Dundonald Burn

D.G. Sutherland

Highlights

The sediments exposed in the stream section at Dundonald Burn include a sequence of estuarine, littoral, aeolian and buried peat deposits. These provide important sedimentary, pollen and marine fossil evidence for changes in sea level and coastal environmental conditions during the Holocene.

Introduction

The site at Dundonald Burn [NS 337 372] comprises a stream section, located 2 km south-east of Irvine. Along the Ayrshire coast, from south of Ayr to north of Ardrossan, major coastal embay-ments have existed at two distinct periods. During the Lateglacial, sea level was initially at 26–28 m OD (Jardine, 1971; Boyd, 1986a) and in areas such as the valley of the River Irvine the sea penetrated inland for over 10 km. Sea level fell from this altitude during the Lateglacial and early Holocene only to flood the lowlands again during the middle Holocene, attaining a maximum altitude of approximately 12 m OD (Jardine, 1971; Boyd, 1982, 1986b). Sedimentary sequences related to the period of low sea level during the early Holocene and the subsequent Main Postglacial Transgression have been studied along the Dundonald Burn close to its confluence with the River Irvine and at the nearby 'Great Bend' [NS 324 372] on the River Irvine (Crosskey, 1864; Smith, 1896b; Jardine, 1971; Jardine and Morrison, 1980; Akpan and Farrow, 1984; Boyd, 1986b, 1988).

Description

The stratigraphic sequence exposed by the Dundonald Burn has been most recently recorded by Boyd (1988) as follows:

5. Orange sand with occasional organic detritus	
4. Peat with occasional silt and fine gravel	0.04 m
3. Bedded organic detritus containing some sand	0.15 m
2. Dark, bedded organic detritus	0.14 m
1. Finely, horizontally bedded clay grading upwards into organic detritus	0.03 m

The basal clays (bed 1) may be equivalent to the grey sands exposed at the base of the Great Bend section (Smith, 1896b; Boyd, 1986b), since Smith (1896b) reported that the sands became peaty towards the eastern end of the section. *Pholas* borings and shells occur *in situ* in these grey sands. At the Great Bend, these sands are unconformably overlain by sands and gravels (Boyd, 1986b), the lateral equivalents of bed 5 at Dundonald Burn. At the Great Bend, a 'basal gravel' layer has been recognized as being distinct from the remainder of these sands and gravels. This 'basal gravel' rests on the grey sands.

The sands and gravels are fossiliferous, containing abundant shells of marine molluscs as well as various types of algae (Smith, 1896b; Jardine and Morrison, 1980; Akpan and Farrow, 1984; Boyd, 1986b). From this area also a number of whale (*Balaena glacialis* (Müller) bones have been recovered (Crosskey, 1864; Smith, 1896b; Jardine and Morrison, 1980). The marine sands and gravels are up to 4.5 m thick and comprise a series of ridges with an amplitude between 0.5 m and 2.0 m (Jardine, 1971; Jardine and Morrison, 1980). Wind-deposited sands with interstratified peat lenses rest upon these marine deposits and extend as much as 2 km inland. Abundant Mesolithic and younger artifacts have been found among the sand dunes (Jardine and Morrison, 1980).

Analysis of the contained fauna has allowed inferences to be made about the conditions of deposition. The occurrence of *Pholas* shells in the grey sands at the Great Bend implies that these were exposed in the intertidal zone following

deposition. The overlying 'basal gravel', however, contains faunal elements indicative of deposition in water depths of around 10 m (Akpan and Farrow, 1984; Boyd, 1986b), whereas the upper marine sands and gravels were laid down in sublittoral water (Akpan and Farrow, 1984; Boyd, 1986b).

Further information as to the chronology of events and the local environment during the early Holocene derives from pollen analysis and radiocarbon dating of the Dundonald Burn organic deposits (beds 2, 3 and 4). Boyd (1988) recognized five local pollen assemblage zones in these organic deposits. The basal *Salix–Filipendula–Filicales* zone indicates a period of open vegetation, and was considered to be of Loch Lomond Stadial or very early Holocene age. The next pollen zone is characterized by pollen of taxa which indicate the expansion of sedges and birch and thereafter a pronounced expansion of coryloid pollen, these vegetational changes being typical of the early Holocene in central Scotland. Following the *Corylus* rise there was a period of locally dense Sa/ix-dominated woodland. The final pollen zone was defined on the basis of two samples from an isolated peat fragment in the overlying sands (bed 5), and is characterized by *Quercus, Ulmus* and *Alnus* pollen indicating immigration of mixed boreal forest into the area prior to marine inudation and erosion of the top of the organic horizon. By comparison with other dated pollen diagrams, the *Corylus* rise may be placed at around 9300 BP and the arrival of alder at approximately 7000 BP (Boyd, 1988).

Four separate samples have been radiocarbon dated from the organic beds. The basal 0.02 m gave an age of 9780 ± 90 BP (SRR–382) and the top 0.02 m 8070 ± 70 BP (SRR–381) (Harkness and Wilson, 1979), both of these dates being in agreement with the relative dating based on pollen analysis. Two further samples from within the organic beds, although not so critically placed, are in accord with the other radiocarbon dates: 8950 ± 90 BP (GU–373) (Ergin *et al.,* 1972) from the top 0.05 m of the organic horizon and 9530 ± 150 BP and 9620 ± 150 BP (Q–642) (Godwin and Willis, 1962) from two assays on wood from within the organic horizon.

Two other dates are of relevance. A thin peat layer resting on littoral sands and gravels at 10.4 m OD and overlain by blown sand a few hundred metres to the south-west of the Dun-donald Burn exposure has been dated to 3944 ± 190 BP (Birm–221) (Shotton and Williams, 1971). A biserially barbed point, manufactured from a red deer antler and probably contemporaneous with Mesolithic occupation of the area, was recovered from the bed of the River Irvine approximately 1 km from Dundonald Burn (La-caille, 1954; Jardine and Morrison, 1980) and this has been dated to 5840 ± 80 BP (OxA–1947) (Bonsall and Smith, 1990).

Interpretation

Based on the available information, the following inferences may be made as to relative sea-level change during the early to middle Holocene along this part of the Ayrshire Coast. During the early Holocene, sea level was low, the intertidal zone occurring at around 2 m OD (the *Pholas* bed). Peat accumulated on low ground inland of the coast, as at Dundonald Burn. Thereafter sea level started to rise, this rise continuing until after 8000 BP and probably after 7000 BP. During this transgression, the sands overlying the peat at Dundonald Burn were deposited. At the time of the maximum of the transgression, the basal gravel at the Great Bend was deposited in a water depth of about 10 m, and sand and gravel ridges were built up to an altitude of 12 m OD. During the subsequent regression towards present sea level, the series of sand and gravel ridges were formed in the littoral zone, and aeolian sands accumulated on their surface.

An organic bed in a stratigraphically similar position to that at Dundonald Burn has been reported near Troon, and radiocarbon dates on the top and base of that deposit support the concept of a low early Holocene sea level. The dates are 8015 ± 120 BP (IGS-C14/149) for the top and 9090 ± 320 BP (IGS-C14/150) for the base (Welin *et al.,* 1975).

The Dundonald Burn area is the only location on the North Ayrshire coast at which the Holocene coastal sediments have been studied in detail. The information obtained has revealed complex changes in both the terrestrial and marine environment, particularly during the early to middle Holocene. These changes have been in response to the climatic amelioration at the onset of the Holocene, but most especially to the variations in sea level and the corresponding migration of the shoreline.

A number of other localities in west-central Scotland, such as Linwood Moss (Jardine, 1971) and Girvan (Jardine, 1962, 1963, 1971) have broadly similar records of environmental change but none of these has provided the range of detail

comparable to that in the evidence from the Dundonald Burn area.

Conclusion

The sediments at Dundonald Burn provide valuable evidence for interpreting the sea-level history of the western Central Lowlands. Changes in the coastal environment during early and middle Holocene times (approximately 10,000–6,000 years ago), culminating in the advance of the sea known as the Main Postglacial Transgression (see Silver Moss above), have been revealed by detailed analyses of the sediments and the fauna and pollen that they contain. Dundonald Burn is an integral component in the network of sites for demonstrating Holocene sea-level change.

References