MT LEYSHON GOLD DEPOSIT, CHARTERS TOWERS, QUEENSLAND

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LOCATION

The Mt Leyshon Gold Mine is 24 km S of Charters Towers, Queensland, at 20º17'31"S, 146º16'15"E; Charters Towers 1:250 000 map sheet (SF 55-02).

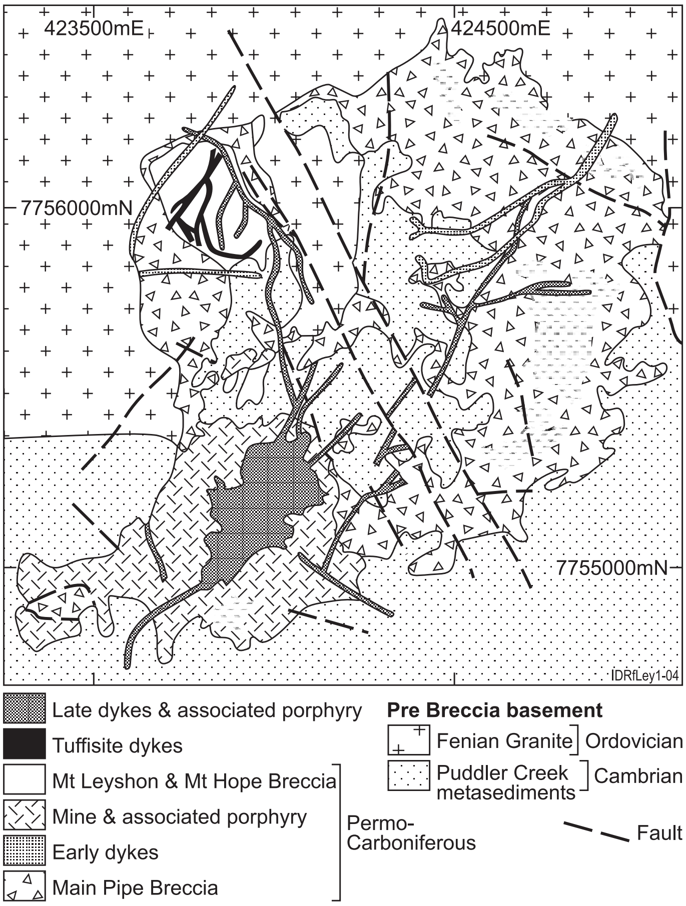

Figure 1. Simplified geology of the Mt Leyshon Breccia and Intrusive Complex.

DISCOVERY HISTORY

The date of the original discovery of Au at Mt Leyshon is uncertain; prospectors operating out of Ravenswood in 1871 made discoveries in the nearby area. Mossman, Fraser and Clarke visited the Mt Leyshon area before making the major Au finds at Charters Towers in 1872. Small-scale hard-rock mining operations commenced in the late 1880s and continued sporadically until the beginning of World War I with 40 000 oz Au produced. Re-treatment of tailings during World War II produced a further 5900 oz (Paull *et al.*, 1990). Renewed exploration during the 1960s and 1970s confirmed a significant tonnage of low-grade Au mineralization. Through the 1980s, further exploration ultimately led to definition of a reserve of 1.5 Mt at 1.5 g/t Au and the decision by Pan Australian Mining Ltd (subsequently Mt Leyshon Gold Mines Ltd) to establish a large-scale, open-cut mine which operated from 1986 to 2002.

PHYSICAL ENVIRONMENT

Prior to mining, Mt Leyshon was a pyramid-shaped hill, rising some 200 m above the surrounding gently rolling plains to a height of 525 m above sea level. The mine is in the sub-tropics and has a dry savanna climate. Rainfall is more intense in summer, with extensive falls associated with cyclones. Annual rainfall is variable, but averages 660 mm. Mean minimum and maximum temperatures range from 22 to 34ºC in January and 11 to 25ºC in July. Open Eucalyptus woodlands, dominated by Ironbark, and cleared grasslands are typical of the local area.

GEOLOGICAL SETTING

The Mt Leyshon orebody is hosted by units of the Mt Leyshon Intrusive and Breccia Complex (Figure 1) which occurs within a NE-trending corridor of Permo-Carboniferous sub-volcanic rocks. The roughly circular complex has an average diameter of 1.6 km and is elongated in a NE direction (Figure 1). Six phases of porphyry intrusion and/or brecciation have been identified. They occur in the following order: - (i) Main Pipe Breccia, (ii) early porphyry dykes and associated small porphyry bodies, (iii) Mine Porphyry and Mt Hope Breccia, (iv) Mt Leyshon Breccia (possibly coeval with iii), (v) tuffisite breccia dykes, (vi) late dykes and associated breccias.

The Mt Leyshon Breccia, the main ore host, is pipe-like, approximately 400 x 300 m in plan, with a minimum vertical extent of 650 m. It developed almost entirely within the large, but generally barren, Main Pipe Breccia on the western edge of the complex. A plug-like body of' rhyolitic porphyry, known as the Mine Porphyry, occurs to the E. Numerous late porphyry and tuffisite dykes cut across both the Mt Leyshon and Main Pipe Breccias. Although the high-energy Main Pipe Breccia vented to surface in a relatively minor way, brecciation within the complex is akin to intrusive-related hypabyssal breccia systems (Orr, 1995).

REGOLITH

Tropical weathering has almost completely oxidized the primary mineralization and host rocks to a maximum depth of 160 m below the summit of Mt Leyshon. The depth of oxidation decreases to only a few metres at the base of the hill, and averages 30-40 m across the ore zone. Here, Au is associated with Fe-oxides, jarosite, alunite and kaolinite in cavities and veins, and is generally disseminated throughout the host rocks. Intense leaching has depleted base metals within the oxide zone without affecting the Au content or its distribution.

MINERALIZATION

Although no rocks in the pit area are completely unmineralized, the bulk of the mineralization is within the Mt Leyshon Breccia (about 80%) and Mine Porphyry (about 15%). The dominant sulphides within

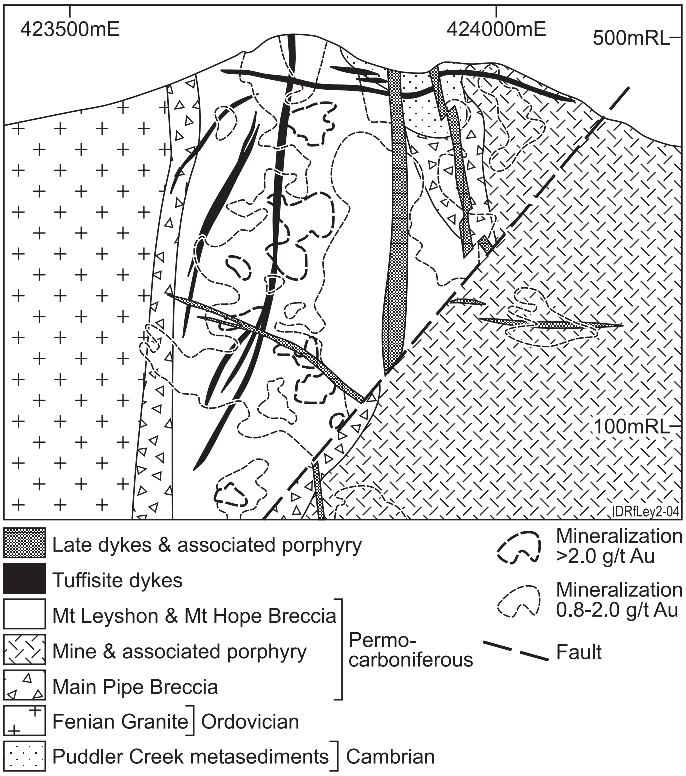

Figure 2. Cross section, 6050N, Northern Orebody.

the orebody are pyrite, chalcopyrite, galena and sphalerite, and the main gangue minerals include chlorite, carbonates, micas and quartz. Typically, mineralization is cavity-fill and matrix-replacement in the breccia or as disseminations in the porphyries, with the less common high grade zones related to veining. Within the Mt Leyshon Breccia, the bulk of the mineralization occurs in two irregular and crudely pipe-like bodies, the southern and northern orebodies (Figure 2) with similar tonnages and grades. A complex set of tuffisite "ring dykes", occurring near the edge of the Mt Leyshon Breccia, are also commonly well mineralized.

The metasediments and Main Pipe Breccia above the Mt Leyshon Breccia are generally unmineralized and have sealed fluids that were channelled up the roof zone, through the upper sections of the Mt Leyshon Breccia and adjacent tuffisite dykes. Significant mineralization has also developed where a flat-lying, late dyke, referred to as the "sill", has intersected this zone and caused accumulation of hydrothermal fluids, resulting in a relatively high grade "blanket" of mineralization (Figure 2: Morrison *et al.*, 1988).

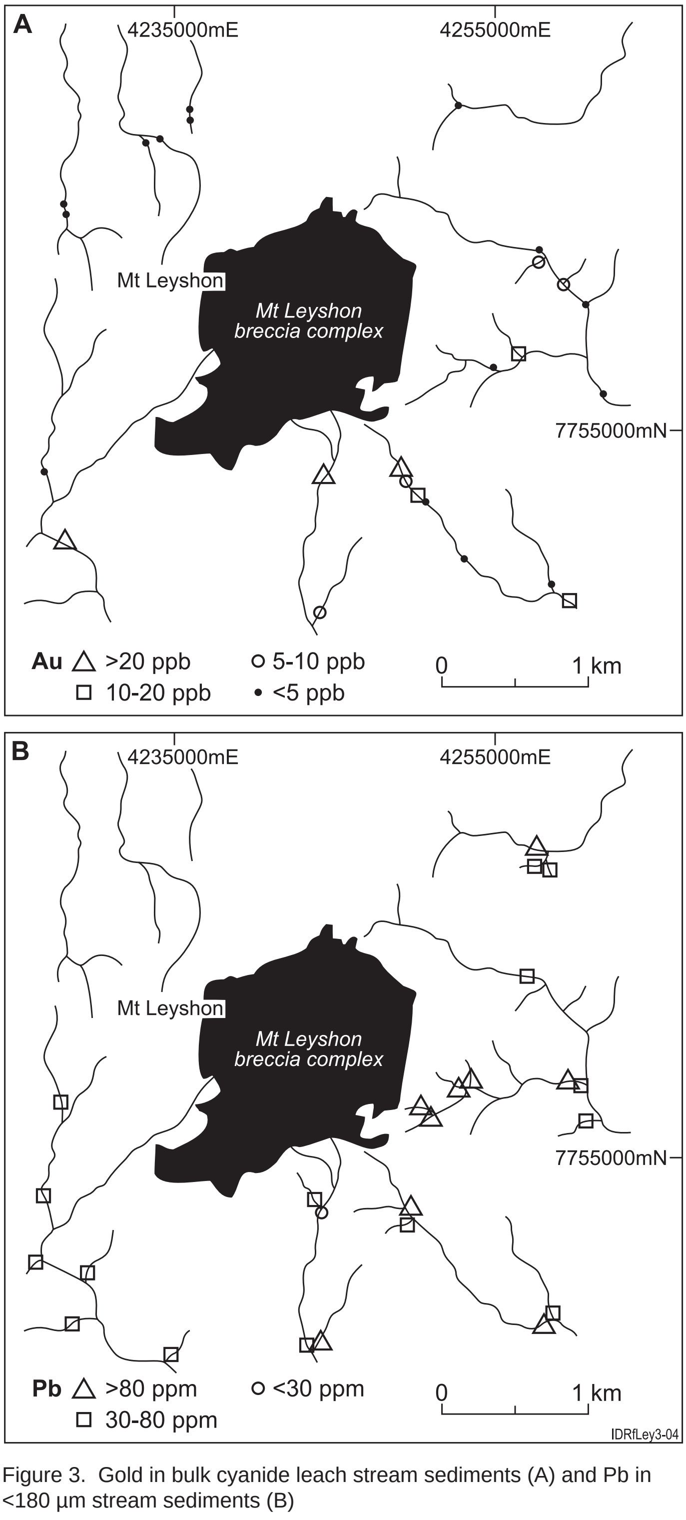

Figure 3. Gold in bulk cyanide leach stream sediments (A) and Pb in <180 µm stream sediments (B)

The hydrothermal system, active during the development of the complex, can be divided into 2 stages. Stage I fluids (450-500ºC) were active prior to intrusion of the Mine Porphyry, producing biotite-dominated K alteration. A quartz-molybdenite-base metal sulphide stockwork developed late in this stage. Stage II fluids (300-400ºC) commenced with the emplacement of the Mine Porphyry and terminated after the intrusion of the late dykes. These fluids were responsible for propylitic alteration and the associated economic mineralisation with base metal, Au and Bi phases being deposited late in this stage (Morrison *et al.*, 1988).

Mine drill hole assays show inter-element correlations between Bi and Au, Cu and As (Table 1). Teale (1987) found that approximately 84 vol% of the total free Au was associated with Bi sulphides and sulphosalts, either as inclusions or at grain boundaries.

An irregular transitional supergene zone occurs just below the base of oxidation. The zone is best developed within the Mt Leyshon Breccia, where it may be up to 20 m thick (average <10 m), but thins to <2 m in the porphyries and other units. The supergene material contains abundant alunite (as veins and matrix replacement), secondary chalcocite, digenite, minor bornite and covellite overgrowing pyrite. Copper is enriched within the supergene zone, reaching 1-2%, compared to generally <0.2% in the primary mineralization. There is no significant Au enrichment in the supergene zone.

REGOLITH EXPRESSION

Stream sediments

Gold in <180 µm stream sediments, analyzed by the bulk cyanide leach technique (Figure 3A), and Pb (Figure 3B) both show strong anomalies in streams draining the complex. Bulk cyanide leach Au data from drainages >1-2 km^2, across the Charters Towers district, show that Au >1 ppb are regionally anomalous and generally can be traced back to an outcropping Au source (Beams, 1990). Thus, the bulk cyanide leach Au values in Figure 3A show all the streams draining the Mt Leyshon Complex and yield strong anomalies (>5 ppb Au). Extremely high bulk cyanide leach Au values, in the range 70-120 ppb, indicate the regional significance of the Mt Leyshon anomaly. Regional data from a population of 18 000 <180 µm stream sediment samples across the Charters Towers district (Beams and Jenkins, 1995) show that Pb is anomalous at >80 ppm. Base metal mineralization associated with the Mt Leyshon Breccia Complex produces a strong Cu-Pb-Zn signal in <180 µm stream sediment samples, *e.g.*, Pb in the 80-200 ppm range (Figure 3B).

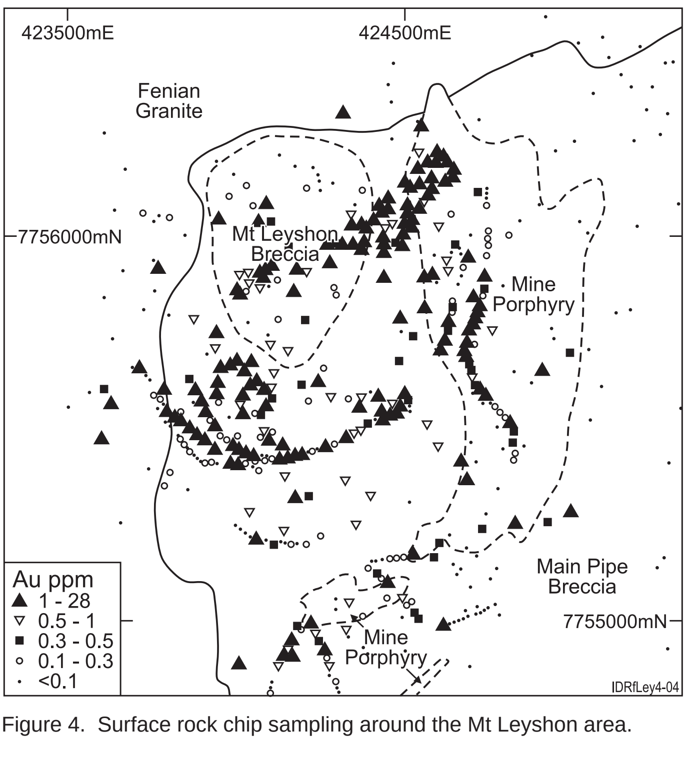

Figure 4. Surface rock chip sampling around the Mt Leyshon area.

Rock chips

Gold data from rock chip sampling, prior to mining, shows that Au ranges from 0.005-28.0 ppm, with values >0.5 ppm concentrated in the NE portion of the intrusive complex (Figure 4). The high Au zones also have highly anomalous Ag, As, Bi, Pb and Zn contents (Scott *et al.*, 1988). Thus, the surface rock chip data illustrate the effectiveness of this sampling method in delineating zones of outcropping mineralization and the strong association of mineralization with chalcophile elements (except Cu) in weathered rock. A comparison of these associations with those of fresh rock suggests that there is little evidence of either surface enrichment or depletion of Au at Mt Leyshon.

Soils

A total of 5945 soil samples were collected on 50 x 50 m or 50 x 100 m grids over the complex and its surrounds. The C horizon of 1-2 m thick residual soil was screened to <180 µm. Copper, Pb, Zn, Au, Mo, S and As are anomalous in the vicinity of the mine (see Sample Media Summary Table; Figure 5). A Mo anomaly occurs to the NE of the mine area anomaly. This indicates that the quartz-molybdenite veining is not only distinct in time but also in space (Morrison *et al.*, 1988).

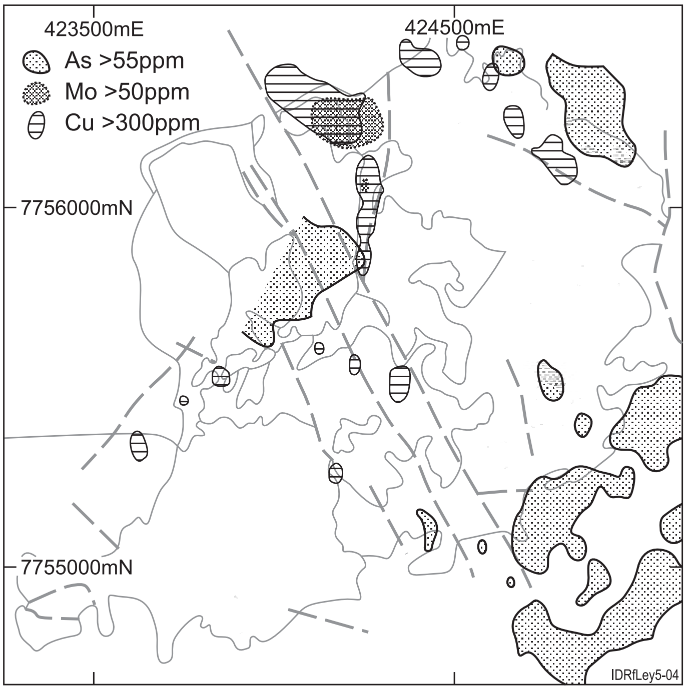

Figure 5. Soil geochemical anomalies for As, Mo and Cu around the complex (same area as Figure 1). Geology shown in outline.

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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 (from mine diamond drilling)	Au	FA	0.01	0.02	0.2	138.52	NA
	Ag	AAS	0.2	1	3	115	NA
	Cu	AAS	2	30	250	27900	NA
	Pb	AAS	5	15	200	27500	NA
	Zn	AAS	2	50	1000	65000	NA
	Bi	AAS	5	<5	<5	330	NA
Surface rock chip	Au	FA	0.005	0.005	0.005	28	NA
	Ag	AAS	0.1	1	3	100	NA
Soil	Au	ICP	0.001	0.05	0.07	3.9	150-300
	Ag	ICP	0.5	0.6	0.8	12	150-300
	Cu	ICP-AES	5	55	100	1190	150-300
	Pb	ICP-AES	5	50	80	2750	150-300
	Zn	ICP-AES	5	90	105	6350	150-300
	As	AAS	1	10	20	780	150-300
	S	ICP	10	70	160	40000	150-300
Stream sediments	Au	BCL	0.00005	0.001	0.005	53.6	>3000
	Pb	AAS	5	11	30	770	>2500

Mine drill hole data are from below the 400 m RL. Stream sediment data are within 5 km of the complex.
Digestions with aqua regia preceded AAS and ICP analysis.
BCL analysis was by agitating 3 kg of sample with 3 kg 0.5% cyanide solution for 24 hours and analysis by atomic absorption.