
Aultbea

[NG 852 920], [NG 880 978]–[NG 892 960]

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Introduction

The peninsula of Rubha Mor, between Loch Ewe and Gruinard Bay (Figure 4.1), (Figure 4.29), exposes about 2500 m of red sandstones belonging to the Applecross and Aultbea formations of the Torridon Group. Exposures are mainly in coastal sections, but are also found inland, notably on several rocky hills that range from 50 m up to 155 m high. The Geological Survey chose this peninsula as the type area for the Aultbea Formation (Peach *et al.*, 1907). The Applecross Formation consists of coarse- to very coarse-grained, reddish-brown pebbly sandstone, whereas the conformably overlying Aultbea Formation is a medium-grained sandstone and is mostly pebble-free. The beds dip south-east varying from 10°–15° on the western coast to 25°–35° on the eastern parts of the peninsula. Inland, the bedrock is commonly obscured by till and peat that may conceal a number of strike-parallel faults.

The area was first mapped by W Gunn for the Geological Survey in 1887 and later revised by Stewart (see British Geological Survey, 1999). Smith *et al.* (1983) studied the palaeomagnetism of these rocks, and Stewart and Donnellan (1992) investigated their whole-rock geochemistry. Stewart (2002) argued that the Applecross and Aultbea formations merely represent facies variations of a coherent package of Torridon Group red fluvial sandstones. He suggested that the two formations are only recognized sensibly in the Aultbea–Rubha Met' area.

Description

The Aultbea GCR site is divided into two subareas. The first, a rocky inland area around Creag an Fhithich Mot. (124 m) [NG 851 920], contains the stratotype for the boundary between the Applecross and Aultbea formations. The second, a 3.5 m-long coastal section from Camas Rainich [NG 880 978], south-east around Creag an Eilean and Leac an Fhaobhair to Camas a' Charraig [NG 8926 9596], which lies roughly 8 km NNE of Aultbea, contains the stratotype for the Aultbea Formation itself.

The upper part of the Applecross Formation, exposed in the north-west part of the Rubha Mor, is about 500 m thick. It consists of reddish-brown pebbly sandstones, which are typically trough cross-bedded. About half the beds have soil-sediment contortions, generally taking the form of open synclines 0.5–2m wide, normally linked by sharp anticlinal cusps. Pebbles on the coast section north-west of Slaggan reach 5 cm in size, but elsewhere they do not exceed 3–4cm. The pebbles are durable types, mainly quartzite, chert and red 'porphyry' (porphyritic rhyolite or rhyodacite) (Williams, 1969b; Anderton, 1980; Stewart, 2002). They are either scattered through the sandstone or concentrated into seams one pebble thick. On the east side of the sandy bay at Mellon Charles [NG 845 908] a medium-grained sandstone unit, 14 m thick, contains a discontinuous grey micaceous siltstone bed a few centimetres thick that shows partial phosphatization. This lies some 15 cm below the upper contact of the sandstones with a c. 1.5 m-thick bed of mid-grey, millimetre-laminated, coarse siltstone to fine sandstone, with traces of ripple-lamination. Coarse-grained sandstones of the Applecross Formation with pebbles of red 'porphyry', white quartz and quartzite, green chert and pink quartz-feldspar rock, immediately overlie the coarse siltstone bed. The pebbles reach 3 cm in size just above the siltstone, but decrease in size and abundance at higher levels in the stratigraphy.

The c. 1.5 m-thick coarse siltstone bed can be traced along strike inland to Creag an Fhithich Mòr at [NG 8500 9194], where it is again overlain by pebbly sandstones. The sandstone grain-size diminishes stratigraphically upwards, i.e. to the south-east. The contact with the Aultbea Formation, about 165 m stratigraphically above the grey siltstone, is exposed 160 m south-west of the south end of Loch Beinn Dearg at [NG 8542 9200]. Coarser-grained sandstones are defined as belonging to the Applecross Formation and finer-grained ones to the Aultbea Formation. However, the finer- and coarser-grained sandstones show metre-scale inter-bedding in this area. The transitional contact is defined in the

centre of a 10 m-thick sandstone interval, where the maximum grain-size first drops below 0.5 mm. This section, from Creag an Fhithich Mòr to the outlet of Loch Beinn Dearg, is the stratotype for the Applecross Formation–Aultbea Formation boundary. Palaeocurrents, measured from trough cross-bedding and linguoid ripples, are directed consistently towards the east or north-east. No change of palaeocurrent direction is observed at the contact between the Applecross and Aultbea formations.

Using the same definition, the Applecross Formation–Aultbea Formation boundary occurs on the coast about 2.5 km north-west of Aultbea [NG 852 907], at a point about 280 m stratigraphically above the grey siltstone bed. The apparently different stratigraphical intervals between the siltstone and the top of the Applecross Formation in the coastal and inland sections are attributed to faulting. Normal faults parallel to the strike are present in the inland section.

One or more grey siltstones similar to that described above are found at about the same stratigraphical level, c. 3.5 km above the base of the Applecross Formation, at localities spread over a distance of nearly 100 km. In the Summer Isles, about 20 km north-east of Aultbea, siltstones at this stratigraphical level have yielded abundant sphaeromorphic acritarch microfossils and filaments (Zhang *et al.*, 1981; Zhang, 1982), including the new genus *Torridonipbycus*, a cyanobacterium. However, the environment in which they lived remains uncertain.

The north-east coast of the Rubha Mòr peninsula (Rubha Beag) exposes some 2000 m of the Aultbea Formation, with the top concealed beneath Triassic sandstone and the base cut out by several strike faults north of Opinan. The type section for this formation is the continuous coastal section, which stretches from Camas Rainich, north of the hamlet of Opinan, to Camas a' Charraig, close to Mellon Udrigle. This section exposes 800 m of mainly pale-red medium-grained sandstones. Contorted bedding and heavy-mineral layers, containing mainly hematite and ilmenite, are typical and are notably abundant on the coast by Rubha Beag at [NG 889 975].

The coast section north of Mellon Udrigle also has a few coarser-grained sandstones, some of which are sparsely pebbly, and some intercalations of fine-grained red sandstones, which are planar bedded and display linguoid ripples.

Interpretation

The Applecross and Aultbea formations consist of sandstones that were laid down in a fluvial system during late Proterozoic times. The exact environment of formation is still the matter of some debate; Stewart (1982) has proposed deposition in a wide, active rift-valley, whilst Nicholson (1993) has suggested that the depositional environment may have been a large-scale braided river system in a thermal relaxation basin formed at a late stage in the rifting process. A recent study of detrital zircons from near Aultbea (Rainbird *et al.*, 2001) showed that their source was probably a significant distance to the west on the Laurentian Shield, suggesting input from a large river system. On the other hand, the palaeocurrent data of Williams (2001) clearly indicate a much closer source area for most of the sandstone detritus.

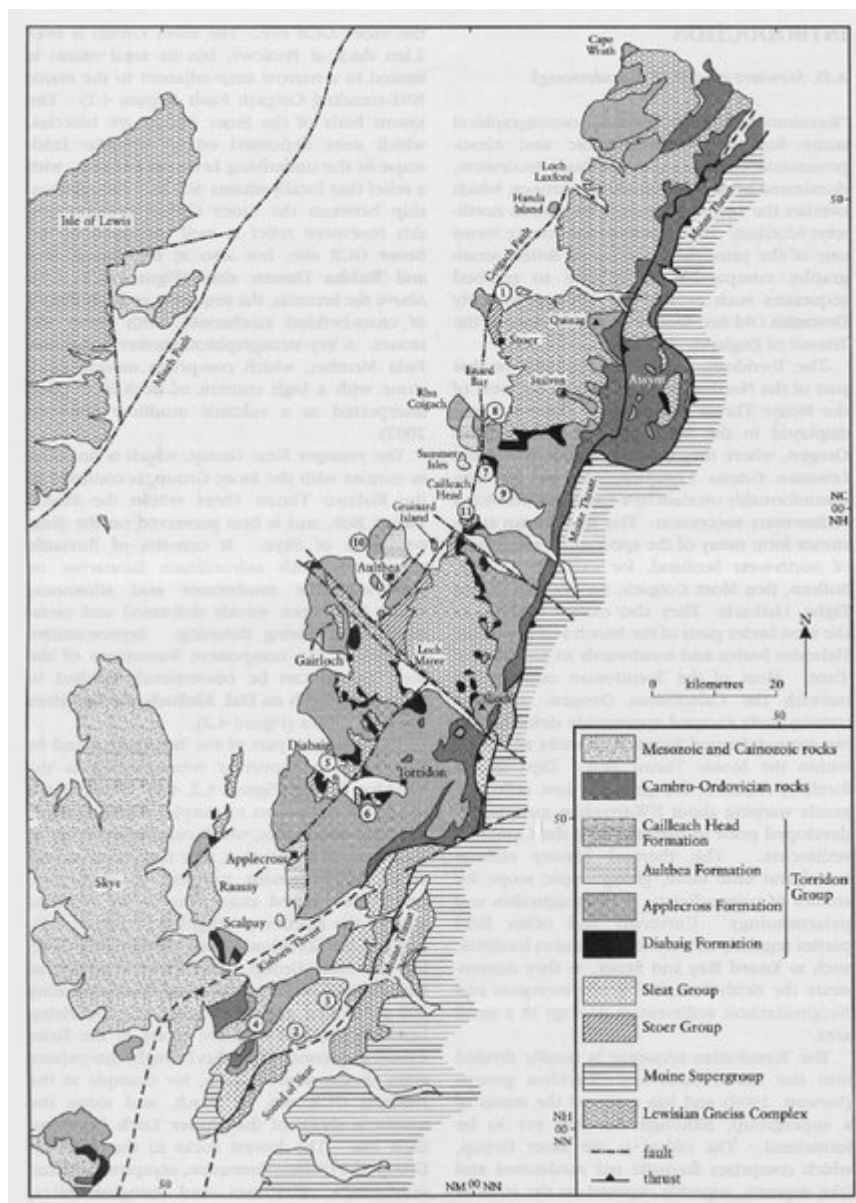
The Applecross and Aultbea formations around Aultbea show abundant soft-sediment contortions, as is common elsewhere in these two formations. Contortions affect about half the beds in the Applecross Formation and almost the entire Aultbea Formation. Such abundance appears to be unusual in the geological record, even among sandstones deposited in rifts. Although such contortions are indicative of dewatering following rapid sedimentation, their precise origin remains unclear, despite substantial research, most recently by Owen (1995, 1996). The structures result from the upward movement of water derived from liquefaction of the underlying bed or beds. Liquefaction is known to result from seismic shaking, but the abundance of the structures in the Aultbea Formation implies that shaking occurred very frequently, which seems improbable. Liquefaction due to abrupt changes in groundwater level has been suggested as a mechanism, but has not been demonstrated experimentally. As all the contortions involve gravitational instability, it follows that they would be more abundant if gravity were stronger. However, there is no independent evidence that the Earth's gravity field in the past was significantly different to that prevailing today (Stewart, 1977).

Conclusions

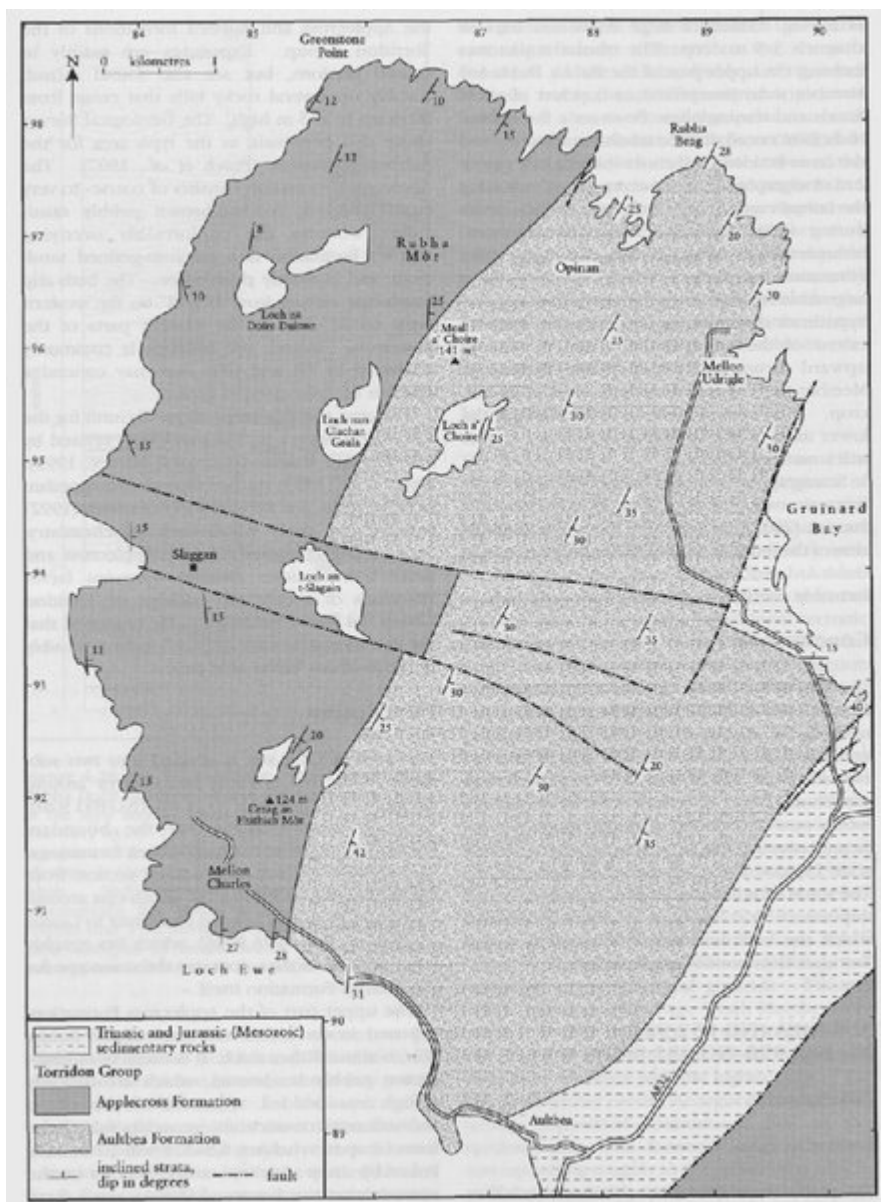
The Aultbea GCR site contains the type section for the Aultbea Formation of the Torridon Group, and its contact with the underlying Applecross Formation. These two formations, which consist mainly of medium- and coarse-grained sandstones respectively, were probably laid down in an extensive braided river system. They have an aggregate thickness of about 5 km and extend for at least 150 km along the north-west coast of Scotland, making them volumetrically one of the most important rock sequences in Britain. Provenance work (Williams, 1969b; Van de Kamp and Leake, 1997; Rainbird *et al.*, 2001) has suggested that the source for at least some of these sediments was not local, and that they were derived from a source located far to the west, now part of the Canadian shield.

The ubiquitous, large-scale, soft-sediment contortions, that are particularly spectacular in the Aultbea Formation, appear to be unique. Their origin, despite substantial research, remains obscure. The Aultbea GCR site remains an important study area for the sedimentology of the Torridon Group sandstones and merits national importance.

References



(Figure 4.1) Geological map showing the distribution of the main stratigraphical divisions of the Torridonian in north-west Scotland and the location of GCR sites: 1— Stoer; 2 — Loch na Dal; 3 — Kyclerhea Glen; 4 — Loch Eishort; 5 — Diabaig; 6 — Upper Loch Torridon; 7 — Rubha Dunan; 8 — Enard Bay; 9 — Achduart; 10 — Aultbea; 11 — Cailleach Head.



(Figure 4.29) Geological map of the Rubha Mor peninsula. After 1:50 000 Sheet 91, Gairloch (British Geological Survey, 1999).