Fuel and energy, geology and man, Northern England

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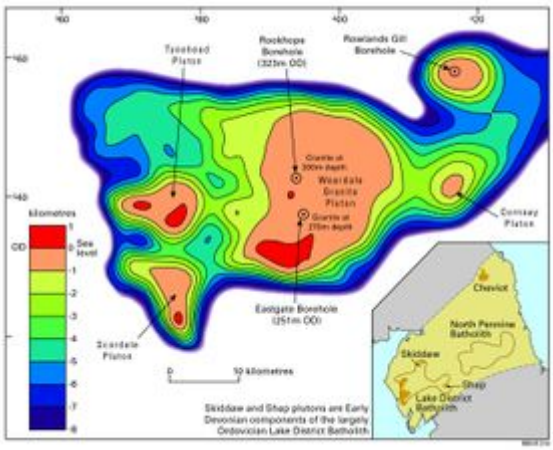
Pillars of coal, the roof supports left behind in old, shallow mine workings, re-appearing in modern excavations at the Langley opencast site, Northumberland [NZ 200 469]. (P711118).

Plenmeller opencast coal workings, Northumberland, photographed in the mid 1980s. (P548139). The site is now restored.

Strata of the Pennine Coal Measures exposed in the West Chevington opencast site [NZ 2440 9660], Northumberland. (P220607).



Contoured top surface of the Weardale Granite Pluton and other components of the North Pennine Batholith. The inset map shows the location of the batholith in northern England in relation to the other major intrusive bodies. P916066.

Coal

As one of the region’s major mineral products, coal provided the main basis for the development of heavy industries. The Westphalian Coal Measures have been most productive, principally from two main coalfields, the Northumberland and Durham Coalfield in the east and the smaller Cumbrian

Coalfield in the west. Small, isolated Westphalian coalfields occur as faulted outliers on the downthrow side of the Stublick Fault Zone. A few seams within older Carboniferous rocks have locally yielded significant quantities of coal. Most notable of these are the Dinantian Plashetts, Shilbottle and Scremerston coals of north Northumberland and the Namurian Little Limestone Coal of the South Tyne valley and Alston area.

The Northumberland and Durham Coalfield is the oldest area of commercial coal mining in Britain with records of working on the banks of the Tyne dating from the 12th and 13th centuries. A slow rise in production over the following few centuries was followed by a massive surge in demand during the Industrial Revolution, and by 1800 annual output had reached 2.5 million tonnes. Production peaked at about 30 million tonnes per year around the turn of the 20th century. For the Cumbrian Coalfield, documentary records of working exist from the mid 16th century, though earlier working is likely. Here too, the heyday of mining came during the latter half of the 19th and first half of the 20th centuries with average annual outputs reaching around 2 million tonnes.

A notable feature of the Northumberland and Durham Coalfield is the geographical variation in the rank of the coal, as discussed in Chapters 6 and 7. A coal's rank largely determines its end use, with low rank coals best suited to domestic or power station use, medium rank coals to gas and domestic coke making, and high rank coals to metallurgical coke making. Coals of high rank occur in west Durham with rank decreasing thence into other parts of the coalfield (P916075). No variation is apparent in the Cumbrian Coalfield, which produced broadly middle-ranking coals. The region's highest rank coal, a 'semi-anthracite', occurs in the Namurian, Little Limestone seam of the Alston area which, at the time of writing, is still mined from drift workings at the Ayle Colliery.

The earliest workings were close to seam outcrops. Then, as mining techniques improved, the extraction of extensive reserves from deeper shafts and larger collieries became possible; 'pillar and stall' extraction, where as much as half the coal was left intact for roof support (P711118), was replaced by longwall methods, in which most of the available coal was recovered. The sinking of Hetton Colliery in 1820 opened a new era for the Northumberland and Durham Coalfield by establishing that workable seams extended seawards beneath the unconformable cover of Permian rocks. These reserves were to sustain the industry through the 20th century with mining eventually extending to almost 7.5 km offshore. Similarly in Cumbria, coal mining finally extended up to 6.5 km offshore beneath the cover of Permo-Triassic rocks.

The second half of the 20th century saw a catastrophic decline in the industry's fortunes, and with closure in 2005 of Ellington Colliery in Northumberland, deep, underground coal mining in the region finally ended. However, the further development of large-scale opencast mining, which had started during the Second World War, enabled continued recovery of substantial tonnages of coal in both coalfields. Opencast extraction continues today at a few sites (P548139) and (P220607), though accessible reserves are limited.

The coal industry exercised a profound effect on the region's landscape. As the industry prospered, communities expanded around the collieries and were linked by railway networks, whilst huge quantities of waste rock accumulated in spoil heaps. Although much has been cleared, partly through land reclamation schemes associated with opencast mining, evidence of this once-great industry survives in the pattern of settlements, the abandoned railway lines and the former coal exporting facilities at the coasts.

Peat

Blanket peat bogs cover extensive areas of the region's uplands, whilst lowland peat occurs more locally on valley floors, the sites of former lakes or coastal plains. Historically, small quantities of

upland peat were employed as domestic fuel and substantial amounts were used in the lead smelting industry of the northern Pennines, particularly in the 18th and 19th centuries. During the 20th century, most peat working was to supply the horticultural market, with supplies obtained from lowland peat deposits in north Cumbria at Solway Moss, Bolton Fell and Wedholme Flow. The last two of these sites are now scheduled as Sites of Special Scientific Interest, with Wedholme Flow granted additional Special Area of Conservation status as an active raised bog. There is very little current extraction.

Oil and gas

The onshore region of northern England has only very limited hydrocarbon potential. Despite the generally pessimistic assessment, the Carboniferous rocks at the southern margin of the Northumberland–Solway Trough have attracted some exploration interest focussed on closed anticlines at or near the basin margin. A number of seismic reflection surveys and some drilling projects have been undertaken, though so far without the discovery of viable reserves. The discovery and successful development of commercial oil and gas fields in the central and southern parts of the East Irish Sea Basin have stimulated further exploration in sedimentary basins beneath the waters around the Isle of Man.

Coalbed and mine-gas methane

Coal-bearing rocks naturally generate methane as a by-product of coalification — the low-grade metamorphism of peat through lignite to coal and anthracite. Some of this methane migrates from the source rock as it forms, but some remains, either adsorbed or held as a free gas in voids. Although the residual methane presented a serious hazard in underground mining, only rarely was it ever encountered in exploitable amounts. In one such situation, methane from Haig Colliery, Whitehaven, was used from 1950 onwards to raise steam at the pithead; in 1953 methane from this source was supplied to Whitehaven gasworks. In general, the West Cumbrian coalfield has relatively high seam-methane content, but the high density of faulting limits any exploitable resource. The Northumberland and Durham Coalfield generally has low seam-methane levels.

Geothermal energy

Among the high heat-flow granites in the region, the most promising geothermal prospect is the Weardale Granite. Measurements made in the Rookhope Borehole (P916066), drilled in 1960–61, indicated a heat flow of nearly twice the national average and raised hopes that the Weardale Granite might provide energy by the ‘hot dry rock’ process. In this, cold water from the surface is pumped via a borehole into hot, fractured rocks at depth, where it is heated, and then returned to the surface via an adjacent borehole. This premise was tested during the 1980s. Because Rookhope is remote from major centres of population, a test hole was drilled at Rowlands Gill, about 10 km south-west of Newcastle and above a pluton on the north-east extremity of the North Pennine Batholith (P916066). This pluton, like the Weardale Granite, lay immediately beneath the sub-Carboniferous unconformity. Although the granite was not reached, the heat flow recorded in the Carboniferous rocks suggests that temperatures of around 230°C would be attained at a depth of 7 km.

More recent investigations, encouraged by saline thermal springs in the deepest workings of the abandoned Cambokeels fluorspar mine in Weardale, have examined the local use of geothermal energy in the Eastgate area of Weardale. An exploratory borehole here in 2004 proved groundwater at a temperature of 46°C at a depth of 995 metres. Any exploitation could be via a ‘low enthalpy

system’ wherein the hot groundwater is extracted directly from deep aquifers.

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