
Life and Death at the Peștera cu Oase

HUMAN EVOLUTION SERIES

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*A Setting for Modern Human Emergence
in Europe*

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Life and Death at the Peștera cu Oase



Part Two

The Cave and Its Contents

Editors' Note. Throughout the volume, the radiometric dates provided are indicated as being "Before Present" (BP), with a distinction made for the radiocarbon dates between radiocarbon years (^{14}C BP) and calendar years (cal BP). However, labeling dates in "years BP" is normally used solely for radiocarbon determinations, in which the "present" is A.D. 1950. For other dates, including the

Uranium-series and electron spin resonance (ESR) ones provided in this volume, "before present" or "years ago" is in terms of the year in which the measurement was made. Given the magnitude of statistical uncertainties in almost all of the radiometric dates here (all except the recent goat metapodial), this technical distinction should make little difference in the evaluation of these ages.



10

The Distributions of Finds and Features

João Zilhão, Ricardo Rodrigo, H el ene Rougier, and  tefan Milota

Introduction

The research strategy underpinning the excavation of the Panta Str amo ilor and the methodology followed in the undertaking of this task are outlined and discussed in Chapter 3. Here, we (1) detail the stratigraphy observed in the excavated area and discuss the *mise en place* of the cave's sedimentary fill, (2) derive the corresponding implications for the interpretation of the finds and features observed on the surface of the different areas of the Pe tera cu Oase system, whether excavated (Panta Str amo ilor) or not (Galeria celor Trei Cranii, Galeria Lung a, Sala Mandibulei, and Galeria Culcu urilor), and (3) diagnose these surficial finds and features as a complex palimpsest with an extended formation history, for which we propose a diachronic model.

The Stratigraphy of the Panta Str amo ilor

From top to bottom, three stratigraphic units—Surface, Level 1, and Level 2—were recognized during the excavation of the Panta Str amo ilor. Their differentiation is apparent in the ~90 cm thick profile exposed at the end of the excavation work (Figure 10.1), whence the samples for the rock-magnetic analyses discussed in Chapter 9 were collected. In the field, these units were defined as shown in Figures 10.2 to 10.4.

Surface

This unit consists of an ensemble of visible finds loose or exposed, on the surface of the deposit (Figures 10.2a–10.2f),

including, in the area of units O-P/35–36 of the grid, those enveloped in a film of clayey silts, <1 cm thick, accumulated between that surface and the cave wall (Figures 10.3c and 10.4a–d).

Level 1

This unit corresponds to a 5 to 30 cm thick bed of bones, primarily of cave bear, intertwined in a very dense, confused mass and mixed with unweathered rocks (broken speleothems and large limestone blocks) fallen from the adjacent cave walls (Figure 10.3d). The interstitial spaces were filled with a fine, gritty cave earth matrix. In addition, in the area of grid units N35 and O/N34A+B, flowstone patches capped the deposit, which also featured significant expanses of subsurface carbonate induration caused by dripping.

Level 2

This unit is a sandy- to coarse-grained deposit, including significant amounts of pebbles and rounded cobbles of limestone and other rocks as well as rolled speleothems (Figure 10.3e–10.3f). It is rich in bear bones, mostly of small size (e.g., isolated teeth, phalanges, or unfused long bones of fetal and very young individuals; Chapter 12), amounting to as much as 25% by volume. Subunits of different texture (e.g., homogeneous lenses of clay, bars of coarse sands and gravel) were identified over the excavated thickness (~65 cm in the mid-N37 profile; Figure 10.3a). Bulkier material (e.g., a complete cranium of an adult bear) was present toward its base, reached in quadrants N36B and N37C+D. The diversity of this deposit suggests an extended, modulated accumulation process, as does

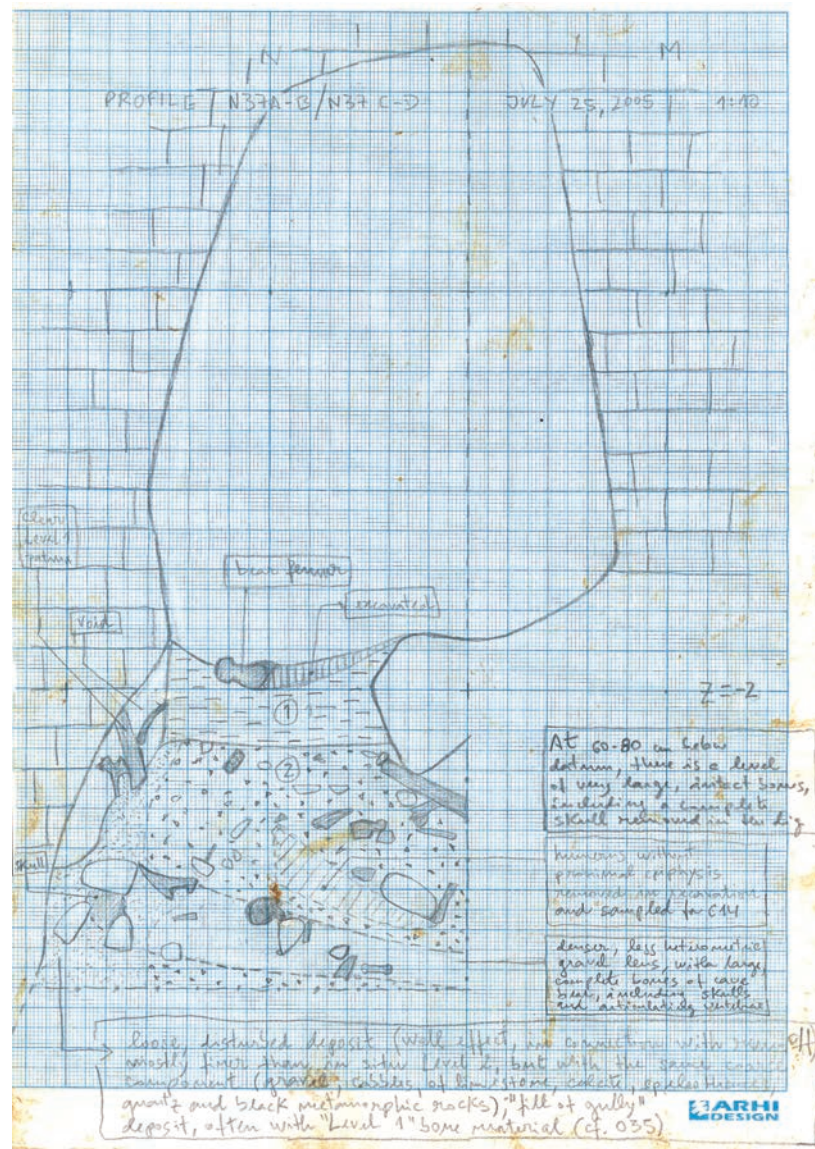


Figure 10.1 The stratigraphic profile recorded July 25, 2005, along the middle of the 37 row of the Panta Strămoșilor excavation grid (reproduction of the field drawing).

the fact that Level 2 sediments covered the well-developed stalactites and draperies adhering to the buried cave wall (Figures 10.3b and 10.4a). Combined with the topography of the latter, these observations indicate that the excavation affected but the “tip of an iceberg” with considerable time depth and a total thickness in the range of multiple meters.

Discussion

In Level 1 (as on the Surface), the bones were white when dry, often severely leached, with a chalky texture apparent in fresh breaks. The amount of leaching underwent by

the Level 1 contents was readily apparent during excavation. For instance, limestone blocks, when removed, often left a “bed” covered by a calcium carbonate film, while a significant amount of bone debris existed not only in the Surface unit but also in Level 1. Although, to a small extent, this debris related to trampling caused by the (limited) circulation of cavers prior to the beginning of the excavation (Figures 10.2b and 10.2f), it mostly resulted from genuine in situ degradation.

In Level 2, bones were orange-to-brown in color, variably displayed minor smoothing of anatomical details, and, chemically, were very well preserved. In association with the clay lenses interspersed in the deposit, the external

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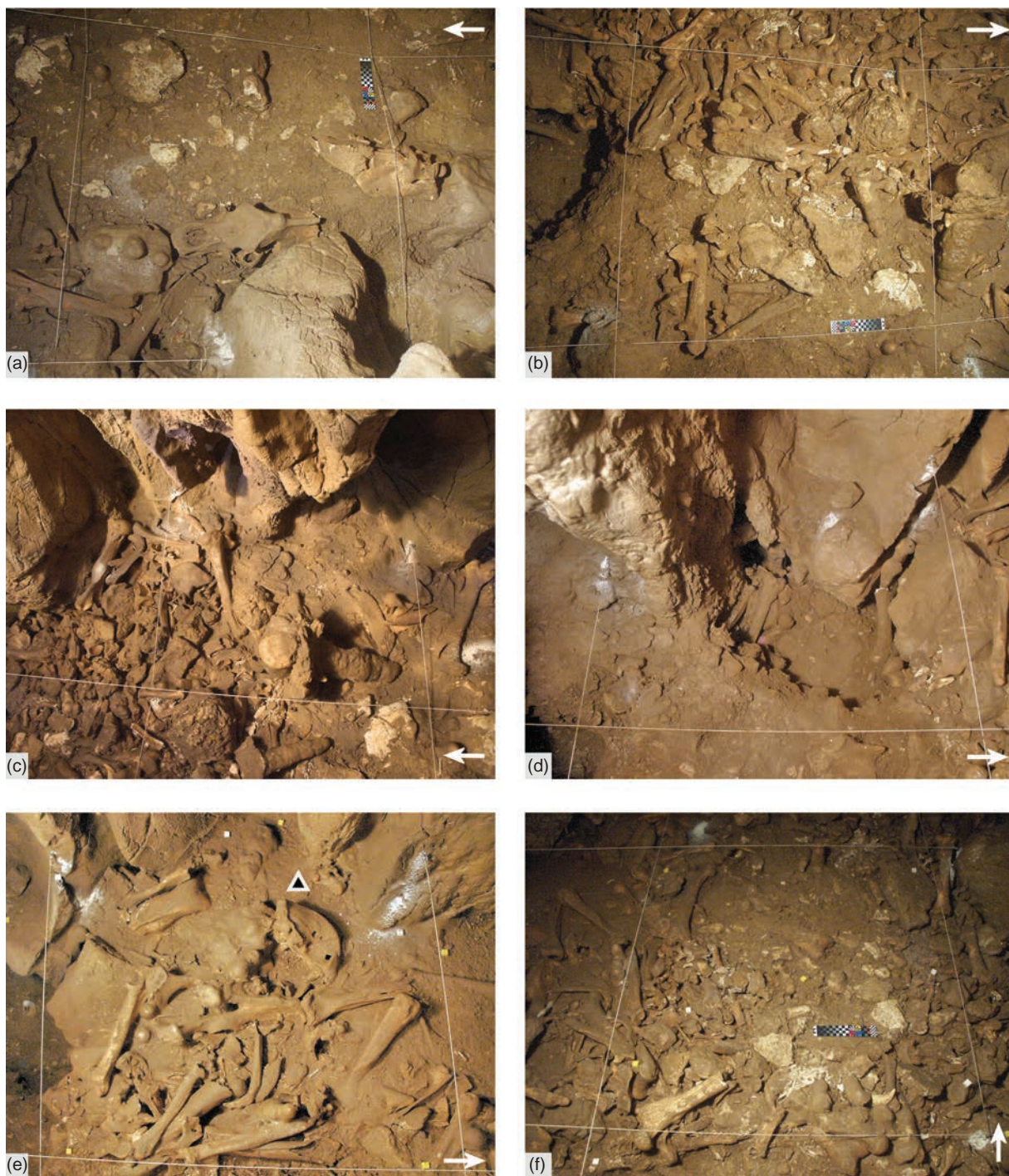


Figure 10.2 Detail views of the surface of the bone jumble in the more downslope grid units of the Panta Strămoșilor in early July 2004, prior to excavation; the arrows point upslope, along the direction of the y-axis of the grid. (a) N32. (b) N33 (note the breakage caused by trampling). (c) M33 (note, fallen in the foreground, the composite PPL6 speleothem). (d) O33 (note the subsidence “tub” and the vertically placed bear bones, including a femur broken accidentally, prior to excavation). (e) O34 (the original position of the Oase 2 face, removed in 2003, is indicated by the triangle). (f) N34 (note the breakage caused by trampling).

The Distributions of Finds and Features



Figure 10.3 Aspects of the stratigraphy of the Panta Strămoșilor fill. (a) The stratigraphic profile along the middle of the 37 row of the grid at the end of the excavation, July 26, 2005 (the dashed line indicates the separation between Levels 1 and 2; compare with Figure 10.1). (b) The O₃₅–36 gully and its fill as seen against profiles along the middle of the 36 row (in the foreground) and the middle of the 37 row (in the background) of the excavation grid (note, in the foreground, how, in row 36 of the grid, Level 2 was exposed as surface along the right wall of the passage, while, against the left wall, its truncated surface, represented by the dashed line, was overlain by a Level 1 deposit that featured voids containing loose bones with a Level 1 appearance). (c) View, looking upslope, over the surface of units O₃₄–35 of the grid (note the clay film sealing the surface of the Panta Strămoșilor, which was thickest in this area, against the left side of the passage). (d) Detail of the excavation of the Level 1 bone jumble in O₃₄ (note the entanglement of the bones and that, along the edges of the O₃₃ subsidence “tub,” the surface of Level 2 has already been exposed; under O_{34.76}, the calcite-covered, complete coxal of an adult bear, the proximal end of O_{34.146}, the complete left humerus of an adult bear, can be seen outcropping from the Level 2 deposit with an inclination diametrically opposed to that presented by the Level 1 material). (e) View, looking upslope, of grid unit N₃₃ with the surface of Level 2 exposed (the overall stratigraphy of the Panta Strămoșilor can be appreciated at the interface with N₃₄, where, under the loose surface material, the dense Level 1 bone jumble is well apparent; the arrow indicates an area where the Level 1 deposit was carbonate-cemented). (f) Detail of the Level 2 deposit as exposed along the interface between grid units N₃₂ and N₃₃ in early July 2004.

LIFE AND DEATH AT THE PEȘTERA CU OASE

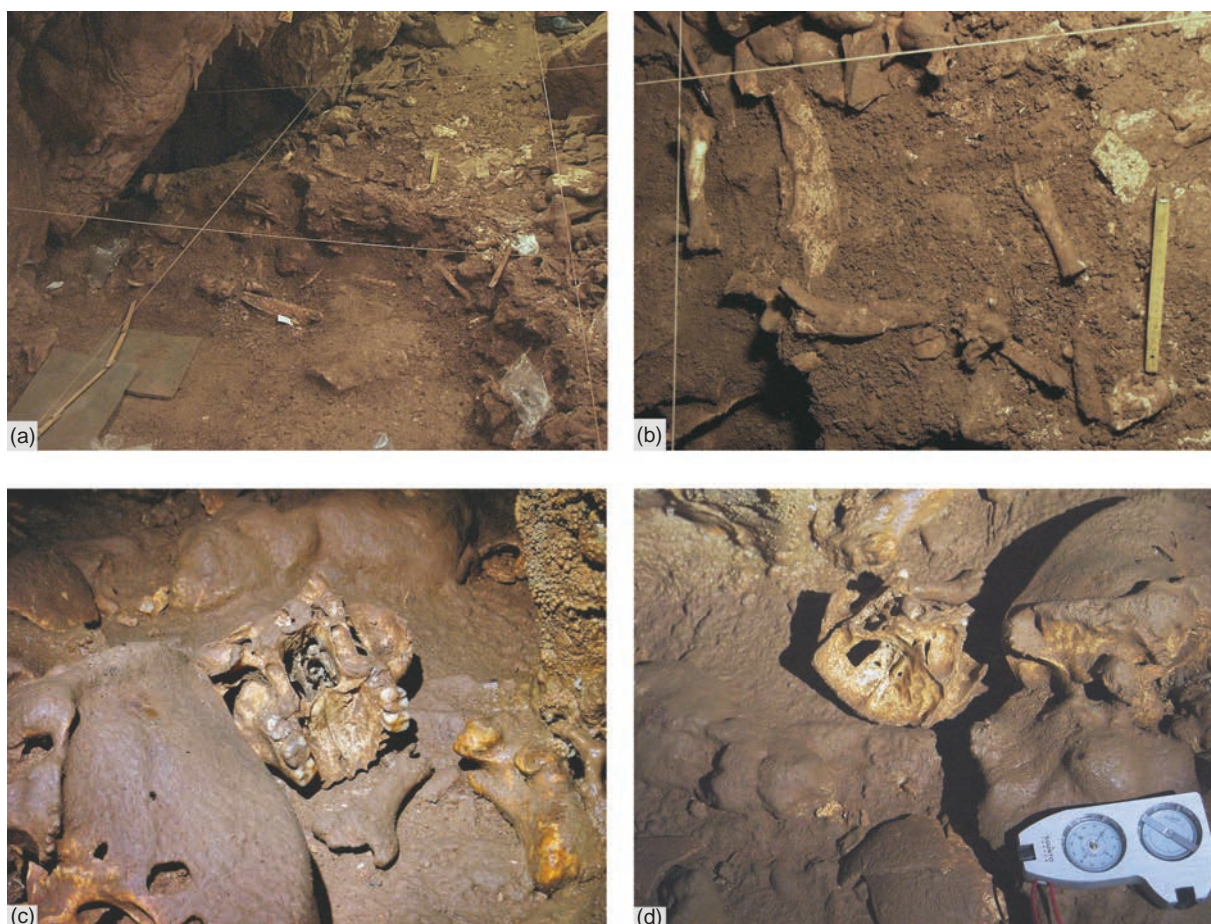


Figure 10.4 The stratigraphic position of the bones of humans and ibex recovered in the Panta Strămoșilor excavation. (a) Upslope view of the excavation of quadrants A–B of the N35 grid unit (note the Surface stratigraphic position, in trampled deposits or covered by a thin clay film only, of the exposed bones). (b) Close-up of the N35A quadrant showing in Surface position, from left to right, O35.64, a left humerus of ibex, N35.141, a cervid antler tine, and N35.136, a left metacarpal of ibex (sample OxA-15867). (c–d) Views of the Oase 2 face, in situ at the time of discovery, in June 2003.

coloration tended to white or gray, but the tissue remained very solid, with no leaching. The excellent preservation of bone over the entire thickness of this level was confirmed by the high collagen content of the radiocarbon and stable isotope samples collected therein and the successful extraction of ancient DNA (aDNA) from its cave bear remains (Chapters 8, 13, and 18). The contrast in preservation suggests that the Level 2 bones underwent rapid burial, whereas an extended period of preburial exposure to surface weathering affected the Surface and Level 1 bones.

Along the wall, in the O and P columns of the grid, Level 1 filled a range of negative features. In units N32A+C and O-P/35–36 these were mainly gullies. In grid unit O33, however, a cylindrical tub with subsurface drainage featured (1) walls lined with large bear bones in vertical position, and (2) a Level 1 fill containing several fragments of the Oase 2 cranium (Figure 10.4d). These features formed postdepositionally as a result of erosion,

subsidence, and wall effect (or combinations of these processes). In units O35C, O36A+C and N36A, the Surface and Level 1 finds corresponded to material infiltrated laterally and vertically into the narrow empty spaces between the top of Level 2 and the encasing rock, the contours of which were very irregular because of speleothem growth (Figure 10.4a). Their overall similarity in appearance to Level 1 remains (in terms of color, size, and preservation) clearly differentiated these finds from those contained in the underlying Level 2 deposits.

In the grid units excavated toward the upper part of the slope, these topographic and stratigraphic arrangements implied lateral contact between Level 2 and Level 1 (Figure 10.3b). The presence in the latter of material derived from the former (namely, gravel and pebbles but almost certainly smaller-sized skeletal parts, such as isolated teeth) can thus be explained by the operation of progradation mechanisms (e.g., erosion by runoff). A

similar situation existed along the main axis of the excavation because, in unit N36, (1) the slope was very steep and (2) Level 2 lay in an immediate subsurface position (especially along the interface with the M column of the grid). The Level 1 deposits recognized further downslope beveled out against this steep slope and, as a result of this disposition, must also include some bone material derived by progradation from upslope Level 2. Such must have been the case especially in the grid units located at the foot of the slope (N35 and O/N34A+B), where the bone bed was thickest (~30 cm).

Further downslope, Level 1 thinned out. It was no more than ~10 cm thick in N33 and even thinner in N32, except in the gully against the wall. This grid unit was excavated first as a stratigraphic recognition trench (Chapter 3). Because of this, the two levels went undifferentiated at the time of digging; consequently, assignment to either Level 1 or Level 2 of the finds made in N32 during the initial couple of days of uncertainty was a post-facto process, carried out on the basis of field notes and inevitably entailing a margin of error.

The Panta Strămoșilor Deposits: Formation Process

The texture of the Panta Strămoșilor deposits, the patterns of bone preservation, the erosional features, and the sedimentation hiatuses documented by the cementation of stabilized surfaces (or the growth of stalagmites over them) are different lines of evidence that, taken together, form a consistent fabric. The direct radiocarbon dates for the fossils (Chapter 8) agree with the uranium-thorium (U-Th) dates for the speleothems collected in direct stratigraphic relationship with the bone accumulations (Chapter 6), and both are in turn consistent with overall stratigraphic patterns. Thus, although doubtless representing the outcome of a complex process, the deposits excavated at the Panta Strămoșilor must have accumulated in ordered and intelligible fashion, and there is nothing in their composition that questions the premise that they were geologically in situ at the time of excavation. Based on these data, we suggest a formation process divided into a number of principal episodes (Figure 10.5).

Episode 1

The earliest depositional episode recorded in the excavated sequence is the accumulation of the upper reaches of Level 2. The nature of the deposit indicates that the accumulation resulted from a rhythmic succession of torrential events of variable but always high or very high energy, entailing the long-distance displacement and water rolling of kilogram-size clasts. According to

provenience, these clasts can be divided in two categories: (1) material washed in from the outside (non-limestone pebbles and cobbles derived from the detritical cover of the Ponor-Plopa Massif or from geological formations located upstream); and (2) material caught up by water flowing through the endokarst (limestone blocks, speleothems, and animal bones).

These clasts, markedly heterometric, were enveloped in a matrix of sand and gravel sufficiently abundant to completely bury them as the competence of the transportation agent decreased and each individual torrential event came to an end. Their rapid, syndepositional burial is also implied by the excellent chemical preservation of the bone fraction. The contrast between the visible abrasion of the rolled speleothems recovered in Level 2 and the pristine or near pristine condition of the bone surfaces, which at most displayed a bit of smoothing, suggests that at the time of displacement the bones were still covered by soft tissue (or at least the periosteum and some ligaments). This inference is consistent with the fact that articulating parts of single skeletons were found in adjacent position (e.g., an ensemble of cervical vertebrae recovered toward the base of the excavation in the N36 grid unit), which in turn implies the transportation of body parts still attached by ligaments.

Combined, these observations indicate that each successive torrential episode was separated from the previous one by a geologically short interval of time—sufficiently short for the decomposition of the soft tissues of the bears that died in the cave during such intervals to have remained incomplete. The radiocarbon dating of Level 2 samples (Chapter 8) confirms the time depth of the deposit, as it returned results of ~43.0 ka ¹⁴C before present (BP) (~46.3 ka cal BP) for its upper part (< 20 cm below the surface), of ~45.5 ka ¹⁴C BP (~49.0 ka cal BP) farther down (20–40 cm below the surface), and of ~47.6 ka ¹⁴C BP (~51.3 ka cal BP) toward the base of the N37 trench (55 cm below the surface). These results suggest an average rate of accumulation in the range of 10 cm per millennium throughout the deposition of Level 2. They thus indicate that the unexcavated, several meter thick “base of the iceberg” of the Peștera cu Oase fossiliferous fill is of Marine Isotope Stage (MIS) 4 age (or earlier).

Episode 2

The dates for the bear bones in the surficial part of Level 2 provide a *terminus post quem* of ~46.3 ka cal BP for the phase of stabilization that followed. This time horizon is consistent with the 47.3/+3.5/–3.3 ka BP uranium-series (U-series date) (1σ uncertainty) obtained for the base of stalagmite PPL9, collected toward the downstream end of the Galeria Culcușurilor, near the Poarta (Chapter 6). This is because the growth and permanence to the

LIFE AND DEATH AT THE PEȘTERA CU OASE

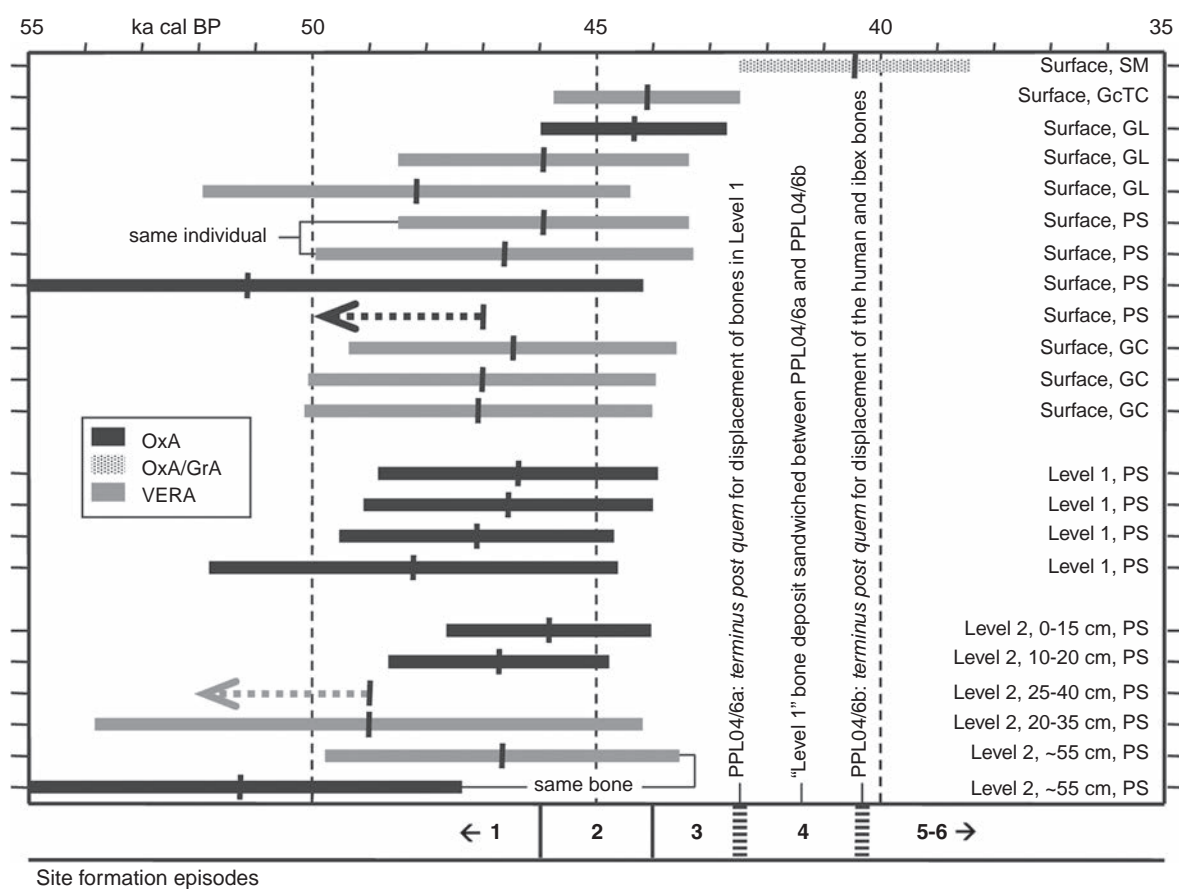


Figure 10.5 The chronometric foundation of the site formation model, based on the mutually concordant and stratigraphically consistent radiocarbon results from the Vienna and Oxford laboratories (Chapter 8) and on the U-Th dating of speleothem PPL6 (Chapter 6). The bars represent the two sigma calibrated age ranges, and the dotted arrows correspond to results reported as minimum ages only (SM, Sala Mandibulei; GcTC, Galeria celor Trei Cranii; GL, Galeria Lungă; PS, Panta Strămoșilor; GC, Galeria Culcușurilor). The OxA-15814 result, obtained on a Surface cave bear vertebra, is a younger outlier, and the porous nature of such bones makes complete decontamination more difficult to achieve; this is all the more so in this case because the sample was embedded in a stalagmite U-Th-dated to ~13.6 ka and the age obtained may well be an underestimation caused by younger carbon introduced by the stalagmite-generating, water-dripping process. For these reasons, we excluded OxA-15814 from the model.

present of this speleothem would not have been possible with subsequent recurrences of the torrential regime responsible for the accumulation of Level 2 in upstream Panta Strămoșilor. This evidence carries the implication that all finds and features found on the surface of the Peștera cu Oase galleries (namely, the bear nests) must post-date the moment when the torrential regime ceased (i.e., ~46.3 ka cal BP). Otherwise, they would not have survived (where the features are concerned) or have avoided burial in water-lain sediments (where the bones are concerned). Bears last hibernated inside the Peștera cu Oase during this stabilization episode, as confirmed by the radiocarbon dates obtained for bear bones from Level 1 of the Panta Strămoșilor and the surface of both the Panta Strămoșilor and the other passages. These dates place the last use of the site by bears in the ~44–46 ka cal BP range

(Chapter 8), that is, right after the termination of the preceding period of torrential accumulation.

Episode 3

Directly dated cave bear remains document the persistence of the taxon until at least the 35–30 ka cal BP interval across the mountainous areas of central and southeastern Europe (Pacher and Stuart, 2009; Chapter 11). They could have gone extinct locally, in the Banat Mountains, at an earlier time, but there are no grounds to support such a hypothesis. Therefore, the fact that no bears hibernated in the Peștera cu Oase after ~44–46 ka cal BP must have been caused by increased competition with other carnivores for the use of the cave or by major changes in the topographic configuration of the system that favored (or

prompted) such a competition. Two possibilities are conceivable: (1) the entrance or entrances may have become unavailable at this time, due to collapses that cluttered them up or at least rendered the size of the remaining openings too small for the bears; (2) the opening of a new entrance close to the nesting areas hitherto in use may have exposed those areas to daylight and to frequentation by other carnivores, thus rendering them inappropriate for bear hibernation. Speleothem dating (Chapter 6) shows that the entrances to the Galeria celor Trei Cranii and the Galeria Lungă had become inoperative by the early Holocene and the Last Glacial Maximum (LGM), respectively. However, these results are only minimum ages for the inhabitation of those entrances, and the overall Peștera cu Oase find distribution patterns, in agreement with other speleothem dating evidence, are consistent with the notion that the closure of the Galeria Lungă exit may in fact predate MIS 4 (see below). Moreover, direct radiocarbon dating indicates that, after ~44–46 ka cal BP, there was a millennia-long hiatus during which no bones entered the Peștera cu Oase system. Combined, this evidence suggests that, in the time interval represented by the Panta Strămoșilor deposits, (1) cave bears accessed the Peștera cu Oase via the Galeria celor Trei Cranii entrance only, and (2) the reason underlying both their abandonment of the site after ~44–46 ka cal BP and the depositional hiatus that followed is likely to lie in the cluttering up of that entrance. The poor chemical preservation of the Surface and Level 1 bear bones indicates a lengthy period of exposure to the main weathering agents operative in the endokarst (namely, runoff and environmental humidity). This evidence is consistent with the hiatus in bone deposition shown by the radiocarbon dates and the period of dripping and speleothem formation documented by the ~42.5 ka BP U-Th date for the external layers of the PPL6a calcite crust (Chapter 6). A period of geological stasis thus seems to have followed the cluttering up of the Galeria celor Trei Cranii entrance, enabling the surface accumulations extant when bears last used the site to be frozen in time, so to speak.

Episode 4

The following episode is the displacement onto the Panta Strămoșilor of the bones that make up the Level 1 jumble. The dating of speleothem PPL6 shows that this displacement occurred some time during the interval defined by the age of the calcite deposits sandwiching the Level 1 material found adhering to the base of this complex speleothem, that is, between ~42.5 and ~40.3 ka BP (Chapter 6). Although the local topographic configuration facilitated its accumulation, the massive nature of the bone bed and the size of its components imply a part-hydraulic, although low-energy mechanism, and require a nearby

point of entrance for the water involved in the process. Assuming the validity of this inference, the formation of the bone bed may thus be taken as a proxy for the establishment, at this time, of a direct connection between the Sala Mandibulei, from where the Level 1 bone material was evidently displaced, and the exokarst. An earlier date for the establishment of that connection remains conceivable but not beyond the *terminus post quem* provided by the chronology of bear hibernation in the Sala Mandibulei, that is, not beyond early Episode 3 or late Episode 2 times.

Episode 5

The ~40.3 ka BP result for the base of stalagmite PPL6b probably also dates the carbonate cementation of the bone bed in the squares located at the base of the slope (N₃₅ and O/N_{34A+B}). The implication is that the corresponding surface stabilized at this time, thus setting a *terminus post quem* for the deposition of the material making up the Surface stratigraphic unit of the Panta Strămoșilor (i.e., for the moment when the material found on the surface of the deposit came to lie on top of it as a result of derivation from an original upslope location). This material includes the remains of the humans and the ibex, all of which were directly dated to a time after ~40.3 ka cal BP (Chapter 8). Given their distribution (see Distribution discussion below), the entry route for the human and ibex material must have been the direct opening into this part of the system, formed some time between the end of Episode 2 and the beginning of Episode 4. And, given the direct dates obtained for these taxa, one can also infer that such an entrance remained in operation between ~40.5 and ~17.3 ka cal BP—in other words, that its closure coincides with the beginning of the period of the Peștera cu Oase-ubiquitous, post-LGM speleothem growth.

Episode 6

The last episode corresponds to the small-scale processes that gave its present form to the palimpsest of surface finds observed across the system. In the Panta Strămoșilor and adjacent areas, the direct radiocarbon dating of such finds indicates the occurrence of (1) farther downslope displacement of material, mostly bear bones, that had remained on the floor of the Sala Mandibulei since Episode 2 times (i.e., since ~44–46 ka cal BP) and (2) downslope displacement of material that first entered the cave during Episode 5. These displacement processes may have been synchronic with the Episode 5 inputs or continued beyond that time. Microstratigraphic observations indicate that the system remained geologically dynamic indeed for several millennia after ~40.5 ka cal BP. For instance, while the inner, dish-shaped side of the

Oase 2 face (which, when found, was the side facing up) was practically clean, the adjacent, refitting parietals were covered by the same homogeneous clay film that sealed the surface of the O₃₄ grid unit, including the ibex and bear bones outcropping from the bone bed or lying on its surface (Figures 10.4c–10.4d). Moreover, a small fragment of the Oase 2 cranium was found in the clay fill of the nasal cavity of one of the bear crania recovered in O₃₄. The agent involved in the deposition of such clays can only have been, therefore, runoff (and of very low energy—enough to film-cover the bone material exposed on the surface of the deposit and infiltrate its hollows but not bury or envelop material raising above that surface). Given the ~275 ka cal BP date obtained for the clay-covered, ibex mandible recovered in O₃₄-Surface (Chapter 8), the deposition of these clays probably postdates the LGM and correlates with the increased environmental humidity responsible for the post-LGM phase of speleothem growth observed throughout the Peștera cu Oase (Chapter 6).

The Issue of the Electron Spin Resonance Determinations

This reconstruction of the sequence and associated processes in the accumulation of the deposits of the Panta Strămoșilor and adjacent portions of the Peștera cu Oase system is based to a substantial degree on the ¹⁴C and U-series determinations on bones and speleothems (Chapters 6 and 8). At the same time, it is at variance with the electron spin resonance (ESR) determinations made on a series of surface and excavated cave bear remains from the same area, a number on the same cave bear specimens that yielded radiocarbon dates.

At face value, these ESR results from the surface of the Peștera cu Oase sedimentary fill can be taken to indicate, as argued in Chapter 7, that the site underwent significant disturbance. In this, the ESR study infers that the disparate ages obtained for two pairs of adjacent samples must reflect the chronologically heterogeneous composition of the surficial bone scatters, because they cannot be influenced by differences in the external dose rate. However, those results are affected to an unknown extent by the discovery post-facto that the instrument used to make the *in situ* gamma spectrometry measurements provided unreliable readings. Moreover, there is no reason to assume that two bones found together in one spot at the time of collection in 2005 had both been lying there for their full depositional histories (or even for most of them).

A slope with the inclination of the Panta Strămoșilor's is a dynamic environment where thousands of years can separate the trapping in a wall niche of the bones lying there together, in apparent association, at the time of

sample collection. Let us consider, for instance, the niche that corresponds to grid unit M₃₆ and whence comes one of those two pairs, the mandible samples 10 and 10bis. While one of them may have been lying there, in direct contact with the wall, for some 40,000 years, the other could well have moved down much more recently from the middle of the Sala Mandibulei, a dozen meters upslope, where it could have been in contact with only clays and other bones, some 30 m below the roof, for the better part of those 40,000 years. In such a scenario, the history of radiation exposure of both samples would have been totally different.

Unfortunately, the data to resolve these issues are not available. Yet the relatively narrow range of radiocarbon dates on cave bear bones and teeth, and especially their correspondence with the U-series dates from the Panta Strămoșilor indicating that they are not merely minimum ages, makes it unlikely that the chronological distribution of the bear remains from the Surface and Level 1 stratigraphic units was as large as the ESR results suggest.

The Panta Strămoșilor Bear Remains: Spatial Distribution

To contribute to the site formation model inferred from the characteristics of the excavated deposits, we undertook a study of the spatial distribution of size- and shape-significant bear bones recovered in the Panta Strămoșilor excavation, grouped into the following categories (Tables 10.1 to 10.3; Figures 10.6 to 10.11): (1) complete and sub-complete crania; (2) complete and subcomplete arm and leg bones of adults (humerus, radius, ulna, femur, tibia, and fibula); (3) isolated teeth; and (4) phalanges. In the comparisons with Level 2, the Surface and Level 1 material was pooled together as, when considered separately, these two units were found to present identical distributions and category ratios.

The Level 2 distributions are graphically rendered in Figure 10.6. Where the larger items are concerned, there is no significant difference between the upper-, mid- and lower-slope grid units. This rather even distribution is consistent with the torrential mode of accumulation inferred from the texture of the deposits. The same can be said of the overrepresentation of the smaller-sized skeletal elements (phalanges are five times more abundant than would be expected if the different bones were present in proportion to their abundance in individual skeletons; Table 10.2). Note, however, that this observation needs to be mitigated against the fact that an unknown proportion of the phalanges may have belonged to juveniles whereas the denominator used to calculate the index considers adult bones only. Even so, the magnitude

The Distributions of Finds and Features

Table 10.1 Spatial and stratigraphic distribution of selected bear body parts from the Panta Strămoșilor excavation

Quadrant(s)	Crania			Adult long bones			Isolated teeth			Phalanges		
	Surface	Level 1	Level 2	Surface	Level 1	Level 2	Surface	Level 1	Level 2	Surface	Level 1	Level 2
N32A	-	-	-	1	-	-	1	5	8	-	5	4
N32B	-	-	-	-	-	-	-	1	9	-	2	2
N32C	2	-	-	-	-	-	1	1	-	-	1	-
N32D	-	-	-	-	-	1	-	-	11	-	-	2
N32ABCD	-	-	-	-	-	-	-	1	63	-	1	42
O32A	-	-	-	-	-	-	-	-	-	-	-	-
O32B	-	-	-	-	-	-	-	1	1	-	-	-
O32C	-	-	-	-	-	-	-	-	-	-	-	-
O32D	-	-	-	-	-	-	-	-	-	-	-	-
N33A	-	-	-	1	3	-	2	1	15	-	2	-
N33B	-	-	-	-	2	-	-	2	4	-	-	-
N33C	-	-	-	2	3	1	1	10	47	-	-	32
N33D	-	-	-	-	1	-	-	4	42	-	2	24
O33A	-	-	-	1	-	-	-	-	-	-	-	-
O33B	-	-	-	-	3	1	-	2	1	-	-	-
O33C	-	-	-	-	-	-	-	-	-	-	-	-
O33D	-	-	-	1	2	1	-	-	3	-	-	7
O33AB	-	-	-	-	-	-	-	1	-	-	-	-
O33ABCD	-	-	-	-	-	-	-	16	-	-	12	-
N34A	-	-	-	1	6	-	-	11	-	-	-	-
N34B	-	-	-	-	3	-	-	36	-	-	5	-
N34C	-	-	-	-	6	-	-	10	1	-	-	4
N34D	-	-	-	1	4	-	1	15	-	-	2	-
N34AB	-	-	-	-	-	-	-	2	-	-	4	-
O34A	1	-	-	-	-	1	-	6	7	1	4	1
O34B	-	2	-	2	3	-	-	-	73	-	-	22
O34C	1	-	-	-	-	2	1	7	12	-	2	7
O34D	1	-	-	3	2	2	1	16	39	-	2	15
O34CD	-	-	-	-	-	-	-	1	5	-	-	3
O34ABCD	-	-	-	-	-	-	-	-	17	-	-	2
N35A	-	-	-	2	1	-	-	28	4	-	8	-
N35B	-	-	-	-	1	-	-	4	19	-	-	13
N35C	-	-	-	-	3	-	-	20	-	-	4	-
N35D	-	-	-	-	3	-	-	15	-	-	1	1
N35ABCD	-	-	-	-	-	-	-	4	-	-	-	-
O35A	-	-	-	2	-	-	-	15	-	-	1	-
O35B	-	-	-	-	4	-	-	14	3	-	5	1
O35C	-	1	-	-	-	-	-	2	6	-	-	3
O35D	-	-	-	1	4	-	-	19	1	-	4	2
O35AC	-	-	-	-	-	-	-	6	-	-	-	-
N36A	-	-	-	-	-	-	-	-	2	-	-	-
N36B	-	-	-	-	-	2	5	-	387	5	-	133
N36C	-	-	-	-	-	1	1	-	-	-	-	-
N36D	-	-	-	-	-	1	-	-	2	1	-	-
N36AC	-	-	-	-	-	-	-	2	-	-	-	-
O36A	-	-	-	1	-	-	-	-	-	-	-	-
O36B	-	-	-	2	1	-	1	32	9	-	11	-
O36C	-	-	-	-	-	-	2	16	-	-	4	-
O36D	-	-	-	-	3	-	-	22	-	-	7	-
O36AC	-	-	-	-	-	-	-	32	-	-	5	-
O36ABCD	-	-	-	2	-	-	1	-	-	-	-	-
N37A	-	-	-	-	-	-	-	-	-	1	-	-
N37B	-	-	-	-	-	-	-	-	-	-	-	-
N37C	-	-	-	1	-	1	-	15	-	-	-	-
N37D	-	-	1	-	-	-	-	-	-	-	-	-

(continued)

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Table 10.1 (continued)

Quadrant(s)	Crania			Adult long bones			Isolated teeth			Phalanges		
	Surface	Level 1	Level 2	Surface	Level 1	Level 2	Surface	Level 1	Level 2	Surface	Level 1	Level 2
N37CD	-	-	-	-	-	1	15	2	224	5	4	56
O37A	-	-	-	-	-	-	-	-	-	-	-	-
O37B	-	-	-	-	-	-	-	7	-	-	2	-
O37C	-	-	-	-	-	-	-	-	-	-	-	-
O37D	-	-	-	-	1	-	-	2	-	-	-	-
O37CD	-	-	-	-	-	-	-	-	3	-	-	3
TOTAL	5	3	1	24	59	15	33	406	1018	13	100	379

Note: Crania and adult long bones—complete and subcomplete only.

Table 10.2 Bear body part ratios in the assemblage from the Panta Strămoșilor excavation

Body part ratios	Surface + Level 1	Level 2	Single skeleton
Isolated teeth ÷ Complete and subcomplete adult long bones	5.3	67.9	-
Phalanges ÷ Complete and subcomplete adult long bones	1.4	25.3	4.67

Table 10.3 Find density of bear bones in the Panta Strămoșilor excavation

Bones per cubic meter	Surface + Level 1			Level 2		
	N37C+D (0.100 m ³)	O34B+D (0.100 m ³)	N33C+D (0.050 m ³)	N37C+D (0.300 m ³)	O34B+D (0.150 m ³)	N33C+D (0.125 m ³)
Complete and subcomplete adult long bones	10	100	120	7	13	8
Isolated teeth and phalanges	410	200	340	933	1047	1160

of the imbalance is such that differential representation of the body parts must be implicated. Moreover, the gradient seen in the distribution of phalanges and isolated teeth along the slope contrasts with the even distribution of the larger bones only in appearance; the gradient is an artifact of the much larger volume of Level 2 deposits excavated in rows 37 and 36. When this factor is considered, the pattern is also one of no variation along the axis of transportation; the density of isolated teeth and phalanges in the Level 2 deposits is approximately one per liter across the excavated area (Table 10.3).

The corresponding density values for the Surface and Level 1 material are distinct. For the smaller elements, they are much lower and show a decrease from the top to the bottom of the slope. The reverse is apparent for the larger elements. These indications are confirmed by the distribution of the Surface and Level 1 finds per quadrant (Figures 10.7 and 10.8), which further reveals first that a significant concentration of small skeletal elements exists in quadrants A and C of grid units O35–36,

whence, conversely, came a very small proportion of the adult long bones and second that most of the larger adult bones were recovered in the grid units adjacent to the foot of the steepest part of the slope, in grid units N–O34.

A pattern of preferential accumulation at the base of the slope and against the wall is also apparent in the distribution of the cranial material. This can be seen in Figure 10.8, where only complete and subcomplete items are considered, as well as in Figure 10.9, where the distribution of all piece-plotted cranial fragments is compared with that of all other piece-plotted skeletal parts. The inheritance of small elements derived from Level 2 via progradation may, in places, have contributed to the observed concentrations of such elements in the Surface and Level 1 stratigraphic units. However, it cannot explain those concentrations. Despite such a potential enrichment, phalanges are more than three times less abundant in these units, relative to the ensemble of complete and subcomplete adult long bones, than they should be if the different body parts were represented in proportion to their abundance in the skeleton.

The Distributions of Finds and Features

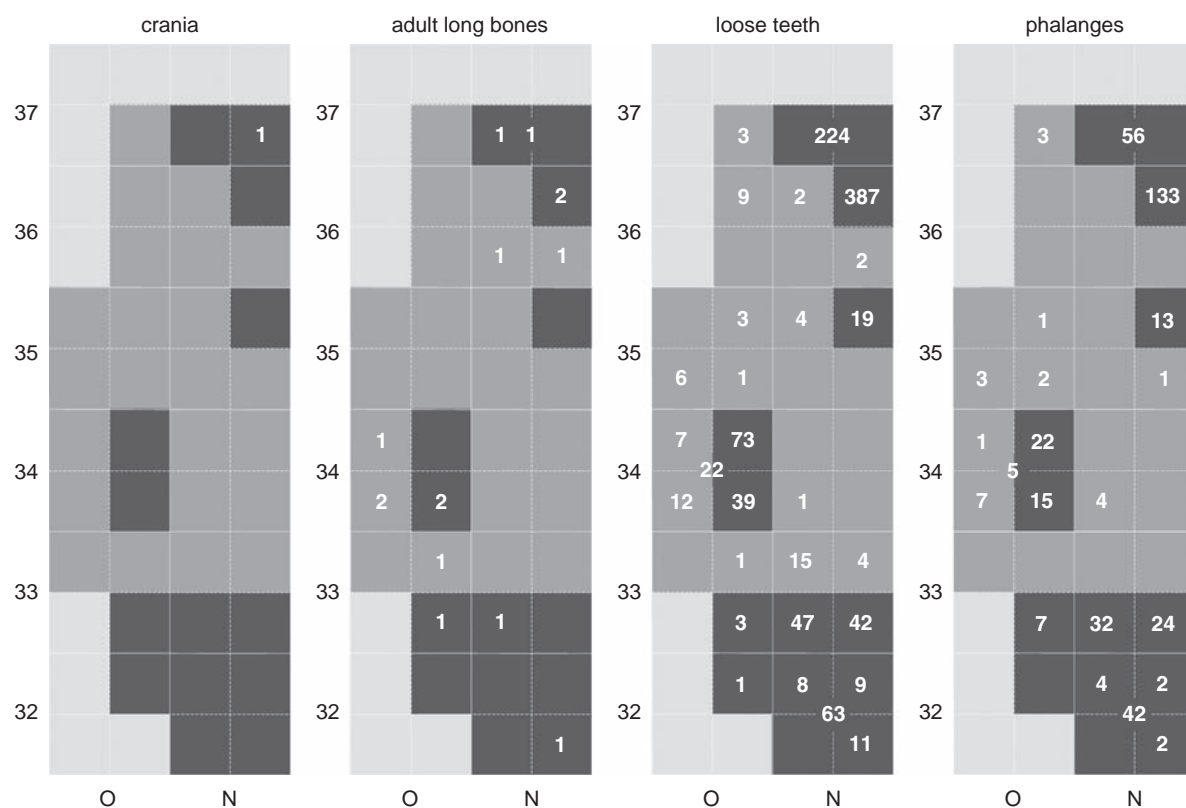


Figure 10.6 Distribution by quadrant of the bear bones recovered in Level 2 of the Panta Strămoșilor excavation (light gray, grid area; medium gray, Level 2 superficially excavated only; dark gray, Level 2 substantially excavated). From left to right: complete and subcomplete crania; complete and subcomplete adult long bones (humerus, radius, ulna, femur, tibia, and fibula); isolated teeth; phalanges.

This is all the more so since, as aforementioned for Level 2, the phalanges may in part belong to juveniles. As the presence of juvenile phalanges would make the numerator larger than it should be and, hence, cause the value of the index to be larger than the calculated value, the true weight of phalanges in the “Surface+Level 1” assemblage may well be even less than the 1.4 estimate given in Table 10.2.

A number of inferences can be derived from the overall spatial distribution of bear body parts recovered in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor:

- Deposition was a primarily gravity-driven process whereby the larger and heavier bones, because of the greater momentum of their movement, were displaced over longer distances than the smaller ones and tended to accumulate against physical barriers (the cave wall; e.g., the complete and subcomplete crania in N₃₂ and O₃₄) or adjacent to where the angle of the slope broke markedly (which is halfway through row 35; e.g., the complete and subcomplete adult long bones in row 34).

- The direction of the displacement vector was at an approximately 45° angle with the axis of the Galeria Culcușurilor, explaining, in combination with the microtopography of the cave walls in the excavated area, the relative abundance of phalanges and isolated teeth in the niches of O₃₅–36 (and especially so in their quadrants A and C), where infiltration in the narrow spaces between the surface of Level 2 and the encasing rock was easy for the smaller bones but problematic for the larger ones.

The Panta Strămoșilor Non-Bear Remains: Stratigraphic Distribution

Despite the differentiation between Level 1 and Level 2, a degree of uncertainty exists concerning the correct stratigraphic assignment of individual finds from areas where provenience ambiguity pertains:

- Where Level 1 filled gullies or other erosive features and likely inherited material from Level 2.

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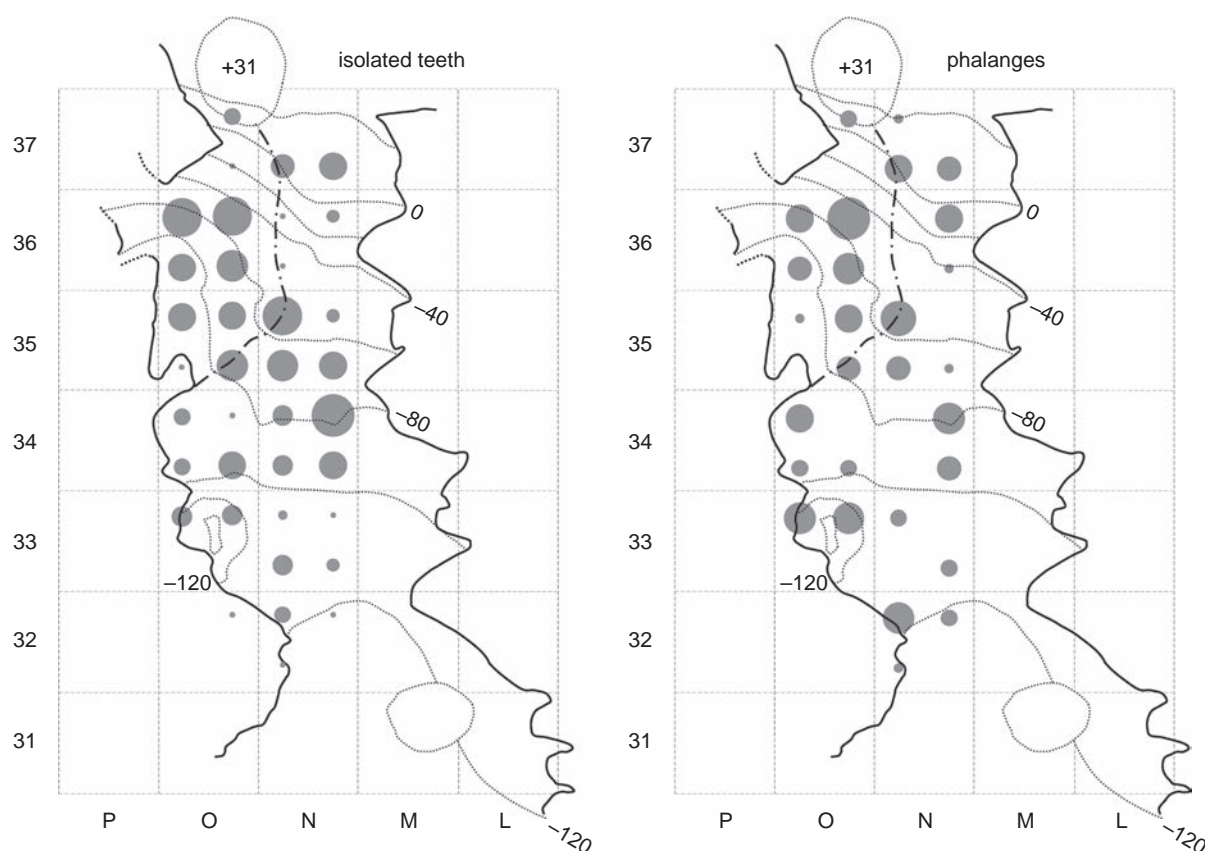


Figure 10.7 Distribution by quadrant of the bear bones recovered in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor excavation. Left: isolated teeth ($N = 443$). Right: phalanges ($N = 116$).

- Where there was lateral contact between Level 1 and Level 2 (which, especially if one considers the poor lighting and difficult working conditions, inevitably entailed a measure of decapage imprecision).
- Where Level 2 was exposed or found immediately subsurface and was dug only at the end of the 2005 field season, at a time when, despite all the care, the circulation of the excavation crew had already created a fuzzy surficial layer and material labeled Level 2 could well correspond to Surface finds buried by trampling.

A detailed discussion of such uncertainties for the cave bear remains is impossible given their large number and also unnecessary because the magnitude of these problems is insufficient to impact their overall spatial distribution patterns. The chronological proximity of the remains would in any case warrant treatment of the material as a single sample for paleontological and paleobiological purposes (Quilès et al., 2006; Chapters 11–12). However, because it has implications for overall site history and formation processes, in particular for the understanding of the mode of accumulation of the human remains, this

discussion is necessary for the non-bear material provenanced to Level 2, which is listed in Table 10.4.

As piece-plotting in Level 2 was carried out only occasionally, our revision focused on the date of the excavation of each find, compared with the date when the decapage of the interface between Level 1 and Level 2 was carried out. We considered stratigraphically secure any finds assigned to Level 2 whose associated excavation date was later than the date of the level's decapage in the square or quadrant of provenience (as recorded in the daily detailed excavation log). When such a posteriority was not documented, we considered that a question mark was justified. After filtering for possible causes of error, we could conclude the following:

- Wolves are indeed present in the Level 2 deposits and in numbers that, although small compared with the bear component, are nonetheless significant in that the spatial distribution and body part representation patterns are the same.
- The cervid remains labeled Level 2 relate to the remains of the species recovered in the Surface and Level 1 stratigraphic units, as indicated by the fact

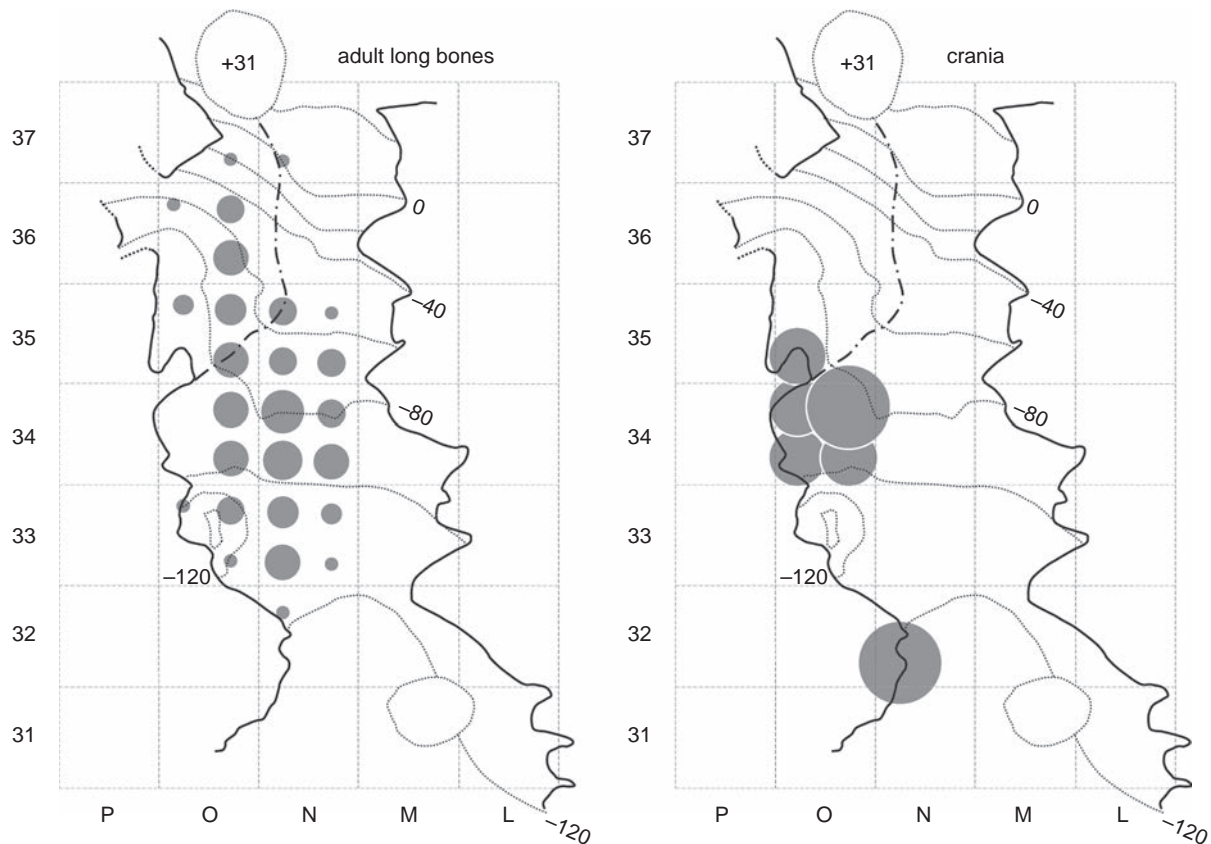


Figure 10.8 Distribution by quadrant of the bear bones recovered in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor excavation. Left: complete and subcomplete adult long bones (humerus, radius, ulna, femur, tibia, fibula) ($N = 84$). Right: complete and subcomplete crania ($N = 8$).

that a mandible fragment from Level 2 in N₃₇C+D was glued back onto a larger, piece-plotted mandibular piece from Surface. The upper canine and antler fragments from N₃₆B, where Level 2 outcropped as the surface of the deposit, probably reflect, in turn, the impact of trampling on deer cranial and dental material distributed (and piece-plotted) across the Surface and Level 1 stratigraphic units of adjacent quadrants.

- Where ibex is concerned, the two N₃₇C+D carpal bones assigned to Level 2 must reflect excavation or labeling error because one of them articulates with a metacarpal from Level 1. The N₃₂ ibex material, in turn, is most certainly Level 1, as it was excavated before the stratigraphic differentiation was recognized and a scatter of surficial ibex bones (found to be ~275 ka cal BP or younger whenever its age was verified by direct radiocarbon dating; Chapter 8) extended across all of the excavated area and beyond, until at least some 10 meters farther downstream in the Galeria Culcușurilor (Figure 10.10).
- The explanation for this ibex material also applies to the three bones of fox labeled Level 2: one comes

from N₃₅B, where that level was exposed on the surface; the other two have the same N₃₇C+D provenience as the ibex carpal that articulates with a Level 1 bone (an actual origin in this level being therefore impossible to exclude).

Given these conclusions, for the purposes of spatial distribution issues we have reassigned to the Surface+Level 1 unit of analysis all the Level 2 piece-plotted material from red deer and ibex, none of which satisfied the criteria to be considered probably or securely in Level 2 (Table 10.4). This reassignment is reflected in the plots presented in Figures 10.10 and 10.11. These plots further show that, in the areas of the Peștera cu Oase where systematic identification of all bone remains apparent on the surface was attempted (the Panta Strămoșilor and adjacent areas of the Sala Mandibulei and the Galeria Culcușurilor), of the remains of noncave dwellers only the ibex material is ubiquitous—human remains do not extend into the Galeria Culcușurilor, and no deer remains were observed on the Sala Mandibulei. This greater visibility of the ibex material is consistent with the radiocarbon evidence

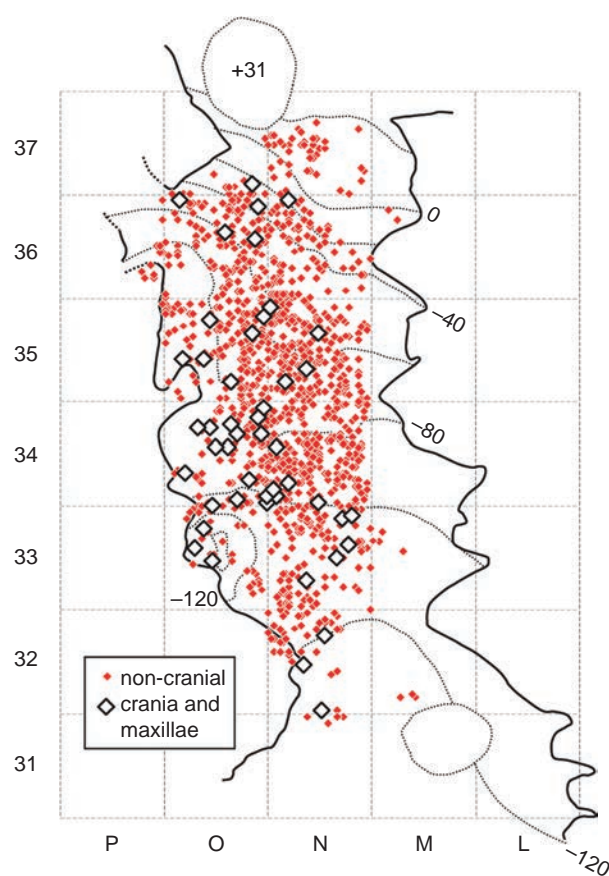


Figure 10.9 Distribution of piece-plotted crania and maxillae of bear recovered in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor excavation against that of all other bear parts (all fragmentation categories).

(Chapter 8) showing that all dated ibex samples are significantly younger than those from bears, deer, wolves, and humans. Combined, the two lines of evidence indicate that the ibex remains entered the Peștera cu Oase at a time when, but for the deposition of the thin silt and clay lenses observed in the O₃₅–36 niches, the Panta Strămoșilor slope had acquired its present form.

Where the mechanism of deposition is concerned, the distribution of the non-bear remains follows the same rules recognized for the Surface and Level 1 bear material. This is seen in the distribution of the cranial fragments (Figure 10.11). Their preferential accumulation against the rock wall of the Panta Strămoșilor, in O₃₃–34 and in the O₃₆ niche, is most apparent for the different fragments into which the Oase 2 human cranium broke as it rolled down the slope. This pattern suggests that the accumulation of the remains of the humans and herbivores from the Surface and Level 1 stratigraphic units was, like those of the bears with which they were associated, primarily gravity-driven. It also allows speculation as to why the excavation failed to recover some 10% of the Oase 2 cranium, as well as its anterior teeth that were lost postmortem; given their small size and the vector of the

displacement process, such missing elements may well have ended up deep in the narrow recesses of the cave wall that extend into units P–Q/35–37 of the grid, beyond the reach of the excavation.

The Peștera cu Oase Surface Palimpsest: The Distribution of Finds and Features and Its Implications

In Figure 10.12, we plot, as a proxy for the overall distribution of the remains of the corresponding taxa, the location of the crania mapped in at the time of drafting of the plan of the Peștera cu Oase system (June 2003). The following observations are apparent:

- The distribution of bear crania is broadly coincident with that of the bear nests, and their limits can therefore be taken as indicating those of the area of the Peștera cu Oase where, during Episode 2 times, bears last hibernated in the cave.
- As fragmentary cave bear material is exposed on the surface until some 20 m beyond the most outward bear crania visible on the floor of the Galeria

The Distributions of Finds and Features

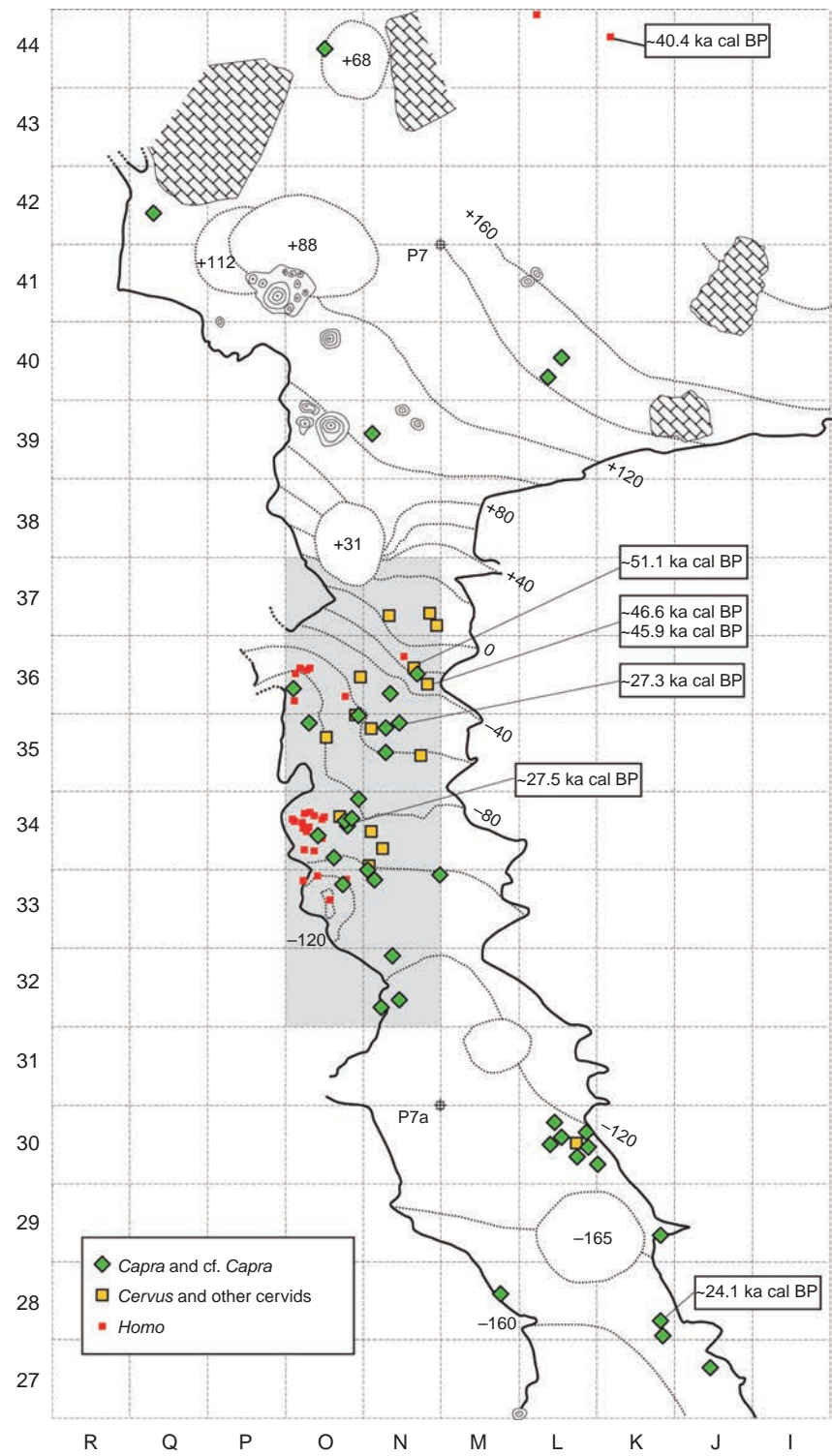


Figure 10.10 Distribution of the piece-plotted bones of humans and herbivores recovered in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor excavation (all fragmentation categories).

LIFE AND DEATH AT THE PEȘTERA CU OASE

Table 10.4 Stratigraphic position of the non-bear bones labeled Level 2 at the time of excavation

Specimen	Description	Quadrant	Observations	Diagnosis
<i>Canis lupus</i>				
N36.118, 170	Axis (2)	N36A	Level 2 here was exposed as surface	Possibly Surface or Level 1
N36.113	Metapodial	N36A		
N36.445, 879	Third phalanges (2)	N36B		
N36.722b	Premolar	N36B		
N36.277	Tibia, right	N36B		
N32.52	Femur, right, shaft	N32B	July 11–14, 2004; in N32, separation of Levels 1 and 2 was approximate and postexcavation; the excavation did not penetrate deep into deposits explicitly recognized as a different unit until July 15, 2004	
N32.77	Humerus, right, shaft	N32B		
N32.105	Maxilla, right, shaft	N32A		
N32.215	Second metacarpal, right	N32C		
N34.127	Lumbar vertebra	N34C	July 22, 2004; all other bones from that day in N34 and O34 are labeled Level 1, including those mapped adjacently and sequentially (N34.125 and N34.126)	
N33.214	Upper third premolar, right	N33C	July 17, 2004; on this day, N33C and N33D were taken “down to a surface corresponding to what had been designated ‘Level 2’ in N32 on July 12–15”	Probably Level 2
N32.356	Third metacarpal, right	N32ABCD	July 15, 2004; on this day, the excavation penetrated deep in Level 2, already partly excavated in previous days	Level 2
N32.392	Rib, shaft	N32ABCD		
N33.124	Fourth metacarpal, right	N33A	July 20–22, 2004; in N33A, the decapage of the surface of Level 2 had been completed July 16	
N33.272	Metapodial	N33A		
N36.110	First phalange	N36D	July 20, 2005; on this day, Level 2 was taken down to about 50 cm below the original surface in N36C and N36D, but its decapage and superficial excavation dated back to July 15, 2005	
N36.107	Cervical vertebra	N36C		
O34.403	Radius, right, proximal	O34A	July 24, 2004; the decapage of Level 2 had been made on the previous day	
O34.191	First phalange	O34C	July 22, 2005; from a trench excavated deep into Level 2 (in O34, the decapage and excavation of the upper part of the level had already been made, in 2004)	
O34.555	Sesamoid	O34B		
N37.594	Lower third molar	N37CD	July 23, 2005; on this day, Level 2 was taken down to ca.72 cm below datum in N37C–D, where decapage and superficial excavation had been made on the previous day (but see note for ibex bone N37.661)	Probably Level 2
N37.52	Metapodial	N37CD		
N37.190	Tibia, left	N37CD		
N37.37	Cervical vertebra	N37D	July 22, 2005; mapped in with an unambiguous “Level 2” label to differentiate it from other bones from the same day and area labeled Surface	Level 2
O37.19	Caudal vertebra	O37CD	July 23, 2005; O37C and O37D dug separately in Surface and Level 1, then as a single unit, alongside N37CD, down to ca.72 cm below datum, in Level 2	
<i>Vulpes vulpes</i>				
N35.504	Radius fragment	N35B	Level 2 here was exposed at the surface of the deposit	Possibly Surface or Level 1
N37.51	Metapodial	N37CD	July 23, 2005; on this day, Level 2 was taken down to ca.72 cm below datum in N37C–D, where decapage and superficial excavation had been made on the previous day (but see note for ibex bone N37.661)	
N37.157	Mandible, left	N37CD		

(continued)

The Distributions of Finds and Features

Table 10.4 (continued)

Specimen	Description	Quadrant	Observations	Diagnosis
<i>Cervus elaphus</i>				
N37.98	Mandible fragment	N37CD	Glued-back onto N37.34 (Surface) and N37.522 (indefinite level)	Surface or Level 1
<i>Cervus elaphus?</i>				
N36.116, 117, 1064, 1065, 1068, 1070	Antler fragments (6)	N36B	Level 2 here was exposed as surface; antler fragments were recovered in Level 1 in all adjacent quadrants	Surface or Level 1
O34.559	Antler fragment	O34C	Level 2 here was only superficially excavated; all other antler fragments from the Panta Strămoșilor are Level 1 or Surface	
N36.1040	Upper canine	N36B	Level 2 here was exposed as surface	
<i>Capra ibex</i>				
N36.304	Lunar, left	N36B	Level 2 here was exposed as surface	Possibly Surface or Level 1
N37.264	Scaphoid, left	N37CD	July 23, 2005; on this day, Level 2 was taken down to ca.72 cm below datum in N37C-D, where its decapage and superficial excavation had been made on the previous day; however, given that this bone has the same provenience as N37.661, a similar diagnosis applies with great probability	Probably Level 1
<i>Capra ibex?</i>				
N32.74	Vertebra, thoracic	N32A	July 11–14, 2004; in N32, separation of Levels 1 and 2 was approximate and post-excavation; the excavation did not penetrate deep into deposits explicitly recognized as a different unit until July 15, 2004; the bone comes from close to the wall, where the surface of the deposit was gullied and filled with Level 1 material	Probably Surface or Level 1
N32.131	Vertebra, lumbar	N32C		
N32.145	Rib, proximal	N32C		
N32.315	Vertebra	N32ABCD	July 11–14, 2004; in N32, separation of Levels 1 and 2 was approximate and postexcavation; the excavation did not penetrate deep into deposits explicitly recognized as a different unit until July 15, 2004	
N32.316	Rib, proximal	N32ABCD		
N33.183	Coxal right, proximal	N33A	Date of excavation unknown (could be July 15, 2004, a day when mostly Level 1 and Surface material was excavated and the decapage of the surface of Level 2 was carried out)	
N35.275	Rib	N35B	Level 2 here was exposed at the surface of the deposit	
N36.1023	Incisor	N36B		
N37.661	Carpal	N37CD	July 23, 2005; on this day, Level 2 was taken down to ca.72 cm below datum in N37C–D, where its decapage and superficial excavation had been made on the previous day; however, this bone articulates with the O36.62 metacarpal from Level 1, so the attribution to Level 2 must result from excavation or labeling error	Level 1

LIFE AND DEATH AT THE PEȘTERA CU OASE

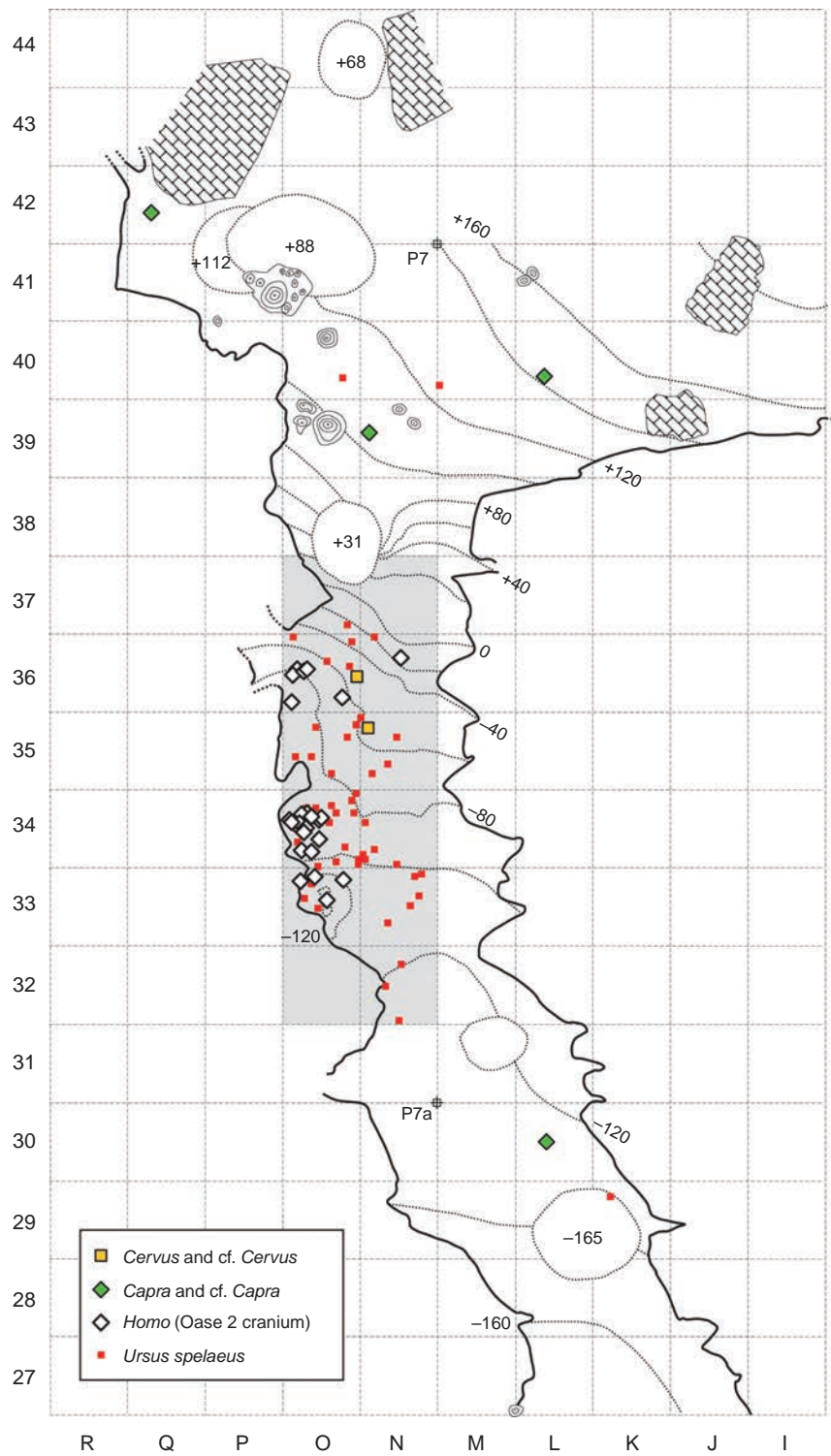


Figure 10.11 Distribution of the piece-plotted crania and maxillae of humans and herbivores recovered in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor excavation against that of all bear crania and maxillae (all fragmentation categories).

The Distributions of Finds and Features

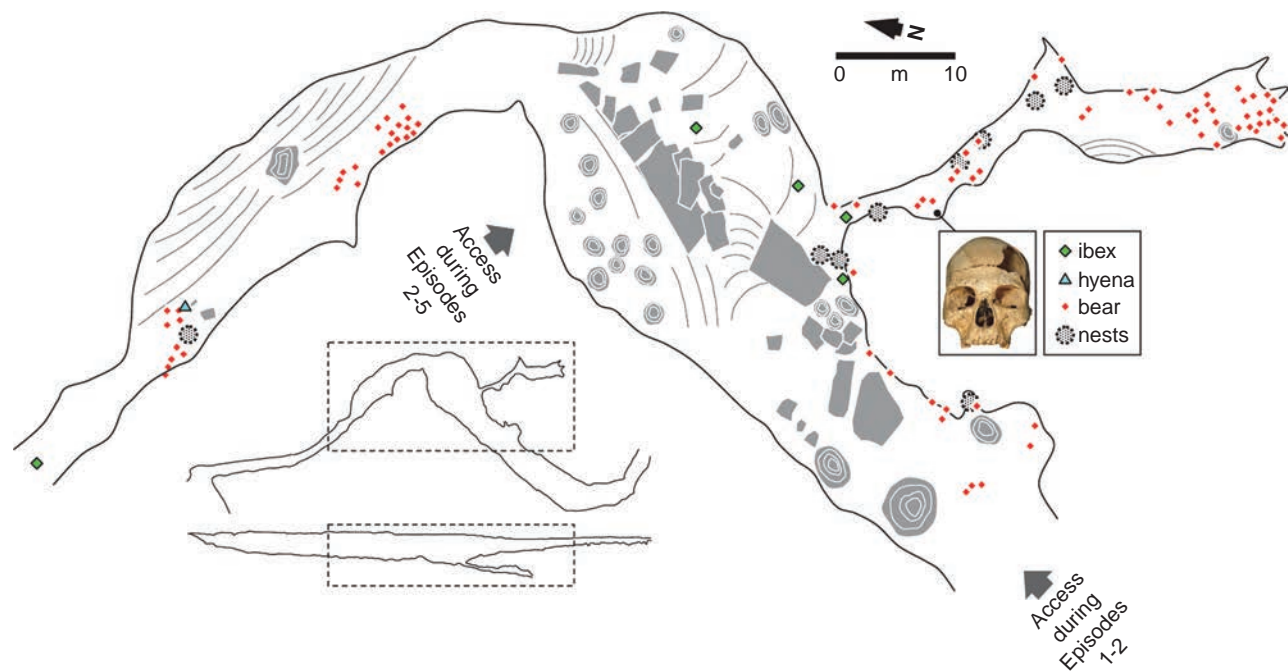


Figure 10.12 Distribution of cave bear nests and of the crania of all taxa identified on the surface of the Peștera cu Oase system during the 2003 site mapping (wolf remains, namely, mandibles, were also observed in the Galeria Lungă; being noncranial, they were not mapped in at the time and are not included in the figure).

celor Trei Cranii, the limits of the distribution are not an artifact of a putative masking of Episode 2 bones and features by the extensive calcite mantles that cover the floor of this passage around topographic stations 9 and 10.

- An empty space corresponding to most of the Sala Mandibulei breaks the distribution of bear crania inside the Peștera cu Oase.
- In this area, however, bear bones can be observed under the talus of large boulders, capped by thick stalagmitic columns, that accumulated against the north side of the Sala Mandibulei; as none were found on top of those boulders, the accumulation of the latter must postdate when bears last hibernated inside the Peștera cu Oase.
- Despite its good visibility everywhere else in the system, no ibex cranial material (or postcrania) was found on the surface of the Galeria celor Trei Cranii, suggesting that the remains of this species entered the Peștera cu Oase via a route different from that of the bears.
- Such an alternative “ibex route” can only have been the direct connection between the Sala Mandibulei and the exokarst whose opening some time between the end of Episode 2 and the beginning of Episode 5 is hypothesized in the framework of the formation process previously proposed; given the stratigraphic

and chronological constraints, the generation of this opening and the collapse responsible for the Sala Mandibulei’s large boulder accumulation are likely to correspond to one and the same event.

- The human remains, all found within the limits of the area of distribution of the ibex, probably also entered the system via the same route.

Although excavations were limited to the Panta Strămoșilor, the nature of the subsurface deposits in the Galeria celor Trei Cranii and the Galeria Lungă could be assessed through the observation of natural cuts.

In the Galeria celor Trei Cranii, these were the > 50 cm deep walls of several subsidence basins, which exposed a heterometric gravel with cobbles packed in a matrix of coarse sands and containing abundant, fragmentary, and evenly distributed cave bear bones. This deposit is identical to Level 2 of the Panta Strămoșilor, and the direct radiocarbon dating of a maxilla collected on the surface of the Galeria celor Trei Cranii (Sample 13; Chapter 8) provides a *terminus ante quem* of ~44.1 ka cal BP for its accumulation. Level 2 of the Panta Strămoșilor and the exposed fill of Galeria celor Trei Cranii are therefore likely to be geologically the same.

In the Galeria Lungă, the natural cuts were the walls of (small carnivore?) burrows excavated in the terminal part of the gallery, observed over a depth of 30–50 cm.

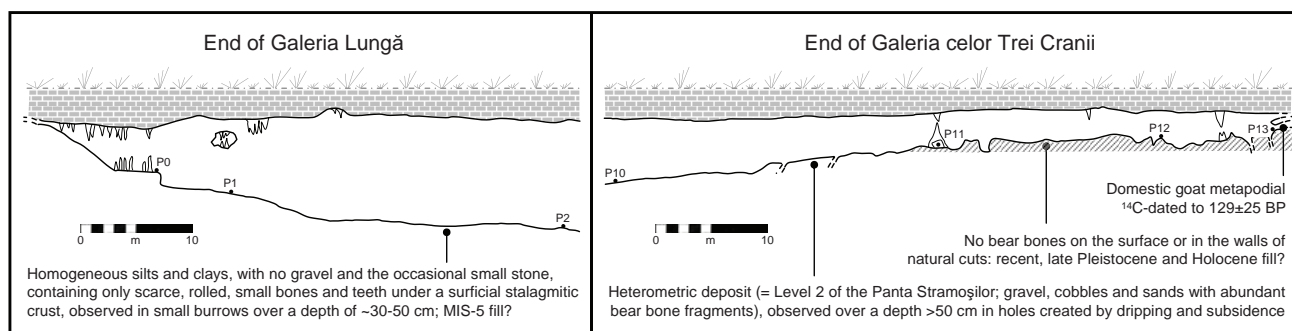


Figure 10.13 Topographic profiles of the Galeria Lungă and the Galeria celor Trei Cranii and subsurface stratigraphy observed in the areas adjacent to their ends. The letter P denotes numbered topographic stations.

Under a surficial stalagmitic crust, they featured a plastic silt and clay fill, with the occasional small stone but no gravel and containing only scarce, rolled, small bones and teeth (in a ~1.5 kg sediment sample collected from the loose fill at the bottom of one of these burrows, we found only a rolled cranial fragment, a premolar, and the germ of a permanent canine of cave bear, the two teeth featuring slight water-induced patination).

These observations are consistent with the twin notions, incorporated in the formation process previously discussed, according to which (1) the fills of the Galeria Lungă and the Galeria celor Trei Cranii belong to different generations of the Peștera cu Oase speleogenesis and (2) the former's connection with the exokarst closed well before the latter's. This conclusion is further supported by the topographic information given in Figure 10.13. The fill of the Galeria celor Trei Cranii rises slowly and gradually (1 m every 15 m over some 60 m) from topographic station 10 to topographic station 13. The former station is where the outermost three bear crania in the passage (those after which it is named) are located, indicating that here the surface of the fill is still that which existed when bears used the cave; the latter, terminal station is where the fill abuts the roof of the passage and is located at a depth of only ~4 m from the exterior ground surface. In contrast, the Galeria Lungă is truncated abruptly by a speleothem-covered collapse (implying a slope whereby, over its last 25 m, the deposit rises on average 1 m every 3 m), and the vertical distance between the top of the passage's fill and the exterior ground surface is of ~12 m. Moreover, recent fox bones were observed on the floor of the Galeria celor Trei Cranii, and the metapodial of a domestic goat collected at the very end of this passage was directly dated to some time in the last few centuries (Chapter 8). Combined, these observations are consistent with the notion of a cluttering up of the Galeria celor Trei Cranii exit through the accumulation in geologically recent times of a talus of loose sediments and boulders through which only small mammals and isolated bones could pass.

The U-series dating of speleothems (Chapter 6) provides further clues to the fact that, contra the situation in the Galeria celor Trei Cranii, the Galeria Lungă became a stable environment, in terms of sediment buildup, during the last interglacial. Speleothems dated to MIS 5 exist on terraces lying only ~4 m above the floor of the Galeria Lungă, but none of such age were identified above the fill (of Panta Strămoșilor Level 2 type) of the Galeria celor Trei Cranii. Here, if any MIS 5 speleothems exist, they must be buried by that fill, as may also be the case in the Panta Strămoșilor, if the draperies and stalactites exposed along its walls by our excavation are indeed of MIS 5 age (as, although undated, they most likely are, given the stratigraphic constraints, which imply that they must be older than the ~50 ka cal BP Level 2 deposits that cover them). These facts suggest that, stratigraphically, the fill of the Galeria Lungă underlies that of the Trei Cranii and Culcușurilor passages and may well correspond to the breccia with bear bones exposed at the Puțul, for which ESR dating of bear teeth collected therein suggests an MIS 5 age (Chapters 5 and 7).

Overall Species Distributions and Changes in Site Function over Time

Of Wolves and Bears

The only non-bear taxon securely represented in Level 2 of the Panta Strămoșilor is the wolf (Table 10.4). Since that level reflects a high-energy sedimentation environment, this association probably corresponds to the mix at the place of deposition of material originally accumulated (1) elsewhere in the endokarst (the bear bones) and (2) near the then extant entrance to the Peștera cu Oase passages (i.e., the entrance to the Galeria celor Trei Cranii) but washed deep inside (the wolf bones).

Where the palimpsest of surface finds is concerned, the time depth of its accumulation, coupled with the

changes in the topographic configuration of the system that can be inferred from the different lines of evidence previously discussed, provide a first level of explanation for the overlapping distributions of the different taxa. Namely, it is clear that (1) the bear remains derive from in situ hibernation deaths occurring deep inside the cave, which is to be expected and (2) the accumulation of the remains of humans and ibex, which long postdate the bears, is in all likelihood related to the opening at a later time of an entrance adjacent to the slope at the bottom of which the bones of those two species were for the most part found.

Two things, however, remain to be explained. First, a direct interaction between wolves and bear bones is implied by the taphonomic study's conclusion that the carnivore gnawing and puncture marks apparent in the bear remains were most probably caused by wolf scavenging rather than conspecific activity (Chapter 12), and, second, in the Surface and Level 1 stratigraphic units of the Panta Strămoșilor, > 90 m inward from the point where the fill of the Galeria celor Trei Cranii abuts the roof, there are remains of noncave dwelling species, namely, red deer, that postdate the period during which torrential accumulation can explain the presence of nonhibernating animals that far from the entrance.

Presumably, bears would not have hibernated in places that were within easy reach of scavengers, so a simultaneous use of the site by the different carnivore species identified can be ruled out as an explanation for the overlapping distribution of the bones of bears (including wolf-marked ones), wolves, and hyenas. A time-sharing scenario—that is, one where wolves and hyenas would come to the Peștera cu Oase at the end of the hibernation season to scavenge on the remains of hibernation deaths—is also unlikely, as such a scenario cannot explain why wolves and hyenas would have stayed away from the site (and the tons of frozen meat available therein in the form of deeply asleep bears) at other times of the year.

Therefore, a parsimonious explanation for the Episode 2 (~44–46 ka cal BP) species distribution pattern is that this episode conflates two separate consecutive moments of site use and that the segregation of these moments could not be picked up by radiocarbon because of the method's limitations in resolving into shorter intervals the millennial time ranges it returns for periods this close to its limit of applicability. In the first moment, the Peștera cu Oase would have remained a bear hibernation site, as documented by the extant nests and the associated skeletal remains of the bears themselves. In the second moment, the Peștera cu Oase, now abandoned by the bears, would have become available to wolves and hyenas, which scavenged the remains left behind by the site's former tenants (bones and, possibly, partly mummified soft tissues too). This

scenario can also explain the bones of red deer, some of which are carnivore-marked (Chapter 17)—they would have entered the site as parts of carcasses brought in by denning wolves in the framework of the second moment of Episode 2 site use. The cause underlying the changes in site function that would have occurred from one moment to the other remains, however, speculative. A possibility is that the second moment corresponds to a period when the cluttering up of the Galeria celor Trei Cranii entrance had advanced to the point of preventing bear access but still allowed use by smaller-bodied wolves and hyenas.

At first glance, the fact that carnivore-marked bear bones also exist in Level 2 is inconsistent with this reasoning, as it establishes the co-occurrence of bear and wolf bones as the rule instead of the exception, thereby dispensing with the need for a special explanation. In fact, the bones recovered in this level are evidently displaced from areas of the site located upstream from the Panta Strămoșilor and presumably include material originally accumulated much closer to the then extant entrance. If the bear bones thus displaced resulted from hibernation deaths, then such an original location must still have corresponded to an area suitable for hibernation, that is, one located at a distance from the entrance sufficient to provide the temperature and light appropriate environment required. So, if wolves were the agent involved in the Level 2 bear bone gnawing and the bear bones in question reflect hibernation deaths, then we have to admit that, during Episode 1 of the formation process, wolves had full access to hibernation areas located deep inside the Peștera cu Oase. We also know that carnivores other than bears indeed frequented the Sala Mandibulei and adjacent areas of the Peștera cu Oase during Episode 2 (rather than their bones having been introduced from the outside by geological processes), as this is implied by the intact, directly dated hyena cranium found in the Galeria Lungă. These observations, however, cannot counter the notion that a simultaneous use of the Peștera cu Oase passages by denning wolves and hyenas and hibernating bears would have been behaviorally anomalous. An explanation remains therefore necessary.

A realistic solution for the conundrum is that not all the bear bones from Level 2 reflect hibernation deaths and that such is namely the case with the carnivore-marked ones. As pointed out by Quilès et al. (2006), bears may have used the cave for shelter during nonhibernating parts of the year too. Death at such times may therefore, occasionally, have generated the presence of bear corpses in more exterior parts of the Peștera cu Oase passages. Scavenged by wolves prior to their torrential inward displacement, the bones from such dead bears would then have become mixed up, in the more interior locations

where we excavated them, with the nonmarked bones of the species generated by hibernation deaths occurring in more interior areas of the cave, suited for bear nesting and beyond the reach of the wolves.

Where the Surface and Level 1 bones are concerned, this explanation, however, cannot apply, as the preservation of the bear nests themselves precludes the operation of the torrential mechanism required to displace 100 meters or more inward of the entrance remains originally accumulated there. A viable, alternative solution lies in admitting that (1) the postulated opening to the Sala Mandibulei through which penetrated, during Episodes 4–5 of our formation model, the surficial human and ibex material, formed prior to the earliest such penetrations (i.e., during the second moment of Episode 2), and (2) such was also, at that time, the access used by the wolves (and hyenas) that sheltered or denned (and died) inside the Peștera cu Oase.

This hypothesis would explain the presence in areas adjacent to the new opening of the remains of cervids (carnivore-marked and, therefore, presumably carnivore-accumulated too), plus the scavenging of the remains of bears that had used those areas for hibernation before they became directly connected to the exokarst. The spatial distribution patterns are consistent with such a scenario. Like those of humans and ibex, all remains of wolf, hyena, or deer come from the Sala Mandibulei, the Galeria Lungă, and the Panta Strămoșilor (Figure 10.12). None were observed on the surface of the Galeria celor Trei Cranii, which one would not expect to be the case if these non-bear carnivores accessed the site's interior passages via the Galeria celor Trei Cranii entrance.

A late Episode 2 (i.e., ~44 ka cal BP) opening of the Sala Mandibulei to the exokarst begs, however, the question of why the radiocarbon dates suggest a depositional hiatus at the site during the ~43–41 ka cal BP interval. Conceivably, this hiatus may simply be an artifact of insufficient sampling, and the time of opening of the Sala Mandibulei entrance should indeed be decoupled from the time of the minor flooding event operating via that entrance that generated the Panta Strămoșilor bone jumble. If the opening formed during the second moment of Episode 2, then it was more or less coincidental with the cluttering up of the Galeria celor Trei Cranii and both processes may well be interrelated. For instance, they could reflect, together with the period of overall stabilization of the site that followed (Episode 3, documented by the weathering of the bear bones subsequently buried in Level 1 of the Panta Strămoșilor), a common underlying cause—external environmental change. Note that the rather abrupt transition from stadial to interstadial conditions marking the onset of Greenland Interstadial (GI) 11 took place around ~44 ka cal BP. Through the expansion of mountain forests in the area, this change could

have modified local ecosystems, thereby impacting the populations of large carnivores in significant ways. In the absence of direct information on local paleovegetation patterns at this time, this hypothesis remains speculative, yet useful—it reminds us that, alongside the modifications in the system's topography, global climate change and its regional paleoenvironmental consequences may also have contributed to the variation observed over time in the use (or abandonment) of the Peștera cu Oase by different carnivore taxa.

Of Ibexes and Humans

In the faunal assemblage generated by the excavation and sample collection work carried out inside the Peștera cu Oase, the ibex number of identifiable specimens (NISP) is almost double that of the cervids. Therefore, the fact that only a couple of the ibex bones were carnivore-marked (Chapter 17) cannot be explained as an artifact of sample size. Moreover, the direct dating of ibex material collected from the Surface and Level 1 stratigraphic units failed to show any chronological overlap with the carnivores that might have accumulated their remains (wolves and hyenas). The same applies to the remains of the Oase 1 and Oase 2 humans, neither of which is carnivore-marked.

A parsimonious explanation for the Surface and Level 1 ibex remains is, therefore, as follows. During MIS 2, the sinkhole to which the Sala Mandibulei became connected at the end of Episode 2 (at the earliest) or at the beginning of Episode 5 (at the latest) functioned as a shelter for ibex herds. In the context of this use of the site, the remains of natural deaths would have dispersed into the adjacent karstic passages through gravity, runoff, and short higher-energy discharges caused by late spring snow melting. Such natural deaths could have included the odd carnivore kill. In fact, differently from the case with the cervid remains, the evidence to that effect should reflect wolf activity in the exterior landscape, because no secure indication exists that carnivores denned inside the Peștera cu Oase during the time interval indicated by the directly dated ibex remains.

A similar mechanism can also explain the accumulation of the Peștera cu Oase humans. These, however, are represented only by skull material, whereas all skeletal parts are represented in the ibex remains. On the other hand, the lack of human postcrania, in particular the absence of neck vertebra despite the evidence for partial mummification of the Oase 2 cranium (Chapter 21), is not readily explained by the kinematics of the Panta Strămoșilor's bone accumulation. Bearing this in mind, some form of human agency cannot be discarded as an explanation for the fact that, of all the taxa represented in the Panta Strămoșilor, *Homo sapiens* is the only species that is represented by cranial material only (hyena is the

other Oase taxon with a similar body part representation, but the one cranium of this species is a surface find from the Galeria Lungă, where no excavation was carried out).

For instance, the adjacent sinkhole could have been used for the selective/ritual disposal/placement of skulls, of which one cranium eventually rolled down as far inside as the O₃₄ grid unit of the excavation, while one mandible eventually made it onto the surface of the Sala Mandibulei. Or such disposals/placements may have been of complete bodies, of which only crania, favored by their spherical shape, were subsequently displaced by natural processes onto the inner karst locations where they have been encountered. However, no material evidence of the operation of that human agency has been obtained and no evidence of past human presence in the cave has been observed. Therefore, the parsimonious reading of the data is that, like those of ibex, the remains of humans reflect natural deaths occurring in the catchment of the sinkhole adjacent to the Sala Mandibulei, into which their corpses were eventually dragged by gravity or rain or snowmelt waters. As a result, skulls or skull parts thereof ended up in the Sala Mandibulei and the Panta Strămoșilor, after skeletonization and through the operation of primarily gravity-driven depositional mechanisms.

Conclusion

When all lines of evidence are considered, the stratigraphic and spatial distributions of the different animal species identified in the Peștera cu Oase system can be accounted for by a complex site formation process that, in short, we reconstruct as follows. Early in the Late Pleistocene, probably sometime during MIS 5, the entrance to the Galeria Lungă ceased to function, due to colmatation by an éboulis cone. Throughout MIS 4 and early MIS 3, bears entered the site via the Galeria celor Trei Cranii, sheltered at its entrance, and used for hibernation the areas of the system most removed from that entrance, namely, the Sala Mandibulei, the adjacent areas of the Galeria Lungă, and the Galeria Culcușurilor. A torrential mechanism of deposition periodically washed downstream the bone remains of bear hibernation deaths, mixing them up with bear and non-bear bones dragged from the exokarst and the entrance. The

process gradually accumulated the Level 2 deposits, eventually cluttering up the Poarta and significantly filling up the Galeria Culcușurilor and the Galeria celor Trei Cranii.

This regime came to an end ~46 ka cal BP, which enabled the in situ pristine preservation of the features, such as nests, left behind by the last bears that hibernated in the Peștera cu Oase. Soon after, the progressive colmatation of the Galeria celor Trei Cranii exit, coupled with the formation of a direct connection between the hibernation areas and the exokarst, due to a collapse that opened the Sala Mandibulei to an adjacent sinkhole, led to abandonment of the site by bears. At this time, hyenas and wolves began to frequent the former bear hibernation areas, scavenging on their scattered remains, bringing in cervid carcasses (or parts thereof), and sometimes also dying in the cave. No further large carnivore activity is recorded inside the Peștera cu Oase after ~44 ka cal BP, but ~42.5–40.3 ka cal BP, a low-energy flooding event created the Panta Strămoșilor bone jumble, where the bones of the bears, wolves, and cervids accumulated in the cave ~44–46 ka cal BP became mixed up in the Level 1 stratigraphic unit of our excavation.

It was on top of the stabilized, variably calcite-cemented surface of this bone jumble that, between ~40.5 and ~17.3 ka cal BP, the remains of humans and ibex, introduced into the Panta Strămoșilor and the Sala Mandibulei via the sinkhole adjacent to the latter and apparently by purely geogenic processes, eventually ended up. The subterranean landscape generated by this formation process was then sealed by the accumulation of mm-thick clay films and the cluttering up of the passages leading out from the Sala Mandibulei. This process must have involved the building up of sediment and éboulis on the outside and, inside, the growth of the massive stalagmitic columns formed over the chaos of blocks piled up against the north side of the Sala Mandibulei. This growth must postdate the last of the ibex and thus probably coincides with the Tardiglacial and Early Holocene phase of speleothem growth documented by the U-series dating of stalagmites collected in many different parts of the system. Finally, it was in the year 2002 AD that this amazing landscape could be appreciated for the first time in its total complexity by the ProAcva cavers, the first large-bodied mammals to enter the site in many millennia.

Part Seven

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