

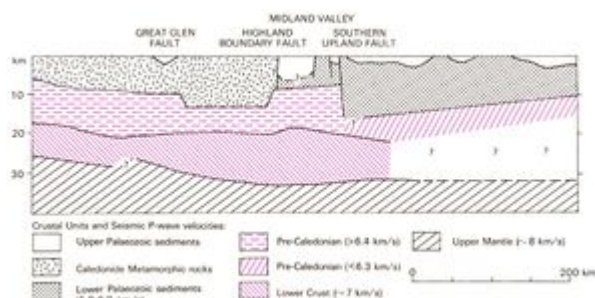
# Pre-Palaeozoic basement, Midland Valley of Scotland

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Cameron, I B, and Stephenson, D. 1985. British regional geology: The Midland Valley of Scotland. Third edition. Reprint 2014. Keyworth, Nottingham: British Geological Survey.

## 2 Pre-Palaeozoic basement



Schematic cross-section through the crust and uppermost mantle of northern Britain (Modified after Bamford, 1979). P915514.

The oldest rocks exposed within the Midland Valley are of Ordovician age but indirect evidence regarding the nature and configuration of the basement rocks may be obtained from two independent sources. A N-S deep seismic profile across northern Britain has revealed horizontal and vertical discontinuities which have been interpreted in terms of major structural elements of the crust. Samples of gneissose rocks from the basement have been carried to higher crustal levels as xenoliths in Carboniferous and Permian volcanic vents.

The seismic profile ([P915514](#)) suggests the presence of high-grade metamorphic basement at a depth of 7 to 9 km below the eastern Midland Valley, but at greater depths (14 to 16 km) below the adjacent Highlands and Southern Uplands structural blocks. Beneath the Highlands and Midland Valley the basement is 20 to 25 km thick and is divided by a seismic discontinuity into Upper and Lower layers. These layers cannot be recognised beneath the Southern Uplands, where the basement has different seismic characteristics and a major, lateral, crustal discontinuity may occur in the region of the Southern Upland Fault. However, similar xenolith assemblages occur in vents and intrusions on both sides of the fault indicating at least some south-eastward extension of the Midland Valley basement rocks.

Two groups of metamorphic xenoliths may be recognised, probably corresponding in broad terms to the Upper and Lower crustal divisions of the seismic profile, but also possibly intermixed in coarsely-banded gneiss formations ([P241835](#), [P241834](#)). Quartzo-feldspathic, foliated acid gneisses, some with biotite or garnet, probably constitute most of the Upper Layer. The Lower Layer, which has seismic properties consistent with a gabbroic or dioritic composition, is probably represented by a range of pyroxene-granulites, consisting essentially of plagioclase and clinopyroxene, usually with spinel and rarely with garnet or orthopyroxene. With increasing proportions of plagioclase a gradation occurs from basic granulites into anorthosites. Mineral assemblages, compositions and textures in both groups are indicative of granulite facies metamorphism with temperatures up to 850°C, pressures of 7 to 12 kb and inferred depths of equilibration of 20 to 35 km. Preliminary

radiometric age determinations on the xenoliths suggest that the basement may have been affected by a Grenvillian metamorphic episode at 1200 to 1000 Ma. A range of unfoliated granitic rocks from tonalite to granite or trondjemite may represent later, possibly Caledonian, partial melts and intrusions within the crust.

The seismic profile shows that the base of the crust occurs at a depth of about 33 km beneath the Midland Valley. Samples of the underlying Upper Mantle material commonly occur as xenoliths in volcanic vents, often together with the less-abundant crustal material. Since they represent partial melt residues and crystal accumulations from the source regions of the Carboniferous and Permian magmas, they are discussed in Chapter 12.

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