Microstructure

Few voids, mesovughs, single- to double-spaced porphyric related distribution; voids and inclusions rather randomly orientated.

Groundmass

Homogeneous, optically moderately active to slightly active, brown in PPL (x25), dark yellowish brown in XP (x25).

Inclusions

c:f:$v_{60\mu m}$ 15:78:7

Inclusions are moderately to well sorted, <0.4mm, mode 0.2–0.15mm, sr–sa. Size distribution is unimodal.

Common	Calcite, micritic, <0.4mm, mode 0.15mm, sr.
Common to few	Chert, <0.4mm, mode 0.25mm, sr–sa, equigranular microquartz.
Few	Quartz, monocrystalline, mode 0.15mm, sr–sa.
	Quartz, polycrystalline, <0.35mm, mode 0.2mm, sr–sa.
	Mica, <0.3mm, mode 0.15, both biotite and white mica laths.
	Alcali feldspar, mode 0.15–0.2mm, sr–sa.
Very few	Serpentinite (?), <0.2mm, mode 0.08mm, sr.
	Quartz-rich metamorphic rock fragments/Schist, mode 0.2mm, sa–sr, quartz ± biotite or white mica ± opaques.
Rare	Amphibole, mode 0.1–0.6mm, sr, brown pleochroism.
	Epidote, 0.1mm, sa.

2.3.2.6. Amphorae of presumed Mendean and North Aegean origin (CKOL 62–67; Taf. 67. 68. 86. 110. 121)

Samples of Mendean type amphorae (CMG 14: CKOL 64–65, CKOL 67) and other Northern Aegean amphorae types (CKOL 62–63, CKOL 66) are considered together, as they present rather similar morphological characteristics and their assumed origin falls within the same broad geographical region (Tables 18a–b).

Petrographic Analysis

Samples CKOL 62, CKOL 64, CKOL 65 and CKOL 67 (Taf. 128. CKOL 67) comprise a medium/coarse- to coarse-grained fabric, characterised by silicate inclusions (quartz, alkali feldspar, quartz-rich metamorphic/schist rock fragments) and few limestone fragments, as well as by distinct bimodality.[698] It has orange brown to dark reddish brown micromass in XP with 3–7% voids. Inclusions are common, subangular to subrounded, moderately to well sorted, with fine to medium sand mode sizes and maximum grain size reaching very coarse sand. Inclusions contain common monocrystalline and polycrystalline quartz, quartz-rich metamorphic rock fragments, and alkali feldspar, accompanied by few micritic limestone fragments and mica, very few microfossils and opaques, rare epidote and plagioclase. Sample CKOL 62 refired light brown, CKOL 64 refired red, CKOL 65 and CKOL 67 refired light red. This variability in refiring colour could point to either possible clay mix or the exploitation of various raw material sources located in a similar (or same) geological environment. The optical activity of the groundmass for these samples suggests original firing temperatures above 850°C, in oxidising atmosphere.

Sample CKOL 66 (Taf. 128. CKOL 66) can be associated to the above group, since it presents strong similarity with respect to texture and inclusion types. It refired dark red, and the optical activity of its groundmass suggests original firing temperatures higher than 900°C, in oxidising atmosphere.

Sample CKOL 63 (Taf. 128. CKOL 63) is characterised petrographically by a very densely grained clay matrix, while its inclusions (e.g. clinopyroxene) or the alterations observed (e.g. biotitisation) point to a slightly different geological environment (metamorphism accompanied by possible hydrothermal alteration) than that inferred by the rest of the samples examined in this section. Sample CKOL 63 refired light red, and the optical activity of its groundmass suggests original firing temperatures higher than 900°C, in oxidising atmosphere.

Chemical Analysis

Among the six samples considered here, CKOL 63 shows a distinctly different chemical composition, mainly reflected in lower magnesium and strontium

[698] With the exception of CKOL 65, see text below for further comments.

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix optical activity
Various North Aegean amphorae types					
62	context late 3rd/early 4th qu. 5th c.	Mendean-like transport amphora	light brown	Silicate/metamorphic & carbonate fabric	slightly active to inactive
63	context late 3rd/early 4th qu. 5th c.	Mendean-like transport amphora	light red	Silicate/metamorphic fabric	slightly active to inactive
66	context ca. 430/20	Mendean-like transport amphora	dark red	Variant of Silicate/ metamorphic & carbonate fabric	inactive
Mendean type amphorae					
64	ca. 440/30	Mendean transport amphora	red	Silicate/metamorphic & carbonate fabric	moderately active
65	ca. 440/30	Mendean transport amphora	light red	Silicate/metamorphic & carbonate fabric	moderately active
67	ca. 440/20	Mendean transport amphora	light red	Silicate/metamorphic & carbonate fabric	slightly active

Table 18a Amphorae samples of presumed Mendean and North Aegean origin and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
Northern Aegean amphorae																
62	1.63	4.44	13.3	56.7	2.40	9.97	0.64	0.12	6.29	16	377	230	278	120	357	95.5
63	1.67	2.67	13.9	62.9	1.68	7.90	0.72	0.12	6.85	17	412	92	187	145	296	98.5
66	2.00	5.05	15.3	57.7	2.30	7.70	1.16	0.11	7.57	18	380	230	262	143	328	98.8
CMG 14																
64	1.55	4.21	13.0	62.2	2.45	5.99	0.67	0.10	6.18	15	366	219	213	107	302	96.4
65	1.85	4.26	13.7	57.2	2.44	10.59	0.67	0.12	6.46	16	307	228	315	115	333	97.3
67	1.38	5.19	14.2	54.5	2.24	10.82	0.71	0.14	7.02	18	316	233	262	123	355	96.2

Table 18b Results of chemical analyses (ICP-OES) for amphorae of presumed Northern Aegean and Mendean origin

content and significantly higher chromium to nickel ratio than the rest approaching 4:1. The remaining samples showed relatively high calcium contents with the exception of CKOL 64. Aluminium is low to medium in all and iron relatively high. Chromium and nickel are relatively elevated and at a ratio of approximately 1.5:1. Samples CKOL 62, CKOL 65, and CKOL 67 cluster together in the dendrogram (Taf. 123), while CKOL 66 is somewhat chemically differentiated from the rest on the basis of higher titanium and zirconium, both possibly the result of the presence of sphene in this sample (see petrographic description below).

Discussion of the Analytical Data

In order to explore the origin of all these samples, comparisons were undertaken with different sets of petrographic data. Samples CKOL 64–65, CKOL 67, characterised by shape as Mendean amphorae, were compared with samples of Mendean amphorae found in Corinth and studied by I. Whitbread.[699] Samples CKOL 64 and CKOL 67 resemble very strongly Whitbread's FC1 samples, which display the same range of inclusions and are also distinctly bimodal. Sample CKOL 65, although similar in composition, is not markedly bimodal, but shares a series of features allowing correlation to that fabric (being closer to Whitbread's FC2 Mendean fabric). The Kolonna samples contain more microfossils and limestone fragments than the Corinth ones, but this variability falls within the limits of the general variability observed in this fabric class, resulting from the mix of possibly two different kinds of clays and the addition of sand. The mix of clays is assumed on the basis of the range of colours acquired after refiring, observed in both sets of samples. In his study of transport

[699] Whitbread 1995, 198–209; one of the samples analysed by Whitbread was stamped.

amphorae found in the Athenian Agora, M. Lawall mentions that three of the Mendean amphorae he examined were thin sectioned.[700] Athens samples resemble the Corinth samples, being bimodal and containing the same set of inclusions (Whitbread's FC1). They also contain microfossils (like the Kolonna samples) and rare rock fragments with quartz, mica, feldspar and possibly epidote (like Corinth and Kolonna samples, but in higher frequency). Sample CKOL 62 resembles strongly Whitbread's Mendean FC1, compositionally and texturally, as well as CKOL 64 and CKOL 67, and its connection to the same production centre of Mendean amphorae should be considered as very probable. In terms of composition, samples CKOL 62, CKOL 64–65, and CKOL 67 resemble strongly Groups Δ, A, and B of the pottery assemblage of the coastal cemetery of ancient Mende.[701] Therefore, it could be argued that samples CKOL 62, CKOL 64–65, and CKOL 67, apart from forming a very homogeneous group in terms of composition, convincingly seem to have an origin in Mende or the Cassandra peninsula in Chalkidiki.

Sample CKOL 66 was compared with the same set of samples from Mendean amphorae found in Corinth and studied by I. Whitbread. It resembles strongly Whitbread's Mendean FC2 (esp. LOT 78-93-82) and, to a lesser extent, since it is not strongly bimodal, FC1 (esp. LOT 78-93-79). There are some minor compositional differences, such as the absence of epidote group minerals and microcline. Nevertheless, there is an obvious similarity to Whitbread's Mendean FC2, and in particular the higher-fired samples, and possible connections to Mendean amphorae or their production centre(s) should be considered. Similarly, chemical analysis does not dismiss this connection, since CKOL 66 does not differ considerably from CKOL 62, CKOL 64–65, and CKOL 67.

As for sample CKOL 63, its chemical composition and the types of inclusions that characterise its fabric clearly distinguish it from the rest of the samples with a North Aegean or Mende association. Its fabric (characterised by quartz-rich metamorphic rock fragments and polycrystalline quartz, along with very few rock fragments heavily altered to biotite) points to a rather metamorphic geological environment in comparison to the rest of the samples. An origin in the wider area of the Thermaic Golf should not be ruled out, though, since zones of metamorphic or sedimentary character co-exist in this area. The exploitation of a different source of raw materials is clearly implied by the distinctly different chemical composition of CKOL 63 to that of CKOL 62, CKOL 64–65, and CKOL 67.

Petrographic Description

Silicate/metamorphic & carbonate fabric (CKOL 62, CKOL 64–65, CKOL 67)

Microstructure

The fabric has very few to few voids, dominantly meso- to macrovughs and few mesoplannar voids (rare megavughs in CKOL 64). The c:f related distribution is single-spaced porphyric related distribution. Voids and inclusions are more or less randomly orientated.

Groundmass

Homogeneous, although CKOL 65 differs slightly in composition and size distribution. The micromass is optically moderately to slightly active, reddish brown to brown in PPL, orange brown to dark reddish brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ ca. 20:77:3 to 25:68:7

Inclusions are moderately to well sorted, <1.8mm, mode 0.2–0.4mm, sa–sr. Size distribution is bimodal (maybe not as strong in CKOL 65).

Fine fraction <125µm

[700] Lawall 1995, 117–119 (samples AS815-P, AS816-P, AS817-P).

[701] Moschonissioti *et al.* 2005.

Dominant	QUARTZ, monocrystalline and polycrystalline, sa–sr.
Few	ALKALI FELDSPAR, sa–sr.
	MICA, frequently white mica and commonly biotite laths.
Rare	OPAQUES, sr, black in PPL and XP.
	EPIDOTE, sa.

Coarse fraction >125µm

Common–frequent	QUARTZ, monocrystalline, mode 0.2mm, sa–sr.
	QUARTZ-RICH METAMORPHIC ROCK FRAGMENTS/SCHIST, <1.8mm mode 0.4mm, sa–sr, consisting of quartz ± alkali feldspar ± biotite.
	QUARTZ, polycrystalline, <0.7mm, mode 0.2–0.3mm, sr–sa.
	ALKALI FELDSPAR, <0.8mm, mode 0.25mm, sr–sa, frequently cloudy, few microcline also present.
Few–common	MICA, <0.6mm, mode 0.2mm, frequently white mica laths and commonly biotite laths or flakes (few oxidised).
	CALCITE, micritic, <1.8mm, mode 0.2–0.4mm, sr, larger grains commonly with quartz, alkali feldspar and mica inclusions.
Few–rare	MICROFOSSILS, <0.7mm, mode 0.25mm, convex shape (ostracods?), in one occasion also sponge spicules (CKOL 67).
Rare–very few	OPAQUES, mode 0.1mm, sr, black in PPL and XP, or very dark red in PPL and XP.
Rare	EPIDOTE, <0.6mm (aggregate in CKOL 65), mode 0.2–0.1mm, few with twinning (in CKOL 65 it is Very few).
	PLAGIOCLASE, <0.5mm, mode 0.2mm, sa, some with oligoclase composition.
Very rare	CLINOPYROXENE, 0.3–0.15mm, sa, colourless in PPL, first order yellow in XP (CKOL 64).
	AMPHIBOLE, 0.2mm, sa, brown pleochroism (CKOL 64).
	SPHENE (?), 0.2mm, sa (CKOL 64).
	PHYLLITE (?), 0.5mm, sr, consisting of biotite + quartz (CKOL 65).

Textural Concentration Features

Few (only in CKOL 67)

Reddish brown (PPL, x50) and dark red (XP, x50), <0.8mm, mode 0.3mm, boundaries clear to diffuse, r–wr, equant shape, neutral optical density, discordant with the external fabric – clay pellets (?).

Silicate/metamorphic & carbonate fabric (CKOL 66)

Microstructure

Very few voids, meso- to macrovughs, single-spaced porphyric related distribution, voids and inclusions rather randomly orientated.

Groundmass

Secondary calcite (?) observed also in PPL and macroscopically, surrounding grains or areas, optically inactive, brownish red in PPL (x25), red in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 20:75:5

Inclusions are moderately sorted, <2.4mm, mode 0.2–0.4mm, sa–sr. Size distribution is unimodal.

Common	QUARTZ, monocrystalline, <0.5mm, mode 0.25mm, sa–sr.
	QUARTZ-RICH METAMORPHIC ROCK FRAGMENTS/SCHIST, <2.4mm, mode 0.6–0.4mm, sa–sr, consisting of quartz ± alkali feldspar ± mica.
	CALCITE, micritic, <0.8mm, mode 0.4–0.2mm, r–sr, frequently decomposed (isotropic in XP).
	ALKALI FELDSPAR, <0.8mm, mode 0.25mm, sr–sa, few cloudy.
Few	QUARTZ, polycrystalline, <0.6mm, mode 0.3mm, sa–sr.

Very few	Mica, <0.4mm, mode 0.2–0.1mm, predominantly oxidised biotite laths.
	Opaques, mode 0.2–0.1mm, sr, black in PPL and XP.
	Plagioclase, <0.8mm, mode 0.6–0.2mm, sa.
Rare	Microfossil, 0.2mm.
	Rock fragment, a) 0.4mm, sa, quartz crystals in crystallitic groundmass, b) 1.2mm, sr, silicate crystals in isotropic groundmass.
	Sphene, 0.15mm, sa.

'Single' Fabric

Silicate/metamorphic & carbonate fabric (CKOL 63)

Microstructure

Very few voids, mesovughs, single-spaced porphyric related distribution, voids and inclusions rather randomly orientated.

Groundmass

Homogeneous, optically inactive, brown in PPL (x25), very dark brown to black in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 25:72:3

Inclusions are moderately sorted, <1.6mm, mode 0.2–0.4mm, sa–sr. Size distribution appears unimodal.

Fine fraction <125μm

Frequent to dominant monocrystalline quartz and alkali feldspar, fairly dense.

Coarse fraction >125μm

Common	Quartz, polycrystalline, <0.4mm, mode 0.25mm, sa–sr.
	Quartz, monocrystalline, <0.6mm, mode 0.25mm, sa–sr.
	Quartz-rich metamorphic rock fragments/Schist, <1.6mm, mode 0.3–0.4mm, sa–sr, conisting of quartz + opaques ± alkali feldspar ± biotite.
	Alkali feldspar, <0.5mm, mode 0.2mm, sr–sa, commonly cloudy.
Few	Calcite, micritic, <0.6mm, mode 0.3mm, r–sa.
	Opaques, <1.5mm, mode 0.2–0.3mm, sr, black in PPL and XP.
Very few	Mica, <0.3mm, mode 0.15mm, frequently white mica laths and commonly biotite laths or flakes (few oxidised).
Very few–rare	Clinopyroxene, mode 0.2mm, sa, colourless in PPL.
	Altered rock fragments, 0.7–0.5mm, sa–sr. Heavily altered fragments mainly to biotite, no diagnostic traces of original minerals and/or texture.
Very rare	Serpentinite, 0.4mm, sr.
	Amphibole, 0.15mm, sr, with brown pleochroism.

2.3.2.7. Amphorae of presumed North Aegean origin (CKOL 78–79; Taf. 68. 86)

Macroscopic Group CMG 15 comprises another amphorae group of presumed North Aegean origin. These samples form a homogeneous fabric, which differs from the other North Aegean amphorae fabrics and is thus presented separately (Tables 19a–b).

Petrographic Analysis

The fabric is medium-grained, characterised by silicate and carbonate inclusions and clay pellets in a micaceous matrix (Taf. 128. CKOL 79). It has orange brown to dark reddish brown micromass in XP with 3–5% voids. The inclusions are common to few, subangular to subrounded, moderately sorted, with fine sand mode sizes and maximum grain size reaching coarse sand. The mineralogical composition of the fabric is characterised by common micritic limestone fragments, monocrystalline and polycrystalline quartz, white mica, quartz-rich metamorphic rock fragments, and few alkali feldspar and opaques. Both samples refired red, implying the use of similar types

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix optical activity
78	context late 3rd/early 4th qu. 5th c.	North Aegean type transport amphora	red	Micaceous, carbonate & silicate fabric with Tcfs	moderately active
79	context late 3rd/early 4th qu. 5th c.	North Aegean type transport amphora	red	Micaceous, carbonate & silicate fabric with Tcfs	active

Table 19a Amphorae samples of presumed North Aegean origin (CMG 15) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
78	1.28	3.75	17.5	54.4	3.06	10.25	0.87	0.08	7.92	19	379	326	201	141	402	99.2
79	1.23	3.19	18.1	53.9	3.11	5.36	0.84	0.07	7.42	19	279	203	185	163	404	93.2

Table 19b Results of chemical analyses (ICP-OES) for amphorae samples of presumed North Aegean origin (CMG 15)

of clays. The optical activity of the groundmass for these samples suggests original firing temperatures most probably not exceeding 800–850°C, in oxidising atmosphere.

Chemical Analysis

Chemically the two samples show several similarities in most of the analysed elements, with CKOL 78 showing, however, higher calcium, chromium, and nickel contents. Iron and aluminium contents are relatively high and so are chromium and nickel in a 1.2:1 and 1.5:1 ratio. The samples did not cluster together in the dendrogram (Taf. 123), while given that only two of these were analysed, it cannot be concluded whether their chemical variability should indicate their attribution to two distinct compositional groups or whether it could be associated with a single group's variability.

Discussion of the Analytical Data

For this North Aegean amphora type so far little is known. Based on archaeological evidence, the most probable origin of these amphorae could be Alonnisos (ancient Ikos) and/or Skopelos (ancient Peparethos).[702] Unfortunately, no samples from these two areas were available to conduct a comparative study; in turn, CKOL 78 and CKOL 79 were compared with various amphorae samples found in Corinth and studied by I. Whitbread, having been attributed an origin in Chios (FC2), Lesbos and Thassos (FC1),[703] since these North Aegean islands are equally suggested as possible production centres for this amphora type. No strong similarities were found with any of these sets of samples. Chian samples are considerably coarser and bear a different kind of Tcfs, although the main inclusion types are similarly silicate containing quartz-rich metamorphic rock/schist fragments (but bearing a different metamorphic texture), while the rare presence of volcanic rock fragments intensifies the different picture. Samples from Lesbos are considerably coarser, and very different in texture and composition (different set of metamorphic rock types, some volcanic traces), while Thassian samples are characterised by large silicate grains and lack the limestone fragments as well as the micaceous matrix observed in CKOL 78 and CKOL 79. Therefore, on the basis of present evidence, the manufacture of these amphorae cannot be related to any of the above production centres. It should also be noted that, although the major inclusion types of these samples do not differ significantly from those discussed in Section 2.3.2.6 (Mendean type and North Aegean amphorae), the less frequent inclusion types do point to distinct geological settings, while the textural features are also quite different. The lack of comparative data and the very small number of Kolonna samples analysed for this macroscopic group also preclude any provenance attribution on the basis of chemical compositions. As noted above the samples did not cluster together and no comments can be made on whether they belong chemically to the same compositional group. It is therefore impossible to attempt any further comparison with other Northern Aegean ceramics analysed in this study (see previous section).

702 Doulgeri-Intzessiloglou and Garlan 1990; Whitbread 1995, 139 fn. 1.

703 Whitbread 1995, 135–153 (Chios); 154–164 (Lesbos); 165–197 (Thasos).

Petrographic Description

Micaceous, carbonate & silicate fabric with Tcfs (CKOL 78–79)

Microstructure

The fabric has very few voids, meso- to macrovughs. The c:f related distribution is single- to double-spaced porphyric related distribution. Voids and inclusions are more or less randomly orientated.

Groundmass

Rather homogeneous, although in CKOL 78 inclusions are unevenly distributed (concentrations of grains). The micromass is optically active to moderately active, reddish brown in PPL, orange brown to dark reddish brown in XP (x25).

Inclusions

$c:f:v_{125\mu m}$	15:80:5 to 15:82:3

Inclusions are moderately sorted, <0.8mm, mode 0.2mm, sa–sr. Size distribution is unimodal.

Common–few	Calcite, micritic, <0.8mm, mode 0.2mm, sr, dominantly with isotropic rim (due to incipient vitrification?). Quartz, monocrystalline, mode 0.2–0.1mm, sa–sr. Quartz, polycrystalline, <0.6mm, mode 0.2mm, sa–sr. Quartz-rich metamorphic rock fragments/Schist, <0.7mm, mode 0.3mm, sa–sr. When schist fragments, contain quartz + biotite ± white mica. Mica, <0.3mm, mode 0.15mm, frequently white mica laths and commonly biotite laths or flakes.
Few	Alkali feldspar, <0.7mm, mode 0.15mm, sr–sa, frequently cloudy.
Very few	Opaques, mode 0.1–0.2mm, sr, black in PPL and XP, or dark red in PPL and XP.
Rare	Plagioclase, mode 0.2–0.15mm, sa.
Very rare	Sandstone, 0.6mm, sa–sr; components include monocrystalline and polycrystalline quartz, quartz-rich and schist rock fragments, alkali feldspar in a Fe oxide-rich matrix.

Textural Concentration Features

Few to common

Dark red (PPL, x50) and very dark red (XP, x50), 0.7–0.4mm, boundaries clear (with surrounding void), sr–r, prolate and equant shape, high optical density, discordant with the external fabric (few silicate inclusions).

Dark red (PPL, x50) and very dark red (XP, x50), 0.5–0.3mm, boundaries clear to diffuse, wr, equant and distorted shape, neutral to high optical density, discordant with the external fabric (no inclusions) – clay pellets (?).

Red (PPL, x50) and dark orange red to dark red (XP, x50), <0.6mm, mode 0.2mm, boundaries clear (with surrounding void or clay minerals rim), r–wr, equant to prolate shape, high optical density, discordant with the external fabric (few with silicate inclusions).

2.3.3. Kitchen ware

2.3.3.1. Cooking wares of presumed Attic origin (CKOL 94. 113. 128; Taf. 71. 74. 118)

CMG 16, represented by CKOL 94, and CMG 17, where CKOL 113 and CKOL 128 are classified, relate to various kitchenware of presumed Attic origin. The three samples analysed do not comprise a homogeneous fabric, presenting compositional differences discerned both petrographically and chemically (Tables 20a–b).

Petrographic Analysis

Sample CKOL 94 is characterised by micritic calcite lumps, schist/quartz-rich metamorphic rock fragments and their mineral constituents (Taf. 129. CKOL 94). In CKOL 113 (Taf. 129. CKOL 113) and CKOL 128 (Taf. 129. CKOL 128) micrite lumps are absent and metamorphic rock fragments prevail, including schist, quartz-rich metamorphic rock fragments and phyllite/shale fragments in variable quantities. The heterogeneity observed petrographically is also detected in colours acquired after refiring:

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix otical activity
94	context late 1st/early 2nd qu. 5th c.	hydria	red	Carbonate & metamorphic fabric	active to moderately active
113	context 4th qu. 4th c.	lid	dark red	Mica schist & quartz-rich metamorphic fabric	moderately active to slightly active
128	context mixed	cauldron	dark red	Quartz-rich metamorphic & shale/ phyllite fabric	inactive

Table 20a Cooking ware samples of presumed Attic origin (CMG 16) and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
94	1.01	2.42	14.4	49.3	2.25	12.53	0.71	0.08	6.28	16	198	143	226	139	303	89.0
113	1.60	1.28	17.5	64.5	2.29	1.06	0.88	0.07	7.76	20	108	47	62	187	367	96.9
128	2.87	2.53	18.2	60.2	1.89	1.17	1.12	0.13	8.68	26	180	97	82	202	373	96.8

Table 20b Results of chemical analyses (ICP-OES) for cooking ware samples of presumed Attic origin (CMG 16)

CKOL 94 refired red, while CKOL 113 and CKOL 128 refired dark red; accordingly, the optical activity of the groundmass for CKOL 94 suggests original firing temperatures not exceeding 800–850°C, and for CKOL 113 and CKOL 128 in the range of 800–950°C, all in oxidising atmosphere.

Chemical Analysis

Chemically, samples CKOL 113 and CKOL 128 show distinctive compositions, that set them clearly apart from CKOL 94, as well as the majority of the remaining assemblage (see also Taf. 123 and Table 20b). This suggests that the two samples may be chemically related, with at least some of the noted differences potentially attributed to their coarseness. Their chemical composition is clearly poor in calcium, with high iron and relatively high titanium and aluminium. Among the trace elements, nickel and chromium are very low, their content approaching the detection limits of the instrument, hence possibly partly responsible for the differences between the two samples. Scandium contents are high, with CKOL 128 bearing the highest scandium content of the entire analysed assemblage. Most characteristic, however, here are the very low strontium contents, which are among the lowest of all examined samples. CKOL 94 on the other hand is rich in calcium with much lower aluminium and iron and significant differences in the trace element composition, evident in Table 20b.

Discussion of the Analytical Data

Provenance from Attica is very plausible for all samples after comparison to a) contemporaneous kitchenware samples from the Athenian Agora from M. Farnsworth's collection[704] and b) Bronze Age coarse ware samples from Eleusis in schist fabrics and being considered as local to the broader region.[705] On the basis of this comparison, CKOL 94 could be considered very broadly similar to Farnsworth's Attic cooking pots, despite textural differences. Although inclusions are less densely distributed and micritic calcite lumps are considerably bigger in size in CKOL 94, in terms of composition it falls into the same broad fabric group characterised by silicates and micritic calcite inclusions. Sample CKOL 113 was found broadly compatible with the main Eleusis subgroup[706] characterised by mylonitic mica schist and phyllite fragments. It cannot be considered as compositionally identical to the Eleusis samples, but it could be argued that both sets of samples point to a similar metamorphic environment, which presents internal variability in metamorphism conditions (as implied by different crystallisation texture of polycrystalline quartz). Sample CKOL 128 bears some similarity to Farnsworth's samples AA42 and AA49 (samples with phyllite fragments). They are not identical in composition (CKOL 128 contains shale and coarse-grained mica schist fragments, while in AA42

[704] The samples checked are AA1, AA2, AA22, AA27, AA42, AA44, AA48, AA49 and AA56; the last two are published in FARNSWORTH 1964, 226 as no. 8 (FARNSWORTH 1964, pl. 67.8) and no. 4 (FARNSWORTH 1964, pl. 66, 4) respectively.

[705] COSMOPOULOS *et al.* 1999.

[706] Samples ELF193-ELF195, ELF207, ELF219.

and AA49 phyllite/shale fragments are dominant) but present the same grain sizes and sorting, pointing to a similar (or same) metamorphic environment. CKOL 128 is also broadly similar to the Eleusis sample ELF219. As mentioned above, this similarity should not be understood as identical compositional concordance, but as pointing to a similar metamorphic environment. Published results of petrographic analysis of Hellenistic plain wares from the Athenian Agora confirm the use of coarse fabrics, characterised by quartz-rich metamorphic rock fragments, for the manufacture of cooking pots, which are most probably local Attic products,[707] in later periods as well. Comparison with the chemical data from NAA analyses of these samples is inconclusive,[708] particularly given the small number and chemical heterogeneity of the samples analysed in this study. Summarising, samples CKOL 94, CKOL 113 and CKOL 128 have certain features in common, but at the same time the simultaneous use of at least two different raw material sources and recipes is evident.

Petrographic Description

'Single' Fabrics

Carbonate & metamorphic fabric (CKOL 94)

Microstructure

Very few voids, predominantly mesoplannar voids rare mesovughs, single- to double-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Darker coloured core (due to firing conditions), optically active to moderately active, reddish brown in PPL (x25), orange brown to orange reddish brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 15:82:3

Inclusions are moderately sorted, <0.8mm, mode 0.2–0.3mm, r–sa. Size distribution is unimodal.

Frequent	Calcite, micritic, microsparitic, and sparitic, <0.8mm, mode 0.3–0.6mm, r–sr.
Common	Quartz, monocrystalline, <0.25mm, mode 0.1–0.2mm, sa–sr.
	Alkali feldspar, <0.3mm, mode 0.15mm, sr–sa.
Few	Schist/Quartz-rich metamorphic rock fragments, <0.5mm, mode 0.25–0.3mm, sa–sr, composed by quartz ± alkali feldspar ± white mica ± opaques.
	Mica, <0.3mm, mode 0.1–0.05mm, predominantly white mica.
Very few	Quartz, polycrystalline, mode 0.2mm, sa–sr.
	Opaques, mode 0.1mm, sr, red in PPL and XP, or black in PPL and XP.
Rare	Epidote group minerals, <0.35mm, mode 0.1mm, sa, zoisite and epidote.

Mica schist & quartz-rich metamorphic fabric (CKOL 113)

Microstructure

Very few voids, predominantly mesoplannar voids and rarely mesovughs, close- to single-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Homogeneous, optically moderately to slightly active, dark brownish red in PPL (x25), very dark reddish brown in XP (x25).

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707 Stolman Group Cooking 1 in Rotroff 2006, 405–407 table D.2.

708 Neff and Glascock 2006, 379–392, data in http://archaeometry.missouri.edu/datasets/datasets.html.

Inclusions

$c{:}f{:}v_{125\mu m}$ 30:65:5

Inclusions are poorly to very poorly sorted, <1.4mm, mode 0.4–0.8mm, sa–sr. Size distribution is unimodal.

Dominant	Schist/Quartz-rich metamorphic rock fragments, <1.4mm, mode 0.8mm, sa–sr, composition of quartz + white mica and/or biotite ± alkali feldspar ± chlorite?
Few	Quartz, polycrystalline, <1.2mm, mode 0.3–0.6mm, sa–sr.
	Quartz, monocrystalline, <0.4mm, mode 0.2mm, sr–sa.
	Phyllite, <0.8mm, mode 0.4–0.6mm, sr, few with folding/crenulation.
	Mica, mode 0.2–0.25mm, white and/or yellowish mica, few with rather anomalous birefringence could be chlorite.
Very few	Opaques, mode 0.1–0.2mm, sr, black in PPL and XP.

Quartz-rich metamorphic & shale/phyllite fabric (CKOL 128)

Microstructure

Very few voids, predominantly mesoplannar voids, close- to single-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Homogeneous, optically inactive, dark brownish red in PPL (x25), very dark red in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 35:62:3

Inclusions are poorly to very poorly sorted, <1.8mm, mode 0.4 mm, sa–sr. Size distribution is unimodal.

Dominant–frequent	Quartz-rich metamorphic rock fragments, <1.4mm, mode 0.8mm, sa–sr, consisting of quartz ± alkali feldspar ± mica.
Common	Quartz, polycrystalline, <1.2mm, mode 0.4mm, sa–sr, few strained.
	Quartz, monocrystalline, <1.6mm, mode 0.5–0.25mm, sr–sa.
Few–common	Phyllite/Shale, <1.8mm, mode 0.4–0.6mm, sr, consisting predominantly of biotite, rarely white mica.
Few	Schist, <1.5mm, mode 0.45mm, sa–sr, consisting of quartz + biotite.
Very few–few	Mica, mode 0.15mm, predominantly biotite laths.
Very few	Alkali feldspar, mode 0.2mm, sr–sa.
	Plagioclase, 0.25–0.4mm, sa–sr.
	Opaques, mode 0.4–0.15mm, sr, black in PPL and XP, or dark red in PPL and XP.
	Epidote group, mode 0.1mm, sr–sa.
Rare	Calcite, micritic, <1.2mm, mode 0.5mm, rather vitrified (non birefringent).

2.3.3.2. Various imported cooking wares (CKOL 86. 95. 97. 104. 105; Taf. 71. 101. 118)

In this section further imported kitchenware is discussed. CMG 18, represented by CKOL 95 and CKOL 97, contains kitchenware of presumed Corinthian origin, while individual samples CKOL 86, CKOL 104 and CKOL 105 have unspecified but different origins (Tables 21a–b).

Petrographic Analysis

Apart from the well-defined local cooking ware fabrics and the few Attic imports, a small number of cooking ware samples proved to be rather dissimilar to local products and are considered as imports of unidentifiable origin. CKOL 86 (Taf. 129. CKOL 86) contains silicate inclusions (quartz, chert, alkali feldspar and quartz-rich metamorphic rock fragments) and few sandstone and mudstone rock fragments; the optical activity of its low-calcareous groundmass suggests original firing temperatures above 900°C. CKOL 95 (Taf. 129. CKOL 95) is characterised by sedimentary/low grade metamorphic rock fragments (micritic limestone, shale, sandstone fragments) and volcanic glass/pyroclastic rock fragments, its optical activity suggesting original firing temperatures around 800–850°C. CKOL 97 (Taf. 129. CKOL 97) differs from CKOL 95 in that it lacks volcanic glass/pyroclastic rock fragments and some limestone frag-

CKOL	Date	Shape	Refiring colour-body	Fabric	Matrix otical activity
86	context advanced 4th to 3rd c.	chytra, lidded	dark red	Silicate & chert fabric	inactive
95	context around 430/20	jug	dark red	Carbonate, sedimentary & volcanic fabric	active to moderately active
97	context 3rd/early 4th qu. 5th c.	jug	dark red	Carbonate, sedimentary & low metamorphic fabric	active to moderately active
104	1st half 2nd c.	lopas	dark red	Acid igneous & carbonate fabric	active to moderately active
105	1st third 3rd c.	lopas	dark red	Carbonate, silicate & chert fabric	moderately active to slightly active

Table 21a Various imported cooking ware samples and summary of attributes

CKOL	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Sc	Cr	Ni	Sr	Zr	Ba	Total
	%									ppm						%
86	0.60	1.84	15.8	64.9	1.84	2.00	0.78	0.18	7.56	17	444	231	76	200	317	95.5
95	1.10	3.06	17.2	58.0	3.30	2.65	0.89	0.13	7.66	18	241	182	103	164	294	94.0
97	1.86	2.08	19.4	57.6	2.09	3.82	0.78	0.11	7.67	20	181	91	295	165	591	95.4
104	2.91	0.72	20.2	58.7	4.98	2.73	0.36	0.12	5.42	4	65	30	142	481	174	96.1
105	0.50	1.92	15.1	62.4	2.67	2.50	0.71	0.16	7.25	18	527	267	101	216	294	93.2

Table 21b Results of chemical analyses (ICP-OES) for various imported cooking wares

ments might well be lime mortar fragments. In terms of original firing temperatures, the optical activity of the groundmass suggests temperatures around 800–850°C. CKOL 104 (Taf. 129. CKOL 104) contains alkali feldspar (sanidine), microsparitic limestone and acid igneous rock fragments (most probably trachyte) pointing to an igneous geological environment; its optical activity suggests original firing temperatures around 800–850°C. CKOL 105 (Taf. 129. CKOL 105) contains silicate inclusions (alkali feldspar, chert fragments, quartz) and micritic limestone, and on the basis of the optical activity of its groundmass original firing temperatures should have been in the range of 800–950°C. Although distinctly different in compositional terms, all samples were originally fired in oxidising (to mixed) conditions, and all refired dark red.

Chemical Analysis

The results of the chemical analysis confirm that these are all noncalcareous fabrics, but that otherwise they do not seem to be related to each other. Sample CKOL 104 is clearly distinguished from the entire analysed assemblage, as is clearly evident on the dendrogram in Taf. 123. The sample shows high potassium and aluminium content and low magnesium and iron, while its exceptionally low scandium and high zirconium are unparalleled in this study. Among the remaining samples, CKOL 86 and CKOL 105 show substantial similarity and they do cluster together in Taf. 123.

Discussion of the Analytical Data

With regard to provenance, little can be said about these samples. Samples CKOL 95 and CKOL 97 (CMG 18, considered as potential Corinthian imports on the basis of archaeological data), CKOL 86 and CKOL 105, all containing sedimentary rock fragment inclusions, are vaguely reminiscent of fabric groups identified by I. Whitbread and L. Joyner within the Ancient Corinth ceramic assemblage dating to Classical and later periods. The above four Kolonna samples, having refired dark red and lacking mudstone-tempering, were compared mainly with I. Whitbread's Corinthian amphora type B fabrics (in particular B FC3).[709] Samples CKOL 86 and CKOL 105 were compared to Corinthian amphora type B FC3 samples.[710] CKOL 86 is not totally irrelevant to B FC3 in terms of composition, but substantial differences are observed: CKOL 86 is coarser, optically inactive, with weak bimodal grain-size distribution, and contains sedimentary to low metamorphic rock frag-

[709] As discussed above (section IX.2.3.2.1), these fabrics are not considered to be of undisputable Corinthian origin.

[710] Whitbread 1995, 277f.; fabric B FC3 is a coarse, red-firing fabric, containing silicates and chert.

ments (sandstone, metasandstone, shale), which are absent or very rare in the Corinth samples. CKOL 105 is equally rather similar compositionally to Corinthian amphora type B FC3 samples (in particular to C-62-265), although the limestone fragments and the absence of mica constitute a noticeable difference between the two sets of samples. As B FC3 is not considered local to Corinth by Whitbread, no further comments can be made on the origin of these two samples. Published petrographic analysis data from Byzantine and Frankish cooking wares from Corinth by L. Joyner,[711] and in particular her Groups 1 (Chert) and 2 (Chert and Quartz), again show similarities and differences when put side by side with CKOL 86 and CKOL 105. Shared features include high frequency of monocrystalline quartz and chert,[712] while differences relate to texture (the Kolonna samples are not evidently tempered) and composition (quartz-rich metamorphic rock fragments, alkali feldspar, limestone fragments are absent from the Corinth samples). Joyner does not put forward a Corinth origin for her groups, without precluding it either, this suggestion being equally valid for CKOL 86 and CKOL 105 on the basis of existing data.

With regard to samples CKOL 95 and CKOL 97, it is impossible to suggest a production centre, but they probably do not originate from Corinth. These samples are far too sedimentary in comparison to any of the Corinth samples studied by Whitbread and totally dissimilar to the sedimentary fabrics distinguished by Joyner, containing rock fragments not observed in the Corinth samples, like (meta)sandstone and shale, possibly pointing to a different sedimentary/low grade metamorphic geological background in comparison to local geology of the Corinth area.[713]

The mineralogical and chemical composition of CKOL 104 is noticeably different from all samples analysed in this study. Its morphotypological attributes find parallels in many Aegean and East Mediterranean sites, while Asia Minor or the Levant are suggested as possible production areas (see Section IX.1.3.10.4 for further discussion and relevant references). Chemical and petrographic analyses conducted on such lopades deriving from the Athenian Agora[714] produced interesting results, as their fabric is equally characterised by trachyte inclusions,[715] while they show similar chemical composition at least in terms of the elements analysed in common.[716] On present evidence, the coastal area of Syropalestine should probably not be considered as the origin of this fabric, since acid igneous rock/trachyte fabrics have not been so far reported from this region, which is characterised by basalt-bearing fabrics or containing serpentinised rock fragments inclusions, in particular for the Ugarit-Hatay region.[717] Conversely, trachyte fabrics have been reported for Asia Minor pottery assemblages, rendering the provenance of this fabric from Asia Minor plausible.[718]

Petrographic Description

'Single' Fabrics

Silicate & chert fabric (CKOL 86)

Microstructure

Very few voids, predominantly mesoplannar voids rare macrovughs, close/single- to double-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Inclusions unevenly distributed (inclusions concentrations), optically inactive, dark brown in PPL (x25), very dark brown to very dark red in XP (x25).

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[711] Joyner 2007, 191–200. 206–225.

[712] Also, the sandstone fragments of CKOL 86 seem to be rather similar to sandstone Type 1 (quartzwacke to quartz arenite) of Group 5 (Sandstone) described in Joyner 2007, 219.

[713] Whitbread 1995, 261–263; Joyner 2007, 191.

[714] Appendixes A and D, respectively, in Rotroff 2006.

[715] Stoltman Group Exotic in Rotroff 2006, 405 table D.2.

[716] Neff and Glascock 2006, 379–391.

[717] Information on coastal Syropalestine fabrics was provided by Dr. M.-C. Boileau (pers. comm.).

[718] Vaughan 1990 on Late Bronze Grey ware from Troy; it is noteworthy that Rotroff also suggests Asia Minor as the most likely area for the production centre of this shape (following Hayes; Rotroff 2006, 186). It should be noted that CKOL 104 finds no parallels in its chemical composition to groups of Late Bronze Age pottery attributed a Trojan provenance using NAA by Mommsen and Pavuk 2007.

Inclusions

$c{:}f{:}v_{125\mu m}$	25:70:5

Inclusions are moderately to poorly sorted, <1.1mm, mode 0.2mm, sa–sr. Size distribution appears bimodal.

Common	Quartz, monocrystalline, <0.3mm, mode 0.15mm, sa–sr.
	Chert, <1mm, mode 0.4–0.2mm, sa–sr, equigranular microquartz, in one case radiolarian.
	Alkali feldspar, <0.3mm, mode 0.15mm, sr–sa.
Few	Quartz-rich metamorphic rock fragments, 0.7–0.5mm, quartz ± alkali feldspar, sa–sr. Commonly fragments are closer to metasandstone.
	Sandstone, 1.1–1mm, sa–sr, quartz ± alkali feldspar ± plagioclase in clay minerals matrix. Commonly fragments are closer to metasandstone.
	Mudstone, 0.6–0.3mm, sa–sr.
Very few	Quartz, polycrystalline, mode 0.2mm, sa–sr.
Rare	Opaques, mode 0.1mm, sr, red in PPL and XP.
Very rare	Shale, 0.8mm, sr.

Carbonate, sedimentary & volcanic fabric (CKOL 95)

Microstructure

Few voids, predominantly meso- to macrovughs, single-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Homogeneous, optically active to moderately active, reddish brown in PPL (x25), orange brown to brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$	25:65:10

Inclusions are poorly sorted, <1.4mm, mode 0.4–0.6mm, r–sa. Size distribution is unimodal.

Common	Calcite, micritic, <0.8mm, mode 0.4–0.6mm, r–sr.
	Shale, <1.4mm, mode 0.4–0.8mm, sr–sa.
	Sandstone, <1mm, mode 0.4–0.6mm; components include quartz, alkali feldspar, white mica in clay minerals matrix.
	Volcanic glass/Pyroclastic fragments, <0.8mm, mode 0.3–0.5mm, sa–sr, silicate crystals (quartz?) in an isotropic mass, slightly weathered.
Few	Quartz, monocrystalline, mode 0.1–0.2mm, sa–sr.
	Alkali feldspar, mode 0.1–0.2mm, sr–sa.
	Mica, <0.25mm, mode 0.1mm, predominantly white mica.
Very few	Opaques, mode 0.1mm, sr, red in PPL and XP, or black in PPL and XP.

Carbonate, sedimentary & low metamorphic fabric (CKOL 97)

Microstructure

Few voids, mesoplannar voids and mesovughs, single-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Darker coloured core (due to firing conditions), optically active to moderately active, reddish brown to brown in PPL (x25), orange brown to dark brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$	30:60:10

Inclusions are poorly sorted, <1.2mm, mode 0.4–0.8mm, r–sa. Size distribution is unimodal.

Frequent–dominant	Calcite, micritic, <1.1mm, mode 0.4–0.8mm, r–sr; few presenting no birefringence (crushed mortar fragments?).
Common	Sandstone, <1.2mm, mode 0.4–0.8mm, consisting of quartz, alkali feldspar, micritic calcite, ± mica (white mica and biotite) in clay minerals matrix.
Few	Shale, <1.2mm, mode 0.8mm, sr–sa.
	Quartz-rich metamorphic rock fragments, <1.2mm, mode 0.4–0.6mm, sa–sr.
	Quartz, monocrystalline, mode 0.15–0.2mm, sa–sr.
	Alkali feldspar, <0.5mm, mode 0.15–0.2mm, sr–sa.
Very few	Mica, mode 0.1mm, predominantly white mica.
	Opaques, mode 0.1mm, sr, black in PPL and XP, or dark red in PPL and XP.

Acid igneous & carbonate fabric (CKOL 104)

Microstructure

Very few voids, mesovughs, single- to double-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Homogeneous, optically active to moderately active, brown in PPL (x25), dark orange brown in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 20:77:3

Inclusions are poorly sorted, <1.4mm, mode 0.4–0.8mm, sa–sr. Size distribution appears unimodal.

Frequent	Alkali feldspar, <0.9mm, mode 0.4–0.6mm, sr, predominantly sanidine.
Common	Calcite, microsparitic, <1mm, mode 0.4–0.2mm, sr.
	Acid igneous rock fragments (Trachyte?), <1.4mm, mode 0.8–0.4mm, sa. Fragments consist of platey feldspar crystals (most probably alkali feldspar), with holocrystalline texture (no glass observed), not bearing any strong metamorphism features, resembling trachytoid texture (subparallel pattern).
Very few	Opaques, <0.6mm, mode 0.15mm, sr, black in PPL and XP.
Rare	Mica, mode 0.1mm, predominantly white mica laths.
	Epidote group, mode 0.05mm.

Carbonate, silicate & chert fabric (CKOL 105)

Microstructure

Few voids, mesoplannar voids and mesovughs, single- to double-spaced porphyric related distribution. Voids and inclusions are rather randomly orientated.

Groundmass

Homogeneous, optically moderately to slightly active, brownish red in PPL (x25), dark red in XP (x25).

Inclusions

$c{:}f{:}v_{125\mu m}$ 20:70:10

Inclusions are moderately to poorly sorted, <0.8mm, mode 0.2mm, sa–sr. Size distribution is unimodal.

Common	Alkali feldspar, mode 0.15–0.2mm, sr–sa.
	Chert, <0.6mm, mode 0.2mm, sa–sr, equigranular microquartz.
	Calcite, micritic, <0.6mm, mode 0.25mm, r–sr.
Few	Quartz, polycrystalline, <0.8mm, mode 0.15–0.2mm, sa–sr.
	Quartz, monocrystalline, mode 0.15–0.2mm, sa–sr.
Very rare	Mudstone (?), 0.7mm, sr.

2.4. Discussion of the analytical results

The integrated approach adopted in this study has yielded significant results with regard to pottery production on the island of Aegina during the Classical period. Aegina, apart from acting as a "pot-seller", as the characterisation "χυτρόπωλις" might suggest, was also a significant pottery producer. The comprehensive characterisation of the local production in its mineralogical and chemical attributes revealed a well established potting tradition. During the Classical period, Aeginetan products include mainly a wide range of cooking ware, along with a rather restricted tableware gamut, characterised by red-firing and buff-firing volcanic fabrics, respectively. Local production is attested also for black glazed pottery (of small-scale with present data), which was so far not acknowledged. It is evident that the local potting industry puts more emphasis on the production of cooking ware, with the use of red-firing non-calcareous clays. On the other hand, the production of tableware (mainly glazed ones), using the white Pliocene clays of Aegina, is considerably limited, and this may be related to the suitability of local raw materials for the manufacture of black glazed pottery. Nevertheless, this did not inhibit the Aeginetan potters from producing such vessels and local consumers from using them along with the imported glazed pottery. It is worth underlying the clear distinction between the two local traditions, each associated with different raw materials, but more importantly with distinct forming techniques as well as firing practices, reminiscent of the similar picture encountered at the Bronze Age pottery assemblage[719] and possibly indicating the existence of separate production units during the Archaic and Classical periods.

The issue of ancient trade was also within the research ojectives of this study. Aeginetan coarsewares are found in many Aegean sites and beyond, reaching as far as Northern Africa, as pottery analyses from the site of Euesperides on the Libyan coast attest.[720] On Aegina itself, a range of imported wares is confirmed, although the origin of these imported pots is not always identifiable. Among the better established imported assemblages, Corinth stands out, providing Aegina (and the rest of the ancient world) with fine tableware, transport amphorae and perirrhanteria. Athens also maintains trading relations to Aegina, as black glazed finewares and cooking pots of Attic origin were identified in the assemblage studied. Other non-local vessels, notably transport amporae, which were most often imported for their contents, relate to more distant sources, like the island of Chios, Mende and the Cassandra peninsula, or even Miletus and coastal Asia Minor.

The attribution to a specific origin was feasible only when relevant comparative data existed. Comparative petrographic datasets that include a good number of samples are published for Corinth, while for other production centres our knowledge is not equally rich yet. The situation is even more difficult in the case of chemical data, as comparisons are further restricted by the small number of samples in each imported fabric of this study, as well as broader methodological problems concerning use of data produced by different techniques and laboratories. Nevertheless, it is hoped that the petrographic and chemical characterisation of these samples along with their detailed typological characterisation will provide valuable comparanda to future studies of pottery trading networks of this period.

3. Discussion of the Archaeological, Macroscopic and Analytical Results

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The detailed definition of a local production of cooking pottery, associated with a red-firing volcanic fabric has been an important outcome of this study.[721] The macroscopic assignment of samples turned out to agree, to a large extent, with the results of the petrographic and chemical analysis. Within the wide range of vessels dated from the 6th to 4th c., the fabric appears to be broadly homogeneous with a possible differentiation reflected in the two petrographic subgroups Red Fabric A and Red Fabric B, as solid and thick-walled shapes like escharai, plates, hearths and storage bins appear only in the coarser Red Fabric A. Beyond this, no differentiation regarding style or shape and consequently workshops, as well as no chronological variation, can be consistently identified among the two subgroups. Macroscopically observed variation such as the more frequent appear-

719 Gauss and Kiriatzi 2011.
720 Swift 2005; see also fn. 935.
721 See section IX.1.2.2 and 2.2.2.

ance of black glittering inclusions in the 6th century and the rarer presence of golden and black glittering inclusions in products of the later 5th and 4th century have not been documented in the analytical data.[722] Especially remarkable is the discovery that in the Classical period the same raw material sources were used as in the Middle and Late Bronze Age, but technically improved by a better preparation of the clay paste. Further finds and future research will hopefully help to illuminate whether continuity characterised the local production of cooking pottery from the Bronze to the Iron Age.

A local origin was initially also assumed for several buff fabrics.[723] However, despite macroscopic analysis indicated certain similarities, the analytical results lead to a different grouping of the samples, not all of which proved to be Aeginetan. As with the Red local volcanic fabric, the Buff fabric used in Classical Aegina's pottery production turned out to be closely connected with a buff fabric already known in the Bronze Age. Pottery made of buff local fabrics can be traced over almost the whole period studied in this volume, even though it is altogether quite scarce compared to the wide range of coarse Red cooking ware. This is unlike the local production in the Early and mainly Middle Bronze Age that is dominated by buff fabrics. In the Classical period, the buff fabrics obviously never became that popular, for reasons other than availability of raw materials, as buff-firing clay deposits are abundant on the island and are used by Aeginetan potters until today.[724] This might also explain certain internal technological variations attested within the Classical Buff fabrics A and B, which due to the relatively limited scale of production seem not to be standardised (in terms of the raw materials selection or the range of shapes associated with these fabrics). The confirmation of the local production of black glazed pottery, which was so far not acknowledged, is especially remarkable in connection with the long lasting discussion on the production of fine painted pottery on Aegina: the current study attests that indeed in the 4th c. glazed tablewares were occasionally produced on Aegina, but at the same time the very small number of examples and their poor quality pose questions about the technical skills and knowledge of local potters (in relation to glazes and firing requirements) and the local availability of appropriate raw materials. A distinct type of mortarium, made of buff fabric and being characterised by a thick rounded rim, was considered to be a local product, on the basis of macroscopic criteria; nevertheless, scientific analyses dismissed this suggestion. Further research is needed to clarify the problem regarding the origin of this mortarium type.

In Aegina, besides the local products, a range of imported wares was also distinguished. The stylistic and macroscopic attribution of a group of samples to Corinth was in all cases confirmed by the scientific analysis.[725] The same holds true for Athenian black glazed fine wares and cooking pots of Attic origin, for Chian amphorae, and, up to a degree, for Laconian pottery.[726]

Some results of our study in relation to pottery imports in Classical Aegina are especially worth mentioning. With regard to the polished jugs of grey fabric, the analytical evidence largely confirms the variation observed stylistically and macroscopically, thus indicating an internal sub-grouping and the possible existence of more than one place of production of this ware, although the exact origin(s) of these 'grey jugs' could not be presently further clarified.[727]

Some new evidence has been produced on the amphorae of type Corinth B.[728] The samples assigned to this amphora type and attributed to a common macroscopic group proved to be petrographically and chemically homogeneous, matching also the results of previous analysis of this type of amphora. Although the current study cannot provide conclusive answers for the location of production, it gives enough evidence for not associating it with Corinth.

Interesting new data also concern amphorae from the Northern Aegean.[729] Among the samples of amphorae of the same basic shape, a group of probable Mendean-like products was separated on the basis of macroscopic and stylistic criteria from a num-

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722 However, one has to bear in mind that only one sample of the 6th century and a relative small number of samples from the 4th century were analysed.

723 See section IX.1.2.3–5 and 2.2.3.

724 For this see section IX.1.2.1.

725 See section IX.1.3.7.1–2, 2.3.1.3 and 2.3.2.1; for the controversial discussion of amphorae type Corinth B see section IX.1.3.7.3 and 2.3.2.1.

726 See section IX.1.3.1 and 2.3.1.1 for black glazed fine wares and 1.3.10.1–2 and 2.3.3.1 for cooking pottery of presumed Attic origin; 1.3.5.2 and 2.3.2.3. for amphorae of presumed Chian origin; 1.3.3 and 2.3.1.2 for pottery of presumed Laconian origin.

727 See section IX.1.3.2 and 2.3.1.4.

728 See section IX.1.3.7.3 and 2.3.2.1.

729 See section IX.1.3.8.1–2 and 2.3.2.6.

ber of loners, thus assuming several different areas of production. The conclusions drawn from the macroscopic and stylistic analysis differ somewhat from the petrographic analysis, according to which most of these samples proved to form a basically homogeneous group that is connected with Mende and the Kassandra-peninsula. Thus, we should expect even within a relatively small geographic area some variability, at least in style, but details remain to be explored in future studies.