# EXCURSION

## The Yorkshire Coast

Leader: Andy Howard (BGS)

**Weekend 22nd-23rd September 2001**

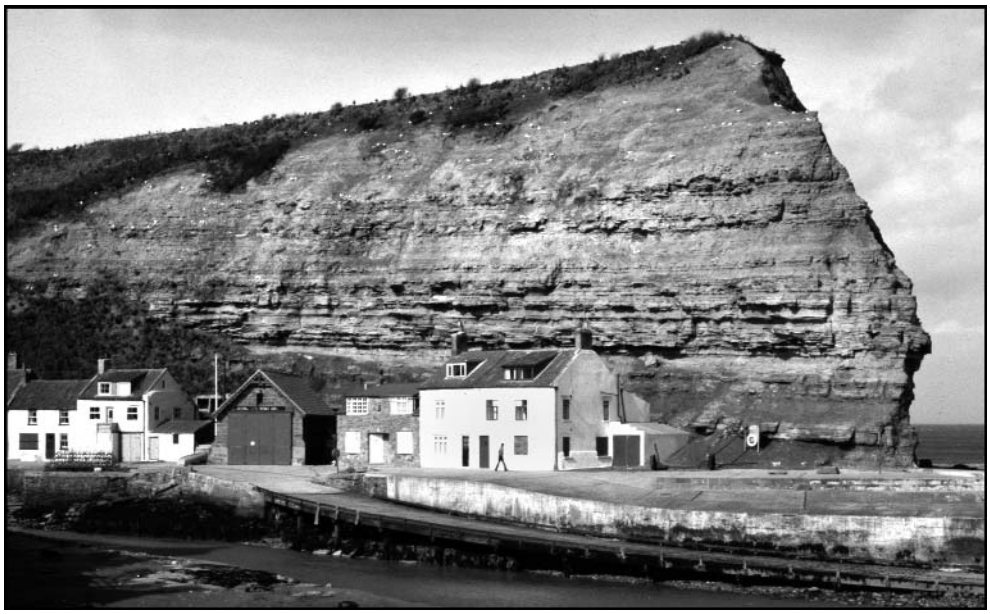
This weekend trip had been organised at short notice to supplement the Society's field excursion programme in 2001, which had been severely curtailed due to countryside access restrictions arising from the Foot and Mouth Disease epidemic. The aim of the trip was to demonstrate the wide variety of Jurassic sedimentary rocks exposed on the Yorkshire Coast and their associated depositional environments, including shallow marine storm deposits, shallow water carbonates, ironstones and fluvial sandstones. Of particular interest was the profound influence of sea level change on the deposition of the sequence, and the trip provided numerous opportunities to compare and contrast the sedimentary facies and fossils in adjacent marine and non-marine formations.

### Cleveland coast

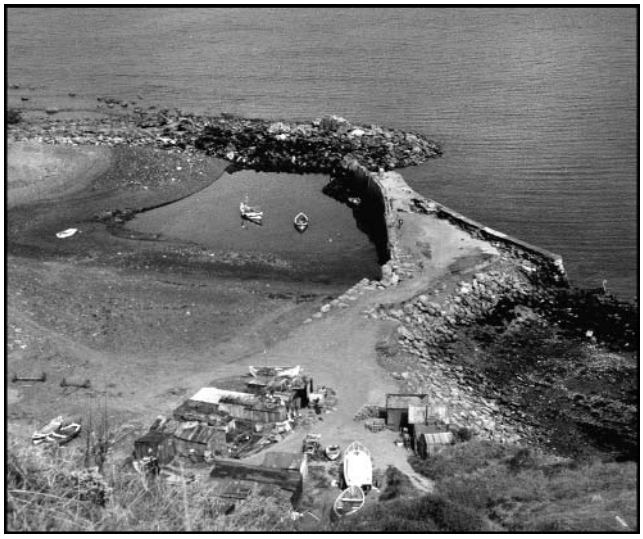
The Saturday was blessed with warm and sunny weather. Twelve EMGS members met in the car park at Staithes, and walked down to the harbour to view the shallow marine sandstones of the Staithes Formation. These are of Lower Jurassic age, and consist of thin, well-laminated sandstone beds interbedded with bioturbated, argillaceous siltstones. The sandstone beds contain abundant evidence of rapid deposition by storms, including hummocky cross-stratification, wave ripples and sharp erosional bases with shell lags. The interbedded siltstones are thoroughly bioturbated by a diverse assemblage of trace fossils, reflecting lower deposition rates during fair weather conditions.

Engineering works on the breakwaters at Staithes harbour had temporarily created a tidal pool that could not be crossed until an hour and a half before low tide. This delay was taken up by an early lunch, leaving the entire afternoon to traverse the excellent exposures of the Cleveland Ironstone and Whitby Mudstone formations on the foreshore between Staithes and Port Mulgrave. The Cleveland Ironstone includes several beds or seams of sideritic ironstone containing ooids (formerly known as 'ooliths') composed of the mineral berthierine, an iron-rich clay mineral. Each ironstone bed contains a diverse and often highly fragmented fauna of marine bivalves and also abundant trace fossils, including the distinctive U-shaped burrow Rhizocorallium. Each ironstone bed was formed during an extended episode of non-deposition and chemical alteration of the sea bed sediments associated with a period of sea level rise. Each bed lies above an upward coarsening sequence of several metres of mudstone, siltstone and fine sandstone, reflecting periods of gradual sediment accumulation and basin infill between the sea level rises.

At Old Nab to the south east of Staithes, former underground pillar and stall workings in the Cleveland Ironstone Formation have been exhumed by marine erosion. After examining these workings, the party moved on to the Whitby Mudstone Formation exposed near Port Mulgrave. Here, a large landslip in 1993 had brought down huge amounts of fresh 'Upper Lias' mudstone and ironstone nodules from the upper cliff, providing a fertile hunting ground for ammonite collectors. Members took the opportunity to gather some fossils, and were able to compare their finds with those of the many dedicated fossil collectors still scouring the landslip material. After searching the Whitby Mudstones for jet, a mineral formed from the compressed and altered remains of fossil wood, the party entered the small harbour at Port



The Staithes Formation above the village harbour.



The view down to Port Mulgrave.

Mulgrave. This was built in the 19th century to ship iron ore from mines at Grinkle, about 2 km inland. The ore was transported to the port through an inclined tunnel, the portal of which is still visible next to the harbour breakwater.

The party ascended the cliffs at Port Mulgrave, noting the landslips associated with a spring line at the base of the Middle Jurassic sandstones that formed the upper part of the cliff. They then followed the pleasant cliff top path back to the Staithes car park.

**Cayton Bay**

In marked contrast to the previous day, Sunday dawned dull, cold and equinoctal; seven members attended for the day. Cayton Bay, southeast of Scarborough, is essentially a buried valley floored by Middle Jurassic rocks, and plugged by glacial till of Late Devensian age. Marine erosion has cut into the softer glacial till plug to form the central part of the Bay, with the stronger Jurassic bedrock forming the headlands, or 'nabs', at each end. The till is extensively slipped with several excellent examples of classic, amphitheatre-shaped rotational landslides, and the beach is strewn with several World War II pillboxes that were originally built at the top of the cliffs.

The day commenced with an examination of the late Middle Jurassic sandstones of the Osgodby Formation, which form the lower part of High Red Cliff at the southern end of Cayton Bay. These sandstones contain a diverse fossil assemblage of marine molluscs and trace fossils similar to the Staithes Formation. But, unlike that formation, the entire rock is thoroughly bioturbated with only traces of original sedimentary lamination remaining, suggesting that storms were of lesser importance as an agent of deposition. The Osgodby Formation contains almost spherical calcareous nodules over 1 m in diameter, each containing beautifully preserved trace fossils. Lying immediately below the Osgodby Formation, the Cornbrash Formation consists of a thin, bioturbated, ferruginous limestone with berthierine ooids and abundant marine fossils including the distinctive, oyster-like bivalve *Lopha marshii*. The Cornbrash, which unconformably overlies the non-marine mudstones of the Ravenscar Group, strongly resembles the ironstone seams of the Cleveland Ironstone Formation. Like each of them, it marks a very long episode of non-deposition associated with a major rise in sea level.

After an extended lunch to wait for the outgoing tide, the party negotiated the boulder field at the southern end of Cayton Bay to view the Middle Jurassic rocks of the Ravenscar Group exposed at Yons Nab. The Yons Nab Fault separates these strata from the younger rocks of High Red Cliff. The Ravenscar Group is mainly composed of marginal marine, deltaic and fluvial sediments but includes thinner units of marine strata. Again, periodic sea level change had a major influence on deposition of the sequence. The lowest strata seen at Yons Nab were the marine, oolitic limestones of the Millepore Bed, a direct equivalent of the Lincolnshire Limestone of Lincolnshire and Humberside. Unfortunately, the high state of the tide made these rocks difficult to examine. The overlying Gristhorpe Member, however, was very well exposed. This unit consists of marginal marine mudstones, siltstones and sandstones and contains abundant evidence of smaller scale oscillations in sea level. Beds containing rootlets and plant fossils, including the famous Gristhorpe Plant Bed, strongly indicate emergence and soil formation, whereas other beds with marine trace fossils indicate submergence and at least quasi-marine conditions.

The excursion concluded with an examination of the Scarborough Formation, another marine unit that overlies the Gristhorpe Member. The Scarborough Formation is composed of well-laminated sandstones interbedded with bioturbated mudstones and siltstones containing a marine bivalve and trace fossil assemblage. It strongly resembles the Staithes Formation and was probably also deposited in a shallow marine setting influenced by major storms. These beds are overlain by a fluvial channel sandstone with a sharply erosional base that cuts down several metres into the underlying marine beds, indicating that deposition of the formation was terminated by a substantial fall in sea level. The channel sandstone displays an excellent example of 'epsilon' cross-bedding, which is formed by lateral migration of meanders within a sinuous fluvial channel. On retracing their steps back to Cayton Bay at the end of the trip, members were able to follow this channel at a higher level in the cliff, and determine both the extent of its lateral migration and the degree of downcutting into the underlying Scarborough Formation.