3D lithostratigraphic model of the Palaeogene in the Avren Plateau

Триизмерен литостратиграфски модел на Палеогенската система в Авренското плато

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Keywords: lithostratigraphic units, Palaeogene, borehole logs, 3D model, Avren Plateau.

Introduction

The Palaeogene is widespread in Northeastern Bulgaria, as it is almost entirely covered with Neogene and Quaternary sediments. Therefore, the 3D lithostratigraphic modeling, based on borehole lithological data and stratigraphic (litho- and chrono-) interpretation of seismic profiles, is the only way to reveal and visualize the deep geological structure. The 3D modeling was successfully applied to Dobrogea area (Valchev et al., 2018), the Varna Plateau (Valchev et al., 2019) and the Dolna Kamchiya Basin (Valchev et al., 2020), while the lithostratigraphic interpretation of seismic profiles was approved in the onshore (Valchev, Dimitrov, 2018) and offshore (Valchev, Dimitrov, 2019) part of the Dolna Kamchiya Basin.

In terms of the regional tectonic zonation, the Avren Plateau includes the southern half of the Avren Step. The last is a part of the eastern slope of the North Bulgarian Dome (*sensu* Georgiev, 2012), which is also known as Varna Monocline (according to Bokov et al., 1987), belonging to the Moesian Platform (Fig. 1a). The studied area also comprises the southern part of the Varna Valley south of Varna and Beloslav Lakes (Fig. 1b).

The Palaeogene succession in the area of modelling includes six formal lithostratigraphical units, as follows: the Komarevo Fm. (Datchev, 1975; Aladžova-Hrisčeva, 1990; Thanetian), the Beloslav Fm. (Gočev, 1933; Aladžova-Khrisheva, 1984; Ypresian), the Dikilitash Fm. (Gočev, 1933; Aladžova-Khrisheva, 1984; Ypresian), the Aladan Fm. (Gočev, 1933; Aladžova-Khrisheva, 1984; Ypresian), the Avren Fm. (Gočev, 1933; Dzuránov, Darakchieva, 1986; uppermost Ypresian–lower

Priabonian), and the Ruslar Fm. (Zlatarski, 1927; Aladžova-Chrisčeva, 1991; Oligocene). Their lithological features, thickness and boundaries were discussed by Valchev and Dimitrov (2020).

On the basis of primary lithological data derived from 53 boreholes' sections and these after the lithostratigraphic interpretation of 5 seismic profiles (Fig. 1b), a 3D lithostratigraphic model of the Palaeogene rocks was created in purpose to elucidate the spatial distribution and relationships of the established lithostratigraphic units.

The generating of the 3D voxel lithostratigraphic model was performed by means of software processing described by Valchev et al. (2018).

3D lithostratigraphic model

For generation of the 3D lithostratigraphic model, individual sets of lithostratigraphic bodies were established. They include base, cover and 6 bodies concerning the Palaeogene lithostratigraphic units (Fig. 1c).

The base comprises different Upper Cretaceous lithostratigraphic units. For the purpose of the 3D modelling, they have not been referred to any specific lithostratigraphic units and have been visualized as an unified body. The Upper Cretaceous base is widespread in the whole studied area.

In total, the Komarevo Formation was established in 22 boreholes' sections. It is distributed in almost entire area of modeling except the areas around the villages of Zvezditsa, Konstantinovo, Bolyartsi, and Benkovski.

The Beloslav Formation was recorded in 11 boreholes in southern and northeastern part of the studied area.

Fig. 1. a) Tectonic subdivision of the territory of Bulgaria (after Dabovski, Zagorchev, 2009) with location of the studied area; b) Sketch map of the Avren Plateau with the location of the studied borehole sections (1) and seismic profiles (2), as the area of 3D modeling is outlined with green line; c) 3D model of the Palaeogene lithostratigraphic units.

The Dikilitash Formation was proved in 45 boreholes and it is distributed in the entire area of modeling excluding its central part (the area of the villages Priseltsi and Zvezditsa).

The Aladan Formation was recorded in 35 boreholes in northeastern, western and southern parts of the area of modeling.

The Avren Formation was proved in 52 boreholes (except C-49 Konstantinovo) and it is developed in the entire studied area. Our previous investigation on the Avren Plateau (Valchev, Dimitrov, 2020) revealed that the unit demonstrates broad lithological varieties. They are described and visualized in a separate article (Valchev, Sachkov, 2020, this volume) and therefore, for the purpose of the present modeling, we unified them into a single lithobody.

The Ruslar Formation was established in all 53 boreholes and it is the most wide spread Palaeogene unit in the Avren Plateau.

The Palaeogene succession is covered by the Neogene Galata Formation. The Quaternary deposits have not been taken into consideration in the present study.

The created model demonstrates that the Palaeogene is distributed in the entire Avren Plateau and shows clearly the “gaps” in the lithostratigraphic record, concerning especially the lowermost four units.

In conclusion, the present study confirmed the importance of the 3D modelling of lithostratigraphic units that are not exposed and proved it as a significant tool for further clarification of the deep geological structure.

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