Shoalstone, Devon

[SX 934 568]–[SX 939 568]

Introduction

The wave-cut platform at Shoalstone, Brixham (Figure 2.31) exposes two sets of red sandstone-filled fissures, or sedimentary dykes, some of which are lined with large sparry calcite crystals. The fissures cut into the Devonian Torquay Limestone, and mark the initial stages of continental deposition in the Permo-Triassic of Devon. The site is important as an excellent example of a rare sedimentary feature that tells a graphic story of uplift, tectonic extension, and continental sedimentary deposition.

The Neptunian dykes at Shoalstone were first described by Pengelly (1866), and subsequently by Ussher and Lloyd (1933, pp. 109–10), Richter (1966), and Durrance and Laming (1982, p. 175).

Description

The sandstone-filled fissures or dykes are best seen on the foreshore of Shoalstone Beach to the east of the swimming pool (Figure 2.32), although they occur in many places on the wave-cut platform between Elderberry Cove, north of Paignton, and at Berry Head. The Shoalstone locality forms part of the Berry Head to Sharkham Point Site of Special Scientific Interest (SSSI).

The dykes range in breadth from less than one centimetre to a metre or more. They are vertical to near-vertical in orientation, trend approximately east-west and north-south, and cut the gently dipping Torquay Limestone. Some examples show cross-cutting relationships. The dykes form a complex pattern of large and small features, and some form sills between the beds of limestone.

The fissures are infilled with two types of sandstone: a fine-grained, compact, deep red lithology, and a more crumbly, coarse-grained sediment with abundant white grains. The former appears to be older, as indicated by crosscutting relationships, and generally consists of calcite and quartz with some argillaceous sediment. The grains all fall within the fine to medium sand grade and are mostly well rounded. Poorly defined parallel bedding is seen in a few places. Occasionally the sediments are conglomeratic in nature. The sediments are normally separated from the limestone walls of the fissures by a thin skin of crystalline calcite (Richter, 1966).

The younger sandstones, which cut across the older ones in places, are harder, finer grained, and brighter coloured (Ussher and Lloyd, 1933; Richter, 1966), and are cemented either by quartz overgrowths or by calcite. Calcite crystals also line the sides of the fissures, and show at least two phases of growth, with brown crystals at the outer margins of the fissures, and large, well-formed, white crystals in the middle.

Interpretation

Pengelly (1866) considered the dykes trending north-south to be younger than those with an east-west orientation. However, the story is not quite so simple, as Richter (1966) showed by detailed mapping of the site (Figure 2.32). He noted that the dykes outcropping on the western part of the beach are all infilled with the paler, coarser-grained sediment. These are interpreted as the older generation of dykes, and they trend both north-south and east-west. To the east, the younger dykes are seen, with a darker red colour, and cutting many of the pale-coloured dykes. Richter's analysis also showed that the majority of the dykes are perpendicular to bedding planes in the Torquay Limestone.

The formational history of the dykes may be summarized as having occurred in two phases (Richter, 1966):

Phase 1. Fissures formed in the Torquay Limestone as a result of north-south tectonic extension. These cracks were infilled with sediment, probably by a combination of fluvial (surface and subsurface flow) and aeolian activity, and the sediment was cemented by calcium carbonate. The cementation of the sediment probably occurred quite quickly as this sediment was itself fractured and the resulting cracks infilled with sediment of a similar age.

Phase 2. An episode of broadly east-west tectonically induced fracturing took place. These fractures cut both the Torquay Limestones and the Phase-1 sediment-filled dykes. The fissures remained open long enough to allow calcium carbonate to be precipitated along the margins of the fissures. Sand was also washed into these fissures.

A third, less clearly defined, phase of deformation has also been identified, and is associated with the formation of silica rather than calcite cements (Richter, 1966).

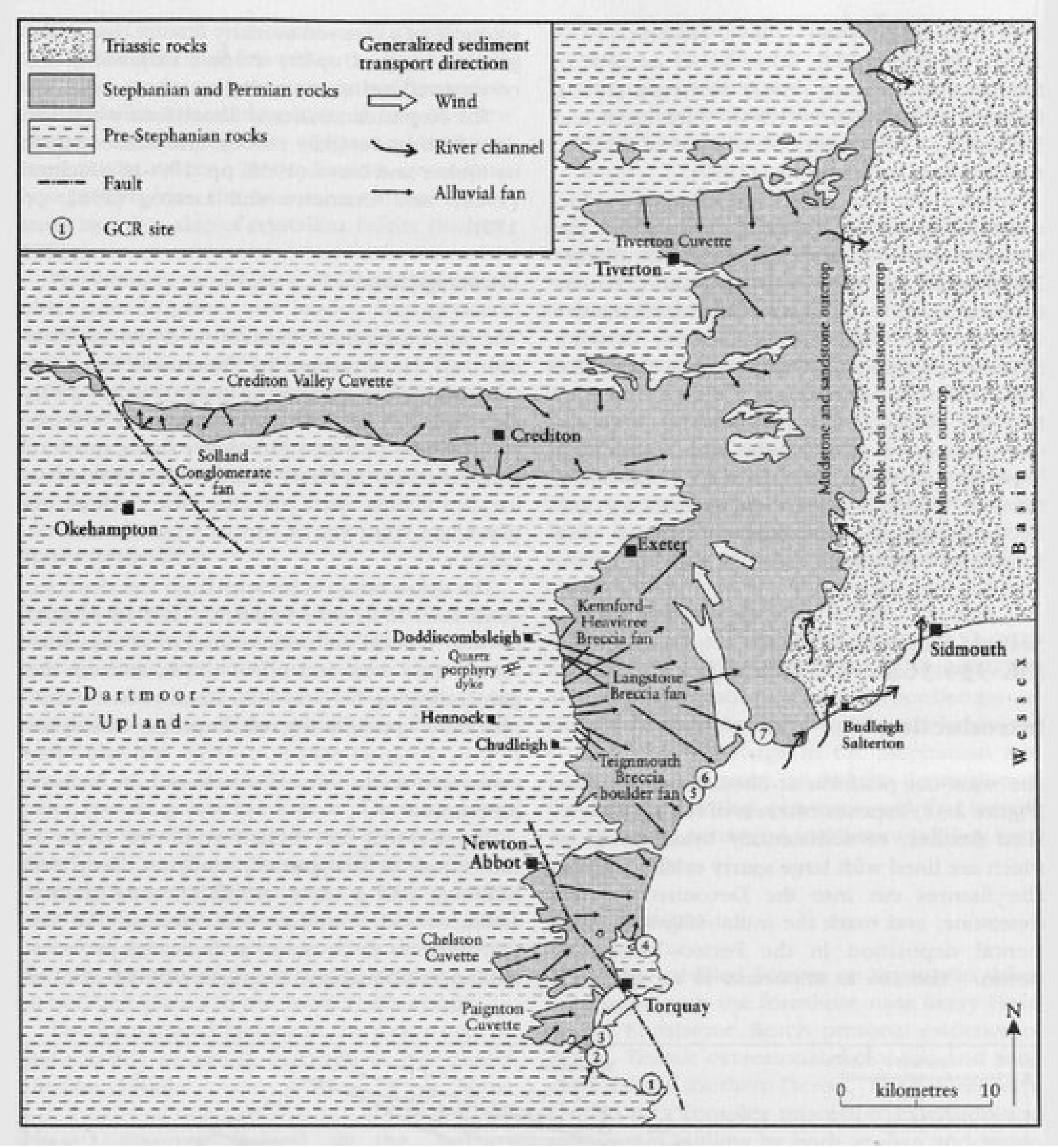
Similar vertical fissures infilled with reddish sandstone are also seen on the coast at Brixham harbour [SX 935 557], and Churston Cove [SX 919 570] (Ussher and Lloyd, 1933; Richter, 1966).

The age of the Shoalstone dykes is uncertain. They are clearly post-Devonian, and almost certainly Permo-Triassic in age. By analogy with similar, but less impressive, fissure fills in the South Devon area at Oddicombe (see below), they are probably Permian in age. Indeed, the sediments around Brixham and Torbay, the Tor Bay Breccia and Livermead Beds (Figure 2.30) are almost certainly Permo-Carboniferous or earliest Permian in age. Uplift and landscape erosion began perhaps in the Stephanian Age (latest Carboniferous), as did the deposition of the Devon 'New Red' sequence, and that may be the age of the extension and fissure infilling seen at Shoalstone.

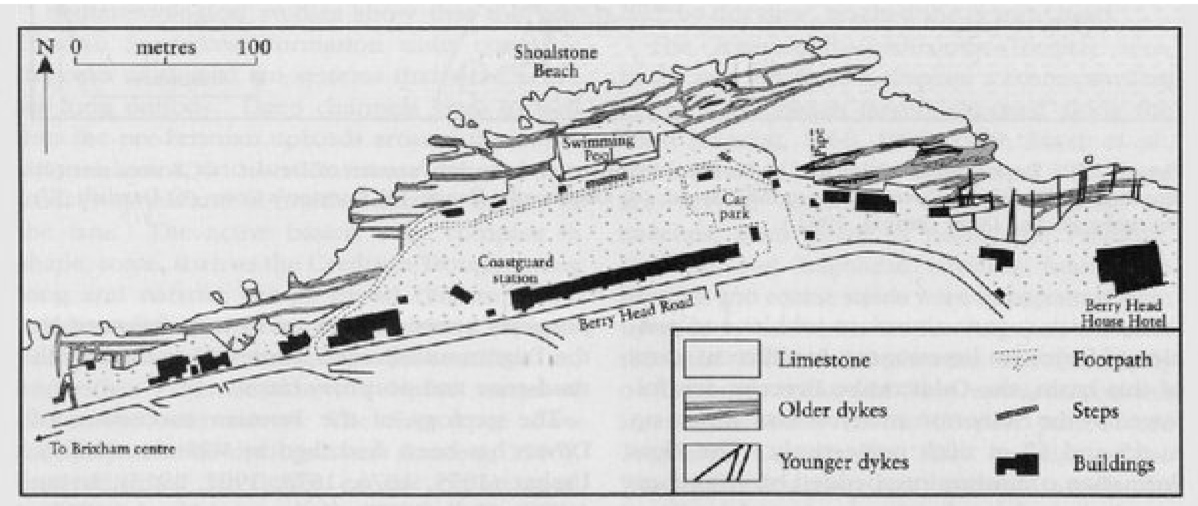
Conclusions

The sediment-filled fissures or Neptunian dykes outcropping on the foreshore near Berry Head and at Shoalstone Beach preserve evidence of Permo-Triassic extensional tectonism and sedimentation in southern Devon. The fissures were formed by a complex process of extension and subsequent infilling by both aeolian and waterborne sediments. The sediments were then cemented by calcite and silica. This is a key site to examine an unusual and spectacular sedimentary phenomenon, and for an insight into the Permian palaeogeography and topography of the Devon area.

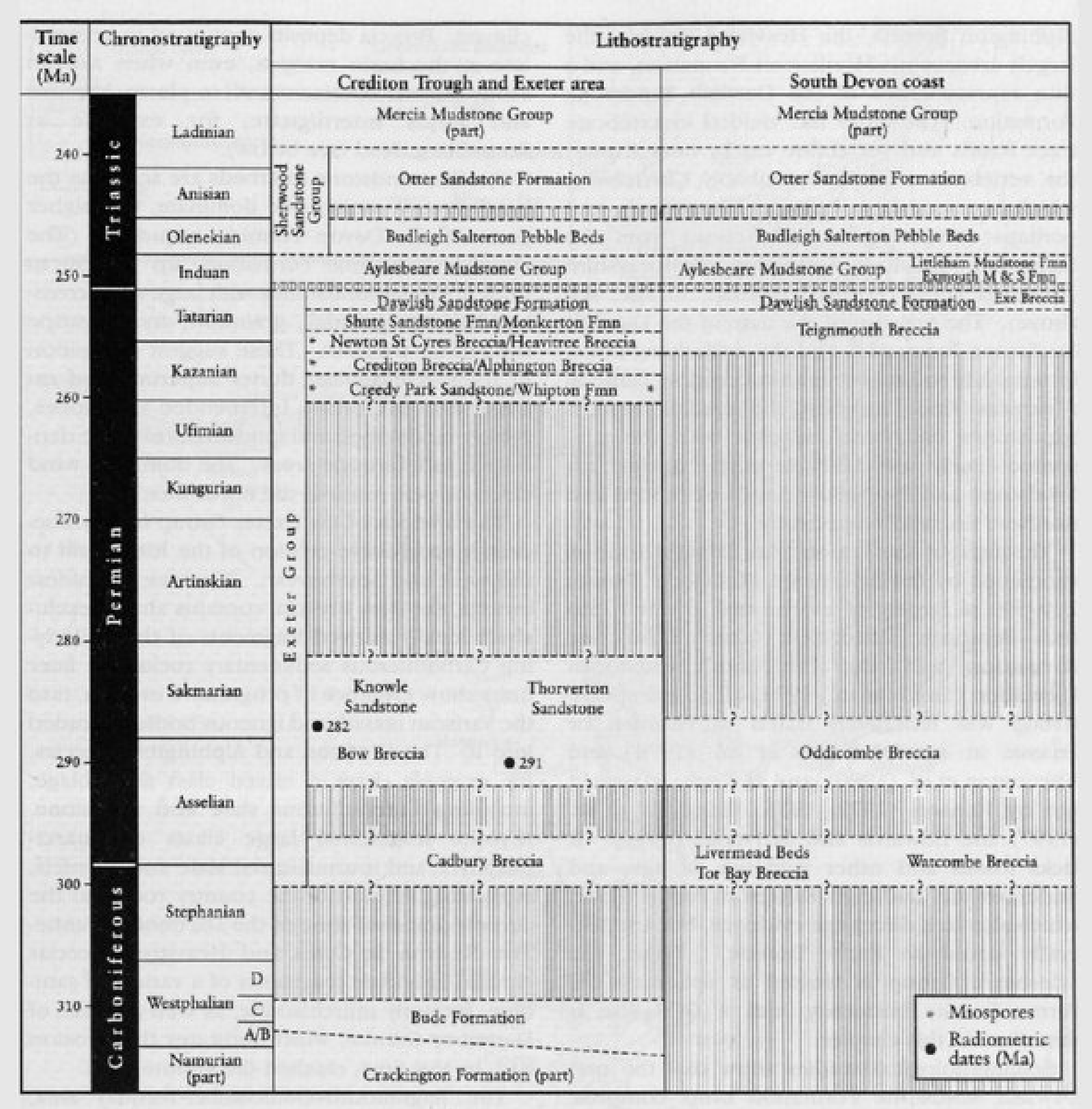
References



(Figure 2.31) Depositional basins and sediment transport trends in the Permian of Devon. GCR sites are: (1) Shoalstone; (2) Saltern Cove; (3) Roundham Head; (4) Oddicombe Beach; (5) Coryton's Cove; (6) Dawlish; (7) Orcombe Rocks. (After Laming, 1982.)



(Figure 2.32) Large-scale map of the sets of Permo-Triassic sandstone fissure fills (Neptunian dykes) on Shoalstone Beach, showing older and younger generations of dykes. (After Richter, 1966.)



(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).