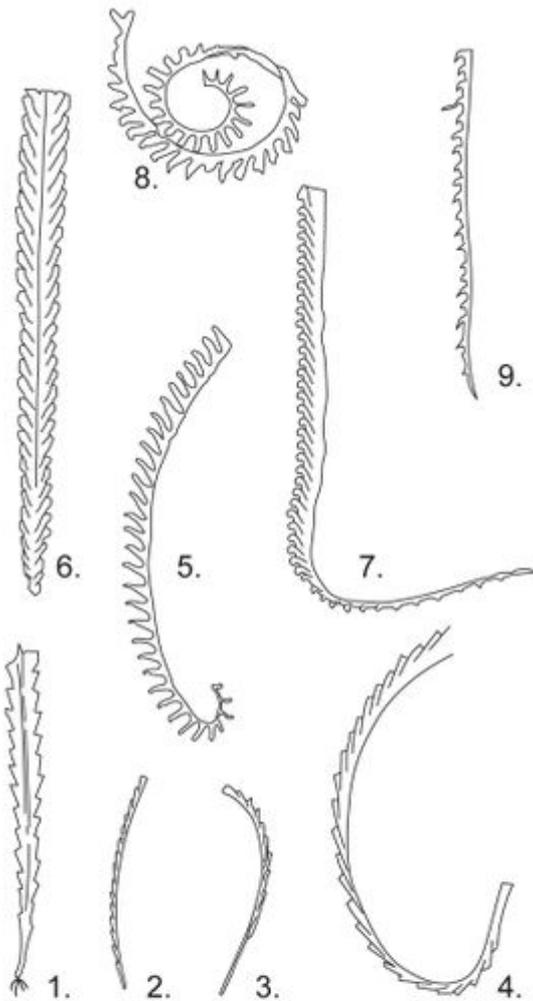


The Coalpit Bay area of Co. Down. A: Location map B: Detailed geological map C: Lithological descriptions of the main formations (in stratigraphical order). (P947805)

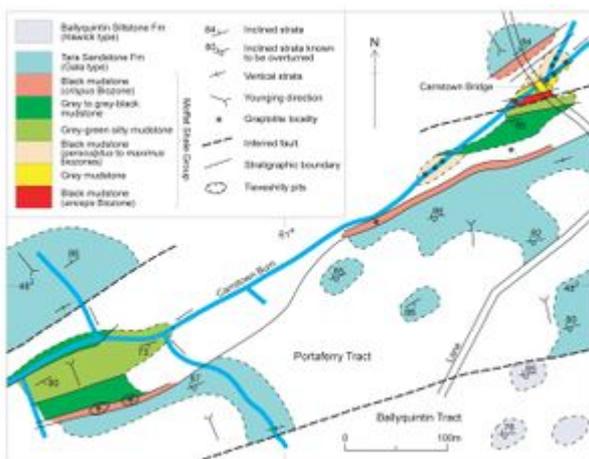


Two soft, light green bentonite beds, 5 cm and 2 cm thick, are displaced by small-scale, sinistral, strike-slip faults. Lying about 3 m stratigraphically below overlying Gala Group turbidites, the mudstones contain numerous graptolites. Upper Birkhill Shale Formation (Moffat Shale Group) at the 'Pit' locality, Coalpit Bay [J 595 788], 1 km south of Donaghadee, Co. Down. (7 cm scale bar). (P947978)



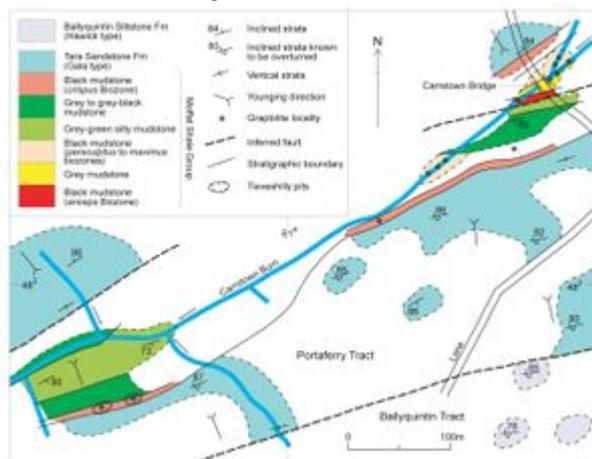
1. *Parakidograptus acuminatus*
2. *Atavograptus atavus*
3. *Lagarograptus acinaces*
4. *Coronograptus cyphus*
5. *Monograptus triangulatus*
6. *Normalograptus ?magnus*
7. *Monograptus argenteus*
8. *Lituigraptus convolutus*
9. *Stimulograptus sedgwickii*

Early Silurian (Llandovery) graptolite zonal index species from Pomeroy (all x2) (after 17). (P947799)



Geological map of the Carrstown Burn and Tieveshilly outcrop. (P947806)

sole markings (large horse-shoe flutes)
demonstrating current flow from lower right
to top left. Shore exposures [J 596 785] of
the Millisle Sandstone Formation (Gala
Tract 7) 400 m southeast of Galloway's
Bridge, Donaghadee, Co. Down. (Hammer
head 17 cm long). (P947979)



Geological map of the Carrstown Burn and
Tieveshilly outcrop. (P947806)

Modelling the stratigraphy and structure of the Southern Uplands-Down-Longford Terrane in a plate tectonic context imparted new impetus to mapping and research in the latter half of the 20th Century and this in turn produced a plethora of lithostratigraphical formation and member names. In Scotland these formations and members have now been systematically organised into a few groups and supergroups ^[1], ^[2]. The following account of the Lower Palaeozoic stratigraphy attempts to extend that rationalism into Counties Down and Armagh.

In Northern Ireland the oldest rocks exposed in the Northern Belt and the northern parts of the Central Belt belong to the Crawford Group and the Moffat Shale Group. The Crawford Group is confined to outcrops in the Acton Inlier of Co. Armagh and at Cultra in Co. Down. The Moffat Shale Group is much more widespread, cropping out at more than 30 localities (P947802), typically broken and imbricated by faulting and invariably surrounded by younger turbidites. The Moffat Shale Group is divided into four formations ^[1], Glenkiln Shale, Lower Hartfell Shale, Upper Hartfell Shale and Birkhill Shale. In the Northern Belt tracts, the Group is stratigraphically succeeded by several different turbidite formations, collectively assigned to the Leadhills Supergroup. The Northern Belt is separated from the Central Belt in both Scotland and Ireland by the Orlock Bridge Fault, the extent and the fabric of the fault rocks indicative of a large, sinistral strike-slip displacement ^[3]. South of the fault there is a sequence of tracts in which turbidite formations of the Gala Group, of a siliceous or quartz-rich petrography, rest on progressively younger units of the Moffat Shale Group ^[4]. South of the Cloghy Fault (the equivalent of the Laurieston Fault in Scotland), turbidites of the Hawick Group are generally fine-grained, rich in carbonate and, except for the Portaferry Tract, are not seen to rest on the Moffat Shale Group.

This classification is somewhat unconventional in that the Moffat Shale Group is the temporal equivalent of large parts of both the Leadhills Supergroup and Gala Group in the same area. In addition the Leadhills Supergroup, Gala and Hawick Groups are composed of numerous formations which do not form part of a single continuous succession but rather occur in separate fault-defined tracts. It is nevertheless, a successful pragmatic approach to the unusual nature of the prism stratigraphy.

Crawford Group

The oldest rocks of the Southern Uplands-Down-Longford Terrane in Northern Ireland occur in the Acton Inlier ^[5]. Exposed in the bed and banks of a stream [J 043 412] 1.4 km west of Acton ([P947802](#)) are some 5 m of purplish red and green mudstone, thin black chert and pale grey to cream weathering radiolarian chert. The purplish red mudstone contains a sparse conodont fauna that includes *Periodon aculeatus*, *Protopanderodus varicostatus*, *Pygodus anserinus* and *P. serra*, and straddles the boundary between the *Pygodus serra*-*P. anserinus* biozones (Bergstrom, pers. comm., 1974) and so indicates a late Llanvirn (mid-Llandeilian) age. These mudstones and cherts clearly resemble and correlate with the Kirkton Formation in the Crawford Group of southwest Scotland ^[1].

On the west side of Helen's Bay at Horse Rock [J 459 831] about 25 m of pillow lavas ^[6] and a thin conglomerate with spilite clasts of the Crawford Group are succeeded by gracilis Biozone mudstones of the Moffat Shale Group. This, the only exposure of pillow lava on the coast of Co. Down, affords excellent natural cross sections of pillow shapes, some of them clearly demonstrating that the lavas are overturned, younging down to the north.

Moffat Shale Group in Counties Down and Armagh

The best exposure, and most complete development, of the Moffat Shale Group is at Coalpit Bay, 1 km south of Donaghadee ([P947805](#)). Swanston and Lapworth in 1876 recognised that all four formations of Lapworth's 'Moffat Series' are present with faunas typical of most, if not all, of the graptolite biozones ^[7].

The early Caradoc Glenkiln Shale Formation (gracilis and peltifer biozones) crops out at low water mark in the core of an east-west trending anticline in the more southerly of the two small peninsulas projecting into Coalpit Bay, some 50 m ESE of the end of a disused sewage outfall. The Ordovician Moffat Shale Group succession can then be traced stratigraphically upward and southward through the Lower and Upper Hartfell Shale Formations as far as a prominent, locally multiple, dark red lamprophyre dyke. The Lower Hartfell black mudstone yields graptolite faunas of the *wilsoni* and *complanatus* biozones and includes a 0.3 m thick grey limestone bed. The almost structureless, pale grey, "barren mudstones" of the Upper Hartfell include several thin sheared black mudstones of the 'anceps Band' near the base of the formation.

The dyke is intruded along, or lies close to, the faulted boundary between the Ordovician barren mudstones to the north and the Silurian Birkhill Shale Formation to the south. At outcrop the faulted nature of the boundary is not immediately obvious but the mudstones immediately to the south of the dyke yield rich graptolite faunas of the *cyphus* Biozone, so implying the absence or excision of some five lower Birkhill graptolite biozones at the systemic boundary. Intermittent exposures of folded grey-black siltstones, mudstones shales and a thin limestone bed of the Birkhill Formation continue to the low cliffs on the southern margin of the bay. At the base of the cliff and particularly in the small pit which gives the bay its name, they are richly fossiliferous and interlayered with many thin beds of soft bentonite ([P947978](#)). The conformable contact with the overlying coarse quartz-rich turbidites of the Gala Group is well exposed at the pit and along strike to the east, where it is displaced by several small strike-slip faults.

Some of the lower parts of the Birkhill Shale Formation, missing in the traverse described above, are represented in the northern peninsula ([P947805](#)) which is composed of mudstone and calcareous siltstone yielding sparse faunas of the *acuminatus* and *atavus* biozones.

The Moffat Shale Group lithostratigraphy at Coalpit Bay thus compares and correlates very closely with that in the Moffat type area of Scotland.

The many other outcrops of the Moffat Shale Group in Counties Down and Armagh are useful markers of the southern edges of the fault-defined accretionary tracts. The mudstones typically occur as imbricated fault slices at the underthrust base of each tract and, except at Coalpit Bay, not as the cores of periclinal anticlines ^[8]. At Horse Rock [J 459 831], on the west side of Helen's Bay (op. cit.) black mudstone of the Moffat Shale Group, with many large olistoliths of grey sandstone are conformably succeeded by thick proximal turbidites of the Grey Point Formation ^[9].

Inland exposures of black mudstone in north eastern Co. Down at Lessans Cottage [J 400 622], Yates Corner [J 396 623] and at Ballyharry railway cutting [J 501 754], contain graptolite faunas attributed to the *gracilis*, *peltifer*, *clingani* and *linearis* biozones and the mudstones thus correlate with the Glenkiln and Hartfell formations ^[10]. In the same area, the Birkhill Shales occur in a number of inliers, notably at Yates Corner, Cunning Burn [J 537 727], and Killaney [J 361 588] with graptolite faunas (P947799) attributed to the *acuminatus*, *atavus*, *acinaces*, *cyphus*, *gregarius* and *i* biozones ^[11].

In Co. Armagh the oldest well-preserved graptolite fauna, in the Acton Inlier, belongs to either the *gracilis* or *peltifer* biozones and occurs in sooty black mudstones that crop out in the east side of the stream valley [J 045 414] 275 m northeast of the conodont locality referred to above. The fauna includes *N. gracilis*, *Didymograptus* cf. *superstes*, *Hallograptus mucronatus*, *Orthograptus calcaratus*, *Dicellograptus divaricatus salopiensis*, *D. sextans*, *Climacograptus bicornis*, *C. antiquus lineatus* and *Pseudoclimacograptus scharenbergi*. Nowhere in the inlier is there graptolite evidence for the mid-Caradoc to early Ashgill lower part of the Hartfell Shale Formation. However, this absence is most likely due to non-exposure of the appropriate horizons as the remaining, upper, part of the Moffat Shale Group succession in the inlier consists of a thick sequence of monotonous, barren, greenish grey and grey mudstones and fine siltstones. These strata probably represent the upper part of the Hartfell Shale Formation although there is no record of black mudstones of the anceps Band.

An unusual and stratigraphically important outcrop of the Moffat Shale Group occurs at Tieveshilly [J 612 481], near the southern tip of the Ards Peninsula (P947806). The locality is located further southeast in the terrane than any other Moffat Shale outcrop in Scotland or Ireland and has yielded copious graptolite faunas ranging in age from the *anceps* to *crispus* biozones, the latter a zone younger than currently recognised in any of the other Irish or Scottish localities ^[12].

Leadhills Supergroup in Counties Down and Armagh

The Leadhills Supergroup ^[1] is the collective name given to the several, petrographically varied, turbidite formations which rest on the Moffat Shale Group in the Northern Belt. The Southern Upland Fault, which forms the northern boundary of the Northern Belt, does not crop out in Ireland and comparison between Irish and Scottish outcrops makes it clear that the most northerly Scottish tracts also fail to crop out in Co. Down. Despite this, by using a combination of detailed petrographical analysis and the presence of the characteristic black mudstones ^[13], five accretionary tracts are recognised in the Northern Belt between Belfast Lough and the trace of the Orlock Bridge Fault (P947807).

The most northerly and oldest, the Ballygrot Tract is superbly exposed in the rocky coastal strip between the western end of Helen's Bay and Grey Point (P947802). The tract is composed of a greater range of characteristic Southern Upland lithologies than any other in Ireland, including spilitic lava, conglomerate, black mudstone, rafts (olistoliths) of sandstone embedded in black mudstone, graded, channelised pebbly and coarse-grained sandy greywacke with interbedded grey mudstone. Inland, southwestward along strike, the Northern Belt is concealed beneath Triassic

rocks in the Dundonald gap. It re-emerges south of Belfast and continues WSW into Co. Armagh and Co. Monaghan as a poorly exposed, narrow strip in which tract boundaries have yet to be established. At the southwest end of the Northern Belt in Co. Cavan two distinct tracts are recognised ^[14].

Gala Group

Between the Orlock Bridge and Cloghy faults, in the northern part of the Central Belt (P947802), there are at least eight accretionary tracts in which the Moffat Shale Group is succeeded by thick turbidite formations of the Gala Group (P947808). These tracts are identified as Gala 3, 4, 5, 6, 7, 7+1, 7+2 and 7+3 ^[15] reflecting the detailed correlation with the outcrop in the Southern Uplands of Scotland ^[16]. Gala tracts 1 and 2 of the Scottish outcrop have not been recognised in Counties Down and Armagh and have possibly been excised by movement on the Orlock Bridge Fault. The presence of additional tracts 7+1, 7+2 and 7+3 helps to explain the fact that the outcrop of the Central Belt in Counties Down and Armagh is at least 45km across the strike and is some 15km wider than in southwest Scotland. In all these tracts the coarser sedimentary clasts that occur in the turbidites demonstrate a homogeneously quartz-rich petrography.

Four Gala tracts in Co. Down merit particular comment. The Millisle Formation of Gala 7 is composed of uncommonly thick bedded and coarse-grained arenites with superb sole markings (P947979) and conglomerate members. The sole markings are particularly well exposed on steeply overturned, north-younging beds forming the headlands immediately south of Coalpit Bay. The same coarse arenites, readily traced for at least 60km northeastward across the North Channel and for a similar distance southwestward into Co. Armagh, are quarried for high quality skid-resistant roadstone.

The Ballywhiskin Tract, Gala 7+1, shows an almost perfect fining-upward sequence. Massive proximal turbidites, with individual beds up to 4 m thick, strike and dip uniformly at the southern margin of the tract and young northward into progressively thinner and finer grained beds over a tract width of about 1km. The thin siltstones and mudstones in the upper part of the sequence are repeatedly folded.

Graptolites occur in dark grey mudstone interbeds in several of the Gala turbidite formations. For example, mudstone interbedded with the massive proximal turbidites of the Ballywhiskin Formation at Whiskin Rocks [J 615 734] have yielded a *turriculatus* Biozone fauna ^[10] and sparse *crispus* Biozone faunas have been collected at a number of localities in the Rowreagh Formation of the Gala 7+3 tract. The Tara Sandstone Formation of the Portaferry Tract is the most southerly formation demonstrating typical Gala Group lithological characteristics. Bands of pyritous black mudstone within the Tara Sandstone Formation at Millin Bay [J 651 490] have yielded *crispus* and/or *griestoniensis* Biozone faunas ^[12].

Soft grey or grey-green bentonite beds occur in all the Gala Group formations in Co. Down, though they are less obvious than in the Moffat Shale outcrops ^[12].

Hawick Group

The distal turbidite sequences south of the Cloghy Fault demonstrate all the typical characteristics of the Hawick Group in the Southern Uplands of Scotland. The formations are largely composed of thinly bedded, fine-grained sandstone and siltstone, commonly with thick mudstone interbeds. Carbonate comprises up to 20% of the rock and is seen in thin section to have extensively replaced the original clay matrix of the greywacke. The carbonate concentrates in nodules or concretions, typically elongate and aligned parallel to bedding, which weather into rows of shallow depressions,

locally merging into honeycomb patterns on joint surfaces. Thin red mudstones occur irregularly throughout the Hawick Group and rare detrital red micas can be seen on fresh surfaces of the siltstones and fine sandstones. Again, bentonite beds occur throughout the Hawick Group, being particularly common in the Ardglass Formation.

The rocks of the Hawick Group appear generally unfossiliferous, apart from a few trace fossils. South of the Cloghy Fault the Moffat Shale Group crops out only in the Portaferry Tract ([P947808](#)). This may be readily explained by noting that the basal thrust or décollement beneath the accretionary tracts in the Northern Belt and northern part of the Central Belt climbs to progressively higher stratigraphic levels in the Moffat Shale Group from northwest to southeast. Further southeast in the Central Belt the décollement may have cut up into the overlying turbidites, leaving the Moffat Shale Group to be completely subducted with the underlying oceanic crust. Recognition of tract boundaries in the outcrop of the Hawick Group is difficult or impossible because of the absence of Moffat Shale inliers and also because of the relatively homogeneous nature of the Hawick turbidite lithologies.

The strata exposed in the Portaferry Tract are arranged in a simple, straightforward and unique stratigraphic sequence ^[121], ^[121]. At Tieveshilly (op. cit.) the Moffat Shale Group is about 80 m thick. It is directly and conformably succeeded by the Tara Sandstone Formation ([P947806](#)), consisting of 150 m of Gala-type, dark grey, quartz-rich arenites with laminae of black mudstone carrying crispus and griestoniensis Biozone graptolite faunas ^[121]. The Tara Sandstone Formation passes up conformably into the unfossiliferous Kearney Siltstone Formation of Hawick Group aspect, consisting of some 600 m of carbonate-rich fine sandstone, siltstone and grey mudstone with red mudstone bands near the base.

References

1. ↑ ^{1.0} ^{1.1} ^{1.2} ^{1.3} Floyd, J D. 1996. Lithostratigraphy of the Ordovician rocks in the Southern Uplands: Crawford Group, Moffat Shale Group, Leadhills Supergroup. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, 86, 153-65.
2. ↑ Floyd, J D. 2001 (for 2000). The Southern Uplands terrane: a stratigraphical review. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, 91, 349-62.
3. ↑ Anderson, T B, and Oliver, G J H. 1986. The Orlock Bridge Fault: a major late Caledonian sinistral fault in the Southern Uplands terrane, British Isles. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, 77, 203-22.
4. ↑ Geological Survey of Northern Ireland. 1997. Geological Map of Northern Ireland. Solid Geology (second edition). 1:250 000. (Keyworth, Nottingham: British Geological Survey).
5. ↑ Geological Survey of Northern Ireland 1985. Armagh, Northern Ireland Sheet 47. Solid Geology. 1:50 000. (Southampton: Ordnance Survey for the Geological Survey of Northern Ireland).
6. ↑ Sharpe, E. N. 1970. An occurrence of pillow lavas in the Ordovician of County Down. *Irish Naturalist's Journal*, 16, 299-301.
7. ↑ Swanston, W. and Lapworth, C. 1877. On the Silurian rocks of the County Down. *Proceedings of the Belfast Naturalists Field Club*, Appendix 1876-77, 107-48.
8. ↑ Peach, B N, and Horne, J. 1899. *The Silurian Rocks of Britain, Vol. 1. Scotland*. Memoirs of the Geological Survey of the United Kingdom, HMSO.
9. ↑ Craig, L E. 1984. Stratigraphy in an accretionary prism: the Ordovician rocks in North Down, Ireland. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, 74, 183-91.
10. ↑ ^{10.0} ^{10.1} Smith, R A, Johnston, T P, and Legg, I C. 1991. Geology of the country around Newtownards. *Memoir of the Geological Survey of Northern Ireland*, Sheet 37 and part of

sheet 38 (Northern Ireland).

11. Smith, R A, Johnston, T P, and Legg, I C. 1991. Geology of the country around Newtownards. *Memoir of the Geological Survey of Northern Ireland*, Sheet 37 and part of sheet 38 (Northern Ireland).
12. Anderson, T B, and Rickards, R B. 2000. The stratigraphy and graptolite faunas of the Moffat Shales at Tieveshilly, Co. Down, Northern Ireland, and their implications for the modelling of the Southern Uplands-Down-Longford Terrane. *Irish Journal of Earth Sciences*, 18, 69–88.
13. Craig, L E. 1984. Stratigraphy in an accretionary prism: the Ordovician rocks in North Down, Ireland. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, 74, 183–91.
14. Geraghty, M. 1997. *A geological description of Monaghan - Carlingford to accompany the Bedrock Geology 1:100 000 Scale Map Series, sheet 8 and 9, Monaghan and Carlingford, with contributions by J Farrelly, K Claringbold, C Jordan, R Meehan and M Hudson*. Geological Survey of Ireland (GSI), 60pp.
15. Geological Survey of Northern Ireland. 1997. Geological Map of Northern Ireland. Solid Geology (second edition). 1:250 000. (Keyworth, Nottingham: British Geological Survey).
16. Barnes, R P, Anderson, T B, and McCurry, J A. 1987. Along-strike variation in the stratigraphic and structural profile of the Southern Uplands Central Belt in Galloway and Down. *Journal of the Geological Society, London*, 146, 807–16.
17. Barnes, R P, Anderson, T B, and McCurry, J A. 1987. Along-strike variation in the stratigraphic and structural profile of the Southern Uplands Central Belt in Galloway and Down. *Journal of the Geological Society, London*, 146, 807–16.

Retrieved from

http://earthwise.bgs.ac.uk/index.php?title=Stratigraphy,_Southern_Uplands-Down-Longford_Terrane,_Northern_Ireland&oldid=32628

Category:

- [The geology of Northern Ireland](#)

Navigation menu

Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

Namespaces

- [Page](#)
- [Discussion](#)

Variants

Views

- [Read](#)
- [Edit](#)
- [View history](#)
- [PDF Export](#)

More

Search

Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

Tools

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)
- [Cite this page](#)
- [Browse properties](#)

• This page was last modified on 25 September 2017, at 14:05.

- [Privacy policy](#)
- [About Earthwise](#)
- [Disclaimers](#)

