C. R. Palevol 14 (2015) 207–217

Contents lists available at ScienceDirect

Comptes Rendus Palevol

www.sciencedirect.com

Human Palaeontology and Prehistory (Palaeoarcheology)

Blade production and the consumption of obsidian in Stentinello period Neolithic Sicily

Production et consommation d'obsidienne au cours de la période Stentinello de la Sicile néolithique

Kyle P. Freund[a,*], Robert H. Tykot[b], A. Vianello[c]

[a] *Department of Social Sciences/Anthropology, Indian River State College, 3209, Virginia avenue, Fort Pierce, FL 34981, USA*
[b] *Department of anthropology, University of South Florida, 4202, East Fowler avenue, SOC107, Tampa, FL 33620-7200, USA*
[c] *Institute, Learning Technologies Group, Oxford University, Oxford, OX2 6NN, United Kingdom*

ARTICLE INFO

Article history:
Received 5 November 2014
Accepted after revision 20 February 2015
Available online 15 June 2015

Presented by Yves Coppens

Keywords:
West Mediterranean
Sicily
Neolithic
Exchange Networks
Obsidian Sourcing
Portable X-ray Fluorescence (pXRF)
Lithic Technology

Mots clés :
Méditerranée occidentale
Sicile
Néolithique
Réseaux d'échange
Zone source d'obsidienne
Fluorescence X portative (pXRF)
Technologie lithique

ABSTRACT

This study explores obsidian consumption during the Early/Middle Neolithic Stentinello period (ca. 5600–4000 cal B.C.) on the Italian island of Sicily through the analysis of 622 obsidian artifacts from eight sites in eastern Sicily and the Aeolian Islands. By combining obsidian sourcing by means of portable X-ray fluorescence (pXRF) spectrometry with techno-typological characterization, it is shown that distinctively wide Lipari blades were the primary artifact type used during this period. Our data suggest that the primary reduction of these materials occurred at the source area by local populations, with obsidian being transported from Lipari to eastern Sicily and Calabria in the form of preformed cores. Despite similarities between Sicily and southern Italy in the initial procurement of Lipari obsidian, there are distinct differences in how these materials were subsequently reduced.

RÉSUMÉ

Cette étude explore la consommation d'obsidienne de la période Stentinello du Néolithique inférieur et moyen (ca. 5000–4000 cal B.C.) sur l'île italienne de Sicile, grâce à l'analyse de 622 objets en obsidienne provenant de huit sites de Sicile orientale et des îles Éoliennes. Par association de la fluorescence X portative avec la caractérisation techno-typologique des objets en obsidienne, il est montré distinctement que les lames de Lipari sont le premier type d'objets utilisés pendant cette période. Nos données suggèrent que la première réduction des matériaux a été réalisée à la zone source par les populations locales, l'obsidienne étant transportée de Lipari jusqu'en Sicile orientale et en Calabre sous forme de nucléus préformés. En dépit de similitudes entre la Sicile et le Sud de l'Italie dans l'approvisionnement initial en obsidienne, il existe des différences nettes dans la façon dont ces matériaux ont été réduits par la suite.

* Corresponding author.
E-mail addresses: kfreund@irsc.edu (K.P. Freund), rtykot@usf.edu (R.H. Tykot), a_vianello@hotmail.com (A. Vianello).

http://dx.doi.org/10.1016/j.crpv.2015.02.006

1. Introduction

This study explores obsidian consumption during the Early/Middle Neolithic Stentinello period (ca. 5600–4000 cal B.C.) on the Italian island of Sicily through the analysis of 622 obsidian artifacts from eight sites in eastern Sicily and the Aeolian Islands. By undertaking a characterization study that integrates elemental sourcing data from portable X-ray fluorescence (pXRF) spectrometry with techno-typological analyses, we discuss the distribution of obsidian subsource products from the island of Lipari. These results are then contextualized within broader regional patterns of obsidian reduction and use. We place the Stentinello period at ca. 5600–4000 cal B.C. based on radiocarbon evidence cited by Ammerman (1987: 345), Robb (2011), and Skeates (1994: 167), pushing back traditional chronologies that place the beginning of Stentinello at ca. 5000 B.C. (e.g., Tusa, 1997: 647).

Obsidian is an igneous rock and a type of volcanic glass that is usually black in color. It is an excellent raw material for the creation of stone tools and was widely exploited by people of the past, frequently across vast geographic distances. During the Neolithic (ca. 6000–3500 B.C.), obsidian was procured from the island sources of Sardinia, Palmarola, Lipari, and Pantelleria and distributed throughout the western Mediterranean (Fig. 1). At present, the vast majority of obsidian found at archaeological sites in the western Mediterranean comes from one of these four sources, although small quantities of obsidian from the Carpathian sources have been documented from Neolithic sites in northeastern Italy (Randle et al., 1993; Williams Thorpe et al., 1979).

Previous studies have led to the general impression that Lipari was the primary obsidian source exploited by Neolithic peoples of southern Italy and Sicily, with lesser quantities of Pantellerian obsidian being procured by communities in western Sicily (see Crummett and Warren, 1985; Francaviglia and Piperno, 1987; Iovino et al., 2008a, 2008b; La Rosa et al., 2006; Nicoletti, 1997). It has to be noted, however, that these interpretations are based on the analysis of a relatively small number of total artifacts and there is not a clear understanding of the spatial and temporal differences that exists regarding how obsidian from the various sources and subsources was procured, reduced, and consequently used. It was therefore our intention to develop a proper methodological framework to address these issues. As a result, this study represents an initial step towards a more comprehensive understanding of the nature of obsidian exploitation in Sicily and a more thorough comprehension of how obsidian was distributed from the islands of Lipari and Pantelleria.

2. Background information

Over the past 50 years, much of the work on obsidian in the West Mediterranean has consisted of analyzing particular archaeological assemblages to document how a specific analytical technique can be used to discriminate the products of the region's various obsidian sources (e.g., Bigazzi et al., 1986; Cann and Renfrew, 1964; Hallam et al., 1976; Tykot, 1996). This tradition of scholarship continues today, being used to show that the various sources and subsources of the West Mediterranean can be distinguished with varying success using analytical techniques such as particle-induced X-ray emission (PIXE), neutron activation analysis (NAA), inductively coupled plasma mass spectrometry ICP-MS, Mössbauer spectroscopy, electron paramagnetic resonance, and XRF (Barca et al., 2007; Le Bourdonnec et al., 2005; Poupeau et al., 2010; Scorzelli et al., 2001; Seccaroni et al., 2008; Tykot et al., 2013).

While this work represents a great success story in geoarchaeological research, questions of broader anthropological significance are less well developed, and it is only in the past two decades that more archaeologically driven questions have been forefronted (see Tykot and Ammerman, 1997). This is not to say that issues surrounding exchange mechanisms and the transportation of obsidian across the sea- and landscape have not been addressed, it is just that the results from so many analyses over the past 50 years make it almost impossible to determine the relative importance of different sources at any one particular site or how the uses of the various source products may or may not have changed through time (Pessina and Radi, 2006: 435). By focusing on one aspect of obsidian consumption, i.e. the raw materials involved, without considering the specific forms in which the obsidian circulated (nodule, core, end-product, etc.), the techniques by which they were worked, and the form of the final tools, the interpretive potential of much of this work is limited (cf. Freund, 2013).

While early obsidian sourcing studies in the West Mediterranean were limited to a small number of scholars, the past two decades have seen a proliferation of research on the subject. Many archaeologists of this new generation recognize the importance of combining sourcing data with other information about form and function of the artifacts themselves in order to address a wider range of questions about how obsidian was incorporated into the lives of the people who used it; this has taken form most notably in Sardinia, Corsica, Liguria, Calabria, and southern France (see Ammerman, 1985; Costa, 2007; Freund and Tykot, 2011; Le Bourdonnec et al., 2010; Léa, 2012; Luglié et al., 2008).

A central component of these analyses has been the reconstruction of source-specific obsidian reduction sequences and the specification of which parts of these sequences are represented at particular sites – i.e., whether an assemblage attests to on-site production commencing with the reduction of raw nodules or merely contains end-products. A central conclusion drawn from these analyses is that multiple knapping traditions existed across the West Mediterranean region over the course of the Neolithic, including pressure-flaked blade industries in southern France and Corsica (Bressy et al., 2008; Costa, 2006; Léa, 2012), direct percussion blade technology in southern Italy (Diamond and Ammerman, 1985), and flake-based industries in Sardinia (Freund, 2014; Luglié et al., 2008). Nevertheless, these conclusions are based on a small number of total analyses and there is still much work to be done in terms of understanding how and where obsidian was acquired, reduced, and consequently used. This is why integrated characterization studies combining sourcing data with techno-typological analyses

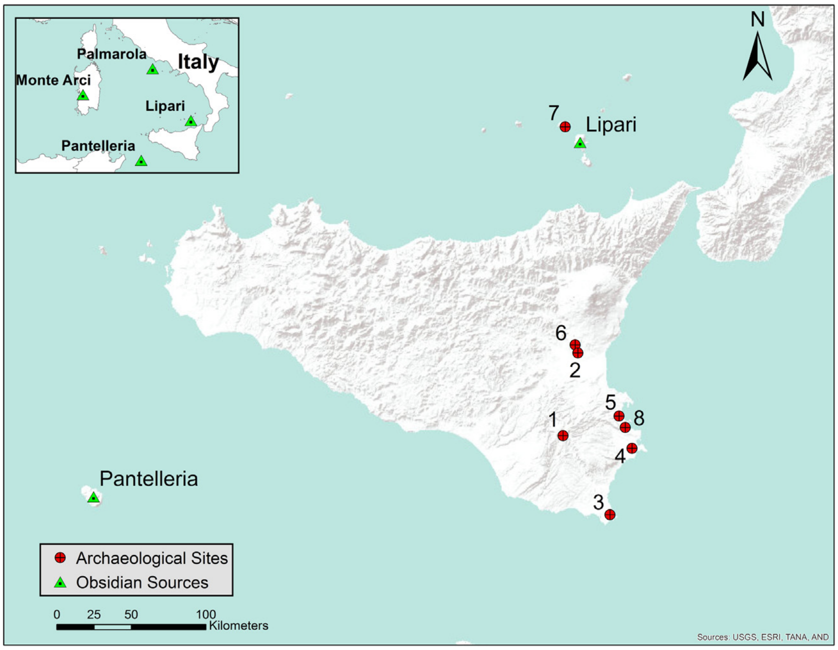

Fig. 1. (Color online.) Map showing the analyzed archaeological sites and relevant obsidian sources. 1. Calaforno; 2. Fontana di Pepe; 3. Grotta Corruggi; 4. Matrensa; 5. Megara Hyblaea; 6. Poggio Rosso; 7. Rinicedda; 8. Stentinello.

Fig. 1. (Couleur en ligne.) Carte montrant les sites archéologiques analysés et les sources d'obsidienne correspondantes. 1. Calaforno ; 2. Fontana di Pepe ; 3. Grotta Corruggi ; 4. Matrensa ; 5. Megara Hyblaea ; 6. Poggio Rosso ; 7. Rinicedda ; 8. Stentinello.

and usewear studies are so critical in interpreting the role of obsidian in larger socio-economic processes through time, and therefore a central component of this research.

2.1. Raw materials

While there are four obsidian sources located in the West Mediterranean (Fig. 1), only obsidian from the island of Lipari is currently known to have been exploited by Neolithic populations of eastern Sicily (Francaviglia and Piperno, 1987; La Rosa et al., 2006; Nicoletti, 1997; Quero, 2008; Tykot, 1995).

Lipari is one of the Aeolian Islands, situated about 30 kilometers north of the island of Sicily. While the earliest permanent occupation of the island is attested at the Stentinello period site of Castellaro Vecchio (Bernabò Brea and Cavalier, 1980), the exploitation of Lipari obsidian has an earlier heritage, being documented at a number of Early Neolithic (early 6th millennium B.C.) Impressed Ware sites throughout Italy (see Bigazzi and Radi, 1998; Vaquer, 2007).

While there are several obsidian subsources on the island, only two are of archaeological importance, Gabellotto Gorge and Canneto Dentro (see Tykot et al., 2013). Previous studies refer to the Lipari source with specific reference to Gabellotto Gorge; however, more recent geochemical analysis has revealed the presence of two elementally distinct outcrops of archaeological importance (see Tykot et al., 2006). Gabellotto Gorge is located on the eastern half of the island in a large gorge that cuts towards the interior of the island. Obsidian from the gorge is found as fist-sized and larger angular nodules, black or gray in color, often containing small spherulitic inclusions of quartz and feldspar (Fig. 2A). The Canneto Dentro subsource is located inland of Canneto Beach approximately 1.5 kilometers southeast of Gabellotto gorge. Obsidian from the subsource is found as spherulitic angular blocks of up to fist sized and smaller.

2.2. Archaeological sites

For this study, a total of 622 obsidian artifacts from eight Neolithic sites on Sicily were analyzed (see Table 1 for numerical breakdown). This includes sites from the southeastern coast of Sicily (Stentinello, Calaforno, Grotta Corruggi, Matrensa, Megara Hyblaea), the Etna province (Poggio Rosso and Fontana di Pepe), and the Aeolian Islands (Rinicedda); all of the analyzed materials came from excavated deposits.

Table 1
List of analyzed sites with breakdown of the sourcing results by site.
Tableau 1
Liste des sites analysés et zones sources par site.

Site	Artifacts Analyzed	Gabellotto Gorge (Lipari)	Canneto Dentro (Lipari)
Calaforno	9	9	0
Fontana di Pepe	4	3	1
Grotta Corruggi	2	2	0
Matrensa	124	124	0
Megara Hyblaea	124	124	0
Poggio Rosso	22	22	0
Rinicedda	204	204	1
Stentinello	133	131	2

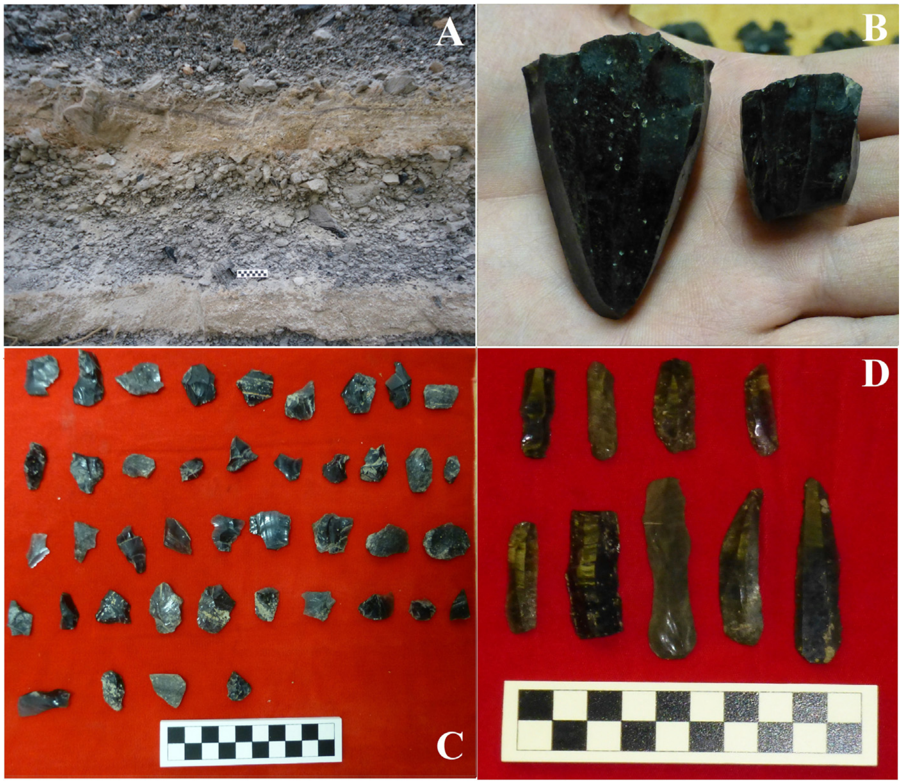

Fig. 2. (Color online.) A. Stratigraphic profile of in situ obsidian from Gabellotto Gorge. B. Pressure-flaked blade cores from Megara Hyblaea. C. Flakes from Matrensa. D. Blades from Stentinello.

Fig. 2. (Couleur en ligne.) A. Profil stratigraphique d'obsidienne in situ de la gorge de Gabelotto. B. Nucléus en lame à éclats obtenus par pression, en provenance de Megara Hyblaea. C. Éclats en provenance de Matrensa. D. Lames en provenance de Stentinello.

Calaforno is an open-air site located near the Comune di Giarratana to the west of the Irminio River (Fugazzola Delpino et al., 2004: 386; Guzzardi, 1980).

Fontana di Pepe is an open air settlement located in the hills of east-central Sicily to the southwest of Mount Etna (Fugazzola Delpino et al., 2004: 373).

Grotta Corruggi is a cave site located in the southeastern Sicily. The site is one of the oldest cave sites in Sicily, along with Uzzo Cave, and was also occupied during the Upper Palaeolithic and Mesolithic (Fugazzola Delpino et al., 2004: 389), although there is no evidence of pre-Neolithic obsidian exploitation.

Matrensa is a settlement located near the coast to the southwest of Grotta Corruggi (Orsi, 1903).

Megara Hyblaea is a settlement situated approximately 22 km north of Siracusa to the northwest of the village of Stentinello (Orsi, 1921, 1924; Villard, 1951).

Poggio Rosso is an open-air site located in the Catania Plain to the southwest of Mount Etna (Fugazzola Delpino et al., 2004: 376). The site is close to the contemporary sites of Tre Fontane and Fontana di Pepe.

Rinicedda is located on the island of Salina and is one of the earliest sites located in the Aeolian islands. A single hut was first excavated by M. Cavalier in 1989 (Bernabò Brea and Cavalier, 1995) and later by M. C. Martinelli.

Stentinello is a Neolithic settlement with a long history of archaeological study (Orsi, 1890, 1911; Tinè, 1961) and gives its name to the period's distinctive pottery (see Scarcella et al., 2011). The site is located north of the modern-day city of Syracuse, in southeastern Sicily.

3. Methods

Since the export of artifacts from Sicily was not permitted, all of our analyses took place on site at the Paolo Orsi Regional Archaeological Museum (Syracuse, Sicily) and the Luigi Bernabò Brea Regional Archaeological Museum on the island of Lipari during the summers of 2012 and 2013. Our study consisted of two parts, techno-typological classification and elemental analysis. Fig. 2 displays some examples of the analyzed artifacts.

A Bruker Tracer III-SD pXRF machine was used to analyze the artifacts. The artifacts were cleaned with water to remove any dirt or other contaminants that could affect the results of our elemental analysis. A filter was placed directly into the machine to enhance results for certain trace elements (Rb, Sr, Y, Zr, Nb) already shown to be successful for West Mediterranean obsidian sourcing (see De Francesco et al., 2012; Freund, 2014; Poupeau et al., 2000; Tykot et al., 2013). The artifacts were placed on the top of the machine and analyzed for a period of two minutes. Source assignations were achieved by calibrating the raw analytical data against standard reference materials to determine the actual concentrations, the results then being compared

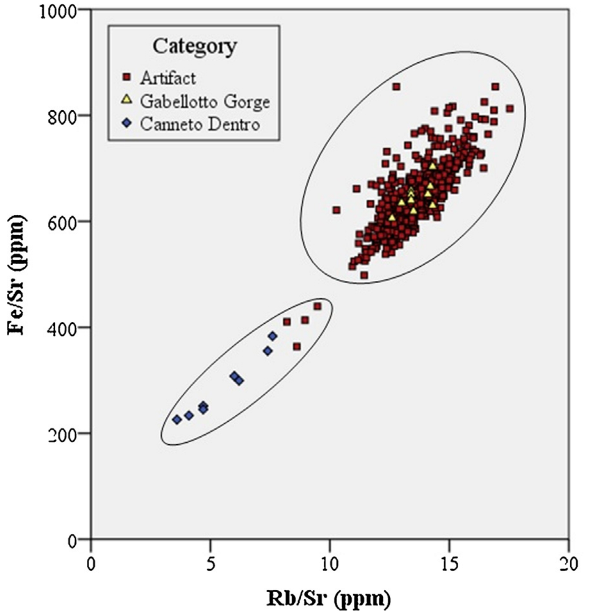

Fig. 3. (Color online.) Bivariate plot of Rb/Sr vs. Fe/Sr for archaeological samples capable of distinguishing between the relevant Lipari subsources. Source reference materials have been plotted with the analyzed artifacts.
Fig. 3. (Couleur en ligne.) Diagramme de Rb/Sr en fonction de Fe/Sr pour les échantillons archéologiques permettant de différencier les sous-zones sources de Lipari. Certains matériaux de référence ont été figurés avec les objets analysés.

with data generated from known geological samples using the same instrumentation. This can most successfully be illustrated through a graph of the element ratios of iron (Fe) and rubidium (Rb) to strontium (Sr; see Fig. 3). For those artifacts whose subsource designations were not immediately apparent, the calibrated concentrations of a range of elements were examined in further detail. Most importantly, we looked for the presence or absence of a high Sr peak that is characteristic of Canneto Dentro material.

In addition to artifact sourcing, each artifact was analyzed techno-typologically. This included recording the maximum length, width, and thickness on all of the artifacts as well as recording attributes pertaining to flaking type (platform, bulb, lip, etc.), to understand how the blanks had been knapped. Artifacts were also categorized as nodules, cores, flakes, blades, or angular waste, data that along with presence of cortex (divided into distinct percentage categories) allowed for the reconstruction of the obsidian reduction sequences. Only the percentage of dorsal cortex was recorded on the flake categories. This in turn allowed for the identification of the various forms in which obsidian entered the site prior to its reduction. Any form of deliberate modification in the form of retouch was also documented as a means of describing Stentinello tool types. Finally, raw material characteristics including color and the presence or absence of spherulites was recorded to see if certain materials were preferred at certain sites.

Because of time constraints and the large number of artifacts recovered from the sites of Rinicedda, Matrensa, Stentinello, and Megara Hyblaea, we decided not to elementally characterize and fully analyze the entire assemblages from these sites, but instead to select statistically representative samples for analysis. Because we conducted our work at two museums over the course of two years, we had to employ several sampling strategies depending on museum protocols and logistical constraints. Despite the varied sampling strategies, we have counts of the total number of artifacts from all sites as well as basic typological information about all of the artifacts, not just the sampled ones, upon which to make interpretations (see Table 2).

For the site of Rinicedda, all of the obsidian artifacts recovered from the excavation were bagged together according to the unit and stratum from which they were recovered; 20% of the obsidian artifacts were randomly selected for analysis. In order to get a representative sample of artifacts recovered from the site, all of the materials were laid out in their provenience-specific bags and 20% of the bags (i.e. every fifth) were randomly selected for analysis. Later, when we counted and categorized the remaining artifacts from the site, we analyzed any remaining cores. We analyzed all of the cores because they represent the first stage of reduction and were more likely to come from diverse subsources. For example, multiple flakes can be removed from the same core all having the same elemental signature; this is less likely to occur among cores.

For Matrensa and Stentinello, we began by analyzing all of the artifacts on display in the museum. Later, when we were allowed access to the rest of the collection from these sites, we divided the artifacts into categories based on their stages of reduction, including nodules, cores, flakes, blades, and angular waste. We then randomly selected a 20% sample of artifacts within each of the remaining categories, including flakes, blades, and angular waste. This was achieved by laying out the divided material on a table and selecting every fifth artifact.

Because we never had complete access to the entire assemblage from Megara Hyblaea at one time and we were told that there were a large number of artifacts, we decided to take a 10% random sample from each box we received. This was achieved by laying out the material from each box and then selecting every tenth artifact for analysis.

4. Results

Table 1 displays the results of the elemental analyses. Of the 622 artifacts analyzed, 618 came from the Gabellotto Gorge subsource on the island of Lipari while four came from Canneto Dentro. The material from Canneto Dentro included an unretouched distal flake and an unretouched medial blade segment from Stentinello, an unretouched whole flake from Fontana di Pepe, and an irregularly shaped multi-platform flake core from Rinicedda.

While the elemental data show that the Gabellotto Gorge subsource was the primary outcrop exploited during this time, there is still a fair amount of variability within the subsource itself in terms of color and knapping quality. Fig. 4 displays the raw material characteristics of artifacts from sites in which 100 or more objects were analyzed. Although an even inter-site distribution exists between artifacts that contain spherulites and those that do not, there is more variation in terms of color. For example, at the

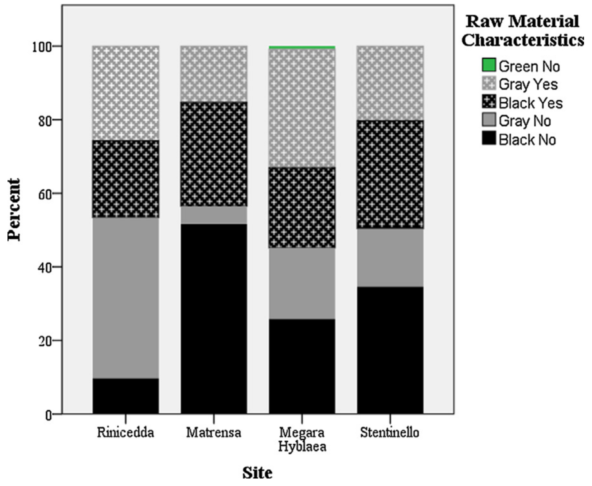

Fig. 4. (Color online.) Raw material characteristics from sites in which 100 or more artifacts were analyzed. 'Black' and 'gray' refer to artifact color while 'yes and no' refer to the presence or absence of spherulitic inclusions.
Fig. 4. (Couleur en ligne.) Caractéristiques des matériaux grossiers en provenance de sites dans lesquels 100 objets ou plus ont été analysés. « Noir » et « gris » se réfèrent à la couleur des objets, tandis que « oui » ou « non » se réfèrent à la présence ou à l'absence d'inclusions sphérulitiques.

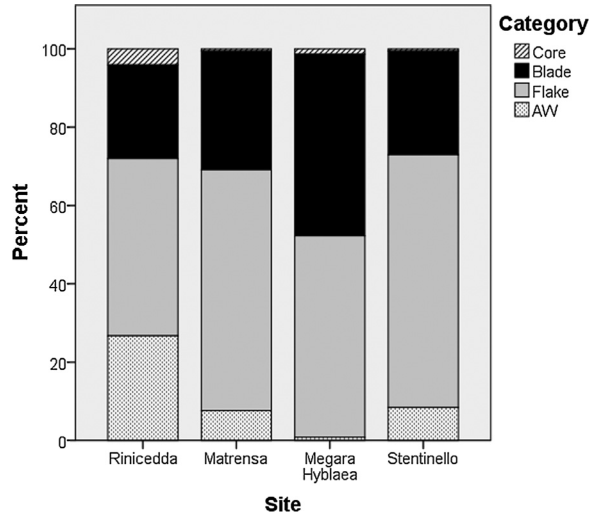

Fig. 5. Typological breakdown from sites in which all artifacts were categorized.
Fig. 5. Débitages typologiques en provenance des sites dans lesquels tous les objets ont été rangés par catégorie.

site of Rinicedda there is a higher percentage of gray obsidian (69%) than black obsidian (31%). In mainland Sicily, it is only at Megara Hyblaea in which gray obsidian outnumbers black obsidian, making up 52% of the assemblage. This could suggest that the residents of Rinicedda were obtaining raw materials in a different manner than contemporary communities on mainland Sicily. This would make sense considering the site's relatively isolated location north of the source itself; however, more information about lithic reduction strategies is needed before more reliable interpretations can be made.

Recording the amount of cortex on an artifact can be informative when discussing the various stages at which raw materials enter a site (Andrefsky, 2009). If raw nodules were reduced on site, then one would expect to find lithic debris that includes both highly cortical primary reduction and later secondary and tertiary flakes with less cortex. Only the percentage of dorsal cortex was recorded on the flake and blade categories. Of the analyzed artifacts, 97% of them had less than 20% cortex. Sixteen artifacts had 20–80% cortex and only two artifacts had more than 80% (see Table 3). Although the only two artifacts that had more than 80% cortex came from the site of Rinicedda, 96% of the site's assemblage had less than 20% cortex. It is therefore clear that the majority of artifacts from all sites were in the secondary and tertiary stages of reduction and primary reduction occurred elsewhere, likely at the source area.

Artifact counts and basic typological data are summarized in Table 2. While artifacts from eight sites were analyzed, it is only at four sites that we see a true representation of Neolithic reduction sequences (see Fig. 5). This is because some of our analyses included artifacts on display at the museum that were biased representations of lithic reduction sequences at the various sites. We therefore focus here on assemblages in which we have robust enough samples to make meaningful interpretations.

Based on the results displayed in Fig. 5, it is immediately evident that blades and flakes are the primary artifact categories represented at the four sites. Of the 55 total analyzed cores, six were prismatic pressure flaked blade cores – found at all four sites (e.g., Fig. 2B), while the other 49 were irregularly shaped flake cores. A further analysis of

Table 2
Basic typological counts of obsidian artifacts at the analyzed sites. Numbers in italics denote the number of artifacts that underwent more extensive analysis (length, width, etc.) as well as elemental characterization.
Tableau 2
Comptages typologiques de base des objets en obsidienne aux sites analysés. Les valeurs en italiques signalent le nombre d'objets qui ont été soumis à de plus nombreuses analyses (longueur, largeur, etc.) et à une caractérisation élémentaire.

Site	Cores	Blades	Flakes	Angular Waste	Total Obsidian
Calaforno	1 *(1)*	3 *(3)*	5 *(5)*	0	9 *(9)*
Fontana di Pepe	0	2 *(2)*	2 *(2)*	0	4 *(4)*
Grotta Corruggi	0	2 *(2)*	0	0	2 *(2)*
Matrensa	2 *(2)*	107 *(71)*	217 *(46)*	27 *(5)*	353 *(124)*
Megara Hyblaea	18 *(10)*	508 *(62)*	563 *(44)*	9 *(8)*	1098 *(124)*
Poggio Rosso	0	22 *(22)*	0	0	22 *(22)*
Rinicedda	39 (39)	233 (69)	441 (53)	260 (44)	974 *(204)*
Stentinello	3 *(3)*	139 *(55)*	339 *(67)*	44 *(8)*	525 *(133)*

Table 3
Breakdown of cortex percentages on all analyzed artifacts by site.
Tableau 3
Pourcentages de débit de cortex sur tous les objets analysés par site.

Site	0–20% Cortex	20–80% Cortex	80–100% Cortex	Total Artifacts
Calaforno	9 (100%)	0	0	9
Fontana di Pepe	4 (100%)	0	0	4
Grotta Corruggi	2 (100%)	0	0	2
Matrensa	123 (99%)	1 (1%)	0	124
Megara Hyblaea	118 (95%)	6 (5%)	0	124
Poggio Rosso	22 (100%)	0	0	22
Rinicedda	195 (96%)	7 (3%)	2 (1%)	204
Stentinello	131 (98%)	2 (2%)	0	133

Fig. 5 reveals that more cores and angular waste were found at the island site of Rinicedda than at contemporary sites on mainland Sicily. The high number of cores at Rinicedda ($n = 39$) is likely a reflection of the site's close proximity to Lipari, where residents had more ready access to raw materials from the nearby island. The high prevalence of angular waste could be a reflection of the modern excavation techniques being employed, which is why one must be careful about making interpretations based on artifacts recovered from early excavations that did not employ modern excavation techniques. Regardless, such limitations likely result in the loss of smaller reduction debris and therefore do not affect our interpretations.

The majority of blades from all sites were highly regular in thickness with parallel edges (Fig. 2D). The blade platforms were generally small and elliptical; lips on the ventral edge of the platform were common. For these reasons, we argue that blades from Stentinello period sites in eastern Sicily were produced using a technique of pressure flaking (see Andrefsky, 2005: 118–119; Pélegrin, 2012: 483). The high degree of regularity in shape and thickness in combination with the small elliptical platforms, the relatively diffuse bulbs of percussion, and the presence of lips on the ventral edge of the platform preclude direct percussion (see Andrefsky, 2005: 118–119; Crabtree, 1972: 44). They also lack the uniform curved profile and large platforms indicative of indirect percussion. This tradition of pressure flaking is mirrored in the reduction of chert from the same sites (e.g., Fig. 6A).

In a previous study of obsidian artifacts from southern Italy, Diamond and Ammerman (1985: 65) argue that the majority of blades from Stentinello period sites in Calabria were created using direct percussion with either a soft or organic hammer, ranging in width from 8–15 mm; these blades were characteristically wide, often reaching more than 20 mm in width. Despite possible differences in how these blades were produced, the artifacts analyzed in Sicily were similar. Based on our analysis of 286 blades from the eight Stentinello period sites, the average width was 14.4 mm with a standard deviation of 5.7 mm; 36 blades from five separate sites were more than 20 mm wide. The average length of whole blades ($n = 128$) was 34.7 mm with a standard deviation of 13.7 mm, indicating a large degree of variability.

Most of the artifacts were unmodified. Of the 286 analyzed blades, 20% were intentionally modified, mainly in the form of marginal retouch. Only 8 blades were invasively retouched, although none in the form of recognizable tool types. Of the 218 analyzed flakes, 17% of them displayed intentional retouch. Twelve of these flakes were heavily retouched and included denticulates, notched pieces, small perforators, abruptly retouched transverse scrapers, and a *pièce esquillée* (see Table 4; Fig. 6). Despite the low prevalence of retouch among flakes, they were still likely used for a variety of everyday tasks, especially considering that 89% of the cores analyzed were flake cores. It is also possible that a large portion of flakes were the result of blade core creation and maintenance. Further studies on obsidian usewear will help clarify how and where flakes were used.

5. Discussion

5.1. Consumption of Lipari obsidian in mainland Italy and southern France

Blades and bladelets are the most common artifact type created with Lipari obsidian, being found throughout Sicily, southern Italy (see Crummett and Warren, 1985; Hodder and Malone, 1984), central Italy (see Tykot et al., 2003), as well as sites in northern Italy such as Gaione (Ammerman et al., 1990; Tykot et al., 2005) and Arene Candide (Ammerman and Polglase, 1993). Lipari material is also found at several Chasséen period (ca. 4400–3300 B.C.) sites in southern France, including Caucade, Giribaldi, and Camplan (see Crisci et al., 1994; Williams Thorpe et al., 1984 for a more complete list).

While it was initially proposed that Lipari obsidian was simply distributed through a model of down-the-line exchange (Hallam et al., 1976), it has become increasingly clear that marked differences exist in how obsidian was obtained, reduced, and integrated into the lives of the

Table 4
Breakdown of flake tool categories by site.
Tableau 4
Catégories d'outils à éclats par site.

Site	Dent.	Notch	Perf.	Trans. Scr.	P.E.	Total
Calaforno	0	0	1	0	0	1
Fontana di Pepe	0	0	0	1	0	1
Grotta Corruggi	0	0	0	0	0	0
Matrensa	0	0	0	1	0	1
Megara Hyblaea	1	0	0	1	1	3
Poggio Rosso	0	0	0	0	0	0
Rinicedda	0	2	2	0	0	4
Stentinello	0	0	0	1	0	1

Dent : Denticulate; Perf: Perforator; Trans. Scr.: Tranverse Scraper: *P.E.*: *Pièce esquillée*.

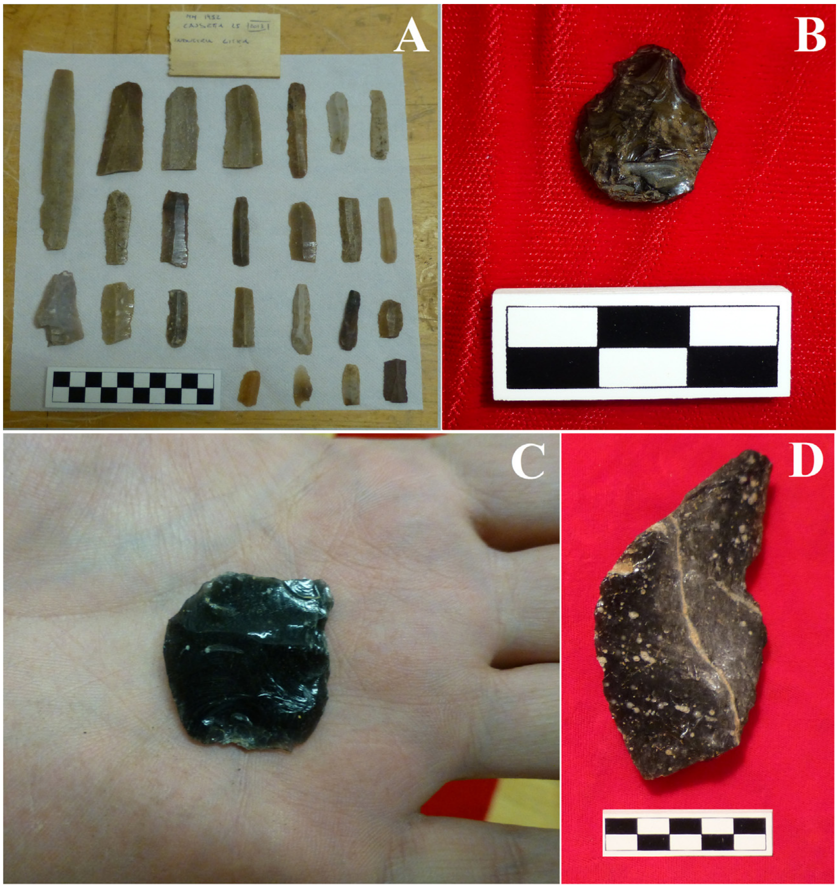

Fig. 6. (Color online.) A. Examples of pressure-flaked flint blades from Megara Hyblaea. B. Retouched perforator from Calaforno. C. *Pièce esquillée* from Megara Hyblaea. D. Notched piece from Rinicedda.

Fig. 6. (Couleur en ligne.) A. Exemples de lames de silex à éclats obtenus par pression, en provenance de Megara Hyblaea. B. Perforateur retouché en provenance de Calaformo. C. Pièce esquillée en provenance de Megara Hyblaea. D. Fragment entaillé en provenance de Rinicedda.

people who used it, both synchronically and diachronically (Pessina and Radi, 2006; Vaquer, 2007). In Calabria for example, Ammerman (1979) argues that certain communities obtained obsidian directly and took a more active role in its subsequent distribution. It is suggested that the secondary reduction of obsidian (i.e. creation of blades) occurred at settlements in southern Italy with the finished products then being distributed northward (Ammerman and Andrefsky, 1982; Bernabò Brea et al., 1990). This model of redistribution has also been proposed in northern Italy and southern France where certain Middle Neolithic sites such as Gaione (Tykot et al., 2005), Terres Longues (Léa, 2012), La Cabre (Binder and Courtin, 1994), and Giribaldi (Crisci et al., 1994) contain more Lipari obsidian and a broader diversity of reduction debris when compared with contemporary communities nearby.

5.2. *Consumption of Lipari obsidian in eastern Sicily*

Lipari was the main obsidian source exploited in eastern Sicily during the Stentinello period, with Gabellotto Gorge being the predominant subsource utilized. Our results suggest that Stentinello period communities in eastern Sicily obtained Lipari obsidian in a similar manner to that of their contemporaries in Calabria. Because of the low prevalence of primary knapping debris at the analyzed sites, we argue that the first stages of reduction occurred at the source area by local populations, with obsidian being transported from Lipari to eastern Sicily and Calabria in the form of preformed cores, likely by sea through the tumultuous Strait of Messina and then further east along the southern coast of Italy where obsidian is present at coastal sites such as Capo Alfiere (Robb and Farr, 2005; Vaquer, 2007) and the Stilo region (see Hodder and Malone, 1984). Once acquired, communities in eastern Sicily used these raw materials to create distinctively wide pressure flaked blades.

Although the vast majority of obsidian found in eastern Sicily comes from a single Lipari subsource, differences still exist in both the appearance and knapping quality of artifacts in archaeological assemblages. The island site of Rinicedda is particularly noteworthy in terms of the high proportion of gray to black obsidian recovered. This could suggest that the residents of Rinicedda were obtaining raw materials in a different manner than contemporary communities on mainland Sicily, which would make sense considering the high number of cores found at the site in combination with the site's relatively isolated location north of the source itself. Nevertheless, the residents of Rinicedda were still plugged into the larger Stentinello world as attested by the presence of distinctive Stentinello pottery and pressure flaked blades.

Despite similarities in the initial procurement of Lipari obsidian, we see no evidence to suggest that sites in eastern Sicily acted as nodes for the subsequent redistribution of obsidian as appears to be the case in many regions of mainland Italy, especially when considering that cores were recovered from five of the eight Stentinello period sites. Regardless, it is unlikely that each Stentinello settlement in Sicily had a person with the expertise and esoteric knowledge required to create such wide pressure flaked blades (see Pélegrin, 2012), a situation mirroring other Neolithic contexts in Corsica and the Aegean, where scholars have argued for the presence of skilled itinerant knappers who moved from village to village offering their services (Costa, 2006; Perlès, 1990). While the presence of itinerant knappers in Sicily is possible, more data from a wider cross section of well-excavated sites are needed to properly test this hypothesis.

6. Conclusions

Through a study of 622 obsidian artifacts from eight sites in eastern Sicily, it is shown that Lipari, specifically Gabellotto Gorge, was the predominant obsidian source exploited by prehistoric populations of the Early/Middle Neolithic Stentinello period (ca. 5600–4000 cal B.C.). Our results suggest that the primary reduction of Lipari obsidian occurred at the source area by local populations, where these raw materials were consequently brought from the island to eastern Sicily and Calabria in the form of preformed cores. In contrast to sites in southern Italy, communities in eastern Sicily maintained a widespread tradition of pressure flaked blade production. Despite similarities between Sicily and Calabria in the initial procurement of Lipari obsidian, we see no evidence to suggest that sites in eastern Sicily acted as such nodes of redistribution as appears to be the case in many regions of mainland Italy.

Although incomplete, the perspective that is emerging from the study of obsidian in southern Italy is particularly interesting and has great potential for exploring the formation of long distance exchange networks at the onset of the Neolithic. This study is therefore an initial step towards a more comprehensive interpretation of the nature of obsidian exploitation in Sicily and a more thorough understanding of how obsidian was distributed from the island sources of Lipari and Pantelleria. In the future, it will be necessary to acquire more data from well-dated contexts where modern excavation techniques have been employed in order to make more concrete interpretations about the differential roles various sites played in the exchange of raw materials across the island. Furthermore, we have demonstrated that the integration of data from all stages of an artifact's life history, including procurement, reduction, use, and discard, makes it possible to more fully appreciate the cultural and socio-economic conditions that mediated its use.

Acknowledgments

We would like to thank the Director of the Paolo Orsi Regional Archaeological Museum, Dr. Beatrice Basile, for allowing us access to the analyzed material. We would also like to acknowledge Dr. Anita Crispino for her precious assistance and Dr. Giuseppina Monterosso for her support. In Lipari, the warm welcome provided by Dr. Maria Clara Martinelli was much appreciated. Comments on an early draft of this paper were provided by Tristan Carter and Albert Ammerman.

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