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# Karstic sediment, Palaeontology & Archaeology

S.03 - Cave deposits

S.08 - Archaeology and Palaeontology in caves



# Bear claw marks in clay: differential conservation in caves harboring bat colonies. Mas d'Azil, Sirach and Lare caves, France

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## Abstract

Numerous traces of bear visits have been found in caves. They generally correspond to claw marks on walls or to cave bear wallows. Sometimes, these clues are not always well preserved and do not allow the confident identification of the presence of bears. The differential preservation of clue on limestone walls can hamper speleologists and paleontologists in their diagnoses. One must not interpret the absence of claw marks on the rock walls of a cave as an absence of bears. In addition to condensation-corrosion, biocorrosion, due in particular to the pervasive presence of bats in a cave, should be considered as a significant process responsible for the removal of traces on limestone walls. After briefly presenting the speleogenetic processes caused by bats, we present the French caves of Mas d'Azil (Ariège), Sirach (Pyrénées-Orientales) and Lare (Alpes-de-Haute-Provence), which have been frequented by bears, to demonstrate these processes. Here, only the claw marks in the clay are preserved, while their extensions on the limestone walls have completely disappeared. These observations confirm that the clues of bear frequentation are preserved in a different way, depending on the history of the cave, but also on the nature of support, rocky or clayey, on which they were produced.

## Résumé

**La conservation différentielle des griffades d'ours dans l'argile dans les grottes abritant des colonies de chauves-souris : grottes de Mas d'Azil, de Sirach et de la Lare.** Des nombreux indices de fréquentation par des ours ont été relevés dans les grottes ; le plus souvent il s'agit de griffades ou de bauges. Parfois, ces indices ne sont pas toujours conservés et ne permettent pas d'identifier l'ours. La conservation variable des traces sur les parois calcaires peut gêner les spéléologues et paléontologues dans leur diagnostic. Il n'est pas possible d'interpréter l'absence de griffades sur les parois rocheuses d'une cavité comme une absence des ours. En effet, la condensation-corrosion, mais surtout la biocorrosion due notamment à la présence massive de chiroptères dans une grotte, peuvent être responsables de la disparition des traces sur les parois calcaires. Après avoir rappelé sommairement les processus de spéléogénèse générés par les chauves-souris, trois cavités françaises fréquentées par les ours permettront d'illustrer le propos. Il s'agit des grottes du Mas d'Azil (Ariège), de Sirach (Pyrénées-Orientales) et de la Lare (Alpes-de-Haute-Provence). Ici, seules les griffades dans l'argile sont préservées, alors que leurs prolongements sur les parois calcaires ont complètement disparu. Ces observations confirment que ces indices de fréquentation animale sont préservés de manière différentielle selon l'histoire de la cavité, mais aussi selon la nature du support, rocheux ou argileux, sur lequel elles ont été réalisées.

## 1. Introduction

Cave bear wallows and claw marks are present in some caves, however, in other caves only bear wallows are present, claw marks on the rock walls are absent.

Examination of caves frequented by bears and recent evidence of biocorrosion generated by bats (AUDRA *et al.*, 2018) can explain this apparent anomaly. The presence of bear claw marks mainly results on the various conservation situations. The question of the absence of bear claws must be considered as well as the question of the absence of art on the walls of prehistoric caves (BRUXELLES *et al.*, 2018).

"Hidden art" has no more foundation than the hidden claw marks of bears, and their absence neither support the conclusion bear absence in the cave, nor the postulate of specific species that did to scratched walls.

The studies in different caves with differential conservation of cave bear claw marks can help to understand and discuss this essential question.



## 2. The effects of biocorrosion on cave walls

The corrosion of cave walls generated or induced by the occupation of caves by wildlife, in particular by the presence of large bat colonies, is called biocorrosion. These processes concern the different types of rocks as sandstone or even migmatites (GUTHERZ & BRUXELLES, 2016). However, the limestone walls of karst caves provide the best examples. The role of bats in the biocorrosion of cave walls may be direct, by their respiration inducing a local rise in temperature, humidity, and CO<sub>2</sub> concentration, and indirect, by the mineralization of guano generating corrosive percolations and release of acidic gases.

While bats are responsible for most of the biocorrosion in caves, condensation-corrosion is also a very active phenomenon in caves to the surface. This phenomenon, mainly maintained by bats, can potentially be supported by other hosts that find refuge in caves.

The massive presence of bats in caves is responsible for a powerful condensation-corrosion which is exerted on the walls and ceilings of the galleries. The volumes of the galleries evolve by expansion of the voids, which causes a significant retreat of the walls with rates of at least 5 to 15 mm / ka (LUNDBERG & MCFARLANE, 2009, 2012, 2015; AUDRA *et al.*, 2018).

Condensation-corrosion processes caused by the prolonged stay of bats lead to a considerable expansion of karst conduits which can reach several meters.

However, it is difficult to appreciate the importance of the retreat of the walls that have disappeared, except when speleothems, display growth laminae. The biocorrosion indifferently cuts the limestone walls and calcite (Fig. 1).

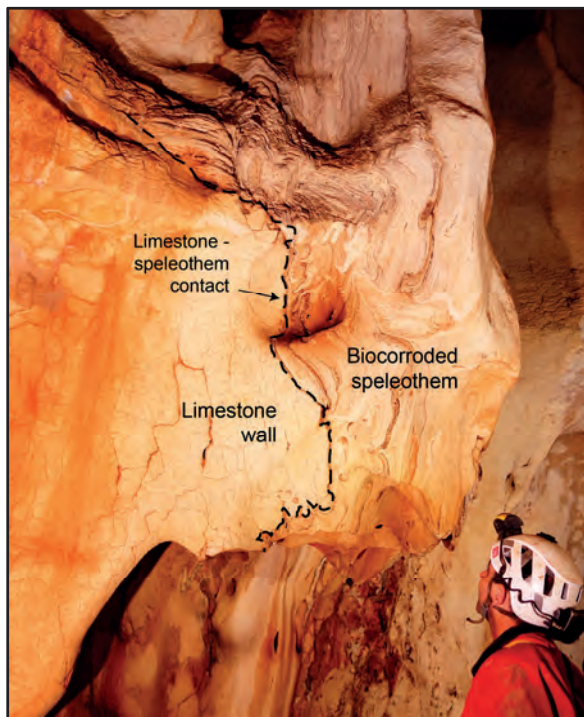


Figure 1: Biocorrosion of the walls of the Guano Chamber, Fairies Cave (Tharoux, Gard, France). To the right, a speleothem showing growth laminae indicates retreat of material. Without the presence of these laminated calcite, it would have been difficult to appreciate the importance of biocorrosion on the rock face (to the left).

## 3. Some examples of differential conservation of claw marks

The Mas d'Azil cave (Ariège) is a prehistoric cave internationally known for its Magdalenian and especially Azilian occupations. The eponymous site of Mas d'Azil is at the origin of the name of this culture from the end of the Paleolithic. It is also an underground bypass of the Arize River. The volumes of the through-cave are large enough to harbor an underground road following the route of the river. A maze of perched galleries develops above and laterally to the underground river. They were formerly directly opened to the surface (north slope). Indeed, the Bats Chamber corresponds to an extreme point, very close to the surface, however collapsed blocks are now closing the access. Formerly, the Bats Chamber was only accessible by narrow conduits to for both animals and men.

From 1956, an artificial tunnel dug in the sediments of the Mandement Chamber (LE GUILLOU, 2013).

In 2017, we discovered bear claw marks on a clay surface in the Bats Chamber (Fig. 3). It was a very astonishing discovery, since no other traces of bear were known in this chamber. The bear that entered in the Bats Chamber through the passages currently plugged (north slope) probably marked all the rock faces, but only those in the clay veneer where biocorrosion is not effective could have been preserved.

The least communication with the surface, whether natural or artificial, allows bats to take up new spaces; and the claw marks left by bears on rocky supports quickly disappeared after biocorrosion effects.

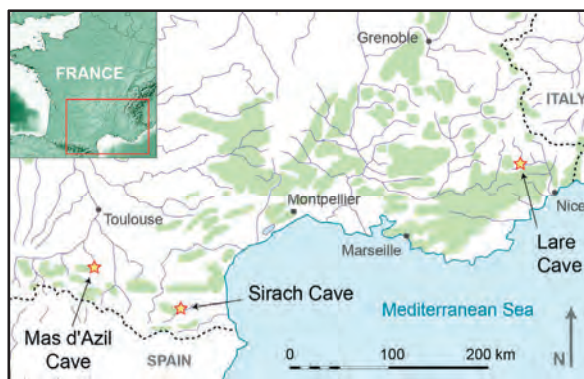


Figure 2: Location map of the three studied bear caves.

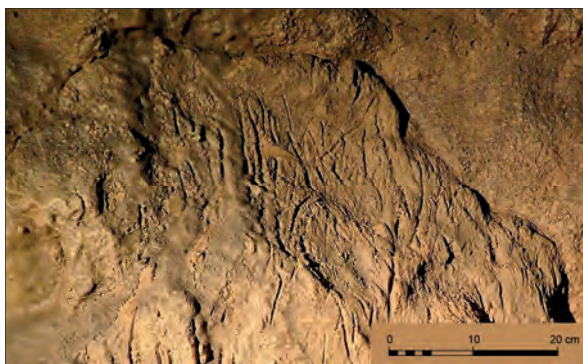


Figure 3: Bear claw marks on a clay veneer in the Bats Chamber, Mas d'Azil Cave (Ariège).

• The Sirach Cave (Pyrénées-Orientales) is a cave known in the past and which opens along a path. It is cited in the work of Abbé LUCANTE (1880). In his speleological inventory, Henri SALVAYRE (1977) mentions the presence of bats, but not the presence of the bear. The cave corresponds to a former functional emergence during the first phases of karstification of the massif (HEZ, 2015).

It is dug in a limestone breccia and has walls on which we can see rounded blocks of all sizes.

Access to this cave is very easy and we also know that the cave was very frequented by bats. Indeed, the porch of the cave has always been widely open to the outside. At the bottom of the cave, there are bear wallows, partly concreted by cave pools. However, there is no claw marks on the rock walls of the cave.

In 2015, we understood the origin of this apparent anomaly. Indeed, many blocks fallen from the vault rest on the ground without being able to identify their imprints on the ceiling. On the ground, the blocks are more or less encrusted with gypsum, indicating the presence of sulphates. In this context, these sulphates coming from guano bats which have now disappeared. Elsewhere, dark borders visible in cross sections of soil fill, along with gypsum blooms, also indicate the presence of old guano piles.

The cave has obviously been frequented for a very long time by colonies of bats favoring a biocorrosion of all the limestone walls several centimeters thick. In the Sirach Cave, the marks of collapses in the vault are entirely erased. On this basis, and due to the presence of bear wallows, we looked for claw marks on non-calcareous supports, less sensitive to biocorrosion.

It is in a niche containing a little clay that we were able to find the only claw marks preserved in this area (Fig. 4).

These claw marks are only visible on the clay support and are not visible above in the limestone blocks of the breccia. The claw marks disappeared in the limestones but were well preserved in the clay.

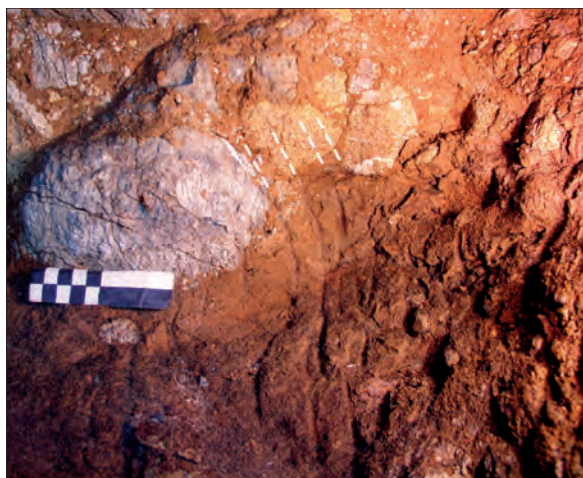


Figure 4: Rare bear claw marks preserved in the clay of the Sirach Cave (Pyrénées-Orientales). There is no longer any trace on the limestone blocks of the breccia. The dotted lines show the extension of the claw marks that completely disappeared on the limestone surfaces.

• The galleries of the Lare Cave (Saint-Benoît, Alpes-de-Haute-Provence) form a maze of tiers of an ancient emergence, which currently pours out at the foot of a nummulitic limestone cliff along the Coulomp valley. Although the cave is somehow difficult in access, it has been continuously opened and visited since at least the Neolithic. Colonies of bats gathering thousands of individuals (mainly Schreiber's bent-winged bat and Greater Mouse-eared bat) occupy the cave especially for swarming. It is mainly a site of transit and reproduction. The cave shows deeply corroded speleothems and in many places limestone walls are entirely bare. The cave has been known for ages for about 300 m. In the inner confined area, which is partly preserved from biocorrosion, old signatures (from 1574) attest continuous visits during the last 6 centuries, the oldest signature (NOBÉCOURT, 2020).

Explorations have pushed the length of the cave to more than 2 km (AUDRA & BIGOT, 2009).

During our numerous visits in the cave, no evidence of the bear presence has been found.

In 2014, a new passage was discovered, showing an impressive pile of guano. Some recent guano deposits are present in the formerly known part, however, similar large pile may have been present, but have disappeared under the footsteps of visitors or after collection as fertilizer.

In 2015, we discovered bear claw marks on a clay bench, which was unfortunately severely degraded by the overcrowding of the cave. This clay bench, located about 200 m from the entrance, is the single place in the cave attesting to the presence of the bear. It is evident that claw marks previously covered any rock walls, but they completely disappeared under the effect of biocorrosion generated by bats swarming.

## 5. Conclusion

The caves of Mas d'Azil, Sirach and Lare harbor bear claw marks, but these are rare and strictly restricted to some patches of clay deposits. Yet is evident that they previously also extended along any limestone walls. Even if rare, they testify the presence of bears. Their partial disappearance can be explained by the condensation corrosion processes boosted by the biocorrosion of limestone walls caused by bats.

Thus, evidences of retreat of the rocky walls by biocorrosion processes should lead us not to conclude too quickly to the absence of bear in a cave.

The clues or traces may have been partially or totally erased; bears indiscriminately scratch the walls, whether they are rocky or clayey.

Consequently, bear claws marks must be carefully searched on different substrates and in particular on clay, which is insensitive to biocorrosion and therefore more likely to preserve claw marks than limestone walls.

The presence of biocorrosion features is a clue to take into account before any hasty conclusion about cave bear absence.

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