Blue Anchor Point, Somerset

[ST 033 435]–[ST 056 434]

Introduction

This locality shows a section of Upper Triassic formations, from the Blue Anchor Formation at the top of the Mercia Mudstone Group, upwards through the Penarth Group into the basal Blue Lias. The Blue Anchor Formation and Penarth Group have yielded a large variety of fossils including fishes, reptiles, coprolites, and the remains of the possible early mammal *Hypsoprymnopsis.* Blue Anchor Point [ST 0385 4368] is the type locality of the Upper Triassic Blue Anchor Formation of the Mercia Mudstone Group (Warrington *et al.,* 1980; Warrington and Whittaker, 1984).

One of the first descriptions of the geology of the cliffs around Blue Anchor was by Boyd Dawkins (1864a), who also summarized the palaeontology. Since then, the sediments have been described by Richardson (1911) and the mineralogy by Bradshaw and Hamilton (1967). The most recent accounts are by Warrington and Whittaker (1984), Warrington and Ivimey-Cook (1995), and Edwards (1999).

Description

The coastal cliffs at Blue Anchor Point form part of the extensive Blue Anchor to Lilstock Coast Site of Special Scientific Interest (SSSI).

Sedimentology

The section at Blue Anchor is composed of deposits from the upper part of the Mercia Mudstone Group and the Penarth Group (Figure 4.22). The majority of the exposed Mercia Mudstone Group comprises red mudstones. The lower part of the overlying Blue Anchor Formation, the Rydon Member, comprises dark green and greenish-grey mudstones and siltstones. Its basal boundary is placed at the base of the lowest dark grey mudstone (Warrington and Whittaker, 1984), although the colour change from the underlying red mudstones is gradational over approximately 1 m.

The overlying Williton Member comprises siltstones and mudstones with gypsum present as nodules and veins that range in colour and form (Warrington and Whittaker, 1984). The gypsum occurs as nodules of pink or white, coarse-grained alabaster in the laminated mudstones, as thin veins of white, fibrous crystals parallel to the bedding, and as conjugate veins of pink satin spar (Bradshaw and Hamilton, 1967). In places, the gypsum has been partly replaced by silica (Mayan., 1981). The gypsum and alabaster veins show complex patterns of intersection that allow reconstruction of the fine-scale tectonic history of the rocks here (Figure 4.23).

The basal unit of the Penarth Group, the Westbury Formation, includes three main bone-bearing horizons, all containing large quantities of vertebrate fossils associated with sand-sized quartz grains and pebbles. Silica overgrowths have been recorded from many of the quartz grains (Antia and Sykes, 1979). The lowest of the bone-bed horizons, a 0.15 m thick sandstone, marks the base of the Westbury Formation; two bone beds occur approximately 1.5 and 6 m farther up the section. The remainder of the formation consists of black shales and dark shelly limestones, some of which contain concentrations of reworked shell debris and have channel fills on the lower surfaces of the bed and rippled upper surfaces. Fibrous calcite crystals are present within the limestone facies (Hamilton and Whittaker, 1977).

The overlying Cotham Member rests unconformably on the Westbury Formation. The Cotham Member comprises limestones with common ripples and desiccation cracks, and rarer septarian-type nodules (Hamilton and Whittaker, 1977). A deformed bed attributed to seismic activity is well exposed here (Mayan, 1983). At the top of the Blue Anchor section, the lowest beds of the Lias Group are seen (Hamilton and Whittaker, 1977; Edwards, 1999).

The following generalized section is taken from Sykes (1977, p. 231), for the Westbury Formation, and Warrington and Whittaker (1984, pp. 101–2) for the Blue Anchor Formation:

	Thickness (m)
Lias Group	
Penarth Group	
Lilstock Formation: Gotham Member:	
Shales, mudstones, and limestones	*c.* 4
Westbury Formation:	
Limestone <(*Pleurophorus*), medium grey, with shells and fibrous calcite	0.23
Black fissile shale with bivalves	0.2
Bone bed: a composite bed:	0.28
(a) massive, calcareous gritstone with many vertebrate fossils, and rare coprolites. Thin, white veins pass through the bed and may cut across the fossils up to	0.12
(b) transition to the bone bed below. Layers of calcareous bone bed sandstone, thin layers of black shale and some limestone; less quartz. Fines downwards	0.05
(c) alternations of non-calcareous, fissile, black shale and thin layers of calcareous bone bed sandstone. Ripples throughout. Shale contains bivalves, which may lie directly on the sandstone. Thin sandstone ranging in thickness from very thin to wedges 11 mm thick. Fine- to medium-grained sandstone, fossils scarce and scattered through the sandstone	0.07
(d) fibrous calcite with a variable thickness	up to 0.03
(e) calcareous sandy bone bed on black shale; shells in lower part; silty towards the top	0.018
Black, fissile shale, many bivalves	0.15
Massive, grey limestone with limestone and shales at the top	0.6
Shale and limestone, black shale and limestone with limestone at the base not determined	
Black shale	0.12
Limestone with fibrous calcite at the top and nodules at the base	0.15
Shales and limestone, poorly exposed	0.91
Limestone and shale. Limestone dark grey, unbedded. The first shales are bedded and unfossiliferous; others are unbedded in places. Silt occurs as a thin alternation with the black shale	0.9
Limestone, dark grey, with bivalves not determined	
Black fissile shale	0.9+
Thin sandy limestone with scattered, well-preserved vertebrates	0.025
Shelly mudstone, many shelly fragments in a mudstone matrix. Upper part is more shelly. Quartz and abraded bone fragments are scattered through the rock. Fragments of Blue Anchor Formation mudstone occur, especially near the base	0.12
Mercia Mudstone Group	
Blue Anchor Formation: Willaton Member:	

Thin beds of greenish-grey or dark grey mudstone with paler shales and a few gypsum horizons	*c.* 4
Blue Anchor Formation: Rydon Member:	
Interbedded greenish or greyish siltstones, rarely pebbly, and greenish mudstones.	
One gypsum horizon	*c.* 30
Red-brown mudstones	

Structural geology

The rocks around Blue Anchor Point have been faulted and folded. To the west of the Point, red-brown mudstones of the Mercia Mudstone Group have been faulted into contact with green and grey deposits in a downfaulted block that consists of the Blue Anchor Formation to Lias sequence (Figure 4.24). An asymmetrical anticlinal fold with an axis trending 100° is seen at Blue Anchor Point (Bradshaw and Hamilton, 1967; Hamilton and Whittaker, 1977; Edwards, 1999); the Blue Anchor Formation sediments are exposed within the core of this anticline (Figure 4.22).

On the foreshore at Blue Anchor Point the sediments that form the northern limb of the anticline dip seawards. These beds display more evidence of tectonic deformation as a few WNW-trending faults cut the exposure (Hamilton and Whittaker, 1977). Many of the gypsum veins seen in the sediments of the cliffs and foreshore owe their origin to the formation of the anticline (Bradshaw and Hamilton, 1967; (Figure 4.22)).

Small-scale synsedimentary microfaults have been described from the sediments of the Williton Member. These are thought to have been produced by the movement of sediment down small inclines (Mayall, 1981).

Palaeontology

A wide range of fossils including remains of plants, invertebrates, and vertebrates have been recorded from several horizons at Blue Anchor. Of particular note are the Westbury Formation bone bed (Boyd Dawkins, 1864a,b) and the sediments exposed some three metres below the bone bed (Hamilton and Whittaker, 1977; Warrington and Whittaker, 1984). Remains of fossil fishes from this area are listed by Dineley and Metcalfe (1999).

Invertebrate taxa are represented by trace fossils and body fossils. Boyd Dawkins (1864a) recorded holes, tracks, and trails from the top 1.83 to 4.17 m of the Blue Anchor Formation near its type locality (Warrington and Whittaker, 1984; Warrington and Ivimey-Cook, 1995). Other trace fossils include *Arenicolites, Diplocraterion, Muensteria, Planolites, Rhizocorallium,* and *Siphonites* from the vicinity of Blue Anchor (Mayall, 1981). Body fossils of several species of bivalve occur in the uppermost part of the Blue Anchor Formation (Warrington and Whittaker, 1984; Warrington and Ivimey-Cook, 1995). Palynomorphs, such as miospores and organic-walled microplankton, are also preserved within these sediments (Warrington and Whittaker, 1984).

Fish fossils include '*Sargodon tomicus*', *Saurichthys apicalis, Acrodus minimus, Gyrolepis alberti,* and *Gyrolepis tenuistriatus* from approximately 3 m below the top of the Blue Anchor Formation and from the top 1.83 m of this unit (Boyd Dawkins, 1864a,b; Warrington and Whittaker, 1984).

Other vertebrate remains include indeterminate (possibly reptilian) bones from the sediments outcropping between 2.44 and 4.27 m from the top of the Blue Anchor Formation near the type site (Boyd Dawkins, 1864a; Warrington and Whittaker, 1984). The Westbury Formation bone beds have produced possible crocodile remains and the bones of the semi-aquatic choristodere *Pachystropheus* (Richardson, 1911; Storrs and Gower, 1993; Storrs *et al,* 1996; Storrs, 1999). From the bone beds, Boyd Dawkins (1864a, pp. 409–12) described a single tooth as belonging to a mammal, *Hypsiprymnopsis rhaeticus.* Owen (1871) thought that the specimen was possibly a broken haramiyid mammal tooth, while others (Clemens *et al.,* 1979; Storrs, 1994, 1999) have suggested it might be an indeterminate tritylodontid or other cynodont.

Interpretation

The sedimentary rocks exposed at Blue Anchor Point and Blue Anchor Bay represent a series of distinct palaeoenvironments, from the dominantly terrestrial conditions of the Mercia Mudstone through to the fully marine Lias.

The red, argillaceous sediments of the lower part of the Mercia Mudstone Group section were deposited in a supratidal sabkha or playa-lake environment (Warrington and Whittaker, 1984), with ephemeral lakes and occasional floods from the surrounding uplands.

The overlying grey and green mudstones and siltstones of the Blue Anchor Formation were deposited on a dominantly terrestrial supratidal and intertidal sabkha plain (Warrington and Whittaker, 1984). The Williton Member contains sulphate nodules and carbon-rich mudstones that may have been formed under the algal mats characteristic of a supratidal sabkha environment (Stevenson and Warrington, 1971;

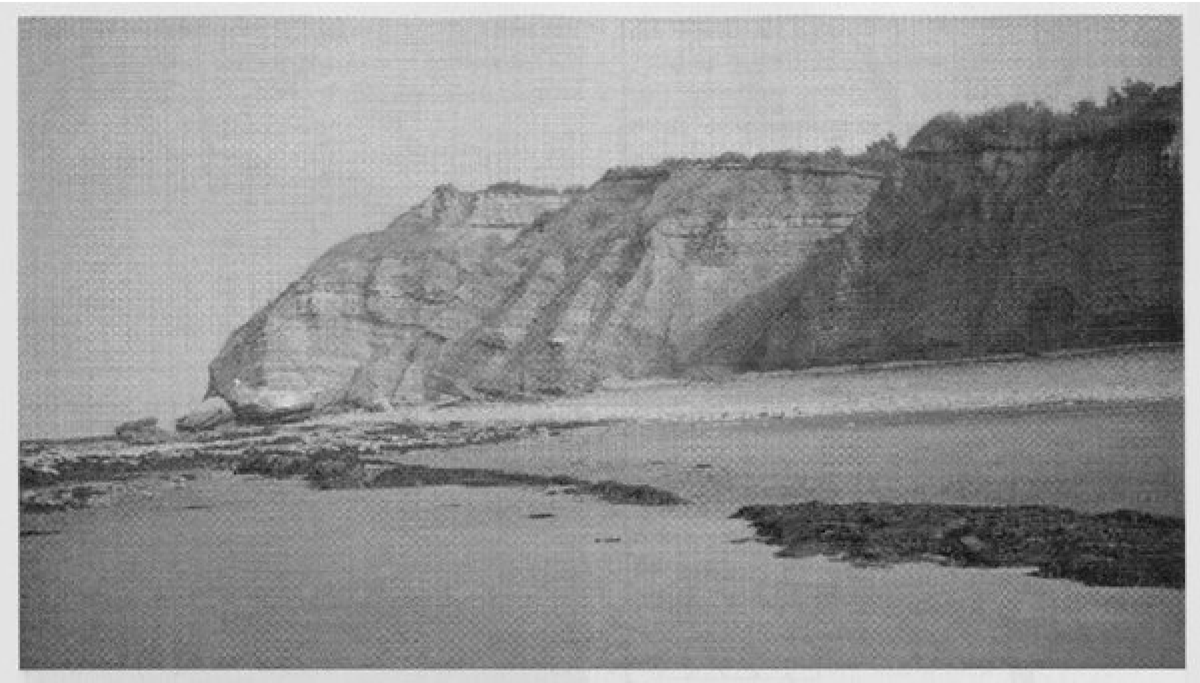
Warrington and Whittaker, 1984). Petrographical analysis of the gypsum nodules indicates that they formed penecontemporaneously with the sediment (Bradshaw and Hamilton, 1967). The algal mat lithologies alternate with various fine-grained sediments that represent low-energy conditions of deposition (Warrington and Whittaker, 1984). The very top of the Blue Anchor Formation represents a shallow-water environment, possibly with tidal influence (Hamilton and Whittaker, 1977).

The basal unit of the overlying Westbury Formation is thought to represent the development of marine or marginal marine conditions. The bone beds represent reworking caused by transgression (Whittaker and Green, 1983). The hard, shell-rich limestones contain sedimentary structures indicative of emergent tidal flat environments, for example oscillation truncated crested and terraced ripples. These pass vertically into laminated muds deposited in standing water (Hamilton and Whittaker, 1977). Sediments of the Cotham Member were deposited in shallow lagoons (Mayall, 1981).

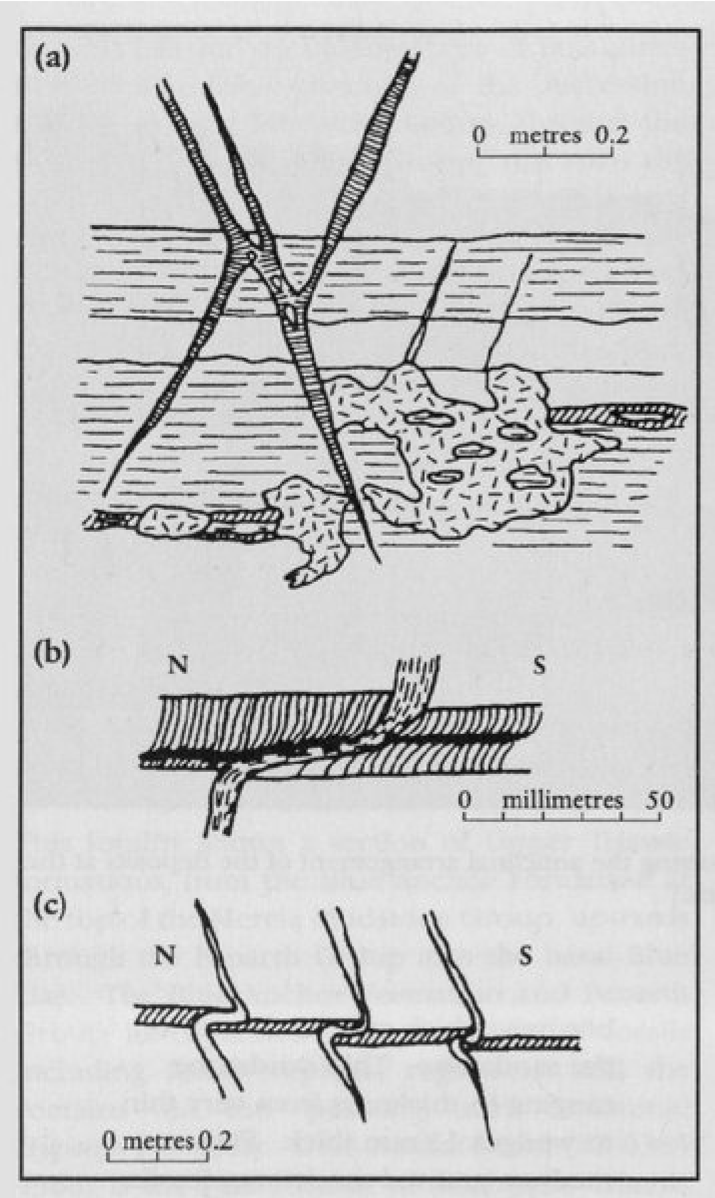
Conclusions

The Upper Triassic sediments exposed in the cliffs and on the foreshore at Blue Anchor form part of one of the best exposures of Rhaetian age sediments in the country. Blue Anchor Point is the type locality for the Blue Anchor Formation, and the exposures here are additionally important as they show gypsum evaporites unusually well. The site has, over the years, produced a wide variety of fossils, including various invertebrates as well as rarer reptilian and mammalian remains, and is nationally important for stratigraphical and palaeoenvironmental reasons.

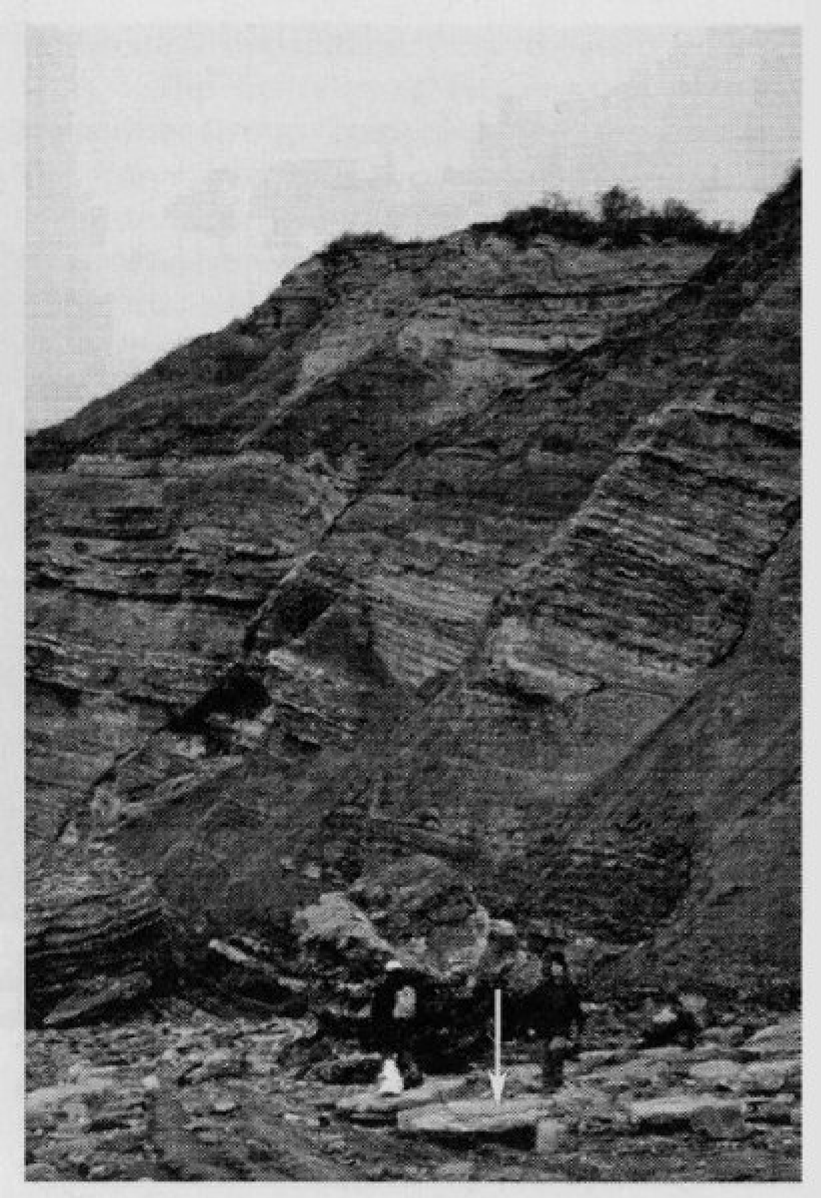
References



(Figure 4.22) View of Blue Anchor Point, looking east, showing the anticlinal arrangement of the deposits at the far left, and multiple faults behind. (Photo: K. A. Kermack.)



(Figure 4.23) Relationships of the various forms of gypsum at Blue Anchor Point. (a) Nodular alabaster in the laminated beds, with white veins parallel and cross-cutting pink veins. (b, c) Horizontal white veins cut by thin, pink veins and both deformed by subsequent movements. (After Hamilton and Whittaker, 1977.)



(Figure 4.24) Detail of the multiple faults at Blue Anchor Point, disturbing the succession of Blue Anchor Formation (lower part of cliff) overlain by Westbury Formation at the top. A boulder of the latter, with the bone bed (arrowed), lies on the beach. (Photo: K. A. Kermack.)