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# Abbotsham Coast

## Highlights

Abbotsham Coast is the best available section through the Bideford Formation, providing detailed sedimentological and biostratigraphical information. It tends to confirm that the Bideford Formation is a lateral equivalent of the upper Crackington and lower Bude formations, and represents a localized development of fluvio-lacustrine, 'Coal Measures'-type deposits (Figure 3.8) and (Figure 3.9).

## Introduction

The section of coast between Greycliff and Rock Nose, 5 km west of Bideford, Devon [SS 403 269]–[SS 417 291], is effectively the stratotype for the Bideford Formation. The strata are extensively exposed in a series of broad and slightly asymmetrical folds, causing repetition of the sequence. Further structural complications are provided by two sets of wrench faults. The exposure has been extensively studied, most recently by Prentice (1960b, 1962), Reading (1965), De Raaf *et al.* (1965), Elliott (1976), Edmonds *et al.* (1979) and Eagar and Xu Li (1993), the latter two studies providing detailed field descriptions of the site.

## Description

### Lithostratigraphy

A summary log of the sequence exposed here is given in (Figure 3.10). It comprises of 750–800 m of mainly mudstones, siltstones and sandstones (De Raaf *et al.*, 1965; Edmonds *et al.*, 1979). De Raaf *et al.* divided it into nine sedimentary cycles, each grading upwards from black mudstones into coarser beds, eventually culminating in sandstones. Four of the most prominent sandstones have been assigned names by Prentice (1960b), as shown in (Figure 3.10). The sandstones marking the top of each cycle have an abrupt upper boundary, and are burrowed or include rootlet horizons. Current directions described by Prentice (1962) mainly from the sandstones suggest a provenance to the northwest.

About 1 m above the Cornborough Sandstone is a thin band of smutty coal. This is one of the few exposures still available of one of the coals or 'culm' beds in the lower Bude Formation. It is badly disturbed by both tectonic activity and mining operations. However, it still shows some traces of a seat earth, confirming that it is an autochthonous deposit.

De Raaf *et al.* (1965) divided the sequence into Northam and Abbotsham formations, which were combined into the Bideford Group. This followed in essence the classification of Prentice (1960b). However, Edmonds (1974) argued that, from a mapping standpoint, it was better to assign the whole sequence to a single formation (the Bideford Formation), a view which has been accepted by most subsequent authors. In the Abbotsham section, the boundary between the Bideford and overlying Bude formations is taken at the top of the Cornborough Sandstone. Elsewhere, however, the relationship between the two formations is more complex, and it is almost certain that the upper Bideford Formation is coeval with the lower Bude Formation.

### Biostratigraphy

#### Marine bands

Mudstones from the base of Cycle 6 in the classification of De Raaf *et al.* (1965) have yielded the following assemblage: *Gastrioceras amaliae* Schmidt, *Anthracoceratites* sp., indet. anthracoceratid, *Dunbarella* sp. and *Cypridina?* sp. (Edmonds *et al.*, 1979). Calver *in* Edmonds *et al.* argued that this made the mudstones equivalent to the Amaliae Marine Band recognized in the Pennines, and is thus lower Langsettian. No evidence has been found of the Listeri Marine Band, despite it being well developed in the nearby Clovelly section.

## Non-marine bivalves

These have been reported from ten horizons in the section. The stratigraphically lowest is at 129 m below the Raleigh Sandstone. Edmonds *et al.* (1979) reported small examples of *Curvirimula* and *Carbonicola* from here. Eagar and Xu (1993) were unable to discover further examples of the *Curvirimula*, but shells of the type thought to be *Carbonicola* were collected and, following detailed investigation, found in fact to belong to *Sanguinolites* Hind *non* M'Coy. They were very similar to an upper Kinderscoutian fauna reported by Eagar (1977) from Sabden Brook (Cock Wood) in Lancashire, and are thought to represent marginal marine conditions.

Calver *in* Edmonds *et al.* (1979, p. 48) reported juvenile specimens of *Curvirimula* cf. *scotica* (Etheridge) from 82 m below the Raleigh Sandstone. Calver suggested that they tend to indicate a position in the topmost Namurian or possibly basal Westphalian but, by comparing with faunas in Belgium, Eagar and Xu (1993) claim that they are middle Namurian (Alportian to Marsdenian) and represent an assemblage unique in Britain.

A new fauna was discovered by Eagar and Xu (1993) from 43 m below the Raleigh Sandstone. Some of the shells were very similar to the *C. cf. scotica* found in the above band, but there was also present a second species with relatively long hinge lines, which they compared with *Curvirimula belgica* (Hind). This latter species tends to indicate the Marsdenian to Yeadonian.

From just below the Raleigh Sandstone, Eagar and Xu (1993) found two discrete bivalve bands, the lower one containing very small shells of the *Carbonicola hellula* (Bolton) group, associated with *Curvirimula* cf. *scotica* and *C. cf. belgica*. The higher band contained small *Carbonicola* aff. *lenicurvata* Trueman shells, associated with rare *Naiadites hibernicus* Eagar. Eagar and Xu subjected the fauna to detailed morphometric analyses, and found a close comparison with faunas found in South Wales between the Cancellatum and Cumbriense marine bands (lower Yeadonian).

From just above the Raleigh Sandstone, in Cycle 4, Calver and Eagar *in* Reading (1965) record *Carbonicola* cf. *bellula* (Bolton). According to Eagar and Xu (1993), this fauna is quite different from the *Carbonicola* shells found below the sandstone, having developed their full size, and including varieties which tend towards *C. lenisulcata* (Trueman) and *C. pilleolum* Eagar. Comparisons with faunas from northern England (Eagar, 1956) indicate the basal Langsettian.

In Cycle 5 (just below the Amaliae Marine Band), Eagar and Xu (1993) record rare shells of the *Carbonicola exima* group, probably belonging to the *C. extenuata* Subzone.

The most diagnostic assemblage has been found at the base of Cycle 8 (Simpson, 1933). Calver and Eagar *in* Edmonds *et al.* (1979) identify the assemblage as including *Carbonicola extenuata* Eagar, *C. crista* Eagar and *C. cf. exima* Eagar, indicating a position in the *Carbonicola Proxima* Subzone (upper *C. lenisulcata* Zone). A similar fauna was also recorded by Eagar and Xu (1993) from a slightly lower level, in the upper part of Cycle 7.

The uppermost bivalve-yielding horizon in this section is 30–40 m above the base of Cycle 8, and has yielded an undiagnostic fauna of *Curvirimula* sp. and *Naiadites* sp. However, shales from below the Cornborough Sandstone exposed in a nearby inland exposure (Roberts Quarry) have yielded a fauna of the *C. torus* Subzone (lower *C. communis* Zone — middle Langsettian).

## Plant macrofossils

Arber (1904) noted a number of specimens from shales associated with the 'culm' beds immediately overlying the Cornborough Sandstone. He concluded that they belonged to the 'Middle Coal Measures' (i.e. Bolsovian), but Crookall (1930b) argued that they were 'Lower Coal Measures' (i.e. Langsettian). Arber did not illustrate all of the species and so the assemblages are difficult to judge. However, they seem to include taxa such as *Neuropteris obliqua* (Brongniart) Zeiller, *Neuraethopteris jongmansii* Laveine, *Karinopteris acuta* (Brongniart) Boersma and *Sphenophyllum cuneifolium* (Sternberg) Zeiller, which tend to suggest the lower *Lyginopteris hoeninghausii* Zone (lower Langsettian). The plant fossils from this locality are currently being reinvestigated by the present authors.

## Interpretation

This is by far the most extensive outcrop of the Bideford Formation, providing a more or less complete sequence through the unit. Edmonds *et al.* (1979, 1985) mention a number of small, inland exposures, mainly of the sandstone units, but nowhere else is the full sequence with biostratigraphical control available.

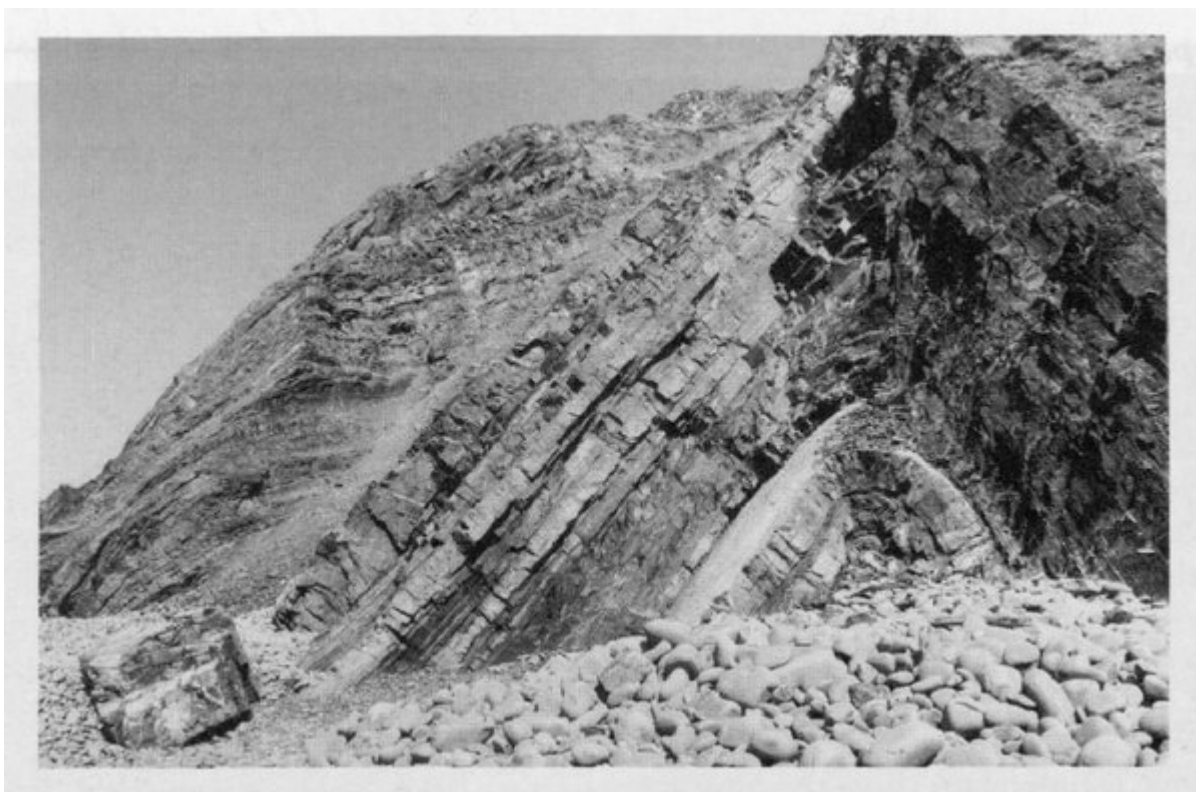
De Raaf *et al.* (1965) used evidence from here to suggest that the Bideford Formation represents a series of shoreline-fronted, fluvial deltas that progressed into a moderately deep basin. An essentially similar model was advanced by Elliott (1976) and Edmonds *et al.* (1979). However, this model is not supported by the absence of marine fossils, except from the mudstone at the base of Cycle 6. Also, in three of the mudstones, which are supposed to represent 'moderately deep basin deposits', there are non-marine bivalves. Thomas (1988) argued that this was evidence that the basin into which the deltas advanced was essentially non-marine, due to dilution of the sea-water by river inflow. Alternatively, the Bideford Formation might be seen as a set of fluvial deposits, albeit in a lower delta-plain setting, in which the sediments were transported into enclosed, inter-distributary bays. They can thus be compared with coeval strata in other parts of Britain, such as Lancashire (Fielding, 1987).

The biostratigraphical data available here are important for understanding the relationship between the Bideford Formation and the Crackington and Bude formations. If the marine band at the base of Cycle 6 is indeed equivalent to the Amaliae Marine Band, then it is also a correlative of the Hartland Quay Shale at Clovelly, the generally acknowledged boundary between the Crackington and Bude formations. Consequently, the Bideford Formation must be a lateral equivalent of the upper Crackington and lower Bude formations. This model is also supported by the presence of an apparently middle Namurian (Kinderscoutian) non-marine bivalve fauna in Cycle 3 of the Bideford Formation, which is older than the Clovelly Court Shale in the lower part of the Clovelly sequence (Eagar and Xu, 1993).

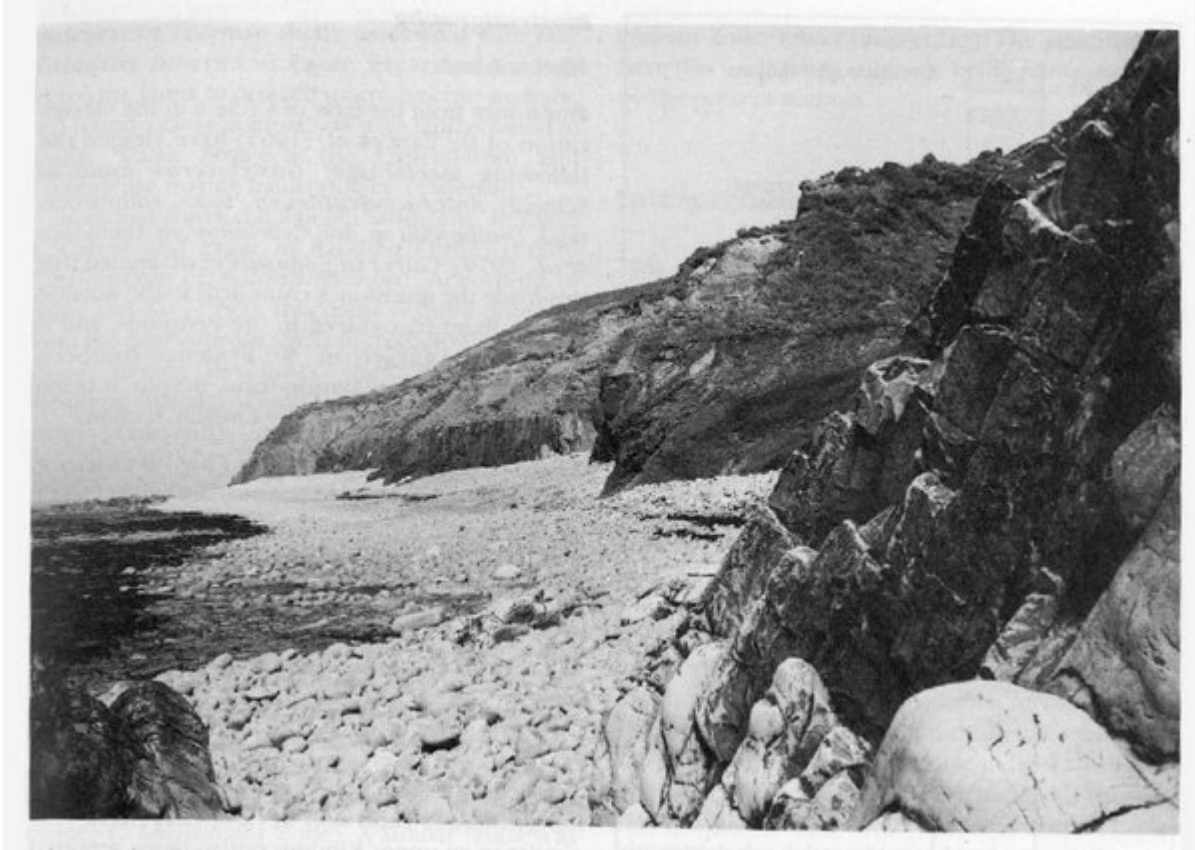
## Conclusion

Abbotsham Coast is the definitive section through the Bideford Formation, which is an interval of rocks about 315 million years old. The rocks are of the same age as the upper part of the Crackington Formation, such as exposed at Clovelly, but were deposited under quite different conditions, either in an estuarine or lower delta-plain setting. The abundant fossil evidence found at Abbotsham is of critical importance for establishing this relationship between the Bideford and Crackington formations, which in turn is significant for understanding the evolution of this part of Britain during the Late Carboniferous.

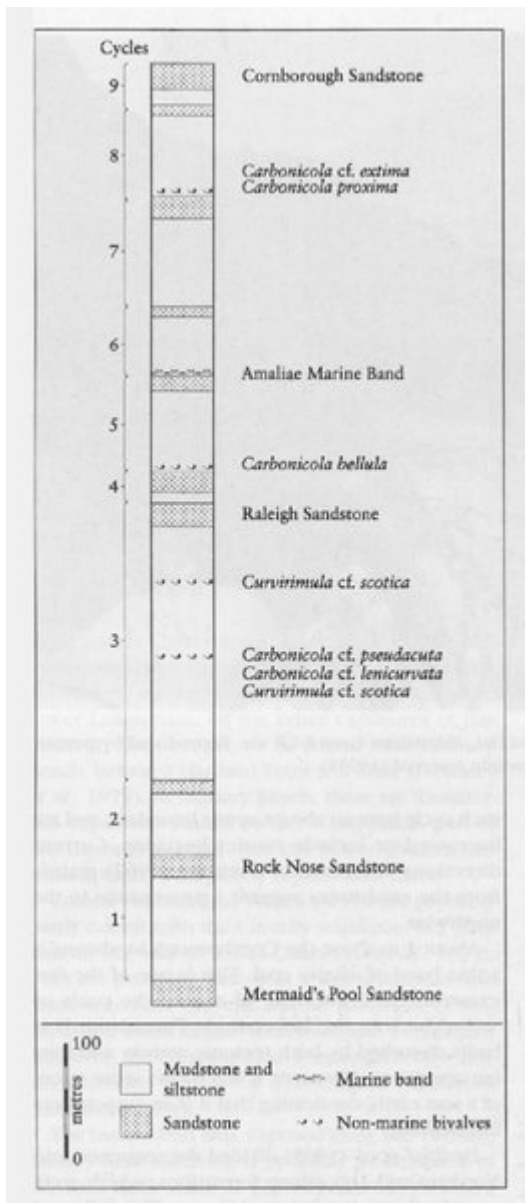
## [References](#)



*(Figure 3.8) Abbotsham GCR site. Typical Bideford Formation succession folded into sharp anticline. (Photo: R.A. Cottle.)*



*(Figure 3.9) Cornborough Cliffs, 1.6 km SW of Westward Ho!, Abbotsham Coast GCR site. Reproduced by permission of the Director, British Geological Survey: NERC copyright reserved (A5935).*



(Figure 3.10) Stratigraphical log of the Bideford Formation at Abbotsham Coast GCR site. Based on Edmonds et al. (1979, fig. 9).