

# OONAGALABI BASE METAL PROSPECT, HARTS RANGE, NORTHERN TERRITORY

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## LOCATION

Oonagalabi is about 135 km NE of Alice Springs (Figure 1) in the Harts Range at 23°07'25"S, 134°51'18"E; Alice Springs 1:250 000 map sheet (SF53-14).

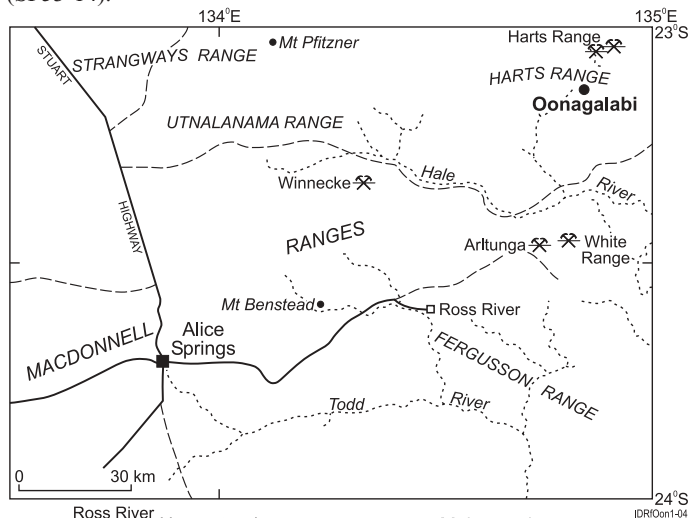


Figure 1. Location map of the Oonagalabi base metal prospect in the Harts Range, Arunta Block, NT.

## DISCOVERY HISTORY

Copper mineralization was discovered here in the 1930s, but there is no record of any work until 1970 when Russgar Minerals NL explored in the Harts Range area. Mineralization was found at three localities by prospectors, but work subsequently concentrated on the Oonagalabi prospect (Joyce, 1981). The mineralization is sub-economic with probable reserves of 25 Mt at 0.5% Cu and 1% Zn (Wygalak and Bajwah, 1998).

## PHYSICAL FEATURES AND ENVIRONMENT

The landforms are erosional. The topography in the Oonagalabi area is hilly to mountainous. Valley sides are steep and the creeks are deeply incised, particularly in first- and second-order streams, which drain from S to N. The region is semi-arid, with an average annual



Figure 2. Geological map of the Oonagalabi prospect (after Skidmore, 1996; uncontrolled mosaic) showing the mineralized calc-silicate (see Figure 3 for location).

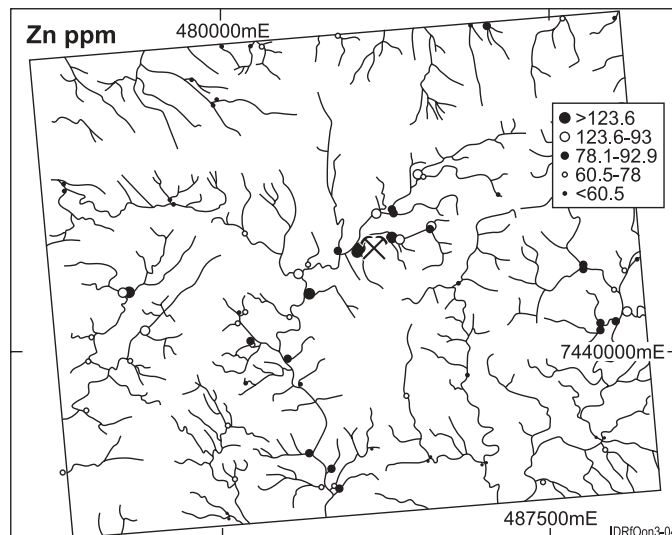
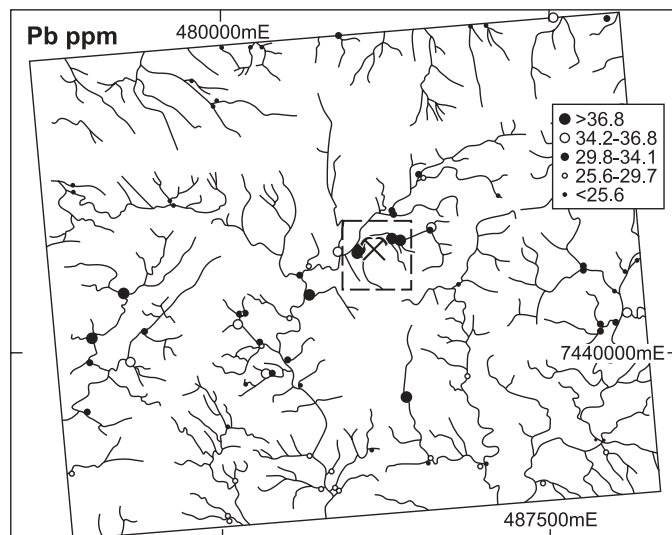
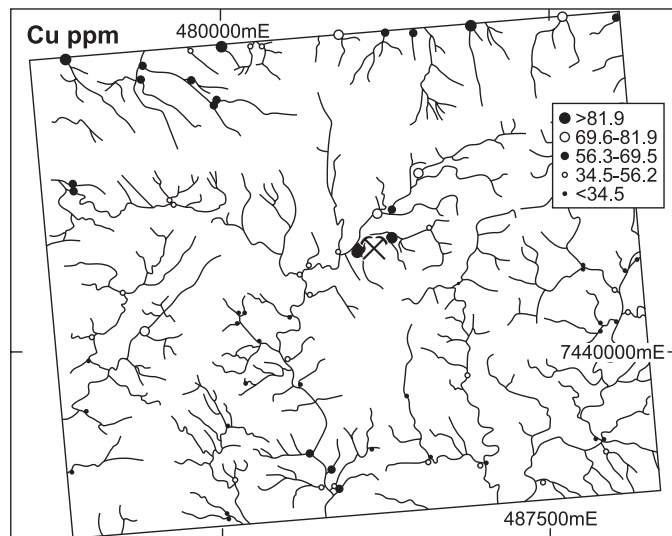


Figure 3. Distribution of Cu, Pb and Zn (ppm) in regional (<180 μm) stream sediments (after Joyce, 1981). Oonagalabi prospect and approximate locations of Figures 2 and 5 indicated.

precipitation of 350 mm, falling mainly in summer when it is hot (22-38°C). The winters are cool (6-21°C) and dry. The hills are covered with tussocks of spinifex interspersed with small trees; larger trees are more common along watercourses.

## GEOLOGICAL SETTING

The Oonagalabi prospect is in a tectonically detached inlier (the

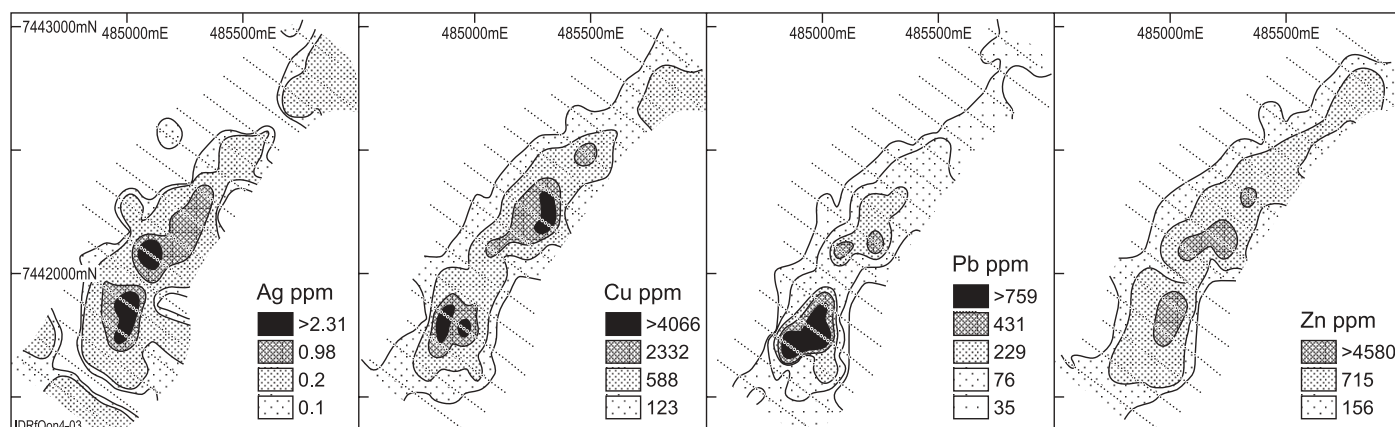


Figure 4. Distribution of Ag, Cu, Pb and Zn in (<75 µm) soils (see Figure 3 for location).

Oonagalabi Tongue; Ding and James, 1985) of the Strangways Metamorphic Complex (Warren and Shaw, 1985). These rocks are part of the upper Bungitina metamorphics (Shaw *et al.*, 1984; Division 1 of the Central Zone of the Arunta Inlier), or the Oonagalabi gneiss complex (Ding and James, 1985). There are quartzofeldspathic gneisses (Figure 2), amphibolite and mafic granulite, with minor lenses of anthophyllite rock. The quartzofeldspathic gneisses and amphibolites were a suite of bimodal volcanic rocks (Warren and Shaw, 1985), deposited in a rift-basin during crustal extension, shortly before high-grade metamorphism. The rocks were metamorphosed to granulite facies during the Strangways Orogeny (about 1780 Ma; Collins and Shaw, 1995) resulting in migmatization and pyroxene-dominated assemblages (Oliver *et al.*, 1988). Later retrogression to amphibolite facies resulted in an amphibole-dominated assemblage (Warren and Shaw, 1985; Oliver *et al.*, 1988).

Their structure is complex, with seven generations of ductile folding, shearing and thrusting related to the juxtaposition of the Strangways Metamorphic complex and the Harts Range complex to the N (Ding and James, 1985). The relationship between these two domains is poorly understood.

### REGOLITH

There are virtually no weathered materials in the area, except on sulphidic lithologies, where an irregular veneer of saprock (up to 10 m) overlies fresh bedrock, although malachite persists on joints and fractures to greater depths. The larger creeks (e.g., Florence Creek) drain to the W and SW, are relatively broad, locally contain sand and/or gravel bars, and cut into an undulating landscape. Stream sediments within these fourth-order creeks are commonly rich in garnet, derived from the mechanical breakdown of the garnetiferous Irindina Gneiss to the N.

### MINERALIZATION

In fresh rock, the sub-economic mineralization is chalcopyrite and sphalerite with minor pyrrhotite, pyrite, galena, cubanite, matildite and native Bi as patches, disseminations and veinlets mainly within calc-silicate rocks. The sulphides become finer grained and more disseminated away from the calc-silicate unit. Sulphidic veinlets and disseminations are discordant to lithological contacts and metamorphic foliation, and are undeformed (Skidmore, 1996). Fine-grained, disseminated gahnite is restricted to the calc-silicate rocks and marbles, but is absent from sulphidic domains, leading Skidmore (1996) to suggest that the gahnite is a product of high-grade metamorphism and is a consequence of anomalous Zn in the marble protolith. Warren and Shaw (1985) proposed a syngenetic volcanogenic model for the mineralization, whereas Skidmore (1996), on the basis of textural and lithological relationships, proposed an epigenetic origin during the Alice Springs Orogeny (300-400 Ma).

### REGOLITH EXPRESSION

#### Outcrop and gossan

In outcrop, malachite staining is prominent; other minerals are azurite, chrysocolla, rare chalcocite, smithsonite and goethite. Galena is generally the only remnant sulphide (Joyce, 1981; Skidmore, 1996).

Some mineralized calc-silicate rocks and marbles have a thin 'gossan' with boxworks or Fe oxide pseudomorphs after sulphides. Limited geochemical data (Neilsen and MacCulloch, 1971) indicate that the gossans contain up to 2.7 ppm Au.

#### Soil

About 400 soil samples from the C-horizon (augered to an average depth of 300 mm) were sieved to <75 µm by Amoco Minerals Australia Co (Joyce, 1981). These delineated a contiguous zone anomalous in Cu (>250 ppm), Pb (>50 ppm), Zn (>250 ppm) and Ag (>0.1 ppm) over a strike of 1400 m and a width of 320 m (Figure 4). Over outcropping mineralization, maximum values obtained were 2.65% Cu, 8940 ppm Pb, 5.5% Zn, and 11.6 ppm Ag.

#### Stream sediments

Regional stream sediment sampling (120 samples <180 µm; Joyce, 1981; Figure 3) confirmed the known zones of mineralization. The maximum Cu, Pb and Zn concentrations in stream sediments (140, 50 and 470 ppm respectively) occur at Oonagalabi; no new anomalies were located.

Five size fractions from stream sediments were analyzed (Skwarnecki *et al.*, 2000): bulk <6 mm, 2-6 mm, 0.5-2 mm, 75-180 µm and <75 µm. Samples were from first- and second-order creeks draining the mineralized area (Figure 5), and the remainder from major third-order streams. Sample sites included those from 'barren' areas upstream, or away from mineralization. The westernmost creek was sampled at 100 m intervals, to determine geochemical dispersion from background, through the mineralized zone, and downstream into the major drainage at Florence Creek. The sediments in the creeks vary from sand to boulders; outcrops are common. The dominant lithologies are quartz-feldspar-biotite gneiss, mafic amphibolite and gneiss (country rocks) and malachite-stained magnesian-amphibole schists, marbles and diopside-bearing calc-silicate rocks (mineralization).

The mineralization has a distinct Au-Bi-Cd-Cu-Pb-Sn-W-Zn signature in all fractions (Skwarnecki *et al.*, 2000). Copper, Pb, Zn and, to a lesser extent, Au and Bi are most widely dispersed over the mineralized zone and downstream to Florence Creek. Anomalous Cd, Sn and W concentrations appear to be restricted to the vicinity of the mineralized zone. These elements have been incorporated into the stream sediments by mechanical dispersion during weathering and erosion of the mineralized zones; there is no obvious scavenging of these elements by Fe and Mn oxides. Arsenic and Sb have very low concentrations and show no clear relationship to the mineralization (in contrast to many VMS deposits). Geochemical anomalies are restricted to first- and second-order streams, and do not persist into the major, third-order creeks. Any size fraction at virtually any reasonable spacing would have detected the mineralized zone and provided the downstream dispersion trails. The best size fractions are 2-6 mm for all elements except Au and <75 µm for all elements except Sn and W.

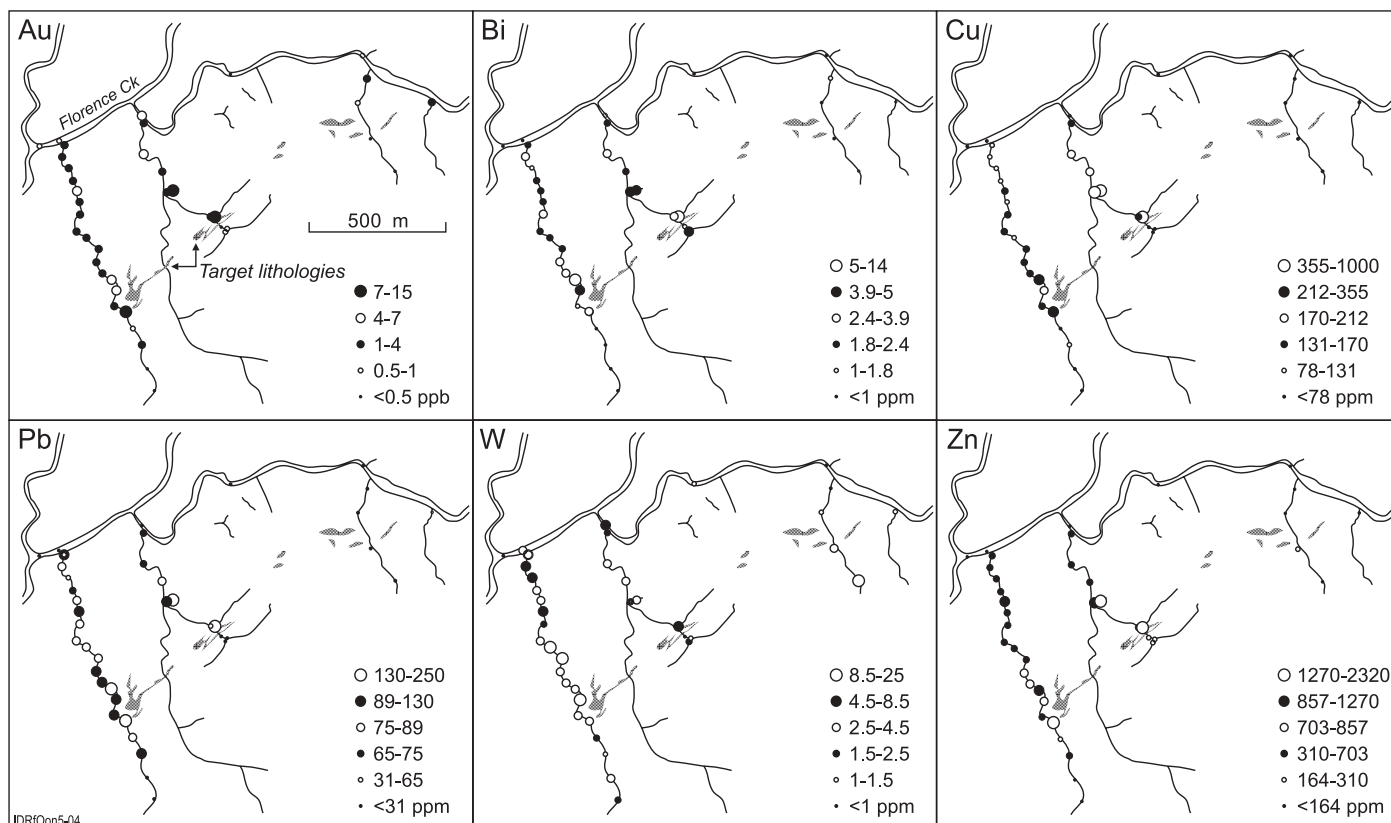


Figure 5. Distribution of Au in the <75  $\mu$ m fraction and Bi, Cu, Pb, W and Zn in the <6 mm fraction in stream sediments (after Skwarnecki et al., 2000; see Figure 3 for location).

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## 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 Pb Zn	AAS1	unknown	750 750 300	4000 4500 4500	29500 3550 32800	12 7 20
Saprolite and saprock	Cu Pb Zn	AAS1	unknown	750 750 1500	3500 2500 7500	312500 8450 68500	80 60 80
Soil (<75 $\mu$ m)	Ag Cu Pb Zn	AAS2	0.1 unknown	<0.1 950 80 500	1 950 450 2500	11.6 26500 8940 55000	300 x 60 400 x 150 400 x 100 400 x 100
Regional (<180 $\mu$ m) stream seds	Cu Pb Zn	AAS3	unknown	25 24 55	75 33 85	134 50 470	
Stream sediments	Au	AAS4	0.0005	bulk <6 mm: 0.0015	bulk <6 mm: 0.003	bulk <6 mm: 0.006	bulk <6 mm:
	Bi	ICP-MS	0.1	1.8	5	13.2	800
	Cu	ICP-MS	1	78	355	922	700
	Pb	ICP-MS	1	31	130	241	1000
	Sn	ICP-MS	1	5	5.5	8	
	W	ICP-MS	0.5	4.5	8	22.5	
	Zn	ICP-MS	2	164	1270	2320	800
				2-6 mm: 0.0015	2-6 mm: 0.0035	2-6 mm: 0.0055	2-6 mm:
	Au	AAS4	0.0005	0.0015	0.0035	0.0055	
	Bi	ICP-MS	0.1	2.4	10.4	16.8	800
	Cu	ICP-MS	1	128	266	1240	800
	Pb	ICP-MS	1	30	130	310	1000
	Sn	ICP-MS	1	4	7	8	350
	W	ICP-MS	0.5	2.5	6.5	7.5	450
	Zn	ICP-MS	2	144	1550	2810	1000
				0.5-2 mm: 0.0005	0.5-2 mm: 0.004	0.5-2 mm: 0.0305	0.5-2 mm:
	Au	AAS4	0.0005	0.0005	0.004	0.0305	
	Bi	ICP-MS	0.1	2.3	4.9	13	400
	Cu	ICP-MS	1	87	312	1020	600
	Pb	ICP-MS	1	29	138	258	1000
	Sn	ICP-MS	1	4	7	9	
	W	ICP-MS	0.5	4	10	35	300
	Zn	ICP-MS	2	309	904	2380	700
				75-180 $\mu$ m: 0.001	75-180 $\mu$ m: 0.0025	75-180 $\mu$ m: 0.0285	75-180 $\mu$ m:
	Au	AAS4	0.0005	0.001	0.0025	0.0285	
	Bi	ICP-MS	0.1	1.9	3.5	10.2	400
	Cu	ICP-MS	1	88	240	993	800
	Pb	ICP-MS	1	38	144	435	1000
	Sn	ICP-MS	1	4	6	7	
	W	ICP-MS	0.5	5	7.5	11.5	
	Zn	ICP-MS	2	263	914	2910	1000
				<75 $\mu$ m: 0.004	<75 $\mu$ m: 0.007	<75 $\mu$ m: 0.0145	<75 $\mu$ m:
	Au	AAS4	0.0005	0.004	0.007	0.0145	800
	Bi	ICP-MS	0.1	2.4	4.1	12.2	550
	Cu	ICP-MS	1	119	498	1540	1000
	Pb	ICP-MS	1	38	206	685	1000
	Sn	ICP-MS	1	5	7	9	
	W	ICP-MS	0.5	5	6.5	8.5	
	Zn	ICP-MS	2	385	1530	3800	1000

AAS1 hydrochloric-nitric-perchloric acid digest. AAS2 hydrochloric-perchloric acid digest.  
AAS3 probably nitric-perchloric acid digest. AAS4 graphite furnace after aqua regia digest.  
ICP-MS after mixed acid digest.