West Rigg Opencut, Durham

[NY 911 392]

Introduction

West Rigg Opencut is a large abandoned quarry, which, during the 19th century, worked a metasomatic replacement deposit of 'limonitic' ironstone associated with the Slitt Vein within the Namurian Great Limestone. It is one of a number of similar deposits, formerly worked in the Northern Pennines, in which primary iron carbonate minerals have undergone supergene alteration to 'limonitic', or 'brown hematite' ores. These deposits have been compared to those of 'Bilbao-Type' (Percival, 1955; Gross, 1970). At West Rigg today, remnants of the worked ore-body may be studied *in situ* in their structural, statigraphical and metallogenic context. The site provides the finest surviving exposure of such a deposit within Britain. In addition the site offers excellent opportunities to examine one of the orefield's major mineralized veins. The site has been described previously by Dunham (1948, 1990), and Young (1995).

Dunham (1990) recorded that these workings were amongst the Weardale Iron Company's main producers of iron ore during the second half of the 19th century. Iron contents varied from 34.3% to 43.4%. The ore was transported from the quarries by means of a specially constructed standard-gauge railway. Total production figures from these formerly important workings are not available.

Description

At West Rigg the Great Limestone, the basal unit of the local Namurian succession, is approximately 18 m thick. Slitt Vein, the longest single vein within the Northern Pennine Orefield, cuts the limestone at West Rigg. This vein here strikes roughly east–west and comprises one of a small number of veins with this general trend known as the 'Quarter Point' veins (Dunham, 1990). Like other Quarter Point veins, Slitt Vein is commonly a wide mineralized structure carrying large amounts of fluorite and quartz, but with comparatively low concentrations of galena and other sulphide ores. The vein has been worked for lead in the past, but its main economic importance lay in the large metasomatic replacement deposits of ironstone present in several places where the vein cuts the Great Limestone, and in the local abundance of fluorite, for which it was worked recently in nearby mines.

The Slitt Vein at West Rigg is up to 5 m wide, and is mineralized mainly with quartz with some impersistent bands and lenses of fluorite. Small amounts of galena have been extracted from near the centre of the vein in old stopes now exposed in the workings. Adjacent to the vein, almost the full thickness of the Great Limestone has been replaced by limonitic ironstone, derived from the supergene alteration of primary carbonates, almost certainly siderite and ankerite. A few metres away from the vein margins this replacement was most extensive within the upper part of the limestone. Here iron mineralization locally extended for up to 61 m on either side of the vein. The extent of the West Rigg Opencut gives a very clear impression of the size and form of these replacement orebodies. Although almost totally extracted, small exposures of ore remain locally in the walls of the workings. Slitt Vein itself has been left as an unworked rib which forms a striking wall-like feature across the centre of the quarry (Figure 3.2). Exactly similar replacement deposits, also associated with Slitt Vein, were worked immediately to the west of West Rigg, at Slitt Pasture and to the east at Rigg, although little is exposed *in situ* at these workings today.

Interpretation

A characteristic feature of veins within the Northern Pennine Orefield is their tendency to be almost vertical, or very steeply inclined, well-mineralized structures within competent wall-rocks, such as limestone and sandstone. In less-competent rocks, such as shales, they are commonly barren or only weakly mineralized. Wall-rock alteration, commonly with the introduction of iron carbonate minerals, is typical of many veins, particularly within limestone. Locally, much more extensive metasomatic replacement of limestone wall-rock has taken place adjacent to some veins, with the

development of sometimes very large replacement deposits, known to the local miners as 'flats'. Many 'flats', including those at West Rigg, contain high concentrations of iron carbonate minerals such as ankerite or siderite. Others are distinguished by concentrations of sulphides such as galena and/or sphalerite significantly higher than in the adjacent veins. Original sedimentary features such as bedding, stylolites and some fossils, are commonly clearly preserved in the altered rock. Such 'flats' are especially common within the Great Limestone. Although such replacement may be found at almost any level within this limestone, three principal 'flat' horizons, known respectively as the 'High', 'Middle' and 'Low' flats have been widely recognized across the orefield (Dunham, 1948). The most extensive replacement at West Rigg occurs at the 'High Flat' horizon.

As noted above, Slitt Vein is the longest single vein within the orefield and is one of the Quarter Point group of veins. These are distinguished from the majority of Northern Pennine veins in being fissures which resulted from original transcurrent rather than vertical movement (Greenwood and Smith, 1977; Dunham, 1990). Where their strike direction most nearly approaches east–west these veins typically contain considerable widths of introduced mineral. This is well demonstrated at West Rigg where most of the vein is composed of quartz. West Rigg Opencut demonstrates, in spectacular fashion, the development of metasomatic alteration of Great Limestone wall-rock by iron carbonate minerals, introduced during an early stage in the main mineralizing process. The 'flats' produced at West Rigg are distinguished by their high iron and low sulphide content. Supergene alteration of the original iron carbonates has produced a large workable deposit of limonitic ore. The West Rigg and similar nearby orebodies may thus be considered as good examples of the 'Bilbao-Type' of iron ore deposit (Percival, 1955; Gross, 1970). Much of this ore, examples of which may be seen locally in some of the remaining faces, is typically a rather structureless, massive or earthy limonitic ore composed dominantly of goethite, although pseudomorphs after curved rhombic crystals of either siderite or ankerite may be found locally.

A characteristic feature of the deposits of the northern, Alston Block, portion of the Northern Pennine Orefield is the great abundance of iron minerals. Indeed, Dunham (1990) observed that ankerite is more abundant than any other mineral in the unoxidized portions of the metasomatic replacement deposits. Iron minerals are, by contrast, remarkably scarce in the otherwise generally similar deposits of the Yorkshire Pennines. Wager (1929) suggested that the abundant iron was derived by the reaction of mineralizing fluids with the Whin Sill which underlies much of the Alston Block. Dunham (1990) has advocated a similar origin for at least part of the silica which is also so abundant here.

Post-mineralization movement along most of the orefield's veins is apparent in the form of locally brecciated vein minerals or slickensided fractures parallel to the vein walls. Clear evidence of renewed lateral movement along Slitt Vein is to be seen in the well-marked, almost horizontal slickensided surfaces of quartz exposed along parts of the south side of the vein at West Rigg.

Conclusions

West Rigg Opencut provides one of the finest surface exposures of a Northern Pennine vein and its associated metasomatic replacement by iron minerals within the Great Limestone. The site is of prime importance in displaying this type of deposit in its structural, stratigraphical and metallogenic context.

References

(Figure 3.2) West Rigg Opencut. Large metasomatic replacement flats of iron ore in the Great Limestone have been removed leaving the vein, here composed mainly of quartz and a little fluorite, as a conspicuous rib across the centre of the quarry. Old lead workings in the centre of the vein may be seen to the left of the figure. (Photo: B. Young.)