TINTAGEL

V.J. May

OS Grid Reference: SX043858–SX070895

Introduction

Much of the northern coastline of Devon and Cornwall is characterized by cliffs cut into relatively resistant rocks. Even on this resistant coastline, differences of rock strength are reflected in the development of a headland and bay topography. The rocky cliffed headland at Tintagel is one of the many locations where the coastal forms are strongly related to major structural features (see Figure 3.1 for general location). It is also one of the few locations where these relationships have been studied in an assemblage of coastal forms, including slope-over-wall cliffs, geos, caves, arches and stacks.

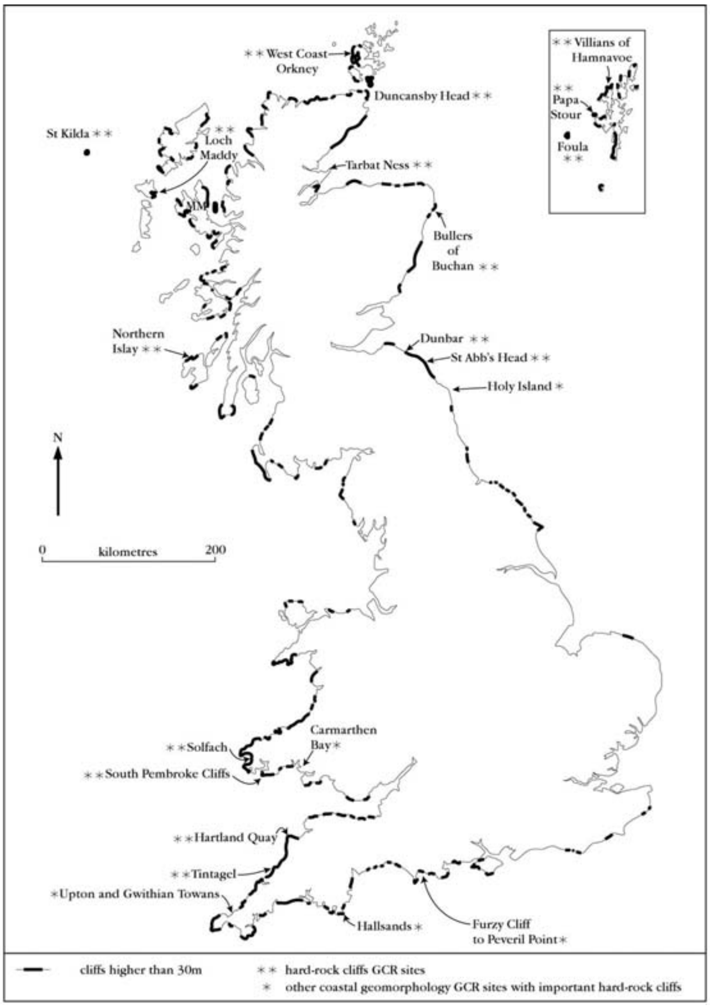

Figure 3.1: High-cliffed coast of Great Britain, showing the location of the sites selected for the GCR specifically for coastal geomorphology features of hard-rock cliffs. Other coastal geomorphology GCR sites that include hard-rock cliffs in the assemblage are also indicated.

Description

The site extends from Start Point in Backways Cove (SX 043 858) in the south to Bossiney Haven (SX 070 895) in the north. There are sandy beaches at Trebarwith Strand and Bossiney Haven, but much of the coast is formed by cliffs that drop over 100 m directly to below sea level. Some lower cliffs form the lower element of slope-over-wall features: some of these latter forms are bevelled, whereas others form hogbacks. The cliffs and rock platforms are cut in Upper Devonian and Lower Carboniferous rocks, the former much affected by metamorphism. Although there are major thrust faults, the cliff form is most influenced by several roughly parallel normal faults. South of Tintagel Island, some short stretches of cliffline are true fault-line cliffs. Elsewhere erosion has cut back the cliffs from their original fault-controlled position. North of the Island, the coastline is more complex, with many inlets and headlands. Erosion along normal faults, less-resistant beds and joint-planes has produced an intricate set of bays, headlands, stacks, blowholes and caves. Local variations of structure and rock strength are the major control on the landforms. Dewey (1909, 1914) and Owen (1934) described the structures of the area, and Steers (1946a) outlined the main coastal features. Cotton (1951) saw much of this coastline as having two cycles of development, placing particular emphasis on the differences in the cliff profiles. The most important work was carried out by Wilson (1951, 1952) who described the relationship between the coastal features and structures (Steers, 1971a).

This very indented cliffed coastline (Figure 3.25) can be subdivided on the basis of its present cliff and beach morphology into six sub-units.

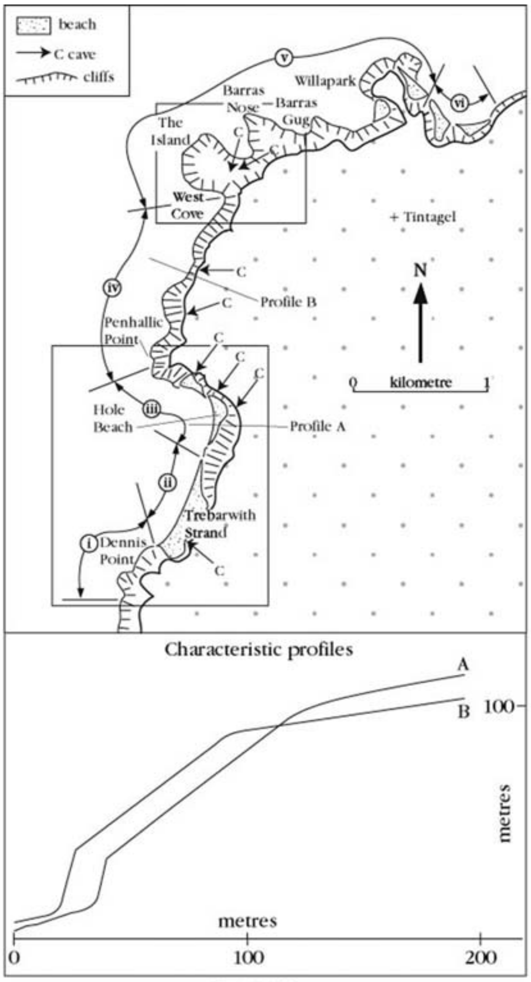

Figure 3.25: Main features of the Tintagel coast (i) Start Point to Dennis Point: vertical and slope-over-wall cliffs; (ii) Trebarwith Strand: sand beach backed by cliffs over 90 m high; (iii) Hole Beach: caves developed on line of faults and thrust planes; (iv) Penhallic Point to West Cove: slope-over-wall; (v) West Cove to Bossiney Haven: complex coast with peninsulas at different stages of separation from mainland; (vi) Bossiney Haven: geo and arch. The inset shows characteristic slope-over-wall forms between Trebarwith Strand and Tintagel Island.

(i) Between Start Point and Dennis Point (SX 043 858 to SX 045 863), the cliffs vary in both height and form. At Backways Cove near-vertical cliffs are only 15 m high at the mouth of a hanging valley, whereas at Dennis Point the overall height of a well-developed slope-over-wall

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form exceeds 80 m. Gull Rock is an isolated stack about 500 m offshore.

(ii) Trebarwith Strand (SX 045 863 to SX 049 868) is a sandy beach, backed by cliffs that rise to over 90 m. Access to the beach is via a hanging valley with a floor at about 14 m OD whose seaward end has been much degraded by paths and steps.

(iii) At its northern end the beach gives way to a complex of boulders, eroded volcanic rocks including elongated pillow lavas. The coastline has a right-angle bend at Hole Beach where it is cut by a normal fault, to the east of which is a major thrust plane. The lower near-vertical rock-faces usually give way to an upper slope but occasionally extend almost to a bevelled surface at about 80 m.

(iv) From Penhallic Point (SX 046 877) to West Cove (SX 050 889) slope-over-wall forms are dominant and the plan is characterized by several straight sections aligned from north-east to south-west *en echelon* and separated by shorter north–south sections.

(v) Between West Cove, Tintagel and Bossiney Haven (SX 065 896), the coastline is very complex. Three promontories, The Island, Barras Nose and Willapark, each with a narrow neck, are in different stages of separation from the mainland. The cliffs are mainly slope-over-wall forms bevelled at about 80 m OD, but at Willapark there is an excellent example of a hogback cliff.

(vi) Bossiney Haven has a strongly joint-controlled geo as well as the well-known Elephant Rock where a high vertical arch has formed almost separating a narrow ‘trunk' of rock from the mainland (Figure 3.26).

Figure 3.26: Elephant Rock, Bossiney, showing the relationship of cliff features to vertical jointing. (Photo: V.J. May.)

The main features of the site were described by Wilson (1952) and this account is based largely upon Wilson's interpretation of the geological features of the area. The coast is cut into Upper Devonian slates, siliceous sandstones, pillow lavas and tuffs and phyllites, which have been overthrust towards the NNW (Wilson, 1951). The overthrust strata were affected by approximately parallel normal faulting. The beds dip generally to the west and the normal faulting throws the thrust-slices down to the west or north-west. The faulting at Tintagel (Figures 3.27 and 3.28) is dominated by two important fault zones: the Castle Fault between West Cove and Smith's Cliff, and the Caves Fault Zone, which cuts through The Island across Tintagel Haven to Barras Gug. Similar fault zones affect the cliffs both north and south of Tintagel. The thrust planes lie at low angles, but the normal faults form sloping shear zones, which Wilson noted are easily worked on by marine erosion. Joints particularly with a general alignment towards 325–330° and north–south joints also play an important part in the coastal morphology of this site.

Figure 3.27: Major fault and thrust at Tintagel as the focus for marine erosion, cave and ultimately stack development. (Photo: V.J. May.)

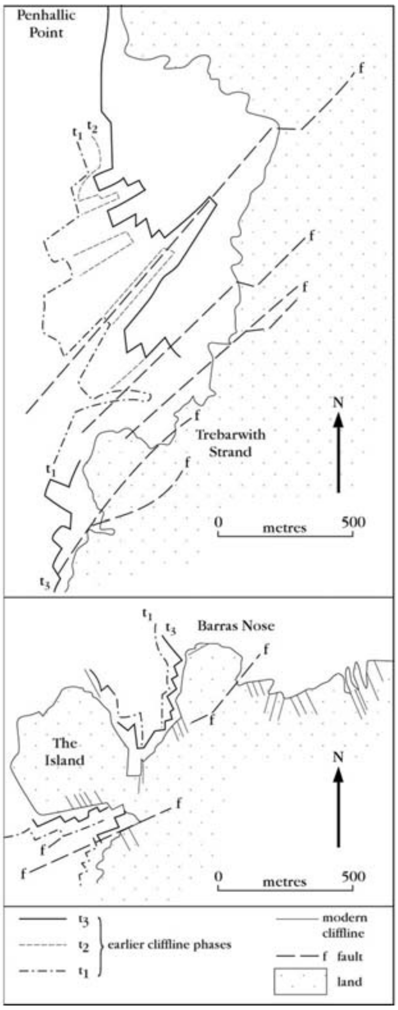

Figure 3.28: Examples of coastline development controlled by major faults, Penhallic Point and Barras Nose. See Figure 3.25 for general location. (After Wilson, 1952.)

Much of the coastline is distinguished by narrow joint-controlled inlets (for example at Bossiney Haven), known locally as 'guts' or 'gugs', caves cut along fault zones, as well as landsliding on undercut seaward-dipping bedding planes and inclined fractures (Wilson, 1952). Marine erosion along such features has allowed the sea to reach relatively weaker materials, such as the slates, and to cut narrow inlets parallel to the coastline. Wilson compared the site with the coastline around Lulworth Cove. The development of caves is strongly associated with fault zones, but Wilson also considered that some inlets associated with faults had been the focus of more rapid erosion when they co-incided with former or present lines of drainage. South of The Island, the en-echelon form of the cliffline is strongly linked to faults and other weaknesses parallel to the general alignment of the coastline.

Interpretation

Wilson (1952) observed that active erosion took place along structurally controlled and preferred locations. Where structural weaknesses were flat or gently dipping, they only influenced the process of marine erosion if they occurred close to sea level. In contrast, steeply inclined lines or zones of weakness could control the direction of marine erosion over a large range of sea levels, for if the line of weakness continues through the cliffs both above and below sea level, any features associated with it can continue to develop whether sea level falls or rises. Normal faults appear to have been most important as they trend at an acute angle to the present-day coastline. Moreover, most of the faults on this coastline strike in a direction more or less parallel to the direction of maximum fetch. Once the sea had penetrated into these parallel fault-zones it began to cut back the cliffline by undercutting the harder rock bands between the inclined shatter zones (Figure 3.27). Since many of the faults dip seawards at about 45°, cliffs develop by removal of the material of the shatter zone material and the development of a structurally controlled sloping surface. The sea would subsequently cut a vertical wall in the lower part of the slope to produce the slope-over-wall form.

Wilson also considered the two-cycle model proposed byCotton (1951) in which the structurally controlled slope was first eroded by the sea, but with a fall in sea level and the onset of periglacial conditions during the last glacial, the upper slope was affected by subaerial slope processes, a talus of debris accumulated to protect the former sea cliff. With a Holocene rise in sea level, the debris would be removed and the sea would exhume and retrim the former sea cliff. Wilson believed that Cotton's two-cycle origin for the cliffs explained many of the coastal features of the area. Unfortunately there is no evidence of relict talus or emerged (‘raised') beach deposits within this site to corroborate it. Caves occur at or close to present sea level, but are absent at higher levels and there are no reports of submarine caves or the continuation of caves below sea level. Nevertheless, the alignment of ‘guts' and coves with hanging valleys indicates that preferred lines of erosion were available to the sea. Along the foot of the cliffs, the debris of ‘ancient rock-falls is still to a great extent protecting the base of the cliff from erosion' (Wilson, 1952, p. 39). Modern falls, however, have the same effect but, as elsewhere on the cliffed coasts of Britain, there has been no investigation of their longevity and their effectiveness in providing temporary armouring to the cliff foot. Between Penhallic Point and Tintagel the cliffs drop directly into the sea with only narrow steps forming the intertidal area. Elsewhere in the site, platforms occasionally reach 150 m in width and occur either at the foot of the cliffs or in the small bays where they underlie the sandy beaches. There has been no detailed investigation of the shore platforms, but their form appears to reflect strongly the effects of rock strength and the detailed structures.

Wilson's (1952) paper remains unusual amongst the coastal literature in considering the detailed relationship between cliff development and rock structures on a hard-rock coast. There are comparable sites, for example, in south-west Wales and at Trearrdur Bay in south-west Anglesey, but no comparable work. Like Hartland Quay (see GCR site report) to the north, this site contains hanging valleys, waterfalls, hog's-back and bevelled cliffs. Unlike Hartland Quay, it also demonstrates very clearly the relationship of structure to cliff development. It is not generally regarded as a longitudinal coast, but in terms of the development outlined byWilson (1952) it has similarities to the coastline around Lulworth Cove (see GCR site report for the Dorset Coast in Chapter 11). Lulworth Cove is backed by relatively weak materials and so the effects of breaching of an outer resistant wall are followed much more strikingly by the development of bays than has occurred at Tintagel. Tintagel is thus important not only because of the links between structures and landforms, but also because it provides a contrasting example to Lulworth Cove.

Conclusions

Tintagel is one of the very few hard-rock sites where the relationships between major structural features and coastal development have been examined in detail. The landforms include geos, caves, stacks, arches and slope-over-wall cliffs. An excellent example of the way in which major structural features can control the development of coastal landforms, it is also a good example of a longitudinal coast, although not so strikingly obvious as the most commonly cited example at Lulworth Cove. Unlike the latter, it is predominantly in hard rocks and the rates of change are less.

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