THE MT CARRINGTON EPITHERMAL GOLD-SILVER-ZINC SYSTEM AND THE HOST DRAKE VOLCANICS

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Introduction

The Mt Carrington epithermal deposits have been mined for gold and silver since the nineteenth century. They were the subject of intense exploration and research over at least three decades, and the gold deposits were mined by Mt Carrington Mines in the period 1988-90. Surprisingly, in 1994, all exploration activity came to a complete halt, and has only been reactivated by the Drake Resources programme in the past year.

Mt Carrington is a low sulphidation epithermal system within a package of late Permian intermediate to felsic volcanic rocks. The mineralisation occurs in very extensive alteration systems; Mt Carrington is one of several such alteration systems throughout the Drake Volcanics.

This abstract relies heavily on past explorers and researchers. In particular the Geological Survey of New South Wakes' excellent metallogenic report for the Warwick-Tweed Heads 250,000 sheet which brings together the work of explorers and researchers, addressing geology, alteration and mineralisation (Brown et al., 2001). Major contributions have also been made by CRA and Aberfoyle geologists, particularly Matt Houston and Lindsay Bottomer respectively.

Mt Carrington is located just north of the township of Drake, which is on the Bruxner Highway between Tenterfield and Casino, in North Eastern NSW.

Geology

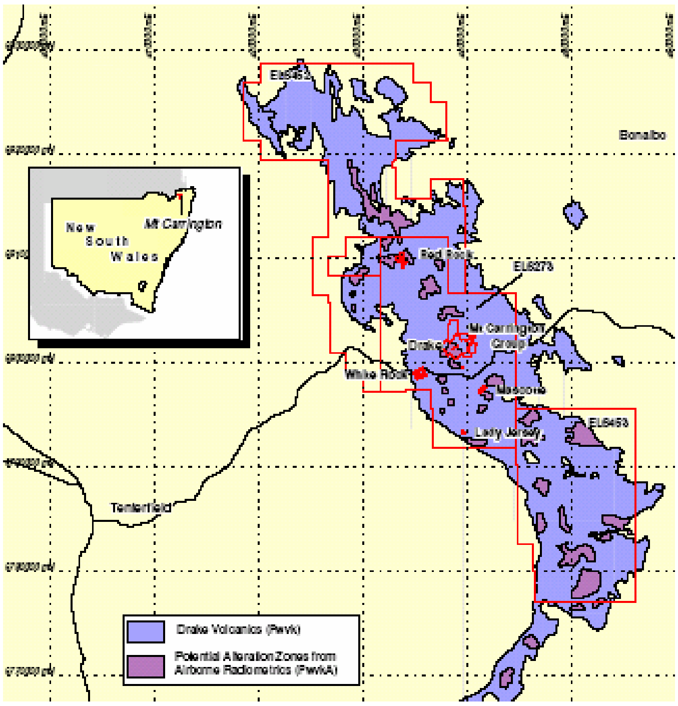
The Mt Carrington epithermal deposits are hosted by the Drake Volcanics, a local subdivision of the Wandsworth Volcanic Group (Brown et al., 2001). The group represents part of a major Late Permian to Early Triassic episode of igneous activity throughout this part of New England. At many locations the volcanic sequences were intruded by high-level plutons.

INTERPRETED RELATIONSHIPS BETWEEN THE STRATIGRAPHIC SUCCESSION IN THE DRAKE AREA (After Brown et al 2001)

AGE	GROUP	STRATIGRAPHIC UNIT	LITHOLOGIES
Tertiary	?	Unnamed	Basalt flows, dolerite sills or dykes
Late Permian-Early Triassic	Leuco-monzogranites	Stanthorpe Monzogranite	Coarse grained equigranular to weakly porphyritic biotite poor leucogranite.
		Morgans Creek Monzogranite	Equigranular, coarse grained monzogranite
	Clarence River Plutonic Suite	Bruxner Monzogranite	Leucocratic altered monzogranite and light grey granodiorite
Late Permian	Wandsworth Volcanics Group	Gilgurry Mudstone	Dark grey to green siltstone
		Drake Volcanics	Complexly interbedded rhyodacitic to andesitic volcanics
Carboniferous		Emu Creek Formation	Interbedded sandstone, siltstone, and conglomerate

The Drake Volcanics cover an area of approximately 700 km2. The Volcanics comprise about 400 metre thickness of interbedded acid to intermediate volcanic flows and volcaniclastic sedimentary rocks. Pyroclastic and flow rocks, agglomerate, breccia, crystal-lithic tuff and sub-volcanic intrusions are common. The compositional types vary from rhyolite to trachyandesite, to andesitic and to dacitic. The rocks of andesitic to trachytic composition are green, grey, blue-green, purple or brown coloured.

The volcanic flow rocks are normally porphyritic. Intrusives include flow banded rhyolites, quartz andesite and andesite, microdiorite, quartz-feldspar porphyry, and “banded felsite”. Flow laminae within the intrusives are typically steep to sub-vertical. The volcanics are characterised by rapid vertical and lateral facies variations and by pervasive alteration related to numerous subvolcanic intrusives.



The Drake Volcanics unconformably overlie the Razorback Creek Mudstone and are themselves conformably overlain by the Gilgurry Mudstone. The volcanics are intruded by numerous Late Permian-Early Triassic granitoids and basic intrusions.

The majority of the Drake Volcanics are interpreted to have been deposited in a shallow marine environment, although there is local evidence of sub-aerial volcanism (Perkins, 1988a, b). The Drake Volcanics are overlain by the marine Gilgurry Mudstone, again of late Permian age.

Local geology

The Mt Carrington deposits occur within an area 20 kilometres in diameter of subdued magnetic response, termed the “Drake Quiet Zone”, by previous explorers. This is interpreted to be a sub-horizontal laccolith of felsic rock, from which many of the felsic bodies with which mineralisation is associated may have originated.

The immediate Mt Carrington area contains andesitic volcaniclastic rocks of largely epiclastic origin, intruded by both andesitic and rhyolitic dykes and other rhyolitic bodies. The main hosts to mineralisation in the district are andesite bodies and coarser fragmental rocks. Debate continues as to whether some of the andesitic bodies are intrusive or extrusive.

Alteration

The Mt Carrington mineralised area contains large areas of pervasive alteration. Silica-sericite-pyrite alteration hosts all of the known main zones of mineralisation in varying degrees of intensity. The intensity of this alteration type has led to many andesites being mapped and logged as felsic rocks, which has caused historical problems in establishing a comprehensive geological map.

Other major alteration types are argillic, propylitic, sericite-illite and ankerite. Smith (1989) suggested a model zonal alteration pattern around mineralisation of proximal sericite-pyrite-dominant to distal, chlorite-dominant propylitic alteration.

Particularly intense silica - sericite - pyrite alteration exists in the central Strauss and North Kylo gold deposit areas.

Mineralisation

Epithermal mineral occurrences are developed throughout the 40 kilometres of strike of the Drake volcanic belt. Although the occurrences are scattered generally throughout the outcrop area of the volcanics there is a concentration of major mineralisation within the Drake Quiet Zone. The centre of the zone lies between Mt Carrington and Red Rock, two of the larger mineralised alteration systems in the field.

A three-fold classification of the mineralisation has been generally used by explorers and researchers in the area:

- discordant fissure veins
- stratabound stockworks
- stratabound disseminations

Most mineral occurrences contain combinations of some or all of the three styles listed above. For example, most fissure veins are accompanied to some degree by stockworks or disseminations along their margins.

Veins are commonly 1metre or less in thickness and comprise massive to often classic epithermal colloform and crustiform laminar banding, with alternating layers of quartz to chalcedonic or jasperoidal silica and sulphides, with sericite, chloritic aggregates, and sideritic to ankeritic carbonates. Veins may have brecciated vein fill in their cores.

Veins typically have dominant pyrite and lesser sphalerite in the gold rich systems such as Strauss and Kylo, Carrington and Guy Bell. Gold occurs as discrete grains up to 150 microns, but is commonly 10 to 30 microns on the boundaries of sulphide grains, and occurs in electrum of between 400 and 800 fineness. Sphalerite may be replaced by fine chalcopyrite. Accessory minerals in the gold deposits are galena, tetrahedrite – tennantite.

In the silver dominant systems such as Lady Hampden, Silver King and White Rock pyrite is the dominant sulphide, with lesser sphalerite and galena, tetrahedrite and tennantite. A variety of sulphosalts such as pearcite, polybasite, pyrargyrite, proustite occur in trace amounts, as do chalcopyrite, gold and electrum. While mineralisation is often vein breccia hosted as at White Rock, there is significantly more disseminated mineralisation at Lady Hampden

Depth of oxidation varies from 60 metres on top of Mt Carrington to less than a few metres in some prospects.

Supergene processes see the development of chalcocite blankets of up to 20m thickness after primary stringer quartz-chalcopyrite veined host rocks in the Gladstone area.

Mt Carrington

The current inferred resources (Kanowna Lights) at Mt Carrington are as follows:

	Mt	**Grade Au**	**Grade Ag**	
Gold resources (Strauss, Kylo)	1.0	3.77	7.00	126,000 oz Au, 0.6 Moz Ag
Silver resources (White Rock, Lady Hampden)	0.78	0.93	176	4.4 Moz Ag, 20,000 oz Au

These resources were calculated when the gold price was US$350/oz Au and when the silver price was US$4.79/oz Ag.

The mineralisation in the Mt Carrington-White Rock area displays local and broad scale zoning. The central Mt Carrington deposits are gold-rich, with Ag: Au ratios of 2: 1. This ratio increases to 100-500: 1 in the silver-dominated systems of Lady Hampden and Silver King, 1200 metres to the southeast. Furthermore primary, and supergene, copper mineralisation is concentrated in the western part of the Mt Carrington mine leases.

The gold rich deposits at Mt Carrington, for example Strauss, North Kylo, West Kylo, Carrington and Guy Bell, concentrate near the centre of the Mt Carrington system. The mineralisation is structurally complex, although steeply dipping vein sets generally dominate. Locally there are stratabound controls on the overall distribution of mineralisation, as in the Strauss pit. The deposits are characterised by unusually high zinc contents, and much of the mineralisation at Strauss and North Kylo averages 1-2% Zn.

There are two main areas of silver mineralisation at Mt Carrington, the Cheviot Hills Fault Trend, containing the Lady Hampden and Silver King deposits, and the Mozart Prospect, and the White Rock area. The former area of mineralisation is hosted by volcaniclastics and lapilli tuffs of the Hampden Member; coarser volcanic rocks appear to be particularly favourable hosts. The majority of the mineralisation occurs as disseminations, although there are high grade sulphide-rich segregations or veins along NE-trending vertical fractures. At White Rock silver-zinc mineralisation occurs in hydrothermal breccias and stockworks in flow-banded rhyolites.

Primary copper mineralisation occurs in the central and western parts of the Mt Carrington field, primarily associated with felsic porphyry bodies. There has been limited exploration for copper mineralisation in general, but one early Newmont drill hole intersected copper veining over most of its length of 279 metres. The grades, although modest, include an aggregate of 164 metres at 0.26% Cu.

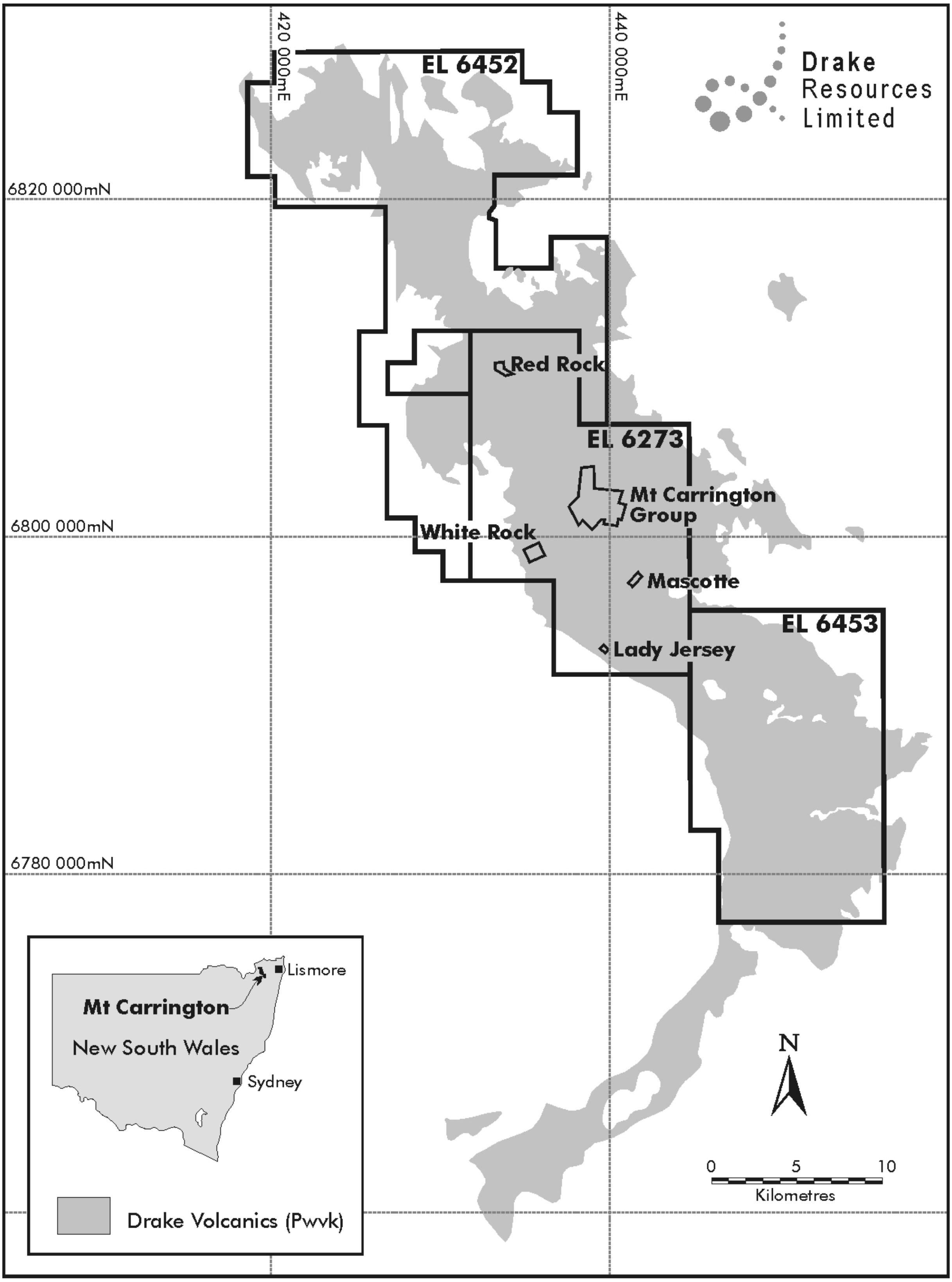
Supergene copper mineralisation has been identified at three locations at Mt Carrington. The main area, Gladstone, displays the transition from chalcopyrite, chalcopyrite rimmed with chalcocite, to chalcocite-only mineralisation. There has been very limited exploration for this style of mineralisation in the district.

Summary

The Mt Carrington gold-silver-zinc deposits occur in an extensive area of alteration within the intermediate to felsic Drake Volcanics. The deposits are considered to have formed during the evolution of this late Permian volcanic belt, at relatively shallow depth in a submarine to emergent environment.

Mt Carrington occurs in the south-western portion of a subtle but well-defined circular structure, nested within a broader magnetic “quiet zone” that is interpreted to correspond directly to a regional-scale but poorly developed caldera-like feature. The flow-banded nature of the intrusives, their commonly fault-like contacts, and the locally faulted margins of the bodies suggest that, despite proximity to surface, the magma was too cool and stiff for significant volumes to be vented to surface.

There are strong spatial and probably genetic relationships between the distribution of certain rhyolitic and andesitic intrusions and the epithermal mineralisation. In particular much of the copper, zinc, gold and silver mineralisation is associated with rhyolitic intrusive bodies which are commonly highly silicified and flow laminated.



Drake Volcanics with Tenements

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