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Hydrating the Earth's deep, dry crust

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The transformation of dry granulites to wet eclogites and amphibolites in the Bergen Arcs of western Norway a classic locality of deep crustal fluid-catalysed metamorphism and deformation. In this study we will focus on the transition between essentially unreacted dry granulite and its reacted hydrous products, i.e. at the hydration interface. We will assess the role of deformation microstructures in assisting fluid infiltration into nominally impermeable lower crustal rocks, the role and potential sources of fluids in driving mineral reactions and thus weakening the rock strength, and the interplay between these mechanisms. The granuilte protolith consists of a Precambrian anorthosite – gabbro assemblage of plagioclase and coronas of garnet around clinopyroxene. 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. Within the retrogressed granulite sample a reduction in the grain size of the plagioclase can be seen in the shear fabric, this corresponds with the development of a crystal preferred orientation (CPO) and the breakdown of the garnet and/or clinopyroxene to amphibole of pargasite composition. Within the amphibolite facies shear zone the amphibole and epidote have developed a strong CPO aligned with the foliation and lineation of the shear zone, while the CPO of the plagioclase is much weaker. Zircons within the shear zone show a range of recrystallization textures consistent with dynamic recrystallization dominated by dislocation creep and dissolution reprecipitation modication of the zircon crystal structure. The zircons likely developed during high-T metamorphism and were subsequently modified during Caledonian orogenesis.