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# Local equilibrium and P-T-deformation-t-(relative age) maps of metamorphic rocks at the thin section scale

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Our understanding of processes governing the evolution of the lithosphere heavily relies on modelling of phase equilibria in metamorphism. This modelling is generally made using equilibrium thermodynamics. However, natural systems are in constant flux, and they never reach global thermodynamic equilibrium. Thermodynamic equilibrium can only be assumed in parts of real systems that are reasonably close to thermodynamic equilibrium (local equilibrium). The identification of such local equilibria in metamorphic rocks that suffered a complex history can be very challenging. It requires approaches that enable estimates of pressure (P) and temperature (T) i) from high variance mineral assemblages, and ii) at least in two dimensions i.e. P–T maps, which can be superposed to the observed microstructures at the thin section scale.
We show that in some favorable cases, the combination of EMPA X-ray maps with muti-equilibrium thermodynamic approaches allows one to calculate P–T-deformation-t(relative age) maps at the thin section scale, and thus to constrain at least part of the metamorphic history from a single thin section, even if it is devoid of low variance parageneses. This is illustrated by different examples from the greenschist and eclogite facies. The P-T deformation maps also provide information on the heterogeneity of rheology at the thin section scale. Such data provide a robust framework for the understanding of metamorphism and large scale modelling of mountain belts geodynamics.