

Quaternary, introduction and events predating the Late Devensian, Grampian Highlands

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Stephenson, D, and Gould, D. 1995. British regional geology: the Grampian Highlands. Fourth edition. Reprint 2007. Keyworth, Nottingham: British Geological Survey.

Introduction

Since the start of the Quaternary some 2.6 million years ago the Grampian Highlands have been glaciated many times. At first, glaciers were restricted to the mountains, but during the last 750 000 years there has been a rhythmic growth and decay of large ice sheets in the middle latitudes of Europe and these covered much of the Scottish mainland (Boulton et al., 1991). Periods of ice-sheet growth during the cold *glacials* were separated at intervals of about 100 000 years by relatively short *interglacials* during which climatic conditions were similar to those of the present day. The glacial period included long cold *stadials* and short warmer *interstadials*.

Table 3 Subdivisions of the Quaternary of Scotland.

Isotope stage	Approx. age BP	Stage (chrono/climatostratigraphy)		Glaciations
1	0 – 10 000*	Flandrian (Interglacial)		PG —
2	10 000–26 000*	LATE DEVENSIAN	Loch Lomond Stadial (10 000–11 000 BP)*	LG Loch Lomond Readvance
			Windermere (Late-glacial) Interstadial (11 000–13 000 BP)*	Main Late Devensian Glaciation
			Dimlington Stadial (13 000–26 000 BP)*	
3	26 000–50 000	Middle	—	
4–5d	50 000–122 000	Early	Early Devensian Glaciation?	
5e	122 000–132 000	Ipswichian (Interglacial)	—	
6–10	132 000–350 000	Wolstonian (Stadial)	Wolstonian (Saalian) Glaciation	
11	430 000	Hoxnian (Interglacial)	—	
12	480 000	Anglian (Stadial)	Anglian Glaciation	

Subdivisions of the Quaternary of Scotland.

P915455

[File:P915457.png](#)

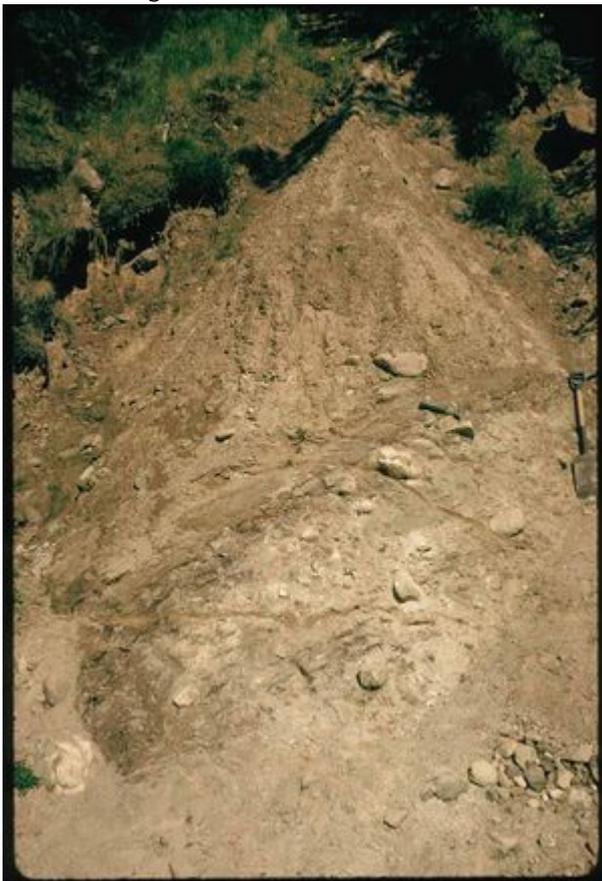
Quaternary fossils from

Ardyne and Elgin.

P915457.



Interglacial deposits, Kirkhill Quarry, Aberdeenshire. The upper till rests on head. The lower palaeosol is developed on lower sands and gravels. P008603.



Glacial and interglacial deposits at Dalcharn, Nairnshire. The hammer lies on an interglacial palaeosol containing several horizons of charcoal and compressed peat. P008524.

As climatic change has had a dominant influence on sedimentation during the Quaternary and there has been little species evolution on which to base biostratigraphical subdivisions, the epoch is divided into a series of climatostratigraphical stages. Although older deposits occur offshore (Andrews et al., 1990; Fyfe et al., 1993; Gatliff et al., 1994) glacial erosion has largely removed evidence of events in the Quaternary predating the last Main Late Devensian glaciation and only the last five or so stages are presently known to be represented in the Grampian Highlands ([P915455](#)). The repeated glaciation has resulted in the modification of the pre-Quaternary topography by the widening, straightening and deepening of pre-existing river valleys, the breaching of watersheds and the excavation of corries. Although most of the products of glacial erosion have been transported offshore, those pertaining to the latest glacial events remain, chiefly on low ground, in the form of hummocky moraines, till sheets and deposits of sand and gravel. Parts of the higher mountains are almost free of drift, excepting where mantled by block-fields or slope deposits, and till is thin or absent in parts of Argyll and Jura because higher precipitation in the western mountains resulted in more active ice streams that deposited the debris in what are now offshore areas. North-east Scotland was generally only weakly glaciated during the Quaternary and consequently it has yielded most evidence of glacial, interglacial and interstadial events predating the Late Devensian Glaciation, which culminated some 22 000 BP (radiocarbon years ago* at the last glacial maximum).

Evidence for events predating the Late Devensian

Pockets of deeply weathered igneous, metamorphic and sedimentary rocks have survived glaciation in several parts of the region, notably in the north-east ([P915447](#)). East of a line from Elgin to Dundee, the bedrock has been patchily but extensively decomposed to a gruss (granular sand), locally to depths of several tens of metres. It has been suggested that this weathering took place under the temperate conditions postdating the Miocene (Hall, 1986) and as such it is distinct from the clayey gruss associated with the Buchan Gravels Group. Pockets of deeply weathered rock also occur farther west, for example within the outcrop of the Foyers and Moy granites and in the Gaick Plateau area ([P915448](#)).

There are few documented sites where there is unequivocal evidence for depositional events predating the Main Late Devensian Glaciation and most occur in North-east Scotland (Gordon and Sutherland, 1993) ([P915447](#)). At Teindland, near Elgin, a fossil soil that has yielded both interglacial and interstadial pollen is overlain by deposits which have been classified by different workers as either solifluction deposits or till (Lowe, 1984). At Crossbrae, near Turriff, a thin layer of peat below soliflucted till has yielded minimal radiocarbon ages in the range of 44 000 to 47 000 BP. A former quarry site at Kirkhill, near Strichen, revealed a sequence of tills and fossil soils interbedded with sand and gravel, including solifluction deposits (Hall and Connell, 1991). These deposits ([P008603](#)) occupy basins and channels between upstanding tor-like prominences of partly decomposed felsite. Many of the clasts in the gravels are formed of this rock type. The occurrence of erratics of biotite-granite and red sandstone in the lowermost beds is evidence for a glacial episode or episodes that predate the lower till. The tills themselves represent separate glaciations and the fossil soils represent interglacial and/or interstadial periods that are older than the limit of radiocarbon dating (about 40 000 BP). It is not clear whether or not the upper till was deposited during the Main Late Devensian Glaciation or during some earlier glacial phase.

A fossil soil containing pollen of full interglacial aspect has been discovered at the base of a high river cliff at Dalcharn, near Cawdor ([P915448](#); Walker et al., 1992). This deposit, which has been disturbed by frost action, overridden by glacier ice and tectonised, underlies a sequence of three tills with distinctive clast compositions and fabrics ([P008524](#)). At least one of the tills may predate the Main Late Devensian Glaciation. The palaeosol rests on, and incorporates, deeply weathered and whitened gravel, but the biogenic material cannot yet be ascribed certainly to a particular

interglacial. Dalcharn provides the first evidence that the northern Grampian Highlands were covered in pine forest during at least one interglacial stage of the middle to late Quaternary.

A few kilometres to the south of Dalcharn, a layer of compressed peat underlying unweathered lodgement till, but overlying weathered lodgement till, has been located in a river cliff of the Allt Odhar, Moy. This peat contains pollen, insect remains and plant debris indicating an appreciably cooler climate than that suggested for the Dalcharn site, and there is a convergence of evidence that it accumulated during an early-Devensian interstadial. It is the first site from the mainland of Scotland providing evidence of woodland during a Devensian interstadial.

Deposits of marine clay, either transported or in situ, have been found below till of the last Main Late Devensian Glaciation at several localities (Sutherland, 1981). Near Drumore and Cleongart in Kintyre ([\(P915448\)](#)), reddish brown till is underlain at about 55 m above OD by grey and brown pebbly and stone-free clays thought to have been deposited in a glaciomarine environment close to an ice front. The fossils in these beds are largely derived. On the north side of the Grampians at Clava, near Inverness, a raft of marine clay, at an altitude of about 150 m above OD and associated with shelly till, has yielded a fauna that is of a cooler-water aspect than the present Scottish marine fauna, but not high arctic. A combination of radiocarbon and amino-acid dating on shells from the clay suggests that the deposit formed during a mid-Devensian interstadial, prior to about 40 000 BP. The raft was probably carried from the Loch Ness basin during the expansion of the ice-sheet of the Main Late Devensian Glaciation (Merritt, 1992). Other localities where there are deposits of deformed and undeformed marine strata which could be either in situ or rafts are shown on [\(P915447\)](#). An ice-transported raft of highly deformed marine clay was visible at the Boyne Limestone Quarry, east of Portsoy. Such clays are associated with shelly tills that contain fragments of temperate and cool water molluscs which at one locality in Buchan have yielded a preliminary amino-acid age determination suggesting a Devensian age, that is post-125 000 BP.

Remains of platform terraces cut by the sea and backed by fossil cliff lines occur on parts of the west coast (Walker, Gray and Lowe, 1992). These, the 'pre-glacial beaches' of the Geological Survey memoirs, are to be found at heights ranging from a few metres above OD in Kintyre to 34 m above OD on Islay and Jura and over 40 m above OD on Colonsay ([\(P915448\)](#)). They are overlain by till in places and may have been glaciated more than once. It is believed that they were formed during periods of rapid combined marine and periglacial erosion. The high cliffs of parts of the Moray Firth and North Sea coasts were also shaped in part prior to the last glaciation. A more widespread rock platform, the Main Late-glacial Shoreline, is discussed below.

Although the distribution of erratics can be attributed largely to the Main Late Devensian Glaciation in the central and western part of the region, the varied transport directions of those derived from major igneous bodies in north-east Scotland is further evidence of a complex glacial history ([\(P915448\)](#)). Boulders of Norwegian larvikite and rhomb porphyry have been found at several localities, notably on the coast north of Aberdeen where some occur in gravels below the Main Late Devensian till. These may have been carried across the North Sea by Scandinavian ice at some period prior to the Ipswichian Interglacial. Other far-travelled erratics include 'Pipe rock', characteristic of the Cambrian of the North-west Highlands. Boulders of Jurassic and Cretaceous rocks, including the well-known Lower Greensand boulder at Moreseat, have probably been derived from the sea floor of the Moray Firth. When these erratics were transported is uncertain, but movement may have occurred during the last as well as earlier glaciations.

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