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Chaotic facies in the Eocene turbidite successions of the Pienidian units in Maramures (Eastern Carpathians - NW Romania)

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INTRODUCTION

The Pienidian units in the Eastern Carpathians consist of Middle Jurassic to Oligocene deep-water sedimentary successions (mainly turbidites), paleogeographically belonging to the Tethysian Suture, but lacking any evidence of oceanic crust. Their origin from an oceanic domain was deduced by structural extrapolations based on geophysical data, by stratigraphic correlations with analogue sequences from Slovakia, Poland and Ukraine and by sedimentologic and petrographic studies which demonstrate the analogy with turbidite complexes formed in the accretionary prisms (Aroldi, 2001). The Pienidian units recorded two important tectonic phases which took place during the Latest Cretaceous (Laramic phase) and the Burdigalian (Styrian phase). In particular, the latest episode generated important tectonic deformations which overthrust the Pienidian nappes over the units of the Median Dacides, part of the European continental margin.

In Maramureş (NW Romania), the Pienidian units consist of sedimentary nappes subdivided into three main tectonic units: a) the Magura group, formed by the Leordina, Petrova and Wildflysch nappes; b) the Pieniny Klippen zone, including the Poiana Botizei Klippen zone; c) the Botiza-Kricevo unit. The Wildflysch Nappe represents the southernmost and the most extended tectonic unit, showing a thrust front approximately E-W directed. Paleostress measurements for this nappe demonstrate a southward directed tectonic transport (Huismans et al., 1997), its present position being in relation with a left-lateral strike-slip tectonic activity along the Bogdan Voda Fault Line.

The lithostratigraphic units forming the Wildflysch Nappe are: the Roaia Formation (Middle-Late Eocene) and the Magura Perciu-Pintenul Sandstone (Oligocene). The Roaia Formation has an average thickness of about 1,200 m and crops out along the whole front of the nappe. The sedimentary succession of the Roaia Formation is made by fine grained turbidite deposits, massive sandstones and coarse-grained deposits, showing both vertical and lateral facies variations. At some intervals, and especially at the front of the western part of the nappe, chaotic deposits, formed by calcareous blocks (up to 100 m in diameter) embedded into a pelitic matrix, occur. The Lutetian-Priabonian age of the Roaia Formation is documented mainly by foraminifera assemblage (Săndulescu et al., in press). The age of the calcareous blocks ranges between Paleocene and Late Eocene.

MICROFACIAL ANALYSIS OF THE CALCAREOUS BLOCKS

Two types of microfacies can be separated within the blocks of Paleocene limestones:

1. Bioclastic wackestone with assemblages of calcareous algae, including both red algae (*Lithophyllum cuvilleri, Arthrocardia* sp., *Corallina* sp., Polystrata alba, Parachaetetes asvapatii) and dasyclads (*Terquemella bosnae, Terquemella macrocapus, Fredericia coniconvexa, Zittelina* sp., *Cymopolia* sp., *Saroissiella feremolis*). Among foraminifera, *Rotalia perovalis* is the most representative.
2. Algal-coral bindstone, formed by algal crusts and coral fragments. The algal assemblage consists of rhodophytes (*Corallina* sp., Lithophyllum sp., Parachaetetes asvapatii, Polystrata alba) and dasyclads (*Rusoella* sp., *Oroseina solaris*). Among foraminifera it is worth to mention *Rotalia perovalis*.

Three types of microfacies can be distinguished within the blocks of Eocene limestones:

1. Bioclastic grainstone with red algae (*Lithotamnion* sp., *Mesophyllum* sp., *Corallina* sp., *Sporolithon* sp., *Lithoporella melobesioides* and *Phlystrata alba*) and benthonic foraminifera (mainly *Nummulites* and *Amphistegina* specimens).
2. Bioclastic wackestone-packstone. Bioclasts are represented by red algae (*Lithophyllum* sp., *Mesophyllum* sp., *Neogoniolithon* sp. and *Lithoporella melobesioides*) and benthonic foraminifera (*Assilina* sp., *Lepidocyclina* sp., *Nummulites* sp.).
3. Bioclastic grainstone with corallinacean and peyssoneliaceans (*Polystrata alba*) algae. Foraminifera include *Amphystegina* sp., *Lepidocyclina* sp., *Rotalia* sp. and *Planorbulina broennimanni*.

The foraminifera assemblage (*Assilina* and *Nummulites*) indicate a Middle-Late Eocene age for the blocks of the microfacies c, d and e, while the samples referring to the microfacies a and b evidence a typical Paleocene micropaleontological age (based on *Rotalia perovalis, Parachaetetes asvapatii, Lithophyllum cuvilleri, Saroissiella feremolis, Oroseina solaris*). In the Eastern Carpathians, Paleogene limestones were documented only in the Median Dacides of Maramureş (Prislop conglomerates, Late Eocene) and in the outer flysch (Izvor Fm., Ionesi & Bucur, 1995).

CONCLUSIONS

Syn-sedimentary tectonic episodes, scattered in the whole succession of the Roaia Formation, prove the onset of active tectonics at least during Middle-Late Eocene. Syn-sedimentary tectonic activity is demonstrated by syn-sedimentary faults, growth-faults and slumped sandstone beds in the turbidite successions and by chaotic deposits interbedded between the normal turbiditic or hemipelagic sedimentation. Moreover, a change in basin geometry and in the orientation of the regional slope is documented by the correlation between syn-depositional tectonic episodes and levels with abrupt direction changes of the overall paleocurrent pattern (Aroldi, 1998).

The chaotic deposits, considered as tectonosomes (Pini, 1999), can be related to periods of strong tectonic activity during sedimentation. Such deposits are considered to be emplaced either by rock falls or by submarine slides during episodes of seismic shock. In particular, the examined calcareous blocks interbedded in the normal turbidite sedimentation can be originated from a pre-existent carbonate platform, probably faulted at its margins. The analyses of paleocurrent data and the presence of abundant metamorphic lithic fragments in turbidite arenites, confirm the hypothesis of a carbonate platform located S and SW in respect to the present position of the nappe. The faulted rim of this platform determined the onset of a general instability with consequent detachment of blocks that were deposited in the basin together with normal turbiditic or hemipelagic sedimentation. The different age of calcareous blocks is a consequence of the faulting activity that progressively uplifted older levels of the platform.

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