

The first evidences for an early UHT granulite facies metamorphic episode in the Bamble sector

Jan Kihle

Two new discoveries, spaced some 23 km apart, of the rare Ultrahigh Temperature (UHT) Granulite facies metapelitic assemblage garnet-corundum have been made in the Bamble area. The Bamble metamorphic sector has thus the second European garnet-corundum localities, and the very first European occurrences of apparently coexisting garnet-corundum-quartz assemblages, known to occur at less than 10 localities worldwide.

Locality #1 Hisøy

An Al-rich, SiO₂-deficient sapphirine-garnet-bearing rock occurs as a metapelitic boudin within granulite facies Proterozoic charnockitic gneisses and migmatites on the island of Hisøy, Bamble Sector, SE Norway. The boudin is made up of peraluminous sapphirine, garnet, corundum, spinel, orthopyroxene, sillimanite, cordierite, staurolite and biotite in a variety of assemblages. Thermobarometric calculations based on coexisting sapphirine-spinel, garnet-corundum-spinel-sillimanite, sapphirine-orthopyroxene, and garnet-orthopyroxene indicate peak-metamorphic conditions near to 930 °C at 10 kbar. Corundum occurs as single 200 to 3000 micron sized skeletal crystal intergrowths in cores of optically continuous pristine garnet porphyroblasts. Quartz occurs as 5–60 micron-sized euhedral to lobate inclusions in the corundum where it is in direct contact with the corundum with no evidence of a reaction texture. Some crystal inclusions exhibit growth zoning, which indicates that textural equilibrium was achieved. Electron Back-Scatter Diffraction (EBSD) studies reveal that the quartz inclusions share a common c-axis with the host corundum crystal. The origin of the quartz inclusions in corundum is enigmatic as recent experimental studies have confirmed the instability of quartz-corundum over geologically realistic P–T ranges. The combined EBSD and textural observations suggest the presence of a former silica-bearing proto-corundum, which underwent exsolution during post-peak-metamorphic uplift and cooling. Exsolution of quartz in corundum is probably confined to fluid-absent conditions where phase transitions by coupled dissolution-precipitation mechanisms are prevented.

Locality #2 Bøylefoss

Cores in garnet porphyroblasts from a retrograded garnet-orthopyroxene-cordierite-gedrite rock are found to contain inclusions of corundum, the corundum itself capsuling multiple inclusions of quartz (and spinel) similar to those observed from Hisøy. The rock at Bøylefoss represents one of several small metamorphic islets of granulites still surviving far outside the classical Bamble granulite facies/amphibolite facies boundary.

Most likely more remainders of this first(?) high-grade metamorphic episode will be discovered in Bamble over the next years, if samples are carefully selected and thoroughly studied, and hence shed light upon a possibly earlier event than hitherto radiometrically established.