

DEVELIN CREEK BASE METAL DEPOSITS, CENTRAL QUEENSLAND

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LOCATION

The Develin Creek Cu-Zn-Ag-Au deposits are located 15 km S of Marlborough and 70 km NW of Rockhampton at 23°02'S, 149°49'E; Duaringa (SF 55-16) 1:250 000 map sheet.

DISCOVERY HISTORY

The Develin Creek deposits are only 80 km NW of the major volcanogenic Mt Morgan Cu-Au deposit (Figure 1; Messenger *et al.*, 1998). Although the Palaeozoic volcanic rocks of the region have been prospected for volcanogenic deposits since the late 1970s, Queensland Metals Corporation Ltd only commenced exploration for volcanogenic deposits in the region during 1986, following the discovery of the Kunwarara magnesite deposit in 1985 (50 km to the E; Milburn and Wilcock, 1998). This ultimately led to the discovery of the Develin Creek deposits in late 1992.

No significant anomalies were found after a semi-regional stream sediment programme in 1988 (Horton *et al.*, 1994), but weakly mineralized float (Au, Ag and As) was traced to a small window of highly weathered Palaeozoic volcanic rock within lateritized Tertiary sediments (Queensland Metals Corporation Limited, 1993). Poorly outcropping gossanous breccias within this window were investigated by costeans and shallow percussion drilling which intersected only intensely weathered volcanic rocks. However, in late 1992, deeper percussion drilling intersected 25 m of sulphides (2.87% Zn, 0.49% Cu and 14 g/t Ag) below 38 m. Subsequent percussion and diamond drilling intersected high grade Cu and Zn mineralization striking for 200 m in a submarine talus breccia, hosted by andesites and basalts (Queensland Metals Corporation Limited, 1993).

Various geochemical sampling media were evaluated. Although stream sediment sampling was ineffective (Horton *et al.*, 1994) probably due to the strong leaching of Cu and Zn during weathering, multi-element soil and rock geochemistry reflects the mineralization (Scott, 1994). The geophysical response of the mineralization (gravity, magnetic and IP) is largely obscured by conductive weathered cover but basement structures can be interpreted (Queensland Metals Corporation Limited, 1993).

PHYSICAL FEATURES AND ENVIRONMENT

The climate is subtropical, subhumid with hot, wet summers and warm, dry winters and a few frosts (Bureau of Meteorology, 2003). The mean annual rainfall of 820 mm falls mainly during December-March. The mean daily maximum and minimum temperatures are 32°C and 22°C in January and 23°C and 9°C in July. The vegetation is brigalow scrub that has been cleared for cattle grazing around the deposits. The deposits occur at about 100 m elevation on one side of a lateritized mesa, which is about 40 m higher than the surrounding country. Small ephemeral streams, including one which cuts through altered volcanic rock, deeply incise the mesa.

GEOLOGICAL SETTING

The Lower Permian Rookwood Volcanics, comprising spilitic pillow lava, agglomerate, volcanic breccia, chert, vitric tuff and tuffaceous sandstone/siltstone, unconformably overlies older Permian and Siluro-Devonian rocks. They form an elongate N striking belt on the E edge of the Permian Bowen Basin, in Central Queensland. The Develin Creek deposits occur within these andesites and basalts. During the Tertiary, the prospective Palaeozoic rocks were unconformably overlain by flat-lying freshwater sandstones, siltstones and conglomerates of the Duaringa Formation (Dickson *et al.*, 1996). This unit contains fossilised trees at its base. The Duaringa Formation is extensively ferruginized near the Develin Creek deposits.

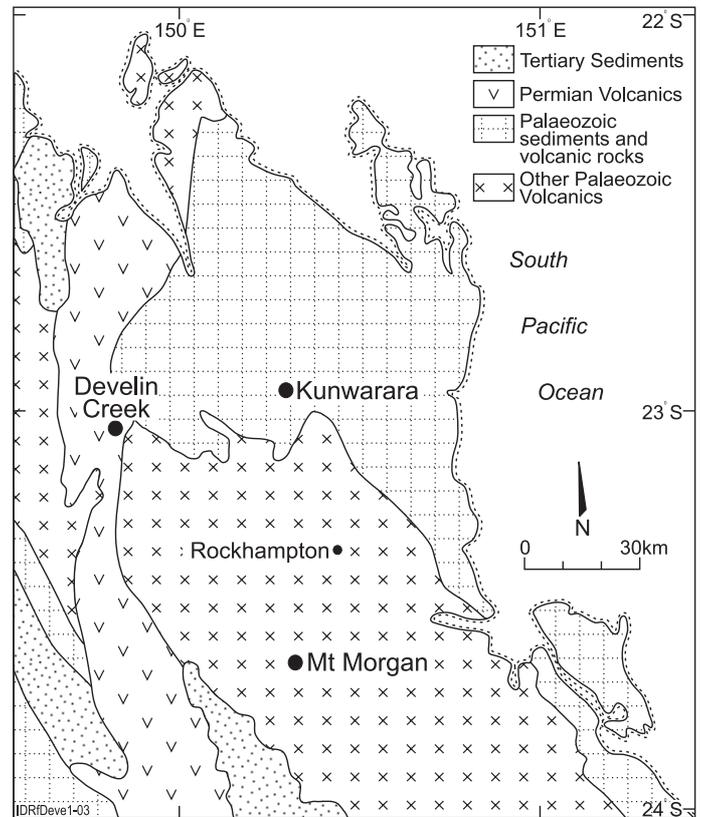


Figure 1. Location map for Develin Creek and the distribution of Palaeozoic volcanic rocks in Central Queensland.

REGOLITH

The Rookwood Volcanics, around Develin Creek, weather by destruction of plagioclase, chlorite and epidote to form smectites and Fe staining to depths of about 45 m. Severe weathering is restricted to about 20 m. However, in mineralized profiles, sulphide-bearing intervals at depths around 40 m may also be severely weathered (Scott, 1994). Barren rocks are less deeply weathered and relatively fresh volcanic rocks outcrop within 250 m of the mineralization. The best mineralization is exposed in an erosional 'window' in severely weathered arenites of the Duaringa Formation. This unit is up to 70 m thick and loosely follows the 100 m topographic contour near the deposit (Figure 2) where it forms a mesa about 40-60 m above the outcropping Rookwood Volcanics. Less than a metre of Quaternary colluvium and red soil, commonly containing pisoliths, also occur.

MINERALIZATION

The Develin Creek deposits occur in two discrete centres (Window-Scorpion and Sulphide City, Figure 3) within 500 m of each other in the andesites and basalts of the Rookwood Volcanics. The Window-Scorpion deposit occurs in a 400 x 200 m zone in altered volcanic rocks astride a NE trending fault (Ron's Fault). The more northerly Scorpion mineralization has an E strike of 200 m and consists of brecciated massive sulphides that grade to 6% Cu, 9% Zn, 43 g/t Ag and 1 g/t Au. The southerly and highly weathered Window mineralization is chalcopyrite massive sulphides and sulphidic breccias with a 2 m thick supergene blanket of covellite-chalcocite at 50 m depth (Queensland Metals Corporation Limited, 1994). The Sulphide City mineralization, NE of the Window-Scorpion deposit, consists of stockwork, disseminated and massive sulphide mineralization in a structurally complex area. The massive sulphides (12 m @ 2.1% Cu and 3.2% Zn in broader zones of lower grade mineralization) occur over 300 x 150 m beneath 100 m of unaltered volcanics. Extensive

chlorite-pyrite alteration underlies the Window-Scorpion and Sulphide City mineralization (Queensland Metals Corporation Limited, 1994;

Horton *et al.*, 1994) but hangingwall alteration is subtle and restricted to slightly elevated abundances of Ba, S, Cu and Zn (Scott, 1994).

REGOLITH EXPRESSION

Weathering of pyrite, chalcopyrite and sphalerite mineralization in the Window-Scorpion deposit has incorporated As, Mo, Pb, Cu and Zn into neo-formed Fe oxides and alunite-jarosite minerals (Scott, 1994) above 40 m. However, the amounts are generally <500 ppm, so near-surface saprolites are generally depleted (<70 ppm Cu and <10 ppm Zn). Nevertheless, an alunite-rich sample from the creek bank in the Window area contains 530 ppm Cu and 11 ppm Zn and subcrop from the Scorpion area contains up to 390 ppm Zn and 40 ppm Cu. Barium, occurring in micas and possibly as primary barite, and S are concentrated in the saprolite. Because As, Cu, Mo, Pb, S and Zn are preferentially incorporated into Fe oxides, ferruginous saprolite or ferruginous parts of saprolite samples should be specifically targeted. In the Window area, residual soils have similar compositions to the bedrocks, i.e., low Cu and Zn but elevated As contents (see table). Hydromorphic dispersion into the Tertiary sediments does not seem to have occurred. However, because the float samples, which led to the discovery of the Window mineralization, contained elevated Au, Ag and As, mechanical dispersion into the cover is possible and interface sampling should be evaluated here.

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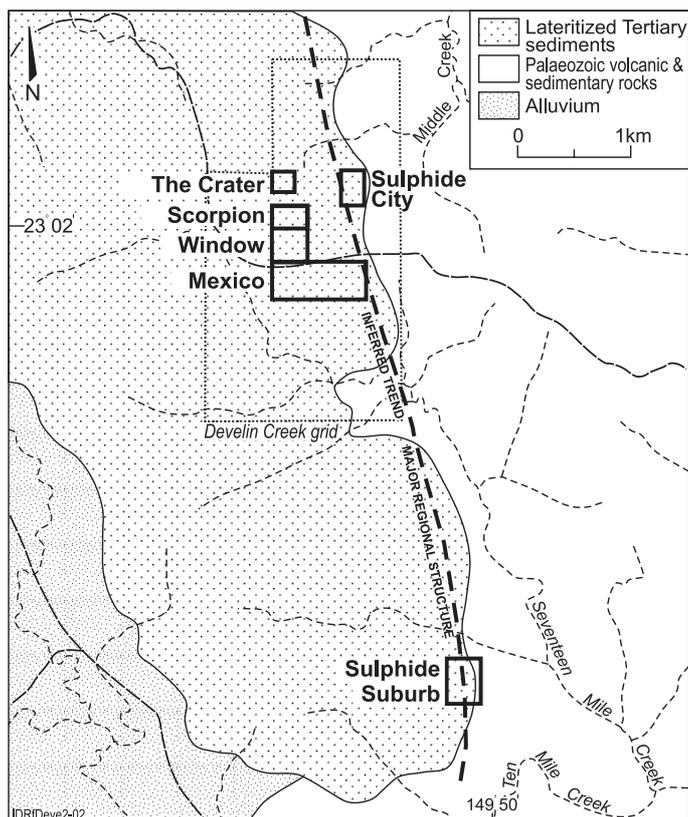


Figure 2. Geology of Develin Creek prospects (after Queensland Metals Corp Ltd., 1993).

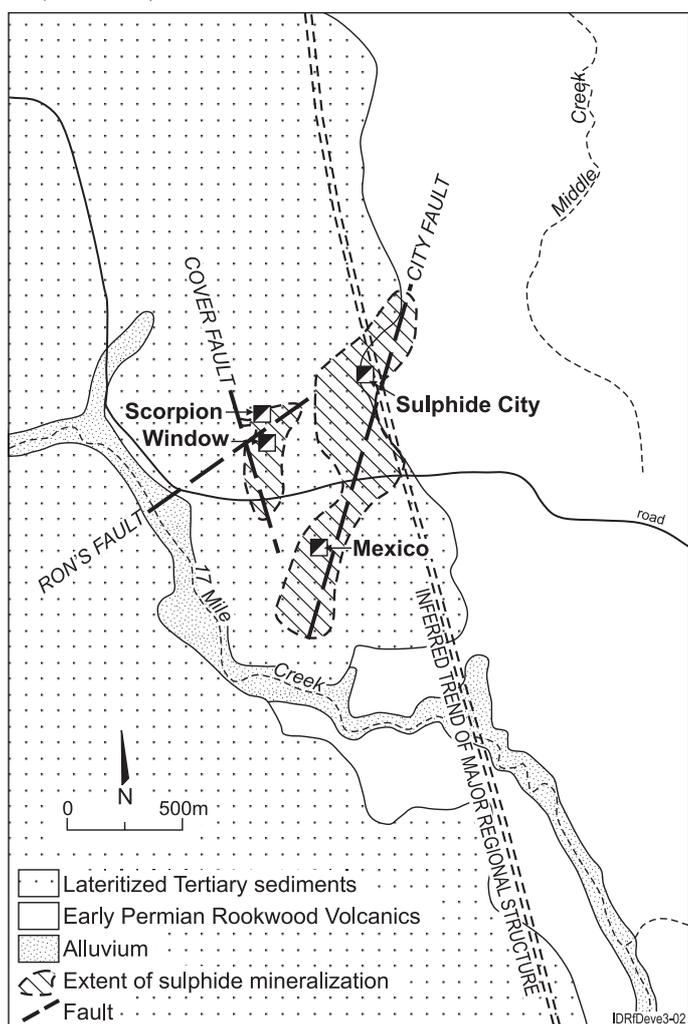


Figure 3. Detailed prospect geology, Develin Creek (after Horton *et al.*, 1994).

SAMPLE MEDIA - SUMMARY TABLE

Sample medium	Indicator elements	Analytical methods	Detection limits (ppm)	Background (ppm)	Maximum anomaly (ppm)	Dispersion distance
Primary mineralization	As	AAS	20	<20	500	
	Cu	AAS	2	40	4.27%	
	Zn	AAS	2	70	5.67%	
Subcrop	As	ICP MS	1	3	860	
	Cu	AAS	2	40	570	
	Zn	AAS	2	10	390	
Soil	As	ICP MS	1	2	170	10's of m
	Cu	AAS	2	40	60	(mechanical dispersion)
	Zn	AAS	2	7	10	

AAS and ICP analysis after dissolution with HClO₄/HF/HNO₃/HCl