
An Fharaid Mhòr to Clachtoll

[NC 038 270]–[NC 069 245]

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Introduction

This exceptionally well-exposed GCR site, northwest of Lochinver, encompasses the peninsula of An Fharaid Mhòr, Achmelvich Bay, and the cliffed and indented coastal section north to Clachtoll. This area has become the type locality for the Inverian tectonothermal event, first recognized by Evans (1965) as a period of deformation and metamorphism distinct from the previously established Scourian and Laxfordian divisions of the Lewisian (Sutton and Watson, 1951). Excellent examples of early layered mafic and ultramafic rocks and mafic dykes of the Scourie Dyke Suite are also present. The site provides a traverse across the 1.5 km-wide Canisp Shear Zone, the largest shear-zone within the Central Region. The shear zone was initiated during the Inverian event and reactivated during Laxfordian reworking.

The area was originally mapped and described by B.N. Peach and J. Horne in 1888, and was described by Peach *et al.* (1907) who first recognized and traced out the Canisp Shear Zone. Modern investigations commenced with the work of Tarney (1963) and Evans (1965), which led to the recognition of the Inverian event (see also Evans and Lambert, 1974). The area was remapped by Sheraton *et al.* (1973) and was described by Tarney (1978). The shear zone itself was the subject of more-detailed structural studies by Jensen (1984) and subsequently by Atfield (1987).

Description

The site extends north-west from Loch Roe for some 4 km to the Bay of Clachtoll. Its southern part includes the area of rocky knolls and boggy hollows east of Achmelvich that culminate in Cnoc an Taighain (88 m above OD). The blown sand area around Achmelvich separates this glacially scoured cnoc and lochan scenery, which is characteristic of much of the Lewisian Gneiss Complex area, from the craggy An Fharaid Mhòr–An Fharaid Beag peninsula. Farther north-west the site area extends south-west from the Lochinver–Stoer road (B869) to the rocky indented coastline that contains cuffed sections up to 60 m high. The small peninsula of A' Clach Thuill is lower and smoother and underlain by Torridonian breccias and sandstones (see Stoer GCR site report, Chapter 4). Geologically, it is convenient to describe the area in two parts: a southern part, around An Fharaid Mhòr, and a northern part that traverses the Canisp Shear Zone (Figure 3.13). Much of the description is based on Tarney (1978) and Atfield (1987).

On the peninsula of An Fharaid Mhòr, the majority of the exposures are banded, grey, tonalitic gneisses with abundant pods of hornblende. On the south-western point of An Fharaid Mhòr, overlooking Loch Roe, the tonalitic gneisses enclose thick sheet-like bodies of mafic and ultramafic gneiss, which form a large recumbent synform with its axis plunging at about 10° to the south-west. The mafic gneisses are typically banded, with anorthositic and mafic components, but show extensive replacement by hornblende. They include hornblende peridotite and garnet-pyroxene-hornblende gneisses. The gneissose banding strikes uniformly north-east and dips gently to the north-west. The gneisses are cut by several generations of pegmatitic leucosome, with the later generations forming undeformed dyke-like bodies that cross-cut the banding. The Badcallian gneissose banding is also cut by several markedly discordant undeformed mafic dykes of the Scourie Dyke Suite.

Evidence for the Inverian event can be readily seen 300 m south-east of the Youth Hostel, on the east side of the Achmelvich road at [NC 063 248]. Here, an amphibolitized 8 m-wide metadolerite dyke of the Scourie Dyke Suite follows the vertical limb of an Inverian monoclinical fold for a distance of about 50 m. The monocline has an amplitude of 20–30 m, and its axis plunges about 40° to the ESE. The middle limb is vertical, and the banding is attenuated but not highly sheared. The dyke trends slightly oblique to the fold and its margin cuts the Inverian fabric in the steep limb, although here it is also slightly affected by later Laxfordian deformation.

The south-western boundary of the Canisp Shear Zone can be demonstrated by making a north-easterly traverse along the coast section from Achmelvich beach across the steeply dipping north-east limb of the Lochinver Anticline, a NW-trending structure that folds the Badcallian gneissose banding (Figure 3.14). Immediately north of the northern beach lies part of the Inverian shear-zone, in which the gneisses are little affected by Laxfordian deformation. The gneisses here are thinly banded, and include felsic, intermediate and mafic varieties, all retrogressed to amphibolite facies. The intensity of Inverian deformation can be approximately monitored by the changes to ellipsoidal shapes shown by the mafic inclusions in the gneisses. The gneisses are cut by a metadolerite dyke (Scourie Dyke Suite), which is affected by marginal Laxfordian shearing but undeformed in its central part.

About 500 m from the beach is the well-defined southern boundary of the reactivated Laxfordian part of the shear zone. A small cleft in the rocky cliff [NC 057 256] marks the change from massive Inverian gneisses into much more finely banded gneisses with a steep dip to the south-west and an intense fine lineation that plunges 20°–30° to the south-east. A large meta-dolerite dyke forms a lens-shaped outcrop on the hillside above the cliff here, and can be examined in the gullies farther west along the coast. This Scourie dyke is intensely deformed locally, especially near its margins where it exhibits small-scale tight folds, whereas the central parts are massive and undeformed. From here northwards for some distance, the shear zone is characterized by heterogeneous deformation, with lenses of the more-massive banded gneisses enclosed within highly deformed zones that exhibit strong planar and linear Laxfordian fabrics. Later cataclastic zones are also evident. This section of coastline, which extends for nearly 2 km to the far side of the Rubha Leumair peninsula [NC 042 262], lies entirely within the Laxfordian part of the Canisp Shear Zone; here, excellent three-dimensional exposures display a range of structural features including good examples of interference fold patterns.

On the north-east side of the small peninsula on the south side of Port Alltan na Bradhan [NC 052 263] is a 25 m-wide, amphibolitized, picrite dyke. This dyke has been intensely deformed during the Laxfordian, and thins to less than 1 m on the north side of the inlet. The marginal parts of the dyke have been converted to green actinolite schist, whereas the central part is composed of fissile talc-chlorite-carbonate schist displaying late-Laxfordian folds. This dyke can be traced for a further 900 m in a WNW direction to the coast, north of Rubha Leumair.

The northern margin of the Laxfordian sector of the shear zone cuts the coast at the inlet of Port Alltan na Bradhan (Figure 3.15). From here, northwards to the Lochinver–Stoer road (B869), is a zone of steep Inverian banding similar to the section on the north-east side of the Lochinver Antiform. The northern boundary of the Inverian shear-zone is less well defined than the southern boundary, but can be traced on the map from Manse Loch in the east [NC 095 248] to Loch na h-Inghinn in the west. Thus the Canisp Shear Zone can be seen to be a composite structure comprising an approximately 1.5 km-wide Inverian shear-zone containing a central 500 m-wide Laxfordian reactivated zone (Figure 3.14).

Interpretation

The southern part of the site, between Loch Roe and Achmelvich Bay, contains granulite-facies felsic and subsidiary mafic gneisses enclosing layered mafic and ultramafic bodies. These rocks are deformed by the Badcallian deformation and cut by mafic dykes of the Scourie Dyke Suite. To the north-east, the country rock gneisses become more felsic, and contain abundant mafic and ultramafic pods, typically forming agmatite, and are variably retrogressed to amphibolite facies. The Lochinver Antiform, which runs through Achmelvich Bay, has a NW-trending axial trace and its axis plunges to the south-east. The Badcallian foliation is folded over this antiform. On the north-east limb, the felsic gneisses with their agmatitic inclusions are progressively deformed into strongly banded, steeply dipping gneisses, recrystallized to amphibolite-facies assemblages, and the axis of the antiform defines the south-west margin of the Canisp Shear Zone (Figure 3.14). These sheared and recrystallized gneisses are cut both by a K-feldspar-bearing pegmatite (similar to those dated elsewhere at 2450 Ma, see Evans and Lambert, 1974), and by a prominent Scourie dyke, thus demonstrating the Inverian age of this part of the shear zone.

Later (Laxfordian) effects in this southern part of the Canisp Shear Zone are limited to very narrow shears cutting the dykes, but farther north the well-defined central part is characterized by heterogeneous deformation, with lenses of more-massive banded gneisses enclosed within highly deformed zones exhibiting strong planar and linear fabrics. This

500 m-wide belt of deformation, concentrated in narrow zones of high strain, is interpreted as formed during the Laxfordian reactivation. The Laxfordian deformation is generally associated with the generation of a new shear fabric, but in places Inverian structures have been modified and deformed (Attfield, 1987).

Beach and Tarney (1978) investigated the chemical changes in the gneisses and Scourie dykes brought about by the retrogressive Laxfordian metamorphism accompanying the shearing, noting increases in Na and Sr contents and loss of Ca. These changes were attributed to the introduction of hydrous fluids up steep zones formed within the overall shear-zone.

There have been conflicting views on the sense of movement on the Canisp Shear Zone. Sheraton *et al.* (1973) suggested a north-down sense of movement on the shear zone during the Inverian, followed by north-up movement during the Laxfordian. Evans and Lambert (1974) suggested a sinistral south-up sense (presumably referring to the Inverian), whereas Jensen (1984) invoked a dextral, south-up sense of movement for the Laxfordian. Attfield (1987) showed that the linear fabrics of the two episodes could be clearly distinguished, and pointed out that the Inverian lineations plunge steeply to the south-east, whereas the Laxfordian lineations plunge shallowly to the south-east. Both movement phases were therefore dextral, but the Inverian was accompanied by a large dip-slip component, whereas the Laxfordian reactivation was dominantly a strike-slip event.

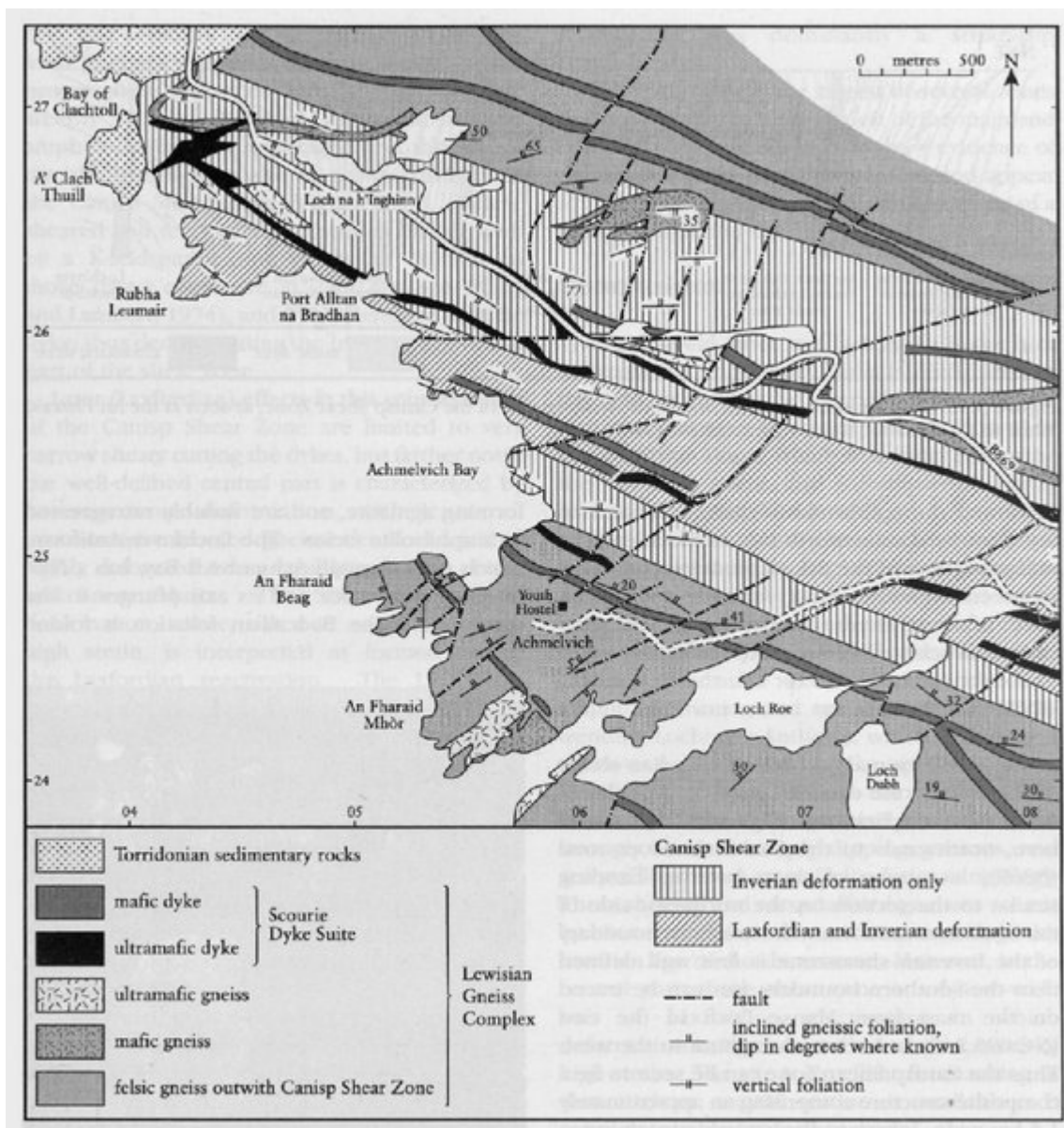
This shear zone is the largest of several zones that traverse the Central Region of the mainland Lewisian. The zones typically show evidence of dominantly strike-slip displacement and appear to represent the deep-seated manifestations of a higher-level strike-slip fault system.

Conclusions

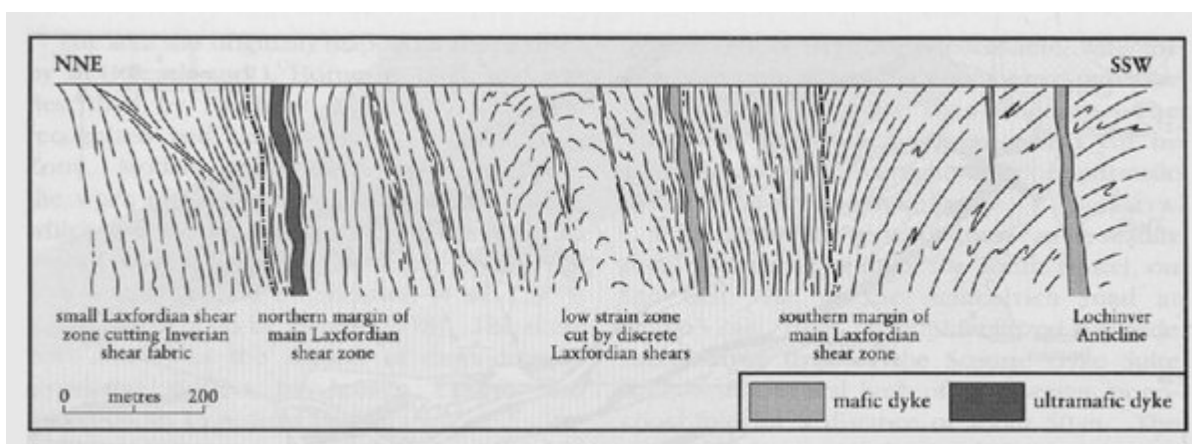
The An Fharaid Mhòr to Clachtoll GCR site is of international importance, as it is recognized as the type locality for the Inverian event. The site also encompasses part of the 1.5 km-wide Canisp Shear Zone, which was initiated during the Inverian event and subsequently partly reactivated during the Laxfordian.

The southern part of the site, between Loch Roe and Achmelvich Bay, contains granulite-facies felsic and mafic gneisses deformed in the Badcallian deformation and cut by mafic dykes of the Scourie Dyke Suite. To the north-east, these gneisses are variably retrogressed to amphibolite facies, and are affected by the NW-trending Lochinver Antiform, which delimits the south-west margin of the Canisp Shear Zone. On the north-east limb of the antiform, the Badcallian rocks are progressively deformed into strongly banded, steeply dipping gneisses, and recrystallized to an amphibolite-facies mineralogy. These sheared and recrystallized gneisses are cut by Scourie dykes, thus demonstrating the Inverian age of the shear zone. However, in the central part of the shear zone is a 500 m-wide belt of Laxfordian reactivation in which deformation is concentrated in narrow zones of high strain. The site is excellent for teaching in that a clean coastal section is available. It remains suitable for further work.

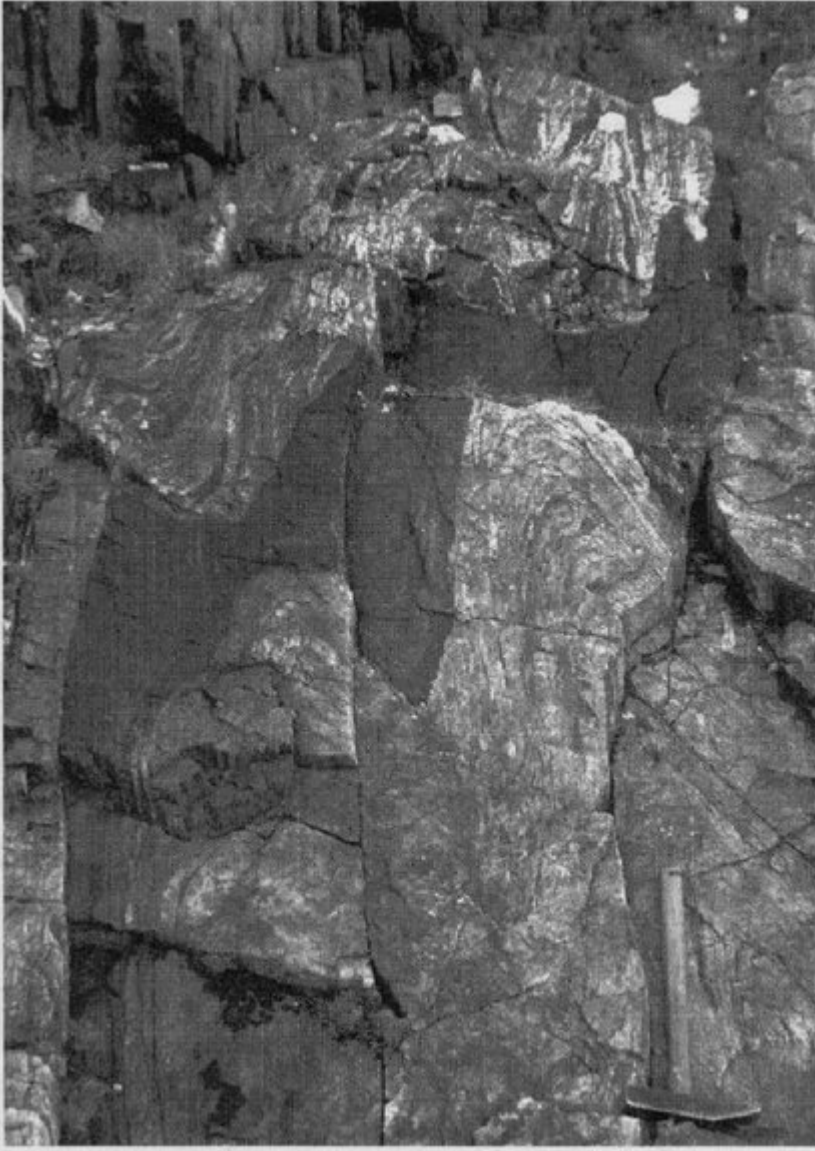
[References](#)



(Figure 3.13) Map of the Achmelvich area, including the An Fharaid Mhòr. to Clachtoll GCR site and showing the western part of the Canisp Shear Zone. Based on Tarney (1978) and Atfield (1987).



(Figure 3.14) Diagrammatic cross-section of the western end of the Canisp Shear Zone, as seen at the An Fharaid Mhòr to Clachtoll GCR site. After Atfield (1987).



(Figure 3.15) Deformed but discordant amphibolitic Scourie dyke in banded felsic and mafic gneisses near to the north-east margin of the Canisp Shear Zone. Port Alltan na Bradhan. The hammer is 37.5 cm long. (Photo: J.R. Mendum.)