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Experimental calibration of a Ti-in-quartz thermobarometer: an overview for applications to mylonites

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During the last decade several trace element thermometers (Ti-in-quartz, Ti-in-zircon, Zr-in-rutile and Zr-in-sphene) were developed at RPI by determining the solubilities of trace elements in minerals as a function of pressure and temperature. The Ti-in-quartz thermometer is of particular interest for potentially estimating the P–T conditions of ductile deformation in crustal rocks because quartz fabric development and microstructural formation has been extensively studied. In this presentation I will discuss the experimental approach and thermodynamic basis used to calibrate trace element solubilities for usage as trace element thermometers, and overview some fundamental considerations necessary to 'take the temperature of ductile deformation'. In our experiments quartz and rutile were crystallized at equilibrium from SiO_2- and TiO_2-saturated fluids (aqueous solutions, hydrous melts) so that TiO_2 activity was unity during quartz crystallization. During growth, Ti4+ substituted for Si4+ on the tetrahedral site in quartz so that the quartz contained the equilibrium concentration of Ti for each P–T condition. In static sub-solidus quartzose systems metamorphosed at high temperature conditions, Ti solubility equilibrium in quartz crystals must be attained by Ti diffusion from a Ti-bearing source (e.g. rutile, garnet, ilmenite, etc.). Due to the low diffusivity of Ti and the timescales of thermal events, Ti solubility equilibrium may not be attained in some systems. There are few studies that have investigated the role of dynamic recrystallization in attaining solubility equilibrium (e.g. Behr and Platt 2011; Grujic et al. 2011; Kidder et al. 2013). Constraining TiO_2 activity during deformation is particularly important. The presence of rutile during deformation does not necessarily guarantee unity TiO_2 activity unless it crystallized during the deformation event of interest.

Behr WM, Platt JP (2011) A naturally constrained stress profile through the middle crust in an extensional terrane. Earth and Planetary Science Letters 303, 181–192

Grujic D, Stipp M, Wooden JL (2011) Thermometry of quartz mylonites: Importance of dynamic recrystallization on Ti[U+2010]in[U+2010]quartz reequilibration. Geochemistry, Geophysics, Geosystems 12, doi:10.1029/2010GC003368

Kidder S, Avouac J–P, Chan Y–C (2012) Application of titanium-in-quartz thermobarometry to greenschist facies veins and recrystallized quartzites in the Hsüehshan range, Taiwan. Solid Earth 4, 663–706