

MICROVERTEBRATE BIODIVERSITY FROM CHERVES-DE-COGNAC (LOWER CRETACEOUS, BERRIASIAN: CHARENTE, FRANCE)

by JOANE POUECH¹, JEAN-MICHEL MAZIN¹ and JEAN-PAUL BILLON-BRUYAT²

¹Laboratoire Paléoenvironnements et Paléobiosphère, UMR CNRS 5125, Université Claude Bernard Lyon 1, Campus de la Doua, 2 rue Dubois, bâtiment Géode, 69622 Villeurbanne, FRANCE (joane.pouech@pepsmail.univ-lyon1.fr);

²Section d'Archéologie et Paléontologie, Office de la Culture, République et Canton du Jura, Hôtel des Halles, 2900 Porrentruy, SWITZERLAND

INTRODUCTION

THE QUARRY of Cherves-de-Cognac (southwest France) yields an important vertebrate fauna of Early Cretaceous (Berriasian) age, which includes microremains. These microvertebrates are very diverse and are present in nearly all of the exposed horizons. The aim of this study is to conduct an analysis of the biodiversity and faunal associations within a series of 28 consecutive levels.

Institutional abbreviation: CHE – Cherves-de-Cognac Collection, Musée d'Angoulême.

GEOLOGICAL SETTING

The site is located in a gypsum quarry. Two lithological units have been identified. Unit 1 is composed essentially composed of gypsum and marlstone: Unit 2 consists of limestone-marl alternations. The depositional environment is interpreted as a lagoon which developed under varying conditions ranging from hypersaline (Unit 1) to freshwater (Unit 2) (El Albani et al. 2004) (see also Mazin et al. this volume). A biostratigraphical study suggests a lower to middle Berriasian age and proposes a correlation with the lower part of the Middle Purbeck Beds of southern England (Colin et al. 2004).

MATERIAL AND METHODS

This study is based on the first 28 levels of Unit 2 (see Mazin et al. this volume). Each level has been sampled separately and sediment samples were dried, weighed and washed in sieves with mesh diameters of 3 mm, 1 mm and 0.5 mm. Microremains were sorted and counted from the latter two meshes. Only teeth were taken into account except for lissamphibians, for which only jaw fragments are known, and turtles, which were

identified by shell fragments. The fossils are very well preserved. The biodiversity analysis was conducted at the family level and the results are presented here in terms of presence/absence data.

RESULTS

Identification

Twenty-four vertebrate families have been identified along the series, covering all major taxa (Figure 1):

- i) two families of chondrichthyans: Lonchidiidae Herman 1977; Rhinobatidae Müller and Henle 1838;
- ii) five families of osteichthyans: Semionotidae Woodward 1890 (in Woodward and Sherborn 1890); Pycnodontidae Agassiz 1833; Aspidorhynchidae Nicholson and Lydekker 1889; Ichthyodectidae Crook 1892; Caturidae Owen 1860;
- iii) one family of amphibian: Albanerpetontidae Fox and Naylor 1982;
- iv) one family of turtle: Pleurosternidae Cope 1868;
- v) one family of lepidosaurians: Squamata Oppel 1811 (Fam. indet.);
- vi) four families of crocodylians: Atoposauridae Gervais 1871; Bernissartiidae Dollo 1883; Pholidosauridae Eastman 1902 (in Zittel and Eastman 1902); Goniopholididae Cope 1875;
- vii) five families of dinosaurs: Dromaeosauridae Matthew and Brown 1922; Theropoda Marsh 1881 (Fam. indet.); Iguanodontia Dollo 1882 (Fam. indet.); Heterodontosauridae Romer 1966; Stegosauridae Marsh 1880;
- viii) one family of bird: Archaeopterygidae Huxley 1871;
- ix) four families of mammals: Triconodontidae Marsh 1887; Multituberculata Cope 1884 (Fam. Indet.); Spalacotheriidae Marsh 1887; Dryolestidae Marsh 1879.

BIODIVERSITY

Level biodiversity. Only three horizons are sterile, lacking microvertebrates. Most of the horizons yield a low biodiversity (four taxa or less). In the lower levels, 12-13 to 31, an association between Lonchidiidae and Semionotidae is almost always present. In the upper levels 40 to 44 (with the exception of level 41, which yields 6 taxa), the families Semionotidae and Pycnodontidae are always present, frequently in association with Lonchidiidae. Levels 32 bis to 37 show an important increase in the number of families present, due in part to the regular occurrence of crocodiles. These levels correspond to the HFZ (Highly Fossiliferous Zone: see Mazin et al. this volume), where macroremains are found. Level 36 is particularly interesting, as it yields 22 of the 24 families known from microremains, that is to say 91.7% of the total, whereas other levels yield an average of only 14.2% of the total families known from the locality. This level contains an association of terrestrial taxa that is unique in the series, including dinosaurs, birds and mammals (10 families from these three clades).

Familial distribution. Two families occur frequently throughout the series: Semionotidae (found in 89% of the levels), which is present in all non-sterile levels, and Lonchidiidae (found in 71% of the levels). Pycnodontidae (54%) are known mainly from the HZF and the upper levels. One family is present in 43% of the levels (Bernissartiidae), while three (Caturidae, Atoposauridae, Pholidosauridae) occur in 29% of the levels and are especially abundant in the HZF. The other families are found exclusively in level 36, with the exception of the family Rhinobatidae, which is known only in level 32 bis.

Stratigraphical distributions of the families among the various levels are provided in the Appendix.

DISCUSSION

Quantitative data (importantly the increased number of teeth, which is correlated with the increase in the amount of data collected for freshwater taxa, such as crocodylians), and the presence of Semionotidae and Lonchidiidae throughout the series, suggest an allochthonous or parautochthonous assemblage for freshwater families. The other taxa are clearly allochthonous and are concentrated in the HZF, which probably records an important increase in freshwater supply. The lower and upper levels of

the sequence could be characterised by low freshwater input, but the continual presence of pycnodontids in the upper levels suggests a change of environmental conditions. Level 36, which yields a terrestrial fauna, might be explained by as a result of washing of the nearby continental surface during a flood event.

Three successive depositional modalities can be proposed. The first was prevalent during deposition of the lower levels (horizons 12-13 to 31), which was characterised by a low freshwater supply. These levels lie stratigraphically above gypsum deposits and probably correspond to the onset of freshwater supply. The second depositional mode (levels 32 bis to 38-39), records an important increase in freshwater input, reaching its climax in level 36. The third mode corresponds to the upper levels (40 to 44), with a return to a low supply of freshwater, associated with a change in environmental or depositional conditions, which was probably linked to an increase in aridity (El Albani et al. 2004).

CONCLUSION

The diversity and abundance of the microvertebrates allows us to refine our models of the depositional environments. The concentration of microvertebrate remains seems to depend mainly on variations in hydrodynamic conditions, and three zones are proposed. Further quantitative study of microvertebrate biodiversity may produce additional environmental data.

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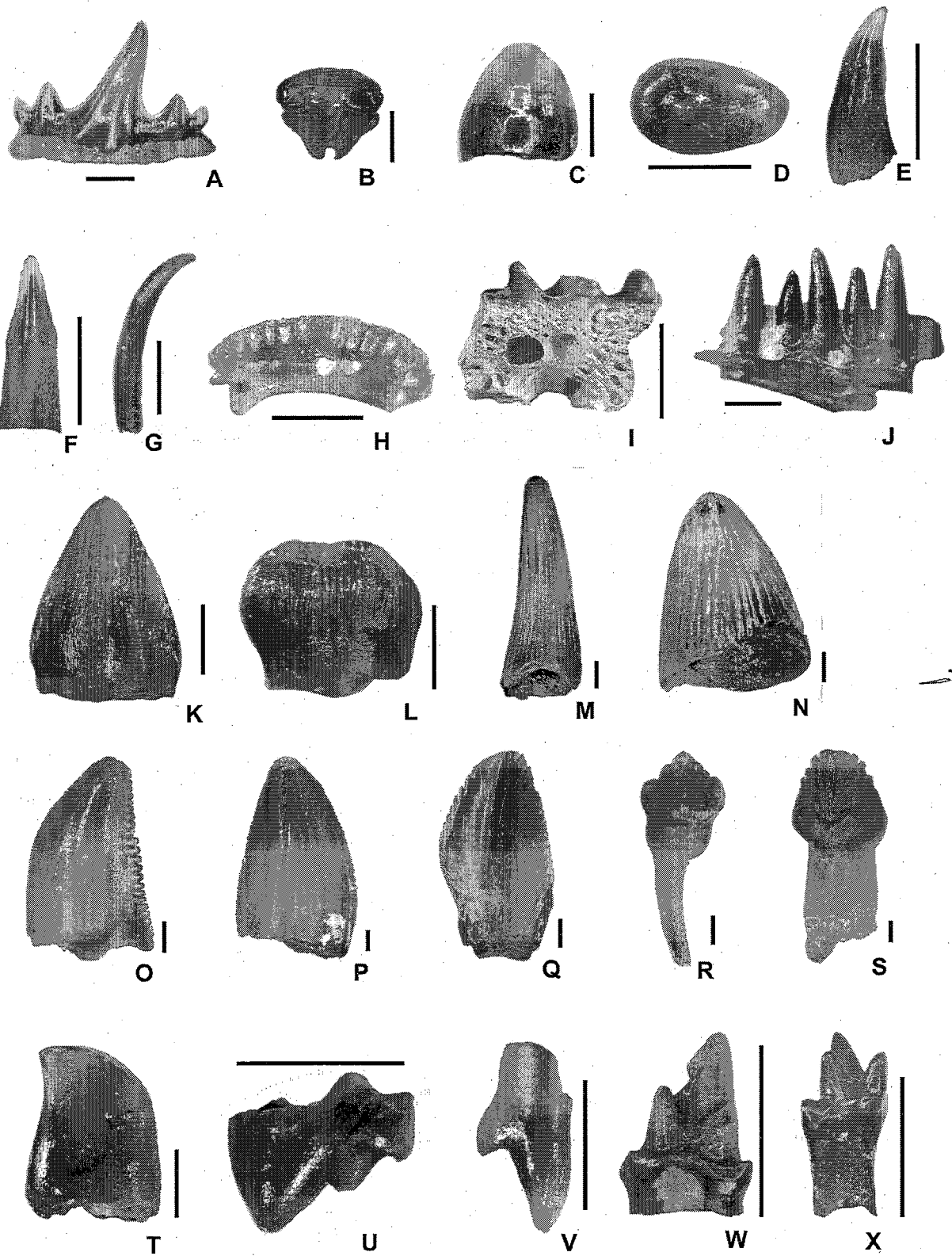


Figure 1. Vertebrate microremains from Champblanc Quarry (Berriasian, Cherves-de-Cognac, Charente, France). A, CHEM03.510. *Parvodus* sp. (Lonchidiidae, Chondrichthyes), anterior tooth, labial view. B, CHEM03.355. *Belemnobatis* sp. (Rhinobatidae, Chondrichthyes), tooth, occlusal view. C, CHEM03.288. *Lepidotes* sp. (Semionotidae, Osteichthyes), oral tooth, lateral view. D, CHEM03.313. Pycnodontidae indet. (Fam. indet., Osteichthyes), crushing tooth, occlusal view. E, CHEM03.296. *Belonostomus* sp. (Aspidorhynchidae, Osteichthyes), tooth, lateral view. F, CHEM03.303. *Caturus* sp. (Caturidae, Osteichthyes), tooth, labial view. G, CHEM03.508. *Thrissops* sp. (Ichthyodectidae, Osteichthyes), tooth, distal view. H, CHEM03.561. Albanerpetontidae indet. (Amphibia), fragment of mandible, lingual view. I, CHEM03.365. Pleurosternidae cf. *Tretosternum* (Testudines), fragment of ornamented osteoderm, view in transverse section. J, CHEM02.035. Squamata indet. (Fam. indet., Lepidosauria), fragment of mandible, lingual view. K, CHEM03.506. *Theriosuchus* sp. (Atoposauridae, Crocodylia), anterolateral tooth, lingual view. L, CHEM03.390. *Bernissartia fagesii* (Bernissartiidae, Crocodylia), posterior crushing (tribodont) tooth, lingual view. M, CHEM03.499. *Pholidosaurus* sp. (Pholidosauridae, Crocodylia), tooth, lingual view. N, CHEM03.512. *Goniopholis* sp. (Goniopholididae, Crocodylia), fragment of crown, lingual view. O, CHEM03.537. *Nuthetes* sp. (Dromaeosauridae, Theropoda, Dinosauria), tooth, lingual view. P, CHEM03.536. Theropoda indet. (Fam. indet. non-Dromaeosauridae, Dinosauria), tooth, lingual view. Q, CHEM02.119. Iguanodontia indet. (Fam. indet., Ornithopoda, Dinosauria), tooth, lingual view. R, CHEM03.419. Heterodontosauridae indet. (Ornithopoda, Dinosauria), tooth, lateral view. S, CHEM02.084. Stegosauridae indet. (Stegosauria, Dinosauria), tooth, lingual view. T, CHEM03.514. Archaeopterygidae indet. (Aves), tooth, lingual view. U, CHEM03.544. *Triconodon* sp. (Triconodontidae, Mammalia), left P³, labial view. V, CHEM03.548. Multituberculata (Fam. indet., Mammalia), left I², distal view. W, CHEM03.545. *Spalacotherium evansae* (Spalacotheriidae, Mammalia), lower right molar, lingual view. X, CHEM03.546. Dryolestidae indet. (Mammalia), lower left molar, lingual view. Scale bars: 0.5 mm, except Q, R and S, 1 mm.

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APPENDIX

Distribution of the families in the 28 horizons sampled, arranged stratigraphically from lower (level 12-13) to upper (level 44) levels:

- Level 12-13: Lonchidiidae, Semionotidae, Caturidae.
- Level 14-15: sterile.
- Level 16: sterile
- Level 17: Semionotidae.
- Level 18: Semionotidae, Pycnodontidae.
- Level 19: Lonchidiidae, Semionotidae, Pycnodontidae.
- Level 20: Semionotidae.
- Level 21: Lonchidiidae, Semionotidae, Pycnodontidae.
- Level 22: Lonchidiidae, Semionotidae, Pycnodontidae.
- Level 23: Lonchidiidae, Semionotidae.
- Level 24: Lonchidiidae, Semionotidae.
- Level 25-26: sterile.
- Level 27: Lonchidiidae, Semionotidae, Pycnodontidae.
- Level 28-29: Lonchidiidae, Semionotidae.
- Level 30: Lonchidiidae, Semionotidae.
- Level 31: Lonchidiidae, Semionotidae, Caturidae.
- Level 32 bis: Lonchidiidae, Rhinobatidae, Semionotidae, Pycnodontidae, Aspidorhynchidae, Caturidae, Atoposauridae, Bernissartiidae, Pholidosauridae.
- Level 32: Lonchidiidae, Semionotidae, Pycnodontidae, Caturidae, Bernissartiidae.
- Level 33: Lonchidiidae, Semionotidae, Pycnodontidae, Caturidae, Atoposauridae, Bernissartiidae, Pholidosauridae, Goniopholididae.
- Level 35: Lonchidiidae, Semionotidae, Pycnodontidae, Caturidae, Atoposauridae, Bernissartiidae, Pholidosauridae.
- Level 36: Lonchidiidae, Semionotidae, Pycnodontidae, Ichthyodectidae, Caturidae, Albanerpetontidae, Pleurosternidae, Squamata (Fam. indet.), Atoposauridae, Bernissartiidae, Pholidosauridae, Goniopholididae, Dromaeosauridae, Theropoda (Fam. indet.), Iguanodontia (Fam. indet.), Heterodontosauridae, Stegosauridae, Archaeopterygidae, Triconodontidae, Multituberculata (Fam. Indet.), Spalacotheriidae, Dryolestidae.
- Level 37: Lonchidiidae, Semionotidae, Atoposauridae, Bernissartiidae, Pholidosauridae.
- Levels 38-39: Lonchidiidae, Semionotidae, Pycnodontidae, Atoposauridae, Bernissartiidae.
- Level 40: Semionotidae, Pycnodontidae.
- Level 41: Lonchidiidae, Semionotidae, Pycnodontidae, Caturidae, Atoposauridae, Pholidosauridae.
- Level 42: Semionotidae, Pycnodontidae.
- Level 43: Lonchidiidae, Semionotidae, Pycnodontidae, Bernissartiidae.
- Level 44: Lonchidiidae, Semionotidae, Pycnodontidae.