



Facultatea de
**Geologie
& Geofizică**
Universitatea
din București



UNIVERSITY OF
BUCHAREST
VIRTUTE ET SAPIENTIA

**THE 14th ROMANIAN
SYMPOSIUM
ON PALAEOONTOLOGY
BUCHAREST - September 14th - 15th, 2023
ABSTRACT BOOK**

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EDITURA UNIVERSITĂȚII DIN BUCUREȘTI
BUCHAREST UNIVERSITY PRESS

2023

TALK

New biostratigraphic and palaeoenvironmental constraints in the uppermost Cretaceous deposits from the Ciula Mică (Geat Valley) – west Vălioara area, northwestern Hațeg Basin (Romania)

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Keywords: Campanian, Maastrichtian, marine, continental, microfossils

The precise age of the vertebrate-bearing continental deposits from the northwestern part of the Hațeg Basin (Ciula Mică-Vălioara area), belonging to the Middle Member of the Densuș-Ciula Formation (Grigorescu, 1992) had been controversial for a long time. These have been considered to represent either the uppermost Cretaceous (Nopcsa, 1905; Antonescu et al., 1983; Grigorescu, 1992) or the Paleogene (Mamulea, 1953); even accepted as uppermost Cretaceous, their age had been assessed variably as Danian (*sensu* latest Cretaceous; Nopcsa, 1905), late Maastrichtian (Antonescu et al., 1983), or early Maastrichtian (Csiki-Sava et al., 2016). With the discovery of more and more occurrences with *in situ* vertebrate remains and Late Cretaceous palynomorph assemblages (see Botfalvai et al., 2021 for a review), a latest Cretaceous age finally became well established for these deposits. Nevertheless, their spatial and temporal relationships with the underlying Upper Cretaceous marine deposits remained elusive. More to the west, in the Răchitova and Ștei areas, volcanoclastic deposits of the Lower Member of this unit are known to unconformably cover the turbiditic marine deposits of the Răchitova Formation. Nevertheless, the relationships of these same marine deposits with the continental ones was until recently unexplored in the Ciula Mică area, whereas only continental deposits were identified in the Vălioara area.

Recently, a detailed investigation of the uppermost Cretaceous beds from the Vălioara-Ciula Mică area was initiated, with several fieldwork sessions taking place between 2019 and 2023. The initial aim of these investigations, relocation of the historical vertebrate fossil sites of Kadić (1916), was fulfilled successfully with the identification of most of the original digging sites (or at least their most probable locations). This allowed a detailed stratigraphical-sedimentological logging of the different vertebrate-bearing successions and led to the discovery of vertebrate fossil accumulations, some potentially the extensions of the old Kadić sites while others are entirely new (Botfalvai et al., 2021). In order to better understand the stratigraphic and palaeoenvironmental context of these new localities, we have also conducted an extensive sampling for microfossils and palynomorphs in the entire north Ciula Mică (Geat Valley)–Vălioara area, especially since in the Geat Valley area the presence of both flyschoid marine and red continental deposits had been noted previously (Vasile, 2010), and palynofacial details have suggested the presence of marine beds in the Ogradiilor Creek, west of Vălioara Valley (Botfalvai et al., 2021). A total of 30 samples were collected from the study area (11 from the Geat Valley, and 19 from different gullies in the west-Vălioara area).

In the Geat Valley, the samples derived from the turbidite-type marine deposits yielded both calcareous nannoplankton and foraminifera assemblages. The calcareous nannoplankton content is of low abundance and moderate preservation, dominated clearly by *Watznaueria barnesia* (> 50%), followed by far less abundant *Micula staurophora*, *Retecapsa crenulata*, *Prediscosphaera cretacea*, and others. Foraminifera are also of low abundance and diversity, dominated by the agglutinate *Haplo-*

phragmoides and the calcareous benthics *Stilostomella* and *Laevidentalina*, associated with planktonics such as *Globotruncana*, *Planoheterohelix*, and *Globigerinelloides*. Some of these samples also yielded a palynoflora dominated by continental taxa, associated with less common dinocysts such as *Isabelidium microarmum bicavatum* and *Odontochitina costata*. The presence of *Boinsonia parca parca* together with the absence of other Campanian marker taxa suggest an Early Campanian age for these deposits, independently supported by the dinocyst taxa that suggest correlation with the Răchitova Formation. Palaeoenvironmental assessment of the recovered assemblages documents sedimentation within an inner-middle neritic marine basin with warm, oligotrophic, and low fertility surface waters. The contact between these Lower Campanian marine beds and the red and grey fossiliferous continental beds appears to be tectonic here.

West of Vălioara, the micropalaeontological-palynological assemblages change significantly. Foraminifera disappear entirely, and calcareous nannoplankton assemblages became very poor and of low diversity, being present only in 3 samples collected from the upper reaches of Ogradiilor Creek, upstream of (but stratigraphically lower than) the rich and important Nvs fossil locality with continental vertebrates reported by Botfalvai et al. (2021). The presence of *Arkhangelskiella cymbiformis* points to a Campanian age of these deposits, while a much poorer assemblage from a somewhat higher sample yielded only very rare individuals of *Watznaueria barnesiae* and *Micula staurophora*. The palynofacies and the presence of very rare dinocysts in these same samples from the upper Ogradiilor Valley, alongside that of continental palynomorphs, also support a Campanian age. They also document a marine (inner neritic) origin for these beds, albeit influx of vegetal material of continental origin was clearly important. Moving up-section along the Ogradiilor Creek, marine microorganisms disappear altogether, and a sample collected near the Nvs vertebrate locality already shows a palynofacies entirely typical for continental, fluvial settings – this is suggestive for the presence of a potentially very important marine-to-continental transitional section along this gully, so far a unique occurrence of this type in the Hațeg Basin. Samples collected in other locations between Vălioara and Ciula Mică, such as in Vârtopilor Creek, around vertebrate locality K1, as well as in Neagului Creek, in the neighborhood of vertebrate localities K2-K3-K4, are barren as far as calcareous nannoplankton is concerned, and their rich and diverse continental palynomorph assemblages together with their palynofacies attest for the establishment of purely continental environments by the time of their deposition, albeit ones that were probably rather water-logged wetlands, of a delta or swamp type.

Acknowledgments: This research was supported by the Ministry of Research, Innovation and Digitization, CNCS – UEFISCDI, project PN-III-P4-ID-PCE-2020-2570, within PNCDI III (to ZCs-S), and the Hungarian National Research, Development and Innovation Office project NKFIH/OTKA PD 131557 (to GB).

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