

PALAEOHISTORIA

*ACTA ET COMMUNICATIONES
INSTITUTI ARCHAEOLOGICI
UNIVERSITATIS GRONINGANAE*

61/62
(2019/2020)

University of Groningen / Groningen Institute of Archaeology

&

Barkhuis

Groningen 2021

Editorial staff

P.A.J. Attema, E. Bolhuis, R.T.J. Cappers, P.D. Jordan, F. Kramer (Editorial Coordinator), M.A. Los-Weijns, S. Needs-Howarth (Copy Editor), D.C.M. Raemaekers, S. Voutsaki

Drawing office

S.E. Boersma, E. Bolhuis (Coordinator), M.A. Los-Weijns, S. Tiebackx

Address

University of Groningen
Groningen Institute of Archaeology
Poststraat 6
9712 ER Groningen
The Netherlands
gia@rug.nl

Website

www.palaeohistoria.nl
DOI: <https://doi.org/10.21827/5beaafbcc2bf2>

Publisher's address

Barkhuis
Kooiweg 38
9761 GL Eelde
The Netherlands
info@barkhuis.nl
www.barkhuis.nl

Typesetting

Hannie Steegstra

Cover design

S.E. Boersma

Cover

A decorated Late Postclassic Mixtec human skull from Teotitlán del Camino, Oaxaca, Mexico, possibly dating to c.1400–1520 CE. The type of adhesive used to affix the mosaic to the skull raised some doubts about the authenticity of the object. Photo P. Erdil. (Collection Nationaal Museum van Wereldculturen. Coll.No. RV-4007-1.)

ISSN 0552-9344

ISBN 9789493194298

Copyright © 2021 Groningen Institute of Archaeology, University of Groningen, the Netherlands.

All rights reserved. No part of this publication or the information contained herein may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronical, mechanical, by photocopying, recording or otherwise, without prior written permission from the Groningen Institute of Archaeology, University of Groningen.

Although all care is taken to ensure the integrity and quality of this publication and the information herein, no responsibility is assumed by the publishers nor the authors for any damage to property or persons as a result of operation or use of this publication and/or the information contained herein.

Contents

| | |
|---|-----|
| In memoriam Piet Kooi <i>W.A.B. van der Sanden</i> | 1 |
| Bibliography of Piet Kooi <i>Kirsten van der Ploeg</i> | 5 |
| In memoriam Harm Tjalling Waterbolk Archaeologist with a passion for nature and landscape <i>J. Bazelmans & J. Kolen</i> | 9 |
| Bibliography of H.T. Waterbolk..... | 16 |
| Super interesting black hole? The micromorphology of organic materials in a Mesolithic hearth pit feature from the site of Soest-Staringlaan (the Netherlands) <i>D.J. Huisman & L.A. Tebbens</i> | 27 |
| Fossilized fashion and social sparkle Dutch Bronze Age bracelets in context <i>S. Arnoldussen & H. Steegstra</i> | 43 |
| A pilot study on <i>coarse ware</i> ceramic fabrics from the Ayios Vasileios Survey Project (Greece) <i>G.J.M. van Oortmerssen & C.W. Wiersma</i> | 111 |
| Tracing the Final Bronze Age–Early Iron Age transition Groningen Institute of Archaeology settlement excavations in the Sibaritide, 2018-2019 <i>P.M. van Leusen & F. Ippolito</i> | 141 |
| Grave goods from Sveta Lucija (Slovenia) in Groningen (the Netherlands) Contextualising old study collections <i>Albert J. Nijboer</i> | 169 |
| Terra sigillata in southern Latium The evidence from the Pontine Region Project, 1987-2014 <i>G.W. Tol, T.C.A. de Haas & P.A.J. Attema</i> | 203 |
| Isolated and backward Westerwolde (Groningen, the Netherlands)? A confrontation of archaeological and historical data from the Middle Ages in a wider geographical context <i>Henny A. Groenendijk & Remi van Schaik</i> | 273 |
| Radiocarbon-based investigations into the authenticity of Mesoamerican artefacts in museum contexts <i>P. Erdil, M. Kuitens, M. Berger & M.W. Dee</i> | 345 |

A pilot study on coarse ware ceramic fabrics from the Ayios Vasileios Survey Project (Greece)

G.J.M. van Oortmerssen¹ & C.W. Wiersma²

¹ Laboratory for Conservation & Material Studies, Groningen Institute of Archaeology, University of Groningen

² Groningen Institute of Archaeology, University of Groningen

Abstract: In this article, we present the results of our pilot study on coarse ware ceramic fabrics from the Ayios Vasileios Survey Project (Laconia, Greece). The aim of this pilot was to explore the potential of optical fabric analysis on coarse wares on the basis of (mineral) inclusions detectable by eye or under modest magnification. We aimed to answer the following question: can we discern Bronze Age coarse wares from Byzantine/Early Modern coarse wares by means of this technique? We studied 177 ceramic fragments by eye and by means of a stereo microscope. This resulted in the description of 51 different provisional fabrics. Only a few of these fabrics could be assigned to a specific time period with certainty, based on a consistent dating of the sherds by the ceramic specialists, who looked at shape, decoration and fabric. Most of the fabrics seem to consist of sherds stemming from various time periods. A comparison between our provisional fabric groups and those published by other researchers in Laconia shows that possible connections or matches between fabrics made by us should be considered either as tentative or as unreliable beyond the level of argued assumptions. To arrive at more reliable ceramic fabric connections, or the identification of similar fabrics, it will be necessary to publish not only textual descriptions and images of thin sections—as seems to be the common approach—but also series of high-resolution pictures of sherds and their fresh sections, as has been done in this article, together with more detailed descriptions of these sherds.

Keywords: Greece, Ayios Vasileios, ceramic fabric analysis, coarse ware, multiperiod.

1. Introduction

The Ayios Vasileios Survey Project carried out three pedestrian field surveys at the site of Ayios Vasileios (Laconia, Greece), between 2015 and 2018 (Voutsaki, Wiersma & De Neef, 2019). Ceramic materials and other remains were systematically collected and studied. The acquired material could be assigned to use of the area during the Bronze Age, the Classical-Hellenistic era and the Roman era, as well as to the Byzantine-Early Modern phases (Wiersma, in press). During the processing of the sherds, it appeared to us that the so-called *coarse wares*¹ associated with the Bronze Age were not easily distinguishable from those associated with the

Byzantine-Early Modern era. Obviously, comparing fabrics from the survey to fabrics from stratified and securely dated contexts from the excavations could help solve such issues. Excavations have been carried out at Ayios Vasileios in the past decade at the so-called palatial complex (Vasilogamvrou, 2011, 2012, 2013, 2016) and the North Cemetery (Voutsaki, Hachtmann & Moutafi, in press; Moutafi & Voutsaki, 2016; Voutsaki *et al.*, 2018). However, as we outline below, the excavated remains, including (un)stratified ceramics from various periods, are only partially studied or still being studied, and can therefore not yet be used for a large-scale fabric study.

We therefore carried out a pilot study on ceramic fabric analysis during the 2018 campaign. The aim of this

¹ Coarse ware entails a rather fluid definition of a type of ceramic product in which – basically – inclusions of different type, size, and sorting are visible by eye. The fluidity of the definition creates misunderstanding and mismatching in communication between ceramic fabric researchers.

pilot was exclusively to explore the potential of optical fabric analysis on *coarse wares* on the basis (mineral) inclusions detectable by eye or under modest magnification. If time permitted, we also wanted to start with the identification and description of fabrics and fabric groups, and, ideally, to link these fabrics to specific time periods. Our ultimate aim is to be able to distinguish Bronze Age *coarse ware* ceramics from Byzantine–Early Modern *coarse ware* ceramics. If possible, we would also like to identify typical Classical–Hellenistic and Roman ceramics fabrics.

In this article, we outline the methods of the pilot study and present the main results, including a detailed description and illustration of a range of identified *coarse ware* fabrics. Finally, we compare the identified fabrics with ceramic fabrics identified at other sites in the region of Laconia on the basis of publications. We will address some difficulties arising from such comparisons and offer possible solutions.

Optical fabric analysis is nowadays an integral part of archaeological pottery research (e.g. Attema et al., 2002; Nijboer et al., 2006; Whitbread, 2016). The technique covers different levels of detail and questioning. The easiest accessible level is to study the fresh section of a sherd – created by breaking off a small piece – by eye or, in connection to this, by means of a hand magnifier. Such a study provides a general impression of characteristics regarding the fabric of the sherd, including information on the coarseness and some types of inclusions. Moreover, hardness and colour (varieties) can be assigned by means of the Mohs hardness scale² and the Munsell soil colour charts.³ The next level of study involves the use of a stereo microscope with a modest, 6–30× magnification. This level reveals relevant information on fracture, texture, percentage of inclusions, sorting of inclusions and identity of most of the inclusions (Moody et al., 2003). These first two steps are also called hand specimen studies or descriptions. A step further in terms of detail (15–100×) involves thin sectioning (e.g. Peterson, 2009). Examination of a thin section may answer questions about the identity of a particular inclusion, as well as the manufacturing mode, level of standardization and firing technique. It does, however, require investment in equipment or in purchasing third-party services, as well as skill in the ability to interpret the sections (Quinn, 2009). These different levels can be applied either individually or in combination in ceramic fabric studies, and they can

also be combined with other methods (Ownby, Druc & Masucci, 2017). The method as a whole puts emphasis on the presence of detectable (mineral) inclusions, so it will not be applicable in the study of fine or pure/purified pottery types. In fact, the paste and its chemical composition are to a large extent neglected in hand specimen and thin section studies.

Recent developments aim to extend or replace the specialized knowledge related to optical fabric analysis with ‘more scientific’ means. Among these methods are (portable) X-ray fluorescence (XRF) and neutron activation analysis (NAA) (e.g. Feuer & Schneider, 2003; Müller et al., 2018). However, these techniques also come with certain difficulties. For example, they focus on the elemental composition of the fired paste and not on the inclusions, and they require vast investments in equipment, as well as specialized knowledge to interpret the acquired data. Machine learning on the basis of standardized images is another technique that has attracted attention for investigating fabrics (e.g. Puglisi et al., 2015; Oksana, 2018). We are currently involved in a case study to compare the optical fabric analysis method applied in this pilot with fabric identification by means of supervised machine learning on the basis of standardized images.⁴

2. The pilot study: possibilities, means and limitations

Definition of coarse ware

Fabric descriptions ‘suffer’ to some extent from subjectivity. For example, the frequency of inclusions can be described as sparse, moderate, common or abundant (Peacock, 1977), the degree of grain-sizesorting can range from well to ill sorted, and the grain shape can range from very angular to well rounded. Comparative charts can be used to help choose a category (see, for example, Boggs, 2009: 41 Fig. 2.12 for an estimate of roundness of inclusions), but subjectivity remains. Within the current study, *coarse wares* are defined according to the publication of Rutter (1993) on Late Helladic IIA pottery from Tsoungiza (Greece), with reference to the Wentworth scale (Wentworth, 1922; Shepard, 1965: 118; Rice, 1987: 38, Fig. 2.2) (Fig. 1). We incorporate Rutter’s system here because a study of the excavated Bronze Age pottery from Ayios Vasileios refers to Rutter for the classification of pottery (Kardamaki, 2017). Relevant for optical fabric analysis and the characterization of

2 The German geologist and mineralogist Friedrich Mohs (1773–1839) created a scale (1812) to measure the hardness of minerals against other known substances and materials. See, for example, <https://www.britannica.com/science/Mohs-hardness#ref221055>. [16-07-2019].

3 See, for example, <https://munsell.com/about-munsell-color/how-color-notation-works/how-to-read-color-chart/> [16-07-2019].

4 The Digital Humanities Project *Dating the undateable: Defining coarse ceramic fabrics by means of machine learning*, in cooperation with the Center for Information Technology, University of Groningen.

| Millimetres (mm) | Micrometres (µm) | Wentworth size class |
|------------------|------------------|----------------------|
| 4096 | | Boulder |
| 256 | — — — — | Gravel |
| 64 | — — — — | Cobble |
| 4.00 | — — — — | Pebble |
| 2.00 | — — — — | Granule |
| 1.00 | — — — — | Very coarse sand |
| 0.50 | — — 500 — — | Coarse sand |
| 0.25 | — — 250 — — | Medium sand |
| 0.125 | — — 125 — — | Fine sand |
| 0.0625 | — — 63 — — | Very fine sand |
| 0.031 | — — 31 — — | Coarse silt |
| 0.0156 | — — 15.6 — — | Medium silt |
| 0.0078 | — — 7.8 — — | Fine silt |
| 0.0039 | — — 3.9 — — | Very fine silt |
| 0.0006 | 0.06 | Clay |
| | | Mud |

Fig. 1. Wentworth (1922) grain size classification (source <http://www.planetary.org/multimedia/space-images/charts/wentworth-1922-grain-size.html>).

fabrics (as either fine, medium or coarse) are the sand fraction, ranging from 0.063–2.0 mm, and the granule-slightly-into-pebble fraction, up to about 10 mm. Rutter (1993: 59) defines the outlines of fine, medium-coarse and coarse fabrics as follows:

Specific mineralogical identifications of these inclusions are usually not suggested, but their colors are described and their approximate frequencies recorded in terms of a four-point scale (“occasional”, “some”, “many”, “massive amounts”). Fine fabrics normally include no grits larger than “very coarse” (maximum dimension of 2 mm.); medium coarse fabrics include grits through the size of “granules” (maximum dimension of 4 mm.); only fabrics with more than “occasional” numbers of grits larger than “granules” are described as coarse. (Rutter 1993: 59)

Rutter’s frequency scale allows room for inaccuracy and preferential interpretation. For this reason, we will interpret the terms more specifically, with “occasional” defined as <5%, “some” as 5–10%, “many” as 10–20% and

“massive amounts” as >20% inclusions. As a result of this, and within the context of the current pilot study, we should consider fabrics with >5% inclusions of a size larger than 4 mm as coarse.

Selection of the coarse wares

The selection of coarse ware material for the pilot study did not strictly depend on a lower limit of at least 5% inclusions equal to or larger than 4 mm. The initial selection by the ceramic specialists⁵ was based on their personal impression of what could be or was considered a coarse ware in their respective study periods. When studying the sherds (focusing on dating the material), small fresh sections were produced whenever necessary by the ceramic specialists, since ubiquitously present calcareous encrustations on the surface of the sherds compromised the ‘readability’ of fabric characteristics, such as colour or presence/absence of inclusions.

Obviously, analysis on surveyed ceramics yields profoundly more insights if the results can be embedded in, or connected to, data from stratigraphic excavations in

5 Bronze Age: Corien Wiersma, Groningen Institute of Archaeology, University of Groningen, the Netherlands; Classical-Hellenistic: Adam Woznura, Ancient History Department, University of Groningen, the Netherlands; Roman-Early Modern era: Mink van IJzendoorn, Faculty of Archaeology, Leiden University, the Netherlands.

the vicinity. It is important to emphasize here again that at the time of our studies, we could not directly compare the survey material to the excavated material from the site. The study of the excavated Bronze Age material, which took place simultaneously, showed that most deposits were not stratified (Kardamaki, 2017). Barely any Classical-Hellenistic material has been excavated, while the Byzantine material, present in copious amounts, has not been studied yet. It was therefore not possible to actually compare fresh sections of stratified and dated ceramics from the site with those from the survey. As a result, the ceramic specialists from the survey were challenged to select *coarse ware* sherds with an irrefutable dating, by creating their own reference collection of *coarse wares*.

In practice, we were barely able to assemble a reference collection: *coarse wares* show a poorly differentiated production method, together with a long production time span. In addition, in the material collected during pedestrian survey, many diagnostic features, such as shape, decoration or surface (treatment), have disappeared. Hence the need for this pilot study. Due to the selection process, not all of the *coarse ware* fragments selected for fabric study received an exact dating. All of the sherds incorporated in this study have been selected on the basis of their appearance by eye as *coarse ware*, or on their size and shape as usually associated with *coarse wares*. Exclusively sherds were taken into account that represented rims, handles, bases and decorated wall fragments. After this initial selection of *coarse ware* material by the ceramic specialists, the fabric pilot was carried out by the fabric specialist (GJMvO), at the Laboratory for Conservation & Material Studies, University of Groningen. Microscopic study by the fabric specialist suggested that some of the material selected by the ceramic specialists qualified as medium-fine to medium-coarse fabric, instead of coarse fabric.

Study of the coarse wares

All of the sherds under study have been photographed before processing. A photograph was taken of the front, rear and section of the sherd. The second step entailed breaking off a relevant area to create a fresh section. This section was again photographed. If possible, a series of nine photographs was taken, whereby the light source position was changed incrementally (Fig. 2). A series of photos imitates to some extent the way in which sections are studied under modest magnification: inclusions and fracture can be studied as the changing light source position imitates the effect of turning the sherd under the microscope to observe inclusions and the fracture surface. These series can be used to construct a virtual reference collection of fresh sections, preferably available in a web-based environment as stop-motion movies. In an ideal situation, every diagnostic sherd should be recorded by means of a drawing and of

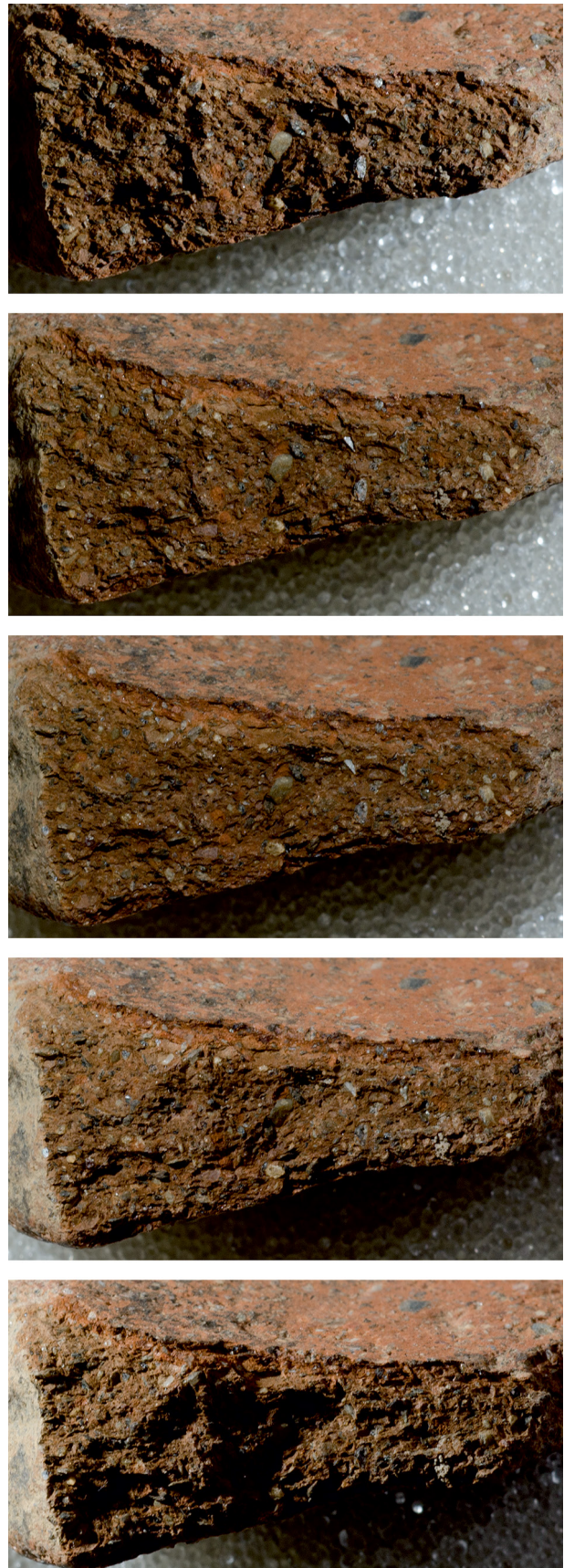


Fig. 2. Selected images (5 out of 9) as an example for a sequence of an identical fresh cross-section under different angles of light source. AVS17-1773GS-002 (Fabric 9) (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).



Fig. 3. Sample of rock fragments and rock-forming minerals taken at the site of Ayios Vasileios before separation. The line represents 1 cm.

photographs taken at different levels of magnification and from various angles. Fresh sections were studied with the aid of a Wild M7A stereo-zoom microscope and an artificial daylight source. The applied magnification was between 6 and 30 \times .

Study of the soil samples

At the start of the fabric pilot, several soil samples were taken from the archaeological site of Ayios Vasileios. Ideally these samples should be collected at outcrops of layers that specifically relate to the Late Bronze Age, the Classical-Hellenistic era or the Byzantine era. This goal could be achieved only in a very general sense, as the excavation trenches had already been backfilled or closed.

The soil samples were sorted on the general level of rock types or individual rock-forming minerals wherever possible. Tiny rock fragments of a metamorphic nature predominate, such as phyllitic/schistose material; phyllite-quartzite; quartzite and quartz; chert; as well as some marble (and other calcium-related components), ferromagnesian nodules; and possibly mudstone. Fig. 3 shows the variety in types and colours of a soil sample as described.

The wide variety of colours, as well as the blending and deformation of structures in rock fragments, makes it particularly difficult to discern types of rock

and minerals under modest magnification. Only the characteristic shine of micas with a preferential orientation – as a constituent of phyllitic material – is easily recognized.

In general, the surrounding landscape is characterized by a combination of limestone-marble and phyllite sources. That limestone and marble are sensitive to erosion and degradation is beyond dispute. But phyllites are susceptible to erosion as well and have been deposited in alluvial fans (Higgins & Higgins, 1996: 51-54). The content of our soil samples consisted of the following rock fragments:

- crystalline (marmorized) limestone/marble; white to light grey or light pink
- quartzite; light grey
- chert; red to (dark) grey
- schist; green and grey mica schist, greenschist
- phyllite; macroscopically similar to schist
- marly limestone/calcareous marl; pale white
- fine-grained conglomerate; (dark) grey

The content of our soil samples reflect the results of a geological survey characterizing the rock types of the building stones that were found in the excavations at the Ayios Vasileios hill (Polymenakos, n.d. 2012: 2-4). A selection of our soil sample constituents has been thin

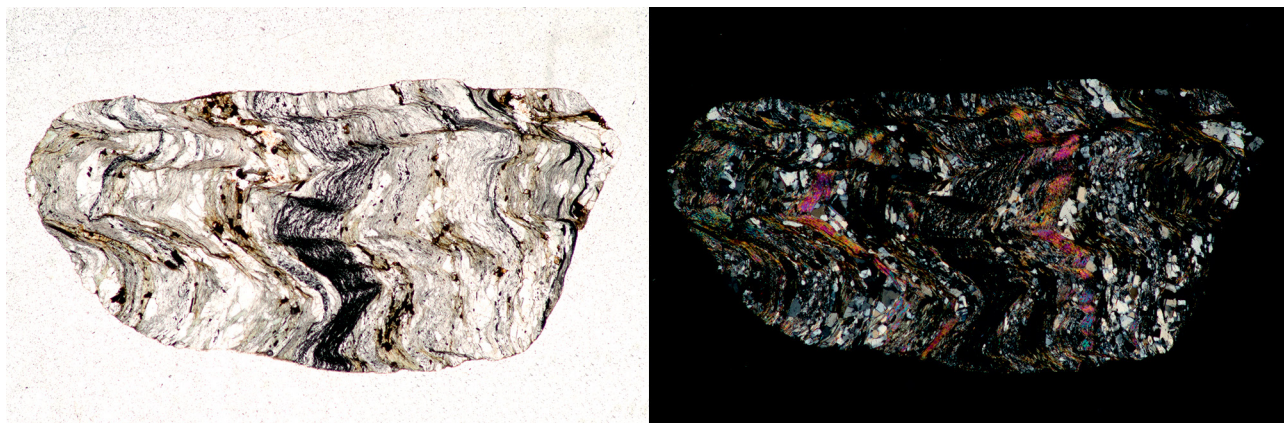


Fig. 4. Example of a small rock fragment in thin section under plain polarized light (l) and crossed polars (r), showing the metamorphic deformation of phyllite-quartzite (width of field each 5.2 mm).

sectioned in an attempt to identify specific rock fragments or minerals (Fig. 4). In some cases, inclusions have been removed from sherds to identify them as well. The thin sections confirm the appearance of the various rock fragments and minerals listed in the geomorphological survey. Only by selecting sand as well as fine gravel, and by then identifying this material on the basis of thin sections, could we collect the necessary tools to identify the majority of inclusions in the *coarse wares* under study in a general sense. It remains rather difficult to distinguish specific constituents in detail on the basis of fresh sections alone.

3. Preliminary results

To date, 177 ceramic fragments have been studied by eye and by means of a stereo microscope. All of the fragments derive from the final survey campaign and have been selected in cooperation with the three ceramic specialists. Dating of the fragments ranged from 'without doubt' (to build in certainty) to 'not dateable at all.' At the start of the pilot, the fabrics specialist was not informed about the dating (options) of the material, to prevent bias on the basis of foreknowledge.

In total, 51 different provisional fabrics have been described to date. Before we continue the further discussion of the preliminary results, we provide one detailed description of a fabric here as an example. It is our intention to publish – in the future – other results of the pilot at the website of the Laboratory for Conservation and Material Studies (LCM, GIA, University of Groningen).⁶

Fabric 13 — 'Micaceous Red' (see Figs. 5-7, 20, 21)

Fabric 13 is a reddish to slightly orange-firing material group, consisting of five sherds:

AVS17-1122GS-004—band handle

- 5 × 3.5 × 1.5ø
- 2.5YR 6/6 (ext)⁷, 5YR 5/2 (ic), 2.5YR 6/8 (oc)

AVS17-1122GS-006—band handle

- 3.5 × 3 × 2ø
- 2.5YR 6/6 (ext), 2.5YR 5/6 (ic), 2.5YR 5/6 (oc)

AVS17-1848GS-002—handle

- 7 × 2.2ø
- 5YR 6/6 (ext), 5YR 4/3 (ic), 5YR 5/6 (oc)

AVS17-1909GS-002—handle

- 6 × 1.8ø
- 2.5YR 6/6 (ext), 5YR 4/2 (ic), 2.5YR 6/8 (oc)

AVS17-4305GS-001—band handle

- 3 × 2 × 1
- 5YR 5/6 (ext), 2.5YR 4/6 (ic), 5YR 4/4 (oc)

By eye, this fabric is characterized as reddish on the basis of the determined Munsell values. In combination with the abundant presence of tiny, shiny mica flakes, the fabric has intuitively been named 'micaceous red.'

Hardness is below average: soft, scoring 2 rather than 3 on the Mohs scale.⁸ The general texture is medium to medium-coarse and somewhat flaky to irregular, due to

⁶ www.lcm.rug.nl.

⁷ ext = exterior, ic = inner core, oc = outer core.

⁸ Average, in the context of fabric analysis, means that, on the basis of more than 25 years of experience, it shows that the majority of fired ceramics represent a hardness between 2 and 4 on the Mohs scale, with emphasis on 2 to 3.



Fig. 5. Fabric 13: AVS17-1122GS-004: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

the mica content. Pores are present below 5% in random directions (possible due to the fact that all sherds are handles, which tend to be formed in a different manner (i.e. rolled) compared with vessel walls) and rounded to elongated in shape. The total amount of inclusions can be described on two levels. If 'inclusions' is considered exclusively the collection of particles that can be clearly separated from the groundmass, then the total amount is between 10-15%. However, mica-containing ingredients seem to 'merge' into the groundmass with a decrease in size. If the total amount of detectable ingredients is

taken into account, the total percentage would be >30%. As a result, the sorting is not very clear: well sorted or very poorly sorted, with a range between 63 and >2000. Predominant are quartz/quartzite (5-10%), phyllite/mica (5-10%, or 20-25% in the second option), organic materials (x-p)⁹ and ferromagnesian nodules (x-p). Some sherds show extreme differences in visibility of the mica, mainly depending on the angle of perception and/or the light source. Despite the differences, the presence of mica is always evident in the exterior of the sherds. The fabric is related to Fabric 12.

⁹ x = absent, p = present <1%.



Fig. 6. Fabric 13: AVS17-1848GS-002: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

Among the 51 defined fabrics, 18 fabrics are represented in only one sherd each, 28 fabrics are made up by 2-5 sherds, and 5 fabrics entail more than 5 sherds. The provisional fabric that is best represented consists of 32 sherds. We do not describe in detail all the fabrics defined thus far, for the following reasons: The fabric groupings are not fixed; further study of more material will very likely lead to a further subdivision, while some of the single-sherd fabrics may be lumped when added material leads to the insight that they are only varieties within a broader collection of characteristics. Most fabrics or single sherds are related to other fabrics

or sherds, due to overlapping or connecting characteristics. This emphasizes the fact that the results of the pilot are by no means a fixed framework for future research, but, rather, a useful starting point as well as a tool.

Single-sherd fabrics

The 18 single-sherd fabrics can be subdivided into two categories: those related to other fabrics (9) or those without a relationship (9). The latter category suggest a non-local or even non-regional origin, mainly on the basis of an absence of phyllite-like inclusions. The non-related single-sherd fabrics will not be described



Fig. 7. Fabric 13: AVS17-1909GS-002: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

further here, since an obvious lack of variability would make any description too absolute. The remaining 42 provisional fabrics will be discussed further below.

Two-sherd fabrics

A total of 33 fabrics consist of two or more sherds (Table 1). The two-sherd fabrics offer the first and most basic means of looking at (in)consistency in dating of sherds. A fabric is considered consistent in date if roughly more than 2/3 of the sherds can be dated in one period. In that case the fabric is shown in boldface (Table 1).

On the basis of consistent dating within a fabric, it is possible to search for specific Bronze Age or Byzantine fabrics. Fabrics with a lower N appear more consistent in dating, but this is likely due to the small sample size

(Kintigh, 1984; Meltzer, Leonard & Stratton, 1992) and should not be interpreted as more promising compared with fabrics with a higher N.

Fabric 6 contains two sherds, namely, rim fragments belonging to amphorae, which are undoubtedly dated as Roman and have no relationship with locally produced ceramic wares from either the Bronze Age or the Byzantine era.

Fabric 21 (Fig. 8) is represented by a rim and a handle; however, the dating could not be narrowed further than Roman-Early Modern for either of them. The fabric is characterized by an orange colour (5YR 4/6-5/6-5/8), with some 15-20% moderately well-sorted inclusions (dominated by quartz/quartzite (10-15%, sub-angular-angular), detectable presence of phyllite (3-5%,



Fig. 8. Fabric 21: AVS17-1456GS-002: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

sub-rounded)) and detectable porosity. The hardness tends to 3. It is related to Fabrics 20 and 22.

Fabric 22 (Fig. 9) contains a lug and a rim, is related to Fabric 21, and is dated in the same time frame. The smooth orange product (5YR 5/8-6/4-6/6) is rather well sorted. It has a sandy feel and a hardness that is above average (Mohs 3). The differences with Fabric 21 are mainly on the level of total amount of inclusions and the percentages of quartz/quartzite specifically (20-30%). Since AVS17-1530GS-001 is a handle and manually

produced – assumedly on the basis of paste production leftovers, it shows a particularly interesting detail: it contains two different zones with different fabric and paste characteristics, illustrating a window of tolerance in pottery production. It also illustrates the option of lumping Fabrics 21 and 22 within a much bigger data sample. The two fabrics together suggest the outline of a Roman fabric.

Fabric 37 is consistent in dating in the Classical-Hellenistic period. It contains two loom weights. Since

Table 1. Provisional categorization of fabrics, represented in 2 to 32 sherds, subdivided into consistent or inconsistent dating. *N* = the number of individual sherds within a provisional fabric on the basis of comparable characteristics; EMOD = Early Modern; BYZ = Byzantine Era; CH = Classical–Hellenistic period; ROM = Roman; BA = Bronze Age; ? = not dateable within a single period.

| N in fabric | Fabric number + consistent date | Fabric number + inconsistent dates |
|-------------|--|---|
| 2 | 6 ROM 21 ROM-EMOD 22 ROM(-EMOD) 37 CH 39 BYZ | 16 BA-BYZ 17 BA-CH 30 CH and ? 40 CH-BYZ 46 BA-BYZ 48 BA and ? |
| 3 | 1 BYZ 2 BYZ 3 BYZ 27 BYZ and ? | 44 BA-BYZ and ? |
| 4 | | 4 BA-BYZ and ? 14 BA-BYZ and ? 29 ? 32 BA-CH and ? 36 CH and ? |
| 5 | 13 BA and ? | 5 CH-BYZ and ? 9 BA-BYZ and ? 15 BA-BYZ and ? 28 BA-CH and ? 33 BA-BYZ and ? 35 BA-BYZ and ? |
| 6 | | 7 BYZ and ? |
| 13 | | 20 BA-BYZ and ? |
| 15 | | 19 BYZ (CH) and ? |
| 32 | | 34 BA-BYZ and ? |

it has no clear connection with other fabrics within the pilot study, it will not be discussed here.

Fabric 39 comprises two tiles with dating in the Byzantine era. Both have been fired (or burned in destruction) at a high temperature and show traces of vitrification. The very poorly sorted main inclusion resembles a type of mud- or siltstone (15–20%), which – together with the absence of phyllite – indicates a non-local origin. The inclusions are invisible by eye due to the red colour of the fired paste. To what extent the vitrification altered a possible micaceous appearance is unclear. The fabric was provisionally considered to have been supplied from elsewhere and has no connection with other fabrics in the pilot study.

Three-sherd fabrics

Within the three-sherd fabrics, **Fabric 1** is characterized by a pale colour (10YR 6/4–8/3) and a micaceous appearance, which makes the fabric as such recognizable by

eye (Fig. 10). This appearance seems to relate to the paste and not to the level of inclusions. In general, the sherds show a standardized production mode, with a low level of surface finishing and some traces of insufficient blending of the paste, as well as a hardness clearly above average.¹⁰ Inclusions are rare (<1%). All of the sherds are firmly dated to the Byzantine era. The three sherds in this fabric are all handles.

Fabric 2, which is slightly more pale orange (7.5YR 6/3–7/1, 10YR 6/2), is represented by a handle and two bases, the latter with traces of wheel-related manufacture. The material dates is firmly dated to the Byzantine era, and is in every sense strongly related to Fabric 1. Refiring of both fabrics under standardized oxidizing circumstances may have led to a comparable orange colour and subsequent lumping of the sherds.

Fabric 3 relates to Fabrics 1 and 2, with slightly more inclusions (Fig. 11), although the total amount is still <5%, with an uneven distribution. The fabric has a less

¹⁰ *Standardized*, in the context of ceramics production, should be read as lacking variation in proportions, sorting, and types of inclusions. In the groups with one or two sherds, we did not remark on the mode of manufacture. This is related to sample size. We did not remark on mode of production for every fabric mentioned. This is mainly related to the nature of the available material: diagnostic vessel body parts – such as bases or rims – may show wheel-throwing marks, while the abundantly present handles are usually handmade as a kneaded product. Working with the Mohs scale in the past 25 years has revealed that most of the fired ceramics show a hardness between 2 and 4. Pre-roman pottery commonly measures 2/3, with 2 being particularly soft and 3 being above average. If ceramics are between 3 and 4, they appear as very hard.



Fig. 9. Fabric 22: AVS17-1530GS-002: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

micaceous appearance compared with Fabrics 1 and 2. The colour range is between 7.5YR 5/3–6/4 and 5YR 5/6. It consists of one base and two base-like fragments. This fabric, too, is firmly dated to the Byzantine era. The ceramic specialists would consider this fabric a genuine *coarse ware*; however, it still does not fit Rutter's definition. Looking at the low level of inclusions, one could define the material as very poorly sorted on the basis of the particle size range. The number of inclusions is so low that the constituents could very well be the result

of random incidents, which would make sorting irrelevant as a categorizing tool. The overall impression of the material is that of an industrial production mode with a low level of surface finishing and some traces of insufficient blending of the paste. In that particular sense, it fits in the definition of *coarse ware*, but it lacks the other *coarse ware*-defining characteristics of large inclusions. The term *fine coarse ware* seems an apt description, even if it appears contradictory.

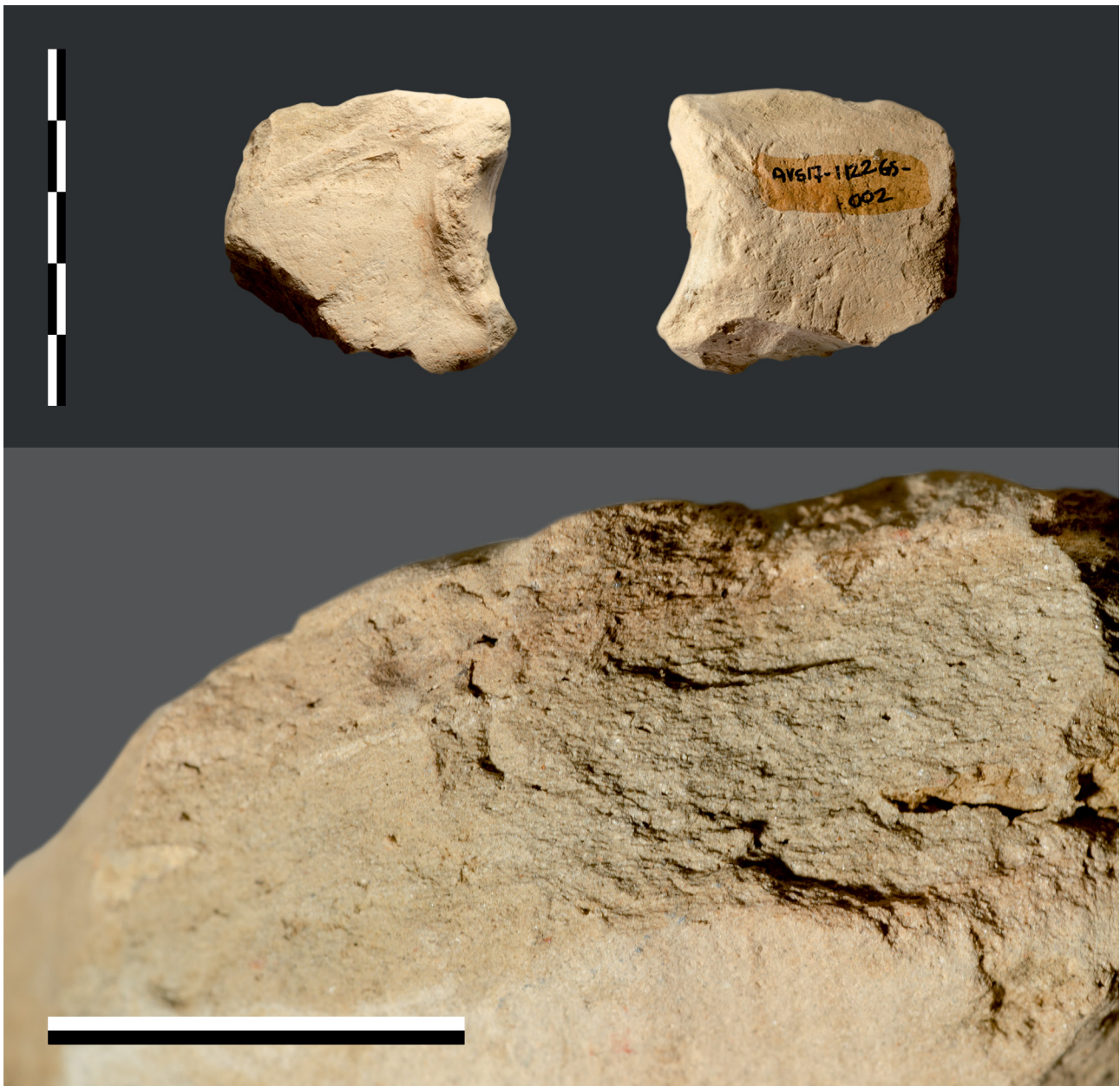


Fig. 10. Fabric 1: AVS17-1122GS-002: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

Fabric 27 consists of a ribbed band handle, a rim and a decorated wall fragment, all dated to the Byzantine era. The appearance is of a standardized production. It is not industrial, as evidenced in loss of attention to surface finishing. It is a smooth orange-firing (5YR 5/8) fabric with occasionally larger inclusions that apparently did not hamper production on a wheel (Fig. 12). It contains around 15% very fine quartz/quartzite, as well as larger scattered inclusions, such as phyllitic material, quartz and reddish iron-like dots or even ferromagnesian nodules. It is related to Fabric 19 via Fabric 20.

Fabric 44, of which the sherds are not consistently dated to a specific period, shows no apparent relation to any of the fabrics in the pilot study.

Four-sherd fabrics

The four-sherd fabrics are all inconsistent in dating; however, numbers 4 and 14 tend to slightly predominate with sherds dated to the Byzantine era (4) or the Bronze Age (14).

Fabric 4 is related to Fabrics 1, 2 and 3, and is slightly more orange-firing than Fabric 3: 5YR 4/6-5/4-5/6. The total amount of inclusions is around 5%, with a variable and uneven distribution of medium to poorly sorted quartz, phyllitic material and white powdery as well as red powdery dots. The micaceous appearance is much less when set against Fabrics 1 and 2. This fabric is discussed in more detail in the next section.

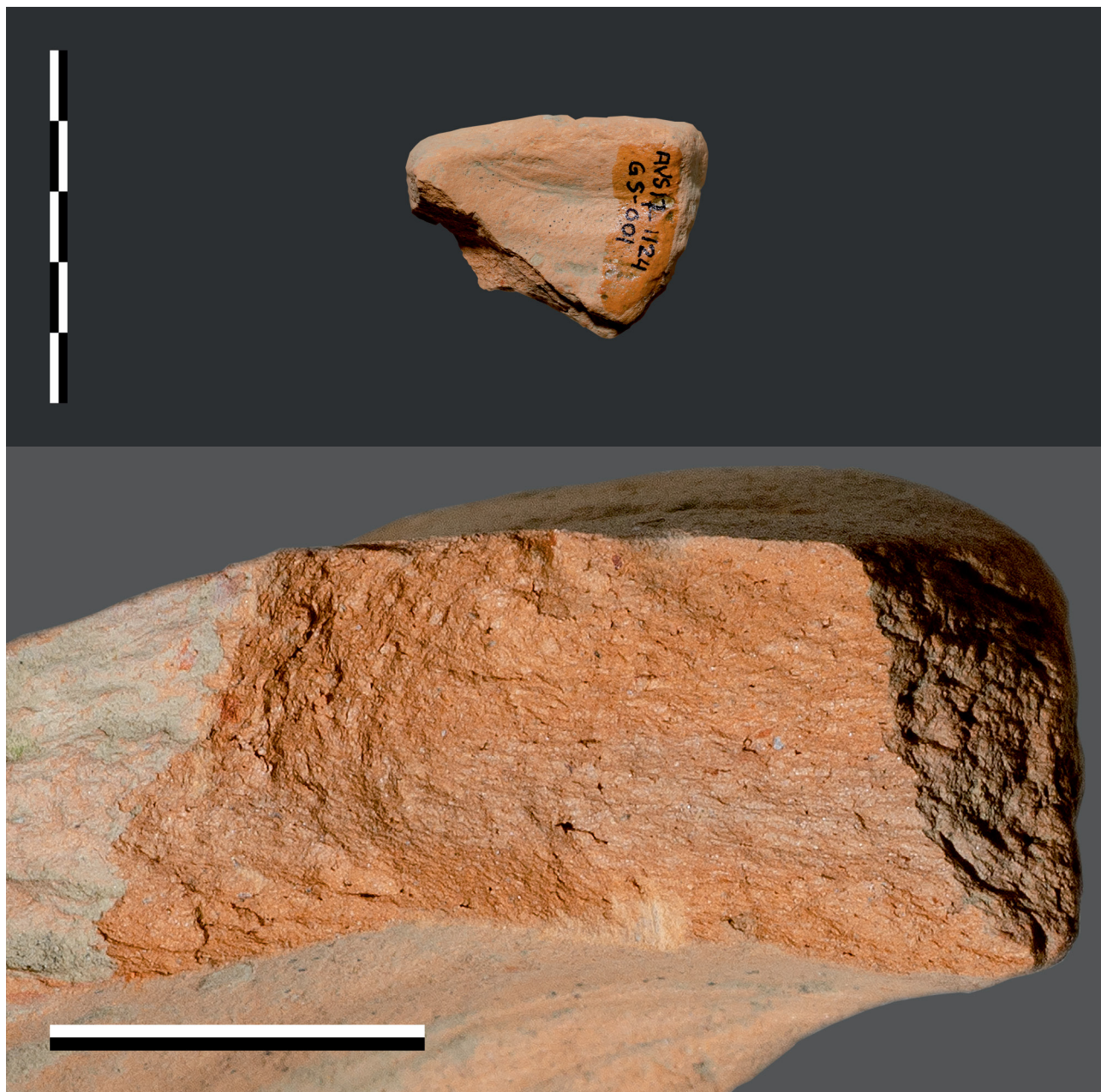


Fig. 11. Fabric 3: AVS17-1124GS-001: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

Fabric 14 is characterized by a high percentage of moderately sorted inclusions (up to >30%), with a slightly micaceous appearance (which is, however, not detectable in the fresh section). The inclusions are a mix of quartz/quartzite and phyllitic material. It is an example of a general, finer, reddish brown-firing fabric (2.5YR 5/8, 5YR 4/4-4/6). The dating is ambivalent, with one Roman, one Bronze Age, one possible Bronze Age and one unknown sherd. Its relation to Fabrics 9, 13 and 15 is discussed in the next section.

Fabric 29 has a triangular relationship to Fabrics 28 and 32. Their characteristics place them in the centre of a scheme, wavering out towards a fine white branch, a reddish orange branch and a red coarse branch (Fig.

13). The firing colours are basically in the range of 5YR 5/6-5/8 (yellowish red), with a moderately sorted predominance of 7-15% sub-angular quartz/quartzite and a sub-dominance of phyllitic material. The fabric consists of band and ring handles. The appearance is only occasionally micaceous. The dating is highly problematic and varies between unknown, Bronze Age and Byzantine era. The implications of the relationship among Fabrics 29, 28 and 32 is discussed in the next section.

Fabric 32 is basically identical to Fabric 29 in terms of the variety of an equal presence of quartz/quartzite and phyllitic material (both 10-15%) and is made up of handles and a base. The dating is problematic in the sense

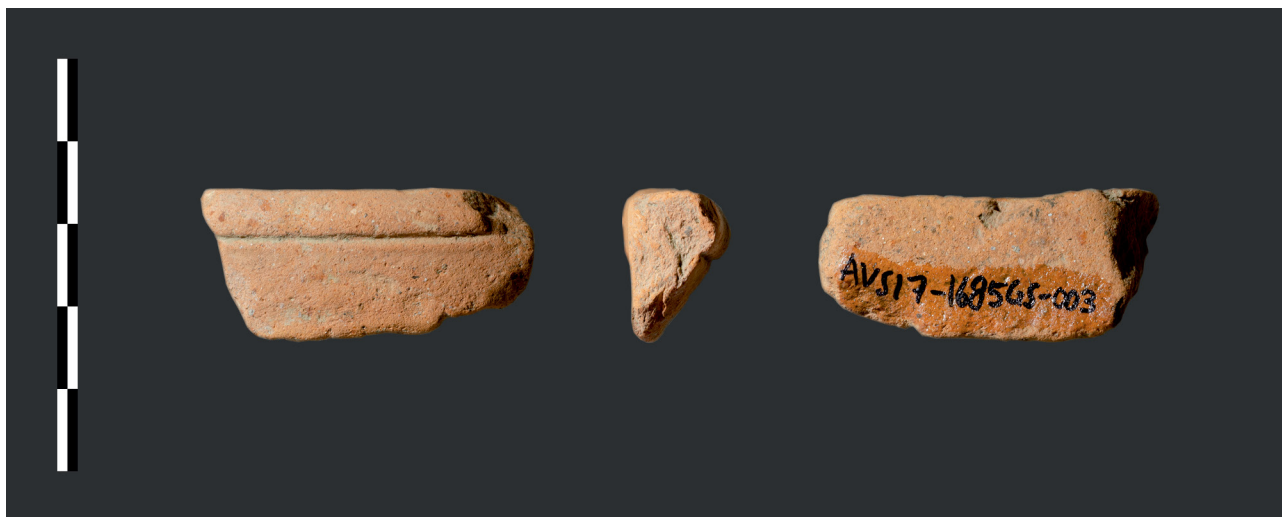


Fig. 12. Fabric 27: AVS17-1685GS-003: view, no fresh section available; the vertical line represents 5 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

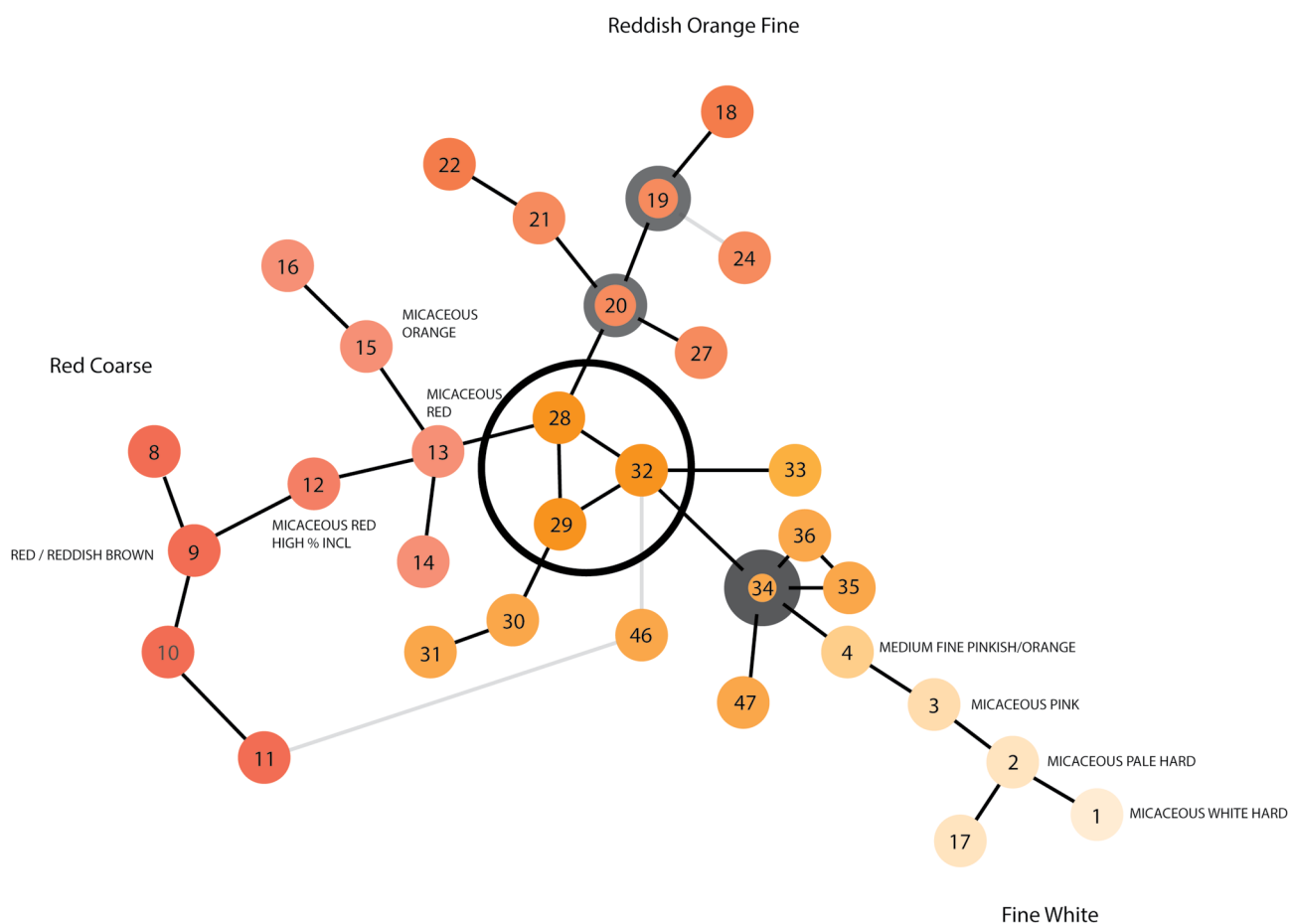


Fig. 13. Chart with relationships between provisional fabrics in the pilot study. The thickness of a circle line indicates the relative volume of a fabric. A black line between fabrics indicate a direct connection, a grey line a more superficial connection (illustration G.J.M van Oortmerssen, © RUG/GIA).

that half of the material is dated to the Bronze Age, while the other half is considered Classical-Hellenistic.

Fabric 36 is an extreme variety of Fabric 34 (which makes up the largest fabric within the pilot study).

It will be discussed under Fabric 34. The dating is highly problematic: unknown or – in one case – possibly Hellenistic.

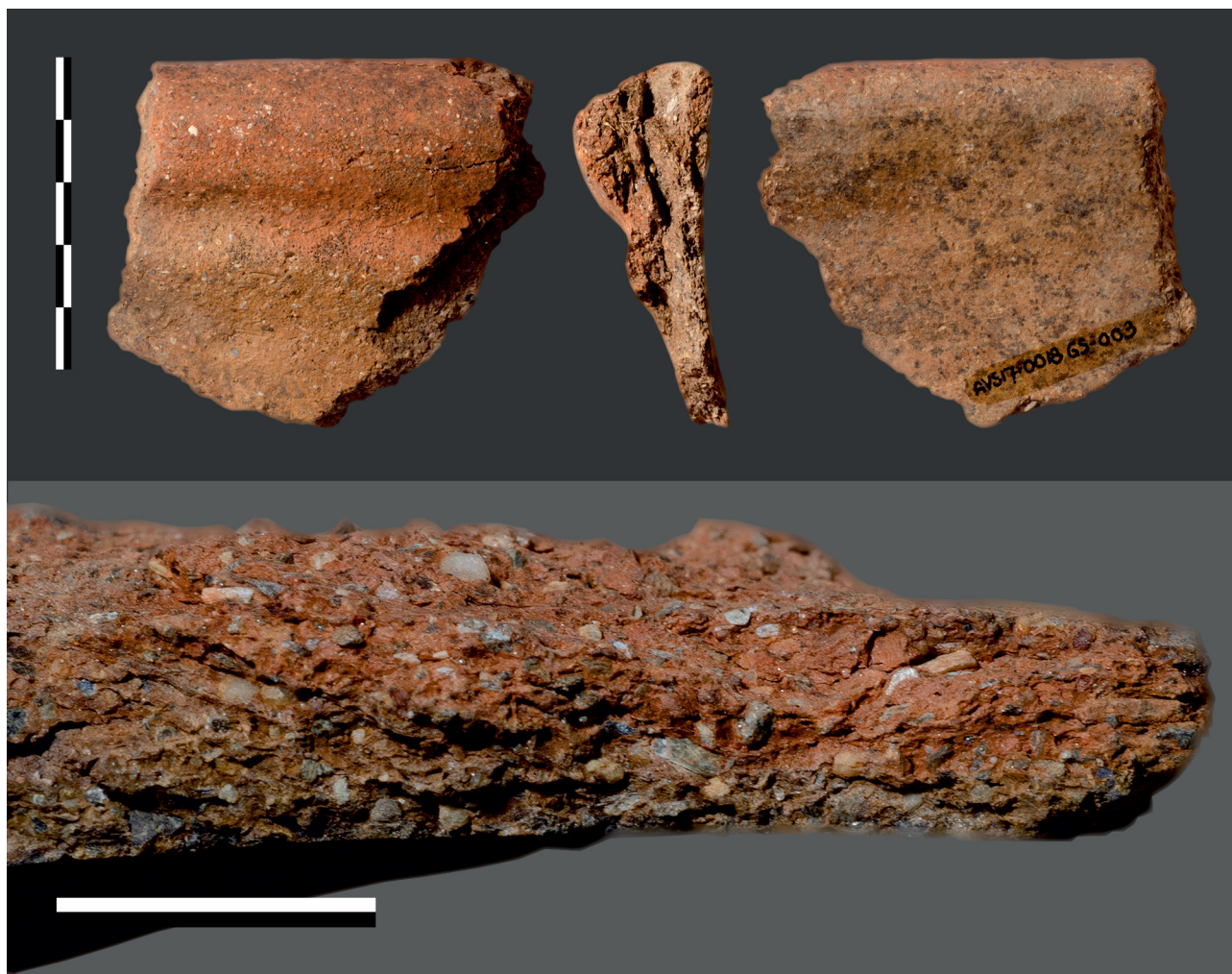


Fig. 14. Fabric 9: AVS17-0018GS-003: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

Five-sherd fabrics

In the five-sherd fabrics, only one out of seven fabrics shows consistent dating (Table 1).

Fabric 13 is predominantly dated to the Bronze Age. The fabric contains exclusively handles. The general impression is that of a reddish-firing paste with a micaceous appearance, although this differs per sherd and with the angle of perception. The five sherds are all handles, and it is therefore impossible to draw conclusions on the mode production: manual or wheel-made. The fabric characteristics can be found in the detailed description in section 3 above (Figs. 5-7, 20, 21).

Within the five-sherd fabrics of inconsistent date, four fabrics show some emphasis on a specific period.

Fabric 5 is preferentially dated around the Byzantine era, containing mostly roofing materials, as well as one basin rim fragment. The colours range in the pinkish-reddish tones (2.5YR 6/4-6/6, 7.5YR 5/4). An indication for firing at a high temperature is found in AVS17-4231GS-007, in the form of traces of partial vitrification. Hardness is well above average (Mohs 3-4), possibly due to high firing temperatures. The

composition of inclusions shows a medium-high percentage of white speckled dots, being limestone/marble/carbonates-related. Traces of phyllitic material are absent, making the fabric probably non-local.

Fabric 9 (Fig. 14) consists exclusively of rims and has fired reddish orange-brown with an emphasis on the 2.5YR 4/6-5/8, 5YR 4/4-5/6, 7.5YR 4/3-5/4 range. On the level of inclusions, phyllitic material is predominant, quartz/quartzite sub-dominant, and the inclusions are moderately sorted, forming a total amount of 20-25%. The general texture is medium to medium-coarse. We have the impression that the fabric is the result of manual production, on the basis of a somewhat irregular distribution of inclusions throughout the paste. We observed no uniform preferential orientation of micaceous flakes, also indicating manual production. The dating of sherds shows a slight preference for the Bronze Age, while various other sherds are dated to the Byzantine era.

Fabric 15 (Fig. 15) is fired reddish orange (2.5YR 5/8, 5YR 5/4-5/8) and characterized by a micaceous appearance, just as Fabric 13, with which it is strongly related.



Fig. 15. Fabric 15: AVS17-3245GS-001: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

For both of these fabrics, it is difficult to discern whether the smallest fraction of inclusions should be considered as inclusions or as part of the paste. The difficulty concerns the phyllitic, micaceous material. Fabric 15 differs from Fabric 13 mainly in colours, whereby Fabric 15 regularly shows a different inner core colour, towards 5YR 5/1–2.5/1. The fabric contains rims and some handles. Whereas Fabric 13 mostly dates to the Bronze Age,

Fabric 15 is quite diverse, ranging from Bronze Age to Roman. The example shown (AVS17-3245GS-001) is assumed to be Bronze Age material.

Fabric 28 tends to orange in terms of colours and is the connection between the red coarse branch and the reddish-orange-firing branch in Fig. 13. It is occasionally micaceous, and it is moderately sorted, with a predominance of quartz-/quartzite-like material, forming

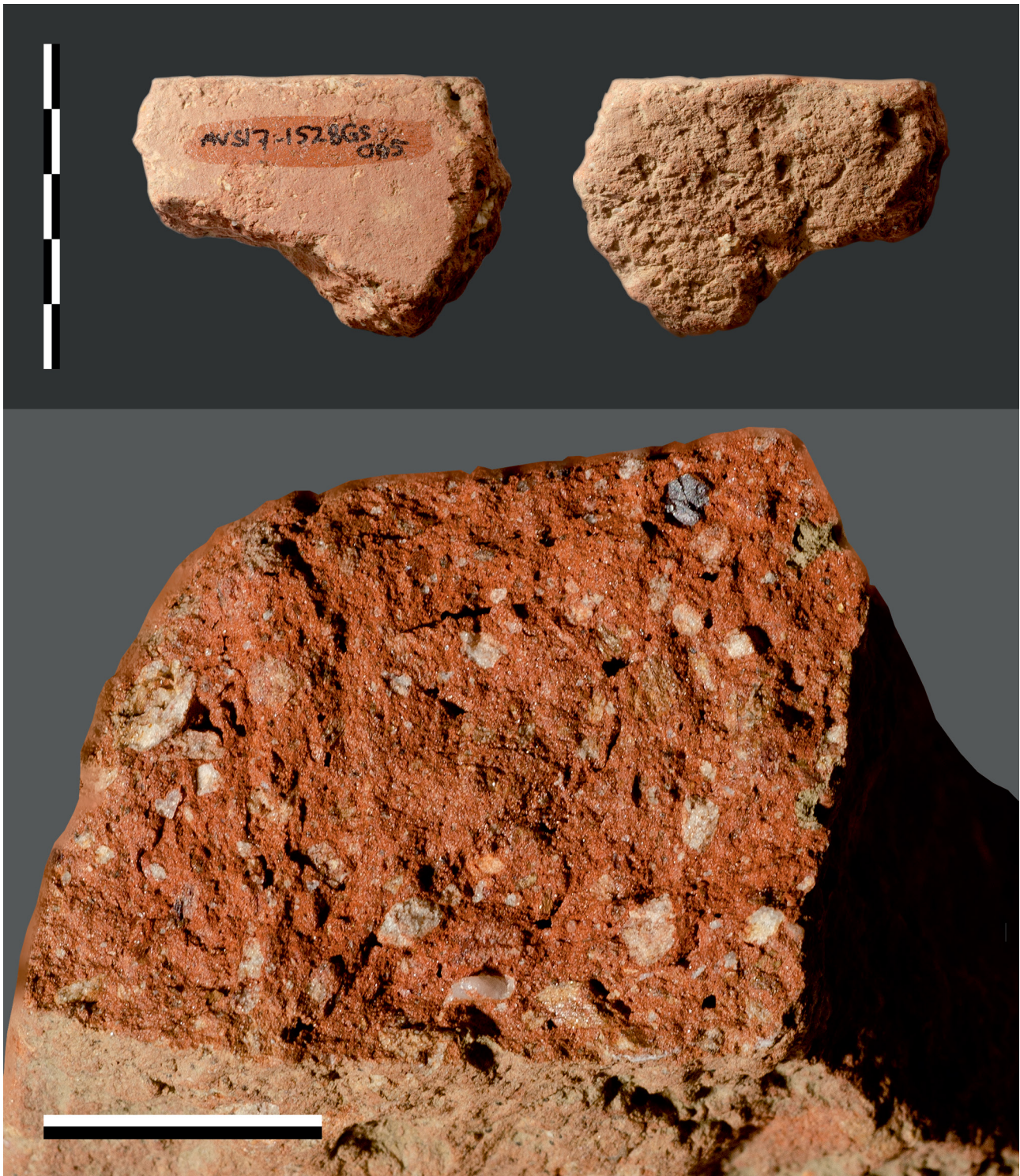


Fig. 16. Fabric 7: AVS17-1528GS-005: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

up to 20-25% in total. The fabric is made up of handles and one foot. Three out of five sherds are firmly dated to the Classical-Hellenistic period, while one is dated to the Bronze Age (a foot), and one is of Bronze Age or Byzantine date.

Fabric 33 is not a genuine fabric but a collection of generally comparable sherds based on amount, sorting and

type of inclusions. These sherds do not fit in any other fabric, and to try to fit them in would blur the characteristics of the other fabrics. The fabric consists of rims and a handle. We anticipate that the sherds in this group will fit into fabrics once a larger dataset has been compiled. The dating is problematically diverse, ranging from possibly Bronze Age, to Historic and Byzantine.



Fig. 17. Fabric 19: AVS17-1529GS-003 with traces of a glaze: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

In general, the collection of sherds can be characterized as a coarse, high percentage containing, poorly sorted mix of quartz/quartzite and phyllitic material, partially with a grey core. No micaceous appearance is present.

The same goes for **Fabric 35**, based on a shared presence of tiny white dots in the paste. Within the pilot, the identity of these inclusions could not be determined; however, it has no calcareous nature. Dating is again problematically diverse: one sherd is of unknown date, while the other four sherds are dated to the Bronze Age, Classical-Hellenistic, Roman and Byzantine period.

Fabrics with more than five sherds

Fabric 7 (Fig. 16) contains six sherds with a high percentage ("massive amounts") of very poorly sorted inclusions in a mix of quartz/quartzite and phyllitic material. According to Rutter's definition, this would make up

a proper *coarse ware*. The colour range is clearly in the red area: 10 R 4/4-4/8, 2.5YR 4/6. Two sherds are dated as Byzantine or Early Modern; the other four sherds could not be dated. The collection is made up of tiles or building materials, mostly fired at a high temperature and showing traces of vitrification. It has no apparent relationship with the other 50 fabrics described so far. However, due to the vitrification, the fabric is more than usually difficult to interpret.

Another interesting issue is the origin of the sherds. All sherds derive from two adjacent units measuring 10 × 10 m, placed directly south of the palace excavations. This strongly suggests that all fragments may belong to the roof of the same building. The location of the Bronze Age palace is only a few metres away. In this context, the question may have been whether the roofing materials have been 'refired' in a destruction event, perhaps the

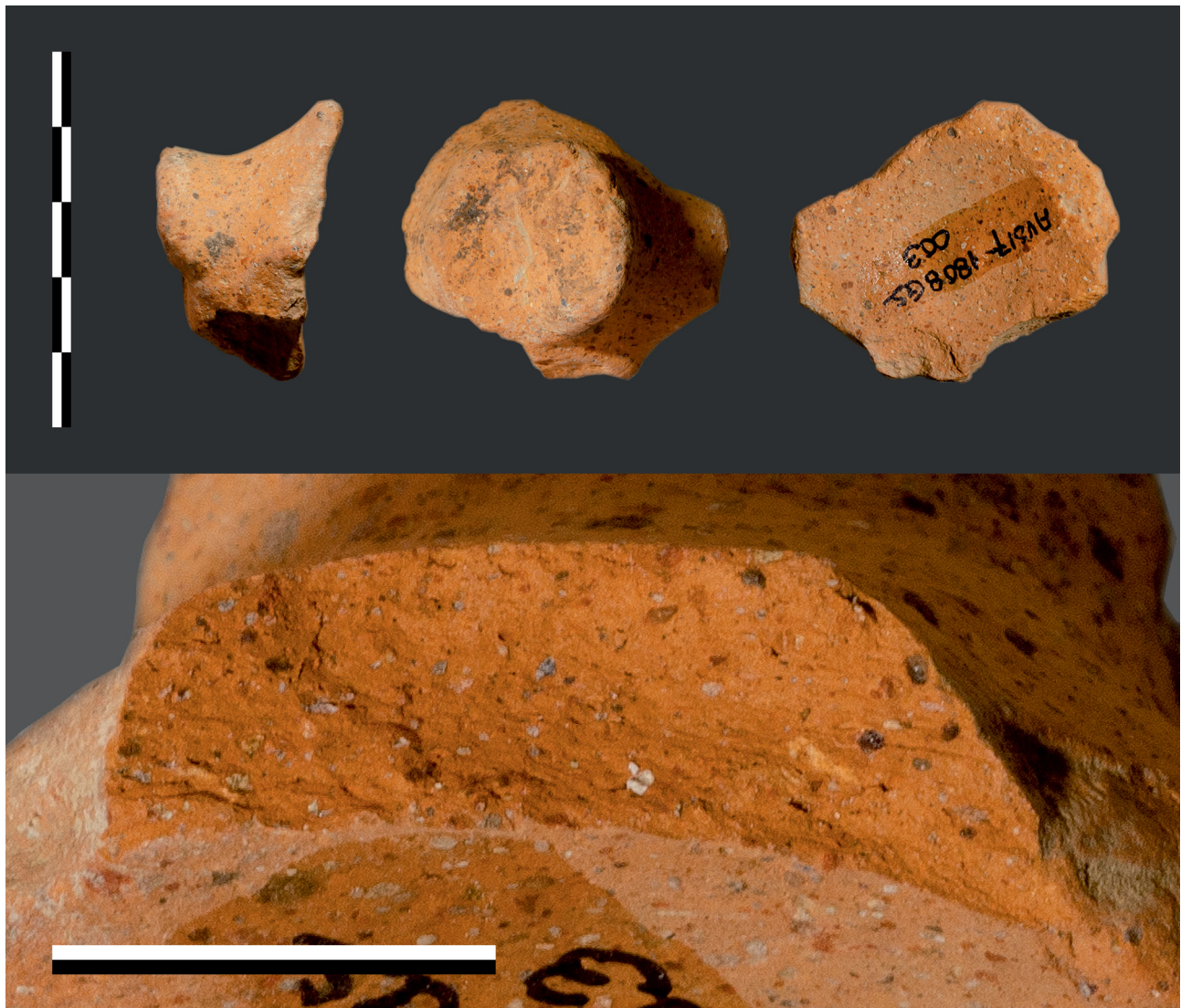


Fig. 18. Fabric 20: AVS17-1808GS-003: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

destruction of the palace. Within a different perspective of a much younger context, the firing temperature with traces of sintering may have another meaning: intentional firing of roofing material at a higher temperature creates relatively impermeable tiles. Moreover, the closest unit (1527) where the current fabric has been found is only 20 m away from the Byzantine church. The construction of the present chapel presumably dates to AD 1828, and its construction followed the destruction of a predecessor (dated to AD 1296 or 1297) during the Greek Revolution (Karadimas in prep.).

Studies on excavated (proto-)Byzantine kilns in Greece have shown a general procedure with firing temperatures up to 800–950 °C (Kondopoulou *et al.*, 2015: 157–158; Raptis, 2012). However, since vitrification is a gradual process and its starting point will be dependent on the composition of the paste, it remains difficult to determine whether the vitrification in Fabric

7 was intentional or the result of a secondary, destruction-related process. This fabric will not help in defining aspects of Bronze Age or Byzantine material, since it shows no relation to other (larger) fabrics containing building materials, or to larger storage jars.

Fabric 19 (Fig. 17) is the second-largest fabric, with 15 sherds. It is made up of vertical band handles, two rims, a roof tile and a rubbing stone. The fabric contains material with a very limited presence of (mineral) inclusions, which makes attribution rather difficult when applying a method that is based on visible inclusions. The chemical or elemental composition of the paste was not measured at this stage. There is an obvious possibility of redistribution and splitting of fabrics as a result of future chemical analysis. The general appearance of the fabric shows a standardized mode of manufacture; reddish, though mainly with orange colours (2.5YR 5/6–6/8, 5YR 5/8–6/8); a fine/pure appearance

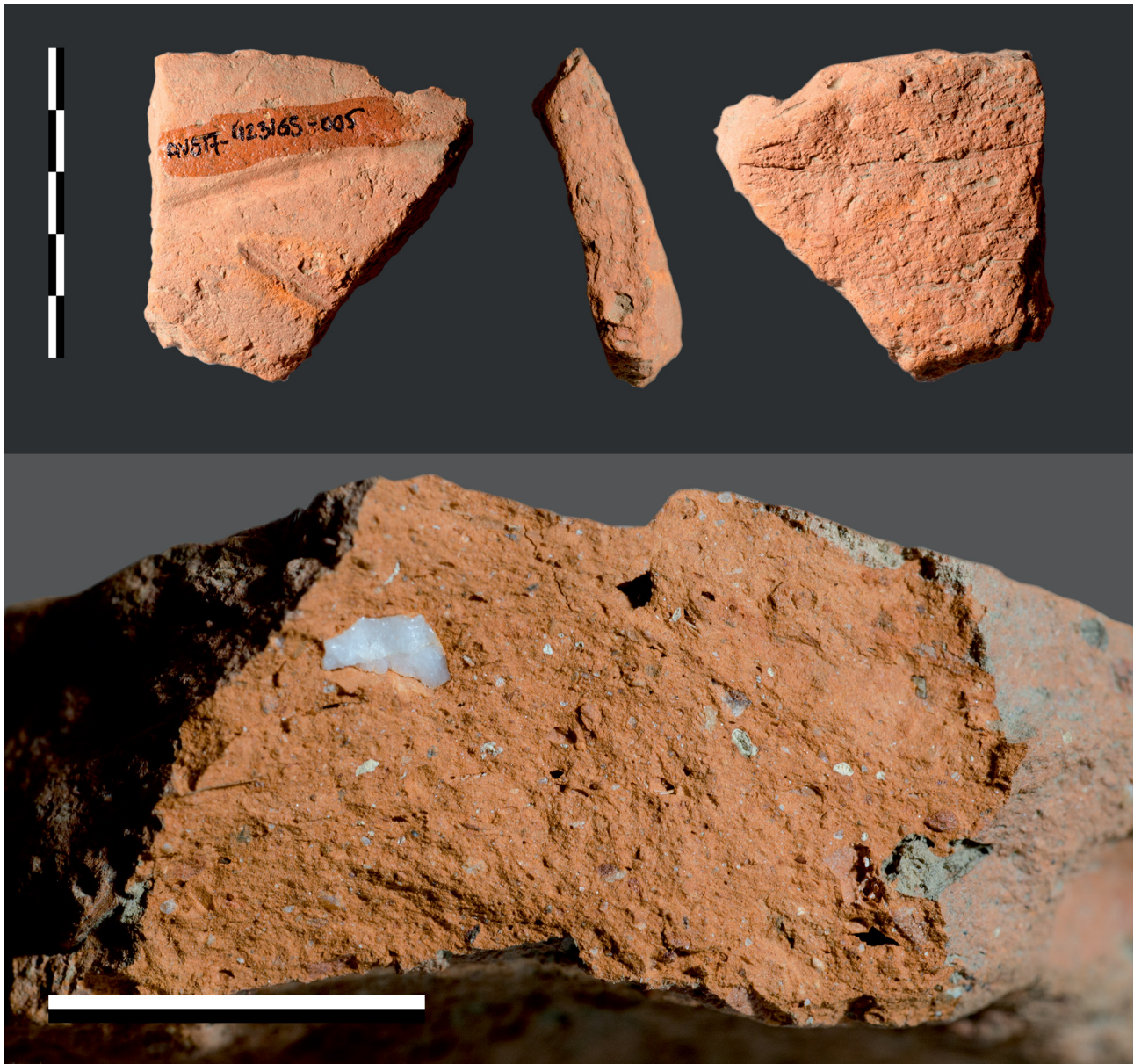


Fig. 19. Fabric 20: AVS17-4231GS-005: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

with occasionally quartz/quartzite, phyllite-like material; tiny red dots and white powdery inclusions (in total “occasional” or <5%); and visible porosity.

Taking into account the limitations of the applied fabric analysis method, it is, however, informative to mention that 8 out of 15 sherds are thought to be Byzantine, 1 is thought to be Classical-Hellenistic, and 6 could not be attributed to a time period. One of the Byzantine sherds shows remains of a glaze, which is considered typical for Byzantine ceramics.

Fabric 20, with 13 sherds, appears related to Fabric 19 in a general sense; however, it has more inclusions (between “some” and “many,” 7-15%) in the fine sand fraction. The fabric shows a divergent dating, related to the Bronze Age (2/13), the Classical period (4/13), and

the Byzantine era (5/13). Two sherds cannot be dated on the basis of diagnostics. This fabric illustrates the essence of the challenge in the pilot, and even more when we consider them in detail: two particular sherds – almost identical at the level of optical fabric characteristics – do not pertain to the same period. Sherd AVS17-1808GS-003 (Fig. 18) is dated in the Late Helladic period (c. 1700-1100 BC), while sherd AVS17-1769GS-001 (Fig. 19) is related to the Byzantine period (c. 330-1453 AD).

Fabric 34 consists of 32 sherds and, in general, has a (pale) orange and coarse appearance (for example, 5YR 5/3-5/8-6/6-6/8, 7.5 YR 5/2-5/4, 10YR 3/1-5/2-5/3). It is characterized by a hardness of Mohs 3 (above average), medium-coarse texture, and “occasional” presence of inclusions (3-5%), which are (moderately to) poorly



Fig. 20. Fabric 13: AVS17-1122GS-006: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

sorted and rounded to angular in shape. Inclusions, such as phyllite, quartz/quartzite, ferromagnesian nodules, white powdery dots and reddish chert, can be absent or present. Many of the inclusions are clearly visible to the naked eye. Of these sherds, 12/32 pertain to the Bronze Age, while 2/32 are attributed to the Classical period and 9/32 are assumed or ascribed to the Byzantine era. Finally, 9/32 are not dateable, or could be either Bronze Age or Byzantine. Once more, this fabric illustrates the main result of the pilot analysis: Bronze Age and Byzantine *coarse wares* are hard to discern. Fabric 34 is related to Fabrics 4 and 35, both with basically the same

'bipolarity,' and to Fabric 36, which has three undatable sherds and one Classical–Hellenistic sherd.

4. The outlines of Bronze Age and Byzantine fabrics?

Have we been able to make any progress in distinguishing Bronze Age fabrics from Byzantine fabrics? In an attempt to discriminate Bronze Age *coarse ware* material from much younger Byzantine *coarse ware* ceramics, it would be interesting to pay attention to the mode of manufacture. It is an oversimplification to state that

there was unstandardized and handmade production in the Bronze Age and more standardized and wheel-made production in the Byzantine era. Such a clear division is not possible in our dataset and within the periods of interest. What is rather complicating our dataset is that most of the sherds within our provisional fabrics are handles. Handles are usually handmade and do not provide indications for the use of the hand or the wheel for the rest of the vessel. We also know that different techniques were sometimes used on the same vessel (i.e. handmade and wheel finished). Moreover, manual production took place in parallel to wheel production, sometimes even in comparable pottery types, in both the Bronze Age and Byzantine era. For example, Kardamaki (2017: 84) describes Late Bronze Age cooking pots from Ayios Vasileios that are wheel-thrown and ones that are hand-built.

The combination of related Fabrics 21 and 22 offers a potential key to a Byzantine fabric, although none of the material in these two fabric sets meets Rutter's definition of a *coarse ware*. The fired paste contains up to 30% well-sorted inclusions and a maximum particle size of very coarse sand (1-2 mm). The two fabrics as a group are related to the relatively large Fabric 20 and indirectly to Fabric 19 (Fig. 13). As mentioned before, Fabric 20 is too diverse in dating (although it has the highest proportion of sherds dated to the Byzantine era), and only the indirectly related Fabric 19 shows a preferential dating in the Byzantine era. If we combine the related fabrics of the reddish orange branch (Fabrics 18 to 22, 24, 27), then the majority date to the Byzantine era (19 sherds) and a minority to the Classical-Hellenistic era (6 sherds) and Bronze Age (2 sherds), with 10 sherds remaining undated. However, dating of *coarse ware* ceramics based solely on their fabric remains problematic if two sherds within the same fabric appear almost identical in terms of fabric characteristics, while they are dated to periods separated in time by at least 12 centuries (see under the description of Fabric 20).

The combination of related Fabrics 1 to 4 also provides a potential key to another Byzantine fabric, although only Fabric 4 approaches to some extent Rutter's definition of a *coarse ware* on the level of inclusions, while the others are finer. Fabric 4 is, however, problematic in other respects. For now, it appears as a collection of varying characteristics that do not fit properly in adjacent fabrics, such as Fabric 3 and Fabric 34. With the availability of more ceramic material, the current provisional Fabric 4 will probably be split up or re-divided. In addition, the dating is uncertain, ranging between Bronze Age to Early Modern. If we leave out Fabric 4, the contours of a Byzantine fabric become much more evident in Fabrics 1, 2 and 3, but Rutter's definition of a *coarse ware* will not apply to the group.

Fabric 9 brings a potential key for Bronze Age material (probably even Early Bronze Age). It is related to

Fabrics 13 to 16 (via 12/13), as well as to Fabrics 8, 10 and 11. The ceramic content of Fabric 9, with four rims, offers limited opportunity to look at manufacture. The impression of manual production is given by the hackly fracture of the section, as well as in the micaceous appearance of the paste, which is not uniform in one direction but variable between areas throughout the sherd.

In particular Fabrics 9 (via Fabric 12, one sherd), 13, 14, and 15 are connected in their low (5-10%) percentage of quartz/quartzite and a low (5-10%) to higher (20-25%) percentage of phylitic material, depending on how the micaceous appearance is interpreted: belonging to the paste or as inclusions. Some sherds show extreme difference in visibility of a micaceous appearance depending on the angle of breakage. However, a micaceous appearance is always visible in the exterior. Major variety within the grouping of Fabrics 9, 12, 13, 14 and 15 is colour, ranging from 2.5YR 5/6-5/8-6/6-6/8 to 5YR 4/4-4/6-5/4-5/6-5/8-6/6 (red to yellowish red to reddish brown to reddish yellow). The general appearance is red in comparison to other fabric groups. Fabrics 13 and 15 are almost identical, with 10 sherds, of which 7 are ascribed to the Bronze Age; however, 1 is dated as Roman. Together with Fabrics 9, 12 and 14, the total number of grouped sherds is 20, with 13 (possible) Bronze Age, 2 Roman and 5 unknown.

The 'group' in the middle (Fig. 13), consisting of Fabrics 28, 29 and 32, as well as the largest group, Fabric 34, show such a wide diversity in dating that the dating cannot be resolved or clarified with the aid of the method applied in the current study.

In summary, time-specific fabrics are hard to identify at Ayios Vasileios among the *coarse wares*. At this point in our fabrics study, we can observe that some *coarse ware* fabrics do seem to occur more frequently in specific periods. However, most of these fabrics seem to appear in other time periods as well, although in lower frequencies.

5. Fabrics in a wider context

To what extent are the potential Bronze Age or Byzantine fabrics comparable to fabrics described in other publications on Ayios Vasileios, and in publications on nearby (stratified) archaeological sites? The first publication (Kardamaki 2017) on the pottery of the Mycenaean palace at Ayios Vasileios entails descriptions of pottery types with notes on the fabric. Any comparison is necessarily preliminary, since the publication deals with only a limited selection of pottery types; the research is ongoing, the (final) results will be published elsewhere (Kardamaki 2017: 74, 111-114), and the fabric descriptions remain on a very general level, which impedes a meaningful comparison. Kardamaki makes anecdotal remarks on some Late Bronze Age



Fig. 21. Fabric 13: AVS17-4305GS-001: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

coarse fabrics. The coarse wares make up only a small part of the pottery found and are in a very fragmented state, but they are still present in most contexts. General types can be associated with goblets and closed shapes, such as jugs, jars and hydrias (Kardamaki 2017: 101).

Another remark concerns a red fabric with a clear micaceous appearance, called red silver mica fabric. It relates to large handmade basin or cooking jar types and is assumed to be an imported product from Kythera (see Kardamaki 2017: 104, 112, where she refers to Zerner 2008 Fig. 5.34/1770, 1777). Elsewhere, Kardamaki (2017: 104) relates the same fabric to a wheel-made cooking pot, again assumed to be an import from Kythera. Zerner is the source of Kardamaki's assumption, but Zerner herself mentions outcrops of micaceous schists on Crete,

on Kythera, as well as in the southern Peloponnese (Zerner, 2008: 207-208). Therefore, the red silver mica fabric may just as well be a Peloponnesian product. Finding a fabric in our pilot study matching the red silver mica fabric might seem easy due to the rather striking visibility of mica. However, in our rather limited set of sherds, a silverish micaceous appearance shows up in many reddish-firing fabrics, making it difficult to put forward a best match. This common appearance of silverish mica (in the fabrics collected in our surveys) strengthens the possibility that the fabric is regional or even local. A suitable connection between Kardamaki's red silver mica and a red-firing micaceous fabric in our pilot study may be found in Fabric 13, with the fragment of ring handle AVS17-1122GS-006 (Fig. 20), ring handle



Fig. 22. Fabric 15: AVS17-4231GS-009 as an example of micaceous appearance, related to the red silver mica fabric as mentioned by Kardamaki: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

AVS17-1848GS-002 (Fig. 6), or handle AVS17-4305GS-001 (Fig. 21). The first two are dated in the Bronze Age, whereas the last one cannot be dated to a specific period.

Fabric 15 is very similar to Fabric 13, with mainly a colour difference towards reddish orange. Options for a match with Kardamaki's red silver mica fabric could be rim AVS17-1773-003 or rim AVS17-3245GS-001 (Fig. 15). The first one has a problematic dating in the Roman era,

where the latter is possibly dated in the Bronze Age. The only sherd in this fabric dated to the Bronze Age with certainty is a rim rather poor in diagnostic features (AVS17-1695TC-001). Fabric 12 – comprising one sherd only and connected to Fabric 13 – offers the most obvious match to the red silver mica fabric of Kardamaki. With the naked eye, a striking presence of micaceous flakes is detectable. An image of band/ring handle



Fig. 23. Fabric 20: AVS17-3681GS-001 + AVS17-3719GS-001: view and fresh section; the horizontal line represents 1 cm (photo Y. de Raaff; illustration G.J.M. van Oortmerssen, © RUG/GIA).

AVS17-4231GS-009, dated to the Bronze Age, is given in Fig. 22, but it seems impossible to capture the impression of the micaceous appearance in a photo.

A similar problem is encountered when we turn to the Byzantine pottery. Sanders' (1993) publication of medieval pottery from Sparta offers some entries on

Byzantine fabrics. His Fabric 17 is characterized as a “fine, lustrous, grey to pink to peach-coloured, soft laminar fabric with rare red inclusions.” It is nicknamed taffy ware after a type of American confection with a satin appearance. In general, this seems comparable to some of our pale- to pink-firing material. The crucial difference between taffy ware and Fabrics 1, 2 and 3 from our set is the established hardness. Taffy ware is noticeably soft (Sanders 1993, 254, 255, 268), whereas all of our three fabrics are either hard or very hard (see also Fig. 10). Occasionally, a combination of fabric and typology confirms a particular dating, such as the decorated vertical band handle AVS17-3681GS-001 + AVS17-3719GS-001, a refit deriving from Fabric 20 (Fig. 23). The grooves in the handle resemble very closely the type of late 12th century AD *stamnos* published by Sanders. In general, the fabrics published by Sanders overlap with our Fabric 20 as well (compare Sanders 1993; fabrics 13 and 14 (255, 269, Fig. 9 nr. 38, 272, Plate 26 nr. 38) with our description and illustration of Fabric 20).

When we try to connect our provisional fabrics to fabrics defined by other researchers at the same site or other sites, it becomes apparent that these connections remain tentative, based on argued assumptions. To arrive at more reliable ceramic fabric connections, or at identification of similar fabrics, ceramic researchers will need to publish not only textual descriptions and images of thin sections – as seems to be the common approach – but also a series of high-resolution pictures of sherds and their fresh sections, together with descriptions of these sherds. Since this type of research is ongoing, the best place to publish the results would be a website with a repository, which can be expanded and kept up to date by a limited number of relevant experts ‘speaking the same language.’ The FACEM¹¹ site serves as a good example.

6. Conclusions

The largest and third-largest fabrics within the current pilot – Fabric 34 (32 sherds) and Fabric 20 (13 sherds) – allow us to answer the current research question: Can we discern Bronze Age *coarse wares* from Byzantine/Early Modern *coarse wares* by means of optical fabric analysis as applied? On the basis of the current pilot study, including the various limitations described, the answer is a quite straightforward “No.” In addition, a comparison with fabric characteristics published by Kardamaki relating to Late Bronze Age pottery from

Ayios Vasileios and by Sanders relating to medieval pottery from Sparta did not create a convincing connection between the fabrics defined by our study of survey materials and the fabrics defined by these researchers based on study of sherds from stratified contexts. This is partly due to the concise descriptions of the fabrics and the absence of illustrations of fresh breaks and partly because the study by Kardamaki was not aimed at defining fabrics.

Summarizing the results of our study thus far, we note that we have not yet been able to indisputably label a specific fabric as Bronze Age or Byzantine fabric. This is mainly due to the limitations of the current fabric pilot: the absence, so far, of fully studied and published stratified material from the excavations of Ayios Vasileios; a limited number of sherds dated with certainty within the survey samples; and a strong bias in the studied material towards handles, which offer limited potential in discriminating manual from wheel-based production.

We can make some cautious suggestions, but their validity will need to be confirmed or rejected through further research. First, the pale- to pinkish-firing materials grouped in Fabrics 1 to 3 offer a potential key to ceramics produced in the Byzantine era. Second, the reddish- to brown-firing fabrics as combined in Fabrics 9-12-13-14-15 offer a potential key to ceramics produced in the Bronze Age, although much less convincingly so than the pale material does for the Byzantine era. Third, three fabrics can be identified as being of Classical-Hellenistic (Fabric 37), Roman (Fabric 6), and Roman to Early Modern (Fabric 22) date, respectively.

We are confident that our pilot study of the fabrics offers a useful jumping-off point to further study fabrics and discriminate among *coarse ware* fabrics at Ayios Vasileios, especially once further study and publication of the stratified material from the excavations has taken place. Studies such as the current one can only become meaningful if data from surveys and excavations are mutually accessible. Researchers working on nearby sites should work together in setting up a shared and standardized system of documentation and presentation of pottery types and fabrics. Only then it will be possible to gain insight into local, regional or even supra-regional varieties in pottery production and exchange.¹² If such a working environment can be created, we recommend further research.

In order to standardize fabric research and fabric descriptions and make them more objective, we are currently running a pilot with machine learning on

11 FACEM.at, for example <http://facem.at/m-219-1>, which entails a *coarse ware* from Paestum (Italy).

12 See, for example, Quinn *et al.* (2011), who argue for a petro-database (an online database for thin section ceramic petrography) and Hein & Kilikoglou (2012). See also Appendix 2: scientific databases and other resources for archaeometry, in Orton & Hughes (2014).

the basis of standardized photographs of fresh ceramic sections.¹³ If successful, this approach would overcome several problems involving accessibility of the material and differences or biases in interpretation of the fabric characteristics.

We realise that our approach as presented here – which is restricted to using a framework of related material characteristics in pottery production – might lead to the criticism debated by Coles, Waterbolk, Butler and Van der Waals as early as the 1960s, regarding the Stuttgart Bronze Age metal analysis project.¹⁴ However, our approach was the only available option at the time of our research opportunities. Given the enormous variation in pottery paste recipes, our visualisation of the connections between fabrics (Fig. 13) shows the emphasis on connecting rather than dividing fabrics. In many respects, our pilot study provides space for further research. We hope that future publications on the ceramics of Ayios Vasileios will help refine our picture of the characteristics of Bronze Age and Byzantine coarse wares.

7. Acknowledgements

The pedestrian survey at Ayios Vasileios is funded by the Institute for Aegean Prehistory (INSTAP) by means of a post-doctoral fellowship to C.W. Wiersma, the Michael Ventris Memorial Award to C.W. Wiersma, the Curtiss T. & Mary G. Brennan Foundation Grant to S. Voutsaki and C.W. Wiersma, the University of Groningen (the Netherlands), and the Netherlands Organisation for Scientific Research (NWO), project grant 275-60-009 to C.W. Wiersma. We thank the Archaeological Society at Athens and the Laconia Ephorate of Antiquities for permission to survey the area. We are grateful to the staff of the Laconia Ephorate and to Dora Kondyli for their assistance. Finally, our thanks go out to the many students who participated in the survey project, for their enthusiasm, and to the people in Xirokambi, for their warm welcome and hospitality.

References

ATTEMA, P.A.J., A.J. BEIJER, M. KLEIBRINK, A.J. NIJBOER & G.J.M. VAN OORTMERSSEN, 2002. Pottery Classifications: Ceramics from Satricum and Lazio, Italy, 900-300 BC. *Palaeohistoria* 43/44, 321-396.

BOGGS, S., 2009. *Petrology of Sedimentary Rocks*. Cambridge, Cambridge University Press.

BUTLER, J.J. & J.D. VAN DER WAALS, 1964. Metal analysis, SAM 1, and European prehistory, *Helinium* 4, 3-39.

COLES, J.M., 1970. Metal analyses and the Scottish Early Bronze Age, *Proceedings of the Prehistoric Society* 35, 330-344.

FEUER, B. & G. SCHNEIDER, 2003. Chemical Analysis and Interpretation of Mycenaean Pottery from Thessaly. *Journal of Mediterranean Archaeology* 16(2), 217-247.

HEIN, A. & V. KILIGOGLOU, 2012. ceraDAT - Prototype of a web-based relational database for archaeological ceramics. *Archaeometry* 54(2), 230-243.

HIGGINS, M.D. & R. HIGGINS, 1996. *A Geological Companion to Greece and the Aegean*. London: Duckworth.

KARADIMAS, N. in prep. Ο λόφος του Αγίου Βασιλείου στο Ξηροκάμπι Λακωνίας πριν από την έναρξη των ανασκαφών

KARDAMAKI, E., 2017. The Late Helladic IIB to IIIA2 pottery sequence from the Mycenaean palace at Ayios Vasileios, Laconia. *Archaeologia Austriaca* 101, 73-142.

KINTIGH, K.W., 1984. Measuring Archaeological Diversity by Comparison with Simulated Assemblages. *American Antiquity*. Society for American Archaeology 49(1), 44-54.

KONDOPOULOU, D., E. AIDONA, N. IOANNIDIS, G.S. POLYMERIS, & S. TSOLAKIS, 2015. Archaeomagnetic study and thermoluminescence dating of Protobyzantine kilns (Megali Kypsa, North Greece). *Journal of Archaeological Science: Reports* 2, 156-168.

MELTZER, D.J., R.D. LEONARD, & S.K. STRATTON, 1992. The relationship between sample size and diversity in archaeological assemblages. *Journal of Archaeological Science* 19, 375-387.

MOODY, J. et al., 2003. Ceramic Fabric Analysis and Survey Archaeology: The Sphakia Survey. *The Annual of the British School at Athens* 98, 37-105.

MOUTAFI, I. & S. VOUTSAKI, 2016. Commingled burials and shifting notions of the self at the onset of the Mycenaean era (1700-1500 BCE): The case of the Ayios Vasileios North Cemetery, Laconia. *Journal of Archaeological Science: Reports* 10, 780-790.

MÜLLER, N.S. et al., 2018. The effect of inter- and intra-source variation: A comparison between WD-XRF and NAA data from Cretan clay deposits. *Journal of Archaeological Science: Reports* 21, 929-937.

NIJBOER, A.J., P.A.J. ATTEMA, & G.J.M. VAN OORTMERSSEN, 2006. Ceramics from a Late Bronze Age saltern on the coast near Nettuno (Rome, Italy). *Palaeohistoria* 47/48, 141-205.

OKSANA, K., 2018. *Using supervised machine learning to classify ceramic fabrics*. Master thesis. Department of Anthropology, University of Manitoba, Winnipeg.

ORTON, C. & M. HUGHES, 2014. *Pottery in Archaeology*. Cambridge, Cambridge University Press.

¹³ See also note 4. The pilot involves ceramics from stratified contexts in Lazio (Italy) dated between the 9th and 5th centuries BC. We are running tests to compare the fabrics as described by fabric specialists with fabric analyses on the basis of the same sherds by means of machine learning.

¹⁴ See, for example Butler & Van der Waals (1964); Waterbolk & Butler (1965); Coles (1969).

- OWNBY, M.F., I.C. DRUC & M.A. MASUCCI (eds), 2017. *Integrative Approaches in Ceramic Petrography*. Salt Lake City, The University of Utah Press.
- PEACOCK, D.P.S., 1977. Ceramics in Roman and Medieval Archaeology. In: D.P.S. Peacock, (ed.), *Pottery and Early Commerce: Characterization and Trade in Roman and Later Ceramics*. London, Academic Press, 21–33.
- PETERSON, S.E., 2009. *Thin-section petrography of ceramic materials*. INSTAP Arc. Philadelphia, Pennsylvania, INSTAP Academic Press.
- POLYMENAKOS, L., n.d. 2012. Γεωλογική Μελέτη Και Αναγνώριση Των Δομικών Καταλοίπων Στην Ανασκαφή Αγ. Βασιλείου Στο Ξηροκάμπι Λακωνίας. Τεχνική Έκθεση. Unpublished Report.
- PUGLISI, G. et al., 2015. Automatic extraction of petrographic features from pottery of archaeological interest, *ACM Journal on Computing and Cultural Heritage* 8(3), Article 13.
- QUINN, P. et al., 2011. Petrodatabase: an on-line database for thin section ceramic petrography. *Journal of Archaeological Science* 38, 2491–2496.
- QUINN, P.S. (ed.), 2009. *Interpreting silent artefacts: petrographic approaches to archaeological ceramics*. Oxford, Archaeopress.
- RAPTIS, K., 2012. Early Christian and Byzantine ceramic production workshops in Greece: typology and distribution. In: Atti del IX Congresso Internazionale sulla Ceramica Medievale nel Mediterraneo, Venezia, 23–27 November 2009, 38–43.
- RICE, P.M., 1987. *Pottery Analysis: A Sourcebook*. Chicago, University of Chicago Press.
- RUTTER, J.B., 1993. A group of Late Helladic IIA pottery from Tsoungiza. *Hesperia*. American School of Classical Studies at Athens 62(1), 53–93.
- SANDERS, G.D.R., 1993. Excavations at Sparta: The Roman Stoa, 1988–91 Preliminary Report, Part 1(c) Medieval Pottery. *The Annual of the British School at Athens* 88, 251–286.
- SHEPARD, A.O., 1965. *Ceramics for the Archaeologist*. Washington D.C., Carnegie Institution of Washington.
- VASILOGAMVROU, A., 2011. Ανασκαφή στον Άγιο Βασίλειο Λακωνίας. *Praktika tis en Athinais Archaialogikis Etairias*, 2011 (2014), 59–68.
- VASILOGAMVROU, A., 2012. Ανασκαφή στον Άγιο Βασίλειο Λακωνίας. *Praktika tis en Athinais Archaialogikis Etairias* 2012 (2015), 63–76.
- VASILOGAMVROU, A., 2013. Ανασκαφή στον Άγιο Βασίλειο Λακωνίας. *Praktika tis en Athinais Archaialogikis Etairias* 2013 (2015), 97–116.
- VASILOGAMVROU, A., 2016. Ανασκαφή στον Άγιο Βασίλειο Λακωνίας. *Praktika tis en Athinais Archaialogikis Etairias* 2016, 131–181.
- VOUTSAKI, S. et al., 2018. Το Βόρειο Νεκροταφείο στον Άγιο Βασίλειο Λακωνίας και η εξέλιξη των ταφικών εθίμων στην αρχή της μυκηναϊκής περιόδου. In E. Zymi, A.V. Karapanagiotou, and M. Zanthopoulou (eds.). *Το Αρχαιολογικό Έργο στην Πελοπόννησο (ΑΕΠΕΛ)*. *Proceedings of the International Conference, 7–11 November 2012. University of Peloponnese, Kalamata*. Kalamata, University of the Peloponnese, 91–99.
- VOUTSAKI, S., C.W. WIERSMA & W. DE NEEF, 2019. The Ayios Vasilios Survey Project: questions, aims and methods. *Journal of Greek Archaeology* 4, 67–95.
- VOUTSAKI, S., V. HACHTMANN & I. MOUTAFI (in press). Space, place and social structure in the North Cemetery, Ayios Vasilios. In B. Eder & M. Zavadić (eds.). *(Social) place and space in early Mycenaean Greece. Discussions in Mycenaean Archaeology*. Vienna, Austrian Academy of Sciences.
- WATERBOLK, H.T. & J.J. BUTLER, 1965. Comments on the use of metallurgical analysis in prehistoric studies, *Helinium* 5, 227–251.
- WENTHWORTH, C.K., 1922. A Scale of Grade and Class Terms for Clastic Sediments. *The Journal of Geology* 30(5), 377–392.
- WHITBREAD, I.K., 2016. Fabric description of archaeological ceramics. In A. Hunt (ed.). *The Oxford Handbook of Archaeological Ceramic Analysis*. Oxford, Oxford University Press.
- WIERSMA, C.W., in press. The Ayios Vasilios Survey Project: diagnostic samples versus total samples and their biases. In A.M. Meens, M. Nazou, & W. Van de Put (eds.). *Fields, Sherds and Scholars. Recording and Interpreting Survey Ceramics: Proceedings of a Conference Held at the Danish Institute at Athens, 24–25 February 2017*. Leiden, Sidestone Press.
- ZERNER, C.W., 2008. The Middle Helladic pottery, with the Middle Helladic wares from Late Helladic deposits and the potters' marks. In W.D. Taylour & R. Janko (eds.). *Ayios Stephanos: Excavations at a Bronze Age and Medieval Settlement in Southern Laconia*. Athens, The British School at Athens, 177–298.

