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From the imprint to the tool: the identification of prehistoric mining implements through the study of digging traces. The case of Grotta della Monaca in Calabria (Italy)

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Introduction

Sometimes prehistoric extractive contexts can turn out to be rather lacking of digging tools employed by ancient miners. In fact, these implements were left where they were used only occasionally. This happened especially when they broke, becoming useless, or when they were stored away in view of a further return to the mine. Therefore archaeologists working in prehistoric extractive sites have to use also indirect evidence to reconstruct the typology of employed tools. Digging traces are thus one of the most important markers; they are able to give often very detailed information about tools set used during mining activities. The case presented in this contribution concerns Grotta della Monaca in Calabria (Italy), a cave rich in iron and copper minerals and intensely frequented since Prehistory for the exploitation of these sources. Within this mine-cave (see Larocca, 2010; Larocca, 2012 for an overall overview), the occurrence of very soft mineralizations has allowed the perfect preservation of several hundreds of prehistoric digging traces. They show very different shapes that have often allowed to make out the tools used in the site between an advanced phase of Neolithic and the beginning of Copper Age (end of the 5th - beginning of the 4th millennium AC).

The underground site and archaeological researches

Grotta della Monaca, located on the Tyrrhenian slope of northern Calabria, is a karst cave that develops within highly fractured calcareous-dolomitic rocks for about 500m in length. The cavity contains abundant iron hydroxides deposits (goethite and lepidocrocite), occurring in each underground space disguised as veins between rocky bedding. In addition copper minerals, particularly carbonates (malachite and azurite), outcrop in the deepest cave sectors, even though by far to a lesser extent. Iron hydroxides and copper carbonates were mined in different prehistoric times. Archaeological researches carried out from 1997 to 2012 have allowed the identification of three different mining phases: the first and most ancient one dates back at the end of Upper Palaeolithic; the second to a final phase of Neolithic; the third and most recent one to the beginning of Copper Age. These extractive phases, recognized and isolated in different cave sectors, have affected firstly iron minerals (Palaeolithic and Neolithic phases), then copper minerals (Eneo-

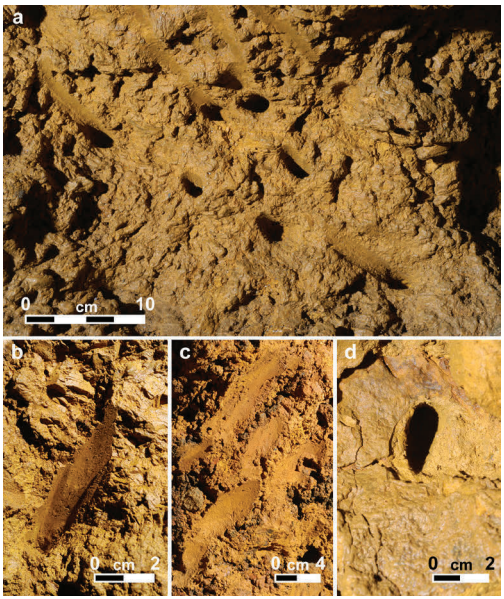

Fig. 1: Prehistoric digging traces on soft iron hydroxides left by tools made from different matters as antler, bone and horn (photo by F. Larocca).

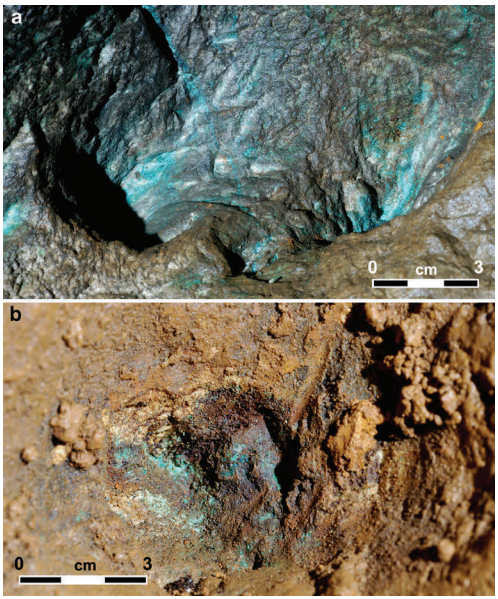

Fig. 2: Prehistoric digging traces on copper carbonates from the deepest cave sectors (photo by F. Larocca).

lithic phase). Palaeolithic mining evidence have been identified only near the cavity entrance (in the so called "Pregrotta"); while Neo-Eneolithic ones are located in the deepest sectors of the cave system ("Sala dei pipistrelli" and "Cunicoli terminali").

Evidence from Pregrotta

Throughout Pregrotta digging traces left by later post-Medieval Period iron hydroxides exploitations (16th-18th century AD) have been long known. Hundreds of these imprints, ascribable to metallic picks, have been identified and recorded. Intense post-Medieval mining activities have disrupted and often deleted the most ancient extractive evidence. For example, Palaeolithic finds, radiocarbon dated to about 20.000 years ago (LTL3580A - 16761 ± 100 BP; 18250-17800 cal AC, 84.6% / 17750-17600 cal AC, 10.8%), only accidentally have reached us: they are attested by a restricted number of flint tools, preserved within a delimited iron deposit saved from next tampering.

During archaeological excavation carried out in Pregrotta loose iron mineral blocks, with stokes traces deeply impressed on their surface, have been often found. These imprints features, with a very irregular shape, have soon excluded the use of metallic picks; in fact they represent a small surviving evidence of most ancient mining activities, certainly dating back to Prehistory. Even though this evidence comes from very disturbed contexts it is comparable with other similar ones found in the innermost cave sector, in which imprints appear both on veins embedded in rock and on loose blocks.

Sala dei pipistrelli and Buca delle impronte

The most significant prehistoric iron hydroxides mining evidence is found particularly in Sala dei pipistrelli. This evidence offers useful data about tools used in extractive activities. Sala dei pipistrelli is a huge completely dark underground place, located in the middle of cave system. Within it several short minor branches open usually near the side walls. One of them is called "Buca delle impronte", literally "Imprints hole": it is the best preserved prehistoric mining context of the whole Grotta della Monaca.

Buca delle impronte is accessible through about a 3m deep shaft, a slight downwards bottleneck opens at its bottom allowing the entrance into an adjoining low and narrow space. Already on the access shaft walls clear digging traces can be observed (*Fig. 1, a*). They appear as stripes mostly with the same orientation and with a slightly curved shape; in their inside, that shows a concave section, are visible scratches parallel in length. These imprints are very similar to those on loose goethite blocks found in Pregrotta as above mentioned. Studies carried out on these imprints show that they were produced by using deer antler picks. This result could be reached thanks to the analysis of the overall imprints shape and above all to the observation of bundles of parallel scratches running lengthwise within stripes. These bundles, displaying a succession of crests and gorges, refer unquestionably to deer antlers outer shape. Other kinds of imprints are visible along the bottleneck walls and particularly in the next narrow and low chamber. Here a thick light yellow goethite vein emerges from calcareous layers. This vein surface is completely covered

for all its extension by several digging traces different in shape and size. The high hydration of the hydroxide has allowed their preservation: being soft this mineral has preserved imprints in negative!

Most of digging traces are ascribed to pointed implements; however other imprints imply the use of tools with sharp and flat point. The lacking of lengthwise parallel stripes within pointed imprints refers to small picks made of material different from deer antlers (*Fig. 1, b*). It can be strongly supposed the use of bone but the recourse to horn or wood for suitably shaped and maybe hafted implements is not to be excluded.

In Buca delle impronte there are also digging traces related to tools used as hoes: iron vein surfaces have been affected by several "hoeings", sometimes with a sideways displacement (*Fig. 1, c*). We do not know the exact nature of this tool but it certainly should have had an arched edge, according to the concave imprints left in negative. In other cases mining tools seem to have been used as a kind of chisels, struck deeper and deeper into the mineral by a series of gradual blows received by a percussion tool, according to the "scalariform" arrangement of the imprints.

Some digging traces certainly refer to the use of small bone shovels made from big mammal scapulas. Maybe these shovels were employed especially in presence of very soft mineral and consequently easily extractable through pressure on vein surface. Also in the case of "shovelfuls" it is possible to recognize a scalariform arrangement of digging traces.

Archaeological excavation carried out in Buca delle impronte, within the chamber next to bottleneck, has investigated up to a maximum depth of 90cm a deposit generated by ancient mining activities. Unfortunately, the tools related to imprints have not been found. Probably they were employed elsewhere or maybe they might lie in sectors still not investigated. However the deposit investigation has revealed several goethite blocks with digging traces on their surfaces. These blocks were associated with abundant charcoals, combustion remains of torches used by miners for underground lighting. Archaeobotanical analysis has identified them with Pinus, sylvestris group: therefore mining activities were carried out using light from torches made of small resinous wooden branches. Radiocarbon dating from some of these charcoals set extractive activities in the first half of 4th millennium cal AC (LTL3582A - 4935 ± 45 BP; 3800-3640 AC, 95.4%).

Evidence from Cunicoli terminali

Other evidence comes from "Cunicoli terminali", the most distant places from surface and developing at the end of Sala dei pipistrelli. They are three and the longest passage is over 60m long. Within them it is hardly possible to stand upright and it is necessary to move forward on all fours or crawling. Here mining activities reconstructions are more difficult than those of Buca delle impronte, as in this hypogean sector iron minerals exploitations overlap and get often confused with copper minerals ones. Turning attention first and foremost to iron minerals, ancient diggings evidence has been found here both in situ (that is on veins surfaces) and on loose blocks.

One of the three passages contains on the roof a rich hydroxide vein, tightly embedded in calcareous layers. Its surface is scattered with digging traces: some of them show a plano-convex

cross section, other an ovoid one. Plano-convex cross section imprints could be ascribed to bone implement, for example a chisel maybe used with other percussion tools. One of them instead derives from a frontal blow inflicted on vein and seems to be left by a goat horn (*Fig. 1, d*). A fragmented goat horn has been actually found in an adjoining passage, even if it has been not near this imprint. The tool has been radiocarbon dated to the half of 4th millennium cal AC (LT-L3579A - 4684 ± 50 BP; 3540-3360 cal AC, 78.3% / 3640-3560 cal AC, 17.1%), therefore in a phase subsequent to mining activities carried out in Buca delle impronte. This implement is nowadays one of the few mining tools found within the cave.

Digging evidence on loose mineral blocks also comes from Cunicoli terminali. A remarkable sample is represented by an imprint deeply impressed on an iron hydroxide compact mass. The sample has preserved a clear trace – 10cm in length – of a powerful deer antler pick stroke.

During the 4th millennium AC copper minerals exploitation, above all malachite, overlaps with iron mining activities. Malachite appears in Cunicoli terminali as thin greenish layers as on calcareous walls as on small stones scattered on the ground and above all enclosed within sedimentary deposits. In some particular cases, quite infrequently, malachite is deposited as small clots within slight rock fractures. Malachite scraping actions on underground passages walls are attested in the whole Cunicoli terminali. Rock portions green in colour, particularly along some passages walls and roofs, show more clear linear marks ascribable to scraping actions (*Fig. 2, a*). This kind of trace is not easy to recognize and it can be often confused with natural grooves. According to calcareous-dolomitic rock hardness, it can be supposed that cupriferous mineral scraping has been carried out using flint or obsidian tools. This evidence is more easily recognizable when malachite lies on soft iron hydroxide substratum: in this case digging traces are perfectly identifiable and explicable. Within the longest passage of Cunicoli terminali digging traces clearly connected with malachite exploitation have been found in some niches in the rock. Malachite, settled on a soft goethite deposit, appears crossed by linear stripes with half-round section (*Fig. 2, b*).

It seems that a bone awl was used for copper carbonate extraction, as attested by two thin oblique stripes survived with the passing of millennia. The will to retrieve even the smallest copper mineral quantity is clear.

Probably copper minerals exploitation from the cave walls has been an occasional event, also because it was of little advantage compared with the resource amount acquired. Within short time cupriferous minerals were sought on the ground, smashing thick concretionary surfaces with grooved hammerstones: under these calcite layers copper carbonates were substantially more conspicuous than on the cave walls! Cupriferous mineral digging traces turn into massive strippings, often difficult to recognize and archaeologically interpret (Larocca, 2011).

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