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The Dalradian rocks of Scotland: an introduction

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ABSTRACT

The Dalradian Supergroup and its basement rocks, together with younger plutons, underpin most of the Grampian Highlands and the islands of the Inner Hebrides between the Highland Boundary and Great Glen faults. The Dalradian is a mid-Neoproterozoic to early-Ordovician sequence of largely clastic metasedimentary rocks, with some volcanic units, which were deformed and metamorphosed to varying degrees during the Early Palaeozoic Caledonian Orogeny.

Sedimentation of the lower parts of the Dalradian Supergroup, possibly commencing about 730 million years ago, took place initially in fault-bounded rift basins, within the supercontinent of Rodinia and adjacent to sectors of continental crust that were later to become the foundations of North America, Greenland and Scandinavia. Later sedimentation reflected increased instability, culminating between 600 and 570 million years ago in continental rupture, volcanicity and the development of the Iapetus Ocean. This left the crustal foundations of Scotland, together with those of North America and Greenland, on a laterally extensive passive margin to the new continent of Laurentia, where turbiditic sedimentation continued for about 85 million years. Later plate movements led to closure of the Iapetus Ocean and the multi-event Caledonian Orogeny. Most of the deformation and metamorphism of the Dalradian strata peaked at about 470 million years ago, during the mid-Ordovician Grampian Event, which has been attributed to the collision of an oceanic arc with Laurentia. The later, mid-Silurian Scandian Event, attributed to the collision of the continent of Baltica with Laurentia and the final closure of the Iapetus Ocean, apparently had little effect on the Dalradian rocks but marked the start of late-orogenic uplift and extensive magmatism in the Grampian Highlands that continued until Early Devonian times.

The Dalradian rocks thus record a wide range of sedimentary environments (alluvial, tidal, deltaic, shallow marine, turbiditic, debris flow) and a complex structural and metamorphic history. In areas of low strain, original sedimentary and volcanic structures are well preserved, even at relatively high metamorphic grades. There is convincing evidence for glacial episodes of worldwide importance and economic deposits of stratiform barium minerals are unique. The Grampian Highlands include two of the World's type-areas for metamorphic zonation, Barrovian and Buchan, with spectacular examples of the key metamorphic minerals, and various stages of migmatite development. Polyphase folding is widespread on all scales and gives rise to a range of associated cleavages and lineations. Regional dislocations, both ductile and brittle, are associated with a range of shear fabrics, breccias, clay gouges and veining.

Contents

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1. Introduction (D. Stephenson)

1.1. The Dalradian Supergroup

The Dalradian Supergroup is a mid-Neoproterozoic to Early Palaeozoic sequence of largely clastic sedimentary rocks, with some notable carbonate and volcanic units that were all deformed and metamorphosed to varying degrees during the mid-Ordovician Grampian Event of the Caledonian Orogeny. The Dalradian rocks, together with Caledonian intrusive igneous rocks, form the bedrock to most of the Grampian Highlands of Scotland and the islands of the Inner Hebrides between the Highland Boundary and