Cairngorm Mountains: new views on an old landscape

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The granite mountains of the Cairngorms form a distinctive and internationally important landscape. Two recent studies provide new information to help develop Earth heritage interpretation and site management.

The Cairngorm Mountains make up the largest continuous area of high ground above 1,000m in Britain and include most of the highest summits in Scotland. These mountains, with their distinctive plateau surfaces and glacially sculptured features, became part of Scotland's second National Park in 2003. They are also included in the UK Tentative List of World Heritage Sites for their exceptional landforms and geological history. In particular, the Cairngorms provide unique insights into the processes of mountain landscape evolution and environmental change in a maritime, mid-latitude setting in the northern hemisphere over the last 400 million years.

Geological foundations of a granite landscape

The Cairngorms are underlain by a granite pluton intruded into metasedimentary rocks of the Dalradian Supergroup. This happened about 427 million years ago during the Caledonian Orogeny. Today's landscape reflects the character and structure of the granite bedrock and its subsequent exposure and erosion through geomorphological processes. The properties of the granite, especially jointing and structural weaknesses, have influenced the patterns of weathering, erosion and landscape evolution. The form of the current landscape, although modified by glacial erosion, is essentially an inherited one. This has been investigated in a joint study by the British Geological Survey and Scottish Natural Heritage.

The results of detailed mapping of the jointing and characteristics of the granite show that zones of weakness were produced by hot fluids reacting with the granite as they moved along joints and fractures in the rock. This happened soon after the granite had been intruded.

The major landscape features of the Cairngorms began to form soon after the granite was exposed, around 390-400 million years ago through selective weathering and erosion of weaker rock. Over time, the pre-glacial rivers excavated the precursors of the present glens along the zones of weakness.

During the Neogene and Palaeogene (between about 65 and 2.5 million years ago), episodes of uplift, etching (deep weathering) and stripping of the deeply weathered rock shaped the overall form of the relief into a series of etchplains ('erosion surfaces'), and tor-capped summit domes where the granite is more massive and poorly jointed.

During successive phases of glaciation in the Quaternary, glaciers and ice sheets selectively deepened and extended the pre-glacial glens. This is the first time that the Cairngorms' origins have been directly traced back to when the granite formed.

The new datasets have been compiled by the British Geological Survey in a Geographic Information System (GIS). These will provide the basis for developing novel interpretative materials. In one application, the pre-glacial relief was reconstructed as a digital terrain model and compared with the present relief to show how glacial erosion had changed the area.

Geomorphological heritage and sensitivity

In a complementary study, Scottish Natural Heritage has compiled a GIS-based inventory of landforms in the Cairngorms. The work assesses the Earth heritage of the area not only as a resource for research, education and interpretation, but also for how it supports special habitats and landscape heritage (see boxes).

Evaluating geomorphological sensitivity to human activity is one way of helping to conserve the area's geodiversity and the habitats it supports through sustainable management. By identifying landforms and processes as potentially sensitive to activities such as afforestation, quarrying or river management, the issues can be addressed through practical management.

Relict landforms may be ascribed a degree of vulnerability to damage or destruction from different human activities, expressed in terms of the degree of damage or loss of Earth heritage interest on a scale from 1 (minimal alteration) to 5 (destruction of landforms).

A similar, but more complicated, exercise was developed for active geomorphological systems. This took into account whether the landforming environment was able to recover from particular activities, whether it would be set into a prolonged period of attempted readjustment to the new conditions (for example, changes in slope drainage), or whether the system would ultimately change its nature and not recover its original character. ■

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Above: Tor landscape on Ben Avon.

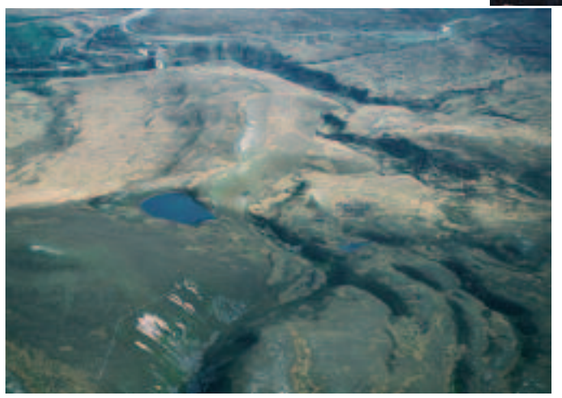
Photo © J.E. Gordon

Right: The Cairngorm Mountains represent a classic landscape of selective glacial erosion. The extensive plateau surfaces with tors have generally been little modified by glacial erosion and contrast sharply with the glacial trough of Glen Avon. This contrast is thought to reflect the former presence of active, fast-flowing glaciers in the glens, whereas the ice covering the plateaux was frozen to the bedrock and relatively inactive.

Photo © P. & A. Macdonald/SNH

Left: Ice-marginal meltwater landforms (meltwater channels and kame terraces) formed in Glen More along the northern flanks of the Cairngorm Mountains during the melting of the Late Devensian ice sheet around 20,000 -15,000 years ago.

Photo © P. & A. Macdonald/SNH



Special habitats and landscapes

The Cairngorms are of great importance for nature conservation. The high-level plateaux are rich areas of montane vegetation, notably for the development of lichen-rich montane heath and the specialised vegetation of snow-beds and springs, which includes many rare species. The detailed mosaic of vegetation communities reflects a close interplay between soils, geomorphology, exposure, snow-lie patterns and microclimate. The lower ground also contains important habitats for birds and the largest areas of native Caledonian pinewoods in Scotland, developed on a range of glacial deposits which provide an intricate topographic and ecological mosaic.

Much of the montane zone is incorporated within Site of Special Interest (SSSI) and National Nature Reserve (NNR) designations. At an international level, a large part of the area qualifies for designation under the European Habitats Directive and the European Birds Directive.

Special mountains

Relict landforms which originated before the ice age are unusual for their scale of development in a glaciated mountain area. They include tors, weathered bedrock and plateau surfaces. These features stand in sharp contrast with the glacial cliffs of the corries, breached watersheds and deeply dissected glens. Together they form an outstanding example of a landscape of selective glacial erosion and show how the erosional effects of the ice-age glaciers were very effective in particular areas but minimal in others due to variations in the basal thermal regime of the glaciers. The occurrence of such a diverse assemblage of physical features in a relatively compact area is exceptional on an international level and invaluable for study. **More information on www.fettes.com/Cairngorms/** – developed by Dr Adrian Hall, Fettes College, Edinburgh.

Further reading

Brazier, V. and Gordon, J.E. in prep. *The geomorphological heritage of the Cairngorm Mountains. Scottish Natural Heritage Commissioned Report.*

Thomas, C.W., Gillespie, M.R., Jordan, C. and Hall, A.M. 2004. *Geological structure and landscape of the Cairngorm Mountains. Scottish Natural Heritage Commissioned Report, No. 064 (ROAME No. F00AC103).*

The River Feshie is a highly dynamic, gravel-bed river noted for rapid channel changes during floods. This braided reach is the most active of any gravel-bed river in Britain.

The postglacial vegetation history of the Cairngorm Mountains is recorded in blanket peat and peat bogs. The lower slopes formerly supported an extensive forest cover of Scots Pine, but this has been greatly reduced following several millennia of human exploitation. Both photos by J.E. Gordon