Gravel Hill Mine, Cornwall

[SW 764 575]

Introduction

The Gravel Hill Mine GCR site is situated at the north-east corner of Perran Beach (Sands), approximately 3.5 km north of Perranporth. The mine worked the Perran Iron Lode for iron ore.

The Perran Iron Lode is one of the largest lodes in South-west England, having been worked over a distance of 6 km, and with a thickness of over 30 m in places. It is a very unusual structure for South-west England as it trends north-west-south-east, which is almost at right-angles to the regional trend of the main-stage tin-copper mineralization, and at 40° to the cross-course lead mineralization in the area. The paragenesis of pyrite-sphalerite-siderite is also most unusual in Cornish terms. The northwestern end of the Perran Iron Lode is exposed in the opencast and underground workings of Gravel Hill Mine (see (Figure 7.62)). The mine is situated in Meadfoot Group rocks ('killas'), of Lower Devonian age.

The highest recorded output for Gravel Hill Mine was in the period 1874 to 1882, given by Dines (1956) as 7400 tons of brown hematite, 300 tons of mixed limonite, and 30 tons of zinc ore. Some of the workings within the cliff section at Gravel Hill Mine are still accessible to a limited extent, although now they are partly flooded. A locked gate controls access to the workings, through which drains copious amounts of mine water.

In addition to the mine workings, also of mineralogical importance at this site is the fragile ferricrete (head) deposit located where the beach meets the sand-dunes, below the opencast cliff sections. Within this head deposit are abundant gossanous ore fragments, most probably representative of the gossanous zone stripped from the lode. This deposit contains a remarkable assemblage of rare and unusual iron phosphate minerals, including rockbridgeite, strengite, strunzite and beraunite (Weiss, 1989; Ryback and Tandy, 1992).

As can be seen from (Figure 7.41) several mines were situated along the Perran Iron Lode, some of which are now hidden beneath the Penhale sand-dunes. The large opencast at Treamble [SW 787 558], worked between 1937 and 1940 is now landscaped and forms part of a holiday camp. Duchy Peru [SW 797 557] and Great Retallack [SW 794 557] were famous for silver minerals, most of which came from north–south cross-course mineralization associated with galena.

There are very few direct references to the mineralization of Gravel Hill Mine, although Dines (1956), and Weiss (1989) did discuss aspects of the mineralogy. Descriptions of the mines were presented by Collins (1912), and Dines (1956). The fault along which the lode is associated was identified as being of regional significance in a structural and mineralogical interpretation by Henley (1971).

Description

The Perran Iron Lode crops out at the northern end of Perran Beach. The lode strikes almost due north-west-south-east and dips 50°SW. From Penhale it extends south-eastwards for at least 10 km, and varies in width from 1 m to 30 m. Typically it comprises brecciated slates cemented by siderite, minor quartz and masses of black sphalerite. The richness of the lode was reported as sporadic, and workings are irregular in size. It is generally believed that the sphalerite pre-dates the siderite. Surface oxidation of the siderite to depths of 60 m has produced oxides and hydrated oxides of iron (hematite, goethite and limonite). The lode was extensively worked for iron ore during the 19th century. The lode is cut in places by later north–south cross-course veins containing pyrite and some argentiferous galena. It could be that the Perran Iron Lode represents a mineralization episode pre-dating granite intrusion (Henley, 1971).

At Gravel Hill Mine the lode is proven to 60 fathoms in depth, and is split vertically into a northern branch (4 m wide) and a southern branch (12 m wide), the two being separated by an area of killas approximately 13 m wide. The cliff exposure was extensively worked by open stoping. Some 155 m to the south-east of these workings was a small but deep openwork known as 'Big Iron Pit'.

Gravel Hill Mine was first known as 'Penhale Iron Mine' (operations commenced about 1840). This working is situated in the cliff section at the north end of Perran Beach. The gossanous nature of the mineralization is clearly seen in the Gravel Hill opencast. The lode here courses E 40°S and underlies about 40°SW. In the north–south cliff-face it is seen to consist of two parts separated by 3 m of killas. The northern branch is about 4 m thick at beach level, with dean ore in the centre, but mixed with quartz veins and killas inclusions near the walls. The southern branch, up to 12 m wide, is mostly formed of limonite with siderite kernels traversed by quartz veins. A quartz-feldspar porphyry ('elvan') dyke occurs a few metres from the footwall of the lode in the cliffs, and trends north of east. The lode has been worked in the cliffs, the stopes on both branches standing as caverns, supported by ore pillars. The base of the oxidized zone is about adit-level. It is stated that at 20 fathoms below adit-level the lode is narrow and consists of fluccan (fault) clay with fragments of blende, galena and pyrite.

The adit level is driven on the northern branch of the lode, and continues 120 fathoms south-east to Borlase's Shaft. Shepherd's Shaft is situated 90 m NNW of Borlase's Shaft. Underground workings are quite extensive, with some especially large open stopes where a north–south lead lode is crossed, (see Perran Beach to Holywell Bay GCR site report, this chapter). Today, because the killas between the two lode sections is so altered and impregnated by iron oxides, it is difficult to recognize the difference between lode and killas.

Interpretation

In the Gravel Hill Mine bands of siderite are flanked by brecciated killas, cemented by quartz, other Iron oxides and some sphalerite. Where oxidation of the siderite has taken place, black, manganese-bearing minerals coat the surface of the limonite. Elsewhere on the Perran Iron Lode sulphides become more important, including chalcopyrite and argentiferous galena. Henley (1971) believed the Perran Iron Lode to occupy a major structural lineament, on either side of which contrasting fold styles could be recognized. He also suggested that movement along the fault had changed direction over time.

The ore paragenesis is still not fully understood as it is difficult to account for the abundance of siderite. Interpretations, based on the principle of mineral zonation, suggest that at depth the iron should give way to lead and zinc and eventually copper. However, there does not seem to be any evidence for this zonal pattern.

Dines (1956) proposed a temporal scheme for the Perran Iron Lode, which is essentially a low-temperature paragenesis, namely:

1. early brecciation, followed by deposition of quartz and sphalerite in some parts of the lode;
2. formation of north–south lodes and deposition of galena with associated silver minerals;
3. re-opening of the Perran Iron Lode and siderite deposition; and finally
4. further brecciation of siderite ore in some areas, and infillings of clay and sulphides in others.

Henley (1971) believed that the siderite deposition took place in a number of phases, separated by pulses of brecciation. Some of the exposed features described by Henley (1971), and which provided important information for ideas on the origin of the deposit, are now overgrown or covered by sand-dunes.

It could be that in fact calcareous solutions, rather than iron-rich solutions were introduced at a late-stage into areas of the fissure system allowing for the formation of siderite. Siderite formation could therefore have been due to a number of factors including the gossanous oxidation of original sulphides, such as pyrite and some sphalerite, alteration of replacement siderite bodies, or oxidation of an original hematite body.

The origin of the texturally variable ferricrete deposit, which occurs where the beach meets the dunes, is uncertain, but generally it is thought to be part of the gossan zone naturally stripped from the lode (although alternatively it could have been the remains of the gossan stripped before working began). It contains manganese and iron minerals, as well as a remarkable suite of rare phosphate minerals, including rockbridgeite, strengite, strunzite and beraunite. If of natural occurrence, a Pleistocene age has been suggested for its formation.

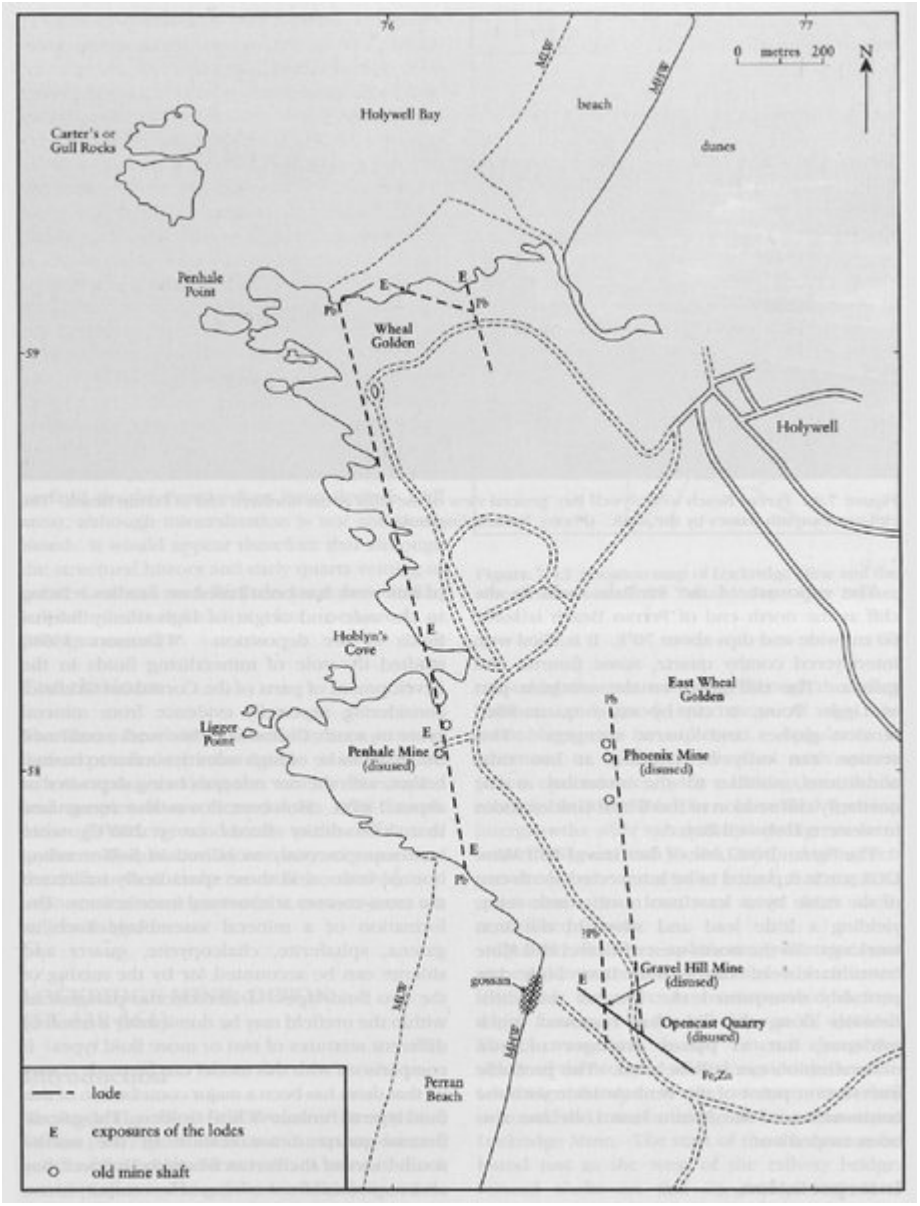
Conclusions

Gravel Hill Mine is the only working and exposure of the Perran Iron Lode now available for study. The Perran Iron Lode is one of the largest and most extensive lodes in South-west England, having been worked over a distance of 6 km and reaching a width of 30 m in places. It is further remarkable in having a north-west-south-east trend, and is generally believed to be a pre-granite vein deposit.

The beachside ferricrete deposit is of considerable mineralogical interest, containing abundant cemented gossanous ore. This fragile rock formation carries a suite of rare iron phosphate minerals, a number being only known from this locality in the British Isles.

References

(Figure 7.62) A close view of the adits in the Perran Iron Lode at Gravel Hill Mine. (Photo: Natural England.)



(Figure 7.41) Perran Beach to Holywell Bay. (E) represents exposures of the lodes within the area (Penhale Lode, Perran Iron Lode, Wheal Golden Lode and East Wheal Golden Lode).