The New Neanderthal Fossil Sample from Grotta Guattari, Monte Circeo (Italy): A Preliminary Synopsis

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ABSTRACT

Grotta Guattari is a prehistoric site on the Tyrrhenian coast of central Italy, approximately one hundred kilometers southeast of Rome. It has been renowned for the discovery in 1939 of a well-preserved Neanderthal cranium and two mandibles. After eighty years, recent excavations conducted between 2019 and 2023 have brought to light important new discoveries, revealing significant geological, paleontological, and archaeological evidence. These discoveries provide insights into the site's stratigraphy and chronology, dating back between 121.5±5.8 and 65.0±2.8 thousand years ago. The human fossil sample now includes 22 elements, some of which are almost complete, while others are fragmentary. The collection encompasses 11 cranial remains, 4 postcranial bones, and 7 dental specimens, which in some cases can be traced back to the same individual with certainty; they are thus numbered, in order of discovery, from Guattari 1 to Guattari 18. This paper systematizes, contextualizes, and briefly describes the entire sample to facilitate future analytical and comparative studies, as well as their long-term conservation. The preliminary results presented in this paper confirm the exceptional significance of Grotta Guattari. Taken together, the human fossil sample from this site represents the largest Neanderthal fossil collection ever discovered in Italy. They provide valuable evidence for understanding Neanderthal morphology and human evolution in Europe, the exploitation of the region by Neanderthals of the Late Pleistocene, as well as the taphonomy and site formation processes.

INTRODUCTION

The karst cavity known as Grotta Guattari (i.e., Guattari Cave) is a prehistoric site in southern Latium (central-western Italy) that was discovered under fortuitous circumstances on 24 February 1939. It opens at ca. 7m above sea level and approximately 100m from the Tyrrhenian Sea coastline, on the eastern slope of the Circeo promontory (Monte Circeo), near San Felice Circeo (Latina): 41°13′58″N 13°05′51″E (Figure 1). The cave is renowned for the 1939 discovery of the Neanderthal cranium Guattari 1, found directly on the paleosurface (Blanc 1939a-d). A mandible (Guattari 2) was also found on the surface (Blanc 1939a, c), while a second mandible (Guattari 3) was discovered later in 1950, in the external sediments referred to as "breccia" (Blanc 1951; Sergi and Ascenzi 1955).

The name Guattari, both as a cave and as a cranium, is also renowned for the hypothesis of a rite that Neanderthals may have practiced there, referred to as "ritual cerebrophagia" (Blanc 1945, 1950, 1958, 1961; see review in Borgognini Tarli et al. 1991). This cannibalistic practice was thought to hold symbolic meaning, though this interpretation is speculative. Nevertheless, the idea remained prevalent in prehistory books for half a century, before being debunked and abandoned since the late 1980s (Borgognini Tarli et al. 1991; Giacobini 1991; Giacobini and Piperno 1991; Stiner 1991a, b; Toth and White 1991; White and Toth 1991).

More recently, additional human fossil specimens were discovered during excavations conducted under the supervision of the local Archaeological Superintendency (Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina; hereafter: SABAP Frosinone-Latina) and the direction of one of us (M.F.R.) from 2019 to 2023. These new excavations have revealed an important geological, paleontological, and archaeological assemblage, which sheds new light on the stratigraphy and chronology of the internal and external deposits (Rolfo et al. 2025). This paper summarizes the main results obtained so far regarding the site and provides a preliminary review of the overall sample of human fossils unearthed to date. Following recent developments that required the official establishment of the research group in charge of the study, our goal is to present the formal, appropriate naming, overall consistency, and main characteristics of the human findings, even though each of the new specimens will be examined in detail in future specific papers.

GROTTA GUATTARI 1939–1950

A.C. BLANC, S. SERGI, AND A. ASCENZI

Alberto Carlo Blanc (1906–1960) was an internationally renowned prehistoric archaeologist. He was involved in the discovery of both Saccopastore 2 in Rome (1935; Blanc 1935), and Guattari 1–2 at Monte Circeo (1939; Blanc 1939a-d). He also led several excavations at Paleolithic sites across the Italian peninsula, as part of the activities of the Italian Institute of Human Paleontology (Blanc 1942). It is not possible to review all his achievements and theories here, but his studies of the Guattari 1 cranium and the already mentioned hypothesis of "ritual cannibalism" deserve special mention (Blanc 1942, 1945, 1961).

The study of the human fossil remains from Grotta Guattari was carried out by Blanc in collaboration with the paleoanthropologist Sergio Sergi (1878–1972), who was also internationally renowned for his morphological and

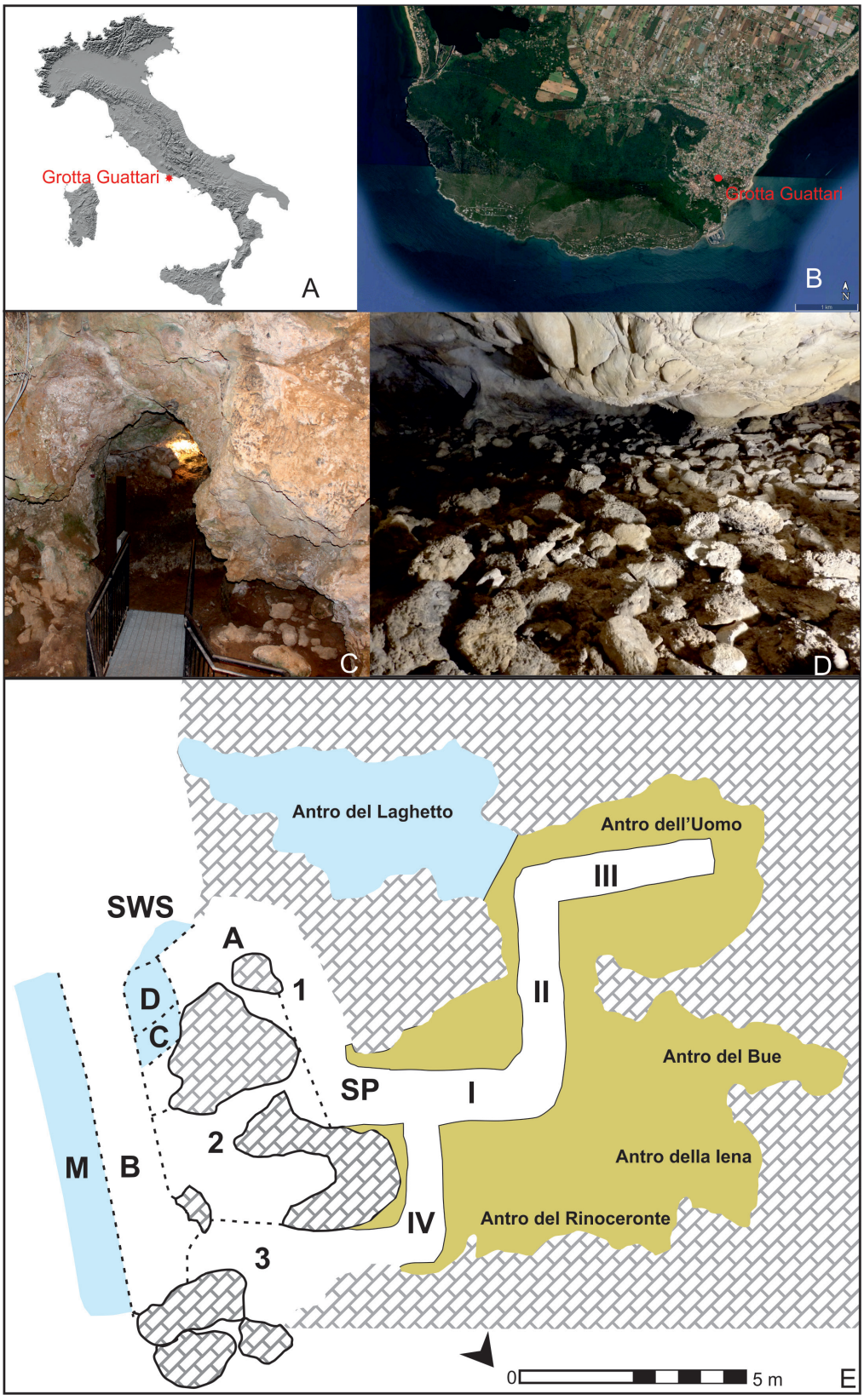

Figure 1. Setting and topography of Grotta Guattari (San Felice Circeo, central Italy): A) its geographical position in the Italian peninsula; B) location within the Monte Circeo (aerial view); C) the entrance of the cave; D) the paleosurface discovered in 1939; E) map of Grotta Guattari with names of excavation areas from 1939 to 2019–2023. Numbers and letters on the white areas (in E) indicate the original trenches opened soon after 1939; letters and legend on the light blue areas indicate the 2019–2023 excavations; traditional names of the various chambers of the cave are reported, with the area called Antro del Laghetto *(AdL throughout the text) evidenced in light blue: this is where most of the new human fossil remains were found recently.*

evolutionary research on the Neanderthals from Saccopastore (Sergi 1929, 1948). On the Neanderthals from Monte Circeo, Sergi published several analytical and comparative studies, focused on both the Guattari 1 cranium (Sergi 1939a, b, 1974) and the Guattari 2 and 3 mandibles (Sergi 1954; Sergi and Ascenzi 1955).

The latter specimen was discovered by A. Ascenzi and G. Lacchei during an informal survey in 1950 (Blanc 1951; Sergi and Ascenzi 1955). Antonio Ascenzi (1915–2000) was himself a renowned scholar, particularly known for his work in morbid anatomy, bone biomechanics, and paleopathology. Also active in paleoanthropology (Ascenzi 1991; Ascenzi et al. 1996, 2000; Manzi et al. 2001), he served as the editor of the monograph "The Neandertal cranium of Mount Circeo," which compiled and finalized both published and unpublished notes by Sergi after his death (Sergi 1974; English translation in Piperno and Scichilone 1991).

DISCOVERY OF GROTTA GUATTARI AND EARLY EXCAVATIONS

Grotta Guattari was discovered in 1939. It is located at the foot of Monte Morrone, a hill forming the southeastern slopes of the Monte Circeo massif (San Felice Circeo, LT). The landowner, Alessandro Guattari, had requested and obtained government authorization to build a hotel on the site. During the excavation work, fossil animal bones began to emerge, which A. Guattari brought to the attention of Blanc (Blanc 1939a). On February 24th, the workers uncovered the narrow entrance to a karst cave, blocked by an ancient debris cone that was later found to have sealed the cave for over 50,000 years (Schwarcz et al. 1991a, b). The discoverers entered a series of chambers, eventually reaching one of the innermost, later named *Antro dell'Uomo* (or "man's chamber"; hereafter *AdU*), where they found a Neanderthal cranium referred to at the time as Circeo I (Blanc 1939c, d), now known as Guattari 1. Shortly thereafter, a human mandible (i.e., Circeo II or Mandible A), and now referred to as Guattari 2, was accidentally discovered not far from the cranium by an employee of A. Guattari.

The Regia Soprintendenza alle Antichità di Roma, having been informed of the discovery, granted permission to the Italian Institute of Human Paleontology, coordinated by Blanc and his colleague Luigi Cardini, to initiate archaeological investigations of the cave. These were carried out in 1939 through the opening of a series of trenches (i.e., B-A-1-2-3-SP-IV-I-II; see Figure 1E) to facilitate access and to investigate the stratigraphy of the cave deposits until reaching the location where the Neanderthal cranium was found (i.e., trench III) (see Blanc and Segre 1953; Taschini 1979). Excavations were suspended during World War II and resumed in the summer of 1950, without yielding any additional human remains, except for a mandible (i.e., Circeo III or Mandible B), now referred to as Guattari 3, discovered in 1950 within the geological layers outside the cave (Blanc 1951).

GUATTARI 1–3: MORPHOLOGY AND ORIGINAL INTERPRETATIONS

Guattari 1 is a paradigmatic example of the cranial morphology shared by most of the late European Neanderthals, as demonstrated by both the detailed studies conducted by S. Sergi (e.g., Sergi 1974) and the subsequent inclusion of this specimen in numerous comparative works and overviews (e.g., Macchiarelli et al. 1995; Recheis et al. 1999; Stringer et al. 1984; see also various papers in Bietti and Manzi 1991, and in Piperno and Scichilone 1991). Relevant features include the long and broad braincase, mid-facial prognathism, the peculiar conformation of the occipital region, the rounded (*en bombe*) profile of the braincase when viewed from behind, and the well-defined posterior projection of the occipital squama (*chignon*). There are also several more localized traits, for instance, the arched supraorbital ridges and wide orbits, the prominent occipital torus, the presence of a well-defined suprainiac fossa, and features of the petro-mastoid region (e.g., Balzeau and Rougier 2013; Harvati 2003). In the lateral view, the profile shows a modest parietal curvature, generally offset by a comparatively more pronounced curvature of the occipital squama, particularly along the lambda-inion tract, in combination with a broad biasterionic breadth (e.g., Manzi 1991). This reflects the distinctive architecture of the Neanderthal braincase, as clearly described by analyses of the midsagittal profile of the cranial vault using both traditional methods (e.g., Stringer and Trinkaus 1981), and geometric morphometrics (e.g., Manzi et al. 2000). In sum, alongside other late Neanderthal specimens—such as La Chapelle-aux-Saints 1, La Ferrassie 1, La Quina H5, the calottes from Feldhofer 1, and Spy 1 and 2, among others—Guattari 1 is one of the specimens that exhibit such a combination of features, in accordance with its chronological attribution (Dean et al. 1998; Hublin 2009).

Sergi's work remains a reference in this regard:

> "Circeo I is an almost complete cranium, although mutilated at its base and in the right temporo-orbital region [...]. The state of ossification corresponds to that of a cranium of 40 to 50 years [...]. The general shape corresponds to that of other Neanderthal crania, particularly that of La Chapelle, both being male and of approximately the same age [...]. The frontal curve of the Circeo cranium is almost exactly the same as that of the Neanderthal calotte. The capacity of the cranium [...] is related to those of the Neanderthal crania of the more classical type [...]. It is the lowest among the larger Neanderthal crania. The face is very broad, orthognathic, extremely narrow in relation to the height [...]. The nose is the highest and broadest among the known Neanderthal crania" (Sergi 1953: 1121; our translation from French).

Moreover, in comparing Guattari 1 to the older, and less typical, fossil crania Saccopastore 1 and 2, he further commented (using terms Sergi himself coined such as Pale-

anthropes, or Neanderthals, and Phanerathropes, or Anatomically Modern Humans):

> "Italy, with the discoveries of Saccopastore and Circeo, has provided evidence of the existence of different forms of European Paleanthropes, belonging to different periods. Saccopastore is an interglacial variant, Circeo is a glacial one. In the interglacial period there is an extensive polymorphism represented by several branches. Among these, it is possible to trace back the origin of the ancestors of some phaneranthropic races. In the glacial period a terminal branch survives, represented by the Neanderthals of great cranial capacity. The two types found in Italy have disappeared, but one of them, Circeo, vanished without any direct continuity with the Phaneranthropes, while Saccopastore, although more primitive in relation to their features and their time, are closer to the Phaneranthropes, that is to present-day humans" (Sergi 1953: 1125–1126; our translation from French).

Regarding the mandibles Guattari 2 (Sergi 1954) and Guattari 3 (Sergi and Ascenzi 1955), a recent reappraisal (Arnaud et al. 2015) has shown that both specimens display Neanderthal-derived features, such as a large retromolar space and an anterior position of the mental foramen. Nonetheless, differences in trait expression have been highlighted—Guattari 2 displays a general morphology consistent with other late Neanderthals, whereas Guattari 3 shows more affinities with more ancient Neanderthals (Arnaud et al. 2015). Actually, while the chronology of Guattari 2 likely aligns with that of the vertebrate assemblage found on the paleosurface inside the cave—i.e., close to about 60 ka (Rolfo et al. 2023)—the stratigraphic context of Guattari 3, found in the external "breccia" sediments, remains uncertain. Such a morphological variability would further support the hypothesis of the evolutionary trajectory followed by human groups in Italy during the Middle and Late Pleistocene (Manzi et al. 2011), characterized by the recurrent persistence of plesiomorphic morphologies—as observed in both the Ceprano calvarium (ca. 400 ka; Manzi 2016) and the Altamura skeleton (ca. 150 ka; Profico et al. 2023)—suggesting that the Italian peninsula may have recurrently acted as a system of eco-geographic refugia.

STUDIES BETWEEN 1970 AND THE EARLY 2000s

Since the 1970s, there has been a reappraisal of the studies of Grotta Guattari, focusing not only on the Neanderthal specimens (see, e.g., various papers in Bietti and Manzi 1991; Piperno and Scichilone 1991), but also on the context of the cave itself, as well as on the other findings from the early excavations, which were fundamental for contextualizing the Neanderthal presence in the region. Within this framework, the malacofauna of the Tyrrhenian levels (Durante and Settepassi 1977) and the analysis of the paleosurface of the cave (Piperno 1977) were published, while the study of the lithic industry carried out by M. Taschini was published posthumously by A. Bietti (Taschini 1979).

A major turning point in the interpretation of these interrelated topics occurred in the late 1980s. It was mostly based on the faunal remains (Piperno and Giacobini 1991; Stiner 1991b) and was formally presented during the international Symposium held in 1989 for the 50th anniversary of the discovery of Grotta Guattari (Bietti and Manzi 1991). On the same occasion, a monograph dedicated to the Guattari Neanderthals was edited by Piperno and Scichilone (1991). From the combination of a number of new studies, based on a heuristic approach different from those of the past, it clearly emerged that Grotta Guattari could no longer be considered a Neanderthal ritual chamber, but rather as a hyena den (Borgognini Tarli et al. 1991; Giacobini 1991; Giacobini and Piperno 1991; Stiner 1991a, b; Toth and White 1991; White and Toth 1991).

In this period, although a general chronological framework for the site had already been hypothesized (Blanc and Segre 1953; Taschini 1979), the first absolute dates for the site, and in particular for the paleosurface, were obtained using ESR analysis on aurochs' tooth enamel and U-Series dating on calcite deposits (Schwarcz et al. 1991a, b); these yielded respectively an age of 57,000±6,000 years BP and 51,000±3,000 years BP. Further dates were based on the amino acid racemization method (Belluomini et al. 1991); the results, around 52,000 years BP, were consistent with the U-Series dates. The geomorphology and stratigraphy of the cave as well as the climatic conditions that led to the closure of the cave entrance and the formation of the stalagmitic crusts on the internal paleosurface were discussed by Segre (1991), also considering the new chronological data. The analysis of the pollen collected both inside and outside the cave in the late 1980s yielded few data, not sufficient for a paleoenvironmental reconstruction (Cattani 1991). A techno-typological approach was used to reinvestigate the lithic industry (Bietti and Kuhn 1991; Kuhn 1995), demonstrating how the reduction sequence was affected by the raw material employed (i.e., the small pebbles of the Pontine plain) and emphasizing the relationship between stone tool technology and animal exploitation strategies.

To date, the Grotta Guattari Neanderthals have also been included in extensive studies focusing on the morphological adaptation and dietary habits of this taxon (e.g., Arnaud et al. 2015; El Zaatari et al. 2011; Fiorenza 2015; Fiorenza et al. 2015; 2020; Hernaiz-García et al. 2024)

ARCHAEOLOGICAL CAMPAIGN 2019–2023

In 2018, because of the 80th anniversary of the discovery of the cave and the reopening of the site to the public, the SABAP Frosinone-Latina promoted a project for the renovation of the visit route. The intervention included the cleaning of trench sections made by Blanc and Cardini, which were no longer visible due to mold and a stalagmitic veil that had accumulated over the decades.

The work was carried out in collaboration with the research team of the University of Rome "Tor Vergata," led by one of the authors (M.F.R.). In the following year (2019), a more comprehensive project began, with the aim of redesigning the internal and external pathways of the site and the planning of two archaeological excavations—one inside the cave in an area that had never been investigated

before, and the second one in the external rock shelter. The first area is known as *Antro del Laghetto* (Blanc 1939c) (see Figure 1E), or "Pond's Chamber," due to the presence of a small body of water resurging between autumn and spring. Excavation began in October 2019 and continued until the autumn of 2023, with periodic breaks also due to the massive rise in groundwater. Underneath a thin stalagmitic layer, the excavation revealed a paleosurface corresponding to that visible on the entire cave floor (Rolfo et al. 2023). This sealing has protected the deposit from post-depositional disturbances, including those at the time of the site's discovery in 1939, making the context extremely valuable as it is intact since the Late Pleistocene, when a debris cone sealed the cave. The excavation in the area outside the cave involved the re-examination of the trenches A and B dug by Blanc near the entrance, and the cleaning of the corresponding sections. This intervention later evolved into a thorough excavation of this area, which was carried out between autumn 2020 and August 2023.

THE SO-CALLED "*ANTRO DEL LAGHETTO*"

The *Antro del Laghetto* (hereafter referred to as *AdL*) is a room of 22m^2 that was investigated with seven excavation sectors. The limits of each area were established following the morphology of the cave, which was naturally divided by a central saddle of stalagmite formations and concretions—Area 1 corresponds to the NE sector of the room; Area 2 identifies the duct that starts from Area 3 and runs for more than 3m toward SE; Area 3 is the SE portion of the room; Area 4 is placed under a natural stalagmite arch; Areas 5 and 6 are located in the central-western part of the room; Area 7 is the part of the room that faces the *AdU*, close to the archaeological trenches II and III excavated in 1939 and the following years.

The deposit was examined down to a depth of 1.5m, reaching a level of stalagmite concretions and collapsed blocks of the vault, which was found to be archaeologically sterile despite not constituting the bedrock of the cave. The excavated sediment was first dry-sieved using 5mm meshes and then water-sieved with 2mm meshes. The stratigraphic units with the highest density of bone remains were investigated using tools that would not create taphonomic marks, such as soft plastic and wooden probes. A water pump was activated during the investigations in order to preserve the stratigraphy and integrity of the archaeological finds from the recurring rise of groundwater after rainfall. Additionally, a raised platform was built to prevent the bones from being trampled and further damaged.

The irregular geomorphology of the *AdL*, with significant altitude differences and numerous collapses and stalagmite formations, prevented the creation of a physical grid system for the excavation area. Instead, several topographic reference points were established and GIS positioned using a Total Station (Leica FlexLine TS09, Leica Geosystems). Therefore, each find was assigned a unique number, hand-drawn on graph paper, and recorded on the GIS map (Figure 2). The orientation and inclination of the finds that were longer than 5cm were recorded to study the spatial distribution and formation processes of the paleosurface.

ADL STRATIGRAPHY

Twenty-five stratigraphic units (SUs) were identified, allowing the recognition of four distinct major levels within the *AdL* (Figure 3). From top to bottom, the description of the levels is as follows.

Level 1 – It includes SUs 18–19 and extends throughout the whole surface of the area and is characterized by a very porous and friable stalagmitic, 2–3cm thick, tuffaceous whitish flowstone, over which there is a thin level—about 1cm of thickness—of ancient and recent mud deposited by groundwater. In some places, the bone remains of the level below (Level 2) were partly visible despite the cover of Level 1. Protruding bones are covered by friable, porous coralloid concretions like those found on most of the specimens present on the paleosurface throughout the cave and on the cranium found in 1939.

Level 2 – It comprised SUs 20, 21, 38 and the top of SUs 51–54, interface layers with the underlying Level 3. It was identified and investigated across the whole extension of the *AdL* area. The sediment is sandy with a distinct yellow color, admixed with small, rounded limestone pebbles and some flowstones; within it, sparse clasts and thin cemented spots were also found. The average thickness is 27cm in Areas 1, 4, 5–7 (see Figure 2), while it is thicker in Areas 2 and 3. The level yielded a total of 4329 faunal finds, 16 human remains, including 3 between Levels 2 and 3 (SUs 51–54), and 7 lithic artifacts (Rolfo et al. 2025). This level is characterized by a significant concentration of finds (N=434) in Areas 2 and 3. The concentration of faunal remains in Area 3, as well as one human bone found in a depression in the concretion (SU 38), are also worthy of mention. The finds lay mostly perpendicular to the center of the depression, suggesting that the depression already existed and that it was filled by the faunal remains as they piled up over time. The level is dated to slightly before 66 ka and 65 ka (230Th/U dating) (Rolfo et al. 2023).

Level 3 – It includes SUs 41, 42, 44–45, 50–51, 53, covers the whole investigated area, and is 20cm deep. This level differs from the overlying Level 2 by an increase in compact tuffaceous flowstone patches and an accentuated superficial alteration of the bone remains, the superficial part of which is nearly completely deteriorated in some cases. Level 3 yielded a total of 4962 mammal remains and a few (N=31) lithic artifacts.

Level 4 – It includes SUs 43, 46–47. Below Level 3, it was identified as a level of clasts collapsed from the cave's walls and ceiling, cemented by several flowstones. The top of Level 4 appears to be a series of natural pools filled by the sandy deposit of Level 3.

SPATIAL DISTRIBUTION OF THE FOSSIL REMAINS

The fossil faunal remains in Levels 2 and 3 are distributed across the entire surface of the *AdL*. Areas 1 and 4 are characterized by a uniform concentration all over the surface,

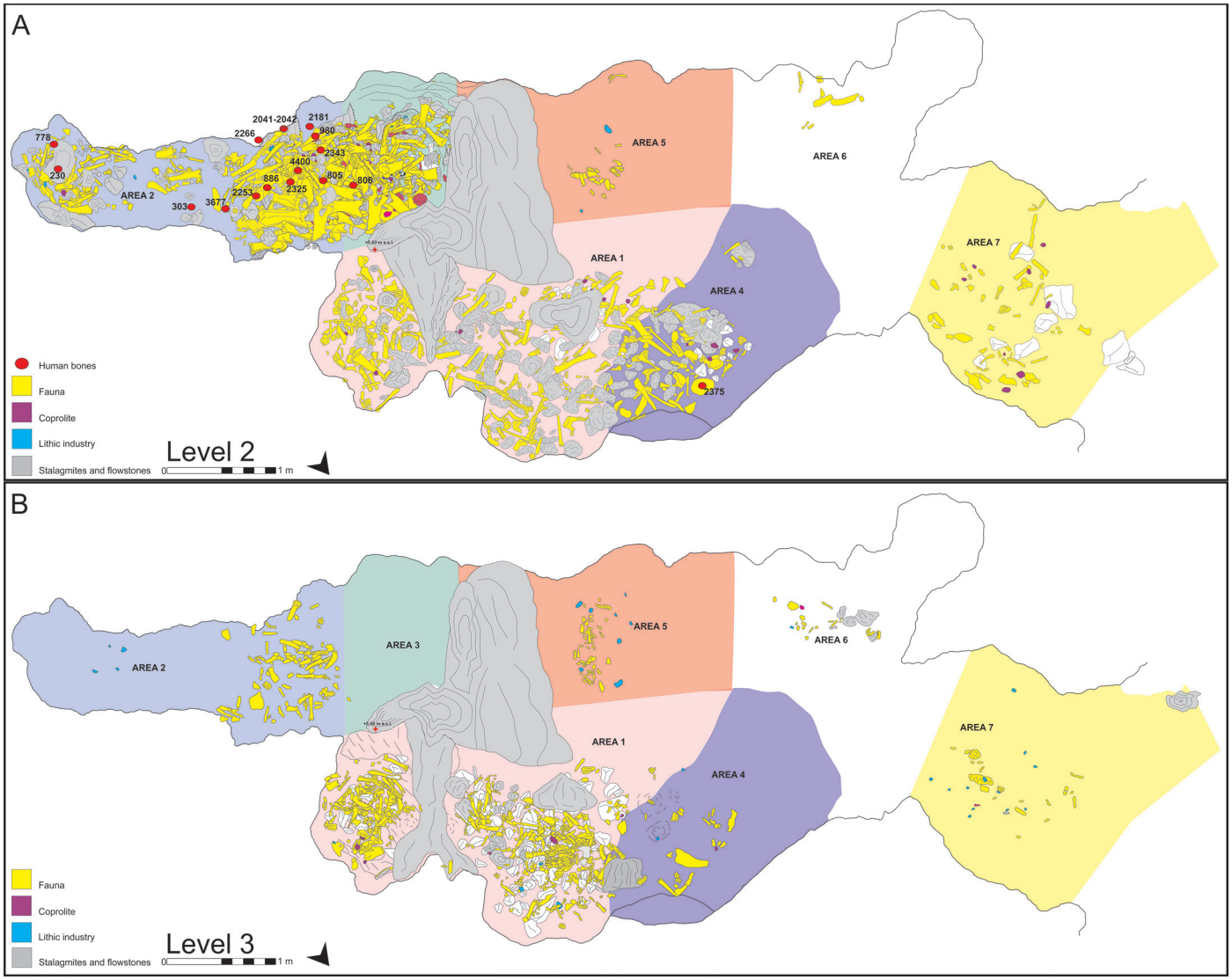

Figure 2. Spatial distribution of the paleontological and archaeological assemblages within the Antro del Laghetto *(AdL): A) map of stratigraphic Level 2; B) map of stratigraphic Level 3; human fossil finds are evidenced by red dots.*

whereas in Areas 2 and 3, the remains seem to be accumulated in a natural depression of the cave floor (SU 38), which straddles both areas. The presence of faunal remains in Areas 5, 6, and 7, towards the *AdU* and the other chambers of the cave, is extremely scarce (Table 1). This pattern can be explained by the natural geomorphology of the *AdL*, which, during the Pleistocene, likely acted as a basin or natural hollow with a pronounced slope towards the southeast (Rolfo et al. 2023). This would explain the natural accumulation of remains in the more depressed areas.

Seventeen human skeletal elements (Table 2) were discovered in Level 2 of Areas 2, 3, and 4 (see Table 1 and Figures 2–3; Figures 4 and 5). Twelve of them (i.e., R805, 806, 886, 980, 2041–2042, 2181, 2253, 2266, 2325, 2343, and 4400; corresponding to Guattari 6–8, 10–16 and 18; see Table 2) were concentrated in a small area of about 1m² between Areas 2 and 3 within a thickness of about 20cm (see Figures 2A, 3, and 5C). The peculiar accumulation of remains in the same layer suggests that they may belong to a few individuals whose remains were introduced by hyenas, probably within a relatively short period of time.

The only human specimen from Area 4 is Guattari 17 (i.e., R2375; see Table 2). It is a partially preserved calvaria that was discovered in a particularly inaccessible recess of the cave, beneath a concretion that protected it from hyena trampling and the increasing pressure of the overlying deposit (see Figure 5E).

THE EXTERNAL AREA

The original project for the external area of Grotta Guattari aimed to clear the rocky walls and bring back to light the old trenches excavated by Blanc and Cardini, which had been entirely filled in during the 1990s. This excavation of the external area was originally intended to allow the

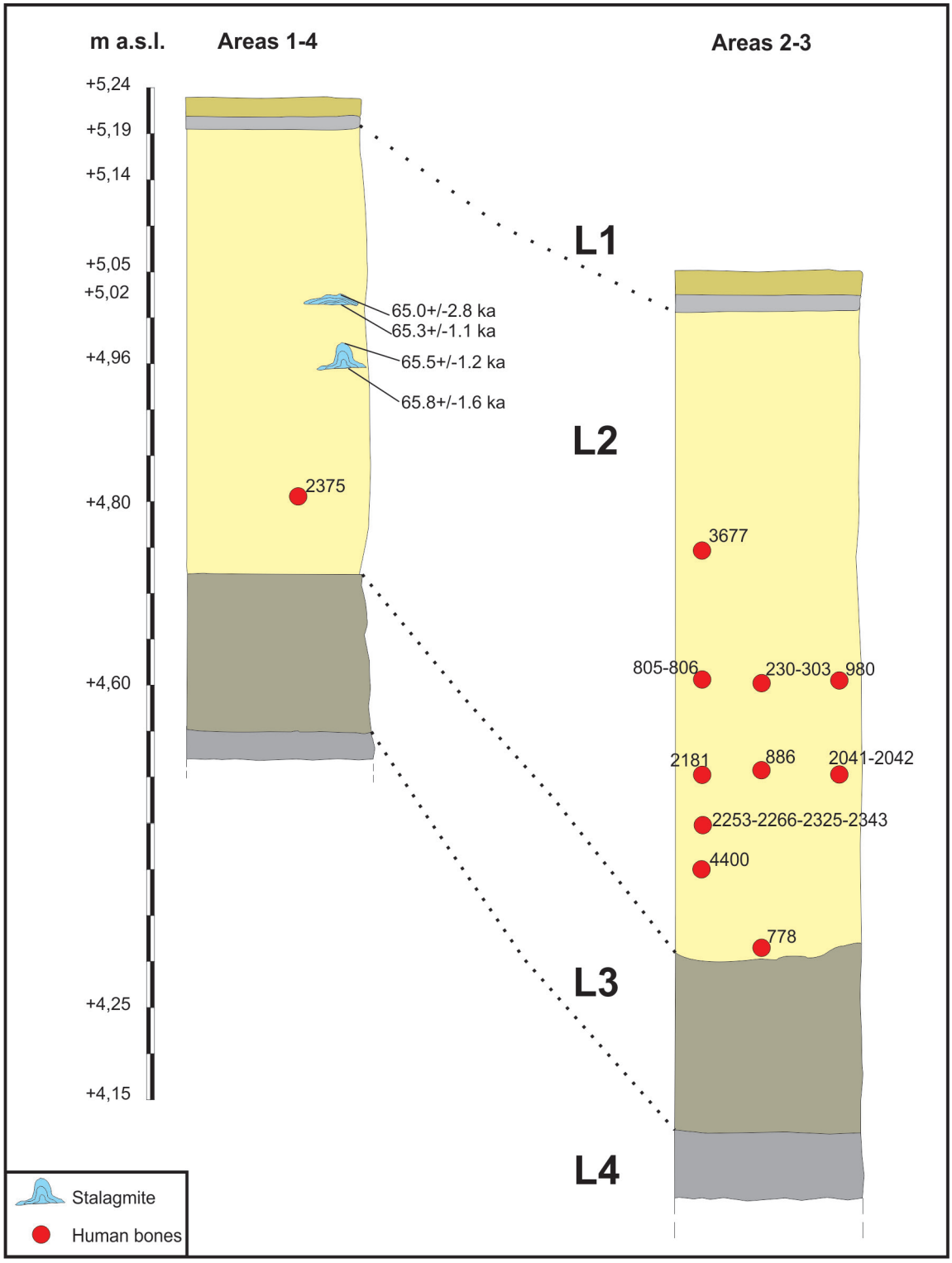

Figure 3. Stratigraphic log of the Antro del Laghetto*, with the location the human remains: the fossil finds are highlighted by red dots and labelled with the excavation numbers (modified after Rolfo et al. 2025) plus relative position of the two stalagmites that have been directly dated.*

TABLE 1. NUMBER AND DISTRIBUTION OF FOSSIL REMAINS FROM *ANTRO DEL LAGHETTO*.

Levels	Excavation areas						
//	*1*	*2*	*3*	*4*	*5*	*6*	*7*
2	184	**136**	**262**	**161**	38	7	48
3	168	42	112	168	10	19	6

Note: Records including human specimens are in bold; compare Table 2 and Figures 2, 3.

TABLE 2. THE HUMAN FOSSIL RECORD FROM GROTTA GUATTARI.

	Name	Excav. n.	Discovery date	Location	Anatomical element	Note
1	Guattari 1	-	1939/02/24	*AdU*	Cranium	Circeo I
2	Guattari 2	-	1939/02/24-28	*AdU*	Mandible	Circeo II, Mandible A
3	Guattari 3	-	1950/08/30	Ext-wall	Mandible	Circeo III, Mandible B
4	Guattari 4	R 230	2019/12/08	*AdL* 2se	Left parietal bone	Two fragments (cf. R 303, 778)
5	- G.4	R 303	2019/12/08	*AdL* 2se	Frontal bone	Large fragment (cf. R 230, 778)
6	Guattari 5	R 3677	2020/07/11	*AdL* 2nw	Left radius	Mid-diaphysis
7	- G.4	R 778	2020/07/20	*AdL* 2se	Frontal bone	Large fragment (cf. R 230,303)
8	Guattari 6	R 805	2020/10/01	*AdL* 2nw	Mandible	No teeth
9	Guattari 7	R 806	2020/10/01	*AdL* 3	Right femur	Diaphysis
10	Guattari 8	R 886	2020/10/05	*AdL* 2nw	Right innominate	Compare G.10
11	Guattari 9	R 1000a	2020/10/07	Ext-wall	Tooth (with 1000b)	Upper right M2
12	- G.9	R 1000b	2020/10/07	Ext-wall	Tooth (with 1000a)	Upper right M3
13	Guattari 10	R 980	2020/10/09	*AdL* 2nw	Left innominate	Compare G.8
14	Guattari 11	R 2041	2020/10/09	*AdL* 2nw	Occipital bone	Large portion (cf. R 2042)
15	- G.11	R 2042	2020/10/09	*AdL* 2nw	Occipital bone	Small fragment (cf. R 2041)
16	Guattari 12	R 2181	2020/10/14	*AdL* 2nw	Isolated tooth	Upper right M1
17	Guattari 13	R 2253	2020/10/14	*AdL* 2nw	Maxilla	No teeth
18	Guattari 14	R 2266	2020/10/14	*AdL* 2nw	Isolated tooth	Lower left M3
19	Guattari 15	R 2325	2020/10/17	*AdL* 2nw	Isolated tooth	Lower left C
20	Guattari 16	R 2343	2020/10/17	*AdL* 2nw	Isolated tooth	Lower right M3
21	Guattari 17	R 2375	2020/10/17	*AdL* 4	Calvarium	Two large portions
22	Guattari 18	R 4400	2020/10/17	*AdL* 2nw	Isolated tooth	Upper right P4

LEGEND

AdU = the chamber of the cave known as "*Antro dell'uomo*" (man's chamber), where the cranium Guattari 1 and probably the mandible Guattari 2 were found in 1939 (see Figure 1E). ***AdL*** = the chamber of the cave known as "*Antro del laghetto*" (pond's chamber), where the new fossil sample was discovered between 2019 and 2020, in the excavation Areas **2** (distinguished in **2nw** and **2se**), **3**, and **4** (see Figures 1E, 2A, 3, 4, and 5). **Ext-wall** = sediments outside the cave (see Figures 1E and 5D).

Notes

a) The findings are ordered by date of discovery. b) Fossils were grouped together as a single specimen (with the same formal name; e.g., Guattari 4) only when the possibility of connection and restoration was unquestionable. c) During the international conference "The fossil man of Monte Circeo: fifty years of studies on the Neandertals in Latium" (see Bietti and Manzi 1989: 47–48) it was suggested and approved to rename all the human fossils from Monte Circeo, which were reported in the past with a general reference to the promontory (Circeo), using instead the name of the cave-site where they were actually found (i.e., Guattari, Fossellone, Breuil). Since that date, this type of notation has been commonly used in the literature, including the "Catalogue of Italian fossil human remains from the Palaeolithic to the Mesolithic" (Alciati et al. 2005).

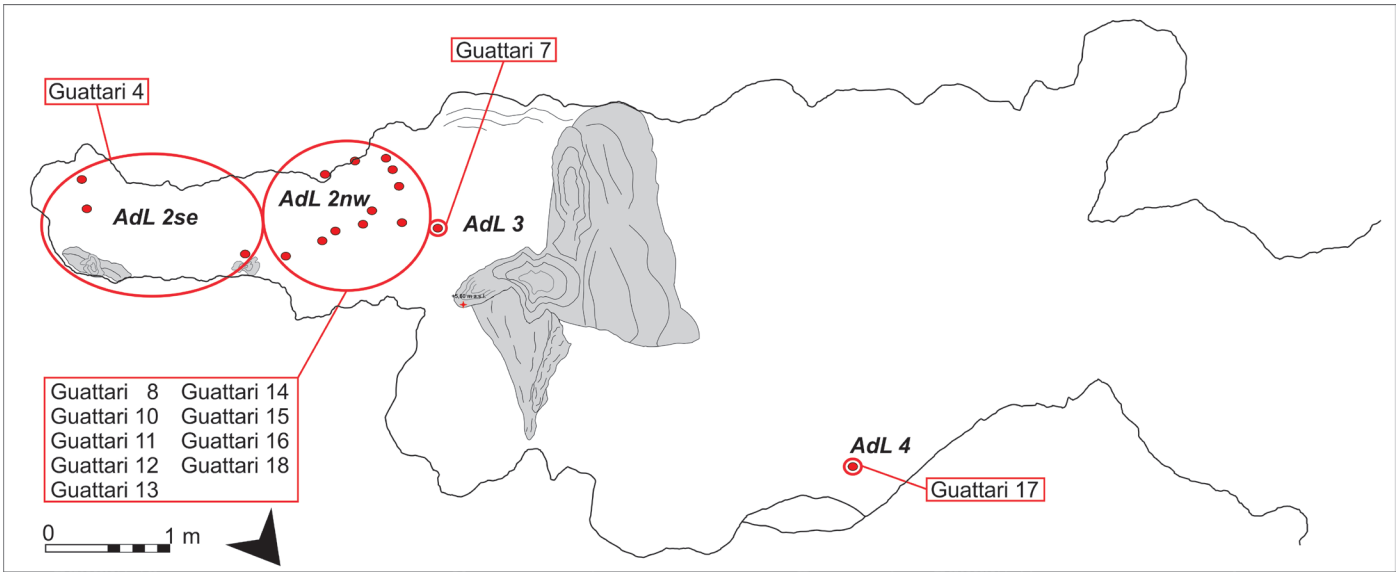

Figure 4. Distribution of human remains in the different areas of the Antro del Laghetto *(*AdL*), whereas Guattari 1 and (probably) also Guattari 2 were found in the* Antro dell'Uomo *(*AdU*) and Guattari 3 in the external "breccia" sediments (*Ext-wall*).*

installation of a new visitor pathway that would enhance the appreciation of both the archaeological history of the site and its natural features. It began in the autumn of 2020 and continued until August 2023. The same methods used for the *AdL* were applied to the fieldwork in this area. The activities involved an irregular L-shaped space of approximately 9m^2. This was organized into several excavation sectors, some of which (i.e., A, B, C, D) had already been defined and partly excavated by Blanc, while others (i.e., M and the South-West section) had never been investigated before.

The emptying of the original trenches (i.e., A, B, C, and D; see Figure 1E) unexpectedly revealed areas of intact archaeological layers. Therefore, it was decided to proceed with an extensive stratigraphic examination of the shelter, connecting all the previous trenches to obtain a unified stratigraphic framework. In addition, the stratigraphic investigation of the new Area M was carried out to retrieve information on layers not documented by Blanc and Cardini.

The areas of greatest archaeological interest were the new Area M and the South-West Section (see Figure 1E). Area M displayed a complex stratigraphic sequence, including a palimpsest of human activity. This level features the remains of a structured hearth, built on large and flat limestone blocks, which we will present in a separate publication. The Neanderthal occupation, already documented by Blanc (1958), is confirmed by the discovery of 4900 findings, including 61 hyena coprolites, 1081 faunal remains (most of them burnt) and 789 lithic artifacts, demonstrating the more intense human occupation of the shelter. Absolute dating places the top of this level at 112±1 and the lower part, underlying the Tyrrhenian fossil beach, at 121.5±5.8 ka (Marra et al. 2023).

The South-West Section corresponds to the southern limit of the shelter, adjacent to the current main entrance to the cave, and forms the southern limit of Blanc's Trincea A. Cleaning of the previously undocumented South-West Section revealed the only complete stratigraphic sequence of the outer rock shelter preserved to date (Figure 6), in which layers containing fossils, coprolites, and lithic remains alternated with sterile or semi-sterile layers. Notably, a fragment of a human maxilla with two teeth (i.e., R 1000 a-b or Guattari 9; see Table 2) was recovered within Stratigraphic Unit 99 (see Figure 5D).

The stratigraphic sequence, including faunal, lithic, and human remains from the external rock shelter of Grotta Guattari, is currently under study. Preliminary data suggest multiple phases of occupation by both humans and cave hyenas. Particularly, the level of the South-West section, a debris flow that yielded the two human teeth, may be tentatively referred to the Neanderthal occupation levels of Area M and close to the chronology of the internal deposits.

THE (NEW) HUMAN FOSSIL SAMPLE

During the 2019–2023 excavations, 19 human remains were found, representing cranial and postcranial anatomical elements, and some isolated teeth. In the previous paragraphs, we provided a summary and contextual information of the human sample, which is also reported in Table 2 and Figures 1–6. This section provides a preliminary description of the new individual findings, according to the formal denomination of the specimens as reported in Table 2. The purpose of this section is to provide notes on their consistency and an overview of their main characteristics, including relevant photographic documentation. As already highlighted, it is worth noting that each specimen will require detailed study. The scientific analyses of the human remains are currently underway and coordinated

Figure 5. Some of the human fossil specimens during fieldwork: A) R 778 in AdL *2se, part of the specimen named Guattari 4; B) R 2041-2042 in* AdL *2nw, combined to form the specimen Guattari 11; C) R 805 and R 806 at the limit of* AdL *2nw and* AdL *3, respectively Guattari 6 and Guattari 7; D) R 1000a-b in the* Ext-wall*, which are two maxillary teeth still in fragmentary alveoli: i.e., Guattari 9; E) R 2375, the calvarium labelled Guattari 17 in* AdL *4.*

Figure 6. Stratigraphic log of the South-West Section outside Grotta Guattari (the debris flow of the external rock shelter), with the location of the human finds R1000a and R1000b (evidenced by a red dot).

by our research group, with the permission of the Italian Ministry of Culture (MiC). All the specimens are currently preserved at the Museo delle Civiltà (MiC) in Rome, where they will also be exhibited to the public.

CRANIAL REMAINS

Guattari 4 (Excavation n. R 230, 303, 334, and 778; Location: *AdL* 2se)

Partial calotte of an adult individual, composed of four large fragments that anatomically connect along the fractures, together representing a large portion of the frontal bone and the anterior portion of the left parietal bone (Figure 7A-E). Considerable ectocranial erosion is observed, particularly affecting the browridges, part of the frontal squama, and almost all the remaining parietal portion.

The specimen exhibits an elongated and slightly curved midsagittal profile, from the massive glabella region, prominent anteriorly, to approximately the vertex area; moderate postorbital constriction, corresponding to a considerable lateral expansion of the anterior endocranial fossa; the sulcus supratoralis is weak, interrupted medially by the bulging frontal squama. The torus is notably thick, gradually decreasing laterally and describing a rounded superior contour of the orbit. Due to the ectocranial erosion, the coronal suture is not visible, except for a short segment on the left frontal squama, apparently fused endocranially. The indentation pattern shows a simple wavy profile, without significant indentations. The cranial vault bones are unusually thick, considering both the diploe and the tables. The supraorbital arches are incomplete, exposing part of the frontal sinus.

Guattari 6 (Excavation n. R 805; Location: *AdL* 2nw)

Incomplete anterior part of a mandible, including the interforaminal portion (Figure 8A). A thin fracture line involving only the external alveolar bone is noted in correspondence with the incisors of the right side.

The symphysis is characterized by the absence of the mental trigone, while a slight hint of chin prominence is noted, possibly accentuated by bone atrophy due to *intravitam* tooth loss. Evidence of complete teeth loss before death is shown by the atrophied alveolar areas at LRM1, LRP4, LRC, and LRI2, whereas the alveoli at LRP3, LRI1, and LLI1 are only partially atrophied. Only on the right side (the left one is incomplete), a single mandibular fora-

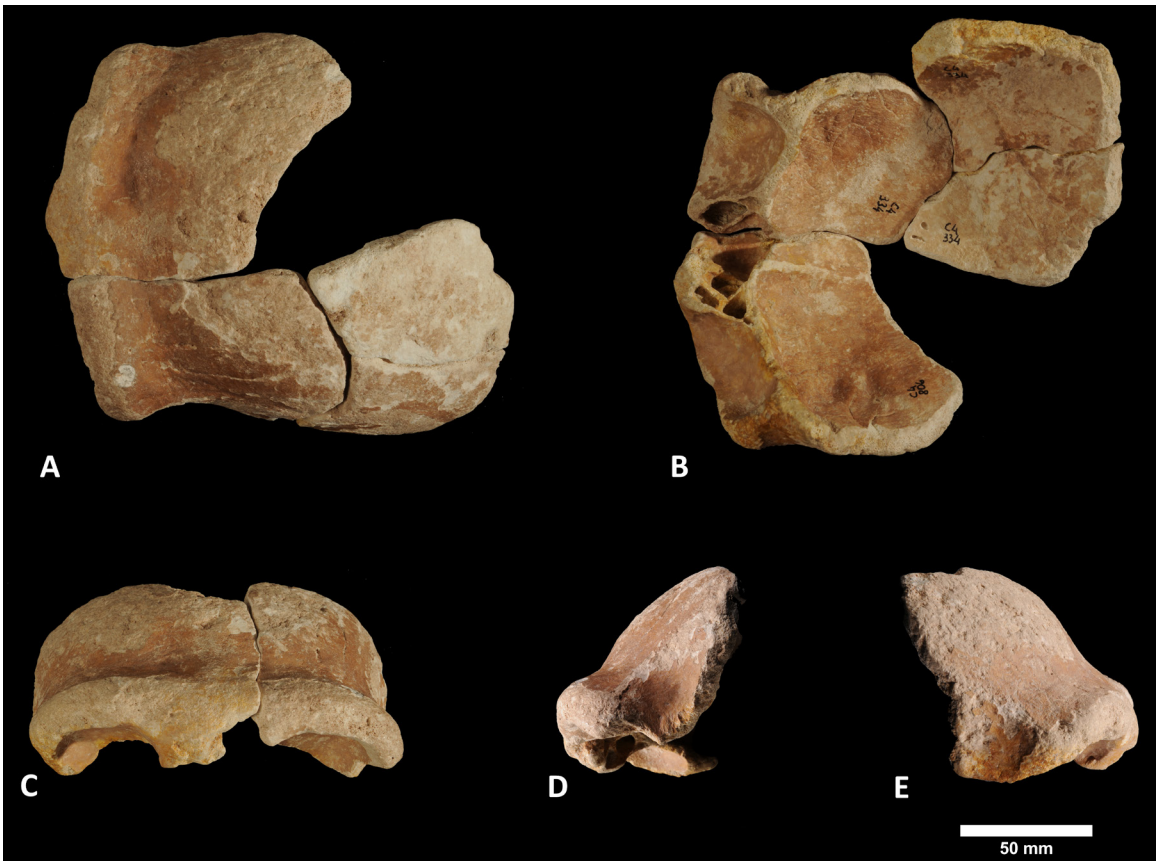

Figure 7. Guattari 4, adult partial calotte. A) superior view; B) endocranial view; C) frontal view; D) left lateral view; E) right lateral view (photo Museo delle Civiltà, Roma [May 2025]).

men, oval and horizontal in shape, is observed under the probable position of P4-M1. The digastric fossae are clearly visible.

Guattari 11 (Excavation n. R 2041 and 2042; Location: *AdL* 2nw)

Rather complete occipital bone (Figure 8B, C), composed of a large fragment and a smaller one, which together represent almost the entire squamous component of the bone, i.e., the entire planum occipitale and part of the planum nuchale. Areas of erosion are visible externally, while the endocranial surface is partially covered by a greyish concretion.

Viewed posteriorly, the bone appears rather squared and moderately convex in both the midsagittal and transversal planes. An elliptical suprainiac fossa is visible on the superior margin of a double arched occipital torus that does not extend laterally. The external occipital protuberance is absent. We note the absence of any synostosis along the lambdoid suture. Endocranially, the occipital crest, cruciform eminence and grooves for the sinuses are visible despite the concretions.

Guattari 13 (Excavation n. R 2253; Location: *AdL* 2nw)

This incomplete maxilla partially preserves the two palatine bones and their alveolar processes (Figure 8D).

Despite severe erosion, the presence of a progressive alveolar ridge atrophy due to *intra-vitam* tooth loss is evident. Residual dental alveoli are visible on the right side, while the left anterior alveolar ridge shows bone remodelling. In palatal view, a well-developed median palatine torus is visible. In frontal view, a large piriform opening and the base of the nasal septum can be observed.

Guattari 17 (Excavation n. R 2375; Location: *AdL* 4)

Calvaria of an adult individual, composed of two large fragments that separated during extraction from the sediments (Figure 9). Ectocranial erosion is observed in some regions of the braincase, especially in the browridge area.

The midsagittal profile is elongated and gently curved, from the massive and prominent glabella region to approximately the vertex area, followed by a rather flat obelic region and weakly expressed occipital bun (*chignon*). The supraorbital torus is noticeably thick; its thickness decreases laterally, describing a rounded superior contour of the orbits. The sulcus supratoralis is moderate, interrupted medially by the bulging frontal squama, which is also characterized by the occurrence of a mid-sagittal keeling culminating in a bregmatic eminence. Barely noticeable postorbital constriction is exhibited, corresponding to a considerable lateral expansion of the anterior endocranial fossa. The biparietal profile is round in posterior view, exhibiting a

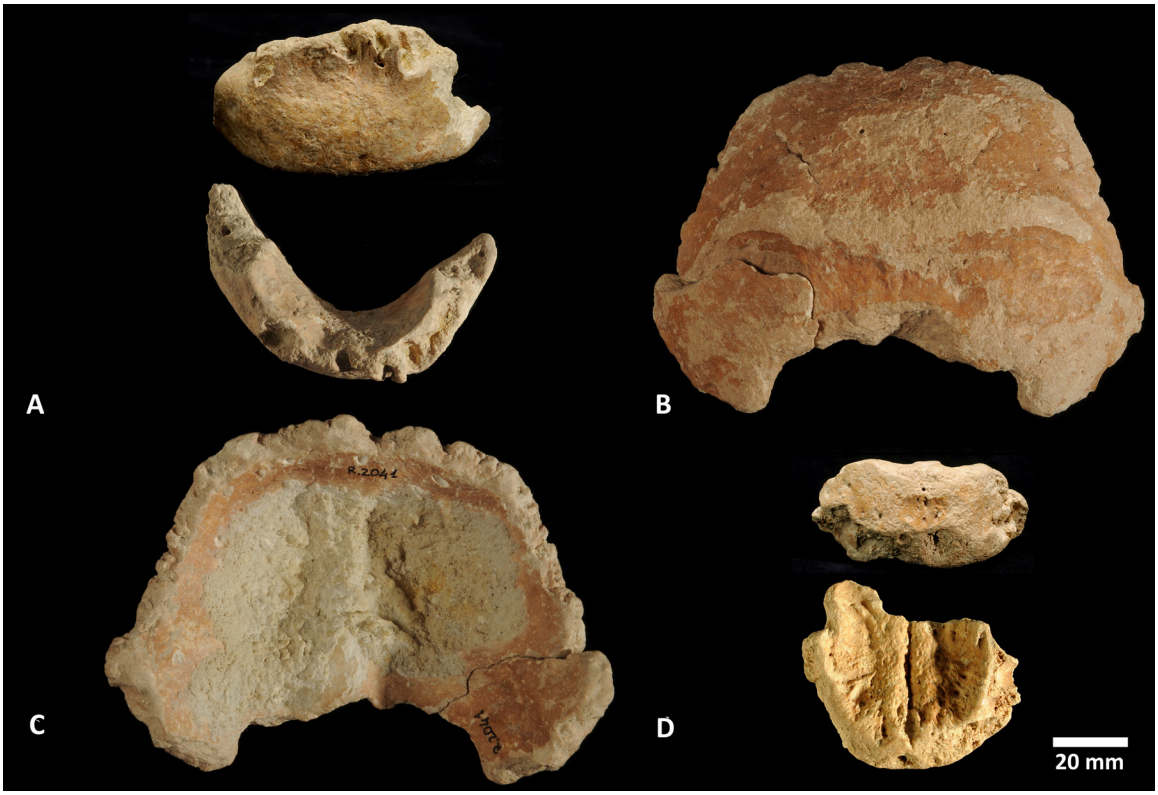

Figure 8. Guattari 6, incomplete adult mandible in anterior and superior views (A); Guattari 11, occipital bone in external (B) and internal (C) views; Guattari 13, incomplete adult maxilla in anterior and inferior view (D) (photo Museo delle Civiltà, Roma [May 2025]).

moderate *en bombe* shape. The occipital bone shows a typical double-arched Neanderthal torus, not reaching the asterionic region, surmounted by a small and smooth suprainiac fossa, which is rather circular in shape. The external occipital crest is very poorly developed, not reaching the inion (absence of the external occipital protuberance). The temporal bone may be detected and examined in detail, including the small mastoid process and the occurrence of the mastoid tubercle, faintly visible on both sides. Sutural synostosis shows interdigitations on the outer table and an incomplete obliteration on the inner table. The frontal bone is affected by a slight endocranial formation, bilateral and symmetrical, attributable to a mild grade of *hyperostosis frontalis interna* (Garralda et al. 2014).

POSTCRANIAL REMAINS

Guattari 5 (Excavation n. R 3677; Location: *AdL* 2nw)

Partial shaft of a left radius, showing post-depositional fractures at both ends (Figure 10 A,B). The medullary cavity is partially filled with greyish concretions. The external cortical surface presents several small pits, likely produced by carnivore teeth, and some more scratches of probable taphonomic post-depositional origin.

The diaphysis is gracile and mildly curved; on the anterior surface, the oblique line is barely appreciable; the preserved portion of the interosseous crest shows moderate projection. The medullary cavity is narrow, and the cortical bone is relatively thick.

Guattari 7 (Excavation n. R 806; Location: *AdL* 3)

Incomplete right femur, preserved from the lower portion of the femoral neck to the distal shaft region (Figure 10C, D). Most of the cortical surface shows signs of superficial erosion and patchy greyish concretions. Both the proximal and distal ends exhibit old damage partially covered by concretions extending into the medullary cavity; recent breakages are also present on the distal portion. The nature of the ancient fractures and the resulting outline of the edges, when preserved, strongly suggest carnivore gnawing, while there are possible traces of rodent activity on the surface of the diaphysis.

The shaft is curved and not particularly robust. Its sections are rounded in the intermediate part and slightly platymeric in the subtrochanteric region. Posteriorly, a small portion of the lesser trochanter is still preserved; the pectineal line is faintly expressed. The linea aspera forms a single, narrow, and slightly elevated ridge, appearing thicker in the proximal part and increasingly faint toward the distal end. The supracondylar lines are barely noticeable.

Guattari 8 (Excavation n. R 886; Location: *AdL* 2nw)

Incomplete right innominate bone (Figure 11A, B). It pre-

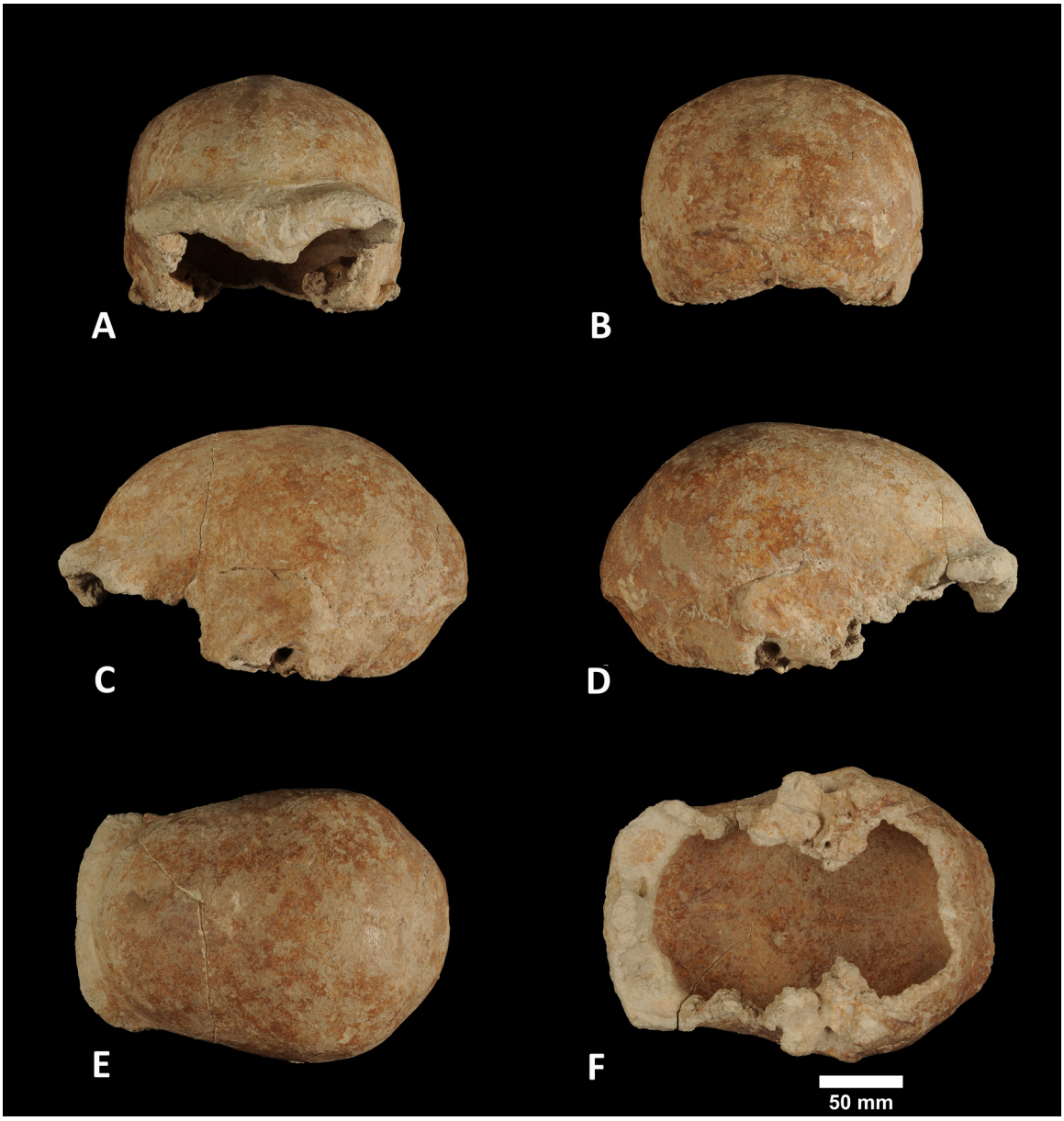

Figure 9. Guattari 17, adult calvaria. A) frontal view; B) posterior view; C) left lateral view; D) right lateral view; E) superior view; F) inferior view (photo Museo delle Civiltà, Roma [May 2025]).

serves anteriorly the area of the iliac pillar and acetabular surface, posteriorly the greater sciatic notch, the arcuate line, and part of the auricular surface. Sediment encrustations are visible across all bone surfaces. The margins of the iliac blade show evidence of both diagenetic alteration and more recent breakage. Although mostly obscured by the latter, some older fracture surfaces are partially preserved; these are irregular in outline and exhibit various detachments of different sizes, potentially compatible with carnivore activity.

The iliac buttress is pronounced, resulting in considerable bone thickness in this region. Although incomplete, the greater sciatic notch appears relatively wide and has a regularly curved shape.

Guattari 10 (Excavation n. R 980; Location: *AdL* 2nw)

Incomplete left innominate bone (Figure 11C, D). It preserves the iliac pillar, the greater sciatic notch, the arcuate line, and a small oval portion of the upper roof of the lunate surface of the acetabular fossa. The iliac crest is preserved only along a short segment near the iliac tubercle. The iliac pillar is well defined, and the greater sciatic notch is well preserved along its midline. Notable diagenetic alteration is evident, particularly affecting the surface texture and microstructure. Recent fractures are visible along all margins of the specimen; although these obscure much of the original surface, some older breakage areas are preserved and are compatible with carnivore activity, as in the case of Guattari 8.

Figure 10. Guattari 5, left radius partial shaft in anterior (A) and posterior (B) views; Guattari 7, right femur diaphysis in anterior (C) and posterior (D) views (photo Museo delle Civiltà, Roma [May 2025]).

Like the right innominate, the left also appears markedly thick along the pronounced and well-defined iliac buttress. Although the anterior margin of the iliac blade is missing, the buttress seems to be positioned anteriorly. The greater sciatic notch is rounded in its midline portion.

THE DENTAL SAMPLE

Seven teeth were found in the *AdL* and in the external sediments of Grotta Guattari. Five of them are isolated teeth coming from *AdL* (R 2181, 2266, 2325, 2343, 4400; i.e., Guattari 12, 14–16 and 18; see Table 2); two other isolated teeth have been discovered during the excavations of the Ex-wall and are considered to belong to the same individual (R 1000a and 1000b; i.e., Guattari 9; Table 2). Overall, the teeth display morphological features typical of Neanderthals (Figure 12).

Piccirilli and colleagues presented a preliminary report of this dental sample in 2023, at the 13th Annual Meeting of ESHE, while a comprehensive paper with morphological description and morphometric analysis is forthcoming (Piccirilli et al. under revision) and will include crown metrics, non-metric dental traits, dental pathologies, digital analysis based on microCT scan, along with the geometric morphometrics of the crown outlines.

Guattari 9 (Excavation n. R 1000a and 1000b; Location: Ext-wall)

R 1000a is an upper right second molar (URM2) with both crown and roots intact. It was found in association with its adjacent tooth, R 1000b, along with a preserved fragment of maxillary alveolar bone that refits with the two teeth (see Figure 12A).

R 1000b is an upper right third molar (URM3), positioned distally to R 1000a. It was recovered with both crown and roots intact, exhibiting no evidence of concretion or post-mortem fractures (see Figure 12B).

Guattari 12 (Excavation n. R 2181; Location: *AdL* 2nw)

Probably an upper right first molar (URM1), with the crown extensively fragmented post-mortem, particularly in the areas of the protocone and paracone. All the roots are also significantly damaged (see Figure 12C).

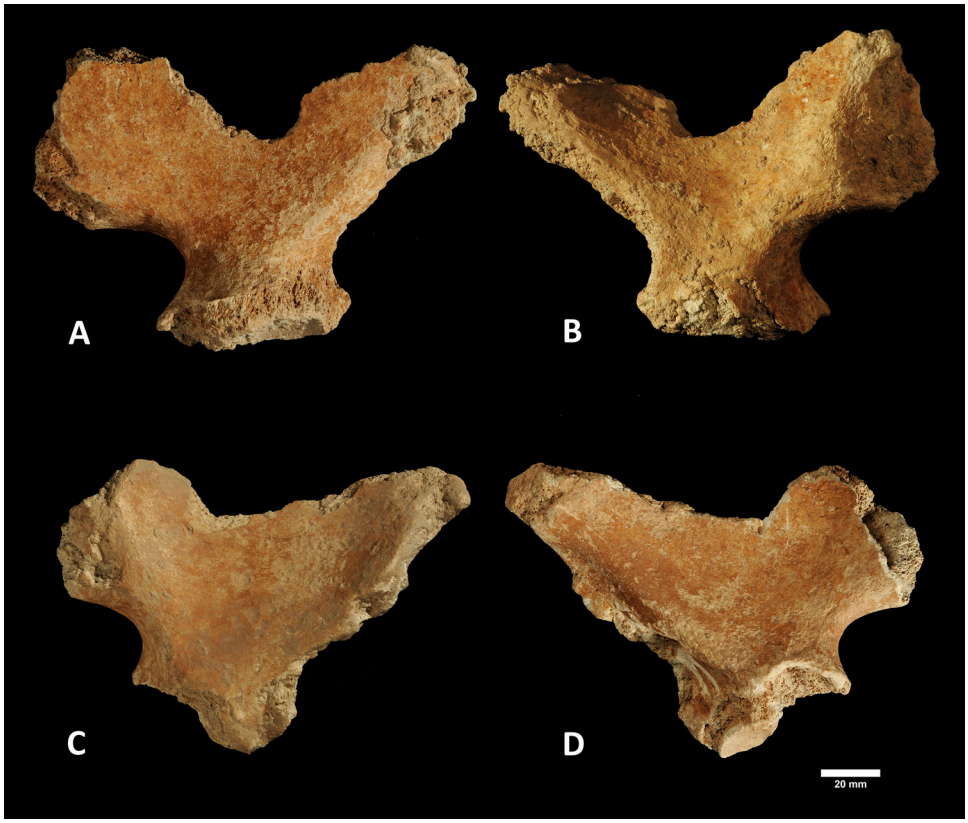

Figure 11. Guattari 8, incomplete right innominate bone in lateral (A) and medial (B) views; Guattari 10, incomplete left innominate bone in lateral (C) and medial (D) views (photo Museo delle Civiltà, Roma [May 2025]).

Guattari 14 (Excavation n. R 2266; Location: *AdL* 2nw)
Lower left third molar (LLM3), recovered with both crown and roots intact. Minor concretions are visible on the occlusal surface (see Figure 12D).

Guattari 15 (Excavation n. R 2325; Location: *AdL* 2nw)
Lower left canine (LLC), recovered with both crown and roots intact. Concretions are present on the mesial surface of the crown and around the root apex (see Figure 12E).

Guattari 16 (Excavation n. R 2343; Location: *AdL* 2nw)
Lower right third molar (LRM3), found with both the crown and roots fully intact. The crown is entirely covered by concretions (see Figure 12F).

Guattari 18 (Excavation n. R 4400; Location: *AdL* 2nw)
Upper right fourth premolar (URP4) with an intact crown. The root shows significant hypercementosis and exhibits post-mortem fractures that have disrupted the hypertrophic cementum. Concretion is present in the groove between the cusps (see Figure 12G).

CONCLUSIONS AND PERSPECTIVES

The human skeletal remains from Grotta Guattari—including specimens discovered over 80 years ago (Blanc 1939a-d) and the newly discovered ones (Rolfo et al. 2023)—represent the most significant sample of Neanderthal bones and teeth ever found in Italy from a single site as well as within a well-defined chronological range (Rolfo et al. 2023). These remarkable findings provide an unprecedented opportunity for intra- and inter-group comparisons of Neanderthals in the Late Pleistocene. Moreover, the discovery of a maxillary fragment with two molars (Guattari 9) from the stratigraphic context outside the cave, together with the mandible Guattari 3 found in 1950 (Blanc 1951; Sergi and Ascenzi 1955), contributes to a new diachronic evaluation of continuities and discontinuities, thus suggesting a more refined reconstruction of the Neanderthal exploitation of a coastal refuge in the central part of the Italian peninsula between MIS 5 and MIS 3.

The importance of the Grotta Guattari human fossil assemblage lies in its potential to place the Italian peninsula within a broader comparative framework that includes other Neanderthal samples of multiple individuals from a single site, such as those from El Sidron in Spain (Rosas et al. 2006), Krapina in Croatia (Gorjanović-Kramberger 1906; Frayer et al. 2008; Radovčić et al. 1988), or Shanidar in Iraq (Cowgill et al. 2007; Pomeroy et al. 2017; 2020; Solecki 1961; Trinkaus 1983). Indeed, only through a robust analysis of within-group variability can meaningful inter-group comparisons be made, offering critical insights into traits' variability, polarity, and the underlying phyletic dynamics. Moreover, the chronological framework that emerges from the discoveries at Grotta Guattari discloses significant

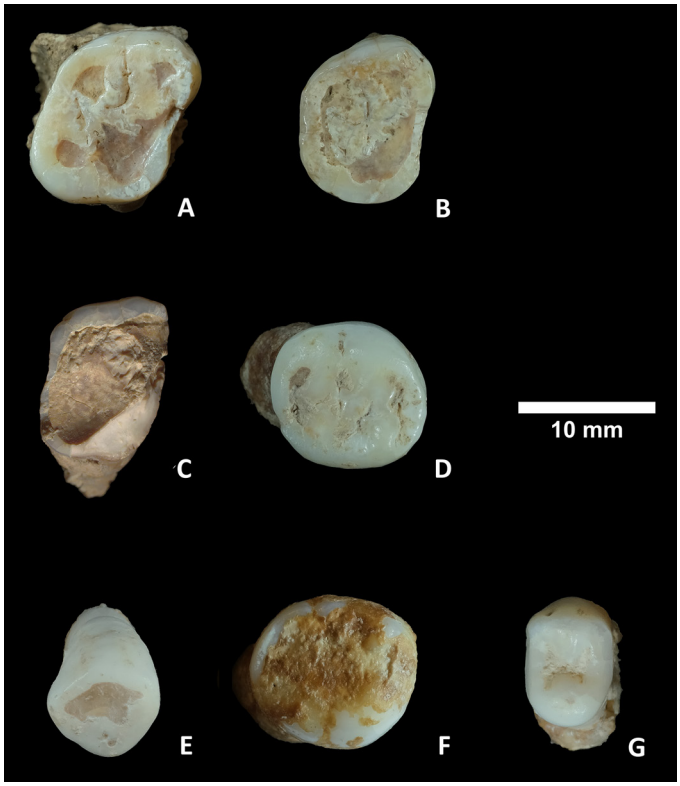

Figure 12. Occlusal view of the isolated teeth from Grotta Guattari. A) Guattari 9 (R 1000a), upper right second molar (URM2); B) Guattari 9 (R 1000b), upper right third molar (URM3); C) Guattari 12 (R 2181), likely an upper right first molar (URM1); D) Guattari 14 (R 2266), lower left third molar (LLM3); E) Guattari 15 (R 2325), lower left canine (LLC); F) Guattari 16 (R 2343), lower right third molar (LRM3); G) Guattari 18 (R 4400), upper right fourth premolar (URP4) (photo BONES Lab, Ravenna [May 2022]).

opportunities for studying a sample of Neanderthals, for whom evidence of multiple individuals in a single context remains, all in all, rare.

The present inventory and preliminary description of the Neanderthal fossil sample from Grotta Guattari to the scientific community—together with its contextualization in the karst site of Grotta Guattari—is specifically aimed at an advanced analytical approach to the finds, although the known complexities of preserving organic finds in this peculiar context will pose considerable methodological challenges. In addition, the observed differences in the preservation and fossilization of the human remains highlight the complex history of the assemblage and raise important questions regarding the relationships between the various remains, their depositional context, and their taphonomy. While the archaeological and paleontological contexts and the analysis of the paleosoils are at an advanced stage (Rolfo et al. 2025), the nature of this exceptional human record calls for a careful, systematic, and as conservative as possible planning of its study.

The present research group is currently designing a multi-methodological approach. It incorporates expertise not only in paleoanthropology in general (e.g., Benazzi et al. 2014; Bruner and Manzi 2008; Di Vincenzo and Manzi 2023; Manzi 2016; Meneganzin et al. 2022), but also in geometric morphometrics combined with virtual anthropology (e.g., Buzi et al. 2021; Di Vincenzo et al. 2019; Lari et al. 2015; Profico et al. 2016; 2023; Riga et al. 2020), aDNA (e.g., Antonio et al. 2019; Modi et al. 2022; Posth et al. 2021; Salem et al. 2025; Vai et al. 2021; Weyrich et al. 2017), paleoproteomic (e.g., Lugli et al. 2019b; Mackie et al. 2017; Silvestrini et al. 2022), isotopic analyses aimed at diet and mobility (e.g., Bernardini et al. 2021; Lugli et al. 2019a; 2022; Stark et al. 2021), classical and virtual histology (e.g., Cerrito et al. 2022; Mahoney et al. 2021; Magri et al. 2024; Nava et al. 2019; 2022a; b), combined with biogeochemical analyses (e.g., Kubat et al. 2023; Nava et al. 2020) and life-history approaches (Müller et al. 2024; Nava et al. 2024). The goal is to reconstruct the biological identity of the Neanderthals from Grotta Guattari with the highest degree of resolution.

Given the complexity of such an analytical framework, our research group has therefore decided to present this inventory, contextualization, and preliminary description of the human fossil sample from Grotta Guattari al Monte Circeo. This lays the groundwork for an integrated analytical strategy, but it is also aimed at providing the scientific community with a first account of the studies conducted to date and those planned for the future.

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AUTHOR CONTRIBUTIONS

Conceptualization – G.M.; Investigation – F.A., S.B., L.B., A.B, F.C., D.C., F.D.V., A.F., M.G., G.M., A.N., E.P., M.F.R., A.S.; Writing, original draft – F.A., S.B., L.B., F.C., A.N., M.F.R., G.M., A.S.; Writing, review & editing – F.A., S.B., L.B., A.B., F.C., D.C., F.D.V., A.F., M.G., G.M., A.N., E.P., M.F.R., A.S.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study consist of morphological observations and documentation of human skeletal remains. Access may be granted upon request to the corresponding authors, subject to approval by the Scientific Committee and by the institution responsible for the collection.

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