Dawlish, Devon

[SX 966 768]–[SX 979 782]

Introduction

The site shows one of the finest continuous exposures in the country of interbedded aeolian sands and water-laid breccia-filled fluvial channels of Permian age. The sediments belong to the Dawlish Sandstone Formation, of which this is the type section. At the northern end of the section, Langstone Rock is the type location of the Exe Breccia, a coarse alluvial fan unit intercalated within dune sandstones. This is a classic site for the study of aeolian bedforms and for understanding the palaeogeographical evolution of the Devon region during Permian times.

The Dawlish Sandstone Formation in its type area has been described by Laming (1966, 1982), Selwood *et al.* (1984), Mader (1985), Mader and Laming (1985), Mader and Yardley (1985), Clemmensen *et al.* (1994), and most recently by Newell (2001).

Description

The sea cliff exposures around Dawlish are part of the Dawlish Cliffs Site of Special Scientific Interest (SSSI). A complete section through the Dawlish Sandstone Formation is exposed in the cliffs around the town, in particular beside the railway line east of Dawlish (Figure 2.41). This unit consists primarily of aeolian and fluvial sandstones, with some interbedded breccias and breccio-conglomerates (Laming, 1982; Selwood *et al.,* 1984; Mader, 1985). The breccia horizons contain some large blocks of reworked aeolian sandstone. This alternation between breccias and sandstones grades upwards into sandstones with occasional mudstone beds. Towards the top of the sequence, the sandstones are incised by channels infilled with breccia (Laming, 1966, 1982; Mader, 1985).

The sandstones at the base of the Dawlish Sandstone Formation are generally well sorted and composed of well-rounded grains, which commonly have frosted surfaces and thin coatings of haematite. Quartz grains dominate (65–80%), although pinkish sanidine feldspar ('murchisonite') crystals up to 20 mm long are present (20%), as well as lithic fragments (10%) (Laming, 1966, 1982). The sedimentary structures are mainly large-scale planar-wedge dune sets, some 0.7 m thick and 5 m wide, with minor planar-tabular cross-bedded sets and trough sets ((Figure 2.41); Mader and Yardley, 1985). The bounding surfaces are predominantly planar and horizontal, as well as gently inclined to create the wedge-shaped sets. The foreset laminae are generally slightly concave-downwards and asymptotic at the base, and they indicate a predominant wind direction towards the northwest (Figure 2.36). Some truncation planes are lined with thin deflation lag veneers consisting of fine gravel. Intercalated breccia lenses from 0.05 to 4 m thick rest on erosion surfaces and fine- upwards into planar-bedded sandstones with scattered gravel clasts.

The top 120 m of the Dawlish Sandstone Formation comprises sandstone with thin beds of breccia (Figure 2.41). Quartz grains dominate, and appear to have been reworked from the underlying aeolian sediments. Cross-bedding is present, but is generally not very well preserved. Large channels and 'washouts' cut into the underlying sandstone are also recorded, and are infilled with medium-grained breccias with quartzite and porphyry clasts (Laming, 1966, 1982).

The overlying Exe Breccia (Selwood *et al.,* 1984, p. 94), formerly the Langstone Breccia, is seen towards the northern end of the beach at Langstone Rock [SX 979 780]. The Exe Breccia overlies and partially interdigitates with the Dawlish Sandstone Formation, and is succeeded unconformably by the Exmouth Mudstone and Sandstone Formation of the Aylesbeare Mudstone Group (Figure 2.30). It comprises up to 85 m of poorly cemented, pebbly breccio-conglomerates composed primarily of angular clasts of sandstone, with some fragments of aureole metamorphic rocks (slate) and porphyry (Laming, 1982; Mader and Laming, 1985). The clasts are generally less than 0.15 m across and are contained in a haematite-stained sand and silt matrix. Graded bedding is recognizable, and cross-bedded and planar-bedded sandstone sets are common at the tops of breccia units. Sets and cosets of cross-bedded breccia up to 0.3 m thick, comprising clasts 20–40 mm in diameter in a silty sand matrix, occur towards the top of the formation.

Interpretation

The Dawlish Sandstone Formation was deposited by aeolian and fluvial processes in a semi-arid climate (Laming, 1966; Selwood *et al.,* 1984; Mader, 1985). Mader and Laming (1985) divided the formation into lower, middle, and upper parts, which were in turn subdivided into eleven units. The lower part comprises interbedded sandstones and breccias, representing deposition in alluvial fans, which pass upwards into deposits of an aeolian dune field. The alluvial fan sediments show some degree of reworking by aeolian processes.

The middle part of the sequence represents a continuation of deposition in the aeolian dune field and in dune flats, with a varying degree of fluvial activity, resulting in sandy braidplains and alluvial fans, and reworking of the aeolian sediments. Hierarchical bounding surfaces indicate that the dune sediments were periodically reworked and redeposited in subsequent generations of dunes. Fluvial incursions are represented by sandy sediments that lack well-defined sedimentary bedding and contain mudstone lenses and layers, interpreted as accumulating on distal parts of alluvial fans (Laming, 1982). Channels incised into the sandstone indicate that during some of the flooding episodes the more common sheet floods were replaced by high-energy erosive channelled flows. The channels were formed when sheet floods were forced into narrow areas between the dunes, and may reflect changes in the climatic regime of the British Isles towards the end of the Permian Period.

The cross-bed sets indicate that the dunes were straight- to sinuous-crested transverse dunes that migrated in essentially one direction, to the NNW There is evidence for some slight variation in palaeowind direction (Figure 2.36), possibly caused by topographical wind deflection as winds blew across the lowland area of the erg and encountered surrounding mountain chains (Mader and Yardley, 1985). The upper part of the sequence reflects a change to deposition on an alluvial fan complex consisting of small-scale, pebbly, distal fans, sandy braid-plains, and rarer dune facies.

The Exe Breccia comprises lower and upper parts (Mader and Laming, 1985). The lower part is generally coarse-grained, with a large proportion of pebbles, and has been interpreted as representing the medial and distal portions of an alluvial fan. The upper part is more sandy, and represents the more distal areas of an alluvial fan. Deposition of the breccias may have resulted from an increase in rainfall associated with climatic change towards the close of the Permian Period.

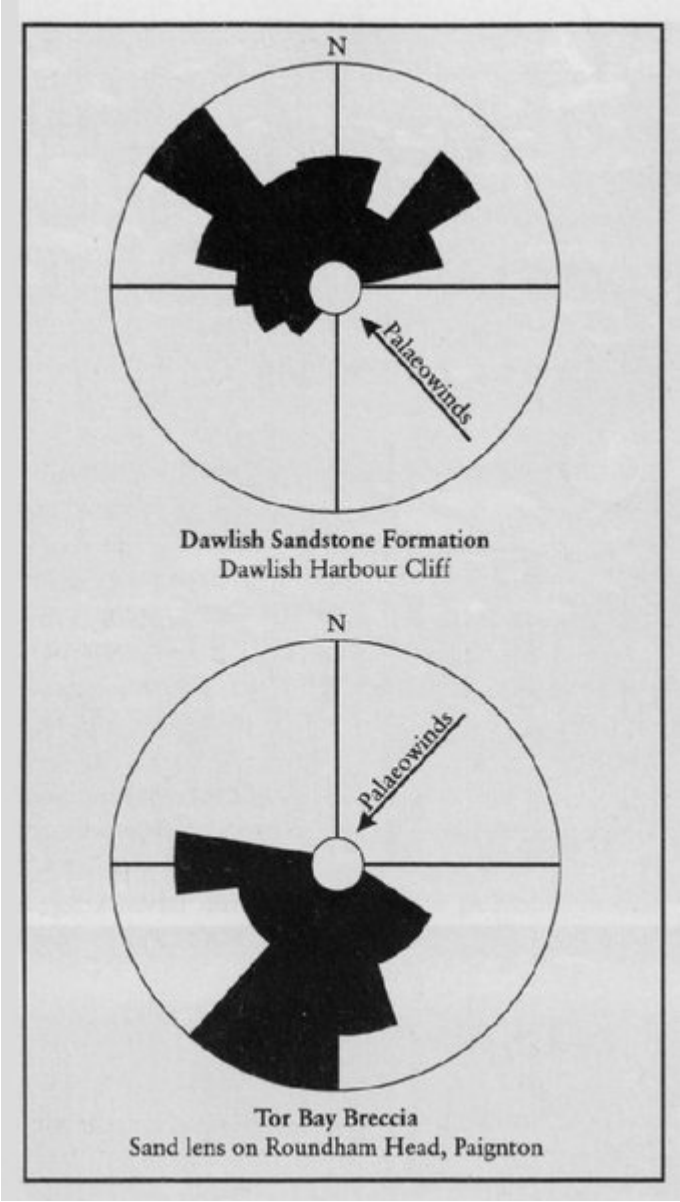
Fossils are absent throughout the Dawlish section, and the Dawlish Sandstone Formation is dated on circumstantial evidence. Footprints, which suggest a Late Permian age, have been found in the unit near Exeter, (Edwards *et al.,* 1997; Edwards and Scrivener, 1999). In addition, around Exeter, the Dawlish Sandstone Formation occurs above sandstones and breccias that have been dated by miospores as Mid to Late Permian (Figure 2.30). Furthermore, at Dawlish, the Dawlish Sandstone Formation interfingers with the Teignmouth Breccia (assigned a Mid to Late Permian age — see GCR site report for Coryton's Cove). The assignment of a this later Permian age to the formation (Edwards *et al.,* 1997; Edwards and Scrivener, 1999) is a substantial shift from the traditionally assigned Early or Mid Permian age (Laming, 1968, 1982).

Conclusions

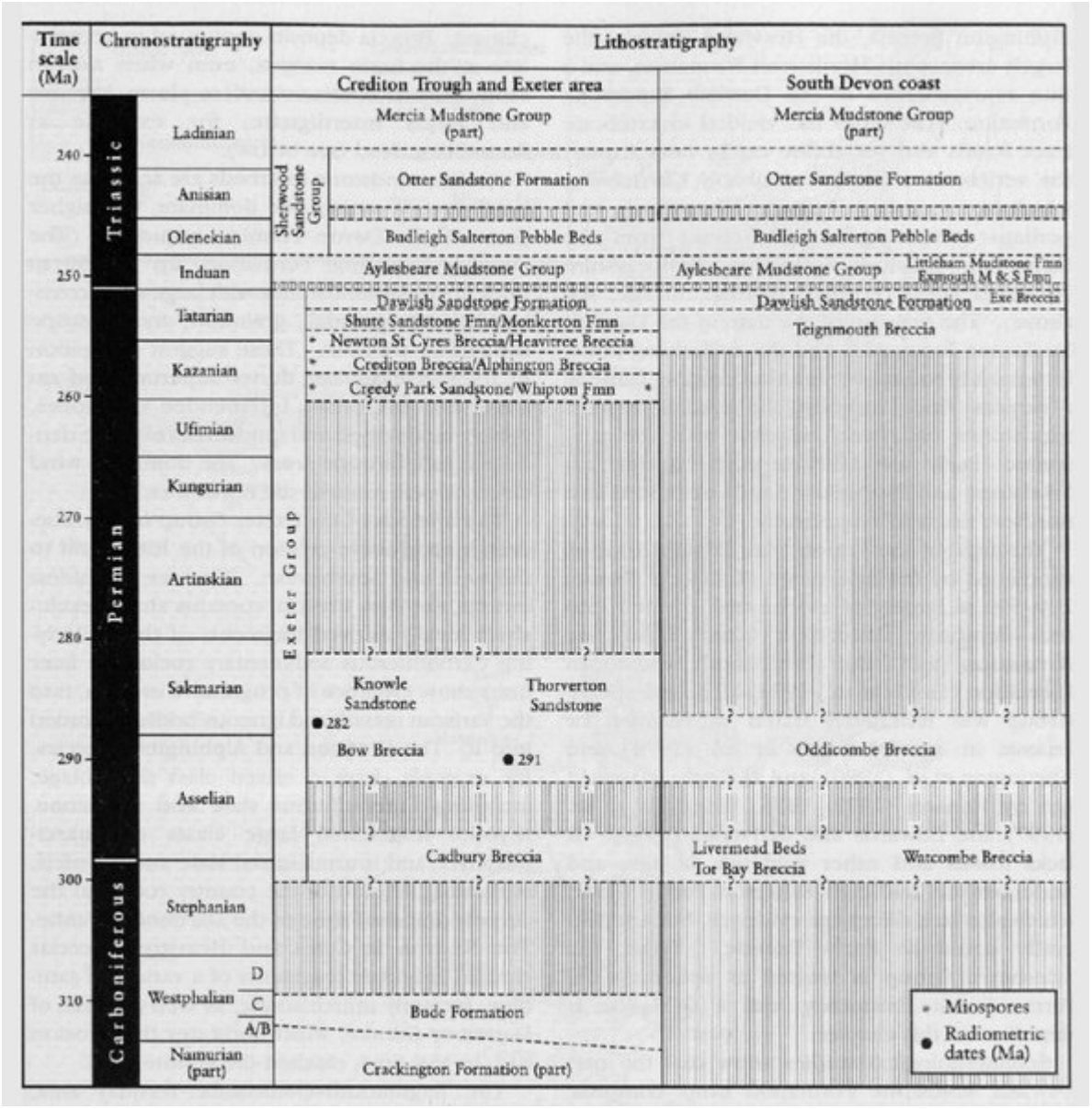
The excellent exposures of the Dawlish Sandstone Formation and the Exe Breccia in the vicinity of Dawlish reflect important changes in sedimentary conditions during the Late Permian Epoch. The lower part of the Dawlish Sandstone Formation represents aeolian sedimentation in dune fields, with occasional incursions of fluvial sandstones and breccias. The upper part of the formation is characteristic of a fluvially dominated system, which reworked much of the aeolian sequence. The Exe Breccia was deposited in an alluvial fan environment. This is a critical site for understanding aeolian sedimentation processes and for reconstruction of the Permian palaeogeography of Devon.

References

(Figure 2.41) Aeolian dune sands in the Dawlish Sandstone Formation. The large-scale cross-bedded unit in the middle of the section represents an eastwardly migrating barchanoid draa. It is interbedded with fluvial sheet-flood sands and gravels (Photo: P Turner.)



(Figure 2.36) Rose diagrams of palaeowind directions from aeolian foreset orientations for the Tor Bay Breccia and the Dawlish Sandstone Formation. (From Laming, 1982.)



(Figure 2.30) Stratigraphy of the Permian successions of the East and South Devon basins. Formal divisions for the Crediton Trough and Exeter area are from Edwards et al. (1997), and the successions around Torquay and Teignmouth are updated tentatively from Smith et al. (1974), Selwood et al. (1984), and Warrington and Scrivener (1990).