Gutcher

[HU 549 990]–[HU 551 999]

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Introduction

The section at Gutcher, on the east coast of the island of Yell, provides easily accessible exposures of a variety of rocks typical of the psammitic succession of the Yell Sound Group (formerly the Yell Sound 'division') (Figure 9.6). These include psammites, partly gneissose psammites, microcline-bearing gneisses, microcline-megacryst augen gneisses (the Valayre Gneiss) and hornblende schists. The Yell Sound Group has been correlated with the Glenfinnan Group and Loch Eil Group rocks of the Moine Supergroup in the North-west Highlands of Scotland (Flinn, 1994, 1995).

Description

The rocks exposed to the south of the ferry terminal at Gutcher belong to the Otterswick Psammites, the highest unit in the Yell Sound Group (Flinn, 1994). Interbanded psairunitic and pelitic rocks are exposed on the beach for about 500 m to the south of the pier. The banding is on a scale of 10–20 cm, and is principally defined by variation in mica content of the rocks. Flinn (1994) showed that the fabric of the Yell Sound Group psammites varies gradationally from granofelsic to schistose as a result of increasing preferred orientation of mica flakes and/or increasing grain-size or content of mica. Variation in mica content is typically manifested in the form of lamination and banding, such as that seen at Gutcher.

Over about a third of Yell, the granofelsic and schistose psammites have been transformed partially or completely to gneisses by recrystallization (Flinn, 1995). This process results in a more than three-fold increase of the grain size of the psammites (from *c.* 0.3 mm to *c.* 1.0 mm), and the destruction of sedimentary structures such as lamination and banding. Mica-poor granofelsic units have recrystallized to form granoblastic gneiss, whereas recrystallization of mica-rich granofels and mica schists has led to the development of quartzofeldspathic leucosomes of migmatitic appearance. This gneissification by recrystallization has occurred in a patchy and unpredictable manner throughout the psammite outcrop on Yell, and the different types of gneisses grade into each other and into the surrounding psammites. At Gutcher, the psammites still retain some of their original features, but the development of lenticular quartzofeldspathic segregations tending towards leucosomes is apparent in some of the more-micaceous bands. Flinn (1995) termed these transitional rocks 'semigneisses', as they show features of both psammites and migmatitic gneisses.

Also present on the beach to the south of Gutcher ferry terminal are several bands of hornblende schist studded with 5 mm-diameter garnets, together with a number of lamprophyre sheets. The garnetiferous mafic rocks, which represent original doleritic or basaltic sheets and dykes, are commonly found within the Yell Sound Group.

In the quarry to the north of the Gutcher ferry terminal are good exposures of shattered microcline-plagioclase leucosome gneiss that show a complex flow-like structure (Figure 9.7). This lithology is bounded by faults and by non-exposure, but is probably a granitic orthogneiss, analogous to similar rocks occurring elsewhere in the Yell Sound Group (Flinn, 1994). East of the gneiss, exposed in the cliffs but separated by a fault, are partially gneissified psammites, which pass east into interleaved hornblende schist and psammite containing small microcline-megacryst augen. Microcline megacrysts of this kind are typical of the Valayre Gneiss, in which the megacryst augen lie within a matrix composed of the local adjacent lithologies. However, the matrix seen here does not match that of the Valayre Gneiss against which the Yell Sound Group rocks are faulted to the north of the GCR site, and the microcline megacrysts are atypically small. The correlation of these rocks with the Valayre Gneiss is therefore uncertain.

The southern 800 m of the Gutcher coastal section, immediately north of the outcrop of the Bluemull Sound Fault (Figure 9.6) is composed of Valayre Gneiss with both leucosomes and megacryst augen. Lack of exposure at critical points means that it is not possible to show whether, as seems likely, the Valayre Gneiss forms a band bounded to the east by

the microcline-plagioclase leucosome gneiss seen in the quarry.

Interpretation

The psammites of the Yell Sound Group represent a metamorphosed sedimentary succession, which has been correlated with the upper parts of the Moine succession of mainland Scotland, and so is considered to be Neoproterozoic in age. The compositional banding and lamination shown by the unrecrystallized psammites are believed to be relict sedimentary features. However, cross-bedding, grading and conglomeratic units are absent, and the thick succession is characterized by a relatively uniform sedimentary facies, suggesting that it was deposited in deep water. The psammites appear to have originated as sandstones of greywacke composition with a grain size little different to their present state.

The leucosome 'semigneisses', which can be seen at Gutcher are, by textural definition, migmatites, i.e. gneisses that are 'pervasively inhomogeneous on a macroscopic scale' (Ashworth, 1985). Migmatites may be formed by a variety of processes, which include magmatic injection, melting, metasomatism or metamorphic differentiation. The granoblastic gneisses that occur elsewhere in Yell resemble diatexites, not migmatites, and diatexites are normally interpreted as a product of extensive melting of the host rock (Brown, 1973; Ashworth, 1985).

The intimate association of leucosome gneisses and granoblastic gneisses that is seen on Yell appears to require a single process for their production (Flinn, 1995). If so, this would eliminate metamorphic differentiation, as it could not explain the formation of the homogeneous granoblastic gneisses. The metamorphic grade of the psammites and gneisses is too low for melting to have occurred; although garnet and kyanite are found in the gneissose and non-gneissose psammites, sillimanite is absent, except where the rocks have been thermally metamorphosed by the intrusions of the Graven Complex on the islands in Yell Sound (e.g. Bigga, Samphrey) (Flinn, 1994). The lack of bulk compositional differences between gneisses and non-gneissose rocks and the nature of their field occurrence preclude origins based on meta-somatic or magmatic injection hypotheses (Flinn, 1994, 1995). Thus, it would appear that none of the normally accepted processes invoked to explain migmatization may be applied to the formation of the gneisses of Yell.

The gneissification appears to be the result of grain-growth recrystallization. In the absence of any other mechanism of gneissification that explains these features satisfactorily, Flinn (1995) suggested that the recrystallization resulted from the pervasive passage of a fluid through the rock along grain boundaries. Fluid flow along the grain boundaries would facilitate the inter-grain diffusion needed for growth, while the differences between the grain-boundary fabrics of the granofels and the schists would lead to differences in the textures of the resultant recrystallized gneisses. The granofels would coarsen to a rock with a similar grain-boundary fabric because the quartz and feldspar grain boundaries would tend to remain pinned by the adjacent isolated mica flakes. In the schists the quartz and feldspar grain boundaries would slide along the continuous strings of mica flakes, allowing the quartz, and feldspar grains to grow freely to form leucosomes (Flinn, 1995). The gneisses retain their compositions indicating that the fluid was dominantly water.

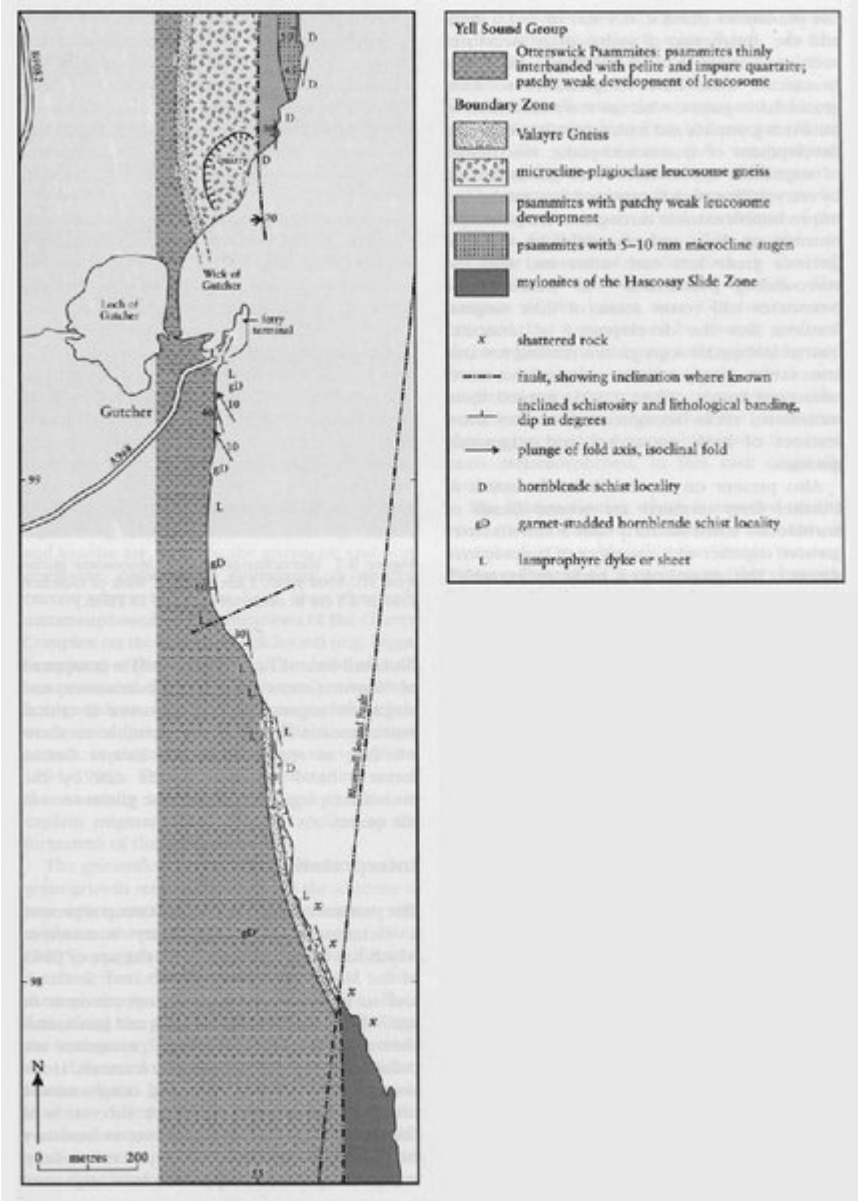
The microcline-plagioclase leucosome gneiss exposed in the quarry at the north end of the Gutcher GCR site is one of a number of lenticular masses of similar rock in the Yell Sound Group that occur inland on Yell. The contacts of the gneiss near Gutcher are not exposed, but it appears to be sharply confined and is considered to be an orthogneiss, formed from a granitoid intrusive body, which was emplaced prior to regional metamorphism. The hornblende schists seen within the psammites also represent early igneous intrusions that have been metamorphosed, in this case originally dolerite or basalt sheets.

The Valayre Gneiss, which is exposed on the coast to the south of the Gutcher GCR site, is described in more detail in the Voxter Voe and Valayre Quarry GCR site report (this chapter). This microcline-megacryst augen gneiss is inferred to represent a lithological and tectonic break in the East Mainland Succession, but has not been interpreted further. The microcline augen are believed to be porphyroblasts, which grew during coeval deformation, localized movements and regional metamorphism in the area (Flinn, 1994).

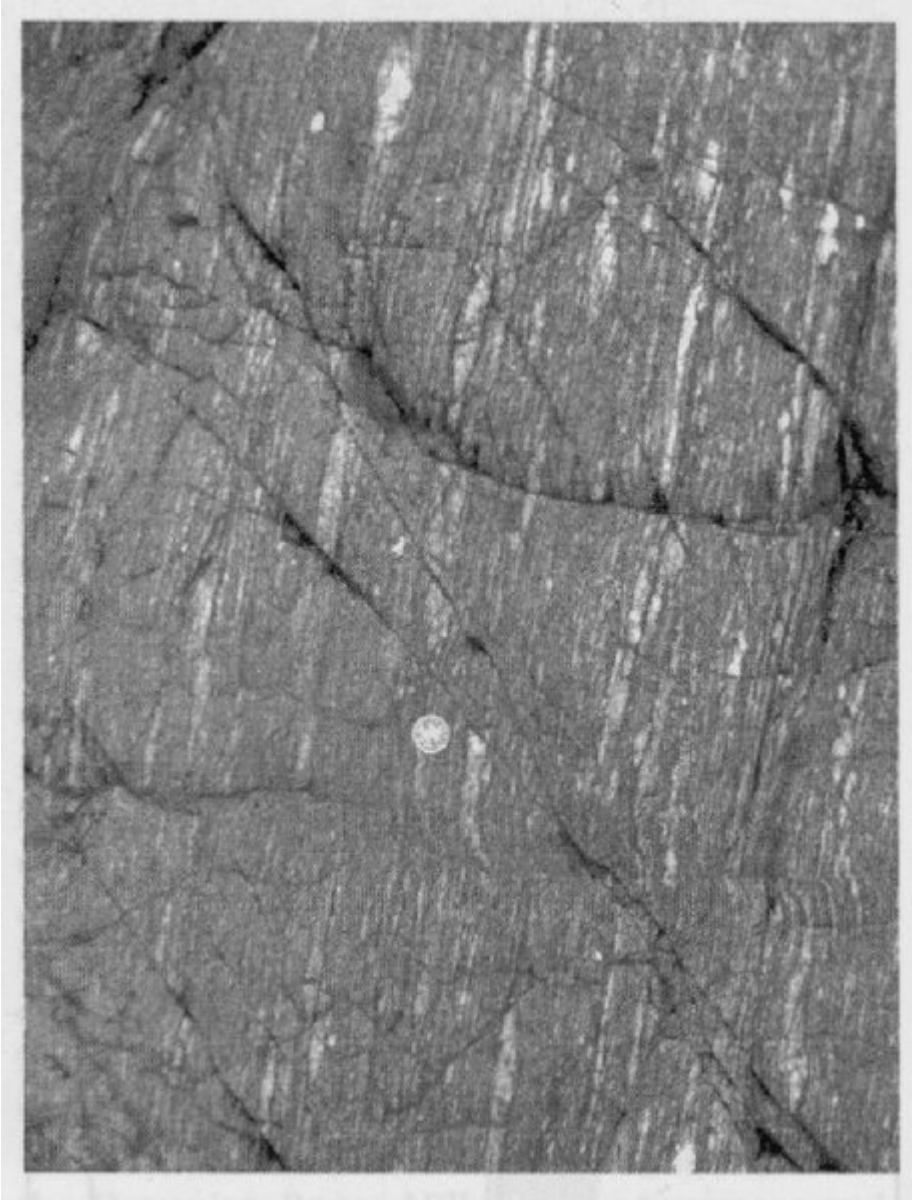
Conclusions

The Gutcher GCR site contains exposures of typical rocks of the Yell Sound Group, which has been correlated with parts of the Moine Supergroup of mainland Scotland. To the south of the Gutcher ferry terminal are metamorphosed sandstones (psammites), which hare been in places partially recrystallized during metamorphism to form 'semigneisses'. Also present within the site are microcline-rich leucosome gneisses, possibly formed by metamorphism of a granitic intrusion, and a microcline-augen gneiss of as yet uncertain origin. The site is one of national importance as it provides easily accessible exposures of many of the different types of gneiss that make up the largely drift-covered island of Yell.

References



(Figure 9.6) Map of the north-east coast of Yell, around the Gutcher GCR site.



(Figure 9.7) Microcline-plagioclase leucosome gneiss from [HU 5506 9840], 1 km south of Wick of Gutcher. Coin is 2.5 cm in diameter. (Photo: D. Flinn.)