Cullernose Point to Castle Point, Northumberland

[NU 260 187]–[NU 259 221]

S.C. Loughlin

Introduction

The Cullernose Point to Castle Point GCR site extends for 3.5 km along the Northumberland coast from the promontory of Castle Point south to Cullernose Point (Figure 6.27). The Great Whin Sill has a striking influence on the scenery in this area. The rocky promontory of Castle Point is the spectacular setting for Dunstanburgh Castle, and inland, 300–700 m from the coast, the sill crops out again to form a distinctive west-facing scarp that has been extensively quarried. A fault that cuts the sill forms the 'haven' of Craster and provides a natural harbour which was used to ship out the quarried stone. The picturesque Craster village is an excellent place to see the quartz-dolerite of the sill used as a building stone.

The sill is intruded immediately below the Great Limestone at the base of the Namurian Series, and both sedimentary rocks and sill dip gently eastwards. Cross-dip sections are well exposed at both the southern and northern margins of the GCR site, and along the intervening coastline the upper dip-slope is well exposed on the shore between tide marks. The excellent coastal exposures at Cullernose Point and at Castle Point clearly reveal the contact metamorphosed sedimentary rocks above and below the sill (Figure 6.28) and (Figure 6.29). Columnar jointing is well developed and there are blocks of baked sedimentary rock incorporated into the quartz-dolerite. Veins and pods of distinctive pink felsic material are particularly abundant near Cushat Shiel and this is perhaps the best site to observe such features in the Whin Sill-complex. It is also one of the best localities to observe evidence for later injections of basaltic magma into the sill.

A number of general papers on the geology of Northumberland with references to the Whin Sill at this GCR site were published in the 19th century (e.g. Winch, 1817; Tate, 1868). The most significant early paper was that of Tate (1871), which provided many illustrations of the intrusive nature of the sill in Northumberland. The intrusive nature was debated for several years until the abundant evidence was collated and presented by Topley and Lebour (1877). E.J. Garwood (in Bateson, 1895) presented a detailed account of the geology of this GCR site. The original geological survey of the Alnwick area was completed between 1871 and 1878 and the six-inch maps were revised between 1921 and 1925, leading to publication of the revised one-inch Sheet 6 (Alnwick) and an accompanying memoir (Carruthers *et al.,* 1930). The later basaltic intrusions and felsic veins and pods at this site were described and analysed by Smythe (1930a) in his paper on the geochemistry of the Whin Sill-complex.

Description

The Great Whin Sill is intruded below the Great Limestone into a sequence of mudstones, sandstones and limestones. Immediately to the north of Dunstanburgh Castle [NU 257 219], the sill and the underlying sedimentary rocks form the spectacular Gull Crag which comprises 16 m of columnar-jointed quartz-dolerite overlying 12 m of sandy mudstone and 2 m of grey and reddish-brown coarse sandstone. The latter is known as the Dunstanburgh Sandstone, which is distinctive because of the presence of abundant rounded clasts of quartz up to 3 mm in diameter. Contact metamorphism at the sill margins is confined to a narrow zone less than 0.5 m wide in which sandstones and limestones are recrystallized. The recrystallized limestones commonly contain pyrite, and mudstones typically become porcellanous. The main walls of Dunstanburgh Castle are made of the coarse, gritty Dunstanburgh Sandstone with a packing of quartz-dolerite boulders. The sill forms crags along the coastline for about 0.5 km south of the castle as far as Cushat Shiel [NU 259 213], a distinctive NW-trending slack that is the site of the Cushat Shiel Fault. The fault offsets the sill by almost 500 m to the west.

South of Cushat Shiel a number of faults intersect the coast, most of which have a trend of east-west or north-east-south-west. The upper surface of the sill is extremely well exposed on the shoreline between tide marks and shows the distinctive pattern of columnar joints perpendicular to the sill margins. At Craster [NU 259 200] a NE-trending fault cuts the sill, forming a natural harbour on the coast and a steep cleft in the escarpment west of the village. There has been very little movement on this structure since emplacement of the sill as the escarpment is not visibly offset. Between Scrog Hill [NU 254 214] and Craster the sill forms a steep west-facing escarpment cropping out 300–700 m inland and rising to a height of 35 m. This escarpment has been quarried extensively for both quartz-dolerite and the underlying Dunstanburgh Sandstone.

Immediately south of Craster is another zone of weakness in the sill known as 'Hole o' the Dike' which trends north-east–south-west. The dolerite within this zone is heavily jointed and there is some calcite veining. A few hundred metres farther south is another recessed feature known as 'Black Hole' [NU 261 191], which has a similar ENE–WSW orientation and is associated with fault-brecciated dolerite and extensive calcite veining. At the southern limit of the site is Cullernose Point [NU 261 187], a promontory rising to 20 m in height and composed entirely of columnar-jointed quartz-dolerite (Figure 6.29). This is a fine example of columnar jointing, with well-developed columns that are clearly perpendicular to the upper and lower margins of the sill. Just west of Cullernose Point at Swine Den, there are some spectacular xenoliths of Dunstanburgh Sandstone and mudstone within the sill (Smythe, 1931) and a few metres south of the main sill outcrop is a vertical quartz-dolerite dyke intruded into a fault. Xenoliths of fault-breccia can be observed within the dyke.

Xenoliths of country rock are also common in the sill in the vicinity of Dunstanburgh Castle and just north of the castle at Rumble Churn (Garwood in Bateson, 1895). The xenoliths of sandstone, mudstone and limestone are strongly affected by contact metamorphism. Mudstones have been converted to biotite-andalusite hornfels with a distinctive spotted appearance; sandstones have commonly undergone recrystallization to quartzite and impure limestones have become calc-silicate hornfels with garnet, wollastonite and idocrase (Westoll *et al.,* 1955). Impure limestones tend to show more alteration than pure limestones, as recognized by Randall (1959). Vesicles in the sill that are close to xenoliths commonly contain radiating crystals of quartz (in places amethysts), which are known locally as 'Dunstanburgh diamonds'.

Veins and pods of pink felsic material are particularly abundant around Cushat Shiel. The veins are up to 5 cm in width and the roundish pods are about 2 cm thick and several centimetres across. This felsic material varies in grain size from pegmatitic to cryptocrystalline in which the major components of quartz and feldspar cannot be distinguished. Smythe (1930a), in his extensive study of the Whin Sill-complex, believed this location to have the greatest concentration of felsic material. He also described intrusions of fine-grained basaltic rock at Cullernose Point and Scrog Hill, the latter being heavily altered. The intrusions are just a few centimetres thick and have chilled margins against the normal quartz-dolerite. The intrusion at Cullernose Point contains rare microphenocrysts of augite but is otherwise non-porphyritic. Smythe's analyses showed that these basic intrusions have broadly the same chemical composition as the sill.

Interpretation

Garwood (in Bateson, 1895) produced a field sketch showing the Cullernose Dyke at Swine Den feeding the sill, but Carruthers *et al.* (1930) were unable to find sufficient field evidence connecting the sill and the dyke. Westoll *et al.* (1955) discussed the emplacement of the Great Whin Sill in this area and described how it crosses pre-existing faults with little displacement but locally turns up or down a pre-existing fault zone to form transgressive connecting dykes between different strati-graphical or structural levels. They suggested that the Cullernose Dyke is an example of this process and the incorporation of inclusions of fault-breccia within the dyke proves the preexistence of the fault. Magnetic evidence appears to support this hypothesis since the Cullernose Dyke has magnetic properties that are very similar to the Great Whin Sill (El-Harathi and Tarling, 1988) but different to the nearby Holy Island dyke system. This suggests that the Cullernose Dyke and the sill had a similar cooling history and may therefore have been emplaced contemporaneously.

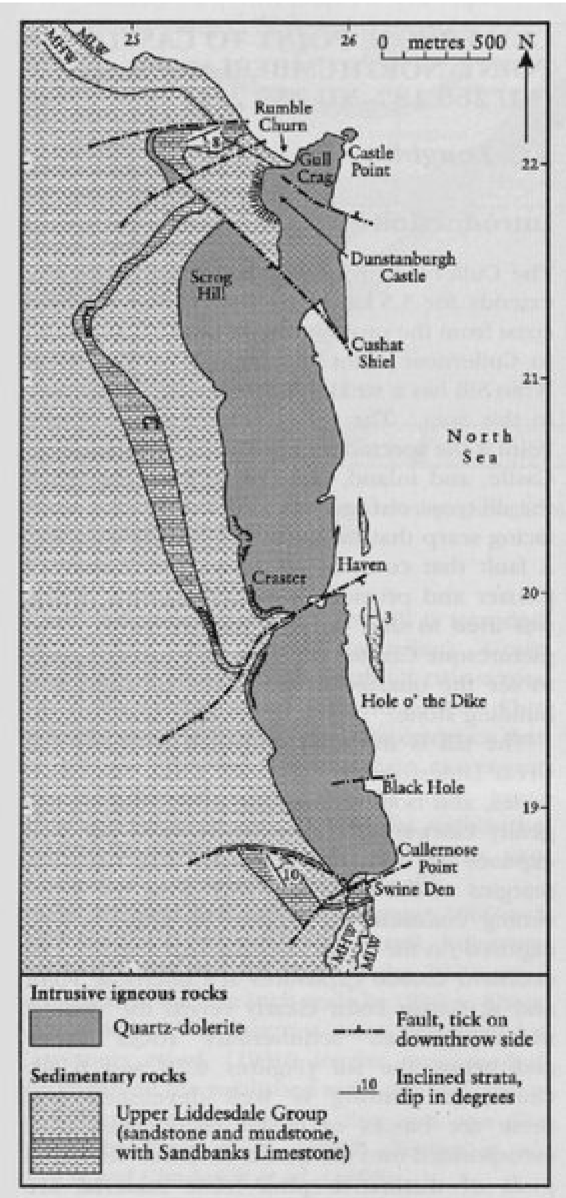
The felsic pods in the vicinity of Cushat Shiel were described and analysed by Smythe (1930a). He concluded that as crystallization of the sill progressed, the remaining magma became progressively more acidic. The composition of this late-stage assemblage typically comprises small feldspar laths, some orthoclase and quartz. This assemblage forms either a relatively coarse-grained pegmatitic facies, an indeterminate fine-grained assemblage or, when concentrated, 'a crypto-pegmatite in spherulitic form'. Such segregation veins and pods are now recognized in the upper parts of many thick sills as the final product of differentiation.

The fine-grained basaltic intrusions, with chilled margins, are similar in composition to the sill and are therefore not differentiates. Smythe (1930a) argued that they must have been intruded later, 'at a time when the sill had become consolidated and cold'. This observation has potential significance in current debates concerning the relative ages of the sill-complex and the accompanying dyke-swarms.

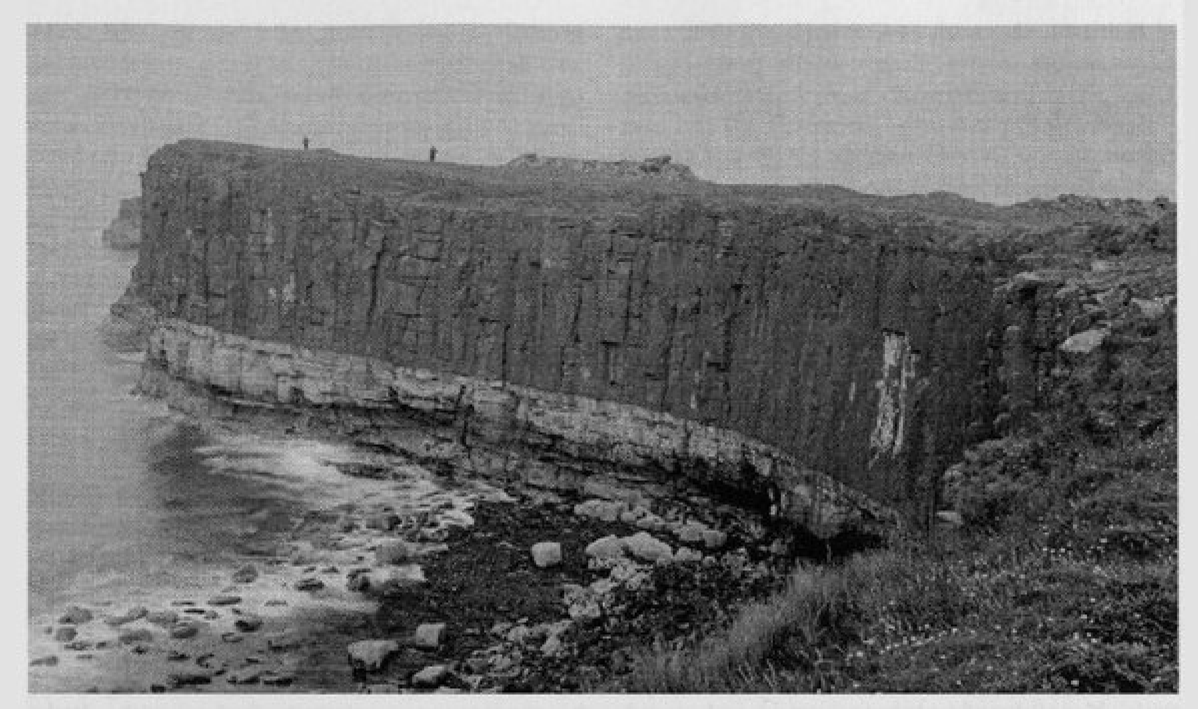
Conclusions

At the Cullernose Point to Castle Point GCR site, excellent exposures reveal classic features relating to the intrusion and late-stage crystallization of a sill. In addition this site provides a spectacular example of the influence of the Great Whin Sill on the scenery of Northumberland, such as the high sea cliffs that were used as the foundations for Dunstanburgh Castle. The cliffs show well-developed columnar jointing and also contain large rafts of sedimentary rock incorporated during emplacement of the sill. These fragments of country rock are baked by the hot magma to form different metamorphic rocks depending on the composition of the original sedimentary rocks. Vesicles in the dolerite close to sandstone inclusions commonly contain radiating quartz crystals or amethyst and are known locally as 'Dunstanburgh diamonds'. In addition, the sill has abundant examples of quartz and feldspar-rich veins, which formed during the final stages of crystallization of the magma, and of later injections of basaltic magma.

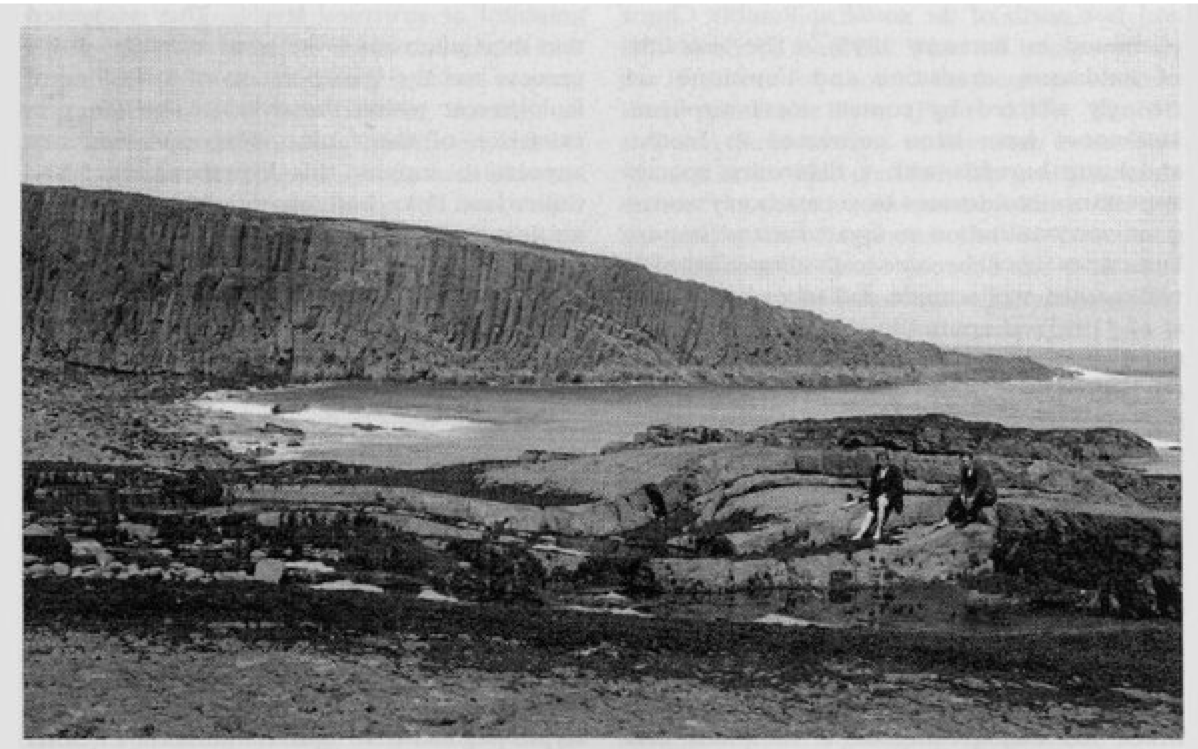
References



(Figure 6.27) Map of the area around the Cullernose Point to Castle Point GCR site. Based on Geological Survey 1:63 360 Sheet 6, Alnwick (1930).



(Figure 6.28) Columnar-jointed quartz-dolerite of the Great Whin Sill overlying sandstone at Castle Point. (Photo: British Geological Survey, No. A3077, reproduced with the permission of the Director, British Geological Survey, © NERC.)



(Figure 6.29) Columnar-jointed quartz-dolerite of the Great Whin Sill at Cullemose Point. The sill, like the underlying sedimentary rocks in the foreground, is gently folded, as is well illustrated by the columns perpendicular to its margin. (Photo: British Geological Survey, No. A3079, reproduced with the permission of the Director, British Geological Survey, © NERC.)