Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01085, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01085
EGU General Assembly 2008

Fluid-present granulite facies metamorphism: evidence from oxygen isotopes, Porya Guba shear zone, Lapland Granulite Belt.

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An enclave of highly magnesium and aluminous granulite is exposed within the early Proterozoic mafic schists and gneisses at Porya Guba, Lapland Granulite Belt, Kola Peninsula, Russia. The enclave is composed of veinlets and lenses containing variable proportions of quartz (*qz*), sillimanite, orthopyroxene and garnet, with subordinate biotite and minor feldspars. Bulk composition of the unit is well represented by the simple system FMAS, with almost no CaO and alkalis. Geothermobarometry on coexisting minerals using the Berman and Aranovich (1996) thermodynamic systematic has revealed very consistent peak metamorphic temperature- pressure conditions around 900^{o}C/1GPa. Regular zoning pattern within the unit from multi- to bi-mineral zones of varying thickness suggests involvement of infiltrating fluid in its formation. To test this possibility, oxygen isotope composition of rock-forming mineral separates (better than 95% pure according to the X-ray diffraction examination of the separates) has been measured with the conventional fluorination technique. All analyzed minerals exhibit regular variations in δ^{18}O values, with those of *qz* ranging from 10-7 per mil. Oxygen isotope thermometry based on $\Delta^{18}O_{qz-mineral}$ gives T-estimates consistent with the high-temperature origin of the granulite (860-930^{o}C according to the empirical calibration by Zheng, 1999), and shows almost no low-temperature resetting, which appears to indicate relatively rapid cooling or, alternatively, very short-lived "spike" of fluid activity which generated the assemblages under consideration. Bulk

rock $\delta^{18}O_{BR}$ for each zone of the enclave has been calculated based on the values for the individual minerals and the volume proportions of minerals in a zone. The $\delta^{18}O_{BR}$ values also vary systematically from zone to zone from 8.6 to 4.5 per mil. Due to a relatively short distance between the samples from different zones (which does not exceed 10-15 m) it appears highly unlikely that the difference in their $\delta^{18}O_{BR}$ has been inherited from the corresponding protoliths. Rather, it can be related to the variations in the fluid/rock ratio during the formation of the zoned enclave.

This work was supported by the RFBR grants #06-05-64976 and 06-05-65059.

References:

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