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Rehydration reactions and microstructure development in lower crustal granulites from the Bergen Arcs, Norway

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An investigation of the feedbacks generated between lower crust–derived fluids and deformation microstructures formed within retrogressed granulites from the Bergen Arcs on the west coast of Norway will be presented. We hope to assess the role of deformation microstructures in assisting fluid infiltration into nominally impermeable lower crustal rocks, the role of fluids in driving mineral reactions and thus weakening the rock strength, and the interplay between these mechanisms.

Granulite wall–rock adjacent to an amphibolite facies shear zone near Isdal, Norway has been sectioned, texturally mapped using electron backscatter diffraction (EBSD) and chemically mapped using energy dispersive x-ray spectrometry (EDS). The granuilte protolith is made up of a Precambrian anorthosite – gabbro assemblage of plagioclase and coronas of garnet around clinopyroxene. Local alteration of the granulite to eclogite and amphibolite occurred during the Caledonian orogen and has been attributed to the infiltration of fluids during the high strain event (Mukai et al., 2014).

In thin section a thin ($\sim$75 μm) rim of pargasite amphibole can be seen between the garnet and plagioclase, while the rim of amphibole is thicker (600 μm) when between the clinopyroxene and plagioclase. Plagioclase is coarse grained (mms in diameter) and displays prominent growth twins within the undeformed regions of the granulite. However, within a sheared domain of the granulite the grain size has been significantly reduced (max diameter = 74 μm) as has the growth twinning. The plagioclase from the sheared domain also displays a crystallographic preferred orientation (CPO) which does not appear to be inherited from the ‘parent’ grains. Within the strained domain there is also an increase in the reaction of garnet to pargasite, which also displays a strong CPO.

These textural relationships offer the opportunity to study the active mechanisms during hydration of the lower crust and evaluate the relationships of solid-state diffusion, dissolution-reprecipitation and dynamic recrystallization with one another.

Mukai, H., Austrheim, H., Putnis, C. V., and Putnis, A., 2014, Textural Evolution of Plagioclase Feldspar across a Shear Zone: Implications for Deformation Mechanism and Rock Strength: Journal of Petrology, v. 55, no. 8, p. 1457-1477.