
Life and Death at the Peștera cu Oase

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*A Setting for Modern Human Emergence
in Europe*

Edited by Erik Trinkaus, Silviu Constantin, João Zilhão

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Contents

Contributors xi

I. INTRODUCTION AND BACKGROUND 1

1. Introduction (Erik Trinkaus, Silviu Constantin, João Zilhão) 3
2. Exploration and Documentation of the Peștera cu Oase (Ștefan Milota, Mircea Gherase, Laurențiu Sarcină, Ricardo Rodrigo, Oana Moldovan, Erik Trinkaus, Silviu Constantin, João Zilhão) 5
3. Problems, Approaches and Fieldwork: 2004–2005 (João Zilhão, Ștefan Milota, Ricardo Rodrigo, Silviu Constantin, Erik Trinkaus) 16

II. THE CAVE AND ITS CONTENTS 31

4. The Karst Geology of the Ponor-Plopa System in Its Regional Context (Silviu Constantin) 33
5. The Ponor-Plopa Cave System: Description, Sediments, and Genesis (Silviu Constantin, Cristian-Mihai Munteanu, Ștefan Milota, Laurențiu Sarcina, Mircea Gherase, Ricardo Rodrigo, João Zilhão) 41
6. Uranium-Series Dating on Speleothems from the Ponor-Plopa Cave System (Silviu Constantin, Stein-Erik Lauritzen) 56
7. Electron Spin Resonance Dating of Vertebrate Remains from the Peștera cu Oase (Rainer Grün, Tegan Kelly, Maxime Aubert) 73
8. Radiocarbon Dating of the Peștera cu Oase Faunal Remains (Thomas Higham, Eva Maria Wild) 77
9. Rock Magnetic Data of Late Pleistocene Sediments from the Peștera cu Oase and Their Paleoclimatic Significance (Cristian Panaiotu, Silviu Constantin, Cătălin Petrea, Viorel Horoi, Cristina-Emilia Panaiotu) 86
10. The Distributions of Finds and Features (João Zilhão, Ricardo Rodrigo, H  l  ne Rougier, Ștefan Milota) 100

CONTENTS

III. THE CAVE BEARS	125
11. Cave Bear Paleontology and Paleobiology at the Peștera cu Oase: Fossil Population Structure and Size Variability (Martina Pacher, Jérôme Quilès)	127
12. Taphonomic Analysis of the Cave Bear Remains from the Peștera cu Oase (Martina Pacher, Jérôme Quilès)	147
13. An Ancient DNA Perspective on the Cave Bears from the Peștera cu Oase (Mathias Stiller, Michael Hofreiter)	159
IV. THE OTHER VERTEBRATES	165
14. Hyena, Wolves, and Foxes from the Peștera cu Oase (Emil Știucă, Alexandru Petculescu)	167
15. Small Mammal Remains from the Peștera cu Oase (Alexandru Petculescu)	185
16. The Ungulates from the Peștera cu Oase (Simon A. Parfitt, Adrian M. Lister)	189
17. Taphonomic Considerations of the Non-Ursid Vertebrate Remains (Erik Trinkaus, Martina Pacher)	204
18. Stable Isotopes and Dietary Patterns of the Faunal Species from the Peștera cu Oase (Erik Trinkaus, Michael P. Richards)	211
V. THE HUMAN REMAINS	227
19. Radiocarbon Dating of the Peștera cu Oase Human Remains (Erik Trinkaus)	229
20. The Human Mandible from the Peștera cu Oase, Oase 1 (Erik Trinkaus, H��l��ne Rougier)	234
21. The Human Cranium from the Peștera cu Oase, Oase 2 (H��l��ne Rougier, Erik Trinkaus)	257
22. Frontal Bone Contours of the Oase 2 Cranium (Sheela Athreya, H��l��ne Rougier)	321
23. The Internal Cranial Morphology of Oase 2 (Marcia Ponce de Le��n, Christoph P. E. Zollikofer)	332
24. The Dental and Alveolar Remains of Oase 1 and 2 (Erik Trinkaus, Shara E. Bailey, H��l��ne Rougier)	348
25. The Oase 1 Human Stable Isotopes (Michael P. Richards, Erik Trinkaus)	375
VI. DISCUSSION	383
26. The Paleoenvironmental Context of the Peștera cu Oase (Silviu Constantin, Jo��o Zilh��o, Erik Trinkaus)	385
27. Paleoanthropological Implications of the Peștera cu Oase and Its Contents (Erik Trinkaus, Jo��o Zilh��o)	389
VII. REFERENCES	401
28. References	403

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Life and Death at the Peștera cu Oase



Part One

Introduction and Background



2

Exploration and Documentation of the Peștera cu Oase

Ștefan Milota, Mircea Gherase, Laurențiu Sarcină, Ricardo Rodrigo, Oana Moldovan, Erik Trinkaus, Silviu Constantin, and João Zilhão

Introduction

Romania is a country dominated by one of the more important mountain chains in Europe, the Carpathian Mountains. They begin in the northwest, in southern Poland, Slovakia, northern Hungary, and southwestern Ukraine, continue southeastward toward the delta of the Danube, then arc strongly around Brașov and extend westward parallel to the Danube, fading out north of the Iron Gates and on to the plains of Banat. The southern portion is sometimes referred to as the Transylvanian Alps, because it helps to enclose Transylvania within the arc of the Carpathians and separate it from the Danube river valley. These mountains form a continuous and important topographic feature of southeastern Europe, and in fact of Europe as a whole.

Although geologically complex, the Carpathians contain extensive limestone deposits and, consequently, an abundance of karst systems. These caves and cave systems have promoted the formation of one of the longest speleological traditions in Europe and the oldest institute in the world dedicated to caves and their contents (the Institutul de Speologie "Emil Racoviță," first established in Cluj, 1920) (Racovitza, 1926). Following the institute's reorganization in the 1950s, with its headquarters in Bucharest and a branch in Cluj, the search, discovery, and exploration of new caves increased; soon it became apparent that institute professionals alone could not ensure all tasks related to such a volume of speleological discoveries. Beginning with the 1970s a national network of speleological clubs developed, and they largely took on the responsibility of exploring, documenting and protecting karst systems. It is in this tradition that a group of cavers from southwestern

Romania began in 2001 the exploration and documentation of the karst system known as the Peștera Ponor-Plopa, near Anina in Caraș-Severin (Figure 2.1).

Documentation and Discovery

The Peștera Ponor-Plopa karstic system has long been known, appearing on national maps listing caves among other regional landmarks, visited by tourists locally, and variably explored by amateur cavers through its numerous openings on the karst plateau. Most of those surface openings provide only limited access to small portions of the cave system, primarily to preserved sections of the original gallery system that ran immediately below the plateau but are restricted in length by collapses and infillings. However, it has long been apparent that the modern stream, which enters the rock at the ponor on the northwestern side of the hill and empties into the Miniș River just outside of the southeastern opening, might provide access to the various galleries within the cave system (Figure 2.2).

With this in mind, the group, which became known formally as the Pro Acva Grup of Timișoara, began in 2001 the slow process of exploring and mapping the various cavities, galleries, dolines (sinkholes), and cave openings that make up the karst system (Bîlgăr, 2004). The Pro Acva Grup originally consisted of Ștefan Milota and Laurențiu Sarcină of Timișoara and Adrian Bîlgăr of Drobeta-Turnu Severin. In 2003 the group was joined by Mircea Gherase of Timișoara and Adrian Danciu of Timișoara and Minneapolis, but later that year Adrian Bîlgăr decided to leave the group for personal reasons. The exploration and mapping process continued slowly, given the difficulties of access to the

LIFE AND DEATH AT THE PEȘTERA CU OASE

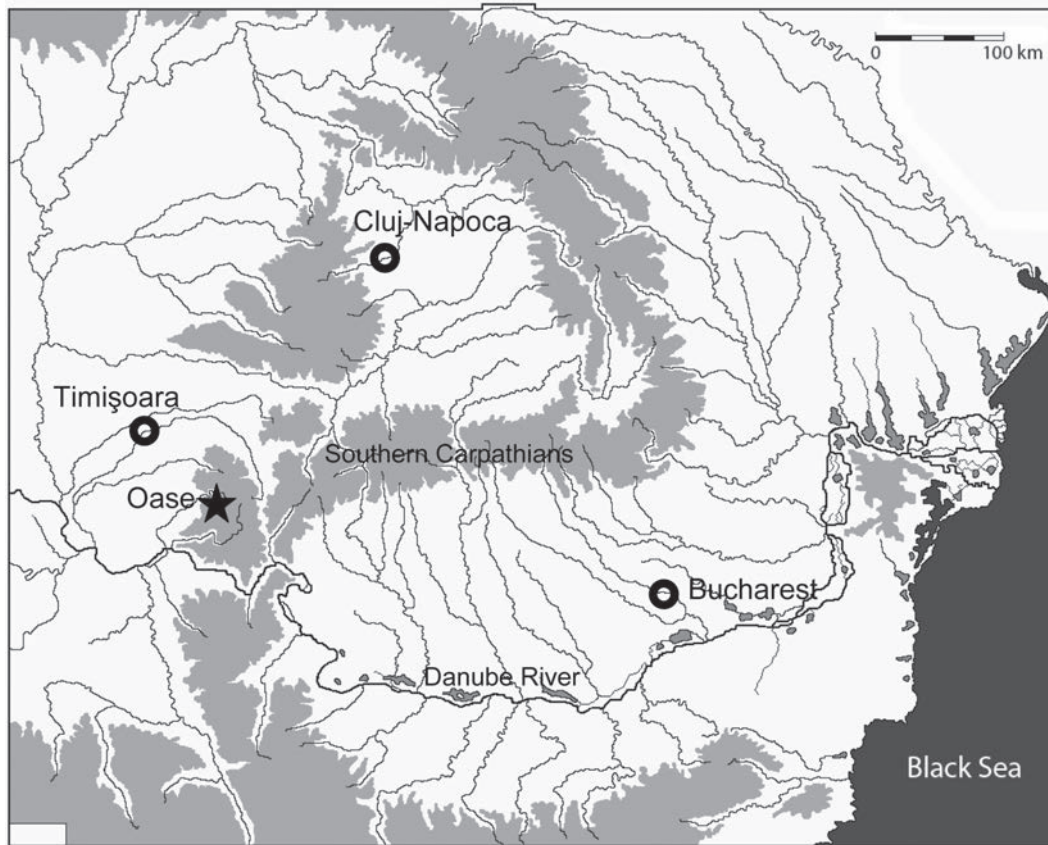


Figure 2.1 Map of the Carpathians and adjacent portions of southeastern Europe, with the location of the Peștera cu Oase (Oase).



Figure 2.2 The entrance into the Peștera Plopa-Ponor from the Miniș River, seen from the outside (left) and the inside (right).

interior of the cave system (involving rock climbing and subaquatic skills); by 2002 a reasonably complete scale map of the system was available, including both the horizontal plans of the various active and fossil galleries and the vertical relationships of those cavities.

It was in the context of this that, in February 2002, Milota, Bilgär and Sarcină entered the system through the southern river, wading ~200 m and then scuba diving ~30 m through a siphon, to arrive above water in the cave interior. They then climbed through what became known as *Puțul* (the Shaft) to a series of horizontal passages above it. Milota noticed that there was fresh air coming through a small fissure; removing the clay and the cave bear bones that had cluttered it, he opened a narrow passageway (later named *Poarta*, or the Gate) onto a set of galleries that had remained closed, protected, and pristine since the end of the Pleistocene (Figure 2.3).

Moving through the new passages, what became the *Galeria Culcușurilor* (Gallery of the Nests) and the *Panta Strămoșilor* (Slope of the Ancestors), and avoiding to the extent possible walking on the ubiquitous skeletal remains of large Pleistocene cave bear (*Ursus spelaeus*), they entered a chamber formed at the confluence with the large original gallery system just below the plateau. In this chamber (subsequently the *Sala Mandibulei*, or the Chamber of the Mandible), lying in the middle of a pristine surface of calcite, they found a largely complete human mandible (Figure 2.4). Although none of them had training in paleontology or comparative skeletal anatomy, they immediately recognized it as human and as potentially of paleontological importance. Leaving the mandible undisturbed, they explored further, into the upper galleries, the *Galeria Lungă* (Long Gallery) to the north and the *Galeria celor Trei Cranii* (Gallery of the Three Skulls) to the south and then exited.

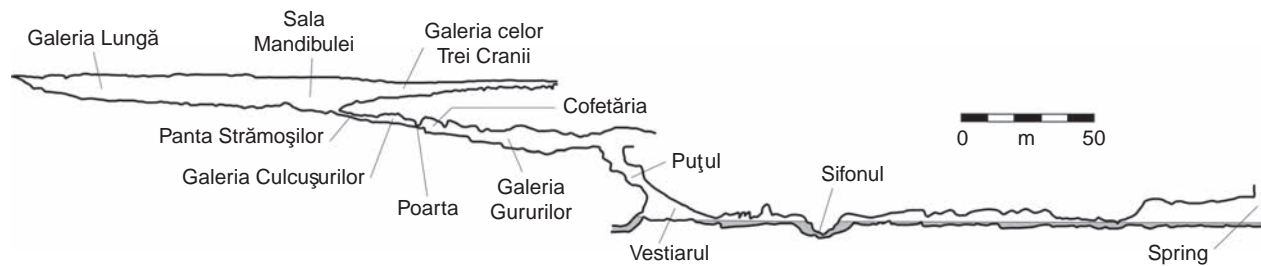


Figure 2.3 Schematic overall plan of the Peștera cu Oase cave system with names of the different areas.

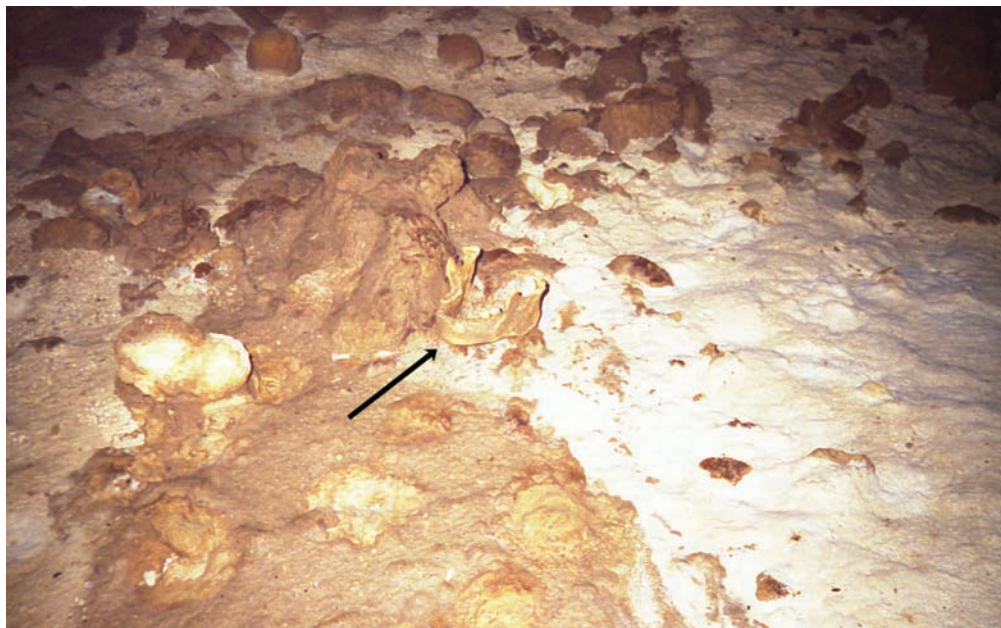


Figure 2.4 The Oase 1 mandible on the calcite surface of the Panta Strămoșilor, as found in 2002.

After their discovery, they contacted the Institutul de Speologie “Emil Racoviță” through the diver Gèza Rajka, who in turn talked with Oana Moldovan, at that time the head of the Cluj-Napoca Branch, requesting advice and collaboration on what they recognized as an important site. Being a cave biologist and not a paleontologist or anthropologist, Moldovan searched for specialists who might be able to provide advice and found, among others, the name of Erik Trinkaus. On March 25, 2002, she sent an introductory e-mail to some of the specialists, stating: “Can you please help me with some advice. I know that we should not touch or move the objects, but probably we can do some preliminary measurements and more photos.” She had not yet been in the cave at that point.

The other people contacted either did not reply or suggested that the cave and the human mandible were of little interest. Trinkaus, always interested in new finds despite knowing little of Romania at the time and being familiar only generally with the Romanian human fossils from Peștera Bordul Mare (Ohaba-Ponor) and Peștera Cioclovina Uscată, replied that they should simply document it as much as possible and, as they already knew, disturb the context as little as possible. A few days later the cavers and Moldovan reentered the cave, further documented the remains photographically, and removed the mandible to Cluj-Napoca. The photograph of the mandible *in situ* (Figure 2.4) was sent to Trinkaus, who principally noted the wide ramus and an apparent similarity to the Middle Pleistocene Arago 2 and Mauer mandibles; the chin was not readily evident in the photograph.

In the meantime, Trinkaus and Moldovan corresponded, and they agreed to meet in Budapest in May 2002, where Trinkaus had already made plans to visit the Natural History Museum. Moldovan took the overnight bus from Cluj and presented the mandible to Trinkaus in the presence of two skeletal biologists, Ildiko Pap of Budapest and Maria Teschler-Nicola of Vienna. The mandible clearly was that of a modern human, given its chin and modest overall robustness, but all agreed that in size, proportions, and details of shape it did not resemble Holocene human mandibles from central and eastern Europe. It warranted further consideration. Given that it was, at that point, little more than an undated modern human mandible from the surface of a cave, of which there are hundreds from caves in Romania, Trinkaus took the mandible with the intention of getting a direct radiocarbon date on it.

After returning home, Trinkaus removed a corner of the basal margin, adjacent to the break on the right ramus, and sent the sample to the Oxford Radiocarbon Accelerator Unit (ORAU) for AMS dating. Having noted some details that resembled Gravettian mandibles and the limestone feel of the bone when sawed for sampling, he expected

perhaps a date between 20,000 and 25,000 before present (BP). On October 14, 2002, he received the result from Tom Higham at ORAU: $> 35,200$ ^{14}C BP. It was immediately evident that this made the Oase 1 mandible the oldest directly dated modern human in Europe. At that time, in 2003, there were suggestions that the Mladeč remains from Moravia might be as old, but these were unconfirmed; the Mladeč remains were later (Wild et al., 2005) shown to be $\sim 31,000$ ^{14}C BP. The purportedly similarly old modern human specimens from Velika Pećina in Croatia and Hahnöfersand in Germany had been shown in 1999 and 2001 to be Holocene in age (Smith et al., 1999; Terberger et al., 2001).

The initial radiocarbon dating of the Oase 1 mandible also produced C and N stable isotope values, including a high $\delta^{15}\text{N}$ of 13.3‰. As noted at the time by Higham, it “is indicative of quite a high level of meat protein sourced by this individual.”

The following spring Trinkaus presented the mandible at the PaleoAnthropology Society annual meetings, emphasizing its mosaic of modern human features (chin, gracile corpus), archaic aspects (wide ramus and large molars), and possible Neandertal aspect (mandibular foramen bridging) (Trinkaus et al., 2003a). Yet at that time only the minimum age of $\sim 35,000$ ^{14}C BP was available. It received brief mention in the scientific literature (Gibbons, 2003) but generated little further interest.

Since it was recognized in late 2002 that an infinite date was unsatisfactory, a second sample of the basal mandible was sent to the Centre for Isotope Research at the University of Groningen after consultation between Moldovan and Trinkaus. The result, which did not arrive until June 2003, was a finite age of $\sim 34,300$ ^{14}C BP; when the Groningen raw data were subsequently placed in combination with the Oxford data, they provided a direct date of $\sim 34,950$, $+990$, -890 ^{14}C BP for the Oase 1 mandible (Chapter 19).

In the meantime, it was apparent to all involved in Timișoara, Cluj-Napoca, and St. Louis that the cave, its contents, and the human mandible were very important. As news on this discovery was likely to spread fast, at least in the speleological community, the post-siphon sector of the cave system was given the name of Peștera cu Oase. Literally meaning “the Cave with Bones,” this rather mundane name was specifically chosen to ensure some degree of camouflage within the many other “caves with bones” in Romania. At the same time, total discretion was kept on the whereabouts of the cave. Further on, the issue was how to organize the future scientific work. Appropriate specialists were available, both within Romania and elsewhere, but few had both the paleontological or anthropological skills and the ability to safely enter the cave. The speleological and aquatic access, which had protected the cave for so long, presented serious

logistical problems. For security reasons (illegal international trade in cave bear skulls is rampant in Romania), opening the cave was unthinkable and probably unfeasible from a financial and engineering point of view. It was also impossible to get adequate funding without a team of recognized specialists.

Mapping and the Oase 2 Cranium

Subsequent to the direct date on the Oase 1 mandible, Trinkaus and Moldovan tried to put together an appropriate team and obtain research funding for the further exploration of the cave; they failed. However, in February 2003, Trinkaus was in Lisbon for the publication of the monograph on the early modern human skeleton from the Abrigo do Lagar Velho, coedited with colleague and Paleolithic archeologist, João Zilhão (Zilhão and Trinkaus, 2002a). While there, he gave an informal talk at the Instituto Português de Arqueologia on the Peștera cu Oase and the human mandible. Zilhão, a caver since his adolescence, commented that one “needed to be insane to dive in caves” but suggested that we contact Ricardo

Rodrigo, an underwater archeologist then at the Instituto Português de Arqueologia and experienced caver and speleodiver. Trinkaus and Rodrigo met, discussed the cave and agreed to pursue the project along with Moldovan and the Pro Acva Grup.

The following summer, with modest funding through Washington University, Trinkaus flew to Timișoara, and Rodrigo drove for three days from Lisbon with a carload of diving and caving equipment, including an air compressor for the scuba tanks. They met up with Moldovan, Milota, and Gherase (plus Olena Moldovan, Oana Moldovan’s daughter) in Timișoara and camped out for a week near the Peștera Plopa-Ponor. While Trinkaus and the two Moldovans kept camp and enjoyed the countryside, Milota, Gherase, and Rodrigo produced the first map of the Peștera cu Oase, entering the cave late morning and returning to camp long after sunset.

The last day, as the mapping was being finished in what became the Panta Strămoșilor, Milota placed his hand on a bone while measuring the passageway and lifted up a complete human facial skeleton. After recovering from the shock and photographing each other with the face (Figure 2.5), they mapped in the face, a temporal bone, portions of



Figure 2.5 Ștefan Milota holding the Oase 2 face in the Panta Strămoșilor immediately after it was found during mapping of the cave in 2003.

the parietal bones, and several other pieces that appeared to be human. Finally, they exited the cave.

Meanwhile, back at the camp, Moldovan had grown impatient for the cavers and decided that opening a bottle of wine would bring them—it did. But as they emerged from the valley of the Miniș and approached the camp, Rodrigo in particular looked sad and explained that exiting through the siphon they had soaked the map notes and all was ruined. To prove this, they opened a waterproof container and, there, wrapped in a dirty T-shirt, was the Oase 2 face. Trinkaus was shocked but pleased. The mapping notes were fine. And the next morning, Rodrigo called Zilhão, caught him in Madrid consulting for the Spanish Ministry of Science, and said in Portuguese what translates roughly as, “João, we found a face. You are learning to dive!”

Publishing, Dating, and Issues: 2003 to 2004

After the field season of 2003 and the discovery of the additional human remains, Trinkaus completed the first report on the Oase 1 mandible, published on September 22, 2003, in the *Proceedings of the National Academy of Sciences USA* (Trinkaus et al., 2003b). A brief report on the cranial remains found that summer appeared shortly thereafter in the *Journal of Human Evolution* (Trinkaus et al., 2003c). Together they made international news, with news stories spanning the globe. At the time, it was recognized that the mandible and the face represented different individuals, given particularly the fully mature young adult age of the mandible and the adolescent age of the face based on its unerupted third molars and unfused sphenoccipital synchondrosis. However, Trinkaus was unable to get a good fit between the temporal bone and either the facial skeleton (across the sphenotemporal suture) or the parietal bones (across the parietomastoid suture). It was therefore concluded that three individuals were present; only subsequently was it shown, by H el ene Rougier with the additional pieces found in 2004, that the temporal bone indeed came from the same individual as the facial skeleton and that the lack of a good fit resulted in part from the absence of a sutural bone along the parietomastoid suture.

In early fall 2003, Moldovan contacted Silviu Constantin, a geologist and experienced speleologist working at the “Emil Racovi a” Institute’s headquarters in Bucharest. As the editor of *Theoretical and Applied Karstology*, Constantin asked Moldovan for a rapid communication article on the Oase discoveries; this was soon published (Moldovan et al., 2003). Moldovan also asked Constantin if he would be interested in joining the research team. Constantin already had

extensively worked as a field geologist in the karst areas from southwestern Romania and was specialized in paleoclimatic analysis and the uranium-series (U-series) dating of speleothems. However, except for free-diving several short sumps, he too was not a qualified diver.

Because the Oase 2 face and other bones were yet another surface find in a cave, and despite the good morphological match between the Oase 2 face and dentition and the dimensions of the Oase 1 mandible, it too needed to be directly dated. Consequently, Trinkaus carefully removed a piece of the internal table of the left parietal bone and sent it to Groningen for AMS radiocarbon dating; there was insufficient collagen preserved. After consultation with Moldovan, Trinkaus then sent a couple of loose fragments that would have attached to the posterior parietal bones to Groningen. Given the chalky appearance of the bone, Groningen only mildly pretreated the bone to decontaminate it, using a 2% HCl solution rather than the usual 4% solution, and obtained a result of 28,980 ± 180, –170 ¹⁴C BP (Chapter 19). The date is almost certainly too young, but it was sufficient to establish that the Oase 2 face was indeed early and probably about the same age as Oase 1.

A sample from a bear metapodial associated with the Oase 2 cranium was also sent to Michael Richards (then at the University of Bradford) for exploratory isotopic analysis. When he had the results ($\delta^{13}\text{C}$: –21.3‰ and $\delta^{15}\text{N}$: 8.5‰), he queried whether the bone derived from a brown or a cave bear; the clear omnivore signal of the $\delta^{15}\text{N}$ value contrasted with the then prevailing view that cave bears were strictly vegetarian. This surprising result led to the further sampling and isotopic analysis of the Oase cave bears and to the availability of the bear remains for ancient DNA (aDNA) analysis by Richards’ subsequent colleague at the Max Planck Institute in Leipzig, Mathias Stiller.

At about the same time, the splash made by the publication of the first papers had triggered an unexpected reaction from Romanian archaeologists. First, the side effect of naming the new cave sector as Peștera cu Oase misled some to believe that excavations had been performed illegally in another cave, one already classified as an archeological site. Second, at the time, there was a hope that such a site was likely to include archeological material, and there was a clear irritation from local archeologists who felt left out. As in many other cases in the history of anthropology and paleontology, a war was about to start, with serious accusations including those of illegal excavations and illegal fossil export of the Oase 1 mandible (which by that time was already back in Cluj). The pressure of these accusations was directed at Moldovan as the Romanian

scientist-in-charge; finally, after several embarrassing meetings, the charges were dropped.

Systematic Fieldwork: July 2004

The published dates for Oase 1 and the discovery of Oase 2 were sufficient to initiate a serious scientific endeavor at the Peștera cu Oase. During fall 2003, Moldovan in Cluj-Napoca, Milota in Timișoara, Zilhão and Rodrigo in Lisbon, and Trinkaus in St. Louis organized a team, lined up a variety of specialists (many of whom never intended to be at the cave), wrote grant proposals, and planned a month's fieldwork in July for each of 2004 and 2005. Zilhão and Trinkaus, along with Milota, Gherase and Sarcină, visited Cluj-Napoca in March 2004 to get acquainted, meet the Romanian press (Figure 2.6), visit the site, and further the organization. The project was funded in late spring by the National Science Foundation, the Wenner-Gren Foundation, the Leakey Foundation, the

Instituto Português de Arqueologia, and Washington University. Permission was obtained through the Romanian authorities with the help of the archeologists Gheorghe Lazarovici and Ion Bălțean.

Once the funding was obtained and the fieldwork was planned, Milota, Gherase, and Sarcină purchased a vehicle (a used Mercedes-Benz diesel van—a box on a truck frame that served exceptionally well) and began the serious work of outfitting the cave. A steel door had been fitted to the Poarta by them during fall 2003, but fieldwork required making the access as easy and as safe as possible without opening up the cave to clandestine visitors. This involved putting ladders up through the Puțul and other short vertical rises, rigging all of the slopes and the siphon with traverse lines, and attempting to get electricity and telephone by wire into the cave. The last two elements never worked properly, and during 2004 light inside was principally through headlamps. In 2005, battery-operated fluorescent lamps provided the much needed light for the excavation area, but the other areas



Figure 2.6 The July 24, 2004, front page of the *Sud Vestul*, with the headline that *Homo sapiens* was born in the Banat Mountains, based on two bones discovered in the valley of the Miniș and dated to 35,000 years ago.

were still lit principally by headlamps. The abundant light in photographs was furnished by special photographic speed lights, and it never represented the normal condition in the otherwise totally black cave interior.

During July 2004, the excavations in the cave were directed principally by Zilhão, the archeologist with the most experience in cave excavation, but done in active consultation with Moldovan, Milota and Trinkaus. The excavation crew, in the cave, consisted principally of Zilhão, Milota, Moldovan, Rodrigo, and H  l  ne Rougier, a French human paleontologist with diving and excavation experience from the Universit   Bordeaux 1 but then working at the Institut royal des Sciences naturelles de Belgique in Brussels. Gherase provided assistance and photography. The crew was joined by Adrian Danciu, a professional television cameraman and member of the Pro Acva Grup, who videotaped much of the work inside and outside the cave. Trinkaus, variably joined by individuals not in the cave on a given day, ran the lab at the Hotel Steier, the residence and lab for the expedition in a suburb of Anina, Steierdorf. The crew was joined for part of the time by Vlad Codrea, a mammalian paleontologist from Cluj-Napoca who screened the sediments for teeth and micromammals, and by Sarcin   when he could take time from work to join the fieldwork.

For part of the time, Constantin joined the team, but since he was not a certified diver at that time he was not allowed to dive the siphon. At that point, the Romanian cavers still had in mind the recent troubles and accusations and decided to do everything by the book. To avoid any legal hassle in case of an accident, Constantin would have to get himself at least a scuba-diving license. As a result, in 2004 he carried out a general geological survey of the area, collected speleotherm samples for U-series datings from the lower level of the cave, and instructed Milota on how to collect useful stalagmites from the Oase sector. To further the archeological exploration of the region and to try to locate a site where the Oase humans might have camped, Ion B  ltean of Alba Iulia and Adela Cinc   of Timi  oara, with the help of Sorin Petrescu of Caransebe  , began the test excavation of a small cave entrance at the north end of the limestone massif, Pe  tera La Ho  tu (formerly Pe  tera Ho  tilor, or the Cave of the Thieves), to see whether contemporaneous Upper Paleolithic archeological deposits might be preserved. This crew was joined for periods of time by friends and cavers (see Preface), who camped near the cave opening to watch over the equipment and, for those who caved, help with the work inside.

The 2004 field season faced a series of logistical, paleontological, and geological issues that took most of the season to work out. An air compressor had been purchased and imported from Austria during winter 2004, which made one essential element—adequate filling of

the diving tanks—routine. Updated and completed diving equipment had been acquired from various places, assuring the ability of all entering the cave to do so safely and efficiently. Yet excavating slowly for hours in a cave, with the temperature $\sim 10^{\circ}\text{--}12^{\circ}\text{C}$ and the relative humidity approaching 100%, required adjustments of clothing and additional purchases as the fieldwork progressed. The electrical wire into the cave turned out to be simply too long, with too much accumulated electrical resistance, to provide adequate power from the generator outside; this meant adjusting caving lights to permit work within the galleries.

And there are always little things that are unanticipated. How does one get large bear bones and very fragile bear skulls out of the cave, through narrows, shafts, and siphons, without damage (put a plastic clothes hamper in a backpack)? How does one keep the constant dripping from the cave ceiling from soaking one's clothing (tie plastic bags to the ends of stalactites and wear a trash bag on one's back)? How does one keep people from inadvertently walking on the bears' nests (run construction barrier tape along the designated paths)? How does one remove two of the most complete cave bear scapulae known (wrap them in plastic film and self-hardening spray foam)? Each required unanticipated solutions and materials.

Some of the needed supplies could be acquired in Anina, but everything beyond basic groceries and a few material supplies had to be purchased either in Re  i  ta 45 minutes away or in Timi  oara 2.5 hours away. Not having done systematic excavation before, Moldovan and the Pro Acva Grup members did the best they could with information supplied ahead of time by Zilh  o and others, but there were multiple trips "into town" before a system was established and the excavations proceeded smoothly. Nonetheless, by the end of the 2004 season, an abundance of cave bear bones, scattered other mammalian bones, sediment, and stalagmite samples had been mapped in, excavated, and transported down the Galeria Culcu  urilor, through the Poarta, down the ladders in the Pu  tul, out through the siphon, out to the Mini  , up to the forest service road to the van, along the rutted forest service road to the main road, and then to the Hotel Steier and into the lab.

The principal achievement of the 2004 season was the recovery, in the area around the original 2003 discovery of the Oase 2 face, of nine pieces of the Oase 2 cranial vault. All but one of these were found and identified in the cave during excavation. The last was discovered in the lab by Trinkaus as he cleaned the dirt out of the nasal cavity of an elderly female cave bear cranium; along with fragments of turbinates, a piece of the occipital bone fell out, having been washed up into the cavity presumably once the ursid cranium had come to rest in the Panta Str  mo  ilor.

And finally, on the last day, when the crew was trying to document photographically the passage between the Panta Strămoșilor and the spot in the Sala Mandibulei where Oase 1 had been found, Milota positioned himself with lights, flat on the floor, in that spot. While waiting for Gherase to take the shot, he scouted around for anything of interest; he found it. Lying within a meter of the original location of the Oase 1 mandible was the missing piece of the posterior right ramus, which subsequently fit perfectly onto the mandible (except for the gap where the dating sample had been taken). He had been looking at a cast of the mandible for a year and knew immediately where that piece would fit.

Just as importantly, the last day in the field was successful in locating on the surface of the plateau the now collapsed or sediment-filled Pleistocene entrances used by the bears, wolves, and other carnivores whose remains were ubiquitous in the Oase galleries. This task was carried out with a SLOTER device, a transmitter/receiver system using very low-frequency electromagnetic wave lengths that had been proven successful, under similar conditions, in the Almonda karstic system of Portugal (Carvalho and Veiga, 1989; Zilhão et al., 1991, 1993).

Putting Together the Pieces: 2004

At the end of the 2004 season, the cleaned bones and sediment samples were boxed and readied to be taken for temporary storage at the Institutul de Speologie “Emil Racoviță” in Cluj-Napoca. The bones, with occasional help from Zilhão and others, were washed, air-dried, sorted, inventoried, labeled, and packed by Trinkaus. The rear building of the Hotel Steier had become the equipment storage area and the “lab.” However, the lack of sediment traps in the plumbing meant that all bones, from tooth germs to complete bear femora, were washed in a bucket, set out in plastic trays to air dry, and then labeled, inventoried, and sorted. Cave bear vertebrae, once wet from the cave and then washed, never dried properly. And of course, the last two days in the field it rained.

Given that the bones were in Cluj-Napoca by the end of the summer, driven there by Gherase and Milota, it was desirable to start the work on the bears, and, naturally, we wanted to see what the newly found pieces of human cranium would do to Oase 2. Trinkaus had to teach during the fall, so it was agreed that Rougier would return to Romania during the fall and work on the human bones. She was joined by a young bear specialist, Jérôme Quilès from the Université de Toulouse II-Le Mirail, France, who had not yet been in the field but would dive in the cave the following summer to document bear nests and other bone distributions. Quilès was aided by Cătălin Petrea, a

student in paleontology and geology at the Institutul de Speologie “Emil Racoviță” in Bucharest.

Together Quilès and Petrea began the process of sorting and identifying the bear and other mammalian bones and collecting comparative data, while Rougier cleaned, sorted, and assembled pieces of Oase 2. Since sections of the vault, particularly of the anterior parietal bones and the frontal bone, were still missing and there was a good chance they would be found the next year, she assembled the cranium into three large sections but left them apart. Most importantly, she was able to show that the 2003 temporal bone did indeed fit onto the rest of Oase 2, confirming that only two human individuals were known from the cave. As a result, she was able to provide the first overall assessment of the proportions of the cranium. What emerged was a curious combination of a large face, a long and flat forehead, a high and rounded rear vault, but a remarkably smooth occipital bone. The work also highlighted the contrast between the big face, which had previously been interpreted as male, and the temporal bone with a small mastoid process, previously deemed to be female.

Continued Fieldwork: July 2005

The winter and spring of 2005 were a time to start rethinking the approach to the Peștera cu Oase. Funding was available for a second month-long field season, planned for July 2005. The Oase 2 cranium was sufficiently complete to be presented, which was done by Trinkaus at the PaleoAnthropology Society meetings that spring. A series of radiocarbon dates was coming in on the bears and the other fauna, indicating that most of the fauna in the cave was older than the human remains although at least one ibex was considerably younger but still Late Pleistocene in age.

There was also some shifting of the people involved. Moldovan in particular, but also Codrea, had decided not to be part of the 2005 fieldwork, although Moldovan remained supportive of the project at a distance. The Romanian academic side of the project was taken over by Constantin, resulting in a codirection of the project by Constantin, Zilhão, and Trinkaus with substantial input from Milota. Constantin was joined by Viorel Horoi, a geologist and sedimentologist from the Institutul de Speologie “Emil Racoviță” in Bucharest. With Horoi came Petrea, to both help with the sedimentological sample collection in the cave (and eventually do the sedimentological work at the Bucharest University) and assist with the bear nest mapping and bone sorting. They were joined by Andrei Soficaru, a human skeletal biologist from the Institutul de Antropologie “Fr. J. Rainer” in Bucharest and Iuliana Constandache, then an archeology student from Iași.

This shifting of people resulted in two groups, one in the cave and one at the hotel. The team in the cave consisted principally of Zilhão, Milota, Rougier, and Rodrigo excavating in the bone bed of the Panta Strămoșilor. They were joined by Gherase, Danciu, and Sarcină, who provided photodocumentation, schlepped buckets and bags of sediment, removed rocks, and helped screen the sediment, now being done in the river inside the cave, before the exit through the siphon. The second group was variably aided in this by Milota. During much of the same time, Horoi and Petrea collected sediment samples from the Panta Strămoșilor but especially from the Puțul, where they dug a vertical sampling trench through a long sediment sequence apparently going back into the Middle Pleistocene. They were joined briefly at times by Constantin (who had received his diving license in the meantime) to collect stalagmites for Uranium-series dating and look for speleogenesis clues in the morphology of the passages and by Quilès, who along with Petrea, mapped in the bear nests and bone distributions in the upper galleries.

Back at the hotel, in the sunlight, Trinkaus, Soficaru, and Constandache washed, sorted, and processed the bones coming out of the cave. The flow of bones in 2004 had been slow, because it took time to get organized during that field season. In 2005, however, the process was known, Rodrigo had brought bright, battery-operated fluorescent lights from Portugal, the supplies were in place, and the work proceeded rapidly. A functional typology of toilet paper had also emerged, so that the supply shoppers (namely, Trinkaus with help from Constandache) could buy what held up best for wrapping the bones in the damp of the cave. It was all that the bone team could do to keep up with the supply, even with help from various cave team members provided during their well-earned days of rest in the sunlight. The process at the hotel started before breakfast with the setting out of trays of bones to dry, and it ended after sunset with the unpacking and arranging of the day's packs and diving containers' supply of bones, teeth, and screened sediment to be sorted. Quilès, meanwhile, sorted through the bones, verifying identifications and collecting data on the bears.

Because of the physically and psychologically demanding conditions of the work, a general rule was followed throughout the project that the inside team would rest after three days; the one time that the rule was broken because bad weather prevented access to the site by road and catching up was required, everybody made little stupid mistakes on the fourth consecutive day of work, confirming the goodness of the rule.

The goals of the 2005 season were simple and clearly formulated in light of both the original assessment of the cave and the results of the work in 2004. The first goal was to conclude the excavation of the Panta Strămoșilor from the longitudinal middle to the left wall (looking upslope)

(squares N to O or P), from the bottom of the bone bed (row 32) to its upslope passage into the Sala Mandibulei (row 37), and from the Surface into Level 2. In 2004 rows 32–33 and 34 (in part) had been excavated (see Figure 3.11), so in 2005 work started with the completion of the excavation of row 34 and continued up to row 37. The second goal was to map in the dozen cave bear nests, mostly below the Panta Strămoșilor in the Galeria Culcușurilor but also in the upper galleries. The mapping of the bear nests was combined with a systematic survey of surface fossil remains in the upper galleries (the Galeria Lungă and the Galeria celor Trei Cranii), where it had been decided from the beginning to only map and survey and not excavate.

The third task was to establish a radiometric chronological framework for the accumulations (paleontological and geological) within the cave. This program built on the radiocarbon analyses of the human fossils in 2003 and of the faunal remains in 2004. Additional bones and teeth were collected from the Surface and Levels 1 and 2 of the Panta Strămoșilor. A dozen bear crania or mandibles, all fragmentary or disturbed, were taken from surface locations, and they were sampled for teeth and bone to be dated through radiocarbon, electron spin resonance (ESR), and U-series dating as well as to be used for stable isotope analysis. Another series of stalagmites were collected from the surface of the upper galleries, the surface of the Panta Strămoșilor and within the Panta Strămoșilor deposits, all of them to assess the beginnings and the ends of the various depositional events.

In good cheer, and with serious effort, these field tasks were largely accomplished. At the end of July, all returned home to rest, recuperate, and sort out what came next.

Putting Together the Pieces: 2005 to 2008

As planned, the July 2005 season was the second and last month-long period of fieldwork. Although occasional visits to the cave were made in the following years to collect additional samples and monitor the security of the Poarta, which remained in place to protect the Oase galleries beyond from unnecessary disturbance, enough information had been obtained to consider that the project's goals had all been achieved: pending results from different strands of analytical work to be carried out in the laboratory to fill in the details, we had obtained a pretty good picture of the depositional context of the human fossils.

Counting neither the preparation work carried out by the Pro Acva Grup ahead of the actual start of the field seasons nor the hours of daily preparation and maintenance of the diving and caving equipment, nor the time driving to and from the site, the "inside team" spent a total of 282 hours (~1500 person-hours) in the

cave over the two seasons. Nearly half of this time was spent getting in (one hour, on average, depending on the number of people involved each day) and getting out (which took much longer, three hours on average each day, because of the added luggage—bones to transport outside, sediments to sieve in the river, rocks and excavation debris to store in out-of-the-way parts of the system).

Risk for those involved existed at almost every step of the process: wading through the underground river between the spring and the siphon (where the team was caught coming out of the cave one evening during the 2005 season by a flash flood through the cave from a thunderstorm); diving through the 8°C cold water (where, fortunately, only minor accidents occurred, such as loss of lighting due to head bumping against the narrow walls of the submerged passage); negotiating the muddy steps of the 20 meter vertical ladder up the Puțul, which were especially dangerous while returning at the end of the day; climbing down with the added weight of a ~40 kg “banana” (cavers’ backpack) full of bones or sediment on everyone’s back (from which we managed to get away with only a couple of bad falls and ensuing back pain, but nothing broken). Ironically, the only nontrivial injury of the three years of work in the cave (a crushed fingernail) was sustained by Milota, one of the most experienced cavers of the whole project.

Add to this the difficult excavation conditions in the Panta Strămoșilor (poor lighting, constrained space, 100% humidity, 12°C air temperature, constant dripping), and the vastness of the Sala Mandibulei, pursuing fieldwork beyond the second field season in the hope of finding additional human remains not only meant tempting luck beyond good reason but also implied an unreasonable challenge to the law of diminishing returns—essentially, not very different from trying to find a needle in a haystack. Moreover, as all excavation is destruction (albeit controlled), and because, despite all the care, it was impossible to avoid some level of unintended degradation of the bone-littered surfaces that had to be traversed to access the different excavation and sampling localities, continued work at Oase would have involved, all things considered, unjustified further damage to the pristine underground landscape discovered in 2002. For these reasons, the team unanimously agreed to put a “completed” stamp on the excavation part of the project at the end of the July 2005 season.

After the dust (or cave earth) had settled on this decision, four team members returned to Cluj-Napoca in December 2005, where the 2005 finds had been taken at

the end of the summer field season, to continue with their inventory and analysis. Rougier and Trinkaus went to complete the assembly and study of the human remains. Quilès and Petrea went to sort and complete the study of the cave bear remains. In addition, Alex Petculescu and Emil Știucă came from Bucharest to take the micromammal and small carnivore remains to Bucharest for study, and Trinkaus collected measurements and photos of the herbivore remains for analysis by others. They were joined by Milota and Gherase, to take photos and generally help out.

Subsequently, a complete cranium on the surface of the Galeria Lungă, originally thought to be cave lion, turned out to be a hyena and was removed from the cave for analysis in October 2007. All of the Peștera cu Oase bones, human, bear, and otherwise, were taken in May 2008 to the Institutul de Speologie “Emil Racoviță” in Bucharest for permanent curation. Quilès, for personal reasons, could not continue with the project, and the analysis of the cave bear remains was taken over by Martina Pacher of the Universität Wien, Austria. The analysis of aspects of the remains continued, in Bucharest, by various team members through 2008. However, since the end of 2005, most of the work has been the long, slow process of analyzing samples in laboratories, putting the Oase data in context, and writing up material for publication.

A series of papers have appeared in the meantime that either are directly on the Peștera cu Oase and its contents (e.g., Trinkaus et al., 2005, 2006a, 2009; Petrea et al., 2006; Quilès et al., 2006; Rougier et al., 2007; Trinkaus and Zilhão, 2007; Zilhão et al., 2007; Richards et al., 2008a; Rougier, 2008) or have extensively employed the data from the Peștera cu Oase and its contents to address specific topics in the Late Pleistocene (e.g., Crevecoeur and Trinkaus, 2004; Trinkaus, 2005b, 2007, 2010, 2011; Zilhão, 2006a, 2011; Pacher and Stuart, 2009; Crevecoeur et al., 2009; Richards and Trinkaus, 2009; Bailey et al., 2009; Stiller, 2009; Stiller et al., 2010; Shang and Trinkaus, 2010; Doboș et al., 2010; Meiri, 2010; Diedrich, 2011). The human remains, both in terms of their morphology and their age, have become increasingly integrated into Late Pleistocene human paleontology and the “origins of modern humans” debate. Aspects of the paleobiology, age, aDNA, and stable isotopes of the cave bears, the best dated large sample from southeastern Europe, have appeared. It is expected that more such specialist analyses and integration of the remains into the greater Quaternary record will emerge, but the recent efforts have focused on pulling together the totality of the research on the Peștera cu Oase, putting new life in these old bones.

Part Seven

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