

---

## Site 14 Moss of Cruden ('Buchan Ridge')

The Moss of Cruden, 11 km south-west of Peterhead, is an area of unusual geological interest (Hall, 1993a) (Figure A1.18). Together with the Moss of Auquharney, the Corse of Balloch and the Hill of Aldie, it forms part of the so-called 'Buchan Ridge' (Flett and Read, 1921) ((Figure 22), (Map 7)), a gently rounded, featureless, east-north-east-trending ridge that attains an elevation of about 140 m above OD. It provides the type localities for the Smallburn Sandstone, a small outlier of Devonian sandstone, the Moreseat Sandstone, a concealed outlier of Early Cretaceous age, and the Buchan Ridge Gravel Member of the Buchan Gravels Formation, of Neogene age. It also includes the important Late Pleistocene interstadial site at Camp Fault. These sites are described in turn.

### Smallburn Sandstone Formation

The Smallburn Sandstone Formation occupies a small area on the northern flank of the Moss of Cruden [NK 023 403]. Exposure is poor, but shallow pitting indicates that the sandstone rests on diorite and is partially concealed beneath Lower Cretaceous Moreseat Sandstone (Figure A1.18). The Smallburn Sandstone is a red-brown arkose, whose grains comprise dominantly quartz, with subsidiary feldspar and lithic fragments of diorite and granite. Quartz and hematite coatings occur on grain surfaces, but development of quartz overgrowths is limited. Preserved porosity varies from 13 to 19 per cent. Clay mineralogy is dominated by interstratified mica-smectite, with some illite (information from R A Downie, Downie Geoscience Ltd, 62 Durwood Avenue, Shawlands, Glasgow). No palynomorphs appear to be preserved in the formation (information from L A Riley, Bovingdon, Herts, 1997).

### Moreseat Sandstone Formation

Weathering and glacial disturbance of the Moreseat Sandstone Formation is widespread and it is only in the ground north of Moreseat that relatively fresh material was recovered from the base of trial pits (Figure A1.18). The Moreseat Sandstone here is a very dark grey, porous silty fine-grained glauconitic quartz arenite. Bioturbation is common, and burrows and moulds of mollusca are present. The rock contains well-preserved palynomorphs indicating a Late Hauterivian to Early Barremian age (information from

W Braham). Thin sections reveal a spicular quartz sandstone with a mixed terrigenous/calcareous mud matrix. Grains are dominantly of quartz, but, prior to the development of voids (moulds) after the dissolution of mollusc fragments and foraminifera, the dominant grain type would have been sponge spicules. Feldspar grains and bioclastic debris have also undergone significant dissolution. Macroporosity is around 30 per cent (information from A R Duncan, Maud, Aberdeenshire, 1997).

The Lower Cretaceous rocks north of the Moss of Cruden were originally fine-grained sandy siltstones, but they are typically decomposed to clayey fine-grained sands and sandy silty clays of vivid orange, tangerine, yellow and white hues.

### Buchan Ridge Gravel Member

The Moss of Cruden is the type area of the Buchan Ridge Gravel Member, part of the Buchan Gravels Formation (compare with Flett and Read, 1921; McMillan and Merritt, 1980) (Figure 22). Exposures also occur at Skelmuir Hill (Bridgland et al., 1997), Whitestones Hill (Kesel and Gemmell, 1981) and Den of Boddam (Bridgland et al., 1997), and other concealed, small gravel masses may well exist (Flett and Read, 1921). At Moss of Cruden, the gravel deposit forms a broad ridge, orientated north-east–south-west, some of the highest ground in this part of Buchan. The type section of the Buchan Ridge Gravel Member occurs in BGS Borehole NK04SW/3 on the highest point of the ridge (McMillan and Merritt, 1980) (Figure A1.18), which proved at least 25 m of coarse flint and quartzite gravel, interbedded with pebbly sand and commonly bound by white kaolinitic clay. Reference sections have been recorded in temporary pits at Moss of Cruden (BGS records), Skelmuir Hill [NJ 987 413] (Bridgland et al., 1997), Boddam [NK 113 415] (Bridgland et al., 1997)

and in BGS Borehole NK04SE/6, near Berryley (McMillan and Merritt, 1980).

The Buchan Ridge Gravel Member is poorly exposed. Temporary excavations and boreholes show white, clay-bound coarse gravels with minor sand and silt units (Merritt, 1981). Gravel clasts are dominantly flint with subsidiary quartzite and vein-quartz. Clasts are generally well-rounded pebbles and cobbles and bear numerous chatter marks. The deposits originally contained less resistant clasts, probably mainly granite, but these have decomposed to ghosts of white sandy clayey silt. This decomposition extends throughout the known thickness of the deposit into the underlying granite and gneiss bedrock. Both sand and gravel units are bound and, in places, supported by, white, sandy clayey silt consisting of well-ordered kaolinite with minor illite (Hall, 1982).

The base of the Buchan Ridge Gravel Member in places contains large nodules of flint and boulders of quartzite (Plate 5a), (Plate 5b). Quartzite blocks up to 30 cm in diameter were recovered from a trial pit close to the western margin of the gravels at Moss of Auquharney [NK 019 400]. In pits at an elevation of approximately 130 m [NK 028 403] the base of the gravels revealed a lag of unworn, nodular flint with blocks up to 25 cm in diameter. In places the gravel is partially cemented by iron concretions containing goethite. Similar deeply weathered boulder gravel containing large nodular flints occurs on Skelmuir Hill at an elevation of about 148 m OD (Bridgland et al., 2000). The Buchan Ridge Gravel Member rests on kaolinised granite and metasedimentary rock (McMillan and Aitken, 1981; Hall et al., 1989) and on highly weathered Lower Cretaceous Moreseat Sandstone (Hall and Jarvis, 1994).

A ground probing radar survey (Greenwood et al., 1995) on the northern slope of the Moss of Cruden has confirmed that the feather edge of the Buchan Ridge Gravel Member rests on weathered Lower Cretaceous sandstone (see Appendix 3). Within undisturbed parts of the Buchan Ridge Gravel Member, low-angle cross-stratification dips towards the axis of the ridge ((Figure A3.3); line 1). Resistivity depth probes and ground probing radar indicate that around 15 m of Buchan Ridge Gravel Member lies beneath the crest of the ridge, resting on weathered granite. The gravels here fill a channel running north-east–south-west and parallel to the line of the ridge.

The Buchan Ridge Gravel Member is overlain by a variable thickness of till, and disturbance attributed to overriding ice is common. At Corse of Balloch, BGS Borehole NK04SW/4 (McMillan and Merritt, 1980) indicates that in situ Buchan Ridge Gravel Member is overlain by almost 10 m of till, derived in large part from the underlying gravel. Temporary excavations east of Camp Fault revealed rafts of flint and quartzite gravel within till (Whittington et al., 1993). To the north of the ridge, a sheet of soliflucted flint gravel, up to 2 m thick, extends well downslope on to weathered granite (Hall, 1993a). This gravel forms part of the 'Flint-quartzite Head' deposits described in Chapter 6 that are widespread around the Buchan Ridge on sheets 87W Ellon and Peterhead 87E Peterhead (Maps 6 and 7).

## **Camp Fault**

This site [NK 049 410] lies on the southern slope of the Moss of Cruden, about 900 m north-west of Moreseat ((Figure A1.19), (Map 7)). It is important for the presence of a buried peat of probable Early Devensian age that separates two till units (Whittington et al., 1993). The lithostratigraphy described below generally follows that set up by Whittington et al. (1993), but in order to adhere more closely to internationally agreed guidelines on lithostratigraphical nomenclature, new names have been adopted here ((Table 7); (Figure A1.8)). Those proposed recently by Sutherland (1999) are not appropriate.

The stratigraphy is known only from trial pits. The oldest deposit recognised is the Camp Fault Till Formation. This is at least 2 m thick and is a grey (2.5Y N5) to very dark grey (7.5YR N3) massive to crudely horizontally bedded diamicton with sparse pebbles. Clast lithologies comprise mainly rounded quartzite and flint, with lesser amounts of subangular granite, basic igneous, red sandstone and soft grey siltstone clasts. The matrix is a micaceous sandy silt and clay mineralogy is largely kaolinite, illite-smectite and minor glauconite. The diamicton rests on, and locally passes down into, and incorporates rafts of Moreseat Sandstone. The direction of ice flow during deposition of the Camp Fault Till is difficult to establish owing to the dominance of very locally derived material. The presence of clasts of grey granite and red sandstone suggest transport from local outcrops to the west of the site.

The Berryley Peat Bed is up to 0.5 m thick in pit A and rests on the mottled top of the Camp Fault Till (Figure A1.19). The peat is truncated by, and both reworked and sheared into, the lower 30 cm of the overlying Aldie Till. In Pit B, the peat bed rests on bedrock and is overlain by sands and gravels containing stringers of peat. This unit is separated from the overlying Aldie Till by a gravel-rich diamicton with a strong downslope clast fabric (Figure A1.19). This intervening deposit, named here as the Hardslacks Gelifluctate Bed, appears to mark a phase, or phases, of periglacial conditions and slope instability.

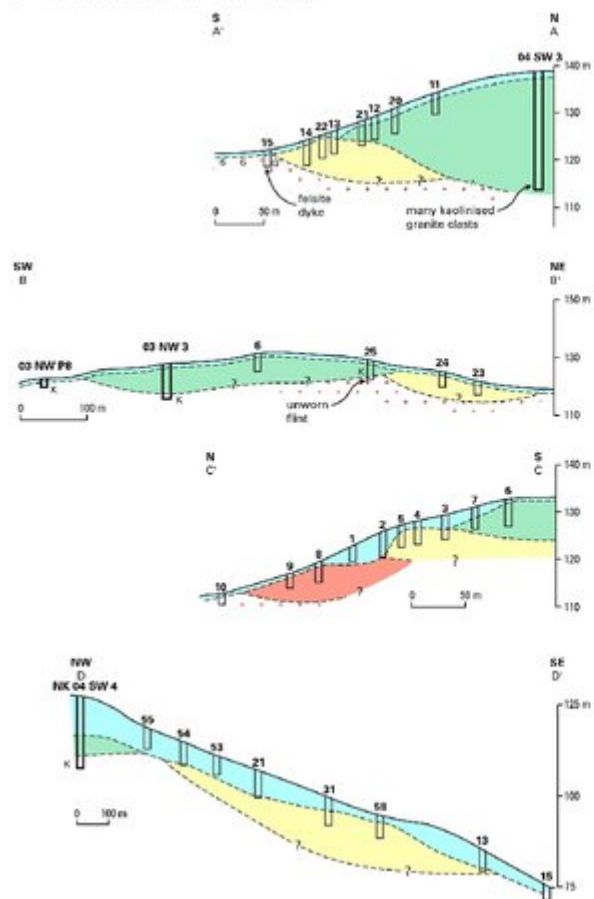
The Aldie Till at Camp Fault is a greenish grey (5GY 6/1) sandy diamicton that is massive or shows a crude horizontal bedding and is up to 2.5 m thick. Clast lithology is dominated by broken rounded pebbles and cobbles of flint and quartzite reworked from the Buchan Gravels Formation, with sparse mica-schist, granite, basic igneous and red sandstone clasts. The matrix is kaolinitic quartz sand. Away from the type-site, the character of the Aldie Till varies greatly in response to marked lateral changes in bedrock and even drift geology. On the Buchan Ridge Gravels at Hill of Aldie, the Aldie Till closely resembles that at Camp Fault. However, in the area underlain by the Moreseat Sandstone Formation, it is indistinguishable from the underlying Camp Fault Till. To the north and east of Camp Fault, the Aldie Till partly incorporates large masses of weathered brown sand with sparse quartzite clasts of unknown derivation and origin. This sand, named here as the Moreseat Farm Sand Bed, was also probably formerly exposed at an infilled gravel pit [NK 0529 4108], from where a cobble of brown, porous arkose of Lower Cretaceous appearance was recovered in 1979. BGS Borehole NK04SE/2 shows that this unit of sand is up to 7 m thick, and rests on a dark grey till that may be equivalent to the Camp Fault Till.

South and east of Moreseat, the Aldie Till passes beneath red clayey diamictons of the Logie-Buchan Drift Group. It thickens on the southern and eastern slopes of the Moss of Cruden in accord with the apparent eastward carry of flint and red granite from the Moss of Cruden, and its weak north-west–south-east clast fabric. These features indicate that the unusual till thickness is probably a product of only minor subsequent glacial erosion as it lies in the lee of the Buchan Ridge. The presence of red granite erratics on the Moss of Cruden has been used to infer ice movement from the north-east prior to the last glaciation (Bremner, 1934a, 1939; Synge, 1956). However, the situation is complicated by the presence of coarse-grained red granites, similar to the Peterhead Granite, in the ground 1 km north and west of Moreseat.

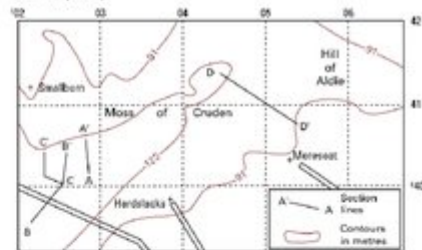
The Berryley Peat Bed has yielded radiocarbon ages (SRR–3724) of  $39\,590 \pm 550$  BP for the humic fraction and  $34\,600 \pm 910$  BP for the humin fraction (Whittington et al., 1993) and luminescence ages of  $160 \pm 16$  and  $251 \pm 24$  ka BP (Duller et al., 1995). The significance of these contrasting ages is uncertain. Pollen analysis of peat layers from the adjacent pits suggests that the peat formed during an interstadial in which birch–pine woodland first developed, probably followed by tundra vegetation in which *Bruckenthalia spiculifolia* was present. This heath is found today in the Balkan Mountains, but is extinct in Scotland (Whittington, 1994). The vegetation assemblage of the Berryley Peat, including the presence of *Bruckenthalia*, is akin in certain aspects to that found at other Early Devensian sites in Scotland at Allt Odhar and Sel Ayre. Hence, the Berryley Peat may correlate with Oxygen Isotope Stage 5c or 5a, when pine–birch woodlands developed widely in north-west Europe during the Brørup and Odderade Interstadials (Behre, 1989) (Figure 7).

## [References](#)

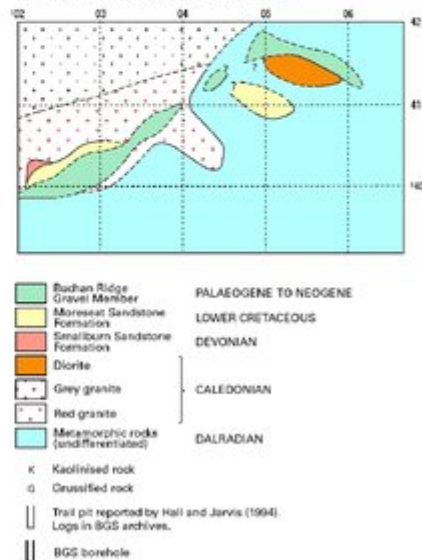
a Transects across the Moss of Cruden



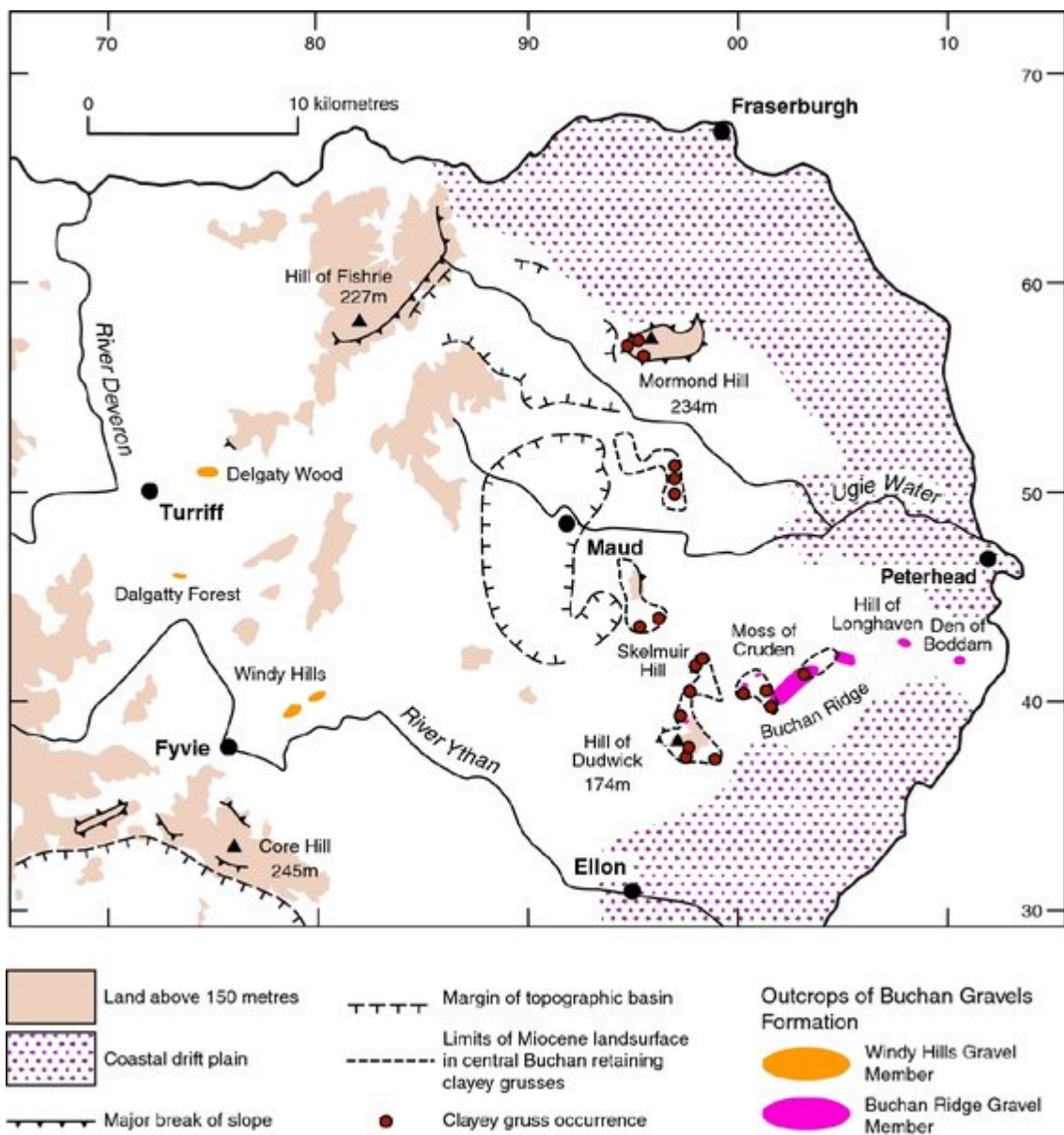
b Locality map



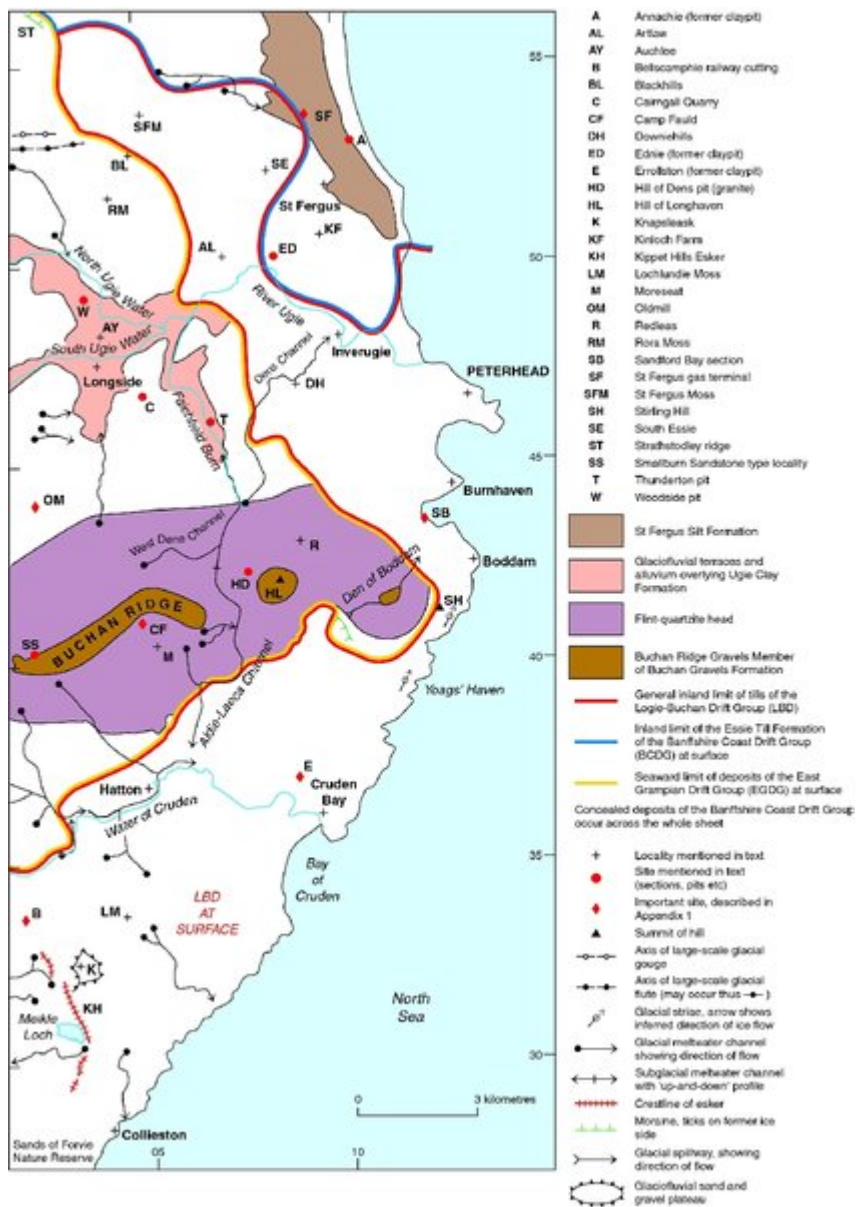
c Subdrift geological map showing outliers of the Smallburn and Moreseat Sandstone formations, and the Buchan Ridge Gravel Member



(Figure A1.18) Investigations on the Buchan Ridge (after Hall and Jarvis, 1994).



(Figure 22) Distribution of Miocene land surface and major topographical features (after Hall, 1985).



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



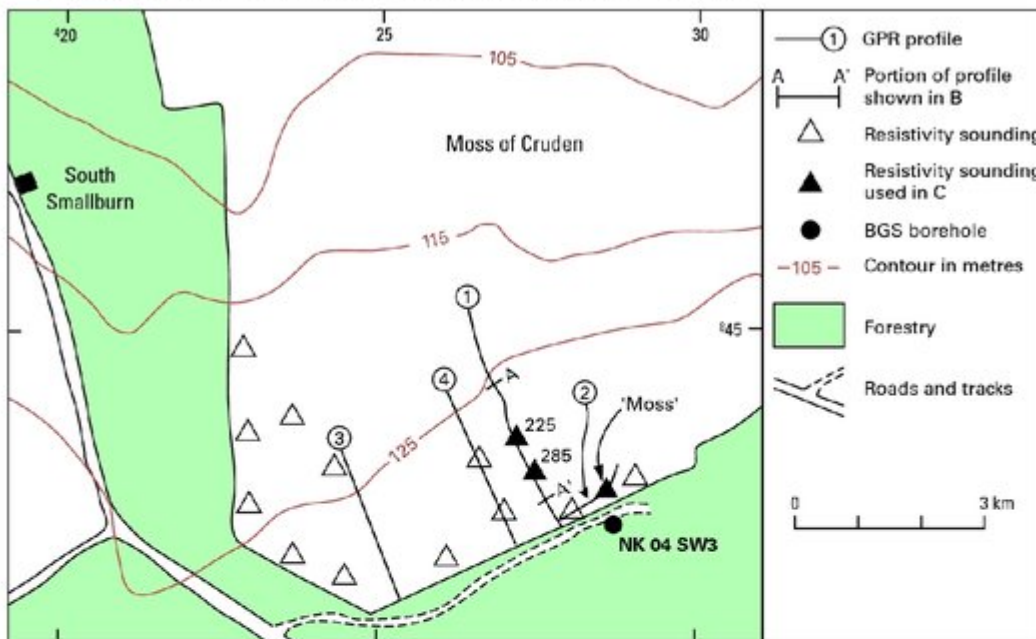


*(Plate 5a) Flint clasts recovered from the base of the Buchan Ridge Gravel Member in a trial pit on the Moss of Cruden [NK 0253 4024]. Little-worn flints such as these were either derived directly from a former cover of Chalk in the area or from a remanié flint deposit. This evidence suggests that the present terrain lies close to the level of the sub-Cenomanian surface. (a P104122, b P104121).*

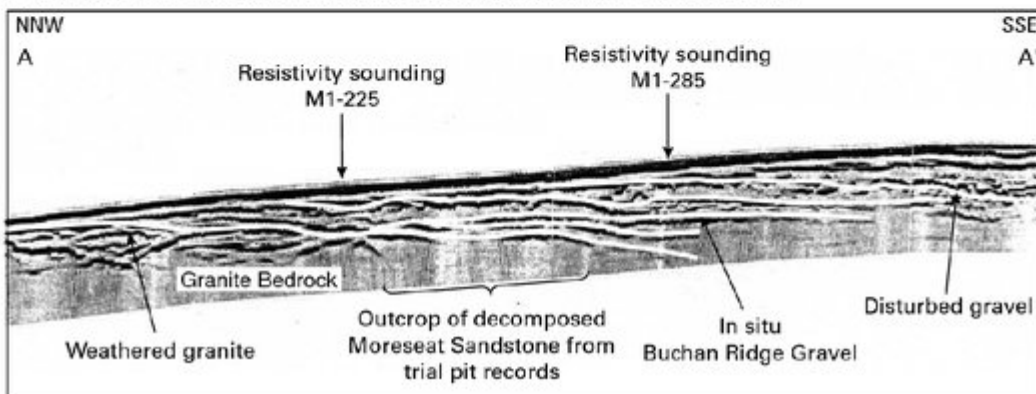


(Plate 5b) Flint clasts recovered from the base of the Buchan Ridge Gravel Member in a trial pit on the Moss of Cruden [NK 0253 4024]. Little-worn flints such as these were either derived directly from a former cover of Chalk in the area or from a remanié flint deposit. This evidence suggests that the present terrain lies close to the level of the sub-Cenomanian surface. (a P104122, b P104121).

a Location of GPR traverses and resistivity soundings on the northern slope of the 'Buchan Ridge' at the Moss of Cruden



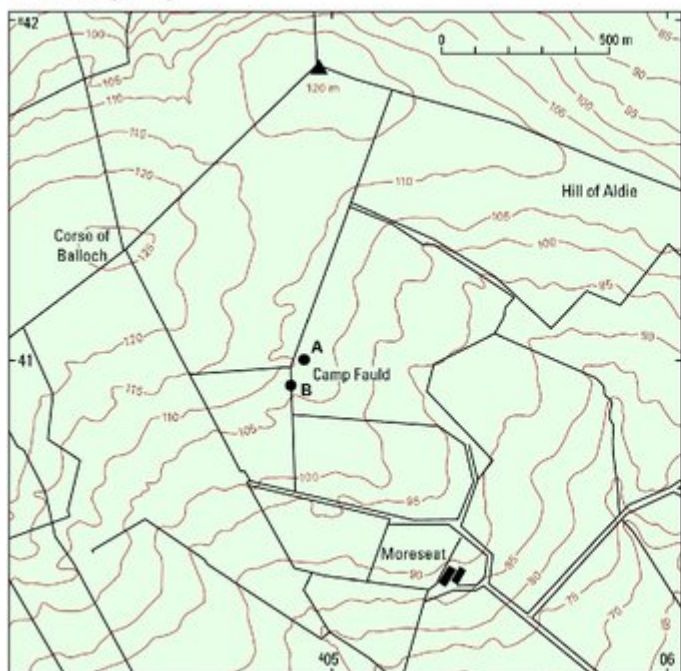
b Interpreted GPR profile (50 mHz) along part of line 1 (162-342 m)



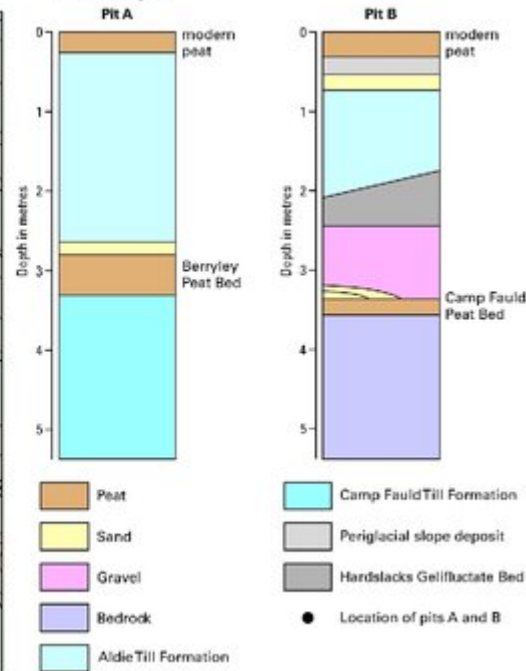
(Figure A3.3) Buchan Ridge. a Location of GPR traverses and resistivity soundings on the northern slope of the 'Buchan Ridge' at the Moss of Cruden b Interpreted GPR profile (50mHz) along part of line 1 (162–342 m).



a Locality map



b Pit logs



(Figure A1.19) Camp Fould site (after Whittington et al., 1993).

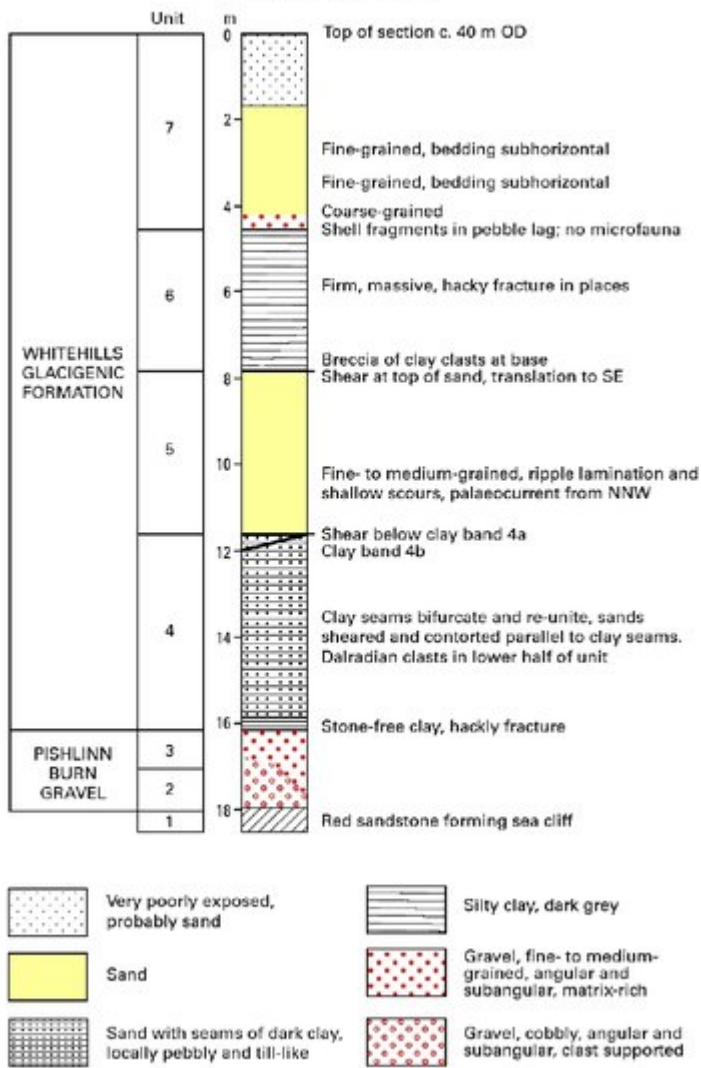
Oxygen Isotope Stage	Teindland/Egin	Boyne Limestone Quarry/Keith	Gardensloven/Banff	Byth/Crossbar	Kirkhill/Lays	Peterhead/Gruden	Ellon/Pylvie	Aberdeen	Banchory	Stonehaven
1	Forbes (Holocene)									
2a	Lock Lomond Stadial	Garnet Hill Gellifluctate Bed		Tadlow Gellifluctate Bed			Woodhead Gellifluctate Bed			
2b	Widderburn Interstadial	Garnet Hill Peat Bed		Tadlow Peat Bed			Woodhead	Mill of Dyce Peat Bed	Loch of Park Dyce Peat Bed	Glenbevie Peat Bed
2c	Urrington Stadial	Boyne Clay Formation	Kirk Burn Silty Formation	Kirk Burn Silty Formation		St Fergus Silty Formation		Tollie Clay Member		
		Blackburne Till Formation	Amhath Till Member	Amhath Till Member	Chesapeake Gellifluctate Bed	Marine Gellifluctate Bed	Ugle Clay Formation	Ordnance Sand & Gravel Formation	Lochline Sand & Gravel Formation	Drumblair Sand & Gravel Formation
		Tadlow Till Formation	Old Hybe Till Formation	Crovie Till Formation	Byth Till Formation	East Lays Till Formation	Kiln Formation	Glen Dyce Silty Formation	Glen Dyce Silty Formation	Lay Silty Formation
					Mythe Till Formation	Sandford Bay Till Member	Marine Till Member	Highland Gellifluctate Till member		Mill of Forest Till Formation
							Aschmole Sand & Gravel Formation	Arne Sand & Gravel Member		Mill of Forest Till Formation
								Don Burn Till Member		
								Anderson Drive		
3	Altona Till Formation	Whorlton's Stageless Formation	Whorlton's Stageless Formation		Corrie Dismant Formation	Refts at Oldmill	Pilgry Till Formation			
4	Woodhead Dismant Formation		Polish Burn Gravel Bed	House of Byth Gravel Formation	Corrie Dismant Formation					
5a		Badenoch Sand Bed		Chesapeake Peat Bed		Banff Peat Bed				Burn of Banchory Peat Bed
5b										
5c										
5d										
5e										
5f										
5g										
5h										
5i										
5j										
5k										
5l										
5m										
5n										
5o										
5p										
5q										
5r										
5s										
5t										
5u										
5v										
5w										
5x										
5y										
5z										
6										
6a										
6b										
6c										
6d										
6e										
6f										
6g										
6h										
6i										
6j										
6k										
6l										
6m										
6n										
6o										
6p										
6q										
6r										
6s										
6t										
6u										
6v										
6w										
6x										
6y										
6z										
7										
7a										
7b										
7c										
7d										
7e										
7f										
7g										
7h										
7i										
7j										
7k										
7l										
7m										
7n										
7o										
7p										
7q										
7r										
7s										
7t										
7u										
7v										
7w										
7x										
7y										
7z										
8										
8a										
8b										
8c										
8d										
8e										
8f										
8g										
8h										
8i										
8j										
8k										
8l										
8m										
8n										
8o										
8p										
8q										
8r										
8s										
8t										
8u										
8v										
8w										
8x										
8y										
8z										
9										
9a										
9b										
9c										
9d										
9e										
9f										
9g										
9h										
9i										
9j										
9k										
9l										
9m										
9n										
9o										
9p										
9q										
9r										
9s										
9t										
9u										
9v										
9w										
9x										
9y										
9z										
10										
10a										
10b										
10c										
10d										
10e										
10f										
10g										
10h										
10i										
10j										
10k										
10l										
10m										
10n										
10o										
10p										
10q										
10r										
10s										
10t										
10u										
10v										
10w										
10x										
10y										
10z										

NOTE: In general, minimal ages are shown. For example, Chesapeake Gellifluctate Bed may be OIS 2c to 4, Anderson Drive Dismant may be OIS 6, Kirkhill Palaeosol Bed may be OIS 9 or 11. All Peat and Palaeosol beds are assigned to the group of the underlying or enclosing deposit. Bolded units are informal, they have not been entered into the BGS Lexicon.

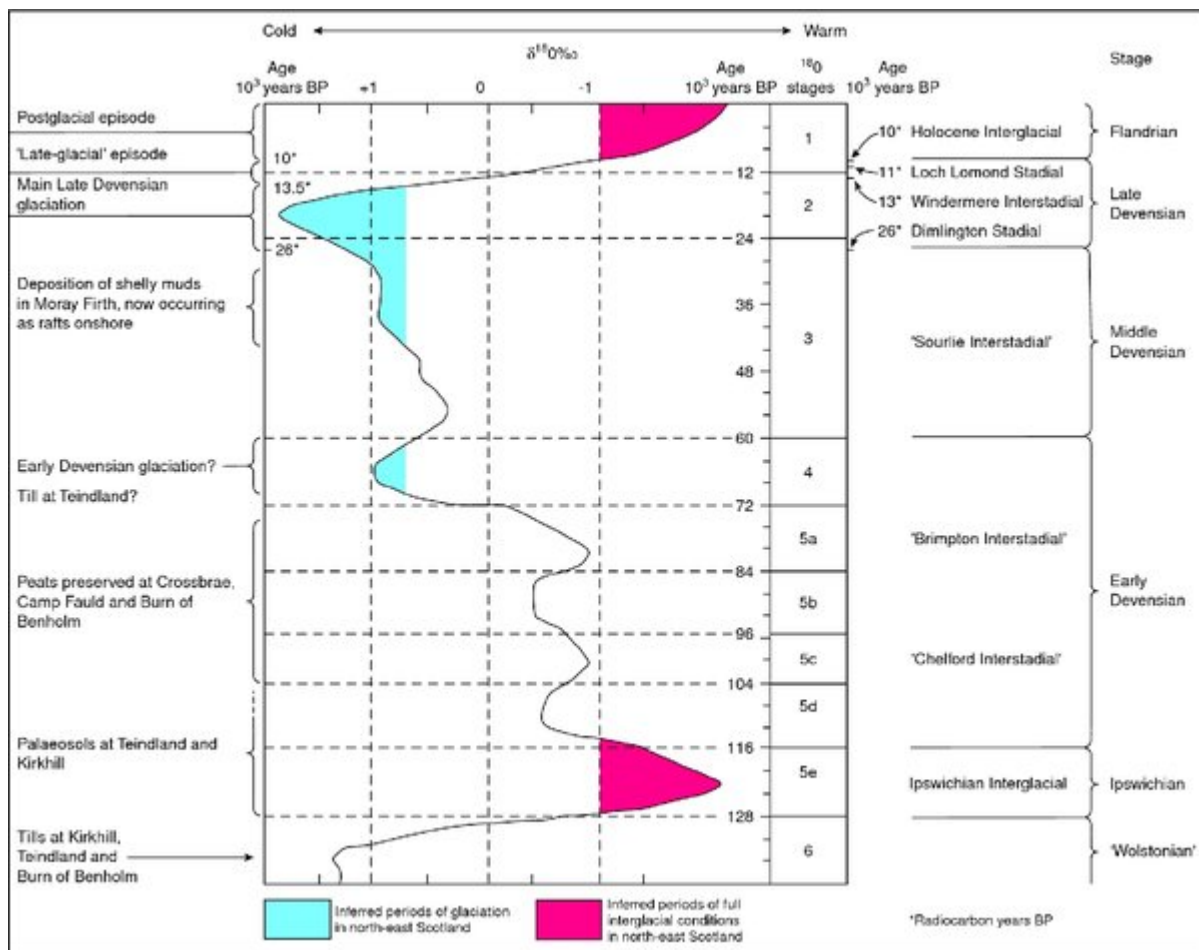
Central Grampian Drift Group East Grampian Drift Group Banchory Coast Drift Group Logie-Buchan Drift Group Means Drift Group Dated unit

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

# Section S1 [NJ 7935 6442]



(Figure A1.8) Lithological log of Section S1 at Castle Hill (after Peacock and Merritt, 1997).



(Figure 7) The 'SPECMAP' oxygen isotope curve for the last glacial—interglacial cycle (after Imbrie et al., 1984) with climato-stratigraphical stages and selected events in north-east Scotland.