GIRILAMBONE AND GIRILAMBONE NORTH COPPER DEPOSITS, NSW

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LOCATION

The Girilambone and Girilambone North Deposits occur 45 km NW of Nyngan and 105 km ENE of Cobar at 31°16'S, 146°53'E; Cobar 1:250 000 map sheet (SH55-14).

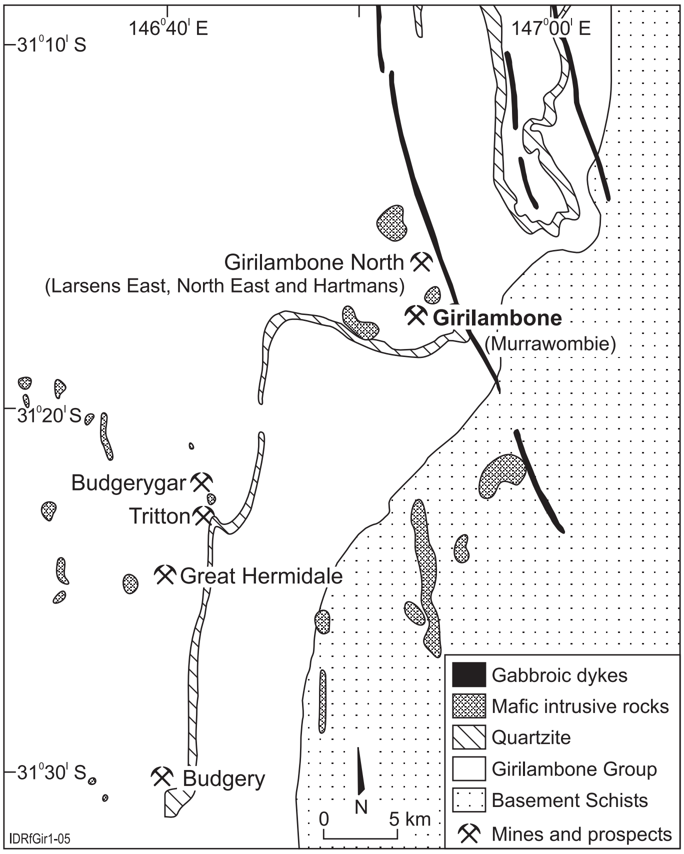

Figure 1. Location of the Girilambone Cu deposits and regional geology (after Fogarty, 2001).

DISCOVERY HISTORY

The outcropping Girilambone Cu mineralization (Figure 1) was discovered by T. Hartman, C. Campbell, G. Gibbs and G. Hunter in 1879 and was mined from 1881-1907 to yield 58 400 t of ore at 1.96% Cu (Shields, 1996). Numerous prospecting shafts were sunk in the region, including in the Girilambone North area some 4 km NW of Girilambone. During 1963-1973, Utah Development Company investigated circular magnetic anomalies defined by a Bureau of Mineral Resources airborne survey of the region. Exploration involved shallow RAB drilling and costeaning into bedrock, with deep drilling establishing a resource of 3.3 Mt at 2.12% Cu. Australian Selection Pty Ltd conducted similar exploration from 1974 to 1983 and discovered 1.5 Mt of primary Cu mineralization (1.8%) at Girilambone North. Various companies also explored in the area but, in 1989, Nord Pacific Ltd. purchased the Girilambone Mine and established a leachable resource of 8 Mt at 1.4% Cu. In 1991, the Girilambone Copper Company was formed as a joint venture between Nord Pacific and Straits Resources to mine the deposit (Fogarty, 1998). Subsequent exploration in the area by the joint venture partners resulted in four additional orebodies so that now, eight primary massive sulphide deposits (including the totally blind Tritton Deposit), with sizes ranging from 1-10 Mt, are known here.

Girilambone North could have been discovered by modern geochemical methods. However, deep drilling numerous anomalies there would have been costly (Utah and Seltrust explored this area for a combined 20 years, prior to 1983, without discovering the Larsens East deposit at Girilambone North) if the Sirotem method had not been used to filter geochemical anomalies and pinpoint drilling targets.

PHYSICAL FEATURES AND ENVIRONMENT

The Girilambone district has dry, hot summers and mild winters, with a mean daily maximum temperature of 36°C in January and 16°C in June. The mean annual rainfall, of 450 mm, falls evenly throughout the year, with erratic local summer thunderstorms. Evaporation is high, averaging 2050 mm per annum.

The Girilambone district has a gently undulating terrain with a drainage divide extending N from Hermidale through Tritton Trig (285m ASL) and Lucknow (Figure 2). Drainage is E towards the N-trending Bogan River (200 m asl), 28 km E of Girilambone. Active erosion has resulted in continued lowering of the base of the regolith and the base of oxide and supergene zones within the Cu deposits, and increased the salinity in the Bogan River floodplain (about 13 000 ppm TDS) compared with 1000-3000 ppm TDS near Girilambone.

The area is thickly vegetated, with varieties of box eucalypts (*Eucalyptus brassiana*) on the deeper soils of flat areas and red mallee (*E. leptophylla*) on low, gravely ridges. Cypress pine (*Callitris glaucophylla*) occurs throughout the area but mulga (*Acacia aneura*) is uncommon. Many species of low shrubs, known locally as 'woody weed', form extensive thickets throughout the district. Much of the area S of Girilambone and some areas near Coolabah have been cleared for cropping, with probable soil contamination by fertilisers.

GEOLOGICAL SETTING

Girilambone occurs within the W portion of the Lachlan Fold Belt (Figure 1), where bed-rocks comprise Ordovician Girilambone Group flysch sediments and medium-grained, quartz-rich greywackes, regionally metamorphosed to quartz-chlorite-sericite schists. Six significant rock types, with differing degrees of fixing of copper in soils and shallow regolith occur within the Girilambone district and are, in decreasing abundance: -

TABLE 1.
LITHOLOGIES AND THEIR REGOLITH EXPRESSIONS

LITHOLOGY	REGOLITH EXPRESSION
Fine grained quartz-chlorite-sericite schist	Light brown kaolinite-quartz-sericite schist
Medium- to coarse-grained psammitic turbidite	Quartz grains in quartz-kaolinite-sericite schist
Mafic volcanic and sub-volcanic schist	Green "Gilgai" clays and chlorite-epidote schist
Minor serpentinized ultramafic dyke	Green weathered medium grained serpentinite
Cross-cutting dolerite dyke	Green clays, ophitic textured spherical boulders
Late stage quartz-gabbro dyke trending NNW from Girilambone	Dark green, to light brown porphyritic dyke

In addition, there are areas of granitoid intrusions. One beneath the town of Nyngan, is possibly Carboniferous and has related late-stage NNW trending quartz-gabbro dykes. Two others, approximately 40 km N of Girilambone, are probably Silurian, where cross-cut by dolerite dykes, or Devonian where there are no dolerite dykes.

REGOLITH

Profiles in the Girilambone district generally consist of 150 mm of pink to red silty sand, and 1-2 m of quartz gravel, quartz-loam and red-brown loam above light-brown, weathered bedrock with fresh rock generally at 60-80 m beneath. Fresh metasediments outcrop near Wongala. No large areas of calcrete occur, but weakly calcareous soils are developed near subcrops of mafic rocks. Very ferruginous soils and nodules are generally absent, except near outcropping mafic rocks and the drainages that contain them as in the Birrimba area, 25 km S of Girilambone, or where associated with quartz-gabbro and dolerite dykes, NE of Coolabah. There is no ferruginous duricrust. However, some topographically inverted drainage sediments with significant maghemite occur in the W of the district and, together with palaeodrainages trending S from Birrimba, are clearly visible on magnetic maps. Even small drainages appear here as weak dendritic magnetic patterns, suggesting that any ferruginous materials, eroded from the top of the profiles, are now concentrated in the drainages. Analysis of drilling (>46 000 saprolite samples from 2-3 m) indicates extensive Cu anomalies in the district (Figure 2).

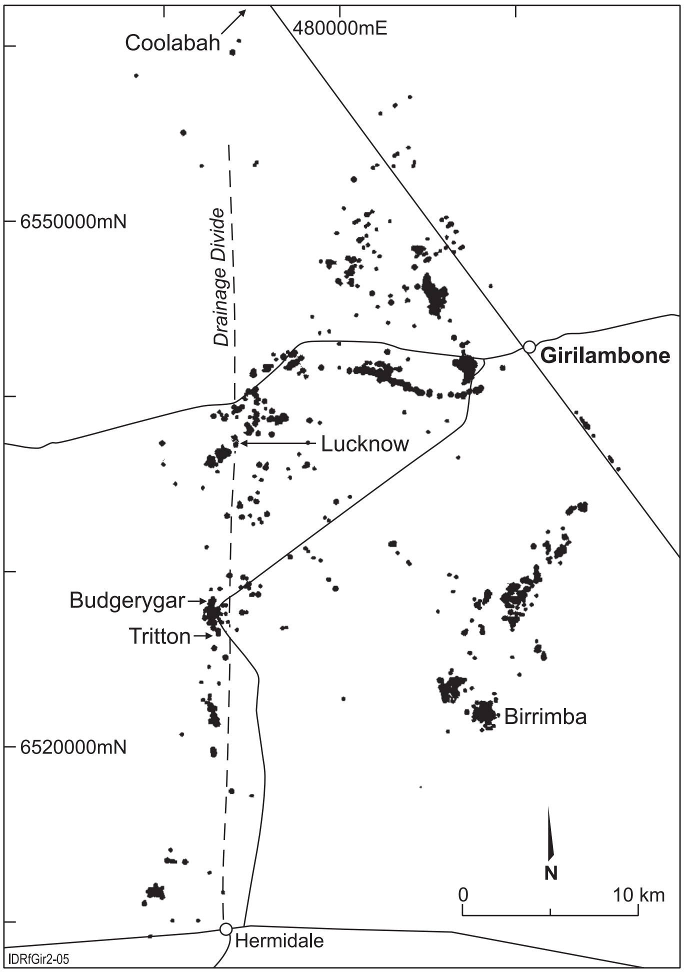

Figure 2. Distribution of anomalous Cu in saprolite near Girilambone. This covers the same area as Figure 1.

MINERALIZATION

Primary mineralization at Girilambone is polymetallic, consisting of pyrite, chalcopyrite, chalcocite, sphalerite and galena, with Au <0.5 g/t and Ag generally at <20 g/t (Fogarty, 1998). Ore occurs in steep-dipping shears, striking WNW within the quartz-chlorite-sericite schist and psammitic turbidites. The Main Lode in the original Girilambone deposit (Murrawombie Pit) consists of lenses of complexly folded and faulted massive sulphides within cryptocrystalline quartz It strikes for 120 m and is 10 m thick. Pyrite-chalcopyrite stringers occur in the footwall of the Main Lode and there is some disseminated mineralization. There is an inferred primary chalcopyrite resource, beneath 85 m under the Murrawombie Pit of 3.4 Mt at 0.96% Cu, with an extra 2.2 Mt of similar grade indicated in the Girilambone North area (Fogarty, 1998).

However, recent mining has been for oxide and supergene, leachable Cu at four deposits, namely at the Murrawombie Pit (the original Girilambone mineralization 6.265 Mt at 1.7% Cu), and Larsens East, Northeast and Hartmans Pits at Girilambone North (3.8 Mt at 0.9% Cu). At these deposits, the leachable mineralization occurs in a supergene zone of chalcocite up to 40 m thick above the primary sulphides. The oxide zone consists of native Cu, widespread malachite and azurite (adjacent to the current water table), with cuprite and phosphates (libethinite $Cu_2PO_4(OH)$ and pseudomalachite $Cu_5(PO_4)_2(OH)_4$) in the upper section of the oxide zone before passing into the ferruginous, relatively Cu-poor, near-surface material (Figure 3). Leaching of Cu and oxidation of sulphides in the regolith in the mineralized zone is

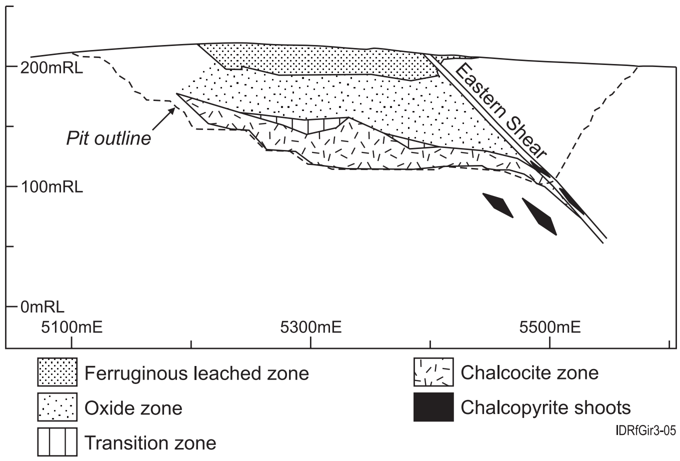

Figure 3. Girilambone Cu Deposit - Drill section 10420N (after Shields, 1996).

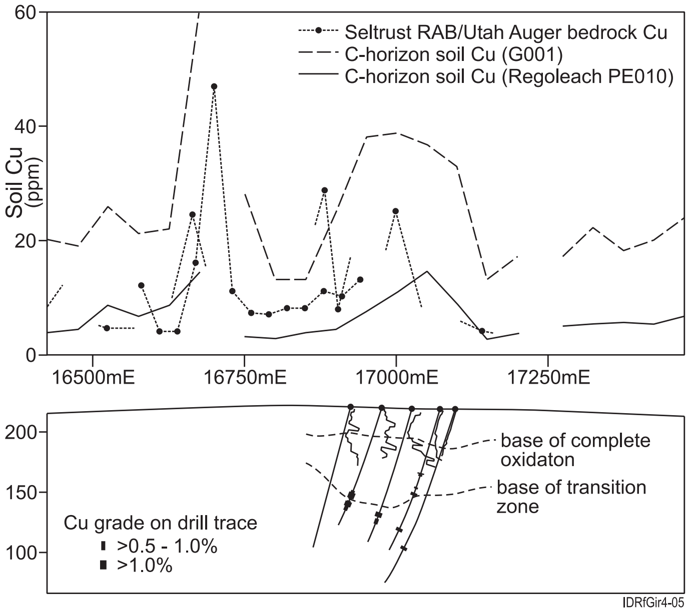

Figure 4. Larsens East Prospect - drill section 2450N.

extremely variable and lenses of massive sulphides, rimmed by white kaolinite, extend up into the saprolite in places. More than 112 000 t of refined Cu has been produced by the Girilambone Copper Company by solvent extraction-electrowinning between 1993 and 2002.

REGOLITH EXPRESSION

Girilambone - (Murrawombie Pit Area)

Gossanous material from this area is quite siliceous and only contains 480 ppm Cu and low contents of other base metals. Nevertheless, the Girilambone deposit is defined by a 1500x1000 m circular Cu anomaly by shallow bedrock drilling (>100 ppm Cu).

Girilambone North Area

Extensive copper anomalies occur over an area of 2200x500 m in shallow bedrock. Subcropping gossan from the Larsens East area contains up to 4900 ppm Cu, 1800 ppm As and 390 ppm Pb. Soil surveys using AAS and Regoleach techniques are generally consistent with the bedrock geochemistry (Figure 4). Numerous deep holes were drilled adjacent to the Girilambone North orebodies and associated mineralization to test bedrock geochemical anomalies lacking associated EM anomalies. Although anomalous Cu was found, there was no significant sulphide mineralization.

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TABLE 2
SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Detection limits (ppm)	Background (ppm)	Threshold (ppm)	Maximum anomaly (ppm)	Dispersion distance (m)
Primary mineralization	Cu	AAS	2	30	2000	440000	-
	Co	AAS	3	10	100	740	-
	Ag	AAS	1	<5	10	470	-
	As	AAS	2	2	200	1900	-
	Au	AAS	0.001	<0.01	0.1	40	-
Supergene mineralization	Cu	AAS	2	100	2000	221000	15
	Co	AAS	3	10	60	460	-
	Ag	AAS	1	<5	10	235	-
	As	AAS	2	2	200	2118	-
	Au	AAS	0.001	<0.01	0.5	22.4	-
Saprolite and saprock	Cu	AAS	2	28	75	5900	100
	Pb	AAS	3	24	80	5506	25
Soil	Cu	ICP	1	13	37	199	-
	Co	ICP	1	5	18	66	-
	As	ICP	1	2	10	36	-
	Au	ICP	0.001	0.002	0.03	0.476	-
Stream sediments	Cu	BLEG	0.1	2	80	345	-
	Au	BLEG	0.0001	0.0005	0.006	0.042	-

AAS and ICP determined after dissolution with $HClO_4$