Research Article

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Archaeometric Study of Iron Age Pottery Production in Central Sicily: A Case of Technological Conservatism

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Abstract: This study presents an in-depth archaeometric investigation of Iron Age ceramic assemblage dating from 950 to 750 BCE from the sanctuary at Polizzello Mountain, Sicily. The site, a key sanctuary utilized by indigenous communities for ritual activities, is examined for its strategic location, structural developments, pottery assemblages, and evidence of communal activities. The study employs petrographic analysis on thin sections, integrated with other analytical methods, to explore the technology behind pottery production. It investigates whether such production reflects a common technological knowledge shared by a broader community or if they represent a blend of different manufacturing traditions. The findings highlight that the pottery from Polizzello Mountain aligns with the well-established Sicilian tradition of combining calcareous components and grog, indicating a local tradition of pottery production with no significant compositional differences suggesting specialized production at the workshop level.

Keywords: pottery technology, Iron Age, Sicily, optical microscopy, thin sections, petrography

1 Introduction

This study presents the results of the archaeometric investigation of Early Iron Age (EIA) and Iron Age (IA) ceramics from the site of Polizzello Mountain, in the Upper Platani river valley, between Caltanissetta and Agrigento (37°36′27.5″N 13°49′34.3″E), which showed traces of occupation from the half of the eleventh century BCE to the half of the fifth century BCE. The context of provenance of the materials is placed on a plateau at top of the mountain and is known as “acropolis.” Such area has been traditionally interpreted as a sanctuary utilized by indigenous groups from this geographic district, who convened on it for communal ritual activities for an extended period covering the temporal arc from the late prehistory to the Greek Classical period (Tanasi, 2007).

Leaving aside the function of the sanctuary in later times and keeping the focus on the IA, its use for ritual purposes is supported by several factors, including the site’s strategic location, the structural development observed across the plateau, the consistent quality of the pottery assemblages, and the presence of evidence indicating communal activities that transpired over several centuries (Tanasi, 2007). Moreover, this interpretation gains further support from the abundant evidence of similar archaeological contexts dated to the Late

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Bronze Age (LBA) and EIA, not only on the island of Sicily but also in the broader central and eastern Mediterranean region (Ferrer, 2013). These and other slightly later contexts (D'Onza, 2019; Öhlinger, 2015) exhibit clear analogies with the findings at Polizzello Mountain, such as the deliberate breakage of artifacts, communal feasting, and ongoing structural modifications over time.

Despite the unique archaeological evidence offered by this site, which sheds light on the complex socio-cultural dynamics characterizing central Sicily during the EIA, many archaeological collections from this region remain relatively understudied, with major reference works only represented by Pantalica (Albanese Procelli & Leighton, 2019) and Cittadella di Morgantina (Leighton, 1993). Consequently, larger questions about the cultural underpinnings of pottery production in the area have yet to be adequately addressed. These questions encompass aspects such as social organization, traditional technological practices, strategies for raw material procurement, and manufacturing techniques. In particular, the study of the technological aspects of pottery production is of paramount importance to comprehend the socio-cultural context in which archaeological ceramics were crafted, utilized, and ultimately discarded within a specific network of interactions involving various participants engaged in the manufacturing process (Cuomo di Caprio, 2007). The quality of ceramic formulations, the employment of production and firing methods, and the careful selection of raw materials collectively underpin the pottery tradition within a given community (Cogswell, Neff, & Glascock, 1996; Dobres, 2000; Schiffer, 2004). Ceramic petrography is a frequently employed technique when addressing intricate questions pertaining to the life cycle of ceramics (Hunt, 2017; Quinn, 2013; Roux, 2011; Whitbread, 2001), particularly when integrated with other analytical methods. These approaches serve to unveil several aspects related to the technology, a crucial component to be juxtaposed with the conventional typological and stylistic classification of the pottery assemblages (Levi, 2010; Santacreu, 2014; Tite, 1999).

Regarding previous archaeometric studies of pottery from Polizzello Mountain, two chemical characterization studies to identify fabrics were conducted, one employing X-ray fluorescence (Pappalardo, Pappalardo, Romano, Rizzo, & Massimino, 2008) and another one using portable X-ray fluorescence (pXRF) (Pappalardo & Mazzoleni, 2020). The former study was centered on a group of 110 samples related to the three construction phases of the structure known as *Sacello E* on the acropolis (phase I: eighth century BCE, phase II: seventh century BCE, phase III: sixth to fifth century BCE) and with a prior phase related to structures (*Edificio Nord*, see Tanasi, 2012) partly obliterated by the *Sacello E* (end of the tenth to the beginning of the ninth century BCE). The analysis brought about the identification of six different groups showing a higher degree of heterogeneity especially between the materials from the Edificio Nord phase and those from the three phases of the *Sacello E*, the older ones being characterized by a higher concentration of strontium. With respect to the latter study, although, the use of pXRF for the classification of prehistoric pottery is quite controversial and limited in scope (Daszkiewicz et al., 2020), the results are more contentious. The work focused on 15 ceramic samples selected from layers related to the three phases of the *Sacello E*. In this case, differences are more apparent between samples related to phase I and phase III. All the samples, except for one, were locally produced with clay sourced from the nearby *Terravecchia Formation*. Both studies seem to suggest a strong correlation between the physical transformations of the site and the compositional variations in the pottery, indicating changes in the local cultural and ritual practices. Additionally, other archaeometric works on pre-protohistoric pottery sharing the same technological features have validated the soundness of the analytical approach adopted in those studies (Raneri et al., 2015; Raudino, Tykot, & Vianello, 2017; Rodriguez et al., 2015; Tanasi, Tykot, Pirone, & McKendry, 2017; Tanasi, Caso, Tykot, & Amoroso, 2019).

In this scenario, the present study seeks to ascertain whether the archaeological ceramics from Polizzello Mountain reflect the cultural background of a broader community sharing common technological knowledge or if different manufacturing traditions contributed to the ceramic assemblage at the sanctuary. Given the possibility that the site may have hosted multiple communities across an extensive landscape and over numerous centuries, the investigation aims to determine whether the standardized EIA ceramic repertoire is marked by well-defined sets of technological features that are broadly shared among multiple communities or if various and diverse traditions were concurrently adopted. Additionally, the study delves into the relationship between pottery technology, typology, and function.

The present study stems from a research project in two parts that due to issues related to funding contingency and sample accessibility were executed in different times, although they were initially meant

to be done and presented at the same time. The first part focused on the chemical analysis for fabric characterization of 68 ceramic samples from 9 LBA to EIA contexts identified at the Polizzello acropolis via instrumental neutron activation analysis (INAA) (Caso, Tanasi, Glascock, & Tykot, 2022). The second part, the subject of this work, is centered on the petrographic study via optical microscopy on thin sections of 21 samples selected from the group of 68. After the presentation of the archaeological and geological context, the new petrographic data will be discussed and compared with the previously obtained chemical data to try defining long-term technological patterns in the production of pre- and proto-historic pottery at Polizzello Mountain.

2 Archaeological and Geological Context

2.1 The Indigenous Communities Between LBA and EIA

The island of Sicily has been at the center of extensive archaeological investigations, and these studies collectively recognize its crucial role in shaping the historical developments of the Mediterranean Sea. In this study, a relative chronology for the LBA and EIA as presented in Table 1 is utilized due to the absence of absolute dating for the archaeological evidence. During the Bronze Age, the various human groups inhabiting the island formed a highly complex and socially stratified society marked by shared cultural characteristics that are observable across Sicily and the broader central Mediterranean region (Bietti Sestieri, 2015; Leighton, 2020; Tusa, 2000).

Those human groups and the approximate areas of the island where they were installed are mentioned several times in the ancient sources, such as Herodotus, Thucydides, and Diodorus Siculus, offering a scenario that archaeological research was traditionally called to clarify but not always with great consensus (La Rosa, 1996; Palermo, 1996). Although many decades of fieldwork and material culture studies managed to identify macro-regions where those groups, Sikels, Sikanians, and Elymians, lived and distinctive pottery and metal productions related to them, the borders of those regions are not firm and cultural contamination between the three productions seems to be the norm (Kolb & Tusa, 2001; Tanasi, 2003). Cross-referenced historical and archaeological studies inform us about *Sikelia*, comprised between the east coast of Sicily and the course of the river Salso on the west inhabited by the Sikels, a *Sikania*, between the course of the river Salso on the east and Platani on the west. Harder to define is the macro-region of election for the Elymians, linked by the Greek sources to the cities of Eryx, Entella, and Egesta. According to a traditional approach, there should be a consistent congruence between the appearance of a certain material culture and/or geographic provenance and an assumed ethnic identity. However, such assumption has not yet been fully tested against the outcomes of archaeometric analyses.

With specific reference to the indigenous communities of the *Sikania*, their material culture displayed a unique and great resistance to outside influences compared to their coastal counterparts and they steadfastly maintained their strong connection to traditional practices and customs, particularly in the realm of pottery production (Bietti Sestieri, 2015; Riehle, Kistler, Öhlinger, Sterba, & Mommsen, 2023). Consequently, by the end of the Bronze Age, a clearer and more pronounced cultural divide had emerged between inland and coastal Sicily (Cazzella & Recchia, 2013). Additionally, inland communities were subject to more significant segregation, so they maintained stronger connections to older customs and traditions, whereas coastal human groups were heavily impacted by foreign models from the Levant and the Aegean, significantly altering the local material production.

Table 1: LBA and IA Sicilian and Aegean chronology (Tanasi, 2012)

Date	Sicilian cultures	Sicilian chronology	Aegean chronology
1270–1050 BCE ca.	North Pantalica	LBA	Late Helladic IIIB–Submycenaean
1050–850 BCE ca.	Cassibile	EIA	Protogeometric–Early Geometric
850–750 BCE ca.	Sant'Angelo Muxaro–Polizzello	IA	Middle–Late Geometric

2.2 The So-Called Sanctuary of Polizzello Mountain

The Polizzello Mountain site (Figure 1) was initially renowned for its rock-cut tombs encircling a small settlement. It was believed that the communal area or acropolis was situated on the upper section of the mountain's northern plateau, as proposed by De Miro (1988). Comparable indigenous upland sites had already been documented throughout Sicily (D'Onza, 2019), including Sabucina, Monte Polizzo, and Colle Madore (Ferrer, 2013; Tanasi, 2020). However, what sets Polizzello Mountain apart is the presence of various foreign and pan-Mediterranean artifacts, along with pottery from non-Sikanian tradition, all found within clearly Sikanian contexts dating from the middle of the tenth to the first half of the ninth century BCE (Palermo, Tanasi, & Pappalardo, 2009).

The most recent archaeological investigations conducted between 2000 and 2006 on top of the plateau were aimed to comprehend the earliest phases of occupation and usage of the area (Panvini, Guzzone, & Palermo, 2009). Eleven different sectors were identified across a large area (Figure 2), labeled from 1 to 9, plus "North Building" and "Trench I/05." Contexts 6, 7, 8, and 9 are namely related to Buildings B, E, D, and C. Context 1 contained a votive pit named "Bothros 2" which held locally made broken ceramics underneath a layer of mixed soil, animal bones, ashes, and charcoal. Votive pits were distributed across the ground floor of the structures, signifying several phases of the sanctuary's use where such practices were integral to the socio-cultural landscape. Context 2 featured a similar ceramic assemblage, although it was associated with clear

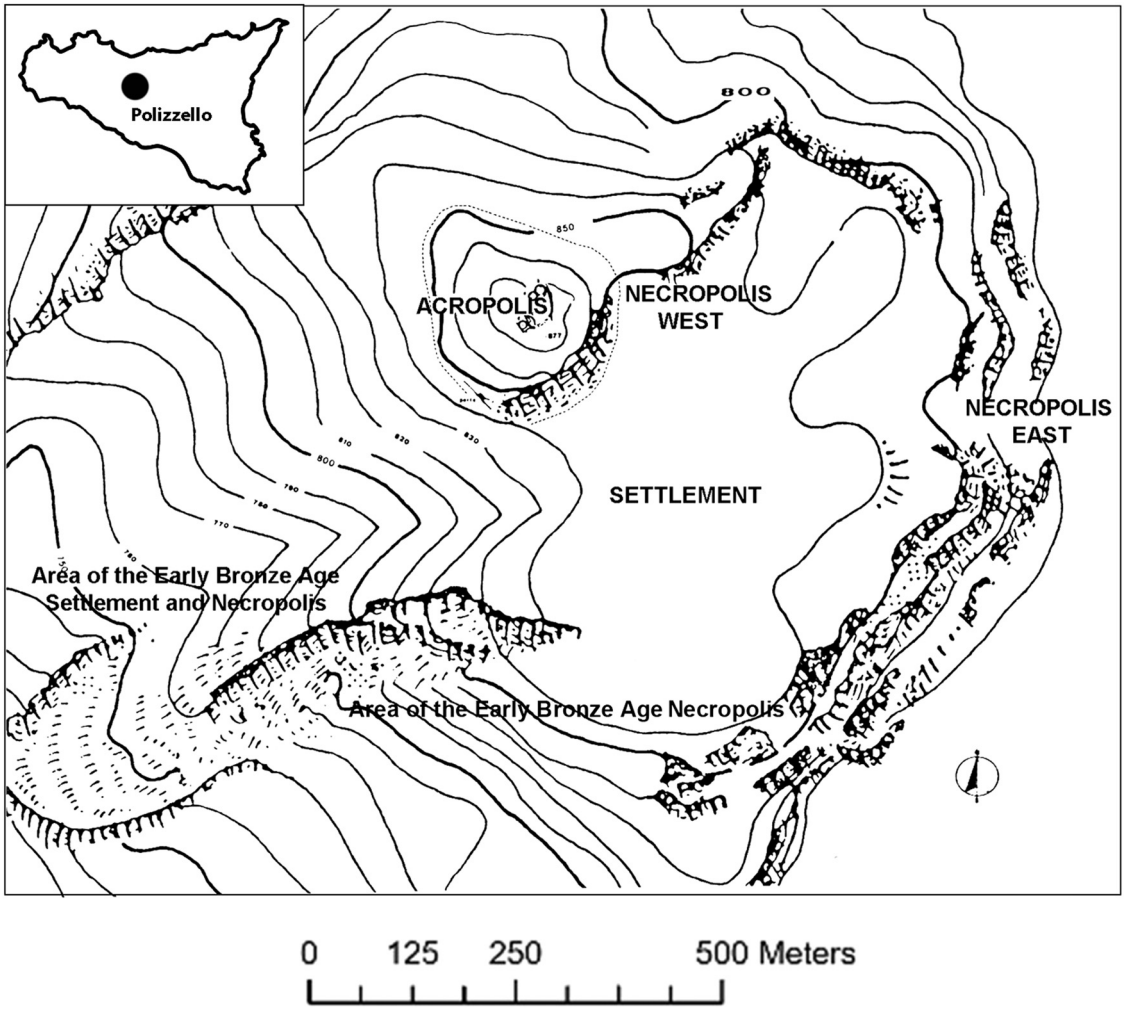

Figure 1: Map of Polizzello Mountain site with indication of the location of the acropolis where the so-called sanctuary was located.

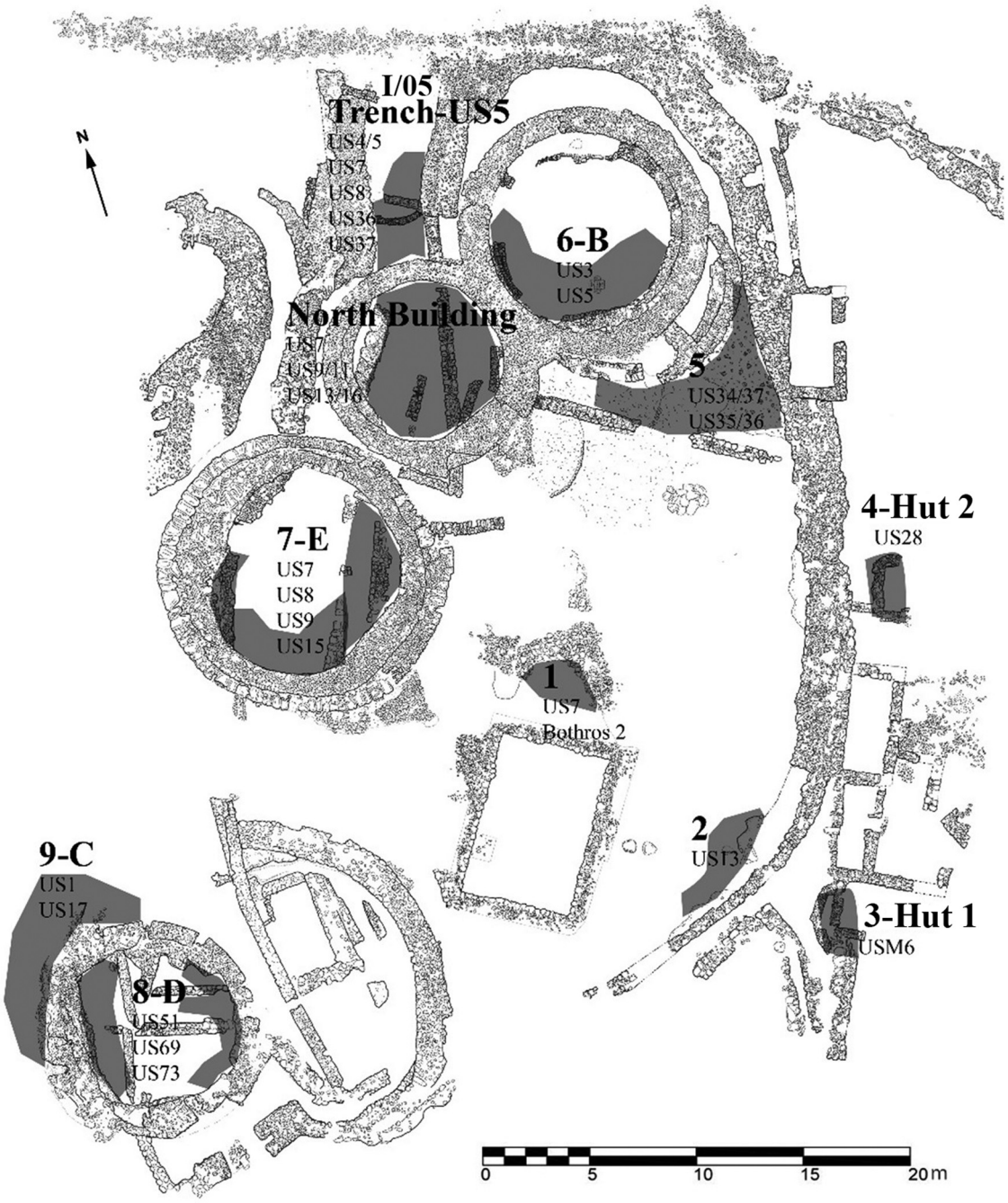

Figure 2: Plan of the Polizzello Mountain sanctuary with indications of the 11 contexts discussed in this study (1–9, North Building, Trench I/05).

evidence of a fire event that also affected Contexts 3 and 4 around the same time. Context 5 pertained to a substantial deposit of animal bones and a structural collapse that obscured a layer where several EIA ceramic shards were found. Contexts 6 through 9 have heavily undergone renovations over the centuries and displayed a very complex, albeit more recent, stratigraphic sequence.

The North Building and the North Trench provided crucial evidence for the EIA phases, characterized by several stone walls and distinct rooms where, among various artifacts, broken and mixed ceramics were recovered (Tanasi, 2009a, 2012). The most diagnostic features of the North Building were two votive pits

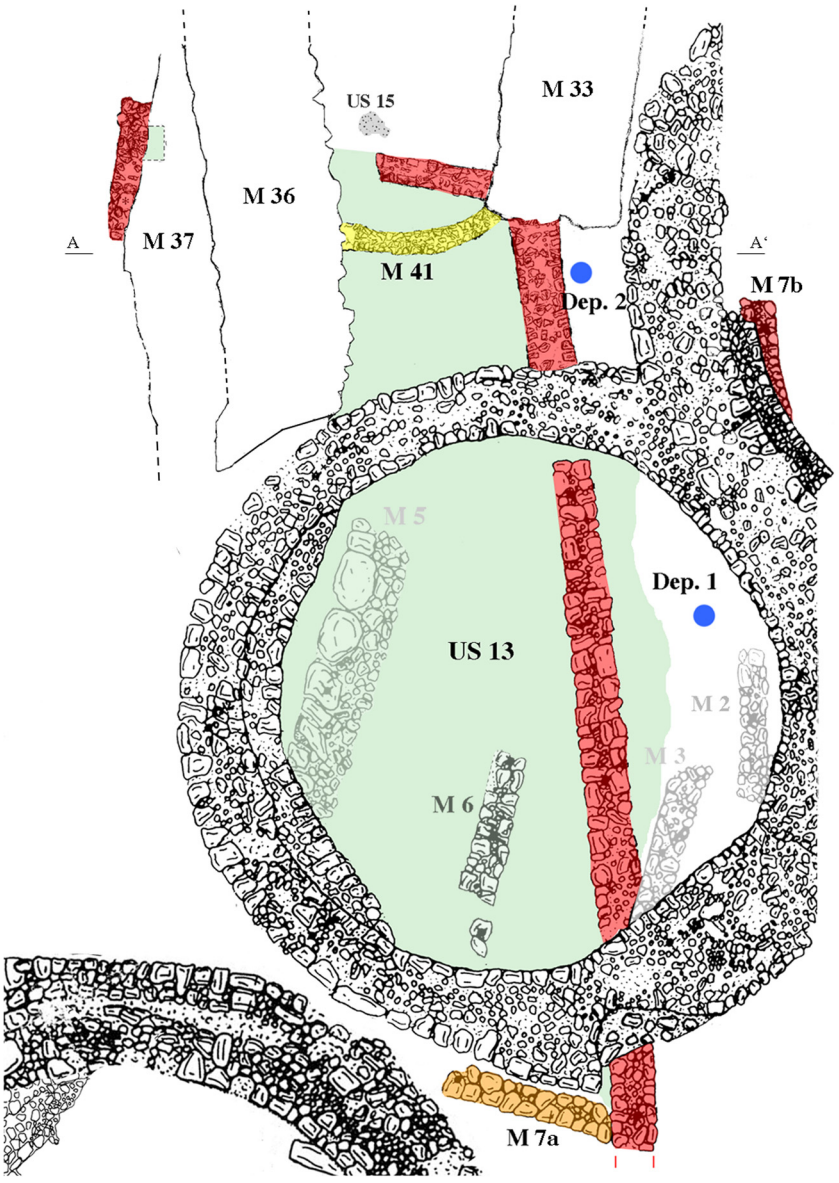

Figure 3: Plan of the North Building with indications of the two deposits.

(Deposits 1 and 2) found east of the structure, which contained different shattered pieces of large containers typical of the local EIA tradition (Figure 3).

The overall ceramic assemblage dates to the EIA with sporadic LBA materials. The shape repertoire, including larger containers such as amphorae, pedestal basins, bowls, jugs, and smaller consumption vessels (cups and pedestal cups), either undecorated or bore a dark or red surface with incised, burnished, or slipped decoration, is consistent with communal activities carried out in the context of an indigenous sanctuary (Ferrer, 2013). The contemporaneous presence of ceramic materials related to the "Sikel" culture of Cassibile and with the "Sikanian" culture of Sant'Angelo Muxaro–Polizzello cultures (Tanasi, 2012) could indicate the blending of different manufacturing traditions belonging to a broad cultural setting. A phenomenon that archaeometric studies could shed light on.

2.3 Topographic and Geological Setting of the Upper Platani Valley

The island of Sicily is situated in the western-central Mediterranean basin, a region shaped by the convergence of the African and European tectonic plates at the core of the central Mediterranean. The local lithology is notably diverse owing to a combination of sedimentary sequences, volcanic activity, and tectonic structures that developed over a timespan ranging from the Paleozoic to the Quaternary period (Antonioli et al., 2006).

Of particular importance are the Messinian evaporite rocks, which originated from a salinity crisis in the Mediterranean region approximately 5–6 million years ago. These evaporite rocks are widely present in the Platani basin and are primarily concentrated in two main areas, Caltanissetta-Enna and Agrigento (Figure 4). The evaporitic sequences encompass selenitic gypsum and salt deposits, often accompanied by concretions of rock-salt and gypsum in archaeological contexts (Leighton, 2011).

The Upper Messinian deposits in the region include a range of geological materials, including calcarenite, clays, and marls ranging from grey to reddish-brown. Additionally, there are poorly cemented quartz-micaceous sandstone formations. The precipitation of iron from local iron-rich soils into autochthonous calcareous and evaporitic deposits has led to the presence of various clay minerals in the area. Fossil contents in both the rocks and soils are notable, consisting of abundant brackish water fauna including bivalves, gastropods, and planktonic foraminifera. The local lithostratigraphy typically comprises fine micas, amphiboles, feldspars, and silica as natural mineral inclusions, forming the compositional core of many clay outcrops throughout the region.

In more recent geological contexts, mixed deposits of sandy and fine-grained clays are commonly found at the base of higher cliffs. These deposits are associated with Upper Pliocene–Pleistocene formations, dating back to 5–2.5 million years, and consist of a combination of clastic and carbonate rock formations (Calò et al., 2012). Therefore, the geological characteristics of the Polizzello Mountain area are representative of the

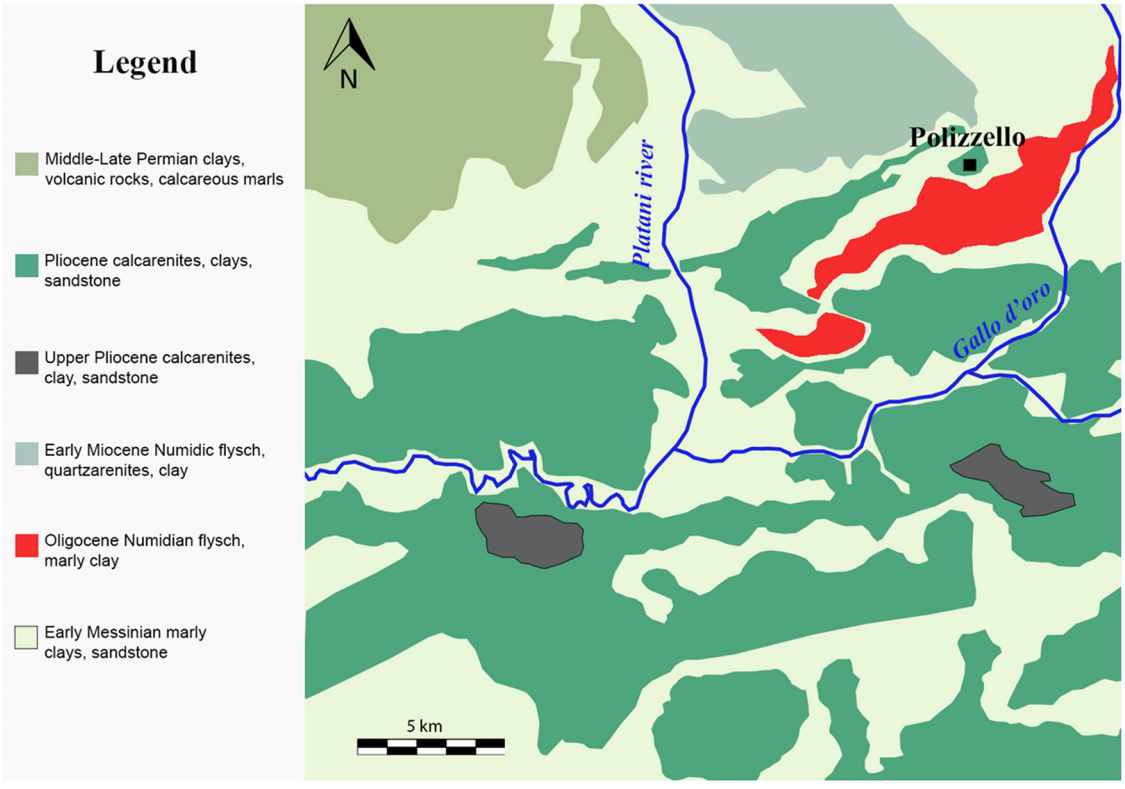

Figure 4: Schematic map of the Upper Platani Valley, including the location of Polizzello Mountain. Each color identifies specific sedimentary formations characterizing the area (Caso et al., 2022).

broader geographic region that extends across the provinces of Caltanissetta and Agrigento to the southern coast of central Sicily.

3 Materials and Methods

3.1 Sampling Strategies

The sampling of the ceramics for the archaeometric analyses took place in 2019 at the Antiquarium of Mussomeli in Caltanissetta, using primary selection criteria like, typology, chronology, and macroscopic fabric features. Samples of 2–4 cm^2 were taken from a statistically representative group of vessels. With respect to typology, tableware, containers, cooking pots, and specialized shapes, as 39071, 39064, and 39095, were considered; whereas, to cover the entire chronological arc of the production (950–750 BCE), the materials sampled belonged to both the Cassibile facies, typical of eastern Sicily, and the Sant'Angelo Muxaro–Polizzello facies that is instead peculiar to central-western Sicily. Regarding the fabric, based on the main observable features, such as hardness, porosity, presence of clasts, and color, five groups were identified (Tanasi, 2012) and samples from each group were selected (Figure 5, Table 2).

Sixty-eight ceramic samples and one clay sample, taken from a source identified about 6 km west of Polizzello Mountain, were tested via INAA and the results were already presented (Caso et al., 2022). Additionally, from that group 21 samples, taken from the most statistically significant pottery typologies, were also investigated with petrographic analyses, here presented, and discussed in relation to the chemical composition[1] (Table 3).

In the group sampled, two vessels presented a typology exclusively related to the Cassibile culture, typical of the Sikel communities of Eastern Sicily, and, therefore, are suspected to be imports from that area. The

Figure 5: Cross-sectional photos depicting the macroscopic characteristics of the five pottery groups (a, b1, b2, d, e) observed at Polizzello Mountain.

1 For the profile drawings of the 21 samples see Tanasi (2006), where they are listed per Inv. No.

Table 2: Macroscopic features of Polizzello Mountain pottery and samples

Macro	Texture	Surface color	Core color	Forming	Clasts	Pores	Decoration
A	Compact	Gray 10YR 6/3–black 10YR 3/1	Black 5YR 1.7/1–dark gray 2.5YR N3	Hand and wheel	Small	Abundant	Brown slip, burnished, incised
B1	Compact	Beige 5R 6/3–orange 5YR 7/6	Black 5YR 1.7/1–dark gray 5YR 4/1	Exclusively wheel	Very small	Few	Red slip, burnished, incised, painted
B2	Coarse	Pink 5YR 8/4–beige 10YR 8/6	Black 2.5YR N3	Hand and wheel	Large; clay nodules	Large	Red slip, burnished, incised, painted
C	Firm and fine	Beige 5R 6/3–orange 5YR 7/6	Dark gray 5YR 4/1	Exclusively wheel	Small	Rare	Red slip, burnished, incised, painted
D	Coarse	Gray 10YR 8/3	Dark gray 2.5YR N3	Hand and wheel	Small-medium	Large	No decoration, incised, painted

Table 3: List of the pots with both petrographic and chemical analyses

Macro	ID	Inv. No.	Macro	Shape and type	Surface treatment/ decoration	Facies	Context	Date
	39071	05/210	B2	Pedestal plate-lamp (Sikel?)	Undecorated	CAS	Trench North Building-USM37	Early 9th BCE ca.
	39054	05/114	C	Pedestal Basin type 5 (Sikel?)	Painted (plumed)	CAS	8-D-US63	9th–8th BCE ca.
	39077	06/02	A	Cup type 4B	Brown slipped	CAS	North Building-US13/14	End 10th BCE ca.
	39079	06/06	A	Cup type 4B grooved rim	Brown slipped	CAS	North Building-US9/11	End 10th BCE ca.
	39056	05/162	B2	Cooking pot type 5	Undecorated	CAS	3-Hut1-USM6	Early 9th BCE ca.
	39101	00/01	B1	Amphora	Undecorated	SAM/P	1-US7	9th–8th BCE ca.
	39083	06/36	B1	Amphora type 2	Undecorated	SAM/P	North Building-US7	End 9th BCE ca.
	39063	04/618	A	Cup type 1A	Incised	SAM/P	1-US7	9th–8th BCE ca.
	39058	05/167	B1	Cup type 1A	Undecorated	SAM/P	7-E (US6)	9th–8th BCE ca.
	39110	04/245	B1	Cup type 1A	Incised	SAM/P	8-D-US63	9th–8th BCE ca.

(Continued)

Table 3: *Continued*

Macro	ID	Inv. No.	Macro	Shape and type	Surface treatment/ decoration	Facies	Context	Date
	39107	04/27	D	Cup type 1A	Incised	SAM/P	Trench North Building-US8	Mid-9th BCE ca.
	39091	S.N.	B2	Cup type 1B	Brown slipped	SAM/P	7-E-US9	9th–8th BCE ca.
	39053	S.N.	B1	Cup type 1C	Undecorated	SAM/P	2-US13	9th–8th BCE ca.
	39072	06/17	B1	Cup type 1C	Red slipped	SAM/P	North Building-US9/11	Early 9th BCE ca.
	39052	05/04	B1	Cup type 3B	Red slipped incised	SAM/P	7-E-US7	Mid-8th BCE ca.
	39068	S.N.	B2	Cup type 3C	Red slipped incised	SAM/P	Trench North Building-US13/16	9th–8th BCE ca.
	39098	05/57	B1	Cup type 5	Undecorated	SAM/P	7-E-US11	9th–8th BCE ca.
	39106	04/15	A	Pedestal Basin	Incised	SAM/P	Trench North Building-US5	Early 8th BCE ca.
	39104	04/606	A	Pedestal Basin	Incised	SAM/P	1-US7	9th–8th BCE ca.
	39064	05/148	A	Askos (Aegean prototype?)	Incised	SAM/P	4-Hu t2-US28	Early 9th BCE ca.
	39095	00/37	A	Askos (Aegean prototype?)	Incised	SAM/P	1-US7	9th–8th BCE ca.

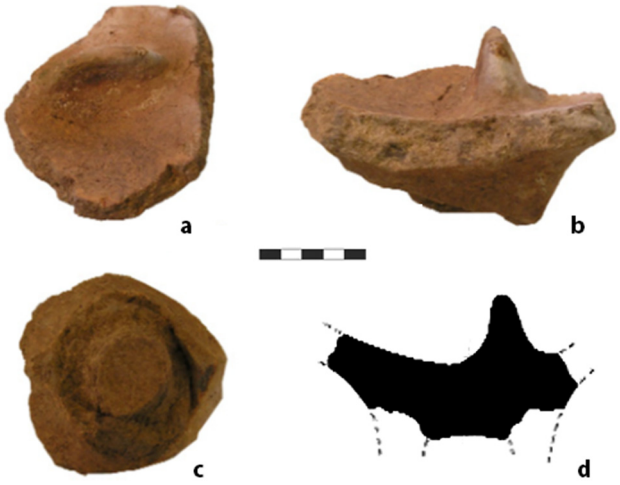

Figure 6: Pedestal plate-lamp 39071 with wick-holder plaque: (a) top view, (b) side view, (c) bottom view, and (d) section view.

pedestal plate, also known as plate-lamp 39071 (Figure 6), characterized by a square vertical plaque at the bottom of the plate, is peculiar to the Sikel productions of eastern Sicily and therefore interpreted as an example of circulation and exchange between Sikanians and Sikels (see for Cugno Carrubbe di Lentini: Frasca, 1982a, p. 22; Cozzo San Giuseppe di Realmese: Carcarella di Enna: Albanese Procelli, 1988–1989, pp. 292–293). The basin 39054, presenting the distinctive painted "plumed" decoration in light red color on yellowish slip (Figure 7), recalls closely well-known comparisons attested in Sikel contexts of the Cassibile culture as Ortigia at Siracusa (Frasca, 1982b, pp. 577–578, Figures 8, 21; Orsi, 1918, pp. 507–508, Figure 96) and Cittadella di Morgantina (Leighton, 1993, p. 187, nn. 287–288, pl. 105).

Two cups with a grooved rim (*coppa ad orlo bifido*), 39077 and 39079, attested only in the central western district of the island between the end of the North Pantalica culture and the beginning of the Cassibile culture (Mannino & Spatafora, 1995, pp. 135–139, Figure 30), and presenting an unusual dark brown slip (commonly found in the later Sant'Angelo Muxaro–Polizzello production) have also been selected.

Seventeen samples were chosen from those identifiable for typology and style as belonging to the Sant'Angelo Muxaro–Polizzello culture. In this group there are two askoi specialized pouring vessels with a sieve-mouth that are traditionally interpreted as of Aegean tradition (Tanasi, 2009b): 39095 and 39064 (Figure 8).

It is worth noting that no kilns or workshops have been found in the area, so it is not possible for example to use kiln waste as reference material.

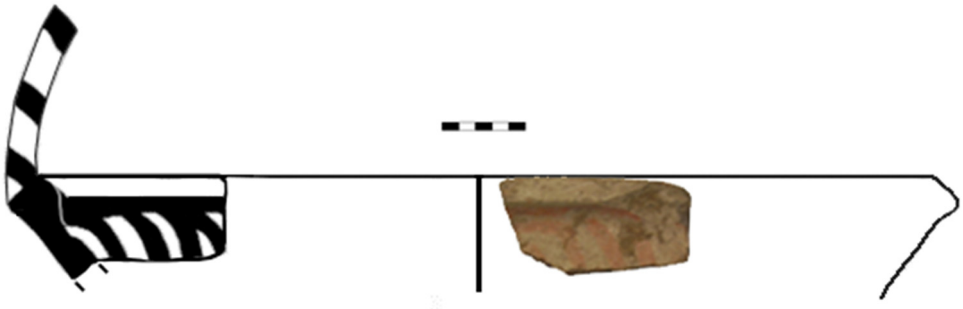

Figure 7: Basin 39054 with painted plumed decoration.

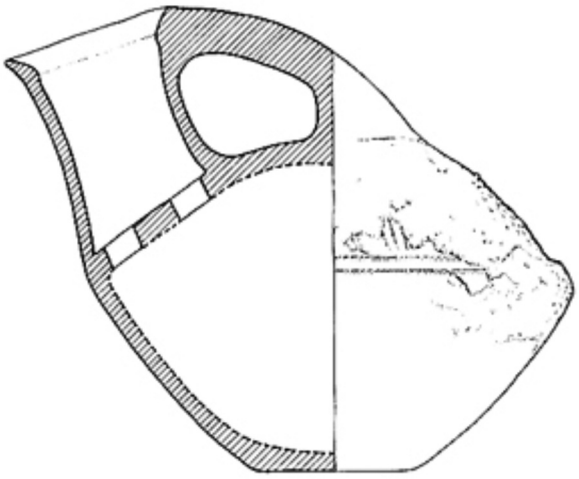

Figure 8: Askos of Sant'Angelo Muxaro type V,43 of the Fatta categorization (Fatta, 1983).

The petrographic study of thin sections was conducted at the Mineralogy Laboratory of the Geoscience Department at the University of South Florida with an Olympus B120C polarizing microscope. Microphotographs were captured with a Canon 7D Mark at 4× and 10× in plane polarized light (PPL) and crossed polarized light (XPL).

3.2 Methods

Samples were classified according to the main structural and compositional features, following the guidelines outlined by Freestone (1995) and Whitbread (1989). The fabrics have been labeled using the framework established by the *Wikipottery Project* for petrographic classification of central Mediterranean pre-protohistoric pottery (Cannavò, Di Renzoni, Levi, & Brunelli, 2019; Cannavò & Levi, 2018; Levi, Cannavò, & Brunelli, 2019). The system is structured with two levels: the first is the group linked to geological/lithological environments and expressed by a capital letter; the second is a number and corresponds to the petrographic fabric; the numbers assigned in this study align with the general Wikipottery classification.

All the analyzed samples from Polizzello Mountain are characterized by the presence of grog and calcareous components, falling under the group S (+grog) which signifies sedimentary components along with grog. The clasts range from 0.06 to 2 mm. Voids are abundant, channels and vughs are also present. Three distinct petrographic fabrics can be identified, as summarized in Table 4.

Fabric S211 (grog–calcite) (Figure 9): Characterized by the presence of grog, brown, or black, and appears as sub-angular and rounded fragments with a homogeneous distribution and voids, calcite and fossils. Notably, there are abundant medium and small-sized rounded calcite clasts as well as few carbonatic rock fragments (limestone). Fossils are also observed. The matrix is homogeneous either optically active or inactive. The fine fraction includes quartz, feldspars, mica, and iron nodules. Cup 39052 and pedestal plate 39071 stand out for their very large quartzarenite composition.

Fabric S212 (grog–calcite) (Figure 10): The main difference with S211 is the higher abundance of carbonates and iron nodules. The matrix is calcareous, resulting lighter in color. Cup 39091 is distinctly characterized by a very large clast (>2 mm) bearing iron-rich filling across the matrix; cup 39072 contains one medium-sized and rounded altered basalt grain; and cup 39107 is characterized by the presence of feldspars.

Fabric S213 (sandstone–grog) (Figure 11): It is only represented by the askos 39095. It displays greater heterogeneity compared to the previous fabrics, with a more abundant fine fraction. The fabric consists of predominantly heterogeneous angular and sub-angular grog, which includes fossils such as ostracods and foraminifera, as well as calcite and sandstone, with a matrix high in calcareous content.

Table 4: Fabrics of Polizzello Mountain pottery: summary of the main characteristics

Fabric	S211 (+grog)	S212 (+grog)	S213 (+grog)
Main components	Grog–calcite	Grog–calcite	Sandstone–grog
N	13	7	1
Samples	39052, 53, 54, 56, 58, 63,71, 77, 79, 83, 98, 101, 106	39064, 68, 72, 91, 104, 107, 110	39095
Coarse fraction	Brown and gray grog with voids, quartz grains and fossils; calcite, limestone	Brown and gray grog with voids, quartz grains and fossils; calcite	Heterogenous grog with fossils (ostracods and foraminifera); sandstone, calcite
Fine fraction	Abundant angular quartz and feldspar, frequent mica and fossils (foraminifera, ostracods, and rare bivalve), Fe nodules	Abundant angular and sub-angular quartz and feldspar, frequent mica and fossils (foraminifera, ostracods, and rare bivalve), Fe nodules	Abundant, quartz and feldspar
Clasts	Abundant medium size, closely and singly spaced, angular sub-angular and rounded; 0.06–2 mm	Single and open-spaced, mostly angular and sub-angular; 0.06–2 mm	Parallel orientation, single and open-spaced, angular and sub-angular; 0.06–2 mm
Matrix	Homogeneous, optically slightly active (39052, 53, 63, 79, 83, 98, 101) or inactive (39054, 56, 58, 71, 77, 106); brown PPL and XPL	Calcareous, homogeneous, optically slightly active, brown PPL and yellow-red XPL	Calcareous, heterogeneous, optically active, brown/red PPL and brown/yellow XPL
Voids	Frequent planar micro-meso voids; common micro-meso channels; rare meso-micro vughs	Abundant planar micro-meso voids, common micro-meso channels, few meso-micro vughs	Frequent micro-meso voids, common channels, few vughs
Notes	Secondary calcite; quartzarenite in 39052 and 39071	Secondary calcite; oolitic limestone in 39091; basalt in 39072; feldspar in 39107	

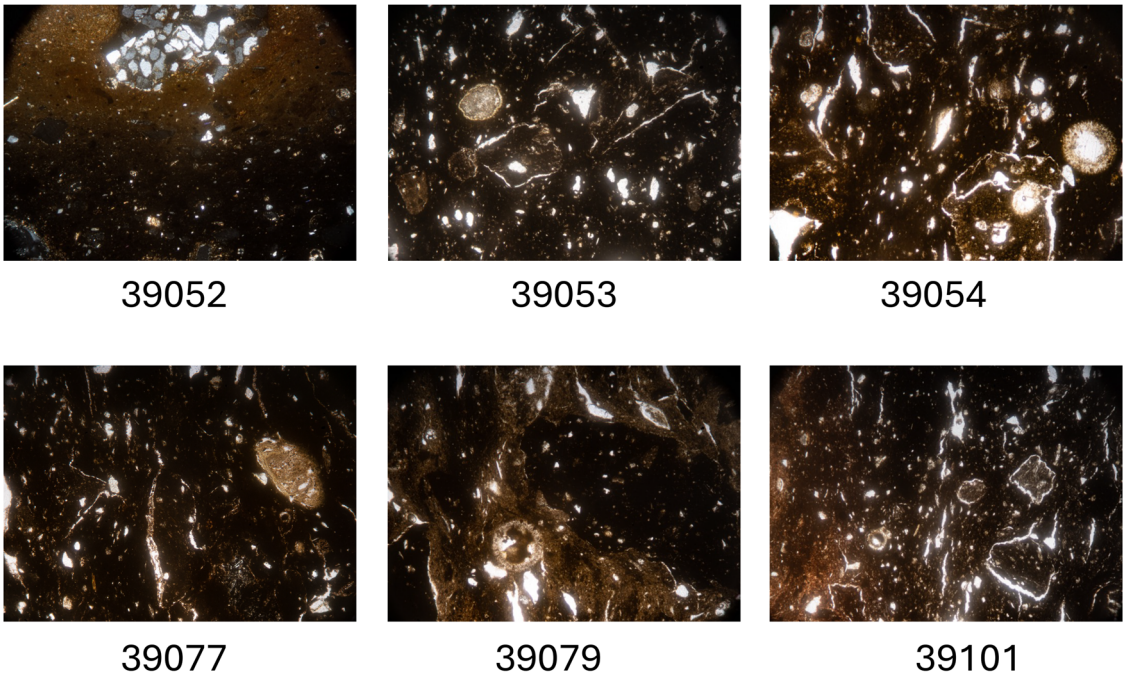

Figure 9: Microscopic images of Fabric S211: 39052 XPL; 39053, 39054, 39077, 39079, 39101 PPL; horizontal dimension 2 mm.

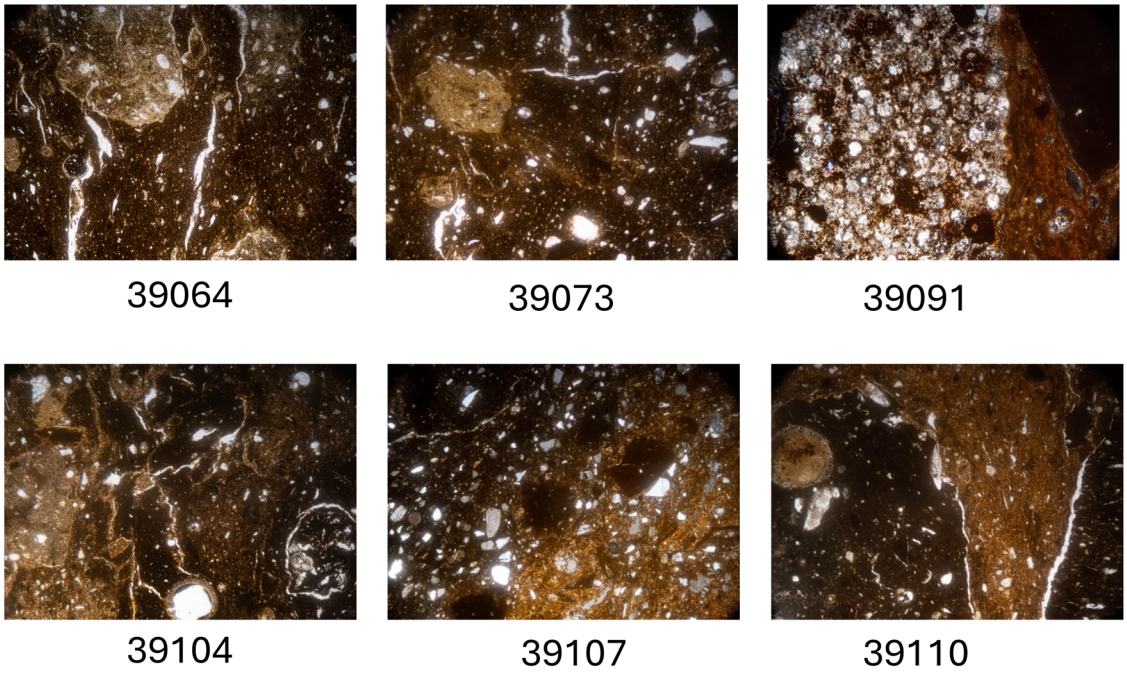

Figure 10: Microscopic images of Fabric S212: 39064, 39073, 39104, 39107, 39110 PPL; 39091 XPL; horizontal dimension 2 mm.

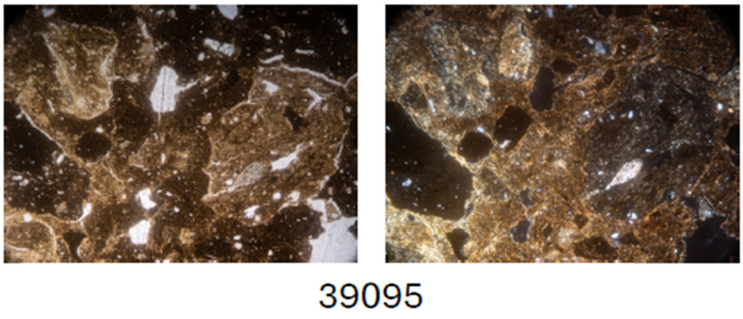

Figure 11: Microscopic images of Fabric S213: 39095 PPL (left) and XPL (right); horizontal dimension 2 mm.

4 Results

4.1 Comparison with Chemical Data and Suggested Origin

The assessment of the raw materials and therefore the production area can be better determined by combining the above-mentioned petrographic with the chemical analyses resulting from the INAA study (Caso et al., 2022). The results of the analyses are summarized as given in Table 5.

The pottery from Polizzello Mountain that has been analyzed exhibits a very similar composition, displaying a range of variability in line with the hypothesis of local raw materials sourced from geological deposits in the Upper Platani Valley. The fabrics incorporating grog combined along with carbonates belong to a well-known traditional composition that is common among pre-protohistoric pottery in sedimentary environments. The possible local origin of the Polizzello pottery is further substantiated through comparison with the chemical analysis.

The results obtained from the INAA data yield three distinct clusters that correspond closely with the petrographic classification. The main chemical differences between these clusters are observed in the

Table 5: Petrographic, chemical, and macroscopic classification of Polizzello Mountain pottery

ID	Petro	INAA	Macro	Shape and type	Surface treatment/decoration	Facies	Context	Date
39063	S211	2	A	Cup type 1A	Incised	SAM/P	1-US7	9th–8th BC ca.
39077	S211	2	A	Cup type 4B	Brown slipped	CAS	North Building-US13/14	End 10th BC ca.
39106	S211	2	A	Pedestal Basin	Incised	SAM/P	Trench North Building-US5	Early 8th BC ca.
39053	S211	2	B1	Cup type 1C	Undecorated	SAM/P	2-US13	9th–8th BC ca.
39058	S211	2	B1	Cup type 1A	Undecorated	SAM/P	7-E (US6)	9th–8th BC ca.
39083	S211	2	B1	Amphora type 2	Undecorated	SAM/P	North Building-US7	End 9th BC ca.
39098	S211	2	B1	Cup type 5	Undecorated	SAM/P	7-E-US11	9th–8th BC ca.
39056	S211	2	B2	Cooking pot type 5	Undecorated	CAS	3-Hut1-USM6	Early 9th BC ca.
39101	S211	2	B1	Amphora	Undecorated	SAM/P	1-US7	9th–8th BC ca.
39079	S211	3	A	Cup type 4B grooved rim	Brown slipped	CAS	North Building-US9/11	End 10th BC ca.
39052	S211	3	B1	Cup type 3B	Red slipped incised	SAM/P	7-E-US7	Mid-8th BC ca.
39071	S211	3	B2	Pedestal plate-lamp (Sikel?)	Undecorated	CAS	Trench North Building-USM37	Early 9th BC ca.
39054	S211	3	C	Pedestal Basin type 5 (Sikel?)	Painted (plumed)	CAS	8-D-US63	9th–8th BC ca.
39064	S212	1	A	Askos (Aegean prototype?)	Incised	SAM/P	4-Hu t2-US28	Early 9th BC ca.
39104	S212	1	A	Pedestal Basin	Incised	SAM/P	1-US7	9th–8th BC ca.
39072	S212	1	B1	Cup type 1C	Red slipped	SAM/P	North Building-US9/11	Early 9th BC ca.
39110	S212	1	B1	Cup type 1A	Incised	SAM/P	8-D-US63	9th–8th BC ca.
39068	S212	1	B2	Cup type 3C	Red slipped incised	SAM/P	Trench North Building-US13/16	9th–8th BC ca.
39107	S212	1	D	Cup type 1A	Incised	SAM/P	Trench North Building-US8	Mid-9th BC ca.
39091	S212	4	B2	Cup type 1B	Brown slipped	SAM/P	7-E-US9	9th–8th BC ca.
39095	S213	1	A	Askos (Aegean prototype?)	Incised	SAM/P	1-US7	9th–8th BC ca.

Cultures: CAS = Cassibile; SAM/P = Sant'Angelo Muxaro–Polizzello.

concentration of Ba, Sr, Mn, Na, Sb, and Ca. Chemical clusters 2 and 3 align with Fabric S211, chemical cluster 1 with Fabric S212, and the single askos with Fabric S213. The chemical composition of the outlier (cluster 4), painted cup 39091, demonstrated higher Ca and Mn content and lower Na. This composition can be linked to the presence of the large clasts of oolitic limestone and represents a variant within Fabric S212. The obtained results point directly to local geology, which exhibits a homogeneous presence of evaporites and carbonate rock formations, alongside iron-rich clay deposits (Basilone, 2018). The main source of carbonate rocks comes from reef limestone, marls, and marly clay deposits where carbonate rocks and sandstone contain small amounts of Ba that occurs mostly in K-feldspar and micaceous deposits alongside Fe and Na. Barium is frequently associated with K-rich minerals that undergo decomposition through chemical weathering. Sodium is widespread within the local geology in the form of sodium chloride (rock salt) and sodium sulfate. Consequently, the varying concentration of Ba-rich and Na-rich feldspars could be linked to the continuous weathering of carbonate rock deposits across the Upper Platani valley. The abundant occurrence of Numidian flysch, calcarenites, marls, and clay deposits in the proximity of the site likely account for the inclusion of quartzarenite and calcarenite in the pottery.

Among the local products, it is noticeable to underline the presence of the two samples hypothetically belonging to Sikel manufacturing tradition and as such potentially imported to the Polizzello Mountain site, pedestal plate-lamp 39071 and pedestal basin painted with plumed decorations 39054, having the same chemical and petrographic fabric. The two askoi 39064 and 39095, typologically interpreted as of Aegean origin, though having the same fabric from a chemical perspective but belonging to two different petrographic groups, are also to be considered as locally made.

4.2 Relationship Between Fabrics, Chronology, and Typology

Pottery production at Polizzello Mountain exhibited a well-established manufacturing tradition, especially with respect to fabrics, during the ninth and eighth centuries BCE, with no significant chronological changes over this period. There is minimal variability between the fabrics, and there are no strong correlations between compositions, types of wares, forming techniques, and contexts of origin.

Fabric S211 is associated with a wide range of shapes and functions, including cooking pots, amphoras, pedestal vessels, and cups, and includes almost all the macroscopic features, from coarser to finer ones. It includes both undecorated pots, such as slipped, incised, and painted specimens. This fabric also includes the pedestal plate of Sikel tradition mentioned earlier.

Fabric S212 is primarily found in cups, all of which are decorated (slipped, incised, or painted). It is possible that this more calcareous fabric was a preferred choice, though not exclusive, for tableware. Other vessels with this composition include an incised pedestal basin and the incised askos with Aegean prototypes mentioned previously. The sample belonging to Fabric S213 is the other incised askos characterized by heterogeneous grog within a highly calcareous matrix.

In terms of the context of origin, there is no clear correlation with the pottery composition. However, we can note that most of the oldest pots, dating back to the Cassibile facies, belong to Fabric S211, while most of Fabric S212 is found in vessels of the Sant'Angelo Muxaro–Polizzello facies. Despite these possible trends, the overall homogeneity of Polizzello Mountain ceramic assemblage is a hallmark of local production.

4.3 Comparison with Other Contexts

It is important to note that fabrics containing a calcareous component and/or grog are typical and specific of sedimentary landscapes and has been observed in several Italian areas including the majority of Sicily, the Po Valley, and the southeastern Italian peninsula (Cannavò et al., 2019, Figure 6). Petrographic analyses of protohistoric Sicilian pottery have revealed the presence of several fabrics using and combining those

Table 6: Local fabrics of protohistoric Sicilian pottery characterized by sedimentary (S) components and or generic (G) components with grog (modified from Cannavò et al., 2019)

Group	Fabric	Main components	*N*	Sites	Chronology	Notes
S	S202	Fossiliferous clay	1	Cannatello	MBA3/FBA1	Daub
	S203	Siltstone; siliceous groundmass	5	Morgantina	FBA3	Pithoi
	S204	Quartz and micrite calcimudstones	1	Cannatello	MBA3/FBA1	Nuragic
	S101	Quarz–feldspar–sandstone	3	Tindari	MBA1-2	Capo Graziano
	S205 (+grog)	Grog–fossils	3	Tornambè	EBA-MBA	Castelluccio, Thapsos
	S206 (+grog)	Grog–fossils	4	Cannatello	MBA3/FBA1	Thapsos
	S207 (+grog)	Grog–fossils	2	Monte Grande	EBA	Casetelluccio
	S208 (+grog)	Grog; calcareous-fossiliferous groundmass	10	Morgantina	FBA3	Piumata, pithoi
	S209 (+grog)	Grog–calcite	8	Thapsos	MBA3	Thapsos, daub
	S211 (+grog)	Grog–calcite	13	Monte Polizzello	EIA	Pedestal Plate (Sikel)
	S212 (+grog)	Grog–calcite	7	Monte Polizzello	EIA	Askos (Aegean prototypes)
	S210 (+grog)	Grog–fossils–micritic calcite–quartz	3	Monte Grande	EBA	Pithoi
	S213 (+grog)	Sandstone–grog	1	Monte Polizzello	EIA	
G	G202 (+grog)	Grog	3	Madonna del Piano	FBA-EIA	
	G203 (+grog)	Grog	17	Thapsos	MBA3	Thapsos
	G204 (+grog)	Grog	20	Monte Grande	EBA	Castelluccio
	G205 (+grog)	Grog	8	Cannatello	MBA3/FBA1	Nuragic
	G206 (+grog)	Quartz–grog	3	Tornambè	EBA-MBA	Castelluccio, Thapsos
	G111 (+grog)	Quartz–feldspar–grog	2	Milazzo–Scuole elementari	EBA-MBA	

Table 7: Local fabrics of FBA–EIA Sicilian pottery: fabrics and groups identified with petrographic analysis

Site	# Fabrics	# Groups	Groups composition
Milazzo–V.le dei Cipressi	1	1	Metamorphic
Paternò	2	2	Effusive basaltic; effusive basaltic + sedimentary
Monte Polizzello	3	1	Sedimentary + grog
Madonna del Piano	4	3	Effusive basaltic; effusive basaltic + sedimentary; grog
Morgantina	6	2	Effusive basaltic + sedimentary; sedimentary
Lipari Acropolis	10	4	Effusive daci-rhyolitic; effusive andesitic + quartz; effusive basaltic + quartz; effusive daci-rhyolitic + quartz

components, particularly in the central and western part of the island. In contrast, the northeastern and eastern regions of Sicily, including Etna, are characterized by different lithologies and distinct ceramic fabrics. Several Sicilian fabrics with sedimentary components and grog, like those found in Polizzello, are summarized as given in Table 6.[2]

Although pinpointing the exact origin is challenging when grog is the primary or sole component of the ceramic paste, the fabrics from various sites are characterized by different components and features allowing them to be confidently considered as local variations within the craft tradition.

In contrast to the Polizzello Mountain ceramic assemblage, other LBA to EIA ceramic collections from sites in central-eastern Sicily exhibit greater variability in the selection of raw materials (Table 7). This variability can be more likely attributed to the local availability of different raw materials than to different levels of social organizations of production.

Petrographic analyses conducted at sites like Morgantina and Madonna del Piano (necropolis) reveal a certain degree of correlation between fabrics, types of wares, and chronology (Fragnoli & Levi, 2012, 2018; Mentesana & Fragnoli, 2021). For example, at Madonna del Piano, grog and basalts are exclusively used for hand-made pottery, while wheel-made pottery is manufactured with other effusive components, including glass. There are clear preferences for specific fabrics associated with each type of ware, such as *piumata* (plumed)*, geometrica, monocroma*, and not painted wares. Similarly, at Morgantina, there is a distinct preference for fabrics associated with each type of ware, such as *impasto, piumata,* and *geometric pottery*. Moreover, over time, there is a decreasing use of sedimentary fabrics in favor of effusive ones. This evidence highlights that the selection of raw materials and the correlation between fabrics, wares, and chronology can vary significantly across different archaeological sites in central-eastern Sicily.

5 Conclusions

Compositional analyses of pottery from Polizzello Mountain reveal that ceramic production in the sanctuary area remained consistent and standardized from half of the tenth to the half of the eighth centuries BCE. The results of petrographic and chemical analyses agree and underscore the importance of petrography in reconstructing technological choices and understanding the variations in chemical compositions. This is particularly relevant for coarse pottery, as is the case with most of the vessels examined in this study.

The raw materials chosen for the ceramic pastes align with the well-established Sicilian tradition, which combines calcareous components and grog. At Polizzello Mountain, there are no significant compositional differences, suggesting a specialized social organization of production, likely at the workshop level. Notably, specimens with stylistic characteristics from other areas also appear to be locally produced, with no evidence of imports identified among the analyzed vessels.

2 Grog-based fabrics have been recently identified even in local adaptations of Greek ceramic types in Archaic contexts from Monte Iato (Öhlinger, Tenconi, Maritan, Montana, & Roppa, 2023).

The results obtained also proved wrong the assumption of a consistent congruence between the appearance of a certain material culture and/or geographic provenance and an assumed ethnic identity, as testified by the local origin of the materials of Sikel and Aegean type. Additionally, the complemented previous scholarship on the same subject (Pappalardo et al., 2008; Pappalardo & Mazzoleni, 2020) focusing on a chronological period of the pottery production not studied before and using alternative chemical techniques of analysis and offering the contribution of the petrographic exam.

In conclusion, this study sheds light on the characteristics of pottery production during a phase that has received limited investigation such as the end of the protohistoric phase and the period just before the colonial phase. The EIA pottery production at Polizzello appears to be consistent with local craftsman tradition, which has been present since prehistoric times.

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