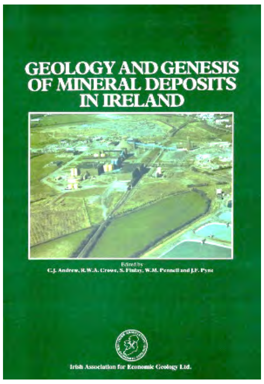

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The geological setting and mineralization of the Carrickittle prospect, County Limerick, Ireland.

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Abstract

Stream sediment and soil sampling in 1965 led to the discovery of lead-zinc-pyrite mineralization near Carrickittle, County Limerick, at the base of the Waulsortian Reef Limestone. Induced Polarization surveys were successful in locating extensions of the mineralization. Weak mineralization occurs as disseminations in the matrix, and also in calcite veinlets, in both dolomitized and undolomitized Reef micrite. Massive mineralization occurs in large calcite veins and in breccia cavities; these cavities have been produced by stylolitization and dolomitization during diagenesis.

Intrusive trachyte sills, related to the East Limerick Volcanic Centre, of Viseán age, are commonly found in the part of the succession drilled; the sills are essentially unmineralized, and are believed to post-date the mineralization.

Introduction

The Carrickittle prospect occurs in eastern County Limerick, 25km SE of Limerick City. The area of the prospect comprises undulating pasture land drained by sluggish, westerly-flowing streams.

The area was selected for exploration by Tara Exploration and Development Company Limited as it has Carboniferous limestone in close proximity to volcanic rocks, considered to have a possible genetic relation to potential mineralization. A stream sediment survey located a strong Pb-Zn anomaly at Carrickittle, which was further defined by a subsequent soil survey and pitting. Various follow-up geophysical techniques were employed, including airborne Input EM and ground EM, magnetic, gravity and IP surveying. Diamond drilling was targeted essentially on the geochemical anomalies, but also to a minor extent on the IP anomalies. A total of 17 out of 33 holes intersected significant galena-sphalerite mineralization and although the intersections averaged 3m of 6%Zn/1.5%Pb, the discontinous style of mineralization indicates that possible tonnages of only tens of thousands of tonnes can be inferred.

Stratigraphy

The general geological plan of the prospect area is shown in Figure 1 and the stratigraphic column and correlation are presented in Figure 2. The prospect lies on the southern flank of the Pallas Grean syncline, an elongated basin of Lower Carboniferous volcanics and carbonate sediments with a 20km long axis; bedding in the prospect area dips uniformly northwards at about 10°.

The oldest beds intersected in the drilling belong to the upper part of the Lower Muddy Limestone Unit, equivalent to the Upper Pale Limestone of Gortdrum and to the Ballysteen Limestone. This comprises dark argillaceous bioclastic calcarenites containing abundant crinoids, with subsidiary lamellibranchs and coral debris. The calcarenites are interbedded with black shales, and chert bands appear at the top of the Unit. The overlying Transition Unit, an intermediate and variable zone underlying the Reef proper, comprises dark calcilutites with minor shaley films, thin cherts and local Reef-type micrites. The Unit varies from 15-60m in thickness, possibly as a result of facies changes, and this renders exact definition of the Reef base in the prospect area problematical.

The Waulsortian Reef Complex consists of pale grey, clean micritic calcilutite with stromatactis development and stylolitic sutures — the latter occasionally associated with zones of solution collapse breccias. Fenestellid bryozoa and brachiopods are common, with occasional layers of coarse crinoid debris. Dips in the Reef are erratic and occasionally high, reflecting the variable bed attitudes in local Reef knolls. The Reef is erratically dolomitized both laterally and vertically, and this varies from a complete absence of dolomitization to hundreds of metres of vertical succession being completely altered. Some of the dolomitization is close to faulting and may be fault-related. As dolomitization of limestone results in a considerable volume loss, there is a marked increase in porosity by way of recrystallization, cavity development and collapse brecciation. The dolomitization is thus considered to be a secondary alteration.

Directly overlying the Reef is the Upper Cherty Limestone Unit, which is comprised of well-bedded dark, bioclastic crinoidal calcarenites with thin shale bands, and a strong development of black nodular chert.

The overlying Lower Volcanic Group, which outcrops mainly to the north of the prospect, commences as a series of submarine and subaerial tuffs, basaltic flows, and agglomeratic vent-fill (Strogen, 1977). Associated trachytic intrusives are widespread, and occur as a series of sills which outcrop immediately south of the prospect. Similar sills were located within a range of carbonate hosts during drilling, with approximately 50% of the drill holes intersecting intrusives. The intrusives are red-brown trachytes or chloritized basic intrusives, occurring in bodies varying from less than 1cm to over 30m in thickness. The contacts between the intrusive rocks and the limestone can be sharp, or may be marked by breccia zones caused by the intrusion (Tyler, 1979; Steed, this volume). The intrusives frequently occur along planes of weakness such as stylolites or lithological or mineralization contacts.

Structure

Faulting in the area is not significant and there is no evidence of any large-scale NE faulting as is commonly found proximally to ore deposits in the Carboniferous in Ireland. Minor normal faults which have been mapped along the base of the Reef have, in part, been based on apparent displacements in the trachyte intrusives, and these displacements have been extrapolated into the limestones. Such apparent displacements might also be explained by facies changes, or by a result of difficulties in correlating the exact Reef base. Correlation of drill hole sequences also indicates that only minor faulting is present. Airborne magnetic data from the Geological Survey of Ireland suggest that NW faults cut the Pallas Grean volcanic syncline, and these may extend southeastwards into the carbonates.

Mineralization

The mineralization consists of pyrite, sphalerite and galena (with minor chalcopyrite and marcasite) and displays two styles. These styles are expressions of the same process, but they have a marked effect on the grades of mineralization.

(a) Disseminated and stringer mineralization

In this style, the mineralization is in disseminated form, and consists of fine- to medium-grained, crystalline, light to dark brown sphalerite, medium-grained crystalline galena and aggregates of fine-grained pyrite. These minerals occur separately, or as intergrowths. In either case, the mineralization occurs in the matrix of both dolomitized and undolomitized Reef micrite. In some instances mineralization, which is commonly associated with coarse-grained calcite, fills, or partly fills, intergrain spaces and minor cavities. The mineralization is also developed along stylolites and, to a lesser extent, in associated collapse breccias. In addition, the sphalerite, galena and pyrite occur, separately or together, in subvertical calcite veinlets (typically 1 to 5mm wide), which occur mainly in the Reef and to a lesser extent in the underlying Lower Muddy Limestone Unit. The veinlets pre-date and post-date the stylolites and have probably developed over a long period of time. This style of mineralization grades up to 4% combined Pb/Zn.

(b) Massive mineralization

The massive style of mineralization occurs in both dolomitized and undolomitized Reef micrite. It may occur in wide veins of coarse-grained sparry calcite. Within the veins replacement textures occur: sparry calcite encloses remnant fragments of micrite, some of which display embayed margins.

Where the host rock is dolomitized, vugs and breccias produced by the dolomitization may be partially or completely infilled by massive mineralization; the mineralization frequently shows a depositional sequence of marginal pyrite followed by sphalerite and minor galena, to a central final infill of calcite. The sphalerite normally displays colloform banding. This style of mineralization may contain up to 35% combined Pb/Zn over 2m intersections.

The trace elements associated with the base metal mineralization were studied by Russell (1972). In 56 samples taken from drill core and from outcrop in the general area, he found no enrichment of Ba, Sr, Rb, Ni, Hg or Fe, and no halo effect for Cu, Pb or Zn. He did, however, note a tendency for Mn to be enhanced erratically outside the main zone of mineralization, although this was based on a limited number of samples.

Galena and sphalerite are not common in the volcanic intrusives, even where the intrusives occur adjacent to massive-type mineralization in the Reef. Rarely they occur as disseminations or in calcite veinlets. These observations were substantiated by numerous analyses of intrusives both by the company and by Russell (1972). Pyrite, on the other hand, is common in the intrusives and is present in disseminated form in calcite-filled amygdales and late-stage calcite veinlets. Chalcopyrite occurs rarely.

Certain parts of the Reef limestone, especially where dolomitized, show a strong local red-brown discolouration. This is due to late-stage oxidation which was probably caused by circulating ground water converting pyrite to haematite-limonite.

Genesis of mineralization

Significant sphalerite-galena-pyrite mineralization occurs sporadically over a strike length of 15km along the base of the Reef Complex around the eastern and southern margin of the Pallas Grean volcanics. It does not appear to be related to major faulting.

At Carrickittle, following deposition of the carbonate sediments, partial consolidation resulted in the formation of stylolitic sutures and related solution collapse breccias. At a later stage in the diagenesis, erratic dolomitization of the Reef limestones locally produced hundreds of metres of dolomitized limestone. This dolomite displays porous, coarse-grained, recrystallized textures with numerous vuggy cavities.

The emplacement of the base metal mineralization followed both the stylolite development and the dolomitization. In the unaltered micrite, mineralization is found disseminated in the matrix, in stylolitic collapse breccias and in high-angled calcite veinlets which occasionally extend down into the Lower Muddy Limestone Unit. Where massive, the mineralization shows a sequential crystallization of pyrite, galena, sphalerite and calcite. The mineralization is clearly epigenetic in style, although the origin of the metals is not known. The metals may have been remobilized from a synsedimentary sulphide source. Subsequent to mineralization, trachytic to basic volcanics, some of which contain pyrite, have intruded the carbonate rocks following planes of weakness which include lithological contacts, stylolites, or contacts of mineralization. Locally, the intrusives have picked up minor sphalerite-galena mineralization which appears both in the matrix of the volcanics and in late-stage cross-cutting, calcite veinlets.

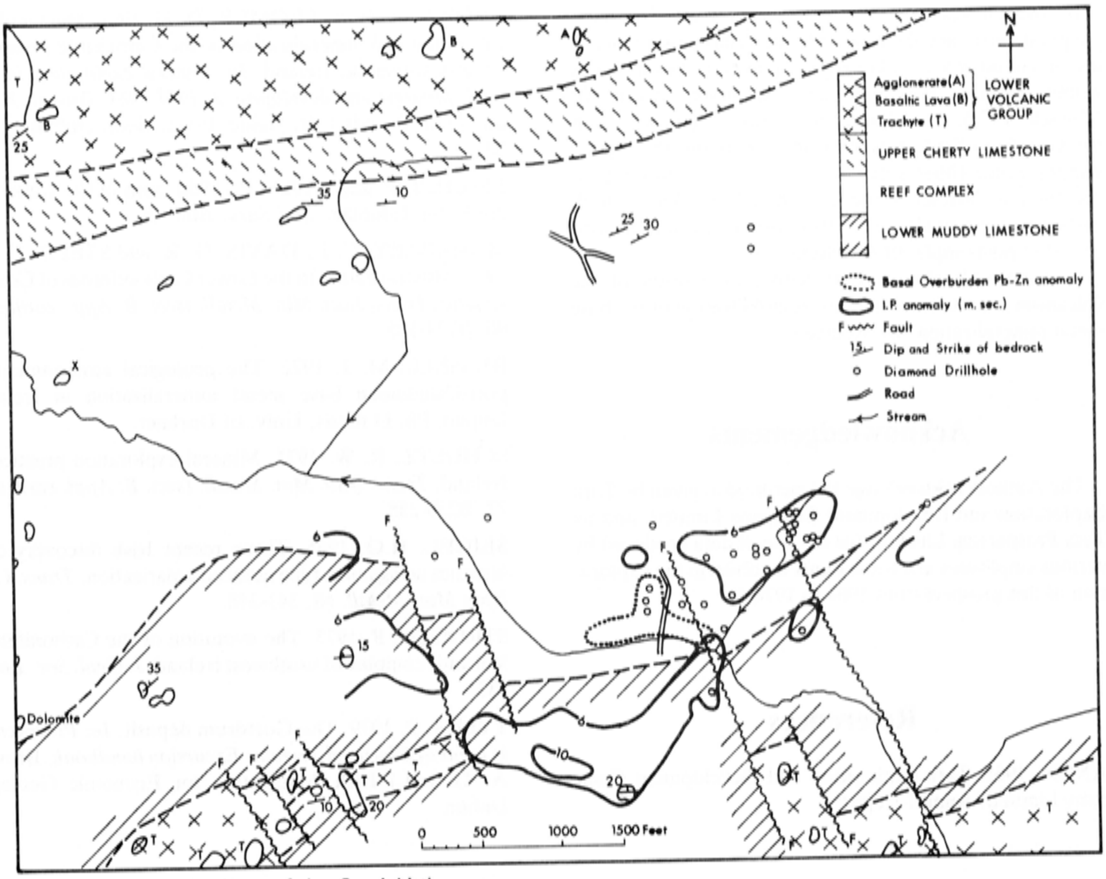

Figure 1. Geology of the Carrickittle area.

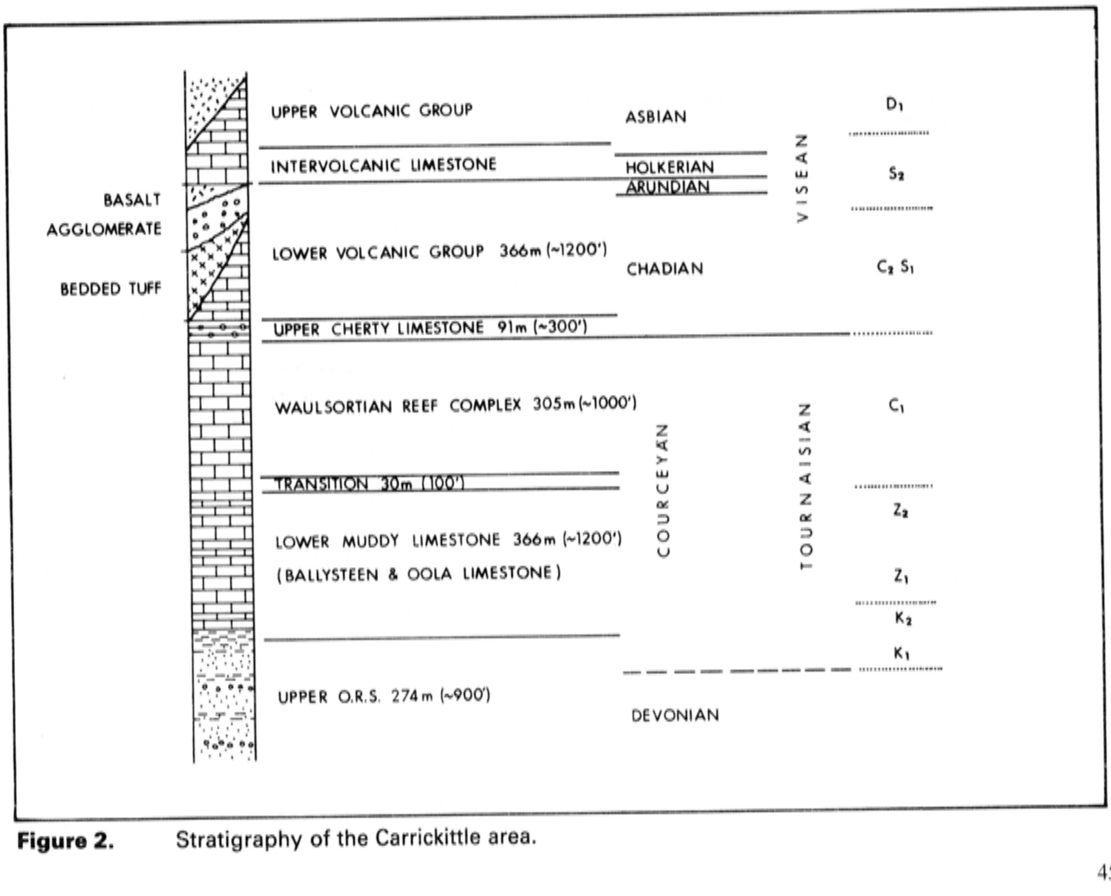

Figure 2. Stratigraphy of the Carrickittle area.

Intrusive dykes and plugs, which occur in the Gortdrum copper deposit, are also related to the Pallas Grean volcanics (Steed, this vol.). At Gortdrum, however, the intrusives exhibit intense alteration and carbonate enrichment (Russell, 1972). In addition, the intrusives pre-date both the Gortdrum Fault system (Tyler, 1979) and the copper mineralization (Morrissey et al., 1971; Steed, this vol.). In contrast, at Carrickittle the intrusives do not have a high carbonate content (Russell, 1973) and have not been subjected to post-emplacement alteration.

It is probable that at Carrickittle, as a result of the volcanism, only local and minor remobilization of the base metal mineralization has occurred.

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