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Kyanite eclogite thermobarometry and evidence for thrusting of UHP over HP metamorphic rocks, Nordøyane, Western Gneiss Region, Norway

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ABSTRACT

Quantitative estimates of metamorphic conditions are combined with previously reported structural analysis to develop the thermotectonic evolution of two separate lithotectonic units metamorphosed during the Late Silurian-Early Devonian collision between Baltica and Laurentia. A structurally higher plate, regionally correlated with the Blåhø Nappe, contains kyanite eclogites associated with microdiamond-bearing kyanite-garnet-graphite gneiss on the north coast of Fjørtoft and correlated with kyanite eclogites at Nogva, Flemsøya. The kyanite eclogites, containing the assemblage kyanite-garnet-omphacite-coesite (now polycrystalline quartz pseudomorphs) ± zoisite ± phengite, yield conditions of 820 °C and 34–39 kbar at Fjørtoft and of 820 °C and 30–36 kbar at Nogva, best characterized by two recently recalibrated geothermobarometers. The conditions at Fjørtoft overlap the diamond-graphite phase boundary and represent the first quantitative petrologic determination of UHP diamond-forming conditions in crustal rocks outside the Dabie Mountains, China and the Kokchetav Massif, Kazahkstan. In a structurally lower plate, eclogitized mylonite with the assemblage kyanite-garnet-omphacite-quartz-oligoclase, produced from the mid-Proterozoic Haram Gabbro that has intruded diorite country rock, yields 780 °C and 18 kbar. This result agrees with other normal HP estimates by Mørk (1985) from partially to completely eclogitized gabbro in the same unit on Flemsøya. We propose that the UHP plate reached a maximum depth of 125 km and then experienced 65 km of exhumation during top-southeast thrusting that brought it into contact with the HP plate. Following this, both plates were exhumed together until reaching a depth of 37 km where they experienced extensive amphibolite-facies re-equilibration and top-west or left-lateral shearing. Temporal details of these histories were determined by monazite U-Th-Pb geochronology described in a companion paper.