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Specific siliceous Fe-Ti-oxide igneous association of the low-spreading mid-oceanic ridges: evidence for the Markov depression, Central Atlantic, 6^o N

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Fe-Ti-oxides rocks are wide spread at the low-spreading mid-oceanic ridges. They are usually considered as a result of crystallizing differentiation of the MORB. However, results of a petrographic and geochemical study of magmatic rocks at the Markov depression (Central Atlantic) revealed existence of specific siliceous Fe-Ti-oxide igneous association that permit to revise a view on their origin.

Magmatic rocks studied were dredged from the Markov depression at the Mid-Atlantic Ridge (MAR), 6^o N, and its vicinity during Cruise 10 of the R/V “Akademik Ioffe” in 2001-2002 and Cruise 22 of the R/V “Professor Logachev” in 2003 [1-3]. This depression is a fragment of the axial rift valley. It’s size is about 20-22 km along the rift, width 8-10 km and deep till c. 5 km. Both slopes of the depression formed mainly by plutonic rocks: peridotites (both mantle and igneous origin) and different gabbroids. Strongly altered and tectonized basalts and dolerites exposed both on the valley’s bottom and it’s northern and southern flanks; young fresh basalts with crusts of volcanic glass were found on the bottom of the valley, or on slopes of neovolcanic rises. The both slopes evolved the same complexes of rocks. Abundance of sediments in the axial valley suggests that the accretion of the new oceanic crust occurs upon predomination of tectonic processes over magmatic.

Most of these rocks subjected to secondary alterations, with occasional preservation of unaltered varieties having distinct cumulative textures and structures. Some magmatic minerals (olivine, pyroxene, and plagioclase) display deformation textures resulted early high-temperature cataclasis. During pervasive low-temperature alterations, peridotites underwent by strong serpentinization, while gabbroids were replaced by fibrous actinolite, with development of prehnite and chlorite along the fractures. In some cases, they are schistosed and brecciated; the thickest alteration zones bear veinlet-disseminated sulfide mineralization [2].

Two types of igneous rocks have been recognized among the dredged fragments: (1) primitive magnesian troctolites and gabbros as well as tholeiites MORB, and (2) mafic and ultramafic rocks of the specific siliceous Fe-Ti-oxide series. The intrusive rocks of the latter usually contain orthopyroxene, magmatic brown hornblende (pargacite), ilmenite (till 5-10%) and subordinate magnetite. Their composition vary from ultramafic cumulates (harzburgite, lherzolite) via pyroxenite, norite, gabbronorite to hornblende Fe-Ti-oxide gabbronorite and gabbronorite-diorite and then to diorite and trondhjemite, which form veins up to 10-15 cm thick. Subvolcanic rocks of this series represented by hornblende Fe-Ti-oxide dolerites and volcanic - by basalts with essential amount of Fe-Ti-oxides.

Geochemistry of the Fe-Ti-oxide series of rocks is very specific. Most of them are depleted in LREE, Zr, Th, Ba, Hf and Ê as well as Ni è Cu, and enriched in Ðb, U, Ti, Ta, Nb, Zn, Cs and Rb in relation to primitive mantle and MORB. Such a rare elements pattern distinguishs these rocks from both MORB and OIB. Their petrological-geochemical characteristics are intermediate between island-arc and intra-plate magmatic rocks. Although high Ti, Ta and Nb contents in the gabbroids are closely resembles to the latter, it is in conflict with deficit of the most incompatible elements concentration.

A depletion of these rocks in incompatible elements suggests, that their parental melts were derived from the source, which was already undergone by melting, and so they could not be the MORB differentiates. At the same time these melts were enriched in water and elements (Ti, Nb, Ta, Pb, U, etc. [4, 5]) as well as silica [6], which are usually inferred to have been mobilized at melting of hydrous mafites. Thus, hydrogenous rocks could be considered as a source of these magmas. The most likely that such rocks were the hydrated part of the oceanic lithosphere, formed mainly by serpentinous peridotites and altered gabbroids with numerous veins of actinolite, chlorite, prehnite, etc. The lithosphere melting, probably, occurred as a result of ascending of asthenospheric plume (a protuberance on the surface of the large asthenospheric lens beneath the MAR).

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