High pressure metamorphism recorded by eclogite-hosting augen gneiss of the Richarddalen Complex, Northwestern Basement Terrane, Svalbard

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The eclogite-hosting felsic and mafic rocks occur within the Richarddalen Complex of northern Spitsbergen. These metaigneous rocks reveal Neoproterozoic protolith ages. The eclogite facies metamorphism has been dated to c. 492 Ma, the age of a leucosome in eclogite inferred to record HP melting on the steep decompression path. Continued exhumation via amphibolite facies conditions occurred at c. 440 Ma (Mazur *et al.,* 2022). The HP metamorphism conditions were estimated to 1.9–2.3 GPa and 690–730°C based on phase equilibria and geothermometry applied to eclogites (Elvevold *et al.,* 2014 and our unpublished data). The eclogite-hosting augen gneiss at Rabotdalen is dominated by K-feldspar-I, plagioclase and garnet-I porphyroblasts embedded in fine grained quartz-dominated matrix. K-feldspar-I includes submicron scale exsolution of albite. The defocused beam microprobe analyses point to its original ternary composition of $Or_{87}Ab_{11}An_{2}$. Plagioclase (currently $Ab_{74}An_{25}Or_{1}$) contains numerous exsolutions of zoisite, which suggests more Ca-rich original composition of the feldspar. Garnet-I is anhedral with locally developed embayments. It is chemically homogenous with composition $Alm_{73}Pyr_{22}Grs_{3}Sps_{2}$. It is rimmed either by an overgrowth or by a corona of individual sub-to-euhedral garnet-II which develops slight zoning from $Alm_{57}Pyr_{22}Grs_{20}Sps_{1}$ in the core to $Alm_{50}Grs_{33}Pyr_{17}Sps_{0}$ in the rim. Garnet-II also forms coronae around clusters dominated by secondary chlorite and titanite, contains inclusions of quartz and is intergrown with rutile. Wreaths of garnet-II are associated with secondary K-feldspar-II ($Or_{93}Ab_{6}An_{1}$). We suggest that the Rabotdalen augen gneiss experienced polymetamorphism with the first event at high temperature (HT) conditions as evidenced by garnet-I chemistry and its embayed grain boundaries, ternary character of K-feldspar and Ca-rich plagioclase. The clusters composed of chlorite+titanite and rimmed by garnet-II, rutile, K-feldspar-II are interpreted as pseudomorphs after primary dark mica and/or cordierite. The eclogite facies assemblage of garnet-II+rutile+zoisite was followed by lower grade formation of K-feldspar-II+chlorite+titanite. The initial HT metamorphism of the Richarddalen Complex may record a Tonian event based on a new Th-U-Pb monazite age of c. 956 Ma that was followed by late Cambrian HP metamorphism and Ordovician-Silurian exhumation through amphibolite-greenschist facies.

Elvevold, S. *et al.*, 2014. Calculated phase equilibria for phengite-bearing eclogites from NW Spitsbergen, Svalbard Caledonides. *Geological Society, London, Special Publications* 390, 385–401.

Mazur *et al.*, 2022. Exhumation of the high-pressure Richarddalen Complex in NW Svalbard – insights from $^{40}Ar/^{39}Ar$ geochronology. *Terra Nova*, 10.1111/ter.12597.