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# Red Brow Cutting, Cheshire

[SJ 568 817]

## Introduction

This widened lane cutting shows a section of about 25 m of the Tarporley Siltstone Formation, the basal unit of the Mercia Mudstone Group. The formation consists largely of red, fine-grained sandstones and siltstones, with parallel rippled bedding, including flaser and wavy bedding in some of the thicker sandstone units. Trace fossils, including *Planolites* and *Isopodichnus*, occur in abundance. In some of the sandstone units there are parallel rows of calcite-filled geodes that represent replaced nodular gypsiferous evaporites. The section is sedimentologically and environmentally important. It shows sediments deposited under marine intertidal conditions that developed over a wide tract of central England during the Anisian.

The site has been described by Thompson (1970a,b), and in detail by Ireland *et al.* (1978).

## Description

### Sedimentology

The Red Brow section is dominated by red sandstones and mudstones that were studied in detail in the 1970s when a 500-m-long section was being actively worked (Figure 3.39). The succession has been divided into five lithofacies (A–E, (Figure 3.40)) by Ireland *et al.* (1978):

#### Lithofacies A

Reddish-brown, mottled grey-green, or off-white sandstones, poorly sorted, especially towards the top, and forming overlapping wedging units up to 2.5 m thick. Most units have an erosional base, often with an overlying mudflake conglomerate; they fine upward, with large-scale planar or trough cross-bedding being succeeded by plane parallel lamination or cross-lamination and flaser bedding, and a thin capping of bioturbated siltstone and mudstone.

#### Lithofacies B

Thin-bedded, muddy, fine sandstone with interbedded shale, in units up to 3.5 m thick. Some units show wavy bedding. Most beds show a sharp base, sometimes with evidence of erosion (tool marks) and slump structures, internal cross-lamination, flasers, mudflakes, and a planar or rippled top that is mud-draped and frequently mud-cracked (Figure 3.41)a. Asymmetrical ripples are also seen, and foam marks and pseudomorphs after halite have been noted. Lithofacies B grades vertically and laterally into C.

#### Lithofacies C

Red-brown, grey-green, or mottled micaceous sandstones interlaminated with flaser-bedded siltstone or mudstone, in beds up to 0.5 m thick. Mudflakes, shallow scour and fill structures, interference ripple marks, pseudomorphs after halite, sole structures, and soft-sediment deformation structures are present.

#### Lithofacies D

Shale, dark brown or grey-green, grading into lithofacies B and C. Rare in occurrence.

#### Lithofacies E

Silty mudstone ('marl'), dark red-brown, with occasional reduced grey and green patches. This is the commonest lithofacies. It is generally structureless and ill-sorted; lamination is rare. Sedimentary structures include symmetrical ripples (Figure 3.41)b, mudcracks, lenticular beds of cross-laminated silt, and sporadic pseudomorphs after halite. The mudstone contains dolomite and scarce gypsum. It is inter-laminated with lithofacies B and C.

## Palaeontology

The Red Brow site is well known for its rich trace fossil fauna (Figure 3.41)c. Ichnotaxa recorded (Ireland *et al.*, 1978) include *Thalassinoides* cf. *suevicus*, *Diplocraterion luniforme*, *Arenicolites* sp., cf. '*Scoyenia?* *triadica*, *Planolites*, *Isopodichnus*, looped trails, and the vertebrate footprint *Chirotherium*.

## Interpretation

The suite of sediments at Red Brow is interpreted (Ireland *et al.*, 1978) as the deposits of an intertidal flat. Various sub-environments are recognized: lower and middle intertidal sandflat (lithofacies B and C), high intertidal mudflat to possibly impersistent sabkha (lithofacies E), and sand bars in tidal flat channels (lithofacies A).

Lithofacies A was deposited by waning currents, as indicated by its fining-up nature, probably in a bar or complex dune, and there is evidence for lateral migration, as bars grew over each other, eroding earlier-formed bars, or grew marginally on mud or silt surfaces.

Lithofacies B shows evidence of frequent alternations of subaqueous and subaerial conditions. The small fining-upwards units were deposited under water by traction currents, with settling out of mud from suspension to form top drapes. Rippled top surfaces were frequently modified by wave action to form nearly symmetrical ripples. The foam marks indicate exposure and wind action, and the pseudomorphs after halite and mudcracks show evidence of emergence and desiccation.

Lithofacies C is interpreted as having formed under similar conditions, but at lower energy.

Lithofacies D resulted from pulses of suspended matter.

Lithofacies E displays alternations between subaqueous and subaerial conditions. The structureless mudstone may have been deposited irregularly from suspension of wind-borne dust, or internal structures may have been destroyed by thorough bioturbation. The symmetrical ripples indicate wave activity. Exposure is indicated by the mudcracks and evaporites.

Overall, the site is interpreted as offering clear evidence for marine marginal conditions (Ireland *et al.*, 1978). Where formerly the 'Waterstones' had been interpreted as probably lacustrine in origin, the combination of detailed, modern, sedimentological study, with evidence from the trace fossil associations, indicates that the finer-grained units at Red Brow represent marine environments.

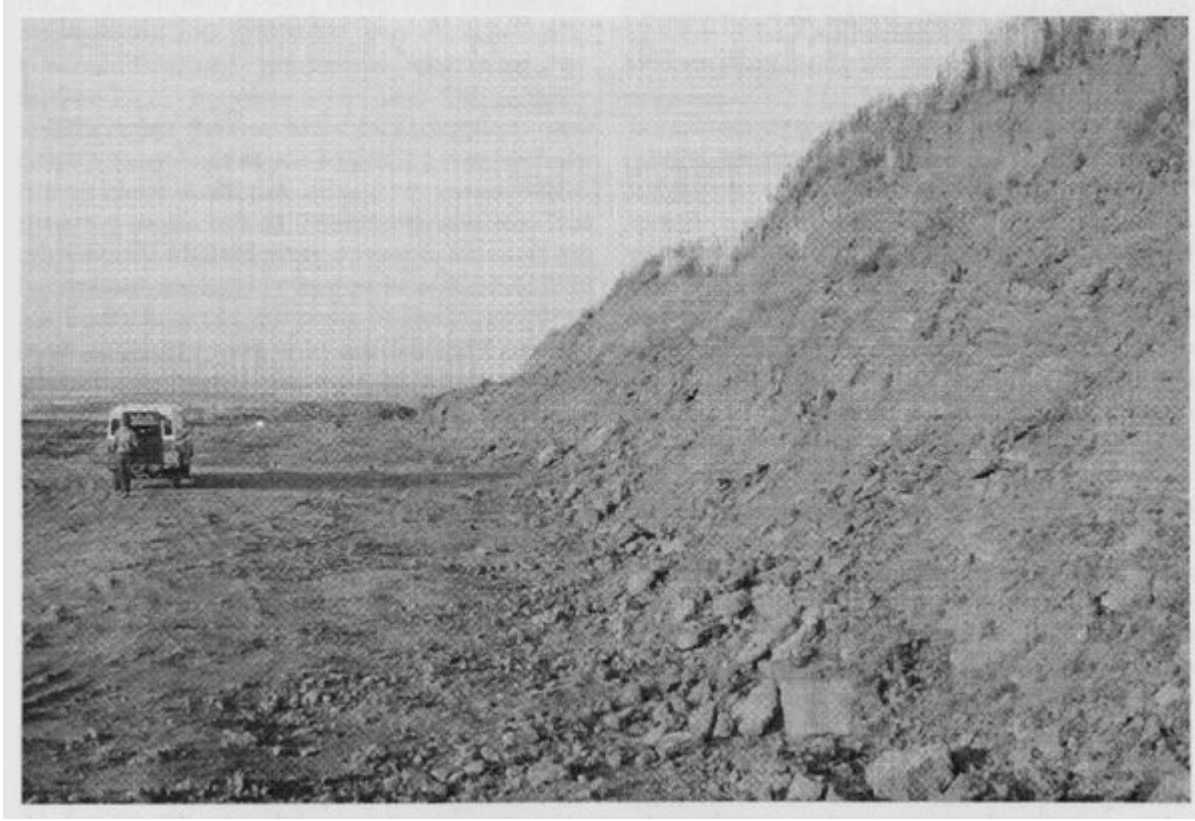
The trace fossils include a range of associations, indicating environments from fully marine, through intertidal, to continental. The branching burrow system *Thalassinoides* is typical of deeper seawater, normally below wave base, and is at least from a low intertidal or sub-tidal position. Several other invertebrate traces indicate the *Skolithos* ichnofacies. In particular, *Diplocraterion* and *Arenicolites*, classic U-shaped burrows, are indicators of intertidal conditions. *Scoyenia* and *Isopodichnus*, in association with mudcracks and vertebrate tracks are continental indicators, belonging to the *Scoyenia* Ichnofacies. Hence, the trace fossils indicate a range of conditions from sub-tidal to freshwater and terrestrial.

## Conclusions

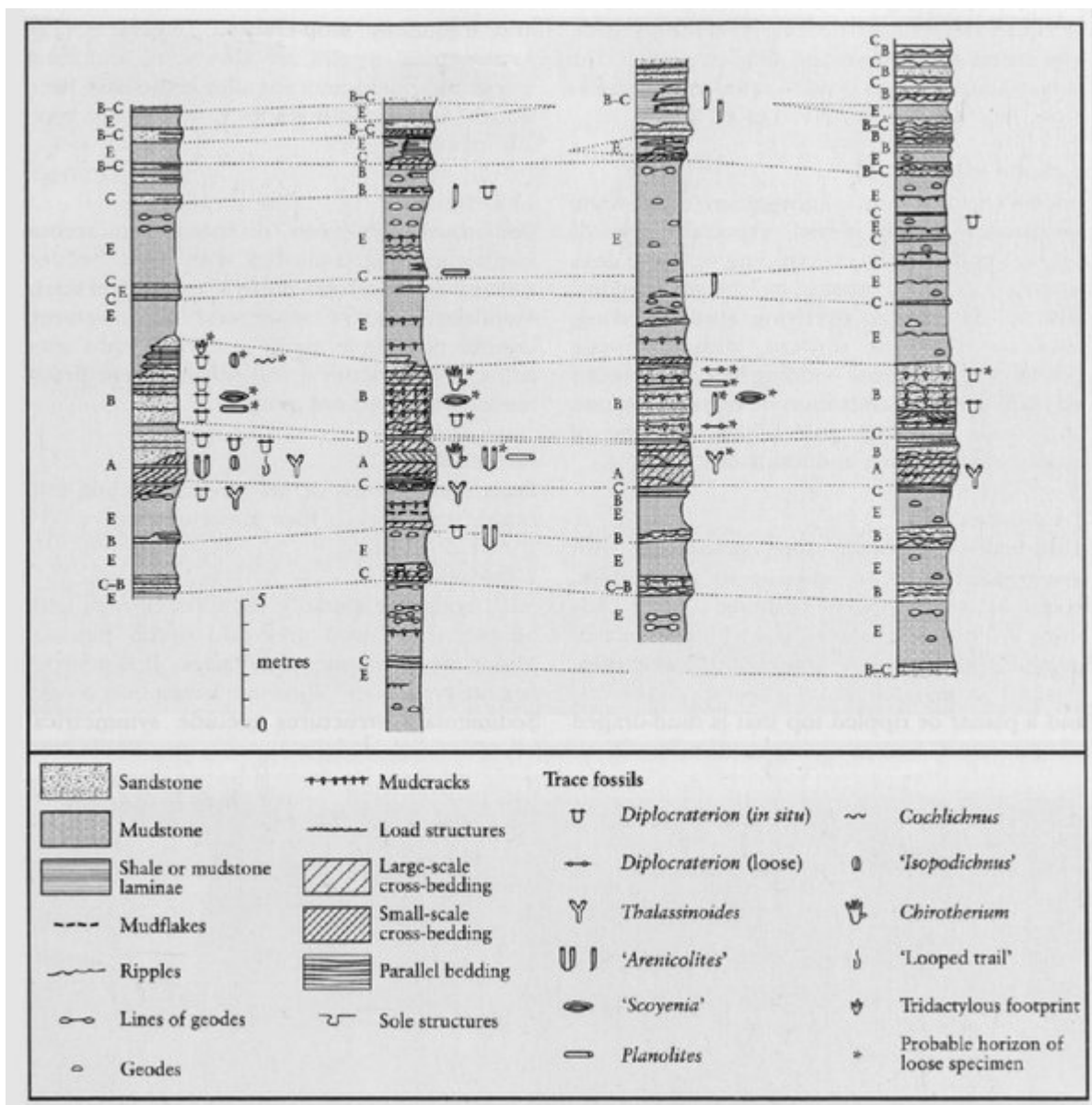
Red Brow provides an excellent exposure of Mid Triassic sediments of sub-tidal to continental origin and was the site of a classic study using sedimentary structures and trace fossils for palaeoenvironmental interpretation. The site comprises deposits from a range of environments, from sub-tidal to continental. Studies here contributed to the resolution of the

origin of the Tarporley Mudstone Formation, formerly the Waterstones', and had wider implications for understanding British Triassic successions, by providing corroborative evidence of shallow marine incursions into the Cheshire Basin and Midlands during the Anisian Age. This is an important site for the study of palaeoenvironmental indicators.

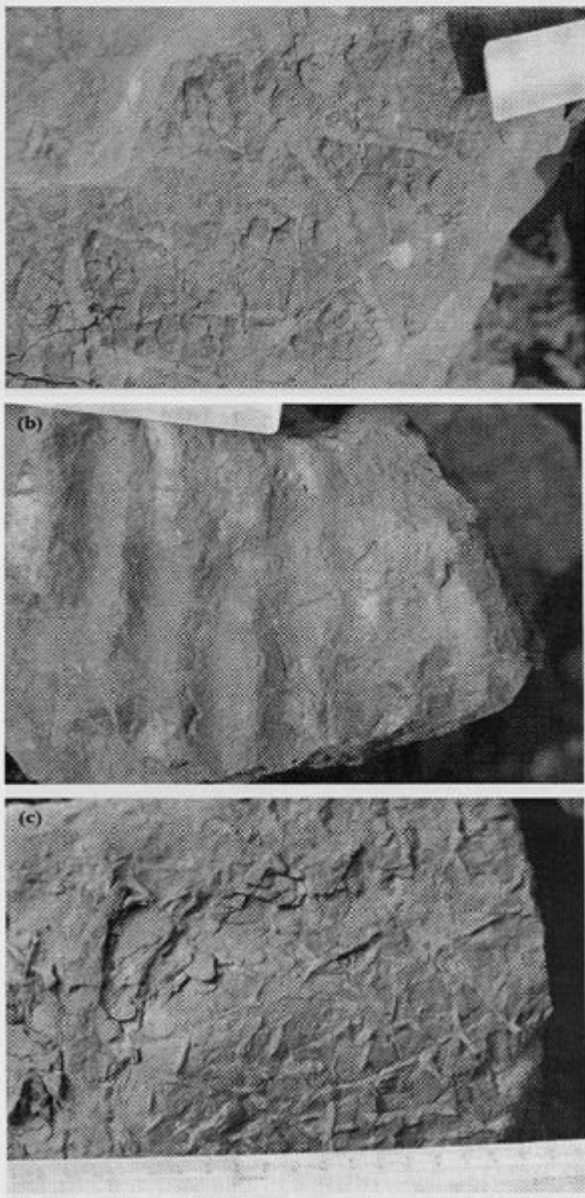
### References



*(Figure 3.39) The section at Red Brow, showing the succession of red sandstones and mudstones. (Photo: M. J. Benton.)*



(Figure 3.40) Sedimentary logs measured through the Red Brow section, showing the interplay of facies A–E. (From Ireland et al., 1978.)



*(Figure 3.41) Sedimentary structures and trace fossils from the Red Brow section, indicative of an intertidal depositional regime. (a) Mud cracks viewed from above, with the cracks filled with overlying sandstone. (Photo: M. J. Benton.) (b) Symmetrical ripple marks. (c) Numerous scattered burrows (Planolites), on the lower surface of a mudstone bed. (Photos: M. J. Benton.)*