Joss Bay, Kent

[TR 383 716]–[TR 402 696]

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Introduction

This site comprises the most extensive Chalk intertidal platform in England and is backed by near-vertical cliffs of Upper Chalk. It is one of the least-modified parts of the coastline on the Isle of Thanet between Margate and Broadstairs (see (Figure 4.1) for general location). The cliffs have retreated at about 0.3 m a^{-1} in historical times, and the platform close to the cliffs has been lowered by about 0.03 m a^{-1}. Coastal retreat takes place by a combination of small rockfalls, shallow rock-slides and marine undercutting. The cliffs have two main orientations, which conform with joint patterns, the Chalk itself being well jointed and closely bedded with a northerly dip of about 1°. Beaches formed of small quantities of flint and chalk occasionally mask the cliff foot, whilst there is an accumulation of predominantly biogenic, shelly sand in the bays. In Botany Bay, a duniform ridge formed at the cliff foot in the early 1980s became sufficiently stable to be colonized by vegetation, but this is not characteristic of the site as a whole.

Although the geomorphology of the Chalk coast has attracted general attention (e.g. Steers, 1946a; Bird, 1984), there have been two groups of detailed studies, one focusing upon the platforms and their development (So, 1965; Wood, 1968; Trenhaile, 1974a,b), the other upon cliff-retreat processes (May, 1964; Hutchinson, 1972). There has been considerable engineering interest in this coastline in general because of the coast protection issues related to cliff retreat and in particular the penetration of caves beneath urban areas, such as at Broadstairs. In reality, cave development within this site is very restricted. The best examples were to the west of the site at Birchington (May, 1964; So, 1965) but they were destroyed as part of a coast protection scheme. Nevertheless, this site still contains good examples of cave-arch-stack development that can be traced in historical records for about 140 years.

Description

The site extends from Foreness Point [TR 383 716] to Hope Point [TR 402 696] south of North Foreland (Figure 4.37). The characteristic form is a vertical or near-vertical cliff about 20 m in height fronted by a sandy beach of varying width up to a maximum of about 180 m, and a well-developed Chalk intertidal platform up to 500 m wide. The plan form of the coast is marked by sharp changes in cliff orientation, which allow the site to be subdivided into four sections:

1. Foreness Point and Botany Bay, which includes several stacks,
2. Kingsgate Bay,
3. Joss Bay, and
4. the cliffs of North Foreland.

There has been some coast protection work, notably in Kingsgate Bay, to protect a cliff-top road and Kingsgate Castle, and in Joss Bay also to protect the cliff-top road. South of Joss Bay, very small segments of cliff have been bricked-up or walled-in in the past. Cave entrances have also been bricked over to prevent undermining of the cliff top and the further development of blowholes. At Foreness Point, sewage outfalls at the western boundary of the site cross the platform and appear to reduce sand transport westwards across the platform. As a result, it is possible to examine the contrasts in platform development with or without a significant sand veneer.

Although the whole of this site is cut into the Upper Chalk, there are differences between its northern and southern parts. Between Foreness Point and White Ness, the cliffs are cut mainly in the *Marsupites testudinarius* biozone above the *Uintacrinus socialis* biozone. Harder bands of the latter are associated with ledges on the platforms, thresholds at the foot of stacks and ramp-like cliff bases (So, 1965). South of White Ness, the coastal alignment is at right angles to the dip and the cliffs are formed mainly in the *Micraster coranguinum* biozone of the Chalk overlain by the *U. socialis;* biozone. Within both Kingsgate Bay and Joss Bay, parts of the cliffs are cut across dry valleys that are underlain by periglacially modified chalk and slope wash. Hutchinson (1972) noted that the Chalk in the upper 3 m of the cliffs at Joss Bay appeared to have been frost-shattered, more or less in *situ,* as occurs elsewhere in the site. Peake (1961) recognized two sets of major joints that are sub-vertical and generally lie within 10° of the main joint directions of 10° and 290°. The Chalk is closely but irregularly jointed between these major joints. Except in the *Micraster* Chalk, flints are uncommon in the cliffs. Their presence south of North Foreland affects the form of the platform, since they appear to provide a degree of armouring to its surface.

May (1964) described the coastal changes around the Isle of Thanet, and So (1965) examined the platforms in detail. They agree that the cliffs are generally retreating at about 0.3 m a^{-1} and the platform is being lowered at about 0.03 m a^{-1}. In detail, the changes are much more varied with many small cliff-falls taking place as well as localized lowering of the platform or accretion of sand. At Kingsgate, May (1964) noted that there had been little change since about 1870 when a brick facing- and buttress-wall was constructed below the castle. In the bay, however, the cliff-top road had been so undermined that it was supported on a concrete bed buttressed above the beach. Between White Ness and Foreness Point, the cliffs run parallel to the main direction of jointing, and rockfalls from the *U. socialis* biozone are frequent. South of White Ness, falls appear to be less frequent, but Hutchinson (1972) described one such fall in detail. This fall, in early 1966, cut the cliff top back by about 2.3 m along about a 20 m length. Hutchinson's analysis demonstrated that a notch of 0.5 m could produce such a failure given the shear strength of the Chalk. By February 1971, a notch 1 m deep was measured at the site of the fall. Thus not only had about 500 m^3 of rock been removed from the cliff, but the sea had also cleared this away and undercut the cliff once more. The average 0.3 m a^{-1} quoted above thus disguises some larger but less frequent events.

Despite their very exposed location, two stacks have formed at the eastern end of Botany Bay. Cartographic evidence shows that the larger of these separated from the mainland after the tithe survey of 1842 when it was joined by a neck of land about 22 m wide. The date of formation of the smaller stack is not known, but it is younger (Figure 4.38).

So (1965) showed that the platforms are gradually extended landwards by cliff recession. They show variable micro-relief often as a result of pitting, block-loosening and more resistant flint patches. Their height decreases from headlands to embayments, particularly at White Ness and Hackemdown Point, even (according to So) when the dip and jointing do not favour this pattern. At Foreness Point, the platform is also lower on the western side of the headland than on the eastern side. Irrespective of the initial height of the platforms, the gradient is greater in the embayments than at headlands. Profiles are characterized by a concave upper and a convex lower section, but are also steeper at Foreness on its eastern side. Wood (1968) showed that this platform steepened markedly seawards. The 120 m closest to the cliffs was very gently-sloping, with an average gradient of about 1 in 400, but below the +0.3 m OD contour it steepened to 1 in 70. At White Ness and Hackemdown Point, low cliffs also occur at the outer edge of the platform. Recession of these low-tide cliffs is also less rapid than the high-water cliffs (So, 1965).

There is often a sandy veneer on the platform, much of it composed of shelly fragments, some from reworking of the Chalk and some from present-day molluscs. In the southern part of the site, flints also form small patches often dose to the foot of the cliff. Wave direction tends to keep the platform south of Hackemdown Point swept clear of sand, apart from small patches infilling hollows in the platform. In Botany Bay, however, considerable quantities of sand can accumulate and during the early 1980s an unusual cliff-foot dune built up and became temporarily stabilized by vegetation. This protected the cliff foot from erosion, although sub-aerial processes of rainwash and frost-shattering continued. As a result a series of small debris-slopes grew on top of the dunes, which themselves rested on the cliff-platform junction and beach.

Interpretation

This site represents very well the relationship between cliffs and platforms on the English coast, especially because the rates of change in both have been documented for a longer period of time than elsewhere. Cliffline crenulation is present but was much better represented in the past by the cliffs at Birchington in north-west Thanet, where a comprehensive set of caves, geos and blowholes had developed. These were mostly destroyed during coast protection works in the late

1960s. As a result some upper parts of the platform described by So (1965) have been destroyed. Because So showed that the platforms on Thanet had a generally upper con cavity, and a lower convexity, and other platforms in England and Wales appear to lack this (Trenhaile, 1974a,b), the remaining platforms that are represented by this site are all the more important members of this suite of active shore platforms.

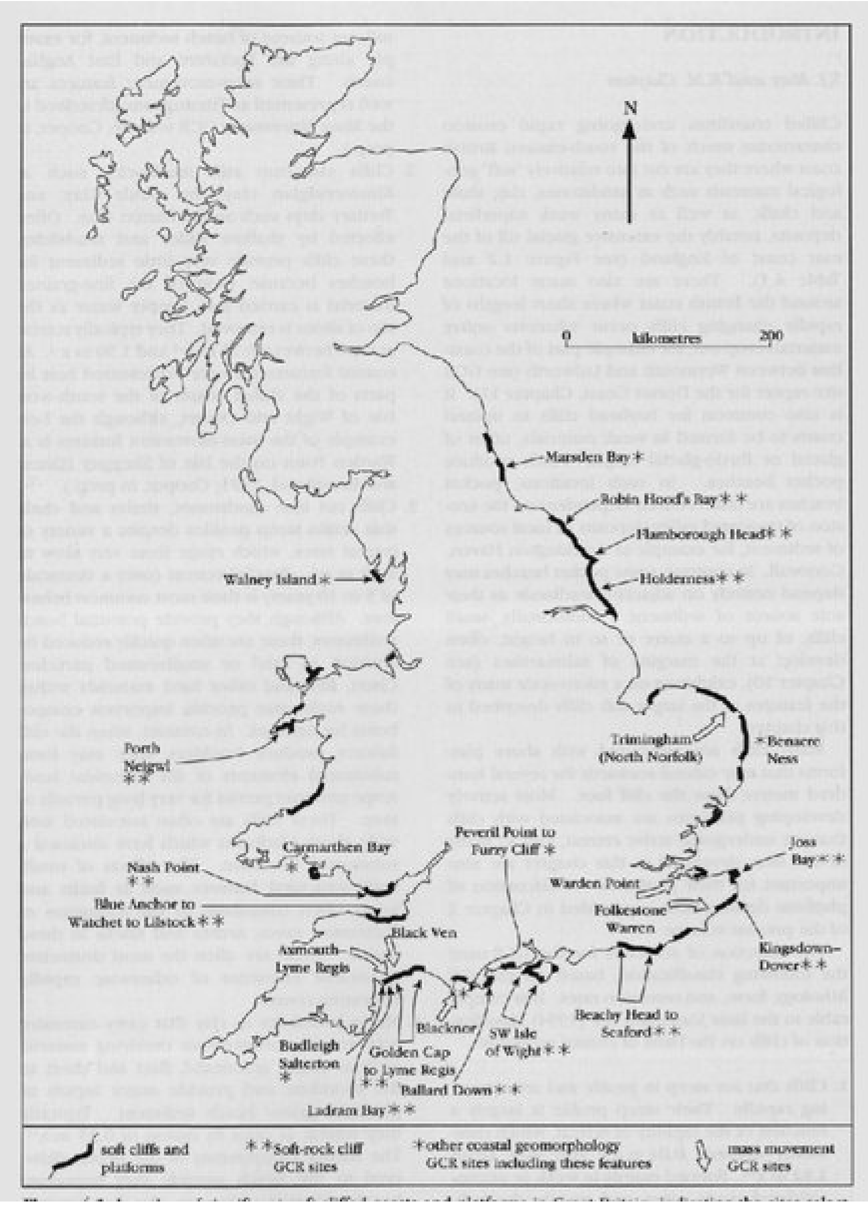
So (1965) argued that the coastal platforms of Thanet were the result of storm waves, both past and present. As water-levels change with the tides, so the zone of effective wave attack and of marine planation also shift vertically. The height at which the water-level associated with storm-wave action remains longest is within the mean neap tidal range. It was argued by So that wave attack would be most frequently focused at mean tide-level and storm-wave platforms would rise up to 1 m above this height; platforms within the site range in altitude between OD and +0.91 m OD, corresponding to a mean tide level of +0.17 m OD. Platforms around the Thanet coast, however, extend below low tide levels, decreasing in height comparatively rapidly and lacking signs of planation. Furthermore, the low-tide cliffs have not receded as rapidly as the rate of cliff recession. These platforms, So concluded, must relate to a lower sea level, but So did not explain their coincidence with low tide levels. Debate elsewhere (Trenhaile and Layzell, 1981; Carr and Graaf, 1982) concerning the duration of wave attack related to the tidal duration curve may throw light on this issue in general, but has not been considered in relation to this site. Similarly, since waves lose energy in crossing the platform, a rising sea level is required to ensure that past platform-widening continues. Wood (1968) considered that the notch at the foot of the cliffs marked the 'true level of present day erosion' and that the platform close to cliffs had been cut with the sea near its present level. The greater retreat of the bays was attributed to the occurrence of sand and the potential for abrasion, whereas the headlands, lacking such aids to abrasion, would erode less rapidly. The width and steepening of the platforms may have resulted from a rise in sea level of as much as 6 m since *c.* 2700 years BP, according to Wood (1968).

Neither Wood (1968) nor So (1965) considered the origins of the bays. The eastern end of Botany Bay, Kingsgate Bay and Joss Bay are each associated with the truncated mouths of dry valleys that are underlain by frost-shattered chalk and slope wash. It is possible that not only were the bays already related to the drainage pattern of eastern Thanet, but also that the more weakened Chalk would aid retreat in the bays. South from White Ness the platforms have an extensive cover predominantly of flint, much of which is in *situ.* The extent to which this provides an armouring to the chalk surface has not been investigated. Between 50 m and 75 m from the main cliff foot there are, however, some small landward-facing micro-cliffs (up to 0.3 m in height) that are capped by this flint layer, which in places coincides in its slope with flint layers in the main cliffs. These flinty layers are uncommon in the bays. South of North Foreland the micro-cliff is close to the position of the main cliff of about 100 years ago. The presence of these higher sections of platform poses a question about the way in which the platforms have developed, since it is evident from the above that the platform is a simple result of cliff retreat (see also GCR site report for Beachy Head to Seaford Head in the present chapter). Other processes appear to be important in the greater lowering close to the cliff foot. One possibility is that waves reaching this area from the northeast, despite refraction across the platform, travel strongly along the foot of the cliff rather than approaching it from seaward. Additional scouring in this position could accelerate platform lowering. The site thus provides continuing opportunities to investigate further the mechanisms by which platforms develop. Most models treat platforms two-dimensionally, concentrating upon the profile of the platform, and thus ignore the three-dimensional form and the behaviour of waves crossing it. In addition, the roughness of the surface itself affects the erosional efficacy of waves crossing it (see GCR site reports for Flamborough Head, and Kingsdown to Dover in the present chapter). The lack of boulders at Thanet means, for example, that platforms are given little protection from wave action, unlike some of these other platforms.

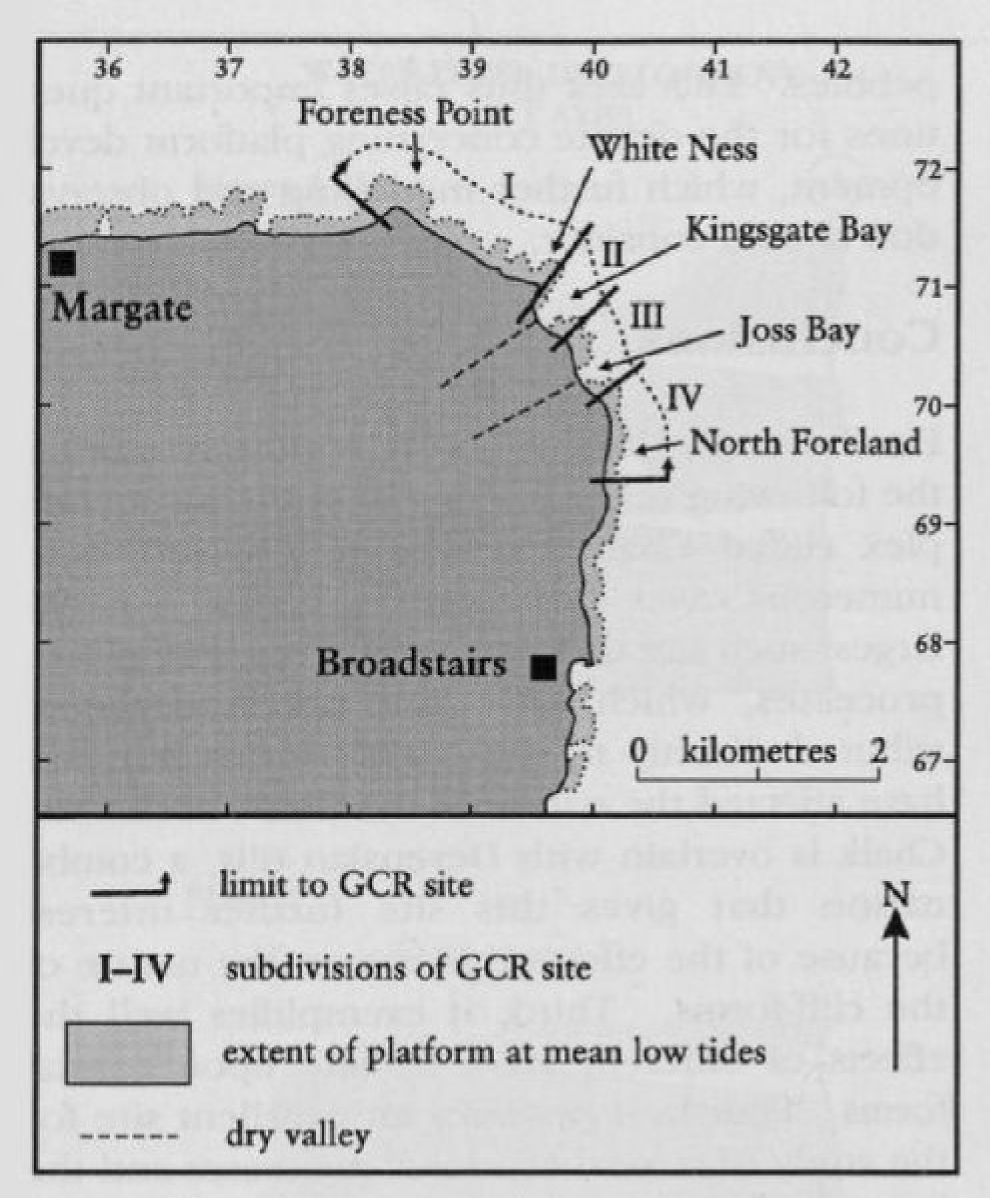
Like other active cliff and platform sites, Joss Bay has to be viewed as part of a network of such features in different tidal and wave environments. It is one of the few sites where there have been both detailed surveys of the platforms and geotechnical investigation of the cliffs. In common with the other sites, its importance also lies in its contribution to understanding of the complex relationships between cliffs, platforms and beaches, especially since this site lacks the considerable shingle cover found on other sites along the English Channel coast.

Conclusions

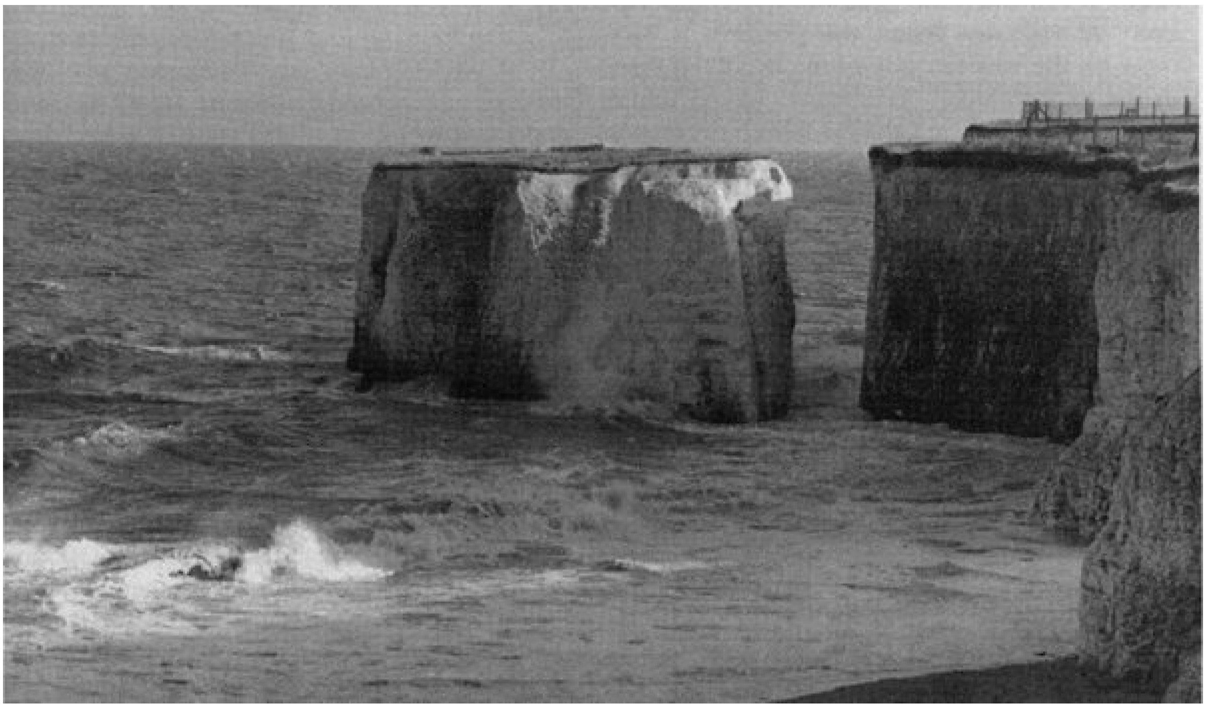
As the most extensive Chalk intertidal platform in England and Wales, Joss Bay provides several insights into the links between platform width, wave energy and platform extension. First, it is very wide and, according to some early literature, at the maximum limit of platform extension. Second, there have been a number of investigations of both the detailed morphology of the platform and of the geotechnical qualities of the cliffs. The rates of retreat of the cliffs and of lowering of the platforms may be causally linked. Third, it has a very restricted sediment veneer. Taken together, the investigations of form and process of the platform and cliff demonstrate the influence of the detailed lithological variations across the platform and the role of platform morphology in affecting the direction and nature of wave attack upon cliffs. Because of the detailed studies, this site provides a reference site against which other platforms can be compared.



(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 4.37) Sketch map of the Joss Bay coastal geomorphology GCR site.



(Figure 4.38) One of two stacks in Botany Bay. This stack was joined to the mainland in 1842 and became separated during the 19th century. (Photo: V.J. May.)