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# Where the Caledonides crosses the Grenville: The Grenvillian Glenelg Inlier as an allochthonous pip within a fold-nappe complex in the Scottish Caledonides

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The Grenvillian (1100 – 990 Ma) and Caledonian (470-420 Ma) orogenies represent pivotal tectonic events in the evolution of Laurentia and Baltica. Significantly, these two orogenic belts lie at a high angle to one another, with an inferred intersection in NW Scotland. This relationship is most readily examined at the Glenelg Inlier of NW Scotland, a basement gneiss inlier within the Scottish Caledonides nappe pile. This inlier contains a Western Glenelg Inlier, composed of orthogneiss with no record of Grenville metamorphism, and a separate Eastern Glenelg Inlier, comprising both ortho-and paragneisses that experienced Grenvillian eclogite-facies metamorphism. The two components of the Glenelg Inlier are interleaved and/or infolded with locally unconformable, basal Moine Supergroup metasediments, deposited (just) after Grenvillian orogenesis. The inlier and the metasediments are now located in the hanging wall of the well-studied Caledonian Moine Thrust. Despite decades of research and classical structural studies, the overall geometry and structural evolution of the Glenelg Inlier and the surrounding Moine metasediments remain elusive. The synthesis presented here is based upon both new, and hitherto unpublished, mapping.

The Glenelg Inlier and enclosing Moine were deformed by three generations of major ductile fold structures (F1-F3). In areas of medium strain, away from the basement inliers, F2 and F3 large-scale structures face and verge towards the west, and record coaxial interference patterns. In areas of higher strain, F2 fold axes were rotated into parallelism with the (westerly) transport direction. Subsequent refolding of these F2 folds by west-vergent (N-S trending) F3 folds led in some areas to high-angle, non-coaxial fold interference patterns, including dome-and-basin structures. On structural grounds, both F2 and F3 are thought to be of Caledonian age.

An approximate restoration of the F2 and F3 folds reveals the pre-F2 basement-cover architecture of the fold nappe. It demonstrates that Moine metasediments can be separated into an ‘upper limb’ and a ‘lower limb’ of a major F1 isoclinal fold nappe with respect to the gneisses of the Glenelg Inlier. Moine metasediments in the ‘upper limb’ are medium strained with locally well-preserved sedimentary structures. In the ‘lower limb’, regional metamorphism (to sillimanite grade), deformation, and migmatisation are more pervasive. The entire region should thus be seen as a large-scale ductile fold nappe complex covering some 20 x 60 km, comprising three parts:
a) a complex, recumbent anticlinal F1 fold core, the Glenelg Inlier, locally with sheared-out parasitic limbs;
b) an ‘upper limb’ that is relatively low strained, broadly right-way-up and contains a coherent Moine stratigraphy up to 8 km thick;
c) a ‘lower limb’ comprising highly metamorphosed, sheared and partially inverted Moine metasediments.

The entire ductile fold nappe complex was subsequently displaced in the hangingwall of the Moine Thrust. The facing and transport direction, as well as the age (Knoydartian or Caledonian?), of the early F1 fold-nappe complex remain uncertain. The Eastern Glenelg Inlier (with the Grenvillian remnants) is in essence the core of a rootless isoclinal fold, and is thus allochthonous in three dimensions. Consequently, the exact exhumation mechanism of the eclogite-facies Eastern Glenelg Inlier cannot be established.