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# Flowerdale

[NG 818 748]

R.G. Park

## Introduction

The compact Flowerdale GCR site provides easily accessible exposures of the Flowerdale marble belt, the most varied and distinctive metasedimentary unit within the Gairloch sequence of the Loch Maree Group. The Palaeoproterozoic Loch Maree supracrustal sequence is enclosed within Archaean gneisses, and forms a stratigraphically distinct part of the Lewisian Gneiss Complex that occurs only around Gairloch and Loch Maree (see Kerrysdale GCR site report (this chapter) for a full description of the group). Quartz-chlorite schist is the main lithology in the marble belt, but the subsidiary lithologies include banded-iron formation, quartzite and metacarbonate rock. Banded-iron formation consists of finely interbanded quartzite and magnetite-rich layers and is found only within Precambrian-age rocks in various parts of the world.

The area was first mapped by C.T. Clough for the Geological Survey in 1889, and later by Park (1963, 1964). Park (2002) summarized the work done in this area in the memoir on the Lewisian geology of the Gairloch area. Al-Ameen (1979) and Williams (1986) have carried out detailed petrographical and geochemical studies of the banded-iron formation in the Gairloch area, including the Flowerdale exposures.

## Description

This GCR site is an area of low, undulating, partly wooded ground on the south-west side of the valley of the Abhainn Ghlas, by Flowerdale Mains Farm, some 2.4 km SSE of Gairloch village. The site is bounded to the north and north-east by alluvium in the valley floor, which conceals a WNW-trending fault that offsets the units of the Loch Maree Group dextrally by over 1 km. North of the fault a thick amphibolite sheet of the Kerrysdale unit forms the steep wooded valley slope that rises rapidly to over 200 m above OD. To the west of the site is the prominent wooded ridge of Druim Obair-latha that rises to c. 100 m above OD, again formed by an amphibolite sheet of the Kerrysdale unit. On the south-west edge of the alluvium a lower ridge extends in a northwesterly direction. The north-east side of this ridge is composed of banded-iron formation and a metacarbonate rock unit occurs a short distance to the south-west (Figure 3.23).

The Flowerdale marble belt is sandwiched between the semipelitic Flowerdale schists to the ENE and a thick amphibolite sheet to the WSW. Some shearing has occurred at its ENE margin (cf. Kerrysdale GCR site). The units dip very steeply south-west. The main lithology is a mid-green-grey, soft, calcareous schist composed mainly of quartz, chlorite and calcite with minor plagioclase, a greenish mica, and scattered small hornblende porphyroblasts in places. Within this lithology are distinctive units of quartzite, banded-iron formation, thin metadolostone beds and graphitic pelite.

The banded-iron formation forms a unit 1020 m thick here and consists of alternating fine stripes of quartz and magnetite together with minor amounts of the green amphibole, grunerite. The magnetite-rich stripes are typically 1 mm thick but can reach 10 cm in places. They alternate with quartz-rich stripes containing variable amounts of grunerite, generally forming minute needles and small amounts of calcite.

The rocks are intensely deformed, with tight to isoclinal folding, a steep NW-trending foliation, and a prominent SE-plunging lineation. At the south-east end of the ridge, near the edge of the trees, a small fold, about 1 m across, plunges about 30° to the south-east. This folds the foliation and isoclinal folding exhibited by the magnetite stripes.

About 50 m to the south-west of the low ridge, quartz-chlorite schist with thin yellow-weathering metadolostone bands are exposed. A thicker band of impure metacarbonate rock ('marble') has been quarried and forms a slight depression along

the length of the outcrop.

## Interpretation

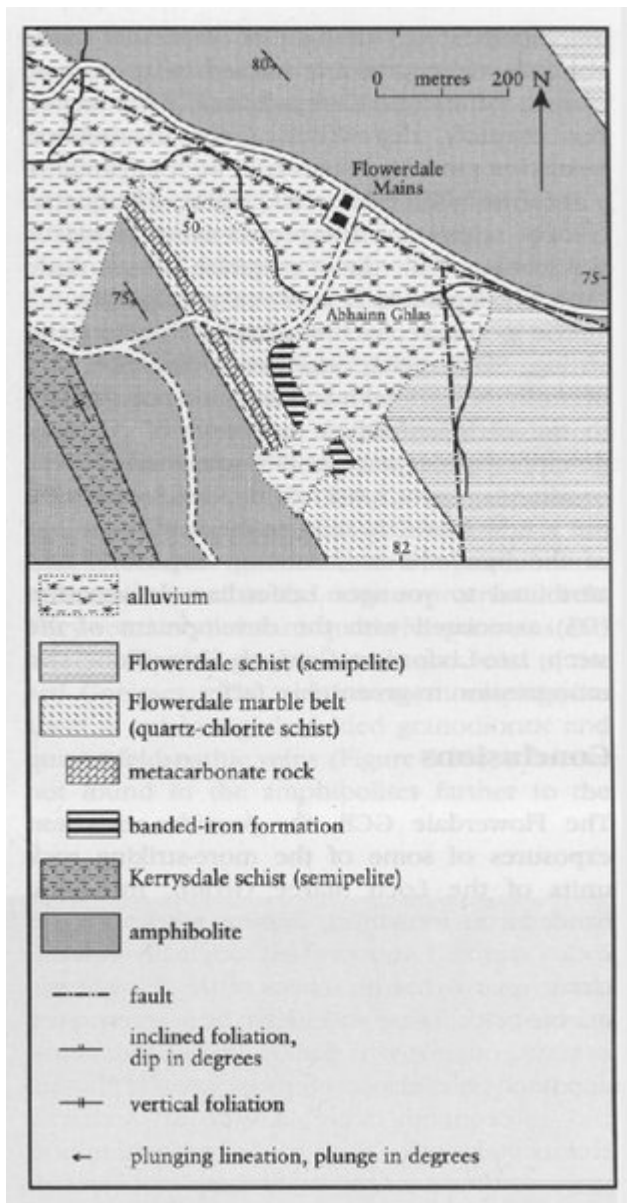
Al-Ameen (1979) and Williams (1986) have carried out detailed petrographical and geochemical studies of the banded-iron formation in the Gairloch area. Williams concluded that the lithology originated as a primary layered chert–iron-oxide sequence, deposited in a shallow-water environment. He postulated that the grunerite was derived from iron silicates (e.g. greenalite) by dehydration and reaction with silica during later metamorphism. Fe-bearing aluminosilicate phases, possibly chamosite, must also have been present to give rise to chlorite, garnet and biotite associated with the banded-iron formation. As the adjacent Kerrysdale amphibolites are thought to represent basic volcanic rocks, probably formed in an oceanic plateau setting (see Kerrysdale GCR site report, this chapter), deposition of the banded-iron formation most likely occurred on a substrate of submarine basalt (Park *et al.*, 2001). The quartz-chlorite schists are interpreted as volcanoclastic sediments, and the carbonate units were probably deposited as chemical precipitates.

The pervasive, well-developed foliation and strong, SE-plunging, elongation lineation that occur in the banded-iron formation are ascribed to the early-Laxfordian deformation, (D1/D2), developed under amphibolite-facies metamorphic conditions. Later, local folding, developed without a new fabric, is seen at the south-east end of the banded-iron formation exposure, and attributed to younger Laxfordian deformation (D3) associated with the development of the steep, late-Laxfordian Gairloch Shear Zone and retrogression to greenschist facies.

## Conclusions

The Flowerdale GCR site provides excellent exposures of some of the more-striking rock units of the Loch Maree Group, including banded-iron formation, impure metacarbonate rock ('marble') and possibly originally volcanoclastic quartz-chlorite schists of the 'Flowerdale marble belt'. These rocks have been interpreted as having originated as shallow-marine sediments, deposited on a Palaeoproterozoic oceanic plateau, and subsequently accreted onto an Archaean continental block. The site is of national importance as it includes the best example of banded-iron formation in Britain and provides an insight into marine processes occurring in an active arc environment during the Palaeoproterozoic. The readily accessible exposures remain suitable for teaching and research purposes.

## [References](#)



(Figure 3.23) Map of the Flowerdale area, Gairloch. Based on Park (1978) and British Geological Survey 1:50 000 Provisional Series Sheet 91, Gairloch (1999).