Philorth valley

D.E. Smith

Highlights

The sub-surface deposits in the Philorth Valley include a sequence of estuarine sediments and peat. These provide important evidence for interpreting the pattern of relative sea-level changes during the Holocene. Because the Philorth Valley is located towards the margin of the area of isostatic uplift, the deposits there have preserved a more detailed record of coastal changes than sites elsewhere.

Introduction

The Water of Philorth is a small stream draining through a landscape of glacial deposits in the district of Buchan, north-east Scotland. The area [NK 011 635] of significant interest lies at the northern end of the valley, west of the farm of Milltown, 3.5 km south of Fraserburgh. In this area, Smith *et al.* (1982) have identified a sequence of deposits that record changes in relative sea level during the middle and late Holocene, including a transgressive episode not found elsewhere in Scotland. This record is important because of its location near the periphery of the area of isostatic uplift in Scotland.

Description

The Philorth Valley is, for the most part, narrow and unremarkable, but in the final 3 km of its course it opens out and an extensive flat area occurs before the stream cuts through a rampart of sand dunes to reach Fraserburgh Bay. The surface of the flat area is largely composed of a brown, silty clay with some areas of sand. A sharp break of slope occurs where this surface meets the surrounding rising ground.

The area was studied by Smith *et al.* (1982). They mapped the surface deposits and found that the brown, silty clay surface lies at a consistent altitude of between +2.2 m and +3.2 m OD, but rises to over +5 m OD where it becomes restricted at its southern margin, near The Neuk [NK 002 624]. Boreholes across the area proved a succession of sands and gravels overlain by peat, then brown, silty clay, and discontinuous sand above (Figure 8.12). Within the peat two minerogenic layers occur, an upper layer of micaceous sandy silt, which tapers up-valley and a lower layer of grey sand, irregularly distributed (Figure 8.12). The surface of the micaceous sandy silt was found to be relatively consistent in elevation at +1.22 m to +2.26 m OD, but the grey sand was found to vary between –1.15 m and +1.80 m OD; at Mains of Philorth, two layers of grey sand were recorded near the side of the valley.

The sequence of deposits is best represented in the area between Milltown and Philorth Home Farm. Here Smith *et al.* (1982) undertook pollen analysis of the deposits at one site and radiocarbon dates on part of the sequence at two sites. Radiocarbon dates were also obtained from a site further up-valley ((Figure 8.12) and (Table 8.1)).

At the pollen site, Smith *et al.* (1982) found that through the basal peat and intervening minerogenic horizons to 0.4 m below the surface of the brown, silty clay, where sampling ended, the vegetational sequences span the early to middle Holocene. The basal peat, grey sand, and peat below the micaceous sandy silt are associated with early Holocene sequences indicating scattered stands of *Betula* and *Pinus,* with *Corylus* and *Salix* in the general area; the valley floor being subject to a fluctuating water table, with sedges, grasses, and a variety of aquatic communities including *Lemna, Potamogeton* and *Typha angustifolia.* The grey sand layer is associated with a temporary decline in aboreal pollen. The top of the peat above the grey sand layer, together with the overlying micaceous sandy silt and much of the peat above it, are associated with increasing values of *Quercus* and particularly of *Alnus;* the silt is associated with high values of *Pinus* and *Quercus,* together with a concentration of *Plantago maritima* and significant representation of freshwater aquatics, notably *Lemna* and *Potamogeton.* The top of the peat and the overlying brown, silty clay yielded pollen indicating *Betula*–*Quercus* woodland,

(Table 8.1) Radiocarbon dates from sites in the Philorth Valley (after Smith *et al.* 1982)

Location	Details of sample	Altitude (metres OD) of sample at contact with minerogenic layer	14C date (years BP)	Laboratory number
Philorth Home Farm	Bottom 2 cm of peat above micaceous sandy silt	1.48	5700 ± 90	SRR–1660
Philorth Home Farm	Top 2 cm of peat below micaceous sandy silt	0.82	6300 ± 60	SRR–1661
Milltown	Bottom 2 cm of peat above micaceous sandy silt	1.82	5140 ± 60	SRR–1686
Milltown	Top 2 cm of peat below micaceous sandy silt	1.11	6095 ± 75	SRR–1687
Mains of Philorth	Top 1cm of peat below brown silty clay	2.59	4760 ± 60	SRR–1655
Mains of Philorth	Bottom 2 cm of peat above grey sand	1.51	6150 ± 250	SRR–1656
Mains of Philorth	Top 2 cm of peat below grey sand	1.47	6885 ± 90	SRR–1657
Mains of Philorth	Bottom 2 cm of peat above grey sand	1.40	7510 ± 120	SRR–1658
Mains of Philorth	Top 2 cm of peat below grey sand	1.34	8465 ± 95	SRR–1659

The brown silty clay present at the surface of the area is today often partially inundated during high tides, and would be even more so affected were it not for dykes along the lower Philorth. Smith *et al.* (1982) suggest that this deposit began to accumulate at about 4760 ± 60 BP as the result of a rise in relative sea level, and that it is still accumulating in places. The silty clay is essentially an estuarine deposit which becomes increasingly alluvial up-valley.

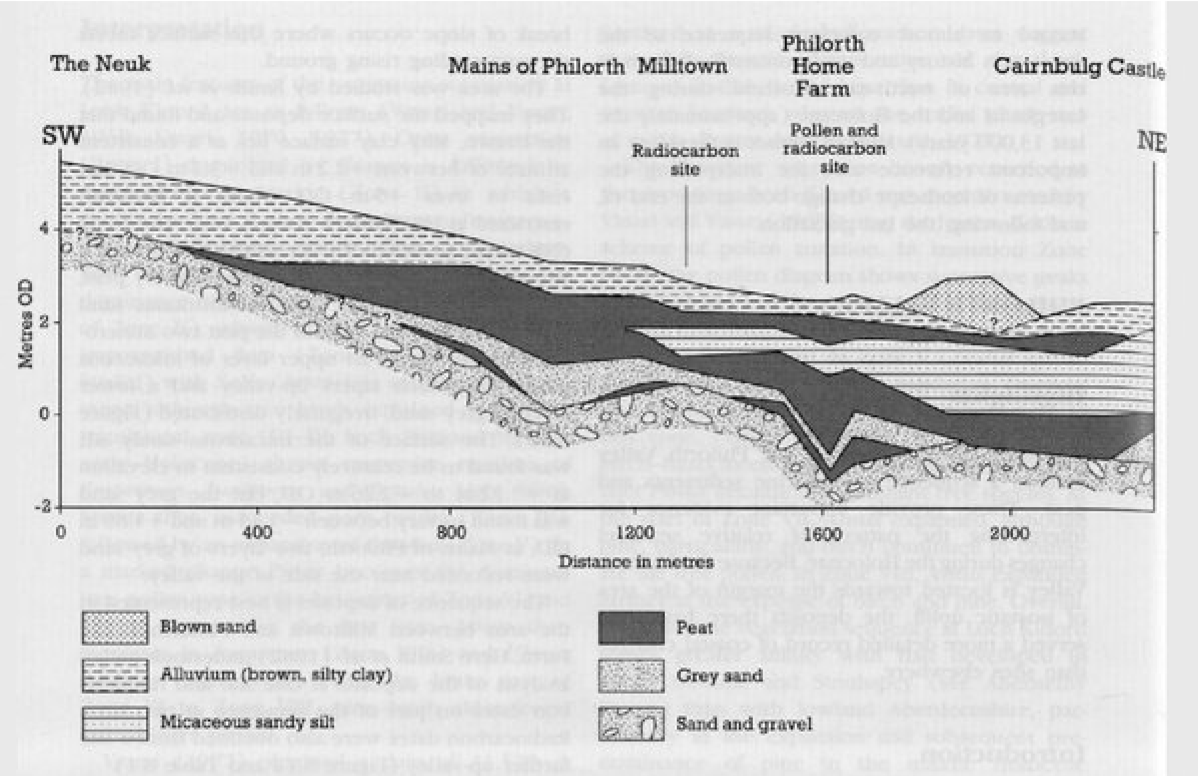
The deposits of the lower Philorth Valley contain evidence of tsunami activity dated at *c.* 7000 BP, and two major marine incursions, the Main Postglacial Transgression and the later one, after 4700 BP, that formed the surface mudflats. The earlier marine incursion in which the micaceous, sandy silt was deposited, culminated between 6096 ± 75 BP and 5700 ± 90 BP. It appears to have been the Main Postglacial Transgression, but is somewhat younger than that event further south, where ages of about 6200 BP in the Tay estuary (see Pitlowie) (Smith *et al.,* 1985b) and around 6800 BP in the Western Forth Valley (see below) (Sissons, 1983a) have been proposed. The Philorth dates, therefore, may be evidence for a time-transgressive shoreline (Smith *et al.,* 1983). Such diachroneity would accord with theories on the formation of relict shorelines in isostatically affected areas. Altitudes on the surface of the micaceous sandy silt (about +2 m OD) demonstrate the decline in altitude of the Main Postglacial Shoreline from the maximum altitudes of over 14 m OD at the head of the Forth Valley, near the centre of isostatic uplift (see Sissons, 1976b). In a recent publication, Cullingford *et al.* (1991)have identified detailed isobase patterns for the Main Postglacial shoreline in eastern Scotland. They place the Philorth Valley below the 2 m isobase and therefore close to the margins of Holocene isostatic uplift.

The second marine incursion identified in this area, in which the brown, silty clay was deposited, took place about 4760 ± 60 BP. It is unlikely to be found in many areas of Scotland. The pace of isostatic uplift over most of Scotland during the late Holocene would probably have exceeded regional sea-level rise. Only areas towards the periphery of the uplifted area would register the more minor fluctuations of the sea surface after the Main Postglacial Transgression. The Philorth Valley site is therefore uniquely valuable for studies of Holocene relative sea-level change in Scotland, and will repay further scientific enquiry.

Conclusion

The sediments in the Philorth Valley record sea-level changes in north-east Scotland during the Holocene. They show that a major coastal flood occurred about 7000 years ago and that there were two subsequent episodes when sea level was relatively higher than at present. This evidence allows comparisons with sites elsewhere in Scotland and contributes towards establishing the wider pattern of sea-level changes during the Holocene. The particular significance of the Philorth Valley lies in its location towards the margin of the area of isostatic uplift (the recovery of the Earth's crust following its depression by the weight of the ice-sheet); as such it preserves a more sensitive record of sea-level change than more central areas that have undergone greater uplift (where the ice was thicker) following the melting of the last ice-sheet.

References



(Figure 8.12) Section along the length of the Lower Philorth Valley showing the sequence of sediments (from Smith et al., 1982).

Location	Details of sample	Altitude (metres OD) of sample at contact with minerogenic layer	14C date (years BP)	Laboratory number
Philorth Home Farm	Bottom 2 cm of peat above micaceous sandy silt	1.48	5700 ± 90	SRR–1660
Philorth Home Farm	Top 2 cm of peat below micaceous sandy silt	0.82	6300 ± 60	SRR–1661
Milltown	Bottom 2 cm of peat above micaceous sandy silt	1.82	5140 ± 60	SRR–1686
Milltown	Top 2 cm of peat below micaceous sandy silt	1.11	6095 ± 75	SRR–1687
Mains of Philorth	Top 1cm of peat below brown silty clay	2.59	4760 ± 60	SRR–1655
Mains of Philorth	Bottom 2 cm of peat above grey sand	1.51	6150 ± 250	SRR–1656
Mains of Philorth	Top 2 cm of peat below grey sand	1.47	6885 ± 90	SRR–1657
Mains of Philorth	Bottom 2 cm of peat above grey sand	1.40	7510 ± 120	SRR–1658
Mains of Philorth	Top 2 cm of peat below grey sand	1.34	8465 ± 95	SRR–1659

(Table 8.1) Radiocarbon dates from sites in the Philorth Valley (after Smith et al. 1982)