

# PLAYING WITH THE TIME. EXPERIMENTAL ARCHAEOLOGY AND THE STUDY OF THE PAST

**Editors:** Rodrigo Alonso, Javier Baena & David Canales





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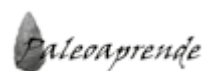
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## EXPERIMENTATION AND TRACES ANALYSIS OF MACRO-LITHIC TOOLS: THE CASE OF *GROTTA DELLA MONACA CAVE* (SANT'AGATA DI ESARO-COSENZA, ITALY)

Experimentación y análisis traceológico  
de herramientas líticas:

El ejemplo de la *Cueva de la Grotta della Monaca*  
(Sant'Agata di Esaro-Cosenza, Italia)

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### Abstract

Grotta della Monaca, located in the south of Italy (North-Western Calabria), is a mine of iron hydroxides and mineral copper. The use of the cave covers a long period: from the Upper Palaeolithic to Post-Medieval times. The cave has been used not only as a mineral resource but also as a burial area, probably serving some form of "cult" role.

Sixty-nine lithic artefacts belonging to the techno-functional categories of querns, grinder/crusher and abrading stones come from the deposits at the entrance of the cave. The multiple roles played by the cave informed the creation of experimental replicas of various activities with the aim creating a reference collection to compare with the archaeological macro-lithic tools.

The first step of the experiments was to collect raw materials similar to those of the archaeological record. In accordance with the petrographic analyses, the raw material comprised sedimentary, metamorphic and igneous rocks.

The experimental reproductions were used as abrading tools for processing deer antler, stone, metal, hide, wood and bone; and also as grinders and grinder/crusher to work minerals, cereals and pulses.

Observation of the archaeological worked surfaces using a stereo-microscope at low magnification enabled the identification of patterns matching the traces left on the experimental specimens by the processing of goethite, an iron hydroxide (in 22 cases), and by stone (in 6 cases). Therefore, Grotta della Monaca can be defined as primarily an atelier, where goethite was processed and subsequently transported out of the cave as powder.

Moreover, through experimentation we found that the hydrated goethite, coming from the inner areas of the cave, is not immediately workable but requires a drying process by exposure to sources of heat or light. We hypothesize a seasonal frequentation of the site, in spring/summer when this process is accelerated or, alternatively, an exposure to artificial sources of heat.

**Keywords:** experimentation, macro-lithic tools, trace analysis, mine.

## Resumen

Grotta della monaca, ubicada en el sur de Italia (Noroeste de Calabria), es una mina de hidróxido de hierro y mineral de cobre. El uso de esta Cueva abarca un largo periodo: del Paleolítico medio a la Edad Moderna. La Cueva ha sido utilizada no solo como una Fuente de recursos minerales, sino como zona de enterramiento, con una probable intención de culto.

Sesenta y nueve herramientas incluidas dentro de las categorías tecno funcionales de molinos, morteros y piedras abrasivas provienen de los depósitos a la entrada de la cueva. Para comprender estos materiales se ha generado una colección de réplicas experimentales que nos permitan conocer el uso de estos objetos.

El primer paso del experimento fue la adquisición de materia prima semejante al registro arqueológico. De acuerdo a los análisis petrográficos, la materia prima se componía de rocas sedimentarias, metamórficas y volcánicas.

Las reproducciones experimentales fueron usadas como herramientas abrasivas Para trabajar asta, piedra, metal, piel, madera y hueso; y también como morteros y molinos para procesar minerales, cereales y legumbres.

La observación de las superficies arqueológicas trabajadas se realizó a través de lupa binocular de bajos aumentos que permitió la identificación de patrones que coinciden con las huellas presentes en las muestras experimentales por el procesamiento de goethita, un hidróxido de hierro (en 22 casos) y de piedra (en 6 casos). Por lo tanto, Grotta della Monaca puede definirse como un taller fundamentalmente, en el que se procesaba goethita y posteriormente era transportada fuera de la cueva en forma de polvo.

Además, a través de la experimentación descubrimos que la goethita hidratada, proveniente de zonas internas de la cueva, no permite su procesamiento inmediato, sino que requiere de un proceso de secado mediante la exposición a fuentes de calor o luz. Nuestra hipótesis sería un uso estacional del yacimiento durante la primavera/verano, cuando el proceso se acelera, o bien alternativamente una exposición a fuentes artificiales de calor.

**Palabras clave:** experimentación, herramientas de piedra, análisis de huellas, mina.

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### INTRODUCTION

Grotta della Monaca is a karst cave located in the region of Calabria (Southern Italy), in Sant'Agata di Esaro (Cosenza) (Figure 1).

The cave is characterized by important mining outcrops: carbonates such as malachite and azurite, sporadic sulphates and phosphates of copper (as brochantite, libethenite and sampleite), while iron ores are predominant (pure goethite, lepidocrocite, yukonite and hematite) (Larocca, 2005; 2011; 2012).

These outcrops, especially those of hydroxides, have been subject to quite intense ancient mining activities in a period dating from the Late Neolithic and Early Eneolithic; while the cultivation of hydroxides continues up to the Post-Medieval periods (Larocca, 2005).

However, over the millennia the cave was frequented not only for mining activity but also as a burial area in the Bronze Age; going back to the Neolithic, it was used to deposit vessels containing vegetable remains or the burnt bone remains of *wild boar* (*sus scrofa*). Such activities cannot be connected to a certain "cult" role, but certainly attest to an intensive use of the site (Larocca, 2005).

Macro-lithic tools were found at the cave entrance ("Pregrotta" area) and 69 were subject to a techno-functional analysis which required extensive archaeological experimentation. Three classes of objects were identified: the querns, grinder/crusher and abrading stone.

### SETTING THE EXPERIMENTAL PROTOCOL

Use-wear analysis is inextricably associated with experimentation, which entails working in laboratory conditions and developing a protocol based on controlled parameters in order to create replicas of the archaeological record (Longo *et al.*, 2001). In our case, this method allowed us to reproduce and to define different combinations of technological and functional traces (Adams *et al.* 2009; Hamon, 2006).

### The petrographic analysis and the collecting of experimental raw materials

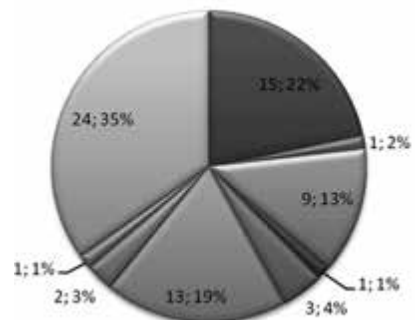
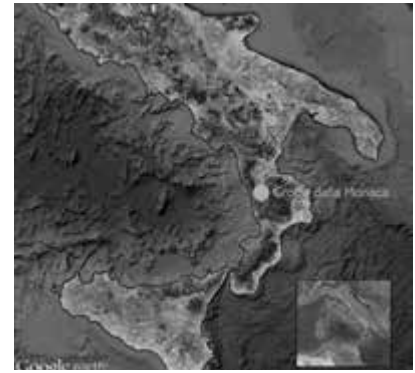
The first step required by the developed protocol was to search for raw materials similar to those used in the archaeological context (Figure 2). Petrographic analyses conducted on the archaeological samples established that the artefacts are composed of: sedimentary rocks (in 66 cases; 96% of the total), metamorphic rocks (in two cases; 3%, to glaucophane schist) and igneous rocks (in one case; 2%, tonalite). The majority of the sedimentary rocks are represented by sandstones (in 15 cases; 22%), limestone (in 13 cases; 19%) and arkose (in nine cases; 13%); analyses showed that quartzarenites (in three cases; 4%), arenite (in one case; 2%) and litoareniti (in one case; 1%) are also present. A small portion of the sample was poorly preserved (in 24 cases; 35%) (Acquafredda, Piccarreta, 2005) (Figure 3).

Thanks to the petrographic data it was possible to identify possible sources of raw materials near the site. Secondary deposits of sedimentary rocks, particularly sandstones, are abundant in a segment of the river Esaro that flow just below Grotta della Monaca. The fragments of sandstone were of different sizes. As the natural morphology of the rocks is already suitable for human use, they do not requires significant technological modifications. Limestone pebbles are also found inside the river whereas igneous and metamorphic rocks are absent from the immediate area. Important deposits of these materials, especially granite, occur a few kilometres from Sant'Agata di Esaro.

### The experimental reference collection

An experimental protocol was developed and implemented for the production of a reference collection. All the data related to the experimentation were organized in a database, including informations on: type of instrument; technological modifications; on what material was the replica used; activity carried out (passive tool, active tool or tool used in combination with other artefact); movement; duration of the experiment.

All replicas were observed with a stereomicroscope, before and after experimental sessions, so as to document changes that occurred on the active surface. The used area of the macro-lithic tools must be observed at various magnifications in order to locate and describe the traces of use. At high magnification, it is possible to observe changes in the grains and note the possible micro-fractures, or rounding which is characteristic of the substance worked.

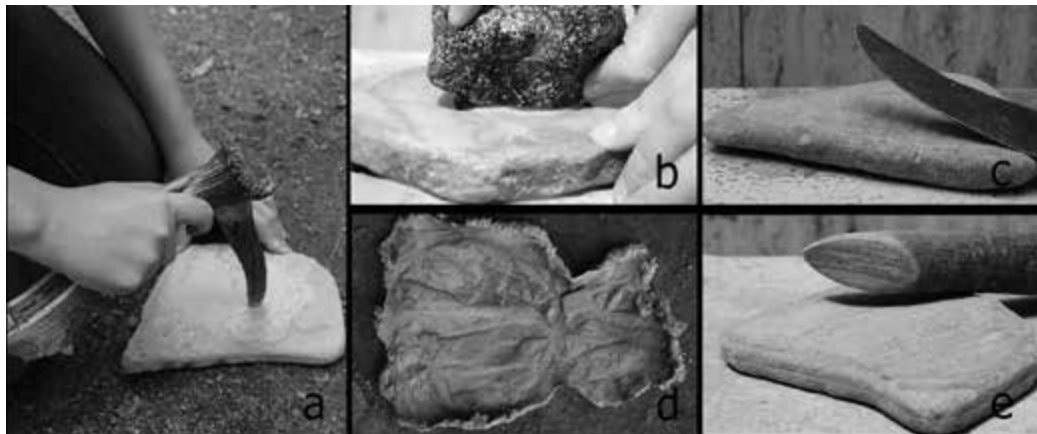


**Figure 1.** Geographic map: indication of the site "Grotta della Monaca" (Calabria-Italy).

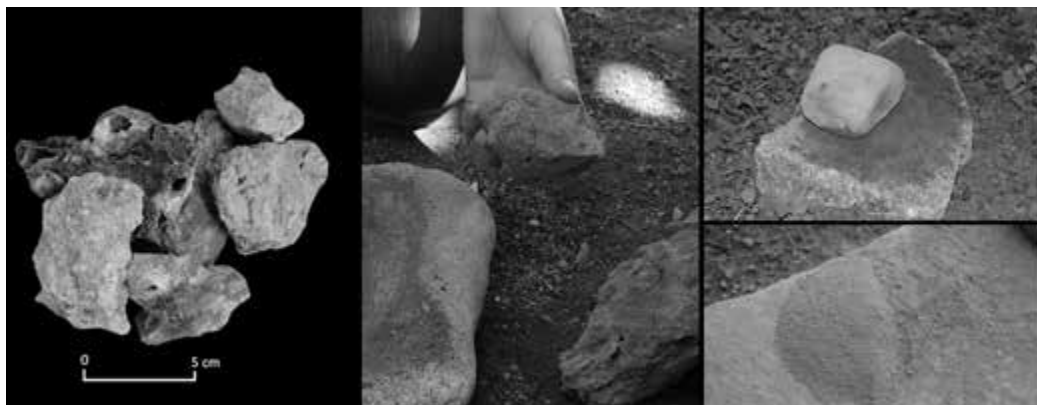
**Figure 2.** Raw material survey in the Esaro river (Calabria-Italy).

**Figure 3.** Rocks more represented at Grotta della Monaca: sandstone 22%; arenite 2%; arkose 13%; litoarenite 1%; quartzarenite 4%; limestone 19%; glaucophane schist 3%; tonalite 1%; indeterminable 35%.

**Figure 4.**  
Experimental tests of abrasion: a) deer antler; b) stone; c) metal; d) hide; e) wood.



**Figure 5.**  
Experimental test: crushing and grinding of goethite.



### THE EXPERIMENTAL TEST

The different usage patterns of Grotta della Monaca over an extended period of time, from the Upper Palaeolithic to the Post-medieval period, have necessitated a wide experimentation, in order to obtain different comparative traces. The tests were designed supposing various possible uses for the macro-lithic tools analysed.

The replicas were used as abrading stones to work deer antler, stone axes, metal objects (copper and iron), leather, bone and wooden objects. Each of the experiments lasted about 1.5/ 2h (Figure 4).

Some replicas were used as querns and grinder/crusher for processing goethite [FeO (OH)], an iron hydroxide. The mineral blocks were crushed and then reduced to powder, using the same handstone as a crusher, in an alternating movement of crushing and grinding, using a quern as a base. Mineral powder (about 3 kg from 5kg of the initial product) was produced, ranging in colour from orange to brown (Figure 5).

During the experimentation was possible to note that the hydrated goethite, coming from the internal areas of the cave, is not immediately workable and requires drying by exposure to sources of light or heat (Figure 6).

Copper carbonates, in particular malachite, were also subjected to experimentation; the small blocks of limestone with the veils of malachite found in the cave, were scraped directly with a chipped stone tool, in our case made of flint, to obtain a colouring powder (8g of powder of malachite-initial blocks of 800g) (Figure 7).

Some experimental tests were performed to check the efficiency of the replicas when processing cereals and legumes. The duration of this test varied between 3/6h.



Figure 6. Experimentation on hydrated goethite.



Figure 7. Experimentation on malachite.

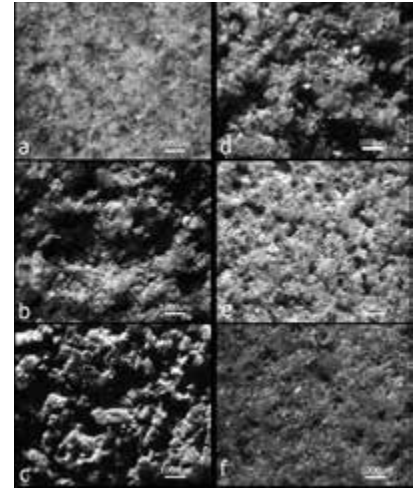


Figure 8. Comparison between the trace observed to the stereomicroscope. Traces of goethite: a) before-experiment; b) after-experiment; c) archaeological traces. Stone abrasion: d) surface before-experiment; e) after-experiment; f) archaeological traces.

## THE RESULTS

The experimentation allowed us to compare the traces that developed on replicas with those visible on the archaeological samples. The use-wear analysis was carried out at the Laboratory of Technological and Functional Analysis of Prehistoric and Protohistoric Artefacts (LTFAPA) of the University of Rome `La Sapienza'. As a result, on 22 macro-lithic tools, including querns and grinder/crusher, displayed traces interpreted as being the result of the pounding and grinding of goethite; six other macro-lithic tools presented traces of abrasion, interpreted as the result of the shaping or re-shaping of lithic objects. The traces related to goethite include disintegration of the microrelief and microfractures on the grains alternating with areas of levelling. Traces on the abrading stone are suggested to be the mechanical levelling of the grains (Figure 8).

The non-workability of hydrated goethite led us to hypothesize that the cave must have been used predominantly during spring/summer; alternatively, the mineral may have been exposed to artificial heating sources.

## ACKNOWLEDGEMENTS

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