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Early retrogression of eclogite in HP and UHP domains, Western Gneiss Region, Norway

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An exhumed subduction zone in W Norway exposes eclogite in domains of high pressure (HP) and ultrahigh pressure (UHP) metamorphism that alternate without evidence for being separated from one another by tectonic shear or ductile flow [1, 2]. We studied nine eclogites from two UHP domains and the interjacent HP area in the Storfjord–Moldefjord region for mineral chemistry and microstructures and found the following features:

(1) Eclogites from HP and UHP domains share a low Al_2O_3 content in orthopyroxene, 0.17–0.26 wt%, provided its grain size exceeds 0.5 mm and its grain boundaries were unaffected by partial recrystallisation or replacement by secondary minerals. Classical geothermobarometry suggests metamorphic conditions of 4.4–5.2 GPa and 795–855 °C for these samples.

(2) Orthopyroxene-free eclogites from HP and UHP domains frequently have primary clinopyroxene with parallel inclusions of needle-shaped quartz ± pargasite, which are absent in secondary (symplectic) clinopyroxene. Chemical integration of mineral surfaces with needle exposure using a scanning electron beam yielded non-stoichiometric compositions that calculate to higher Ca-Eskola and lower Ca-Tschermak's components than the host. The molar ratios of these endmembers are consistent with the needles being formed by the reaction: 2 Ca-Eskola = Ca-Tschermak's + 3 quartz.

(3) An orthopyroxene-free HP eclogite without quartz needles has clinopyroxene with inclusions of lamellar albite. Chemical integration also yielded non-stoichiometric compositions. Calculated endmembers suggest that the inclusions formed by the reaction: 2 Ca-Eskola + 3 jadeite = Ca-Tschermak's + 3 albite.

(4) Further retrogression of eclogite from HP and UHP domains partially transformed needle-shaped quartz to irregularly shaped albite within clinopyroxene by the reaction: quartz + jadeite = albite (Figure 1).

These observations argue that HP and UHP domains contain individual eclogite bodies that share a retrogression history from the stability fields of diamond and Ca-Eskola to that of quartz. Therefore, the spatial distinction between the studied HP and UHP domains unlikely reflects differences in former peak metamorphic conditions rather than factors that cause a variable efficiency of eclogite retrogression, e.g. by a channelled subduction zone fluid flow.

[1] Spencer *et al.* (2013), *Chemical Geology* 341, 84-101.

[2] Young (2018), *GSA Bulletin* 130, 926-940.

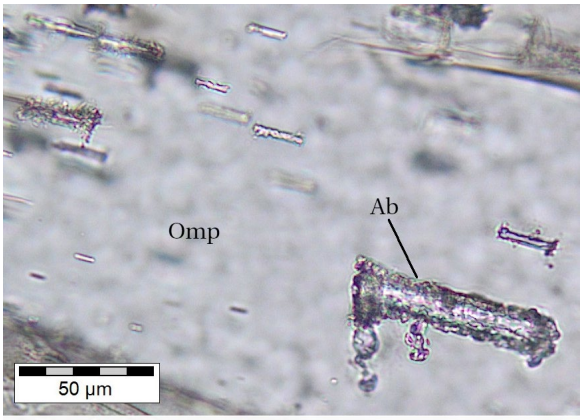

Figure 1: Albite (Ab) replaced former quartz needles in clinopyroxene (Omp), Ulsteinvik UHP eclogite, PPL.