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The Bulgarian Early Cretaceous basin in the Tethys panorama

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Т. Николов, Ц. Цанков – Положение болгарского раннемелового бассейна в Тетисе. Болгарский раннемеловой бассейн развит в северной периферии Тетисского океана, в части прилежащей к Европейскому фрагменту Евразийской литосферной плиты. Бассейн – заддугового типа, и формировался на Мизийской микроплите. В общем плане, бассейн дуговидного характера, выпуклый к северу. К югу располагается авулканическая островная дуга. Еще более к югу от этой авулканической островной дуги развит сравнительно узкий внутридуговой бассейн, ограниченный с юга хорошо выраженной вулканической островной дугой. Срединно-океаническая зона Тетисского океана проходила через Егей.

Abstract. The Bulgarian Early Cretaceous basin developed within the northern periphery of the Tethyan Ocean adjacent to the European fragment of the Eurasian lithospheric plate. The basin was of a back-arc type, and formed over the Moesian microplate. It had an arc configuration convex to the North. An avolcanic island arc was situated South of it. Further South, a comparatively narrow interarc basin developed that was bounded to the South by a well-expressed volcanic island arc. The mid-ocean zone of the Tethys Ocean passed through the Aegean.

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Key words: Early Cretaceous; Bulgaria; Balkan-Caucasian segment; Tethys

Introduction

The Lower Cretaceous sedimentary formations are widespread in Bulgaria. They have developed in various facies with considerable thicknesses, and contain abundant fossils that belong to different organic groups. Therefore, the position of the basin is of considerable interest in respect to palaeogeodynamics, palaeogeographic and palaeobiogeographic relations, and evolution peculiarities.

The Bulgarian Early Cretaceous basin has been, from a palaeobiogeographic viewpoint, a part of the Mediterranean Province of the Tethys. This province embraced North Africa, Southern Europe, Caucasus and Asia Minor (Nikolov, 1987).

Within the frame of the general tectonic panorama of the Tethys Ocean, the Bulgarian Early Cretaceous basin has developed within the northern periphery of the Tethys, adjacent to the European fragment of the Eurasian lithospheric plate (Dercourt et al., 1985; Nikolov, 1987). The basin was of a back-arc type, and formed over the southern part of the Moesian microplate.

Principal features of the basin

The Early Cretaceous basin in Bulgaria embraces a considerable territory of this country, mostly its western and northern parts. It is asymmetrical, with a steep southern slope and a wide northern part developed over the southern margin of the Moesian microplate. Two main zones may be distinguished in the basin. The southern one is very narrow, with an almost trench character, mobile tectonic regime and intense compensated subsidence. This depression was filled by predominantly terrigenous sediments with considerable thicknesses reaching up a total of 5 km. In general, this

depression has an arcuate shape convex to the North (1965). Here we will designate this depression as Peri-Moesian marginal flysch basin. To the North, a vast zone is characterized by a comparative tectonic quiescence, and a wide development of shelf clayey-carbonate and carbonate facies with thicknesses reaching 1000-1200 m. To the South of the basin, an avolcanic island arc is located. Its outline and relief changed gradually. Within the Balkan Peninsula, this arc was represented by the Thracian (Rhodopi for some authors) island. To the East, it is represented by the Euxinian block and by the Northern Transcaucasian island arc (Stille, 1928; Wilser, 1928a, 1928b; Бончев, 1957; Kotetishvili, 1989). Its continuation to the North-west is not clear due to intense post-Cretaceous transformations.

There are grounds to suppose that the Early Cretaceous island arc in this part of the Tethys (Balkan-Caucasian segment) is represented by fragments of the ancient Pontian-Caspian plate (Stille, 1928; Бончев, 1975) that has been particularly intensely disrupted during the Late Cimmerian and Austrian movements.

An important role in the Early Cretaceous palaeogeography of the western part of the Balkan Peninsula has been played by the Getic region and the Serbo-Macedonian Massif according to Grubić (1974) or the so-called Dardanian diagonal (Bončev, 1977) which separate the East-Serbian basins from the Dinarides. The Dinarides themselves have been a part of the central zone of the Mediterranean region during Early Cretaceous times, whereas the Lužnica flysch trough developed East of the Dardanian diagonal. However, this trough transepted, according to Grubić (1974), the Getic region and the Serbo-Macedonian massif. According to the author cited, East of the Getic cordillera the Danube trough has been formed as a prolongation of the South Carpathians. Grubić (1974) believes that traces of palaeo-oceanic crust have been preserved in Krajna (East Serbia), its fragments being exposed in Deli Jovan. It is not proven that this oceanic crust has been of an Early Cretaceous age but it is undoubtedly covered by Upper Jurassic-Lower Cretaceous pelagic sediments. Moreover, volcano-sedimentary rocks ("Vratarnica series" that embraces also the base of the Lower Cretaceous) with manifestations of basic volcanic activity are present in this zone. The above-lying Timok (= Sinaya, pars) beds contain also diabases and diabase tuffs. Partially analogous to them are the Azuga beds in the South Carpathians.

A comparatively narrow interarc basin has been located between the northern avolcanic island arc of the Balkans, and a well-expressed volcanic island arc to the South. To the North-west, it continues through the Krajna region of East Serbia, the western parts of the South Carpathians towards the Apuseni Mts where Lower Cretaceous volcanic and volcano-sedimentary rocks are known (Bleahu et al., 1981). In the same interarc basin, the Lower Cretaceous volcano-sedimentary rocks of the South-east Rhodopes developed, being represented mainly by the phyllite complex of the Makri unit exposed North-west of Alexandroupolis (Nikolov, 1987; Papadopoulos et al., 1989). The age of the phyllitoid rocks of the Dolno Loukovo Formation is still subject of discussion. Initially, an Early Cretaceous (Боянов, Липман, 1973; Липман, Боянов, 1976) or Late Jurassic-Early Cretaceous (Boyanov, Trifonova, 1978) age has been proposed on the basis of radiolarians. Later on (Tikhomirova et al., 1988; Zagorčev et al., 1989), practically the whole Dolno Loukovo Formation has been referred to the Lower Jurassic after revision of the same radiolarians from the black slates from the valley of the Koulidzhikska River as well as by new finds of radiolarites within the clastolava packet of the tholeiitic basalts. Correlations between the Makri unit and the Dolno Loukovo Formation as well as a reinterpretation of the data of Boyanov and Lipman (loc. cit.) allow us to believe that the uppermost part of the Dolno Loukovo Formation belongs to the Lower Cretaceous, and its rocks have been formed within the interarc basin.

The Lower Cretaceous of the island Samothraki is a part of the ophiolitic complex represented by gabbro and diabases. Polygenic breccias, coral limestones and schists are also present (v. Braun, 1968; Nikolov, 1987). Evidence exists also for the development of a subduction zone situated South of the volcanic island arc. This zone is well visible on pl. 4 (Aptian) of Dercourt et al. (1985).

A model of the Berriasian-Early Barremian Balkan-Caucasian segment of the Tethys (Figs. 1, 2) shows that it has been built of a frontal deep trench, accretionary prism, volcanic island arc, interarc trough, avolcanic island arc, and back-arc flysch trough. North of this trough, a shallow shelf developed. Relics from these geodynamic elements in the eastern (Caucasus) part give grounds to suppose that the active continental margin has had there a calmer dynamics. The western (Balkan) part of the segment was bounded to the East by the system of the West-Pontide transform faults (Fig. 1). Their strike was oblique to the principal geodynamic trends (Dercourt et al., 1985).

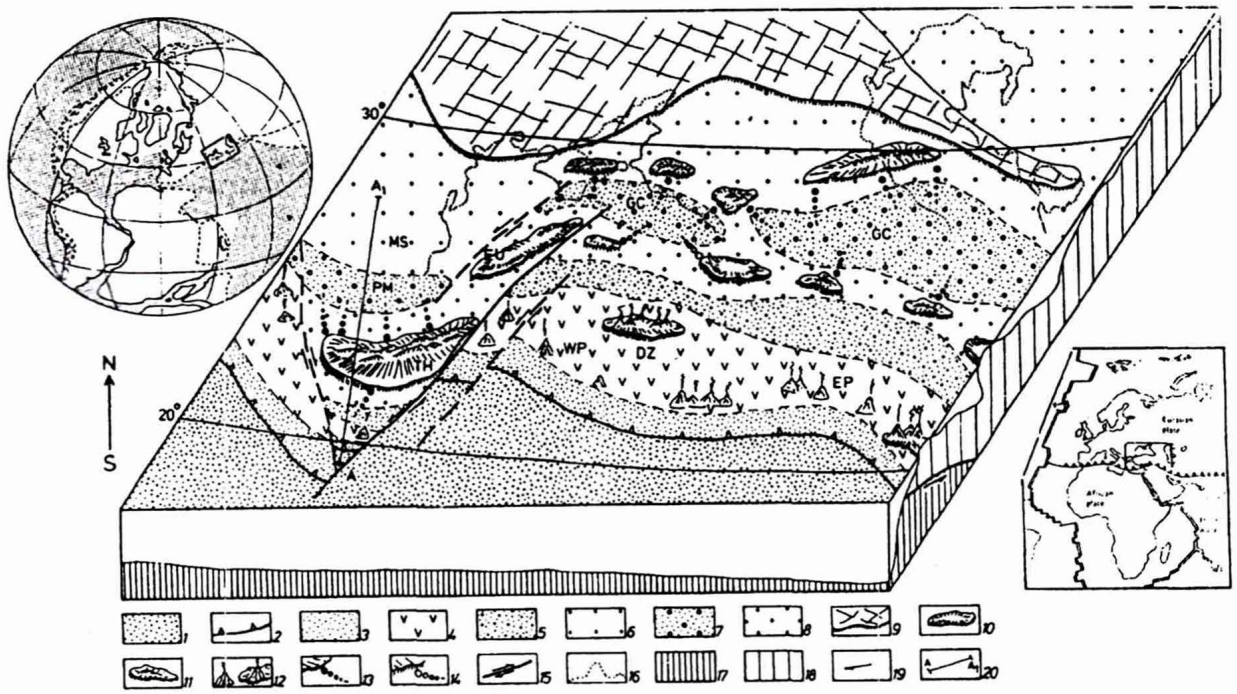

Fig. 1. Schematic block-diagram of the Berriasian-Early Barremian paleogeodynamic setting in the North-Eastern Mediterranean area of the Tethys ocean between the Balkan Peninsula and the Caspian Sea
1 — northern slope of the Tethys ocean; 2 — subduction zone; 3-7 — South-European active continental margin: 3 — zone of the subduction trench, 4 — volcanic island arc, 5 — deep marine basin (interarc basin), 6 — avolcanic island arc, 7 — flysch basin (back-arc basin); 8 — shallow marine basin, 9 — emerged land; 10 — avolcanic island with a low relief; 11 — avolcanic island with a high relief; 12 — volcanic island; 13 — siliciclastic turbidites; 14 — calciturbidites; 15 — transform fault; 16 — contours of actual Black and Caspian Seas; 17 — oceanic crust; 18 — continental crust; 19 — direction of the subduction of the oceanic crust. Abbreviations: DZ — Dzirula island; EU— Euxinian island; EP — Eastern Pontides; GC — Great Caucasus marginal flysch basin; MS — Moesian microplate; PC — Ponto-Caspian plate; PM — Peri-Moesian marginal flysch basin; R — Russian continental plate; Sc — Scythian microplate; TH — Thracian island; U — Ukraina craton; WP — Western Pontides. A-A_1 — profile line (see fig. 2)
On the inset: Berriasian-Valanginian principal position (left) and present geotectonic position (right) of the investigated area

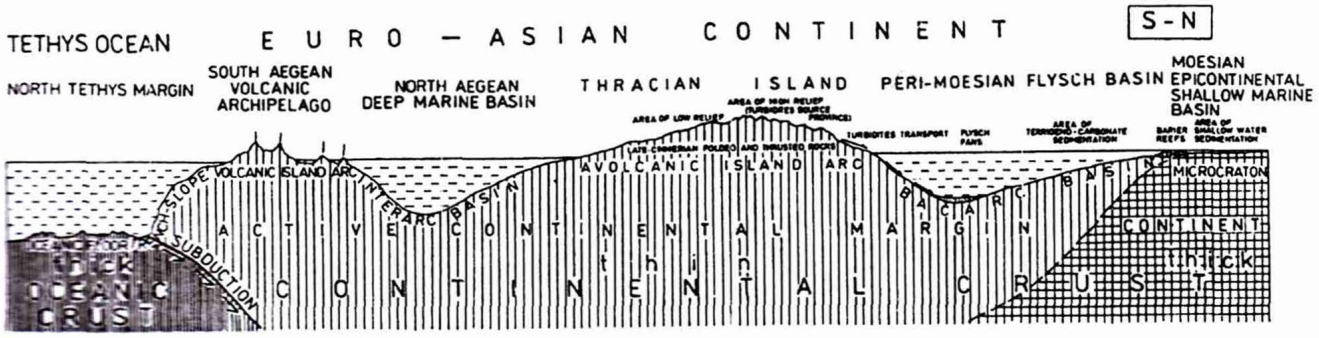

Fig. 2. Schematic paleogeodynamic profile through the Eastern part of the Balkan Peninsula during the Berriasian-Early Barremian time (on the fig. 1-profile line A-A_1)

Along these faults, the disintegration of the Pontian-Caspian plate occurred together with a considerable sinistral shift both of the subduction zone and of the adjacent active continental margin. The Moesian microplate was bounded to the West by the suture of the already closed Vardar ocean branch. Early Cretaceous right-lateral displacements probably occurred along this suture. The Balkan part of the segment, narrowing in a wedge-like manner to the South, is outlined by traces of a deep trench, volcanic island arc and narrow interarc basin that have developed in the area between the Samothraki island and the South-east Rhodopes in the Circum-Rhodope zone of Papadopoulos et al. (1989). Hence, the Berriasian-Barremian geodynamic interval exhibits the typical features of the two-arc model of the European continental margin in this area.

Many new data show that the dynamics of the island archipelago played an important role in the palaeogeodynamic evolution of the Early Cretaceous basin within the Balkan-Caucasian segment in the northern parts of the Tethys.

Conclusions

Three stages may be outlined in the geodynamic evolution of the Bulgarian Early Cretaceous basin, and namely: Berriasian-Early Barremian, Late Barremian-Aptian, and Albian.

The Berriasian-Early Barremian interval is characterized with a tectonic posthumity, the main features being inherited from the Late Jurassic evolution.

A considerable differentiation of the basin began at the beginning of Late Barremian time. It was triggered by originating new of/and activated old fault structures. Considerable carbonate platforms have been formed, separated by depression with intense terrigenous sedimentation (Николов, Хрисчев, 1965; Рускова, Николов, 1984).

At the end of Aptian time, an intense Austrian folding occurred in the Central and Eastern Fore-Balkan, followed by gradual uplift of this area. The strongest regressive tendency was expressed in the eastern part of the country due to the uplift of the Euxinian block (Бончев, 1957; Николов, 1969).

The Lower Cretaceous of Bulgaria, although possessing some specific peculiarities, has many common features with the other parts of the Tethys, and namely: (1) development of flysch sediments; (2) carbonate platforms; (3) Urgonian sediments and their terrigenous-carbonate mantles. The general position of the Bulgarian Early Cretaceous basin has also many common features with the Pyrenees, South-east France, the Peri-Alpine ranges, the Carpathians and Caucasus.

The Bulgarian Early Cretaceous basin has developed over a thin continental crust. There is no evidence on Bulgarian territory about a presence of oceanic crust in this basin. The Austrian tectonics at the end of Early Cretaceous times has been a remarkable step in the formation of the Alpine tectonic aspect in the eastern parts of the Balkan Peninsula.

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