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Deformation and reaction fabrics in eclogites from the Western Gneiss Region (Norway) - evidence of dehydration reactions attributed to episodic deformation

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The eclogites from Vårdalneset, Western Gneiss Region, Norway, show an exceptional large variety of reaction and deformation microfabrics that document the processes and conditions during burial and exhumation. Coarse grained eclogites comprise about 35% omphacite, 25% garnet and 20% amphibole with various amounts of white mica, zoisite, kyanite, rutile, zircon and pyrite. Their fabric is characterized by few mm long and several hundred µm wide amphibole and omphacite grains aligned in the foliation plane with zoned garnet porphyroblasts up to several mm in diameter. In contrast, finer-grained mylonitic eclogites with grain diameters of few hundred µm comprise systematically higher amounts of garnet (45%) and omphacite (35%) and generally less amphibole (< 5%) but similar amounts of zoisite, white mica, rutile and quartz. In the coarse-grained eclogite, amphibole shows evidence of dislocation creep as indicated by undulatory extinction, subgrains and recrystallized grains in necks of boudinaged coarse amphibole layers as well as in contact to garnet. The large garnet porphyroblasts generally show a complex zonation with an inclusion-rich Fe-poor and Mg-rich inner core surrounded by a zone with Fe- and Ca-rich patches and a broad Mg-rich, Ca- and Fe-poor rim. Only at contact to coarse amphibole an additional, a few tens of µm thin serrated rim further enriched in Mg can occur. At the direct contact to such serrated Mg-rich rims, amphibole is partly replaced by a fine-grained quartz-kyanite ± rutile aggregate, indicating dehydration reactions of amphibole. Quartz - kyanite ± rutile aggregates are surrounding garnet also in contact to omphacite, zoisite and to other garnet crystals. The microstructures suggest that deformation and dehydration of amphibole are coupled and played an important role during deformation of the eclogites finally leading to the mylonitic eclogites with higher amounts of garnet and omphacite. Deformation is suggested to have triggered the dehydration reaction by a slight and local increase in temperature. Furthermore, deformation provided additional pathways for the escaping fluids along the increased grain and phase boundary area, as indicated by commonly present quartz within interstitials between recrystallized amphibole grains. In all samples, few µm wide amphibole rims replacing garnets document restricted rehydration-reactions at a later stage. The large variety of the deformation and reaction microfabrics exemplarily show that both deformation and metamorphic reactions did not proceed at long-term continuous conditions, but that both are coupled and occurred episodically.