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Heterogeneities of the Earth's crust in the Barents-Kara Region as a result of plume magmatism

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Large areas of the European shelf seas (North, Norwegian, Greenland, Barents, Pechora, Kara) were regions, where under the influence of deep mantle masses activation of magmatic and tectonic processes, which impacted the formation of morphostructures and sea bottom topography, composition and thickness of marine sedimentary strata, ore genesis took place. According to modern conception, in the Mesozoic and Cenozoic, lithosphere plates of the West Arctic Region were a part of the Laurasian Continent and overlaid the Iceland mantle plume. Plume volcanism leaves a peculiar trace on the surface of lithosphere plates formed during their passing over plume hotspots. The age of magmatic formations along the plume trace regularly changes from the oldest Late Permian – Early Triassic in the south Kara and Pechora seas; then the Late Jurassic – Early Cretaceous in the Barents Sea, north of Novaya Zemlya, Frantz Josef Land (FJL),), Spitsbergen; the Paleogene in the Southeast and West Greenland, and, finally the Miocene – present day in Iceland and Spitsbergen.

It was interesting to analyze the morphostructural features of magnetic anomalies after airborne magnetic and satellite data due to plume magmatism show in the Barents-Kara Region. An investigation of magnetic anomaly field structure of the Barents Sea water area along seismic lines and extended profiles crossing known deposits was carried out. Geomagnetic and density sections to a depth of 40 km were constructed; this allowed the estimation of deep structure heterogeneity of the Barents Sea water area.

Within the Barents Sea water area, permeable areas with lenticular-laminated structure of the upper and lower Earth's crust containing feebly magnetic areals with reduced rock density within the depth interval of 8-12 km and 15-20 km are revealed. They are usually combined with increased subhorizontal stratification of medium with extended seismic boundaries and represented by rheologically weakened zones. Main cause of such zones formation is, most likely, their increased fluid saturation. Such deep lamination may be caused by plume age dynamics and non-uniform warming and subsequent cooling of different pracontinent parts associated with it. Morphology analysis of multiscale magnetic anomalies – near-surface (altitude 100-300 m) and satellite at a height of 100 km (Champ) indirectly confirms plume volcanism show in the Barents-Kara Region. A multirank periodicity in the Iceland plume activity is traced in sequence of extended alternating satellite anomalies of northwest strike with an intensity of $\pm$10-20 nT. Extended negative anomalies framing a positive anomaly may be caused by deep heating of asthenospheric rocks. Heat flows (HF) formed during magmatism impulses caused pyrolytic transformations of organic matter of sedimentary strata and development of oil- and gas-formation areas. Presence of a thick sedimentary cover on platform plates in the Kara and Barents seas during the Mesozoic plume magmatism contributed to formation of numerous bedded intrusions, sills; plateaus appeared, volcanoes of central type and volcanogenic-sedimentary island formed in the areas where magma reached the surface.

Middle- and Late Paleozoic destruction of the Barents – Kara Plate did not totally destroy the Proterozoic continental crust during plume magmatism; it caused its thinning and downwarping. Thermal relaxation after this tectonic event caused a rather quick fixation of quasistationary background HF values characteristic for other Paleozoic structures as well. Average value of deep heat flow in the Barents Sea amounts to 54 MW/m2 Zones of local temperature and heat flow elevation formed in a stationary field in conditions of structural-geological and thermophysical heterogeneities. A common tendency of confinedness of large hydrocarbon deposits to the areas with increased thermal potential is revealed in the shelf of West Arctic seas.