Burnmouth

Author D.C. Greig

O.S. 1:50 000 Sheets 67 Duns and Dunbar and 75 Berwick-upon-Tweed

B.G.S. 1:50 000 Sheet 34 Solid

Route: (Figure 11) and (Figure 13)

Introduction

The fishing village of Burnmouth is the most southerly on the east coast of Scotland, situated under 50-m cliffs 4 km north of the Border and 3 km south of Eyemouth. It lies immediately adjacent to the A1 road between Berwick and Edinburgh. Long vehicles should be left in the upper village [NT 953 608], but private cars may be taken down the steep winding road which descends 0.5 km to the harbour [NT 957 610]. Berwick, 9 km distant, is the nearest railway station. The foreshore at the village affords an extensive exposure of the Cementstone Group, at the local base of the Carboniferous, and of the conformable junction with the highest beds of the underlying Devono-Carboniferous Upper Old Red Sandstone. Nearby to north both formations are faulted against the southward continuation of the Silurian rocks of Eyemouth, and to south the younger Carboniferous rocks of the Fell Sandstone Group are well exposed. The Carboniferous sediments are approximately vertical, under the influence of the Berwick Monocline, a Hercynian structure associated with the N–S fault which throws these Upper Palaeozoic rocks down against the Silurian greywackes to the west. Details of this fold are exposed at Hilton Bay, 2 km south of Burnmouth, as well as parts of the higher groups of the Lower Carboniferous, the Scremerston Coals and the Lower Limestones (Geikie 1864, Greig 1988)

From the road down to the harbour several thick dykes and the axis of asteeply plunging fold may be picked out among the rocks exposed on the opposite side of the gully to the north. Such features characterise the rocks at locality 1. Examination of the first four localities is best done around low tide and involves about 4.5 km of walking on a very rough rocky shore.

1. Partanhall–Breeches Rock: Silurian greywackes, porphyrite dykes

From the harbour follow the base of the cliffs northward past the cottages of Partanhall. The country rocks here are Silurian greywackes, but Carboniferous rocks occur within 30 m to seaward, and there are many porphyrite intrusions within the Silurian outcrop. All the rocks are highly inclined on an approximately N–S strike. Some 300 m beyond the cottages a dyke, 6 to 9 m wide, may be seen, following a rather sinuous E–W course across the lower foreshore. This tholeiitic intrusion cuts the Lower Carboniferous rocks and belongs to the Late Carboniferous-?Permian suite which occurs widely in southern Scotland. This dyke is displaced by the fault which forms the landward limit of the Carboniferous. From here to Breeches Rock, 500 m to north, the Silurian rocks are cut by several thick intrusions of porphyrite, broadly concordant with the greywackes but in detail seen to be cross-cutting, ramifying, and bifurcating. The most southerly exposures include an ill-defined intrusion up to 35 m wide which includes lenticular windows or narrow screens of greywacke and off-shoots of igneous rock, particularly from its eastern margin. Some 400 m north of the first tholeiite dyke another, 3 m wide on a parallel course, cuts both the Silurian rocks and two 6-m porphyrite intrusions. Breeches Rock may have been named from the legs-astride appearance of an arch formed on its landward side by the downward divergence of a 5-m dyke of acid porphyrite and a massive bed of greywacke. A 15-m porphyrite dyke forms Gull Rock, 50 m west of Breeches Rock. These porphyrite dykes belong to the Siluro-Devonian suite of intermediate composition noted also in the areas of St Abbs, Coldingham, and Eyemouth.

Near Breeches Rock and Gull Rock the Silurian rocks exhibit the paired-fold structural pattern seen in the Eyemouth area just to north, but there are many local complexities, including examples of downward-facing folds plunging NE, contrary to the general direction. South of Breeches Rock such complexities are less evident because of the proliferation of

igneous intrusion. Return by the shore to Burnmouth Harbour.

2. Burnmouth Harbour: Upper Old Red Sandstone

The topmost 45 m of the Upper Old Red Sandstone forms a lenticular outcrop between the Silurian and the Cementstone Group, extending 700 m southward from Partanhall. The rocks are well exposed only on the shore immediately north of the landward end of the western wall of the harbour, where the beds are inverted, dipping at 70° west towards the Silurian outcrop. The fluvial sandstones are mainly reddish brown but locally cream-coloured or green, with a sparse content of small pebbles of quartz and mudstone. Five sedimentary cycles have been recognised (Smith, 1967, 1968), in each of which the grain-size decreases upwards, with an increase in argillaceous content and in the number and size of calcareous, cornstone, concretions. The form of internal cross-bedding also varies within each cycle. A few fragments of the fish genera *Holoptychius* and *Bothriolepis* and of the plant *Archaeopteris* have been found. To seaward these red sandstones are succeeded in unbroken sequence by the thin mudstones, sandstones, and limestones, predominantly grey, which typify the Cementstone Group. The palaeontological evidence from the Cementstone Group indicates that the lowest beds were formed long after the beginning of the Carboniferous Period, possibly in late Tournaisian time (Scott et al 1984). In the absence of any sign of a break from the underlying beds of Upper Old Red Sandstone it follows that the topmost Upper Old Red Sandstone beds are Carboniferous in age. Evidence from elsewhere shows an unbroken downward transition to undoubted Devonian rocks, the base of the Carboniferous being indiscernible, and the Upper Old Red Sandstone is therefore classified as 'Devono-Carboniferous'. From the eastern wall of the harbour a thick dyke of tholeiite can be readily distinguished, following a locally faulted course seawards across the steeply dipping sediments.

3. Burnmouth Foreshore: Cementstone Group

Near-vertical sediments of the Cementstone Group are very well exposed on the shore between Burnmouth Harbour and Ross Point. The full local thickness of almost 500 m may be examined, but many of the softer shaly beds are submerged at even low stages of the tide. The succession consists of thirteen major cross-bedded sandstones, between 5 and 28 m thick, separated by thicker groups of mudstones, thin sandstones, and cementstones. Detailed study by Smith (1967) has indicated patterns of sedimentological variation within the Group which may not be apparent on an initial visit. For example, in the middle of the succession the cementstone bands are thicker and more common than elsewhere, the intervals between the major sandstones are thicker, and the development of red and purple colouration in the predominantly grey rocks is at a minimum. The thickest of the major sandstones occur among the uppermost beds. Seawards across the exposures the dip gradually 'decreases' from 55° (inverted) towards the west to 80° (normal) to the east.

The major sandstones, which form 30% of the total thickness, are characterised by erosive bases, by upward fining of grain, and by upward variation from trough to planar cross-bedding, and ripple-lamination above. Increase in overall thickness may arise from coalescence with higher, lower, or laterally adjacent sandstones, giving rise to repetition of variations of grain-size and cross-bedding. The rock is micaceous and in many cases argillaceous, feldspathic, and carbonaceous. Concentration of calcite has led in places to the formation of strongly cemented wedges and lenses and conspicuous sub-spherical concretions of the order of a metre in size. Conglomerate occurs locally in the troughs of cross-bedding.

Sandy micaceous mudstones make up 70% of the intervening softer beds and the thin sandstones and cementstones 15% each, the three lithologies typically recurring in cycles (cementstone-mudstone-sandstone-mudstone-cementstone) each up to a maximum of 3 m. The cementstones are variable in constitution, basically fine-grained argillaceous dolomite, in some cases sandy, with quartz grains and mica, and in some instances with alternations of these two types finely interbanded. Extremely fine-grained types occur, as well as others in which the coarser quartz grains predominate. Evidence of ripple-lamination, mudcracks and burrows indicates deposition in relatively quiet shallow water, intermittently marine. Dolomitisation of the original calcite took place early, prior to the formation of dolomite-bearing conglomerates in the adjacent younger rocks.

The eastern wall of the harbour follows the outcrop of the second thick sandstone, some 80 m above the base of the Group. Specimens of the non-marine bivalve *Modiolus* cf. *latus* occur in the mudstones below the next two thick sandstones, 40 m and 120 m higher in the succession. Other non-marine fossils which may be found within the mudstones of the Group are *Serpula* sp., *Spirorbis* sp., *Naiadites* sp., ostracods, estheriids, fish-spines, rootlets and other plant remains. *Spirorbis* has been particularly noted below a 15-m sandstone, about 200 m east of the harbour wall, and fish-spines are present at the base of a 5-m sandstone, 100 m farther east, just above near Quarry Rocks.

4. Maiden's Stone: Fell Sandstone

The prominent sandstone stack of Maiden's Stone, which stands just below H.W.M. 300 m south of Ross Point is situated just above, east of, the base of the Fell Sandstone Group, hence the local name 'Maidenstone Sandstone'. This formation is composed almost entirely of white, yellow, or pink sandstone, cross-bedded and locally convoluted. Described by Smith (1967) as quartz-arenites, the rocks are distinguished from the sandstones of the Cementstone Group by the sparsity of biotite and clay material. The basal beds of the Group cut down by as much as 6 m into those below, include pellets of local mudstone, and are somewhat arkosic. Local features include ironstone nodules and coarse-grained sandstone with small quartz pebbles. Interbedded with the sandstones are a few thin lenses of red sandy mudstone, examples near the Maiden's Stone being about 5 m thick. The Fell Sandstone Group forms the foreshore from Ross Point to Hilton Bay [NT 969 593], but the essential features of the Group are adequately displayed in the rocks between Ross Point and the Maiden's Stone. At most states of the tide it is difficult to progress beyond Heathery Carrs and as little extra is to be gained by continuing farther south across arduous terrain, a return by the shore is recommended.

5. Chester Hill: Upper Old Red Sandstone Conglomerate

A cliff of conglomerate about 150 m long forms the steep north-eastern face of Chester Hill. Access to it may be gained from a disused loop of the A1 road at Greystonelees [NT 957 604] or from the East Flemington farm road [NT 953 608]. The rock consists of rounded and sub-rounded pebbles of greywacke and leucocratic porphyritic rock, up to 30 cm across, set in a sparse finely pebbly matrix. Most of the material is ill-sorted but some of the finer-grained beds show rough horizontal stratification and are even-grained. The petrography and disposition of the conglomerate suggest that it is of Devono-Carboniferous age, resting unconformably on Silurian greywackes, which are doubtfully exposed immediately below, towards the eastern end of the cliff. Scattered evidence shows that the conglomerate crops out over an area of 1 km westward, across Ayton Hill. Lying nearly horizontal, in contrast to the very steep beds at Burnmouth Harbour, it must be situated clear of, and to the west of the influence of the Berwick Monocline.

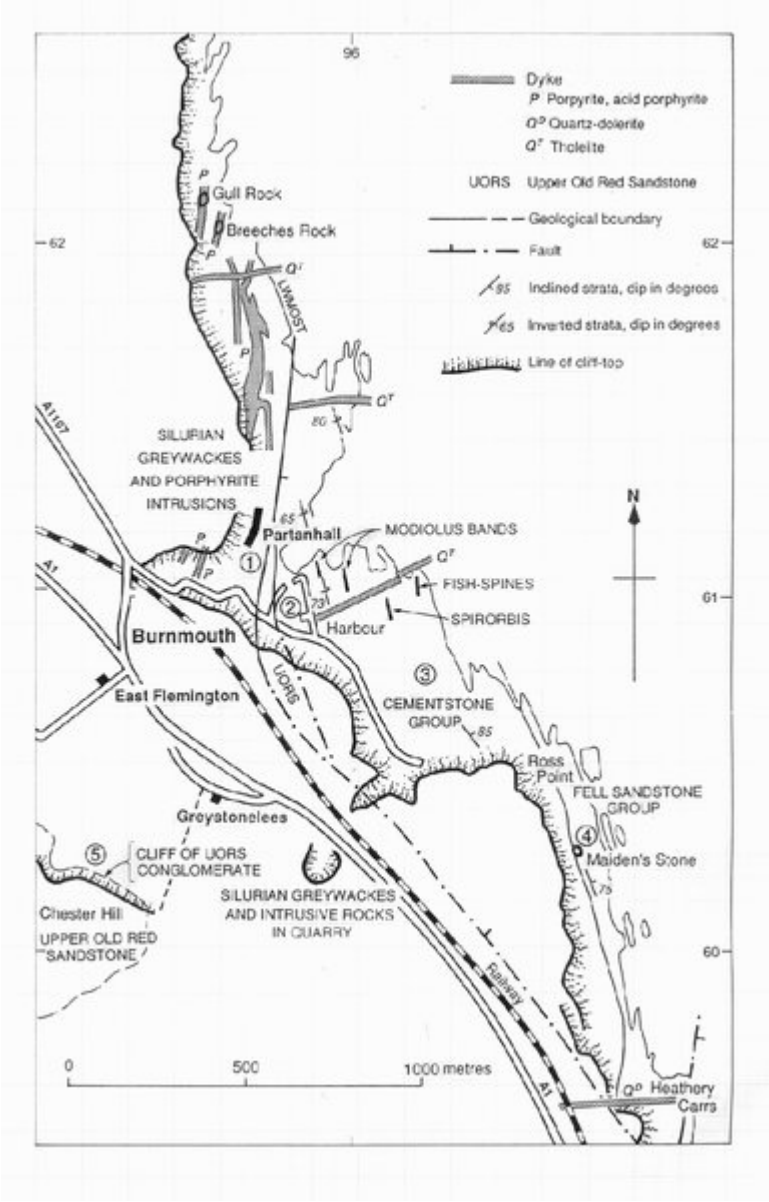
6. Lamberton Beach: Scremerston Coal Group

Approach to Lamberton Beach and Hilton Bay is best from the old A1 road where there is roadside parking [NT 967 580] then across the railway bridge [NT 9731 5801]. The gently dipping rocks occupying Lamberton Beach and the cliffs from the Border north to the NW–SE fault at the Old Fishery constitute the principal exposure of the Scremerston Coal Group north of the Tweed. The Lamberton (Dun) Limestone crops out close to the top of the cliffs. The upper beds of the Group on the cliffs are difficult to examine but include a relatively high proportion of mudstones and a persistent marine horizon, the Marshall Meadows Marine Band, some 16 m below the Lamberton Limestone. Where exposed on the cliff above Lamberton Beach the marine band comprises 4 m of strata, yellow sandstone at the top with brachiopods and burrows, grey mudstone at the base with bivalves. The Coal Group is dominated by thick cross-bedded sandstones, which in many cases channel deeply into the underlying strata, and in consequence the succession varies considerably along the outcrop. For example one band of cross-bedded sandstone, by several phases of channelling and coalescence, varies along the outcrop between 4.5 and 14 m in thickness. The Group includes at least 12 coal seams, none seen to be more than 25 cm thick. Two lie just below the marine horizons; most of the others lie close together near the base of the exposed section. Traces of old mines are visible on the shore just north of the Border.

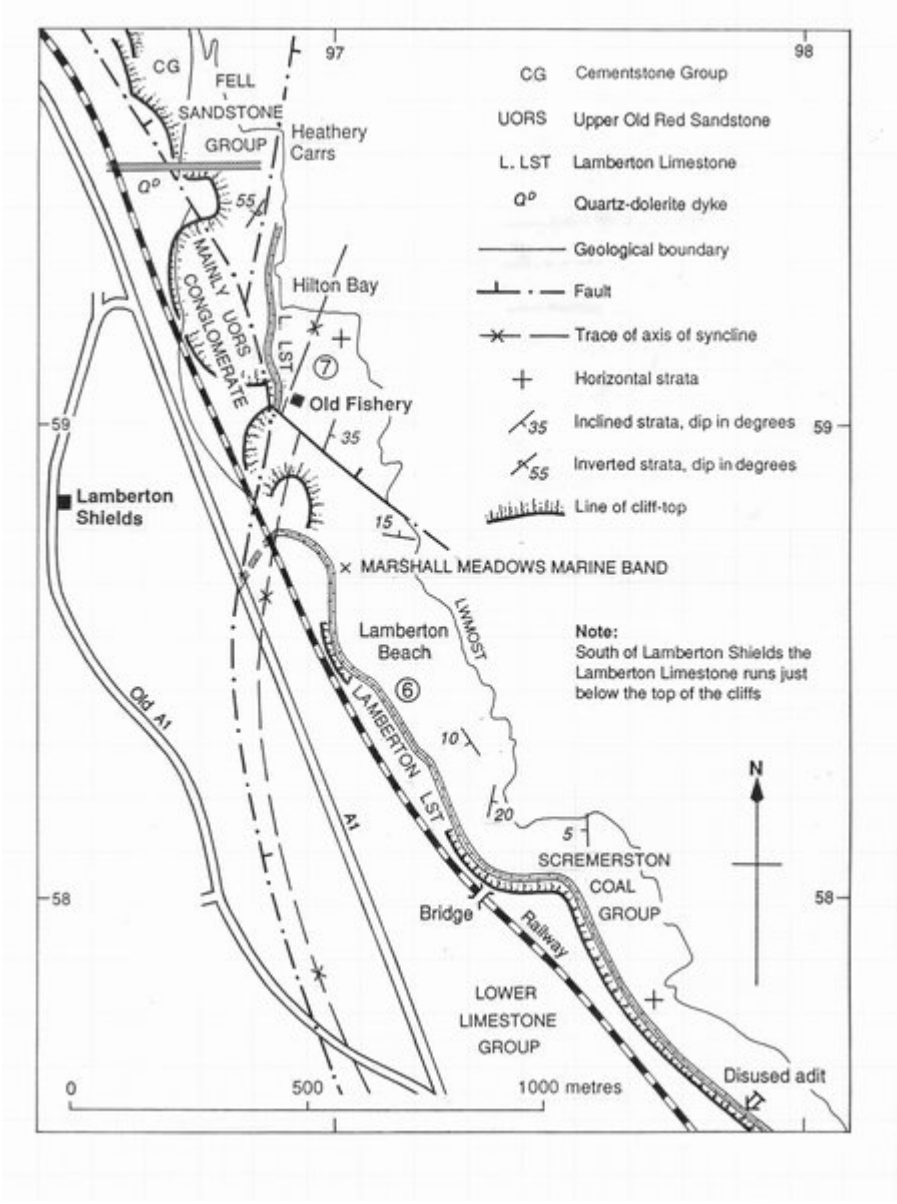
7. Hilton Bay: Berwick Monocline

The form of the Berwick Monocline (Shiells, 1963) is best seen and studied in the vicinity of the old Lamberton Salmon Fishery, north of the NW–SE fault. The headland ridge to north is separated from the slopes immediately east of the railway by a high col, which marks the course, approximately N–S, of the main boundary fault, the landward limit of the very steep strata of the monocline. The synclinal axis, the eastern element of the structure, runs NNE, high on the seaward side of the headland ridge. The steep rocks are exposed just east of the railway, and more extensively on the foreshore to the north, in Hilton Bay. Below H.W.M. in the bay these beds comprise shale and sandstone, the topmost 20 m of the Scremerston Coal Group, the Lamberton (Dun) Limestone at the base of the Lower Limestone Group, and succeeding marine mudstones and a sandstone of that Group. The steep inverted beds young eastwards, towards the sea. At this locality the limestone is 1.2 m thick and is rich in the colonial coral *Lithostrotion junceum*. Also present in the limestone and in the overlying 5.5 m of mudstone are algal layers, bryozoa, productid and chonetid brachiopods, bivalves, and fragments of orthocones and goniatites. The limestone is underlain by a 10-cm seam of coal with a well-developed seatearth. In marked contrast the rocks extensively exposed east of the headland, below the Old Fishery buildings, dip seawards at low angles. Mainly sandstones low in the Lower Limestone Group, cross-bedded and locally convoluted, they are cut off southwards by a NW–SE fault which crosses H.W.M. at a re-entrant just south of the buildings. Thus from the cliff-top east of Lamberton Shields the view to north shows the general form of the Berwick Monocline — strata steep on the landward side, gently dipping on the seaward side. The structure is essentially a grossly asymmetric syncline 'facing' eastwards, the eastern limb dipping at low angles to the east, the western limb close to vertical on a northerly strike, with an inverted westward dip at many localities. The widespread occurrence of gently dipping beds farther inland, as at Chester Hill and extensively in the Merse of Berwickshire, demonstrates that a complementary anticline is present. Southwards from Hilton Bay the main boundary fault runs parallel to and very close to the axial trace of the syncline and the beds to west are much less steep. To north, as we have seen on Burnmouth foreshore, the steep median limb of the double fold is very much wider, the boundary fault being deflected to north-west.

References



(Figure 11) Burnmouth.



(Figure 13) Lamberton.