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Romito 9: A new Palaeolithic burial from Grotta del Romito (Calabria, Italy)

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ABSTRACT

During recent excavations at Grotta del Romito (Papasidero, northern Calabria, Italy), a new Upper Palaeolithic burial—designated Romito 9—was identified. The burial pit had been partially disturbed ab antiquo, resulting in an altered depositional context. The burial pertains to a female individual, approximately 11–12 years of age, and is associated with an archaeological layer dated to 16,129 ± 100 uncal BP (19,809–19,157 cal BP, 2σ), corresponding to the evolved phase of the local Epigravettian culture. Romito 9 presents a richly furnished burial, featuring the use of red ochre and abundant ornamentation. It represents the earliest known funerary evidence chronologically positioned between the Gravettian burials of Italy and those of the Final Epigravettian. This intermediate position underscores the continuity of complex ceremonial traditions characteristic of the Gravettian, prior to the ritual simplification documented in southern Italy during the Final Epigravettian. The individual, likely a prepubertal female at the time of death, exhibits dental dimensions more closely aligned with Middle Upper Palaeolithic (MUP) individuals than with those from the Late Upper Palaeolithic (LUP). Her estimated adult stature would have exceeded that of Romito's LUP adult females by approximately 20 cm, approaching the maximum values recorded for LUP females and aligning closely with the average stature of LUP adult males from the site. Given the paucity of comparative data for LUP individuals of the same age range, her body proportions and overall dimensions appear to be more consistent with MUP populations. A meticulous excavation strategy, combined with detailed post-excavation analysis of the funerary context, facilitated the reconstruction of both taphonomic and post-depositional processes. This work further enabled the creation of a visual model illustrating the original position of the buried individual and portions of the associated ornamentation.

1. Introduction

A new discovery in the Palaeolithic site of Grotta del Romito (Papasidero, Calabria, Italy) adds new data to our knowledge of Epigravettian burial rites and contributes to fill the gap between Middle Upper Palaeolithic (MUP) and Late Upper Palaeolithic (LUP) skeletal record. In this paper we present a new burial (Romito 9) to be added to the other eight individuals previously discovered at the site: by Paolo Graziosi during the 1960s and two during the 2000–2016 excavations by the University of Florence (Martini, 2006b). The detailed analysis of the finding, including taphonomy, anthropology, palaeogenetics, as well as the study of the funerary practice and grave goods, is ongoing. The main goal of this contribution is to present preliminary information concerning the anthropological and archaeological data of the newly discovered burial and its chronology in order to highlight the complexity of the Epigravettian funerary practice, also providing a short synthesis

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on Upper Palaeolithic funerary rituals in Italy.

Upper Palaeolithic human burial record is usually subdivided according to both chronological and cultural frameworks, distinguishing between Middle Upper Palaeolithic (MUP), corresponding to Gravettian remains, and Late Upper Paleolithic (LUP), which includes Solutrean, Magdalenian and Epigravettian remains (Pettitt, 2011). The boundary between the two groups is placed at the peak of the Last Glacial Maximum (LGM), around 22-18,000 cal BP (Orombelli, 2007; Clark et al., 2009). The LGM would have caused the abandonment of part of Northern Europe and the occupation of refuge areas in the Southern part of the continent (Franco-Cantabric area, peninsular Italy, South-Eastern Russia) (Housley et al., 1997; Barbujani and Bertorelle, 2001;

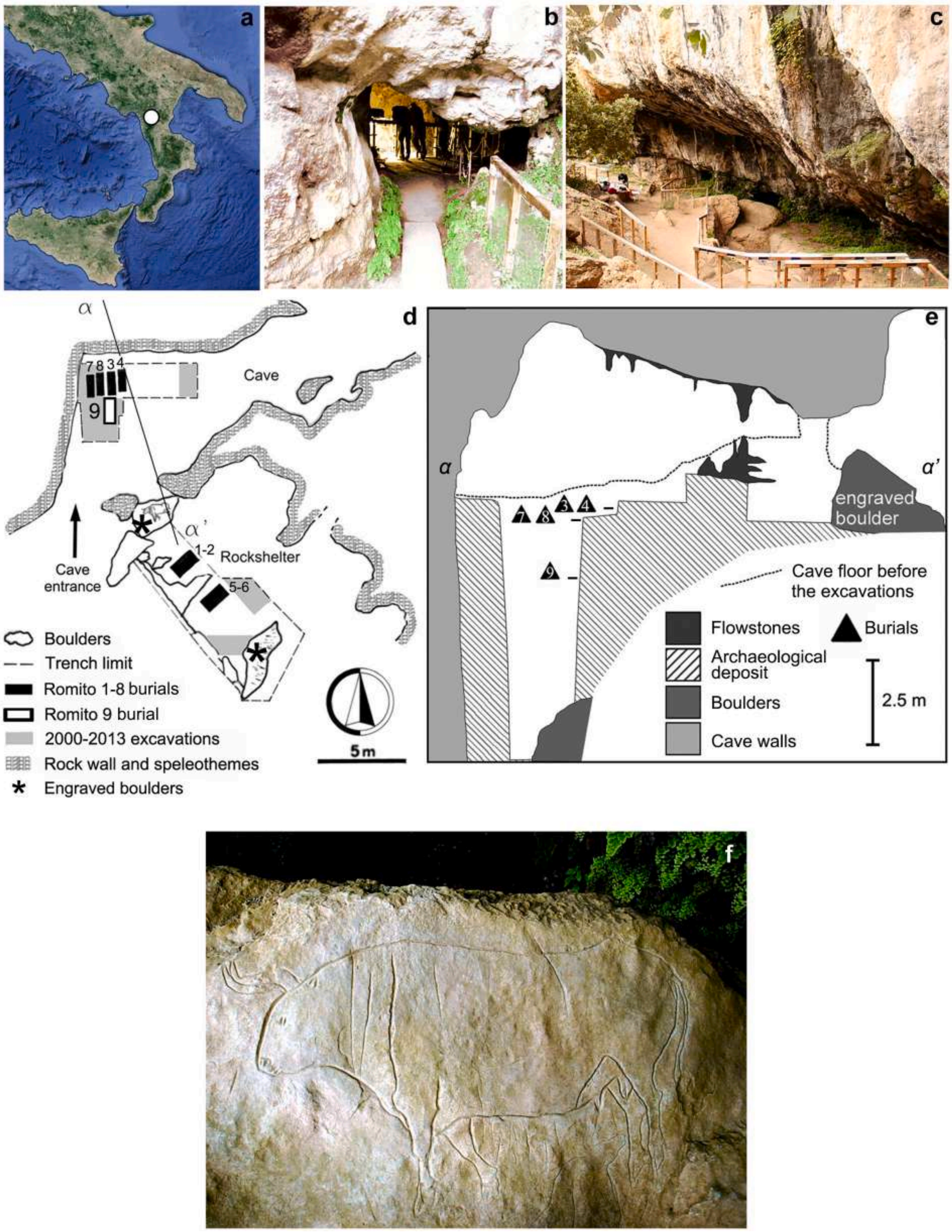

Fig. 1. – Grotta del Romito. a: Site location (Calabria, Southern Italy); b: entrance of the cave; c: the rock shelter area; d: site plan; e: cross-section of the site and of the deposit (see site plan "d"); f: the aurochs engraving (Archive of Museo e Istituto fiorentino di Preistoria).

Dolukhanov et al., 2001; Bocquet-Appel et al., 2005; Banks et al., 2008; Posth et al., 2023; Scorrano et al., 2022). Given the intermediate chronological position of Romito 9 between MUP and latest LUP burials, we shall analyse in Romito 9 the measures and features that appear to better distinguish the MUP and LUP human samples and can be recorded in a juvenile individual, for this reason, cranial measures will not be examined.

Following Frayer (1978), the dental dimensions decrease from MUP to LUP. For what relates to body dimensions and proportions, the MUP human samples compared to LUP ones show longer limb bones (Jacobs, 1985; Ruff, 1994); higher stature (Formicola and Giannecchini, 1999; Holt, 2003; Niskanen and Junno, 2006); similar (Holliday, 2002) or slightly heavier (Ruff, 1991) weight; longer limb bones compared to skeletal trunk height (Holliday, 1997); slight variation in limb proportions (Holliday, 1997). For all of these features (dental dimensions, stature, weight, body and limb proportions) the ranges of MUP and LUP samples overlap. It is not possible to assign a skeleton to MUP or LUP on the basis of any of them, but we want to investigate if the selected features in Romito 9 are more on the MUP or the LUP side of the variation. Data from Romito 9 will be compared to MUP and LUP juvenile individuals (data recorded by one of us, PFF, or collected from literature), and in the juvenile early Homo KNM WT-15000 for general comparative use. We included KNM WT 15000 among comparisons for several reasons (see Supplementary informations 2.2). Neandertal fossils have not been used for comparison, because well preserved neandertal juvenile remains are rare and the available few are aged between 0 and 5 years (Martín-González et al., 2012), too much younger than the individual under study to represent an appropriate comparison sample.

2. Grotta del Romito, the site and its setting

Grotta del Romito (Papasidero, Cosenza, Northern Calabria, 39° 54′N, 15° 55′E) opens in the western side of Monte Ciagola, a limestone hill at 275 m a.s.l., about 25 km from the Tyrrhenian coast (Fig. 1/a). Grotta del Romito, with its important examples of rock art and multiple burials, is one of the most significant Palaeolithic sites of the Italian peninsula and is a key-site in the framework of the Upper Palaeolithic of the Mediterranean basin (Martini and Lo Vetro, 2011, 2018 and references therein). The stratigraphic sequence at Grotta del Romito represents one of the most significant records of Upper Palaeolithic occupation on the Italian Peninsula, spanning from the Middle Gravettian to the Late Epigravettian, and continuing into the Mesolithic (Sauveterrian), with evidence of recurrent human presence over approximately 15,000 years (Blockley et al., 2018). A subsequent phase of human frequentation during the Middle Neolithic marks the final documented prehistoric occupation of the site. Near the cave entrance, the sedimentary fill reaches a thickness of approximately 8 m, with Palaeolithic deposits—up to 7 m thick—lying beneath the overlying Holocene layers.

3. The Romito 9 burial, its archaeological context and chronology

3.1. Discovery and excavation

The newly discovered burial, Romito 9, is the earliest among those found at the site. Its chronology is based on the radiocarbon date of 16,129 ± 100 uncal BP (19,809–19,157 cal BP) obtained from layer E16, into which the burial pit was cut (hereafter referred to as E16 pit). Romito 9 burial is located near the western wall of the cave and lies about 2 m below the cluster of four Late Epigravettian burial previously found in the same area (Martini, 2006b; Martini and Lo Vetro, 2014) corresponding to about 3.5 m below present level (Fig. 1/d, e). Romito 9 was initially detected and partially excavated in 2006, but the excavation could only be completed in 2010 (Martini and Lo Vetro, 2018; Ortisi et al., 2016). The present paper provides a detailed account of this burial and corrects aspects of the preliminary data previously published before the completion of the excavation (Craig et al., 2010).

The excavation of the stratigraphic levels deposited after the phase associated with the Romito 9 burial revealed a highly complex stratigraphic context resulting from the occurrence of two successive pits of different chronology which significantly disturbed the underlying layers. During excavations along the western part of the inner trench (2009) a large subcircular pit (D33 pit, dated about 13.000 uncal BP), containing large limestone blocks, was detected. It cuts the lowermost levels from D34 to E10 and partially intersects a portion of a more ancient pit (E10 pit) which originates from the top of layer E10 (dated to 15273 ± 150 uncal BP, 18,826–18,261 cal BP). The edge of the cut of E10 pit was partially overlaid by a hearth (designated E9 hearth), which is associated with the occupation phase corresponding to layer E9 (Fig. 2, section b-b1). E10 pit is N-S oriented and filled by incoherent soil with some large limestone blocks. Beneath the blocks, but not in direct contact with them, some disarticulated human bones (part of the neurocranium, some vertebrae and lower limb long bones), clumps of red ochre and ornaments (pierced deer canines and *Cyclope neritea* shells) were found. At the time of the excavation, the findings (both human bones and artifacts) were dubitatively interpreted as part of a secondary burial (Craig et al. 2010).

The excavation of the E10 pit was completed in 2010, its filling deposit about 50 cm deep contained several large stones (maximum diameter 30–40 cm) which had apparently been selected for their similar size and also did not appear to be randomly arranged. Some of these blocks were placed vertically to fill the voids between the horizontally and obliquely disposed stones. Notably, none of these stones was in direct contact with the human bones (Fig. 3). Among the stones, some small clumps of red ochre, several fragmented animal bones, charcoals and small stones were found. A few of the small stones bear traces of ochre. The filling sediment beneath the stones was browner in colour than the level surrounding the stones themselves and the clumps of ochre were more frequent. Below the browner level, a greyish level (10–15 cm deep) was identified. At the top of the greyish level some unarticulated human bones (vertebrae and ribs) were unearthed: they laid at the same level as the human remains previously unearthed in the northern portion of the E10 pit during the 2006 excavation. In the southern part of the E10 pit excavated in 2010, the pierced *Cyclope neritea* shells were rare and no large red ochre clumps were found. These observations strongly suggest that the fill of the E10 pit contains material resulting from the reworking of an underlying burial structure (see Fig. 7).

During the 2010 excavations, when the same depth of the 2006 excavation in the northern part of the E10 pit was attained in the southern part, some articulated human bones (left upper limb and coxal bone) together with undisturbed grave goods (pierced deer canines and *Cyclope neritea* shells) were found in the central and southern part of the pit. Moreover, at the northern edge of the pit the articulated *calcanei* and *tali* were identified. The articulated human bones laid on a thin level of red-brownish ochre that covered the bottom of the pit. In 2010, the complete unearthing of the walls of the deep E10 pit led to the identification of an earlier pit (E16 pit, recognised as the original burial pit) which has been dug and almost entirely disrupted by the later E10 pit. Nonetheless, portions of the E16 pit were preserved along its short southern margin and a small segment of the adjacent eastern wall.

Within this preserved section, a narrow strip of the original burial fill was identified (Fig. 3). After the recovery of human bones and artifacts, a small trench passing through the edge of the E10 pit was dug in order to establish the level from which the original E16 burial pit had been cut. The small trench (43 × 35 cm) has been opened along the south section of the excavation extending through the Epigravettian levels from E11 to E16. Once reached the level E16, the cut of the burial pit (E16 pit) has been found (Fig. 2, section c-c1). Stratigraphic evidence indicates that the E16 pit was opened at the top of the underlying layer F (Ghinassi et al. 2009).

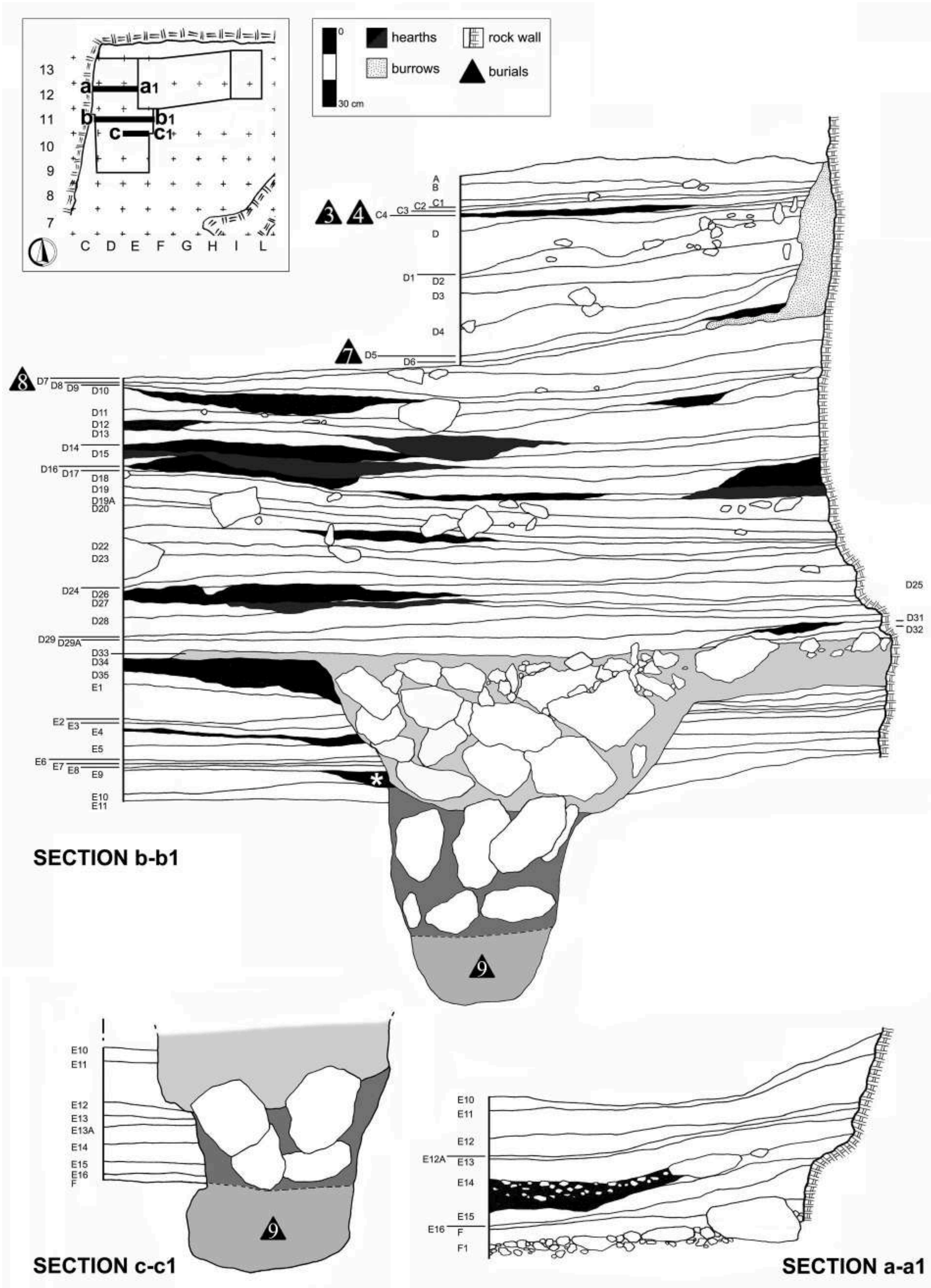

Fig. 2. – Grotta del Romito- Stratigraphic sections with burials position (Archive of Museo e Istituto fiorentino di Preistoria).

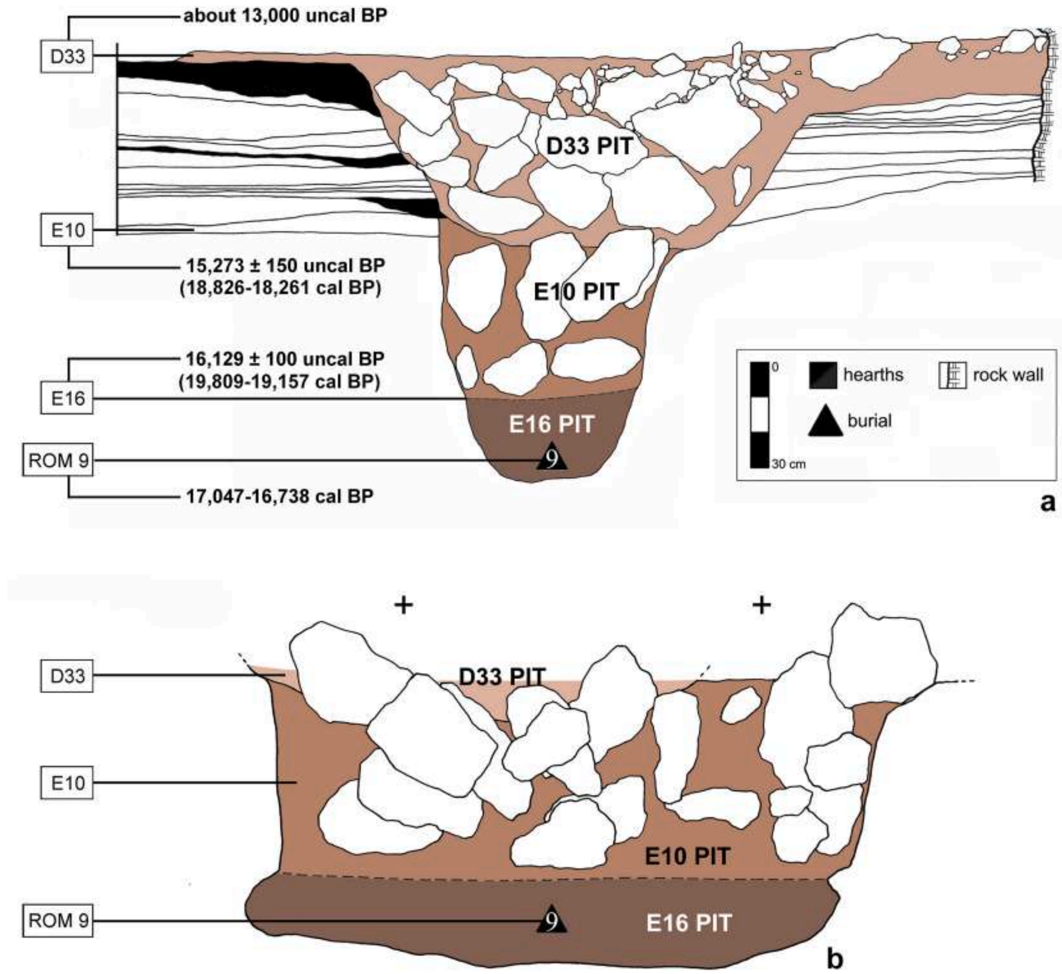

Fig. 3. Grotta del Romito- Stratigraphic sections and ^{14}C dates (Archive of Museo e Istituto fiorentino di Preistoria).

The archaeological sequence can be summarized as follows (Table 1; Fig. 3), progressing from the primary burial event (E16/E16 pit) to the most recent intrusive pit (E10 pit):

1) **Layer E16.** Opening of the burial pit (E16 pit) and deposition of the corpse on a bed of red-brownish ochre (Fig. 6/d). The corpse is then partially covered (from the waist to the feet) by a level of red-bright ochre (Fig. 5/a). From the pelvis to the feet hundreds of pierced *Cyclope neritea* shells and some pierced deer canines were recovered. The deceased also wore personal ornaments at the forelimbs (a bracelet and an armlet) composed of pierced deer canines. Pierced *Cyclope neritea* shells were likely part of a decorated cover (i.e. hide, fur or mat) even if the hypothesis of strings of beads stitched on clothes, as in the case of Sunghir 1, can't be ruled out (Fig. 4).
2) **Layers E15-E10.** The site was reoccupied by humans during the deposition of layers E15 to E10, which subsequently sealed the burial context (Fig. 3/a).
3) **Level E10.**
   - 3a Excavation of a deep pit (E10 pit) reaching the earlier E16 burial pit. E16 burial pit was almost entirely destroyed except for a small portion of the eastern edge adjacent to the southeast corner of the pit.
   - 3b Breaching of the burial and dislocation of much of the skeleton (Fig. 5/a). The original infilling of the E16 pit, along with the skull, right trunk and upper limb, lower limbs, personal ornaments was largely displaced (Figs. 5/c, 6/a, 7). Most of the disturbed bones are displaced in the northern part of the E10 pit.
   - 3c Filling of the pit with large stones of similar size, some of them bore ochre staining presumably originating from the original burial fill.
4) **Layers E9-D33.** Human frequentation of the cave and accumulation of deposits over the E10 pit.
5) **Layers D33.** Excavation of the D33 pit which partially destroyed the E10 pit. The D33 pit was filled chaotically with unselected stones of varying sizes.

In summary, in light of the chronology of the sequence the burial would be related to a chronological step dated to 16,129 ± 100 uncal BP (19,809–19,157 cal BP) which corresponds to the onset of the Evolved Epigravettian (Laplace, 1964; Palma di Cesnola, 1993).

3.2. ^{14}C measures from human bones and shells of the burial

Nine samples were selected from the burial context (Romito 9) to be submitted to AMS (Accelerator Mass Spectrometry) radiocarbon dating. ^{14}C results obtained on the samples are given in Table 3. We preliminarily note that the carbon and nitrogen elemental data obtained on bone collagen (sample LTL17200) correspond to a C:N ratio of 3.5 which falls in the range corresponding to a good collagen preservation (DeNiro, 1985; van Klinken, 1999). Carbon and nitrogen stable isotopes data obtained on the same sample are fully overlapping with those previously obtained on the same skeleton by Craig et al. (2010). The results of calibration (grey intervals) are shown in Fig. 8 where the good overlap between the bone data can be qualitatively assessed. In order to check this consistency quantitatively the *R_Combine* function of OxCal was

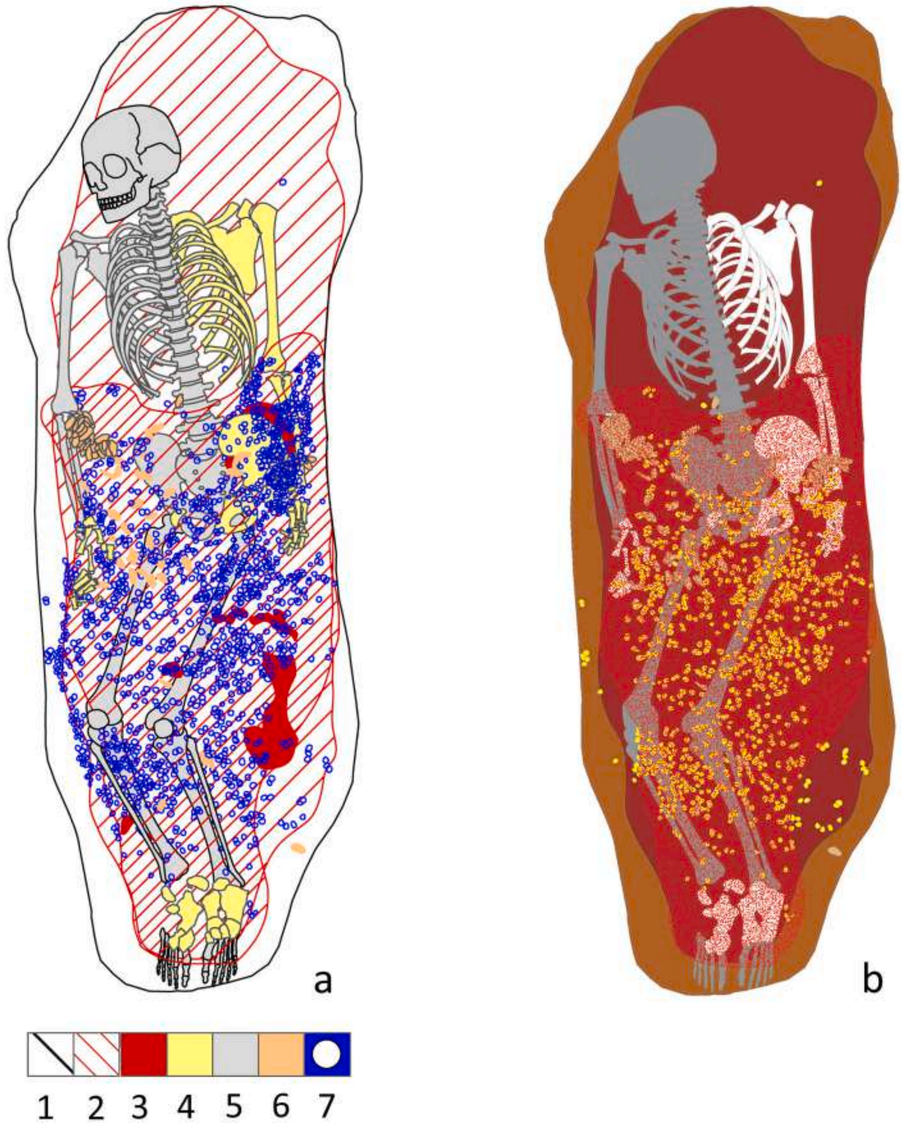

Fig. 4. – Grotta del Romito, Romito 9 burial. Left (a), 1: outline of the burial pit on the bottom; 2: ochre; 3: lumps of ochre; 4: human bones in primary deposition; 5: dislocated bones placed in their hypothetical original position 6: pierced atrophic deer canines; 7: pierced shells. Right (b), reconstruction hypothesis of Romito 9 burial (Archive of Museo e Istituto fiorentino di Preistoria).

used. The performed statistical analysis indicates that the six ages are consistent among them, χ^2-Test: df = 5 T = 10.5(5 % 11.1), and this allows to calculate a refined age (as weighted average of the independent determinations) as 13,912 ± 33 uncal BP corresponding to a calendar age of 17,047–16,742 cal BP with a confidence level of 95.4 % (red intervals in Fig. 8).

The interpretation of ^{14}C data obtained on marine organisms are more complex and they do not appear consistent among them and with the data obtained on bones. The result obtained on *Cerithium* corresponds to background and is then given as >45 ka, while for the sample of *Cyclope neritea* an uncalibrated ^{14}C age of ~23ka is obtained, which is inconsistent with the data on the terrestrial bone sample. The age of the *Dentalium* is indeed significantly younger than the other marine samples. When this age is corrected for the marine effect and calibrated to calendar ages as detailed above, a calendar time range between 18,415 and 17,425 cal BP is obtained (95.4 % probability), about one thousand years older than bones.

4. Romito 9 burial: funerary features

4.1. Body position

The original body position of Romito 9 lying in E16 pit was disturbed by the digging of the later E10 pit which reached a large part of the original plane of deposition of the corpse. The intrusion brought to light and disturbed the majority of the skeleton: the skull, most of the trunk skeleton, right upper limb, right hip bone, lower limbs with the exception of the feet (Fig. 5/a), some human remains were slightly dislocated, that is they have been found unarticulated but still very close to their original position (sacrum, left hand bones, right upper tibial epiphysis (Fig. 5/c). The remaining undisturbed parts of the skeleton (Fig. 5/d) are articulated (the left part of the rib cage; the whole left upper limb; the left ileum, ischium, pubis and femoral head; the left and right tarsal bones), or not strictly articulated (the bones of the right hand) although they were very close to each other and placed in a symmetrical position with respect to the articulated left hand. The overall position of the different groups of human bones suggests a single body lying supine with upper limbs extended at the sides of the trunk and lower limbs

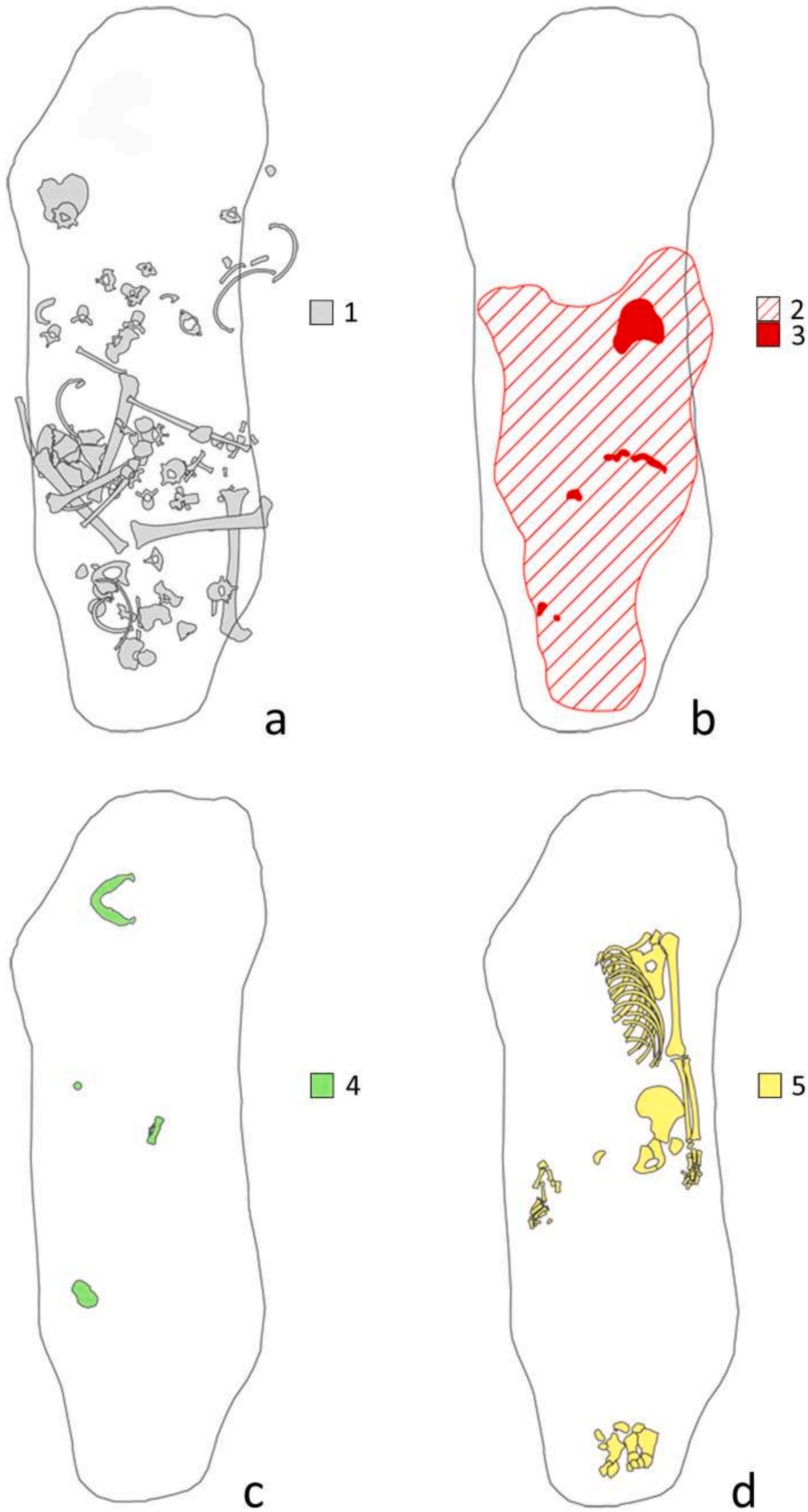

Fig. 5. – Grotta del Romito, Romito 9 burial. Outline of the burial pit bottom and position of human bones and ochre. a: highly dislocated human bones (1); b: covering ochre and ochre lumps (2, 3); c: slightly dislocated human bones (4); d: human bones in primary position (5) (Archive of Museo e Istituto fiorentino di Preistoria).

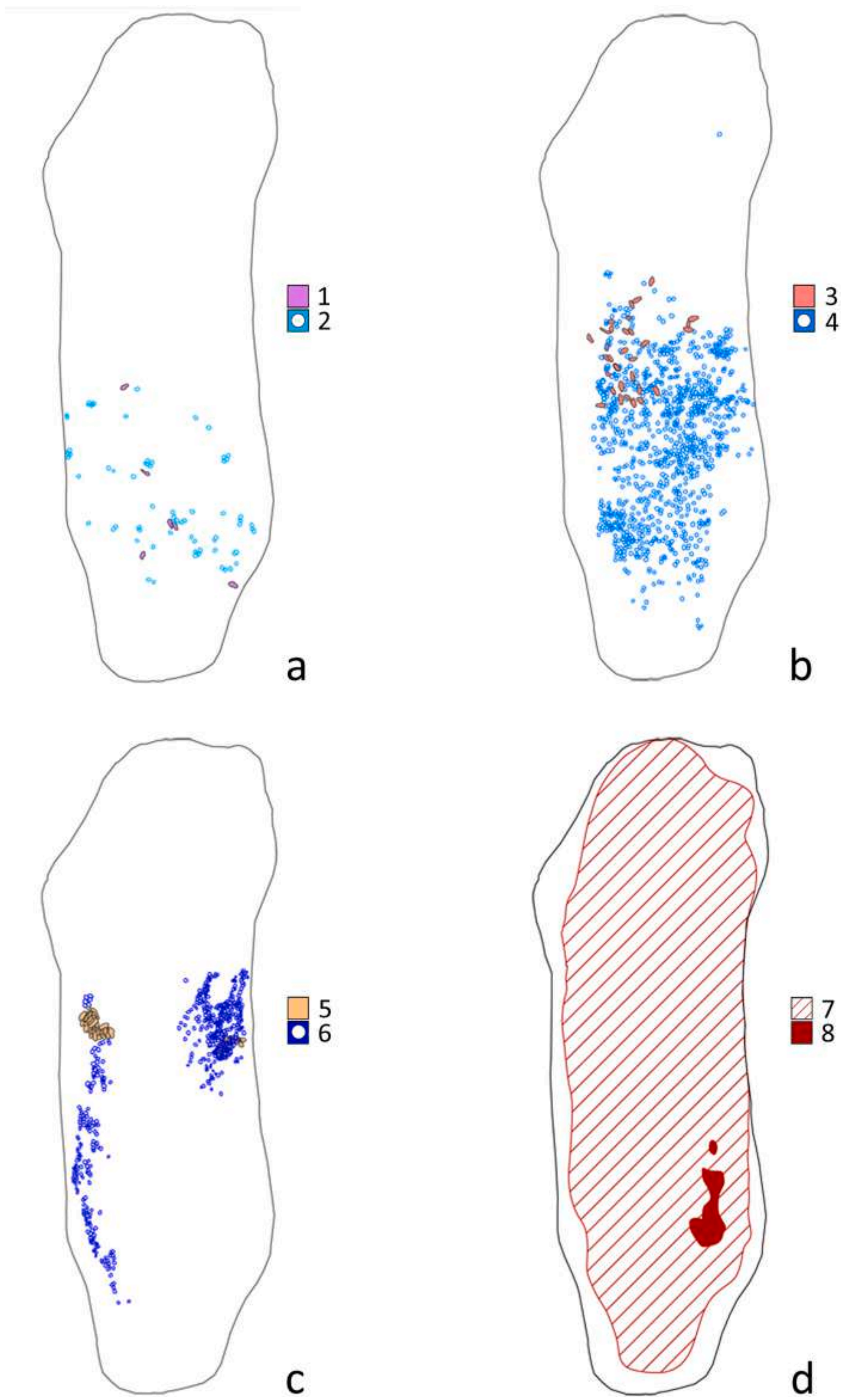

Fig. 6. Grotta del Romito, Romito 9 burial. Outline of the burial pit bottom and position of ornaments and ochre. a: highly dislocated pierced atrophic deer canines (1) and shells (2); b: slightly dislocated pierced atrophic deer canines (3) and shells (4); c: pierced atrophic deer canines (5) and shells (6) in primary position; d: ochre on the bottom of the pit (7) and ochre lumps (8) (Archive of Museo e Istituto fiorentino di Preistoria).

slightly flexed to the right. The undisturbed part of the skeleton, together with the associated personal ornaments, was still covered by a thin layer of the original filling of the E16 pit.

The disturbed bones have been found displaced and disarticulated in a way that is incompatible with the normal bone movements and disarticulations observed in a corpse decomposing in a grave (Duday et al., 1990). No displacement attributable to bioturbation has been observed. The disturbed bones have been mainly displaced in the northern part of the pit. The pit has then been re-filled with large stones some of which carrying traces of ochre (Fig. 3).

4.2. Personal ornaments

Romito 9 was laid on a red ochre bed and was gifted with a rich

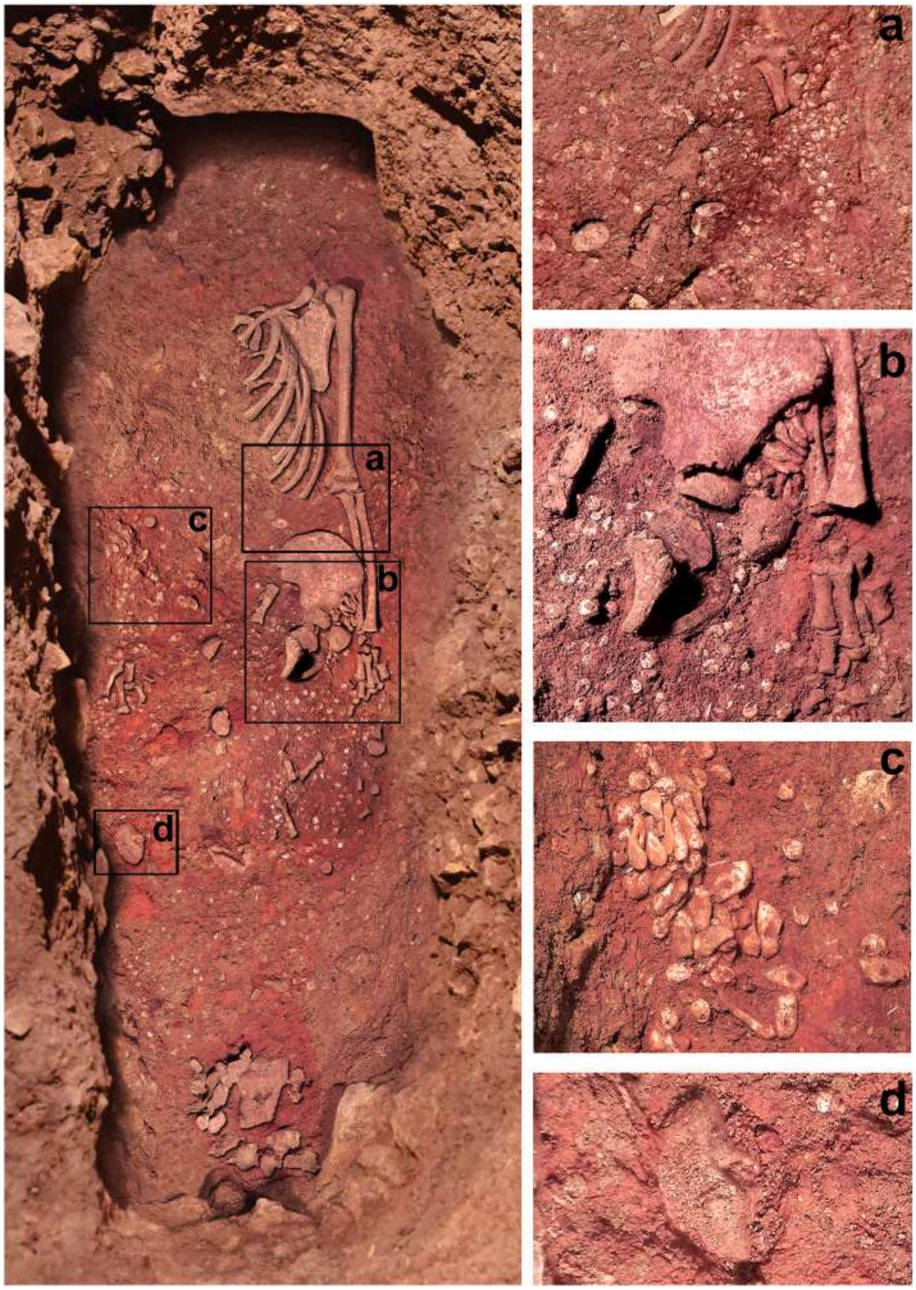

Fig. 7. – Grotta del Romito, Romito 9 burial with articulated bones and ornaments in situ, general view and details during the excavation: a: pierced shells above the right arm; b: bracelet of pierced atrophic deer canines on the right cuff, c: pierced atrophic deer canines on the left arm; d: right tibia upper epiphysis (Archive of Museo e Istituto fiorentino di Preistoria).

ornamentation. This ornamentation includes thousands of artifacts: 99 pierced red deer (*Cervus elaphus*) atrophic canines and almost 1462 pierced marine molluscs shells (*Cyclope neritea*), very sparse *Dentalium*, a *Cerithium* shell and perhaps two single and isolated ochre clumps. The partial disturbing of the burial, about 1000 years later (based on stratigraphic chronology), altered the original position of some of the osteological and ornamental materials which were found at a higher position than their original deposition.

In situ pierced marine mollusc shells (n. = 308) were recovered above the articulated left forearm and hand, as well as along the eastern side of the pit floor, in the area where the right forearm and hand should have been originally placed. Other i*n situ* pierced marine mollusc shells (n. = 184) were found on the same side, further down, at the height of the right lower limb (Figs. 6/c-6 and 7/a). Twenty-one in situ pierced red deer atrophic canines were found around the left wrist and where the right forearm should have been located, just below the elbow (Figs. 6/c-5 and 7/b). Slightly dislocated pierced atrophic deer canines (n. = 41) were found in the area between the right forearm and pelvis (Figs. 6/b-3 and 7c).

Additionally, several hundred slightly displaced pierced marine mollusc shells were found in the area from elbows to ankles excluding the feet (Fig. 6/b-4). Highly dislocated pierced atrophic deer canines (n. = 6) and about 20 pierced marine mollusc shells were found at the level of the legs in a higher position than the other ornaments (Fig. 6/a). No grave goods other than pierced marine mollusc shells and red deer canines were recovered from either the original burial pit (E16) or the later intrusive pit (E10). The excavation of the E10 pit reopened, damaged, and partially disrupted the original E16 burial of Romito 9. The corpse was laid supine, with slightly flexed and right bended lower limbs, the spatial distribution of pierced mollusc shells suggest that they were part

Table 1
– Scheme of the archaeological sequence: the D33 pit, the intrusive pit (E10 pit) and the burial pit (E16 pit).

Pit name	Starts from layer	Dug through layers	Ends at layer	Absolute dating (uncal BP)	2σ cal BP
D33 pit	D33	D34-E11	E11	D33: about 13,000 (see Table 2)	–
Intrusive pit (E10 pit)	E10	E11-E16	E16	E10: 15,272 ± 150	18,826–18,261
Burial pit (E16 pit)	E16	E16-layer F	Undetermined level	E16: 16,129 ± 100	19,809–19,157

of an ornamented cover rather than ornamentation of personal cloths (Fig. 6/a, b). Pierced red deer atrophic canines are part of two personal ornaments: a bracelet around the left wrist and an armlet around the right forelimb (Figs. 6/c and 7/b,c). It cannot be ruled out that some other ornaments and grave goods have been removed during the disturbing of the burial which has been probably unintentionally detected and partially disturbed about 1000 years after its original deposition, if intentional, the motivations behind such an action cannot be determined based on the current archaeological evidence.

5. Anthropology

The skeleton of Romito 9 is exceptionally well preserved except for the postmortem deformation of the parietals The methods of analysis and the state of conservation of the bones are detailed in Supplementary Information.

5.1. Sex, age-at-death and puberal stage

5.1.1. Sex

Analysis of sex-specific amelogenin peptides in tooth enamel (Supplementary Information), highlighted the lack of the AMELY-(58–64) peak allowing us to determine the sex of Romito 9 as female. Figure 9 shows the absence of peaks in the chromatogram extracted at m/z 440.2 (dashed line) while the peak of the AMELX peptide is present in the chromatogram extracted at m/z 540.3 (solid line), the inset shows the relative mass spectrum. Female sex, when needed, will be considered for estimations.

5.1.2. Age-at-death and puberal stage

No deciduous teeth are present, among permanent teeth, upper M2s had just erupted, their occlusal plane is at the level of the cervical margin of M1s. Lower M2s were fully erupted. Slight dental wear is present on upper I1s and M1s, respectively grade 3 and 2 (Molnar,

Table 2
Grotta del Romito, radiocarbon ages from layers D29-F3.I and age of layer D30 (tephra). All ages have been previously published (Ghinassi et al., 2009; Craig et al., 2010; Blockley et al., 2018). Except ROM D30 tephra (Blockley et al., 2018), all 2σ calibrations have been updated for this study using OxCal 4.4, IntCal20 Curve (intcal20.14c), Atmospheric data from Reimer et al. (2020). * Tooth dentinal collagen (C. elaphus).

Sample code	Lab code	Layer	Material	uncal BP	δ 13 ‰	2σ cal BP
R-33	LTL1050A	D29	charcoal	12494 ± 75	−25.3 ± 0.3	15,073–14,302
ROM D30	–	D30	*tephra ash*	–	–	15,792–15,318
ROM D33	LTL14264A	D33	charcoal	13300 ± 100	−26.9 ± 0.3	16,290–15,700
R-31	LTL1052A	D35	charcoal	12970 ± 150	–	15,970–15,110
R-37	LTL1046A	E2	charcoal	13650 ± 120	−27.8 ± 0.3	16,945–16,163
R-36	LTL1047A	E5	charcoal	13646 ± 120	−32.8 ± 0.5	16,941–16,156
ROM CE 7	OxA-26324	E5	animal tooth*	15230 ± 70	−19,60	18,705–18,283
ROM E7	LTL14265A	E7	charcoal	14809 ± 60	−24.9 ± 0.7	18,253–17,949
ROM 39	LTL1591A	E10	charcoal	15273 ± 150	−33.6 ± 0.6	18,826–18,261
ROM 40	LTL1592A	E16	charcoal	16129 ± 100	−19.4 ± 0.3	19,809–19,157
ROM 41	LTL1593A	F1	charcoal	17376 ± 90	−21.6 ± 0.4	21,345–20,760
ROM 20	LTL239A	F2	charcoal	18978 ± 130	−30.8 ± 0.1	23,152–22,511
ROM 28	LTL606A	F3.I	charcoal	18483 ± 95	−26.5 ± 0.3	22,618–22,185

Table 3
List of the radiocarbon dated sample from Romito 9. (*) Measurement carried out with the CEDAD gas ion source (see text for details).

Sample ID	Lab Code	Sample material	Δ^{13}C** (‰)	Radiocarbon Age (***)	2σ cal BP	Carbon and nitrogen elemental and stable isotopic data	Measurement year
Romito 9	**LTL3034A**	Bone (Femur)	−18.8 ± 0.5	13915 ± 70 BP	17,082–16,638		2008
Romito 9	**LTL16774A**	Bone (Rib)	−18.8 ± 0.6	13789 ± 75 BP	16,998–16,470		2016
Romito 9	**LTL17200A**	Bone (Rib)	−17.7 ± 0.6	13961 ± 75 BP	17,296–16,669		2017
Romito 9	**LTL17200A**(*)	Bone (Rib)	18.6 ± 0.6	14013 ± 150	17,409–16,566	Δ^{13}C = -19.00 ‰ Δ^{13}N = 12.83 ‰ C = 42.1 %; N = 15.1 %	2017
Romito 9	LTL17876A	Tooth (Dentine)	−16.3 ± 0.3	14097 ± 85 BP	17,381–16,970		2018
Romito 9	LTL21196A	Trabecular Bone	−20.8 ± 0.4	13802 ± 75	17,007–16,492		2021
Romito 9-A	LTL19153A	Cerithium	−0.7 ± 0.2	>45′000 BP			2019
Romito 9-B	LTL19154A	Dentalium	2.9 ± 0.3	15609 ± 75 BP	18,415–17,456		2019
Romito 9-C	LTL19861A	Cyclope neritea	+5.0 ± 0.3	23064 ± 120 BP	26,865–25,874		2020

(**) Measured on line by the AMS system and used for fractionation correction of the radiocarbon age.

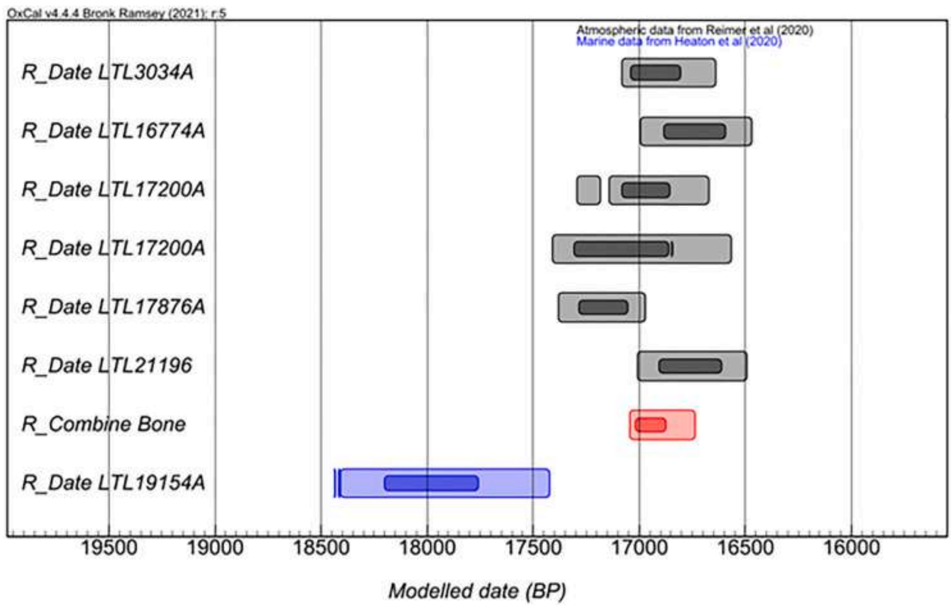

Fig. 8. – Calibrated radiocarbon ages. Light and dark intervals refer to one and two standard deviation confidence level. Grey intervals refer to data obtained on bone and teeth. The red interval refer to the statistical combination of the 14 C ages obtained on the terrestrial samples. Blue intervals referent to the 14C age obtained on the Dentalium sample. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

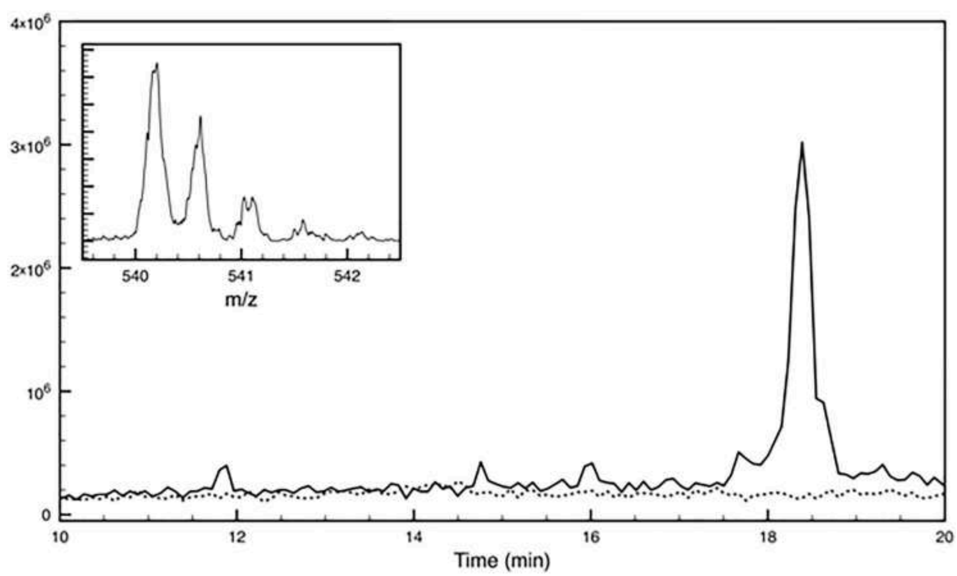

Fig. 9. Chromatograms of amelogenin peptides of Romito 9: the absence of peaks in the chromatogram extracted at m/z 440.2 (dashed line) while the peak of the AMELX peptide is present in the chromatogram extracted at m/z 540.3 (solid line) and the inset shows the relative mass spectrum.

1971). Female dental age determinations (see Supplementary Table 9 for teeth formation) are: 10.3 yrs (Demirjian et al., 1973), 10.5 yrs (Demirjian and Goldstein, 1976), 10.9 yrs (Cameriere et al., 2006), mean dental age is 10.6 yrs. Considering the osteological development of Romito 9, Supplementary Info Fig. 3, her age can be estimated at more than 10 and less than 12 yrs. Using the length of the long bones, the age estimated using modern reference samples (Ruff, 2007) is 11 yrs. The age-at-death of Romito 9 is thus estimated to be 11–12 (Fig. 10).

Skeletal and dental indicators (Lewis et al., 2016), used to assess puberal status are in (Suppl. Info., table 10, Fig. 4). Canine mineralization, proximal ulna and hamate hook formation are in the acceleration stage (stage 2), distal humerus, hand phalanges and CMV are in the PHV-transition stage (stage 3).

5.2. Dental dimensions

To evaluate dental dimensions in Romito 9, we compared MD and BL crown diameters for each tooth to a sample of Middle Upper Paleolithic (MUP) and Late Upper Paleolithic (LUP) individuals (Suppl. Info 1 Tables 4–7, Figs. 1 and 2).

As compared to MUP and LUP means (Supplementary Fig. 1) dental measures in Romito 9 are:

- intermediate (i.e. smaller than MUP and larger than LUP) in 10 cases;
- larger than both MUP and LUP in 16 cases;
- smaller than both MUP and LUP in 4 cases

To evaluate the overall dental dimensions in Romito 9 in comparison

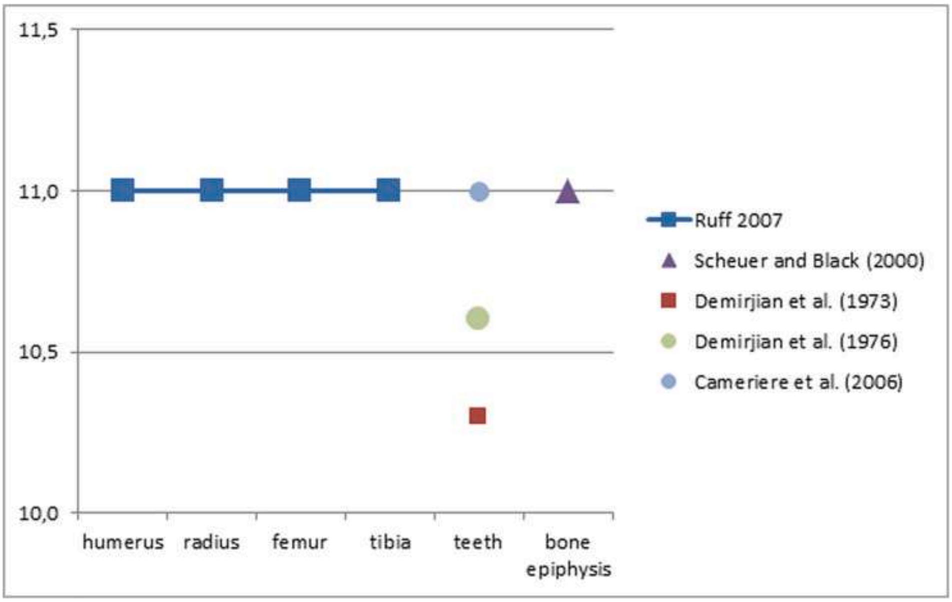

Fig. 10. Age in years of Romito 9.

Table 4
Stature estimation following formulas using diaphysal (d) and total (t) lengths Ruff (2007), Feldesman (1992) and Robbins Schug et al. (2013))-.

	Anatomical	Ruff (2007) 11y (d)	Ruff (2007) 11y (t)	Feldesman (1992) 11y	Robbins Schug et al. (2013) no age
	146.3	–	–	–	–
Femur	–	145.2	145.5	144.8	143.8
Tibia	–	149.7	145.0	–	–
Femur + tibia	–	147.8	145.4	–	–
Humerus	–	147.8	–	–	–
Radius	–	149.1	147.5	–	–
Humerus + radius	–	148.3	–	–	–

Table 5
Bi-iliac breadth/stature ratio. Living bi-iliac breadth = skeletal bi-iliac breadth +0.5 cm. Stature in juvenile MUP *Homo sapiens* fossils and in Lower Pleistocene Homo ergaster KNM-WT 15000 determined using femur's formula, Ruff (2007). Sunghir 2 (Alexeeva et al., 2000); Paglicci 12 data collected by the author; Dolni Vestonice 13 e 14 (Sládek et al., 2000); Arene Candide Prince (Sergi et al., 1974); KNM-WT15000 and adults (Ruff and Walker, 1993).

	Age	Bi-iliac breadth (living) cm	Stature cm	Bi-il.-breadth/ stature
Romito 9	11yrs	22.8	145.0	0.157
Sunghir 2	13yrs	21.8	152.2	0.143
Paglicci 12	13–14yrs	21.7	155.5	0.139
A.Candide Prince	15yrs	23.3	168.9	0.138
D.Vestonice 14	16–17yrs	26.5	181.8	0.146
D.Vestonice 13	17–19yrs	26.9	165.8	0.162
KNM-WT 15000	12yrs	23.0	157.0	0.146
Living African	Adult	–	–	0.148–0.174
Living European	Adult	–	–	0.160–0.188

to MUP and LUP samples and to the sample of Final Epigravettian individuals found in the same site (Romito 1–8) we performed a PCA, considering all tooth MD and BL diameters. The results are presented in Supplementary Fig. 2. MUP and LUP are clearly separate along PC1 (accounting for more than 70 % of the Variance), Romito 9 is close to MUP sample while Final Epigravettian individuals Romito 1–8 are close to the LUP sample. The only indication of dental reduction in Romito 9 comes from the upper C MD crown diameter which is very small when compared to the Romito Late LUP sample, z-score −2.20 (Suppl. Info 1, table 8, Figs. 1 and 2). We think it is more likely an individual feature than an indication of general tooth reduction as it is contradicted by all other dental dimensions (Supplementary Fig. 1).

5.3. Estimation of stature and body mass

Living stature estimated with the anatomical method is 146.3 cm, Supplementary Information Table 11, The range of variation of femur mathematical stature estimations (Table 4) is narrow, 1.7 cm (143.8–145.5). We observe more marked variation following bone, measure (total length vs. diaphyseal length) and limb. Using diaphyseal lengths (Ruff, 2007), the stature based on tibial length is 4.5 cm taller than the femoral one; humeral and radial statures are similar (1.4 cm difference); humeral height is 2.6 cm taller than the femoral one; radial and tibial statures are similar (0.6 cm difference). Looking at total lengths, femoral and tibial heights are similar (0.5 cm difference), radial height is 2.5 cm taller than tibial one. Most of the observed differences can be explained considering the inter (upper limb/lower limb) and intra (brachial and crural indexes) limb proportions in Romito 9 and in the modern reference sample: her crural index is about 5.5 points higher than that observed in the modern reference sample: this explains the higher tibial stature. Romito 9's interlimb humerus + radius/femur + tibia) index is about 2–3 points higher than that observed in the modern sample: this explains why upper-limb-bone statures are taller than lower-limb-bone ones. For these reasons we think that femoral methods are more appropriate in order to estimate Romito 9's stature.

The mean of the anatomical method and the four femoral mathematical methods produces a stature estimation of 145 cm for Romito 9. Using this estimated juvenile stature, 145 cm, we estimated that her adult stature, Supplementary Table 13, would have been in the range 162.3–166.1 cm, with a mean value of 163.8 cm. Body mass estimation in Romito 9, Supplementary Table 14, ranges between 36 kg and 40.4

Table 6
Adult stature (cm) in Upper Paleolithic. For Romito 9 we used the mean of the estimated range (162.3–166.1 cm). (1) Mean of the results with the methods: Trotter and Gleser. (1958), "white" and "negro"; Sjøvold (1990), "All races"; Formicola and Franceschi (1996), "LS" and "MA"; Feldesman and Fountain, 1996, "Asia", "Black", "White" and "Generic"; Raxter et al., 2008; Maijanen and Niskanen (2010), "LS" and "MA"; Ruff et al., 2012. (2) Mean of the results with the methods: Trotter and Gleser. (1952), "white" and "negro"; Bach (1965); Sjøvold (1990), "All races"; Formicola and Franceschi (1996), "LS" and "MA"; Maijanen and Niskanen, 2010, "LS" and "MA"; Raxter et al., 2008; Ruff et al. (2012). (3) Carretero et al. (2015), Pablos et al. (2016); (4) Blanchard et al., (1972), Henry Gambier et al., 2002; (5) Guerret, 1953. MUP female individuals: Grotte des Enfants 5, Paglicci 25, Veneri 2, measured by PFF; Dolni Vestonice 3, Trinkaus and Jelinek (1997); Predmost 4 and 10, Matiegka (1938). LUP female individuals: Grotte des Enfants 3, San Teodoro 1, San Teodoro 4, Romito 7, Romito 8, measured by PFF; Arene Candide 2 and 3, Paoli et al., 1980; Cap Blanc, Von Bonin, 1935; Oberkassel 2, Trinkaus (2015).

	Sex	2σ cal BP	n	mean	sd	min	max	Bone, Method
Romito 9	F	17,047–16,738		163.8				
MUP	F		6	166.5	7.755	156.6	173.2	Femur M1 (1)
LUP	F		8	156.9	4.992	149.8	164.4	Femur M1 (1)
Romito 1	F			142.6				Humerus M1 (2)
Romito 4	F	13,366–13,095		154.3				Humerus M1 (2)
Romito 5	F	12,930–12,716		146.4				Humerus M1 (2)
El Miròn (3)	F	18,847–18,696		155.7				Talus + 2nd metatarsal
S.Germain-la-Rivière (4)	F	19,535–18,733		153.0				
Abri Lafaye (5)	F	18,836–18,265		155.1				
Chancelade	M	18,640–18,201		156.3				Femur M1 (1)
Romito 3	M	–		165.0				Femur M1 (1)
Romito 7	M	14,189–13,843		160.9				Femur M1 (1)
Romito 8	M	–		163.1				Femur M1 (1)

Table 7
Body mass, stature and body mass index in Romito 9 and in other juvenile individuals.

Individual	Period	Age	Body mass	Stature	BMI	WHO 15 th	WHO 50 th	WHO 85 th
Romito 9	LUP	11-12y	37.8	1.45	18.0	15.59	17.28	20.35
Enfants 6	MUP	13y	45.6	1.53	19.5	16.62	18.53	21.93
Sunghir 2	MUP	13y	44.7	1.52	19.3	16.62	18.53	21.93
Paglicci 12	MUP	13-14y	41.1	1.56	16.9	16.62	18.53	21.93
A. Candide Prince	MUP	15y	44.9	1.67	16.2	16.62	18.53	21.93
A. Candide 17	LUP	17y	52.8	1.52	22.9	18.68	21.12	25.28
KNM-WT 15000	–	12y	50.0	1.59	19.8	16.06	17.87	21.12

MUP *Homo sapiens*: Paglicci 12 and Enfants 6, data collected by the author; Sunghir 2, Alexeeva et al., 2000; Arene Candide Prince, Sergi et al., 1974. LUP *Homo sapiens*: Arene Candide 17, Paoli et al., 1980; Lower Pleistocene Homo ergaster: KNM WT-15000, Ruff (2007). Recent: WHO (1995).Weight in kg (femoral head breadth), stature in m (femur), Ruff (2007).

kg, the mean value is 37.8 kg.

5.4. Trunk height, intermembral and intramembral proportions, trunk to limb proportions, body width and body mass index

We estimated skeletal trunk height (STH) (Franciscus and Holliday, 1992) in Romito 9–400 mm, Suppl. Info par. 3.8. The intermetaphyseals and maximum lengths of the long bones of the limbs (humerus, radius, femur and tibia) in Romito 9 are in Supplementary Tables 15 and 16. Intermembral index are 66.2 (max. length) and 66.7 (intermetaphyseal). In the upper limb intramembral indexes are 75.2 (max. length) and 76.5 (intermetaphyseal), in the lower limb are 85.7 (max. length) and 86.4 (intermetaphyseal). The ratios of long bone maximum length to STH are: 67.5 (humerus); 50.8 (radius); 96.3 (femur); 82.5 (tibia). Bi-iliac breadth (BIB) in Romito 9 is 223 mm, adding 5 mm to account for soft parts (Ruff and Walker, 1993), the BIB/height ratio in Romito 9 would be 0.157 (Table 5).

5.5. Pathology, trauma and stress indicators

In the very well preserved and nearly complete skeleton of Romito 9 we did not find macroscopical traces of pathology or trauma nor traces of tooth enamel defects.

6. Discussion

6.1. Stratigraphic position, and chronology of Romito 9 burial

Romito 9 is a primary burial stratigraphically dated to ca. 19,800–19,100 cal BP, at the transition between the Ancient and Evolved Epigravettian according to the Italian chrono-cultural framework (Palma di Cesnola, 1993; Martini, 2008).

However, the direct radiocarbon dating of the juvenile female individual yields results approximately 2000 years more recent than the stratigraphic one, placing the burial at the beginning of the Final Epigravettian. This discrepancy between a consistent stratigraphic radiometric sequence (see Tables 1 and 2) and a coherent set of direct dates obtained from the human specimens (Table 3) remains unresolved. At present, no definitive explanation can be offered for the 2000-year divergence between the two datasets.

Following the stratigraphic evidence, the E10 pit was partially sealed by a hearth which is in phase with layer E9, so there is no continuity between D33 pit and E10 pit. It is certain that the E16 burial pit opens into E16, cutting through layer F, as demonstrated by the cross-section made along the southeastern wall of the intrusive E10 pit, which revealed part of the original edge of the E16 burial pit.

Based on the direct dating of the skeleton (mean calibrated date, Table 3), the burial should correspond to the layers between E5 and E8 (chronology in Tables 1 and 2). However, this not only contradicts the stratigraphic evidence but would also imply a pit nearly 1 m deep, an unlikely scenario in the context of current Upper Palaeolithic evidence. Where burial pit depths are well documented for this period, they never exceed approximately 45 cm. Regarding the Gravettian period, data are either lacking or insufficient for the Balzi Rossi burials. Among more recently excavated burials, Paglicci 25 was found in a pit approximately 40 cm deep (Mezzena and Palma di Cesnola, 1993), while a depth of around 40 cm has been hypothesized for the pit of Kostenki 18 (Reynolds et al., 2017). At Lagar Velho, the burial pit was no deeper than 20–30 cm

(Zilhao, 2005). Although metric data are unavailable for the burial pits at Arene Candide Principe (Cardini, 1942), Dolní Věstonice 3 (Trinkaus and Jelinek, 1997) and 13–15 (Klima, 1988), and Předmostí (Svoboda, 2008), the authors describe them as shallow. As regards post-gravettian contexts, the situation appears unchanged. Romito 7 and 8 burial pits were approximately 45 cm deep (Martini et al., 2004). At Riparo Tagliente and Villabruna A, the burial pits were slightly shallower: 40 cm in the former (Bartolomei et al., 1974) and no more than 40 cm in the latter (Aimar et al., 1992). Oriente C burial pit was shallower, about 25 cm (Lo Vetro and Martini, 2006). The size of the burial pit was not given in El Miròn, but the authors mentioned a shallow grave (Geiling and Marín-Arroyo, 2015). In conclusion, accepting the radiometric dating of the Romito 9 skeleton—which, as demonstrated, conflicts with the stratigraphic evidence—would require assuming the existence of a burial pit over twice as deep as any securely documented from the Upper Palaeolithic. When evaluating the chronology of Romito 9 in relation to the depth of the burial pit, it is important to emphasize that the disarticulation of the skeleton can only be plausibly explained by the later intrusion of pit E10, which intersected the original E16 burial pit after the decomposition of the body.

It is worth noting that such discrepancies between direct radiometric dates and stratigraphic context are not unprecedented in Palaeolithic and Mesolithic contexts. For example, in the Mesolithic burial at Mezzocorona (Dalmeri et al., 1998), the direct radiocarbon date was more recent than the archaeological context suggested. Similarly, at Riparo Tagliente, radiocarbon determinations from different anatomical elements of a single individual produced significantly divergent results (Yavuz et al., 2024).

6.2. Chrono-cultural contextualization of Romito 9 burial

Romito 9 raises important questions regarding the cultural step marking the end of the Gravettian tradition and the emergence of the markedly sober funerary practices that characterize the Final Epigravettian in Southern Italy—namely, a clear reduction in the use of ochre, ornaments, and grave goods (Martini and Giacobini, 2024). The evidence from Romito 9 suggests that the rich funerary customs associated with the Gravettian persisted up to the onset of the Evolved Epigravettian, at least in Southern Italy.

The Italian Upper Palaeolithic burial record (complete references in Martini, 2006a, ed.) is one of the most abundant in the Europe (May, 1986; Binant, 1991; Mussi and Roebroeks, 1996; Mussi, 2008; Henry-Gambier, 1990, 1995, 2001, 2002, 2008; Pettitt, 2011; Riel-Salvatore and Gravel-Miguel, 2013), composed either by burials older than about 27,000 cal BP or younger than about 16,000 cal BP. The dearth of human remains, either buried or not, in the 27-16,000 cal BP range is also observed in Europe, where only a few human burials and fragmentary bones are known. Therefore, one of the most interesting issues in Romito 9 burial is its chronology as it contributes to fill the gap existing from the peak of the LGM to the last part of the Late Glacial in Europe and it is the only evidence in Italy concerning this period. The comparison with the Gravettian burial "Prince" from Arene Candide Cave (Pettitt et al., 2003) is particularly interesting. It is the burial of a young individual, 15 years old, buried supine facing left, dated to 27, 879–27,292 cal BP. A large amount of ochre was placed below and over the body, and a rich personal ornamentation (*Cyprea, Nassa, Echinoidea*, small gastropods and pierced *Cervus elaphus* atrophic canines, ivory pendants) and grave offerings (four *bâtons percés* and a very long flint blade) were present. Notwithstanding some differences (the absence of grave offerings in Romito 9 could be simply due to the disturbing of the burial), we observe in Romito 9 an attitude towards the death similar to the tradition rooted in the Gravettian burial ritual in Italy (Baousso da Torre 1 and 2, Barma Grande 2, Caviglione, Grotta dei Fanciulli 4, S. Maria di Agnano 1, Paglicci 12 and 25) as well as in other parts of Europe.

After the middle Gravettian in Europe there is a gap of about four millennia in the funerary evidence spanning the Late Gravettian and post-Gravettian cultural complexes (Solutrean and Ancient Epigravettian) up to the peak of LGM. The only burial dating back to this period is the Early Magdalenian inhumation of Mittlere Klause (Germany), dated to 23,055–21,984 cal BP (Street et al., 2006). This burial falls within a time frame when only a few occupation sites in all Europe are known, in contrast with the Late Palaeolithic evidence that after some millennia yields an increase of the archaeological record of human finds (single or multiple burials) and sites (Street et al., 2006; Orschiedt, 2013).

After another gap of approximately three millennia, additional funerary evidence -more or less coeval with Romito 9- appears in Western Europe, dating to a period of about two millennia between ca. 19,000 and 18,000 cal BP, at the end of the Last Glacial Maximum. All these burials are associated with the Magdalenian cultural tradition. One of the human remains from St. Germain-la-Riviere (France) can be identified as a primary burial: a young adult female, placed in a highly-flexed position, was protected by large stone slabs, stained with red ochre and maybe ornamented with grave goods; the direct date, 19,535–18,733 cal BP, relates the burial to the Middle Magdalenian (Blanchard et al., 1972; Henry-Gambier et al., 2000). In the Laugerie-Basse rockshelter a young adult male skeleton was found and referred to Middle Magdalenian by its stratigraphic position and the direct date 19,380–18,733 cal BP (Henry- Gambier, 2001). The body laid on its left side with flexed lower limbs, placed underneath a large stone block and dressed up with *Cypraea* shell pendants from the forehead to the feet (Wüller, 1999). The adult woman ("Red Lady") of El Miròn (Spain), directly dated to 18,847–18,696 cal BP (Geiling and Marín-Arroyo, 2015), was found in a deposit dating to the Lower Magdalenian, interred with abundant red ochre (Straus et al., 2015). Another evidence with rich grave goods and body ornaments is the burial of Abri Lafaye (France). In this Magdalenian site, the remains of at least three incomplete skeletons (an adult female, an infant, an adult cranium) were found. The position of the adult female (maybe the body was placed on the right side with tightly flexed legs: Henry-Gambier, 1990) and other details of the funerary practice were not documented. The adult female was directly dated 18,865–18,197 cal BP (Henry-Gambier et al., 2000). A Late Upper Palaeolithic context was proposed for the primary burial of Cap Blanc (France). The body of the adult female was in a flexed position on the right side underneath the famous sculpted frieze of horses (the relationship with the burial cannot be demonstrated), without grave goods neither ornaments, the head and feet were protected by large stone blocks (Wüller, 1999; Archambeau and Bahn, 2001). The remains, excavated in 1911, have not been dated directly but the stratigraphic context relates the burial to the ancient phase of Middle Magdalenian (phase III). To the Middle Magdalenian refers the primary burial of the Chancelade rock shelter (France). A skeleton of an adult male was found in a tightly flexed position (the knees were in contact with the mandible), on the left side, with ochre around the body (Wüller, 1999). The skeleton has not been dated directly. In the European samples we observe some loose remains (sometimes the association of the cranium with other skeletal remains and artifacts is not clear) thus it is difficult to interpret the evidence as burials. They can indicate variable secondary practices or the preservation of relics: Cova Beneito (Spain), related to an archaeological context dated to 21,270–18,902 cal BP (Balbin Behrmann, 2015), St. Germain-la-Riviere consisting in some fragmentary human remains directly dated to 19,535–18,733 cal BP Henry-Gambier et al. (2002). Some of these burials, notably St. Germain-la-Riviere and El Miròn, indicate that around 19,000 cal BP in continental Europe a still rather rich funerary practice persisted.

In Italy, the Final Epigravettian burial ritual, approximately 3000 years more recent than that of Romito 9 (according to stratigraphic chronology), marks a clear shift from Gravettian funerary customs, although regional differences between northern and southern Italian burials are evident. In Southern Italy during the Final Epigravettian, common features of this later ritual include the absence or marked reduction of ochre use, a scarcity or lack of personal ornaments and, in general, of grave goods. These characteristics are particularly clearly exemplified by the six Final Epigravettian burials from Grotta del Romito, as well as other sites across central and southern Italy (e.g., Vado all'Arancio Rockshelter, Caves of Continenza, Maritza, Paglicci) and Sicily (e.g., the Caves of San Teodoro and Oriente) (general references in Martini, 2006a ed.; see also Fabbri and Lo Vetro, 2021; Henry-Gambier, 2005; Giacobini, 2006a,b; Giacobini, 2007; Mussi, 2008; Martini et al., 2007; Martini and Giacobini, 2024). Most of these burials have a standardized supine position of the body with fully extended lower limbs. Both the Ligurian burials (Arene Candide and Fanciulli), for the occurrence of body ornaments and the evidence in Northern Italy (Villabruna A and Tagliente shelters), for the presence of painted or engraved stones (Martini, 2016), differ from these. The enduring presence in Southern Italy of the Gravettian funerary tradition at the onset of the Evolved Epigravettian aligns with the continuity in artistic tradition at Grotta Paglicci, and, to a lesser extent, in a general view, in lithic productions (Palma di Cesnola, 1993; Martini, 2008; 2016). The process of regionalization, both in lithic productions and symbolic aspects, starts at the beginning of the Final Epigravettian and concerns both peninsular Italy and Sicily.

The burials dated between 23,000 and 18,000 cal BP in Europe, more or less coeval with Romito 9 (see Supplementary Table 2), allow us to identify a number of recurrent features in Magdalenian funerary practices some of which closely parallel those observed in the Romito 9 burial. These include the flexed position of the body, as seen at Abri Lafaye, Laugerie-Basse, Saint-Germain-la-Rivière, Chancelade, and possibly Cap Blanc; the use of ochre, documented at Mittlere Klause, Chancelade, and Saint-Germain-la-Rivière; the presence of personal ornamentation, particularly at Saint-Germain-la-Rivière and Laugerie-Basse; and the placement of large stone blocks to protect the body or parts of it, as noted at El Mirón, Saint-Germain-la-Rivière, Laugerie-Basse, and Cap Blanc. In contrast, the differences with the Final Epigravettian record from southern Italy are evident, particularly with regard to the position of the deceased and the lack or rarity of ornaments and other grave goods.

6.3. Anthropology

Romito 9 was a 11-12 years old female individual at the time of death, in the acceleration/PHV puberal status stage (stage 2–3). Puberal stage has been assessed in few ancient samples ranging from Bronze Age to Middle Ages (Arthur et al., 2016; Doe et al., 2019a, 2019b; Lewis et al., 2016), in all of these samples puberal stage 2 is largely predominant in individuals aged 10-12y. Recent work on Upper Palaeolithic skeletons (Lewis et al., 2024) has shown that puberty had begun by 13.5 years of age for the majority of individuals and that the age of menarche was probably between 16 and 17 years of age. Romito 9 seems in advance as compared to the only female individual of similar age at death, Paglicci 12 (aged 13.5), confirming that adolescence period was as variable during Upper Palaeolithic as it is today (Lewis et al., 2024). Considering that the age of menarche coincides with the ossification of the iliac crest and is attained after the peak height velocity (PHV) and before the fusion of the phalangeal epiphyses (Lewis et al., 2016) and that these indicators are not matched in Romito 9, we think that she didn't attain menarche when she died.

A PCA of Romito 9 and Romito 1–8 Final Epigravettian individuals shows that overall dental dimensions approach the former to MUP and the latter to LUP. Even if not compelling, as MUP and LUP overlap in dental dimensions, it is an indication that the extreme dental reduction observed in Final Epigravettian individuals Romito 1–8, did not affect Romito 9. Romito 9 is estimated to be about 145 cm in stature and 37.8 kg in weight. Stature estimation should be reliable because different methods, anatomical and mathematical (Feldesman, 1992; Ruff, 2007; Robbins Schug et al., 2013) produce very similar values. On the contrary body mass estimation and related body mass index (BMI) are more questionable. Body mass %SEE (percent standard error of estimate) are high, 13.9 %–19.1 %, in the 11–12 years range, while estimated stature %SEE for lower limb bones are markedly lower, 1.5 %–2.1 %, (Ruff, 2007). Romito 9 was slightly shorter than LUP juvenile individuals Roc de Cave (probably 2–4 years older) and Arene Candide 17 (probably 5–6 years older) and intermediate in stature between MUP taller individuals Enfants 6 and Sungir 2 (probably 1–2 years older) and shorter Predmost VII (probably 1–3 years older), Supplementary Table 12.

If she would have reached the age of 18 yrs, Romito 9's stature is estimated in the range 162.3–166.1 cm. Comparing this value to Upper Palaeolithic adult statures (Table 5), Romito 9 would be slightly shorter than the MUP female mean (166.6 cm) and close to the LUP maximum (164.4 cm) recorded on San Teodoro 1. Regarding other LUP female individuals from Romito, Romito 9 would be markedly taller, about 20 cm, than the two female individuals from the "shelter", Romito 1 and 5 who are the shortest in the European LUP, and about 9 cm taller than the female individual from the "cave" Romito 4. Her stature would be similar to the LUP males from Romito (individuals 3, 7 and 8). The reduction of stature at the end of the Upper Palaeolithic, Formicola and Giannecchini, 1999, is evident in Final Epigravettian individuals from Romito, especially those from the "shelter" (Romito 1, 5 and 6) due to the general trend observed in Europe and to a certain degree of endogamy suggested by the presence of a chondrodystrophic dwarf, Romito 2 (Frayer et al., 1988) buried over Romito 1. The stature reduction is observed also in the few chronologically close European individuals (i.e. in the 20,000–15,000 cal BP range), stature estimation is possible for three females (El Miròn, S.Germain-la-Rivière, Abri Lafaye), with the caution due to the unusual method of estimation (El Miròn) and to the uncertainty in bone measures (Abri Lafaye), their statures, around 155 cm, are close to the European LUP mean, the only male, Chancelade, has a similar stature several cm shorter than Romito 9 estimated adult stature. Different hypothesises have been put forward to explain the reduction in body size observed in LUP populations, reduced mobility, climatic adaptation, selection to reduce nutritional demand (E. G. Frayer, 1981; Ruff, 1994; Holliday, 1997, 1999; Pearson, 2000; Weaver and Steudel-Numbers, 2005; Formicola and Holt, 2007). Whatever the reason, the reduction of stature in the final phases of the LUP especially affected the Romito group, but did not affect Romito 9 whose estimated adult stature would be similar to European MUP female mean and close to the maximum observed in the European LUP female sample.

Body proportions vary significantly during growth (Feldesman, 1992; Ruff and Walker, 1993; Ruff, 2007) and comparing growing individuals, even if slightly different in age, could be misleading especially when age is close to the adolescent growth spurt as is the case with Romito 9. Additional problems, when dealing with fossil remains, come from sex related differences, and from the fact that all individuals are older in age than Romito 9. Romito 9 has a short radius as compared to the humerus (Supplementary Table 15), shorter than MUP individuals Paglicci 12 and Arene Candide Prince and anatomically modern *Homo sapiens* Qafzeh 11 and similar to LUP individual Roc de Cave. On the contrary, her tibia is long when compared to the femur, Supplementary Table 16, similarly to MUP individual Sunghir 2. Limb proportions do not discriminate between MUP and LUP adult samples (Holliday, 1997; Ruff et al., 2002), especially concerning the upper limb, and the same seems to hold concerning juvenile individuals.

The bi-iliac breadth/stature ratio (BIB/stature) in Romito 9 is 0.157 (Table 5), the range observed in a sample of 5 MUP immature individuals, older than her (13–19 years), is 0.138–0.162, Lower Pleistocene KNM-WT 15000, very close in age to Romito 9, at 0.146. Compared to adult individuals, Romito 9 falls in the living African range (0.148–0.174) for BIB/stature and outside living Europeans range (0.160–0.188).

The estimation of stature obviously determines the value of the BIB/stature ratio and different values would be obtained using different formulas or bones. For instance, as *Homo sapiens* juveniles Romito 9 and Sunghir 2 and Lower Pleistocene *Homo ergaster* KNM-WT 15000 have higher crural indexes compared to the recent sample used by Ruff (2007), using the tibia instead of the femur to estimate their stature we would obtain taller stature and hence lower BMIs. On the contrary, as Paglicci 12 and Arene Candide Prince have lower crural indexes than the recent sample, their tibial statures would be lower than femoral ones and hence the BMIs would be higher. However, the differences would not change the general picture: Romito 9 and the five MUP immature individuals show low values for the BIB/stature ratios, the mean of the values of BIB/stature ratios in MUP juveniles (0.147) is nearly identical to the value observed in Lower Pleistocene *Homo ergaster* KNM-WT 15000 (0.146). The BMI of Romito 9 would be 18.0 (Table 7), intermediate between MUP individuals Arene Candide Prince (16.2) and Paglicci 12 (16.9) and Sunghir 2 (19.3) and Enfants 6 (19.5), while the only LUP individual (sub-adult Arene Candide 17) would have a higher BMI (22.0). Comparing the Upper Palaeolithic individuals with modern reference standards for North America, WHO (1995), we see that the fossil individuals are all placed between the 50th and 85th percentiles except Paglicci 12 and Arene Candide Prince who are close to the 15th percentile value. The 12y old Lower Pleistocene individual KNM-WT15000 would have a BMI (19.8) slightly higher than similarly aged MUP individuals.

7. Conclusions

The burial of Romito 9, an 11–12-year-old female individual from southern Italy, exhibits several features in common with European funerary practices dating to ca. 23,000–18,000 cal BP. These include the use of ochre, personal ornamentation, and a flexed burial position, elements also observed in Magdalenian burials in southwestern Europe. Such practices suggest that aspects of the Mid Upper Palaeolithic (MUP), particularly those rooted in the Gravettian funerary tradition, persisted into the post-Gravettian phases, even after the formal end of the culture. In Italy, a marked shift in funerary customs becomes evident after ca. 16,000 cal BP, during the Final Epigravettian. This change has been defined as a transformation in the "aesthetic of death" (Martini and Giacobini, 2024), characterized by the simplification and sobriety of ritual behavior. This trend is especially evident in central and southern Italy, where burial contexts typically lack ochre, personal ornaments, and grave goods. However, regional variation is apparent. In Liguria (e.g., Arene Candide, Grotta dei Fanciulli), some continuity with Gravettian traditions remains visible. In northeastern Italy, engraved stone blocks were incorporated into the burial contexts, as observed at Riparo Villabruna and Riparo Tagliente (Bartolomei et al., 1974; Aimar et al., 1992).

Despite these insights, the funerary record between ca. 18,000 and 16,000 cal BP across Europe remains extremely limited. The current paucity of data precludes the formulation of a robust model for burial practices during this transitional period. This scarcity likely reflects broader demographic dynamics associated with the Last Glacial Maximum (LGM), during which significant depopulation events occurred across mid-latitude regions, particularly in the peri-Alpine zones between 27,000 and 19,000 cal BP (Tallavaara et al., 2015). If funerary behavior is taken as a proxy for population presence and cultural continuity, it is significant that the post Gravettian burials dating back to the LGM peak (23-18,000 cal BP) are concentrated in southern Europe. This suggests that southern refugial zones may have played a crucial role in the maintenance and transmission of symbolic behaviors during and immediately after the LGM.

In terms of biological anthropology, a number of physical traits distinguish Late Upper Palaeolithic (LUP) populations from their Gravettian predecessors, including reductions in dental dimensions, overall stature, and body linearity. In this regard, Romito 9 clearly aligns with the MUP morphological pattern and contrasts with the more gracile individuals from the later Final Epigravettian burials at the same site. Conversely, the few known individuals from the 19,000–18,000 cal BP interval in France and Spain (e.g., El Mirón, Saint-Germain-la-Rivière, Abri Lafaye, Chancelade) already exhibit the reduced stature that typifies LUP groups.

Taken together, the burial context and biological profile of Romito 9 suggest a persistence of MUP cultural and morphological traits into the early phases of the LUP in southern Italy. This continuity may represent a regional resilience of Gravettian traditions within a broader framework of post-LGM cultural transformation.

CRediT authorship contribution statement

F. Martini: Writing – original draft, Writing – review & editing, Conceptualization, Investigation, Resources, Project administration, Funding acquisition. **D. Lo Vetro:** Writing – original draft, Writing – review & editing, Investigation, Resources, Visualization, Conceptualization. **F. Macciardi:** Validation. **L. Calcagnile:** Writing – original draft, Methodology, Resources, Formal analysis, Investigation. **G. Quarta:** Writing – original draft, Methodology, Resources, Formal analysis, Investigation. **G. De Benedetto:** Writing – original draft, Methodology, Resources, Formal analysis, Investigation. **G. Vincenti:** Writing – original draft, Methodology, Resources, Formal analysis, Investigation. **O. Rickards:** Validation. **G. Scorrano:** Validation, Resources, Investigation. **P.F. Fabbri:** Writing – original draft, Writing – review & editing, Methodology, Formal analysis, Investigation, Resources, Visualization, Conceptualization.

Declaration of competing interest

The authors, F. Martini, D. Lo Vetro, F. Macciardi, L. Calcagnile, G. Quarta, G. De Benedetto, G. Vincenti, O. Rickards, G. Scorrano, P. F. Fabbri, declare no conflict of interest.

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Appendix A. Supplementary data

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