Magnesian Limestone between South Shields and Seaham - an excursion

From Earthwise

Jump to navigation Jump to search

Scrutton, Colin, Editor Northumbrian rocks and landscape: a field guide. 2004. 2nd edition. Published by the Yorkshire Geological Society .

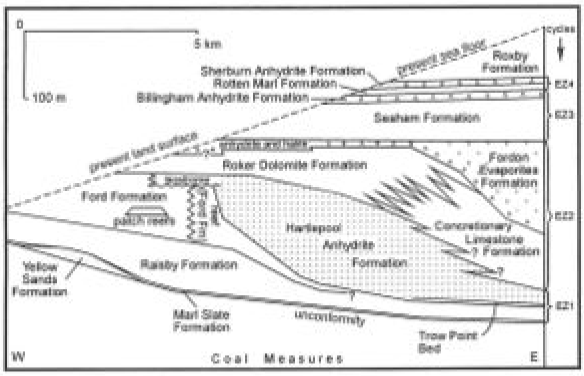

Figure 13.1 Permian strata in the excursion area, with the evaporites restored to their original position. Slightly modified from Smith (1994).

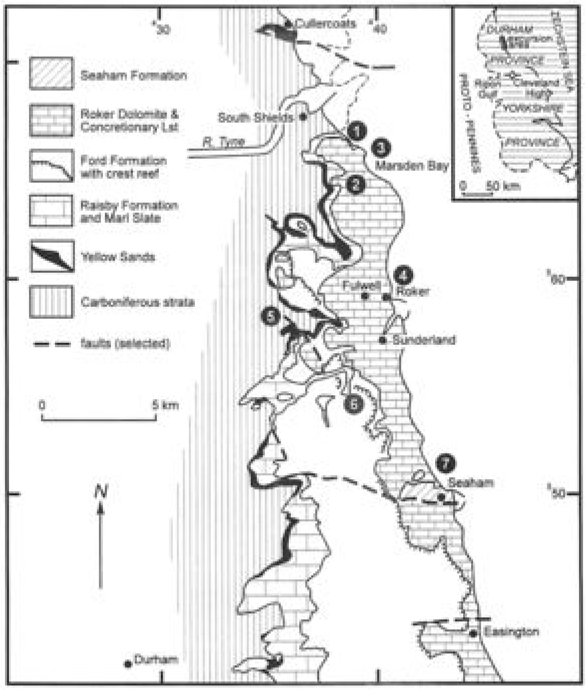

Figure 13.2 Distribution of Permian strata in the excursion area, showing the approximate positions of localities 1-7. Slightly modified from Smith (in Johnson, in press).

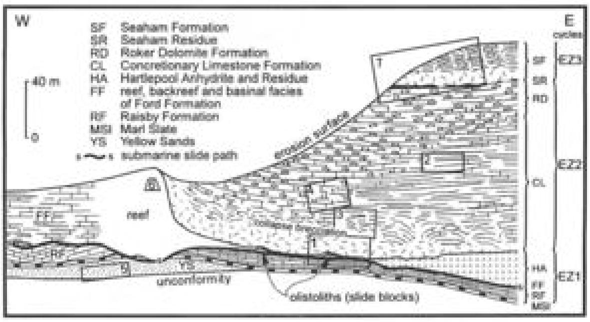

Figure 13.3 Permian strata in the excursion area, showing the approximate stratigraphical positions of localities 1-7. The Hartlepool Anhydrite would not normally be present close to the coast but is included for completeness.

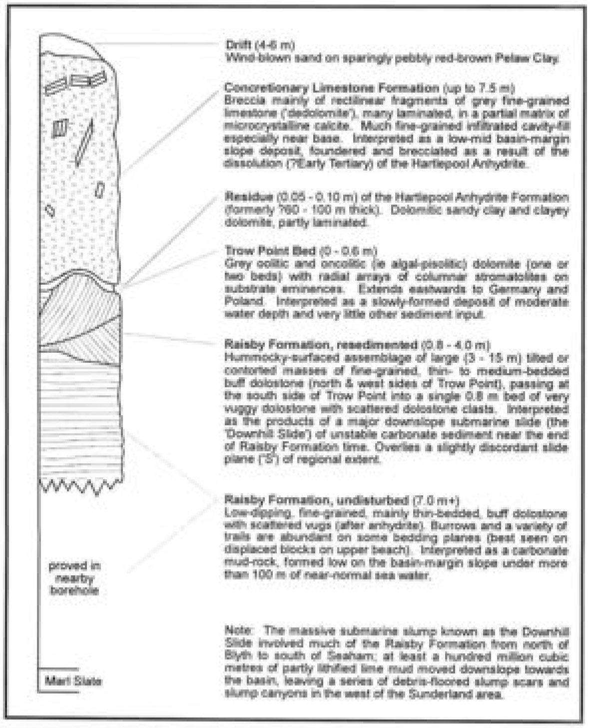

Figure 13.4 Strata exposed at Trow Point.

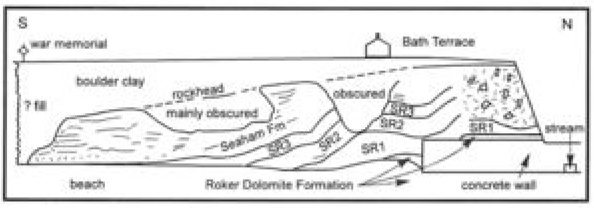

Figure 13.5 Strata exposed in the cliffs north of Seaham Harbour.

By **Denys Smith** GEOPERM and University of Durham.

□

Contents

Purpose

To examine the Permian rocks in the coastal area of County Durham (including Tyne & Wear) and to interpret their mode of origin.

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.

This excursion occupies one full day (or two half days) and takes a minimum of 8 hours, including a 1-hour lunch break. All the exposures are close to roads and parking is available nearby. About 25 km travelling, some urban, is involved between the first and last stops. Parts of the coastal sections are not accessible at high tides.

Maps

O.S. 1:50 000 Sheet 88 Tyneside & Durham; B.G.S. 1:50 000 Sheet 21 Sunderland.

Geological background

The highly varied rocks to be seen on this excursion were all formed during the last few million years of the Permian Period and comprise the Yellow Sands Formation and the internationally known and spectacular Magnesian Limestone. The sequence is shown in Figure 13.1.

Most of the Permian Period in northwest Europe, including County Durham, was dominated by erosion, uplift and reddening of Carboniferous and earlier rocks that had been **faulted** and gently **folded** by the late Carboniferous **Variscan** earth movements. During this time, perhaps for 40 **Ma**, the region drifted slowly northwards from the wet equatorial belt to the dry trade wind belt, where it formed part of one of the great deserts of world history. A mature desert land surface — a peneplain, now represented by the **unconformity** — and the patchy aeolian Yellow Sands (?360–355 Ma old), are all that remains of this prolonged episode.

Subsidence of a broad belt extending from the ancestral Pennines eastwards to Lithuania and Poland created a vast inland drainage basin during the desert phase. A dramatic change of scene late in the Permian period took place when the Boreal Ocean, perhaps following a **glacioeustatic** sea-level rise, broke in from the north, flooding the inland desert basin and instantly (in geological terms — perhaps 5 to 15 years) forming the tropical Zechstein Sea. The middle of this sea was probably initially 200–300 m deep, but was almost completely filled with salts by the end of the period.

The thick and variably fossiliferous Magnesian Limestone of the Durham coastal cliffs was formed on the gentle shallow submarine slopes near the western margin of the Zechstein Sea during the last 5 to 7 Ma of the Permian. The sequence in the cliffs and adjoining inland areas is divided into five major **carbonate** formations that are grouped into three main cyclic units (Figure 13.1) separated by the insoluble residues of former salts (**halite** and **anhydrite**). The fracturing and foundering of the carbonate rocks resulting from the dissolution of these former salts is one of the three most spectacular features of the Durham coastal cliffs, the others being the striking evidence of downslope submarine slumping and sliding in two of the formations and the bewildering array of **calcite concretions** in the Concretionary Limestone Formation.

The geographical distribution of the main formations of the Magnesian Limestone in northern coastal Durham is shown in Figure 13.2, together with the approximate position of the recommended stops. The stratigraphical position of the rocks at the localities to be visited is shown on Figure 13.3. Each of the main formations is seen in at least one location, except the back-reef facies of the Ford Formation, and the Marl Slate which are omitted for logistical reasons. They may be studied at Ford Quarry [NZ 3630 5720] and Claxheugh Rock [NZ 3630 5760] respectively (1½ hours required, hard hats).

Excursion details

Locality 1 [NZ 384 667], Trow Point (S.S.S.I., no hammering), South Shields (1 hour)

Park in Trow Lea car park [NZ 383 667], near The Water's Edge. This complex exposure is summarized in Figure 13.4.

Locality 2 [NZ 385 641], Cleadon Park Quarry, northeast corner (30 mins)

Park in Quarry Lane, near the junction with Larch Avenue; the face is adjacent. Keep within 100 m of the road. This 3–5 m vertical face is in about the middle of the Concretionary Limestone Formation. Most of the rock is finely laminated unfossiliferous spherulitic limestone but a few thin graded beds are present and these contain moulds of the **bivalves** *Liebea* and *Schizodus*. The spherulites were formed by the recrystallization of the rock whilst it was deeply buried, and are up to about 8 cm across. Some have been slightly rotated and fractured by dissolution. Small patches of buff powdery **dolomite** lie between many of the spherulites and, in the southeast corner of the face, all the limestone locally passes laterally into soft buff **dolostone**. These rocks were probably formed on the low–middle part of the basin-margin slope, in anoxic conditions under perhaps 120–200 m of stratified sea water. The laminites were built up of ?annual couplets of **pelagic** lime mud (winter) and **phytoplankton** (summer); the graded beds are probably **turbidites**, composed of lime mud and lime silt that was originally deposited in oxygenated shallower water on the shelf or higher on the slope and redistributed into the basin by turbid suspension currents.

Locality 3 [NZ 398 651], northwest end of Marsden Bay, an S.S.S.I. (50 mins, hard hats essential)

Park at the northwest end of Marsden Lea car park [NZ 397 651] then take the steps to the beach, turning right at the bottom and walk southeast (no farther than the tall narrow stack). The cliffs here are formed mainly of 16–20 m of cream and buff fine-grained dolostone of the Concretionary Limestone Formation. Concentrate for the first 135 m on the general appearance of the rock face from a distance, for this is one of the best places in Britain for seeing the effects of foundering caused by the dissolution of underlying **evaporites**. All the strata have foundered by about the same amount (?60–100 m) but some parts have been let down gently and without much dislocation whereas others have had a more complex history of subsidence and are intensely fractured ('**breccia**-gashes'). After the first 135 m inspect the rock in detail. As at Locality 2, it comprises a mixture of finely laminated and unlaminated rock, here mainly fine-grained buff dolostone but also includes unlaminated **oolite**; some of the unlaminated beds, including the oolite, contain moulds of *Liebea, Permophorus* and *Schizodus,* many are graded and some have tight folds and shear-planes caused by downslope slumping and sliding. The inferred depositional environment is as for Locality 2.

Locality 4 [NZ 407 596], Roker promenade, Sunderland (40 mins)

Park in any of several east–west residential roads off the coast road and (from NZ 4068 5961) proceed down the steps to the beach, noting the large blocks of Concretionary Limestone beside the steps, probably from Fulwell quarries 2 km to the west. Turn right at the bottom, to inspect the c.8 m cliff of Roker Dolomite dolostone. This is unevenly bedded and **dips** gently southwards; it is cream and buff, mainly finely oolitic, soft and porous, and most of the **ooliths** have hollow centres. Tabular **cross-lamination** is present and thin beds of mud- or silt-grade dolostone drape broad low-amplitude ripples. Several disturbed beds up to 0.6 m thick, probably debris-flows, lie on scoured surfaces. Moulds of *Liebea* and *Schizodus* occur in some beds. These rocks were probably formed high on the basin-margin slope, in well-oxygenated water of moderate energy.

The famous 'Cannon-Ball Rocks' are the second main feature of interest at Roker. They form a rounded mass against the promenade just north of the steps and comprise a tightly-packed assemblage of subspherical calcite concretions with patches of inter-concretion fine-grained buff dolomite. The concretions are up to 0.25 m in diameter and most are concentrically laminated and partly coarsely radially crystalline.

Locality 5 [NZ 357 576], Castletown river cliff (except at high tide); (40 mins)

Wellingtons can be an advantage in approaching this exposure. Park in Sunderland Enterprise Park [NZ 3578 5672] and take the footpath signposted 'Hylton Riverside' to the south-southeast through a narrow wooded valley to the riverside. Here the exposure on your left comprises Yellow Sands (6 m+) resting unconformably on Upper Coal Measures sandstone (2 m+). This is the only good exposure of the unconformity in the Sunderland area; it is an almost plane erosion surface and represents a time gap of at least 40 Ma. The underlying sandstone, except for the uppermost 0.3 m, has been reddened by desert weathering and is the youngest permanently exposed Carboniferous stratum in northeast England. The Yellow Sands is a typical desert dune formation; it is weakly cemented (but with patchy well-cemented nodules) in a parallel-laminated coarse-grained basal unit (c.1 m thick) and strongly trough cross-bedded in the remainder where it is medium- to coarse-grained and almost incohesive. The sand is cut by several minor faults and fissures, some of which harbour downward-tapering brown clay probably squeezed down from the Marl Slate when the faults and fissures were created.

Locality 6 [NZ 391 545] Tunstall Hills S.S.S.I. (40 mins)

Approach by the track from Tunstall Road [NZ 3895 5464], parking at [NZ 3916 5456 or [NZ 3912 5452]. The rock here is massive brown reef limestone of the Ford Formation and was formed near the seaward crest of the reef. It comprises a sparse framework of filter-feeding fanlike *(Fenestella, Synocladia)* and twiggy *(Acanthocladia, Dyscritella)* **bryozoans** that were fixed to the substrate or to each other, and the remains of other marine organisms (mainly bivalves, **brachiopods** and **gastropods**) that lived in the protected spaces between the bryozoans or were attached to them. High on the main face, twiggy bryozoans are thickly encrusted with concentrically finely laminated limestone that may be **algal**. Another feature of the main face is a number of steeply inclined contemporaneous tension cracks, some of which have been filled by laminated limestone whereas others have remained partly unfilled and have yielded coarse frosted wind-blown sand grains.

The ridge extending southeastwards from here is the surface expression of the comparatively resistant reef rock; lower land to the east of the ridge corresponding with the basin which here was at least 60 m deep. The reef is more than 300 m wide, but its southwestern margin was removed during the last (i.e. late Devensian) ice age when Glacial Lake Wear overflowed southeastwards and cut the spectacular channel of Tunstall Hope.

Locality 7 [NZ 43 49], Seaham S.S.S.I. (parts covered at highest tides) (60 mins, hard hats are advisable.)

Park in the car park [NZ 430 494] and walk via the northwest corner of North Dock [NZ 432 495] and the cobbled path northwards down to the beach. Follow the beach for c. 150 m to the north-northwest, noting the industrial debris, to cliffs [NZ 4306 4966]–[NZ 4303 3975] where the southeast-dipping sequence is shown in Figure 13.5. This is one of the best places in Britain for seeing an evaporite dissolution residue.

The harbour was cut into a headland of Seaham Formation limestones, which are well exposed in several large faces. Most of the limestones were originally fine-grained and thinly bedded, and many contain large numbers of *Liebea*, *Schizodus* and *Calcinema*; they are finely cross-bedded and rippled, and some are graded. Changes to some of the limestones, probably during deep burial, resulted in the creation of thick beds full of spectacular calcite concretions not unlike those at Locality 2 but without the distinctive fine lamination of the latter.

Seaham Formation (8 m+). Slightly dislocated thin- to thick-bedded mainly fine-grained buff and grey limestone with abundant *Liebea*, *Schizodus* and *Calcinema* (a small stick-like ?alga) in some beds.

SR 1–3: Seaham Residue (6–9 m). The insoluble remains of the Fordon Evaporite Formation, here otherwise dissolved. Comprises lower (SR1) and upper (SR3) units of heterogeneous calcareous clay and clayey limestone and a dislocated median unit (2 m) of white to buff oolitic limestone.

Roker Dolomite Formation, top of. Cream and buff finely oolitic dolostone, partly fractured and altered to limestone.

Glossary

Bibliography

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

Categories:

- Northumbrian rocks and landscape: a field guide
- 7. Northern England

Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 11 May 2020, at 12:18.