



# New results on the Palaeolithic occupation of Grotte des Teux-Blancs (Saône-et-Loire, France) in the context of the Magdalenian of Eastern France

*Neue Ergebnisse zur paläolithischen Besiedlung der Grotte des Teux-Blancs (Saône-et-Loire, Frankreich) im Kontext des Magdalénien Ostfrankreichs*

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**ABSTRACT** - The Côte Chalonnaise (Saône-et-Loire, France) is a region rich in Palaeolithic sites. The Magdalenian, however, is underrepresented in the region when compared to other periods. Recent research at the site of Grotte des Teux-Blancs provides new insights into the Palaeolithic occupation of the site and proves its use during the Magdalenian. Since the first excavation in 1913, the site has received little attention from researchers. To reconstruct the site's occupation history, excavations were carried out in the back-dirt in addition to a new analysis of the known inventories. These excavations were able to provide insights into the 1913 excavation methods as the excavated sediments were deposited on the back-dirt separated by layers, forming an inverse stratigraphy. The analysis of the finds shows a small Middle Palaeolithic and a larger Upper Palaeolithic assemblage. In particular, the lithic and organic artefacts attest to the use of the site, in a hunting context, during the Magdalenian. The embedding of the site in the Magdalenian of Eastern France suggests that Grotte des Teux-Blancs, together with other sites west of the Bresse, was part of the same settlement system as the sites of the French Jura.

**ZUSAMMENFASSUNG** - Die Côte Chalonnaise (Saône-et-Loire, Frankreich) ist eine Region reich an paläolithischen Fundstellen. Das Magdalénien ist im Vergleich zu anderen Perioden in der Region jedoch unterrepräsentiert. Neue Arbeiten an der Fundstelle Grotte des Teux-Blancs können Einblicke in die Besiedlung der Fundstelle im Paläolithikum geben und ihre Nutzung im Magdalénien belegen. Seit der ersten Ausgrabung im Jahr 1913 hat die Fundstelle wenig Aufmerksamkeit in der Forschung erfahren. Zur Rekonstruktion der Besiedlungsgeschichte wurden neben einer Neuanalyse der bekannten Inventare Ausgrabungen im Abraum durchgeführt. Letztere konnten Einblicke in die Ausgrabungen von 1913 liefern, bei denen die ausgegrabenen Sedimente nach Schichten getrennt auf dem Abraum abgelagert wurden, wodurch sich eine inverse Stratigraphie ergibt. Die Analyse der Funde zeigt ein kleines mittelpaläolithisches und ein größeres jungpaläolithisches Inventar. Besonders für das Magdalénien belegen lithische und organische Artefakte die Nutzung der Fundstelle in einem Jagdkontext. Die Einbettung der Fundstelle ins Magdalénien Ostfrankreichs legt nahe, dass die Grotte des Teux-Blancs gemeinsam mit anderen Fundstellen westlich der Bresse Teil eines Siedlungssystems mit den Fundstellen am französischen Jura war.

**KEYWORDS** - Côte Chalonnaise, Magdalenian, Middle Palaeolithic, Lithic technology, Settlement dynamics, Eastern France  
Côte Chalonnaise, Magdalénien, Mittelpaläolithikum, Steinartefakttechnologie, Siedlungsmuster, Ostfrankreich

## Introduction

Southern Burgundy is a region rich in Palaeolithic sites. Research started in the early 1860s, at sites like Solutré (Arcelin 1872) and Grotte de la Verpillière I in Germolles (Méray 1869), and flourished in the beginning of the 20<sup>th</sup> century. After a period of intensified activities in the southern part of Eastern France in the 1950s, research became more focused on the southernmost part of Burgundy with the perennial

excavation project at Solutré and on sites in the French Jura (Desbrosse 1976a, 1976b, 1980a; Combier & Montet-White 2002). Other regions, like the Côte Chalonnaise, moved out of focus until research was revived in 2006 by the University of Tübingen (Floss 2007, 2019; Herkert 2020). The Côte Chalonnaise typically describes the wine region west of the city of Chalon-sur-Saône but is also synonymously used for the Palaeolithic site cluster north- to southwest of the city. After the discovery of Grotte de la Verpillière II,

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a few meters southeast of Grotte de la Verpillière I, and the establishing of perennial excavations at both sites, the focus of research was broadened to include other sites in the area in order to gain a deeper understanding of the site use and settlement patterns of the Côte Chalonnaise during the Palaeolithic (Floss 2019). In addition to the excavations, special attention has been paid to the re-analysis of old collections and a detailed review of the research history (Dutkiewicz & Floss 2015; Rebentisch 2019; Herkert 2020). So far, the long-lasting research has brought to light evidence of the human occupation of the Côte Chalonnaise during the (late) Middle Palaeolithic, Châtelperronian, Aurignacian, and the Gravettian (Floss et al. 2013, 2016; Floss 2019; Herkert 2020; Herkert & Frick 2020; Nordwald & Floss 2021). In 2016 and 2017 the site of Grotte de la Verpillière II revealed several Neanderthal remains, making it the only Palaeolithic site besides Vergisson II that has yielded Neanderthal remains in the region (Bauer & Floss 2018; Floss 2019). Recent work indicates the presence of Palaeolithic cave art at the site complex of Agneux caves in Rully (Floss et al. 2018a, b; Rebentisch 2019). However, from the beginning of the Last Glacial Maximum (LGM) until the end of the Palaeolithic there is little to no evidence for human occupation of the Côte Chalonnaise. Two leaf point fragments from Grotte de la Verpillière I represent the only potential sign for a Solutrean occupation (Dutkiewicz & Floss 2015). In the past, a Magdalenian occupation has been stated for the sites of Grotte des Teux-Blancs (Mayet et al. 1921; Combier 1956), Grotte de la Folatière (Bourdier 1947; Guillard 1959), and the

Mère Grand cave site (Arcelin 1877; de Mortillet 1910, 1913) (Fig. 1), but the transmitted record is insufficient to unequivocally support this today. Therefore, the site of Grotte des Teux-Blancs was chosen for reinvestigation as the most promising site to reassess its previous, poorly founded, attribution to the Magdalenian as indicated by Mayet et al. (1921) and Combier (1956). Besides a reinvestigation of the known collections, excavations in the back-dirt were carried out to evaluate the archaeological potential of the site (Schray 2020; Schray et al. 2020).

### Grotte des Teux-Blancs

Grotte des Teux-Blancs is located approximately 12 km west of Chalon-sur-Saône. The site is situated at the western slope of the mountain range of Montadiot and around 800 m east of the community of Saint-Denis-de-Vaux (Fig. 2: 1). The cave is part of a Jurassic limestone cliff, which protrudes strikingly from the landscape only a few meters north of the cave and is eponymous for the sites' name translating to "white rocks". The site is also known by the less common local names *Beurne aux Loups* or *Beurne au Renard* (Lènez 1935; Armand-Calliat 1943; Combier 1956). From the plateau that opens a few meters above the cave entrance the river valley of the Orbize, called *Vallée des Vaux*, and the site complex of Saint-Martin-sous-Montaigu (La Roche and Château Beau), on the opposite slope, are visible. Grotte des Teux-Blancs is nowadays situated at the border of a small forest, but a similar view would be possible from

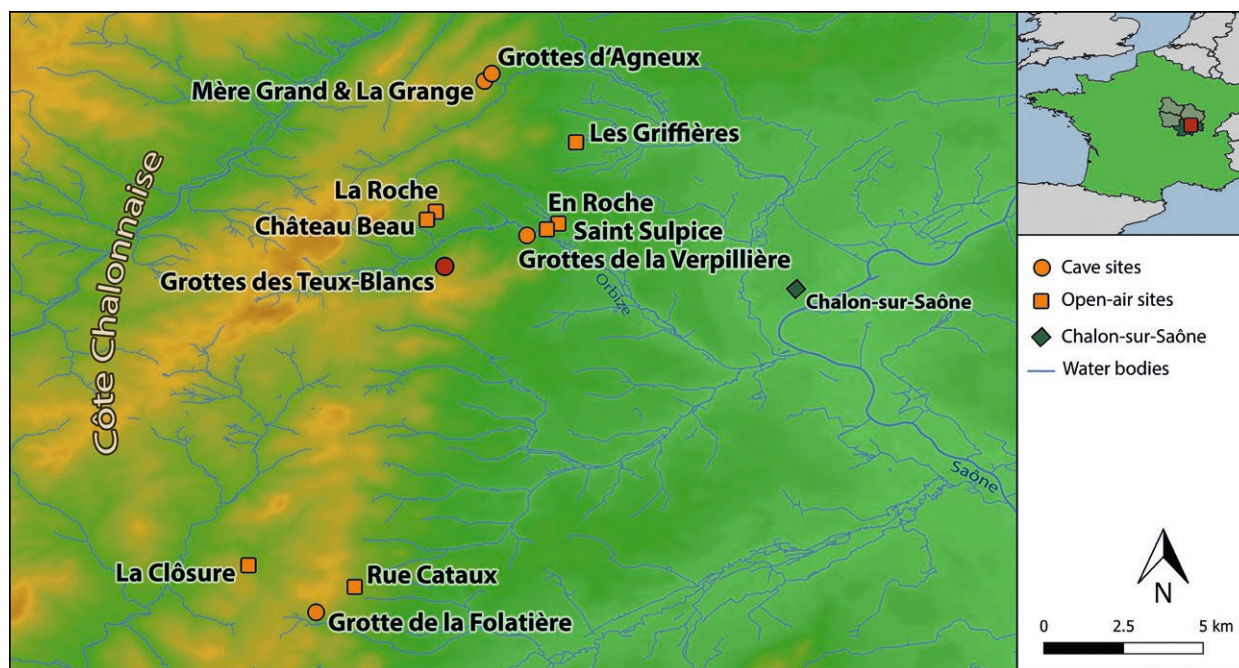
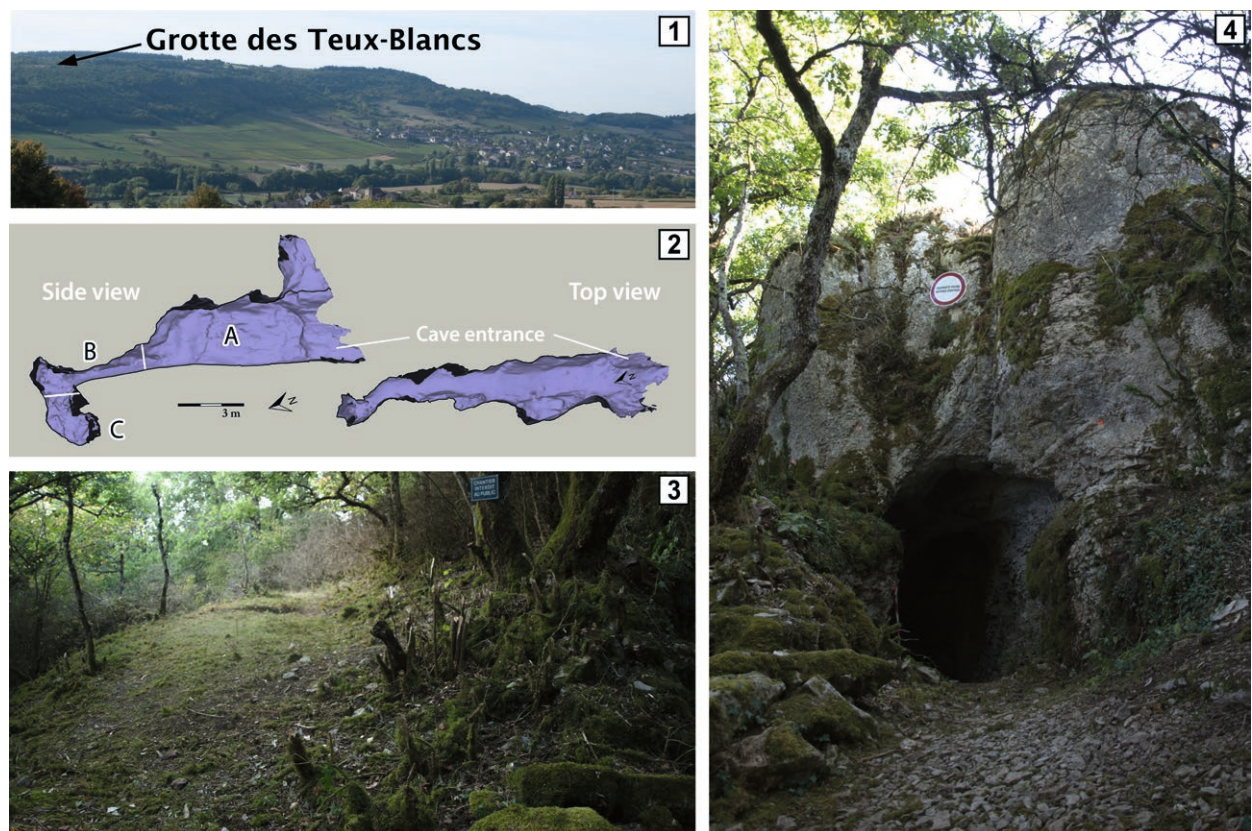


Fig. 1. Map of the geographical location of Grotte des Teux-Blancs (red) and other Palaeolithic sites (orange) in the Côte Chalonnaise. Map basis: © European Union, Copernicus Land Monitoring Service 2021, European Environment Agency (EEA), Open Street Map (Geofabrik) (S. Schray).

Abb. 1. Karte der geographischen Lage der Grotte des Teux-Blancs (rot) und anderen paläolithischen Fundstellen (orange) in der Côte Chalonnaise. © European Union, Copernicus Land Monitoring Service 2021, European Environment Agency (EEA), Open Street Map (Geofabrik) (S. Schray).



**Fig. 2.** Overview of the site. 1 Location of Grotte des Teux-Blancs in the landscape. 2 Current plan of the cave with reconstructed areas of excavation. A Excavation of 1913. B Excavation of 1932. C Excavation of 1998. 3 Back-dirt terrace west of the cave entrance. 4 Entrance of the cave (plan of the cave modified after C. Hoyer, S. Schray).

**Abb. 2.** Übersicht der Fundstelle. 1 Lage der Grotte des Teux-Blancs in der Landschaft. 2 Aktueller Höhlenplan mit rekonstruierten Grabungsarealen. A Grabung 1913. B Grabung 1932. C Grabung 1998. 3 Im Westen an die Höhle anschließende Abraumterrasse. 4 Eingang der Höhle (Höhlenplan modifiziert nach C. Hoyer, S. Schray).



**Fig. 3.** Excavations at Grotte des Teux-Blancs. 1 Picture of the excavation team of 1913 in front of the cave with Joseph Mazenot on the right wearing a hat (archive R. Desbrosse). 2 Excavation of the back-dirt sediments in 2019 with trench 1 in the back and trench 2 in the front (S. Schray).

**Abb. 3.** Ausgrabungen an der Grotte des Teux-Blancs. 1 Foto des Ausgrabungsteams von 1913 vor der Höhle mit Joseph Mazenot mit Hut rechts (Archiv R. Desbrosse). 2 Ausgrabung der Abraumsedimente im Jahr 2019 mit Schnitt 1 im Hintergrund und Schnitt 2 im Vordergrund (S. Schray).

the cave entrance during times with less vegetation (Fig. 2: 4). The cave opens to the south-southwest and is relatively small in dimension. The size of the cave corridor decreases continuously in a tubular shape over its 12 m of length (Fig. 2: 2). The cave has a size of 2.80 m height by 1.70 m width at the entrance declining to 0.60 m of height and 0.70 m of width at the end of the corridor right before a 2.30 m deep pit opens on a surface of roughly one square meter (Herkert 2020). The pit derives from unauthorized emptying of the cave and reveals a profile of densely calcinated sediments towards the cave entrance. The terrain leading to the cave forms a little corridor of three meters of lengths that was supposedly filled up by a sediment cone prior to the excavations (Fig. 2: 4) (Combiér 1956).

After hearing of the existence of the cave from Emile Menand, the site was first excavated by Lucien Mayet under the local direction of Joseph Mazenot (Fig. 3: 1). There is very little information about their work as, besides a short note in a conference paper (Mayet et al. 1921), it was never published, and the documentation is not known to be preserved. During the excavations of 1913, the sediment cone in front and presumably the first six meters inside the cave were excavated to the first step of the cave roof, which represents the major part of the cave filling (Fig. 2: 2.A). Reportedly, the sediments were dug in layers of 15 cm and deposited in the area adjacent to the northwest, forming a small terrace (Fig. 2: 3) (Combiér 1956). Stratigraphic observations of the cave sediments are only known for the excavation of 1913, in which all sediments are described as pervaded by limestone debris and heavily affected and displaced by water flow (Mayet et al. 1921). During this excavation, four layers were distinguished and described (Fig. 4) (Mayet et al. 1921; Combiér 1956; Schray et al. in press):

1. A superficial layer containing fragments of pottery and skeletal parts of an adolescent human attributed to a mixture of Neolithic and more recent times.
2. A layer of reddish sediments attributed to the Magdalenian.
3. A layer infused by limestone debris, which was first attributed to the Aurignacian by Mayet et al. (1921; *Courrier de Saône-et-Loire* 03.10.1913), but later reattributed to a Mousterian by Combiér (1956).
4. A layer, located at the posterior part of the excavation, containing only faunal remains from hyenas overlying an isolated hand axe.

In 1932, an instructor from Chalon-sur-Saône named Olivier Rossé investigated the cave, though the outcome of this investigation is unknown, and three young men from the neighbouring village of Givry excavated inside the cave (Lènez 1935; Combiér 1956). These men recovered a few faunal remains that were given to Lènez for analysis (Lènez 1935). Based on what can be reconstructed, the excavation must have taken place in the small tube that forms the last

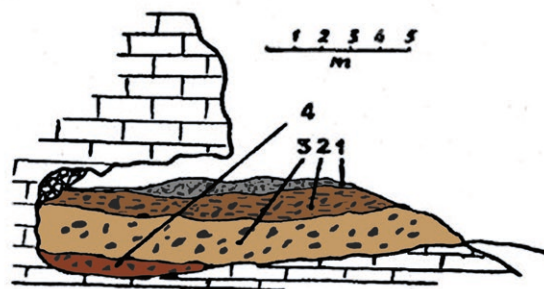


Fig. 4. Sketch of the stratigraphy based on descriptions by the excavators of 1913 (modified after Combiér 1956: Fig. 1).

Abb. 4. Skizze der Stratigraphie anhand von Beschreibungen der Ausgräber von 1913 (modifiziert nach Combiér 1956: Fig. 1).

third of the cave (Fig. 2: 2.B). This can be supported by the description of the faunal remains originating from very dense and cemented sediments (Lènez 1935) similar to those that can still be observed in that part of the cave today. A plan of the cave from the 1970s (S.C.A.P. 1979) shows that unauthorized emptying of the cave, traced back to February 1998, led to the formation of the pit in the back (Fig. 2: 2.C) (H. Floss & L. Deroches pers. comm.). Only faunal remains were found during this activity (Schray et al. 2020). The most recent work was carried out by a team from the University of Tübingen. Since the cave was said to have been excavated to the bedrock in most parts, a test excavation was started in the back-dirt in 2018 and extended in 2019 (Fig. 3: 2) (Schray et al. 2020).

## Material & methods

There are four collections of material from Grotte des Teux-Blancs. The collection of the former *Laboratoire de Géologie* of the University Claude Bernard Lyon 1 stores 114 finds from the excavation of 1913; the Musée Denon, in Chalon-sur-Saône, stores eleven faunal remains found in 1932; the amateur archaeologist Victor Donguy found seven faunal remains and a flake on the surface of the cave; and numerous finds were recovered during the 2018 and 2019 excavations. In total, 587 lithic artefacts, 69 pieces of colouring material, 23 osseous artefacts, two pendants, 31 human remains, >18 kg of faunal bones, >300 faunal teeth and fragments, 99 g of burnt bones, 99 fragments of antler, 75 fragments of ivory, 37 fish remains, >7,000 micro-faunal remains, and several pieces of pottery and recent material were recovered from the back-dirt (Tab. 1) (Schray 2020).

Finds from the 1913 excavation with the catalogue numbers UCBL-FSL 883633 to 883672, stored in Lyon, which include 108 lithic artefacts, one worked piece of haematite, two antler points, one antler splint, one perforated carnivore tooth, and one digested unidentified bone fragment, were analysed. The stratigraphic information of these finds was not transmitted,

Find category	Amount	Find category	Amount
Lithics	587	Burnt bones	99 g
Colouring material	69	Antler	99
Osseous artefacts	23	Ivory	75
Pendants	2	Fish remains	37
Human remains	31	Micro fauna	>7,000
Faunal bones	>18 kg	Pottery	54
Faunal teeth/fragments	312/>1,000	Recent materials	55

Tab. 1. Find quantities recovered from the back-dirt in 2018 and 2019 after category.

Tab. 1. Anzahl der in den Jahren 2018 und 2019 aus dem Abraum geborgenen Funde nach Fundkategorie.

with the exception of the carnivore tooth, which was supposedly found in the first layer (Comber 1956; Gros & Gros 2005). Though other finds, such as pottery, faunal remains, and human remains, are mentioned in previous publications, these could not be retraced for this study. As well as the 1913 material, chronologically

significant and informative finds, such as lithic and osseous artefacts, pendants, colouring material, and human remains, from the back-dirt were analysed in detail. The main focus of this study, however, is on the lithic artefacts.

The finds from the back-dirt originate from two trenches. With the goal of reaching the former surface of the slope, to estimate the remaining volume of cave sediments in the back-dirt, the position of the trenches was chosen at the presumed western and eastern ends of the terrace area (Fig. 5). Due to the unstratified nature and small scale of the finds, they were measured in a square meter grid by excavated buckets, which were approximately ten litres in volume, as collective finds. Because of the poor accessibility of the site, most sediments were dry-sieved at the site using coarse- (6 mm) and fine-meshed (2 mm) sieves (Fig. 5). A minimum number of two sub quadrants per trench were chosen as sample columns to be water screened and sorted. The differences in material recovered by the two techniques were only marginal due to the adaption

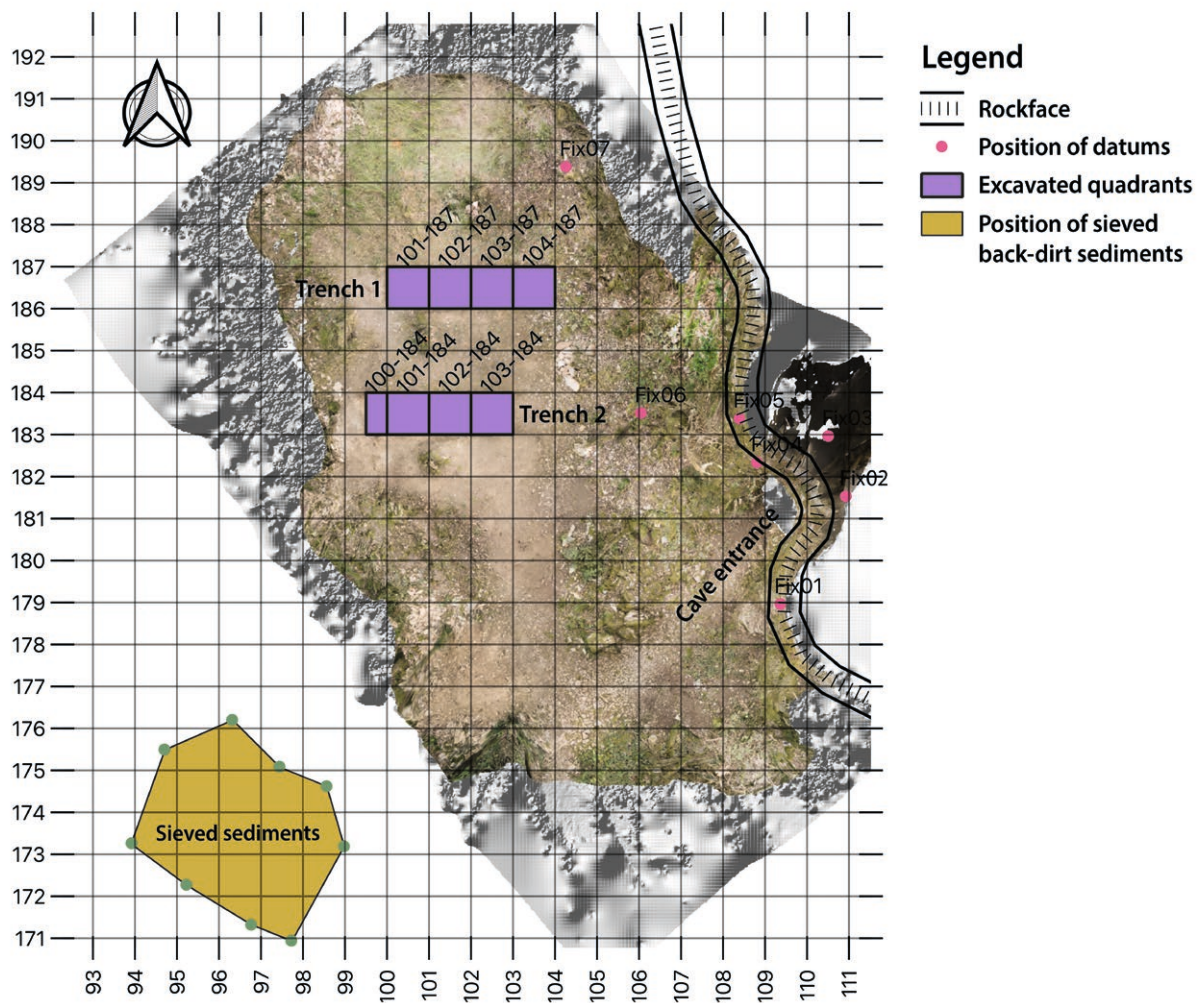


Fig. 5. Plan of the back-dirt terrace in the local measuring grid with the position of the cave, the datums of the total station, the trenches, and the sieved back-dirt sediments (K. Herkert).

Abb. 5. Plan der Abraumterrasse im lokalen Messnetz mit der Position der Höhle, der Fixpunkte der Totalstation, der Schnitte und der gesiebten Abraumsedimente (K. Herkert).

of the methods used for dry sieving. Additionally, this allowed to get another insight into the geological composition of the back-dirt sediments.

The lithic artefacts were studied by typological and technological characteristics using attribute analysis (Demars & Laurent 1989; Floss 2012a; Tafelmaier et al. 2020). Modified lithics and all blanks, besides micro-flakes, were analysed individually while debitage under ten millimetres was only sorted and counted. From 695 known lithics, a total of 394 lithics were studied in detail. The metric distinction between blades and bladelets was set at 12 mm (Tixier 1963) and at ten millimetres between flakes and micro-flakes. Over 40 attributes were recorded and entered into a MS Access-database. Based on a combination of typological and technological features, pieces like blades and bladelets with specific striking and core reduction characteristics were assigned to the Upper Palaeolithic while others with indifferent characteristics were left unassigned. The identification of modifications was affected by the high degree of edge damage due to the taphonomic reasons described above. Therefore, modifications were only recorded as such when they were of regular nature and patinated the same way as the rest of the piece. Additionally, a high percentage of artefacts was fractured, sometimes even to a degree that the blank type was unidentifiable.

## Results

### Stratigraphic observations of the back-dirt

During the excavation of the back-dirt, distinct differences in the colour and composition of the sediments could be observed. According to these observations, layers were defined as geological horizons (GH) even though they are not viewed as closed geological units (Fig. 6). The GHs were named per trench after their appearance during the excavation. Their stratigraphic succession (from youngest to oldest) is the following (Tab. 2):

- GH 1: Represents the topsoil layer which forms the current walking surface of the terrace. It has a thickness of up to ten centimetres and is traversed by roots. Until the formation of topsoil at the surface, GH 1 was originally part of what is now defined as GH 2 and 2B.
- GH 2B: This layer is similar in colour and composition to GH 2 but needs to be separated due to its stratigraphical position under GH 1 and over GH 1B in trench 2. The deposits of GH 2B are interpreted as back-dirt sediments from the 1932 excavation.
- GH 1B: Was defined as a layer of brown topsoil sediment that is situated between GH 2 and GH 2B in trench 2 (Fig. 6). The layer is similar in thickness and composition to GH 1 except for a slight reddish tinge and the presence of a few bigger limestone pieces. The identification of the GH against GH 1 was difficult during the excavation but became evident when studying the northern profile.

GH 2: GH 2 is underlying GH 1 and 1B in trench 2 as well as GH 1 in trench 1 and has a beige-yellowish colour. It is pervaded by small limestone debris that can reach up to a few centimetres in size. The limestone pieces have a yellow stain and dull edges. This GH is up to 95 cm thick and has an average thickness between 50 and 75 cm. GH 2 is interpreted as back-dirt sediments from the excavation of 1913.

GH 3: The sediments of GH 3 are beige-yellowish with a clear red to orange tone, and they lay loosely over each other. Bigger limestone pieces are rare but when present sediment free hollows appear between them. While this GH is generally composed of three to four centimetres limestone pieces with very little sediment between them in trench 2, there are only a few limestone pieces and more sediment in trench 1. This layer only appears in the western areas of both trenches and has a maximum thickness of 30 to 40 cm. Due to the loose character of the GH with hollows between the limestones, a fast non-natural deposition can be concluded. GH 3 is therefore, interpreted as back-dirt sediments from the 1913 excavation.

GH 4: This GH differs the most from the previously described layers. It is made up of grey-blueish coloured limestone pieces, around five centimetres in size, and yellow-reddish sediments that probably infiltrated from GH 3. The limestone pieces lay loosely on top of each other, and their edges are fresh rather than rounded, suggesting that they originate from the cryoclastic detachment of the cave wall. The thickness of the GH is almost 25 cm in trench 2 and only a few centimetres in trench 1. At the base of the layer, grey limestone blocks, up to 50 cm in size, are present. Archaeological finds are infrequent but non-fossil molluscs appear in bulk. As part of the back-dirt sediments of the 1913 excavation, GH 4 represents the cryoclastic covering from the former cave filling.

GH 5: Was only reached at its surface and is therefore not visible in the profile. The GH appears in between the limestone blocks of GH 4. The sediments have a brown topsoil-like colour with a slight tendency to grey. This GH is considered to represent the former surface of the terrain, prior to the deposition of the back-dirt. This is in accordance with the present slope of 25 to 30 degrees which is within the range of natural slopes.

GH 1A: The GH is characterized by brown topsoil-like sediment and was only discovered in trench 1, where the GH is located under GH 2, 3 and 4 and over GH 2A. The limits

of the layer were difficult to identify during excavation. GH 1A is considered to represent the former topsoil before the deposition of the back-dirt sediments and thus correlates with GH 5.

GH 2A: The layer was only identified in trench 1 and is comparable to GH 2 in terms of appearance. Due to its position under GH 1A, GH 2A is interpreted as part of the original slope deposit

GH 4A: This layer is only present in trench 1 and is positioned under GH 2A. This GH is composed of medium sized limestone pieces and beige-yellowish to brownish sediments.

The presence of two distinct topsoil layers (GH 1 & 1B) is apparent in the northern profile of trench 2 (Fig. 6). The position of topsoil layer GH 1B under GHs 2B and 1 suggests that GHs 1 and 1B reflect two chronological distinct soil formation processes at the surface. Meaning that the sediments of GH 1B, and below, must have been deposited in a first event and a topsoil layer had already formed before the second event where the sediments of GH 2B were deposited. According to known information, the first event is the excavation in 1913 and the second event is the excavation(s) that took place in 1932 (Fig. 7). The situation of GH 1A, 2A, and 4A in trench 1, however, is different. GH 1A most likely represents the former topsoil layer before the

deposition of the back-dirt sediments in 1913, which is also represented by GH 5 in the west. Due to the state of the excavation, it is not possible to confirm or deny whether the GH realigns with GH 5 further down the slope to the west. The GHs 2A and 4A are interpreted as slope deposits, that were cut by the excavation. The thicker part of GH 1 in the eastern part is viewed as perturbed likely caused by bioturbation or undocumented anthropogenic intrusion.

Differences in the amount of limestone debris between both trenches might be explained by the deposition of sediments from the cave entrance with more debris closer to the cave, in the area that is now trench 2.

### Distribution of finds

Some artefact categories show a pattern of distribution within the back-dirt. This is particularly evident in the distribution of organic artefacts, human remains, pottery, and chronologically significant lithic artefacts (Fig. 8). While the distribution does not always follow the defined layers, there is a clear vertical dispersion of finds. The human remains, for example, were found in most layers, with the majority originating from GH 2 and 3. Nevertheless, the remains are mostly concentrated along the slope in two vertically distinct positions. This largely fits with the description that the human remains were

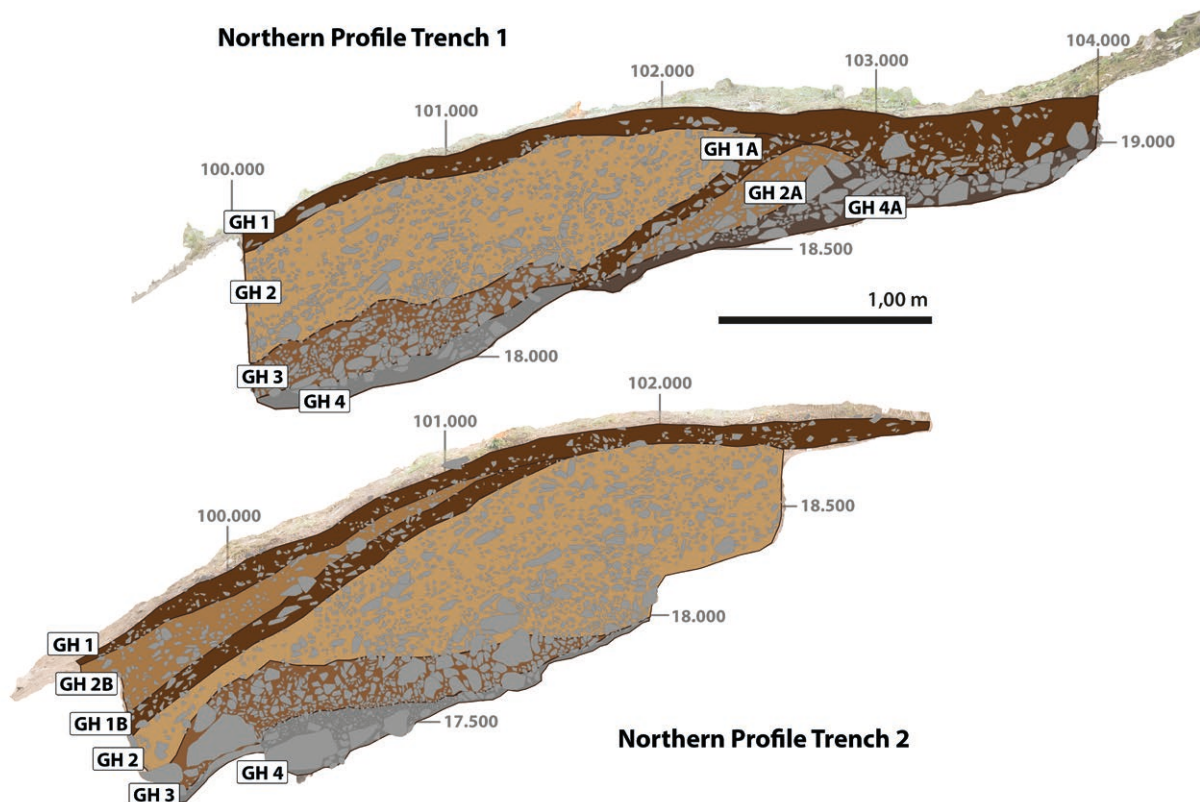


Fig. 6. Northern profiles of the excavation trenches in the back-dirt of Grotte des Teux-Blancs (K. Herkert & S. Schray).

Abb. 6. Nordprofile der Ausgrabungsschnitte im Abraum der Grotte des Teux-Blancs (K. Herkert & S. Schray).

Stratigraphic succession	Trench 1	Trench 2	Interpretation
GH 1	✓	✓	Recent topsoil
GH 2B	-	✓	Back-dirt from 1932 excavation
GH 1B	-	✓	Topsoil layer formed after the excavation of 1913
GH 2	✓	✓	Back-dirt sediments from 1913 excavation
GH 3	✓	✓	Back-dirt sediments from 1913 excavation
GH 4	✓	✓	Cryoclastic debris from 1913 excavation
GH 5	✓	✓	Former topsoil before the 1913 excavation
GH 1A	✓	-	Potential former topsoil before the 1913 excavation, correlates with GH 5
GH 2A	✓	-	Slope deposit
GH 4A	✓	-	Slope deposit

**Tab. 2.** Stratigraphic succession of the geological horizons and their interpretation within the two excavation trenches of the back-dirt.

**Tab. 2.** Stratigraphische Abfolge der geologischen Horizonte und deren Interpretation innerhalb der beiden Grabungsschnitte im Abraum.

found in the first layer in 1913. However, the recovery of human remains in different layers of the back-dirt could indicate different chronological origins of the remains. Lithic artefacts appear throughout the

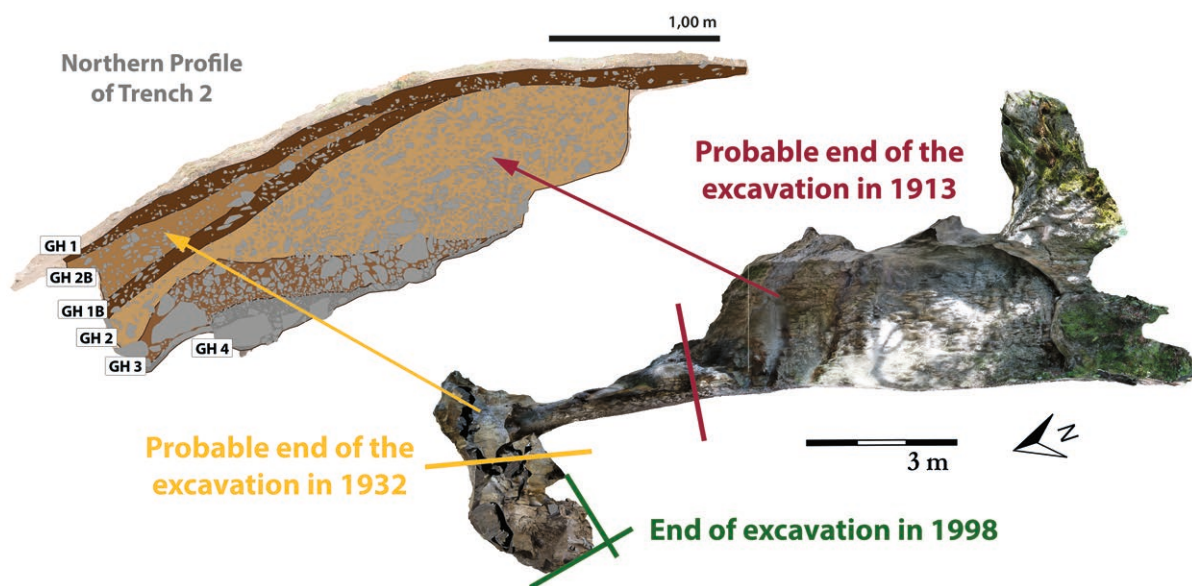
back-dirt. The majority of backed-bladelets were found in GH 2 with only two pieces each found in GH 3 and 4. They show a clear band-shaped distribution along the slope. Other chronologically distinct lithics, like burin spalls and tools, were also mainly found in GH 2, within the same area as the backed bladelets. The organic artefacts were also mostly found in GH 2. Their concentration is a little more dispersed but still follows the slope. The pottery was mostly found at the bottom of the trenches which fits the previous stratigraphic description. Smaller fragments of pottery, mostly only a few millimetres in size, were also scattered throughout the back-dirt.

**Lithic artefacts**

The analysed inventory is composed of 95 flakes, 74 blades, 174 bladelets, 120 micro-flakes, 95 fragmented blanks, 3 pieces with unknown blanks, 9 cores, and 125 pieces of debris (Tab. 3).

**Middle Palaeolithic**

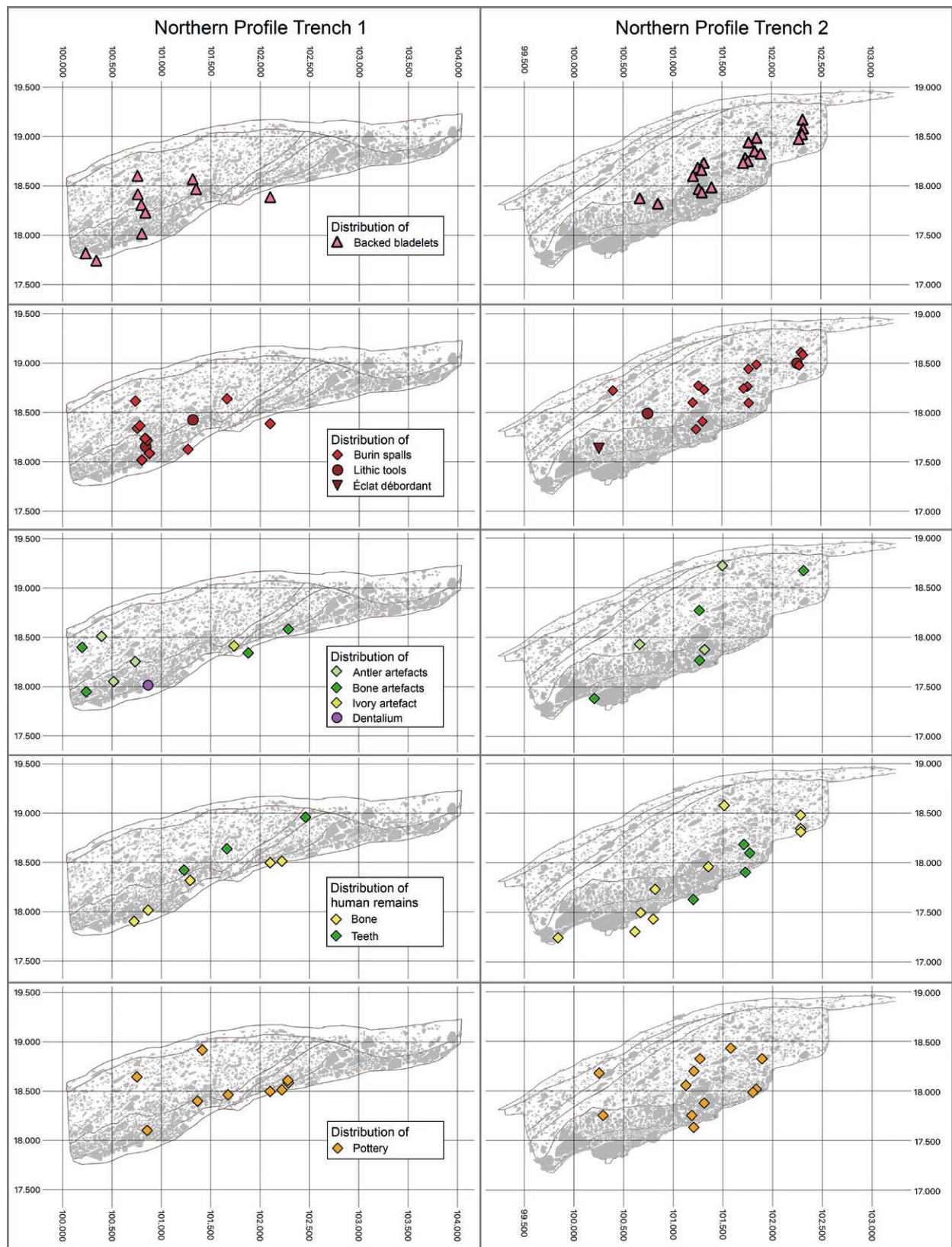
For 15 artefacts an attribution to the Middle Palaeolithic was possible. The assemblage is composed of one big hand axe; two side-scrapers; two Levallois cores; nine blanks, that were produced using the Levallois or discoid reduction concept; and one laterally retouched flake (Fig. 9, Tab. 4). The hand axe is 145 mm long, 85.5 mm wide and 33.3 mm thick. While one face is more thoroughly worked, the other shows bigger negatives from the shaping process. The hand axe broke into three pieces during the 1913 excavation (Combiér 1956), as a result of which some areas cannot be reconstructed (Fig. 9: 1). One



**Fig. 7.** Reconstruction of the different excavation areas and location of the corresponding sediments in the back-dirt (K. Herkert, S. Schray, C. Hoyer).

**Abb. 7.** Rekonstruktion der verschiedenen Ausgrabungsareale und Lage der korrespondierenden Sedimente im Abraum (K. Herkert, S. Schray, C. Hoyer).





**Fig. 8.** Spatial distribution of the significant lithic and organic artefacts, human remains, and pottery plotted against the northern profiles of trench 1 and 2 (K. Herkert).

**Abb. 8.** Räumliche Verteilung der aussagekräftigen lithischen und organischen Artefakte, Menschenreste und Keramik geplottet auf den nördlichen Profilen von Schnitt 1 und 2 (K. Herkert).

Lithic artefacts	Excavation of 1913	Back-dirt excavation 2018 & 2019	Total
Flakes	42	53	95
Blades	42	32	74
Bladelets	4	170	174
Micro-flakes	-	120	120
Fragmented blanks	3	92	95
Unknown blanks	3	-	3
Cores	5	4	9
Debris	9	116	125
Total	108	587	695

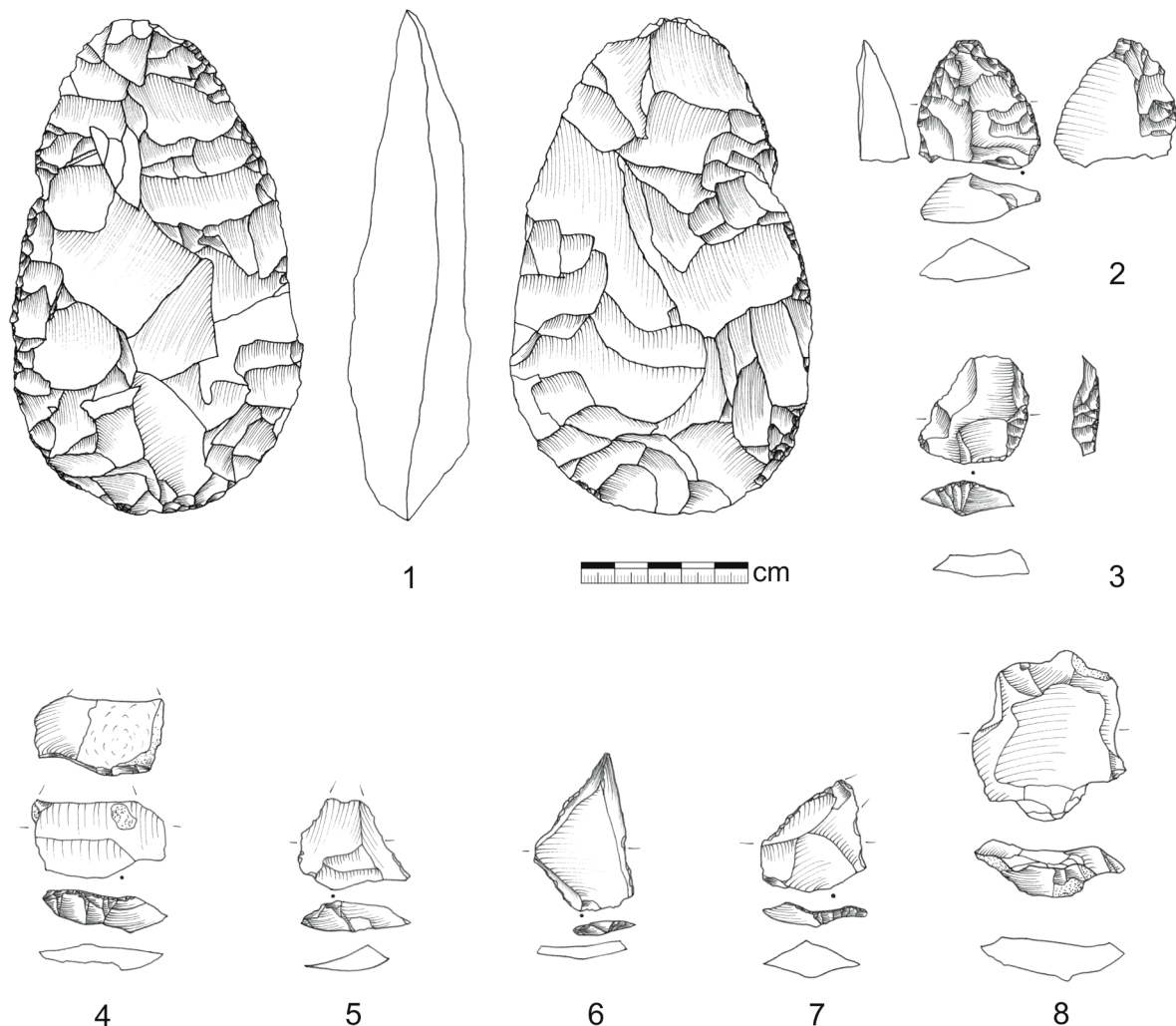
**Tab. 3.** Number and type of lithic artefacts found at Grotte des Teux-Blancs in total and distributed between the collections of the 1913 excavation in Lyon and the excavation of the back-dirt in 2018 and 2019.

**Tab. 3.** Zahl und Art der in der Grotte des Teux-Blancs gefundenen Steinartefakte gesamt und verteilt auf die Sammlungen der Grabung von 1913 in Lyon und der Ausgrabung des Abraums 2018 und 2019.

Artefact type	Excavation of 1913	Back-dirt excavation 2018 & 2019	Total
Hand axes	1	-	1
Side-scrappers	2	-	2
Levallois cores	2	-	2
Levallois flakes	5	-	5
Levallois points	3	-	3
Débordant flakes	-	1	1
Laterally retouched flakes	1	-	1
Total	14	1	15

**Tab. 4.** Type and number of Middle Palaeolithic lithic artefacts found at Grotte des Teux-Blancs distributed between the collections of the 1913 excavation in Lyon and the excavation of the back-dirt in 2018 and 2019.

**Tab. 4.** Typ und Anzahl der in der Grotte des Teux-Blancs gefundenen mittelpaläolithischen Steinartefakte verteilt auf die Sammlungen der Grabung von 1913 in Lyon und der Ausgrabung des Abraums 2018 und 2019.



**Fig. 9.** Middle Palaeolithic lithic artefacts from Grotte des Teux-Blancs. 1 Hand axe, blank negatives were destroyed by the fractures, 2-3 side-scrappers thereof 2 with bifacial working edge, 3-4 Levallois flakes with *chapeau de gendarme*, 5-6 Levallois points, 7 pseudo-Levallois point, 8 Levallois core (Drawings B. Schürch).

**Abb. 9.** Mittelpaläolithische Steinartefakte aus der Grotte des Teux-Blancs. 1 Faustkeil, weiße Negative wurden beim Bruch zerstört, 2-3 Schaber davon 2 einseitig bifaziell gearbeitet, 3-4 Levallois-Abschläge mit *chapeau de gendarme*, 5-6 Levallois-Spitzen, 7 Pseudolevallois-Spitze, 8 Levallois-Kern (Zeichnungen B. Schürch).

of the scrapers is a double scraper with one bifacially worked edge (Fig. 9: 2) and the other one is a regular side-scraper worked on a flake that was produced on a Levallois core using centripetal reduction (Fig. 9: 3). Among the unmodified pieces produced using the Levallois concept are five flakes, two points, and one pseudo-Levallois point (Fig. 9: 4-7). The side-scraper and one Levallois flake have a *chapeau de gendarme* type striking remnant (Fig. 9: 3-4) that is the result of repeated preparation of the striking platform during unidirectional blank production using the Levallois concept (Bordes 1961). A red quartzite flake represents the only possible Middle Palaeolithic lithic artefact found during the back-dirt excavation. It is attributed to this period because it is an *éclat débordant* which is a typical preparation product from the Levallois and discoid production concept common in the Middle Palaeolithic (Boëda et al. 1990; Boëda 1993).

#### Upper Palaeolithic

A total of 231 artefacts were assigned to the Upper Palaeolithic. Besides 36 backed bladelets, one microburin, two backed points, five burins, four end-scrapers, one burin-scraper combination tool, three pieces used for drilling, nine modified pieces, one blade and three bladelet cores, blanks, such as 50 blades, 90 bladelets, and 26 burin spalls, were also attributed to the Upper Palaeolithic based on present features (Tab. 5). The tools are dominated by small, backed pieces that are exclusively from the back-dirt excavation.

**Backed pieces.** A total of 36 backed bladelets were recovered from the back-dirt (Fig. 10: 1-15). The majority are preserved as medial fragments. The size of the bladelets ranges from 19.2 mm to 1.4 mm long, 7.4 to 1.0 mm wide and 8.0 to 0.7 mm thick. Nine bladelets show characteristics of being produced on burins and are therefore characterised as burin spalls. Two of them carry a mirrored retouch. Six fragments could be refitted to a total of three backed bladelets (Fig. 10: 1-3). They were found in close proximity to each other so the fracture could be of a recent nature. Two fragments of the same piece represent the only inversely retouched backed bladelets (Fig. 10: 2). Another refit was made with two fragments that taper and could be referred to as head bladelets (Fig. 10: 1). Head bladelets are defined as tapering backed pieces that were used as the foremost bladelets in a series of backed bladelets hafted onto an organic point (Pétillon et al. 2011). Two further pieces can be addressed as head bladelets, one of them with a bilaterally worked pointed end and ventral splintering of the unworked edge (Fig. 10: 5). Eleven backed bladelets show impact traces at their basal or terminal ends, these are mostly on the ventral surface, but some also affect the edges (Fig. 11: 1-7). One identified microburin (Fig. 10: 16 & 11: 8) has a fine worked inverse retouch and an intentional basal fracture common of the "notch fracture technique" (*Kerbstechtechnik*) (Bolus 2012).

Artefact type	Excavation of 1913	Back-dirt excavation 2018 & 2019	Total
Backed bladelets	-	36	36
Microburins	-	1	1
Backed points	-	2	2
Burins	4	1	5
End-scrapers	2	2	4
Combination tools	1	-	1
Borers	-	3	3
Pointed blades	1	-	1
Modified blanks	1	7	8
Cores	1	3	4
Blades	24	26	50
Bladelets	2	88	90
Burin spalls	2	24	26
Total	38	193	231

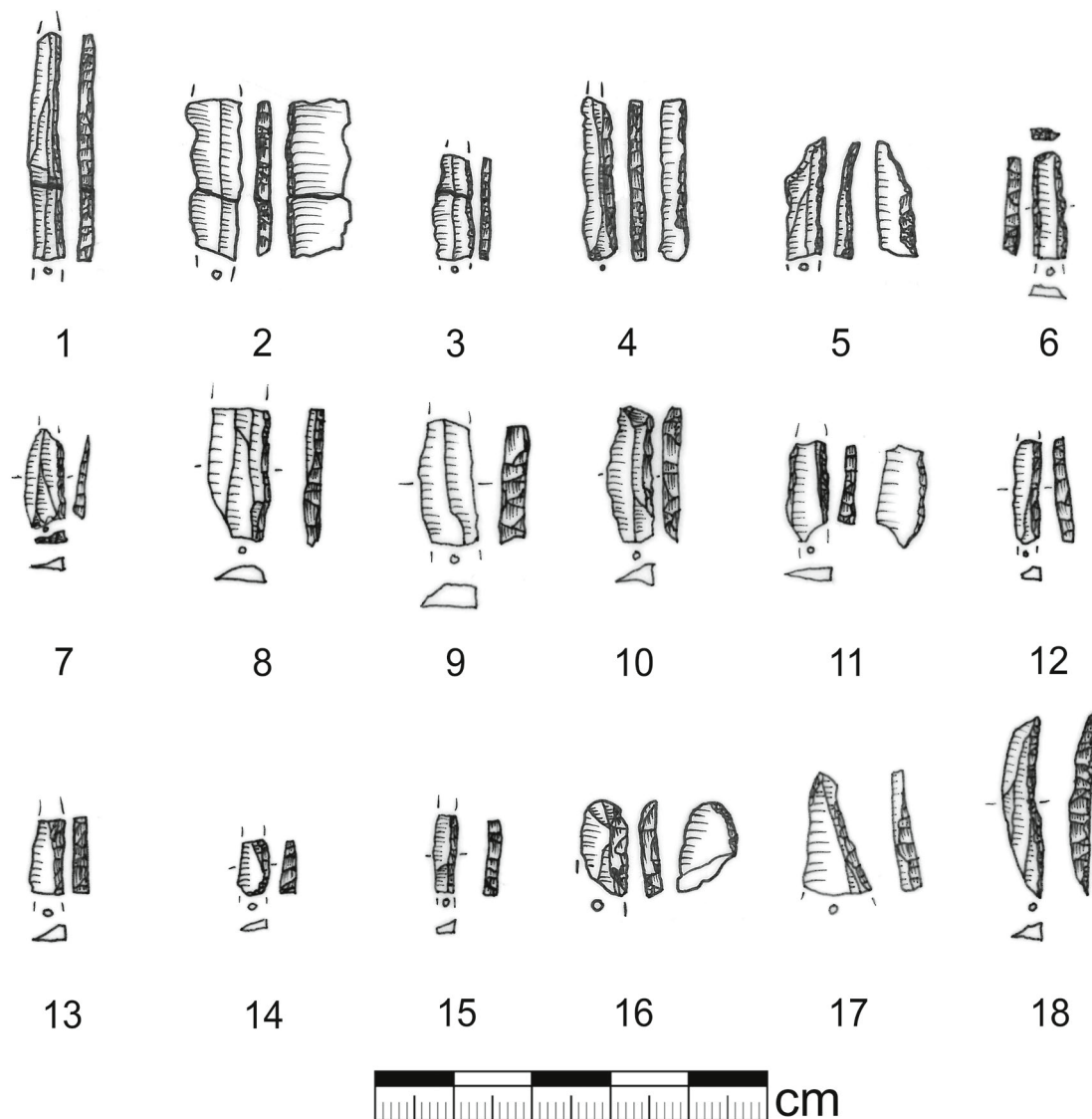
**Tab. 5.** Type and number of Upper Palaeolithic lithic artefacts found at Grotte des Teux-Blancs distributed between the collections of the 1913 excavation in Lyon and the excavation of the back-dirt in 2018 and 2019.

**Tab. 5.** Typ und Anzahl der in der Grotte des Teux-Blancs gefundenen jungpaläolithischen Steinartefakte verteilt auf die Sammlungen der Grabung von 1913 in Lyon und der Ausgrabung des Abraums 2018 und 2019.

Additional to the backed bladelets, two backed points were found (Fig. 10: 17-18). One is fully preserved and was worked on a delicate slightly twisted bladelet. The back of this point was attached to the right lateral side with a mirrored retouch. It can be referred to as a *bipointe* but, contrary to typical azilian points (Floss & Weber 2012), the retouch was placed on the straight, slightly concave edge and not on the convex edge. The other backed point is distally preserved. The tip of the left edge and the right lateral edge were retouched with the latter showing an impact fracture at the tip.

**Burins and burin spalls.** The burins are composed of the following subtypes: two double dihedral burins, one simple dihedral burin, one mixed double burin, and one transversal burin (Fig. 12: 1-5). The latter is the only one recovered from the back-dirt. Both dihedral burins show negatives of numerous burin blows. One of the double dihedral burins can be typologically classified as a busked burin due to the presence of a notch and the preparations of one burin facet and the striking platform (Fig. 12: 2). The simple dihedral burin was produced on a crested blade.

Besides nine backed bladelets, 26 further pieces can be referred to as burin spalls. Eight bladelets show a dorsal retouch attached before the production of the bladelets, and eight carry dorsal negatives of previous bladelet production or preparation. One bigger bladelet of the latter category shows negatives of bidirectional production resembling the preparation product of a burin. Together with another piece,



**Fig. 10.** Backed pieces from Grotte des Teux-Blancs. 1-15 Backed bladelets, thereof 1-3 refitted, 2 inversely retouched, 1 and 5 head bladelets, 6 notched backed bladelet, 6-7 truncated, 16 inversely retouched microburin, 17-18 backed points (Drawings B. Schürch).

**Abb. 10.** Rückengestumpfte Stücke der Grotte des Teux-Blancs. 1-15 Rückenmesser, davon 1-3 zusammengesetzt, 2 ventral retuschiert, 1 und 5 head bladelets, 6 gezähntes Rückenmesser, 6-7 mit Endretusche, 16 ventral retuschierter Kerbrest, 17-18 Rückenspitzen (Zeichnungen B. Schürch).

they are the only burin spalls made of Tertiary chert rather than local Cretaceous flint.

**Burin-scraper combination tool.** The only burin-scraper combination tool was found during the excavation of 1913. The lateral retouch of the left edge merges into a steep scraper cap at the basal end of the blade (Fig. 12: 6). The terminal end is worked into a dihedral burin. The striking platform of the burin is broken off and the last production ended in an *outré-passé*.

**End-scrapers.** Four end-scrapers were found at Teux-Blancs cave (Fig. 12: 7-10). Two were found during the excavation of 1913 and two in the back-dirt. One was worked on a secondary crested blade. Two end-scrapers have a lateral retouch that merges into the scraper end. The fourth end-scraper is small in dimension and has a finely retouched scraper cap.

**Other modified pieces.** Other modified pieces are a bilaterally retouched and pointed blade, a notched blade and a notched bladelet, one borer, two pieces that show macroscopic wear marks of drilling activities, one laterally retouched blade, and three laterally retouched bladelets (Fig. 12: 11-14). From the last, one retouched bladelet must be highlighted due to its fine, bilateral retouch. In addition to the previously mentioned burin and end-scraper, one bladelet and one blade show remnants of crested preparations (Fig. 12: 15-16) that prove the use of the crested preparation typical for the Upper Palaeolithic (Floss 2012b).

**Cores.** The Upper Palaeolithic assemblage of Grotte des Teux-Blancs includes one blade and three bladelet cores (Fig. 13). The blade core has one production face that was reduced bidirectionally from two opposite striking platforms. It was discarded due

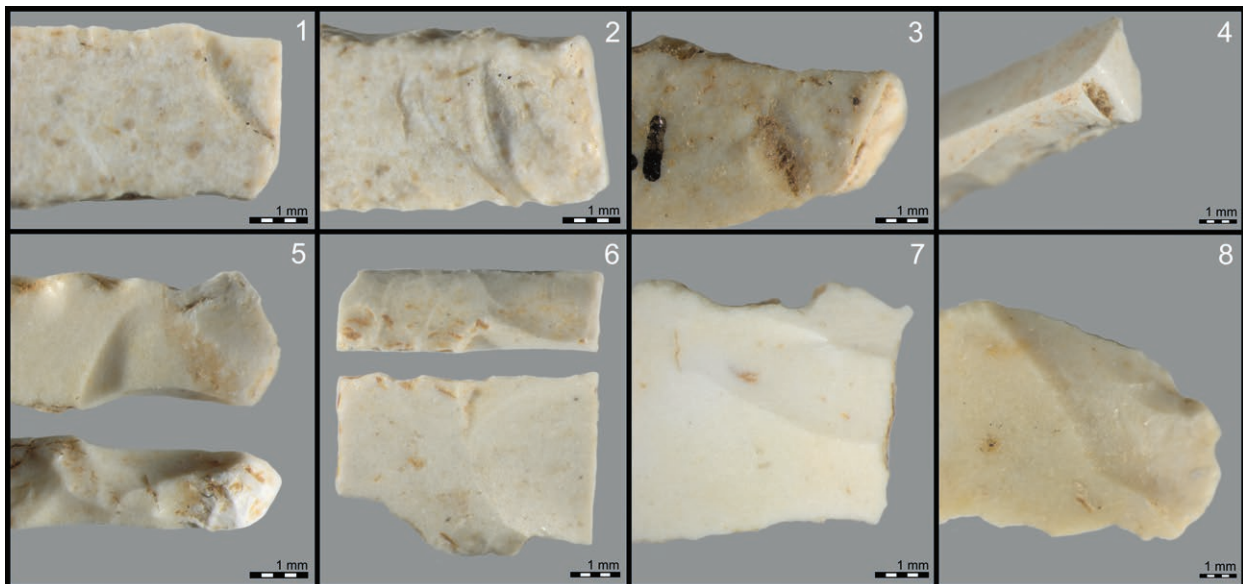


Fig. 11. Backed pieces with impact traces from Grotte des Teux-Blancs. 1-7 Backed bladelets, 8 Microburin (S. Schray).

Abb. 11. Rückengestumpfte Artefakte mit Impact-Spuren aus der Grotte des Teux-Blancs. 1-7 Rückenmesser, 8 Kerbrest (S. Schray).

to a hinge. There is one double carinated bladelet core, one fragmentary preserved bladelet core, and one bladelet core with a wide production surface. The latter is from the 1913 excavation and was not identified as a core in previous studies (Combiér 1956).

#### Chronologically insignificant artefacts

Three flake cores could not be attributed to a specific period. One core is mostly covered with cortex and has two production surfaces that each function as the striking platform for each other. Another core on a flake shows almost completely circumferential production negatives. Further modified pieces are a splintered piece out of Tertiary chert (Fig. 12: 16), one partially retouched flake fragment, and one partially retouched thick blade fragment. The latter two are made from a pink and a grey variant of the local chert.

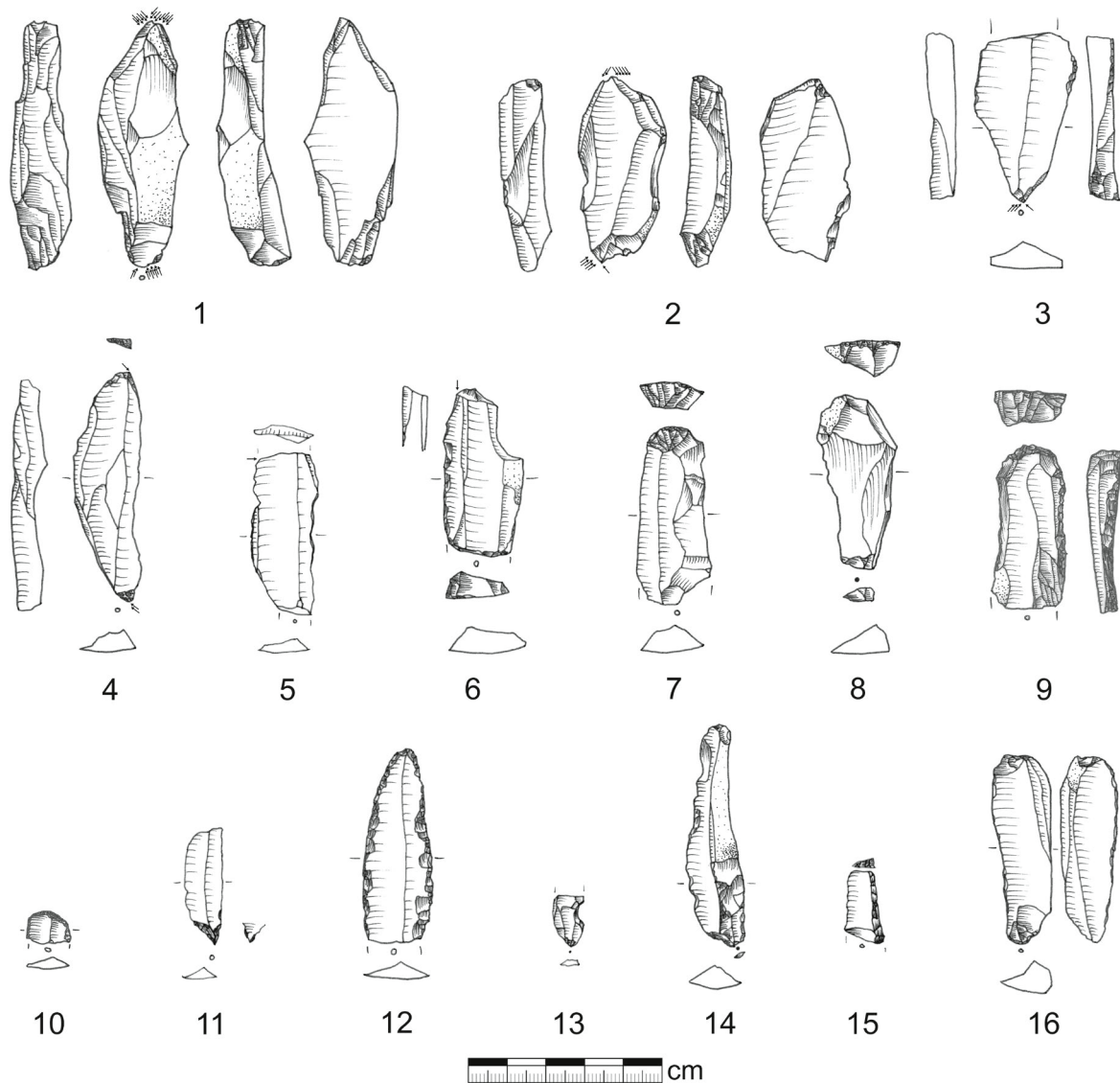
#### Used raw materials

The most used raw material in both the Middle and Upper Palaeolithic is secondary deposited Upper Cretaceous flint (Fig. 14). These deposits are often referred to as *argiles à silex* in French or flint bearing clays in English (Frick 2016). The formation and deposition processes of Cretaceous nodules in Tertiary sediments have not been conclusively studied yet (Rué et al. in press). Outcrops of the secondary deposited raw material are in the Chalonnais and Mâconnais (Fig. 15). The nearest known sources to Grotte des Teux-Blancs are at various places in the community of Germolles and at the site of Fontaines Les Griffières (Gros & Gros 2005; Herkert et al. 2015). The raw material is very variable in terms of colour, graininess, and quality (Frick et al. 2012). These characteristics can vary greatly within a deposit and

within one nodule. The local Cretaceous flint tends to patinate fast. White patination is most common, but brown, yellow, or beige can also be observed, and sometimes areas can even gleam bluish depending on the thickness of patination (Fig. 14: 1). As the archaeological pieces do not differ macroscopically from other outcrops of secondary deposited Cretaceous flint, the origin has not yet been further determined; however, a local acquisition seems most likely. The exceptions to this are the one bladelet core, five bladelets, and one blade which are made of Upper Cretaceous flint of a grey-blue variety with white marbling (Fig. 14: 2). This variety is typical for the Mâconnais especially in the area between Charbonnières and Mâcon northeast of Solutré. The white marbled appearance is due to the discolouring of bryozoan microfossils by weathering (Béreziat & Floss 2016; Rué et al. in press).

The use of local Jurassic chert, often referred to as *chaille*, is documented by two Levallois blanks from the Middle Palaeolithic and five chronologically insignificant pieces. The raw material derives from layers of the *Bajocien* and *Bathonien* in the Chalonnais. Compared to Cretaceous flint, it is rather coarse grained and of a lesser quality. The colours vary from pink to grey and beige to brown, and multiple colours can appear within a single nodule (Fig. 14). Similar to Cretaceous flint, Jurassic chert can be found all over the Côte Chalonnaise and Southern Burgundy (Fig. 15). The outcrops nearest to Grotte des Teux-Blancs are at the site complex of Saint-Martin-sous-Montaigu and the area of the sites of Grottes d'Agneux, Mère Grand, and La Grange near Rully (Gros & Gros 2005; Herkert 2020).

A less common, non-local raw material is Tertiary chert. It is characterized by a grey to sometimes blue tinted colour with a slight banding and usually a



**Fig. 12.** Lithic artefacts from Grotte des Teux-Blancs. Upper Palaeolithic 1-15. 1-5 Burins, thereof 1-2 double dihedral burins, 1 worked on secondary crested blade, 3 dihedral burin, 4 mixed double burin (burin on truncation and dihedral burin), 5 transversal burin, 6 burin-scraper combination tool, 7-10 end-scrapers, thereof 7 worked on secondary crested blade, 8-9 laterally retouched, 11 borer, 12 pointed blade, 13 notched bladelet, 14 secondary crested blade, 15 secondary crested bladelet, 16 splintered piece (Drawings B. Schürch).

**Abb. 12.** Steinartefakte aus der Grotte des Teux-Blancs. Jungpaläolithikum 1-15. 1-5 Stichel, davon 1-2 doppelte Mehrschlagstichel, 1 an sekundärer Kernkantenklinge gearbeitet, 3 Mehrschlagstichel, 4 gemischter Doppelstichel (Stichel an Endretusche und Mehrschlagstichel), 5 Querstichel, 6 Stichel-Kratzer Kombinationsgerät, 7-10 Kratzer, davon 7 an sekundärer Kernkantenklinge gearbeitet, 8-9 mit Lateralretusche, 11 Bohrer, 12 Spitzklinge, 13 gekerbte Lamelle, 14 sekundäre Kernkantenklinge, 15 sekundäre Kernkantenlamelle, 16 ausgesplittertes Stück (Zeichnungen B. Schürch).

relatively smooth surface (Fig. 14). The identification of Tertiary chert can be difficult when a high degree of patination is present. Two backed bladelets, two burin spalls, a splintered piece, five blades, and one bladelet were made from Tertiary chert. Some sources are known in the French Jura, but the most common source used during the Upper Palaeolithic is in the Mont-lès-Étrelles region, around 100 km northeast of Grotte des Teux-Blancs (Fig. 15) (Béreiziat 2019; Cupillard 2019).

Lastly, two pieces of quartzite and one piece of quartz were identified. There is the *éclat débordant* made of a red quartzite, one fragment of a small flake out of grey micro-quartzite, and a micro-flake of clear quartz (Fig. 14). The source of this material is unclear,

but it is probable that it originates from pebbles of the Orbize River, which has its source in the granite foothills of the Massif Central and the associated Morvan Massif.

**Other finds**

Other important finds made at Grotte des Teux-Blancs are osseous artefacts, pendants, human remains, and colouring material. The osseous artefacts are composed of ten antler points, two remnants of worked antler, three smoothers, two small bone points, an ivory point and four worked bone fragments (Fig. 16). The majority of the artefacts can be attributed to the Upper Palaeolithic. Most of the antler points show at least a slight longitudinal groove, which is often viewed as

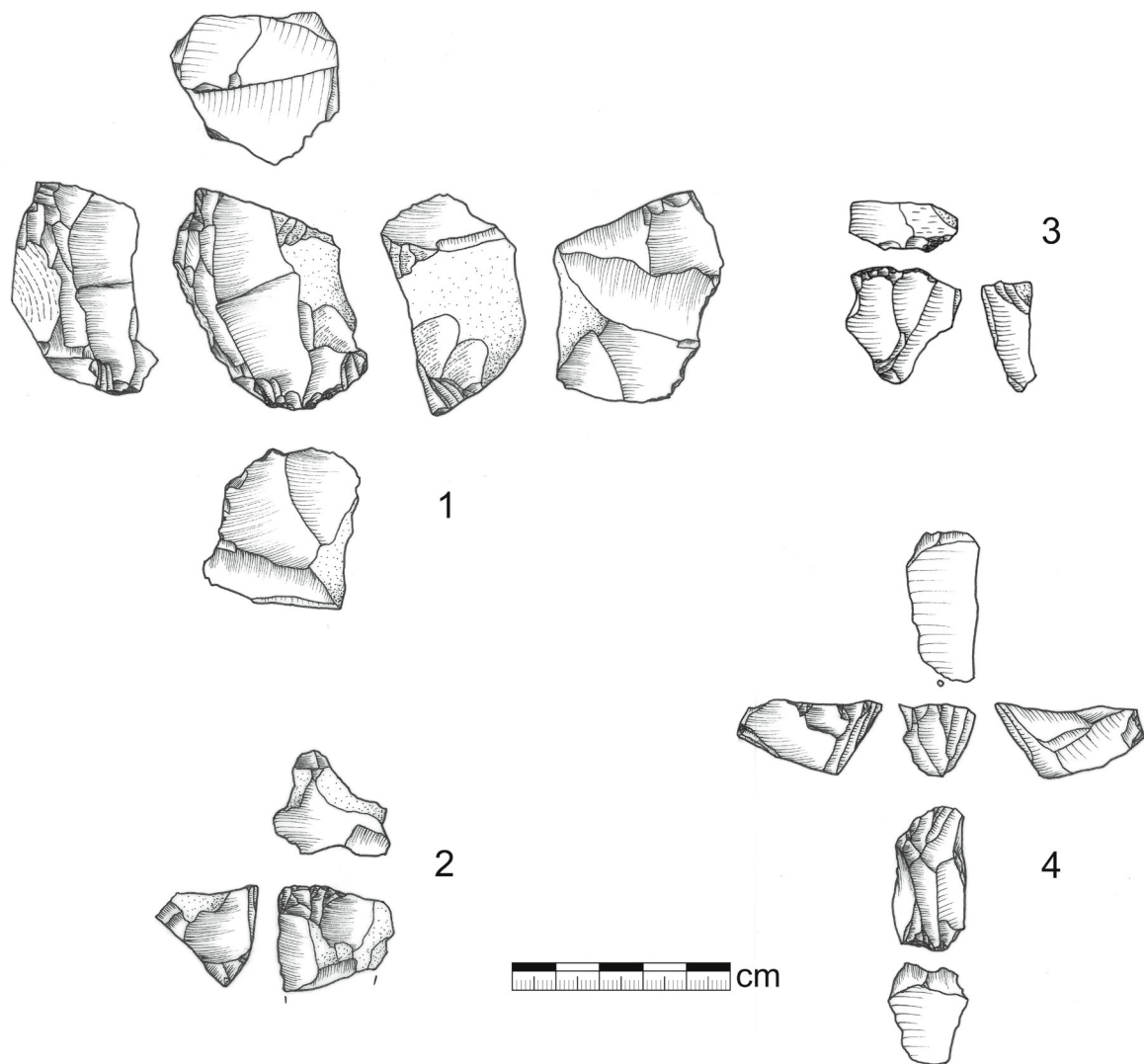


Fig. 13. Upper Palaeolithic cores from Grotte des Teux-Blancs. 1 Blade core, 2-4 bladelet cores, thereof 4 double carinated (Drawings. B. Schürch).  
 Abb. 13. Jungpaläolithische Kerne aus der Grotte des Teux-Blancs. 1 Klingenkern, 2-4 Lamellenkerne, davon 4 doppelt gekielt (Zeichnungen B. Schürch).

linked to the use of backed bladelets as composite tools (Langley et al. 2016). One double bevelled base exhibits pronounced striations (Fig. 16: 6). The two points found during the 1913 excavation (Fig. 16: 7-8) differ from the others in shape. One of the points has a trapezoidal cross section and a pronounced groove. The orientation of the other fragment is unclear. It was previously published as a distal fragment (Combiér 1956) but could also be a basal fragment (Fig. 16: 8). A total of four pendants were recovered from Teux-Blancs cave: one perforated tooth of a small carnivore previously addressed as fox tooth (Combiér 1956; Gros & Gros 2005), a perforated deer canine, a fragment of dentalium, and a perforated piece of haematite (Fig. 17). The haematite was possibly also used to extract colouring material. In this regard, two pieces of colouring material that show striking features similar to lithic blanks need to be mentioned. Over 30 human remains were recovered from the back-dirt (Fig. 18). The whereabouts of the human remains found in the 1913 excavation are unknown. According to

previous researchers, cranial and possibly postcranial remains of an adolescent individual were recovered (Mayet et al. 1921; Combiér 1956). The remains found in the back-dirt comprise ten teeth, one cranial fragment, numerous phalanges and vertebrae, a rib, and a patella. They originate from a minimum of five individuals from age groups infans I and II, juvenile, and adult (M. Kairies pers. comm.). The remains from a minimum of two adult individuals show signs of teeth abrasion and palmar ossifications of the medial phalanges that could suggest an advanced age stage.

#### Site use

The studied finds from Grotte des Teux-Blancs indicate that the site was used in a hunting context during the Upper Palaeolithic. The antler, bone and ivory point fragments in connection with the backed pieces suggest that the site was most likely visited after a successful hunt. Broken hunting implements were discarded, repaired, or replaced at the

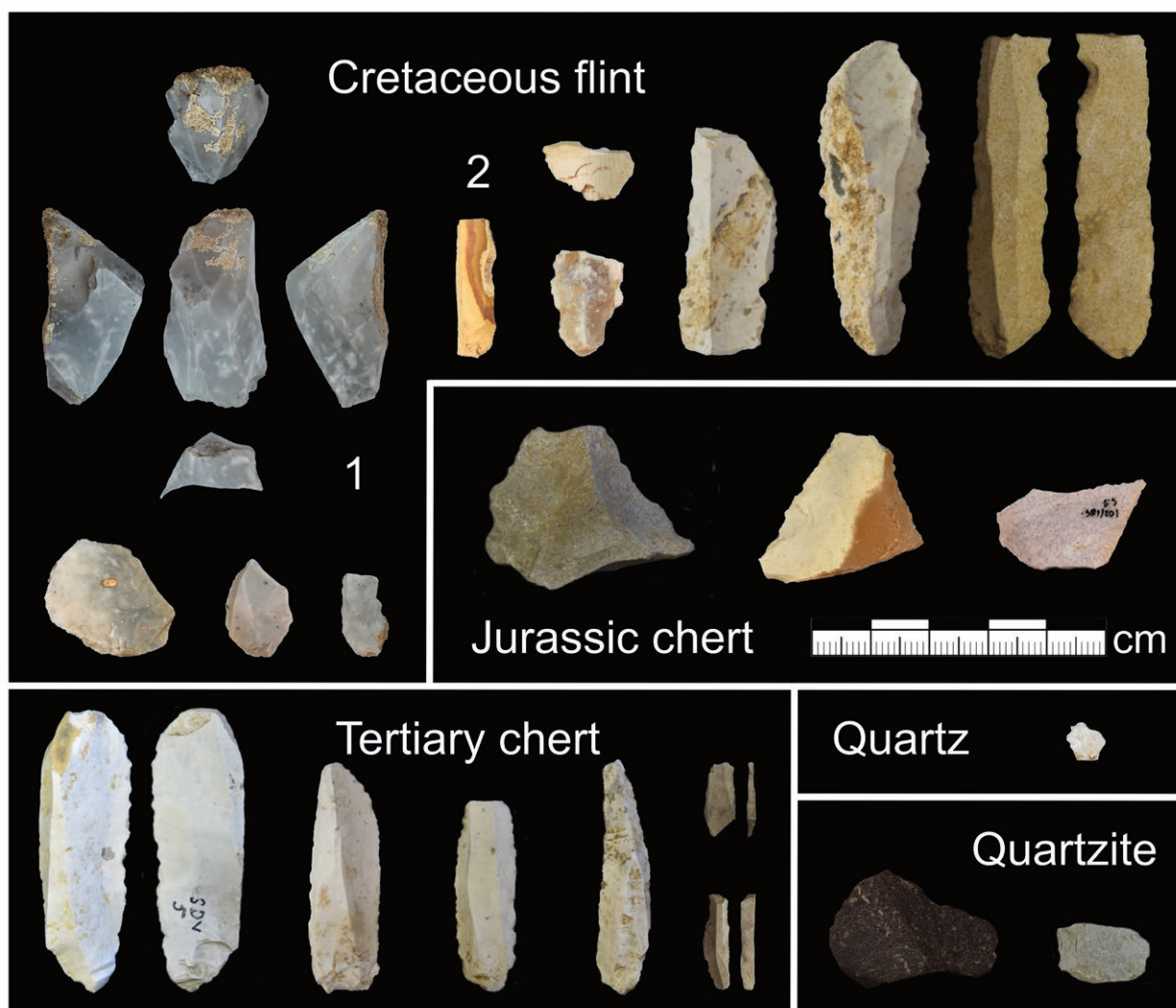


Fig. 14. Raw material spectrum of lithic artefacts found at Grotte des Teux-Blancs (S. Schray).  
 Abb. 14. Rohmaterialspektrum der Steinartefakte aus der Grotte des Teux-Blancs (S. Schray).

site. This is indicated by the presence of fractures observed on osseous points, backed pieces with impact fractures and broken edges as well as a pronounced bladelet production on both cores and burins. The fractured osseous points and lithics with impact fractures indicate that the kill was taken to the site for processing. The processing of animal tissues at the site could also be indicated by the presence of smoothers. Studies on this artefact type also referred to as *lissoirs* (Leroy-Prost 1975) or bevelled tools (Rašková Zelinková 2010) suggest their use for hide working (Semenov 1964; Rašková Zelinková 2010), however, their type of use is still discussed and needs further research. The colouring material found at the site might also be related to this processing activity (Semenov 1964; Wolf et al. 2018). The suggested use of the site suits the caves' location at the edge of the Montadiot mountain range. This area provides a suitable location for hunting and observing game, as within one kilometre Montadiot yields a view over the landscape in any direction and even the French Jura is visible to the east.

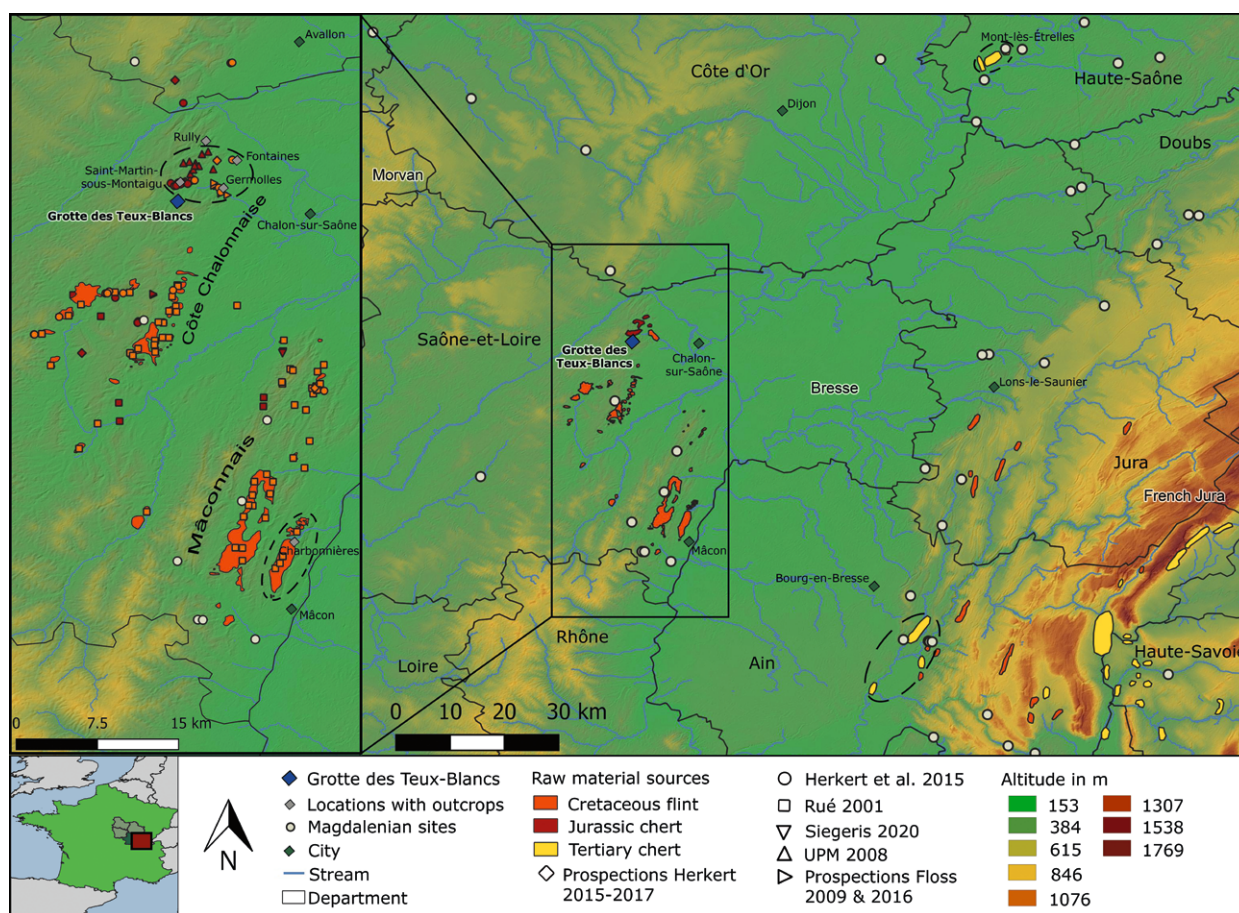
Lithic production at the site is attested to by a few finds from the Middle Palaeolithic which used the Levallois concept and by numerous finds from the Upper Palaeolithic which were produced using laminar production concepts. The analysis of the lithic artefacts shows an overall low percentage of dorsal cortex coverage and only six cortical blanks are present. This suggests that the first stage of the *chaîne opératoire*, the decortication and preparation, took place outside of the site before finished cores were brought in. This is the case for both the Middle and Upper Palaeolithic assemblages.

## Discussion

### Stratigraphy

The identification of geological layers, in combination with the distribution of finds within the back-dirt, suggest a differentiated inverse deposition of the cave sediments by defined layers or excavated spits by the excavators in 1913. The original description of the colour and composition of the stratigraphy of the





**Fig. 15.** Map of raw material sources of Cretaceous flint, Jurassic chert and Tertiary chert with the presumed raw material sources of the lithic artefacts of Grotte des Teux-Blancs in dashed lines. Map basis: © European Union, Copernicus Land Monitoring Service 2021, European Environment Agency (EEA), Open Street Map (Geofabrik), Data basis: Affolter & Bressy 2009; Béreiziat 2019; Herkert 2020; Rué 2001 (S. Schray).  
**Abb. 15.** Kartierung der Rohmaterialquellen von Kreidefeuerstein, Jurahornstein und Tertiärsilex mit den vermuteten Rohmaterialquellen der Steinartefakte der Grotte des Teux-Blancs in gestrichelten Linien. Kartengrundlage: © European Union, Copernicus Land Monitoring Service 2021, European Environment Agency (EEA), Open Street Map (Geofabrik), Datenbasis: Affolter & Bressy 2009; Béreiziat 2019; Herkert 2020; Rué 2001 (S. Schray).

cave also corresponds broadly to the layers identified in the back-dirt. This is especially the case for GH 4 and layer 1, GH 3 and layer 2, and GH 2 and layer 3. No GH could be identified that corresponds to layer 4 in the excavated areas of the back-dirt. This coincides with the almost complete lack of artefacts attributable to the Middle Palaeolithic in the back-dirt. This may be the result of the sediments from layer 4 not being deposited within the excavated areas but instead possibly northwards or further down the slope. However, this makes it difficult to conclusively assess the Middle Palaeolithic occupation, especially in regard to the stratigraphic assignment as described by Mayet et al. (1921) and Combiér (1956). Therefore, the cultural attribution of layer 3 remains questionable. It must be assumed that a correct separation between the layers 3 and 4 was not made or simply was not possible during the excavation. The degree of taphonomic changes, the possible displacements, and the homogenous colour of sediments should not be underestimated.

The layers show a low degree of mixing with non-Palaeolithic or recent materials besides pottery

that is mostly present at the base of both trenches and often only has a size of a few millimetres. Therefore, the layers are not considered as closed entities.

### The Palaeolithic occupation

#### Middle Palaeolithic

Based on the analysis, a Middle Palaeolithic and an Upper Palaeolithic assemblage could be identified. The first is characterized by the presence of a big oval-shaped hand axe and the use of the Levallois concept. The hand axe was previously attributed to the *Acheuléen supérieur* (Combiér 1956, 1996a; Gros & Gros 2005) and therefore used to set back the known occupation of the region to an early phase of the Middle Palaeolithic. Based on the given data and lack of context for the finds, this cannot be supported here. So far, the earliest secured date of the occupation of the Côte Chalonnaise is from Grotte de la Verpillière II, which is dated to the end of MIS 4 and the beginning of MIS 3 (Heckel et al. 2016; Richard et al. 2016; Zöller & Schmidt



**Fig. 16.** Osseous artefacts from Grotte des Teux-Blancs. 1 Bone point, 2 ivory point, 3-8 antler points, thereof 3-4 and 7 with elaborated groove, 6 double bevelled base with striations, 8 possible basal point fragment, 9-11 smoothers, thereof 9 with x-shaped cutmarks (S. Schray, K. Herkert).  
**Abb. 16.** Organische Artefakte aus der Grotte des Teux-Blancs. 1 Knochenspitze, 2 Elfenbeinspitze, 3-8 Geweihspitzen, davon 3-4 und 7 mit deutlicher Rille, 6 doppelt abgeschrägte und schraffierte Basis, 8 mögliches basales Spitzenfragment, 9-11 Glätter, davon 9 mit x-förmigen Einschnitten (S. Schray, K. Herkert).

2016; Floss 2019; Herkert & Frick 2020). Recent work has shown that the Middle Palaeolithic assemblages of the Côte Chalonnaise are heterogenous due to the geographic location between neighbouring complexes and are characterized by the presence of mostly Levallois based reduction and

morphological variable bifacially worked objects (Frick 2016; Herkert 2020; Herkert & Frick 2020). The described assemblage of Teux-Blancs cave fits into this description, even though the significance is limited due to the small inventory size and the missing context.



**Fig. 17.** Pendants from Grotte des Teux-Blancs. 1 Perforated deer canine, 2 perforated carnivore tooth, 3 perforated piece of haematite, 4 dentalium shell (S. Schray).

**Abb. 17.** Anhänger aus der Grotte des Teux-Blancs. 1 Durchlochte Hirschgrandel, 2 durchlochter Karnivorenzahn, 3 durchlochstes Stück Hämatit, 4 Dentaliumgehäuse (S. Schray).

### Upper Palaeolithic

The presence of backed bladelets (Demars & Laurent 1989) and antler points (Langley et al. 2016; Pétilion 2016; Pfeifer 2016) together with backed points (de Sonneville-Bordes 1989; Béreziat 2019) and a micro-burin (Bolos 2012) argues for a clear identification of a Magdalenian occupation at Teux-Blancs cave. While the rest of the assemblage, such as the dihedral burins, end-scrapers, and cores, fits into the technological spectrum of the Magdalenian, it cannot be clearly ruled out that there was an additional early or middle Upper Palaeolithic occupation as has been proven at other sites in the Côte Chalonnaise (Floss 2019). On one side, this is due to the remaining questionable attribution of layer 3 from the 1913 excavation. On the other side, the Magdalenian shares characteristics of its lithic technology with other Upper Palaeolithic cultures. One of the dihedral burins (Fig. 12: 2), for example, can be typologically addressed as busked burin, which are typical for the Aurignacian (Demars & Laurent 1989). Additionally, backed projectiles, including backed bladelets, are also characteristic for the Gravettian (Demars & Laurent 1989). However, the inventory does not reflect any further distinct chronologically significant pieces except for the Magdalenian.

The two other sites in the Côte Chalonnaise that have previously been attributed to the Magdalenian were both excavated at the dawn of Palaeolithic

archaeology. The site of Mère Grand in Rully (Fig. 1) is a cave that was excavated in the 1860s (Arcelin 1877) and from 1956 to 1957 (Combiér 1957). Two occupational layers were distinguished and assigned to the Magdalenian and the Middle Palaeolithic (Arcelin 1877; de Mortillet 1910, 1913). Parts of the inventory are missing today (Rebentisch 2019; Herkert 2020), however, a recent analysis of the preserved collection could not identify characteristic Magdalenian artefacts (Herkert 2020). Nonetheless, new investigations, under the direction of K. Herkert and H. Floss in 2021, on the neighbouring site of La Grange showed indications of a Magdalenian occupation (Fig. 1) (Herkert et al. 2022). Grotte de la Folatière (Fig. 1) in Cullès-les-Roches, has a research history stretching back to 1865 and is characterized by several unfortunate circumstances, such as the discovery that parts of the occupational layers had been displaced during the Roman period, resulting in a bad contextualization of the finds and find horizons (Guillard 1938, 1959; Bourdier 1947; Gros & Gros 2005; Herkert 2020). The site is said to have been occupied during the Middle Palaeolithic, Châtelperronian, Aurignacian, Gravettian, Solutrean, Magdalenian, Neolithic, and the Roman period (Guillard 1959; Gros & Gros 2005; Baffier et al. 2015; Herkert et al. 2015); but, due to the mixture of finds the validity of this claim is limited.

The lack of secure evidence raises the question of a settlement hiatus from the LGM until the end of



**Fig. 18.** Selection of human remains from Grotte des Teux-Blancs. 1-5 teeth, thereof 4-5 with abrasions, 6-9 phalanges, thereof 8-9 with palmar ossifications, 10 patella, 11 vertebral fragment, 12 rib. Age groups: 1 Infans I, 6 Infans I-II, 2 Infans II, 3 Juvenis/Adult, 4-5 and 7-12 Adult (S. Schray).

**Abb. 18.** Auswahl der Menschenreste aus der Grotte des Teux-Blancs. 1-5 Zähne, davon 4-5 mit Abrasionen, 6-9 Phalangen, davon 8-9 mit palmaren Verknöcherungen, 10 Knie-scheibe, 11 Wirbelfragment, 12 Rippe. Altersklassen: 1 Infans I, 6 Infans I-II, 2 Infans II, 3 Juvenis/Adult, 4-5 und 7-12 Adult (S. Schray).

the Palaeolithic in the Côte Chalonnaise. This may be a fitting explanation for the absence of Solutrean sites in the region, as even the nearby eponymous site of Solutré itself is located at the margin of its distribution. However, for the Magdalenian this does not seem to be a suitable explanation as the human expansion of Magdalenian cultural expression over wide parts of Europe accompanied the improving climatic conditions after the LGM. Changed settlement patterns, which saw humans favouring a more intense occupation of the French Jura during the Magdalenian, have previously been suggested to be accounted for the lack of sites in the Côte Chalonnaise (Floss 2019). Nevertheless, there is scattered evidence of sites west of the Bresse Graben in the Mâconnais and Côte d'Or that are embedded within the same settlement system with the site cluster in the French Jura that has been defined as the Circum-Jurassic Group by Maier (2015). This evidence renders the assumption inconclusive

and argues against a hiatus in the region during the Magdalenian. Moreover, a bias in both research and conservation should be considered for the period of the Magdalenian in the Côte Chalonnaise. To answer the question of conservational bias, the study of open-air sites plays a central role. Research of open-air sites in the Côte Chalonnaise occurred almost contemporaneously with the beginning of Palaeolithic research of cave sites (Gros & Gros 2005). While sediment traps like caves and rock shelters offer protection to archaeological remains, open-air sites face bigger obstacles in preservation and identification. Most of the open-air sites in the Côte Chalonnaise are known by extensive surface collections. This reveals a major obstacle: the issue of cultural contextualisation. With surface collections, a separation of different occupational phases is difficult, smaller artefacts like backed bladelets are often overlooked and the preservation of organics is not always given.

This makes the identification of cultural remains from the Magdalenian, which are characterised by such artefacts, even more difficult. Recent excavations at the open-air sites of Saint-Martin-sous-Montaigu Château-Beau (Hoyer et al. 2019) and Germolles En Roche (Herkert & Floss 2019) revealed intact stratigraphic layers, while the excavation at Fontaines Les Griffières showed a high degree of intrusion by agricultural use (Floss 2019). In addition to agriculture, the Côte Chalonnaise, as well as most of the area west of the Bresse Graben, is characterised by viticulture. Vast areas are covered with perennial plants making access for archaeological research difficult. Additional to the soil intrusion by the deep roots of the vines and the terracing of the vineyards, erosion of the intervening rows is a threat to archaeological deposits. The excavations at Château-Beau, which are at the border of a vineyard, showed that intact Gravettian layers start only a few centimetres below the surface (Hoyer et al. 2019; Floss & Hoyer 2021). Therefore, preservation needs to be accounted for when investigating the absence of open-air sites from the LGM and Magdalenian. For the sparse record of Magdalenian occupation of caves, different aspects need to be considered. For some cave sites the inaccessibility due to sealing or almost complete sealing by sedimentation can be estimated (Combiér 1996a). This is documented at Grotte de la Verpillière II which was sealed during the early Upper Palaeolithic (Frick 2016) and by a dated sediment remnant close to the ceiling of Grotte d'Agneux I that proves complete sedimentation occurred before the beginning of the Holocene (Floss et al. 2018a). Additionally, possible evidence has been disturbed by early excavations as the sites of Grotte des Teux-Blancs, Mère Grand, and Grotte de la Folatière show.

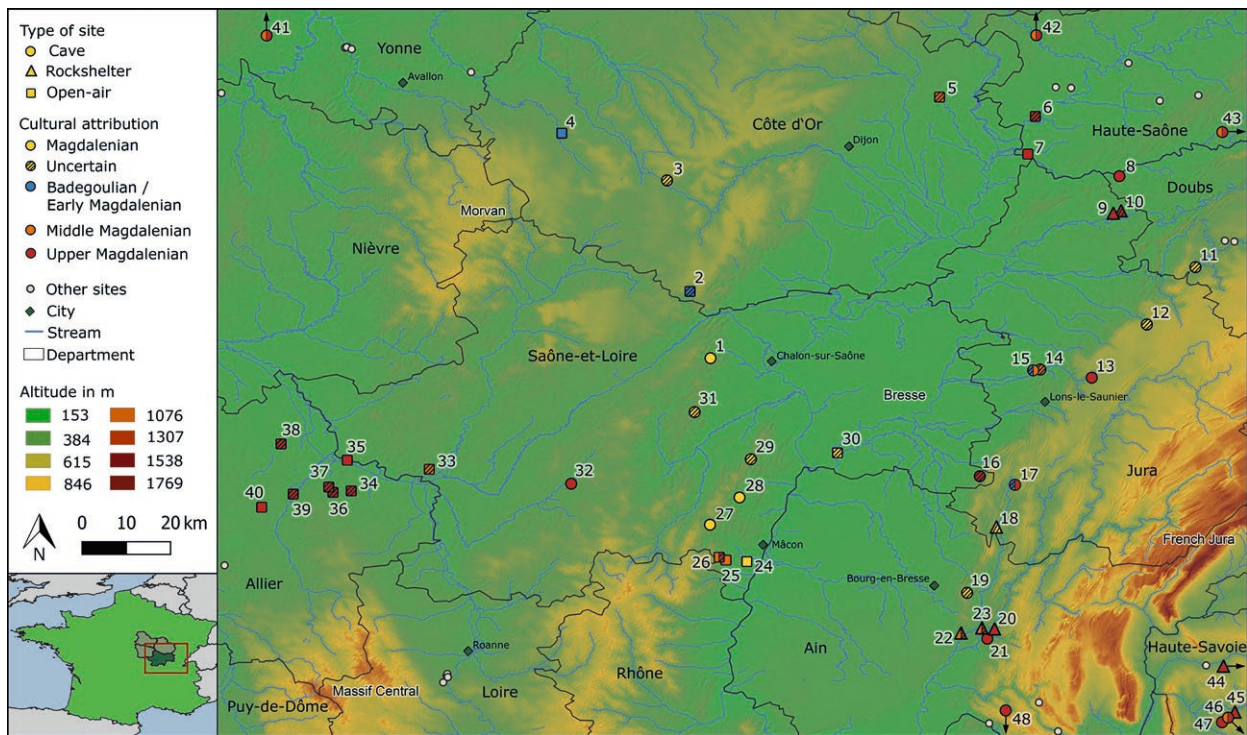
#### *The Magdalenian of Teux-Blancs in the context of the southern part of Eastern France*

The Magdalenian of Eastern France is typically divided into three main phases based on the division of Breuil (1913) and de Sonneville-Bordes (1989) for Southwestern France. In the past, the Badegoulian was considered part of the first phase of the Magdalenian. It is a flake-based industry where raclette type artefacts, transversal burins, and the absence of backed bladelets are typical (de Sonneville-Bordes 1989). However, the latter does not apply to all regions. Badegoulian sites in the Paris Basin already show a pronounced production of backed-bladelets (Débout et al. 2012). The sites of Grotte des Teux-Blancs (Combiér 1956) and En Creusilly (Joly 1959) have previously been attributed to the Badegoulian due to the absence of backed bladelets and the presence of raclettes. The artefacts from Teux-Blancs that were identified as raclettes by Combiér (1956), however, have now been shown to be heavily edge-damaged and taphonomically worked pieces and numerous backed-bladelets have now been recovered

from the back-dirt excavations. Additionally, the site of En Creusilly is the backfill of a fissure that has not been re-studied for several decades. After a recent re-examination of the 20<sup>th</sup> century finds, the site of Poron des Cuèches is the only site in the southern part of Eastern France that was securely attributed to the Badegoulian (Mouton & Joffroy 1957; Baffier et al. 2015).

The early Magdalenian is clearly distinguished from the Badegoulian by a laminar-based blank production. In the southern part of Eastern France only the sites of La Baume de Gigny and Grotte Grappin have yielded early Magdalenian dates, but the context of the dated pieces is uncertain (Cupillard et al. 2015).

The second phase is the Middle Magdalenian. Typical artefacts are backed bladelets, a dominance of dihedral burins among the burins, as well as the higher percentage of these burins in comparison to end-scrapers. The Middle Magdalenian in France is further subdivided into the facies à *navettes*, à *triangle*, and à *Lussac-Angles* (Cupillard et al. 2015), even though some are only sporadically represented in Eastern France. The *Magdalénien à navettes* is defined by the navette artefact type, which is an elongated antler piece with a rounded and split end (Allain et al. 1985). With the exception of Grotte Grappin and Maszycka cave in Poland, the few sites that have yielded this type of artefact are located in Southwestern France. Additional characteristics of this facies are thick double bevelled and grooved antler points as well as decorations and artwork that focus on human depictions (Allain et al. 1985; Paillet et al. 2017). Further sites, such as the site complex underneath the Rock of Solutré (Fig. 19: 25) and the sites of Farincourt and Rigney (Fig. 19: 42-43) are indirectly linked to the facies by these additional features (Béreiziat 2019, 2020; Combiér & Montet-White 2002; Desbrosse 1976a). The *Magdalénien à triangle* is characterized by the presence of non-isosceles, triangular lithic points, *baguette demi-ronde*, and double bevelled antler points (Cupillard et al. 2015). The only site in Eastern France assigned to this facies is Chaze II, about which there is hardly any information (Desbrosse 1976a; Cupillard & Welte 2006; Cupillard et al. 2015). The *Magdalénien à Lussac-Angles* is defined by the eponymous antler points. Lussac-Angles points are short antler points with a long, single bevelled, undecorated base, a groove on the upper side, and an optional groove on the opposite side (Pinçon 1988). Further typical artefacts are *baguettes demi-ronde*s, notched smoothers, and conic antler or ivory points. Antler points with a double bevelled base are not typical. Sites associated with the facies are La Croze-sur-Suran in Saint-Martin-du-Mont (Fig. 19: 22), Route de la Roche in Solutré-Pouilly (Fig. 19: 26), and Grotte du Trilobite in Arcy-sur-Cure (Fig. 19: 41) (Débout et al. 2012; Lajoux et al. 2016, 2019; Malgarini et al.



**Fig. 19.** Map of Magdalenian sites in the south of Eastern France after type of site and cultural attribution. Numbering of the sites 1-40 can be found in appendix 1; 41 Grotte du Trilobite, 42 Farincourt, 43 Rigney, 44 Veyrier, 45 Les Douattes, 46 Romains, 47 Grotte de Bange, 48 La Raillarde. Map basis: © European Union, Copernicus Land Monitoring Service 2021, European Environment Agency (EEA), Open Street Map (Geofabrik) (S. Schray).

**Abb. 19.** Kartierung der magdalénienzeitlichen Fundstellen im Süden Ostfrankreichs nach Fundstellenart und kultureller Zuordnung. Die Nummerierung zu den Fundstellen 1-40 ist Appendix 1 zu entnehmen; 41 Grotte du Trilobite, 42 Farincourt, 43 Rigney, 44 Veyrier, 45 Les Douattes, 46 Romains, 47 Grotte de Bange, 48 La Raillarde. Kartengrundlage: © European Union, Copernicus Land Monitoring Service 2021, European Environment Agency (EEA), Open Street Map (Geofabrik) (S. Schray).

2017; Béreiziat 2019, 2020). These sites have yielded short antler points that have a strong resemblance to the Lussac-Angles type ones.

The last phase, the Upper Magdalenian, is the phase with the highest site density in Eastern France. In the Upper Magdalenian, backed bladelets dominate all other tool types, end-scrapers become more common than burins, burins are mainly on truncations, and varied backed points appear (Demars & Laurent 1989; de Sonneville-Bordes 1989; Debout et al. 2012; Béreiziat 2019). End-scrapers are also favourably made on small flakes. A decrease in the size of lithics can be observed leading to the hypothesis of an azilianisation during the final phase of the Upper Magdalenian (de Sonneville-Bordes 1989; David 1996). Antler points typically have a double bevelled base and thick antler points are less frequent (Langley et al. 2016; Pétilion 2016). While barbed points are a widespread artefact type during the Upper Magdalenian, they are not common in Eastern France (Desbrosse 1980; Pétilion 2016). Upper Magdalenian sites cluster at the borders of the French Jura, in the department of Haute-Saône and in a cluster of not well contextualized sites in the department of Allier.

To put the Magdalenian occupation of Grotte des Teux-Blancs in context with other Magdalenian sites, the area within a radius of 100 km around the

site, covering the southern part of Eastern France, was considered in a literature-based review (Fig. 19, Appendix 1). Despite such a review not allowing many parameters, from site formation processes to the recovery of the assemblages, to be done justice, it can still be assumed that people using a common technological and typological spectrum engaged in similar activities produced similar archaeological remains. For Grotte des Teux-Blancs, it must be noted that even if a representative portion of the back-dirt has been excavated, a larger proportion has not yet been explored and thus the present study only accounts for a section of the assemblage.

Most parallels between the assemblage of Grotte des Teux-Blancs and the Magdalenian assemblages of the 39 sites considered in this review were found with Upper Magdalenian sites, such as Grotte du Crest in Viry (Fig. 19: 31) (Combiér 1959; Horiot 1965; Delporte 1966a; Evin et al. 1994), Abri des Câbones (Fig. 19: 9) (Desbrosse 1976a; David 1984, 1992, 1996; d'Errico & David 1993; Cupillard 1998), and Abri Gay (Fig. 19: 21) (Bonnamour & Desbrosse 1965, 1966; Combiér 1980; Desbrosse 1980a; Pion 2000; Oberlin & Pion 2009; Miller 2012; Béreiziat 2013; Cupillard et al. 2015;). The excavation of Grotte du Crest was carried out between 1953 and 1961 by the *Groupe Spéléo-Archéologique Charollais* but the finds were

never analysed and published in detail. New investigations on the site were started in 2021 under the direction of H. Floss. Abri des Câbones was excavated from the 1950s to the 1980s by several researchers and was subsequently analysed by David (1996). Abri Gay was first excavated in the 1930s and then again for several years starting in 1965. The sites show a dominance of backed bladelets, the balanced ratio of burins and end-scrapers, and rather precisely worked antler points with double bevelled bases. While backed points are absent in Grotte du Crest, they appear in large quantities at Abri des Câbones and in small quantities at Abri Gay. The production of backed bladelets on burin spalls is shown at Grotte du Crest. Abri Gay yielded mostly simple burins and few dihedral burins. At Abri des Câbones, dihedral burins are typical and more numerous than burins on truncation.

On the other hand, some observations made for the assemblage of Teux-Blancs cave can also be seen in Middle Magdalenian assemblages. For the site of Route de la Roche, in Solutré-Pouilly, which is one of a few recently excavated sites, small backed bladelets are also known (Lajoux et al. 2019). Though this might be due to the improved excavation methods of modern excavations compared to excavations carried out in the 20<sup>th</sup> century. Additionally, the antler points found in 1913 at Grotte des Teux-Blancs show characteristics that tend to the Middle Magdalenian, like the thickness and the trapezoid cross section (Langley et al. 2016; Pétilion 2016). These observations again expose the problem associated with the lack of temporal depth for the assemblage and leave open the possibility of several Magdalenian occupations at the site.

For both the Upper Magdalenian occupation of Abri Gay (Béreziat 2013; Béreziat & Floss 2016) and the Middle Magdalenian occupations of Grotte Grappin in Arlay (David 1996; Cupillard & Welte 2006; Béreziat & Floss 2016; Béreziat 2019, 2020), Abri de la Croze-sur-Suran (Féblot-Augustins 1997; Béreziat & Floss 2016; Malgarini et al. 2017), and Abri de la Colombière (Béreziat & Floss 2016) an acquisition of raw material from the region of Chalon-sur-Saône is stated (Fig. 19: 15, 20-23). In this regard Grotte des Teux-Blancs might represent a missing link in a settlement system of the Côte Chalonnaise and the southern Circum-Jurassic Group (Maier 2015) during the Magdalenian. Further sites that consolidate the connection between the French Jura and west of the Bresse Graben are Veyrier, Les Douattes, Grotte de Bange, La Raillarde, Grotte des Romains, and Grand'Baille (Fig. 19: 20, 44-48), all of which exhibit raw material from the Mâconnais and Chalonnais mountains (Stahl Gretsche 2004; Affolter 2009a, b; Maier 2015; Béreziat & Floss 2016). Grotte des Teux-Blancs itself also shows a raw material connection to the Mâconnais with Cretaceous flint and possible connections to the French Jura or the Mont-lès-Étrelles

region through the presence of Tertiary chert. However, evidence for sites in the Bresse Graben that would further connect the French Jura sites with the ones west of the Bresse has been absent until the recent publication of surface collections from Pré des Teppes at the Seille-Saône river confluence (Fig. 19: 30) (Meunier 2019). To date, wet conditions in the Bresse plain during the Magdalenian, caused by braided river systems and flows of meltwater from the glaciers that led to the formation of palaeolakes and swamps, were seen as the reason for the lack of sites (Maier 2015). Considering that hardly any open-air sites are known in the studied area, a bias of known sites is indicated. While there may certainly have been natural obstacles in some parts, such as the Bresse Graben, a bias in research history and preservation conditions needs to be considered for the whole area (Fig. 19). The degree of bias might vary greatly from region to region and demands small-scale evaluations, as shown above by the example of the Côte Chalonnaise. For the rift valley of the Bresse, which was formed by the resistance of the Massif Central to the pressure of the alpine folding and subsequently filled by alluvial deposits during the Pliocene, the geological setting does not provide the natural shelters of a karst system and aside from that undertaken at the Seille-Saône confluence no further research is known in the Bresse. Additionally, the presence of thick Holocene deposits complicates the search for Palaeolithic sites in general. Therefore, the lack of Magdalenian sites in some areas must be taken with caution and viewed differentiated as a potential product of bias rather than true absence.

## Conclusion

The combination of a re-analysis of the collection of 1913 and the excavation of part of the back-dirt sediments provided new insights into the Palaeolithic occupation of Grotte des Teux-Blancs. The excavation of the back-dirt did not only result in the recovery of significant finds, which helped in the chronological attribution of the site, but could also give more insights into the excavation methods utilized in 1913. The excavated sediments were deposited by their distinct layers forming an inverse stratigraphy in the back-dirt. The sediments excavated in 1932 could be found on top of these inversely deposited layers, separated by an old topsoil layer. The analysis of the finds could distinguish a minimum of two chronologically distinct assemblages. The Middle Palaeolithic assemblage comprises only a few lithic artefacts. In contrast to previous research, the relatively big hand axe found in 1913 is not viewed as proof for an occupation of the region in an early phase of the Middle Palaeolithic. Instead, it is viewed together with the present Levallois based blank production as part of the heterogeneous expression of the Middle Palaeolithic in the Côte Chalonnaise, that can be observed since the end of MIS 4 and beginning of MIS 3 (Herkert & Frick

2020). Besides chronologically insignificant pieces, the majority of finds can be attributed to the Upper Palaeolithic. Both lithic and osseous artefacts speak for a clear attribution of a Magdalenian occupation. Therefore, Teux-Blancs cave represents the only site that has yielded a valid record for a Magdalenian occupation in the Côte Chalonnaise and is one of only a few Magdalenian sites in Southern Burgundy. To this point, the Magdalenian occupation of Grotte des Teux-Blancs cannot be assigned more closely, but several parallels to Upper Magdalenian sites can be found. The results of direct dating might be able to contribute to a further chronological attribution in the future. According to raw material interaction between the Chalonnais, Mâconnais, and French Jura the people visiting Grotte des Teux-Blancs during the Magdalenian belonged to the same settlement system previously defined as the Circum-Jurassic Group (Maier 2015). The assessment of Magdalenian sites in the south of Eastern France has revealed a high probability of bias in preservation and research concerning open-air sites in the area. This is especially the case for the Bresse Plain where continued research might be able to further connect the Magdalenian sites east and west of the Bresse.

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ID	Site	Lat	Long	Type of site	Attribution	References
1	Grotte des Teux-Blancs	46.7944	4.6955	cave	M0	Mayet et al. 1921; Lènez 1935; Combier 1956; Combier & Thévenot 1976; Gros & Gros 2005; Schray 2020; Schray et al. 2020, in press
2	En Creusilly	46.9622	4.6441	open-air	(q) M1	Joly 1959; Hemingway 1980; Taborin 1993
3	Grotte Boccard	47.2476	4.5861	cave	(q) M0	Nicolardot 1970; Thévenot 1978, 1982; Maureille et al. 2008; Djindjian 2014
4	Poron des Cuèches	47.3701	4.3151	open-air	M1	Wernert 1956; Mouton & Joffroy 1957; Hemingway 1980; Chaline 1994; Baffier et al. 2015
5	Roncière	47.4630	5.2836	open-air	(q) M2	Soriano & Lechenet 2000; Baffier et al. 2015
6	Champ Chaillot	47.4141	5.5291	open-air	(q) M3	David & Richard 1989; David 1996
7	Aubigny	47.3148	5.5102	open-air	M3	David & Richard 1989; Séara & Thévenin 1995; David 1996
8	Grotte de la Roche	47.2614	5.7429	cave	M3	Millotte 1958; Pétrequin 1967; Desbrosse 1976a; David & Richard 1989; David 1996
9	Abri des Cabônes/ Abri Colonel Martin	47.1507	5.7337	rockshelter	M3 (d)	Desbrosse 1976a; David 1984, 1992, 1996; d'Errico & David 1993; Cupillard 1998
10	Abri de Châteneuf	47.1603	5.7594	rockshelter	(q) M3	David & Richard 1989; David 1996; Maier 2015
11	Myon	47.0252	5.9378	cave	(q) M0	Millotte 1958; David & Richard 1989; David 1996
12	Grotte des Planches	46.8794	5.8133	cave	(q) M0	Barbier et al. 1981; David 1996
13	Chaumoisi-Boivin (Abbé Dumont)	46.7443	5.6712	cave	M3b (d)	Gauthier 1955; Millotte 1958; Desbrosse 1976a; David 1996; Drucker et al. 2012
14	Grotte de Chaze II	46,7644	5,5400	cave	M2 (d)	Desbrosse 1976a; Cupillard & Welte 2006; Cupillard et al. 2015
15	Grotte Grappin/Grotte de Saint-Vincent	46.7631	5.5239	cave	(q) M1/M2 (d)	Allain et al. 1985; David 1996; Cupillard & Welte 2006; Cupillard et al. 2013; Malgarini et al. 2017; Béreiziat 2019, 2020
16	La Balme de Cuiseaux	46.4939	5.3892	cave	(q) M3 (d)	Combier 1965, 1996a; Combier & Thévenot 1976; Desbrosse 1976b, 1980a; David 1996; Gros & Gros 2005; Fornage-Bontemps 2011; Cupillard et al. 2015
17	Baume de Gigny	46.4685	5.4751	cave	(q) M1/M3 (d)	Desbrosse 1976a; Campy et al. 1989; David & Richard 1989; David 1996; Fabre 2010; Cupillard et al. 2015
18	Abri Sous-la-Roche	46.3593	5.4294	rockshelter	(q) M0	Desbrosse 1976a, b; Millotte 1979; David & Richard 1989; Monjuvent 1994; David 1996
19	Grotte de la Tes- sonnière	46.1929	5.3546	cave	(q) M0	Desbrosse 1976a, 1977, 1980a, b; Monjuvent 1994
20	Grotte de la Grand'Baille	46.0841	5.4056	cave	M3	Desbrosse 1976a, 1980a; Pion 2000; Béreiziat 2012; Kretschmer 2015
21	Abri Gay	46.0839	5.3996	rockshelter	M3 (d)	Bonnamour & Desbrosse 1965, 1966; Desbrosse 1976b, 1980a; Combier 1980; David 1996; Pion 2000; Oberlin & Pion 2009; Miller 2012; Béreiziat 2013; Cupillard et al. 2015
22	Abri de la Croze-sur- Suran	46.0890	5.3377	rockshelter	M2/(q) M3 (d)	Tournier & de Beauregard 1922; Desbrosse 1965, 1976a, 1980a; Evin et al. 1994; Féblot-Augustins 1997; Djindjian 2000; Pion 2000; Oberlin & Pion 2009; Drucker et al. 2012; Malgarini et al. 2017
23	Abri de la Colombière	46.0857	5.3965	rockshelter	M2/M3 (d)	Movius & Judson 1956; Desbrosse 1976a; Schvoerer 1979; Evin et al. 1994; Bridault et al. 2000; Pion 2000; Oberlin & Pion 2009; Paillet & Man-Estier 2010; Drucker et al. 2012; Cupillard et al. 2015
24	Varennes-lès-Mâcon	46.2742	4.7876	open-air	M0	Floss 1998

**Appendix 1.** List of sites used for comparison with cultural attributions. Magdalenian in general (M0), Badegoulian / Lower Magdalenian (M1), Middle Magdalenian (M2), Upper Magdalenian (M3), attribution questionable (q), directly dated (d). Data basis: Kretschmer 2015: CR806 E1 Magdalenian sites Database; Maier 2015; this article.

**Appendix 1.** Liste der zum Vergleich herangezogenen Fundstellen mit kulturellen Zuweisungen. Magdalénien allgemein (M0), Badegoulien / unteres Magdalénien (M1), mittleres Magdalénien (M2), oberes Magdalénien (M3), Zuordnung fraglich (q), direkt datiert (d). Datengrundlage: Kretschmer 2015: CRC806 E1 Magdalenian sites Database; Maier 2015; dieser Artikel.

25	Solutré Terre Sève & Crot du Charnier	46.2982	4.7200	open-air	M2/M3 (d)	de Mortillet 1873; Combier 1955; Joly 1970, 1972; Thévenot 1978; Combier & Montet-White 2002; Turner 2002
26	Solutré, Route de la Roche	46.2973	4.7252	open-air	M2 (d)	Lajoux et al. 2015, 2016, 2019; Paillet et al. 2017
27	Les Furtins	46.3673	4.6949	cave	M0	Leroi-Gourhan 1950; Combier 1965; Piffaut 1993
28	Balme de Rizerolles/Azé I	46.4388	4.7716	cave	M0	Combier 1996b; Floss 2000, 2005, 2019; Barriquand et al. 2011
29	Four-de-la-Baume	46.5352	4.8017	cave	(q) M0	Mayet & Mazonot 1913a, b; Martin & Ray 1914; Desbrosse 1971; Combier 1996a; Baffier et al. 2015
30	Pré des Teppes	46.5651	5.0194	open-air	(q) M0	Meunier 2019
31	Grotte de la Folatière/ Grotte de Culles-les-Roches	46.6542	4.6550	cave	(q) M0	Guillard 1938, 1959; Bourdier 1947; Lafond 1949; Combier 1965; Gros & Gros 2005; Baffier et al. 2015; Herkert et al. 2015; Herkert 2020
32	Grotte du Crest	46.4751	4.3371	cave	M3 (d)	Combier 1959; Horiot 1965; Delporte 1966a; Evin et al. 1994
33	La Goulaine	46.5077	3.9773	open-air	(q) M2	Cabrol 1940; Combier 1959; Delporte 1966a, 1968; de Bayle des Hermens 1970; Aubry et al. 2003; Angevin & Langlais 2009; Péré-Noguès 2015; Angevin 2020
34	Bornat	46.4535	3.7766	open-air	(q) M3	Delporte 1967, 1968; Dugas & Raynal 1979
35	Norvent	46.5327	3.7659	open-air	M3	Genty 1979
36	Tilly	46.4560	3.7242	open-air	(q) M3	Delporte 1967, 1968; Dugas & Raynal 1979
37	Les Truges	46.4560	3.7242	open-air	(q) M3	Delporte 1967, 1968; Dugas & Raynal 1979
38	Grands Chenaux/ Chenauds	46.5725	3.5964	open-air	(q) M3	Delporte 1966b; Dugas & Raynal 1979; Genty 1979
39	Coupe Guitton	46.4446	3.6270	open-air	(q) M3	Delporte 1968; Genty & Genty 1971; Genty 1979
40	Les Forts	46.4110	3.5450	open-air	M3	Genty & Genty 1971; Genty 1979

**Appendix 1.** List of sites used for comparison with cultural attributions. Magdalenian in general (M0), Badegoulian / Lower Magdalenian (M1), Middle Magdalenian (M2), Upper Magdalenian (M3), attribution questionable (q), directly dated (d). Data basis: Kretschmer 2015: CR806 E1 Magdalenian sites Database; Maier 2015; this article. (continued)

**Appendix 1.** Liste der zum Vergleich herangezogenen Fundstellen mit kulturellen Zuweisungen. Magdalénien allgemein (M0), Badegoulien / unteres Magdalénien (M1), mittleres Magdalénien (M2), oberes Magdalénien (M3), Zuordnung fraglich (q), direkt datiert (d). Datengrundlage: Kretschmer 2015: CRC806 E1 Magdalenian sites Database; Maier 2015; dieser Artikel. (Fortsetzung)

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