Geology of the Newtonmore–Ben Macdui district : description for sheet 64 (Scotland)

R A Smith, J W Merritt, A G Leslie, M Krabbendam and D Stephenson *Contributors* B C Chacksfield, N R Golledge, E R Phillips

Bibliographical reference: Smith, R A, Merritt, J W, Leslie, A G, Krabbendam, M, and Stephenson, D. 2011. Bedrock and Superficial Geology of the Newtonmore–Ben Macdui district: Description or Sheet 64 (Scotland). British Geological Survey Internal Report, OR/11/055. 122pp.

British Geological Survey Geology and Landscape Open Report OR/11/055

Keyworth, Nottingham: British Geological Survey, 2011

The National Grid and other Ordnance Survey data are used with the permission of the Controller of Her Majesty's Stationery Office. Licence No: 100017897/2011. Keywords Newtonmore, Ben Macdui, geology.

Front cover James Hutton's Locality above Dail-an-Eas Bridge [NN 9388 7467], looking north-east up Glen Tilt whose trend is largely controlled by the Loch Tay Fault. Here Hutton observed granite veins cutting and recrystallising Dalradian metasedimentary rocks and deduced that granite crystallised from a hot liquid. BGS Imagebase P601616.

Foreword

This report, and the 1:50 000 Series geological maps that it describes, is the published product of a programme funded by central Government to improve the understanding of the geology of the UK. The information that these publications provide underpins the exploration of earth-based resources, assessment of natural hazards and ground conditions, and land-use planning. A major part of this report provides comprehensive knowledge and understanding of the geological, geomorphological and environmental changes that have occurred over the past few million years, and which were responsible for the present distribution of superficial deposits and landforms. The Newtonmore and Ben Macdui districts lie within the Cairngorm National Park, which is one of the most popular tourist locations in Britain. This places particular focus on land-use and development decisions within the area, but also enhances opportunities for developing geotourism and academic research. The description of the bedrock geology reviews the earlier published and unpublished work on the area while the Quaternary section is essentially the first comprehensive description of the region.

Acknowledgements

The accompanying bedrock 1:50 000 geological maps were compiled mainly from 1:10 000 and 1:25 000 maps produced by B Beddoe-Stephens, J E Cavill, A Crane, T P Fletcher, S Goodman, M Krabbendam, A G Leslie, S Robertson, C G Smith, M Smith, R A Smith and D Stephenson. In addition information on the Cairngorm Pluton was taken from published work of T N Harrison and information on the Grampian Group lithostratigraphy and sedimentology was taken from the PhD thesis of C J Banks.

The Quaternary geology of the 1:50 000 maps was compiled from 1:10 000 and 1:25 000 maps of the superficial deposits produced mainly by N R Golledge and J W Merritt, with contributions from B Beddoe-Stephens, T Bradwell, J E Merritt, T

P Fletcher, A J Highton, S Robertson, M Smith, R A Smith and D Stephenson.

The first draft of this Sheet Description was written by R A Smith (Bedrock) and J W Merritt (Quaternary), with contributions from N R Golledge, A G Leslie, M Krabbendam and D Stephenson. Information on the concealed geology was provided by B C Chacksfield and on the petrology by E R Phillips. The final draft was prepared by R A Smith and J W Merritt and scientifically edited by N R Golledge and D Stephenson.

Notes

The word ‘district’ is used in this description to refer to the area covered by Sheets 64W (Newtonmore) and 64E (Ben Macdui) of the 1:50 000 geological map of Scotland. The Newtonmore and Ben Macdui maps are published separately, as Bedrock and Superficial Deposits with simplified bedrock editions.

The Newtonmore and Ben Macdui sheets are the western and eastern halves respectively of the area which was formerly covered by Sheet 64 (Kingussie) of the Geological Map of Scotland.

National Grid references in the text are given in the form [NN 951 744] depending on which 100 km square they refer to (NN, NO, NH, or NJ). Numbers proceeded by S or N refer to the Scottish BGS sliced rock/thin section collection held at BGS, Edinburgh.

BGS services and products relating to the district are listed in the Information Sources.

Contents

Foreword

Acknowledgements

Contents

Summary

1 Bedrock geology

1.1 Introduction

1.2 Previous work

1.3 Lithostratigraphy

1.3.1 Glen Banchor Subgroup of the Badenoch Group

1.3.2 Dalradian Supergroup

1.4 Igneous intrusions

1.4.1 Neoproterozoic to Ordovician: pre- and syntectonic intrusions

1.4.2 Caledonian Igneous Supersuite

1.5 Structure and metamorphism

1.5.1 Ductile deformation

1.5.2 Regional metamorphism

1.6 Faulting

1.7 Geophysics

2 The physiography, Cainozoic landscape evolution and Quaternary geology of the district

2.1 Physiography

2.2 Landscape evolution during the Cainozoic era

2.3 The Quaternary record

2.3.1 Pre-Late Devensian events

2.3.2 Late Devensian

2.3.3 The pattern of deglaciation

2.3.4 The Windermere (Lateglacial) Interstadial

2.3.5 The Loch Lomond Stadial

2.3.6 Holocene

2.4 Quaternary geology of the Eastern Grampian Highlands

2.5 Lithostratigraphy of the Newtonmore–Ben Macdui district

2.6 Superficial deposits and Quaternary landforms

2.6.1 Till

2.6.2 Morainic deposits

2.6.3 Glaciofluvial deposits

2.6.4 Glacioclacustrine deposits

2.6.5 Alluvial and organic deposits

2.6.6 Periglacial deposits

2.6.7 Landslide deposits

2.6.8 Features of glacial erosion

2.6.9 Features of glaciofluvial erosion

3 Applied geology

3.1 Mineral resources, quarrying and mining

3.1.1 Mineralisation

3.1.2 Road stone, building stone, sand and gravel, clay

3.1.3 Peat

3.2 Groundwater/aquifers

3.3 Geology, planning, hazards and heritage

3.3.1 Geological heritage and geodiversity

4 Information sources

4.1 BGS maps

4.2 BGS books

4.3 BGS documentary collections

4.4 BGS material collections

References

Summary

This report provides an account of the geology of the Newtonmore–Ben Macdui district in the Grampian Highlands of Scotland, which extends from the Cairngorm massif in the north-east, west across to the Upper Spey valley and south into the upper parts of Glen Tilt and Glen Fearnach. The district is nearly all remote countryside with steep-sided glens between upland plateaus with relatively few distinct mountain peaks. The entire area lies within the Cairngorm National Park and much of the land is covered by large estates run for game conservation and recreational sports.

The bulk of the rocks are metasedimentary and most of these are assigned to the Neoproterozoic Dalradian Supergroup (Figure 1). In the north-west near Newtonmore, a ridge or ‘palaeohigh’ of older metasedimentary rocks, the Glen Banchor Subgroup, is considered to lie below the Dalradian. The Dalradian Supergroup forms a thick succession of originally clastic, carbonate and pelitic rocks. Much of the latter is graphitic and pelagic in origin. The metasedimentary rocks were intruded by relatively minor basic igneous and granitic bodies as the Rodinian palaeocontinent broke up.

At about 470 Ma the Laurentian continental margin collided with an island arc causing the Grampian Event of the Caledonian Orogeny. The orogeny is mainly manifest in four deformation phases which included early large nappe-like folds, ductile shear-zones and prograde Barrovian regional metamorphism. Most of the rocks in this district lie within the kyanite zone but, because most of the rocks are siliceous, this index mineral is scarce. Semipelitic rocks are locally migmatitic. The earlier Precambrian metamorphism in the Glen Banchor Subgroup is overprinted by the Grampian metamorphism.

In Siluro-Devonian time (Caledonian), the Cairngorm and Glen Tilt plutons were emplaced within the nappe pile together with other minor silicic to basic igneous intrusions of similar age. Where country rock composition was suitable, contact metamorphic aureoles are observed adjacent to the large intrusions. The region continued to be uplifted and cut by late-Caledonian to Carboniferous faulting. Several major faults, such as the Loch Tay Fault, cross the district on NE- to NNE trends and have overall sinistral displacements.

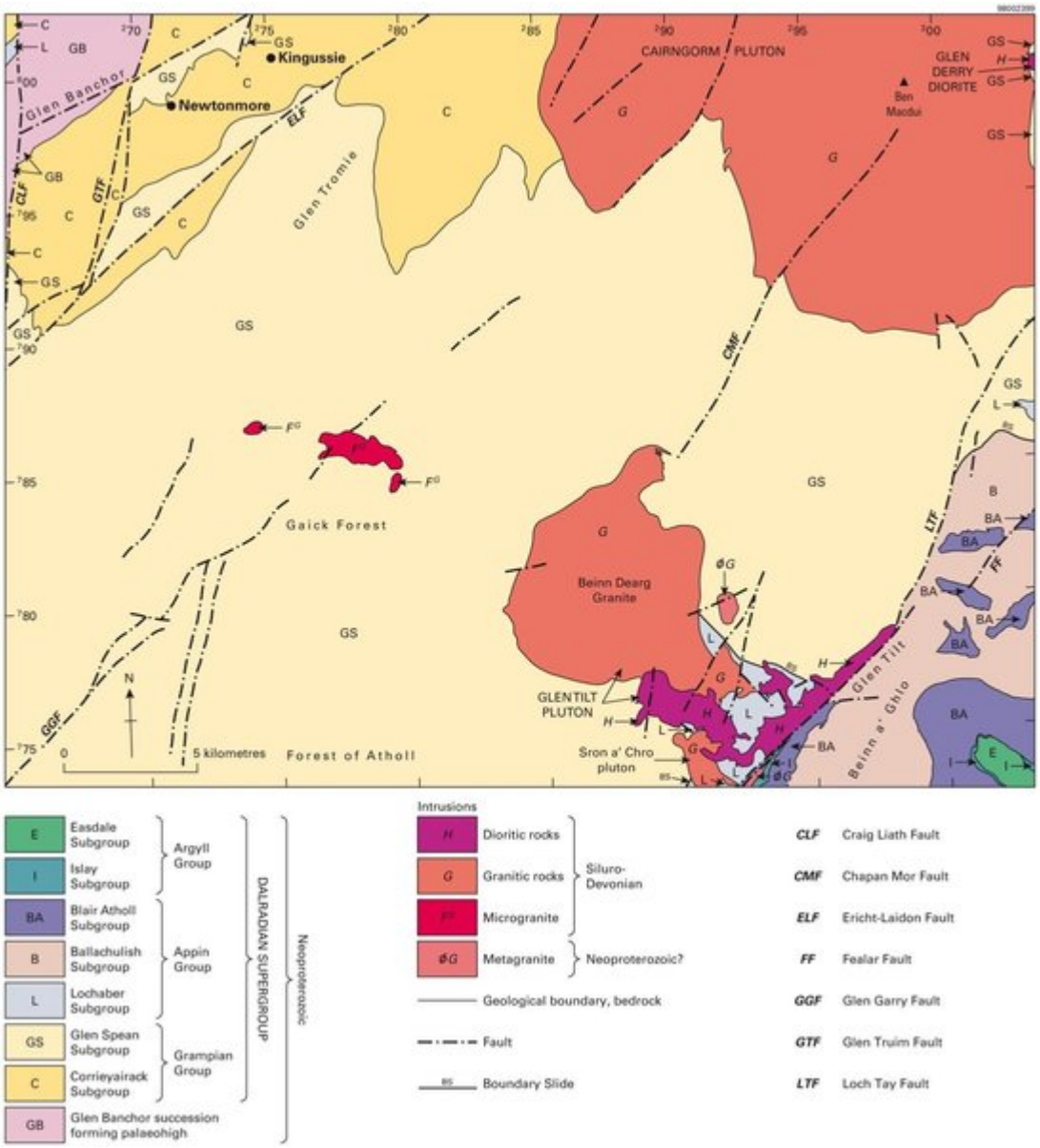
The geological record during the Tertiary (Palaeogene and Neogene periods) is largely one of slow landscape evolution by subaerial erosion, intermittent regional uplift and the development of deep weathering profiles. The Paleocene Epoch was marked by considerable volcanic activity along the western seaboard of Scotland. Uplift of as much as 1.5 km was associated with this event, causing an eastward tilting of peneplains formed during the Late Cretaceous and earlier. Some valleys in the district, such as the Dee-Geldie Water and Tarf Water, may have first become established on these tilted peneplains. A warm, humid climate prevailed until the late Miocene, during which time the effects of chemical weathering penetrated deeply below the land surface forming clayey saprolites, pockets of which remain in the district. Mechanical weathering became increasingly intense during the Pliocene and early Pleistocene epochs as the climate deteriorated and granular disintegration occurred.

During the Quaternary Period (i.e. the last 2.6 million years) the Scottish mainland has experienced numerous glacial episodes, but only the last widespread glaciation, the Main Late Devensian (MLD), has left an appreciable sedimentary record. Many geomorphological features, however, such as the Lairig Ghru, have clearly evolved during several glacial episodes. The MLD glaciation began between 32 and 28 ka before present day (BP), when the region became overwhelmed entirely by ice. There is growing evidence from north-west Europe that the Last Glacial Maximum (LGM) occurred relatively early in the Late Devensian, before 22 ka BP. A period of glacial retreat followed before significant readvances occurred after 18.4 ka BP, particularly involving coastal ice streams and possibly including a readvance in the Cairngorms.

Deglaciation commenced in a cold, arid environment and parts of the Cairngorms probably witnessed several thousand years of ice-free, periglacial conditions before the onset of rapid warming at about 14.7 ka BP, the beginning of the Windermere (Lateglacial) Interstadial (WI). The abrupt amelioration in climate occurred when temperate waters of the Gulf Stream returned to the sea off the western coasts of the British Isles. River terraces and alluvial fans formed across the district by paraglacial processes, sweeping away loose glacial debris before soils became stabilized by vegetation. An oscillatory climatic deterioration occurred during the WI and it is likely that glaciers had already started to build up in the mountains before more sustained cooling began at about 12.9 ka BP, at the start of the Loch Lomond Stadial (LLS) (Younger Dryas). Glaciers undoubtedly existed in the district during the LLS, but controversy remains as to their extent and whether any remnants of the MLD ice sheet survived during the WI.

The Holocene began abruptly at about 11.7 ka BP when the warm Gulf Stream current became re-established, providing an ameliorating influence on the climate of the British Isles. Intense erosion would have occurred at first on the bare ground before vegetation became established and soils developed. At first braided rivers flowing across gravelly floodplains were common, but they later stabilised into the mainly single-thread and locally meandering streams of the present day.

References



(Figure 1) Outline Bedrock Geology of the Newtonmore–Ben Macdui district (Sheet 64W & E)