PORTIA AND NORTH PORTIA Cu-Au-Mo PROSPECTS, SOUTH AUSTRALIA

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LOCATION

The Portia and North Portia prospects are located approximately 50 km north of Olary at 31º26'S, 140º27'E; Curnamona 1:250 000 sheet (SH/54-14).

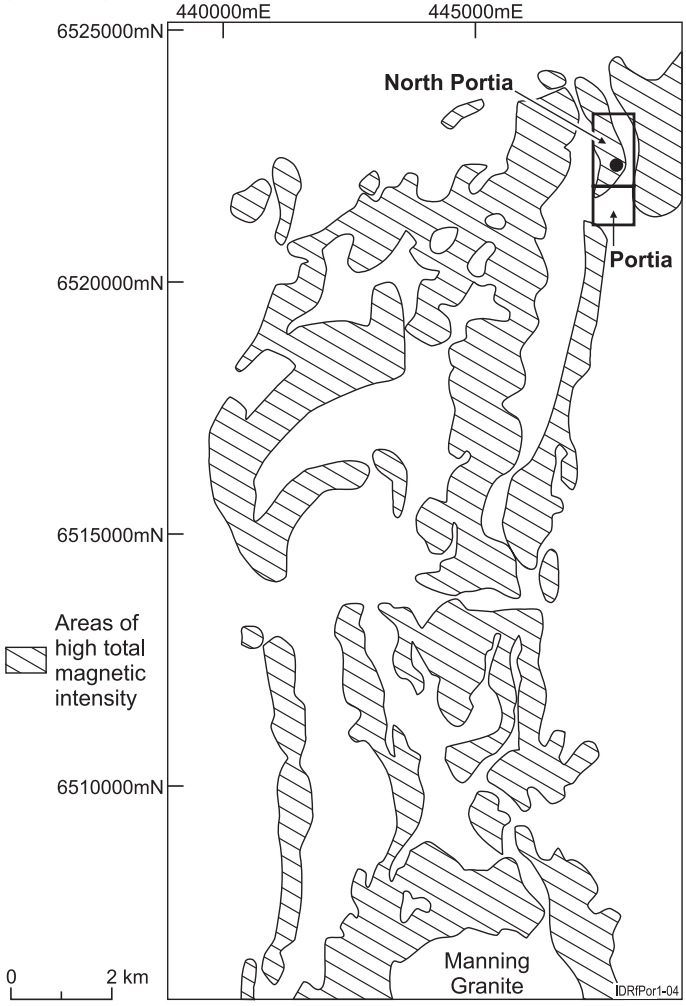

Figure 1. Schematic diagram of the total magnetic intensity of the Benagerie Ridge Magnetic Complex. The Portia prospect is in an area with low magnetic intensity, the North Portia in an area of greater magnetic intensity. The thickness of sedimentary cover increases towards the north, averaging 6 m above the Manning Granite to >50 m at the prospects. The dot at North Portia is the location of drill-hole BEN388.

DISCOVERY HISTORY

During 1996, Pasminco Exploration targeted a buried structure with a distinct airborne magnetic signature, the Benagerie Ridge Magnetic Complex (Figure 1). Air-core drill traverses across the strike of the magnetic eastern limb delineated the Portia prospect, which is situated in a local zone of low magnetic signature. Gold grains were found at the unconformity between the Tertiary sediments and the saprolite of the Proterozoic bedrock. Follow-up air-core drilling towards the N and along the strike of magnetic pyrite-bearing albitite units, in 1997, led to the discovery of the saprolite- and bedrock-hosted Cu-Au-Mo mineralization of the North Portia prospect.

PHYSICAL FEATURES AND ENVIRONMENT

The prospects are at the southern end of the Strzelecki Dune Field (Figure 2). The area has low relief (elevation approximately 70 m above sea level), with red-brown aeolian sand as low degraded dunes, separated by swales with calcareous alluvium and poorly developed gilgai (Gibson, 1999). The climate is semi-arid and has irregular annual rainfall averaging less than 200 mm. Mean minimum and maximum temperatures are about 20-32ºC (January) and 7-15ºC (July). Vegetation is thin, mainly saltbush and bluebush, with eucalyptus species growing along ephemeral drainages (Ker, 1966).

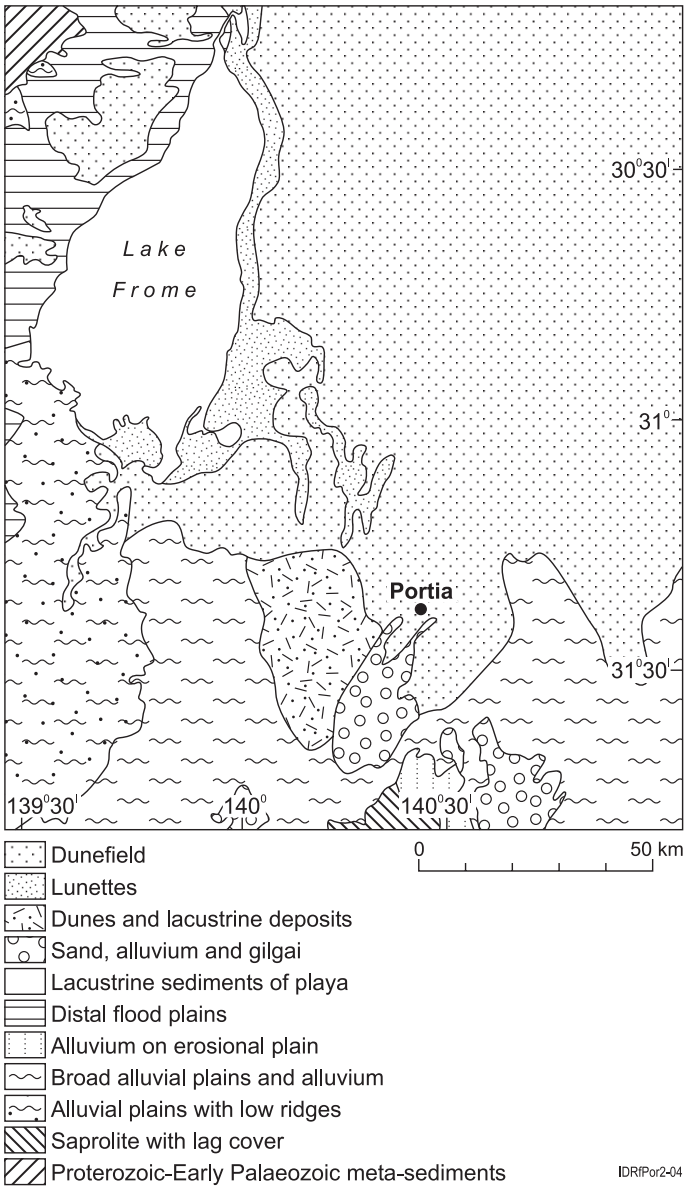

Figure 2. Geomorphic units of part of the Curnamona region (Frome Embayment) near the Portia and North Portia prospects, after Gibson and Wilford (1999).

GEOLOGICAL SETTING

The Portia and North Portia prospects are overlain by about 50-75 m of Quaternary and Tertiary sediments. The Proterozoic host and footwall rocks are intensely albitized and oxidized (hematite- and magnetite-bearing). Prior to albitization, the host rocks were finely laminated carbonaceous shales and evaporite- and carbonate-rich beds of saline silt and shale (Teale, 1999). The hanging wall is carbonaceous phyllite

intercalated with albite- and muscovite-rich beds.

REGOLITH

The regolith (Figure 3) includes, from the top down:

Soils, developed in degraded dunes and present-day floodplain deposits, consisting of 1-2 m of light brown, fine sands, with soft, powdery carbonate and groundwater gypsum in the subsoil.

Quaternary fluvial sediments, 3-8 m of moderately sorted, unconsolidated fine- to medium-grained olive brown sand and clay.

The Tertiary Namba Formation (50 m thick), comprised of various grey smectite-bearing clays with red and brown mottles. The sand-rich upper Namba Formation is thought to be a fluvial and flood plain deposit, whereas the clay-rich middle and lower units were deposited in low-energy shallow lacustrine environments (Tan, 2001).

The Tertiary Portia Unit, light grey clays with abundant kaolinite, variable amounts of mica (5-20%) and minor quartz (<5%), but with up to 20% quartz sand at the base of thicker parts of the unit. The Portia Unit is probably transported, filling a palaeovalley across the prospects, and sourced from proximal saprolite.

Saprolite, over 90 m thick, developed on the Proterozoic bedrock, comprised of quartz and kaolinite, with variable amounts of goethite, hematite and mica.

Proterozoic phyllites, containing K-feldspar, albite, biotite, chlorite, scapolite, actinolite, pyrite, Fe-oxides, rutile, quartz, and vein and matrix calcite and dolomite.

MINERALIZATION

Primary mineralization only occurs at North Portia and consists of chalcopyrite and molybdenite, with minor bornite and Au, in pyritic albitite host rocks. Some coarse-grained Au occurs in sulphide-poor veins in the hangingwall carbonaceous phyllite. There are two populations of Au grains, with mean compositions of 9.5% and 24% Ag for the first and second population respectively (Teale, 1999). Native Cu, covellite and chalcocite also occur in the saprolite from 85 to more than 100 m depth, *i.e.*, below the local water table at about 70-80 m.

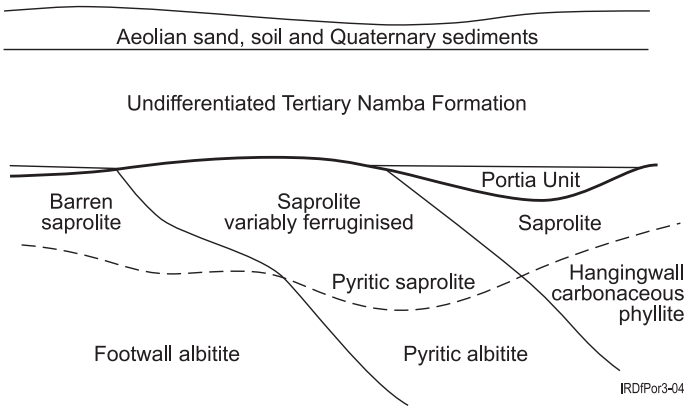

Figure 3. Regolith model of the Portia and North Portia prospects.

At Portia, irregular grains of Au (with 4-8% Ag) occur in the basal sand-rich part of the Portia Unit. Some contain arsenopyrite inclusions and appear to represent placer deposition (Tan, 2001). Some parts of the grains have Ag-depleted rims which, together with numerous etch pits, grooves and voids on their surfaces, indicate dissolution. Minor amounts of small (1 µm) possibly diagenetic Au particles also occur in the Portia Unit.

In the saprolite of the Proterozoic bedrock at Portia, irregular Au grains (large grains have dimensions of 800x1400 µm) contain <10% Ag (*i.e.*, similar to some of those in the unweathered bedrock at North Portia) and a few have galena and altaite (PbTe) inclusions. These are probably *in situ* primary grains, although some have secondary Ag-depleted rims (Tan, 2001). For the Portia prospect there is an inferred mineral resource of 270 000 t ore at 7 g/t Au (Skidmore and Fielding, 1999).

REGOLITH EXPRESSION

Saprolite of Proterozoic bedrock

High Cu, Au, Mo, As, Ni and Co concentrations occur in the mineralized pyritic saprolite (Summary Table), hosted by primary and secondary minerals including chalcopyrite, chalcocite, covellite, native copper, electrum, molybdenite, arsenopyrite, pyrite (Ni, Co) and sphalerite. Where these minerals are oxidized, element concentrations decrease sharply, except in the ferruginous saprolite, which is distributed across a 250 m wide zone up-dip of the mineralized sequence. In contrast, Zn appears to be concentrated in the ferruginous saprolite as the Zn abundance in the pyritic saprolite is less. Overall, the footwall and hanging-wall units are poor in these elements.

Tertiary and Quaternary Sediments

The highest trace element abundances in the sedimentary units occur in the Portia Unit, which contains up to 330 ppm Cu, 0.33 ppm Au (North Portia), 51 ppm Au (Portia), 70 ppm Mo, and 200 ppm As. In the other units, these elements are generally below threshold (*i.e.* median value of the Portia Unit). Despite higher maximum values in the Portia Unit, the median concentrations of Co and Zn are similar in the Portia Unit and Namba Formation (Summary Table). The same applies to Zn, but Zn in the Namba Formation would have been derived from distal source(s) whereas Zn in the Portia Unit is thought to have been derived locally, like the Au. Where the Portia Unit is absent, the base of the Namba Formation contains up to 180 ppm Cu, 0.1 ppm Au, 70 ppm Mo and 110 ppm As within 10 m of the sediment-saprolite unconformity.

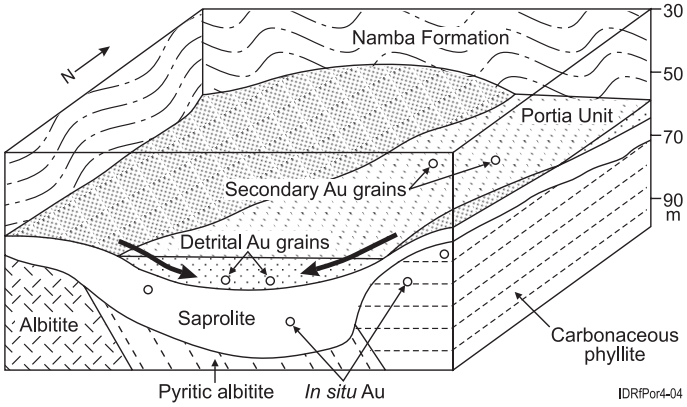

Figure 4. Model of the geology and Au distribution at the Portia prospect. Gold in the Portia Unit is dominantly detrital, whereas that in saprolite is in situ.

The distributions of Ag, Bi, Cd and Sb show low and sporadic occurrences in both the saprolite and sediments. However, due to the high detection limits (1 ppm for Ag and 5 ppm for Bi, Cd and Sb; Tan, 2001), the potential of these elements as pathfinders was not tested effectively.

Preservation of Au and Cu

The placer Au, concentrated at the base of the Portia Unit, is sourced locally from the Proterozoic bedrock. The coarse-grained Au is probably derived from sulphide-poor veins and has been preserved in the saprolite. It was eroded with the saprolite and deposited in the Portia Unit and lower Namba Formation. The reducing and near-neutral groundwaters do not favour the formation of Au-complexing ligands such as chloride, thiosulphate and monohydroxide, hence the detrital and *in situ* primary Au grains have remained largely unaltered. Similarly, the reducing groundwaters have allowed secondary covellite, chalcocite and native copper to remain stable in the pyritic saprolite.

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SAMPLE MEDIUM – SUMMARY TABLE

Sample medium	Indicator element	Analytical technique	Detection limit (ppm)	Median (ppm)	75th percentile (ppm)	Maximum (ppm)
Namba	As	XRF	0.5	7	13	110[1]
Formation	Au	ICP-MS[4]	0.01	< 0.01	< 0.01	0.1[1]
	Cu	XRF	1	30	52	180[1]
n = 265	Mo	XRF	0.1	5	8	70[1]
	Ni	XRF	1	25	30	50
	Co	XRF	1	13	20	30
	Zn	XRF	1	60	80	270
Portia Unit	As	XRF	0.5	87	120	200
	Au	ICP-MS[4]	0.01	0.01	0.03	0.33, 51[2]
n = 32	Cu	XRF	1	110	190	330
	Mo	XRF	0.1	23	30	70
	Ni	XRF	1	39	70	120
	Co	XRF	1	12	15	100
	Zn	XRF	1	44	70	240
Non-	As	XRF	0.5	7	21	140
Ferruginous	Au	ICP-MS[4]	0.01	<0.01	0.02	0.45
Saprolite	Cu	XRF	1	70	99	1530
	Mo	XRF	0.1	2.5	7	31
n = 115	Ni	XRF	1	8	11	25
	Co	XRF	1	<1	3	8
	Zn	XRF	1	7	21	103
Ferruginous	As	XRF	0.5	34	64	290
Saprolite	Au	ICP-MS[4]	0.01	0.02	0.07	4.28
	Cu	XRF	1	110	180	2940
n = 294	Mo	XRF	0.1	39	140	1680
	Ni	XRF	1	35	50	430
	Co	XRF	1	18	30	310
	Zn	XRF	1	140	180	1240
Pyritic	As	XRF	0.5	65	88	270
Saprolite	Au	ICP-MS[4]	0.01	0.06	0.10	5.86
	Cu	XRF	1	850	1700	59200[3]
n = 213	Mo	XRF	0.1	57	120	1770
	Ni	XRF	1	81	160	1120
	Co	XRF	1	140	330	1740
	Zn	XRF	1	11	40	90
Unweathered	As	XRF	0.5	9.5	11	20
wall rock	Au	ICP-MS[4]	0.01	0.01	0.02	0.32
	Cu	XRF	1	6	26	280
n = 96	Mo	XRF	0.1	1.5	1.9	28
	Ni	XRF	1	31	36	49
	Co	XRF	1	7	9	58
	Zn	XRF	1	41	56	98

[1] Lower part of the Namba Formation within 10 m of the sediment-saprolite unconformity

[2] North Portia and Portia Prospects, respectively

[3] Hosted in secondary minerals such as chalcocite, covellite and native Cu

[4] After cyanide leach