Cullivoe

[HP 546 029]–[HP 551 021]

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Introduction

The low coastal outcrops of the Ness of Cullivoe peninsula, on the north-east coast of the island of Yell, lie entirely within the outcrop of the Hascosay Slide Zone (Figure 9.12). The zone is made up of closely packed masses of coarse-grained mafic and felsic gneisses contained within fine-grained, dominantly hornblendic mylonitic rocks. Flinn (1994) has described the zone in detail, and termed the mylonitic rocks 'blastomylonites' as they appear to have been strongly recrystallized at high temperatures during mylonitization. The peninsula provides excellent clean and readily accessible exposures of these mylonitized mafic rocks, and complements the Hascosay GCR site, which provides a section through the whole slide zone.

Description

The GCR site encompasses the foreshore and low cliffs on the north-east and south-east sides of the Ness of Cullivoe peninsula. The majority of the rocks within the Cullivoe GCR site are fine-grained, mylonitic rocks with parallel laminae and bands, ranging in thickness from 0.1 mm to 2 cm (Figure 9.13). Pale-coloured quartz-plagioclase-dominated bands alternate with dark bands, composed mainly of hornblende and biotite with, locally, clinopyroxene and garnet. Flinn (1994) termed these rocks 'banded blastomylonites'. On the scale of the whole slide zone, the overall foliation of the mylonites lies parallel to the zone margins in both strike and dip, and the mineral lineation plunges on average about 20° to the NNW. However, in detail, the foliation shows considerable local variation in strike and dip due to small- and medium-scale folding.

The Cullivoe peninsula is particularly suited for studying folding of the banded blastomylonites. Throughout the peninsula the mylonites show irregular non-cylindrical folds, typically on scales of several metres. Smaller-scale isoclinal and intrafolial folds are unevenly distributed, generally in closely spaced groups, and spectacular examples can be seen in various localities (e.g. at [HP 548 028]). The folds generally plunge gently northwards, roughly parallel to the mineral lineation, but their axial planes have no preferred orientation and they exhibit a variety of shapes and profiles. Many of these intrafolial folds take the form of isolated detached lenses contained between the laminae of the mylonites.

A unique structure exposed in the cliff at Little Ness [HP 544 031] testifies to the orthorhombic (coaxial) nature of the deformation within the slide. This structure takes the form of a thin pegmatitic vein folded into a pile of ptygmatic folds, but which truncates the laminations of an unfolded mylonite. The pile of ptygmatic folds crosses the laminations at 90° with the fold axial planes parallel to the laminations.

Unlike other exposed tracts of the Hascosay Slide, few undeformed residual masses of gneiss are recognizable on Cullivoe Ness. Those that are still recognizable include several small hornblendite lenses and some distinctive ultramafic relics. The latter include fist-sized lenses of lustrous green actinolite, and larger zoned masses up to 3 m in diameter. The zoned masses have steatite in the core, surrounded by concentric zones of anthophyllite, actinolite and biotite. At the south end of Cullivoe Ness [HP 553 022] are several nearly spherical masses of pyroxenite, up to 7 m in diameter, with thin skins of talc and/or serpentinite.

In the Hascosay Slide Zone the blastomylonites include mylonitized aplitic and pegmatitic rocks that are cut by thin undeformed very fine-grained hornblendite veins, which in turn are cut by undeformed aplitic and pegmatitic veins, and these by Late Caledonian lamprophyre sheets.

Interpretation

The Hascosay Slide Zone has formed through intense deformation and recrystallization at relatively high temperatures (600°–700° C; Flinn, 1994). Prior to the deformation, the rocks of the slide zone appear to have comprised mafic and felsic gneisses with masses of hornblendic gneiss, together with basic and ultrabasic igneous rocks, psammites, aplitic microgranites and pegmatitic granites. The less-resistant rocks have been mylonitized, whereas the more resistant have been variably sheared and recrystallized, but mylonitized to a lesser extent.

The folds that can be seen at Cullivoe Ness appear to result from flow perturbations of the laminated mylonite, due to the lithological variations, high strain, and presence of resistant gneiss masses.

The intrafolial isoclinal folds are preserved within lenses contained within the foliation of the mylonites. These folds probably developed progressively during the mylonitization, being initiated as perturbations in the overall flow. Once formed, they resisted further deformation, causing the laminae to diverge around them while the lens continued to flatten. The shapes of the lenses together with the enclosing laminae have orthorhombic symmetry.

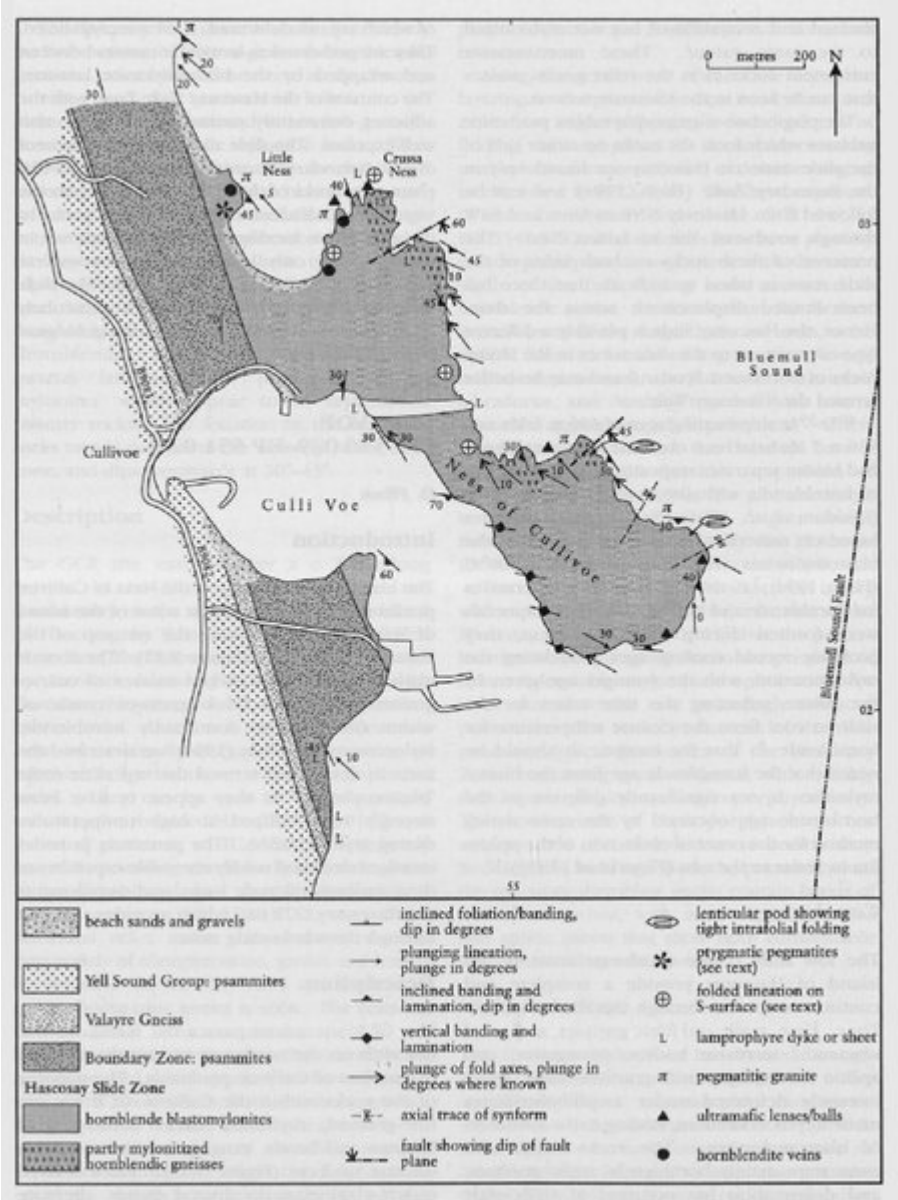
The overall symmetry of the blastomylonites in the slide zone, as shown by the preferred lattice and/or grain-shape fabrics, is orthorhombic. The plane of flattening dips to the west, and the extension direction, mineral lineation and fold axes plunge about 20° to the NNW. There is no consistent sense of overturning of the minor folds. Flinn (1994) stated that the lineation did not indicate the direction of monoclinic shearing, as is normally assumed in such zones, but instead represented the coaxial extension direction as a result of compression normal to the slide zone. Hence, Flinn (1994) interpreted the formation of the Hascosay Slide Zone as the result of orthorhombic deformation.

Late in the development of the Hascosay Slide, it was invaded by thin veins of tholeiitic basalt of Mid-Ocean Ridge Basalt (MORB) affinity, similar in composition to the globular meta-dolerite bodies seen in the country rocks adjacent to the slide zone in the Hascosay GCR site. These veins were metamorphosed to form the homblendite veins that can be seen at Ness of Cullivoe. Later intrusions include pegmatitic and aplitic veins, and lamprophyre dykes. These minor intrusions are commonly found cutting the Yell Sound Group and early meta-igneous rocks on Yell, and examples are also seen cutting the Hascosay Slide Zone within the Cullivoe GCR site.

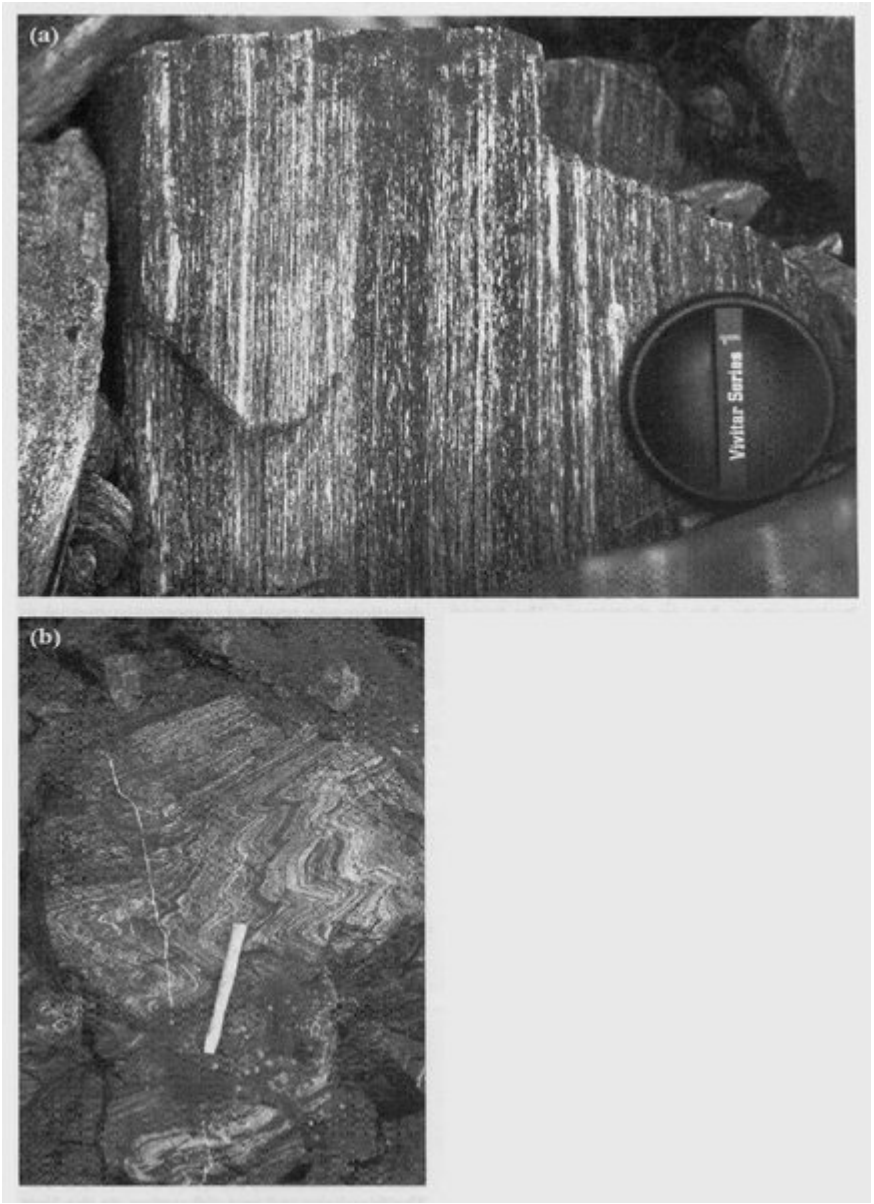
Conclusions

The Cullivoe GCR site lies within the Hascosay Slide Zone, a NNW-trending zone of intense deformation and mylonitization, which lies within the Boundary Zone of north-eastern Yell. The foreshore and low cliff-section on the Ness of Cullivoe peninsula expose laminated and thinly banded mylonitic mafic and felsic gneisses with abundant amphibolitic mafic bodies and subsidiary psammites. This is the best location for the study of spectacular folds of the mylonites. In a number of places highly deformed and partially mylonitized relict masses of the parent gneisses are preserved, together with some metasomatically zoned masses of ultramafic rock. The Cullivoe GCR site is of national importance as it provides spectacular yet readily accessible examples of the structurally complex Hascosay Slide Zone and is ideal for detailed further studies and for teaching purposes.

References



(Figure 9.12) Map of the Ness of Cullivoe and the area around Culli Voe, on the north-east coast of Yell.



(Figure 9.13) Typical blastomylonites of the Hascosay Slide Zone on the Ness of Cullivoe. (a) 'Banded blastomylonite' with hornblende and biotite [HP 551 022]. The lens cap is 7 cm in diameter. (Photo: D. Flinn, BGS No. P541972, reproduced with the permission of the Director, British Geological Survey, © NERC.) 1 (b) Folded blastomylonites [HP 548 028]. The hammer is 40 cm long. (Photo: D. Flinn, BGS No. P541974, reproduced with the permission of the Director, British Geological Survey, © NERC.)