WINNECKE GOLDFIELD, NORTHERN TERRITORY

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LOCATION

The Winnecke Goldfield is located about 70 km NE of Alice Springs (Figure 1), at 23°20'00"S, 134°21'00"E; Alice Springs 1:250 000 sheet (SF53-14).

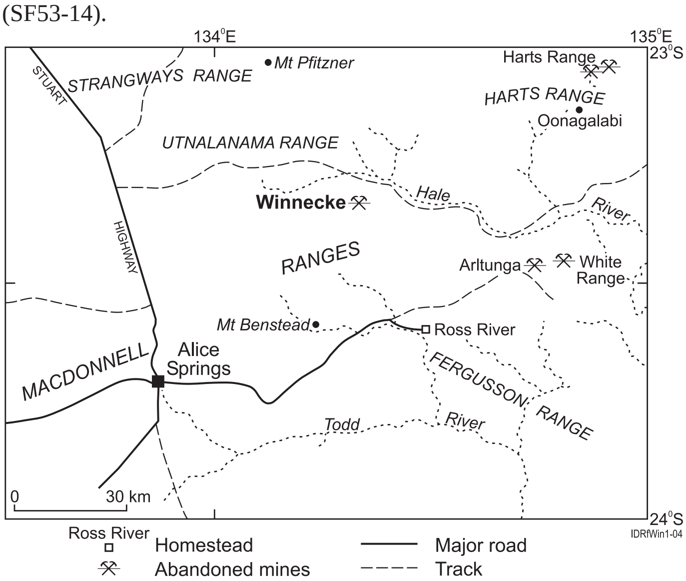

Figure 1. Location map of the Winneke Goldfield, MacDonnell Ranges, Arunta Block, NT.

DISCOVERY HISTORY

The main period of prospecting and mining occurred between 1901 and 1905, with sporadic activity up to 1940. The total recorded production is about 1500 oz (46.65 kg; including 127 oz (3.95 kg) of alluvial gold); unrecorded production probably does not exceed 500 oz (5.55 kg; James, 1991). Limited exploration has been carried out since about 1970, with no significant discoveries.

PHYSICAL ENVIRONMENT

The southern part of the Winneke area consists of high quartzite ranges sloping down to the north to hills of gneiss with a colluvial pediment. The remainder consists of remnants of high river terraces, undulating alluvial plains and sandy river channels with small basement rises of weathered bedrock between. The climate is semi-arid with an annual rainfall of 320 mm and average temperatures that range from 20-35ºC in January and 2-20ºC in July. The steep talus hill slopes are partly covered with a low, open shrubland with hummock grasses (spinifex clusters). The ridge tops and lower slopes have a low shrubland of eucalypts and acacias with tussock grasses. Alluvial tracts are marked by an open woodland with ghost gums and other eucalypts and some acacias.

GEOLOGICAL SETTING

The Winnecke Goldfield straddles the structural contact between the Palaeoproterozoic Arunta Province and the basal Neoproterozoic sequence of the Amadeus Basin (Figure 2). The Arunta Province rocks include: - i) the Erontonga Metamorphics (cordierite-garnet-sillimanite gneisses, calc-silicate and amphibolites) and the Anuma Schist (staurolite-kyanite-mica schist and gneiss) of the Winnecke Block; ii) the Ankala Gneiss (biotite schist and gneiss, calc-silicate and marble, quartzofeldspathic gneiss and amphibolite), of the Ankala Block N of the Amadeus Basin; iii) the Irindina Gneiss (quartzofeldspathic gneiss, biotite schist and amphibolite) of the Ankala Block; and iv) the Mulga Creek Granitic Gneiss (muscovite-biotite granitic gneiss and minor amphibolite) of the Ankala Block (Figure 2).

The overall metamorphic grade is upper amphibolite facies. However, retrograde greenschist facies rocks occur within schist zones, which are related to faulting and thrusting along deformation zones within the Arltunga Nappe Complex during the Devonian-Carboniferous Alice Springs Orogeny (Forman, 1971).

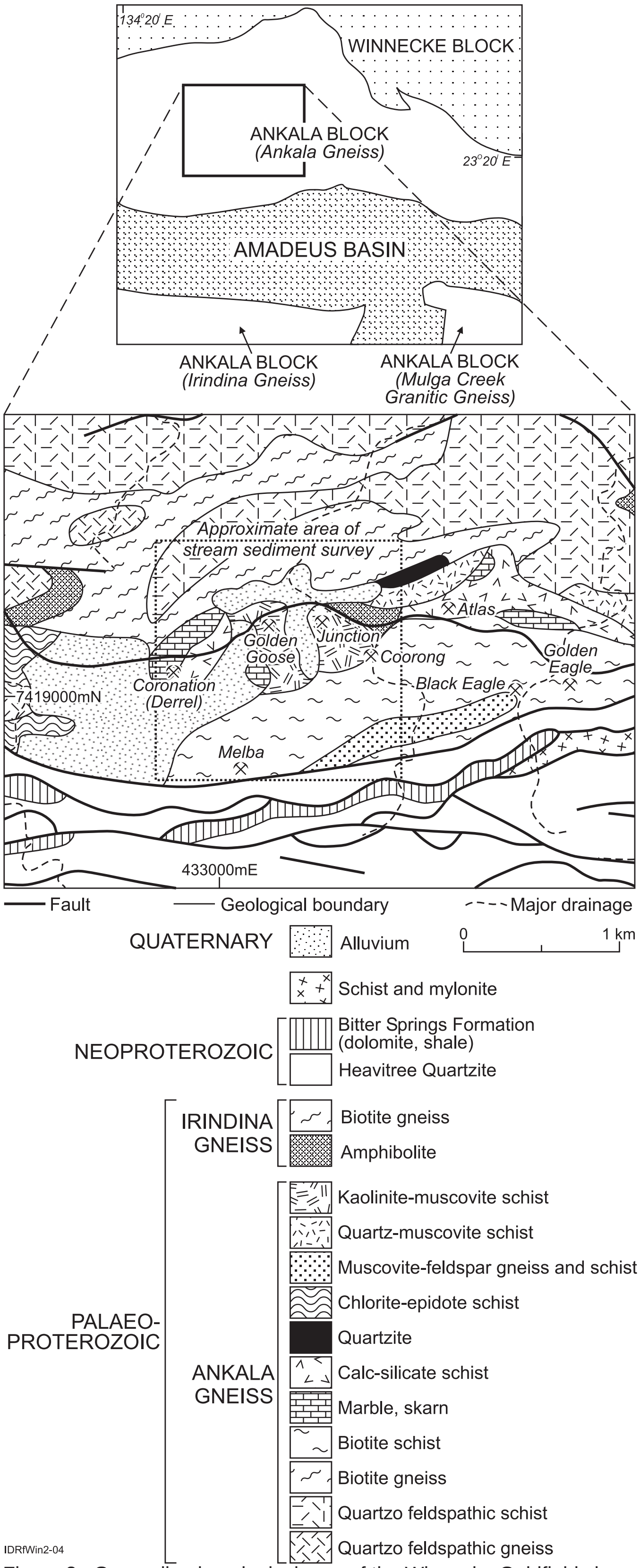

Figure 2. Generalised geological map of the Winnecke Goldfield showing the locations of the old gold mines (after Pigott, 1984) and the location of the area of stream-sediment sampling in Figure 3.

The basal part of the Amadeus Basin consists of the Heavitree Quartzite (quartzites with grits and conglomerates) and the Bitter Springs Formation (shales and dolomites). These units unconformably overlie Arunta rocks at Mt Laughlen (Joklik, 1955), to the S of Winnecke, but are strongly deformed and have been thrust over the Arunta Group in the Winnecke area.

REGOLITH

The area is generally hilly but there are alluvial flats in the Golden Goose-Coronation area. To the S, the terrain becomes mountainous towards the contact between the Arunta Inlier and the Amadeus Basin. Apart from the alluvial flats, the regolith-landforms are erosional and the area is covered by residual soil and lag derived largely from Arunta Province lithologies and the quartz veins transecting them. Some of the outcrops of the Arunta Province rocks are ferruginized.

Sediment in the creeks varies from sand to gravel to boulders. Outcrops of Arunta Province rocks locally occur in creek banks. In a few places, gossanous quartz, similar to that hosting mineralization at Golden Goose, is found in stream sediments. However, the dominant lithologies in most stream sediments are quartzite and chert from the Heavitree Quartzite to the S. Vein quartz is also common and some is locally derived. Quartzite, from the Heavitree Quartzite, has significantly diluted detritus from the Arunta Province rocks. An exception is the creek draining the old Coronation workings, where quartzite is absent and the debris is locally derived.

MINERALIZATION

The Winnecke gold deposits occur in the greenschist retrograde schist zones (Shaw and Langworthy, 1984) mainly within rocks of the Arunta Province. The age of the gold mineralization is presumed to be 322 Ma (Carboniferous), based on K-Ar dating of muscovite from quartz veins in the White Range area of the Arltunga Nappe Complex (Stewart, 1971).

According to Wygralak and Bajwah (1998), there are two styles of Au mineralization: i) Auriferous quartz veins, with native Au concentrated in those portions of the veins that are composed of gossanous quartz. These mineralized portions form irregular domains within otherwise barren veins. ii) Stratabound mineralization in hydrothermally altered quartz-muscovite-kaolinite schists, graphitic schists or sericitic schists.

The largest deposit is Golden Goose. Quartz reefs are dominant; the veins form a zone 10-20 m wide and can be traced for 90 m along strike. Individual veins dip 35-45ºN, parallel to the approximately E-W foliation, although local splays and rolls occur. The veins pinch and swell along strike and down dip. The quartz within the veins is milky white, locally ferruginous and, below the zone of weathering (about 12 m; Matthews, 1905; Hossfeld, 1940), contains minor pyrite. In the weathered zone, domains of boxworks, with or without Fe oxides, carry native gold. Drilling through the mineralized zone (Pigott, 1985) indicates that economic Au grades are restricted to the upper 15 m.

Hydrothermally-altered metasedimentary rocks host subsidiary mineralization. The altered zone, striking E and dipping 35-45ºN, contains a stockwork of thin, irregular, commonly folded, quartz veinlets cutting, and parallel to, the foliation. This zone becomes more siliceous with depth, and the degree of silicification and ferruginization increases from W to E (Pigott, 1985).

The Coorong mine is located about 550 m E of Golden Goose. The lode consists of a quartz-veined breccia up to 2.5 m wide, trending ENE and dipping 55ºN, and is conformable with wall-rock foliation and can be traced for 100-150 m along strike. Within the lode, there appears to be a single major quartz vein (up to 0.6 m wide) that pinches and swells along strike and down dip (Swingler and McLennan, 1987). Footwall rocks are brecciated, coarse-grained muscovite-biotite schists. The hangingwall consists of interbedded quartzite and pelitic schist (Pigott, 1985). The depth of the old workings is 30 m (Hossfeld, 1940). Mineralization occurs within soft, friable, ferruginous material associated with veinlets and masses of quartz.

The Junction mine is located about 300 m E of Golden Goose. Gold mineralization occurs in a single E-striking quartz reef up to 2 m thick, locally with ferruginous cavities and traces of Cu carbonates (Swingler and McLennan, 1987). The vein can be traced along strike for about 30 m. Wallrocks are mainly pelitic and psammitic schists.

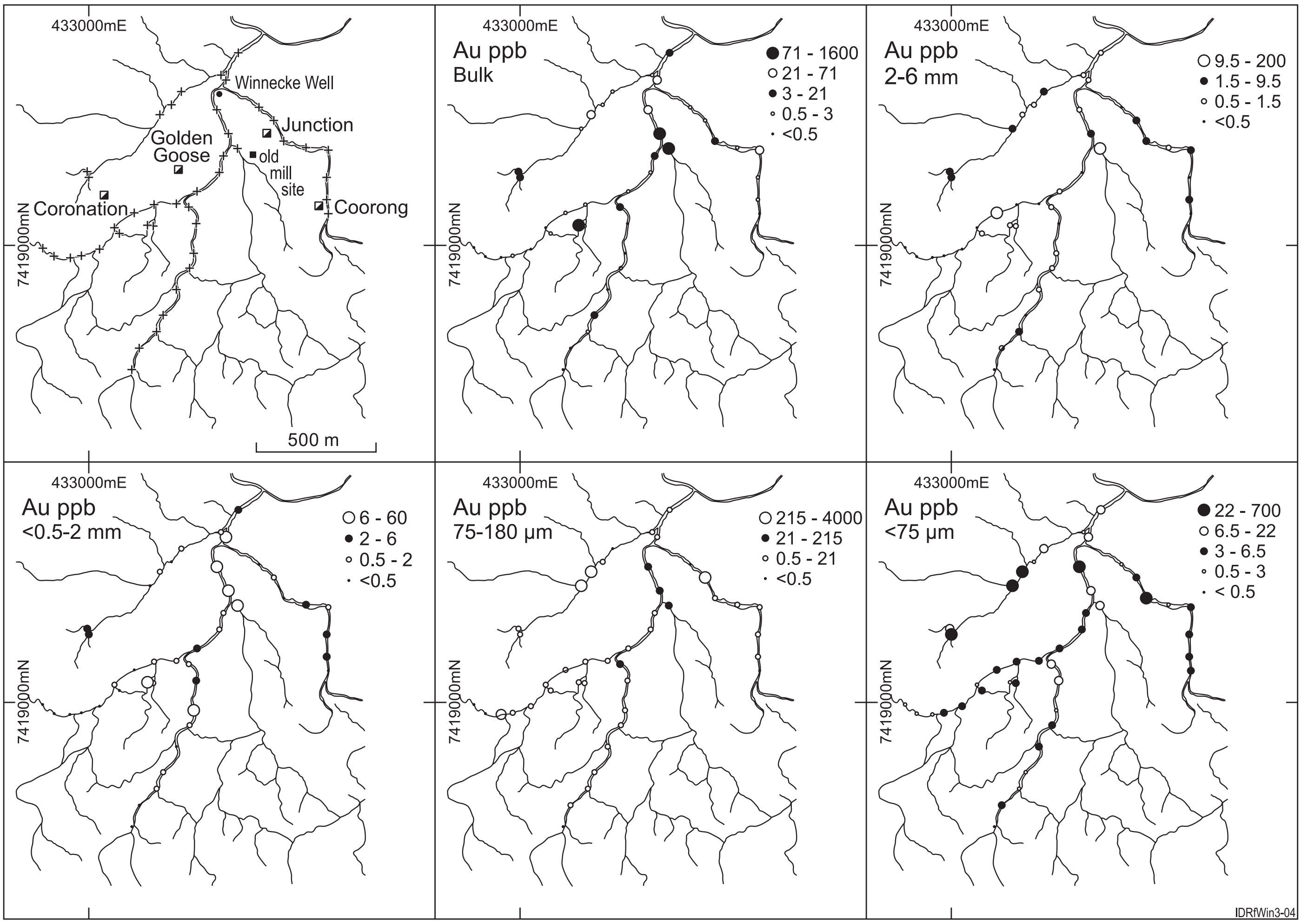

Figure 3. Drainage at Winneke (A) and distributions of Au (ppb) in the bulk <6 mm (B), 2-6 mm (C), 0.5-2 mm (D), 75-180 µm (E) and <75 µm (F) fractions in stream sediments at Winnecke. See Figure 2 for location.

REGOLITH EXPRESSION

Stream sediments. An orientation stream sediment survey investigated five size fractions (Skwarnecki *et al.*, 2000): bulk <6 mm, 2-6 mm, 0.5-2 mm, 75-180 µm and <75 µm. Gold contents are similar for all fractions, although there is a general trend to greater concentrations in the 75-180 µm and <75 µm fractions. Concentrations are generally low (commonly <11 ppb Au), although there are anomalies in each fraction (Figure 3). The most prominent anomalies are related to downstream dispersion of tailings from the old mill (in all fractions, but particularly in the bulk <6 mm, 75-180 µm and <75 µm fractions). There are sporadic samples with relatively high Au concentrations in most fractions, some proximal to known mineralization (but with no consistent dispersion trains), and others that may be local alluvial concentrations. Gold shows no significant correlation with any other element in any fraction.

Of the other elements investigated, only Bi, Sb and W are likely to assist geochemical exploration for Winnecke-style Au mineralization, using the fine fractions. Copper, Ni, Zn, Ba and Pb distributions are controlled by with Mn oxides, whereas Ce, Pb, Rb, Ti, U, W, Sn, Sr and Zr are associated with Fe oxides and heavy detrital minerals.

The signature of Au mineralization is weak (except in the creek draining the Coronation workings) due to severe dilution of any locally derived sediment by exotic detritus from the Heavitree Quartzite to the S, and by apparent alluvial concentrations not directly related to known occurrences of mineralization. Other factors may be that the mineralization itself is either not significant, or that Au is so heterogeneously distributed in the lodes, with subsequent dispersion into the creeks is irregular, giving a poor overall geochemical signal in stream sediments.

Soils. A soil survey (minus 180 µm fraction) over the Golden Goose deposit defined Au (>50 ppb) and W (>20 ppm) anomalies over the mineralized zone (Pigott, 1984, 1985). Although there are minor anomalies in As (up to 14 ppm), Cu (to 70 ppm), Pb (to 56 ppm) and Zn (to 240 ppm) coincident with the mineralized zone, they are not diagnostic, as stronger anomalies occur elsewhere, presumably related to particular lithologies and/or ferruginized saprock.

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SAMPLE MEDIUM - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Detection limits (ppm)	Background (50th percentile, ppm)	Threshold 90th percentile, ppm)	Maximum anomaly[1] (ppm)		Dispersion distance (m)
Primary mineralization						Arunta	Amadeus	
	Ag	AAS/perchloric	1			6	<1	
	As	XRF	2			135	7	
	Au	AAS/aqua regia	0.01	insufficient	insufficient	60	4	
	Cu	AAS/perchloric	2	data	data	540	100	
	Pb	AAS/perchloric	5			230	80	
	Sb	XRF	4			14		
	W	XRF	10			250	10	
	Zn	AAS/perchloric	2			150	14	
Soil	Au	as above	0.05	<0.050	0.270	4.9		200 x 300
(<180 µm)	W		10	<10	15	75		100 x 100
Stream				bulk <6 mm:	bulk <6 mm:	bulk <6 mm:		All fractions
sediments	Au	AAS/GF aqua regia	0.0005	0.0012	0.063	1.530		100
	Bi	ICP-MS/mixed acid	0.1	0.43	2	7.3		<400
	Sb	ICP-MS/mixed acid	0.1	0.5	1.25	1.8		?
	W	ICP-MS/mixed acid	0.5	1.8	2.85;	5.5;		400-500
				2-6 mm:	2-6 mm:	2-6 mm:		
	Au	AAS/GF aqua regia	0.0005	0.0007	0.0059	0.172		
	Bi	ICP-MS/mixed acid	0.1	0.16	0.3	1.1		
	Sb	ICP-MS/mixed acid	0.1	0.3	0.91	1.8		
	W	ICP-MS/mixed acid	0.5	1.6	2.4	6		
				0.5-2 mm:	0.5-2 mm:	0.5-2 mm:		
	Au	AAS/GF aqua regia	0.0005	0.00095	0.0125	0.037		
	Bi	ICP-MS/mixed acid	0.1	0.26	1	2.1		
	Sb	ICP-MS/mixed acid	0.1	0.5	1.08	2		
	W	ICP-MS/mixed acid	0.5	1.8	2.6	7		
				75-180 µm:	75-180 µm:	75-180 µm:		
	Au	AAS/GF aqua regia	0.0005	0.00295	0.210	3.190		
	Bi	ICP-MS/mixed acid	0.1	0.36	1.4	1.4		
	Sb	ICP-MS/mixed acid	0.1	0.52	1.9	2.2		
	W	ICP-MS/mixed acid	0.5	1.45	2.8	4.5		
				<75 µm:	<75 µm:	<75 µm:		
	Au	AAS/GF aqua regia	0.0005	0.0052	0.04	0.655		
	Bi	ICP-MS/mixed acid	0.1	0.3	0.79	0.8		
	Sb	ICP-MS/mixed acid	0.1	0.52	0.91	1.4		
	W	ICP-MS/mixed acid	0.5	1.4	1.95	3.5		

[1] Excluding stream-sediments contaminated by old tailings

GF - graphite furnace Mixed acid - HF/HCl/HNO_3