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Pyroxene microstructures in eclogite from UHP domains and an interjacent area, Western Gneiss Region, Norway

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The Western Gneiss Region (WGR) in W Norway exposes ultrahigh pressure (UHP) metamorphic eclogite of Scandian age in domains that are spatially separated from one another for unknown reasons. We studied five eclogites from the two northern UHP domains and the area in between (at the localities Årsetneset, Fjørtoftvika, Riksheim, Synes, Ulsteinvik) for petrography, mineral chemistry and by Raman spectroscopy. The peak metamorphic mineral assemblages contain garnet, Na-pyroxene (jadeite 0.13–0.46) and – depending on the sample – rutile, ilmenite, quartz, kyanite and/or orthopyroxene. Depending on strain accumulation, the eclogite facies fabric is poikiloblastic or has a foliation formed by elongated grains and grain aggregates of Na-pyroxene and garnet. Secondary processes formed amphibole, biotite and symplectite of plagioclase and diopside. Irrespectively, all samples contain Na-pyroxene with needle-shaped inclusions that are in parallel to the presumed c-axis of the host. These needles are either bi-mineralic (quartz + pargasite) or monomineralic (quartz). Chemically integrated compositions obtained at mineral surfaces with needle exposure using a scanning electron beam yielded lower Ca-Tschermak's and higher Ca-Eskola components than the host. The molar ratios of these calculated endmembers are consistent with the needles being formed by the reaction: 2 Ca-Eskola = Ca-Tschermak's + 3 quartz. If Ca-Eskola is regarded to be typical for UHP metamorphism, then the spatial distribution of eclogite with quartz needles does not support a separation of the two northern UHP domains by the interjacent area.

Garnet has minor compositional zoning with smooth gradients at grain rims. Mineral core compositions of garnet and needle-bearing Na-pyroxene suggest minimum metamorphic conditions after needle formation in the ranges of 700-790 °C and 1.0-1.6 GPa, when the calibrations of the Fe–Mg geothermometer of Krogh Ravna (2000) and the jadeite + quartz geobarometer of Carswell & Harley (1990) are applied. Subsequent retrogression partially transformed quartz needles into albite needles with irregular outline in two of the samples (Riksheim, Ulsteinvik) at the expense of jadeite in the proximal host. Rare associated needles of cristobalite and an unknown phase with albite chemistry in these two southernly samples, perhaps as a result of retrogression, were not observed in the three northernly samples. Hence, the evolution of the pyroxene microstructures after formation allows to investigate spatial differences in the retrogression history.

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