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**New human fossil from the latest Pleistocene levels of Grotta Romanelli (Apulia, southern Italy)**

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Abstract  
Grotta Romanelli can be counted among the most interesting sites for the late Upper Palaeolithic of the Mediterranean area, since returned a consistent record of lithic artefacts, faunal remains, mobiliary and parietal art, and human fossils which represent the least-known materials from the context. The resumption of the investigations in 2015, after 40 years of inactivity in the cave, provided relevant results. During the 2019 campaign, a distal phalanx of the hand was recovered in the so-called *terre brune* levels, providing for the first time a clear stratigraphic and chronological reference for the human fossils record of Grotta Romanelli. In addition to morphological description and age estimation, the new finding is here analyzed using 3D Micro-CT scans. The new human fossil confirms the exceptional richness of the paleoanthropological record of Grotta Romanelli, opening new avenues of investigation and posing crucial questions on the use of the cave and cultural practices at the Late Pleistocene-Holocene boundary.

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## 2 New human fossil from the latest Pleistocene levels of Grotta 3 Romanelli (Apulia, southern Italy)

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### AQ1 Abstract

10 Grotta Romanelli can be counted among the most interesting sites for the late Upper Palaeolithic of the Mediterranean area,  
11 since returned a consistent record of lithic artefacts, faunal remains, mobiliary and parietal art, and human fossils which  
12 represent the least-known materials from the context. The resumption of the investigations in 2015, after 40 years of inactivity  
13 in the cave, provided relevant results. During the 2019 campaign, a distal phalanx of the hand was recovered in the so-called  
14 *terre brune* levels, providing for the first time a clear stratigraphic and chronological reference for the human fossils record  
15 of Grotta Romanelli. In addition to morphological description and age estimation, the new finding is here analyzed using  
16 3D Micro-CT scans. The new human fossil confirms the exceptional richness of the paleoanthropological record of Grotta  
17 Romanelli, opening new avenues of investigation and posing crucial questions on the use of the cave and cultural practices  
18 at the Late Pleistocene-Holocene boundary.

AQ2 **Keywords** *Homo sapiens* · Distal phalanx of the hand · Morphology · Upper Palaeolithic · Final Epigravettian

### 20 Introduction

21 One of the richest human records in the Italian Peninsula  
22 comes from Grotta Romanelli (GR) (Sardella et al. 2018,  
23 2019; Fig. 1), in the Apulia region (SM 1). This cave has  
24 been excavated since the beginning of 1900 and the paleoan-  
25 thropological record includes three burials, cranial remains,  
26 mandibles, isolated teeth, and postcranial elements (SM 2  
27 and 2.1). After 40 years from the latest campaign, in 2015,

new fieldwork and excavations started in the site, thanks to 28  
a project supported by Sapienza University of Rome. During 29  
the new excavations, a human bone was found in the upper 30  
part of the sedimentary succession, generally known as *terre 31*  
*brune*. This new human finding, a distal phalanx of the hand, 32  
has been studied through the use of Micro-CT imaging and 33  
is here described together with its stratigraphic context and 34  
a chronological assessment (SM 2.2 and 2.3). 35

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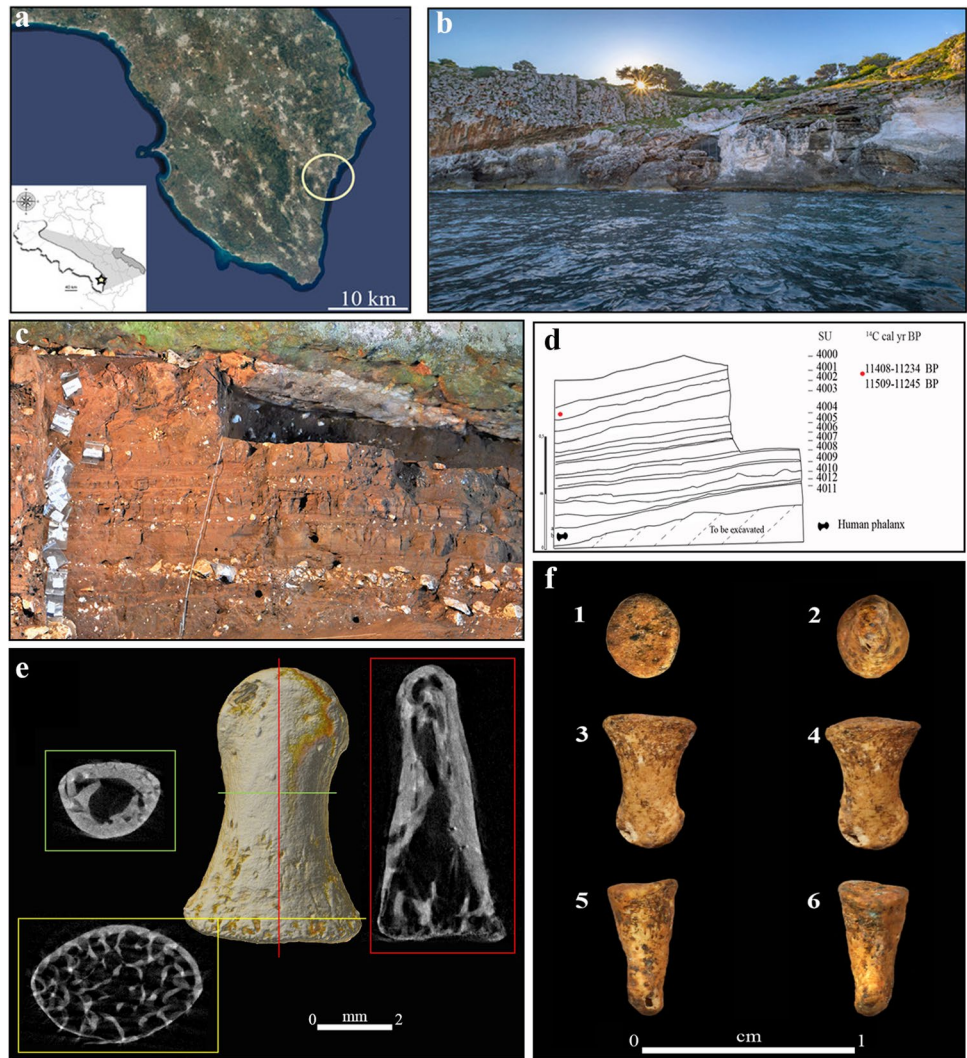
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**Fig. 1** Geographic position of Grotta Romanelli (a); photo of the Romanelli bay (b, modified from Forti et al. 2020); sedimentary succession of SS3 (c) and its stratigraphic log (d). Superior view of the digital model of the human phalanx RR1127 (center), reconstructed from microCT-scan. In different colors are reported two coronal sections, one near the distal end (upper left, green) and the other at the proximal end (lower left, yellow). In red is reported a mid-sagittal section (right) (e). RR1127 from Grotta Romanelli (f) in proximal (f1), distal (f2), anterior (f3), dorsal (f4), lateral (f5), and medial (f6) views



36 **The new human remain from Grotta Romanelli**  
 37

38 The distal phalanx of the hand, labeled with the catalog  
 39 number RR1127, was found during the 2019 fieldwork  
 40 activities and it is temporarily housed in the PaleoFac-  
 41 tory Laboratory, Department of Earth Sciences, Sapienza,  
 42 University of Rome.

43 RR1127 (Fig. 1) is a small tubular extremity bone from  
 44 a human individual. The specimen is almost complete,  
 45 missing a portion of the distal portion (1 × 1.5 mm). The  
 46 maximum length of the fragment, from the double proxi-  
 47 mal facet up to opposite tip, is 7.8 mm (Table 1).

48 The phalanx is flattened on the palmar surface and  
 49 rounded dorsally, showing a D-shaped appearance in the  
 50 cross-section of the shaft. This morphology character-  
 51 izes it as a hand phalanx. Furthermore, its tapering shape

indicates that the phalanx is a distal one, although lacking 52  
 a hypertrophied ungual tuberosity. 53

The process of fusion between distal epiphyses of phalan- 54  
 ges and the shafts starts around 13.5 years old in females and 55  
 16 years old in males (Schaefer et al. 2009). On the proximal 56  
 facet, signs of bony activity that may suggest the start or the 57

**Table 1** Measurements of RR1127 from Grotta Romanelli

Measurements	mm
Maximum length (ML)	7.8
Midshaft breadth (MB)	2.8
Midshaft height (MH)	2
Proximal breadth (PB)	4.5
Distal breadth (DB)	3.3
Distal height (DH)	2
Proximal height (PH)	3.5

continuing of the processes of epiphyseal fusion are not visible. In Fig. 1 (yellow box), where it is reported the coronal section of the proximal end, it is evident the starting of that process, called billowing (White et al. 2011). This evidence, very common on the epiphyses of sub-adults, is characterized by an undulated surface. Even if the billowing is not visible on the proximal articular surface of the specimen (Fig. 1), the beginning of this process is well detachable from the inner view.

Given the juvenile age of the individual, it is not possible to distinguish to which finger it belongs. As well, any degenerative process of the joint is not noticeable. In addition, the phalanx does not show any concavity or marked bony characteristics related to stress. This evidence allows classifying the individual as a sub-adult. The possible young age is further corroborated by the lack of a well-developed ungual tuberosity.

In literature, most of the analyzed findings of fossil phalanges are from adult individuals (for a complete review of the specimens, see Lorenzo et al. 2015). A comparison with modern cases of human sub-adults (Gaskin et al. 2011) suggests that the individual belongs to the group of children (3–12 years old, following age subdivision in Buikstra and Ubelaker 1994).

## Discussion and conclusion

The juvenile distal phalanx of the hand here described is the first human remain from GR, precisely contextualized *in-situ*, that is chronologically attributed to the final Late Pleistocene (for a complete review of the human fossil record from GR, see Supplementary Materials 2.1). In fact, the stratigraphic provenance and chronology of the human fossils collected in the first half of 1900 during the excavations by Gian Alberto Blanc (Blanc 1920, 1928) are still poorly constrained. Other human materials recovered by Paolo Emilio Stasi in the early years of 1900 (Stasi and Regalia 1904) are shrouded by even more uncertainty.

Therefore, the newly discovered human phalanx RR1127 confirms that human frequentation occurred in the cave in the latest Pleistocene levels, between 13,886–13,589 and 11,319–11,188 cal. years BP. However, SS3 succession, which enclosed the human finding, is characterized by several erosional surfaces, like that recognized at the base of SU 4011 and sedimentary structures (i.e., SU 4011a), that suggest the presence of runoff processes within the cave (SM 4). Taphonomic and stratigraphical analyses show the impact of water flows in the deposition of fossils within the sedimentary succession in the cave, especially during the formation of the *terre brune* deposit (SM 2.3 and 4). This may explain why the RR1127 was found isolated and disarticulated in the inner chamber of GR.

From a social perspective (SM 5), RR1127 suggests that the access to the cave was probably not limited upon an age-based distinction of the members of the human group and fixes new research questions for the future: (i) Was GR used as a burial ground? (ii) Did the use of the cave change over time, i.e., from a living area to a burial ground or *vice versa*? (iii) What was the role of young individuals in the Upper Paleolithic societies, since the consistent number of juvenile individuals in late Upper Paleolithic burials? (iv) Is there any specific area of GR where people were laid down or buried? (v) Is there any specific association between the human remains and the parietal art in GR?

The discovery of a human bone during the new excavation campaigns confirms the richness of the paleoanthropological heritage of GR and reveals that is paramount to conduct further research in this renowned site, where much has yet to be discovered. New human findings from GR can add crucial elements in the contextualization of the human occupation of the cave and its use. The detailed and thorough contextualization of new findings (i.e., mineralogical, isotopic and paleobotanical analyses, study of vertebrate remains, lithic artefacts, and mobiliary art) can enrich the knowledge on the European-western Asian Late Pleistocene framework. In the future, historical collections from GR should be revised to better define their morphological and biometric variability, their stratigraphic provenance (if possible), the exact number of the remains for each level (as defined by Blanc 1920), the ration of adult and juvenile individuals, and, in the case of burials, the demography.

Last, the RR1127 human phalanx shows how even a small finding may determine a new push in the research by opening new questions and provide important information in the understanding of an overlooked site.

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