LEAVAD

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OS Grid Reference: ND174462

Highlights

The principal interest at Leavad comprises a large raft of Lower Cretaceous sandstone believed to have been transported from the sea floor off Caithness by ice moving onshore. The erratic mass is an outstanding example of its kind and lies within a sequence of glacial deposits which includes three tills. The latter provide important evidence for interpreting the glacial sequence of Caithness and the patterns of ice movement.

Introduction

The principal interest at Leavad (ND 174462) in eastern Caithness is a large (nearly 800 m long) erratic of Lower Cretaceous sandstone believed to have been transported by ice over a distance of at least 15 km from the sea floor off the Caithness coast. The erratic occurs in a sequence of deposits, including three tills, so thatLeavad is potentially an important reference site for the Pleistocene stratigraphy of Caithness. The deposits atLeavad were formerly exposed in a quarry and have also been investigated by boreholes (Tait, 1908, 1909, 1912; Carruthers, 1911; Crampton and Carruthers, 1914).

Description

The first accounts of the Leavad Quarry (Tait, 1908; Carruthers, 1911) described a decomposed calcareous sandstone with more resistant concretions, quite unlike any other sandstone in the neighbourhood. Tait (1908)1908) initially considered it to be a small outlier of Jurassic rocks resting unconformably on Old Red Sandstone, but was unable to confirm this because no contact was seen. He recognized similarities between the large concretions in the sandstone and egg-shaped stones dredged from Wick harbour, transported there by ice from a source near Brora. Subsequently, Tait (1909)1909) reported fissures of boulder clay with Highland metamorphic rocks between the concretions and, within the latter, fossils identified as a Lower Cretaceous (Neocomian) assemblage by Kitchin (Lee, 1909). Above the calcareous sandstone was a boulder clay, coarser in texture and with more stones of local origin (Old Red Sandstone). Tait raised the possibility that the Cretaceous sandstone might be a glacially transported mass, similar to that at Moreseat in Aberdeenshire (seeMoss of Cruden).

To settle the question of the origin of theLeavad sandstone a series of boreholes was put down in 1910. The findings were described byCarruthers (1911), Tait (1912) and summarized by Crampton and Carruthers (1914). The deposits containing the sandstone mass occupied a buried channel of the Little River to a depth of at least 24.1 m below the floor of the quarry: they comprised the following sequence (Tait, 1909, 1912).

15.	Sandy till with stones of local origin (exposed in the quarry)	0.6 m
14.	Sand and sandstone with Cretaceous fossils (5.2 m exposed in the quarry)	7.9 m
13.	Dark-green, bedded clay with shells and Foraminifera	1.5 m
12.	Dark clayey sand	0.6 m
11.	Dark-green clay with shells	0.4 m
10.	Clay and sand	0.8 m
9.	Greenish clay with shell fragments	0.2 m
8.	Dark shelly till with striated stones	0.6 m
7.	Yellowish-green, sandy till with stones of local origin	5.0 m
6.	Gravel	0.8 m
5.	Yellowish sandy clay and gravel	0.6 m
4.	Gravel	1.5 m
3.	Yellowish sandy clay and gravel	8.0 m
2.	Brown sandy clay	0.6 m
1.	Clean sand and gravel	> 0.7 m

The boreholes confirmed that the sandstone (bed 14) is an erratic block, and its size was estimated at 878 m long, 549 m wide and 7.9 m thick.

Tait noted that beds 3, 5 and 7, which he interpreted as till, with interbedded gravel layers (beds 4 and 6), were quite distinctive from the dark, shelly till of bed 8, being more sandy in composition, lighter in colour and containing stones largely of local Old Red Sandstone origin. Lee (in Carruthers, 1911) identified the fossil assemblage in the dark-green clay (beds 9, 11, 13 as post-Cretaceous, but noted differences with that found elsewhere in the shelly till of Caithness. He suggested that the clay might belong to some part of the Crag, but the dominance of thermophilous forms, typical of the Miocene, indicates an earlier age (Hall, unpublished data). If the dark-green clay does indeed represent an erratic mass of Miocene clay then its occurrence at Leavad is of great interest, for no sediments of this age are known from the Moray Firth west of 1°W (Andrews *et al.*, 1990).

Interpretation

Carruthers (1911), Tait (1912) and Crampton and Carruthers (1914) all considered that the Leavad erratic was transported to its present position from the floor of the Moray Firth by the same ice moving onshore which deposited the shelly till of Caithness (Peach and Horne, 1881c; see Baile an t-Sratha). The nearest Lower Cretaceous sediments to Leavad occur just offshore (Andrews *et al.*, 1990) implying a minimum distance of transport of about 15 km. A similar sandstone has also been encountered about 1 km north of Leavad (Crampton and Carruthers, 1914). This may also be presumed to be an erratic.

On account of its size the Leavad erratic is frequently quoted as a spectacular example of a glacially transported mass (Charlesworth, 1957; Sissons, 1967a; Embleton and King, 1975a). Similar features in Scotland include the Moreseat erratic (Jamieson *et al.*, 1898), the Comiston boulder (Campbell and Anderson, 1909), the Kidlaw erratic (Kendall and Bailey, 1908) and the Plaidy erratic (Jamieson, 1859, 1906; Read, 1923). Others elsewhere in Britain are described by Charlesworth (1957), Sparks and West (1972) and Embleton and King (1975a). Possible mechanisms of entrainment of such masses have been discussed by Weertman (1961) and Boulton (1972a) (see also Clava).

If Tait's descriptions of the section and boreholes are valid, the Leavad erratic is also of considerable stratigraphic interest as the only known site where the three till members represented in Caithness are superimposed: a till of local origin appears to overlie a shelly till derived from offshore, which in turn overlies a lower local till. Leavad may therefore be an

important reference site demonstrating the succession of Pleistocene deposits in Caithness, the interpretation and chronology of which are still debatable. At present no exposures exist in the original sandpit, although along the Burn of Tacher (ND 176465) a dark till overlies a lighter brown one. Possibly these represent the shelly till and lower local till, respectively. The upper local till is not exposed.

Conclusions

Leavad is notable for a large mass of sandstone incorporated within a sequence of till deposits. It is a well-known example of a large erratic and was transported by an ice-sheet from its original location in the bedrock offshore and deposited within the glacial sediments at Leavad. The occurrence of three tills in the sequence provides potentially important evidence for the pattern of successive ice movements across the area and the interaction of different ice masses. As yet, the ages of these deposits are not firmly established.

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