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Early Neoproterozoic (c. 1000-960 Ma) sedimentation and magmatism in northern Scotland: constraints on tectonothermal events within the peri-Rodinian Valhalla Orogen

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A new synthesis for the evolution of Rodinia suggests that an early to mid-Neoproterozoic accretionary orogen ('Valhalla orogen') developed along the northeastern margin of Laurentia following the subduction of internal oceans during supercontinent amalgamation. Interpretation of tectono-metamorphic events within this area is complex because all the rock units that record Neoproterozoic orogenesis in this region were later strongly reworked during the Ordovician-Silurian Caledonian orogeny. At least two discrete cycles of early to mid-Neoproterozoic sedimentation and tectonic activity have been proposed, although the age and tectonic affinities of many metasedimentary units are still uncertain. New isotopic data has been obtained from two Laurentian sucessions: the metasedimentary Yell Sound Group (Shetland Islands, northern Scotland), and the Naver nappe (part of the early Neoproterozoic Moine Supergroup, mainland Scotland). U-Pb (SIMS) data obtained from detrital zircon grains places an upper limit of c. 1020-1005 Ma on the sedimentation of these units. A lower limit is represented by U-Pb zircon ages of c. 960-965 Ma obtained from intrusive metagranites in the Yell Sound Group and Naver nappe. Concordant sheets of amphibolite present in both successions are thought to have been emplaced at the same time as the protoliths of the metagranites. The amphibolites have chemical affinities with arc basalts, supporting a location near to an active plate margin along the periphery of Rodinia. The Yell Sound Group and Naver nappe successions are lithologically and temporally comparable with other Laurentian units, including the Krummedal Succession (East Greenland), the Sværholt Succession (north Norway) and the Northwestern Terrane of Svalbard (the latter also containing c. 960 Ma granitoids). Subduction-related magmatism of this age had previously been reported only within the Sværholt Succession and the Eastern Terrane of Svalbard, but now appears to extend into northern Scotland. The new data therefore lend support to the concept of an early Neoproterozoic accretionary orogen that developed along the margin of this sector of Rodinia.