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Bronze Age pottery from the Aeolian Islands: definition of Temper Compositional Reference Units by an integrated mineralogical and microchemical approach

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Abstract An integrated microchemical–petrographic approach is here proposed to discriminate the provenance of archaeological pottery artefacts from distinct production centres. Our study focuses on a statistically significant sampling ($n = 186$) of volcanic temper-bearing potteries representative of the manufacturing and dispersion among the islands of the Aeolian Archipelago during the Bronze Age. The widespread establishment of new settlements and the abundant recovery of Aeolian-made ceramic in southern Italy attest for the increased vitality of the Archipelago during the Capo Graziano culture (Early Bronze Age–Middle Bronze Age 2; 2300–1430 BC). Potteries from three of the main known ancient communities (Lipari, Filicudi and Stromboli) have been studied integrating old collections and newly excavated material. Volcanic tempers have been first investigated through multivariate analyses of relative abundances of mineral and rock clasts along with petrographic characters. In addition, we performed in-situ mineral chemistry microanalyses by Electron Microprobe and Laser Ablation—Inductively Coupled Plasma Mass Spectrometry to assess major and trace element composition of the most common mineral phases.

Four Temper Compositional Reference Units have been recognised based on compositional trends. Two units (AI and AX) are unequivocally distinct by their peculiar trace element enrichment and petrographic composition; they mostly contain samples from the sites of Lipari and Stromboli, respectively. Units AIV and AVIII, restricted to the sites of Filicudi and Stromboli, show distinct petrographic characters but overlapped geochemical fingerprints.

1 Archaeological framework

The Bronze Age marks the renaissance of the Aeolian Islands. The Archipelago, is a key archaeological context since Early Neolithic because of the availability of obsidian in Lipari, the only island continuously inhabited as a central place in the Archipelago. The islands knew a long decline during the Copper Age because of the progressive abandon of lithic technologies.

The Archipelago is located in a strategic position in the southern Tyrrhenian Sea (Fig. 1) allowing the control of maritime circulation between Aegean, eastern and western Mediterranean, Sicily and peninsular Italy [1–3] i.e. on the main routes pointing to the Sardinian mineral resources. Consequently, new settlements appeared on the islands at the onset of the Bronze Age, during the Capo Graziano culture (Early to Middle Bronze Age 2; 2300–1430 BC).

The increasing importance of the Archipelago is documented by the importation of Mycenaean pottery (Late Helladic I–II) during the late stages of the Capo Graziano cul-

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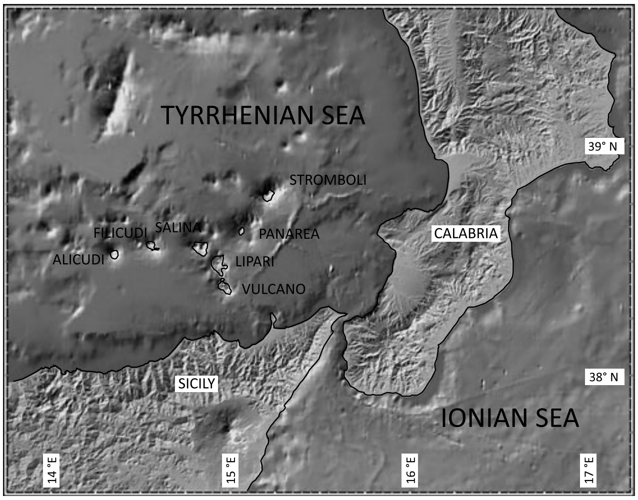

Fig. 1 Shaded relief map of the southern Tyrrhenian Sea. Volcanoes of the Aeolian Archipelago hosted several settlements during the Bronze Age. Trades occurred among the different islands and with Sicily and Calabria. Their strategic position allowed the control on trades from the western to the eastern Mediterranean basin. Map is from GeoMappApp© (http://www.geomapapp.org)

ture at Lipari, Filicudi and Stromboli (Capo Graziano II; 1700–1430 BC; [4–8]).

At the same time Aeolian pottery is documented in maritime exchanges as for instance the finding of the shipwreck of Pignataro di Fuori [9, 10] near the Lipari coasts, unique evidence for the Italian Bronze Age, and several occurrences of pottery with the peculiar Capo Graziano style in Sicily [11–18] and Italian mainland [19–23]. The typical Aeolian pottery classified as *impasto ware*, resulting by mixing clay and a relatively coarse temper, is shaped by mould or coil, burnished and decorated with incised or impressed geometrical patterns. The social organisation of this pottery production can be classified at the domestic workshop level [24, 25]. Capo Graziano settlements, typically composed of oval stone huts, are initially situated (Capo Graziano I; 2300–1700 BC) on coastal plains such as the Contrada Diana in Lipari [26] and Filo Braccio in Filicudi [27, 28]. Starting from the late Capo Graziano culture, a general movement of the villages is observed, possibly induced by defence needs (Capo Graziano II; 1700–1430 BC). Naturally defended places, such as the Acropolis of Lipari [1], the Montagnola of Filicudi [27] and the plateau of San Vincenzo in Stromboli [8, 29] are settled at this time. During Capo Graziano II, pottery is characterised by a typical decorative style with incised zig-zag (a stylised representation of the sea), lines and alignments of points.

2 Rationale and sampling

Since late 1960s John Williams analysed the whole pottery sequence (from Early Neolithic to Late Bronze Age) efficiently discriminating Aeolian productions from the imported extra-Aeolian ones based on petrographic observations [30, 31]. The distinction is made possible by the different petrographic character of tempers being of volcanic origin those of the Aeolian Archipelago while containing sedimentary and metamorphic clasts those from the Calabrian and Sicilian grounds. Volcanic tempers used for Aeolian pottery production are in fact sands deriving by the natural dismantling of the rock units outcropping nearby a given workshop. Aeolian Islands consist of seven stratovolcanoes belonging to an active, subduction-related magmatic arc (200 km long) growing in the southern Tyrrhenian Sea (Fig. 1). Subaerial volcanism of the Aeolian Islands having started at ∼0.22 Ma BP is still quiescent at Lipari and Vulcano and persistently active at Stromboli [32]. Basaltic to rhyolitic extrusive series are present on all islands. Lava and pyroclastic products belong to calcalkaline (CA), high potassium calcalkaline (HKCA), shoshonitic (SHO) and, more rarely, potassic (KS) affinities [33, 34].

According to Williams studies, local productions prevailed during Early and Middle Bronze Age, with evidence of self-sufficient productions in Lipari and Filicudi, later replaced by imported and/or local products using imported clay from northern Sicily [30, 31, 35, 36]. The high probability of common clay sourcing makes difficult to distinguish the intra-archipelago workshops based on bulk compositional analyses because tempering may not significantly affect group distinctiveness until large amount of temper are added [37, 38]. On the other hand, if tempers are locally added they would reflect the local geochemical fingerprint. Provenance studies should thus focus on this component in order to track the location of the manufacturing centres. A study of potteries from the same region has, however, demonstrated that petrography alone is not sufficient for a correct provenance attribution even when tempers of volcanic origin are used [39]. This is mainly due to the similar compositional evolution of the volcanic activity in the region that makes challenging a safe attribution to a compositional group based on the pure petrographic characters even for a well trained observer.

Moving from this background we set up a microchemical approach to assess the robustness of petrographic classification with the aim of defining Temper-based Compositional Reference Units to allow easy attribution of a given sample to a production area and/or craft tradition. This study re-considers samples from Williams collection along with additional samples from Lipari Museum and two new excavations (San Vincenzo, Stromboli [8] and Filo Braccio, Filicudi [28]) and few occurrences from the shipwreck of Pignataro di Fuori recovered off the coasts of Lipari. Pottery from Stromboli, the northernmost island of the Archipelago, has never been analysed before. The investigated collection includes pots of different shapes and functions covering the entire Capo Graziano chronological sequence in Lipari ($n = 46$), Filicudi ($n = 56$) and Stromboli ($n = 80$), plus few from the shipwreck of Pignataro di Fuori ($n = 4$).

Samples with non-volcanic-temper, abundantly found at Stromboli and more rarely on the other islands, attesting a Calabrian and/or Sicilian provenance, are not investigated in the present paper.

3 Methods

Mineralogy and petrography were determined on thin petrographic sections by a polarising microscope. Point counting (at least 500 points for each thin section) was performed on 139 thin sections, whose area is sufficiently large to ensure a modal distribution representative of sample variability.

Modal distribution data have been treated by multivariate statistics in order to get a classification of pottery reflecting the compositional variability and the archaeological site of provenance. Principal Component (PCA) and Discriminant Analysis (DA) have been performed using SPSS 17.0 statistical package (Table II, electronic supplementary material). This approach has been helpful for the definition of the compositional groups and the identification of possible imports.

Major element composition of minerals and glasses was assessed by electron microprobe. Analyses were carried out with the Superprobe Jeol JXA 8200 at the Eugen F. Stumpfl Laboratory of the Leoben University (Austria). Analytical conditions are the following: acceleration voltage 15 kV, beam current 10 nA, focused beam (∼1 μm diameter), peak counting time 20 s and background 10 s. Analytical data were corrected through the ZAF method. A set of natural and synthetic standards have been used for internal calibration.

In-situ trace elements have been measured at Centro Interdipartimentale Grandi Strumenti (CIGS) at the Università di Modena e Reggio Emilia using a Nd:YAG deep UV (213 nm) New Wave Research UP-213 laser ablation system (LA) coupled to a Thermo Fisher Scientific X-SeriesII Induced Coupled Plasma Mass Spectrometer (ICP-MS). Instrumental drift correction was computed by linear correction of measured analyte intensities among repeated measurements of the NIST 612 glass. ^{44}Ca has been routinely employed as internal standard based on electron microprobe CaO contents. LA–ICP–MS spectra were obtained with unit mass resolution. They require few if any interference corrections, due to very low molecular and doubly charged species production. In this study $\mathrm{ThO^+/Th^+}$ was maintained below 0.5 % and $\mathrm{Ba^{2+}/Ba^+}$ below 0.1 %. Analytical routine comprises 100 μm pre-ablation scan (dwelling time: 2 s, 5 Hz laser fire, laser fluency $18 \div 20$ J/cm^2) followed by 80 μm ablation scan (dwelling time: 30 s, 20 Hz laser fire, laser fluency $18 \div 20$ J/cm^2). Data reduction performed with Plasma Lab® software, by Thermo Scientific.

4 Results

4.1 Mineralogy and texture

In his pioneering works, Williams [30, 31] proposed a classification based on petrographic criteria, identifying three main groups named A, B and C. Group A (with nine subgroups AI to AIX) includes pottery of Aeolian production bearing volcanic-derived tempers, ranging from basaltic-andesitic to rhyolitic in composition [33, 34]. Group B consists of pots imported from North Sicily and Calabria, containing clasts of metamorphic and plutonic rocks. Potteries of group C are interpreted as Aeolian production but characterised by mixed temper of both metamorphic or plutonic and igneous origin. Here we focus on samples pertaining to petrographic group A to check the robustness of the petrographic classification and infer possible intra-archipelago relationships. We build over Williams's work keeping when possible his structure and definitions. His classification can be tested and improved by a statistical approach considering quantitative parameters defined by petrography and point counting such as: abundance of mineral and glass phases, compositions and abundance of lava clasts (e.g. basalt and basaltic andesite vs. andesite and rhyolite), modal ratios of plagioclase/pyroxene, mineral/lavas and glass/lavas. There result a total of 13 different components to operate for statistical analyses (Table I, electronic supplementary material). Statistical distribution have been computed on 139 samples (see methods), analyses parameters and output are resumed in Table II (electronic supplementary material). When samples are divided by their site of sampling, multivariate analyses show a good separation for the three islands and some "intruders" representing possible exchanges among the three sites (i.e. Lipari, Filicudi and Stromboli). Plots of PCA and DA (Figs. 2A–2B) show a clear distinction of Lipari population (abundance of glass) from Filicudi and Stromboli (abundance of lava clasts). Notwithstanding the overlapping of Filicudi and Stromboli shown in the PCA plot, some compositional differences (clinopyroxene at Filicudi and pumice at Stromboli) are emphasised by DA where the two Islands result more separated (80 % of cross validated grouped cases correctly classified).

PCA and DA based observations along with modal mineralogy and texture allow clustering the investigated samples in four groups. Three of them: AI, AIV and AVIII strictly correspond to Williams description [35], while a new group AX is characteristic of Stromboli. Simple pie diagrams of modal distribution of the main characters reveal the basic differences among the groups (Fig. 3). Compositional groups clearly show up when PCA is run by disregarding the site of sampling (Figs. 2C–2D). Under these conditions PCA shows a significant separation of groups AI and AX while group AVIII overlaps with AIV (in particular the AIV from Filicudi). The difference among the four

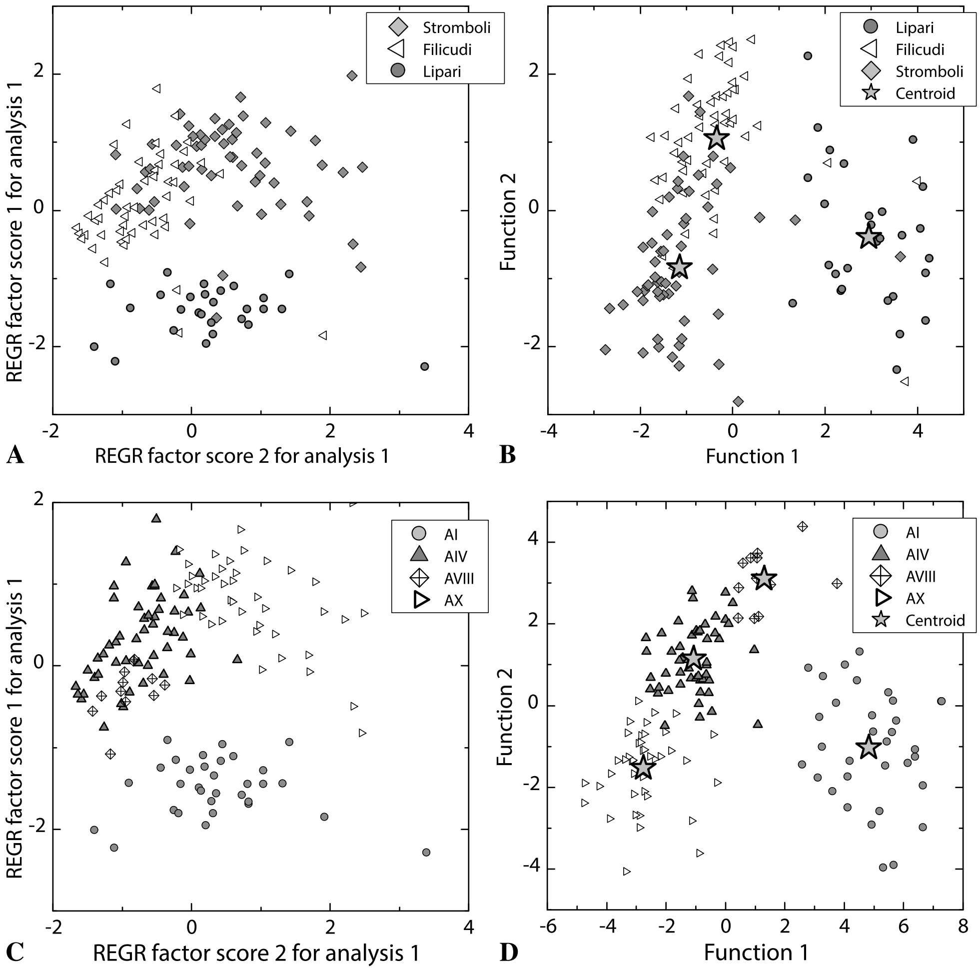

Fig. 2 (**A**) Principal Component Analyses (PCA) based on 13 measured petrographic components (mineral, rock and glass clast abundance) grouped based on their site of sampling. (**B**) Discriminant Analyses (DA) of the same population showing a good separation between Lipari population and the other two islands (Filicudi and Stromboli). (**C**) PCA and (**D**) DA of the whole population without the limit of the sampling site. The four different compositional groups (AI, AIV, AVIII and AX) are clearly separated. Compositional groups are defined in the text

groups arises from DA (Fig. 2D). Here the group AIV is in an intermediate position between AX and AVIII allowing the use of these statistical set to help classifying a given sample.

Iteratively crossing PCA and DA analyses and petrographic observation we refined the compositional characters of each group estimating 98 % of cross validated cases are correctly classified in the petrographic groups. Results are resumed in Table 1. The lower cross validation when PCA and DA account for the site of sampling attests for dispersion of elements pertaining to a given compositional group in other sites. Accordingly statistic disregarding the site of provenance clearly separates the compositional groups. It appears that AI mainly occurs on Lipari and AIV is restricted to Filicudi and Stromboli with the majority on the former island. AVIII is characteristic of Filicudi while AX is typically found at Stromboli.

The resulting petrographic characters of these groups can be confidently described as follows.

Table 1 Distribution of petrographic groups among the different sites

	Lipari	Filicudi	Stromboli
Group AI	27	3	2
Group AIV		38	14
Group AVIII	1	11	
Group AX		2	41

Group AI: Temper is characteristically rich of colourless fresh volcanic glass fragments and pumices (Figs. 3, 4A and 4B) and less plagioclase and pyroxene phyric lava clasts (basaltic andesite and andesite) with crypto-microcrystalline groundmass. Y-shaped glass shards (Fig. 4B) or perlite fragments (Fig. 4C) can be also present. Plagioclase, the most abundant mineral phase (Fig. 3) is strongly zoned and sieve-textured, enriched in glassy inclusions (Fig. 4D). Pyroxene (both monoclinic and orthorhombic), locally shows resorption embayments and poikilitic inclusions. Few dacitic to rhyolitic clasts containing quartz and K-feldspar are also present (Fig. 4E). Olivine (generally altered to iddingsite), sanidine, xenoliths of quartzite and scoriae rarely occur. Hydrous phases are almost lacking, except of rare horn-

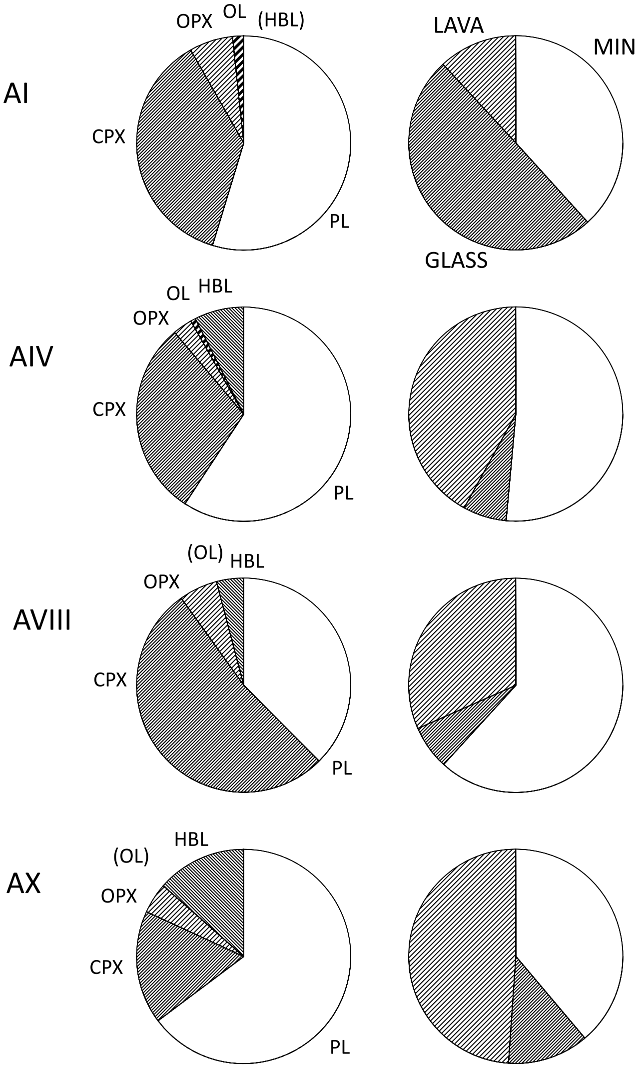

Fig. 3 Pie diagrams showing the mineral distribution in each compositional group (*left*) and the relative abundance of minerals (MIN), glassy clasts (GLASS) and rock clasts (LAVA) in the studied samples. Abbreviations for minerals are: PL (plagioclase), CPX (clinopyroxene), OPX (orthopyroxene), OL (olivine), HBL (hornblende; both *green* and *brown*)

blende. Temper grains are subangular, generally finer than medium sand. This group is mainly present in Lipari, subordinately in Filicudi and Stromboli (Table 1).

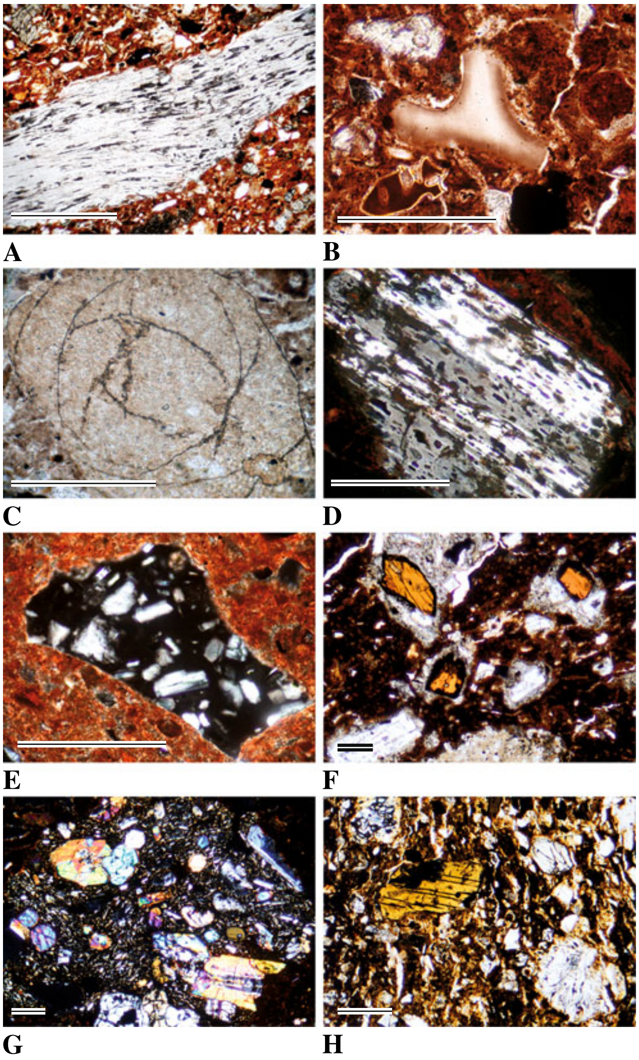

Fig. 4 Significant mineral and rock clasts characterising the studied pottery pastes. Scale bar is 0.2 mm. (**A**) Pumiceous glassy clast with fluidal texture; (**B**) Y-shaped glass shard; (**C**) massive perlitic glass with typical conchoidal fractures; (**D**) twinned plagioclase with sieve texture due to abundant melt inclusions; (**E**) clast of rhyolite with microphenocrysts of quartz and feldspar; (**F**) euhedral brown hornblende grains, surrounded by oxidised rim within lava clasts; (**G**) basaltic lava clast characterised by fluidal microcrystalline groundmass and pyroxene, feldspar and olivine phenocrysts; (**H**) brown to greenish hornblende and pumiceous clast

Group AIV: Temper mostly consists of mineral phases and lava clasts with very low to negligible glass content (Fig. 3). Minerals are plagioclase, clinopyroxene and scarce orthopyroxene. Hydrous minerals are represented by euhedral brown hornblende and subordinate green hornblende and biotite. They usually show opaque rims (Fig. 4F). Andesitic lava clasts with micro- to cryptocrystalline groundmass and phenocrysts of plagioclase, pyroxene and hydrous minerals are also present. Olivine (iddingsite), quartzite xenoliths and scoriae may locally occur. When present, volcanic glass shows subrounded morphologies, with orange and brown colours and palagonitic devitrification. Temper grain size do not exceed medium sand with unimodal or bimodal distribution. This group is well attested both in Filicudi and Stromboli (Table 1).

Group AVIII: Large abundant grains (up to 2 mm) of plagioclase, clinopyroxene and orthopyroxene, along with some pyroxene-plagioclase glomerocrysts represent a distinct feature for this group (Fig. 3). Lava clasts (basaltic to basaltic andesite lavas; Fig. 4G) with oxidised or crypto- to microcrystalline groundmass are mainly characterised by pyroxene as single phenocrysts or glomerophyric aggregates, together with iron oxides and plagioclase. Glassy clasts (scoriae and palagonite) are very rare. Hydrous phases are absent or limited to few green hornblende grains. Pyroxenes, both rhombic and monoclinic, may represent up to 34 % (average 27.3 %, Fig. 3) of the temper, largely prevailing over plagioclase (average 17.6 %, Fig. 3). The temper does not exceed medium sand grain size, it is poorly sorted or with bimodal distribution. This group is typical of Filicudi pottery, mainly from the earlier village of Filo Braccio. One sample is from Lipari (Table 1).

Group AX: Temper contains abundant plagioclase, less clinopyroxene, orthopyroxene and hydrous phases. Green hornblende without opaque rims (Fig. 4H) is more abundant than any other group (Fig. 3). Lava clasts (basaltic andesite to andesite) are characterised by subrounded morphologies and large clasts (up to 7 mm), with pyroxene phenocrysts and crypto- to microcrystalline groundmass. Pumices, quartzite xenoliths and spherulitic glass are frequent. Iddingsitised olivine is rare. The temper is poorly sorted and coarse with clasts often larger than 2 mm and subangular morphologies. Samples belonging to this group are found in the archaeological site of Stromboli with the exception of two from Filicudi (Table 1).

4.2 Mineral chemistry

Group separation can be independently verified based on major and trace element variability of the observed temper phases. If petrographic groups reflect local productions then the chemical composition of the tempers must reflect the composition of local lava suites i.e. the geochemical flavour of that given volcanic centre. Hence we performed microchemical in-situ analyses by Electron Microprobe (major elements) and Laser Ablation ICP-MS (trace elements) on clinopyroxene, plagioclase and hornblende.

Lipari samples (AI) show a bimodal distribution for clinopyroxene in the Na_2O vs. FeO_{tot} diagram (Fig. 5): one region includes samples from the shipwreck of Punta Pignataro along with AI samples from Stromboli and Filicudi. The compositional field of samples pertaining to group AIV from Filicudi and Stromboli completely overlap with group AVIII from Filicudi and the AX group from Stromboli. In general major elements for both ortho- and clinopyroxenes do not allow separate groups AIV, AVIII and AX.

Trace elements in clinopyroxene give indication for a different distribution of group AX. Group AIV from Filicudi and Stromboli are not resolvable from AVIII. However, in all trace element systematic they present an unimodal distribution while group AX samples always trend bimodally with a cluster plotting toward markedly enriched compositions. Rare Earth Elements content of clinopyroxene is a useful tool to distinguish the characters of parental lavas. Figure 6 shows the relationship between Eu* and Sm_N, where Eu* is a measure of the depth of the Eu anomaly calculated as $Eu_N/(Sm_N \cdot Gd_N)^{1/2}$ and the "N" subscript indicates that values are normalised to chondrite composition [40]. When clinopyroxene crystallises along with or after plagioclase, Eu in the residual melt is preferentially extracted from the melt with respect to the other REEs because of the compatible behaviour of Eu^{2+} in plagioclase. Samples from Li-

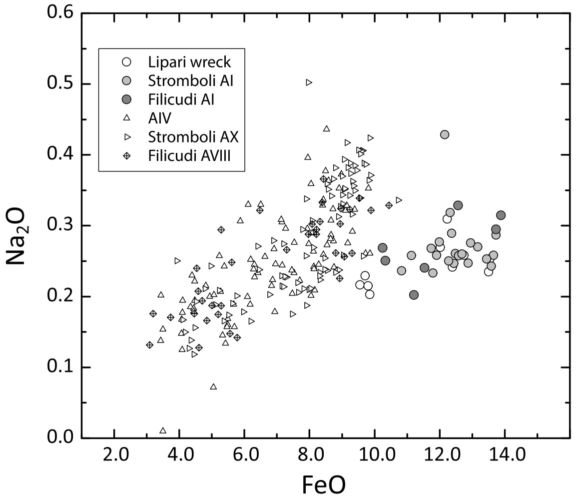

Fig. 5 Na_2O vs. FeO_{tot} (weight %) distribution in clinopyroxenes determined by in-situ electron microprobe analyses. Samples are divided on the basis of petrographic groups and sites of sampling

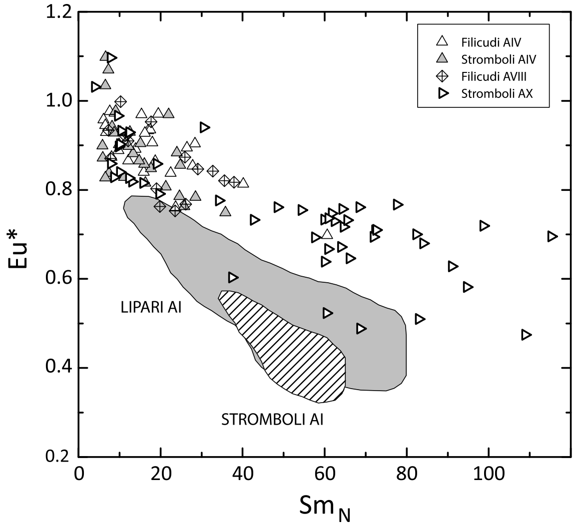

Fig. 6 Eu* vs. Sm_N distribution in clinopyroxenes determined by in-situ Laser Ablation coupled with Induced Coupled Plasma Mass Spectrometry. Eu* [$= Eu_N/(Sm_N \cdot Gd_N)^{1/2}$] the N subscript refers to chondrite normalisation [40]. Samples are grouped by petrographic characters and site of sampling

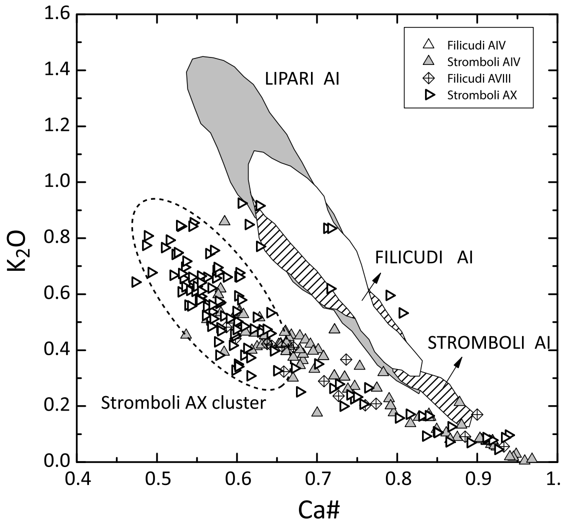

Fig. 7 Compositional variability of K_2O vs. Ca# in plagioclase of the four volcanic temper-based Aeolian pottery groups sampled at the different archaeological sites. Ca# = $CaO/(CaO + Na_2O + K_2O)$ here used as a proxy of anorthite content

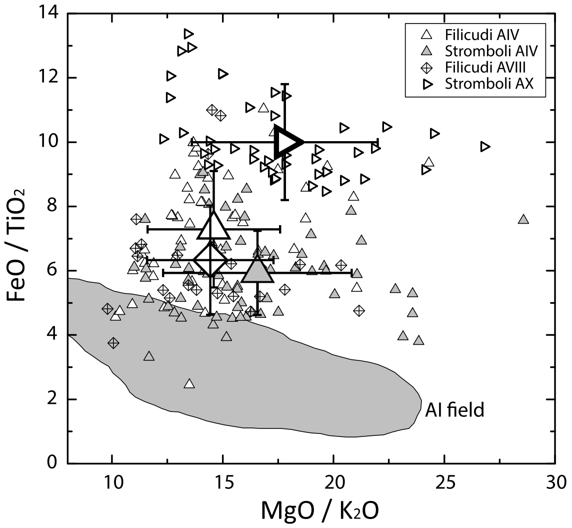

Fig. 8 Compositional variability in hornblende defined as FeO_{tot}/TiO_2 vs. MgO/K_2O. *Large symbols* represent the average and 1σ error bar relative to petrographic groups AIV, AVIII and AX. Subgroups AIV from Stromboli and Filicudi are plotted separately although they show no statistically significant separation

pari AI plot in a well separated trend from the other petrographic groups. Coherently, Stromboli pottery attributed to the same AI group plots in the same field. AX samples along with AIV and AVIII trend parallel but shifted to higher Eu* values. Worth noting that AX samples have a bimodal distribution and range to higher Sm_N values than other groups.

A similar pattern also appears in plagioclase major element systematic. Here the Ca# value [= $CaO/(CaO + Na_2O + K_2O)$] is used as a proxy of the anorthite content. Group AI (from Lipari, Filicudi and Stromboli) plots along a well defined trend characterised by high K_2O at a given Ca# (Fig. 7). Filicudi and Stromboli AIV groups overlap at high Ca# values in the lower trend, while the petrographic group AX of Stromboli clusters in the same trend at high K_2O values.

Hornblende and other hydrous phases crystallise in magma suites when the silicate liquid reaches water saturation, i.e. when the magma has already separated a significant amount of anhydrous phases, in particular plagioclase. Amphibole variability of major element systematic shows large overlapping of compositional fields. We found the largest discrimination of amphibole from the four petrographic groups using a FeO_{tot}/TiO_2 vs. MgO/K_2O diagram (Fig. 8). AI and AX groups plot in separated fields from the others. Average values ($\pm 1\sigma$ bars) in Fig. 8 show that AX is statistically separated from AIV and AVIII. In this figure Filicudi and Stromboli AIV groups are plotted separately to show their compositional superposition. This behaviour is present in all major and trace element systematic.

5 Discussion and conclusions

Based on modal mineralogy and texture of the Aeolian Bronze Age pottery we recognised four statistically separated groups (AI, AIV, AVIII and AX) among the volcanic temper-bearing pots collected at Lipari, Filicudi and Stromboli archaeological sites. These groups we confidently assume as Temper Compositional Reference Units for the specified context [41]. They match those proposed by Williams [31, 35] with the addition of a new unit (AX) [42] recently found in the Stromboli archaeological site of S. Vincenzo [8]. The inferred petrographic subdivision is independently tested by mineral chemistry (major and trace elements) of representative phases such as clinopyroxene, plagioclase and hornblende, giving a robust statistical framework for sample identification.

Unit distribution among the islands mainly match with the provenance sites (Fig. 2, Table 1). The geographical distribution of AI, AX and AVIII is almost exclusively restricted to the localities where they have been collected, respectively Lipari, Stromboli and Filicudi (Fig. 2, Table 1). A minor amount of samples pertaining to a given unit is found in a different island attesting for an active intra-archipelago exchange network. Their limited number is, however, not statistically relevant to infer reliable exchange fluxes. Overall, collected data support the hypothesis of independent, domestic-workshop, production centres in each insular community. This is coherent with the observation that Italian Bronze-age communities locally produced their own pottery because of a poorly hierarchical society where work division was not yet completely settled.

The existence of a flourishing production in Filicudi is also suggested by the local production of a unique masterpiece: the cup with an incised decoration representing a complex pattern with sea waves, human figures and boats [28].

A controversial case is that of unit AIV. Stromboli and Filicudi AIV subsets completely overlap in all mineral compositional fields (both major and trace elements) and petrography, strongly supporting their provenance from a single production centre, independently from their occurrence in different Aeolian Islands. Samples of this unit have been found at Filicudi (73 % of the total) and Stromboli (27 %). This observation may attest for a strong exchange network between these two islands. To date archaeological evidences suggest the occupation of Filicudi to predate the settlement of Stromboli [8, 28]. This may alternatively suggest that the abundance of Filicudi-made pottery at Stromboli could be evidence for import from Filicudi to Stromboli before the onset of a local manufacturing resulting in production of AX pottery.

Other considerations arise by comparing AIV and AVIII distribution in Filicudi. Their difference only lies in mineral modal distribution and petrographic characters (Fig. 3) while completely overlap in the compositional systematic (Figs. 5–8). This aspect may suggest the adoption of different formulae in a given workshop oriented to obtain different technical properties or esthetical effects linked to the transition from the lower village of the phase CGI (where AIV and AVIII are alternatively employed) to the upper village of the phase CGII (where AIV predominates).

Overall, there is no correspondence between composition and shape/function of the vessels attesting for a general adoption of the same pasteware for the whole local production set (mainly bowls, cups, and jars).

Crossing petrographic data (modal mineralogy and texture) and mineral chemistry is a reliable approach to unravel the provenance of an artefact in a network of different production centres and commercial exchanges. Provenance of a pottery, even a small shard, can be robustly inferred by this approach. On the other hand some potentialities ask for further extend elemental analyses to the whole population of mineral, glass and lava clasts used as temper and compare them with the compositional variability of the volcanic rocks of the Archipelago.

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