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VERTEBRATE TAPHONOMY AND DINOSAUR PALAEOPATHOLOGY FROM A LOWER CRETACEOUS BAUXITE LENS, NORTH WEST ROMANIA

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Abstract: The Lower Cretaceous bauxite lens at Cornet, North West Romania, was deposited in a karstic environment as part of a system of sink holes, probably on an island in the Tethys Ocean. This bauxite lens has yielded thousands of bones and bone fragments since the initial excavations in 1978. The fauna is of restricted taxonomic diversity, and consists predominantly of ornithopod dinosaurs and rare pterosaurs. The bones have a limited size range, show a wide range of abrasion characteristics, are frequently broken and show little or no evidence of *in situ* weathering damage. Sorting of the skeletal elements is apparent: vertebral centra are over-represented in the collection. Of particular note are a few bones with evidence for predation or scavenging, in the form of circular punctures and elongate grooves, and pathological damage, including abnormal bone growth.
Keywords : Lower Cretaceous, Bauxite, Karst, Dinosaur, Taphonomy, Palaeopathology, Romania

Taphonomie des vertébrés et paléopathologie des dinosaures d'une lentille de bauxite, Crétacé inférieur du nord-est de la Roumanie.

Résumé : La couche lenticulaire de bauxite du Crétacé inférieur de Cornet, au nord-est de la Roumanie, s'est formée dans un environement karstique, probablement sur une île de l'océan Téthys. Cette lentille de bauxite a livré des milliers d'os et fragments d'os depuis les premières fouilles en 1978. La faune a une diversité taxinomique restreinte, et consiste principalement en des dinosaures ornithopodes et de rares ptérosaures. Les os sont de tailles similaires, montrent divers motifs d'abrasion, sont fréquement brisés et ne montrent peu ou pas d'usure par des agents atmosphérique *in situ*. Le tri des éléments squelettiques est apparent: les centres vertébraux sont sur-représentés dans les échantillons. De plus, quelques os témoignent d'une part de l'action de prédateurs ou de charognards sous la forme de ponctuations circulaires et de sillons, et d'autre part d'indices pathologiques, tels qu'une croissance osseuse anormale.
Mots-clés : Crétacé inférieur, Bauxite, Karst, Dinosaure, Taphonomie, paléopathologie, Roumanie
Abbreviations : MTCO - Muzeul Tarii Crisurilor, Oradea.

INTRODUCTION

The vertebrate fauna discovered in the Lower Cretaceous karstic bauxite lens at Cornet, North Western Romania, has attracted considerable interest due to the unusual nature of the sedimentological context. The vertebrate association preserved in the bauxite consists of dinosaur, pterosaur and possible bird remains.

Tiberiu Jurcsak and Elisabeta Popa, palaeontologists from the Muzeul Tarii Crisurilor, Oradea, worked in the bauxite lens in 1978, and extracted by blasting many tonnes of bauxite and associated bones. Popa has prepared most of the material, producing a collection which consists of over nine thousand bones, especially vertebral centra, phalanges and metapodials. Teeth, long bones and skull elements are very rare. Between 1978 and 1979 Florian Marinescu, a geologist from the Institute of Geology, Bucharest, excavated by hand a collection of approximately 600 vertebrate fossils. Recently, this material has been donated to the Muzeul Tarii Crisurilor, Oradea. Small-scale hand excavations were undertaken between 1978 and 1983, after which the mine was closed.

Until 1994, when the mine reopened, little attention was paid to the sedimentary context of the fossils (Patrulius *et al.*, 1983). The revision of the fauna and the analysis of the sedimentology and taphonomy began in 1994 as a joint project between the Muzeul Tarii Crisurilor, Oradea, and the Department of Earth Sciences, University of Bristol. Fieldwork carried out in 1995 and 1996 enabled small-scale, detailed excavations to focus on the sedimentology of the site and the *in situ* characteristics of the bones. The history of the site is detailed in Benton *et al.* (1997).

LOCATION

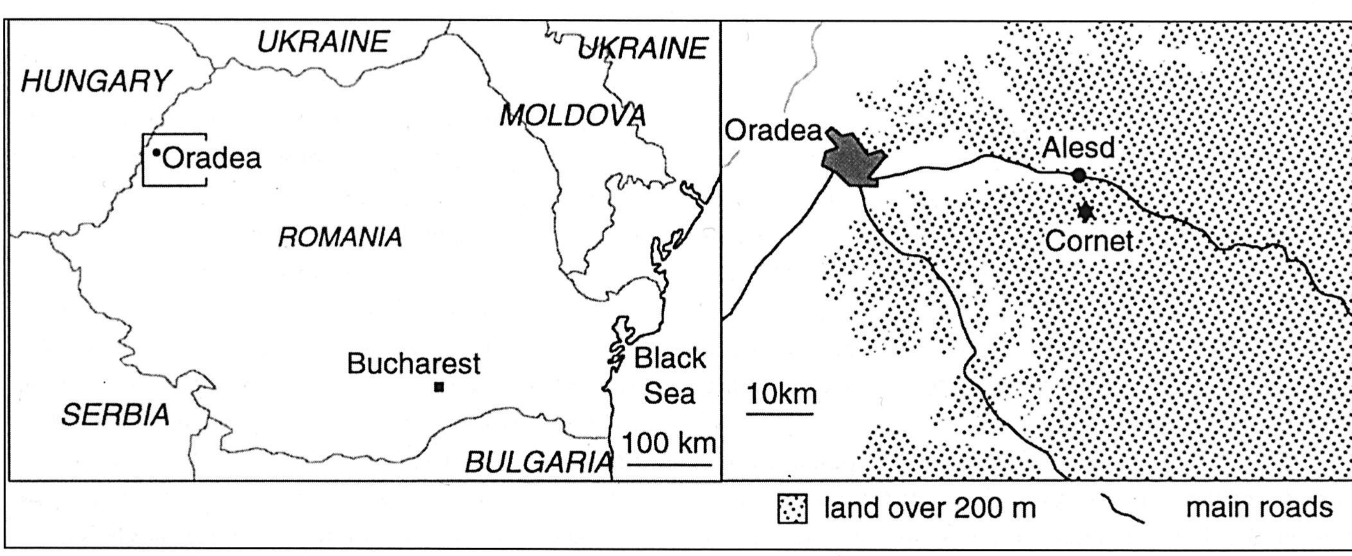
The bone-bearing lens (lens 204 of the S.C. "Bauxita Min" S.A. Dobresti Company) is located approximately 40 km east-south-east of Oradea, in north west Romania (fig. 1). Lens 204 is one of many subterranean and surface bauxite deposits in the Cornet area, which are worked commercially to supply the aluminium processing plant in Oradea. Excavation of the bauxite is still a low-level technological process, and relies heavily on manual labour, with limited use of large-scale mechanisation.

Lens 204 is approximately 40 m below ground, and is reached by a steeply inclined adit and connecting passages. The bauxite lens is approximately 35 m long and 20 m wide, and is kidney-shaped in outline. The main part of the chamber is small, approximately 8 m long by 4 m wide, and is roughly circular in shape.

GEOLOGY AND SEDIMENTOLOGY

The geology and bauxite sedimentology of the Cornet 204 lens has been described (Patrulius *et al.*, 1983; Grigorescu, 1993), has been reviewed in detail by Benton *et al.* (1997), and will only be briefly summarised here. The Mesozoic karst geomorphology (both surface and subterranean features) was formed in the Tithonian Cornet Limestone, uplifted during late Kimmeridgian movements (Bordea and Mantea, 1991), and covers a wide geographical area. The karst topography is overlain by substantial deposits of bauxite, indicative of subaerial exposure and pedogenetic processes, facilitated by humid-tropical climatic conditions. The bauxite deposits, part of the Lower Bauxite Formation of Dragastan *et al.* (1988) (fig. 2), may be several metres thick, and infill both the surface and subterranean features of the Mesozoic karstic landscape. Determinations of the age of the bauxite deposits vary. Patrulius *et al* (1983) consider the sediments to be of late Berriasian to earliest Barremian age, while Dragastan *et al.* (1988) suggest deposition between the late Berriasian and early Valanginian. The continental bauxite deposits are regionally overlain by Barremian-Aptian lacustrine and marine limestone (Bleahu, 1972; Bordea and Mantea, 1991; Grigorescu, 1993; Benton *et al.*, 1997). Similar, but stratigraphically younger, sequences are recorded in

Figure 1 The location of Cornet. a: Romania, showing the location of Oradea, b: Bihor province, showing Cornet to the south of Alesd.



the Hateg Basin, Southern Carpathians, Romania, and in neighbouring Hungary (Daranyi, 1972; Papiu *et al.*, 1971).

Cretaceous	Aptian	Ecleja Formation
		Gugu Formation
		Upper Bauxite Formation
	Lower Barremian	Lower Pachyodont Limestone
		Gastropod Limestone
		Characaea Limestone
	Valanginian	Lower Bauxite Formation
	Upper Berriasian	
Jurassic	Tithonian	Cornet Limestone
	Kimmeridgian	Vad Limestone
	Oxfordian	
	Middle Callovian	

Figure 2 Mesozoic stratigraphy in north west Romania. Modified from Dragastan *et al.* (1988).

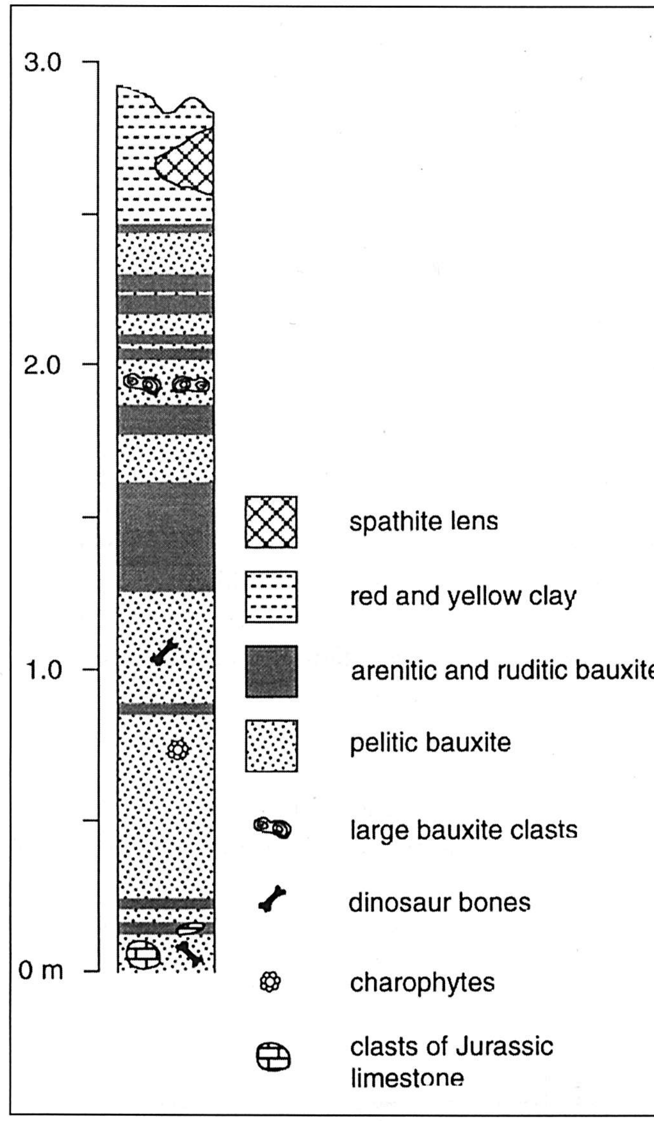


Figure 3 Simplified geology of the bauxite and associated sediments of Cornet lens 204 (modified from Patrulius *et al.*, 1983).

Patrulius *et al.* (1983) documented a detailed sedimentology and stratigraphy for the centre of Cornet lens 204 (fig. 3). In this description the base of the sequence is marked by crystalline calcite overlying the Tithonian Cornet Limestone. The calcite is, in turn, overlain by slightly bituminous black limestone, followed by a thick deposit of reddish-brown boehmitic bauxite. The bauxite consists of interbedded massive, argillaceous bauxite with thinner coarser-grained, sometimes gritty beds. The bauxite is overlain by laminated kaolinite. The bones were recorded from the fine-grained bauxites, towards the base of the section (Patrulius *et al.*, 1983; Grigorescu, 1993; Benton *et al.*, 1997).

Fieldwork carried out at Cornet lens 204 during the summer of 1995 enabled a sequence of sedimentary logs of the bauxite lens to be measured around the northern wall of the excavated cavern (fig. 4). The sedimentary logs highlight several interesting features of the lens 204 bauxite. The sections are dominated by bauxitic sediments, which show a wide range of grain sizes. Generally the sediments are clay- or silt-grade, although arenaceous and rudaceous beds occur. The bauxite is characterised by a rich reddish-brown colour, and is frequently cut by thin white calcite veins. Most of the hand specimens examined are massive with no sedimentary structures, although small patches of *in situ* crystalline calcite and occasional floating grains are present. The larger clasts comprise reworked calcite, and dark red and blackish pellets of reworked bauxitic sediments. In places the structureless argillaceous bauxite is interbedded with thin (maximum thickness of 0.01 m) beds of coarser-grained gritty conglomerates and sandy bauxite.

Crystalline calcite is an important feature of the sediments, and although generally occurring at the base of the sections, is found higher up in the sequence, towards the middle of the lens, as massive blocks (fig. 3, log 4). Correlation between the individual sections was difficult, especially in the north western areas of the lens. Many of the beds are laterally discontinuous, and wedge out over a distance of less than 1 m. A notable exception to this is the kaolinite layer overlying the bauxite. This unit was recorded in four of the six sections, and its presence or absence from logs 5 and 6 could not be determined due to large sheets of flowstone which have been deposited since excavations in 1978.

These six new sections generally agree with the observations of Patrulius *et al.* (1983) and Grigorescu (1993), although some significant differences exist. The first, and perhaps most important, difference relates to the stratigraphic abundance of the vertebrate remains. The sedimentary logs provided by Grigorescu (1993) show the vertebrate fossils occurring in a single pelitic bauxite unit. However, the 1995 fieldwork identified eleven bone-bearing units. The logs show that the bones are concentrated towards the centre of the lens. This supports observations published by Jurcsak (1982), who recorded a 0.6 m thick band of bone-supported conglomerate in the centre of the bauxite lens (Benton *et al.*, 1997). The second significant difference concerns the nature of the sediment associated with the bones. Patrulius *et al.* (1983) reported that the fossils were preserved in the finer-grained, argillaceous bauxites. However, the bones discovered in 1995 were often associated with units rich in limestones clasts. The museum collection preserves several examples of the bone-rich conglomeratic facies (Benton *et al.*, 1997).

A detailed model for the development of the karstic geomorphology of the Padurea Craiului Mountains has been constructed (Patrulius *et al.*,

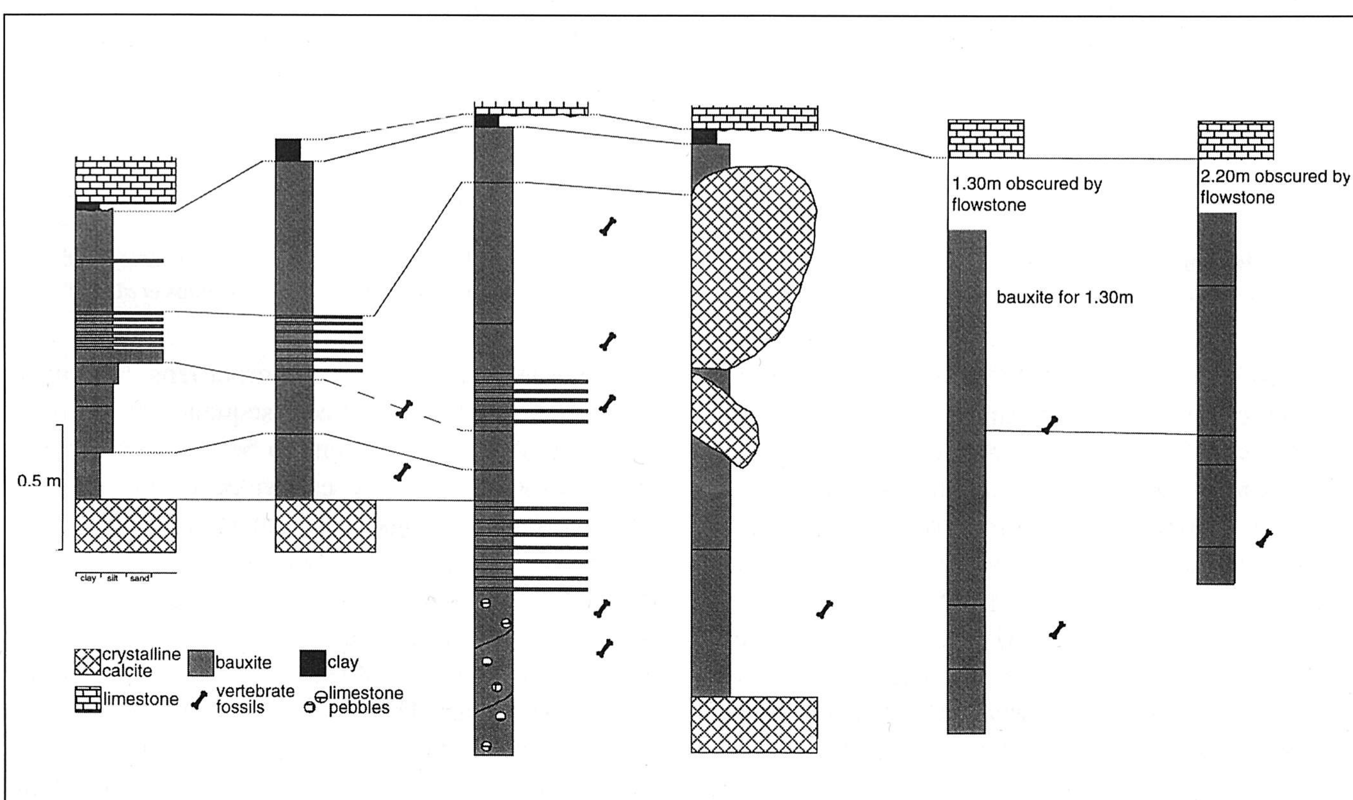


Figure 4 Sedimentary logs measured around the 'walls' of the mine chamber cut into Cornet bauxite lens 204.

1983), and is summarised in Benton *et al.* (1997). It is thought that the bauxite (a product of humid tropical belt subaerial weathering of local igneous and metamorphic rocks) and bones were washed into one of the three sinkholes on a small plateau on the slope of a small hill (Jurcsak and Kessler, 1991). The bauxite came from the hill slopes and from nearby ponds and lakes (as shown by the presence of charophytes, ostracods and freshwater gastropods) (Benton *et al.*, 1997).

TAXONOMY AND PALAEOBIOLOGY

Ornithopod dinosaurs are over-represented in the collection, with rare pterosaurs, supposed birds, an ankylosaur and a small theropod. Most of the specimens belong to a small species of *Camptosaurus*, identified on the basis of fused carpal bones, dentary and maxillary teeth (Tallodi-Posmosanu and Popa, 1997). Specimens characteristic of juveniles, for example unfused ornithopod neural arches, are present in the Cornet collection.

The dryosaurid *Valdosaurus* (Sues and Norman, 1990) is represented by a partial femur, vertebrae and metatarsals (Jurcsak and Kessler, 1991; Galton and Taquet, 1982). This genus is still poorly known, and is therefore difficult to characterise. However, it is thought to be comparable with material described from the English Wealden (Lower Cretaceous) and Albian sediments of Niger, West Africa (Galton and Taquet, 1982).

Jurcsak and Kessler (1991) assigned a dermal spine to an unknown species of ankylosaur. Theropod remains are extremely rare, only two ungual phalanges can be definitely attributed to a small predator. Their presence is also attested by the presence of tooth marks on some of the ornithopod bones (Benton *et al.*, 1997).

The pterosaurs were identified by Jurcsak and Popa (1982, 1984) as *Gallodactylus*, *Dsungaripterus* and an ornithocheirid. The *Dsungaripterus* material represents a taxon previously known from Asia. Three bird taxa have been reported from the Cornet faunal assemblage (Jurcsak and Popa, 1983; Kessler and Jurcsak, 1986; Jurcsak and Kessler, 1991). However, these fossils could represent a small theropod dinosaur or pterosaur (Benton *et al.*, 1997). Aquatic and semi-aquatic vertebrates are absent from the Cornet assemblage.

Invertebrate remains are extremely rare, but ostracods, gastropods and charophytes have been recorded (Patrulius *et al.*, 1983; Dragastan *et al.*, 1988), which suggest a lacustrine environment in the vicinity of the karstic landscape.

The Cornet faunal assemblage represents a single palaeocommunity which inhabited an island (see below). *Camptosaurus* is by far the most abundant animal in the Cornet palaeoenvironment, although *Valdosaurus* may have been almost as important. Both animals were low-level browsers. The low faunal diversity may be due to the fact that most of the bones in the collection are not taxonomically diagnostic. The apparent contradiction between the presence of aquatic invertebrates (ostracods and gastropods) and the absence of aquatic vertebrates is interesting. The large number of vertebrate fossils recovered from Cornet, and the relatively good degree of bone preservation may indicate that the lack of aquatic vertebrates is a true reflection of the composition of the palaeocommunity, rather than a taphonomic bias.

PALAEOGEOGRAPHY

The Cornet fauna lived on an island, one of several located off the northern shore of the Tethys Ocean. The vertebrate fossils show evidence of insularity and dwarfism (Benton *et al.*, 1997).

Camptosaurus, the most common dinosaur represented at Cornet, is a primitive form of an ornithopod known widely from stratigraphically older deposits in North America and Western Europe. This early occurrence suggests early isolation of the Cornet fauna. The dispersal of *Camptosaurus* in Europe was probably achieved through a land route across the North Atlantic epicontinental seaway, at some time during the Oxfordian (Galton and Powell, 1980).

The *Valdosaurus* material is comparable with the Wealden genus from the Isle of Wight , West Sussex and West Africa, and it has an intercontinental geographical range (Galton and Taquet, 1982). The presence of the pterosaur *Dsungaripterus* suggests faunal links with Asia.

Recently, Csiki (1997) described the possibility of faunal continuity between the Early Cretaceous dinosaurs from Cornet and the Late Cretaceous dinosaurs fauna of Hateg, southern Romania. Further studies of these two Romanian faunas will shed new light on local palaeogeography.

TAPHONOMY

Caves have for many years made a significant contribution to the science of palaeontology, both as a provider of specimens for taxonomic studies, and as a source of data and inspiration to taphonomic studies. Some of the first taphonomic experiments were constructed to explain the abundant Quaternary bone assemblages preserved in English limestone caves (Buckland, 1822). Caves are good sites for bone preservation, as the bones are protected to some degree from diurnal and seasonal changes in environmental conditions, which frequently damage or destroy bones (Shipman, 1981). Also, when washed into more inaccessible passages and caverns, the bones are largely protected from damage by predators and scavengers, plant roots and microbial activity (Simms, 1994). Simms (1994) describes three classes of vertebrate accumulations in cave sediments: biotic autochthonous (where the animals lived and died within the cave system), biotic allochthonous (where the vertebrate remains were carried into the caves by animals) and abiotic allochthonous (where the materials were transported into the cave systems by water or gravity, for example pit traps, water hole traps, slumping and collapse and reworking from the host limestone). The fossils preserved in the Cornet bauxite lens are characteristic of an abiotic allochthonous assemblage. Although the preservation of the bones is frequently very good, the nature of the host sediments, and especially the stratigraphy can cause great problems when interpreting vertebrate cave assemblages.

The bone-bearing bauxite lens at Cornet is one of two locations where vertebrate materials preserved in bauxite have been documented. A crocodile tooth and some indeterminate bone fragments were recovered from the bauxite deposit at Boszorkanyhegy, Hungary of Albian age (Kretzoi and Noszky, 1951; Mindszenty, pers. com., 1995). The discovery of the bones in lens 204 is extremely unusual and scientifically important.

Method

Field- and laboratory-based analyses of the bones were undertaken to elucidate the taphonomic history of the Cornet vertebrate assemblage. During the 1995 and 1996 field seasons many bones were examined *in situ* and dip and long axis orientations were recorded.

Due to the large number of specimens recovered from the Cornet bauxite lens and the limited time available for study, a random sample of bones were used for the taphonomic analysis. The presence of articulated and complete material was noted. Each specimen was characterised according to a number of key features including bone shape, maximum and minimum lengths, the degree of abrasion and weathering, the nature of any fractures and bone compaction and distortion. Additional features, such as bite marks and pathologies were noted when present.

Individual bones were classified according their overall shape into the following categories: blade (flat, approximately rectangular in outline), rod (elongate, but with a round, triangular or square cross-section, e.g. ribs and limb shafts), disc (e.g. dermal scutes), cubiod (somewhat longer than wide, tends to be blocky, e.g. vertebral centra) and 'strange' (the shapes which do not readily fit into any of the other classes, e.g. chevron bones).

Results

The results of the taphonomic study of the Cornet vertebrate fossils are presented in the appendix.

Virtually all of the material from Cornet is disarticulated and incomplete. The most commonly occurring bone shapes are rods and cuboids. Blade-, disc- and 'strange'-shaped bones are all represented, but to a lesser degree. This distribution reflects the proportions of identifiable skeletal elements preserved in the assemblage. Vertebrae and vertebral centra (cuboid shapes) make up 40 per cent of the total collection. Of secondary importance (24 per cent) are foot bones (for example, metapodia, metatarsi and phalanges), which represent cuboid and slightly elongate shapes, and indeterminate bone fragments (24 per cent). Elongate limb bones and epiphyses constitute 9 per cent of the collection. The remainder consists of skull fragments, teeth, shoulder and pelvic girdle, rib and limb bones.

Ninety-eight bones from the research collection were measured, with maximum and minimum dimensions recorded. Maximum length measurements ranged from 17 to 125 mm, with most of the sample falling within the range of 20 to 59 mm. Similar data were recorded for the smallest axis of the specimens. In this case the total range is much narrower: from 4 to 40 mm; most of the specimens have a minimum length of between 10 and 29 mm.

The abrasion characteristics of the individual fossils were described following the scheme of Fiorillo (1988), and the modifications of Cook (1995a, b). The material covers a range of abrasion stages: from fresh and unabraded (stage 0) to extremely abraded (stage 4). The range of abrasion stages indicates that this is an attritional assemblage. Most of the specimens display features characteristic of stages 1 (slight abrasion) to 2 (moderate abrasion).

Few (less than 5 per cent) of the museum collection shows any evidence of the parallel cracking and flaking characteristic of *in situ* weathering (Fiorillo, 1988). The fractures and planes of breakage on a bone can reflect damage to individual specimens produced during several phases of taphonomic modification. A single bone may document pre- and postmineralisation processes. Several types of fracture have been categorised from the Cornet collection. These include straight fractures, which typically occur at 90^o to the bone fibres, and are indicative of breakage after mineralisation. Spiral fractures are characterised by breakage surfaces at low angles to the direction of the bone fibres and are thought to be a result of premineralisation damage (Fiorillo, 1988). Virtually all of the bones recovered from lens 204 are incomplete, although in many cases it is only a small proportion of the bone that is missing. Different fracture types are common, straight, post-mineralisation fractures dominate. These are probably a result of damage during initial exploitation of the site, when explosives were used to remove blocks of bauxite (Benton *et al.*, 1997).

Post-depositional compaction affects approximately half of the lens 204 collection. Distorted bones typically display a slight twisting about their axial length. The vertebrae and metapodials best display this damage, and are no longer symmetrical. Many specimens also show evidence of cracking and crushing (Benton *et al.*, 1997), the cracks are infilled with calcite and occasionally argillaceous bauxitic sediment.

Several of the bones recovered from lens 204 display modifications resulting from predator or scavenger activity (Benton *et al.*, 1997). These features were first documented by Jurcsak and Popa (1979), and consist of isolated tooth marks, paired tooth marks and elongate grooves produced when the teeth scratched the surface of the bones. The punctures typically consist of a rounded or oval hole, which may have slight cracking around the margins (fig. 5).

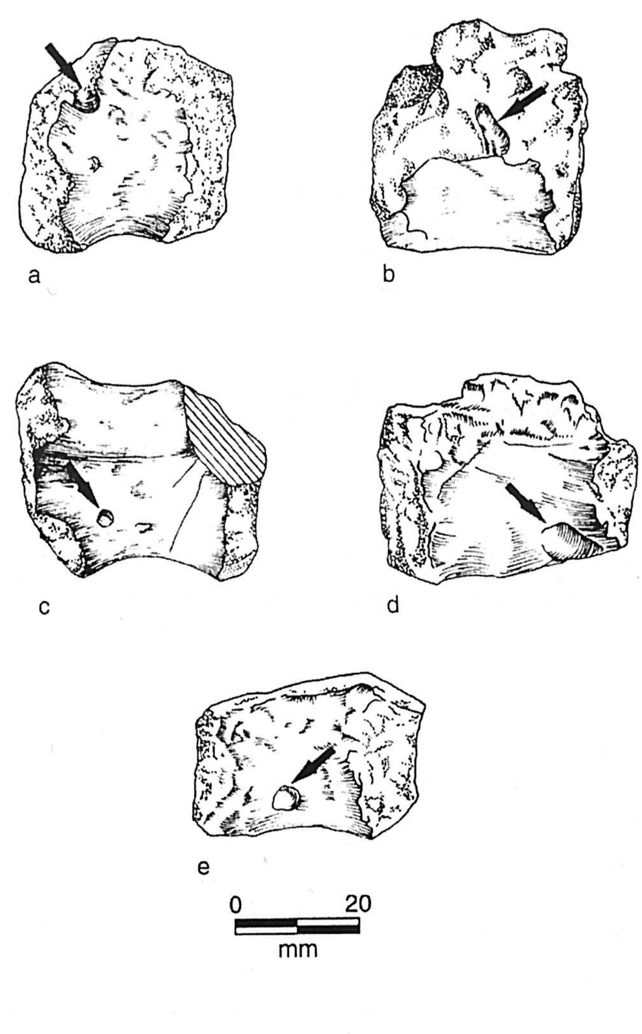


Figure 5 Predator or scavenger damage to selected bones from Cornet bauxite lens 204. a (MTCO 15027), c (MTCO 19260) and e (MTCO 19256): punctures, with round or slightly ovate outlines; b (MTCO 14781) and d (MTCO 19264): elongate grooves.

Taphonomic Interpretation

The physical taphonomic characteristics of the vertebrate assemblage have enabled a depositional history of the bones to be constructed. Field data collected during 1995 and 1996 suggest that there is no preferred orientation to the bones. However, Benton *et al.*, (1997) note that many of the skeletal elements preserved in the larger blocks of bauxite show parallel alignment of elongate bones. This is perhaps explained by the large degree of lateral variation of the sediments within the bauxite lens. The sedimentary logs (fig. 3) show that beds can wedge out over a distance of 1 m, therefore it is likely that the bed which produced the parallel-aligned bone conglomerate was completely removed during earlier phases of excavation.

The somewhat limited range of size and shape of the bones within the assemblage could be attributable to two processes: hydrodynamic sorting and the trampling action of animals, crushing more delicate skeletal elements. All of the bones fall into either Group I or Group II of Voorhies' classification (Voorhies, 1969), and have shapes and densities which facilitate movement by water. Vertebrate accumulations dominated by Groups I and II bones are typical of a transported assemblage (Behrensmeyer, 1975).

According to the 'classic' theories of vertebrate taphonomy the presence of material showing evidence of moderate levels of abrasion (abrasion stage 2) indicates that the assemblage had undergone considerable transportation. However, recent experiments (Cook, 1995b) suggest that vast distances of transport are required to produce small changes to the surface of fresh bones. Bones which have been weathered or buried, undergoing some chemical alteration, are more prone to transport-induced rounding. Thus, it is likely that most of the lens 204 assemblage was subject to some reworking. The wide range of abrasion states is indicative of an attritional assemblage, which forms over a considerable period of time, and often incorporates material from a wide geographical area. Significant amounts of abrasion can also result from biological activity, for example when bones are kicked along game trails and around watering holes. It is probable that the range in abrasion states reflects a complex history of cycles of deposition and reworking, within the cave system and on the hillsides, plateau and around the areas of standing water.

The low incidence of *in situ* weathering damage suggests that the bones were either rapidly buried in the wet and waterlogged sediments adjacent to water, submerged in the pools and lakes, or washed into the sinkholes and caves soon after death.

The vertebrate accumulation preserved in the bauxite lens at Cornet reflects a series of taphonomic and sedimentological processes (fig. 6). The bauxite is detrital in origin, and was initially formed during the weathering of igneous and metamorphic source rocks under humid tropical or sub-tropical climates. The bauxite accumulated as palaeosols on the karstic topography, possibly close to small pools and lakes. At this time the opening to the lens 204 chamber was one of three sink holes situated on a small plateau on the south-facing slopes of a hill (Jurcsak and Kessler, 1991; Benton *et al.*, 1997). The bauxite palaeosol sediments were washed into the cavern via the sinkhole, probably by a combination of high-energy, periodic flash flood events and lower-energy gravity and fluvial processes. It is clear from the bands of coarser and fine-grained bauxite that sedimentary processes resulting in hydrodynamic sorting and preferential deposition of the different sediment clast sizes played an important part in the formation of the sedimentary accumulation within the cave, suggesting that flowing water was depositing and reworking the sediments.

It is likely that the bones were washed into the caves after the death of the dinosaurs, as such, the deposit is classified as an abiotic allochthonous accumulation. However, the possibility that some of the animals may have died within the cave system cannot be discounted, for example by falling to their death through the sink hole opening to the cave, even though this appears to be highly unlikely. The concentration of the bones towards the centre of the lens recorded by Jurcsak (1982), and supported by the 1995 field work, indicates that at least part of the cavern infill originated as a talus cone beneath the sinkhole aperture.

PALAEOPATHOLOGY

Pathological damage is known in fossil vertebrates (Bachmayer *et al.*, 1975; Jurcsak *et al.*, 1980-1981; Mlikovsky and Lukas, 1988), although there

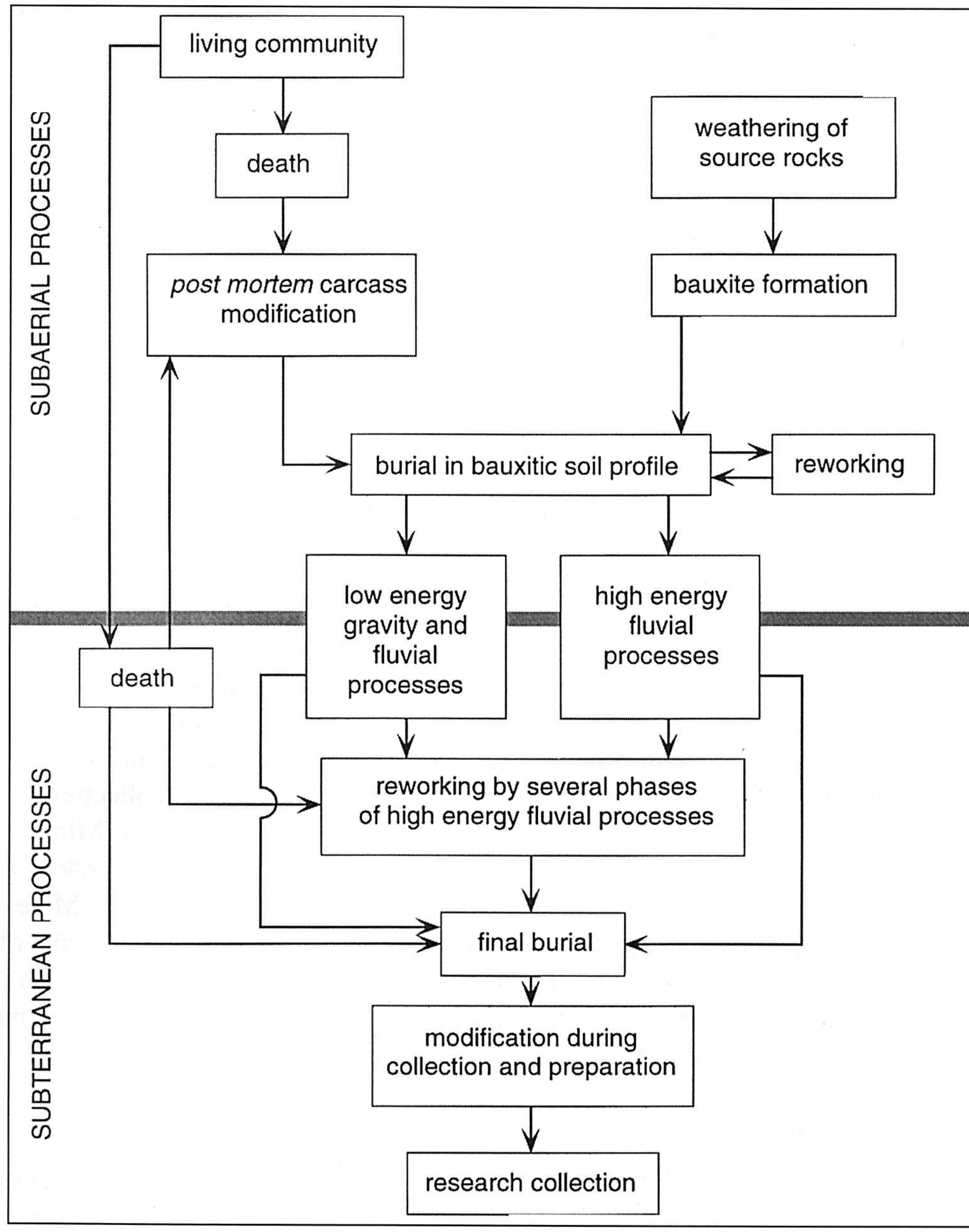


Figure 6 Flow chart to summarise the possible interactions between the sedimentological and taphonomic processes responsible for the formation of the Cornet lens 204 vertebrate-bearing accumulation.

are few publications documenting osteological abnormalities in the fossil record. Over recent years more attention has been paid to these abnormalities, which provide significant information on the life habits of animals (Gross *et al.*, 1993).

A few bones (less than 0.05 per cent) in the Cornet collection show evidence of pathological damage. Pathological damage is generally limited to phalangeal bones (Posmosanu, in press). The most interesting specimen is a pes phalange (MTCO 7598/14.762), which belonged to an adult (fig. 7). There is evidence of a healed transverse fracture which shows an irregular bone growth on both sides of the outer surface. Ventrally, on the proximal end an extensive exostosis occurs: a rough, 8 mm thick bone growth. In order to interpret the pathological damage, the abnormal phalange was compared with normal ones, and asymmetrical bone growth can be observed along the physiological axis of the bone.

The cause of the bone deformation is diagnosed as resulting from a traumatic injury of the leg, possibly during an ontogenetically early stage of the animal's growth, which healed imperfectly. The development of the exostosis may have been the response of the organism to bone marrow infection. The leg was probably fully functional, with only a limited loss of mobility.

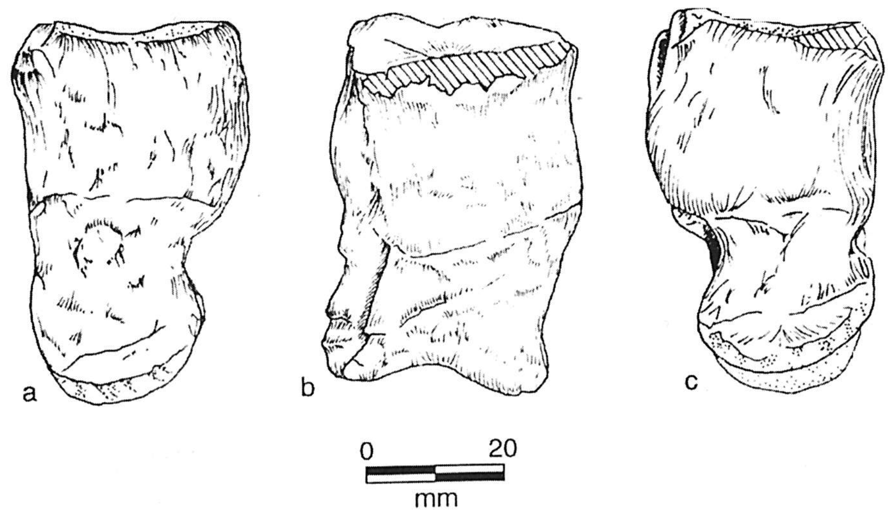


Figure 7 Pes phalange with pathological abnormalities (MTCO 7598/14.762), a lateral, b dorsal, c medial views.

CONCLUSIONS

The vertebrate assemblage preserved within the bauxite lens 204 at Cornet, North West Romania is dominated by the remains of ornithopod dinosaurs, such as *Camptosaurus* and *Valdosaurus*, as well as rarer pterosaurs. The ornithopods had intercontinental ranges, *Camptosaurus* is known from North America and Western Europe, and *Valdosaurus* is comparable with genera from the Isle of Wight and Western Africa. The pterosaur *Dsungaripterus* shows links with Asiatic faunal assemblages. The Cornet faunal assemblage represents a single, taxonomically restricted palaeocommunity which inhabited a small island.

The accumulation formed by a complex process of deposition and reworking of the bauxitic palaeosol sediments and vertebrate material, both on the surface of the karst and within the cave system.

Evidence of abnormal bone growth, caused by some form of pathological process, is seen on a few of the bones.

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Table 1 : Cornet lens 204 sleletal abundances.

Skeletal Element	Number of Occurences: *MTCO : Cornet Collection*	Number of Occurences: *Marinescu Collection*
Occipital fragments	1	1
Parietal fragments	-	1
Jugal fragments	-	1
Left maxillary fragments	1	-
Quadrate fragments	1	-
Indeterminate skull fragments	4	4
Dentary teeth	13	3
Maxillary teeth	5	1
Tooth fragments	5	6
Axis	-	1
Atlas	14	2
Cervical vertebrae	34	17
Dorsal vertebrae	13	10
Sacral vertebrae	23	13
Caudal vertebrae	519	125
Vertebrae centra	1972	73
Neural spines	-	1
Chevrons	-	1
Vertebrae fragments	1227	-
Apophyses fragments	782	-
Humeri	5	1
Humerus fragments	30	4
Scapulae	1	-
Ulna	7	4
Proximal and distal ends of ulnae	34	-
Radius	2	3
Fused carpal	8	-
Femur fragments	2	2
Tibia fragments	3	-
Epiphyses	-	22
Illium	-	4
Ischium	-	2
Astragalus	40	7
Astragalus fragments	74	1
Calcaneum	71	4
Coracoid	51	12
Distal or proximal ends of metapodia	1110	-
Metacarpal	16	14
Metatarsus II	27	6
Metatarsus III	4	3
Metatarsus IV	3	3
Metatarsus fragments	-	47
Carpal phalanges	-	22
Tarsal phalanges	-	23
Phalanges	246	-
Phalanges fragments	266	-
Ungual phalanges	215	57
Ungual phalanges fragments	216	10
Rib fragments	47	-
Dorsal ribs	-	16
Sacral ribs	-	14
Cervical ribs	-	4
? Ossified tendons	-	4
Indeterminate fragments	2285	30
	n = 9377	**n = 579**

Table 2 : Cornet lens 204 proportions of bone shapes, n = 94

Bone Shape	Number of Occurences	Percentage of Sample
Blade (flat, approximately rectangular in outline)	5	5,32
Rod (elongate, with a round, triangular or suare cross-section)	25	26,59
Disc	4	4,25
Cuboid (longer than wide, blocky)	52	55,32
"Strange" (shapes which do not fit the other categories)	8	8,51

Table 3 : Cornet lens 204 bone abrasion, n = 192. Abrasion stages defined by Fiorillo (1988) and Cook, 1995 a, b)

Abrasion stage	Number of Occurences	Percentage of Sample
Stage 0 (fresh and unabraded)	4	4,12
Stage 0-1	17	17,53
Stage 2 (slight abrasion)	30	30,93
Stage 1-2	23	23,71
Stage 2 (moderate abrasion)	4	4,12
Stage 2-3	16	16,49
Stage 3 (heavy abrasion)	2	2,06
Stage 3-4	1	1,03
Stage 4 (extreme abrasion)	0	0

Table 4 : Cornet lens 204 bone dimensions (maximum and minimum lengths) n = 98

Length (mm)	Maximum dimension		Minimum dimension	
	Number of Occurences	Percentage	Number of Occurences	Percentage
0-9	0	0	19	19,39
10-19	2	2,04	37	37,76
20-29	12	12,24	32	32,65
30-39	24	24,49	9	9,18
40-49	29	29,59	1	1,02
50-59	12	12,24	0	0
60-69	9	9,18	0	0
71-79	6	6,12	0	0
80-89	3	3,06	0	0
90-99	0	0	0	0
100-109	0	0	0	0
110-119	0	0	0	0
120-129	1	1,02	0	0