

## **Dissolution-precipitation creep at mid-crustal levels of the Scandian Caledonides: the COSC-1 case study**

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The thermo-mechanical properties of the middle and lower crust exert a fundamental control on the structure of orogenic belts, and on the amount and style of shortening during continental collision. By virtue of the deep erosional level, the internal parts of the Scandinavian Caledonides expose middle and lower crustal sections involved in subduction-exhumation history and nappe stacking. In this study we analysed the development of a mylonitic microstructure and the associated deformation mechanisms in amphibolites from the middle portion (1.5-2.2 km of depth) of the COSC-1 drill core, central Sweden.

Mylonitic amphibolites are common in the drill core. They are composed of hornblende, plagioclase, chlorite, quartz, epidote, carbonate and ilmenite. The plagioclase displays two generations: (1) fractured millimetric porphyroclast cores (Plag1; Ab 99), which are wrapped by the foliation and are dark in the SEM-cathodoluminescence images, and (2) rims (Plag2; Ab 80-90), some tens of microns in size, are bright in the cathodoluminescence images, heal the fractures and overgrow the cores of Plag1. Plag2 grows syn-deformationally, as it is commonly found in strain shadows around Plag1 porphyroclasts.

The hornblende preserves corroded cores (Amp1) with higher Mg number compared to the rims (Amp2). The Amp2 is lengthened as the foliation and shows intergrowths with Plag2 and chlorite in strain shadows. Amphibole crystals are commonly boudinaged parallel to the foliation, with chlorite filling the boudin necks. Preliminary pressure and temperature estimates, using Amp2 and Plag2 pairs, constrain their growth at 600°C and 1GPa.

EBSD analysis indicates a homogeneous orientation of the porphyroclastic Plag1 without the development of low-angle boundaries, suggesting that Plag1 crystals are strain free. Furthermore, the fractures are sealed by the Plag2 with the same crystallographic orientation as the plagioclase core. The Plag2 grains have their [100] axes oriented subparallel to the stretching lineation, but they are also internally strain free. Thus, we interpret the CPO of Plag2 as a result of oriented grain growth during dissolution-precipitation creep.

The enrichment of Ca in Plag2 could reflect either a difference in the PT conditions compared to the growth of Plag1 or a possible metasomatic event characterized by an influx of a Ca-rich fluid, as suggested by the presence of intergranular calcite crystals as well as discrete calcite veins.

The X-ray chemical maps and the EBSD maps suggest that (micro)cracking and dissolution-precipitation creep were responsible for the development of the mylonitic amphibolites, and that crystal plasticity was not a dominant deformation mechanism, although deformation occurred at pressure and temperature conditions at which plagioclase is expected to deform by dislocation creep. In conclusion, in middle crustal levels the presence of water at the grain boundaries enhances chemical reaction and is responsible for deformation through dissolution and precipitation processes that create a strong preferred crystallographic orientation in the newly grown minerals.