Research Article

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Obsidian from the Neolithic Layers of “Grotta di San Michele Arcangelo di Saracena” (Cosenza), Italy. A Preliminary Report

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Abstract: The paper presents the results obtained by techno-typological analysis of a lithic assemblage from the Neolithic layers of Grotta San Michele Arcangelo di Saracena (Cosenza) together with the results of micro-wear analysis obtained from a preliminary selection of obsidian artifacts with different provenances distinguished by pXRF analysis. The site provides one of the best preserved Neolithic sequences in the area, from the earliest Impressed Wares (or *Impresse Arcaiche*) (early sixth millennium BC) to the Spatarella pottery style (end fifth – early fourth millennium BC). Along the Neolithic sequence, it is possible to observe some major changes within lithic resources management. In particular, it is possible to notice some techno-typological breakages between the Early Neolithic and the further stages, until the second phase of the Late Neolithic, when another rupture, corresponding to the *Spatarella* facies, is evident.

Keywords: obsidian, Neolithic, lithic studies, micro-wear analysis

1 Introduction

Lithic studies from Sicily and Calabria (Ammerman & Andrefsky, 1982; Collina, 2015; Freund, Tykot, & Vianello, 2015) have shown how techno-typological and provenance analysis can deal with major questions involving early specialized craftsmanship, modalities of early maritime/terrestrial transports, and exchange networks that emerge from the presence and circulation of a particular kind of lithic raw material such as obsidian. The latter, not being a ubiquitous material since the sources of this volcanic rock are limited to a few on small volcanic islets, i.e., Lipari (Aeolian Archipelago), Pantelleria (Sicilian Channel), and Palmarola (Isole Ponziane), or major islands (Sardinia), has been nevertheless one of the main raw materials exploited in Neolithic southern Italy, reaching inner and mountainous territories far from the coast, like the one analyzed here. In this paper, we present a multiscale analysis of a lithic assemblage (with a focus on obsidian) from Grotta di San Michele at Saracena (Calabria, Italy). The site provides one of the best preserved Neolithic sequences in the area, from the earliest Impressed Wares (or *Impresse Arcaiche*) (early

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sixth millennium BC) to the Spatarella pottery style (end fifth – early fourth millennium BC), providing evidence for a reception site of final products. Here, Neolithic communities intentionally selected obsidian as a raw material, but not or minimally participating in the stages of its reduction sequence.

The San Michele Arcangelo di Saracena cave, located south of the Pollino National Park, is important due to its archaeological levels testifying human presence since the Early Neolithic, up to the Middle Bronze Age (Tiné & Natali, 2014).

The cavity is of karst origin and opens, at about 750 m above sea level, on the right side of the valley of the Garga stream, near the modern town of Saracena (Cosenza, Italy), in the southern part of the Italian peninsula (Figure 1).

Excavation campaigns conducted between 1998 and 2007 by the Soprintendenza at the Museo Preistorico Etnografico “Luigi Pigorini” at Rome involved two distinct areas:

– the Alpha test pit where the most recent levels are preserved (up to the proto-Apennine facies);
– the Beta test pit where an anthropic deposit, over 6 m thick, was investigated, covering the time spanning between the Early Neolithic, with archaic impressed ceramics, and the full Copper Age, of Piano Conte facies, and constituted a complete sequence for the Neolithic of southern Italy (Tiné & Natali, 2014) (Figure 2).

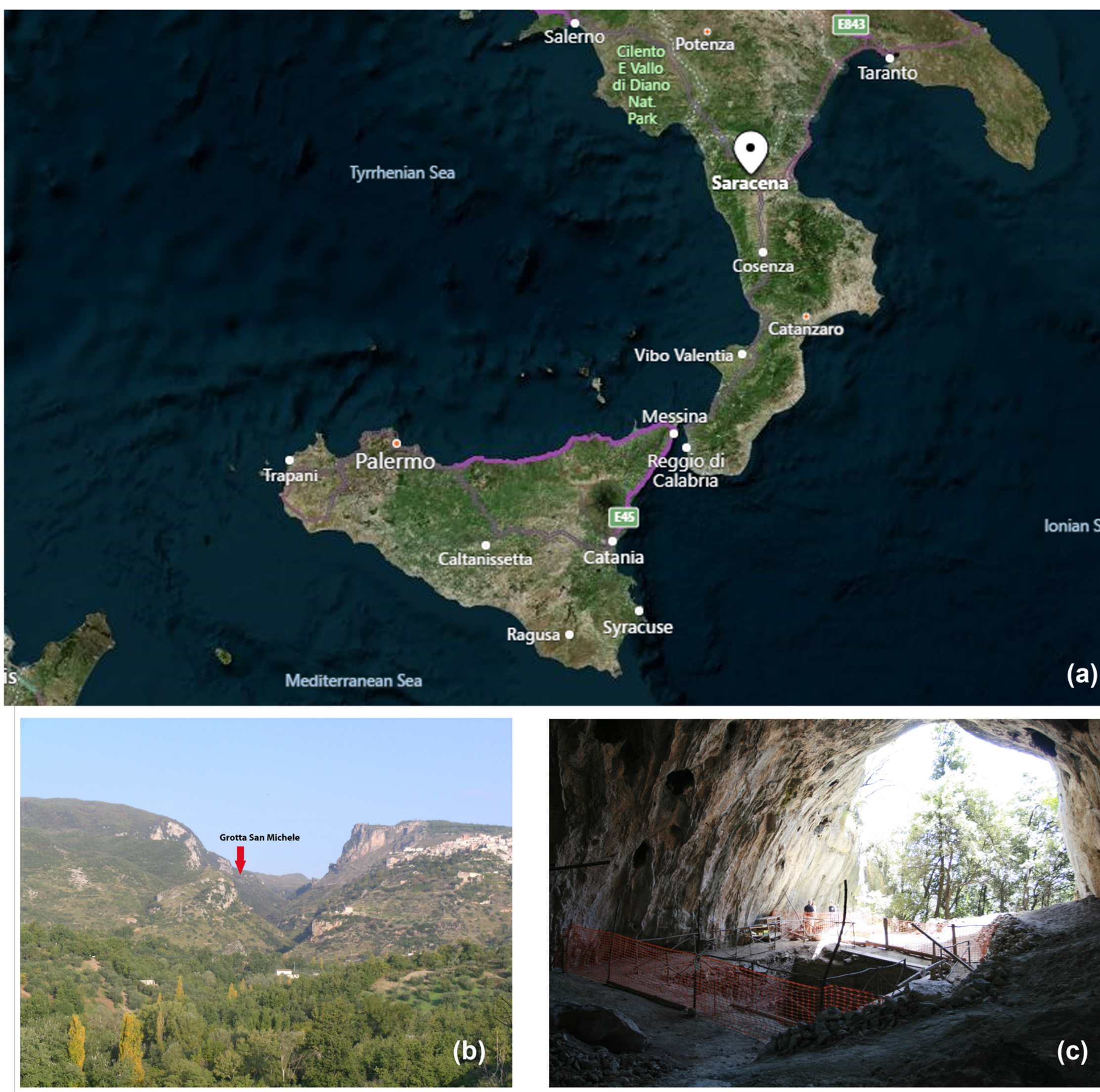


Figure 1: Location of Grotta San Michele Arcangelo di Saracena (Cosenza) (a); panoramic view of the Garga valley where the cave opens (b); the inner part of the cave during an excavation campaign (c).

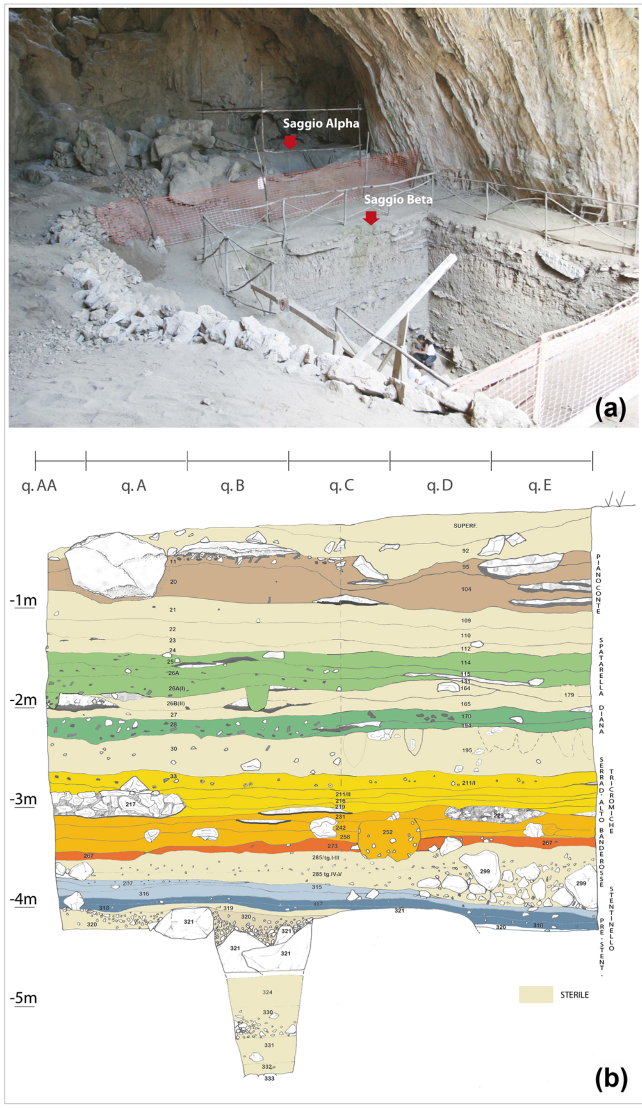


Figure 2: A view of Saggio Alpha and Saggio Beta (a); stratigraphy of Saggio Beta (b). Modified after Tiné and Natali (2014).

The earliest traces of human presence in the cave during the Neolithic Age go back to the archaic impressed ware horizon. This is the time when Neolithic communities from south-eastern Italy (Puglia, Basilicata) settled in the Sibari plain (Natali & Forgia, 2018; Tinè, 2009).

Among the most unexpected and striking data is the presence in Saracena of some levels containing impressed ware of the evolved phase of impressed ware (*Stentinello*). A series of levels containing painted ware belong to the Middle Neolithic. Analyses have shown a first type of *Bande Rosse* pottery to have strong ties in style to the area of the Tavoliere and the plain of Bari. The Middle Neolithic sequence is closed by levels containing painted ware in the style of Serra d'Alto. The Late Neolithic layers, of Diana-Bellavista phase, are very rich in pottery and lithics. The end of the Neolithic sequence in Saracena shows a series of layers containing pottery of facies Spatarella (Tiné & Natali, 2014).

Table 1 summarizes the already published (Tiné & Natali, 2014) AMS radiocarbon dates for the Neolithic horizons of the site.

Table 1: Radiocarbon dates from Grotta San Michele Arcangelo di Saracena. All dates have been calibrated with the OxCal 4.3 software (Bronk Ramsey, 2009) using the IntCal13 curve (Reimer et al., 2013)

Lab id.	Neolithic horizon	Stratigraphic units	Sample	Method	Conventional radiocarbon age	SD	Calibrated radiocarbon age (BC) (95.4%)
LTL210A	Bande Rosse	36/267–273	Seed	AMS	6261	40	5320–5070
LTL2152A	Bande Rosse	36/267–273	Seed	AMS	6172	50	5300–4990
LTL208A	Serra d'Alto	33–34/211; 216; 219	Seed	AMS	5725	40	4690–4460
LTL206A	Diana	28/170–194	Seed	AMS	5540	40	4460–4330

2 Methods

The study of the obsidian industry from the Neolithic layers of Grotta San Michele Arcangelo di Saracena follows three different and complementary approaches.

Tool manufacture and assemblage variability have been addressed by a techno-typological approach, combining different criteria of analysis (Freund et al., 2015; Martinelli, Tykot, & Vianello, 2019; Odell, 2001).

In order to face with the procurement of the raw material, X-ray fluorescence analyses have been carried out on the totality of the archaeological sample, with a portable nondestructive device (pXRF) (Tykot, 2018, 2019).

Use-wear analysis of obsidian artifacts (Clemente Conte & Gibaja Bao, 2009; Clemente Conte, Lazuén Fernández, Astruc, & Rodríguez Rodríguez, 2015; Hurcombe, 1992; Iovino, 1996; Kononenko, Torrence, & White, 2015) embraces a large sample including the whole Neolithic sequence and all the sources and sub-sources represented here, at different Neolithic stages (Lipari, Palmarola, Sardinia SA, and Sardinia SB2). The selection of the obsidian products for the micro-wear studies is preliminary to the planning of the whole analysis and let us test the conditions of the obsidian tools' surfaces. The preliminary results presented here, even if not representative of the whole Neolithic assemblage, nevertheless, shed new lights on some technical behaviors and preferences in raw material management for a prolonged and continuous period. Tool functionality has been inferred comparing the archaeological record with the experimental use-wear reference sample produced by the first author (Forgia, 2003) and with published experimental samples such as Walton (2019), Hurcombe (1992), and Iovino (1996). Artifacts were collected with all the precautions to allow a correct reading of the functional data. The materials collected by sediment sieving were distinguished from those recovered directly from the excavation. Laboratory treatment involved a preparation phase (manual cleaning and washing with an ultrasonic bath, drying with a jet of compressed air) and an observation phase, with photographic reproduction and data collection. The observation was carried out in low (10–100×) and high (100–500×) magnification optical microscopy and with scanning electron microscopy (SEM) (Ollé & Vergès, 2014; Longo, Iovino, & Lemorini, 2000–2001). The first phase of macroscopic observation was followed by the identification and punctual observation of any active margins. The kinematics was already evident with the first observations at low magnification, while the identification of the contact material and of any activity required a more careful examination and the data crossing of macro- and micro-wear, their location, and/or arrangement on the tool.

3 Results

Eight hundred and forty-four chipped stones have been selected for this study, from contexts (stratigraphic units – US) with an absolute chronology or, at least, a well-defined relative chronology (573 obsidian products from this selection).

3.1 Raw Materials

The lithic industry of Grotta San Michele di Saracena is comprised of two different types of raw materials: flint, present in different varieties and colors, whose supply areas are still to be determined, and obsidian. The provenance of the latter has been determined by pXRF analysis of the whole archaeological sample, with 99% coming from Lipari, as anticipated based on visual appearance and the results of other studies on sites in Calabria (Ammerman & Andrefsky, 1982). The source analyses will be published in detail separately. Here, we present a first discrimination among tools originating from Lipari and the few tools originating from other central Mediterranean sources.

3.1.1 Obsidian

The presence of obsidian is recorded from the Impressed Ware layer – advanced phase (*Impresse Evolute* or *Stentinello*) Neolithic horizon (Natali & Forgia, 2018) (Table 2). While during the previous period (facies of the Impressed Ware – archaic phase or *Impresse Arcaiche*), the exclusive raw material was flint, during the new facies obsidian is 15% of the total lithic artifacts.

With the Neolithic painted ware horizons (*Bande Rosse* and *Tricromiche*), the percentage of the raw materials is inverted: the percentage contribution of the flint is significantly reduced, if compared to the Early Neolithic, settling at just 15% against 85% of obsidian.

In the final part of the Middle and in the early part of the Late Neolithic (*Serra d'Alto* and *Diana*), there is a slight decrease in the percentage contribution of obsidian, compared to flint, with 80% of the total number of artifacts.

During the second part of the Late Neolithic (*Spatarella*), the value of obsidian decreases significantly, reaching 67%, against 33% of flint.

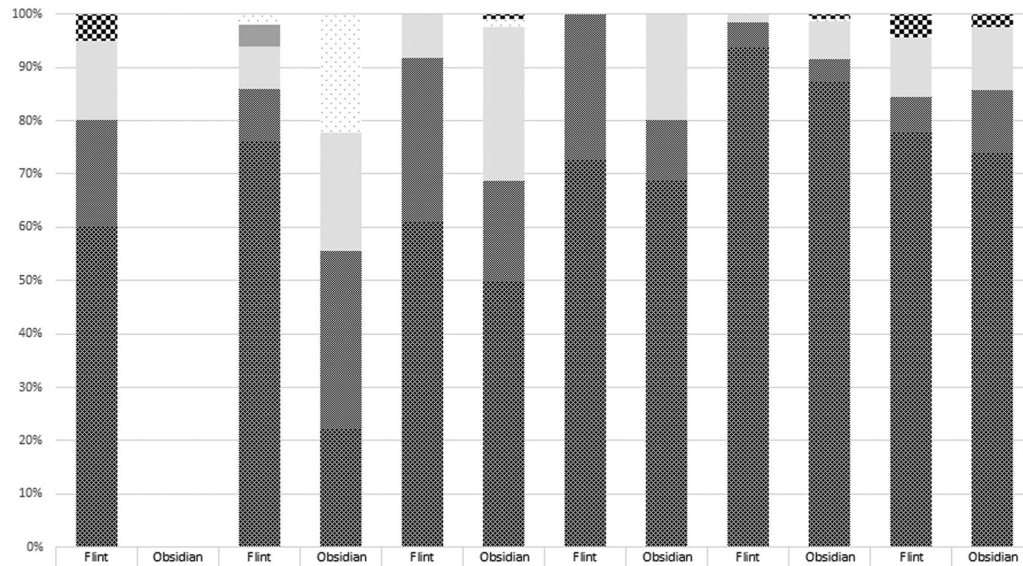
Obsidian from Grotta San Michele is black or black-gray on the surface and gray in transmitted light. Although macroscopic characteristics suggest an origin from Lipari, only laboratory analyses have been able to discriminate different sources and sub-sources.

3.2 Lithic Techno-Typology

The analysis took into consideration the main features of the artifacts: morphology and size of the striking platforms (if preserved), number and dèbitage axis of the negative scars, presence of cortex and, finally, the dimensional ratio. The latter included recording the maximum length, width, and thickness for all artifacts and the attributes pertaining to flaking type (platform, bulb, etc.). Artifacts were also divided in cores, fragments, angular waste, debris, flakes, and blades; data that, along with presence of cortex (divided into distinct percentage categories), allow for the reconstruction of the obsidian reduction sequences (Martinelli et al., 2019), letting us observe possible similarities or differences from that described for sites on Lipari, i.e., the main source for the obsidian exploited at Saracena.

Table 2: Percentage (%) of flint and obsidian artifacts in the different Neolithic horizons of Grotta San Michele di Saracena

	Impresse Arcaiche		*Impresse Evolute*		*Bande Rosse – Tricromiche*		*Serra d'Alto*		*Diana*		*Spatarella*	
	NR	%	NR	%	NR	%	NR	%	NR	%	NR	%
Flint	64	100	50	85	36	15	11	20	65	22	45	33
Obsidian	0	0	9	15	208	85	45	80	227	78	84	67
Tot.	64	100	59	100	244	100	56	100	292	100	129	100



	Flint	Obsidian	Flint	Obsidian	Flint	Obsidian	Flint	Obsidian	Flint	Obsidian	Flint	Obsidian
	Impesse arcaiche		Impresse evolute		Bande rosse - Tricromiche		Serra d'Alto		Diana		Spatarella	
cores	5%	0	0%	0%	0%	1%	0%	0%	0%	1%	4%	2%
angular waste	0,0	0	2%	22%	0%	1%	0%	0%	0%	0%	0%	0%
debris	0,0	0	4%	0	0%	0%	0%	0%	0%	0%	0%	0%
fragments	15%	0	8%	22%	8%	29%	0%	20%	2%	7%	11%	12%
flakes	20%	0	10%	33%	31%	19%	27%	11%	5%	4%	7%	12%
blade(let)s	60%	0	76%	22%	61%	50%	73%	69%	94%	87%	78%	74%

Figure 3: Basic typological counts of obsidian artifacts: the category "blade(let)s" includes the laminar supports at all (whole supports; proximal, mesial, and distal portions).

The first observation concerning the whole Neolithic sequence is the absence, at least in the part of the cave subjected to excavation, of primary knapping debris, possibly indicating a core reduction activity on-site. Final products, mainly (tertiary) blade(let)s, flakes, and non-cortical fragments, are the main categories represented by the sample (Figure 3).

Fragmentary and/or fragmented objects have been included among the laminar supports, if of clear laminar derivation, such as proximal, mesial, or distal portions of blade(let)s. Laminar supports, both in flint and obsidian, prevail on flakes along the whole Neolithic period. During the *Diana* facies, the selection of laminar supports is at the highest rank: flint blade(let)s are 94% and obsidian 87%. Cores, all along the sequence, are present in a very low percentage (from 1 to 3%), with two significant exceptions: in fact, they represent almost 5% of the total in the Early Neolithic (Impressed Ware – archaic phase) and are completely absent from the facies of *Serra d'Alto* and *Diana* (with the exception of one small fragment of a core).

Whole blade(let)s are not frequent in the Neolithic sequence of Grotta San Michele: the highest percentages (15.4%) are found in the Early Neolithic. In the Middle Neolithic (*Bande Rosse, Tricromiche,* and *Serra d'Alto*), the presence of intact supports stands at 5%, while it decreases to 0.8% in the first phase of the Late Neolithic (*Diana*) and is at 7% in the second phase of the Late Neolithic (*Spatarella*).

Proximal fragments are quite common throughout the sequence (with an average of 25%), while the most common are mesial fragments with a peak of 67% during the *Diana* facies.

The regularity of the latter, in most cases, suggests intentionality in the partitioning of the artifact. Traces of an intentional activity in the partitioning of the products have been detected by micro-wear analysis.

The information deriving from the analysis of the striking platform revealed a meaningful difference between the production techniques of obsidian and flint artifacts, along the different horizons of the Neolithic, and from the percentage of partition of the artifacts, mainly blades.

The observation of percentage distribution of striking platform morphologies of flint and obsidian artifacts, in the different horizons of the Neolithic, highlights a low incidence of natural and dihedral platforms and a more important presence of faceted platforms, especially in correspondence with the earliest phases of the Neolithic (facies of the *Impresse Arcaiche* and *Evolute*). It must be mentioned that there is an absence of point or linear platforms during the Early Neolithic phase (*Impresse Arcaiche*). Punctiform/linear morphology, which appears in the second phase of the Early Neolithic (*Impresse Evolute*), shows a constant increase with a peak, in correspondence of the *Diana* facies (64%), in conjunction to the registration of the minimum value of the plain platforms (26%). With the subsequent facies of *Spatarella*, at the end of the Neolithic, a significant decrease in punctiform morphology, with 34%, and a substantial increase in plain morphologies with a value of 56% of the total are observed.

When artifacts are considered on the basis of their raw material (flint and obsidian), it is evident that the high degree of correlation between plain and punctiform striking platforms is essentially linked to the obsidian products only.

Based on the analysis of 395 obsidian laminar supports from the different Neolithic phases at Grotta San Michele (Figure 4), the average width was 10.2 mm with a standard deviation of 3.7 mm (Bande Rosse), 9.3 mm with a standard deviation of 2.3 mm (Tricromiche), 9 mm with a standard deviation of 2.4 mm (Serra d'Alto), 10.9 mm with a standard deviation of 3.5 mm (Diana), and 9.2 mm with a standard deviation of 2.6 mm (Spatarella). Even if data on the length have been also recorded, they are not presented here, given the high degree of partition in the supports.

Of the total amount of the artifacts, a minimum of 19% up to 29% (depending on the phase) was intentionally modified, in order to obtain burins, end scrapers, backed tools, or notches. Only at the end of the Late Neolithic (Spatarella) do flat retouched pieces (arrowheads) appear, with 15.4% of the total retouched artifacts. The essential typology of the whole Neolithic assemblage, according to Laplace typology, is presented in Table 3.

3.3 Micro-wear Analysis of the Obsidian Assemblages

3.3.1 Early Neolithic (*Stentinello*)

For the Early Neolithic, since there is no obsidian associated with the *Impresse Arcaiche* horizon, seven artifacts were selected from different Stratigraphic Units (US) pertinent to the *Stentinello* horizon (Table 4).

Two (Id. 287 AA1 – US 287 and Id. 06 097 – US 285 V) come from Palmarola, while the others are from Lipari.

Since at a first observation in low power approach of Id. 287 AA1 use-wear was not detected, while traces were visible at a higher magnification by a metallographic microscope, the artifact was selected for

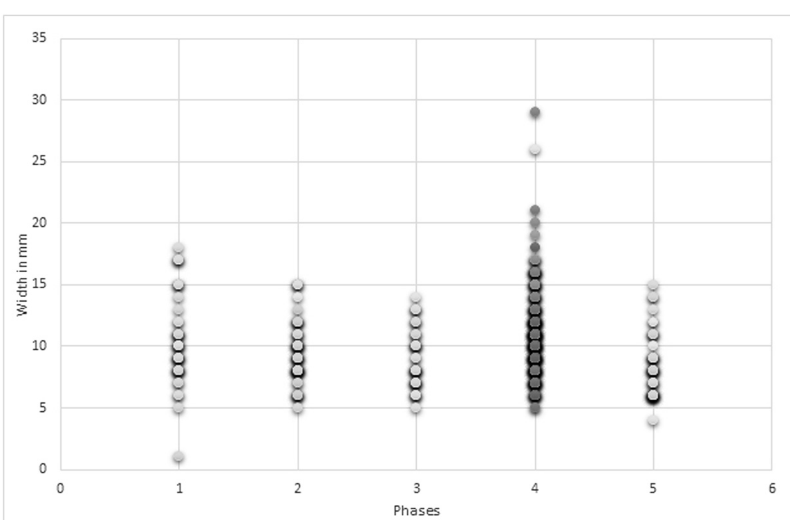


Figure 4: Graph of width (obsidian laminar supports) per separate phases: Bande Rosse (1), Tricromiche (2), Serra d'alto (3), Diana (4), and Spatarella (5).

Table 3: Typological description of the Neolithic assemblage

	Impresse Arcaiche		*Stentinello*		*Bande Rosse*		*Tricromiche*		*Serra d'Alto*		*Diana*		*Spatarella*	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Burins	1	7.1	0	0.0	1	6.3	0	0.0	0	0.0	5	7.0	3	7.7
End scrapers	2	14.3	0	0.0	1	6.3	1	5.3	0	0.0	4	5.6	4	10.3
Backed tools	8	57.1	11	61.1	2	12.5	5	26.3	3	30.0	9	12.7	9	23.1
Flat retouches	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	15.4
Substr.	3	21.4	7	38.9	12	75.0	11	57.9	7	70.0	53	74.6	17	43.6
Dv-Divers	0	0.0	0	0.0	0	0.0	2	10.6	0	0.0	0	0.0	0	0.0
Tot.	14	100	18	100	16	100	19	100	10	100	71	100	39	100

observation also by SEM. The abrasion localized by metallographic in correspondence to point number 1 in Figure 5 was clearly visible at an original magnification (OM) of 200× and 3D resolved by SEM.

Functional analysis revealed unused artifacts (Id. 06 097/094 and 134). When used, longitudinal (Id. 287 AA1) and rotatory (Id. 06 208 – Figure 6) actions were documented. Also noted was a transverse action recorded on the cutting edge of a trapeze (Id. 016 119 – Figure 6). The latter has been analyzed also by SEM and seems to be compatible with wear resulting from a strong impact with a hard material (such as bone), likely in a shooting activity.

3.3.2 Middle Neolithic (Bande Rosse, Tricromiche, and Serra d'Alto)

For the Middle Neolithic, *Bande Rosse* horizon, eleven artifacts were selected: six originate from a source different from Lipari and show no evident traces of use; only one, number 06 79, from US 285 III, shows technological traces on its retouched edge (as a scraper) (Table 5).

Artifacts made up of Lipari obsidian have been used and the active edges were involved in longitudinal activities, such as incision (four tools) or sawing (one tool). Inferred contact materials are wood and hide.

Three artifacts have been analyzed from the *Tricromiche* horizon. The artifacts are all from Lipari and one results unused (05 145). The two showing traces have been involved in cutting/sawing activities. Traces are compatible with a contact with dry hide. In one case, the contact material remained undetermined.

Of the three artifacts of *Tricromiche/Serra d'Alto* horizons, two are from sources different from Lipari (Id 219 and 219 BC1-2). One piece (n. 219) is unused, but shows trampling wear. The active edges of n. 219 BC1-2 and n. 05 108 were involved in scraping activities on hard wood.

3.3.3 Late (first phase "recente") Neolithic (*Diana*)

Of the nine artifacts of the first phase of the Late Neolithic (*Diana facies*) analyzed by micro-wear, all are from Lipari (Table 6). Five seem to be unused, while the others were involved in tasks that caused use-wear distributed in a longitudinal way to the active edges, evidencing cutting, sawing, and incision activities. Experimental traces compatible with the archaeological ones, observed on these tools, are those caused by contact with dry hide (Id. 04 230, 04 184/5).

3.3.4 Late (second phase "finale") Neolithic (*Spatarella*)

For the second phase of the Late Neolithic (*Spatarella style*), nine artifacts have been analyzed. Three are from sources different from Lipari (Id. 04 113, 103, 27) as detailed in Table 7. One from Lipari (Id. 04 109) and one from Sardinia (Id. 04 103) seem to be unused. Wear compatibility is with tasks involved with siliceous plants reaping (Id. 04 42) and dry hide processing (Id. 04 105).

Table 4: Micro-wear analysis (synthetic report) of a selection of obsidian artifacts from the Early Neolithic (Stentinello) layers

Id.	Description	US	Cultural facies	Provenance	Activity	Action	Movement	Inferred contact material	Use	Wear compatibility
287 AA1	Laminar pr. (mesial fr.)	287	Stentinello	Palmarola	Incision	Longitudinal	Bidirectional	Abrasive + dry	Used	Dry hide
06 097	Mesial flake	285 V	Stentinello	Palmarola	—	—	—	—	Unused	—
06 119	Trapeze	287	Stentinello	Lipari	Shooting	Transverse	Unidirectional	Hard material	Used	Animal body (bone contact after shooting)
06 094	Mesial flake	285 IV	Stentinello	Lipari	—	—	—	—	Unused	—
06 208	Retouched flake	287	Stentinello	Lipari	Piercing	Rotatory	Bidirectional	Soft humid material	Used	Fresh hide with additives
06 126	Fragment	300	Stentinello	Lipari	—	—	—	—	Used	—
06 134	Flake	301 II	Stentinello	Lipari	—	—	—	—	Unused	—

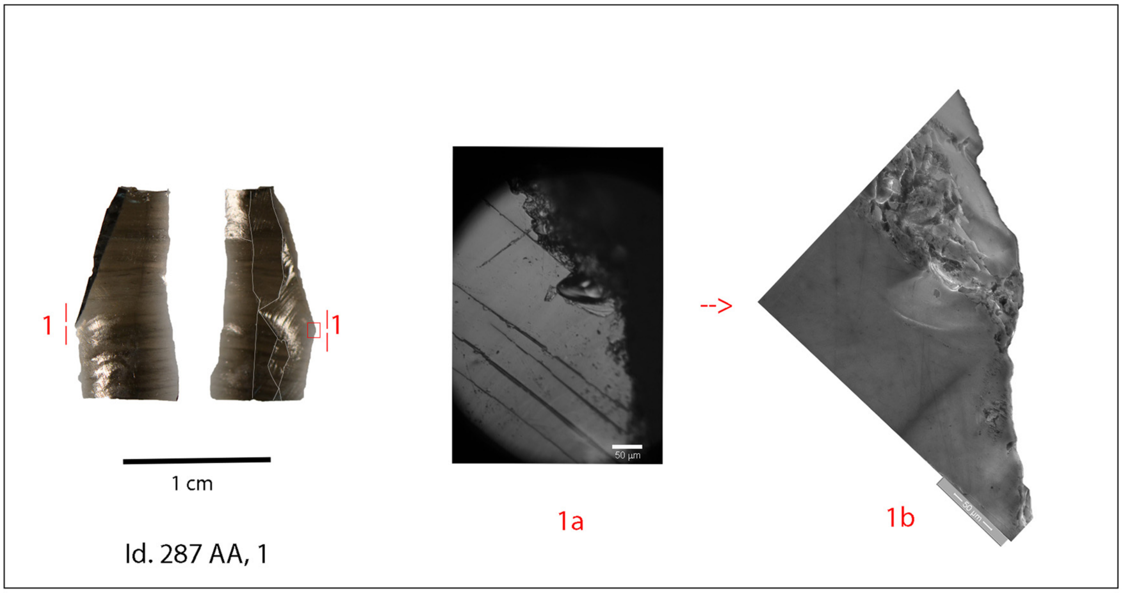


Figure 5: Id. 287 AA, 1. Use-wear observed with reflected-light optical microscope (OM 200×) (1a) and SEM (1b). Particular of the same scar with feather termination.

4 Discussion

As discussed in Freund et al. (2015), blades and bladelets are the most common artifact type created with Lipari obsidian, being found throughout Sicily, southern and central Italy, as well as at sites in northern Italy.

Results from techno-typological analysis carried out on Neolithic lithic assemblages from sites on source islands, e.g., Diana on Lipari (Martinelli et al., 2019), show a variety of products, with high percentages of categories linked to the early phases of the reduction sequence of the raw material, testifying a local transformation of obsidian. Ammerman and Andrefsky (1982), on the other hand, 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.

At Saracena, the lack of primary knapping debris, the absence of exhausted cores (only 2% on the total of the products is represented by cores at the end of the Neolithic period, with Spatarella), and the prevalence of laminar supports (portions of blade(let)s) on the other categories suggest that the first stages of reduction occurred, mostly, at different (southern) areas and that Neolithic communities exploiting the cave brought here, in prevalence, only the final products.

A substantial difference between the levels of the Early Neolithic (Impressed Ware and Stentinello) and the more recent levels has been observed in lithic resources management at Grotta San Michele di Saracena. The first difference is relevant to raw material exploitation. The horizon of the Impressed Ware – archaic phase presents a lithic assemblage consisting exclusively of flint artifacts. The presence of cores, although in minimal quantities, could attest to a modest on-site reduction activity. Obsidian appears in the advanced phase of the Early Neolithic, starting from the *Stentinello* horizon. With Stentinello, the geological sources for obsidian reaching Saracena are two: Lipari and Palmarola; from a techno-typological and a functional point of view, obsidian looks to have been tentatively and experimentally introduced in a still flint-dominated assemblage; in this phase, the lithic industry shows a high incidence of backed tools (as in the previous phase), among the retouched artifacts.

It is only within the early stages of the Middle Neolithic (*Bande Rosse* and *Tricromiche*) that the percentage contribution of flint decreases sharply, in favor of obsidian which will remain the most used raw material for the whole Neolithic. The last datum, considered within the topographical position of the

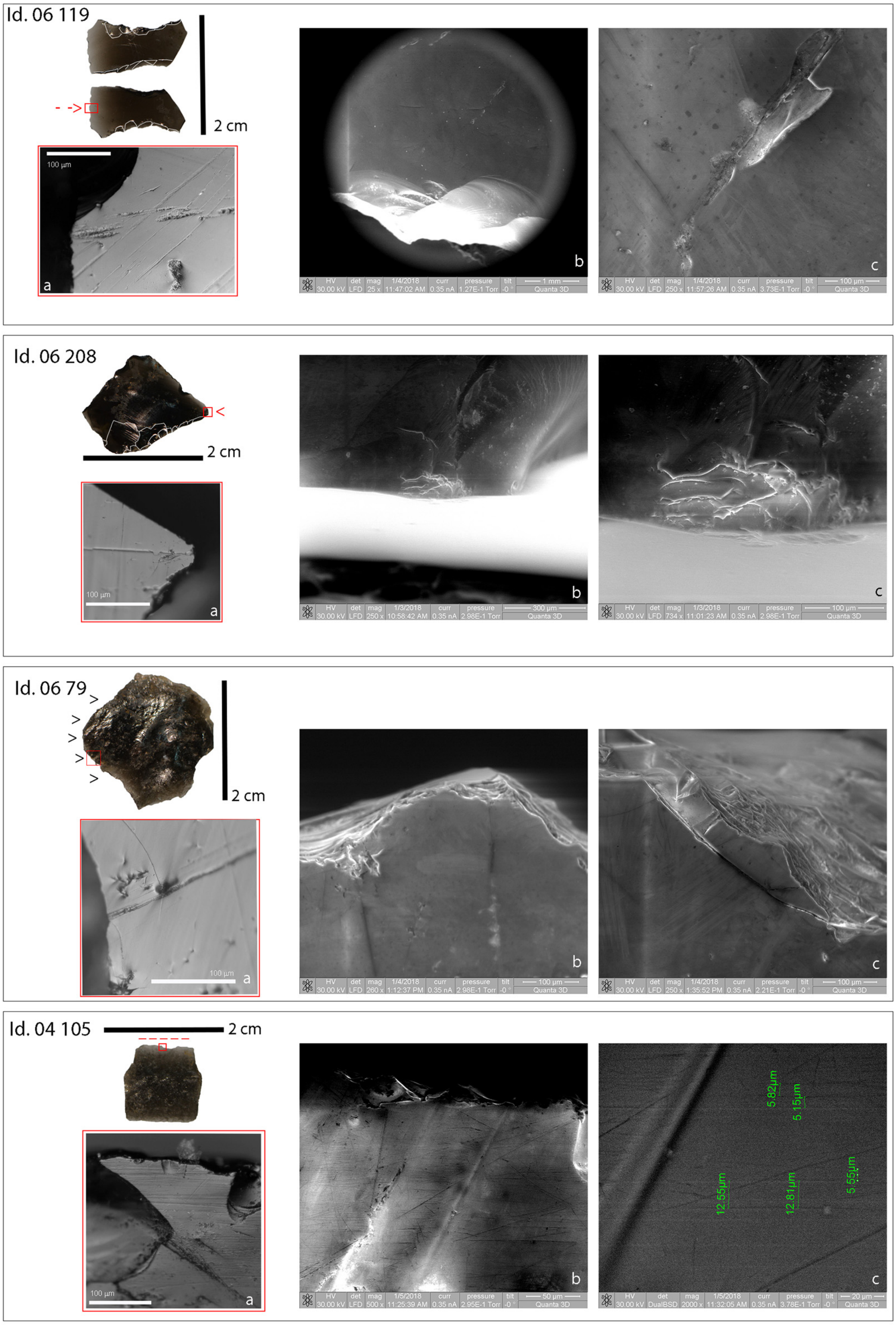


Figure 6: Obsidian tools from Neolithic layers. Id. 06 119, 06 208, 06 79, and 04 105: use-wear location on tools; use-wear (scratches, incipient fractures, striae, abrasion) observed with a reflected-light optical microscope (OM 200×) (a) and by SEM (b and c).

Table 5: Micro-wear analysis (synthetic report) of a selection of obsidian artifacts from the Middle Neolithic (Bande Rosse, Tricromiche, Serra d'Alto) layers

Id.	Description	US	Cultural facies	Provenance	Activity	Action	Movement	Inferred contact material	Use	Wear compatibility
06 57	Laminar pr.	285 I	Bande Rosse	Lipari	Incision	Longitudinal	Bidirectional	Hard material	Used	Bone
06 75	Trapeze	285 III	Bande Rosse	Palmarola	—	—	—	—	Unused	—
06 28	Laminar pr. (mesial fr.)	267	Bande Rosse	Lipari	—	—	—	—	Unused	—
06 79	Scraper	285 III	Bande Rosse	Lipari	—	—	—	Hard material	Unused	Stone hammer
281 A4		281	Bande Rosse	Lipari	—	—	—	—	Unused	—
06 72	Laminar pr.	285 III	Bande Rosse	Lipari	—	—	—	—	Unused	—
06 059	Laminar pr. (distal fr.)	285 I II	Bande Rosse	Lipari	Incision	Longitudinal	Unidirectional	Hard material + dry	Used	Dry hide (uncertain)
06 034	Distal flake	267	Bande Rosse	Lipari	?	Longitudinal	Unidirectional	Undet.	Used	Undet.
06 006	Laminar pr. (mesial fr.)		Bande Rosse	Lipari	Incision	Longitudinal	Unidirectional	Soft humid material	Used	Soft wood
06 45	Laminar pr. (worked)	285 II	Bande Rosse	Lipari	Incision	Longitudinal	Unidirectional	Soft humid material	Used	Fresh hide with additives
06 017	Laminar pr. (mesial fr.) worked	267	Bande Rosse	Lipari	Sawing	Longitudinal	Bidirectional	Soft humid material	Used	Soft wood
05 178	Laminar pr. (mesial fr.)	242 I	Tricromiche	Lipari	Sawing	Longitudinal	Bidirectional	Hard material + dry	Used	Dry Hide
05 144	Laminar pr. (proximal fr.)	242	Tricromiche	Lipari	Incision	Longitudinal	Unidirectional	—	Used	Undet.
05 145	Laminar pr. (mesial fr.)	242	Tricromiche	Lipari	—	—	—	—	Unused	—
219	Fragment	219	Tricro-Serra d'Alto	Lipari	—	—	—	—	Unused	Trampling
219 BC1 2	Laminar pr. (worked)	219	Tricro-Serra d'Alto	Lipari	Scraping	Transverse	Unidirectional	Hard material	Used	Hard wood
05 108	Laminar pr. (mesial fr.)	219	Tricro-Serra d'Alto	Lipari	Scraping	Transverse	—	Hard material	Used	Hard wood

Table 6: Micro-wear analysis (synthetic report) of a selection of obsidian artifacts from the Late (first phase "recente") Neolithic (Diana) layers

Id.	Description	US	Cultural facies	Provenance	Activity	Action	Movement	Inferred contact material	Use	Wear compatibility
04 230	Laminar pr. (mesial fragment)	194	Diana	Lipari	Sawing	Longitudinal	Bidirectional	Hard material + dry	Used	Dry hide
03 79	Bladelet (proximal fragment)	28 I	Diana	Lipari	Cutting	Longitudinal	Unidirectional	Abrasive	Used	Undet.
04 191	Laminar pr. (mesial fragment)	170 I	Diana	Lipari	—	—	—	—	Unused	—
04 205	Laminar pr. (mesial fragment)	170 III	Diana	Lipari	—	—	—	—	Unused	—
04 169	Laminar pr. (mesial fragment)	170 I	Diana	Lipari	—	—	—	—	Unused	—
04 171	Laminar pr. (mesial fragment)	170 I	Diana	Lipari	—	—	—	—	Unused	—
04 170	Laminar pr. (mesial fragment)	170 I	Diana	Lipari	—	—	—	—	Unused	—
04 185	Laminar pr. (mesial fragment)	170 I	Diana	Lipari	Incision	Longitudinal	Unidirectional	Abrasive + dry	Used	Dry hide
04 184	Laminar pr. (proximal fragment)	170	Diana	Lipari	Incision	Longitudinal	Unidirectional	Abrasive + dry	Used	Dry hide

Table 7: Micro-wear analysis (synthetic report) of a selection of obsidian artifacts from the Late (second phase "finale") Neolithic (Spatarella) layers

Id.	Description	US	Cultural facies	Provenance	Activity	Action	Movement	Inferred contact material	Use	Wear compatibility
04 113	Fragment	144	Spatarella	Sardinia SB2	Incision	Longitudinal	Unidirectional	Abrasive + dry	Used	Undet.
04 103	Laminar pr. (whole)	119	Spatarella	Sardinia SA	—	—	—	—	Unused	—
04 27	Laminar pr. (mesial fragment)	114	Spatarella	Sardinia SA	Incision	Longitudinal	Unidirectional	Soft humid material	Used	Undet.
04 42	Laminar pr. (mesial fragment)	114	Spatarella	Lipari	Reaping	Longitudinal	Unidirectional	Abrasive	Used	Siliceous plants
04 029	Laminar pr. (mesial fragment)	114	Spatarella	Lipari	Cutting	Longitudinal	Unidirectional	Abrasive	Used	Undet.
04 109	Laminar pr. (mesial fragment)	119	Spatarella	Lipari	—	—	—	—	Unused	—
04 108	Laminar pr. (proximal fragment)	119	Spatarella	Lipari	—	—	—	—	Used	—
04 105	Laminar pr. (mesial fr.)	119 I	Spatarella	Lipari	Incision	Longitudinal	Unidirectional	Hard material + dry	Used	Dry hide
04 104	Fragment	119 I	Spatarella	Sardinia SA	—	—	—	—	Unused	—

cave, situated in a mid-range of elevation, shall be evidence of an intentional selection of the raw material by the Neolithic human groups peopling the cave, mainly during specific periods, such as the *Bande Rosse/ Tricromiche* phase, where the percentage of the natural glass is very high.

A second difference emerges from the study of the production technology. The presence ratio of different types of striking platforms shows a constant growth of punctiform and linear, compared to plain typology. The main presence of the punctiform typology is observed in the *Diana* phase. The latter consideration is evidence of a difference in the technical choices for the production of flint and obsidian artifacts and suggests a specialization in obsidian debitage, perhaps to be linked to the Lipari or southern Calabria specialized workshops. The excavation, conducted in the central part of the cave, did not find evidence of any important traces of knapping activities, excluding a few obsidian cores and some angular waste or fragments eventually related to some stage of the reduction sequence, likely circulating with selected final products, because of their sharp edges. Even if it is not possible to exclude such activities outside the limited area of the excavation, it appears possible to consider the hypothesis that mainly finished products reached the site, especially during the *Diana facies* where a high standardization of the technology of production of bladelets has been observed and an intentional selection of supports shall be hypothesized.

Among laminar products, therefore, which make up the vast majority of chipped stone products, entire ones are not frequent; the proximal fragments are quite common, while the most common are the mesial fragments, with a peak of 67% in correspondence with the *Diana* facies. The regularity of the latter would suggest the intention of partitioning the supports, interpretable in some cases, as a functional choice for the handle of the supports themselves.

From a strictly typological point of view, two conceptions emerge from our analysis: the first, including the two phases of the Early Neolithic, sees the prevalence of backed tools, while, during the final stage of the Neolithic (Spatarella), flat retouch is used in the production of arrowheads.

The sample analyzed by use-wear shows no differences in the use of different sources of obsidian; even if not enough to define the whole range of tasks carried out by the Neolithic groups peopling the cave, it nevertheless sheds new light on some technical behaviors, such as the preference, during the advanced phases of the Neolithic, to use obsidian tools in tasks concerning cutting or incision activities, on the contrary to the earlier phase (Impressed Ware) when obsidian was still used to produce tools, such as trapezes, likely used as projectiles for hunting tasks.

We argue that Saracena well represents a site of reception of final products (both for flint and obsidian) with some differences among the early and the final stages of the Neolithic. Since a reduction activity for chert seems not to occur locally in the cave, the high proportion of laminar products among the chert pieces may imply that also the chert assemblage is reaching the cave in prepared form through exchange networks. What is being observed in the Grotta San Michele would be the operation of just one lithic system both for obsidian and chert, differently from the case observed to the south, in the Acconia area, where two complementary systems, one for obsidian and the other for chert, have been described by Ammerman (1979). While obsidian has not been documented during the Impresse Arcaiche, and the raw material represents only 15% of the whole lithic assemblage of Stentinello, with the painted pottery horizons it becomes suddenly the main raw material until the last Neolithic phase with Spatarella. This strong preference has to be connected also to functional choices that preliminary results of the micro-wear analysis suggest a link to the high effectiveness of the natural glass in activities involving a longitudinal motion of the edges, with respect to the contact material.

The analysis of different phases of the Neolithic sequence of Grotta San Michele shows at least two main approaches regarding the choice and supply of raw materials and the transformation and use of the artifacts. The difference between two different technological conceptions is evident in correspondence to the passage from Impressed Ware to painted ware horizons. From this moment, the sequence finds some stability until a new change with the *Spatarella* facies, at the end of the Neolithic. During this last phase, furthermore, the presence of four obsidian artifacts from Sardinian geological sources is quite interesting for the economic implications and questions linked to the agency and modalities of such long-distance trade and exchange in a context where the standard supply was from one-source (Lipari) since the Middle

Neolithic. These four artifacts originate from a source different from the one regularly used, so they can be considered "eccentric" (Tykot, 2011), even if their functional destination and modalities of use seem not to differ from the ones from Lipari. In our case, "eccentric" shall imply changes in the exchange network of agro-pastoral communities of southern Italy at the end of the Neolithic.

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