



## The last cave lion of the late Upper Palaeolithic: The engraved feline of Grotta Romanelli (southern Italy)

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### ABSTRACT

On the occasion of the review of the portable art of Grotta Romanelli, a decorated stone with a feline figure was object of an interdisciplinary study. The analysis considered different approaches so to: characterise the stratigraphic setting of the finding, the rock support, look into the techniques used to decorate the stone, elaborate a graphic documentation (photographs, 3D models and tracings), relate the symbolic production with the environmental context, and consider the motifs into the wider late Upper Palaeolithic (LUP) art production.

The work allows confirming that the represented subject corresponds to a *Panthera spelaea*, and fixing some issues concerning the variability of the decorating activity, which is in line with the graphic tradition of the European LUP. Style and formal variable features of the figure might have responded to specific social conventions or to single author's skills, tracing new investigation lines about the cultural behaviour and the decorating activity: from the collection of the raw material and the preliminary modelling of the support, to the different artistic techniques (engraving and painting), from the use of the object to the definition of possible local artistic variations and/or inspiration at large scale. Moreover, it questions the thematic aspect in relation to the local fauna and its influence in the symbolic production, highlighting the importance of this stone in the wider debate about the extinction of the cave lions. Indeed, the Romanelli lion may represent the last evidence of this animal in Europe.

### 1. Introduction

The European cave lion (*Panthera spelaea*) can be considered one of the largest felid ever existed and its key ecological role as apex predator in the Mammoth Steppe trophic chain, often hunting even larger preys, among which horse (*Equus ferus*), red deer (*Cervus elaphus*), reindeer (*Rangifer tarandus*), giant deer (*Megaloceros giganteus*), and others including occasionally young woolly rhino (*Coelodonta antiquitatis*) and

young mammoth (*Mammuthus primigenius*) (Sotnikova and Nikolskiy, 2006; Stuart and Lister, 2011).

During the Late Pleistocene, this animal was present on a wide area over the European continent, coming often in contact with hominids, competing for resources within a shared territory. These contacts strongly influenced the cultural behaviour and the symbolic production of the human societies, collecting lion canines to be used as pendants, and representing the animal in parietal and portable art production of

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the Upper Palaeolithic societies (Masseti and Mazza, 2013; Stuart and Lister, 2011).

Animal depictions in the European Palaeolithic art are mainly characterised by the greater presence of equids (horses), bovids (bison, aurochs and goats) and cervids (male and female), with other animal taxa which are less represented (Delporte, 1990; Lorblanchet, 1995; Paillet, 2017). In this context, of more scarce presence are proboscideans, suids, birds, fish, leporids and carnivores. The latter belong to the order Carnivora, which includes the suborder Feliformia (feliforms), and within these families of Ursidae (bears or ursids), Phocidae (seals), Mustelidae (mustelids), Felidae (felids), Canidae (canids) and Hyaenidae (hyaenas).

Felid figures are between 2 and 2.5% of the total number of animal depictions in Palaeolithic art, and are identified with certainty in at least 202 representations mainly in France, with a small number (around 10%) in Germany, Spain, Czech Republic, Italy, Romania and Russia (Barrière, 1993; Clottes and Azéma, 2005; Fritz et al., 2011; Nougier and Robert, 1965; Rousseau, 1967). The portable and parietal images of felids are ascribed to the entire Upper Palaeolithic cycle, though most of them are mostly numerically concentrated in sites from ancient chronologies, Aurignacian-Gravettian: over 50% of the total number of figures are found in Chauvet cave (Clottes and Azéma, 2005), and around 12% at Roucadour (Lorblanchet, 2010). The unique piece of the lion-man from Hohlenstein-Stadel (Hahn, 1986) is from these times.

During the Western Europe Magdalenian, felid representations, especially lion, are more common in the portable art than in the parietal art. According to Fritz et al. (2011), 38 examples are in the portable art, and 14 in the parietal art, and the majority would come from La Marche cave (Pales and Tassin de Saint Péreuse, 1969). In the Epigravettian Italy, feline representations are on portable supports at: Tagliente shelter within a burial dated to  $13,190 \pm 90$  BP ( $16,126\text{--}15,571$  cal BP) (Guerreschi, 2005), and Grotta Romanelli from the uppermost part of the stratigraphic successions (specifically layer C *inf.* or lower *sensu* Acanfora, 1967) whose chronology is comprised between  $10,295 \pm 75$  BP ( $12,471\text{--}11,820$  cal BP) and  $9,790 \pm 80$  BP ( $11,402\text{--}11,067$  cal BP) (Sigari et al., 2021). This latter is the subject of this work and will be further described in detail.

Despite the scarcity of lion figures in the Palaeolithic art, the representation of this animal informs about its ethology (in few cases represented while preying e.g., Chauvet, or running e.g., La Vache) and provides important details about its body, some of which would not otherwise be inferred from skeletal evidence (absence of mane, long tail with quiff, sexual dimorphism, primordial pouch and claws). Moreover, their presence or absence poses crucial questions linked to their existence in the place and in the time of their representation, to the environmental influence in the symbolic production, and to the economic and cultural value attributed to this animal, as the extreme rarity of bone remains in the archaeological sites suggest as well.

According to the literature, the paleontological remains of *P. spelaea* in the late Upper Palaeolithic (LUP) of Italy are very scarce and limited to three archaeological sites, i.e. Grotta della Madonna, Grotta all'Onda and Fredian shelter (Masseti and Mazza, 2013), and two palaeontological sites in the Salentine Peninsula have provided lion bones as well, Grotta delle Tre Porte and Fondo Cattie (Mecozzi et al., 2021a).

Therefore, the review of the only known feline figure found in Grotta Romanelli finally provides not only a reassessment of the symbolic production of Grotta Romanelli considering the raw material procurement, the art techniques, the use of the decorated stones made by the LUP societies, and the feline theme in the LUP art of Italy and Europe, considering the figurative style as a chronological and cultural factor. It further casts lights onto the relationship humans-carnivores in this cave as already emerged in other works (Sardella et al., 2014; Mecozzi et al., 2021b). Moreover, the presence of a feline figure invites to investigate over the last evidence of lions along the Italian Peninsula, and so the influence of the local environment in the imagery, and the role played by felines in the cultural-economic system of the LUP societies.

## 2. Grotta Romanelli

### 2.1. Site setting and history of studies

Grotta Romanelli ( $40^{\circ}00'58''\text{N}$ ,  $18^{\circ}26'01''\text{E}$ ) is a coastal cave facing the sea along the coast of the Ionian Sea in the Salentine Peninsula (Fig. 1). The geology of the area is characterised by the presence of Jurassic to Cretaceous limestones/dolostones of the Apulia carbonate platform up to Quaternary marine and continental sediments. Along the coastline in which Grotta Romanelli opens, the main outcrops of limestone, breccia and calcarenite rocks are referred from Upper Cretaceous to the Early Pleistocene (Altamura Formation, Torre Tiggiano Limestone, Castro Limestone, Porto Badisco Calcarenite, Andrano Calcarenite and Gravina Calcarenite Units) (Bosellini et al., 1999; Ricchetti and Ciaranfi, 2013). Most of the cliffs along the coast are modelled on the Castro Limestone (Upper Oligocene) (Fig. 1) made of a reef to backreef succession of calcarenites and calcirudites with clumps of corals, algae, macro foraminifers and bivalves. The limestone is stratified with clinoforms up to  $30^{\circ}$  dip. The Castro Limestone is unconformable over the Upper Cretaceous limestone sequence of Altamura Formation (Bosellini et al., 1999; Pomar et al., 2014) (Fig. 1) that locally outcrop along the coast as in the case of the Romanelli bay where Grotta Romanelli opens at 7.4 m a.s.l. (Forti et al., 2020) (Fig. 1). Grotta Romanelli is therefore modelled in coarse bioclastic calcarenite-calcirudite with fragments of rudists, corals, bryozoans, calcareous algae and large foraminifera, including orbitoids [Ciolo member of Altamura Formation (Parente, 1994; Schlüter et al., 2008; Ricchetti and Ciaranfi, 2013)] (Fig. 1). The geomorphological modelling and the relationships between cave formation and evolution within the climatic and environmental changes occurred during the Quaternary are represented by the marine and the slope deposits outcropping along the cliff (Pieruccini et al., 2022) (Fig. 1).

The cave is 11.5 m in width and 9 m in height and its inner space can be divided into two main sections: the collapsed chamber (CC), with large boulders litter the floor clearly witnessing the ceiling collapse, and the inner chamber (IC). The boundary between the two parts is marked by a step-like vertical surface of the vault, called the “pediment” (Fig. 2).

Moreover, the cave preserves a sedimentary infilling that in great part has been excavated in the past (Pieruccini et al., 2022). At the time of its discovery and first recording, the cave appeared as fully filled by the sediment impeding any investigation that started only 26 years later (Botti, 1874; Sigari and Sardella, 2018). Since the earliest studies carried out by Stasi and Regalia (1904), the deposit has been removed, up leaving the portion still in place in the IC (Fig. 2). The archaeological and paleontological findings as well as the overall stratigraphic meaning of the sedimentary filling witness a long history of the cave, including human frequentation making it, since the first investigations, a unique study-case for the Mediterranean Late Pleistocene (Blanc, 1920). However, the chronology and the litho- and morpho-stratigraphic setting has been recently reassessed revealing a much older age for the beginning of the sedimentary and archaeological record that span from Middle Pleistocene to the Holocene (Pieruccini et al., 2022).

### 2.2. The deposit: stratigraphy, chronology and archaeology

#### 2.2.1. Stratigraphy and chronology

The overall stratigraphic setting of the succession infilling Grotta Romanelli is made of 5 major stratigraphic units, namely from bottom to top ISU1, 2, 3, 4 and 5 (Inner Stratigraphic Units, Pieruccini et al., 2022, Fig. 3). The lowermost unit (ISU1) is mainly made of polygenic rounded to subrounded gravels, pebbles and cobbles with minor coarse sands of marine origin highlighting the sea level highstand that entered the cave modelling marine notches. Unconformably on top, there are monogenic cemented to strongly packed, roughly layered angular to subangular gravels deriving from the degradation of roof and walls eventually reworked over short distance within the cave (ISU2) dated to the Middle



**Fig. 1.** A) Location of Grotta Romanelli and the geological context (after Bosellini et al., 1999, modified); B) view over the Romanelli bay and the cave entrance (red arrow); C) line drawing of the main lithological and Pleistocene deposits outcrop neighbouring Grotta Romanelli (after Pieruccini et al., 2022, modified) (elaboration: L. Forti).

Pleistocene by means of U/Th datings (Pieruccini et al., 2022). ISU3 [formerly Layer G of Blanc (1920) or *Terre Rosse*] is unconformable on top of ISU2 and it is made of reddish finer-grained sediments, made of layered and laminated silts, clays and sands with scattered angular limestone fragments. The fine-grained fraction was flushed into the cave from the external and redistributed over short distance by means of laminar flows. This Unit, bearing olive pollen (Russo Ermolli et al., 2021), is attributed to the Last Interglacial. ISU3 is buried in the middle portion of the cave by ISU4, a roofspall with large unaccommodated blocks that is pre-dated of 74 ka, the age of the flowstone covering the unit (Pieruccini et al., 2022). The uppermost unit of the succession is ISU5 [formerly layers A-E of Blanc (1920) or *Terre brune*], made of brownish to yellowish thinly layered and laminated sands, silts and clays with different amount of autochthonous gravelly limestone fragments indicating an external provenance for the sandy and finer fraction and their deposition by laminar flows. The majority of the portable art objects were found in ISU5, which can be further subdivided into sub-units characterised by different sedimentary facies (Fig. 3) and particularly from ISU5.C. The chronology of ISU5 is constrained between  $11,120 \pm 45$  BP (13,117–12,908 cal BP) and  $8,048 \pm 75$  BP (9,135–8,639 cal BP) (Calcagnile et al., 2019; Sigari et al., 2021) (Fig. 3).

### 2.2.2. The archaeology of the Grotta Romanelli

The archaeological record of the deposits infilling the cave was discovered within ISU2, 3 and 5 that traditionally constituted the so-called “lower” (ISU2, 3) (Piperno, 1974) and “upper” complexes (ISU5) (Pieruccini et al., 2022) (Fig. 3). The record of ISU2 and 3 is attributed to the Middle Palaeolithic, while ISU5 bears rich deposits

attributed to the Upper Palaeolithic with numerous lithic and bone tools, animal bones, human bones and finds linked to an intense symbolic graphic activity, i.e. ochre clumps, hundreds of decorated rock fragments, engraved bones, deer perforated teeth (Bietti, 2003; Blanc, 1939; Fabbri, 1987; Sardella et al., 2018; Stasi and Regalia, 1904). The lithic material counts approximately 10,000 artefacts. According to Bietti (1990: 131) “The tools from Grotta Romanelli are very different from the Final Epigravettian of the northern Adriatic. Characteristic types include small circular and subcircular endscrapers, large truncated blades, and Arenian points. The last (named after *Arene Candide*) resemble some Early Epigravettian foliate points, and one wonders if they would not have been so classified if found in an Early Epigravettian context”. Therefore, the lithic industry falls into the Epigravettian production.

The bone industry is too scarce to provide further information and a complete technological study still lacks.

Three burials were found in the upper part of ISU5, attributed to an adult and two children (Stasi and Regalia, 1904). More isolated human remains were found in the Twenties by Blanc (1920, 1928), and later studied by Fabbri (1987), who described these bones as belonging to a minimum of six adult individuals and six young individuals. Unfortunately, very few remains could be attributed to the ISU5\_C, whereas the majority are of uncertain stratigraphic context. A distal phalanx of a child hand was unearthed during the latest excavation activities, finally providing a more precise chronological reference, i.e. between  $11,829 \pm 80$  BP and  $9,822 \pm 45$  BP, as well for the human remains within the cave (Mecozzi et al., 2022).

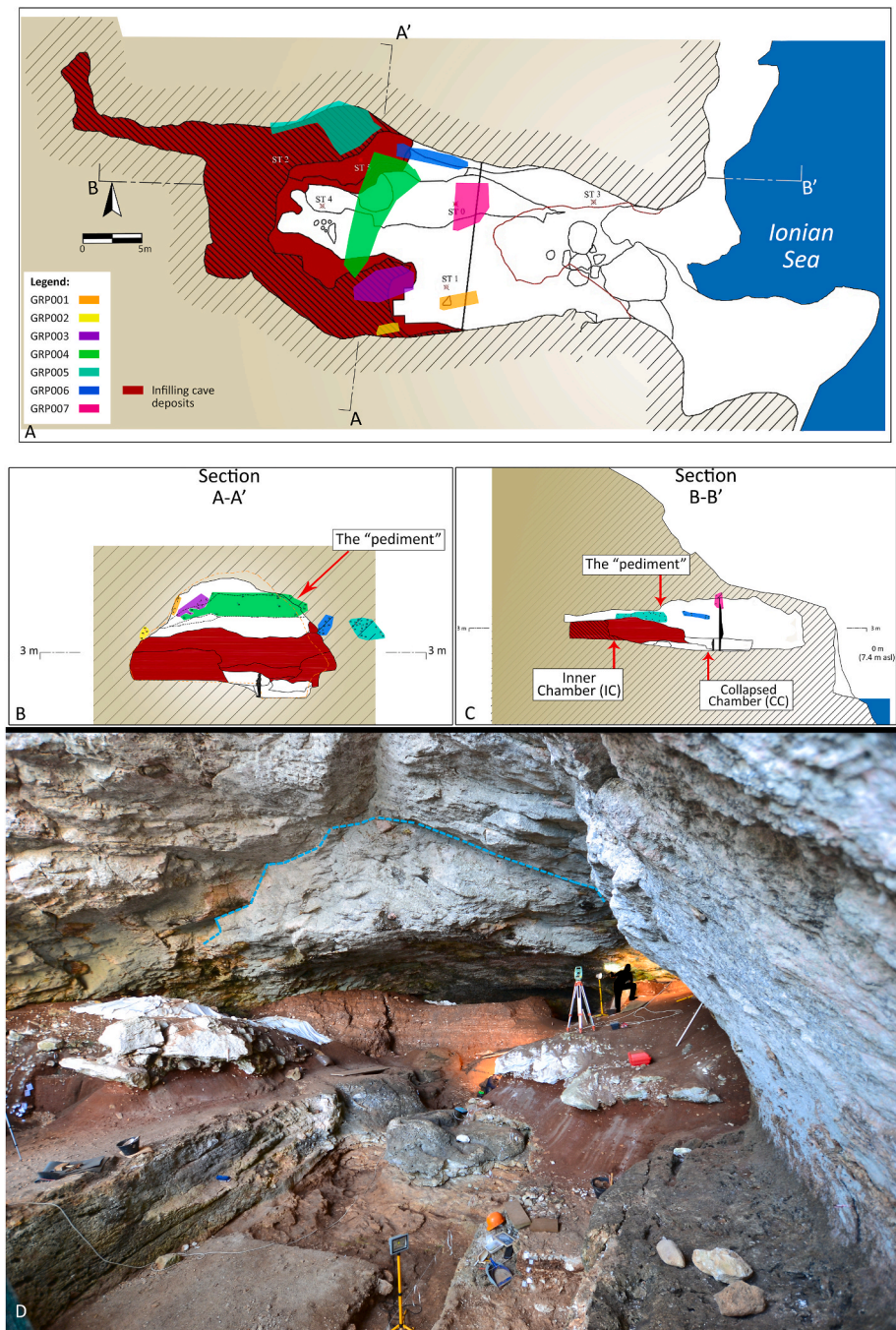


Fig. 2. A–C) Planimetry and sections of GR with the indication of the inner and collapsed chambers and the “pediment”. The parietal art areas are highlighted by different colours, and in red is the infilling deposit (after Sigari et al., 2021; Sigari, 2022, modified); D) panoramic view of the inner cave space, marking the upper limit of the “pediment” (light blue dashed-line) (photograph: L. Forti).

### 2.3. The palaeoenvironment around Grotta Romanelli

The faunal assemblage of ISU5 was characterised by both temperate species adapted to steppes and grasslands and cold species, with even North-Atlantic and subarctic species, that crossed the plain emerged in front of the cave during a phase of marine lowstand (Cassoli et al., 1979). The faunal record is composed of more than 50,000 animal bone remains with approximately 32,000 belonging to 109 bird species. Temperate species are dominant for both mammals and birds. Among the latter there are: little bustard (*Tetrax tetrax*), great bustard (*Otis tarda*), rock dove (*Columba livia*), great cormorant (*Phalacrocorax carbo*), mallard (*Anas platyrhynchos*), hawks and cranes. The mammal faunal

assemblage is composed by: red deer (*Cervus elaphus*), red fox (*Vulpes vulpes*), and auroch (*Bos primigenius*). Less frequent are wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*). Hare (*Lepus europaeus*) significantly present as well. More carnivores are represented by wild cat (*Felis silvestris*), badger (*Meles meles*), wolf (*Canis lupus*), the extremely rare marten (*Martes martes*) and lynx (*Lynx* sp.). Other scarcely identified animals are alpine marmot (*Marmota marmota*), monk seal (*Monachus monachus*) and dolphin (*Delphinus delphis*) (Cassoli and Tagliacozzo, 1997; Tagliacozzo, 2003).

The onset of a cold climate phase is suggested by the occurrence of cold species e.g., wild ass (*Equus hydruntinus*), and North-Atlantic to subarctic bird species e.g., rough-legged buzzard (*Buteo lagopus*) and the

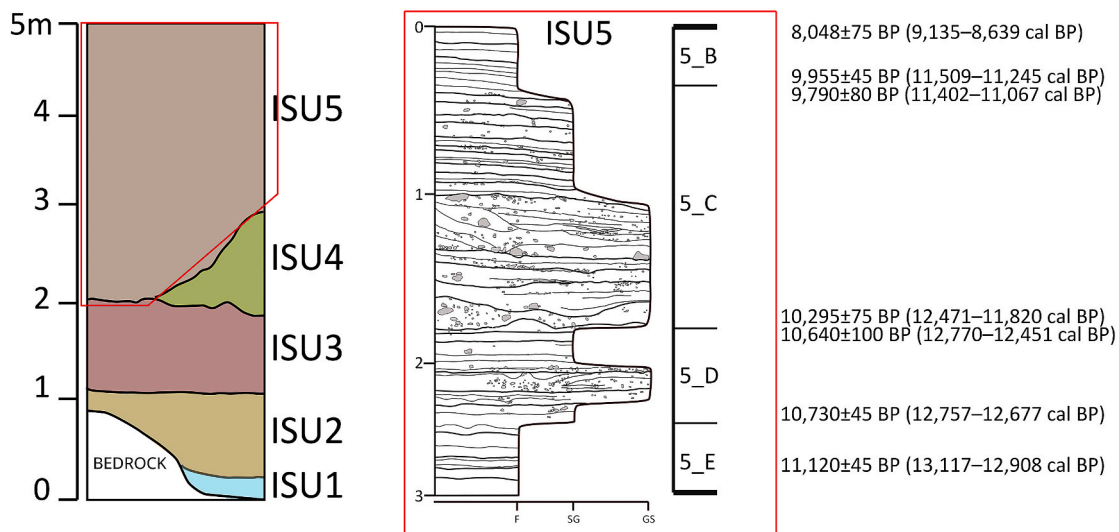


Fig. 3. Stratigraphical sketch of the sedimentary succession of Grotta Romanelli. To the left (after Pieruccini et al., 2022, modified), the stratigraphical units. To the right, detail of ISU5 (F – fine-grained, silty-clayey sediments (elaboration: P. Pieruccini); SG Sands and gravels with minor fines; GS gravels and sands with minor fines). ISU5 subunits (E-B) are defined according to different sedimentary facies.

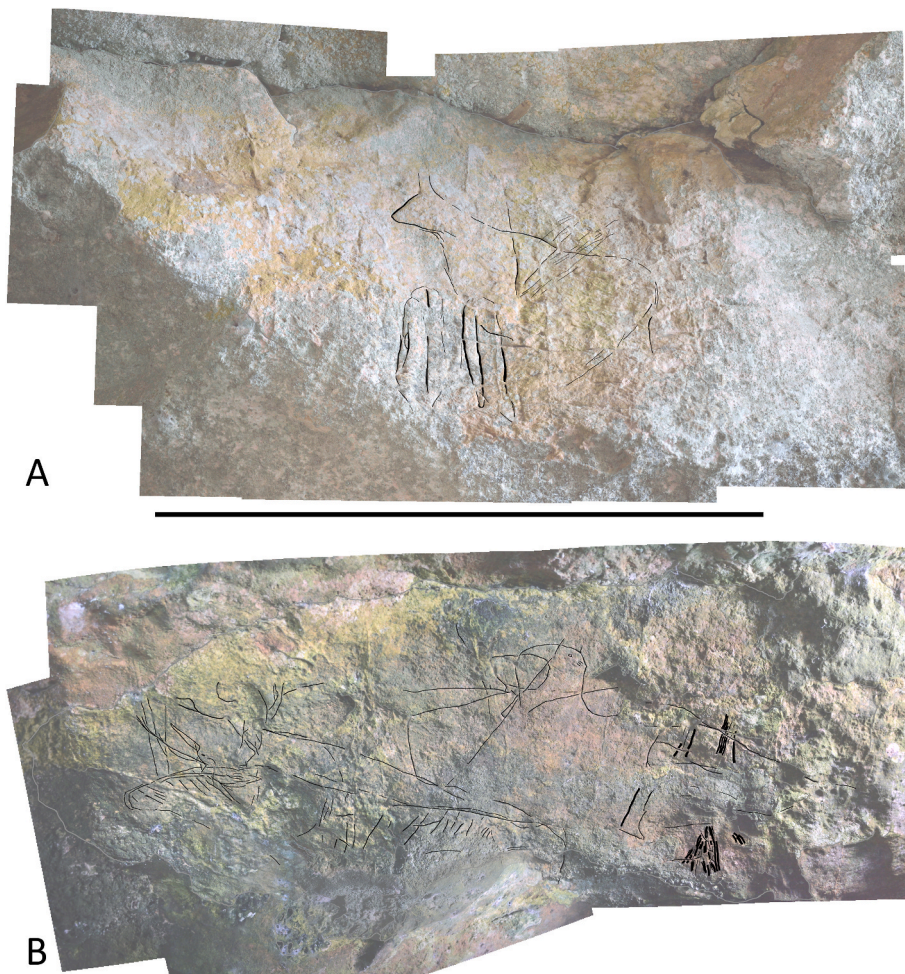


Fig. 4. A) The most known zoomorph of Grotta Romanelli of the panel GRP006-A, that was initially interpreted as a bovid (Graziosi, 1933; Regalia, 1905; Stasi, 1905) and recently reviewed as a cervid in Sigari (2022), and a series of linear signs; B) the panel GRP005-F with an auk and a bovid figure (after Sigari et al., 2021, modified).

most known great auk (*Pinguinus impennis*) (Cassoli and Tagliacozzo, 1997; Tagliacozzo, 2003).

The vegetation around the cave was typical of an open environment with Mediterranean, mesophilus and riparian arboreal elements dominated by herbs over trees and shrubs (Russo Ermolli et al., 2021).

## 2.4. The symbolic production

### 2.4.1. Parietal art

The presence of art in Grotta Romanelli was reported for the first time in 1905, after the discovery of two engraved panels on the northern wall of the main chamber (Stasi, 1905).

According to the literature the parietal art ensemble was concentrated in the collapsed chamber (see Fig. 2-C) and was characterised by the presence of oval and fusiform figures linear marks, and a semi-naturalistic bovid figure recently reinterpreted as a cervid (Fig. 4A) (Battaglia, 1935; Blanc, 1928; Graziosi, 1932, 1933, 1956, 1973; Sigari, 2022; Sigari et al., 2021; Stasi, 1905).

At the beginning of the new millennium, new publications claimed the presence of further engravings although without reporting their precise locations: Mussi and De Marco (2008) described a possible female silhouette and a bovid figure in the IC of the cave, and Ciccacese (2000) reported a further bovid and the “lost” deer figures.

New investigations on the wall engravings led to identify more figures, confirming the extension of the decorated area to the inner

chamber as well (see Fig. 2A–C, the parietal art areas are differently coloured in the planimetry and sections). Here, in two opposed areas, GRP002 and GRP005 (see Fig. 2A and B), four panels showed the presence of animal figures (bovid and bird), geometric signs and finger flutings (Sigari, 2022; Sigari et al., 2021) (Fig. 4).

### 2.4.2. Portable art

Several examples of portable art on bone and stone (including supposed engraved fragments from the ceiling and the walls of the cave) were recovered from ISU5. However, a limited part of this record has been published so far. Out of c. 200, only 110 engraved rock fragments were studied and all decorated bones were excluded (Acanfora, 1967).

The review undertaken within the framework of the project ‘Dec.O. - Decorated Objects of Romanelli Cave, a key site of the Late Pleistocene-Early Holocene Mediterranean’, funded by the Fyssen Foundation, reconsidered the whole record leading to the identification of 213 objects, of which 186 are on stone and 27 on bone (Sigari, 2023).

Most of the portable art finds are on stone and engraved. The engravings may have been executed using a range of tools, as witnessed by the scratched grooves whose depth and width reveal the choice of the best tool and gesture according to the support characteristics. The figurative motifs are the minority and primarily portray zoomorphs, i.e. bovid (2), unidentifiable animals (2), horse (1), feline (1), boar (1), deer (1) and a probable wolf (1) (Fig. 5). An anthropomorphic figure was recently recognised as well as. Conversely, non-figurative motifs are the

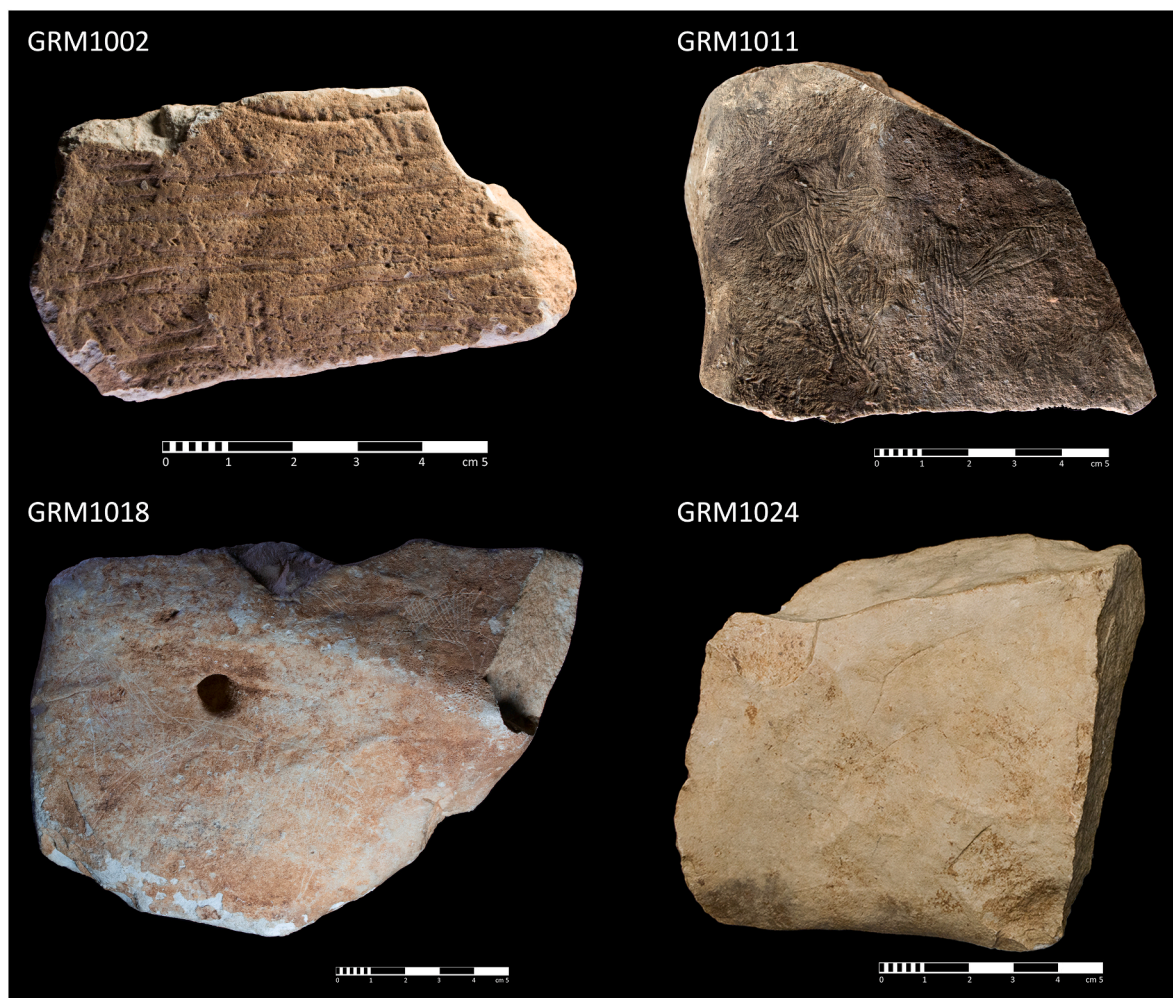


Fig. 5. Selection of decorated stones from the old excavations of Grotta Romanelli: GRM1002 is a flat rock fragment with a geometric composition; GRM1011 is a stone with an animal (a wolf?) engraved; the stone GRM1018 has two herbivores (a horse and a female deer); and a boar decorates the GRM1024 (photographs: D. Sigari).

most recurrent themes with fringed-like rectangles, meanders, ladder-forms and composition of signs, or series of parallel strips.

Numerous finds are broken so that the graphic units (GU) on them are incomplete. Although the intentionality of the fracture remains an open question, none of the decorated stones seem to be a fragment of a decorated vault. Nevertheless, the petrographic characterisation of the stones supports their selection from the local limestone that is the same formation into which the caves opens, namely the Ciolo member of the Altamura Formation (Forti et al., 2020).

Within this rich record of portable art, worth of attention is the find GRM1023 (named GR44 in Acanfora, 1967) from ISU5\_C, a limestone fragment, now stored in the *Museo delle Civiltà* in Rome, that has three decorated faces with a feline figure on one of them.

### 3. Methods

The review of this portable art piece considered different analysis approaches so to: characterise the rock support, look into the techniques used to decorate the stone, elaborate a graphic documentation (photographs, 3D models, tracings and image processing with *DStretch*), relate the symbolic production with the environmental context, and consider the motifs into the wider LUP art production.

#### 3.1. Tracing

Tracing was digitally done using several photographs taken with different light angles in order to enhance the engraving marks thanks to the cast shades. Moreover, the photographic documentation was processed by using *DStretch* as well as to highlight the reddened areas. Different filters (LDS, LRE, YRD, YRE and YBR), at different scales (12.5, 15 and 20), were useful to better highlight the pigment, whose presence was later confirmed by the spectroscopic analysis.

Tracings permit to identify the themes, to report the techniques of the graphic units and can assess the relative chronology of the decorative motifs.

#### 3.2. Geological characterisation

Geological analyses were performed on the portable art find to gather information about the lithological provenance together with the post depositional and weathering processes. The macroscopic analysis was based on: type of limestone and degree of weathering, texture, shape of the block (i.e. roundness), colour by using the *Munsell Colour Charts* and presence or lack of coatings.

#### 3.3. Microscopy

The engravings were observed using a portable microscope *DinoLite Rack MS36B* to characterise the techniques and the overlapping relationships between the figures. Specific areas were selected so to solidly confirm the relative chronology of the graphic sequence.

#### 3.4. Raman spectroscopy

Due to its intrinsic chemical selectivity and high lateral resolution, micro-Raman Spectroscopy is commonly used in heritage science for the identification of pigments and colorants, providing the signature of the molecular compounds present in the materials from which the pigment is derived.

Raman spectra were collected using a high-resolution *Renishaw inVia Qontor* Raman spectrometer equipped with a Peltier-cooled ( $-70\text{ }^{\circ}\text{C}$ ) NIR-enhanced charge-coupled device (CCD) camera, a *Leica DM2700* microscope, and 785 nm excitation wavelength. The measurements were carried out with a 50x long working distance objective (NA 0.5, theoretical laser spot diameter of  $1.9\text{ }\mu\text{m}$ ) using laser power of 1 mW and acquisition time of 120s per spectrum.

#### 3.5. 3D reconstruction: optical scanner and photogrammetry

High detail model of GRM1023 and its engravings was made using the *Artec Space Spider* structured light optical scanner. The scanner reaches a high level of accuracy (0.05 mm) and, at the same time, allows scanning of object up to 40 cm in length, without posing any danger to the integrity of the scanned specimen.

GRM1023 was carefully placed cloth with an opaque black colour to avoid colour contrasts during scanning. Three scans were made at separate times rotating the rock fragment, capturing the entire find collecting information about its texture and morphology.

The scan session duration was of 10 min and data were saved within the software *Artec Studio 16 Professional*. Through the same software the scans were aligned to create the original morphology of the object in all its parts.

After cleaning the ordinary disturbing elements, the mesh was created, to which the texture was subsequently applied. The final models are constituted by 1.600.000 facets and have been exported in the OBJ file type (Conti et al., 2023).

GRM1023 was also digitised by photogrammetry, using an automated setup to acquire a total of 207 pictures/photos. For this shooting, an automatic turntable (Miops Capsule Pan) was programmed to handle both the rotation of the object and the triggering of the camera. During the scanning, the camera was fixed and the subject was manually repositioned after each orbit of the turntable, for a total of 5 different positions. The process was later repeated by placing the camera at a different height.

The pictures were obtained by using a Nikon D800, a 36 MP full frame sensor digital camera, with a macro lens (*Nikkor AF-S 60 mm Micro f/2.8 G*) and a circular polarizer filter (*Hoya Pro1 Digital Filter*). A ring flash (*Quantum Quadralite RX400*) was used for lighting, paired with a linear polarizer to make best use of cross polarization and avoid unwanted glares and/or reflections that could have undermined the quality of the reconstruction.

The pictures were then processed by using *Agisoft Metashape 1.8.5* that generated the sparse cloud, the final mesh directly from the depth maps, and the texture. The final 3D model has 1,759,728 faces and 879,876 vertices (Fig. 6) (Lai et al., 2023).

### 4. The decorated stone GRM1023 and the feline figure

GRM1023 measures 18.3 cm in length, 15.1 cm in height, and 8.5 cm in width. It has a polyhedral asymmetrical shape with a semi-flat face engraved with the feline figure (Face A). It has a roughness faces in the background (Face B and C) and a lateral sharp fracture that broke the engravings (Fig. 7).

The stone support is made of limestone, specifically a grainstone to wackestone typical of the Upper Cretaceous limestone (Altamura Formation, Ciolo limestone member) into which the cave opens. The dominant colour of the piece is very pale brown (10 YR 8/4) with reddish brown (5 YR 4/4) coatings inherited from the ISU5 sediments that buried the find and locally dark brown (10 YR 3/3) coatings, due to Mn oxides. The degree of roundness of the edges is high, notably along the sides of the block including the fracture. The stone support shows a strong degree of weathering on the surface where carbonate leaching processes led the original lithotype to a friable “chalk-like” aspect. Shape, lithology, and the ‘chalk-like’ weathering indicate that the block derives from mechanical and/or chemical degradation of the cave walls or vault that occurred during the deposition of the ISU5\_C sediments. Moreover, the “chalk-like” consistency and the rounded edges are related to weathering phases that occurred after the fall and are mainly associated to carbonate leaching, due to drip and water run-off. After being engraved GRM1023 was abandoned on the floor and later buried by the almost continuous sedimentation of ISU5. The presence of abundant reddish-brown coatings on the fracture suggests that the fracturing had already occurred before the burial (Fig. 7).

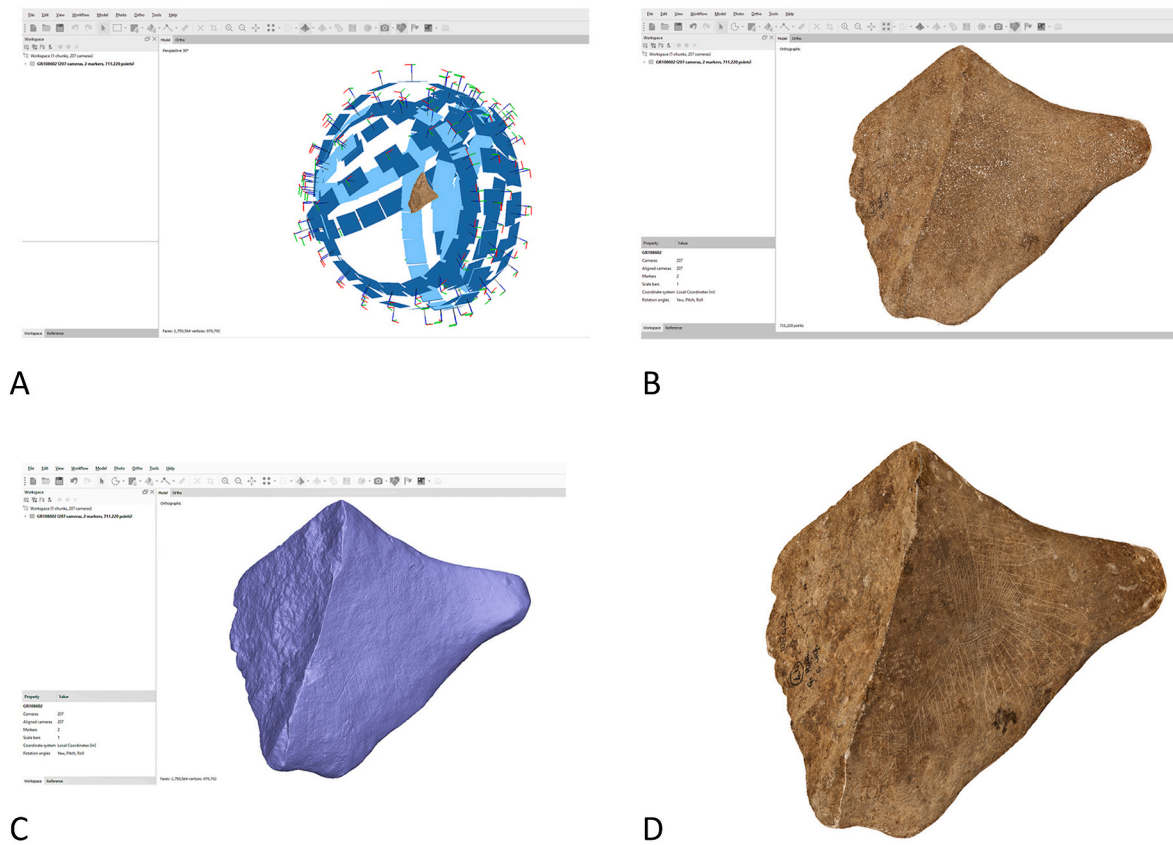


Fig. 6. The photogrammetric model of GRM1023: A) indication of the camera position and the number of taken photographs; B) the sparse cloud; C) the mesh; D) the final model (elaborations; J. Conti and G. Lai).



Fig. 7. The stone GRM1023 and its three decorated faces. From left to right, Face A, B and C (photographs: D. Sigari).

Nowadays, the whole surface is shiny due to the application of polystyrene (a transparent varnish) after its discovery, probably on the occasion of its exposition.

Excluding the fracture surface, GRM1023 has all its three main faces A, B and C engraved:

- Face A (Figs. 8 and 9) is an almost triangular and regularly flat surface. Its whole area is engraved and two graphic units can be recognised:

- 1) GRM1023-1. This is an incomplete animal measuring 12 cm in length and 6.2 cm in height. Despite the fracture of the stone and the consequent loss of the head of the zoomorph, our analysis may confirm the attribution of the engraving to a lion (*Panthera spelaea*). The animal has three limbs with zigzagged claws and their position, together with the tail, which is up, suggests the movement with a clear representation in perspective. The rear part of the animal, the belly, the limbs and the tail are filled with parallel lines. Further secondary details are expressed by the primordial pouch and a zigzag line marking the upper limit of the belly,

**GRM1023**

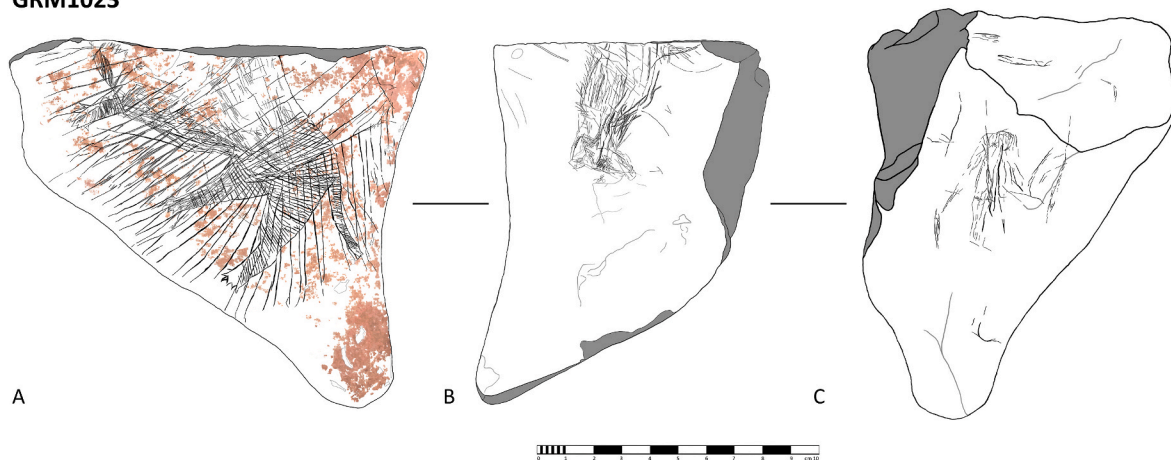


Fig. 8. Tracing of the three decorated faces GRM1023. From left to right, Face A, B and C (tracing: D. Sigari).

**GRM1023-A**

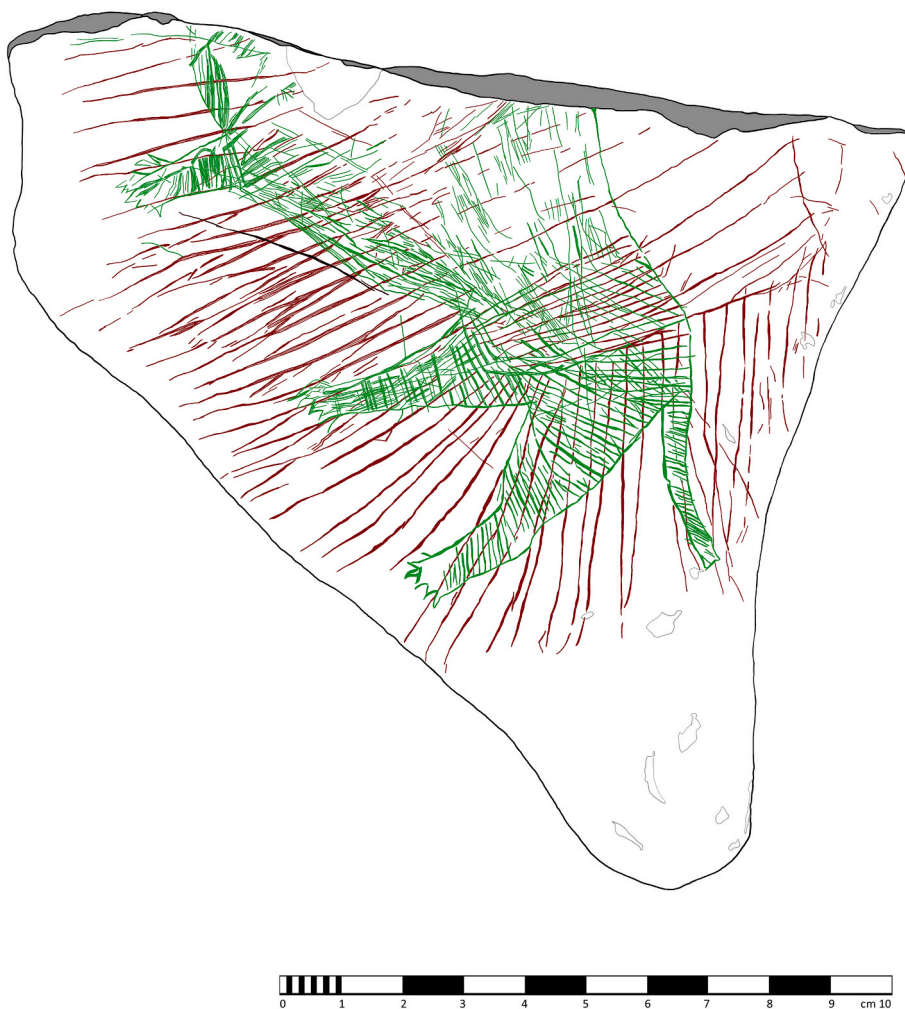
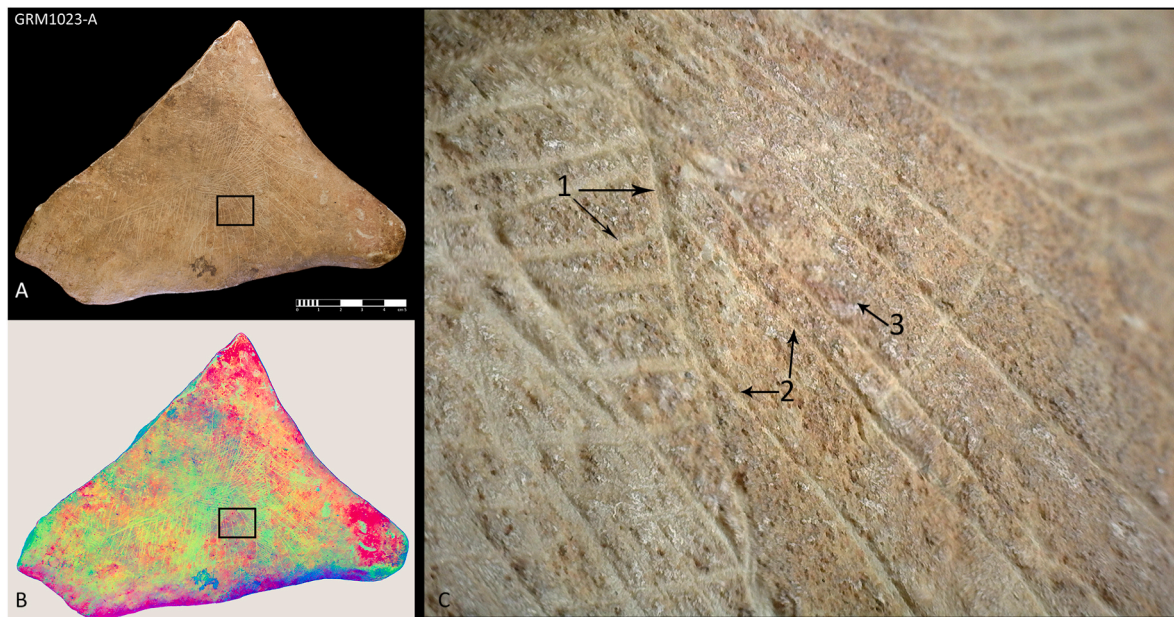


Fig. 9. The engraved face A, with the two graphic units highlighted in red (GRM1023-2) and green (GRM1023-1) (tracing: D. Sigari).

whose inner area is filled with almost horizontal scratchings. The figure is differently scratched as suggested by the engraving marks, highlighting attention to specific parts of the animal body

The figure overlaps GRM1023-2 and it is apparently associated to almost straight lines with radial disposition under the belly and at the rear the animal. Most of the body is engraved by using a thin



**Fig. 10.** A) GRM1023 face A with the indication of the microscopically magnified area in C; B) GRM1023 face A after using DStretch filter YBR at 12.5 scale; C) magnified pictures of the engraved area highlighted in A: 1. are the grooves of the animal GRM1023-1. The arrows indicate both the flat and wide marks used to fill the paw of the lion and the thin and deep mark of the outline; 2. are the thin V-shaped scratching marks of the geometric sign GRM1023-2; 3. reddish residues of pigment. It is evident how the engraving marks of the lion overlap the ones of the geometric sign.

pointed tool which has left a typical V-shaped profile groove. Differently, two limbs, the breast and part of the belly were marked using a large pointed tool, whose groove profile is almost flat with parallel striations inside (Fig. 10). Their location both outside and inside the animal makes their interpretation complex, but we suggest that some of them are related to the animal.

- 2) GRM1023-2 is 12.7 cm long and 11.3 cm high. This graphic unit is a sort of fringed-like rectangle, whose inner area is divided into a number of strips. The sign is incomplete in its lower part due to the fracture of the stone and to the rubbing of the rock surface. The GU was done by using a thin-pointed tool that left thin V-shaped profile grooves.

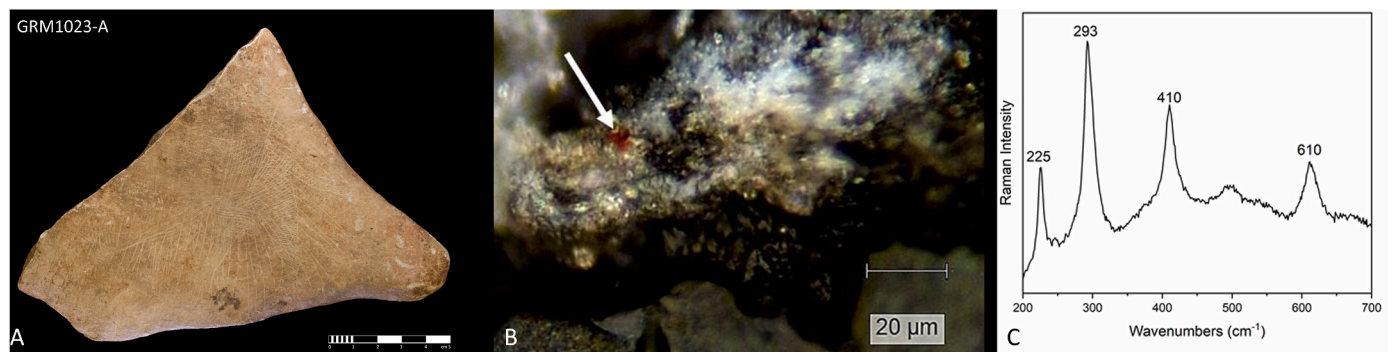
Thanks to *DStretch* it was possible to enhance red spots which are in correspondence of the back of the lion and between the two hindlimbs of the animal, and of two vertexes of this face of the stone (Fig. 10). The most representative Raman spectrum performed on the red spots reveals four main bands at 225, 293, 410 and 610  $\text{cm}^{-1}$  (Fig. 11) typical of hematite ( $\text{Fe}_2\text{O}_3$ ) (Caggiani et al., 2016), an iron oxide used as pigment since antiquities, confirming that this face was painted.

- Face B (Fig. 8) has an almost trapezoidal shape with some irregularities. In the half close to the fracture surface a zoomorphic figure lacking one of the hindlimbs and the bottom is engraved (GRM1023-3). The animal, probably an *E. hydruntinus*, measures 4.8 cm in length and 5.2 cm in height, has short limbs and a thick body filled by numerous lines.
- Face C (Fig. 8) is more irregular than the other faces. A series of straight lines form an unidentifiable motif, GRM1023-4, which is 8.4 cm long and 6.4 cm wide.

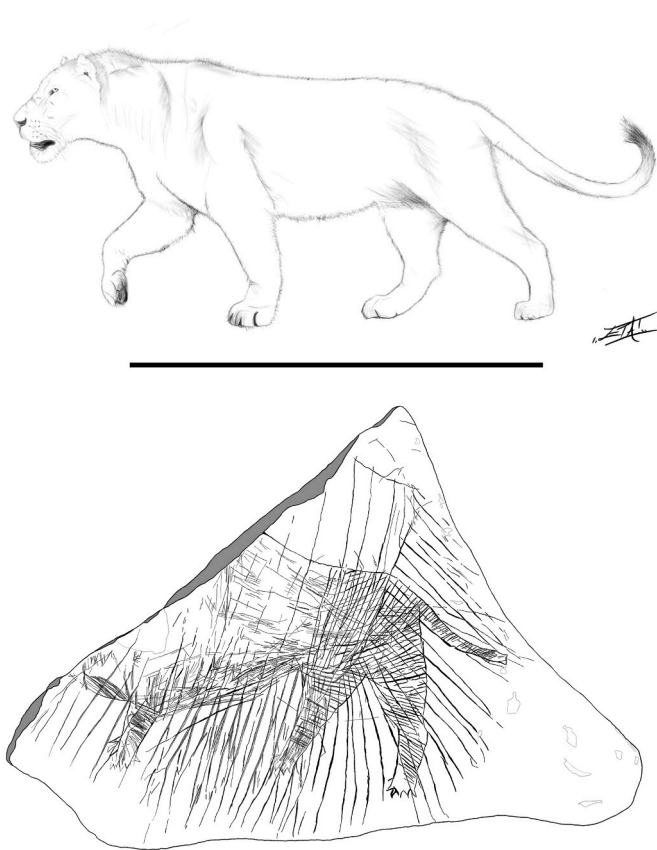
## 5. Discussion

### 5.1. Theme and style

Despite the scarce frequency of felid representations in the Palaeolithic art, i.e. between 2 and 2.5% of the total corpus of Palaeolithic art (Paillet, 2017), and a series of imprecise delineation of the contours and anatomical incompleteness, the study of the Romanelli piece revealed features typical of this family of mammals. Indeed, the general anatomy of the trunk, the claws, the primordial pouch, and the configuration of



**Fig. 11.** A) GRM1023 face A with the indication of the sampled area for the Raman spectroscopy; B) optical microscope image of GRM1023 face A. The Raman spectrum has been acquired on the red particle; C) Raman spectrum acquired in small red particles of sample GRM1023: the characteristic bands of red ochre are present.



**Fig. 12.** Comparing cave lions. Above, reconstructions of *Panthera spelaea* (drawing: Eta!Beta?). Below, tracing of GRM1023 face A with the engraved lion.

the caudal limb and the morphology of the hindquarters in relation to the trunk match with this attribution.

In detail, by considering both chronological data and physical-anatomical details, the specific case of the graphic unit GRM1023-1, despite the absence of the head, witnesses a Pantherinae (pantherine), that can be identified as a cave lion (*Panthera spelaea*) (Fig. 12). Indeed, if the massive body of GRM1023-1 suggests a big feline, the long tail and the absence of elements recalling a spotted fur (it is remarkable the example of Chauvet cave where spotted leopards were painted on the cave walls) lead to exclude any interpretation of either a lynx or a leopard. Furthermore, according to the literature (see: [Diedrich, 2013](#); [Ghezzi and Rook, 2015](#); [Sabot et al., 2017](#)), it should be reminded that the last occurrence of leopards in Western Europe and Italy is not younger than the Last Glacial Maximum. Finally, considering more felids, *Felis silvestris* bones were recognised within palaeontological record of the ISU5.C ([Tagliacozzo, 2003](#)). However, the wildcat has a thick and tubular tail, which is far different from that of GRM1023-1, whose tail is thin and long closer to lion's tail. Therefore, the most plausible interpretation of GRM1023 is that it portrays a *P. spelaea*.

Despite the anatomical parsimony of the Romanelli feline, it is possible to identify, beyond the subject matter, some morpho-stylistic convergences in other assemblages with clearly identifiable lions. For example, the non-fallen position of the tail or its medium-raised position, which finds references in the rock art of Les Combarelles I ([Barrière, 1993](#)), Font-de-Gaume ([Capitan et al., 1910](#)) and Les Trois-Frères ([Bégouën and Breuil, 1958](#); [Bégouën, 2014](#)) dated to the Middle Late Magdalenian, and Lascaux, attributed to the Early Magdalenian or to the Late Solutrean ([Aujoulat, 2004](#)). The same position has also been documented in assemblages of portable art dated to the Late Magdalenian, specifically at La Vache ([Clottes and Delporte, 2004](#)), and to the Middle Magdalenian period at La Marche ([Pales and Tassin de](#)

[Saint Péreuse, 1969](#)) (Fig. 13).

Stylistic links between Grotta Romanelli and La Vache portable art can be identified when considering the infill of some parts of the trunk and/or limbs. A less accentuated infill is identified in more Magdalenian portable art examples such as at La Madeleine ([Tosello, 2003](#)) and Labouiche ([Pales and Tassin de Saint Péreuse, 1969](#)). The infill can also be seen in some older images from Chauvet ([Clottes and Azéma, 2005](#)). The fillings are formal resources, often used to remark anatomical details, and this may explain why it can be recognised in multiple cases.

Another feature that can be compared is the indication of the claws, which, in the case of GRM1023-1, are identified on the two hind paws by means of a zigzagging delineation. This anatomical feature is identified in the rock art of Lascaux ([Aujoulat, 2004](#)), Les Trois-Frères ([Bégouën, 2014](#)), Font-de-Gaume ([Capitan et al., 1910](#)) and possibly Labouiche ([Pales and Tassin de Saint Péreuse, 1969](#)).

The formal and stylistic characteristics of the Romanelli feline with other lion figures fit very well in the general Palaeolithic corpus of feline images. More precisely, the animal GRM1023-1, dated between 12,700 and 11,000 cal BP, fully belongs to the figurative trend that coexists with a wide European tradition of progressive simplification and a tendency towards a simplification and schematisation of the figurative motifs at the end of Palaeolithic. This can be clearly seen in the Iberian peninsula, where the definition of the 5th, or Epipalaeolithic style has been adopted ([Bueno Ramírez et al., 2007](#); [Bueno Ramírez and de Balbín Behrmann, 2021](#); [García-Díez et al., 2021](#); [García-Díez and Cacho Quesada, 2015](#); [García-Díez and Vaquero, 2006](#)), or even in France where the Azilian and the Laborian graphic tradition spread ([Guy, 1993](#); [Naudinot et al., 2017](#); [Paillet et al., 2018](#); [Roussot, 1990](#)).

The analysis of the overlapping relations shows that the lion was done after the GU GRM1023-2, which recalls the painted “hut” of La Mouthe cave ([Rivière, 1897](#)), or some rectangular motifs like the ones of El Buxu, or Murat shelter, suggesting a reuse of the rock fragment. Looking into the LUP art of Italy, it is possible to identify other examples of an animal and a gridform in a very close association, i.e. overimposition, for instance, in Luine (Valcamonica, northern Italy). However, in this case the two fish figures are overlapped by two gridforms ([Sigari and Fossati, 2023](#)) possibly indicating a synchronic intentional composition.

Finally, the vertical lines under the belly of the lion suggest possible association between the two graphic units. However, uncertainties still exist about their exact interpretation: the hair of the belly? The grass into which the feline walks? More fringes of the rectangle GRM1023-2? Radiating grooves like the ones surrounding the so-called “shining bull” of Le Rocher de l’Imperatrice ([Naudinot et al., 2017](#); Fig. 7)?

So, the feline figure of Grotta Romanelli represents a unique case, in both parietal and portable art, of Grotta Romanelli, which is mostly characterised by bovid and deer figures ([Sigari et al., 2023](#)). However, it reminds the variety of figurative themes, which are further enriched by this animal, together with a boar, a penguin and probably a wolf.

## 5.2. The last lions of Italy and their cultural meaning for the LUP societies

The engraved lion GRM1023-1 questions why the animal was represented, and if it was part of the biological landscape into which the human groups, that found shelter in Grotta Romanelli, moved. Indeed, looking into the faunal record, no bones of the same animal have been found so far in GR.

The presence of *P. spelaea* bones dated to the end of Late Pleistocene in southern Europe is very scant ([Fosse et al., 2017](#); [Persico, 2021](#); [Stuart and Lister, 2011](#)). A gap or a degree of uncertainty exists for the record of the last lions in Italy ([Persico, 2021](#); [Russo et al., 2023](#); Fig. 1), due to methodological issues linked to the dates publication (see: [Fosse et al., 2017](#): 110).

Despite no *P. spelaea* remains have been found in GR so far, few and fragmentary bones were unearthed in two more sites of the Salentine peninsula ([Mecozzi et al., 2021a](#)). The fossil remains discovered within



**Fig. 13.** Lion figures in the Palaeolithic art: A) Grotta Romanelli; B) Tagliente shelter; C) Font-de-Gaume cave (Capitan et al., 1910); D) La Marche cave (Pales and Tassin de Saint Péreuse, 1969); E) Lascaux cave Leroi-Gourhan and Allain, 1979; F) La Marche cave (Pales and Tassin de Saint Péreuse, 1969); G) Labouich e cave (Pales and Tassin de Saint Péreuse, 1969); H) La Vache cave Buisson and Delporte, 1988.

the stratigraphic sequence at Grotta delle Tre Porte and Fondo Cattie confirm the presence of the lion in the area around GR roughly in the same stratigraphic and chronological setting of ISU5. Therefore, the lion figure GRM1023-1 might represent the very last evidence of *P. spelaea* – human interaction at the end of the Late Pleistocene in southern Europe, supporting the hypothesis of a decisive influence of the environmental elements in the symbolic production.

How and why lions were represented, i.e. what was the symbolic value of this animal, is a debatable issue. Its archaeological contextualisation and the relations of the theme and its style with other sites offer further reflection and research insights. Unfortunately, the lion representations are very few, and in the Italian Epigravettian record are even less with only two finds: one from the Tagliente shelter (Guerrischi, 2005) and GRM1023 from Romanelli. A third figure, always from Tagliente shelter, was mentioned by (Mezzena 1964: Fig. 3), but it has not been taken into consideration by the following literature anymore. The slightly different chronologies between the two find, together with the strong stylistic divergences suggest different graphic influences. However, the association of the engraved lion of Tagliente shelter with a burial invites us to consider affinities in the symbolic behaviour of the Epigravettian societies, and so to evaluate any potential link between GRM1023 and the human remains found in the LUP deposits (Fabbri, 1987; Mecozzi et al., 2022).

Finally, the engraved support shows evidence of fractures after the

engraving process (clearly identifiable by the absence of the anterior region of the lion). In recent years, evidence of abandonment, fractures and reuses (symbolic and/or functional) of artistic productions have been documented, confirming that the decorated supports have different times and functions of use (López-Calle et al., 2022; Tosello, 2003, 2004). But still, no clear evidence of intentional breaking (i.e. percussion points) is to be seen on the stone.

## 6. Conclusion and further perspectives

The review of GRM1023 allowed fixing some issues concerning the variability of the decorating activity at the end of the Late Pleistocene, which is in line with the graphic tradition of the late Upper Palaeolithic style. The presence of monochrome painting residues confirms the common trend of using red monochromatic pigment, and the different engraving marks confirm the attention paid to specific parts of the animals. Moreover, the diversity of the engraving tools enhances the artistic skills of the person who decorated the object.

The people who lived in Grotta Romanelli collected pebble- and boulder-sized rock fragments fallen down from the cave-roof and walls and produced portable art objects, occasionally reusing the same pieces. The pebbles were entirely decorated according to the natural shape of the stones and, in case of irregularities, even rubbing to “prepare the canvas”. The fragmentary aspect of the stones should not be explained as

the result of a decorated and later broken vault, but as a cultural behaviour or as unintentionally post-decorating breaking off.

Despite the scarcity of lion representations, GRM1023-1 and the engraved figures known from other Italian and European sites suggest a general shared visual heritage of the LUP societies. GRM1023-1 perfectly fits within the late Upper Palaeolithic style, although the combination of details, perspective, rigid forms, and geometric filling make it a unique case, similarly to other figures of the Grotta Romanelli portable art. The differences in style and formal variable features with other sites might be linked to specific social conventions or to single authors. However, further studies with valid comparisons are needed to definitively evaluate possible local artistic variations and/or inspiration at large scale.

Next studies should also consider the use of lion as animal-symbol in ritual contexts, like in the Tagliente shelter, where a stone with an engraved lion was found in association with a burial. The human remains of GR invite reconsidering the potential association with the figurative production, especially with the cave lion.

Finally, the interdisciplinarity of this review remarks the importance of this kind approach in the research as well as a more detailed insight not only into the symbolic value of the felines in the LUP, but also further details in the general debate about the extinction of the cave lion in Europe, possibly witnessing the last depiction of this animal and also its last evidence before its disappearance.

#### Credit author statement

All authors contributed substantially to the research here presented and to the paper, and they all approved the final version of the manuscript. In particular, the authors contributed to the following parts: Conceptualisation (DS), Methodology (DS, CB, CC, JC, LF, GL, MGD, IM, PP), Investigation (DS, CB, CC, LF, MGD, IM, PP, RS), Formal analysis (DS, CC, JC, LF, GL, IM, PP), Writing – original draft (DS, CC, JC, LF, GL, MGD, IM, PP, RS), Writing – review & editing (DS, CB, CC, JC, LF, GL, MGD, IM, PP, RS), Visualisation (DS, JC, LF, GL, MGD, PP), Supervision (DS, CB, LF, MGD, IM, PP, RS).

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

Data will be made available on request.

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