

TURBIDITIC AND PELAGIC UPPER CRETACEOUS OCEANIC RED BEDS IN THE ROMANIAN CARPATHIANS

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Abstract. Upper Cretaceous Red Beds are widely distributed in the former Tethyan Realm, in the European, Asian and Central North Atlantic regions. This type of sedimentation followed in many regions the Lower Cretaceous Black Shales, indicating the replacement of an anoxic regime with an oxic one. For a better understanding of causes which produced such changes in deposition, the Upper Cretaceous Red Beds were intensively studied since 2002, by the participants in the IGCP-UNESCO Project 463-Upper Cretaceous Oceanic Red Beds: Response to Ocean/Climate Change (CORB). The Third Workshop of this Project was held in Romania in 2004, the one-day conference being followed by a three-day field trip in the Romanian Carpathians. Most of the investigated sections in the field are situated in the Bend Area of the Romanian Carpathians. Upper Cretaceous Red Beds from the above-mentioned region display various facies (pelagic/hemipelagic, turbiditic), covering the interval Cenomanian-Maastrichtian (including the K/T boundary interval). The causes which produce this type of sedimentation are various. Changes in geochemical regime, in palaeoproductivity of surface waters as well as in palaeogeography were assumed to interact.

Key words: Upper Cretaceous, red beds, Romanian Carpathians.

INTRODUCTION

A major change in the world oceans from disoxic sediment deposition to an oxic depositional regime took place within the Upper Cretaceous. Such change, in the western Tethys and Central North Atlantic oceanic basin, occurred shortly after deposition of the Bonarelli horizon (Cenomanian/Turonian boundary interval), which is marked by a significant change in the $\delta^{13}\text{C}$ carbon isotope.

The deep sea red pelagic deposition of clays and marls continues into early Cenozoic (Paleo-cene/early Eocene). This change resulted in major modification in the location of the organic carbon reservoir, therefore it has a direct economic impact, as it affected location of source rocks for oil hydrocarbon generation, and it may also indicate changes in the climate and atmospheric conditions.

Several Earth processes, such as paleoceanographic (e.g., changes in global ocean chemistry, paleocirculation), tectonic (opening and closing of the seaways, migration of the continent plates), climatic (change from greenhouse to icehouse conditions) and eustatic (major sea-level rise), could contribute to this change. Another possibility is that this dramatic change in Late Cretaceous sediment deposition may signal a change in paleoproductivity, which could alter the balance between carbon sources and sinks in the oceans.

Some scientists suggested that the increase in organic carbon in deep sea sediments during the middle Cretaceous was, in part, related to an increase in organic productivity in the oceans. Therefore, does the lack of

organic carbon in deep ocean sediments during the Late Cretaceous represent a major change in bioproductivity in the ocean? If it does, what caused such a major change? If no carbon was buried under the oceans, what was the carbon cycle during this time period and what was its effect on the paleoclimate?

Global change from deposition of pelagic "black shale" to deposition of oxic sediments may indicate more fundamental changes in long-term carbon cycling on Earth.

The above-mentioned issues constitute the subject of IGCP UNESCO 463-Upper Cretaceous Oceanic Red Beds: Response to Ocean/Climate Change (CORB) -, which was approved to be funded between 2002-2006. The first two meetings (during the summer of 2002 and 2003) were held in Italy (Ancona) and respectively in Turkey (Bartın, on the coast of the Black Sea).

ROMANIAN WORKSHOP

As Cretaceous Oceanic Red Beds are widely distributed in the Romanian Carpathians, made by different facies (turbiditic and pelagic) as well as covering different stages, the members of the IGCP-UNESCO 463 planned the Third meeting of this project in Romania. Consequently, the Third Meeting of IGCP UNESCO Project 463 was held in Romania, between 15th-18th of August 2004.

The workshop was organized by the National Institute of Marine Geology and Geo-ecology (GEOECOMAR Bucharest) and sponsored by National Institute of Marine

Geology and Geo-ecology (GEOECOMAR Bucharest), UNESCO/IUGS Programme, as well as by the Romanian Ministry of Education and Research. Twenty-three participants from ten countries, Austria, Bulgaria, China, Czech Republic, Germany, Poland, Romania, Spain, Turkey and USA attended the conference and the following field trip.

On the first day of the workshop, twenty-three participants presented results of their current research on CORBs at the conference held in Bucharest, at the Museum of Geology (Institute of Geology and Geophysics).

In the beginning of the Workshop IGCP 463, Prof. Dr. Nicolae Panin, General Director of the National Institute of Marine Geology and Geo-ecology (GEOECOMAR), institution which organized this event, welcomed the participants to the conference. Prof. Dr. Theodor Neagu also welcomed the participants, on behalf of the Romanian Academy. The co-leaders of the IGCP-UNESCO Project 463, Prof. Chengshan Wang (China) and Prof. Robert Scott (USA) presented a review on the progress and new data on studies of Upper Cretaceous Red Beds, as well as their significance for paleo-climatical, paleoenvironmental and paleoceanographical changes.

The oral and poster presentations informed on Upper Cretaceous Oceanic Red Bed successions from the DSDP Atlantic Drillings, Betic Cordilleras, Apennines, Austrian Alps, Polish, Czech, and Romanian Carpathians, as well as Bulgaria, Turkey, Caucasus and the Tibetan regions. The discussed sections were presented from a lithological, sedimentological and biostratigraphical point of view. The identified calcareous nannofossils, planktic foraminifera and dinoflagellates were used to define zones in the Cenomanian, Turonian, Coniacian, Santonian Campanian, and Maastrichtian stages.

The first day of scientific presentations and discussions of the IGCP-UNESCO Project 463 meeting was followed by three days of field trip in the Romanian Carpathians. Mihaela Carmen Melinte, Titus Brustur, Dan Jipa and Stefan Szobotka (National Institute of Marine Geology and Geo-ecology – GEOECOMAR Bucharest) prepared a detailed field guidebook, presenting the geology of the Romanian Carpathians, which focused on the East Carpathian Flysch Zone and description of red beds, cropping out in this area (Melinte *et al.*, 2004). The participants were guided in the Romanian Carpathians by the scientists of the GeoEcoMar (Mihaela Carmen Melinte, Stefan Szobotka, Cristina Angheluță and Titus Brustur).

UPPER CRETACEOUS MARINE RED BEDS IN THE ROMANIAN CARPATHIANS

On the first day, the participants left Bucharest, travelling along the Prahova Valley. On the way, in Nistorești locality, Upper Campanian-Maastrichtian red pelagic/hemipelagic sediments were examined and sampled for geochemical investigations (Fig. 1).



Fig. 1 Participants examining the red marls of the Gura Beliei

The field trip continued in the Ialomița Valley, where Campanian-Lower Paleocene red cherry marls of the Gura Beliei Formation were examined. This type of red sediments occurred only in the southern end of the Eastern Carpathians, representing the post-tectonic cover of nappes involved in Cretaceous and Miocene tectonical movements. Gura Beliei Marls contain diversified calcareous nannofossil and planktonic foraminiferal assemblages, as well as scarce macro-faunas, mainly represented by the *Belemnitella* genus.

At the end of the first day, we examined the green and red jaspers, and the radiolarian green and red rocks of the Azuga Facies, interbedded within the calcareous turbidites of the Tithonian-Barremian Sinaia Formation.

The aim of the second day of the field trip was to present the oldest Upper Cretaceous red beds of the East Carpathians, representing the sedimentary of the inner nappes of the Flysch Zone. In the Cernatu-Dalnici and Covasna areas (Fig. 2), the red beds (the so-called



Figure 2 Participants examining Upper Cretaceous red beds in Covasna Valley

variegated Shale Formation) conformably overlay the Lower Cretaceous Black Shales. The above-mentioned red beds are mainly composed of red and green shales, with radiolarian chert intercalations. Based on the presence of the ammonites *Stoliczkaia dispar* and *S. notha*, the base on the variegated shales was dated as uppermost Albian. The benthic foraminifera, the dinoflagellates and the radiolarian assemblages indicated that the deposition of the CORB in the region was continuous during the Cenomanian-Coniacian interval.

During the third (and last) day of the field trip, the participants travelled from the Braşov town to the Buzău river basin to see the red beds of the sedimentary cover of Outer Dacidian and Inner Moldavidian Nappes of the Eastern Carpathians. The pelagic red beds of the Dumbrăvioara Formation were examined in the Poiana Florilor-Teliu area (Fig. 3).

All three members of this lithostratigraphical unit, the uppermost Albian-lowermost Cenomanian Lower Member of Red Shales (containing *Neohibolites ultimus* and microfaunal assemblages with *Rotalipora appen-ninica*), the Lower Cenomanian-Lower Turonian Middle Member, made up from black and grey shales (containing macrofaunal assemblages with *Puzosia planulata*, *Romaniceras spp.*, *Hamites spp.*, *Acanthoceras rhotomagense*, *Inoceramus aff. hercynicus* and *I. crippei*) as well the Lower Turonian Upper Member of Red Shales (with the base situated within the UC6a Nannofossil Zone and the top within the UC9b Nannofossil Zone) were investigated.

The last outcrop examined during the last day was the Cretaceous Red Beds belonging to the sedimentary cover of the Audia Nappe. The red beds crop out as narrow strips, overlaying the Black Shale Formation, specifically the Upper Member of it (the Glauconitic Sandstone,



Figure 3 The participants of the Romanian Meeting IGCP-UNESCO 463, in the last day of the field trip, in the Poiana Florilor area (Buzău Valley). *First row (back):* Okan Tüysüz (Turkey); *Second row (left to right):* İsmail Ömer Yılmaz (Turkey), Polina Pavlishina (Bulgaria), Xiumian Hu (China), Constantin Manea (Romania), Mihaela Carmen Melinte (Romania), Cristina Angheluță (Romania), Peng Ping'an (China). *Third row (left to right):* Miroslav Bubik (Cehia), Florentin Maurrasse (SUA), Robert Scott (SUA), Camilo Ponton (SUA), Ion Stănescu (Romania), Ines Wendler (Germany), Jaime Gallemi (Spain), Wang Chengshan (China), Stephanie Neuhuber (Austria), Ewa Malata (Poland), Yuping Chen (China), Yan Rong Zou (China). *Photo:* Dr. St. Szobotka.

lithostratigraphic unit similar to the Lgota Beds of the Polish Carpathians). The CORB are uppermost Albian-Lower Coniacian in age, according to their calcareous nannofossil content (from UC0 up to UC10 Nannofossil Zones). Locally, the red shales (described also as Bota-Botița Formation) contain, within their lower part, bentonites. In places, breccias with granodioritic elements (proceeding from a cordillera, which was active only during the Late Cretaceous interval) could be observed.

The participants sampled all the visited sections for micropaleontological investigations, as well as for organic chemistry studies.

FUTURE PLANNED WORK

A full report of the participants in the IGCP-UNESCO Project 463 about their joint investigations on Romanian sections will be given during the Fourth Meeting of the project, in 2005.

After discussion among the leaders of the IGCP projects, it was decided that the IGCP463 & 494 2005 Workshops would be shifted from Jaen, Spain to Neuchatel, Switzerland.

The annual planning session will be 2 days during September 1-2, 2005, followed by the optional Prealpes field trip (September 3-4), which precedes the 7th Cretaceous Symposium September 5-9 in Neuchatel, Switzerland.

The planned meetings will give us the opportunity to engage the interest and future participation of other Cretaceous specialists.

The objectives of the 2005 workshop are to exchange data among participants and to interact on the topic of the "Cretaceous Oceanic Red Beds". Project progress, future studies, collaboration, publications, and organizations will be fully discussed. We will try to refine the existing hypotheses and to develop multiple working hypotheses to explain the deposition of Upper Cretaceous Red Beds (CORB).

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