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Phase relation modelling associated with metasomatic processes in open systems: application to an example of Mg-metasomatism from the Neves area, Tauern window, Eastern Alps.

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Fluid flow within the continental crust, and the concomitant fluid-rock interactions, are likely responsible for mass transfer and significant change in bulk rock chemistry (i.e. metasomatism). Strain localization and formation of ore deposits are very commonly associated to metasomatism. Metasomatic processes are studied combining petrology, geochemistry, fluid inclusion analysis and/or thermodynamic modelling (P-T-X). To model and quantify the mass and fluid flux integrated with time, the driving forces and controlling factor, such as fluid chemistry (solubility, speciation, chlorinity ...), P-T conditions and phase relations, the degree of disequilibrium between the fluid and the host-rock must be clearly identified.

This study focuses on phase relations modelling during metasomatic processes based on the mineralogical and chemical characterisation of metasomatic rocks from the Tauern Window. Samples are amphibole- and chlorite-bearing micaschists resulting from the transformation of a granodiorite under amphibolite conditions (550-570°C and 0.5-0.6 GPa). The studied outcrop is similar to some extent to Mg-metasomatic rocks reported in several localities in the Alps, including Dora Maira, Gran Paradiso or Monte Rosa and summarised in Ferrando (2012). Although all the localities reported in Ferrando (2012) and the Tauern window have their own characteristics (eg. different P-T conditions, fluid chemistry, mineralogy, age...), they also share similar features. For instance, the gain in Mg with respect to the protolith is systematically coupled with a gain in fluid, and a loss of Ca, Na and sometimes Si. This shared feature suggests that a unique and simple process must be involved in all these localities.

Thermodynamic models are developed using chemical potentials of perfectly mobile components of the system as variable (μ_i), following the definition of Korzhinskii (1959). It means that the chemical potential of the mobile component (MgO, CaO, Na₂O, SiO₂, H₂O) is controlled by the environment, which we consider here as an externally-derived fluid. The computed projections and pseudo-sections show that the reequilibration of the granodiorite with the externally-derived fluid (high μ_{MgO} and low μ_{CaO} , $\mu_{\text{Na}_2\text{O}}$, μ_{SiO_2}) induce a series of metasomatic reactions leading to the breakdown of the granodiorite assemblage into amphibole, then muscovite-chlorite and eventually talc. From these models, it is possible to quantify the amount of mass lost and gained

along the defined reequilibration path and eventually estimated the required fluid flux.