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A complete sedimentological transect of the early Neoproterozoic Morar Group in northern Scotland: reappraisal of the basin and tectonic setting

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The early Neoproterozoic Morar Group in northern Scotland forms the lower part of the Moine Supergroup, deformed and metamorphosed within the Precambrian Knoydartian and Lower Palaeozoic orogenies. It has remained uncertain whether it was deposited in a shallow-marine 'failed rift' basin within Rodinia or a foreland basin on the margin of the Grenville orogen, which is important to determine for tectonic reconstructions. In this context, we assess the sedimentology across a complete transect of the lower and middle Morar Group in northern Scotland, to assess systematically for the first time the depositional environment(s) and tectonic setting. Detailed sedimentological analysis is possible in areas of low tectonic strain in the lower and middle parts of the Morar Group (Krabbendam et al. 2011), and the complete succession of facies over ca. 4-6 km stratigraphy as exposed in northern Scotland is from: medial-distal fluvial braidplain deposition in the lower Morar Group; to, predominantly, tidally influenced shallow-marine deposition within the middle Morar Group. Six lithofacies are identified in the stratigraphic succession (LF) from: fining-upward sequences of amalgamated and multi-storey sets of trough cross-bedded psammite (metre-scale), characteristic of medium-energy braidplain deposition, in LF1; to, coarsening-upward sequences of rhythmically interbedded psammite and pelite units with bundles of bidirectional wave-ripple sets, characteristic of tidally influenced shallow marine, in LF6.

Overall, the lower and middle parts of the Morar Group represent a transgressive stratigraphic succession, in which there is both an upward and eastward predominance of finer and more complex shallow-marine facies, and a concomitant loss of fluvial facies. Superimposed on this trend are shorter-scale transgressive-regressive facies cycles (ca. 1-2 km thick) which reflect gradual changes in accommodation space in the Morar basin. Most of the lower and middle Morar Group was deposited in environments close to, or within, a shallow marine palaeo-shoreline setting in the Morar basin. Palaeoflow develops from unimodal NNE-ENE directed flow at the base of the exposed lower Morar Group, to broadly bimodal NW-SE flows in the upper middle Morar Group. The facies are inconsistent with a rift basin setting, and the lower and middle Morar Group lack hallmark features of rift basin deposits. Within ca. 4-6 km of stratigraphy: there is no evidence for episodic emplacement of fault-generated detritus; no volcanic input; abrupt lateral and vertical facies changes; and no abrupt changes in paleoflow. We suggest, instead, that the lower and middle Morar Group were deposited in a transition between a foreland basin to the Grenville orogen and a marine basin associated with the Asgard Sea between Baltica and Laurentia.

Reference:

Krabbendam, M., Strachan, R. A., Leslie, A. G., Goodenough, K. M. and Bonsor, H. C. (2011) The internal structure of the Moine Nappe Complex and the stratigraphy of the Morar Group in the Fannichs – Beinn Dearg area, NW Highlands, *Scottish Journal of Geology*.