The distribution of the H2O content in nominally anhydrous minerals and its effect on shear zone widening (Holsnøy, West-Norway)

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High-grade anorthositic granulites from Holsnøy in the Bergen Arcs (western Norway) were subducted and underwent high pressure (HP) eclogite-facies metamorphism during Caledonian orogeny. They indicate that local eclogitization is linked to an interplay between deformation, fluid infiltration and subsequent fluid-rock interaction. The final result is an interconnected network of hydrous eclogite-facies shear zones surrounded by pristine unreacted granulites. This local transient eclogitization process temporarily weakens the subducting plate and therefore, might have had a strong impact on its deformation.

In a first quantitative study we combined detailed field-mapping with numerical modelling to investigate the evolution of hydrous eclogite-facies shear zones with respect to the regional far-field stress and we discuss the strain partitioning. Although it is supposed that strain localises within the shear zones, we were able to show that widening overcomes the effect of stretching because of the fluid-rock interaction during deformation. The availability of a free fluid phase, which is continuously infiltrating the system, has a strong effect on shear zone widening. The most appropriate effective diffusion coefficient to emulate nature-like structures and hydration front widths by simple, hydro-mechanical numerical models was $10^{-12}$ m$^2$.s$^{-1}$. Our first conclusions suggest that a continuous fluid infiltration seems to be required to reproduce the observed structures. However, a complex model is necessary to understand how the fluid infiltrates and consequently, transforms the granulite adjacent to the shear zone widening.

Mass balance considerations reveal that the eclogitization of the granulite did not result in significant compositional changes, hence the fluid composition was quickly rock buffered. In order to better understand the link between enhancing deformation and fluid-infiltration fronts, we aim to determine the H$_2$O content stored in minerals (including nominally anhydrous minerals, NAMs) perpendicular to the deformation structure from the core of the eclogite-facies shear zone to the macroscopically unaffected granulite. Hydrogen in garnet, pyroxene, plagioclase can significantly weaken the mineral structure, especially when substituting for silica. Additionally, it is crucial to
constrain the amount of H$_2$O needed for the transition from nominally anhydrous to hydrous assemblages. The H$_2$O content was measured using transmission Fourier transform infrared spectroscopy using single points and maps to investigate potential zoning. An entire 20 cm wide transect was investigated, between unaltered granulite and the core of the eclogite-facies shear zone. This study will provide new constraints on the dynamic weakening processes affecting metastable dry and rigid crustal rocks.