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Protracted shearing at mid crustal conditions in the Scandinavian Caledonides

Francesco Giuntoli (1), Luca Menegon (1), Clare Warren (2), James Darling (3), and Mark Anderson (1)

(1) School of Geography, Earth and Environmental Sciences, Geology, Plymouth University, Plymouth, United Kingdom, (2) Department of Environment, Earth and Ecosystems, Centre for Earth, Planetary, Space and Astronomical Research (CEPSAR), The Open University, Milton Keynes, United Kingdom, (3) School of Earth and Environmental Sciences, University of Portsmouth, Portsmouth, United Kingdom

The basal thrusts of mountain belts localize much of the tectonic transport associated with crustal shortening and mountain building processes. These are often the results of protracted shearing from higher to lower metamorphic grades, but several open questions remain regarding the timing, the mineralogical behaviour and the rheology of these shear zones.

In the Lower Seve Nappe of the Scandinavian Caledonides (central Sweden), a main mylonitic foliation is visible in the mid-lower portions (from 1.6 to 2.5 km of depth) of the COSC-I drill core and is overprinted by a younger, discrete, brittle-to-ductile fabric.

Amphibole and plagioclase thermobarometry in mafic amphibolites suggests that the mylonitic foliation developed under epidote-amphibolite facies conditions (~600°C, 0.8-1 GPa). EBSD analysis of titanite grains located in pressure shadows indicates that such grains are strain-free and were growing during deformation, probably due to ilmenite destabilization and dissolution and titanite reprecipitation. In-situ LA-ICP-MS U-Pb ages of titanite grains constrain the development of this mylonitic fabric at around 418 ± 9 Ma.

The later brittle-to-ductile fabric is particularly well developed in micaschists as C-type and C'-type shear bands, a few tens of microns wide, that are invariably defined by new grains of chlorite and white mica. Locally, these C and C' planes are extremely sharp and cut the surrounding minerals. Chlorite and white mica thermobarometry highlights that this younger fabric developed at much shallower conditions of 300-400 °C and ~0.3 GPa. Research is ongoing to characterize the deformation mechanisms responsible for this fabric development and the timing of deformation. The results suggest that these fabrics formed due to protracted shearing from epidote amphibolite to greenschist facies conditions during the Scandian collision and, presumably, during the exhumation of the Lower Seve Nappe.