Ugie valley - locality, Cainozoic of north-east Scotland

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Merritt, J W, Auton, C A, Connell, E R, Hall, A M, and Peacock, J D. 2003. Cainozoic geology and landscape evolution of north-east Scotland. Memoir of the British Geological Survey, sheets 66E, 67, 76E, 77, 86E, 87W, 87E, 95, 96W, 96E and 97 (Scotland). Contributors: J F Aitken, D F Ball, D Gould, J D Hansom, R Holmes, R M W Musson and M A Paul.

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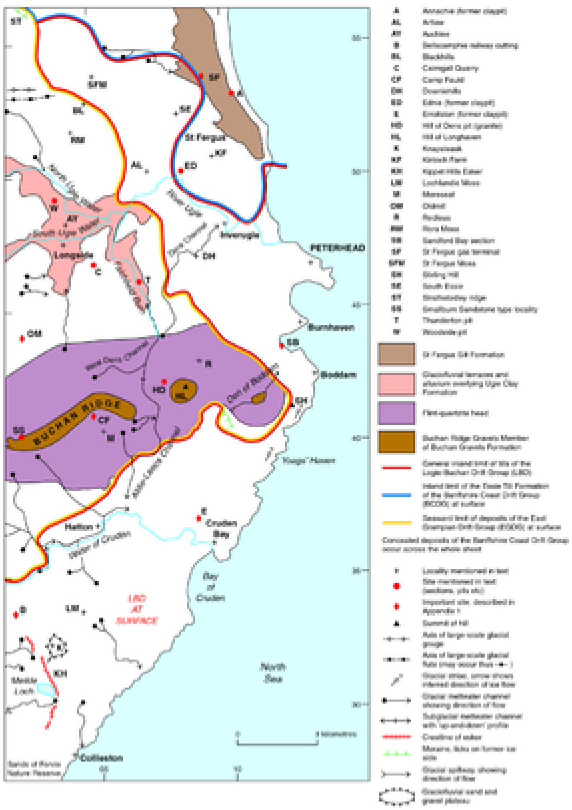
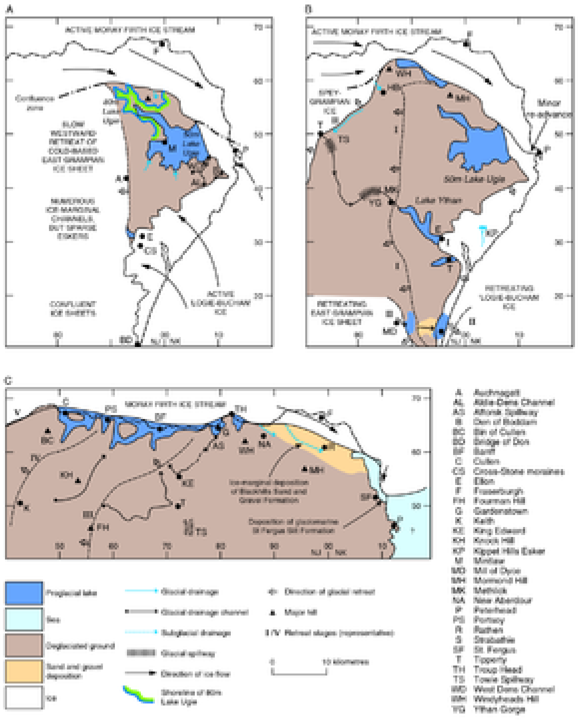
Ugie valley



Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 87E Peterhead. P915377.

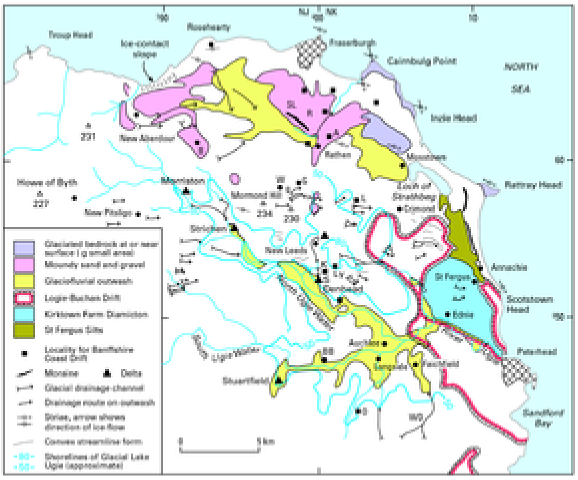


Tentative reconstructions of former proglacial lakes in north-east Scotland. P915289.

Deposits of interbedded red, reddish brown, grey and green silt, clay and fine-grained sand occur widely in the valley of the River Ugie and its tributaries on Sheet 87E (P915377). It is generally believed that the deposits were laid down in a lake (Glacial Lake Ugie), or lakes, that were dammed by ice to the east in the coastal area during the last glaciation (P915289) McMillan and Aitken, 1981; Hall 1984). The complex relationship between periglacial phenomena, deglacial landforms and lacustrine sediments suggests that a significant re-advance of coastal ice occurred, providing important evidence supporting, but not proving, a two-phase Main Late Devensian glaciation.

Lacustrine deposits

The glaciolacustrine deposits (Ugie Clay Formation, Chapter 8) are mostly preserved beneath glaciofluvial terrace gravels at elevations up to 50 m OD. Locally, they reach a thickness of over 17 m and seem to have been derived partly from sediment sources to the west and north, and partly from coastal ice (Peacock et al., 1977; McMillan and Aitken, 1981; British Geological Survey, 1992). At Baluss Bridge (NK 002 470) near Mintlaw (P915312), a bed of organic mud 0.17 m thick interbedded with the laminated silts contains Palaeozoic and Mesozoic palynomorphs, presumably derived from offshore (Connell et al., 1985; Hall and Connell, 1991). The bed lies below flat-bedded terrace sand and gravel some 4 m thick, and is underlain by till and gravel. It can be traced north for some 500 m, where it reaches the terrace surface at about 35 m OD.



Landforms and deposits in and adjacent to the Ugie catchment. P915312.

Though no lake shorelines have been mapped, measurements of the upper levels of the Ugie lake are provided by deltas at elevations of about 80 m and 50 m above OD (P915312). South of Morriston, in the upper valley of the North Ugie Water, eastward-dipping deltaic foresets some 2 to 3 m high were formerly seen in a gravel pit (NJ 915 578) cut into a flat-topped terrace with a surface level slightly over 80 m OD. Near New Leeds, in another gravel pit (NK 002 500), south-westward dipping deltaic foresets, of which 2 to 2.5 m were exposed, underlay thin topset beds that were locally cryoturbated. Spot heights on the delta top are 78 m, 80 m and 84 m OD. The New Leeds delta was fed by glacial meltwater from a shallow channel to the west, and/or from an ice-front that lay a short distance to the east (see below). A near-surface, thin layer of red clay, possibly glaciolacustrine, was observed in 1990 at about 62 m OD in the south-east corner of Leys Quarry.

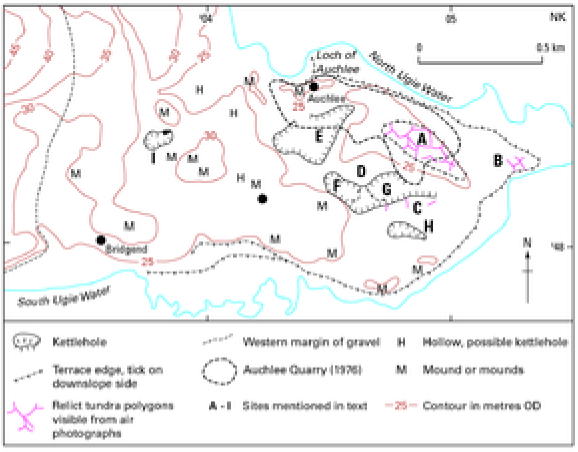
The presence of a lake with a water level a little above 50 m OD is supported by the occurrence of a glaciolacustrine delta with a surface level at 52.5 m OD at Denhead (Figure A1.13; Peacock et al., 1977; Connell, 1984d), where the sediments, disrupted by ice-wedge casts, were carried from glacier ice lying to the north. This delta is perched above a younger meltwater channel, indicating that meltwater from the north continued to enter the lake as its level fell from 80 m to below 50 m. The gravels in the valley of the North Ugie Water at Strichen, and at Stuartfield on a tributary of the South Ugie Water, may also be deltaic deposits related to the 50 m lake, but no supporting evidence is available from the sedimentology. The Stuartfield deposit is large in relationship to the small catchment, suggesting that it was derived from a nearby ice-front.

No exits have been identified for the 80 m and 50 m glacial lakes in the lower Ugie catchment. However, since all the ground towards both the north and east coasts lies below 50 m OD, lakes at this level must have been dammed by coastal ice belonging to the Moray Firth ice stream as well as ice from the south-east associated with the Logie-Buchan Drift Group. Thus both ice-streams were present at the time of formation of the glacial lakes. However, the 80 m lake is likely to have been restricted to the valley of the North Ugie since no associated deposits or landforms occur elsewhere.

A narrow, east-south-east-trending ridge (normally less than 80 m wide), which locally reaches a little over the 55 m contour, extends for nearly 2 km from west of Blackhill (NK 017 568) to near Strathstodley (NK 017 568), straddling sheets 97 and 87E (P915312). Mapping suggests that it is formed of sand, gravel and morainic material (Glentworth and Muir, 1963). Its morphology and composition invite comparison with recessional moraines that were formed in lakes in Glen Spean at the close of the Loch Lomond Stadial (Sissons, 1979). This ‘Strathstodley Ridge’ is interpreted as such a moraine, which was possibly laid down in a small lake co-existing with the 80 m Ugie Lake discussed above. It is likely to have been formed close to the maximum westward limit of the coastal ice at this time.

Terrace gravels and their relationship to the lake sediments

The low glaciofluvial terraces that extend along the valley of the North Ugie Water north of Longside (Figure A1.13; British Geological Survey, 1992) slope gently from about 45 m OD to just below 25 m OD over a distance of about 4 km. Much or all of the terrace deposit, which varies from sand to boulder gravel (Peacock et al., 1977; McMillan and Aitken, 1981), was derived from the north-west as indicated by cross-bedding and the azimuth of palaeochannels seen in former quarries. The contact of the terrace gravels against the till of the surrounding slopes is rarely represented by a marked back feature because of extensive geliflucton of till over the gravel. The gravels overlie red till at the former Ardlow Quarry (NK 073 505), and red silt at Auchlee (P915313) see next. At Dumpston Quarry (NK 029 500), the terrace deposits include numerous boulders of grey granite, possibly Strichen granite, up to 0.5 m across.

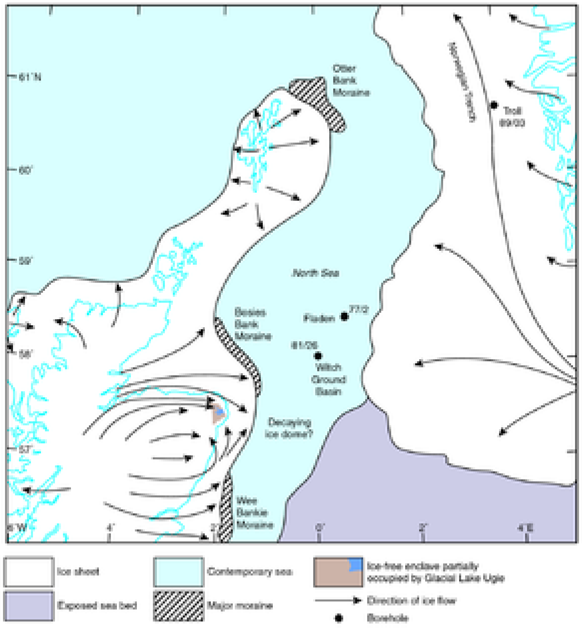


Glaciofluvial deposits and landforms in the vicinity of Auchlee, north of Longside. P915313.

The surface of the terrace gravels is commonly in the form of low mounds and hollows, with a relief of a few metres, similar to those seen formerly in cross-sections in Auchlee quarry. Air photographs taken in 1968 show that the fossil tundra polygons seen at this locality (Clapperton and Sugden, 1977) are mostly restricted to a terrace fragment (A on P915313) immediately to the south of the North Ugie Water, and to remnants of a slightly lower terrace at (B) and (C). Terrace fragment (A) is truncated by a low scarp on its south-western side. The morphology of the elongated depression (D) shows clearly that it is not a river channel. It is believed to be a subsidence feature formed by the melting of a mass of buried ice during climatic amelioration. As such, any tundra polygons would have been destroyed. The three shallow kettleholes (E, F and G), which are partly floored by peat, are interpreted as having formed during the continued melting of the ice that formerly underlay depression (D). Kettlehole (E) is the site of the former Loch of Auchlee, from which the neighbouring farm takes its name, and the other kettleholes in the area, including (H) and (I) were probably also occupied by lochans prior to agricultural drainage.

Exposures seen in the former Auchlee quarry in 1974 showed 1 to 2 m of fine-grained to cobbly gravel overlying a minimum of 3 m of fine- to coarse-grained sand with interbeds (0.1 to 1 m thick) of red, grey and brown silt and clay. The sand, which is known to pass downwards into greyish brown to greenish grey silt (McMillan and Aitken, 1981), is interpreted as a prodeltaic lacustrine deposit that passes upwards into the horizontally bedded braided terrace gravel. Its reddish colour associates it with the deposits of the Logie-Buchan Drift Group lying to the east.

It is envisaged that the glaciolacustrine deposits were overlain by glaciofluvial gravels derived from upstream as the lake level fell. The gravels subsequently became permanently frozen with the formation of tundra polygons, probably prior to the Windermere Interstadial (13 to 11 ka BP) (Ballantyne and Harris, 1994), though Gemmell and Ralston (1984) attributed the formation of the polygons to the Loch Lomond Stadial (11 to 10 ka BP). The thawing of the permafrost could have been associated with the rise in water level to at least 30 m OD following the deposition of the terrace gravels at Faichfield (see below), and would certainly have been completed during the relatively warm interstadial when the ground ice (or relict glacier ice) also disappeared.



Second major expansion of the Main Late Devensian ice sheet. P915291.

In contrast to those at the confluence of the North Ugie Water and the South Ugie Water, the terrace gravels at Faichfield (Figure A1.13) were transported by streams flowing from the Dens channels to the south (Hall, 1984), as shown by the orientation of cross-bedding foresets and palaeochannels. In a former quarry (NK 063 467) where the surface level is about 30 m OD, the gravels were seen to be capped for a distance of some tens of metres by reddish brown laminated silt and clays up to 1.5 m thick (Peacock et al., 1977). The silts and clays are indistinguishable from those below the gravels elsewhere and, unless they are overbank deposits, suggest that there was a rise in water level following deposition of the fluviatile or glaciofluvial gravel. Such a rise could have been caused either by the re-establishment of an ice-dammed lake with a water level close to 30 m OD, or by a marine incursion following a relative rise in sea-level. The latter is thought improbable as the highest raised beaches in the vicinity stand at 15 to 16 m OD in the vicinity of St Fergus (see below). The reestablishment of the lake is more likely to be the result of a significant glacial re-advance of one or both of the coastal ice streams. Supporting evidence includes the record at the former Ednie clay pit (NK 085 502), where red deposits enclosed irregular masses (possibly rafts) of dark grey till, dark blue clay and sand, the latter two items possibly derived from overridden lacustrine deposits (Wilson, 1886; BGS records). The timing of such a re-advance is unknown, but it is tempting to suggest that it followed the cold interstadial between about 22 and 18 ka BP, recognised in the northern North Sea basin (Sejrup et al., 1994, 2000) and correlates with the subsequent Dimlington Advance (Eyles et al., 1994) after 18 ka BP (P915289,P915291).

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