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The Lake Chisholm Exempt Area

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INTRODUCTION

A Landsat study, carried out under the Mt Read Volcanics Project, drew attention to several areas in western Tasmania as being worthy of further investigation for the occurrence of mineral deposits (Duncan, 1986). The study confirmed that the Rapid River Lineament, defined for 25 km by the straight drainage course of the river, was one of the most prominent WNW-trending linear features of the region.

The Lake Chisholm area (centred on AMG co-ordinates 339 000 mE; 5 444 000 mN) contains the intersection of a Precambrian carbonate horizon — the Black River Dolomite — with the Rapid River Lineament. It is well recognised that reactive carbonate horizons can host various types of mineral deposits and that ore fluids may be focussed by large structures of the kind represented by the lineament.

A study of recent exploration disclosed that BHP Minerals Limited had cut a prospecting grid over the intersection area while searching for carbonate-replacement cassiterite-sulphide deposits in Exploration Licence 18/83 (Anon, 1984; fig. 1). The grid was designed to cover a broadly coincident INPUT/aeromagnetic anomaly noted during exploration on the neighbouring EL18/80. The geophysical information was derived from a 1973 INPUT survey commissioned by Esso Australia Limited during exploration of EL2/73 (Neale, 1974) and a 1956 Rio Tinto Australian Exploration aeromagnetic survey (McCarthy, 1958).

BHP completed geological mapping, C-horizon soil sampling and a Genie EM survey on the Lake Chisholm grid. The results suggested that a narrow, dipping, continuous conductor coincided with a weak arsenic geochemical response in shallow auger holes. The company attributed the geophysical anomaly to a black shale, did not analyse the auger samples for gold, and concluded that the results did not warrant further testing and dropped the ground.

In the absence of further company interest, it was resolved, from a consideration of the previous exploration results, that the Department should reserve the area and further test the Lake Chisholm grid for sediment-hosted Carlin-type gold deposits. This work was to use both conventional exploration methods and the newly developed soil and water Huminex geochemical methods.

An area of 25 km^2 was exempted from the *Mining Act* on 12 August 1987. Although company exploration had not revealed any substantiated gold anomalies in the carbonate rocks of the Smithton Region (see following section), it was thought that the proving of gold mineralisation in the carbonate rocks at Lake Chisholm would open up the extensive carbonate suite of the Smithton Synclinorium for further company exploration.

OVERVIEW OF PREVIOUS EXPLORATION

Previous exploration in the rocks of the Smithton Synclinorium has concentrated on the tin and tungsten potential of the carbonate rocks. This was a result of speculation that extensions of the Pieman Granite underlie the Balfour and Smithton areas and provided the heat and fluid source to generate mineralisation in the carbonate rocks, in the style of the Renison, Cleveland and King Island mineral deposits. Exploration licences previously held for these commodities were EL12/65 (Pickands Mather and Co. International), EL6/72 (Australian and New Zealand Exploration Co.), EL1/77 (CRA Exploration Pty Ltd), EL18/80 (BHP Co. Ltd), EL49/80 (Shell Co. of Australia Ltd), EL52/80 (Electrolytic Zinc Co. of Australasia), EL7/83 and 8/83 (Geopeko Limited), EL18/83 (BHP), and EL7/85 (Savage Resources Limited).

Exploration licences held for other commodities were:

- EL2/73, Esso Mineral Enterprises Australia Inc. — base metals;

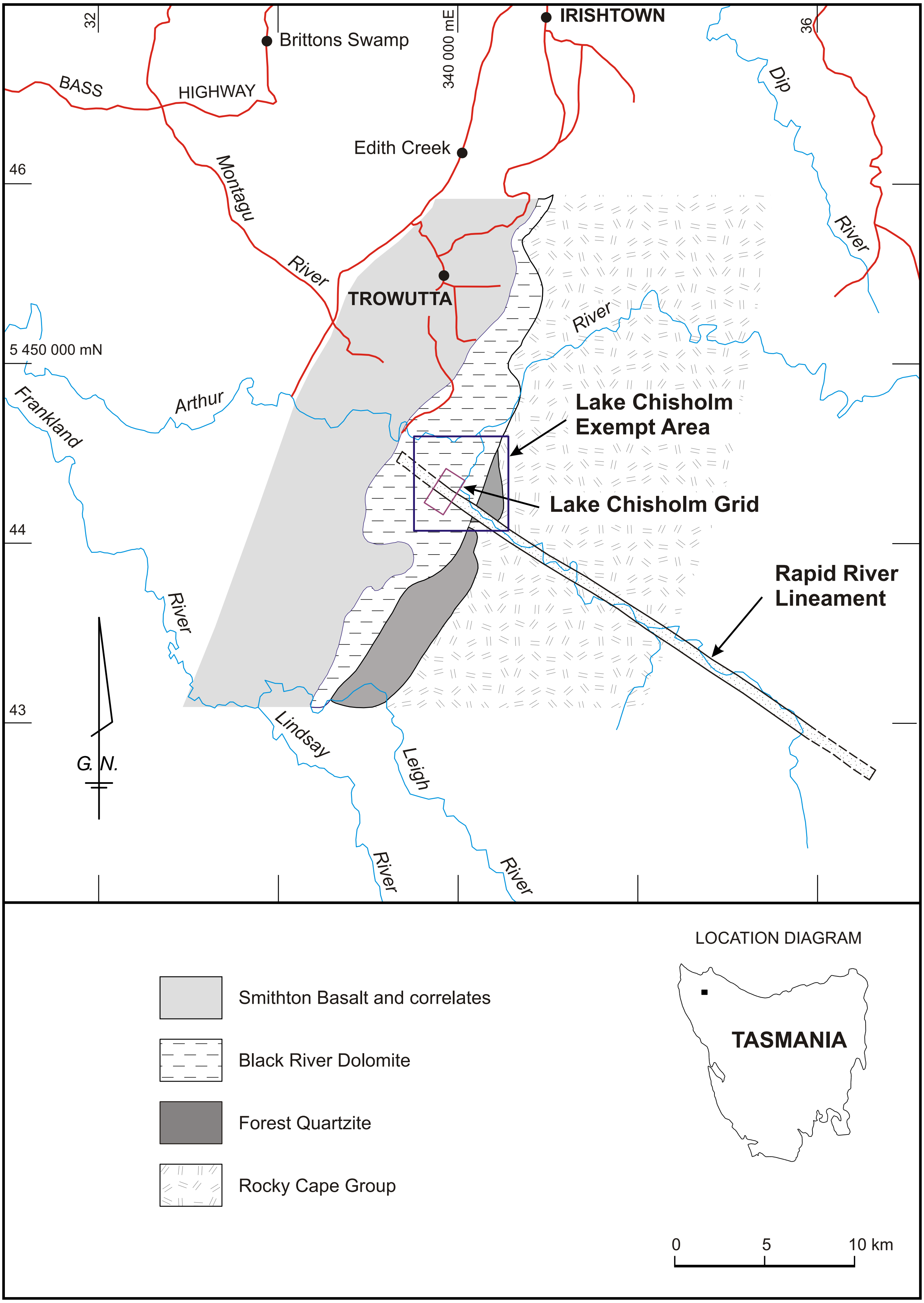

Figure 1

Location and geology, Lake Chisholm

- EL1/77, CRA Exploration Limited — included shale-hosted lead-zinc deposits similar to the Selwyn Basin, Canada;
- EL18/80, BHP Company Limited — included Carlin-style gold, diamonds, MVT lead-zinc deposits and sedimentary copper;
- EL43/84, Mineral Holdings Australia Pty Ltd — industrial mineral carbonates;
- EL12/86, BHP Company Limited — chromite in Tertiary alluvial sediments;
- EL21/87 and 22/87, Aureole Resources Pty Ltd — platinoids, gold and base metals;
- EL7/85, Savage Resources Limited — included gold, silver, base metals and hematite;
- EL46/89 and 52/89, Geopeko Limited — carbonate-hosted lead-zinc-silver, Carlin-style gold;
- EL29/90, Newcrest Mining Limited — Carlin-style gold in carbonate rocks;
- EL 19/92, CRA Exploration Pty Ltd — sediment-hosted base metals.

This exploration has not recorded any significant metallic mineral deposits in the Smithton Synclinorium. Results relevant to low-order gold anomalies are summarised below.

In 1984 Mineral Holdings Australia Pty Ltd reported anomalous gold and platinum values in samples of Smithton Dolomite just north of EL29/90. These values reached 4 g/t gold and 0.46 g/t platinum but subsequent resampling by both CRA Exploration and Pan Australian Mining Ltd failed to confirm the values and the initial high results were put down to contamination.

In 1986 Savage Resources Ltd, exploring in EL7/85, reported anomalous gold values in Wacker drill samples of bedrock on the Plowright Grid of the Northern Domal Prospect near Robbins Beach (Annett, 1986). Gold values reached 39 ppb over 150 m in fragmented basic volcanic rocks adjacent to a fault interpreted from aeromagnetic anomalies. For various non-technical reasons, the company did not follow up this geochemical lead before the ground was relinquished (Shannon, 1988).

Newcrest Mining Limited, exploring EL29/90 at Trowutta, detected weak gold anomalies to 9 ppb in bulk cyanide leach stream-sediment samples from catchments draining an area of the Roger River Fault. High copper and zinc contents from the same samples suggested that the anomalies were due to high backgrounds in the mafic volcaniclastic rocks (McEwen, 1992).

Most recently, CRA Exploration Pty Ltd has explored EL19/92 at Trowutta for sediment-hosted copper deposits in a range of lithological and structural settings (Parkinson, 1994). Stream sediment and rock-chip sampling confirmed that the mafic lithicwackes of the Kanunnah Subgroup had average background levels of copper and zinc of approximately 200 ppm. Two sediment samples from streams draining basalt and mafic lithicwacke adjacent to the Roger River Fault contained 61 ppb and 26 ppb gold. A chloritic, sheared rock sample from a quarry on the Roger River Fault contained 4.35% copper and was weakly anomalous in gold (12 ppb) and silver (7 ppm). This sample was not followed up and its significance is unknown.

RESULTS OF THIS INVESTIGATION

The Lake Chisholm area is some 57 km by road south of Smithton in State Forest [CQ374444], with a small Forest Reserve enclosing the actual lake. The old BHP exploration grid is located one kilometre east of the Forest Reserve in a previously logged area. Access to the grid was along old logging tracks, some of which were impassable to vehicles due to regrowth. Enough of the BHP grid was preserved by way of flagging and tapes to allow the accurate location of the required traverses.

With the objective of testing the area for gold, the following techniques were employed:

- water sampling (Huminex) of selected catchments;
- location and flagging of the BHP grid;
- field examination of anomalous areas;
- soil sampling (A-horizon Huminex) on selected traverses;
- rock-chip sampling and analysis; and
- petrography.

Water sampling

Nine water samples were taken from the creeks draining the area of the grid and were analysed by the Huminex method. The results, expressed as the concentration of gold relative to carbon, were all less than 1 ppm and are far less than the value of 10 ppm considered as anomalous for this geochemical method (W. E. Baker, pers. comm.). The highest value of 0.96 ppm Au was recorded less than 200 m downstream from the area of best gold values in the A-horizon soils on line 12 000 mN. A water sample was selected from Lake Chisholm as a background level for the area and at 0.16 ppm Au was the lowest reading of the survey (Appendix 1).

Soil sampling

Three short traverses were selected over the core of the combined arsenic-EM anomaly which is 1400 m long and 200 m wide. A-horizon soil samples were taken every 50 m on lines 12 000 mN, 11 800 mN and 11 600 mN (fig. 2).

The gold content of the soil samples, determined by Huminex techniques, were all less than 0.04 ppb, with the exception of two samples on line 12 000 mN which analysed 0.14 ppb Au and 0.11 ppb Au at 10 550 mE and 10 450 mE respectively (Appendix 2).

Rock-chip sampling

Outcrop in the area is poor, with the only substantial bedrock in the core of the anomaly being exposed on line 11 200 mN. Eleven rock samples (C102620–630) were selected for examination, nine from the grid and two from the nearby Julius quarry, 4 km to the west (Appendix 3). The samples comprised black laminated shale, grey siltstone, silicified, banded and brecciated dolomite, and brecciated and banded chert.

Rock samples C102624, 626, 627 and 630 were taken of the bedrock lithologies — black graphitic shale, siltstone and breccia — on line 11 200 mN at 10 650 mE. These samples were petrographically determined as argillite, lithic siltstone, and phyllite breccia with up to 5% pyrite (Appendix 4). Much of the coarser pyrite grains are anisotropic and may be arsenic-rich, with cores containing fine inclusions of chalcopyrite, sphalerite and pyrrhotite. The microstructures indicate a diagenetic origin with little metamorphic recrystallisation (Appendix 4).

Chemical analysis of four samples (C102623, 624, 627 and 630) by the Department's laboratory showed subdued base metal contents in the sediments (Cu, Pb, Zn up to 62 ppm, 13 ppm and 35 ppm respectively), with arsenic having the highest value of 66 ppm in the pyritic black shale. Gold contents in these rocks, determined by fire assay, did not report above the detection limit of 0.03 ppm (Appendix 5).

CONCLUSIONS

The Huminex geochemical exploration method used on the combined EM/arsenic anomaly has not shown a sufficiently anomalous gold response to invite further investigation for gold mineralisation. The method appears internally consistent, with slightly elevated water drainage values corresponding with the best response from A-horizon soil samples from the northern traverse covering the combined anomaly.

Bedrock sampled on line 11 200 mN, on the axis of the anomaly, has up to 5% pyrite, with a slightly elevated arsenic response due to the sulphide content. No gold above the detection limit of 0.03 ppm was measured in the shale. This has confirmed the BHP conclusion that the EM anomaly was due to a shale and has further shown that the shale contains diagenetic sulphides.

There is therefore no record from this study of gold-bearing solutions being active along the Roger River Lineament and mineralising the adjacent carbonate rocks. The test of the model has proved negative in this area and the potential of the Smithton Synclinorium dolomite to host Carlin-style gold mineralisation remains unproven.

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[14 March 1997]

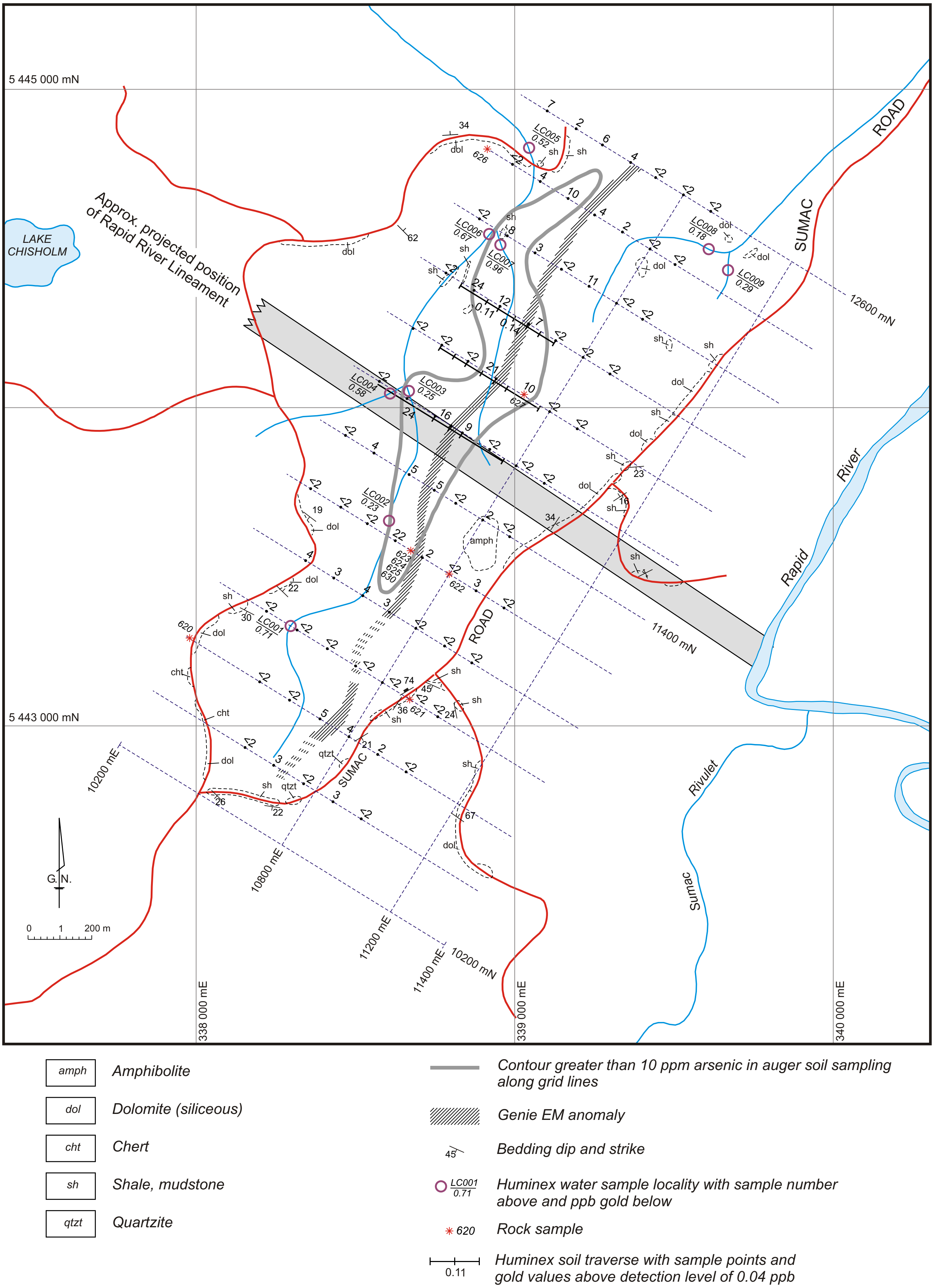

Figure 2

Sample locations and results, Lake Chisholm

APPENDIX 1

Huminex analyses of water samples — Lake Chisholm grid

Sample No.	Grid Co-ordinates (m)	Au/C (ppm)	Comments
LC001	10,800N; 10,500E	0.71	Stagnant water
LC002	11,200N; 10,550E	0.23	Running water
LC003	11,600N; 10,400E	0.25	Running water
LC004	11,600N; 10,350E	0.58	Running water
LC005	12,400N; 10,300E	0.52	Running water
LC006	12,200N; 10,300E	0.67	Running water
LC007	12,200N; 10,350E	0.96	Stagnant water
LC008	12,500N, 11,000E	0.18	Running water
LC009	12,500N, 11,000E	0.29	Running water
LC010	Lake Chisholm	0.16	Standing water

Au/C (ppm) — results expressed as the concentration of gold relative to carbon
Analyst: W. E. Baker

APPENDIX 2

A-horizon Huminex soil sampling — Lake Chisholm grid

Sample No.	Grid Co-ordinates (m)	Au (ppb)
C102601	11,600N; 10,500E	*
C102602	11,600N; 10,550E	*
C102603	11,600N; 10,600E	*
C102604	11,600N; 10,750E	*
C102605	12,000N; 10,600E	*
C102606	12,000N; 10,550E	0.14
C102607	12,000N; 10,700E	*
C102608	12,000N; 10,650E	*
C102609	12,000N; 10,500E	*
C102610	12,000N; 10,450E	0.11
C102611	12,000N; 10,350E	*
C102612	11,800N; 10,750E	*
C102613	11,800N; 10,700E	*
C102614	11,800N; 10,650E	*
C102615	11,800N; 10,600E	*
C102616	11,800N; 10,550E	*
C102617	11,800N; 10,500E	*
C102618	11,800N; 10,450E	*
C102619	11,800N; 10,400E	*

* all samples marked thus are less than the detection limit of 0.04 ppb
Analyst: W. E. Baker

APPENDIX 3

Rock Sampling — Lake Chisholm

Reg. No.	Rock type	AMG Co-ordinates mE	mN
C102621	brecciated chert	338 660	5 443 100
C102622	finely banded chert	338 780	5 443 490
C102623	laminated black shale	338 650	5 443 570
C102624	pyritic black shale	338 650	5 443 570
C102625	quartz	338 650	5 443 570
C102626	chert, banded, brecciated	338 950	5 444 840
C102627	pink-grey siltstone	339 010	5 444 070
C102628*	algal dolomite (silicified)	335 000	5 442 200
C102629*	quartz concretion in chert	335 000	5 442 200
C102630	quartz + limonite	338 650	5 443 570

* Julius Quarry

APPENDIX 4

Petrology of samples from the Lake Chisholm area

Sample C102624A: Pyritic argillite

Hand specimen

This is a black argillaceous rock, locally bleached to grey. The cleavage is moderate to poor, and bedding is very weak. Pyrite occurs as cubic crystals, to a few millimetres in size, and lenticular to discoidal concretions to a few centimetres in size, flattened parallel to the bedding. Weathering has produced some secondary yellow-brown iron minerals, probably goethite and jarosite.

Thin section

The rock matrix comprises very fine-grained (clay to silt-sized) recrystallised quartz and white mica, with minor pyrite, chlorite and amorphous carbon. There is little indication of metamorphic or sedimentary layering, or original detrital grains.

Porphyroblast-like spots rich in a fine-grained, low birefringent mineral (cordierite or andalusite?), with minor chlorite and mica and a corona of pyrite, are relatively common. These exhibit a rotated cleavage, indicating a syn-kinematic origin. Some small lenticular silty layers occur more rarely.

Pyrite comprises perhaps 5% of the rock, mostly as anhedral to subhedral grains less than 10 µm in size, and more sporadically as subhedral to euhedral crystals up to 3 mm in size. These larger crystals are typically elongate parallel to traces of bedding and have quartz pressure shadows at a high angle to this (parallel to the cleavage). Fine inclusions are present in the cores of these pyrites, and include gangue (unfoliated), chalcopyrite, sphalerite and pyrrhotite. Many of the crystals are stylolitically truncated parallel to the cleavage. The microstructures all indicate that the pyrite was probably diagenetic in origin, with little metamorphic recrystallisation. Much of the coarser pyrite is weakly anisotropic and is probably arsenic-rich. Weathering has replaced pyrite with limonite in parts of the rock.

The rock could be classified as a pyritic argillite which has been only slightly affected by regional metamorphism. The sulphides would give rise to geochemical and geophysical anomalies over this rock type.

Sample C102624B: Phyllitic lithic siltstone

Hand specimen

This is a mottled grey-black argillaceous rock, with a weak phyllitic cleavage and some bedding. Pyrite occurs as lenticular concretions to a few millimetres in size, partly altered to limonite. Mottling appears to be a result of fine spotting and irregular bleaching.

Thin section

The rock matrix comprises very fine-grained (clay to silt-sized) recrystallised quartz and white mica, with minor limonite (after pyrite), chlorite and amorphous carbon. There is a weak crenulation cleavage and very minor sedimentary layering. The major difference from C102624A is the evidence of a large detrital component. This component is mostly silt-sized (up to 150 µm) degraded biotite (chlorite-muscovite), argillaceous material and minor quartz. Some fine quartz veinlets are present. The porphyroblastic spots are similar to those in C102624A, but are largely plucked from the section.

Sample C102624C: Phyllitic lithic siltstone

This rock closely resembles C102624B in both hand specimen and thin section, but has a comparatively distinct lamination, resulting from layers rich in fine amorphous carbonaceous material.

Sample C102626: Banded, brecciated chert

Hand specimen

This is a finely laminated, black to off-white cherty rock, brecciated by milky white vein quartz.

Thin section

The rock is a partly recrystallised chert. The earliest clasts consist of brown (carbonaceous?) chalcedonic quartz (<10 µm), which is partly replaced by coarser quartz (highly undulose grains up to 60 µm). The rock contains numerous veinlets and blebs of both fibrous to radiating chalcedony and well-crystallised quartz. Much of this could be infilling of shrinkage cracks during diagenetic recrystallisation of an opaline precursor. Very rare fine pyrite (<5 µm) and limonite (after pyrite?) are present in both the chert and quartz veins.

Sample C102627: Phyllitic mudstone

Hand specimen

The rock is argillaceous to silty and phyllitic, with a pink colour (bleached off-white in parts) and some red blebs. There is a very weak cleavage and little indication of bedding.

Thin section

The rock matrix (~45%) comprises fine-grained micaceous material with ~20% silt to sand-sized quartz grains, ~20% white mica flakes, ~10% fine-grained, limonitic, arenaceous lithic clasts, and ~5% clay pellets (<15   3 mm).

There is a moderate crenulation cleavage and the rock could almost be classified as a phyllite, but original mudstone textures are relatively well preserved.

Sample C102630: Pyritic silicified phyllite breccia

Hand specimen

The rock is a massive mottled medium to dark grey quartzitic breccia with abundant limonitic pseudomorphs after euhedral pyrite (<3 mm). There is no indication of bedding or cleavage.

Thin section

The rock comprises angular clasts of fine-grained phyllitic material (~30%) in a quartzitic matrix, which appears to vary from silicified phyllite to vein quartz. Limonite pseudomorphs after euhedral pyrite (0.01–10 mm) are distributed relatively homogeneously throughout the rock.

The rock appears to represent local brecciation and silicification of the phyllite with concurrent recrystallisation (and remobilisation?) of the pyrite. This may be related to the brecciation of the chert (C102626).

APPENDIX 5

Analyses of rock chip samples — Lake Chisholm Grid

Sample No.	C102623	C102624	C102627	C102630
Laboratory No.	876051	876052	876053	876054
Element (ppm)				
Au	<0.03	<0.03	<0.03	<0.03
Ag	6	9	<5	9
As	<10	66	<10	31
Bi	<5	5	<5	5
Cu	14	50	23	62
Mo	23	7	2	15
Pb	13	11	<4	7
Sb	<5	5	<5	<5
W	11	13	<10	<10
Zn	10	23	25	35
Tl	1.4	1.6	1.1	<0.2
Hg	<0.05	<0.05	<0.05	<0.05
Field description	black shale	pyritic black shale	siltstone	limonitic quartzite breccia

Analyst: W. E. Baker