BALLARD DOWN

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OS Grid Reference: SZ041825

Introduction

Ballard Down (see Figure 4.1 for general location) forms a distinct promontory at the eastern end of the Isle of Purbeck where differential erosion of sands and clays to the north and south of the Chalk cuesta has produced Studland Bay and Swanage Bay respectively. Strahan (1898), Davies (1935) and Arkell (1947) described the stacks and cliffs around Old Harry Rocks, and Steers (1946a) described its main features. Precheur (1960) related the formation of the stacks to jointing in the Chalk. May and Heeps (1985) describe some of the changes that have taken place. Despite the comparative lack of research at this site, it is widely used as a textbook example of the cave–arch–stack– ? stump sequence (Figure 4.29).

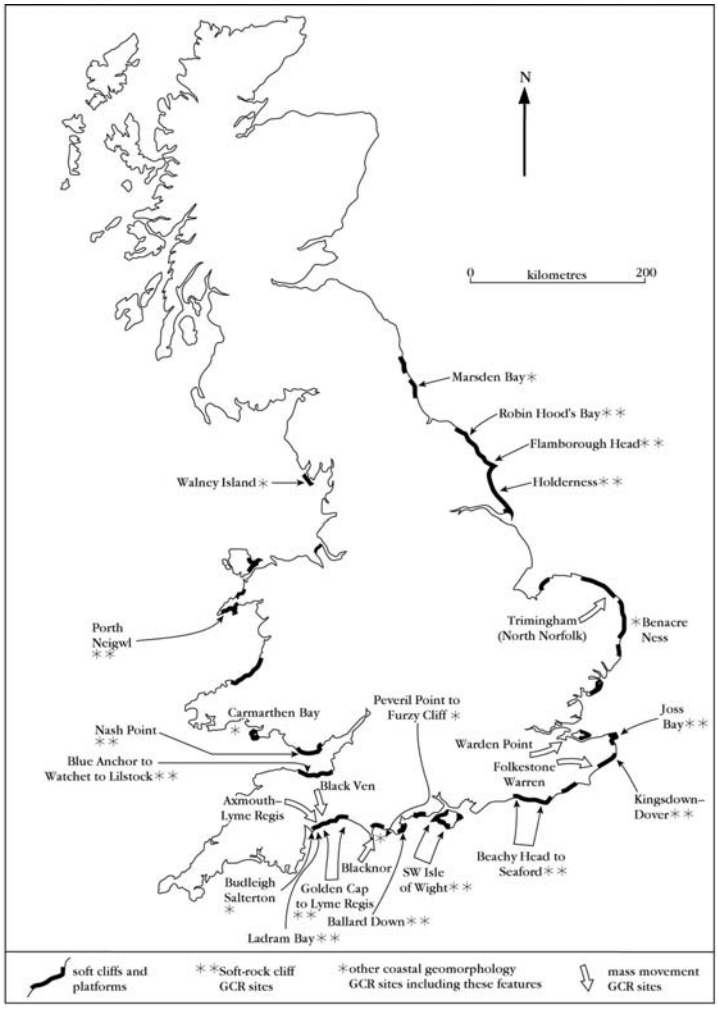

Figure 4.1: Location of significant soft-cliffed coasts and platforms in Great Britain, indicating the sites selected for the GCR specifically for soft-rock cliff geomorphology. Other coastal geomorphology sites that include soft-rock cliffs and sites selected for the Mass Movements GCR 'Block' that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

Figure 4.29: The cave–arch–stack sequence at Handfast Point, looking north-east, with Old Harry Rocks to the right. (Photo: V.J. May.)

Ballard Down is a key site for coastal geomorphology, and one of many GCR sites that collectively form the Dorset and East Devon Coast World Heritage site, which was declared on account of its Earth science features of interest. Ballard Down includes a series of predominantly Chalk cliffs, platforms and associated beaches, best known for the classic assemblage of stacks, arches and caves at Handfast Point (May and Heeps, in press). The site is also important for revealing not only the relationships between local tectonic structures and coastal form, but also the effects of different wave dynamics on the north and south sides of the peninsula. In terms of wave energy, Ballard Down is the most sheltered of the major Chalk cliff systems and forms a key element in the network of such sites.

Description

The Ballard Down GCR site lies to the north of Swanage and is cliffed throughout its length. The cliffs rise from about 30 m on the Wealden clays in Swanage Bay to 117 m at Ballard Point (SZ 040 813). They then fall to little more than 20 m at Handfast Point where they turn west and continue at a similar height to the northern end of the site towards Studland on the Reading Beds and London Clay in Studland Bay. These cliffs can be divided into six different sections.

First, the clay and sand cliffs that cut across the northward-dipping Wealden and Lower Greensand rocks at the northern end of Swanage Bay, and are marked by many small mass-movements as well as some larger slides that have brought about a scalloped outline to the plan form of the cliff top. These unstable cliffs collapse onto the predominantly shingle beach, and small lobes and fans of debris occasionally spread onto its upper surface. There are several springs within these cliffs that give rise to local gullying, as well as the larger surface movements.

Second, from SZ 040 810 to SZ 048 813 (Ballard Point), the cliffline cuts at a very acute angle across the south-facing Chalk scarp of Ballard Down. The Chalk dips northwards here at angles ranging from 60° to 90°. The slopes have vertical sections both near to the top and particularly towards Ballard Point, but much of the cliff is characterized by shallow slides, scree slopes and a cover of scrubby vegetation (Figure 4.30a,4.30b. Marine action is only effective at the eastern end where these subaerial features become less dominant and the cliff-foot protection afforded by boulders and a shingle beach diminishes.

Figure 4.30: Ballard Down. Views looking east from SZ 038 810(a) taken on 12 January 2001 and (b) on 16 January 2001, showing the development of the landslip over four days. In (a) note the chalk scar formed by the failure of the slope. In (b), note the rectangular scar of the shallow rockslide that followed removal of bedrock and weathered slope materials at the back of the earlier failure. (Photo: V.J. May.)

Third, from Ballard Point (SZ 048 813) to the southernmost of the Pinnacles (SZ 053 820) the cliffs are close to vertical and cut across the Chalk either side of the Ballard Down Fault. Despite the considerable changes in dip either side of the fault, there is no significant change in cliff-form. Throughout this section the cliffs fall directly into the sea. There is no intertidal platform, although there is occasionally a narrow beach of Chalk and flint shingle exposed at low tide. A submerged platform with a veneer of boulders extends seawards from the foot of

the cliffs. The cliff foot is undercut in parts and there are several small caves, including one where the Ballard Down Fault reaches sea level.

Fourth, from the Pinnacles to Handfast Point, the coastal forms become increasingly more complex, with five small bays, several stacks, and many small caves and arches (Figure4.31). The largest cave, Parson's Barn, is 12 m in height at its mouth.May and Heeps (1985) mapped the changes between 1887 and 1982, showing how the stacks at Handfast Point have developed (Figure 4.31). Precheur (1960) considered that the stacks developed where the sea has eroded a series of major vertical joints. These can be seen in the blocks that have not yet separated from the mainland. Small caves usually develop at sea level; arches cannot form, according to Precheur, because the Chalk forming the upper part of the cliffs is too weak to form permanent roofs. The stacks, in contrast, are relatively resistant to erosion as their foot is formed of harder Chalk. May (1971b) outlined the relationship of the erosional forms to the jointing pattern.

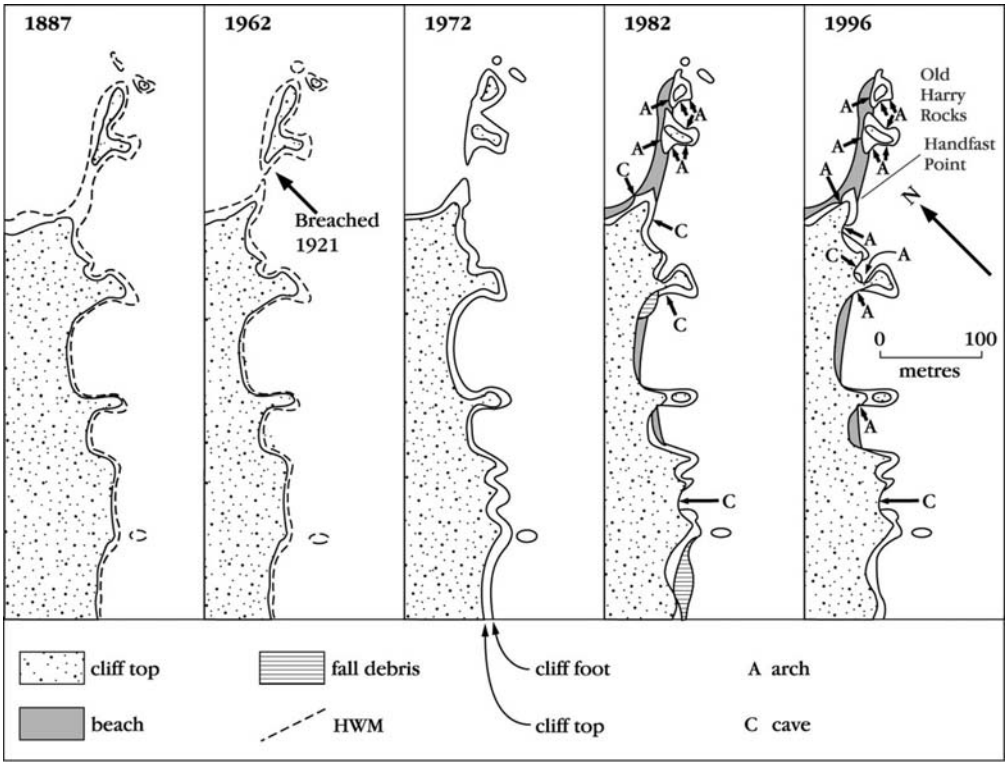

Figure 4.31: Cave–arch–stack development at Handfast Point 1887–1996. (Sources: 1887 Ordnance Survey and May and Heeps, 1985)

Fifth, the cliffs forming the northern sheltered side of Ballard Down, to the west of Handfast Point, appear to have a simple vertical form, but detailed surveys show that their form is made up of several facets (Figure 4.32). May and Heeps (1985) described the cliffs as affected only by rainwash, frost-action and gentle wave action. Notching and undercutting is rare. According to May and Heeps, many of the cliff profiles have a central truncated debris slope upon which further research is required.

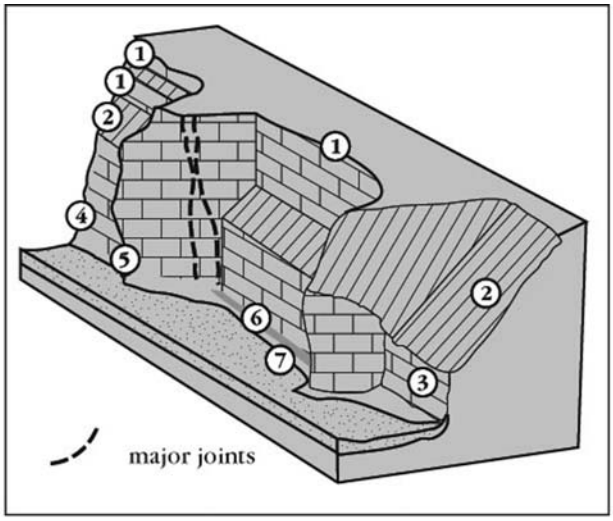

Figure 4.32: Multi-faceted northern cliffline west of Handfast Point towards Studland. 1. Vertical upper cliff; 2. vegetated debris slope; 3. lower vertical cliff; 4. smooth cliff-platform junction; 5. notch; 6. flint and chalk pocket beach; 7. chalk platform.

Finally, at the western end of the Chalk cliffs towards Studland, the cliffs are cut in the Reading Beds and the London Clay and are affected by small slides and gullying, some of the latter associated with paths between the beach and the cliff top. Erosion of the lower cliff at the junction of the Chalk and Reading Beds provides large broken flints that litter the upper beach.

The beaches of the site also vary considerably. South of Ballard Point, they are formed mostly of flint, but chalk pebbles and cobbles are predominant close to the cliffs at Ballard Point. Their proportion decreases southwards until they form less than 10% at the southern end of the site. This beach includes a great mixture of other materials.Calkin (1968) reported that ‘rounded pebbles of Purbeck Marbles and others of limestone from the reefs at Peveril Point can be picked up at the north-east end of Swanage Bay'. Sandstones and quartz pebbles from the Wealden are common. There are also granite pebbles, which are generally regarded as derived from ballast carried into Swanage Bay by vessels arriving to pick up quarried stone from Swanage. North of Ballard Point, the beaches are very limited in size and formed mainly of chalk and flint recently eroded from the cliffs. North of the Pinnacles, the beaches are almost entirely formed of chalk and flint. Much of the flint is angular, retaining the form of flints derived directly from erosion of the cliffs. The chalk pebbles tend to be more rounded, but are quickly reduced in size. There is also a thin veneer of sand on parts of the intertidal platform, which increases in width towards Handfast Point. West of Handfast Point, the beach and platform are narrow, but increasingly cloaked westwards by cobbles of chalk and flint. Below the cliffs of Reading Beds and London Clay, the beach includes more sand, although there are considerable spreads of chalk and flint cobbles as well.

Interpretation

Research at this site has focused on three issues:

1. the question of the development of the stack–arch–cave complex at Handfast Point, and its relationship to the strength and structures of the Chalk,

2. the nature of the cliff profiles along the northern side of Ballard Down,

3. the relationship between cliff erosion, beach development and protection of the cliff foot by beaches and debris.

Like several other Chalk sites, Ballard Down has a set of well-developed stacks, arches and caves associated with a headland. The penetration of headlands by cross-joints and faults aids the development of these erosional features at Handfast Point.May (1971b), Precheur (1960) and May and Heeps (1985) have described changes in these cliffs and discussed their location. Precheur, in particular, considered that a hard pedestal band was important for the longevity of

caves and arches as well as such features as the Pinnacles. As the Chalk dips northwards, harder bands dip below sea level and become less effective. The pedestal band is important both because it provides greater strength at the base of rock columns and because it channels water flow through the joints. Well-developed, near-vertical joints are opened up at their base by the sea, and very close jointing in the upper part of the cliffs encourages small blocks to fail. The joints are harder than the surrounding bedrock, but individual clasts within the joints are vertical and have a greater tendency to drop out than the surrounding horizontal and better supported blocks. The stacks are a result of the narrowing of the headland, jointing patterns and the relative resistance of a pedestal band to erosion.

The cliff profiles along the northern side of Ballard Down are, like many other cliffs in the Chalk, marked by a central grassy slope that is cut across the bedrock and is veneered with chalk debris. The size of this debris slope tends to increase towards the western end of the cliffs. Marine undercutting of the lower cliff has been too slow to destroy this segment. The upper vertical segment can only retreat under the influence of subaerial processes. It is possible that the debris slope represents a former slope formed when these cliffs were less exposed to marine action. These forms have not been dated, but two hypotheses were put forward byMay and Heeps (1985). First, with a lower, glacial, sea level the dip slope of the Chalk would be affected by frost-shattering and other periglacial processes. As a result, a debris slope could form, but it is surprising that it did not affect the whole slope given the relative weakness of the Chalk. A rise in sea level would reactivate these cliffs in the bevelled cliff hypothesis (see Chapter 2). Such an hypothesis ignores the effects of the rather late opening of Poole Bay. A second alternative is that these cliffs have been active during the period since sea level reached its present position, but were protected temporarily. This is a possibility since there have been very large accumulations of sand in Studland Bay and features such as the cliffs at Redend Point (see GCR site report for South Haven Peninsula below) have been protected from the sea in the recent past.

The third focus for research at the site concerns the rate of supply of flint and chalk from Chalk cliffs to the beaches and the longevity of sediment fed to them.May and Heeps (1985) described the sediment budget of a rockfall and its debris just south of Handfast Point. Unlike the cliff profile described at Joss Bay by Hutchinson (1972) (see GCR site report), this fall produced a significant amount of flint that entered the pocket beach. The flint supply was insufficient to build up a beach that could protect the foot of the cliff, and chalk pebbles were quickly reduced by attrition and disappeared within a matter of months. Even if longshore transport were possible, the supply to other beaches would not be significant. Along the northern cliffline in contrast, there is a constant supply of small platy chalk clasts, which rapidly become rounded into small shingle-sized fragments. The minimal wave activity limits the extent to which they are then moved further. Attrition appears to be the most important process at present, although at the time of writing, further investigations were in progress.

In summary, these cliffs offer an interesting contrast to two other east-facing cliffed sites in the Upper Chalk, Joss Bay and Flamborough Head. At Joss Bay, there is less variation in dip and there are very wide platforms. At Flamborough Head, the cliffs are much more intricate in plan and are more exposed. Ballard Down is a textbook example of the development of coastal forms such as stacks. The contrasts in cliff morphology within the site give it further geomorphological importance.

Conclusions

Chalk cliffs and platforms in the northern part of Ballard Down are comparatively simple when contrasted with very complex stack, cave and arch forms around Old Harry Rocks. With the eastern part of the Furzy Cliff to Peveril Point GCR site, this forms a fine, internationally renowned, example of a transverse coast. The development of caves, arches, and stacks is a major feature of this site, but it is also an excellent example of the ways in which steep cliffs change as a result of both marine and subaerial processes. Unlike many such sites it is well-documented. It is one of a network of contrasting cliff sites in which stacks are a key feature, but this is one of the few locations where the dynamics of erosional forms continue to be monitored.

Its international significance is recognized with its inclusion in the Dorset and East Devon World

Heritage Site.

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