THE RIO SECCO CAVE, A NEW FINAL MIDDLE PALEOLITHIC SITE IN NORTH-EASTERN ITALY

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Abstract

This article describes Rio Secco Cave, a newly discovered Middle Paleolithic site in the eastern Italian Pre-Alps. Sedimentary succession, faunal remains, lithic assemblages and one \(^{14}C\) date define a chronological range from OIS 3 to the Holocene with evidence of human presence at the end of the Middle Paleolithic. This site shows for the first time the presence of the last Mousterians in the central northern Adriatic region between the Venetian Alps and Dalmatia.

INTRODUCTION

The final phase of the Middle Paleolithic in northeastern Italy is documented through numerous sheltered sites and open-air settlements that show evidence of short-term occupations or repeated use for complex tasks mostly aimed at exploiting mineral, non-mineral and food resources. Large amounts of lithic raw material as well as the physical-geographical and ecological variability at the belt between the upper Venetian-Friulian alluvial plain and the Pre-Alps depict the context in which Neanderthal groups lived, occupied territories and migrated according to seasonal rhythms with low residential mobility (Fiore et al., 2004; Peresani, 2001; Porraz, 2005). According to their topographic position, some of the main caves in the Venetian Pre-Alps (Grotta di Fumane, Riparo Tagliente, Riparo Mezzena) can be considered reference sites for sites that have been subjected to frequent, complex and intense human occupation where the lithic productions were intimately integrated with the acquisition, processing and consumption of animal resources (Fiore et al., 2004; Peresani, 2001; Thun Hohenstein and Peretto, 2005). These contexts were associated with various ephemeral camps that in some cases can be related to tool production tasks, due to their very close proximity to lithic raw material sources. In other cases these short-term camps were simply used as waypoints in a logistical system of mobility. Segmented tool production sequences like those recorded in the lithic assemblages are the most useful indicators for predicting human behavior and variability in the way these items circulated (Peresani and Porraz, 2004). The settlement system spans from the Venetian Pre-Alps to the neighboring western and eastern regions, where sites are exclusively ephemeral and reveal limited and specific evidence that can infer Neanderthal exploitation at the edge of the mountain context (i.e., Caverna Generosa, Bona et al., in press) or to specific situations in availability of mineral resources.

To this backdrop a recently discovered site stands out; Rio Secco Cave on the Pradis plateau, with its rich scientific evidence that shows human mobility indexes, territory occupation, and collection and exploitation of mineral and non-mineral resources in the key region situated in the plain-alpine contact region. Including the neighboring Piedmontese transect, the Pradis plateau is located between distinct morphological and ecological
areas: on the west the Venetian area rich in caves, shelters and open-air sites, some of which are relevant to Mousterian culture; at the east the Giulian Alps with Divje Babe I cave (Turk, 1997), the Trieste Karst with several sites mostly still undated (Tozzi, 1994) or reported to the Early Würm (Grotta degli Orsi – Boschian, 2003), northwestern Croatia and Dalmatian coast where well-known sites and a few recently discovered archives are reported (Karavanic, 2001).

PRESENTATION OF THE SITE

Rio Secco cave was discovered in 2002 during a survey aimed to explore archaeological evidence and to reconstruct the earliest human history of the western Friulian region. It lies at an altitude of 580 m on the Pradis Plateau in the eastern part of the Carnic Pre-Alps (Fig. 1), an orographic unit 850 km² bounded to the north by the high water-course of the Tagliamento River, to the south by the high western Friulian plain, to the east by the eastern bank of the Cavazzo Lake and to the west approximately by the meridian passing through the Claut Village. Altitudes range from 310 m in the Tagliamento valley at the extreme northeastern sector of the area to 2,479 m at Mt. Pramaggiore. Several N–S and W–E oriented valleys with 400 to 800 m elevations and high crests (2,000–2,300 m) between them dissect the region and make the landscape extremely complex with steep slopes that are sometimes inaccessible.

The plateau is enclosed by the following mountains: the Pala Mount (1,231 m) to the east, the Rossa Mount ridge (1,369 m) to the north, the Ciaurlec Mount (1,148 m) to the west (Fig. 2). To the south it terminates above the Cosa stream cut which runs southward dissecting the hilly landscape, a system formed by WSW–ENE oriented crests between 250 m and 500 m with progressively decreasing elevation until they reach a clear contact to the upper Pordenone alluvial plain. To the southwest, the Col Palis (374 m)–Col Vaita (367 m) ridge rises from the Meduna fan and from the Ciaurlec Mount and Castelnuovo hills, and bounds to the north the Sequals marsh in proximity of which a few Mousterian artifacts were recovered from the surface.

Almost 6 km² in area, the plateau elevation rises from 530 m to 590 m. From its northeastern side through a threshold formed by reliefs 1,000...
m higher than the plateau it is possible to enter the narrow Arzino Stream valley, a tributary of the Tagliamento running southward from the inner Pre-Alps to the plain. To the west, the Chiarza stream valley connects with the Meduna Stream in the Tramontina Valley, crossing the Pre-Alps up to the upper course of the Tagliamento. Due to its geographic setting between the upper Friulian plain and the Carnic Pre-Alps, the Pradis Plateau stands at a strategic position, which may have facilitated human penetration into the alpine region and the upper Tagliamento basin.

The Pradis Plateau has a gentle undulating landscape deriving mainly from the lightly sloped carbonatic formations (Rudist Limestones and Scaglia Rossa – Cretaceous) and partly from the Flysch (Upper Paleocene–Middle Eocene) over one third of the total surface (De Nardo, 1999). The limestone bedrocks were affected by karst degradation processes producing an uneven microtopography with isolated blocks, brattices and large dolines lined up along the main fractures or tectonic discontinuities. The bedrock is permeated by a dense system of more than 200 explored cavities, some of which penetrate some kilometers deep and vary in altitude by a few dozen meters (Cucchi and Finocchiaro, 1981). The few waterways dissecting the plateau run through the bottom of deep and narrow gorges with several shelters and caves opening on the walls.

The Flysch outcrops on the northwestern side and connects to the karst plateau to the Pala Mount. Due to its impermeability, a surface hydrographic system developed draining toward the karst sector where it is almost completely absorbed in the substrate. The landscape assumes typical fluvial features with several valleys, terraced surfaces and thin alluvial sheets. The Cosa and Rio Secco streams run in gorges almost 1,000 m deep originating from a combination of tectonic uplift with karst and alluvial erosion processes and which divide the plateau from the western slope of the Ciaurlec Mount.

Some caves opening at the base of rockwalls within large collapsed dolines or in the gorges cut by the Cosa and its tributaries have been explored for the presence of Pleistocene fills. Of these caves, the Grotte Verdi and the Grotta del Clusantin were used during the Mousterian and late-glacial Epigravettian (Bartolomei et al., 1977; Corai, 1980; Peresani, in prep). The Grotte Verdi caves were almost totally emptied by uncon­trolled excavations during the 1960s and were investi­gated by research teams in 1970–1971 that recovered several Mousterian lithic artifacts from the lowermost deposit in Riparo I (sections 7–13): few sidescrapers, one sidescraper on a thinned blank, various flakes partly affected by pseudo­retouches. From the same shelter, just a few sidescrapers and flakes damaged by pseudo-retouches were recovered in sections 3, 4 and 5. Additional Middle Paleolithic artifacts were found in sections 4 and 5 at Riparo II and in a reworked deposit.

**LITHIC RESOURCES**

The stratigraphic series spanning from the Upper Triassic to the Miocene in the Carnic Pre-Alps is complex due to the various sedimentary settings (platform, basins, etc.) and as a result of intense tectonic activity in this area since the Mesozoic. Rocks are mostly carbonatic – dolomites and micritic, oolitic or bioclastic limestones, marls and marly limestones – overlain by the Claut and Clauzetto Flysch respectively and by the molassic succession (Carulli et al., 2000). These formations have variable chert content: the dolomites of the Monticello Formation, with rare nodules and/or black flint lenses; the Dolomia di Forni, the most important and extended basin unit, with frequent flint levels in the lower portion of the sequence; the Chiampomano Limestone, with dark flint nodules and beds sporadically present and becoming more frequent at the top; the Soverzene Formation in carbonatic facies and in dolomitic facies, in which dark/black flint nodules and beds abound, flint sometimes has a yellowish color in the dolomitic facies; the Verzegnis Encrinites Mount, containing flint beds in the encrinitic calcarenites lower portion; the Igne Formation, in which dark flint beds abound discontinuously; the Vajont Limestone, with rare brownish or reddish flint nodules and flint beds mostly in the lower and upper portions of the formation; the Fonzaso Formation, rich in brownish or reddish flint nodules and flint beds, with local predominance of the silicified portion over the carbonatic one; the Rosso Ammonitico Superiore, presenting in its nodular facies large red flint nod-
Fig. 3. Above left, the site viewed from the right side of Rio Secco section with position of the GRS I sounding; right, representation of the sedimentary succession with the anthropically modified bone recovered in unit 5 and used for radiocarbon dating.

ules and beds; the Biancone micritic limestones, where flint varies from light (white) to dark in the form of nodules and beds; the Socche Limestone and its bioelastic carbonatic sandstones with flint becoming more frequent in the western zone than in the easternmost where it dramatically decreases or disappears; the Scaglia Variegata, with dark flint sometimes in large nodules; the Scaglia Rossa and its red nodular flint locally present.

Nevertheless, the extensions covered by these formations are restricted: partly they are distributed in W–E strips according to the main tectonic lines corresponding to the overthrusts as in the case of the Dolomia di Forni; partly they consti-
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tute the upper portions of some main massifs like the Valcalda, Verzegnis and Piombada mounts, 13–14 km away from the site to the N–NE.

Looking north, behind the important structural element known as the Alto Tagliamento Line and partially merging with the present-day river course, the micritic and bioclastic limestones of the Livinallongo Formation outcrop 20 km from the site. These limestones are partially or completely silicified and sometimes include flint beds and nodules typically colored green. Their geographic distribution is restricted to the upper Tagliamento valley, the Lumiei Stream valley and the middle Chiarza stream valley from which it is rapidly dismantled and transported by the river flows. The richest exploitable outcrops occur in the Bivera Mount area, at the Creta Forata Massif foot, over Ampezzo and along the Lumiei Stream.

In spite of such relative abundance and their suitability for flaking, these fine-textured pre-alpine flints were not intensely exploited for two reasons: 1) poor accessibility to the primary exposures, which were often scattered on the highest mountain ridges and far from the main rivers; and 2) intense fissuration of the flint beds and nodules resulting from tectonic activity. Forming a dense discontinuity net, this second factor dramatically affects the possibility of using these raw materials except when re-cementation processes periodically ameliorated the lost isotropic qualities.

Secondary deposits are also varied and are sources of pebbles and sub-rounded flint cobbles. Well rounded pebbles are available in the polygenic breccia of the lower Preplans sandstone, an Oligocene-Miocene clastic unit in the western-central part of the region that has been interpreted as pertaining to the molassic sequence. Coarser materials can be collected both on river and stream gravel plains and on glacial and fluvio-glacial deposits at various points along the Tagliamento basin.

**STRATIGRAPHY**

Rio Secco Cave is a large sheltered cave opening on the left slope of the homonymous stream, ca. 20 m above the present-day bed. Facing south, the great shelter has a large, flat roof derived from the collapse of large slabs driven by the stratified limestone. The sheltered area is bounded from the outside through a large boulder ridge positioned north–south on which two dry-stone walls lean forming the presumed remains of a shelter used until a few dozen years ago. The cave opens at the center of the rockshelter wall and continues as a gallery heading for 12 m until the sediments completely fill this old karst system. Outside the fill forms a slope-waste deposit thickening along the present-day drip-line where the large boulders define the vast original roof extension.

During the summer of 2002 the fill was explored through two test pits named GRS I and GRS II: GRS I was opened at the left side of the cave-mouth on a 2 x 2m square, then was restricted to 0.5 x 0.5 m in the NE corner following the lower boundary of unit 4; GRS II was dug at the foot of the rock-wall facing GRS I but several meters from it. This second test pit proved to be completely sterile and for this reason was discontinued after 1 m excavation depth.

GRS I exposed a 1.7 m thick sedimentary succession including four distinct units at the NE corner of the test pit that were observed and described (Fig. 3).

**Unit 1:** reworked deposits resulting from uncontrolled excavations; bones, fragments of pottery and a few flint flakes including one pseudo-Levallois point have been recovered.

**Unit 2:** layer of charcoal visible on the western section incorporated into the upper part of unit 4 and partially removed by the uncontrolled excavations. It contains a few lithic artifacts covered by a thin carbonatic concretion and late Neolithic–Bronze Age pottery. It includes unit 3, a small cache with fragmented pottery.

**Unit 4:** clast-supported coarse breccia with discontinuous incoherent yellowish-brown dolomitic sand inills. Stones and boulders have a chaotic orientation and are covered by thin blooming concretions on the lower surfaces. Locally these are visible levels made of thin breccia with sub-rounded to rounded coarse grains locally cemented. Archeologically sterile, this unit yielded rare bones.

**Unit 5:** this unit includes several levels made of incoherent matrix-supported breccia. Medium-small sized carbonatic stones that are occasionally larger, sub-angular to sub-rounded; dark yellowish-brown clayey-silty matrix; reddish-brown
clayey-silty coatings, continuous on the upper stone surfaces. It contains fragmented charred wood, small bone fragments and lithic artifacts. The lower boundary was not reached.

This succession documents two main sedimentary events controlled by freezing-thawing processes and rock collapses that acted to degrade the walls and the roof of the sheltered cave. Owing to the restricted size of the explored area we cannot evaluate whether the large collapses at the drip line or the stream deep cut facing the site refer to this sedimentary cycle or to other cycles. Unit 5 records a depositional phase at the cave-mouth due to colluvial processes from the outermost zone and/or of non-carbonatic fine sediments originating from the degradation of the Flysch and reworked in the inner karst system. Reworked deposits may occur frequently as it has been revealed elsewhere in other inactive cavities. In most cases these are occluded or nearly filled up. The deposition of these fine-textured silicatic sediments maybe also relate to the outermost stream activity, although neither sedimentary structures were observed or siliciclastic rock outcrops throughout the Rio Secco basin upstream from the cave.

A fragmented diaphysis (species undeterminable) recovered in unit 5 displays cut-marks that were made with a lithic tool (Fig. 3) was radiocarbon dated to 37,790 ± 360 B.P. (LTL429A). As discussed by Housley et al. (1997) and Zilhao and D’Errico (2003), direct dating of human-modified animal bones gives the most accurate proof of human occurrence in caves used by animals and humans, while unmodified animal bones – often used in 14C analysis – can be totally unrelated to any human settlement.

The successive sedimentary phase records a conspicuous cave-fill aggradation coincidental with the deposition of unit 4, which led to an almost complete obstruction at the cave-mouth. In relation with the sedimentological features and archaeological content observed at the top of unit 4, this event can likely be temporally placed at an interval extending from the late Middle Weichselian to the Late-glacial. The variable sedimentation rate throughout the succession is also discernible in the opposing degrees of anthropization recorded in both units. The uppermost 50 cm of the stratigraphy at this stage had been recently re-worked and thus it was impossible for us to infer information about the termination of this sedimentary cycle.

FAUNAL REMAINS

From GRS 1, dozens of faunal remains were recovered. Due to the small size of this assemblage some very preliminary observations will be advanced about the agents that acted to produce it and about the human and non-human occupations at the mouth of the cave. At the moment no data can be provided to support paleoenvironmental reconstructions.

Unit 1 contains 43 pieces with variable degrees of preservation: strongly weathered remains are associated with very fresh present-day deposits. Identified pieces consist of one badger mandible (Meles meles), one phalanx and one incisor probably belonging to wild boar (Sus scrofa), and two Caprinae teeth. In unit 2, among the 33 recovered faunal remains, there are a marmot clavicle (Marmota marmota) and one indeterminate fragment showing a series of short cut-marks. The unit 5 bone assemblage counts 92 remains including one metapodium and three cave bear (Ursus spelaeus) deciduous canines and one marmot (Marmota marmota) metacarpus. A small fragmented herbivore rib has preserved subcircular areas (pits) produced by the pressure of large carnivore teeth (Ursus?). Anthropic activity on animal bones in this unit is evident by a dozen burnt bones and by the diaphysis with cut-marks which was sacrificed for 14C dating. Bone preservation is good – the surfaces are fresh with sharp edges and contrast with ca. 12 pieces bearing blunt or rounded edges presumably altered by water transport or more likely trampling. In sum, this faunal assemblage is the result of both large carnivores using the cave as a den and from human carcass processing. Butchering activities are also recorded in unit 2. Remains collected from unit 1 define a non-homogeneous assemblage produced by the reworking of both old and modern items.

LITHIC ARTIFACTS

Very few fictile remains and lithic artifacts were recovered in a good state of preservation from the GRS 1 sounding. Except for unit 1 with its reworked content, only two units provided
evidence of human presence and these consist of very few items, presumably due to the limited extent of the excavation. Although unit 5 was explored on a more reduced area (0.5 x 0.5 m), it reveals the highest concentration of lithic and faunal remains along the overall stratigraphy.

**Unit 1:** Some pieces were recovered from reworked sediments: fragmented Bronze Age pottery and four flint artifacts, two small cores and two flakes in a good preservation state unaffected by patina or other alteration. Both of the cores differentiate from flakes by the presence of thin carbonatic films on their surfaces: the first one was found on a rounded block of Soverzene flint collected in the Meduna stream plain, the second one on a greenish very fine cretaceous flint nodule of unknown provenance. Flakes are made in limestone or in Jurassic flint. The latter is a pseudo-Levallois point struck from a cobble bearing traces of stream/fluvial transport. The thin edge opposed to the back displays modification presumably due to utilization. Because these items are indistinguishable in their taphonomic features, they can be grouped according to their technological features into two assemblages: 1) Late Neolithic–Bronze Age (the cores); and Mousterian (the pseudo-Levallois point).

**Unit 2:** This unit contains one fragmented bladelet with cortical back and one bladelet flake-core. The flint is gray and vitreous, lightly patinated, presumably collected from cretaceous formations (Biancone?) in the Venetian Pre-Alps behind the Alpago Basin. The core was obtained on a thin plunged flake struck from flint filled with cemented fissures. Flaking occurred along the main axis following the distal thickening (Fig. 4: 1). As listed below, the following traces are visible: remains of lamellar scars, a stop notch, the last failed or hinged detachments ending the sequence. Further operations aimed to shape and regulate the volume can be observed on the lower face.

**Unit 5.** From this unit one Levallois core and five artifacts were recovered. The core is in Livinallongo flint and the lower surface has abraded ridges and features typically derived from fluvial transport (Fig. 4: 3). Similar provisionable raw materials are likely to be found in the fluvial or fluvio-glacial alluvial gravels spread throughout the Tagliamento river basin. The core has a trimmed striking platform covering the overall perimeter and centripetal recurrent scars on the extraction surface with repeatedly struck hinges leading to its discard. Among the five entire and indeterminate fragmented flakes we describe one flake with centripetal scars affected by pseudo-retouches and one small pseudo-Levallois point produced with discoid technology (Fig. 4: 2) made from coarse textured flint similar to the Verzegnis Encrinites.

The unit 5 group defines a homogeneous assemblage containing Levallois technology and presumably discoid technology as suggested by the core and the pseudo-Levallois point, which is a typical primary product of this method. As a rule, the technological features (dihedral butt with convex surfaces, the operative sequence) exclude any doubt that this item is a by-product of the Levallois procedure. Indeterminable fragments and other flaking waste products indicate on-site flake production. However, less certainty is possible for framing the artifacts recovered in unit 2 either chronologically or culturally. Technological features like to place them in the Upper Paleolithic...
and presumably the Epigravettian, but they clash with the co-association of fragmented pottery. Moreover, no carbonatic film has been deposited on these potsherds, contrary to the lithics. An association resulting from reworked non-coeval items cannot thus be excluded a priori.

CONSIDERATIONS

Our estimates using chronometric, lithological and paleontological data seem to support the interpretation that the explored stratigraphy of the Rio Secco cave was rapidly deposited as a consequence of roof collapse and other events in a few tens of thousands of years. At the moment no palaeoecological data are available to infer whether the final Middle Paleolithic at Rio Secco is embedded in sediments formed under interstadial or stadial conditions, or to confirm the chronological position of the human occupation recorded in unit 5. Recent improvements from the Azzano X pollen record, a core from the Friulian plain, indicate continuous oscillations in the percentage values of Pinus, Picea, Betula, Graminae and xerophytes, possibly resulting from alternations between steppe/taiga environments. According to Pini et al., (in press) the climate never reached temperatures supporting broad-leaved forests.

A handful of sites with Mousterian industries fall by different numeric ages (\(^{14}\)C, U/Th, TL, racemization) in the radiocarbon interval of 40–30 ka BP in northeastern Italy and Croatia. At Fumane Cave in the Veneto Pre-alps, the group of units A reveals variablecrioergic activity and wooded landscape in units from A11 to A10 that persisted until unit A3, when conditions shifted toward more open contexts and a cool-dry climate. The Rio Secco date covers the dispersed radiocarbon set depicted by units A11, A10, A9 and A6, which contain Levallois (A11, A10 and A6) and discoid (A9) lithic assemblages (Peresani et al., in press). Levallois products are mostly long and thin and were obtained using the unidirectional recurrent method, whereas the centripetal recurrent was applied during the final steps of the reduction sequence (Broglio et al., 2003). An abrupt technological change observed in unit A9 is due to the appearance of complete and exclusive discoid reduction sequences (Peresani, 1998). To the same interval belong the undated upper sections from another well-known site in the Lessini Mountains, the Tagliente shelter, which has recently provided evidence of technological variability at the very end of the Mousterian or at least during OIS 3 (Arzarello and Peretto 2005). Rio Secco should also be contemporary with levels from B to E1 and E1/E2 in Mujina Pecina, Dalmatia, a site dated to 45–34 ka BP (Rink et al., 2002). The archaeological content counts Levallois items in lower levels (E–D) and small tools like notches and denticulates in the uppermost ones (C–B).

Rio Secco cave records for the first time the final Middle Paleolithic in Friuli and provides a numeric age at the MP–EUP boundary, a period which has until now been better investigated in the neighboring regions. Given its particular position at the crossroads of the plains-mountains areas and the total preservation of the cave fill, many new topics could be approached by future research on stratigraphy and paleoecological setting, chronology, site-function and site dynamics, as viewed through techno-economical and archaeozoological analyses of lithic and non-lithic relics recovered in this human context.

Acknowledgments

Archaeological surveys on the Pradis Plateau and research on the Rio Secco Cave have been carried out through concession by the Ministero dei Beni Culturali and the Soprintendenza per i Beni Archeologici of Friuli-Venezia Giulia (Dr. S. Vitri). The authors are very grateful to Dr. P. Visentini, Director of the Museo della Grotta at Pradis for his invitation to commence and conduct field research and surveys; Clauzetto Municipality for financial support; Mr. L. Colledani for information about the site location; geologist A. Riva for details concerning the geology of the area and the flint sources; geomorphologist R. Aviglano for text revision; students and collaborators that took part in the field-work; N. Uomini for revision of the English text. The following study is part of the Research Project granted by the University of Ferrara and entitled “Evolution of techno-functional systems and subsistence strategies from the Palaeolithic to the Mesolithic in differentiated ecological contexts”. For this specific work F. Gurioli carried out the analysis of faunal remains.

REFERENCES


PINI R., DONEGANA M., RAVAZZI C., AVIGLIANO R., CALDERONI G. in press. Late Pleistocene pollen stratigraphy and vegetation history at Azzano Decimo, southeastern Alpine foreland.


19–36.
THUN Hohenstein U., Peretto C. 2005. Faunal exploitation in the Middle Palaeolithic: Evidences from Riparo Tagliente (Verona, Italy). In: Données récentes sur les modalités de peuplement et sur le cadre chronostratigraphique, géologique et paléo-