Watermill Cove, St Mary's

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Highlights

This is the most important Quaternary site south of the glacial limit on the Isles of Scilly. Exposures here contain the finest raised beach sequence, and the most impressive Middle–Late Devensian organic sequence, on the islands. The raised beach is unique because it is the only example on Scilly to contain a distinct bed of unconsolidated sand above the beach shingle, cobbles and boulders. The organic sequence has yielded pollen assemblages indicative of open grassland vegetation thought to be contemporary with periglacial conditions. Radiocarbon dates from the organic material are critical in showing that it pre-dates the glacial event which impinged on the northern islands.

Introduction

Mitchell and Orme (1967) recorded raised beach sediments at Watermill Cove, noting that the beach of small cobbles and boulders is overlain by *c.* 2 m of 'coarse sand stained black and red by manganese and iron', in turn covered by undifferentiated head. Though they did not explicitly correlate the raised beach here with either their upper 'Porth Seal' or lower 'Chad Girt' raised beaches, Page (1972), in a paper concerned with the radiocarbon dating of organic interglacial deposits in Britain, argued that both the 'Upper Head' and 'Lower' or 'Main Head' of Mitchell and Orme's scheme (1967) could be identified at the site. He therefore implied that raised beach sediments underlying the Lower Head were 'pre-Gipping or Hoxnian' in age, thereby effecting a correlation of these deposits with the earlier Chad Girt raised beach. Page (1972) was the first to identify organic beds lying stratigraphically between the raised beach and the head at Watermill Cove. He interpreted this material as Hoxnian in age in view of its stratigraphic position in relation to the units identified by Mitchell and Orme, and reported radiocarbon dates of around 22 ka BP from bulk organic samples from the site. He used these dates, along with others from sites of Hoxnian or supposed Hoxnian age elsewhere, to argue that the Hoxnian occurred between about 25 500 and 21 100 BP. Page's (1972) controversial paper was criticized by Shotton (1973) on the basis that there is no evidence to justify Page's assumption that the organic material at Watermill Cove is Hoxnian in age.

Scourse (1991) described the sections at Watermill Cove and, on the basis of further radiocarbon dating, pollen analysis and correlation with other sedimentary units on Scilly, proposed that the entire sequence above the raised beach is Middle or Late Devensian in age, much younger than envisaged by either Mitchell and Orme (1967) or Page (1972).

Description

The section containing organic material lies at [SV 925 123], to the south-east of Watermill Cove proper on the north-east coast of St Mary's (Figure 8.1). Lying below 1–2 m of coarse granitic head ((Figure 8.5); bed 7) there is a relatively undisturbed unit of sand and silt containing organic material ((Figure 8.5); beds 3–6). The unit averages between 1 and 1.5 m thick, and extends laterally for about 20–25 m along the base of the section at around 4.4 m OD. This unit can be subdivided into four beds ((Figure 8.5); beds 3–6). The lowest (bed 3) is a brown to black organic silt, highly humified, containing some quartz granules. It is overlain by a fawn to light brown sand (bed 4), less organic than bed 3, again containing quartz granules; the contact between beds 3 and 4 is gradational. Bed 5 is a black, richly organic, highly humified silt, while bed 6 is very similar to the upper parts of bed 4.

Pits dug at the base of the section (Scourse, 1991) revealed a unit (bed 1) of homogeneous coarse to medium light brown sand, separated from the overlying organic material by a layer of coarse cemented granitic head (bed 2) just a few centimetres thick (Figure 8.5). The sands are unce-mented and appear to rest on solid granite. The contact between beds 1 and 2 is sharp and erosional.

Farther to the north-west, on the southern shore of Watermill Cove itself [SV 924 123], a raised beach consisting of both rounded granite cobbles and sand is exposed at the same elevation. No raised beach cobbles are visible within the main exposure, but it is clear that the sand (bed 1) there forms part of the same exposure of raised beach.

The coarse granite head (bed 7) overlies the entire sequence. Most of the Devensian organic sites on Scilly (e.g. Cant Morval, Porth Askin, Porth Seal; (Figure 8.1)) have been severely disrupted by deposition of the overlying head. At Watermill Cove, however, only the uppermost parts of bed 6 have been deformed.

Interpretation

The sand unit (bed 1), along with the raised beach cobbles along the southern shore of Watermill Cove, form the stratotype of the Watermill Sands and Gravel (Scourse, 1991). This is the basal stratigraphic unit of the Quaternary succession on the islands, and is clearly of littoral origin. The sand has a dominant mode of 1.04) on the coarse/medium sand boundary with moderate to good sorting. Though it resembles dune sand it lacks the high kurtosis characteristic of such sediments and may therefore be of backshore origin.

The thin head (bed 2), like the more massive head (bed 7) above the organic sequence, is interpreted as a solifluction deposit which must have spread across the surface of the exposed beach. To the north-west of the organic sequence a prominent quartz-porphyry dyke (elvan) crosses the shore platform from south-west to north-east. Clasts derived from this dyke can be found in the main body of head (bed 7), indicating that the dominant direction of solifluction was from the east, north-east or north in response to the local slope morphology.

Solifluction is interpreted by Scourse (1991) to be the cause of the accumulation of the organic sequence at the site. Solifluction down the slopes of the neighbouring headlands would have ponded any small stream flowing down the valley into the Cove, forming a small lake or large pond into which the sediments accumulated. The organic content of beds 3–6 varies conversely with coarse minerogenic content; organic content reaches 10% in beds 3 and 5 coincident with minima in the coarse minerogenic fraction. The varying sediments of these beds are therefore interpreted to represent inwashings of coarse minerogenic sediment, probably associated with active solifluction within the catchment, contrasting with phases of quiescent organic sedimentation.

The lacustrine origin of the organic sequence is further supported by the occurrence of obligate aquatic taxa in the pollen spectra. These include *Sparganium* type, *Potamogeton,* cf. *Sagittaria,* and the algae *Botryococcus* and *Pediastrum.* These are all represented by quite high frequencies in beds 3 and 5.

The pollen diagram (Scourse, 1991; Fig. 14, p. 420) from beds 3–6 can be divided into two assemblage zones on the basis of changes in the frequency of *Pinus.* Zone WC1 is dominated by herb taxa, particularly Cyperaceae, Gramineae, *Solidago* type and Rubiaceae, and occurs within bed 3. *Pinus* values remain below 1% throughout zone WC1, but rise to a peak of 51% in WC2 with a concomitant decrease in the frequencies, though not the diversity, of the herb taxa. Zone WC2 coincides with beds 5 and 6. Intact *Pinus* grains consistently only contribute around 10% of total *Pinus.* As in the case of the Carn Morval pollen diagram (see above), which also contains a distinctive *Pinus* peak, this is not interpreted as an increase in the local representation of this tree. Rather, it is explained as a combination of long-distance transport with differential weathering and a decline in the pollen productivity of the local vegetation probably resulting from climatic deterioration.

The importance of the obligate aquatic taxa, and the behaviour of Cyperaceae, lends support to the evidence of the sediments themselves, and the geomorphological context of the site, that this sequence formed in a small lake, and that the high humic content of the organic material represents allochthonous material from within the catchment. The very high values for Cyperaceae and *Sparganium* type in the basal level suggest ponded conditions, the subsequent decline in both representing the infilling of the basin with minerogenic sediment (bed 4); this is supported by the lack of pollen in this bed. The renewed importance of the obligate aquatic taxa, and in particular cf. *Sagittaria,* which reaches a peak of 12%, in beds 5 and 6 suggests a second phase of ponding. The stratigraphy and pollen record therefore indicate two ponding episodes at Watermill Cove.

Page (1972) obtained two radiocarbon dates from the organic material corresponding to Scourse's (1991) beds 3–6; these were 21 200 +900/–600 BP (GaK-2471) and 22 200 +400/–400 BP (T-833). Scourse (1991) obtained a further eight dates from humic and humin fractions of beds 3 and 5; these were from samples taken up to 3 m back from the face of the section ('second series' samples) in addition to samples from only 0.75 m from the face ('first series' samples). Apart from the bed 5 second series determinations, the humic extract samples are younger than the humin residues, and the second series dates older than the first series. This pattern is very similar to the radiocarbon results from other similar organic sites on Scilly; the differences in radiocarbon content indicate that contamination by modern humus, probably transported by percolating groundwater from recent/modern soil, is a problem at the face and the base of the profile, but that this contamination is less of a problem higher in the sequence. It is probable that the thin head (bed 2) acts as an impermeable layer, and that groundwater charged with modern carbon has percolated, and continues to percolate, through bed 3, which acts as an aquifer, along the contact with the head, modern humus being deposited in the process. The older second series bed 5 humic extract date can be explained in terms of the inwashing of older mor humus into the basin; the likelihood of such allochthonous humus being present is supported by the pollen diagram.

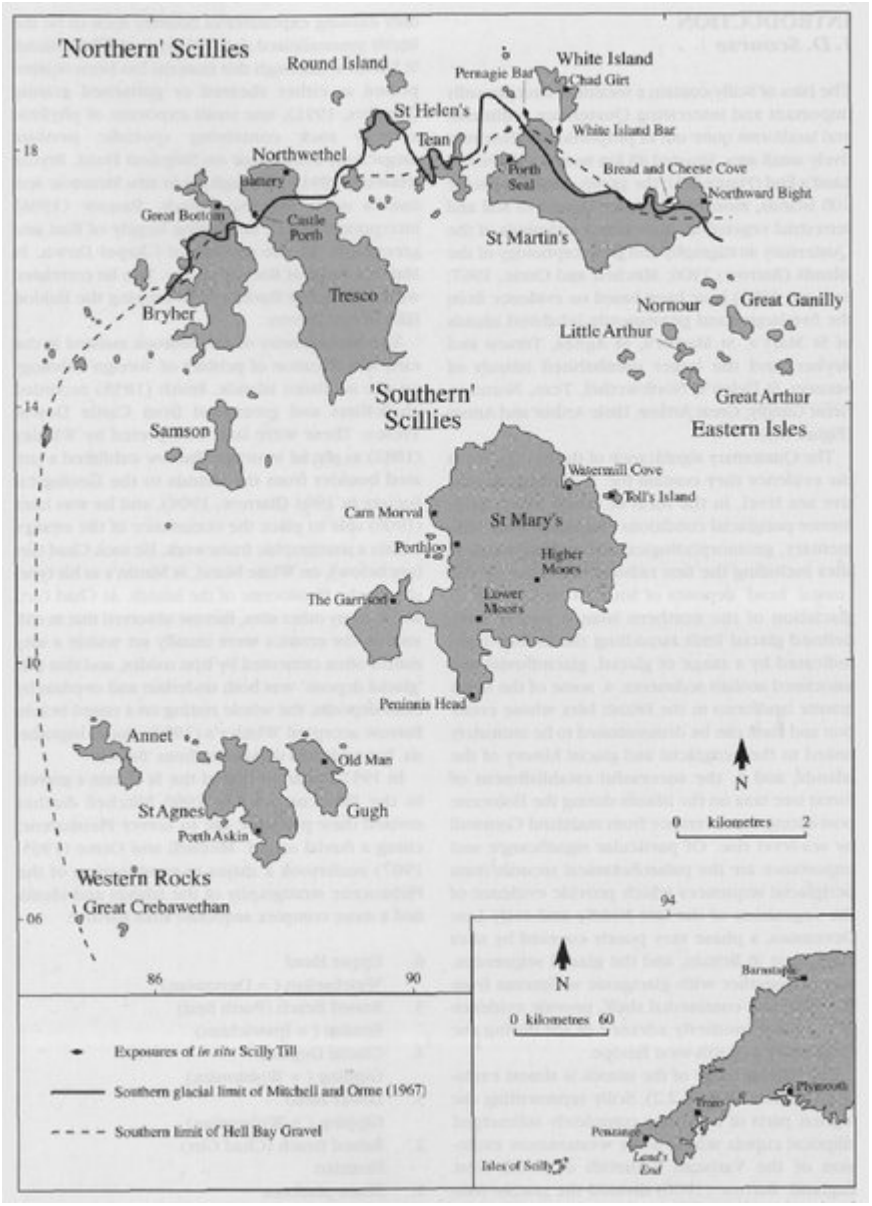
On the basis of this analysis of the radiocarbon content of the materials in beds 3–6, Scourse (1991) suggests that the most reliable determination for bed 3 is 33 050 + 960/–860 BP (Q–2408) and for bed 5, 26 680 + 1410/–1200 BP (Q–2407). This demonstrates that the organic sequence accumulated during the latter part of the Middle Devensian, and provides maximum and minimum ages for the underlying and overlying units. The overlying head (bed 7) must post-date 26 ka BP, and the underlying head (bed 2) and the Watermill Sands and Gravel must pre-date 33 ka BP. The age of the Watermill Sands and Gravel (bed 1) is uncertain everywhere on Scilly, but by correlation with similar raised beaches on mainland Britain it is probably of interglacial age.

Scourse (1991) correlates all the sedimentary units at Watermill Cove, other than the basal raised beach, with the Porthloo Breccia (Figure 8.3). In the absence of the Old Man Sandloess at the site it is not possible to correlate beds 2–7 definitively with either the upper or lower Porthloo Breccia. However, the radiocarbon dates and pollen spectra are very similar to analogous sequences at other organic sites on Scilly where stratigraphic relationships can be established with the Old Man Sandloess (Carr Morval, Porth Askin) indicating that probably at least bed 2 and beds 3–6 can be correlated with the lower Porthloo Breccia.

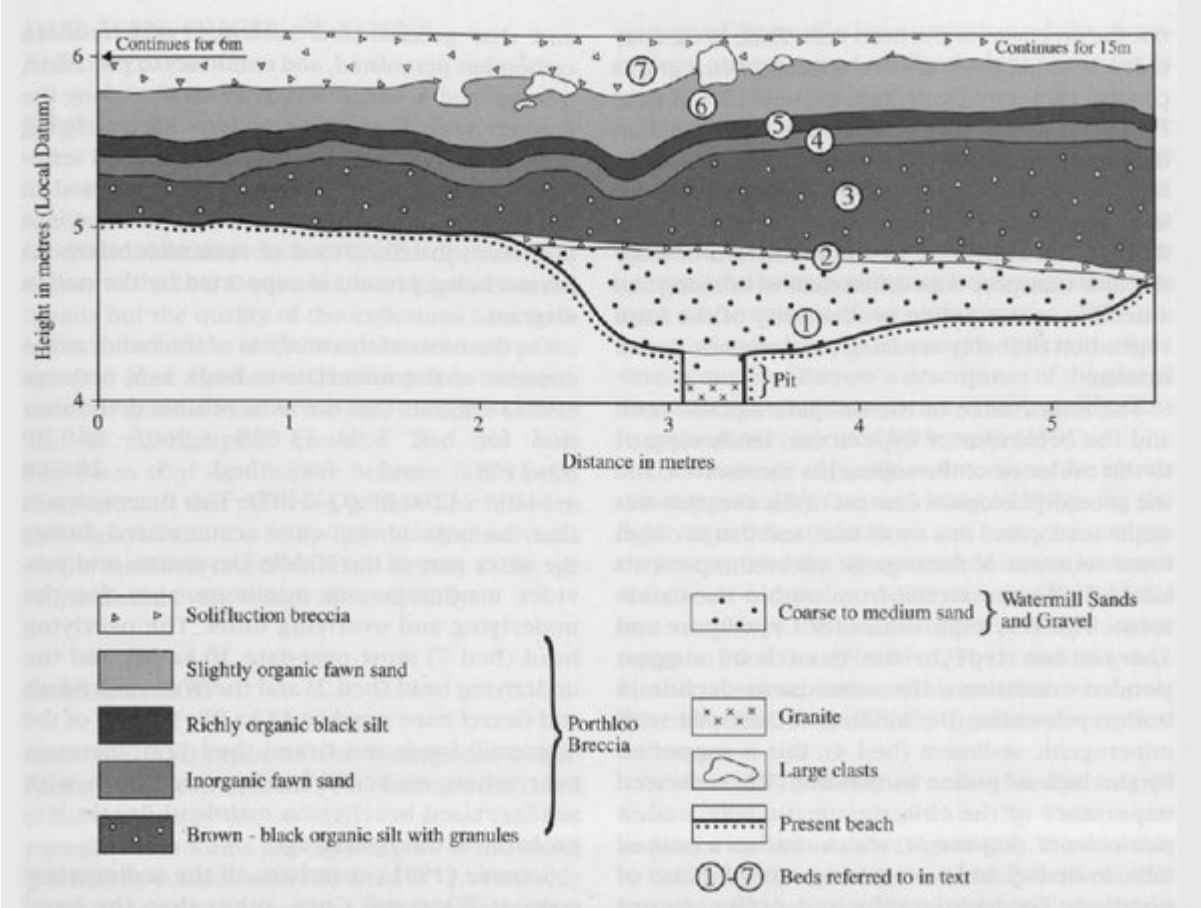
Conclusion

Watermill Cove contains the best exposures on Scilly of raised beach sediments deposited in an interglacial temperate stage, before a glacier advanced as far as the northern islands around 19 ka BP. The site also contains excellent exposures of organic sediments deposited under cold tundra-like conditions between 33 ka and 26 ka BP. Pollen analysis of these sediments reveals an open grassland type vegetation with no trees.

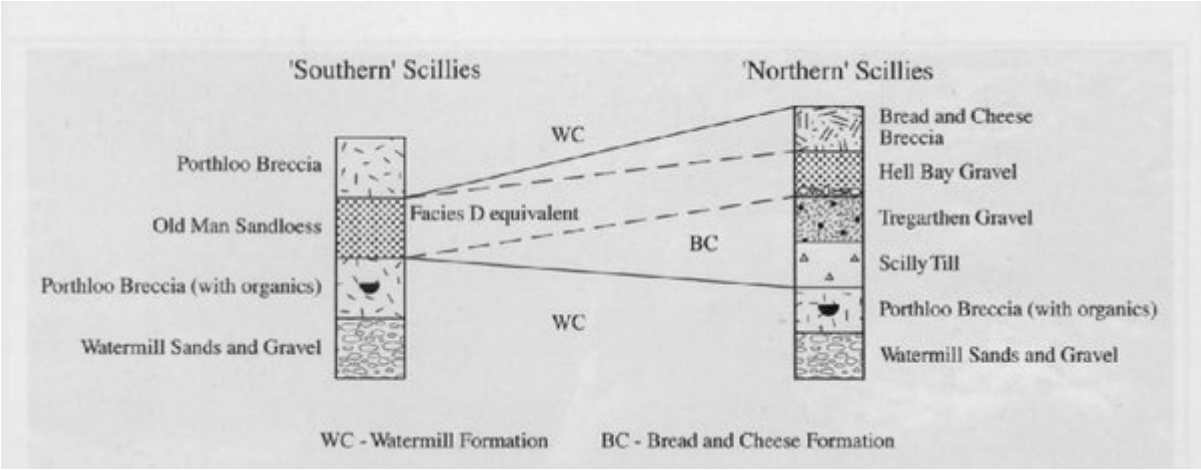
References



(Figure 8.1) The Isles of Scilly: critical sites, exposures of the Scilly Till, the southern limit of the Hell Bay Gravel and Mitchell and Orme's (1967) glacial limit. (Adapted from Scourse, 1991.)



(Figure 8.5) The Pleistocene sequence at Watermill Cove. (Adapted from Scourse 1991.)



(Figure 8.3) A lithostratigraphic model for the Isles of Scilly. (Adapted from Scourse, 1991.)