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HARTLAND QUAY

V.J. May

OS Grid Reference: SS221226–SS230278

Introduction

The coastline of North Devon runs transversely across Devonian and Carboniferous strata, but at Hartland Point it changes direction abruptly towards the east (see Figure3.1 for general location). Much of the coastline is cliffed, broken only by small valleys that have been eroded to present sea level (for example at Crackington Haven) or form hanging valleys (for example south of Hartland Quay). South of Hartland Point, the relationships between coastal valley systems and coastal retreat are of particular interest. This site contains fine examples of cliffs and shore platforms, and demonstrates clear relationships between cliff forms, platform development and lithological variations (Arber, 1911). Furthermore, it is also noted for a remarkable set of river valleys that have been truncated by the cliffline, so that their floors now lie well above present sea-level (Arber, 1911; Arber, 1949). Unlike similarly truncated streams in the south-west Isle of Wight (see GCR site report in Chapter 4), those in the Hartland Quay area have been unable to erode valleys to sea level and so many reach the shore via waterfalls (Arber, 1911). In some cases the streams have also cut gorges that include waterfalls. In common with other hard-rock coasts, Hartland Quay has been the attention of only limited research since the detailed monograph byArber (1911). Keene (1986, 1996) and Goudie and Gardner (1985) have reviewed the development of the site in the light of more recent interpretations of Pleistocene geology in western Britain (Stephens and Synge, 1966; Kidson and Tooley, 1977).

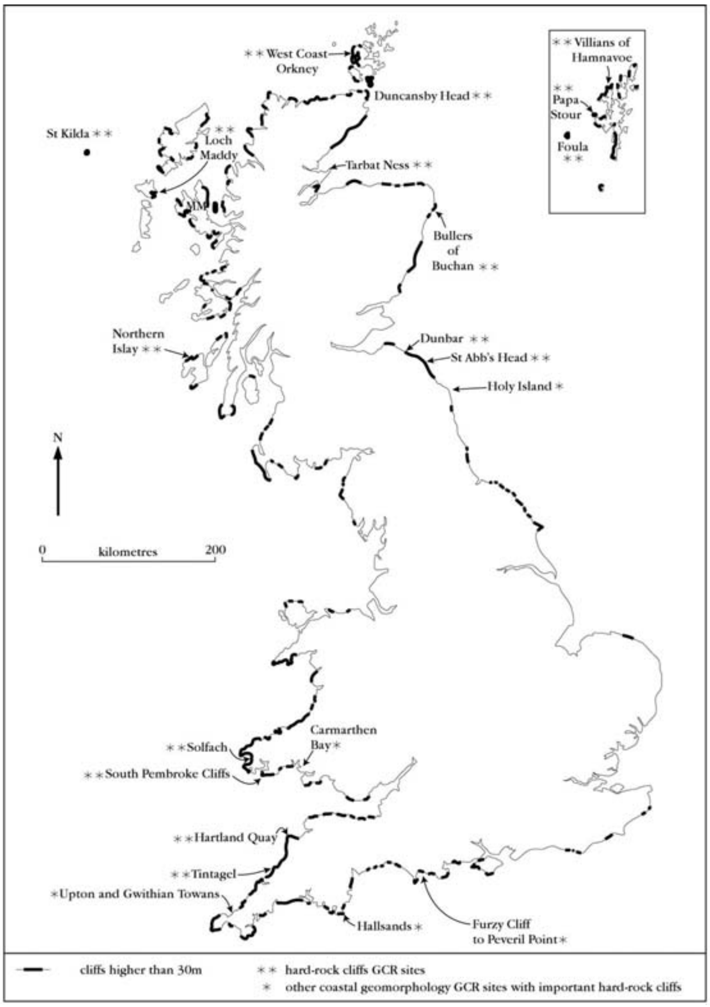

Figure 3.1: High-cliffed coast of Great Britain, showing the location of the sites selected for the GCR specifically for coastal geomorphology features of hard-rock cliffs. Other coastal geomorphology GCR sites that include hard-rock cliffs in the assemblage are also indicated.

Description

Described as 'perhaps the finest coastal scenery in the whole of England and Wales' (Steers, 1946a, p. 219), this site extends some 6 km from Longpeak Beach in the south (SS 221 226) to Hartland Point in the north (SS 230 278). Cliffs cut into Carboniferous interbedded fine-grained sandstones and shales vary in height between 25 m and 100 m. The structural features lie east–west, following the Variscan trend. Because the shales are eroded more easily than the sandstones, these structures are etched out both in the cliffs and the platforms. Caves have been cut in the weaker shales and mudstones, or along faults on the axial planes of the folds (Keene, 1996). Five valleys truncate the coastline and reach the sea via waterfalls. A platform, up to 300 m in width, dominates the intertidal zone. Its mean width is 160 m (based on 30 measurements at different localities), with headland platforms being on average 50 m wider than those in bays). Beach development is limited, being mainly confined to small bay-head accumulations of locally derived shingle and cobbles. There are also considerable areas of boulders resting both at the cliff foot and upon the platform. The cliffs are subject to much localized mass-movement, for example at Blagdon Cliff where there is a fault-controlled landslide. To the east of the site at Keivill's Wood (SS 352 237), the co-incidence of a large rotational slip scar and an almost flat boulder spit (The Gore) have been interpreted as the scar and lag deposit of a large landslide, which based on chart evidence pre-dates 1795 (Keene, 1996). The rate of retreat of the cliffs around Hartland Point has been estimated at between 20 and 40 mm a^{-1}. With sea level at or close to its present level for the past 6000 years, this suggests net retreat of up to 240 m, a distance close to the width of the platforms.

The cliffs at Hartland Point and Blagdon Cliff reach over 100 m, but decline to just over 30 m at the mouth of Tichberry Water (SS 228 267), which flows into the sea over the northernmost of the waterfalls that distinguish this stretch of the coastline. The narrow flat floor of its valley is continued southwards between a small hill known as ‘Smoothlands' and the continuation of its southern valley side. A small stream fed from a spring flows along part of this hanging valley floor to enter the sea over a 22 m cliff on the northern side of Damehole Point (SS 226 265). Two streams, Blegberry Water and Abbey River, both flow onto Blegberry Beach via waterfalls, although of very different forms. At Blegberry Water the stream flows from about 35 m OD down a joint-controlled waterfall that Arber (1911) described as a ‘primary sheer waterfall' (Figure 3.32). Abbey River in contrast has a flat floor that hangs some 12 m above beach level. The valley is underlain by solifluction debris, and the stream has cut (in Arber's terminology) a ‘mature canyon'. Steep cliffs up to 100 m in height form the coastline to Hartland Quay.

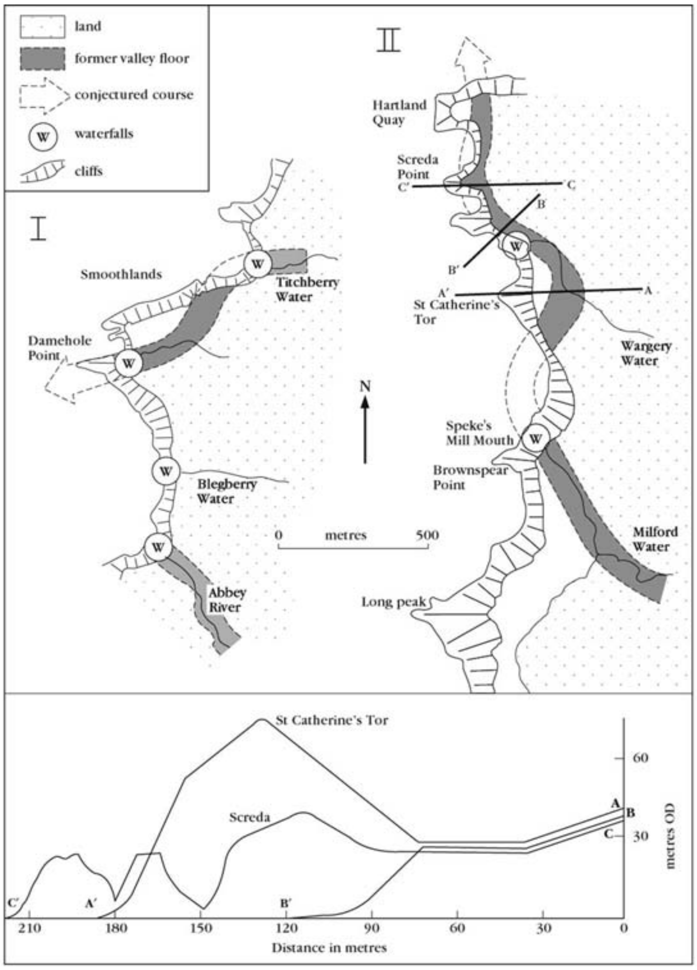

Fig 03.31

Figure 3.32: Hartland Quay GCR site – showing the pattern of truncated valleys. The profiles A–A', B–B', C–C' are shown at the bottom of the figure. Section I lies to the north of Section II. (After Arber, 1911.)

Between Hartland Quay and Speke's Mill Mouth, the cliffs vary in height from below 30 m to over 70 m. Each of four small headlands (Hartland Quay, Screda Point, Screda Bay south-side, and St Catherine's Tor) slope inland to a flat-floored valley that hangs at about 30 m OD above each of the intervening bays. Wargery Water flows along part of the hanging valley to drop to the sea at Childspit Beach. To the south, Milford Water flows over a flat-floor until it plunges into the sea over ‘the most spectacular' waterfall at Speke's Mill Mouth (Arber, 1911). To the south the cliffs rise to over 100 m at Longpeak. Each of the small headlands is associated with reefs that run at right angles to the cliffline and extend across the platform. The platform is varies between about 250 m and 150 m in width although its elevation varies a great deal depending upon the arrangement of the beds across which it cuts. For example north of Hartland Quay it is a broad feature cutting across all the exposed beds, whereas to the south at Screda Point, buttress reefs are predominant (Figure 3.33). On the platform, these buttress reefs often appear as steeply dipping walls of rock.

Figure 3.33: Cliffs, platform, beach and truncated valleys south of Hartland Quay. (Photo: Lou Johnson, www.walkingbritain.co.uk.)

The hanging valley floor between Hartland Quay and St Catherine's Tor is rock-floored with only a shallow depth of weathered material resting on it. There is neither soliflucted infill nor incised valley. The flat-floored hanging valleys become gradually lower in height towards Hartland Quay and are usually interpreted as representing the truncated remnants of the former floor of the Wargery and Milford Waters. The waterfalls vary from sheer falls across great slabs of rock to stepped features confined to very steep-sided narrow gorges or ‘gutters' (Arber, 1911). The detailed form depends to a substantial extent upon the exact arrangement of the beds over which they flow as well as the nature of the material itself.

Interpretation

The well-developed platforms and cliffs offer ample evidence that this is an active coastline along which rockfalls, landslides and stream erosion all play a part.Arber (1911) interpreted the features here as resulting from the inability of the streams to erode sufficiently rapidly to compensate for the rapidly retreating cliffline. The truncated downstream courses often survive as dry hanging valleys. He described the hanging valleys as sea-truncated valleys, and reconstructed the former courses of both Titchberry Water and Milford Water. Streams that once flowed farther seawards were cut into by the retreating cliffline, and their water was diverted, usually resulting in the formation of waterfalls. Arber described the waterfalls as ‘unique in Britain' and his investigation remains the only detailed examination of them. Although the detailed form of the waterfalls depends on local variations in rock strength and the dip of the strata, Arber divided them broadly between those where the sea was more active in eroding the cliffs than the stream was in downcutting. In contrast where the stream was the more effective agent, the waterfalls more commonly formed gutter or canyon falls. The differences in waterfall morphology may provide an indicator of the very variable rates of cliff retreat in comparatively hard coasts where cliff-top retreat is often recorded as minimal. Although coastal waterfalls occur elsewhere in Britain, they are uncommon and nowhere as common as here. The reasons for this remain speculative, but seem likely to relate to the high proportion of streams flowing towards or along the coast, the impermeability of the strata, and the relatively slow rate of downcutting compared to cliff retreat.

Steers (1981) argued that although storm waves reach to and above the junction of cliff and platform there was no reason to assume that the platform is of wholly modern origin. Since the emerged ('raised') beaches at Trebetherick and Fremington are only a little higher than the present platforms, Steers argued that there is no reason why the platforms should not be much older in origin than they appear. In contrast the erosional activity of the cliffs and the platforms and the site's exposure might suggest that this cliffline had retreated considerable distances. A consistent contemporary rate over the last 6000 years for example would, however, only place the cliffs between 250 m and 120 m farther out to sea. Farther north on the south coast of Wales, there are well-preserved emerged platforms and beaches. The shales and sandstones around Hartland present a significantly different surface for erosive processes. Whereas the Carboniferous Limestone of Gower is comparatively free of discontinuities, the Carboniferous shales and sandstones of Hartland are very thinly bedded, much folded and faulted and provide numerous opportunities for erosion by both marine and slope processes.

An ice-margin explanation is proposed by Goudie and Gardner (1985) as an alternative to the coastal retreat explanation. If the Fremington tills are Anglian in age, then ice entered the nearby Taw–Torridge valley about 450 000 years BP. Irish Sea ice probably extended far enough south during the penultimate glacial period to allow marginal drainage channels to develop between the ice and the coastal slope (Stephens and Synge, 1966; Kidson and Tooley, 1977; Keene, 1996). This coast was, however, ice-free during Devensian time (Keene, 1996). Goudie and Gardner (1985) outlined a possible alternative origin for the hanging valleys, for with the ice margin at or close to the coast, the usual outlets of the streams might become blocked. As a result a lake would build up until the lowest point of the valley side was overtopped. A new valley was then cut by the diverted stream. With greater discharge, higher impermeability and probably more and larger sediment loads, the streams would cut broad valleys. Once the ice retreated, the streams would revert to their former courses. The lack of infilling of the hanging valleys is seen as supporting this argument. Although this hypothesis, which was developed in order to explain the Valley of the Rocks west of Minehead (Mottershead, 1967), appears to offer a satisfactory explanation for that feature, its extension to the Hartland area appears less convincing.

The ice-margin hypothesis does not explain satisfactorily the dissection of the valleys in the Hartland area, where the former Milford Water has its left bank removed at four separate locations. The implication of the hypothesis is that the stream flowed over the ice at these points (since coastal retreat is not considered as a complementary process). The nature of the evidence and the origin of these unusual coastal landforms warrants further detailed investigation. Keene (1996) points out that the valley of Milford Water upstream of the truncated supposed meltwater section is also flat and steep sided. Valleys such as Abbey River are, in contrast, infilled by soliflucted material, probably of Devensian age. Their rock floors lie much closer to present sea level. Unconsolidated angular material in a matrix of finer-grained materials is entirely local. Post-Devensian increases in stream activity account for the development of meander terraces in the soliflucted material (Keene, 1996). In both cases, subsequent retreat of the cliffs would have allowed truncation to have taken place leaving them hanging above the present beaches.

Farther south at Marsland Water and Welcombe Mouth, valleys are incised much nearer to present sea level and there is clear evidence that earlier valleys were filled by soliflucted debris (probably Devensian in age: Keene, 1996). This suggests that at least in that area pre-Devensian streams flowed to a similar local base-level to today, but does not necessarily confirm that the coast was near its present position. On balance, the ice-margin hypothesis is less likely unless either Devensian ice reached the area and was banked against the coast or the valleys preserve forms that derive from the Anglian glacial presence along this coast. The latter also seems unlikely given that there have been four major changes of sea level since the Anglian and that cliffs could retreat at least 200 m in each interglacial period. An intrinsic part of the debate arises from the anomalous relationship of the truncated valleys to the structures. The majority of valleys follow the strike of the rocks. The question to address therefore is whether the development of drainage in these patterns is anomalous. If not, then the simple explanation that the valleys result from truncation by coastal retreat would appear most likely.

Conclusions

This part of the north Devon coast displays excellent examples of cliffs, platforms and differential adjustment of stream systems to coastal retreat. The only site in Britain where the development of coastal waterfalls has been examined in detail, Hartland Quay is also important for the remarkable truncation of valleys running along, rather than towards, the cliffs.

The shore platforms have been cut across the complex structures, but little research on them has been carried out. This site has caused controversy in that the origins of one of its main features, Arber's 'sea-truncated valleys', remain open to discussion. It contains some of the best examples of coastal waterfalls in Britain, the cliffs are finely developed, and a series of hanging valleys give the site unusual characteristics. The platforms are also well developed, although, as Steers has pointed out, they may well owe their existence to more effective marine activity in the past. If the ice margin was sufficiently close to produce (or at least influence) the flat-floored valleys, there remains the possibility that sea-ice and later periglacial conditions may also have played a significant role in the development of this site. However, in the absence of clear evidence that Devensian ice was marginal to the coast, the ice-margin hypothesis for valley development is less convincing. These valleys differ from those along the south-west coast of the Isle of Wight where cliff retreat has cut across the upper courses of cliff-top valleys. On the western hard-rock coasts, similar beheaded valleys occur, for example at Dinas and Cemaes, north of Fishguard, but these have been explained as ice-marginal overflow channels (Steers, 1946a). The different forms of waterfall described by Arber (1911) add to the unusual nature of this site.

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