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Fabrics of Western Greek Amphorae from Campania and from the Bay of Naples

Introduction

In the last decennium our knowledge of the pottery production in the Bay of Naples has increased significantly and this is also valid for the production of transport amphorae[1]. Of particular importance is the monographic study of Hellenistic amphorae from Ischia and from a series of shipwrecks by G. Olcese who distinguished four mineralogical groups, attributed to Ischia (group I), Naples (group II and III) and to Cuma (group IV) on the basis of archaeometric analyses[2]. Of similar relevance are the recent excavations at Piazza Nicola Amore in Naples (metro station *Duomo*) which explored an area between the city walls of *Neapolis* and the ancient coastline where pottery workshops producing Greco-Italic amphorae were identified[3]. Less clear remains the situation at Cumae[4]. In particular the studies of the new materials of Naples allow us to follow the development of Western Greek amphorae from the late 6th c. BC to the beginning of the 4th c. BC.[5] and from the end of the 4th c. to the 3rd or even the beginning of the 2nd c. BC[6] thus leaving a hiatus for the development in the 4th c. BC when the Western Greek type Sourisseau form 4 with rather elongated rims developed to the beginning of Greco-Italic amphorae with triangular rims[7]. However, due to the complex geological situation in Campania and in particular in the Bay of Naples, determined by the volcanic nature of this area, it is still not possible to characterize the petrographic 'fingerprint' of single production centres unambiguously and to attribute fabrics to these sites, but the definition of fabrics given in this paper should be understood as a first step in a long process of research[8].

The material basis of this paper is given by amphorae from the excavations along the fortification wall B in the Lower Town of Velia where imports from the Bay of Naples arrived with a percentage of nearly 25% in contexts of the 3rd and early 2nd c. BC. This complex of

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[1] Olcese 2013a; Olcese 2013b; Olcese et al. 2013; For the general problematic see also Gassner and Trapichler 2012, for the production of amphorae of non-Greek type at Ischia see Sourisseau 2011, 149-73 with the earlier bibliography.

[2] Olcese 2010, in particular 185-230. Unfortunately these mineralogical groups do not always correlate to the chemical groups. The best correspondence is found for mineralogical group I and chemical group D characteristic for Ischia, see I. Iliopoulos in Olcese 2010, 202.

[3] Febbraro and Giampaola 2009; Febbraro and Giampaola 2012a; Giampaola and Febbraro 2012b; Gassner and Scoppetta 2014; Pugliese 2014.

[4] Savelli 2006 and summarizing Gassner 2015.

[5] For the early development see Gassner and Scoppetta 2014, cat. 5 (Sourisseau form 2, late 6th c. BC), cat. 9 (second half of the 5th c. BC) cat. 14-18 (beginning of the 4th c. BC).

[6] For the late 4th and the 3rd c. BC see Pugliese 2014, 33-54 with the preceding bibliography, for Greco-Italic amphorae of the type MGS VI see Febbraro and Giampaola 2009, 126-32 fig. 10.

[7] Compare e. g. Gassner and Scoppetta 2014, cat. 14-18 (early 4th c. BC) to Pugliese 2014, 38-40 fig. 13-15.

[8] For the geological situation see Morra et al. 2014. One of the problems is also the possible transport of raw materials, as suggested for Ischia and Naples, see Morel 1985, 376; Olcese 2012, 345-49 with previous bibliography.

about 20 samples[9], analysed by thin sections, is complemented by a small selection of transport amphorae of the 5th c. BC from contexts at Naples, Piazza Nicola Amore[10] as well as by some fragments of Dressel 2-4 amphorae from a kiln near Villa Fiorentino at Sorrento[11]. Equally the samples of fabric BNAP-A-11, probably to be connected with Pompeii, rely on samples of Dressel 2-4 amphorae from the excavations of C. Panella at the north-eastern slopes of the Palatine at Rome[12].

These selection of samples allowed us to define a rather broad range of fabrics of which 11 could be attributed to production sites situated within the Bay of Naples while six fabrics belong to production centres that can be attributed to Campania in a more general way, either in the plain of the Volturno river in the north or in the plain of Salerno to the south, though a localisation inside the Bay of Naples cannot be totally excluded either. At the present state of research it is however difficult, if not impossible to identify their exact site of production. In the first part of this contribution we present a short description of these fabrics and their contexts, starting with those for which a attribution to the town of Naples seems most probable (BNAP-A-1 to BNAP-A-7), followed by fabrics probably stemming from the area of the Bay of Naples in general (BNAP-A-8 to BNAP-A-10) and from Sorrento (SURR-A-1)[13]. At the end we present fabrics for which only a general attribution to Campania is possible (CAMP-A-1 to CAMP-A-6). In the second part of the paper Roman Sauer publishes the results of the petrographic analyses.

Fabrics from the area of Naples (BNAP-A-1 to BNAP-A-6, PG-C1[14])

Fabrics that might be assigned to workshops in or in the immediate vicinity of *Neapolis* are divided into two groups. The first group comprises fabrics, which have been identified with amphorae found during the excavations at Piazza Nicola Amore, the second group refers to imports to Velia during the 3rd and 2nd c. BC.

The first group from Naples itself (BNAP-A-1 to BNAP-A-3) stems from contexts of the 6th to the early 4th c. BC in the excavations at Piazza Nicola Amore at Naples and consists of one fragment with rim Sourriseau form 2, but mainly of fragments of Sourisseau form 4[15]. These fabrics are all very similar, but can be distinguished by differences in size and quantity of the particles. Their attribution to the local production of the Bay of Naples is based on the clear presence of volcanic particles that can be seen under the binocular in all samples, and on the

[9] The number of imports from the Bay of Naples to Velia is clearly higher (about 80 fragments), but only 20 of them have been analysed petrographically. The publication of these excavations is actually in preparation (Gassner et al., in prep.). For preliminary reports on the excavations see Gassner and Sokolicek 2000; Gassner et al. 2003; Krinzinger 2006, 175-78; Gassner 2016.

[10] Fabrics BNAP-A-1 to 4, see also Gassner and Scoppetta 2014. My particular thanks for the generous permission to reuse them in this occasion goes to Daniela Giampaola.

[11] These amphorae were sampled in 1994 and our particular thanks for this possibility go to T. Buddetta from the museum of Sorrento. See now also Olcese 2012, 369-70 and Olcese et al. 2013, 55-6 with the previous bibliography.

[12] My warmest thanks go to Clementina Panella for the possibility to present the samples here.

[13] The description of the fabrics for the database was done by Carina Hasenzagl.

[14] PG-C = Petrographic group – Campania, see also the contribution of Roman Sauer in this paper.

[15] Gassner and Scoppetta 2014 with the previous bibliography. Fabric BNAP-A-4, attributed to the Bay of Naples as well in this publication, could come from an area in the surroundings and is not treated here anymore as it is only one sample. Also fabric BNAP-A-5 has been defined on Hellenistic amphorae from the excavations of Naples, but cannot be presented here.

comparison with local fabrics of the Coarse ware[16]. It was also confirmed by the petrographic analyse of M137/1.

BNAP-A-1

M136/12; M137/1[17]

This fabric is characterized by a granular matrix which shows clear traces of carbonate when using an amplification of 40. Among the inclusions big particles with volcanic origin of black or dark-brown colour are clearly visible. Their distribution is irregular. Also visible are big, transparent inclusions.

BNAP-A-1 (pl.4) was identified with amphorae of the form Sourisseau 2 (M137/1, cat.1, pl.1) and Sourisseau 4 (M136/12, cat.2, pl.1).

BNAP-A-2

M137/2; M137/5[18]

Fabric BNAP-A-2 (pl.4) is very similar to BNAP-A-1, but temper is more frequent and the inclusions are normally slightly smaller. Black particles are less frequent, while the small carbonate particles are well visible.

BNAP-A-2 was identified with amphorae of the form Sourisseau 4 (cat.3; cat.4, pl.1).

BNAP-A-3

M137/3[19]

Fabric BNAPA-3 (pl.4) is still more strongly tempered than BNAP-A-2; in particular, its carbonate particles are more frequent. Their distribution is irregular.

It was identified with an amphora of the form Sourisseau 4 (cat.5. pl.1).

BNAP-A-3 is rather similar to fabrics of common wares produced in the Bay of Naples, in particular BNAP-C-11 and BNAP-C-10, both having been identified in materials of the 4th and the beginning 3rd c. BC from Cuma[20].

Samples of the second group (fabrics BNAP-A-6 and BNAP-A-7) have been found at Velia in contexts of the 3rd and early 2nd c. BC. They were attributed to the production of Naples by R. Sauer (PG-C1). Macroscopically they are similar to the fabrics described above so that their production at *Neapolis* or in the immediate surrounding seems probable. Because of optical differences in the fabrics, presumably due to different firing temperatures the archaeometric group PG-C1 has been split into two different fabrics in the archaeological description.

BNAP-A-6

M 10/31; M 10/45[21]

This fabric (pl.4) shows temper consisting of volcanic particles, but also of white carbonate particles. Sample M10/45 shows a matrix riddled with carbonate at a magnification of 40.

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[16] www.facem.at: fabrics BNAP-C-1 to BNAP-C-12; see also Febbraro and Giampaola 2012b; Trapichler 2012.

[17] M136/12=Gassner and Scoppetta 2014, cat. 15; M137/1=Gassner and Scoppetta 2014, cat. 5.

[18] M137/4=Gassner and Scoppetta 2014, cat. 16; M137/6=Gassner and Scoppetta 2014, cat. 17.

[19] M137/3=Gassner and Scoppetta 2014, cat. 14.

[20] FACEM- http://facem.at/BNAP-c-10; FACEM- http://facem.at/BNAP-c-11; see also Munzi et al. 2012; Trapichler 2012.

[21] M10/31: inv. 523/98-68; M10/45: inv. 209/99-385.

Similarities of this fabric can be observed with fabric BNAP-C-1[22], identified with Coarse wares of the early 2nd c. BC from the excavations of Piazza Nicola Amore in Naples.
Both samples stem from Greco-Italic amphorae and present Gassner rim types 10 and 11[23] (cat.6; cat.7, pl.1).

BNAP-A-7
M 10/42; M 10/46[24]
BNAP-A-7[25] (pl.4) is very similar to BNAP-A-6, but fired at a higher temperature so that the colour of the fabric is rather orange. It also contains a higher percentage of white particles. At an amplification of 40 it is clearly visible that the matrix is rich of carbonate.
Both samples stem from Greco-Italic amphorae and present Gassner rim type 12[26] (cat.8; cat.9, pl.1).

Fabrics from the Bay of Naples (BNAP-A-8 to BNAP-11; SURR-A-1, PG-C2 and PG-C3)

These fabrics can be attributed to the area of the Bay of Naples as well, but show characteristics that make suppose a provenance from the wider surroundings of *Neapolis*, including the *CAMPi Flegrei* in the west of Naples and the Sarno River plain in the southeast[27]. Fabrics BNAP-A-9 and BNAP-A-10 belong to the archaeometric group PG-C3, but macroscopically have to be distinguished clearly because of their different colour which is due to a different temperature of firing. BNAP-A-8 shows similar characteristics, but belongs to the archaeometric group PG-C2, which is distinguished from PG-C3 by a higher content of carbonate in the matrix. Unfortunately, these characteristics are sometimes hard to detect in the macro-photos.
While BNAP-A-8 and BNAP-A-10 were observed on amphorae of the Greco-Italic type, dating to the 3rd c. BC, BNAP-A-9 occurs already in the 5th c. BC. with Western Greek amphorae of the form Sourisseau 2 and 3[28].
Fabric BNAP-A-11 might also belong to this group, which corresponds to the so-called *Black-Sand-fabric*, a terminus created by D.P.S. Peacock[29]. However, the term "fabric" in this case is not used for one specific type of fabric, but groups several variants for which a provenance from the Sarno River plain was assumed[30]. BNAP-A-11 was defined on Roman amphorae of the type Dressel 2-4, found on the North-Eastern slope of the Palatine in Rome. The fabric has been identified as "Black Sand fabric" by C. Panella on the basis of macroscopical comparison with pieces found at Pompeii. It has, however, also been observed with Greco-

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[22] FACEM- http://facem.at/BNAP-c-11.
[23] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.
[24] M 10/42: inv. 209/99-646; M 10/46: inv. 209/99-381.
[25] BNAP-A-7 was already identified by H. Liko as AH13, see Liko 2001.
[26] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.
[27] For the definition of the 'Bay of Naples' see Morra et al. 2014, 30.
[28] In this context it has to be noted that in the 5th c. BC we also find a flourishing production of amphorae of the Etruscan type in this area, see Albore Livadie 1985, 129-33 and Gassner 2015, 347-48.
[29] Peacock 1977, 262-269; Panella and Fano 1977; Peña and McCallum 2009b, 176-180. See also *Black Sand fabric*: University of Southampton (2014) *Roman Amphorae: a digital resource* [data-set]. York: Archaeology Data Service [distributor] (doi:10.5284/1028192) with bibliography.
[30] For the variety of fabrics see e. g. the images for Dressel 1: University of Southampton (2014) *Roman Amphorae: a digital resource* [data-set]. York: Archaeology Data Service [distributor] (doi:10.5284/1028192) or Dressel 2-4, Italian fabric: University of Southampton (2014) *Roman Amphorae: a digital resource* [data-set]. York: Archaeology Data Service [distributor] (doi:10.5284/1028192).

Italic amphorae of the 3rd c. BC (rim type Gassner 12a) in the material of Velia[31]. The local production of Greco-Italic amphorae at Pompeii was confirmed by the recent exploration of a kiln in the *domus* VII, 15, 9-10, dated to the 2nd c. BC[32]. Also the fabric SURR-A-1, typical for the local production of Sorrento, was defined on amphorae of the type Dressel 2-4, found in a kiln at Sorrento.

BNAP-A-8 (PG-C2)

M10/8; M10/34[33]

The fabric (pl.4) consists of a carbonate rich ground mass. The temper is bimodal sorted and dominated by decomposed carbonate grains, often present only as moulds. Well visible are also quartz grains and many black particles of volcanic origin.

M10/8 (cat.10, pl.1) stems from a Western Greek amphora of Sourisseau form 3, dating to the 5th c. BC, M10/34 (cat.11, pl.2) from a Greco-Italic amphora rim type Gassner 10.

BNAP-A-9 (PG-C3h)

M6/7; M6/120[34]

Fabric BNAP-A-9 (pl.5) is defined by highly fired samples of whitish colour with evident volcanic inclusions.

Both M6/7 (cat.12, pl.2) and M6/120 (cat.13, pl.2) belong to Western Greek amphorae of the form Sourisseau 2/3 and come from contexts of the first resp. the second half of the 5th c. BC. The appearance of this fabric in the 5th c. BC is also confirmed by a sample of the same type from the excavations of Piazza Nicola Amore at Naples[35].

BNAP-A-10 (PG-C3)

M10/27[36]

Characteristic for this fabric (pl.5), often presenting a badly fired grey core, is the dense tempering with quartz and black particles of volcanic origin. The distribution of the inclusions is irregular. Equally frequent are white and light yellow particles. In particular the yellow particles proof to be moulds when looked at with an amplification of 40.

M10/27 (cat.14, pl.2) belongs to an amphora with Gassner rim type 10[37].

BNAP-A-11 (PG-C4)

M160/1; M160/2; M160/3[38]

BNAP-A-11 (cat.15-17, pl.5) presents a rather hard fabric with a high amount of temper, consisting mainly of dark grey, dark brown and – rarely – black (volcanic) particles and frequent colourless grains. Very characteristic is the presence of moulds of carbonate. At the present state of research the exact provenance from Pompeii, as suggested for the so-called

[31] Inv. 209/99-633, Inv. 209/99-636, materials from the excavations of the fortification wall in the Lower town of Velia 1997-1999.

[32] Coarelli and Pesando 2004; Proietti de Santis 2005; Peña and McCallum 2009, 58.

[33] M10/8: inv. 202/91-41 (Insula II), see Liko 2001; Liko 2002; M10/34: inv. 525/4/98-124.

[34] M6/007: inv. 11/88-22; M6/120: inv. 19/90-53, published Gassner 1994, Nr. 6, Abb. 141; see also Gassner 2003, 202-3 tab. 20, fig. 103 and 430 colour plate 6, where it was defined as Velinian Fabric Code A12.

[35] M137/7. This sample has not been published in Gassner and Scoppetta 2014.

[36] Inv. 605/98-4.

[37] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.

[38] M160/1: PNE OSII 20137; M160/2: PNE OSII 2674; M160/3: PNE OSII 2674.

Black Sand fabric[39], cannot be confirmed by archaeometric analyses as we did not have access to materials securely produced here.

SURR-A-1 - Dressel 2-4 amphorae, produced at Surrentum/Sorrento (PG-C5)

The only samples that can be clearly attributed to a production site come from Sorrento where various kilns of the Roman period have been found[40]. The fabrics SURR-A-1 was defined on the basis of amphorae of the type Dressel 2-4 that have been found in a kiln at the site of the actual museum (Villa Fiorentino). They belong to the same group analysed also by G. Olcese and her collaborators[41].

SURR-A-1

M39/1; M39/3[42]

The reddish fabric (cat.18-19, pl.5) is densely tempered with regularly distributed particles. Most characteristic are black, angular particles of volcanic origin. Frequent are also grey and white inclusions, transparent quartz and mica. Irregularly dispersed are carbonate pseudo-morphoses.

Fabrics from Campania (CAMP-A-1 to CAMP-A-5, PG-C6 to PG-C7)

For the following fabrics a provenance from Campania can be assumed. This includes the bay of Naples, but also the region north to it with the plain of the Volturno river and the territory of Capua as well as the area in the south with the Bay of Salerno and the Tusciano river plain. At the present state of research it is not possible to correlate any of these fabrics unambiguously to a distinct area so that the more generic code “Campanian” was chosen[43].

The fabrics CAMP-A-1 to CAMP-A-4 have been attributed to one archaeometric group (PG-C6) by Roman Sauer. Macroscopically this group does not seem homogeneous what might be due to different firing temperatures with the effect that carbonate particles display different levels of conservation.

CAMP-A-1 (PG-C6)

M10/44[44]

CAMP-A-1 (pl.5) displays a reddish fabric, densely tempered with dark grey inclusions. Very frequent are transparent particles of quartz and inclusions of carbonate resp. carbonate pseudomorphoses which distinguish fabric CAMP-A-1 from fabrics from the area of the Bay of Naples like BNAP-A-6 to BNAP-A-11.

M10/44 (cat.20, pl.2) was identified with a Greco-Italic amphora with rim type Gassner 12, typical for the 3rd c. BC[45].

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[39] See note 28.

[40] See in general Olcese 2012, 369-370 with further bibliography. Budetta 1996, 127; Russo 1999 n. 25; Caputo 2004, n.109.

[41] Olcese et al. 2013, 55-56 with previous bibliography.

[42] Excavations Villa Fiorentino, US 1 (M39/1) and US 2 (M39/3).

[43] Further results for the pottery production in the Bay of Salerno can be expected by the current project of Alberto De Bonis “Ceramic production in the plain of Paestum”, Lise-Meitner-Project M 1918-G25 at the University of Vienna (2016-2018).

[44] Inv. 209/99-379.

[45] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.

CAMP-A-2 (PG-C6h)

M10/33[46]

CAMP-A-2 (pl.5) resembles strongly CAMP-A-1, but evidently was highly fired as is indicated by the nearly violet colour of the fabric. It is very rich of carbonate grains and in particular of carbonate pseudomorphoses.

M10/33 (cat.21, pl.2) was identified with a Greco-Italic amphora with rim type Gassner 12[47].

CAMP-A-3 (PG-C6)

M10/41[48]

CAMP-A-3 (pl.6) presents a granular reddish matrix. It is tempered by small dark grey particles and less frequent, irregularly occurring white carbonate particles.

M10/41 (cat.22, pl.3) was identified with a Greco-Italic amphora with Gassner rim type 12[49].

CAMP-A-4 (PG-C6)

M10/28[50] (cat.23, pl.3)

CAMP-A-4 (pl.6), attributed by R. Sauer to the archaeometric group PG-C6 as well, differs macroscopically from the other fabrics as it displays a badly mixed matrix and is characterized by irregularly distributed white particles (carbonate?) while carbonate pseudomorphoses, typical for the previous fabrics, are rather missing. To a minor degree also grey particles and transparent quartz are visible. Some of the smaller grey particles might be of volcanic origin.

M10/28 (cat.23, pl.3) was identified with a Greco-Italic amphora with Gassner rim type 12[51].

CAMP-A-5 (PG-C7)

M10/35; M10/38; M10/40[52]

CAMP-A-5 (pl.6) is a granular fabric of reddish-brown colour which was defined as PG-C7 by Roman Sauer. The poorly sorted temper consists of white and grey particles and white and transparent quartz. Seldom have we found tiny black particles for which a volcanic origin seems possible.

While M10/35 (cat.24, pl.3) and M10/38 (cat.25, pl.3) stem from Greco-Italic amphorae with rim type Gassner 12 resp. rim type Gassner 10, both documented in contexts of the 3rd c. BC, M10/40 (cat.26, pl.3) comes from a handle fragment showing the well-known stamp of Γ]AIOC/]PICTΩN[53]. The stamp APICTΩN was documented for the production at Ischia both by archaeometric analyses and by a misfired sample[54]. According to the archaeometric analyse by Roman Sauer a provenance from Ischia can be excluded for M10/40 so that we have to assume another workshop where the stamp APICTΩN was used. Similar conclusions have been drawn already by G. Olcese who identified a Sicilian version of ΓAIOC/APICTΩN[55].

(V. G.)

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[46] Inv. 525/4/98-122.

[47] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.

[48] Inv. 209/2/99-637.

[49] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.

[50] Inv. 512/98-63

[51] For the typology of rims see Gassner and Sauer 2015, 5-6 pl. 2.

[52] M10/35: inv. 533/2/98-39; M10/38: inv. 517/97-38; M10/40: inv. 703/97-139

[53] Van der Mersch 1994, 163-64.

[54] Olcese 2010, 98-104, mineralogical group I, chemical group D.

[55] Olcese 2010, 98.

Petrographic types of transport amphorae of Gulf of Naples

23 selected samples have been analysed petrographically by means of thin sections. The detailed analyses results are shown in table 1, fig.1 and plates 7-20 (the analysis method is described at the end).

The analysed samples were grouped into 13 petrographic groups/ subgroups (PG), which all belong to the region of Campania (PG-C).

Petrographic groups PG-C1, PG-C1a (pl. 7-8; 10)

Samples: M10/29, M10/42 (BNAP-A-7), M10/45 (BNAP-A-6), M10/46 (BNAP-A-7), M137/01 (BNAP-A-1)

The groundmass is stained brownish red to reddish brown red with numerous dark inclusions. It is micaceous, mostly optically inactive and calcareous. The mean temper content of the analyzed amphora fragments varies from 23% to 30%, arithmetic mean is 27%. The sand/silt proportions in the samples are nearly equal (sand/silt: 13:14). The temper, mainly angular grains, shows a poor to very poor sorting. The average grain size varies from 0.08-0.12 mm. The maximum grain size observed in thin sections is 1.1 mm.

The temper particles consist mainly of monocrystalline quartz, mostly decomposed carbonate grains, muscovite and volcanic rock fragments. Subordinate or less frequent are K-feldspars (partly sanidine), plagioclase, iron oxide cemented grains, greenish to colourless clinopyroxenes and brown volcanic glass fragments (obsidian?). Rare to very rare biotite and oxidized sheet silicates, polycrystalline quartz, chert, crystalline rock fragments (mainly quartzite), siltstone/sandstone fragments, molds of foraminifera, bioclasts and other heavy minerals (melanite, brownish amphibole, altered olivine) can be observed.

Following volcanic rock particles have been distinguished: Most common are dark particles consisting of a blackish, often weathered, brownish groundmass with a network of numerous small plagioclase laths, and occ. bigger plagioclase phenocrysts. Subordinate partly oxidized grains, consisting mainly of plagioclase laths together with small clinopyroxene and magnetite inclusions occur. Occasionally grains with analcime or small leucite inclusions (leucite is partly altered to analcime?) can be observed. Typical is also the content of fresh or strongly altered glass shards (occ. Still attached to large clinopyroxene crystals) and rare large flakes of volcanic biotite. Very rare to rare light coloured, probably dacitic/trachytic rock fragments, occ. with sandine inclusions can be observed.

The observed microfossils consist mainly of foraminifera, rare ostracod shells, echinid spines, undeterminable shell fragments and very rare siliceous spicules.

The sample M137/01 has a similar composition but exhibits a bimodal sorting and seems to contain less brownish volcanic glass shards. But due to the small sample size it is not sure whether it really belongs to a slightly different petrographic subgroup PG-C1a.

Interpretation

Typical is the bad sorting (high silt content), high content in volcanic rock particles, brownish, volcanic glass shards and greenish to colourless clinopyroxenes, together with molds of dissolved carbonates and microfossils. The groundmass shows a significant muscovite content.

The samples differ slightly in their degree of firing (e.g. shows M10/29 a slightly lower firing temperature). The utilised raw materials seem to be mixtures of marine microfossiliferous, calcareous shale or clay and weathered, altered volcanic material (paleosol).

Raw materials of this type are typically available in the bay of Naples/Ischia.

Comparable in their petrographical compositions are the fabrics of the kitchen ware samples (M152/04), (M152/30), (M152/33, (M152/36). But some samples show a higher degree of firing and partly a higher content of coarse grained temper.
Mineralogically and petrographically this fabric seems to be also very similar to fabric group II (Ischia/Naples) described by Iliopoulos 2013, but he is describing a lower fired fabric type (still with an optically active micromass!). Only the described occurrence of cephalopods among bioclasts in the fabric could not be found (is also not documented on pictures!). To my opinion the occurrence of cephalopods is very unlikely and probably due to an (translation?) error. I think the variations of the fabric types could be easily explained by differing firing temperatures applied to very similar raw materials.

Petrographic group PG-C1n (pl. 9)
Sample: M10/31 (BNAP-A-6)
The groundmass is stained light brownish with numerous dark inclusions. The micaceous, groundmass is calcareous, and optically active. The total temper content is 28%. (sand/silt: 14:14). The temper, subangular to angular grains, is poorly sorted. The grain size (arithmetic mean of 50 grains) is 0.14 mm. The maximum grain size observed in thin sections is 0.65 mm.
The temper particles consist mainly of monocrystalline quartz, carbonate grains, molds of dissolved carbonate grains, muscovite, K-feldspars (partly sanidine), plagioclase and volcanic rock fragments. Subordinate or less frequent iron oxide cemented grains, greenish to colourless clinopyroxenes and brownish, volcanic glass fragments occur. Rare to very rare are biotite/oxidized sheet silicates, polycrystalline quartz, siltstone/sandstone fragments, foraminifera, bioclasts, siliceous bioclasts and the heavy minerals (melanite, brown amphibole, olivine) can be observed.
Following volcanic rock particles have been distinguished: most common are dark grains exhibiting a blackish, often weathered, brownish groundmass with a network of numerous small plagioclase laths and rare larger plagioclase crystals. Subordinate partly oxidised grains, consisting mainly of small plagioclase laths together with small clinopyroxene and magnetite inclusions and also grains with analcime or small leucite inclusions can be observed. Typical is also the content of fresh or strongly altered glass shards (occ. attached to large clinopyroxene crystals) and rare large flakes of volcanic biotite. Very rare to rare light coloured, probably dacitic/trachytic rock fragments, occ. with sanidine inclusions, can be observed.
The observed microfossils mainly consist of, often well preserved, foraminifera, echinid spines and undeterminable shell fragments.

Interpretation
Different to PG-C1 is the significant lower firing temperature. Therefore well preserved, calcareous microfossils (foraminifera, echinid spines) and carbonate grains can be observed.
Raw materials of this type are available in the surroundings of the bay of Naples/Ischia.
Mineralogically and petrographically the fabric PG-C1n seems to be also very similar to fabric group II (Ischia/Naples), described by Iliopoulos 2013. Also similar is fabric E, described by Bezeczky 2005.

Petrographic groups PG-C2; PG-C2a (pl.11-12)
Samples: M10/8 (BNAP-A-8), M10/34 (BNAP-A-8)

The fine grained groundmass is stained orange-red with numerous light-yellow to whitish small spots. It is iron oxide rich, slightly calcareous and optically inactive under crossed polarizers (M10/8).
Sample M10/34 shows a dark-grey (reduced), optically inactive core and an oxidised, orange-reddish, optically inactive to active outer rim.
The total temper content (>15µm) of the analyzed amphora fragments is 25%. The sand fraction is strongly dominating (sand/silt: 23:2). The temper, moderately rounded to sub-angular grains, exhibits clearly bimodal sorting (artificially added sand!). The grain size shows an arithmetic mean (50 grains) of 0.23 mm. The maximum particle size observed in thin section is 0.74 mm.
The temper particles mainly consist of colorless to dark green clinopyroxene grains. Frequent decomposed carbonate grains (often only molds of dissolved, partly well rounded carbonate grains are visible) and iron oxide cemented grains (included also totally altered, brownish volcanic rock fragments) occur. Less frequent are monocrystalline quartz grains, feldspars and volcanic rock fragments (often altered). Rare to very rare can be observed: mica (biotite/oxidized sheet silicates, muscovite), heavy minerals (amphibole, colourless garnet, melanite, TiO_2-minerals, olivine), chert, crystalline rock fragments (mainly quartzite).
The coarse temper (sand fraction) is dominated by colourless to dark-greenish clinopyroxene. The volcanic rock fragments are often heavily altered and consist mainly of dark grains consisting of a blackish or brownish groundmass with a network of numerous small plagioclase laths (M10/38).
M10/34 shows additionally fresh, isolated, brown volcanic glass shards and occasionally clinopyroxenes with still attached brown glass.
The very small, fine grained silt fraction of the clay paste consists of particles of fine grained quartz, mica (biotite plus muscovite), small, rounded iron-oxide particles and molds of fine grained carbonate particles.
Microfossils are very rare, foraminifera are not present, occ. siliceous sponge spiculae occur.

Interpretation
Typical are the artificially added sand temper, the abundance of clinopyroxene grains and the significant presence of melanite. The groundmass is optically very similar in both samples.
This fabric was probably produced of calcareous, iron oxide bearing shale, artificially tempered with volcanic sand (beach sand?).
Similar clay raw materials of this type are available in the surroundings of the bay of Naples, for example near Sorrento (siliceous sponge spicules, esp. in sample M10/8). Sample M10/34 shows more fresh volcanic particles compared to M10/8.
Our samples do not fit well to the previously published fabric group 1, Ischia. But similar petrographical fabrics have been published by Bezeczky 2005. Possible source areas for the raw materials used could be, partially marine sediments in the region of Sorrento and principally well developed, mature paleosols of older land surfaces in the area of the Gulf of Naples, now hidden (covered) by rocks and volcanoclastic sediments from the younger eruptions of the mount Vesuvius. Several paleosols have been developed from altered volcanic ashes during the last 25000 years within the long periods between the eruptions.
Paleosols have been described in the surroundings and noted in some large outcrops, sand pits and quarries, below volcanic sediments of the last large Vesuvius eruption. Unfortunately no analyses of such paleosols, in respect of usability for ancient pottery production, have been published.

Petrographic group PG-C3 (pl.13)

Sample: M10/27 (BNAP-A-10)

The analysed sample shows a greenish-white-grey, outside, orange-red (oxidized) groundmass with large, brownish or dark, rounded clasts.

The groundmass is optically inactive and calcareous. The total temper content of the analyzed amphora fragment is 23%. The sand fraction is dominating (sand/silt: 17:6). The temper, moderately rounded, angular grains, is poorly sorted. The grain size shows an arithmetic mean of 0.15 mm. The maximum grain size observed in thin section is 2.1 mm.

The temper particles consist mainly of quartz and mostly decomposed carbonate grains (often only molds of dissolved carbonate grains are visible). Subordinate potassium feldspars (partly sanidine), muscovite, greenish to colourless clino-pyroxene grains and iron oxide cemented grains occur. Less frequent to rare are polycrystalline quartz, chert, volcanic rock fragments and plagioclase. Very rare mica (biotite/oxidized sheet silicates), molds of dissolved foraminifera, sandstone/siltstone fragments, garnet (partly melanite), crystalline rock fragments (quartz-feldspar fragments, mainly quartzite) can be observed.

Following volcanic rock particles have been distinguished: occ. dark porous “scoria” grains consisting of a light greyish or brownish groundmass and rare strongly altered, brownish grains composed of a network of plagioclase laths and clinopyroxene phenocrysts.

The carbonate grains/molds often show a rhombohedral shape (former dolomite grains?)

Interpretation

Different (compared to PG-C2) is the higher content of polycrystalline quartz, chert and the occasional presence of dissolved foraminifers. Typical are also big, rounded, brownish siltstone clasts and the poor sorting (higher silt content).

This fabric was probably produced from calcareous, marine shale. The firing temperature can be considered as high, but probably slightly less high compared to PG-C3h. Temper and clinopyroxene content is slightly higher compared to PG-C3h.

No clear provenance interpretation can be given to date due to lack of reference samples and published, well documented reference data. But a provenance within or near the Bay of Naples seems to be probable.

Petrographic group PG-C3h (pl.14)

Samples: M6/7, M6/120 (BNAP-A-9)

The analyzed samples show a greenish to yellowish, fine grained, optically inactive, calcareous groundmass. The temper content of the analyzed amphora fragments is about 20%. The sand fraction is dominating (sand/silt: 14:6). The temper, moderately rounded to angular grains, is poorly sorted. The grain size shows an arithmetic mean of 0.11 mm. The maximum grain size observed in thin sections is 3.8 mm.

The temper particles consist mainly of monocrystalline quartz. Frequent to subordinate molds of carbonate grains, potassium feldspars (partly sanidine) and muscovite can be observed. Less frequent to rare are polycrystalline quartz, chert, volcanic rock fragments and plagioclase. Very rare are mica (biotite/oxidized sheet silicates), molds of dissolved foraminifera and carbonate bioclasts (visible in vitrified groundmass), sandstone/siltstone fragments, greenish to colourless clinopyroxenes, garnet (partly melanite), crystalline rock fragments (quartz-feldspar fragments, mainly quartzite) and siliceous bioclasts.

Following volcanic rock particles have been distinguished: Most common are dark grains consisting of a blackish or brownish groundmass with a network of numerous, small

plagioclase laths. Subordinate also grains, consisting mainly of plagioclase with small clinopyroxene inclusions and occasionally grains with analcime or small leucite inclusions.
Typical are the dark, brownish, partly rounded, iron oxide cemented clasts (mainly siltstone, subordinate also fine grained quartz rich sandstone) and totally altered, brownish volcanic rock fragments.
A big, brownish, fine grained, iron-oxide cemented sandstone particle (present in sample M6/20) consists mainly of quartz (often polycrystalline), subordinate K-feldspar, chert, quartzite and oxidized mica (partly bloated due to high firing temperature) and few quartz-feldspar rock fragments. Carbonate grains are not present or totally destroyed.
The heavy mineral composition (a heavy mineral grain mount was available) is characterised by a massive dominance of dark-greenish to colourless clinopyroxenes. Besides also zircon and traces of rutile, brookite/anatase, titanite, hornblende/amphibole and garnet (partly melanite) can be observed.

Interpretation
Characteristic is the isotropic, light greenish-grey groundmass (stronger reduced atmosphere or higher firing temperature compared to PG-C3). Typical again is the presence of coarse grained, iron oxide cemented particles, polycrystalline quartz and molds of dissolved bioclasts in the groundmass (shell fragments, small foraminifera, bivalves, ostracods). The bulk composition of the temper particles is very similar to PG-C3. This fabric seems to be produced from a mixture of carbonate rich, marine shale (marl) and a more iron rich, silty shale with weathered volcanic rock fragments.
The firing temperature can be considered as very high (partial vitrification of grains).
Raw materials of this type are available in the Bay of Naples/Ischia as well as in the surroundings.

Petrographic group PG-C4 (pl.15)
Samples: M160/1, M160/2, M160/3 (BNAP-A-11)
The samples show a fine grained, iron rich, dark brownish-red stained groundmass. The oxidized, very fine grained groundmass is calcareous and optically inactive. The total temper content varies from 26% to 34% (sand/silt 31:1). The temper, mainly subangular to angular grains, is bimodally sorted. The average grain size varies from 0.21-0.22 mm. The maximum grain size observed in thin sections is 1.52 mm.
The temper particles mainly consist of volcanic rock fragments and frequent colourless to dark green clinopyroxene grains. Less frequent are feldspars (mainly sanidine and volcanic plagioclase). Subordinate to very rare can be observed: iron oxide concretions and opaque material, brown volcanic glass, mono and polycrystalline quartz and moulds of former carbonates, mica (biotite/oxidized sheet silicates), foraminifera, siliceous bioclasts (sponge spiculae), heavy minerals (amphibole, melanite, TiO_2-minerals, olivine), crystalline rock fragments (mainly quartzite) and leucite.

Interpretation
Typical are the artificially added sand temper, the abundance of volcanic rock fragments, clinopyroxene grains, sanidine and the significant presence of melanite and the very low amount of detrital quartz. All three samples are very similar. They are also comparable to analysed Pompeian red plates from Carnuntum, but our samples show a lower firing temperature.

Based on the characteristic mineralogical-petrographic composition, the utilized clay was most likely a volcanic soil or paleosol (e.g. altered tuffite), artificially tempered with volcanic sand (to avoid shrinkage). The raw materials fit very well to raw material available in the bay of Naples and also in the surroundings of Pompei. Unfortunately, no detailed mineralogical-petrographic descriptions of available raw materials in this Region are published to date.

Petrographic group PG-C5 (pl.16)

Samples: M39/1, M39/4 (SURR-A-1)

The samples show a fine grained, dark, iron rich, brownish-red stained groundmass. The micromass is non calcareous and optically inactive. The temper content of the analyzed amphora fragments is about 30% (sand/silt: 22:8). The temper, mainly subangular to angular grains is bimodal to very poorly sorted. The average grain size varies from 0.15-0.17 mm. The samples are artificially tempered with sand (grain size around 0.4 mm diameter). The maximum grain size observed in thin sections is 1.34 mm.

The temper particles consist mainly of monocrystalline quartz and K-feldspars (partly sanidine) and subordinate of greenish to colourless clinopyroxenes, muscovite, volcanic plagioclase and partially weathered volcanic rock particles (partly leucite bearing grains). Rare to very rare biotite/oxidized sheet silicates, polycrystalline quartz, chert, molds of former carbonate grains, traces of foraminifera, siliceous bioclasts (siliceous sponge spiculae), sandstone/siltstone/claystone clasts (melanite, olivine, amphibole) can be observed. Due to higher degree of firing the sample M39/04 is not well preserved, therefore the analysis was difficult and is probably not very accurate

The heavy mineral composition (heavy mineral mount) is dominated by green clinopyroxenes and traces of garnet and amphibole.

Interpretation

Fabric PG-C5 was produced from an artificially tempered, weakly calcareous, iron rich, silty clay or loam.

Typical seems to be the presence of siliceous sponge spiculae in the groundmass and a temper rich in clinopyroxenes and partially altered volcanic rock fragments.

The mineralogical composition of the volcanic temper fits to volcanic sand available regionally, in the region and surroundings of Naples.

Similar clay compositions are also known from the region of Sorrento (comparable clays were collected by us 1995 in the surroundings of Sorrento, see also Peña – McCallum 2009).

The samples probably could also be compared with the published fabric group S0-1, but the characteristic sponge spiculae present in our sample are not mentioned there.

Petrographic group PG-C6 (pl.17)

Samples: M10/28 (CAMP-A-4), M10/41 (CAMP-A-3), M10/44 (CAMP-A-1)

The groundmass is stained light brownish.

The fine grained groundmass is non calcareous and optically inactive. The average temper content of the analyzed amphora fragments is 30%, varies from 20-38%. (sand/silt: 22:8). The temper, mainly subrounded to angular grains, is very poor sorted. The grain size varies from 0.13-0.14 mm. The maximum grain size observed in thin sections is 1.43 mm.

The temper particles consist mainly of monocrystalline quartz, former carbonate grains and K-feldspars. Frequent to subordinate are polycrystalline quartz, greenish to colourless clinopyroxenes, iron oxide particles, muscovite, foraminifera (originally partly filled with pyrite) and chert. Rare to very rare biotite/oxidized sheet silicates, plagioclase, bioclasts

(partly echinid spines), siliceous sponge spiculae, volcanic rock particles, volcanic glass, crystalline rock fragments, sandstone/siltstone fragments, melanite, colourless garnet, amphibole and rutile can be observed.
The feldspars are partially sericitised. The pores are partially rimmed by silica cement?

Interpretation
The utilised raw materials were marine, calcareous clays, artificially tempered with fine sand. Characteristic volcanic rock fragments are very rare. Typical seems to be a significant content in melanite grains (esp. in M10/44).
Typical is the lower firing temperature compared to PGC6h.
The raw materials are likely from the surroundings of the bay of Naples. To enable a better petrographic provenance interpretation of the regional fabrics and to provide a data base, the various regional clays and sands should be first documented and carefully analyzed (petrographically and chemically).

Petrographic group PG-C6h (pl.18)
Sample: M10/33 (CAMP-A-2)
The groundmass is stained brownish. The temper content of the analyzed amphora fragment is about 27% (sand/silt: 20:7). The very fine grained groundmass is non calcareous, optically inactive, but partly recrystallized. The temper, mainly subrounded to subangular grains, is poor sorted. The grain size is 0.14 mm. The maximum grain size of particles observed in thin sections is 1.21 mm.
The temper particles consist mainly of former carbonate grains and quartz. Frequent to subordinate are feldspars, polycrystalline quartz, altered volcanic rock fragments and carbonate bioclasts. Rare to very rare chert, plagioclase, crystalline rock fragments, greenish to colourless clinopyroxenes, biotite/oxidized sheet silicates, foraminifera, altered brown volcanic glass and heavy minerals (amphibole, melanite) can be observed

Interpretation
Typical are the higher firing temperature compared to PG-C6h and the high content of dissolved carbonate particles and bioclasts (shell fragments, ostracods, foraminifera). The provenance is probably as PG-C6.

Petrographic group PG-C7 (pl.19)
Sample: M10/35 (CAMP-A-5)
The groundmass is optically inactive and calcareous. The temper content of the analyzed amphora fragment is about 21% (sand/silt: 9:12), shows moderately rounded angular grains and poor sorting. The mean grain size is around 0.1 mm. The maximum grain size observed in thin sections is 0.38 mm.
The temper particles consist mainly of monocrystalline quartz. Less frequent iron oxide cemented particles and dissolved carbonate grains are visible. Frequent to subordinate potassium feldspars (partly sanidine) and muscovite occur. Less frequent to rare are polycrystalline quartz, crystalline rock fragments (partly quartzite), chert (partly radiolarite), brownish, altered volcanic glass fragments and plagioclase. Very rare are greenish to colourless clinopyroxenes, biotite/oxidized sheet silicates, sandstone/siltstone fragments, garnet (partly melanite), brownish amphibole and quartz-feldspar fragments.

Interpretation
Typical for PG-C7 are frequent, brownish, iron-oxide and iron-oxide rich, silty claystone particles, the appearance of biogenic chert grains (partly radiolarite), granitic rock particles and globiginerid foraminifera in the groundmass, the presence of strongly altered, brownish volcanic glass particles and the absence of further volcanic rock particles.
Different to PG-C3 is the absence of coarse sized iron oxide particles!
Raw materials of this type should be available in the surroundings of the bay of Naples.

Petrographic group PG-C7a (pl.20)
Samples: M10/38, M10/40 (CAMP-A-5)
The groundmass is stained brownish red to reddish brown-red with small dark inclusions. The micaceous groundmass is non calcareous and optically active to inactive. The temper content of the analyzed amphora fragments is about 23%, (sand/silt: 15:8). The temper, mainly angular grains, is very poor sorted. The grain size varies from 0.09-0.12 mm. The maximum grain size of particles observed in thin sections is up to 0.96 mm.
The temper particles consist mainly of monocrystalline quartz and decomposed carbonate grains. Less frequent to subordinate are iron oxide particles, muscovite, K-feldspars, plagioclase, polycrystalline quartz, chert, still preserved carbonate grains (occ. well rounded!) and altered volcanic rock fragments. Rare to very rare biotite/oxidized sheet silicates, well preserved foraminifera, carbonate bioclasts, greenish to colourless clinopyroxenes, other heavy minerals (e.g. melanite), crystalline rock fragments (mainly granitic, quartzite), siliceous sponge spicule and brownish, strongly altered volcanic glass particles can be observed.
The fine carbonate grains partly show a rhombohedral shape (former dolomite crystals).

Interpretation
Mixture of a paleosol and a marine calcareous shale or clay. Typical for PG-C7a is the low content in volcanic rock particles and overall a lower firing temperature. Raw materials of this type (including dolomite bearing carbonates) are available in the larger surroundings of the bay of Naples.

Applied Methods

Thin section analyses
From all amphorae samples petrographic thin sections have been prepared. Thin-section analyses were used to characterise the various fabrics by their typical texture (optical properties of matrix, amount of temper, grain size, sorting, pore types, etc.) and also to obtain some provenance information by analysing the mineralogical-petrographic composition of their inclusions (temper). So far available, thin section samples of our own raw material data base have been used for comparison.
Generally the grain size fraction of >15 µm has been used for the overall estimation of petrographic particle composition (description of method see below) for all samples. In samples with no obvious intentional sand temper (e.g. no visible bimodal grain size distribution, natural raw materials) all particles >15µ have been counted as natural temper. In cases of clear artificial temper of (coarse grained sand bimodal grain size distribution), the differences in composition between intentionally added sand (e.g. coarser fraction) and the finer grained original clay paste are mentioned in text (highlighted).

First by means of point counting analysis the proportion of matrix to temper was estimated (= volume percent). Two temper grain fractions (> 0.063 mm = sand fraction) and silt fraction (0.063 -0.015 µm) have been distinguished, derived by point counting of 400-500 points. Visible porosity (relationship of coarse and fine pores) has been described qualitatively in text. Quantitative estimation of porosity in conventional (not impregnated with stained epoxy resin) thin sections is difficult and also inaccurate (large pores are often artificial; e.g. dissolved carbonate grains due to high firing temperatures or caused by preparation issues). Furthermore sample size is often too small for statistical counting of large pores. Very fine porosity is not visible in conventional thin section. Due to these problems other analytical methods would be needed.
Grain size was estimated by measuring of 50 temper grains (largest diameter). Sorting and roundness was estimated by standard comparison charts
Grains > ≈15µ were considered as "temper".

For a standardized characterization of the "temper" particles and to enable graphical presentation of the results, the following method, developed for semi quantitative estimation of the proportions of different temper grains, occurring in the ceramic thin-sections, was used:

The relative grain proportions were classified as follows:
a) occurrence within one (representative) field of view

"dominant"	(more than 20 grains):	A (80)
"very frequent"	(10-19 grains):	B (50)
"frequent"	(5-9 grains):	C (30)
"subordinate"	(2-4 grains):	D (15)

b) occurrence within five fields of view

"moderate"	(5-9 grains):	E (10)
"rare"	(2-4 grains):	F (5)

c) The very rare constituents were classified as follows

"very rare"	(more than one occurrence per thin section):	G (3)
"traces"	(one occurrence):	H (1)

All samples were analyzed with the same magnification (160x).
To enable the graphical presentation, the estimated verbal frequencies were then replaced by the numbers (given in parentheses).
Graphical comparisons with results derived by conventional particle counting (e.g. 300 temper grains per thin-section) showed a very good practical comparability within the main constituents.
But the new applied method is significantly faster. Furthermore it showed also better results for the minor, often more significant constituents, due to the fact that one is forced to screen the entire thin-section.

(R.S.)

Catalogue

Cat. 1. (pl.1). Western Greek amphora, Sourisseau 2. BNAP-A-1, M137/1. Naples, Piazza Nicola Amore, US2476. Gassner and Scoppetta 2014, cat. 5, pl. 1; pl. 3a. End of the 6th – early 5th c. B.C.

Cat. 2. (pl.1). Western Greek amphora, Sourisseau 4. BNAP-A-1, M136/12. Naples, Piazza Nicola Amore, US1826. Gassner and Scoppetta 2014, cat. 15, pl. 2; pl. 3a. End of the 5th – beginning of the 4th c. B.C.

Cat. 3. (pl.1). Western Greek amphora, Sourisseau 4. BNAP-A-2, M137/2. Piazza Nicola Amore, Naples US1826. Gassner and Scoppetta 2014, cat. 16, pl. 2, pl. 3b. End of the 5th – beginning of the 4th c. B.C.

Cat. 4. (pl.1). Western Greek amphora, Sourisseau 4. BNAP-A-2, M137/5. Naples, Piazza Nicola Amore, US1826. Gassner and Scoppetta 2014, cat. 17, pl. 2; pl. 3b. End of the 5th – beginning of the 4th c. B.C.

Cat. 5. (pl.1). Western Greek amphora, Sourisseau 4. BNAP-A-3, M137/3. Naples, Piazza Nicola Amore, US1826. Gassner and Scoppetta 2014, cat. 14, pl. 2; pl. 3c. End of the 5th – beginning of the 4th c. B.C.

Cat. 6. (pl.1). Greco-Italic amphora, Gassner rim type 11. BNAP-A-6, M 10/31. Velia, Lower Town, Fortification, wall B, Inv. 523/98-68. First quarter of the 2nd c. B.C.

Cat. 7. (pl.1). Greco-Italic amphora, Gassner rim type 10. BNAP-A-6, M10/45. Velia, Lower Town, Fortification, wall B, Inv. 209/99-385. Second third of the 3rd c. B.C.

Cat. 8. (pl.1). Greco-Italic amphora type, Gassner rim type 12. BNAP-A-7, M10/42. Velia, Lower Town, Fortification, wall B, Inv. 209/99-646. Second third of the 3rd c. B.C.

Cat. 9. (pl.1). Greco-Italic amphora, Gassner rim type 12. BNAP-A-7, M10/46. Velia, Lower Town, Fortification, wall B, Inv. 209/99-381. Second third of the 3rd c. B.C.

Cat. 10. (pl.1). Western Greek amphora, Sourisseau 3. BNAP-A-8, M10/8. Velia, Insula II, Inv.202/91-41. Liko 2001a; Liko 2001b. 5th c. BC.

Cat. 11. (pl.2). Greco-Italic amphora, Gassner rim type 10. BNAP-A-8, M 10/34. Velia, Lower Town, Fortification, wall B, Inv.525/4/98-124. First quarter of the 2nd c. B.C.

Cat. 12. (pl.2). Western Greek amphora, Sourisseau 2-3. BNAP-A-9, M6/007. Velia, Insula II, Inv. 11/88-22. Second half of the 5th c. BC.

Cat. 13. (pl.2). Western Greek amphora, Sourisseau 2-3. BNAP-A-9, M6/120. Velia, crossroad in front of Insula II, Inv. 19/90-53. Second half of the 5th c. BC.

Cat. 14. (pl.2). Greco-Italic amphora, Gassner rim type 10. BNAP-A-10, M10/27. Velia, Lower Town, Fortification, wall B, Inv. 605/98-4. Last third of the 3rd c. B.C.

Cat. 15. Amphorae type Dressel 2-4. BNAP-A-11, M 160/1. Rome, scavo del Palatino nord-orientale, PNE OSII 20137. 1st c. AD.

Cat. 16. Amphorae type Dressel 2-4. BNAP-A-11, M 160/2. Rome, scavo del Palatino nord-orientale, PNE OSII 2674. 1st c. AD.

Cat. 17. Amphorae type Dressel 2-4. BNAP-A-11, M 160/3. Rome, scavo del Palatino nord-orientale, PNE OSII 2674. 1st c. AD.

Cat. 18. Amphorae type Dressel 2-4. SURR-A-1, M39/1. Sorrento, Villa Fiorentino, 1994, US 1 (kiln site). 1st c. AD.

Cat. 19. Amphorae type Dressel 2-4. SURR-A-1, M39/3. Sorrento, Villa Fazzoletti, 1994, US 2. 1st c. AD.

Cat. 20. (pl.2). Greco-Italic amphora, Gassner rim type 12. CAMP-A-1, M10/44. Velia, Lower Town, Fortification, wall B, Inv. 209/99-379. Second third of the 3rd c. B.C.

Cat. 21. (pl.2). Greco-Italic amphora, Gassner rim type 12. CAMP-A-2, M10/33. Velia, Lower Town, Fortification, wall B, Inv. 525/98-122. First quarter of the 2nd c. B.C.

Cat. 22. (pl.3). Greco-Italic amphora, Gassner rim type 12. CAMP-A-3, M10/41. Velia, Lower Town, Fortification, wall B, Inv. 209/99-637. Second third of the 3rd c. B.C.
Cat. 23. (pl.3). Greco-Italic amphora, Gassner rim type 12. CAMP-A-4, M 10/28. Velia, Lower Town, Fortification, wall B, Inv. 512-3/98-63. First quarter of the 2nd c. B.C.
Cat. 24. (pl.3). Greco-Italic amphorae, Gassner rim type 12. CAMP-A-5, M 10/35. Velia, Lower Town, Fortification, wall B, Inv.533/2/98-63. 3rd c. BC.
Cat. 25. (pl.3). Greco-Italic amphorae, Gassner rim type 10. CAMP-A-5, M 10/38. Velia, Lower Town, Fortification, wall B, Inv.517/97-38. Beginning of the 3rd c. BC.
Cat. 26. (pl.3). Greco-Italic Amphorae handle with stamp of Γ]ΑΙΟC/]ΡΙCΤΩΝ. CAMP-A-5, M10/40. Velia, Lower Town, Fortification, wall B, Inv. 703/97-139.

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Plates 7-20

Description info:
First line codes in order: petrographic group; fabric; sample number
Second line: image short description

		matrix properties												texture and grain size								composition of temper grains																															
Petrographic group	sample number	very fine grained	coarse granular or micaceous	non calcareous	calcareous	optically active	optically inactive	optically inactive,partly recrystallised	isotropic, Fe-oxid rich clay	reducing firing conditions	oxidizing firing conditions	high firing temperature	low firing tempearture	total temper content (%)	Matrix <15 µm (Vol %)	temper >0,0625 mm (Vol%)	temper <0,0625 mm (Vol%)	av. grain size (mm)	max. grain size (mm)	sorting	roundness	monocrystalline quartz	polycrystalline quartz	chert	K-feldspar	K-feldspar sericitised	sanidine	plagioclase	volcanic plagioclase	muscovite	biotite/oxidised sheet silicates	carbonate grains	molds of former carbonates	foraminifera	carbonate bioclasts	siliceous bioclasts	siltstone/sandstone fragments	shale fragments	clay nodules (not resolved clay paste)	crystalline rock fragments, not sp.	quartzite	volcanic rock fragments	volcanic tuff	volcanic glass brown	volcanic glass (colourless)	heavy minerals	clinopyroxene	melanite	amphibole	olivine	iron oxide concretions+opaque matte	overfired, vitrified grains, slag particle	leucite
PG-C1	M10/29	x	x		x		x				x			30,1	70	18,3	12	0,120	1,100	5	3-5	b	g	g	d		f	c	g	b	f	0	a	g	h		g			g		c		e		g	b	g			c		
PG-C1	M10/42		x		x		x				x			28,3	72	13,5	15	0,075	0,590	4	4	a	h	g	c		d	d	d	c	g	0	c	g		g						b		f		g	d	h		g	c		
PG-C1	M10/45		x		x		x				x			23,3	77	8,3	15	0,103	0,740	5	4	a			c		d	d	d	b	f	0	a	h	g	g						b		d		f	d				c		
PG-C1	M10/46		x		x		x				x			27,1	73	12,8	14	0,077	1,380	4	4	b	g	g	c		d	d	d	c	g	0	b		g	g						c		c		f	d	h			c		
PG-C1n	M10/31		x		x	x					x		x	28,5	71	14,4	14	0,140	0,650	5	4-5	b	g		c		d	g	d	b	g	b	c	f	f	g	g					c		d		g	d				e		
PG-C1a	M137/01	x-	x		x		x				x	x		26,3	74	17,3	9	0,089	1,250	6	4	a		g	e		d			d	d		b	h	f	h						c					d			h	d		
PG-C2	M10/8	x			x		x				x			24,8	75	22,8	2	0,230	0,580	6	3-4	d	h	g	e		g	h	g	g	g	h	c							h		f				g	b	g	g		c		
PG-C2a	M10/34	x			x		x			x	x			24,8	75	22,8	2	0,230	0,740	6	3-4	d	h	g	f		f	g	f	g	g	d	d		g	h				h		f		g		g	b	g	g		c		
PG-C3	M10/27	x			x		x				x			23,2	77	17,1	6	0,150	2,100	5	4	a	e	f	d		d	f	g	d	g	0	a	g			g			g	h	f					d	h			d		
PG-C3h	M6/007	x			x		x			x	x	x		18,1	82	10,1	8	0,0981	1,138	5	4	a	g	g	d	h	g	g	g	d	g		c	g	h	h	g			g		f				g	g					g	
PG-C3h	M6/120	x			x		x			x	x	x		23,6	76	17,1	6	0,12	3,800	5	4	b	e	g	c		g	g	h	f	g		d	g	g		g				g	g				g	g					g	
PG-C4	M160/1	x			x		x				x			25,8	74	25,6	0	0,209	1,004	6	3-4	g	h		g		c		f		g		e	h		h			f	h		b		g			c	g	g	g	f		
PG-C4	M160/2	x			x		x				x			33,1	67	31,2	2	0.24	1,520	6	3-4	g		h	g		d		e		g		d						g			b		8			b	g	h	g	g		h
PG-C4	M160/3	x			x		x				x			32,6	67	31,9	1	0,219	0,813	6	3-4	g	g	h	g		d		f		g		e						f			b		g			c	g	h	g	g		g
PG-C5	M39/01	x		x	x		x				x			25,0	75	16,9	8	0,17	1,340	5-6	4-5	b	g	h	d	g	e		d	d	f	h	d	h		f	g	g		h		e		g		g	e	h		g	d		
PG-C5	M39/04	x			x		x				x			35,7	64	26,1	10	0,15	0,700	5-6	4-5	b	g	g	d	g	e		d	e	g	h	d			h	g	h			h	f					d	h			d	g	
PG-C6	M10/28	x		x			x				x			19,7	80	13,5	6	0,130	1,230	4	3-4	b	f	d	c			f		d		0	b	d						g		g				g	d				d		
PG-C6	M10/41	x		x			x				x			37,7	62	26,8	11	0,130	0,920	5	3-4	a	d	e	c			d	g	c		0	c	f	g	g	g					f		g	g	g	d	g			c		
PG-C6	M10/44	x		x			x				x			32,6	67	27,1	6	0,140	1,430	5	3-4	b	c	f	b			e	f	d	g	0	b				g			g		f				g	c	g			c		
PG-C6h	M10/33	x		x				x			x			27,2	73	20,5	7	0,140	1,210	4	3-4	b	d	f	c			f			g	0	a	g	e					f		e		g		g	f				g		
PG-C7	M10/35	x	x		x		x				x			20,5	79	8,67	12	0,096	0,380	5	4	a	e	d	c			d		c	g	0	b				g			e	g			e		g	f	h			b		
PG-C7a	M10/38		x	x	x			x			x			22,1	78	13,6	8	0,094	0,956	5	4	a	d	e	c			f	f	c	g	g	a	g	g					g	h	d		g	g		f				c		
PG-C7a	M10/40		x	x		x					x			23,7	76	15,9	8	0,120	0,620	5	4	b	d	f	d			d	g	c	g	c	c	g	f		g			f		e		g			f	h			d		

Legend:

frequency: a: dominant, b: very frequent, c: frequent, d: subordinate, e: moderate, f: rare, g: very rare, h: traces

sorting: 1= very well, 2:=well, 3=moderate, 4= bad, 5=very bad, 6=bimodal

tr. = traces ; for further explanations see text (methodology)

Table 1: Petrographic thin section analyses.

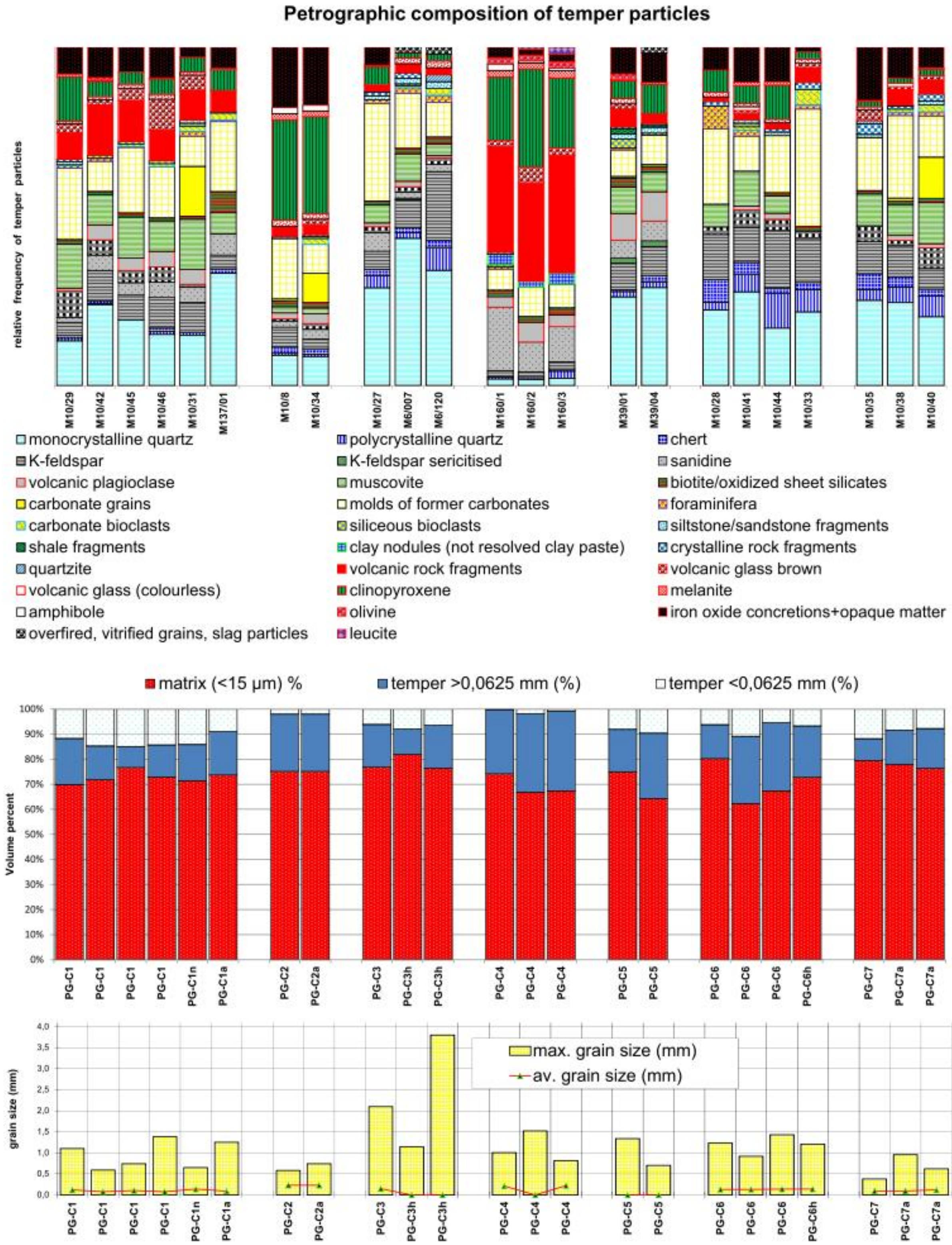
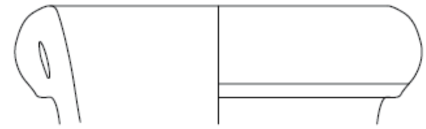
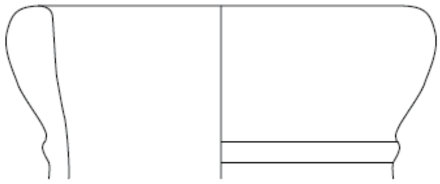


Fig. 1: Graphical presentation of thin section analyses.

Pl.1



cat. 1



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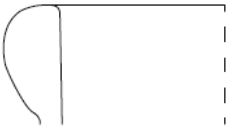
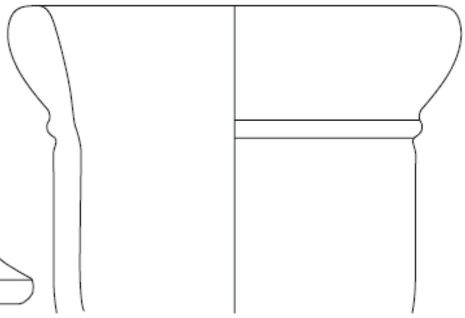


cat. 3

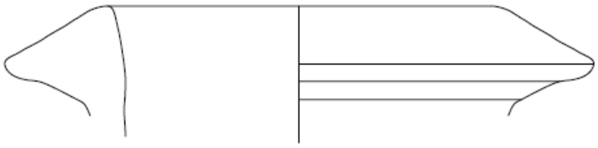
cat. 4



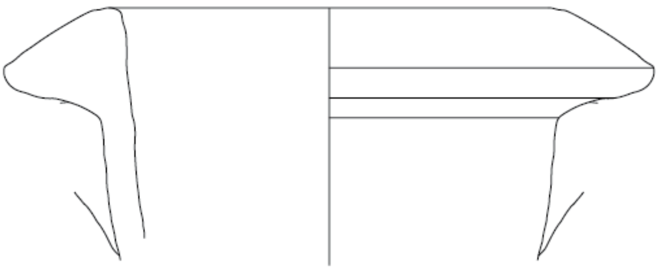
cat. 5

cat. 6

cat. 7



cat. 8



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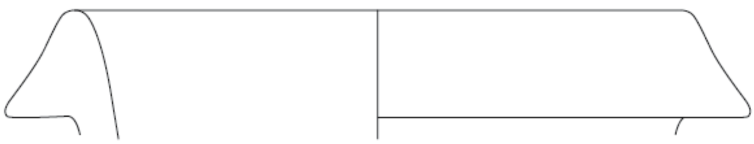
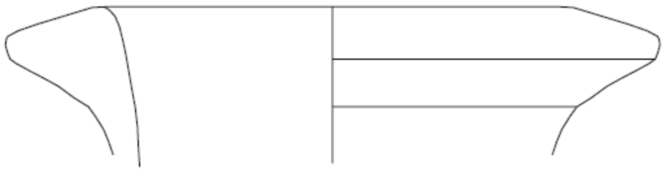


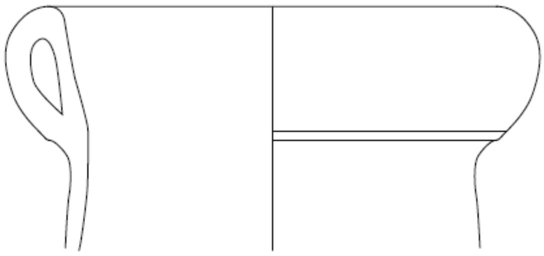
cat. 10

5 cm

Pl.2



cat. 11



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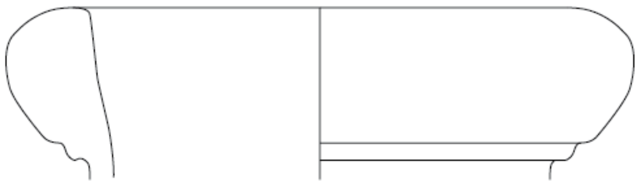
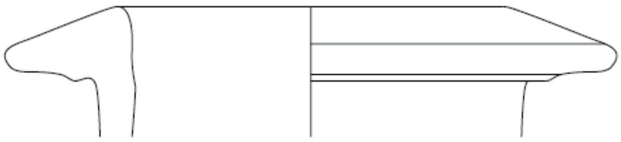


cat. 13



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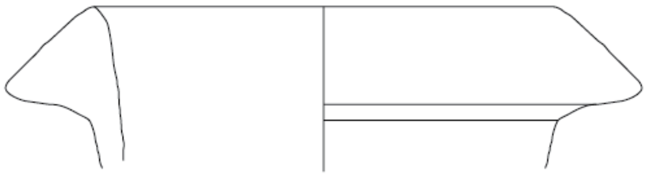

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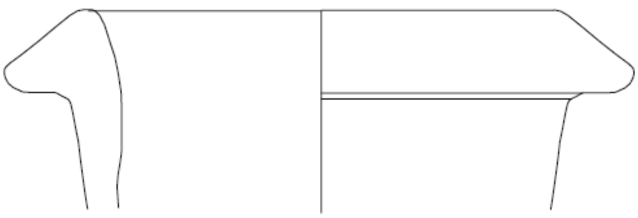

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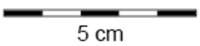
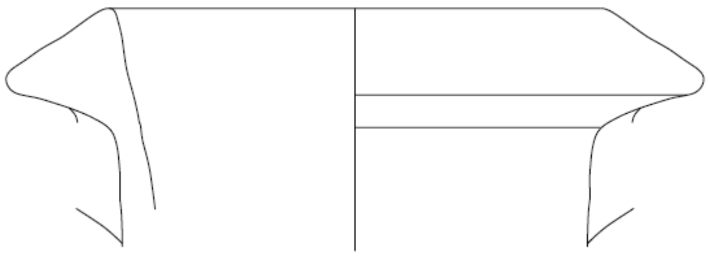
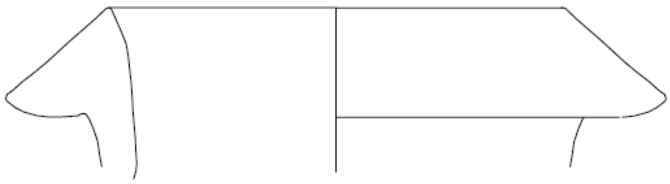


Pl.3



cat. 22



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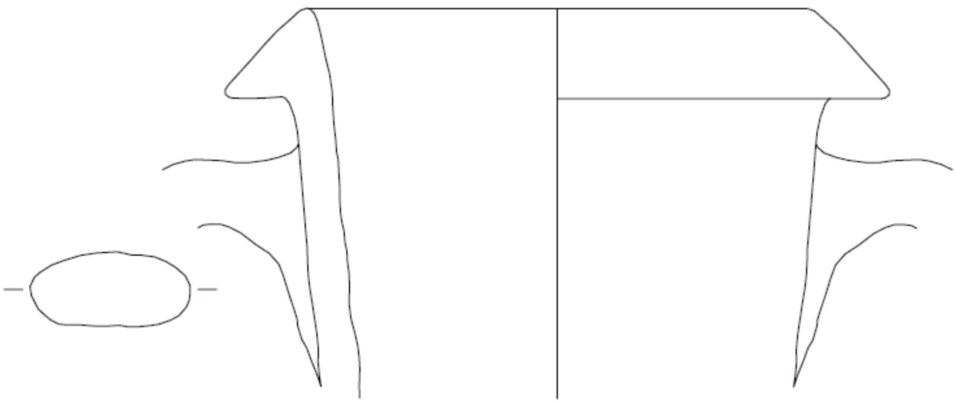

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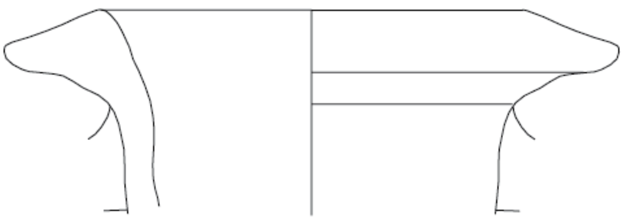

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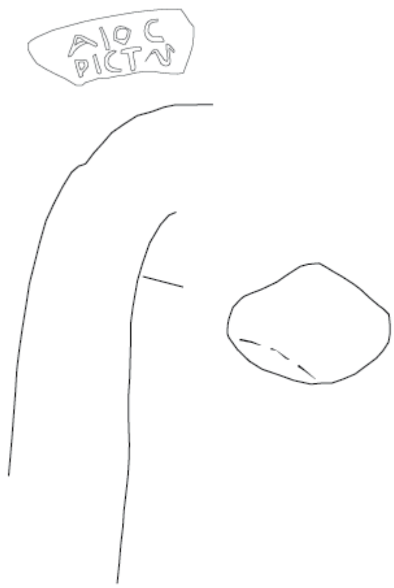


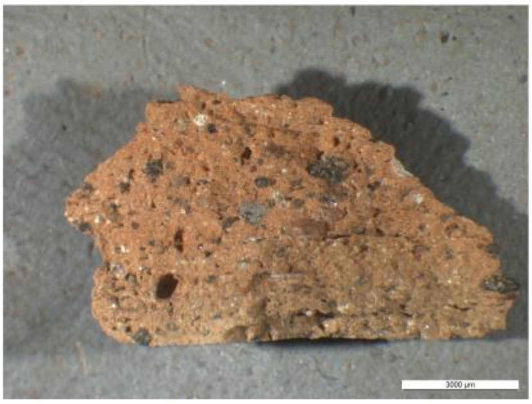
cat. 26

5 cm

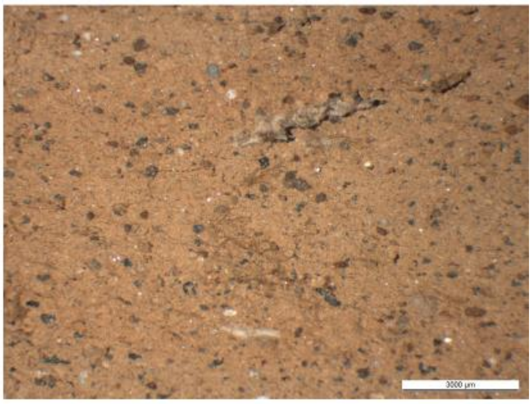
Pl.4

BNAP-A-1 (at x8 magnification)

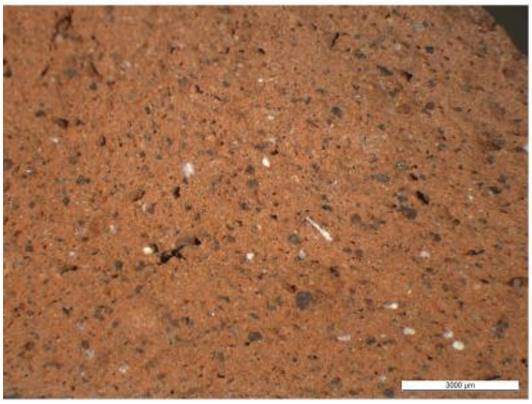
BNAP-A-2 (at x8 magnification)



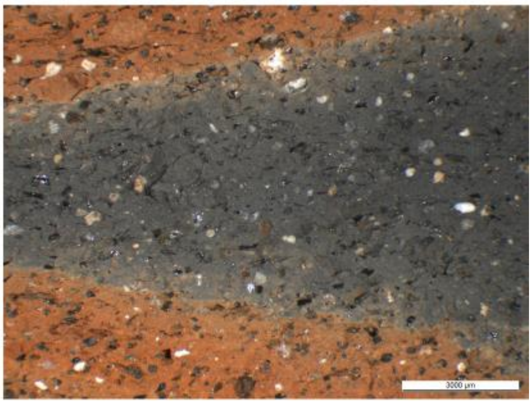
BNAP-A-3 (at x8 magnification)



BNAP-A-6 (at x8 magnification)

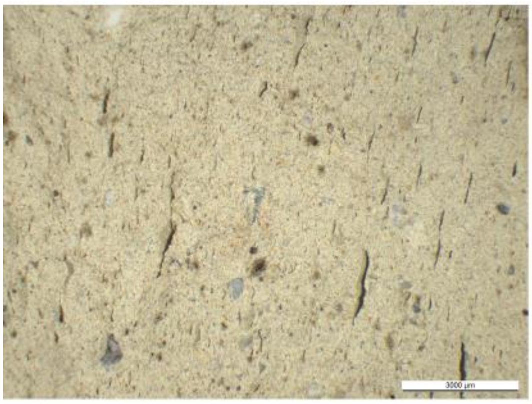


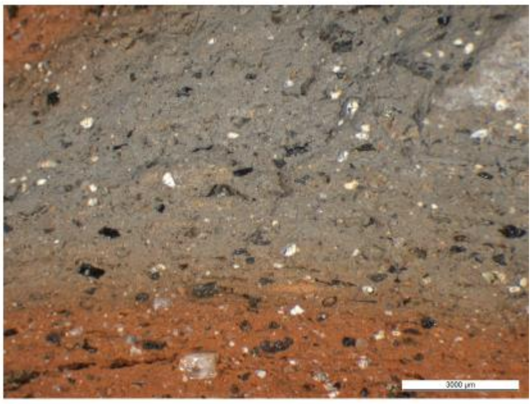
BNAP-A-7 (at x8 magnification)

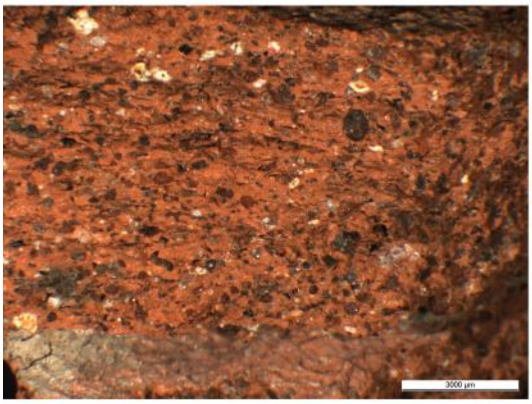


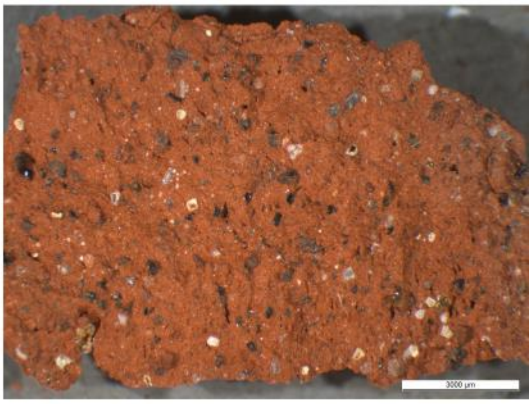
BNAP-A-8 (at x8 magnification)

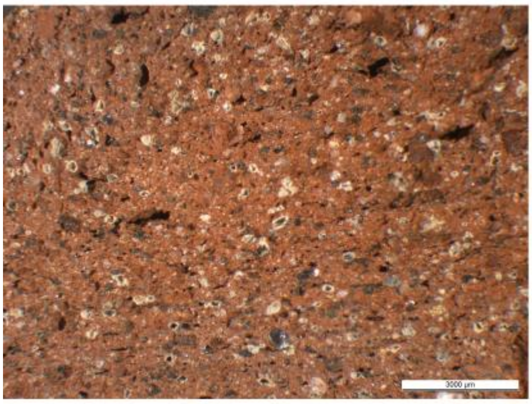
Pl.5

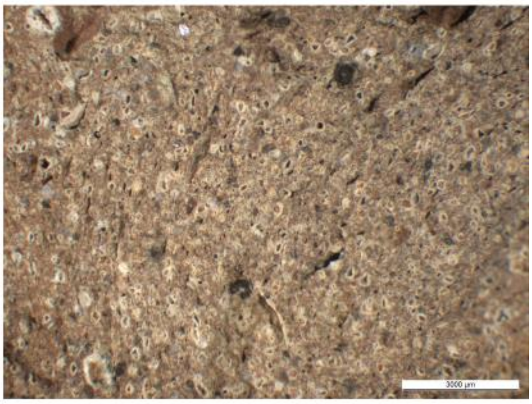

BNAP-A-9 (at x8 magnification)


BNAP-A-10 (at x8 magnification)

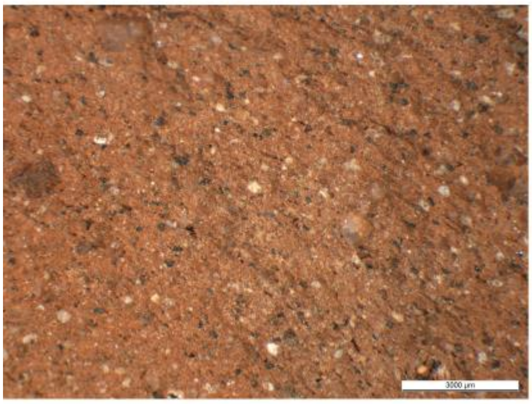

BNAP-A-11 (at x8 magnification)


SURR-A-1 (at x8 magnification)

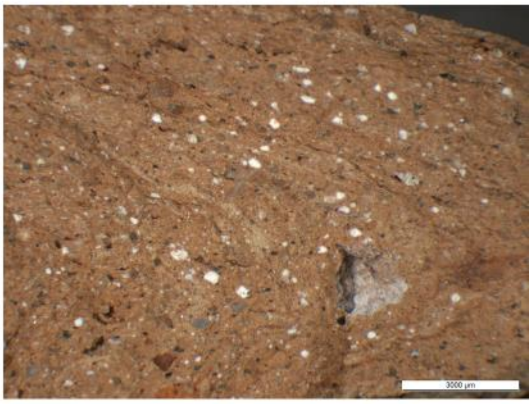

CAMP-A-1 (at x8 magnification)


CAMP-A-2 (at x8 magnification)

Pl.6



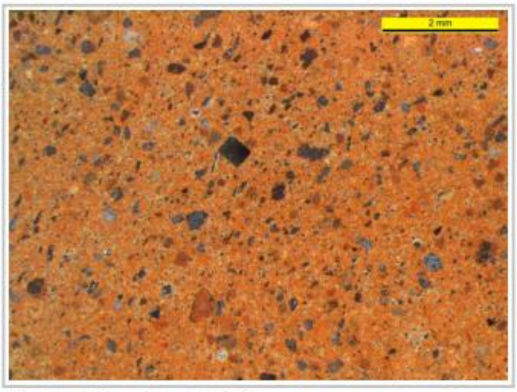
CAMP-A-3 (at x8 magnification)



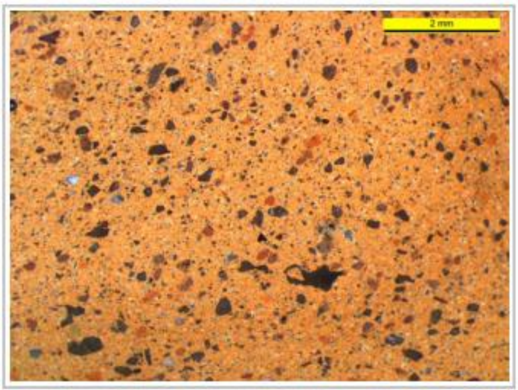
CAMP-A-4 (at x8 magnification)

CAMP-A-5 (at x8 magnification)

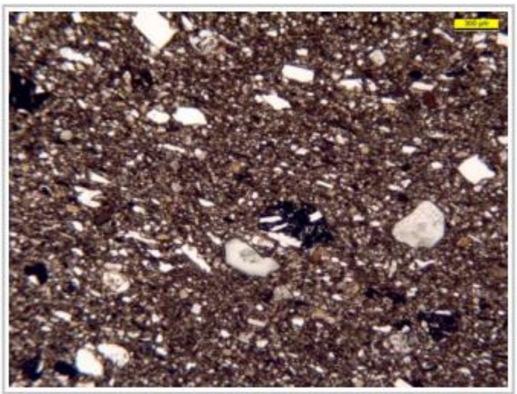
Pl.7



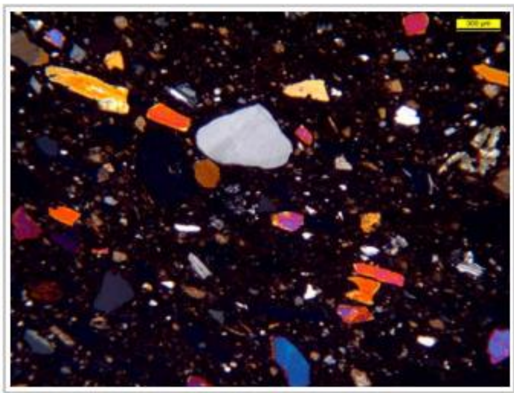
PG-C1; BNap-A-7; M10/46
thin section overview; incident light



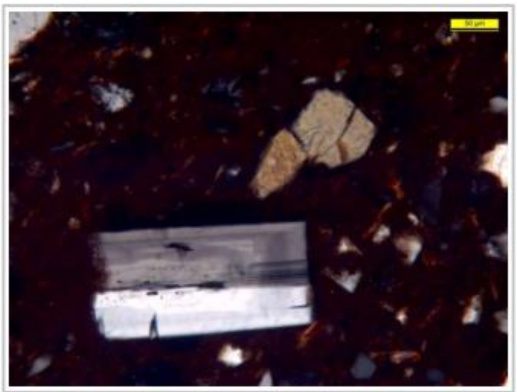
PG-C1; BNAP-A-7; M10/42
thin section overview; incident light



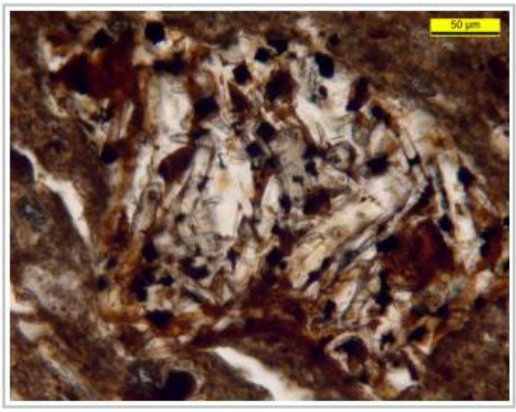
PG-C1; BNap-A-6; M10/45
Thin section overview; //pol



PG-C1; BNap-A-7; M10/29
thin section overview; #pol

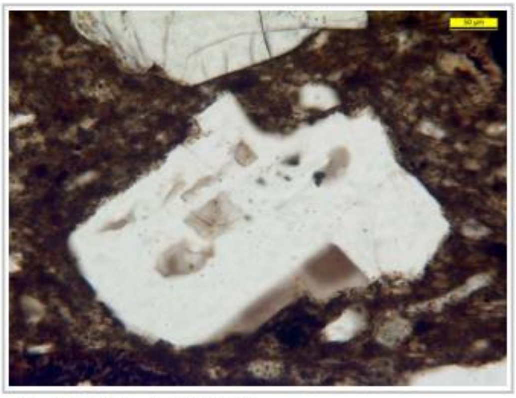


PG-C1; BNAP-A-7; M10/42
plagioclase grain; #pol

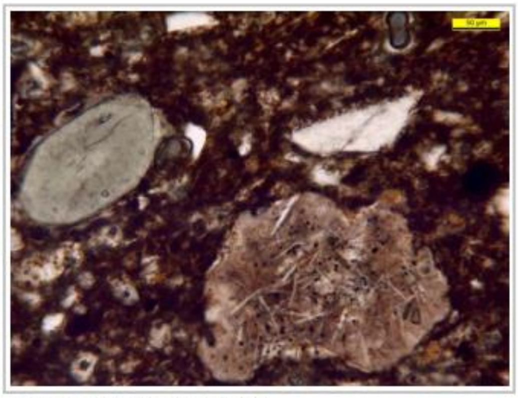


PG-C1; BNap-A-7; M10/29
volcanic rock fragment; //pol

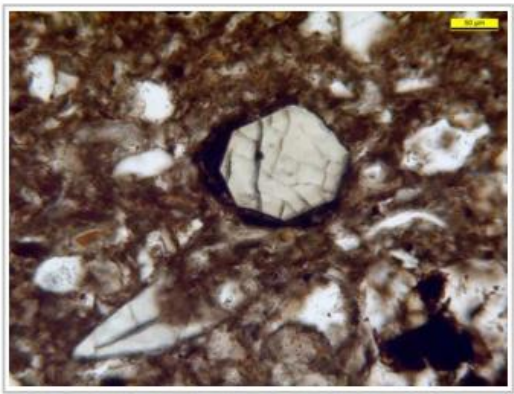
Pl.8



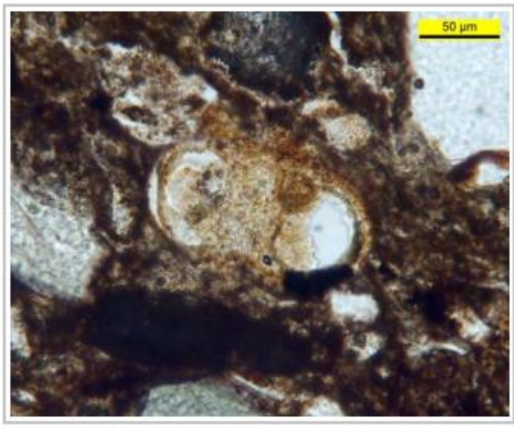
PG-C1; BNap-A-7; M10/29
feldspar with brown glass inclusions; //pol



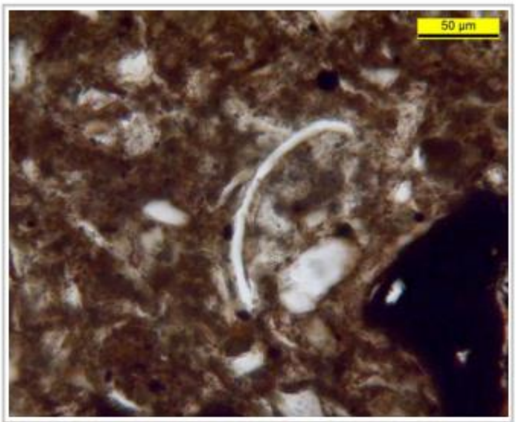
PG-C1; BNAP-A-7; M10/42
clinopyroxene, volcanic glass; //pol



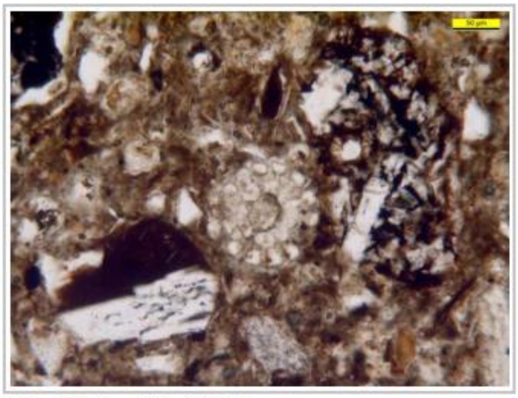
PG-C1; BNap-A-7; M10/46
clinopyroxene rimmed by brown glass; //pol



PG-C1; BNap-A-7; M10/29
dissolved foraminifer, clinopyroxene; // pol

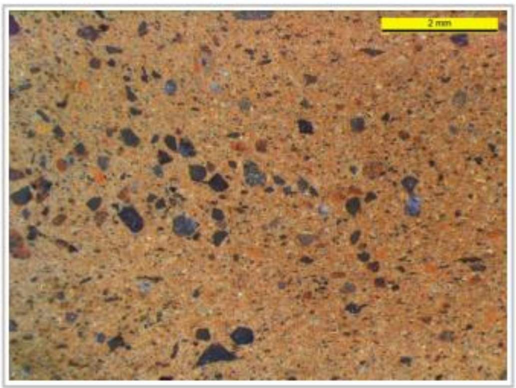


PG-C1; BNap-A-7; M10/46
mold of dissolved ostracod fragment; //pol

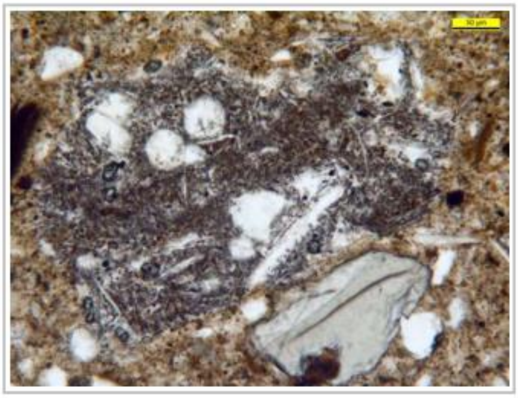


PG-C1; BNap-A-6; M10/45
volcanic rock fragment, echinid spine; //pol

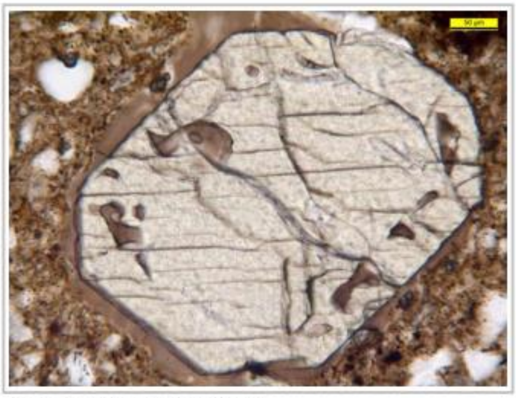
Pl.9



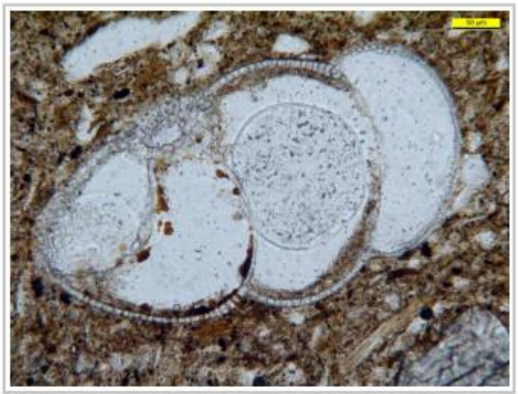
PG-C1n; BNap-A-6; M10/31
thin section overview; incident light



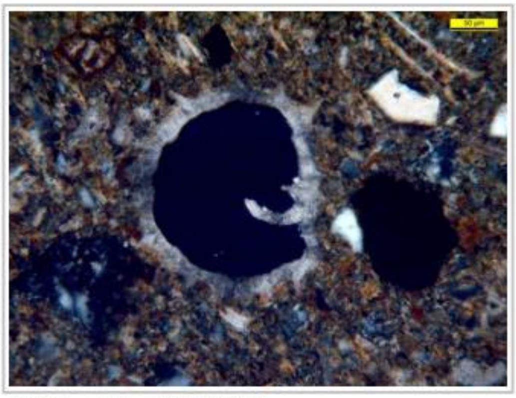
PG-C1n; BNap-A-6; M10/31
volcanic rock fragment with leucite inclusions; //pol



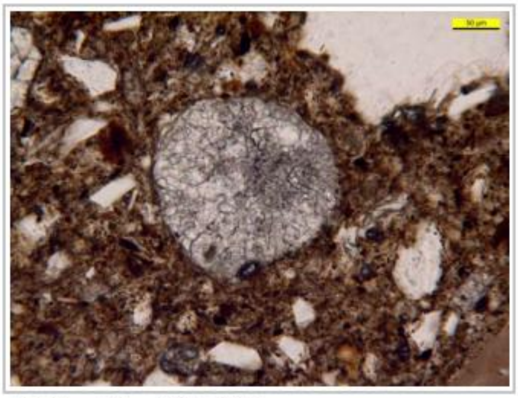
PG-C1n; BNap-A-6; M10/31
clinopyroxene rimmed by brown volcanic glass; //pol



PG-C1n; BNap-A-6; M10/31
foraminifer; //pol

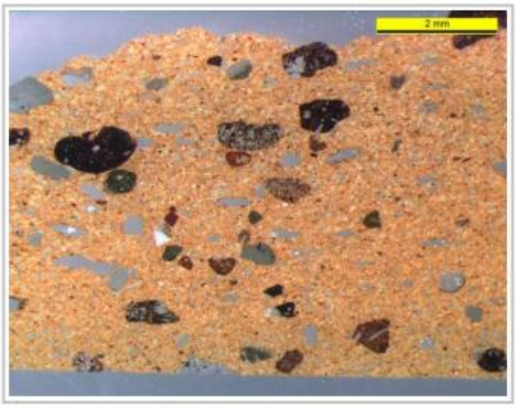


PG-C1n; BNap-A-6; M10/31
foraminifer; #pol

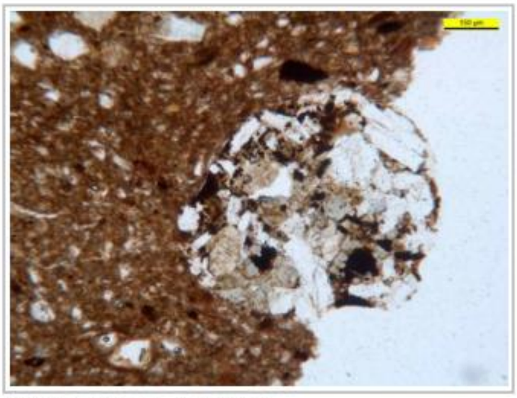


PG-C1n; BNap-A-6; M10/31
sparitic carbonate grain; //pol

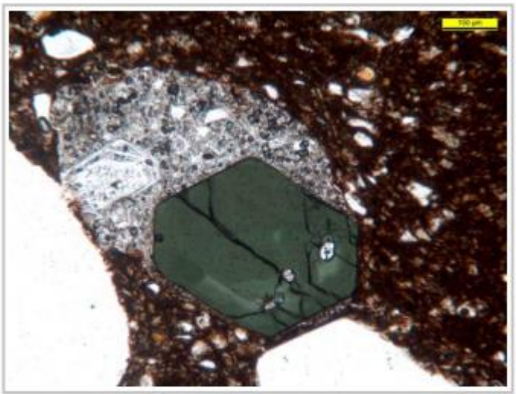
Pl.10



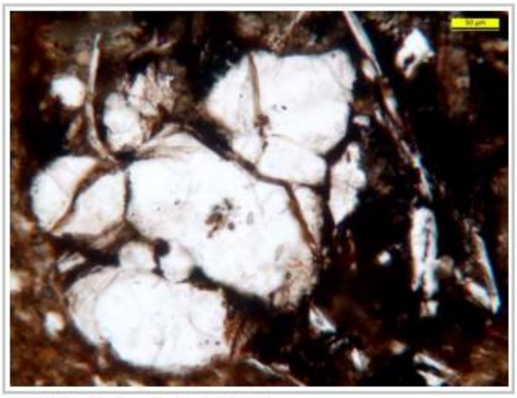
PG-C1a; BNap-A-1; M137/01
thin section overview; incident light



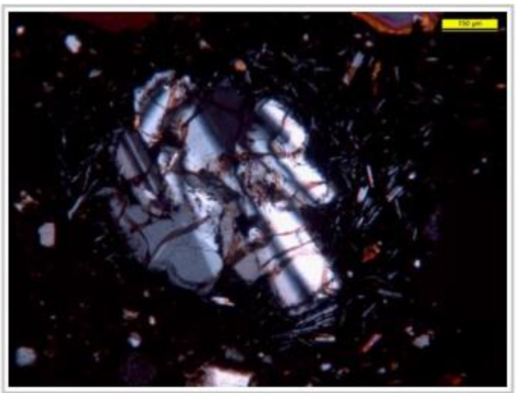
PG-C1a; BNap-A-1; M137/01
volcanic rock fragment; //pol



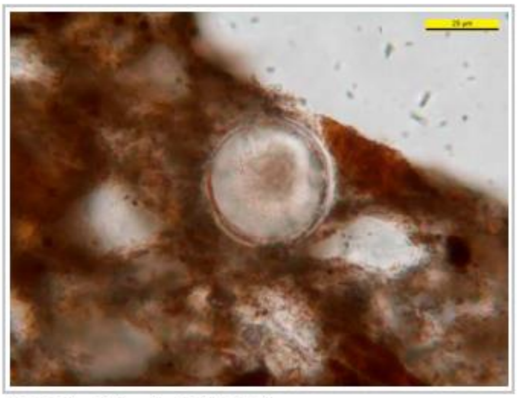
PG-C1a; BNap-A-1; M137/01
clinopyroxene in volcanic rock fragment; //pol



PG-C1a; BNap-A-1; M137/01
leucite in volcanic rock fragment; //pol

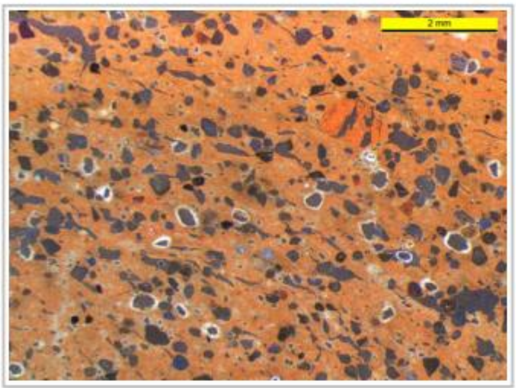


PG-C1a; BNap-A-1; M137/01
plagioclase in volcanic rock fragment; #pol

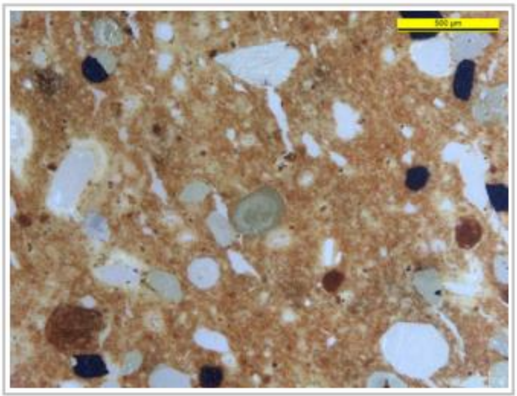


PG-C1a; BNap-A-1; M137/01
siliceous microfossil; //pol

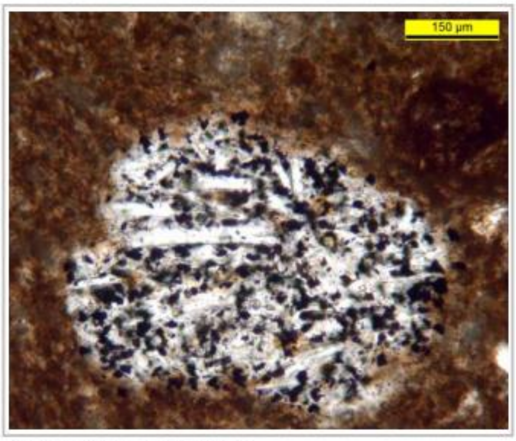
Pl.11



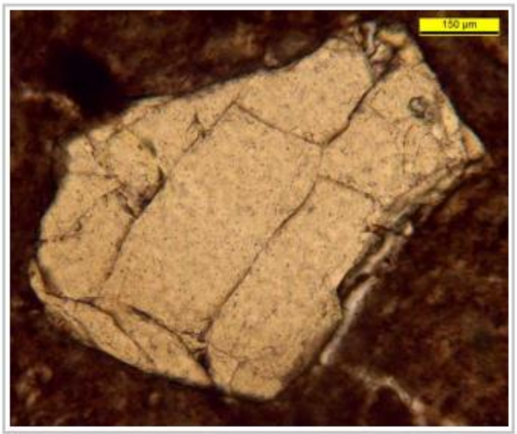
PG-C2; BNap-A-8; M10/08
thin section overview; incident light



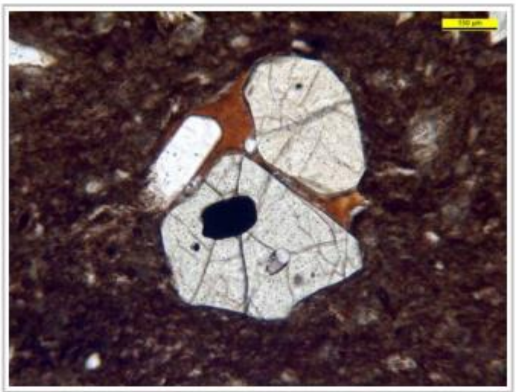
PG-C2; BNap-A-8; M10/08
thin section overview; //pol



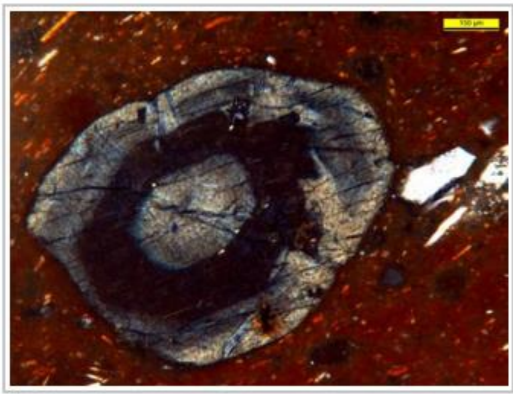
PG-C2; BNap-A-8; M10/08
volcanic rock fragment; //pol



PG-C2; BNap-A-8; M10/08
melanite grain; //pol

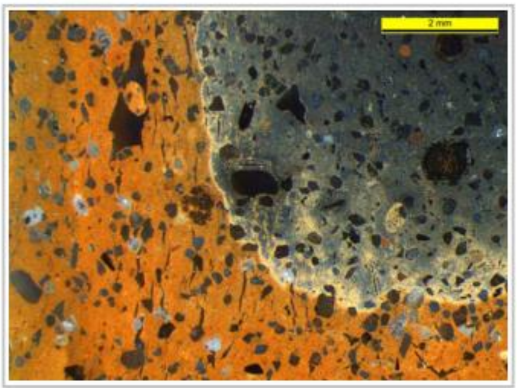


PG-C2; BNap-A-8; M10/08
clinopyroxenes with volcanic glass; //pol

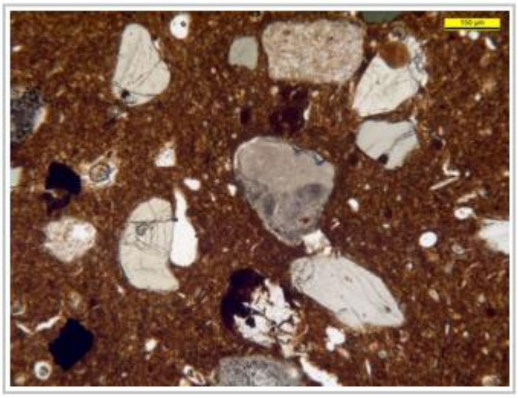


PG-C2; BNap-A-8; M10/08
zoned clinopyroxene; #pol

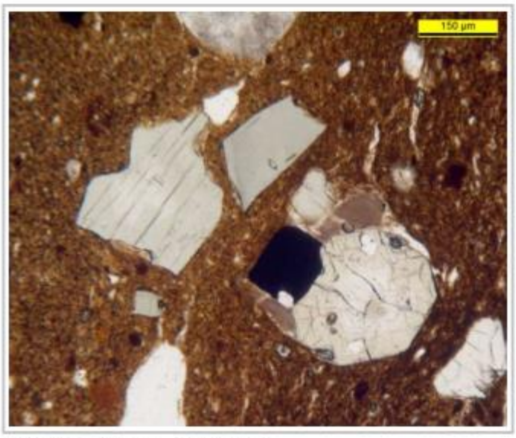
Pl.12



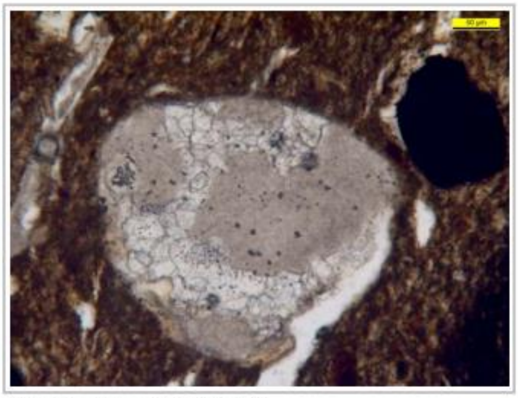
PG-C2a; BNap-A-8; M10/34
thin section overview; incident light



PG-C2a; BNap-A-8; M10/34
thin section overview; //pol

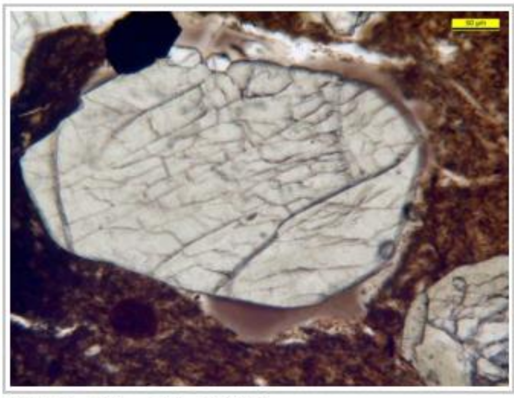


PG-C2a; BNap-A-8; M10/34
clinopyroxenes, volcanic rock fragments; //pol



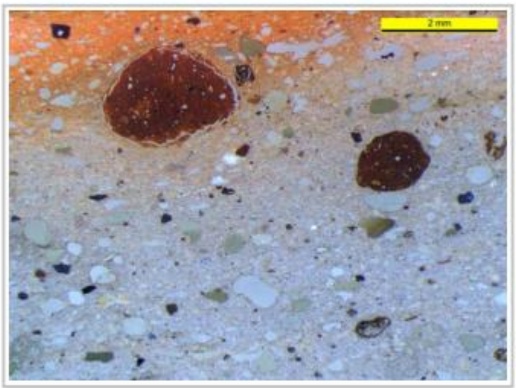
PG-C2a; BNap-A-8; M10/34
carbonate grain; //pol

PG-C2a; BNap-A-8; M10/34
biotite; #pol

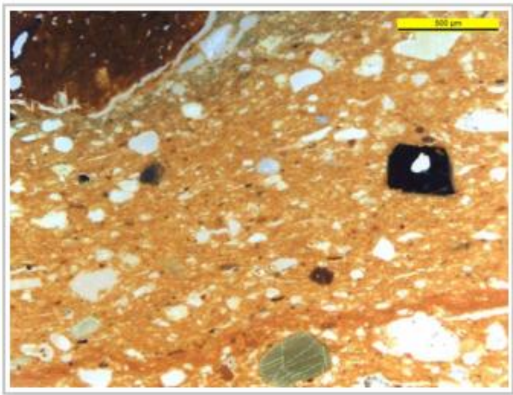


PG-C2a; BNap-A-8; M10/34
clinopyroxene rimmed by volcanic glass; //pol

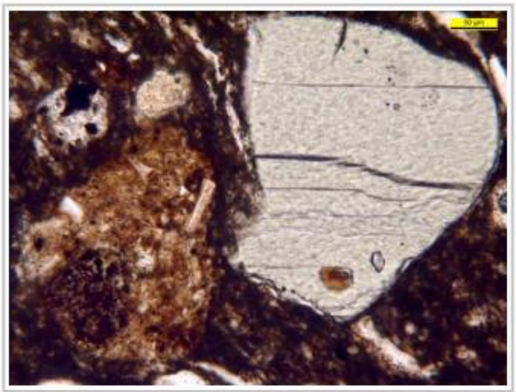
Pl.13



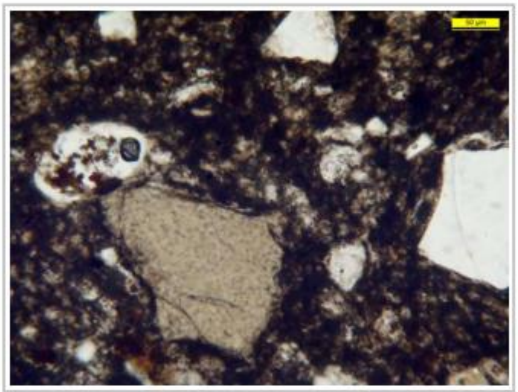
PG-C3; BNap-A-10; M10/27
thin section overview; incident light



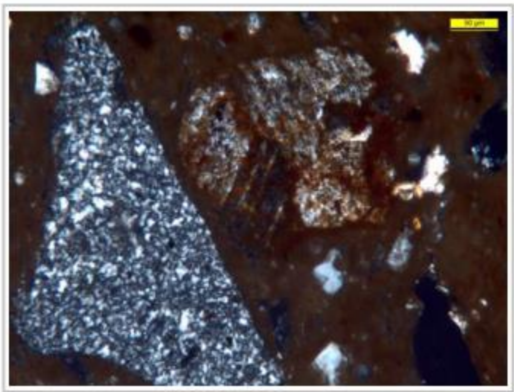
PG-C3; BNap-A-10; M10/27
thin section overview; //pol



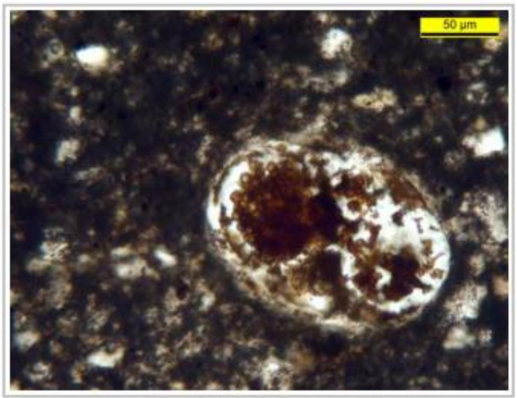
PG-C3; BNap-A-10; M10/27
altered volcanic rock fragment, clinopyroxene; //pol



PG-C3; BNap-A-10; M10/27
dissolved foraminifer, melanite; //pol

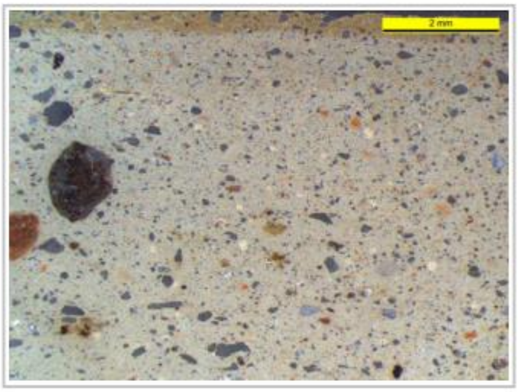


PG-C3; BNap-A-10; M10/27
chert grain; #pol

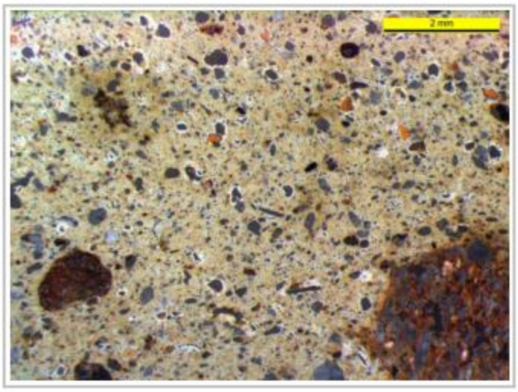


PG-C3; BNap-A-10; M10/27
dissolved foraminifer; //pol

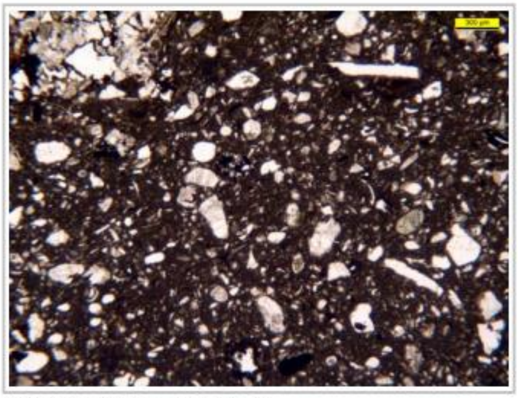
Pl.14



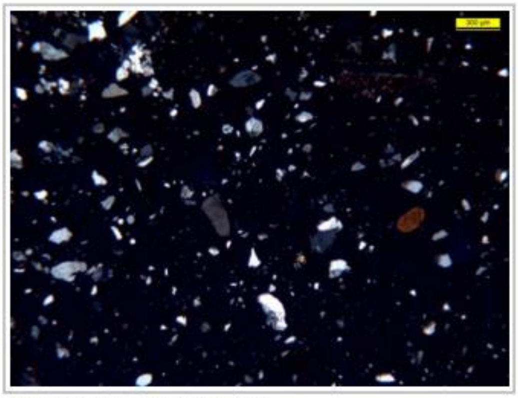
PG-C3h; BNap-A-9; M6/007
thin section overview; incident light



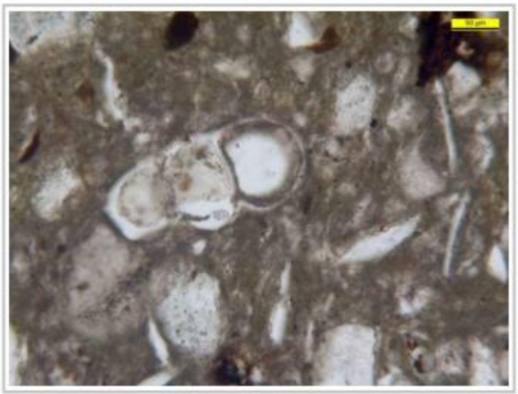
PG-C3h; BNap-A-9; M6/120
thin section overview; incident light



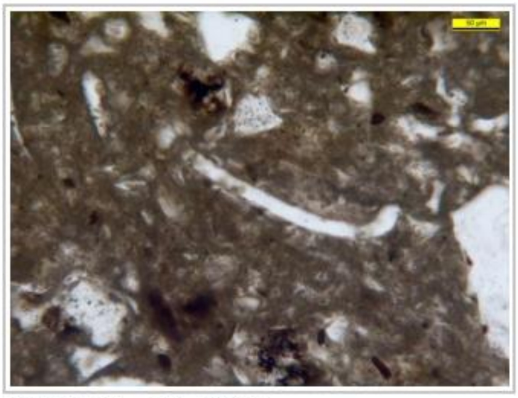
PG-C3h; BNap-A-9; M6/007
thin section overview; //pol



PG-C3h; BNap-A-9; M6/007
thin section overview; #pol

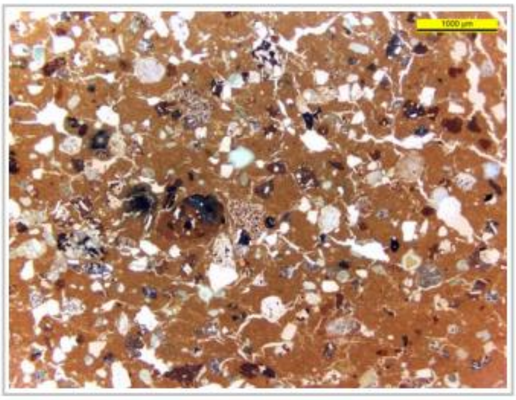


PG-C3h; BNap-A-9; M6/120
dissolved foraminifer; //pol

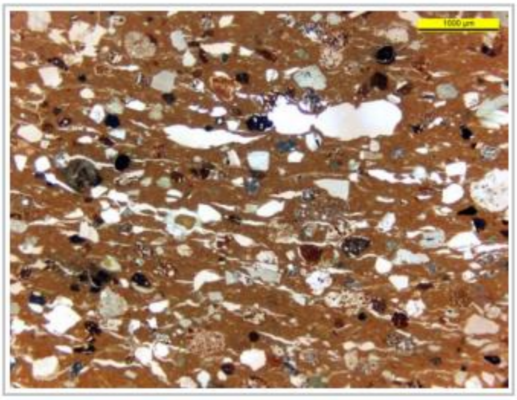


PG-C3h; BNap-A-9; M6/120
dissolved ostracod fragment; //pol

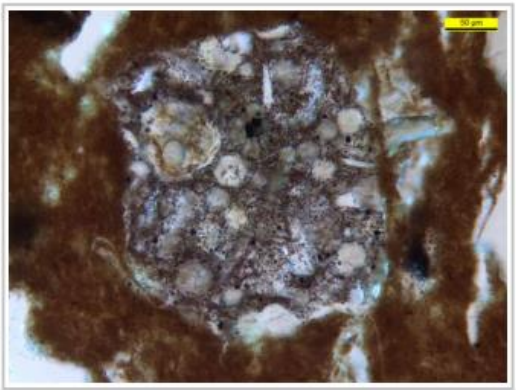
Pl.15



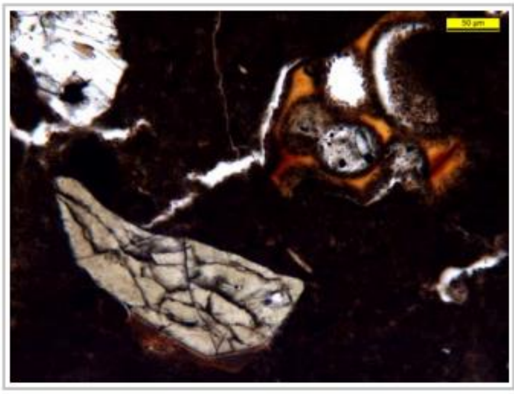
PG-C4; BNap-A-11; M160/2
thin section overview; //pol



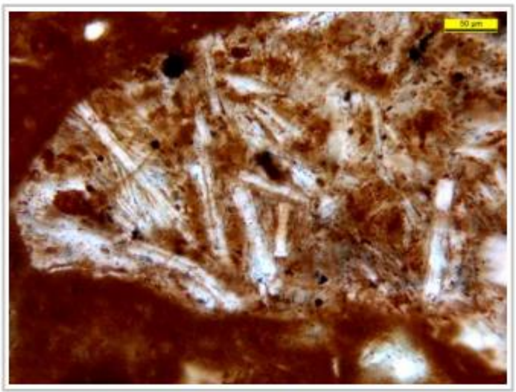
PG-C4; BNap-A-11; M160/3
thin section overview; //pol



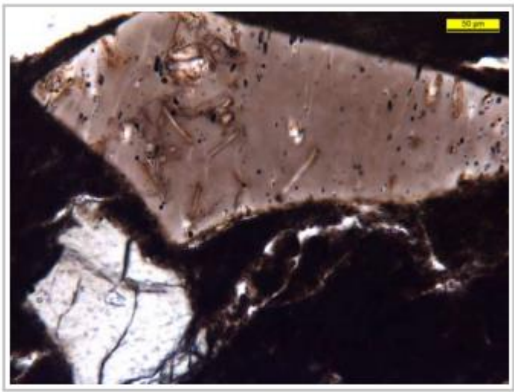
PG-C4; BNap-A-11; M160/1
Volcanic rock fragm. with leucite inclusions; //pol



PG-C4; BNap-A-11; M160/2
clinopyroxene, altered volcanic glass; //pol

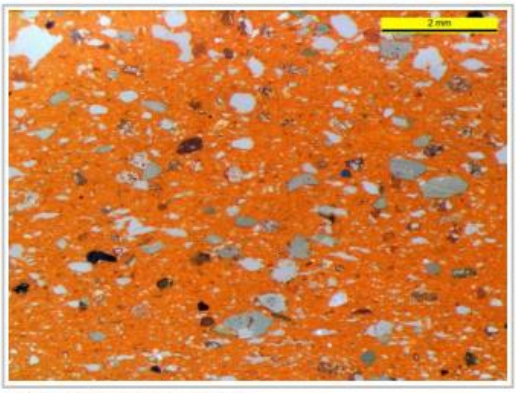


PG-C4; BNap-A-11; M160/1
altered volcanic rock fragment; //pol

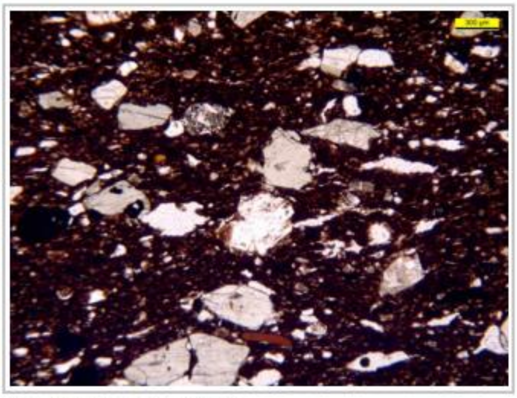


PG-C4; BNap-A-11; M160/3
brown volcanic glass; //pol

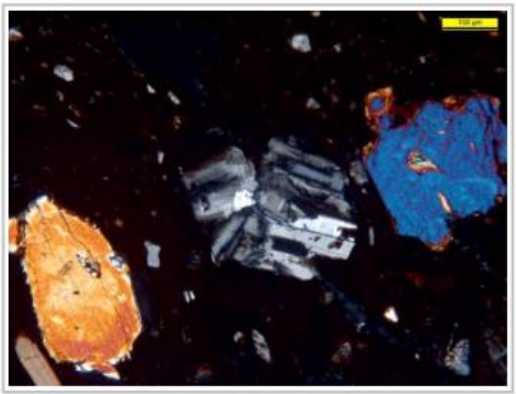
Pl.16



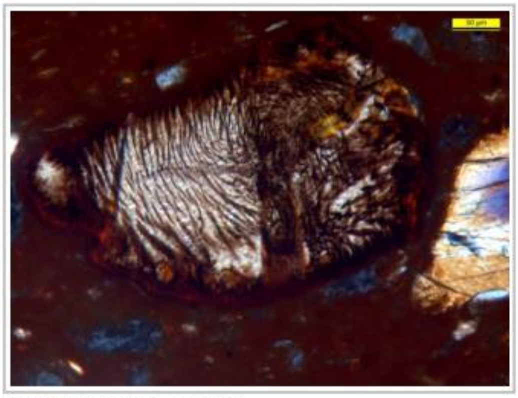
PG-C5; SURR-A-1; M39/1
thin section overview; incident light



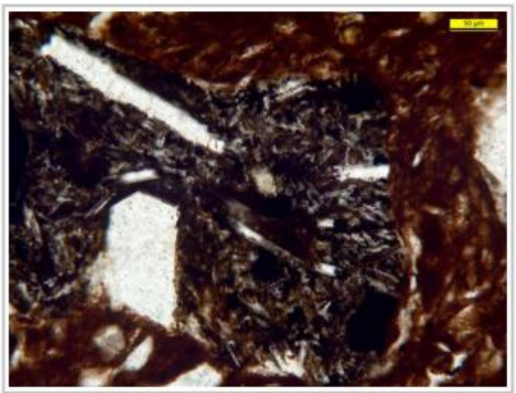
PG-C5; SURR-A-1; M39/1
thin section overview; //pol



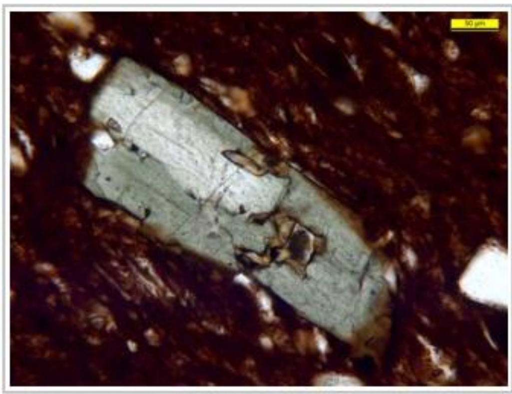
PG-C5; SURR-A-1; M39/1
clinopyroxenes volcanic rock fragment; #pol



PG-C5; SURR-A-1; M39/1
altered olivine grains; #pol

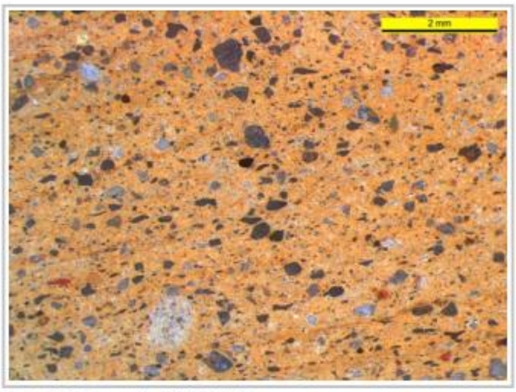


PG-C5; SURR-A-1; M39/1
volcanic rock fragment; //pol

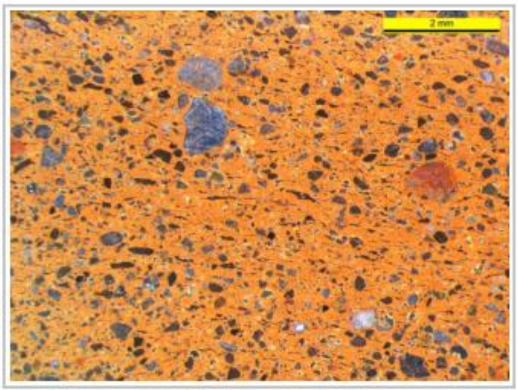


PG-C5; SURR-A-1; M39/1
zoned clinopyroxene; //pol

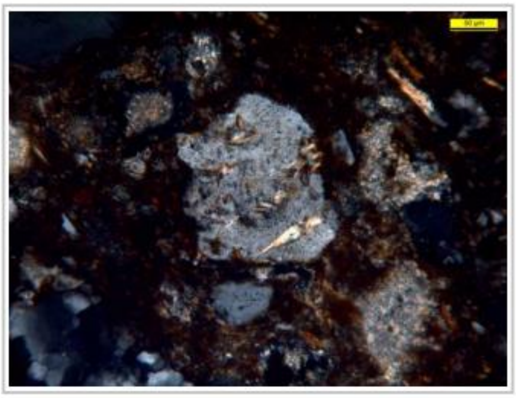
Pl.17



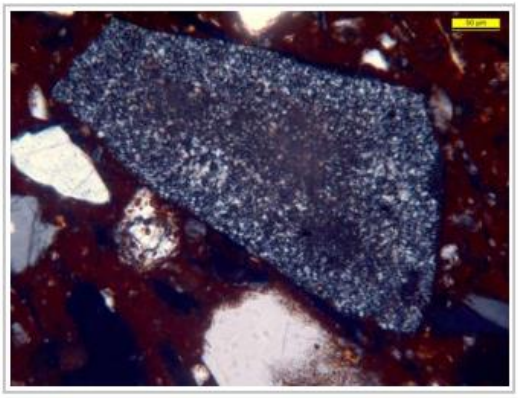
PG-C6;Camp-A-4; M10/28
thin section overview; incident light



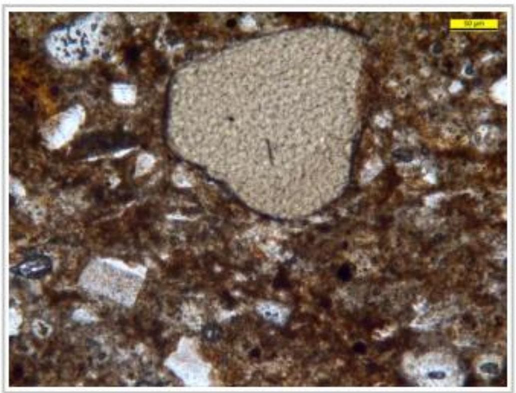
PG-C6;Camp-A-3; M10/41
thin section overview; incident light



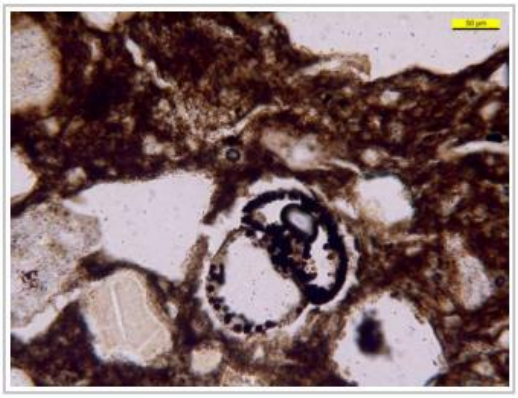
PG-C6;Camp-A-4; M10/28
sericitised K-feldspar grains; #pol



PG-C6;Camp-A-3; M10/41
quartz and a large chert grain; #pol

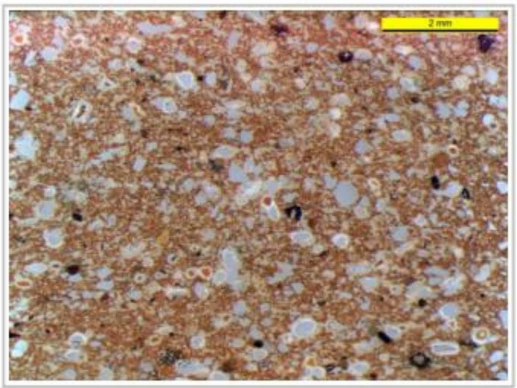


PG-C6;Camp-A-4; M10/28
melanite grain; //pol

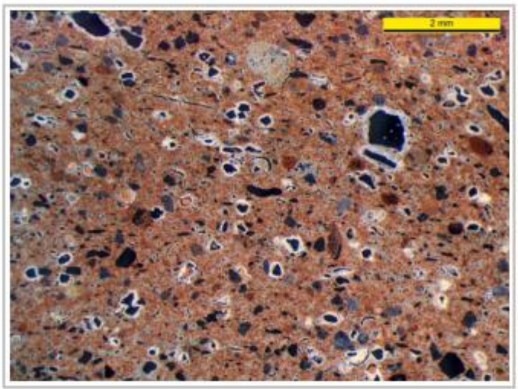


PG-C6;Camp-A-3; M10/41
mold of dissolved foraminfer; //pol

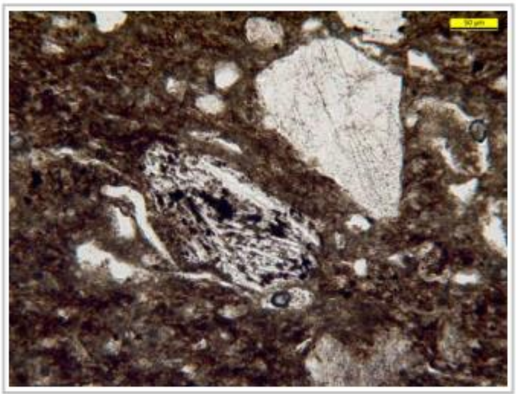
Pl.18



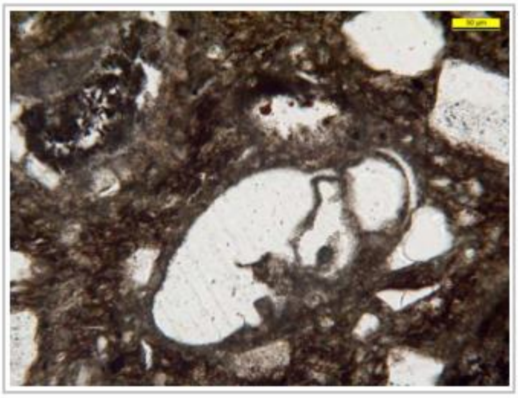
PG-C6h;Camp-A-2; M10/33
thin section overview; incident light



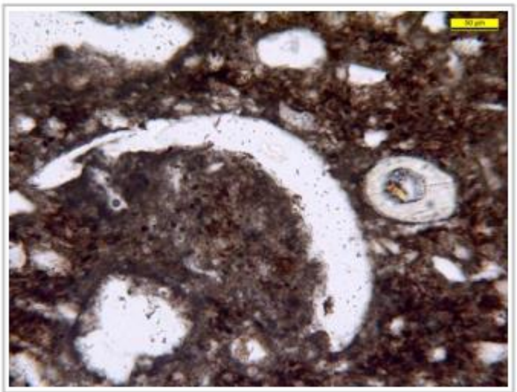
PG-C6h;Camp-A-2; M10/33
thin section overview; incident light



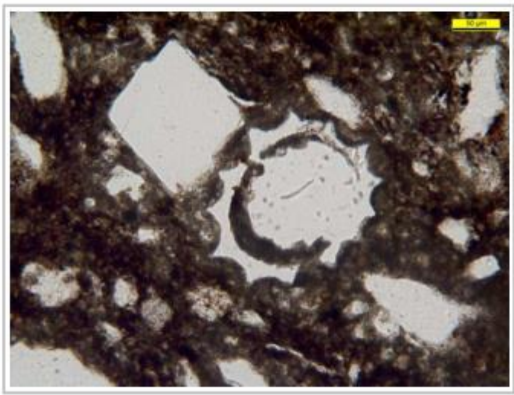
PG-C6h;Camp-A-2; M10/33
quartz grains, volcanic rock fragment; //pol



PG-C6h;Camp-A-2; M10/33
mold of dissolved foraminfer; //pol

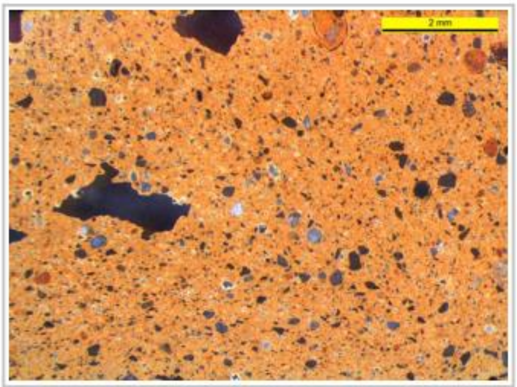


PG-C6h;Camp-A-2; M10/33
mold of a dissolved shell fragment; //pol

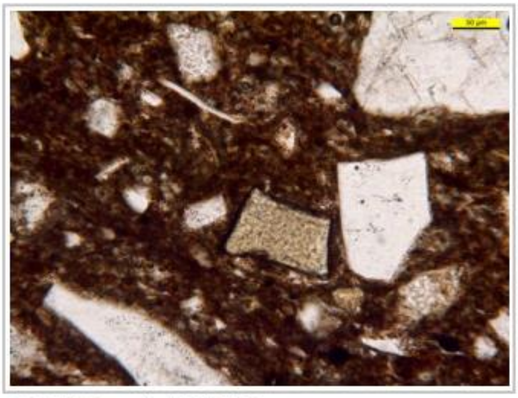


PG-C6h;Camp-A-2; M10/33
mold of dissolved echinid spine; //pol

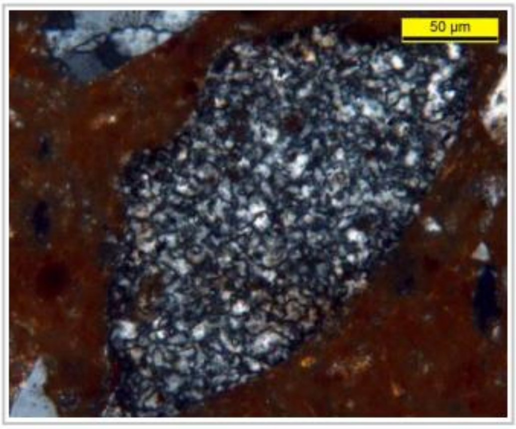
Pl.19



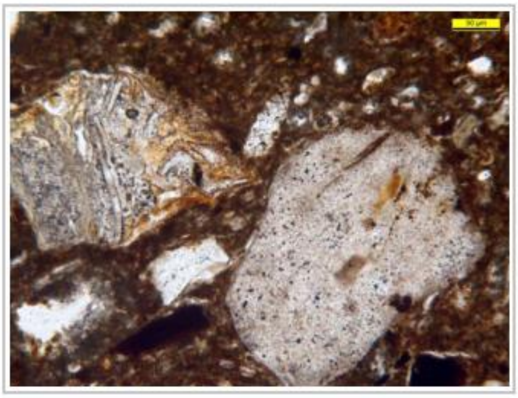
PG-C7; Camp-A-5; M10/35
thin section overview; incident light



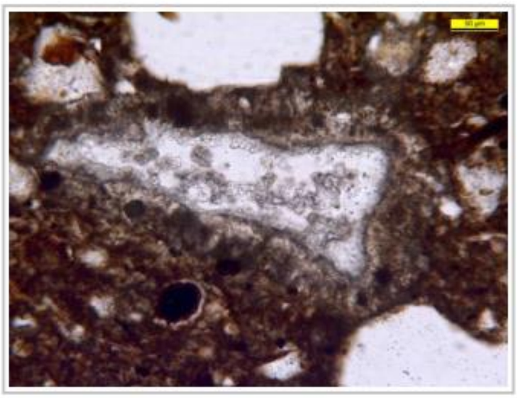
PG-C7; Camp-A-5; M10/35
Thin section overview; //pol



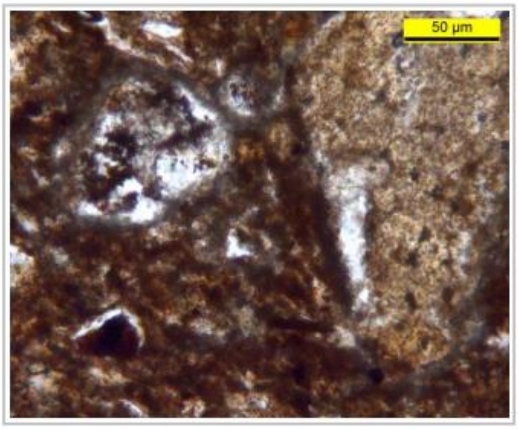
PG-C7; Camp-A-5; M10/35
chert grain; #pol



PG-C7; Camp-A-5; M10/35
altered volcanic rock fragments; //pol

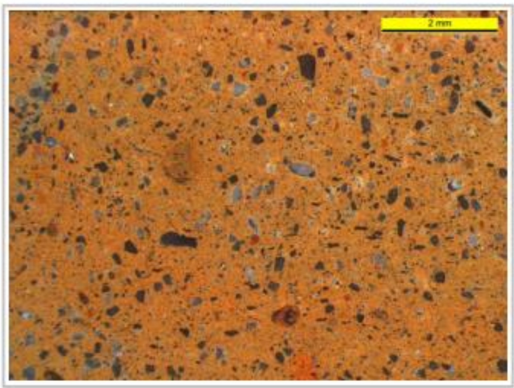


PG-C7; Camp-A-5; M10/35
quartz and altered carbonate grains; //pol

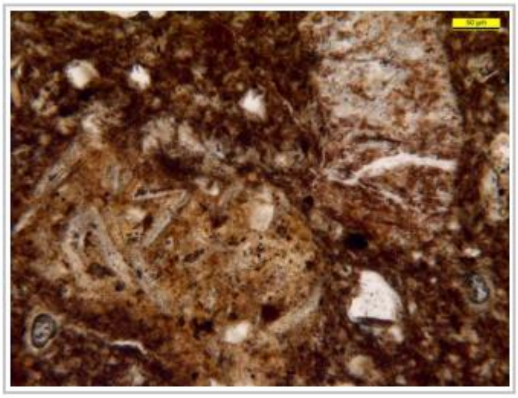


PG-C7; Camp-A-5; M10/35
altered carbonate grains; //pol

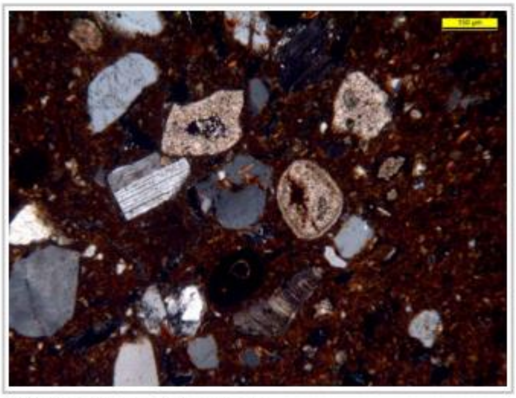
Pl.20



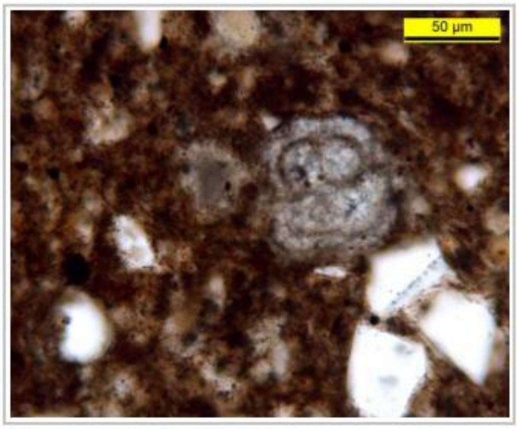
PG-C7a; Camp-A-5; M10/38
thin section overview; incident light



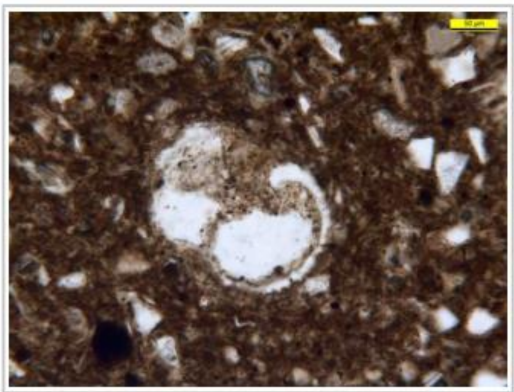
PG-C7a; Camp-A-5; M10/38
altered volcanic rock fragments; //pol



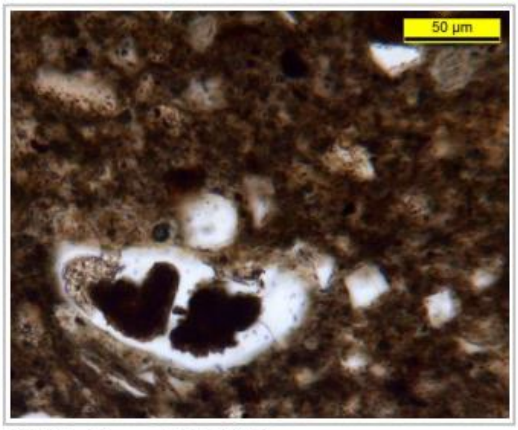
PG-C7a; Camp-A-5; M10/40
quartz, carbonate and feldspar grains; #pol



PG-C7a; Camp-A-5; M10/38
quartz grains, foramifer; //pol



PG-C7a; Camp-A-5; M10/38
mold of a dissolved foraminfer; //pol



PG-C7a; Camp-A-5; M10/38
mold of a dissolved foraminfer; //pol