Geology and landscape of Holy Island and Bamburgh - an excursion

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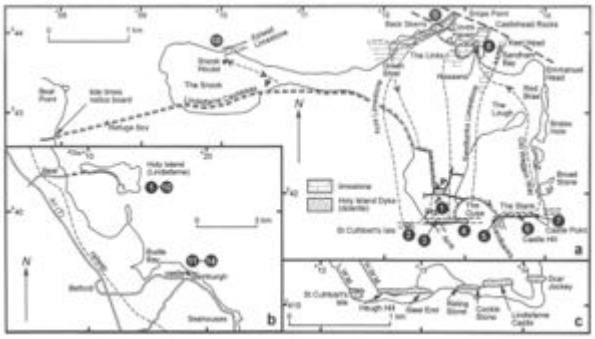

Figure 6.1 (a) Map of Holy Island (Lindisfarne) showing localities described in the text. Inset maps of (b) access roads in the Holy Island/Bamburgh area, and (c) of the Holy Island dyke echelon segments.

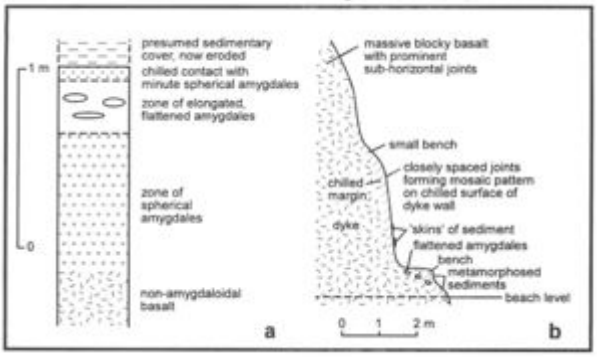

Figure 6.2 (a) Section of top of dyke on St Cuthbert's Island (Locality 2). (b) Profile of southern wall of the Heugh Hill dyke segment (Locality 3).

Figure 6.3 Bench on the Cockle Stone segment of the Holy Island Dyke, with Lindisfarne Castle on the Castle Hill segment in the background. Photo: C. T. Scrutton.

Figure 6.4 Cliff on northwest side of Nessend (Locality 8) showing sequence below capping of Sandbanks Limestone (with nesting birds). Photo: J. R. Senior.

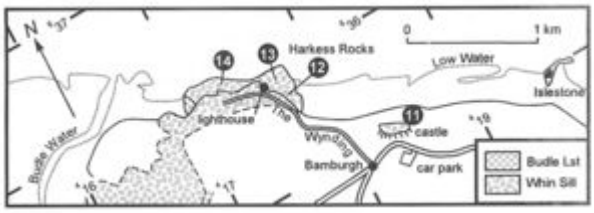

Figure 6.5 Map of localities in the Bamburgh area.

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Purpose

A two-part excursion to examine the geology and landscape of Holy Island (Lindisfarne) and the Whin Sill near Bamburgh.

Logistics

This section was compiled in 2006 when the printed guidebook was published. Before visiting this site please ensure you have up-to-date contact and access information.

On Holy Island, the official car park is on the northeast side of the village [NU 128 421], Figure 6.1a). At Bamburgh, parking is often possible on the grass at the side of The Wynding; otherwise use the car park opposite Bamburgh Castle[(NU 183 34]8, Figure 6.5). Holy Island lies within the Lindisfarne National Nature Reserve, so the use of hammers is forbidden without the permission of English Nature (Tel: 01289 381470).

Note: Holy Island is cut off from the mainland at high tide. Tide and recommended crossing times are posted at the mainland end of the causeway to the island. Towards high tide the surge channel (the Lindis Beck) fills very rapidly and unwary travellers and their cars are regularly inundated by the sea! Do this part of the excursion on a falling tide.

Maps

O.S. 1:50 000 Sheet 75, Berwick-upon-Tweed; O.S. 1:25 000 Sheet 452 (NU 04/14), Holy Island; B.G.S. 1:50 000 Sheet 4, Holy Island (solid); 1:63 360 Sheet 4, Holy Island (drift).

Geological background

The rock head geology of Holy Island consists of a near peneplaned surface of cyclic sediments belonging to the Lower Carboniferous, Middle Limestone Group (Brigantian Stage). Each cycle starts with fossiliferous marine limestone (Eelwell, Acre and Sandbanks), followed normally by marine shales then deltaic sediments including non-marine shales with ironstone concretions, siltstones, sandstones, a seatearth and thin coal.

During the Variscan Orogeny these Carboniferous sediments were subject to east–west compression against the Cheviot Block. The resulting shear force produced a series of minor anticlines and synclines, particularly well exposed along the northern shore of Holy Island, and also allowed the emplacement of the Holy Island Dyke. This is the most northerly of the four late-Carboniferous doleritic dyke echelons of the north of England which belong to the Whin Sill suite. The off-set

nature of the Holy Island Dyke echelon results in a series of low islands (St Cuthbert's Isle, Plough Rock, Plough Seat, Goldstone Rock) and low hills (Heugh Hill and Beblowe (Castle) Hill).

The individual dyke segments are topographically highest at their western ends and their upper surfaces are characterized by flat planes gently dipping to the east. These surfaces are formed of chilled rock and indicate that the dyke 'topped', i.e. reached an upward termination below the erosion surface at the time of intrusion (Randall & Farmer, 1970). A 150–230 mm zone a few centimetres below the chilled surface contains numerous amygdales, up to 406 X 203 by 25 mm deep, which are markedly flattened, parallel to the chilled surface (indicating the easterly dip to be tectonic) and elongated in locally consistent directions between northeast and southeast. The amygdales contain quartz and calcite but where the filling has been removed, the lower surface exhibits ropy flow structures analogous to those on lava flow surfaces.

The Whin Sill was intruded penecontemporaneously with the dykes and although around Bamburgh it is not as thick as in County Durham it displays fascinating intrusive relationships.

Late Quaternary glaciers left a patchy cover of tills containing erratics of local, Cheviot and Scottish origin (Hodgson *in* Fullerton & Sharp, 1980). After the last, Devensian, glaciation sea-level was much lower in the North Sea Basin, and in Mesolithic times (8500–6500 B.C.) Holy Island was a low hill on a wide coastal plain with the coast-line at about -30 m. Rising sea-level at the end of the Mesolithic period (6500–3000 B.C.) destroyed the land bridge between Eastern England and Netherlands/Denmark and flooded the coastal plains of north Northumberland. Mesolithic flint scatters and 9th century A.D. farm settlements found at the base of the sand dune cover which occurs over much of the northern part of the island suggests that these dune sands (The Links and The Snook) are of recent origin.

Excursion details

Holy Island

Locality 1, Priory and Parish Church [NU 126 417]

From the village car park (Figure 6.1a, [NU 128 421]) walk to the largely 13th century Benedictine Priory and St Mary's parish church (13th century with later additions). Note the handsome red sandstone ashlar used in the Priory church which is reputed to have been brought from mainland shoreline quarries at Cheswick Black Rocks [NU 038 477], but could equally have been quarried from the eastern shore line of the island. The purple, reddish and white sandstones used in the parish church were certainly obtained from the Nessend area (Locality 8, [NU 131 438]); much dolerite from The Heugh has been used as the rubble core of the walls. All the sandstone ashlar has been weathered to some extent by the prevailing wind and rain. Particularly fine examples of deep reticulate weathering may be seen on the crossing piers in the Priory church.

Locality 2, St Cuthbert's Island or Hobthrush [NU 123 416]

This low island southwest of the parish church is only accessible at low water. No vertical contacts are exposed on the eastern margin of this segment of the dyke echelon, but the dominant joints on the island are sub-horizontal. The flat surface, which has a slight easterly dip, and which lies mainly below high water mark, is formed of chilled rock (Figure 6.2a). The lower amygdale zone can be traced in the low cliffs on the north and west shores of the island. On the east side there is a marked feature formed by a minor normal north–south fault zone (down-throwing c. 1 m to the east) which repeats the dyke sequence.

The remains of a hermitage used by St Cuthbert around 685 AD are still visible.

Locality 3 [NU 126 416]

The contact between the dyke and the Carboniferous country rock is particularly well exposed along the southern margin of the Heugh Hill dyke segment. About 60 m from the western end, there are three small rafts of saccharoidal limestone in the southern contact zone and a little to the east 'skins' of limestone indicate that much of the lower part of the exposure is actual dyke wall. The dominant cooling joints are near vertical and perpendicular to the dyke wall, but obvious jointing also occurs parallel to the dyke wall.

The Acre Limestone is exposed on the foreshore 200 m to the east [NU 127 416]. The limestone is quite fossiliferous with many small productid brachiopods, spiriferids and occasional small orthoconic nautiloids. Generally it is flat lying but here it has been flexed into a number of northerly elongated dome-like structures. Further east on the foreshore, just beyond the path over Heugh Hill, the shale overlying the limestone has been notably bleached and spotted (metamorphosed). Just to the east of the path a xenolith of shale can be seen in the dyke.

On clear days there are fine views of the Fame Islands (east-southeast), Bamburgh Castle (south) and the Kyloe Hills with the Cheviot Hills in the distance (southwest) from the coastguard building [NU 127 417]. Geophysical surveys on the Heugh revealed the foundation of several buildings on the crest of this dyke segment, including rectangular remains possibly of the Anglo-Scandinavian monastic watch tower, the likely base of a windmill (the 'Cockpit') and the late 17th century Fort overlooking Steel End.

On the foreshore some 75 m east of the path, a near horizontal surface or bench, c.1.5 m wide and just above beach level, occurs in the southern wall of the dyke (Figure 6.2b). There are patchy skins of sediments on both the dyke wall, visible to a height of 6 m, and the bench, which extends eastwards for 75 m.

Locality 4, Steel End [NU 130 416]

At the eastern end of the Heugh Hill dyke segment, a smooth chilled surface dipping 5 east, exposed at low tide, represents the original upper surface of the dyke. Abundant elongate amygdales and many 'ropy flow' structures, all with a southwest trend, can be seen where not seaweed covered. To the west are a series of northwest–southeast trending shatter zones.

The Ouse embayment, viewed from the jetty at Steel End, originated by the erosion of softer Carboniferous sediments, and is protected to the west and east by sections of the Holy Island Dyke (The Heugh and Riding Stone). Walking east around The Ouse note the depression between the shingle ridge on the west side of the bay and the priory ruins, the residue of a seaward extension of the channel from The Lough.

Locality 5, Cockle Stone [NU 134 417]

Near the wooden remains of the lime jetty at high water mark on the eastern side of The Ouse are exposures of the Sandbanks Limestone with small brachiopods (productids, spiriferids and *Chonetes),* intruded by the Riding Stone-Cockle Stone segment of the dyke echelon. At the south side of the eastern end of the segment a 4 m wide flat bench of chilled rock (Figure 6.3) exhibits 'ropy flow' structures which trend east-northeast.

Locality 6, Castle or Beblowe Hill [NU 136 418]

From this high vantage point on the southeast side of the island, the southward-staggered emplacement of segments of the Holy Island Dyke echelon (Plough Rock, Castle Hill, Riding Stone, the Heugh and St Cuthbert's Isle) is clear, and is reflected in the off-set nature of the coastline to the west. The boggy hollow to the north of the castle with the large pool ('The Stank') is all that remains of a marine gulf that once separated the Castle Hill island from the rest of Holy Island. This gulf is now partly filled with marine sediments.

Here the dyke segment is almost 60 m wide. At the western end, skins of sediments cling to the south wall of the dyke which dips 60° south. Below the castle a small 'white Whin' off-shoot from the main dyke extends some 11.5 m into shale. Joints parallel to the dyke wall are obvious along the length of the dyke, but near the lime kilns these joints flatten giving the false impression that the dyke is converting into a sill.

Locality 7, Castle Point Lime Kilns [NU 138 417]

At the eastern end of Castle Hill is the large complex of six limekilns built in 1860. Large quantities of limestone (for example, 3590 tons for the year ending October 1866), brought from Nessend Quarry [NU 130 438] via the mineral waggonway (now used as a pathway), were calcined in these kilns. The lime was shipped from the Castle Jetty.

Follow the path north along the old limestone waggonway past The Lough, a freshwater body of gth century origin, presumably constructed during the monastic development.

Locality 8, Nessend [NU 130 438]

East from Nessend, the rocky skerries of Keel Head divide Sandham Bay into two unequal parts. These harder rocks are the upper posts of the Sandbanks Limestone, sandwiched between two shale units which are eroded away to form the main bay feature. The lower units of the Sandbanks Limestone formerly formed the cap rock of Nessend, but the hard yellowish limestone was exploited during the 1 gth century to provide feedstock for the limekilns at Castle Point. These limestones are remarkably unfossiliferous.

The 20 m vertical cliffs (beware of falling rocks and nesting birds) forming the northwest coast of Nessend overlooking Coves Haven [NU 131 439], are capped by a Sandbanks Limestone selvage left by quarrying (Figure 6.4). Beneath the limestone is an excellent section in the Acre Limestone Cyclothem; shales with ironstone concretions (at beach level) overlain by thin flaggy sandstones and then thicker units of sandstone which show signs of hand working for building stone (possibly mediaeval) and black powder blasting (igth century). The colours of the sandstones *in situ* (white, reddish and purples) match those of the sandstone ashlar used in the village and Parish Church. Towards the top of this cliff is a prominent impure coal horizon.

Continue northwest across Coves Haven, an embayment produced by the erosion of softer shales. Around 17go ironstone nodules from the shales were mined in the intertidal area by the Carron (Iron) Company and exported by sea to feed smelters at Falkirk.

Locality 9, Snipe Point and Back Skerrs [NU 126440]–[NU123439]

Here at low tide, an erosion surface of easterly dipping Acre Limestone shows a splendid complex of shallow north–south periclines and basins east of Snipe Point [NU 127 441] and at Back Skerrs [NU 123 439], an effect of the Ford-Felkington Disturbance Zone. The eastern end of Snipe Point promontory is truncated diagonally by a west-northwest–eastsoutheast wrench fault which continues

across the mouth of Coves Haven to Castlehead; a smaller parallel wrench fault with associated calcite-filled tension gashes and slickensiding on Snipe Point promontory can be seen to truncate and therefore post-date the pericline-basin complex.

The Acre Limestone at Snipe Point, which contains small productid brachiopods, zaphrentid corals and trace fossils, is overlain by thin shales and siltstones with sideritic concretions. North from Snipe Point, the base of the limestone is underlain in places by vestigial coals, seatearth and sandstones with sideritic concretions.

Continue to the gth century settlement site at Green Shiel, turn south past deteriorating kilns of the Kennedy Limeworks (c. 1850) and join the western waggonway which leads back towards the village and the carpark.

Locality 10, The Snook [NU 100 437]

Should time and tides permit, park off the road at the Lindisfarne Causeway and Jack Mathison's Bank junction [NU 107 434] and walk northwest towards Snook House. On the coast to the north the dolomitized and flexured Eelwell Limestone is exposed, containing the compound coral *Actinocyathus florybrmis* and brachiopods. This limestone was worked for lime burning in the 1790s and calcined in a one pot kiln on site (no longer visible) using local coals for fuel.

Bamburgh

Drive to Bamburgh and park either in the car park or at the side ofThe Wynding (Figure 6.5).

Locality 11, Bamburgh Castle [NU 183 351]

In the crag below the castle the Whin Sill is transgressive across the cross-bedded, red Carboniferous sandstone, rising from northeast to southwest.

Locality 12, Harkess Rocks [NU 177 356]

Here the upper chilled margin of the Whin Sill is well exposed on the foreshore close to the base of the small cliff. Just below the chilled contact are numerous elongated amygdales (of a similar nature to those seen in the Holy Island Dyke), indicating that this upper contact was horizontal during sill emplacement. The amygdales can often be measured in metres, are often filled with quartz and calcite with a little chlorite, and frequently have ropy-flow structures, the latter indicating an east–west flow direction. A few inclusions of limestone and shale are visible close to the contact.

To the northwest the sill is covered by sand, but reappears at a higher level as a 1.50 m fault scarp, perpendicular to the coastline, in which inclusions of shale can be seen. Towards the sea, the sill transgresses up through shale along a north–south line; this exposure is terminated by a fracture zone with several splay faults trending east-northeast. A second complex fracture zone occurs some 20–30 m further northwest, with the dips of coarse sandstones changing from 35° east to 20° northwest across the fault zone.

Locality 13, Stag Rock [NU 175 358]

This almost vertical exposure, trending almost due east, is ornamented by the painted figure of a stag. Adjacent to the lighthouse the Whin Sill has been injected into shale above the Budle Limestone, but halfway to Stag Rock the sill has transgressed into shales underlying the limestone, which is now on the dip slope above the sill. Further out towards the sea the Budle Limestone is again found below the sill. Northwest of the lighthouse the limestone, in an anticline, again rests on

the sill.

Locality 14, [NU 172 360]

Here the sill contains a large basin-shaped limestone inclusion some 1.5 thick and 20 m in diameter, whilst 300 m further west [NU 171 360], the Whin Sill and the overlying limestone have been polished and etched by wind-blown sand.

Glossary

Bibliography

> At all times follow: Countryside code and Code of conduct for geological field work

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