ISLE OF LISMORE, THE DOG STONE AND CLACH THOLL

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Highlights

These three coastal localities together demonstrate key features relating to the geomorphology and dating of the Main Rock Platform, one of the most distinctive Quaternary shorelines in western Scotland. The speleothem deposits on Lismore, in particular, hold great potential for the dating of this shoreline.

Introduction

This site consists of three separate parts which together demonstrate the key aspects of the Main Rock Platform, a striking feature of the geomorphology of the western seaboard of Scotland (Bailey *et al*., 1924; Wright, 1928; McCann, 1968; Gray, 1974a, 1978a; Dawson, 1980b, 1984, 1988a; Rose, 1980b; Sutherland, 1981b, 1984a; Wain-Hobson, 1981; Gray and Ivanovich, 1988). The shore platform and its associated landforms are best developed along the coast of the Firth of Lorne (Gray, 1974a, figure 1). The Isle of Lismore site comprises two stretches of the north-west coastline of the island; the northern one at Port Ramsay (NM 872454) is 0.4 km long, the southern one (between NM 805395 and NM 831411), north-east of Achadun Bay, is 3 km long. Together these provide an excellent demonstration of the extensive development of the platform and its backing cliff, and also include the major speleothem sites that have a significant bearing on interpreting the age(s) of the platform (Gray and Ivanovich, 1988). On the adjacent mainland, two classic erosional features are associated with the platform. The Dog Stone (NM 853311) is a raised sea stack located immediately north of the promenade at Oban. Clach Tholl (NM 900448) is a raised natural arch located *c.* 1 km south-west of Port Appin.

Description

The Isle of Lismore provides an example of the continuity and excellent development of the shoreline over a long stretch of coast (Figure 10.5; see Gray and Ivanovich, 1988, figure 3), and as such is typical of the shoreline in the Firth of Lorn area. A cliffline 5–15 m high can be traced uninterrupted along virtually the whole length of the site, and a platform up to 100 m wide is also present, particularly in the south-west. Some of the classic features associated with the shoreline are also present at this site, including undercuts at the base of the cliffs (for example, around localities 14–17, Figure 10.5) and caves (such as Uamh na Cathaig – locality 18 – which is about 10 m deep; see Gray and Ivanovich, 1988, figure 4).

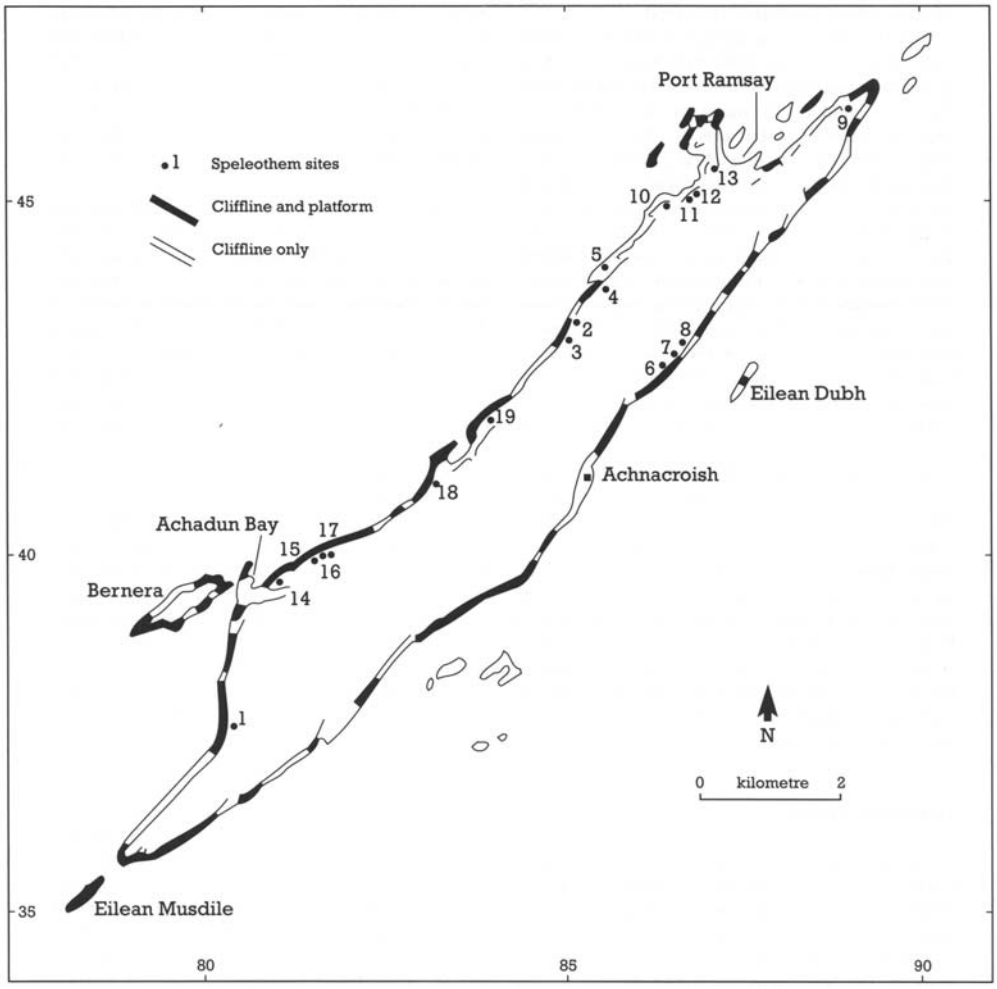

Figure 10.5: Distribution of the Main Rock Platform on the Isle of Lismore and localities mentioned in the text (from Gray and Ivanovich, 1988).

The presence and development of the shoreline on Lismore have been important factors in the evolution of ideas on the age and origin of the Main Rock Platform. In particular the sheltered location of the island and its occurrence within the glacial trough of the Great Glen were both referred to by Sissons (1974d, p. 43) in his paper arguing for a Loch Lomond Stadial age for the shoreline.

Speleothem samples from four sites, undercuts and caves in the base of the cliffline, have been dated by uranium-series disequilibrium methods (Gray and Ivanovich, 1988). Five samples produced a range of ages: two from the Holocene, two from the Late Devensian and one from the Early Devensian. From analytical results, Gray and Ivanovich (1988) considered that the two samples that gave Late Devensian ages were unreliable and that they may actually be of Holocene age. However, the sample that gave the Early Devensian age (of 103.3 ka +28.4/-20.0 ka, HAR-3228) was considered reliable. Thus at least two periods of speleothem formation occurred.

The Dog Stone is an undercut, raised sea stack eroded in Devonian (Old Red Sandstone) conglomerate standing in front of the Main Rock Platform cliffline. Its name is derived from a legend that relates that this is where the giant, Fingal, tied up his dog, Bran, when he went hunting in the Hebrides. The real significance of the feature was first appreciated by the geologist Hugh Miller in 1857 (Miller, 1858) and since then it has been singled out for special mention by several authors (for example, Bailey *et al.*, 1924; Sissons, 1967a; Gray, 1974a, figure 6; Gray and Ivanovich, 1988, figure 2b). It has been selected here because of the absence of stacks from the Lismore site, the long history of description and its legendary associations.

Like the Dog Stone, Clach Tholl is an example of a special type of feature not present at the

Lismore site. Clach Tholl is the clearest raised, natural arch associated with the Main Rock Platform in western Scotland, although another good example occurs below Gylen Castle on South Kerrera (NM 805265) (see Gray, 1974a, figure 5). It is developed along a dipping fault plane in a quartzite headland 1 km south-west of Port Appin. Its name is derived from the Gaelic words meaning "hole in the rock'. It is widely known as a famous geomorphological landmark (see, for example, Price, 1976, figure 33; Gray and Ivanovich, 1988, figure 2a).

Interpretation

In the work of the Geological Survey of Scotland, undertaken at the end of last century and the beginning of the present one, the presence of the separate erosional shoreline that is now termed the Main Rock Platform was not recognized. Instead the surveyors included the erosional shoreline fragments with the "25 ft beach', of Holocene age (Kynaston and Hill, 1908; Bailey *et al*., 1924), mainly due to the fact that the two sets of features broadly correspond in altitudinal range. Indeed, Wright (1928, p. 100) called the postglacial sea "the cliff-maker par excellence'. McCallien (1937a), however, was not convinced that the rock platform and cliffs had been cut by the same sea that deposited the Holocene beach sediments. He believed (McCallien, 1937, p. 197) that "since the Ice Age there has not been enough time for the cutting away of so much solid rock as is indicated in the raised platform around our coasts'. Instead he suggested that the platform was pre-glacial or interglacial in age, and believed it to be a coincidence that the Holocene sea had re-attained the altitude of the earlier platform.

Subsequently, an interglacial origin for the platform became widely accepted (McCann, 1966b, 1968; Synge, 1966; Sissons, 1967a; Gray, 1974a). Gray (1974a) undertook a detailed study of the platform in the vicinity of the Firth of Lorn, giving it the name Main Rock Platform. On the basis of 304 levelled altitudes on 106 platform fragments, he demonstrated a clear east–west tilt on the shoreline from about 11 m OD north of Oban to 4 m OD in mid-Mull, an overall gradient of 0.16 m km-1. However, the gradient is not uniform throughout, for a number of bends and one possible fault were identified (see alsoRingrose, 1989b). Gray argued that if the platform was formed during an interglacial episode, then the tilting is likely to imply tectonic instability of the area.

A major challenge to the idea that the Main Rock Platform was an interglacial feature came from Sissons (1974d). He was struck by the similarity between it and the Buried Gravel Layer, an erosional shoreline that he had identified earlier in the Firth of Forth. Since the latter is eroded into till and Lateglacial marine sediments, yet is overlain by Holocene marine and estuarine sediments, he argued that the shoreline must have been formed during the latter part of the Lateglacial. To explain the extent of erosion in such a short interval in the sheltered estuary of the Firth of Forth he suggested (1974d, p. 46) "that the critical factor was the periglacial climate that characterized the stadial ... the erosion of unconsolidated sediments by the sea would be facilitated by slumping and flowing associated with seasonal thawing'. He argued that the Main Rock Platform could be correlated with the Buried Gravel Layer, thus explaining many characteristics of the former. For example, its tilt (due to differential glacio-isostatic rebound), its apparent lack of direct evidence of having been glaciated (due to its Lateglacial age), and its development in sheltered locations (due to periglacial frost shattering rather than wave action). Sissons used the term "Main Lateglacial Shoreline' to refer to the correlation of the two features.

Fieldwork by Gray (1978a) in the area between the Firth of Lorn and the Firth of Clyde showed that the Main Rock Platform as well as having an east–west tilt also has a north–south tilt, reaching sea level in south Kintyre, south Arran and south Ayrshire. He demonstrated that the shoreline does not correlate with the till-covered platforms of eastern Ireland; these also extend into Kintyre (see Glenacardoch Point) and other areas of south-west Scotland (see Port Logan) but at a higher level than the Main Rock Platform. Subsequent work by Dawson (1980b, 1988a), Rose (1980b, 1980f), Sutherland (1981b) and Wain-Hobson (1981) in other parts of western Scotland have added to the altitudinal information on the Main Rock Platform and have lent support to the correlation of the Main Lateglacial Shoreline. Studies in modern periglacial environments have also substantiated the hypothesis of rapid rates of shore platform formation (for example, Sissons, 1974a; Dawson, 1980b) and indicated the processes that may have been involved in Scotland (Hansom, 1983; Matthews *et al*., 1986; Dawson *et al*., 1987b; Shakesby and Matthews, 1987; see also review by Trenhaile, 1983).

Gray and Ivanovich (1988) reviewed the geomorphological arguments for and against a Lateglacial age: most of the evidence favours such an age, but some is contradictory. Fresh light on the problem has come recently from the uranium-series disequilibrium dates on the Isle of Lismore (Gray and Ivanovich, 1988). The samples giving Holocene ages are in accord with the hypothesis that the platform was eroded during the Lateglacial. However, if valid, the Early Devensian date throws doubt on the view that the shoreline was entirely formed during the Lateglacial. From these results and the contradictory geomorphological evidence for a Lateglacial age, Gray and Ivanovich (1988) were led to the conclusion that the Main Rock Platform may be polycyclic in origin. Browne and McMillan (1984) have also disputed a solely Lateglacial age, suggesting partial inheritance from an earlier platform which pre-dated at least the Late Devensian ice-sheet. Gray (1989) and Dawson (1989) have recently debated several aspects of the distribution and development of the Main Rock Platform in western Scotland.

The Main Rock Platform is important in several respects. First, it is one of the best-developed raised shorelines in Scotland and indeed in Europe. It is directly comparable with the "Main Line' of northern Norway, also a rock-cut, glacio-isostatically tilted shoreline which was formed during the Younger Dryas (Marthinussen, 1960; Andersen, 1968; Sollid *et al.*, 1973). Second, recent ideas on rapid, periglacial formation of the platform have been widely adopted and incorporated into models of shore platform formation (see, for example, Trenhaile and Mercan, 1984). Third, the deformation of the platform with its tilt, bends and possible faults (Gray, 1974a, 1978a; Ringrose, 1989b) are relevant to understanding the crustal stability/instability of the area. It is particularly important that the age of the shoreline is understood so that the time-scale and origin of the deformations can be better appreciated. Such aspects are relevant to earthquake engineering (see, for example, Davenport and Ringrose, 1985; Davenport *et al.*, 1989). The Isle of Lismore site has great potential for clarifying the age and origin of the Main Rock Platform: the other two sites are outstanding examples of specific raised shoreline features associated with the platform.

Conclusions

These three sites together represent key features of the geomorphology of the Main Rock Platform, one of the most prominent fossil shorelines in western Scotland. The age of the platform is uncertain. It appears to have been formed, at least in part, during the Loch Lomond Stadial (about 11,000–10,000 years ago), but it may also be partly an older feature that has been reworked. Isle of Lismore demonstrates the shore platform and cliffline and also includes the critical cave sites where dating of deposits has been undertaken; the Dog Stone and Clach Tholl show additional landforms (stack and rock arch, respectively) associated with the shoreline.

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