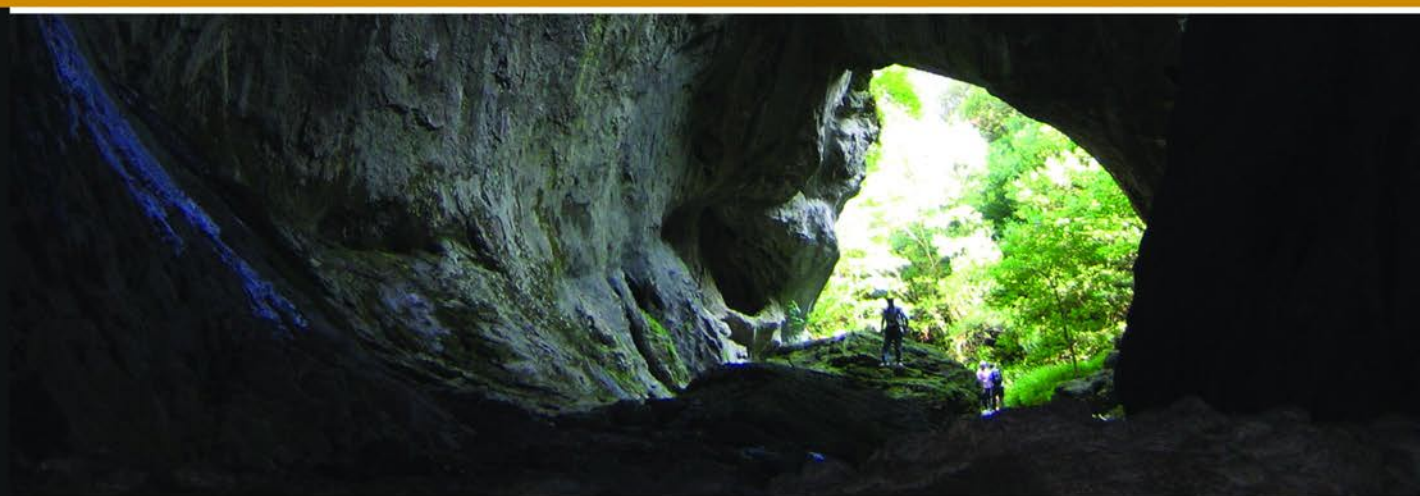




Palaeolithic and Mesolithic Research in the Central Balkans

edited by Dušan Mihailović



PALAEOLITHIC AND MESOLITHIC RESEARCH
IN THE CENTRAL BALKANS

Publisher

Serbian Archaeological Society

Editor in chief

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Redaction

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Cover design

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Printed by

Scanner Studio

Printed in

120

Serbian Archaeological Society
Commission for the Palaeolithic and Mesolithic

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BELGRADE
2014

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LOOKING FOR HOMININS IN MUSEUM DRAWERS - POSSIBLE UPPER PLEISTOCENE SPECIMENS FROM SERBIA: MORPHOLOGICAL DESCRIPTIONS AND RADIOCARBON DATING

Mirjana Roksandic, Predrag Radović, Bridget A. Alex,
Sanja Pavić, Milan Paunović and Zoran Marković

Abstract: With the exact nature of the interactions between Neanderthals and anatomically modern humans, and the identity of the bearers of early Upper Paleolithic technology still open questions essential to expand the human fossil data of Southeast Europe. In our attempt to do so, we investigated a small collection of six previously unpublished human cranial fragments from Serbia, housed at the Natural History Museum in Belgrade and the National Museum in Kraljevo. Tenuous contextual evidence suggested a possible Pleistocene age for the specimens. We conducted a macro-morphological analysis and accelerator mass spectrometry radiocarbon dating in order to assess taxonomical positions and absolute dates for the specimens. Thorough prescreening and chemical characterization of bone samples were used to ensure high reliability of ^{14}C dates. Although the results showed all specimens to be Holocene-aged anatomically modern humans, this should not discourage future research. On the contrary, if indeed we want to understand the early presence of modern humans in the Central Balkans, more research is needed. This includes further checking of old museum collections, but emphasis will need to be placed on new excavations of Pleistocene sites in the region.

Key words: hominins, Pleistocene, Serbia, Upper Palaeolithic

Introduction

The debate over who the bearers of the early Upper Paleolithic (Aurignacian) technology were, and how this technology spread into Europe at around 40ka, is still far from over (Hoffecker 2009). Upper Paleolithic technologies are often equated with the advancement of “anatomically modern humans” (AMHs) into the territory occupied by Neanderthals, and used to suggest their superior behavioral capacities - the presumed “behavioral modernity” (Klein 2000). There is strong support for a relatively abrupt population replacement in Western Europe (Bischoff et al. 1989): with estimates ranging from 5000 years for Western Europe (Higham et al. 2006) to 10,000 years for Central Europe (Kuzmin and Keates 2014). This replacement does not necessitate AMHs’ essential behavioral superiority; and although this is still a predominant paradigm for the European fossil record (see recent critical review by Villa and Roebroeks, 2014), it has been challenged when larger geographic areas are taken into account (Richter et al. 2012). Furthermore, the relatively abrupt replacement of the Middle Paleolithic by the Upper Paleolithic is not necessarily demonstrated for Eastern Europe (Kuzmin and Keates 2014), nor can it be assumed that Upper Paleolithic technologies were introduced by AMHs (Higham et al. 2014). As long as our focus is on well-researched Western Europe, which represents an end point of the AMH migration, we will not be able to fully grasp the dynamics of the interactions between AMHs and Neanderthals that led to the global outcomes. As amply demonstrated by the sites such as Bacho Kiro in Bulgaria (Kozłowski and Ginter 1982), as well as Cioclovina (Harvati et al. 2007), Pesteria Muierii (Soficaru et al. 2006) and Pesteria cu Oase (Trinkaus et al. 2003; Zilhão et al. 2007; Trinkaus and Zilhão 2013) in Romania, Southeast Europe is essential to this debate. Recent advances in dating techniques have allowed re-dating of a number of key specimens deemed to be Upper Pleistocene modern humans, which were subsequently removed from the Pleistocene

record, further emphasizing the importance of the Romanian and Eastern European material (for review See Ahern et al. 2013).

Serbia, covering the southern part of the Pannonian Plain and the Central Balkans, borders Romania to the east and represents one of the probable routes for the expansion of AMHs to Western Europe. Unfortunately, the human fossil record of Serbia is poor relative to the neighbouring countries (Roksandic submitted). Only two Pleistocene AMH specimens had been published in detail so far: a fragmented mandible from the vicinity of Belgrade (Roksandic and Dimitrijević 2001) and a fragmented calotte from Bački Petrovac near Novi Sad (see Radović et al. 2014). Both specimens had been recovered from loess deposits of Serbian Podunavlje, which were formed exclusively during Pleistocene (Nenadić and Bogičević 2010). Since one of these specimens (Bački Petrovac) is now lost, any “new” discoveries from Serbia may be significant for our understanding of the Upper Pleistocene biological and cultural dynamics in Europe.

This prompted us to investigate a small collection of six previously unpublished human cranial fragments housed at the Natural History Museum in Belgrade (NHMBEO) and the National Museum in Kraljevo (NMKV), for which the evidence (however tenuous) seemed to suggest a possible Pleistocene age. The fact that all the specimens were discovered accidentally by non-professional individuals brings serious doubt into the alleged chronological context. Therefore, we first conducted a macro-morphological analysis in order to taxonomically classify the specimens. Then, we prepared the samples for accelerator mass spectrometry (AMS) radiocarbon dating using state-of-the-art methods of prescreening and pretreatment — methods now considered routine for Pleistocene bones (Yizhaq et al. 2005; Brock et al. 2010). However, before dating the samples, we conducted additional chemical characterization in order to ensure that the dated carbon derived from human collagen, rather than contaminants or non-human collagen that may have been applied for conservation. The results of our analysis are presented here.

Material and methods

Over the course of 2013 we located six unpublished human cranial fragments of possible Pleistocene origin recovered from Serbia. Five of those are presently housed at NHMBEO and they include: a human mandible from Mečije Rupe cave near Svrljig (reportedly discovered in 1931); a partial human cranium from Kolubara river estuary near Obrenovac (a suburb of Belgrade) discovered in 1952; a fossilized posterior portion of a human neurocranium from an unknown locality; a fragmentary human skull from Iline Vode (Kragujevac municipality); and a fragmentary human parietal from Sava river basin near Ostružnica (discovered in 1947). Another specimen was discovered in 2013 at Kotež (Belgrade) among construction gravel mined from the Danube banks, today part of the NMKV collection. A brief discussion of the conditions of the finds mostly based on museum records was provided for each of the specimens. Macro-morphological description was provided for each of the individuals and their affiliation with fossil hominin groups is discussed using standard morphological features. Age and sex of the represented individuals was assessed using standard methods (Ubelaker and Buikstra 1994).

In order to better interpret the archaeological and paleoanthropological relevance of this material, it was essential to provide chronological context for each specimen. Six specimens have been prepared for AMS radiocarbon dating and dated at the D-REAMS Radiocarbon Laboratory, Weizmann Institute of Science, Israel. Because the specimens have uncertain histories, with regard to collection and storage practices, we took into account the possibility that they were treated with organic glues or consolidants that could compromise the radiocarbon content. Therefore bone samples were subjected to extensive prescreening procedures aimed at identifying potential contaminants. First samples underwent the prescreening procedures applied to all bones at the D-REAMS Radiocarbon Laboratory: measurement of percent insoluble fraction as well as Fourier Transform Infrared Spectrometry (FTIR) of bone powder and insoluble fraction

(Yizhaq et al. 2005). Percent insoluble fraction (%IF) is the percent by weight that remains after dissolution in 1 N HCl, which comprises the organic content of bone as well as any insoluble contaminants. Insoluble fraction values for fresh bone are about 20%, while archaeological bone usually falls below 5% depending on the depositional environment (Van Klinken 1999). Splitting factor (SF) reflects the crystallinity of bone, which increases as bones undergo diagenesis. Fresh bone has a SF between 2.4-2.9, while archaeological bone can range from 3-7 (Berna et al. 2003). SF is calculated from the FTIR spectra of bone powder, as the sum of the height of the peaks at 565 cm⁻¹ and 604 cm⁻¹ divided by the height of the valley between them, measured from a standardized baseline (Weiner and Bar-Yosef 1990). Finally, the samples were measured by AMS, also at the D-REAMS Radiocarbon Laboratory. Radiocarbon dates were converted to calibrated dates using IntCal13 atmospheric curve (Reimer et al. 2013) with OxCal software v4.2 (Bronk Ramsey 2009).

Results

Contextual information for the specimens in question is essentially minimal and mostly based on the entries into the NHMBEO ledger and handwritten labels associated with specimens. The following list shows *translation labels* for specimens housed at NHMBEO, along with the information from the museum ledger and any additional information (if available):

1) *A human mandible from the Mečije Rupe cave, village Pirkovac near Svrlijig, prof. Petar Petrović, July 3rd 1931.* According to the museum ledger, the specimen was apparently found in association with a left mandible of *C. capreolus*. We included this specimen in our paper mostly because of the recent discoveries at the site.

2) *Collection number 205, the upper portion of a human skull, excavated in 1952 by bulldozer at the Kolubara river estuary, near Obrenovac (a suburb of Belgrade).* The specimen is entered in the museum ledger as “Pleistocene”. In addition, the Kolubara fragment was allegedly found in association with the remains of other Pleistocene mammals (Roksandic and Dimitrijević 2001).

3) There are no labels/ledger entries associated with the specimen (number 807 is written on the specimen itself). However, the specimen is a part of “Pleistocene” collection; therefore we included it in our analysis.

4) *Collection number 199, fragments of human skull from cultural layer, Iline Vode, 5km south of Kragujevac municipality. Brought by Sergije Matvejev.* There is no additional information for the specimen in the ledger. As a part of the “Pleistocene” collection, we included the specimen in the analysis.

5) *Collection number 202, a fragment of human skull, Sava near Ostružnica, Belgrade, December 8th 1947, gifted by “Brodarsko-bagersko preduzeće”.* In the museum ledger, this specimen lacks contextual information other than that provided by the label and the note that it was “excavated from Pleistocene sediments” by a local building company.

The Kotež specimen was discovered in 2013 by V. Radosavljević, a student of veterinary medicine living in Kotež (Belgrade). Radosavljević noted a fragment of a human skull in the gravel load which he purchased for the domestic building project. After contacting archaeology student A. Todorović, the specimen was donated to NMKV. Although the exact stratigraphic context of the find is unknown, we can say with some certainty that it must have been excavated on the banks of Danube by the Pančevo Bridge at Krnjača, where sand and gravel are commercially mined by a local company. At Krnjača, 10 m thick Middle/Lower Pleistocene polycyclic-fluvial deposits are positioned between marshy-fluvial deposits of the Holocene (17-20 m thick) and the Middle/Late Miocene (Sarmatian-Pannonian) clays beneath. The Pleistocene deposits have yielded remains of large mammal fauna (*Mammuthus trogontherii*, *Megaloceros* sp., *Bison prisus*, and *Alces* sp.) (Nenadić and Bogičević 2010: 191).

Macro-morphological descriptions

- The **Mečije Rupe** mandible comprises a largely complete corpus and anteroinferior portions of the rami (Fig. 1). It shows significant post-mortem erosion (located mostly on the external surface) and a fresh cut in the region of the right lateral prominence (probably a result of inadequate excavation technique). Three molars in advanced stages of dental attrition were preserved (left M1 – M2 and right M2). Parts of the enamel are broken off due to taphonomic factors (mesial and lingual surfaces of left M1 crown, mesial surface of left M2, and inferior halves of mesial, buccal and lingual right M2 crown surfaces). Most of the missing teeth were lost post-mortem (or at least peri-mortem), except for the third molars (missing due to hypodontia). In spite of post-depositional damage to the alveolar bone, it is obvious that roots of the molars have been exposed during life by the alveolar bone recession. Although this recession is usually correlated with periodontal processes, the quality of the alveolar margin in Mečije Rupe specimen (which is thin, knife-edged) rather suggests a compensatory eruption due to attrition (Ogden 2008).



Figure 1. A mandible from Mečije Rupe.

The mandible is thick and strongly built. On the anterior symphyseal region, the distinctive mental trigone is bounded by the mental fossae and by the robust lateral/anterior marginal tubercles – forming a chin. Digastric fossae and the genial tubercles are present. Seen in norma lateralis, mental foramina are positioned below P3 – P4. Although there is damage to both of the anterior ramal borders, it is clear that retromolar space would not have been present if the third molars had erupted. In occlusal view, prominentia lateralis is positioned at M1 – M2 and there is no gutter-like extramolar sulcus. The medial face of the specimen shows a shallow submandibular fossa, an inclined and high (at M3 level) mylohyoid line, no planum alveolare and an inclined mylohyoid groove with no bony bridge. The occlusal surface of the first molar displays a five-cusped pattern, while both second molars display four-cusped patterns.

According to Schwartz and Tattersall (2000) a clearly defined chin, as seen in Mečije Rupe, represents an autapomorphic *H. sapiens* feature. Other morphological characters are also in accordance with modern human anatomy (see Mounier et al. 2009). Moreover, the robust morphology of the mandible and dental attrition suggest a an adult male individual.

- The **Kolubara** specimen consists of a damaged frontal, partial parietals and nearly complete occipital bone (Fig. 2). The fragments are distorted, showing multiple cracks and pits, and erosion, mostly due to taphonomic factors. An unprofessional reconstruction, which involved joining of the parietal fragments and occipital bone to the right parietal (today detached), also contributed to specimen's poor state of preservation. On the frontal bone, the supraorbital region is almost complete; however, there is damage to the inferior parts of the zygomatic processes

and to the medial part of the left orbital margin. There is a lot of erosion to the outer table of the frontal squama, with wide areas of its original surface missing. The medial portions of the orbital plates are also missing, due to damage to the interior aspect of the bone, revealing spacious and fan-shaped (according to Szilvassy 1986) frontal sinuses, which extend laterally into the orbital roof and up into the squama. The superior parts of the nasals and a small fragment of the left frontal process of the maxilla are preserved. The right parietal is very fragmentary, consisting of the smaller supero-anterior portion still attached to the adjacent bones and the bigger posterior fragment along the sagittal and lambdoid sutures. The left parietal bone is better preserved, but it lacks the most of its inferior portion. The occipital shows a distorted squama, with cracks and the damage to the superior angle; the basilar portion of the bone was not preserved. While the outer table of the occiput is mostly intact, there is considerable erosion to the inner table; this is exactly the opposite of what we observed in the frontals and parietals, where the cerebral surface is less eroded compared to the outer table.

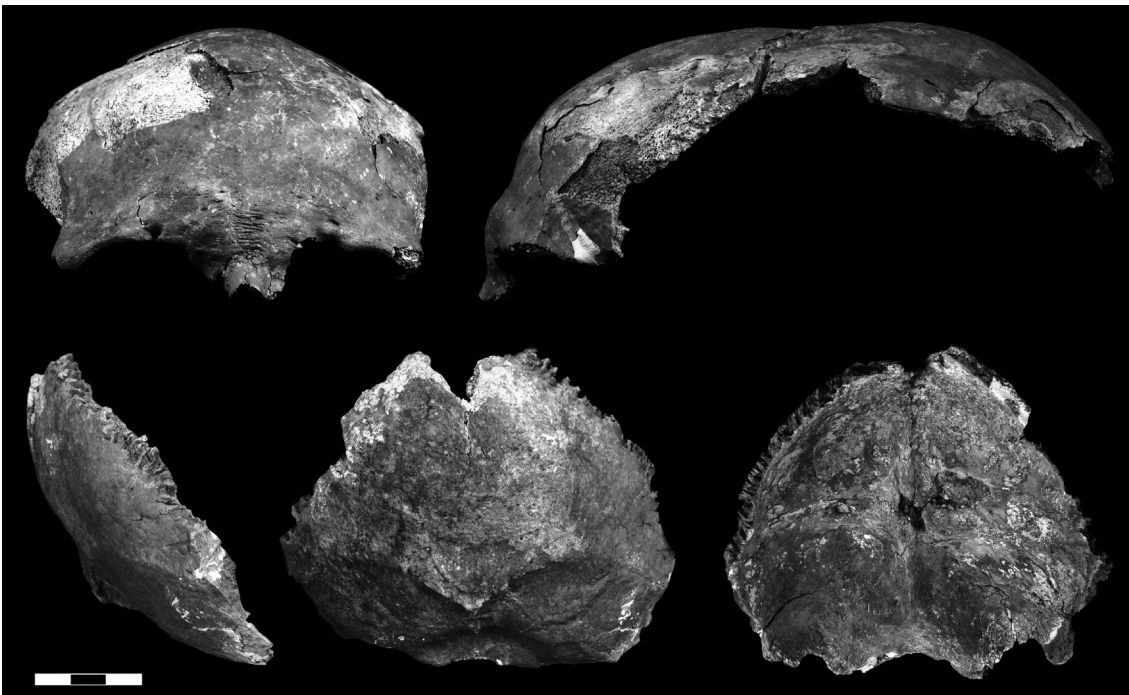


Figure 2. Kolubara specimen.

The Kolubara frontal shows a prominent, bulging squama with frontal eminences. The specimen shows no supraorbital torus; moderately developed superciliary arches are followed laterally by thin supraorbital trigones and there is no supratoral sulcus. Viewed in lateral projection, there is only a slight gabbellar projection relative to the nasion. A medial supraorbital foramen (damaged) and a supratrochlear notch are present on the right, and a large, blurred medial supraorbital notch is present on the left; numerous nutrient foramina were detected in the supraorbital region. Orbital plates show small vascular impressions, but there is no *cribra orbitalia*. The supranasal region shows a complex zigzag shaped suture. Although we could not calculate the length-breadth index, preserved fragments indicate a dolichocephalic cranium. The posterior part of the frontal squama and parietals show some slight keeling, but this could be exaggerated by postdepositional erosion and distortion. Both frontal and parietal endocranial surfaces show a normal modern pattern of vascular grooves and arachnoid pits. In spite of the distortion, the occipital squama is evidently curved in lateral view. The nuchal region is robust, showing distinct superior nuchal lines, forming a strong external occipital protuberance at their meeting point. Inferior nuchal lines are also present. Just above the inion, there is a conspicuous triangular depression.

This structure is seen in many modern human specimens and it is quite different from transversely oval suprainiac fossa seen in Neanderthals (Balzeau and Rougier 2010). The appropriate term for the structure is “supranuchal fossa” (Sládek 2000). Despite the damage, the endocranial surface of the occipital shows a specific dural sinus drainage pattern: left dominant asymmetric type 3, according to the classification system of Delmas and Chifflet (1950) – the superior sagittal sinus continues as the left transversal sinus, with right transversal sinus also present but with no appreciable connection with the sagittal sinus.

The Kolubara specimen exhibits a typical modern *H. sapiens* anatomy. Based on the robust occipital region, and the supraorbital morphology, the skull probably belonged to a male individual. While the preserved portion of the coronal suture is mostly opened, the level of sagittal suture closure suggests an adult. However, a more precise age of the individual is difficult to determine based on the available fragments; as Hershkovitz et al. (1997) have shown, sagittal suture ossification does not represent a particularly reliable aging method, as it was found to be age-independent.

- The specimen from an unknown locality (designated only as 807, Fig. 3) represents a posterior portion of a human neurocranium, which consists of a moderately thick, fragmented occipital and parietal bones. The bone is generally in good condition with the endocranial surface particularly well preserved. There is only slight post-depositional erosion on the ectocranial surface. The occipital bone preserves mainly the right part of the occipital planum and a small portion of the right nuchal region. On the endocranial aspect, part of the cruciform eminence is

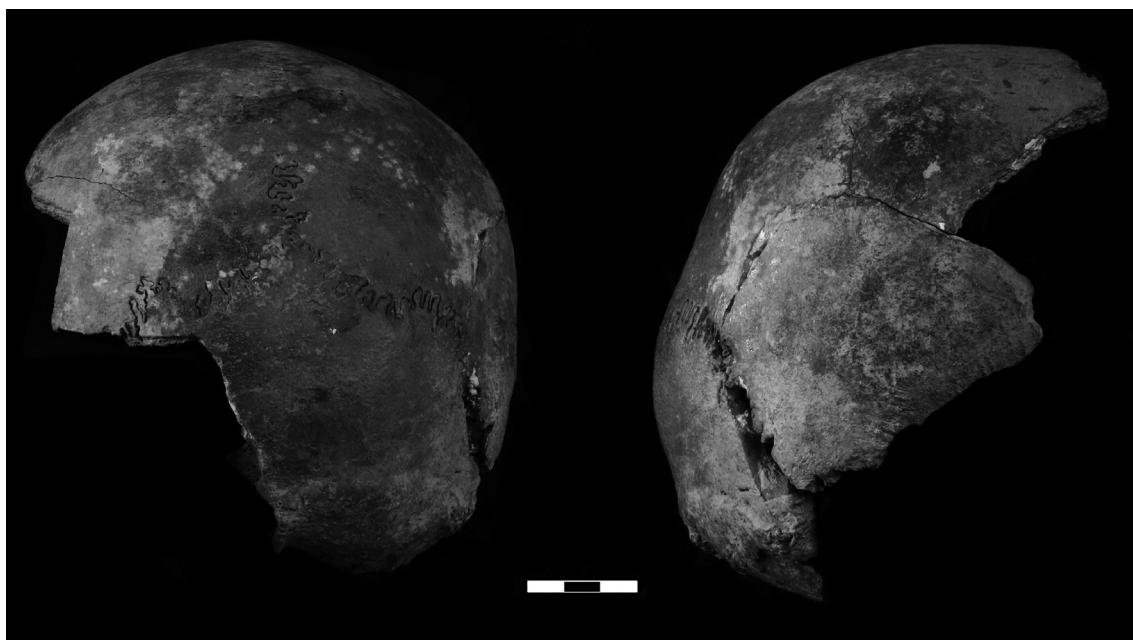


Figure 3. Specimen from an unknown locality (807).

preserved; parts of the cerebral fossae (with the exception of the lower left) and the occipital and parts of the transversal sulci are also preserved. The right parietal bone is more complete, consisting of a large posterior fragment, with both posterior angles preserved. On the lower end, the parietal striae are discernable. The left parietal is less complete, lacking the lateral portion. Parietal endocranial surfaces show a normal pattern of the vascular grooves, sagittal sulcus and arachnoid pits. The medial parts of the lambdoid suture on both sides and a large part of the sagittal suture are preserved. The sutures are deeply denticulated and they show minimal to significant closure.

Viewed in the lateral projection, it is evident that the specimen represents a part of a short, high skull. The occipital displays a modern pattern of the curvature of the squama. Although the exact position of the opisthocranium could not be determined due to the fragmented nature of the

specimen, it is obvious that it must have been located high on the squama. The nuchal region is robust, with an external occipital protuberance and conspicuous nuchal lines which outline a torus-like structure for the entire breadth of the bone. There is a shallow triangular depression above the inion, clearly distinct from the condition seen in Neanderthals (Balzeau and Rougier 2010). The endocranial portion of the occipital shows a right dominant asymmetric type 3 dura mater sinus drainage pattern (according to the classification system of Delmas and Chifflet 1950) – both transverse sinuses are present, but only the right one is in continuation with the superior sagittal sinus. Although the absence of the temporal bones and large portions of parietals makes it difficult to visualize the shape of the vault from the rear, the contour is apparently like that of a modern human – somewhat smoothed “*en maison*” shape. There is a well-defined eminence on the right parietal bone.

The morphology of the specimen clearly indicates a modern *H. sapiens*. Moreover, the thick vault bones, along with the robust nuchal region and partial suture closure, suggest a an adult male individual.

- A fragmented human skull from **Iline Vode** exhibits of a number of neurocranial elements (Fig. 4). These include: a partial frontal bone; the right posterior fragment of the braincase; and two smaller parietal fragments. The frontal preserves the mid-squamosal region, including the left glabellar region with sinus exposed, and a section of the right half of coronal suture, connected to a narrow band of parietal. The posterior braincase fragment consists of the right half of the occipital squama, the posterior half of the right parietal and a small fragment of the temporal along the parietomastoid suture. The smaller (left?) parietal fragment shows no sutures preserved, while the larger one preserves a part of the lambdoid suture. The middle meningeal grooves are thin and display a modern pattern of ramification. The cranial sutures display deep denticulation and significant closure; there are many small ossicles in the lambdoid suture. All fragments show heavy taphonomic erosion of both tables, with observable (but also eroded) plant root markings. These are not to be confused with traces of small capillary impressions, which are frequent on the

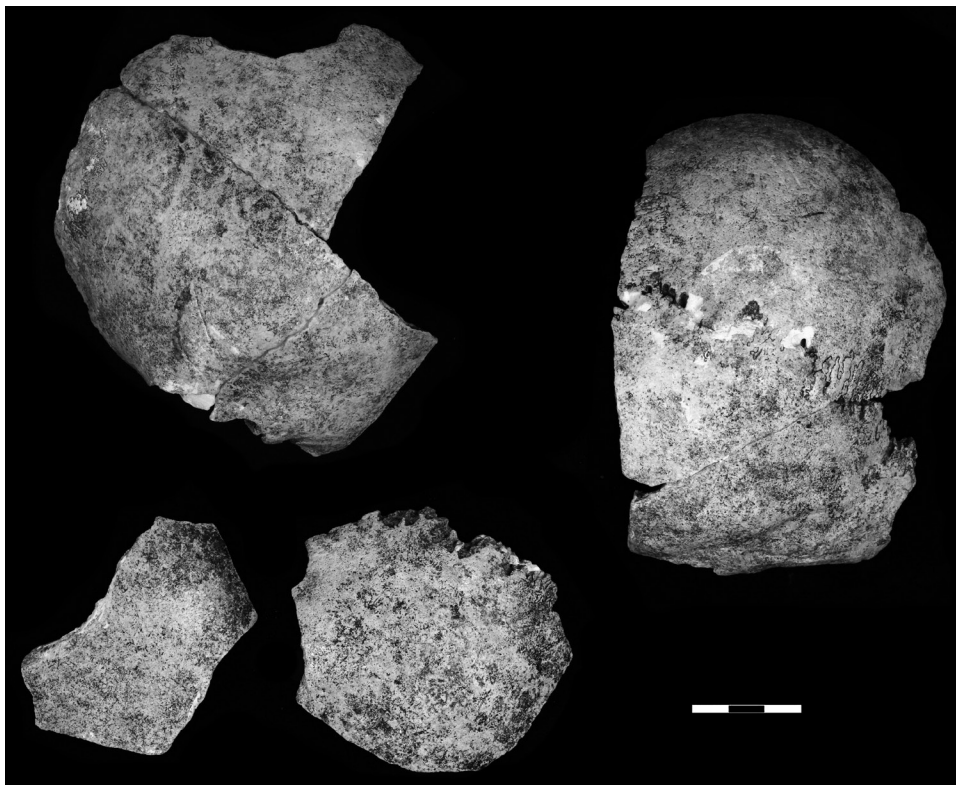


Figure 4. A fragmented skull from Iline Vode.

inner table of the skull; there are studies which suggest that these vascular impressions in older individuals represent healed lesions with different aetiologies (Lewis 2004).

Iline Vode shows no deviations from modern human anatomy. The skull was short and globular, with pronounced parietal and frontal eminences. The glabellar region is smooth and shows only a minimal prominence. The outer surface of the occipital bone is also smooth, with no projecting nuchal crest viewed in lateral profile and with only slight expressions of nuchal lines. On the inner surface of the occipital there is a right dominant asymmetric type 3 sinus drainage pattern (following the classification system of Delmas and Chifflet 1950). Based on the gracile morphology, bone thickness, and suture closure, the specimen most likely was an adult female.

- The **Ostružnica** specimen is represented by the superior half of the left parietal bone, which preserves the occipital angle and significant portions of the lambdoidal and sagittal sutures (Fig. 5). The fragment shows significant post-mortem erosion, especially on the external table of the bone. The bone is not especially thick. Sutures show moderate denticulation and there is no evidence of closure. The curvature of the bone is pronounced, suggesting a large, rounded parietal eminence. The middle meningeal grooves display a complex pattern of ramifications. On the superior inner border, superior sagittal sinus is well defined.

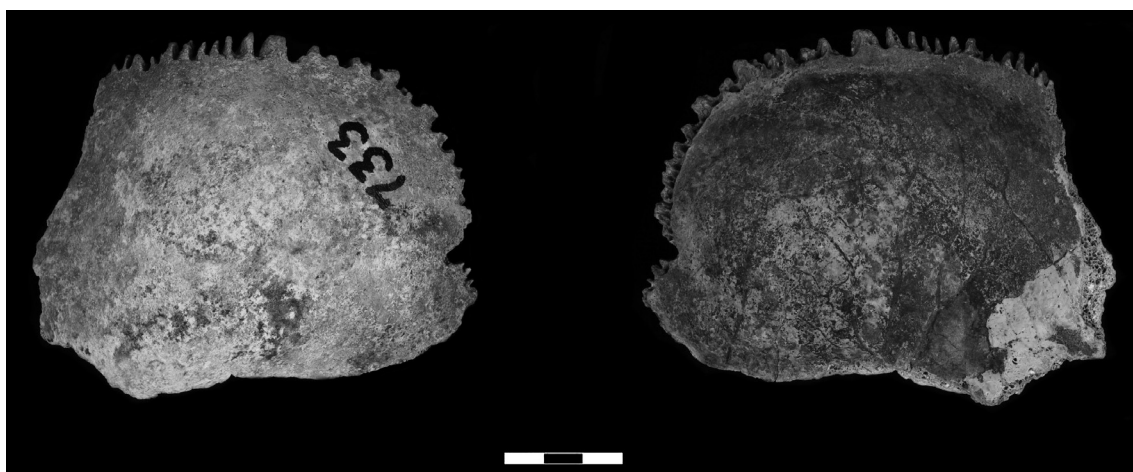


Figure 5. Ostružnica parietal.

Parietal bones of modern humans generally show a high degree of curvature, related to the increase of neurocranial globularity and brain size (Lieberman et al. 2002). Although we could not quantify parietal curvature using the linear diagnostic metric, there is no doubt that Ostružnica fits with modern *H. sapiens* in this regard. Also, the complexity of the middle meningeal arterial network seen in the specimen is very modern, clearly different from the low level of meningeal traces seen in non-modern humans (Bruner et al. 2005). These traits manifestly point to a modern *H. sapiens* designation for Ostružnica specimen. Although there is no suture closure, the thickness of the bone suggests an adult individual.

- The **Kotež** calvaria consists of an almost complete frontal bone joined to small fragments of the parietal bones (Fig. 6). While otherwise very smooth and glassy, the external surface shows weathering damage, mostly on the left portion of the specimen. The internal surface remains without erosion. The color of the specimen is distinctly dark brown. On the frontal, posteromedial portions of the orbital plates are missing, and parts of the sinuses are exposed. A thin crack (about 1mm at its widest) extends from the posterior part of the fragment to the region of the frontal eminences, about 1 cm from the midline. The right parietal fragment is better-preserved showing the complete sphenoidal angle and sections of the temporal lines, while the left fragment only follows the coronal suture as a narrow band of bone extending only medially.

The Kotež specimen is characterized by small size and very modern and gracile morphology. The frontal bone shows a very high and rounded frontal squama with pronounced frontal em-

inences. Thin superciliary arches are well separated from thin and flat supraorbital trigones, and there is only a slight projection of the glabella in lateral view. The coronal profile of the specimen indicates a broad and smoothly curved top of the skull, with no sagittal keeling. Sinuses do not seem too capacious. The supraorbital margins are very sharp and there are supratrochlear notches on the both sides. The coronal suture is weakly denticulated (running almost without any denticulations on the left medial half), and there is only minimal suture closure. Both temporal lines and parietal striae are clearly observable on the right parietal fragment. On the internal surface of the specimen, there are deep grooves of the anterior branch of the middle meningeal arteries, which are preserved to a greater extent on the right parietal. A few smaller arachnoid pits (less than 0.5 cm wide) are observable both on the frontal and parietals, but there is also one larger pit (1.3 cm wide) connected to the meningeal groove on the left parietal fragment. Small capillary impressions are quite frequent on the inner surface of the calvaria. On the basis of morphology, there is no doubt that the Kotež specimen represents the remains of an adult anatomically modern *Homo sapiens* female. No primitive traits were observed.

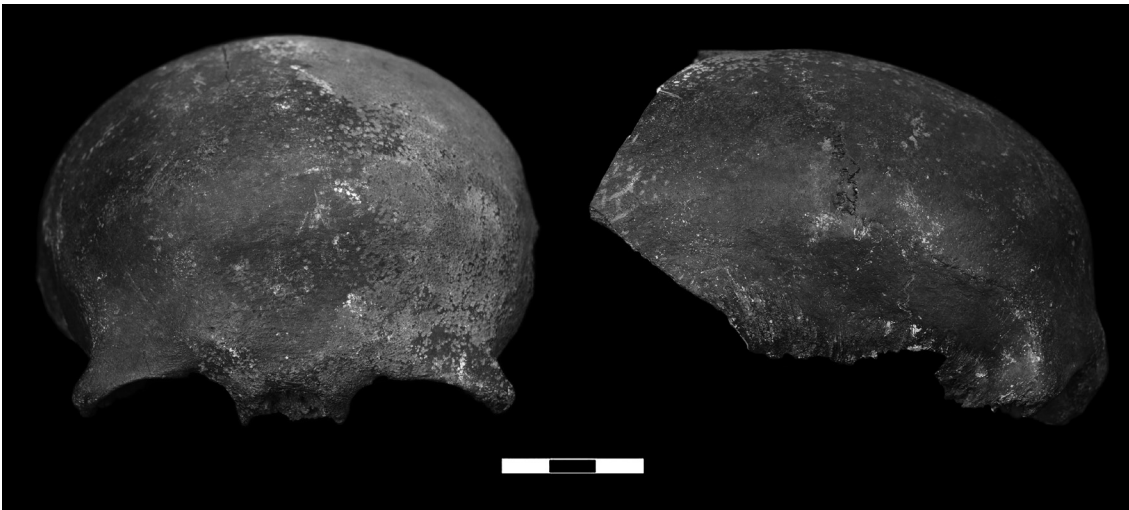


Figure 6. Kotež specimen.

Prescreening results

The percent insoluble fractions of the bones were surprisingly high, more similar to average values from modern bones than those from Pleistocene-age bones (Tab. 1). FTIR spectrometry of the insoluble fractions showed peaks representative of collagen. Some spectra also showed clay peaks, but no evidence of organic contaminants was observed (Fig. 7).

However, glue derived from non-human animal collagen cannot be distinguished from human collagen by FTIR spectrometry of insoluble fractions. Therefore we used Zooarchaeology by Mass Spectrometry (ZooMS) to test for the presence of non-human animal collagen. ZooMS is a method of zooarchaeological identification based on species-specific peptide sequences in bone collagen (Buckley et al. 2008). Bone powder from the surface and interior of all specimens was sent to the BioArCh laboratory at the University of York for ZooMS analysis. The measured peptide markers are consistent with those expected from hominins, and not other mammals used for collagen-based glues (Welker, pers. comm.).

Six specimens have undergone radiocarbon pretreatment procedures for bone collagen. The procedure consisted of acid-base-acid (ABA) treatment, gelatinization, filtration through Ezee-filters and ultrafilters (Vivaspin™ 15-30 kD MWCO) and lyophilization as described by Brock et al. (2010) and Yizhaq et al. (2005). The percent efficiency (Tab. 1) represents the percent by weight of sample that survives pretreatment through lyophilization. It is noteworthy that the samples' percent efficiencies were much lower than their respective %IF, which reflects the

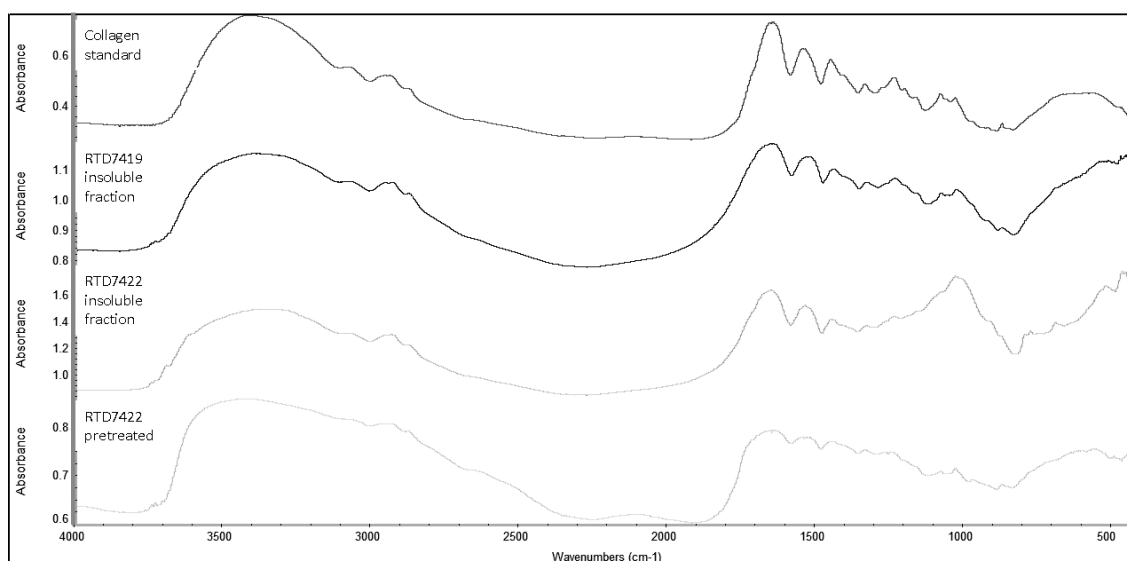


Figure 7: Fourier transform infrared (FTIR) spectra of samples during prescreening and pretreatment. From top: Collagen standard showing diagnostic peaks; insoluble fraction of RTD7419 appears to be pure collagen; insoluble fraction of RTD7422 contains collagen as well as clay peak at 1033cm⁻¹; RTD7422 after full radiocarbon pretreatment shows clay eliminated.

percent by weight that survives acid dissolution in 1 N HCl. The high %IF and lower percent efficiencies suggests that some non-collagenous material or degraded collagen was effectively removed during pretreatment. This pattern increases our confidence that potential contaminants have been removed and the measured radiocarbon dates will reflect the age of the bones.

Radiocarbon dating results

The final dating results, both calibrated and non-calibrated, are shown in Table 1. All of the samples were Holocene aged, ranging from modern to 5450 calBP (95% highest probability density).

Lab ID	Collection	Collection number	Locality	SF	% IF	% eff	%C	14C BP	calBP (95%)
RTD7422	NHMBEO	?	MečijeRupe	3.4	16.4	0.84	42	975 ± 36	950- 800
RTD7389	NHMBEO	204	Kolubara	3	20	0.94	34.4	1003 ± 39	980- 800
RTD7419	NHMBEO	807	?	3	6.7	0.64	42.4	1296 ± 48	1300- 1090
RTD7418	NHMBEO	199	IlineVode	3.1	12	0.26	20.4	4094 ± 97	4850- 4300
RTD7483	NHMBEO	202	Ostružnica	3.1	14.2	0.58	41.2	220 ± 46	<430
RTD7390	NMKV	-	Kotež	2.7	20.1	0.8	41.1	4559 ± 54	5450- 5040

Table 1. Prescreening and AMS radiocarbon dating results for five specimens housed at the Natural History Museum Belgrade (NHMBEO) and one from the National Museum Kraljevo (NMKV).

Discussion and conclusion

All of the specimens presented here show clear modern human morphologies. There are no indications of primitive (non-modern) traits in any of the specimens. The robust nuchal structure seen in the specimen an unknown locality (807) is apparently similar to “nuchal tori” of

many males in the early Central European Upper Paleolithic (Mladeč, Pavlov etc.) (Frayner et al. 2006).¹ However, this structure should not be overemphasised as the ¹⁴C date for the specimen is recent, which shows that the morphology of the nuchal region is simply a reflection of a strong neck musculature.

This modern morphology of the specimens is in accordance with their ¹⁴C ages. Although it is disappointing that the measured age of the specimens did not correspond to our expectations based on contextual information, the study was successful in multiple regards. First, the measured radiocarbon ages likely reflect the date of the humans' deaths, rather than artificially younger ages due to modern carbon contamination. By thorough prescreening and chemical characterization we are confident that Pleistocene specimens are not being overlooked due to inaccurate dating. Secondly, the study demonstrates the need for reliable absolute dating to validate age-claims based on documentation and morphological/taphonomic features. Taphonomic characteristic and tenuous recorded association of these specimens with Pleistocene-aged strata and material can not be used as reliable indicators of their true age.

Considering the importance of the Central Balkan Pleistocene human fossil record, our search for undescribed specimens from old museum collections will certainly be continued. However, if indeed we want to understand the early presence of modern humans in the Central Balkans, emphasis will need to be placed on excavations of known and recently discovered Pleistocene sites

Acknowledgments

Radiocarbon dating and prescreening was supported by National Science Foundation (NSF) Doctoral Dissertation Improvement Grant #1334615, Fulbright Student Scholarship from the US-Israel Educational Foundation, and NSF Graduate Research Fellowship Program Award DGE-1144152. Funding for Mirjana Roksandić was provided by NSERC Discovery Grant no (371077-2010).

¹ While Frayer et al. (2006) use the term “nuchal torus” in their descriptions of the Mladeč AMHs, most authors reserve the term only for a specific projecting transverse bar of bone on sharp-angled occipitals of *H. erectus* and other archaics (Mai et al. 2004: 369). This structure is more robust and differently built in *H. erectus* than corresponding structures in UP humans, so there is the question of whether or not the robust nuchal structures in UP skulls even qualify as a true nuchal tori.

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