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Constraining Silica Solubility in H_2O at high grade conditions: Insight from the Bundelkhand craton, India

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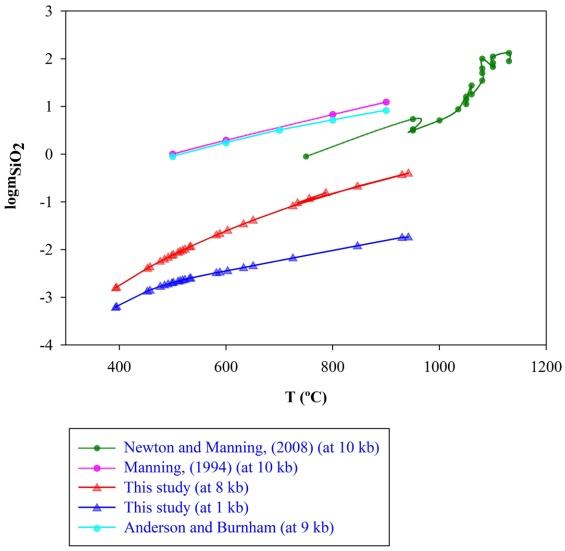
Experimental studies on the solubility of silica in aqueous fluid at high pressure (P >10 kb) and temperature (T: 100ºC-1000ºC) confirm that in extreme P-T conditions (lower crust-upper mantle depths), silica exist as supercritical fluid. However, the experimental results are not adequately tested in natural silicic magmatic systems at high grade conditions as yet. Paleoproterozoic quartzolites, occurring as NE-trending quartz reefs (bulk $SiO_2 \geq 89$ wt%, volume $>4*10^9 m^3$) intrusive into the 2.6-2.3 Ga granitoid in the Bundelkhand craton (India) is a well-exposed natural laboratory to test the experimental results. Since this silica-rich fluid (quartz reefs) comprises rutile, we used the rutile saturation equation of Hayden and Watson, (2007) and calculated the possible crystallization temperature range (300º-950ºC) of the Si-rich fluid at different bulk TiO_2 values. In the rhyolite-MELTS (v. 1.0.x), assuming varying H_2O (5wt%, 8wt%, 15 w %) and fO_2 (NNO, QFM) for bulk rock (SiO_2 89-95 wt%), the liquidus yielded at ~1000º-900ºC, comparable to rutile saturation temperature. With crystallization temperatures (300º-950ºC), we then calculate the amount of silica dissolved in water at 1-10 kb using the solubility equation of Manning, (1994). We find that our results tend to close to 10 kb line (Fig.1), in tune with the presence of euhedral magmatic epidote (Ps: 0.26-0.33) (8 kb) in the rocks. We also find that the silica solubility in natural multielement system (quartz reefs) could be more controlled by pressure rather temperature, and silica solubility may drop at ≥10 kb (mantle depths) compared to those found in experiments with inclusion-free Brazilian quartz as starting material. Our ongoing work requires more data to have a robust estimate of temperatures and silica solubility at high grade conditions for the quartz reef rocks. We suggest that high-temperature exsolved extremely silica-rich fluid during crustal evolution may have a deeper origin with transcrustal emplacement history.



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