NASH POINT

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Introduction

Much of the coastline of the Vale of Glamorgan is formed of cliffs cut in the Lias limestones and mudstones and fronted by platforms that attain widths in excess of 500 m. The line of cliffs is broken by a number of small steep-sided valleys. This site (see Figure4.1 for general location) comprises the cliffed coastline east and west of Nash Point and is cut mainly in limestone and mudrocks of the Blue Lias. The cliffs vary in height from 62 m to less than 30 m, and are commonly near-vertical, even overhanging in places. Intertidal platforms are generally between 200 m and 250 m in width (Figure 4.10). Although they slope seawards, their micro-relief is largely controlled by the relative strength of the limestones and the argillaceous beds across which they are cut. Variations in cliff-form are not always directly associated with variations in rock type. Similarly, the coastal plan does not always accord with the terrestrial landforms that it transects. Because of its exposure to the Atlantic Ocean, this is a high-energy environment; both the cliffs and the platforms have been the foci of much recent investigation (Trenhaile, 1969, 1971, 1972, 1974a,b, 1983; Trenhaile and Layzell, 1981; Carr and Graff, 1982; Sunamura, 1983; Williams and Davies, 1984, 1987; Davies and Williams, 1986; Davies *et al*., 1991; Williams *et al*., 1993).

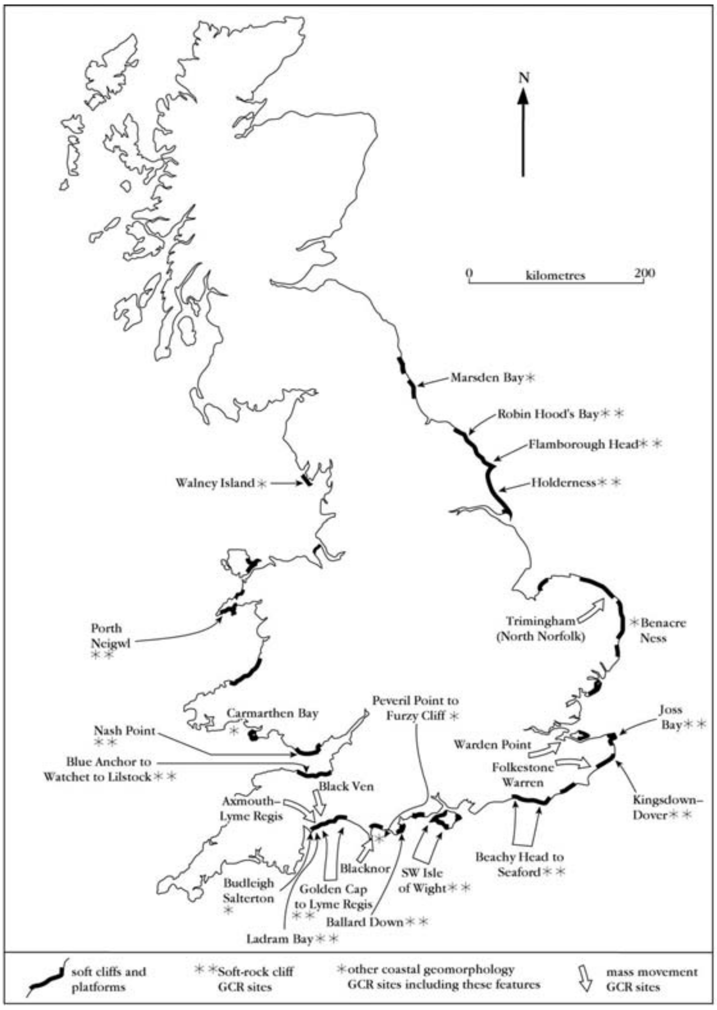

Figure 4.1: Location of significant soft-cliffed coasts and platforms in Great Britain, indicating the sites selected for the GCR specifically for soft-rock cliff geomorphology. Other coastal geomorphology sites that include soft-rock cliffs and sites selected for the Mass Movements GCR 'Block' that occur on the coast are also shown.

Figure 4.10: Nash Point, this view from directly above the site demonstrates the near-vertical nature of the cliffs and the width of platforms at low water. The micro-relief of the shore platforms is controlled largely by the the relative strengths of alternating beds of limestone and argillaceous rocks and jointing patterns, on this photograph particularly noticable in the vicinity of Nash Point itself (see also Figure 4.8b). (Photo: CCUCAP, © the Countryside Council for Wales.)

Nash Point has been described as an example of a site with structurally controlled platforms (Davies, 1972). Trenhaile (1969, 1971, 1972, 1974a,b, 1983) and Sunamura (1983) debated shore-platform development by reference to this and other British sites, and cliff and beach features were described by Williams and Davies (1987). A review of the literature suggests that the processes operating on this site have probably received more direct and regular attention than any other vertical cliff site in the UK (Mackintosh, 1868; Keatch, 1965; Trenhaile, 1969, 1971, 1972; Williams and Davies, 1984, 1987; Davies and Williams, 1986; Williams and Caldwell, 1988).

Description

The site extends from the western side of St Donat's Bay (SS 934 677) to Cwm Nash (SS 905 699). To the east of Nash Point, the continuous line of cliffs is broken by the valley of the Marcross Brook. The western cliffs are aligned towards the south-west, facing the dominant and prevailing wind (over 40% of all winds) across a fetch of 5000 km. The eastern cliffs trend east–west. The dominant and prevailing winds blow alongshore but the southerly onshore winds have a fetch of only 24 km. According to Trenhaile (1972), this part of the coastline is characterized by longshore drift.

The tidal range is 6 m. Surges associated with low atmospheric pressure have been recorded, increasing water levels by up to 1.5 m (Williams and Davies, 1987). This is a relatively high-energy environment, having recorded cumulative wave energy densities of 68 × 105 joules m^{-1} crest $width^{-1}$ over one day, and wave power of 85,000 joules m^{-1} s^{-1} (Williams and Davies, 1987). Assuming a still-water level at mean high-water neap tides, the total breaking wave force recorded in one storm was of the order of 7 × 10^5 Pa (7 bars). Cliff retreat has been estimated by several writers (summarized by Williams and Davies, 1987) and varies between 0.1 m a^{-1} and 0.02 m a^{-1}.

The Lias around Nash was divided by Trueman (1922, 1930) into:

1. The *Arietites bucklandi* biozone – thick concretionary limestones alternating with thin mudstones, and

2. the *Sclotheimia angulata* biozone – mainly thick mudstones alternating with thin limestones.

The limestone beds reach almost 1.0 m thick in places, whereas the mudstones rarely exceed 0.5 m. There are three main groups of near- vertical joints trending NNE–SSW, NE–SW, and SE–NW. Joints resulting from pressure-release rebound lie most commonly parallel to the cliff face (the direction of greatest stress release). The platforms grade seawards at low angles (i.e. around 2°), and are broken only by small scarps and shallow solution features (Trenhaile, 1972). The platforms owe much of their uniformity to the exposure of single beds of limestone and so contrast dramatically with the platforms in the Lias on the southern side of the Bristol Channel. Characteristic profiles and the location of major breaks of slope are shown in Figure 4.8b. On the platforms, small scarps (generally less than 0.25 m in height) are associated with erosion of thin shale horizons and undercutting of the thicker beds.

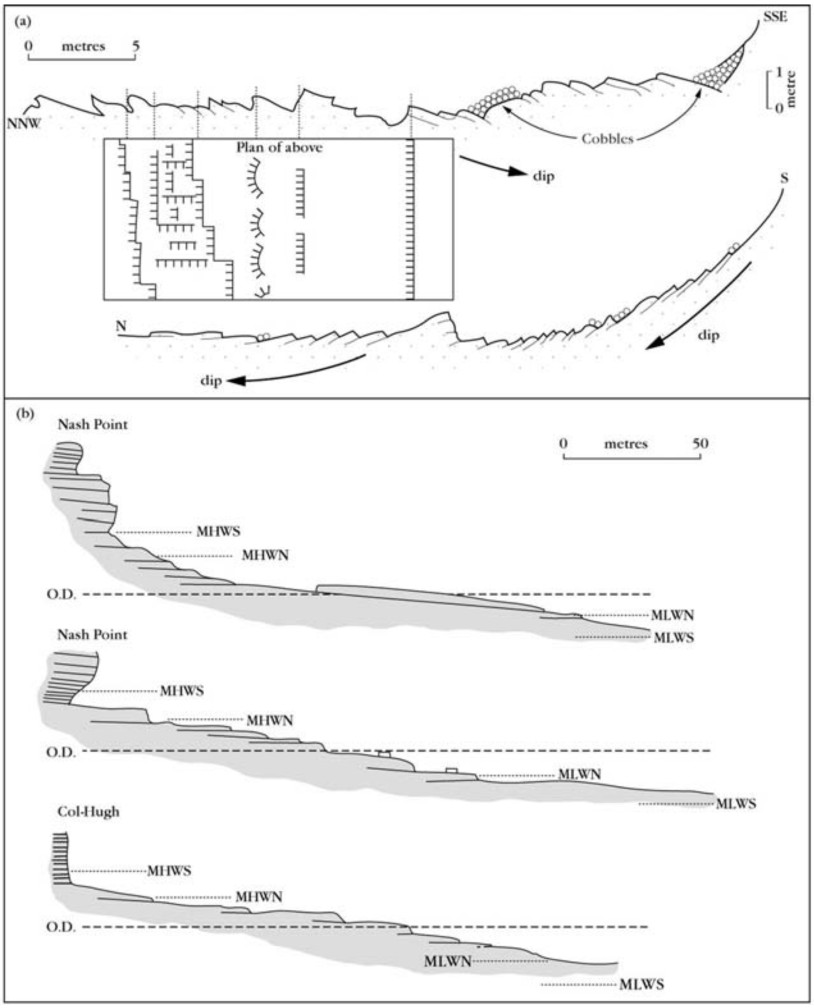

Figure 4.8: (a) Cross-sections, showing characteristic forms of the platform east of Watchet, where the dip of strata to landward or seaward strongly affects the pattern of micro-cliffs, (b) three characteristic platform profiles at Nash Point, Vale of Glamorgan (see GCR site report in the present chapter) where dip of strata is more uniform than at Watchet. Mean high- and low-water spring tide levels (MHWS and MLWS) and mean high- and low-water neap tide levels (MHWN and MLWN) are shown. (Part (b) is after Trenhaile, 1972.)

Interpretation

A substantial literature concerning this site has focussed on two separate morphological units of the coast, the platform and the cliff. Trenhaile (1974a,b) discussed the development of shore platforms here and elsewhere in Britain (for example Robin Hood's Bay, see GCR site report in the present chapter). At Nash Point, the shore platform has probably evolved from the destruction of a series of higher platforms and is partly an inherited feature (Trenhaile, 1972).

However, the rate of cliff recession and the present erosion of the platform indicate that more extension of the platforms has occurred than in the southern part of Gower. The development of platforms around Nash Point contrasts also with that on the southern side of the Bristol Channel. The platforms at Nash Point are strongly related to the dip of the strata, their surfaces being structural, whereas on the Somerset coast they are cut across steeply dipping strata. At Nash Point, lowering of the platform is mainly brought about by retreat of low steps, and Trenhaile (1972) concluded that contemporary scarp retreat is of the order of magnitude necessary to bring about parallel slope retreat. The platforms could be regarded as an example of the principle that the timescale of observation affects the significance of time in landform development (Schumm and Lichty, 1965): Johnson's (1919) model of platform development is not necessarily supported by the evidence from this site when long periods of time are considered. Over shorter timescales (i.e. under 100 years), there is a trend towards dynamic equilibrium in which there are ‘fairly high correlations' between platform gradient and elements of platform morphology.

Williams and Davies (1984, 1987) demonstrated that retreat of the cliffs and thus extension of the platforms at high-water level resulted from several processes. Large-scale cliff failures usually occurred as a result of toppling and translation failures. The latter are usually very complex, low frequency and high magnitude events. The detachment of joint blocks also affects the cliffs. Although small in extent, their product is removed quickly by wave action, and so it is difficult to estimate the volumes of individual movements.Williams *et al*. (1993), having analysed rockfalls along 22 km of adjacent coastline, developed numerical models of cliff failure. Translation failure was predicted in cliffs where the*angulata* series formed a high proportion of the cliff mass and where cliffs are buttressed by limestone of the*bucklandi* biozone. Toppling failures were predicted for vertical and overhanging cliffs that were undercut at the base.

Caves cut into the cliffs are restricted to the low-energy environment of the W–E-trending cliff sections. Davies and Williams (1986) showed that interaction between the presence of particular limestone beds at the cliff base and within the cliff, and protection from the most direct wave attack is crucial. The most suitable basal limestone strata are the most massive (Trueman Bands, 28, 39, 47, 48 (Trueman, 1922/1930), but other limestone strata also form cave lintels. Caves do not develop where there is a high proportion of mudstone, requiring an average of over 66% limestone strata in exposed cave walls. Caves do not usually develop where there is a wide or low angle shore platform. 76% of the caves are associated with joints perpendicular to the cliff face. Cave retreat appears to operate at a similar rate to cliff recession. This examination of cave development is especially important to coastal geomorphological studies, because it goes beyond the usual suggestion that caves are associated with lines of weakness. Furthermore, the role of the basal beds can be shown to be consistent with the characteristics of arch and stack development described elsewhere in the present chapter (see GCR site reports for Flamborough Head, Ballard Down and Ladram Bay in the present chapter). The rate of cliff retreat may be the controlling factor, since any general retreat of the cliff will increase the wave energy available for cave excavation, and lowering of the platform in front of the cave will enhance the available wave energy. The three morphological units, the platform, the cliff, and the cave therefore appear to be functionally linked, but further investigation is required.

In terms of exposure to wave energy, this is the most-exposed, and best-documented Lias cliff site in southern Britain. It contrasts with other Lias sites at Robin Hood's Bay and Watchet (see GCR site reports in the present chapter) in its exposure and relatively high-energy environment. Although platforms around the Chalk (for example, Joss Bay) have also been described in some detail (So, 1965), they rarely display the marked alternation between hard and weaker beds that characterize the Lias and produce the sloping stepped form of the platforms at Nash Point. Although caves are a common feature of many cliffed coasts, few are described in the geomorphological literature, and Nash Point is an exception.

Conclusions

Nash Point is situated in a relatively high wave-energy environment and is dominated by platforms over 500 m in width and vertical cliffs over 60 m in height. The cliffs have received much less attention in the geomorphological literature than the platforms, but have many features in common with other cliffs undergoing active erosion. This is one of few sites where cave development has been investigated in detail. Like the platforms of the Isle of Thanet, the platforms at Nash Point are simple in form when compared to others elsewhere on the British coast. The initial surveys by Trenhaile (1969, 1971, 1972, 1974a,b) provide a basis upon which later studies have been able to build. As a result the site is important within British coastal geomorphological studies because of both the repeated surveys and an increasing understanding of the processes that occur here. Few vertical-cliff sites have been as examined and the processes so elucidated as at Nash Point, and, as a result, it is internationally important for its coastal geomorphology.

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