

# Mineralisation and Mining at Minera, North Wales

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## REGIONAL BACKGROUND

### Mining origins

Metals have been mined in North Wales from distant times, strikingly demonstrated in recent years by excavations in the copper mines of the Great Orme's Head, Llandudno. Here radiocarbon dates circa 1400BC confirm extensive mining activity in the Bronze Age in what now appears to be one of the most important ancient mining sites in Europe. During the Roman occupation an urgent demand for lead was in part satisfied from a number of sites dotted across the uplands of the north-east Wales. Evidence of the discovery of coins and 'pigs' of lead with Roman inscriptions, indicates that the main producing areas at that time were around Prestatyn in the north and on the high ground between Holywell and Halkyn in the centre of the region.

### Geology and mineralisation

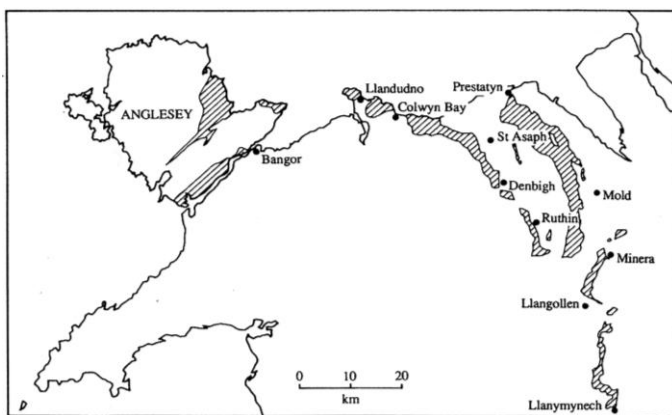


Figure 1. Outcrop of Dinantian rocks in North Wales.

They record the progress of a marine inundation, which encroached, on the northern flank of 'St George's Land', an upland area of ancient rocks represented today by the Snowdonia Mountains.

In the late Carboniferous uplift of the region took place, a consequence of the 'Variscan' mountain building episode. It was during this period that the structure and fracture patterns of the mineral districts were defined. Orebodies within the North-East Wales mining districts are generally confined to simple fault fissures; tension fractures more or less parallel to the dip of the strata. Current thinking is that the metals were carried within sodium chloride brines expelled by the compaction of sediments in the Irish Sea and Cheshire Basins. These solutions permeated favourably disposed fractures within the fringing limestones, where the principle ores, galena and sphalerite are found as veins accompanied by calcite and infrequently by quartz. The precipitation chemistry of the sulphide ores is open to debate but necessarily must have involved a source of sulphur.

### MINERA DISTRICT

The Minera mining field is compact and occupies the northern part of a six-mile, ribbon-like outcrop of Lower Carboniferous rocks, truncated in the north by the Llanellidan fault, a component of the 'Bala Lineament'. To the south, the whole 360 metres of the limestone sequence is revealed at Eglwyseg in a spectacular series of scarps, terminated dramatically high above the Vale of Llangollen at the 'Aquaduct Fault'.

The ore minerals of commercial interest at Minera were galena and sphalerite. Smithsonite occurred in the higher parts of some veins, notably at the Park and Pool Park Mines, but seldom in workable quantities. Chalcopyrite is recorded, but only in tiny quantities.

Most of the lead/zinc production in North Wales arose from fissure veins hosted by carbonate sediments of the Dinantian (Carboniferous Limestone); Figure 1. The eastern outcrop was the most important extending southwards from the coast and flanking the eastern slopes of the Clwydian Hills; Figure 2. Twice stepped eastwards by major faulting the outcrop terminates at Llanymynech in Shropshire, a total distance of forty miles.

The Dinantian rocks are a thick sequence, mainly limestones, which were deposited in shallow-water under tropical conditions some 350 million years ago.

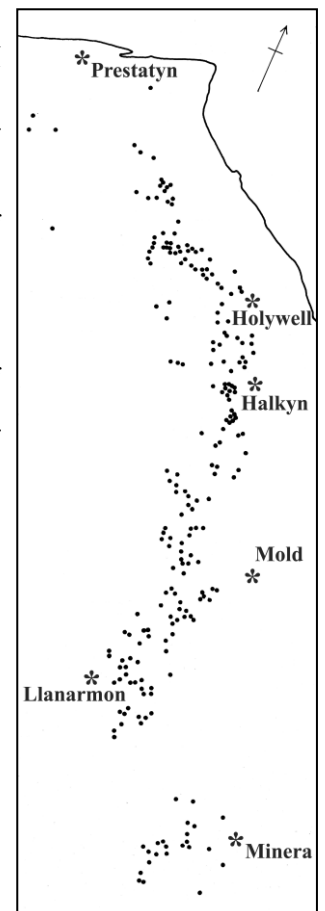


Figure 2. Mine sites as a guide to the extent of mineralisation.. (After Lewis, 1967)



Figure 3. Quartz from the Minera Lead Mines.

### The veins

Workable orebodies were found in fault fissures occurring as far south as World's End, but the richest mines were developed in the complex Minera Fault Zone, consisting of two main NW-SE fractures with a downthrow to the north-east; Figure 5. The combined displacement across these fractures is untypically large for lead-zinc veins in north-east Wales being up to 500 metres at its maximum. The fracture on the north side is known as the North or Red Vein, while that on the south is known as the South or Main Vein. The Main Vein has many branches especially in the northwest, where its identity is lost in a spread of veins, which all terminate at the Llanellidan Fault.

There was an obvious zoning of the lead-zinc mineralisation with depth. Sphalerite, little more than a curiosity in the shallower western parts of the mine, gradually increased in abundance with depth, until at the deepest parts of the mine in the southeast, the ratio of zinc ore to lead ore raised was ten to one.

The lead-zinc mineralisation is of the 'Mississippi Valley Type', similar in most respects to that of the Northern Pennines and the Peak District. Unlike most areas of MVT mineralisation in North-east Wales, where calcite is the sole accessory or 'gangue' mineral, at Minera quartz predominates; Figure 3. It occurs massive, well crystallised in the many small 'vugs', or finely crystallised resembling blocks of salt. Silicification of wall rock is common. Where calcite occurs, the common forms are six sided prisms surmounted by a shallow rhombohedron; Figure 4. Sometimes crystals are shot through with specks of chalcopryite and malachite.



Figure 4. Calcite from, Minera Lead Mines.

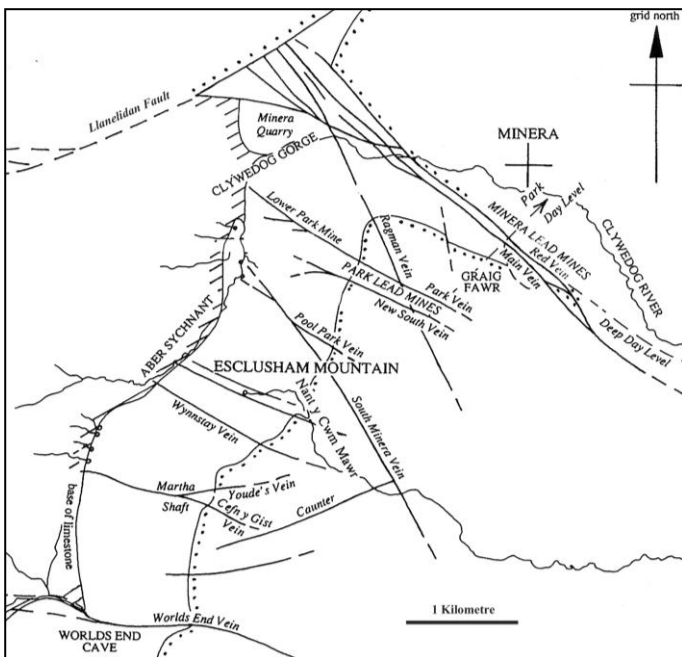


Figure 5. Sketch map of the Minera Mining Field.

The veins were productive throughout the limestone strata and workable deposits were sometimes found in the overlying Cefn y Fedw sandstone. Yields fell off rapidly, however, as the underlying Ordovician shale or 'bluestone' was approached. There is evidence that thick shale beds in the Cefn Mawr Limestone produced local enrichment due to clogging of the vein fissures and 'ponding' of mineralizing solutions, as in the mines in the Holywell-Halkyn area, but in the major fractures at Minera this effect was much less important. In working of the mines immediately south of the River Clywedog, 'flat' veins occurred which were reputed to have been very rich. Recent examination has confirmed the great extent of these workings. Some of the flats were found to occur at bentonite clay horizons in the upper part of the Loggerheads Limestone. Other flats were associated with low angle movement along bedding planes, 'slickensides' being a prominent feature on the roofs of some of these old workings.

## Mining history

That the Romans mined lead at Minera has long been inferred; the mineral veins would have been easily discovered at outcrop, a Roman road passes close by, and residues of lead smelting have been recorded in a Roman context only three miles distant. Proof remains elusive though ancient working is inferred by the discovery of a stone mortar; (Figure 6) in workings 50 metres below surface in 2005.



Figure 6. Stone mortar, White vein.

The earliest documentary evidence refers to a flourishing mining industry around the year 1301. Thereafter mining seems to have proceeded sporadically through late medieval times. It is likely that these early workings were in the north-west in an area known as 'Top Eisteddfod'. The ground is 'pock-marked' with run-in shafts and waste hillocks, where a spread of veins was worked at shallow depth on the outcrop of productive horizons in the middle and higher limestone beds. In their 1995 survey of metal mine sites in mid and north-east Wales, the Clwyd-Powys Archaeological Trust said of the 'Top Eisteddfod' area, "This extensive well-preserved mining area is of unique archaeological and historical importance in Wales".

By the start of the eighteenth century there was a strong Cornish influence in mining techniques; much expertise and capital came to Minera from outside the area. In about the year 1720 mining began in a systematic manner, starting where the ore-bearing strata were still at modest depth, in what became known as the West End Mine; deeper shafts were sunk and horizontal tunnels driven to intersect the lead veins. Several companies were involved in the working of the mines and all these ventures seemed to have been successful. In the latter half of the eighteenth century,



Figure 8. Winding at the Meadow (City) Shaft, the centre of activities at the Minera Mines in the 1890's.

profitable until 1815 when 'swallows' were intersected at the '170yd level', allowing water to pour into the workings from the west. In 1816 seven pumping engines were at work in different parts of the West and East End Mines raising a total of 4000 gallons of water per minute and consuming over 300 tons of coal per week. With little co-operation between the several proprietors over drainage, mounting financial problems and lengthy litigation the last of the Minera Mines closed by 1824.

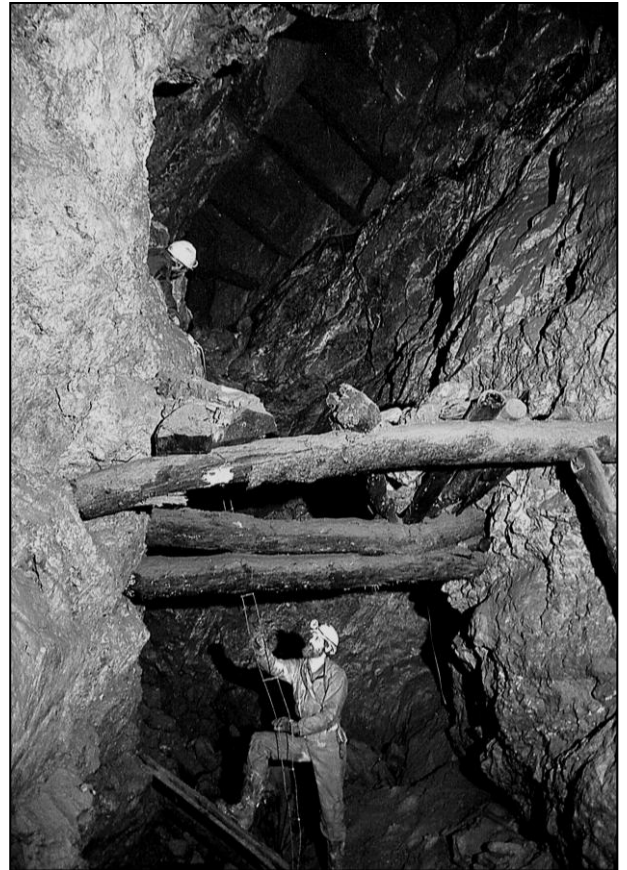


Figure 7. Stopes in the Busy Bee Vein

however, the West End Mines suffered crippling water problems. Hitherto waterwheels had provided the power for the pumps but in 1783 it became necessary to install a Boulton and Watt pumping engine. Though a second engine was added a few years later, in 1799, with the workings only 80 yds deep, the situation was described by James Watt Jnr as follows: 'All the workings below (adit) level upon these different veins are inundated with water in wet seasons, and the engines sometimes overpowered; the waters are supposed to accumulate in a natural cavern in the side of the hill of Craig Vawr to the south of the valley, and thence to penetrate through the fissures in the rock into the mine.' With the extension of an adit level to the cavern and the erection of a third engine considerable quantities of ore were raised until about 1817 when increasing pumping costs and breakdowns rendered the enterprise uneconomical.

The East End Mines, worked separately, had their own pumping engines and adit system and were very

In 1849 leases were taken up for the whole of the area occupied by the old mines, and the Minera Mining Company was formed. Under the able stewardship of the great mining engineers, John Taylor and Sons, an immensely successful period of 30 years followed. Deep drainage was secured by a day level brought up to the east end of the property and extended over the next 10 years to intersect the fissures which poured water into the mines at their western extremity. During the course of this driveage several rich runs of ore were located; Figure 7. In the east the mine was developed down to the 270 Yard level from several shafts. Shallower levels were extended through previously unworked ground into the old western workings. Skilful planning by the new company in its early years was a major factor in Minera's rise to become Britain's leading producer of lead and zinc ores in the 1860's and 1870's.

As the years went by reserves of lead ores in the western and central parts of the mine became exhausted. Some sections were re-opened to extract zinc ore, which, being of lesser value, had been left in the workings; from 1880 the tonnage of zinc ores raised exceeded those of lead. Development proceeded at depth in the eastern ground the main winding shaft being deepened to the 430 Yard level; Figure 8. In the 1890's the veins still further to the east were exploited from a new sinking called, the New Minera Mine. The quantity of zinc ore raised from these deepest workings outweighed that of lead by ten to one. By the earliest years of the 20th century it was this fact coupled with low zinc prices and increasing mining costs, which led to cessation of pumping and abandonment of the deep workings in 1909. Mining continued on a smaller scale above the rising water level until the mines finally closed in 1914. Total production in the 200 years up to 1914 is estimated at over 400,000 tons of lead + zinc concentrates.

### **The present**

Since the 1980's, the Wrexham Council has run an interpretation centre at the Meadow Shaft and dressing floors at the deep, south-eastern end of the Minera Mines. At the time of writing, a community group, the Minera Quarry Trust, has employed consultants to assess the long-term viability of several projects to regenerate the Minera Quarry area, traversed by the oldest workings in the mining field. Project proposals include a study of evidence of medieval and possible Roman mining and the creation of guided public access into natural caves and eighteenth century lead-workings.

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