Scottish Upper Coal Measures Formation

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Scottish Upper Coal Measures Formation (UCMS), Carboniferous, Midland Valley of Scotland

Scottish Upper Coal Measures Formation is part of the Scottish Coal Measures Group

Name

The epithet 'Scottish' is applied to the Upper Coal Measures to distinguish them from the formation in England and Wales on account of the different definition of the base of the formation (Waters et al., 2007[1]).

Lithology

The Scottish Upper Coal Measures comprise sandstone, siltstone and mudstone in repeated cycles, which most commonly fine-upwards. The mudstone occurs most commonly as structureless beds and seatearth. The sequences are usually reddish brown and purplish grey. Coal seams are not common, are normally less than 0.3 m thick and may be replaced, totally or in part, by red (haemetitic) and dark grey carbonaceous diagenetic limestone. Brecciation textures may occur and nodular pedogenic carbonate is present in some clay/silt grade rocks in Fife.

Genetic interpretation

Fluviodeltaic ('Coal Measures) facies. The reddish brown and purplish grey colours are due to oxidation of originally grey strata beneath the Permian unconformity, but some reddening may be primary, related to periods of lowered water table during deposition.

Stratotype

The partial type section of the Scottish Upper Coal Measures is from surface to 285 m depth in the Hallside Borehole (BGS Registration Number NS65NE/66) (NS 6693 5974) south-east of Glasgow in the west Central Coalfield (see Browne et al., 1999, fig. 7, col. 4[2]). Reference sections are provided by the Killoch No. 1 Bore (BGS Registration Number NS42SE/7) (NS 4756 2023) from the sub-Permian unconformity at 39.9 m depth to an 'ashy conglomerate' at 123.6 m depth (the strata at 63.9 m depth including *Anthraconaia pruvosti* of the undifferentiated Phillipsii and Tenuis chronozones), and the Killoch No. 1A Bore (BGS Registration Number NS42SE/8) (NS 4758 2024) which continues the section from 123.6 m depth at the 'ashy conglomerate' mentioned above, to the Aegiranum (Skipsey's) Marine Band at 481.3 depth.

Lower and upper boundaries

The base of the formation is drawn at the base of the Aegiranum (Skipsey's) Marine Band (AGMB) (Forsyth et al., 1996[3]; Browne et al., 1999, p.19[2]), which is underlain by cyclical sedimentary rocks of the Scottish Middle Coal Measures (Figure 6, Column 4). In Fife and Lothian this bed has been tentatively recorrelated with the 'Buckhaven *Planolites* Band' and the Montague Bridge Marine Band (see Browne et al., 1999, and references therein[2]). The Aegiranum Marine Band is at a lower stratigraphical level than the Cambriense Marine Band, the top of which marks the base of the Pennine Upper Coal Measures.

The top of the Scottish Upper Coal Measures is marked by an erosional unconformity of regional extent beneath Permian strata.

Thickness

Based on the interpretation of commercial seismic data the maximum thickness of the formation probably exceeds 1200 m under the Firth of Forth. Up to 460 m in central Ayrshire. A generalised thickness of 280 m in the main coalfield area at Machrihanish was given by BGS (1996)[4].

Distribution and regional correlation

The Midland Valley of Scotland, Machrihanish and the small basins of the Southern Uplands (excluding Solway).

Age and biostratigraphical characterisation

Westphalian C–D (Bolsovian–Asturian). The fauna of the formation includes, in its lower parts, nonmarine bivalves of the Upper Similis-Pulchra and the combined Phillipsii and Tenuis chronozones. *Anthraconaia adamsi, A. spathulata* and *Naiadites hindi* may, for example, occur in the Upper Similis-Pulchra Chronozone, and *A. pruvosti, Anthraconauta phillipsii* and *An. tenuis* in Phillipsii/Tenuis strata (see Trueman and Weir, 1946[5]; Mykura, 1967[6]; Calver, 1969[7]; Cameron and Stephenson, 1985, fig. 29[8]). The Aegiranum Marine Band at the base of the formation has a rich and varied 'benthonic and cephalopod' fauna with calcareous brachiopods, ammonoids and nautiloids (see Calver, 1969[7]). There is no evidence of marine conditions above the Upper Similis-Pulcra Chronozone. In the upper part of the Upper Coal Measures only scarce plant remains and the annelid *Spirorbis* sp. are found (Cameron and Stephenson, 1985[8]). Floras indicative of the Bolsovian and Asturian stages have been identified (Scott, 1976[9]).

Plant impressions from a sedimentary intercalation in the Mauchline Volcanic Formation exposed in

the River Ayr near Stairhill (NS 4521 2423) were formerly regarded as being characteristic of an Asturian (Westphalian D) or more likely late Stephanian age (see Wagner, 1966[10]; Mykura, 1967, pp. 25, 27, 80[6]; Ramsbottom et al., 1978, fig. 14:4, p. 62[11]). However, with further evidence, including the presence of *Lobatopteris geinitzii* (von Gutbier, emend. Sterzel) comb. nov., Wagner (1983[12]; see also Brand, 1983, p. 175 and references therein[13]) was able to compare the assemblage with lower Rotliegend floras of central Europe and give it a probable early Permian (early Autunian; Asselian) age, which is still accepted (see Cleal and Thomas, 1995, pp. 229–233[14]). However, biostratigraphical problems associated with geologically long-lived plant genera, phylogenic variation, climate change and the potential of mixed diachronous and refugial floral assemblages at the Carboniferous–Permian boundary make desirable an independent reinterpretation of the fossil flora and palynology at the Stairhill site (Hilton in Dean, 2002[15]).

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