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Data Article

Archaeometric data from the *Via dei Sepolcri* ceramic workshop in Pompeii (Southern Italy)



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ABSTRACT

The present article provides chemical, paleontological and mineralogical data obtained during an archaeometric characterization of 40 samples (33 pottery sherds, 5 clay samples, 1 sand sample and 1 red earth pigment) collected in the *Via dei Sepolcri* ceramic workshop in Pompeii, Italy. The workshop was still active during the 79 CE eruption of Mt. Vesuvius and the archaeometric data obtained in our investigation reveal distinct differences between pottery and geological

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Keywords:

Ceramic production
Thin Walled pottery
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Pompeii
Raw materials
Campania region

raw materials belonging to an early 'Phase 1' production (from the beginning of the 1st century CE to the 62 CE earthquake) and a subsequent 'Phase 2' production (from the 62 CE earthquake to the 79 CE eruption). These data inform the discussions and interpretations presented in the article entitled "A pottery workshop in Pompeii unveils new insights on the Roman ceramics crafting tradition and raw materials trade", edited by Grifa et al. [1].

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Specifications Table

Subject	Archaeology
Specific subject area	Archaeometry
Type of data	Tables Figures Excel spreadsheet
How data were acquired	Polarized light microscopy Reflected light microscopy Digital image analysis X-ray powder diffraction Inductively coupled plasma mass spectrometry Scanning Electron Microscopy Energy-Dispersive Spectroscopy Fourier Transform Infrared Spectroscopy
Data format	Raw Analyzed
Parameters for data collection	All samples were examined in thin section and as powders (grain size <10 μm) obtained using a McCrone Micronising Mill (agate cylinders) and a wet grinding time of 15 min. For paleontological analyses, aliquots of samples were disaggregated and washed with water through 230 and 120 mesh sieves (63 μm and 125 μm respectively).
Description of data collection	Chemical, mineralogical and petrographic characterization of 40 samples consisting of 33 pottery sherds, 5 clayey materials, 1 sand sample and 1 red earth pigment. Paleontological analyses on 3 pottery samples and 2 clayey sediments.
Data source location	The Via dei Sepolcri workshop, Archaeological site of Pompeii (Italy); DST, Università degli Studi del Sannio (Italy); DiSTAR Università degli Studi di Napoli Federico II (Italy); UCLA/Getty Conservation Program and Cotsen Institute of Archaeology, University of California Los Angeles (USA).
Data accessibility	With the article and available on Mendeley Data Repository name: Supplementary materials for: Archaeometric data from the Via dei Sepolcri ceramic workshop in Pompeii (Southern Italy) Direct URL to data: (http://dx.doi.org/10.17632/37ws9rnxbp.1)
Related research article	C. Grifa, C. Germinario, A. De Bonis, L. Cavassa, F. Izzo, M. Mercurio, A. Langella, I. Kakoulli, C. Fischer, D. Barra, G. Aiello, G. Soricelli, C. R. Vyhnał, V. Morra, A pottery workshop in Pompeii unveils new insights on the Roman ceramics crafting tradition and raw materials trade, J. Archaeol. Sci. https://doi.org/10.1016/j.jas.2020.105305 .

Value of the Data

- This paper furnishes the first archaeometric data on pottery and raw materials from a workshop discovered in Pompeii and still active during the 79 CE eruption.
- Archaeologists and researchers in the archeological sciences who are involved in the study of Roman pottery will benefit from these data.
- The data represent an important dataset for future studies on Pompeian pottery, as well as a tangible example of Roman pottery technology active during the 1st century CE.

1. Data Description

The data reported here refer to a recent archaeometric investigation carried out on 33 pottery fragments (both fired and unfired) collected in the *Via dei Sepolcri* workshop in Pompeii (Italy) along with 5 clay samples, 1 volcanic sand sample and 1 red earth pigment considered to be possible geological raw materials and additional materials used in ceramic manufacturing. Results are summarized in 7 figures and 7 supplementary tables, the latter provided as supplementary material (in an Excel spreadsheet) and consisting of: the archaeological information of the collected samples (Suppl. Table 1); the synoptic table of the performed analytical techniques (Suppl. Table 2); textural and mineralogical features of the samples analysed via PLM (Suppl. Table 3) (main abbreviations [2]); the chemical composition of selected pottery samples obtained via ICP-MS (Suppl. Table 4); clay samples used for the statistical comparison of their chemical composition with their potential source areas and their high-CaO (HCC, CaO > 6%) and low-CaO (LCC, CaO < 6%) chemical imprint (Suppl. Table 5) (references [3–5]); the mineralogical composition of samples and equivalent firing temperatures (EFTs) (Suppl. Table 6); the species and number of specimens of the benthic foraminifers found in the PSP32, 33, 46 and occurrence of the same species in sediments collected in the Montecorvino Rovella (MCR1) and in the Rufoli di Ogliara (RUF1) (Suppl. Table 7). Moreover, $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ values of samples MCR1 clayey samples and PSP11 and PSP33 archaeological pottery have been compared (data from Morra et al. 2020) (Suppl. Table 4).

Tabulated raw data of figures (.csv format) are also available, along with supplementary tables, at Mendeley Data (<http://dx.doi.org/10.17632/37ws9rnzpxb.1>) [dataset] [6].

1.1. Pottery and geological materials

The workshop produced Thin Walled pottery vessels (hereafter TW) that were typically used for liquids. The pottery consists of just a few typological variants: more commonly small, closed forms, and less commonly open forms with curved or straight handles. TW exhibiting different types of external decorations were recovered from Phase 1, including four samples with sandy-like decoration (PSP22, 24, 35 and 40), egg-shell pottery (PSP29 and 38), undecorated TW pottery (PSP19, 21, 25, 34, 41) and some prototypes of red slipped TW (PSP28, 39 and 43; Suppl. Table 1). One red slipped TW sample (PSP39) showed small and imprecise engravings on the external surface. Additionally, two clayey materials (PSP45 and 46) and a red earth sample (PSP37) found in a large cooking pot were collected as possible raw and additional (complementary) materials.

The red slipped TW with engraved decoration (*guillochis*) represents Phase 2 core production; most objects recovered from this phase are unfired vessels (PSP1–11, PSP23 and PSP30, Suppl. Table 1), although fired vessels of the same types were also collected (PSP12–16 and PSP18).

Apart from pottery, samples from the later phase also include raw materials used for pottery manufacture, including three clay bodies (unshaped clay material plus volcanic temper, PSP32, 33, 44) and a volcanic sand (PSP20).

Samples from both phases have been analysed by means of a comprehensive archaeometric approach (Suppl. Table 2).

1.2. Data for phase 1 pottery

1.2.1. PLM

Type i) clay has coarse-grained, residual, non-plastic inclusions of quartz and feldspar with sporadic volcanic temper (clinopyroxene and scoriae) whereas more abundant volcanic temper (frequent clinopyroxene, sporadic scoriae, garnet and amphiboles) can be observed in Type ii) clay (Suppl. Table 3). In samples PSP22, 25 and 40, a poorly preserved, reddish or dark slip can be noticed.

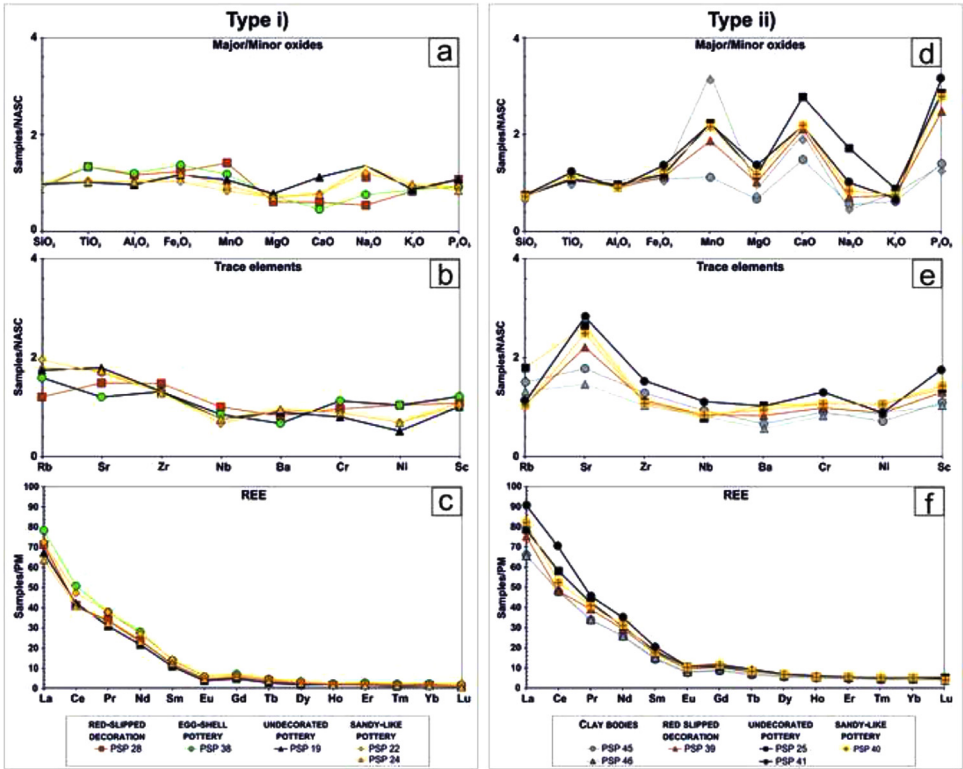


Fig. 1. Major, trace elements and REE patterns of Type (i) (a-c) and Type (ii) (d-f) samples and raw materials of Phase 1. Major and trace element contents were normalised to the North American Shale Composite (NASC) [18] whereas REE concentrations were normalised to Primordial Mantle (PM) [19].

1.2.2. Chemical composition

In Fig. 1, diagrams for samples of Phase 1 distinguish two types of clay raw starting materials: Type i) clay with low-Ca (CaO < 4 wt%) and high-Si (SiO₂ > 55 wt%) (Fig. 1a); Type ii) clay with intermediate calcium oxide (4 < CaO < 10 wt%) and intermediate silica (45 < SiO₂ < 55 wt%) concentrations (Fig. 1d). Moreover, Type i) clay is generally characterized by higher variability in the content of all major elements (Fig. 1a), whereas Type ii) clay displays constant values for SiO₂, TiO₂, Al₂O₃, Fe₂O₃, K₂O and higher variability for remaining elements (Fig. 1d). Broad chemical differences between these two types of base clays are also reflected in some variations in minor and trace elements, including REEs (Suppl. Table 4). In particular, Type i) clay (Fig. 1b) differs from the Type ii) clay (Fig. 1e) for the lower variability of Sr, Zr and Sc, whereas a general increase in the content of La, Ce, Pr, Nd, Sm and Eu is also noticed (Fig. 1c and f).

Type i) clay raw materials have been compared via Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA) with low-CaO clays from the Campania region (Suppl. Table 5) [3–5].

In this respect, a sequence of multivariate statistical analyses was applied to the dataset:

- (a) ICP-MS raw data were log₁₀ transformed to avoid any risk of errors in classification of the objects [7,8];
- (b) Principal Component Analysis (PCA) simplified the calculation procedure since 96% of the variability is explained at the 9th component (Fig. 4a in [1]);

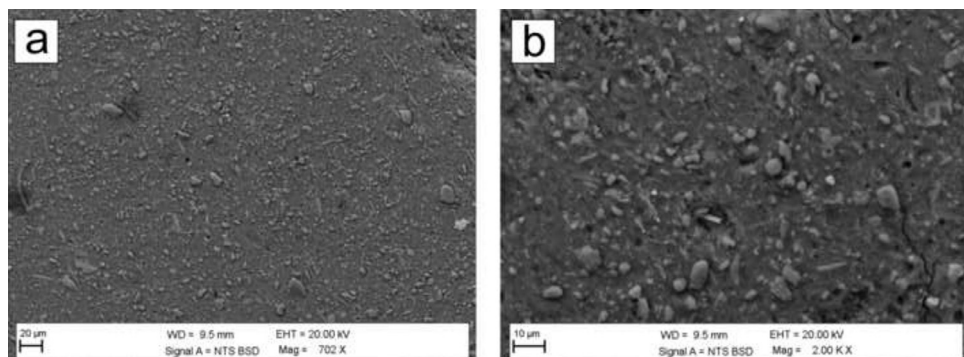


Fig. 2. Back-scattered electron (BSE) images of clay PSP46. Note the fine-grained texture of the clayey sample (a-plastic grains never exceed $20\ \mu\text{m}$).

- (c) 9 elements (Sc, Nb, MgO, Rb, Mn, Na_2O , Ba, Ni, TiO_2) from Ca-poor samples formed the resulting eigenvalues matrix for the Hierarchical Cluster Analysis (HCA).

The resulting dendrogram places the samples PSP22 and PSP24 in the same group of alluvial/lacustrine clayey sediments (SMV2, CET2, SQ1, PMV2 and VEL1) (Fig. 4a in [1]).

As far as the Type ii) clay is concerned, PLM and SEM observation (see Section 1.2.4) highlighted that samples PSP45 and 46 are very fine-grained (Fig. 2). For this reason, the above-mentioned multivariate statistical procedure was performed on the PSP45 and 46 samples and high-CaO clays from the Campania region (Suppl. Table 5) [3–5]. Only those elements experimentally considered “immobile” after a clay manipulation [4] have been considered for the statistical treatment of chemical data. In this case:

- (a) Principal Component Analysis (PCA) simplified the calculation procedure since 98% of the variability is explained at the 4th component (Fig. 4b in [1]);
- (b) 4 elements (Nb, TiO_2 , Sc, Mn) from high-CaO samples formed the resulting eigenvalues matrix for the Hierarchical Cluster Analysis (HCA).

The resulting dendrogram showed that samples PSP45 and 46 are placed in the same group of the clay sediments from the Island of Ischia; as matter of fact, they also share the intermediate-CaO concentration along with other peculiar chemical characteristics ($\text{Zr} = 252$ and $200\ \text{ppm}$; $\text{Cr} = 110$ and $100\ \text{ppm}$, in PSP45 and 46 respectively) (Fig. 4b in [1]) [4,5].

1.2.3. XRPD

XRPD analyses (Suppl. Table 6) indicate for Ca-poor, overfired samples (PSP19, 21, 22, 24, 34), the presence of abundant feldspar, scarce quartz and clinopyroxene, scarce calcite, traces of hematite and scarce hercynite (absent only in PSP25 that also shows scarce analcime). All these samples have residual illite. Fired samples PSP35, 39, 40 and 43 (intermediate-Ca) show higher amounts of illite and calcite. Furthermore, newly formed Ca-silicates (clinopyroxene and Ca-feldspar) are also noticed in sample PSP41.

1.2.4. SEM/EDS

Optical and electron microscopy observations of samples PSP46 (Type i) clay (Fig. 2) indicate that the clay is a fine-grained sediment (never exceeding $20\ \mu\text{m}$); moreover, paleontological analyses highlighted that this clay is barren of fossils (Suppl. Table 7).

1.3. Data for phase 2

1.3.1. PLM

Dark sandy material (PSP20) is formed of grains of feldspar (plagioclase and sanidine), clinopyroxene, leucite and minor quartz, garnet, amphibole, olivine, hematite, biotite and juveniles such as pumices and leucite-bearing scoriae (Suppl. Table 4). Equivalent mineralogical and textural features are observed for non-plastic components of clayey bodies PSP32, 33 and 44 (ca. 5% vol.) (Suppl. Table 3). Main components forming the tempers in both fired (PSP12–16 and PSP18) and unfired (PSP1, 3, 4, 6, 10 and 11) samples are almost the same as observed in raw sandy material and clayey bodies, even if additional sporadic biotite can be detected in unfired pottery. Furthermore, most of these samples (both fired and unfired) show the occurrence of sporadic fossil foraminifera and bivalves (Suppl. Table 4). Significant differences between fired and unfired samples were found in the zoning and optical activity of the clay matrix. In particular, in unfired samples, the matrix shows a sharp zoning with a gray core and a light brown rim. In fired samples, on the other hand, the color of matrix changes particularly in PSP12 (red-orange, isotropic) and PSP13 (from red-orange and anisotropic in the core to orange and isotropic at the rim) (Suppl. Table 3). Lastly, unfired samples are characterized by a thin, red-orange slip covering both the internal and the external surfaces of the vessels. In fired samples, this slip is slightly darker.

1.3.2. Chemical and isotopic composition

Compositional data showed the high-CaO content of PSP32, 33 and 44 samples, and small variations in their overall chemistry (Suppl. Table 4, Fig. 3). However, a lower CaO amount is recorded in PSP32 with respect to PSP33 and 44 (Suppl. Table 4, Fig. 3a); the same sample shows higher concentrations of SiO₂, Ba, Zr and LREE (Suppl. Table 4, Fig. 3a-c). Similar contents of major (Fig. 3a), trace elements (Fig. 3b) and REEs (Fig. 3c) were observed in the fired (PSP13 and PSP18) and unfired samples (PSP1, PSP10 and PSPS11). Carbonate-bearing clays cropping out in the Campania region (Suppl. Table 5) [1,4], whose typical chemical variability is showed in Fig. 4, have been compared as well.

The Sr-Nd isotopic composition of clay body (PSP33) and unfired material (PSP11) are 0.709565 and 0.710302 for ⁸⁷Sr/⁸⁶Sr and 0.512186 and 0.512196 for ¹⁴³Nd/¹⁴⁴Nd, respectively (Suppl. Table 4), in good agreement with data from the clay sample RUF1 (⁸⁷Sr/⁸⁶Sr = 0.710404 and ¹⁴³Nd/¹⁴⁴Nd = 0.512124) (Suppl. Table 4).

1.3.3. XRPD

XRPD analyses carried out on clay body PSP33 and unfired sample PSPS11 suggest the occurrence of abundant quartz, frequent calcite, sporadic feldspar and clinopyroxene, and traces of dolomite and amphibole (only in PSP33) (Fig. 5a; Suppl. Table 6). On the other hand, their plastic counterpart is composed of a variety of clay minerals such as illite, kaolinite, chlorite and other smectite-like phyllosilicates with a poorly-ordered crystalline structure (Fig. 5a; Suppl. Table 6). As far as the fired pottery is concerned, mineral assemblages consist of illite/mica + calcite for samples PSP12, 13 and 18; calcite + pyroxene + illite/mica for sample PSP 16; calcite + pyroxene + feldspar + illite/mica for samples PSP14 and 15 (Fig. 5b; Suppl. Table 6).

1.3.4. Paleontological analyses

The results of paleontological analyses on benthic foraminifera indicate that a total of 65 fossils specimens are present in PSP32 and 33 (Suppl. Table 7). PSP32 contained only 3 species of benthic foraminifera, assigned to *Uvigerina longistriata* after [9], *Oridorsalis umbonatus* [10] and *Lenticulina?* sp. The assemblage of PSP33 consists of 62 specimens and is characterized by *Heterolepa dutemplei* [11] and *Uvigerina* spp.

A good match (6 species) with PSP33 assemblages was observed in the benthic fauna of sample MCR1 from Montecorvino Rovella, in which *H. dutemplei*, *Martinottiella communis* [11], *Melonis affinis* [10], *O. umbonatus*, *Planulina ariminensis* after [12] and *U. longistriata* have been

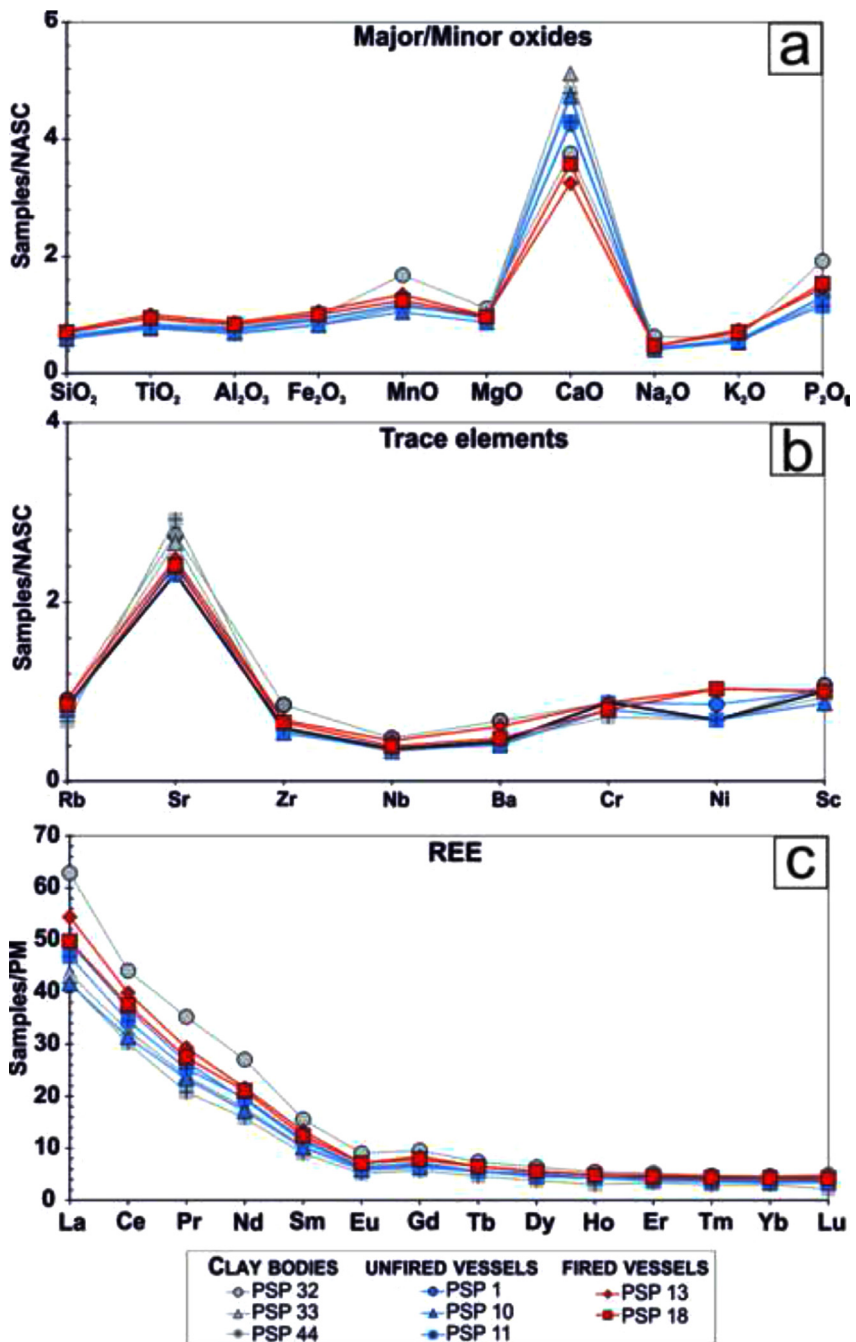


Fig. 3. Major (a), trace element (b) and REE patterns (c) of samples of pottery and clayey raw materials of Phase 2. Major and trace elements contents were normalised to the North American Shale Composite (NASC) [18] whereas REE concentrations were normalised to Primordial Mantle (PM) [19].

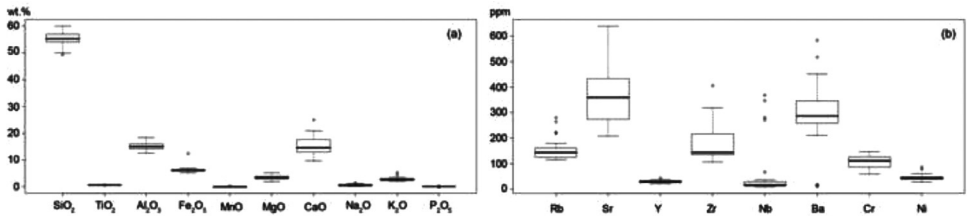


Fig. 4. Boxplots showing the chemical variability of Campania High-CaO clays for (a) major oxides and (b) trace elements.

recognized. Moreover, sample PSP 33 has *Gyroidina altiformis* [13] and *P. ariminensis* in common with RUF1 clay (Suppl. Table 7).

1.3.5. SEM/EDS

Micro-textural and micro-chemical analyses, carried out on the red-orange thin slip covering both the internal and the external surfaces of the vessels (Suppl. Table 3), show that tiny, bright Fe- and Ti-rich particles are scattered in a Si, Al, and K rich clay matrix (Fig. 6) that also contains quartz.

Significant differences in the chemical composition of the external slip with respect to the clay matrix has been revealed via EDS analyses. In particular, higher Ca concentration characterizes the clayey ceramic bodies.

1.3.6. FTIR and Raman spectroscopy

ATR-FTIR analyses of the orange slip (Fig. 7), carefully scratched from unfired pottery samples (PSP1, 5, 11), reveal the typical peaks of hematite at 527 and 460 cm^{-1} , along with those of quartz (796, 779, 691 cm^{-1}) and kaolinite (ca. 3694, 3650, 3621, 1640, 1000, 912, 418 cm^{-1}) [14]. Absorption bands of calcite (ca. 1425, 873 cm^{-1}) [15–17] are also visible. ATR-FTIR results showed a similar mineralogy for the red/orange material found adhering to the internal walls of some large jars from the Phase 1 layers (PSP37) (Fig. 7).

2. Experimental Design, Materials and Methods

A total of 40 samples were selected from the two phases of pottery production (Suppl. Table 1): 14 pottery samples from Phase 1 (8 fired and 6 overfired vessels), 19 pottery samples from Phase 2 (12 unfired and 7 fired vessels), 5 clayey raw material samples, 1 sand sample and 1 red earth sample (Suppl. Table 1).

The analytical strategy carried out on the investigated set of samples (Suppl. Table 2) was organised in five subsequent steps, considering: (i) the availability of archeological materials (initial weights range from 0.8 to 190 g; Suppl. Table 1), (ii) representativeness of the selected samples from the previous analytical step, and (iii) state of conservation:

Step 1. Mineralogical (X-ray powder diffraction - XRPD) and petrographic (polarized light microscopy - PLM) analyses were carried out for all the 40 specimens (Suppl. Table 2). This step allowed recognizing similarities among samples in order to select representative samples for further analytical steps.

Thin sections of the samples were prepared and analyzed by PLM using a Nikon Eclipse 6400 POL microscope equipped with a Nikon DS-Fi1 camera in order to identify the mineralogical phases present and to examine their textural features. Digital image analysis (DIA) using ImageJ software was utilized for determinations of grain size distribution (hereafter GSD) by estimation of $\varphi = -\log_2 [mF]$ (mF = minimum Feret) and circularity ($C = 4\pi(A/p^2)$, where A = area, p = perimeter) values, which were calculated to quantify the shapes of the grains.

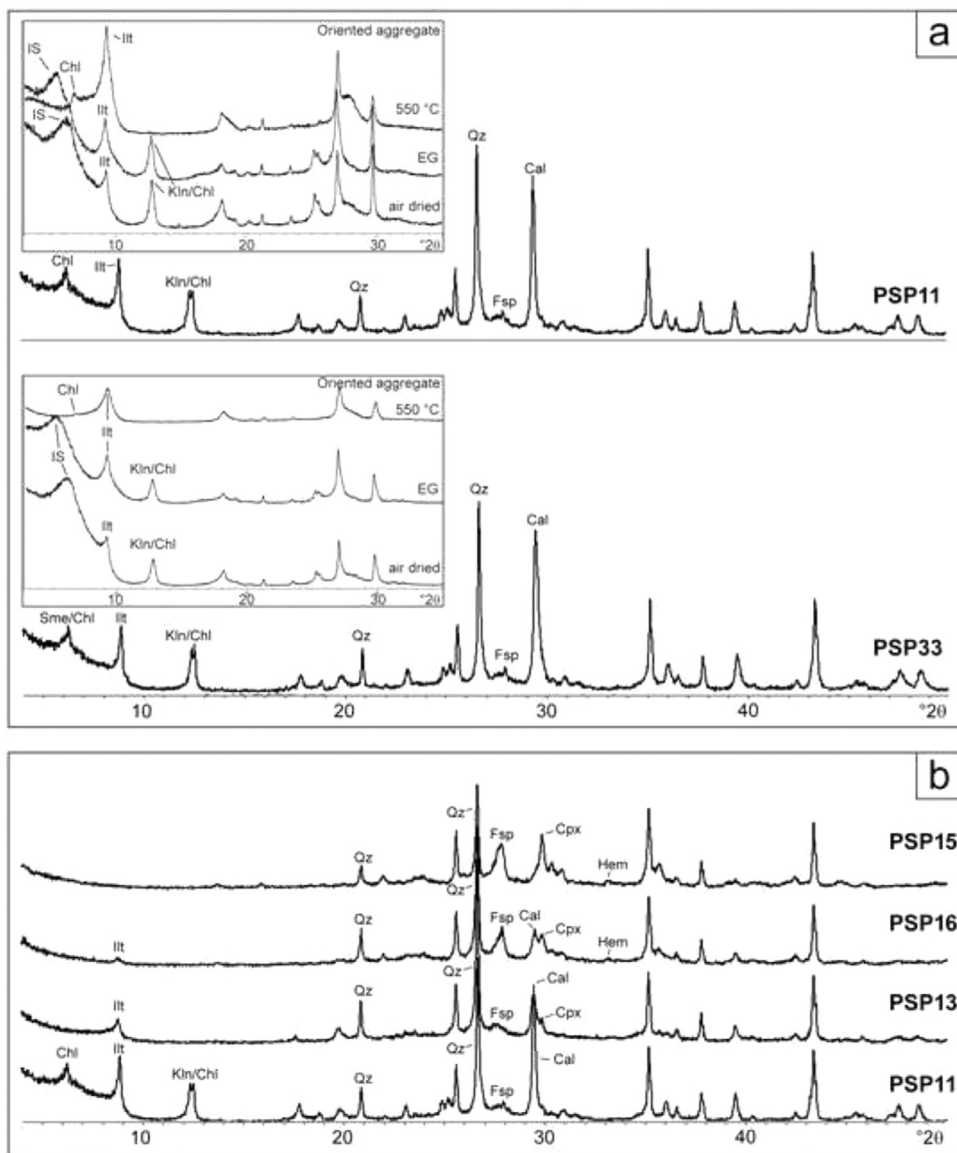


Fig. 5. (a) XRPD pattern of a representative unfired vessel (PSP11) compared to that of the clay body recovered in the workshop (PSP33). (b) XRPD patterns of both unfired (PSP11) and fired vessels (PSP13, 16, 15). The XRPD patterns are representative of the different firing temperatures estimated for the pottery of Phase 2 (PSP13: 850–900 °C; PSP16: 900–950 °C; PSP15: >950 °C). Abbreviations: Ill: illite; Kln: kaolinite; Chl: chlorite; Sme: smectite; IS: interstratified clay minerals; Qz: quartz; Fsp: feldspar; Cal: calcite; Cpx: clinopyroxene; Hem: hematite.

Mineralogical analyses were also carried out via XRPD using a Panalytical X'Pert Pro-diffractometer (CuK α radiation, 40 kV, 40 mA, 3–70° 2 θ scanning interval, RTMS detector, 0.017° equivalent step size, 60 s per step equivalent counting time). Powders with grain size <10 μ m were obtained using a McCrone Micronising Mill with agate cylinders and a wet grinding time of 15 min; a qualitative analysis was performed using X'Pert HighScore Plus 2.0 software.

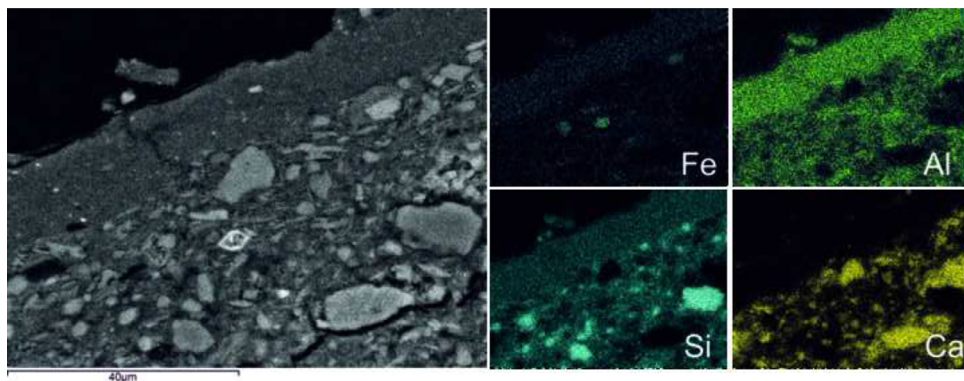


Fig. 6. Scanning electron photomicrograph of ceramic slip (sample PSP11) and energy dispersive X-ray spectroscopy maps of the most representative elements (Fe, Al, Si, Ca).

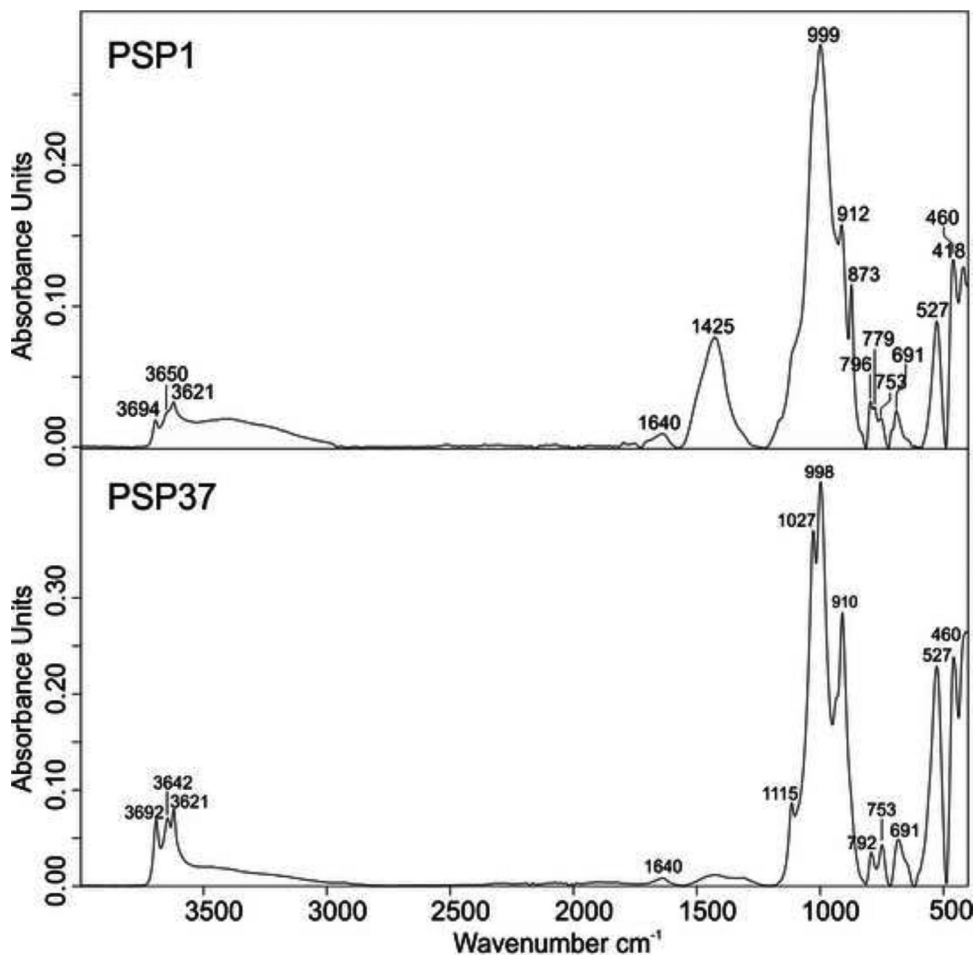


Fig. 7. ATR-FTIR spectra of the ceramic slip scratched from the sample PSP1 (a) and of the reddish deposit recovered in the workshop (PSP37).

Step 2. Chemical analyses were performed by ICP- MS on 22 powdered samples selected as suitably representative after Step 1. Major and trace element compositions of representative samples of each ceramic class were analysed by inductively coupled plasma mass spectrometry (ICP-MS) on fused raw materials at Actlabs, Ancaster, Ontario (Package 4LITHO, see <http://www.actlabs.com> for analytical details). Major elements are reported as weight percent oxides (wt%), normalised to 100% (LOI-free), while trace elements are expressed in ppm.

Step 3. Scanning Electron Microscopy (SEM) was carried out on carbon-coated thin sections of 7 samples using a Zeiss EVO 15 HD VPSEM working at 20 kV; *in situ* chemical analysis was undertaken via Oxford XmaX 80 Energy-Dispersive Spectroscopy (EDS). The beam was calibrated on a cobalt standard before any measurements were made.

Step 4. Based on the state of conservation and typology of samples (unfired/fired/overfired), the slips of 12 samples were selected for investigation by combined spectroscopic analyses. Raman analyses were performed with a Renishaw Raman spectrometer and a 785-nm laser probe on Spectra were recorded in extended mode in the range of 100 to 2500 cm^{-1} . Spectra were treated and analysed by software WiRE 4TM.

Fourier Transform Infrared Spectroscopy (FTIR) was carried out on few milligrams of powdered samples by means of a Bruker Alpha FTIR in ATR (Attenuated Total Reflectance) mode in the mid-infrared spectral range between 4000 and 400 cm^{-1} with 64 spectra scans and a spectral resolution of 4 cm^{-1} . Data acquisition and processing were carried out using the Opus 7.2 software (Bruker) and the spectra were smoothed using the Savitzky-Golay algorithm and baseline correction (Rubberband method).

Step 5. Finally, samples with a significant amount of material were selected for paleontological analyses; five samples were analysed to compare the microfaunal content of the raw clay found in *Via dei Sepolcri* (samples PSP32, PSP33 and PSP46) with the assemblages of the Upper Miocene deposits collected in the Montecorvino Rovella (MCR1) and Rufoli di Ogliara (RUF1) clay quarries (see [4] for mineralogical, chemical and petrophysical features), which represent potential sources of the material used in ceramics manufacture in 79 CE in Pompeii. Aliquots of samples were disaggregated and washed with water through 230 and 120 mesh sieves (63 μm and 125 μm respectively); the residues were examined under a reflected light microscope and the benthic foraminifera were collected.

CRedit Author Statement

Celestino Grifa: Project Administrator, Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing, Original Draft - Review & Editing, Funding acquisition. **Chiara Germinario:** Methodology, Formal analysis, Investigation, Validation, Writing - Review & Editing. **Alberto De Bonis:** Data Curation, Methodology, Formal analysis, Investigation, Validation, Writing - Review & Editing. **Laetitia Cavassa:** Resources, Investigation, Writing - Review & Editing. **Francesco Izzo:** Formal analysis, Investigation, visualisation, Writing - Review & Editing. **Mariano Mercurio:** Formal analysis, Investigation, Validation, Writing - Review & Editing. **Alessio Langella:** Writing - Review & Editing. **Ioanna Kakoulli:** Resources, Writing - Review & Editing. **Christian Fischer:** Resources, Writing - Review & Editing. **Diana Barra:** Formal analysis, Investigation, Writing - Review & Editing. **Giuseppe Aiello:** Formal analysis, Investigation, Writing - Review & Editing. **Gianluca Soricelli:** Writing - Review & Editing. **Christopher R. Vyhnal:** Writing, Original Draft - Review & Editing. **Vincenzo Morra:** Supervision, Writing - Review & Editing, Funding acquisition.

Declaration of Competing Interest

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Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:[10.1016/j.dib.2020.106706](https://doi.org/10.1016/j.dib.2020.106706).

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