The uptake of Ti in experimentally grown, hydrothermal quartz

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Characterization of the concentration of titanium in quartz is particularly valuable because it is the basis of the TitaniQ geothermobaromater [1], the cause of quartz cathodoluminesent centers (CL), and a measure of quartz cooling history [2]. The partitioning of Ti between quartz and a fluid depends on the P and T of crystallization, the activity of Ti^{4+} in solution, and the crystal growth rate [3].

We are growing quartz in cold-seal pressure vessels to determine the influence of crystal growth rate on TitaniQ. A Pt capsule containing a seed crystal is placed within a gold capsule packed with silica glass beads, water, and powdered rutile. The experiments are isothermal (800°C) and isobaric (1 kbar). The silica glass supplies Si^{4+} and the rutile supplies Ti^{4+}. The growth rate is varied by using different sieve sizes of glass. After an experiment, we collect scanning electron microscope cathodoluminescence (SEM-CL) images of the quartz overgrowth and newly formed crystals in the outer capsule. Ti measurements are made by electron probe microanalysis (EPMA).

We observe a relationship between the sieve size of silica glass and the morphology of the quartz. In experiments with large silica glass fragments (.24892-.17526 mm), the overgrowth covers a smaller portion of the seed crystal and we observe dissolution textures on residual fragments of silica glass. In experiments with small silica glass fragments (.06096-.04318 mm), the overgrowth covers a larger portion of the seed crystal and has a high density of open-ended fluid inclusions. We find that quartz does not grow uniformly around the seed crystal, which complicates the measurement of growth rate. Titanium concentrations range from 434 ppm to 602 ppm for three of the experiments, which is higher than the values predicted by TitaniQ of 274- 476 ppm.

[1] Thomas, Watson, Spear, Shemella, Nayak & Lanzirotti (2010), *Contributions to Mineralogy and Petrology* **160**, 743-759. [2] Mercer, Reed & Mercer (2015), *Economic Geology* **110**, 587-602. [3] Huang & Audetat (2012), *Geochimica et Cosmochimica Acta* **84**, 75-89.