

# TRITTON COPPER DEPOSIT, GIRILAMBONE DISTRICT, NSW

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## LOCATION

The Tritton Copper Deposit is 22 km SE of Girilambone (Figure 1) and 50 km NW of Nyngan, at 31°23'43"S, 146°43'19"E; Cobar 1:250 000 (SH55-14) and Coolabah 1:100 000 map sheets.

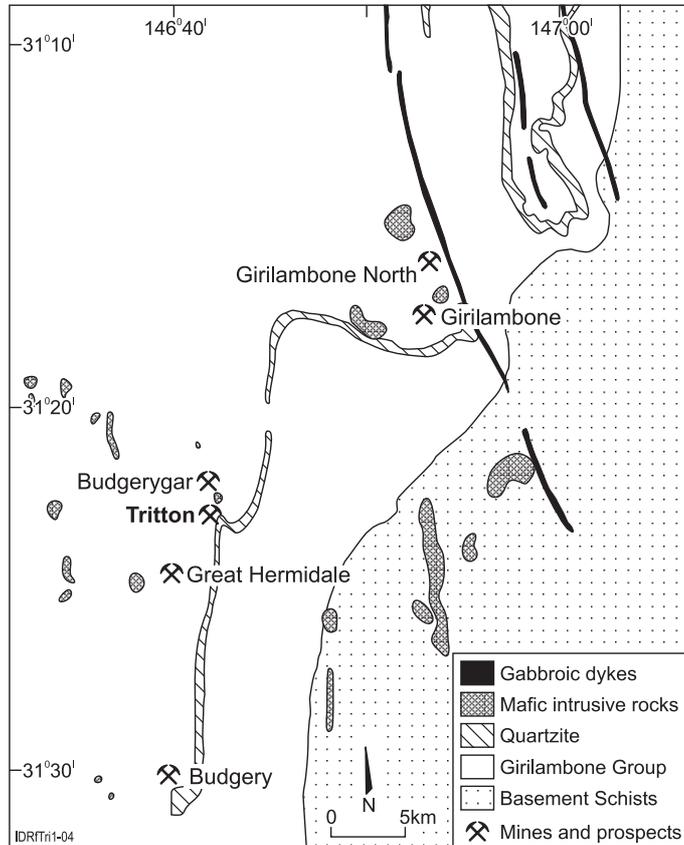


Figure 1. Location of the Tritton Copper Deposit and regional geology (after Fogarty, 2001).

## DISCOVERY HISTORY

Copper was first discovered at the Budgery group of mines (Budgerygar, Budgerygar North and Bonnie Dundee) in 1906 when a 'pipe-like' body of chalcocite, carbonates, native copper and cuprite was found (Fogarty, 1998). The Utah Development Corporation and Seltrust Mining Corporation Pty Ltd acquired tenements stretching from Girilambone to Hermidale following the release of an airborne geophysical survey by the Bureau of Mineral Resources in 1960. Although efforts were concentrated in the vicinity of the Girilambone Copper Mine (Figure 1), Utah Development Corporation also RAB drilled and bedrock sampled the Budgerygar area (Fogarty, 1998). However, no further mineralization was located in the area until 1993, when intensive exploration by joint venture partners, Nord Pacific Ltd and Straits Resources Ltd tested the anomalous geochemistry, associated with the regionally extensive 'Rockdale Anomaly'. This led to the discovery of the Tritton deposit. Transient electromagnetic surveys (SIROTEM) in the Budgerygar area identified two highly anomalous late time conductors, Tritton and Budgerygar. Subsequent RC and deep diamond drilling identified mineralization to depths of 1000 m and resource drilling delineated a proven and probable reserve of 4.96 Mt at 2.9% Cu, 0.21 g/t Au and 10 g/t Ag (Tritton Resources Ltd, 2003). Soil geochemical surveys, RAB and vacuum programs identified several other anomalies in the area, although none have led to significant mineralization at depth.

## PHYSICAL FEATURES AND ENVIRONMENT

The landscape consists of flat to gently undulating erosional plains with less than 9 m relief (Chan *et al.*, 2003). More resistant lithologies, e.g., quartzite and minor volcanic units, form low ridges (<30 m) and are typically N-trending. Drainage is to the E, within the catchment of

the N-flowing Bogan River and upper reaches of the Macquarie River. Much of the land in the vicinity has been cleared for agriculture (grain cultivation and livestock grazing). Vegetation is mainly varieties of Bimble Box (*Eucalyptus populnea*), Red Box (*Eucalyptus polyanthemus*) and White Cypress Pine (*Callitris glaucophylla*), with minor Mulga (*Acacia anoura*) and Ironwood shrub (*Eucalyptus redunca*). The Girilambone region is sub-arid with 445 mmpa mainly in winter. Mean daily January temperatures are 19-34°C and 4-16°C in July (Commonwealth Bureau of Meteorology, 2003).

## GEOLOGICAL SETTING

The Girilambone district is in the W portion of the Palaeozoic Lachlan Orogen and is situated on the E margin of the Cobar Basin, where Ordovician meta-sediments of the Girilambone Group dominate. Lithologies include strongly foliated, bedded and laminated quartz to quartzo-feldspathic sandstone, quartzite, shale, phyllite and chert. A number of small mafic volcanic units, intrusive rocks and late-Silurian to Devonian gabbroic dykes cross-cut the Girilambone Group in a NW direction (Fogarty, 1998; Figure 1). Regional metamorphism is to the lower or middle greenschist facies, with abundant chlorite, muscovite, quartz and minor epidote.

## REGOLITH

Exposure of Girilambone Group lithologies at Tritton is limited to quartzite outcrop on N-trending silicified ridges and weathered light-brown greywacke schist in dendritic ephemeral drainages. There is a thin but extensive cover of locally derived gravelly colluvium-alluvium and red earthy loams up to 2 m deep on slopes and exposed in gullies. The soil on low-lying ridges is skeletal and is strewn with a lag of angular quartz. There are no ferruginous, siliceous or calcareous indurated horizons in the vicinity of the Tritton deposit, although they occur elsewhere in the Girilambone region. Minor gossan occurs at Budgerygar to the N of Tritton. Throughout the region, weathering has penetrated typically to 60-80 m, depending on the lithology, and weathering is deeper on shears. Quartz and ferruginous lag are not extensive; maghemite gravel occupies palaeo-drainages further W.

## MINERALIZATION

There are three mineralized zones at Tritton, upper, central and lower, which strike for up to 450 m at approx 028° and dip E at 20-70°, are up to 35 m wide and are open below 1000 m (Fogarty, 1998). The uppermost part reaches approximately 180 m below surface (Figure 2). High-grade primary mineralization occurs as pipe-like massive sulphide

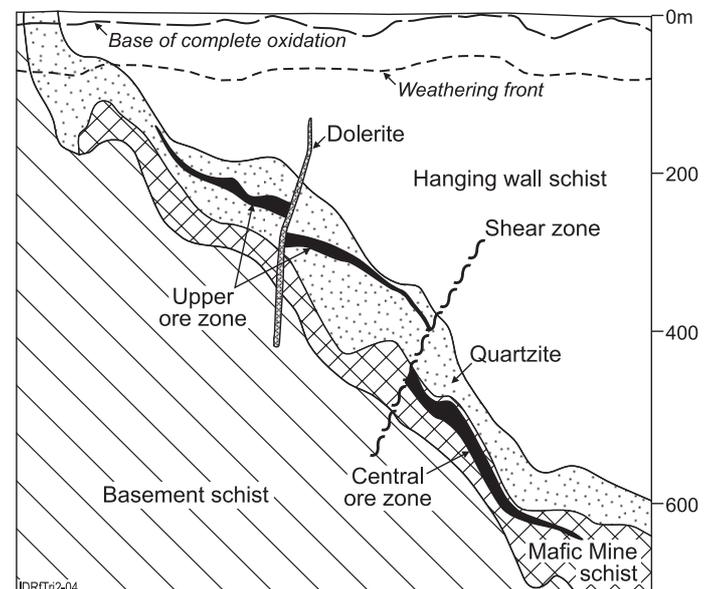


Figure 2. Schematic geological cross section of the Tritton prospect showing geology and mineralization (after Fogarty, 2001).

zones, similar to the steeply dipping structurally controlled metal sulphide deposits of Girilambone and Girilambone North. There is no secondary mineralization at Tritton. Copper grades vary, the upper zone is generally about 5% Cu (locally reaching 20-30% Cu) but only 1% Cu in parts of the lower zone.

The upper zone mineralization is hosted by, and is wholly within, quartzite and consists of chalcopyrite replacing pyrite. A high-grade banded massive bornite and chalcopyrite pod occurs in the centre, with stringer and vein mineralization on the periphery. Chlorite, carbonate and epidote alterations are common throughout. Siderite alteration occurs in the hanging wall with sulphide mineralization and epidote alteration is so intense that, in places, it replaces all other minerals (Berthelsen, 1998). The central and lower zones are situated below the main quartzite, within the lower mafic Mine Schist. Mineralization is banded massive sulphides with alternating pyrite- and chalcopyrite-rich layers. The primary chalcopyrite-pyrite mineralization is rich in Co, Au, Zn, Sb, As, Mo, Se, Ag with minor Te and W as well as S, Fe and Cu.

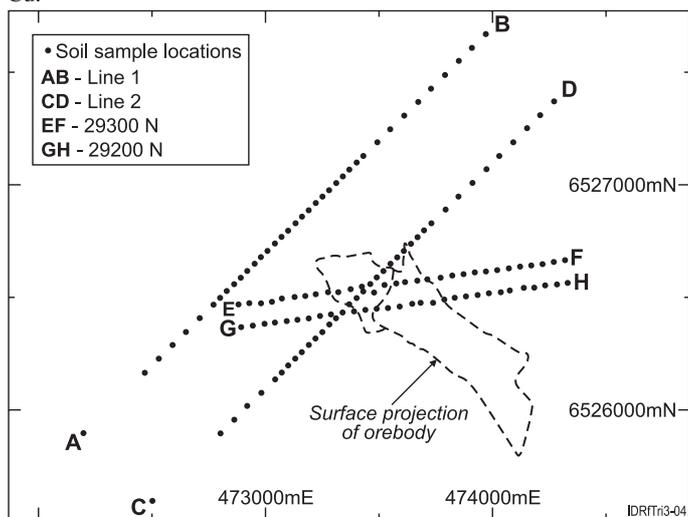


Figure 3. Soil geochemical surveys in relation to the Tritton Copper Deposit.

### REGOLITH EXPRESSION

Until recently, geochemical surveys over the Tritton Copper Deposit failed to identify a surface signature of concealed mineralization. However, Ackerman (2004) and Ackerman and Chivas (2004) have identified anomalies in residual soil overlying the up-dip and up-plunge extension of the upper zone of Cu sulphide mineralization (Figures 3-5). Strong leaching has removed most ore-related elements from the weathering profile, which has been partially truncated by erosion. Nevertheless, there is a distinct multi-element signature in residual soil with anomalous As, Sb, W, Br, Ba, Au and Zr. Lanthanum, Sm and Eu (LREEs) occur in soils on the quartzite extension of the upper mineralized zone and Sb, As, Na, Bi, Zn, Cu, Ag, Au and LREEs at the W and up-dip extension of the same zone.

Analysis of the Tritton weathered profile allowed these chemical signatures to be examined in detail to provide a reliable suite of elements for exploration. Of the anomalous elements identified in soil geochemical surveys, the LREEs, Ba, Br, Na, W and Zr represent the litho-geochemical signature of outcropping quartzite rather than a mineralization signature. Furthermore, the enrichment of LREEs was found to be a function of regolith processes rather than alteration related to mineralization or rock-forming processes. Thus, mineralization identified in residual soils is indicated by anomalous concentrations of the elements Sb, As, Bi, Cu, Au and Zn (Ackerman and Chivas, 2004).

A second soil geochemical signature characterized by anomalous Ni, Co, and Mg was identified directly above deep-seated Tritton mineralization and may be related to a series of cross-cutting mafic dykes which intersect the upper and central zones of mineralization. A known association of mafic bodies with copper sulphide mineralization is recognized from this and other deposits, thus providing a secondary indicator suite of elements for geochemical exploration of primary Girilambone-style Cu mineralization.

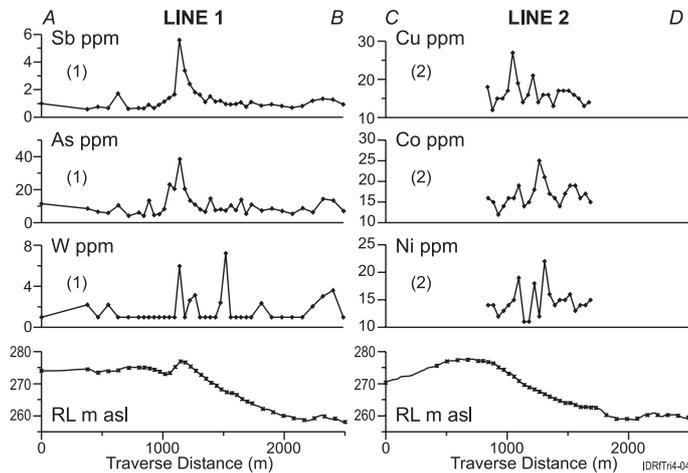


Figure 4. Stacked geochemical soil sample traverse lines 1 and 2. The lowermost profile shows the topography along the traverse. Analytical methods are indicated in parentheses: (1) INAA, <63 mm fraction, (2) Aqua regia digest, ICP-AES on <2 mm fraction.

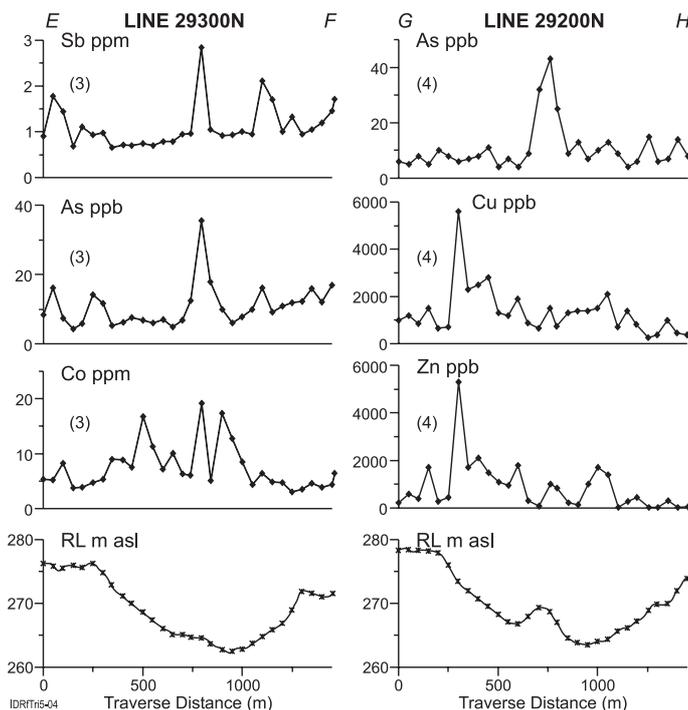


Figure 5. Stacked geochemical soil sample traverse lines 29300mN and 29200mN. The lowermost profile shows the topography along the traverse. Analytical methods for each profile are indicated in parentheses: (3) INAA on <2 mm fraction, (4) AMDEL Deepleach 11.

### ACKNOWLEDGEMENTS

Nord Pacific Resources Ltd provided Regoleach and Deepleach data, samples and assistance in the field. this is gratefully acknowledged. Mike Fogarty and Ben Thompson are thanked in particular.

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**SAMPLE MEDIA - SUMMARY TABLE**

Sample media	Indicator elements	Analytical methods	Detection limits (ppm)	Background (ppm)	Threshold (ppm)	Maximum anomaly (ppm)
Primary mineralization	Cu	AAS <sup>1</sup>	2	25	170	211000
	Fe	INAA	200	16000	35000	420000
	Au	INAA/AAS <sup>2</sup>	0.005/0.001	0.002	0.07	0.88
	Zn	INAA	50	75	160	12000
Primary rock - pathfinders	Sb	INAA	0.2	1	10	90
	As	INAA/AAS <sup>1</sup>	1	<5	10	573
	Co	INAA	0.5	5	120	1130
	Mo	INAA	5	<5	8	32
	Se	INAA	2	<2	5	590
	Ag	INAA/AAS <sup>1</sup>	5/1	<5	8	32
Soil (<2 mm) - mineralized signature	Sb	INAA	0.2	1	2	6
	As	INAA	1	5	16	39
	Cu	ICP-AES <sup>3</sup>	1	12	25	100
	Zn	ICP-AES <sup>4</sup>	0.001	0.18	1.65	5.3
	As	ICP-MS <sup>5</sup>	0.005	0.315	0.6	0.98
	Bi	ICP-MS <sup>5</sup>	0.005	0.105	0.135	0.194
Soil (<2 mm) - mafic signature	Co	INAA	0.5	5	15	19
	Mg	ICP-MS <sup>5</sup>	1	270	365	486
	Ni	ICP-AES <sup>3</sup>	0.01	<0.01	0.065	0.17

<sup>1</sup> After HF/HClO<sub>4</sub>/HNO<sub>3</sub>/HCl digestion

<sup>2</sup> AAS on fire assay prill after aqua regia extraction

<sup>3</sup> After HCl digestion

<sup>4</sup> After DeepLeach11 extraction (Amdel)

<sup>5</sup> After Regoleach extraction (ALS Chemex)