3 Applied geology

3.1 Mineral resources, quarrying and mining

3.1.1 Mineralisation

Presently the Newtonmore–Ben Macdui district has not produced any significant economic minerals and no indications of economic metalliferous mineral deposits were found during the latest survey. The following description summarises the results of geochemical sampling and mineral collecting in this area.

The Cairngorm granite has primary magmatic characteristics similar to Sn-U granites (Plant et al., 1980: Plant et al., 1990) however, its emplacement into essentially dry crystalline basement rocks has inhibited the generation of water-rock interaction necessary to induce extensive metalliferous mineralisation. Late-stage pegmatitic and hydrothermal fluids produced veins of quartz and mineralised pegmatites with miarolitic vugs including the semiprecious smoky ‘Cairngorm’ quartz, beryl, K-feldspar, muscovite (p. 65 of Barrow et al., 1913, p 85 of Highton, 1999). In the past a thick vein of high-quality quartz has been quarried to the south-west of Carn na Caim, near [NN 659 803], and several other, similar quartz veins are known in the vicinity.

Minor accessory minerals such as garnet, topaz and uraninite are reported from the Cairngorm Granite (Harrison, 1988) as well as the rare minerals, bertrandite, genthelvite (Highton, 1999) and phenakite (Livingstone, 2002). Elsewhere in the Dalradian outcrop, the Argyll Group and particularly the Ben Eagach Schist Formation has been found to host sedimentary exhalative mineralisation in the form of stratabound Zn-Pb-Ba sulphates, silicates and sulphides (Colman and Cooper, 2000). Equivalent lithostratigraphical units crop out in the south-east part of the Ben Macdui area but no mineral potential has been identified to date.

Geochemical anomalies over the Cairngorm Pluton are evident in the regional geochemical atlas of the East Grampians (British Geological Survey, 1991) with Be, Li, and Sn anomalies over the Cairngorm Pluton and locally Mo. Radio-active elements such as U and Rb are also high over the pluton. The granite is enriched in Yttrium and heavy rare-earth elements.

Minor Zn, Pb and Cu anomalies occur along Glen Tilt. Stream sediments over the Glen Tilt and Glen Derry diorites have local Cr values over 500 ppm and lesser Ni anomalies (British Geological Survey, 1991). They also have high Sr anomalies particularly compared to the Cairngorm granite, which correlates well with the whole-rock values (British Geological Survey,

1991). Stream sediments around the Glen Tilt Pluton have local silver anomalies (British Geological Survey, 1991). North-east of the Glen Tilt Pluton a local stream-sediment anomaly of >2 % Mn associated with high Zn values is attributed to secondary enrichment.

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

Greenish grey and white mottled marble was in the past exploited from the Glen Banvie Formation along Glen Tilt (near Marble Lodge on Sheet 55E) and attractive examples can be seen in nearby Blair Castle. Thin marbles occur in the same formation near Forest Lodge but quantities are limited and imperfections, such as minor sulphides in the rock, together with difficulties in transport make it an uneconomic prospect.

3.1.3 Peat

Peat deposits cover much of the Gaick plateau but few deposits are more than 1 m in thickness. Extraction has occurred in the past for fuel in domestic consumption (Barrow et al., 1913). The most accessible peat mosses are south of the Spey near Newtonmore and along Glen Banchor at Dalballoch, and between Insh and Killiehuntly at the foot of Glen Tromie. Smaller areas occur near Loch Etteridge and west of Crubenmore. In some valley bottoms such as Glen Feshie,

there are 2–3 metres of peat, but generally over the hills and forests of Gaick and Atholl, peat is less accessible and locally eroded into hags. Commercial exploitation is unlikely and much of the area is under conservation.

3.2 Groundwater/aquifers

Supplies of good quality, potable water can be found in many parts of the district from surface sources. Water analyses carried out during a regional stream sediment sampling programme (British Geological Survey, 1991) of the East Grampians, found high acidity waters over the Cairngorm and Glen Tilt granites, extending westwards onto the Gaick Psammite Formation. This is probably the effect of blanket peat on the Gaick plateau as areas of similar bedrock have low acidity to the north and south at lower altitudes. The stream waters also have very low conductivity (up to 15 microsiemens) over the Cairngorm granite and low values (15–31 microsiemens) extend south across the Gaick to the Glen Tilt Pluton. The association of high acidity and low conductivity waters is characteristic of upland, peat-bog environments. Levels of bicarbonate in stream waters are also low over the Cairngorm-Glen Tilt area and fluoride is low over the Glen Tilt and Gaick areas rising towards the Cairngorm granite. In this case the increase in fluoride may relate to the enrichment in the element accompanying the magmatism of the Cairngorm Pluton.

Groundwater occurs in most rock formations but the amount of water available depends largely on the rock type and the frequency of fissures and joints within 100 m of rockhead. This is because much of the groundwater movement occurs within cracks and joints in the near-surface weathered zone. Faulted zones in metamorphic bedrock, such as along the Glen Truim Fault, are potential targets.

There is good potential for abstracting groundwater from the gravelly alluvium in the Spey valley for local consumption. A few farms have developed wells in the alluvium of the Spey and Tromie valleys. Currently much of the water used in the area (c. 6 million litres per day) is taken from Loch Einich. This supply cannot satisfy public water demand at certain times and lies within an environmental sensitive area where augmentation schemes are not acceptable. Scottish Water is in the process of developing the aquifer in the gravels below the Spey valley. Water will be abstracted from a network of 60 boreholes penetrating to an average depth of 50 m but the aquifer may extend to depths of 85 to 100 m before reaching bedrock. This network could provide an average of 9 million litres per day to the area stretching from Cromdale in the north to Newtonmore in the south. Alternative schemes involving direct abstraction from the River Spey or an infiltration gallery on the river bank are also being considered.

There may be potential for more supplies of water from surface reservoirs either for public use or hydro-electric schemes. At present the Cuaich hydro-electric scheme in Glen Truim, which feeds into the larger Loch Tummel Scheme, takes water westwards from Loch an t-Seilach via a tunnel to Loch Cuaich and then from the 2.5 MW Cuaich Power Station along an aqueduct to Loch Ericht. This scheme was developed in the 1940s/1950s and there may be scope to upgrade the scheme in the search for additional sustainable supplies of energy. Other sites which might be considered include Loch Gynack, Loch an Duin and tributaries to Glen Tilt.

3.3 Geology, planning, hazards and heritage

Geological assessments play an important role in planning land-use development. With the increasing demand to manage developments and their visual impact, knowledge of the geological environment is required in planning. Other factors to be considered are the potential mineral resources available and the types of geological hazards likely to be encountered in the area. There is a growing awareness of the value of geological heritage and geodiversity in the rock outcrops and landscape, not only in the geological community but in the fields of education, recreation and tourism. These interests need to be balanced against the continuing need for the provision of land for housing, commercial, industrial, waste disposal and mineral extraction.

No minerals are currently being exploited in the Ben Macdui and Newtonmore districts, although there may be potential for hardrock quarrying. Rock, till and sand and gravel generally provide sound foundation conditions below the weathered zone. Poor foundation conditions can be caused by surface deposits such as peat, clay and silt, alluvial deposits, slipped ground, scree and landfill. Where peat and soft clay are buried they can give rise to variably compressible ground and

waterlogged silt and fine sand may become liquefied so all these deposits require careful site investigation.

Potential for landslip and rockfalls should be considered in future developments. The stability of superficial deposits on steep slopes may be affected by loading, saturation, natural undermining by meandering rivers and/or excavation. These processes make them susceptible to minor landslip and debris flow. The stability of bedrock in cliffs and steep-sided excavations may depend on its resistance to weathering and the presence of joints, faults and inclined foliations Movement on such planar features may give rise to rockfalls as well as landslips.

Former quarries and sand and gravel workings may have affected the local water drainage and this factor should be considered if the sites are used for landfill. Landraise, in which natural hollows and valleys are infilled, would also be possible in these districts.

Man-made (or artificial) ground includes tips of waste rock near former quarries, landfill, and both railway and road embankments. Worked ground is mapped where excavations have been made in the original ground surface; this category includes quarries and cuttings for road and rail. Where excavations have been backfilled, the ground is designated as ‘infilled ground’.

3.3.1 Geological heritage and geodiversity

Areas such as the Cairngorms and Glen Tilt include classic Geological Conservation Review sites (GCRs) of which the most celebrated is Hutton’s locality near Forest Lodge (Stephenson, 1999). This historical site is known worldwide as a locality where Hutton (1794) demonstrated that granitic magma intruded metasedimentary strata. A full geodiversity audit of the Cairngorm National Park as a whole has been made recently (Barron et al., 2012a) together with a landscape assessment (Barron et al., 2012b).

There are several Quaternary GCRs in the Cairngorms (Gordon, 1993; Werrity and McEwen, 1993). Within the Cairngorms, the range of pre-glacial, glacial, glacio-fluvial and periglacial features makes it an outstanding area for geomorphological and environmental study (Shaw and Thompson, 2006; Kirkbride and Gordon, 2010). Loch Etteridge (Walker, 1993), south of Newtonmore, lies in an ice hollow that has preserved organic lake sediment important in dating late Quaternary history. Glen Feshie contains an outstanding assemblage of valley-floor and valley-slope landforms and deposits formed during late Glacial to Holocene times.

All GCR sites have been notified as Sites of Special Scientific Interest (SSSI), which are the responsibility of Scottish Natural Heritage, Battleby Redgorton, Perth, PH1 3EW.

Hill walking and climbing are common activities in the Cairngorms. Harveys have recently produced a Cairngorms map at 1:40 000 in their British Mountain Map series, which includes a geological map and description of the geology. However, the potential for geotourism has hardly been tapped.

References