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Mantle Evolution under the Bouvet Triple Junction (SMAR) from the aspect of Tectonic and Geochemistry

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Three main structures of the oceanic floor - Mid Atlantic Ridge (MAR), American Antarctic Ridge (AAR) and Southwest Indian Ridge (SWIR) – constitute the Bouvet Triple Junction (BTJ). These constituents have changed their position relatively each other a lot of times during the evolution (Ligi et al., 1999). The unstable character of their interaction was the main cause of the complicated structure of BTJ.

The segment of BTJ is characterized by the tholeiitic type of magmatism. However those magmas have different conditions of generation and eruption. Nevertheless basaltic rocks of the studying segment of the rift valley SWIR are determined as moderately enriched tholeiites on the basis of trace and major element variations. Normalized patterns of incompatible elements of BTJ basalts are characterized by relative maxima of Nb, Ta, and La and minima of Pb and less pronounced minima of Th and U. There is a clear Sr minimum in the most fractionated basalts from the Spiess Ridge. Apparent "garnet signature" expressed in the elevated values of (Gd/Yb)N ratio (up to 2.5) present in some basalt compositions. This indicates the presence of garnet in the source of basaltic melts of the BTJ.

Ni excess over Mg and Mn deficiency over Fe in olivine phenocrysts suggest the presence of olivine-free pyroxenite lithologies in the sources of primary melts (Sobolev et al., 2007). The lowest amounts of pyroxenite component (X PX Mn/Fe = 0-10%) were recorded for the samples from the station S18-63, located in the MAR valley. The greatest range (X PX Mn/Fe = 0-90% in the single rock) was observed in samples from the station G96-10 situated on the western slope of the Spiess Ridge. Obtained results suggest the participation of recycled crustal component in the generation of primary melts. That component was involved in the rising mantle in the form of silica oversaturated eclogite as previously subducted oceanic crust or as fragments of ancient continental lithosphere. Melts generated from eclogite, enriched with silica, are interacting with peridotite, and converting it to the olivine-free pyroxenite (Sobolev et al., 2007).

The range of common isotope signatures is: 206Pb/204Pb = 18,125 – 19,367; 207Pb/204Pb = 15,53 – 15,665; 208Pb/204Pb = 38,492 – 39,229; 143Nd/144Nd = 0,512603 – 0,513017; 87Sr/86Sr = 0,703181 - 0,705453. The correlations between pyroxenite component XPXMn and 207Pb/204Pb and 208Pb/204Pb are observed. These correlations suggest that the mantle beneath the BTJ has its origin from the enriched source.

BTJ isotopic signatures (Sr, Nd, Pb) and trace element patterns are similar to those in the alkaline basalts of Antarctic Peninsula (Hart et al., 1997). These features imply melting of enriched constituent in the mantle source common to the western Antarctica and SWIR. The long-term enrichment of mantle is seen in the more radiogenic Pb and Sr and less radiogenic Nd of basalts and likely indicate contamination by continental crust. Such global mantle heterogeneities could have been formed during various and complicated stages of South Ocean geodynamic evolution.