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# THE REDISCOVERED CAVE BEAR "*URSUS SPELAEUS* ROSENMÜLLER 1794" HOLOTYPE OF THE ZOOLITHEN CAVE (GERMANY) FROM THE HISTORIC ROSENMÜLLER COLLECTION

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**C. G. Diedrich: The rediscovered cave bear "*Ursus spelaeus* Rosenmüller 1794" holotype of the Zoolithen Cave (Germany) from the historic Rosenmüller collection**

**Abstract:** The historic Rosenmüller collection formerly housed in the Preußische Geologische Landesanstalt Berlin was recently rediscovered, whereas the holotype of the "cave lion skull" was already redescribed from the same collection of the Pleistocene bone rich famous Zoolithen Cave (Bavaria, Germany). The material of the historical Rosenmüller cave bear collection which was labelled in 1797, includes also the holotype skull of "*Ursus spelaeus* Rosenmüller 1794", which was thought to be lost. Only this skull of three originals has a quite unique brain case skull morphology as result of pathological deformation in the posterior part, and non-fused brain case sutures being figured historically already quite well. Therfore the holotype must be the here presented one which is of an early adult male to which the lower jaws do not belong. The holotype and large collection of Rosenmüller is housed now in the collection of the Natural History Museum of the Humboldt-University Berlin. Here only the skull is designed as the holotype because the lower jaws are composed and are even from different individuals. The holotype skull has a "primitive tooth morphology" on the well preserved $P^4$ to $M^2$ dentition, typical also for the subspecies *Ursus spelaeus spelaeus* Rabeder et al., 2004 to which it can be referred preliminary. This dentition type and missing breccia remains attached to it is typical for the "upper layers" of the cave sediments which both date the skull preliminary into the Early Weichselian (Late Pleistocene). This skull might have a possible impact on the new DNA based cave bear systematics after a combined DNA and metrical analysis.

**Key words:** Cave bear, "*Ursus spelaeus* Rosenmüller 1794", holotype skull, Zoolithen Cave, South Germany

## INTRODUCTION

The Ice Age spotted hyena *Crocuta crocuta spelaea* (Goldfuss, 1823) holotype of "*Hyaena spelaea*" (Goldfuss, 1823) from the "Gailenreuther Cave", being synonymous with the Zoolithen Cave, and the steppe lion *Panthera leo spelaea* Goldfuss 1810 were recently rediscovered and redescribed (Diedrich, 2008) within the study of many historical collections in Central Europe within the "European Ice Age spotted hyena project".

The cave is of high importance for the Pleistocene mammal research because all three holotypes of the Late Pleistocene animals, the cave bear "*Ursus spelaeaus* Rosenmüller,

1794", the "cave lion *Felis spelaea* Goldfuss, 1810" (cf. Diedrich, 2008) and the "cave hyena *Hyaena spelaea* Goldfuss, 1823" (cf. Diedrich, 2008) were found and established here on material from the Zoolithen Cave at Geilenreuth (Bavaria, southeastern Germany).

The Zoolithen Cave is one of the most famous and most bone rich caves in Europe, and was under several investiagtions (e.g. Esper, 1774; Heller, 1972). About the history of the cave and its fossils Heller (1966, 1972) or Poll (1972) reported with a review of the literature but without the restudy of the originals in different European museums collections. At least Groiss (1972, 1978, 1979, 1983, 1996) started some new field research about the geology and palaeontology in the Zoolithen Cave, such as Rosendahl and Kempe (2004). Many animals were described from the Zoolithen Cave more in detail (e.g. "*Ursus spelaeus*": Rosenmüller, 1794; Weinstock, 2001, Hofreiter et al., 2001; *Lynx lynx*: Groiss, 1983; Mustelidae: Eberlein, 1996; *Gulo gulo*: Goldfuss, 1818; Döppes, 2001), but the non-cave bears are still insufficiently described such as the lions. Also the interpretation of a hyena den and their bone accumulation – versus "by floodings accumulated bones" – was recently mentioned by Diedrich (2008). The forgotten hyena material recently gave a new insight to the giant bone accumulation of the most famous megafauna cave in Europe – which was not only a cave bear den as suggested generally (e.g. Esper, 1774; Heller, 1966, 1972; Poll, 1972; Groiss, 1983). It was in use also as a hyena, and even wolf den, whereas the latter "cave wolves "*Canis spelaeus*" are not studied or revised yet. The hyena material of *Crocuta crocuta spelaea* Goldfuss, 1823 is recently reinvestigated, whereas some of the specimens are historically important originals of Goldfuss (1810, 1823), Cuvier (1822, 1825, 1836 – 49) and Soemmering (1828).

Cave bear remains from the Zoolithen Cave were already figured by Esper (1774), and were under new investigations by osteometry (Weinstock, 2001), radiocarbone dating (Poll 1972; Hofreiter et al., 2001) and DNA analysis (Hofreiter et al., 2001). Since 1794 the cave bear skull holotype was thought to be lost and was never redescribed or figured again. The only historic figuration remained with the descriptions of Rosenmüller (1794) (Fig. 1A), whereas at least a detailed history of the "cave bear making" including this figuration was reviewed by Kempe et al. (2005).

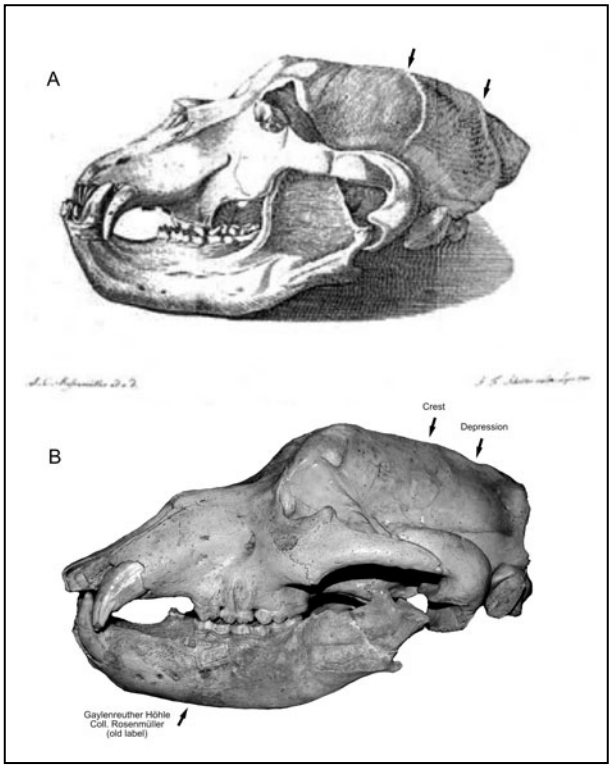


Fig. 1. "*Ursus spelaeus*" holotype. A. Figuration from Rosenmüller (1794), B. Original in the Natural History Museum of the Humboldt-University Berlin (coll. No. MB Ma.5017). Remarkable and important is the brain case. The crest figures the non-fused parietal/frontal sutures and the parietal foramina.

## MATERIALS AND METHODS

The cave bear bone material from the Zoolithen Cave was excavated since the end of the 18th Century with the most famous and largest collection of Rosenmüller, who labelled the site as "Gaylenreuther Höhle, 1797" (cf. Fig. 1B). This collection was formerly stored in the collection of the "Geologische Preußische Landesanstallt", and then in the "Bundesanstalt für Rohstoffe Berlin" (= BGR). Those gave recently the material to the "Museum für Naturkunde der Humboldt-Universität Berlin" (= MB). This collection includes also the "*Felis spelaea*" holotype (Diedrich, 2008). The Zoolithen Cave collection was studied with all material including lions and hyena remains.

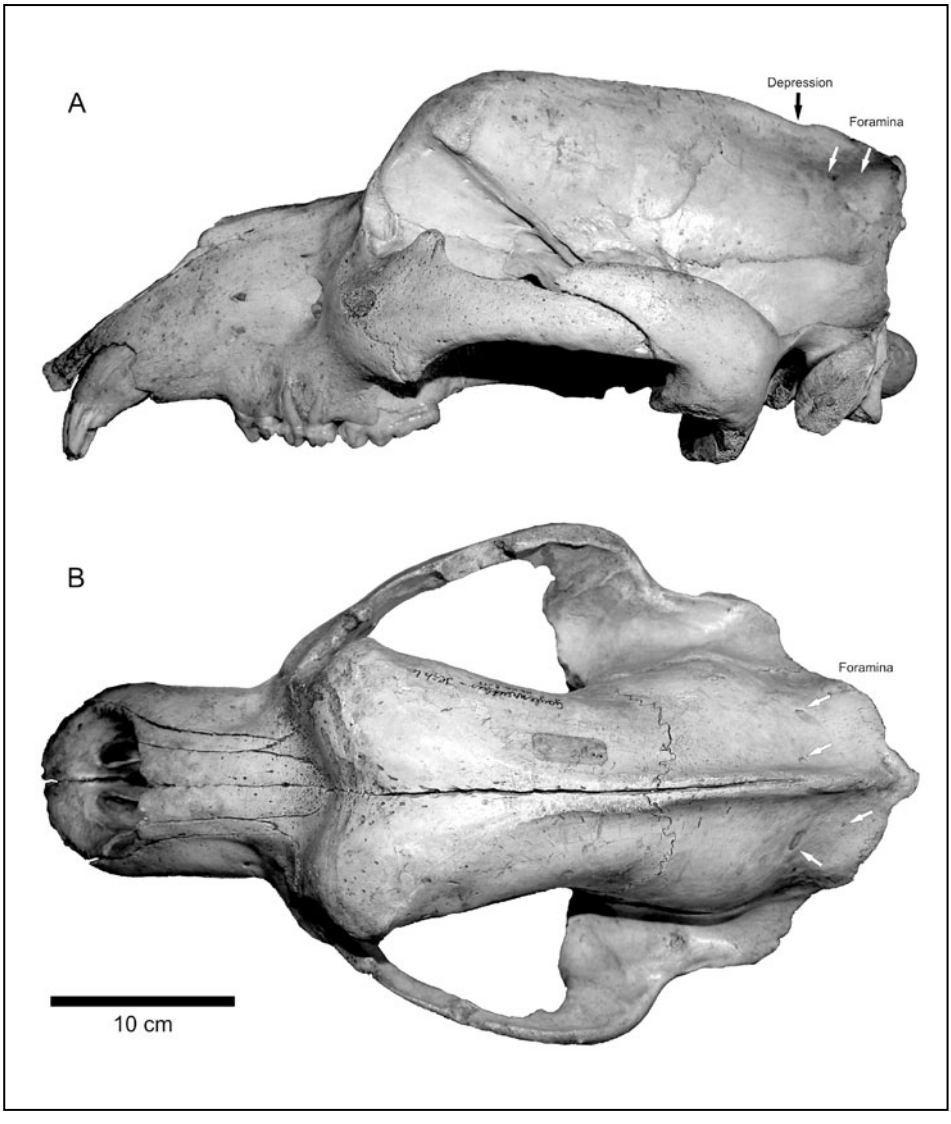


Fig. 2. "*Ursus spelaeus* Rosenmüller 1794" holotype skull of an early adult male cave bear (see non-fused sutures) with open parietal foramina (parietal foramina openings – ?cranial hernia). A. lateral, B. dorsal (MB Ma.5017).

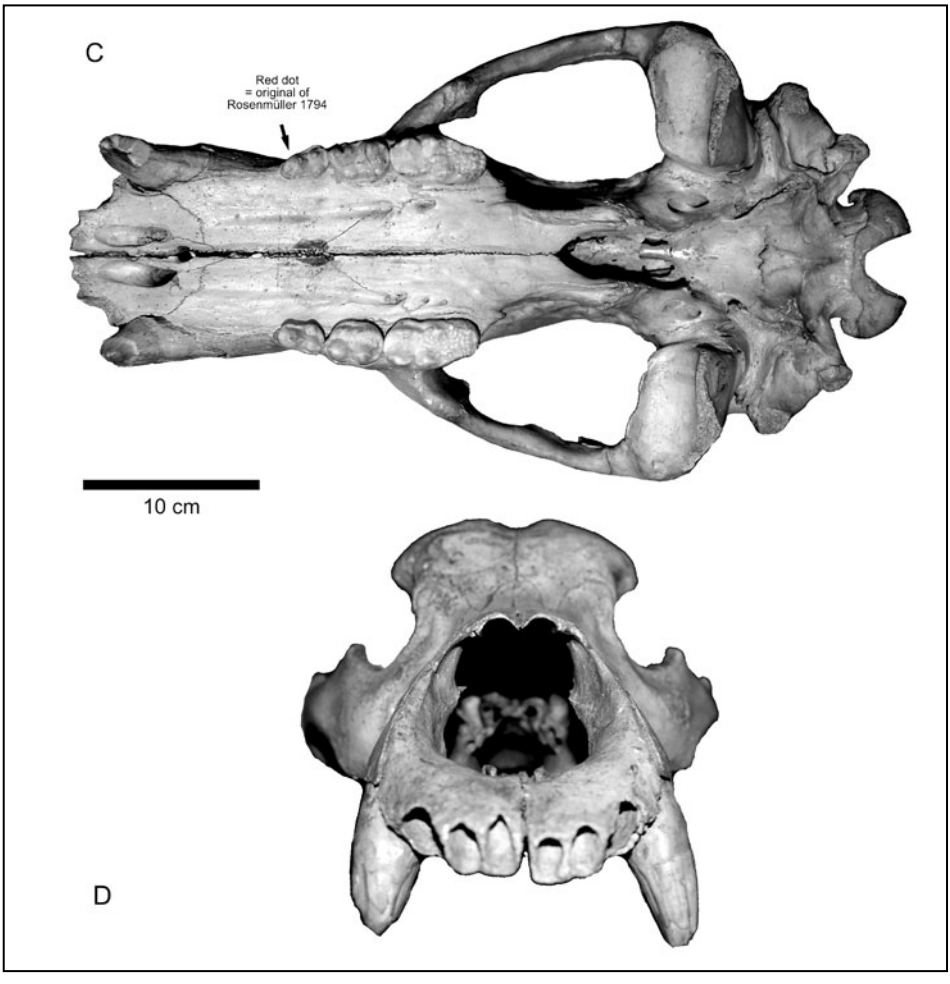


Fig. 3. "*Ursus spelaeus* Rosenmüller 1794" holotype skull of an early adult male cave bear. C. ventral, D. frontal (MB Ma.5017).

## GEOLOGY AND DATATION

It is important, that bones of the Rosenmüller collection were from the first excavations, and most probably mainly from "upper layers", such as the described for the holotype of "*Ursus spelaeus*". Cave bear teeth from the Zoolithen Cave were dated by radiocarbon with data around 28.905 and 40.484 BP (Poll, 1972; Hofreiter et al., 2001) indicating cave bears used the cave as a den well at least in the Middle Weichselian (Late Pleistocene). Rosendahl and Kempe (2004) dated speleothems at the bottom of the cave and suggested a mixed megafauna to range from the OIS 3-8 (late Middle Pleistocene, Saalian to Late Pleistocene, Middle Weichselian). They discussed different bone layers, which was described coarsely already by Goldfuss (1823) and Rosenmüller (1794). Those separated an "upper layer" with bones which are clean on the surface (such as the cave bear holotype skull = Late Pleistocene) and bones from the bone breccia (Saalian to ?Early Weichselian). Obtained from the stratigraphy and preservation the cave bear holotype skull with its "clean surface" and non-attached bone breccia must be from the "upper layers", and therefore of Late Pleistocene Age.

Systematic Palaeontology
Family Ursidae Gray, 1825
Genus *Ursus* Linné, 1758
Species *Ursus spelaeus* Rosenmüller, 1794
***Ursus spelaeus spelaeus* Rabeder et al., 2004**

Holotype: Skull of an early adult male individual with composed lower jaws from other individuals (MB coll. No. MB Ma.5017). Only the skull is designed here as the holotype, which is also marked historically with a red dot.

Locus typicus: Zoolithen Cave near Burggeilenreuth (Bavaria, south-eastern Germany, Europe).

Stratigraphy: "Upper layers", most probably Early to ?Middle Weichselian (Late Pleistocene).

Description: A nearly complete skull in total length of about 472 mm of an adolescent male of about 2-3 years of age, which brain case or nasal sutures and other ones are not fused. The lower jaws are composed ones from other individuals, which are also lacking most of the incisive teeth. The left mandible lacks the $P_4$. The left one has a modern lost of the ramus. The skull (Figs. 2-4) is lacking all incisive teeth, but has all $P^4$-$M^2$ and the canini. The latter are damaged modernly on their tips. The parietals have open foramina on both sides each, which are below a saggital crest depression. The tooth morphology is perfectly preserved in such an early adult cave bear (Fig. 4), only one tip of the right $P^4$ is broken of modern.

## DISCUSSION

The Rosenmüller collection has survived many centuries, and went finally now into the Museum of the Humboldt University Berlin. Here a large collection can be identified as his described one in 1794 due to many old labels mostly sticking on many bones. The holotype skull had a separate label. The collection includes mainly cave bears, lions and hyena (cf. Diedrich, 2008) skull, teeth and bone remains.

Within the cave bears collection of Rosenmüller only three skulls were stored nicely on some gypsum plaster socket and were all marked as "originals" with a red dot. Only one of those skulls has lower jaws such as historically figured by Rosenmüller (1794, see Fig. 1). This is one important criterion; others are the unique brain case open parietal foramina and non-fused sutures of the parietal/frontals (in the drawing visible as a "crest", cf. Fig. 1) which let this skull identify well as the holotype of "*Ursus spelaeus* Rosenmüller 1794". For sure such skulls of very old collections mostly are not 100 % exactly in the preservation as being figured in 1794. As demonstrated for the holotypes of "*Felis spelaea*" and "*Hyaena spelaea*" of the Zoolithen Cave both skulls were damaged during the past 200 years (cf. Diedrich, 2008), which is not of wonder after two world wars and the movement of collections several times. The same historic damage seems to have happened therefore to the holotype of "*Ursus spelaeus*" too, which lost anterior teeth or the canine tips. The latter is proven by fresh fractures on the canines. Also the left mandible ramus is recently broken of modern and incisive teeth seem to have been lost also from those lower jaws. Therefore all three holotypes mentioned above were damaged during two world wars and over time. This has to kept in account, to understand the few differences to the old historical figuration and photograph presented here (cf. Fig. 1), which are as a result of historic damages not 100 % identical.

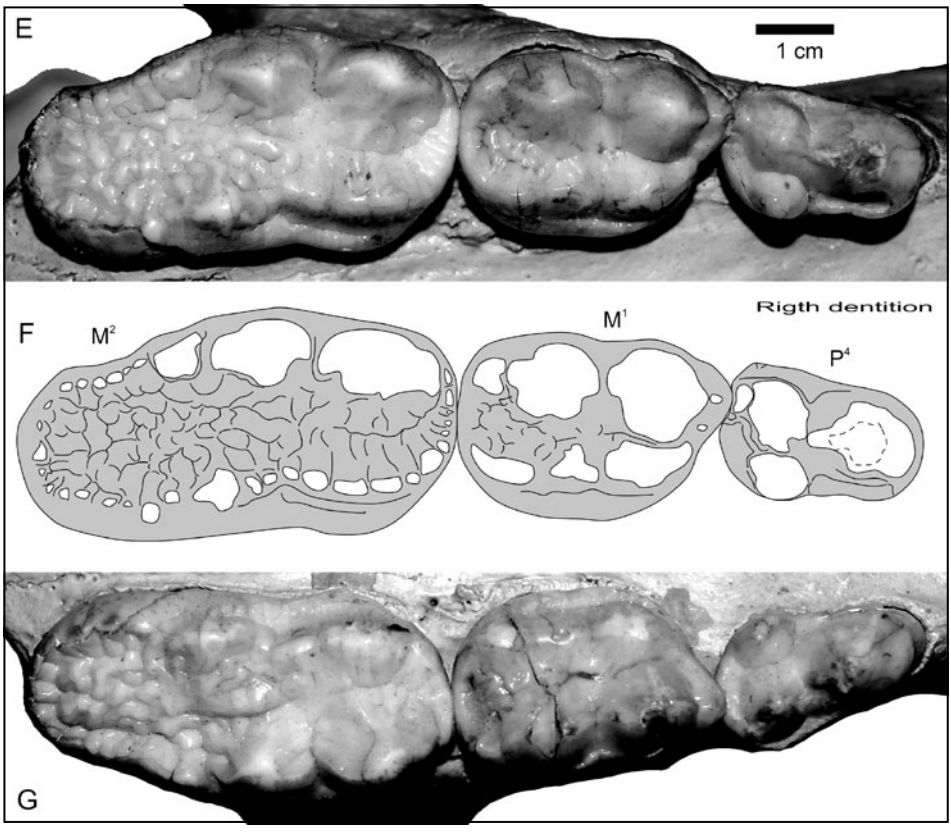


Fig. 4. "*Ursus spelaeus* Rosenmüller 1794" holotype skull of an early adult male cave bear. E. right maxillary dentition, F. redrawing, G. left maxillary dentition (MB Ma.5017).

The dentition of the skull, especially the $P^4$ to $M^2$, can be referred here to the "primitive types" of the Weichselian cave bears sensu Rabeder (1999) (cf. Fig. 4). The $P^4$ has only three main cusps (para-, meta- and protocone) and has no accessory cusplets between the meta- and protocone. This supports first a datation of the holotype skull into the Early (?to Middle) Weichselian (Late Pleistocene, cf. method after Rabeder, 1999). It is also important to distinguish the holotype from recently by DNA-analysis based cave bears *U. spelaeus eremus* Rabeder et al., 2004 and *U. spelaeus ingressus* Rabeder et al., 2004 or *U. spelaeus ladinicus* Rabeder et al., 2004 forms (cf. Rabeder and Hofreiter, 2004) whereas it still remains unclear, if the "haplotypes" are species or subspecies which systematic therefore is used differently (Rabeder and Hofreiter, 2004). The holotype should refer to a classical "*Ursus spelaeus spelaeus* Rabeder et al., 2004" after its tooth morphology presented here with less evolved enamel surfaces (Fig. 4), but this can only be proven finally by a future genetical DNA analysis. If this holotype represents at the end this cave bear "form", the modern taxonomy and recent DNA-only based phylogenetic tree will be not affected; in contrast it will be supported.

## CONCLUSION

The holotype skull of "*Ursus spelaeus* Rosenmüller 1794" is rediscovered within the large cave bear collection from the Zoolithen Cave (Germany) of Rosenmüller, which was labelled

in 1797 being housed in the Natural History Museum Berlin. From three original skulls only one has the historically figured lower jaws. An important second criterion for the identification is a depression on the brain case and a crest. It is a skull of a male not fully grown up individual which had a pathology on the brain case parietal bones with foramina openings, and non-fused parietal/frontal sutures figured both well historically. The lower jaws are composed of different individuals and do even not belong to the skull, and are not designed to refer to the holotype, which is only the skull. The primitive dentition morphology dates the skull into the Early to possible Middle Weichselian and corresponds to the *Ursus spelaeus spelaeus* Rabeder et al. 2004 subspecies based on tooth morphology. Finally only a future DNA analysis will place the holotype skull into the modern cave bear systematics.

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## ZNOVUOBJAVENIE HOLOTYPU MEDVEĎA JASKYNNÉHO „*URSUS SPELAEUS* ROSENMÜLLER 1794" Z JASKYNE ZOOLITHEN (NEMECKO) V HISTORICKEJ ZBIERKE ROSENMÜLLERA

### Zhrnutie

Historická zbierka J. C. Rosenmüllera, v predchádzajúcom období deponovaná v Preußische Geologische Landesanstalt v Berlíne, sa v súčasnosti „znovuobjavila", zatiaľ čo holotyp lebky leva jaskynného bol už znovuopísaný z rovnakej zbierky pleistocénnych nálezov zo slávnej jaskyne Zoolithen (Bavorsko, Nemecko). Materiál Rosenmüllerovej historickej zbierky medveďov jaskynných, ktorá bola označená v roku 1797, zahŕňa aj holotypovú lebku "*Ursus spelaeus* Rosenmüller 1794", ktorá sa považovala za stratenú. Len táto lebka z troch originálov má unikátnu morfológiu, vyobrazenú aj v dobovej kresbe. Holotypová lebka patrí mladému dospelému samcovi, avšak sánka s ňou spojená patrí inému jedincovi. V súčasnosti je veľká časť Rosenmüllerej zbierky uložená v zbierkach Prírodovedného múzea Humboldtovej university v Berlíne. Za holotyp sa považuje len lebka, keďže sánka patrí inému jedincovi(-com). Holotypová lebka má „primitívnu zubnú morfológiu", zistenú na zachovaných zuboch P4 až M2, typickú pre poddruh *Ursus spelaeus spelaeus* Rabeder et al. 2004, ku ktorému môže byť predbežne priradená. Tento typ chrupu a chýbajúce zvyšky kostnej brekcie sú typické pre „vrchné vrstvy" jaskynných sedimentov, ktoré sú datované do ranej fázy posledného zaľadnenia (vrchný pleistocén). Holotypová lebka môže mať vplyv na systematiku medveďov jaskynných, založenú na analýze DNA v kombinácii s metrickou analýzou.