# Ogmore Coast

[SS 871 741], [SS 885 727]

## Introduction

This critical site comprises a coastal section between Ogmore-by-Sea and the headland of Trwyn y Witch, near Southerndown (Figure 5.85), and is fully accessible only at low tide. It is of major metallogenic importance for three reasons; firstly, it is of relevance with respect to the timing of the MVT Pb-Zn-Cu-Ba mineralization of the South Wales–Mendip Orefield; secondly, the relationship of the oxide-facies Fe-Mn mineralization sporadically developed throughout the district, to the MVT mineralization is clarified; and thirdly, evidence is seen for a further, post-early Jurassic phase of metalliferous vein mineralization.

Neither lead nor iron have been worked at the Ogmore Coast GCR site: the exposure is entirely natural, occurring along a series of wave-cut platforms and cliff sections. Inland, there arc a number of largely obliterated, small, trial workings for lead in the area between the Ogmore Coast site and Bridgend, and Fe-Mn ores have been extracted at the T■ Coch Mine, near Porthcawl [SS 828 795]. The latter site is of considerable mineralogical importance due to the occurrence of the Pb and Pb-Mn vanadate minerals vanadinite and pyrobelonite (Criddle and Symes, 1977). Wulfenite has also been reported (Braithwaite and Lamb, 1986). However, there are only scattered samples of the manganese and iron ore in small remnants of tips and in farm tracks, and the site now yields little information regarding the geology of the deposit.

The importance of the Ogmore Coast GCR site was determined only recently, following mapping of the Bridgend sheet (British Geological Survey, 1990). Its importance relates to the fact that it categorically demonstrates that Pb-Ba-dominated mineralization post-dated the initial marine transgression which occurred in the area during late Triassic to early Jurassic times. Moreover, the evidence, superbly exposed in these wave-cut platforms, indicates that the mineralization occurred during the ongoing transgression, and is considered to have been exhalative into the marine environment (Fletcher, 1988).

More-recent examination of the Ogmore Coast sections (Bevins and Mason, 2000) reached broadly similar conclusions to those of Fletcher (1988) but with some additional findings. Of particular importance is evidence for the relationship between the MVT Pb-Ba mineralization and the oxide-facies iron mineralization.

In addition, further, fault-controlled Lower Jurassic-hosted vein mineralization, was discovered in 1999 at Trwyn y Witch. This mineralization, pyrite-dominated but carrying lead and zinc sulphides, is of a quite different character to the lead-barium mineralization. Its paragenetic relationship to its host structure suggests that minor metallogenic events may have affected the area as late as mid Tertiary times. The features exposed along the Ogmore Coast are therefore critical to understanding the metallogenic history of South Wales.

## Description

The section of interest at the Ogmore Coast GCR site extends for nearly 4 km south-east from Trwyn y March, near the mouth of Afon Ogwr, to Trwyn y Witch, to the south of Southerndown. Several individual features of interest are exposed along the section, which is accessible both at Ogmore-by-Sea and Dunraven Bay, although access to the central section, between Pant y Slade and Black Rocks, is affected by a considerable tidal range.

The section is entirely underlain by gently folded, fossiliferous Dinantian limestones, upon which the Mesozoic rocks lie unconformably. In places at the north-west end of the section, breccias of Triassic age represent terrestrial wadi-type deposits formed in the arid late Triassic landscape, along topographical highs of Upper Palaeozoic rocks. To the south-west, a series of early Jurassic wave-cut platforms have been eroded into the palaeo-coastline of Dinantian limestones, and the Dinantian strata are overlain by a sequence of Lower Liassic calcarenites, with a basal conglomerate. These marginal facies pass up and laterally into the more typical 'Blue Lias' facies at Southerndown, while the northern side of the prominent headland of Trwyn y Witch is the footwall of a normal fault, dropping the Lower Lias down against the Dinantian rocks, which constitute the headland.

Mineralization along the section takes a variety of forms, from what might be considered typical, Dinantian carbonate-hosted MVT veins to complex, and perhaps syn-sedimentary deposits, occurring at and just above the unconformity (Figure 5.86), and finally fault-hosted vein mineralization occurring at even higher stratigraphical levels. The mineralization is described from north-west to south-east along the section.

Along parts of the north-western end of the section, the eroded surface of the Dinantian strata is seen to be impregnated with earthy red hematite. This hematization extends down into the limestone to varying degrees but is particularly marked where it has followed Variscan joints and also where it has partially replaced calcite occurring in tension-gash sets, again interpreted as being related to Variscan deformation. In both cases, this has resulted in the formation of thin (< 1 cm), red hematite veins. In the vicinity, upper surfaces of affected limestone beds often have a bleached appearance.

The Dinantian limestones of South Wales host a number of significant hematite deposits, particularly in the Llantrisant area (see Mwyndy Mine GCR site report, this chapter), but in many exposures, both adjacent to the orebodies and in areas where no orebodies are known, their hematization, particularly along joint systems, is a notable feature. At the Ogmore Coast site, the hematized limestones and thin joint-veins of hematite are cut by clean, MVT calcite-barite-galena veins. This important relationship is discussed below in more detail.

The wadi-type deposits at the north-western end of the exposure form a chaotic ridge, approximately 60 m in width and 10–15 m in thickness, extending from the top of the low cliffs seaward across the extensive platform. The clast-supported breccia deposits consist of angular fragments of Dinantian limestone, randomly arranged and largest in the upper part, where they reach several metres across. They occupy a shallow channel, cut into the Dinantian strata, and are both cemented and veined by calcite and barite, with galena present locally. Several generations of cement minerals are discernable by careful examination (Lee, 1991). The veins cut both the breccia matrix and, in places, the clasts.

To the south-west, where Jurassic marine sedimentary rocks overlie eroded platforms of Dinantian limestones, MVT epigenetic veins, carrying calcite with barite and galena, are of frequent occurrence within the Dinantian rocks. These pass upwards into the basal Jurassic conglomerates and overlying sandstones, where the mineralization takes on a number of forms. At the unconformity, palaeokarstic fissures are common in the Dinantian limestones. They are particularly prevalent on a 100°–120° trend, along which the limestones have been dolomitized, prior to the development and infill of solution cavities. The dolomitization manifests itself as brownish zones, usually a few tens of centimetres in width. The fissures have been filled with rounded to subangular clasts of both limestone and dolomitized limestone, to depths of over 1 m in places. The same fractures have then opened up, so that veins within the Dinantian rocks pass up into mineralization occurring as cements to these palaeokarstic fissure-fills. However, the fissure-fills are not affected in their entirety; so that while some zones are severely impregnated by calcite, barite and accompanying galena, others nearby are almost devoid of minerals. Where present, the minerals occur typically as rims about the clasts.

A second set of veins, trending 040°, is also present, and exhibits similar features. These veins are relatively infrequent, but where they do occur they tend to be much wider than the abundant 100°–120° veins. Both veins, however, exhibit the same overall paragenetic sequence, comprising early, pink to pinkish-buff, fine-grained barite, which is overgrown by coarse-grained calcite, followed by bladed, white barite in large fan-like aggregates which reach several tens of centimetres in size. Galena forms euhedral, cubic crystals from a fever millimetres to 3 cm in size; locally these are aggregated together, forming relatively rich concentrations. Galena overgrows calcite and is often embedded in barite, so that it evidently precipitated at an early stage in the growth of the second generation (white) barite.

The Dinantian palaeosurface is highly bored in places. The borings, up to 7 cm deep and a few millimetres wide, are attributed to *Trypanites* and the lamellibranch *Lithophaga* sp. (Fletcher, 1988), and where not completely filled by Liassic sediment have been mineralized by coarse-grained calcite.

Further mineralization extends upward into the basal Lias, where solution cavities have formed both in the basal breccias and in the overlying strata. These features are most prevalent along the Slade Trough, between Ogmore-by-Sea and

Southerndown. This feature, described by Fletcher (1988), is a dip in the unconformity, up to 10 m deep and 200 m wide, so that the basal Lias is exposed at the present-day sea-level. Here, the basal breccias are relatively thick (up to 2 m) and are overlain by calcarenites and coquinoid limestones. Mineralization occurs in flat-lying cavities, 10–40 cm in length and width and 5–15 cm in depth. The floors of these cavities are highly embayed, while the roofs are relatively bedding-parallel. The cavity-fill consists of a lower layer of fine-grained, banded, geopetal sediment, which is capped by up to 6 cm of coarse calcite. Barite occurs firstly as a fine-grained buff-coloured cement to the geopetal sediments, and secondly as white to pink, crystalline deposits both overlying the calcite and in veinlets cutting the geopetal sediments.

To the south-east, between the beach at Dunraven Bay and the headland of Trwyn y Witch, the Lower Lias consists of the 'normal' facies of alternating limestones and dark-grey shales. Mineralization in the Lias is limited to thin, calcite-bearing joint-veins within the limestones. However, the south-eastern end of Dunraven Bay is marked by a major fault which juxtaposes 'normal' Lower Lias against the basal facies and, towards the tip of the headland, the underlying Dinantian limestones. Along the length of the fault plane, which dips steeply to the SSE, is sporadically developed vein mineralization.

The veining is up to 0.5 m in width and consists of calcite, with up to 70% pyrite. Both minerals have a shattered and re-cemented appearance, and the vein is devoid of open vugs. Galena and sphalerite both occur in trace amounts, forming thin (1 mm), but often persistent, veinlets cutting the deformed pyrite and calcite. The mineralization does not occur as a single continuous vein, but as a number of elongate boudin-like pods within the fault-gouge comprising sheared Liassic shale and limestone. In polished section, a depositional sequence of galena overgrown by pale, banded sphalerite is seen. Both galena and sphalerite enclose pyrite, but it is uncertain whether this pyrite represents a second generation or merely represents cataclastic pyrite debris overgrown by the lead-zinc sulphides.

## Interpretation

The fact that MVT calcite-barite-galena veins cut hematized Dinantian limestones and also thin joint-veins of hematite is of critical importance in understanding the pattern of metallogenesis in South Wales. It is highly likely that this hematization represents the regional oxide-facies iron mineralization present in the Dinantian limestones in the Bridgend–Porthcawl district, and that therefore the oxide-facies mineralization pre-dates the MVT Pb-Ba mineralization of the South Wales Orefield. The age of hematization is constrained by the fact that it is cut by MVT veins which are of early Jurassic age, based on the relationship between the MVT mineralization and the lowermost Jurassic strata. This suggests that the hemati-zation is of Triassic age, an inference in accordance with the postulated late Triassic age for the oxide-facies iron mineralization (Rankin and Criddle, 1985). These observations therefore are of importance in the interpretation of the genesis of the iron ores, as discussed in the Mwyndy Mine GCR site report, and serve to support the conclusions presented.

The age of the MVT mineralization itself is constrained by the fact that it is restricted to the marginal facies of the basal Lias, and is certainly not seen in the 'normal' Lias at Southerndown. The textures of the mineralization led Fletcher (1988) to conclude that it was deposited from fluids exhaled into the marginal Liassic sediments near to surface, the cooling of the fluids causing galena and barite to precipitate from solution. The exact timing is unclear, but the fact that this mineralization is restricted to the basal Lias around topographical highs of Dinantian limestone and is not present in higher beds is supportive of an early Jurassic age. As a rule, exhalative mineralization is developed when hydrothermal fluids discharge onto the seafloor, forming stratiform, often bedded, mineral deposits. However, evidence for this type of mineralization in the Upper Triassic-Lower Jurassic strata of South Wales is scant; the only documented occurrence is in Rhaetian black-shales exposed along the disused railway cutting, *c.* 1 km to the south-east of Cowbridge, where galena crystals (or cerussite-bearing cavities thereafter) have been recorded scattered through the rock (Willey, 1970). Given the amount of galena and barite exposed along the Ogmore Coast section, one might expect true sedimentary exhalative Pb-Ba mineralization to be of more widespread occurrence in the South Wales area. Perhaps the rate of sedimentation was too great to permit the concentration of these minerals in recognizable amounts, except during occasional periods when euxinic environments with low sediment input prevailed, resulting in lithologies like the Rhaetian black-shales described by Willey (1970).

The Pb-Ba mineralization occurring in karstic fissures in the Dinantian limestones, which are filled by Lower Jurassic conglomerates, is epigenetic with respect to the conglomerates, since the fissures have clearly re-opened to an extent in places. Furthermore, in some fissures only a part of the conglomerates have been mineralized along a clear line of pervasive microfracturing, which has permitted the fluids to deposit minerals around the conglomerate clasts. Wider zones of mineralization in the same fissures reveal crustiform deposition of calcite, barite and galena in open zones between walls of re-cemented conglomerate.

The cavity-fill structures of early Lower Jurassic age were formed when hydrothermal solutions entered solution cavities floored with geopetal sediment, the replacement of the latter by barite possibly being of metasomatic origin. Again, there are epigenetic features present, such as the development of crystalline barite in thin, cross-cutting veins that traversed the geopetal sediment.

Exposures in the north-western part of the section show that the mineralization was at least partly epigenetic with respect to the Triassic breccias, for some veins cut straight through clasts in the breccias. However, the cement-like calcite-barite developed locally could either be very early (diagenetic) or alternatively be an epigenetic filling of voids within these highly permeable, clast-supported deposits.

The veining along the fault at Trwyn y Witch is clearly younger than the unconformity-related deposits at the Ogmore Coast site, since it occurs at much higher horizons in the Lower Lias. Additionally, it is wholly different in character, not only since it occurs on a major fault-fracture but also since it consists largely of pyrite-calcite; barite is absent, while galena and sphalerite occur only in minor cross-cutting veinlets.

The deformation of this mineralization into a series of pods within the gouge of the fault zone suggests that it pre-dates the main movement on the fault, which is a re-activated Variscan fracture (Perkins *et al.,* 1979). The deformation is intense and includes the cataclasis of pyrite and recrystallization of calcite; the minor Pb-Zn sulphide veinlets cut the deformed minerals. The fault has an apparent polyphase history of activity; its SSE dip, but with older rocks in the hangingwall, shows that the final movement was reverse in nature, a movement consistent with compressive stresses acting from south to north and probably connected to the Alpine Orogeny of Miocene age. Such reversed movement would better explain the intensity of the pyrite-calcite deformation, and would suggest that the pyrite-calcite mineralization is post-Liassic/pre-Miocene in age, while the cross-cutting galena and sphalerite veinlets represent a still younger, if minor, phase of metallic mineralization.

Fault-controlled rifting along ENE–WSW-trending fractures was associated with the development of the Mesozoic Bristol Channel Basin (Nemcock and Gayer, 1996). The basin was initiated during Permo-Triassic times and rifting then occurred episodically through to early Cretaceous times, with the accumulation of 1–2 km of shallow-water calcareous marine sediments (Nemcock *et al.,* 1995). Inversion of the basin occurred in early Tertiary times, and much of the Mesozoic sequence was then eroded away onshore, leaving only Triassic and Lower Jurassic rocks exposed.

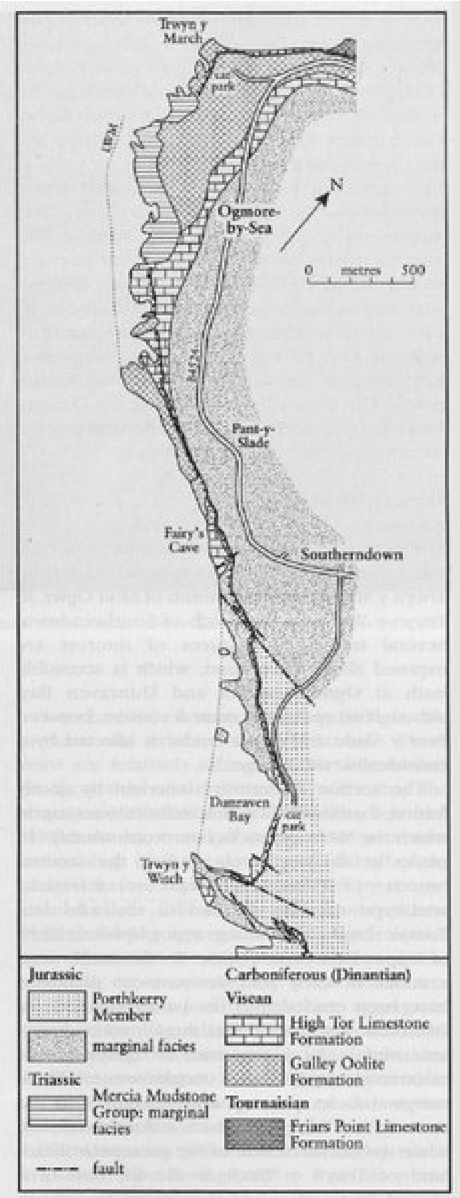
The fault at Trwyn y Witch is interpreted as being active during the extensional phase of basin development (Nemcock and Gayer, 1995), and was probably active then as a normal fault, the later reverse movements being due to Alpine compressive-related re-activation. Nemcock and Gayer (1995) modelled palaeostresses within this basin, and concluded that the main post-Triassic rifting phase commenced towards the end of the Pliensbachian (Middle Liassic), after 600 m of Liassic sediments had been deposited. This conclusion tends to suggest that the pyrite-calcite vein was emplaced at some point between the end of the Pliensbachian and the Aptian (Lower Cretaceous), when rifting ceased.

MVT mineralization is a potential effect of any sedimentary basin development, particularly where such development is controlled by extensional tectonics and marginal normal faulting. The pyrite and calcite were probablysourced from the pyritic shales and limestones which constitute the Lower Jurassic sequence in this area, away from marginal zones. The source of the minor galena and sphalerite veinlets is, however, more enigmatic.

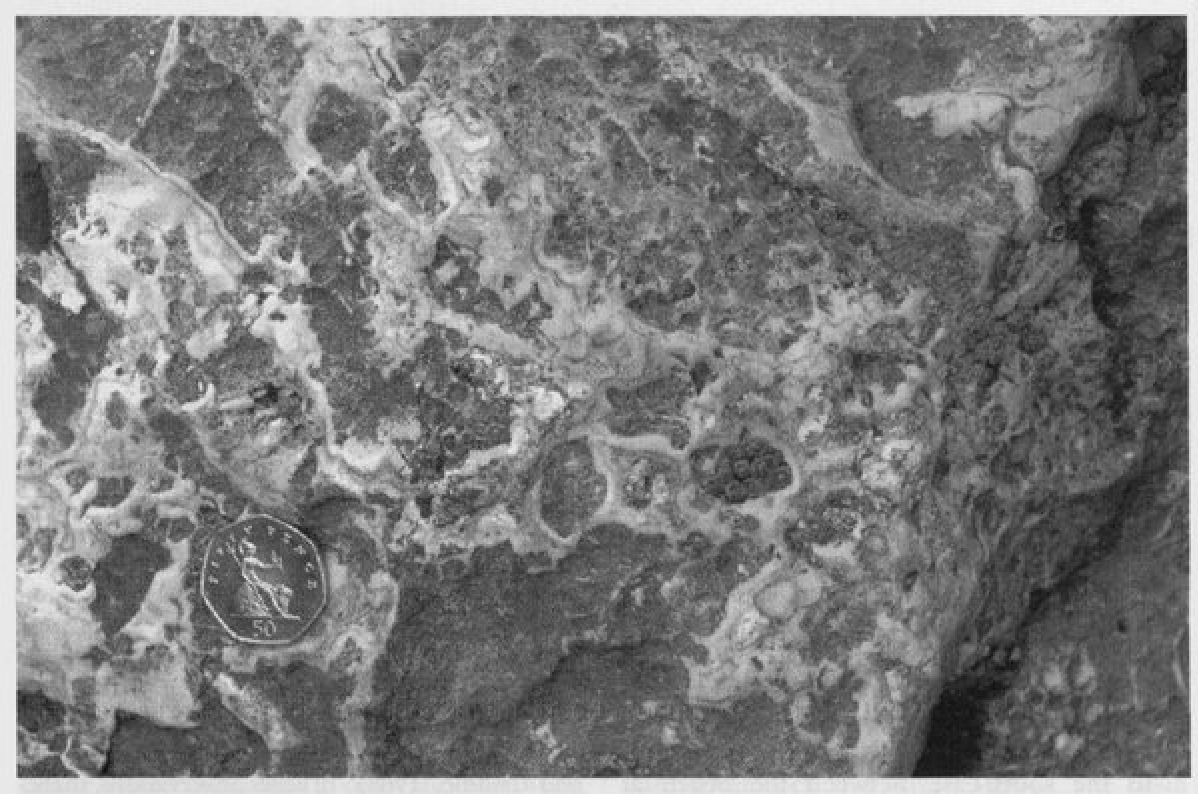
## Conclusions

The excellent exposures in the Ogmore-by-Sea to Trwyn y Witch coastal section present documentary evidence for the sequence of metallogenesis in South Wales. Initially, Triassic subaerial weathering and leaching of iron from red-beds resulted in minor amounts of hematite, occurring as joint veins and as hematized zones in Dinantian limestones. Later, as basin development progressed in the Bristol Channel area, MVT fluids invaded the Dinantian limestones, Triassic breccias and the overlying marginal Liassic sediments, to deposit abundant calcite, barite and galena in veins and cavity-fillings. Basin-related extension caused the re-activation of Variscan fractures in early Jurassic times, with the emplacement of vein pyrite-calcite at Trwyn y Witch. This fault was re-activated once again during Alpine Earth movements in Tertiary times, moving in a reverse sense and deforming the calcite and pyrite, which were later cross-cut by minor galena and sphalerite veinlets.

**References**




*(Figure 5.85) Map of the Ogmore Coast GCR site. After Wilson et al. (1990).*



*(Figure 5.86) Photograph of calcite, barite and galena mineralization in Lower Lias strata at the Ogmore Coast GCR site. (Photo: S.R. Howe.)*