TIMBARRA GOLD DEPOSIT, NEW ENGLAND REGION, NEW SOUTH WALES

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LOCATION

The Timbarra Au deposit is located at 152º10'E, 29º08'S, about 15 km ESE of Tenterfield (Figure 1) and 25 km SW of Drake in NE New South Wales; Grafton 1:250 000 map sheet (SH56-06), Tenterfield 1:100 000 map sheet (9339).

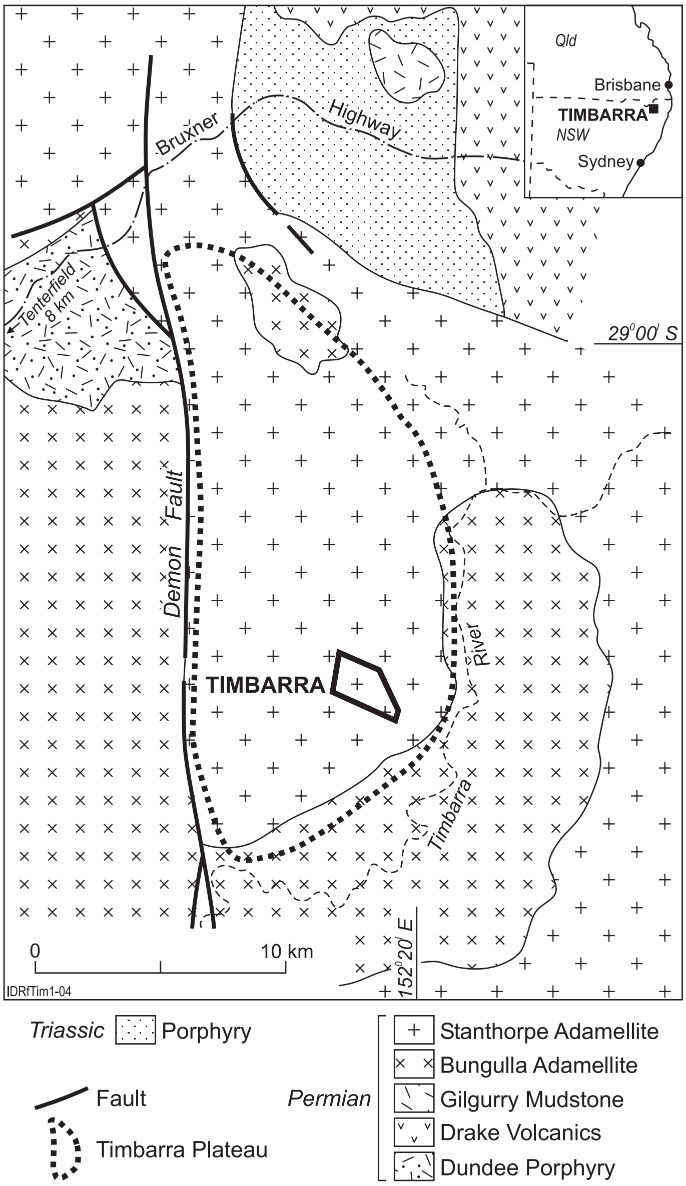

Figure 1. Location and geology of the Timbarra area, after Mustard et al., (1998). The outline of the Timbarra Plateau is shown (compare Figure 2).

DISCOVERY HISTORY

Alluvial and colluvial Au were discovered at Timbarra in 1850 and primary mineralization at Poverty Point in the 1870s. Further deposits were found by Ross Mining Ltd using soil geochemistry and drilling in the vicinity of old alluvial workings, supplemented with bulk leach extraction Au (BLEG) and <180 µm fraction stream sediment geochemistry (Nielsen and Roberts, 1998)

PHYSICAL ENVIRONMENT

The Timbarra Au deposit is on an isolated remnant plateau (900-1100 m asl). The ground is rugged on the escarpment and local changes in elevation of 150-200 m occur within short distances. Vegetation on the eastern side of the plateau is wet sclerophyl with rainforest in the valleys. The central plateau and W side are dominated by more open, dry sclerophyl forest. There are permanent streams with sandy beds in the lower gradient valleys (about 5º) on the plateau; the streams in the steeper valleys (up to 15º) near the escarpment have beds of sand with rocky bars and boulders. Mean annual rainfall at Tenterfield is 852 mm, with November-March being the wetter months. Mean temperatures are 14-27ºC (January) and 1-14ºC (July).

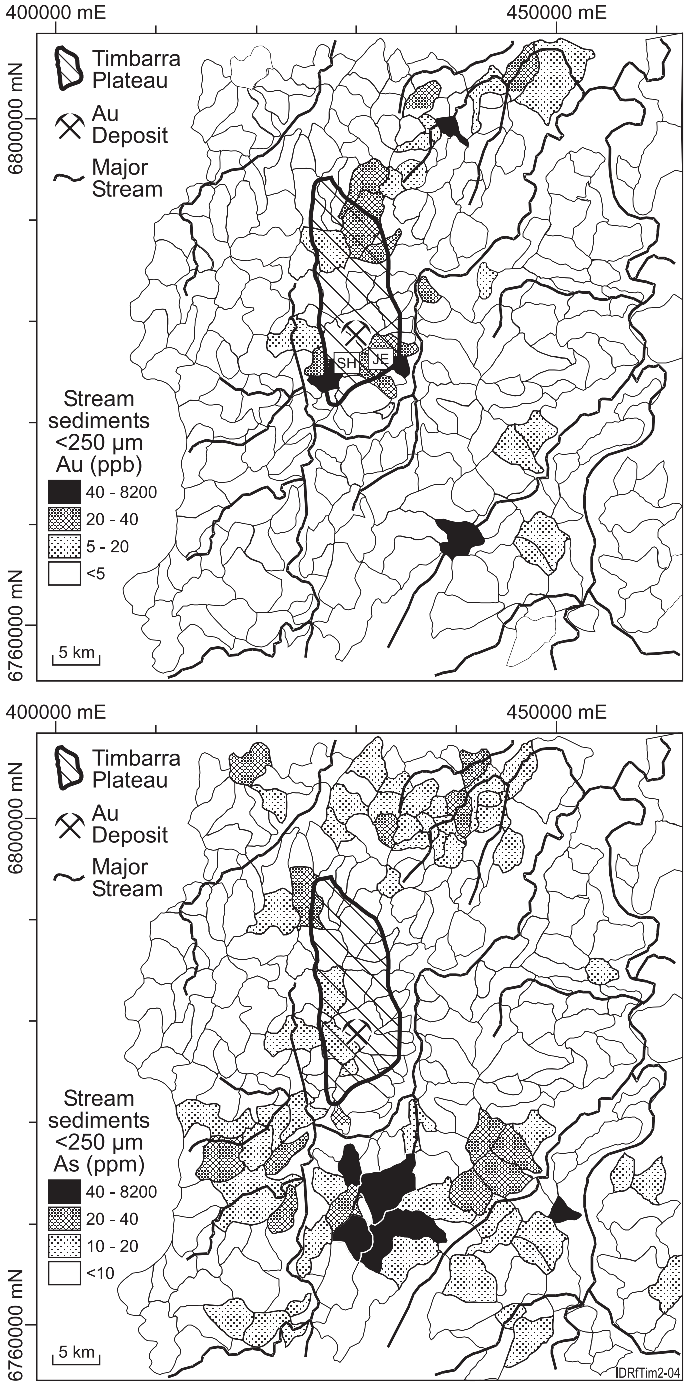

Figure 2. Regional stream sediment Au and As concentrations in catchments of the Timbarra area. SH = Surface Hill prospect, JE = James East prospect.

GEOLOGICAL SETTING

Timbarra is located within a Palaeozoic subduction-related accretionary complex of oceanic crustal terranes and is dominated by I-type, high K, Permo-Triassic granites of the New England Batholith (Gilligan and Barnes, 1990; Mustard *et al*., 1998; Figure 1). Mineralization is mostly hosted within the leucocratic Stanthorpe Granite (238-244 Ma) that contains K feldspar megacrysts, hornblende and biotite, rare mafic enclaves and accessory tourmaline, magnetite, sphene, cassiterite and zircon. The Stanthorpe Granite has been subdivided into a number of phases including K-feldspar porphyrytic units (or layers), aplitic dykes,

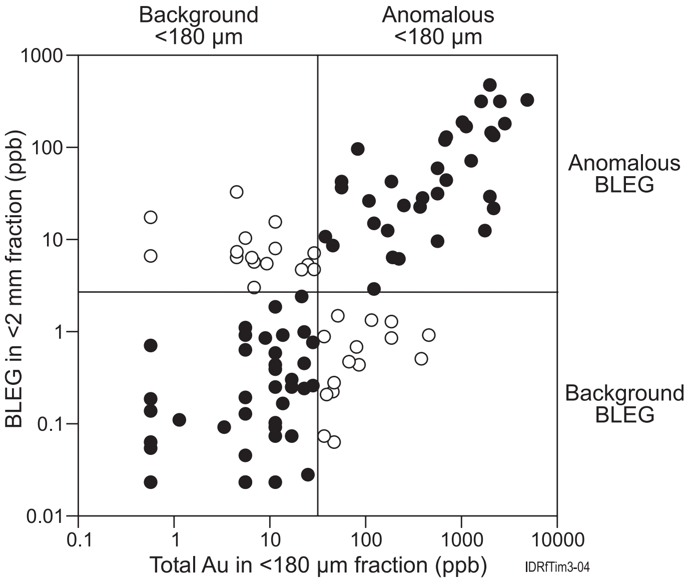

Figure 3. Scatterplot of total Au contents of <180 µm fraction and BLEG in the <2 mm fraction of stream sediments from the Timbarra Plateau. Thresholds to local background determined using probability plots. Filled circles are where BLEG and <180 µm samples locally are either both anomalous or both at background. Open circles are where one medium is anomalous and the other medium at background. (Data from Nielsen and Roberts, 1998).

minor layered pegmatitic segregations and fine-grained carapaces that have interconnected mariolitic fabrics. The granites are bounded by major faults to the E and W (including the 120 km long Demon Fault) shown on Figure 1. NNW-striking dextral shearing and associated joints have been identified in all deposits (Mustard *et al.*, 1998).

REGOLITH

The plateau is part of a weathering surface dating from at least the Miocene (Ollier, 1982), dissection of which has produced a skeletal regolith. Weathering of the granites penetrates <5 m from surface, with deeper weathering along faults and other structures. Skeletal soils overlie poorly consolidated, quartz-rich grits containing some partially weathered feldspars and kaolinite. Stream sediments are mainly quartz with some kaolinite and variable amounts of organic materials ranging from clastic and non-degraded debris to soluble organic materials that colour the water a dark brown and stain the stream sediments. Thin remnants of palaeo-colluvium and alluvium are scattered across the plateau.

MINERALIZATION

The primary mineralization at Timbarra is sulphide-poor, disseminated Au within the roof of structurally-controlled microgranitic carapaces (Taylor, 1992; Simmons *et al.*, 1996; Mustard, 2001). Ross Mining Ltd delineated a resource of 16.8 Mt at 0.73 g/t Au in their 1999 annual report. Pervasive sericite-chlorite-albite hydrothermal alteration is associated with mineralization but there is only minor quartz or carbonate veining. The Au mineralization is localized and enhanced by faults, joints and cooling fractures within the roof of the granite (Mustard *et al.*, 1998). The two elements most closely associated with Au are Mo and Bi. Gold grains are generally <100 µm. Gold has been enriched into palaeo-colluvial placers, with Au grains up to 2 mm in length, and there are recent accumulations in streams.

REGOLITH EXPRESSION

Mineralization in the Timbarra plateau has a clear regional geochemical expression. Anomalous Au and As were detected in (i) the <250 µm fraction of stream sediments and (ii) leaves from various adjacent trees species, along a number of major stream draining the plateau (Figure 2) in a low-density regional survey (Cohen *et al.*, 1995, 1999). A detailed stream sediment geochemical survey over most of the Timbarra Plateau and adjacent escarpments by Ross Mining Limited delineated known mineralization. They also detected a range of other anomalies using the aqua regia (AR) extractable Au content of the <180 µm fraction and BLEG analysis of <2 mm sediments (Nielsen and Roberts, 1998;

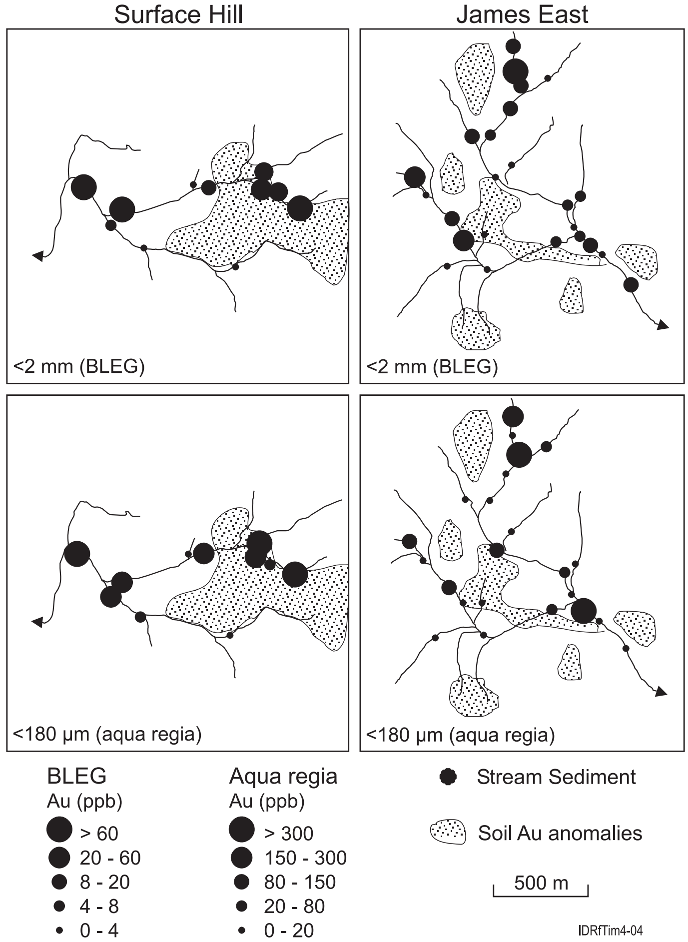

Figure 4. Comparison of <180 µm fraction Au and BLEG in the <2 mm fraction of stream sediments draining the Surface Hill and James East prospects and adjacent anomalous soils.

Mitchell and Nielsen, 1999). Stream sediment Au patterns associated with mineralization are not uniformly reflected by AR Au in the <180 µm or BLEG in the <2 mm fractions. These data are also poorly correlated, due to a combination of fractionation loss of Au-rich fines during sampling and some potential interference of organic material with the cyanide extraction, creating problems in the design of follow-up surveys (Figure 3). Correlation between Au and other indicator elements is poor in the <180 µm fraction.

Dispersion trains from two prospects (Figure 4) show a contrasting relationship between total Au in the <180 µm fraction and BLEG in the <2 mm fraction, and pronounced differences in the distribution of Au between different size fractions in the stream sediments (Cohen *et al.*, 2001). At the Surface Hill prospect, the stream sediments display elevated AR Au contents in all fractions and BLEG for over 2000 m downstream from mineralization. There is a poor correlation between Au and loss-on-ignition at 425ºC (LOI), a strong correlation between AR Au and BLEG, and a progressive decrease in the ratio of Au in the coarse to fine fractions. At James East, elevated Au contents are generally restricted to the <63 µm fraction beyond 200 m downstream from mineralization and the response in the <180 µm fraction is highly variable, with many values below 1 ppb near mineralization. At James East, the Au contents of the <180 µm fraction of stream sediments wet-screened in the field were generally much higher than the <180 µm fraction dry-screened from <2 mm bulk samples collected at the same sites. This may be related to physical or chemical mobilisation of organically bound Au from the large volumes of sediment and water used during the protracted process of wet sieving the <180 µm fraction in the field. There is also a strong correlation between Au and organic material in stream sediments at this prospect. These features suggest that transport of Au is principally mechanical at Surface Hill but mainly hydromorphic at James East. At both prospects, the <63 µm fraction provides less variability in Au analyses (partly related to nugget effects) and higher geochemical contrast for Au than either <2 mm BLEG or <180 µm fraction stream sediments.

Prominent bulk soil Au anomalies are associated with significant mineralization at various locations on the plateau. However, sporadic and lower contrast soil Au anomalies are distributed across the area. The distribution of some of these anomalies suggests fluvial dispersion on the Miocene land surface, with others being associated with colluvial sheets that were deposited at various stages during dissection of the plateau. These sources make a variable contribution to Au patterns in the adjacent stream sediments as the configuration of the drainages has evolved since formation of the plateau.

ACKNOWLEDGEMENTS

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SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Fraction	Indicator elements	Analytical methods	Detection limits (ppb)	Threshold (ppb)	Maximum anomaly (ppb)	Dispersion distance (m)
Primary mineralization	Bulk	Au	AR-AAS	1	5	5	minimal
		Mo	AR-AAS	1000	2000	75000	
		Bi	AR-AAS	100	1000	65000	
		As	AR-AAS	100	5000	7200	
Alteration zone	Bulk	Au	AR-AAS	1	5	8	minimal
Soil	Bulk	Au	AR-AAS	1	5	12	~250
		Mo	AR-AAS	1000	10000	250000	
		Bi	AR-AAS	100	5000	75000	
		As	AR-AAS	100	10000	100000	
Stream sediments	Bulk	Au	BLEG	0.1	4 (local)	2000	>2000
		Au	AR-AAS	1	3	400	>2000
		Bi	AR-AAS	100	10000	30000	minimal
	<180µm	Au	AR-AS	1	40 (local)	5000	>2000
		Au	INAA	2.5	<2.5 (regional)	8000	~10,000
	<63µm	Au	AR-AAS	1	60 (local)	12000	>2000

AR-AAS - Atomic absorption spectrophotometry after aqua regia digestion