

# Coal of the Westphalian, Carboniferous, Wales

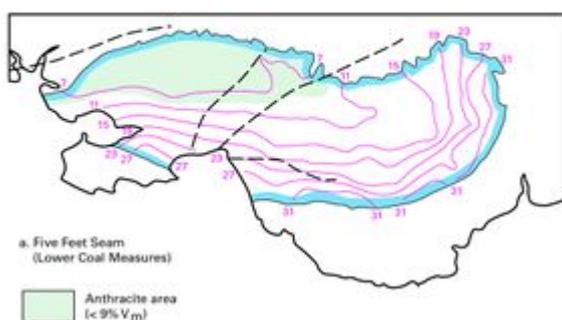
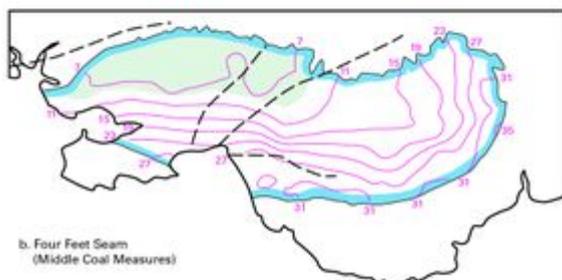
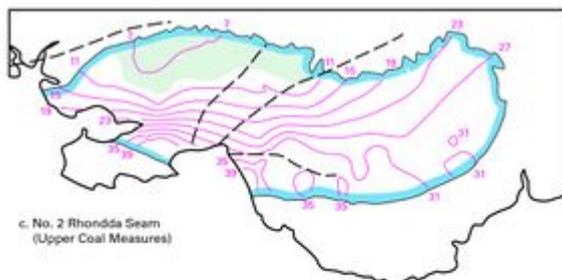
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Dunraven open cast site, excavation in Middle Coal Measures, in 1969. P662430.



Maps showing rank of coal (%Vm) in the South Wales Coalfield (adapted from White, 1991). P916196.

Coal forms an insignificant proportion, probably less than 2 per cent, of the Westphalian sequence in south Wales, yet its economic, cultural and social significance has been immense. It is traditionally accepted, probably because it is often repeated, that coal was used for cremation on Garth Mountain during the Bronze Age (some 4000 years ago) and that the Romans were the first to work it systematically. Serious extraction began in the Middle Ages, with the initiation of smelting in the Swansea district, of tin and lead from Cornwall, and silver and lead from north Wales. However, it was the 19th century that witnessed the greatest expansion of mining, for iron smelting and the insatiable appetite of steam locomotives and domestic heating. By the end of the 19th century, Cardiff became the most important coal exporting port in the world. The subsequent decline through the 20th century as a result of competition from oil and coal imports has been inexorable. Now in the 21st century, there is one workers' cooperative deep mine, some small private shallow mines and isolated large-scale machine-driven opencast operations ([P662430](#)).

One of the distinctive features of the South Wales Coalfield is the variation in 'rank' of the coals ([P916196](#)). The bituminous coals are low rank, soft and friable with a high proportion, 20 to 40 per cent, of volatiles and a carbon content from 84 to 91 per cent; they are good house, gas and coking coals. In contrast, anthracite is a hard lustrous coal of high rank, with a low proportion (3 to 8 per cent) of volatiles, a low hydrogen content, a high (over 93 per cent) carbon content and low ash; it burns at high temperatures with little flame or smoke and is unsuitable for coke manufacture. Steam coals are intermediate between the bituminous and anthracite coals, although they grade into each other.

The sedimentary rocks across the coalfield indicate very low grade metamorphism but the patterns of illite crystallinity indicate an increase into the anchizone grade in the extreme northwest sector of the main basin. This pattern is also displayed by coal rank values, based on volatile content and vitrinite reflectance, which indicate a distinct increase in rank from the south-east to the north-west ([P916196](#)). The bituminous coal occurs mainly along the south and east crops, steam coal between the Taff and the Neath valleys, particularly about the Rhondda valleys, and the anthracite occurs along the north crop westwards from the Neath valley, especially in the Gwendraeth valley, into Pembrokeshire. These variations in rank have stimulated much debate and controversy over many years. The broad correspondence of the coal isovols (lines of equal volatile matter) to the stratigraphical boundaries indicate that coal rank developed prior to the formation of the main coalfield structure. However, the correspondence is not precise as the isovols drop gently to lower stratigraphical horizons to the south-east.

In the lowermost coal seams the rank expressed in vitrinite reflectance values varies from 1 per cent in the south-east to 4 per cent in the north-west, which reflects a variation in maximum maturity temperature from about 150°C to 325°C. Such a difference is difficult to reconcile solely by different depths of burial as the depocentre for the preserved sequence lies to the south of the area of highest rank. Detailed studies in the Ffos Las opencast site, which lies across the Llanon and Trimsaran disturbances, indicate that rank developed both before and during thrusting. Similarly, a geothermal gradient of 310°C per km in the eastern part of the coalfield (higher in the west) suggests that burial alone cannot be responsible for this gradient. Localised zones of higher temperature have been correlated with in-seam thrust detachments, suggesting that the thrusts channelled both hot fluids and a wide spectrum of mineral phases, including gold traces, into the coals. In north Wales, there are records of coal extraction in both the Flint and Denbighshire coalfields since the 15th century. The last working collieries, at Bersham, near Wrexham, and Point of Ayr, on the Dee estuary, limped through to their final demise in the last years of the 20th century, even though reports of extensive

reserves had been a persistent feature of their final years.

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