

COPPER HILL PORPHYRY Cu-Au PROSPECT, CENTRAL NSW

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LOCATION

The Copper Hill Cu-Au prospect is located 4 km N of Molong and 230 km WNW of Sydney at 33°03'S, 148°52'E; Bathurst (SI 55-8) 1:250 000 map sheet.

DISCOVERY HISTORY

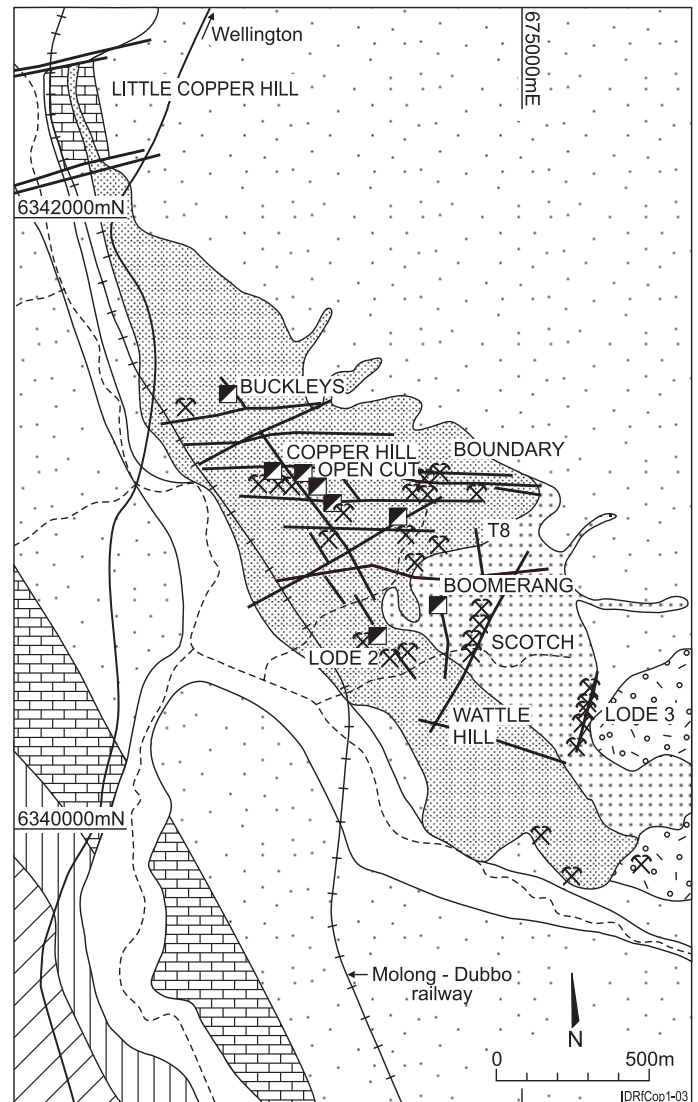
Copper Hill is the oldest mined Cu deposit in NSW. Mining commenced in 1845 (Carne, 1908). From 1845-1851, 3300 t of supergene copper ore was mined, with only sporadic production thereafter. Modern exploration commenced in the late 1960s and early 1970s when Anaconda Australia Inc and Amax Exploration (Australia) Inc recognized its porphyry Cu potential. They conducted induced polarization surveys, geological mapping and percussion drilling to unweathered bedrock on a 100' x 400' grid. This culminated in 11 diamond drill holes and a resource of approximately 130 Mt at 0.15% Cu was estimated. In the mid 1980s, when gold prices improved, Homestake Gold of Australia Ltd., and Cyprus Gold Australia Ltd., intersected 217 m at 1.67 g/t Au and 0.72% Cu in quartz-magnetite stockwork and sheeted veins (Hole 58). Discovery of a large, low grade Cu-Au deposit at Cadia and the nearby high grade Au-Cu deposit at Ridgeway, about 40 km S of Copper Hill, gave further incentive. In the late 1980s and early 1990s, MIM Exploration Pty Ltd. and Newcrest Mining Ltd., in joint venture with Cyprus Gold Australia Ltd., delineated Au-rich mineralization 300 m long, 50 m wide and up to 200 m deep. Within this zone, 18.5 Mt at 0.55% Cu, 0.55 g/t Au and 0.02 g/t Pd was identified using a 0.4% Cu cut-off. Exploration by the current tenement holder, Golden Cross Resources Pty. Ltd., has involved induced polarization pole-dipole surveys and visualization using 3D inversion software to outline new areas of sulphide-rich mineralization.

PHYSICAL FEATURES AND ENVIRONMENT

The deposit occurs as a NW-trending elongate hill up to 350 m high and 60 m above the floor of a broad valley on its western side and 20 m above extensive agricultural land on its eastern side. The climate is temperate with warm to hot summers and cool to cold winters. The mean annual rainfall of 710 mm falls relatively evenly throughout the year, but with erratic local rainfall during summer. The average maximum and minimum temperatures are 31°C and 13°C in January and 13°C and 0°C in July. The vegetation is remnant savanna woodland (5%) and agricultural crops and pastoral grasses (95%).

GEOLOGICAL SETTING

The Copper Hill Intrusive Complex consists of an early quartz diorite in its SE third and several later phases of porphyritic dacite in the remainder. The initial workers delineated two dacite phases with the earlier extensively hydrothermally altered and the later essentially unaltered (Chivas and Nutter, 1975; Scott, 1978). However, Poltock (2001) postulated multiple phases of intrusive dacite stopping out earlier phases to help explain the distribution of mineralization. Moderate to strong hydrothermal alteration accompanied the intrusion of the dacites, giving rise to potassic, chloritic, sericitic and propylitic alteration in both the intrusives and adjacent Ordovician volcanics. Notwithstanding the number of dacite phases, the complex is late Ordovician (447±5 Ma; Girvan, 1992) and intrudes intermediate to basic volcanic and volcanoclastic rocks of the lower Ordovician Fairbridge Volcanics and, at Little Copper Hill, the middle Ordovician Reedy Creek Limestone (Figure 1). Volumetrically insignificant late-stage quartz-feldspar porphyry and andesite dykes also occur (Chivas and Nutter, 1975). The rocks are contact metamorphosed up to 200 m into the intruded limestones and volcanic rocks and prehnite-pumpellyite regional metamorphism is recognized in the volcanic rocks further from contacts. During the Silurian and Devonian, sediments were deposited in the area following periods of tectonic activity (Benambran through to



Quaternary	Alluvium	Shaft
Silurian	Molong Limestone	Pit
Late Ordovician	Dacite Porphyry - phase 2	Fault
	Dacite Porphyry - phase 1	Streams
	Diorite	
Middle Ordovician	Cheesemans Ck Formation	
	Reedy Ck Limestone	
Lower to Middle Ordovician	Fairbridge Volcanics	

Figure 1. Location map of Copper Hill Deposit and local geology.

Animblan Orogenies). Flows of Tertiary basalt are preserved S and E of Copper Hill unconformably overlying Palaeozoic lithologies.

REGOLITH

Although weathering below the summit of Copper Hill may extend to 80 m, weathering of the dacitic intrusives generally extends to 30-50 m depth above sericitic alteration, with only 20 m of weathering above chloritic and propylitic alteration. Propylitically-altered and unaltered Fairbridge Volcanics are essentially unweathered. Soils over the deposit are light brown to grey-brown, <0.5 m thick and commonly contain >40% of rock fragments >2 mm. Thicker brown soils, with only a minor lithic component, occur over the Ordovician Fairbridge Volcanics to the E of the deposit (Dickson and Scott, 1989). During the Tertiary, periods of ferruginization and/or silicification (including the formation of greybilly or silcrete at Little Copper Hill) affected the deposit. Quaternary alluvium occurs in the valley to the W of the deposit.

MINERALIZATION

The Copper Hill mineralization occurs in an area 2 x 1 km within the central part of the intrusive complex. As in other porphyry-related mineralization, that at Copper Hill occurs as quartz-pyrite-chalcocopyrite and quartz-magnetite-chalcocopyrite stockworks and veins and as sulphides in carbonate veins. There are no apparently consistent paragenetic relationships between different types of veins (Chivas and Nutter, 1975). As well as these different vein types, Scott (1978) recognized a zoned alteration system in which a central sericite-quartz-pyrite zone is surrounded by more chloritic assemblages (which tend to be more chalcocopyrite-rich than the sericitic core) and propylitic assemblages of epidote-chlorite-carbonate with Pb-Zn mineralization. Subsequent drilling indicates that propylitic alteration is also found at depth and alteration zones are asymmetric (Figure 2). Potassic alteration (K-feldspar and biotite) occurs in the central part of the mineralized area, where it is associated with early quartz-magnetite stockwork and sheeted veins and Cu-Au-Pd mineralization (Girvan, 1992; Trudu, 1994). The best Au grades occur in this area of about 300 x 50 m, which includes Hole 58 (217 m @ 1.67 g/t Au and 0.72% Cu). Palladium occurs as the telluride, merenskyite, with the best Au grades. Poltock (2001) postulated successive phases of intrusive dacite that stopped out earlier mineralization, developed in successive carapaces to explain the distribution of mineralization.

At Little Copper Hill, where dacitic porphyry intrudes impure limestone, contact metamorphism developed calcite-andradite-quartz-pyroxene but no significant skarn occurs in unweathered rocks. However, Cu- and Zn-rich gossanous material was mined from this area in the past (Chivas and Nutter, 1975).

Supergene mineralization, composed of chalcocite, digenite, native Cu, malachite and azurite, occurs as a layer up to 5 m thick overlying primary mineralization below 30-40 m depth in the centre of the deposit. This mineralization commonly grades >1.1% Cu and 0.4 g/t Au, but its extent has not been fully defined.

REGOLITH EXPRESSION

Potassic alteration is only poorly developed at depth and so its

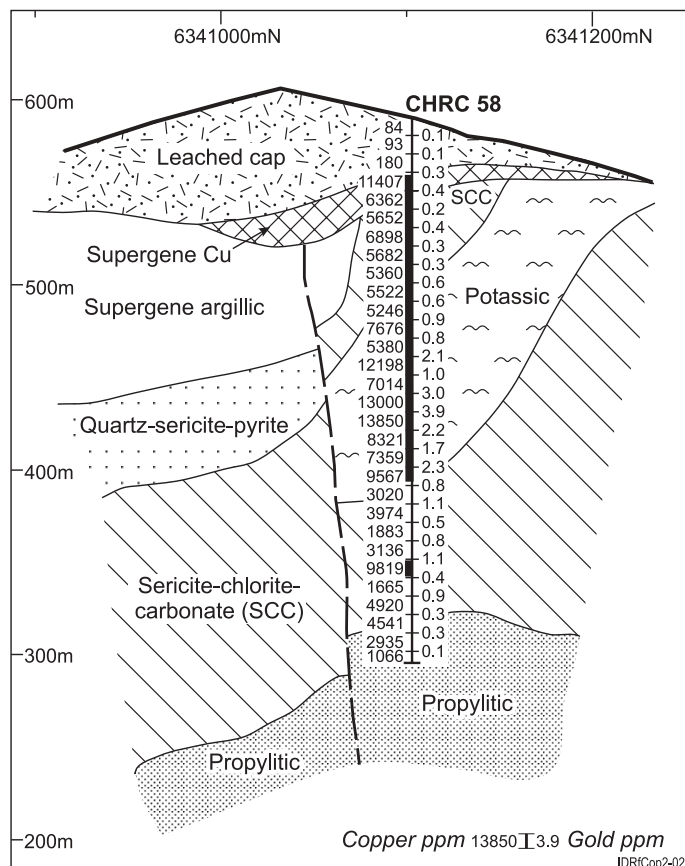


Figure 2. Copper and Au contents and alteration mineralogy through drill hole CHRC58, Section 674300 E (after Golden Cross Operations Pty. Ltd., 2001). Thick line Cu grade >0.5%.

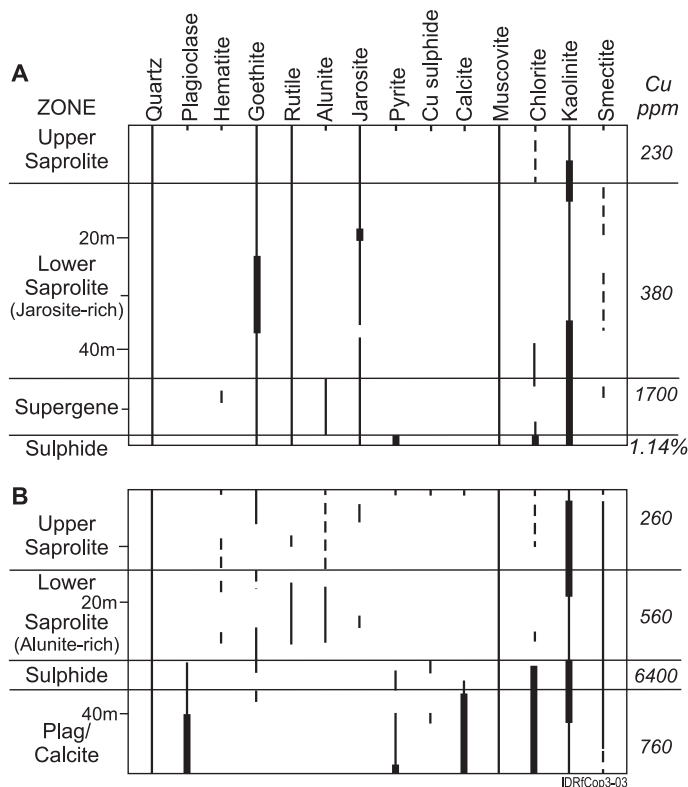


Figure 3. Weathering profile through (A) sericitic alteration and (B) through chloritic alteration (after Scott, 1988).

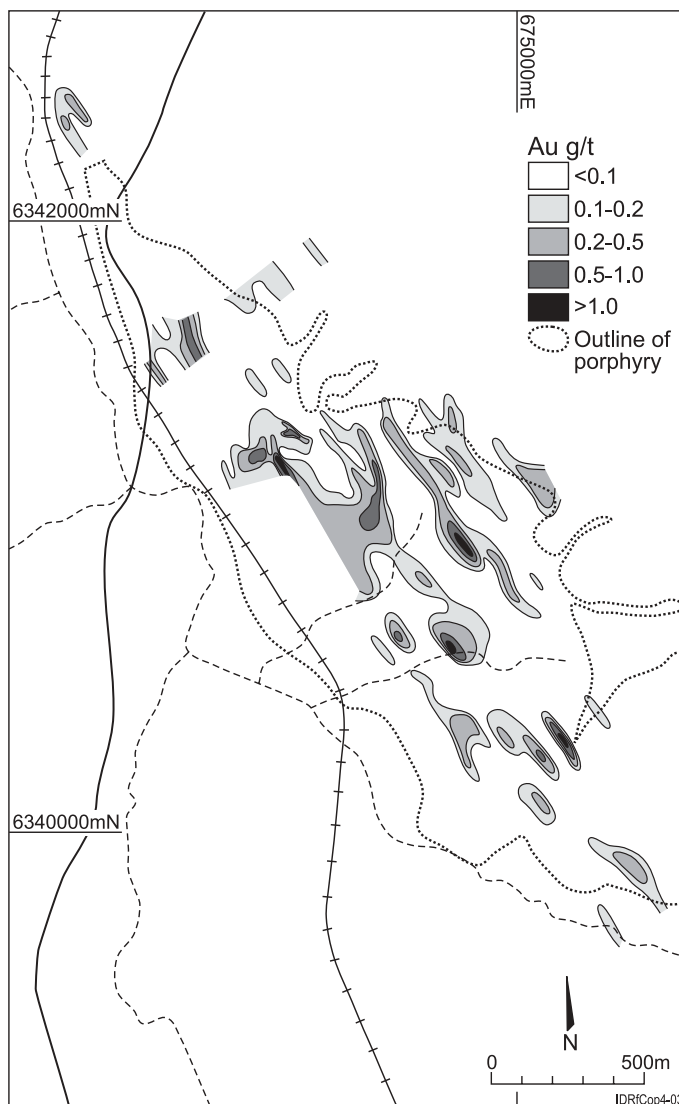


Figure 4. Gold distribution shown by bottom-of-hole samples (4-37 m) from RAB drilling on 100 x 30 m centres after Cyprus Minerals Australia Co plan M87-2518.

weathering characteristics are unknown, although biotite would be expected to weather readily and such alteration would be difficult to recognize in the regolith. Stockwork material occurs only in two small outcrops where magnetite and sulphides are weathered to hematite and goethite. Weathering of sericitic assemblages (quartz-muscovite-chlorite-sulphides) commences at about 50 m with breakdown of chlorite to kaolinite±smectite and sulphides to goethite, alunite and jarosite. Muscovite remains stable in a 10 m supergene zone and goethite and kaolinite dominate the saprolite from 40 m to the surface (Figure 3A). Weathering of chloritic assemblages (quartz-plagioclase-chlorite-muscovite-calcite-sulphides) is by breakdown of sulphides, feldspar, calcite and chlorite at 30 m. Products are alunite, goethite, smectites and kaolinite that form a 15 m thick alunite-rich zone overlain by kaolinite and Fe oxides in the upper saprolite (Figure 3B). Propylitically altered and unaltered intrusives and volcanics are only weakly weathered, with feldspar, chlorite and calcite retained to shallow depths and commonly retained in low outcrop which only shows surface weathering (Scott, 1988).

Above the supergene sulphide zone, Cu and Au are depleted and are similarly abundant in weathered sericitic and chloritic rocks (Figure 3). However, muscovite survives weathering better than chlorite (which readily alters to kaolinite±smectite), so that the sericitic alteration zone can be readily mapped at surface. Because pyrite is generally more abundant in the sericitic zone than the chloritic zone, goethite is also more abundant in the sericitic zone (Scott, 1988).

Outcrop and near-surface saprolite from the intrusive complex and surrounding volcanic rocks have high Cu backgrounds; those in the volcanic rocks reflect the distribution of native Cu in saprolite. Soils over the intrusive complex are generally residual and their Au-Cu contents reflect those of the underlying saprolite.

Gold was determined within the lower saprolite by Cyprus Minerals Australia Ltd in 1988 using bottom of RAB hole samples. This material from the weathered intrusive rocks commonly contained >100 ppb Au and six areas with >1 g/t were identified (Figure 4).

ACKNOWLEDGEMENTS

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SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Detection limits (ppm)	Background (ppm)	Maximum anomaly (ppm)	Dispersion distance
Primary rock	Cu	AAS	20	130	2.1%	
	Au	FA (50 g)	0.010	0.020	43	
Supergene Mineralization	Cu	AAS	20	400	4.8%	
	Au	FA (50 g)	10	0.030	0.500	
Outcrop/saprolite	Cu	AAS	20	400	770	minimal
	Au	FA (50 g)	0.010	0.030	0.420	
Soil	Cu	AAS	20	100	4700	10's of m (by mechanical means)
	Au	FA (50 g)	0.010	0.010	0.330	

AAS analysis after HClO₄/HF/HNO₃/HCl digestion