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Deep structure model of the Taragai area of the Sutarsky ridge (Lesser Khingan) from geophysical field and magnetic petrology data interpretation

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The study area is located within the Lesser Khingan part of the Bureya-Jiamusi superterrane, where a unique stock of garnet peridotites was discovered near Mount Taragai [1]. Authors concluded that the temperature and pressure during the formation of this high-pressure mantle mineral association were 1400°C and 5 GPa, respectively. Later on, geochemical and microscopic investigations revealed that the garnet peridotite stock is a diatreme [2].

The prime objective of the study is to create a depth model for the Taragai area based on the interpretation of geophysical field and magnetic petrology data, which is of interest not only for paleogeodynamic reconstructions to constrain the formation of the junction zone between the Central Asian and Pacific fold belts, but also for the development of a model for mineralization in the area associated with explosive activities.

Calculation of various transformations of Bouguer gravity and magnetic anomalies showed that the Taragai diatreme is an almost vertical stock; at a depth of 10 km beneath it no bodies with anomalous magnetization were identified. An increase in the density at a depth of 2-5 km is probably due to the non-magnetic ultrabasic intrusion of the Birobidzhan igneous complex of Ordovician age [3]. At depths of 12-25 km, another area of increased density is revealed, in the marginal western part of which a body with high magnetization is located. This anomalous area possibly reflects a larger mafic intrusion, which, along a south-dipping slope, is associated with an area of mantle compaction; the latter can be identified with a mantle magma chamber. Analysis of the depth model suggests the presence of two magmatic paleo-foci: in the mantle and in the crust at depths of 40-70 km and 12-25 km. The calculated depths reflect the current density and magnetic inhomogeneities and not the paleodepths at the time intrusions formed.

Compositional analysis of titanomagnetites from gabbro-dolerites of the Birobidzhan igneous complex showed that the TiO_2 content in them ranges from 13.61 to 27.44% averaging 21.25±3.34%. To eliminate the silicate matrix effect, the composition of titanomagnetites was calculated using the TiO_2/FeO value, the distribution of which is clearly bimodal with mode values of 0.23±0.02 and 0.34±0.03, and the distributions of both sets are close to normal. This distribution of the TiO_2/FeO value indicates the co-occurrence of two groups of titanomagnetite compositions in the studied dolerites of the dike. Applying the 2σ rule to estimate the range of possible TiO_2/FeO values at 95% confidence level, we obtain two ranges of Curie temperatures for primary titanomagnetites - approximately 260-340 and 50-200°C. Further, according to the empirical “magma chamber depth – titanomagnetite Curie temperature” relationship [4], the depths of magmatic paleo-chambers that “remembered” the primary titanomagnetites were calculated. According to the calculations, the first was located at depths of 50-70 km in the upper mantle and the second at 25-38 km in the Earth’s crust.

A preliminary paleomagnetic study on gabbro-dolerites of the Birobidzhan igneous complex showed that they formed near the equator, which indirectly confirms the Early Paleozoic age of magmatites of the Birobidzhan igneous complex, since, according to reference paleomagnetic data (Siberia, Northern China), in the late Paleozoic and Mesozoic the Bureya-Jiamusi superterrane was located at higher latitudes of the northern hemisphere.

[1] V. Moiseenko, A. Dementienko, Doklady Akademii Nauk. 444. 2012

[2] N. Berdnikov et al., Doklady Akademii Nauk. Nauki o Zemle. 512. 2023

[3] N. Petruk et al., State Geological Map of the Russian Federation. Scale 1:1000000 (3rd generation). Far Eastern Series. Sheet M-52. Explanatory Notes. St.Petersburg: VSEGEI, 2012

[4] Magnetism and Conditions for the Formation of Igneous Rocks. Moscow: Nauka, 1975