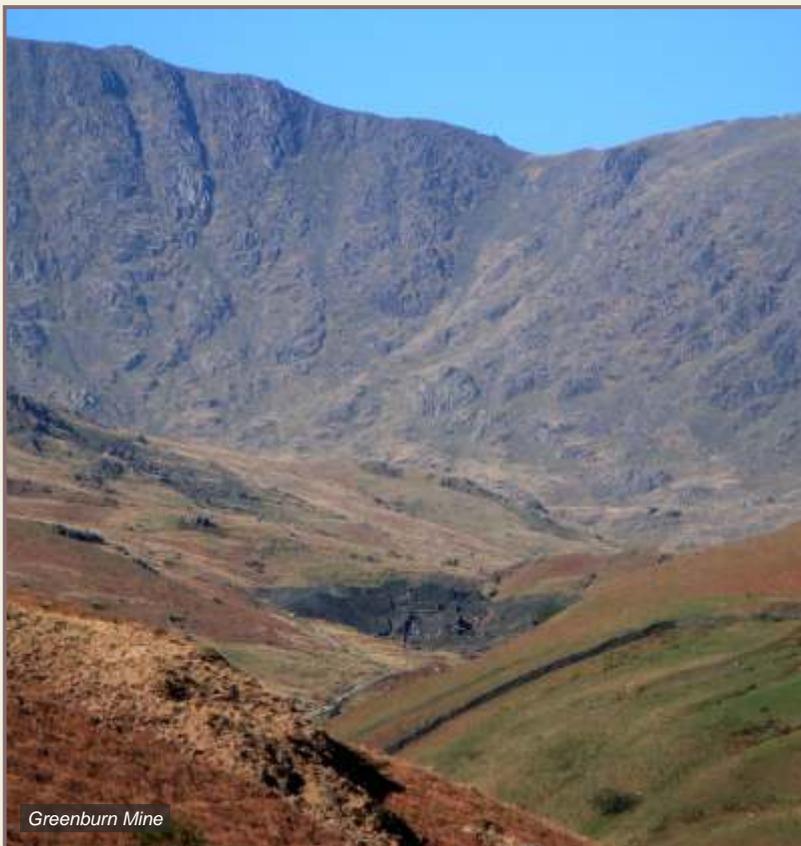


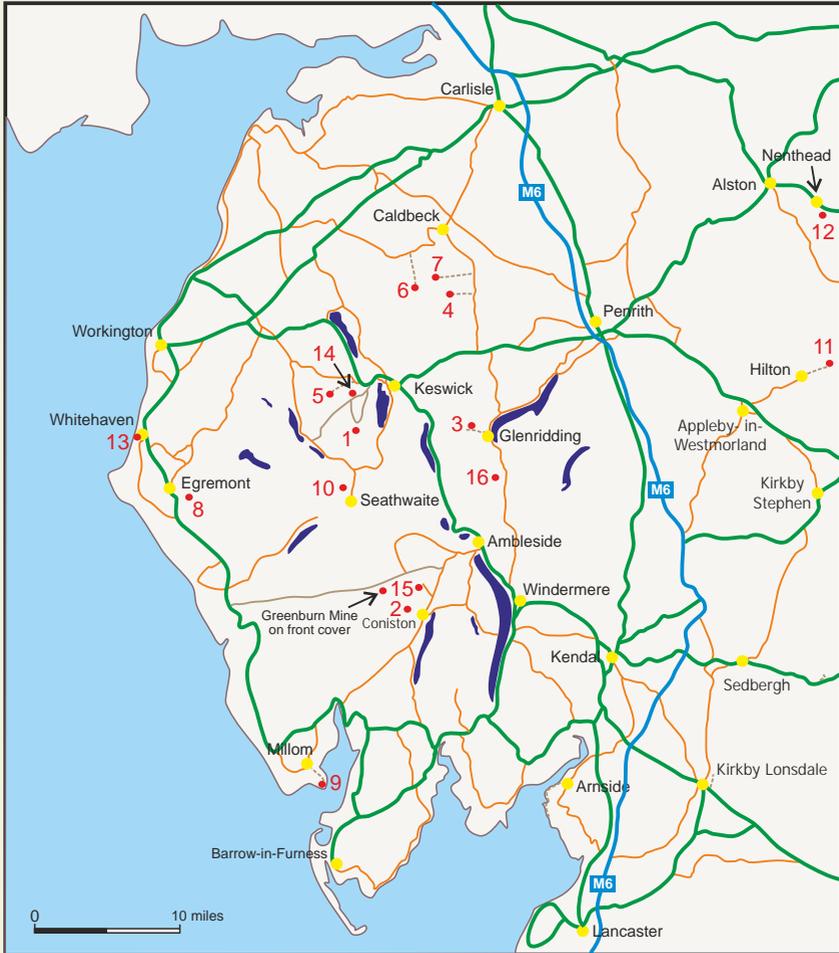
Mines in Cumbria



Cumbria RIGS

Regional Important Geological & Geomorphological Sites

Visitors to these former mining areas should not enter adits. All internal mine workings have a high risk of rock falls. Also there are vertical shafts on the surface and below ground which are not protected. Cumbria RIGS are not liable for any injury sustained by visitors.



Map showing the location of the Mines

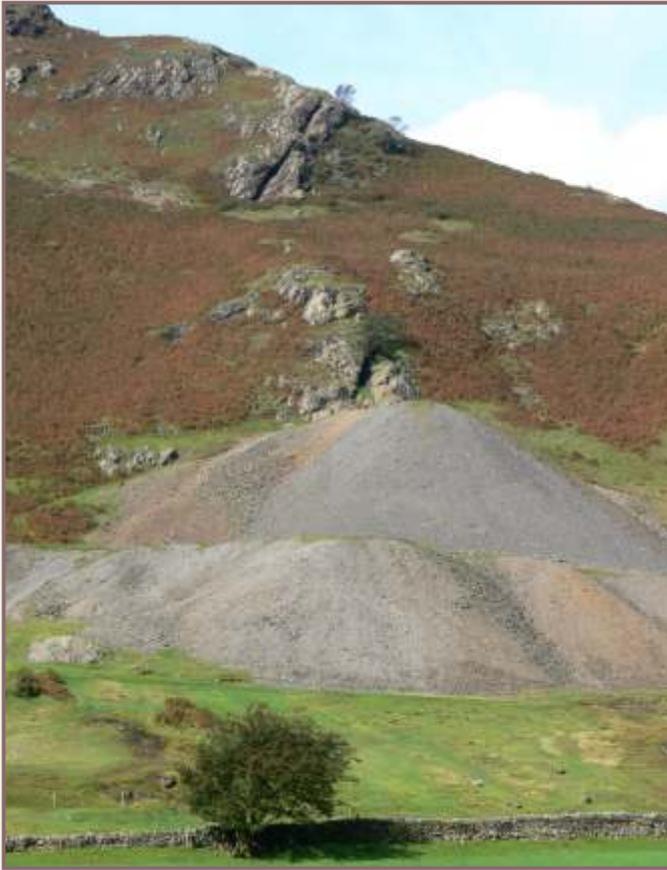
- | | |
|-------------------------|-----------------------------|
| 1. Goldscope Mine | 9. Hodbarrow Mine |
| 2. Coniston Copper Mine | 10. Seathwaite Mine |
| 3. Greenside Lead Mine | 11. Hilton Mine |
| 4. Carrook Mine | 12. Nenthead Mine |
| 5. Force Crag Mine | 13. Haig Pit |
| 6. Roughton Gill Mine | 14. Barrow and Uzzicar Mine |
| 7. Driggeth Mine | 15. Penny Rigg Quarry |
| 8. Florence Mine | 16. Myers Head Mine |

Mineralisation: There are two major types of mineralisation in the Lake District. The earliest is the chalcopyrite-arsenopyrite and is of Lower Devonian age. This mineralisation is associated with the underlying granite batholith. The source of the mineralising fluids may have been the Borrowdale Volcanic Group and fluids from the granite batholith. Data from fluid inclusions within minerals from Lower Devonian veins, indicated that the temperature of ore-forming fluids was in the order of 200 to 350 degrees Celsius.

The second is galena-sphalerite mineralisation and is Lower Carboniferous in age and is associated with tensional tectonic activity when Gondwanaland was moving northwards towards Laurentia. The Lower Carboniferous veins formed at lower temperatures, in the range 110 to 130 degrees Celsius (*C. J. Stanley and D. J. Vaughan, 1982*).

| Age | Characteristic Minerals | Mining Areas | Reference |
|--|---|--|---|
| Jurassic c. 190 - 180 Ma | Pyromorphite - Copper sulphides - Malachite ± mimetite ± linerite ± cerrusite | Caldbeck Fells - Roughtongill, Driggeth, Drygill | Davidson and Thomson (1948) Ineson and Mitchell (1974) |
| Permo-Triassic ? | Hematite ± quartz ± calcite ± dolomite ± baryte ± fluorite | West Cumbria hematite deposits | Dunham and Rose (1977) |
| Permian c. 290 - 260 Ma | Baryte ± quartz ± carbonates ± galena | Sandbeds, Force Crag? | Gough (1963) Stanley (1979) |
| Lower Carboniferous c. 360 - 330 Ma | Quartz ± Chalcedony ± Baryte ± Galena ± Sphalerite ± chalcopyrite ± calcite ± dolomite | Greenside, Tilberthwaite Barrow, Force Crag Goldscope Pb, Yewthwaite, Thelkeld, Roughtongill, Carrock E-W | Stanley and Vaughan (1982) |
| Lower Devonian c. 390 - 370 Ma associated with Acadian Orogeny | Quartz - Muscovite - Apatite - Wolframite - Scheelite - Arsenopyrite - Pyrite chalcopyrite - bismuthinite - bismuth - molybdenite - spalerite - carbonates | Carrock (associated with Skiddaw Granite | Shepherd <i>et al.</i> (1976) |
| | Quartz - Chlorite - Dolomite - Arsenopyrite - Chalcopyrite | Coniston veins, Greenburn, Tilberthwaite, Dale Head North, Goldscope Cu Carrock End | Stanley and Vaughan (1980, 1982) |
| Uncertain (pre- Bala) (Devonian?) | Graphite - Pyrite Chalcopyrite | Borrowdale Volcanic Group | Ineson and Mitchell (1975) |

Classification of Lake District Mineral Deposits



1. Goldscope Copper Mine

Goldscope Mine is in the Derwent Fells at grid reference NY228185. It was in 1556 Daniel Hechstetter of Ausberg brought fellow Germans to the mine and utilised their superior mining techniques to mine the copper vein which was 9 feet thick. It was the richest copper mine known at that time and was named by the Germans 'Gottesgab' God's Gift which became corrupted into Goldscope, the name it is known by today. The ore mined here was brass-yellow coloured chalcopryite (CuFeS_2). In 1852 a lead vein (galena, PbS) running NE by SW was intersected. At this time copper was running out and the production of lead became predominant.



St. George adit

2. Coniston Copper Mine

Coniston Copper Mine is best approached from Coniston. The Coppermines Valley is centred at grid reference SD285987. The mine lies within the Borrowdale Volcanic Group. The mineral deposits occur in the faults and fissures caused by upward pressures of an underlying granite mass, and filled by circulating

mineral-bearing solutions. Owing to the almost vertical inclination of these faults, the mines developed on the richer ore bearing ones went very deep. At Coniston levels were worked to a depth of 490 metres. These sorts of depths presented considerable problems to the miners. The mineral mined at Coniston was chalcocopyrite, a copper sulphide (CuFeS_2). Large quantities of magnetite (Fe_3O_4) was encountered at depth which ultimately lead to closure of the mine.



Workings in Red Dell Valley



Coppermines Valley



Adit at Brim Fell

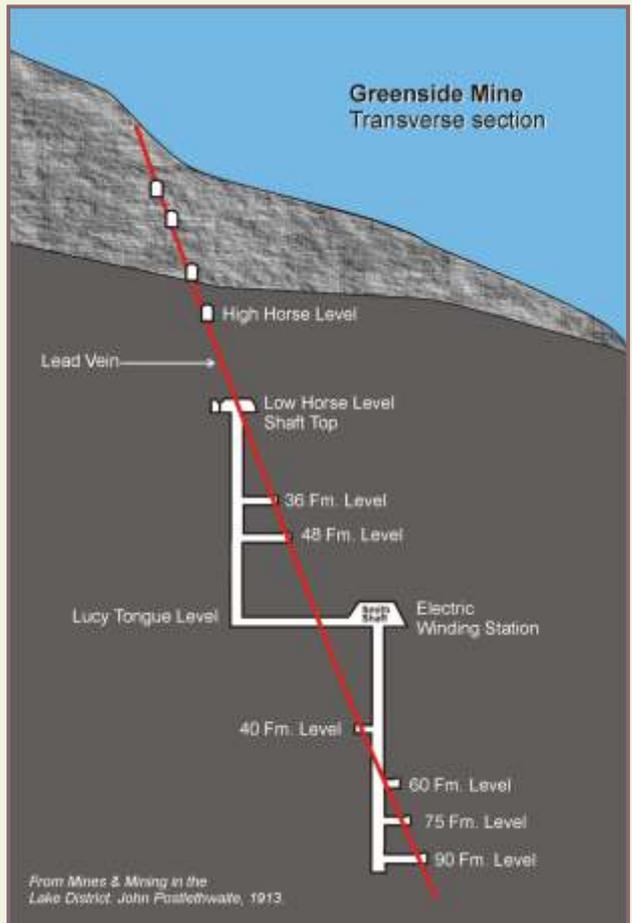
The mining for copper started before the 17th century and production was at it's highest during the Elizabethan and mid-Victorian eras. Over 600 people were employed in the mining area during the 1850's. During the 1560's German miners from Keswick were involved in developing the workings.

3. Greenside Lead Mine

Greenside Mine is located 2 kilometres west of Glenridding at grid reference NY364171. It was one of the most valuable mines in the county and was opened in 1825. The N-S trending lead-bearing vein produced 200,000 tons of lead concentrate. The principal ore was galena (PbS) and when smelted yielded 2 oz of silver per ton. The levels go down to a depth of 400 metres and to aid the removal of ore an electric locomotive was installed in 1893. The mine continued to be worked until its closure in 1959.



Mill workings





4. Carrock Mine

Carrock Mine is located on the western Caldbeck Fells at the head of Mosedale, at grid reference NY323330 and is famous for the production of tungsten. A suite of north/south trending Wolframite/Scheelite (tungsten manganese oxide, $(\text{Mn,Fe})\text{WO}_4$ / calcium tungstate CaWO_4) veins penetrate the Skiddaw granite and the Carrock Fell complex of gabbros. There are three main mineral veins known as the Emerson, Harding and Smith. Mining operations were carried from 1906 until 1981 when the mine became unprofitable.



A worked Wolframite/Scheelite mineral vein running up the fell adjacent to the mine



5. Force Crag Mine

Force Crag Mine is located two miles southwest of Braithwaite on a good level track at grid reference NY200216. It was an important mine in the northern Lakes and the site is now run by the National Trust. There has been a mill at the site in Coledale since 1840 and it operated up to the mid-1980's. More than 60,000 tons of barytes (barium sulphate, BaSO_4), 1248 tons of zinc (sphalerite, ZnS), 624 tons of lead (galena, PbS), and 20,000 ounces of silver have been extracted from the mine.



Centre: *Mineral processing equipment*
Right: *Main adit*



6. Roughton Gill Mine

Roughton Gill Mine can be approached from Fell Side at grid reference NY305375. A track leads southwards for 1.5 miles. The mine is the most famous in the Caldbeck Fells and also one of the oldest. The principal minerals were lead and copper (chalcopyrite, CuFeS_2) and galena, PbS). There are two mineral veins, the Silver Gill trending E-W and the Roughton Gill trending NNE-SSW. A smelting works were installed at the site in 1794. Mineralisation in this area of the Caldbeck Fells has been dated to the Jurassic (190 to 180 million years ago).



Roughton Gill Mining area from High Pike

7. Driggeth Mine

The mine is located on the eastern flank of High Pike at grid reference NY328352.

The minerals mined here were lead (galena, PbS), copper (chalcopyrite, CuFeS_2), baryte (barium sulphate, BaSO_4) and zinc (sphalerite, ZnS).

Mining started in 1724 and continued until 1909.

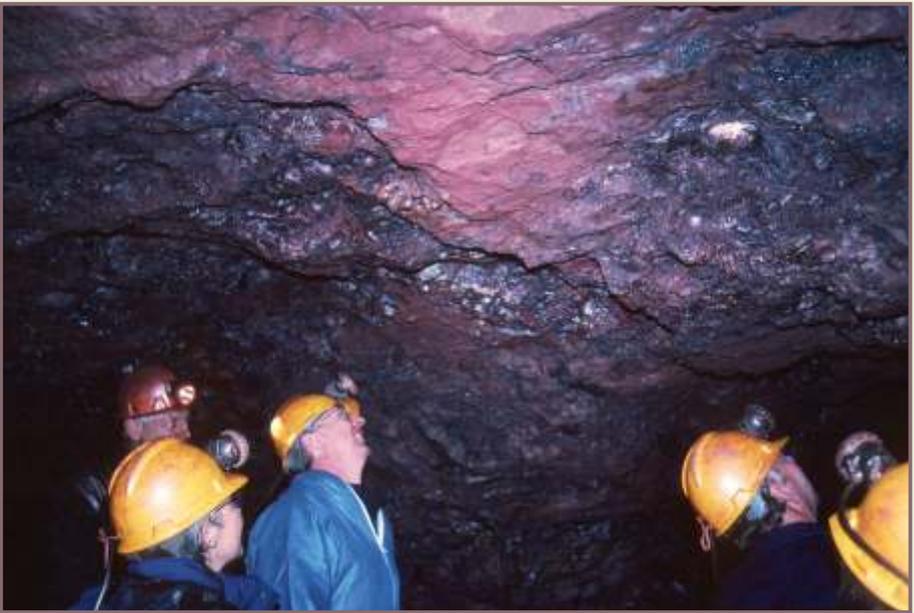
During the period of operation a total of 3800 tons of lead and 40,000 oz of silver were produced. The silver is extracted from galena using the Pattinson's process, where the galena was melted in pans and the lead was allowed to crystallise. The crystallised lead was pure and was removed from the pan. This process was repeated thus enriching the silver within the melt.



Spoil tips at Driggeth Mine

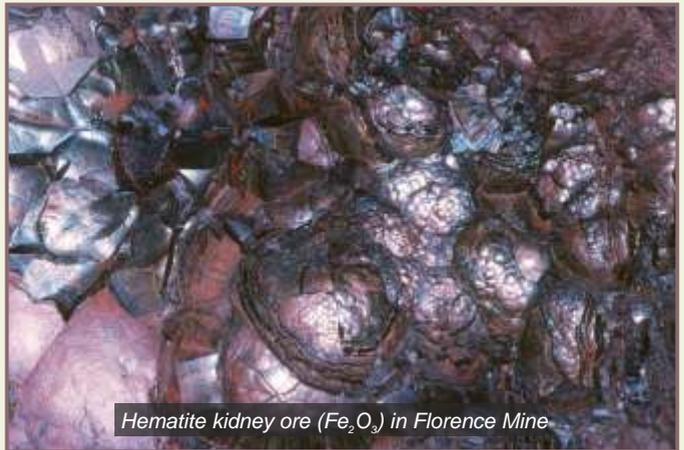


Pattinson's Level, Driggeth Mine (Please note do not enter mine shaft)



8. Florence Mine

Florence hematite mine is located on the southern boundary of Egremont at grid reference NY018103. The mine opened in 1914 and was the last working iron ore mine in Europe. It closed in 2009 due to the high cost of pumping water out of the mine. It has the largest 'flat-type' iron ore replacement body in the West Cumbrian iron orefield, and has massive kidney ores exposed in situ (see photograph below). The hematite (Fe_2O_3) ore deposits are within the Carboniferous Limestone which surrounds the Lake District area, and are related to faulting that resulted from the mountain-building phase at the end of the Carboniferous 300 million years ago. The ores, are Permo-Triassic in age (290 to 205 million years ago) and are believed to have formed by replacement of the limestones by the precipitation of iron oxides from hypersaline solutions, which rose up through the rocks from a source in the Irish Sea Basin.



9. Hodbarrow Mine

The Lower Carboniferous Limestones at Millom contained one of the largest bodies of hematite (an iron ore) ever discovered. In 1855 Nathaniel Caine and John Barratt formed the Hodbarrow Mining Company in order to exploit the recently discovered body of hematite. The quality of Hodbarrow hematite (Fe_2O_3) was very high, with

an iron content between 55% and 65%. The hematite was deposited by hot mineralised water at 100°C into faults, where the mineralised fluids were able to flow and crystallise. The photograph below was taken at Hodbarrow Point where mineralised faults can be seen. Cars may be parked at grid reference SD174791.



The Hodbarrow mine operated for 112 years and in 1967 production came to an end.



Statue in Millom

The mine workings were frequently flooded by sea water and in 1890 a barrier was constructed but in 1900 it collapsed in a spectacular fashion, as seen on the left. A second barrier was completed in July 1904 and today it is an RSPB reserve (see photograph above).



A mineralised fault at Hodbarrow Point



The Upper Wadhole

10. Seathwaite Graphite Mine

Seathwaite Graphite Mine is unique as it contains the purest graphite deposits ever found, which has 96% carbon. It was the only graphite mine in the country. The graphite or wad occurs in pipes in a dolerite that was intruded into the Borrowdale Volcanic Group rocks above the village of Seathwaite. The intrusion is Devonian in age (380 million years ago) using potassium-argon as the dating technique. The source of the carbon is not known, but one theory is a reaction of superheated water vapour reacting with underlying Skiddaw Group rocks (*ref: Minerals of Northern England., R. F. Symes, B. Young, 2008*). In the 18th century wad was a valuable commodity and theft became a problem at the mine. Black Sal was a notorious smuggler of wad and was allegedly hunted to death by wolfhounds.



The Lower Wadhole

11. Hilton Mine

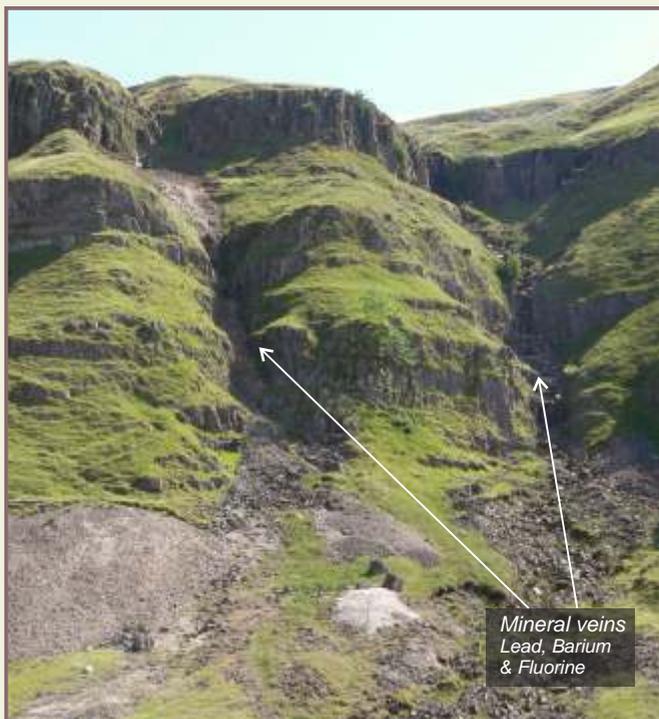
Hilton Mine is located 2 miles northeast of Hilton at grid reference NY763227.

Access is on a good track and has bridleway status but is within Warcop Firing Range. Visitors must check that access is allowed by phoning 0800 783 5181.

The mine opened in 1824 extracting galena (PbS) a lead ore from Melmerby Scar Limestone, a formation in the Lower Carboniferous. The London Lead Company operated the mine until 1876.

Twenty years later the mine reopened, not for lead but barite

(barium sulphate, BaSO_4). Barite has many uses, such as a filler for paint, a pigment for paper and textiles, a lubricant for drilling for oil and gas, also medical uses, e.g. barium meal. The mine closed in 1919.



Dow Scar, Hilton Mine

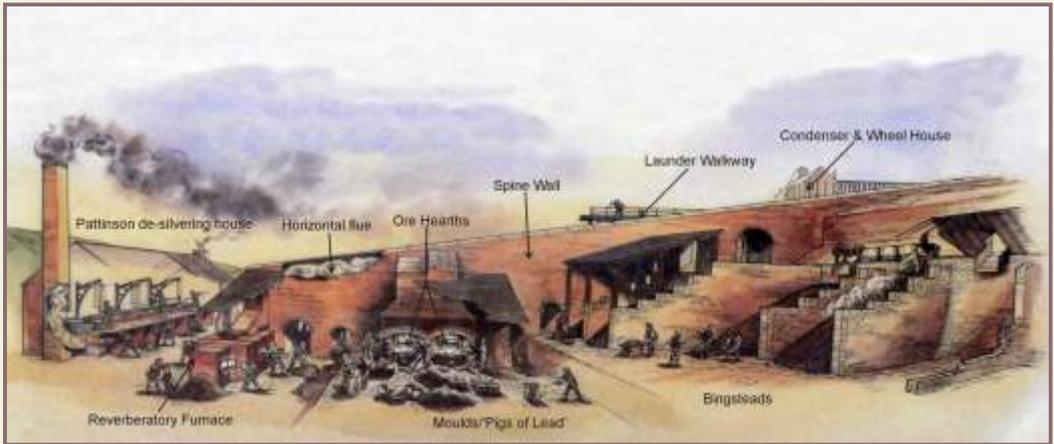


Hilton Mine workings

12. Nenthead Mine

Nenthead lead mine is at grid reference NY784434 and the public is allowed to visit the above ground workings.

Nenthead grew into a major centre for mining in the Northern Pennines. The original name for this mine was Carr's Mine and was operated by the Quaker run London Lead Company from 1848 until 1881.



The drawing above shows the layout of the workings in the 19th century. Below as it is today.



Lead vein (galena, PbS) in Carr's Mine



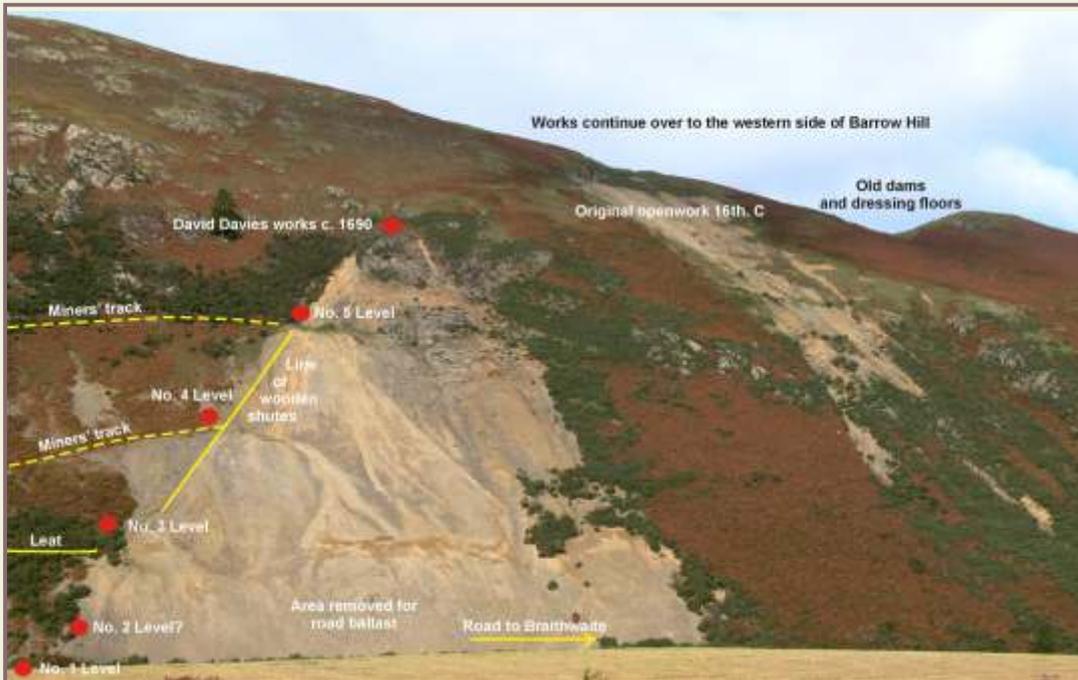
13. Haig Pit

Haig Coal Pit is now a museum and is located in Whitehaven at grid reference NX967176. The Pit was sunk during the First World War and was named after General Douglas Haig, Commander-In-Chief of the British Forces. Between 1914 and 1918 the two shafts were sunk to a depth of 12,000 feet by James Johnstone and Co. In 1920 two steam engines were installed, built by Bever Dorling of Bradford.



Statue in Whitehaven

Haig Pit closed in 1986 and was the end of deep mined coal in Northwest Cumbria. The site was left derelict until 1993 when Haig Pit Restoration Group, an independent voluntary organisation, was set up after buying the Haig Pit for £1. The group is working towards restoring the buildings and engines, providing an educational and informative attraction based on local mining history.



14. Barrow and Uzzicar Lead Mine

Barrow mine is located in the Derwent Fells 1 mile south of Braithwaite at grid reference NY232222. The mine has been worked for over 300 years until it closed in 1910. The vertical height of the mine shafts was 700 feet. The minerals extracted were galena (PbS), baryte ($BaSO_4$), cerussite (white lead, $PbCO_3$) and aragonite (calcareous spar, $CaCO_3$). Mining continued across the road adjacent to Uzzicar farm where early bellpits were dug and a 60 foot waterwheel was constructed along with dressing floors. In the mid-seventeenth century, mining took place high on the western flank of Barrow as shown in the photograph below.



Uzzicar Mine - The site of the water wheel and dressing floor



15. Penny Rigg Quarry

Although this leaflet concerns mining it is considered appropriate to include a slate quarry. Slate has been an important resource for Cumbria, especially in the Coniston area. Penny Rigg Quarry is located in the Tilberthwaite Valley at grid reference NY306008, the entrance to the quarry is 200 metres from the parking area. This long narrow quarry is aligned with cleavage. It is cleavage that enables the rocks to be easily split along parallel planar surfaces into thin slates. The rock in the quarry is in the Seathwaite Fell Formation, a sedimentary infill of a volcanic caldera basin, in the Upper Borrowdale Volcanic Group. The cleavage resulted from regional metamorphism that occurred during the Acadian Orogeny in the Late Devonian, some 380 million years ago. This regional metamorphism formed the Tilberthwaite slate belt that was so important for the Coniston slate industry.

(ref: Northern England, British Regional geology. British Geological Survey, 2010).



Slate being split along cleavage



16. Myers Head Mine

Myers Head Mine is situated at the head of Dovedale at grid reference NY395119. Like many of the Lake District's old mines it is situated amongst magnificent scenery. The workings at the mine consist of two levels known as the Pasture Beck Trials. The mine opened in 1866 by the Low Hartsop Mining Company. Lead was the objective but only small amounts were discovered. However, zinc (sphalerite, ZnS) was found in abundance but at the time zinc had few uses, so the mine closed in 1878.



The main adit situated above the ruins shown above

Cumbria RIGS

Conserving Geological Sites



Cumbria RIGS was formed in 1992 to identify and record important places for geology and geomorphology. Cumbria RIGS are supported and funded by Cumbria County Council. The group consists of voluntary professional and amateur geologists. Once RIGS are approved and recorded they need to be conserved, they are visited periodically and if funds are available clearance work is carried out.



*Fluorite (CaF₂)
Hilton Mine*



*Baryte (BaSO₄)
Force Crag Mine*



*Galena (PbS)
Northern Pennines*

Mining history: Cumbria and the Lakeland fells are renowned for its metalliferous mineralisation and mining in the county is very ancient. The earliest mining records, date from Edward III. During the reign of Elizabeth I it was recognised that English mines were badly operated and in 1564 the Company of Mines Royal was formed in order to improve mining efficiency. It was in the same year that Mines Royal transferred a grant to Daniel Hechstetter from Augsburg in Germany. At this time German technology in mining and smelting techniques was in advance of all other European countries. Soon after German miners started to arrive in Keswick and a new lease was granted allowing them to search for copper in the Lake District. Since then, the mining industry in Cumbria expanded providing significant employment for workers in the county. Many towns and villages have their origin in mining, such as Coniston, Millom, Glenridding and Nenthead.

Text and photographs by Michael Dewey

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