Berwick-Upon-Tweed

OS. 1:50000 Sheet 75 Berwick-upon-Tweed

B.G.S. 1:50000 Sheets 1 & 2 (England & Wales) Berwick-upon-Tweed and Norham, Solid and Drift

Introduction

The object of the excursion is to examine the Lower Carboniferous stratigraphy and structure of the area both north and south of the River Tweed estuary. Geologically it is known as the Berwick embayment of the Northumberland Trough, which includes Dinantian strata belonging mostly to the Asbian and Brigantian stages. The upper part is of Yoredale facies and forms the main part of the excursion. The basic structure of the district is monoclinal but associated with this major fold are many minor folds and fault which are well exposed along the foreshore. The dips are unusually high in comparison with the rest of the strata in Northumberland and therefore virtually all the Lower Carboniferous succession crops out within the hinterland of the town. The area to the south of Berwick was important in the past for coal mining and is the type locality for the Scremerston Coal Croup. Many of the numerous limestones in the Lower and Middle Limestone Groups have been worked in the past and burnt in local kilns for agricultural lime. The Fell Sandstone Group forms an important aquifer in the district. The local sandstones have been used widely for building stone, particularly the ancient ramparts of the town, its pier and the famous Border Railway Bridge across the Tweed. Although too thin for economic exploitation an oil shale is exposed south of the town. The Lower Carboniferous strata of Northumberland were deposited in a continuously down-warping basin, the Northumberland Trough, elongated approximately east-west and bounded to north and south by the Cheviot Block and Alston Block respectively. A subsidiary basin to the north-east, the Tweed Basin or Berwick embayment of the Northumberland Trough is separated from the main trough by the Cheviot granite and Lower Old Red Sandstone igneous rocks to the south with the Southern Uplands forming a boundary to the north (Chadwick and Holliday 1991). There are over 1000 m of Dinantian sedimentary rocks in this Tweed Basin, as compared with three times that thickness in central Northumberland.

Sedimentation began with the Cementstone Group (400 m+) which consists mainly of fine-grained sandstones, siltstones and mudstones. Within this sequence only a few of the calcareous horizons (cements tones) and shales yield marine fossils. They are exposed in the south bank of the River Tweed [NT 975 515] near East Ord. The succeeding Fell Sandstone Group (200 m) represents a shallow marine accumulation (Smith 1967), or deltaic fan, carried in mainly from the north-east. Strata of this group are exposed on the shore [NT 998 523] at Tweedmouth. The overlying Scremerston Coal Group (300 m) includes dominantly clastic sediments indicative of shallow water conditions, with fairly well sorted limestones and siltstones, sporadic marine bands (rarely of limestone) and numerous coal seams. Sedimentation in the Lower Limestone Group shows the beginning of more important and eventually more extensive marine transgressions in which limestones of considerable lateral extent were deposited and coal swamp environments were correspondingly reduced. A Yoredale type of facies was also established, characterized by rhythmic or cyclical sedimentation. Each cyclothem apparently represents the building up to sea level of an initially downwarped deltaic accumulation. An ideal Yoredale cyclothem would show a regular order from limestone through shale to sandstone, seatearth and coal, but such cycles are seldom regular and usually one or more of the members is repeated, out of order or missing. The Lower Limestone Group rocks of the Tweed Basin exhibit an unusual cyclothemic facies in which the basal units are grey to dark grey in colour, whilst the uppermost beds are red, purple and green. This colour cycle probably represents a penecontemporaneous oxidation resulting from sub-aerial weathering at the end of each cyclothem. The calcareous phase is locally missing from the cyclothem, but the colour cycle is still present in a reduced thickness. (Frost 1969).

metres	**Generalized 'Berwick' cyclothem**	
3.0	Alternation of green, grey and red shales, with seatearths	Red
18.0	Massive cross-bedded red sandstone with intercalations of red and green shale	Red

1.5	Thinly bedded sandstone; pale grey and yellow	Grey
1.5	Sandy shale, grey |developing locally into an algal or oil shale	Grey
3.0	Finely laminated dark grey shale | developing locally into an algal or oil shale	Grey
0.15	Marine shale	Grey
1.0	Dolomitic limestone with few fossils	
1.0	Argillaceous limestone with broken fossils	
	Gradational contact	

Recent seismic interpretation of data in Northumberland by Chadwick and Holliday (1991) has established links between deep basement structures and those of the mapped upper crustal geological features. This has confirmed earlier ideas that the Carboniferous structures may have resulted from extensional reactivation of older basement fractures. Comparison of structural trends in the Southern Uplands and Scottish borders with those in Northumberland shows a dominant east-north-east to west-south-west alignment both in the Lower Palaeozoic and Upper Palaeozoic rocks. The base of the Carboniferous is interpreted by geophysical means to lie at a depth of about 3 km.

The complex structure at surface in the Berwick area were well documented by Shiells (1964). In this part of north-east England, towards the end of the Carboniferous Period, east-west compression (Hercynian) produced a major east facing monocline directly controlled by the configuration of the basement rocks. Concentrations of minor folds in the Eelwell, Acre and Oxford limestones are interpreted as accommodation structures around the hinge of this monoclinal flexure.

Excursion A. Spittal Foreshore (Route: (Figure 14) (Figure 15) to (Figure 16))

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From Berwick, travel south on the A1167 and turn left at roundabout for Spittal. Pass under the railway bridge, turn right at the bottom of the hill for Spittal Promenade. Keep straight on along Main Street until the end of the houses where a parking area is available overlooking the sea. This excursion is best attempted at half to low tide and involves a traverse of some 3 km of rocky (slippery) and sandy foreshore returning by the cliff path. However, many cliff sections are accessible at or near high tide by descending from the cliff path. There is also vehicular access to the southern end of the section from Scremerston village. Follow the signs to Cocklawburn Beach. Turn left at Sea House [NU 023 495] (named Cocklawburn House on the gate) follow a track for 30 m over a cattle grid and park on the cliff top. Alternatively proceed south along the road to Cocklawburn Beach.

1 Bear's Head: Scremerston Coal Group

Some 30 m of this group, consisting of thin coals, seatearths, ferruginous and carbonaceous shales and cross-bedded sandstones, are exposed beneath the Dun Limestone on the foreshore at Spittal and at the beginning of the cliffs. Small scale faulting disrupts the continuity of the strike.

2. Huds Head: Dun Limestone

This limestone, which is the same as the Lamberton Limestone of Scotland, is here 1.5 m thick. The basal 10 cm are impure and shaly with poorly preserved specimens of the colonial coral *Siphonodendron junceum*, and gigantoproductoids. Fossils are better preserved in the upper part, although partly dolomitized. These include bryozoans, *Osagia* .sp., and the corals *Dibunophyllum* sp., *basaltiform Lithostrotion* sp., *Palaeosmilia murchisoni*. The brachiopods *Composita ambigua*, *Rugosochonetes hardrensis* and productoids are present in the shales above. The overlying sandstone shows contorted cross-bedding at the top. The origin of sediment is from the north-west. Garnets form 70% of the heavy mineral suite. The sandstone was used for the construction of Berwick pier.

3–6 Red Shin Cove: Woodend Limestone to Watchlaw Limestone

The Woodend Limestone (3) is 2 m thick though up to 4 m. inland. It is off-white to pale grey and partly dolomitized *Siphonodendron junceum* and gigantoproductoids are common. The Woodend Coals (4), lying some 17 m above the limestone, comprise 30 cm of carbonaceous shale on 40 cm. shaly coal. The coal is considered to be high in the Nm miospore zone. Beyond more thick sandstones lies a 1.2 m. cementstone band (5) overlain by 1.8 m of green shale. These shales are overlain by an algal band up to 50 cm thick, an oncolite comprising near spherical nodules of the alga *Somphospongia* cf. *multiformis*. The succeeding Doupster Oil Shale is 4.5 m thick and has a fossiliferous base with fish debris, ostracods and plant fragments.

The Watchlaw Limestone (6) is pink to red in colour, recrystallized and dolomitized. Analysis shows — CaO 42%, MgO 11 %, compared with typical Yoredale Limestone — CaO 50%, MgO <1 %. (NB Except at low tide it is not possible to continue along the foreshore from this point, so ascend to the cliff path and by-pass the area of steep cliff known as Maidenkirk Brae). From the cliff top, the lens-like nature of the beds below the Watchlaw Limestone and the wash-out beneath Maidenkirk Brae is well displayed.

7. Ravens Nest: Beds below the Oxford Limestone

Descend to the beach again near Cuddy's Cove [NU 019 498]. Some 70 m of alternating sandstones, siltstones and mudstones dip steeply eastwards at angles between 40° and 50°. Some of the intervening shales show minor folds where sandwiched between the more competent strata. The quartz grains in some sandstones are heavily coated by haematite. Although the Greenses Coal and the Beadnell Limestone, normally one cyclothem below the Oxford Limestone, are not exposed in this area, TC spores have been obtained from the coal horizon.

8. Cargies Kiln: Oxford Limestone

This 5 m thick limestone is the first limestone horizon which can be traced throughout Northumberland with certainty, and hence keeps the same name. It is not particularly fossiliferous but has distinctive features such as well developed 'posts', thin shale partings, large crinoid stems and obvious red '*Girvanella'* haloes. Rolled algal nodules are common in the shale partings. The insoluble residue is 4.3%. The faunal assemblage includes *Dibunophyllum bipartitum*, *Gigantoproductus* sp., and *Latiproductus latissimus*, *Eomarginifera* d. *tissingtonensis* occurs in the overlying shales. The base of the Middle Limestone Group is taken at the base of the Oxford Limestone. The type locality of the Oxford Limestone is a quarry at Oxford Farm, some 4 km to the south-west. It was formerly worked on the coast at Cargies Kiln.

9–12. Sea House: Oxford Limestone to Acre Limestone

The Middle Limestone Group which extends from the base of the Oxford Limestone to the base of the Great Limestone, contains a well developed Yoredale facies with thick and laterally continuous limestones. Conditions of deposition were now more uniform throughout the County with the Tweed Basin geographically linked to the Northumberland Trough and receiving a similar supply of sediments.

There are six thin limestones in the strata between the Oxford and Eelwell limestones (9) which can be closely correlated with calcareous horizons further south. The Eelwell Limestone (10), is some 8 m thick and slightly dolomitized and characterized by many large gigantoproductoids, *Syringopora* sp., *Lithostrotion* sp. and cyathaxonoid corals. The top layer is rich in spiriferoids. The exposures are dominated by the anticlinal overfold and overthrust near Saltpan Rocks (Figure 17). The strata between the Eelwell and Acre limestones (11) contains a 30 cm

thick, sulphur-rich coal, the Acre Coal, which is overlain by dark grey shales and underlain by a dark grey seatearth. The Acre Limestone (12) some 4.5 m thick, forms a reef out at sea, south of Sea House. It is paler grey in colour compared with the underlying limestones and, as well as containing a plentiful coral and gastropod fauna, is dominated by the alga *Saccaminopsis carteri* which acts as a valuable marker for this bed.

13 Near Skerr, Middle Skerr, Far Skerr: Sandbanks Limestone

This limestone, otherwise known as the Four Fathom Limestone, occupies much of the foreshore, forming a syncline between Near Skerr and Middle Skerr and an anticline between Middle Skerr and Far Skerr. It is 8.5 m thick and split into many posts or beds by shaly partings. The limestone is famous for large specimens of the straight-shelled, cephalopod, *Orthoceras* sp., over 1 m in length.

14. Cheswick Black Rocks: Great Limestone

This limestone lies some 30 m above the Sandbanks Limestone, is some 10 m thick and has a distinctive pinkish colour in this area. The Great Limestone forms the base of the Upper Carboniferous. It has been worked throughout the County by virtue of its thickness and purity.

Excursion B. Berwick Foreshore (Route: (Figure 18))

Author: D.V. Frost

Parking is available in the town at [NU 000 531] in an area known as The Parade, next to the Barracks and the Holy Trinity Church. It can be approached from Walkergate. It is also possible to proceed further east by car through the Cow Port Gate and follow the signs for the Golf Course and park on the cliff top [NU 003 534]. From the cliff top paths alongside the golf course the planated folds of the Lower Carboniferous rocks are well displayed at low tide. The strata range from the sandstone below the Oxford Limestone to the Acre Limestone near the top of the Middle Limestone Group. Two important faults, the Green's Haven Fault and the Meadow Haven Fault separate the region into distinct structural zones.

1. Green's Haven: Fault, syncline

The Green's Haven Fault can be seen in the cliff just south of the pier in Green Haven. The hade is 25° to the south. An area of sheared Eelwell Limestone occurs in the fault zone and slices of limestone appear to have been dragged along the fault suggesting a relative dextral translation of the opposing fault blocks. The overall movement is, however, oblique slip. Between the Green's Haven Fault and the cliff the Green's Haven Syncline (Fowler 1926) whose axial plane trends 035° and plunges gently north-eastwards. The dips are 30° or less on the flanks. The structure is traced by outcrop of the Eelwell Limestone which is complicated by two minor anticlines in the hinge region.

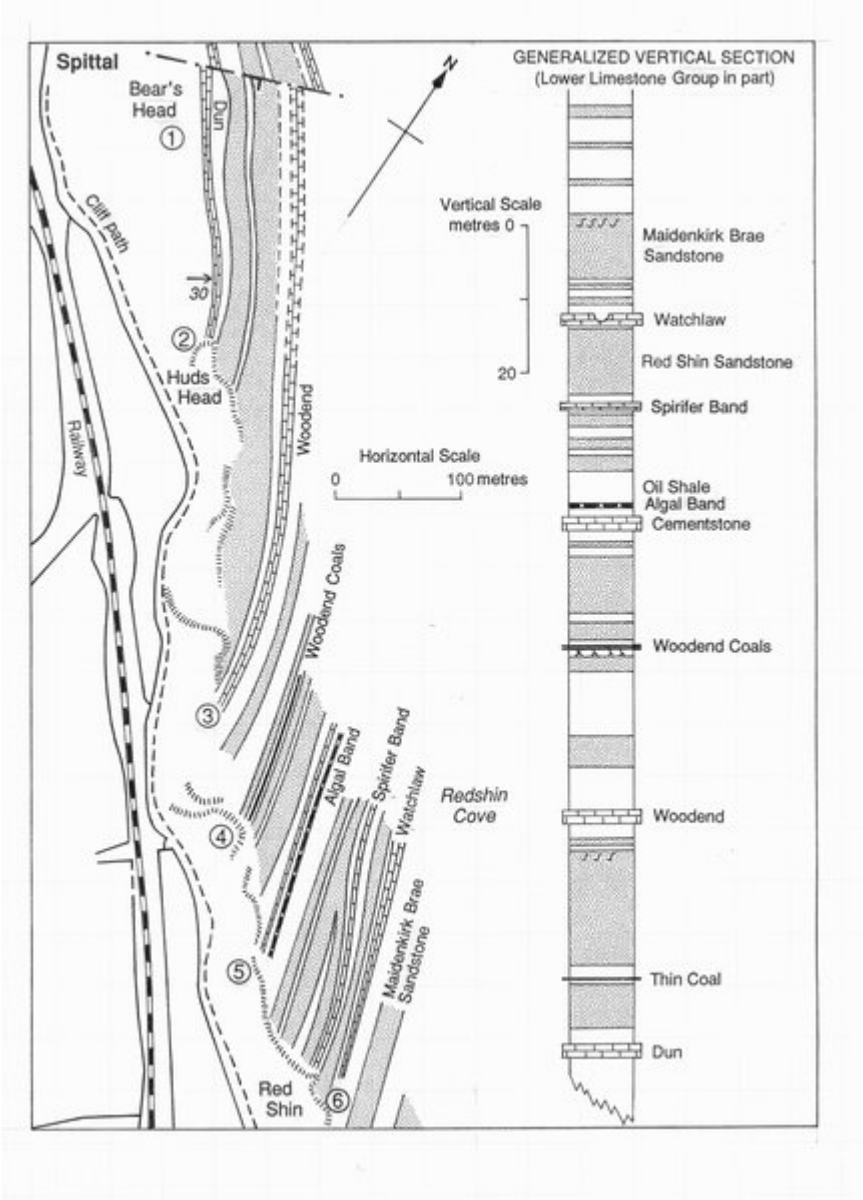
2. Ladies Skerrs: pericline

To the south east, the Green's Haven Syncline passes into the Ladies Skerrs Pericline trending 035° and plunging at 5 degrees to 10 degrees. The structure is marked by the outcrops of the Bath House Wood (Upper and Lower) and Colwell limestones. Asymmetry is marked with the steepest south-eastern limb approaching near vertical attitudes; with only 15° to 20 typical of the north western flanks. The fold is truncated by the Green's Haven Fault on the north-east. A small fault trending E–W with downthrow to the south cuts through the centre of the fold. Several minor structures occur in the Lower Bath House Wood Limestone on the south-west flank of the main fold. These form en-echelon anticlines, some broken by reverse shears.

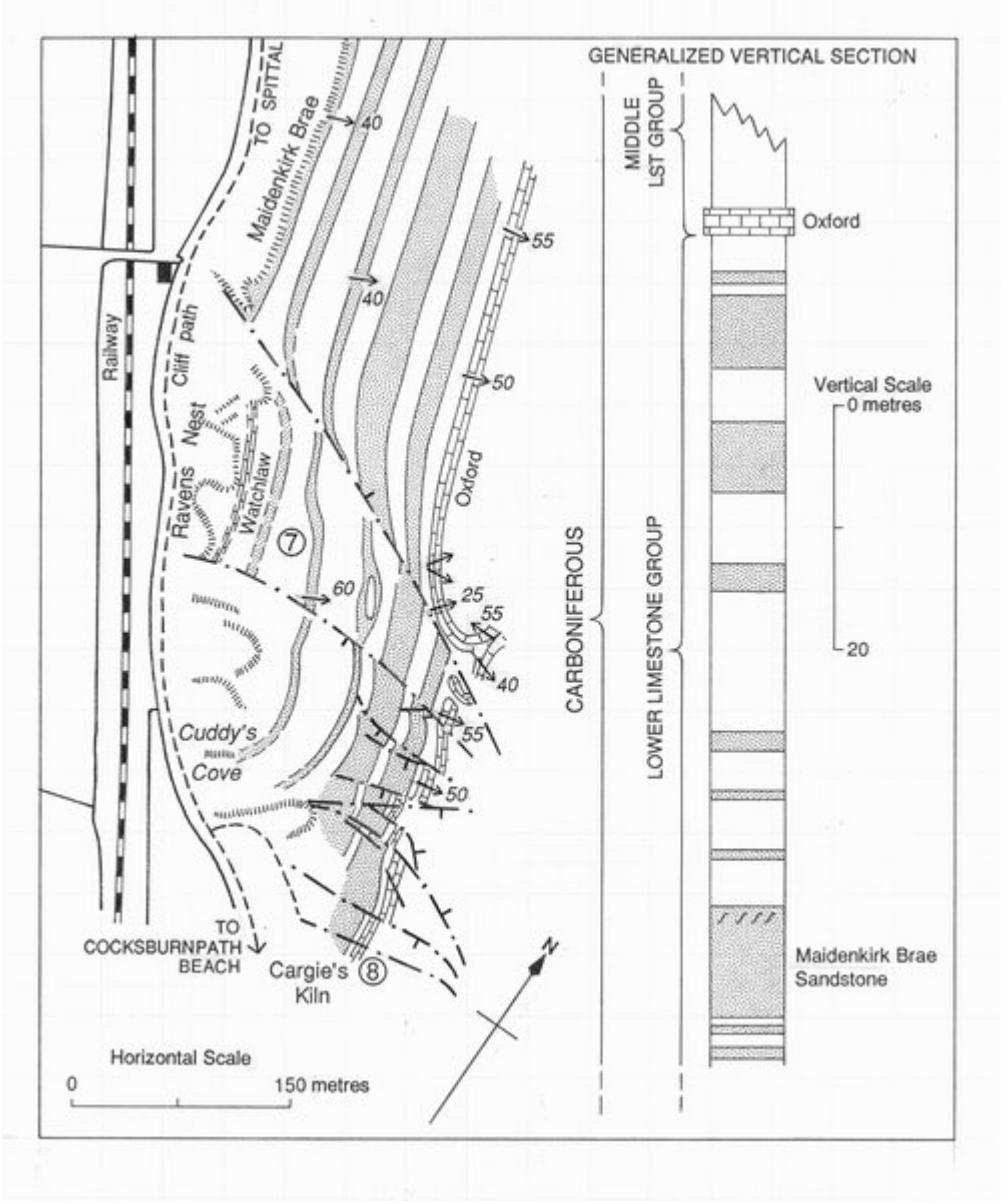
3. Bucket Rocks: syncline

The Ladies Skerrs Pericline passes south into the Bucket Rocks Syncline trending 030° and formed by the Shotto Wood and Eelwell limestones. As with the two previous structures to the north, minor folds are present on the nose of the fold. The syncline is truncated by The Meadow Haven Fault which trends 080 degrees as a complex zone of sheared and contorted blocks. Pinnate shear joints and tension gash echelons in the strata north of the fault indicate dextral movement, but again the overall movement is of oblique slip. The minor fold structures on the Berwick foreshore are all concentrated around the hinge areas of larger folds and they have substantially attributed to the accommodation of these structures (Shiells,1964). When most of the foreshore is covered by the sea, excellent exposures of the Eelwell and underlying limestones are accessible in the cliffs along the shore.

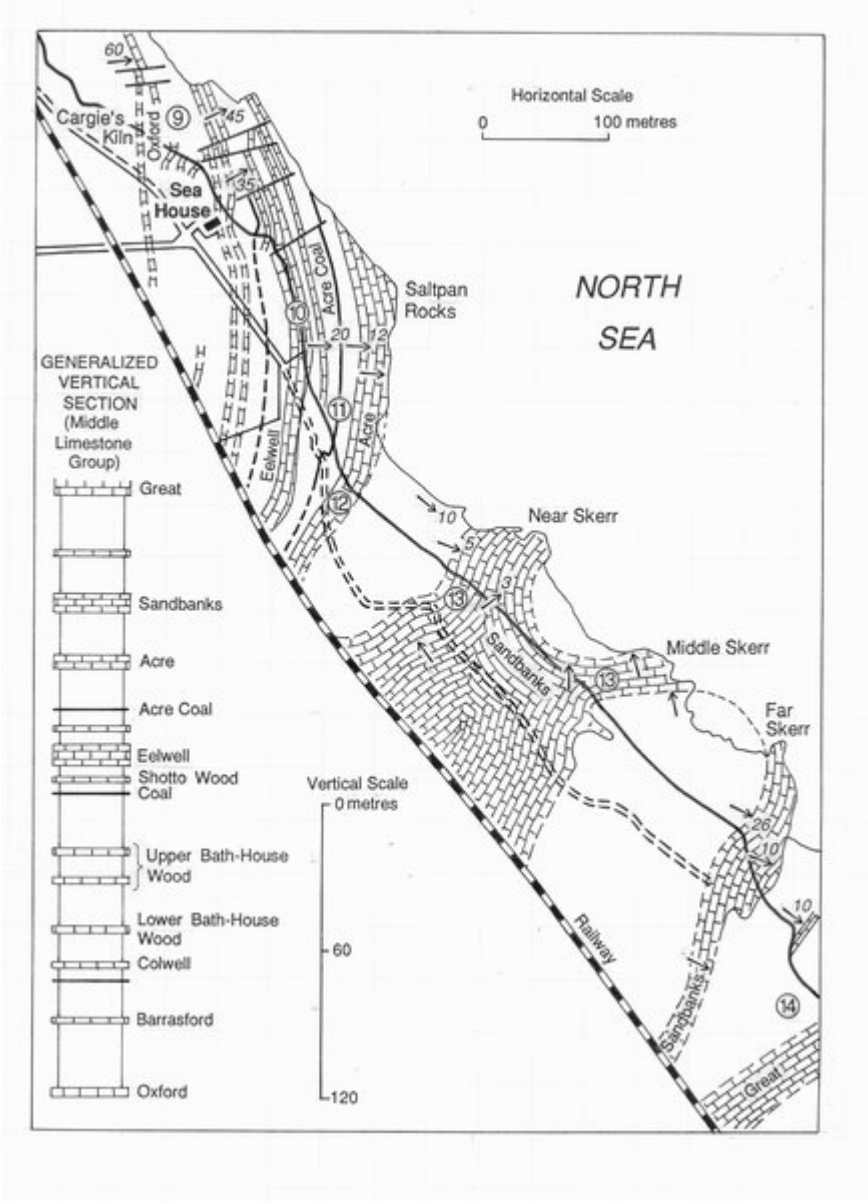
References



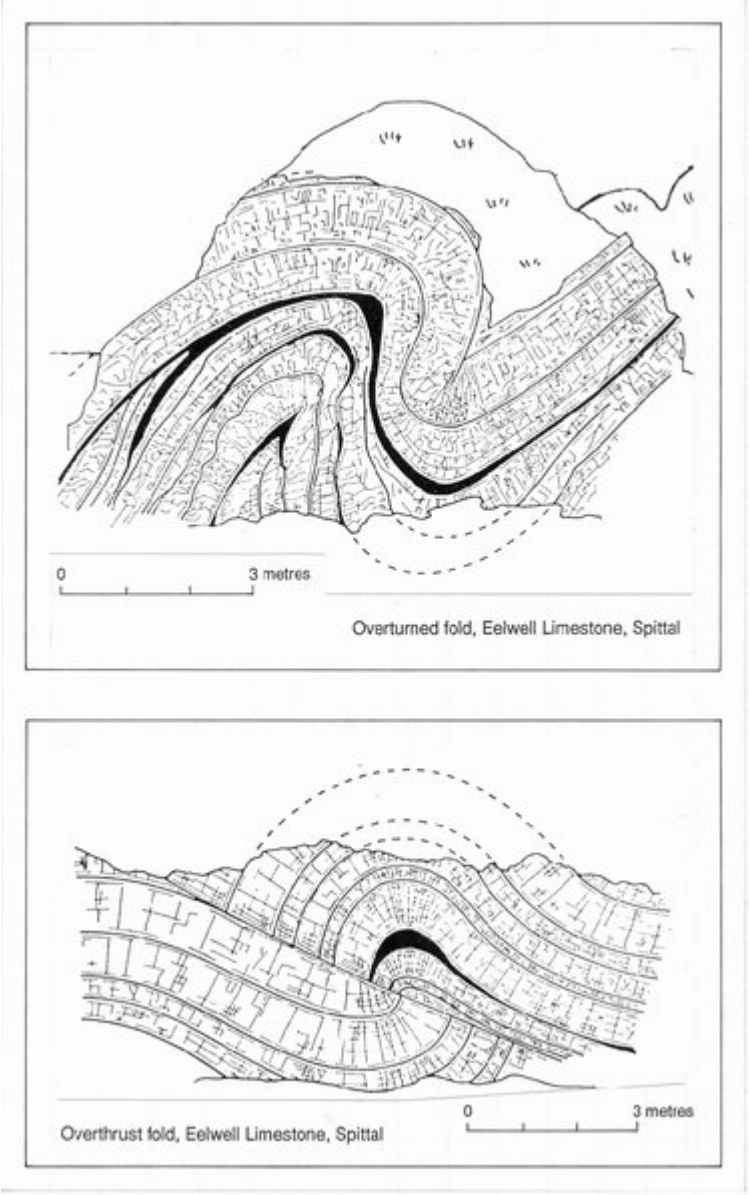
(Figure 14) Spittal foreshore north part.



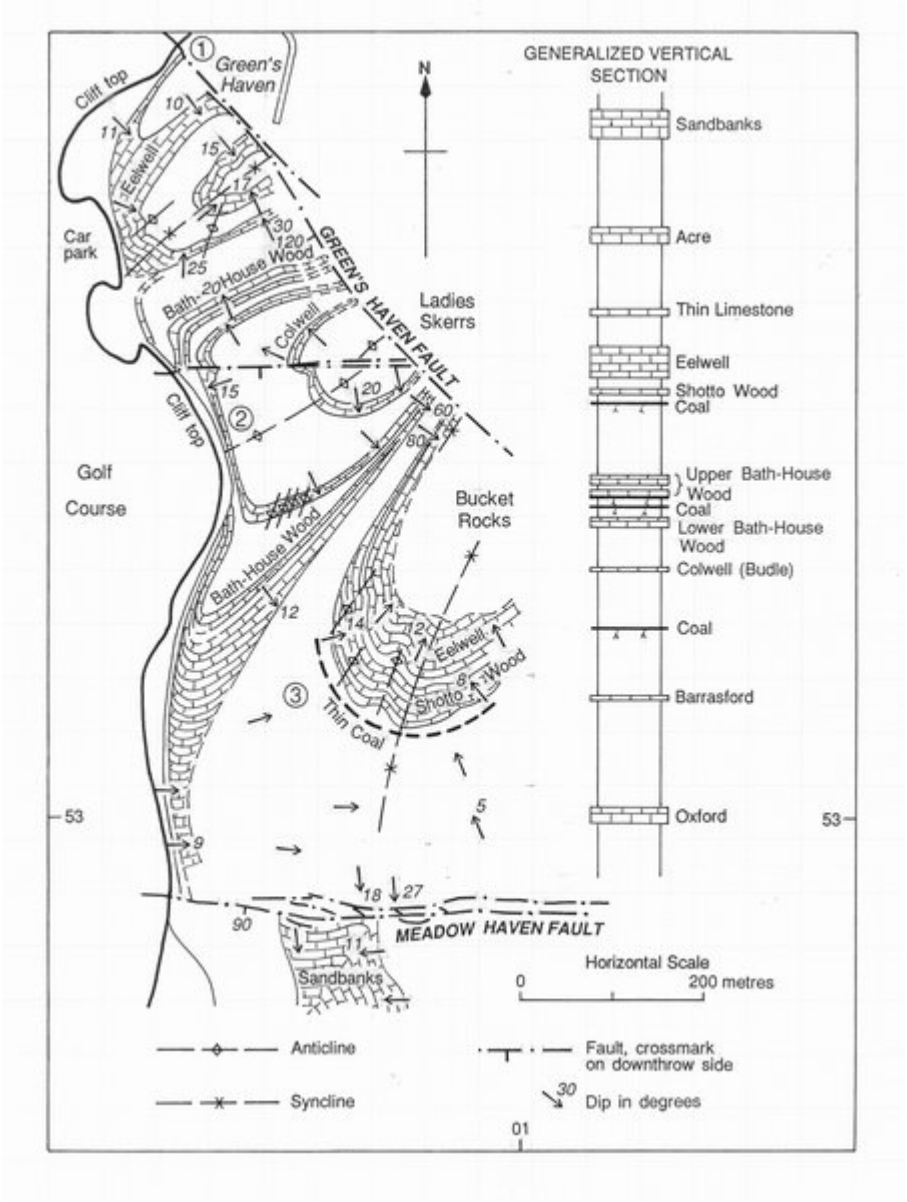
(Figure 15) Spittal foreshore central part.



(Figure 16) Spittal foreshore, south part.



(Figure 17) Folds in the Eelwell Limestone.



(Figure 18) Berwick Foreshore.