

Mountain building in Scotland



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Contents

Introduction	5
Learning Outcomes	6
1 Introduction	7
2 Britain's oldest rocks: remnants of Archaean crust	8
3 Orogenies in the Proterozoic	9
4 Continental break up and opening of the Iapetus Ocean	10
5 Arc-continent collision: the Grampian phase of the Caledonian Orogeny	11
6 Exhumation of the Grampian mountains	12
7 Sedimentation and tectonics at a mid-Ordovician to Silurian active margin	13
8 Multiple plate collisions and the end of the Iapetus Ocean	14
9 Sedimentation at the end of the Caledonian Orogeny; Section 10 Legacy	15
Conclusion	16
Keep on learning	17
Acknowledgements	17

Introduction

The course gives a brief outline of the geological history of the Scottish Highlands. It offers the opportunity to study igneous, metamorphic and structurally complex rocks, indicating their natural settings in Scotland: the deformed rocks of the Dalradian basin, the Caledonian granites, and the Highland Border Complex. The materials are presented as a series of PDFs. Each file represents a section of the book. If you wish to purchase a copy of *Mountain building in Scotland* please contact [Open University Worldwide](#).

This OpenLearn course provides a sample of Level 3 study in [Science](#).

Learning Outcomes

After studying this course, you should be able to:

- describe the geological history of the Scottish Highlands
- give examples of igneous, metamorphic and structurally complex rocks.

1 Introduction

The document attached below includes the table of contents and first section of *Mountain building in Scotland*. In this section, you will find the following subsections:

Table of contents

1.1 Setting the scene

1.2 Recognizing ancient mountains

1.3 Orogeny through geological time

1.3.1 Geological time: a brief note

1.3.2 Disentangling the continents

1.4 The collage of ancient orogenic belts in the North Atlantic region

1.5 What caused the Caledonian Orogeny?

1.6 The tectonic map of Britain and Ireland

1.7 The scope of this book

Please click to view '[1 Introduction](#)' (PDF, 14 pages, 850KB).

2 Britain's oldest rocks: remnants of Archaean crust

The document attached below includes the second section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 2.1 Introduction
- 2.2 The Lewisian Complex
 - 2.2.1 The nature, age and origin of the gneiss protoliths
 - 2.2.2 Deformation and high-grade metamorphism
- 2.3 Basement inliers in the Moine Supergroup
- 2.4 Summary of Section 2

Please click to view [‘2 Britain's oldest rocks: remnants of Archaean crust’](#) (PDF, 6 pages, 290KB).

3 Orogenies in the Proterozoic

The document attached below includes the third section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 3.1 Introduction
- 3.2 Palaeoproterozoic rifting, sedimentation and magmatism
- 3.3 The Palaeoproterozoic Laxfordian Orogeny
 - 3.3.1 Assembly of the Lewisian Complex
 - 3.3.2 Formation of Proterozoic crust
- 3.4 Synthesis: the broader view of Palaeoproterozoic events
- 3.5 Mesoproterozoic events
 - 3.5.1 Mesoproterozoic rifting: deposition of the Stoer Group
 - 3.5.2 The Greenville Orogeny
- 3.6 Neoproterozoic events
 - 3.6.1 Early Neoproterozoic continental sedimentation: the Sleat and Torridon Groups
 - 3.6.2 Early Neoproterozoic marine sedimentation: The Moine Supergroup
 - 3.6.3 The Dava and Glen Banchor Successions
 - 3.6.4 Extension-related magmatism
 - 3.6.5 Evidence for a Neoproterozoic (Knoydartian) Orogeny?
- 3.7 Summary of Section 3

Please click to view ['3 Orogenies in the Proterozoic'](#) (PDF, 14 pages, 525KB).

4 Continental break up and opening of the Iapetus Ocean

The document attached below includes the fourth section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 4.1 Introduction
- 4.2 The Dalradian Supergroup
 - 4.2.1 Dalradian sedimentary basins: seeing through metamorphism
 - 4.2.2 Primary rock types and terminology
 - 4.2.3 Lithostratigraphic subdivisions of the Dalradian Supergroup
- 4.3 Dalradian sedimentation and tectonics
- 4.4 Dalradian basin evolution
- 4.5 Age of the Dalradian Supergroup
- 4.6 Cambrian-Ordovician shelf sedimentation in north-west Scotland
- 4.7 Summary of Section 4

Please click to view '[4 Continental break up and opening of the Iapetus Ocean](#)' (PDF, 12 pages, 450KB).

5 Arc-continent collision: the Grampian phase of the Caledonian Orogeny

The document attached below includes the fifth section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 5.1 Introduction
- 5.2 Ocean closure during the Grampian phase
 - 5.2.1 Ophiolites and the evidence for obduction: a Grampian suture zone?
 - 5.2.2 Evidence for an ancient magmatic arc
 - 5.2.3 Evidence for an ancient subduction zone: the Clew Bay Complex
 - 5.2.4 Summary of Section 5.2
- 5.3 Structural development of the Grampian Highlands
 - 5.3.1 Introduction
 - 5.3.2 Structure of the Grampian Highlands
 - 5.3.3 The deformation sequence
 - 5.3.4 Summary of Section 5.3
- 5.4 Metamorphism in the Grampian Highlands
 - 5.4.1 Introduction
 - 5.4.2 The metamorphic map of the Dalradian
 - 5.4.3 The relative timing of porphyroblast growth and deformation
 - 5.4.4 The absolute timing of metamorphic mineral growth
 - 5.4.5 The causes of Grampian metamorphism
 - 5.4.6 A synthesis of Grampian metamorphism
 - 5.4.7 Summary of Section 5.4
- 5.5 Summary of Section 5

Please click to view ‘

[5 Arc-continent collision: the Grampian phase of the Caledonian Orogeny](#)’ (PDF, 26 pages, 1.1MB).

6 Exhumation of the Grampian mountains

The document attached below includes the sixth section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 6.1 Introduction
- 6.2 Uplift and cooling history of the Grampian mountains
- 6.3 Magmatism during exhumation
- 6.4 The record of exhumation in sedimentary basins
- 6.5 Synthesis: time constraints on the Grampian phase
- 6.6 How high were the Grampian mountains?
- 6.7 Summary of Section 6

Please click to view '[6 Exhumation of the Grampian mountains](#)' (PDF, 7 pages, 350KB).

7 Sedimentation and tectonics at a mid-Ordovician to Silurian active margin

The document attached below includes the seventh section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 7.1 Introduction
- 7.2 Mid-Ordovician to Silurian sedimentation in the Midland Valley Terrane
 - 7.2.1 Ordovician sedimentation
 - 7.2.2 Silurian sedimentation
 - 7.2.3 Summary of Section 7.2
- 7.3 Sedimentation and tectonics in the Southern Uplands Terrane
 - 7.3.1 Sedimentation
 - 7.3.2 The Southern Uplands as an accretionary prism?
 - 7.3.3 Summary of Section 7.3
- 7.4 Interpretation: regional tectonic framework for the Midland Valley and Southern Uplands
 - 7.4.1 Introduction
 - 7.4.2 What caused a subduction zone reversal?
 - 7.4.3 A missing fore-arc basin?
- 7.5 Summary of Section 7

Please click to view ‘

[7 Sedimentation and tectonics at a mid-Ordovician to Silurian active margin](#)’ (PDF, 6 pages, 180KB).

8 Multiple plate collisions and the end of the Iapetus Ocean

The document attached below includes the eighth section of *Mountain building in Scotland*. In this section, you will find the following subsections:

- 8.1 Introduction
- 8.2 Palaeocontinental reconstructions
 - 8.2.1 The global view
 - 8.2.2 A model for the closure of the Iapetus Ocean
 - 8.2.3 Summary of Section 8.2
- 8.3 Tectonics of the Northern Highlands
 - 8.3.1 Structure and metamorphism of the Northern Highlands
 - 8.3.2 Magmatism and the timing of deformation
 - 8.3.3 Regional implications
 - 8.3.3 Summary of Section 8.3
- 8.4 Silurian-Devonian strike-slip displacements on the Laurentian
 - 8.4.1 Geometry and amount of displacement
 - 8.4.2 Time constraints on fault zone displacements
 - 8.4.3 Sinistral displacements in the Southern Uplands
 - 8.4.4 Summary of Section 8.4
- 8.5 Collision of Eastern Avalonia with the Laurentian margin
 - 8.5.1 The sedimentary record of a far-felt collision
 - 8.5.2 Diachronous collision and terrane linkage
 - 8.5.3 Sediment dispersal and basin shallowing
 - 8.5.3 Where is the Iapetus Suture?
 - 8.5.3 Summary of Section 8.5
- 8.6 Late Silurian to Early Devonian deformation of Eastern Avalonia
 - 8.6.1 The cleavage pattern
 - 8.6.2 Time constraints on cleavage formation and deformation
 - 8.6.3 Summary of Section 8.6
- 8.7 Granite magmatism and convergence
 - 8.7.1 Origin of the Newer Granites
 - 8.7.2 Summary of Section 8.7
- 8.8 Summary of Section 8

Please click to view '[8 Multiple plate collisions and the end of the Iapetus Ocean](#)' (PDF, 17 pages, 590KB).

9 Sedimentation at the end of the Caledonian Orogeny; Section 10 Legacy

The document attached below includes the ninth and tenth sections of *Mountain building in Scotland*, as well as the index. In these sections, you will find the following subsections:

- 9.1 Introduction
- 9.2 The Old Red Sandstone and the Devonian Period
- 9.3 Distribution and stratigraphy of the Late Silurian to Devonian Basins
- 9.4 Sedimentation and tectonics in the Midland Valley
 - 9.4.1 Structure of the Midland Valley in the Devonian Period
 - 9.4.2 Late Silurian–Early Devonian sedimentation
 - 9.4.3 A Mid-Devonian hiatus
 - 9.4.4 Renewed deposition in the Late Devonian
 - 9.4.5 Summary of Section 9.4
- 9.5 Sedimentation and tectonics in the external basins
 - 9.5.1 A southward-migrating mountain front
 - 9.5.2 A short-lived Mid-Devonian ocean basin
 - 9.5.3 Summary of Section 9.5
- 9.6 Orogen-scale drainage and sediment dispersal patterns
- 9.7 Summary of Section 9

10 Legacy

- Acknowledgements
- Index

Please click to view '[9 Sedimentation at the end of the Caledonian Orogeny](#)' and '[Section 10 Legacy](#)' (PDF, 14 pages, 770KB).

Conclusion

This free course provided an introduction to studying Science. It took you through a series of exercises designed to develop your approach to study and learning at a distance and helped to improve your confidence as an independent learner.

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Figures 3.8, 3.14, 4.12, 5.18, 5.20, 5.21 K.A. Jones;

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