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A fossil venting system in the Feragen Ultramafic Body, Norway?

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Carbonation of ultramafic rocks in ophiolites and on the seafloor has recently been the focus of extensive research, as this alteration reaction not only influences the carbon flux between hydro- and lithosphere, but also provides natural analogues for industrial CO_2 sequestration. It is a significant part of the hydrothermal circulation in the oceanic crust, as demonstrated by carbonate precipitation at hydrothermal vents. We provide microstructural and geochemical data from a previously little known ophicarbonate occurrence in the Feragen Ultramafic Body, Sør-Trøndelag, Norway.

Along the northern edge of the Feragen Ultramafic Body, strongly serpentinised peridotites are carbonated. In places, the carbonation took place pervasively, leading to the formation of soapstones consisting mainly of talc and magnesite. More common is the carbonation of serpentinite breccias. Within the clasts, some of the serpentine mesh centres are replaced by magnesite, and, subordinately, dolomite or calcium carbonate. Four types of matrix have been identified in different localities: fine-grained magnesite, coarse-grained calcium carbonate, brucite occurring in large fans (up to 1 mm in diameter), and dolomite. Inclusion trails in the coarse-grained calcium carbonates record botryoidal growth, indicating crystallisation from a fluid in open space, and a hexagonal precursor phase, suggesting that aragonite was replaced by calcite. Brucite-cemented serpentinite breccias occur very locally in two outcrops with a size less than 10 m^2. Many of the brucite fans have a similar arrangement of inclusions, with an area rich in dolomite inclusions in the centre of the brucite crystals, and magnetite inclusions concentrated in the tips. Dolomite as a matrix phase often grows inwards from hexagonal, rectangular, rhomboidal, or irregular pores. Many dolomite grains are probably cast pseudomorphs after (calcitised) aragonite. Some carbonate crystals are crosscut or replaced by serpentine.

The carbonated serpentinites are discordantly overlain by carbonate-cemented ultramafic conglomerates. The clasts comprise variably serpentinised and carbonated peridotites as well as some fine-grained magnesite. The matrix phase is dominantly dolomite.

Oxygen isotopes ratios record significantly lower temperatures for the cementation of the conglomerates than for the underlying *in situ* carbonated serpentinites and the carbonated ultramafic clasts in the conglomerate.

The ophicarbonates in the Feragen Ultramafic Body record strong variations in fluid chemistry and/or pressure and temperature conditions, both spatially and temporally. The occurrence of different carbonate minerals in close proximity indicates heterogeneous alteration conditions and focussed fluid flow. Inclusions and replacement reactions record fluctuating alteration conditions.

While the formation of magnesite is consistent with a fluid influenced by the dissolution of serpentinite, the growth of calcium carbonate and particularly of brucite may indicate a special fluid formed by the mixing of serpentinising fluids and seawater, as observed at hydrothermal venting systems.