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Renowned for their dramatic and distinctive landscape, the Cairngorm Mountains lie at the heart of the Scottish Grampian Highlands. The mountains and their environs are amongst the most heavily used upland regions of the United Kingdom, supporting in various ways a significant part of the central Grampian Highlands economy. Forming the core of the recently designated Cairngorms National Park, the mountains host one of the finest assemblages of pre-glacial, glacial and periglacial features in

in the UK, containing a wealth of information about past environmental change and landscape evolution through periods of arid, tropical, arctic and modern temperate climate. The Cairngorm Mountains are recognised internationally for their earth heritage value, and are included on UNESCO’s ‘Tentative List’ of World Heritage sites. Policy development and implementation in the Cairngorms is politically sensitive, as shown by the recent furore over development of the Cairngorm Mountain Funicular Railway and the

Understanding landscapes

Elucidating the geological controls on the landscape of the Cairngorm Mountains

by Chris Thomas and Martin Gillespie

Europe, and presently support a sub-arctic fauna and flora. The landscape, climate, fauna and flora combine to produce a mountain environment unique

protracted and often heated debate over the status, extent and planning framework of the National Park.

Over the past three years, the BGS has studied the links between geology and landscape in the Cairngorms in a project co-funded by Scottish Natural Heritage. Though its primary aim is scientific, the project was driven by a requirement for Cairngorm earth heritage information presented in a form suited to a range of non-specialist users. These include: land managers such as the new National Park authority, to enable them to adopt measures appropriate to sustainable land use and conservation; recreational visitors looking for informative maps and guides; and secondary and tertiary education establishments, who require resource materials for teaching — the Cairngorm Mountains are included as a case example in the Scottish curriculum and form an important study area for degree-level Quaternary science and glaciology.

The Cairngorm massif forms a broad dome some 30 kilometres by 20 across,



Typical Cairngorm Granite tors. Note the person for scale.

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rising from 300 to 500 metres above sea level at its margins, to a deeply dissected central plateau at around 1000 metres. The massif includes the largest area of land above 900 metres elevation, and four of the five highest mountains, in the UK. Landscape features typical of the Cairngorm massif include high and extensive rolling plateaux, deeply incised troughs with steep sides and flat bottoms, spectacular corries, and large tors. Prior to this project, very little was known of the relationship between geology and the location, trend and development of these classic Cairngorm landforms.

The massif is underlain almost entirely by the Cairngorm Granite, dated at circa 420 million years old. Remote sensing analysis and field survey of the pluton has generated new datasets and thematic maps of the granite, integrated in a project-specific geographic information system (GIS). These illustrate the orientation of fractures, the distribution of texturally distinctive rock units, and the distribution and orientation of alteration zones and veins. These data have led to a substantial improvement in our understanding of the geological ‘architecture’ and history of the Cairngorm Granite. Combined with a review of the distribution and character of Cairngorm landforms, these advances provide insights to the links between geology and landscape in the massif.

Chemically, the granite is relatively uniform, but mapping has highlighted several distinctive textural variants. The spatial distribution of these bears little relationship to any Cairngorm landscape features, indicating that contrasts in the primary rock characteristics have had little influence on the development of the landscape.

The development of the massif as a major positive topographical feature is due to the slower rate at which the granite has weathered and eroded relative to the surrounding metamorphic rocks. The size, elevation and overall form of the massif are controlled almost entirely by the size and shape of the granite pluton, and by the relatively shallow level in the crust at which the pluton was emplaced. The pluton was exposed at the Earth’s surface during the Middle Devonian Period, around 380 million years ago, and appears to have been a positive ‘upland’ feature from that time until the present day. Little

modified by glacial erosion, the high plateaux represent an ancient land surface that has remained relatively unchanged over tens or even hundreds of millions of years.

The negative topographical features we see in the landscape today (the valleys, cols, saddles and corries) have formed as a result of locally enhanced rates of weathering and erosion along linear zones of altered granite. These zones formed when hot fluid moved through fractures in the granite as it cooled. During the glacial stages of the Quaternary Period, ice sheets were largely static over the high plateaux, hence their largely unmodified condition.

In contrast, ice moving off the plateaux scoured the floors and walls of many valleys, modifying their profiles and leading to the development of troughs such as Lairig Ghru. Ice accumulation and scouring formed corries on slopes of a suitable altitude and aspect. Tors, which form in relatively unfractured rock that is less susceptible to weathering and erosion than fractured rock, are particularly common and spectacular on the eastern plateaux, where they can exceed 15 metres in height.

There is an important growing cultural awareness of the value of landscapes, the need to manage and understand them sensitively, and the importance of understanding geology as the underpinning framework. The BGS is uniquely placed to study the links between geology and landform development through its extensive expertise and knowledge of the distribution and development of bedrock and glacial deposits in the UK, and its ability to supply the growing need for public-friendly presentations of earth science topics. ■



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Typical scenery in the Cairngorm Mountains: high, rolling plateaux dissected by deep troughs and corries. The boulder-strewn terrain in the foreground is typical of the high plateaux.

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