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Controls on the aqueous solubility of zircon and formation of hydrothermal zircon at upper crustal conditions

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Zircon persists in the rock record because it has very low solubility in most natural waters. However, petrologic studies and thermodynamic modeling suggest zircon may be soluble, and Zr mobile, under certain conditions, which can lead to formation of hydrothermal zircon. Using a modified version of the Supcrtbl database [1] we find that at 0.2 GPa in H_2O saturated in zircon and quartz the molal concentration log(Zr) shows a 1:1 (-) correlation with pH in acidic solutions and a 1:1 (+) correlation in alkaline fluids (Fig. 1). As a result, a pH=12 fluid that may form during serpentinization at 600°C has log(Zr) = -3.4, ~7 orders of magnitude higher than at a near-neutral pH of 5. pH neutralization of a zircon-saturated alkaline fluid will cause precipitation of hydrothermal zircon. However, the Supcrtbl database is based on the Supcrt92 database that predates most experimental measurements of zircon solubility and therefore shows poor agreement with experiments. Some of these experiments show enhanced solubility caused by complexing with Si, alkali-silicates, or F [2]. We will present experimental zircon solubilities measured at 0.2 GPa and 600-800°C in H_2O ± NaF using isotope dilution (Fig. 2) and compare to solubilities predicted using Supcrtbl. Reconciling theory and experiment will constrain the conditions, and interpretations of U-Pb ages, of hydrothermal zircon.

1. Zimmer K. et al. (2016) *Geosci.* **90**, **Part A**, 97–111.
2. Matthews and Sverjensky (2024) AGU Conference.

Figure 1

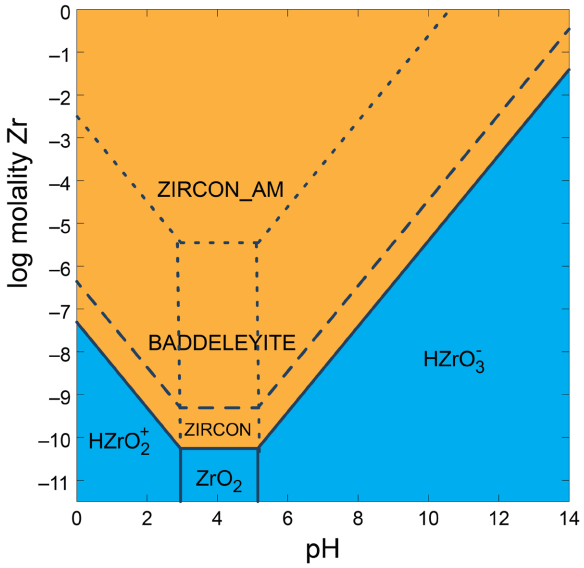

Figure 2