Castle Hill

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Highlights

Deposits exposed in the coastal section at Castle Hill include a complex sequence of glacial, glaciolacustrine and possibly marine sediments. Organic remains, including shells of marine molluscs and pollen, are also present in some of the beds. Although the importance of the site for interpreting the Quaternary history and changing sedimentary environments of the Moray Firth coast is firmly established, the full details of the record await further investigation.

Introduction

Castle Hill [NJ 794 643], a coastal section at Gardenstown, demonstrates an important sequence of Pleistocene sediments, the interpretation of which is fundamental to an understanding of the timing and mode of the last glaciation of the north coast of Buchan. The site has been described in most detail by Jamieson (1906), Read (1923) and Peacock (1971a), and Jamieson (1865) provided a list of marine shells collected at the locality. A progress report of current research was given in Sutherland (1984b). There is, however, no overall agreement as to the stratigraphy of the site, nor is the chronology of the events recorded at Castle Hill established.

Description

Jamieson (1906) recorded a basal layer of partly worn clasts mixed with earthy debris that was overlain by a sequence of shelly sands and clays, which he considered to be a marine deposit. He did not report any till in the sections. Read (1923), however, noted a sequence comprising a basal layer of 'gravelly material', red till and, above, a series of sands and clays . Peacock (1971a) recorded a basal till overlain by a sequence of shelly sands, gravels and clays, the last being pebbly and till-like in one bed. Overlying the shelly sediments was a bed of dark grey silt and the section was capped by around 17 m of fine-grained non-fossiliferous, micaceous, yellow sand. A radiocarbon date of >39,500 BP (Birm–191b) was reported by Peacock (1971a) from the shelly horizons, but this failed to resolve the age of the deposits.

The full succession was not observed by Sutherland (1984b), but he identified the following sequence:

11.	Silts, sands and minor clays.	*c.* 17 m
10.	Dark grey, laminated silts and fine sands.	?
9.	Red-brown till.	?
8.	Gap.	10 m
7.	Bedded, medium sands and silts.	?
6.	Shelly gravel.	0.1 m
5.	Irregularly bedded and disturbed, yellow, medium sands and massive, grey clays.	*c.* 2 m
4.	Dark grey, massive clay.	*c.* 1.5 m
3.	Organic sand.	0.2–0.6 m
2.	Angular, platy clasts of Dalradian metasediments in a loose sandy matrix with occasional bedded sand lenses.	0.8–2.0 m
1.	Weathered Old Red Sandstone bedrock.	

The clasts in bed 2 comprise Dalradian metasedi-ments indicating derivation from the slopes immediately to the west of Castle Hill. The upper part of bed 5 was thought to be slumped. Sutherland was uncertain as to whether the organic sand (bed 3) was part of the slumped material or whether it represented an interstadial deposit. The bedding in bed 7 indicated deposition of the sands by a west to east current. No clearly *in situ* beds were reported by Sutherland assemblage, dominantly of *Pinus* grains; the upper part of the silts was involuted and cracked. Cross-bedding in the lower 2–3 m of bed 11 indicated deposition by a current flowing from N35°W, and in the upper part, dewatering structures were present.in the gap in the section, but minor exposures revealed very shelly gravels, sands and massive, grey clays. Bed 9, the only till encountered at Castle Hill, formed a bench around the hill and was similar to till on the neighbouring hill slopes. One sample from bed 10 had an organic content of 14% and a sparse pollen Sutherland (1984b) also provided additional information on the age of the deposits: amino acid analyses (D-alloisoleucine : L-isoleucine ratios) of two shell fragments of *Arctica islandica* (L.) from the shelly gravel below the till suggested that the shells were of Ipswichian to Devensian age. The details are:

Laboratory No.	Ratio	
	Free	Total
BAL–309B	0.333	0.097
BAL–309C	0.366	0.176

Information on the Castle Hill fossil shells has been summarized as follows by J. D. Peacock (unpublished data). The Castle Hill locality was examined by Miller (1859, p. 333) and shells of marine molluscs in the Hugh Miller Collection in the Royal Museum of Scotland labelled 'Glacial shell beds, Gamrie, Banff were almost certainly collected from this site (J. D. Peacock, unpublished data). They include paired valves of *Macoma balthica* (L.), *M. calcarea* (Chemnitz) and *Tridonta montagui* (Dillwyn) as well as fragments of *Timoclea ovata* (Pennant). These are partly enclosed in a matrix of coarse-grained, slightly clayey sand. *Arctica islandica* (L.) occurs only as umbonal fragments. The bed from which the shells were collected probably corresponds to bed 7 of Jamieson (1906), bed 5 of Peacock (1971a) and bed 6 of Sutherland (1984b). Jamieson (1906) listed 25 species of mollusc from this locality, many occurring as entire shells. The fauna as a whole is of high-boreal to low-arctic aspect and the excellent preservation of the paired valves suggests that the bed itself is either *in situ* or was transported and deposited by ice *en masse* without significant deformation (see Boyne Quarry).

Interpretation

Read (1923) assigned the sands and clays that he described to his Banffshire 'Coastal Deposits', which he considered to pre-date the last glaciation (from the south) of this coastal area. The shelly deposits described by Peacock (1971a) were considered by him to be the product of the last glaciation (from the north-west) of the area, and the upper sequence of grey silts and yellow sands he assigned to the Banffshire 'Coastal Deposits' which, he argued, had been deposited in an ice-dammed lake during the retreat of the last (Late Devensian) ice-sheet. This lake drained southwards along the Afforsk meltwater channel [NJ 790 623].

The Castle Hill sequence is important for resolving the problems of the last glaciation of the eastern Moray Firth coast. Most workers are agreed that the last till to be deposited along this coastline was the product of glaciation from the north-west (Jamieson, 1906; Synge, 1956; Hall, 1984b; Sutherland, 1984a; Hall and Connell, 1991). Both Read (1923) and Bremner (1928, 1934a) advocated later glaciation to explain the movements of erratics and the sequence of meltwater channels but, with the exception of a few sections, no till has been ascribed to this later glaciation. Those sections originally considered to show an upper till have been reinterpreted as either due to complex glacial deposition (Simpson, 1955) or solifluction (Synge, 1956; Peacock, 1971a). The till (bed 9) at Castle Hill identified by Sutherland (1984b) is therefore considered to have been deposited during this period of glaciation from the north-west.

Debate, however, surrounds the date of the glaciation that deposited the till at Castle Hill. The majority opinion is that the last glaciation of this area was during the Late Devensian (Synge, 1956; Peacock, 1971a; Clapperton and Sugden, 1977; Hall, 1984b), but Sutherland (1984a) has suggested that the Late Devensian ice limit may have lain to the west and that the last glaciation here was an Early Devensian event (see also Sutherland, 1981a). The available dating evidence from Castle Hill does not allow these two conflicting interpretations to be resolved.

The sediments overlying the till at Castle Hill (beds 10 and 11) are most probably glaciolacustrine sediments, as envisaged by Peacock (1971a), but the possibility of an organic cryoturbated horizon in these deposits, as reported by Sutherland (1984b), may indicate a more complex history than the brief existence of an ice-dammed lake during a period of deglaciation. The sediments underlying the till are of uncertain origin. They may represent a period of lacustrine sedimentation during ice advance or possibly, in part, marine sedimentation, as suggested by Sutherland (1981a).

Castle Hill has one of the thickest and most complex sequences of Pleistocene sediments along the north Buchan coast. The site is important for elucidation of the glacial chronology of this area, and with possibly two organic horizons within the sequence and abundant marine mollusc shells in certain strata, including one bed possibly *in situ,* there is considerable potential for dating the events represented by the sediments. More widely, the site will ultimately provide evidence relevant to the debate on the extent of the Late Devensian ice-sheet and the possibility of ice-free areas remaining in northeast Scotland at the maximum of that glaciation.

Conclusion

Although the sequence of deposits at Castle Hill has a long history of research, the ages and origins of the different beds are not yet fully established. The site is nevertheless important because of the dating potential provided by the organic contents of the deposits. Further research at Castle Hill should help significantly to resolve the question of the timing of the last glaciation of the eastern Moray Firth coast and the detailed sequence of geomorphological changes that occurred both before and after that event.

References