Excursion 11 Dundrennan Ranges, Gipsy Point: Silurian submarine slump features

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OS 1:50 000 Sheet 83 Newton Stewart & Kirkcudbright

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Route maps: (Figure 37) and (Figure 38)

Main points of interest Major slump structure, sand volcanoes and sedimentology of the Raeberry Castle Formation, Wenlock graptolites.

Logistics The area lies within the Ministry of Defence Test and Evaluation Establishment near Dundrennan, a strip of coastline which has been **used as a firing range for many years.** Recently announced plans (1994) indicate that its future is uncertain. The MOD has no objection to people visiting the area, except **when firing is in progress!** At such times **red flags and explanatory notices are displayed.** Notification of firing times is held by the Harbour Master and Tourist Information Office in Kirkcudbright. Access on foot is feasible without special permission when the range is not in use, normally evenings, weekends and public holidays, although it is always best to inform the range authorities in advance. Large parties, or visitors wishing to take vehicles into the range area, should contact the Commanding Officer beforehand (Test and Evaluation Establishment, Dundrennan, Kirkcudbright DG6 4QZ). **Do not touch** any strange objects encountered during the excursion.

Introduction

The primary aim of this excursion is to examine a gigantic slump structure, lying within a channel in a sequence of Wenlock turbidites belonging to the Gipsy Point Unit of the Raeberry Castle Formation (Riccarton Group). A series of sand volcanoes, probably formed by de-watering of the slump, lies just above the disturbed beds. Other tectonostratigraphical units within the Raeberry Castle Formation, showing diverse facies associations, can be seen further east along the coast. These represent channels, lobes and fringes within a submarine fan complex that built out from the north; the dominant transport direction was from the NE. From the entrance to the MOD establishment on the A 711 Kirkcudbright–Dundrennan road [NX 718 474] proceed south towards the shore, along the road leading to Little Balmae (Figure 37). About 1 km from the shore there is a small car park [692 449], to the left of which a track, with a sign marked 'Gipsy Point' leads down to the coast. A ten-minute walk brings the visitor to an area of numbered firing targets, and an old tank which forms a convenient landmark. From here proceed to the cliff top above Port Muddle. The localities of interest are indicated on (Figure 38). Comprehensive details of the section are given by Kemp (1987b). For a longer excursion this itinerary could be extended to examine the stratigraphically adjacent Ross Formation at localities 3 and 4 of Excursion 5 (Kirkcudbright).

1 Port Muddle: Gipsy Point Unit

This bay is excavated at the seaward end of a fault trending NNE, which may be traced inland as a boggy depression. All the beds in this vicinity lie within the Raeberry Castle Formation, now known to be Wenlock in age. Four thin bands of graptolite-bearing hemipelagite, which crop out below the cliff on the east side of the bay, provide confirmation.

According to Kemp (1987a and b), there are three definable tectonostratigraphical units within the Raeberry Castle Formation: the Gipsy Point Unit, the Raeberry Unit, and the Mullock Bay Unit. It is the Gipsy Point Unit (*riccartonensis* to *flexilis* biozones) that occurs here, on both sides of Port Muddle. All the beds are vertical and show quite diverse facies associations. Kemp described an A Member, of rather monotonous thin- to medium-bedded turbidites with some hemipelagic muds, and a B Member, with channelised arenites, rudites and slumps, interbedded with thin-bedded

sandstones, siltstones, and mudstones. Kemp interpreted these deposits as part of a meandering and laterally migrating channel-levee complex on a submarine fan, with the coarser deposits lying within the channels and the fine beds representing levees. All these sedimentary features are easily visible from the cliff top. It is possible to descend to the shore here, but the details are better seen at Gipsy Point.

2 Gipsy Point: slump

A walk of some 300 m in a WSW direction, keeping the old tank to the left and crossing a ruined wall, brings the visitor to the cliff top at Gipsy Point [NX 685 436]. A new military earthwork lies just to the west. The slump, which lies within the B Member of the Gipsy Point Unit, is well seen from the cliff top. It is some 30 m thick and lies within a channel-fill sequence consisting of chaotic and disordered thin-bedded sandstones. The sequence is vertical and youngs NW; above and below the slump the beds are undisturbed. One prominent horseshoe-shaped sedimentary fold within the slump sequence is particularly evident from this vantage point. It is clear that the sediment forming the slump must have slid down the process, but remaining cohesive.

It is possible, with care, to descend to the coast from here, to examine the slump more closely. The erosive base of the slump (SE side) can be seen cutting into the underlying beds, forming fossilized channels with flute casts; in some places rip-up clasts can be seen in the mudstone. The whole sequence has been folded by a large anticline–syncline pair which traverses part of the section and is clearly seen as a large box-fold on the vertical face near the point of descent from the cliff top.

3 Gipsy Point: sand volcanoes

Directly overlying the large slump is a single layer (now vertical) of spectacular sand volcanoes, originally described by Lovell (1974), who suggested that they formed as a result of dewatering of the underlying slump. Above lies a coarsening-upward sequence of thin sandstone–mudstone layers, interpreted as an interchannel or overbank sequence. The sharp junction between the top of the slump, with its attendant sand volcanoes, and the overlying beds is very well seen in the cliff face. This shows clearly that the original channel had been abandoned by the time renewed deposition began.

Lovell identified ten sand volcanoes, occurring ill three groups, over 100 m of strike section. Five of these are easily accessible, even at mid-tide. The largest and most obvious is over 3 m across, and is almost completely preserved. It is about 1.5 m deep and has a depressed central crater nearly 0.5 m across. Several of the other volcanoes are cut across, showing laminated sandstone with complex internal structure, as if the water had escaped in a series of pulses. One small volcano directly overlies another smaller one. A thin sandstone bed connects the sand volcanoes of the landward and central groups, but does not extend to the seaward set. In this latter group, however, is a sand volcano, cut so as to display the central pipe, which in this case is filled with coarse sandstone. Stringers of gritty material have developed in the underlying sandstone, and penetrated upwards into the sediment overlying the volcano during the dewatering process. This example is the only one to show a direct connection between the beds above and below the volcano.

The thin sandstone beds of the overbank sequence directly overlying the sand-volcano horizon show some interesting sedimentary structures. Firstly there are ripple marks with slightly different orientations, seen on successive vertical faces near the cliff edge. Secondly there are other structures, well worth examining, on the lower surfaces of the thin sandstone units down on the shore, a few metres above the sand volcanoes. Some of these faces are smooth but show convolute lamination in cross-section; other surfaces display very fine load casts. In some instances an otherwise smooth surface has only one or two isolated load casts, of which some are simple, whereas others are grouped together like bunches of grapes. Many faces, however, are entirely covered with load casts. One surface, about a metre above the sand volcanoes, displays strings of clearly orientated load casts, suggestive of modified ripples.

Small dolomitised concretions can be seen within the slump close to the base of the cliff, and several small fault-planes within the vicinity are likewise dolomitised. These may possibly have been synsedimentary faults penetrated by the diagenetic fluids associated with the concretion-forming process.

4 Big Raeberry: Raeberry Unit

The section east from Gipsy Point to Mullock Bay shows many features of interest and should be visited if time permits. From the east side of Port Muddle, to the far side of Howwell Bay, underneath the prominent hill of Big Raeberry, the turbidites belong to the Raeberry Unit (*rigidus* to early *flexilis* biozones) of the Raeberry Castle Formation. Kemp (1987) who logged the whole section in detail, recognised three separate facies. The medium- to occasionally thick-bedded turbidites of the A Member were interpreted as deposits of the depositional lobe of a submarine km. The very regular, thin-bedded turbidites of the B Member were considered to be a fringe facies of the fan lobe, whereas the alternating medium- and thin-bedded base-absent turbidites of the C Member were taken to represent a channel-mouth facies.

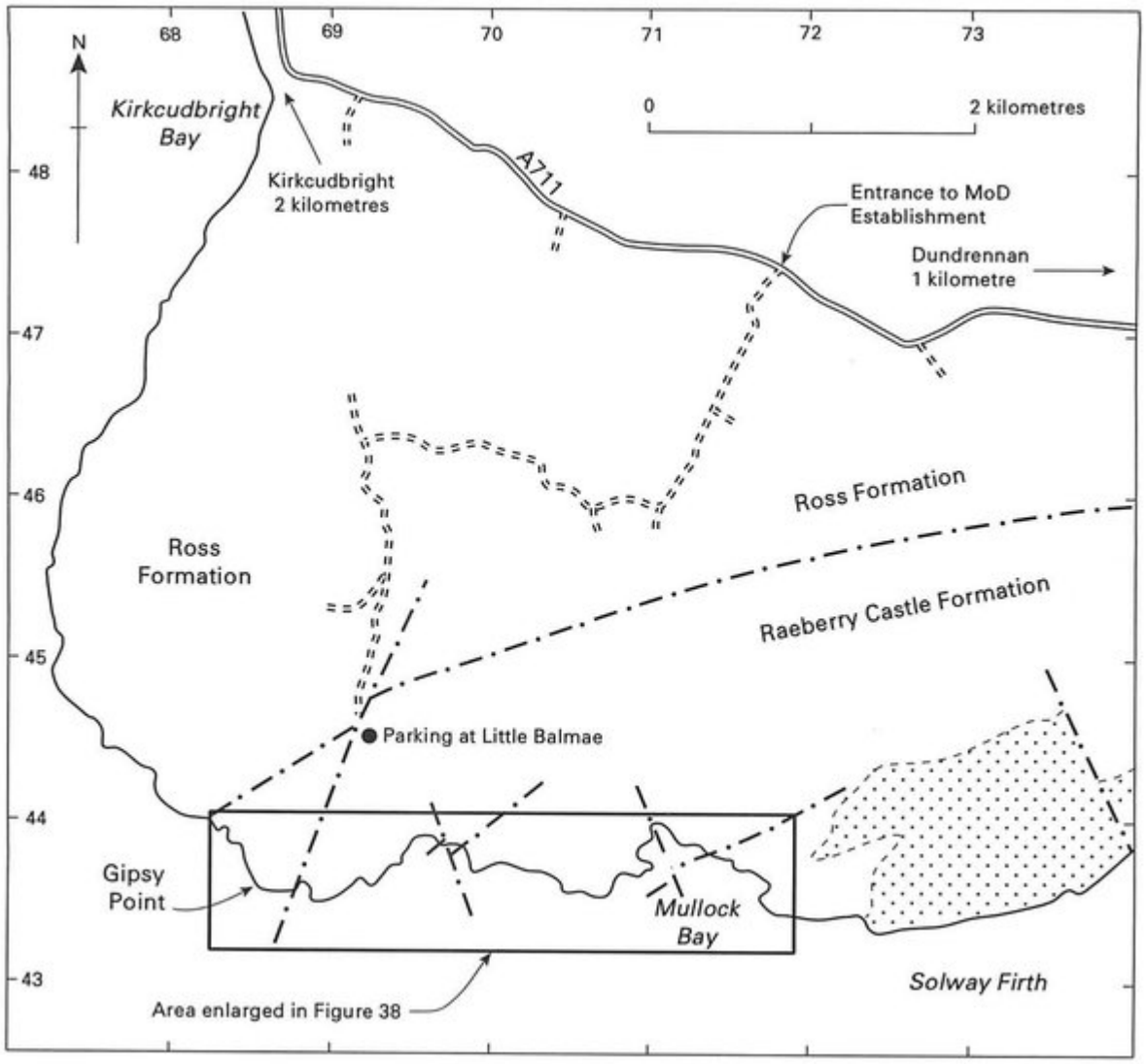
These distinctions are evident in the cliff section east of Big Raeberry, where the beds young to the NW. Just west of the prominent feature known as the Haystack [NX 702 437], the alternating thick and thin beds of the C Member form spectacular Z-folds (Locality 4a in (Figure 38)). In the prominent north—south-trending cliff some 200 m to the east (Locality 4b) all three members are clearly seen. The seaward end is formed from the varied lithologies of the A Member, the top of which is marked by a thick bed forming a notch in the cliff top. Landward of this lie the strikingly regular, alternating sandstones and siltstones of the B Member, of which the top is marked by a prominent vertical band of structureless siltstone, known as the 'homogenite wall'. This bed may be at the same horizon as the Gipsy Point slump, marking some large-scale event within the depositional basin. The ragged-looking C Member, with its projecting sandstone bands, is distinct and forms the north end of the cliff. The bases of many of the sandstones throughout this sequence are marked with flute casts showing variable transport directions.

5 Mullock Bay: Mullock Bay Unit

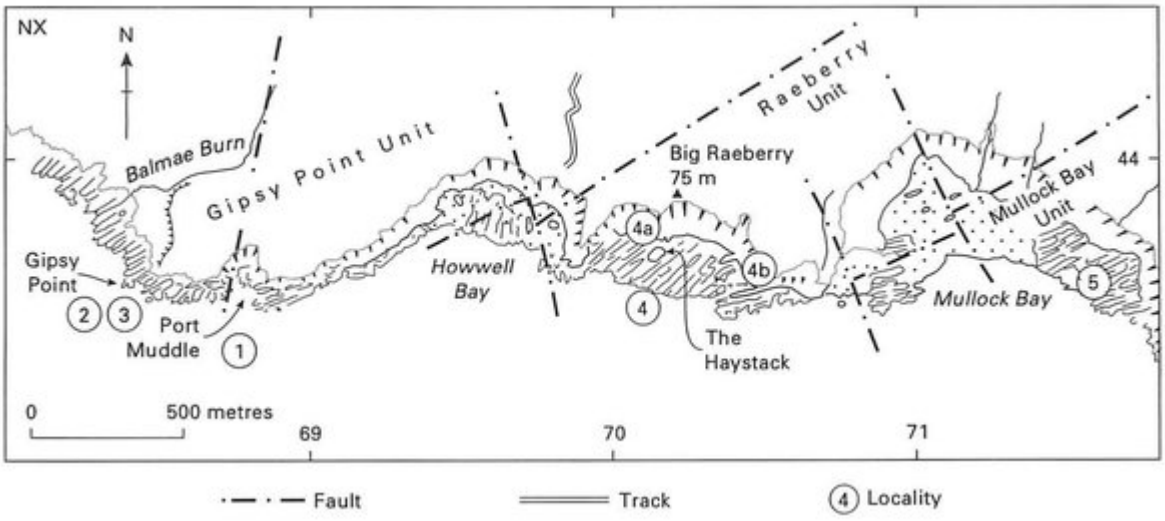
About i km further east, excellent sections in the Mullock Bay Unit of the Raeberry Castle Formation are well exposed along the shore. The beds here yield graptolites of the *ellesae* and *lundgreni* biozones, and are distinguished by having more hemipelagite and less sandstone than any of the other units seen along this section. Kemp (1987) divided these into two members. Member A consists of thinly bedded fine sandstones, siltstones and mudstones, alternating with channelised arenites and rudites. They are quite like the B Member of the Gipsy Point Unit, and like them are interpreted as having formed in a channel-levee system on a submarine fan. The B Member consists of a complex of alternating thin- to medium-bedded sandstones and shales, with occasional coarser horizons considered to represent prograding depositional lobes.

Return to Port Muddle along the cliff top or the shore.

References



(Figure 37) Locality map and outline geology for the Ministry of Defence Dundrennan Range.



(Figure 38) Shore section between Gipsy Point and Mullock Bay showing localities and outline geology.