GOORNONG SOUTH GOLD DEPOSIT, CENTRAL VICTORIA

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LOCATION

The Goornong South Au deposit is located 4 km N of Fosterville and 25 km NE of Bendigo, Victoria (Figure 1) at 36°42'S, 144°30'E; Bendigo (SJ 55-1) 1:250 000 map sheet.

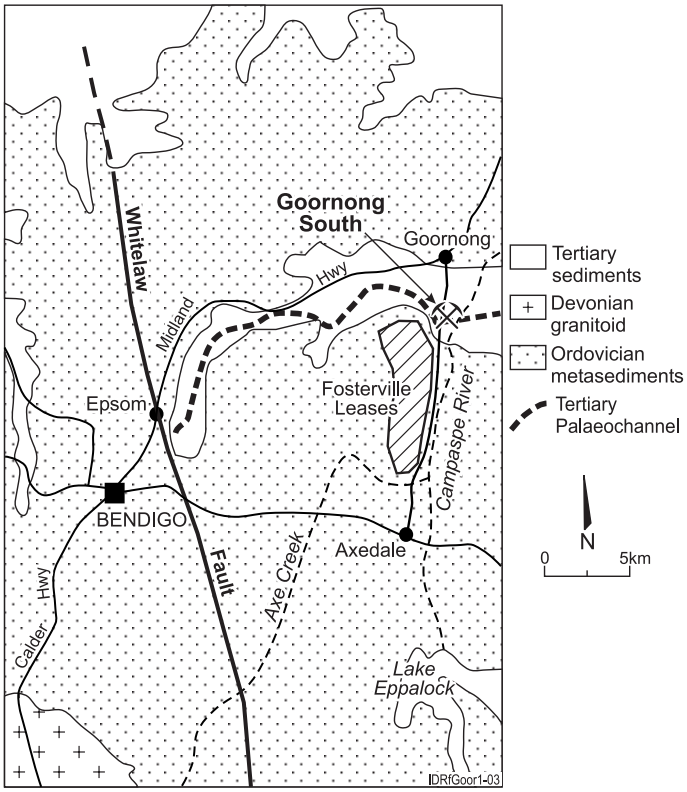

Figure 1. The Goornong South mineralization relative to the Fosterville Leases and regional geology.

DISCOVERY HISTORY

The Goornong South deposit does not outcrop. There is mineralized float around a low rise at the S end of the deposit and shallow prospecting pits at the N and S ends. The float contains up to 1.8 ppm Au and 1700 ppm As, and ferruginous saprolite from one of the N pits contains up to 5.2 ppm Au and 2700 ppm As (Scott and Van Riel, 1999b). This Au-As association in regolith is similar to that at the nearby Fosterville deposits and encouraged Perseverance Exploration Pty Ltd., to commence geochemical sampling of weathered bedrock. During late 1995, three lines (50 m apart; 10 m sampling interval) were auger drilled over the rise at the S end of the deposit. These outlined a broad (>150 x 150 m) anomaly in As (>100 ppm) and Au (>50 ppb). Nine reverse circulation holes in 1996 yielded disappointing results (best intersection 4 m @ 1.02 g/t Au). Nevertheless, porphyry dykes, a favourable structure and anomaly alignment to the 340º magnetic trend of the Fosterville mineralization all encouraged persistence with the bedrock auger program. As the depth to bedrock increased in the middle of the prospect, RAB drilling replaced augering and an almost continuous 1.3 km long anomaly was identified (Figure 2). In 1997, a further 36 holes were drilled (2200 m of RC drilling) over the whole length of the Goornong South anomaly, but with a focus on the area just to the N of the original drilling. This program was designed to test oxide resources suitable for heap leaching and produced results such as 10 m @ 4.6 g/t Au, 6 m @ 7.5 g/t Au and 18 m @ 1.8 g/t Au. Subsequent infill drilling during 1998 (30 holes) defined a deposit of 783 000 t of oxide ore @ 1.4 g/t Au in the S portion of the Goornong South anomaly (Gold Mining Journal, 1998).

PHYSICAL FEATURES AND ENVIRONMENT

The Goornong South deposit occurs among rounded low-relief hills in a broad valley formed by the N-flowing Campaspe River several kilometres to the E (Figure 1). The vegetation has largely been cleared, for agricultural and pastoral purposes, although remnants of

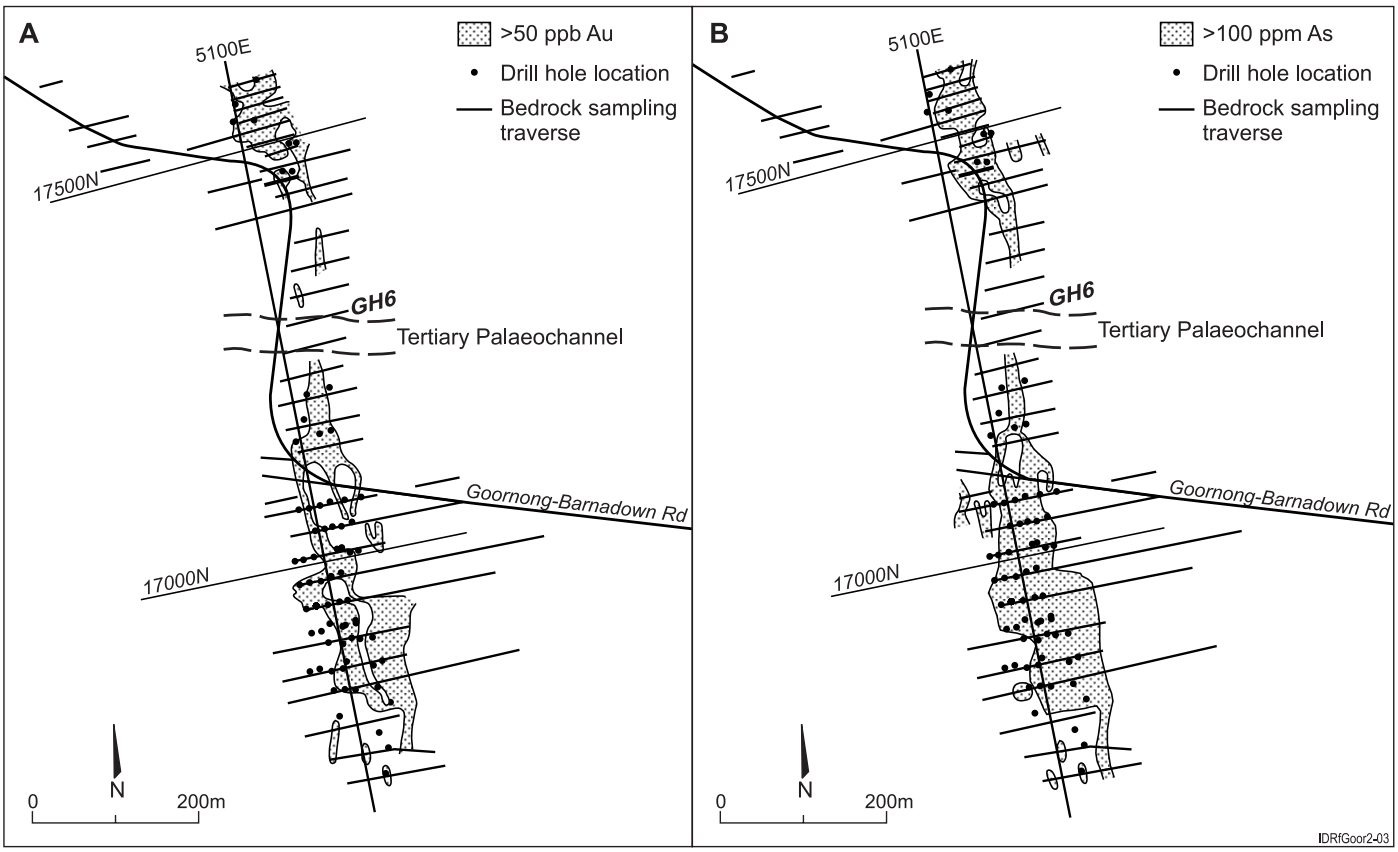

Figure 2. Distribution of Au (A) and As (B) in bedrock around Goornong South.

box-ironbark scrub occur at the N end of the deposit. The climate is temperate with hot, dry summers and cold, wet winters and frosts especially between June and August. The mean annual rainfall of 550 mm falls mainly during May-October although local thunderstorms may occur outside that period. The mean daily temperature ranges are 14-29°C in January and 3-12°C in July.

GEOLOGICAL SETTING

The Au mineralization at Goornong South occurs in Ordovician turbidites of the Ballarat Trough of Central Victoria. Silurian-Devonian granitoids intrude the turbidites (Cherry and Wilkinson, 1994; Ramsay *et al.*, 1998) but, in the Fosterville - Goornong South area, the closest granitoid is the Harcourt Granodiorite, nearly 30 km away. However, mid-Devonian porphyry dykes (Arne *et al.*, 1998) occur in the turbidites of the Fosterville workings and similar dykes occur at Goornong South (Scott and van Riel, 1999a). Since the Mesozoic, there have been several periods of weathering (Hughes *et al.*, 1998) with distinct regolith units formed by erosion and deposition. Early in the Tertiary, the auriferous White Hills Gravel was deposited but this, and the underlying Ordovician bedrock, were eroded by dominantly N-flowing streams to produce the late Tertiary Calival Formation, which includes the auriferous 'deep leads' of the area (Cherry and Wilkinson, 1994). Ferruginization and/or silicification also took place during the Tertiary (Hughes *et al*., 1998; Kotsonis, 1998).

REGOLITH

The Ordovician sandstones and siltstones are weathered to 30-40 m but, at Goornong South, this regolith is overlain by variable thicknesses of Quaternary cover. This cover is alluvium, from recent streams (Campaspe River system) and possibly aeolian material (*e.g.*, Cherry and Wilkinson, 1994). Kotsonis (1998) has also raised the possibility of wind-blown sludge (from 19th century mining operations at Bendigo) occurring in the soils here. Pedogenic calcrete occurs in the top metre of the soil over much of the deposit. At the extreme ends of the deposit, the cover is shallow (<1 m) but over the economic mineralization it is generally 5-10 m thick. Over the central part of the anomaly, RAB drilling intersected up to 30 m of gravel which probably represents an infilled Tertiary palaeochannel.

MINERALIZATION

Although the Gooornong South mineralization strikes over 1.3 km, only the oxide resource in the S portion has been properly defined. There, a deposit, 250 x 100 m, containing 783 000 t of oxide ore @ 1.4 g/t Au, has been outlined (Gold Mining Journal, 1998). At both Goornong South and Fosterville, the Au was originally in pyrite and arsenopyrite as <10 µm inclusions (Zurkic, 1998). The sulphides have weathered to leave fine-grained Au intimately associated with neo-formed Fe oxides. The better studied Au mineralization at Fosterville is structurally controlled and disseminated into the host turbidites rather than strongly associated with quartz veins, as in most Central Victorian Au deposits (Zurkic, 1998). It may also have been formed later (mid-Devonian rather than Siluro-Devonian, Arne *et al*., 1998) and at shallower depth than typical mesothermal deposits (Ramsay *et al.*, 1998).

REGOLITH EXPRESSION

Fresh mineralization at Goornong South has a Au-As-Sb association. On oxidation of the host sulphides, the Au is retained in Fe oxides. Such Au-rich saprolites also retain substantial As, Sb and W, with elevated Cu, Th, U and Zn in the more ferruginous parts (Scott and van Riel, 1999a). Thus, Perseverance Exploration Pty Ltd defined the mineralization in bedrock, using thresholds of 50 ppb Au and 100 ppm As (Figure 2). However, the cover is commonly >5 m thick and samples had to be obtained by RAB drilling. Thus, soil was investigated as a possible cheaper sampling medium.

The surface soil above the deposit contains a substantial proportion of transported material, reflected by feldspar in samples overlying saprolite from which the feldspar has been weathered. However, the coarse (>2 mm) fraction of the soil generally contains abundant lithic fragments, including Au- and As-rich gossanous material, indicating

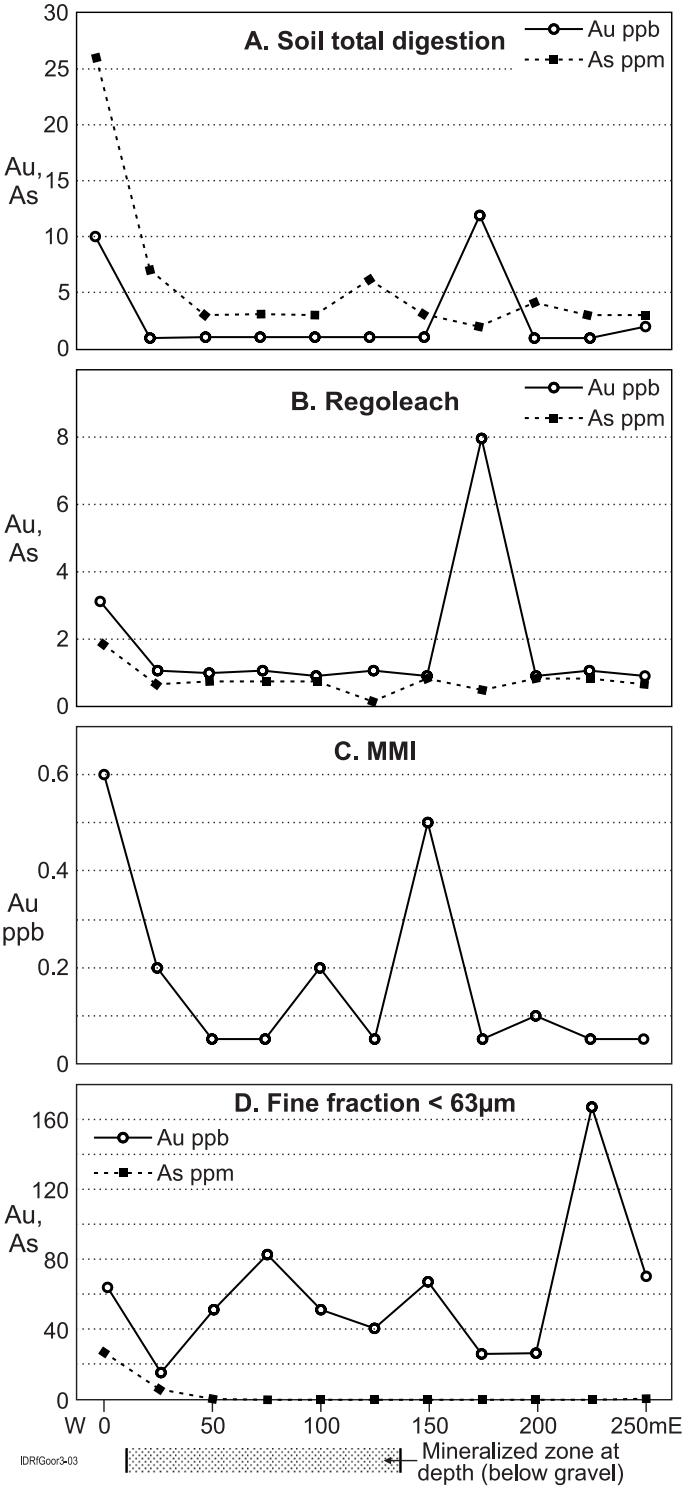

Figure 3. Gold and As contents along traverse GH6 in soil by total and partial analysis. See Figure 2 for location.

that this has been mechanically moved through the transported cover. Because the original Au is fine grained, substantial Au also occurs in the <63 µm fraction of the soil. Arsenic is only slightly enriched in the Fe-poor, clay-rich fraction (see table). As this fraction is also prone to contamination by aeolian material, Scott and van Riel (1999a) recommended the soil coarse fraction as the most robust sampling medium in this area of central Victoria, where cover is thin (<10 m). Calcrete occurs within the soils over much of the deposit but shows no preferential concentration of Au (Scott and van Riel, 1999a).

Selective leaches of soils from along a 250 m traverse over a palaeochannel with up to 30 m of sediment (traverse GH6; see Figure 2) in the central portion of the Goornong South anomaly revealed: -

- Gold, determined by Regoleach, MMI and total digestion, show anomalies in broadly similar positions along the GH6 traverse (Figure 3). Compared to total digestion, the anomalies are reduced to less than 30% in Regoleach, and to 5% with MMI. Because

MMI is only a weak leach, which liberates ions adhering to the surface of soil particles (Birrell, 1996), it would appear that most of the Au along the GH6 traverse is not attached to soil particles and perhaps occurs as discrete Au grains. Thus, comparison of MMI with total digestion analyses may give information about the form of Au in soil.

- The high Au contents in the fine fraction of the soils over the whole traverse, rather than just above the mineralized zone, suggest that the Au is either hydromorphically dispersed or has been mechanically transported laterally. If it were hydromorphically dispersed, it would adhere to soil particles. MMI analyses suggest this is not the case. The topography is subdued but the area above the palaeochannel still may be receiving fine silt from the W, where mineralized float has also been found. Material blown into the region from workings to the W is also possible. Thus, very detailed landscape mapping with digital elevation models may be necessary to interpret the soil geochemistry.
- Regoleach, MMI and total digestion analysis of surficial soils over gravels at Goornong South show broadly similar results although the magnitude of the Au anomaly differs (Figure 3). The difference in MMI and total Au abundances for the same samples suggests that most the Au in the soil along the traverse is not loosely bound but mechanically rather than hydromorphically incorporated into the soil. Thus, very careful evaluation of regolith processes within a prospect is necessary to confidently interpret results of a geochemical survey where transported materials occur.

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SAMPLE MEDIA - SUMMARY TABLE

Sample medium	*Indicator elements*	*Analytical methods*	*Detection limits (ppm)*	*Background (ppm)*	*Maximum anomaly (ppm)*	*Dispersion distance (m)*
Primary rock	As	AAS	20	<20	3800	
	Au	GFAAS	0.001	0.020	16	
Subcrop/saprolite	As	INAA	1	30	2700	minimal
	Au	INAA	0.005	0.020	9.7	
Soil - coarse fraction	As	INAA	1	5	380	10's of m (by
	Au	INAA	0.005	<0.005	0.038	mechanical
- fine fraction	As	INAA	1	8	28	means)
	Au	INAA	0.005	<0.005	170	

GFAAS = Graphite furnace AAS determination on a 50 g sample after aqua regia digestion
AAS = Determination after perchloric acid digestion.