Thurstaston Common, Merseyside

[SJ 244 848]

Introduction

This section, known as 'Thurstaston Road Cutting' in the GCR unit records, provides a magnificent exposure of interbedded aeolian and fluvial sandstones, representing a portion of the Helsby Sandstone Formation. The Thurstaston Soft Sandstone Member, predominantly aeolian, and the Thurstaston Hard Sandstone Member (fluvial) are both present, with the former unit characterized by spectacular soft-sediment deformation structures. This site is important for the evidence it offers on Triassic palaeoenvironments, and as the type location of the Thurstaston Soft and Hard sandstone members.

The site has been described by Rice (1939a,b), Thompson (1970a,b, 1985), and Macchi and Meadows (1987).

Description

The road cutting at Thurstaston is said to have been excavated for the owner of the Cunard Shipping Line so that his view of the Dee estuary would not be obstructed by common people walking across Thurstaston Common. The Triassic succession in the Wirral Peninsula is thinner than in adjacent parts of the Cheshire and East Irish Sea basins, and overlies a NE–SW-trending ridge that separates these major basins.

The section offers a continuous exposure of the upper part of the Wilmslow Sandstone Formation and the lower part of the Helsby Sandstone Formation. At the north-western end of the road cutting the lowest beds, belonging to the Wilmslow Sandstone Formation, are exposed. These comprise red, fine-grained sandstones with flat bedding and high-angle cross-stratification. The sands are well sorted and grains have a 'millet-seed' texture. One of the cross-bedded dune sets in this part of the section is 2 m thick, and it is overlain by a thinly bedded sequence of predominantly flat- to low-angle cross-bedded sandstones, some exhibiting adhesion structures.

Within these cross-bedded sequences is a wavy-bedded sandstone unit, some 0.5 m thick, which exhibits considerable variation in grain size. Small-scale fining-upwards units and ripple cross-lamination are common. This sequence passes up into very finely flat-laminated sandstones with evidence for variably wetter and drier interdune surfaces.

This succession is truncated by an erosion surface exhibiting considerable relief (Figure 3.29)a. In one place the surface appears to be undercut, a feature that was interpreted to indicate that the underlying sandstones has been cemented prior to the erosion. Macchi and Meadows (1987), however, suggest that the erosion surface is the result of downcutting by a fluvial channel into wet, but not cemented, sediment. The channel-fill unit overlying the erosion surface comprises medium- to coarse-grained sandstones exhibiting planar and trough cross-bedding with evidence of the former presence of intraformational clasts. This unit is noticeably more thoroughly cemented by silica than the units above or below. It comprises the Thurstaston Hard Sandstone Member' (Thompson, 1985), and is the basal unit of the Helsby Sandstone Formation of this locality.

The overlying Thurstaston Soft Sandstone Member at the south-east end of the section is notable for large-scale cross-stratification in which some of the beds show spectacular soft-sediment deformation structures (Figure 3.28), and (Figure 3.29)b. Three sets of contorted bedding are distinguishable, the middle one showing the most spectacular distortion, with foresets in the large-scale cross-stratification swept up and overturned into extraordinary shapes. Deformation structures include water/air escape structures, oversteepened cross-bedding, slumped and inverted beds, brecciation (probably of a moistened surface or evaporitic crust), and complete liquefaction resulting in structure-less zones.

Interpretation

The depositional environment of the Wilmslow Sandstone Formation has been debated. Thompson (1970a) suggested that the sediments were deposited by braided rivers, while Macchi and Meadows (1987) preferred an aeolian origin. The textural maturity, the absence of both pebbles and mudstone horizons, and the rounded 'millet-seed' character of the sand grains suggest an aeolian depositional environment with dry sand flats and individual migrating dunes. Variations in the style of cross-stratification, from high-angle, sharply based to asymptotically based, and the numerous reactivation surfaces represent changes in bed-form consequent on variations in wind velocity and direction. The overlying thinly bedded upper portion of the formation was probably deposited in an interdune environment. The adhesion structures indicate variations in the aridity of the climate, and exposure of the water table at times. Flat-bedded sands may indicate aeolian reworking of fluvially deposited sands.

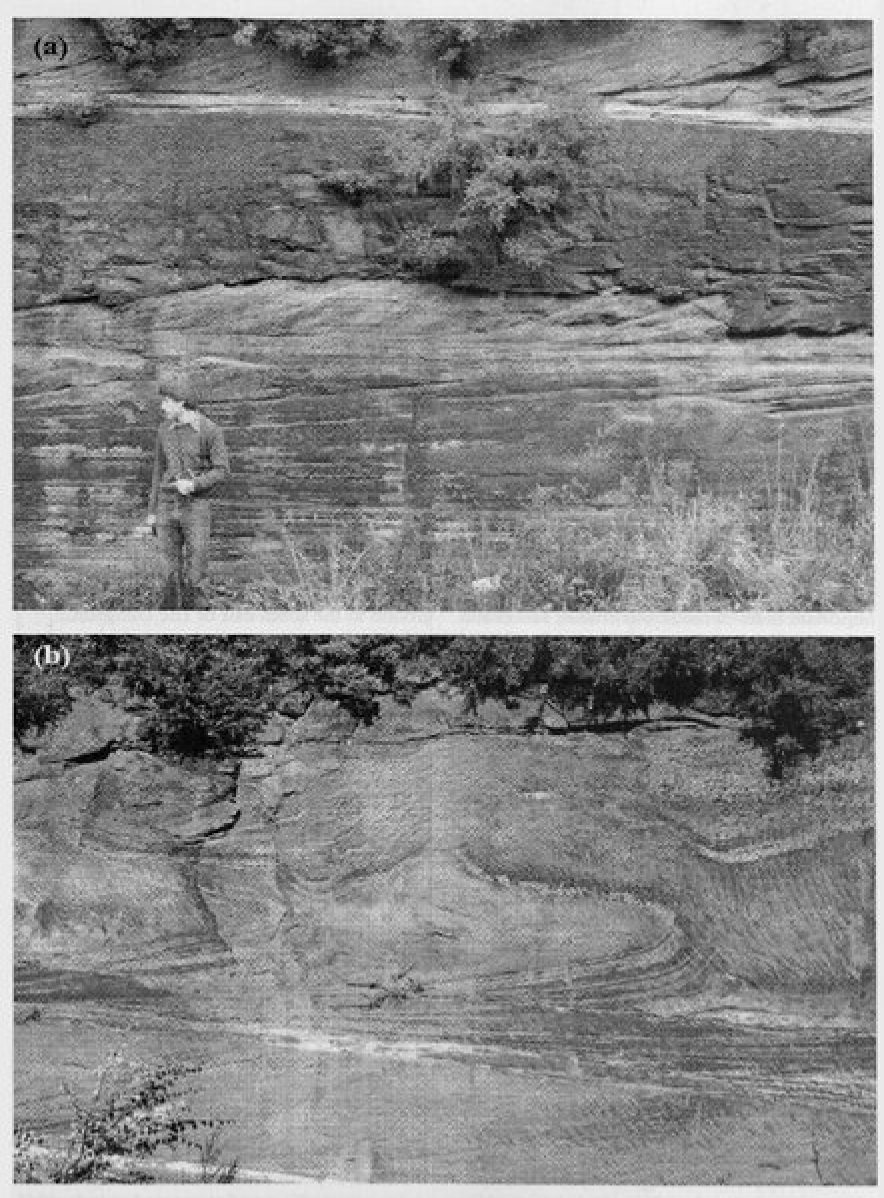
The Thurstaston Hard Sandstone Member is clearly fluvial in origin, as shown by the presence of small-scale cross-stratification and mudstone intraclasts. The succeeding Thurstaston Soft Sandstone Member was, in contrast, deposited in aeolian dunes, as indicated by the sandstone texture and the large-scale cross-stratification.

The contorted bedding in the Thurstaston Soft Sandstone Member (Figure 3.29)b has long been a classic attraction of the site (Rice, 1939b; Thompson, 1970a,b). Smaller-scale deformed bedding is often explained as a result of a sudden increase of bed traction forces, which effectively pull the foresets over. Larger-scale deformation, as at Thurstaston, might result from changes of pore-water pressure and thixotropic action at, for example, points of spring emergence in a fluvial regime (Thompson, 1970a). It is not clear, however, whether the deformation happened during deposition, or after. The scale of the deformation, and the fact that the deformed foresets do not lose their cohesiveness, despite some extraordinary contortions, may suggest that the porous, well-sorted sandstone was swamped with water some time after deposition and partial, but not complete, consolidation. Deposition of further sediment might have put pressure on this saturated sediment below, and forced the water to rise, pulling the foreset laminations upwards and creating the spectacular distortions. Macchi and Meadows (1987), on the other hand, suggest that it is equally likely that the large-scale recumbent slump folds in the Thurstaston Soft Sandstone Member could have arisen from slope instability of wet sediment, or disturbance by local tectonic activity.

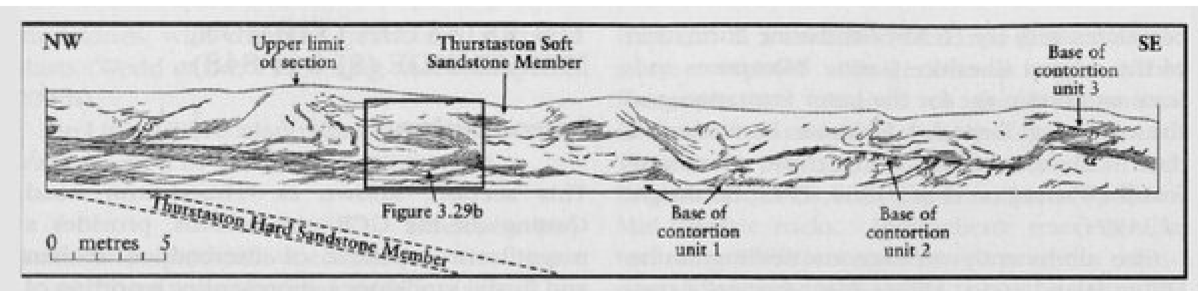
Conclusions

The Thurstaston road cutting shows three important units of the Lower Triassic succession in the Wirral, the Wilmslow Sandstone Formation, and the Thurstaston Hard and Soft sandstone members of the Helsby Sandstone Formation. These represent major changes in depositional regime, from aeolian to fluvial, and then aeolian again. The soft-sediment deformation structures are classic examples, well known to generations of students. This is a critically important site for the study of Triassic sedimentology.

References



(Figure 3.29) Thurstaston Common road cut. (a) The lower bounding erosion surface of the Thurstaston Hard Sandstone Member, overlying the Wilmslow Sandstone Formation. (b) Deformed cross-bedding in contortion unit 1 in the Thurstaston Soft Sandstone Member. Field of view of (b) is about 5 m. (Photos: (a) M. J. Benton, (b) P. Turner.)



(Figure 3.28) Contorted bedding in the Thurstaston Soft Sandstone Member. The area of Figure 3.29a is at the far north-western end of the section shown here. (After Rice, 1939b.)