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Radiocarbon Dating and Faunal Stable Isotopes for the Galeria Principală, Peştera Muierii, Baia de Fier, Gorj County, Romania

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Key words: Upper Paleolithic, Middle Paleolithic, cave bears, Late Pleistocene, diet.

Abstract: Radiocarbon dates and stable isotope signatures are presented for six faunal samples from the Galeria Principală, Peştera Muierii. Despite stratigraphic incertainties, the samples should date from the earlier Upper Paleolithic of this portion of the site to ~30,000 ^{14}C BP and the Middle Paleolithic levels to ~41,000 to ~47,500 ^{14}C BP, with the deeper levels being beyond radiocarbon age (>52,000 ^{14}C BP). These dates therefore imply that the Pleistocene human occupation of the site consists of a relatively late Early Upper Paleolithic (or very early Middle Upper Paleolithic) and a fairly late Middle Paleolithic. Stable isotope analysis of the dated samples reinforces the ecological flexibility of Late Pleistocene cave bears.

Cuvinte-cheie: Paleolitic superior, Paleolitic mijlociu, urşi de peşteră, Pleistocen târziu, dietă.

Rezumat: În acest articol sunt prezentate datele radiocarbon şi analizele izotopice obţinute pentru şase eşantioane faunistice prelevate din Galeria Principală din Peştera Muierii. În ciuda provenienţei stratigrafice incerte, ele datează nivelul paleolitic superior vechi din această zonă a peşterii la cca. 30,000 ^{14}C BP, iar nivelurile caracteristice Paleoliticului mijlociu le situează între cca. 41,000 şi 47,500 ^{14}C BP. Aceste date arată că pentru Pleistocen, ocupaţia umană se plasează la sfîrşitul a paleoliticului superior vechi (sau chiar la începutul Paleoliticului superior mijlociu); în ceea ce priveşte paleoliticul mijlociu de aici, acesta este relativ târziu. Analizele izotopice pun în evidenţă flexibilitatea ecologică a urşilor de peşteră în Pleistocenul Superior.

Introduction

The archeological excavations in the Peştera Muierii (also, Peştera Muierilor), Baia de Fier, Gorj County (45° 11' N, 23° 46' E), initially in the 1920s and then more systematically in the early 1950s, yielded an abundance of Paleolithic and more recent archeological remains and a large sample of Pleistocene faunal remains (Nicolăescu-Plopşor 1935, 1956, 1957; Daicoviciu *et al*. 1953; Gheorghiu *et al*. 1954; Gheorghiu and Haas 1954; Nicolăescu-Plopşor *et al*. 1957). Even though the Paleolithic archeological remains continue to pertain to discussions of the Paleolithic of Romania (especially of the Middle Paleolithic and the early Upper Paleolithic) (Cârciumaru 1999; Păunescu 1989, 2000; Dobrescu 2008), it is principally the early modern human fossil remains from the site which have drawn attention (Gheorghiu and Haas 1954; Nicolăescu-Plopşor 1968; Soficaru *et al*. 2006; Cosac, 2006-07; Trinkaus, 2008). These human remains, directly radiocarbon dated to ~30,000 ^{14}C BP (~35,000 cal BP) (Olariu *et al*., 2003; Soficaru *et al*., 2006), have consequently joined the small sample of securely dated European human fossils that derive from the time period of the Early Upper Paleolithic (Trinkaus, 2005, 2007). The remainder of the contents of the complex cave system, however, remains poorly dated.

It is readily apparent from the existing fieldnotes and the collections in various institutions [to our knowledge, there are paleontological and/or archeological remains from the Peştera Muierii in at least the Muzeul Olteniei (Craiova), Institutul de Arheologie "Vasile Pârvan" (Bucureşti), Institutul de Antropologie „Fr. J. Rainer" (Bucureşti), Institutul de Speologie "Emil Racoviţă" (Bucureşti), Muzeul Naţional de Istorie (Bucureşti), and Muzeul Militar Naţional (Bucureşti)] that any attempt to securely date the deposits of the Peştera Muierii would require the re-excavation of portions of the cave and the acquisition of datable material from primary contexts within stratigraphic profiles. This situation is especially evident in the existing collections,

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since they can only represent a partial retention of paleontological and archeological remains from the excavations, and none of the remains has detailed stratigraphic and horizontal proveniences other than indications of the gallery, trench, and depth below datum marked on a minority of the remains. Nonetheless, as part of the project to securely date and analyze the Muierii human remains (Soficaru *et al*., 2006), samples of faunal remains from a stratigraphic sequence were dated to help provide a general chronological framework for the site's deposits. It is hoped that these dates, presented here, will assist in establishing a temporal framework for the Paleolithic deposits of the Peştera Muierii.

The Peştera Muierii

The Peştera Muierii consists of a series of interconnected galleries at multiple levels (cf., plans in Gheorghiu and Haas 1954; Păunescu 2000). The largest gallery, the Galeria Principală, is >70 m long and 5–10 m wide, with a smaller section near the entrance, the Gura Peşterii, being the south cave entrance. Parallel to it is a narrower gallery at a lower elevation, Galeria Secundară towards the front of the system and the Galeria Musteriană deeper within. This lower chamber connects with the Galeria Principală at the front of the Galeria Secundară and at the back of the Galeria Musteriană. Additional galleries extend off of these main passageways and at their ends away from the modern entrance. The principal excavations, carried out from 1951 to 1953, consisted of a trench across the Gura Peşterii, two trenches at right angles to each other in the entrance portion of the Galeria Principală (Sector I and Sector II, with Sector I being deeper within the cave), three small soundings deep within the Galeria Principală, and then most of the surface areas of the Galeria Secundară and the Galeria Musteriană (Gheorghiu and Haas 1954, fig. 13). The faunal dating samples all derive from Sector I of the Galeria Principală, excavated in 1952.

Previous Radiocarbon Dates for the Peştera Muierii

In addition to the series of radiocarbon dates on the human remains from the Peştera Muierii (Soficaru *et al*. 2006), there have been only two previous attempts to date the deposits of the cave system. A bone from the Mousterian Level I of Sector C of the Galeria Musteriană, at a depth of 1.40 – 1.50 m, provided an age of 42,560 +1,310, -1,120 ^{14}C BP (GrN-16977) (Păunescu 2000). In addition, a bear bone (*Ursus spelaeus*?) of unknown provenience within the cave system and of unknown stratigraphic depth provided an age of >29,000 ^{14}C BP (Mo-105) (Vinogradov *et al*. 1968). The first date may be either finite or a minimum age; if the former, it is a reasonable age for a relatively late phase of the Middle Paleolithic. The second date only serves to establish that there were the remains of bears at least of oxygen isotope stage 3 age within the cave system, a not surprising result.

New Faunal Dates for the Galeria Principală

Given the general absence of horizontal provenience for the faunal remains from the Peştera Muierii, we selected six samples, all labeled "B.F.52" (Baia de Fier 1952), "G.P." (Galeria Principală), "S.I" (Sector I), and then a depth or a depth range below datum (Table 1). Four of them are diaphyseal samples from metapodials of *U. spelaeus*, one is a diaphyseal sample from a metapodial of a large felid (*Panthera spelaea*?), and the last is a root of a maxillary molar of *Alces alces*.

The stratigraphic depths of the samples, if datum is near the surface of the original deposits and the schematic stratigraphic profile of Păunescu (2000: fig. 118) can be used as a general guide, should span the levels designated "Aurignacian" and "Mousterian" with the deepest sample possibly predating the Middle Paleolithic accumulation in this portion of the cave. This assumes that 1) the levels across Sector I of the Galeria Principală were reasonably horizontal (which is clearly not the case, as drawn), 2) the samples all derive from one part of Sector I, 3) Păunescu's stratigraphic profile is accurately to scale, and 4) the reference datum was close to the surface. At present, none of these assumptions are verifiable, but all of them should provide a working framework for the samples.

The samples were removed with a stainless steel disk saw on a Dremel tool, and submitted to the Oxford Radiocarbon Accelerator Unit (ORAU) for

accelerator mass spectrometry (AMS) dating. None of the samples had macroscopic evidence of any form of preservative. All of the samples, being of bone and tooth root, were pretreated following standard ORAU procedure (Brown et al., 1988) combined with ultrafiltration (Higham et al. 2006). Ultrafiltration sorts the collagen fraction by molecular weight, removes smaller fractions likely to be from contamination (<30 kD), and dates only the higher (>30 kD) molecular weight portion (Higham *et al*. 2006). Ultrafiltration commonly produces dates that are modestly older and/or more precise than AMS dates run without ultrafiltration.

Sample bone and root weights range from 520 mg to 900 mg, with collagen yields beween 12.0 and 77.5 mg (Table 1). Most importantly, the carbon-nigrogen (C:N) ratios are all between 2.9 and 3.5, as they should be for well preserved bone (DeNiro 1985). The $\delta^{13}C$ values for the *U. spelaeus* samples are moderately negative, but this is common for samples of *U. spelaeus* (Richards *et al*., 2007, and references therein).

Table 1

Radiocarbon results for faunal remains from the Peştera Muierii, Baia de Fier, Romania. All samples are from the depth below datum brackets indicated from the Galeria Principală (GP), Sector I (SI), 1952 excavations. All samples were run using ultrafiltration (Higham 2006) at the Oxford Radiocarbon Accelerator Unit (ORAU). Calendrical years based on CalPal 2007 (www.calpal.de)

Sample number	Mui05-5	Mui05-6	Mui05-8	Mui05-9	Mui05-10	Mui05-11
Curating institution	Inst. Archeol.	Muzeul Olteniei	Muzeul Olteniei	Inst. Archeol.	Inst. Archeol.	Inst. Archeol.
GP SI depth (m below datum)	0.90	1.20 – 1.40	1.40 – 1.60	1.60 – 1.70	1.70 – 1.90	1.90 – 2.05
ORAU number	OxA-15554	OxA-15530	OxA-16380	OxA-16381	OxA-16382	OxA-16383
Species	*Alces alces*	*Ursus spelaeus*	*Panthera spelaea*	*Ursus spelaeus*	*Ursus spelaeus*	*Ursus spelaeus*
Bone	Molar root	Metapodial	Metapodial	Metapodial	Metapodial	Metapodial
Radiocarbon age (^{14}C years BP)	30,060 ± 280	40,850 ± 450	47,500 ± 900	40,950 ± 450	42,700 ± 550	>52,400
"Calendrical" age (cal years BP)	35,367 ± 318	44,372 ± 790	51,292 ± 2081	44,467 ± 783	46,182 ± 1176	--
$\delta^{13}C$	−19.9‰	-20.3‰	-19.1‰	-20.3‰	-20.2‰	-20.7‰
C:N	3.5	3.3	3.2	3.2	3.2	3.2
Sample weight (mg)	520	640	900	800	840	800
Collagen weight (mg) (ultrafiltered gelatin yield)	13.1	52.2	77.5	51.7	60.5	12.0
Burnweight (mg) (gelatin combusted for graphitization)	5.6	5.3	5.4	5.3	5.2	5.2
%C (% carbon on combustion)	46.9%	43.4%	48.8%	47.5%	46.9%	44.9%
%N (% nitrogen on combustion)	16.1%	15.1%	17.9%	17.5%	17.2%	16.4%
$\delta^{15}N$	(7.3)	6.0	8.2	3.7	3.4	7.3

The resultant samples provide a series of dates that are bracketted by the *A. alces* molar at -0.90 m and ~30 ka ^{14}C BP and a *U. spelaeus* metapodial at -1.90-2.05 m at >52.4 ka ^{14}C BP. Three of the remaining four samples, between -1.20 and -1.90 m, cluster around 41 to 43 ka ^{14}C BP, with one sample, the felid metapodial, being substantially older but still finite at ~47.5 ka ^{14}C BP (Table 1). If the reference to the schematic chart of Păunescu (2000) has any validity, the most recent date is probably associated with the small early Upper Paleolithic assemblage, one which has been designated "Aurignacian" but typologically and technologically could as well derive from an early Gravettian level. The deepest and oldest date may well predate the Middle Paleolithic occupation of at least this portion of the cave. The other samples, despite either vertical mixing of the remains (always possible with smaller bones such as metapodials) or horizontal variance in the depths of the levels (likely given the horizontal extent of Sector I of the Galeria Principală), appear to date a relatively late phase of the Middle Paleolithic, well within OIS 3.

Carbon and Nitrogen Stable Isotopes

In addition to the radiocarbon dates, the ORAU sample preparation and analysis provide carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotopes for these samples (Table 1). The bone collagen isotope values likely reflect dietary protein consumed over the past 10 to 20 years of life for an adult long-lived mammal (Wild et al., 2000). Although the δ^{13}C values can be used to assess whether the dietary protein carbon is derived from marine versus terrestrial sources or from C_3 or C_4 plants, it is the trophic level of the protein consumed that is of interest here. The δ^{15}N of bone collagen is ~2‰ to ~4‰ higher than dietary protein (Schoeninger and DeNiro 1984; Schwarcz and Schoeninger 1991), and one therefore can use it to see if dietary protein derived mainly from plants or from higher trophic level protein sources, especially as compared to other fauna from the same site. Of particular relevance here, since most of the samples are from *U. spelaeus*, is experimental work with living bears (Hilderbrand *et al*. 1996) that shows bone collagen δ^{15}N values to be an accurate reflection of diet. In general δ^{15}N values for herbivores are <6.0‰, >8.0‰ for carnivores, and in between for omnivores (Bocherens 2002).

Unfortunately only one specimen of a herbivore is available in this sample, the molar root of *A. alces*. Tooth roots (having been formed early in development) sometimes provide augmented δ^{15}N values relative to adult values (Jenkins *et al*. 2001). The value of 7.3 ‰ is therefore in parentheses, indicating that it may be anomalous (it is certainly high compared to most herbivore values) and should not be taken to represent the trophic level of this species.

The δ^{15}N value of 8.2 ‰ for the large felid is within the carnivore range but relatively low for as pure a carnivore as felids tend to be. In contrast, the range of δ^{15}N values for the cave bears (3.4 to 7.3 ‰) spans much of the range documented for these large Late Pleistocene ursids (Richards *et al*. 2007). Isotope values have long been used to argue that cave bears were exclusively vegetarian (e.g., Bocherens, 2002), but recent data from the Peştera cu Oase (Caraş-Severin County) supplemented with data from Peştera Cioclovina and Peştera Muierii have shown that cave bears in fact span a range of dietary profiles, from purely vegetarian to moderately carnivorous (Richards *et al*. 2007), undoubtedly reflecting the same kinds of ecological and dietary flexibility known for extant brown (*U. arctos*) and black (*U. americanus*) bears (MacHutchon and Wellwood 2003; Belant *et al*. 2006; Mowat and Heard 2006). The four samples of *U. spelaeus* from the Peştera Muierii reinforce this pattern.

Conclusions

We remain a long way from sorting out the chronology and associated archeology and paleobiology of the Late Pleistocene occupants (human and faunal) of the Peştera Muierii. However, in addition to the early modern human remains from the site bringing the locality into paleoanthropological awareness, it may be possible through analyses of the preserved remains from the earlier excavations to shed some light on the site and its occupations by humans, bears, and other denizens. These radiocarbon determinations, despite uncertainties regarding their stratigraphic associations,

provide additional data on the time span of the Pleistocene paleontological and anthropological deposits within the cave system. It is hoped that they will provide a further foundation for future interpretations of the site and its contents.

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