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# An Ard

[NG 805 751]

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## Introduction

This small GCR site on the peninsula of An Ard, 2 km south of Gairloch village, is the type locality for the Palaeoproterozoic-age Ard Gneisses. The gneisses occur as foliated granodiorite and tonalite sheets that intrude the metasedimentary and mafic volcanic and intrusive rocks of the Loch Maree Group. They lie adjacent to the semipelitic Charlestown schists that occur to the north-east (Figure 3.24). Plagioclase megacrysts, now forming augen, are well developed in parts, and the gneisses contain screens and inclusions of the mafic amphibolite. The rocks lie within the Gairloch Shear Zone and have a prominent foliation and lineation that formed during the Laxfordian event.

The site was originally mapped by Clough in 1889 (Peach *et al.*, 1907), and was remapped by Park (1964). Park (1964) interpreted the Ard Gneisses as formed by granitization of the Charlestown semipelitic schists, but subsequently Park (1978) recognized that mylonitic gneisses marked their boundary with the semipelitic schists. Hence, he revised his initial view and regarded the transitional zone as a tectonic junction between older Scourian gneisses and metasedimentary rocks. More-recent work including U-Pb zircon age dating has revealed that the Ard Gneisses represent granitic sheets, originally intruded into the supracrustal rocks of the Loch Maree Group at 1903 Ma, and deformed and metamorphosed during the Laxfordian reworking (Park *et al.*, 2001; Park, 2002).

## Description

An Ard peninsula protrudes south-westwards into Loch Gairloch, dividing the beach of Gaineamh Mhòr to the north from Gairloch pier and the habitations of Charlestown to the southeast. The peninsula is rocky with grass and scrubby woodland and rises gently to 48 m above OD. Clean exposures of the Ard Gneisses occur along the rocky northern coast of the peninsula, and on the south side around Gairloch pier and at the back of the fish factory (Figure 3.24). Protruding from its north side is the rocky promontory of An Dun, with its Stone Age fort. The metasedimentary schists are exposed along the main road from Gairloch, and the transitional zone between the schists and the Ard Gneisses is exposed along the foot of the raised sea cliff adjacent to the approach road to Gairloch pier.

The Ard Gneisses consist of two main components: a western outcrop, c. 280 m wide, of relatively coarse-grained, granodioritic, augen gneiss that forms the south-western part of the peninsula, beyond the amphibolite sheet which trends south-east from An Dun; and an eastern outcrop, c. 140 m wide, where finer-grained tonalitic gneiss forms three narrow strips separated by amphibolite sheets (Figure 3.24).

The granodioritic gneiss contains quartz, plagioclase, K-feldspar, biotite and epidote, and the original plagioclase feldspar megacrysts are recrystallized and deformed into augen, generally only 2–5mm across (Figure 3.25). The tonalitic gneisses have a similar assemblage but lack K-feldspar. The gneisses are intensely deformed, with a penetrative NW-trending steeply dipping foliation and a steeply NW-plunging lineation. The amphibolite sheets are well foliated, but are typically coarser grained than the amphibolites to the north-east in the main supracrustal belt. They contain abundant quartz-feldspar veins and more rarely thin granitic sheets and veins of the Ard Gneisses. The south-western amphibolite sheet is cut by tightly folded granodioritic and quartzofeldspathic veins (Figure 3.26), a feature not found in the amphibolites farther to the north-east.

North-east of the tonalitic gneiss is a 250 m-wide outcrop of the Charlestown semipelitic schists. These are quartz-biotite-plagioclase schists similar to the Flowerdale schists (see Kerrysdale GCR site report, this chapter) but rather coarser grained. This outcrop includes a narrow amphibolite band. The transitional zone between the tonalitic gneisses and the metasedimentary rocks is about 20 m wide and consists of mylonitic gneisses, which resemble the

metasedimentary schists except for the presence of small augen. There appears to be some interbanding of metasedimentary and igneous material within this zone but because of the high degree of deformation, the two rock-types are difficult to distinguish from each other.

## Interpretation

This site allows the relationships between the Ard Gneisses and the surrounding metasedimentary and metavolcanic rocks of the Loch Maree Group to be demonstrated. The gneisses contain evidence for only one deformation episode and enclose foliated amphibolite sheets of Loch Maree Group type, which are veined and cut by granitic sheets and migmatitic veins. The tight folding of the veins is evidence that the granitic material was intruded into the amphibolites before the folding and foliation were developed in the gneisses. The deformation increases in intensity north-eastwards towards the transitional zone, and appears to be younger than that responsible for the main foliation and lineation in the metasedimentary rocks; it is considered to possibly relate to the third Laxfordian deformation. There is no sign of earlier structures in the Ard Gneisses, which are interpreted as igneous sheets, intruded during the earlier Laxfordian deformation (Park *et al.*, 2001).

Park *et al.* (2001) obtained a U-Pb zircon TIMS age of  $1903 \pm 3/-2$  Ma from the Ard Gneisses exposed behind the fish factory on the south-east side of the An Ard peninsula. This Palaeoproterozoic age is considered to represent crystallization of the granodiorite protolith, probably during the Laxfordian D1/D2 event. As the Ard Gneisses intrude the metasedimentary and metavolcanic rocks of the Loch Maree Group, these units must have formed prior to 1900 Ma.

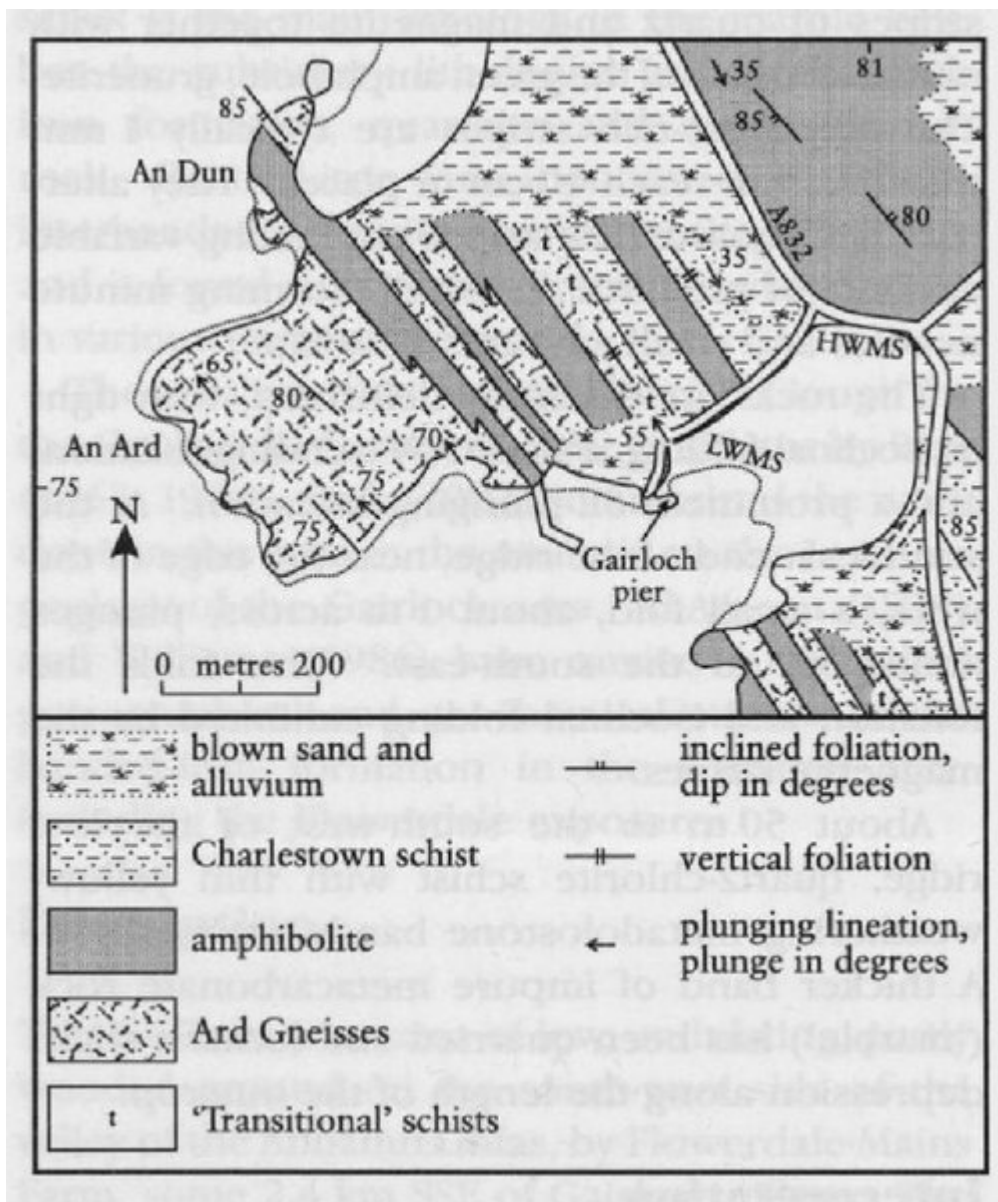
Holland and Lambert (1973) and Park *et al.* (2001) presented geochemical data for the Ard Gneisses. The data plots give a primitive arc signature on discrimination diagrams and show many of the characteristic features of the so-called TTG ('trondhjemite-tonalite-granodiorite) suites. The geochemical patterns are distinct from those of the metasedimentary rocks of the Loch Maree Group, indicating that these do not represent a significant component of the source material for the gneisses (Park *et al.*, 2001). Winchester *et al.* (1980) analysed a number of samples of the 'transitional' schists from several localities along both sides of the Ard Gneisses outcrop and concluded that they are chemically distinct from the metasedimentary rocks but similar to the meta-igneous Ard Gneisses. The Ard Gneisses are thus now considered to represent a component of primitive magmatic material intruded into the Loch Maree Group, probably above an active subduction zone. Calc-alkaline plutonic suites of similar ages have been found across other Palaeoproterozoic continent-continent collision belts of the North Atlantic region (e.g. in East Greenland; Kalsbeek *et al.*, 1993), allowing the possibility of interregional correlation across a wide area.

## Conclusions

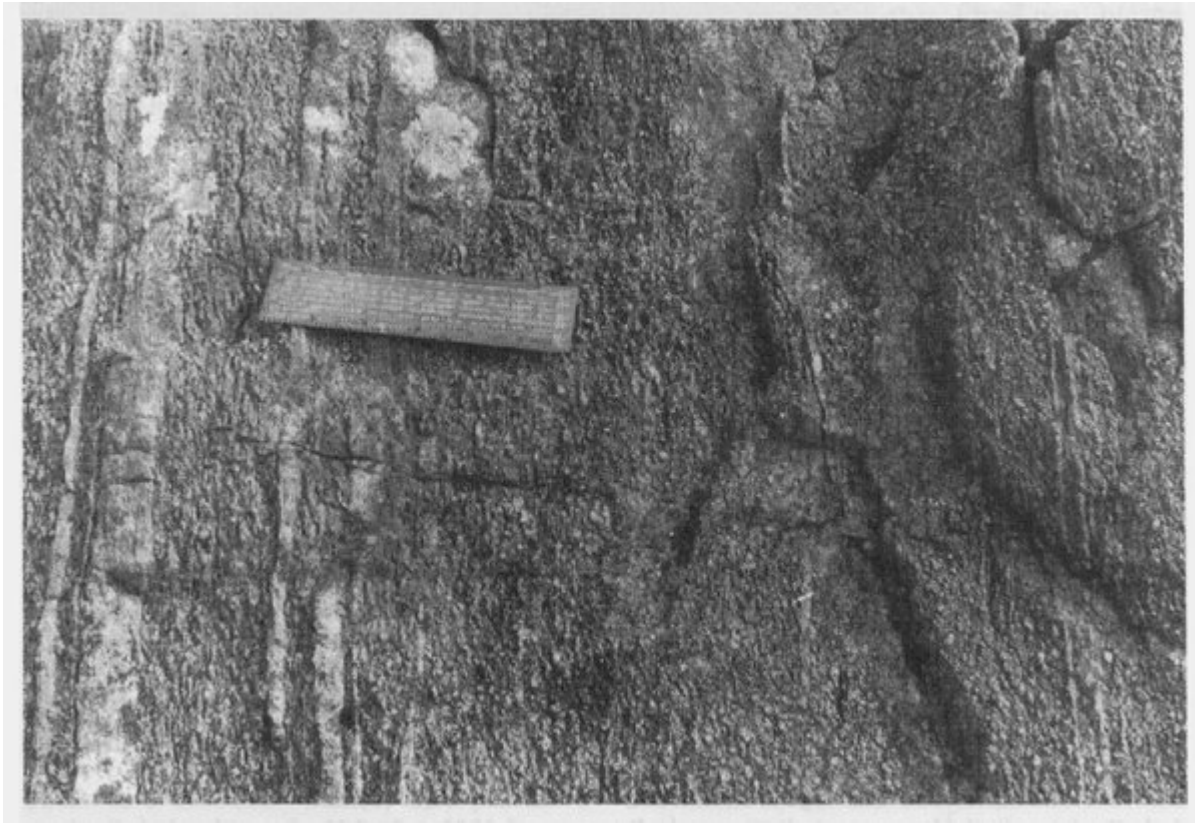
The An Ard GCR site is the type area for the Palaeoproterozoic Ard Gneisses, foliated granodioritic and tonalitic gneisses that intrude the metasedimentary and metavolcanic Loch Maree Group. The site essentially complements the Flowerdale and Kerrysdale GCR sites that represent the Loch Maree Group. The Ard Gneisses are an important element in the tectonostratigraphical history of the Lewisian Gneiss Complex, as they represent deformed early-Laxfordian granites. U-Pb zircon age dating implies that granodiorite and tonalite sheets were emplaced into the Loch Maree Group rocks at *c.* 1900 Ma. Hence, they provide a minimum age for the Loch Maree Group deposition and formation. Geochemical data suggests that the gneisses were intruded above an active subduction zone. The strong foliation and lineation developed in the gneisses are interpreted as a result of the later Laxfordian deformation episodes linked to the formation of the Gairloch Shear Zone.

Confirmation of the Palaeoproterozoic age of the Ard Gneisses has allowed correlation to be made with similar intrusions in east Greenland and Scandinavia, allowing the main Laxfordian tectonothermal event to be placed in its North Atlantic context. For this reason, the site is considered to be of national and international importance.

## [References](#)



(Figure 3.24) Map of the An Ard area, Gairloch. Based on Park (1978) and British Geological Survey 1:50 000 Provisional Series Sheet 91, Gairloch (1999).



*(Figure 3.25) Gneissose granodiorite (Ard Gneisses) showing augen structure and well-developed foliation, An Ard peninsula [NG 803 753]. 6-inch ruler for scale. (Photo: R.G. Park.)*



*(Figure 3.26) Amphibolite (Loch Maree Group) cut by pale-grey granodiorite sheets (Ard Gneisses) that themselves are tightly folded. Note the steeply plunging lineation parallel to the fold axes. The hammer is 37 cm long. An Ard peninsula [NG 803 753]. (Photo: R.G. Park.)*