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Mantle heterogeneity under spreading zones of polar regions of the Atlantic Ocean: sources and formation

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A number of provinces with prevailing distribution of enriched rift basalts are specified within spreading zones of Indo-Atlantic segment of the World Ocean. The main reason of EMORB-type melts formation is determined by source heterogeneity which is resulted in numerous causes: recycling of old oceanic crust, hotspots within immediate proximity to rift zone, formation of metasomtizated mantle at the early stage of ocean opening which is involved in melting process later on. The spatial distribution of enriched tholeiites within Polar Atlantic is confined by Knipovich, Kolbeinsey and Gakkel ridges. The Knipovich ridge spreading zone formation coincides in time with magmatism appearances in adjacent continental regions. Comparative studying of Neogene and Quaternary magmatism of the Svalbard Island and modern magmatism of the Knipovich ridge reveals pyroxenite mantle participation in the melting process. The main source for Neogene magmas of the Svalbard Island was olivine-free pyroxenite with high $^{87}Sr/^{86}Sr$ and lower $^{143}Nd/^{144}Nd$ ratios, which could be a result of interaction of recycled substance of old oceanic crust and low continental crust with mantle peridotite. Due to its preferential fusibility this pyroxenite could be the source for substantial magmas volume under the rigid continental lithosphere that subsequently could have caused its disintegration. With successive rejuvenation of Svaldbard and Knipovich ridge magmatism (from Neogene till nowadays) for its mantle sources there has been traced the decreasing of pyroxenite component share at the expense of increasing of peridotite share accompanied by regular change of Sr and Nd isotope composition of these sources.

The old Antarctic continent played a pivot role in the South Ocean formation, geodynamics and magmatism of trap formations and rift zones. The area of Karoo–Maud plume distribution at the early stages (about 180 – 170 Ma) included the southeastern part of Africa and the west of East Antarctic and nowadays it occupies the area of Bouvet hotspot modern location. Development of Karoo–Maud plume caused the formation of considerable mantle heterogeneity and contributed to disintegration of continental blocks within the forming South Ocean. Magmatism of the formed spreading basins of the western Antarctic (Powell and Bransfield) is characterized by greater range of enrichment and evidence to possible melting of pyroxenites which represented the fragments of low parts of continental lithosphere involved into the melting process at mantle asthenospheric upwelling in spreading zones. This component is close by its isotope characteristics to a component revealed within the western edge of Southwest Indian Ridge near the Bouvet triple junction and is represented by a mixture of sources like HIMU and EM-2.