
GREENOCK MAINS

J.E. Gordon

OS Grid Reference: NS635277

Highlights

The sequence of glacial and glaciofluvial deposits exposed in stream sections at Greenock Mains is significant for interpreting the movement patterns of the Late Devensian ice-sheet.

Introduction

The site at Greenock Mains (NS 635277) comprises a series of exposures on the Greenock Water, 8 km west of Sorn, which show a layer of sand and gravel interbedded between two tills. This sequence is important for interpreting the glacial history of Ayrshire. It has been described by Smith (1898) and by (Holden, 1977a, 1977d) who considered that it represented a local readvance of the Late Devensian ice sheet.

Description

In his classic paper on the glacial deposits of Ayrshire, Smith (1898) first described the sections at Greenock Mains, noting 47 ft (14.3 m) of upper boulder clay, stratified in part, overlying 32 ft (11.1 m) of sand, gravel and lower boulder clay. He recorded that the upper boulder clay was shelly in its upper part.

More recent descriptions of the section have been given by Holden (1977a, 1977d) and Abd-Alla (1988). The basic sequence comprises:

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| 3. | Red-brown, sandy till with clasts of sandstone, shale, siltstone and occasional igneous rocks | up to 4 m |
| 2. | Sand and gravel | up to 20 m |
| 1. | Chocolate-brown, sandy till with shells and clasts of sandstone, shale, igneous and metamorphic rocks; locally with dark grey, silty-clay matrix | up to at least 4 m |

Abd-Alla (1988) found that the deposits in bed 1 differed significantly between the two sections that he studied in terms of their grain-size distributions and geochemistry, and to a lesser extent in the relative proportions of the clay minerals present. The deposits in section closely resembled the shelly till present at other localities in Ayrshire. They also showed an increase in clay and silt content with depth and weathering in their upper part. At the other section, the deposits were comparable in their properties to the shelly clay at Afton Lodge (see above).

In the sand and gravel (bed 2) above the shelly till (bed 1) Holden recognised channel forms, arched-bedding, poor sorting of materials and the presence of large cobbles, all suggestive of a high-energy fluvial environment of deposition typical of a sandur. Palaeocurrent analysis indicated water flow from the north-east.

Holden recorded no shells in the upper till, but apart from this and colour, both tills were similar in particle size composition and their relatively high percentage of clasts of local origin and small percentage of clasts of Highland origin. Abd-Alla (1988) noted that the upper till was weathered to a depth of up to 3 m.

Interpretation

From the clast fabric, Holden concluded that the lower till (bed 1) was deposited by ice originating in the Highlands and moving locally from west to east across the Greenock Mains area after it had bifurcated in central Ayrshire in the presence of Southern Uplands ice. It is

part of the classic shelly till unit of central and southern Ayrshire (Geikie *et al.*, 1869; Smith, 1898; Richey *et al.*, 1930; Eyles *et al.*, 1949) (see also Afton Lodge) and is one of a number of exposures in the Ayr valley and near Muirkirk referred to by Geikie (1863a), Smith (1901) and Holden (1977a). Abd-Alla (1988) argued that at one section at Greenock Mains, bed 1 was an *in situ* marine deposit on the grounds of the similarity of its properties to those of the shelly clay at Afton Lodge, for which he accepted an *in situ* marine origin. However, as at Afton Lodge, such a contention requires further investigation, together with full evaluation of the alternative hypothesis of ice transport of a large block of sediment (see Clava).

From a study of field relations Holden inferred that the overlying sands and gravels were part of the same series of deposits as the extensive surface sands and gravels in the Ayr valley. The latter were interpreted by Geikie (1894) and Charlesworth (1926b) as proglacial lake sediments, but Holden considered them to be ice-contact deposits. From the weathering indicated by the clay minerals and the downcasting of fines in the shelly till of bed 1, Abd-Alla suggested that at least a short interval occurred before the deposition of the overlying sand and gravel; such a suggestion is compatible with observations in modern glacier forefields (Boulton and Dent, 1976).

Holden found that the upper till above the sands and gravels was confined to an area of about 8 km² and considered it to represent a local readvance of the Highland ice that last covered the area. He apparently did not investigate the possibility of whether it might be a flow till or part of a single, complex sequence of deposits similar to those recorded in modern glacier environments (Boulton, 1972b; Boulton and Paul, 1976; Paul, 1983). Such a possibility merits further investigation, particularly since many other tripartite sequences in Britain have now been re-interpreted in such terms (see Hewan Bank; Martin, 1981; Eyles *et al.*, 1982).

Sutherland (1984a) has indicated that if the till was indeed the product of a readvance of Highland ice then this implies that active ice continued to occupy the Firth of Clyde and Ayrshire lowlands after the eastern Central Lowlands had been deglaciated.

Greenock Mains is an important reference site for the glacial stratigraphy of Ayrshire, representing the classic shelly till and glaciofluvial sediments of the area. It is also notable for the presence of an upper till which may represent a local readvance of the Late Devensian ice sheet or may be part of a single, complex sequence of deposits. The upper till is distinct from other tills in a similar stratigraphic position farther south in Ayrshire (such as at Nith Bridge) in that it was deposited by ice flowing outwards from the Firth of Clyde and not from the Southern Uplands.

Conclusions

The ice-deposited sediments at Greenock Mains are important for interpreting the glacial history of Ayrshire. They include two tills derived from different ice sheets: a lower shelly till characteristic of this area and an upper till which may represent a local readvance of the last ice sheet. Greenock Mains forms part of a network of reference sites for reconstructing the pattern of movement and retreat of the last ice sheet (approximately 18,000–13,000 years ago).

Reference list

- Abd-Alla, M.A.A. (1988) Mineralogical and geochemical studies of tills in south-western Scotland. Unpublished PhD thesis, University of Glasgow.
- Boulton, G.S. (1972b) Modern Arctic glaciers as depositional models for former ice sheets. *Quarterly Journal of the Geological Society of London*, **128**, 361–93.
- Boulton, G.S. and Paul, M.A. (1976) The influence of genetic processes on some geotechnical properties of glacial tills. *Quarterly Journal of Engineering Geology*, **9**, 159–94.
- Charlesworth, J.K. (1926b) The readvance, marginal kame-moraine of the south of Scotland, and some later stages of retreat. *Transactions of the Royal Society of Edinburgh*, **55**, 25–50.
- Eyles, V.A., Simpson, J.B. and McGregor, A.G. (1949) *Geology of Central Ayrshire*. (Explanation of One-Inch Sheet 14). 2nd Edition. Memoirs of the Geological Survey of Scotland. Edinburgh, HMSO, 160pp.

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- Eyles, N., Sladen, J.A. and Gilroy, S. (1982) A depositional model for stratigraphic complexes and facies superimposition in lodgement tills. *Boreas*, **11**, 317–33.
- Geikie, A. (1863a) On the glacial drift of Scotland. *Transactions of the Geological Society of Glasgow*, **1**, 1–190.
- Geikie, J. (1894) *The Great Ice Age and its Relation to the Antiquity of Man* 3rd ed. London, Edward Stanford, 850pp.
- Geikie, A., Geikie, J. and Peach, B.N. (1869) Ayrshire: southern district (Explanation of Sheet 14). *Memoirs of the Geological Survey of Scotland*. Edinburgh, HMSO, 27pp.
- Holden, W.G. (1977a) The glaciation of Central Ayrshire. Unpublished PhD thesis, University of Glasgow.
- Holden, W.G. (1977d) Greenock Mains. In *Western Scotland I* (ed. R.J. Price). INQUA X Congress 1977. Guidebook for Excursion A12. Norwich, Geo Abstracts, 15–6.
- Martin, J.H. (1981) Quaternary glaciofluvial deposits in central Scotland: Sedimentology and economic geology. Unpublished PhD thesis, University of Edinburgh.
- Paul, M.A. (1983) The supraglacial landsystem. In *Glacial Geology. An Introduction for Engineers and Earth Scientists* (ed. N. Eyles). Oxford, Peramon Press, 71–90.
- Richey, J.E., Anderson, E.M., MacGregor, A.G., Bailey, E.B., Wilson, G.V., Burnett, G.A. and Eyles, V.A. (1930) The Geology of North Ayrshire. (Explanation of One-Inch Sheet 22). *Memoirs of the Geological Survey of Scotland*. 2nd edn. Edinburgh, HMSO, 417pp.
- Smith, J. (1898) The drift or glacial deposits of Ayrshire. *Transactions of the Geological Society of Glasgow*, **11**, (supplement), 134pp.
- Smith, J. (1901) The drift or glacial formation of the Clyde drainage area. In *Fauna, Flora and Geology of the Clyde Area. Handbook on the Natural History of Glasgow and the West of Scotland* (eds G.F.S. Elliot, M. Laurie and J.B. Murdoch). Glasgow, British Association for the Advancement of Science, 520–7.
- Sutherland, D.G. (1984a) The Quaternary deposits and landforms of Scotland and the neighbouring shelves: a review. *Quaternary Science Reviews*, **3**, 157–254.