
18 Lower and Middle Jurassic rocks between Robin Hood's Bay and Hawsker Bottoms

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Purpose

To view one of the finest Lower Jurassic sections in Northern Europe, starting with the Redcar Mudstone Formation (Calcareous Shales; Lower Lias) in the Robin Hood's Bay dome structure and ending with the Alum Shales Member (Whitby Mudstone Formation; Upper Lias). The overlying Dogger and Saltwick Formations (Aalenian, Middle Jurassic) are exposed in cliff sections at Hawsker Bottoms.

Logistics

This is quite a strenuous day, entirely dependent on favourable tides. Park in the Old Station car park in Robin Hood's Bay [NZ 950 055]

There are toilets, pubs and cafes in Bay Town, but none en route.

Note: The beach traverse takes at least 4 hours to complete at a moderate pace for a fit person and with few stops. Start on a falling tide (2–3 hours below low tide). **Do not attempt this section at the wrong state of tide with an on-shore wind as there are many places (marked on the sketch map) where the tide rushes in and you could be cut off.** The ascent up the cliff at the end of the section at Hawsker Bottoms is very difficult. The cliff is still negotiable, although a difficult scramble (sometimes aided by an *in situ* rope). Consider this carefully before embarking on the section past Castle Chamber.

Wear a safety helmet. Try to keep clear of the cliffs as there is a constant rain of debris (from shale fragments to sandstone blocks of many tonnes weight). Try to go in pairs so that one can watch the cliff while the other looks at the geology; indeed this is a lonely section so *inform someone* (i.e. Coastal Wardens) where you are going and at what time you intend returning to Robin Hood's Bay.

At the end of the section when you have ascended the very steep cliff path at Hawsker Bottoms, there is a brisk cliff-top walk of at least 1 hour's duration back to Robin Hood's Bay.

Maps

O.S. 1:50 000 Sheet 94 Whitby; O.S. 1:63 360 Tourist Map North York Moors; B.G.S. 1:63 360 Sheets 35 & 44 Whitby & Scalby.

Geological background

This 11.5 km section is on the northern limb of the Robin Hood's Bay dome structure, one of several inversion structures (intra-Jurassic) found in the Cleveland–Sole Pit Trough Depositional Basin (Kent *in* Rayner & Hemingway, 1974)

This well-defined and classically exposed equidimensional structure (Figure 18.1) is truncated to the east by the north-south Peak Fault, considered to be both a late Liassic synsedimentary fault and a sinistral transcurrent fault which has displaced the seaward part of the dome possibly some 8 km southwards (Hemingway *in* Rayner & Hemingway, 1974)

The base of the Lias (Hettangian Stage) is not exposed even at the lowest tides in Robin Hood's Bay and there may be some slight discrepancy in the actual thicknesses of the lower Liassic sequences which are exposed on the extensive

wave-cut platform. A summary geological succession is given in (Figure 18.1).

There are thick deposits of tills in the central areas of Robin Hood's Bay and it has been suggested that these Late Quaternary deposits infill valley features at two points: The Sands, just South of Bay Town [NZ 954 045], and at Stoupe Beck [NZ 958 035]

Indeed the base of the pre-glacial valley at Stoupe Beck seems to be below present sea level. These tills contain erratics from a variety of sources and supply exotic beach pebbles in the central section of the Bay (identifying them provides an interesting pastime when waiting for the tide to go out!). The cliffs predominantly composed of till are unstable and subject to extensive landslips but occasionally the tills can be seen to be divided by a central sandy sequence.

Excursion details

From the Old Station car park [NZ 950 055], pause at the top of the hill to appreciate the panoramic views of the bay and the dome structure visible at low tide, then descend the hill through Bay Town to the Landing slipway. At this point it would be an advantage to take the coastal cliff path southwards to Boggle Hole.

Locality 1 [NZ 952 046]

There are fine views from the path of the minor faults exposed on the beach (at Locality 4) which radiate from the centre of the bay and the dome structure.

Locality 2 [NZ 956 041]

At the exit of Mill Beck onto the beach at Boggle Hole identify the 'Double Band' which forms a prominent scar feature to the south of the beck at the base of the cliff. This Double Band forms a prominent marker horizon within the *oxynotum* Biozone (Sinemurian).

(Figure 18.2) The 'Double Band' at Boggle Hole. These two prominent bioturbated fine sandstones containing a variety of trace fossils form a useful marker horizon on the foreshore.

Locality 3 [NZ 959 038]

Walk out into the centre of the bay to the limit of the tide and then work back up-sequence over the harder continuous scars (beach features of calcareous siltstones, fine sandstones and nodule horizons) with intervening softer siltstones and shales (also with nodules) which constitute the Calcareous Shales (lower Redcar Mudstone Formation) at this locality. At the furthest extremity you will be within the *obtusum* Biozone (although the reefs furthest out to sea to the southeast contain the ammonite *Arnioceras* indicating the *semicostatatum* Biozone). About halfway between High Scar and the Double Band at the base of the cliff the ammonite faunas change to *Gagaticeras*, *Oxynoticeras* and *Epararietites* indicative of the *oxynotum* Biozone. All the sediments exposed as scar features or interleaving shales/siltstones are fossiliferous, with body fossils such as bivalves (*Gryphaea*, *Pleuromya*), crinoids (*Pentacrinites*) and numerous belemnites. These sediments are also extremely bioturbated with widespread *Chondrites* together with more substantial trace fossils such as *Teichichnus*, *Rhizocorallium*, *Ophiomorpha* and *Diplocraterion* usually associated with the more indurate levels.

At some levels within the softer shales and siltstones large, isolated, flat, subcircular, iron-rich, concretions can be seen. These are usually highly bioturbated and sometimes contain *Pentacrinites*, belemnites and ammonites. These have been interpreted as 'scours', where bottom currents winnowed out the finer material leaving marginally coarser-grained sediments and shell debris behind, which then attracted iron diagenesis. These 'scours' form a sporadic but integral part of the entire section to be viewed for the rest of the day up to the top of the Cleveland Ironstone Formation.

Return to the Double Band at the base of the cliff at Boggle Hole and follow this prominent beach feature across Mill Beck (where it is displaced slightly at a small northeast–southwest fault).

Locality 4, Dab Dumps [NZ 956 047]

Around the foreshore between Boggle Hole and Bay Town (known as Dab Dumps) there are a series of small faults associated with the dome structure of Robin Hood's Bay. The throw on these faults can be illustrated using the Double Band as the datum horizon on the foreshore.

Locality 5 [NZ 955 048]

The sediments above the Double Band contain the ammonite *Echioceras* indicative of the *raricostatum* Biozone. These form the upper parts of the Siliceous Shales.

Opposite the slipway at Bay Town, rare ammonites in the shales of Ground Wyke Hole indicate the start of the Ironstone/Pyritous Shales (Lower Pliensbachian). All ten subzones of the Lower Pliensbachian have been determined in the Ironstone/Pyritous Shales on the north side of Robin Hood's Bay between Bay Town and Castle Chamber. Ammonites are sporadic and poorly preserved in these sediments (which are characteristically cyclic shale-silt units with prominent ironstone concretion levels) but the genera *Acanthopleuroceras*, *Apoderoceras*, *Platyplesioceras*, *Tropidoceras* and *Androgynoceras* are represented. Most of the beds also contain a variety of bivalves, belemnites, brachiopods and wood debris; they are also very bioturbated, commonly with *Chondrites*, but also with *Rhizocorallium*, *Ophiomorpha* and *Teichichnus*.

Locality 6 [NZ 953 052]

From this point (where curious vertical 'starlike' pyrite bodies may be seen in the shales) onwards, the sediments of the *ibex* Biozone are rich in the large bivalve *Pinna*. Over beds some 26.5 m thick the communities of *Pinna* can be seen either in life position, with the open aperture probably facing the predominant bottom current direction (the planed-off bivalve shells having a distinctive lozenge appearance), or with the large triangular shells current sorted and lying parallel to the bedding planes (storm redistribution?).

Locality 7 [NZ 954 054]

Throughout the remaining part of this section almost to Castle Chamber, horizons of red sideritic nodules are well displayed in cliffs and on the foreshore where they often display a ramifying and connected appearance. These ironstone nodules usually have septarian centres. A prominent nodule horizon may be seen at the base of the cliff with diffused reddish margins and cream-coloured septarian interiors. This is near a prominent normal fault (you might like to pause and try to work out the throw on this fault).

Working northeast towards Ness Point (North Cheek) the slight northern dip on the northern limb of the Robin Hood's Bay dome brings in younger horizons. There are rare ammonites in this part of the section (in nodules and as pyritic nuclei in shales/siltstones), bivalves are common (i.e. *Pseudopecten*, *Pleuromya* and other myids and *Gyphaea*) and there are at least three thin and impersistent limestone horizons comprised of current sorted *Gryphaea* shells (mixed with belemnites and other bivalves). Cliff exposures near Dungeon Hole [NZ 953 054] show these Pliensbachian sediments to have numerous fining upwards cycles often with minor erosion gutters.

Locality 8 [NZ 960 061]

Just past the waterfall and shipwreck remains at Ness Point and just in view of Castle Chamber, look for a particular ironstone nodule bed on the foreshore. This 0.10 m thick composite bed of sideritic nodules has large subvertical burrows in the top, filled with chamositic oolitic ironstone (the first oolitic ironstone in the Yorkshire Jurassic Basin). Some 9 m above this oolitic horizon is one of several curious ironstone horizons; this one is bimodal in origin with small concretions (0.10 m in diameter) at the top of a 0.20 m concretionary bed.

From Ness Point on to Castle Chamber large fallen blocks of sandstone from the Staithes Formation may be seen on the foreshore. The stratigraphical top of these blocks often have rippled surfaces and are covered with well-preserved shell

debris, including *Pseudopeecten*, *Protocardia*, *Gryphaea*, *Liostrea* and the scaphopod *Dentalium*, the latter often displaying well-developed current orientation. At Bulmer Steel at the base of the cliff and on the foreshore look for a 3.5 m section of grey siltstones with grey nodule horizons where *Oistoceras figulinum* might be found (indicating the top Subzone of the *davoei* Biozone).

Locality 9, Castle Chamber [NZ 960 067]

The Ironstone Shales (shales/siltstones) at the top of the Redcar Mudstone Formation grade imperceptibly into the shallow-water siltstones/sandstones of the Staithes Formation. Some 4.5 m below the floor of Castle Chamber is a prominent laminated sandstone, the first real arenaceous horizon of the Staithes Formation. The small sandstone cliff overhang at Castle Chamber provides a good shelter/safety point and the section there forms the biostratigraphical boundary between the Lower and Upper Pliensbachian, with the first *Amaltheus* some 0.3 m below the roof sandstones. The cross-laminated sandstone/siltstone horizons which form the floor and roof of Castle Chamber (usually with oyster beds at the base of both) are exposed on the foreshore between Castle Chamber Point and the Cow and Calf Rocks. Both sandstone units exhibit scour gutters at the base.

Walking northwest towards Clock Case Nab, you will pass over shallow water sediments, particularly sandstones with nests of *Protocardia truncata* (often the centres for sideritic diagenesis). Occasional finds of *Amaltheus stokesi* in these sediments indicate the base of the *margaritatus* Biozone.

Locality 10, Clock Case Nab [NZ 956 071]

A thin split ironstone nodule horizon can be seen at the base of Clock Case Nab. Looking northwest across the embayment called Far Jetticks towards Hawsker High Cliff and High Scar, there is a fine view of the upper Middle Lias (*spinatum* Biozone) on the foreshore section with a thick sequence of the Upper Lias (Whitby Mudstone Formation: Grey Shale Member to Alum Shale Member) in the cliff section above.

Locality 11, Far Jetticks [NZ 953 073]

The Upper Middle Lias section at Far Jetticks, some 12.5 m thick, may be compared with that seen in the Staithes–Port Mulgrave section (Excursion 16). All the subzone index ammonites may be found on this section together with many belemnites, bivalves and nests of *Tetrahynchia*.

While in the vicinity of Hawsker High Cliff look (*with extreme caution*) at the fallen material at the base of the cliff. Pyrite-skinned nodules contain *Harporoceras exaratum* and *H. falciferum* (index fossils of the Mulgrave Shale Member), while grey nodules containing *Dactyloceras* and *Hildoceras* indicate the Grey Shale and Alum Shale Members.

Locality 12, Hawsker High Scar [NZ 951 077]

The calcareous sandstone that forms the top of the scar, which may involve a 3 m scramble, is some 3.20 m below the top of the Middle Lias. The sediments here indicate an important event boundary within the Yorkshire Basin, where the shallow-water sediments of the Cleveland Ironstone Formation abruptly change to deeper-water sediments of the Whitby Mudstone Formation (Grey Shale Member).

Locality 13, White Stone Hole [NZ 950 076]

The Grey Shale Member is reasonably well exposed here near the base of the subcliff. The Mulgrave Shale Member is well exposed 200 m to the northwest, where the continuous concretion horizon of the Top Jet Dogger and the Whale Stone concretions some 2 m below can be seen at the base of the subcliff (the productive jet horizon on the Yorkshire coast is between these two concretion bands).

At this point the beach section becomes less clear as it is littered with deltaic sandstone blocks from the cliff above. From White Horse [NZ 949 078] onwards the foreshore section is largely obscured by large landslips. At the top of this landslip

complex is a path of sorts (it continually changes owing to movement) which should be followed to Pursglove Stye [NZ 945 082]

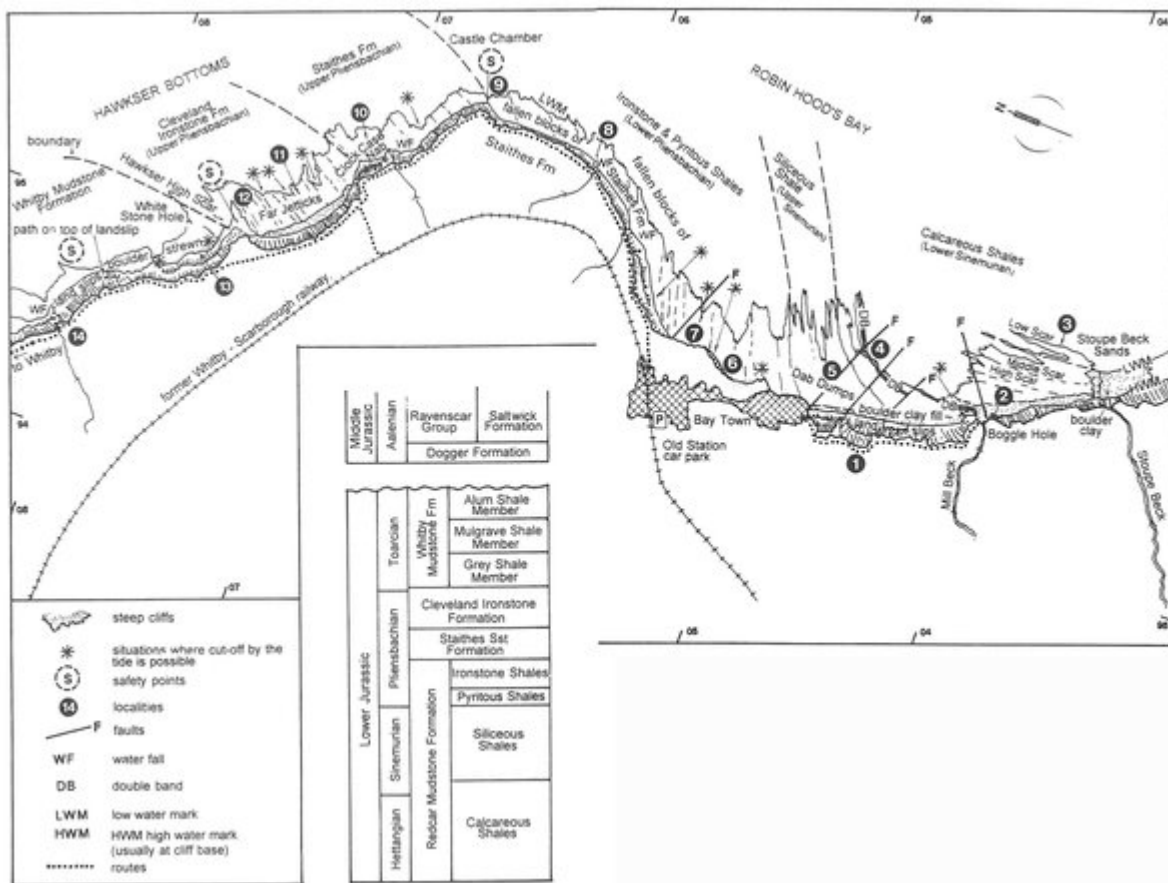
At Pursglove Stye, the remains of the steep path up the cliff (now disrupted by landslip) may be seen sometimes marked by a fixed rope (NB — test the rope before relying on it). Ascend the steep Heather covered Alum Shales slope carefully, picking your route with care until you reach the base of the vertical Middle Jurassic sandstone cliff at Location 14 [NZ 946 081], where you will meet the coastal cliff-top path.

Locality 14 [NZ 946 081]

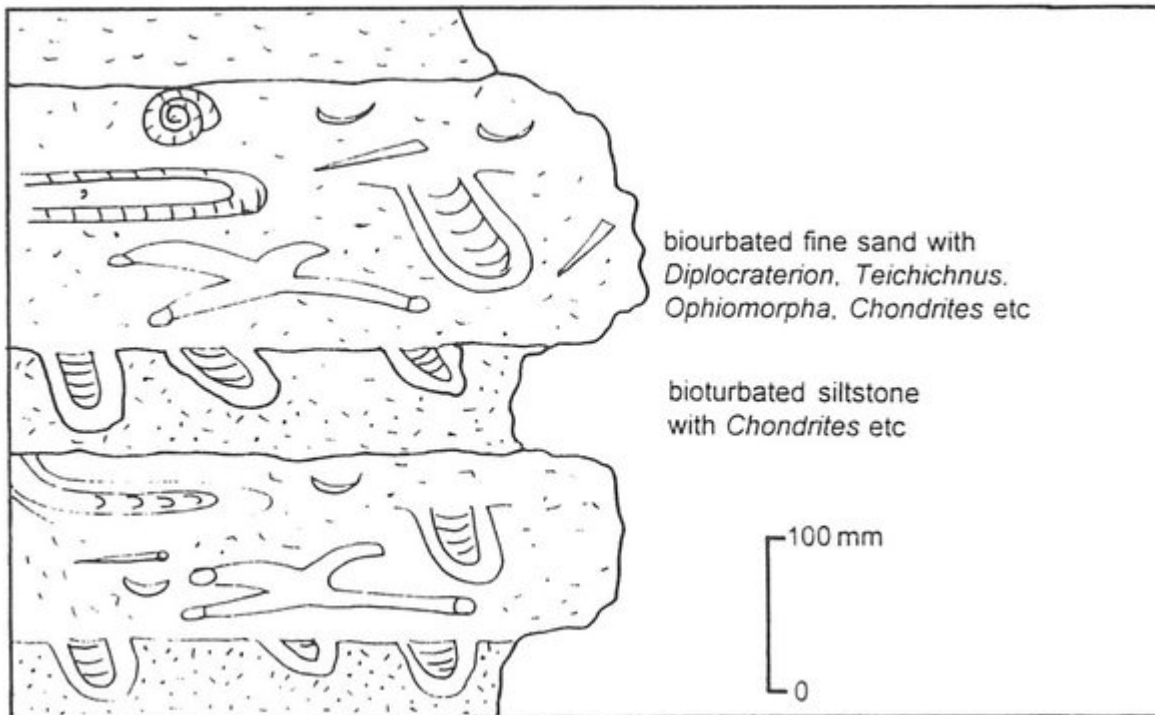
Before finally getting to the top of the cliffs at Hawsker Bottoms, an interesting minor detour involves walking southeast for 0.1 km at the base of the vertical Middle Jurassic sandstone cliff. The sections in the Saltwick Formation are particularly good with excellent channel features, but at the end of this path is also an excellent exposure of the ferruginous sandstones of the Dogger Formation (Aalenian, Middle Jurassic). This marine sandstone contains sporadic bivalves and often has a remainie bed at the base consisting of phosphatic pebbles and ammonite fragments eroded from the Upper Lias beneath. There is a stratigraphical hiatus at the junction of the Lias Shales with the Dogger.

On reaching the cliff-top footpath, walk back to Robin Hood's Bay and the car park, stopping, and with care, looking at the Jet Rock workings (with rare jet planks) at the top of Clock Case Nab [NZ 954 070].

Bibliography



(Figure 18.1) Map of the foreshore between Robin Hood's Bay and Hawsker Bottoms, with the geological successions for the area.



(Figure 18.2) The 'Double Band' at Boggle Hole. These two prominent bioturbated fine sandstones containing a variety of trace fossils form a useful marker horizon on the foreshore.