

Overstepping the garnet isograd: A comparison of QuiG barometry and thermodynamic modelling

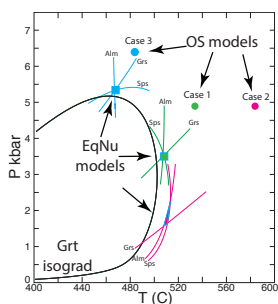
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Metamorphic P-T paths have generally been inferred by assuming a close approach to equilibrium during progressive metamorphism but several recent papers (e.g. Pattison et al. [1]) have suggested that significant overstepping of metamorphic reactions may be common. This paper explores the consequences of such overstepping in light of metamorphic P-T path determinations.

Model calculations have been done in which an arbitrary degree of overstepping is assumed (the “OS” model). The composition of garnet that would form at these conditions is computed from the largest decrease in Gibbs free energy. This composition is then used to estimate the P-T conditions of garnet nucleation had it been assumed that nucleation occurred in equilibrium with the matrix assemblage (the equilibrium nucleation or “EqNu” model). The EqNu model yields P-T conditions that are at lower temperature and higher or lower pressure (depending on the coexisting calcic phase) than the



true OS conditions. The degree of discrepancy also increases with the degree of overstepping.

The model is applied to three natural samples. The Raman shift of the 464 cm^{-1} peak of quartz was used to determine the pressure on quartz inclusions in garnet and a thermo-elastic model applied to determine the entrapment

isochore. Model calculations assuming overstepping along the entrapment isochore were compared with the EqNu model. A sample from the garnet isograd in eastern Vermont requires little or no overstepping (affinity < 1 kJ/mole garnet). A sample from the garnet zone from Vermont requires overstepping of around 50 °C and 2-5 kbar (affinities around 10kJ/mole garnet). A blueschist sample from Sifnos, Greece yields a similar amount of overstepping. These results indicate that overstepping of garnet nucleation reactions may be common and pronounced in regionally metamorphosed terranes and that the P-T conditions and paths inferred from garnet zoning studies may be egregiously in error.

[1] Pattison, D.R.M. *et al* (2011) *Jour Met Geol* **29**, 953-977.