

Petrology and provenance of the Siluro-Devonian (Old Red Sandstone facies) sedimentary rocks of the Midland Valley, Scotland

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Abstract/Summary

This report describes the composition and provenance of the sedimentary rocks of the Silurian and Devonian sedimentary sequences (Old Red Sandstone facies) of the Midland Valley of Scotland. The work forms part of a multidisciplinary project being undertaken by the British Geological Survey to examine the evolution of the Midland Valley of Scotland. This work is an integral part of the British Geological Survey's Geology and Landscape Northern Britain Programme. Medium- to coarse-grained sandstones were analysed from the Lanark, Stonehaven, Dunnottar- Crawton, Arbutnott-Garvock, Strathmore and Stratheden groups, as well as the Silurian inliers of the southern Midland Valley. Several general observations can be made regarding sandstone composition within central Scotland: (i) there significant differences in sandstone composition between the southern and northern Midland Valley; (ii) a negative correlation exists between the modal proportion of volcanic lithic clasts and monocrystalline quartz, with the increase in quartz reflecting an increase in the compositional maturity of the sandstones; (iii) a positive correlation can be drawn between polycrystalline quartz and monocrystalline quartz within these sandstones; (iv) a negative relationship exists between the variation in the modal volcanic lithic clasts and plagioclase possibly reflecting a decrease in the grain size of the sandstone and/or the period of transport prior to deposition (i.e. maturity); and (v) the covariation in polycrystalline quartz and metamorphic lithic clasts define a positive correlation suggesting that these two components were derived from the same source. The clear discrimination between sandstone formations analysed from the southern and northern Midland Valley suggests that they were derived from two separate source terranes and that, in general, there was little (if any) mixing of detritus. Sandstones of the northern Midland Valley, in general, exhibit a higher metamorphic lithic and polycrystalline quartz contents, with these components having been derived from the Dalradian Supergroup source terrane located immediately to the north of the Strathmore basin. A clear discrimination can be made between the Auchtitench Sandstone Formation (southern Midland Valley) and Gourdon Sandstone Formation (northern Midland Valley) and the remainder of the Silurian and Devonian sandstones. These formations contain a high proportion of plagioclase and volcanic lithics, consistent with the stratigraphical position of these sandstone dominated units immediately above the Duneaton Volcanic (southern Midland Valley) and Tremuda Bay Volcanic (northern Midland Valley) formations. In the northern Midland Valley, the mean sandstone compositional data suggests that there are significant differences between the Stonehaven Group of the Stonehaven district, and the stratigraphically higher Arbutnott-Garvock and Strathmore groups of the Aberfoyle and Strathmore districts. This along strike variation is thought to reflect changes in the geology of the source terrane from southwest to northeast. The preservation of these differences in source terrane geology within the sandstones indicates that along strike mixing of sediment was limited and that the sandstones were deposited relatively close to source. In the southern Midland valley, the sandstones from the Cock Rig, Henshaw, March Wood, Eastgate, Greywacke Conglomerate and Swanshaw Sandstone formations are compositionally similar. Although the deposition of the Greywacke Conglomerate Formation represented a significant change in depositional environment at the base of the Lanark Group, this was not reflected in a major change in sandstone composition. This change occurs at the base of the Auchtitench Sandstone Formation, coinciding with the onset of Lower Devonian volcanism.

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Geology, Stratigraphic -- Devonian, Geology -- Scotland. Publisher. Edinburgh : W. P. Nimmo. Copyright-evidence. Evidence reported by ian white for item oldredsandstoneo00millrich on February 28, 2007: no visible notice of copyright; stated date is 1869. Copyright-evidence-date. 20070228183048. Old Red Sandstone, thick sequence of Devonian rocks (formed from 416 million to 359.2 million years ago) that are continental rather than marine in origin and occur in northwestern Europe, Scandinavia, Greenland, and northeastern Canada. Deposits of Old Red Sandstone have been extensively studied. The rocks were deposited in structural basins between the ranges of the Caledonian Mountains, which were also formed during the Devonian Period when a section of northwestern Europe collided with a landmass made up of parts of present-day North America and Greenland. Thick deposits of sand and mud, 11,000 metres (36,000 feet) deep and often stained red by oxidized iron minerals present, slowly accumulated in these sinking basins.