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ORIGINI

PREHISTORY AND PROTOHISTORY OF ANCIENT CIVILIZATIONS

XXXIX
2016

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THE FONDARCA CAVE AND CAVITIES USED AS A CULT PLACE DURING THE BRONZE AGE IN CENTRAL ITALY

Gian Maria Di Nocera*

With contributions by: Giorgia Agresti, Filippo Bozzo, Giorgio Brocato, Patrizia Costa, Emilia Gallo, Francesco Marano, Azzurra Mascelloni, Federico Moresi, Giancarlo Pastura, Claudia Pelosi, Elena Pizzo, Fabio Rossi, Ulderico Santamaria.

ABSTRACT – *The Fondarca Cave, or Grotta delle Nottole, is a large Karst cave on Mount Nerone, a mountain located in the north of the Italian region of Marche. The need to understand aspects of rituals carried out by the ancient inhabitants of central Italy in natural cavities during the Bronze Age makes this cave particularly significant. Systematic investigations were first carried out in Fondarca between 2001 and 2005. After a break, investigations were resumed in 2013 and are still under way. The Fondarca hypogeum was used for most of the Metal Age, until at least the Late Bronze Age. The hypogeum is related to the Sentino Gorge caves; besides, some of its archaeological elements suggest a connection to the facies of Grotta Nuova, situated along the central Tyrrhenian area. The amazing natural landscape surrounding the cave, its periodical attendance, and the lack of burial and housing facilities seem to suggest that the cave was used as a cult place. This hypothesis is further strengthened by the finding of several fireplaces, food leftovers (probably from collective meals) and objects in bronze and amber, in an environment characterised by water dripping.*

KEYWORDS – Cave, Bronze Age, cult, amber.

RIASSUNTO – La Grotta di Fondarca, o Grotta delle Nottole, è una ampia cavità di origine carsica collocata sul Monte Nerone, un complesso montuoso nelle Marche settentrionali. L'interesse per questo contesto nasce dall'esigenza di comprendere gli aspetti del culto manifestato dalle antiche popolazioni dell'età del Bronzo in Italia centrale nelle cavità naturali. Le prime ricerche sistematiche a Fondarca furono condotte tra il 2001 e il 2005. Dopo un periodo di interruzione le indagini sono state riprese nel 2013, fino ad oggi. Questo ipogeo, utilizzato per gran parte dell'età del metalli fino almeno all'età del Bronzo recente, si pone in relazione al gruppo di grotte della gola del Sentino, con elementi archeologici che suggeriscono rapporti nell'ambito della *facies* di Grotta Nuova lungo la fascia medio-tirrenica. Lo spettacolare ambiente naturale in cui è collocata la cavità, la sua frequentazione periodica, la mancanza di sepolture e di strutture abitative, la presenza però di numerosi focolari, di resti di pasto, probabilmente collettivo, e di oggetti in bronzo e in ambra, in un ambiente dominato da acque di stillicidio, rende plausibile una funzione cultuale della grotta.

PAROLE CHIAVE – *Grotta, Età del bronzo, culto, ambra.*

INTRODUCTION

The Fondarca Cave or *Grotta delle Nottole* is part of the wonderful landscape of Mount Nerone, in the north of Marche, an area where italian prehistory has not been thoroughly investigated yet (fig. 1). The area surrounding Mount Nerone is charming, characterised by mountain paths and panoramic valleys, with lush vegetation growing on the limestone massif. An eco-system of extraordinary beauty thrives in a landscape modelled over the centuries by ongoing Karst processes. One of the most beautiful places in the area is certainly Fondarca, a natural rock arch which is evidence of the area's Karst topography (fig. 2). The arch was originally a large cave which collapsed thousands of years ago. The original cave was probably part of a network of mutually interconnected natural caves. Here, nature creates an especially magical atmosphere. At a few metres distance from the Fondarca Arch, there is a cave with a narrow entrance called *Grotta delle Nottole*. The cave is approximately 40 metres deep and over 20 metres broad. It is situated approximately ten metres above the springs of a stream called *Giordano*, in the municipality of Cagli (fig. 3), near the village of Pieia (Pesaro-Urbino, Marche).

The entrance, opening towards south-west at a height of 686 metres a.s.l., consists of an arch-shaped opening situated next to the ground, partially obstructed by debris from the rock crag hanging above (fig. 4).

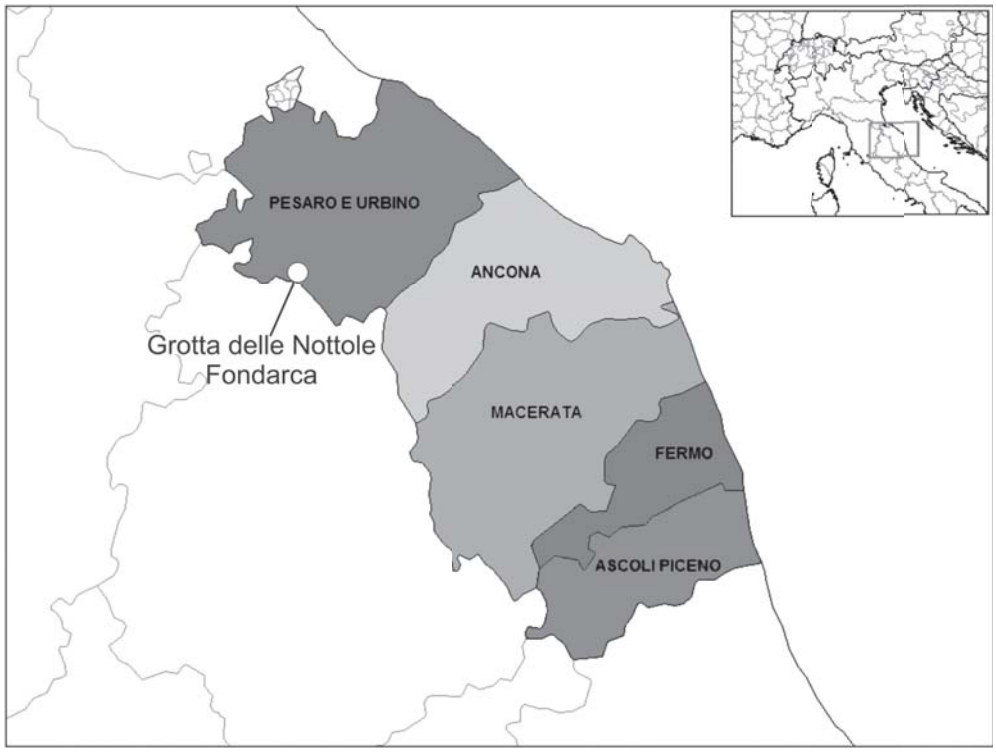

Fig. 1 – Map of the Marche Region and location of *Grotta delle Nottole* – Fondarca.

Fig. 2 – Fondarca Arch.

Fig. 3 – The Giordano Valley near Pieia. Landscape in front of Fondarca (photo by Gaetano Alfano).

Fig. 4 – External access to *Grotta delle Nottole* with a small natural recess on the right.

The first systematic investigations, directed by Mirella Cipolloni, started in 2001 and campaigns continued until 2005[1]. After a break, investigations have been resumed in 2013 and are still under way. Excavation is carried out by *Università degli Studi della Tuscia* - Viterbo, upon concession of the Archaeological Superintendent's Office of the Marche Region[2].

[1] I would like to express my sincerest and deepest gratitude to Ms Mirella Cipolloni for having proposed me to continue the investigations she started in the Fondarca Cave and for her ongoing encouragement.

[2] We would like to thank Ms Chiara Delpino, archaeologist of the Superintendent Office Department, for her close and precious cooperation. Also, we would like to extend a special thanks to the Municipality of Cagli for their help and support. My deep gratitude to Mr. Arnaldo Cherubini for the early planimetric map.

Fig. 5 – Excavation phase, photograph taken from the interior of the cave.

The decision to resume excavations in *Grotta delle Nottole* stems from the scientific need to understand some aspects of rituals carried out by the ancient inhabitants of Central Italy in natural caves during the Bronze Age (fig. 5). Indeed, these aspects of religious culture in the ancient world have been scarcely investigated so far. Multiple features are commonly associated with caves, where man still feels dominated by darkness and uncertainty. Besides, although rituals carried out in caves play an important role in cult, the traces they leave are generally weak, the remnants of a past which is still difficult to identify and interpret. They are what remains of actions repeated over time, whose meaning, once deeply substantial, is yet to be deciphered.

PREVIOUS INVESTIGATIONS

Mirella Cipolloni's excavation campaigns (2001-2005) were the first systematic investigations carried out in *Grotta delle Nottole*. Although the cave was already notorious, only some quick inspections had been carried out. Cipolloni's campaigns were mainly aimed at identifying, circumscribing and detecting the numerous attempts at illegal excavation which, unfortunately, had taken place in the cave over time. During the campaigns, some of the profiles which had been previously exposed were cleaned, allowing to verify the existence of layered deposits and the presence of material dating back to various phases of the Bronze Age, especially to the beginning of the Middle Bronze Age.

Besides, the first investigations allowed

to determine that *Grotta delle Nottole* found its likely collocation among the central Italy caves used as cult places in the period ranging between the end of the Early Bronze Age and the beginning of the Middle Bronze Age. The scarce data available at that time allowed to associate *Grotta delle Nottole* with a group of caves located in the Sentino Gorge, especially *Grotta dei Baffoni* and *Grotta del Mezzogiorno*, based on elements which suggested a connection to the *facies* of *Grotta Nuova*, along the Central Tyrrhenian area (Cipolloni Sampò 2005).

The excavation was carried out in an area whose total surface measured 50 m^2, situated near the entrance of the cave and encompassing both its sides. The stratigraphic analyses of the sequence carried out during this excavation - only partially published in a descriptive form - allowed to identify the presence of alternate, basically sterile geological strata, with extended anthropic units rich in charcoal and pottery. Indeed, investigations have never unveiled actual facilities, but only several fireplaces with abundant combusted material. The first excavation seemed to suggest that the cave had been periodically used during the Bronze Age: the presence of fireplaces, together with the periodical nature of the cave's attendance may suggest that *Grotta delle Nottole* was actually used for cult purposes. Although no actual evidence that the cave was a cult place was found, the lack of housing or burial remains and the high and constant humidity rate must have brought about the association of the cave with cult rituals.

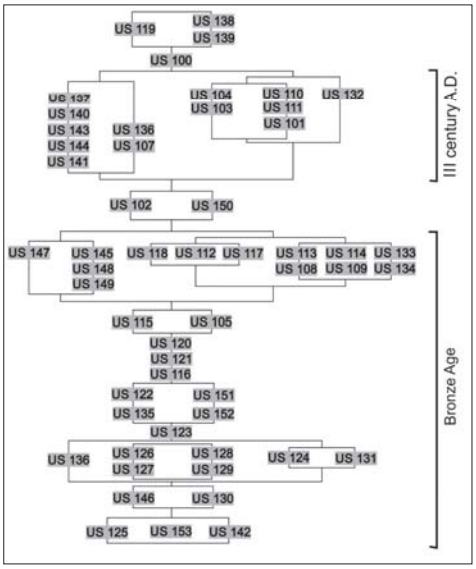

Fig. 6 – Stratigraphy diagram.

STRATIGRAPHIC SEQUENCE

The high humidity rate in the constantly wet soil, the presence of guano lenses, the difficulty in distinguishing the colour shades of stratigraphic units (further: US) in artificial light and, finally, the nature of the ground, consisting of a clast-based matrix, have sometimes made excavation difficult. However, it was possible to distinguish the stratigraphy sequence probably dating back to a historical age from the one dating back to the pre-protohistoric age (figs. 6-7). The oldest sequence in fact has been obliterated by well-recognisable sterile units. Besides, the most recent part of the stratification has been altered by excavation and dug pits to the point that it is difficult to establish stratigraphic connections. This characteristic has been observed all along the excavation area. On the contrary, the Bronze Age sequence is more easily readable.

The excavation campaigns carried out in 2013-2015 were aimed at extending excavation to the inner part of the cave and the entrance area (fig. 8). Another aim

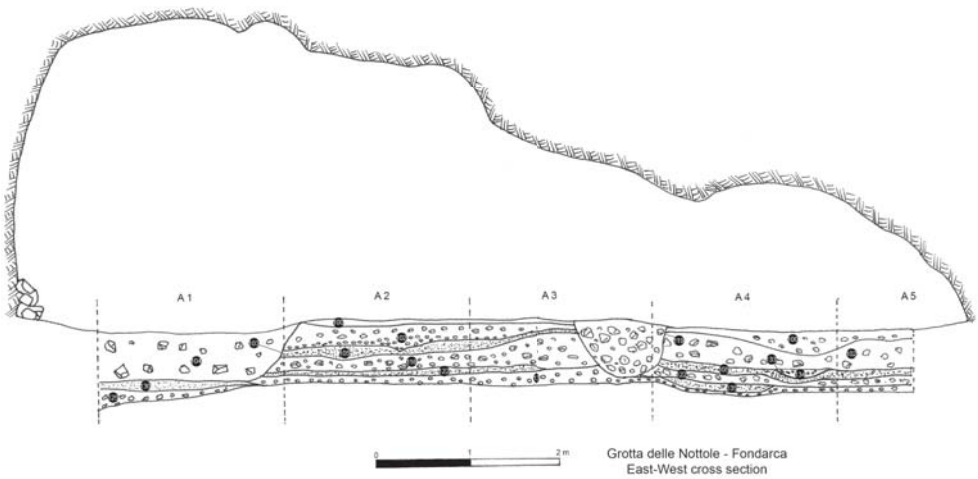

Fig. 7 – Main stratigraphic West-East cross section and cave profile.

of the campaigns was relating the sequence recognised by the Cipolloni campaign to the new excavation.

A simple description of the site's stratigraphy can be achieved by proceeding from the most recent to the oldest layers, trying to identify the most significant aspects of the stratigraphy. The square A3 is cut by a large irregular modern pit (US 119), whose diameter totals approximately one metre. This pit removed part of the superficial layer (US 100) extending on all squares. In this pit, a Roman bronze coin was found, an Antoninianus dating back to the 3rd century AD[3], associated with an extremely rare tiny fragment of *terra sigillata*. The cave's current surface is cut by other modern-age pits. Some smaller pits with their fill layers follow in the A1 square (US: 104, 103, 110, 111). A layer of natural deposit made up of loose brown ground is located in US 106, in the western area of the excavation, encompassing squares B1 and C1. A fireplace is easily identifiable in A3 (US 101, Fireplace 1), another one in C1 (Fireplace 3). The latter is a large combustion area situated right on the rock bed, with charcoal residues and a ceramic wall fragment (an edge of the fireplace); another fragment of Roman pottery is the final part of this ephemeral structure. Other fireplaces are ascribed to this phase (Fireplaces 3, 12, 15). In square E1, under fireplace 15, a sequence made up of historical age layers has emerged (US143, US144, US141, US142). This sequence is the result of the subsequent collapse of the wall, having occurred several times. From the chronological point of view, US 102 and 150 are quite important, since they mark the separation of the upper sequence (which can be dated back to the late Roman imperial period) from the lower sequence (dating back to the Bronze Age). These two US are characterised by their crumbly texture and yellowish

[3] I would like to thank prof. Alessia Rovelli for the identification.

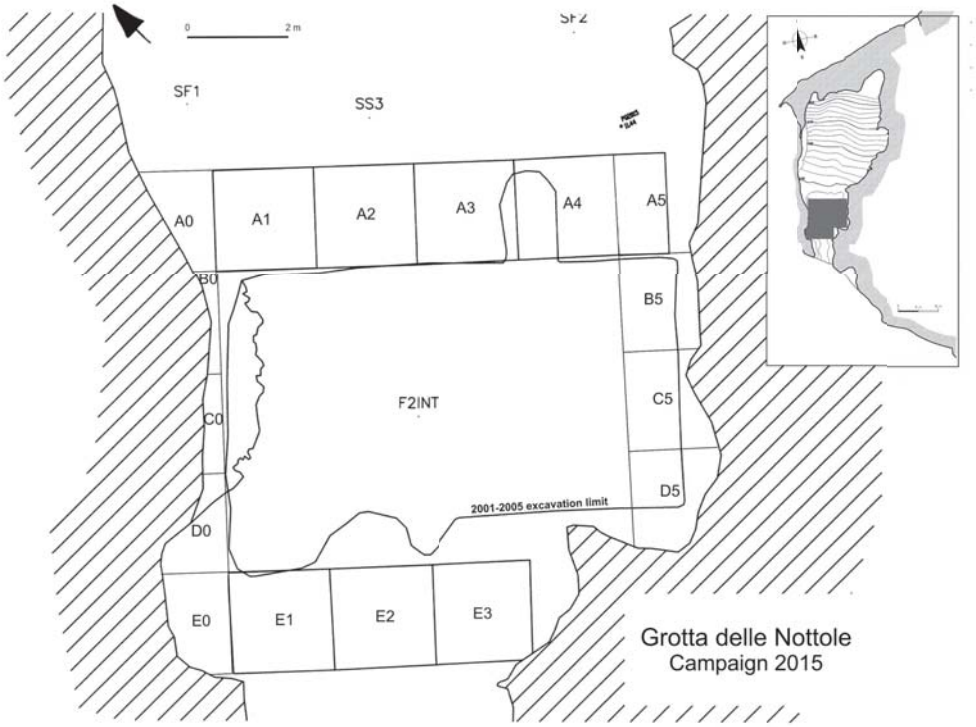

Fig. 8 – Basic planimetric map of excavation sectors.

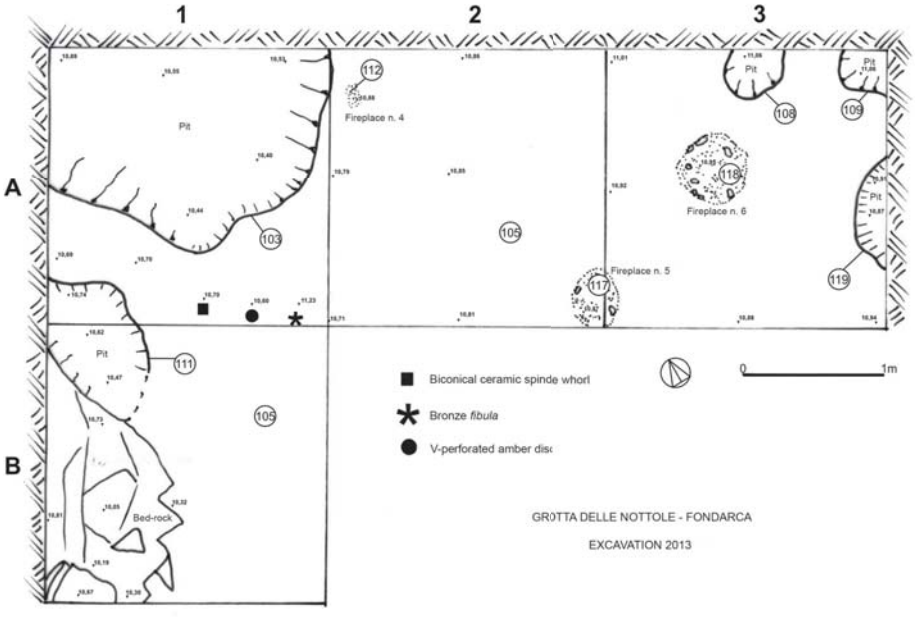

Fig. 9 – Planimetric map of US 105 with fireplaces and *in situ* material.

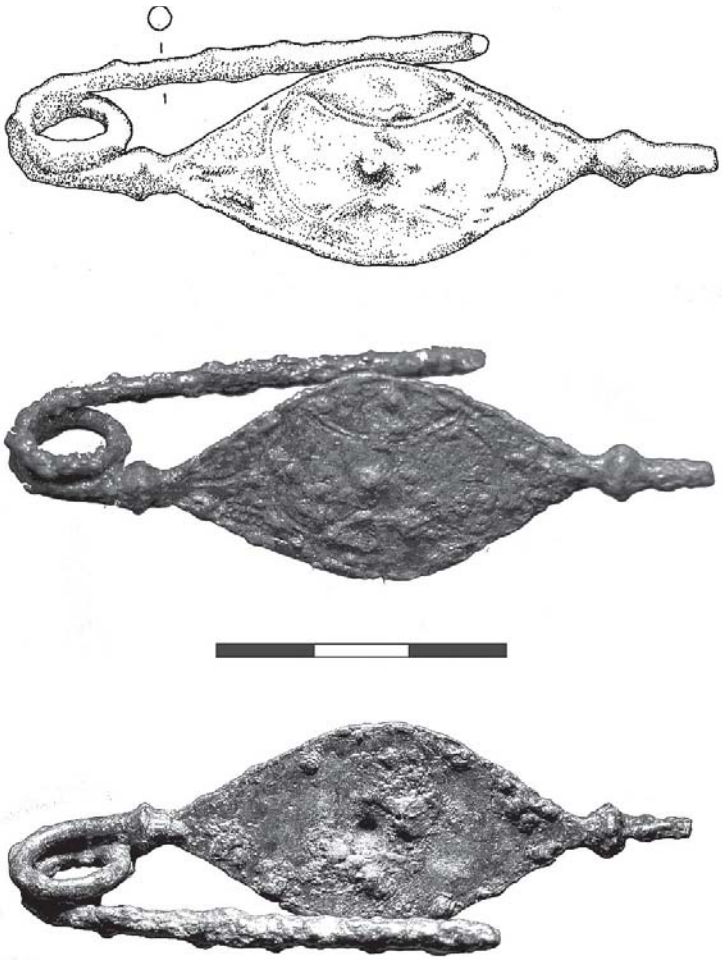

Fig. 10 – Foliated violin-bow fibula from US 105.

colour; they consist of a basically sterile, small-size clast-based matrix.

In squares A1, A2, A3, below these separation layers, at least three fireplaces (US118, Fireplace 6; US112, Fireplace 4; US 117, Fireplaces 5) and two small pits with their fill (US113, US108; US114, US108) can be easily identified. These remains cut a light grey area, rich in charcoal, that is, US 105 (fig. 9). US115 dates back to the same period and stretches over squares C1 and D1. In particular, in US105 - especially in square A1 - the following items were found: a bronze *foliated violin-bow fibula* (fig. 10), a biconical ceramic spindle whorl (fig. 11) and an amber disc-shaped "button" with a V-shaped perforation (fig. 12). Most of the prehistoric pottery fragments were found in this layer. Once removed, another fireplace emerged in square A1 (US120, US121, Fireplace 7), included into a light ash layer (US116) where a fragment of bronze rod was also found

(fig. 35). In the squares situated in the area north of E1 (toward the entrance) an extremely interesting small structure was constructed (item 17, US 149) at the same time as the fireplaces: a small pit, surrounded by rubble and filled with a fragment of *Sus sp.* jaw and a sherd dating to the Bronze Age. The presence of fauna in the anthropic layers and in the fireplace areas is always clearly visible (see Mascelloni's contribution on local fauna).

Fireplace 14 (US 136) is probably among the most ancient and best preserved in the sequence. It is situated in an area encompassing squares A3, A4, B3 and B4, and had already been partially detected during the previous Cipolloni campaigns. The fireplace, which has now been completely exposed, looks like a reddish area altered by fire, especially at its centre, consisting of numerous thin layers of gray ash.

The sequence continues with layers of ash and pottery, followed by sterile layers of natural origin.

The newly excavated area is approximately 0.80-1 metre deep in all its parts: therefore, it has now merged with the 2005 Cipolloni campaign excavation. The total surface of the excavated area now covers 90 m^2 and is chronologically consistent. However, it was not possible to reach the bedrock of the cave which - according to georadar investigations carried out in 2013 (see further contribution by Gallo *et alii*) - includes one further deposit layer whose thickness totals 50-70 cm.

The stratigraphy confirms what had been observed during the previous excavation: the existence of alternate anthropic greyish formations, rich in charcoal, and sterile beige natural formations with clasts. Besides, the stratigraphy seems to provide evidence that *Grotta delle Nottole* was periodically attended, fires were lit and meat-based meals were consumed in the cave. There are several fireplaces in a limited space; they

Fig. 11 – Biconical spindle whirl from US 105.

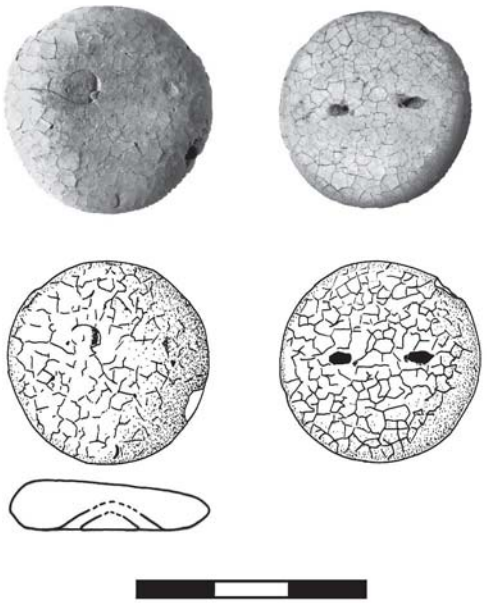

Fig. 12 – V-perforated amber "button" from US 105.

consist of well-recognisable circular or sub-elliptical areas. The archaeological material is scarce but clearly recognisable. The beige layers with clasts are natural events that obliterated the areas of soil which were once attended and are evidence that the cave was periodically abandoned.

FONDARCA AND OTHER BRONZE AGE CAVES IN CENTRAL ITALY

Placing Fondarca against a wider geographical background, it is necessary to point out that in central Italy there are numerous caves used during the Bronze Age; many of them were excavated a long time ago and this is the reason why archaeological documents do not always comply with current scientific standards. The first systematic inventory of these contexts was carried out by A. Guidi (Guidi 1991-1992). The contexts' functions are not always easy to determine and have prompted a strong interest among scholars (fig. 13). Some of these caves are home to burial places or were used as a shelter for men or animals; in several other cases, they were used as cult places. As justly stated by some authors, the determination of the caves' function can only be based on rigorous critical analysis of archaeological material (Grifoni Cremonesi 1996; Cocchi Genick 1996). Besides, these scholars have pointed out that a correct interpretation of the sites' functions is not always possible, especially when archaeological data is scarce and not easy to interpret. This is the case of caves interpreted as cult places: indeed, caves are often simply associated with holy sites with a magical-religious meaning, without taking into due consideration other factors which may contribute to understanding the actual use of the cave (Grifoni Cremonesi 2007: 22). This is exactly what happened at *Grotta dei Piccioni*, where the presence of several burial sites and circles of stones led excavators to hypothesise cult models associated to funeral rites and their general background, identified as an ideology connected to agriculture and the cycle of vegetation (Cremonesi 1976). The problem is that it is not always possible to tell religious rituals from funeral and magic ones.

Besides, manifestations of cult, meant as a set of ritual practices and beliefs connected to certain symbols, are often ephemeral and do not leave many recognisable tracks. During the Early Bronze Age in continental Italy, cult practices connected to mountains and probably linked to the celestial sphere - as documented by the carvings found in Val Camonica and Monte Bego - are associated with groups of caves identified as home to cult rituals such as, for example, the caves of Mount Cetona, between Toscana and Umbria. It is also possible to recognise manifestations of cult connected to specific caves. These caves are often home to burial sites and they hosted rituals associated with the cult of the dead, including offerings for the dead and, very likely, for specific gods. In any case, burials within a cave seem to be part of a ritual linked to the cult of natural underground caves, not a widespread funerary habit (Peroni 1996: 122-123). In the Middle Bronze Age, the frequency with which ritual offerings were laid in the most remote corners of the caves increased. This habit of leaving offerings in a cave can be held as a ritual linked to underground gods and, probably, to fertility and fecundity rituals. In the caves hosting in-depth springs, streams or ponds, this interpretation is even

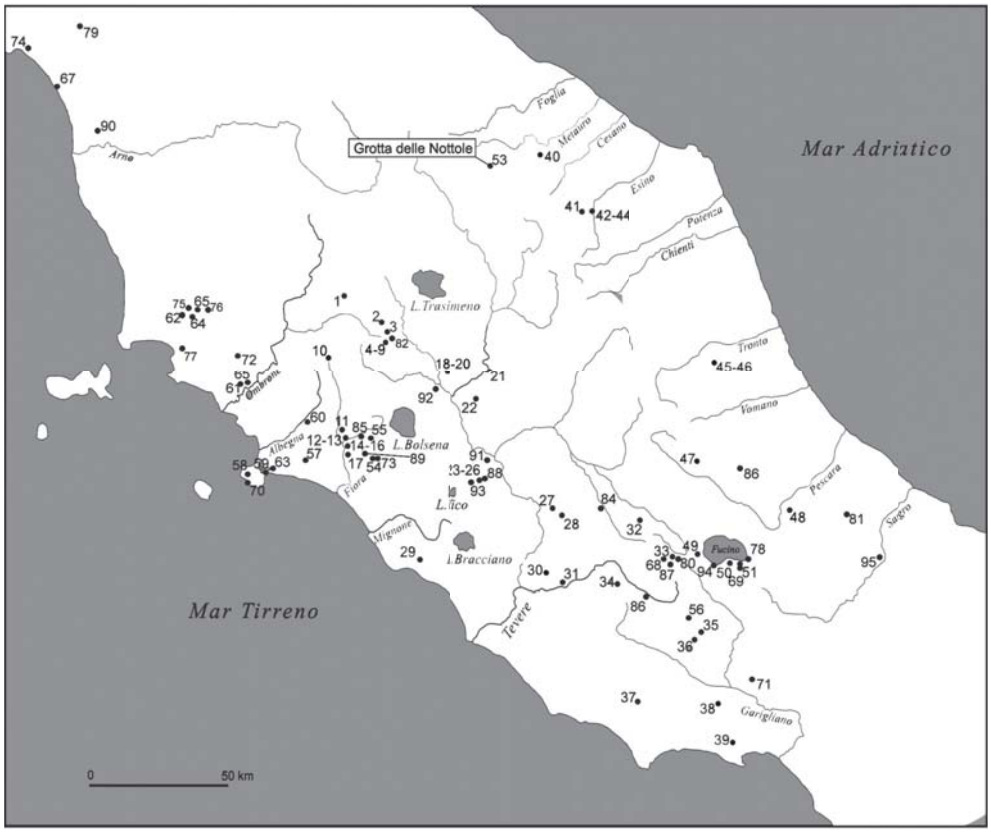

Fig. 13 – Map of distribution of caves in central Italy during the Bronze Age.
1) Grotta del Beato Benincasa; 2) Grotta dell'Orso; 3) Grotta Lattaia; 4) Riparo del Capriolo; 5) Antro del Poggetto; 6) Le Tre Tombe; 7) Antro della Noce; 8) Grotta di S. Francesco (Cetona); 9) Grotta della Carbonaia; 10) Poggio La Sassaiola; 11) Felcetone; 12) Grotta Nuova; 13) Grotta dell'Infernetto; 14) Grotta Misa; 15) Grotta della Paternale; 16) Grotta di Carli; 17) Grotta di Don Simone; 18) Tane del Diavolo, cavità A; 19) Tane del Diavolo, cavità B; 20) Tana del Faggio; 21) Grotta di S. Francesco (Titignano); 22) Grotta Bella; 23) Caverna della Terra Rossa; 24) Caverna del Piluccio; 25) Cavernetta della Stipe; 26) Caverna dell' Acqua; 27) Grotta Scura; 28) Grotta del costone di Battifratta; 29) Crepaccio di Pian Sultano; 30) Grotta dello Sventatoio; 31) Grotta Polesini; 32) Grottone di Val de'Varri; 33) Grotta Beatrice Cenci; 34) Grotta Morritana; 35) Grotta-riparo del Peschio Tornera; 36) Grotta Regina Margherita; 37) Grotta Vittorio Vecchi; 38) Grotte di Pastena; 39) Grotticella di Valle Oliva; 40) Grotta del Grano; 41) Caverna di Frasassi; 42) Grotta del Carbone; 43) Grotta dei Baffoni; 44) Grotta del Mezzogiorno; 45) Grotta S. Angelo; 46) Grotta Salomone; 47) Grotta a Male; 48) Grotta dei Piccioni; 49) Grotta di Ciccio Felice; 50) Grotta-riparo Continenza; 51) Grotta La Punta; 52) Grotta Maritza; 53) Grotta delle Nottole; 54) Grotta del Lago; 55) Grotta delle Settecannelle; 56) Grotta Madonna delle Cese; 57) Grotta dei Sassi Neri; 58) Grotta Settefinestre; 59) Grotta di Ansedonia; 60) Grotta delle Cava di Montecavallo; 61) Grotta dello Scoglietto; 62) Grotta Prato; 63) Grotta di Punta degli Stretti; 64) Grotta della Spinosa di Perolla; 65) Grotta di Spaccasasso; 66) Grotta Giulia; 67) Tana della Volpe; 68) Grotta Cola II di Petrella; 69) Grotta dei Porci; 70) Grotta doi Cala dei Santi; 71) Grotta del Cane; 72) Grotta del Fontino; 73) Ponte dell'Abbadia; 74) Tecchia della Gabellaccia; 75) Grotta del Somaro; 76) Grotta del Pesce; 77) Grotta dell'Artofago; 78) Grotta la Cava; 79) Tana del Cerro; 80) Grotta Cola I di Petrella; 81) Grotta del Colle; 82) Tombetta della Strada; 83) Grotta delle Marmitte; 84) Grotta delle Venelle; 85) Grotta dello Sbirro; 86) Grotta Mora di Cavorso; 87) Grotta la Dama; 88) Cavernetta di Sant'Egidio; 89) Grotta Baragliu; 90) Grotta Borghetto; 91) Grotta Alta di Piazza Castello; 92) Grotta sul Torrente Romealla; 93) Cavernetta Terza; 94) Grotta San Nicola; 95) Grotta di Ciccio.

more evident. The cult of underground waters seems to be an innovation introduced during the Bronze Age (Bernabei, Grifoni Cremonesi 1995-1996; Bianco 1999), but rarely documented also during the Neolithic. Instead, the so-called "ritual fireplaces" - where cereals and legumes were burnt - seem to bear aspects of continuity with the Neolithic age. During the Middle Bronze Age, fireplaces are associated with pots containing burnt food, cultivated or wild plants and fruit seeds. In central - southern Italy, the use of caves as cult places seems to decline; actually, cave attendance as a custom fell into desuetude at the end of the Middle Bronze Age (Peroni 1996: 226-227). Among the best known examples, there are *Grotta Nuova* and *Grotta Misa* in Lazio (Domanico, Miari 1991-1992). In *Grotta Nuova*, the pots were situated in a stream flowing inside the cave. They contained wheat seeds, broad-beans and other vegetables. The pots were turned upside down (Negroni Catacchio 1991-1992; Cocchi Genick 2002; Grifoni Cremonesi 2007: 226). An underground stream also flows in *Grotta Misa*, where several pots and a fireplace were found. The ashes were extended and positioned into a circular shape in order to place small mounds of wheat, millet and broad-beans (Negroni Catacchio *et alii* 1989-1990) at the fireplace's centre. In the cave of Val di Varri, in Abruzzo, there is a small inner pond which is fed by a stream when rains are copious. Here, several pots containing broad-bean seeds were also found, associated with seven fireplaces (Güller, Segre 1948). The case of *Grotta Pertosa*, near Salerno, is more complicated (Trucco 1991-1992; Mieli, Trucco 1999): an underground river feeds the innermost area of the cave. Two wooden structures were built during the Middle Bronze Age; they were associated with a large number of pots. Besides, hundreds of miniature pots arranged into rows and stacks were found into a recess in the remotest part of the cave. This type of context has been interpreted as a votive offering.

In the Sentino Gorge, in the Marche region, there is a group of caves associated to internal water springs or water dripping, which is often connected to Apennine-culture pottery. In these caves, *Grotta del Mezzogiorno*, *Grotta dei Baffoni*, *Grotta del Prete* and *Grotta di Frasassi* (Lucentini 1997; Pacciarelli 1997), there are fireplaces and small holes containing wee wiled broad beans. An interesting aspect is that this type of context is connected to ritual offers related to the cult of waters, but the offerings are placed in caves which do not look like "labyrinths"; on the contrary, these caves can easily be accessed through large entrances. This kind of ritual seems to have been carried out especially in continental central and southern Italy, where the use of caves as spas during the Early Bronze Age is evident, as is the case in *Grotta dello Sventatoio* (Angle *et alii* 1991-92).

However, it is between Tuscany, Umbria and Marche that, during the Bronze Age, the need arises to identify physical environments with places rich in symbolical and ideological elements, that is to say, actual holy sites. In the area near Mount Cetona (Calzoni 1933), with its numerous caves, and the Sentino Gorge, where caves are scattered but unified by the natural landscape, caves might have been held as a representation of mind landscapes and may have played this role along most of the second millennium BC.

BRONZE AND AMBER FOUND IN THE FONDARCA CAVE AND RELATIONS WITH CENTRAL AND NORTHERN ITALY AND EUROPE

The bronze *fibula* (see the contribution by Pelosi *et alii*) found in US 105 is especially interesting both from the chronological and the formal point of view. The *fibula* has been altered by corrosion[4], the tip of the brooch pin and the safety clasp are missing. It is a *foliated violin-bow fibula*, with two knots at both ends of the bow. The foliated part is broader than the rest of the object and the outer side has been decorated with a carved decoration similar to a "labrys"; at its centre, there is a boss shaped by hammering. Besides, the *fibula* bears traces of a carved frame running all along the edges of the foliated part. This type of *fibula* is more clearly distributed in central and northern Italy, between the Late and the Final Bronze Age. However, the expanded foliated arch seems to belong mainly to the Late Bronze Age (Carancini, Peroni 1999: 18; Damiani 2010: 393-396). Similar objects have been found in the Belverde di Cetona caves, especially in a context of cult-related offerings such as *Antro della Noce*, excavated by Calzoni in 1928 (Calzoni 1933, fig. 80; Bianco Peroni 1970, fig. 77, *A6*). Further comparison can be made with settlements such as Moscosi di Cingoli, situated on the upper course of the Musone river, in the Marche Apennines (Sabbatini, Silvestrini 2005, fig. 4, *14*); the settlement of Mezzano, situated on the banks of the lake carrying the same name (near Viterbo-Pellegrini 1993: 65, fig. I, *3*) and, finally, Scarceta. Similar *fibulae* have been documented in funerary contexts such as *Cavallo Morto*, near Anzio (Angle *et alii* 2004, figs. 6-7; graves 31/3 and 39/3), or in the sands of the river Sile, near Treviso (Fasani 1984: 593) and those of the river Mincio, in Peschiera (Fasani 1984: 550, fig. 3). Although foliated violin-bow *fibulae* decorated with knots have been found in several places, the decoration on the Fondarca *fibula* is the only one of its type. This *fibula*, like other objects found in the same layer, is an important piece of chronological evidence. From the point of view of the item's formal aspect, it must be specified that this object has been documented in Italy as dating back to a period between the Late Bronze Age and the Final Bronze Age. In Fondarca, however, among the archaeological material uncovered so far in layers 105 and 115, no evidence has been found that the area was attended during the Final Bronze Age. While waiting for further chrono-logical information, to be achieved via radiometric dating, also the contexts consisting of fireplaces (n. 4, 5, 6, 11), pit 17, and earth layers immediately above US 105 can be associated with the Late Bronze Age.

Among the material found together with the *fibula*, there is an amber "button". It consists of a flat, convex, lens-like disc whose diameter measures 2.7 cm. The surface has been altered and a beige crust with pronged micro-cracks has formed over the object. At the centre of the flat part there are two small oblique interconnected holes. Analyses carried

[4] We would like to extend a special thanks to Ms Lucia Ghedin for having cleaned and consolidated the *fibula* and the amber item.

out on fragments of the object have confirmed the nature of the finding: amber from the Baltic region (see further the contribution on analyses by Pelosi *et alii*).

Baltic amber has played a vital role in the relations between several central and northern European regions and Mediterranean regions (Kristiansen 1998: 233-235) since the Early Bronze Age. The archaeological findings dating to the Bronze Age made it possible to identify northern Europe as the place where amber was collected and later transported towards the Mediterranean regions through trade routes (Makarorowicz 2009; Negroni Catacchio 2011). The crucial period for the development and use of amber ornaments in Italy is the transition phase between the Late Bronze Age and the Early Iron Age (Bellintani 2010). Although projects for the characterisation of amber are currently under way (Bellintani *et alii* 2006), investigations have not been completed yet and not all prehistoric amber items have been analysed. However, it can be observed that, although the use of amber certainly increases over the centuries, it is only after the Late Bronze Age that amber seems to spread significantly along the peninsula. Moreover, it is not very likely that some routes connected extraction areas directly with the amber final destination. As it has already been observed, exchanges were likely to occur indirectly, through several intermediate steps. It is also likely that in certain circumstances amber acquired a symbolic meaning in addition to its merely commercial value (Bergonzi, Cardarelli 1991-1992). The finding of amber in *Grotta delle Nottole* can also be included in this wider picture and it is possible that the presence of amber in a context carrying a strong cult-related connotation is consistent with its symbolic value.

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The general state of preservation of pottery is considerably compromised by several context-related factors. It is not possible to see pots -or parts of them - in their original form: indeed, all the findings are extremely fragmented. Macroscopic analysis of the cracks allowed to identify three main types of fabric occurring in varying quantities. The most common kind of fabric consists of small and medium-size stone and vegetable material, followed by a gross type of clay body consisting of a large amount of stone material (mostly limestone clasts with angular edges). The third type is characterised by purified clay bodies with a compact and homogenous structure, with no evident added material. This type of fabric was found in smaller amounts. The fragments' colour is mainly dark and light brown; a significant amount of pottery is in several shades of red, with a small amount of black pottery. The surface of the fragments bears traces of processing, such as smoothing and splinting.

The extreme fragmentation of the pottery found in Fondarca has made it extremely difficult to reconstruct the original shape of the forms and make consistent comparisons. Therefore, we chose to describe here only the material allowing precise comparison and providing precise chronological reference.

Based on the excavation stratigraphy, the study of pottery has confirmed that the upper layers situated immediately above the obliteration layers (US 102 and US 150) have been altered; indeed, in these strata, terracotta items dating back both to historical and protohistorical phases have been found.

The fragment of a *a bozza cava* wall (fig. 14.*5*) is similar to fragments found in the Eneolithic settlement of Conelle di Arcevia (AN) (Cazzella, Moscoloni (eds.): tab. 40.*1*; tab. 60.*7*) and in the necropolis of Fontenoce-Cava Kock (MC) (Carboni *et alii* 2005: fig. 1.*3-4*) and documents that the cave was attended as early as the Eneolithic period.

Other fragments worthy of attention have been found in the upper layers and can be dated to the first phases of the Middle Bronze Age. In US 141, the fragment of a wall with oblique incisions of a continuous-line false meander (fig. 14.*1*) has been found. A similar item was found in *Grotta del Mezzogiorno* (AN) (Cocchi Genick *et alii* 1993: motif 33; Puglisi 1956: fig. 13.*4*): the decoration, documented in the *facies* of Grotta Nuova, shows that the cave was attended in the first phases of the Middle Bronze Age. This has been confirmed by the finding of another fragment decorated with a band motif and hatched parallel lines in US 144 (fig. 14.*4*). A similar motif decorates the shoulder of a small *olla* found in *Grotta di Frasassi* (AN), also referring to BM 1-2 (Lucentini 1997: fig. 14). Unfortunately, most fragments found in the layers above US 102 and 150 have not allowed exact

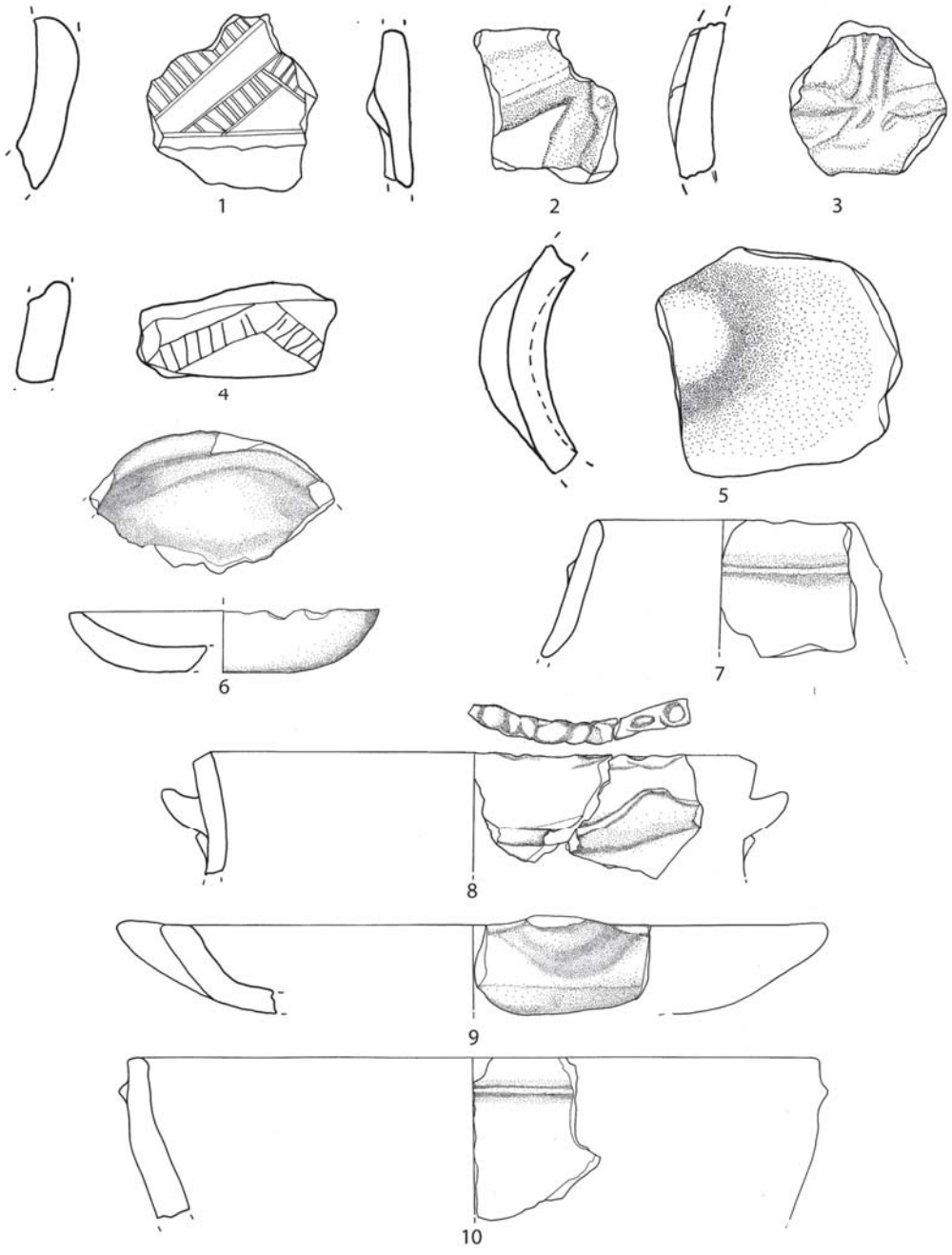

Fig. 14 – Pottery from Fondarca: US 141: n. 1, 5,8-10; US 144: n. 4; US 105: n. 2-3. Scale 1/2 (n. 1-5), scale 1/3 (n. 6-10).

chronological dating, due to frequent alterations of the strata themselves. Among the small quantity of well-preserved fragments, it is worth mentioning the fragment of a large bowl with an indistinct rim, flattened outer edge and a plastic plain triangular-section cordon decoration situated immediately below the rim. This item, found in US 141 (fig. 14.*10*), can be associated with a similar finding from Riparo del Capriolo (SI) (Balducci *et alii* 2007: fig. 6.*1*), which can be dated to a transitional phase between the Early and the Middle Bronze Age. The fragment of a cut rim was found in the same US: the rim is slightly everted, bears finger marks and has a cordon decoration and a triangular grip, both situated immediately below the rim (fig. 14.*8*). This item can be compared with an ovoidal pot found in the Phase E layers of the Eneolithic settlement of Conelle d'Arcevia (AN) (Cazzella, Moscoloni (eds.): tab. 40.*1*; tab. 6.*6*). Therefore, the fragment may once again indicate that the cave was attended as early as the Eneolithic period. In US 141, also the sherd of a shallow bowl with an inverted rim and triangular grip (fig. 14.*9*) of the same type well documented in the *facies* of Grotta Nuova (Cocchi Genick 2001: type 448) was found; similar items have been found at the Scarceta (GR) site, in the layers dating to Middle Bronze Age 1-2 (Poggiani Keller 1999*a*: fig. 22.*3*). A peculiar fragment has been found in US 144: it is probably a small dish, roughly made (fig. 14.*6*), very similar to an object found in the Middle Bronze Age settlement of Dicomano (FI) (Sarti 1980, fig. 19.*5*). The alteration of the deposit's upper layers is further confirmed by US 100, a layer where several pottery fragments have been found, especially bottoms and rims. Among these, it is worth mentioning a small inverted-rim *olla*, with a rounded edge and a triangular-section cordon decoration (fig. 14.*7*) immediately below the rim. This fragment is very similar to an item found in the Late Bronze Age levels in Meldola (FC) (Gonzalez Muro *et alii* 2010: fig. 29.*5*). As far as the upper layers of the deposit are concerned, there is no other item which may help chronological dating.

The stratigraphy portion below strata 102 and 150 is more reliable, since lower layers have not been altered by man during the historic age. This is confirmed by the type of pottery found here. At first glance, the material found in this marker horizon allows to identify a sequence included between the Late Bronze Age and the early phases of the Middle Bronze Age. More accurate analysis allowed to identify the material found in US 105 as especially interesting: it is at this level that the *fibula*, an amber button, and a biconical ceramic spindle whorl were found. The *fibula*, as well as the pottery found in the level itself, seems to confirm dating at the Late Bronze Age. It is worth mentioning a fragment of a carinated bowl with maximum diameter at the rim (fig. 15.*9*) which can be associated to an item found in Moscosi di Cingoli (MC), dated to Late Bronze Age I (MC) (Sabbatini, Silvestrini 2005: fig. 1.*4*) and the fragment of a carinated form (probably a cup) flaring up towards the rim of the object, with a sharp edge (fig. 15.*8*). This item can be associated with a type of deep carinated cup quite common in the Marche region in the advanced phase of the Late Bronze Age (Baldelli *et alii* 2005: fig. 11.*14*). However, this form - also documented in Tanaccia di Brisighella (RA) (Farolfi 1976: fig. 9.*9*) and in house 61 in Scarceta (GR) (Poggiani Keller 1999b: fig. 45.*6*) - was

very common also in Middle Bronze Age 3 (Baldelli *et alii* 2005: fig. 8.*19*).

Precise reference to Late Bronze Age 1-2 can be made, thanks to the fragment of an everted rim with a rounded outer edge (fig. 15.*11*) from a carinated cup, very similar to an item found in Cortine di S. Maria in Campo (AN) (Damiani 2010: fig. 16.*4*). The same form can be found in the Meldola (FC) settlement, also dating to the Late Bronze Age (Gonzalez Muro *et alii* 2010: fig. 24.*6*). A fragment of inverted thickened rim (probably from a small-size bowl) found in the same US (fig. 15.*6*) is similar to an item also found in the Meldola (FC) settlement (Gonzalez Muro *et alii* 2010: fig. 27.*1*). In US 105, fragments consistent with more general forms associated with the Middle Bronze Age have been found: it is the case of a small curved-sided cup (fig. 15.*7*). Part of the slightly everted, rounded outer rim has been preserved. This object is documented in the *facies* of Grotta Nuova (Cocchi Genick 2001: type 168B) and also in later contexts: for example, the item found in the "Casa laboratorio" in Scarceta (GR), which can be dated back to the Final Bronze Age (Poggiani Keller 2001: fig. 5.*5*). Two sherds from two inverted-rim bowls can also be dated back to an early phase of the Late Bronze Age (fig. 15.*10*, *13*). Finally, several rim fragments have been found in this US: unfortunately, they did not allow to reconstruct the original form of the pottery items. In the same US, also several plastic decorations, especially triangular and rounded-section cordon decorations have been found; among these, it is worth mentioning two sherds of a wall decorated with perpendicular cordon decorations (fig. 14.*2*, *3*). Unfortunately, in this level no handles or grips were found but a triangular grip immediately below the rim of an open vessel (probably a large bowl) (fig. 15.*12*). Due to this lack of evidence, it is not possible to use typical Late Bronze Age handles and grips as further evidence that the cave was attended during this chronological phase.

In the lower US, the pottery was increasingly fragmented. It is difficult to identify the layers showing the transition between the Late Bronze Age and the Middle Bronze Age. This transition might be identified in US 120, a small combustion area where a small quantity of pottery has been found - more specifically, only two rim sherds. Although the diameter has been reconstructed, the pottery's fragmented state of preservation does not allow precise comparison with other items. The first one is the fragment of a straight rim (fig. 15.*2*) which, in spite of some minor differences, might be classified into type 218 B of the typology created by D. Cocchi Genick for the forms belonging to the *facies* of Grotta Nuova (Cocchi Genick 2001), which can be dated back to Middle Bronze Age 1B. The second form identified in this level is a flat inverted thickened rim (fig. 15.*1*), probably from an *olla*, similar to items found both in the Bronze Age (more precise chronological dating of the object was impossible) levels of Grotta Sant'Angelo (TE) (Di Fraia, Grifoni Cremonesi 1996: fig. 52.*13*) and in the Late Bronze Age layers of the Bagnara di Romagna (RA) site (Cattani, Lentini 2013-14: fig. 25.*7*).

As we proceed to lower layers, pottery was increasingly fragmented: this is evident in US 122, where some rim sherds were found. These fragments do not allow to determine the shape of the vessel form, which can only be inferred from a sherd

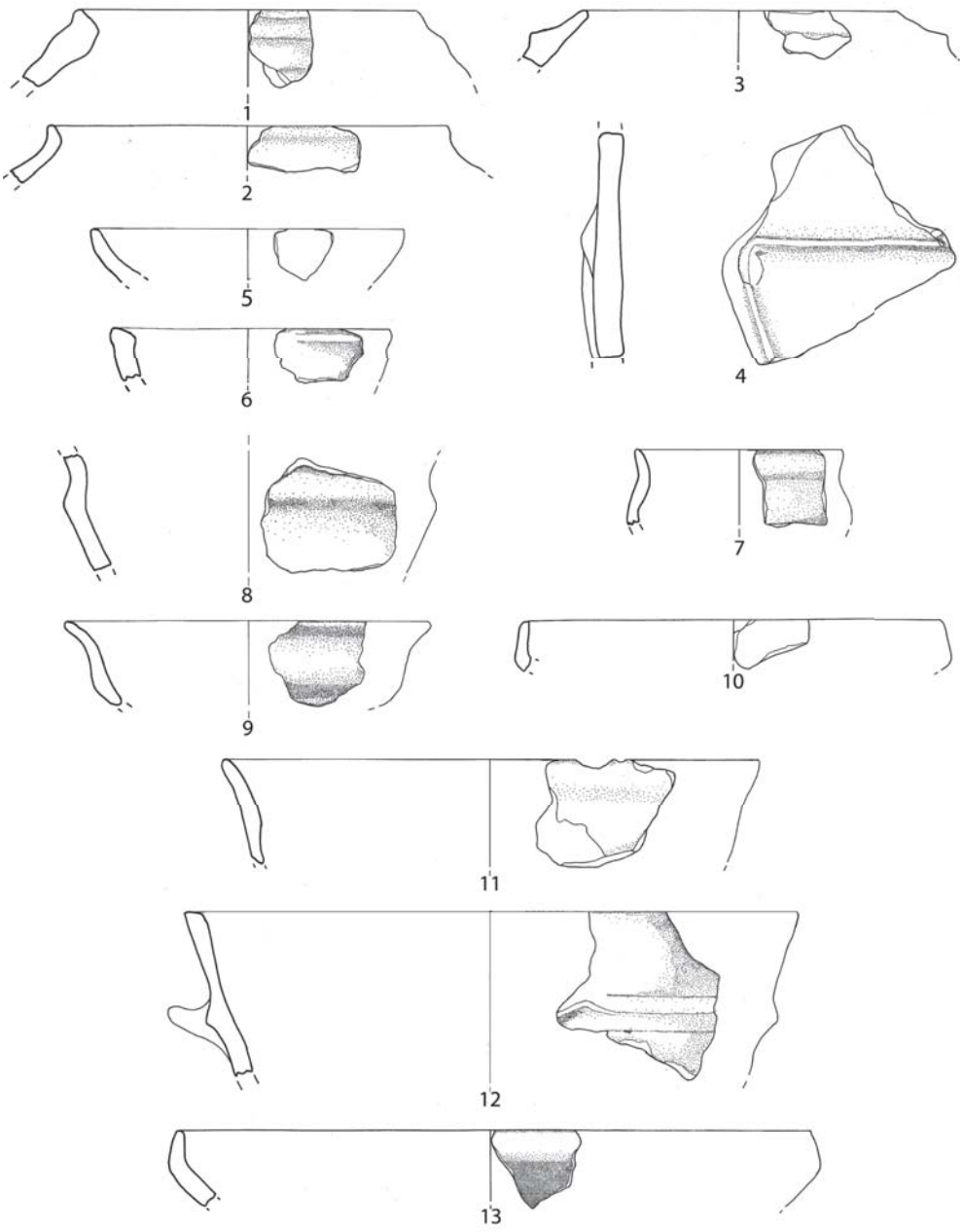

Fig. 15 – Pottery from Fondarca: US 121: n. 1-2; US 122: n. 4-5; US. 122: n. 3; US 105: n. 6-13. Scale 1/3.

(fig. 15.*5*) consistent with a small convex bowl, very similar to an item found in the early Middle Bronze Age phases of Riparo del Capriolo (Cuda *et alii* 2001: fig, 6.*5*). This is, however, a generic form, which does not allow precise chronological dating. In the same layer, some plastic decorations were found: the fragment of a wall with two plastic triangular-section cordons which cross perpendicularly is especially interesting (fig. 15.*4*). Among the decorations, a boss which might be attributed to the Middle Bronze Age is worth mentioning. The last layer of the sequence including pottery is US 123, where some fragments of rim were found. Most of them are too fragmented to allow precise comparison with other items. The only finding allowing some considerations is the sherd of an inverted rim, with a rounded outer edge and a triangular-section cordon decoration immediately below the rim (fig. 15.*3*). The fragment probably comes from a globular *olla* consistent with type 69 of the classification by D. Cocchi Genick (Cocchi Genick, 2001), to be chronologically attributed to Middle Bronze Age 1B-2A. Also, in this US several fragments of wall decorated with horizontal triangular and round-section cordon decorations have been found.

Although, as previously mentioned, the state of preservation of the pottery found in Fondarca brought about several interpretation problems, it is possible to draw some preliminary conclusions stemming from the analysis of the material available. The presence of elements relating to the Eneolithic period in the upper layers of the deposit documents that the cave was already attended as early as this period. Besides, the presence of decorated fragments in the same levels is not only evidence that the cave was attended already during the early phases of the Middle Bronze Age (as confirmed by the material found in the levels below), but also documents a peculiar similarity with the *facies* of Grotta Nuova, especially with the group carrying the same name. This similarity had already been noticed during the analysis of material found in the notorious caves of the Sentino Gorge (Lucentini 1997: 37-38; Cocchi Genick 2005): the significant decorative elements found during the excavation campaigns in Fondarca seem to be closely interconnected to these sites. Furthermore, it must be taken into due consideration that the presence of pottery and decorations documented in the *facies* of Grotta Nuova had already been detected during the 2001-2005 excavation campaigns (Cipolloni Sampò 2005). A new element which had not emerged during the first investigations carried out in the Fondarca Cave is certainly the dating of the cave's attendance to the Late Bronze Age, as documen-ted by US 105 pottery findings. Unfortunately, it must be pointed out that the scarce amount of pottery found so far does not allow more in-depth conside-rations. The lack of diagnostic elements, such as grips and handles, and the excessive fragmentation of the pottery deprive the record of a vital element for the chronological dating of part of the pottery inventory.

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GEOLOGICAL ASPECTS

Along the road, at some distance from the village of Pieia (from the village on, you can only walk to the site) it is possible to see the landscape of the southern side of Mount Nerone: the massive rock faces of an extended geological formation of *Calcare Massiccio*. Among the steep mountain faces of the Valley of Fosso Giordano, the Fondarca Arch, with its pit-like cavity, and the nearby *Grotta delle Nottole* are evidence of the extensive Karst processes generated by water over time (fig. 16).

Calcare Massiccio is the name of a geological formation usually referring to an indistinct stratification of calcareous deposits in a marine environment, on a carbonate platform dating back to the

Fig. 16 – Detail of the Karst landscape on the southern side of Mount Nerone: Fondarca (photo by G. Brocato).

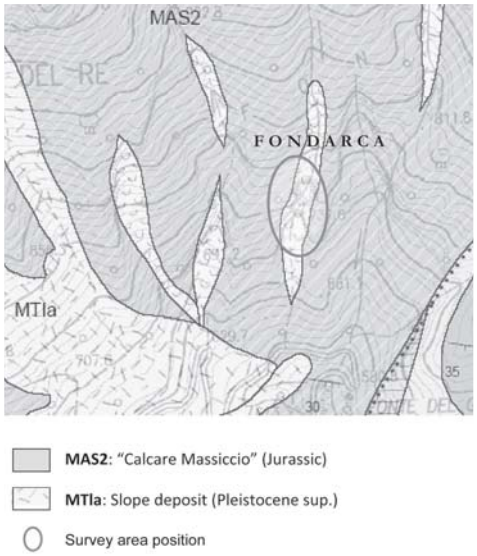

Fig. 17 – Excerpt from the Geological Map of the Marche Region (Regione Marche 2010a)

Lower Jurassic[5]. *Calcare Massiccio* is generally compact, vacuolated, white and greyish, and it often acquires a carious aspect. It can be found in central Italian Apennines, especially at the foot of the Umbria-Marche sedimentary sequence (Cecca *et alii* 1987; Cecca 1993; Petti *et alii* 2005; Selli 1954; S.G.I. 1972; Regione Marche 2009; Regione Marche 2010a). On the geological map (fig. 17) it is possible to identify the predominance of this formation in the area object of study. The deposits of the mountainous side overlap with this formation wherever the site's morphology allows.

The chemical, hydro-geological and geological characteristics of *Calcare Massiccio* caused the reduction in flowing of surface waters, which seep into the geological formation, thus feeding underground water circulation and, as a consequence, the ongoing Karst processes. The Karst system of Mount Nerone has evolved to a significant extent: a large and diverse amount of local erosion patterns occur; this contributes to the unique aspect of the area's landscape (Regione Marche 2010b).

Most of these massive Karst morphologies are larger than the current water provision allows: this proves that extended paleo-Karst phenomena occurred in hydro-geological and climate conditions different from the current ones. Indeed, underground environments are currently less extended (Castiglioni 2000).

The vertical Fondarca Cave, a sinkhole generated by the collapse of rocks whose diameter is estimated to be around 50 metres, is characterised by the typical bell shape and its walls are counter sloping. The astounding Fondarca Arch on the southern side and a smaller arch on the south-eastern side are all that remains of the original Karst cave's great vault. The analysis of aerial photographs and topographical surveys have allowed to identify the morphologies of the remnants of at least two further Karst abimes situated nearby, which, via the two arches described above, are connected to the Fondarca pit (fig. 18). The reconstructed perimeters seem to have been determined by a set of fractures (joint set) occurring in the rock due to mechanical reasons having caused no visible or measurable movement of the two portions of rock (Castiglioni 2000: 221-222).

The position of these specific

[5] Lower Jurassic, (Hettangian – Pliensbachian, between 201.3 +/- 0.2 Ma and 182.7 +/- 0.7 Ma) (I.C.S. 2012).

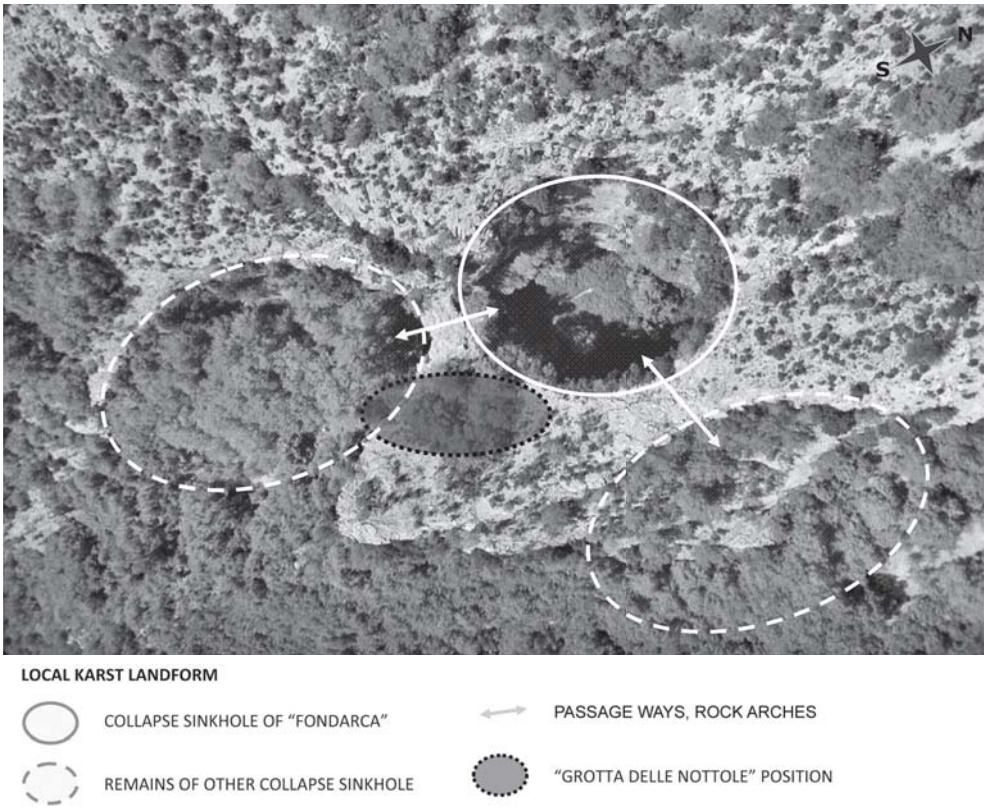

Fig. 18 – Aerial photograph taken from a drone. The geo-morphological interpretation emphasises the extended Karst phenomena occurring in the area (Image by F. Bozzo; interpretation by G. Brocato).

morphologies shows that the cave was probably part of a large, ancient underground drainage system. Besides, the subhorizontal erosion phenomena visible both on the rocky walls between the Fondarca Cave and the Arch and in the large Karst abime are evidence of significant erosion by a paleostream (probably situated underground) having occurred in ancient times. It is likely that large quantities of water (which cannot be found anymore at this level) used to flow in this stream (fig. 19).

The underground environment of the cave is situated on the side descending from the Fondarca Arch towards the valley of the Giordano pit. It can be accessed through a low crack in the rocky wall proceeding from North-West/ South-East. Here, the slope of the side facing the cave abruptly decreases from 20° to 0° along some metres in front of the cave access, resuming its original steepness as it descends nearer to the valley. Some deposits of rubble from the rocky side, debris of collapsing stone and eluvial-colluvial deposits can be found in the surroundings, in the areas of possible accumulation.

The cave entrance is semi-elliptical; its

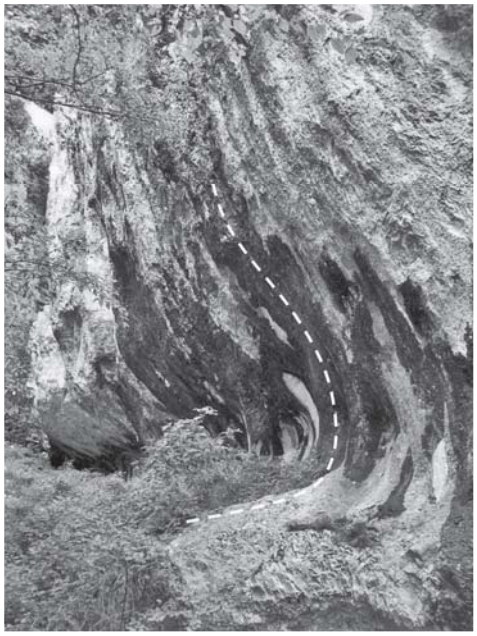

Fig. 19 – Paleofluvial erosion on the rock wall situated between the Fondarca Cave and Arch. The dotted line underlines the site's erosive morphology (photo by G. Brocato).

width is approximately 5 metres and its height slightly exceeds one metre. The cave has an elongated body of irregular shape which extends from South/West to North-East for around 600 m^2, with height ranging between 2 and 5 metres. The vault is initially quite low and later ascends as you proceed towards the interior of the cave, forming the large underground environment. The planking level is initially sub-horizontal and later ascends towards the bottom of the cave. Temperature and humidity in the cave are quite constant: they total 14°C and 82% respectively, as measured during the excavation campaign. The inside of the cave has no flowing water in it.

On the cave's walls and vault, some water dripping and condensation phenomena occur, causing the formation of carbonate deposits such as crusts, ribbed bulges and small stalactites. On the surface of the planking level there also are some sparse carbonate deposits. It is important to remember that a colony of bats (Chiroptera) lives in the cave, generating quite a large amount of excrements which contribute to the deposit formation.

The current planking level consists mainly of a debris deposit, originating in the partial collapse of the vault - which is obstructed by blocks and rocks - and situated in the innermost part of the cave, where two smaller cavities of natural origin connected to the large Karst system can be found. The deposit descends towards the entrance; the slope is initially 30°, then becomes sub-flat, with a slight counter slope. Near the entrance, the deposit probably also includes accumulated material having originated outside the cave.

The debris deposit is generally heterogeneous and includes sparse clasts and blocks. The material situated on the surface mainly consists of large, medium and small-size collapsed calcareous blocks, mostly immersed in a varying quantity of fine-grained matrix whose colour ranges from dark brown to brown, from beige to gray. As one proceeds from the bottom of the cave toward the entrance, the composition of the deposit changes: from very gross grains to small grains, up to loam clay clast sediments (fig. 20).

In the flat area, in the portion of deposits investigated during the excavation, the stratification of the sediment consists of thin clast layers and lenses, in a loam clay matrix, and of some layers composed mainly of clay loam. The size of the clasts is generally less than 10 cm, except for blocks coming from local collapsing of the cave, with sharp edges

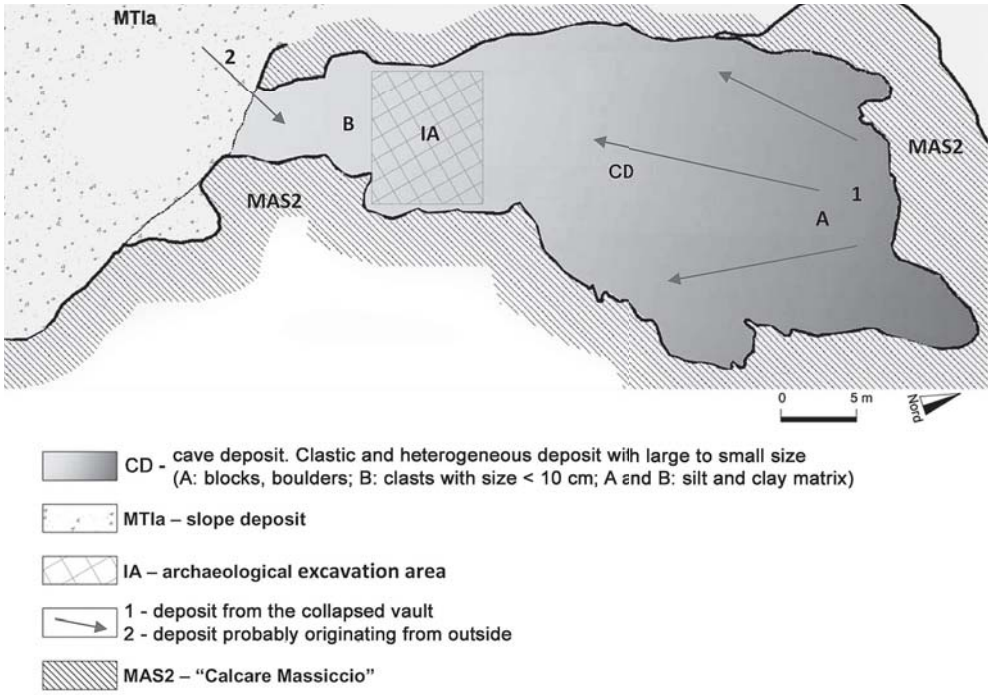

Fig. 20 – Plan of the debris deposit inside the cave (Planimetric survey by F. Bozzo, geological re-elaboration by G. Brocato).

indicating minimum movement or no movement at all.

Archaeological investigation has allowed to identify a complex stratigraphy due to the combination of speleogenesis processes[6], specific environmental conditions and anthropic and animal contribution.

The fast-method geo-morphological analysis of the surface shows that the debris deposit in the cave seems to be heterogeneous from the spatial point of view; the size of the grains decreases as one proceeds from the innermost part of the cave towards the entrance. The deposit, mainly generated by a massive collapse of the vault, is modified by the produce of alteration and rock disaggregation processes occurring all over the underground environment and by external material of natural, animal, and anthropic origin. (*G.B.*)

TOPOGRAPHY AND RELIEF FEATURES

The complex geological and orographic aspects which characterise the calcareous

[6] The main speleogenesis processes are: action of water-based solutions (corrosion and deposit of calcium carbonate); mechanical erosion by water, with transfer and deposit of material; action of gravity, due to vault or wall collapsing and subsequent forming and accumulation of debris - including large-size rubble - at the bottom of the cave (Castiglioni 2000: 231).

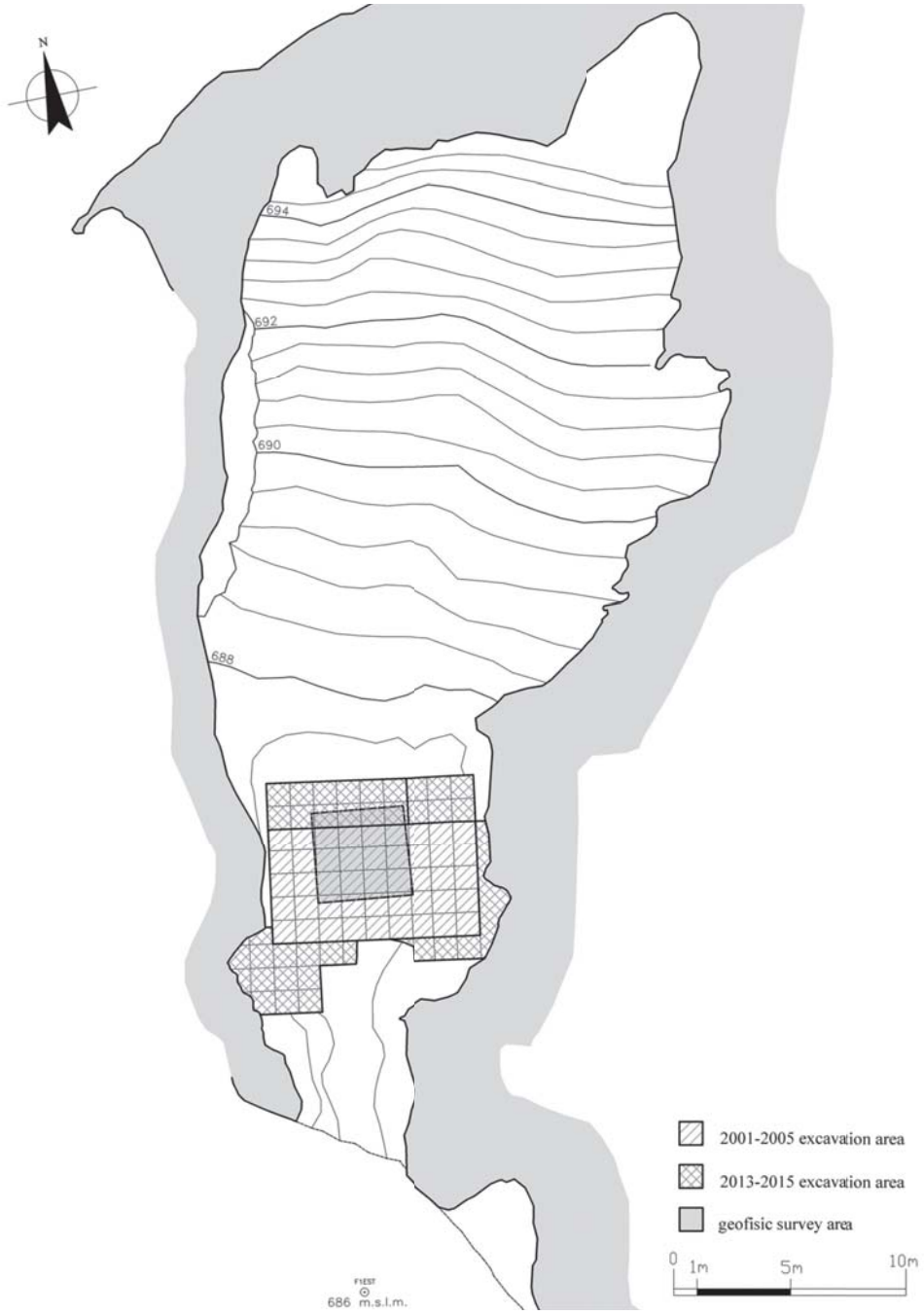

Fig. 21 – Planimetric map of *Grotta delle Nottole* including the location of excavation areas and the area investigated with a georadar – 2015 campaign (by F. Bozzo).

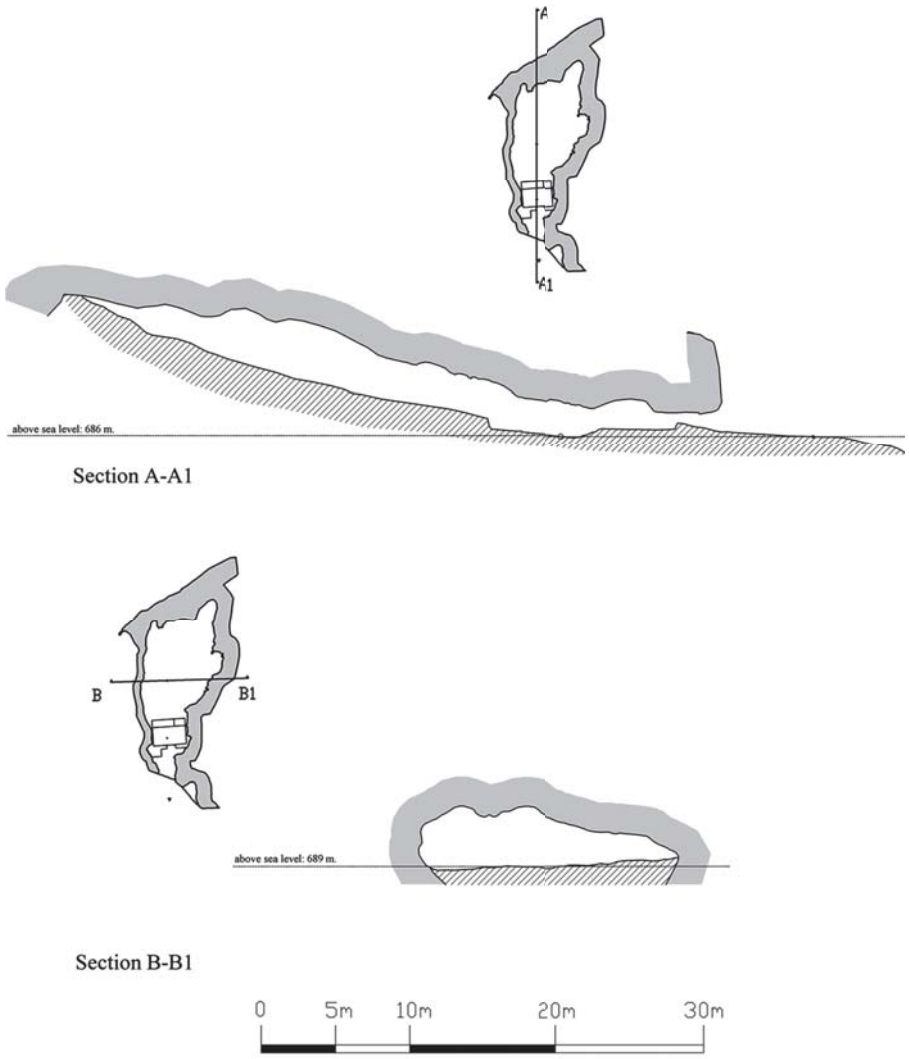

Fig. 22 – Orthogonal sections of *Grotta delle Nottole* – 2015 campaign (by F. Bozzo).

formation of Mount Nerone have made it extremely difficult to set the internal volumetric layout of the underground cavity of *Grotta delle Nottole* into a wider background (figs 21, 22, 23). The spur at the entrance of the cave is characterised by the presence of massive vertical walls and several slope variations, making it impossible to get a general view of the cave. The combined presence of these elements deprives analysis of a vital element for the correct interpretation of the site's anthropisation processes occurring since ancient times. Therefore, a set of topographical surveys was organised. Together with the usual excavation

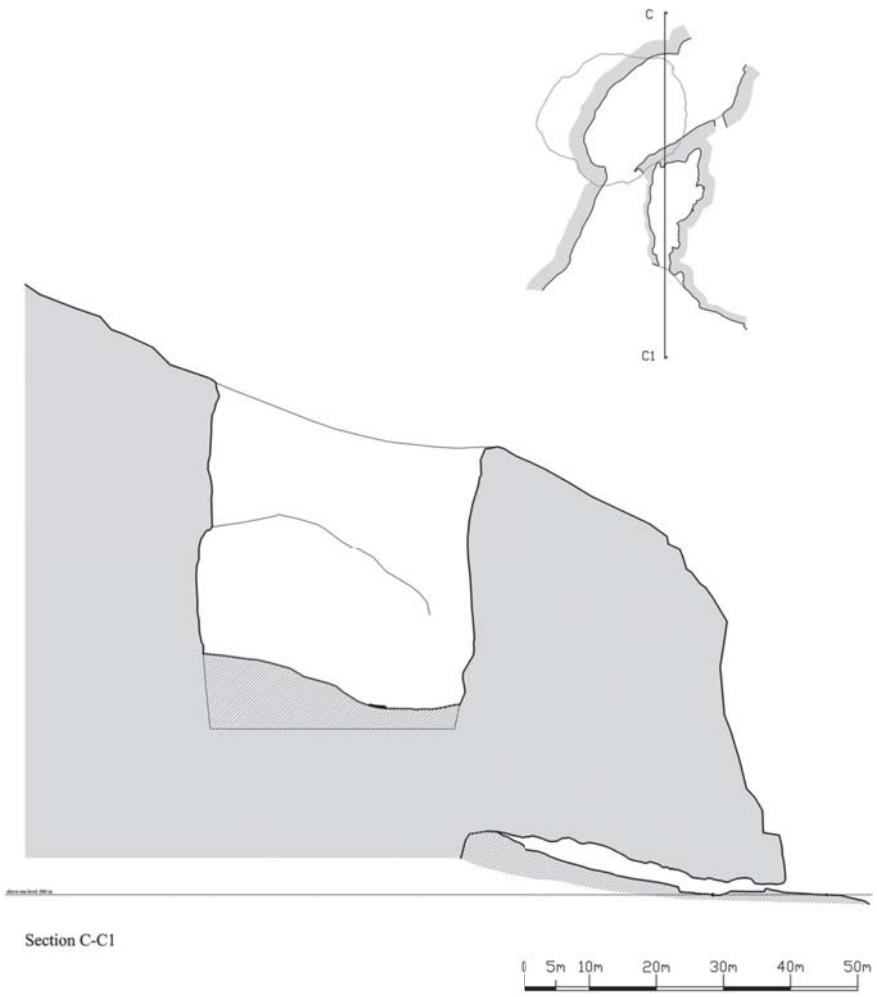

Fig. 23 – Section of *Grotta delle Nottole* and connection to the natural context above surrounding the Fondarca Arch (by F. Bozzo).

documentation, the survey outcomes were aimed at clarifying the relation between the internal and the external areas of the cave. Specific attention was devoted to the possible connection between the tunnels in the innermost sector of the cave and the remains of a ponor situated on the S-SE side of the sinkhole, behind the Fondarca Arch. These tunnels are barely identifiable because they are covered by large mounds of debris. With the help of a total station, a grid of polyline points was established. The polyline points included old and new points of reference in the cave and covered the entire external area, thus establishing the topographical basis needed to make connections with direct, indirect and photogrammetry surveys. The polyline

was connected to targets for the analytical orthorectification of the photographs shot from a drone[7]. The resulting photogrammetry images were later connected to the general planymetry via Autocad and superimposed onto the internal volumetric layout of the cave[8] (fig. 24). The creation of this topographic map has allowed to get more detailed information and to clarify some of the problematic aspects regarding the existing connections between the underground area and the external sinkhole. The two areas apparently connect at the furthest detectable northern end of the cave; however, the lowest point of the northern end is estimated to be at a height of approximately 20 mt. The presence of a connection between the ponor and the cave can be hypothesised at the far N-E end of the cave, with a linear distance of approximately 13 metres and a difference in height (between the summit of the vaults) totalling approximately 19 metres. It must be specified that, considering the current state of the investigations and taking into conside-ration the limitations imposed on data reading by the mounds of debris, this connection can only be hypothesised. As for the internal topography of the cave is concerned, the first step was to design a general planimetric map which takes into consideration the cave's profile and the large collapsed portions of the cave. The latter contribute to the extreme steepness of the current planking level. Therefore, some level curves have been added to the planimetric map. The curves where drawn at regular intervals of 40 cm of height and obtained thanks to a re-elaborated version[9] of a tight grid of height points on the planking level. The squaring pattern of the old and new excavation areas and of the area where geophysical investigations were carried out have been included in the planimetric map. The traditional archaeological documentation was completed by two sections: a longitudinal section (A-A^1) proceeding W-NW/E-SE, and a transverse one (B-B^1) proceeding N-NE/S-SW, so as to depict both the volumes of the vault and the pattern of formation of the cave's fill layers. (*F.B.*)

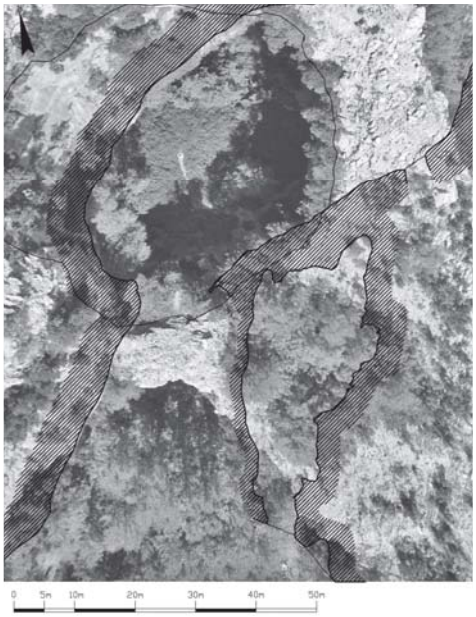

Fig. 24 – Planimetric map superimposed onto the photogrammetry image of the sinkhole (by F. Bozzo).

[7] An hexacopter drone was used for taking zenital photos. The drone had a carbon frame with self-stabilisation on two axes. A 10-30 lense Nikon Mirrorless photo camera was mounted on it.

[8] Pictures have been processed via Perspective Rectifier software.

[9] Contour lines have been drawn thanks to the Leica LGE 11.00 software.

GEORADAR TEST IN THE *FONDARCA CAVE*

Scientific research carried out on the Fondarca's site was further completed by georadar investigations, aimed at determining the bedrock share and the characteristics of the archaeological stratigraphy. This method allows to detect traces of buried bodies and stratigraphies both speedily and accurately, thus completing the information provided thanks to the documentation drawn during excavation (Boschi 2012). In this specific case, investigations were carried out with an instrument capable of recording data in real time, to verify the level of prospection's penetration and the characteristics of stratification. The area of study was defined by creating an actual grid (4x4 m), with topographic nails at the planking level, which was then georeferenced with the aid of a total station. During the acquisition phase, a sampling rate of 0.5 meters between a prospection and the next one was used, both in the transverse and in the longitudinal sections. When all the profiles were correctly displayed, we moved to the processing phase, using various filters and gains specifically aimed at improving interpretation (Conyers, Goodman 2007). Special filters were used to eliminate external noise (temporal filters) and to be applied on the scan directions (spatial filters) After the profiles had been filtered, the first goal was to identify and localize the buried objects and, where possible, to reconstruct their shape and size. A key factor to quickly achieve these results was the processing of the time slices (or slice maps) (Conyers, Goodman 2007), which allowed to correctly display macroscopic wave amplification differences inside the reference grid. Differences in amplification usually correspond to changes in sedimentation or to the presence of buried materials and objects. As highlighted in the B Scan, it was possible to determine the depth and grade of the calcareous underlayer. The B scan allowed good penetration of the electromagnetic wave up to 1.50 meters, even though investigations were conducted on moist soil. The processing allowed to reconstruct a tridimensional cross section through the interpolation of the transverse and longitudinal scans, defining the thickness of individual lithostratigraphic units. Therefore, it was possible to uncover the presence of the calcareous underlayer at an altitude ranging between 0.70 and 1.00 metre above the planking level and to define a deteriorating trend from West to East over the origin of the scan grid.

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Azzurra Mascelloni*

The faunal remains collected during both the 2013 and the 2015 excavations are a fairly small sample (588 findings in total) although in good conditions. In this faunal analysis, however, we will describe in detail only 311 remains from the Bronze Age stratigraphic units in *Grotta delle Nottole*.

In the sample (table 1), among general categories, 123 remains were attributed to small herbivores (39,55% of the total), while those of large herbivores are generally rarer (53 findings, 17,04% of the total); the distinction in this case has been dictated mostly by the thickness of bone fragments.

Five remains (1,61% of total) were attributed to the category of small animals; it was impossible, however, to determine whether they belonged to small herbivores or carnivores.

Three remains (0,97% of the total) were attributed to the general category *Sus sp.*: once again, it was impossible to determine whether the pigs were domestic or wild. The remains consisted of two fragments of rib, one of which with cut marks, and a flat bone fragment. The remaining 5 findings (1,61% of total) have not been identified, given the small size of the fragments and the lack of diagnostic elements.

Amongst domestic animals (32,15% of the sample with 100 remains in total), the most frequent are caprovines (NISP=62, 19,93% of the total). In addition to these, 3 sheep (*Ovis aries*) and 1 goat (*Capra hircus*) remains were identified (0,97% and 0,32% of the total respectively).

Caprovines are the most represented species also by Minimum Number of

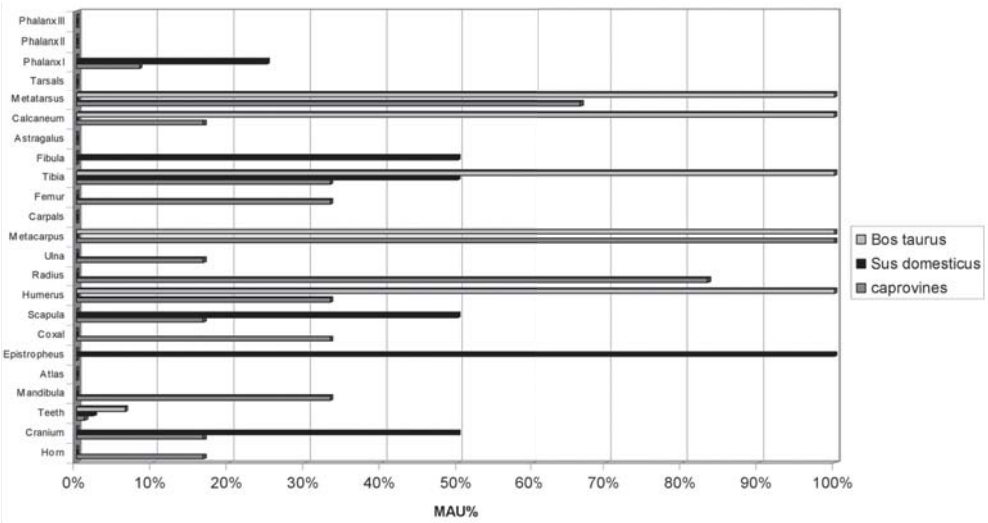


Fig. 25 – Minimum Animal Unit (MAU) for caprovines, *Sus domesticus* and *Bos taurus*.

Individuals (MNI), with 5 identified individuals (31,25% of the total MNI). Among these, it was possible to identify a perinatal (age at death under 2 months) thanks to a metacarpal whose epiphyses are not fused yet; instead, an individual of about 12 months was identified by observing the degree of dentine wear on the third and fourth premolar and the first molar found in the fragment of a mandible, while another fragment of hemimandible containing all the teeth from the third premolar to the third molar belonged to an animal of about 12-24 months. A prime adult of approximately 24-30 months has been identified thanks to a freshly fused distal epiphysis of the femur, while the last individual is already in the senile category, since a first or second lower molar has been attributed to a caprovine of 4/8 years, given the high degree of dentine wear.

The caprovines' skeleton appears to be quite complete (fig. 26), since also bones such as the phalanx and the calcaneum were found, usually discarded during the dismemberment operations; these data confirm that caprovines were probably killed and slaughtered *in situ*.

The Archaeozoological Index of Minimum Animal Unit (MAU) shown in table 1 referring to the main domestic species points out that the most represented portions for caprovines are the metapodials and the radio, followed by the humerus, femur and tibia; this pattern is clearly compatible with meat exploitation. The location of cut marks and split marks can be related to the dismemberment of the carcass, due to their location in correspondence of the major anatomical joints. Next to slaughtering evidence it was possible to identify traces of burning on three radio portions (all

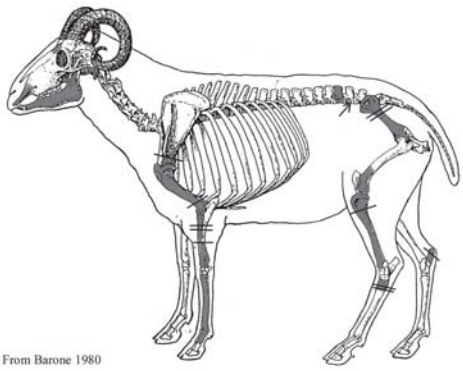


Fig. 26 – Caprovines anatomical elements distribution and cut marks localisation.

pertinent to the same individual) and on a coxal fragment. Given the scarcity of available data and the presence of numerous and widespread combustion areas in Bronze Age levels, it is not possible to determine whether the combustion is linked to food preparing or to post-depositional events.

The pig (*Sus domesticus*), of which 17 remains have been found (5,47% of the total), is the second most common specimen, followed by cattle (*Bos taurus*), with 16 remains (5,14 % of the total).

The MNI for pigs is 3 (18,75 % of the total): it was possible to identify a perinatal with age at death under 2 months thanks to the finding of a complete tibia whose epiphyses are not fused, while the dentine

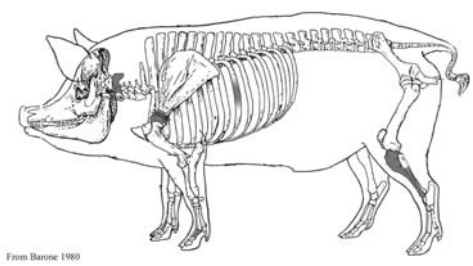


Fig. 27 – Pig (*Sus domesticus)* anatomical elements distribution and cut marks localisation.

wear of a lower first molar indicates the presence of a second young animal of about 7- 11 months. The last individual is a generic adult over 20 months, as proved by the recovery of a first completely fused phalanx.

The pig remains show an interesting distribution pattern of anatomical portions. It must be noticed (fig. 27) how the skeleton is represented in almost all its major skeletal districts; therefore, it is possible to draw the conclusion that individuals belonging to this species were killed and slaughtered at the site.

Cut marks are situated on the occipital condyle of a young individual, while some splits affect the scapular joint area of an adult. Both pieces of evidence can be interpreted as the result of dismemberment actions. No traces of burning were found on pig remains.

The MAU data (fig. 25) are misrepresented by the fact that almost all the anatomical portions are represented by a single fragment and in the calculation of the MNE (from which the MAU derives), the more frequent skeleton anatomical portions such as the phalanges are usually underestimated, while the axis is the most frequent anatomical part.

A single cattle (*Bos taurus*) individual has emerged from the analysis of the faunal remains (6,25 % of the total individuals); it is a prime adult of about 3-4 years, identified by observing the dental wear of some fragments of the mandible and maxilla with teeth; other osteological remains are compatible with this result.

As for the cattle is concerned, the collected remains consist almost exclusively of portions of both front and rear legs; the calculation of the MAU shows that they all are equally represented (table 1 and fig. 28). This result is due to the fact that

Taxon	NISP	MNI	NISP%	MNI%
Bos taurus	16	1	5,14	6,25
Sus domesticus	17	3	5,47	18,75
Capra hircus	1	5	0,32	31,25
Ovis aries	3		0,97	
caprovines	62		19,93	
Canis familiaris	1	1	0,32	6,25
Domestic animals total	**100**	**10**	**32,15**	**62,5**
Ursus arctos	2	1	0,64	6,25
Cervus elaphus	5	1	1,61	6,25
Capreolus Capreolus	7	1	2,25	6,25
Sus scrofa	5	2	1,61	12,5
Sciurus vulgaris	1	1	0,32	6,25
Wild animals total	**20**	**6**	**6,43**	**37,5**
Large herbivore	53	-	17,04	-
Small herbivore	123	-	39,55	-
Small animal	5	-	1,61	-
Sus sp.	3	-	0,97	-
Martes sp.	1	-	0,32	-
Rodentia sp.	1	-	0,32	-
Not Identified	5	-	1,61	-
Grand total	**311**	**16**	**100**	**100**

Table 1 – NISP and MNI table for the faunal remains from Bronze Age levels in *Grotta delle Nottole.*

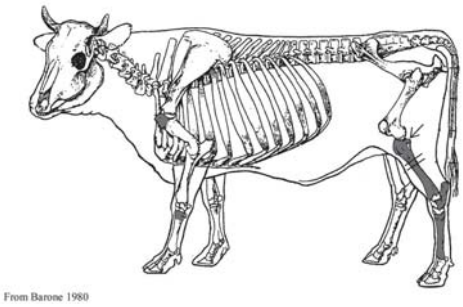


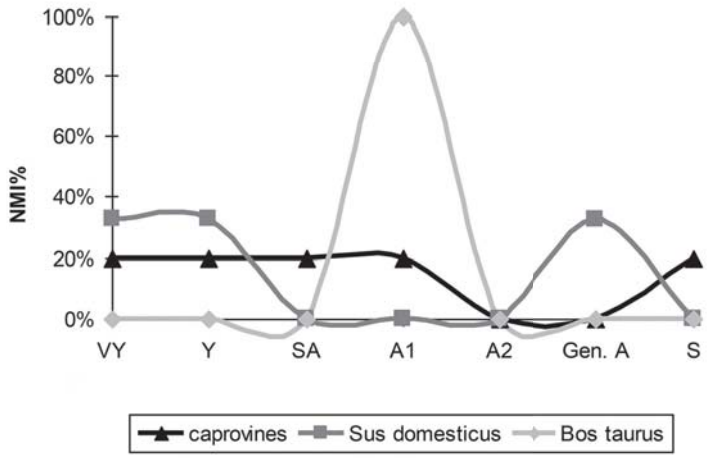
Fig. 28 – Cattle (*Bos taurus*) anatomical elements distribution and cut marks localisation.

probably there was only one adult individual in this faunal assemblage. A complete metatarsal has allowed to calculate a height at the withers of 106,66 cm, based on the coefficients proposed by Matolcsi (De Grossi Mazzorin 2008). This is probably a female individual, although during the Bronze cattle shows a sometimes quite sensitive reduction in size over the values referring to Neolithic contexts, as seems to be the case at *Grotta Sant'Angelo* (Wilkens 1996).

The presence of numerous teeth indicates that probably the individual was killed and slaughtered in the immediate proximity of the cave; however, the archaeological deposit probably includes only the portions richest in meat and the skull.

The mortality curves (fig. 29) of the three domestic species, created according to the MNI index described above show that both the caprovines' and the infant pig categories are well represented: it was possible to identify at least one perinatal individual and one under 12 months.

The mortality curve of caprovines shows that the exploitation of these species was biased towards the use of secondary products, among which the exploitation for milk seems to prevail. However, evidence of exploitation for meat can be inferred by the presence of a subadult and a prime adult, while the presence of a senile individual could be linked to exploitation for wool, confirmed by the finding of a spindle in US 105. Caprovines certainly had an economic and livelihood significance, since they provided a wide range of resources and were perfectly



adapted to the environment around the cave, where they could easily be bred. However, given the particular archaeological context, it is not certain that the high infant mortality is connected to economic rather than purely cultual aspects.

Regarding the pig, economic interest lies in its meat yield; however, the prevailing presence of individuals under one year of age is not compatible with this kind of exploitation. The presence of perinatal individuals, especially in the pig's case, is not unusual in Bronze Age cultual contexts, like, for example, Cave 10 at *Sorgenti della Nova* (De Grossi Mazzorin, Minniti 2002; Minniti 2008), where over 60% of pig remains belonged to foetal or infant individuals. Another interesting piece of evidence can be found in data from the horizons of the Early and Middle Bronze age Cave of Mora Cavorso in Jenne (Rolfo *et alii* 2013), where foetuses/perinatals make up 14,8% of the caprovines and even 57,4 % of the pigs.

As far as cattle is concerned, since the only identified individual is a prime adult, it can be assumed that the principal aim was the exploitation of this species for meat.

Among the domestic animals, a fragment of proximal epiphysis of a dog's (*Canis familiaris*) ulna was also identified, making up 0,32% of the total. The ulna belongs to an adult individual (6,5% of total MNI). However, data is too scarce to allow more in-depth analysis of the aspects related to the presence of this species in *Grotta delle Nottole*, which is often connected to pig for cultual aspects and rituals (Minniti 2008).

Among wild animals (although they are only represented by a few findings each, for a total of 20 remains, that is, 6,43% of the total), a fairly wide range of species was found. Cervids prevail with 12 remains in total: these include 7 fragments (2,25% of the total) attributable to the roe deer (*Capreolus capreolus*) and 5 (1,61% of total) to the red deer (*Cervus elaphus*). Both species are represented by one individual each, that is, 6,25% each of the total. The red deer found in the Bronze Age levels of *Grotta delle Nottole* was an adult animal: almost exclusively anatomical portions related to the extremities were found. Determining the exact age at death according to these findings was impossible. Some phalanx and pelvis fragments show traces of cut marks. These traces' position, together with the selection of anatomical portions, indicates that this animal was hunted in the wood areas around the cave and probably skinned and butchered on site.

The roe deer (*Capreolus capreolus*) remains are attributable to a single individual aged 12-18 months at death, according to the degree of tooth wear and the antler fragments, which already bear hints of ramifications. For this species, a wide variety of anatomical portions was found: next to legs bones some cranial portions and fragments of the antler were found. On the distal epiphisis of a tibia traces of cut marks compatible with the dismemberment of the carcass were indentified. The antler fragments do not show signs of processing; therefore, at the current state of research it is not possible to prove the exploitation of these animals for the creation of instruments with the help of hard materials. However, it is not possible to exclude that the presence of these remains has had a votive meaning.

During the excavations, 5 remains of wild boar (*Sus scrofa*) (1,61% of the total) were found and attributed to two different

individuals (12,5% of the total), both adults: one of about 20 months (presence of a first phalanx already fused) and one of 3-4 years according to tooth wear analysis of a mandibular fragment. This species was hunted in the wood area around the cave for its meat yield, although it is possible that wild boar was the object of cult practices, similarly to what has been conjecture about the domestic form. The mandible described above was in fact found in two fragments in the fill (US 148) of a small pit (US 149) situated in the D1 square, dug in the ground and surrounded by stones on three sides. The two pieces, both related to a single hemimandible of a female wild boar, were laid on the bottom of the pit, along with two fragments of unidentified long bone and pottery fragments. The position of these materials at the bottom of this small pit may shows that the items did not accumulate in that specific place for natural causes; it is possible to consider these items as a part of a votive ritual offering, probably linked to fertility and reproduction rituals, since the remains belong to a female individual. In addition to the lower mandibula fragments recovered in this small pit, a central metapodial, a first phalanx and a fragment of the humerus were also found in the excavated area. None of these remains bears traces of butchering or burning.

It is worth mentioning the discovery of 2 remains (0,47% of total) of bear (*Ursus arctos*) in US 105 and 123: a fragment of the scapular blade and one of the tibia, which can be both attributed to a single mature individual. Cut marks (figs. 30, 31) were identified on both findings; the presence of this species in the faunal assemblage is thus definitely linked to human activity. The cut marks on the distal tibia and on the scapular blade are to be referred to skinning practices, while the split on the scapula is rather related to the dismemberment of the carcass.

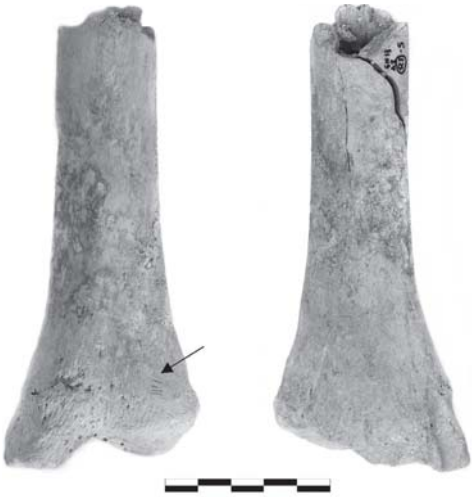


Fig. 30 – Bear (*Ursus arctos*) tibia with cutting traces.

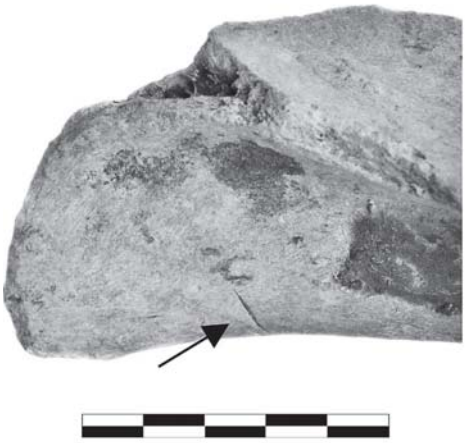


Fig. 31 – Bear (*Ursus arctos*) scapular fragment with split.

Finally, evidence of a very rare *mustelidae* (*Martes sp.*), mouse (*Sciurus vulgaris*) was found, together with the remains of other unidentified rodents

(*Rodentia sp.*). The species' very sporadic presence in the faunal assemblage is probably not linked to human activity, but to their living habits. These species left gnaw marks and pit marks on some of the bones (NR = 20). These findings confirm that the occupation of the cave was probably seasonal, and in periods when the cave was not attended carnivores and rodents scavenged animal remains left inside the cave in the periods when the cave was attended. The age of death data from the other identified species confirms this hypothesis by placing occupation moments from June to July and between December and January, when the first and second annual delivery took place (Minniti 2008).

CONCLUSIONS

The faunal assemblage of *Grotta delle Nottole*, although it only accounts for a fairly small number of remains from the phases of the Bronze Age, opens an interesting interpretation scenario that supports the hypothesis stemming from the analysis of contexts and other classes of findings. The evidence of behaviour patterns related to the sphere of rites, such as the presence of numerous combustion areas and small pits on living surfaces, is supported by the faunal assemblage analysis, which features unusual characters based on the typical composition of faunas from housing areas (of which, however, the cave does not bear evidence).

Indeed, the age at death of individuals belonging to some of the main domestic species identified on the site (such as caprovines and pig) deviates from the usual pattern of exploitation for economic purposes and subsistence. The prevalence of perinatal and very young individuals (in particular among the pigs) is a common feature in contexts with clear ritual characterization (Minniti 2008; Rolfo *et alii* 2013; Negroni Catacchio, Cardosa 2015). The association between the pig's remains and small cavities in the ground is one of the aspects of greater evidence in contexts used for ritual and votive purposes. A manifest example is offered by all the artificial underground structures of *Sorgenti della Nova*, where these structures are, moreover, accompanied by vast burned areas and carbon concentrations (De Grossi Mazzorin, Minniti 2002). The discovery of a female wild boar mandible placed in a small pit in *Grotta delle Nottole* somehow confirms the link between pigs – whether domestic or wild – and the concept of fertility and regeneration that is expressed in ritual and votive forms involving these animals.

Among the domestic species, the presence of cattle is especially interesting, as the land surrounding the cave is not suitable for breeding this species. All the remains found in the Bronze levels can be attributed to a single individual, which was probably selected for its optimal meat yield, since inside the cave bones were found mostly from hindquarters. Next to these, however, also numerous teeth both from lower and upper jaws were found; therefore, it can be assumed that also the skull has been laid in the cavity. The age range and the anatomical portions of the cattle seem to indicate that the animal was part of a larger ritual and probably was killed and slaughtered outside the cave, where only selected anatomical portions were then introduced.

Also wild species are of particular interest: they consist of mostly cervids, wild boar and bear. The cervids were hunted in the wood areas surrounding the

cave and then skinned and butchered on site. The presence of roe deer antlers and cranial fragments might also be related to votive aspects, which might be connected to what has been observed in the range of cattle anatomical portions.

The wild boar was certainly the object of rituals, as confirmed by the finding of jaw fragments belonging to a female individual in the particular context of pit (US 149). The sex selection of this individual might be referred to reproductive and fecundity aspects.

Finally, the presence of a bear in the faunal assemblage might probably be linked to human activity since several cut marks have been identified on both bones; however, given the scarcity of data related to wildlife species, at the current state of research it is not possible to state with certainty that the presence of bears in *Grotta delle Nottole* was linked to cultual purposes rather than subsistence ones.

Also the seasonal use of the cave, documented by various stratigraphic evidence and confirmed by faunal analysis, cannot be reduced to a residential function; it rather hints at recurring attendance at precise times of the year, an element that often characterises ritual behaviours.

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SPECTROSCOPIC INVESTIGATION OF METAL AND AMBER OBJECTS FROM THE BRONZE-AGE SITE OF FONDARCA

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Claudia Pelosi*
Ulderico Santamaria*

RESEARCH AIMS

The aim of this work is to investigate the composition of some of the objects found in the archaeological context of Fondarca, as explained in the archaeological section of this paper.

In particular, the *fibula* and the small bar and button (described by archaeologists as bronze and amber objects respectively) have been examined. Knowing the constituent materials is especially relevant to the identification of the technological processes used for ancient artefacts and also to making hypotheses about the origins of the materials used, such as amber.

To gather compositional and technological information about the examined object, non-invasive X-ray fluorescence spectroscopy (XRF) and micro-invasive Fourier transform infrared spectroscopy (FTIR) were used.

XRF was applied on the metal objects in order to establish their composition in terms of chemical elements. FTIR was selected as molecular spectroscopic technique to confirm the presence of amber and, possibly, its provenance.

ANALYTICAL METHODS

Amber button fragments (fig. 32) were examined via infrared spectroscopy using a Nicolet Avatar 360 Fourier transform spectrometer. For each fragment, 128 scans were recorded in the 4000 to 400 cm^{-1} spectral range (MIR) in diffuse reflection modality (DRIFT), with a resolution of 4 cm^{-1}. Spectral data was collected using the OMNIC 8.0 (Thermo Fisher Scientific Inc.) software. Samples have been ground with spectrophotometric grade KBr (1% sample in KBr) in an agate mortar. The spectrum of the KBr powder was used as a background.

Metal objects, a *fibula* and a small bar, were analysed via X-ray fluorescence spectroscopy, using the following instrument set-up: Assing Surface Monitor II equipped with Ag tube, operating at 40 kV, 75 μA, spot 2 mm, acquisition time 60 sec.

Five measurement points were selected for the *fibula* and two for the bar. The analysis was performed after cleaning and

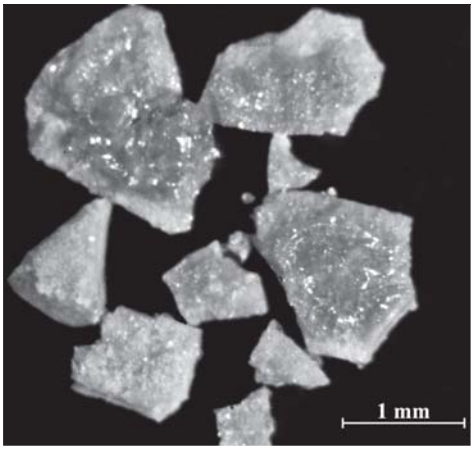

Fig. 32 – Micro-fragments detached from the amber button. One fragment was examined by FTIR spectroscopy.

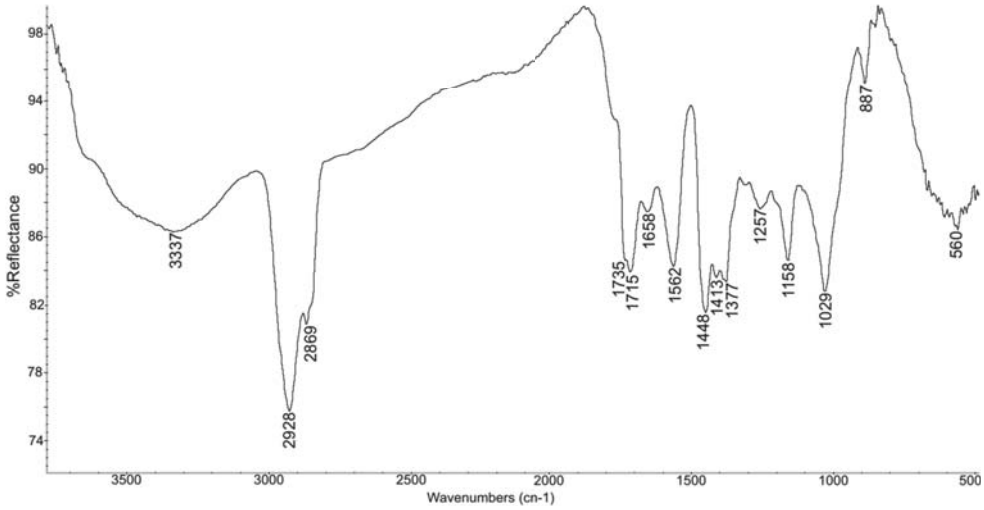

Fig. 33 – FTIR spectrum, in diffuse reflectance modality, of one micro-fragment from the amber button as shown in fig. 39.

removal of the concretion layers from the surface of the objects.

RESULTS AND DISCUSSION

The FTIR spectrum of button fragment is shown in fig. 33. By comparing the infrared spectrum with the literature database and works, it is possible to remark the presence of amber (Angelini, Bellintani 2005). The characteristics bands of infrared spectrum seem to refer to Baltic amber, especially the so-called Baltic shoulder at 1257-1158 cm^{-1} (Angelini, Bellintani 2005; Khanjian *et alii* 2013). The presence of an evident band at 1562 cm^{-1} has been attributed to C-O asymmetric stretching metal carboxylates, which supposedly are the products of reaction between metal salts and carboxylic acid group in amber (Khanjian *et alii* 2013).

The results of the XRF analysis carried out on metal objects are summarised in Table 2.

The *foliated violin-bow fibula* appears well-preserved, apart from several corrosion patinas.

The XRF analysis performed on points 1-5 (see fig. 34) allowed to determine the elementary compositions, starting from a layer of about 100-150 μm, thanks to the penetration capability of X-rays. As a consequence, the results cannot be considered strictly quantitative due to the matrix effect of the oxidation layer. However, removing the corrosion layer was deemed inappropriate due to the fragility of the artefact. In fact, the presence of a diffused pitting phenomenon might cause material loss and, therefore, alter a surface which currently appears well preserved and legible.

The presence of corrosion patinas made it imperative to study the material composition from a qualitative and semi-

Description	Values	Ca	Fe	Ni	Cu	As	Sn	Pb
1 fibula – green area on the edge, side 1	**cps**	126	134		9171	134	192	
	%	1.29	1.37		93.99	1.37	1.97	
2 fibula – brown area, side 1	**cps**	280	289	225	24247	197	357	
	%	1.09	1.13	0.88	94.73	0.77	1.39	
3 fibula - green area, side 1	**cps**	238	237	226	21445	176	278	
	%	1.05	1.05	1.00	94.89	0.78	1.23	
4 fibula - brown area, side 2	**cps**	276	246	312	22013	169	301	
	%	1.18	1.06	1.34	94.41	0.72	1.29	
5 fibula - green area, side 2	**cps**	1185	253	264	17975	205	458	
	%	5.83	1.24	1.30	88.37	1.01	2.25	
1 bar - section	**cps**	203	88		15759		241	75
	%	1.24	0.54		96.29		1.47	0.46
2 bar – brown area	**cps**	519	253		14753		419	116
	%	3.23	1.58		91.86		2.61	0.72

Table 2 – Results of the XRF analysis expressed as cps (counts per seconds) and as percentage (%) of the main detected elements.

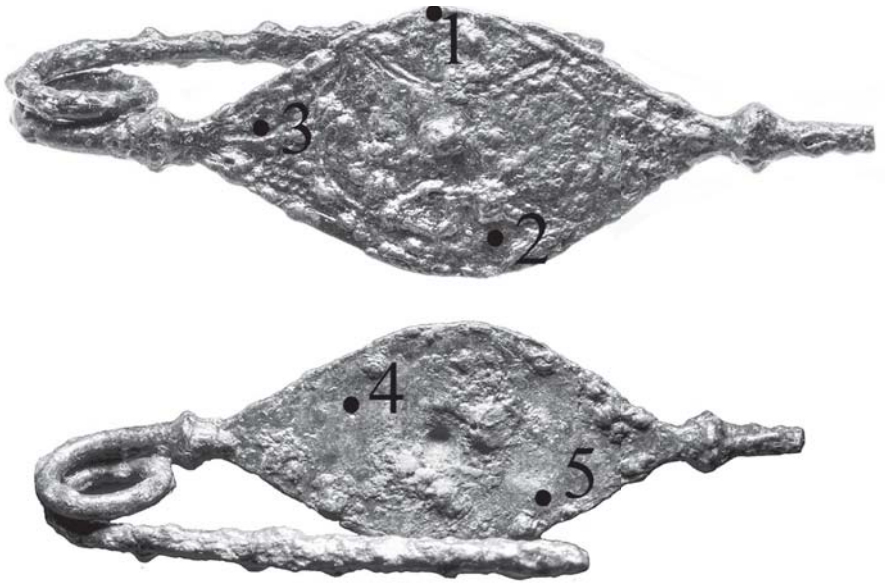

Fig. 34 – Metal fibula with the points analysed by XRF spectroscopy.

quantitative point of view by calculating the relative percentages (table 2). In fact, in table 2, % values are calculated by obtaining the ratio of the element line counts and the total counts of all detected elements and then by multiplicating per cent.

According to the results reported in

table 2, the *foliated violin-bow fibula* is made of bronze alloy with a low content of tin (less than 2%). Copper is the main detected element, with percentage values ranging from 88 to 94%. This data suggests that a copper-rich alloy was used, whose mechanical properties were suitable for the production of the Fondarca *fibula* foil (Dungworth 1997: 908-909).

Moreover, in the examined points low percentages (about 1%) of iron (Fe), nickel (Ni) and arsenic (As) have also been detected. The presence of iron can be associated both to its slag-forming function in the copper extraction processes and to the fusion practices involving the use of iron (Giardino 1998; Gargani *et alii* 1993).

The presence of about 1% As in all the examined points suggests that arsenic was probably among the extracted minerals. The intentional addition of arsenic should give medium (2.5-6%) or high (6%) percentage values for this element, as investigated by other authors (Giardino 1998: 185).

Values lower than 2% have been associated to the presence of this element in the mineral used for copper extraction (Lechtman, Klein 1999).

Concerning Ni, the values close to 1% suggest that this element was probably among the extracted minerals; besides, the presence of Ni in this percentage can also be due to its use in metal-working processes (Gargani, Spinedi, Baffetti 1993). This hypothesis may be supported by evidence of a non-homogeneous distribution of Ni, which has been found only in points 2-5.

Finally, calcium has been detected in percentages ranging from approximately 1% to 6%. The presence of calcium can be associated to soil residues in the corrosion patinas.

The small bar is characterized by diffused corrosion on the surface but also by local degradation phenomena of the metal alloy (Scott 1991; Giardino 1998: 212). Two polished areas are clearly visible on the bar surface in correspondence of the section (XRF point 1 in fig. 35) and along the main axis (XRF point 2 in fig. 35).

The elements detected in the two examined points are copper (average value 94%), tin (average value 2%) and lead (average value 1%). The addition of lead to the metal alloy had the function of improving some physical

Fig. 35 – Small metal bar with the points analysed by XRF spectroscopy.

properties such as workability (Gargani *et alii* 1993).

Iron and calcium have been also detected and their presence can be interpreted in the same way as for the *fibula*.

CONCLUSIONS

This contribution reported the results of the spectroscopic analysis performed on two metal and one amber objects from the archaeological site of Fondarca. The objects, a *fibula*, a small bar and a button, are attributed to the Bronze age.

The FTIR analysis on some micro-fragments gathered from the detached pieces of the button, confirmed the presence of amber, as constituent material, with the typical Baltic shoulder at 1257-1158 cm^{-1}.

XRF spectroscopy detected the composition of *fibula* and bar, in terms of chemical elements. The *foliated violin-bow fibula* is made of bronze alloy with low content of tin (less than 2%) and some other elements that can be associated to the extraction minerals such as complex copper and iron sulfates (chalcopyrite), copper arsenates and other minerals containing As and Cu.

The little bar is also made of bronze alloy but with the addition of lead, probably with the aim at improving the workability of the material. The bar doesn't contain nickel, suggesting the possible different source of the materials used for the two objects.

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GENERAL CONCLUSIONS

by all the authors

In order to understand the actual function of the Fondarca Cave, it might be useful to list all the functions the cave never fulfilled, based on the available archaeological data. The next necessary step, however, is to formulate a plausible hypothesis regarding the cave's function during the Bronze Age, strictly based on collected evidence. First of all, no traces of human burials have been found during excavation; therefore, it can be reasonably assumed that the cave cannot be included among natural cavities devoted to the cult of the dead and was not used as a necropolis. Secondly, the interior of the cave does not contain open waters such as underground streams or ponds, usually associated with votive depositions (e.g. containers or vegetable remains). Therefore, the cave does not seem to be defined as a place used for cult rituals devoted to the fertility of earth. Besides, those areas of the cave which are the darkest and most difficult to access do not seem to be the most used ones, thus underlining that cave attendance was not selective. Finally, the Fondarca cave could not have been used as a housing facility or animal shelter, because the low and constant temperature, together with a high humidity rate, makes the cave an unsuitable habitat for man or animals[10]. Besides, excavation does not offer any evidence of this use of the cave. Once a whole set of hypotheses about the cave's functions has been dismissed - such hypotheses have been documented in several other central Italy caves, such as the Sentino Gorge - it must be accepted that a precise answer on the actual function of Fondarca cannot be provided. Indeed, it is necessary to recognise that both research carried out so far and, especially, collected evidence, allow to work out a plausible interpretation, but they cannot offer a certain answer. However, the analysis of all the collected evidence and research data can provide a possible interpretation about the purposes of the cavity's attendance during the Bronze Age. First of all, the physical place where the cave is situated must be taken into consideration. The way to the cavity, away from the main road, is impervious and can only be walked on with great difficulty: the path ascends along a steep slope before it gets to the cave's entrance and to the natural arch above. The path is dead-ended, with no exits. Getting to Fondarca is possible by ascending the path. From the naturalistic point of view, the surrounding landscape may arouse strong feelings, just like the caves in the Sentino Gorge. During the Bronze Age, places such as mountain tops, woods and the interior of caves were landscapes carrying a strong ideological and religious value. The Fondarca Cave's stratigraphy clearly shows that the cave was periodically attended. The alternation of extended sterile beige layers and dark, greyish layers, containing a large amount of archaelogical

[10] The cave could have been used as animal shelter, but there are not the right climatic conditions for sheeps and goats.

material, is evidence of cyclical attendance of the cavity. The cave was probably attended in the period between March and September, when the external environment was milder and the cave was easier to reach. In addition, the internal walls did not host colonies of bats in that period. Even today, the bats (*Nyctalus noctula*) are the hypogaeum's typical fauna in autumn and winter. Bats are migratory animals and they cannot be found in the cave during spring and summer; therefore, even the innermost part of the large internal area might have been attended by man. In the cave, open waters cannot be found, but there is plenty of dripping waters, the primary source of formation of stalactites and stalagmites. The only "facilities" found in the anthropised layers are some clearly recognisable fireplaces. Probably, several fires were periodically lit inside the cave. The fauna analysed so far provides several interesting indicators. The presence of an adult bovine, whose remains consist of those bodily parts that are richer in meat, is an odd element in such an impervious area, where breeding an ox would be impossible. The ox is associated to wild species hunted in this territory, such as cervids (red deer and roe deer), wild boars and bears. In any case, some anatomical portions bear traces of slaughtering. A hemimandible of a female wild boar has been deposited at the centre of a small pit (n. 17) surrounded by stones and associated with a pottery fragment. It is a small facility, whose nature is certainly ephemeral; however, in this context, it acquires a specific magical-religious significance. The remains of an adult bear's shoulder blade and tibia bearing marks of cutting by a metal instrument is further evidence of the fact that selected parts of several animals were introduced into the cave (Rubat Borel 2011: 65-66).

The evidence collected so far seems to suggest that the Fondarca Cave, a place notorious for its unique landscape, was periodically - possibly cyclically - attended in the Bronze Age by human groups litting fires and organising ritual banquets with previously selected meat, with ceremonies involving the offering of food deposited into small pits and circles of stones. The bronze *fibula*, the amber button and the pottery itself are evidence of a complex set of cultual relations, deeply rooted in the local area and, at the same time, extending to the central Tyrrhenian and the Emilia area. From the chronological point of view, the cave was undoubtedly used from the Early until the Late Bronze Age; however, recent excavations seem to suggest (based on rare pottery sherds from outside the stratigraphic context) that the cave was already used as early as the Eneolithic phase.

As is the case for several central Italian caves, the memory of these events has been preserved in the Medieval age, when a hermitage was built in the natural arch area (Presciutti *et alii* 2014: 199-200). The remains of the hermitage walls are still visible, bearing traces of elevated facilities: these remains, together with an ancient toponym dedicated to S. Ercolano da Fondarca, are the only concrete vestige of a possible religious use of the area.

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