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# The effect of deformation on the TitaniQ geothermobarometer

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The Titan in Quartz (TitaniQ) geothermobarometer is a powerful tool to identify the thermal (Wark and Watson (2006)) and pressure history (Thomas et al. (2010)) particularly in deformed rocks.

In order to investigate the effect of the deformation on the TitaniQ thermobarometer and to study the deformation mechanisms responsible for the incorporation of Ti into the recrystallized quartz grains, we performed deformation experiments with a Griggs- type solid medium deformation apparatus. The experiments were performed on quartz single crystals with the addition of rutile powder and 0.1wt% $H_2O$ at a pressure of 1.0 -1.5 GPa and a temperature ranging from 800-1000°C at strain rate of 10-6 s-1. These conditions correspond to the dislocation creep regimes 2 and 3 of Hirth and Tullis (1992). We performed high strain axial compression experiments (up to 40%) with compression normal {m} and in O+ direction.

The strongly deformed quartz crystals show a wide variety of deformation structures varying from initial crystal lattice distortion (producing bands of undulatory extinction) to subgrain rotation recrystallization, and some grain boundary migration.

EMPA measurements and element distribution maps, show no significant increase of Ti content neither in rotated sub-grain nor in the newly crystallized or recrystallized grains. However, element distribution maps reveal locally high Ti concentrations along cracks, indicating precipitation of secondary Ti-phases on a $\mu$m-scale. Therefore, transport of Ti took place via fluid along cracks in these experiments.

Our preliminary observations indicate that (1) Ti in a fluid (water) was available at grain boundaries of the sample during the experiment. (2) During the deformation experiment the newly crystallized (recrystallized) quartz grains do not incorporate Ti in measurable quantities (by EMPA). Thus, they do not re-equilibrate to the deformation conditions (high P and T) with respect to its trace element content. The kinetics of resetting of trace element concentration are most likely controlled by precipitation from a fluid (e.g. Huang and Audétat (2011). In our experiments neither subgrain rotation nor locally migrated grain boundaries alone are sufficient to equilibrate trace element content. The mechanism by which Ti is getting incorporated in the quartz, needs to be explored by further experiments.

References:
Hirth, G., & Tullis, J. (1992). Dislocation creep regimes in quartz aggregates. Journal of Structural Geology, 14(2), 145-159.
Huang and Audétat (2011) A critical look at the titanium-in-quartz (TitaniQ) thermobarometer. Mineralogical Magazine Goldschmidt Abstract p.1065
Thomas, J. B., Watson, B. E., Spear, F. S., Shemella, P. T., Nayak, S. K., & Lanzirotti, A. (2010). TitaniQ under pressure: the effect of pressure and temperature on the solubility of Ti in quartz. Contributions to Mineralogy and Petrology, 160, 743-759
Wark, D. A., & Watson, B. E. (2006). TitaniQ: a titanium-in-quartz geothermometer. Contributions to Mineralogy and Petrology, 152, 743-754.