Evolution of brittle structures in plagioclase-rich rocks at high-grade metamorphic conditions – Linking laboratory results to field observations

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Plagioclase-rich lower crustal granulites exposed on the Lofoten archipelago, N Norway, display pseudotachylytes, reflecting brittle deformation, as well as ductile shear zones, highlighting plastic deformation. Pristine pseudotachylytes often show no or very little difference in mineral assemblage to their host-rocks that exhibit limited, if any, metamorphic alteration. In contrast, host-rock volumes that developed ductile shear zones exhibit significant hydration towards amphibolite or eclogite-facies assemblages within and near the shear zones. We combine experimental laboratory results and observations from the field to characterize the structural evolution of brittle faults in plagioclase-rich rocks at lower crustal conditions. We performed a series of deformation experiments on intact granulite samples at 2.5 GPa confining pressure, a strain rate of $5 \times 10^{-5}$ s$^{-1}$, temperatures of 700 and 900 °C, and total strains of either ~7-8 % or ~33-36 %. Samples were either deformed ‘as-is’, i.e. natural samples without any treatment, or with ~2.5 wt.% H$_2$O added. Striking similarities between the experimental and natural microstructures suggest that the transformation of precursory brittle structures into ductile shear zones at eclogite-facies conditions is most effective when hydrous fluids are available in excess.