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ISLAMIC POTTERY PRODUCTION IN EASTERN SICILY (10th-11th CENTURIES): PRELIMINARY ARCHAEOMETRIC DATA ON LOCAL AND IMPORTED PRODUCTS FROM PATERNÒ (SICILY).

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ABSTRACT

From the 9th to the 11th century, Sicily has been part of the Islamic oecumene, the *dār al-Islām*. Up until now, very few studies have been carried out on the centres of pottery production of this period, and most of them concern the Emiral capital of the isle, Palermo.

The archaeometric data obtained with chemical and minero-petrographic analyses on Islamic pottery found in Paternò – a town situated in the southwestern slope of Mt. Etna – has provided a certain number of issues of very important matter. The selection of the samples has been made among the archaeological finds coming from the excavation near the church of Cristo al Monte, on the hilltop, which represented the inner part of the medieval *madīna*.

The mineralogical and chemical characterization of the ceramic body has been attained using optical microscopy on thin sections and X-ray fluorescence respectively, in order to define the probable provenance of each sample. Further information of technological matter has been provided using X-Ray diffraction on powdered samples, which furnishes mineralogical data useful to hypothesise the firing temperatures: the main task attained on this issue was the focus on the self-slipped ware with salted water, one of the main technological class in Islamic Sicily. Finally, energy dispersive X-Ray fluorescence was adopted for a preliminary investigation of pigments used to decorate the lead glazed pottery. The issues related to both the local and imported pots – the latter represented almost completely by Palermo's products – provided some important historical and archaeological information about the means of Sicilian pottery production during this important period.

KEYWORDS: Pottery production, Eastern Sicily, glazed pottery, Islamic archaeology

1. INTRODUCTION AND HISTORICAL BACKGROUND

The Islamic period of medieval Sicily is little known from a historical point of view for different aspects, especially in its archaeological perspective. While the number of studies for the western part of the isle – and for the Emiral Capital of Palermo in particular – is growing (Nef and Ardizzone, 2014), there are still a lot of shadows for the most important cities in Central and Eastern Sicily. The characterization of ceramics of the 10th-11th centuries found in Paternò (Catania) is inspired by the need of a wider comprehension of the material culture for those territories that remained, for a longer period, a frontier zone (*ṯaġr*) between the *Dār al-Islām* ("The house of the *Islām*") and the imperial oecumene of Constantinople.

Islamic troupes arrived in Sicily following Asad Ibn al-Furāt, an important malikī jurist who guided the beginning of the *ǧihād* against the isle under the banners of the Aghlabid Amirs of Ifrīqiya (modern Tunisia) in 827 C.E. (Nef, 2011). After the major conquests of Agrigento (828) and Palermo (831), a time of periodic confrontation between Muslim and imperial forces occurred, along the roads between the two sides of the island and around the fortified *kastra* (Nef and Prigent 2013, Arcifa, 2013). From the 9th to the 11th century, Eastern Sicily was the main theatre of war, and occasionally capitulations of cities took place: Enna (859), Syracuse (878), Taormina and Rometta (902 and 962-4) are just a few examples (Fig. 1). Since 916 C.E., Islamic Sicily passed under the rule of the Shiite Caliphate of the Fatimids (Pellitteri, 1997).

For Catania and Paternò, the chroniclers did not furnish a certain date of surrender or fall after siege. In particular, Paternò is a town situated on the southwestern side of Mt. Etna, and the written sources did not have historical remarks about it, except for the important citation of this centre among the "cities" (*mudun* sing. *madīna*) of Islamic Sicily. According to this list of the Arab geographer al-Muqaddasī (X century), a "city" (*madīna*) is the capital of an administrative department (*iqlīm*), an information that needs to be better evaluated in its territorial dimension (al-Muqaddasī, 1991).

The medieval documents about Paternò's territory record the presence in this area of a *Murum Marabotti* (Garufi, 1913) and of the *Rocca que dicitur de Maraboto* (Ardizzone, 1927), related to some *sepolturae sarracenorum*[1]. These terms could witness the existence of a *ribāṭ* in Paternò, i.e. a military-religious institution widely spread along the border zones of the *Dār al-Islām* in this period (Picard and Borrut, 2003). This fascinating hypothesis needs to be ascertained with archaeological data.

A certain number of archaeological excavations took place on the hilltop of *Baṭarnū*, the so-called "Collina Storica". Along the northern wall of the Bianchi's Graveyard joined to the church of Cristo al Monte, the Superintendence to the Cultural Heritage of Catania (dir. L. Maniscalco) found a hydraulic complex consisting of a semi-circular cistern that was replenished with rainwater by built canals and terracotta pipes, or *qawādīs* (sing. *qādūs*, Fig. 8), an Arabic term that remained in the Sicilian dialect (*catusu*). The archaeological evidences detected at the moment show the implantation of these buildings during the 10th century, after a long period of abandon of the hilltop. Since then, two Islamic phases have been detected: the main building phase is datable between the 10th and the very beginning of the 11th century (Phase IV); probably during the central decades of the 11th century, these structures collapsed, as recorded in a series of destruction and abandon layers (Phase V, Arcifa, Messina in press.).

In this context, this archaeometric study aims to give new important data for the study of the production of Islamic pottery in Sicily. In fact, the state of the research in this topic is still unripe even if some Sicilian centers of production have already been recognized in the past by archaeometric tools: Palermo (Giarrusso and Mulone, 2014), which was the Islamic capital of the isle during these centuries; Siracusa (Ben Amara et al., 2009), which represented the main Byzantine city until its conquest in 878; Mazara del Vallo (Molinari, 2010), Agrigento (Alaimo and Giarrusso, 2007) and Piazza Armerina (Alaimo et al., 2010). Unfortunately, the archaeometric data presented in these papers – consisting almost exclusively of petrographic features – do not allow a comparison among these centers of production, and for the most part of them a more extensive and multivariate analysis needs to be done.

A further perspective has also a socio-economic and historical importance: starting a study on the productive landscape of a frontier zone represents an opportunity to better understand in what senses – negative and positive – urban and rural sites were affected by a "never-ending holy war" (*ǧihād dā'im*, al-Muqaddasī, 1991).

2. EXPERIMENTAL

2.1 Materials

For what concerns the Islamic Sicilian pottery, five main technological classes can be distinguished: i) self-slipped ware with salted water (SSW); ii) lead-

[1] Translations: "The wall of the Marabouts", the "so-called Maraboto rock" and "muslim tombs".

glazed ware (LGW), which was provided of a light-coloured surface as well as with a SSW treatment in the first firing process, in order to furnish a white base for the metal oxides used as pigments (Cuomo Di Caprio, 2007); iii) painted ware (PW); iv) cooking ware (CW); v) common ware (Com. W., Table 1).

The painted ware of this period is characterized by different kinds of banded motifs, for which a chrono-typological differentiation has been proposed (Arcifa, 2010): a loop motif characterized the amphorae during the middle-byzantine period (late 8th-9th century) and was still widespread between Sicily and Southern Italy until the mid-11th century (Raimondo, 2002, Arthur and Leo Imperiale, 2015). Other kinds of decorations were depicted in transport amphorae produced between Palermo and Western Sicily: the sinusoidal line characterizes the earliest products (end 9th-beginning 10th century), which was substituted by oblique and parallel strokes during the 10th century (Nef and Ardizzone 2014). The surface of the PW could be whitened with a SSW treatment (i.e., sample PCM 25/42).

In order to achieve a certain characterization of these different products and their provenance, fourteen samples have been selected from the abovementioned Paternò archaeological excavation (Par. 1, PCM). Furthermore, three kiln wastes for self-slipped (PCM 25/35), lead-glazed (PCM 25/36) and painted (PCM 25/42) ware have been analysed as reference samples for local production. Finally, with the aim to compare the data of some products supposed of Palermo and North Eastern Sicily, we studied two samples representative of Palermo's common (Pa1) and lead glazed ware (Pa2) and two samples of common (TF1) and painted ware (TF2) from Taormina.

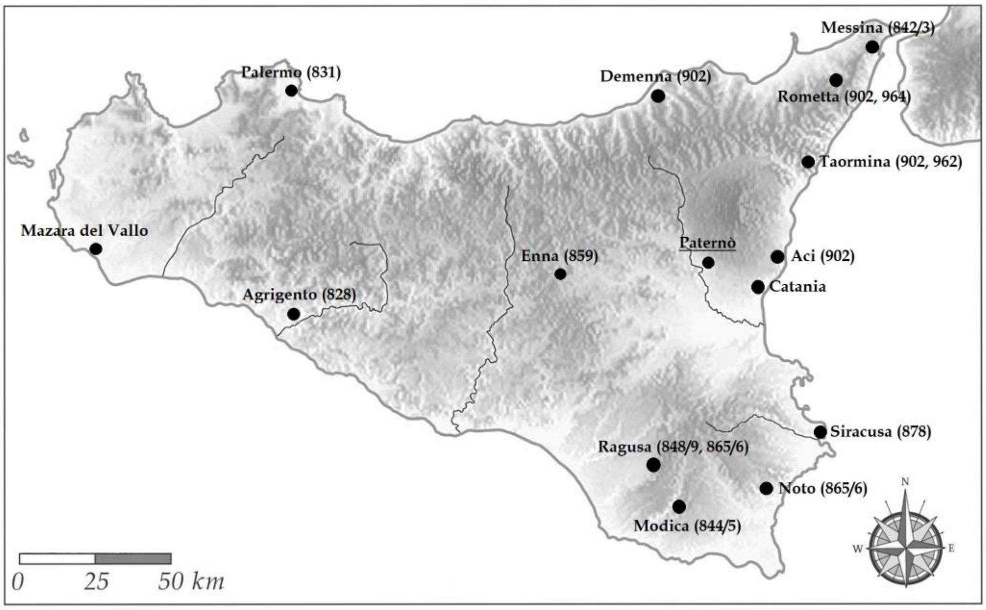


Figure 1. Main Sicilian towns and their date of conquest (CE) by the Islamic power during the 9th-10th centuries.

2.2 Methods

Once catalogued and prepared, the samples were analysed at the laboratory of the Department of Biological, Geological and Environmental Sciences at the University of Catania, using the following analytical methods: i) optical analysis with a polarized-light microscope (OM); ii) mineralogical analysis with X-ray diffraction (XRD) using a SIEMENS D5000, with Cu-kα radiation and Ni-filter; iii) chemical analysis of bulk with wavelength dispersive X-ray fluorescence (WDXRF), carried out using a Philips PW 2404/00 spectrometer, and of glassed surface with energy dispersive XRF (EDXRF) Bruker Tracer IV SD. The combination of these complementary analytical techniques allowed us to suppose their provenance, as well as to raise some important technological issues linked to the different classes.

The main task of this paper, in which a preliminary report of a research still in progress is presented, is the proposition of a multidisciplinary approach for the characterization of Sicilian Islamic pottery in general, in order to improve the chemical and petrographic data about the ceramic productions of this period, which remains mostly unknown – especially for the Eastern part of the isle. Earlier Islamic pottery analysis has been reported (Al-Shorman & El-Khouri, 2013; Amiri et al., 2013; Sarhaddi-Dadian et al., 2015).

3. RESULTS AND DISCUSSION

3.1 Petrographic analyses

Using the optical microscope on thin sections, a total number of eight fabrics has been detected (Fig. 2).

Samples of fabric A show a scarcely micaceous groundmass, with dominant quartz (grain size: 50-500 μm), minor amounts of plagioclases, pyroxenes and very scarce amphiboles and volcanic rock fragments. The latter mainly show a porphyritic texture with plagioclase phenocrysts. Metamorphic rock fragments are also very scarcely represented. It is possible to distinguish the sub-fabric A1 (PCM 14/2, PCM 14/3, PCM 25/35, PCM 25/36, PCM 25/38), characterized by minor amount of medium-fine grains than the samples of the sub-fabric A2 (PCM 25/42, PCM 25/43).

Table 1. Sampling and methods applied. SSW = self-slipped ware with salted water, CW = cooking ware, LGW = lead glazed ware, PW = painted ware.

Sample	SU	Chronological context	OM	XRF-WDS	XRF-EDS	XRD	Tech. Class
PCM 14/2	14	10th-11th cent.	X	X		X	SSW
PCM 14/3	14	10th-11th cent.	X	X		X	SSW
PCM 19/4	19	10th-11th cent.	X	X		X	CW
PCM 25/35	25	10th-11th cent.	X	X		X	SSW
PCM 25/36	25	10th-11th cent.	X	X	X	X	LGW
PCM 25/37	25	10th-11th cent.	X	X	X	X	LGW
PCM 25/38	25	10th-11th cent.	X	X		X	PW
PCM 25/39	25	10th-11th cent.	X	X		X	PW
PCM 25/40	25	late 9th-early 10th?	X	X		X	PW
PCM 25/41	25	9th-early 10th?	X	X		X	PW
PCM 25/42	25	10th-11th cent.	X	X		X	PW/SSW
PCM 25/43	25	9th-11th cent.	X	X		X	PW
PCM 25/44	25	10th-11th cent.	X	X	X	X	LGW
PCM 25/45	25	10th-11th cent.	X	X	X	X	LGW
Pa1	Ref. Sam.	10th-11th cent.	X	X		X	Com. W.
Pa2	Ref. Sam.	10th-11th cent.	X	X	X	X	LGW
TF1	Ref. Sam.	mid-9th cent.	X	X		X	Com. W.
TF2	Ref. Sam.	mid-9th cent.	X	X		X	PW

The fabric B consists of one single sample (PCM 25/41), which presents a micaceous groundmass, with medium-fine quartz as predominant inclusion, common micas (biotite and muscovite), scarce feldspars and very scarce pyroxenes (50 - 125 μm) and carbonate clasts (50 - 250 μm).

The sample PCM 19/4 of the fabric C is characterized by a scarcely micaceous groundmass, with coarse grains of dominant plagioclases and volcanic rock fragments with porphyritic and in some cases vesicular texture, scarce (< 5%) quartz, amphibole and metamorphic rock fragments. These petrographic features suggest a Mt. Etna production area (Barone et al., 2010).

The fabric D (PCM 25/37) has a scarcely micaceous groundmass, without coarse inclusions, and a fine fraction formed by dominant quartz and scarce carbonate clasts, very scarce pyroxenes, feldspars and micas.

The fabric E samples show a homogeneous fossiliferous groundmass with carbonate clasts as dominant medium-coarse to medium-fine fraction, common quartz with a medium-to-fine grain size and scarce flint and feldspars. The sub-fabric E2 (PCM 25/44) distinguishes by the E1 (PCM 25/39, PCM 25/45) for the minor amount of carbonate components, due to a higher degree of vitrification of the groundmass. Both the sub-fabrics show abundant brown clay clots. Worth of note is that the Palermo reference samples (Pa1 and Pa2) belong to the fabric E.

The fabric F (PCM 25/40) are quite similar to the fabric E samples, but the dominant inclusions are formed by quartz characterized by different size and shape.

The reference samples from Taormina have different petrographic features: the fabric G (TF1) shows a scarcely micaceous groundmass with dominant coarse-to-medium grain size metamorphic rock fragments (500–2000 micron), scarce micas and quartz and very scarce amphiboles, feldspars and pyroxenes. The fabric H (TF1) is fine grained, with inclusions formed by quartz, micas, calcite and pyroxenes.

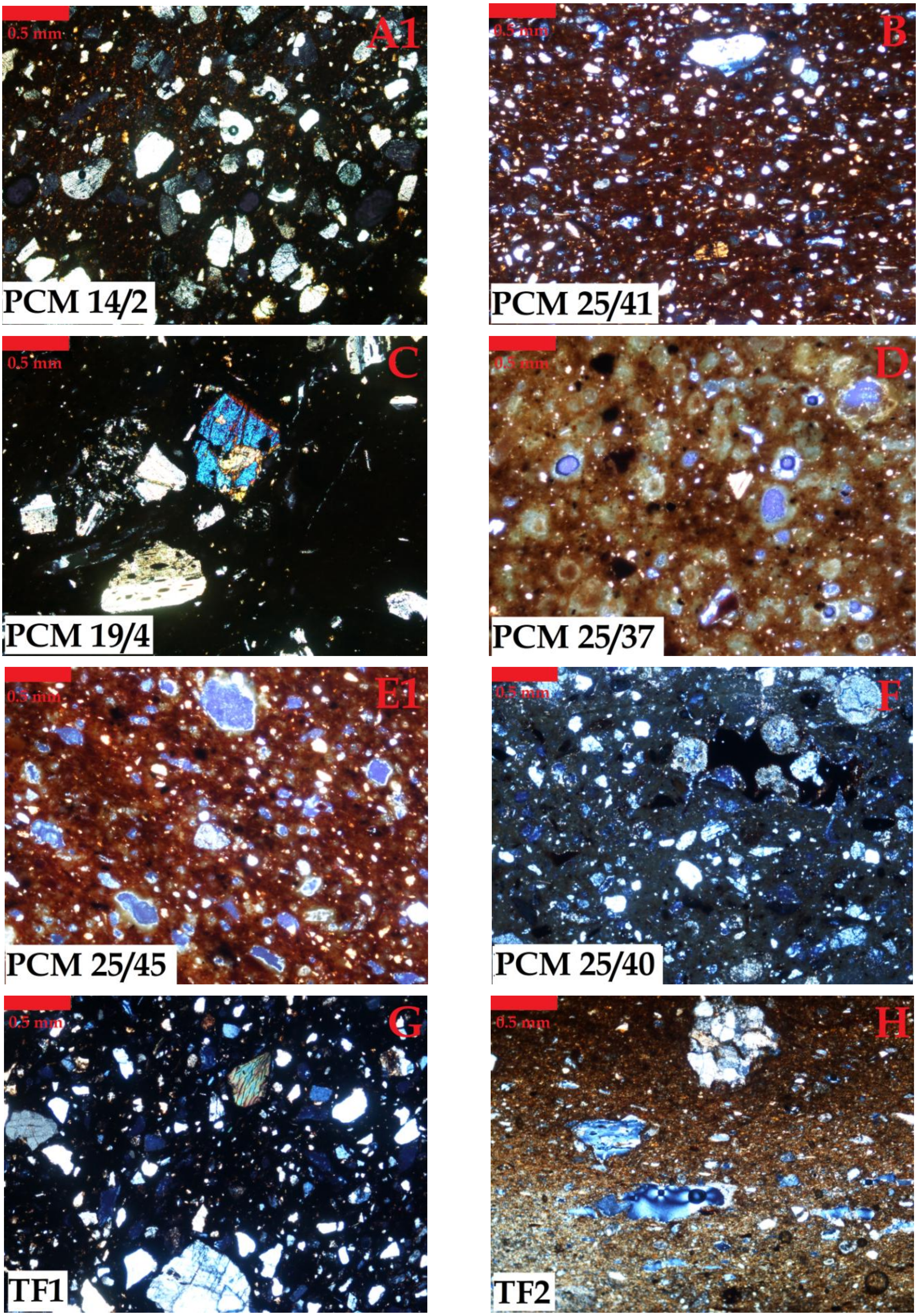


Figure 2 – microphotographs of representative samples for each Fabric (from A to H). (crossed nicols).

The petrographic observations allow us to give some preliminary hypothesis about the production sites of the studied pottery. The fabric A samples probably represent the most significant Paternò local production since the kiln wastes analyzed (PCM 25/35, PCM 25/36, PCM 25/42) belong to this fabric. The sample PCM19/4 (fabric C) represents one of the local cooking ware, produced adding volcanic rock fragments to the clay. On the contrary, the pottery of fabric E is supposed to be representative of the Palermo manufacture, as suggested by the close similarity with the reference materials and with literature data (Giarrusso and Mulone, 2014). The fabric F is similar to the Palermo samples, but it could derive from other centers of production in Western Sicily (probably Agrigento, Alaimo and Giarrusso, 2007). Finally, regarding the sample PCM25/37 of fabric D, it is not possible to suppose the site of production on petrographic basis. The Taormina fabrics (G and H) both showed very different features with respect to the other groups.

3.2 Chemical analyses

Even if the amount of samples still prevents a significant statistics, chemical data (tables 2-3) confirmed the main petrographic groups (A and E) due to the following features: 1) samples of fabrics A and B have high SiO_2 amounts (average 60.65 wt%), CaO contents from 8.2 to 11.8 % and, among the trace elements, higher V abundances; 2) the samples belonging to the fabric E present lower SiO_2 content (and high CaO and Sr; 3) fabrics C, D and F (a single sample for each one), show different chemical compositions from the samples of the previous groups.

The biplot diagrams of the first two principal components, calculated using major and trace elements, are reported in Fig. 3 and Fig. 4, respectively. On the whole, the multivariate analysis allows us to confirm the petrographic observations. Samples belonging to fabric A are plotted in a restricted area that may be related to local production as stated by petrography, joined to the only sample of fabric B, probably representing another production from Northeastern Sicily. Regarding the Paternò samples of fabrics E, they have chemical composition close to the reference specimens from Palermo, thus suggesting this provenance.

The chemical data for fabric C, D and F do not allow us to constrain the production center, since they do not show chemical and petrographic similarities with the reference materials such as Taormina samples (fabrics G and H).

3.3 X-ray diffraction and the self-slipped surface technology

The mineralogical data (Table 4) permit some considerations about the production of some technological classes. With the exceptions of few samples, all the studied potteries are characterized by the presence of newly-formed Ca-silicates and by absence of calcite and clay minerals. However, these features, suggesting high firing temperature, seem related to the light surface on pottery due to the addition of seawater or salt to the clay and/or the water during the forming procedure (Cuomo di Caprio, 2007, Bonifay, 2004). According to Barone et al. (2012), the addition of NaCl decreases the temperature of formation of Ca-silicates, as well as the decarbonation apex and the amount of Fe forming hematite, the latter representing the main cause of the bleaching effect.

The XRD data of the samples with thick whitened layer (PCM14/3, PCM25/35, PCM25/36, PCM 25/44) showed high anorthite and diopside abundances. On the contrary, the samples in which the white layer is thin (PCM14/2, PCM25/45, Pa2, Fig. 5) have no Ca-silicates or only low amount of Gehlenite. These cases could suggest that the mineralogical composition of the SSW samples – i.e. the amount of the silicates of higher temperature - was probably affected by presence of salt, and not necessarily by the attainment of high firing temperatures (750°C; Barone et al., 2012, contrarily to what reported in the previous literature, > 850-900°C; Ben Amara et al., 2009). In this scenario, the variability in thickness of the whitened layer and mineralogical composition may be related to different factors: the abundance of NaCl in the system; the duration of the phase of reducing atmosphere at the end of the firing process; the peak of temperature achieved in the kiln; etc. In fact, the most homogeneous white surface is obtained when this firing process does not get to a too much high vitrification, i.e. with a lesser amount of Ca-silicates. The data will be improved, especially by a wider range of firing experiments, which also include the possibility of an experimental archaeology program attained in some kilns still existing in the Paternò territory. Nevertheless, these data suggest that the NaCl effects cause not only the appearance of a white surface on pots, but also a sensible decrease in the firing temperatures needed to obtain a good final product. The best light surfaces do not require high temperatures, thus possibly representing a very important technological feature in the production of those pots that required two cooking processes – the lead glazed pottery. NaCl represented a good way in economizing fuel during the "cottura a biscotto" (first firing process), producing a good white surface capable of standing out the colors of Sicilian glazed potteries from the Islamic period up to the 13th-14th centuries in some Proto-majolica productions (Cuomo Di Caprio and Fiorilla, 1992).

Regarding the samples without whitened layer (PCM 25/38, PCM 25/40, PCM 25/41 and PCM 25/43), we can suppose, on the basis of XRD data, high temperature firing processes (900-950°C), while in PCM 25/39, Pa1, TF1 and TF2 the presence of calcite testifies low firing temperatures (650-750°C).

On the whole, the discussed firing temperatures are in accordance with other Sicilian Islamic pottery productions. For Agrigento amphorae and their supports (600-800°C) as well as for cooking pots (600-700°C), very low temperatures were suggested, while for pots with a light surface that sometimes turns to a patchy greenish yellow, higher temperatures have been proposed (Alaimo and Giarrusso, 2004, 2007). For the Palermo pottery, with no surface treatments and glazed ware, similar variations in the firing yield were supposed (Giarrusso and Mulone, 2014), according to the relation between the remaining carbonate granules and the voids generated by their decarbonation.

Tables 2-3. Chemical data: major, minor (wt %) and trace (ppm) elements.

Sample	Fabric	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	L.O.I.
PCM 14/2	A1	63.324	0.759	13.17	5.019	0.09	2.02	8.217	1.472	2.853	0.256	2.82
PCM 14/3	A1	61.15	0.841	14.024	5.632	0.084	2.38	10.178	1.948	2.667	0.226	0.87
PCM 19/4	C	53.997	1.188	18.781	7.028	0.127	2.713	10.048	1.584	2.844	0.779	0.91
PCM 25/35	A1	60.258	0.855	14.623	5.422	0.083	2.482	10.756	1.498	2.853	0.26	0.91
PCM 25/36	A1	58.013	0.809	15.225	4.916	0.079	2.592	11.872	1.464	2.69	0.291	2.05
PCM 25/37	D	46.651	0.921	14.555	4.697	0.063	3.158	20.344	0.922	2.182	0.527	5.98
PCM 25/38	A1	59.925	0.873	14.779	5.482	0.089	2.511	9.274	1.175	3.024	0.258	2.61
PCM 25/39	E1	51.672	0.783	13.867	5.142	0.097	1.498	15.785	0.282	2.25	0.554	8.07
PCM 25/40	F	54.315	0.742	13.539	4.682	0.104	3.135	14.277	0.805	2.684	0.528	5.19
PCM 25/41	B	62.343	0.935	13.53	5.844	0.086	2.242	8.261	0.86	2.957	0.342	2.6
PCM 25/42	A2	63.211	0.912	14.469	5.877	0.097	1.807	8.926	1.365	2.735	0.34	0.26
PCM 25/43	A2	58.695	0.875	14.86	5.389	0.095	2.533	10.462	1.037	2.938	0.837	2.28
PCM 25/44	E2	52.59	0.772	13.146	5.58	0.084	1.576	18.205	0.962	1.907	0.209	4.97
PCM 25/45	E1	54.73	0.801	13.434	5.396	0.093	1.622	15.763	0.842	2.095	0.333	4.89
Pa1	E1	49.5	0.778	13.558	5.262	0.09	1.737	17.026	0.262	2.105	0.253	9.43
Pa2	E1	50.715	0.776	13.286	5.157	0.094	1.763	16.815	0.847	2.021	0.476	8.05
TF1	G	62.33	0.766	16.523	5.409	0.095	1.479	2.21	1.745	3.766	0.507	5.17
TF2	H	46.261	0.693	14.491	4.158	0.101	2.886	13.905	0.738	3.988	0.35	12.43

Sample	Fabric	Sr	V	Cr	Co	Ni	Zn	Rb	Y	Zr	Nb	Ba	La	Ce	Pb	Th
PCM 14/2	A1	372	118	93	11	40	90	89	21	210	13	374	48	84	18	8
PCM 14/3	A1	398	114	111	12	44	81	86	28	222	16	341	53	107	11	9
PCM 19/4	C	931	198	103	18	47	120	92	29	237	31	627	78	113	18	10
PCM 25/35	A1	368	138	114	12	47	87	95	28	239	18	393	55	89	8	10
PCM 25/36	A1	276	137	110	10	49	71	57	25	151	6	329	50	101	6976	100
PCM 25/37	D	627	142	142	10	65	99	80	35	225	21	336	58	119	2946	40
PCM 25/38	A1	481	141	116	11	48	113	103	29	229	17	359	50	102	20	8
PCM 25/39	E1	659	91	96	18	54	99	82	29	263	15	240	51	112	21	9
PCM 25/40	F	600	126	107	16	57	114	90	22	209	13	350	45	80	18	8
PCM 25/41	B	405	126	111	12	46	105	99	30	320	17	394	55	111	21	9
PCM 25/42	A2	388	146	121	13	48	87	99	31	289	20	378	51	104	10	10
PCM 25/43	A2	408	139	115	11	48	113	98	24	223	15	404	49	104	22	8
PCM 25/44	E2	388	105	100	16	54	87	60	27	222	10	224	57	116	3664	49
PCM 25/45	E1	493	104	96	18	55	93	71	36	255	15	248	58	107	6092	74
Pa1	E1	340	89	93	19	53	107	72	28	235	14	265	53	89	26	10
Pa2	E1	462	93	94	14	56	91	65	35	247	13	381	45	110	6570	82
TF1	G	188	107	67	11	39	88	113	25	197	18	863	50	93	392	15
TF2	H	258	113	84	10	48	115	126	24	138	13	764	45	78	35	11

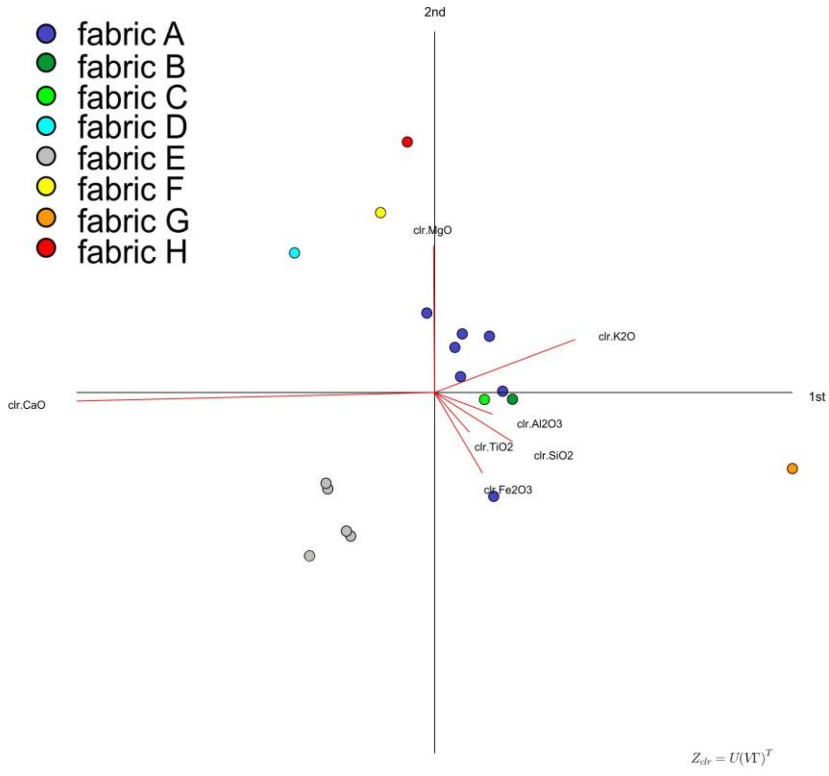


Figure 3. Biplot representation of PC1 and PC2 of major elements explaining the 92% of the total variance.

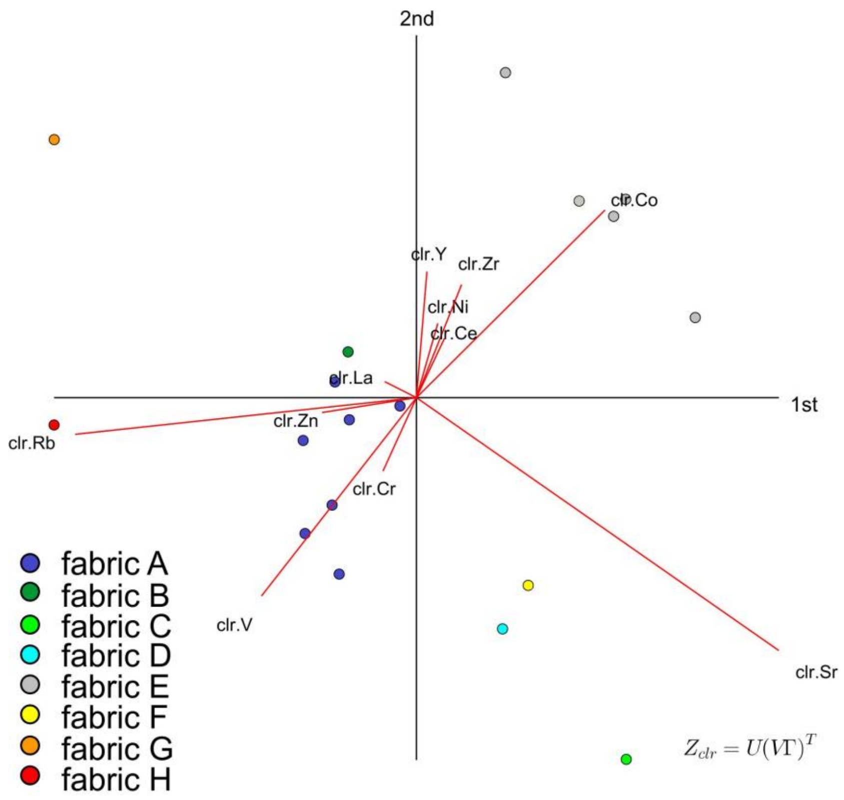


Figure 4. Biplot representation of PC1 and PC2 of minor elements explaining the 60% of the total variance.

Table 4. Mineralogical results (XRD) and ceramic body of the cited samples. Qz = Quartz, Ab = Albite, Di = Diopside, Micr = microcline, An = anorthite, Hm = Hematite, Gehl = Gehlenite, C Min = Clay minerals, Cc = Calcite; XXX = very abundant, XX = abundant, X = scarce, tr = trace. SSW = self-slipped ware with salted water, CW = cooking ware, LGW = lead glazed ware, PW = painted ware, * indicate the pottery with whitened surface.

Sample	Fabric	Qz	Ab	Di	Micr	Mica	An	Hm	Gehl	C Min	Cc	Tech. Class
PCM 14/2	A1	XXX	X		X	X						SSW *
PCM 14/3	A1	XXX		X	X	X	XX					SSW *
PCM 19/4	C	XXX		X		X	XX	X	X			CW
PCM 25/35	A1	XXX		XX	X		XX	X				SSW *
PCM 25/36	A1	XXX		XX	X		XX					LGW *
PCM 25/37	D	XXX		XX			XX	X	X			LGW *
PCM 25/38	A1	XXX		X			XX	X				PW
PCM 25/39	E1	XXX	Tr							XX	XX	PW
PCM 25/40	F	XXX		XX	X		XX		X			PW
PCM 25/41	B	XXX		X	X		XX	X				PW
PCM 25/42	A2	XXX		XX			XX					PW *
PCM 25/43	A2	XXX		X	X		XX	X				PW
PCM 25/44	E2	XXX		X			XX	XX				LGW *
PCM 25/45	E1	XXX		X			X	XX	XX		X	LGW *
Pa1	E1	XXX			X				X	X	XX	Com. W
Pa2	E1	XXX						XX	X	XX	XX	LGW *
TF1	TF1	XXX	XX		XX					XX		Com. W
TF2	TF2	XXX	XX		XX					XX	XX	PW

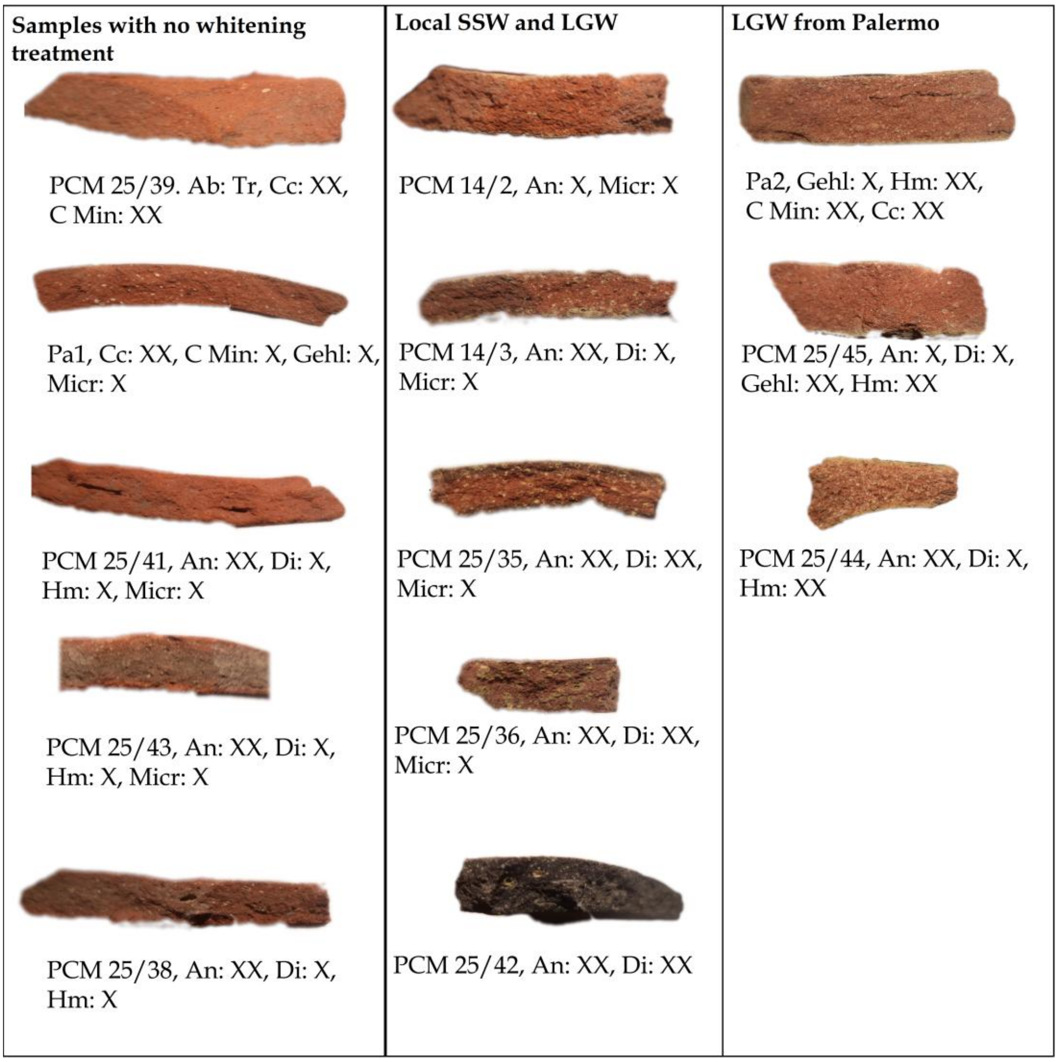


Figure 5. Ratio between whitened layer and amount of Ca-silicates.

3.4 pXRF on glaze and pigments

pXRF-EDS spectra have been collected on glazed surfaces. Furthermore, a wide usage of medieval sources about the glazed pottery production is proposed, with the aim to obtain a picture of the relationships existing among raw materials, craftsmen and productive networks. The chemical characterization of the pigments used for the polychrome decoration under the lead glaze (Figs. 6-7) may be summarized as follows:

- Each spectrum is dominated by the lead peaks, an evidence that confirms the technology of the glassy coating as a Pb-based glaze;
- The measure on brown pigments has shown also the peaks of manganese (Mn) and iron (Fe);
- Copper seems to be widespread on the glaze, but the green pigment displays a higher peak related to smaller ones of zinc (Zn) and sometimes tin (Sn). The use of Cu-rich pigments in Sicilian glazed pottery it is also reported in Caltagirone ceramics, dated between the 13th and the 18th century (Crupi et al., 2010).

Dark brown pigments, obtained by grinding Mn and Fe rich phases, are particularly widespread since ancient times (Colomban et al., 2001, Clark et al., 1997). The usage of manganese variously mixed with iron for the medieval palettes of potters is reported in the few literary works on this matter. The Persian potter and alchemist from Kashan, Abū al-Qāsim (its manuscript dates back to 1301 AD), refers about the *muzarrad*, which was a pigment obtained mixing *maġnisiya* (manganese) with cobalt and sometimes iron, in a ratio 10:1 (Allan, 1973). In the 14th century Cairo, the Arab Author Ibn al-Ukhuwwa recommends the potters to use the *maġnīz* in vases decoration (Ibn al-Ukhuwwa, 1976). In the 16th century, Cipriano Piccolpasso writes about the recipe of a brown pigment composed by the following metallic parts: 1 manganese, 1 "rame arso" (roasted copper), 6 "rena" (silicates from sands) and 10 lead, occasionally with the addition of one part of "zaffera nera" (Piccolpasso, 1879). The Renaissance glassworkers used the same raw materials to obtain black glass (Moretti, 2012).

Regarding the use of Cu-based pigments, it provides two hues depending on the kind of grinding process (Grifa et al., 2016). It is well known that the green color obtained from copper wastes is widely spread. Abū al-Qāsim al-Kashānī and Cipriano Piccolpasso recorded similar technological traditions. The Persian author mentions the "roasted copper" and the "copper hammerscales", from which the oxidation furnish the green pigment, as well as the yellow pigment derives from the roasted iron (Allan, 1973); the term *tūbān*, reported in the list of Ibn al-Ukhuwwa, refers to the pigment obtained from the copper oxidation (Ibn al-Ukhuwwa, 1976). Similarly, Cipriano Piccolpasso, more than two hundreds year later, says: "Take some old copper pieces and put them in the half of a pot or something else, and cook them as we will say, until the copper roasts. The best roasted copper – Dioscoride refers – is the red one, that once grinded looks like cinnabar" (Piccolpasso, 1879). The reference to the Greek author could probably explain the similarities among these traditions as far as time and space.

The presence of copper, zinc and a small amount of tin in the spectra could testify that among the "old copper pieces" there could also be some brass and bronze pieces. This hypothesis is supported also by the Renaissance glassworkers that called "Orpello", "Tremolante" and "Canterello" the brass foils, melted in order to obtain an intense green glass (Moretti, 2012). Furthermore, some partnerships between glassworkers and metal smiths are registered among the documents of the Geniza (Cairo, Egypt), probably due to the provision of raw materials used for glass works (Goitein, 1967).

4. ARCHAEOLOGICAL CONSIDERATIONS AND CONCLUSIONS

Due to the fact that the kiln wastes (PCM 25/35, PCM 25/36, PCM 25/42) are joined, chemically and petrographically, in the same fabric A with some other samples, we can propose that this ensemble represents the local production. Further researches will clarify the reasons behind the additional differentiation in two sub-fabrics, the relationships with other probable productions of Eastern Sicily (Fabric B) and the possible existence of a "group of ateliers" among different and more or less close centers.

We still lack of an adequate number of archaeometric data in order to start writing the history of medieval pottery technologies in Sicily, as well as of a certain revaluation of archaeological and written sources. Procedures of production, commerce and consumption of ceramics during the Middle Ages will require more efforts among the different research fields, in order to acknowledge a valuable multidisciplinary approach.

Nevertheless, a certain widespread interest for pottery productions in Islamic Sicily, which products circulated along the shores of Central Mediterranean during the apex of Fatimid Sicily and of its capital Palermo (10th-11th century, Ardizzone, Pezzini, Sacco 2015), increased the number of available data related to this time interval. Archaeological and archaeometric studies have partially characterized at least five centers of production: the *madīna Ṣiqilliya* (Palermo), Mazara del Vallo (Molinari and Valente, 1995, Molinari, 2010; 2012), Agrigento (Bonacasa Carra and Ardizzone, 2007), Piazza Armerina (Alaimo et al., 2010, Pensabene et al., 2014, Alfano et al., 2015) and Syracuse (Fiorilla, 2009, Ben Amara et al., 2009). To this list, we can now add Paternò, that is probably just one of the different centres of production around Mt. Etna, which products seem to have competed with Palermo's pots especially at the end of the Islamic period, as witnessed by certain archaeological finds in Southern Italy (Arthur, 1986, pp. 546-547, Fig. 1.4 e p. 554. Molinari, 1995, p. 194). However, the ceramic records studied for this archaeological site suggests two more reflections linked to the documentary and literary data.

We found that between the beginning and the end of the Islamic phase in Paternò (Phases IV and V, 10th-beginning of the 11th century and throughout the 11th century, respectively), the widest local production is constituted by the whitened pots, tiles, bricks and pipes (Fig. 8, Table 8.1). Considering that all the local glazed pottery and part of the cooking and painted wares were provided with a light surface, we can imagine that the craftsmen widely used one of the main local raw materials: clay and salt from the Salinelle, surrounding the northern and eastern sides of the hill. This fact is remarkably related to some medieval documents – which date from the 12th century onwards - testifying that at least one area of production was closely related to the main monuments of the hilltop. Among the wells donated by the local lords (Henry and his son, Simon Aleramico), a *cretazzu* in the nearby of the Church of S. Leonardo is registered (Ardizzone 1927, pp. 37-38). Even if this term probably needs more philological insights, C. Ardizzone possibly related it to the *stazzuni* (i.e., an area of production containing a built kiln) painted in the "*Pianta di Paternò, e terre concesse dal Conte Henrico alla Chiesa di Giosafat*", drawn and written in the 16th century when the priory of S. Mary of Giosafat entered into the properties of the monastery of S. Nicolò l'Arena in Catania (Fig. 8.2). The view depicted the north-western of the suburbs (*propre Castrum* in the documents). We can reasonably assume that the main area of production - equipped also with sources for the water supply (Fig. 8.3) – could be situated in this zone, since the most important related evidences have been found in the northern slope of the hill, where we can see the rest of the *stazzuni* depicted in the 16th century. The geological features of this territory fit with an important archaeological find that well testifies a glazed pottery production in the nearby: a fragment of a kiln bar with a significant drop of glaze (Fig. 8.1). Future characterizations of the clay sediments from the Salinelle, as well as further archaeological prospections and excavations, will provide accurate details on this productive landscape.

Another important datum derives from the percentages of Palermo's glazed products during the first Islamic period (Phase IV of the archaeological excavation north of Cristo al Monte church, *supra*): almost the entire lead glazed ware records of the UUSS related to this phase (10th-early 11th century) come from the Emiral Capital of Sicily (Table 8.2). This important remark not only fits well with the studies about the distribution of Palermo's products along the coasts of the Central Mediterranean (Fig. 10.1), but the kind of pottery – almost totally bowls and plates, with a few amphorae (Fig. 10.2) - that circulates even suggests an interesting philological interpretation of an Arabic text. In fact, the Arab geographer Ibn Ḥawqal has described, in his *Ṣūrat al-arḍ*, the markets (*aswāq*, sing. *sūq*) of this *madīna* and among the merchants and craftsmen he reports a "group" (or "community", *ṭā'ifa*, Raymond, 1997; Geoffroy, 2000) of *ġaḍā'iriyyūn*. Such a term could be translated with "manufacturer of porcelain-like translucent dishes" (Goitein, 1967, pp. 110-111, Shatzmiller, 1994, pp. 117-118) – as inferred from the word *ġaḍā'ir* (sing. *ġaḍār*, *ġiḍār* and *ġuḍār*), which means "plates", *scutella* (Dozy, 1881, vol. 2, p. 216, Fili, 2003, pp. 401, 404-406) and also to the other recurrance of this kind of craftsman along the *dār al-Islām* for the same period. This short passage (Ibn Ḥawqal, 1992, p. 114), which will deserve more attention in the future, seems to suggest that during the visit of the geographer in 973 AD, an important number of artisans were engaged in the production of these particular products.

Such a high-specialized industry should not be surprising: the documents of the Geniza testify that an enormous numbers of craftsmen of different kinds (over 450: Goitein, 1997, Shatzmiller, 1994) operated in the sector of ceramics, which seems to have known this kind of specialization.

Further multidisciplinary researches will have to better focus on the production procedures of the different artisans, the channels of communications in which their products circulated and their consumptions, keeping in mind this peculiar aspect of the pottery industry in the Islamic world.

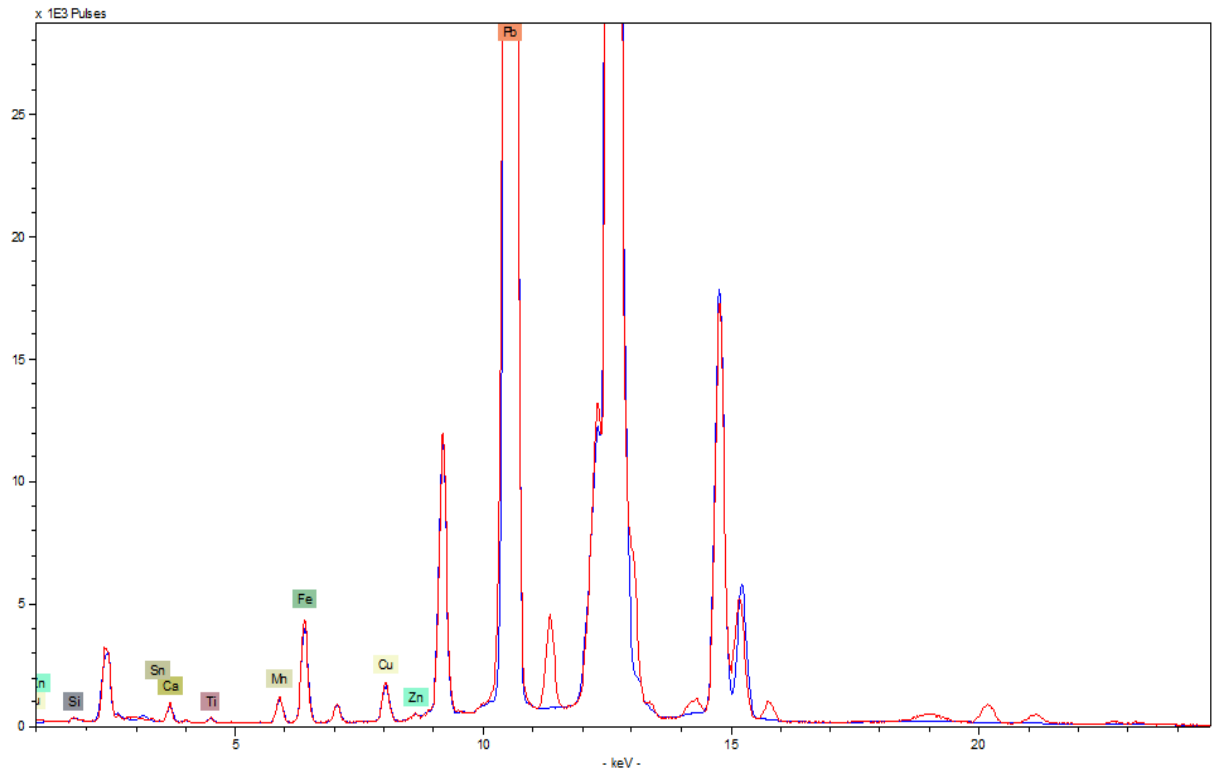


Figure 6. XRF-EDS spectrum of brown pigment on sample Pa2.

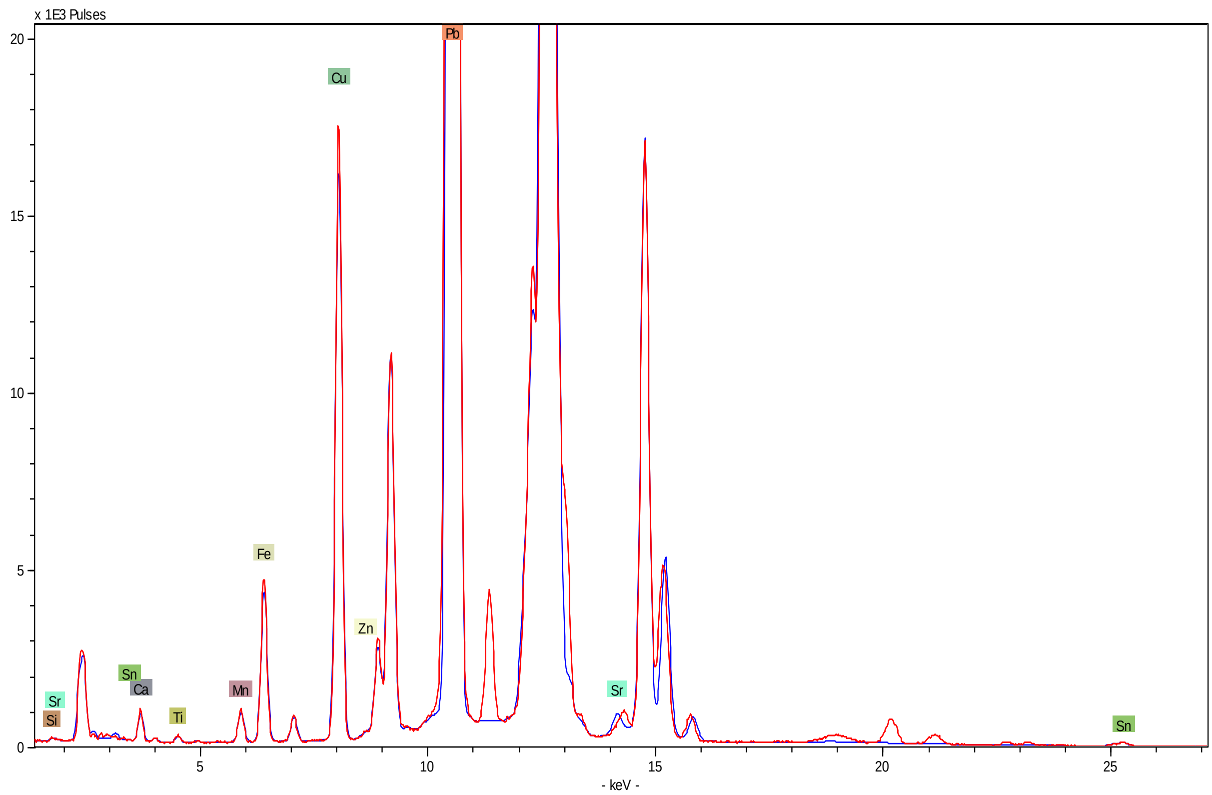


Figure 7. XRF-EDS spectrum of green pigment on sample Pa2.

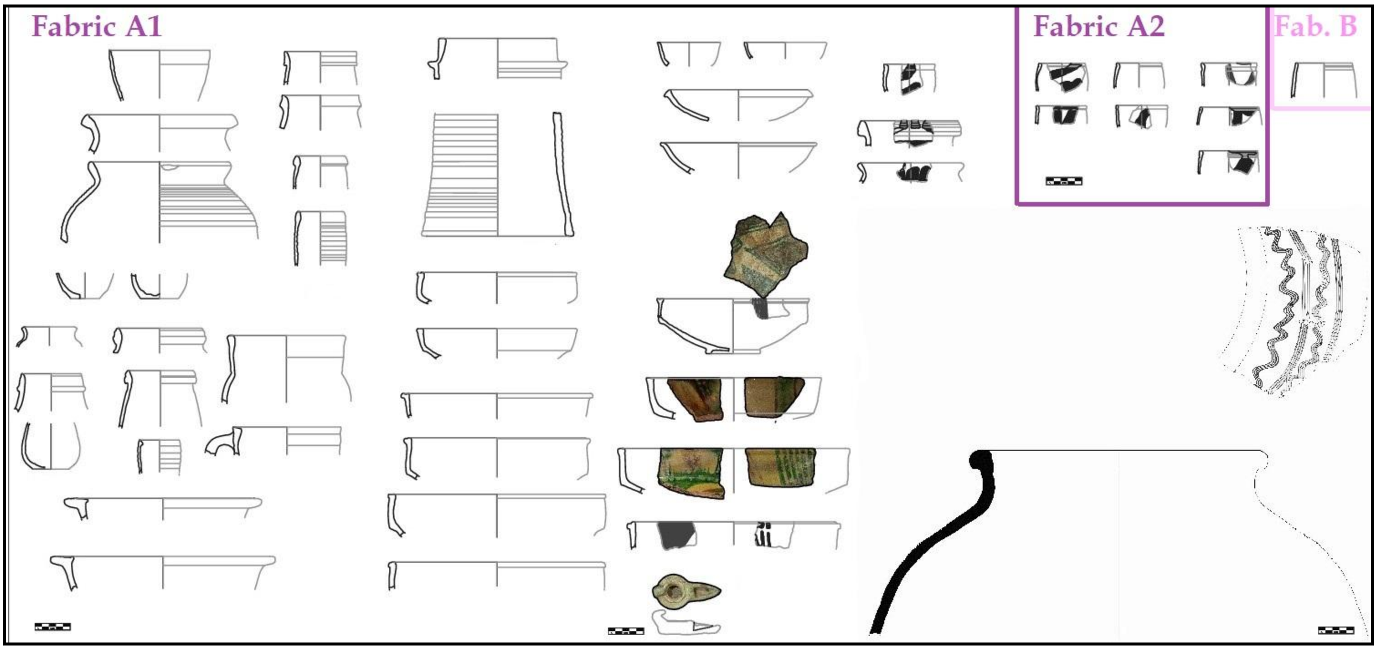
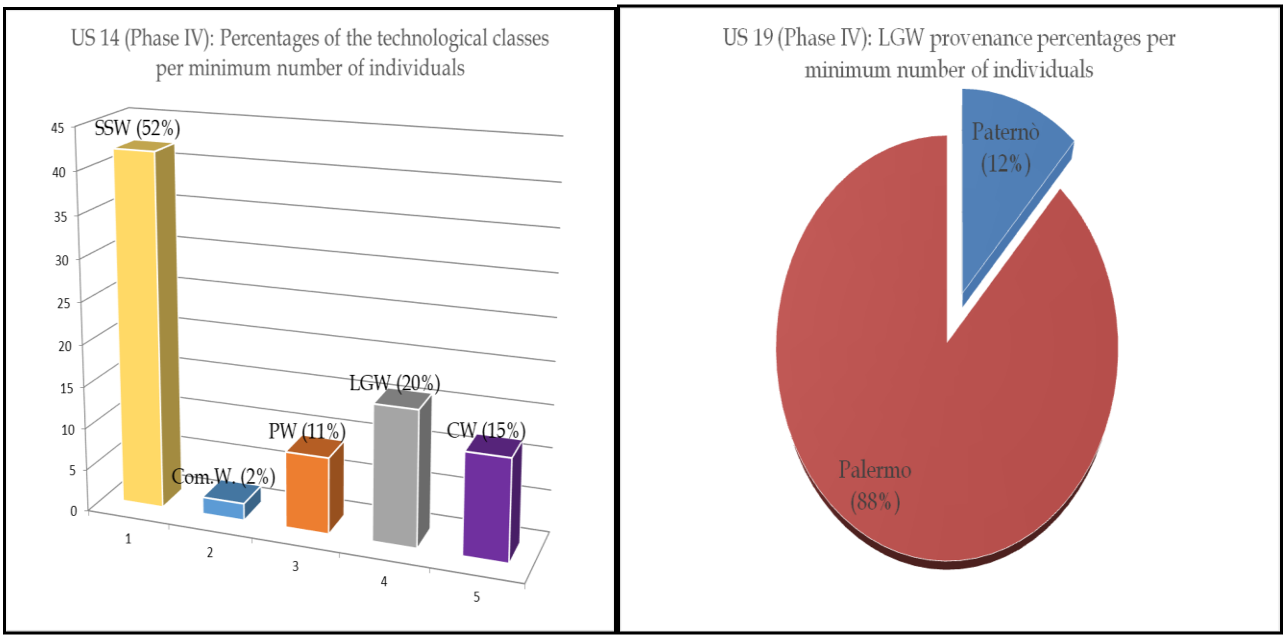


Figure 8. Local products (Fabric A1-A2) and probable Eastern Sicilian importations (Fabric B). The impressed jar at the bottom right drawn by S. Arrabito.

Table 8 – Ceramic records for the Islamic phase of the excavation at the church of Cristo al Monte.



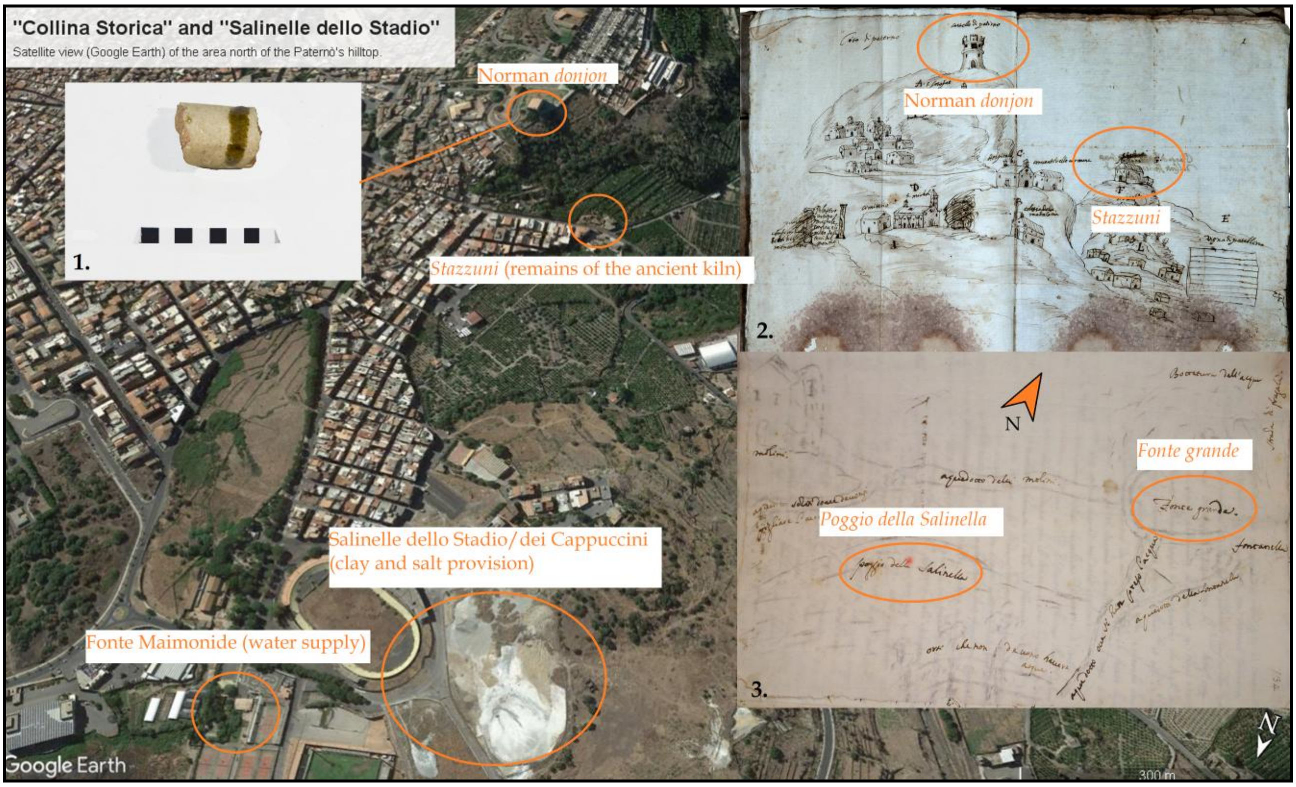
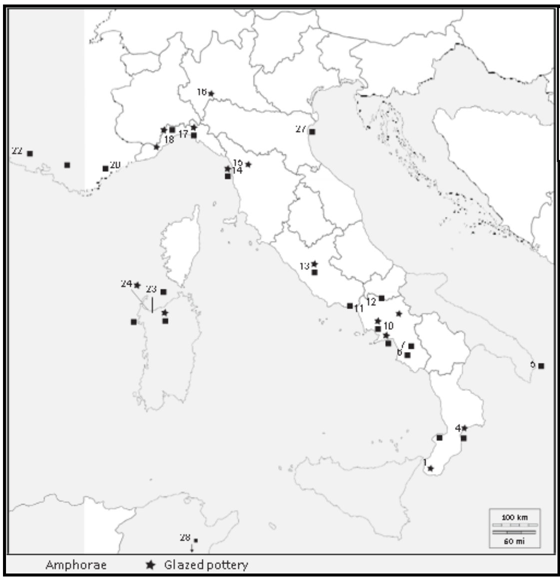


Figure 9. Probable production area in the northern slope of the hilltop of Paternò:

1. ***Kiln bar found during the restoration of the Norman tower (1980's).***
2. ***"Pianta di Paternò, e terre concesse dal Conte Henrico alla Chiesa di Giosafat", 16th century.***
3. ***"Schizzo di pianta relativo alle acque di "Fontana Grande", 18th century[2].***



1 (left) - Distribution of Palermo's pottery in the Central Mediterranean (Ardizzone et al. 2015, p. 240 fig. 5)
2 (below) **–** Vessels found in Paternò imported from Palermo.

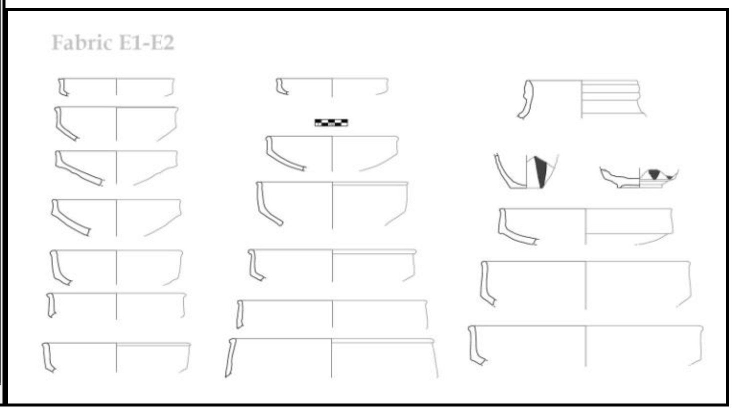


Figure 10. Palermo's products between Paternò and the Central Mediterranean.

[2] These and other interesting cartographic evidences, preserved in the Archivio di Stato of Catania, are available for free on the following site: http://www.ascatania.beniculturali.it/index.php?it/192/indice-delle-piante-topografiche.

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