
Excursion 14 Barrhill And Newton Stewart: stratigraphy, provenance and structure of Ordovician turbidites

OS 1:50 000 sheets 76 Girvan, 77 Dalmellington to New Galloway 83 Newton Stewart 6 Kirkcudbright

BGS 1:50 000 sheets 8W Carrick, 4W Kirkcowan, 4E Wigtown

Route maps: (Figure 42) and (Figure 44)

Main points of interest Typical sections illustrating Kirkcolm/Galdenoch and Portpatrick/Glenwharzen formation relationships; Shinnel Formation; Moffat Shale Group; D3 folding.

Logistics A general north to south route starts from the village of Barrhill, about 20 km SE of Girvan on the A714, and ends near Newton Stewart. Most localities are accessed by narrow single-track roads with roadside parking adequate for 3–4 cars or a minibus. Localities 4 and 9 are adjacent to the main A714, with lay-bys adequate for larger coaches. Some rough walking is involved in Localities 1, 2, 3 and 8.

Introduction

Several of the localities include sections within the Leadhills Group where critical stratigraphical relationships can be demonstrated. Such sections are particularly rare and valuable in the Southern Uplands, where exposure is generally poor and field relationships between rock units often inconclusive. The overall stratigraphical relationships are shown in (Figure 2) and may also be compared with the stratigraphical transect of the Rhins of Galloway shown in (Figure 46).

Barrhill (Figure 42)

1 Cross Water: Kirkcolm Formation; folding in greywackes

From the crossroads at the village hall in Barrhill, take the moor road to New Luce as far as a small bridge (with concrete parapets) over the Cross Water, about 1 km SW of Barrhill Station. Cars may be parked at the roadside near the bridge [NX 221 806]. In the Cross Water, about 200 m upstream of this bridge, several good small-scale D3 fold pairs with sinistral vergence can be seen in medium-bedded quartz-rich greywackes of the Kirkcolm Formation.

The general strike locally is about 070° and the intermediate limbs of the folds strike about 130° . Axial planes trend east–west and the fold axes generally plunge steeply towards the west. Folds of this type are very common in the Northern Belt, particularly in the thinly bedded Kirkcolm Formation (also seen at Locality 2 of Excursion 6), and provide evidence for sinistral strike-slip movement.

The low rock ridge, which runs parallel to the river and crosses the field between the concrete bridge and the railway line, is the south-western strike continuation of the Galdenoch Formation, interbedded with the Kirkcolm Formation and described in detail at Locality 3.

2 Linn Dhu, Cross Water: greywacke and laminated siltstone with graptolites

From the concrete bridge, drive back 1 km towards Barrhill, to where the road turns to run north, about 300 m south of Barrhill Station. Park at the roadside and walk SE about 200 m and down a steep bank into the Cross Water [NX 229 812].

The river exposes a strike section in a thick succession of grey and black striped and laminated siltstones. The black laminae have yielded graptolites of the *Nemagraptus gracilis* Biozone at several localities, including an exposure just downstream from a high cliff of boulder clay on the west bank. Such siltstone units are commonly interbedded with the

Kirkcolm Formation greywackes and, about 50 m downstream from this cliff, in an attractive waterfall known as the Linn Dhu, thickly bedded quartz-rich greywackes of the Kirkcolm Formation are well displayed in water-polished exposures.

3 Cross Water, Barrhill: contact between Galdenoch and Kirkcolm formations; greywackes and laminated siltstones

From the Linn Dhu, return to the road, drive back towards Barrhill for about 1 km and park at the old cattle market about 400 m beyond the cemetery. From the market, walk back up the road away from Barrhill for about 150 m to a sharp bend in the road near a covered water-supply reservoir. Use the gate in the wall on the south side of the road and cross the field into the river gorge at Locality 3 [NX 230 815].

The Cross Water hereabouts displays an excellent section where interbedding of the Kirkcolm and Galdenoch formations can be reliably demonstrated. From the Linn Dhu (Locality 2), the river continues north for 200 m, cutting through greywacke and thick laminated siltstone, until it is deflected to the NE by a resistant bed of massive greywacke forming the base of the Galdenoch Formation. The river follows this bed for almost 300 m along strike to the NE before it finally breaches the obstacle and continues north across strike. The resulting cross-strike section forms Locality 3, about 300 m upstream from the old cattle market. It is the proposed type section for the Galdenoch Formation, a unit characterised by greywackes rich in andesitic detritus, including pyroxene- and hornblende-andesite lithoclasts as well as remarkably fresh grains of detrital pyroxene and hornblende. Some specimens contain up to 25 per cent pyroxene and are virtually resedimented crystal tuffs. The andesitic material is thought to have come from a volcanic island arc which was active during deposition of the greywackes. Andesitic detritus is conspicuously absent from the greywackes of the Kirkcolm Formation.

A measured section through the Galdenoch Formation here (Figure 43) proves it to be about 25 m thick and dominated by thickly bedded, medium- to coarse-grained greywacke with very little interbedded siltstone. The Galdenoch Formation greywacke is succeeded conformably by grey and black laminated siltstone of the Kirkcolm Formation, the contact being exposed in the field north of the river. Beds strike 050° and dip 60° to the south but young towards the north and are therefore overturned.

The presence of several parallel outcrops of pyroxenous greywacke in the Barrhill area (Figure 42) suggests that the Galdenoch Formation occurs as a series of packets which interfinger with the Kirkcolm Formation. Such a situation could arise as a result of repeated overlapping of distinct fan systems derived from opposite sides of the depositional basin. This interpretation is supported by contrasting palaeocurrent directions in the two formations. The numerous large flute casts which occur on the undersides of greywacke beds at the base of the Galdenoch Formation ((Figure 43)b) all indicate a sediment source to the south or SE, whereas current directions deduced for the Kirkcolm Formation immediately downstream (Figure 43)a indicate sediment transport from the opposite (northerly) direction (Stone et al., 1987; Evans et al., 1991).

4 War Memorial, Barrhill: Galdenoch Formation greywackes

Drive back into Barrhill, turn right at the crossroads and park by the War Memorial at the south end of Main Street [NX 236 820]. The memorial is built on a knoll of massive Galdenoch Formation greywacke, part of the same packet of beds which forms the type section (Locality 3). The Kirkcolm Formation laminated siltstone underlying the Galdenoch Formation greywacke may be seen again in a small quarry nearby.

5 Altercannoch Quarry: Galdenoch Formation greywackes

Leave Barrhill on the B7027 and drive SE for about 2 km to a small quarry on the south side of the road [NX 252 810]. Park in the quarry to examine a good section in thickly bedded NW-younging greywackes of the Galdenoch Formation. An interesting feature is the large lenticular block of black shale which occurs as a rip-up clast in a bed towards the top of the section. This clast has yielded a large collection of graptolites of the *N. gracilis* Biozone.

Newton Stewart (Figure 44)

6 Clachaneasy Quarry: Portpatrick Formation greywackes

Return to Barrhill and continue south on the A714 towards Newton Stewart. At Clachaneasy, about 14 km south of Barrhill and 1.5 km south of Bargrennan, turn left off the A714 on to the minor road which crosses the River Cree. About 200 m beyond the bridge, park at the roadside [NX 358 753] to examine, on the right (south) side of the road, a large abandoned quarry in greywacke of the Portpatrick Formation (Figure 44). This is a good place to see the massive thickly bedded units which are typical of this formation.

The greywackes of the Portpatrick Formation are characteristically poor in quartz but rich in andesitic detritus and fresh grains of pyroxene and hornblende. Occasionally, as here, they also contain rare fragments of blue amphibole, both as individual detrital grains and as crystals within schist lithoclasts. Although originally loosely described as glaucophane, the amphibole has now been identified as the closely related mineral crossite. Glaucophane/crossite schists are metamorphic rocks of the blueschist facies and are usually associated with deep burial and low thermal gradient (high-pressure, low-temperature conditions), as found in metagreywacke terranes above subduction zones. Their presence in the Portpatrick Formation indicates that a terrane of this sort was exposed to erosion during the late Ordovician.

7 Minnoch Bridge: Glenwhargen Formation greywackes

From Clachaneasy Quarry, continue east along the minor road for a further 200 m and turn right at a T-junction. After about 1 km this road crosses the Minnoch Water at a large stone arch bridge over a rocky gorge. Park in the large car park just beyond the bridge on the left and walk down to the river below the bridge.

The bridge is built on greywacke of the Portpatrick Formation but the greywacke exposed about 20 m downstream belongs to the Glenwhargen Formation. This formation is highly quartzose and, in sharp contrast to the Portpatrick Formation, almost totally devoid of andesitic material. Bedding is generally vertical, strikes about 045° and youngs south. A north-verging fold pair can be seen on the east bank of the river, plunging about 20° towards 030°. At this locality the contact relationship between the two formations is unclear but at the next locality they are demonstrably interbedded.

8 Knockville Moor: contact between Portpatrick and Glenwhargen greywackes

Return to the A714 and continue south towards Newton Stewart for about 3 km from Clachaneasy. If the party is small (1–2 cars), turn right through the gate on to the rough track to Knockville Farm and park, with permission, at the farm [NX 362 724]. Alternatively, park in one of the large lay-bys on the A714 and walk up to the farm (c.500 m) to request access permission. From the farm, walk NNW about 600 m across two fields to the gate near a T-junction between two dykes. From the gate in the dyke, walk NW out on to the moorland for a further 500 m to a large *roche moutonnée* which lies 330 m NE of the prominent cairn [NX 3525 7295]. An undoubted conformable stratigraphical contact between older Portpatrick and younger Glenwhargen formations is exposed on the north side of the *roche moutonnée*.

Greywackes of the two formations are visibly different in the field. Those of the Glenwhargen Formation are pale grey, often weather white, and are commonly rich in quartz pebbles. They are usually well bedded and often show obvious lamination even in coarse-grained units. By contrast, Portpatrick Formation greywackes are dull bluish grey, weather with a brownrusty crust and tend to form rounded exposures of massive sandstone in which bedding is often obscure.

A measured section at the Knockville Moor locality (Figure 43)c shows that the basal units of the Glenwhargen Formation (at the top of the section) are relatively thinly bedded and fine-grained, in strong contrast to the underlying top units of the Portpatrick Formation sequence. Beds are vertical and young north. An interesting feature is the presence of a single thin quartzose greywacke bed interbedded near the top of the Portpatrick Formation. More typical thicker-bedded and coarser-grained greywackes of the Glenwhargen Formation can be seen in numerous isolated exposures on the moorland to the north.

The Portpatrick/Glenwhargen interbedding is analogous to that at the Kirkcolm/ Galdenoch boundary (Locality 3) except that in this case the andesite-rich greywacke is predominant. The outcrop of the Glenwhargen Formation, which

sometimes bifurcates into two distinct subunits, is mappable for over 35 km to the NE, as far as the Cairnsmore of Carsphairn granite. Further NE, and also towards the SW, the unit becomes much thinner and is represented by only a few sporadic quartzose beds in the Scaur Water (Floyd, 1982) and on the Rhins of Galloway basin.

9 A714 at Glenhapple: Moffat Shale Group black cherty mudstone

From Knockville, continue south on the A714 for a further 1.2 km to a roadside cliff section near Glenhapple [NX 375 715] which exposes black cherty mudstone and thick greywacke. The mudstone is probably part of the Moffat Shale Group underlying the Portpatrick Formation and has been brought up along a splay of the Fardingmullach Fault. The greywacke immediately to the south of the mudstone belongs to the Shinnel Formation and its contact with the cherty mudstone is sheared and veined and probably tectonic. A 4 m-wide porphyritic microdiorite (porphyrite) dyke trending 015° cuts the greywackes and cherty mudstones here.

10 River Cree: Moffat Shale Group black shales; Shinnel Formation siltstones and greywackes

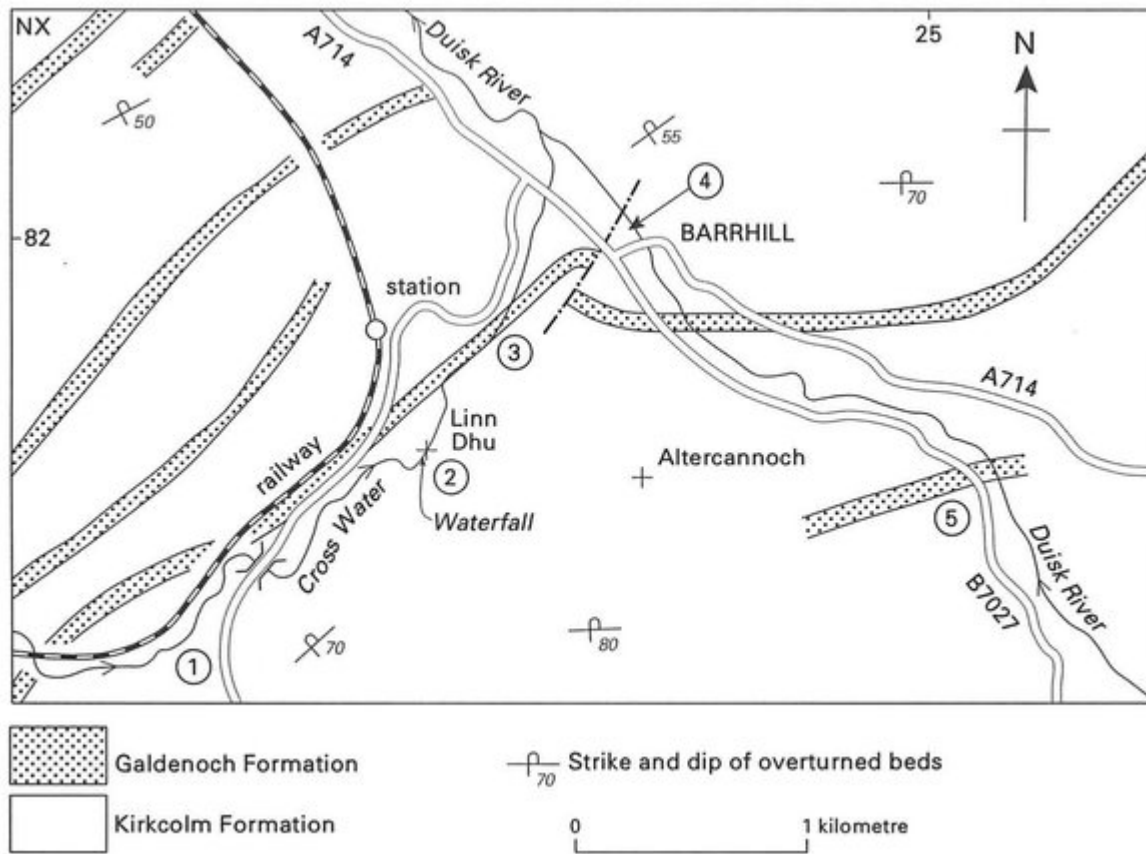
Continue south on the A714 to Newton Stewart, turn left across the Bridge of Cree into Minnigaff and turn left again almost immediately on to the Wood of Cree road. Continue north out of Minnigaff and take the left turn over the Penkiln Burn bridge and past the church. About 2 km north of Minnigaff and 400 m north of Boreland Lodge, a fisherman's path on the left leads down about 300 m to the River Cree [NX 401 669].

At this locality, a large bend of the River Cree exposes deformed black shales on the north bank and on some small islands in the river. These black shales belong to the Moffat Shale Group, which underlies the Shinnel Formation at this locality and has been brought up along a splay of the Orlock Bridge Fault. Graptolites obtained from the shales indicate the presence of the *D. dingani* or *P. linearis* biozones. This is one of the few localities where black shales are exposed along the line of the Orlock Bridge Fault, which forms the boundary between the Northern and Central Belts in the Southern Uplands.

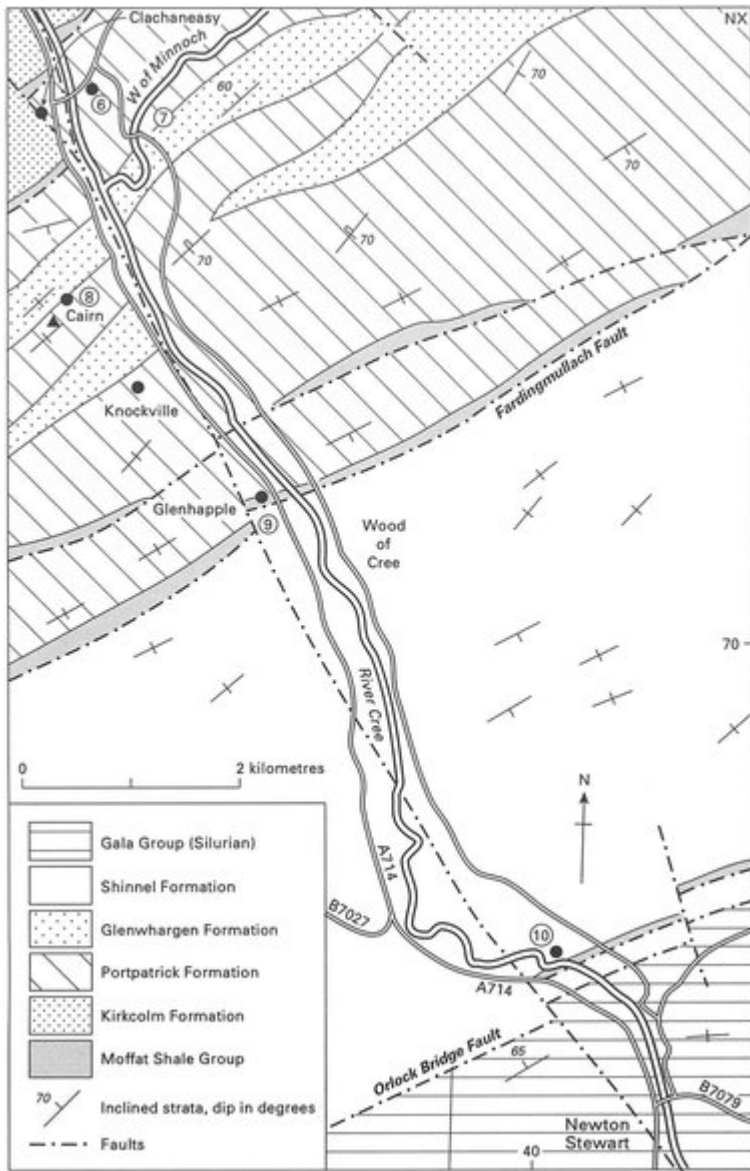
A short distance upstream, and round the bend in the river, there is a 150 m section in laminated siltstones which are typical of the Shinnel Formation and form its basal beds hereabouts. Beds strike about 055° with a general steep dip towards the north. NW across a small fault the succession becomes coarser grained and there is a good section in medium- to thickly bedded Shinnel Formation greywackes on the east bank of the river. Groove casts and graded bedding indicate that the succession youngs north. Rip-up clasts of dark shale can be seen in several of the greywacke units.

Petrographically, the Shinnel Formation is quite similar to the Kirkcolm Formation, with little or no andesitic detritus, but with a generally higher, though more variable, quartz content.

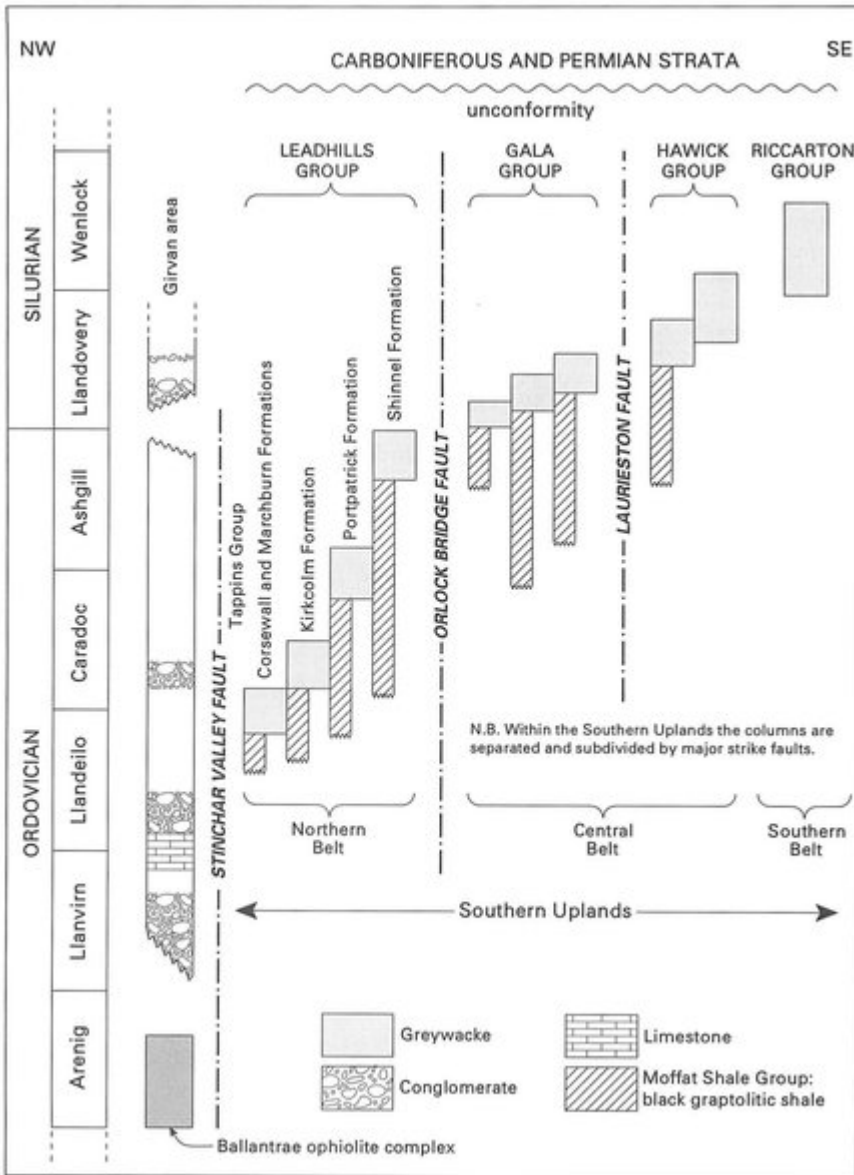
[References](#)



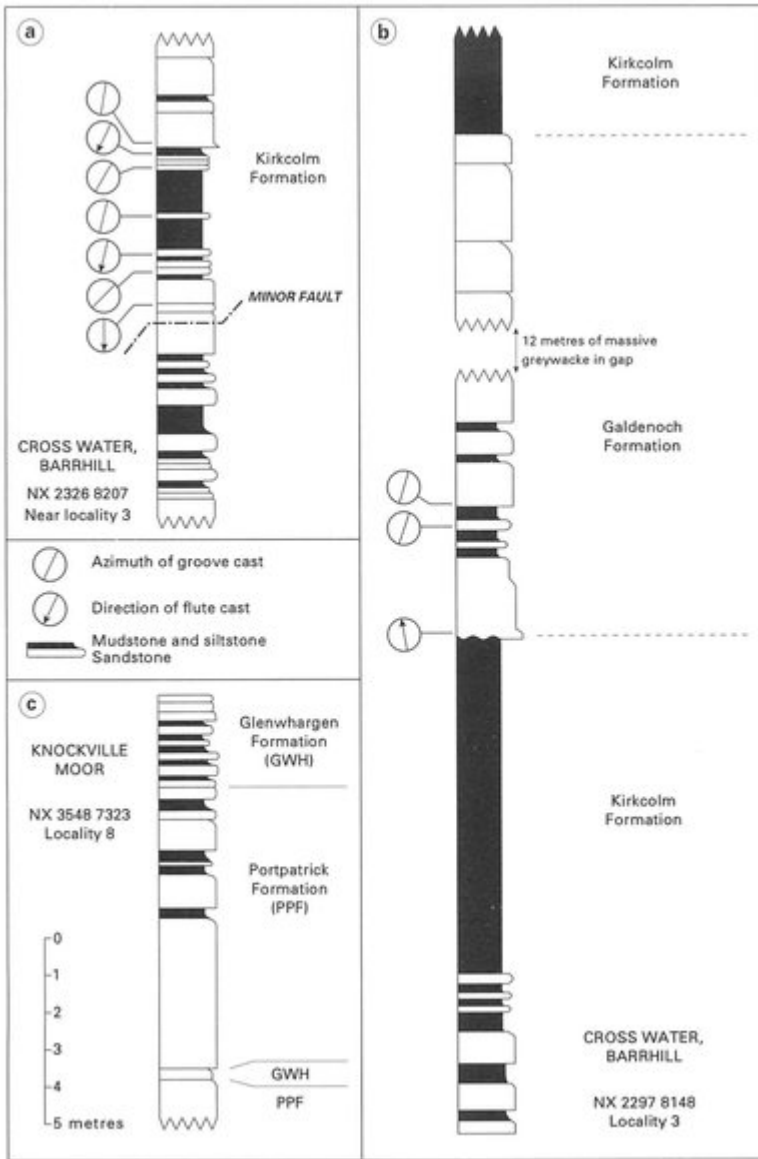
(Figure 42) Locality map and outline geology for the Barrhill area (Localities 1–5).



(Figure 44) Locality map and outline geology for the area north-west from Newton Stewart (Localities 6- 10).



(Figure 2) Schematic representation of stratigraphical relationships in south-west Scotland.



(Figure 43) Measured sections in the Lower Palaeozoic strata between Banhill and Newton Stewart.