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Paleomagnetic Constraints on the Chronology and Geodynamics of the Dacian Basin – Eastern Paratethys

R. Stanca* (University of Bucharest) & D.V. Palcu (Utrecht University)

SUMMARY

Reviewing previous studies and adding new paleomagnetic and micropaleontologic data, this paper focuses on the Middle Miocene chronology and stratigraphy in the Dacian Basin area - a critical moment in a critical location – a choking point between the water masses of the Eastern and Central Paratethys. Firstly, it gives a new time-frame for one major tectonic, biologic and basin evolution event – the intra-Sarmatian tectonic phase - that took place in the above mentioned time interval. Secondly, it proposes a revision of the timing for one of the regional sub-stage boundaries of the Middle Miocene in Paratethys (the Volhynian and the Bessarabian). And thirdly, it offers new, reliable magnetic data from four locations that will be further used in studies regarding tectonic rotations in the Carpathian orogenic system.

Introduction

This project is part of a larger scientific effort to analyze, understand and reconstruct the Paratethys depositional environment evolution in terms of chronology, climatic changes and geodynamics. Reviewing previous studies and adding new paleomagnetic data, this paper focuses on the Middle Miocene chronology and stratigraphy in the Dacian Basin area. It proposes a revision of the timing for one major tectonic, biologic and basin evolution event – the intra-Sarmatian tectonic phase (STP) - that took place in the above mentioned time interval as well as a new timing for the regional sub-stages boundaries of the Middle Miocene in Paratethys.

Paratethys was a large epicontinental sea, gradually closing from Oligocene onwards till present days, that, along with the Mediterranean Sea, was one of the two remnants of the Tethys Ocean.

The Paratethys realm is characterized by episodes of full connection to the Global Ocean or isolation and semi-isolation, correlated with the collision of Africa, Arabia and India with Eurasia, but also with glacio-eustatic sea-level changes. These shifting settings are responsible for the formation of much of the hydrocarbons source rocks and reservoirs in Eastern Europe (Black Sea and Caspian Sea), as well as for large volumes of evaporites. Also due to the problematic connection, Paratehys has hosted a particular mixture of commonly found marine faunas and endemisms (Harzhauser and Piller, 2007). With a complex stratigraphy and various chronology issues, the system proves to be a real challenge that requires a better and thorough understanding.

Data acquisition and processing

Paleomagnetic sampling was performed using a hand-held electric drill in six different locations from the Dacian Basin: Dara and Cerna, in fine sediments, with carbonatic laminae and/or tuffitic horizons, and poorly cemented sandstone levels, Valea Tisei, Salcia, Madulari and Campinita. Two oriented cores were collected per each sedimentary horizon at a stratigraphic interval of 1-2 m.

Alternating fields (AF) demagnetization was used for the Dara samples; the demagnetizing steps were small (2-20 mT), the peak value being of 100 mT. The Valea Tisei, Cerna and Salcia samples were demagnetized thermally with temperature steps of 20-50^{0}C until the top value of 300^{0}C was reached. The obtained results were combined with two other rock magnetic experiments: Curie balance and magnetic susceptibility. The entire processing stage took place in the Paleomagnetic Laboratory Fort Hoofddijk of the Utrecht University (Netherlands) which, for the last two magnetic methods above mentioned, is equipped with an AGICO Kappabridge MFK1 susceptibility meter and a horizontal translation type Curie Balance.

A horizontal 2G Enterprises DC SQUID magnetometer was used to measure the NRM of demagnetized samples. The results were further analyzed using Zijderveld orthogonal plots and stereographic projections in PALDIR software; sample ChRM direction was determined applying the principal component analysis. Samples with a maximum angular deviation (MAD) bigger than 15^0 were not considered relevant for the study. The obtained values for inclination (I) and declination (D) were uploaded in PALPLOT.

Results

The onset of the STP is primarily marked by a change in lithology, from fine sediments (marls) to poorly cemented sandstones; this is due to an uplift of 6-7000 m (Sanders, 1998) and accentuated erosion that signalled the formation of important hydrocarbon reservoirs. Taking into account these constraints, the Dara section can be easily situated in the pre-tectonic facies, whereas the Cerna section is of a syntectonic age. The magnetic results situate the upper half of the Cerna section between the C5n.1n chron at the base and the C4r.2r at the top (Fig. 1) and the Dara section seems to have its base within the C5r.2r and finishes in the C5n.2n (11.056 – 9.984 Myr) time interval. But the uppermost part of the Dara log is represented by the onset of a sandy stage; this transition can be due to the beginning of the STP, which, according to the above presented results, would correspond to the middle part of the C5n.2n chron.

Micropalaeontological results position also a boundary between two local sub-stages of the Sarmatian (Volhynian /Bessarabian - Vh/Bs) at the base of the section (between sampling points 1 and 18) and further research is being conducted in order to better determine the exact boundary level and date it.

The results for Valea Tisei, Salcia, Madulari and Campinita sections assigned them to the Middle to Late Miocene time interval. Their strong magnetic response makes them suitable for further investigations regarding tectonic rotations in the Carpathian orogenic system that can come as additional data to (Dupont-Nivet et al., 2005).

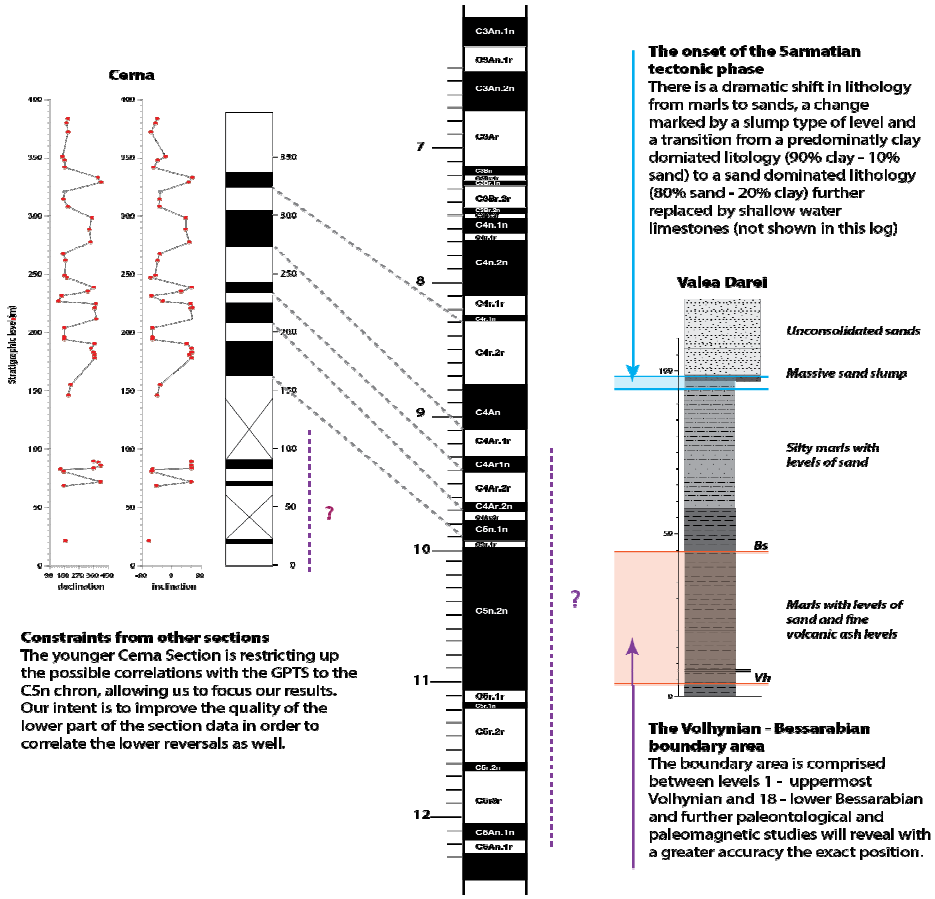

Figure 1 *Preliminary results for Cerna and Dara (Valea Darei) sections and additional explanations (the question marks represent the target sub-sections for which further studies are being conducted in order to increase their quality).*

Conclusions

The magnetic and micropaleontological results from the Dacian Basin offer a new time-frame for the STP as well as a potential thorough dating of the Vh/Bs boundary. The latter locations present a very satisfactory response so far that makes them reliable for paleolatitudes study.

References

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