Garnet grain distribution along a pelitic eclogite to amphibolite path: Adula Nappe, Switzeraland

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Eclogite facies assemblages in the Adula Nappe have been well-documented in mafic and ultramafic litholigies [e.g. 1, 2], but have only been reported for a few pelitic samples [e.g. 3]. Alp de Confin is located within the structurally upper portion of the Adula Nappe and contains an unpublished 30m x 50m paragneiss outcrop that is progressively zoned from eclogite-facies whiteschist in the core to retrograde amphibolite-grade metapelites along the edges.

Preliminary X-ray tomograph analysis of samples from different zones were made at the University of Lausanne to examine garnet size distributions related to the polymetamorphic history of the Adula. Statistical analyses of the tomography results indicate that an even crystal size distribution for garnet is present within the whiteschist, but that a bimodal distribution is exists in the amphibolite-grade paragneisses. This shift in garnet distribution is also mirrored by a reduction in the modal proportion of garnet from ~20% in the whiteschist to <5% in amphbolite-grade samples. The change in garnet modes and crystal size distributions may be due to a reaction involving garnet and the breakdown of paragonite to plagioclase, because no staurolite or biotite is present.

References

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Breakdown of dolomite in H_2O-rich fluid: An experimental study

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The existence of calcite + periclase or brucite in contact-metamorphosed dolomite is a potential indicator of reaction in the presence of H_2O-fluid. We have undertaken an experimental study of the breakdown of dolomite to determine the rate of reaction and the minerals that form during cooling. Experiments were conducted with natural and synthetic dolomite powder, dolomite rock, and isotopically characterized H_2O. Samples were heated in cold-seal hydrothermal vessels to temperatures ranging from 650 to 750 °C at pressure of 50 and 100 MPa. In general, we find that dolomite breaks down rapidly in H_2O-rich fluid, that Mg has a high solubility in the fluid, and that magnesite and nesquehonite precipitate from the fluid on quench. The total moles of dolomite reacted over the time of the experiment was found to be proportional to the cube root of time, approximately (Fig. 1). The rate in mol/s is $d\xi/dt = 6.9\times10^{-10}\ t^{-0.7}$.

The overall rate of a heterogeneous reaction is generally found to be proportional to a power greater than one of the affinity of the reaction. Over the duration of our experiments, the affinity changed with time because the fluid composition became more CO_2 rich with the increase in ξ. At constant temperature and pressure, the affinity of the reaction is $A = RT \ln(f^*_{CO2}/f_{CO2})$, in which f^* is the equilibrium value of the fugacity of CO_2, 31.7 MPa at $x_{CO2} = 0.225$. The affinity was determined from the value of x_{CO2} during experiment. Within error, the instantaneous reaction rate is proportional to the square of the affinity—the least-squares fit gives an exponent of 1.8. In comparison with nature, the lack of brucite and the existence of basic Mg carbonate minerals in our experiments suggest that aqueous fluids encountered in nature are substantially more H_2O rich than those in our closed-system experiments.