New constraints on the timing of eclogite facies metamorphism of the Richarddalen Complex, Northwestern Basement Terrane, Svalbard

William C. McClelland [1], Karolina Kośmińska[2], Marian Janák[3], Jane A. Gilotti[1], Jarosław Majka[2,4], Iwona Klonowska[2], Stanislaw Mazur[5]

[1] Dept. of Earth and Environmental Sciences, University of Iowa, Iowa City, IA 52242, USA
[2] Faculty of Geology, Geophysics and Environmental Protection, AGH UST, 30-059 Kraków, Poland
[3] Earth Science Institute, Slovak Academy of Sciences, 840 05 Bratislava, Slovakia
[4] Department of Earth Sciences, Uppsala University, SE-752 36 Uppsala, Sweden
[5] Institute of Geological Sciences, Polish Academy of Sciences, 31-002 Kraków, Poland

The Richarddalen Complex in the Northwestern Basement Terrane of Svalbard contains eclogite of uncertain age. Mafic rocks occur as dikes within granitic orthogneiss and larger metagabbro bodies in an assemblage of Tonian orthogneiss and metasedimentary protoliths. We have calculated HP metamorphism at P < 2.3 GPa and T = 690–720 °C for eclogite, followed by retrograde amphibolite facies metamorphism at P = 1.2 GPa (Elvevold *et al.*, 2014). U-Pb dates from granitic orthogneiss have long been interpreted to record the c. 960–980 Ma protolith age of Tonian intrusions. Cryogenian U-Pb zircon ages from eclogite and other mafic rocks have been interpreted as protolith emplacement (Gromet & Gee, 1998) or eclogite facies metamorphism (Koglin *et al.*, 2022). Gromet & Gee (1998) argue for HP metamorphism at c. 455 Ma based on U-Pb analysis of titanite in amphibolite. New analysis of seven samples confirm Tonian and Cryogenian protolith ages for granitic orthogneiss, eclogite, metagabbro and mafic to felsic gneiss exposed in Rabotdalen and Richarddalen that have all experienced HP metamorphism. Zircon from orthogneiss and coronitic gabbro show little evidence for low-U rim growth but have experienced Pb-loss. Zircon from eclogite and metasedimentary units have well developed 1–10-µm-thick, low-U (<1 ppm) rims that are interpreted to record eclogite to post-eclogite facies metamorphic growth. Rim analysis by SIMS and depth-profiling by LA-ICPMS of grains pressed into indium mounts failed to yield consistent results due to extremely low count rates. A 10-cm-thick leucosome within eclogite yielded large euhedral zircon characterized by low U (0.07–0.4 ppm) and Th/U (0.001–0.1) and steep HREE patterns with a moderately negative Eu anomaly. LA-ICPMS analysis using 30 and 150 µm diameter spots and a double-fractionation correction method defined an age of 492 ± 4 Ma (n=35/45; MSWD = 0.9). The leucocratic body is interpreted as a HP melt formed on the steep retrograde path and the best estimate of the timing of HP metamorphism in the Richarddalen Complex.

Elvevold, S., Ravna, E.J., Nasipuri, P., Labrousse, L., 2014. Calculated phase equilibria for phengite-bearing eclogites from NW Spitsbergen, Svalbard Caledonides. *Geological Society, London, Special Publications* 390, 385–401.

Gromet, L.P., Gee, D.G. 1998. An evaluation of the age of high-grade metamorphism in the Caledonides of Biskayerhalvøya. *GFF* 120, 199–208.

Koglin, N., Läufer, A., Piepjohn, K., Gerdes, A., Davis, D.W., Linnemann, U., Estrada, S., 2022. Palaeozoic sedimentation and Caledonian terrane architecture in northwest Svalbard: Indications from U–Pb geochronology and structural analysis. *Journal of the Geological Society*, doi.org/10.1144/jgs2021-053.