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## The secret entrance of the “Galerie Breuil” in the Mas d’Azil cave (Ariège, France)

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### ABSTRACT

The Mas d’Azil cave is a major site for the study of European prehistory, and the evolution of the discipline itself, especially regarding our understanding of the late Upper Paleolithic. In particular, its mobiliary art is one of the richest and the most beautiful known in a Magdalenian context. Lesser known however, is its rock art. Few publications are devoted to these works of prehistoric art, and despite several field work campaigns we still lack a general synthesized study of them at the scale of the entire cave system.

A survey of the Mas d’Azil cave system is currently underway, and the aim of this project is to map the archaeological and geoarchaeological organization of the site. Obtaining a reliable topography of the cave, an endeavor begun in the 1980s but never finished, is essential to resituating the archaeological deposits relative to the various natural processes and formations having affected and conditioned their deposition and conservation, as well as the different historical phases of exploitation of the cave.

Using this survey approach, we already have a clearer picture of the repartition of Magdalenian areas and circulation spaces of the right bank. Thus, if the residential areas are located on the upper parts of the cave (*La Rotonde*, *Galerie Des Silex*), that benefit from more stable and mild temperatures, the lower parts (*Salle Piette*, *Galerie Rouzaud*) do not appear to have been residential areas. Our approach also shows that the current entrance of the “Galerie Breuil”, which is located at the end of one of the lower rooms and is the main decorated part of the cave, was likely unknown to the Magdalenians. They could only have entered the *Galerie Breuil* via a smaller hidden corridor that was blocked after the Magdalenian occupation, as the growth of the speleothem obstructing this passage dates to 13 000 y BP. The clear difficulty encountered by Magdalenian occupants as they attempted to access this gallery may have contributed to a symbolic separation between residential and symbolic, and therefore decorated, spaces, where access to the latter may have been actively limited and/or controlled.

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In this paper, we propose to describe the palaeotopography of the cave during the Magdalenian period, supported by the analysis of the stratigraphy, new dates, as well as the historical archives from early excavations. By crossing these different lines of evidence we will investigate the question of accessibility and visibility of prehistoric rock art in a cave that have sometimes been considered a Magdalenian “aggregation site”.

## 1. Introduction

Exceptional not only by its sheer size and visible footprint in the landscape, the Mas d’Azil cave, situated in the Ariège department of the northern Pyrenean piedmont (Fig. 1 and Fig. 2), was an important site during prehistory, but also for the development of the discipline, specifically in its European context<sup>1</sup>. While the site was frequently occupied during the Protohistoric and Neolithic periods, it has been archaeologically exploited since the middle of the 19th century, is eponymous for the Azilian (Piette, 1889, 1895), and remains a significant reference for the Magdalenian, most notably for the structuration of its middle phases (see Delporte, 1979). For nearly half a century, successive excavations, and above all those of Piette at the end of the 1880 s, have provided an astounding collection of archaeological objects, especially mobiliary art, for the European Magdalenian (e.g. Piette, 1907; Péquart and Péquart 1960, 1961a, 1961b; Clottes et al., 1981; Schwab, 2008). The Aurignacian has also recently been confirmed to be present as well, which has permitted a revision of the occupation dynamics of the landscape at the eve of the Last Glacial Maximum (Jarry et al., 2017).

Following preventive archaeological interventions for the touristic redevelopment (Jarry et al., 2013, 2015a; Pallier et al., 2015), a pluridisciplinary project, beginning in 2013, is currently underway that will eventually provide geological and archaeological map of the site, based on a revised 2 and 3-dimensional topography of the site, as well as a complete geoarchaeological study (Jarry, 2015)<sup>2</sup>. Our method seeks to replace the old data available from publications and archives by confronting them with our new observations and studies of the site.

We propose here to illustrate this approach through an investigation of the accessibility of the decorated parts of the cave, and more particularly that of the gallery named after Henri Breuil himself (*Galerie Breuil*). The current access to this narrow gallery of the cave system is found in the back of one of the lower rooms, the *Salle Piette*. It has nev-

<sup>1</sup> Note 1: This contribution uses unpublished data from the archives of X. Leclercq (works on the *Galerie Breuil*) and F. Rouzaud (cave topography). Their studies, unfortunately unfinished, remain as crucial contributions for the exploration and understanding of this prestigious monument. We hope to pay tribute to these two researchers, whose work provides the base upon which a part of our current studies are constructed

<sup>2</sup> Note 2: This work was, and remains, part of the thematic survey project (programme de prospection thématique): “The Mas d’Azil Cave, archaeological and geoarchaeological cartography” (La grotte du Mas d’Azil, cartographie archéologique et géoarchéologique) directed by Marc Jarry, Céline Pallier, Laurent Bruxelles and François Bon. This research program is supported by the French Minister of Culture and Communications, Inrap (Institut national de recherches archéologiques préventives), the TRACES laboratory (CNRS – UMR 5608), the University of Toulouse Jean Jaurès, and the Grottes&Archéologies association. We wish to thank the town hall and mayor of the Mas d’Azil, Mr. Raymond Berdou, for their welcome in the cave and continued support. We would also like to thank Sesta (Service d’Exploitation des Sites Touristiques de l’Ariège) and its director, Mr. Pascal Alard, and the site director, Jacques Azéma, for the access they grant us to a cave they manage with passion. We have also not forgotten the landowners, in particular Mme. Jackie Carrière, Mr. Patrice Commenge, and Mr. Jean Paulin. Finally, the English translation of this article from its original French was done by Lars Anderson (lars.anderson9@gmail.com), who we would also like to sincerely thank. This work was presented to the IFRAO Congress 2015 (Caceres) in the session “Conspicuous or hidden: the issue of visibility in the understanding of prehistoric Rock Art” directed by C. Bourdier, V. Feruglio, O. Fuentes, G. Pinçon, G. Robin. We would like to thank João Zilhão and the anonymous reviewer for the useful comments, which improve the quality of our paper.

ertheless long been accepted that there is no true direct continuity between these two sectors; the simple passage letting us move currently from one to the other is not an archaeological reality (Alteirac and Vialou, 1980, 1984).

## 2. Parietal art in the cave: background

The first discoveries of parietal art in the cave coincide with the rise of the study of such phenomena at the beginning of the 20th century. While surveying the cave walls, Abbé Breuil would discover the first prehistoric engravings in 1902 (Breuil, 1903), before E. Cartailhac highlighted several other parietal manifestations (in Bégouën and Breuil, 1912–13). These initial traces are all localized in the upper network of galleries of the cave system, and it isn’t until 1912 that H. Bégouën, accompanied by his sons and Breuil, would discover parietal works of art in a small room of the lower network of galleries (*op. cit.*) (“sector A”, Fig. 3 and Fig. 4-a).

A little over 20 years later, in 1937, J. Mandement, while digging a 7-meter-long trench, would unblock a low passage filled with silts that opened onto a previously unknown gallery decorated with several engravings and a few paintings, that he would dedicate to “his old friend Breuil” (in Vialou, 1987: 233). A campaign of tracings, conducted much later, remains to date the most complete study of these works and the most important reference (Alteirac and Vialou, 1980, 1984; Vialou, 1987) (“sector B”, Fig. 3 and Fig. 4-b).

At the end of the 1980s, a team lead by F. Rouzaud conducted a topography of the entirety of the cave system. This map is still unpublished, but it the basis of our current work.

Even if some of these parietal assemblages are published, an exhaustive study at the scale of the entire cave system is still lacking (see, among others: Breuil, 1903; Bégouën and Breuil, 1912–1913; Leroi-Gourhan, 1978; Alteirac and Vialou, 1980, 1984; Vialou, 1987). To resume our current state of knowledge, the parietal artistic manifestations are present in four sectors on the right bank (see Fig. 2).

- The *Galerie Du Masque* (Fig. 2-1) where one can find a human profile, and engraved symbol and the hindquarters of a horse. This gallery opens upon the *Salle Mandement*. The decorated portion is located close to the gallery’s entrance in a large area with a low ceiling. The other portion of this gallery was filled entirely with alluvial deposits during the Magdalenian period.
- The *Galerie Du Four* or *Du Renne* (Fig. 2-2) where, amongst an assemblage of traced lines, one can find an engraved horse and bison (Breuil, 1903). This gallery opens upon the *Salle Des Conférences*. The decorated portion is located close to the entrance of the room, uniquely on the ceiling. This gallery was in large part filled with rimstone formations, likely formed before this portion

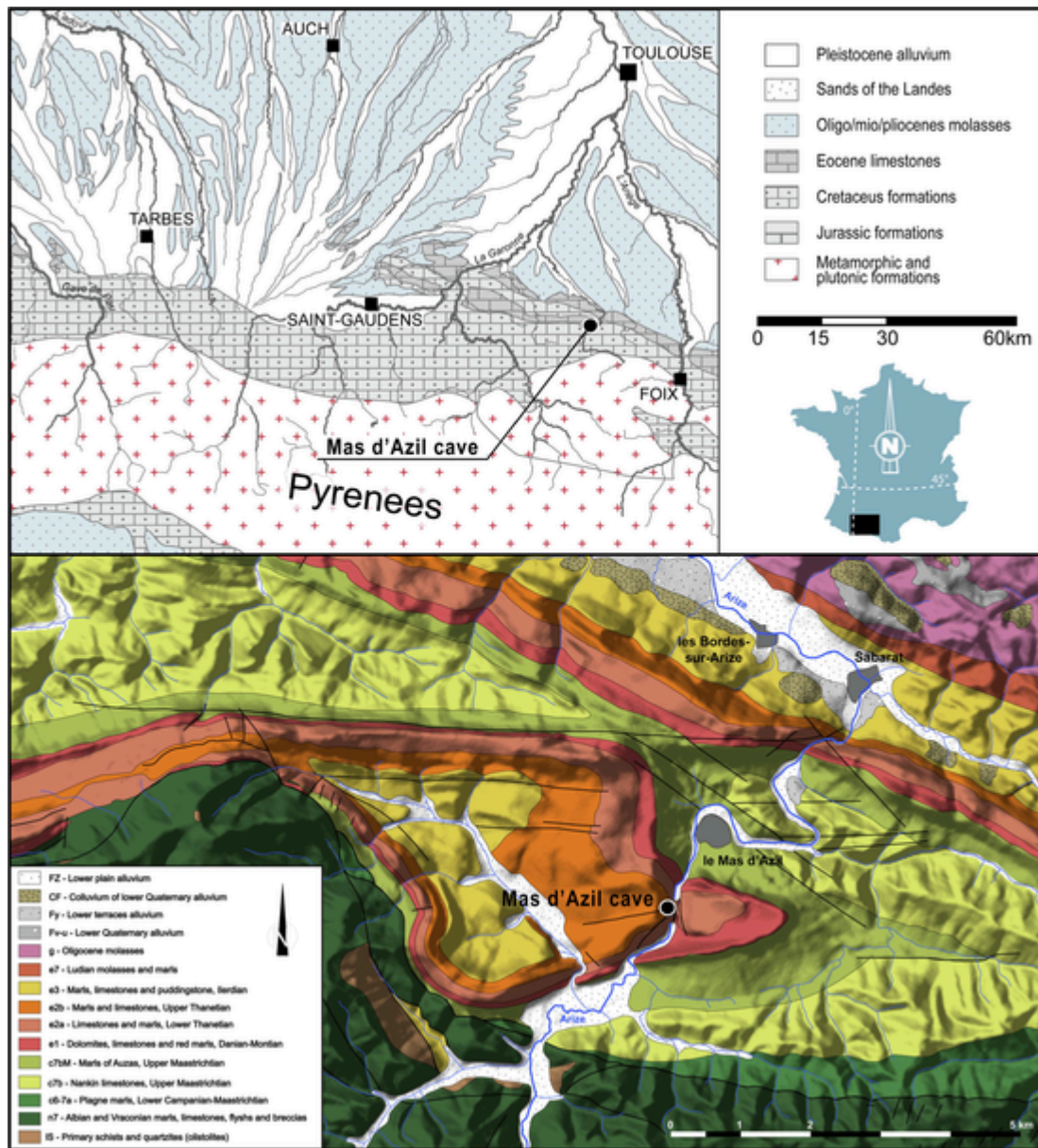
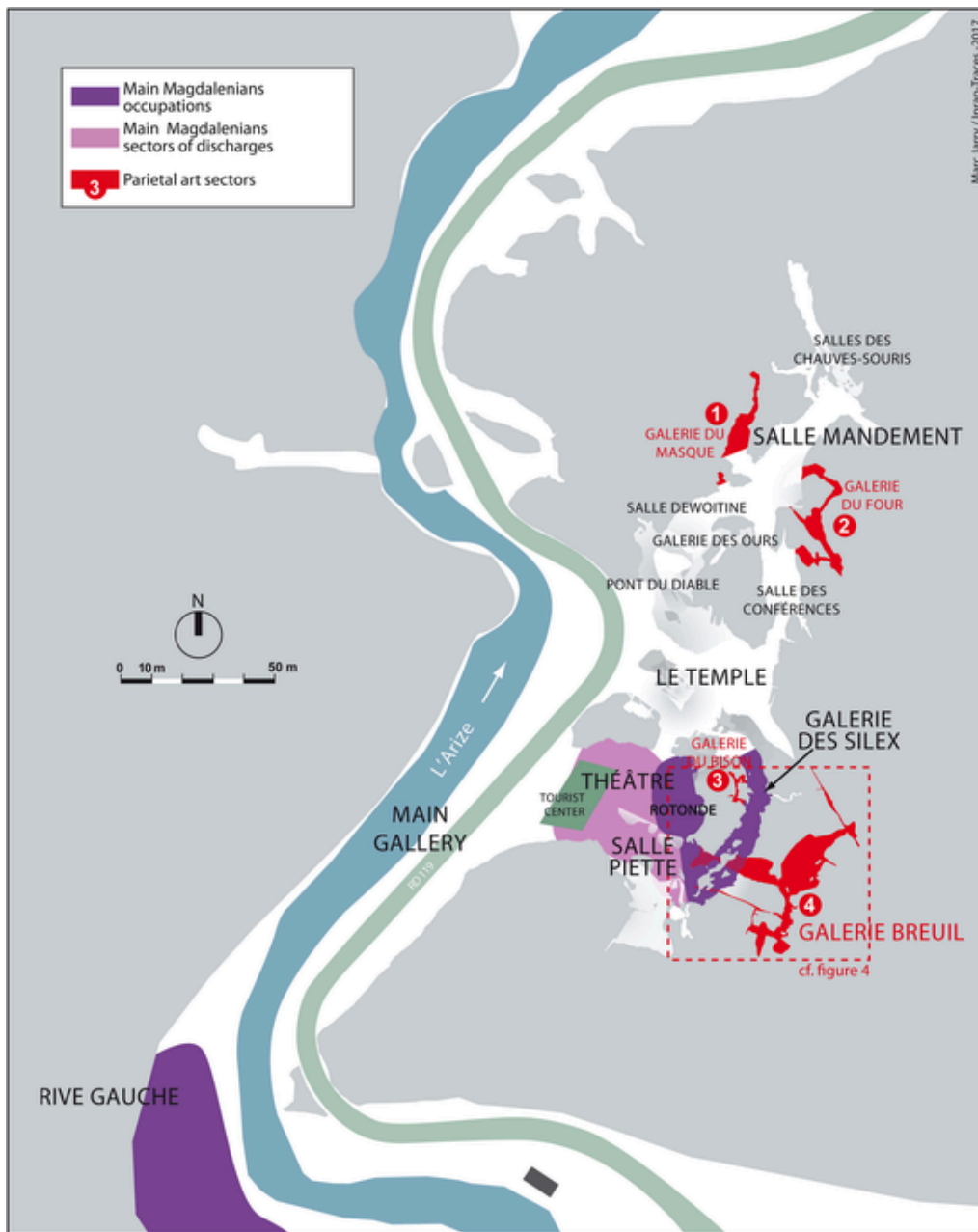


Fig. 1. Localization of the Mas d'Azil cave on a simplified geological map (a) and on the local geological map overlain upon a digital elevation model (b). (figures by © Marc Jarry/INRAP-TRACES (a) and © Laurent Bruxelles/INRAP-TRACES (b)).





**Fig. 2.** General map of the Mas d'Azil cave with principal occupation areas (purple), refuse areas (pink), and decorated areas (red). The numbers of the decorated sectors correspond with those used in the text (figure by © Marc Jarry/INRAP-TRACES on a background modified from DRAC Occitanie/François Rouzard, Xavier Leclercq, and the Spéléoclub de l'Arize archives. Completed in Jarry *et al.* 2015b and topographical points by Vincent Arrighi/INRAP 2016. CAD by Marc Jarry/INRAP-TRACES and Pauline Ramis/Grottes&Archéologies). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

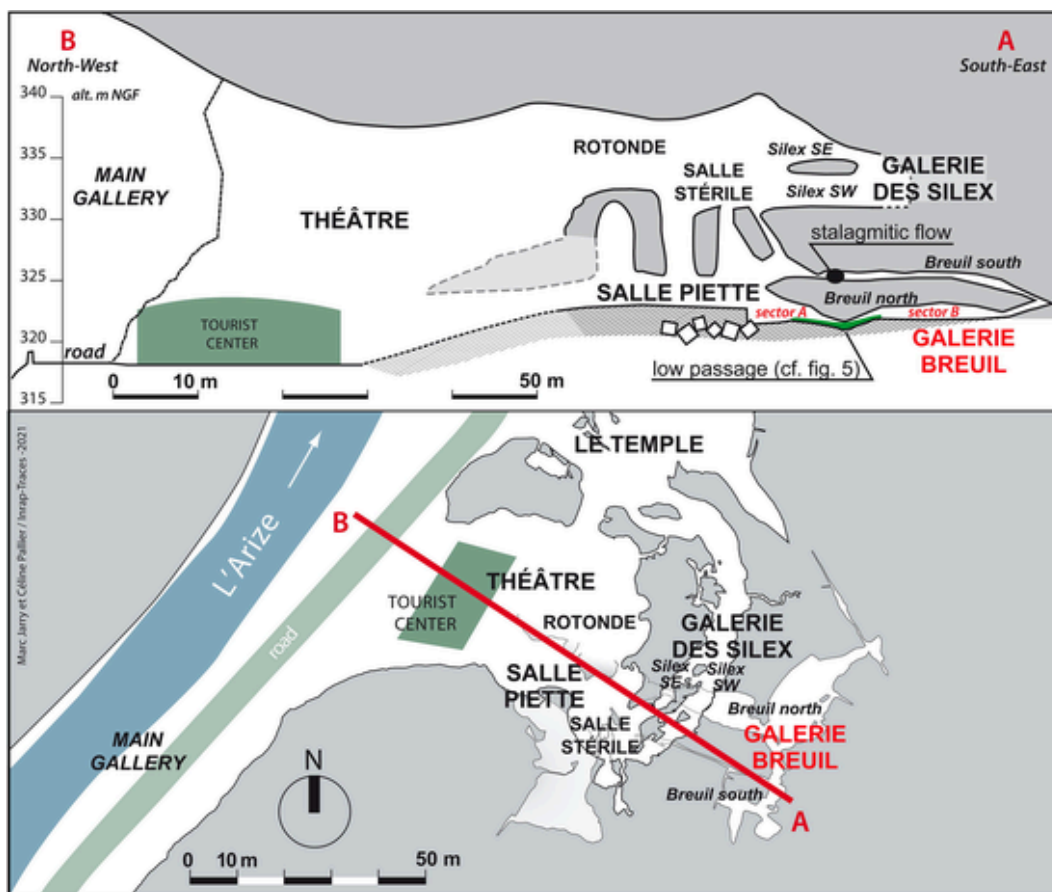


Fig. 3. Schematic section of the galleries on the right bank of the Mas d'Azil cave, from the main gallery to the Galerie Breuil (figure by © Marc Jarry/INRAP-TRACES and Céline Pallier/INRAP-TRACES).

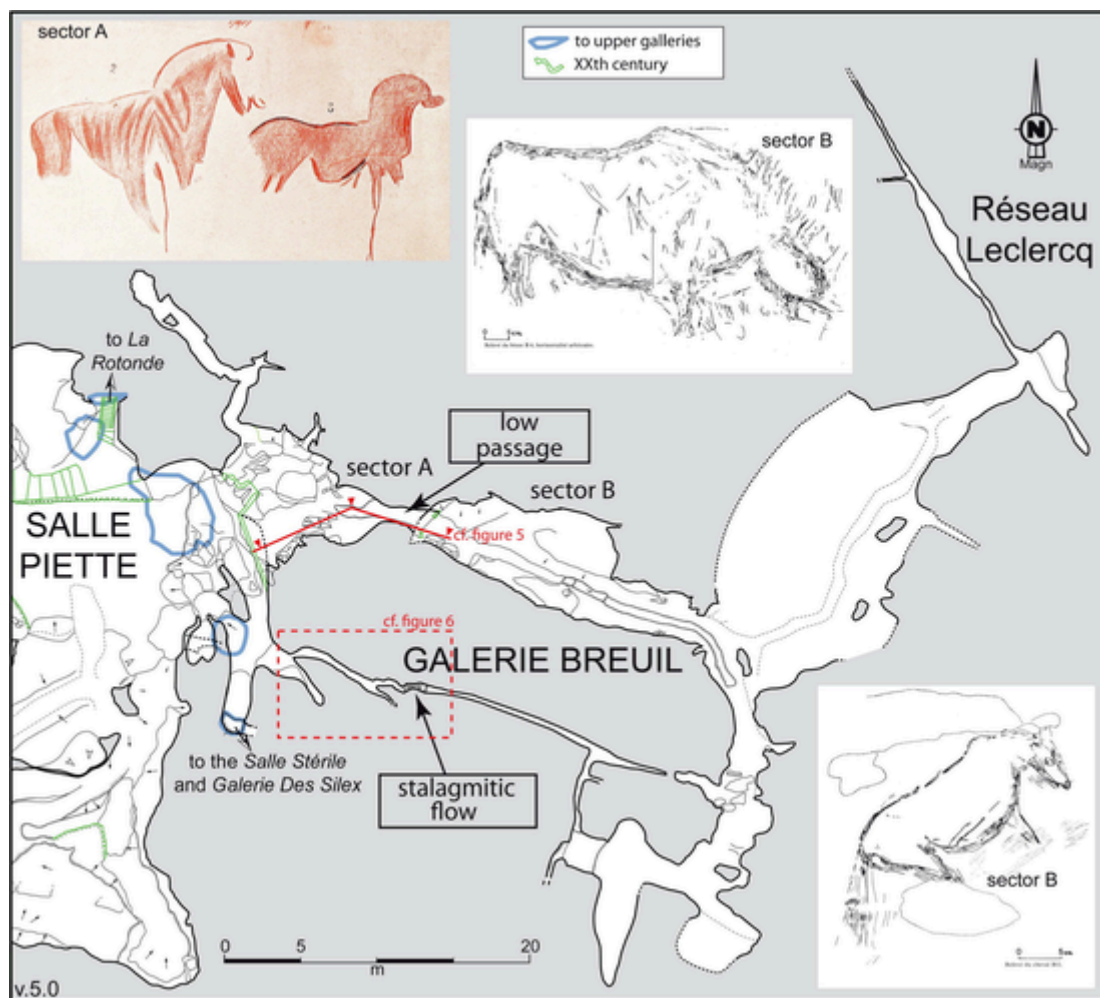
was decorated. If this is true, then the space available to engrave was quite reduced and to access it one would have had to crawl<sup>3</sup>.

- The *Galerie Du Bison* (Fig. 2-3): from the *Galerie Des Silex* (in the sector that was deepest in its initial configuration), two extremely narrow entries lead, after some contortions that even the most experienced speleologists would find difficult, to an engraved bison and a few engraved symbols. This area was discovered relatively late, after the discovery of the *Galerie Des Silex* by Mandement in 1936 (Péquart and Péquart, 1960).

<sup>3</sup> Note 3: The *Galerie Du Four* or *Galerie Du Renne* seems to have been the first to have provided parietal engravings, during the explorations conducted by Henri Breuil in 1902 (Breuil, 1903), while the *Galerie Du Masque* was discovered by E. Cartailhac a few years later in 1908. However, a later description by H. Bégouën underlines a possible confusion between these two sectors: "It was during the second excavation campaign in 1902 that Mr. Breuil noted the first few engravings on the walls. In 1908 Mr. Cartailhac augmented the number and highlighted, among others, a human head where the natural accidents of the rock were accentuated with perfectly neat engravings. All of this can be found in an upper gallery of the right bank, in a cul-de-sac with a low ceiling that was not a habitation area" (Bégouën and Breuil, 1912–1913, p. 139 – our translation from the original French text). This explains A. Alteirac and D. Vialou's assimilation of the sector described by Breuil in 1902 with that which was explored by Cartailhac in 1908 in favor of a single part of the site, this lateral gallery opening onto the *Salle Mandement* that they go onto baptize the *Galerie Du Four* (Alteirac and Vialou, 1984). We have retained the *Galerie Du Four* title for the small passage that leaves from the *Salle Des Conférences* and is, according our current working hypothesis, distinct from the *galerie du Masque* (and thus equally distinct from the *Galerie Du Four* noted by Alteirac and Vialou). In reality, while we await a better comparison between the terrain and the archives, and as was suggested to us by Y. Le Guillou, we must admit that a proper resolution of this issue had yet to be obtained.

- The *Galerie Breuil* (Fig. 2-4): the entrance currently located in the east of the *Salle Piette* is reduced by the construction of a stone wall and a metal gate to protect the gallery. The first room, "sector A" (according to the sector names attributed by Alteirac and Vialou, 1980), is actually a hidden nook of the *Salle Piette*. On the map (Fig. 4) we present the topography above the above-mentioned construction. Sector A has numerous red, and more rarely black, paintings on its walls, as well as a few engravings (Fig. 4, A). These are not directly dated, but the many specialists having studied them have all concluded that they differ significantly from the works in the rest of the *galerie Breuil* (Leroi-Gourhan, 1965; Vialou, 1987). Our recent work (Jarry et al., 2017; Pallier et al., in preparation) shows however that these cannot be associated with the Aurignacian, as we know that this area was submerged during a major alluvial event that succeeds the Aurignacian occupation levels (*op. cit.*). While waiting for further analyses we can simply indicate that this decorated portion of the cave can be associated with a significant time lapse, situated somewhere between the Gravettian and the middle Magdalenian. To gain access to "sector B" of the *galerie Breuil* one must pass through the low passage unblocked by Mandement in 1937 (see above). In this second area of the gallery we find the majority of the art works, roughly thirty different paintings and engravings (Alteirac and Vialou, 1980, 1984<sup>4</sup>) (Fig. 4 B).

<sup>4</sup> Note 4: This description, inspired by a map provided by A. Alteirac and D. Vialou (1984, p. 392), summarizes only the main parietal traces they surveyed in the *Galerie Breuil*.



**Fig. 4.** Topography of the *Galerie Breuil* and the *Réseau Leclercq*. To enhance the readability of the map the upper level galleries are not shown. The 20th century modifications to the cave are shown in green, the vertical shafts connecting the Rotunda to the lower levels are shown in blue (figure by © Marc Jarry/INRAP-TRACES, modified from Rouzaud *et al.* (unpublished), revised for detail on the galleries using Leclercq (unpublished). Southern access point corrected in 2013 by M. Jarry, C. Salmon, and L. Bruxelles. Vertical shaft locations corrected in 2013 by M. Jarry and F. Bon, spatialized in 2016 by V. Arrighi. Examples of parietal works: sector A after Bégouën and Breuil 1912–13 and sector B after [Alteirac and Vialou, 1980](#). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The question of the conditions of access to the principal decorated area of the *Galerie Breuil* was already broached and published by D. Vialou and his team, especially X. Leclercq ([Vialou, 1987](#)). We know additionally that certain discoveries linked to exploration and topographical work conducted by Leclercq have remained in part unpublished following his untimely death. Besides the artistic manifestations mentioned in the deep section of the gallery (dots, lines, red key-shapes or “claviformes”...; *op. cit.*), Leclercq’s archives indicate that finger prints and other indeterminate markings in clay, covered by thin layer of calcite also exist (an observation that our team was able to confirm during our work in this area of the cave system<sup>5</sup>). Moreover, A. Alteirac and Vialou both indicate that Leclercq “had reunited a certain number of speleological and prehistoric elements that led him to think that a passage had existed with the upper-level galleries” ([Alteirac and Vialou, 1980: 57](#) – our translation from the original French text)

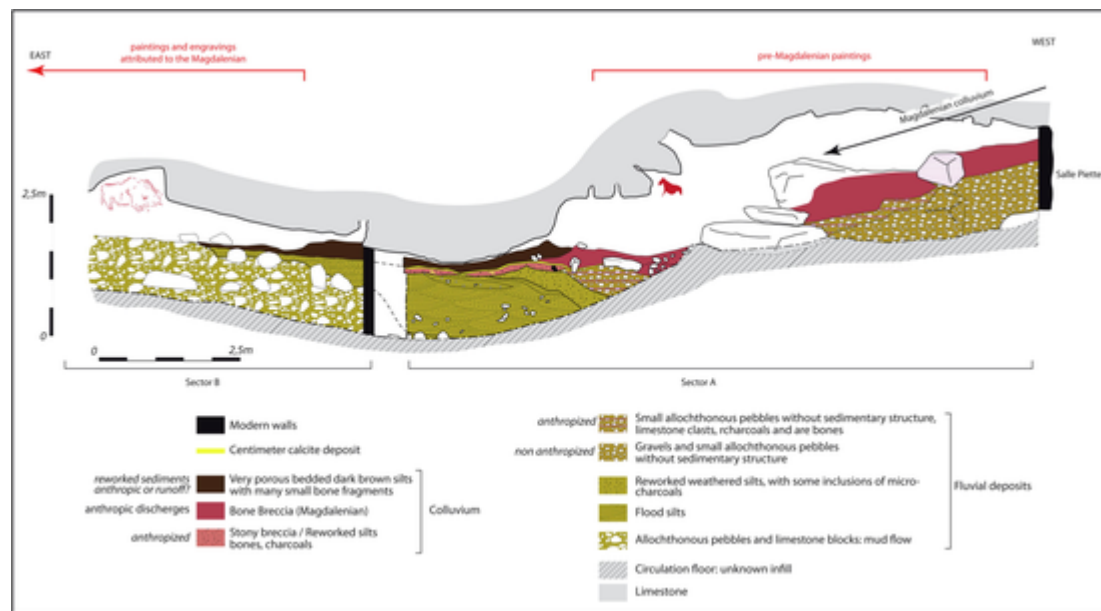
Our survey of the possible paths, building on a revision of the topography and of the data available in older publications and archives, pushed us to reexamine the hypothesis of one (or several) points of ac-

cess to the *Galerie Breuil* and the consequences for such a hypothesis on the current and prehistoric perception of this space and its parietal art. Before doing so however, it is useful to review and explain the principal phases of geological evolution of the cave system as to understand the environment(s) in which the human occupations occurred throughout time.

### 3. Context and materials

The current work conducted by our pluridisciplinary team in the cave system has underlined that the Mas d’Azil, a complex subject of karstological study, additionally provides a significant sedimentary record, reflecting environmental changes and several glacial phases ([Pallier et al., in preparation](#)). The Arize, the river that traverses the cave as it descends from the Pyrenees, cuts perpendicularly through the east–west oriented geological structure known as the pre-Pyrenees ([Fig. 1](#)). Its staggered path is a function of the resistance of the different types of rocks it encounters. The river borders the east of the Lézères-Pradals synclinal (Canérot *in: Gourinard et al., 1973; Souquet et al., 1979*) and initially passed at the periclinal termination. Its ancient path can be seen on the landscape in the form of the Baudet pass, just above the cave, where we can additionally find the Arize river’s ancient alluvial deposits. As the river dug itself into the Thanetian limestone, it was pro-

<sup>5</sup> Note 5: This observation, conducted during the construction of the morphokarstic map by Manon Rabanit and Hubert Camus, both members of the thematic survey project team, was localized, photographed, and presented to the Archaeological service of the Occitanie region in June 2015.



**Fig. 5.** Schematic longitudinal stratigraphy of the fill at the low passage between the *Salle Piette* (sector A) and the *Galerie Breuil* (sector B) (stratigraphy and CAD by © C. Pallier/INRAP-TRACES).

gressively absorbed into losing streams, only to resurge a few hundred meters downstream, to the north of the synclinal. This hydrogeological feature, ultimately leading to an underground river course, was a subterranean stream capture of the Arize river. This stream capture phenomenon was responsible for the excavation of the principal gallery of the Mas d'Azil cave system; the river currently flows within in it, and since the 19th century, a road follows alongside the river as it traverses the *Massif De L'Arize*.

A part of the Arize river's history is therefore directly visible through the cave's morphology and deposits. Significant siliceous alluvial fill is associated with parietal morphologies that are characteristic of a paragenetic evolution. Throughout the climatic fluctuations of the quaternary, the river experienced several phases of alluvial filling and re-excitation. The cave recorded important traces of these different phases, allowing us to highlight both their geometry and chronological sequencing. The phases of sediment accumulation are responsible for the excavation of the looping lateral galleries of the right bank. These looping galleries were formed after the principal gallery, to which they are connected, and are logically located at higher altimetric positions relative to the passages that functioned as drains in preceding phases of the cave's evolution.

Absolute dating of the main episodes of sedimentation are currently underway, yet in the meantime we can note that the artistic manifestations on the walls of the lower network of galleries must logically be posterior to the last phase of sedimentary infilling, and this last phase can be positioned, via relative chronology, after the Aurignacian occupations of the cave.

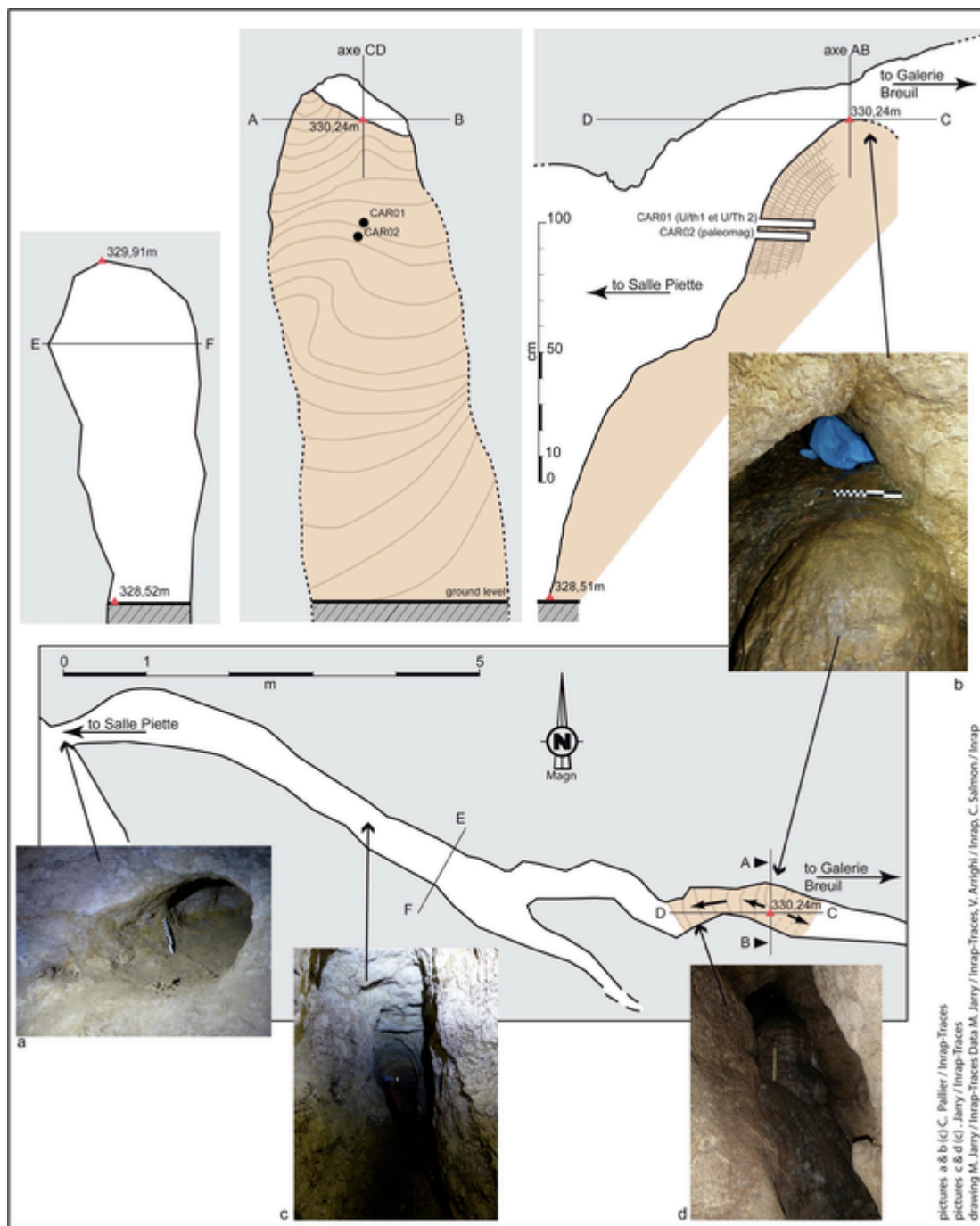
The result of this story is a complex topography consisting of several levels, with a system of looping galleries on the right bank that allowed the river to continually find a path through the *Massif De L'Arize* when the main passage was blocked with sediment. The Magdalenian occupations are integrated into the second half of one of these phases, a purging of the cave's accumulated alluvial deposits that occurred during the Last Glacial Maximum. The Magdalenians arrive therefore in a cave where the Arize had retaken its path through the main conduit, yet much of the cave remained encumbered by fine silts, upon which they set up camp (Fig. 4). Certain functional aspects of the different spaces remain to be validated, but excluding the left bank, it appears that the "domestic" Magdalenian occupations are situated mostly on the upper

level formed by the *Rotonde* and the *Galerie Des Sillex*, who communicate directly with each other:

- The *Rotonde* is a vast open space in the main conduit of the cave. Its terrace, situated significantly above, and therefore quiet far from, the noisy and humid Arize, is removed from the influence of air currents coming from outside. This terrace is separated from the river by the so-called *Secteur Du Théâtre*, whose current slope is the result of phases of sediment removal corresponding to the different construction and reorganization events occurring within the cave throughout the 19th century. We know however, thanks to the observations of the Abbé Pouech, that the terrace was uneven and sloped strongly towards the Arize even before these phases of sediment removal.
- The *Galerie Des Sillex* is a comfortably sized passageway whose northern most portion was filled during the Magdalenian occupation. In fact, the air current that presently passes through this gallery did not exist at the time of occupation, and this was additionally the only area of the cave to benefit from the thermoregulatory effects of the encasing limestone. During the winter this area was one of the least cold in the theatre sector. The Magdalenians most likely accessed this area via the southern portion of the *Rotonde*, which presents itself in the form of an alcove, improperly described by Breuil as sterile (*Salle Stérile*) in which (or just next to, at the junction with the *Rotonde*) one can find a series of vertical shafts.

The *Salle Piette*, below the *Rotonde* and the opening of the *Galerie Des Sillex*, communicates with these upper chambers via the aforementioned vertical shafts, which seem to have been filled over time with sediments mixed with domestic and/or butchery remains, likely from occupations on the upper levels, as well as limestone rubble coming from the desquamation of the cave walls and ceiling. These recent observations privilege, contrary to a popular interpretation, the idea that the *Salle Piette* was not an occupation area, but rather a vertical outlet into which debris from upper level occupation fell over time. While this does not directly imply that any stratigraphy identified by Piette is false, it does mean that we should treat such stratigraphic interpretations with caution.





**Fig. 6.** Access to the *Galerie Breuil* from the ‘balcony’ of the *Salle Piette*. Topography and sampling in the stalagmitic flow (Figure © Marc Jarry/INRAP-TRACES. Data collected by V. Arrighi/INRAP, M. Jarry/INRAP-TRACES, and C. Salmon/INRAP. Pictures by (a and b) C. Pallier/INRAP-TRACES and (c and d) M. Jarry/INRAP-TRACES).

This general presentation of the cave pushes us to ask yet another question, one regarding the differential conservation of the art works within the network of galleries, as different alterations of the cave walls were identified in different parts of the karstic system.

#### 4. Differential conservation of parietal works?

In 1903, while discussing his first artistic discoveries in the cave, Breuil had already noted that “the deterioration of the parietal engravings of the Mas d’Azil removes nearly all their value as objects of study”, but at the same time underlined that “the fact that they are located at the end of a dark gallery [we believe Breuil is discussing the

*Galerie Du Four* in this passage], that was not a room where people lived and could not have served this purpose, is a precious piece of information for the question of the generality and destination of decorations in caves” (Breuil, 1903, p. 436 – our translation from the original French text). The multiplication of discoveries over time only lent more support to Breuil’s initial reflections: “We note that the parietal art of the Mas d’Azil concerns the totality of the network on the right bank: it is therefore a deep and complex site, typically Pyrenean [...]. The selection of narrow galleries separated from areas of higher circulation seems to be deliberate and already quite significant even if other ‘sociological’ and ‘psychological’ parameters likely intervened during the

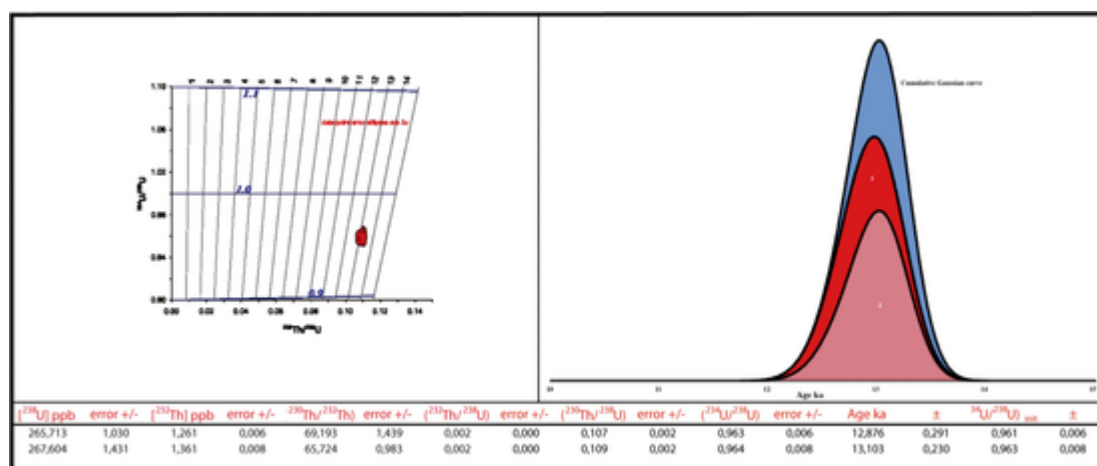


Fig. 7. Dates and results obtained using the  $^{230}\text{Th}/\text{U}$  disequilibrium dating method (Figure © Bassam Ghaleb/UQAM-Géotop).

making of these choices.” (Vialou, 1987: 233 – our translation from the original French text).

Several observations made during the course of our systematic survey of the cave permit us to further substantiate these prior conclusions, as well as bring to light some elements regarding the current spatial distribution of parietal works in the network.

Firstly, a significant erosion of cave walls, posterior to the prehistoric occupations in certain parts of the cave system and sometimes accompanied by the disappearance of a significant section of stone, was observed. In the highest parts of the *Rotonde* we can see the impact of colder climatic phases via frost weathering, as well alterations beneath the fill levels, and tearing surfaces that correspond to the crumbling of blocks near areas of mechanical weakness linked to the presence of tectonic joints. In the *Galerie Des Silex*, the distribution of alterations beneath the fill levels of cave walls, revealed by the artificial extraction of silts, has allowed us to determine which wall and ceiling surfaces were accessible to Magdalenian artists: more often than not these were quite small and difficult to access areas where the silts had already been partly evacuated by underlying sinkhole effects. Where wall and ceiling sections are easiest to access the impact of frost weathering and/or condensation corrosion is particularly visible.

The impact of aerological factors are more significant in the *Salle Du Temple* and even more so in the northern chambers, such as the *Salle Mandement* and the *Galerie Des Chauves-Souris*, which explains why parietal works are uniquely preserved in the more confined lower galleries. It is quite possible that the rock art of the Mas d’Azil known today is simply the result of differential erosion, leaving only the most concealed and protected works behind. The lateral galleries, narrower and partially filled, did not experience the full amplitude of the alterations seen in the larger and more open galleries. Thermic regulation in these narrow passages lessened temperature fluctuations and therefore limited the amount of condensation on the exposed parts of the cave wall. Additionally, the absence of bat colonies in these small galleries significantly reduced the possible impact of bio-corrosion.

## 5. Towards a hidden entry?

Despite the uncertainties introduced by a differential conservation, the parietal art of the Mas d’Azil seems to be today confined to the most intimate areas on the cave system. Accessing these areas necessitates complex and risky speleological maneuvers, which underline nonetheless the significant desire on the part of the artists to reach these areas, separated from the habitation areas, to paint and/or engrave them. While this statement holds true for the *Galerie Du Masque*, the *Galerie Du Four*, and even more so for the *Galerie Du Bison*, is this also the case for the *Galerie Breuil*?

After the small room (sector A, in reality a small nook of the *Salle Piette*) decorated with red paintings, the conduit continues to a low point, only to ascend afterwards towards galleries that become more and more narrow as one progresses, within which are located engravings and paintings attributed to the Magdalenian (Breuil, 1952; Leroi-Gourhan, 1965; Alteirac and Vialou, 1980, 1984; Vialou, 1987).

In sector B, that is to say the *Galerie Breuil* itself, significant debris flows, posterior to the Aurignacian but anterior to the Magdalenian, have reworked the alluvial deposits (Fig. 5). These debris flows occurred during a low water phase of the Arize in the principal gallery, and have a significant westward slope at the aforementioned low point of the conduit in question, likely in relation to the sinkhole in the *Salle Piette* (Fig. 6).

These debris flows (Jarry et al., 2015b) are covered by flood silts with cross-bedded layers that fill the majority of the low passage. The flood silts have a westward facing erosional surface, covered by reworked non-layered silts with micro-charcoal fragments. In sector B, an important reworked formation of exogenous river cobbles with a yellow silty matrix, coming from the west, sits upon the aforementioned reworked silts. The slope of this surface is 15 to 20° to the east. In the upper parts of this river cobble deposit the cobbles are encased in a reddish sandy-silt matrix with rare charcoal fragments and bone fragments inferior to 1 cm, which could be the result of infiltrations from the overlying breccia. An unconformity separates these reworked fluvial deposits from the superposing roughly ten-centimeter layer of indurated limestone gravel and reworked silts. The presence of a few bone and charcoal fragments and exogenous river cobbles in these reworked silts provide us with the first subtle indications of the first frequentations of this area. This poorly developed level is sealed by a fine layer of calcite around 1 cm in thickness. At this particular point in time, a space of only ten centimeters separates the deposits from the cave walls.

The Magdalenian materials that constitute much of the bone-rich breccia, coming from the vertical shafts connecting upper network to the *Salle Piette* below, then progressively filled a significant portion of the latter. A final deposit of dark brown layered silts with bone fragments came then to rest upon the bone-rich breccia either by water runoff, that had additionally reworked the underlying bone-rich breccia, or by the reworking of the breccia as the Mandement unblocked the passage.

These observations show therefore that:

- 1- The western part (sector A/the chamber with red paintings) of the *Galerie Breuil* was still accessible before the Middle Magdalenian, but the low passage separating sector A from B was likely already blocked or at least extremely difficult to traverse.

2- The complete obstruction of the low passage and of sector A (the small chamber with red paintings) by waste of mostly anthropic origin excludes the possibility of access to sector B from the Middle Magdalenian and onwards (a hypothesis already evoked by Vialou (1987) and confirmed by our study).

It is therefore necessary to find another point of access to sector B of the *Galerie Breuil* to better evaluate when the area was accessible, and subsequently provide a temporal frame in which these decorations could have been made. This trail was already touched upon by Leclercq: “the discoveries at the end of the gallery reinforce the hypothesis that direct passage between the room (sector A) and the gallery (sector B) was not possible. While squeezing through the low and narrow passages at the end of the network, past the ‘last’ red dot, mostly on the arched ceiling, red key-shapes with loops (“claviformes rouges à boucle”) can be found, and in the nooks of the less cramped rooms one can find engraved animals. These traces continue for roughly ten meters until the deepest areas that intersect with a system of faults that X. Leclercq believed, without having had the time to verify, connected these difficult to reach lower passages to the upper level where one finds the *Galerie Des Silex* and the decorated recess.” (Vialou 1987: 233 – our translation from the original French text).

Conserved in his archives, Leclercq’s detailed topographical notes allowed us to find the path he proposed, which has been rendered impassable by a flowstone, which he supposes “did not exist during the Palaeolithic” (letter to D. Vialou dated the 23rd of June 1978 – our translation from the original French text).

If we follow this path inversely to the way in which it must have been taken by the Magdalenians, it begins at the southern extremity of the main conduit of sector B in the *Galerie Breuil*, which branches to the right roughly thirty meters after the low passage. After one passes through a flattener and a very narrow passage one arrives in a tight network that ascends to the west (Fig. 4). By following the red dots left on the walls and ceiling by the Magdalenians, and after a few small climbs and low passages, one arrives in a narrow straight gallery oriented towards the west. This gallery narrows even further at its distal extremity, where it is blocked by a stalagmitic flow. The cavity does, however, continue, as the topography of the network shows. A more direct passage to sector does therefore exist, as was hypothesized by Leclercq. From the other side, we begin in the *Salle Piette*, a small and delicate climb on a ledge to the south east, notably where the opening of one of the vertical shafts that communicates with the *Galerie Des Silex*, brings one to a difficult to pass low passage (roughly 0,5 m in diameter). This pass opens up onto a low (roughly 1,25 m) narrow (0,6 m at its widest) gallery. Moving along this gallery one’s path is rapidly blocked by the other side of the stalagmitic flow described above. This junction point, having had an imprecise placement in the old topography, has been re-measured and the stalagmitic flow is now confirmed to be one and the same from both sides. While the passage was once unobstructed, and as already highlighted by Leclercq, it could only have been used by the Magdalenians if the calcite flow is posterior to their occupation of the cave.

In hopes of resolving this issue and validating the hypothesis that the passage blocked by the stalagmitic flow was in fact the one used by the Magdalenians to access sector B, two calcite cores were taken from the flow at a depth that would have allowed for the passage of an individual (Fig. 5). The first core was for dating and the second was for palaeomagnetic study (currently underway).  $^{230}\text{Th}/\text{U}$  dating was conducted on two calcium carbonate samples ( $\text{CaCO}_3$ ) taken from the

deepest portion of the first core (at 20 cm)<sup>6</sup>. The two calculated ages, statistically identical when taking into account the error of such dating methods, suggest that the precipitation of the calcite in question took place around  $13 \pm 0,3$  ka (Fig. 7). This date, sitting at the transition between the Alleröd and the Younger Dryas, and thus corresponding to the Recent Azilian, is well after the Magdalenian, and at least two millennia before the Middle Magdalenian.

## 6. Conclusions

The date of  $13\,000 \pm 300$  BP obtained on the core extracted from the stalagmitic flow confirms that the conduit was passable during the Magdalenian occupations of the site, while the stratigraphic study of the profile at the low passage shows that the lower passage had been blocked by river cobbles and fluvial silts for a long period before the Magdalenian occupation. Furthermore, progressively the *Salle Piette* was filled by deposits accumulated from the Middle Magdalenian occupations of the upper level. The formation of these detrital deposits is partly synchronous with the Middle Magdalenian occupation, and they were secondarily cemented by the calcite along the cave walls as they eventually covered the lower entrance to sector B completely, impeding access via the low passage. This breccia effectively rendered the lower entrance unusable as of the Middle Magdalenian, while the upper entry remained open until being later blocked by the growth of a stalagmite.

We therefore have an upper entry for the *Galerie Breuil* that is both difficult to access and requires a complicated advance, which in turn implies a higher investment than that which is required for the current lower entryway, which we know, additionally, was likely impassable at the time of the Magdalenian occupations. If we follow this hypothesis we must therefore reposition the different parietal decorations in their initial order of reading, rather than their order of discovery. We do nevertheless have to mention that the “precise” dating of the closing of the low passage is impossible; did it occur slightly before or during the Middle Magdalenian occupations? Did the filling of the low passage immediately reach the ceiling, or was it more gradual? We cannot exclude the possibility that a squeeze existed at the beginning of this period, which would have permitted the passage of prehistoric individuals under difficult conditions, though no more difficult than the passage through the upper entry.

Our observations have confirmed that while the occupations related to the daily life of these people concerned, for the most part, the more easily accessible and more clement upper levels of the network (*Rotonde*, *Galerie Des Silex*), the lower levels (*Salle Piette*, *Galerie Rouzaud*) in contrast appear to be refuse zones that were not actually occupied: the *Salle Piette* for example isn’t a prehistoric campsite but a point of convergence between sedimentary and archaeological contributions coming from several vertical shafts connecting to the upper levels. In regards to the *Galerie Breuil*, its current entry, a small nook containing a

<sup>6</sup> Note 6: The samples were analyzed for their isotopic content and composition of uranium and thorium by the isotopic dilution method using a *Nu II instrument* Multicollector-Inductively Coupled Plasma Mass Spectrometer (MC-ICPMS). The results show that the isotopic content and composition of both samples are identical within the error ranges provided by the method. This indicates that the carbonated component is relatively homogenous and quite pure as the proportion of detrital  $^{232}\text{Th}$  is very low, around 1.3 ppb. The proportion of  $^{238}\text{U}$  is also homogenous and quite typical of stalagmites and stalagmitic floors at around 266 ppb. The  $^{234}\text{U}/^{238}\text{U}$  ratio is nearly identical, though a slight deficit of  $^{234}\text{U}$  was noted with a ratio of 0.964, which is not typical for the precipitation of carbonated components. Nevertheless, significantly lower ratios have already been observed in other karstic contexts (Genty et al., 2004). The authors attributed the deficit of  $^{234}\text{U}$  to the fact that infiltrated water mineralizes through sediments/rock low in  $^{234}\text{U}$ . The same hypothesis could be suggested for the deficit observed in the above samples. At any rate, the  $^{230}\text{Th}/^{238}\text{U}$  and  $^{234}\text{U}/^{238}\text{U}$  ratios allow us to calculate  $^{230}\text{Th}/\text{U}$  dates for the precipitation of the carbonates in the stalagmitic flow under study.



collection of mostly red paintings, was not accessible by the Magdalenians; they gained access to this area through difficult to reach, narrow, and for some nearly invisible, passages located in the inner most depths of the cave. We have, therefore, concealed and confined decorated spaces in a monumental cave, which offers us another example regarding the status of artworks and decorated sectors that fits with what we currently know about the Magdalenian of the Pyrenees (Vialou, 1987; Bégouën et al., 2009; Sauvet, 2007). The *Galerie Breuil*, like the *Galerie Du Bison*, cannot be reached without an intimate knowledge of inner-most depths of the cave network, and the frequentation of these passages are likely not comparable to the more common daily activities occurring in other parts of the cave... all of this within a cave site that has been considered by some to be a considerably sized aggregation site (Conkey, 1992).

The demonstration that the only surviving cave art from Mas d'Azil is a "hidden art" is in no way contradictory, in our opinion, to the proposed interpretation that it is one of the main aggregation sites known for the Magdalenian in the Pyrenees. It should be remembered that the term "aggregation site" refers to the idea that this site was a gathering place where numerous economic and more properly social activities took place, by a large community meeting here from several parts of the south-western part of France and further. If this is the case, it is very likely that the parietal decoration participated in the first instance in some of these social activities, but there is nothing to prevent us from thinking that their access did not follow rules implying that they were revealed at the end of a journey, like initiation rites. Finally, and above all, our contribution insists on the differential conservation of this art - and this is undoubtedly the main lesson that we wish to retain from this study - making it impossible to apprehend the integrity of the cave's wall decoration.

#### CRedit authorship contribution statement

**Marc Jarry:** Supervision, Conceptualization, Project administration, Writing – original draft, Funding acquisition. **Céline Pallier:** Supervision, Conceptualization, Writing – original draft. **Laurent Bruxelles:** Supervision, Conceptualization, Writing – original draft. **François Bon:** Supervision, Conceptualization, Writing – original draft. **Lars Anderson:** Visualization. **Vincent Arrighi:** Investigation. **Hubert Camus:** Investigation, Writing – review & editing. **Marc Comelongue:** Writing – review & editing, Resources. **Carole Fritz:** Writing – review & editing. **Bassam Ghaleb:** Investigation. **Mathieu Lejay:** Writing – review & editing. **Hélène Martin:** Writing – review & editing. **Yann Potin:** Writing – review & editing. **Manon Rabanit:** Writing – review & editing. **Christian Salmon:** Investigation. **Gilles Tosello:** Writing – review & editing.

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