



## **Grenville Foreland basin sedimentation in Scotland: structure, stratigraphy and sedimentology of the early Neoproterozoic Torridon and Morar group sequences**

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The Grenville Orogen was pivotal in the amalgamation of the Rodinia Supercontinent and resulted from the continent-continent collision between Baltica-Laurentia and Amazonia. Detrital zircon geochronology has shown a number of earliest Neoproterozoic (c. 1000 – 960 Ma) successions in Arctic Canada, East Greenland, Svalbard and Norway to be sourced from the Grenville Orogen. One of the most complete and most proximal of those occurs in Scotland, represented by the Torridon and (metamorphosed) Morar groups. Structural restoration of later Caledonian and Knoydartian deformation shows that the preserved part of this foreland basin measured at least 250 x 250 km with a minimal stratigraphic thickness of 6-9 km. Following several years of structural, stratigraphic and sedimentological research, the following depositional evolution can now be reconstructed:

- 1) an initial progradational episode marked by coarse, fluvial braidplain mollasse-type sediments deposited directly on basement and orogen-parallel (eastward) palaeocurrents (Applecross Fm of the Torridon Gp; Lower Altnaharra Fm of the Morar Gp);
- 2) a switch to orogen-normal palaeocurrents (northward) concomitant with a transgression from fluvial (Aultbea Fm of the Torridon Gp; Upper Altnaharra Fm of the Morar Gp) to tidally influenced distal fluvial and shallow-marine sand deposits (lower and upper Glascarnoch Fm, resp., of the Morar Gp) and then to finer-grained, deeper-marine sediments (Vaich Pelite Fm of the Morar Gp); and
- 3) a brief return to fluvial-deltaic deposition before resuming the shallow-marine transgressive trend (contained in the Crom Fm of the Morar Gp) into very fine-grained deep-marine deposits (Dibiedale Fm of the Morar Gp).

Given the tectonic stability of the underlying Archaean cratonic basement and the absence of evidence for rifting, we interpret this depositional pattern to be primarily caused by fluctuations in sediment flux due to changes in the uplift rate within the Grenville Orogen. Both Scottish and Canadian Grenvillean eclogites underwent retrogression and exhumation shortly after 1000 Ma; in the fringing foreland basin this is coincident with the initial progradational phase. Reduction in uplift rate (exhumation) associated with decreasing erosion resulted in overall lowering (albeit fluctuating) of sediment flux and onset of the transgressive phase.

The marine part of the basin may represent an inland branch of the newly proposed Asgard Sea between Laurentia and Baltica. We speculate that detritus of the Krummedal and Krossfjord sequences in East Greenland and Svalbard travelled via this branch from the Scottish part of the basin. The Torridon-Morar sequence thus represents a transition between a Grenville foreland basin *sensu-stricto* and an associated marine basin, stretching away from the orogen.