Site 6 Howe of Byth Quarry

Howe of Byth gravel quarry [NJ 839 573] lies at the confluence of a broad north-east trending valley and a meltwater channel orientated north-west to south-east and which now drains the Moss of Fishrie (Map 4). The site, on Sheet 97, is thought to provide evidence of the glaciation of north-east Scotland in both the Late and Middle Devensian (Hall et al., 1995b). The sequence at the site also includes peat of the Late-glacial (Windermere) Interstadial overlain by cryoturbated gravel laid down during the following Loch Lomond Stadial.

The lithostratigraphy of the site was first set up informally by Hall et al. (1995b), but many of the units have been renamed subsequently by Sutherland (1999) in order to adhere more closely to international lithostratigraphical guidelines. As outlined in Chapter 8, the new names have been incorporated into the regional lithostratigraphy only where appropriate (Table 7). The original and new names are given in (Table A1.5) for comparison.

The oldest deposit is the Howe of Byth Gravel Formation, up to 13 m thick (Figure A1.10), which rests on granite, psammite and weathered red arkosic sandstone bedrock. It consists mainly of quartzite cobbles, which show crude subhorizontal bedding and are derived from the local Devonian conglomerates, together with sparse lenses of imbricate pebble gravel and cross-bedded sand. Palaeocurrents were directed towards the south. Brown gravel-rich diamictons, with a silty sand matrix, occur in the upper part of the H owe of Byth Gravel For mation and thicken to the north. In 1997, new sections in the northern part of the quarry showed the unit to comprise up to 8 m of gravel and gravelly diamicton. The beds and lenses of quartzite gravel were discontinuous and 20 to 80 cm thick, dipping gently southwards. The diamicton units were reddish brown in colour and comprised sandy matrix-supported quartzite gravel. Erect pebbles were noted at two locations within these diamictons indicating cryoturbation. The pit had been extended northwards by 1999 and erect pebbles were also observed towards the top of the unit. The gravels could now be seen to occupy a broad depression in the bedrock surface and the lowest beds contained much soft red sandstone similar to the underlying bedrock. The gravels were heavily iron stained with much black 'iron-pan' in the upper 4 m or so. The diamictons were seen to be greenish grey in colour and some of them could be traced for over 200 m southwards.

The Howe of Byth Gravel Formation is interpreted as forming an ice-proximal fan, deposited by meltwater draining southwards, with associated debris flow activity. In the distal parts of the fan, lenses of imbricate gravel and cross-bedded sand suggest formation of ephemeral bars. Although the high-energy, ice-proximal nature of the formation implies that ice was present along the northern coast of Buchan, the only material of nondurable Moray Firth origin observed within it was a single clast of grey mudstone.

Luminescence dating has given ages of 45 ± 4 and 37 ± 4 ka BP for sands within the Howe of Byth Gravel Formation (Hall et al., 1995b). If correct, these imply that the formation is Middle Devensian in age. This is contemporary with the Skjonghelleren Glaciation of western Norway between 42 and 36 ka BP (Larsen et al., 1987) (Figure 43). However, the degree of weathering observed in 1999 may cast doubt on the dating results. Similar developments of iron-pan were present in the gravels at Tillybrex, near Ellon, which are probably pre-Devensian in age (Chapter 8), and have been seen in the oldest gravel unit at Leys, likely to be of OIS 8 age (see below). A problem is that the gravels contain much Old Red Sandstone-derived iron oxide as coatings to clasts. This material is easily mobilised and can give the impression of prolonged weathering. It is noteworthy that the most advanced development of staining and pan is in the proximal part of the fan where Old Red Sandstone material is most abundant in the gravel.

Overlying the Howe of Byth Gravel is the Byth Till Formation. This freshlooking, reddish brown, massive, matrix-supported, silty sandy diamicton is up to 3 m thick, but averages 0.8 to 1 m. Clast lithology is dominated by quartzite, psammite and Devonian sandstone. The Byth Till has a strong west–east clast fabric. The distinctive lithology and fabric suggest that it was deposited by a different ice stream to that from which the Howe of Byth Gravel was derived. The Byth Till is placed in the East Grampian Drift Group and is probably of Late Devensian age.

In the northern part of the quarry, the Byth Till Formation is overlain by up to 3 m of quartzite cobble gravel, the Auchmedden Gravel Formation. In lithology, this unit resembles the Byth Gravel except that it is less weathered. Clast

imbrication suggests deposition by meltwater flowing to the south from an ice front to the north; not obviously that which laid down the underlying Byth Till. The Auchmedden Gravel dates from the deglaciation phase of the last ice sheet, while ice remained to the north of the site.

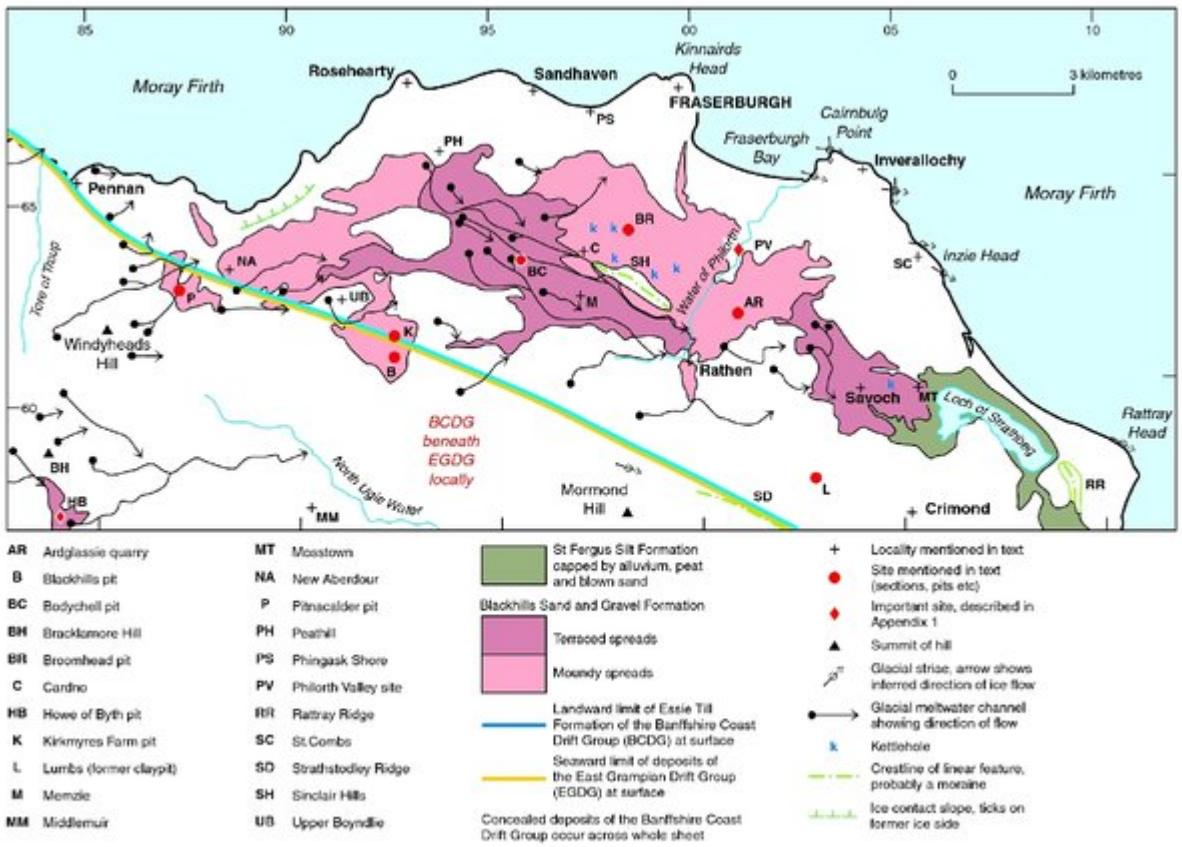
To the south, the Auchmedden Gravel thins and the Howe of Byth Gravel extends close to the surface. The Thinfolds Peat Bed, up to 1 m thick, lies within a shallow basin on the surface of the till. Pollen analysis shows typical Late-glacial (Windermere) Interstadial pollen assemblages. This dating is supported by a radiocarbon age determination of about 11.3 ka BP (SRR–4830) (Table 8) and by luminescence ages of 13 ± 1.4 and 14 ± 4 ka BP. Overlying the peat is a unit of cryoturbated gravel about 1 m thick, the Todholes Gravel Bed, and 1.3 m of Holocene peat (Figure A1.10).

Further notes taken on visits to the quarry in 1999 to 2000 are given in Hall and Connell (2000).

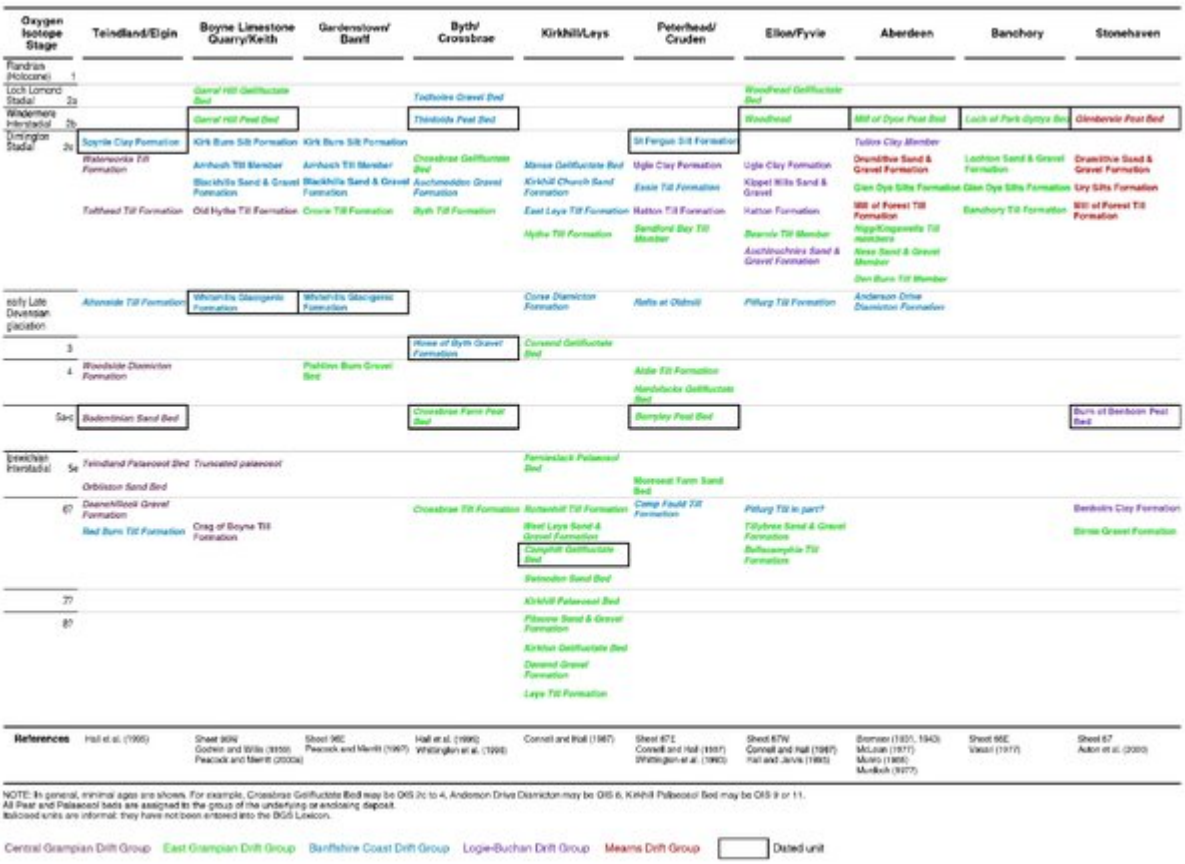
(Table A1.5) Lithostratigraphy at the Howe of Byth.

New name	Old name	Age
Peat (unnamed)	Peat (un-named)	OIS 1
Todholes Gravel Bed (Banffshire Coast Drift Group)	Todholes Gravels	Loch Lomond Stadial
Thinfolds Peat Bed (Banffshire Coast Drift Group)	Byth Peat	Windermere Interstadial
Auchmedden Gravel Formation (Banffshire Coast Drift Group)	Auchmedden Gravels	OIS 2
Byth Till Formation (East Grampian Drift Group)	Byth Till	OIS 2
Howe of Byth Gravel Formation (Banffshire Coast Drift Group)	Byth Gravels	OIS 3 ?

References



(Map 4) Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 97 Fraserburgh.

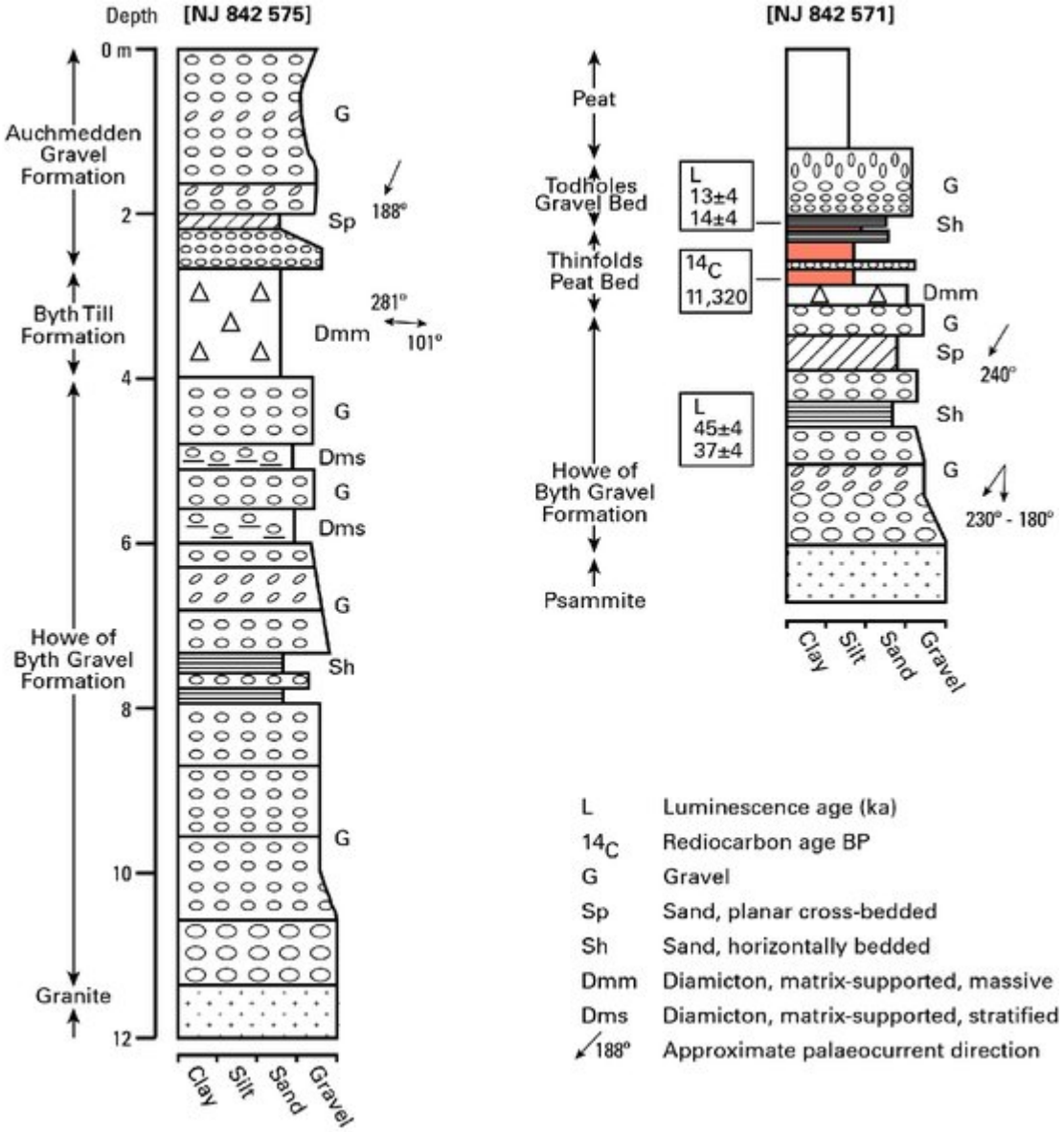


(Table 7) Correlation of lithostratigraphical units in north-east Scotland.

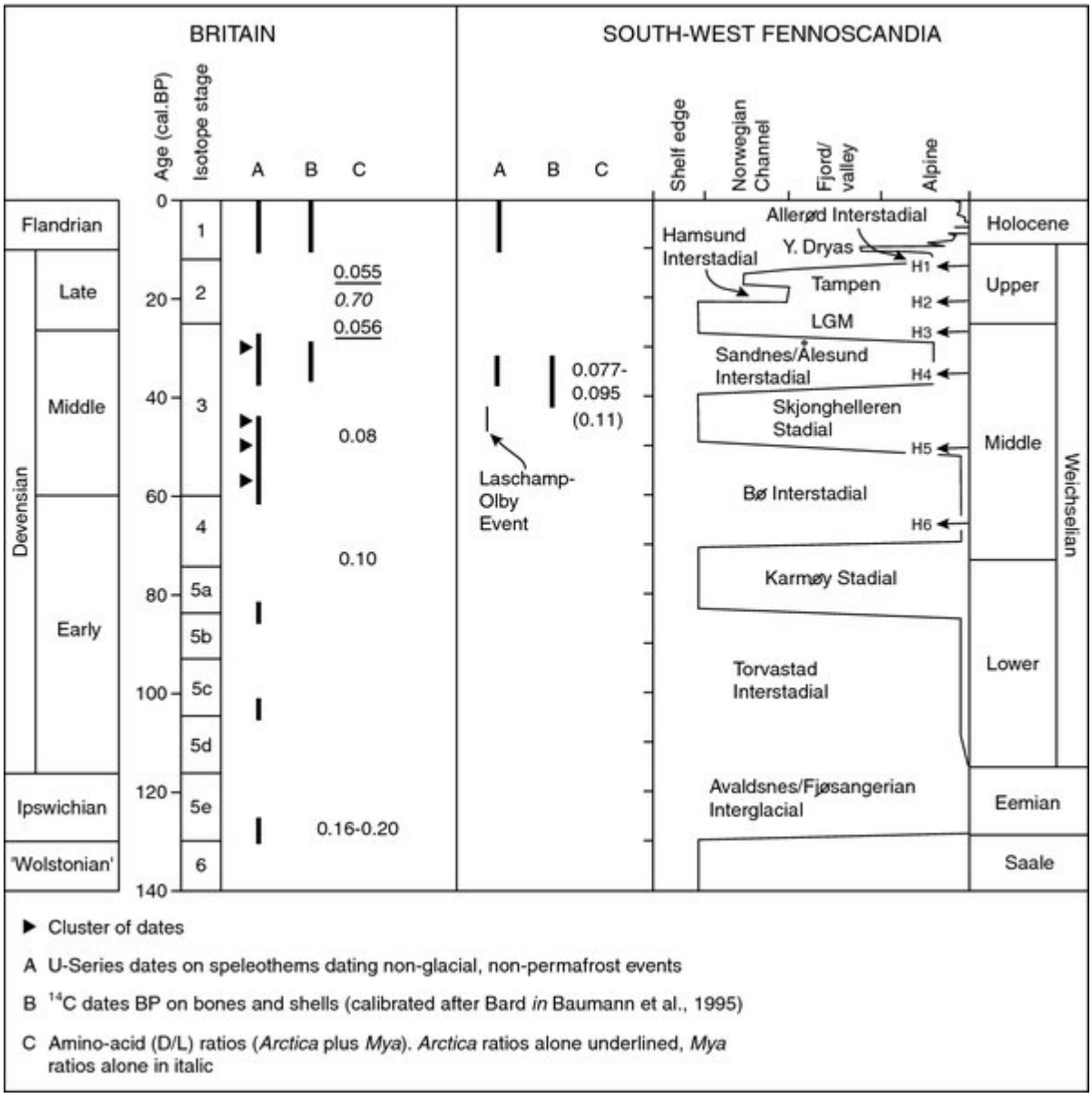
New name	Old name	Age
Peat (unnamed)	Peat (un-named)	OIS 1
Todholes Gravel Bed*	Todholes Gravels	Loch Lomond Stadial
Thinfolds Peat Bed*	Byth Peat	Windermere Interstadial
Auchmedden Gravel Formation*	Auchmedden Gravels	OIS 2
Byth Till Formation†	Byth Till	OIS 2
Howe of Byth Gravel Formation*	Byth Gravels	OIS 3 ?

* Banffshire Coast Drift Group
† East Grampian Drift Group

(Table A1.5) Lithostratigraphy at the Howe of Byth.



(Figure A1.10) Graphic logs and lithostratigraphy of representative sections at the Howe of Byth sand and gravel quarry (after Hall et al., 1995b).



(Figure 43) Devensian—Weichselian events in Britain and south-west Fennoscandia (after Peacock and Merritt, 1997; Sejrup et al., 2000). Norwegian data from Baumann et al. (1995) and Mangerud et al. (1981). D/L amino-acid ratios corrected according to Miller and Mangerud (1985). British data from Baker et al. (1995), Bowen (1989), Gordon et al. (1989), Lawson and Atkinson (1995) and Miller et al. (1987).

Site	Grid reference	Laboratory number	Age (years BP)	Dated material and setting	Reference
Rothes cutting	NJ 277 498	Beta-86532	11 110 ± 70	peat under remobilised till	Appendix 1
Garral Hill, Keith	NJ 444 551	Q-104	10 808 ± 230	peat under remobilised till	Godwin and Willis (1959)
Garral Hill, Keith	NJ 444 551	Q-103	11 098 ± 235	peat under remobilised till	Godwin and Willis (1959)
Garral Hill, Keith	NJ 444 551	Q-102	11 308 ± 245	peat under remobilised till	Godwin and Willis (1959)
Garral Hill, Keith	NJ 444 551	Q-101	11 888 ± 225	peat under remobilised till	Godwin and Willis (1959)
Garral Hill, Keith	NJ 444 551	Q-100	11 358 ± 300	peat under remobilised till	Godwin and Willis (1959)
Woodhead, Fyvie	NJ 788 384	SRR-1723	10 780 ± 50	peat under remobilised till	Connell and Hall (1987)
Howe of Byth	NJ 822 571	SRR-4830	11320	peat beneath gravel	Hall et al. (1995)
Moss side, Tarves	NJ 833 318	I 6969	12 200 ± 170	peat under remobilised till	Clapperton and Sugden (1977)
Loch of Park	NO 772 988	HEL-416	10 280 ± 220	kettlehole infill	Vasari and Vasari (1968)
Loch of Park		HEL-417	11 900 ± 260	kettlehole infill	Vasari and Vasari (1968)
Mill of Dyce	NJ 8713 1496	SRR 762	11 550 ± 80	kettlehole infill	Harkness and Wilson (1979)
Mill of Dyce	NJ 8713 1496	SRR-763	11 640 ± 70	kettlehole infill	Harkness and Wilson (1979)
Glenbervie	NO 767 801	GX-14723	12 460 ± 130	peat under remobilised till	Appendix 1
Glenbervie	NO 767 801	SRR-3687a (humic)	12 305 ± 50	peat under remobilised till	Appendix 1
Glenbervie	NO 767 801	SRR-3687b (humin)	12 340 ± 50	peat under remobilised till	Appendix 1
Brimzieshill Farm	NO 7936 7918	SRR-387	12 390 ± 100	peat under remobilised till	Auton et al. (2000)
Rothens	NJ 688 171	SRR-3803	10 680 ± 100	kettlehole infill	Appendix 1
Rothens	NJ 688 171	SRR-3804	11 640 ± 160	kettlehole infill	Appendix 1
Rothens	NJ 688 171	SRR-3805	11 760 ± 140	kettlehole infill	Appendix 1

(Table 8) Radiocarbon dates from Late-glacial sites in the district.