High-pressure behaviour of carbonates and hydrates, and devolatilization of the subducted oceanic crust

S. POLI[1]*, E. FRANZOLIN[2] AND J-F. MOLINA[3]

[1]Univ. Milano, Via Botticelli 23, 20133 Milano, Italy (*correspondence: stefano.poli@unimi.it)
[2]IMP-ETH Zürich, 8092 Zürich, Switzerland (ettore.franzolin@erdw.ethz.ch)
[3]Univ. Granada, Fuentenueva s/n, 18002-Granada, Spain (jfmolina@ugr.es)

Dolomite, magnesite and Mg-calcite are found to coexist with a variety of hydrous phases in basaltic and gabbroic rocks that underwent deep subduction processes. The transport of carbon and hydrogen to depth and the locus of fluid release to the overlying mantle wedge, source of arc magmatism, are controlled by phase relationships involving carbonates, hydrous phases and volatile-free minerals.

Ca-Mg-Fe partitioning between garnet, clinopyroxene and carbonates defines the compositional space where lawsonite, epidote, talc are allowed to form in the presence of a C-O-H fluid. Experimental data [1] show that an increasing amount of C-O-H volatile components at a Ca/(Fe+Mg) ratio in clinopyroxene higher than unity promotes the crystallization of lawsonite at temperatures beyond the stability limit observed at H_2O-saturated conditions. The abundance of lawsonite, and therefore, its ultimate desappearance in the subducted oceanic crust can be modelled by the normative anorthite content of the bulk composition. As a consequence lawsonite and dolomite/ magnesite are expected to coexist in deeply altered volcanoclastics or in differentiatied gabbroic rocks of noritic composition at temperatures approaching the basalt wet-solidus.

New experimental data at 3.5 GPa are intended to unravel the effect of variable bulk and volatile compositions in two model compositions in the chemical system Na_2O-CaO-FeO-MgO-Al_2O_3-SiO_2-C-O-H, enriched in the *an* component. Experiments are performed in a piston cylinder apparatus, at fH_2 fixed at HM, OH (X, COH) buffer using a double capsule technique, after [2].

The small difference between the *dP/dT* slope of lawsonite devolatilization reactions and the *dP/dT* slope of P-T paths for subducting slabs greatly amplifies the role of bulk composition in generating the fluid that modifies the subarc mantle chemistry.

[1] Poli *et al*. (2009) *Earth Planet. Sci. Lett.* **278**, 350-360. [2] Eugster & Skippen (1967) *Res. Geochemistry* **2**, 492-526

Pulses of rapid garnet growth observed from microsampling and Sm/Nd geochronology in a single zoned garnet

A.D. POLLINGTON* AND E.F. BAXTER

Department of Earth Sciences, Boston University, Boston, MA 02215 (*apolling@geology.wisc.edu)

Chemically zoned garnets have the potential to provide geoscientists one of the most useful records of the changing conditions within the tectonically evolving crust where metamorphic mineral growth occurs. Yet full exploitation of this continuous multi-million year record of tectonic processes requires high resolution geochronologic measurements. An improved method for microsampling narrow growth zones of garnet porphyroblasts based on chemical composition has been developed and implemented on a single large (6 cm) garnet from a shear zone in the Stillup Tal, within the Tauern Window of the Austrian Alps. Despite evidence for fluid flow and major-element metasomatism in the shear zone [1], a late-Hercynian age whole rock isochron indicates that the Sm-Nd system was not disturbed by these water-rich fluids during the Alpine Orogeny. This method coupled with updated partial dissolution protocols to remove Nd-rich mineral inclusions leads to small but pure garnet samples (each yielding 2-12 ng Nd) which can be dated at a very high precision using Sm-Nd isochrons. Here, we present precise garnet-matrix isochron ages from 12 distinct concentric growth zones within this garnet. Age uncertainties for these 12 garnet zones range from ±0.43 to ±0.67 Ma (2σ). The radial pattern of ages is consistent with an average constant volumetric growth rate of 10.28 +0.76/-0.66 cm^3/Myr over a total growth span of 7.55±0.52 million years. However, at a finer level of detail afforded by the spatial and temporal resolution of the dataset, the data reveal two brief distinct pulses of accelerated growth (at least 5 times faster than the background rate) which correlate with prominent chemical excursions in the zoned garnet, indicating significant shifts in pressure, temperature, bulk composition and/or the introduction of catalyzing fluids during these pulses. These data provide evidence that tectonometamorphic processes leading to garnet growth within this shear zone (i.e. exhumation, fluid flow, heating) were pulse-like in nature, rather than steady, during the waning stages of the Alpine orogeny 28-20 million years ago.

[1] Selverstone *et al.* (1991) *J. Met. Geol.* **9**, 419-431.