Geophysical Research Abstracts,
Vol. 11, EGU2009-5765, 2009
EGU General Assembly 2009

Metasomatic alteration of monazite: constraints on fluid chemistry and the dating of mass transport

DE Harlov (1) and CJ Hetherington (2)

(1) Deutsche GeoForschungsZentrum, Chemistry and Physics of Earth Materials, Telegrafenberg, D-14473 Potsdam, Germany (dharlov@gfz-potsdam.de, +49 331 288-1402), (2) Department of Geosciences, Texas Tech University, Lubbock, Texas 79409-1053 USA

Monazite [(Ce,La,Nd,Th,Ca)(P,Si)O_4] is a common Th-bearing LREE orthophosphate mineral in both igneous and metamorphic rocks. Thorium enrichment or depletion in monazite as $ThSiO_4$ and/or $CaTh(PO_4)_2$ can occur in the form of overgrowths, as magmatic zoning, or as patchy, curvilinear intergrowths with sharp compositional boundaries, both along the monazite grain rim as well as in the grain interior. Recent advances in the dating of monazite using the electron microprobe have indicated that these overgrowths and intergrowths, whether enriched or depleted in Th, can give ages younger than the original monazite. The morphology of the intergrowths suggests that the original monazite grain could have been partly metasomatised by a Th-Si-Ca-bearing fluid. This hypothesis has been tested in the piston-cylinder apparatus at 1000 MPa and 900 °C utilizing unzoned, homogeneous, Th-bearing monazite-(Ce) grains plus a series of alkali fluids including 2N NaOH, 2N KOH, and H_2O + $Na_2Si_2O_5$. In each experiment a subset of the monazite grains acquired $ThSiO_4$-enriched intergrowths with sharp compositional boundaries that show no evidence of being overgrowths. These experiments support the hypothesis that Th-enriched and Th-depleted intergrowths observed in natural monazite can be metasomatically induced via dissolution-reprecipitation yielding information concerning the nature of the fluid present under a variety of P-T conditions. Subsequently, these intergrowths could also be used to date multiple metasomatic events assuming that all the original Pb is removed during metasomatic alteration. The results of these experiments also seriously question the use of monazite-based ceramics as repositories for radioactive waste since under high pH conditions they would be susceptible to partial dissolution and the subsequent release of Th into local aquifers.