Coupled reaction driven deformation, strain softening and CO2 metasomatism in peridotites from the Reinfjord Ultramafic complex, northern Norway

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The Seiland Igneous Province (SIP) ultramafic rocks in the Reinfjord intrusion is cut locally by narrow (mm-cm) thick shearzones, containing extremely fine-grained material with a distinct shape-preferred orientation. Offset off dykes across numerous micro-faults are documented in field images in areas close to the major fault zone cutting through the area. Mineralogical changes occurs in relation to the shear zones, with increase opx and introduction of dolomite and decrease in olivine and clinopyroxene due to the reaction:

Olivine + Clinopyroxene + CO_2 = Dolomite + Orthopyroxene

As evidenced by coronas of orthopyroxene and dolomite between olivine and clinopyroxene in the shearzones. In addition large olivine grains proximal to the shearzones show a microstructure with subgrain walls decorated by rounded grains of dolomite and more irregular and elongated grains of orthopyroxene. Local variations in the opx/dolomite ratio suggest at least some material transport within the shearzone.

The shearzones thus gives a unique view into CO_2-Metasomatism of the lower crust, but also perhaps could provide a proxy for the pressure during late stage solidification or post solidification of the magma-chamber of the SIP, something which is only available from pressure estimates of the surrounding metasediments obtained by geothermobarometry on mineral assemblages sensitive to resetting at such elevated temperatures. Moreover the shearzones provide a unique insight into the interplay between CO_2-metasomatism and reaction accommodated strain softening. Experiments has shown how CO_2 can influence the flow laws of olivine by imposing a brittle and more localised type of deformation (Rowettta and Blasic, 1987). This is also confirmed by fractures extending into large olivine grains proximal to the shearzones.

References:

Rowettta and Blasic (1987): Microfracture and crack healing in experimentally deformed peridotite. JGR, VOL. 92, NO. B12, pages 12,902-12,910