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# The geology of the Qinetiq/Ministry of Defence firing range at Aberporth, Ceredigion

Part of 1:25 000 sheet SN25

Integrated Geoscience Surveys South Programme

Internal Report IR/05/011



BRITISH GEOLOGICAL SURVEY

INTERNAL REPORT IR/05/011

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Part of 1:25 000 sheet SN25

T. Huw Sheppard

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## Foreword

This report is the published product of a survey made by the British Geological Survey (BGS) of the geology of the Qinetiq/Ministry of Defence (MoD) firing range at Aberporth, Ceredigion. The Aberporth site lies within 1:25 000 scale series sheet SN25, and the firing range lies within that part of SN25 which falls within the boundaries of 1:50 000 scale series sheet 194 (Llangranog). The survey of sheet 194 is co-funded by the Wales Assembly Government.

The range was surveyed by T. H. Sheppard in May 2004.

The majority of localities cited within the text lie within the confines of the Aberporth firing range and visiting permission must be sought from Qinetiq Aberporth. The majority of other localities cited similarly lie on private lands and permission to visit must be sought from the relevant landowners.

## Acknowledgements

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## Summary

The Aberporth firing range is exclusively underlain by upper Ordovician (Ashgillian) mudstones of the Nantmel Mudstone Formation. The rocks dip uniformly to the north-west and comprise the northern limb of a regional anticline (upfold) in the Nantmel Mudstone formation, the axis of which trends south-west to north-east through Parclyn. A minor splay of the Ceibwr Bay Fault crosses the south-eastern corner of the range, being exposed by the sea cliffs in Cribach Bay. No quaternary (glacial) deposits were identified by the survey, and rockhead appears commensurate with the ground surface across the greater part of the range estate. The Gwrddon valley, to the south-west of the site, may have originated as a meltwater channel excavated beneath an ice-sheet during the last Ice Age.

# 1 Introduction

Aberporth lies on the Ceredigion coastline, some 7km north-east of Cardigan (Figure 1). The QinetiQ/MoD range occupies a headland promontory north-west of Aberporth town, and the area of the site is approximately 1.5 square kilometres. The bedrock of the Aberporth area is of Ordovician age. Younger rocks are not preserved. The area was overridden by the Irish Sea Glacier during the Devensian (last Ice Age), but appears to have been a site of glacial erosion, rather than deposition.

## 2 Ordovician

The Aberporth range is entirely underlain by the Nantmel Mudstones Formation, which crops out across a wide tract of Central Wales from the coast west of Penbryn, inland to Newcastle Emlyn and south as far as Carmarthen. At Aberporth these rocks comprise a succession of black to greenish-grey, well-bedded mudstones and rare thin siltstones, with individual mudstone beds generally less than ten centimetres in thickness and siltstone beds seldom thicker than 2-3mm. The rocks are deep-water marine sediments, deposited at a depth of several hundred to perhaps 1000m of water on the sea-floor of an ancient ocean basin known as the Welsh Basin (Soper *et al*, 1987; Davies *et al*, 1997), which existed throughout much of Lower Palaeozoic time (570 Million years to approximately 400 Million years ago). The Nantmel Mudstones are of late Ordovician Ashgill age (approximately 440 Million years old) and are characterised by abundant invertebrate burrows (bioturbation), which appear as a dark speckle in the rock. The main burrow style found in the Nantmel Mudstones at Aberporth is a form called *Chondrites*, which originally comprised a ramifying feeding network excavated beneath the sea floor by an annelid (worm). The abundance of burrowing indicates that, despite the depth of water, the sea-floor was supplied with sufficient oxygen to support marine life.

The rocks dip uniformly to the north-west (Figure 1) and comprise the northern limb of a geological structure where the rocks are folded into an arch (called an 'anticline'). The central axis of the arch runs through Parclyn, south-east of the site; in this area, the rocks begin to dip south-east, making up the other side of the anticlinal arch. A small fault, which only disturbs the rocks by a few metres, splays off the regionally important Ceibwr Bay Fault (Davies *et al*, 2003) and runs across the southern boundary of the site (Figure 1), bifurcating into two fault planes in Cribach bay, where it is marked by a zone of mineralised quartz veins. None of these faults are expected to be geologically active.

## 3 Devensian

Approximately 20,000 years ago during the Late Devensian (the last Ice Age), the area which is now the Irish Sea was instead occupied by a large ice sheet known as the Irish Sea Glacier (Davies *et al*, 2003), which flowed from the high ground of Scotland and the English Lake District. This ice mass overrode the coastline of west-Wales, rising over the cliffs in the Aberporth area, with ice spilling inland towards Newcastle Emlyn, down the tributary valleys of the river Teifi. Although clays, gravels and other sediments deposited by this ice-mass are common in the Aberporth area, none appear to be present on the range. The absence of such sediments suggests the area was being actively eroded by ice as it rose up over the steep cliffs, and thus the range area acted as a source for sediments which were then deposited elsewhere. That the Aberporth site was exposed to erosion during the Ice Age is suggested by the form of

the Gwyrddon Valley to the south-west of the range. Narrow, gouge-like valleys of a shape similar to that of the Gwyrddon are common in the coastal areas of West Wales, and have been interpreted as troughs dug into bedrock by water flowing beneath the Irish Sea Glacier (Glasser *et al*, 2004) rather than as river channels. It is very likely that the Gwyrddon valley originated as a subglacial channel of this sort dating from the last Ice Age, or perhaps even earlier.

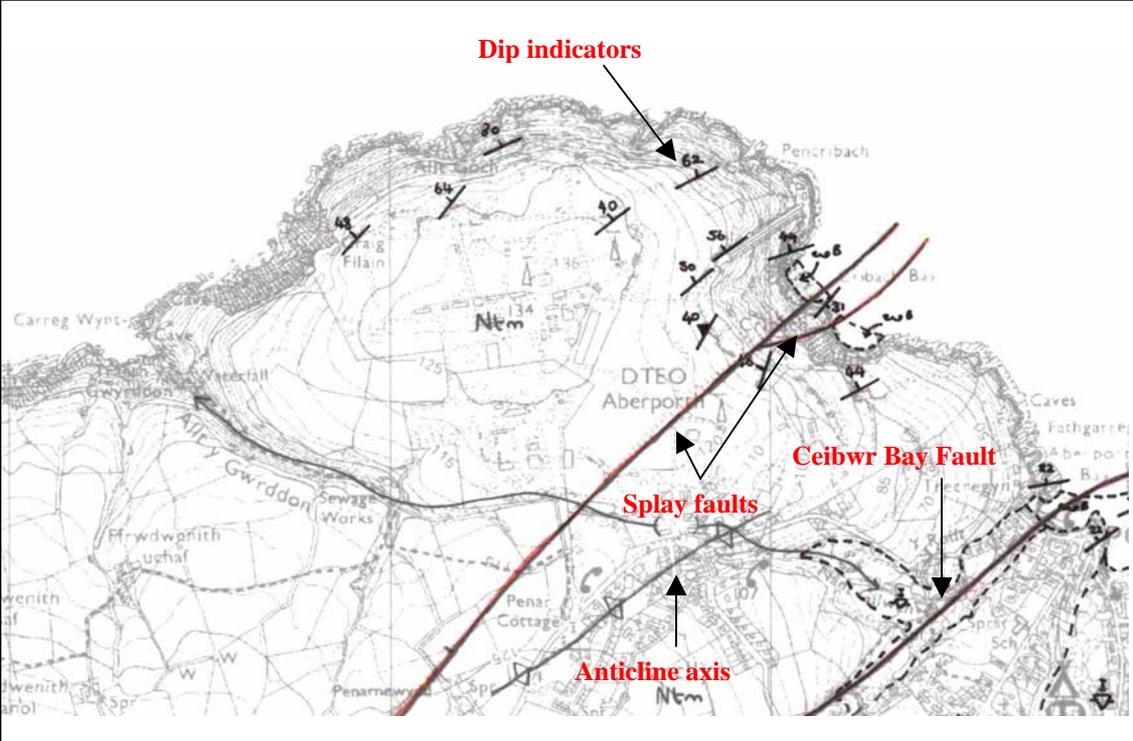


FIGURE 1. A geological sketch map of the Aberporth range, derived from hand-drawn field maps. ‘dip indicators’ show the direction in which the rocks are dipping (small tick) and the degree of inclination of the dip (number). ‘Anticline axis’ is the ‘arch’ of the fold which runs through Parcelyn. The Ceibwr Bat Fault and the small splays which cross the MoD site (red lines) are indicated.

## References

Most of the references listed below are held in the Library of the British Geological Survey at Keyworth, Nottingham. Copies of the references may be purchased from the Library subject to the current copyright legislation.

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