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REE Distribution in Metamorphic Garnets (the Lapland Granulite Belt)

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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' behaviour in the garnets during regional metamorphism (Drugova et al., 1998; Hickmott et al., 1987; Skublov et al., 2000). In particular, all the garnets are found to be HREE-enriched. However, REE pattern of low-Ca garnets markedly differs from that of high-Ca garnets from the same complex, e.g. in the presence of a major negative Eu-anomaly. The paper deals with data on REE 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 abundances were determined by INAA technique.

Inhomogeneous granulite conditions were different in the south-eastern Salnye Tundry (11.5-13 kbar and 1000 ºC), north-eastern River Lotta (6 kbar and 900 ºC) and south-western River Javre (9 kbar and 800 ºC) domains of LGB. Mafic schists derived from metamorphism of mafic igneous rocks are dominant among the Salnye Tundry granulites. 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 Korva-Tundra suite comprises garnet-kyanite-biotite-muscovite schists. P-T parameters are defined to be 7-8 kbar and 550-650 ºC.

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 (Figure. 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 Figure 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, HREE-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, 250 g). 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). 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 analogues 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 low temperature of their formation.

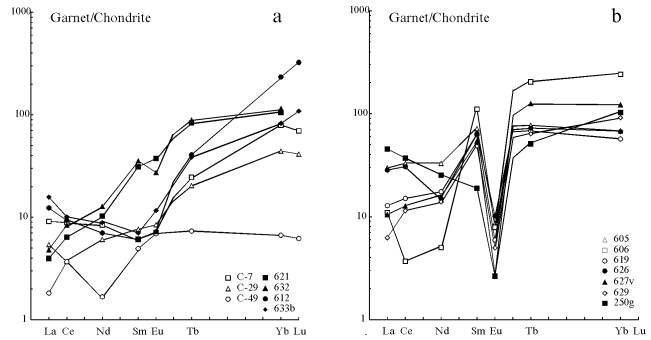

Figure 1:Chondrite-normalised REE patterns for garnets from mafic schists (a) and acid granulites (b)