Petrology of the lamprophyres.

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Chuya complex of mica lamprophyres situated in the southeast part of Gornyi Altai and extends to Mongolia. Dikes of this complex are distributed irregulary and form the belts or the areas accompanying fault zones. Lamprophyres from two largest areas, named south-chuya and yustyd respectively, were characterized in geological, petro- and geochemistry terms. Radiological characteristics give evidence of synchronic formation of the dikes from different areas. Bulk-rock analysis indicates, that the rocks are basic to intermediate, calc-alkaline and ultrapotassic. On the most petrochemical and geochemical binary plots the rocks of dykes from different areas fully or partially overlap. The multi- element and rare-earth diagrams of all investigated rocks are equal in the form, at the position of HFSE minima, have high La/Yb (17-62) and Gd/Yb (4-9,7) relations. Geochemistry characteristics allow us to suggest that all rocks were formed as a result of small degrees partial melting of garnet mantle source. However, in our studies, fundamental differences in the isotopic composition of Nd and Sr and some petrochemical features have been established. For the yustyd area rocks the initial isotopic relations are closes to BSE. And for the lamprophyres from another area εNd varies from (-2.84 - - 4.05) and $^{87}Sr/^{86}Sr$>0.70858. In our work we discuss three hypotheses forming the lateral variability in composition of the lamprophyres of the Chuya complex: 1) heterogeneity of the mantle; 2) contamination the rock forming melt by crust material; 3) liquid immiscibility, accompanied by redistribution of some major and trace elements.

The role of fluoride-silicate liquid immiscibility in REE ore genesis

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The Mid-Proterozoic peralkaline Strange Lake pluton (Québec-Labrador, Canada) hosts potentially economic concentrations of high field strength elements (HFSE), including the rare earth elements (REE), zirconium and niobium in zoned (Zr-rich borders and Ca-F-REE-rich cores) and unzoned pegmatites. Based on bulk rock geochemistry, mineralogy and fluid inclusion data, HFSE enrichment in the pluton has previously been interpreted to be due to extreme fractional crystallization and late hydrothermal alteration. However, recently collected melt inclusion data suggest that a third process, namely melt immiscibility, may have played an important role in the concentration of the HFSE.

Three types of melt inclusion have been identified in quartz from the Strange Lake granite after heating to 900-950 °C and quenching. Type 1 inclusions are composed of silicate glass and display enrichment in Zr, Nb and Ti with increasing alkalinity. Type 2 inclusions also contain silicate glass and, in addition, a globule of a REE-bearing calcium fluoride glass (up to 14 wt.% REE). Type 3 inclusions contain calcium fluoride glass with multiple silicate globules. Calcium fluoride glass in both Type 2 and 3 inclusions in some cases contains a REE fluoride glass globule (up to 50 wt. % REE).

We propose that fractional crystallization enriched the magma in fluorine, leading to silicate-fluoride liquid immiscibility prior to and during emplacement of the pegmatites. This caused partitioning of Zr, Nb and Ti into the silicate melt and F, Ca and REE into the fluoride melt. Further evolution of the melts occurred separately. Quartz, feldspars and arfvedsonite crystallized from the silicate melt, enriching the latter in Zr, Nb and Ti, and fluorite crystallized from the fluoride melt, enriching its residue in REE. The latter melt eventually exsolved a REE-fluoride melt.

The observed zoning of many pegmatites is interpreted to reflect crystallization of the silicate melt, including formation of zirconosilicates in the outer zone, and migration of exsolving or heterogeneously incorporated (prior exsolution) calcium fluoride melt inwards. This latter melt subsequently exsolved a REE-fluoride melt and the two melts crystallized to form the fluorite- and REE mineral-rich pegmatite cores. To our knowledge, this study provides the first example, in which silicate-fluoride liquid immiscibility has been shown to help concentrate the REE to potentially economic levels.

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