Closehouse Mine, Durham

[NY 850 227]

Introduction

Closehouse Mine is a disused barite mine at the head of the Arngill Valley, a tributary of the River Lune which in turn drains into the River Tees near Middleton-in-Teesdale. The Closehouse deposits occur within the Lunedale Fault System, a complex, roughly E–W-trending structural zone which defines the boundary between the Alston Block to the north and the Stainmore Trough to the south (see (Figure 3.1)). The cyclothemic sequence of Lower Carboniferous limestones, sandstones and mudstones are strongly folded adjacent to the fault, which is here intruded by a wide dolerite dyke belonging to the Whin Sill suite of intrusions. Wide bodies of barite mineralization occur within the fault, mostly within the dolerite. The structural and stratigraphical relationships of the orebody are spectacularly displayed in the large opencast workings.

The presence of rich mineralization in this area appears to have been discovered at an early date as numerous ancient hushes mark the course of the main ore-bearing structures. The London Lead Company acquired the lease for the mine in 1770 and explored the deposits by driving a long level, the Deerfold Level, beneath the old hushes. Despite the great abundance of barite it seems that little lead ore was obtained. The London Lead Company surrendered its Lunedale leases in 1880 and the mine lay abandoned until 1939, when, attracted by the abundance of barite, Athole G. Allen (Stockton) Ltd acquired the lease. Production of barite, by underground mining, began at Closehouse Mine in 1945. At this time selective room and pillar mining was employed to extract the purest masses of barite. By the 1960s opencast extraction had started, and all underground mining ended at Closehouse in 1981. Dunham (1990) recorded that total output of dressed barite had by then reached over 300 000 tons. Opencast extraction ceased in 2000.

The geology and mineralization of the Closehouse deposits have been described in detail by Dunham (1948, 1990), and Hill and Dunham (1968). The Closehouse area was also the subject of an IGS Mineral Reconnaissance Study (Cornwell and Wadge, 1980). Vaughan and Ixer (1980) have described an early high-temperature sulphide assemblage from part of the workings, and Young (1985e) and Young *et al.* (1985a, 1994) have described the occurrence of several supergene minerals.

Description

Hill and Dunham (1968) provided a very detailed description of the stratigraphical and structural features of the Closehouse Mine deposits. Although subsequently brought up to date by Dunham (1990), most of the features outlined in the earlier account are still readily appreciated at the site, and Hill and Dunham's map and section are therefore reproduced here (Figure 3.14).

Mineralization at Closehouse occurs within several sub-parallel veins within the Lunedale Fault System. The Lower Carboniferous rocks here comprise a cyclothemic succession of limestones, sandstones and shales, locally intruded by the Whin Sill. The main deposits occur within the Closehouse North Vein on the west side of the Arngill Valley (Figure 3.15). This occupies a fault which dips at 45°–52°S with a downthrow to the south. In the immediate vicinity of the mine the Carboniferous rocks lie almost horizontally on the north side of the vein. On the south, or hangingwall side, they are folded into an asymmetric anticline and complementary syncline (Figure 3.14). The fault was intruded, prior to mineralization, by a dolerite dyke up to 30 m wide, which comprises part of the Whin Sill suite of intrusions. Much of the dolerite is altered to the distinctive clay-carbonate rock known to miners as 'white whin'. Mineralization occurs mostly within this dolerite intrusion, both as fissure-fillings and replacing the altered dolerite. Barite is the most abundant introduced mineral throughout the Closehouse deposits. Much of this is typically very coarse-grained with individual crystals commonly up to 10 cm long. Dunham (1948) described the presence of water-clear barite in a replacement flat deposit within the Smiddy Limestone on the north side of the vein. Galena occurs sparingly as coarsely crystalline lenses. A little sphalerite is found locally. Massive quartz is present in places. Large blocks of metasomatized limestone found within the opencast workings, but unlocated *in situ,* have been found to consist of ankerite with cavities containing calcite and acicular crystals of aragonite. Coatings of a bluish-green clay within barite-rich 'white whin' vein breccia have been identified as barium-muscovite (Lawson, pers. comm. in Dunham, 1990).

Vaughan and Ixer (1980) described a sulphide assemblage including pyrite, pyrrhotite and arsenopyrite from parts of the deposit for which they proposed an early, high-temperature origin.

Supergene minerals recorded from Closehouse Mine include pyromorphite (Dunham, 1948; Young, 1985e), rosasite (Young *et al.,* 1985a), anglesite (Dunham, 1990), and aurichalcite, cuprite and leadhillite (Young *et al.,* 1994).

Interpretation

The Lunedale Fault System, into which the Closehouse deposits are emplaced, is regarded as the southern boundary of the Alston Block, separating it from the Stainmore Trough and Cotherstone Syncline to the south. This clearly acted as a growth fault, during Carboniferous times, allowing much greater thicknesses of sediment to accumulate in the Stainmore Trough than on the Alston Block. The Carboniferous rocks on the south, downthrow, side of the fault are folded into a conspicuous asymmetric anticline and associated syncline (Figure 3.14). Dunham (1990) suggested that this may result either from compression or from subsidence into the Stainmore Trough.

Folding was followed by intrusion into the fault of a wide dyke of dolerite belonging to the Whin Sill suite. Francis (1982) suggested that the Haydon Bridge and Hett dykes may have acted as feeders for the emplacement of the Whin Sill. The wide dyke at Closehouse in a very similar structural setting may also be considered as a potential feeder dyke. Further tension, perhaps accompanied by some transcurrent movement following the emplacement of the dyke, produced numerous closely spaced, near-vertical fractures in the dyke, allowing access of fluids which converted much of the intrusion to the clay-carbonate rock known as 'white whin'. Ineson (1968) described these alteration processes in which carbon dioxide, water and potash were added and Fe, Mg, Ca and Na removed.

The Closehouse deposits lie within the outer, barium mineral, zone of the Northern Pennine Orefield.

Vaughan and Ixer (1980) described a sulphide assemblage which includes pyrite, pyrrhotite, high-Fe sphalerite and arsenopyrite, which appears to pre-date the main barite mineralization. They concluded that this provided evidence of formation temperatures of around 250°C, significantly higher than the depositional temperatures of the main constituents of the barium zone of the orefield. Similar small occurrences of relatively high-temperature mineral assemblages have been described from elsewhere in the orefield, where they also clearly pre-date the main mineralization (Dunham, 1990). This early sulphide mineralization exhibits some similarities to vein mineralization in parts of the Lake District for which a Caledonian age is generally advocated. The proximity of this mineralization at Closehouse to the Lunedale Fault and to the sub-Carboniferous basement may invite speculation on a genetic relationship, perhaps involving the remobilization by the intrusion of the Whin Sill, of Caledonian mineralization in the Lunedale Fault and its emplacement in fissures in Carboniferous rocks.

The main mineralization at Closehouse is dominated by an abundance of barite, whilst other minerals, including sulphides, are typically present only in subordinate amounts. Whereas some of this mineralization clearly fills fissures, a considerable proportion of the barite ore deposits clearly replaces Whin Sill dolerite. It appears that during mineralization substantial volumes of carbonate-rich 'white whin' reacted with mineralizing fluids in a similar fashion to limestone, giving rise to large replacement deposits dominated by barite. Replacement of limestone has also occurred at Closehouse where, for instance, a barite-rich flat containing water-clear barite occurred within the Smiddy limestone (Dunham, 1948).

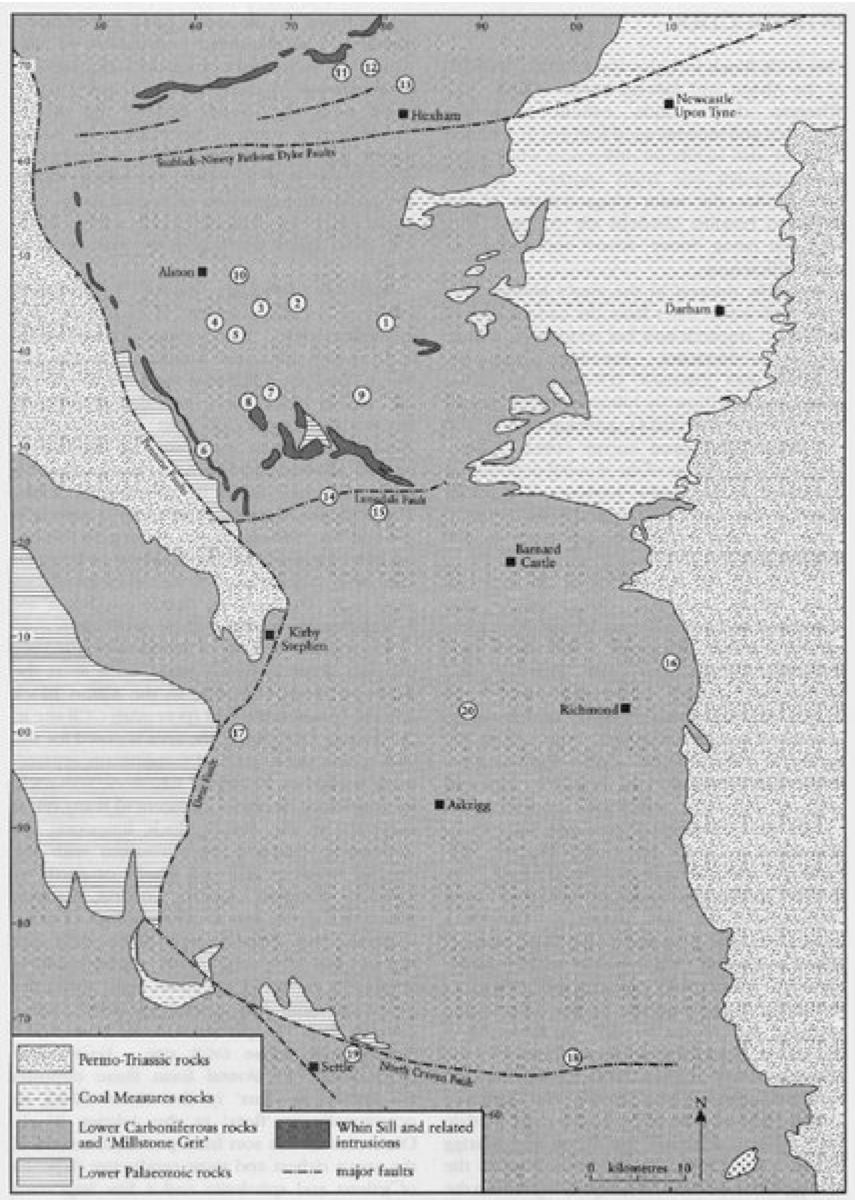
The great abundance of mineralization within the Lunedale Fault System at Closehouse suggests that this may have acted as a major channel, conveying mineralizing fluids, perhaps originating in the adjacent Stainmore Trough. Dunham (1990) presented evidence that significant mineralization may be associated elsewhere with this structure, including the Durham Coalfield, where mineralization is concentrated adjacent to its easterly continuation, the Butterknowle Fault.

Supergene mineralization at Closehouse is consistent with oxidation of the deposit at present topographical levels.

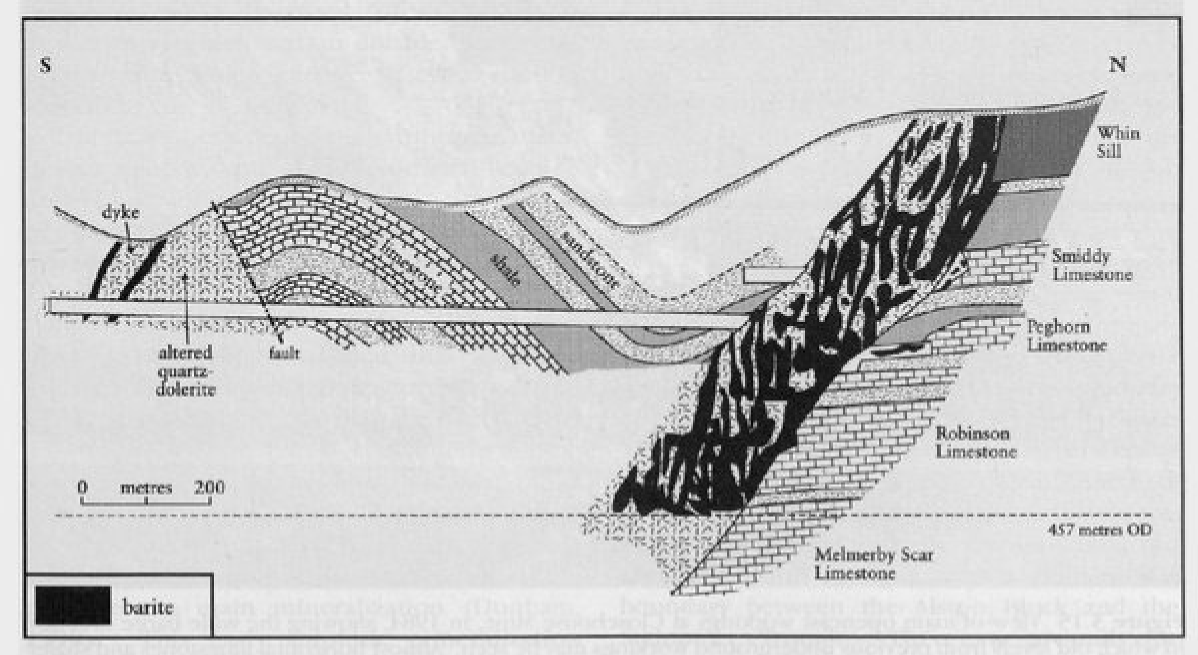
Conclusions

Closehouse Mine provides excellent large-scale sections through a major barite deposit in the outer zone of the Northern Pennine Orefield. The mineralization can readily be studied in its stratigraphical and structural context. Much of the barite mineralization occurs as a replacement of Whin Sill dolerite intruded into the Lunedale Fault System, which defines the boundary between the Alston Block and the Stainmore Trough. There are grounds for supposing that this structural line may have acted both as a route for the emplacement of theWhin Sill and as a major channel for mineralizing fluids. The presence of earlier relatively high-temperature sulphide mineralization invites speculation on possible remobilization of Caledonian mineralization at depth within the Lunedale Fault System.

References



(Figure 3.1) Geological sketch map with locations of GCR sites. 1– West Rigg Opencut; 2 – Killhope Head; 3 – Smallcleugh Mine; 4 – Tynebottom Mine; 5 – Sir John's Mine; 6– Scordale Mines; 7 – Lady's Rake Mine; 8 – Willyhole Mine; 9 – Pike Law Mines; 10 – Blagill Mine; 11 – Settlingstones Mine; 12 – Stonecroft Mine; 13 – Fallowfield Mine; 14 – Closehouse Mine; 15 – Foster's Hush; 16 – Black Scar; 17 – Cumpston Hill North and South Veins; 18 – Greenhow (Duck Street) Quarry; 19 – Pikedaw Calamine and Copper Mines; 20 – Gunnerside Gill.



(Figure 3.14) Section through the main orebody at Closehouse Mine, showing folding in associated Carboniferous beds. After Hill and Dunham (1968).

(Figure 3.15) View of main opencast workings at Closehouse Mine, in 1984, showing the wide barite orebody in which old levels from previous underground workings may be seen. Almost horizontal limestones and shales on the footwall are exposed on the right of the picture. Steeply folded sandstones and limestones on the hangingwall can be seen on the left. (Photo: B. Young.)