THE GEOLOGY OF THE ENDEAVOR MINE: AN UPDATE

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Introduction

The Endeavor zinc-lead-silver mine is located 43km NNW of Cobar. The mine contains two styles of mineralisation: above about 900m depth an irregular sub-vertical sheet is hosted by a turbidite sequence and broadly coincides with an anticline axial plane; at the bottom of this sheet mineralisation bifurcates into grossly concordant zones. These concordant zones are hosted by a shale-rich sequence and underlying limestone.

This paper updates the geology of the mine in light of recent compilations and newly collected data on deeper-seated mineralisation.

History

The Electrolytic Zinc Company of Australasia Ltd discovered the orebody in 1973. Initially a bullseye anomaly was identified in an aeromagnetic survey. Follow-up auger sampling outlined a base metal soil anomaly prior to diamond drilling intersecting ore in 1974 (Schmidt 1989). Mine production from what was initially known as the Elura orebody began in 1983. In 1998 drilling beneath the mine at over 1000m below the surface intersected mineralisation close to the contact with limestone, which until that time, was not recognised as occurring in the mine area.

The current owners of the mine, CBH Resources Ltd, purchased the mine in 2003. Production is ramping up to a rate of 1.4MT per annum. At June 2005 the Endeavor Mine Resources totalled 17.7MT at 4.9%Pb, 8.7%Zn and 69g/tAg and Reserves 11MT at 4.5%Pb, 7.9%Zn and 66g/tAg. Mine production totals about 24MT.

Regional Geology

The Endeavor mineralisation is contained within the Cobar Basin, which is in turn part of the Lachlan Fold Belt. Basement rocks include Ordovician sediments and Silurian granitic rocks. The basin contains mainly siliciclastic sediments with minor volcanic rocks and carbonates. Sedimentation continued from the Late Silurian until the Early Devonian. Polymetallic mineralisation within the Cobar Basin is thought to have coincided with a period of basin compression and folding (Lawrie and Hinman 1998). The mineralisation is largely discordant and vein or replacement in form. It is associated with silicic, carbonate and chlorite alteration. Most of the major known mineral deposits, including Endeavor, CSA, Peak and Hera are located along a linear structural corridor at least 200km in length (Figure 1). All of these major deposits are located adjacent to protrusions of basement into the Cobar Basin associated with gravity low anomalies. Most mineralisation is hosted by siliclastic marine turbidites.

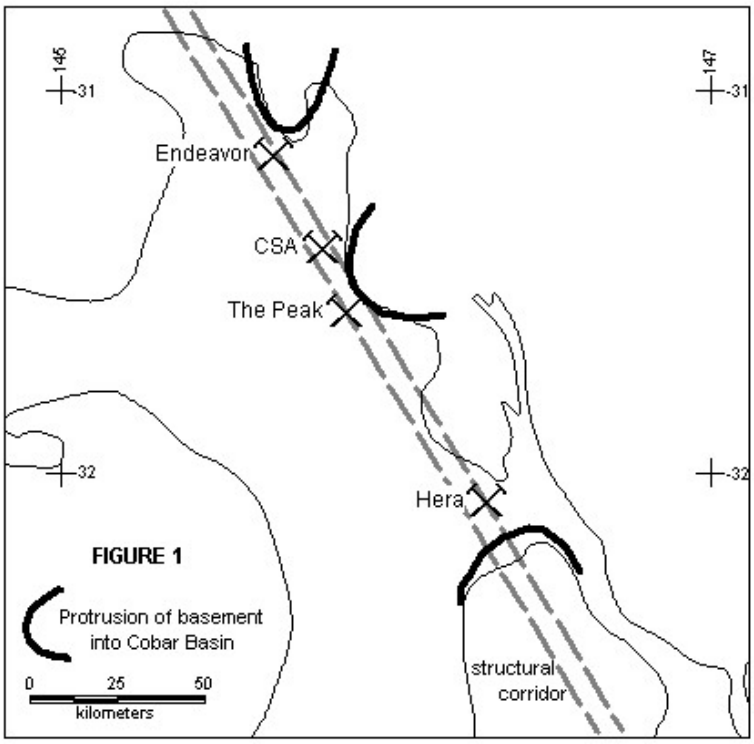

Figure 1: Structural corridor connecting Endeavor, CSA, The Peak and Hera Mines

Stratigraphy

The host rocks at Endeavor consist of a limestone breccia overlain by a turbidite sequence of interbedded shale and sandstone/siltstone. Although the carbonate rocks have been interpreted as belonging to the Brookong Formation of the Kopyje Group (David et al 2000) and the turbidites are thought to be lithologically equivalent of the CSA Siltstone (Schmidt 1989), the regional correlatives of these rocks are uncertain.

The limestone at Endeavor is generally a clast-supported breccia. Fragments are 5 to over 40mm in diameter and are composed of crystalline limestone, crinoid stems, coral and shale.

The sandstone/siltstone beds within the turbidite sequence are 2mm to 1m thick and are generally graded. Laminations and cross bedding are common. Interbedded shale is dark grey and massive to laminated in texture. Minor tuff beds are pale green and 2 to 10cm in thickness. The turbidite sequence is over 1200m in thickness. Generally, this sequence contains approximately 20 to 40 percent sandy/silty beds and 60 to 80 percent shale. Two shale-rich units can be recognised within the turbidite sequence. The Lower Shale is about 200m above the limestone contact and the Upper Shale 700m. Both units are approximately 50m thick and contain less than about 15 percent sand/silt. The contact between the limestone and turbidites is grossly conformable. A transitional unit of about 100m thickness contains black shale with fossiliferous and sandstone-rich beds.

Structure

The general dip of the rocks in the mine area is about 20 degrees to the SW. Several open folds have sub-vertical axial planes that strike NNW. A slaty cleavage sub-parallels the fold axial planes. Folding within about 10m of massive mineralisation is often tight. Fold axial planes deviate from the regional orientation where they sub-parallel the boundaries of apophyses of massive mineralisation.

A number of different fault sets occur in the mine area. All sets are filled with variable amounts of quartz, chlorite, siderite and graphite. Concordant structures are probably the earliest structures in the mine area. These are possibly filled with the thickest veins adjacent to the limestone contact and around anticline axes. A later set of faults and shears parallel the cleavage and axial plane. Steeply dipping, N and NNE faults in turn cut these. These have apparently mainly vertical displacements of up to 50m.

Mineralisation

High-grade massive sulphide mineralisation at Endeavor is enveloped by sulphide stringers, which are in turn enveloped by siderite alteration. The halo of siderite alteration extends for several tens of metres away from sulphide mineralisation and consists of 1 to 2mm diameter clots that preferentially replace sandy beds. Chloritic alteration also occurs.

Above about 900m depth the sulphide stringers form a large continuous lens or sheet which lies in an anticline axial plane. This lens ranges in thickness from 15 to 120m, extends from the surface to 900m at the S end of the mine, and has a strike length of at least 800m. At about 900m depth the mineralisation bifurcates into grossly concordant zones that dip down both the anticline limbs (Figure 2). The body of low-grade sulphides is open along strike in both directions (Figure 3) and down dip on both limbs. Sulphide minerals form two textures within the stringer zone. Stringers of sulphide generally sub-parallel slaty cleavage in the axial plane zone. The stringers are 5mm to 2m thick and mainly consist of pyrite, sphalerite, galena and chalcopyrite. Siliceous alteration sometimes accompanies the sulphide stringers, particularly in the upper parts of the mine. Similar stringers parallel to cleavage also occur in the concordant zones. However, in addition pyrite and base metal sulphides form conformable sulphide blebs that generally replace sandstone/siltstone beds and laminae. These blebs are preferentially distributed close to the cleavage-parallel stringers.

In the axial plane zone, high-grade massive sulphide mineralisation forms lenses within the stringer mineralisation. The steeply dipping N and NNW faults offset what was originally a semi-continuous body (Figure 3). In addition, steep pipe-like thickenings occur within the lenses. The largest of these, the Main Lode, has a diameter of up to 120m and a plunge length of almost 1000m. The massive sulphide lenses have a core consisting of pyrrhotite, sphalerite, pyrite and galena. More pyrite-rich material generally envelops the pyrrhotite-rich core zones. Sulphide textures are both massive and banded. Sulphide banding generally parallels the boundaries of the sulphide lenses and pipes.

Within the axial plane zone, sulphide mineralisation generally appears to be more intense within more sandstone/siltstone-rich sections of the sequence. In long section (Figure 4), it appears the massive axial plane mineralisation lenses out into stringers on the contact with the Lower Shale. Similarly, although not well defined, the Northern Pods appear to thin and lens out upwards on the contact with the Upper Shale. Within the Main Lode, the pyrrhotite core thins within the Upper Shale.

The composition of mineralisation changes vertically and laterally in the mine area. Within the axial plane zone, silver is concentrated in the upper and lateral sections of the high-grade massive lens, probably mainly within sulphosalt minerals. Grades of 300 to 1000 g/t are found compared with an average mine grade of about 70 g/t. Copper is concentrated at the base of the massive axial plane lenses within the centre of the pipe-like thickenings. Grades of over 4 percent are attained compared with an average mine grade of 0.2 percent. Lead and zinc are highest grade within the pyrrhotite cores of massive lenses.

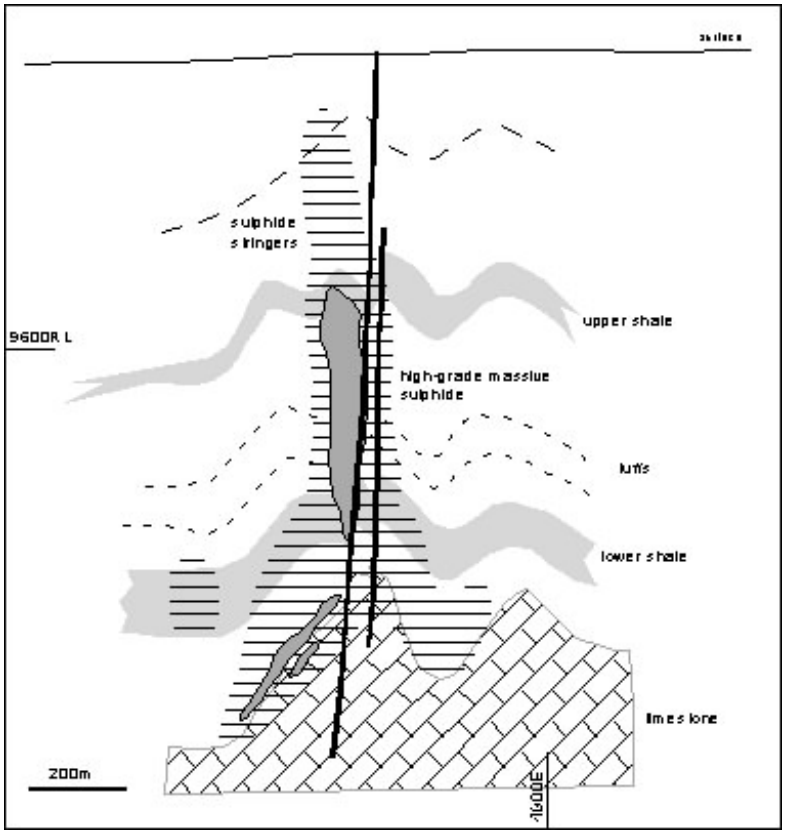

Figure 2: Cross section at 7000N, showing how the mineralisation bifurcates into two concordant zones that dip down both anticline limbs.

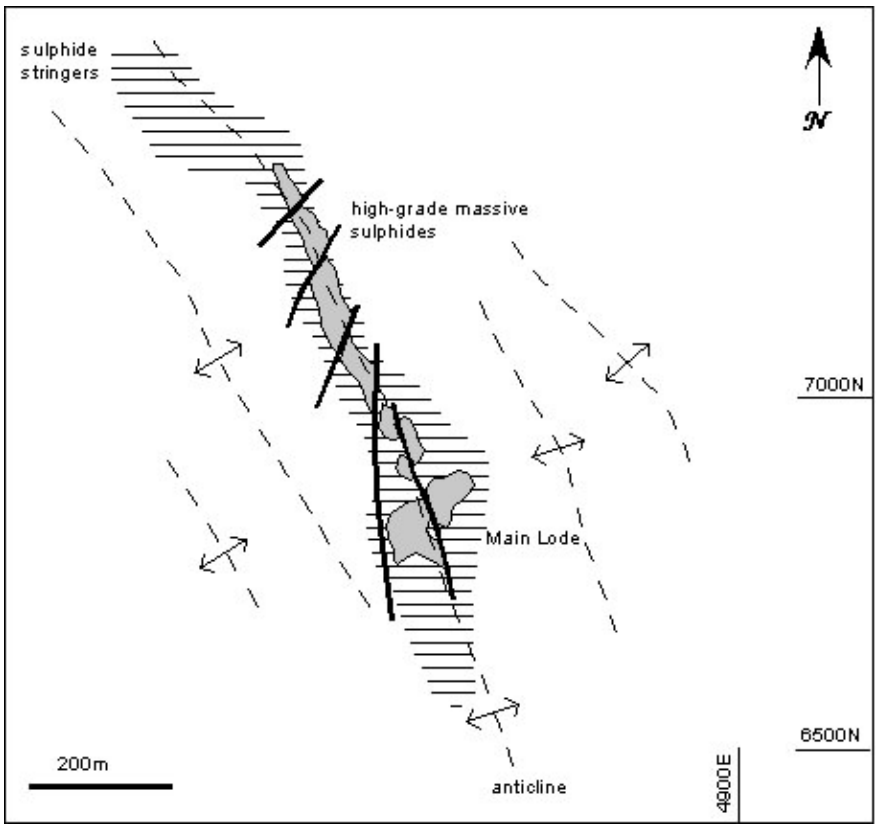

Figure 3: Plan view at 9400RL of the Endeavor Ore Body surrounded by a halo of low-grade sulphide stringers which is open along strike.

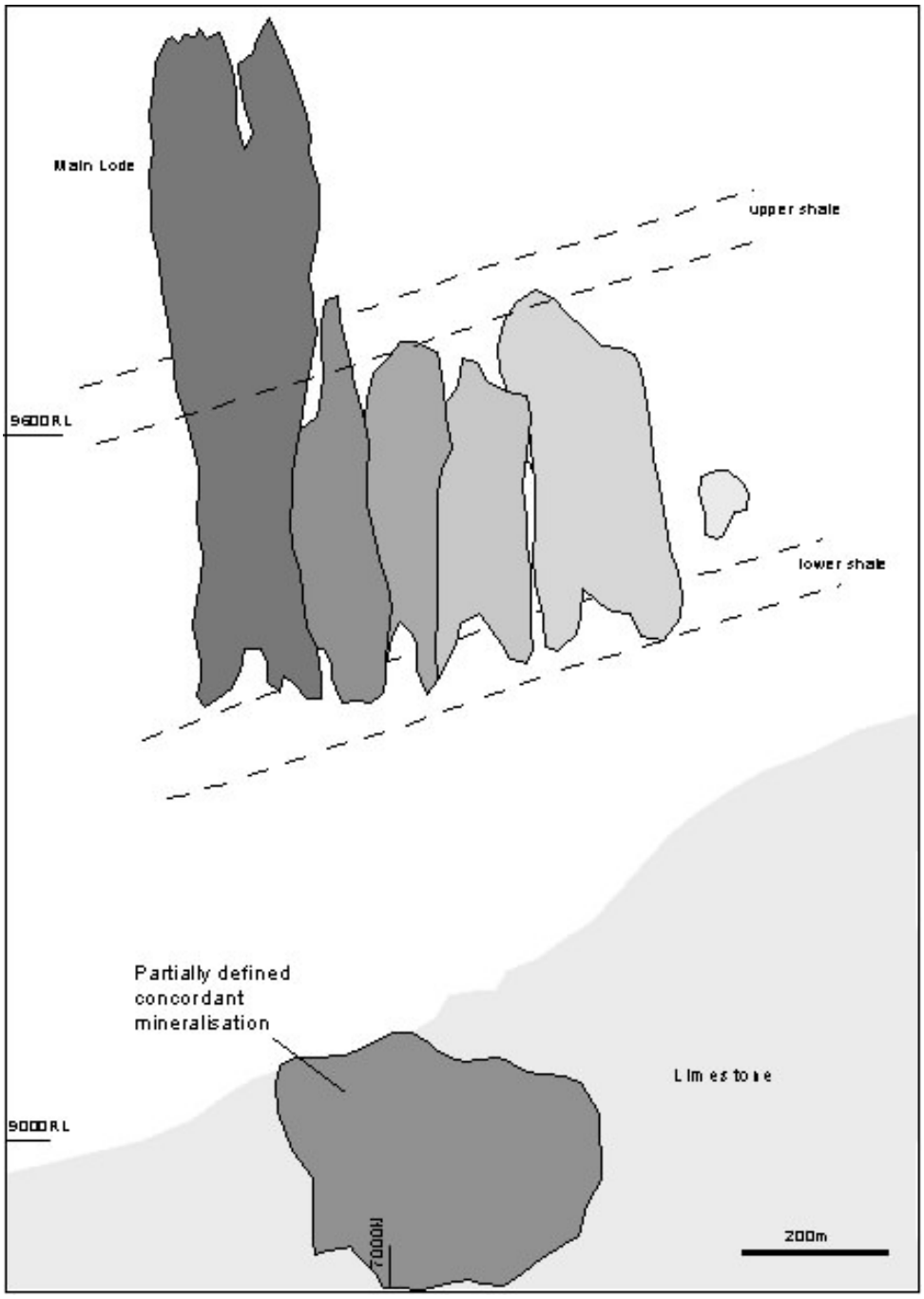

Figure 4: Long section of the ore body with schematic upper and lower shale units and limestone including concordant mineralisation adjacent to the limestone contact.

Exploration

For much of the mine's life, the grades within the stringer zone were sub-economic (less than 10 percent combined Pb and Zn). High metal prices have led to the current investigation into the economics of mining portions of the stringer zone.

Massive sulphide mineralisation has been intersected adjacent to the limestone contact within an envelope of concordant stringers. Due to the relative location of underground workings to the east and up-dip from this mineralisation, previous drilling has not been able to define its thickness and extent. Current drilling is targeting this mineralisation by deep surface drill holes from the west.

Several zones of massive axial plane mineralisation are yet to be closed off. Lenses to the north in particular remain open and are untested by drilling. Stringer mineralisation is open along strike in both directions and down dip on both limbs. These extensive zones are planned to be tested by drilling and an Electro-Magnetic survey using large underground loops and down-hole probes.

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References

David, V., Leevers, P. and Lorrigan, A., 2000, A new look at Elura deposit, NSW. Unpublished report

Lawrie, K.C. and Hinman, M.C., 1998, Cobar-Style Polymetallic Au-Cu-Ag-Pb-Zn deposits. AGSO Jour Aust Geol & Geophys, 17(4), 169-187

Schmidt, D.L., 1989, Elura Zinc-Lead-Silver Mine Cobar. Geol. Soc. Aust. Cobar Field Meeting Oct 6-8, 1989

Webster, A.E. and Lutherborrow, C., 1998, Elura zinc-lead-silver deposit, Cobar. In Geology of Australian and Papua New Guinea Mineral Deposits (Eds: D.A. Berkman and D.H. MacKenzie). 587-592 The Aus IMM Melbourne