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# Shallow refertilization processes in the Siberian sub-cratonic mantle: evidence from garnets and associate minerals from the Zagadochnaya kimberlite (Yakutia, Russia)

L. Ziberna (1), P. Nimis (1), A. Zanetti (2), A. Marzoli (1), and N. V. Sobolev (3)

(1) University of Padua, Department of Geosciences, Padua, Italy (luca.ziberna@studenti.unipd.it, paolo.nimis@unipd.it, andrea.marzoli@unipd.it), (2) IGG-CNR, Pavia, Italy (zanetti@crystal.unipv.it), (3) V.S. Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russia (sobolev@uiggm.nsc.ru)

Garnets (Grts) from cratonic mantle frequently show a marked variability in terms of Rare Earth Element (REE) patterns, which is usually interpreted as the product of different episodes of metasomatism and refertilisation operated by fluids/melts migrating through a formerly strongly refractory lithospheric column. In literature, particular emphasis has been placed on the origin of LREE-enriched sinusoidal patterns, for which different models have been proposed (e.g. [1-3]). In this contribution, petrography, and major and trace elements mineral chemistry of peridotitic and pyroxenitic garnet xenocrysts and associate minerals from the diamond-barren Zagadochnaya kimberlite (Yakutia, Russia) are reported, in order to reconstruct the depth of provenance, the parent lithology and the petrochemical processes governing their evolution.

Group A Grts have moderate $Cr_2O_3$ contents (1.3-5.2 wt%) and are characterized by progressively increasing CI-normalized [4] REE from La to Lu ($La_N/Yb_N$ = 0.001–0.008), with HREE close to 10 xCI. Group B Grts are variably enriched in $Cr_2O_3$ (5.4-8.6 wt%) and are distinguished from group A by a less LREE-depleted composition and nearly flat normalized pattern from Sm to Lu. Group C Grts are $Cr_2O_3$-rich (7.3-8.4 wt%) and are characterized by strongly sinusoidal REE patterns with $Yb_N$ between 0.5 and 3.0. Although the geochemical variability documented by groups A, B and C could be related to different metasomatic stages involving the migration of different melts/fluids, numerical simulation of interaction between melt and strongly refractory peridotite indicate that it could be the result of a unique, widespread process of lithosphere refertilisation operated by cognate kimberlitic melts.

Most of group B and C Grts show secondary domains rich in Cr-diopside + Cr-spinel ± phlogopite. In these domains the Grts are (Ca, Cr)-depleted, enriched in almost all the incompatible trace elements, and show humped CI-normalized REE patterns (maximum at Eu). The melt composition calculated in equilibrium with these secondary garnets, their low Ti/Zr ratios ($\sim$ 10) and the presence of phlogopite suggest an origin by reaction with a melt of type-II kimberlite affinity. According to the Ca concentration profiles across Grt zoning, this late-stage event took place shortly ($< 10^4$ years) before the Zagadochnaya kimberlite eruption, i.e. it was probably related to the same magmatic stage of the host kimberlite.

A simple explanation for the absence of diamond at Zagadochnaya is provided by the shallow origin of mantle samples (estimated pressures $<$ 4.0 GPa), as previously suggested by [5]. Only a minor portion of the mantle sampled by the Zagadochnaya kimberlite may have been seated within the diamond stability field. Moreover, the late-stage reactions with the host kimberlite may have led to resorption of any small diamond load originally present.

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