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Volatile components in primary magmas of Siberian Trap Province

I. Ryabchikov
Russian Academy of Sciences, Institute for Geology of Ore Deposits (IGEM), Moscow, Russian Federation (iryabchikov@gmail.com)

Magmatism in the Siberian CFB province is mainly represented by the voluminous lava flows of tholeiitic plateau basalts and subordinate amounts of highly magnesian volcanics and dyke rocks. These highly magnesian rocks (subalkaline picrobasalts from Putorana Plateau, meimechites) are strongly enriched in incompatible trace elements and are characterized by high LREE/HREE ratios. It suggests that their primary magmas were near solidus melts formed at high pressures. P-T conditions of the generation of these hi-Mg melts must be nearly identical with the P-T parameters characterizing magma-generating mantle plume. To assess the formation conditions of hi-Mg Siberian magmas we investigated melt and fluid inclusions in the phenocrysts of these rocks, which were analyzed for major and trace elements (EMPA and SIMS methods). High Ti/Na ratios and high normative olivine contents in the melt compositions recalculated to the condition of equilibrium with mantle peridotites imply, that initial pressure of magma generation is in the range of 7-9 GPa.

Ion microprobe data for reheated melt inclusions in phenocrysts from Siberian rocks show relatively low concentrations of water by comparison with nonvolatile components of comparable incompatibility (Ce and La). Similar decoupling of H_2O and light REE was found for OIBs which belong to EM2 mantle reservoir. This has been interpreted as diffusive dehydration of the EM2 source during its storage in a drier ambient mantle. Similar mechanism of diffusive loss of water to the surrounding mantle may be proposed for magmas in Siberian Trap Province. Fluorine whose partition coefficients for major minerals of mantle rocks are similar to those of water is characterized in the investigated melts by close correlation with its non-volatile analogue (Nd). Concentrations of volatiles other than water in the mantle source of Siberian magmas are similar to the estimates for the sources of OIB magmas.

Low concentration of H_2O and moderate contents of other volatiles imply that the estimates of near-solidus temperature based on comparison with volatile free systems would not be changed significantly. Comparison of the estimated from melt inclusion data pressures with experimental data shows that the temperature of rising plume material was ca 400°C higher by comparison with convecting upper mantle at the same depth. This proves that plume material arrived from deep levels in the mantle below certain thermal boundary layer.