

NEW COBAR Cu-Au DEPOSIT, COBAR GOLDFIELD, NEW SOUTH WALES

K.G. McQueen¹, K.M. Scott² and P.A. Leah³

¹CRC LEME, Australian National University, Canberra, ACT 0200

²CRC LEME, CSIRO Exploration and Mining, P. O. Box 136, North Ryde, NSW 1670

³DWLBC-Murray Bridge, PO Box 390 (DX 51203), Murray Bridge SA 5253

LOCATION

The New Cobar deposit is approximately 2.5 km SE of Cobar (Figure 1 inset) at 145°51'19"E, 31°31'4"S; Cobar 1:250 000 map sheet (SH55-14).

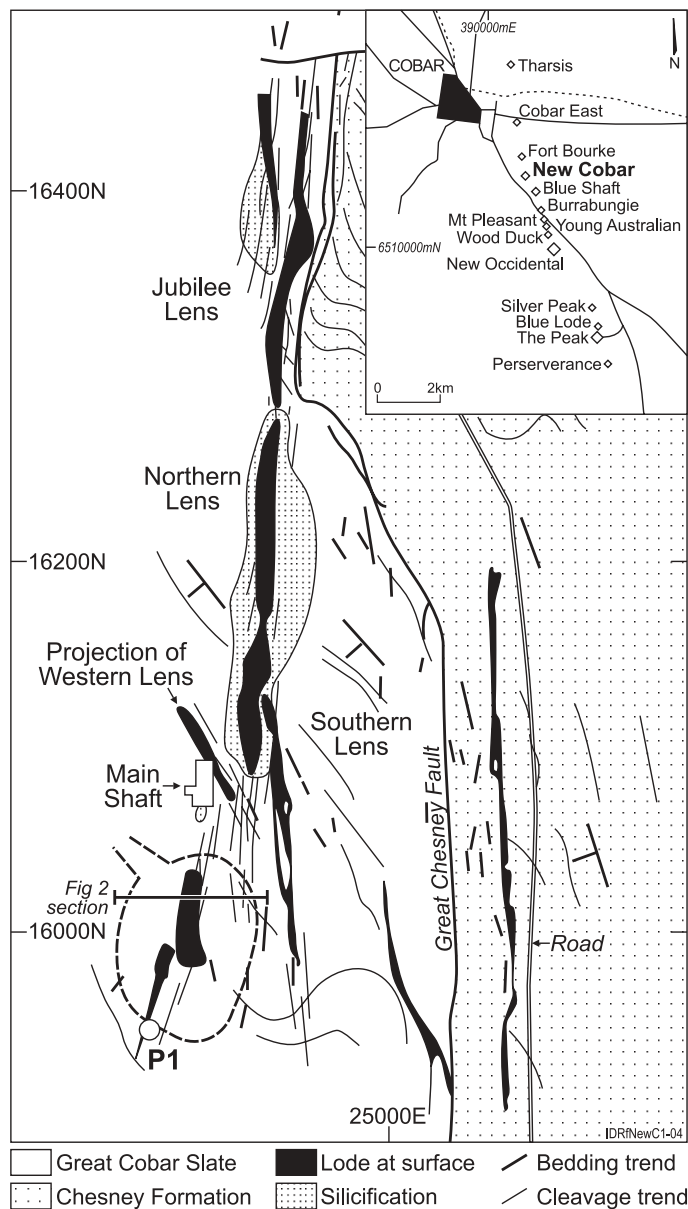


Figure 1. Plan of deposit showing geology with insert of location. Inset AMG grid; geology local grid 15°31'41" W of AMG. P1 is the profile in Figure 3.

DISCOVERY HISTORY

The New Cobar deposit is exposed on Fort Bourke Hill, a prominent hill SE of the Great Cobar Cu deposit (discovered in 1870). Despite intense silicification over the hill and its proximity to the Great Cobar mineralization, because of the lack of Cu staining, Au was not recognized at Fort Bourke Hill until 1887. Free Au in oxide ore with a typical grade of 12 g/t was worked until 1897 and Au was extracted from sulphide ores until 1907. Gold and Cu production became important again between 1934 and 1948 (Stegman and Stegman, 1996). Total historic production (pre 1996) was 242 510 oz Au, 5023 t Cu and more than 860 kg Ag (Stegman and Pocock, 1996). In 1996, Peak Gold Mines Pty Ltd identified a significant remnant oxide Au resource of 0.66 Mt at 3.0 g/t at New Cobar (0.8 g/t cut-off). This led to new open

pit mining in two stages (Figure 2) from late 1998 to mid 1999 and from mid 2001 to the present.

PHYSICAL FEATURES AND ENVIRONMENT

The deposit is in an area of low NNW trending rises with two prominent small hills, Fort Bourke Hill and The Peak, rising about 50 m above the plain. Ephemeral watercourses drain mainly to the SW. The climate is semi-arid with an average annual rainfall of 350 mm, mainly in winter.

Mean minimum and maximum temperatures are 20-34°C (January) and 2-16°C (July). Natural vegetation around the deposit has been severely disturbed by a long period of mining; the region now consists of open woodland and more sparsely timbered or cleared areas. Dominant species include Bimble Box (*Eucalyptus populnea*), Cypress Pine (*Callitris glaucophylla*), Belah (*Casuarina cristata*), Wilga (*Geijera parviflora*), Mulga (*Acacia aneura*) in the N and introduced woody weed.

GEOLOGICAL SETTING

The New Cobar deposit is located on the E margin of the early Devonian Cobar Basin and is hosted by siltstones and sandstones of the Great Cobar Slate (Figure 1). It is one of a number of Au-bearing, polymetallic deposits that comprise the Cobar Goldfield. The deposit is structurally controlled and localized in a NNW-trending shear zone, immediately W of a major thrust (Great Chesney Fault) which separates the Great Cobar Slate from the underlying Chesney Formation. The host rocks have undergone low-grade greenschist facies regional metamorphism and multi-stage deformation.

REGOLITH

The New Cobar deposit is associated with a prominent (50 m) residual hill in a dominantly erosional setting. Silicification and ferruginization associated with the mineralization and its weathering have resulted in the positive surface expression of the deposit. It has been exposed to weathering and erosional stripping for a long period, and soils above the deposit are thin (<100 mm) lithosols. The nearby landscape has small hills and linear ridges of exposed and variably weathered bedrock, masked by thin colluvium over footslopes. Narrow, incised drainages on the hills pass out into broader drainages with shallow alluvium. The regional landform consists of a slightly raised and modified palaeosurface of undulating, rounded ridges (up to 10 m relief) and higher weathered Palaeozoic rocks (up to 30 m). Colluvium and alluvium, including gravel, sand, lithosol and red earth with a possible aeolian component, overlie this. Lag, composed of lithic and ferruginous fragments, is common. Transport on gentle slopes and alluvial flats is by sheetwash during periods of infrequent but intense rainstorms. Weathering profiles throughout the region vary considerably but are commonly 20-80 m thick. In some places, particularly along faults, oxidation may extend to 100 m or more. There is evidence for both wet-humid and later arid weathering conditions through the Tertiary (Leah, 1996; Scott and McQueen, 2000). Relative tectonic stability during this period allowed the development of thick weathering profiles which have undergone variable erosion, particularly during the late Miocene (Leah, 1996).

The present groundwater in the area of the Cobar Goldfield generally has low salinity (3200-6500 mg/L total dissolved solids) and a pH of 7-7.5. Sodium and Cl⁻ contents (as measured around the Peak gold mine; N. Overvest, pers. comm. 2004) range from 700-1400 and 400-2200 mg/l respectively.

MINERALIZATION

Mineralization at New Cobar consists of five steep E-dipping and

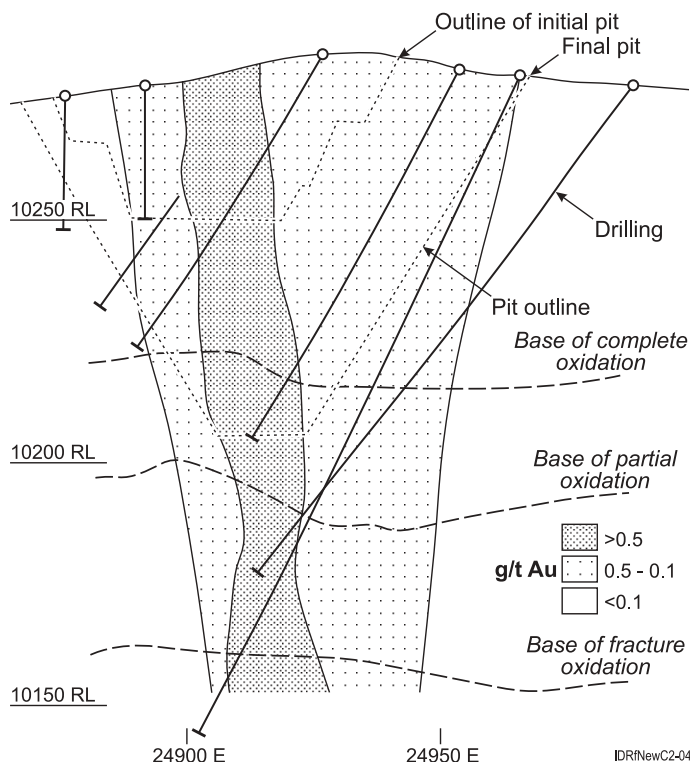


Figure 2. Cross section of weathered profile at 16025mN with Au grades and progressive evolution of pit.

steeply N-plunging lenses (Figure 1) of Au-Cu mineralization localised within a NNW-trending shear zone. The host shear zone ("lode shear") is a second order splay fault that adjoins a flexure in the Fort Bourke Fault, which is sub-parallel to the Great Chesney Fault. The mineralization strikes for 500 m, but is most strongly developed in a central zone approximately 300 m long and up to 35 m wide. Disseminated pyrite occurs in a zone at least 25 m wide surrounding the mineralization. Primary ore is a stockwork of pyrrhotite-chalcocopyrite-gold veins that overprints an older quartz-magnetite vein stockwork. Both stockworks have gradational margins. Primary ore minerals include pyrite, pyrrhotite, magnetite, chalcocopyrite, arsenopyrite, galena, sphalerite, gold, Bi-sulphides and sulphosalts. Paragenesis of the deposit is complex (Stegman and Pocock, 1996; Leah and Roberts, 2000). Alterations include i) an early pre-cleavage stage of pervasive silicification, ii) pre-cleavage white quartz veining, iii) cleavage-parallel quartz veining, iv) coeval, pervasive, green, chloritic alteration associated with a distinctive set of conjugate subhorizontal quartz veins, and v) a set of northwest-trending subvertical quartz veins. This last vein set comprises quartz breccias with cleaved host rock fragments, referred to as 'pebble shears'. These are strained breccia pipes that host the main mineralization. The 'pebble shears' have three significant phases of alteration, i) early, barren, colloform-banded quartz-magnetite veining, ii) barren quartz veining sub-parallel to cleavage and, lastly, iii)

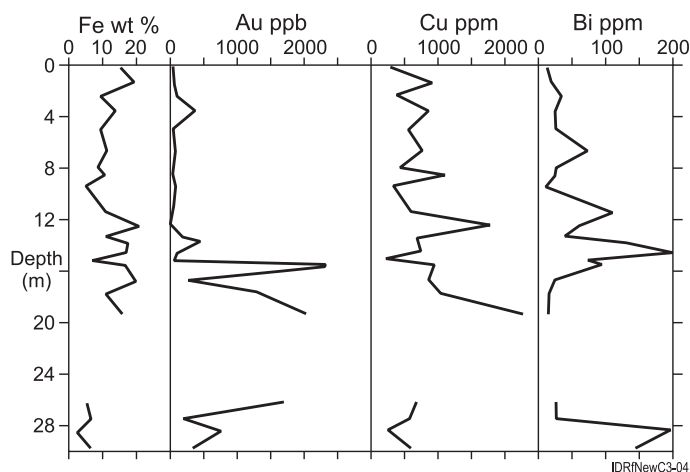


Figure 3. Profile P1 (see Figure 1) down the mineralized zone in the initial New Cobar open pit showing Au and some pathfinder element abundances in the upper part of the weathering profile.

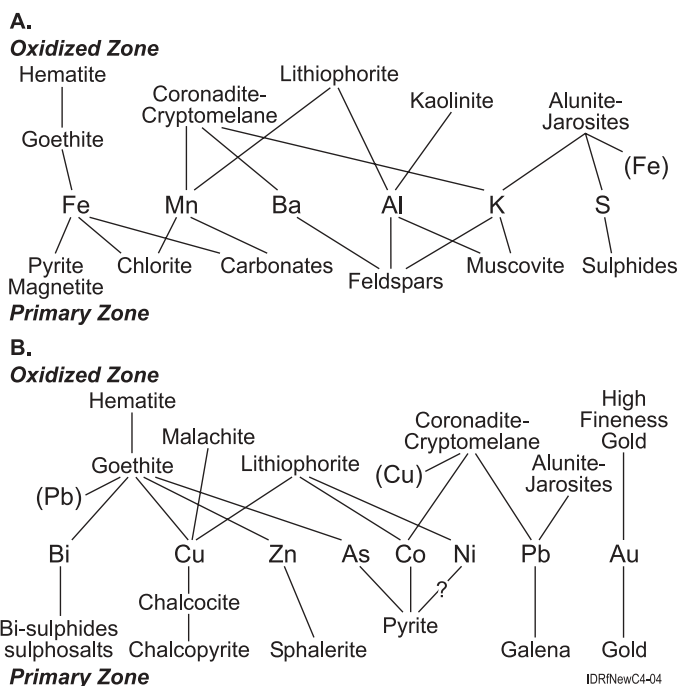


Figure 4. Schematic summary of some major (A) and minor (B) element hosts in the primary and oxidized zones.

irregular aggregates and disseminations of sulphide-Au.

REGOLITH EXPRESSION

Weathering at New Cobar extends to 130 m below surface (Figure 2). Strong oxidation reaches about 73 m and moderate to weak oxidation extends from 85 to 107 m (Figure 2). Secondary alteration includes malachite veining and underlying supergene chalcocite, native Cu and traces of covellite, and extends from 76-108 m. Some sulphides, particularly pyrite, persist into the oxidized zone where they are encased in vein quartz or in chemically impermeable lithorelicts. Depth to the water table is about 100 m.

The strongly oxidized zone shows depletion of Co, Cu, Ni and Zn up the profile. Although depletion of Cu is progressive, the others are substantially lost at the site of active weathering and breakdown of sulphides. Molybdenum and W are concentrated at 100-110 m depth in the secondary sulphide zone, whereas Se is concentrated above 40 m. Silver has been depleted relative to Au above 40 m depth (and possibly above 65 m) and Au has been strongly depleted in the upper 10-15 m (Figure 3). Although depleted relative to primary concentrations, elements such as Ag, As, Bi, Cu, Mo, Pb, Sb, Se and W are sufficiently abundant in the near surface zone to act as useful pathfinders for Au mineralization. Elevated Pb extends for up to 70 m around the deposit in the upper part of the oxidized zone (Scott and McQueen, 2000; 2001).

The dominant regolith minerals over the mineralized zone are hematite, goethite, quartz (mostly relict primary, but also some secondary), kaolinite and relict muscovite. Supergene Au occurs in gossanous material in the upper parts of the regolith but malachite is the main Cu mineral in the oxide zone, occurring as vein fillings of acicular crystals. It appears to have formed from Cu precipitated from solution rather than by direct replacement of other secondary or primary Cu minerals. Zinc generally has been strongly leached from the oxide zone and no secondary Zn minerals have been detected. However, goethite is an important host mineral for Cu and Zn in the oxidized zone (containing up to 2.3% and 0.7% respectively). Similarly, As is low and no separate As minerals have been identified. Lithiophorite (Cu, Co, Ni) and coronadite-cryptomelane (Cu, Co, Pb) are widespread Mn minerals in the oxide zone and are important hosts for their respective trace elements (Figure 4; Scott and McQueen, 2001; McQueen *et al.*, 2001). Chalcantite has been detected at depth. Covellite and native Cu occur in the upper part of the supergene zone. Copper and Pb arsenates also occur below the base of complete oxidation (Leverett *et al.*, 2003)

Ferruginous mottles and veins in saprolite and saprock provide an

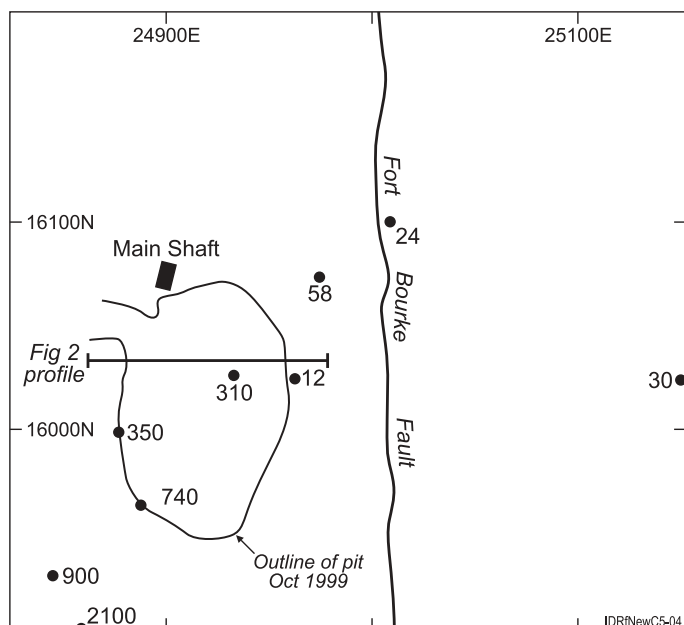


Figure 5. Location of drilled profile at New Cobar South open pit with Pb content (ppm) in near-surface ferruginous saprolite samples

important sampling medium for New Cobar style mineralization with Pb contents >300 ppm in surficial and near surface saprolite, up to 70 m from mineralization (Figure 5). Studies of the nearby Wood Duck and Peak South prospects (Cairns *et al.*, 2001) indicate that ferruginous and ferruginized lithic lag retain geochemical signatures over mineralization in this type of environment. Major surface disturbance at New Cobar makes it difficult to investigate this medium at the deposit itself.

Indicator element dispersions around the New Cobar deposit are controlled by i) the transfer of these elements to different host minerals up through the weathering profile during two contrasting climatic regimes and ii) the interplay between chemical (hydromorphic) and mechanical dispersion. Elements such as Pb, As, Bi, Sb and W show limited chemical dispersion deeper in the profile but are mechanically dispersed in hematitic lag at the surface. Copper and Zn are chemically more broadly dispersed around the deposit with some leaching. Silver has been strongly leached in the upper profile (relative to Au) under late-stage arid weathering.

REFERENCES

- Carins, C.J., McQueen, K.G., and Leah, P.A. 2001. Mineralogical controls on element dispersion in regolith over two mineralised shear zones near the Peak, Cobar, New South Wales. *Journal of Geochemical Exploration* 72: 1-21.
- Leah, P.A., 1996. Relict Lateritic Weathering Profiles in the Cobar District. In: W.G. Cook, A.J.H. Ford, J.J. McDermott, P.N. Standish, C.L. Stegman, and T.M. Stegman (Editors). *The Cobar Mineral Field - A 1996 Perspective*. The Australasian Institute of Mining and Metallurgy. Melbourne, pp. 3-39.
- Leah, P.A., and Roberts, C.A. 2000. New Cobar pit. In: M.J. Spry (Editor) *Central West Symposium Cobar 2000 Field Trip Guide*. Cooperative Research Centre for Landscape Evolution and Mineral Exploration, Perth. pp.8-12.
- Leverett, P., McKinnon, A.R. and Williams, P.A. 2003. Mineralogy of the oxidised zone of the New Cobar orebody. In: I.C. Roach (Editor) *Advances in Regolith*. CRC LEME, Bentley, pp. 267- 270.
- McQueen, K.G., Scott, K.M., Ogilvie, P.G. and Crowther, B.R., 2001. Atlas of regolith materials from the weathered zone, New Cobar Deposit. CRC LEME Restricted Report 162R. 24 pp. (Unpublished)
- Scott, K.M. and McQueen, K.G., 2000. The mineralogy and geochemistry of the New Cobar Au-Cu mineralisation in the regolith and exploration implications for the Cobar District, western NSW. CRC LEME Restricted Report 137R. 35 pp. (Unpublished)
- Scott, K.M. and McQueen, K.G., 2001. The mineralogy and geochemistry of the New Cobar Au-Cu mineralisation in the oxidate and supergene zones, Cobar District, western NSW. CRC LEME Restricted Report 167R. 36 pp. (Unpublished)
- Stegman, C.L., and Pocock, J.A. 1996. The Cobar Gold Field - a geological perspective. In: W.G. Cook, A.J.H. Ford, J.J. McDermott, P.N. Standish, C.L. Stegman, and T.M. Stegman (Editors). *The Cobar Mineral Field - A 1996 Perspective*. The Australasian Institute of Mining and Metallurgy. Melbourne, pp. 229-264.
- Stegman, C.L., and Stegman, T.M. 1996. History of mining in the Cobar area. In: W.G. Cook, A.J.H. Ford, J.J. McDermott, P.N. Standish, C.L. Stegman, and T.M. Stegman (Editors). *The Cobar Mineral Field - A 1996 Perspective*. The Australasian Institute of Mining and Metallurgy. Melbourne, pp. 3-39.

SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Detection Limits (ppm)	Background (ppm)	Max anomaly (ppm)	Dispersion distance (m)
Primary mineralization	Au	INAA	0.005	<0.005	0.075	
	Cu	ICP	5	200	4.6%	
	Pb	ICP	20	<20	18.5%	
Supergene mineralization	Au	INAA	0.005	0.050	0.390	
	Cu	ICP	5	500	26.9%	
	Pb	ICP	20	380	3400	
Saprolite and saprock	Au	INAA	0.005	<0.005	25	
	Cu	ICP	5	50	1800	
	Pb	ICP	20	500	2500	
Surficial saprolite	Au	INAA	0.005	0.030	0.650	70 m along strike, 25 m across strike
	Cu	ICP	5	250	380	
	Pb	ICP	20	300	2100	

ICP digestion: HF, HClO₄, HNO₃ and HCl