

# Rediscovery of the Moratalla amber (Murcia, Spain): a Cretaceous outcrop in the southernmost end of the peninsular amber strip

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## INTRODUCTION

Amber, sometimes called resinite, is ancient tree resin that experienced polymerization. Resins are complex mixtures of terpenoids and other biomolecules. True amber are scattered throughout earth's surface in deposits from the Triassic (ca. 235 MYA) to 40,000 years. For practical reasons fossilized resins that are less than 40,000 years old (the limits of <sup>14</sup>C dating) are called copal. Almost all of the amber produced in the Mesozoic, and much of the Cenozoic amber, is from conifers.

The Spanish amber outcrops are associated with coal deposited on deltaic environments and the main part of them is Albian in age. They are distributed in a strip from the east to the north of the Iberian Peninsula that corresponds to the coastal line during the Early Cretaceous (Peñalver & Delclòs, 2010). The Spanish Mesozoic amber originated from Cheirolepidiaceae and/or Araucariaceae (both families are conifers).

Three are the aspects that may give relevance to an amber outcrop: i) its occurrence near an archaeological site having local amber, ii) historical reports about its existence, and iii) presence of preserved fossils inside its amber (bioinclusions). From the over 120 Cretaceous amber localities known in Spain, only a few could be considered relevant; for example, only seven of them have yielded bioinclusions. The rediscovered amber outcrop at Moratalla at least fits into the second aspect.

## HISTORICAL REPORTS

In González Carvajal (1832), page 547, there is the description of an old mining concession to the priest Blas Navarrete Ayala to obtain amber, gold and silver in Moratalla: "En Madrid á 10 de ... de ... 1630. Célula de S.M. concediendo permiso al licenciado Blas Navarrete Ayala, presbítero, para beneficiar una mina que habia descubierto en término de la villa de *Moratalla*, la cual parecia ser de ambar y otros géneros, como oro y plata segun demostraba en el modo de piedra y tierra, y se hallaba situada en término de la dicha villa, desde las casas de Ondares al rio abajo hasta llegar al rio Orarabe y mil pasos á cada lado del arroyo." Two years later, Canga Argüelles (1834) cited again this amber in the page 314. The interest of the priest by mining gold and silver is clear, but only the amber actually occurs in the Moratalla strata. The amber most likely was exploited to be used in the pharmacopeia of that period. In fact, almost a century later of the discovery of the Moratalla amber, the apothecary Jorge Basilio Flores published in the same province of Murcia a text indicating that the amber was an expensive product used by him to treat specifically the syncope.

A century later of these first two cites, Jiménez de Cisneros (1936) cited it again when he described the amber of Agost in Alicante Province, located relatively close to Moratalla.

## GEOLOGICAL SETTING

Hoedemaeker (1973) cited this amber

at the Barranco de Hondares: "Upstream along the same barranco several sandstone intervals of the Tosca Formation contain large amounts of amber which was exploited in historical times." According to this author the Tosca Formation is constituted by levels of limestones with sandstones. Overlapping the Tosca Formation appears a more or less massive, thick, white and yellowish sugary dolostone sequence devoid of siliciclastic detritus that he named "Ubacas dolostone formation".

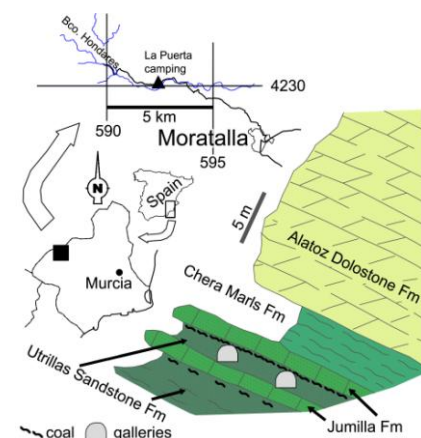


fig. 1. Geographic location of the Moratalla amber and schematic stratigraphy.

More recently, Martín-Chivelet (1992) revised the lithostratigraphy of the Prebetic Zone at the Jumilla-Yecla Plateau. According to this author, the "Arenas de Utrillas" sensu Aguilar et al. (1971) change laterally in the Prebetic Zone to the Jumilla Formation, mainly constituted by limestones with less presence of dolomites, that intercalates with the Utrillas sandstones (Fig. 1).

**palabras clave:** ámbar, Cretácico, minería, micelios fúngicos

**key words:** amber, Cretaceous, mining, fungal mycelia

Overlapping the Jumilla Formation there is a marly interval of the Chera Marls Formation. The dolostones, sandstones, and marls together form the Tosca Formation of Hoedemaeker (1973). The thick dolomite unit named as "Ubacas dolostone formation" by Hoedemaeker (1973) was considered as the Alatoz Dolostone Formation by Martín-Chivelet (1992).



**fig. 2.** Moratalla amber in situ inside the mined galleries; a) orange amber piece associated with abundant coal (scale= 1 euro coin); b) orange amber piece strongly fractured (scale = 3 cm); c) piece with a red core (black arrow) surrounded by a typical light-brown cortex (white arrow).

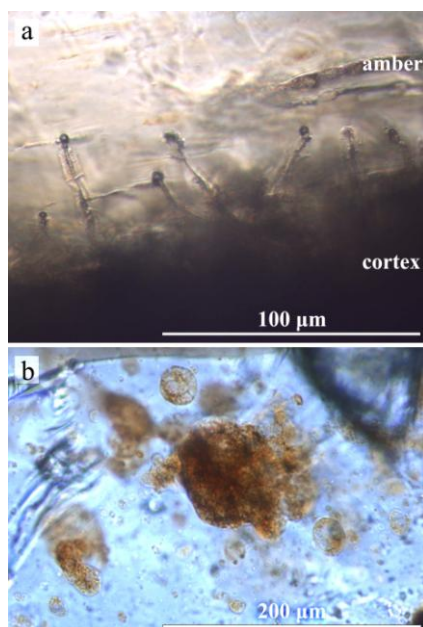
The Utrillas Sandstone and Jumilla interfingering formations are dated as Late Albian p.p.- earliest Cenomanian by Martín-Chivelet (1992) thus this amber may have a Late Albian age.

### OCCURRENCE AND CHARACTERISTICS

In August 2012 the amber outcrop of Moratalla was relocated in the Hondares ravine by the authors (Fig. 1). The amber is concentrated in several sandstone levels at the top of a sequence of sandstones and marls. It occurs in association with carbonaceous plant remains (Fig. 2a), but no fossil conifer charcoal (fusain) or plant cuticles were observed. The main amber concentration was mined in the past in the manner of two horizontal galleries separated by a few meters. The right

gallery is 8 m in length, 3 m in width and 1 m in height, meanwhile the left one is 10 m in length, 2 m in width and 1.8 m in height. They are located close the northwest ravine end. Most likely, Hoedemaeker visited these galleries thus being the reason that he indicated that the Moratalla amber was exploited in historical times.

The amber pieces are from a few millimeters to 5 cm in diameter, and yellow or light orange (Fig. 2b) to dark red in color (Fig. 2c). They generally are strongly fractured (Fig. 2b), surely as a consequence of the highly cemented matrix, thus they are friable and opaque; the minute fragments are transparent under the stereomicroscope. In addition, many amber pieces are strongly altered by oxidation. Some pieces show opaque cortices light brown in color (Fig. 2c) having similar characteristics to those described in Cretaceous European ambers. A microscope preparation showed that these cortices are constituted by a filamentous structure (7-8  $\mu\text{m}$  in diameter) (Fig. 3a); Speranza et al. (2010) identified this kind of structures forming cortices as fungal mycelia. In addition, this amber is very rich in protist-like inclusions (not true protist fossils) (Fig. 3b).



**fig. 3.** True and not true microorganismal fossils as inclusions in the Moratalla amber; a) fungal hyphae in the limit between the cortex and the unaltered core of amber; b) protist-like inclusions.

### DISCUSSION

The area around the Moratalla amber outcrop potentially could provide new

amber localities. A prospection of this area is in progress. The current data indicate that the rediscovered outcrop is not suitable to obtain abundant bioinclusions as insects and other arthropods. The fungal mycelia in the form of cortices are the only fossils observed into this amber up to now. Apart of the historical reports of this amber outcrop, it is relevant because is the southernmost one respect to the Early Cretaceous coastal line. This is the unique amber outcrop known in the Autonomic Community of Murcia and currently it is cataloged as an important geological heritage by the local Historical Heritage Service.

### ACKNOWLEDGEMENTS

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