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Preliminary account of plant mesofossils from the Maastrichtian Budurone microvertebrate site of the Haţeg Basin, Romania

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ABSTRACT

The Maastrichtian Budurone mesofossil flora includes 19 different types of angiosperm fruits and seeds. All fruits and seeds are small, 0.6–2.6 mm long and 0.5–1.9 mm broad, with calculated fruit volume ranging between 0.08 and 3.59 mm^3 and seed volume between 0.08 and 0.79 mm^3. The fossils show great similarity with other Cretaceous angiosperm fossils regarding their dimension and organisation. However, comparison with other Late Cretaceous and Early Cenozoic floras from Europe shows that surprisingly few of the Budurone fossils can be assigned to taxa previously described from Europe, and so far only a few taxa appear to be shared with other mesofossil floras. This indicates that the Budurone flora may have been isolated from the other European floras or represents a different kind of depositional environment. Fruits are mainly indehiscent nuts and drupes, and seeds are mostly anatropous without special ornamentation indicating a mixture of biotic and unassisted dispersal. This together with the small size of the fruits and seeds indicates that the Budurone plants grew in typical Late Cretaceous open vegetation perhaps under a seasonally dry climate.

1. Introduction

Numerous mesofossil floras rich in angiosperm flowers, fruits and seeds have been discovered from Late Cretaceous strata of Europe (e.g., Knobloch and Mai, 1986; Friis et al., 2006a). Together with rich palynological assemblages these plant remains are the primary source for understanding terrestrial ecosystems in Europe during this time interval. Sites including terrestrial faunas are less common and terrestrial biota including both animal and plant fossils are almost absent from the latest Cretaceous of Europe (Csiki et al., 2008). The discovery of mesofossils at the Budurone microvertebrate site in the Haţeg Basin, Romania, is therefore of great interest in providing direct information of the plant community co-occurring with the rich and diverse continental fauna. The Budurone mesofossils are also important in representing the best dated mesofossil assemblage from the latest Cretaceous and thus providing insight into the Cretaceous vegetation immediately before the K/T boundary events.

We here give a preliminary account of the Budurone mesofossil flora. The flora is angiosperm dominated. The fruits and seeds included in the flora are in general appearance similar to other Late Cretaceous floras from Europe, but it is remarkable that there are almost no taxa shared with other Late Cretaceous floras and most of the Budurone plant fossils are new to science.

2. Material and methods

2.1. Geological setting

The plant material was discovered and extracted from the Budurone locality near the village of Vălioara (Fig. 1) while sieving for microvertebrate fossils in the Densuş-Ciula Formation of the Haţeg Basin, Transylvania, Romania. The locality was first identified in the late 1990s and has been collected intermittently from that time.

The Budurone fossil locality is situated in the unnamed middle member of Maastrichtian continental Densuş-Ciula Formation, exposed in the northwestern part of Haţeg Basin, Romania (Grigorescu, 1992, 2005). The Maastrichtian fluvial sediments in this area, in the neighborhood of the Vălioara village, are represented by alternating red and green coloured, coarse-grained, poorly sorted conglomerate beds dominated by metamorphic rock fragments, with medium to fine-grained sandstones and silty mudstones. A relatively high proportion of the coarser deposits, compared to other outcropping areas of the Densuş-Ciula Formation, characterizes the Maastrichtian deposits around Vălioara. This is due to the close proximity of their source area to the northwest: the uplifted metamorphic basement of the Poiana Ruscă Mountains bordering the Haţeg Basin. Fine-grained deposits in the sequence vary from red and brown-red in colour

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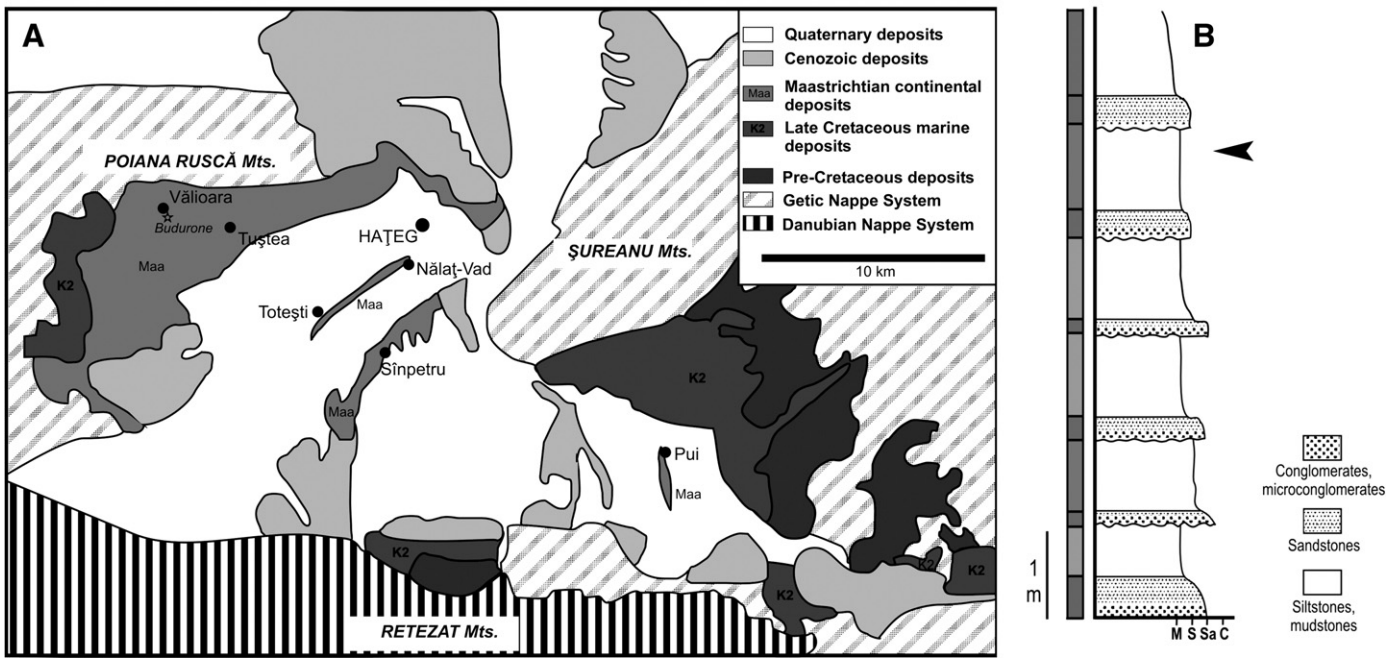

Fig. 1. A. Simplified geological map of the Haţeg Basin, showing the location of the Budurone fossil site (star). B. Lithological column along the Budurone creek, with the fossiliferous level indicated by arrow. Column to the left indicates approximate colour changes.

(when associated with diffuse layers of small, irregular calcareous concretions) to green-grey and to blackish dark grey, indicating shifting palaeoenvironmental conditions between well-drained and more poorly drained floodplain environments.

Several microvertebrate bone beds have been identified around Vălioara, in the fine-grained drab-coloured, greenish silty mudstones (Grigorescu et al., 1999; Vasile, 2008). The Budurone locality, located in the bed of the homonymous creek, a small, seasonal tributary of the Vălioara Brook, is of particular interest because of its unique lithology and peculiar fossil content (Csiki et al., 2008).

The Maastrichtian beds of the Budurone valley are poorly exposed because the steep valley sides are heavily vegetated; the outcrop is restricted to the narrow bed of the creek and is usually partly submerged or covered by mud. Accordingly, the observations concerning the local lithology are very patchy. Correlations with other Maastrichtian deposits near Vălioara are also impeded by the isolated location of the Budurone valley, surrounded by grass-covered hills and cultivated fields. However, it has been possible to measure a short lithological succession that includes the Budurone site (Fig. 1B).

The local lithological column (Fig. 1B) is characterized by a complete lack of red-coloured deposits, suggesting locally extensive reducing conditions. The coarse-grained deposits are represented by microconglomerates that grade vertically into well-sorted medium sandstones; occasionally, coarser conglomerates also occur, but the maximum size of the ruditic clasts is smaller than observed elsewhere around Vălioara. The base of the coarser beds is usually clear-cut, often irregular, erosional; their thickness is usually less than 50 cm. Transition to the overlying finer-grained deposits is sharp, less commonly transitional. The fine-grained beds are dominantly well-sorted, massive silty mudstones and mudstones, varying in colour between grey, bluish-grey and dark blackish grey. Their thickness is greater than the coarser beds, normally surpassing 50 cm and sometimes reaching 1 m.

The fossiliferous level is located in the upper part of the measured section, and is a 1-m thick bed of dark, blackish-bluish massive, micaceous silty mudstone. X-ray diffractometry suggests that the composition of the bed is dominated largely by smectitic clay minerals; the swelling character of the wetted rock is consistent with these data. The microvertebrate remains are concentrated in the upper part of the bed, close to the erosional boundary with the overlying conglomeratic sandstones. The microvertebrate bone bed that also includes the plant fossils described here is dominated by the skeletal elements of mainly aquatic taxa (fishes, frogs, albanerpetontids), with less frequent remains of semi-aquatic (turtles, crocodilians) or purely terrestrial (lizards, dinosaurs) taxa. This abundance spectrum is unique among reported Maastrichtian microvertebrate accumulations from the Haţeg Basin, and suggests the preservation of a largely autochtonous, locally derived aquatic–peri-aquatic community (Csiki et al., 2008).

Another unusual feature of the Budurone locality is the occurrence, along with the vertebrate remains, of a diverse plant mesofossil assemblage represented by a variety of small-sized plant fossils, mostly fruits and seeds, which is not yet reported from any other contemporaneous microvertebrate bone bed from Haţeg. The preservation of the plant remains was probably due to the low-energy depositional setting, supported by the sedimentary features of the host rock as well as taphonomic features of the associated vertebrate remains. It has been, however, enhanced by the highly reducing nature of the fossiliferous bed, as suggested by the presence of small, framboidal pyrite concretions and common presence of charred wood fragments; both of these are again reported only from the Budurone site.

2.2. Preparation of material

The plant mesofossil was recovered when searching for microvertebrates. The sediment samples were air dried till dry, then soaked in water with a low-concentration of hydrogen peroxide until the complete break-down of the matrix. The dry sediment was then coarsely screen-washed at the site (in the river) using two mesh sizes (1.5 mm and 0.7 mm) followed by drying in the air. Subsequently, the screened material was soaked and screen-washed in the laboratory using a 1 mm, a 0.6 mm, and occasionally also a 0.35 mm screen. Matrix adhering to the surface of the fossils was removed using HF and HCl and rinsing in water. The plant mesofossils are generally well preserved and coalified. The fossils were studied and sorted into roughly similar groups using reflected light microscope. For investigation of cellular details the material was mounted on aluminium stubs with nail polish as glue, sputtercoated with gold and studied using a Hitachi S-4300 Field Emission Scanning Electron Microscope.