Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14892

# The solubility of monazite in carbonate melts at upper mantle and crustal conditions

**SRIJITA RAY**, GREGORY MARK YAXLEY AND ANDREW BERRY

Australian National University

Presenting Author: u7068719@anu.edu.au

Rare earth elements (REEs) are critical components for modern electronic devices. REE mineralisation is often associated with carbonatites [1]. However, the processes that lead to REE enrichment in carbonatites are not well understood. Economic REE mineralisation is commonly associated with phosphate minerals like monazite or xenotime. This study aims to determine the conditions that lead to crystallization of monazite from carbonatite magma by determining the solubility of monazite in carbonate melts as a function of pressure, temperature and melt composition.

Piston-cylinder experiments were conducted at upper mantle pressures of 1 and 2 GPa, and temperatures from 1000 to 1450°C. We prepared a mixture of sintered oxides with the composition of a natural REE-bearing monazite and a synthetic sodic-dolomitic composition that corresponds to a mantle-derived carbonatite melt. The monazite and melt mixes were combined in a 1:1 ratio in most experiments, which crystallized monazite, thereby demonstrating saturation of the melt in monazite. We investigated the effect of composition on monazite solubility by systematically varying the Ca# (from 0.2 to 1.0) and adding $SiO_2$ (up to 15.3 wt%) and $CaF_2$ (up to 20 wt%).

Preliminary results indicate that (1) monazite is very soluble in sodic dolomitic carbonate melt at upper mantle and crustal conditions with the equilibrated melt containing the equivalent of up to 31 wt% $CePO_4$, (2) with increasing temperature the solubility of monazite increases in carbonate melt, (3) the solubility of monazite decreases with increasing $SiO_2$ in carbonate melt, (4) monazite solubility does not appear to be influenced by the presence of fluoride in the melt nor by variation in Ca#, and (5) pressure over a range from 1 to 2 GPa has negligible effect on the solubility of monazite.

The data is being used to generate a regression model to understand monazite solubility as a function of temperature, pressure and melt composition, which will allow the conditions where monazite forms in natural carbonatites to be predicted.

[1] Chen, Wei, et al. "Geochemistry of monazite within carbonatite related REE deposits." *Resources* 6.4 (2017): 51.