Lower and Middle Coal Measures, Westphalian, Carboniferous, Midland Valley of Scotland

Now known as the Scottish Lower Coal Measures Formation and the Scottish Middle Coal Measures Formation respectively.

The Lower and Middle Coal Measures were formerly called the Productive Coal Measures to distinguish them from the overlying Upper Coal (Barren Red) Measures. The limits of the two divisions have been given above and the major features of the stratigraphy and classification based on marine bands and non-marine bivalves are shown on P915537.

The Westphalian of the British Isles has been subdivided into a series of chronozones which are based on the distribution of the numerous species of non-marine bivalves. In the Lower and Middle Coal Measures (Westphalian A and B) the zones are, in ascending order, the Lenisulcata, Communis, Modiolaris and Lower Similis-Pulchra chronozones. In the Midland Valley only the upper part of the Lenisulcata Chronozone can be recognised from the mussels, and this only in parts of Ayrshire and the Central Coalfield, but typical faunas of the other chronozones are present over the region.

While mussels are mainly useful for identifying ranges of strata, marine bands are more useful for the identification and correlation of individual beds. A small group of up to three bands is present near the top of the Lenisulcata Chronozone but they normally only contain Lingula. The Vanderbeekei Marine Band lies in the middle of the Modiolaris Chronozone. It consists of mudstone and contains a varied fauna of bivalves and goniatites but yields only Lingula in some areas.

A group of up to four bands occurs in the Lower Similis-Pulchra Chronozone which usually only contains Lingula but bivalves are present in a few areas. The Aegiranum Marine Band marks the top of the Middle Coal Measures and of Westphalian B, and contains the most varied fauna of all of the bands. The bed is developed as a limestone in some areas and carries a rich fauna including calcareous brachiopods, goniatites and nautiloids.
Numerous thick coals occur throughout the succession but the bulk of the worked seams are in the Communis, the upper part of the Modiolaris and the lower part of the Lower Similis-Pulchra chronozones. Many of them split into two or more seams when traced laterally and correlation is achieved by a comparison of lithological sequences and from faunal evidence.

In most parts of the region the Lower Coal Measures rest conformably on the Passage Group. The main exception is in north Ayrshire where the Passage Group contains volcanic rocks, and mussels of Communis age occur 10 m above the lavas.

**Lithology**

The rocks consist of white or grey sandstones, grey or dark grey siltstones and mudstones with ironstones, and numerous coals and seatclays. The sandstones are locally quite coarse especially in the lower part of the sequence where they form the dominant lithology in a rather variable development. Bands of nodules of clayband ironstone are common and blackband ironstone was formerly worked in several areas. Some of the major coal seams are persistent within a coalfield although splitting laterally into two or more leaves is not uncommon.

**Lateral variation**

Originally the Lower and Middle Coal Measures probably extended over the whole of the Midland Valley, although evidence is lacking north of the Ochil Fault, and they overstepped on to the relatively positive Southern Uplands. In the eroded remnants of the outcrop the greatest thickness is preserved in the relatively confined areas between parallel faults associated with the Southern Upland Fault in the Douglas area and in the Littlemill area of south Ayrshire (P915536). The zone of attenuation of strata, approximately coincident with the Burntisland Anticline, which affects relative thicknesses of older Carboniferous groups is much less apparent in the Lower and Middle Coal Measures. Comparative vertical sections of the Lower and Middle Coal Measures are given in P915537.

In the Kincardine area the strata are contained in a N–S-trending syncline which plunges northwards north of Clackmannan and southwards south of Clackmannan. The outcrop is bounded to the north by the Ochil Fault against which the strata are upturned.

The base of the Coal Measures in this area and throughout the Central Coalfield is taken at the Lowstone Marine Band which is fairly widespread although the correlation becomes more tentative in the Glasgow area. The Vanderbeckei and Aegiranum marine bands occur throughout the area except in the Kincardine area where beds of the latter age have been removed. All four non-marine bivalve chronozones are represented.

The Lower Coal Measures succession is thickest in the axial part of the syncline, around Clackmannan, where it is about 150m thick. The Middle Coal Measures are also about 150m thick. Attenuation is considerable towards the north, but less so in other directions, repeating the pattern of thickness variation that occurred during deposition of the Namurian. Further south in the Central Coalfield the Lower Coal Measures and the Middle Coal Measures are each about 190 m thick. The Lower Coal Measures thin westwards to about 100 m in the Glasgow area. Comparative thicknesses have to be regarded with caution in view of the uncertainty of the correlation of the horizons used as the base.

In the Clackmannan and Coatbridge areas the upper part of the Middle Coal Measures consists of thick red sandstone rather than the usual grey mudstone, pale sandstone and coals.
In the small outlier at Westfield, in Fife, the Lower Coal Measures are about 160 m thick and the base is placed at the Bogside Ironstone and Coal. The Middle Coal Measures are about 200 m thick. In east Fife the Lower Coal Measures are up to 275m thick, but offshore in the Methil area they consist mostly of tuffaceous rocks. The Middle Coal Measures are up to 210 m thick.

In the Midlothian Syncline the base of the Coal Measures is taken at the Seven Foot Coal in the north and at the Melville Group of coals in the south.

The Lower Coal Measures are about 160 m thick and the Middle Coal Measures measure about 240m.

The non-marine bivalve faunas found in Midlothian are relatively poor, but the Communis, Modiolaris and Lower Similis-Pulchra chronozones are all represented.

In the Douglas area the Lower Coal Measures are up to 340m thick and the base is placed at the Porteous Band, which is a marine band containing Lingula only. The Middle Coal Measures are about 330 m thick. There is little variation in thickness of the strata.

All four non-marine bivalve zones are present although the evidence for the Lenisulcata Chronzone is slight. Three marine bands, including the basal Porteous Band occur in the Lower Coal Measures and all are included in the Lenisulcata Chronzone. Both the Vanderbeckei and Aegiranum Marine bands are present and two other marine bands occur, one with Lingula alone, in the upper part of the Middle Coal Measures.

An unconformity underlies the greater part of the Coal Measures outcrop. Only in the north of the outlier is there continuity from the Passage Group into the Coal Measures. Elsewhere the basal beds of the Coal Measures rest on rocks ranging in age from Lower Limestone Group to Passage Group. The precise age of the Coal Measures strata overlying the unconformity is unknown.

In Ayrshire, the Lower and Middle Coal Measures show a pattern of thickness variation which is similar to the variation seen in the Namurian but it occurs in a lesser degree.

The succession is thickest in the Dalmellington and New Cumnock areas and in the Littlemill Trough between the Kerse Loch Fault and the Littlemill Fault. The Lower Coal Measures are up to 210 m thick and the Middle Coal Measures are about 300 m thick. The thickness is reduced abruptly northwards across the Kerse Loch Fault and there is further attenuation north-westwards towards the Inchgotrick Fault.

Comparison of thickness is dependent on the equivalence of the horizons used as the base of the Coal Measures, and in Ayrshire different horizons are used in different areas. South of the Kerse Loch Fault the Passage Group/ Lower Coal Measures boundary is not well defined and it is probable that it should be drawn lower than it is shown on P915537, column A. In east Ayrshire the base is taken at the second Lingula band below the Pathhead Thick Coal.

The reduction in thickness northwards and westwards is due in part to an unconformity at the base of the Coal Measures in the area to the north of the Kerse Loch Fault. In this area the Coal Measures are resting on Passage Group lavas and the basal beds become progressively younger northwards and westwards so that on the south side of the Inchgotrick Fault the local base is only a few metres below the Vanderbeckei Marine Band. The succession increases in thickness again north of the fault where the lowest beds belong to the Communis Chronzone.

Musselbands in the succession south of the Kerse Loch Fault indicate that the Lenisulcata Chronzone is present, but its occurrence on the north side of the fault has not been proved.
The Vanderbeckei Marine Band has been found in most parts of the outcrop except north Ayrshire. In this area the horizon of the Shale Coal is taken as its equivalent.

The Aegiranum Marine Band occurs in south Ayrshire and parts of central and north Ayrshire, but may be absent locally in the northern part of the outcrop.

Four other marine bands occur in the upper part of the Middle Coal Measures. They have their optimum development in the Littlemill Trough but elsewhere they are not all represented.

**Contemporaneous igneous activity**

Evidence of contemporaneous igneous activity in the Lower Coal Measures was found in boreholes in the Firth of Forth, off Methil and Kirkcaldy. In the area east of Methil the Lower Coal Measures sediments are replaced by tuffaceous rocks and a basalt lava flow. South-east of Kirkcaldy thin tuff bands occur in the Lower Coal Measures succession.

**Bibliography (for all Carboniferous)**


Category:

- Midland Valley of Scotland