

Carboniferous rocks of the Southern Uplands of Scotland - lithostratigraphical province

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Dean, M T, Browne, M A E, Waters, C N, and Powell, J H. 2011. framework for the Carboniferous successions of northern Great Britain (Onshore). British Geological Survey Research Report, RR/10/07. The Sanquhar and Thornhill basins

[File:P912768.jpg](#)

Figure 5

Lithostratigraphical nomenclature for the Midland Valley of Scotland. See Section 3 for description of lithofacies, and Figures 6 and 10 for other localities discussed in text. This figure is not intended to name all the formations in the region. Fm formation; Gp group; LCM Lower Coal Measures.

[File:P912769.jpg](#)

Figure 6 Generalised

vertical sections and correlation for Carboniferous strata in Scotland. Based on Lumsden et al. (1967), BGS (1987a), Browne et al. (1999), McMillan (2002) and BGS (2008). The profiled location of the numbered and lettered sections is given in the inset map. See Appendices 1 and 2 for the names of the lithostratigraphical units shown by BGS Lexicon of Named Rock Units computer codes. M marine band; L Lingula band. v indicates named volcanic rock units; blue colour indicates named limestone beds; dashed

lines indicate conjecture;
wavy lines indicate
unconformity surfaces.

The Sanquhar and Thornhill basins (Figure 6, P912769, Columns 5, 6) occupy much of the valley of the River Nith. At Sanquhar the beds mostly belong to the Scottish Coal Measures (the Scottish Lower, Middle and Upper Coal Measures formations all being present), but small thicknesses of the Clackmannan Group (undivided) and the Passage Formation are present below an unconformity. At Thornhill, rocks of the Yoredale Group (Closeburn Limestone Formation), Clackmannan Group (Enterkin Mudstone and Passage formations) and Scottish Coal Measures Group (including the Scottish Lower, Middle and Upper Coal Measures formations) are recognised.

Yoredale Group (YORE)

The Yoredale Group, as defined in full in Section 6.7, is restricted to the Thornhill Basin, with a single formation, the Closeburn Limestone Formation.

Yoredale Group

[Closeburn Limestone Formation](#)

Clackmannan Group (CKN)

The Clackmannan Group is present in both the Sanquhar and Thornhill basins.

The term 'Clackmannan Group' (Figure.5, P912768) was first used in the Airdrie district by I H S Hall (BGS, 1992) and Forsyth et al. (1996). The succession comprises the Lower Limestone, Limestone Coal, Upper Limestone and Passage formations, which represent a variable section of *mixed shelf carbonate and deltaic ('Yoredale') facies*, *fluviodeltaic ('Millstone Grit') facies* and *fluviodeltaic ('Coal Measures') facies*. The formations are characterised by strongly cyclical, upward-coarsening units of limestone, mudstone, siltstone and sandstone capped by coal and seatearth, the proportions differing in each of the formations. Thus, beds of laterally extensive limestone, with diverse marine faunas, are more conspicuous in the Lower and Upper Limestone formations than elsewhere; coals are most common in the Limestone Coal Formation; and sandstones and seatearths (including some economically important high-alumina seatclay, fireclay and bauxitic clay) are the most prominent constituents of the Passage Formation. Depositional environments, likewise, show an underlying similarity, being related to the repeated advance and retreat of fluviodeltaic systems into embayments of varying salinity. The Lower and Upper Limestone formations contain the highest proportion of marine deposits (*mixed shelf carbonate and deltaic ('Yoredale') facies*), whilst the Passage Formation is dominated by alluvial deposits (*fluviodeltaic ('Millstone Grit') facies*). The Limestone Coal Formation occupies an intermediate position (*fluviodeltaic ('Coal Measures') facies*).

The base of the group is taken at the base of the Lower Limestone Formation, where a cyclical sequence of marine limestone-bearing strata normally rests conformably on various formations of the Strathclyde Group. The base of the Scottish Coal Measures Group (*fluviodeltaic ('Coal Measures') facies*) defines the top of the group.

The type area of the Clackmannan Group is the Clackmannan Syncline. It extends across the Midland Valley of Scotland and includes Machrihanish and Arran. Up to 1800 m thick in the Clackmannan area, the group is mostly Namurian in age, but ranges from Brigantian to early Langsettian.

The Clackmannan Group also occurs in the Southern Uplands of Scotland at Sanquhar and Thornhill. In the eastern part of the Sanquhar Basin the Clackmannan Group (undivided) comprises an older, highly variable sequence of mainly arenaceous and argillaceous strata, which were probably deposited in semi-isolated sub-basins during the period of maximum marine transgression. In the west of the basin, younger sandstones, siltstones and carbonaceous mudstones with marine bands probably represent marginal deltaic conditions. The base of the group is unconformable on the mainly greywacke sandstones of the Ordovician Tappins and Barrhill groups, and the top is taken at the base of Tait's Marine Band, of possible Westphalian age (Wilson in Davies, 1970, p.52), at the base of the cyclical sandstones, siltstones, mudstones, seatrocks and coals of the Scottish Lower Coal Measures Formation. In the Sanquhar Basin the Clackmannan Group is about 40 m thick in total and falls within the age range of late Visean to Langsettian.

In the Thornhill Basin the Clackmannan Group (see Section.5.3) comprises the marine-intertidal Enterkin Mudstone Formation of '*mixed shelf carbonate and deltaic ('Yoredale') facies*', and the Passage Formation of '*fluviodeltaic ('Millstone Grit') facies*'. The base of the group is unconformable on the mainly sandstone-dominated turbidites of the Ordovician Glenlee Formation, Leadhills Supergroup, and the top is taken at the conformable base of the Scottish Lower Coal Measures Formation of '*fluviodeltaic ('Coal Measures') facies*'. In the Thornhill Basin the Clackmannan Group is up to 55 m thick in total and falls within the age range of late Visean to pre-Westphalian.

[Clackmannan Group](#)

Sanquhar Basin

In the Sanquhar Basin the Clackmannan Group has not been formally divided into constituent formations. However, lower and upper sequences within the group are recognised.

[Clackmannan Group](#)

Thornhill Basin

In the Thornhill Basin the Clackmannan Group comprises the Enterkin Mudstone and Passage formations:

[Enterkin Mudstone Formation](#)

[Passage Formation](#)

[Townburn Sandstone Member](#)

Scottish Coal Measures Group (CMSC)

The Scottish Coal Measures Group, as defined in full in Section 4.6 is present in both the Sanquhar and Thornhill basins, where it is again divided into Lower, Middle and Upper formations.

Lithologically the group comprises a cyclical alternation of sandstone, siltstone and mudstone with coal seams well developed in the middle of the sequence. The rocks are typically grey, but they redden towards the top of the group as they approach the Permian (Variscan) unconformity. The lithofacies reflect steady basin subsidence in a generally deltaic environment with periodic marine incursions. Rare marine bands, *Planolites* bands and especially non-marine bivalve 'musselbands' are important for correlation.

There is no formally defined Lowstone Marine Band equivalent at the base of the Scottish Coal Measures Group in these basins. In the western part of the Sanquhar Basin the base is taken at the base of Tait's Marine Band (TMB), whilst in the east it occurs at an unconformity above the mainly sandstone, calcareous mudstone and siltstone of the older sequence of the Clackmannan Group (undivided). Generally in the Thornhill Basin the nonmarine fossiliferous Scottish Coal Measures Group overlies the nonfossiliferous sandstone facies of the Passage Formation. The top of the group in both basins is the Variscan Unconformity. At Sanquhar this is partially overlain by the olivine basalts of the Lower Permian Carron Basalt Formation, whilst in the Thornhill Basin the Carron Basalt Formation and red sandstones of the Lower Permian Thornhill Sandstone Formation occur immediately above it.

The maximum thicknesses of the Scottish Coal Measures Group in the Southern Uplands region are about 555 m in the Sanquhar Basin and about 141 m in the Thornhill Basin. Based on the presence of nonmarine bivalve 'musselbands', both areas include strata of Langsettian (Westphalian A) to Bolsovian (Westphalian C) age.

The Scottish Coal Measures Group is also present in the Stranraer Basin, and outcrops on the eastern side of the northern Rhins peninsula between Jamieson's Point (NX 032 711) and Lochans (NX 060 572). The sequence, formerly referred to the now obsolete Leswalt Formation, comprises about 30 m of grey, red, and mottled yellow-brown sandstone, interbedded with purplish grey shale, rare seatclay, and a single pervasively weathered olivine-basalt sheet. The strata lie unconformably on steeply inclined Lower Palaeozoic greywackes, and become more arenaceous upwards. A flora from thin interbedded siltstones seems most likely to be of Westphalian age, and the strata belong to either the Scottish Lower or Middle Coal Measures formations. The Scottish Upper Coal Measures Formation appears to be missing here, so the upper boundary of the Scottish Coal Measures Group is considered unconformable beneath beds of red sandstone and breccia of Permian age (see Stone, 1995, and references therein).

[Scottish Coal Measures Group](#)

[Scottish Lower Coal Measures Formation](#)

[Scottish Middle Coal Measures Formation](#)

[Scottish Upper Coal Measures Formation](#)

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