LITHIC TECHNOLOGY, 2017
VOL. 42, NO. 1, 35–48
http://dx.doi.org/10.1080/01977261.2017.1290335

Routledge
Taylor & Francis Group

Contextualizing the Role of Obsidian in Chalcolithic Sicily (*c.* 3500 – 2500 BC)

Kyle P. Freund[a], Robert H. Tykot[b] and Andrea Vianello[c]

[a]Department of Anthropology, Indian River State College, Fort Pierce, USA; [b]Department of Anthropology, University of South Florida, Tampa, USA; [c]Independent Scholar, Sheffield, UK

ABSTRACT

Through the analysis of 106 obsidian artifacts from eight Chalcolithic sites throughout the island of Sicily (*c.* 3500–2500 BC) this paper discusses the interplay between the procurement of obsidian raw materials and their consequent reduction, in turn highlighting long-term trends in lithic exploitation from the Neolithic through Chalcolithic eras. By combining obsidian sourcing with techno-typological analysis, this paper takes an initial step toward a more comprehensive understanding of the nature of obsidian exploitation in Chalcolithic Sicily and a more thorough comprehension of how obsidian was distributed from the islands of Lipari and Pantelleria. We in turn argue that when lithic data are analyzed within a *chaîne opératoire* approach combining analyses from multiple stages of artifact life histories, this information represents a powerful means of engaging with major social science questions, where a particular regional data set can be used to contribute to debates of broader archaeological significance.

KEYWORDS

Central Mediterranean; Chalcolithic Sicily; obsidian; blade production; provenance; social change

Introduction

Through the analysis of 106 obsidian artifacts from eight Chalcolithic sites throughout the island of Sicily (*c.* 3500–2500 BC; Figure 1), this paper discusses the procurement and exploitation of obsidian raw materials from the island sources of Lipari and Pantelleria. By combining obsidian sourcing by means of portable X-ray fluorescence (pXRF) spectrometry with techno-typological analysis, this paper highlights the dynamic interplay between the procurement of obsidian raw materials and their consequent reduction. Central to this work is the idea that integrated "characterization" programs that meld raw material sourcing with techno-typological considerations and an object biography approach combining data from multiple stages of artifact life histories represent a powerful means of engaging with major social science questions, where a particular regional data set can be used to contribute to debates of broader archaeological significance.

The results of this study highlight how long-standing obsidian exchange spheres remained intact in Sicily from the Neolithic to the Chalcolithic in the face of wider technological and social changes taking place throughout the rest of the Central Mediterranean. It is further shown that the production of Chalcolithic blades differs from that of earlier time periods, likely related to a broader shift in the social and symbolic role of these raw materials in that society. These conclusions derive from experimental work conducted by Pélegrin (2012) that demonstrates how the widths of obsidian pressure-flaked blades correspond to various "modes" of production. When comparing the widths of Chalcolithic blades to those of previous time periods (i.e., the Neolithic), this paper argues that the actions surrounding the production of Chalcolithic blades were far less performative and involved a range of motions likely enacted in less conspicuousness social contexts. The implications of such conclusions are discussed.

Background information

While the circulation of obsidian in Sicily during the Neolithic is well documented, the use of these raw materials in the Chalcolithic has received far less attention in what appears to be an important transitional period characterized by the decline of long-distance Neolithic exchange networks (see Table 1 for a list of relevant periods and associated dates). As it relates to obsidian procurement, previous studies have led to the general impression that Lipari was the primary obsidian source exploited by prehistoric communities 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; Hallam, Warren, and Renfrew,

CONTACT Kyle P. Freund kfreund@irsc.edu Department of Anthropology, Indian River State College, 3209 Virginia Avenue, Fort Pierce, Florida 34981, USA

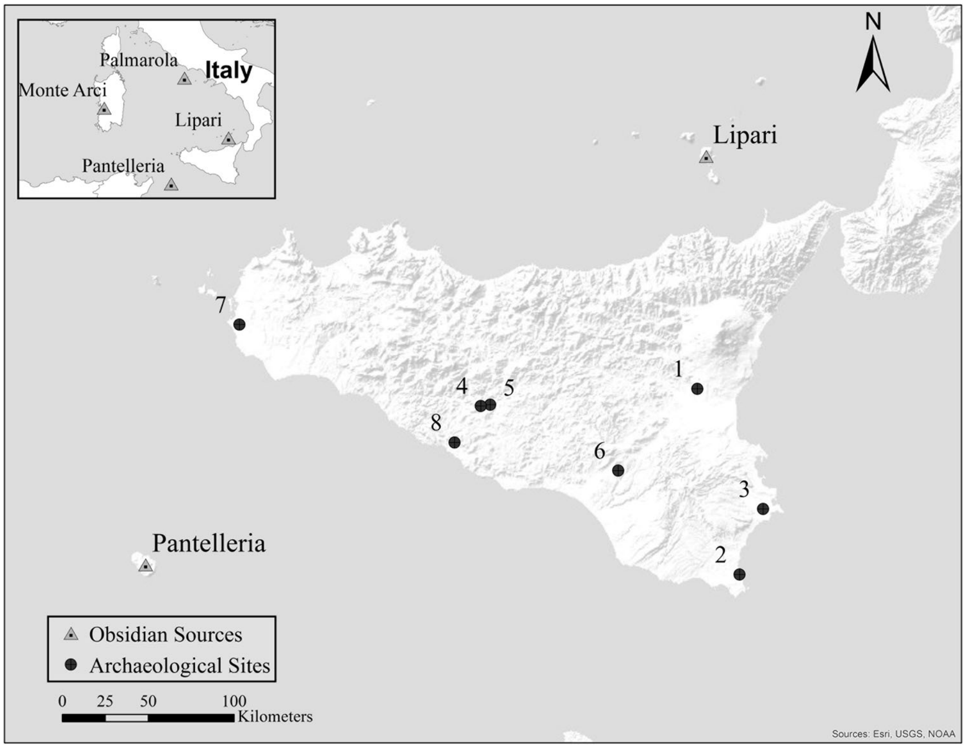

Figure 1. Map of analyzed Chalcolithic sites: 1. Contrada Orto del Conte; 2. Grotta Calafarina; 3. Grotta del Conzo; 4. Malpasso; 5. Menta; 6. Sant'Ippolito; 7. Sant'Onofrio; 8. Serraferlicchio.

1976; Iovino, Maniscalco, et al. 20008a; La Rosa, Palio, Pappalardo, Pappalardo, and Romano, 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 exist regarding how obsidian from the various sources and subsources was procured, reduced, and consequently used. Moreover, obsidian from Palmarola has recently been reported on the island of Ustica north of Sicily (Foresta Martin et al., in press), and such evidence highlights the need for geochemical analyses of larger numbers of obsidian artifacts in southern Italy so that it becomes possible to move beyond long-held *a priori* assumptions that black or gray raw materials found in the region come from Lipari.

Table 1. The periods, cultural phases, and absolute dates (calibrated) of Sicilian prehistory (after Leighton 1996:9).

Period		Cultural Phase	Absolute Dates
Mesolithic		Uzzo/Perriere Sottano	10000–6000 BC
Neolithic	Early	Impressed/Stentinello	6000–5000 BC
	Middle	Stentinello/Trichrome/Serra d'Alto	5000–4000 BC
	Late	Diana	4000–3500 BC
Chalcolithic	Early	Conzo/P. Notaro/S. Cono	3500–2500 BC
	Late	Serraferlicchio/Malpasso/Beaker	3000–2500 BC
Bronze Age	Early	Castelluccio	2500–1430 BC
		Rodi-Tindari/Vallelunga	2000–1430 BC
	Middle	Thapsos/Milazzese	1430–1250 BC
	Late	Pantalica I/Ausonian I	1250–1050 BC
		Pantalica II/Ausonian II	1050–900 BC

Geological sources

Lipari is one of the Aeolian Islands, situated about 30 km north of the island of Sicily. The earliest exploitation of Lipari obsidian is during the sixth millennium BC as represented at Impressed Ware sites in Apulia such as Favella della Corte and Torre Sabea (Bigazzi and Radi 1998; Gratuze and Boucetta 2009). The use of Lipari obsidian continues through the mid-second millennium BC on the island of Sicily. While there are several obsidian subsources on the island, only two are of archaeological importance, Gabellotto Gorge and Canneto Dentro (Tykot, Iovino, Martinelli, and Beyer, 2006). 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 Freund, Tykot, and Vianello 2015; Tykot, Freund, and Vianello, 2013). Gabellotto Gorge is located on the eastern half of the island in a large gorge that cuts toward the interior of the island. Obsidian from the gorge is found as angular nodules roughly 10 cm in size or smaller, black or gray in color, often containing small spherulitic inclusions of quartz and feldspar. Due to modern development, the current source includes interspersed primary and secondary deposits running from the coast to the interior of the gorge. The Canneto Dentro subsource is located inland of Canneto approximately 1.5 km southeast of Gabellotto Gorge. Obsidian from the subsource is found as fist-sized and smaller spherulitic angular blocks embedded within a 3–4-m-high tephra matrix.

The island of Pantelleria is located in the Strait of Sicily approximately 100 km to the southwest of modern-day Sicily (see Figure 1). Five obsidian outcrops have been located on the island (Francaviglia 1988), but not all of them are of archaeological importance. All of the island's obsidians are peralkaline and can be distinguished from other Central Mediterranean sources by their distinctive greenish hue as well as much higher concentrations of iron. The exact nature of the archaeological distribution and use of the various Pantelleria subsources is poorly understood, but its use likely began in the sixth millennium BC, continuing locally and on the island of Sicily through the mid-second millennium BC There have been, however, claims of pre-Neolithic exploitation of Pantelleria obsidian in northern Africa, although there is still much work to be done in the region in terms of establishing reliable chronologies and in recovering obsidian from well-excavated contexts (see Mulazzani et al. 2010). One of the few radiocarbon dates associated with obsidian comes from Kef Hamda in Tunisia, where associated materials indicate an early sixth millennium BC date (7610 ± 125 BP, 5660 BC; Camps 1986).

Archaeological sites

For this study, a total of 106 obsidian artifacts from eight Chalcolithic sites on Sicily were analyzed. Because of the low number of analyzed sites specifically dating to the Early and Late phases of the Chalcolithic, in combination with the extremely localized nature of such divisions (see Leighton 1999:91; Tusa 1997:326), all analyses were combined into a single discussion of Chalcolithic (*c.* 3500–2500 BC) obsidian consumption. This includes two sites from the southeastern coast of Sicily (Grotta Calafarina and Grotta del Conzo), two from the province of Catania (Contrada Orto del Conte and Sant'Ippolito), three in south-central Sicily (Malpasso, Menta, and Serraferlicchio), and one on the far west coast in the province of Trapani (Sant'Onofrio). Except for materials from Sant'Onofrio, all artifacts come from excavated deposits from residential sites. The site of Menta is unique in that it is a burial context.

All known obsidian artifacts from each site were analyzed. While the total counts from each site vary, it is nonetheless difficult to assess whether or not these counts are truly representative of the distribution of obsidian across space. This is because many sites were excavated during the early to mid-twentieth century, and in many cases detailed records of the total counts of obsidian artifacts and their curation histories do not exist. Further contextual details are provided below:

- Contrada Orto del Conte is an unpublished Early Chalcolithic site located south of Mount Etna in east-central Sicily.
- Grotta Calafarina is a prehistoric cave site in the southeast corner of Sicily with a long history of occupation, from the Neolithic through Bronze ages (Fugazzola Delpino, Pessina, and Tiné 2004:389). The site was originally excavated by P. Orsi from 1897 to 1898 (see Orsi 1907), and later by L. Bernabò Brea from 1944 to 1945. The analyzed artifacts were from the Early Chalcolithic.
- Grotta del Conzo is a prehistoric cave site excavated by S. Tinè in the 1950s. The site was occupied from the Late Neolithic through Chalcolithic (Fugazzola Delpino et al. 2004:388), although the analyzed artifact dates to the Early Chalcolithic.
- Malpasso is a Late Chalcolithic settlement located in central Sicily. Pottery from the site has become a diagnostic marker of the Late Chalcolithic (Leighton 1999:91).
- Menta is a Late Chalcolithic Malpasso facies circular tomb located near Milena in central Sicily (La Rosa 1994, 1997:153).
- Sant'Ippolito is a Chalcolithic site located on a hill near the modern city of Caltagirone. The site was originally excavated by P. Orsi in the early 1900s (see Orsi 1928).
- Sant'Onofrio is an unpublished Chalcolithic site located along the coast of western Sicily, near the modern city of Marsala. The analyzed artifacts were found on the surface.
- Serraferlicchio is a Chalcolithic site in south-central Sicily excavated by P. Orsi and P. E. Arias in 1928 and 1937 (see Arias 1937). The *black on red* painted pottery typical of this settlement has become a diagnostic marker of the Chalcolithic.

Methods

All of the analyses took place on-site during the summers of 2012 and 2013 at the Paolo Orsi Regional Archaeological Museum (Syracuse), the Regional Archaeological Museum of Gela (Gela), the Regional Archaeological Museum of Agrigento (Agrigento), the Antiquarium of Milena (Milena), the Regional Archaeological Museum of Taormina (Taormina), the Baglio Anselmi Archaeology

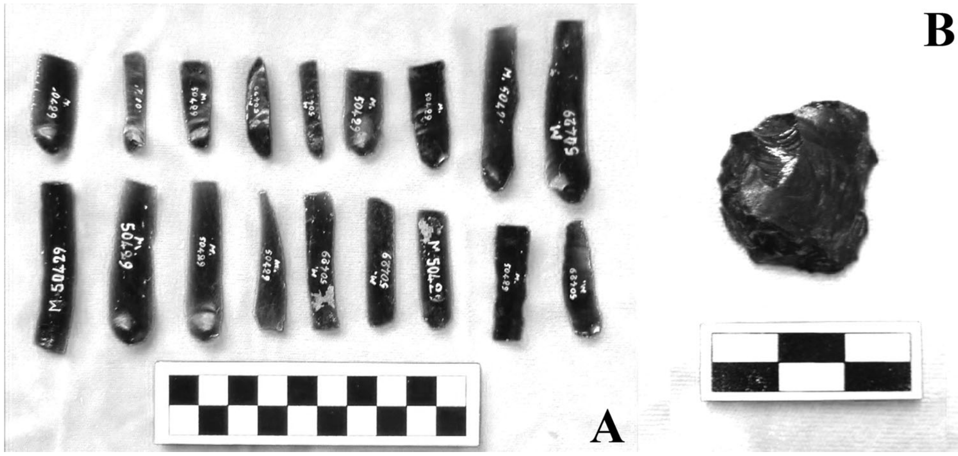

Figure 2. (a) Ventral surfaces of pressure blades from Contrada Orto del Conte; (b) transverse scraper from Sant'Onofrio.

Museum (Marsala), and the Basso Belice Prehistoric Archaeology Museum (Partanna).

A Bruker Tracer III-SD pXRF instrument 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 Central Mediterranean obsidian sourcing (see De Francesco, Bocci, Crisci, and Francaviglia, 2012; Freund 2014a, 2014b; Tykot et al. 2013). The artifacts were 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 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) for the Lipari subsources, with the presence of a higher Sr concentration characteristic of Canneto Dentro material (Figure 3). For Pantelleria obsidian, trace elements Rb, Y, Zr, and Nb easily distinguish the Balata dei Turchi and Lago di Venere subsources (Figure 4).

In addition to artifact sourcing, each artifact was analyzed techno-typologically. This included recording the maximum length, width, and thickness of 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 the 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 tool types. As will be shown, retouch is largely absent. When retouch

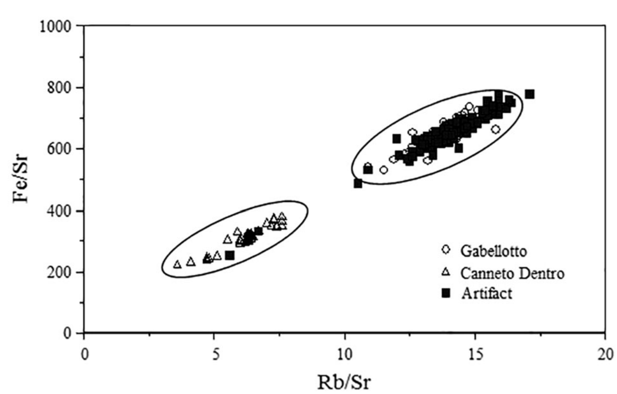

Figure 3. Assigning archaeological artifacts to specific Lipari subsources using elemental data (in ppm) from portable X-ray fluorescence (pXRF) spectrometry analyses.

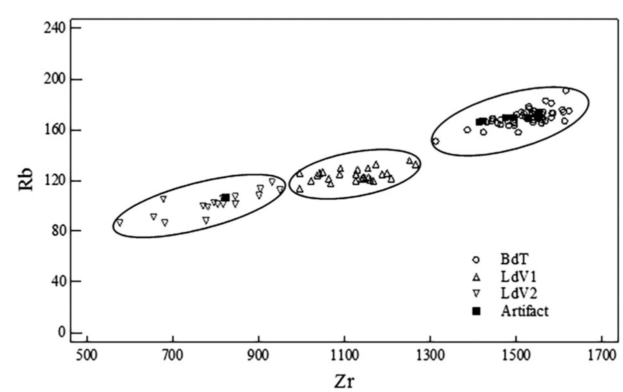

Figure 4. Assigning archaeological artifacts to specific Pantelleria subsources using elemental data (in ppm) from portable X-ray fluorescence (pXRF) spectrometry analyses.

is present, it is marginal and does not affect the associated measurements of width that are so critical to this study. Finally, raw material characteristics including color and the presence or absence of spherulites were recorded to see whether certain materials were preferred at certain sites.

Results

The breakdown of the sourcing results and basic typological counts are provided in Tables 2 and 3. Of the 106 analyzed artifacts, 98 came from Gabellotto Gorge and two came from Canneto Dentro. The material from Canneto Dentro consists of two blade fragments, one proximal and one distal. Six artifacts from two sites were sourced to Pantelleria, including five artifacts from Balata dei Turchi and one from Lago di Venere. Artifacts from Balata dei Turchi included a proximal blade, two whole flakes, and two pieces of angular waste. A whole Lago di Venere flake was also recovered from Sant'Onofrio. While Pantelleria obsidian is common at sites in central and western Sicily, it is rarely dominant, nor is it universally found. For example, no Pantelleria obsidian is found at Serraferlicchio in central Sicily.

An analysis of the raw material characteristics of the analyzed artifacts reveals a broad range of diversity (Figure 5). Unfortunately, the low number of total artifacts from most sites prevents making statistically valid comparisons. What is striking, however, is the low number of spherulitic artifacts from Contrada Orto del Conte, a site from which 70 artifacts were analyzed. A further analysis of raw material characteristics divided according to their typological category

Table 2. Typological data and sourcing results of the analyzed obsidians from Sicily.

Site	Source	Category	State	Cortex	L	W	T
Contrada Orto del Conte	GG	Blade	w	0 to 20	34	14	4
Contrada Orto del Conte	GG	Blade	w	0 to 20	34	7	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	30	10	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	34	10	5
Contrada Orto del Conte	GG	Blade	p	0 to 20	32	6	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	29	12	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	31	12	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	51	11	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	62	15	2
Contrada Orto del Conte	GG	Blade	m	0 to 20	52	12	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	55	15	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	53	12	2
Contrada Orto del Conte	GG	Blade	d	0 to 20	46	11	2
Contrada Orto del Conte	GG	Blade	m	0 to 20	45	9	4
Contrada Orto del Conte	GG	Blade	w	0 to 20	43	9	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	40	10	2
Contrada Orto del Conte	GG	Blade	d	0 to 20	39	11	5
Contrada Orto del Conte	GG	Blade	w	0 to 20	39	11	3
Contrada Orto del Conte	GG	Blade	p	0 to 20	17	12	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	24	7	1
Contrada Orto del Conte	GG	Blade	p	0 to 20	22	12	2
Contrada Orto del Conte	GG	Blade	p	0 to 20	21	9	2
Contrada Orto del Conte	GG	Blade	m	0 to 20	20	9	3
Contrada Orto del Conte	GG	Blade	p	0 to 20	29	10	6
Contrada Orto del Conte	GG	Blade	w	0 to 20	26	10	3
Contrada Orto del Conte	GG	Blade	m	0 to 20	29	8	3
Contrada Orto del Conte	GG	Blade	p	0 to 20	34	17	5
Contrada Orto del Conte	GG	Blade	w	0 to 20	39	11	2
Contrada Orto del Conte	GG	Blade	p	0 to 20	25	12	3
Contrada Orto del Conte	GG	Blade	m	0 to 20	24	11	4
Contrada Orto del Conte	GG	Blade	m	0 to 20	34	11	3
Contrada Orto del Conte	GG	Blade	d	0 to 20	18	10	3
Contrada Orto del Conte	GG	Blade	d	0 to 20	26	11	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	23	10	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	25	10	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	25	9	2
Contrada Orto del Conte	GG	Blade	p	0 to 20	24	12	3
Contrada Orto del Conte	GG	Blade	d	0 to 20	25	10	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	27	12	2
Contrada Orto del Conte	GG	Blade	m	0 to 20	20	13	4
Contrada Orto del Conte	GG	Blade	m	0 to 20	20	12	5
Contrada Orto del Conte	GG	Blade	d	0 to 20	17	8	1
Contrada Orto del Conte	GG	Blade	d	0 to 20	28	13	3

(*Continued*)

Table 2. Continued.

Site	Source	Category	State	Cortex	L	W	T
Contrada Orto del Conte	GG	Blade	p	0 to 20	23	11	3
Contrada Orto del Conte	GG	Blade	m	0 to 20	17	10	1
Contrada Orto del Conte	GG	Blade	m	0 to 20	25	13	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	30	15	6
Contrada Orto del Conte	GG	Blade	w	0 to 20	35	10	1
Contrada Orto del Conte	GG	Blade	p	0 to 20	24	7	4
Contrada Orto del Conte	GG	Blade	w	0 to 20	23	10	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	28	8	4
Contrada Orto del Conte	GG	Blade	w	0 to 20	28	17	4
Contrada Orto del Conte	GG	Blade	m	0 to 20	20	10	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	27	9	2
Contrada Orto del Conte	GG	Blade	w	0 to 20	36	13	2
Contrada Orto del Conte	GG	Blade	d	0 to 20	27	12	4
Contrada Orto del Conte	GG	Blade	w	0 to 20	28	10	3
Contrada Orto del Conte	GG	Blade	w	0 to 20	33	16	5
Contrada Orto del Conte	GG	Blade	w	0 to 20	23	9	2
Contrada Orto del Conte	GG	Blade	p	0 to 20	26	13	3
Contrada Orto del Conte	GG	Blade	d	0 to 20	27	9	2
Contrada Orto del Conte	GG	Blade	m	0 to 20	18	12	1
Contrada Orto del Conte	GG	Blade	w	0 to 20	29	11	2
Contrada Orto del Conte	GG	Blade	p	0 to 20	25	10	1
Contrada Orto del Conte	GG	Blade	d	0 to 20	21	12	2
Contrada Orto del Conte	GG	Blade	p	0 to 20	16	12	3
Contrada Orto del Conte	GG	Blade	d	0 to 20	16	10	2
Contrada Orto del Conte	GG	Flake	w	0 to 20	11	11	2
Contrada Orto del Conte	GG	Flake	w	0 to 20	13	28	2
Contrada Orto del Conte	GG	Flake	d	0 to 20	18	22	2
Grotta Calafarina	GG	Blade	d	0 to 20	31	12	2
Grotta Calafarina	GG	Blade	w	0 to 20	31	10	2
Grotta Calafarina	GG	Blade	w	0 to 20	37	12	8
Grotta Calafarina	GG	Blade	w	0 to 20	36	11	3
Grotta Calafarina	GG	Blade	p	0 to 20	23	10	2
Grotta Calafarina	GG	Blade	w	0 to 20	27	9	2
Grotta Calafarina	GG	Blade	w	0 to 20	22	12	3
Grotta Calafarina	GG	Blade	p	0 to 20	22	8	2
Grotta Calafarina	GG	Blade	m	0 to 20	25	9	2
Grotta del Conzo	GG	Blade	p	0 to 20	45	20	5
Malpasso	GG	Blade	w	0 to 20	81	21	8
Malpasso	GG	Blade	p	0 to 20	48	15	3
Malpasso	GG	Blade	w	0 to 20	35	12	2
Malpasso	GG	Blade	d	0 to 20	31	10	2
Menta	BdT	Blade	p	0 to 20	13	6	2
Menta	GG	Flake	p	0 to 20	14	14	6
Menta	BdT	Flake	w	0 to 20	20	19	3
Sant'Ippolito	GG	Blade Core	p	0 to 20	30	52	54
Sant'Ippolito	GG	Blade Core	w	0 to 20	44	30	20
Sant'Ippolito	GG	Blade	w	0 to 20	55	18	5
Sant'Ippolito	GG	Blade	w	0 to 20	42	14	2
Sant'Ippolito	GG	Blade	w	0 to 20	33	7	3
Sant'Ippolito	GG	Blade	p	0 to 20	40	12	3
Sant'Ippolito	GG	Blade	p	0 to 20	42	9	3
Sant'Onofrio	BdT	Flake	w	0 to 20	29	23	8
Sant'Onofrio	LdV	Flake	w	0 to 20	12	14	3
Sant'Onofrio	BdT	Ang. Waste	w	0 to 20	–	–	–
Sant'Onofrio	BdT	Ang. Waste	w	0 to 20	–	–	–
Sant'Onofrio	GG	Ang. Waste	w	0 to 20	–	–	–
Sant'Onofrio	GG	Ang. Waste	w	0 to 20	–	–	–
Serraferlicchio	GG	Blade	p	0 to 20	26	10	3
Serraferlicchio	CD	Blade	p	0 to 20	30	17	4
Serraferlicchio	CD	Blade	d	0 to 20	38	12	3
Serraferlicchio	GG	Blade	w	0 to 20	53	18	4
Serraferlicchio	GG	Blade	w	0 to 20	60	17	6
Serraferlicchio	GG	Flake	w	20 to 80	42	19	5

L=maximum length; W=maximum width; T=maximum thickness; Ret=retouched; Neo=Neolithic; Stent=Stentinello; MN=Middle Neolithic; LN=Late Neoltihic; EChal=Early Chalcolithic; EBA=Early Bronze Age; GG=Gabellotto Gorge; CD=Canneto Dentro; LdV=Lago di Venere; BdT=Balata dei Turchi; w=whole; p=proximal; d=distal.

highlights this diversity (Figure 6). While there are no clear patterns among other artifact categories, it is evident that Chalcolithic blades ($n = 76$) were mainly produced from black, non-spherulitic obsidian (Figure 2a). While about 60% of Neolithic Stentinello blades from Sicily were produced from non-spherulitic obsidian

Table 3. List of analyzed sites, with counts of artifacts from each subsource along with basic typological counts.

Site	Dating	Total	GG (Li)	CD (Li)	BdeiT (Pa)	LdV (Pa)	Nodules	Cores	Blades	Flakes	Angular Waste
Contrada Orto del Conte	Early Chalcolithic	70	70	0	0	0	0	0	67	3	0
Grotta Calafarina	Early Chalcolithic	9	9	0	0	0	0	0	9	0	0
Grotta del Conzo	Early Chalcolithic	1	1	0	0	0	0	0	1	0	0
Malpasso	Late Chalcolithic	4	4	0	0	0	0	0	4	0	0
Menta (Burial)	Late Chalcolithic	3	1	0	2	0	0	0	1	2	0
Sant'Ippolito	Chalcolithic	7	7	0	0	0	0	2	5	0	0
Sant'Onofrio	Chalcolithic	6	2	0	3	1	0	0	0	2	4
Serraferlicchio	Chalcolithic	6	4	2	0	0	0	0	5	1	0

Li=Lipari; Pa=Pantelleria; GG=Gabellotto Gorge; CD=Canneto Dentro; BdT=Balata dei Turchi; LdV=Lago di Venere.

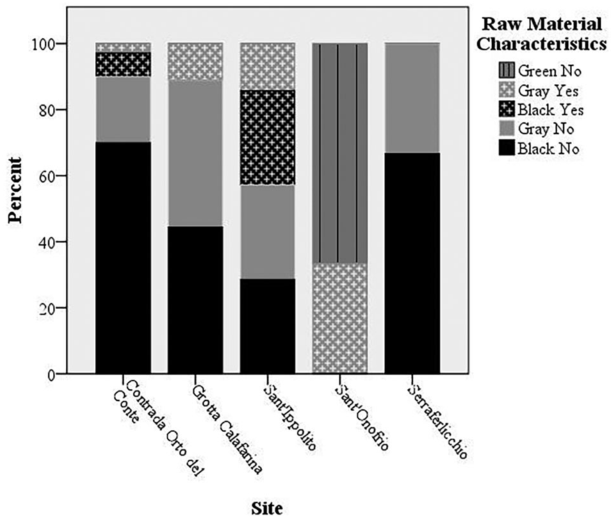

Figure 5. Raw material characteristics from sites in which five or more artifacts were analyzed. "Black" and "gray" refer to artifact color, while "yes" and "no" refer to the presence or absence of spherulites.

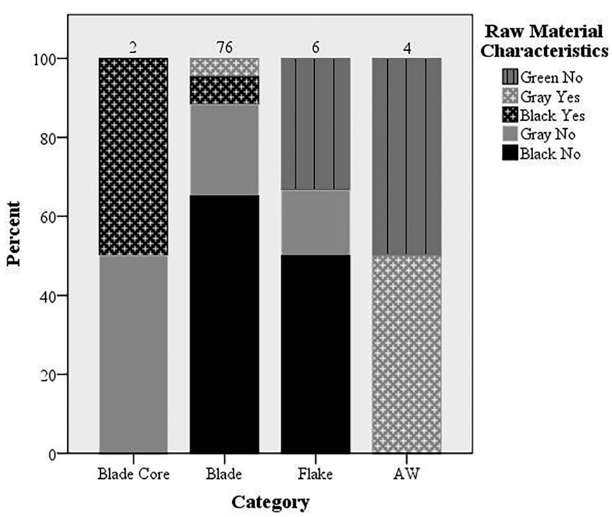

Figure 6. Raw material characteristics from sites in which five or more artifacts were analyzed. "Black" and "gray" refer to artifact color, while "yes" and "no" refer to the presence or absence of spherulites. Total counts within each category are listed above the bars.

(Freund 2014b:146; Freund et al. 2015), almost 90% were produced from non-spherulitic obsidian during the Chalcolithic. This suggests that a clear selection of better quality raw materials for blade production took place.

An analysis of cortex demonstrates that most of the artifacts were in the tertiary stages of reduction (Table 4). Only a single whole flake from Serraferlicchio displayed more than 20% cortex. This is further emphasized by the low number of cores ($n = 2$) and other primary knapping debris found at the sites. Both cores came from Sant'Ippolito and were categorized as unipolar pressure-flaked blade cores. In contrast to earlier time periods, there is little evidence of the working of raw materials on-site.

Twenty per cent of the 92 analyzed Chalcolithic blades were intentionally modified, mainly in the form of marginal retouch. Only two blades were invasively retouched, although neither in the form of recognizable tool types. Of the eight analyzed flakes, two displayed intentional retouch. They included a transverse scraper and a *pièce esquillée* from Sant'Onofrio, made of Balata dei Turchi and Lago di Venere obsidian, respectively (Figure 2b).

Despite the lack of evidence for local production, the finished products are similar to those of earlier time

Table 4. Breakdown of cortex percentages on all analyzed Chalcolithic artifacts by site.

Site	0–20% Cortex	20–80% Cortex	80–100% Cortex	Total Artifacts
Contrada Orto del Conte	70 (100%)	0	0	70
Grotta Calafarina	9 (100%)	0	0	9
Grotta del Conzo	1 (100%)	0	0	1
Malpasso	4 (100%)	0	0	4
Menta (Burial)	3 (100%)	0	0	3
Sant'Ippolito	7 (100%)	0	0	7
Sant'Onofrio	6 (100%)	0	0	6
Serraferlicchio	5 (83%)	1 (17%)	0	6

periods in that blades appear to be produced through pressure-flaking. The blades were highly regular in width and thickness and possessed small elliptical platforms with relatively diffuse bulbs of percussion. Nevertheless, Chalcolithic blades differ from those of the Neolithic in that they appear to be narrower. This is important because experimental work undertaken by Pélegrin (2012) has demonstrated that the widths of pressure-flaked blades correspond to their technique of manufacture. More specifically, Pélegrin (2012:479) outlines five "modes" of obsidian and flint blade production that range from using a hand-held pressure tool to force blades off of a core to using a large lever to apply extreme force in the removal of blades. It is shown that the width of a blade corresponds to its mode of production, and while these categories are not mutually exclusive—i.e., the width of a blade can correspond to one or more modes of production – this classification scheme is extremely useful in understanding the circumstances that surround ancient blade production and the actions that underpin their manufacture.

Chalcolithic blades considered in this study ($n = 92$) averaged 11.4 mm in width with a standard deviation of 2.9 mm; only a single blade from Malpasso was over 20 mm wide. The median length of whole blades ($n = 43$) was 33 mm with a standard deviation of 12.7 mm. When considered within the framework of Pélegrin's (2012) classification scheme, Sicilian Chalcolithic blade production corresponds most directly with the "short crutch sitting" mode of production (Figure 7), in which blades are removed by a knapper applying force to the core using a short crutch from a sitting position. It is important to note that the average width of Chalcolithic blades also overlaps with widths obtained through the use of a shoulder crutch from a sitting position and a long crutch from a standing position. Regardless, when considering the full distribution of widths within the analyzed assemblages, the "short crutch sitting" appears to be the most probable mode of production. Since the distribution of widths is not multi-modal, there is no

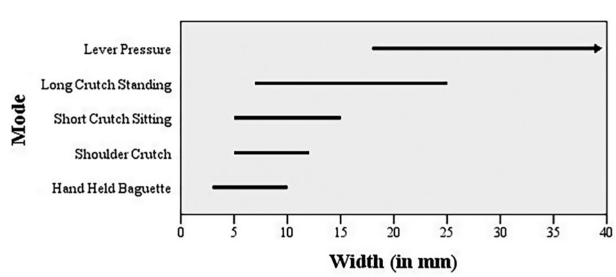

Figure 7. Widths of pressure-flaked obsidian blades and their corresponding modes of production as shown though experimental reconstruction (after Pélegrin 2012:479).

evidence to suggest that multiple production techniques are represented. Nevertheless, more data from other Chalcolithic sites with statistically significant numbers are needed for future inter-site comparisons of blade production techniques.

As previously stated, Neolithic blades in Sicily appear to be wider than those of the Chalcolithic. This is certainly true when compared with the Stentinello period of the Neolithic (*c.* sixth–fifth millennia BC); however, there is currently not enough data available from the Late Neolithic Diana period (*c.* early fourth millennium BC) to make valid comparisons. What limited data from the Diana period that is available comes from the site of San Martino in northeastern Sicily; these data are problematic, though, in that they combine blade widths from both obsidian and flint artifacts. Nevertheless, flint makes up less than 2 per cent of the assemblage, so the results are still useful for general comparisons. Based on a study of 162 blades from San Martino, Quero (2012:25–26) claims that Diana period blades average 35.2 mm in length, 13 mm in width, and 4.1 mm in thickness, and that the widths in particular frequently reach 14 to 15 mm, but rarely exceed 20 mm. For both flint and obsidian blades, these dimensions correspond to the "short crutch sitting" or "long crutch standing" mode of production.

Nevertheless, we must be careful about drawing wider conclusions about Diana period obsidian blade production based on results from one site. When considering the earlier phases of the Neolithic, more data about obsidian blade dimensions are available. For example, based on the analysis of 331 pressure-flaked blades from 10 Stentinello sites on Sicily, it has been shown that the average width was 14.3 mm with a standard deviation of 5.5 mm; 39 blades from six separate sites were more than 20 mm wide (Freund 2014b:136–37; Freund et al. 2015). These dimensions correspond to the "long crutch standing" mode of production, particularly when considering that widths above 20 mm fall well outside the range of blades that can be produced though "short crutch sitting." In fact, these ranges also correspond well to the use of a large lever in the removal of blades from the core (Figure 7).

In order to test whether the widths of Neolithic Stentinello blades were significantly different from those of Chalcolithic blades, a *t*-test was run using SPSS 21 statistical software. An initial attempt was made to run the analysis using the widths of all blades, including whole, proximal, medial, and distal blades. However, what was found was that their distributions were highly skewed and not capable of being normalized using logarithmic or Box–Cox transformations. This is likely due to the fact that many of the larger blades were slightly wider

Table 5. Results obtained from independent *t*-tests relating to maximum widths of whole blades from Stentinello and Chalcolithic sites.

		Levene's Test for Equality of Variances		*t*-test for Equality of Means						
									95% Confidence Interval	
		F	Sig.	t	df	Sig.	Mean Diff.	Std. Error Diff.	Lower	Upper
Width	Equal Variances	**4.538**	**.034**	2.428	186	.016	.06496	.02675	.01218	.11773
	Unequal Variances			**2.950**	**99.077**	**.004**	.06496	.02202	.02126	.10865

Note: Valid values are in bold.

in the middle than at the proximal of distal ends. When both distal and proximal blade fragments were included, the distribution became quite skewed. However, by only comparing the widths of whole blades, a simple log10 transformation normalized the data, as confirmed through a Shapiro–Wilk test of normality. Based on the results from Table 5, it is clear that the variances of the two populations were not equal. Therefore, the output for unequal variances was used. The t-score was 2.950, df = 99.077, p = .004. Therefore, with an alpha of 0.05, one can claim that Stentinello blades are significantly wider than those of the Chalcolithic. Moreover, there is significantly less variance among blades of the Chalcolithic, which suggests a more standardized output. This is especially relevant in that it provides additional support for the suggestion that Chalcolithic blades were produced through a different technique than in earlier eras and involved a range of motions that were likely enacted in a divergent set of social contexts.

Discussion

In stark contrast to the East Mediterranean where obsidian use continues throughout the Bronze Age until the end of the second millennium BC (see Carter 2008; Coqueugniot 1998), large-scale Central Mediterranean obsidian circulation networks of peninsular Italy and southern France experience a dramatic collapse by the third millennium BC (Freund 2014b:117). Considering that obsidian circulation declines just at a time of increasing maritime mobility and long-distance exchange throughout most of Europe, this represents a major restructuring of socio-economic interaction spheres and symbolic systems, in turn corresponding with the arrival of a new suite of prestige items and cultural practices often associated with incipient metallurgy and changing burial patterns (see Robb 1994, 2007).

Outside of the source areas, small amounts of obsidian are found in central and northern Italy as well as in southern France during the Chalcolithic, although many of these sites have not been properly dated and are often associated with both Late Neolithic and Chalcolithic phases (see Figure 8). From those sites with more secure Chalcolithic dates only a handful of artifacts have been analyzed; nevertheless, some basic patterns can be elucidated. Based on the analysis of four artifacts from Riparo Valtenesi in north-central Italy, both SA and SC Sardinian obsidians are present (Randle, Barfield, and Bagolini, 1993). Both Sardinian and Lipari material are also present at the coastal sites of Suese and La Padula in northern Tuscany (Bigazzi and Radi 1998). In southern Italy, 11 sites have been tentatively dated as post-Neolithic, all from the Acconia survey area (Ammerman 1985).

In contrast to the significant decline in obsidian consumption in mainland Italy and France, these raw materials continued to be used on the islands of Ustica and Malta (Foresta Martin et al., in press; Malone, Stoddart, Bonnano, and Trump 2009:250; Tykot 2015) as well as near the source areas at sites in Sardinia, Corsica, and Sicily, although there are major changes in how these materials were now being worked. For example, an analysis of 154 Chalcolithic artifacts from the Sardinian site of Bingia 'e Monti has shown that mainly SC Sardinian obsidian was used to create expedient flake tools and lunates, a significant difference from the formal tools and blades that characterize much of the Late Neolithic (Freund 2014a). In Sicily, pressure-flaked blade technology continued, but there were considerable differences in the size and shape of these blades when compared to those from previous periods.

Structural reconfiguration in Chalcolithic Sicily

When considering the distribution of obsidian throughout Sicily, this study has demonstrated that long-standing obsidian exchange spheres remained in place from the Neolithic to the Chalcolithic despite wider technological and social changes taking place throughout the rest of the Central Mediterranean. While Pantelleria obsidian was present mostly in small quantities in western and south-central Sicily, Lipari obsidian was of much greater importance. Because of the low prevalence of primary knapping debris at the analyzed sites, it is

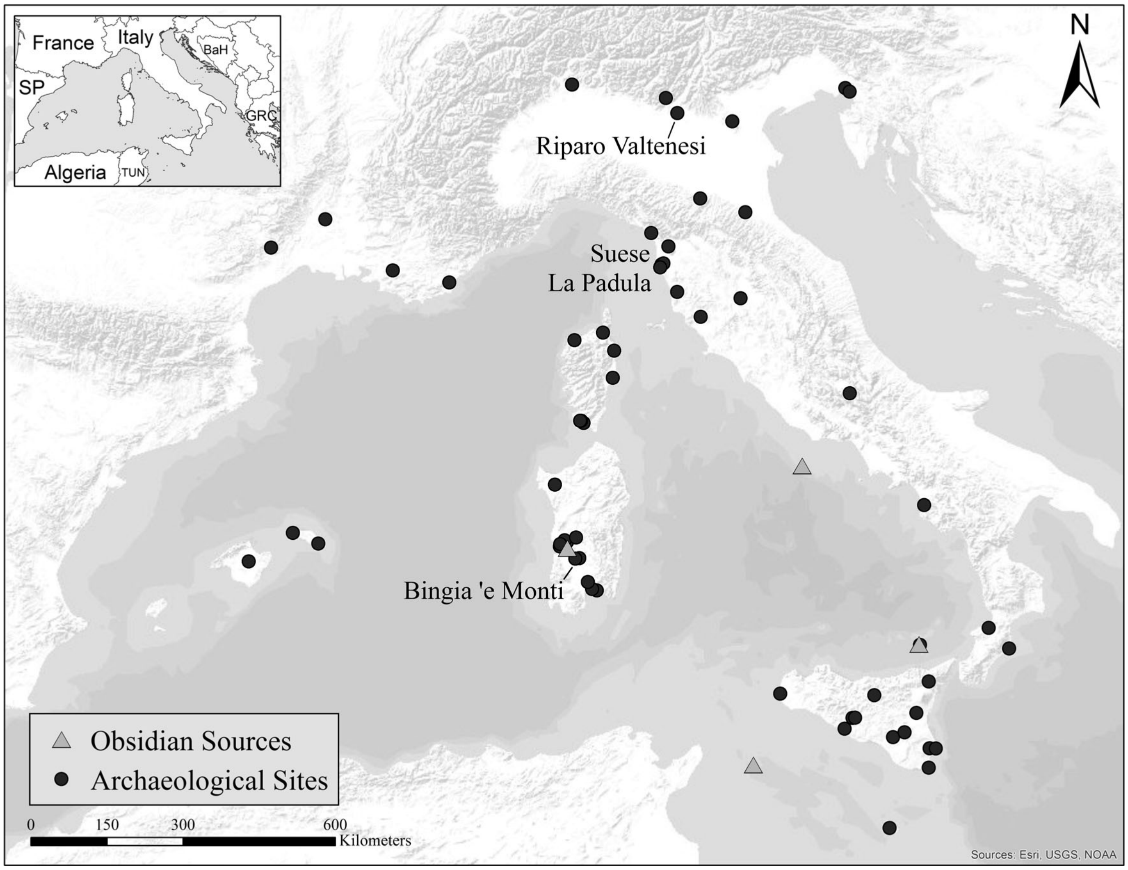

Figure 8. Chalcolithic archaeological sites with obsidian (see Freund 2014b for more details). Sites mentioned in the the text are labeled.

likely that the first stages of Lipari obsidian reduction occurred at the source area by local populations, with these materials being transported from Lipari to Sicily in the form of preformed cores or finished products. However, without further evidence from Chalcolithic sites on Lipari itself it is difficult to determine where exactly these blades were produced, either solely on Lipari or also at sites elsewhere on Sicily. Regardless of the locations of initial production, the finished products were likely transported from the coastal regions inland through a model of down-the-line exchange (cf. Tykot 2011) or some other form of circulation structured by village-to-village interactions (Ibáñez, Ortega, Campos, Khalidi, and Méndez, 2015). The exchange of finished products during the Chalcolithic differs from the Neolithic where the comparable prevalence of exhausted cores and flakes at sites on Sicily suggests more on-site working of pre-formed cores from Lipari (see Freund et al. 2015).

Evidence for cultural contact between Sicily and Pantelleria is well established throughout prehistory (see Cazzella, Cultraro, and Recchia, 2011; Malone 2003:252), and the lack of Pantelleria material in the analyzed assemblage—in combination with its presence at or near the southern coast—would seem to indicate that these materials were being acquired casually by travelers boating between these islands. This is also supported by the unstructured utilization of obsidian from multiple subsources, although more data are needed to make more concrete interpretations.

The production of Chalcolithic blades differs from that in earlier time periods, and is likely related to a broader shift in the social and symbolic role of these raw materials in that society. This study has shown that Chalcolithic blades were likely produced by using a short crutch from a sitting position, while a long crutch was used from a standing position to produce the distinctively wide pressure blades during the Stentinello Neolithic. According to Pélegrin (2012:470–75) there are fundamental differences between the complexities of "short crutch standing" vs. "long-crutch standing." This stems from the marked difference in force generated by the entire body from a standing position compared to a sitting position. The shape and rigidity of the long crutch is therefore crucial, and it becomes more difficult to hold the core in place, in turn affecting core preparation and the selection of appropriate holding devices. The point to be made here is that the two

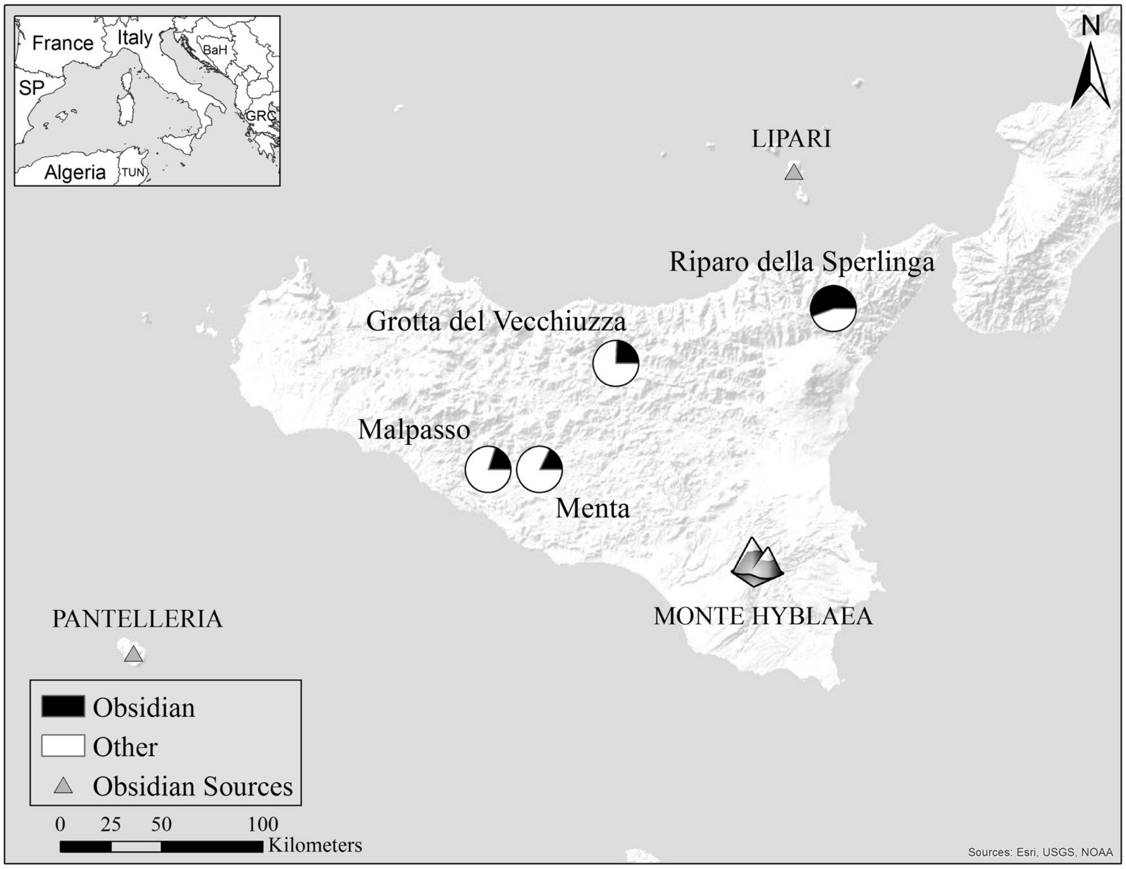

Figure 9. Distribution map of the percentage of obsidian in chipped stone assemblages dating to the Chalcolithic. Black: obsidian; white: other lithic material.

techniques are distinct, and long crutch standing requires a greater deal of skill and esoteric knowledge to enact. All of this combines into what we argue is a more performative range of motions that would be suitable to more conspicuousness arenas of interaction, particularly when—as discussed below—there is convincing evidence that throughout Sicilian prehistory obsidian likely served a range of social functions outside of mundane daily tasks.

When considering the degree of expertise required to produce Stentinello blades, we therefore argue that it is unlikely that each settlement in Sicily had a person with the esoteric knowledge required to create such products (cf. Freund et al. 2015:215), a situation mirroring other Neolithic contexts in Italy, 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; Guilbeau 2011; Perlès 1990). We can therefore imagine Neolithic blade production being actualized in performative contexts whereby specialists are quite literally putting their whole bodies into the act (see Guilbeau 2011 for a similar discussion). In contrast, Chalcolithic blade production was more quotidian and standardized, and judging by the lack of evidence for on-site working such reduction likely occurred at a select number of sites, involving a range of motions enacted in less conspicuousness arenas of interaction. In this sense, the actual act of producing blades was less symbolically and socially important in relation to functionality.

While obsidian is extremely sharp and easy to work when compared to other raw materials (Inizan, Reduron-Ballinger, Roche, and Tixier, 1999:22), it is not particularly durable in that it is extremely brittle and thus not ideal for carrying out many daily activities. Therefore, in many regions with a variety of lithic alternatives obsidian generally makes up a small percentage of the overall chipped stone assemblages (see Freund 2014b). Based on available data, this appears to be the case in Chalcolithic Sicily (Figure 9), and in such contexts obsidian likely served other functions, perhaps related to body modification, including hair cutting, shaving, scarification, tattooing, and piercing (Robb 2007:203). While there is little direct evidence for these practices in the Central Mediterranean (i.e., usewear analyses), the use of obsidian blades for body modification is well attested in the archaeological and ethnographic record, including in the contemporaneous Bronze Age Aegean of the third–second millennium BC (Carter 1997) and the western Pacific (Kononenko and Torrence, 2009; Kononenko, Torrence, and Sheppard 2016; Specht 1981). The presence of two flakes and a blade in the assemblage analyzed from the burial at Menta further highlights obsidian's close association with the body. Further indirect evidence of these practices comes from the Tyrolean Iceman of Late Neolithic/Early Chalcolithic northern Italy, who had his hair cut and displayed several linear tattoos (Pabst et al. 2009). In the future, usewear analyses will be critical in recognizing the presence of such activities, in turn building upon work conducted by Iovino, Maniscalco, et al. (2008a), and Iovino, Martinelli, and Skakun 2008b).

Conclusions

By combining obsidian sourcing with techno-typological analysis of 106 artifacts from eight Chalcolithic sites in Sicily, this paper discusses the procurement and exploitation of obsidian raw materials from the island sources of Lipari and Pantelleria. In addition to providing one of the first overviews of post-Neolithic obsidian consumption on Sicily, this paper also explores long-term trends in the production of pressure-flaked blades. We in turn argue that when lithic data are analyzed within a *chaîne opératoire* approach combining analyses from multiple stages of artifact life histories, this information represents a powerful means of engaging with major social science questions.

More specifically, the results of this study suggest that long-standing obsidian exchange spheres remained intact in Sicily from the Neolithic to the Chalcolithic in the face of wider technological and social changes taking place throughout the rest of the Central Mediterranean. Despite minor changes in the ways in which these raw materials were procured and distributed, Chalcolithic blades began to be produced through a different technique of pressure-flaking. Using blade width as a proxy for various modes of production, it is shown that Chalcolithic blades are statistically narrower than those of earlier time periods, which likely resulted from a fundamentally different way of producing these products that involved a range of motions embodied in less conspicuousness social contexts. This study also demonstrates that obsidian rarely made up a large percentage of chipped stone assemblages in Chalcolithic Sicily and was almost never used to produce shaped tools. When considered in combination with the fact that obsidian is highly brittle and is thus not ideal for carrying out many daily activities, we argue that these raw materials may have served a distinct social role in practices ranging from hair cutting to shaving, tattooing, piercing, or scarification (cf. Robb 2007:203).

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, and we acknowledge the previous assistance offered by Dr. Anita Crispino and Dr. Giuseppina Monterosso. We thank Dr. Giuseppe Turco of the Gela Archaeological Park for his support in Gela, as well as Dr. Nuccia Gullì at the superintendence of Agrigento. We also thank the superintendent of Caltanissetta, Dr. Salvatore Gueli, and Dr. Carla Guzzone of the same superintendence for granting access to the Antiquarium in Milena, and Mr. G. Palumbo for his assistance onsite. Dr. Rossella Giglio offered invaluable assistance in the Trapani province. Finally, we thank all staff at the museums we visited, who helped us accessing the materials.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Kyle Freund is an assistant professor of anthropology at Indian River State College (Florida), whose primary research centers on prehistoric farming communities of the Central Mediterranean, with an emphasis on the reflexive relationship between material culture and long-term social processes. His specializations include lithic analysis, archaeometallurgy, spatial statistics, and field survey.

Robert Tykot is a professor in the Department of Anthropology at the University of South Florida, and Director of the Laboratory for Archaeological Science. He has conducted extensive analytical research on geological sources and determining the specific source of obsidian artifacts in the Mediterranean. He also conducts elemental and isotopic analysis on marble, ceramics, metals, and human remains.

Andrea Vianello, formerly at the University of Oxford, is the author of volumes on prehistoric exchanges and material culture in the Mediterranean. He focuses on prehistoric material culture in the Mediterranean (Aegean to Iberia) and human–environment dynamics, and has researched Sicily since 2000, with regular field trips. He also conducts elemental and isotopic analysis on ceramics, metals, and human remains.

ORCID

Andrea Vianello http://orcid.org/0000-0002-2323-6767

References

Ammerman, A. J. (1985). *The Acconia survey: Neolithic settlement and obsidian trade*. London: Institute of Archaeology Occasional Publication 10. University of London.

Arias, P. E. (1937). La Stazione Preistorica di Serraferlicchio. *Monumenti Antichi del Lincei*, *36*, 693–838.

Bigazzi, G., & Radi, G. (1998). Prehistoric exploitation of obsidian for tool making in the Italian peninsula: A picture from a rich fission-track data-set. In C. Arias, A. Bietti, L. Castelleti, & C. Peretto (Eds.), *Actes of the 8th international Congress of prehistoric sciences, Forli, Italy* (pp. 619–624). Forli: ABACO.

Camps, G. (1986). The young sheep and the sea: Early navigation in the Mediterranean. *Diogenes*, *34*(136), 19–45.

Carter, T. (1997). Blood and tears: A cycladic case study in microwear analysis. The use of obsidian blades as razors? In M. A. Bustillo & A. Ramos-Millán (Eds.), *Siliceous rocks and culture* (pp. 256–271). Madrid: Consejo Superior de Investigaciones Científicas.

Carter, T. (2008). The consumption of obsidian in the early bronze age cyclades. In N. Brodie, J. Doole, G. Gavalas, & C. Renfrew (Eds.), *Horizons: A colloquium on the prehistory of the cyclades* (pp. 225–235). Cambridge: McDonald Institute Monographs.

Cazzella, A., Cultraro, M., & Recchia, G. (2011). Relazioni tra l'Italia Centro-Meridionale. la Sicilia e l'Area Egeo-Balcanica durante l'Eneolitico. In *Atti della XLIII Riunione Scientifica - L'Età del Rame in Italia* (pp. 157–164). Firenze: Istituto Italiano di Preistoria e Protostoria.

Coqueugniot, É. (1998). L'Obsidienne en Méditerranée Orientale aux Époques Post-Néolithiques. In M.-C. Cauvin, A. Gourgaud, B. Gratuze, N. Arnaud, G. Poupeau, J. L. Poidevin, & C. Chataigner (Eds.), *L'obsidienne au Proche et Moyen Orient: Du Volcan à l'Outil* (pp. 351–361). Oxford: BAR International Series 738. Archaeopress.

Costa, L. J. (2006). Récents Acquis sur la Circulation Préhistorique de l'Obsidienne en Corse. *Bulletin de la Société Préhistorique Française*, *103*(1), 71–85.

Crummett, J. G., & Warren, S. E. (1985). Chemical analysis of calabrian obsidian. In A. J. Ammerman (Ed.), *The Acconia survey: Neolithic settlement and obsidian trade* (pp. 107–114). London: Institute of Archaeology Occasional Publication 10. University of London.

De Francesco, A. M., Bocci, M., Crisci, G. M., & Francaviglia, V. (2012). Obsidian provenance at several Italian and Corsican archaeological sites using the non-destructive x-ray fluorescence method. In I. Liritzis & C. M. Stevenson (Eds.), *Obsidian and ancient manufactured glass* (pp. 115–129). Albuquerque: University of New Mexico Press.

Foresta Martin, F., Di Piazza, A., Doriano, C., Carapezza, M. L., Paonita, A., Rotolo, S. G., & Sagnotti, L. (in press). New insights into the provenance of the obsidian fragments of the Island of Ustica (Palermo, Sicily). *Archaeometry*.

Francaviglia, V. (1988). Ancient obsidian sources on Pantelleria (Italy). *Journal of Archaeological Science*, *15*, 109–122.

Francaviglia, V. M., & Piperno, M. (1987). La Répartition et la Provenance de l'Obsidienne Archéologique de la Grotta dell'Uzzo et de Monte Cofano (Sicile). *Revue d'Archéométrie*, *11*, 31–39.

Freund, K. P. (2014a). Obsidian consumption in Chalcolithic Sardinia: A view from Bingia 'e Monti. *Journal of Archaeological Science*, *41*, 242–250.

Freund, K. P. (2014b). *A multi-scalar analysis of the politics of obsidian consumption in the west mediterranean (ca. 6th – 2nd Millennia B.C.)* (Ph.D. dissertation). Department of Anthropology, McMaster University, Hamilton, Ontario.

Freund, K. P., Tykot, R. H., & Vianello, A. (2015). Blade production and the consumption of obsidian in stentinello period Neolithic Sicily. *Comptes Rendus Palevol*, *14*, 207–217.

Fugazzola Delpino, M. A., Pessina, A., & Tiné, V. (Eds.). (2004). *Il Neolitico in Italia. Ricognizione, Catalogazione e Pubblicazione dei Dati Bibliografici, Archivistici, Materiali e Monumentali* (Vol. I, II, III). Firenze: Istituto Italiano di Preistoria e Protostoria.

Gratuze, B., & Boucetta, S. (2009). Provenance study of obsidian blades. In V. Tiné (Ed.), *Favella: Un Villaggio Neolitico nella Sibaritide* (pp. 387–389). Rome: Istituto Poligrafico e Zecca dello Statto.

Guilbeau, D. (2011). Le Début du Néolithique en ItalieMéridionale: Ce que Nous Disent les Productions en Silex du Gargano. *Origini*, *XXXIII*, 83–106.

Hallam, B. R., Warren, S. E., & Renfrew, C. (1976). Obsidian in the western Mediterranean: Characterisation by neutron activation analysis and optical emission spectroscopy. *Proceedings of the Prehistoric Society*, *42*, 85–110.

Ibáñez, J. J., Ortega, D., Campos, D., Khalidi, L., & Méndez, V. (2015). Testing complex networks of interaction at the onset of the near eastern neolithic using modelling of obsidian exchange. *Journal of the Royal Society Interface*, *12*, 20150210.

Inizan, M.-L., Reduron-Ballinger, M., Roche, H., & Tixier, J. (1999). *Technology and terminology of knapped stone*. Nanterre: CREP.

Iovino, M. R., Maniscalco, L., Pappalardo, G., Pappalardo, L., Puglisi, D., Rizzo, F., & Romano, F. P. (2008). Archaeological volcanic glass from the site of Rocchicella (Sicily, Italy). *Archaeometry*, *50*(3), 474–494.

Iovino, M. R., Martinelli, M. C., & Skakun, N. N. (2008b). Production and function(s) of obsidian tools at the neolithic site of Contrada Diana (Aeolian Islands, Sicily). In L. Longo (Eds.), *Prehistoric technology 40 years later: Functional studies and the Russian legacy* (pp. 439–444). Oxford: Archaeopress.

Kononenko, N., Torrence, R., & Sheppard, P. (2016). Detecting early tattooing in the pacific region through experimental usewear and residue analyses of obsidian tools. *Journal of Archaeological Science: Reports*, *8*, 147–163.

Kononenko, N. A., & Torrence, R. (2009). Tattooing in Melanesia: Local invention or lapita introduction? *Antiquity*, *83*(320), Retrieved from http://antiquity.ac.uk/projgall/kononenko/

La Rosa, V. (1994). Le Nuove Indagini nella Media Valle del Patani. In S. Tusa (Eds.), *La Preistoria del Basso Belice e della Sicilia Meridionale nel Quadro della Preistoria Siciliana e Mediterranea* (pp. 287–304). Palermo: Società Siciliana per la Storia Patria.

La Rosa, V. (1997). Sopralluoghi e Ricerche attorno a Milena nella Media Valle del Platani. In *Dalle Capanne alle Robbe: La Storia Lunga di Milocca-Milena* (pp. 141–164). Milena: Pro Loco.

La Rosa, V., Palio, O., Pappalardo, G., Pappalardo, L., & Romano, F. P. (2006). Analisi delle Provenienze di Ossidiane del Territorio di Milena (CL). In *Atti della XXXIX Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria: Materie Prime e Scambi nella Preistoria Italiana, Firenze, November 2004* (pp. 499–508). Firenze: Istituto Italiano di Preistoria e Protostoria.

Leighton, R. (1996). Research Traditions, Chronology, and Current Issues: An Introduction. In R. Leighton (Ed.), *Early Societies in Sicily: New Developments in Archaeological Research* (pp. 1–19). London: Accordia Research Centre.

Leighton, R. (1999). *Sicily before history: An archaeological survey from the Palaeolithic to the iron age*. Ithaca: Cornell University Press.

Malone, C. (2003). The Italian neolithic: A synthesis of research. *Journal of World Prehistory*, *17*(3), 235–312.

Malone, C., Stoddart, S., Bonnano, A., & Trump, D. (Eds.). (2009). *Mortuary customs in prehistoric Malta: Excavations at the brochtorff circle at Xaghra (1987–94)*. Cambridge: McDonald Institute Monograph.

Mulazzani, S., Le Bourdonnec, F.-X., Belhouchet, L., Poupeau, G., Zoughlami, J., Dubernet, S., … Khedhaier, R. (2010). Obsidian from the epipalaeolithic and neolithic Eastern Maghreb. A view from the Hergla context (Tunisia). *Journal of Archaeological Science*, *37*, 2529–2537.

Nicoletti, F. (1997). Il Commercio Preistorico dell'Ossidiana nel Mediterraneo ed il Ruolo di Lipari e Pantelleria nel Più Antico Sistema di Scambio. In S. Tusa (Eds.), *Prima Sicilia: Alle Origini della Società Siciliana* (pp. 258–69). Palermo: Catalogo della Mostra.

Orsi, P. (1907). La Grotta di Calafarina presso Pachino, Abitazione e Sepolcro. *Bulletino di Paletnologia Italiana*, *33*, 7–22.

Orsi, P. (1928). Stazione e Necropoli al Bersaglio di Caltagirone. *Bulletino di Paletnologia Italiana*, *48*, 82–88.

Pabst, M. A., Letofsky-Pabst, I., Bock, E., Moser, M., Dorfer, L., Egarter-Vigl, E., & Hofer, F. (2009). The tattoos of the Tyrolean Iceman: A light microscopical, ultrastructural and element analytical study. *Journal of Archaeological Science*, *36*(10), 2335–2341.

Pélegrin, J. (2012). New experimental observations for the characterization of pressure blade production techniques. In P. M. Desrosiers (Eds.), *The emergence of pressure blade making: From origin to modern experimentation* (pp. 465–500). New York: Springer.

Perlès, C. (Ed.). (1990). *Les Industries Lithiques Taillees de Franchti (Argolide, Grece)*. Bloomington and Indianapolis: Excavations at Franchthi Cave, Fascicle 5. Indiana University Press.

Quero, T. (2012). Il Sito Neolitico di San Martino-Spadafora (Me): Analisi dei Materiali e Inquadramento Culturale. In M. A. Orlando (Eds.), *Premio Decio de Lorentiis, per la Valorizzazione e la Diffusione degli Studi Preistorici e delle Scienze della Terra* (pp. 1–38). Galatina: Editrice Salentina.

Randle, K., Barfield, L. H., & Bagolini, B. (1993). Recent Italian obsidian analyses. *Journal of Archaeological Science*, *20*, 503–509.

Robb, J. E. (1994). The neolithic of peninsular Italy: Anthropological synthesis and critique. *Bulletino di Paletnologia Italiana*, *85*, 189–214.

Robb, J. E. (2007). *The early Mediterranean village*. New York: Cambridge University Press.

Specht, J. (1981). Obsidian sources at talasea, west New Britain, Papua New Guinea. *Journal of the Polynesian Society*, *90*, 337–356.

Tusa, S. (Ed.). (1997). *Prima sicilia* (Vol. I, II). Palermo: Assessorato dei Beni Culturali.

Tykot, R. H. (2011). Obsidian finds on the fringes of the central Mediterranean: Exotic or eccentric exchange? In A. Vianello (Eds.), *Exotica in the prehistoric Mediterranean* (pp. 33–44). Oxford: Oxbow Books.

Tykot, R. H. (2015). Obsidian lithics tested by XRF. In A. Bonanno & N. C. Vella (Eds.), *Tas-Silġ, Marsaxlokk (Malta) I: Archaeological excavations conducted by the university of Malta, 1996–2005* (p. 471). Belgium: Peeters, Ancient Near Eastern Studies Supplement 48, 471–472.

Tykot, R. H., Freund, K. P., & Vianello, A. (2013). Source analysis of prehistoric obsidian artifacts in Sicily (Italy) using pXRF. In R. Armitage (Eds.), *Archaeological chemistry VIII, ACS symposium series* (pp. 195–210). Washington, DC: American Chemical Society.

Tykot, R. H., Iovino, M. R., Martinelli, M. C., & Beyer, L. (2006). Ossidiana da Lipari: Le Fonti, la Distribuzione, la Tipologia e le Tracce d'Usura. In *Atti del XXXIX Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria: Materie Prime e Scambi nella Preistoria Italiana* (pp. 592–597). Firenze: Istituto Italiano di Preistoria e Protostoria.