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Tectono-metamorphic evolution of medium-grade metapelites of the Northern Apennine Paleozoic basement inferred from quantitative modeling of microstructures

D. Lo Pò (1), R. Braga (1), A. Montanini (2), and G. Molli (3)

(1) Università di Bologna, Dipartimento di Scienze della Terra e Geologico-Ambientali, Bologna, Italy (deborah.lopo@unibo.it), (2) Università di Parma, Dipartimento di Scienze della Terra, Parma, Italy (alessandra.montanini@unipr.it), (3) Università di Pisa, Dipartimento di Scienze della Terra, Pisa, Italy (gmolli@dst.unipi.it)

A combined microstructural-petrological study on a rare medium-grade metapelite from the exposed Northern Apennines Paleozoic basement is presented. The quantitative modeling of microstructures, in particular, provides important pressure-temperature constraints for pre-peak, peak and exhumation stages of internal units of the southern segment of the Variscan chain now reworked within the northern Apennines nappe stack. The studied sample, described in Molli et al. (2002), is a fine-grained micaschist belonging to the micaschist-amphibolite complex exposed in the Cerreto area. It shows a phengitic white mica + biotite mylonitic foliation wrapping around mica fishes, quartz, plagioclase, garnet porphyroclasts, which represent remnants of earlier tectono-metamorphic stage(s). The last stage, related to a shearing event, is responsible for the development of the mylonitic-fabrics associated with fine-grained phengitic white mica and biotite, plagioclase, quartz, chlorite, REE-rich epidote, ilmenite and rutile. Rutile cores surrounded by ilmenite rims have been observed in both garnet rim and matrix. Thermodynamic modeling was performed in the TiMnNaCaKFMASH system, using the XRF bulk-rock composition of the investigated sample and assuming the bulk H_2O content similar to the loss on ignition value. Garnet core isopleths intersections indicate T= 580°C and P=0.90 GPa. These PT constraints are associated to peak metamorphic conditions. The intersection area belongs to the Bt + Pl + Grt + Chl + Pg + Rt quadrivariant field, in agreement with the observed mineralogical assemblage, except for paragonite, chlorite and phengitic white mica. Calculation of paragonite and chlorite modes suggests that these mineral phases occur in low modal abaundances (about 3% in the intersection area). The presence of pre-kinematic phengitic white mica may be related with the prograde evolution represented by multivariant fields containing this mineral at temperature below the peak conditions. Pyrophanite component in ilmenite, phengite amount in fine-grained white mica and the transition from rutile to ilmenite constrain the mylonitic stage at T= 550°C and P= 0.60 GPa in the Bt + Chl + Phg + Pl + Ilm + Rt field. The resultant clockwise P-T-d path indicates that the Cerreto metapelites underwent crustal thickening at lower-middle crust conditions and a subsequent retrograde stage likely related with the exhumation of this crust sector along ductile shear zones.

Molli, G., Montanini, A. and Frank, W. (2002). MORB-derived Variscan amphibolites in the northern Apennine Basement: The Cerreto metamorphic slices (Tuscan-Emilian Apennine, NW Italy). Ofioliti 27, 17-30.