Results of Use of High-Accuracy Gravity Surveying for Exploration for Reefs in the Volgograd Region

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In recent years reefs of Carboniferous and Devonian age that are favorable for oil and gas have been found in the outer part of the border step of the Peri-Caspian depression and others of Early Permian age in the sub-salt unit along the border of the depression. In order to evaluate the methods, high-accuracy gravity and magnetic profiles were made in the western part of the border zone in three sectors. See Fig. 1. A total of 152 km of profiles was run: three profiles with a total length of 60 km in the Sarpinsko-Tingutin area; three profiles with a total length of 78 km in the Lugovo-Proley area; and one profile 14 km long in the Aleksandrovsko-Kisolov area. The gravity survey was at an accuracy of ±0.04 mgal, and the magnetic survey accuracy was 5 gammas.

The results of the gravity surveys are shown in Figs. 2 and 3 in the form of curves of $\Delta g$ and their derivatives. On all the profiles (Fig. 2 and 3a and b) there is a sharp decrease in values of gravity toward the southeast; there is an intense gravity step of 15-20 mgal in the Sarpinsko-Tingutin section, 22-28 mgal in the Lugovo-Proley section, and 21 mgal on the Aleksandrovsko-Kisolov profile. This step reflects the zone of junction of the southeast continuation of the Voronezh anticlize and the Peri-Caspian depression.

Local residual positive anomalies in the zone of the border step coincide in plan with the position of reefs that were penetrated by drilling (Fig. 2a). In moving from south to north from profile II to profile III, there is an increase in the magnitude of the local anomaly from 0.8 to 1.6 mgal; this suggests a greater thickness of the barrier reef in the north part of the Sarpinsko-Tingutin area. Further, on a background of the local positive anomalies there are narrow local minimums at their crests. See Fig. 3a and b. For example, a $\Delta g$ minimum on profile I (Fig. 3c) is located above well 38-CT, which yielded gas at 100 thousand m$^3$ per day from the 2237-2263 m depth interval. This minimum is probably related to the presence of the pool.