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# Bread and Cheese Cove, St Martin's

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## Highlights

This is the most important Quaternary site on the Isles of Scilly. It is crucial to the arguments concerning the evidence for, and age of, the Late Devensian glaciation of the northern islands. The site contains the stratotypes of the Scilly Till and the Bread and Cheese Breccia.

## Introduction

The significance of Bread and Cheese Cove was first recognized by Mitchell and Orme (1967) who described glacial sediments (presumed Wolstonian) cropping out in the low coastal cliffs at the cove. Scourse (1991) undertook a reinvestigation of the sedimentology of these 'glacial' deposits to establish their precise depositional origin and, in particular, whether post-depositional downslope movement had occurred. He also discovered brown humic organic beds underlying the supposed glacial sequence at the base of the cliffs. Pollen analyses of these organic deposits indicated open grassland vegetation consistent with deposition in a periglacial regime, and enabled correlation with other organic sequences in the islands — at Watermill Cove, Carn Morval, Porth Askin and Porth Seal (Figure 8.1) — all of which have been radiocarbon dated to the late Middle and early Late Devensian. Radiocarbon determinations on the organic sediments at Bread and Cheese Cove yielded Holocene ages (c. 10–7.5 ka BP) which are clearly incompatible with the lithostratigraphical and pollen evidence, and indicate sample contamination by younger carbon.

## Description

Bread and Cheese Cove [SV 940 159] lies on the northern coast of St Martin's (Figure 8.1). Mitchell and Orme (1967) recorded the presence of till and outwash gravel between the Lower (Main) Head and the Upper Head at this site. Their section is still readily observed, but Scourse (1991) was further able to identify the presence of organic sediments at the base of the section (Figure 8.10). A granite wave-cut platform rises towards the south-west and underlies a coarse granitic solifluction breccia (bed 3). At the base of the section there is a deposit of very coarse granite rubble and boulders, which extends outwards from the modern cliff across the granite platform. Forming the matrix between these boulders, and also a coherent unit towards the base of the section, is a humic horizon (bed 1), a dark brown sandy silt with quartz granules. Pits dug at the base of the section by Scourse (1991) revealed a richly organic black sand (bed 1) resting either on the granite boulders or the wave-cut platform. Bed 3 is overlain gradationally by bed 4, a clay-rich light brown diamicton containing abundant erratic clasts. Bed 4 forms a lens some 22 m in length with a maximum thickness of 2 m. At one point (Figure 8.10) the diamicton is overlain by a small lens of iron-cemented sandy gravel (bed 5), which also contains abundant erratic clasts. Both the diamicton and the gravel are overlain by up to 4 m of coarse, dominantly granitic, breccia (bed 6) which contains occasional erratic clasts. The section is capped by a number of large granite boulders.

## Interpretation

On the basis of lithological characteristics and pollen assemblage zones, Scourse (1991) correlated beds 1–3 with the Porthloo Breccia and bed 5 with the Tregarthen Gravel (Figure 8.3) and (Figure 8.10). He defined (Scourse, 1991) bed 4 as the stratotype of the Scilly Till, and bed 6 as the stratotype of the Bread and Cheese Breccia.

Pollen spectra from the basal organic deposits (bed 1) are dominated by herb taxa, in particular Gramineae, *Solidago* type, Rubiaceae and *Ranunculus repens* type. Tree taxa are almost completely absent, as are plant macrofossils. There are no significant changes in the pollen stratigraphy through the sequence. This assemblage is typical of open grassland vegetation, and is very similar to the spectra from other comparable organic sequences on the Scillies, all radiocarbon

dated to the late Middle or early Late Devensian.

The coarse breccia deposits (beds 3 and 6) were interpreted by Scourse (1987, 1991) as solifluction deposits laid down under periglacial conditions. There is no evidence for breccia deposition, and therefore of solifluction, between the granite platform and the organic sediments. The organic sediments fill cracks in the surface of the platform, and the interstices between granite boulders associated with the platform. These boulders probably represent an immature beach deposit, organic sedimentation having occurred directly on the surface of the beach. Many of the sand grains and granules found within the organic sediment are extremely well rounded, suggesting a beach origin. This interpretation is supported by the presence of unambiguous raised beach deposits (lithostratigraphically assigned to the Watermill Sands and Gravel) in a similar stratigraphic position beneath the Porthloo Breccia at many sites on the Isles of Scilly. The organic deposits are probably lacustrine, ponding having been effected by contemporaneous local solifluction. The sediments and pollen spectra indicate that beds 1–3 accumulated during periglacial climatic conditions.

The stratotype of the Scilly Till (bed 4) is dark yellowish-brown, drying to light yellowish-brown. It is largely non-calcareous, but mineralogical data (Catt, 1986) suggest that it is not heavily weathered, containing a number of easily weatherable minerals such as muscovite, glauconite, chlorite, biotite, augite, apatite, olivine and calcite. It contains abundant siliceous sponge spicules (Jenkins, 1986), but no calcareous microfossils or macrofossils. These data suggest a marine derivation with subsequent partial decalcification. The Scilly Till at this site is geochemically similar to other Late Devensian tills from the Irish Sea Basin (Burek and Cubitt, 1991).

The Scilly Till is extremely poorly sorted and crudely stratified with a number of sub-horizontal iron-stained sand partings up to 1 mm thick. The contained clasts are very freshly striated and faceted, and consist of a wide variety of lithologies, including Cretaceous flint, Variscan greywackes and quartzites, red sandstones and schistose metamorphic rocks, in addition to local granitic material (Hawkes, 1991). The till also contains small granules of a distinctive light green glauconitic micrite which is derived from the Miocene Jones Formation offshore to the north (Pantin and Evans, 1984).

Three features set the Scilly Till apart from the underlying Porthloo Breccia: the high clay content, low clast concentrations and the diverse erratic and mineralogical assemblage. The geochemistry, distinctive erratic and mineralogical assemblage, abundance of clay and silt and presence of sponge spicules are all consistent with derivation from the offshore area to the north of the Isles of Scilly.

A coarse lag of angular granite boulders occurs at the base of the Scilly Till at its contact with the Porthloo Breccia. The upper contact with the Bread and Cheese Breccia is clearly soliflucted.

Statistical (eigenvalue) analysis of clast macrofabric data shows that the central and upper parts of the Scilly Till are very similar to lodgement tills from both modern (Dowdeswell and Sharp, 1986) and fossil (Rose, 1974) contexts, and are quite different in fabric character from the overlying and underlying solifluction deposits (Porthloo Breccia and Bread and Cheese Breccia). However, the base of the deposit is more characteristic of remobilized or slumped till. Given that the Scilly Till may be largely of lodgement origin, the fabric data are consistent with ice flow from north-west to south-east (Scourse, 1991).

Scourse (1991) concludes that while it is impossible to interpret the precise depositional origin of the Scilly Till from this one small exposure, it is different in a number of fundamental characteristics from undoubted soliflucted till, as represented by the Hell Bay Gravel at other sites (Figure 8.3).

The grain-size and lithological content of the sandy gravel (bed 5) suggest clear affinities with the stratotype of the Tregarthen Gravel (Figure 8.3) at the Battery (Castle Down) site on Tresco (see below). This material is interpreted by Scourse (1991) as a glaciofluvial gravel deposited very close to the Scilly Till.

In its general characteristics the Bread and Cheese Breccia (bed 6) is very similar to the Porthloo Breccia, and is similarly interpreted as a periglacial solifluction deposit. However, it does contain occasional erratic clasts clearly derived from the underlying Scilly Till and Tregarthen Gravel. It cannot, therefore, be correlated with the Porthloo Breccia on lithological grounds, even though it was deposited in a similar environment. It has therefore been defined as a separate stratigraphic unit (Scourse, 1991).

The large granite boulders capping the section have been interpreted by Scourse (1987) as fossil 'ploughing blocks' (Tufnell, 1972). Large boulders lying on the surface of solifluction sheets and lobes have been extensively reported from contemporary periglacial environments where they have been termed 'ploughing blocks' because they move at velocities faster than the flow of the deposits on which they rest.

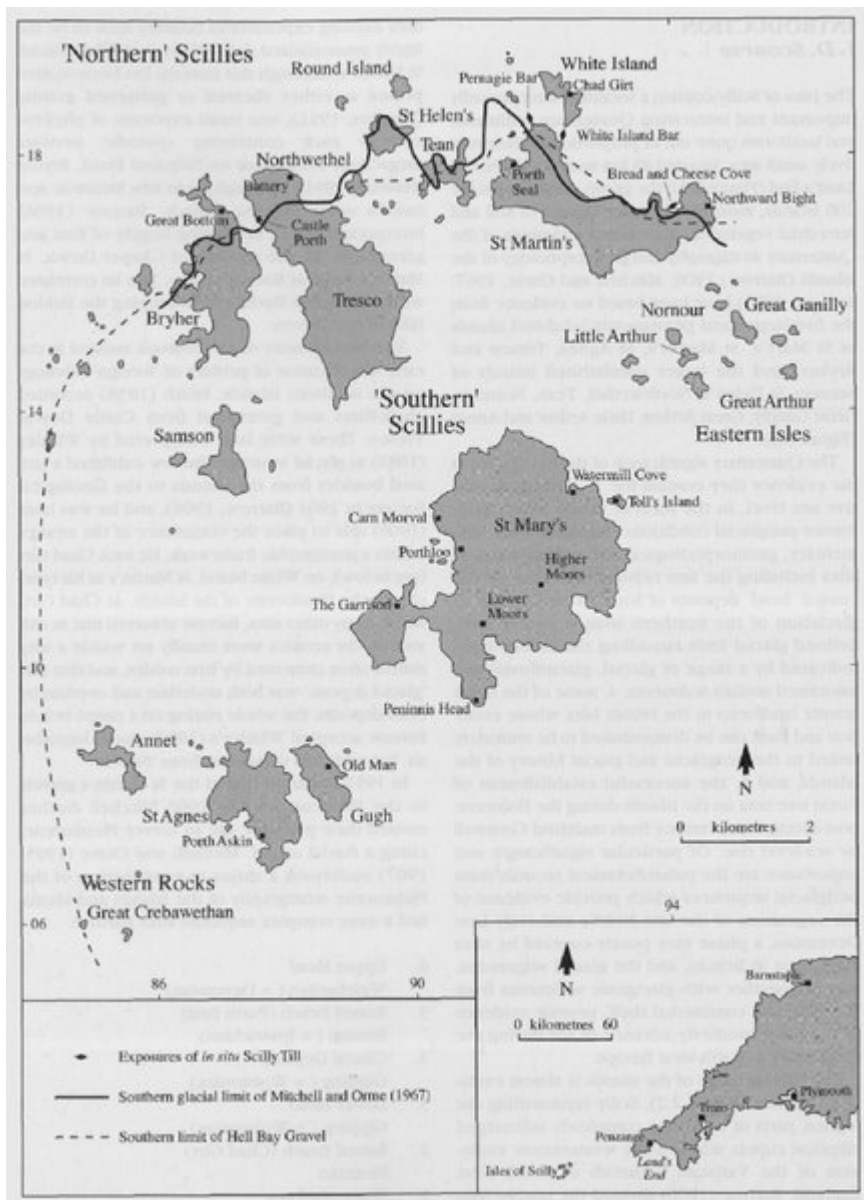
The Bread and Cheese Cove sequence is unique because it is the only site on the Isles of Scilly where dateable organic sediments occur beneath the glacially derived units of the Bread and Cheese Formation of the northern Scillies (Figure 8.3). Humic extract dates of  $7880 \pm 180$  BP (Q-2369) and  $7830 \pm 110$  BP (Q-2411), and a humin date of  $9670 \pm 65$  BP (Q-2368), are however clearly aberrant, with values very much younger than  $^{14}\text{C}$  and TL dates on related stratigraphical units elsewhere on the Scillies, and the occurrence of glacial and solifluction deposits overlying material yielding Holocene-equivalent radiocarbon determinations clearly suggests that the samples are wholly unreliable. Furthermore, these results are inconsistent with the pollen spectra from this same unit.

Scourse (1991) attributes these erroneous results to contamination by modern carbon derived from rootlet penetration and/or groundwater deposition of modern humus. In particular, the impermeable surface of the granite immediately beneath the organic deposit concentrates groundwater flows through the overlying permeable organic material. It is therefore probable that post-depositional concentration of groundwater-derived humus has occurred in this material. Scourse (1991) has demonstrated, through split humic/humin radiocarbon analyses of other similar organic sequences on the Isles of Scilly, that such hydrogeological contexts consistently produce erroneously young radiocarbon determinations.

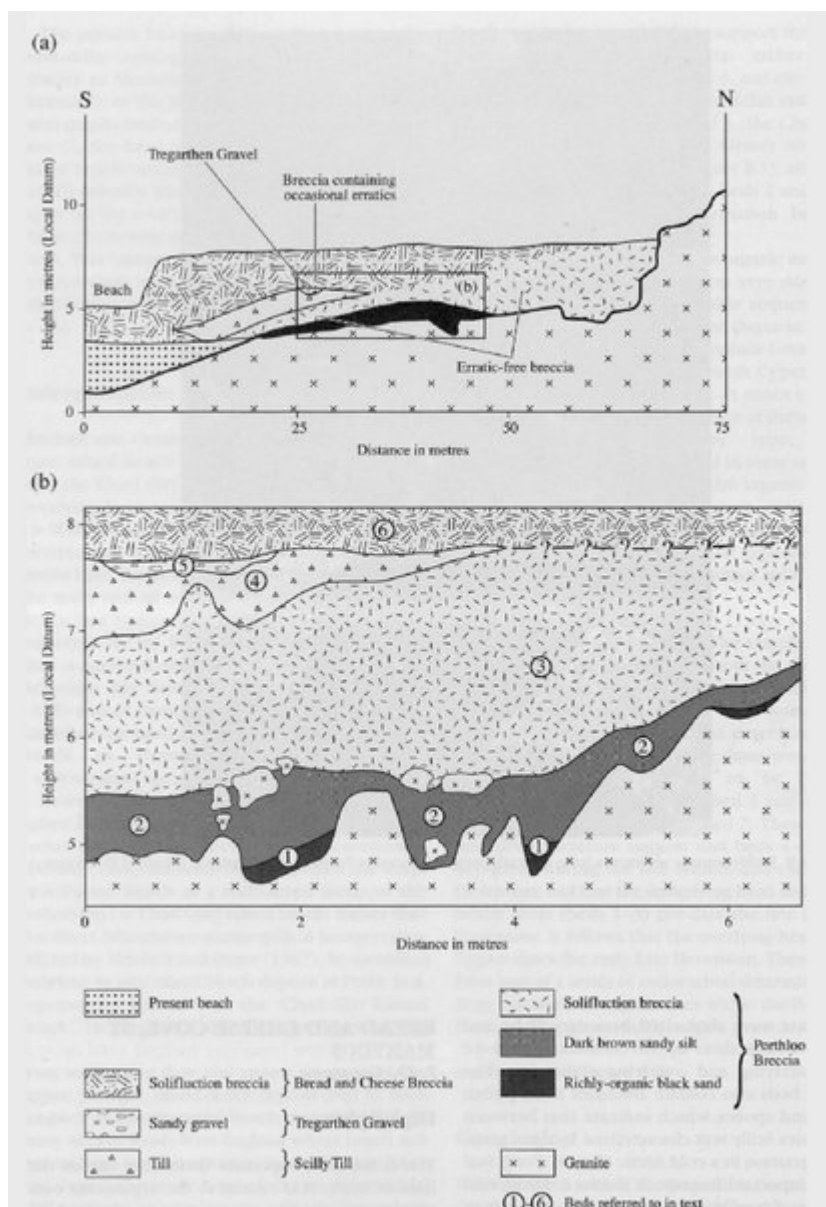
## **Conclusion**

Bread and Cheese Cove provides the most complete vertical succession of Pleistocene sediments on the Isles of Scilly. It also contains the most extensive exposure of glacial sediments on the Scillies, providing vital evidence for the glaciation of the northern islands. These sediments appear not to have moved since they were originally deposited, and provide evidence for the direction of movement of the glacier with which they are associated. The sequence also contains meltwater sediments associated with the ice, and slope deposits laid down in cold non-glacial climates both before and after the glacial event. The site is also unique because it is the only place on the Isles of Scilly where organic deposits rich in fossil pollen have been discovered beneath the glacial sediments. These organic deposits provide evidence of open grassland vegetation on the islands prior to the ice advance. From other sites on the Scillies it is known that this type of vegetation was present on the islands around 30 ka BP. This therefore provides evidence that the glaciation must have occurred after this time, during the Late Devensian.

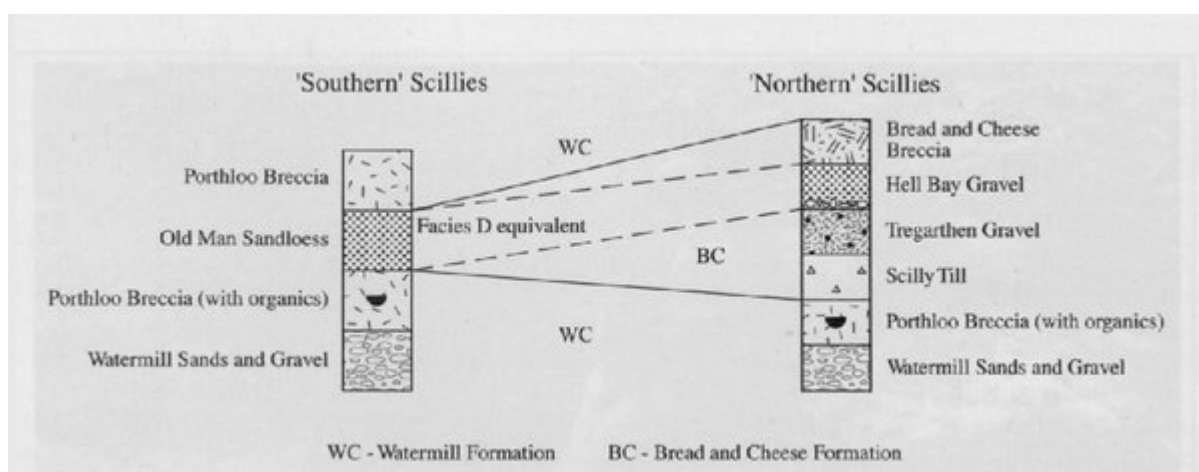
## **References**



(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 8.10) The Pleistocene sequence at Bread and Cheese Cove. (Adapted from Scourse, 1991.)



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