Willyhole Mine, Durham

[NY 805 336]

Introduction

Two relatively short, roughly ENE–WSW-trending, veins known as 'Reddycomb Vein' and Willyhole Vein', cut Lower Carboniferous limestones, sandstones and mudstones on the east side of Herdship Fell, Upper Teesdale. The spoil heaps are noted for the abundance of supergene greenockite in association with both smithsonite and oxidized sphalerite (Young *et al.,* 1987). Originally worked for lead ore between 1852 and 1889, when 758 tons of lead concentrates were raised, the workings were re-opened in 1896 to produce zinc ore, some 712 tons of which were produced between then and 1912 when mining ceased. The remains of the small dressing plant erected at this time can still be seen at the site (Beadle, 1980). The bottom level of the mines was re-opened for investigation during the 1914–1918 war, although no mining appears to have followed (Carruthers and Strahan, 1923). Although described here as Willyhole Mine' it is commonly referred to locally by the alternative name of 'Reddycomb Mine'.

Dunham (1990) recorded that the Reddycomb Vein averaged 0.6–0.9 m in width, , although locally this increased to as much as 3 m. No figures are given for the Willyhole Vein however. Both veins contained galena and sphalerite together with a little barite. Carruthers and Strahan (1923) noted that a mass of sphalerite 0.6 m across was encountered during the 1914–1918 re-opening. Supergene smithsonite is abundant.

The veins lie close to the inner margin of the barium zone of the Northern Pennine Orefield within one of the local concentrations of zinc mineralization outlined by Dunham (1948).

Description

Although no mineralization is exposed in *situ* in either of the veins today and the underground workings are inaccessible, the remaining spoil-heaps contain an abundance of zinc ore. Both smithsonite and highly oxidized sphalerite are plentiful. Much of the smithsonite is present as the brown cellular 'dry bone' variety, although pale-buff to pale-grey small mammillated crusts are not uncommon and a few smithsonite pseudomorphs after 'nail head' calcite have been found.

Newly fractured surfaces of sphalerite commonly display rich, vivid-yellow crusts of greenockite up to 40 mm across. These crusts resemble specimens of greenockite reported from numerous worldwide localities in a similar paragcnesis (Palache *et al.,* 1944).

Interpretation

Supergene cadmium mineralization is more abundant at this site than so far described at any other site in the orefield. Young *et al.* (1987) described similar, but much less-abundant, mineralization from several localities within the Northern Pennines. These authors confirmed the presence of greenockite at Willyhole Mine and Blagill Mine, but draw attention to the difficulty of obtaining undoubted X-ray patterns for either greenockite or its cubic dimorph hawleyite from many of these sites, despite the confirmation of the yellow encrustations as cadmium sulphide by microchemical and energy dispersive X-ray analysis. They concluded that in fact many of the vivid-yellow cadmium sulphide crusts found on oxidizing sphalerite in the area are amorphous.

The distribution of supergene cadmium mineralization within the Northern Pennines seems to be principally concentrated in areas of most intense zinc mineralization. Analyses of Northern Pennine Orefield sphalerites reveal a range of cadmium contents, held in solid solution, of between 343 ppm and 3000 ppm (El Shazly *et al.,* 1957; Young *et al.,* 1987). Within the Northern Pennine Orefield there appears to be no clear correlation between the cadmium content of sphalerite and the occurrence of free cadmium sulphide encrustations. There is limited evidence that there is a similar lack of correlation between these features in other areas of Britain where supergene cadmium mineralization has been recorded

(El Shazly *et ai.,* 1957; Smith, 1982; Mostaghel, 1985a). Young *et al.* (1987) concluded that the presence of supergene cadmium mineralization in the Northern Pennines is related more to the state of oxidation of the sphalerite than to its cadmium content. They also suggested that the amorphous nature of much of the area's cadmium sulphide encrustations may be explained by its development as a residual phase, remaining as zinc was removed in solution during supergene alteration.

Conclusions

Willyhole Mine presents the finest opportunity in the Northern Pennine Orefield to examine and study the occurrence ot and processes which lead to the formation of, supergene cadmium mineralization of this sort.

References