Settlingstones Mine, Northumberland

[NY 849 688]

Introduction

Settlingstones Mine (Figure 3.12) is the largest and most important of a small cluster of mines which worked several veins on the north side of the Tyne Valley around the small town of Haydon Bridge. The Fallowfield Mine and Stonecroft Mine GCR sites (see GCR site reports, this chapter) also lie within the Haydon Bridge portion of the orefield. Although these deposits are hosted by Carboniferous rocks which structurally form part of the Northumberland Trough (see (Figure 3.1)), they are generally regarded as comprising the northernmost worked deposits of the Northern Pennine Orefield. The Settlingstones Vein, which strikes approximately north-east-southwest, cuts Lower Carboniferous limestones, sandstones and mudstones into which the Whin Sill is intruded. The sill formed one of the most important wall-rocks for the ore-shoots worked in this mine.

Settlingstones was first worked as a lead mine, probably during the 17th century. Records of lead production are available only for the period 1849–1873 when a total of 16 902 tons of lead concentrates were raised. In the original lead workings the main gangue minerals were barite and ankerite. As the mine was developed southwestwards the vein was followed through a NNW–SSE-trending cross-course beyond which the vein filling changed dramatically to witherite, with only very small amounts of sulphides and other minerals. From 1873 the mine's production changed from lead ore exclusively to witherite. Settlingstones soon became established as the world's leading, and for long periods sole, commercial source of witherite. Between 1873 and its closure in 1969 Settlingstones produced around 630 000 tons of witherite product.

The Settlingstones deposit was remarkable for the great abundance of witherite, which, outside of the Northern Pennines, is of considerable rarity. The mine yielded numerous very fine specimens of crystallized witherite and barite, spectacular examples of which are to be seen in most of the world's major mineralogical collections. The Settlingstones Vein also contained local concentrations of nickel ores and strontianite, and was noted for the presence of the barium zeolite harmotome.

Descriptions of the mine, its orebodies and the minerals present include those by Russell (1927), Trestrail (1931, 1938), Dunham (1948, 1990), Ineson (1972), and Young and Bridges (1984). Research on the Settlingstones witherite orebody has contributed much to the understanding of the origins of the Northern Pennine Orefield.

Although no mineralization is exposed *in situ* at the site today, and all underground workings are totally inaccessible, the remaining dumps contain vein material which still offers opportunities for study and research on this unique deposit.

Description

The mineralogical importance of Settlingstones Mine lies in the mineralization present in Settlingstones Vein south-west of the cross-course at which the vein filling changed to witherite. According to Dunham (1990) the vein ore-shoots averaged 2.4 m in width, although locally widths of 9.1 m were recorded. The vein was noted for the presence of a number of branches or loops, at least two of which were large enough to be workable for witherite. Witherite contents in the run of mine ore were commonly above 77%. Witherite at Settlingstones typically occurred as white to pale-cream crystalline masses. In cavities, terminated crystals, commonly forming complex twinned aggregates, were abundant. Specimens of witherite exhibiting rounded, rather nodular crystalline surfaces were also common. The only other mineral present in quantity in the vein was barite, much of which occurred as sharply terminated crystals lining cavities in the witherite. Dunham (1990) noted that the distinctive morphology of these crystals, in which the dominant faces are (110) combined with (001), appears to be characteristic of barite found in association with witherite.

Minor constituents of the witherite vein included well-formed, colourless, small cruciform twinned crystals of the barium zeolite harmotome, commonly found encrusting witherite crystals in vugs (Young and Bridges, 1984; Dunham, 1990). Radiating crystalline aggregates of pale-green or pale-buff strontianite were present locally (Young *et al.,* 1985b) and some good calcite crystals were found in places. Barytocalcite is a very rare late-stage member of the mineral assemblage (Young, 1993).

Ore minerals were comparatively scarce within the witherite orebodies, although galena and sphalerite, together with a little pyrite, were widely found in small amounts. Russell (1927) described the occurrence of niccolite and ullmannite in a pipe-like deposit within the vein from which about half a ton of niccolite is said to have been raised. Young *et al.* (1987) identified gersdorffite in specimens from this occurrence.

The Whin Sill was a major wall-rock throughout the workings at Settlingstones Mine. Metasomatism by mineralizing solutions altered large volumes of the Whin Sill dolerite to the pale-grey clay-carbonate rock known to miners as 'white whin'. Hard sandstone, including a thick sandstone thermally altered by contact with the sill, was also an important wall-rock in parts of the mine.

During its long life as a witherite mine, ore was raised at Frederick Shaft [NY 8423 6825] adjacent to the Fourstones to Grindon Hill road, the Stanegate. Processing took place at the treatment plant adjacent to the Ellen pumping shaft [NY 8500 6878] on the south bank of Settlingstones Burn. Upon closure the shafts were sealed, the mine buildings demolished and much of the site was cleared. Remnants of the spoil heaps remain today near the site of the treatment works. These contain an abundance of witherite, together with blocks of the very distinctive barite. Small specimens of harmotome, commonly encrusting witherite or filling veinlets within 'white whin' may also be found on the spoil heaps.

Interpretation

The veins of the Haydon Bridge area occur within Carboniferous rocks, and locally the Whin Sill, in the southern portion of the Northumberland Trough. They thus do not form part of the structural unit known as the Alston Block', to which the other veins of the oreﬂeld belong. However, their form, and mineralogy have much in common with the main Northern Pennine Orefield, of which they appear to comprise the northernmost expression. These veins all lie within the outer, barium-rich, zone of the orefleld.

The Northern Pennine Orefield is unique in the world for the abundance, within its outer zones, of large concentrations of barium carbonate minerals, most abundant of which is witherite. Settlingstones Vein was the largest witherite deposit known. The reasons for the considerable abundance of barium carbonate minerals in this orefleld have not yet been satisfactorily explained.

Dunham (1990) noted that examination of witherite veinstone from the south-western workings of Settlingstones Mine, where an increasing amount of barite was present in the vein, shows undoubted evidence of witherite replacing original barite. Dunham (1990) described thin-sections of witherite forming interlocking platy pseudomorphs after barite. Moreover, bands of galena and sphalerite, seen as part of the crustified structure where the vein was dominantly barite, were seen to continue through cavities in the later witherite, or to hang into them. This is entirely consistent with the work of Hancox (1934) which showed that much of the area's witherite resulted from replacement of original tabular barite.

Young and Bridges (1984) suggested that reaction between these late-stage carbonating fluids and altered dolerite wall-rock produced the small but widespread encrustations of harmotome found coating witherite and other minerals in vugs both at Settlingstones Mine and the nearby Stonecroft Mine and Greyside Mine. In limestone wall-rocks the same paragenetic position is typically occupied by barytocalcite or alstonite (Young, 1985c). Barytocalcite has been observed as a very rare late-stage constituent of the Settlingstones witherite deposit (Young, 1993).

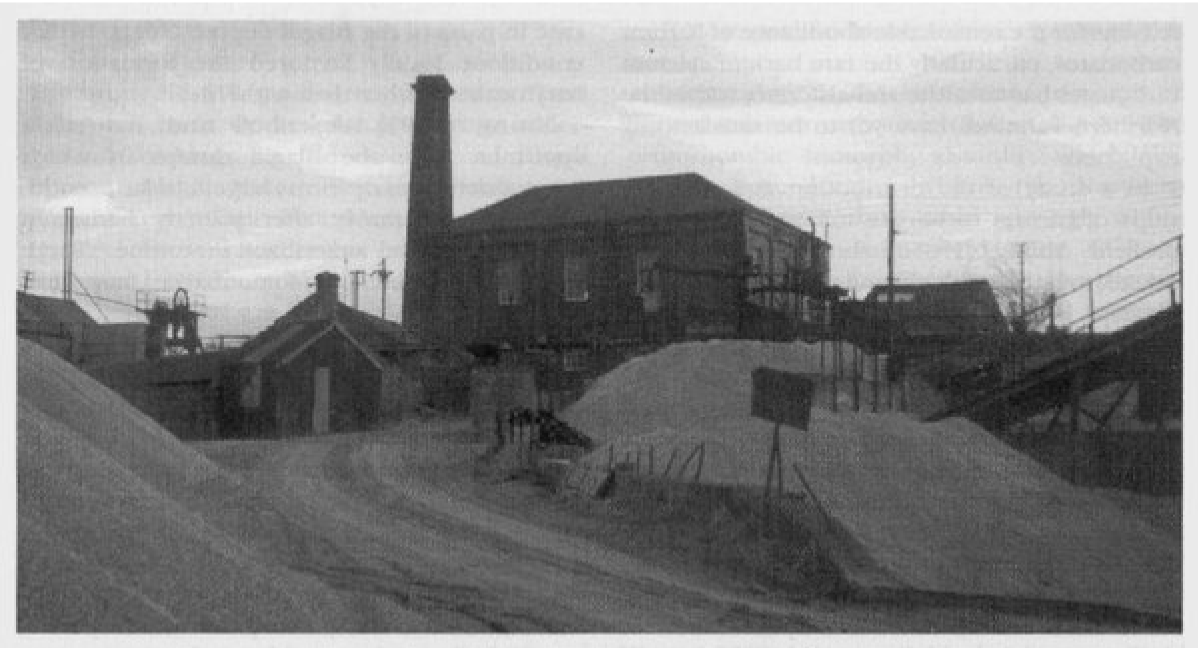
The nickel mineralization at Settlingstones appears to have been restricted to one pocket cut many years ago at the mine's 70-Fathom Level (Russell, 1927). Young *et al*. (1985b) presented comparative analyses of the nickel minerals from Settlingstones and other Northern Pennine localities, and suggested that the Whin Sill may have been the source of the nickel for each of these occurrences.

Although generally regarded as being distal deposits of the Northern Pennine Orefield, the view has been canvassed that the veins of the Haydon Bridge area may be related to mineralization associated with the Stublick Fault Zone, which forms the boundary between the Alston Block and the Northumberland Trough (Young *et al.,* 1992b). It is significant in this context that barium and base-metal mineralization is common along a restricted belt of country astride this fault zone across much of northern England (Cooper *et al.,* 1991). Some mineralization on the southern margin of the Northumberland Trough shows important similarities to deposits with similar structural settings in Ireland, such as Tynagh. It is thus possible that significant base-metal, and perhaps barium mineralization, may be present at depth along the Stublick Fault Zone. Similarities between $\delta^{34}S$ of anhydrite in Lower Carboniferous anhydrites in the Solway Basin and those of barite in the veins of the Haydon Bridge area support a source for mineralization within the trough and may thus lend some support to this hypothesis (Crowley *et al.,* 1997). If so the deposits in the Settlingstones and nearby veins, which occupy antithetic faults within the hangingwall of the Stublick Fault Zone, may be high-level expressions of this mineralization.

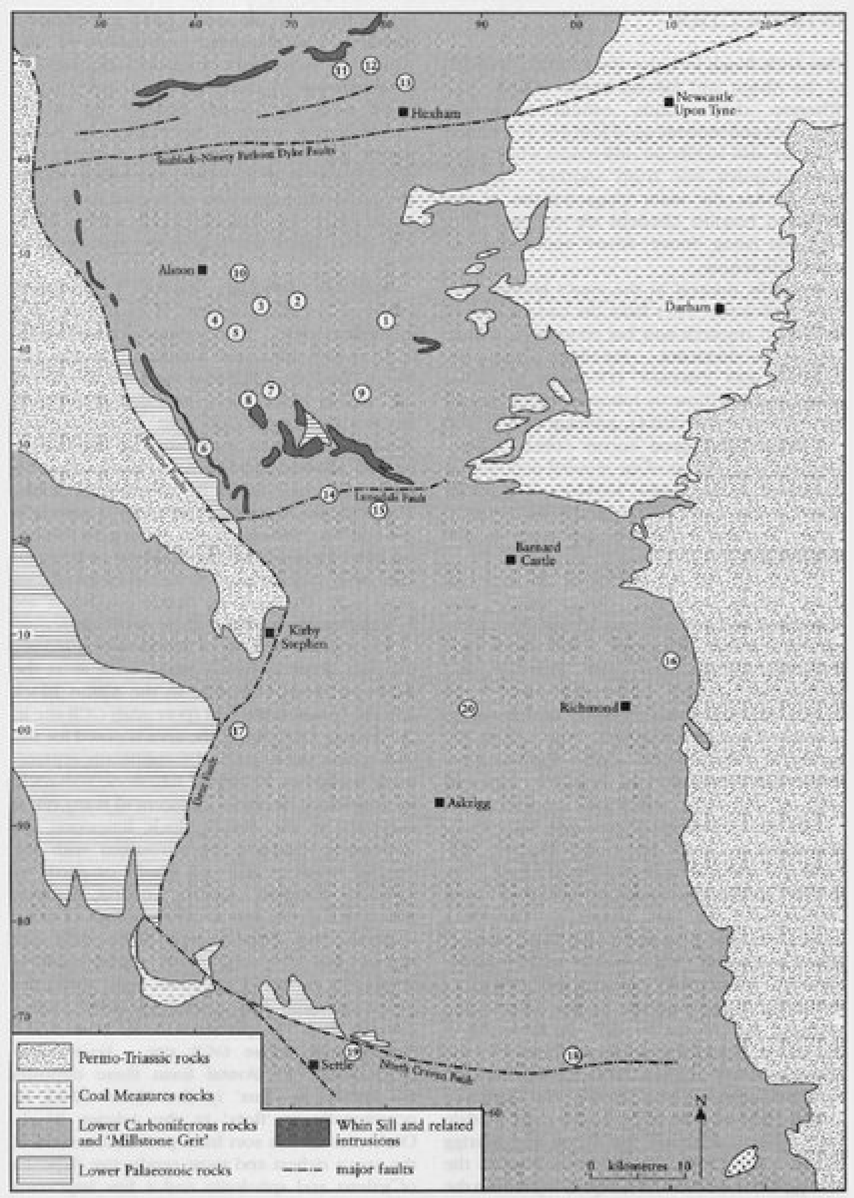
Conclusions

Settlingstones Mine is an important site for witherite mineralization. Its position is crucial to understanding and interpreting the origin of this and the nearby veins. Although no mineralization is visible *in situ* at the site today, the increasingly overgrown spoil-heaps contain useful quantities of vein and wall-rock which allow study of the mineralization of this once important commercial deposit.

References



(Figure 3.12) The treatment plant and stockpiles of witherite product in 1967 at Settlingstones Mine. The head frame of the Ellen pumping shaft may be seen behind the buildings to the left of the picture. (Photo: B. Young.)



(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.