Site 19 Strabathie

The Late Devensian glaciolacustrine sediments that were formerly exposed at Strabathie sand and gravel quarry, north of Aberdeen, provided rare evidence of the type of sedimentation that took place during the decay of the coastal Logie-Buchan ice stream and retreat of the East Grampian ice sheet. In particular, it indicates that a glacial lake formed, to a height of at least 30 m above OD, ponded between the ice masses as they retreated.

The coastal area north of Aberdeen comprises a belt of ridged hummocky terrain, underlain by a complicated drift succession derived from both the East Grampian ice sheet and Logie-Buchan ice stream (Auton and Crofts, 1986; Aitken, 1991) ((Figure 50), (Map 9)). Simpson (1955) noted a marked lateral and vertical lithological variations in the sequence and interpreted the hummocky features as kames. Synge (1956) interpreted the succession at Strabathie as a series of overlapping fan deltas and noted that deposits forming the ridges locally overlay red laminated clay. The detailed sedimentology at Strabathie was described by Thomas (1984) and Thomas and Connell (1985), who identified four main facies (Table A1.11). Aitken (1991) interpreted the morphology of the ridges, and sedimentary structures within the deposits, as indicating deposition of coarse-grained sediments as a series of subglacial esker, ice-marginal kame and fan delta deposits.

The abandoned sand and gravel pit at Strabathie [NJ 958 135] is located 1 km from the coast and 8 km to the north of Aberdeen. The eastern end of the pit, now a refuse tip, was excavated within a broad easterly trending ridge, standing up to 15 m above the surrounding terrain. The central and western parts of the pit were excavated into an area of low ridges and scattered hummocks. The pit is flanked on its northern margin by a deep meltwater channel; its southern margin is a steep south-facing slope.

Thomas (1984) and Aitken (1991, 1993) both noted that each of the lacustrine facies contained numerous dropstones. They also recorded the vivid red-coloured silt and clay lamination within the fine-grained sediments, and that the diamicton facies was also laminated.

Thomas (1984) proposed that the esker delta facies sediments were deposited by a subglacial meltwater stream that flowed from a tunnel at the base of an overhanging ice margin (Figure A1.23). It debouched directly into an ice marginal lake to the east of an ice front. Coarse-grained sediment was deposited at the tunnel exit and, as the glacier retreated, the sediments built up a ridge of off-lapping delta-fans. Pulsating turbidity currents deposited finer grained sediment away from the ridge, while coarse-grained material was deposited into the more distal parts of the lake from floating ice. The overhanging ice margin eventually collapsed, when the lake water drained away, and the decaying ice released diamicton to cap the proximal lacustrine facies. Aitken (1991) presented a similar interpretation of the sedimentary sequence, but found no evidence for an overhanging ice margin, which he considered would have been inherently unstable. He interpreted the diamicton facies as subaqueous, cohesive debris flows from the ice margin.

The lacustrine facies (2 and 3) at Strabathie contained two types of enigmatic structures (Figure A1.24).

- Planar-based mounds, comprising either poorly sorted, dirty gravel, with bedding dipping away from the axis of the mound, or mounds with 'cores' of stony diamicton passing laterally (away from the mound axis) into poorly sorted gravel. The mounds ranged between 1 and 5 m in width and 0.2 to 2 m in height and were draped by laminated sediments. The contact of the mound material with underlying, laminated, fine-grained sediment was sharp, with only very slight indications of deformation or penetration. Thomas (1984) and Thomas and Connell (1985) reported that these structures were conical in shape. They interpreted these bodies of sediment as resulting from the break-up and capsizing of debris-laden ice-bergs releasing sediment to the lake floor. Aitken (1993) reported that one 'mound' structure took the form of a buried, low hummocky ridge, about 100 m in length. He interpreted the sediments as fan deposits that accumulated at the mouths of glacial tunnels, which, during glacial retreat, formed an elongate cone or series of cones of gravel with opposed bedding (beaded eskers).
- Diamicton infilling isolated troughs and resting disconformably on successions of laminated silts, sands and fine-grained gravels. Thomas (1984) and Thomas and Connell (1985) observe that the sediments underlying the

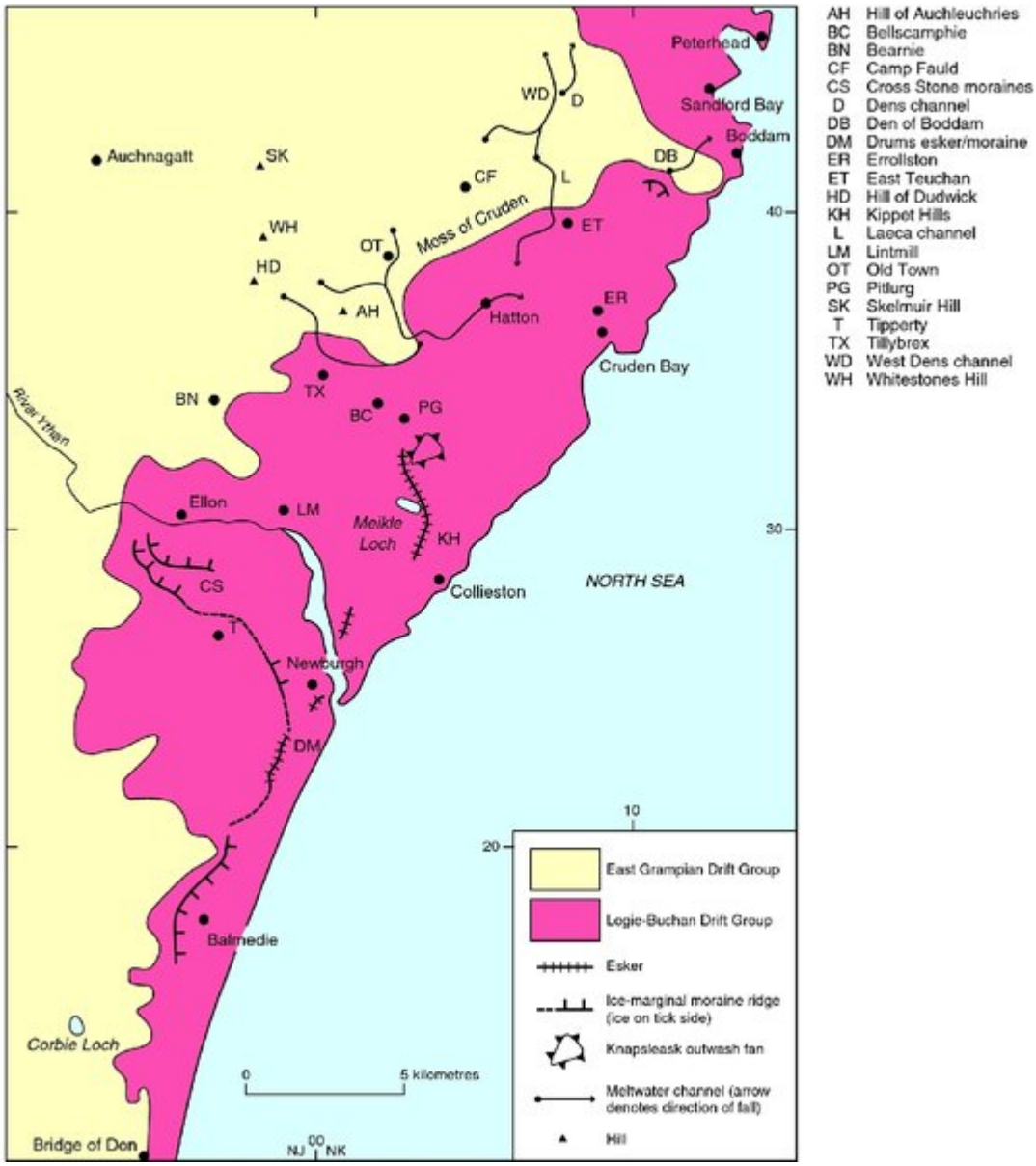
diamicton were downwarped and cut by numerous small-scale, mainly reverse faults. Aitken (1993) did not record any faulting, but noted that the trough fills were indistinctly laminated and showed crude normal grading, marked by concentration of clasts towards the base. Thomas (1984) and Thomas and Connell (1985) interpreted the single trough observed by them, as resulting from grounding and in situ decay of a debris-rich ice-berg, whereas Aitken (1991, 1993) interpreted such features as being the products of cohesive mass flows.

The setting of the glaciolacustrine deposits at Strabathie and their sedimentary structures, suggest deposition in an ice-dammed lake that was ponded between the previously confluent East Grampian ice sheet and Logie-Buchan ice stream offshore The presence of the latter is indicated by the red laminae and red-brown diamictons. The lake at Strabathie was one of a series that formed as the East Grampian ice 'un-zipped' southwards from the coastal ice (Figure 42). The water level in the Strabathie lake would have stood at least as high as 30 m above OD, the height of the mounds at Strabathie pit. If the lake was connected to the sea, as seems probable, and assuming that falling sea levels accompanied deglaciation, the lake must have formed at an early stage in the deglaciation. By analogy with sea level data from the St Fergus site, about 40 km to the north, the ponding at Strabathie probably occurred before 15 300 BP. This is the approximate age of the St Fergus Silt Formation, near Peterhead (Hall and Jarvis, 1989), which were deposited when sea level stood at about 12 m above OD (see Site 11 St Fergus).

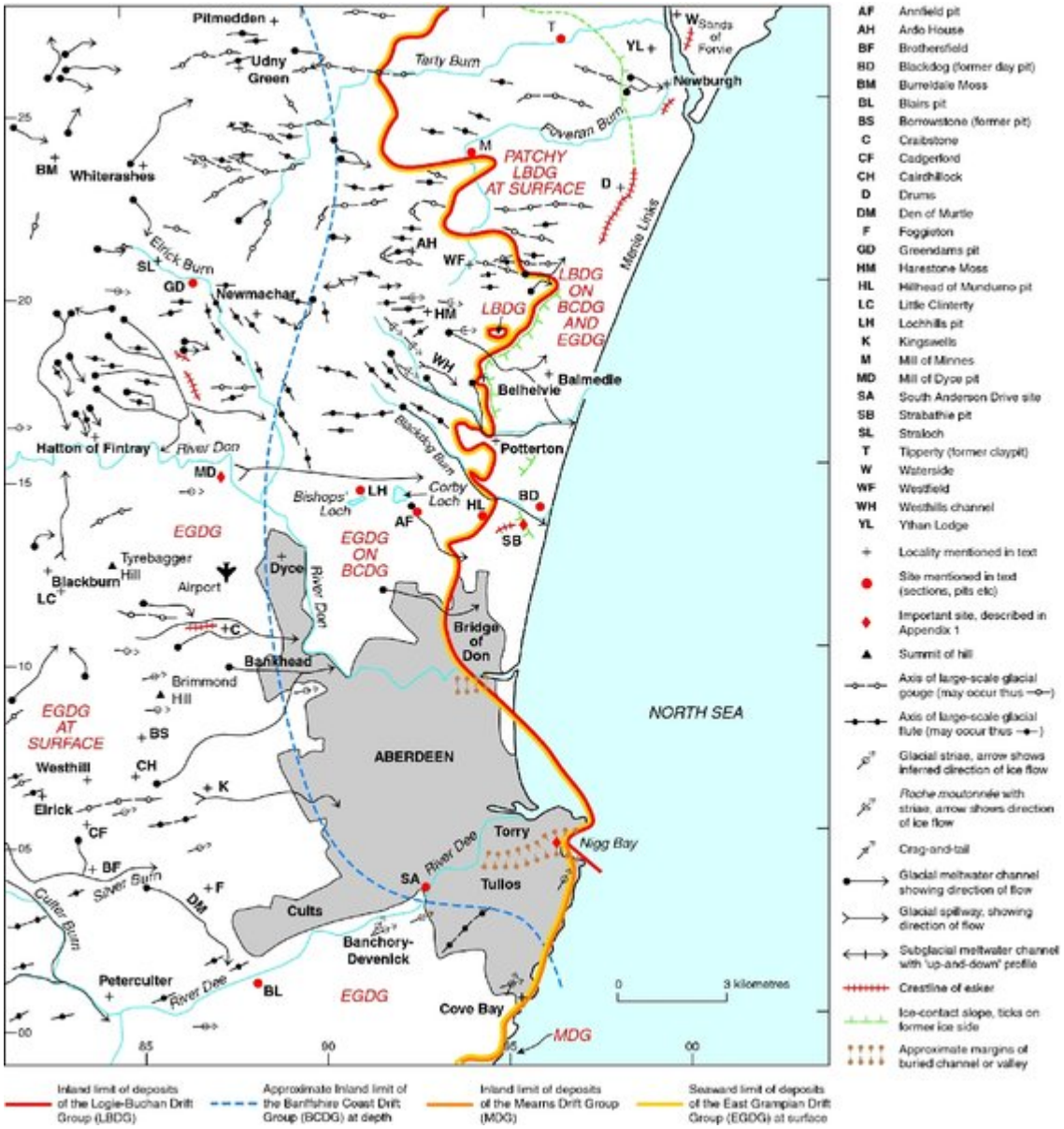
(Table A1.11) Sedimentary facies at Strabathie (after Thomas,1984).

Facies		Description
1	Esker delta	Wide range of coarse-grained sediments with rapid vertical and lateral variations. Deposits include cross- and planar-laminated sand, pebbly sand, and clast-supported pebble, cobble and boulder gravel, all intercalated with lenses and wedges of diamicton
2	Proximal lacustrine	Laminated silt, cross-stratified and massive sand; fine-grained gravel occurring down-dip of Facies 1
3	Distal lacustrine	Laminated and massive clay, silt and sand, interstratified with thin, rhythmic alternations of clay and silt, or silt and sand (passing with transitional contact south westwards into Facies 2)
4	Diamicton	Massive, stony, red-brown diamicton with significant proportions of silt and clay, locally capping the proximal lacustrine facies

References



(Figure 50) Distribution of the Logie-Buchan Drift Group and related features.



(Map 9) Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 77 Aberdeen.

Facies		Description
1	Esker delta	Wide range of coarse-grained sediments with rapid vertical and lateral variations. Deposits include cross- and planar-laminated sand, pebbly sand, and clast-supported pebble, cobble and boulder gravel, all intercalated with lenses and wedges of diamicton
2	Proximal lacustrine	Laminated silt, cross-stratified and massive sand; fine-grained gravel occurring down-dip of Facies 1
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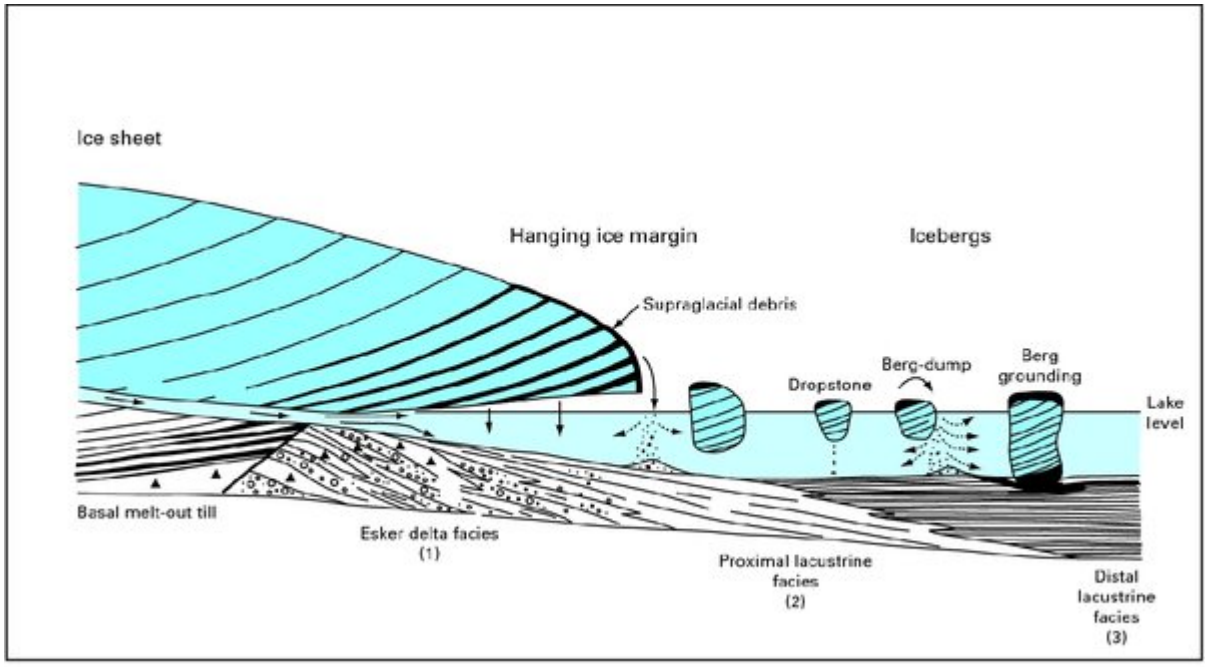
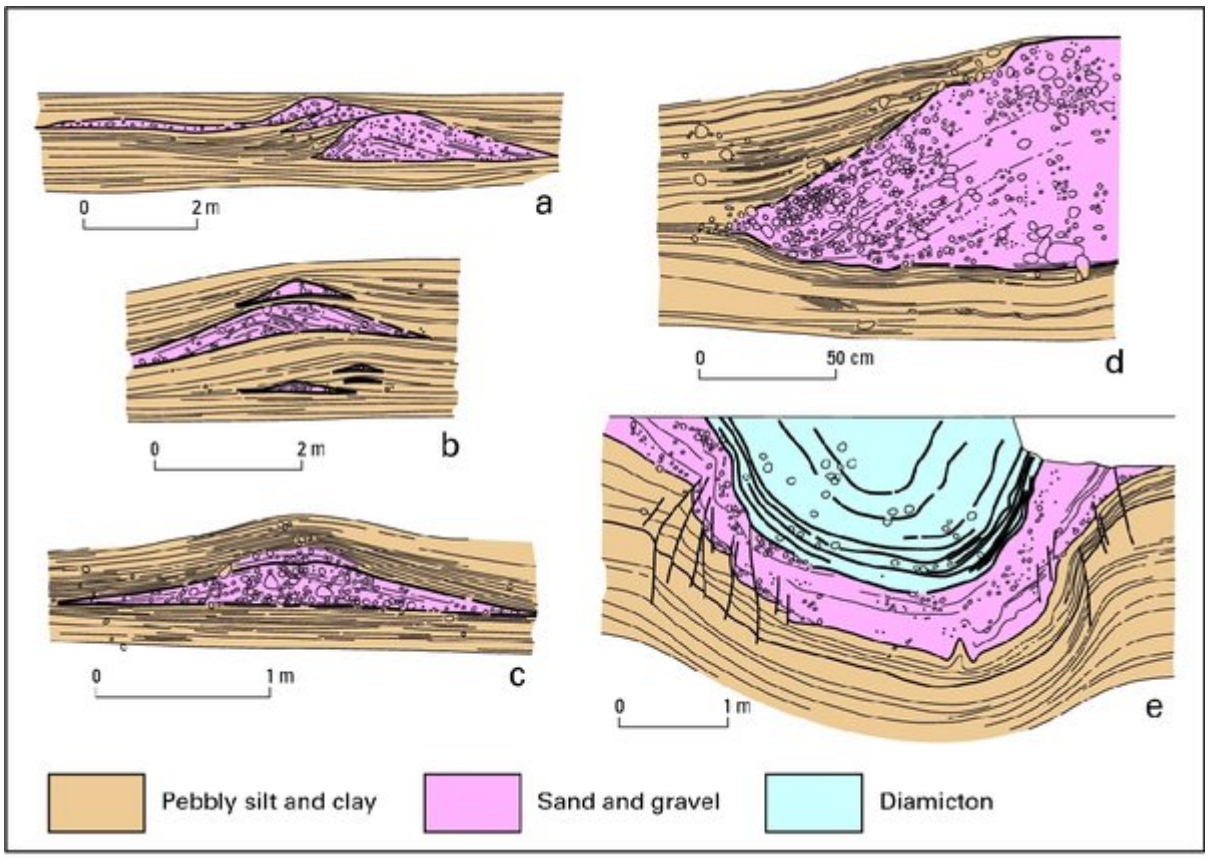
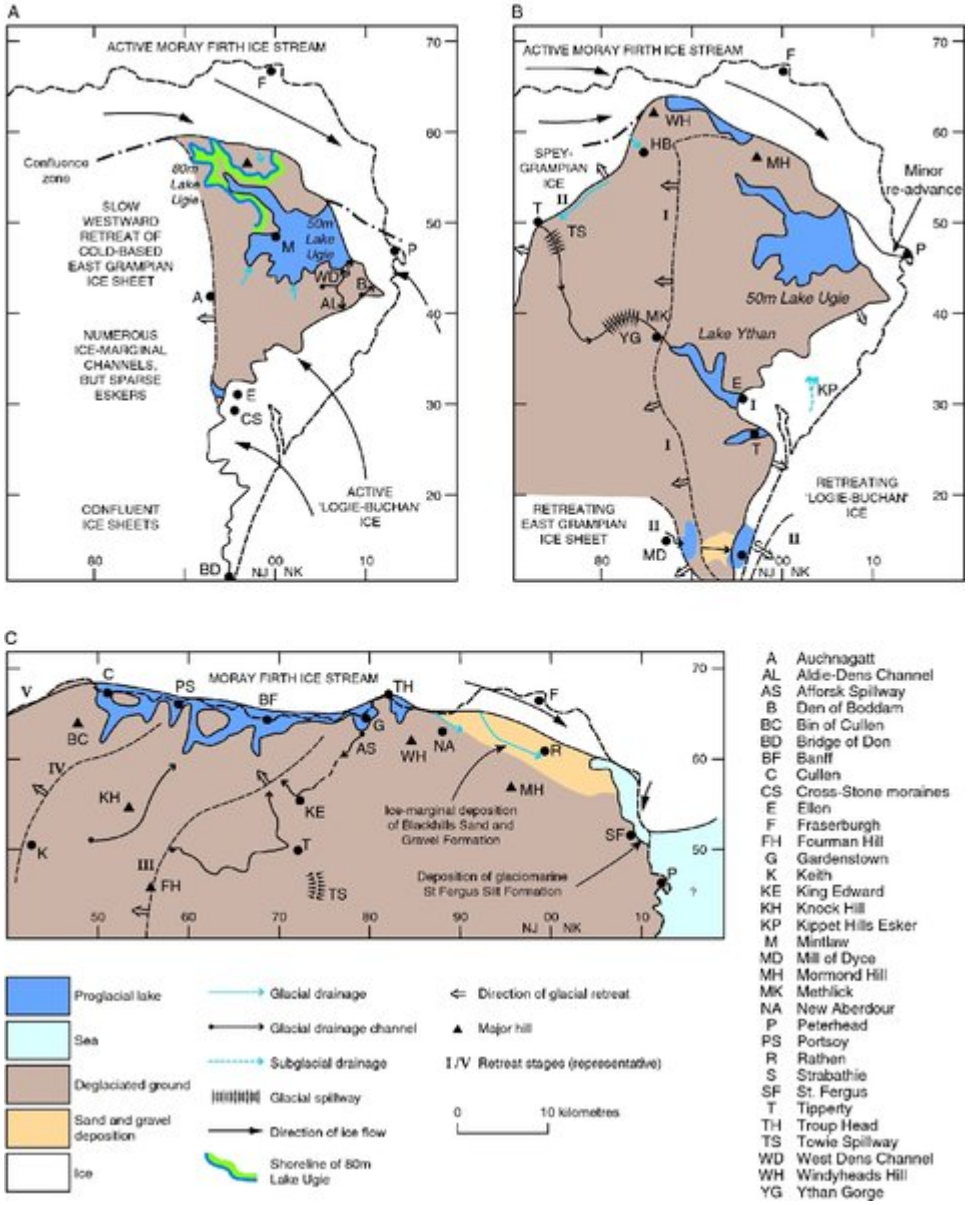


(Figure A1.23) A palaeoenvironmental model of the Strabathie subaqueous esker-delta (after Thomas, 1984).



(Figure A1.24) Iceberg dump and grounding structures at Strabathie (after Thomas, 1984). a—d dump structures; e grounding structure



(Figure 42) Tentative reconstructions of former proglacial lakes in north-east Scotland. a Creation of '50 m' Lake Ugie shortly after the maximum of the second major expansion of the Main Late Devensian ice sheet (after 18 ka BP) and following the earlier ponding of the 80 m' lake. Widespread glacial over-riding of glaciolacustrine deposits occured east of Lake Ugie. b Parting of East Grampian and 'Logie-Buchan' ice with the formation of Lake Ythan. c Diachronous ponding along the Banffshire coast and glaciomarine incursion around St Fergus at about 15 ka BP.