

# THE COPPER HILL PORPHYRY COPPER-GOLD PROJECT

## SUMMARY

The Copper Hill Cu-Au deposit contains 535,000 tonnes of copper and 1.47 million ounces of gold. It is located 5 kilometres north of Molong in eastern New South Wales and is held 100% by Golden Cross Resources Ltd (GCR) (Figure 1).

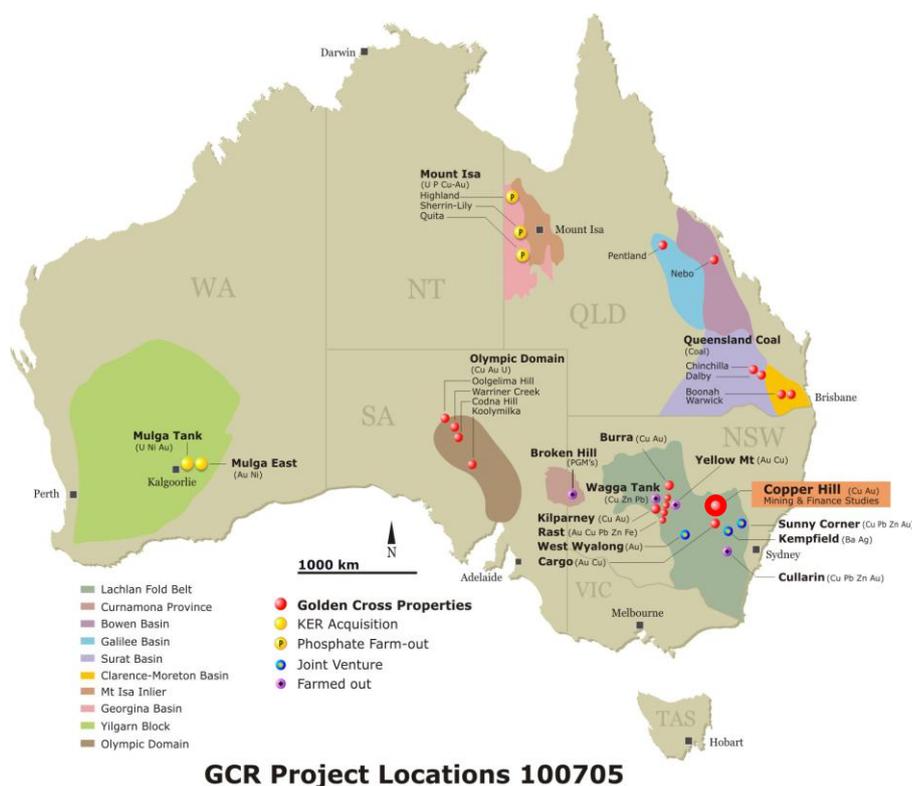


Figure 1

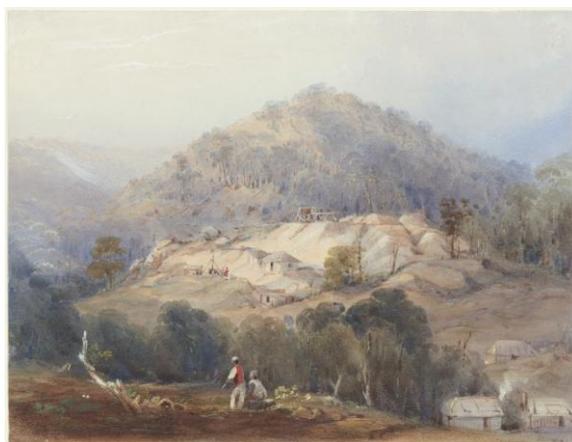
The tenement contains the Copper Hill Igneous Complex of late-Ordovician calc-alkaline, multi-phase dacite-tonalite intrusions within a north-south trending sequence of Ordovician basaltic andesite lavas and sediments extending along strike for 18 kilometres within the tenement.

Drilling by GCR has focused on the Copper Hill itself, Buckley's Hill - Copper Hill North, Wattle Hill and the adjacent eastern zone at Boundary. A diffuse body of mineralisation has been defined, extending NNW for over two kilometres, up to 800 metres wide and extending to depths of over 400 metres. This mineralised body contains, using a 0.2% copper cut-off grade, 173 million tonnes at an average grade of 0.31% copper and 0.26 grams per tonne gold. The deposit is now subject to on-going resource estimation, pit optimisation, mining and financial modelling studies.

A detailed airborne magnetic & radiometric survey and Induced Polarisation surveys, in conjunction with compiled geochemical data, new geochemistry and geological interpretations have defined the intrusive complex and areas of known mineralisation. Drilling these zones and extensions is underway.

## HISTORY

Copper Hill was probably the first copper mine in New South Wales with production commencing prior to 1845. (Figure 2)



Conrad Martens "The Molong Copper Mine c.1845. Figure 2

Modern exploration commenced in the late 1960s when conceptual models of porphyry copper systems were being developed in the southwestern USA. Recognition that Copper Hill was one of several porphyry systems in eastern Australia led to active exploration programs throughout the 1970's and early 1980's.

A major turning point in the exploration history of Copper Hill was the drilling of hole CHRC-58 by Cyprus Gold Australia Ltd in 1989. This vertical hole returned 217m at 1.17g/t gold and 0.72% copper.

The Cadia Valley development, near Orange in the late 1980s and early 1990s, with the higher grade Ridgeway discovery, in a more potassium-rich, monzonitic porphyry setting, gave further impetus to the copper-gold search at Copper Hill

To date approximately \$12 million have been spent on the property by GCR using a range of exploration techniques including geophysics and geochemistry. In total, over 700 holes have been drilled within the Exploration Licence with about 25,000 metres of diamond coring and 65,000 metres of reverse circulation percussion drilling.

## GEOLOGICAL SETTING

Copper Hill is located in the central part of the Molong Volcanic Belt (MVB), which forms part of the Molong-South Coast Anticlinorium within the Lachlan Fold Belt. The MVB is a remnant of the disrupted Macquarie Arc, an island arc system composed predominantly of andesitic lavas and tuffs and intruded by rare, stock-like monzonite, diorite, tonalite and dacite bodies from Ordovician to early Silurian times. The intrusions associated with significant mineralisation are those of both Ordovician and early Silurian age which display strong alteration and distinctive magnetic responses. (Figure 3)

Within the MVB, three major porphyry systems have been identified; those at Newcrest's Cadia Valley Operations (including Cadia Hill, Ridgeway and Cadia East), then Copper Hill and GCR's other porphyry project, the Cargo copper-gold system.

Fore- and back-arc sedimentary facies drape the volcanics and limestone units are widespread

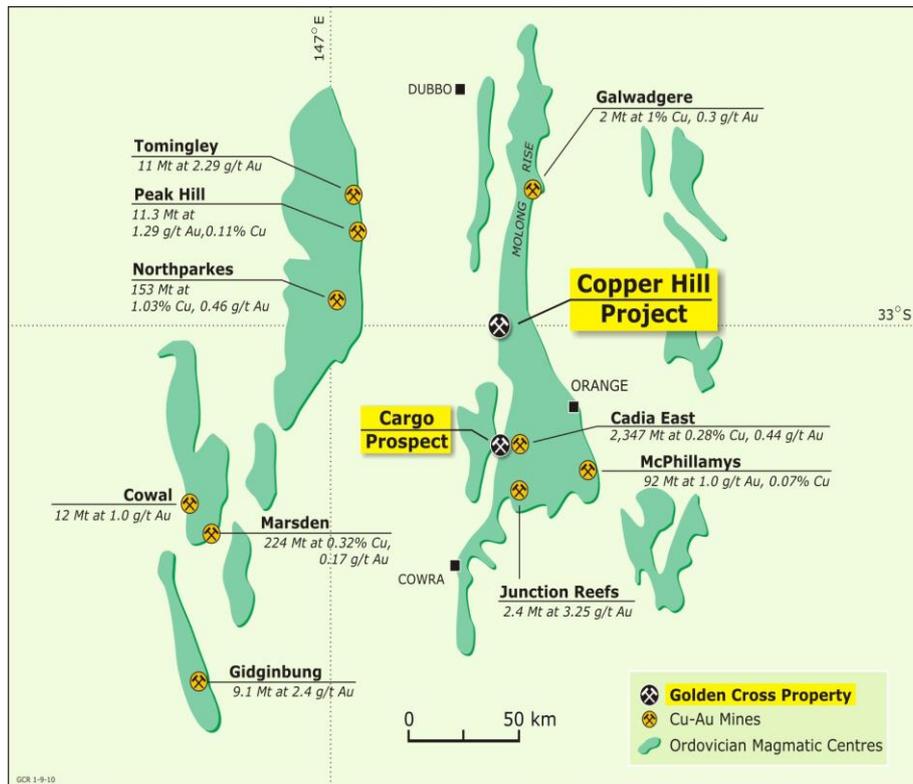


Figure 3

## GEOLOGY OF COPPER HILL

The basal sequence at Copper Hill comprises the Lower Ordovician Fairbridge Volcanics, predominantly a sequence of massive basaltic andesite lavas and tuffs but including intermediate to basic volcanics and volcanoclastic sediments. These are overlain by the Reedy Creek Limestone of Middle Ordovician age. Conformably above the Reedy Creek Limestone are quartzite, sandstone and andesite of the Cheeseman's Creek Formation of Upper Ordovician age. The Ordovician sequence has been intruded by an igneous complex consisting of subvolcanic intrusive dacites, tonalites and diorites. The dacite porphyries carry most of the copper-gold mineralisation

Unconformably overlying these rocks are Siluro-Devonian limestones and sandstones which onlap the Ordovician from the west.

The Copper Hill Igneous Complex dominates the scene in this part of the MVB. It forms a topographically outstanding, northwest-trending cluster of dacite, tonalite and lesser diorite intrusives. At Little Copper Hill, two kilometres north, dacite porphyries coalesce to form a narrow body which broadens toward the southeast to a width of 800 metres at Copper Hill then tapers again southward where it encounters (or intrudes) a non-outcropping microgranodiorite body one kilometre south near Wattle Hill.

## ALTERATION AND MINERALISATION

High grade mineralisation (1.0% Cu and + 1.5g/t Au) is contained in stockworks and sheeted vein sets within, and forming carapaces to, dacite porphyries

exhibiting strong hydrothermal alteration, with local quartz-magnetite and carbonate veining. Lower grade mineralisation (average 0.3% Cu and 0.3g/t Au) occurs as thin veinlets and very fine-grained disseminations of chalcopyrite and pyrite with variable alteration within dacite porphyries and andesitic lavas and tuffs.

To varying degrees throughout the complex the porphyries have undergone potassic alteration overprinted by pervasive propylitic alteration with replacement by sericite, carbonate, quartz, chlorite, laumontite and clay associated with disseminated and veined pyrite, chalcopyrite, lesser bornite and hematite. A zone of intense argillic alteration, predominantly kaolinite, lies within the central west of the complex and carries moderate chalcocite mineralisation. Chalcocite is also present in the thin (up to 5m) supergene blanket below a 20 – 40m leached cap and oxidised zone. The latter contains zones with elevated gold values and work has only recently commenced to accurately define oxide gold resources excluded by the 0.2% copper cut-off.

## **STRUCTURE**

The Copper Hill Igneous Complex is ellipsoidal in shape and elongated in a NW-SE direction, as are the mapped zones of alteration and the main body of mineralisation. Dioritic rocks on the southeastern end of the complex have a more easterly trend.

The complex has a distinctive magnetic pattern characterised by a low magnetic response and the shape of the magnetic pattern provides a strong suggestion the intrusions have been emplaced into a dilational jog, the result of sinistral strike-slip movement between hypothetical NW-SE structures.

Subsequent interpreted structural events include possible tilting of the entire complex, the uplift of the central Copper Hill horst zone, down-thrown blocks to north and south with sub-vertical, northeast trending fault contacts and shallowly east-dipping listric faults. A major NW-SE trending fault on the western side of the deposit generally marks the western extent of mineralisation. There is no firm evidence for any of these hypotheses.

## **RESOURCES**

GCR has undertaken a comprehensive compilation of the entire Copper Hill drill hole database and Hellman and Schofield Pty Ltd (H&S) has completed a series of resource estimations using the data provided by GCR.

GCR has divided the deposit into 4 zones for resource estimation – oxide (including leached cap), supergene, primary, and barren dykes. The primary, or sulphide zone, has been further subdivided, for modelling purposes, into argillic, carapace, 'mineraliser porphyry' and sub-grade (+1000 ppm Cu) halo zones. All drill hole traces were divided using these zones and 'wire-frame' models created in 3-D space for data analysis and estimation. Assay samples were composited to nominal 2 metre intervals.

Resource estimates were generated by ordinary kriging using the variogram models to assign search ellipse orientation. The latest estimates have been constrained by the wire frame zones created within the primary zone outlined above and represent the most accurate assessment of the deposit to date.

Resource Category	Mt	%Cu	g/t Au	Kt Cu	Moz Au	% Mt
Measured	75	0.34	0.32	258	0.79	43%
Indicated	64	0.29	0.23	186	0.46	37%
Inferred	34	0.27	0.20	91	0.22	20%
<b>Total</b>	<b>173</b>	<b>0.31</b>	<b>0.26</b>	<b>535</b>	<b>1.47</b>	<b>100%</b>

## METALLURGY

Metallurgical test work by Metcon Laboratories has advanced, but is still in the preliminary stages, using samples of high grade material from hole GCHR64 and more typical samples from 16 other core holes widely spread throughout the deposit. Copper recoveries of about 80% to 85% are indicated but, in order to create a +25% copper concentrate, gold-bearing pyrite is removed as tails thus reducing gold recoveries to about 50%. Metcon is working on this issue and hopes to improve gold recoveries by floating the excess pyrite (with gold) from the tails for treatment by carbon-in-leach. (Figure 4)

The Copper Hill bulk mineralisation has a relatively low ball mill bond work index which will reduce residence time in the mill and yield savings in processing costs.

Copper Hill copper concentrates contain no deleterious elements.



Figure 4

## EXPLORATION – ADDITIONAL TARGETS

New exploration targets have been generated by a combination of recent high resolution airborne magnetics and radiometrics, a detailed Induced Polarisation (IP) survey across areas of known intrusives, by the collection of new geochemical surveys and the compilation and review of all previous geochemical and geological data. Planned work on targets identified so far, from northwest to southeast, follows:

Drill testing of Little Copper Hill at depth will be required. IP results show an anomaly at 200 metres depth beneath secondary surface copper mineralisation and shallow old workings. One shallow hole, drilled in early 2011, failed to intersect significant mineralisation.

At Buckley's Hill, substantial intersections of higher grade mineralisation have recently been made, providing the current focus for exploration drilling. (Figure 5) Bulk, undiluted intersections include 486 metres @ 0.33% copper, 190 metres @ 0.42% copper and 313 metres @ 0.25% copper. Intervals within these zones included 66 metres @ 0.61% copper and 108 metres @ 0.48% copper, both carrying better than 0.3 g/t gold. Thus a zone has been broadly defined by core drilling to be 200 metres wide near surface, over 480 metres wide at depth at the southern end, extending for over 250 metres along strike and remaining open to the northwest.

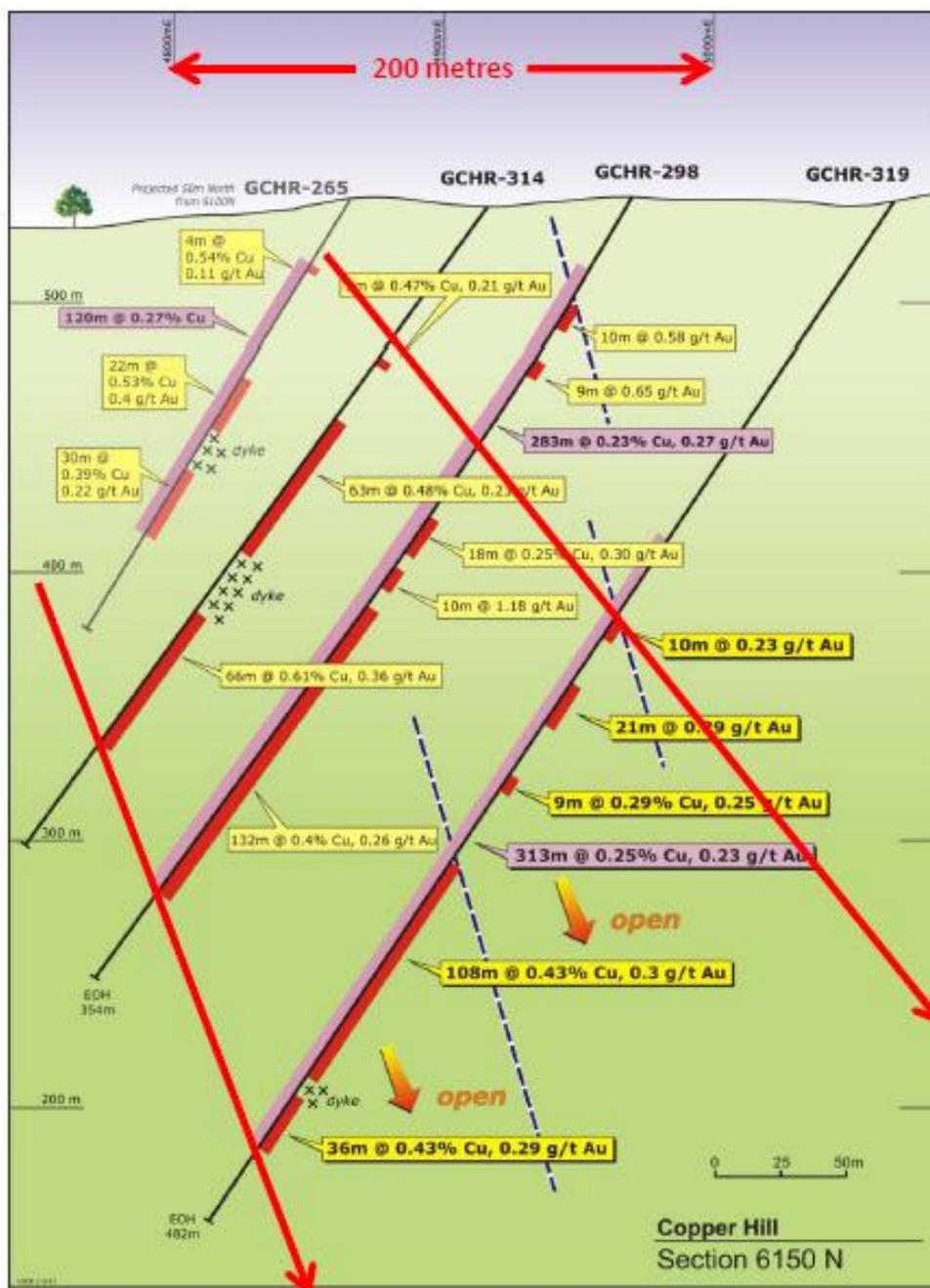


Figure 5

Further south, within the Copper Hill deposit, metallurgical holes have been drilled east to west and north to south to obtain samples for testing and to better define the high grade carapace and stockwork zones. Recent results, from undiluted bulk

intervals of 143 metres @ 0.57% copper and 0.7 g/t gold and 244 metres @ 0.33% copper and 0.46g/t gold, support and extend previous drilling.

Review of the drill hole geology and IP data at Copper Hill North and at Boundary reveals potential for a mineralising porphyry body to exist on the eastern side at depth. An intact, high grade carapace zone could lie hidden here.

Recognition of the west-northwest trending Western Fault and the apparent truncation of the mineralisation, including the supergene argillic zone, leads to the hypothesis that a substantial part of the Copper Hill deposit may have been displaced. The Western Fault location has yet to be defined accurately by drilling, another job for 2011. The sense of movement is conjectural but it is suggested by the writer that the western block has been down faulted, with strike-slip (sinistral) movement towards the south.

Indications, of a high grade (+1% copper) zone extending northwest from Wattle Hill towards Copper Hill, have been recognised. (Figure 6) This zone requires detailed drilling to determine its controls but may represent a contact zone between two intrusions, or a structural zone, evidenced by major brecciation, which hosts intervals of 3 metres @ 2.8% copper and 8 metres @ 3.72% copper

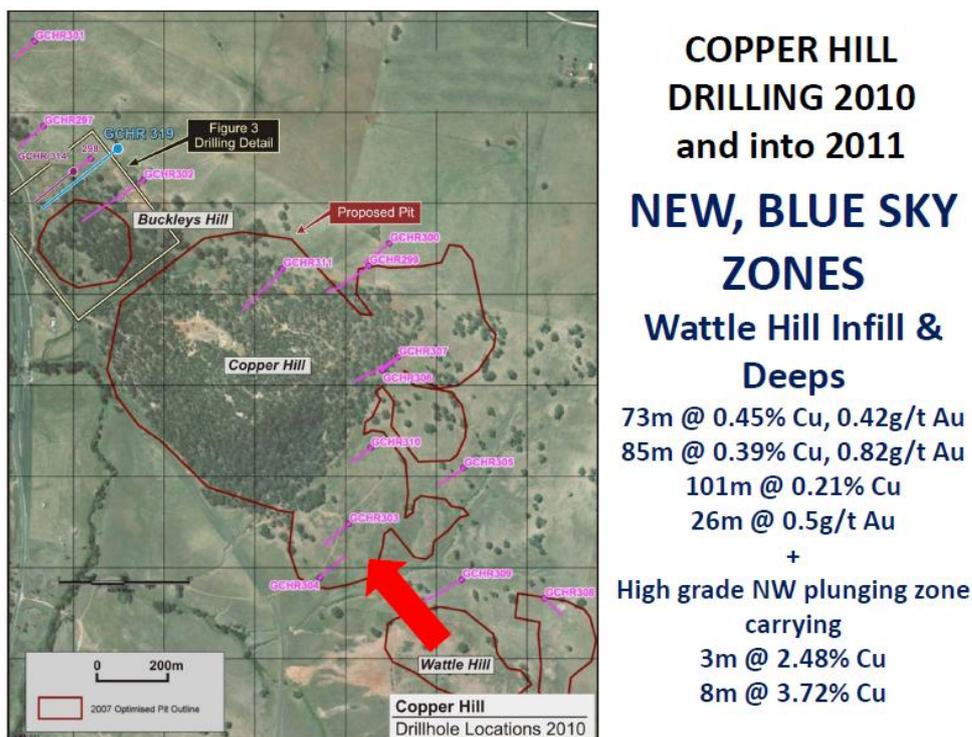


Figure 6

The two kilometre strike length stretching from Wattle Hill, south of Copper Hill, to the Hayshed and Vale Head prospects contains untested IP anomalous zones and geochemical anomalies which require drilling.

The Power Anomaly, (Figure 7) in basaltic andesites about 1.5 kilometres east of Copper Hill, was discovered by the IP survey and has been drilled by only one hole to a depth of 420 metres. Only trace chalcopyrite was observed but anomalous gold grades were returned over two 5-metre intervals.

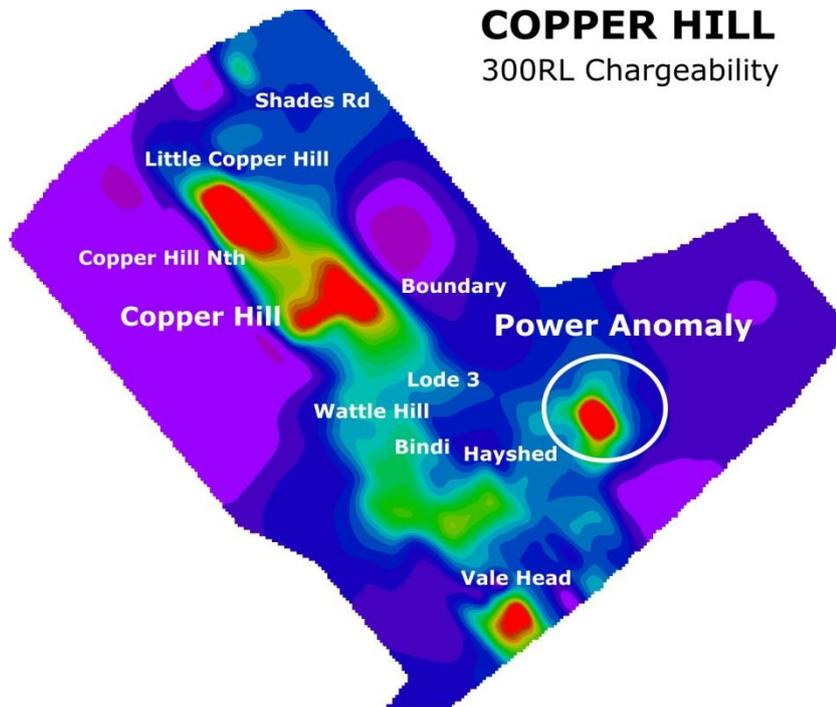


Figure 7

Five to 10 kilometres further south, analysis of the high-resolution airborne data has indicated anomalies with potentially exciting signatures. Magnetic highs have been interpreted to represent magnetite skarns, formed at the base of the overlying limestones by ascending hydrothermal fluids. This untested area holds potential for new intrusive complexes or discrete porphyries beneath cover. (Figure 8)

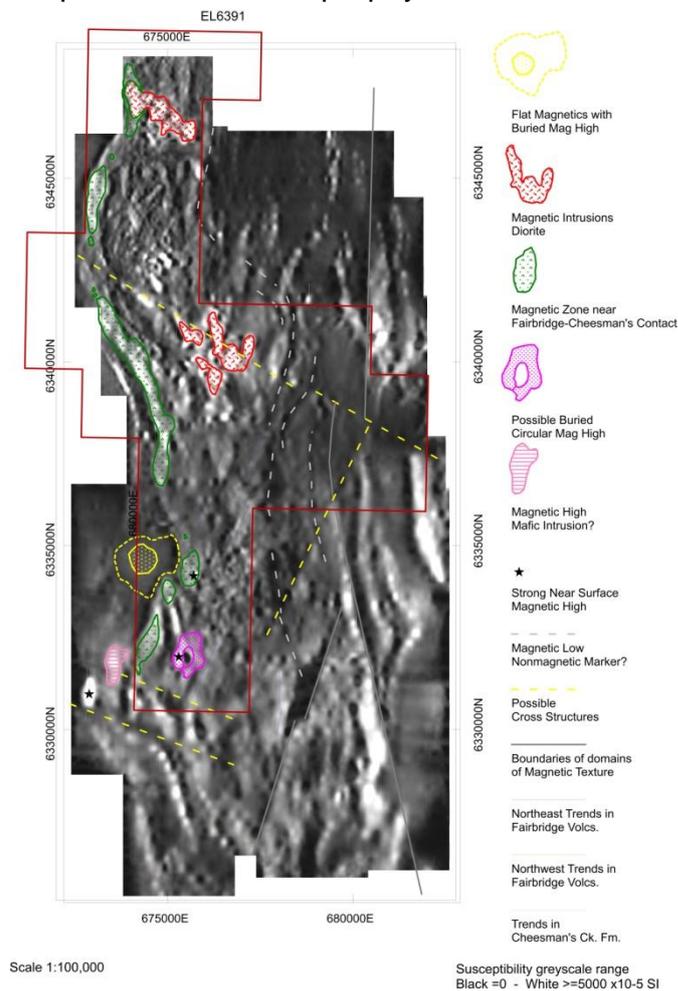


Figure 8

## INFRASTRUCTURE

Copper Hill is very well placed in regard to infrastructure (Figure 9); it lies 5 kilometres north of Molong (pop. 1500) and the towns of Orange (pop 40,000) and Wellington (pop. 10,000) lie 40 kilometres southeast and 60 kilometres north respectively. A large percentage of the workforce is likely to come from these and other nearby towns and from rural properties in the district. Support for the project, by Cabonne Shire Council and its local residents, is strong and tangible. The district has excellent capacity for construction and fabrication. Major mines operate in the region and local maintenance facilities and supply chains are well established.

The Mitchell Highway is a primary highway which leads east to Sydney through Orange and Bathurst. Heading north through Molong it passes beside Copper Hill before continuing north to Wellington and Dubbo then west to Cobar and Broken Hill. Driving time from Sydney to Copper Hill is less than four comfortable and scenic hours.

The former Orange to Dubbo railway line now terminates on the western side of Copper Hill. Track is 80lb, suitable for low-speed, high axle-weight with in-bound construction materials and outbound concentrate trucks joining the main Australian east-west rail line at Molong.

A 132kv power sub-station lies on the eastern outskirts of Molong only 4.5 kilometres from Copper Hill. The transmission grid in the region currently has excess capacity.

The Copper Hill site topography lends itself to creating a relatively small 'footprint' in terms of waste dumps, tailings dams, ROM pads, mill and plant sites and loading facilities. Haul and dump routes will be very short, in the order of 500 to 800 metres. With a low life-of-mine strip ratio (0.6:1), relatively little waste rock will be generated and much will be consumed building dam walls, bunds, road base and foundations. No major pre-strip is required.

The site lies on a minor watershed allowing opportunities for bunds to retain all stormwater and prevent run off. Tailings dam sites will double as sources of top soil for remediation and provide broad, gently sloping valleys allowing multiple secondary catchment opportunities for added environmental safety.

By siting the mill and plant complex behind Wattle Hill, noise and light pollution will be reduced.

Dried copper concentrate will be conveyed 500 metres from the plant to an overhead hopper above the existing rail line for loading into purpose-built rail cars.

Water will be sourced primarily from limestone aquifers adjacent to the site, from water bores on site, from local impoundments on Back Creek, pit dewatering and waste water from Molong and Wellington. No water entitlements have been sought or granted but there are no competing water users between Molong and Wellington.

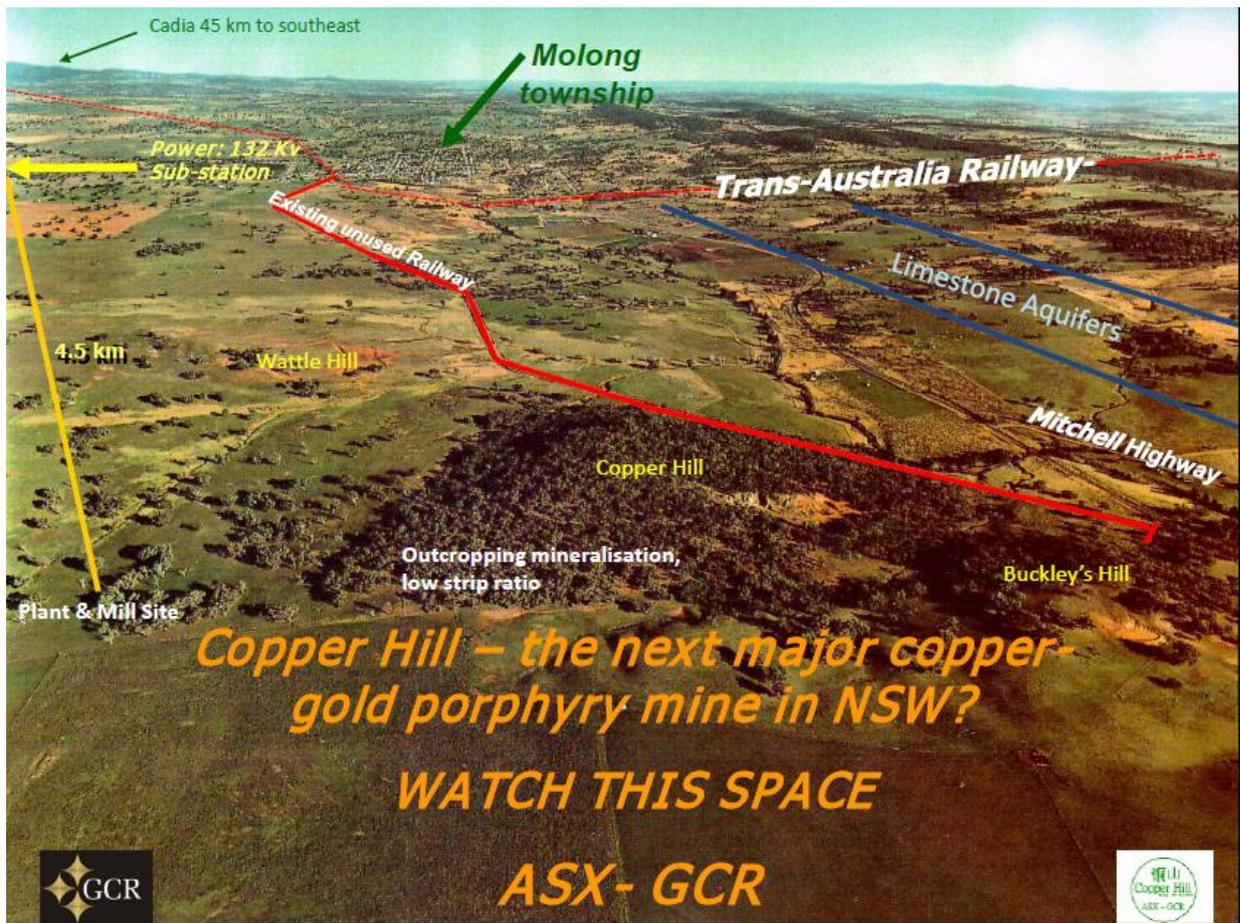


Figure 9

Kim Stanton-Cook, March 2011.

Compiled from papers and presentations by Geologists Paul Burrell, Chris Torrey, Bret Ferris, Keith Scott, Eath Chhun, Glenn Coianiz, Anne Eastwood, Greg Corbett, Alan Chivas, Vladimir David, Dick Glen and Chris Johnston and Geophysicists Bob White & Steve Collins.

### **Further Reading:**

Ordovician igneous rocks of the central  
Lachlan Fold Belt:  
Geochemical signatures of ore-related Magmas

**Eath Chhun**

<http://ses.library.usyd.edu.au/bitstream/2123/610/2/adt-NU20050104.16105101front.pdf>

### **Tectonic setting of porphyry copper-gold mineralisation in the Macquarie Arc**

**R. A. GLEN<sup>1</sup>, A. J. CRAWFORD<sup>2</sup>, D. R. COOKE<sup>2</sup>**

<sup>1</sup>Geological Survey of New South Wales, PO Box 536, St Leonards, NSW 1590, Australia

<sup>2</sup>Centre for Ore Deposit Research (CODES), University of Tasmania, GPO Box 252-79, Hobart, Tasmania 7001, Australia. [http://www.ga.gov.au/image\\_cache/GA3687.pdf](http://www.ga.gov.au/image_cache/GA3687.pdf)

## **COPPER HILL PORPHYRY CU – AU PROSPECT, CENTRAL NSW**

K..M. Scott and C.E. Torrey

[HTTP://CRCLEME.ORG.AU/REGEXPORE/COPPERHILL.PDF](http://CRCLEME.ORG.AU/REGEXPORE/COPPERHILL.PDF)

Copper Hill Project – 2007 Update

Glenn Coianiz (Mines and Wines 2007)

<http://smedg.org.au/M&W07/Glenn%20Coianiz%20-%20Copper%20Hill%20Cu-Au%20porphyry.pdf>

## **THE PORPHYRY COPPER AT COPPER HILL, NEW SOUTH WALES**

A.R. Chivas <http://economicgeology.org/cgi/content/abstract/71/5/942>

Toorong Resources, with a link to Arctan Services

**Copper Hill, 3D IP Survey**

<http://www.toorong.com/3dip/index.html>

An example of the 3D IP survey, from Copper Hill, NSW, can be seen in Exploration Geophysics [Vol.32-Nos 3&4 pp152 \(2.3m pdf\)](#).

And see:

**Architectural Controls on Palaeozoic Porphyry Au-Cu Mineralisation in the Cadia Valley, NSW**

<http://smedg.org.au/M&W%202010/Harris%20Cadia%20Au-Cu%20Mineralization.pdf>

## **DISCOVERY OF THE CADIA RIDGEWAY GOLD-COPPER PORPHYRY DEPOSIT**

John Holliday, Colin McMillan and Ian Tedder, Newcrest Mining Limited, Exploration Department

<http://www.smedg.org.au/Sym99cadia.htm>

## **NORTHPARKES – 40 YEARS ON AND STILL PROSPECTIVE**

Andrew Lye

<http://smedg.org.au/M&W%202010/Lye%20Northparkes.pdf>