Site 15 Ellon, Bellscamphie

In the Leask area, to the north-east of Ellon, there are three lithologically distinctive till units belonging to each of the main drift groups in the region (Map 6) (Map 7). Two of these tills may predate the Late Devensian. Several sites, including 'Bellscamphie', provide evidence of the pattern and timing of movement of three major ice masses affecting eastern Buchan (Figure 50).

In 1906, T F Jamieson described several localities in the Ellon area at which a distinctive shell bearing 'indigo boulder clay' was found underlying younger glacial and glaciofluvial deposits (Figure A1.20). Jamieson regarded the 'indigo boulder clay' as the oldest glacial deposit in the Ellon area and suggested deposition by ice moving from the Moray Firth. All of Jamieson's original sections have long been obscured (Hall and Jarvis, 1993b). Recent investigations, notably a programme of shallow pitting, have led to a revision of the glacial stratigraphy in this area (Hall and Jarvis, 1993b; Hall and Jarvis, 1995).

Lithostratigraphy at Bellscamphie and Pitlurg

Mechanical excavations into the sides and floor of the abandoned railway cuttings at Bellscamphie [NK 019 337] and Pitlurg [NK 021 346]

(Figure A1.20) have shown the existence of four lithostratigraphical units (Table A1.9). The nomenclature set up by Hall and Jarvis has been formalised here and extended. It does not follow that set up by Sutherland (1999), who replaced the Bellscamphie Till with the Elton Till (presumably Ellon Till).

Bellscamphie Till Formation

The oldest unit identified is the Bellscamphie Till, which rests on Ellon Gneiss. It is massive, overconsolidated and the clasts, which are mainly subangular, are dominated by psammite derived from local sources. Flint clasts are conspicuous and were very probably transported from outcrops of the Buchan Ridge Gravel Member to the north and north-west, especially as the clay mineralogy of the till matrix is dominated by kaolinite. Sparse palynomorphs of probable Mesozoic age also have been recovered from the matrix of this till.

Pitlurg Till Formation

This unit is equivalent to Jamieson's 'indigo boulder clay' and overlies either the Bellscamphie Till or bedrock. The slightly calcareous clay-silt matrix of the diamicton is massive and overconsolidated with varied clay mineralogy. Palynological preparations of the matrix (information from W Braham, Hemel Hempstead, Herts, 1990) have yielded rich assemblages of late Oxfordian to Ryazanian dinoflagellate cysts indicating a provenance for the dark grey clay matrix in the Kimmeridge Clay Formation of the Moray Firth. Other components of Callovian and mid-Barremian age would also support a north-north-west to north-west provenance. Clast lithologies include large proportions of dark mafic igneous and metamorphic rocks. Small numbers of red-brown sandstones of Devonian or Permo–Triassic age, together with a distinctive white (possibly) Mesozoic sandstone, could have been derived either from the north, or from the bed of the North Sea to the east. At Pitlurg, the Till shows a weak north–south fabric (Hall and Jarvis, 1995).

Very sparse, small, abraded shell fragments are present in the till. Amino-acid D/L ratios of shell in the Pitlurg Till at Bellscamphie are 0.272 (LOND–590) and 0.212, 0.101 (LOND–589). The range of ratios indicates a mixed population of shells of different ages. Correlation of the *Arctica* sp. ratios with the D/L sea level events recognised by Bowen and Sykes (1988) indicates that the shells are of OIS 7 age or younger, with the single D/L ratio of 0.101 indicating an age equal to, or younger than, OIS 5e.

Kippet Hills Sand And Gravel Formation

The clast composition of the Kippet Hills Sand and Gravel Formation includes psammite similar to that found around Collieston. Distinctive components of

the assemblage are limestones/dolomites and mudstone clasts of Permian and Neogene age and possibly also Mesozoic provenance. These lithologies indicate transport from the bed of the North Sea to the south and east (see Site 16 Kippet Hills, Slains).

Hatton Till Formation

The distinctive red-coloured Hatton Till rests with a sharp planar contact on underlying units. Locally, thin beds of till are interstratified with the Kippet Hills Sand and Gravel Formation suggesting deposition by debris flow processes. However, at the south-west end of the Bellscamphie cutting, interbedded red, grey and brown diamictons occur indicating probable glacitectonic reworking of older deposits into the base of the Hatton Till. The clast lithologies in the diamicton are similar to those of the Kippet Hills Sand and Gravel Formation with which it shares a provenance.

Discussion

The Hatton Till and Kippet Hills Sand and Gravel Formation are typical representatives of the Late Devensian Logie-Buchan Drift Group. It is confirmed that Jamieson's 'indigo boulder clay' (Pitlurg Till) forms an extensive stratigraphical unit concealed beneath deposits of the Logie-Buchan Drift Group in the Ellon area. Boreholes, trenches and shallow pits indicate that the Pitlurg Till extends northwards from Slains to Auchleuchries (Figure A1.20). The deposit may extend north-eastwards beyond Hatton as boreholes there show thick, stiff, dark grey clayey tills lying beneath deposits of the Logie-Buchan Drift Group (Merritt, 1981).

The Pitlurg Till lies immediately beneath deposits of the Logie-Buchan Drift Group in the Bellscamphie area, but the situation is more complicated in the surrounding area. For example, at Ellon, Jamieson (1906, p.22) recorded up to 6 m of grey till derived from the west lying between his 'indigo boulder clay' and 'Red Clay'. Stream sections near Lintmill Bridge [NJ 988 308], east of Ellon, show Hatton Till overlying grey till with a sandy matrix and a strong west–east macrofabric. At Bearnie [NJ 967 339], some 4 km north of Ellon, 1 m of Hatton Till overlies a dark grey sandy till up to 2.7 m thick. This till, named here as the Bearnie Till Member of the Hythie Till Formation, has a multimodal clast fabric, but the clast composition suggests a local provenance. Furthermore, the till matrix has yielded a rich dinoflagellate cyst assemblage dominated again by late Oxfordian to Ryazanian elements derived from the Kimmeridge Clay Formation in the Moray Firth. These Jurassic palynomorphs are probably derived by local reworking of the nearby Pitlurg Till.

At two sites north-east of Pitlurg [NK 048 363]; [NK 037 356], road improvements have revealed up to 3.5 m of brown to dark brown till overlying metamorphic bedrock and with clasts predominantly derived from it. This till also contained common rounded flint clasts derived from outcrops of the Buchan Ridge Gravel Member to the north and has a strong north-north-west–south-south-east clast fabric. The lithology and unusual fabric characteristics of this till suggest that it is a correlative of the Bellscamphie Till. As the till is overlain directly by sands and gravels of the Kippet Hills Sand and Gravel Formation, other units in the local succession must have been eroded away or never deposited. Part of the succession is probably also absent in sections in the immediate vicinity of Bellscamphie where Hatton Till rests on Pitlurg Till with no intervening grey till of western provenance (Bearnie Till). This is likely because the Hatton Till at Bellscamphie apparently incorporates material from older diamictons.

The stratigraphy at the former gravel pit at Tillybrex [NK 002 348], 2 km north-west of Bellscamphie (Figure A1.20), is also of interest (Hall and Jarvis, 1995). Thin red diamicton and clay rests on brown diamicton of inland derivation, up to 11 m of gravel and a basal yellow-brown till of westerly derivation with psammite and flint clasts (Merritt, 1981). The gravel, named here as the Tillybrex Gravel Formation (Chapter 8, (Figure 50)) showed a range of sedimentary structures indicating flow towards the west, and included a number of syngenetic ice-wedge casts, indicating deposition under permafrost conditions. The gravel included many badly weathered clasts (Merritt, 1981) and was locally heavily cemented by iron and manganese oxides, suggesting a period of weathering after deposition (Jones and Milne, 1956). The stratigraphy at Tillybrex leaves little doubt that there are at least two tills of inland derivation in the Ellon district and that deposition of these tills was separated by a period of interstadial and perhaps interglacial conditions.

The provenance of the Pitlurg Till is uncertain. The presence of Jurassic palynomorphs suggests transport from the Moray Firth and this accords with the weak northerly fabric of the till at Pitlurg. Transport directly from the north is unlikely, however, as any ice movement from this direction would be across the flint gravels of the 'Buchan Ridge' and the till contains little flint. Transport via the Ythan valley, as suggested by Jamieson (1906) is unlikely, as no occurrences of dark grey clayey diamictons derived from the Moray Firth are known between Turriff and Ellon. A component of movement onshore from the bed of the North Sea is suggested by the small proportions of Devonian and Mesozoic clasts within the till.

The only information on the age of the Pitlurg Till is provided by amino-acid ratios of contained shell fragments. As argued above, these data suggest that the till is no older than Ipswichian in age and do not rule out formation during an early phase of the Late Devensian, in which case it is probably equivalent to the Whitehills Glacigenic Formation (Table 7). More dates are needed to resolve the age of this deposit. The 'indigo boulder clay' has traditionally been correlated with other dark grey clayey tills and erratics found beneath, or incorporated into, tills of inland derivation and probable Devensian age (Jamieson, 1906; Hall, 1984a). An OIS 6 age has been suggested for these deposits (Hall and Connell, 1991). One of them, the Benholm Clay Formation, at Site 26 Burn of Benholm, is almost certainly pre-Devensian in age. Thus it would seem that blue-grey tills were laid down both in the Late Devensian and also before the Ipswichian, probably in OIS 6.

The Bellscamphie Till rests on bedrock and is the oldest till in the immediate area. It was deposited by ice moving from the north-west or west. Possible correlative deposits in the Ellon area are the thin tills of inland derivation that rest on bedrock and underlie dark grey clayey till east of Hatton and underlie the Tillybrex Gravels at Tillybrex (Merritt, 1981) (Figure A1.20). Farther afield, it probably correlates with one of the two pre-Devensian tills of inland derivation at Kirkhill (Hall and Connell, 1991) and with the Camp Fauld Till on the Moss of Cruden (Whittington et al., 1993).

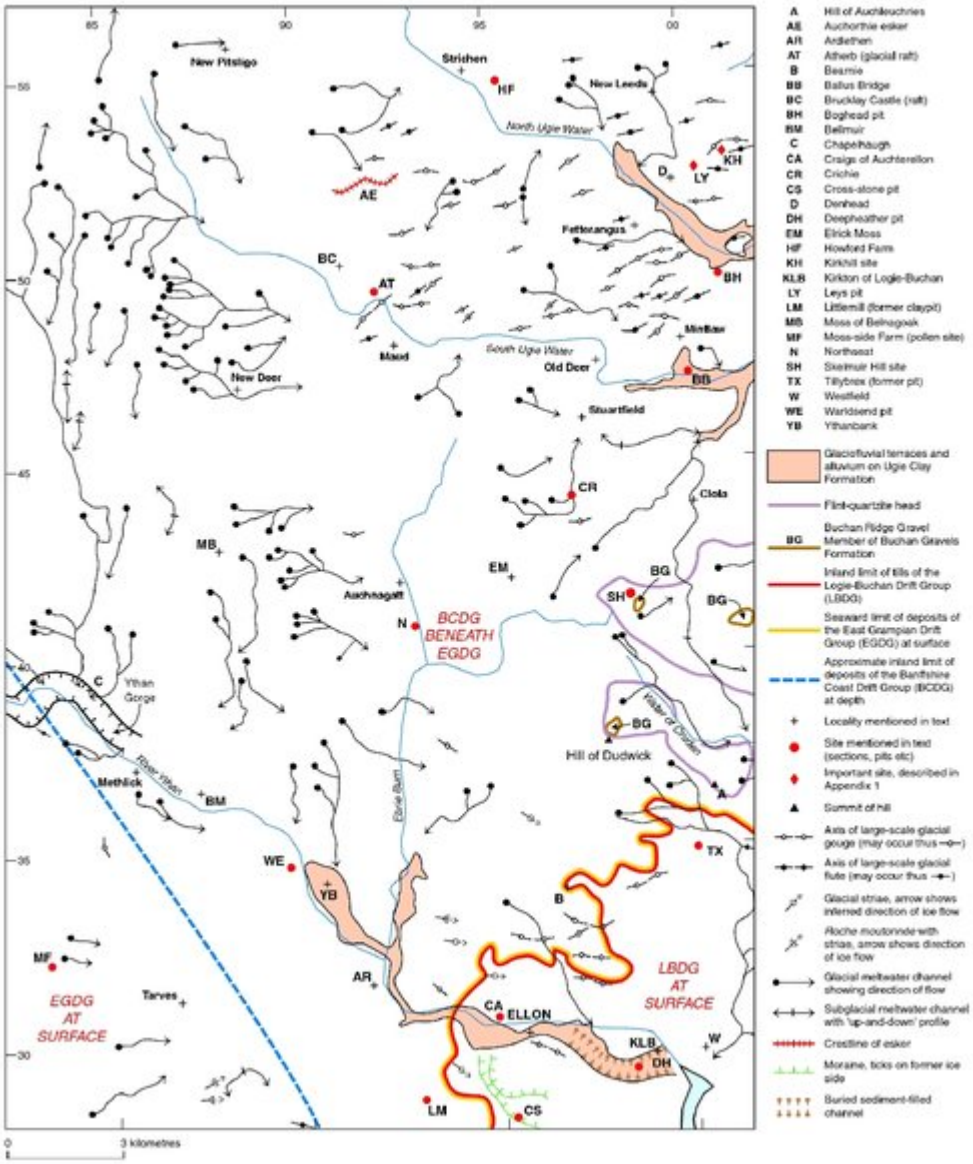
(Table A1.9) Lithostratigraphy in the vicinity of Ellon, Leask and Slains.

	Lithostratigraphical unit	Lithology	Thickness m	Age
F	Hatton Till Formation (1)	Red (10R 4/6) calcareous clayey silty diamicton, locally interbedded with Unit E	1-2.3	OIS 2
E	Kippet Hills Sand and Gravel Formation (1)	Pinkish grey sand and gravel with dolomite and calcareous mudstone clasts, and shell fragments	up to 5.0	OIS 2
D	Bearnie Till Member of Hythie Till Formation (2)	Dark grey sandy diamicton with clasts of local provenance and material reworked from Unit C	up to 2.7	OIS 2 ?
C	Pitlurg Till Formation (3)	Very dark grey to dark grey (7.5YR N3) slightly calcareous clayey silty diamicton with Jurassic clasts and fossils	up to 7.0	OIS 2 ? in part OIS 6 ?
B	Tillybrex Gravel Formation(2)	Weathered gravel with clasts of psammite and flint	up to 11	>OIS 6 ?

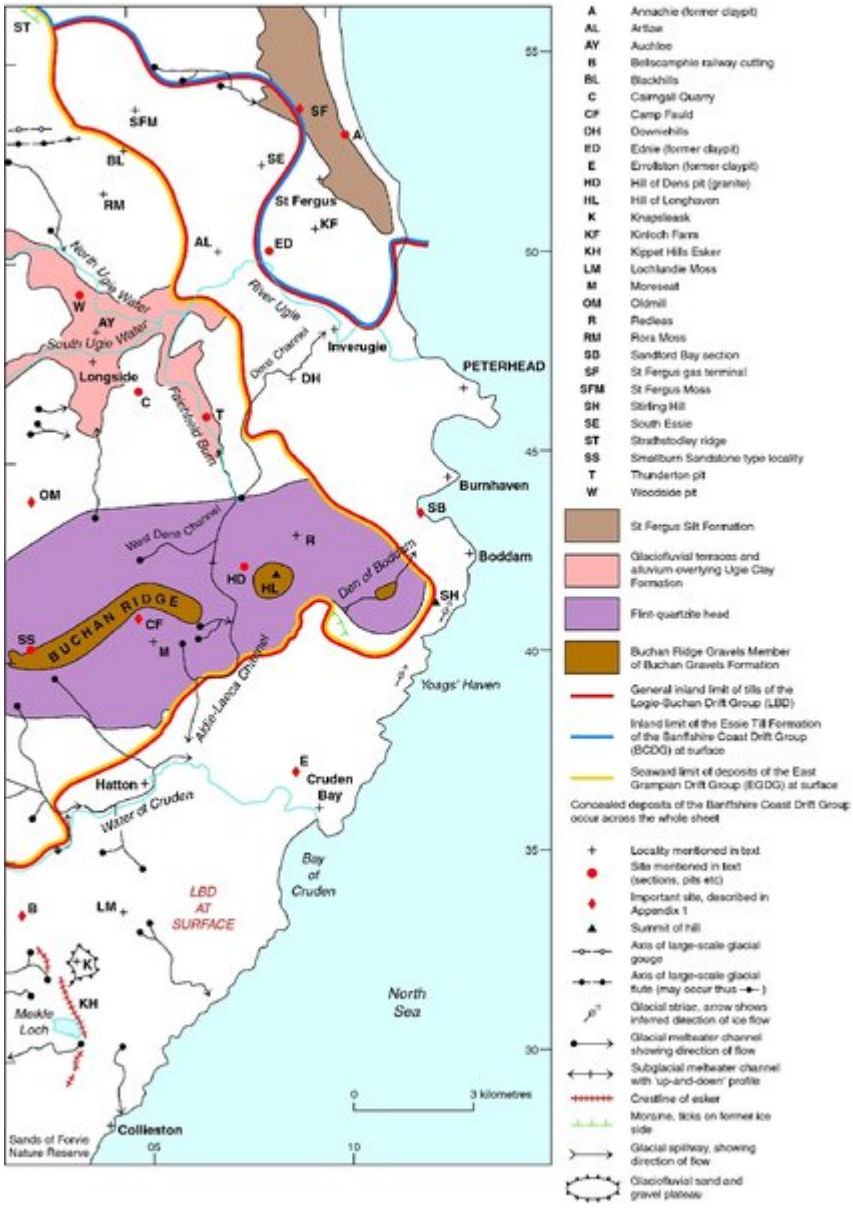
A	Bellscamphie Till Formation(2)	Strong brown (7.5YR 5/4) non-calcareous, sandy silt matrix diamicton	up to 2.1	>OIS 6 ?

- (1) Logie-Buchan Drift Group
- (2) East Grampian Drift Group
- (3) Banffshire Coast Drift Group

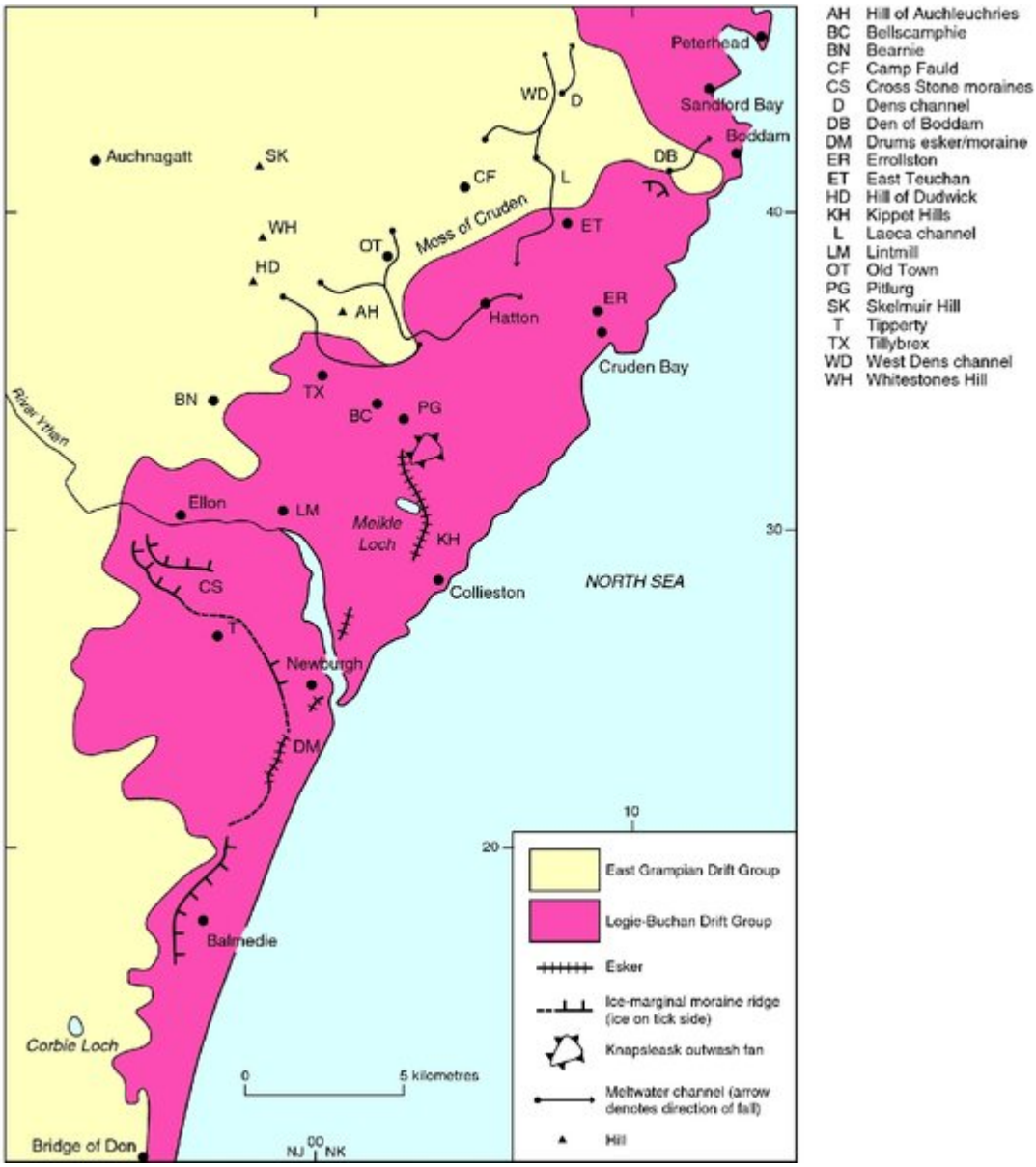
References



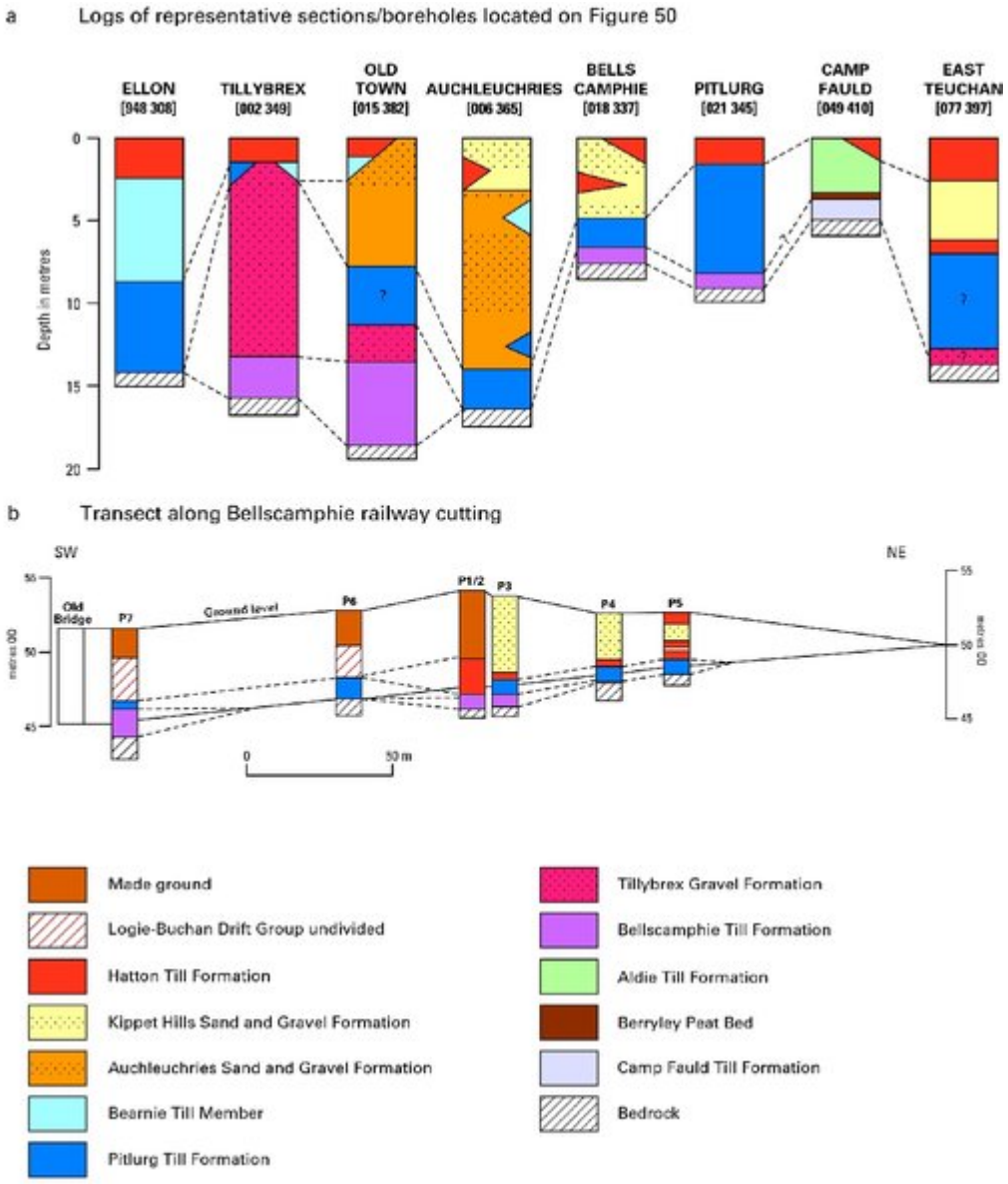
(Map 6) Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 87W Ellon.



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



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

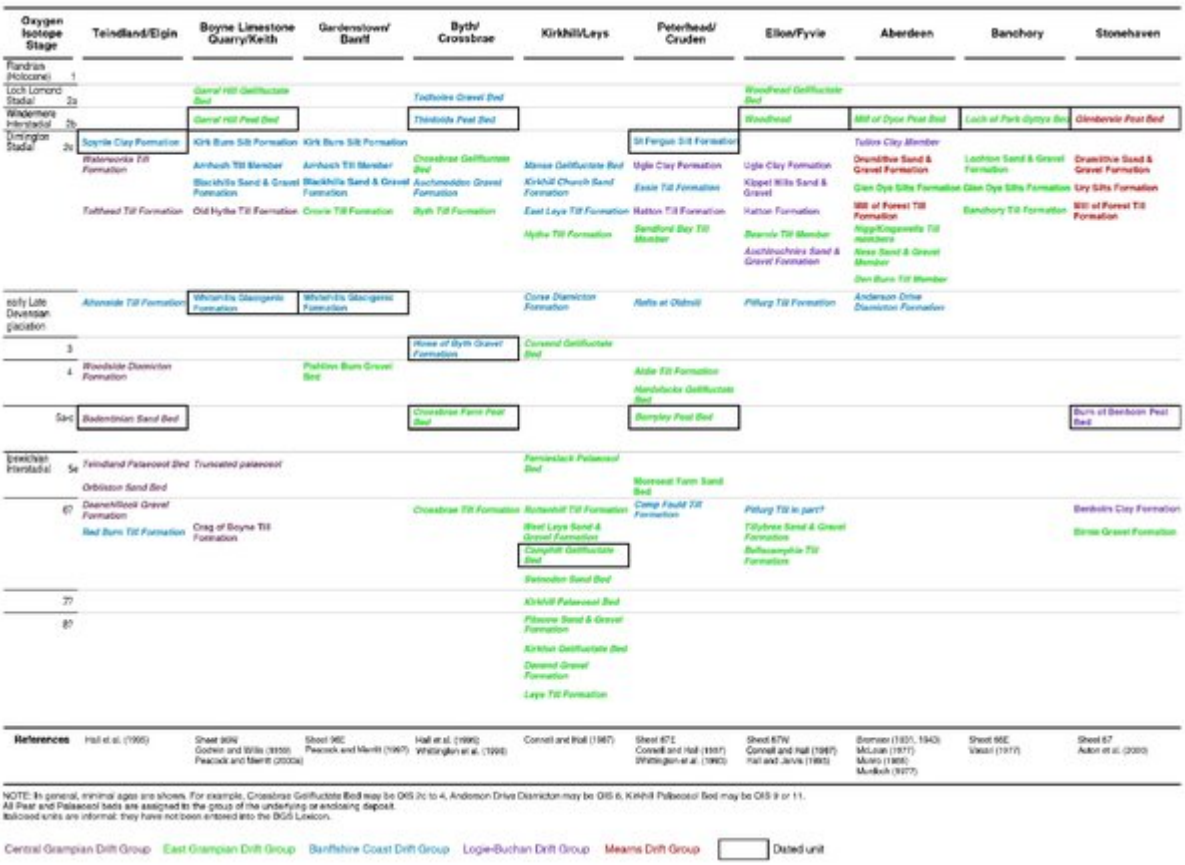


(Figure A1.20) Schematic logs and correlations in the Ellon area (after Hall and Jarvis, 1995).

	Lithostratigraphical unit	Lithology	Thickness m	Age
F	Hatton Till Formation*	Red (10R 4/6) calcareous clayey silty diamicton, locally interbedded with Unit E	1–2.3	OIS 2
E	Kippet Hills Sand and Gravel Formation*	Pinkish grey sand and gravel with dolomite and calcareous mudstone clasts, and shell fragments	up to 5.0	OIS 2
D	Bearnie Till Member of Hythie Till Formation†	Dark grey sandy diamicton with clasts of local provenance and material reworked from Unit C	up to 2.7	OIS 2 ?
C	Pitlurg Till Formation‡	Very dark grey to dark grey (7.5YR N3) slightly calcareous clayey silty diamicton with Jurassic clasts and fossils	up to 7.0	OIS 2 ? in part OIS 6 ?
B	Tillybrex Gravel Formation†	Weathered gravel with clasts of psammite and flint	up to 11	>OIS 6 ?
A	Bellscamphie Till Formation†	Strong brown (7.5YR 5/4) non-calcareous, sandy silt matrix diamicton	up to 2.1	>OIS 6 ?

* Logie-Buchan Drift Group
† East Grampian Drift Group
‡ Banffshire Coast Drift Group

(Table A1.9) Lithostratigraphy in the vicinity of Ellon, Leask and Slains.



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