OBTAINING AGE INFORMATION ON METAMOPHIC PROCESSES USING MN AND HREE DIFFUSION IN GARNETS

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Garnet is the main mineral containing Mn and HREE in metamorphic rocks. Usually Mn and HREE exhibits some zoning in garnets. Both, Mn and HREE contents increase with temperature drop [1].

Garnets from the polymetamorphic Belomorian complex (Tupaya Guba region) were studied using ion microprobe. These garnets from the gneisses are related to high-pressure granulite stage M_2 followed without interruption by high-pressure amphibolite stage M_3 [2]. The garnets are untypical zoned in HREE as low-grade garnets. HREE drop rim ward significantly (fig. 1). The minimum temperatures of metamorphism were determined as 730-760°C for garnet core and 680-700°C for garnet rim by garnet-biotite thermometer. The pressure was constant - about 6.5-8 kbar.

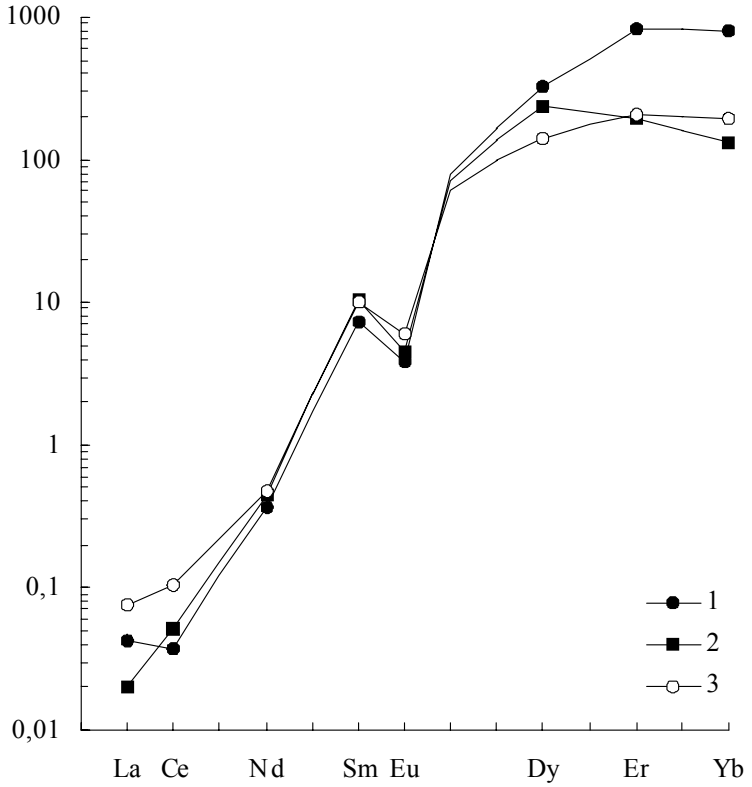

Fig. 1. Normalized REE distribution in garnet (sample 973). Chondrite C1 after [3].
1 - core, 2 - middle, 3 - rim.

HREE exhibit a Rayleigh fractionation profile (fig. 2), Mn concentration has been homogenized to flat profile (1,18 wt.% at the core and increase in the outer rim up to 1,73 wt.%). It can be explained only by quick time (approximately 10-15 Ma) estimated for the metamorphic event. HREE diffusion rates more than two orders of magnitude slower than Mn diffusion rate [4, 5], and more time of metamorphic event is required to homogenize the HREE profiles.

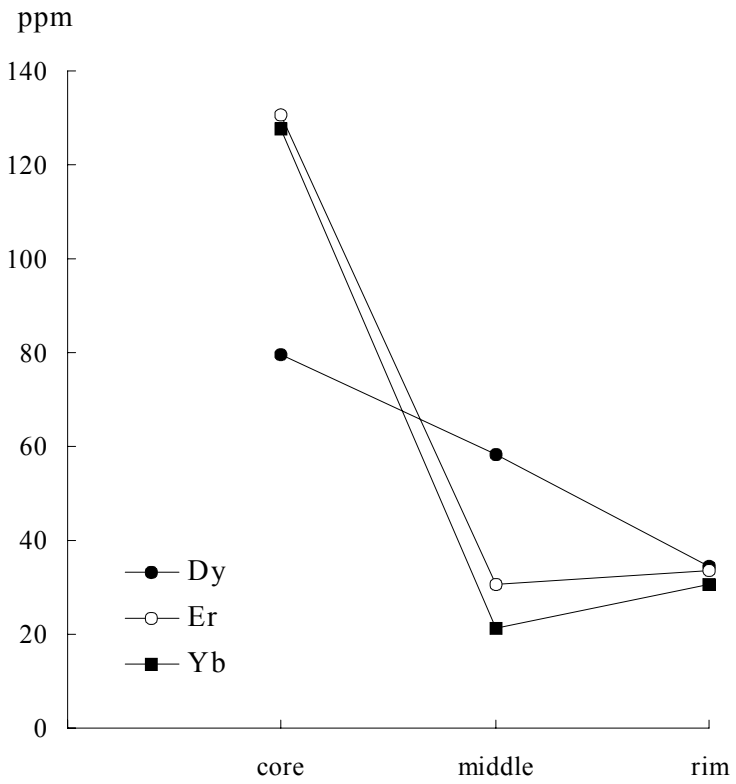

Fig. 2. HREE zoning in garnet (sample 973)

Ayres and Vance presented the alike results of modeling of trace element and Mn data for garnets from the Zanskar area of the Indian Himalaya - 3-10 Ma estimate for the metamorphic event [6].

References

1. *Drugova G. M.* Principal stages in metamorphic evolution of Chupinskaya series in Belomorsky folded belt // Proc. RMS. 1999. № 3. P.49-57 (in Russian).
2. *Schwandt C. S., Papike J. J., Shearer C. K. et al.* A SIMS investigation of REE chemistry of garnet in garnetite associated with the Broken Hill Pb-Zn-Ag orebodies, Australia // Can. Mineral. 1993. V.31. P.371-379.
3. *McDonough W. F., Sun S.-s.* The composition of the Earth // Chem. Geology. 1995. V.120. P.223-253.
4. *Coghlan R. A. N.* Studies in diffusional transport: Grain boundary transport of oxygen in feldspars, diffusion of oxygen, strontium and the REEs in garnet, and thermal histories of granitic intrusions in south-central Maine using oxygen isotopes. PhD Thesis, Brown University.
5. *Van Orman J. A., Grove T. L., Shimizu N. et al.* Rare earth element diffusion in a natural pyrope single crystal at 2.8 GPa // Contribs Mineral. and Petrol. 2002. V.142. P.416-424.
6. *Ayres M., Vance D.* Constraints on the thermal evolution of the Indian Himalaya from manganese and erbium distributions in metapelitic garnets // Mineral. Mag. 1994. V.58A. P.34-35.