



local equilibrium and P-T-deformation-relative age mapping at the thin section scale

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The mineralogy and deformation features of metamorphic rocks provide key information on the geodynamics and the rheology of rocks at different spatial scales. However, linking deformation with metamorphic conditions requires spatially continuous estimates of pressure (P) and temperature (T) conditions at least in two dimensions (P–T maps) that can be superposed to the observed structures of deformation.

Recently developed solid solution models for chlorite and dioctahedral K-white mica provide a means to calculate P–T conditions of crystallization from the composition of these minerals in equilibrium with quartz and water (Dubacq et al., 2010; Vidal et al., 2006). The combination of X-ray maps of mineral composition with these models makes it possible to calculate P–T-deformation-t(relative age)-Fe²⁺/Fe³⁺ maps at the thin section scale for metapelitic samples, including those free of low variance parageneses. The method has been applied to several examples, which show that in rocks metamorphosed at < 550 °C, the composition of phyllosilicates does not change significantly by lattice diffusion with varying P and T. Different compositions of chlorite and mica grains coexisting metastably in the same thin section are therefore indicative of different P-T conditions of crystallization that were achieved at different times. The nucleation of new grains during P–T variation is activated by deformation, so that the location of the different chlorite-mica generations characteristic of different P–T conditions is correlated to the microstructures. The P–T-deformation maps highlight historical information about the P–T and deformation history. They provide also information about the heterogeneity of rheology at the thin section scale. Such data are though to be valuable constrains for the large scale modeling of mountain belts geodynamics. Calculated maps of Fe²⁺/Fe³⁺ in phyllosilicates are also adapted to evaluating at least qualitatively the redox condition and possibly the depth at which oxidation from externally derived fluid occurred during the sample history.