P4 Au-As-Sb-PYRITE MINERALIZATION, COBAR DISTRICT, NEW SOUTH WALES

Neil F. Rutherford[1] and Chris. J. Salt[2]

[1]*Rutherford Mineral Resource Consultants, 87 Brook Street, Coogee, NSW 2034*

[2]*BHP Billiton Iron Ore Area C, P.O. Box 655, Newman, WA 6753*

LOCATION

The mineralization at P4 is approximately 35 km SW of Cobar and 2 km WSW of McKinnons Gold Mine at 31°47'42"S, 145°40'17"E (Figure 1); Cobar 1:250 000 (SH55-14) and Wrightville (8034) 1:100 000 map sheets.

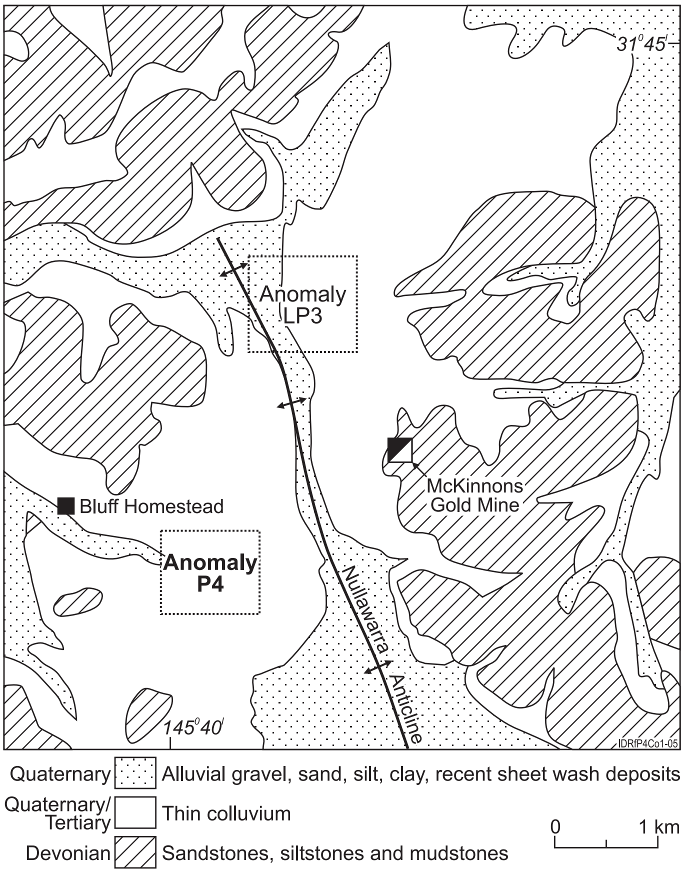

Figure 1. Location map and geology around LP3, P4 and McKinnons Gold Mine (after Glen, 1987).

DISCOVERY HISTORY

A regional partial leach soil sampling program by Burdekin Resources NL covered approximately 1000 km^2 and was centred on the McKinnons Gold Mine (Johnson 1995, 1996). It detected a subtle multi-element anomaly in mid-1995 that led to the discovery of low-grade Au in quartz-sulphide veins and disseminated mineralization within deeply weathered host rocks under thin transported cover at P4. The work also delineated numerous other subtle geochemical anomalies, including Anomaly LP3 (Rutherford and Salt, this volume) and Goldwing, a new, small, sub-economic disseminated Au-pyrite resource. Anomaly P4 does not appear to contain an economic resource but has only had superficial assessment.

PHYSICAL FEATURES AND ENVIRONMENT

The region is dominated by low, undulating hills and broad alluvial flats with a typical relief of about 20 m. The anomaly occurs at the head of a catchment. The area is flat to gently sloping and is generally open, with some cleared land strewn with dead tree trunks; the remainder is sparse, mixed woodland. Vegetation is dominated by an *Acacia-Eremophila* association with ironwood, wilga, mulga and emu bush. Cypress pines (*Callitriss spp.*) are scattered but common within drainages. The climate is semi-arid and has both summer and winter rainfall averaging about 330 mm per annum. Evaporation varies from 320 mm in January to about 50 mm in July. Mean daily temperature ranges are 20-34°C in January and 4-16°C in July. The water table has lowered under arid conditions. The weathering front is some 40-50 m below the present surface.

GEOLOGICAL SETTING

The main lithologies are bedded siltstones, fine to medium-grained sandstones, mudstone, minor limestone (Lerida Limestone) and various calcareous and fossiliferous units of the Devonian Amphitheatre Group along the western part of the Cobar Trough. Rhyolitic volcanics occur with limestone a few kilometres to the N. Folding is along the NNW-trending Nullawarra Anticline with an axis approximately 1 km E of Anomaly P4 (Figure 1). Deep-seated shears parallel this anticline and may be the source of regional mineralization, such as at the McKinnons deposit (see McQueen *et al.*, this volume). These fractures parallel the western tectonic margin of the Cobar Trough.

REGOLITH

The region was intensely weathered and ferruginized in the late Cretaceous, followed by uplift and partial erosion of the weathered profile during the Tertiary (Leah, 1996; Cohen *et al.*, 1996). Regionally, the soils are dominantly red earths and calcareous red earths, probably developed on sediments derived from sheet-wash erosion of a Cretaceous laterite profile and wind blown materials (Leah, 1996). On the W side of the P4, there is a sheet-wash plain with a lag of siltstone, tiny quartz fragments, ferruginous pisoliths and a few fragments of vein quartz (>1 mm). Similar sheet-wash occurs on the E side of the anomaly but without vein quartz. Quartz float defines faults and shears in areas with sheet-wash cover. The sheetwash overlies partially eroded saprolite, developed on Devonian siltstone, with minor fine-grained sandstone. Weathering decreases to the E. Saprolite in the central part of the anomaly is intensely bleached and generally grey, light grey, beige-pink or white. Just above the weathering front, goethite has stained the rocks orange to medium-brown. The saprolite is generally yellowish, mustard, light brown or medium brown, reflecting its goethite content or, near surface, pinkish red-brown, due to hematite. The portable infra-red mineral analyser (PIMA) indicates an increasing kaolinite content in the saprolite away from the mineralization both vertically and laterally (Marshall and Scott, 1999). Ferruginous pisolith lag is scarce, due to erosion of the upper part of the weathered profile. Transported ferruginous units (probably of Tertiary age) occur near catchment margins. Over the centre of the anomaly, silcrete has developed near the top of the saprolite, beneath the transported overburden. Much of this silcrete was formed by precipitation of silica leached from bedrock and the alteration halo under a low pH generated by weathering of pyrite at the weathering front. Calcite, opaline silica and gypsum occur at the base of the transported materials.

MINERALIZATION

Sulphide intersections beneath the weathering front indicate that the P4 mineralization consists of grey vein quartz with abundant pyrite (Johnson, 1995, 1996). The vein system is enclosed by a siliceous, pyritic envelope, 50-100 m in width, similar to that of the nearby McKinnons deposit (McQueen *et al.*, this volume). The mineralization is hosted by a N- to NNW-trending shear. It also appears to be similar to the McKinnons mineralization in its relationship to the axis of the Nullawarra Anticline, although it occurs on the opposite side of the fold. Probably, it also occupies a local, but buried, topographic high within the pre-Quaternary landscape. The present weathering front, at approximately 45 m depth around the mineralization, is sharp, with only a 10-30 mm transition from completely weathered to fresh sulphide. Away from mineralization, the weathering front is deeper by some 20 m, particularly to the E.

Maximum concentrations in the RAB drilling are 0.3 g/t Au, 200 ppm Cu, 940 ppm Pb, 1000 ppm Zn, 2.4 ppm Ag, 2250 ppm As, 380 ppm Sb. Gold, Cu, Pb, and Zn concentrations are greatest in the weathered bedrock, whereas the Ag, As and Sb concentrations are greatest in pyrite-rich sulphides. Only about three RAB holes intersected the top of the mineralization and its alteration halo at or just beneath the present

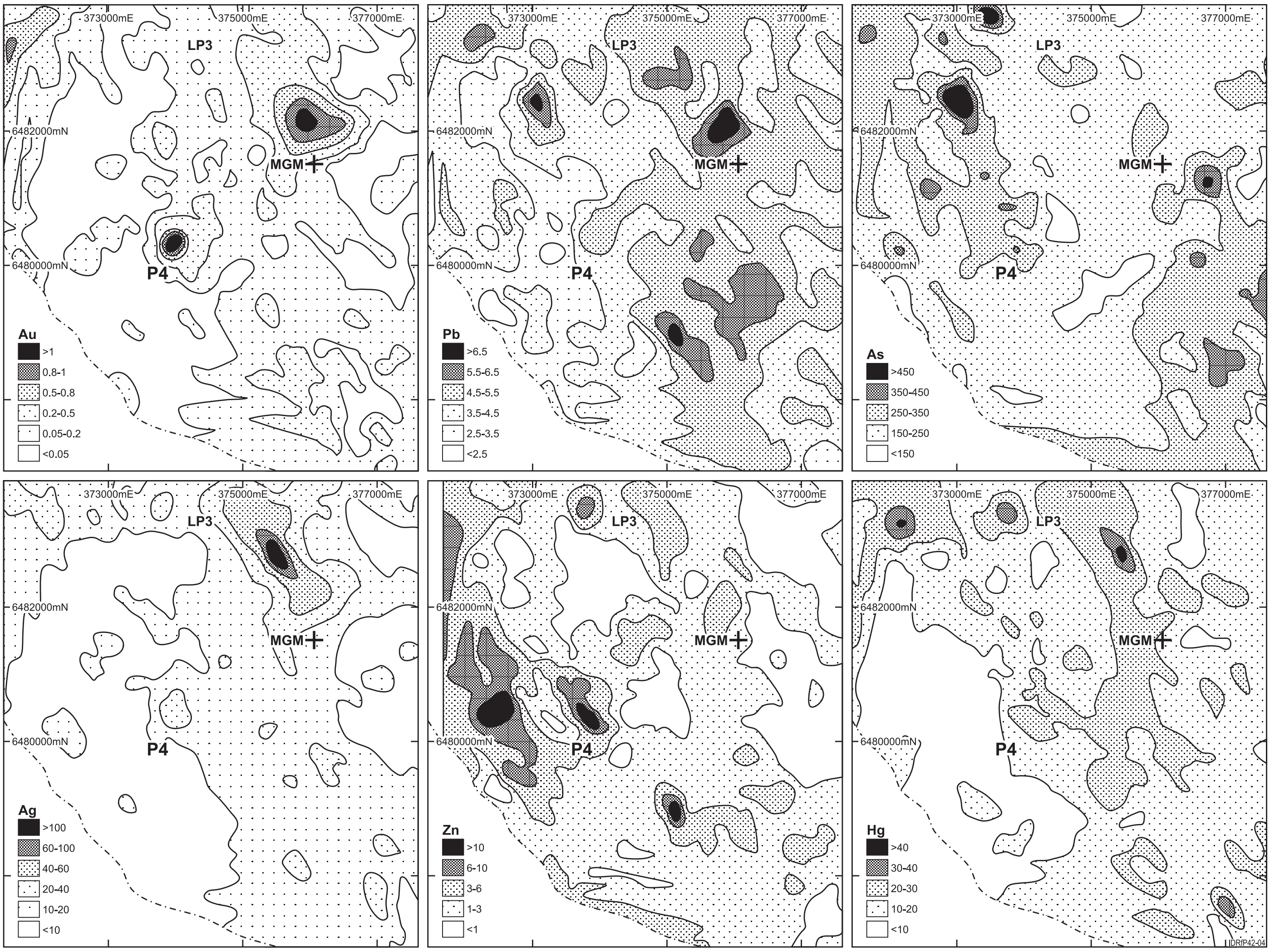

Figure 2. Soil geochemistry of the <75 µm fraction for dilute HCl-soluble Au (ppb), Pb (ppm), As (ppb), Ag (ppb), Zn (ppm) and Hg (ppb) of the area shown in Figure 1.

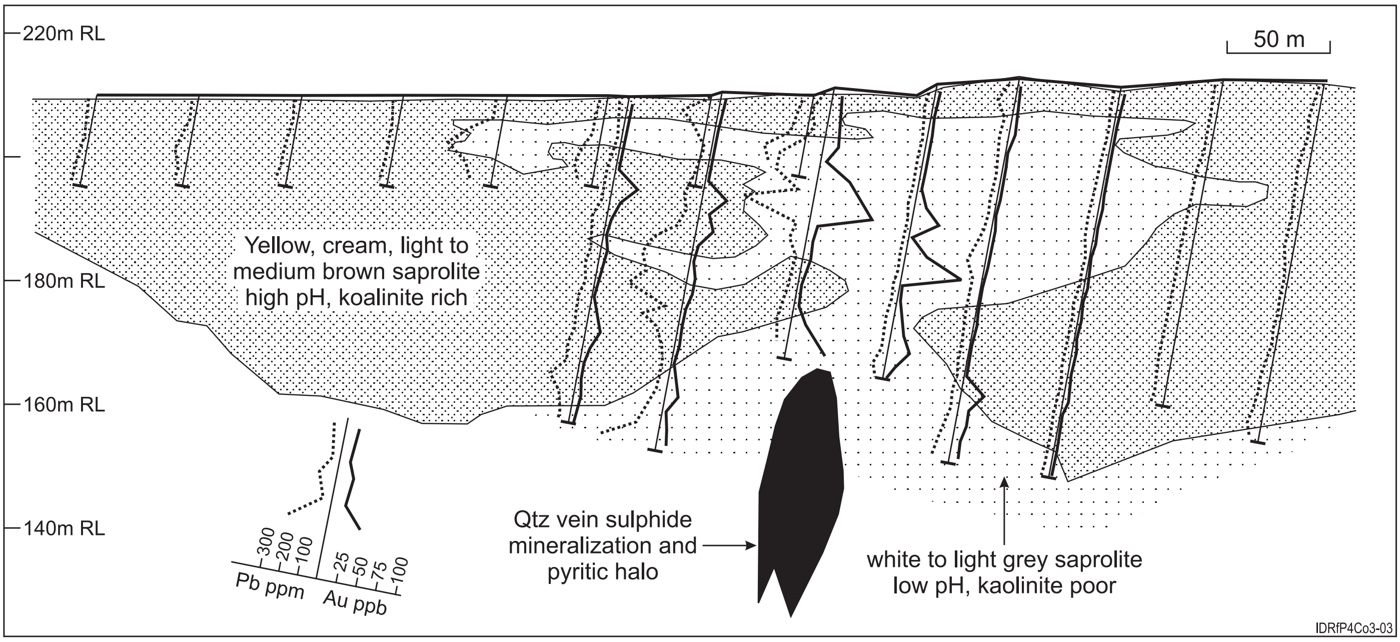

Figure 3. Section along an oblique line centred at 374081N 6481346N across the P4 Anomaly for Pb and Au.

weathering surface.

REGOLITH EXPRESSION

The P4 Anomaly is indicated by Au-Ag-As-Bi-Cu-Hg-Mo-Pb-Sb-Tl-Zn in the soil as determined by dilute HCl leaching of the <75 µm fraction. The soil was collected from 250-300 mm depth on a 100 x 400 m grid (Figure 2). Samples were given (i) a partial leach with dilute HCl, and the solution was analysed by ICP-MS (see Table), and (ii) an aqua regia leach. Regionally, the partial leach anomalies are controlled by lithology, regolith and proximity to structures. Many elements (As and Zn, for example) are concentrated in and along margins of the Quaternary drainage system.

Soil data show that there has been notable dispersion of soluble Cu, Zn, Tl and Sb for some 1000 m down catchment, detectable at the ppb level. It highlights the need to assess geochemistry on a catchment-by-catchment basis as physical attributes and depth of erosion may vary across a region, resulting in different distribution patterns for different elements. Where low pH has developed in a deeply weathered and eroded landscape, a target zone may have abnormally low abundances for many elements in what remains of the weathered profile, as soluble elements may have been leached and redistributed down catchment. This points to the folly of taking only shallow bottom-of-hole samples in RAB programs in such terrains and of not drilling to below the base of oxidation to assess the composition of the whole weathered profile (Rutherford, 2004). Assessing the distribution of the colour of RAB cuttings also helps in interpreting the character of the weathered profile.

Regional sampling of pisolitic lag shows low base metals but elevated As and Sb around the P4 mineralization compared with pisoliths from surrounding catchments; this is consistent with patterns in the soil data. Pisolith distributions indicate erosion levels in the laterite profile; they are largely absent where the profile has been eroded to the mottled zone or below.

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SAMPLE MEDIA – SUMMARY TABLE

Sample medium	Indicator elements	Analytical method	Detection Limits (ppm)	Background (ppm)	Maximum anomaly (ppm)	Dispersion distance (m)
Soil	Au	ICP-MS[1]	0.00004	0.0001	0.0042	200
	Cu		0.2	3-4	9.4	1000
	Pb		0.1	2-3	6-9	200
	Zn		0.1	2-3	15	1200
	As		0.05	0.1-0	0.350-0.500	200
	Sb		0.0005	0.025	0.060-0.080	500
	Tl			0.011-0.025	0.092	1200
	Ag		0.001	0.025-0.030	0.077	100
	Mo			0.035-0.060	0.180	100
	Bi			0.040	0.067	200
	Hg			0.010-0.020	0.030-0.040	200
Pisoliths	Cu	ICP-AES	1	5-15	20-25	Not able to be determined
	Pb		1	10-25	45-55	
	Zn		1	10	85	
	As		1	25-30	60-70	
	Sb		2	6-12	23	
	Bi			0.5-1.0	1.55	
Saprolite/ saprock	Au	ICP-AES	0.001	0.002	0.3	50 – 70 m laterally - see cross section
	Cu		1	5-15	204	
	Pb		1	5-15	944	
	Zn		1	15-30	998	
	Ag		0.1	0-0.2	2.4	
	As		1	2-4	2250	
	Sb		2	3	377	

[1]After a partial leach of a 4 g aliquot with dilute HCl (cold extraction in 40%HCl with intermittent agitation over four hours prior to dilution before analysis).

