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New radiocarbon dates for the Late Glacial occupations (Ahrensburgian & Magdalenian) at “Grotte du Coléoptère” (Bomal-sur-Ourthe, Prov. of Luxembourg, BE)

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1. Introduction

Recently a series of Final Palaeolithic (Younger Dryas) and Mesolithic sites in the Belgian Meuse basin have been redated by means of the radiocarbon dating technique. Although most of these contexts were already radiocarbon dated in the late 20th century, the improvements in sample preparation, in particular of collagen samples, and in dating accuracy of the last decades prompted the need for new dating research. One of the selected sites is the cave site of ‘Coléoptère’ (Juzaine, Bomal-sur-Ourthe, BE) occupied during the Late Glacial and Early Holocene (Dewez, 1975; 1987; Dewez *et al.*, 1983).

The first excavations in the cave, led by J. Hamal-Nandrin and J. Servais, took place in 1923 and 1924. They identified layers dated to the Neolithic/Metal Ages (layer A) and the Magdalenian (layer B) based on the artefacts. They also excavated the terrace, where they found the same layers as inside the cave, with an additional layer (layer A') containing among others, triangular microliths, but mixed with Magdalenian lithic artefacts (Hamal-Nandrin & Servais, 1925) (**Fig. 1**). The faunal remains initially collected also showed a mix with cold- and temperate-environment species (*i.e.* reindeer and beaver).

The material from J. Hamal-Nandrin and J. Servais was re-studied in the context of M. Dewez's resumption of the excavations at the site in 1972, specifying and clarifying their initial discoveries (Dewez, 1975, 1987). Four campaigns were undertaken by Dewez, the *Centre interdisciplinaire de Recherches archéologiques de l'Université de Liège* and the *Société Wallonne de Paléthonologie*, in 1972, 1974, 1976 and 1978. These focused on the terrace of the cave. There, they identified three artefact bearing layers (Toussaint & Toussaint, 1983): a Magdalenian layer (8), an Ahrensburgian layer (6b) separated from the Magdalenian by a sterile layer (7) and a Mesolithic occupation layer (layer 5), that contained a lithic industry affiliated with the Beuronian (Dewez, 1975; Dewez *et al.*, 1983; Kozłowski, 1983).

2. Radiocarbon dates

2.1. Sample selection

The redating-project focused on layers 6b and 5, as the Magdalenian was not the main aim of the research projects. In this paper only the dates from layer 6b will be discussed, while the results of the redating of the Mesolithic level will be presented in a separate paper (Vandendriessche *et al.*, submitted). Three bone samples were selected from the Ahrensburgian layer 6b. None of the bones shows anthropogenic marks.

2.2. Sample preparation

The bones were sampled using a diamond saw attached to a Dremel drill tool. Each sample consisted of approximately 500 mg of bone material, obtained by scraping about 2 µm from the outer surface of each bone.

Collagen extraction was carried out at the ArcheOs research laboratory at Ghent University (Belgium) using a modified version of Longin's method (Longin, 1971). Before hydrolysis,

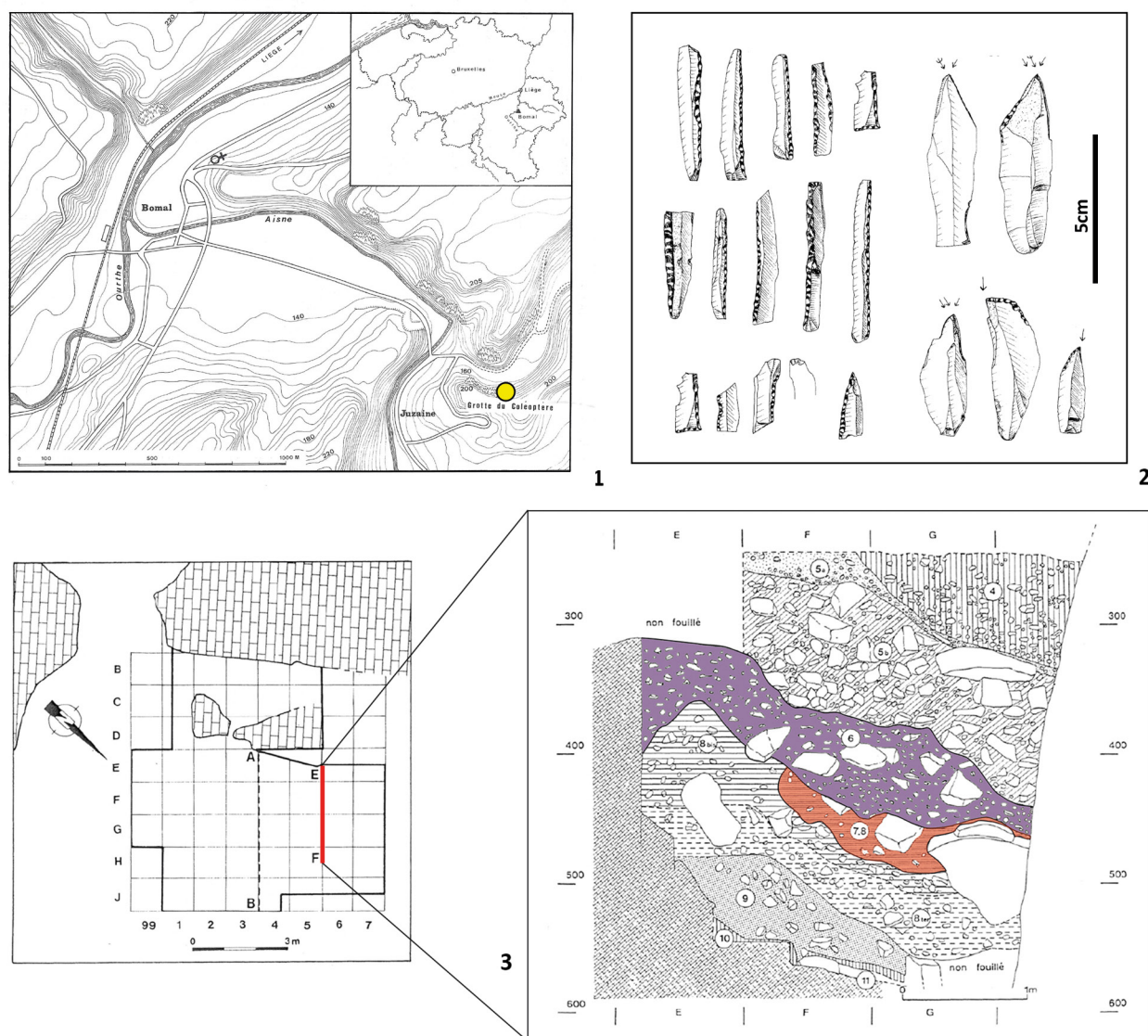


Fig. 1 – 1.1. Location of the site. 1.2. Lithic artefacts from the Magdalenian layer 8. 1.3. Stratigraphy of the terrace deposits (based on Dewez, 1975; Dewez *et al.*, 1983).

the demineralized samples were washed with NaOH and subsequently filtered using Eze filter separators (pore size: 60-90 μm) before undergoing freeze-drying (Robert *et al.*, 2024).

At the Isotope Bioscience Laboratory (ISOFYS) of Ghent University, the total organic carbon and nitrogen content of the samples was measured using an Elemental Analyser (EA ISOLINK, ThermoFinnigan, Bremen, DE). To evaluate the reliability of the ^{14}C dating, the C:N ratios of all samples, which contained insufficient collagen, were calculated following Ambrose (1990), DeNiro (1985), and Wojcieszak *et al.* (2020). These quality assessments align with the procedures used at the radiocarbon dating laboratory of the Royal Institute for Cultural Heritage (Brussels, BE).

2.3. Sample dating and calibration

Samples were transferred into quartz tubes with CuO and Ag and combusted to CO_2 . Graphitization of CO_2 was carried out using H_2 over a Fe catalyst on the Automated Graphitisation Equipment (AGE) (Boudin *et al.*, 2019; Nemec *et al.*, 2010; Wacker *et al.*, 2010) which is linked to the Elementar Vario Isotope Select. Targets were prepared and ^{14}C concentrations were measured with accelerator mass spectrometry (AMS) at the Royal Institute for Cultural Heritage in Brussels (BE) (Van Strydonck & van der Borg, 1990; Boudin *et al.*, 2015).

	Lab code	Layer	BP	St. dev.	Cal BP (95 %)	Dating material	C:N	Technique	Reference
NEW DATES									
COL15	RICH-34336	6B	12375	35	14835-14189	<i>Rangifer tarandus</i> Scapula	3.1	AMS	this paper
COL16	RICH-34337	6B	12396	35	14846-14239	<i>Rangifer tarandus</i> Phal.	3.2	AMS	this paper
COL17	RICH-34338	6B	10196	32	11946-11749	<i>Lepus</i> sp. ulna	3.2	AMS	Crombé <i>et al.</i> , 2024
LEGACY DATES									
	Lv-686	8B	12150	150	14843-13614	bone splinters		conventional	Gilot, 1997
	Lv-717	8	12400	110	14986-14099	<i>Rangifer tarandus</i>		conventional	Gilot, 1997
CO/76 153	OxA-3635	7, 8	12870	95	15668-15112	<i>Equus ferus</i> phalanx with cutmarks		AMS	Charles, 1998

Tab. 1 – List of radiocarbon dates from layers 8 to 6B at ‘Coléoptère’.

^{14}C results are expressed in pMC (percentage modern carbon) and indicate the percent of modern (1950) carbon normalized to $\delta^{13}\text{C} = -25\text{‰}$ VPDB using the $\delta^{13}\text{C}$ measurements (Stuiver & Polach, 1977).

All radiocarbon dates were calibrated using IntCal20 (Reimer *et al.*, 2020) and OxCal version v4.4.4.

2.4. Results

Surprisingly just one sample (RICH-34338) produced a date in accordance with the cultural attribution of layer 6b, *i.e.* the Ahrensburgian Culture (**Tab. 1**). The date of *ca.* 11,950-11,750 cal BP obtained on a hare bone falls in the later stage of the Younger Dryas and perfectly fits with the numerous dates obtained at the nearby Ahrensburgian site of Remouchamps, situated at *ca.* 17 km to the northeast of Coléoptère (Crombé *et al.*, 2024).

The two remaining samples on reindeer remains (RICH-34336 and RICH-34337) are dated much older, to *ca.* 14,835/14,850-14,190/14,440 cal BP. These clearly belong to reworked material from the underlying Magdalenian layer 8.

3. Discussion

The presence of reworked older material in layer 6b is not surprising as at some locations on the terrace, Dewez (1983, fig. 3 & 4) could observe that layer 6b was directly superimposing layer 8 or layer 7-8. The latter is considered a mixture of both layers 7 and 8 due to cryoturbation processes (Toussaint & Toussaint, 1983). In addition, admixture was also observed during the first excavations in the first quarter of the 20th century. Unfortunately, as we could not locate or study the archaeological material collected by Dewez from layer 6b, it is impossible to assess the degree of intermixing of Ahrensburgian and Magdalenian material in this layer. However, according to Dewez analysis of the small lithic industry retrieved by Hamal-Nandrin and Servais there is only one artefact, a *lamelle à bord abattu rectiligne*, which most likely points to a limited admixture with layer 8 (Dewez, 1987).

Despite these problems and restrictions the two newly obtained dates allow us to further define the chronological boundaries of the Magdalenian occupation(s) at Coléoptère. Compared to the radiocarbon dates obtained in the late 20th century on bone samples from layer 8 (**Tab. 1**), the new dates seemingly fit well with both conventional dates performed by Louvain-la-Neuve. Despite the large standard deviations of the latter and the fact that date Lv-686 was performed on a bulk sample of bone splinters, they largely fall within the same time range (**Fig. 2**), which covers the largest part of the Bølling and the Dryas I/Bølling transition. On a broader scale, the new dates also fit perfectly among the younger set of dates obtained until now on other Magdalenian sites in the Meuse basin, such as Chaleux and Trou Da Somme (see overview in Noiret & Léotard, 2024).

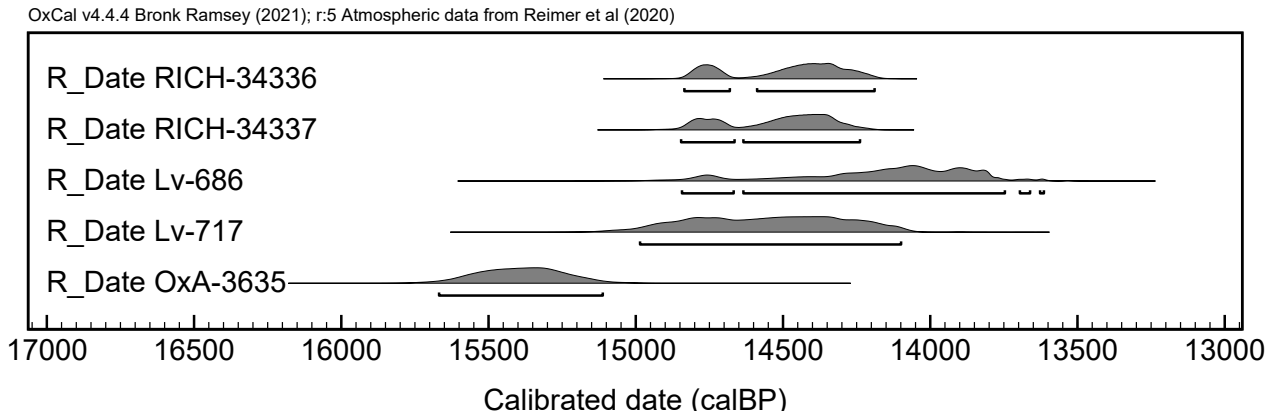


Fig. 2 – Calibrated radiocarbon dates belonging to the Magdalenian occupation(s) at ‘Coléoptère’.

Remarkably, the only AMS-date from the late 20th century (OxA-3635) turns out to be much older showing no overlap at all with the other dates. Either it refers to an older Magdalenian occupation event pre-dating the start of the Late Glacial climatic amelioration by half a millennium or even more, or it needs to be considered as an aberrant date. It is known that the bone collagen pretreatment protocol used by the Oxford laboratory from 1989 until 2000 may have resulted in contaminated dates as a result of column resin bleeding often yielding too old dates (Higham *et al.*, 2006; Burky *et al.*, 1998). The same age discrepancy problem has also been encountered during the redating of old Oxford-samples from the Remouchamps-cave (Crombé *et al.*, 2024) and several Mesolithic burials (*cf.* Toussaint 2010; Crombé *et al.*, in prep.). In all these cases the recently obtained dates turned out to be younger compared to the previously obtained Oxford-dates.

4. Conclusion

The two new Magdalenian dates from Coléoptère cave offer intriguing results. Besides indicating admixture between the occupation layers at the site, they allow to position the Magdalenian occupation of the site in a more precise manner at the transition between Dryas I and Bølling and/or first half of the Bølling. At the same time, they reveal an important age discrepancy within the dating evidence gathered until now that strongly suggest the need for further dating research, not only at ‘Coléoptère’ but also at other Meuse Basin sites where similar chronological ambiguities occur. Indeed, rigorous dating research taking into account principles of chronometric hygiene is needed to increase our understanding of the precise position of the Late Magdalenian occupations of the Meuse Basin and of the timing of the recolonization of our regions after the Last Glacial Maximum (*cf.* Miller, 2012; Matthews *et al.*, 2025).

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Abstract

This short note reports on three radiocarbon dates performed on animal bones from the Ahrensburgian layer 6B at the 'Coléoptère' cave at Bomal-sur-Ourthe in the Belgian Meuse basin. One date situates the Ahrensburgian occupation in the late Younger Dryas, whereas both other dates fall within the time-period of the Magdalenian Culture. The latter indicates that layer 6B is a mixed context including reworked material from the underlying Magdalenian layer 8. Both these dates correlate well with the legacy dates from layer 8, except one, situating the Magdalenian occupation at the Dryas I/Bølling transition or early Bølling.

Keywords: Cave of 'Coléoptère' (Juzaine, Bomal-sur-Ourthe, BE), Meuse basin, radiocarbon dates, Magdalenian Culture, Ahrensburgian Culture.

Samenvatting

In dit kort artikel worden drie nieuwe koolstofdateringen uitgevoerd op dierlijke botresten afkomstig van de Ahrensburgiaan laag 6B in de Coléoptère grot te Bomal-sur-Ourthe besproken. Een eerste datering situeert de Ahrensburgiaan bewoning aan het einde van de Jonge Dryas, terwijl beide andere dateringen chronologisch samenvallen met de Magdaleniaan bewoning van het Maasbekken. Dit bewijst dat laag 6B een vermengde context is waarin vondstmateriaal van de onderliggende Magdaleniaan laag 8 opgenomen is. Beide dateringen correleren perfect met eerdere dateringen, behalve een, en situeren de Magdaleniaan bewoning op de Dryas I/Bølling overgang of de vroege Bølling.

Trefwoorden: Grot van 'Coléoptère' (Juzaine, Bomal-sur-Ourthe, BE), Maasbekken, koolstofdateringen, Magdaleniaan cultuur, Ahrensburgiaan cultuur.

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