



Depleted isotopic composition of super-large rare metal deposits from the Kola peninsula (First data on the Sm-Nd- Lu-Hf system)

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In the central part of Kola Peninsula there are two world's largest complexes of highly alkaline nepheline syenites (Khibina and Lovozero massifs). Rare metal loparite and eudialyte deposits occur in the second (differentiated complex) and third intrusion (eudialyte complex) of Lovozero. Our previous investigations, (Kram, Kogarko, 1994) demonstrated, that the mantle source of these world's largest alkaline intrusions exhibit significantly depleted signatures ($^{143}\text{Nd}/^{147}\text{Nd} +5\text{--}+2.5$, $^{87}\text{Sr}/^{86}\text{Sr}$ 0.70336-0.70400). It was of great interest to investigate minerals of rare metal ores by laser ablation to assess isotope characteristics also in Lu-Hf system. We investigated ^{143}Nd , $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{177}\text{Hf}/^{179}\text{Hf}$ of loparite, mozandrite, belovite, pyrochlore, apatite, eudialyte, parakeldishite, zircon from the second and third complexes and also from pegmatites. Average ^{143}Nd for loparite and mozandrite from second phase of Lovozero is equal to 2.99, 3.1 for the third phase and 2.77 for pegmatites. Loparite from Khibina pegmatite yields 3.03, $^{87}\text{Sr}/^{86}\text{Sr}$ was estimated in apatites, loparites, belovites and pyrochlores. Average $^{87}\text{Sr}/^{86}\text{Sr}$ for the second phase of Lovozero -0.70392, 0.70364- for the third phase. $^{87}\text{Sr}/^{86}\text{Sr}$ from Khibina loparite from pegmatite is very similar-0.70365. $^{177}\text{Hf}/^{179}\text{Hf}$ Interestingly that belovite and pyrochlore from some pegmatites $^{177}\text{Hf}/^{179}\text{Hf}$ are characterised by high radiogenic strontium-up to $^{87}\text{Sr}/^{86}\text{Sr}$ equal 0.71352. $^{177}\text{Hf}/^{179}\text{Hf}$ was investigated mostly in eudialytes. Average value $^{177}\text{Hf}/^{179}\text{Hf}$ in eudialytes of second and third phases of the Lovozero intrusion is 6.5. Zircons and parakeldishite from pegmatites yield the same value.

The plotting of the obtained data on the mantle correlation diagrams $^{143}\text{Nd} - ^{177}\text{Hf}$, $^{87}\text{Sr}/^{86}\text{Sr} - ^{177}\text{Hf}/^{179}\text{Hf}$ demonstrates that the alkaline rocks and ores of the Lovozero and Khibina rare metal deposits have depleted mantle sources similar to OIB. Alkaline rocks of the Kola peninsula are the most enriched in rare elements, and they were generated due to the partial melting of the depleted material. This is possibly explained by the rapid development of mantle metasomatism, which resulted in the transport of rare elements and alkalis to the zone of magma generation.

. The accumulation of ^{87}Sr in late minerals of pegmatites (belovite, pyrochlore) is likely to be related to the significant fractionation of Sr by early minerals (loparite, apatite) and enrichment of residual liquids in Rb. Late mineral in pegmatites-puatovite (CsFe_2S_3) contain 1.3% Rb. Very fast increase in Rb/Sr ratio in residual melts/fluids may result in the significant growth of radiogenic Sr in late minerals.

References

Kramm U, Kogarko LN (1994) Nd and Sr isotope signatures of the Khibina and Lovozero agpaitic centres, Kola alkaline province, Russia. *Lithos* 32: 225-242