

Experimental Pb incorporation during hydrothermal monazite replacement in alkali conditions

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Monazite is widely used in U-Th-Pb dating of magmatic or metamorphic rocks and hydrothermal ore deposits. Frequently, monazite presents compositional and isotopic zoning. As solid state diffusion is very slow in monazite, the compositional domains correspond to successive crystallizations and/or replacement induced by dissolution-precipitation process during hydrothermal alteration or metamorphic reactions that release water. In nature, monazite recrystallized by replacement can incorporate significant amounts of non-radiogenic Pb, with possible disturbance of U-Pb and Th-Pb isotopic systems, particularly at low temperature ($T < 400^{\circ}\text{C}$).

In this study, Pb incorporation mechanisms have been investigated during hydrothermal monazite replacement (Manangotry, standard, 555 ± 2 Ma) at 300, 400, 500 and 600°C , at pressure of 2 kbar under alkali conditions (NaOH 1M in ^{18}O doped solution) in the presence of quartz.

At 300°C , no evidence of monazite replacement was observed. From 400 to 600°C , experimental products show a replacement texture with pristine monazite (Mnz1) surrounded by one alteration rim (Mnz2), with a different composition (SEM and EPMA). Micrometric pores and Si-rich inclusions occur within both Mnz1 and Mnz2. Replacement degree increases with temperature. The ^{18}O signature (RAMAN, Nano-SIMS) confirms the secondary origin of the replaced Mnz2 and Si-rich inclusions. Mnz2 contains various Pb amounts (hundreds to thousands of ppm, EPMA), which are lower for the highest temperatures. The isotopic in-situ U-Th-Pb dating of Mnz2 (LA-ICPMS) confirms the presence of radiogenic Pb inherited from Mnz1 with no isotopic Pb fractionation. Finally, a TEM study (currently in progress) should provide more insights on the re-distribution of inherited Pb within the secondary Mnz2.