Geophysical Research Abstracts
Vol. 14, EGU2012-11942, 2012
EGU General Assembly 2012

Another dimension to metamorphic phase equilibria: the power of interactive movies for understanding complex phase diagram sections

E. Moulas, M.J. Caddick, N. Tisato, and J.-P. Burg
ETH Zurich, Department of Earth Sciences, Switzerland (evangelos.moulas@erdw.ethz.ch)

The investigation of metamorphic phase equilibria, using software packages that perform thermodynamic calculations, involves a series of important assumptions whose validity can often be questioned but are difficult to test. For example, potential influences of deformation on phase relations, and modification of effective reactant composition (X) at successive stages of equilibrium may both introduce significant uncertainty into phase diagram calculations. This is generally difficult to model with currently available techniques, and is typically not well quantified.

We present here a method to investigate such phenomena along pre-defined Pressure-Temperature (P-T) paths, calculating local equilibrium via Gibbs energy minimization. An automated strategy to investigate complex changes in the effective equilibration composition has been developed. This demonstrates the consequences of specified X modification and, more importantly, permits automated calculation of X changes that are likely along the requested path if considering several specified processes. Here we describe calculations considering two such processes and show an additional example of a metamorphic texture that is difficult to model with current techniques. Firstly, we explore the assumption that although water saturation and bulk-rock equilibrium are generally considered to be valid assumptions in the calculation of phase equilibria, the saturation of thermodynamic components ignores mechanical effects that the fluid/melt phase can impose on the rock, which in turn can modify the effective equilibrium composition. Secondly, we examine how mass fractionation caused by porphyroblast growth at low temperatures or progressive melt extraction at high temperatures successively modifies X out of the plane of the initial diagram, complicating the process of determining best-fit P-T paths for natural samples. In particular, retrograde processes are poorly modeled without careful consideration of prograde fractionation processes. Finally we show how, although the effective composition of symplectite growth is not easy to determine and quantify, it is possible to successfully model by constructing a series of phase equilibria calculations.