A pre-Heinrich Event 3 assemblage at Fumane Cave and its contribution for understanding the beginning of the Gravettian in Italy

Ein vor das Heinrich 3-Ereignis datierendes Inventar aus der Fumane-Höhle und sein Beitrag zum Verständnis des Beginns des Gravettien in Italien

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Abstract - In Europe, the cultural trajectories of large-scale Upper Paleolithic cultural complexes, such as the Aurignacian and the Gravettian, represent highly debated topics. In this paper, we examine the evidence from the youngest anthropic layer D1d at Fumane Cave (Venetian Prealps, northeastern Italy) to investigate the nature of human settlement dynamics in the Great Adriatic-Padanian Region following the late Protoaurignacian cultural unit and before the advent of the Heinrich Event 3. We present an unusual charcoal feature unearthed during archaeological excavations and we conduct a careful techno-typological assessment of the lithic assemblage using a combination of reduction sequence analysis and attribute analysis. We thus explore the mode of occupation of the site and discuss the available radiocarbon dates on a regional and supra-regional scale. This study permits to assign layer D1d to the Gravettian as described in several sites south of the Alps and along the Italian peninsula. Moreover, the scarcity and general composition of the lithic assemblage supports the idea according to which human settlement at the edge of the Great Po Plain was sparse and intermittent in the early stages of this technocomplex. Finally, we address the early radiocarbon age estimation available for layer D1d and hypothesize different scenarios that need to be further explored.

***Zusammenfassung -** In Europa stellen die Verläufe großmaßstäblicher Kulturkomplexe des Jungpaläolithikums, wie z.B. des Aurignaciens und des Gravettiens, stark debattierte Themen dar. In dem vorliegenden Beitrag untersuchen wir die Zeugnisse der jüngsten archäologischen Schicht D1d der Fumane Höhle (Venezianische Voralpen, Nordostitalien), um die Art der menschlichen Siedlungsdynamik in der Großen Adria-Padanischen Region nach dem späten Protoaurignacien und vor dem Aufkommen des Heinrich-Events 3 zu untersuchen. Wir präsentieren einen ungewöhnlichen Holzkohlebefund, das bei archäologischen Ausgrabungen zutage getreten ist, und führen eine sorgfältige techno-typologische Bewertung des lithischen Inventars durch, wobei wir eine Kombination aus Reduktionsfolge- und Attributanalyse anwenden. Auf diese Weise untersuchen wir die Art der Besiedlung der Fundstelle und diskutieren die verfügbaren Radiokarbondaten auf regionaler und überregionaler Ebene. Diese Studie erlaubt es, die Schicht D1d dem Gravettien zuzuordnen, wie sie an mehreren Standorten südlich der Alpen und entlang der italienischen Halbinsel beschrieben wurde. Die Seltenheit und allgemeine Zusammensetzung der lithischen Inventare unterstützt zudem die Hypothese, dass die menschliche Besiedlung am Rande der Grossen Poebene in den frühen Phasen dieses Technokomplexes spärlich und diskontinuierlich war. Schließlich befassen wir uns mit der frühen Radiocarbondatierung der Schicht D1d und stellen verschiedene Hypothesen auf, die zukünftig weiter untersucht werden müssen.*

Keywords - Early Upper Paleolithic, Lithic Technology, Foragers, Great Adriatic-Padanian Region
Frühes Jungpaläolithikum, Lithische Technologie, Foragers, Große Adriatisch-Padanische Region

Introduction

The Italian mid Upper Paleolithic is known from several cave and open-air sites. They are distributed in different environmental settings, from the pre-Alpine continental region to the eastern and western Mediterranean costal belt along the peninsula (Palma di Cesnola 2001; Mussi 2002). In Italy, like in

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other regions of Europe, the development of the Aurignacian and the appearance of another large-scale cultural complex, the Gravettian, are debated. According to recent reassessment conducted at Fumane Cave (Falcucci 2018) and Bombrini Rockshelter (Riel-Salvatore & Negrino 2018), the Protoaurignacian lasted well after the Campanian Ignimbrite volcanic eruption (Giaccio et al. 2008) and the partially contemporaneous Heinrich Event 4 (Bond & Lotti 1995), most likely up to 36 ka calBP. According to other authors, instead, the Protoaurignacian was replaced by the Early Aurignacian (e.g. Tejero & Grimaldi 2015; Degano et al. 2019). Whatever the definitive answer to this important question will be, the Aurignacian was at some point in time replaced by the Gravettian, whose techno-typological signatures seem to have spread in a rather short time-span across Europe (Reynolds & Green 2019). In Italy, the earliest known Gravettian assemblage is dated to ca. 33.9-32.8 ka calBP at Rio Secco Cave at the edge of the Great Po Plain (Talamo et al. 2014) and slightly later at Paglicci Cave in the southern Adriatic region (Palma di Cesnola 2004).

In order to elucidate the changes in human settlement dynamics that occurred under changing climatic conditions between 36 and 30 ka calBP, we need to construct a more comprehensive archeological database. This can be achieved through the discovery of new stratified sites with late Pleistocene deposits, but also with the assessment of unpublished assemblages dated to this time span. Here, we analyze for the first time the youngest anthropic layer discovered at Fumane Cave in northeastern Italy (Fig. 1) with the aim of clarifying its cultural attribution and the nature of human settlement dynamics in the Prealps following the late Protoaurignacian at ca. 36 ka calBP (Higham et al. 2009) and predating the Heinrich Event 3. This assemblage has received little attention because of the small number of artifacts recovered compared to the underlying Protoaurignacian, Uluzzian, and Mousterian layers. According to Bartolomei et al. (1992), the D1d assemblage can be assigned to a Gravettian *sensu lato*, although no technological and typological studies have been conducted to verify its cultural attribution, understand the modality and circumstances of the occupation of the cave, and discuss the reliability of the available radiocarbon dates. We will address these issues with the final goal to discuss the importance of the site in its regional setting and within the Italian mid Upper Paleolithic record.

The site of Fumane Cave

Fumane Cave is one of the most studied Paleolithic sites of Europe. Located in the Monti Lessini, Venetian Prealps, it was first excavated in 1988 (Bartolomei et al. 1992). Archaeological excavations have been conducted since then and are now under the direction of one of us (MP). The deposit has accumulated for most of the Late Pleistocene, and several Mousterian, Uluzzian, and Protoaurignacian layers document the repeated frequentation of the cave from both Neanderthals and modern humans (Bartolomei et al. 1992; Cassoli & Tagliacozzo 1994; Broglio et al. 2003; Broglio et al. 2005; Broglio & Dalmeri 2005; Higham et al. 2009; Peresani 2012; Benazzi et al. 2015; López-García et al. 2015; Peresani et al. 2016; Falcucci et al. 2017).

The youngest sedimentary succession – named macro-unit D – formed during a phase of climatic deterioration (Broglio et al. 2003; López-García et al. 2015), which resulted in different episodes of rock-collapse and aeolian sedimentation that progressively sealed the cave entrance. The last unit was only noticed at the entrance of the cave and in its internal part and was named D1 (Fig. 2). From a lithological point of view, it is mostly formed of very coarse materials (boulders and stones) mixed with sandy matrix.

Evidence of human presence are less dense if compared to the early and late Protoaurignacian layers. D1 was divided in different layers, from bottom to top: D1c, D1d, D1e, and D1f (Figs. 3 & 4). D1c was described as Aurignacian *sensu lato* (Bartolomei et al. 1992). The D1c lithic assemblage (n = 172) is mostly formed of flakes blanks (75 % of the total blanks). Among tools (n = 6), two endscrapers on flake, a retouched flake, a scaled piece, a bladelet with lateral retouch, and a blade with scaled retouch were collected. At the time being, we can only attribute this assemblage to an undifferentiated Upper Paleolithic. The overlying D1d, which is the focus of this paper, was assigned to the Gravettian *sensu lato* (Bartolomei et al. 1992; Broglio 1997). Finally, D1e and D1f were described as almost sterile layers. The discovery of several large-sized bones with gnawing marks points towards the presence of carnivores during the formation of D1e-f.

A few radiocarbon dates are available for layer D1d and the overlying layer D1e (Broglio & Dalmeri 2005; Higham et al. 2009). According to these dates, layer D1d formed between 35.9-33.2 ka calBP. If only the most recently obtained date was considered, the assemblage would date to ca. 35.9-35.0 ka calBP. A more roughly chronological framework for the formation of the stratigraphic sequence was provided by López-García et al. (2015) using the biostratigraphy of the small mammals assemblage. The authors identified the Heinrich Event 3, which took place at around 30 ka calBP (Bond & Lotti 1995; Hemming 2004), in the overlying layer D1e.

Materials and methods

In this study, we focus our attention to the youngest anthropic layer D1d, which comprises spits D1d base and D1d tetto. This layer, which was easily discernible during excavations, is only present in the cave entrance and cave mouth. An extended accumulation of macro- and micro-charcoals was found over a large extent of

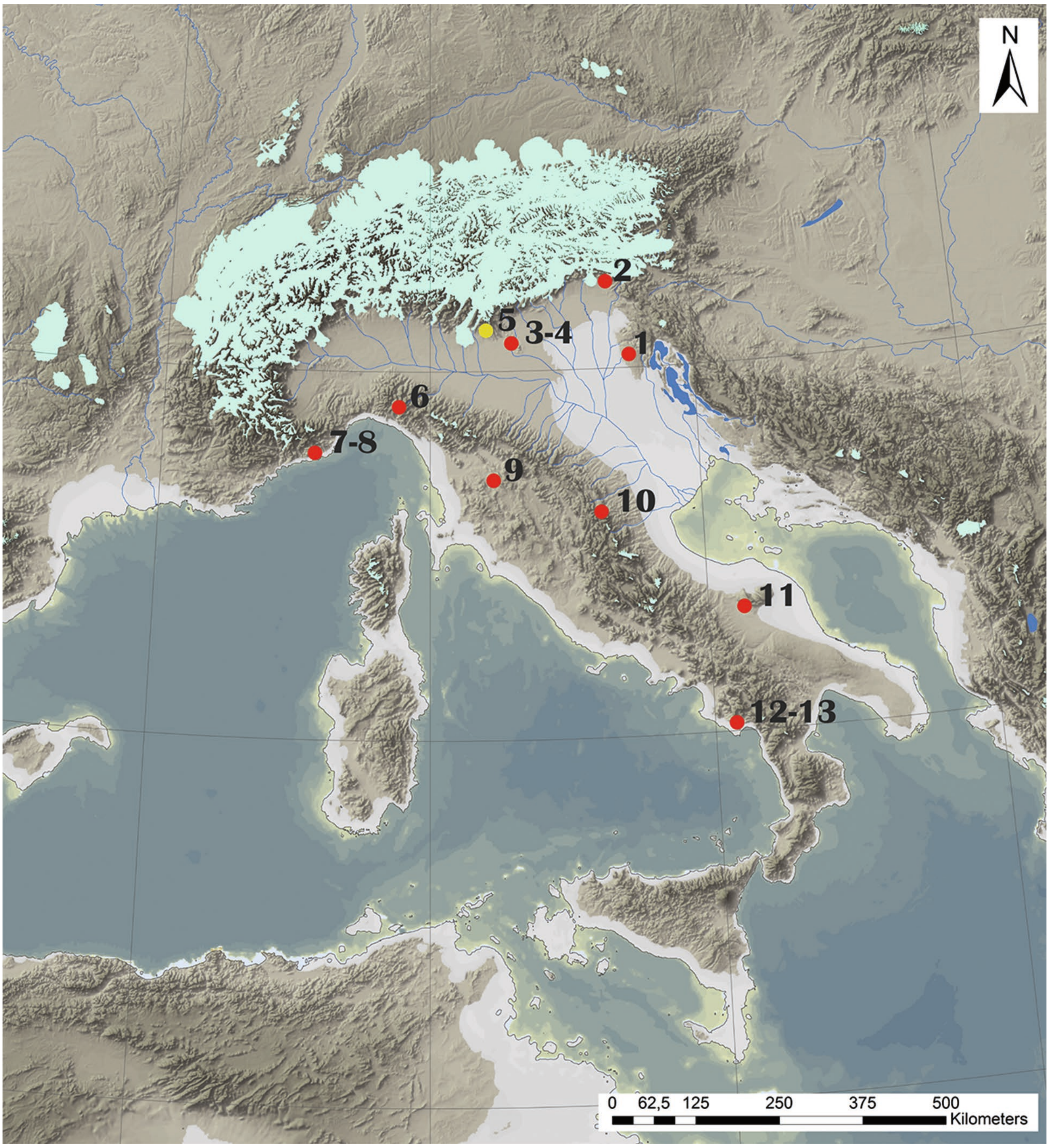

Fig. 1. Map of the Great Adriatic-Po Region and the Italian peninsula, showing the Late Pleistocene maximum extent of glaciers (after Ehlers & Gibbard 2004) and the continental belts during MIS2. The map shows the location of Fumane Cave (in yellow) and other sites discussed in the paper: 1) Kontija 002 Rockshelter; 2) Rio Secco Cave; 3–4) Broion sites (cave and rockshelter) and Paina Cave; 5) Fumane Cave; 6) Piovesello; 7–8) Mochi Rockshelter and Bombrini Rockshelter; 9) Bilancino; 10) Fonte delle Mattinate; 11) Paglicci Cave; 12–13) La Cala Cave and Calanca Cave.

Abb. 1. *Karte der Adria-Po Region und der italienischen Halbinsel, mit der maximalen Ausdehnung der Gletscher im Spätpleistozän (nach Ehlers & Gibbard 2004) und den Kontinentalgürteln während der MIS2. Die Karte zeigt die Lage der Fumane-Höhle (in gelb) und anderer im Text besprochener Orte: 1) Kontija 002 Rockshelter; 2) Rio Secco-Höhle; 3) Broion-Höhle und –Rockshelter; 4) Paina-Höhle; 5) Fumane-Höhle; 6) Piovesello; 7) Mochi Rockshelter; 8) Bombrini Rockshelter; 9) Bilancino; 10) Fonte delle Mattinate; 11) Paglicci-Höhle; 12) La Cala-Höhle und 13) Calanca-Höhle.*

its surface. This unusual feature is currently under anthracological investigation. The layers on top of D1d are almost devoid of lithic artifacts (see above) and will not be considered. We conducted a careful screening of the excavation notebooks and photos taken during the excavations to evaluate the stratigraphic integrity of the assemblage. The total number of artifacts collected (n = 159) is fairly low if compared to the Mousterian, Uluzzian, and Protoaurignacian units (Peresani 2012; Peresani et al. 2016; Falcucci et al. 2017). The archaeological material was either directly excavated using a 33×33 cm grid or

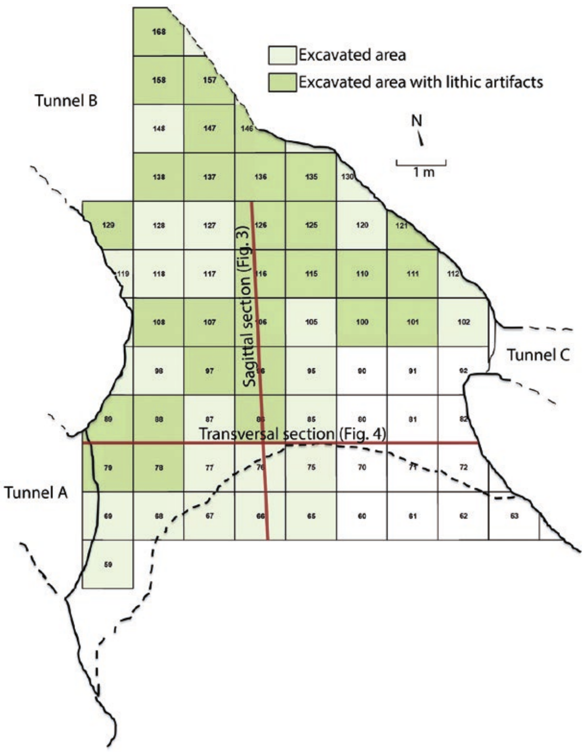

Fig. 2. Plan view of the cave entrance and the lateral tunnels showing the grid and the excavation zones of the stratigraphic complex D1. Squares colored light green are the square meters excavated between 1988 and 2005. Lithic artifacts from layer D1d have been retrieved in square meters colored dark green. Solid red lines outline the sagittal and transversal sections drawn in figures 3 and 4. The present-day drip line is projected to the ground by the dotted line (drawing: A. Falcucci).

Abb. 2. *Grundriss des Höhleneingangs und der seitlichen Gänge mit dem Raster und den Ausgrabungszonen des stratigraphischen Komplexes D1. Hellgrün gefärbte Flächen sind die zwischen 1988 und 2005 ausgegrabenen Quadratmeter. Lithische Artefakte aus der Schicht D1d wurden in dunkelgrün gefärbten Quadratmetern geborgen. Rote Linien umreißen die in den Abbildungen 3 und 4 gezeichneten Sagittal- und Transversalschnitte. Die heutige Tropfenlinie wird durch die gepunktete Linie auf den Boden projiziert (Zeichnung: A. Falcucci).*

recovered from wet sieving. In this study, we consider all recovered artifacts. They were counted and divided according to the technological class and the sub-square of provenience. The minimum number of flaked products (MNFP) was calculated by considering only blanks with preserved butts.

We analyzed the lithic artifacts using a combination of reduction sequence analysis (Boëda et al. 1990; Inizan et al. 1995; Conard & Adler 1997; Soressi & Geneste 2011) and attribute analysis (Andrefsky 1998; Odell 2004; Tostevin 2013). We applied the same procedure to study the early and late Protoaurignacian layers at the site (Falcucci et al. 2017; Falcucci 2018). By doing so, we were able to interpret and objectively evaluate patterns of core reduction and tool manufacture. Furthermore, we performed diacritic analyses (Dauvois 1976; Roussel 2011; Pastoors et al. 2015; Falcucci & Peresani 2018) to reconstruct the chronology, the direction of removals, the stages of production on cores and short sequences of removals on blanks. We describe tool types using a revised and simplified version of the most used Upper Paleolithic typologies (Sonneville-Bordes de 1960; Demars & Laurent 1992), while bladelets with marginal retouch are described after Falcucci et al. (2018). The width metric boundary between blades and bladelets was placed at 12.0 mm (Tixier 1963), in agreement with most of the studies conducted on European Upper Paleolithic assemblages.

Excavations of layer D1d

Macro-unit D1 was first excavated in 1988, when this sedimentary body was discovered in the atrial part of the cave. In 1991, D1 was divided into different layers according to their lithological features (Fig. 5: a & b). D1c is a layer of dolomitic yellow sands with boulders interpreted as the result of a landslide event on top of which a loamy layer with stones and rich in charcoal was described (D1d). At first, D1d was considered as an almost sterile layer from a few to 30 cm in thickness. Further landslide events were claimed for interpreting the origin of the overlying layers D1e and D1f (Bartolomei et al. 1992). One of the last extensive excavations of macro-unit D1 took place in 1996, when the excavators decided to open a larger excavation area to investigate the Protoaurignacian from layers D3 and A2–A1. In this year, an ambiguous feature characterized by high concentration of charcoal, ashes, and few burned bones was described (Fig. 5: c). The external limit of the feature was not reached. From 2001 to 2005, D1 was excavated in the innermost part of the cave, thus adding a few square meters to the total area of ca. 53 sqm explored. Here, layer D1d was still visible, although its upper limits were more difficult to record. The layer was still characterized by the presence of charcoals, which could be up to five centimeters in size and formed a continuous charcoal-line at base of the layer (Fig. 5: e). They were extremely numerous in squares 127–137, where a large-sized charcoal body was unearthed and interpreted as a possible branch or trunk of a tree (Fig. 5: d & f). A few clasts (ca. 5–10 cm in size) that rested over this charcoal body were altered and blackened. The underlying sediment was reddish in some areas, which was interpreted as evidence for the action of fire.

Results

Overview of the lithic assemblage

A total number of 159 lithic artifacts were recovered in D1d. They are in most cases blanks (n = 131; 82 %), followed by tools (n = 13; 8 %), angular debris (n = 10; 6 %), and cores (n = 5; 3 %). The assemblage was made on chert of different carbonatic formations from the western Lessini plateau. Raw material nodules could be easily collected within 5–15 km from Fumane Cave, from both outcrops and loose coarse stream or fluvial gravels, slope-waste deposits, and soils in the

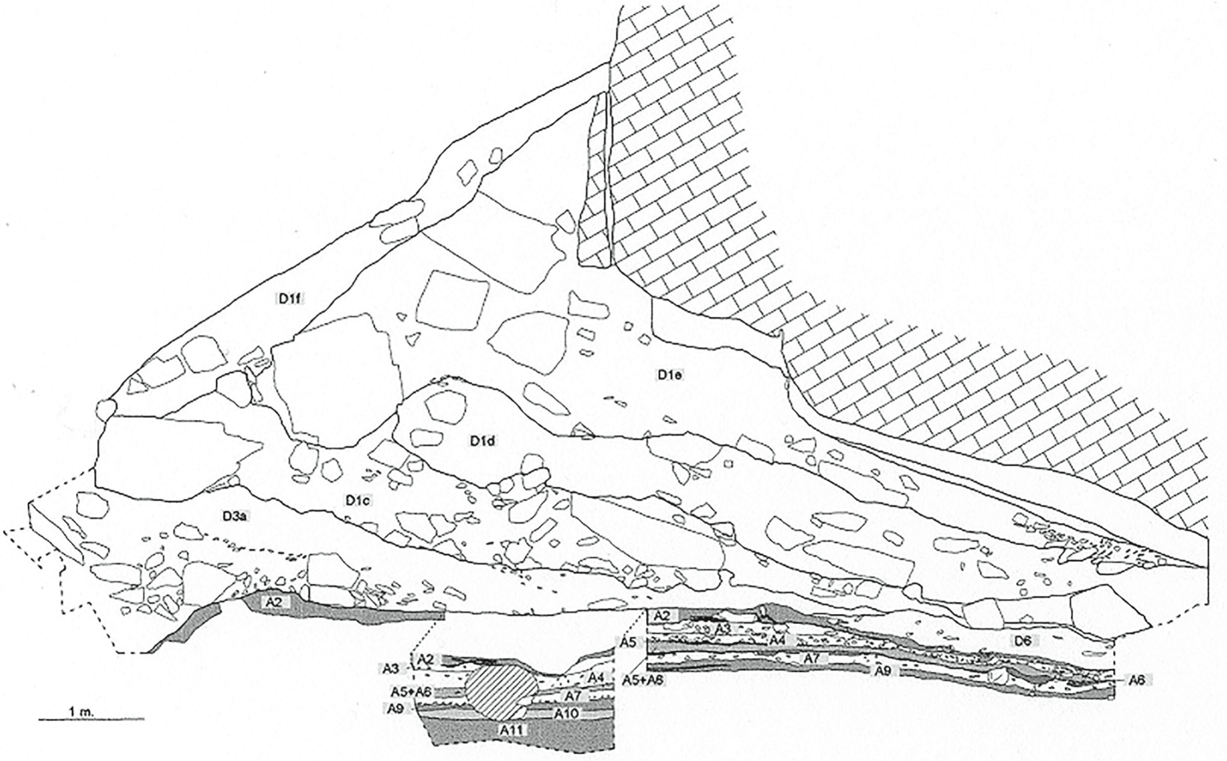

Fig. 3. Sketch of sagittal section of the cave with evidence of the late Mousterian (A11-A5), Uluzzian (A4-A3), early Protoaurignacian (A2), late Protoaurignacian (D6–D3a), and the stratigraphic complex D1 (D1c, D1d, D1e, and D1f) (section by M. Cremaschi and M. Peresani, redrawn by S. Muratori).

Abb. 3. *Skizze des Sagittalschnitts der Höhle mit Nachweisen des späten Mousterien (A11-A5), Uluzzien (A4-A3), frühes Protoaurignacien (A2), spätes Protoaurignacien (D6-D3a) und der stratigraphische Komplex D1 (D1c, D1d, D1e und D1f) (Profilzeichnung von M. Cremaschi und M. Peresani, neu gezeichnet von S. Muratori).*

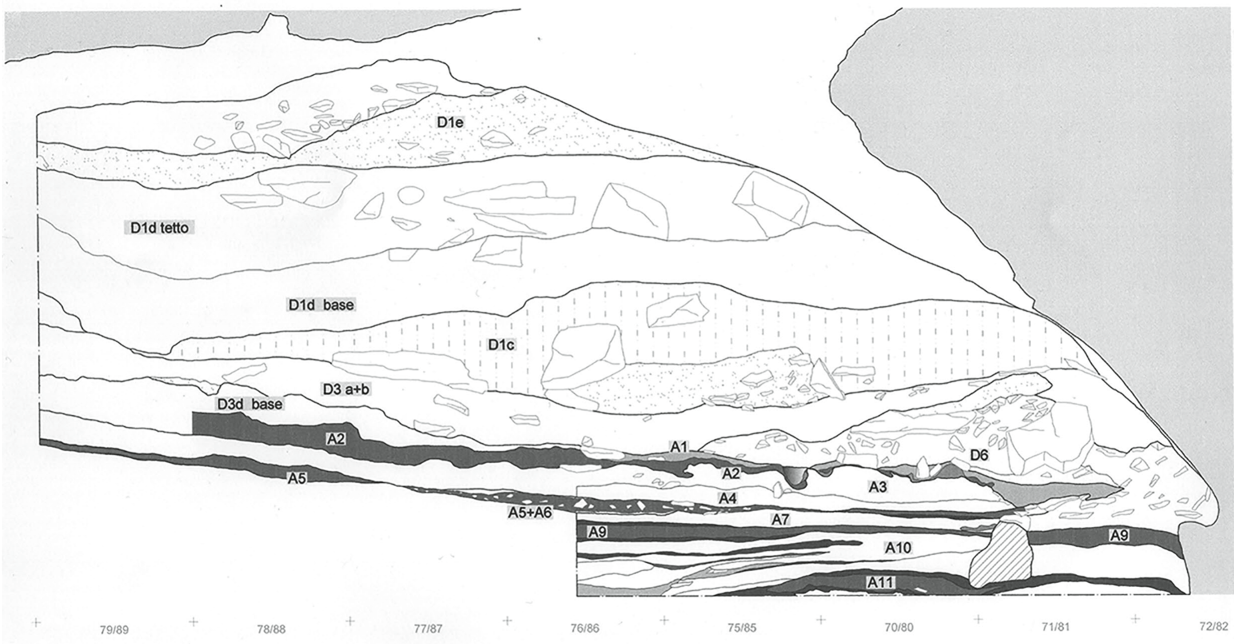

Fig. 4. Sketch of transversal section of the cave showing layer D1d divided into a lower (D1d base) and an upper (D1d tetto) spit (section by M. Peresani and S. Muratori).

Abb. 4. *Skizze des Höhlenquerschnitts mit der Schicht D1d, die in einen unteren (D1d-Basis) und einen oberen (D1d-Tetto) Abtrag unterteilt ist (Profilzeichnung von M. Peresani und S. Muratori).*

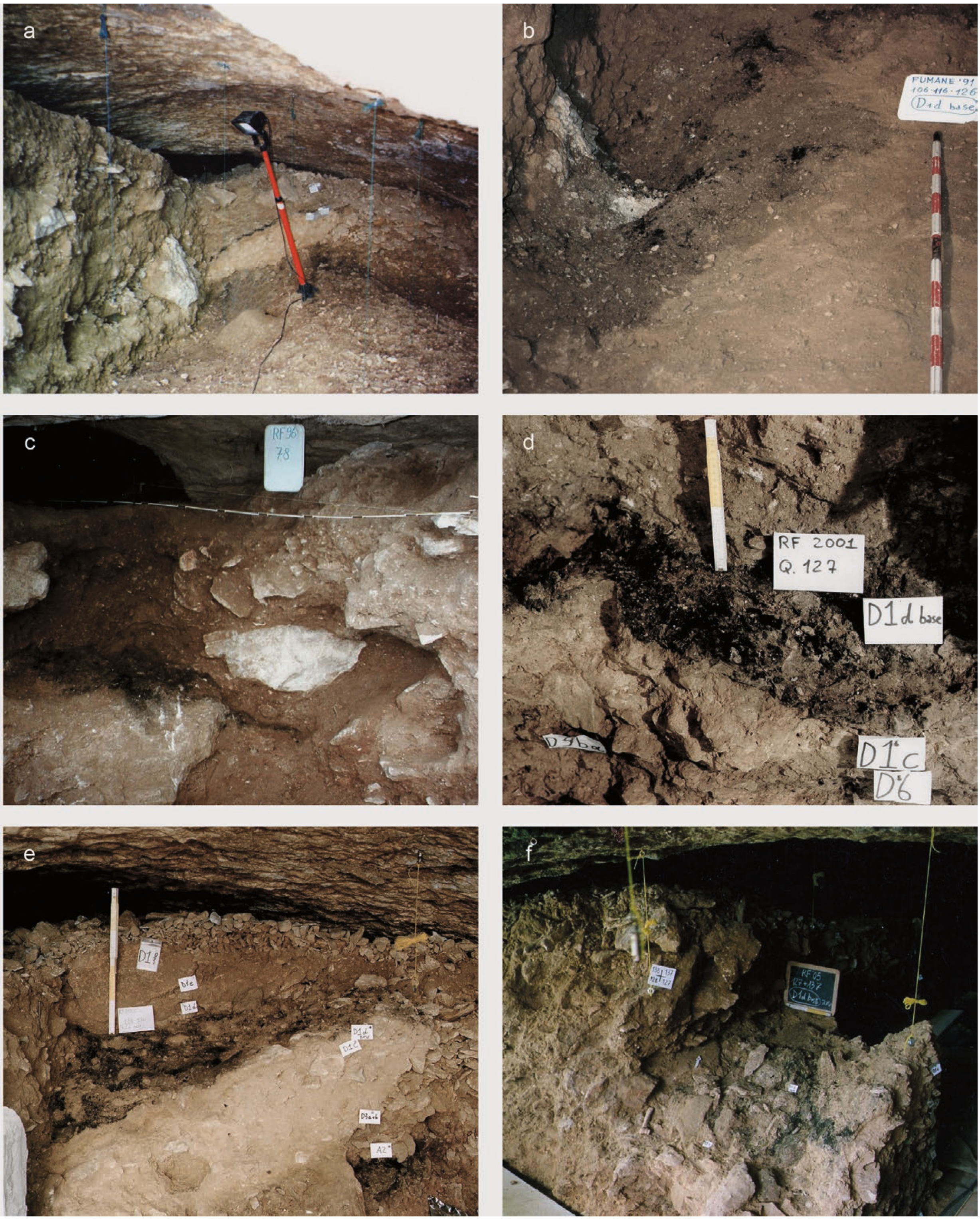

Fig. 5. Exposition of layer D1d during the excavation campaigns conducted in 1991 in the cave-mouth (a and b), in 1996 in square 78 at the entrance of tunnel A (c), in 2001 in square 127 (layer D1d with large fragments of charred wood) (d), in 2002 in squares 126 and 136 (e), and in 2005 in squares 127 and 137 (f) (pictures elaborated by A. Farina).

Abb. 5. *Aufnahme der Schicht D1d während der Grabungskampagnen 1991 im Höhleneingang (a und b), 1996 im Quadrat 78 am Eingang des Tunnels A (c), 2001 im Quadrat 127 (Schicht D1d mit großen verkohlten Holzfragmenten) (d), 2002 in den Quadraten 126 und 136 (e) und 2005 in den Quadraten 127 und 137 (f) (Bilder ausgearbeitet von A. Farina).*

immediate surroundings of the site (Bertola 2001). The most attested types are from the Maiolica (67 %), the Scaglia Rossa (11 %), and the Scaglia Variegata (11 %) formations. The degree of fragmentation among blanks is high (79 %) and only 31 artifacts are complete. Among complete artifacts, flakes are more numerous (n = 21). This is in part due to the higher robusticity of flake blanks. The classification of blanks according to their technological classes is showed in figure 6. Flakes are the most numerous blanks, both in the overall count and in the minimum number of flaked products (MNFP) category. Despite that, all cores discarded at the site show laminar removals and can be classified either as bladelet core (n = 4) and blade-bladelet core (n = 1). We interpret that as the result of an on-site production of laminar blanks that were likely exported. Flakes are, in most cases, the by-products of such productions.

Core diacritic analysis

Although not numerous, cores represent an important piece of evidence to understand the lithic technology of layer D1d. In the following paragraphs we will describe each core using a diacritic method of analysis, previously adapted by Falcucci and Peresani (2018) for the study of blade and bladelet cores from the underlying Protoaurignacian layers. Schematic drawings of cores are shown in figures 7 and 8. Furthermore, we made available the 3d models of these artifacts to allow readers to objectively evaluate our interpretations.

Core AF308: This burin-like bladelet core (Fig. 7: a) is made from a maintenance flake that displays a few laminar unidirectional removals (phase 1). The flaking surface is placed on a narrow edge of the blank, between its ventral (see right view) and dorsal side. There is no evidence of operations carried out to isolate the flaking surface, while the flat striking platform has been created by removing a total core tablet (phase 2). The angle at discard between the flaking surface and the striking platform is very steep (ca. 40°–50°). The flaking direction is unidirectional, and the flaking surface is convex. Bladelet removals from the optimal production phase (phase 3) are about four centimeters in length, have sub-parallel edges, and a slightly curved to curved longitudinal profile. The core was discarded after the detachment of a set of hinged bladelets (phase 4).

Core AF300: This prismatic bladelet core (Fig. 7: b) of small dimension (length at discard is 34 mm) bears traces of accidental heating, which altered a significant part of the flaking surface. Nevertheless, removals are still visible. The core was likely made from a small cobble and displays a cortical back with red iron oxide stains. The initialization phase consisted of the decortication of the core's perpendicular flanks by means of bidirectional removals, parallel to the cobble longitudinal axis (phase 1). The core displays two opposite flat striking platforms, with clear evidence of re-shaping by detaching total and partial core tablets (phase 2). Both striking angles are around 60°–70°. Interestingly, the flaking direction displays several bidirectional removals. However, the core cannot be typed as strictly bidirectional, since all last lamellar removals are irregular, hinged, and continue towards the core's perpendicular flank (phase 4). These removals could in fact either be related to a maintenance operation aimed at rectifying the core longitudinal convexity, or an aborted attempt to begin a successive blank production after rotating the core. Removals from the optimal production phase have sub-parallel edges and are around 35 mm in length and 4–6 mm in width (phase 2). Finally, noteworthy are two perpendicular removals detached from the flaking surface. They are likely related to a final, unsuccessful maintenance operation aimed at pursuing the bladelet production (phase 3).

Core AF318: This wide-faced flat bladelet core (Fig. 7: c) is made from an indeterminate blank that presents an inclusion of fresh cortex in the middle of the core back (phase 1). The striking platform is flat, steep (ca. 35°–45°), and has been (re)shaped by a partial core tablet. The external platform ridge is heavily abraded. The knapping progression is parallel to the axis of core symmetry and the reduction pattern is sub-parallel (phases 3, 4, and 5). The core flaking surface was likely rejuvenated by removing maintenance blanks. The partially visible maintenance blank is likely a blade of five centimeters in length and

Blank Types	n	%	MNFP	%
Flake	**89**	***62***	**40**	***66***
Full production	56	*63*	21	*53*
Semi-cortical	15	*17*	7	*18*
Initialization	7	*8*	3	*8*
Maintenance	11	*12*	9	*23*
Blade	**17**	***12***	**9**	***15***
Full production	9	*53*	5	*56*
Semi-cortical	6	*35*	2	*22*
Initialization	-	-	-	-
Maintenance	2	*12*	2	*22*
Bladelet	**38**	***26***	**12**	***20***
Full production	33	*87*	12	*100*
Semi-cortical	2	*5*	-	-
Initialization	-		-	-
Maintenance	3	*8*	-	-
Total	**144**	***100***	**61**	***100***

Fig. 6. Distribution of blank types according to the overall number of lithics recovered and the minimum number of flaked products (MNFP). One burin spall is included in the category maintenance of bladelets. The count includes blank types of tools. Percentages are rounded.

Abb. 6. *Verteilung der Grundformen laut der Gesamtzahl der geborgenen Steinartefakte und der Mindestzahl der Abschlagprodukte (MNFP). Ein Stichelabfall ist in der Kategorie „Instandhaltung von Lamellen" enthalten. Die Zählung umfasst Grundformen der Werkzeuge. Prozentsätze sind gerundet.*

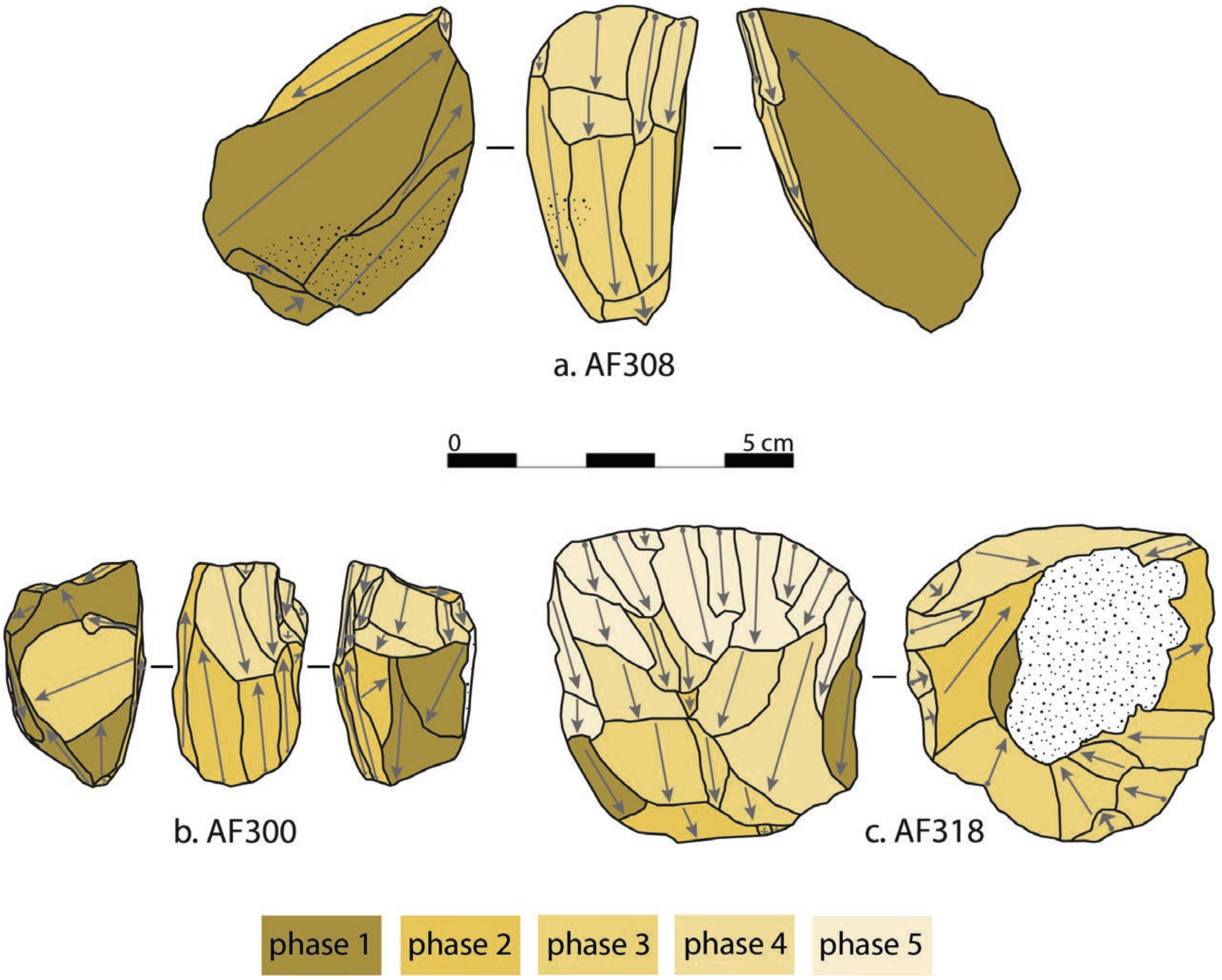

Fig. 7. Schematic drawing of bladelet cores from unit D1d. Arrows indicate the direction of removals. The oldest reduction phases are colored darker, while the successive phases are lighter. See chapter 'Core diacritic analysis' for an accurate interpretation of the different reduction phases identified (drawings: A. Falcucci).

Abb. 7. *Schematische Zeichnung der Lamellen-Kerne aus Einheit D1d. Pfeile zeigen die Schlagrichtung der Negative an. Die ältesten Phasen sind dunkler gefärbt, während die nachfolgenden Phasen heller gefärbt sind. Siehe Kapitel 'Core diacritic analysis' für eine genaue Interpretation der verschiedenen identifizierten Reduktionsphasen (Zeichnungen: A. Falcucci).*

between 13–17 mm in width (phase 2). Removals on the core back are perpendicular to the main flaking direction and might be related to isolation and/or reshaping operations. The last bladelet negatives visible (between 10–20 mm in length) do not cover the whole extent of the flaking surface and are, in several cases, hinged (phase 5). This is related to the fact that the flaking surface was flattened after a rather prolonged production.

Core AF273: This prismatic bladelet core (Fig. 8: a) is made from an elongated cobble that was probably split in half following its longitudinal axis (phase 1). Removals on the core flanks served at isolating a narrow reduction surface and maintaining the appropriate transversal convexities (e.g. phase 2). The striking platform is flat and was formed by removing a total core tablet (phase 2). The striking angle is about 75°. The flaking direction is strictly unidirectional, and the flaking surface is slightly convex. Removals from the optimal production phase are big bladelets with sub-parallel edges of up to 55 mm in length and 8–10 mm in width (phase 3). The core has been likely discarded early in the production both because of a non-silicified impurity located at the junction between the flaking surface and the core flank, and an unsuccessful detachment that resulted in the formation of a pronounced step almost in the middle of the flaking surface (phase 5). Among the maintenance removals still visible, noteworthy is a short lamellar blank detached from the non-prepared cortical base, which was used to maintain the core longitudinal convexities (phase 4).

Core AF246: This semi-circumferential core (Fig. 8: b) displays removals of both blade and bladelet blanks. The initialization phase is no more visible, but the small remnant of cortex on the back suggests that the core was made from a nodule and that a decortication phase took place prior to

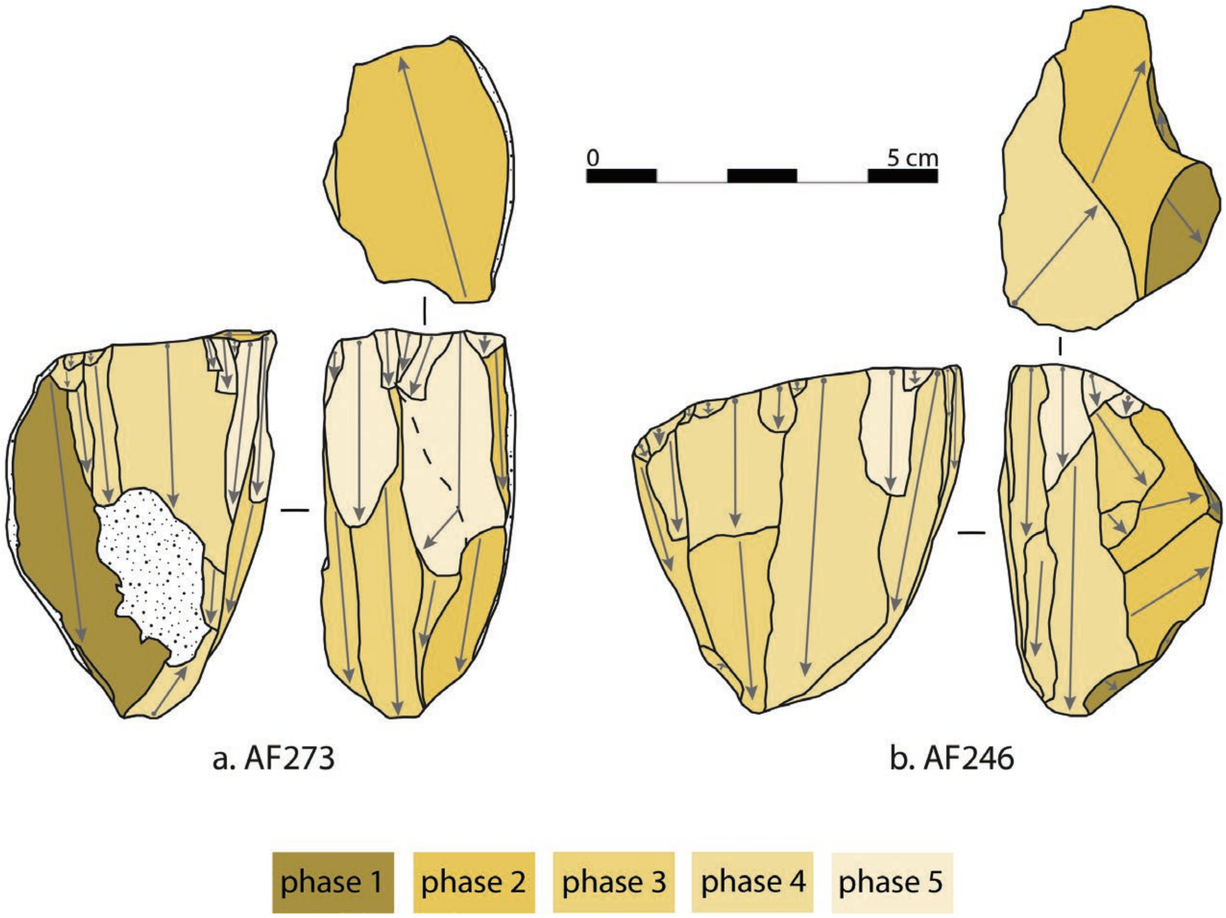

Fig. 8. Schematic drawing of bladelet (a) and blade-bladelet (b) cores from unit D1d. Arrows indicate the direction of removals. The oldest reduction phases are colored darker, while the successive phases are lighter. See chapter 'Core diacritic analysis' for an accurate interpretation of the different reduction phases identified (drawings: A. Falcucci).

Abb. 8. *Schematische Zeichnung der Lamellen-Kerne (a) und Klingen-Lamellen-Kerne (b) aus Einheit D1d. Pfeile zeigen die Schlagrichtung der Negative an. Die ältesten Phasen sind dunkler gefärbt, während die nachfolgenden Phasen heller gefärbt sind. Siehe Kapitel 'Core diacritic analysis' für eine genaue Interpretation der verschiedenen identifizierten Reduktionsphasen (Zeichnungen: A. Falcucci).*

the laminar production. The core has a flat striking platform with evidence of reshaping by means of complete (phase 1) and partial (phase 2) core tablets. The striking angle is ca. 70°. The production of blanks is based both on adjacent wide and narrow surfaces (phases 3 and 4). Interestingly, removals on the wide face seem to be in most cases classifiable as small blades, while the narrow face displays only slender bladelets of up to five cm in length. The flaking progression seems to be frontal to the narrow face from the top view, suggesting that the production gravitated in this area of the core, with the wide face mainly used to maintain the core transversal convexities. This is also supported by the presence of a set of orthogonal removals (neo-crest) that were used to isolate and maintain the transversal convexities of the narrow face (phase 2). The core was discarded in an advanced stage of reduction, although it does not appear to be fully exhausted (phase 5). We were able to associate a blank, recovered one square meter away, to a knapping stage prior to phase 4 (Fig. 9: e). This blank is a small blade (width: 13 mm, length: 60 mm) that was detached at the junction between the narrow and wide face. Its cross-section is lateral steep and, according to its overall shape, can be classified as a lateral comma-like maintenance blade (Falcucci et al. 2017) with plunging distal end and twisted profile. Most of the removals on its dorsal face can be classified as bladelets.

Technological attributes of the blanks

Blades were detached using direct marginal percussion, possibly using a soft organic hammer. Dorsal scar pattern is always unidirectional (Fig. 9: b–e), and the cross-section is, in most cases, trapezoidal (n = 10). Blanks were thus detached following two ridges present on the core flaking surface. Bladelet dorsal scars are visible only in two cases (Fig. 9: b & e). Blades are generally light (width to thickness ratio mean: 3.7) and complete items (n = 5) range from 59 mm to 110 mm in length. Despite the absence of proper

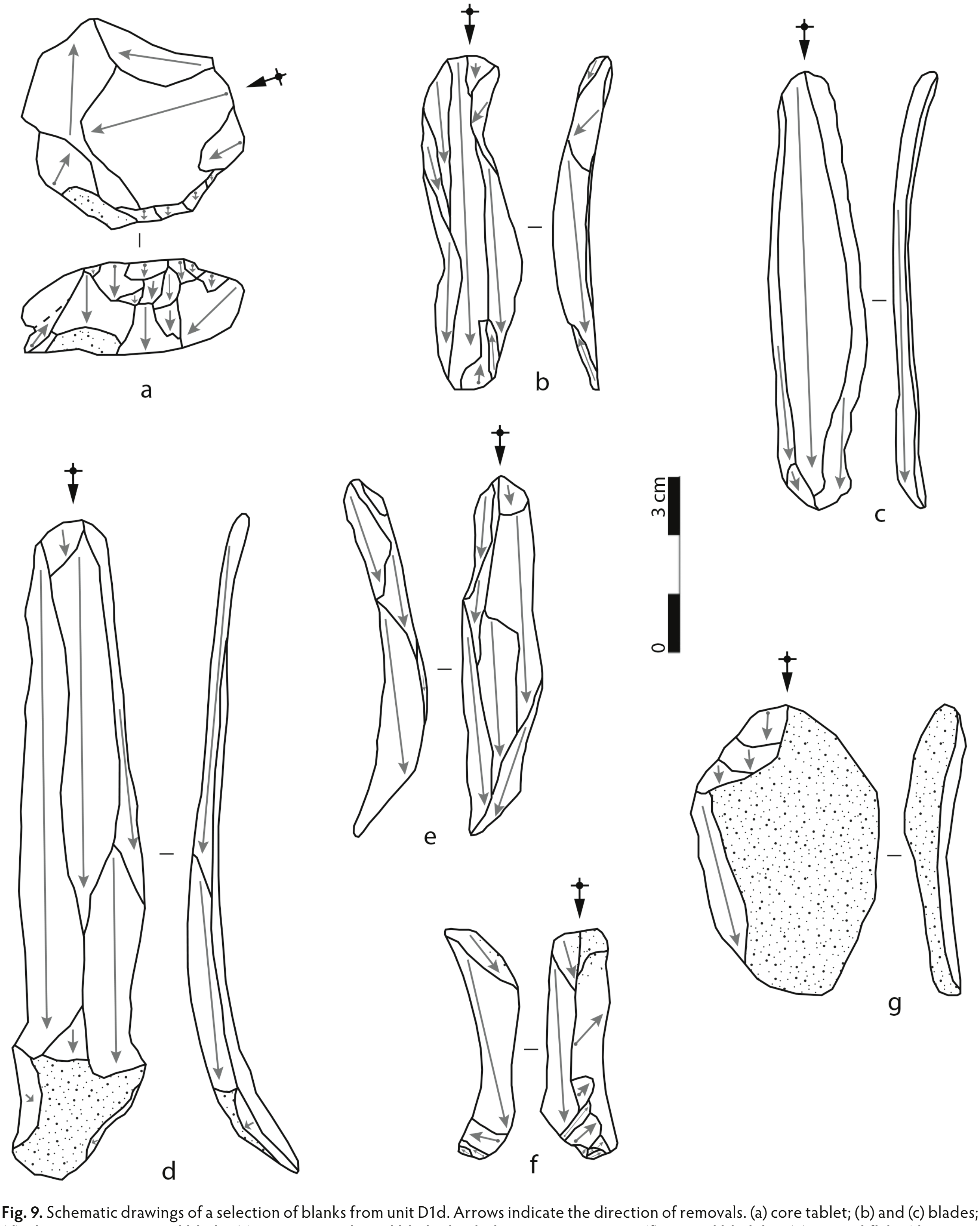

Fig. 9. Schematic drawings of a selection of blanks from unit D1d. Arrows indicate the direction of removals. (a) core tablet; (b) and (c) blades; (d) plunging semi-cortical blade; (e) maintenance lateral blade that belongs to core AF246; (f) crested bladelet; (g) cortical flake (drawings: A. Falcucci).

Abb. 9. *Schematische Zeichnungen einer Auswahl von Grundformen aus der Einheit D1d. Pfeile zeigen die Schlagrichtung der Negative an. (a) Kerntablett; (b) und (c) Klingen; (d) konvexe halb-kortikale Klinge; (e) seitliche Erhaltungsklinge, die zum Kern AF246 gehört; (f) Kernkantenklinge; (g) Rindenabschlag (Zeichnungen: A. Falcucci).*

blade cores, blade production was likely carried out at the site. A semi-cortical blade with a plunging distal end permits to estimate the production of blanks of up to 90 mm in length (Fig. 9: d). Finally, a few semi-cortical blades come from the first shaping of bladelet cores. Bladelets are more numerous compared to blades. They usually belong to the optimal production phase and, as in the case of blades, they were likely detached using direct marginal percussion. Dorsal scar pattern is unidirectional sub-parallel. Two bladelets bear evidence of neo-cresting. In one case, neo-cresting is bilateral and was performed on the core base to correct the distal convexity (Fig. 9: f). Semi-cortical bladelets are only two, while bladelets belonging to the initialization phase are missing. In the case of bladelet cores on small nodules, the core was thus shaped using both flakes and small-sized blades. Bladelets have a mean width of 7.7 mm and thickness of 2.2 mm. Complete bladelets (n = 4) range from 16 mm to 52 mm in length.

Despite their high frequency, flakes were not the primary objective of blank production. Flake cores are absent and only one flake tool – an endscraper – was found. Several flakes belong to the initialization (Fig. 9: g) and maintenance phases carried out during laminar productions. Among them, a few crested flakes (n = 4), a core tablet (Fig. 9: a), and a rejuvenation flake were recovered.

Tool composition

Tool types are listed in figure 10. Most of the tools discarded at the site are made on lamellar blanks and, except for one bladelet and one blade with direct convergent retouch, they are all fragmented.

Common tools are few. Among them, two endscrapers were recovered (Fig. 11: c & d). In one case, the scraper's head has evidence of re-sharpening that resulted in a series of irregular, hinged removals (Fig. 11: d). Retouched blades were modified using direct retouch. In two cases, retouching is marginal (e.g. Fig. 11: b), while in the other retouching is scalariform (Fig. 11: a).

The rest of tools are made on lamellar blanks. In most cases, they have been modified by marginal semi-steep retouch. One complete bladelet displays a unilateral direct retouch on the right edge that reaches the distal end to form a pointed tip. Bladelets with inverse lateral retouch have marginal retouching located in the right side. Retouching is very steep (ca. 80°) in one case, although it does not form a proper back. One mesial fragment of a retouched bladelet displays an alternate retouch (Fig. 12: c). A retouched burin spall is particularly interesting (Fig. 12: b). This is a mesial fragment and its size is extremely reduced (width: 1.6 mm, thickness: 1.8 mm). The invasive back (ca. 90°) is created by means of crossed retouching which removed the original side of the bladelet, opposite to the portion of the visible ventral face of the burin-like core. These features recall tools commonly assigned to the microgravette points. Finally, one exceptional find is a fragmented mesio-distal portion of a Vachon point (Demars & Laurent 1992; Simonet 2011). This point is made from a big bladelet, which was modified using a crossed

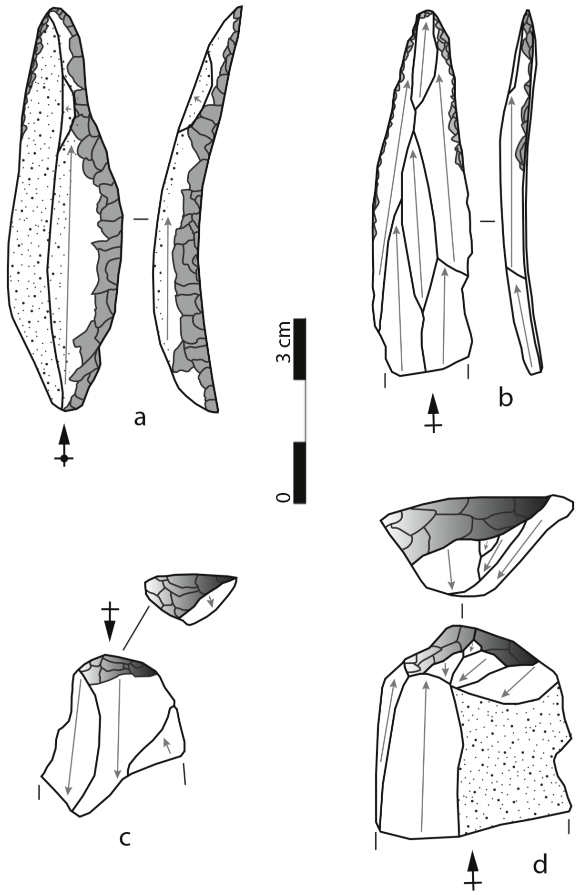

Fig. 11. Schematic drawings of a selection of common tools from unit D1d. Retouching is colored light grey and arrows indicate the direction of removals. (a) blade with direct, scalariform convergent retouch; (b) blade with direct convergent retouch; (c) endscraper on flake; (d) endscraper on semi-cortical blade (drawing: A. Falcucci).

Abb. 11. *Schematische Zeichnungen einer Auswahl gängiger Werkzeugformen aus Einheit D1d. Die Retusche ist hellgrau eingefärbt und Pfeile zeigen die Richtung der Negative an. (a) Klinge mit direkter, skalariformer konvergenter Retusche; (b) Klinge mit direkter konvergenter Retusche; (c) Kratzer an Abschlag; (d) Kratzer an halbkortikaler Klinge (Zeichnung: A. Falcucci).*

Tool Types	n
Endscraper	2
Blade with direct lat. retouch	1
Blade with direct conv. retouch	2
Bladelet with alternate lat. retouch	1
Bladelet with direct conv. retouch	1
Bladelet with direct lat. retouch	2
Bladelet with inverse lat. retouch	2
Possible microgravette	1
Vachon point	1
Total	**13**

Fig. 10. Distribution of tool types. Classification of retouched bladelets is based on Falcucci et al. (2018). lat. stands for lateral and conv. for convergent.

Abb. 10. *Verteilung von Werkzeugtypen. Die Klassifikation der retuschierten Lamellen basiert auf Falcucci et al. (2018). lat. steht für lateral und konv. für konvergent.*

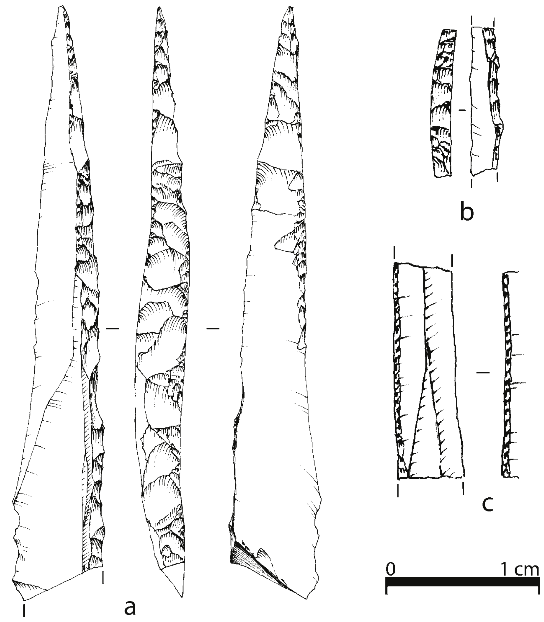

Fig. 12. Drawings of a selection of lamellar tools from unit D1d. (a) point of Vachon on bladelet; (b) fragmentary possible microgravette on burin spall; (c) bladelet with lateral alternate retouch (drawings: G. Almerigogna).

Abb. 12. *Zeichnungen einer Auswahl von Lamellenwerkzeugen aus Einheit D1d. (a) Vachon-Spitze an Lamelle; (b) Fragment einer mögliche Mikrogravette an Stichellamelle; (c) Lamelle mit seitlich alternierender Retusche (Zeichnungen: G. Almerigogna).*

steep (ca. 90°) retouch along the right side, completed by a low angle bilateral inverse retouch in the distal end of the tool. The backing operation results in a very slender product with a lateral steep cross section and a robust distal end (Fig. 12: a). This point well fits in the definition given by Simonet (2011), according to whom the retouching of a Vachon point answers to the need of obtaining a thick and narrow backed point with an axial symmetry.

Other findings

Besides from stone artifacts, other findings are rare in layer D1d. The first is a mesial portion of a bone tool made from an ulna of an indeterminate species. The artifact is broken in both extremities and anthropic modifications are very clear (e.g. longitudinal striations). It might be interpreted as a remnant of a pointed artifact with a triangular cross section. The second is a complete marine shell assigned to *Homalopoma sanguineum*, a species found in both the modern lower Adriatic, Ionian, and Tyrrhenian coasts (Bertola et al. 2013). This finding might attest to movement of foragers and/or circulation of goods across hundreds of kilometers as shown from findings in Central and Eastern Europe (e.g. Bosinski 1999; Niţu et al. 2019).

Discussion

The D1d lithic assemblage and site interpretation

The assemblage of layer D1d at Fumane cave is homogeneous in its defining features. Lithic technology is oriented towards the production of laminar blanks, using standardized reduction procedures. Bladelet production is based on the exploitation of narrow core faces with the objective of producing rather slender blanks with regular sub-parallel edges. This pattern differs from the underlying early and late Protoaurignacian layers, where emphasis is placed in the isolation of convergent flaking surfaces with the goal to obtain bladelets with convergent outlines and pointed distal ends (Falcucci et al. 2017; Falcucci 2018; Falcucci & Peresani 2018). In D1d, the few discarded bladelet cores are exhausted or have knapping accidents that prevented the continuation of the production. On the other hand, blades were both obtained by means of independent reduction procedures, as well as during the early phases and maintenance of bladelet production. Independent blade production was likely carried out on-site, as suggested by the presence of few blanks related to the maintenance of blade cores, while non-exhausted blade cores were likely exported. Knappers used similar reduction procedures described for the bladelet production with the intention to obtain long products with low thickness values. Among retouched tools, two artifacts are particularly interesting. They are typical of the Gravettian technocomplex and have never been recovered in the underlying layers at Fumane Cave. A few bladelets with marginal retouch were also recovered. These tool types are common in the underlying Protoaurignacian layers as well (Falcucci et al. 2018).

Overall, the technological and typological features described point towards the assignment of the assemblage to the Gravettian (see chapter 'The Gravettian in Italy'). Moreover, the scarcity of the artifacts recovered, and the general composition of the assemblage are evidence of a rather short-time occupation of the cave. Most of the discarded backed points and retouched bladelets are broken, as well as the few domestic tools recovered. The western Monti Lessini is a region characterized by an abundance of high-quality chert (Bertola 2001; Longo & Giunti 2010; Bertola et al. 2018), and both Neanderthals and modern humans responsible for the formation of the earlier cultural units were aware of the potentialities of the raw material sources. For instance, exogenous tools are only exceptionally imported in Mousterian (Delpiano et al. 2019b) or early Protoaurignacian layers (Bertola et al. 2013; Falcucci et al. 2017). We thus believe that foragers took advantage of this favorable setting and produced new domestic tools and rejuvenated composite hunting weapons. The intense exploitation of bladelet cores and the overall paucity of laminar blanks support this interpretation. On the other hand, the large-sized raw material nodules might have been imported, shaped into blade cores, and finally exported. Noteworthy is the high concentration of charcoals described during the excavations, which might be evidence of a specialized activity carried out at the site. Additional data on this feature as well as on the faunal assemblage will provide a better framework of human activity at the site and possible information about the seasonality of the occupation, as was done for the Protoaurignacian (Facciolo & Tagliacozzo 2005). We thus hypothesize that Gravettian foragers took advantage of the ecological and mineralogical setting of the region and used the site as a hunting stop and a flaking workshop.

The sporadic occupation described at Fumane Cave is in line with the available evidence for the Gravettian in the northern Great Adriatic-Padanian Region, where human occupation seems to be sparse and intermittent (Peresani 2019 et al. in press). At Rio Secco in the Carnic Prealps, for instance, the early Gravettian layer attests to ephemeral frequentations with a handful of lithic artifacts and a combustion feature (Peresani et al. 2014). Among them, we notice a burin with a refitted burin spall and evidence of cresting, a backed bladelet with double truncation, an unfinished backed point, and an endscraper. The sites of Broion Rockshelter (De Stefani et al. 2005), Broion Cave (Broglio & Improta 1995), and Paina Cave (Bartolomei et al. 1988) in the Berici Hills are also similar. At Broion Rockshelter, few common tools, backed points, and ornamental beads were recovered.

Evidence for the presence of Gravettian assemblages is scanty in Western Dalmatia and Istria. The most important site is Kontija 002 Rockshelter, located on the northern side of the Lim bay (Istria Peninsula, Croatia; Janković et al. 2015). Systematic excavations, conducted from 2014 to 2018, have permitted to retrieve several thousand lithic artifacts, as well as faunal remains. From a typological standpoint, the lithic assemblage is dominated by backed bladelets and bladelets with marginal retouch. According to the radiometric dates, the site attests to one of the oldest Gravettian occupation in the eastern side of the Adriatic (Janković pers. comm.). In sum, the available data suggest that Gravettian foragers occupied these sites at the edge of the Great Po Plain for short-term tasks and left few traces of their displacements.

The Gravettian in Italy

The D1d assemblage at Fumane Cave well fits in the Italian Gravettian record, formed of several sites found in regions south of the Alps and along the Tyrrhenian and Adriatic coasts (Palma di Cesnola 2001; Gambassini 2007). In Italy, the early Gravettian appears to be more homogeneous than later stages of this techno-complex, despite intra-site variability is still high according to some (e.g. Boscato et al. 1997). According to Palma di Cesnola (2004) and Laplace (1966), the early Gravettian is characterized by the presence of backed points and the absence of other typical tool types. After this phase, the Adriatic and Tyrrhenian records seem to take different cultural trajectories. The main difference lies in the manufacture and use of Noailles burins (e.g. Aranguren & Revedin 2001), which are well known in western Italy and totally absent in Adriatic Italy (Gambassini 2007) and the Balkans (Mihailovic & Mihailovic 2007). This cultural variant is well known in France as well and might represent the result of cultural contacts between foragers settled in adjacent regions (Santaniello & Grimaldi 2019).

A few Italian sites attest to the presence of early Gravettian occupations that took place before this supposed cultural division (see figure 1 for the localization of the sites discussed in this section). Among them, Paglicci Cave (Apulia, southeastern Italy) is probably the most important both because of the high density of Gravettian lithic assemblages and the detailed typological (Palma di Cesnola 2004; Palma di Cesnola 2006) and technological (Wierer 2013) studies available. The earliest Gravettian assemblage comes from layer 23A–C, whose beginning is dated to about 33.1–31.2 ka calBP (Palma di Cesnola 2004). Several features of this assemblage recall what we observed at Fumane Cave. At Paglicci, flakes are in most cases by-products of the laminar productions, as also suggested by the low transformation ratio. Laminar cores are usually oriented according to the longitudinal axis and flaking surfaces are placed on a narrow core face. Flaking progression is unipolar and blades are usually slender. Core transversal convexities are maintained through the use of lateral crests and, sporadically, opposite striking platforms can be opened to maintain core longitudinal convexities. Only few blades display bidirectional removals and many among them have been described as maintenance blades. Bladelets are clearly the main objective of the lithic production and several bladelet cores are described as burin-like cores. Blades and bladelets can also be produced simultaneously (Wierer 2013). From a typological standpoint, backed points are the most frequent tool type and can be also made on burin spalls. We notice from the drawings published in Palma di Cesnola (2004) that a few backed points display a low angle ventral retouch that complement the crossed retouch of the back. They are alike the Vachon point recovered in layer D1d at Fumane Cave. On the other hand, bladelets with lateral semi-abrupt marginal retouch are rare (n = 2). Palma di Cesnola (2004) lists two possible *fléchette* fragments (Pesesse 2008) as well, which are virtually absent in other Italian Gravettian sites. Another important site on the central Apennines watershed is Fonte delle Mattinate on the Colfiorito plateau (Marche, central Italy), where Gravettian short-term, recurrent frequentations took place in the interval between ca. 34 to 29 ka calBP (Giaccio et al. 2004). At this open-air site, bladelets with marginal retouch were found together with backed points and a microgravette. The presence of exogenous arenitic chert attests to distant movements and/or contacts (Silvestrini et al. 2005).

In the Tyrrhenian coast, early Gravettian sites seem to be slightly younger if compared to the eastern record (Talamo et al. 2014). The site of La Cala Cave (Campania, southwestern Italy) contains few early Gravettian layers (3m, 3d, 2, 1m, and 1d) covered by a middle Gravettian with Noailles burins (Palma di Cesnola 1969; Boscato et al. 1997). The early Gravettian is dated to about 31.4–29.9 ka calBP (Boscato et al. 1997) and the lithic technology is characterized by unidirectional flaking progressions. Cores with bidirectional removals are rare and opposite striking platforms are seldom used to maintain the core convexities. Interestingly, cores with two opposite striking platforms are more frequent in the upper cut 1d. Bladelets are frequently produced from burin-like cores and are usually very small in size (10–12 mm in length). Blanks, burin spalls included, are modified into backed points, typologically assigned to the microgravette type. A few bladelets with marginal direct and inverse retouch are attested at La Cala as well. They are more numerous in the lowermost Gravettian layer 3m (Borgia & Wierer 2005). The archaeological record of the nearby Calanca Cave is comparable to what described at La Cala (Bachechi & Revedin 1993).

Moving north, a slightly more recent early Gravettian assemblage was discovered in the open-air site of Piovesello in proximity of the Appennine watershed (Emilia-Romagna, northwestern Italy; Peresani et al. 2018). Here, the techno-typological features of the lithic assemblage are comparable to other early Gravettian sites. The lithic technology at Piovesello was meticulously studied through the use of lithic refitting, which were also the object of digital reconstructions (Delpiano et al. 2019a; Zangrossi et al. 2019). Refitted cores show the use of two different operational procedures. The first allowed the production of both short blades and bladelets from the same raw material nodule, while the second aimed at producing exclusively bladelets from burin-like cores. Flaking progression is usually unidirectional, while second striking platforms were only opened to maintain the core convexities. Among the few tools discarded, microgravette points are common, some of them made on burin spalls, alongside with two bladelets with marginal direct retouch.

At Mochi Rockshelter (Liguria, northwestern Italy), the Gravettian is found in unit D, on top of the Proto-aurignacian unit G and Aurignacian unit F. According to Palma di Cesnola (2001), the base of unit D corresponds to an early Gravettian with backed tools and almost devoid of Noailles burins. A re-evaluation of the lithic assemblage from unit D–f3 suggests, instead, that the assemblage should be assigned to the Gravettian with Noailles burins (Santaniello & Grimaldi 2019). According to Douka et al. (2012), the base of unit D might not attest to the earliest Gravettian at Mochi. According to the radiocarbon dating, the formation of the middle and upper part of unit F might in fact relate to a series of intermittent and not yet well defined early Gravettian occupations. New studies are however needed to ascertain this hypothesis, which would imply that a cultural hiatus existed between the early Gravettian and the Gravettian with Noailles burins at the site, given that the intermediate unit E was described as semi-sterile. A similar situation seems to characterize La Cala as well, where Palma di Cesnola & Bietti (1985) noticed a sterile layer, in the internal part of the cave, above the early Gravettian. For this reason, Santaniello & Grimaldi (2019) have hypothesized that a temporal hiatus, and thus absence of cultural continuity following the earliest Gravettian phase is very likely.

The Gravettian with Noailles burins represents the most intense frequentation of Tyrrhenian Italy and attests the movement of hunter-gatherers across several hundreds of kilometers to carry out specialized activities. The most important assemblage is perhaps Bilancino (Toscana, central Italy; Aranguren & Revedin 2001). This open-air site was a specialized summer seasonal camp for the harvesting and the processing of hygrophilous herbs. Vegetal residues found on pestle-grinders and grinding stones provide the earliest evidence of a technique used in the preparation of flour based on wild plants (Aranguren et al. 2007; Revedin et al. 2010; Revedin et al. 2015). The technological assessment of the lithic assemblage suggests that laminar production was based, in several cases, on bidirectional knapping progressions (Grimaldi et al. 2011). The most common tool type is the Noailles burin, but few microgravette points and backed bladelets are also present. Finally, the late Gravettian is characterized by the disappearance of the Noailles burins in the west and the development of different types of truncated tools in the east (Palma di Cesnola 2001; Gambassini 2007).

In the light of this comprehensive comparison, we underline that the features of the D1d assemblage at Fumane Cave are well framed in the Italian early Gravettian record and are not comparable to the middle or late Gravettian.

If we enlarge our scope to the rest of Europe, we notice that the early Gravettian is a rather homogeneous phenomenon, with important patterns of land-use specialization and in situ innovations. According to Reynolds & Green (2019), it indicates the spread of new foragers and/or technological innovations across several hundreds of kilometers within a very short chronological span (but see Bicho et al. 2017). From a technological standpoint, the use of unipolar knapping progressions carried out on narrow flaking surfaces for the production of regular and slender blanks seems to be a defining characteristic, despite the expected regional variability (e.g. Digan 2006; Moreau 2009; Goutas et al. 2011; Taller & Floss

2011; Taller & Conard 2016). New hunting equipment consisted mostly in the production of backed points of different sizes (i.e. gravette and microgravette points), which can be considered as parts of a highly mobile and modular technology (Taller & Conard 2019). The Gravettian seems to differ from the previous Aurignacian because the shape of the bladelet implements were mostly achieved through the use of invasive retouching, while in the Aurignacian the overall shape of bladelet tools were dictated by the technological choices during the knapping. We found that this feature is particularly important in isolating the Gravettian occupation at Fumane Cave from the underlying Protoaurignacian layers, where blade and bladelet technologies can be separated for the clear use of rather standardized unidirectional convergent reduction patterns to produce pointed bladelets (Falcucci & Peresani 2018).

The age estimation of layer D1d

After having addressed the field evidence and the technological features of the Gravettian assemblage at Fumane Cave, we finally need to discuss the age estimation of layer D1d (Fig. 13) in relation to other Gravettian sites excavated in Italy (Fig. 14). In north-eastern Italy, the earliest Gravettian assemblage so far discovered is at Rio Secco, which dates to ca. 33.9–32.8 ka calBP (Talamo et al. 2014). Slightly later dates were obtained at Broion Rockshelter (De Stefani et al. 2005) and Broion Cave (Broglio & Improta 1995). If we enlarge our scope, the earliest known Gravettian in Europe is from the Swabian Jura. A recent assessment of the extensive radiocarbon database available at Hohle Fels places the beginning of the Gravettian (layer IId and IIe) at ca. 35 ka calBP (Taller & Conard 2019). The human occupation of the cave in this time span is more sporadic compared to the later phase, which takes place between 33–31 ka calBP. These dates are in line with other Gravettian sites of the region, such as Geißenklösterle and Brillenhöhle (Conard & Moreau 2004; Moreau 2009). Only one outlier and isolated sample from the Gravettian deposit at Geißenklösterle dates to 38.6–36.6 ka calBP (Higham et al. 2012). In southwestern France, a recent radiocarbon re-assessment of the Gravettian sequence at Pataud Rockshelter points for an early Gravettian at about 33 ka calBP (Douka et al. 2020). Fumane Cave might thus contain the oldest Gravettian assemblage in Europe.

In Italy, few sites are dated in the time span between 36 and 30 ka calBP. Among those, a few assemblages have been assigned to the Aurignacian. At Paglicci, for instance, the last Protoaurignacian layer 24 a0–a1 is sealed by the Codola tephra (Giaccio et al. 2008), which dates to ca. 33 ka calBP. This tephra represents a reliable age determination for the end of the Protoaurignacian at the site, as well as a terminus post quem for the beginning of the Gravettian (Palma di Cesnola 2004). At Paglicci, the technological comparison between the late Protoaurignacian from unit 24 and the Gravettian from unit 23 suggests that there is no evidence of local transition between these two technocomplexes (Borgia et al. 2011). The operational procedures used to produce blade and bladelet implements reveal significant differences. For instance, in unit 24, bladelets were detached from wide flaking surfaces, whereas narrow flaking surfaces were exploited in unit 23. In the former case, bladelets are twisted and asymmetrical, while in the latter bladelets are straight and symmetrical. Furthermore, bidirectional knapping is only attested in the Gravettian assemblage, although mostly used for maintenance operations. Most of the retouched tools from unit 24

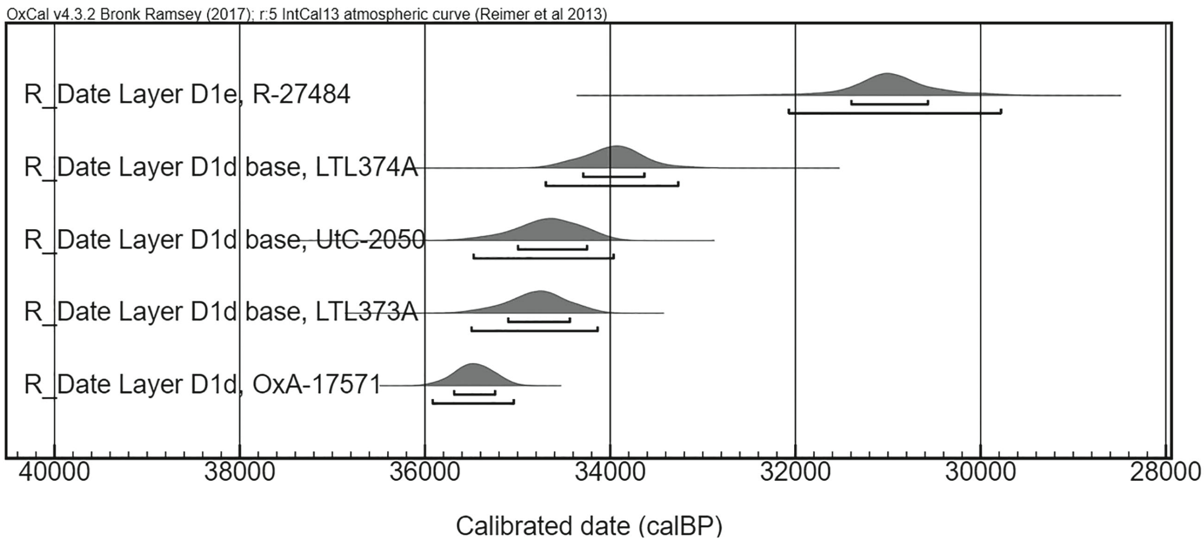

Fig. 13. Calibrated ages from layers D1e, D1d, and D1d base. ^{14}C dates, listed in figure 14, were calibrated using the IntCal 13 curve (Reimer et al. 2013) on OxCal Software, version 4.3 (Bronk Ramsey & Lee 2013).

Abb. 13. *Kalibrierte Alter von Schichten D1e, D1d und D1d-Basis. ^{14}C-Daten, die in Abbildung 14 aufgeführt sind, wurden unter Verwendung der IntCal-13-Kurve (Reimer et al. 2013) auf der OxCal-Software, Version 4.3 (Bronk Ramsey & Lee 2013), kalibriert.*

Site	Context	Lab. ID	Material	^{14}C age	95.4 % Range calBP	Reference
Broion Cave	E	UtC-2693	bone	25 250 ± 280	30 150–28 705	Broglio & Improta 1995
Broion Cave	D	UtC-2694	bone	24 700 ± 400	29 656–27 890	Broglio & Improta 1995
Broion Rockshelter	1c	UtC-13321	charcoal	25 860 ± 200	30 657–29 532	De Stefani et al. 2005
Broion Rockshelter	1b	UtC-13320	charcoal	28 460 ± 260	33 220–31 598	De Stefani et al. 2005
Broion Rockshelter	1b alfa	UtC-10504	charcoal	27 960 ± 300	32 702–31 216	De Stefani et al. 2005
Fonte delle Mattinate	C1	GU-9426	charcoal	25 930 ± 325	30 851–29 414	Giaccio et al. 2004
Fonte delle Mattinate	B-27	--	charcoal	28 300 ± 790	33 964–31 039	Silvestrini et al., 2005
Fumane Cave	D1e	R-27484	terrestrial shell	26 890 ± 530	32 070–29 780	Broglio & Dalmeri 2005
Fumane Cave	D1d	OxA-17571	charcoal	31 590 ± 160	35 916–35 041	Higham et al. 2009
Fumane Cave	D1d base	LTL373A	charcoal	30 842 ± 340	35 497–34 136	unpublished
Fumane Cave	D1d base	UtC-2050	charcoal	30 700 ± 400	35 474–33 963	Broglio & Dalmeri 2005
Fumane Cave	D1d base	LTL374A	charcoal	29 828 ± 390	34 695–33 265	Broglio & Dalmeri 2005
La Cala	1m	OxA-5870	charcoal	26 380 ± 260	31 069–29 979	Boscato et al. 1997
La Cala	3dm	OxA-5869	charcoal	26 880 ± 320	31 405–30 534	Boscato et al. 1997
Mochi	F Top	Rome-1	charcoal	27 230 ± 570	32 810–30 345	Bietti et al. 2004
Mochi	F 34	OxA-19857	shell	26 030 ± 110	30 840–29 740	Douka et al. 2012
Mochi	F 40	OxA-19728	shell	26 410 ± 110	31 040–30 400	Douka et al. 2012
Paglicci	23a	UtC-1414	charcoal	28 100 ± 400	33 103–31 210	Palma di Cesnola 2004
Piovesello	7	LTL-13257A	charcoal	26 020 ± 80	30 681–29 899	Peresani et al. 2018
Piovesello	7	LTL-14195A	charcoal	25 650 ± 100	30 235–29 444	Peresani et al. 2018
Rio Secco	6	MAMS-15907	charcoal	29 390 ± 135	33 915–33 310	Talamo et al. 2014
Rio Secco	6	MAMS-15906	charcoal	28 995 ±135	33 609–32 816	Talamo et al. 2014
Rio Secco	6	Poz-41208	charcoal	28 300 ±260	32 977–31 471	Peresani et al. 2014
Rio Secco	6	Poz-41207	charcoal	27 080 ±230	31 380–30 807	Peresani et al. 2014

Fig. 14. The available radiocarbon dataset of Italian sites with early Gravettian assemblage discussed in this paper. Dates were calibrated using the IntCal 13 curve (Reimer et al. 2013) on OxCal Sofware (Bronk Ramsey & Lee 2013). The ^{14}C date OxA-11348 from Fumane Cave was omitted because the same charcoal sample was later used by Higham et al. (2009) for the new determination after ABOx treatment (OxA-17571). Dates for the upper cuts of unit F from Mochi were included for completeness, despite the lack of a techno-typological analysis of the assemblage.

Abb. 14. *Der verfügbare Datenbestand an Radiocarbondatierungen der im Text diskutierten italienischen Fundstellen des frühen Gravettien. Die Daten wurden unter Verwendung der IntCal-13-Kurve (Reimer et al. 2013) mit der OxCal-Software (Bronk Ramsey & Lee 2013) kalibriert. Das ^{14}C-Datum OxA-11348 aus der Fumane-Höhle wurde weggelassen, weil dieselbe Holzkohleprobe später von Higham et al. (2009) für die neue Bestimmung nach dem ABOx-Verfahren verwendet wurde (OxA-17571). Die Daten für die oberen Schnitte der Einheit F aus Mochi wurden der Vollständigkeit halber aufgenommen, trotz des Fehlens einer techno-typologischen Analyse der Inventare.*

are bladelets. Retouching is rather standardized and intended to give a peculiar shape to the bladelets. The right edge has marginal continuous semi-abrupt retouch, often rectilinear. The left edge, instead, displays a deep direct abrupt retouch, frequently localized at the proximal side of the blank to shape a triangular edge with a pointed or rounded proximal end. These so-called "Paglicci type" bladelets are an exclusive feature of the site and might attest to a specific regional adaptation of the late Protoaurignacian technocomplex. Furthermore, a few carinated pieces are described (Palma di Cesnola 2004). Differences are thus significant between the late Protoaurignacian at Paglicci and the D1d assemblage at Fumane Cave. At Mochi, the so-called typical Aurignacian from unit F has a long chronological time span (Douka et al. 2012) that needs to be further investigated (see chapter 'The Gravettian in Italy'). The unit is in apparent cultural continuity with the underlying Protoaurignacian from unit G, both in the techno-typological composition of the assemblage and in the provenance and use of raw materials (Tejero & Grimaldi 2015). Bladelets with marginal retouch are still present and carinated pieces are numerous.

At Fumane, the sole feature that recalls the previous Protoaurignacian phase is the presence of few bladelets with marginal retouch. These artifacts are however found in other early Gravettian assemblages as well. Mechanisms of cultural continuity as well as functional equifinality are viable explanations to justify the presence of bladelets with marginal retouch alongside with backed tools. This issue needs to be addressed by conducting accurate technological and functional comparisons between Aurignacian and Gravettian assemblages, as well as detailed taphonomic analyses to assess the presence and extent of post-depositional processes that might be responsible for the displacement of lithic implements accross adjacent layers. At La Cala, for instance, bladelets with marginal retouch are more numerous in the lowermost Gravettian layer 3m, in contact with the Protoaurignacian layer (Benini et al. 1997; Boscato et al. 1997).

In the light of these observations, two main hypotheses can be planted to explain the early age determination for the beginning of the Gravettian at Fumane Cave:

a. Gravettian features were present in northeastern Italy already at 36–35 ka calBP. In this scenario, the evidence south of the Alps and along the Italian Peninsula might attest to a rather patchy framework, where synchronous cultural facies coexisted for a few thousand years, before being replaced by a fully formed Gravettian component. In this case, the Gravettian would not abruptly replace the Aurignacian, which might support the hypothesis of a gradual cultural transition (e.g. Bicho et al. 2017);
b. The age determinations at Fumane are too old and likely the results of sediment mixing between the upper Protoaurignacian and the Gravettian layers. This is not a remote possibility, given that macro-unit D1 was mostly excavated in the internal part of the cave, where significant deformations due to post-depositional processes were noted (Falcucci 2018). Another interpretation is that layer D1d contains artifacts accumulated over several thousand years and the dated charcoals are not directly associated with the Gravettian lithic assemblage (Reynolds & Green 2019). However, the continuity of the charcoal layer and its fast sealing due to the sedimentary genesis of macro-unit D1, the size of the charred wood, the recovery of several lithics in proximity to the charcoal feature, and the consistency of the four radiocarbon dates point in favor of a preservation of the anthropogenic context.

Both hypotheses are extremely intriguing and need to be carefully considered when planning future research, taking into consideration both the questions related to the intra-site variability and the accurate comparison of the evidence from a regional and supra-regional perspective.

Conclusions and Future Research

In this paper we analyzed for the first time the youngest anthropic layer at Fumane Cave in northeastern Italy. In the light of the techno-typological features of the lithic artifacts, we exclude to assign the assemblage to a late phase of the Aurignacian, in favor of the Gravettian. The small number of artifacts recovered, together with their general composition, suggests that Gravettian foragers visited the cave for a short period of time. They collected high quality raw materials in the western Lessini plateau to produce blade and bladelet implements, while discarding broken artifacts. The dense scatter of charcoal remains and the presence of burned bones suggests that a not-yet defined specialized activity, probably related to the hunting sphere, was taking place at the site. We will analyze the faunal assemblage and conduct an anthracological analysis of the charcoals to better assess this aspect.

Overall, layer D1d supports the data available for the early Gravettian in the Great Po Plain, where sites are scattered and are characterized by low density of archaeological materials. This pattern was probably the result of a rather ephemeral human presence in the region and a settlement strategy characterized by short-term occupations. Furthermore, similarly to Rio Secco (Peresani et al. 2014), the use of high-quality knappable chert attested at Fumane cave suggests that Gravettian foragers were aware of the potentialities of different regions. This settlement strategy was probably responsible for the homogeneity of the cultural record in Italy that characterizes the early Gravettian. In this framework, the changing climatic conditions might have played an important role in the human displacement across the Great Adriatic-Po Region, which extended from the western Balkans to peninsular Italy (Peresani 2019 et al. in press). Future research needs to take in strong consideration the role of this vast continental shelf, emerged as consequence of the lower sea level during the MIS3 and especially MIS2 (Maselli et al. 2014), in the likely diffusion of the Gravettian from the Danube basin to Mediterranean Europe (Broglio 1996; Gambassini 2007; Talamo et al. 2014).

For the time being, we are inclined to be careful about the beginning of the Gravettian at Fumane Cave. A very rough age estimation places this assemblage between 35.9 ka calBP and 32.0-29.7 ka calBP, up to the Heinrich Event 3 at ca. 30 ka calBP. Excluding the uncertainty over the available radiocarbon dating, the attribution of layer D1d to the early Gravettian is important in the debate over the development of the Upper Paleolithic in Italy because (a) extends the number of known and well-studied Gravettian sites in the northern Adriatic region, and (b) supports the data produced at Rio Secco, according to which the Gravettian technocomplex first appeared in northeastern Italy and thus moved south along the Italian Peninsula. In this perspective, attention needs to be given to the role of the Apennine Range in the successive cultural separation between eastern and western Italy to better understand patterns of human settlements during the MIS2.

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