Site 11 St Fergus

Interest in the Quaternary deposits around St Fergus, 6 km north-west of Peterhead (Map 7), began in the mid-19th century following the discovery of an apparently in situ arctic marine fauna (Jamieson, 1858, 1906). It occurred in a stoneless grey clay exposed in a former brick pit close to present sea level near Annachie [NK 105 532] (Figure A1.15). Similar deposits were subsequently encountered in BGS boreholes drilled to the east of the village (McMillan and Aitken, 1981) and in site investigations and construction works at the gas terminal from 1980 onwards. The dominantly massive, very dark grey to dark greenish grey, calcareous silts containing shelly horizons were described and named as the St Fergus Silts by Hall and Jarvis (1989). The unit is named formally here as the St Fergus Silt Formation of the Banffshire Coast Drift Group (Chapter 8; (Table 7)). Early geomorphological work in the area by Walton (1956) and Donner (1963) indicates the presence of raised beach deposits in the area to heights of up to about 30 m above OD, but the most prominent feature was reported at about 15 m OD.

St Fergus Silt Formation occurs on sheets 87E Peterhead and 97 Fraserburgh where it is overlain mainly by alluvial deposits, including peat and lacustrine silt, which mark the site of a former freshwater loch (Anderson *in* Scott, 1890), and by blown sand (Glentworth and Muir, 1963). The formation probably extends to the north of the Loch of Strathbeg (Figure A1.13) where grey plastic clays have been recorded (Wilson, 1886). Dark grey sandy silts and clays are also widespread beneath terraced glaciofluvial sand and gravel deposits in the vicinity of Savoch [NK 047 588] and dark grey silts occur at 9 m above OD at Coralhill [NK 061 607]. The southern boundary of the formation is obscured by thick surface peat and/or organic mud, but probably lies immediately south-east of St Fergus village. To the west, the St Fergus Silt Formation is bounded by a till slope and a Late-glacial raised beach at about 16 m OD, whereas to the east, the deposits locally form the backslope of the abandoned Postglacial (Flandrian) cliff (Figure A1.15).

The dark grey silts, clays and fine-grained sands of the St Fergus Silt Formation form a generally coarsening upwards succession (Peacock, 1999) with a maximum reported thickness of about 16 m above (McMillan and Aitken, 1981). The surface level is generally 7 to 10 m, but locally up to 16 m above OD adjacent to a low ridge that borders the outcrop to the north of Annachie Bridge [NK 105 531] (Figure A1.15) and extends towards Rattray Head. Exposures of faulted, tilted and deformed masses of bedded silt and sand in the ridge led Hall and Jarvis (1989) to interpret the feature as a (push) moraine formed by a re-advance of ice from the east or north-east. This conclusion is supported by borehole evidence that indicates that the St Fergus Silt Formation passes under, and is therefore mainly older than the moraine feature. If correct, the surface level of the formation in the vicinity of the ridge is likely to be anomalous due to proglacial glacitectonic disturbance. A cutting through the cliffline backing the Flandrian raised beach at Pittenheath [NK 104 554] also revealed faulted, tilted and sheared masses of bedded sand and black clay.

Another low north-trending ridge is cut by the cliffline just to the north of St Fergus village [NK 097 522]. In 1990, the ridge was observed to consist of planar and ripple bedded sand with thin beds of gravel and red diamicton and local 'streaks' of grey clay and clayey sand. The sequence is folded into a gentle anticline trending parallel to the ridge and is down-faulted to the east locally. The ridge is draped and flanked by reddish brown diamicton. The folding may either have been associated with the advance that formed the other ridge at St Fergus, or an earlier incursion of the 'Logie-Buchan' ice stream.

Shell fragments have been reported from many boreholes, and the presence of dropstones (gneiss, chalk and red sandstone) suggests either a proximal glaciomarine environment or a situation in which stones were ice-rafted by sea ice from a nearby shore (compare with Peacock et al., 1978).

Ice flowing out of the Moray Firth probably eroded the chalk fragments from Upper Cretaceous strata that crop out on the sea floor to the north of Fraserburgh. In excavations west of Annachie Bridge, the deposits consist of both massive and laminated calcareous silts over 5.8 m thick with dropstones up to cobble size (Hall and Jarvis, 1989). Here the St Fergus Silt Formation is underlain by dark grey diamicton also with erratics of chalk and granite.

In excavations at a locality [NK 1023 5285] west of Annachie Bridge, Hall and Jarvis (1989) reported the occurrence of a shell bed at 4.6 m depth. It was formed entirely of valves, mostly paired and unabraded, of *Hiatella arctica* together with low concentrations of the cold water foraminferid *Elphidium excavatum* forma *clavata*. Previously, a poorly preserved boreo-arctic assemblage including the bivalves *Hiatella arctica* and *Yoldiella* sp. and the ostracods *Roundstonia globulifera* and *Cytheropteron montrosiense* had been recovered from the former clay pit at Annachie (Jamieson, 1858, 1865; Brady et al., 1874). However, it seems likely that temperate species in the fauna, such as the bivalve *Thyasira ferruginea*, have either been misidentified, or have been reworked from older sediments during the formation of the moraine (Peacock, 1999). The faunal distribution and the general coarsening-upwards sequence perhaps indicate shallowing and a reduction in the rate of sedimentation through time. The *Hiatella* bed has yielded adjusted radiocarbon ages of 14 915 ± 205 BP (Lu–3028) (Hall and Jarvis, 1989) and 14 345 ± 65 BP (Beta-101953), though these figures are regarded as approximate (Peacock, 1999). Additionally, D/L amino-acid ratios of 0.071 (Lond–584) (mean, SD 0.005, n=9) have been obtained on *Hiatella arctica* from the same excavation (information from G Sykes). These ratios are commensurate with a Middle or Late Devensian age.

The position of the St Fergus Silt Formation within the local stratigraphy is difficult to ascertain because it rests on a variety of older deposits. The records of commercial boreholes associated with the St Fergus Gas Terminal suggest that the formation overlies an undulating surface of greyish brown or green clayey diamicton. Although the clasts in these diamictons are mainly of local igneous and metamorphic lithologies, in at least one borehole [NK 095 545] the weakly calcareous, very dark greyish brown (2.5 Y 3/2) sandy silty clay matrix contains a rich dinoflagellate flora. Possible Late Jurassic to Early Cretaceous cysts were obtained together with some Quaternary forms (information from R Harland, 1980). A provenance either from the north-west in the Moray Firth, or from the north-east to east in the western North Sea is indicated. In a borehole near North Blackwater [NK 100 537], the St Fergus Silt Formation is reported to rest on reddish brown diamicton (presumably Logie-Buchan Drift Group) that in turn overlies greyish green till. In another borehole immediately east of Annachie, red till is reported to overlie grey till, but to be capped by dark grey till (McMillan and Aitken, 1981). Both records suggest that Logie-Buchan Drift Group deposits could be locally present below the St Fergus Silt Formation. On the south-eastern side of the gas terminal, probably close to the former North Blackwater Farm [NK 100 537], the St Fergus Silt Formation is reported to rest on dark shelly till with chalk erratics (Hall and Jarvis 1989). Similar dark diamicton with chalk fragments and numerous erratics of granite, probably derived from the local, but unexposed, St Fergus Granite, has been seen in spoil heaps towards the sea. Wilson (1886) recorded a dark coloured till containing supposed Old Red Sandstone flagstone and marl erratics in the St Fergus area and an erratic of ooidal sandstone at Pittenheath [NK 100 550].

The back feature of the Late-glacial raised beach located on (Figure A1.13) stands at just under 15 m above OD [NK 093 529] and is fronted by a platform up to 120 m wide. The platform is underlain by sand and gravel that passes seawards into silt. The latter is possibly the uppermost part of the St Fergus Silt Formation, which implies that the two deposits are roughly contemporaneous. The sand and gravel is disposed as 'herring bone' sets of cross-beds, suggesting intertidal deposition.

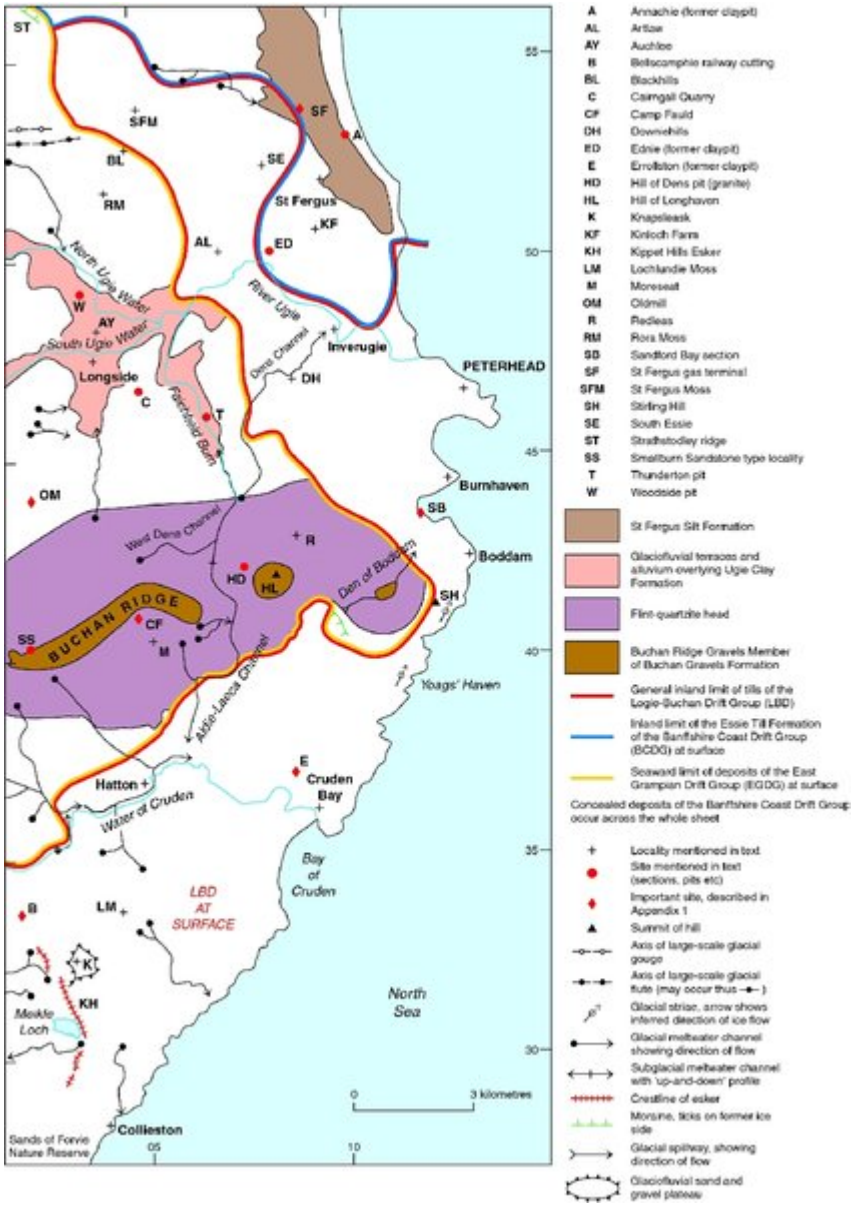
Discussion

Most of the molluscan fauna in the St Fergus Silt Formation would not be out of place in a glaciomarine setting and the adjusted radiocarbon ages between 14 ka and 15 ka BP on shells of *Hiatella arctica* fall within a period when high-arctic faunas lived in the northern North Sea (Sejrup et al., 1994; Peacock, 1995). This poses a problem, however, because raised beaches and raised marine deposits generally have been assumed to be absent in peripheral areas of eastern Scotland on theoretical grounds that the contemporary sea level was below OD (Sissons, 1976; Lambeck, 1995). Much more ice must have been present in the vicinity, both onshore and offshore in the North Sea basin. The isolated occurrence of the St Fergus Silt Formation may be explained if, apart from the St Fergus area, much of the coastline of north-eastern Buchan east of Troup Head and north of Aberdeen was ice covered until relative sea level had fallen close to or below its present level.

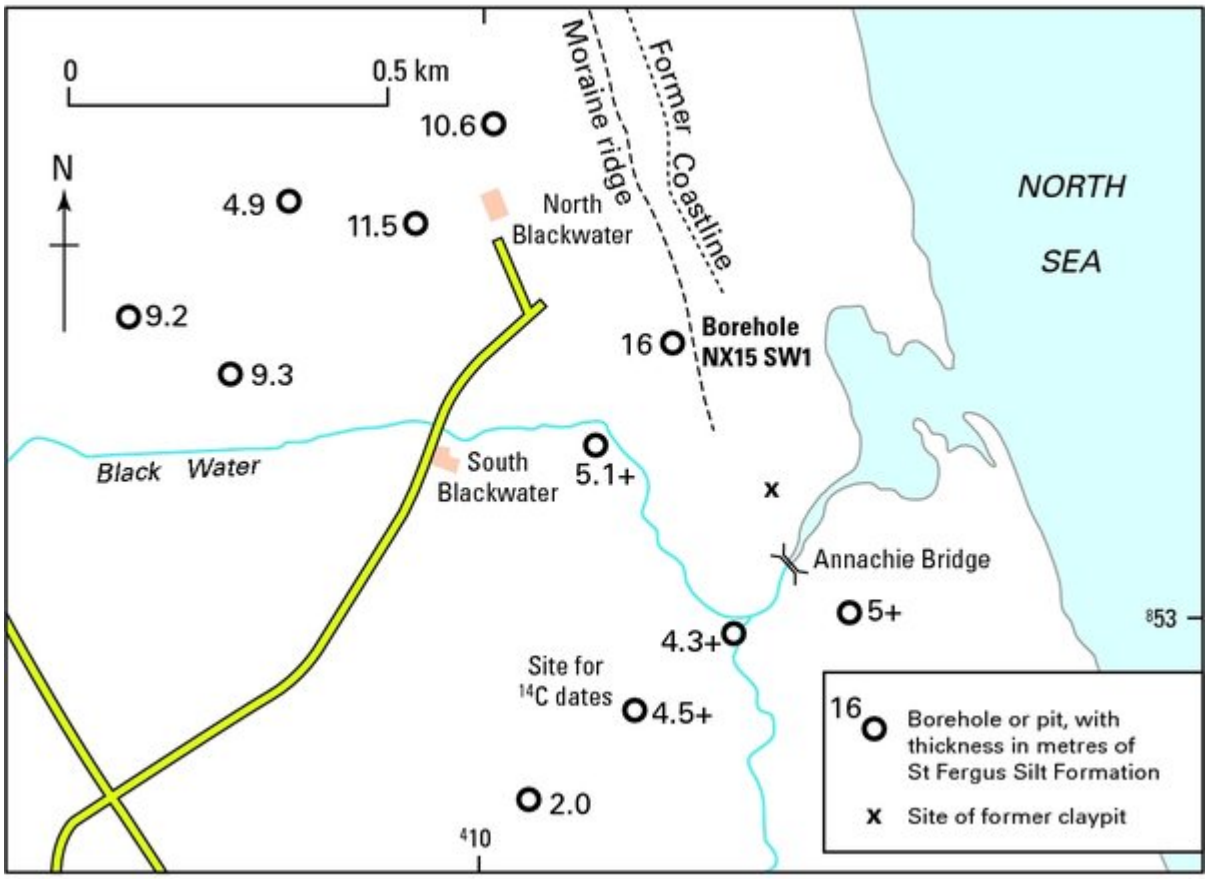
The surface level of the St Fergus Silt Formation and the height of the supposed raised beach backing it, imply a marine transgression to a mean sea level of at least 12 m above OD and therefore considerable glacio-isostatic depression at

about 15 ka BP (Peacock, 1997). This is taken as supporting evidence for total ice cover in Buchan during the Main Late Devensian glaciation (Hall and Bent, 1990) and for coalescence of the Scottish and Scandinavian ice sheets during at least an early phase of that glaciation (Sejrup et al., 2000) (Figure 41), (Figure 44).

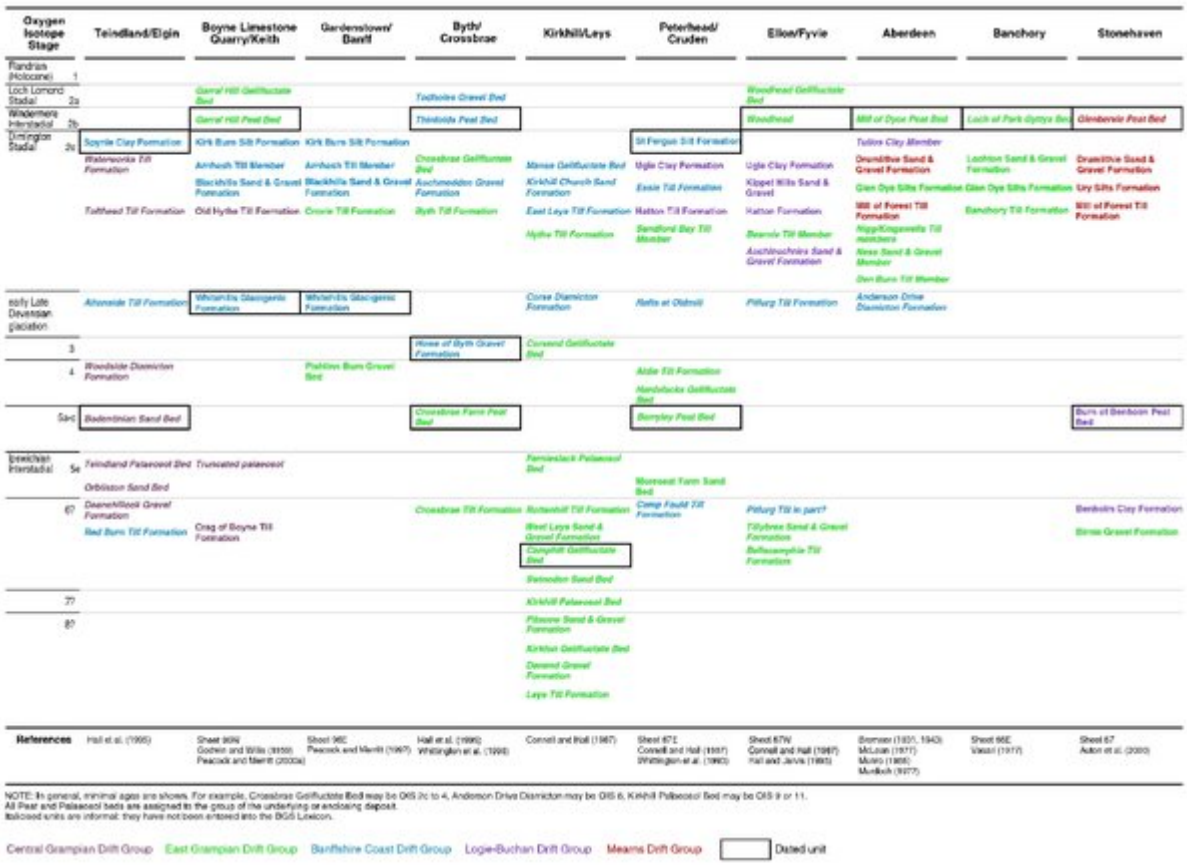
References



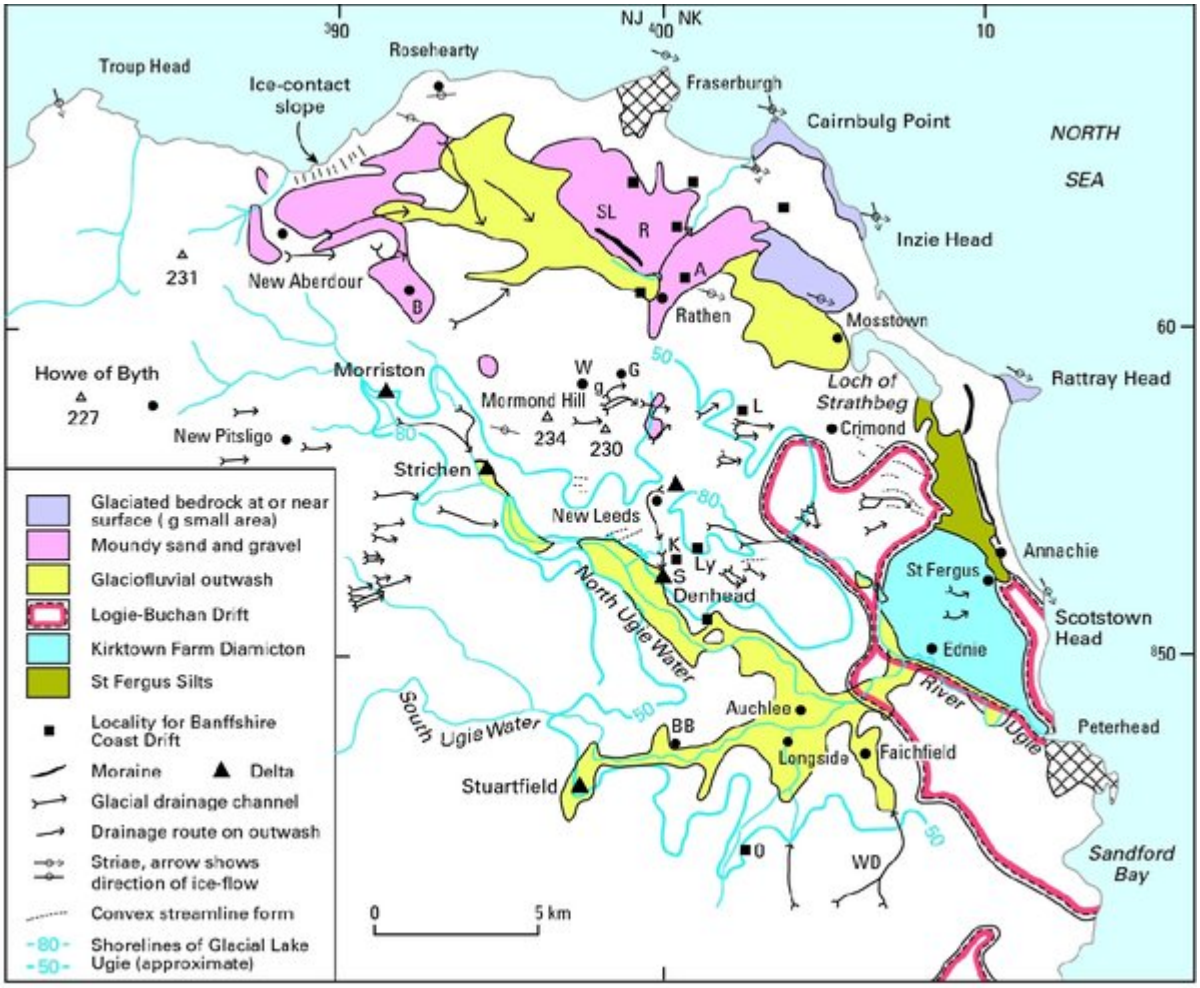
(Map 7) Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 87E Peterhead.



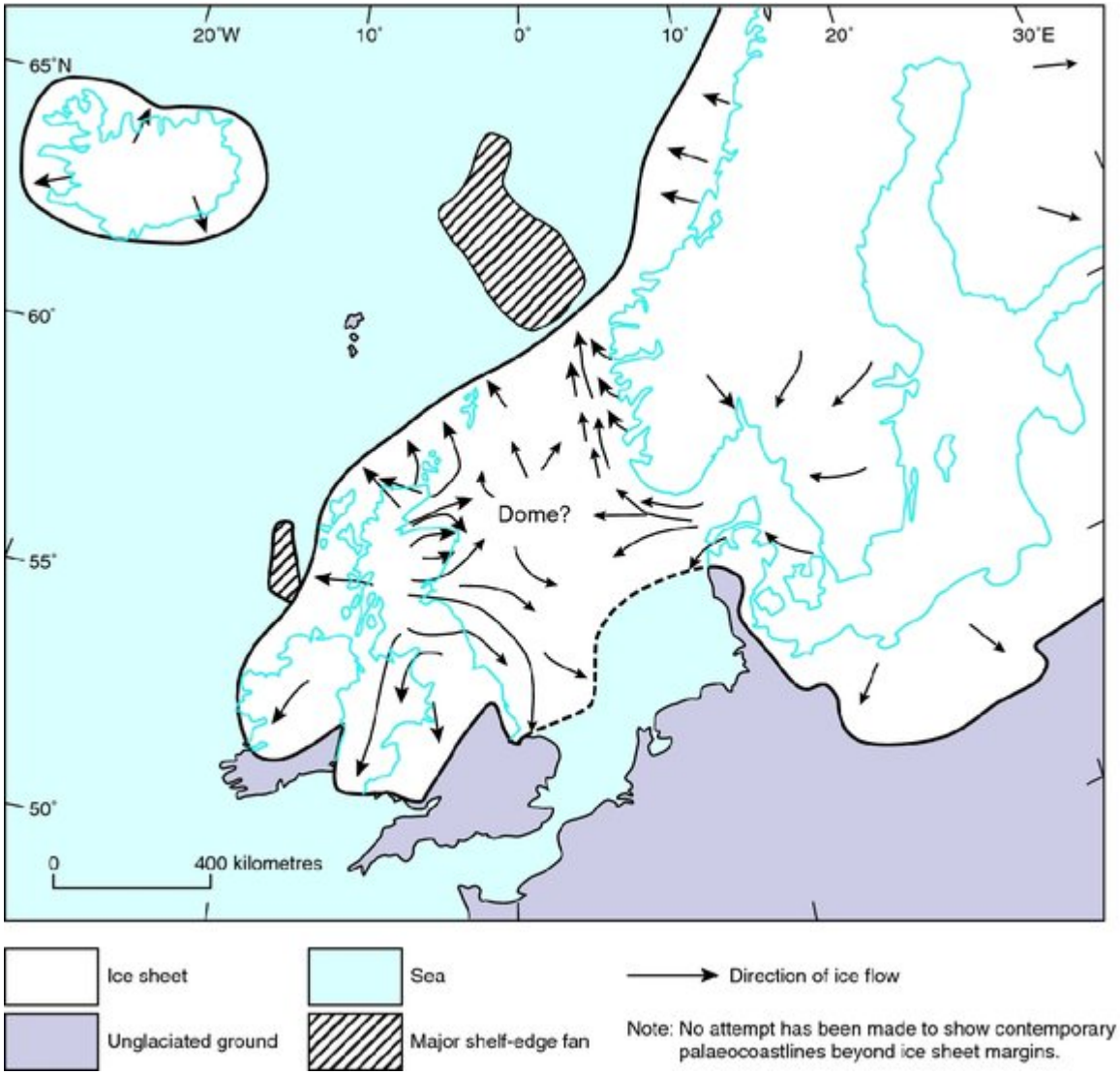
(Figure A1.15) Localities at St Fergus (after Peacock, 1999). See (Figure A1.13) for general location of the St Fergus Silt Formation.



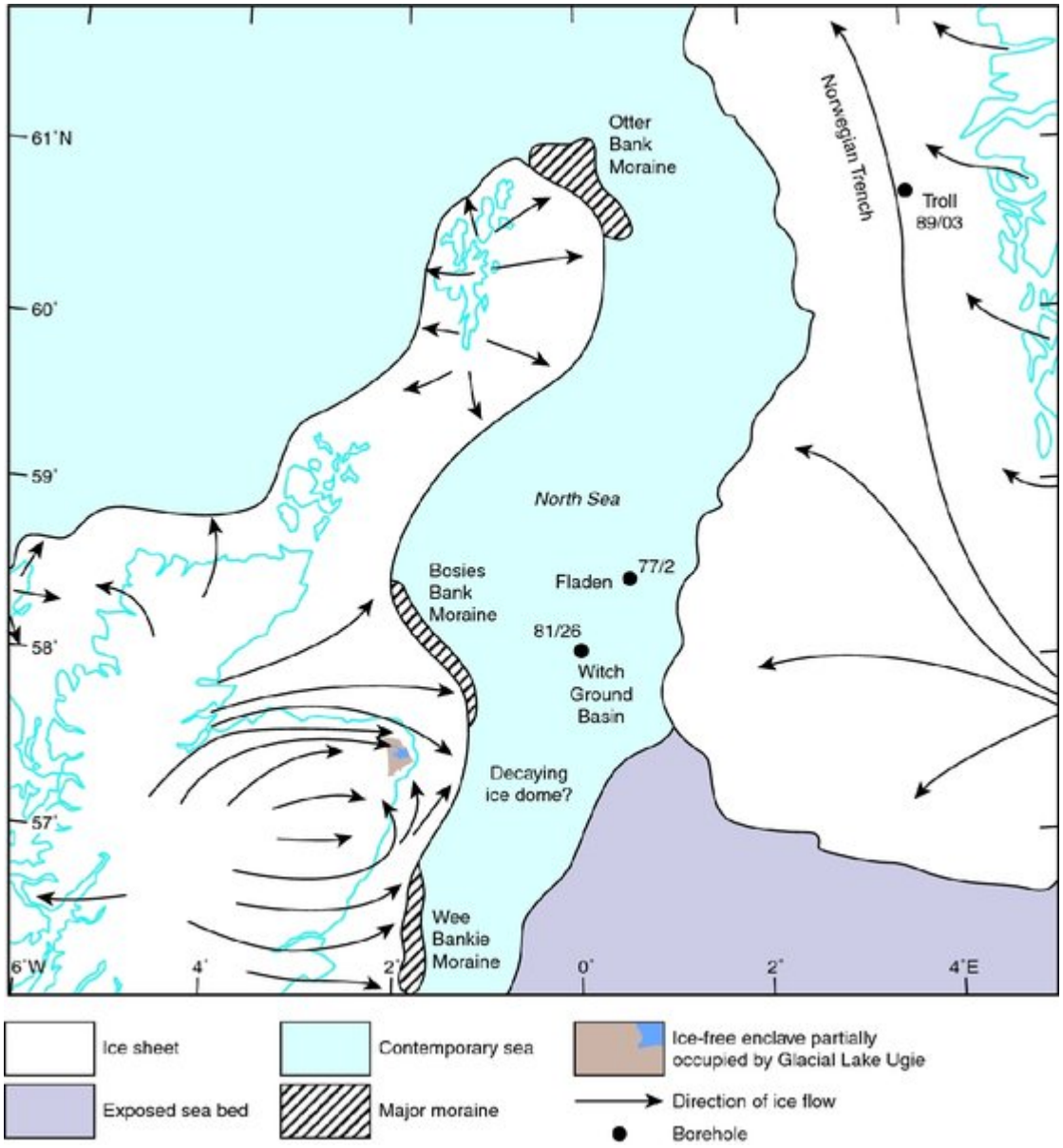
(Table 7) Correlation of lithostratigraphical units in north-east Scotland.



(Figure A1.13) Landforms and deposits in and adjacent to the Ugie catchment. A, Ardglassie; B, Blackhills; BB, Ballus Bridge; G, Greenhill; K, Kirkhill; L, Lumbs; Ly, Leys; O, Oldmill; R, Red Loch; SL, Sinclair Hills; W, Upper Waughtonhill; WD, West Dens channel.



(Figure 41) Reconstruction of the maximum extent of the Main Late Devensian—Weichselian ice sheets (28—22 ka BP) showing possible location of former ice streams (modified from Sejrup et al., 2000).



(Figure 44) Tentative reconstruction of ice margins at the maximum stage of the second major expansion of the Main Late Devensian ice sheet (after Hall and Bent, 1990 and Sejrup et al., 1987). This stage is correlated with the maximum of the 'Dimlington Advance', 18.5—15.1 ka BP (Sejrup et al., 1994).