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Genetic significance of an Albian conglomerate clastic wedge, Eastern Carpathians (Romania)

Cornel Olariu [a,*], Dan C. Jipa [b], Ronald J. Steel [a], Mihaela C. Melinte-Dobrinescu [b]

[a] Jackson School of Geosciences, The University of Texas at Austin, 2275 Speedway Stop C9000, Austin, TX 78712, USA
[b] National Institute for Marine Geology and Geo-ecology (GEOECOMAR), 23-25 Dimitrie Onciul Street, RO-024053 Bucharest, Romania

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ABSTRACT

The impressive 2000 m thick conglomerates of the Bucegi Formation exposed in the southernmost part of the Eastern Carpathians were interpreted initially as large alluvial fans, and later suggested to be deposited as deepwater submarine-slope deposits. However, the routing system of the coarse sediment transfer from the source area to the deepwater slope (source-to-sink analysis) has not been explained and the mechanisms involved in the shelf sediment storage and bypass onto the slope have not been discussed.

The present research on the Albian Bucegi Formation has provided the following new insights on their source-to-sink aspect: (1) that the Upper Member of the Bucegi Formation, with its frequent channelized and sheet like fine conglomerates and sandstones, contrasts greatly with the Middle and Lower members of deepwater slope and basin-floor origin. The Upper Member is interpreted as fluvial and shallow-marine deposits that were temporarily stored and reworked on a 'shelf', albeit a narrow one, bridging the area between the deforming hinterland and the deepwater slope deposits; (2) the Upper and Middle members are genetically linked and developed through the basinward migration of a large-scale (hundreds of metres in amplitude) clinoform with relative flat-lying topsets and slightly steeper (few degrees), coarser grained slopes that built out to the south and southeast; a configuration that is common along continental margins and also generally along all types of deepwater basin margins; (3) the Middle Member contains a range of submarine, sediment density flows that vary from high-density, mobile debris flows to lower-density sandy turbidites. The sediment textures (sorted grain populations) inherited from the shelf 'sorting factory' can to some extent still be recognised in the slope stratigraphy; and (4) the large (10–20 m diameter) carbonate and metamorphic olistoliths that are ubiquitous on the shelf and (to a lesser extent) slope, reflect the steep gradients and very active tectonic setting of the fractured and thrusted hinterland, from which these outsized blocks were transported onto the adjacent shelf.

The now-proposed, narrow shelf platform of the Albian Bucegi basin margin thus functioned to temporarily store sands and gravels, to distinctly sort some of this sediment, and to eventually bypass both sorted and new flood-generated, unsorted materials onto the slope. Compared with other basin margins, this Albian Bucegi margin was extremely coarse grained because of its proximity to the actively deforming mountain range, to a fractured basement that produced more gravel than sand, to the great sediment flux from steep short rivers, and to the narrowness (10–20 km) of the shelf.

1. Introduction

The Albian conglomerates of the Eastern Carpathians, firstly described as the 'Bucegi Conglomerates' (Popescu-Voiteşti, 1918) represent an extremely thick (up to 2000 m) accumulation of bedded conglomerates intercalated with some sandstone and olistoliths (Murgeanu and Patrulius, 1963; Patrulius, 1969). The Albian conglomerate outcrops extend from the northern part of the Eastern Carpathians, up to their southernmost end (i.e., the Romanian Carpathian bend area), being described under different names, i.e., Bucegi, Ciucaş–Zăganu, Piatra Mare and Ceahlău conglomerates (Murgeanu and Patrulius, 1963; Săndulescu, 1984, 1994). An Albian age was established by the dating of the underlying and the overlying deposits based on their macrofaunal assemblages (Murgeanu and Patrulius, 1957; Murgeanu et al., 1963; Patrulius, 1969) and calcareous nannofloral associations (Melinte and Jipa, 2007).

The conglomerates of the Bucegi Formation were interpreted as post-tectonic "molasse" deposits (Panin et al., 1963; Contescu, 1974) relating to the Ceahlău Nappe. The latter reflects the most widespread and main Cretaceous tectonic movement (Murgeanu et al., 1963; Dumitrescu and Săndulescu, 1968; Săndulescu, 1984) of the Outer Dacides nappe system. The Early Mid Cretaceous "Austrian" tectonic phase started in the Late Barremian (ca. 130 Ma) and ended at around 100 Ma (Aptian to Early Cenomanian), and was followed by an extensional collapse (Săndulescu, 1988, 1994; Ştefănescu and Melinte, 1996; Cloetingh et al., 2006).

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The depositional environment of the Albian conglomerates of the Eastern Carpathians was interpreted as fluvial derived with minimum marine reworking of the sediments (Panin et al., 1963) based on a morphometric study of the clasts, or as a shallow water fan delta (Mihăilescu et al., 1967; Patrulius, 1969). The Bucegi Formation has been conventionally interpreted as 'post-tectonic' (Panin et al., 1963; Contescu, 1974; Săndulescu, 1984; Schmid et al., 2008), because it overlies traditional 'flysch' deposits, and because of its coarse-grained and supposed non-marine character.

Stanley and Hall (1978) suggested that the conglomerates of the Bucegi Formation formed on a deepwater depositional slope through the analogy with modern continental slopes and with the modern Var River system in southern France. The deep water depositional setting, if correct, challenges the post-tectonic interpretation of the Bucegi Formation, as such steep, coarse-grained, deepwater slopes were more likely to be syntectonic. Jipa (1979, 1981, 1984) also suggested that conglomerates of the Bucegi Formation represent large (hundreds of metre thick) accretion deposits of a basin margin or geosynclinal (deep basin tectonically active) instead of typical "molasse".

We propose, using new outcrop observations and previous studies, a shelf to deepwater slope model for the Bucegi Formation. This interpretation as a coarse-grained shelf-margin sedimentary prism, and an improved understanding of the sediment transfer mechanism across the margin, have implications for the Carpathian evolution and also for understanding basins with similar tectonic settings and sedimentary fill.

This paper focuses on the sedimentology on the Middle and Upper members of the Bucegi Formation to (1) document the subaerial to shallow water shelf-dispersal system of the Upper Member, (2) present the arguments for a shelf-to-slope clinoform setting, (3) demonstrate the subaqueous origin of the Middle Member bringing arguments on what was earlier suggested by Stanley and Hall (1978), and (4) argue that the Bucegi Formation is a syntectonic clastic wedge and not post-

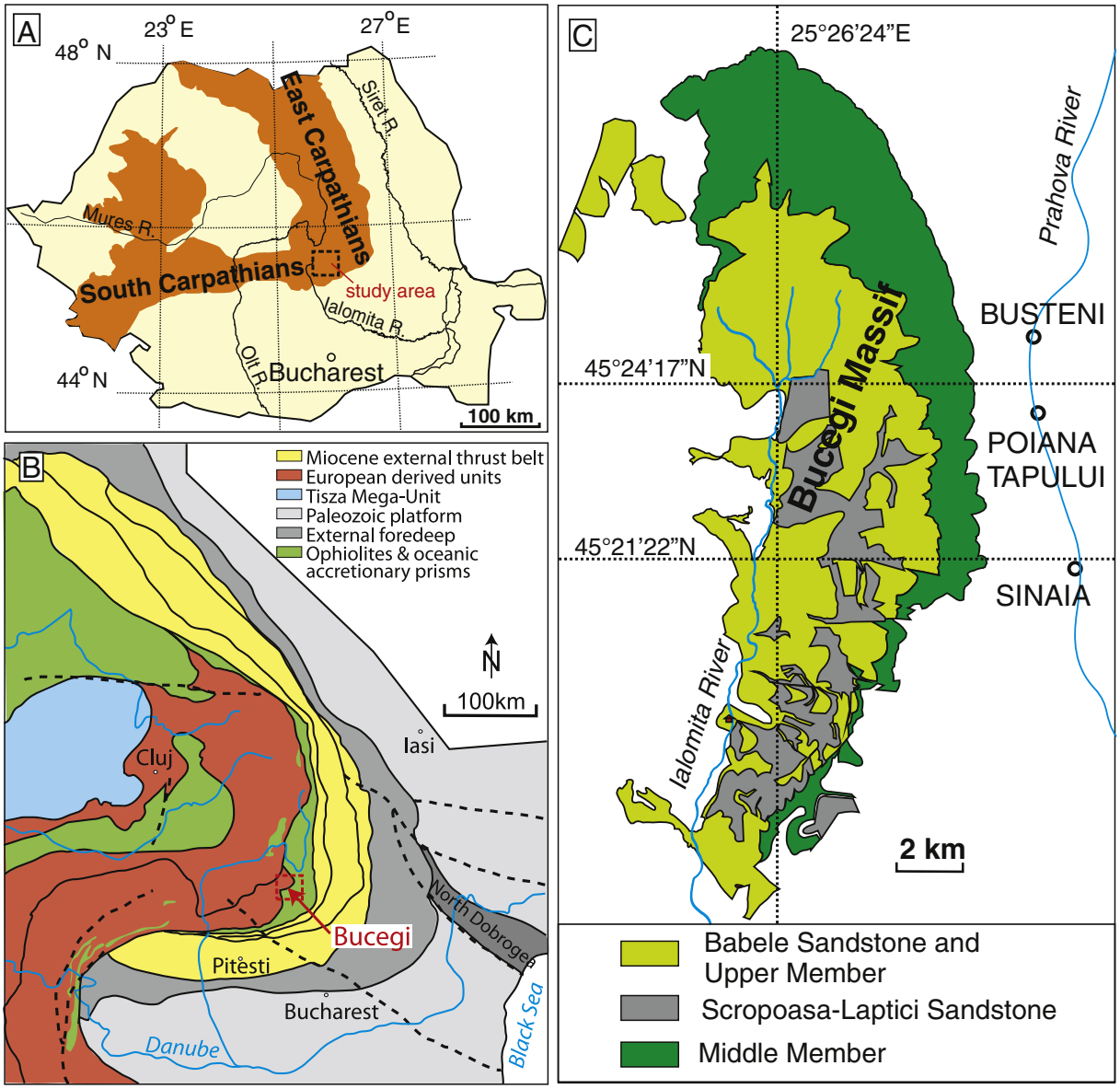

Fig. 1. Location of the study area. A — Map of Romania with location of the Bucegi Mountains at the southern end of the Eastern Carpathians (Romania). B — Simplified geotectonic map. C — Detail map of the Bucegi Mountains with the lithostratigraphic units. Box (B) in (A) and (C) in (B).
Panel B is modified after Schmid et al. (2008). Panel C is modified from Patrulius (1969).