Original Study

Sara Marino*, Elena Natali, Robert H. Tykot, Andrea Vianello

PXRF Determination of the Obsidian Industry from the S–F Area of Piani della Corona EBA Settlement (Bagnara Calabra–RC, South Italy)

https://doi.org/10.1515/opar-2017-0016
Received December 3, 2016; accepted June 6, 2017

Abstract: Archaeological excavations in the S–F area of Piani della Corona settlement have affected a portion of 2200 m^2 of a large plateau (490 m asl). The researches, conducted between 2007 and 2008 by the Superintendence of the Museo Preistorico Etnografico "L. Pigorini" with the Archaeological Superintendence of Calabria, have revealed traces of a large village from the EBA. Before settling in the EBA, human groups belonging Recent Neolithic frequented the plateau. Two burials located near the Bronze Age ditch belong to this period, and there are also sporadic ceramic fragments recovered from the huts. The importance of Piani della Corona is mainly due to its strategic location, serving as a bridge between Calabria, Sicily and the Aeolian Islands, as proven by the archaeological record. A very important role was provided by the obsidian industry, dated after the most distinctive archaeological ceramics class, to the EBA. Out of the 238 obsidian tools found in the S–F area (blades, cores and amorphous splinters), 88 artifacts were analyzed by pXRF. Their chemical determination made it possible to clarify the procurement dynamics and exchange routes with the Aeolian Islands for the EBA, integrating new data in an on-going research.

Keywords: EBA network, pXRF, obsidian, Aeolian Islands, Sicily, Tyrrhenian Sea, sociocultural influences, Gabellotto

1 Introduction

This report concerns pXRF analyses conducted in the Pigorini Museum in Rome between June and September 2015 on the obsidian artifacts of the Early Bronze Age (EBA) settlement of Piani della Corona, (Bagnara Calabra, RC), S–F areas. The analyses are part of a larger project of the University of South Florida, coordinated by R. Tykot and A. Vianello, which encompasses southern Italy and is investigating primarily the movement of Lipari obsidian.

The archaeological investigations at Piani della Corona were conducted between 2007 and 2008 by the Archaeological Superintendence of Calabria, with the Superintendence of the Pigorini Museum. The site is located at a site of strategic importance in the landscape, on a plateau 490 m above sea level, which dominates the Calabrian Tyrrhenian southern coast, the Strait of Messina, the north-eastern part of Sicily and the Aeolian Islands.

Article Note: This article is a part of Topical Issue on Portable XRF in Archaeology and Museum Studies, edited by Davide Tanasi, Robert H. Tykot & Andrea Vianello

***Corresponding author: Sara Marino,** La Sapienza University of Rome, Italy E-mail: sara.marino@uniroma1.it
Robert H. Tykot, Department of Anthropology, University of South Florida, Tampa, Florida 33620, United States
Elena Natali, Andrea Vianello, Independent researcher

A series of surveys and test pits identified 2 archaeologically significant areas on the plateau (Agostino, 2011). These develop a total area of about 720 m^2 and can be divided into 2 main areas: one, smaller, is called "S–F" and another, larger, is the "M" area. The following report covers only the obsidian artifacts from the S–F area (Figure 1).

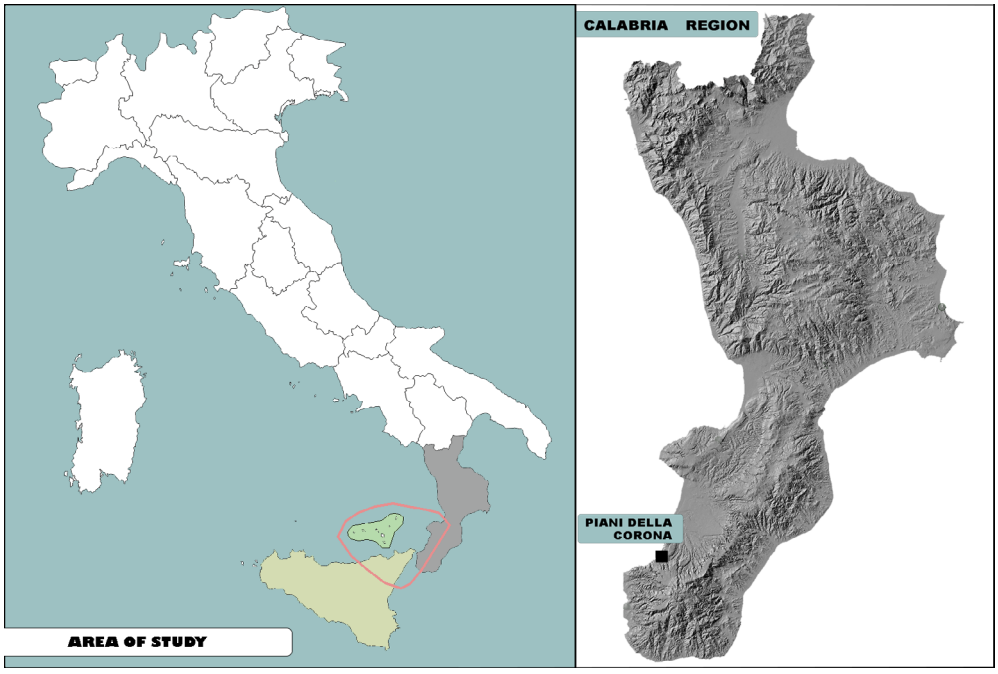

Figure 1. Geographical positioning of Piani della Corona EBA settlement (Bagnara Calabra, RC).

The settlement of Piani della Corona is currently one of the few EBA sites extensively investigated with stratigraphic methodologies in Calabria for this period. It provides a very important model for the study of settlement dynamics since there are complex and multi-layered architectural structures. It has relevance for the socio-economic and cultural aspects of ancient societies, allowing us to reveal the influences from Sicily and the Aeolian Islands to Calabria, as confirmed by the very high percentage of obsidian and typological characteristics of the ceramic finds.

Since the first excavations, it has been possible to identify a first phase dated to the Late Neolithic period (Diana-Bellavista *facies*) represented by 2 isolated burials in simple pits and ceramic materials from different contexts spread across the surrounding area.

Afterwards, during the EBA, Piani della Corona emerged as a complex settlement organized in a series of defensive and residential structures (Figure 2):

1. 1 ditch, with double palisade;
2. 4 rectangular huts with apse in axis with the ditch;
3. 2 water tanks, related the housing facilities;
4. 1 drainage pit external to the ditch;
5. 2 cremation burials (one of which is well preserved), culturally contemporary with settlement.

From the chrono-typological study of ceramic finds of Piani della Corona, the S–F area emerges with a cultural framework similar to the local Cessaniti-Capo Piccolo 1 *facies*, probably dated to an early phase (Marino, 2016). In support of this chronology are also the 2 radiocarbon dates, that place the settlement in the last century of the 3rd millennium in a general way before the eruption of the Avellino pumice. These dates are regionally aligned with the recent dating from Punta di Zambrone site (Pacciarelli et al., 2015), partly contemporary with Filicudi Filo Braccio (area L) and Pantelleria Mursia (sector D) (Alberti, 2013;

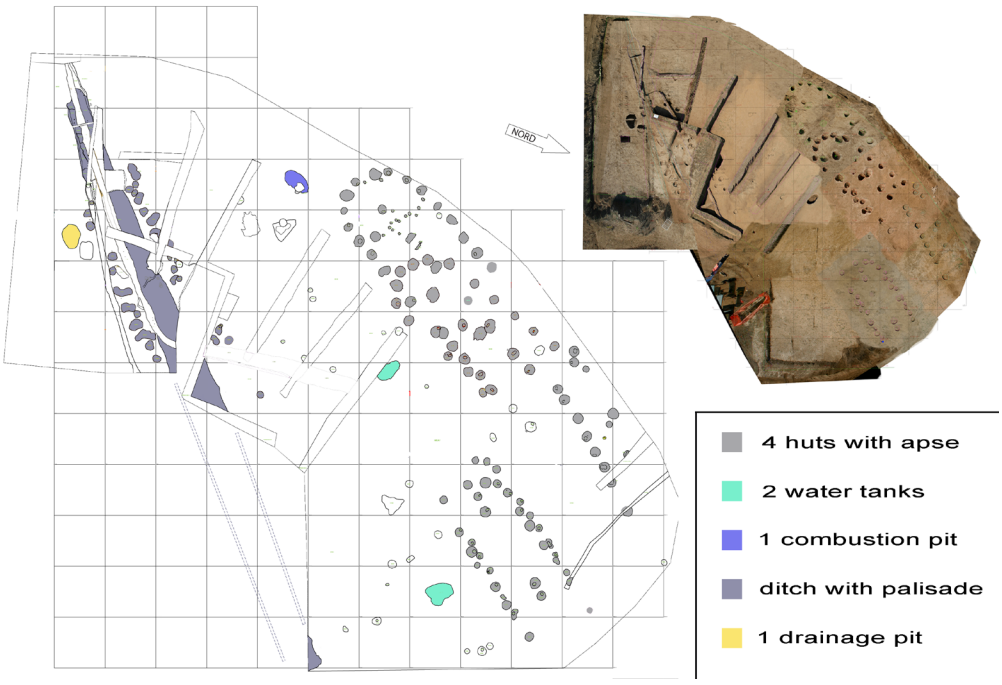

Figure 2. S–F area on the Piani della Corona plateau.

Martinelli et al., 2010; Cattani et al., 2012, Cattani, 2016) and probably shortly before the beginning of the Sicilian *facies* RTV (Ardesia, 2013–14).

From Piani della Corona, 238 obsidian artifacts come from the S–F area come, distributed in all the architectural structures and stratigraphic units. Half of the obsidian artifacts, 119 finds, come from stratigraphic units related to the huts, especially hut 2 that is the best preserved of the entire group. The remaining set comes from the ditch, water tanks 1 and unauthorized surface collections, which took place before the beginning of the official excavation (Figure 3).

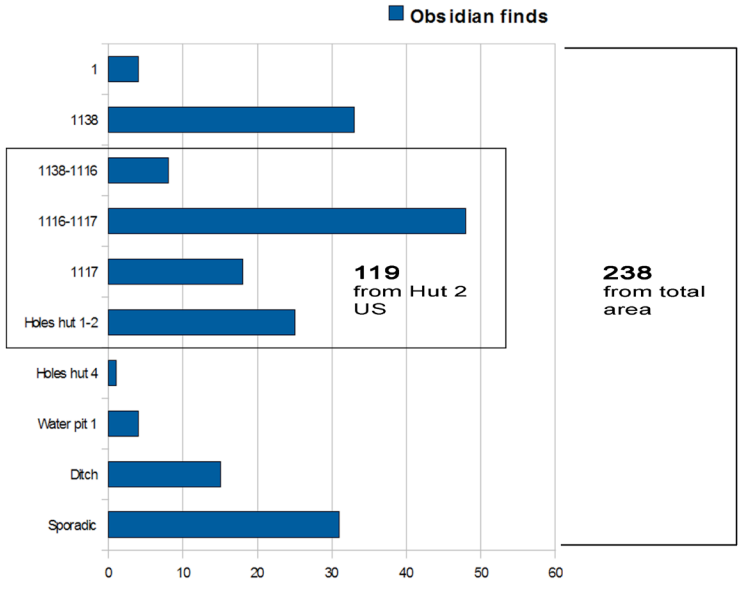

Figure 3. Distribution of obsidian artifacts in the S–F area.

2 Methodology

Typologically, there are 4 obsidian artifact groups. The majority consisted of amorphous chippings and processing waste (53 artifacts; Figure 4). The remaining part of the assemblage consists mainly of blades and fragments of blades, generally trapezoidal, with a flattened section and simple marginal non-continuous retouch (15 artifacts). Cores and fragments of cores are also present, with the superficial cortical part still preserved (16 artifacts). The shape seems to be polyhedral. Finally, it is relevant the presence of 4 tanged arrowheads with bifacial retouch (Figures 5–6).

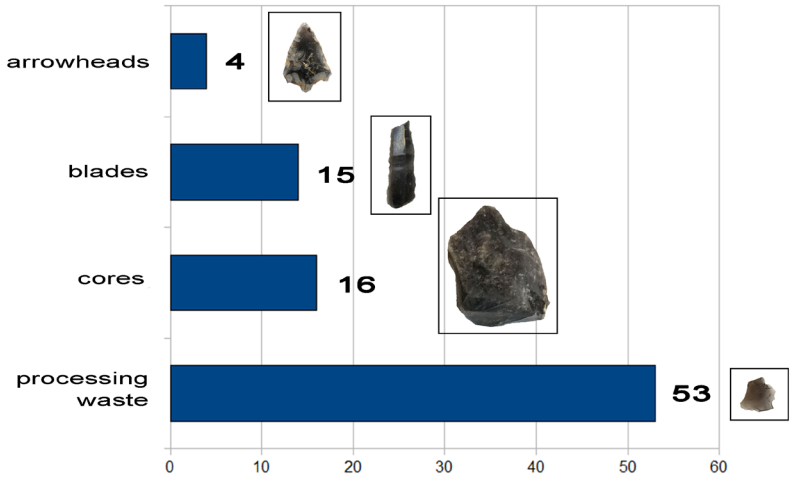

Figure 4. Graph–typological the largest obsidian artifacts groups analyzed in the S–F area.

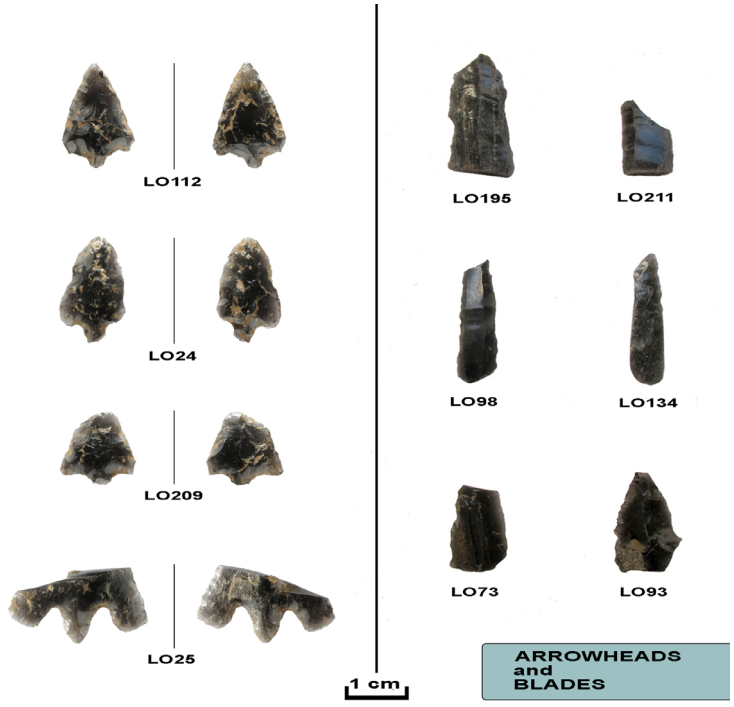

Figure 5. Some of the major typological groups of obsidian analyzed in the S–F area.

Figure 6. Some of the major typological groups of obsidian analyzed in the S–F area.

The criteria adopted in selecting the obsidian samples to be analyzed were as follows:
1. Topographic
The artefacts were selected from all settlement contexts and from secondary and functional structures. At topographical level most of the analyzed samples came from huts (especially hut 2, the best preserved), from the ditch and from stratigraphic units of areal and surface. Only a small proportion comes from the water tanks 1, and the secondary structure leading to hut 1.

2. Stratigraphic
Samples were selected from the following contexts: stratigraphic units of the settlement structures, stratigraphic units of the surface, cleaning and sporadic contexts from regular excavations and unauthorized surface collections.

3. Typological
Samples of all major shapes (blades, cores, arrowheads, debitage and processing waste) were analyzed to determine whether there were any variations of origin for specific shapes and, if so, determine any difference between cores and processing waste. At the typological level, most artefacts consisted of flakes and debitage. The blades and arrowheads are the only completed artifacts: these and the cores were given particular attention.

For this study, a Bruker Tracer III-SD pXRF instrument was used, with analyses carried out for 90 seconds, at 40 kV and 11 μA, using a filter designed to enhance trace element values. The data has been calibrated and matched with samples taken from the geological subsources, according to an established procedure. The use of elemental analysis method has been a staple in obsidian sources studies since the pioneering paper by Cann and Renfrew in 1964 (Cann & Renfrew, 1964). Energy dispersive X-ray fluorescence (ED-XRF) has since been established, and hand-held models of XRF have become a preferred instrument for being portable, non-destructive, and increasingly, trace element detection abilities. pXRF and lab XRF have been compared (Craig et al., 2007), and recently pXRF analyses have been integrated with analyses using other instruments and methodologies (Orange et al., 2017). The literature on pXRF and obsidian is vast, and suffices here to say that the instrument has sufficient detection abilities to discriminate among sources and subsources within a continental area, with some current instruments achieving high levels of precision (Tykot, 2016). The basic methodology is to analyze geological samples and then compare analyses of obsidian artifacts with known samples: any match links the artifact to the corresponding geological source.

3 Results and Discussion

88 obsidian artifacts were analyzed and are all from Lipari in the Aeolian Islands (see supplementary materials). More precisely, about 98% of the analyzed obsidian came from the Gabellotto Gorge subsource, while the rest came from Canneto Dentro, located approximately 1.5 km from Gabellotto Gorge. A second group of analyses on obsidian tools from the "M area", still in progress at the time of writing, is yielding equivalent results.

Overall, in the central Mediterranean there are four main sources: Lipari, Pantelleria, Palmarola and Mt. Arci in Sardinia, but Lipari obsidian is predominant in southern Calabria (as in neighboring regions), with an extremely rare presence of obsidian from Pantelleria and no obsidian from the other two regions. The Lipari obsidian is glassier, sharper but more brittle than Pantelleria obsidian. Exported obsidian from Lipari is gray or dark, with or without phenocrysts. Transparency is very variable depending on the artifact, but usually notable. Lipari obsidian can be usually recognized by optical examination, but scientific methods such as X-ray fluorescence provide non-destructive and more accurate ways to determine not only the main source, but also its subsource.

The results confirm the findings of a study of 25 sites recently analyzed in Sicily by the University of South Florida project (Tykot et al., 2013), as well as other analyses by the same team in preparation for publication. The chronological span covers the period from the Neolithic to the Middle Bronze Age. It appears clear that the ancient people of Calabria preferred procuring their obsidian from the Aeolian Islands (and Gabellotto Gorge was the preferred subsource) for an extended period of time, with Pantelleria being exploited remarkably much less (Tykot et al., 2013).

While more data will be published in the foreseeable future, the consistency of the results allows for some conclusions at this stage. Considering only the sites between the final Copper Age and the EBA period, with the latter period possibly contemporary with the Piani della Corona settlement, the data remains unchanged, and confirms the prevalence of Gabellotto Gorge obsidian. From the study of ceramic typology, it is possible to distinguish four geographic groups: Calabro, Siculo-Aeolian, Campano and Lucan-Apulian. At Piani della Corona, the Calabro group is the most widespread, a conclusion to be expected given that this type of material culture is frequently found, and possibly locally originated in the area; ceramics of the Siculo-Aeolian group are however also present.

Thus, the close links between Calabrian and Sicilian cultures are recognizable not only by the presence of obsidian across the region, but also by ceramic types. Only from a macroscopic analysis most ceramic vessels from Piani della Corona probably used clays sourced locally, and therefore style rather than materials provide clues of intense exchanges between Calabria and Sicily. The same ones are involved at the moment in eastern Sicily, specially Milazzo surroundings and at least south Ognina (Bernabò Brea, 1966; Tigano, 2009), but also a group of sites in the Aeolian Islands, including Filicudi Filo Braccio and Lipari Diana-Castello (Bernabò Brea & Cavalier, 1980, 1991; Martinelli et al., 2010), all sites participating in the obsidian exchange network and most likely connected with Calabrian sites such as Piani della Corona, as the South Florida project proves.

Pottery from Piani della Corona has not been thin-sectioned or chemically analyzed for provenance, and very few data exists on other Calabrian contemporary contexts, for example following recent analyzes from the nearby site of Punta di Zambrone (EBA-RBA), in which geological allochtonous components cannot be excluded (Fragnoli et al., 2014). However, a recent research project at S. Vincenzo in Stromboli has provided some useful data: among EBA and MBA1-2 vessels (Capo Graziano *facies*), a part of pottery from Stromboli was made with Calabrian and northern Sicily fabrics. In addition, there are Aeolian shapes made of Calabrian and northern Sicily fabrics and non-Aeolian shapes made with Aeolian fabrics (Brunelli et al., 2013; Cannavò et al., 2017; Fragnoli, et al., 2012).

To summarize, the data reveal an exchange network between (eastern) Sicily, the Aeolian Islands and the Tyrrhenian coast of Calabria during the EBA, centered on the exchange of obsidian from Lipari. As suggested by pXRF analyses at Piani della Corona, this network was already developed in the earliest stages of the Bronze Age and most likely it exchanged prepared obsidian cores, which were probably worked locally to produce standardized blades, in an established technological package proven by the typological

study of the obsidian tools. In this network between the Aeolian Islands and the Tyrrhenian coast of Calabria, Stromboli probably acted as an important port of call on the northern route, as demonstrated by archaeometrical analyses of pottery, but a southern route via mainland Sicily and the Strait of Messina as well as direct routes from Lipari were also possible given the negligible distances, and indeed the web of contacts probably thrived on multiple maritime and inland routes at the same time.

The pXRF analyses on obsidian at Piani della Corona provide a contribution to a broad perspective on the consumption and exchange of obsidian tools from Lipari, but they also show a Neolithic network still very active in the Bronze Age and still able to change and expand. Bronze Age ceramics that previously hinted at widespread exchanges between Sicily and Calabria need to be taken in account, and must be considered a development of an established and organized exchange network in general based on raw materials and in this case on the obsidian. It is difficult to link obsidian exchanges with Bronze Age contexts because usually obsidian is present in previous contexts and therefore it is not immediately clear how much Neolithic practices and Bronze Age developments are linked. Piani della Corona proves that the exchange network of obsidian from Lipari was still very active during the first part of the Bronze Age, and the area of Piani della Corona shows multiple routes linking Sicily and Calabria, which often involved several of the Aeolian Islands: the reason for the later routes to be centered on those islands most likely was still the sourcing of Lipari obsidian, an activity that was shaping cultural and economic exchanges well past its supposed prime.

Acknowledgments: We thank the Superintendence of Calabria and the Pigorini Museum in Rome for the availability to study the obsidian artifacts; Dr. Rossella Agostino, scientific director of the excavations at Piani della Corona; Dr. Vincenzo Tiné and Dr. Marilena Sica.

References

Agostino, R. (2011). Il basso Tirreno reggino tre l'età del Bronzo e del Ferro. In G. De Sensi Sestito, S. Mancuso (Ed.), Enotri e Brettii in Magna Grecia. (pp. 77–93). Soveria Mannelli: Rubbettino.

Alberti, G. (2013). A Bayesian 14C chronology of Early and Middle Bronze Age in Sicily. Towards an independent absolute dating. Journal of Archaeological Science, 40 (5), 2502–2514, Doi: https://doi.org/10.1016/j.jas.2012.08.014

Ardesia, V. (2013–14). La cultura di Rodì-Tindari-Vallelunga in Sicilia: origini, diffusione e cronologia alla luce dei recenti studi. Parte 1–2. Ipotesi di Preistoria, 6, 35–170.

Bernabò Brea, L. (1966). Abitato neolitico e insediamento maltese dell'età del Bronzo nell'isola di Ognina (Siracusa) e i rapporti fra la Sicilia e Malta dal XVI al XIII sec. a.C. Kokalos, XII, 40–69.

Bernabò Brea, L., & Cavalier, M. (1980). Meligunìs Lipára IV: L'acropoli di Lipari nella preistoria. Palermo.

Bernabò Brea, L., & Cavalier, M. (1991). Meligunìs Lipára VI: Filicudi. Palermo.

Brunelli, D., Levi, S.T., Fragnoli, P., et al. (2013). Bronze Age pottery from the Aeolian Islands: definition of Temper Compositional Reference Units by an integrated mineralogical and microchemical approach, Appl. Phys. A, Doi:10.1007/s00339-013-7775-3

Cannavò, V., Di Renzoni, A., Ferranti, F., et al. (2017). L'età del Bronzo a Stromboli: il villaggio terrazzato di San Vincenzo come avamposto nord-orientale dell'arcipelago eoliano. Scienze dell'Antichità, 22 (2), 297–313.

Cann, J.R., & Renfrew, A.C. (1964). The Characterization of Obsidian and its Application to the Mediterranean Region. Proceedings of the Prehistoric Society, 30, 111–133.

Cattani, M., Nicoletti, F., & Tusa, S. (2012). Resoconto preliminare degli scavi dell'insediamento di Mursia (Pantelleria). Proccedings of the XLI Riunione Scientifica IIPP. (pp. 637–651). Firenze: IIPP.

Cattani, M. (2016). Il villaggio del bronzo di Mursia (Pantelleria): strategie insediative e aspetti culturali. Scienze dell'Antichità, 22 (2), 387–402.

Craig, N., Speakman, R.J., Popelka-Filcoff, R.S. et al. (2007). Comparison of XRF and PXRF for analysis of archaeological obsidian from southern Perú. Journal of Archaeological Science, 34 (12), 2012–2024. Doi: https://doi.org/10.1016/j.jas.2007.01.015

Fragnoli, P., Capriglione, C., Jung, R., et al. (2014). Before sampling: systematic procedures of macroscopic pottery classification within the Punta Zambrone (VV) research project. Quaderni del Centro Studi Magna Grecia, 19, 293–310.

Fragnoli, P., Brunelli, D., Levi, S.T., et al. (2012). Scambi ceramici nei contesti Capo Graziano delle isole Eolie: dati petrografici e petrologici a confronto. In G. Vezzalini, P. Zannini (Ed.), Proceedings of the A.I.Ar 2012, VII Congresso Nazionale di Archeometria. Bologna: Pàtron Editore 2012, pp. 122–136.

Marino, D., & Pacciarelli, M. (1996). Calabria. In D. Cocchi Genick (Ed.), L'antica età del bronzo. (pp. 147–162). Firenze: OCTAVO.

Marino, S. (2016). L'insediamento dell'antica Età del Bronzo di Piani della Corona (Bagnara Calabra, RC). Lo studio dei materiali dalle Aree S-F (Unpublished MA dissertation). Università degli Studi della Basilicata. Scuola di Specializzazione in Beni Archeologici, Matera.

Martinelli, M.C., Fiorentino, G., Prosdocimi, B., et al. (2010). Nuove ricerche nell'insediamento sull'Istmo di Filo Braccio a Filicudi. Origini, XXXII, 285–314.

Orange, M., Le Bourdonnec, F.X., Bellot-Gurlet, L., et al. (2017). On sourcing obsidian assemblages from the Mediterranean area: analytical strategies for their exhaustive geochemical characterisation, Journal of Archaeological Science, 12, 834–844. Doi: https://doi.org/10.1016/j.jasrep.2016.06.002

Pacciarelli, M., Scarano, T., & Crispino, A. (2015). The transition between the Copper and Bronze Ages in southern Italy and Sicily. In H. Meller et al. (Ed.), 2200 BC – A climatic breakdown as a cause for the collapse of the world?, Proceedings of 7th Archeological Conference of Central Germany, 23–26 October 2014, Halle (Saale), Germany. Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, pp. 253–282.

Tigano, G. (2009). Mylai II. Scavi e ricerche nell'area urbana (1996–2005). Messina.

Tykot, R.H., Freund, K.P., & Vianello, A. (2013). Source Analysis of Prehistoric Obsidian Artifacts in Sicily (Italy) using pXRF. In R.A. Armitage & J.H. Burton (Ed.), Archaeological Chemistry VIII. (pp. 195–210). ACS Symposium Series 1147. Washington DC: American Chemical Society.

Tykot, R.H. (2016). Using non-destructive portable X-ray fluorescence spectrometers on stone, ceramics, metals, and other materials in museums: advantages and limitations. Applied Spectroscopy, 70 (1), 42–56.

Supplemental Material: The online version of this article (DOI: 10.1515/opar-2017-0016) offers supplementary material.