
Hilbre Island and Hilbre Point, The Wirral, Cheshire

[SJ 186 876]; [SJ 203 885]

Potential GCR site

Introduction

At Hilbre Island and Hilbre Point, the reddish sandstones with minor, laterally impersistent, beds of silty mudstone, are assigned to the Ormskirk Sandstone Formation. Sedimentary structures, such as trough cross-bedding, rippled bedding surfaces, and desiccation surfaces indicate deposition in river channels and emergence. Trace fossils are common at this locality, and include invertebrate burrows and many fine examples of vertebrate footprints. The site is important for documenting the palaeoenvironment of the Ormskirk Sandstone Formation in detail, and for its spectacular trace fossil assemblages.

The Triassic geology of the Wirral area has been documented by several authors (see above, Burton Point), and the Hilbre site was described briefly by Hull (1869, p. 57) and Macchi and Meadows (1987), and more fully by Thompson (1998) and King and Thompson (2000a,b).

Description

Hilbre Island is a small island situated in the Dee Estuary, approximately 1.5 km west of West Kirby. Hilbre Point is on the mainland, approximately 1 km north of West Kirby, and is bordered by the Dee Estuary and Liverpool Bay. The Triassic sediments are exposed in a series of low cliffs and foreshore reefs. Hilbre Island, together with the smaller islands of Little Eye and Middle Eye, forms a local Nature Reserve, and the sites fall within the boundaries of the Dee Estuary Site of Special Scientific Interest (SSSI). Joints and fractures cutting the Triassic sediments are generally aligned parallel or sub-parallel to a large-scale fault located within the Dee Estuary (Macchi and Meadows, 1987).

Sedimentology

The Ormskirk Sandstone Formation reaches a maximum thickness of more than 250 m in the Liverpool area (Jackson *et al.*, 1987). The unit typically consists of predominantly red, well-cemented, even-grained, unfossiliferous sandstones. Scattered pebbles occur in the lower parts of the formation, but pebbles are generally more common in the upper parts. The pebbles have an average diameter of 60 mm and are mainly well-rounded and composed of reddish or purplish quartzite. Less common clasts include grits, siliceous breccia, sandstone, granite, mica-schist, and tourmaline-schist (Wedd *et al.*, 1923; Jackson *et al.*, 1987; Macchi and Meadows, 1987).

The section exposed on the south-west coast of Hilbre Island (Figure 3.25) is dominated by red and yellowish, medium-grained sandstones, with occasional bands of breccia. Some of the beds are micaceous, and nodules of barite are scattered throughout the section. The pebbles are typically composed of vein quartz, reworked sandstone and intraformational mudstone clasts. Occasional beds of argillaceous material are present, and are characterized by grey and red, silty mudstones. Sedimentary structures are well preserved in the sediments on the southwest coast of Hilbre Island. At the base of the cliffs (Figure 3.26) and (Figure 3.27), the sandstones display well-developed trough cross-bedding, and they are overlain by a sequence of interbedded sandstones and mudstones, which may be laterally impersistent. Desiccation cracks are frequently associated with the mudstone beds. The interbedded sandstones are overlain by a substantial unit of flat-bedded sandstones, which is in turn overlain by trough cross-bedded sandstones. Within the trough cross-bedded sandstones is a conspicuous layer of rudaceous sediments, the Hilbre Island Breccia, which is matrix-supported, and contains angular and subangular clasts of sandstones, gritstones and mudstones, with rounded quartz and quartzite clasts (Wedd *et al.*, 1923; King and Thompson, 2000a).

On Little Hilbre Island the following sequence was recorded by Wedd *et al.* (1923, p. 76):

| | Thickness (m) |
|--|---------------------|
| Sandstones, pale-yellow, coarse and hard, cross-bedded, with subangular pebbles in the lower 1.2 to 3 m in places. | Exposed up to 15.24 |
| Breccia-bed; many subangular fragments of rocks, mostly Carboniferous, in a fine-grained, incoherent sandy matrix | 0.30 |
| Sandstones, red- and yellow-streaked, soft and fine-grained | 3.05 |
| Sandstones, hard, yellow, cross-bedded, with concretionary weathering; becoming red towards the main island | 15.24 |

The breccia is easily traced to Hilbre Island, where a marl bed in the lower part of the section is underlain by approximately 15 m of coarse-grained red and yellow, bedded sandstone with concretions, and overlain by mottled red and yellow sandstone (Wedd *et al.*, 1923).

At Hilbre Point, a three-dimensional exposure of pebbly sandstones is seen. The sediments show trough cross-bedded sets with a maximum thickness of 1 m, and set thickness generally decreases upwards through the section. The foresets have asymptotic bases (Macchi and Meadows, 1987). Planar- and cross-bedded units are less common, and may be associated with deformed cross-bedding, several scales of rippled surfaces (bar- and dune-scale) and reactivation surfaces. Intraformational clasts are common in many of the beds (Thompson, 1986). Although the sandstones are frequently pebbly there are no breccia beds at Hilbre Point (Wedd *et al.*, 1923).

Palaeontology

The reddish sandstones exposed in the southwest area of Hilbre Island (Figure 3.27) have yielded abundant vertebrate footprints and trackways (King and Thompson, 2000a). The footprints are preserved at several horizons (Figure 3.27), for example in poorly cemented friable sandstones associated with thin beds of clay, and in a thick bed of coarse-grained sandstone associated with desiccation cracks. The footprints are assigned to the ichnogenera *Chirotherium* and *Rhynchosauroides* (King and Thompson, 2000a,b), typical trace fossils of the English Midlands and Cheshire Basin Early to Mid Triassic rocks. Invertebrate trace fossils, including *Skolithos* and *Planolites* of the continental *Scoyenia* Ichnofacies, occur at some 15 horizons in association with the vertebrate tracks.

Reworked invertebrate fossils have been recorded from the sediments at Hilbre Island, including an orthid brachiopod and a silicified Carboniferous coral (Davies, 1961).

Interpretation

Hilbre Island and Hilbre Point are situated on the south-eastern margin of the East Irish Sea Basin (Jackson *et al.*, 1987; Cowan, 1993; Jackson and Mulholland, 1993; Meadows and Beach, 1993), and comparison with offshore borehole records has helped to elucidate the stratigraphy to some extent. The stratigraphical position of the 'Bunter Pebble Beds' and the 'Bunter Upper Mottled Sandstone' around Liverpool has been debated. For example, Greenwood (1916) used evidence from the mineralogical composition of the sandstones to suggest that they are more similar to the Helsby Sandstone Formation than the Chester Pebble Beds Formation of the central Cheshire Basin. The whole pebbly and coarse sandstone unit of the area was more generally equated simply with the Chester Pebble Beds Formation, but the definition of the Ormskirk Sandstone Formation for a unit previously recognized around Formby, Ormskirk, and Preston in west Lancashire (Warrington *et al.*, 1980), and its recognition offshore (Jackson *et al.*, 1987; Meadows and Beach, 1993) indicates that the sandstone units on the Wirral might in fact represent this formation (Figure 3.19). This view is followed by King and Thompson (2000a) who noted that the pebbles in the Hilbre conglomerates are compositionally similar to those of the Chester Pebble Beds Formation, having presumably been reworked from that unit into the Ormskirk Sandstone Formation essentially unchanged in relative proportions and general appearance.

The Ormskirk Sandstone Formation marks the top of the Sherwood Sandstone Group, and correlates with the Helsby Sandstone Formation of the central Cheshire Basin. Miospores indicate an Anisian age for the latter formation and the overlying Tarporley Siltstone Formation, a date corroborated by comparison of macrofossils (Warrington *et al.*, 1980, 1999; Benton *et al.*, 1994).

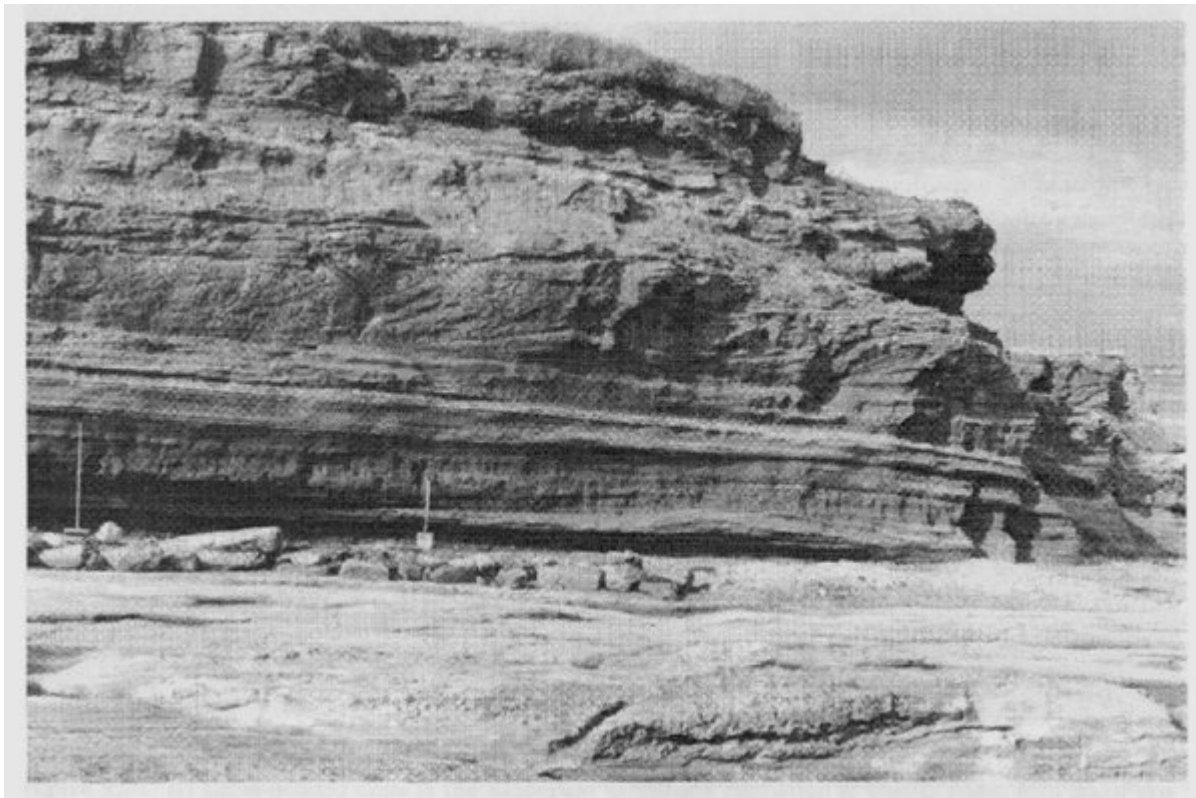
The dominantly arenaceous sediments on Hilbre Island and at Hilbre Point suggest a continental setting, characterized by braided river channels (Thompson, 1986; Macchi and Meadows, 1987). The three-dimensional cliff exposures at Hilbre Point, with their elongate sand bodies with trough cross-bedding, have been interpreted as tongues of sediment deposited parallel to the direction of water movement. The decrease in cross-bedding set thickness upwards through the sequence, and the associated bar-scale and megaripple-scale bedforms, indicate a steady decrease in current velocity (Macchi and Meadows, 1987). The high degree of lateral and vertical variation characteristic of the Ormskirk Sandstone Formation is consistent with a braided channel system interpretation (Thompson, 1986).

In detailed palaeogeographical reconstructions of the East Irish Sea Basin during deposition of the Ormskirk Sandstone Formation, Meadows and Beach (1993, pp. 261, 262), show a major braided river system running northwestwards over Hilbre Island, and feeding clastic sediments into the centre of the offshore basin. The region was the site of a complex of braided channels separated by sand flats, with aeolian dunes and playa lakes in some of the major interchannel areas.

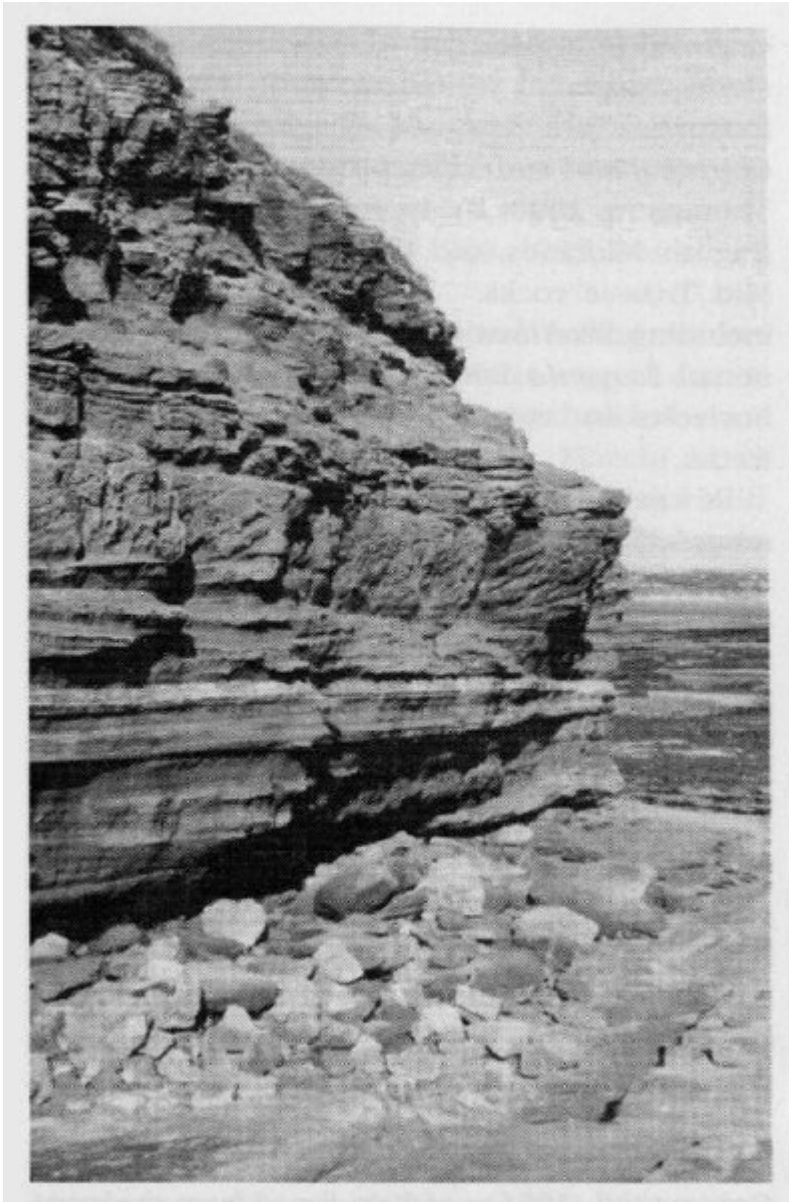
Conclusions

The sediments in the cliffs and foreshore reefs at Hilbre Island and Hilbre Point provide an excellent onshore record of the Ormskirk Sandstone Formation, which continues offshore where it provides a major hydrocarbon reservoir unit. The sediments, comprising reddish, pebbly sandstones, with occasional mudstone beds, are continental, and were deposited by a complex system of braided rivers and streams. The vertebrate tracks, associated with argillaceous sediments and mud cracks, indicate periods of emergence. This is a key site for stratigraphical and palaeoenvironmental studies on the margin of the East Irish Sea Basin.

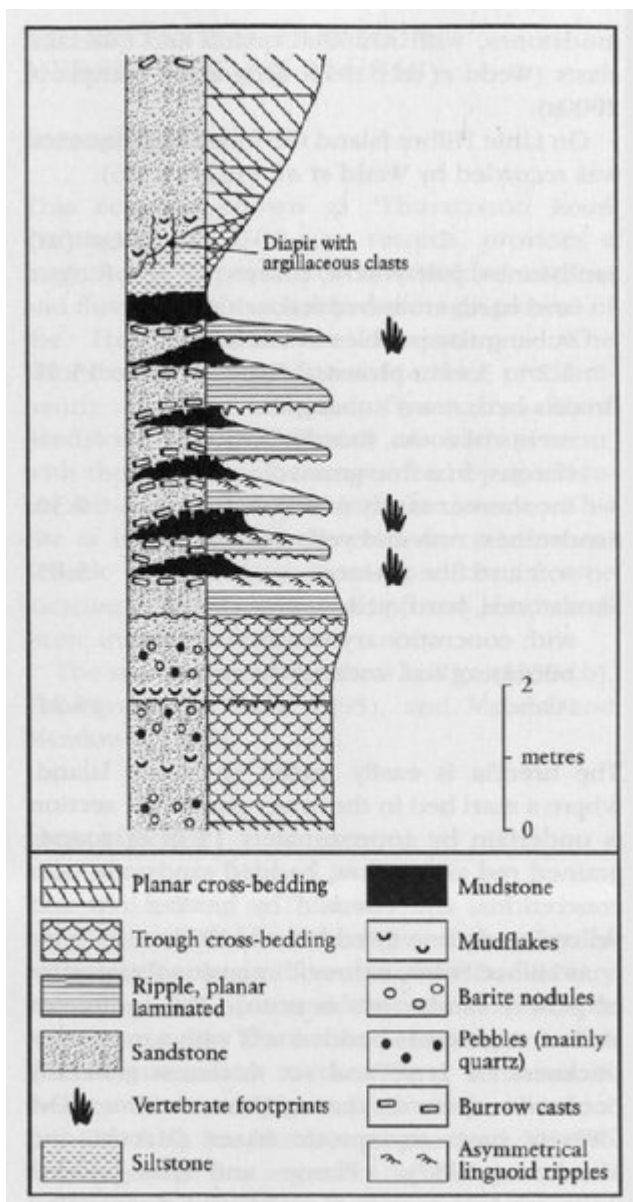
References



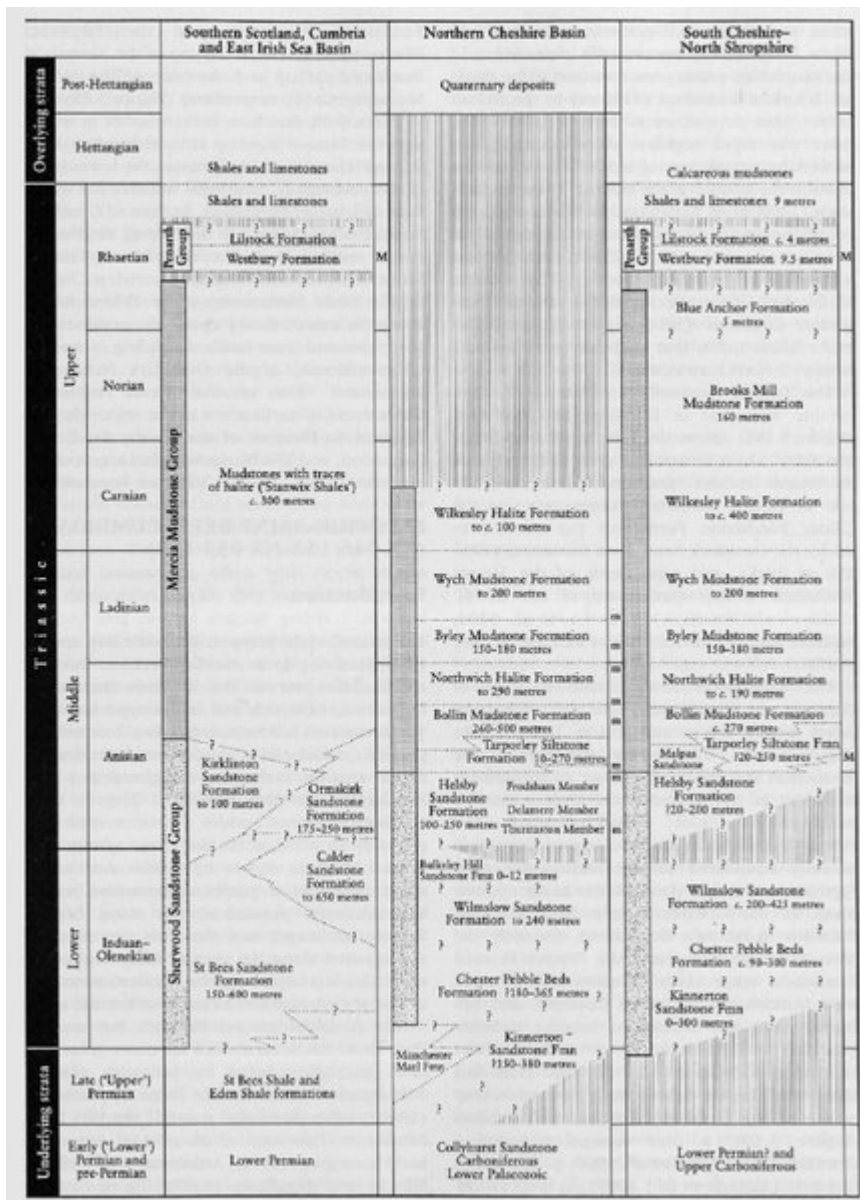
(Figure 3.25) The Ormskirk Sandstone Formation on the southern point of Hilbre Island, showing planar-bedded and cross-bedded sandstone units. (Photo: M. J. King.)



(Figure 3.26) The Ormskirk Sandstone Formation on the southern point of Hilbre Island, close to the site that yielded trace fossils, including vertebrate footprints. (Photo: M. J. King.)



(Figure 3.27) Simplified graphic sedimentary log through the Ormskirk Sandstone Formation at the southern tip of Hilbre Island. (After King and Thompson, 2000a.)



(Figure 3.19) Stratigraphical columns for the Triassic successions of southern Scotland and Cumbria, and the East Irish Sea and Cheshire Basin areas. M, macrofossils; m, microfossils. Based on Warrington et al. (1980), Jackson et al. (1987), Wilson (1993) and Ivimey-Cook et al. (1995), Jackson and Johnson (1996), Akhurst et al. (1997) and Warrington (199713).