

## Foraminifers in Paleogene sediments at Crna Skala in the Delčevo Basin, Republic of Macedonia

### Палеогенски фораминифери от находище Црна Скала в Делчевския басейн, Република Македония

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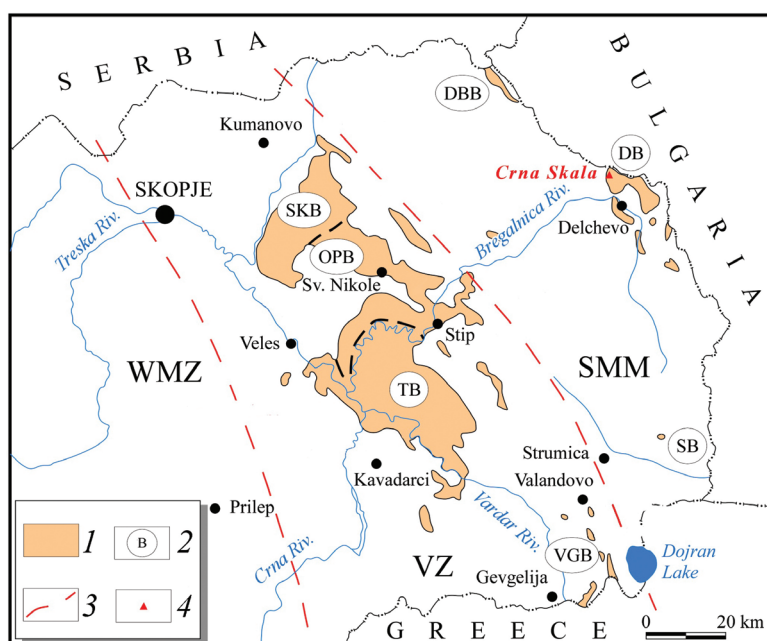
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### Introduction

The Delčevo Basin is located in the NE part of the Republic of Macedonia. To the northeast, the basin extends locally to the area of Crna Skala (close to the Macedonian/Bulgarian border), and continues on the territory of Bulgaria (Fig. 1). The Paleogene sediments of the Delčevo Basin are developed in several outcrops with NNW–SSE trends, usually lying

transgressively upon the high-grade metamorphic and magmatic rocks of the Serbo-Macedonian Massif, and mostly covered by Neogene effusive and sedimentary rocks. At some places the Paleogene sediments were found to be disrupted. The first evidence for the presence of Paleogene in the Delčevo Basin was provided by Belmustakov (1948), who dated these sediments as Oligocene. Based on the study of gastropods, bivalves and other fossil groups, Temkova (1957) and



**Fig. 1.** Sketch map of the Palaeogene basins in the Republic of Macedonia  
1, Distribution of Palaeogene sediments; 2, Paleogene basins: Tikveš Basin (TB), Ovče Pole Basin (OPB), Skopje-Kumanovo Basin (SKB), Delčevo Basin (DB), Valandovo-Gevgelija Basin (VGB), Strumica Basin (SB), Deve Bair Basin (DBB); 3, Tectonic boundary; 4, Studied section. Other abbreviations used: Serbian-Macedonian Massif (SMM), Vardar Zone (VZ), Western Macedonian Zone (WMZ)

Gjuzelkovski (1959) determined the overall age of the Paleogene rocks in the Delčevo Basin as Late Eocene, and Kovačević et al. (1973) referred them to the Priabonian. This study aims to achieve a further understanding of the age of the Paleogene sediments from the Delčevo Basin by means of micropaleontological examination of foraminifer fauna.

### Geological setting, materials and methods

According to the current knowledge, the Paleogene sediments of the Delčevo Basin are nearly 700 m thick. In terms of their lithology, these rocks are developed in flysch succession that can be subdivided into two units: basal and upper flysch lithozone. Our work was focused on the upper flysch lithozone, which is 400–600 m thick. For the purposes of this study, the Crna Skala section, that is located 8 km north of the town of Delčevo, was sampled. A total of 26 samples were collected from approximately 75-m thick sequence of rhythmic clay-marl-sandstone alternation, and positive results for foraminifer fauna were obtained from all stratigraphic levels. Technical work was carried out by using classical methods for the micropaleontological analysis (chemical break up, washing, drying, selection and determination). Selected foraminiferal specimens were photographed with an electron microscope JMS-5510-JEOL.

### Results and discussion

After a careful examination of the samples collected from the Crna Skala section, abundant benthic and less common planktonic foraminifers were found: 16 species from 14 genera that belong to 11 families: Spiroplectamminidae Cushman, 1927, Trochamminidae Schwager, 1877, Cibicididae Cushman, 1927, Nonionidae Schultze, 1854, Bagginidae Cushman, 1927, Caucasinidae Bykova, 1959, Bolivinidae Glaessner, 1937, Hauerindae Schwager, 1876, Heterolepidae Gonzáles-Donoso, 1969, Nodosariidae Ehren-

berg, 1838 Globigerinidae Car., Park. and Jones, 1862. The systematic classification of the foraminiferal fauna follows that of Loeblich and Tappan (1988). Benthic foraminifers from the studied section include the following taxa: *Spiroplectinella carinata* (d'Orbigny), *Trochamina deformis* Grzybowski, *Quinqueloculina juleana* d'Orbigny, *Triloculina angularis* d'Orbigny, *Triloculina gibba* d'Orbigny, *Baggina subconica* (Terquem), *Heterolepa dutemplei* (d'Orbigny), *Lenticulina* sp., *Pullenia quinqueloba* (Reuss), *Bolivina* cf. *cookei* Cushman, *Cibicides* cf. *westi*, *Cibicides ungerianus* (d'Orbigny), *Anomalinoidea acutus* (Plummer), *Caucasina eocenica* Chalilov, and *Valvulineria jaksoensis* Cushman. In contrast, the planktonic foraminifers yielded only specimens of *Globoturbotalia angulificalis* (Blow) whose stratigraphic distribution within the foraminiferal association from Crna Skala section defines Early Oligocene age. This species also occurs in other coeval sections in Macedonia, together with typical Oligocene species (Stojanova et al., 2013).

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