Quartz-in-epidote barometery: an experimental assessment

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Resolving pressure-temperature (PT) conditions of igneous and metamorphic rocks is fundamental for understanding the evolution of crustal lithosphere. We focus on quantifying the suitability of a quartz-in-epidote (qtz-in-ep) solid mineral barometer because theoretical calculations applying an isotropic elastic model [1] suggest that qtz-in-ep inclusion pressures (P_{incl}) exhibit minimal temperature dependence, with the potential to elucidate the growth conditions of epidote in geologic environments with poor PT constraints (e.g., skarn deposits, retrograde rocks). We carried-out heating experiments and compare Raman spectroscopic shifts in the 464 cm^{-1} band of quartz (and therefore P_{incl}) with modeled P_{incl} for three epidotes derived from samples with well constrained PT conditions: 1) FT-1E from Froznitz Tal (P_{incl} = 6.8 kbar), 2) LdC-31C from Lago-di-Cignana (P_{incl} = 2.6 kbar), and 3) HF-14C from the Upper Schieferhuelle in Western Tauern (P_{incl} = 0.74 kbar).

At elevated temperatures, we encountered difficulties in separating the quartz ν_{464} Raman peak and shoulder epidote peaks due to the convergence resulting form the T-sensitivity of the quartz band. Our low pressure HF14C quartz peaks were particularly difficult to fit at elevated temperatures and displayed lower entrapment pressures (P_{ent}) than modelled P_{ent}; however, experimental P_{ent} for samples FT-1E and LdC-31C match modelled P_{ent} extremely well. Ambient quartz inclusion pressures are consistent with previously constrained PT conditions : 1) FT-1E: P_{ent} = 21.5 (T_{ent} = 625 ºC), 2) LdC-31C: P_{ent}= 11.7 kbar (T_{ent} = 550 ºC), 3) HF-14C: P_{ent} = 7.4 kbar (T_{ent}= 500 ºC). Reference PT conditions for these samples are as follows: 1) FT-1E: P = 20 – 24 kbar, T = 625 ºC [2], 2) LdC-31C: P = 32 – 34 kbar, T = 550 ºC [3], 3) HF-14C: P = 7 – 8 kbar, T = 500 ºC [4]. Qtz-in-ep pressures from sample LdC-31C are consistent with early, low-P epidote precipitation that pre-dates high-P metamorphism or low-P retrogression in the Lago-di-Cignana region.

[1] Guirard and Powell (2006) *EPSL* **244**, 683-694.
[2] Selverstone and Spear (1985) *Jour. Met. Geo.* **3**, 439-465
[3] Frezzotti et al. (2011) *Nat. Geosc.* **4,** 703-706
[4] Selverstone et al. (1992) *Contrib. Min. Pet.* **112,** 347-357