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Contact metamorphism of graphitic semipelites constrains the depth of emplacement of the Re di Castello intrusion (Adamello Batholith)

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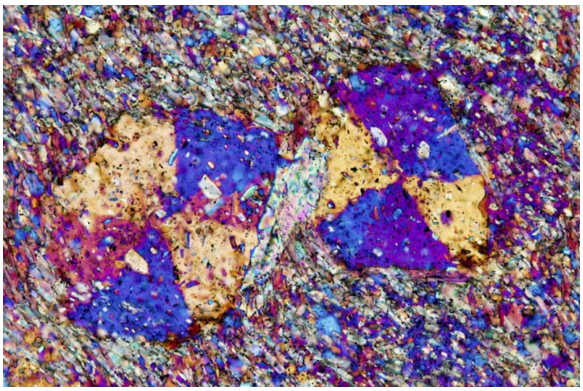

We have studied the contact metamorphism in the *Lozio shale* graphitic metapelites cropping out in the upper Caffaro Valley (southern Adamello). The samples are located at variable distance (max. 500 m) from the intrusive contact with the Re di Castello quartz diorite.

Near the contact the hornfelses display the mineralogical assemblage K-feldspar-cordierite-biotite-muscovite-plagioclase-quartz-graphite, with rare needles of fibrolitic sillimanite in only one sample (LOZ1). Andalusite was never observed throughout the aureole. Cordierite is the most prominent mineral in the hornfelses and forms sector twinned crystals <0.5 mm (Figure 1) and/or dendritic porphyroblasts reaching 2 cm. Its abundance affects the reactive bulk composition of the hornfelses and explains the presence of K-feldspar rather than Al_2SiO_5 associated with muscovite and quartz.

Thermometry based on Raman spectroscopy of carbonaceous materials (RSCM) on sample LOZ1 provided ~610-620 °C as maximum temperature recorded at the intrusive contact.

The thermodynamic modelling of the same sample in the TiNCKFMASH system and in the presence of graphite failed at predicting a stability field for the mineral assemblage (Kfs-Crd-Bt-Ms-Pl-Qz-Sil-Gr) observed in all samples. Conversely, calculated assemblages predict a wide *P-T* region of stability of Al_2SiO_5-bearing assemblages before the Ms+Qz breakdown, and K-feldspar only after it. This discrepancy is probably due to uncertainties in the thermodynamic properties and solution models for cordierite, which plays a major role in the studied rocks.

The *P-T* conditions recorded by LOZ1 were thus constrained by an alternative bathograd-like approach, considering phase relationships in the simplified KNASH-C system (Figure 2). In order to form sillimanite only as product of the incomplete Ms-Qz breakdown - divariant for the presence of Na in Ms and Kfs and shifted to lower T due to the presence of graphite - an isobaric path typical of contact metamophism must have crossed above the Ms_{ss}-Qz-Kfs_{ss}-Sil-And-fluid invariant point, i.e., at P>3.3 kbar. The same univariant point also constrains the minimum temperature at the intrusive contact, which was >615-620 °C.

Assuming an average crust density of 2.7 g cm^{-3}, the estimated pressure corresponds to a minimum paleo-depth of emplacement of 12.2 km.