REE DISTRIBUTION IN METAMORPHIC GARNETS

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A preliminary examination of trace and REE distribution patterns in the garnets from metamorphic rocks reveals an overall picture of their elements' behavior in the garnets during regional metamorphism [1, 2, 3]. In particular, all the garnets are found to be HREE-enriched, however, REE pattern of lower-Ca garnets markedly differs from that of higher-Ca garnets from the same complex, e.g. in the presence of a major negative Eu-anomaly. The paper deals with data on REE and trace elements abundances both for garnets derived from Lapland Granulite Belt (LGB) and aluminous schists from the supracrustal Korva-tundra suite which is adjacent to it on the south. REE and trace elements abundances were determined by INA technique.

Inhomogeneous granulite conditions were different in the southeastern (Salnye Tundry, 11.5–13 kbar and 1000°C), northeastern (River Lotta, 6 kbar and 900°C) and southwestern (River Javre, 9 kbar and 800°C) domains of LGB. Mafic schists derived from metamorphism of mafic igneous rocks are dominant among the Salnye Tundry granultites. In the Javre domain, the bulk rocks are garnet–sillimanite gneiss and quartzite-gneiss. In the Lotta domain, the granulite assemblage comprises cordierite-bearing garnet-sillimanite gneisses. The Upper Archaean supracrustal Korva-tundra suite comprises garnet-kyanite-biotite-muscovite schists. P-T parameters are defined to be 7–8 kbar and 550–650°C.

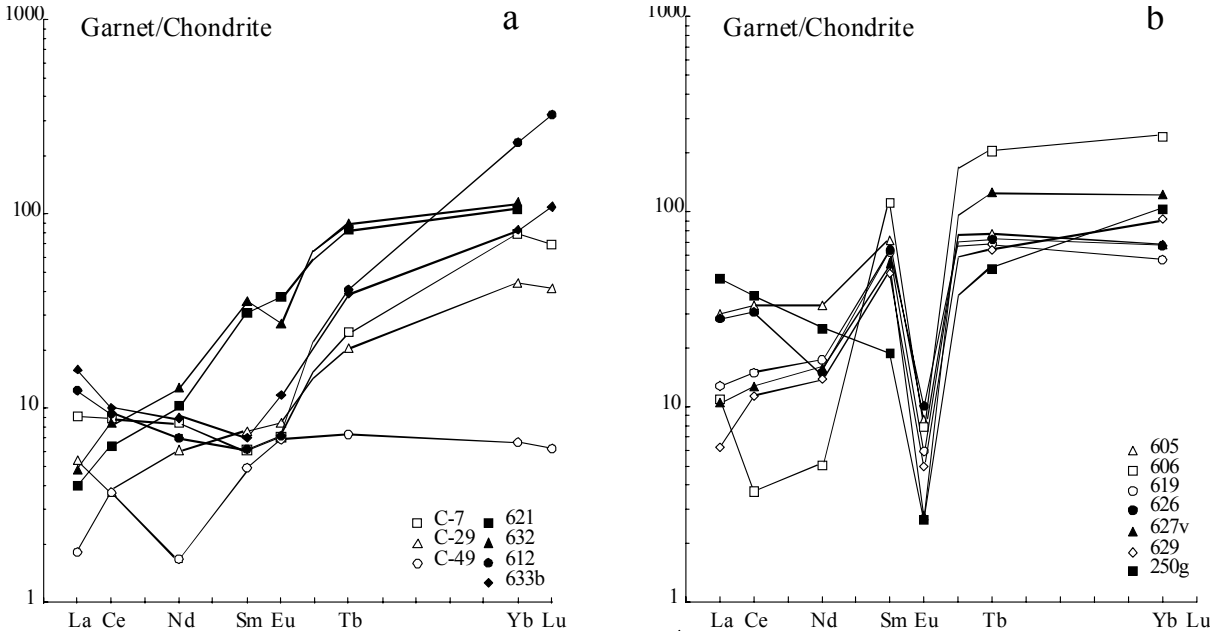

Fig. 1. Chondrite-normalised REE patterns for garnets from mafic schists (a) and acid granulites (b). Normalising coefficients from [4]

Two garnet groups from LGB mafic schists are distinguished based on REE-distribution pattern: the Salnye Tundry (samples C-7, C-29, C-49) and Javre (samples 621, 632) garnets (Fig. 1a). The latter show higher REE abundance and maximal Yb abundance (La/Yb = 0.06) as compared to the former. The Salnye Tundra garnets are depleted in REE and show minimal Sm abundance (La/Yb = 0.17–0.19). The sample C-49 differs from the above two garnets in an extremely high MgO-content and belongs to a subgroup of garnets derived from the igneous source rocks, probably, garnet peridotites. This garnet is depleted in REE as compared to two garnets mentioned, and shows maximal Ce- and minimal La- and Nd-abundances. It exhibits a rather high LREE/HREE ratio (La/Yb = 0.41). Judging from fig. 1a, the garnets from mafic schists in the Javre and Salnye Tundry domains (excluding sample C-49) show a similar curve of REE, the Javre garnets (with lower temperature formation) being, as a whole, REE-enriched. Different REE-distribution pattern is characteristic of the garnets derived from acid granulites, i.e. gneiss, quartzite-gneiss and granite (fig. 1b). All the garnets show an intense Eu-anomaly, especially pronounced in quartzite-gneisses and granites. Eu/Eu* ratio falls into the 0.03–0.15 range. Besides, they are enriched in HREE, their Tb and Yb concentrations being as 120-100 times as chondritic

ones. La/Yb ratio in the garnets from quartzite-gneisses (samples 606, 627v) and granites (sample 629) is 0.07–0.13, and more differentiated (La/Yb = 0.34–0.66) in those from aluminous gneisses (samples 605, 619, 626, 250g). The garnets derived from the Korva-tundra kyanite-two-mica schists (samples 612, 633b; fig. 1a) are found to exhibit quite different REE-distribution pattern as compared to that of garnets from LGB acid granulites: despite a lower Ca-content of the garnets derived from the Korva-tundra schists, they lack Eu-anomaly pertinent to low-Ca garnets from other LGB domains. Their overall shape of REE distribution curve is most close to REE plotting garnets from the mafic Salnye Tundry, the only difference being expressed in higher La, Ce, Yb, and Lu (La/Yb = 0.08–0.29).

High-Ca Javre domain garnets reveal HREE enrichment as compared to those from their Salnye-Tundry analogs suggesting lower P-T parameters of the granulite metamorphism within the Javre domain. This conclusion is confirmed by the examination of the garnets from contact-metamorphic rocks in British Columbia [5]. The garnets showing prograde zoning derived from the increase in temperature accompanying with that of MgO-content and the decrease in MnO-content from the core towards crystal rim exhibit a regular depletion in HREE abundances.

REE-distribution patterns in the garnets from LGB allows to infer some conclusions.

1. The garnets from the mafic schists show a gentle slope of LREE/HREE enrichment and lacking Eu-anomaly. The garnets from the Javre schists are enriched in REE as compared to their Salnye Tundry analogs suggesting lower parameters of the granulite metamorphism within the latter.

2. Different shapes of REE-distribution curves in the garnets from the Salnye Tundry mafic schists are due to an extremely high-magnesian garnets of igneous origin whose non-differentiated REE distribution is similar to that of ultramafic rocks.

3. Lower-Ca garnets from the aluminous gneisses show HREE-enrichment and pronounced negative Eu-anomaly whose intensity tends to enhance with the increase in SiO_2-content of the host rock.

4. The increase in HREE abundances in the garnets is, at first, due to lowering temperature of their formation.

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