



## **Hydrothermal-magmatic system in the Mid-Atlantic Ridge, 6° N (Markov Deep)**

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A new type of sulfide deposits of the Mid-Atlantic Ridge (MAR) has been studied in the metasomatically altered brecciated gabbroids. It was found in the Markov Depression of the Sierra Leone Segment, the axial part of the ridge, during Cruise 10 of the R/V “Akademik Ioffe” in 2001-2002 and confirmed during Cruise 22 of the R/V “Professor Logachev” in 2003.

The dredged magmatic rocks are subdivided into two associations: (1) MORB basalts and their intrusive analogs, and (2) rocks of siliceous Fe-Ti-oxide series, including volcanic and subvolcanic varieties (hornblende basalts and dolerites) and intrusive rocks (ultramafic cumulates, troctolites, ferrogabbronorites and ferrodiorites). Practically all the magmatic rocks are enriched in Pb, Cu, U, Rb, Ta, Nb, as well as Cs and Rb, and depleted in Th and Hf. The Fe-Ti-oxide series rocks differ in the elevated contents of Zn, Sn and Î and low contents of Ni and Cr.

Major ore-bearing zone is contained in cataclased hornblende gabbro and gabbronorites of Fe-Ti-oxide series, which are situated in the lower part of the eastern slope of the depression. Mineralization in the metasomatically-altered rocks includes quartz-sulfide and prehnite-sulfide veins, as well as disseminated and stringer-disseminated cooper sulfides. Pyrite, chalcopyrite, sphalerite, pyrrotite, bornite, chalcocite and digenite are major ore phases in the zone. Grains of native metals (Cu, Pb,

Zn and Sn) are found among unconsolidated sediments immediately beneath the ore-bearing zone in the eastern slope of the depression.

The study of mineral assemblages of ore-bearing metasomatites and fluid inclusions in minerals showed that hydrothermal processes began at temperatures 800-850°C and metasomatic processes occurred at temperatures from ~400Ñ to 160Ñ and low oxygen potential. The stringer-dissiminated ores were formed at 170-280Ñ.  $\delta^{34}\text{S}$  values in sulfides varies from +3.0 to +15.3‰, which are intermediate between those of isotopically light magmatic rocks and heavy sea water.

These data indicate that hydrothermal fluids were initially of magmatic origin and separated from water-bearing melts of the Fe-Ti-oxide series in a shallow magma chamber. During development of the hydrothermal system, they were gradually diluted by sea water circulating in fractured oceanic lithosphere. Ore components could be obtained both from the ore-bearing magmatic fluids and cataclased wall-rock Fe-Ti-oxide series gabbroids through exrtaction by metasomatic processes.

Thus, a new perspective type of sulfide ore deposits was found in the axial part of the MAR. It is probably a fragment of ancient "black smoker" feeder system, which was recently exposed on the eastern slope of the Markov Depression owing to modern tectonic movements.