MIOCENE FORAMINIFERAL TESTS - SOURCE OF DATA ON PALAEOENVIRONMENTS

Ivona Tukac[1], Jasenka Sremac[2], Hrvoje Posilović[2], Đurđica Pezelj[2] & Vladimir Bermanec[3]

1 Tucibati 33, 47 000 Karlovac, Croatia
2 Faculty of Science, Department of Geology, Institute of Geology and Palaeontology, Horvatovac 102 a, 10 000 Zagreb, Croatia, e-mail: jsremac@yahoo.com ;
3 Faculty of Science, Department of Geology, Institute of Mineralogy and Petrography, Horvatovac b.b., 10 000 Zagreb, Croatia

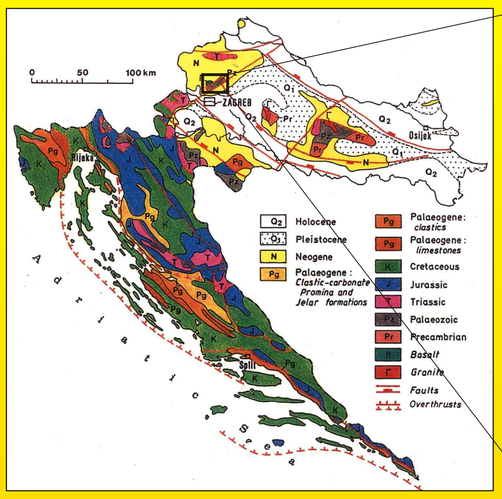

Fig.1. Geologocal map of Croatia (Velić, I. & Velić, J. 1995).

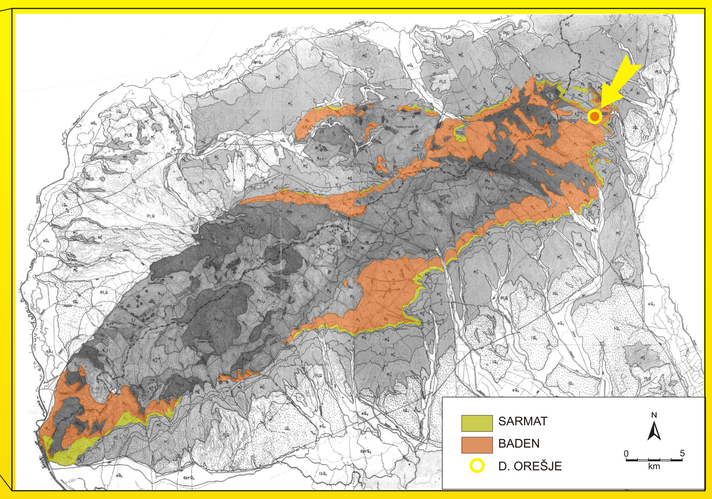

Fig.2. Simplified geological map of the Medvednica Mt. with geographic range of the Badenian and Sarmatian sediments. Locality D. Orešje is marked with yellow ring (after Šikić, 1997; modified).

Miocene rocks in Northern Croatia, deposited in Southwestern Paratethys, are well developed and represented with different clastic and carbonate facies (Fig.1). A nicely exposed Miocene profile was described from Donje Orešje quarry in SE Medvednica Mt. (Fig.2). Upper Badenian marls of the Zone Bulimina-Bolivina contain numerous fossils of benthic foraminifer genera: *Bolivina*, *Cassidulina*, *Globocassidulina*, *Uvigerina*, *Cibicidoides*, *Planulina*, *Elphidium*, *Asterigerinata*, and planktonic taxa: *Orbulina, Globigerinoides* and *Globigerina*, varying in abundance from 1,59 to 85,81 %. Sarmatian sediments were deposited continuously (Fig.3).
They contain less abundant fossil communities, with generally smaller specimens. Lower Sarmatian Zones Anomalinoides badenensis and Elphidium reginum, as well as Middle Sarmatian Zone Elphidium hauerinum were recognized. Content of planktonic foraminifera is significantly reduced, and varies from 0,68 % to 16,28 %. The most abundant taxa are *Elphidium, Anomalinoides, Bolivina, Ammonia and Rosalina* (SREMAC et al., 2005).

During the taphonomical processes, due to the microbiological activity, H_2S, CO_2 and different organic acids cause the decrease in pH of the sea water. Sulphide minerals (e.g. pyrite) can be precipitated under such conditions. Depending on the deposition rate and chemical composition of pore waters this primary sulphidization can be preserved, or oxidized into iron oxide minerals. During the increase in pH and Eh of microenvironments, $CaCO_3$ can be precipitated, often fulfilling the whole foraminiferal tests. According to the different environmental factors, sulphide and carbonate mineralization can not be precipitated together within the same microenvironment (GARRELS et al, 1990; BRIGGS et al., 1991; CASTAINER et al., 1999).
In Badenian samples (Figs. 5 A-D) sulphide minerals are not present. Presence of hematite indicates a well oxygenated environment. Sparry calcite is present within the foraminiferal tests, usually typical for elevated pH values of sea-water (>8). It is possible to find traces of the fossil microbial activity within the tests. Sarmatian tests (Figs.6 A-C), on the contrary, often contain pyrite. Gradual decrease in sparry calcite moulds can be traced in Sarmatian beds.
Data obtained from diagenetic features support a theory of shallowing-upward and gradual decrease of salinity during the Sarmatian.

Fig. 5. SEM images of foraminiferal tests from the Badenian of D. Orešje

A. Coccolith and romboedral authigenic calcite crystals on the surface of the shell.

B. Calcite infilling inside the foraminiferal chamber.

C. Filamentous bacterial mucus on the surface of a romboedral calcite crystal inside the foraminiferal test.

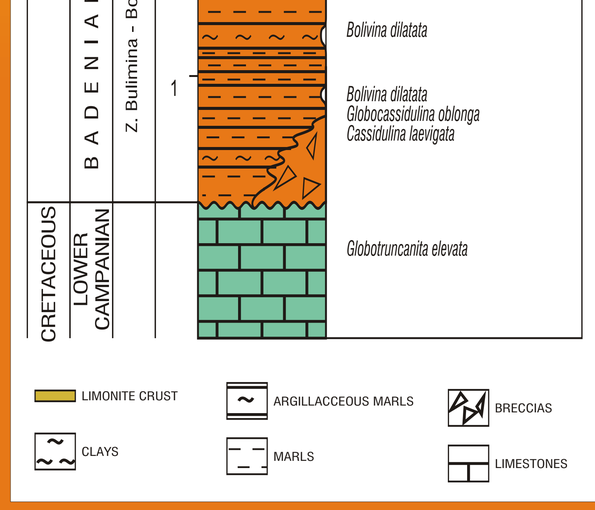

Fig.4. Detailed stratigraphic column through the Badenian and Sarmatian sediments in the quarry D. Orešje (Mt. Medvednica, Croatia). (Sremac et. al., 2005).

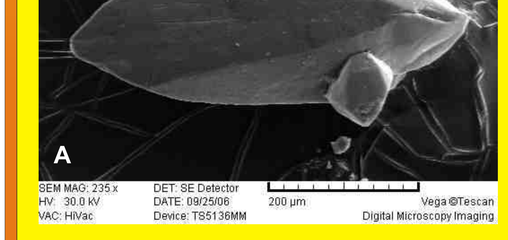

Fig. 6. SEM images of foraminiferal tests from the Badenian and Sarmatian of D. Orešje

A. Authigenic calcite crystal from the Badenian marl.

B. BSD image of the iron oxide mineralization on the surface of the foraminifera.

C. BSD image of the framboidal pyrite inside the Sarmatian foraminiferal test.

Fig. 3. Diagenetic mineralization processes were investigated by a Tescan TS 5136 SEM microscope equipped with an Oxford energy dispersive spectrometer in a Electron microscope laboratory, Faculty of Science, Department of Geology, Zagreb.

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