

Bimetasomatism in the Eclogite Facies: Evidence from the Tauern Window, Austria

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Mineralogical and compositional changes of eclogite and adjacent calcareous metapelite and talc schist from the Eclogite Zone, Austria, were investigated in order to understand fluid-mediated compositional changes during subduction zone metamorphism. Whereas the eclogite in contact to the metapelite shows almost no change in volume, minor gain of Si, Ca and Na and loss of Mg, the metapelite shows a 30% volume loss, mainly as SiO₂, depletion of Ca and enrichment of K, Mg, Fe and Na – the latter two stemming from an external source. Trace element changes are less spectacular but corroborate changes in the major elements (Sr goes with Ca, Ba with K, etc.)

The eclogite in contact to the talc schist also underwent no significant change in volume, but minor enrichment in Mg and depletion in Na. The talc schist is ultrabasic in composition and of uncertain origin. It experienced more than 30% volume loss towards the contact, where Mg, Fe, Si, Na and Ti are depleted and no major element is enriched.

These changes in bulk composition are expressed in mineralogical, textural and mineral chemical changes of considerable complexity, and are not just limited to the very obvious retrograde interactions. The earliest composition changes are already manifest in the cores of garnets and demonstrate a rather continuous interaction throughout the entire metamorphic history. As the lithological boundaries are planar over distances of tens of metres at least, the volume losses are not induced by folding but rather by (pure or general) shear. Some composition changes cannot be explained by material exchange between the two lithologies (bimetasomatism) alone but must have been caused by advection parallel to the lithological boundaries. Rare garnets and epidotes with oscillatory zoning patterns near the contact indicate local abundance of fluid. The compositional changes are too systematic and complex to be explained as primary (volcano-)sedimentary layering or mixing of clays and ashes.

Characterization of CaCO₃ polymorphs grown in silica hydrogel in the presence SO₄²⁻ or CrO₄²⁻ by XAS

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It has been noted that the presence of tetrahedral anions like SO₄²⁻ and CrO₄²⁻ in the medium for synthesis strongly influence CaCO₃ crystallization by promoting the formation of vaterite or vaterite/aronite with respect to calcite. This influence has been related to either interface phenomena, such as preferential adsorption of these ions on particular sites on the surface of a specific polymorph or to changes in the relative free energy of the polymorphs due to differential incorporation of the tetrahedral anions. In order to confirm the incorporation of SO₄²⁻ and CrO₄²⁻ into the structure of the different CaCO₃ polymorphs and to study how and to what extent it may occur, crystals of calcite, aragonite and vaterite were grown in the presence of high concentrations of one of these anions using the silica gel method and were studied by X-ray absorption spectroscopy (XAS) at the Cr and S K edges in the XANES and EXAFS (only for Cr) regions. Measurements were conducted in the SUL-X beamline of the ANKA synchrotron radiation facility at the KIT (Germany). In all the experiments calcite was the most abundant polymorph in the precipitate, while vaterite and aragonite appeared as minor phase. While calcite grew as elongated single crystals, both aragonite and vaterite appeared as spherulitic aggregates. The incorporation of SO₄²⁻ and CrO₄²⁻ was confirmed in the three polymorphs, with significantly higher concentrations in calcite. In the case of calcite XAS spectra were recorded on differently oriented single crystals. Differences are very small and may point to a possible preferential orientation of the tetrahedral SO₄²⁻ anion in the structure. Finally, the comparison between spectra from the three polymorphs evidenced slight differences between those corresponding to calcite and aragonite. Differences are most marked to the spectrum of vaterite for SO₄²⁻ (Cr contents in vaterite were too low for a reliable comparison).

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