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Refining the prograde and retrograde P–T path during metamorphism in the Guilleries Massif (CCR, NE IBERIA) through control of evolving effective bulk compositions

Gisela Leoz Munte, Joan Reche Estrada, and Francisco Martínez
Universitat Autonoma de Barcelona, Geology, Cerdanyola del Valles, Spain (gis.leoz@gmail.com)

The predictability of metamorphic assemblages or P-T paths using equilibrium-closed system models, relies on the assumption of quasi equilibrium state/s having been achieved at various stages during metamorphism. Models must implement the effect of local-mosaic effective reaction volumes (ERV's) each one characterized by its effective bulk composition (EBC's) [3,7]. In order to constrain and define the sequence, size and shape of all ERV's that stablished in a rock as a response to evolving conditions we must have an accurate knowledge of chemical and physical properties of rocks, petrochronological information on P-T stages, deformation types and rates, fluid influxes and their coupling effects.
For example, chemical - zoning patterns in garnet porphyroblasts mirror the interaction of variation in P–T conditions and changes in EBC [2] due to chemical fractionation during crystal growth, plus the effects of intracrystalline diffusion during and after garnet growth. Nevertheless as fractionation is path-dependent, finding the P–T trajectory that fits best the observed garnet zoning has proven to be difficult.

Peak conditions along a andalusite-sillimanite HT-LP P-T path in the high-grade Osor Fm. Metapelites of the Guilleries massif occurred at 305±6 Ma (SHRIMP II U-Pb monazite age), related to a magmatic pulse, probably at the end of the main P increment due to recumbent D1+2 folding and/or thrusting [5,6]. Using various petrographic and petrochronological costraints, bulk chemical and microprobe analyses and equilibrium modelling using Theriak-Domino [1] and the module THERIA_G [2] we have found a profitable way to refine this prograde P-T path.

The retrograde P-T path in Guilleries toke place probably pre-, syn- and post D3, related with exhumation. Reactional domains such as local containing bi-mu-pl-sil-spn-st-chl pseudomorphs after g, suppose excellent constrainers of the P-T conditions of this retrograde Variscan P-T path. Analysis of this domains with compositional EMPA X-ray map processing using XMaptools [4], allows for a precise mineral characterization of the analysed domains as well as to constrain evolving local EBC's during stages of retrogression. Though this approach plus Theriak-Domino T-X phase diagrams we demonstrate that those domains behaved as K-Na open-systems during isobaric ca. 6 kbar. cooling to 550±50ºC prior to the final cooling and decompression.

Though this approach we found that the complete P-T loop of Variscan metamorphism in Osor is counter-clockwise, being similar to other LP-HT, magmatic intrusive-related metamorphic settings elsewere.

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