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Geochemical heterogeneity of tholeiitic magmatism within the ocean polar regions as a consequence of superplume - lithosphere interaction

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Earth polar regions underwent the plume influence expressed in large igneous provinces at the continents. In the southern hemisphere the global plume Karoo-Maud with maximum of its activity at about 180 Ma stimulated the Gondwanaland disintegration at about 165 Ma (Elliot et al., 1999). Later, during about 40 my, there could take place its spreading along the upper existing boundaries that caused the formation of two younger plumes – Parana-Etendeka and Kerguelen. The geochemical comparison of plume magmatism of the eastern edge of the Queen Maud Land with the basalts of the early stages of the Kerguelen plume activity within spreading zones of the Indian Ocean (130-90 Ma) has demonstrated the similarity of the enriched source of continental and oceanic lavas. The plausible explanation for this could be the supposed spreading of the global Karoo-Maud plume during at least 180 my in the eastern direction and further towards the opening Indian Ocean till its modern position within the Kerguelen plateau.

Influence of this plume is limited by systems of Andre Bayn and Du-Toit transforms and does not stretch to the west part of Indian Ocean and South Atlantic. In this region geochemical specifics of the tholeiites were formed under the process of geodynamic transformation of the South Atlantic region about 30 Ma, when South America has been separated from West Antarctica. This process has lead to formation of enriched tholeiitic basalts. New Re-Os isotopic data and Ni, Mn olivine content for tholeiites from SW Indian ridge near Bouvet triple junction evidence that fragments of ancient continental lithosphere could be involved into melting during early stages of evolution. This component can be as large as dozens percent.

Two factors – passive upwelling of the warmer mantle along the rift zone and active mantle ascending along the continental margin, have caused formation of the global North-Atlantic trap province. On the basis of the studied Spitsbergen Island basalts and Knipovich ridge lavas it has been shown that in the source of both continental basalts and rift tholeiites there is marked a similar enriched mantle component - pyroxenite mantle. Its share progressively decreases from Neogene trap intrusions via Quaternary alkaline lavas to insignificant admixture in the depleted and weakly enriched magmas of the Knipovich ridge.

Enriched rift basalts were formed during transformation of paleo-Spitsbergen fracture zone into spreading Knipovich ridge. This process was accompanied by magmatism at the western part of Spitsbergen during its separation from northern part of Greenland. Enriched melts could be formed by the involvement into the melting process of the metasomatized depleted mantle which was originated at the early stages of Norwegian-Greenland Sea opening.

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