Tangy Glen

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Highlights

The stream sections at this locality provide exposures in high-level, shelly clays. These are believed to be a unique occurrence of *in situ* marine sediments deposited during a Middle Pleistocene glaciation when relative sea level was higher than at present.

Introduction

The Tangy Glen site comprises stream sections along three burns on the west coast of Kintyre *c.* 13 km north-west of Campbeltown: Tangy Burn [NR 659 279], Drumore Burn [NR 670 329] and Allt a'Ghlaoidh [NR 670 337]. During the last century a number of localities were discovered in Scotland at which marine shells contained in sands or clays were overlain by glacial sediments (see Jamieson, 1858, 1866; Smith of Jordanhill, 1862; Crosskey and Robertson, 1873b; Fraser, 1882a, 1882b). These sites occurred at altitudes considerably in excess of the more widely distributed fossiliferous clays which post-dated the glacial deposits, and considerable debate ensued as to the nature of the high-level deposits and their place in the glacial sequence (J. Geikie, 1874; see also Clava). As a consequence a special committee of the British Association was convened to investigate these occurrences and one of the three areas they investigated was the sequence of shelly clays on the west coast of the Mull of Kintyre. These deposits were first reported by Crosskey and Robertson (1873b) at Tangy Glen and, although the main exposures of the clays are found in stream-cut sections to the north (Horne *et al.,* 1897), it is by the name of the original locality that the site is commonly known. The most detailed description of the stratigraphy of the shelly clays of Kintyre is that given by Horne *et al.* (1897). Subsequently the deposits have been investigated by Munthe (1897), Jessen (1905) and Gray (1985). Gray (1985) and Bowen and Sykes (1988) provided details of amino acid analyses of shells from the clays, and Sutherland (1981a) placed them in a wider context of related deposits in Scotland.

Description

The glaciation of the Kintyre peninsula was recorded by Horne *et al.* (1897) as being in a generally westerly direction based on the evidence of striae as well as the occurrence of erratics of Arran granite across the area.

Horne *et al.* (1897) reported clays occurring in three separate localities along approximately 4 km of coastline. In Tangy Glen the clays occur up to a height of about 135 ft (41 m) above present sea level, whereas to the north in Drummore Glen the top of the clays was taken to be 199 ft (60 m) and beside the Cleongart Burn (Allt a'Ghlaoidh), about 179 ft (55 m). Of these three exposures that at Cleongart was by far the most fossiliferous and it is the one that has been most closely investigated.

Horne *et al.* (1897) excavated two trenches across the top and base of the shelly clays in the Allt a'Ghlaoidh exposure as well as drilling three holes upstream and two in a line to the south in order to determine the continuity of the deposit in those directions. The stratigraphy they established is given below and illustrated in (Figure 10.2).

3. Till, reddish-brown with abundant boulders most of which are local schist. No Arran granite erratics were observed in the section, but these occur frequently in the neighbourhood.	22.5 m
2. Shelly clay, stiff, dark bluish. The upper part is relatively stone-free, but fragments of schist occur in the lower part. Shells occur throughout.	8.4 m
1. Compact coarse sand and gravel. Unfossiliferous.	>1.2 m

This succession has been confirmed in its broad details by subsequent workers (Munthe, 1897; Jessen, 1905; Gray, 1985) although more detailed descriptions have been given of the shelly deposits. Both Munthe (1897) and Gray (1985) identified a stoney layer in the clays, which Munthe compared to a 'veritable boulder clay', although Jessen (1905) disagreed that it could be compared to a glacial sediment.

Interpretation

The initial work of Crosskey and Robertson (1873b), Brady *et al.* (1874) and Horne *et al*. (1897) produced lists of species of marine molluscs, Foraminifera and ostracods, but did not attempt to establish whether there were any vertical variations in the species representation except for sequential analyses in the most southerly of the boreholes. No comment was made on the significance of any changes in the occurrence of different species at different levels in the clays. The most common molluscs recorded by Horne *et al.* (1897)were the bivalves *Arctica islandica* (Linné), *Astarte sulcata* (da Costa), *Macoma calcarea* (Gmelin), *Nicania montagui* (Dillwyn), and *Nuculana pernula* (Müller) and the gastropod *Turritella tenebra* (Linné). It was noted, however, that there was an apparent mixture of species deriving from both arctic and more southerly latitudes. It was also noted that the majority of the mollusc shells were broken.

In contrast to this initial work, Munthe (1897) examined twelve samples taken vertically through the deposit. On the basis of the fossil content of these samples Munthe concluded that the period of deposition of the clays coincided with a succession of cold to warm to cold climate. Munthe further interpreted the gravel at the base of the section (bed 1) as a glacial deposit, and hence argued that the warm phase in the middle portion of the clays was an interglacial. He considered that during the two cold phases water depth would have been at least 40 m (that is, upwards of 95 m above present sea level), but that during the warm phase a water depth of between 6 m and 25 m was more likely (between 51 m and 70 m above present sea level). Munthe accepted, however, that there were certain species which apparently implied different climatic conditions from those he interpreted and he suggested that these were reworked from previous deposits.

Jessen (1905) did not accept Munthe's (1897) subdivision of the deposit on the basis of its fauna. In contrast, he pointed out that the only mollusc shells to be found with valves together and in growth position were those indicative of an arctic climate. He suggested that since the shells of all the southerly indicators were in a fragmentary condition, they were derived. The deposition of the clays was envisaged by Jessen as taking place during a glacial phase when the sea level was about 90 m above that of the present.

During deposition of the clays in the lower part of bed 2 the ice front was at some distance from the site, but an advance brought the ice margin near to the adjacent shore and at this period a pre-existing deposit was eroded and the broken shells from this were redeposited in the middle portion of the clays. An increased quantity of gravel and boulders was deposited at this time because of the proximity of the ice front. Subsequently the glacier retreated and conditions similar to those during deposition of the basal clays resumed. At some later date ice advanced over the whole site depositing the till that caps the section. This last advance was considered by Jessen to be 'much younger' than the underlying clays. Both Munthe (1897) and Jessen (1905) accepted that during the glaciation(s) of the area ice movement was from east to west.

A quite distinct glacial history was offered for the southern Kintyre peninsula by Synge and Stephens (1966). They suggested that the Tangy Glen shelly clays were a till emplaced during an early glaciation with ice movement from north to south. There was a subsequent 'main' ice movement from east to west during which the overlying red till was deposited, but after this there occurred a final ice movement, again from the north, with an ice margin in the general area of Tangy Glen, where 'morainic accumulations' were referred to as being present. Striae oriented S10°E were cited as supporting evidence for this final ice movement. No further justification was advanced for regarding the shelly clays as being glacial in origin.

The shelly clays were regarded by Sutherland (1981a) as being *in situ* marine deposits and he argued that they had a common origin with the other similar deposits encountered around the Scottish coast, such as at Clava and Afton Lodge. He noted that the maximum altitude to which the high-level shell beds had been encountered decreased with increasing distance along glacier flow-lines, and presented a model explaining the distribution in terms of crustal depression in front

of an expanding ice-sheet, with world sea level being relatively high during the initial glacial advance but subsequently falling as the large ice-sheets in the Northern Hemisphere expanded. The fauna of the shell beds was considered by Sutherland to indicate moderately arctic conditions and he argued that the conditions necessary to produce the deposits seemed to have occurred during the Early Devensian when, according to deep-sea core evidence, the last major period of glaciation was initiated (Shack-leton and Opdyke, 1973; Ruddiman *et al.,* 1980).

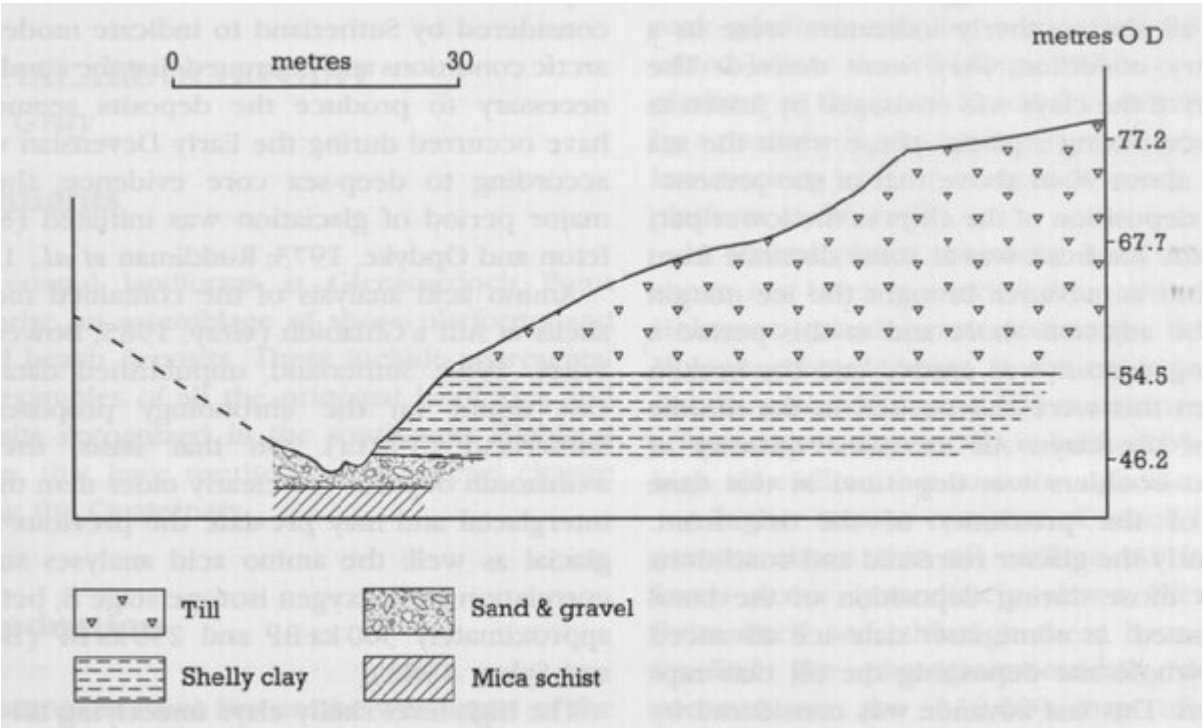
Amino acid analysis of the contained mollusc shells at Allt a'Ghlaoidh (Gray, 1985; Bowen and Sykes, 1988; Sutherland, unpublished data) has cast doubt on the chronology proposed by Sutherland (1981a). On that basis, the Allt a'Ghlaoidh deposits are clearly older than the last interglacial and may pre-date the previous interglacial as well: the amino acid analyses suggest correlation with oxygen isotope stage 8, between approximately 300 ka BP and 250 ka BP (Bowen and Sykes, 1988).

The high-level shelly clays underlying till along the west coast of Kintyre are some of the best examples of a type of deposit encountered at only a few sites in Scotland. Their origin has been controversial since their discovery last century. Current published opinion favours the interpretation of the deposits as being in *situ.* The amino acid analyses imply that the deposit is of Middle Pleistocene age, although the length of period during which they were deposited is unclear. A Middle Pleistocene age distinguishes the Tangy Glen deposits from those at Clava (Devensian age) and would mean that the deposits are the only known representatives in Scotland of a marine event, possibly associated with ice-sheet glaciation, during oxygen isotope stage 8.

Conclusion

The clays containing shells of marine molluscs at Tangy Glen form part of a suite of such deposits that occurs in Scotland well above present sea level. Although they have a long history of research dating back to the last century, their respective ages and origins remain a source of scientific argument. Current work suggests that the high-level clays at Tangy Glen were laid down when the land was depressed by ice during a Middle Pleistocene glaciation (approximately 275,000 years ago), which would make them the only known deposit of their kind in Scotland. They therefore have an important bearing on interpreting this significant part of the Quaternary history of Scotland, about which little is otherwise known.

References



(Figure 10.2) Tangy Glen: lithological succession at Cleongart (from Horne et al., 1897).