

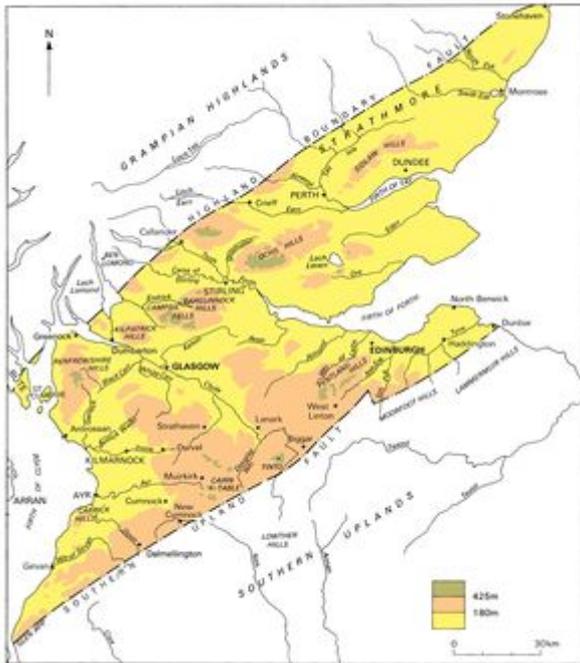
# Physiography, Midland Valley of Scotland

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## Physiography



Physiographical map of the Midland Valley.  
P915512.

The Midland Valley of Scotland is the name given to the relatively low lying central part of Scotland lying between the Grampian Highlands and the Southern Uplands. It is defined geologically to the north by the Highland Boundary Fault, which extends from Stonehaven in the north-east to the Firth of Clyde at Helensburgh, and its limit in the south is the Southern Upland Fault which lies parallel to the Highland Boundary Fault and extends from Dunbar to Glen App. The region has the structure of an ancient rift valley or graben in which strata between two parallel faults have subsided relative to the horst blocks on either side.

The physiographic contrast across the Highland line is a consequence of the difference in the resistance to erosion of the rocks on either side of the fault. Similarly the topography south of the Southern Upland Fault is quite distinct from that north of the fault although the line of separation makes a less noticeable feature except at the edge of the Moorfoot and Lammermuir Hills. The rocks north of the Midland Valley are the eroded remnants of the mountains formed during the later part of the Caledonian Orogeny about 400 million years ago, and the rocks of the Southern Uplands were deformed into their present configuration at about the same time. Outwith the Midland Valley Lower Palaeozoic and older rocks have been strongly folded and indurated, but between the faults the rocks are mainly of Upper Palaeozoic age and are relatively undeformed.

Although the region is known as the Midland Valley the term is appropriate only in the structural sense of a rift valley; physiographically the area is rather more diverse than the name suggests

(P915512). Much of the region consists of farmland lying below 180m, but there are many upland areas of rough pasture and moorland.

Thick piles of volcanic rock of Devonian and Carboniferous age, relatively resistant to erosion form a line of hills in the northern part of the region. Carboniferous lavas form the Renfrewshire Hills (522 m), the Kilpatrick Hills (401 m), the Campsie Fells (578 m) and the Gargunnock Hills (485 m), and Devonian lavas continue the north-easterly trend in the Ochil Hills (728 m) and the Sidlaw Hills (455 m). A more or less continuous strip of low ground, floored by Devonian sediments, extending from Loch Lomond to the coast around Montrose, lies between the line of volcanic hills and the Highlands. The feature widens out in the north-east to form the broad farmland of Strathmore.

Coarse conglomerates of Lower Devonian age form areas of high ground adjacent to the Highland Boundary Fault around Callander and Crieff.

In the southern part of the region the upland areas correspond to the outcrop of the older and more resistant rock-types. The conspicuous range of the Pentland Hills (579 m) consists of an upthrust outcrop of folded Silurian strata and Devonian conglomerates, sandstones and lavas. They are sharply defined on the south-east side by the Pentland Fault.

In south Lanarkshire and eastern Ayrshire a large area of dissected high ground extends from around Tinto (707m) to New Cumnock and northwards towards Strathaven. The area contains inliers of folded Silurian rocks, which form the Hagshaw Hills (470 m) and Nutberry Hill (522 m), and intrusions of granodiorite and felsite explain the prominence of Distinkhorn (384m), south of Darvel, and the Tinto Hills respectively. Devonian sandstones and conglomerates occupy the high ground to the south of Muirkirk which culminates at Cairn Table (593 m).

Farther south-west, the upland area north of Dalmellington is unusual in that it consists of Coal Measures strata. The relief is due to the relative resistance to erosion of dolerite sills intruded into the sediments, and sills cap Benbain (407m), Benbeoch (464m) and Benquhat (435m). Devonian lavas form the Carrick Hills (287 m) south of Ayr.

The rest of the region consists of areas of undulating lowland underlain by strata of Devonian and Carboniferous age. The two largest lowland areas are central Ayrshire from Ardrossan to Ayr and extending inland to Kilmarnock and Cumnock, and the central belt from the Glasgow area to the Firth of Forth and into Fife and East Lothian. The undulating lowland landscape is enhanced by conspicuous landmarks formed of intrusive sheets or plugs of igneous rock (e.g. North Berwick Law and Traprain Law, near Haddington, in East Lothian, the castle rocks of Stirling and Edinburgh, Dumbarton Rock and Loudoun Hill, near Darvel in the west).

The present form of the landscape is the net result of several erosive agencies acting during various intervals up to a total of tens of millions of years. Attempts to chronicle the development of the landscape are necessarily tentative since glacial erosion and the mantling of the lower ground by drift deposits has removed or buried much of the evidence of the pre-Quaternary planation. The remnants of planation levels thought to be late Tertiary in age are recorded in the clustering of summit and bench levels about a few limited altitude ranges. George (1960) recognised levels at about 700, 580 and 510 m on the northern and southern flanks of the Midland Valley and at about 325 and 180 m in central parts of the area. These he attributed to pulsatory uplift in late Tertiary times with marine erosion causing benching of the Upper Palaeozoic sediments of the rift and exposing in places the Lower Palaeozoic inliers. However, warping, differential isostatic adjustment and differing resistance to erosion of the various rock types involved make the correlation of levels problematical, and there is no sedimentary evidence to support the hypothesis of considerable submergence in mid Tertiary times.

The drainage of the Midland Valley west of a line from Ben Lomond to a point near West Linton flows into the Firth of Clyde. East of that line the rivers run into the Firth of Forth and the North Sea. A subsidiary watershed parallel to the main watershed extends south-eastwards from near Greenock and divides the River Clyde catchment from that of the Ayrshire rivers discharging into the lower part of the Firth of Clyde.

Rivers in the northern part of the Midland Valley have their headwaters in the southern Highlands where deep glens cross the grain of the country in a south-easterly direction. They enter the Midland Valley in the strip of low ground south-east of the Highland border which extends from the Howe of the Mearns south-westwards through Strathmore and Strathallan to the Carse of Stirling. The Forth, Earn and Tay collect most of the drainage and transport it through breaches in the line of volcanic hills formed by the Campsie Fells, and the Ochil and Sidlaw Hills.

South of the Forth, the rivers draining the eastern part of the Midland Valley flow north-eastwards into the Firth of Forth.

The River Clyde rises in the central part of the Southern Uplands in the Lowther Hills and crosses into the Midland Valley near Lamington. From Lanark to the estuary the Clyde follows a north-westerly course across the south-west part of the Central Coalfield. There is a notable contrast in the geomorphological maturity of the Clyde valley above and below the confluence with the Douglas Water, near Lanark. Upstream the valley is mature, the river meanders and has a rate of fall of about 0.8m/ km but downstream it falls into a gorge at Bonnington Linn, has a rate of fall of about 15 m/ km and occupies a deeply incised geomorphologically immature valley.

The upper Clyde is graded to a base-level about 170m above OD and probably formerly drained through the Biggar Gap into the Tweed. The broad drainage basin of the lower Clyde in the Glasgow-Paisley area is abruptly constricted to a width of about 2 km between Dumbarton and Langbank where the river passes through the gap between the volcanic uplands of the Kilpatrick Hills and the Renfrewshire Hills.

Several explanations have been offered to account for the initiation and development of the drainage system. Mackinder (1902) proposed that the drainage commenced by south-easterly flowing consequent streams draining an uplifted tilted peneplain. Later Bremner (1942) and Linton (1951) suggested that the system was developed early in the Tertiary on a newly emergent of Cretaceous sediments mantling the older rocks and the initial easterly flowing consequent drainage was later superimposed on the underlying rocks. George (1960, 1965) argued for a mid Tertiary submergence of an already dissected landscape and a pulsatory emergence permitting the formation of a sequence of planation platforms and benches on which the drainage system was superimposed. None of the explanations is entirely satisfactory for Scotland as a whole and especially for the Midland Valley. Difficulties in the formulation of a comprehensive account of the development of the drainage system stem from the fragmentary and tenuous nature of the evidence and the subsequent modification of it by glacial action. Additionally, the long interval of time, tens of millions of years, during which the landscape developed and the lack of any sedimentary record for much of the Tertiary and Quaternary makes explanation necessarily tentative.

The general form of the topography of the Midland Valley was established in Tertiary times, but it suffered modification during the Quaternary glaciation. Glacial erosion moulded the landscape and altered the transverse and longitudinal profiles of the valleys. Glacially eroded material was deposited mainly on the lower ground effectively obscuring the form of the solid rock surface. Relative changes in sea level led to the formation of raised beaches which are so characteristic of the coastal scenery, especially around the Firth of Clyde.

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