INTERNATIONAL JOURNAL OF CONSERVATION SCIENCE
ISSN: 2067-533X Volume 11, Special Issue 1, 2020: 305-318 www.ijcs.uaic.ro

NEW DATA ON THE EXPLOITATION OF OBSIDIAN IN THE MEDITERRANEAN BASIN: THE HARBOUR OF PYRGI AND THE TRADE IN NEOLITHIC AGE

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Abstract

The contribution shows the first results of ongoing research on the origins and prehistoric assumptions of the well-known Etruscan and Roman harbour of Pyrgi, an ancient Ceretan harbour in southern Etruria. In the light of recent land and submarine investigations, traces of ancient frequentations and contacts dating back to the Neolithic era are emerging when the coastal morphology and environmental characteristics of the site were very different from the current ones. The Etruscan port of Pyrgi, which continues its historical history in Roman and Medieval times, appears as the heir of one or more landing points frequented perhaps already in the Middle Neolithic. As part of this contribution, around 60 obsidian finds (waste resulting from the manufacture of arrowheads) were analyzed using the LA-ICP-MS technique (Laser Ablation Inductively Coupled Plasma Mass Spectrometry). The comparison between the data obtained on the archaeological finds and the bibliographic data relating to the geological obsidians of the peri-Tyrrhenian area allowed the identification of the provenance of the finds. In particular, most of the finds can be attributed to the Aeolian area, highlighting the leading role played by the Aeolian archipelago in the development of trade of this material. Other sources of supply have been identified on the island of Palmarola and in Sardinia (Monte Arci) although with a lower incidence. The discovery of numerous findings in obsidian from overseas, which took place in the area immediately surrounding Pyrgi, offers different suggestions about the origin of the docking place, with traces of centuries-old frequentation, extended from the Neolithic to the modern era.

Keywords: *Obsidian; Trace elements; LA-ICP-MS; Provenance; Pyrgi; Etruria; Neolithic period*

Introduction

This contribution comes from the latest research carried out on the origins of the port of *Pyrgi*, the ancient port of the Etruscan metropolis of Cerveteri in southern Etruria, overlooking the Tyrrhenian Sea, on the coast about 50 km north of Rome. A long tradition of studies has identified the structures of the port with the large canal in front of the Castle of Santa Severa, which today occupies the site of the Etruscan city on which in the third century BC the Roman colony was built. The canal, about 200 meters long and 50 meters wide, is now submerged with the two lateral ballasts that made up the quays [1-4]. The city of *Pyrgi*, the base of the military and commercial fleet of Cerveteri, and of the famous Tyrrhenian pirates mentioned by Greek

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sources, stretched for at least 10 hectares along the coast to the large emporium sanctuary under excavation since 1957 by the Archaeological Superintendence and University of Rome “La Sapienza”: one of the major Etruscan sanctuaries open to the Mediterranean with numerous cults including that of *Uni* assimilated to the Phoenician *Astarte, Leukotea, Tinia,* Apollo, *Cavatha* and *Suri*.

Exceptional finds including the terracotta high relief with the myth of the “*Seven against Thebes*” and the three gold plates inscribed in Etruscan and Phoenician tell the historical development of the site until Romanization [5-11]. The ancient environmental characteristics of the place where the settlement of Etruscan and Roman Pyrgi developed in classical times and later, in the Middle Ages, the Castle of Santa Severa, are probably the main ones responsible for the choice of the site by the numerous generations that, over the centuries, have followed one another in this stretch of the Tyrrhenian coast.

The presence of a natural landing point, protected from winds and currents, together with a notable availability of fresh water, must have represented, at least since the Neolithic period, a strong element of attraction for the agricultural-pastoral communities of the time and for the first sailors of the Mediterranean.

A promontory, now submerged, had to reach out to the sea for hundreds of meters, in front of the current castle, perhaps crossed by a marshy depression or by a real waterway whose bed was later artificially transformed by the Etruscans and Romans in the canal port. In addition to the availability of fresh water brought by the waterways still present in the area, belonging to an extensive catchment area, it is almost certain that the perennial spring located immediately behind the Etruscan sanctuary was already usable and frequented. The Pyrgi site offers, therefore, since prehistoric times the best conditions for the birth of a landing point which due to its characteristics falls exactly within the ideal canons of primitive harbor, well remembered in the Odyssey: “a comfortable port, where there is no there is a need for a rope ... clear water flows from the end of the port, a spring under the caves: poplars grow around" [12]. Overall, for the more recent phases of prehistory, starting from the Neolithic period, on the basis of the study of the traces visible in the aerial photography documents, the analysis of paleo-soils and the geological formations emerging along the beach and on the seabed, it seems to be able to reconstruct a landscape characterized by lagoons and coastal marshes, certainly navigable with small boats such as the one found in the necropolis of Caolino del Sasso di Furbara, rich in plant and animal species. An habitat very similar to that still somewhat existing in the nearby Macchiatonda Nature Reserve, marked by the coastal hygrophite scrub and by a much more advanced and jagged coastline than today [13-16].

The archaeological findings testify the presence of a human settlement active since the Middle Neolithic and with traces of frequentation in the Bronze Age, which existed near the place occupied, later, by the Etruscan sanctuary, not far from the sea. Numerous finds, found in the embankment and in the filling of the foundation pits of the Etruscan temple buildings, indicate the existence of huts with half-timbered walls, agricultural activities (manual grinders) and the breeding of sheep, cattle and pig cattle. Fragments of pottery with engraved and embossed decorations are the memory of domestic activities for the preparation and consumption of food, for the processing and storage of products [5, 17].

The presence of some obsidian finds on the Pyrgense beach and in the immediate hinterland, as in the case of the Macchiatonda and Pian Sultano sites may document, since prehistoric times, the existence of contacts and commercial exchanges by sea between the settlements of the *Pyrgi* coast and other places in the Mediterranean, from which the precious volcanic glass was to come, used since the Neolithic era for the construction of cutting tools and present only in particular overseas locations including Lipari, Palmarola and Sardinia [5, 18-20].

In relation to the origins of the Pyrgense landfall point, documented up to now on the historical and archaeological plan since the end of the seventh century BC, it is worthwhile to report here some preliminary considerations and working hypotheses that are being defined based on the latest research.

Of particular interest are the information acquired from the studies conducted in recent years on the rise in the level of the oceans and the Mediterranean caused by the combined action of multiple factors related to eustasia, glacio-hydro-isostasia and vertical terrestrial tectonics [21-25].

As far as the central Tyrrhenian and therefore the coasts of ancient Etruria are concerned, significant data are already available which have already made it possible to reconstruct the sea rise curve with a good approximation. Since the end of the last glacial period, there has been a sharp rise in the sea, which in the period between 14,000 and 7,000 years from today brought its level from - 90 to –10 meters. The following period recorded a steady but slower rise with a rise that stood at around -1.80 meters, between the end of the Iron Age and the Etruscan era, and at -1.35 meters in the Roman Augustan era. These data allow us to begin to set the problem of the port of Etruria and specifically also the port of *Pyrgi* in a completely new perspective, in the light of a phenomenon of marine ingress up to now never defined with certainty in its real historical dynamics and in its true proportions. In the case of *Pyrgi*, for the purpose of understanding primitive port, it is necessary to proceed with the reconstruction, as punctual as possible, of the transformations of natural coastal landscapes, which have taken place over time, from distant prehistory to the present day.

The use of the data provided by the latest studies on marine elevation, analyzed in relation to the current bathymetry and the geological conformation of the seabed, allows formulating the first working hypotheses useful for the identification of some ancient coastlines. To give an idea of the sea rising over the millennia, using modern topographical references, the beach of about 14,000 years ago is located 12 km off the coast of the Castle of Santa Severa, on a seabed now submerged at a depth of 80/90 meters. It is probable that towards the end of the last glaciation, in front of the current Castle of Santa Severa, there was a large coastal area, at times flat, slightly descending towards the sea, almost certainly frequented by groups of hunters gatherers of the Middle Paleolithic - above which some tools found on the current shore can be referred [3].

The subsequent rise in the sea level due to the establishment of the Holocene climatic conditions seems to have led, over a few millennia, to the "rapid" submersion of a large swath of territory to reach, around 6,500 years from now, the definition of a coastal morphological structure of particular interest for the study of the origins of the Pirgense port. In this phase, framed in the 5th-4th millennium BC, in the middle of the Neolithic period, the territory, now lying between –7 and –9 meters deep, emerged and characterized by the presence of a more advanced coast line than current of at least 500 meters, in front of the Castle, and by two promontories extended over 2 km in length, today respectively submerged in front of the tip of Macchiatonda and the seaside town of Santa Severa. The bathymetry analysis indicates with good certainty that in this prehistoric phase the shallow waters of today's Secche di Macchiatonda can be reconstructed as two large outcropping islands located immediately in front of the promontory as well as two other smaller islets emerge from the sea, a short distance away from the mainland, to close the pyrgense body of water to the north and south (Fig. 1): a natural morphology that is particularly predisposed for the birth and development of landing points protected by Scirocco and Libeccio seems to emerge.

The jagged profile of the larger islands, the presence of extensive formations that shield the main currents and protect what appears to be a large, well-sheltered inlet, create more than legitimate suspicions about the possibility that these natural characters may have played an important role for the birth of coastal settlements around one or more landing places frequented since prehistoric times. What described in relation to the morphology of the Pyrgensian coast in the Neolithic phase acquires particular significance if we consider that in the same period it does not seem possible to reconstruct comparable paleo-environmental situations along the entire Tyrrhenian coast in the stretch between the Punta di Anzio and the Secche di Palo-Torre

Flavia not far from *Pyrgi*. Perhaps it is not to be considered a coincidence that just in coincidence with these other formations, also today submerged in the City of Ladispoli, the port of Alsium developed, which in historical times became a further ports belonging to *Caere* [27]. For the sailors of 6,500 years ago ascending from the mouth of the Tiber towards the north, the current shoals of Torre Flavia and Macchiatonda had to appear as large emerged promontories that stretched into the open sea and that abruptly interrupted the monotonous linearity of the flat coast offering a landmark clearly visible from the sea and an excellent natural shelter.

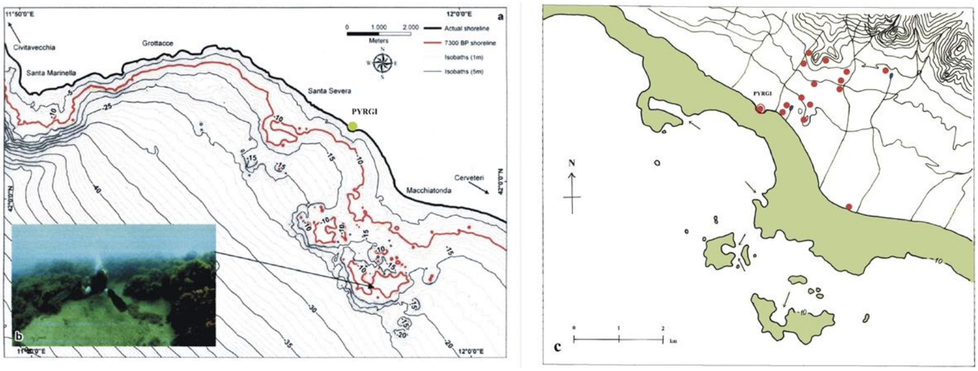

Fig. 1. a-b Reconstruction of the ancient morphology of the Pyrgense coast line in the Neolithic era, (the red line indicates the profile of the emerged lands today located about 10 meters deep after [26](Rovere et al. 2010); c Pyrgensian coast with the emerging islands in front of Santa Severa and Macchiatonda, the sites with obsidian and ceramic materials attributable to the Neo-Eneolithic phase (red circles), the main sources, the possible natural landing points (indicated by arrows) (Enei 2013).

In addition to the paleomorphological aspects, another non-secondary factor to be evaluated for the genesis of the Pyrgensian landing is undoubtedly the considerable availability of fresh, spring and non-spring waters, easily available along the ancient beaches and in the immediate hinterland. Still today at least five different ditches bring the waters of the Tolfa Mountains to the sea, fed in the final stretches also by some perennial springs and other outcrops located almost close to the shore. In particular, it is worth mentioning the presence of a rich vein of water that rises in the immediate vicinity of the famous Etruscan sanctuary, in Vigna Murata, a short distance from the beach of the Black Sands [24]. It is likely that it is a source frequented since from the most remote antiquity and which has played a non-secondary role for the choice of the site by the prehistoric community settled in its vicinity, and subsequently, in Etruscan times, for the uses of the city and the great sanctuary, built in correspondence with the occupied place from the prehistoric settlement. Significant in this regard is the recent discovery of numerous ceramic fragments in unturned dough that took place in the ground just behind the source, some of which can be framed in a final phase of the Bronze Age and the early Iron Age.

The existence of an obvious natural port, favored by the ancient conformation of the coast and the availability of fresh water in places very close to the sea, seems to be well integrated with what is reported by the archaeological finds from prehistoric times that took place in Pyrgi and in the immediate surroundings. The surface surveys carried out in recent years in the area immediately surrounding the port, as part of the Ager Caeretanus project, have led to the identification of numerous sites with traces of frequentation that the ceramic and lithic materials frame between the Neolithic and the end of the bronze age [17, 27-28].

The presences are concentrated in particular in the immediate hinterland of the Castle of Santa Severa, in the lands next to the excavations of the sanctuary and in the coastal plain, no more than 2.5 km away from the current coastline.

In the more strictly Pyrgean area, in addition to the well-known Neolithic and Bronze Age materials recovered during the excavations of the monumental sanctuary, there is a prehistoric presence right on the relief, located a few hundred meters south of the sacred area, dominating a large stretch of coast and the perennial spring of the Vigna Murata.

This hill, known to date for the indication of burials and a possible Etruscan place of worship as well as for the remains of a rustic Roman villa, has recently revealed interesting traces of a prehistoric settlement. Unfortunately, the materials relevant to this settlement are very scattered and washed away by subsequent interventions and by intense ancient and modern agricultural activity. Despite the dispersion, numerous fragments of unturned ceramic can be recognized, among which a perforated clew grip and a bowl with rectilinear walls of probable neo-Eneolithic manufacture are associated with some elements attributable perhaps to the Bronze Age and to a lithic industry with flint and obsidian plates.

It is however, above all, the presence and distribution of the obsidian finds, material of probably overseas origin, well attested and widespread around the port of *Pyrgi*, which suggests the arrival of people and products by sea and therefore the existence of a point a landing place, frequented by sailors starting from at least the middle Neolithic period, some of the numerous lithic anchors found on the seabed can also be attributed to prehistoric and not only Etruscan boats [3].

Finally, the discovery of an important site with materials attributable to the middle and recent Neolithic and the Eneolithic, also found in Santa Severa Nord, in the immediate Pyrgense hinterland, a short distance from the coast, returns new valuable information. The settlement is in an excellent position on the plain in a sector of territory crossed by two streams, next to a source, protected to the north by slight hills. More than 300 obsidian fragments have been recovered during the reconnaissance, scattered in an area of about 2,000 square meters of surface: nuclei, many processing chips and small lamellae, indicate the existence of a probable arrival point and processing of the precious volcanic glass.

The Neolithic site returns flint materials with arrowheads of various types, blades, lamellas and knives, numerous ceramics with bowls, plates, flask vases, olle with some imprinted decoration and engraved (Fig. 2). There are also numerous green stone axes of probable Alpine origin, lava stone mills and grinders, hammers and anvils.

Fig. 2. a-b Flint arrowheads and lithic tools from the Santa Severa North site; c Stone hammer; d Green stone axes; e Millstones and mills.

Some obsidian fragments (58 samples) recovered from *Pyrgi* archeological site were analysed by LA-ICP-MS in order to determine the provenance of archaeological artefacts (Fig. 3).

Fig. 3. Obsidian cores from the Santa Severa Nord site.

Experimental

Materials and Methods

Geochemical analyses of obsidian archaeological finds (Fig. 3 and Table 1) were carried out at the Department of Biology, Ecology and Earth Sciences, University of Calabria, Italy, using the scanning electron microscope equipped with an EDS system (EDAX GENESIS 4000) to determine the major element composition and the LA-ICP-MS for the trace element composition.

Table 1. List of archaeological obsidian samples analysed by LA-ICP-MS

N.	Sample code	N.	Sample code
1	Ager Caerentanus 127_1	30	Ager Caerentanus 127_30
2	Ager Caerentanus 127_2	31	Ager Caerentanus 127_31
3	Ager Caerentanus 127_3	32	Ager Caerentanus 127_32
4	Ager Caerentanus 127_4	33	Ager Caerentanus 127_33
5	Ager Caerentanus 127_5	34	Ager Caerentanus 127_34
6	Ager Caerentanus 127_6	35	Ager Caerentanus 127_35
7	Ager Caerentanus 127_7	36	Ager Caerentanus 127_36
8	Ager Caerentanus 127_8	37	Ager Caerentanus 127_37
9	Ager Caerentanus 127_9	38	Ager Caerentanus 127_38
10	Ager Caerentanus 127_10	39	Ager Caerentanus 127_39
11	Ager Caerentanus 127_11	40	Ager Caerentanus 127_40
12	Ager Caerentanus 127_12	41	Ager Caerentanus 127_41
13	Ager Caerentanus 127_13	42	Ager Caerentanus 127_42
14	Ager Caerentanus 127_14	43	Ager Caerentanus 127_43
15	Ager Caerentanus 127_15	44	Ager Caerentanus 127_44
16	Ager Caerentanus 127_16	45	Ager Caerentanus 127_45
17	Ager Caerentanus 127_17	46	Ager Caerentanus 127_46
18	Ager Caerentanus 127_18	47	Ager Caerentanus 127_47
19	Ager Caerentanus 127_19	48	Ager Caerentanus 127_48
20	Ager Caerentanus 127_20	49	Ager Caerentanus 127_49
21	Ager Caerentanus 127_21	50	Ager Caerentanus 127_50
22	Ager Caerentanus 127_22	51	Ager Caerentanus 127_51
23	Ager Caerentanus 127_23	52	Ager Caerentanus 127_52
24	Ager Caerentanus 127_24	53	Ager Caerentanus 127_53
25	Ager Caerentanus 127_25	54	Ager Caerentanus 127_54
26	Ager Caerentanus 127_26	55	Ager Caerentanus 127_55
27	Ager Caerentanus 127_27	56	Ager Caerentanus 127_56
28	Ager Caerentanus 127_28	57	Ager Caerentanus 127_57
29	Ager Caerentanus 127_29	58	Ager Caerentanus 127_58

The LA-ICP-MS equipment was an Elan DRCe (Perkin Elmer/SCIEX), connected to a New Wave UP213 solid-state Nd-YAG laser probe (213 nm). Samples were ablated by laser beam in a cell, and the vaporised material was then flushed [29] to the ICP, where it was quantified. Each ablation crater was generally 50 μm in diameter and nearly invisible to the naked eye. The procedures for data acquisition were those normally used in the Mass Spectroscopy Laboratory of the Department of Earth Sciences, University of Calabria [30-32].

Only two/three point analyses were carried out on portions of archaeological fragments without roughness or alterations, and were sufficient to assign provenance. In order to remove any trace of soil, each find was cleaned by ultrasound in Millipore water. Calibration was performed on glass reference material SRM612–50 ppm by NIST (National Institute of Standards and Technology) in conjunction with internal standardisation, applying SiO_2 concentrations [33] from SEM-EDS analyses.

In order to evaluate possible errors within each analytical sequence, determinations were also made on the SRM610–500 ppm by NIST and on BCR 2G by USGS glass reference materials as unknown samples, and element concentrations were compared with reference values from the literature [34-35]. Accuracy, as the relative difference from reference values, was always better than 10%, and most elements plotted in the range +/-5%.

Results and discussion

Chemical analyses of major oxides were reported in the TAS diagram (Figure 4, after [36]). As shown, chemical compositions of obsidian samples display a homogeneous distribution, all the samples fall into the rhyolite field, with an evident enrichment in alkalis and a constant SiO_2 level.

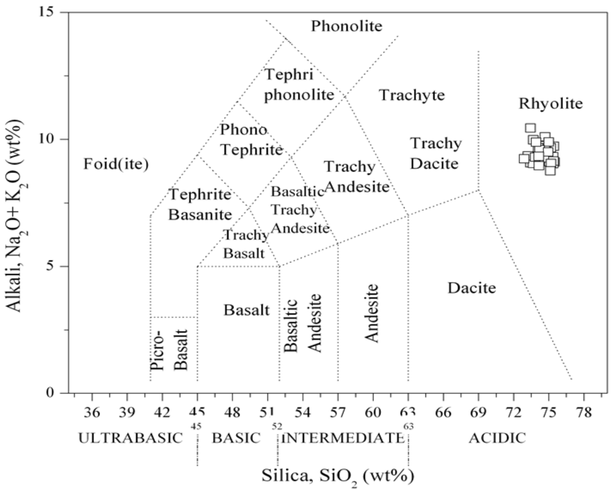

Fig. 4. Plot of obsidians chemical composition into the Total Alkali Silica (TAS) diagram [35].

The main potential sources for archaeological obsidians from Neolithic contexts in the Mediterranean area have been identified and compositionally characterised in Lipari (Sicily), Pantelleria (Sicily), Monte Arci (Sardinia) and Palmarola (Latium) [20, 37-39]. Geological obsidian samples from these localities in the Tyrrhenian area show similar silica and alkali contents. Only the Island of Pantelleria is characterized by values that slightly differ from those of the other sources [40-42]. For this reason, the use of trace- and rare-earth-element compositions allows a more accurate discrimination of the sources [43].

Table 2 lists some of trace and rare earth elements, determined by LA-ICP-MS; each trace element quantity, in the table, represents the mean value of two/three analyses.

Table 2. Average chemical compositions (n= 3) for the different obsidian shards (ppm).

Sample code	Sr	Y	Zr	Nb	Ba	Ce	Zr/Y	Y/Zr	Nb/Sr	Nb/Zr
Ager Caerentanus 127_1	16.3	-	170.6	34.0	13.9	97.3	-	-	2.079	0.199
Ager Caerentanus 127_2	14.9	37.6	152.5	33.9	14.9	105.3	4.055	0.247	2.271	0.222
Ager Caerentanus 127_3	18.1	-	155.1	31.5	14.5	99.0	-	-	1.744	0.203
Ager Caerentanus 127_4	24.7	43.3	170.7	33.1	32.8	101.9	3.942	0.254	1.338	0.194
Ager Caerentanus 127_5	14.6	38.7	152.7	33.8	12.5	103.8	3.944	0.254	2.321	0.221
Ager Caerentanus 127_6	15.6	41.2	168.4	35.3	15.4	114.9	4.083	0.245	2.267	0.210
Ager Caerentanus 127_7	19.2	-	168.8	33.9	14.2	98.9	-	-	1.766	0.201
Ager Caerentanus 127_8	14.2	-	148.5	33.5	8.4	99.1	-	-	2.364	0.225
Ager Caerentanus 127_9	14.7	36.5	158.2	34.6	18.9	107.8	4.339	0.230	2.347	0.218
Ager Caerentanus 127_10	16.9	40.3	159.0	35.7	18.1	109.8	3.942	0.254	2.106	0.224
Ager Caerentanus 127_11	15.2	38.1	156.0	34.2	13.5	106.6	4.090	0.244	2.251	0.220
Ager Caerentanus 127_12	17.1	42.0	175.2	37.2	15.5	116.5	4.172	0.240	2.179	0.213
Ager Caerentanus 127_13	14.2	36.3	144.4	33.3	12.7	101.7	3.979	0.251	2.344	0.230
Ager Caerentanus 127_14	17.1	41.5	165.7	36.1	13.9	111.6	3.996	0.250	2.116	0.218
Ager Caerentanus 127_15	15.4	39.0	148.6	31.6	13.7	98.5	3.807	0.263	2.046	0.213
Ager Caerentanus 127_16	6.1	49.3	259.2	65.4	8.2	171.3	5.255	0.190	10.674	0.252
Ager Caerentanus 127_17	16.0	38.2	162.1	33.9	12.2	107.6	4.242	0.236	2.122	0.209
Ager Caerentanus 127_18	18.3	-	154.2	33.0	11.9	101.6	-	-	1.801	0.214
Ager Caerentanus 127_19	6.7	49.7	247.7	65.7	9.4	169.9	4.981	0.201	9.744	0.265
Ager Caerentanus 127_20	13.2	-	144.4	32.6	16.0	99.2	-	-	2.463	0.225
Ager Caerentanus 127_21	14.3	36.5	154.9	32.7	16.2	110.1	4.237	0.236	2.297	0.211
Ager Caerentanus 127_22	15.8	-	168.4	33.1	12.2	98.0	-	-	2.093	0.197
Ager Caerentanus 127_23	6.0	44.4	234.6	60.8	8.3	152.4	5.285	0.189	10.126	0.259
Ager Caerentanus 127_24	15.6	39.7	159.4	32.6	11.7	98.2	4.011	0.249	2.093	0.205
Ager Caerentanus 127_25	17.7		164.2	32.3	18.1	97.4			1.828	0.197
Ager Caerentanus 127_26	18.1	36.1	152.4	33.9	17.4	104.2	4.218	0.237	1.874	0.222
Ager Caerentanus 127_27	22.7	37.3	153.8	34.2	14.8	103.3	4.125	0.242	1.506	0.223
Ager Caerentanus 127_28	27.9	32.6	134.8	31.5	12.4	93.7	4.141	0.241	1.129	0.234
Ager Caerentanus 127_29	15.8	38.5	163.6	35.4	15.2	96.3	4.247	0.235	2.243	0.216
Ager Caerentanus 127_30	12.2	37.4	156.6	31.8	12.0	96.9	4.185	0.239	2.607	0.203
Ager Caerentanus 127_31	29.5	38.4	160.5	29.3	13.8	94.7	4.181	0.239	0.993	0.182
Ager Caerentanus 127_32	25.7	39.6	163.8	31.4	12.6	95.6	4.132	0.242	1.225	0.192
Ager Caerentanus 127_33	13.8	38.2	157.1	32.0	12.5	99.2	4.111	0.243	2.321	0.204
Ager Caerentanus 127_34	16.7	36.1	161.0	29.8	13.1	93.4	4.463	0.224	1.786	0.185
Ager Caerentanus 127_35	15.5	37.7	152.4	31.4	13.2	93.2	4.044	0.247	2.028	0.206
Ager Caerentanus 127_36	109.2	20.2	205.2	25.9	896.3	120.6	10.156	0.098	0.237	0.126
Ager Caerentanus 127_37	23.6	35.2	146.4	32.7	25.0	98.2	4.157	0.241	1.384	0.223
Ager Caerentanus 127_38	15.4	37.8	156.9	33.5	10.9	104.1	4.153	0.241	2.172	0.213
Ager Caerentanus 127_39	10.7	50.0	260.9	61.2	13.2	155.2	5.215	0.192	5.739	0.234
Ager Caerentanus 127_40	14.0	35.3	142.9	33.1	12.9	104.2	4.046	0.247	2.374	0.232
Ager Caerentanus 127_41	13.6	39.4	160.1	32.0	13.1	100.9	4.060	0.246	2.349	0.200
Ager Caerentanus 127_42	18.4	38.2	166.3	32.7	11.0	100.0	4.354	0.230	1.778	0.197
Ager Caerentanus 127_43	13.7	38.3	156.5	31.3	12.1	93.6	4.089	0.245	2.278	0.200
Ager Caerentanus 127_44	2.2	2.9	103.1	7.9	6.0	7.4	35.423	0.028	3.650	0.076
Ager Caerentanus 127_45	5.1	52.8	257.5	65.9	6.7	160.7	4.873	0.205	12.946	0.256
Ager Caerentanus 127_46	15.6	41.0	164.2	33.4	18.3	98.9	4.002	0.250	2.138	0.203
Ager Caerentanus 127_47	15.2	39.6	157.0	31.6	12.6	93.9	3.961	0.252	2.086	0.201
Ager Caerentanus 127_48	14.1	38.8	159.2	35.2	13.8	108.6	4.106	0.244	2.491	0.221
Ager Caerentanus 127_49	34.5	5.0	12.3	2.4	147.0	19.3	2.441	0.410	0.071	0.199
Ager Caerentanus 127_50	8.9	52.9	281.2	66.6	14.4	170.7	5.312	0.188	7.523	0.237
Ager Caerentanus 127_51	14.8	44.5	171.6	34.8	12.3	109.1	3.856	0.259	2.359	0.203
Ager Caerentanus 127_52	3.2	9.3	191.1	6.2	10.4	7.2	20.614	0.049	1.943	0.032
Ager Caerentanus 127_53	15.8	39.4	158.9	33.5	13.0	104.3	4.038	0.248	2.126	0.211
Ager Caerentanus 127_54	15.6	41.5	167.8	34.4	10.6	104.4	4.048	0.247	2.203	0.205
Ager Caerentanus 127_55	15.4	41.1	168.0	33.5	10.9	104.7	4.087	0.245	2.171	0.199
Ager Caerentanus 127_56	6.3	55.3	284.8	76.3	9.5	194.1	5.153	0.194	12.105	0.268
Ager Caerentanus 127_57	6.1	53.2	270.4	68.3	6.7	164.9	5.086	0.197	11.214	0.253
Ager Caerentanus 127_58	14.7	39.9	167.7	35.4	13.7	104.1	4.202	0.238	2.408	0.211

In particular, selected trace elements, such as Nb, Y, Zr, Rb and Sr were chosen because they are particularly indicative of the genetic processes producing obsidian and can be considered sufficient to characterize its different sources [41].

The results obtained on the archaeological shards of Pyrgi site were thus compared with bibliographic geological data (Table 3) of peri-Tyrrenian area [30, 38, 40].

Table 3. Chemical compositions of trace elements concerning the main sources of the Mediterranean area.

Source		Sr	Y	Zr	Nb	Ba	Ce	Zr/Y	Y/Zr
Mt. Arci SC	(Barca et al., 2007)	117	24	232	28	965	133	9.696	0.103
Mt. Arci SB1		33	19	96	27	183	63	5.045	0.198
Mt. Arci SB2		76	23	147	33	476	85	6.265	0.160
Mt. Arci SA		26	34	78	51	137	58	2.278	0.439
Lipari		14	37	153	31	14	105	4.107	0.243
Palmarola		6	48	245	62	8	154	5.105	0.196
Pantelleria		3	168	1749	373	28	429	10.396	0.096
Pantelleria	(Acquafredda et al., 1999)	4	160	1725	354	64	397	10.812	0.092
Lipari		13	46	184	38	34	115	4.000	0.250
Palmarola		4	64	310	70	28	175	4.844	0.206
Mt. Arci		24	40	98	55	111	51	2.450	0.408
Mt. Arci		122	26	266	30	759	130	10.231	0.098
Mt. Arci SA	(Tykot. 1997)	31	37	121	49	152	51	3.270	0.306
Mt. Arci SB1a		84	29	198	36	470	77	6.828	0.146
Mt. Arci SB1b		76	33	166	40	320	65	5.030	0.199
Mt. Arci SB1c		82	31	176	38	345	67	5.677	0.176
Mt. Arci SB2		56	26	161	30	298	66	6.192	0.161
Mt. Arci SC1		130	27	247	29	936	116	9.148	0.109
Mt. Arci SC2		131	28	245	29	907	124	8.750	0.114

The diagrams Ba *vs* Ce and Ba *vs* Nb are shown in the Figures 5-6. The data relating to the obsidians attributed to the various Tyrrhenian sources (Pantelleria, Palmarola, Lipari and Mt Arci-Sardinia, known in the literature with the abbreviations SA, SB1, SB2 and SC) were also plotted for comparison.

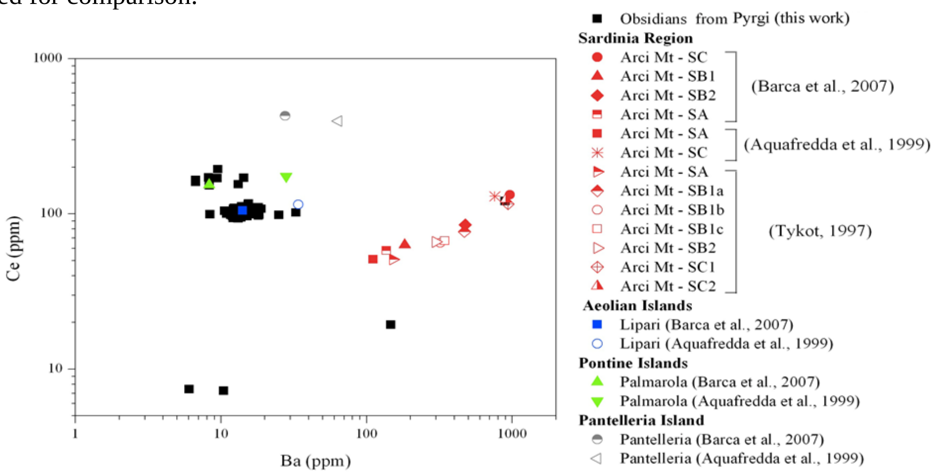

Fig. 5. The binary diagram of the Ce–Ba contents of archaeological finds and geological sources.

Based on the chemical composition of the analyzed findings, it was possible to discriminate the origin of the Pyrgi obsidians. Their composition is attributed to two main sources: Lipari (Aeolian Island) and Palmarola (Pontine Island).

The clear attribution of the obsidian shards to these two sources is visible, while Pantelleria can be excluded, as it appears clearly separate. A single sample would seem to fall instead in the Monte Arci field, while other three samples appear without a clear attribution.

The diagram Zr vs Ba (Fig. 7) confirms undoubtedly the geochemical similarity between the archeaeological finds from Pyrgi and the geological source of Lipari (number of matching samples = 48), followed by Palmarola (number of matching samples = 8). Mt Arci was also confirmed as source of one sample.

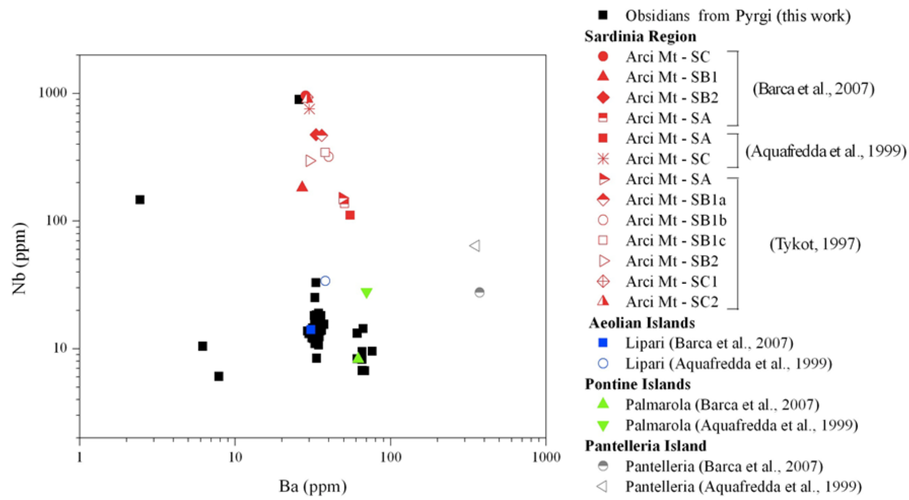

Fig. 6. The binary diagram of the Nb–Ba contents of archaeological finds and geological sources.

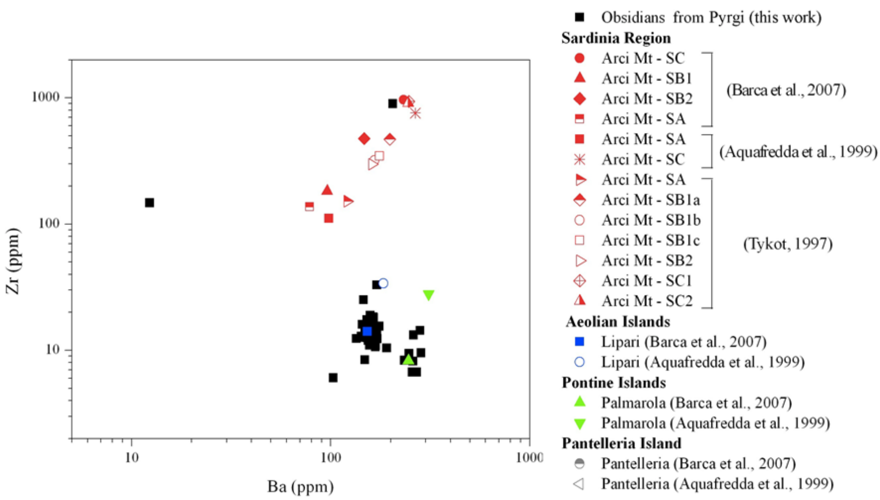

Fig. 7. The binary diagram of the Zr–Ba contents of archaeological finds and geological sources.

This diagram also confirms the uncertain provenance for two of the three analysed shards without attribution, while only one sample is still of doubt provenance.

In conclusion, the majority of analysed finds shows a clear Aeolian provenance, some of them come from the nearby Pontine Islands and only one sample overlaps the geological obsidian of Mt Arci (Sardinia).

Conclusions

In conclusion, the paleoenvironmental and archaeological picture that is emerging from the research seems to begin to shed new light on the most remote origins of the Pyrgean landing. It is very probable that the port, famous since the Etruscan era and remained alive for many centuries, up to the present day as a mooring channel, is to be considered the logical continuity, and perhaps also the last memory, of a well-established port, older and more complex, dating back to prehistoric times. Moreover, in the absence of these prehistoric assumptions, undoubtedly linked to the original natural conditions of the place, it would not be easily explainable the choice of the site by the metropolis cerite, distant from *Pyrgi* as many as 13 kilometers, for the construction of its main port and the relative emporium sanctuary.

The hypothesis that advances is that the landing point, placed in the context of ancient coastal marshes and continuously transformed over the centuries due to the constant rising of the sea, has always been frequented over time, without interruption, starting at least from the V-IV millennium BC. It is reasonable to believe that the known lack of archaeological data relating in particular to the early Iron Age is for *Pyrgi* more due to the limited extension of the areas investigated in the town, to the randomness of the finds, and above all to the demolition of a large stretch of coast by the sea, which does not result in a real absence of life, in the Villanovan phase, between the ninth and eighth centuries BC. In this regard, in addition to the materials mentioned near the source close to the sanctuary, there is a fragment of a probable faired cup with decorations on the shoulder, framed between the end of the eighth century and the beginning of the seventh, found as a residue in one layer of the Augustan era, in the excavation of the Piazza della Torretta inside the Castle of Santa Severa. The piece, together with the materials recovered at the source, confirms the existence of a visit to the *Pyrgi* site also in the context of the full and late Iron Age. Otherwise, it would be very difficult to understand why nothing stable and significant existed at the very point best prepared by nature for the port, frequented by the Neolithic at the end of the Bronze Age, where the Ceretans structured their main *Epineion* before the last years of the seventh century BC. In fact, numerous indications suggest that *Pyrgi* should also be included in the list of the dense network of maritime sites active on the Ceretan Sea not only from the early Iron Age but in all probability also from a long time ago. It is not unthinkable, moreover, that the ancients themselves were somehow aware of the remote origin of the Pyrgensian settlement which, perhaps for this reason, as in the case of *Alsium*, is remembered as an ancient Pelasgic foundation. Precisely in relation to the mythological origins of the sanctuary, it may not be accidental that its construction took place exactly coinciding with an area already frequented from remote times, starting from the Neolithic era. The phenomenon of the recurrent use by the Etruscans of places inhabited in prehistoric times is very evident in the *Ager Caeretanus*, especially in the case of the necropolises, which are often built directly on the remains of Bronze Age settlements.

Moreover, the "Pelasgic" origin of the *Pyrgi* sanctuary, which the ancients already feel as a sacred place that goes back to distant times, could find a concrete reference and a direct explanation in the religious site chosen for its construction: a place that from ancestral times it was frequented by men, ancestors, gods and heroes of myth including Nanas-Odysseus, welcomed by Agylla (Lycophr, Alex, scholia, 805) and the Tyrrhenian lydian, nephew or son of Heracles [27].

The discovery of numerous findings in obsidian of overseas origin occurred in the territory immediately surrounding the investigated area, offers new information about its centuries-old frequentation, extended from the Neolithic to the Modern era. The comparison between the obtained data concerning the archaeological obsidian finds and the bibliographic data of the peri-Tyrrhenian source area allowed the identification of the origin of almost all the finds. In particular, most of the finds show a provenance from the island of Lipari, followed by some samples from the island of Palmarola, and only one sample from Monte Arci.

The data seem to confirm the crucial role of the Etruscan harbour of *Pyrgi*, which continues its history in Roman and Medieval times, as landing points that have been frequented for thousands of years.

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Received: December 12, 2019
Accepted: February 29, 2020