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**CORINNA PROJECT**

# EL26/95 SPECIMEN CREEK WESTERN TASMANIA

# ANNUAL REPORT TO 6.3.99

Volume 1 of 2

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31st July, 1998

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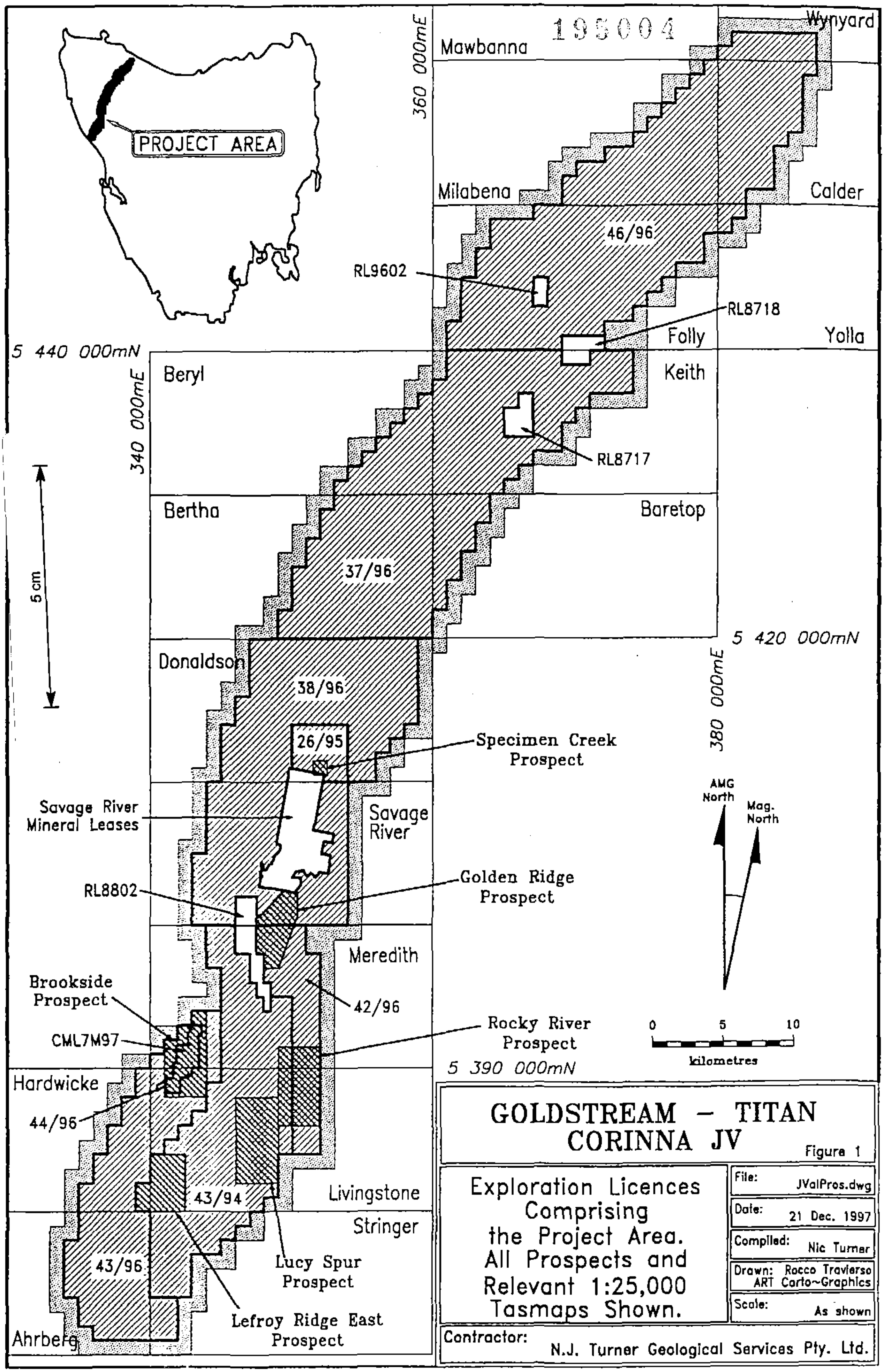
| | |
|---|---|
| Appendix 5 | Leamon, D.E. 1998. Comments on airborne geophysical data EL26/95 Specimen Creek, west Tasmania. |
| Appendix 6 (separate volume) | Sharpe, R. 1998. Petrographic investigation of the alteration and vein assemblages at the Specimen Creek Prospect, Arthur Mobile Belt, Western Tasmania. CODES SRC. |

LIST OF PLANS

| | |
|---|---|
| Plan 1 | Access, drainage, contours, regional stream seds., previous soil work, geology. |


195004
PROJECT AREA
Wynyard
Mawbanna
360 000mE
Milabena
Calder
46/96
RL9602
RL8718
Folly
Yolla
5 440 000mN
Beryl
Keith
340 000mE
RL8717
5 cm
Bertha
Baretop
37/96
5 420 000mN
Donaldson
38/96
380 000mE
26/95
Specimen Creek
Prospect
AMG
North
Mag.
North
Savage River
Mineral Leases
Savage
River
Golden Ridge
Prospect
RL8802
Meredith
Brookside
Prospect
42/96
CML7M97
Rocky River
Prospect
0
5
10
kilometres
5 390 000mN
Hardwicke
44/96
GOLDSTREAM - TITAN
CORINNA JV
Figure 1
43/94
Livingstone
Stringer
43/96
Lucy Spur
Prospect
Lefroy Ridge East
Prospect
Ahrberg
Exploration Licences
Comprising
the Project Area.
All Prospects and
Relevant 1:25,000
Tasmaps Shown.
File: JVallPros.dwg
Date: 21 Dec. 1997
Compiled: Nic Turner
Drawn: Rocco Traviorso
ART Carto~Graphics
Scale: As shown
Contractor:
N.J. Turner Geological Services Pty. Ltd.

## 1.0 Summary


- Previous diamond drilling by the Goldstream-Titan Joint Venture at Specimen Reef returned unpromising gold values but intersected a substantial, post-deformational alteration and vein system.
- Petrographic studies show that the alteration is characterised by white mica and siderite/ankerite whilst most of the veins are characterised by siderite/ankerite. High grade gold occurs in association with brannerite in a siderite/ankerite vein in IMI/Savage Resources' drill hole SP1. Overall, the system has many similarities to Archean and Proterozoic quartz-carbonate shear hosted Au deposits.
- Geophysical interpretation suggests that Specimen Reef is in a NE trending structure which extends 2km on either side of the old workings.
- Sampling, mapping and geophysics are recommended to confirm the structure with a view to drill testing along its strike. There is also scope for further drill testing at the old workings.
- The Specimen Reef structure may be related to the Donaldson Fault which is a substantial regional structure.


## 2.0 Introduction

This report outlines progress in EL26/95 for the year to 6.3.99. It should be read in conjunction with two earlier annual reports, one to 6.3.97 and the other to 6.3.98.

The annual report to 6.3.97 discusses land tenure information and geology. It includes a comprehensive review at historical mining and modern mineral exploration at Specimen Reef by consultant Lindsay Newnham. The report to 6.3.98 gives results of diamond drilling by the Goldstream-Titan Joint Venture at Specimen Reef.

## 3.0 Tenement information

EL26/95 has an area of about 15skm and lies immediately north of the Savage River Mine leases (Figure 1). The licence will remain current to 5.4.06, providing that the licensee's performance is deemed satisfactory by the Tasmanian Minister of Mines.

The recent State and Commonwealth Governments' Regional Forest Agreement will not affect access for mineral exploration and development in EL26/95.

## 4.0 Previous work by Goldstream and Titan

A soundly based interpretation of the subsurface disposition of Specimen Reef was produced as part of the consultant's review of historical mining and modern mineral exploration. The Joint Venture drilled two diamond holes to test the interpretation.

The holes were drilled in a north westerly directed 'fence' perpendicular to the strike of Specimen Reef (Plan 1). The lower hole (SCDDH1) was aimed at a narrow intersection reported by IMI/Savage Resources from their SP1 drill hole. This 3m intersection included 0.2m of 910gpt at 141m but was otherwise low grade. It lies to the east of Specimen Reef in Newman's interpretation. SCDDH2 was designed to provide a near-intersection of Specimen Reef, about 30m above SCDDH1.

IMI/Savage Resources' drill hole SP13 was used as a reference for locating the Joint Venture's holes (Appendix 4A). Logs and analytical results of the drilling are given in the Annual Report to 6.3.98 and in Appendices 4B and 6 of this report.

SCDDH1 should have passed close to the previous rich intersection at about 160m. An isolated 1m assay of 0.24gpt was returned from 145m but otherwise, no gold values above detection limit were returned from this vicinity. Instead, the hole intersected 2m averaging 0.56gpt at 189-191m with an interval of intensely broken core at 189-189.65m. This intersection corresponds to the extrapolated position of Specimen Reef in the consultants interpretation.

SCDDH2 encountered scattered anomalous gold values of 30-50ppb in the interval 133-140m. Virtually everywhere else gold was under detection limit. The anomalous interval corresponds closely with the onset of pervasive alteration in the core (Appendix 4B) and is within a few metres of the extrapolated position of Specimen Reef at 142m. Intervals of intensely broken core were encountered at158.15-159.5m and 163.5-164m but no gold values are associated with them.

Both drill holes returned gold values from the predicted positions of Specimen Reef. They intersected the reef in a zone that would be down-plunge of the lodes in the old mine if the lodes were structurally controlled by the intersection of Specimen Reef with the main foliation in the host rocks. No lode was intersected.

Substantial intervals of fairly continuous alteration and veining were encountered in both holes (170-221m in SCDDH1, 129-179.9m in SCDDH2). The alteration and veining are younger than the main foliation so the reef-foliation intersection is unlikely to be an ore control. Historical records give a south easterly plunge of about 45° for the lodes. Further drilling would be required to test down-plunge positions in that direction.

## 5.0 Work within this reporting period

During the current period the Joint Venture has received consultant Robina Sharp's report on the petrography of the SCDDH1 core (Appendix 6) and consultant David Leaman's report on airborne geophysical data for EL26/95 (Appendix 5). Also, regional stream sediment sampling has been carried out in EL26/95 and lithologies in SCDDH2 were logged.

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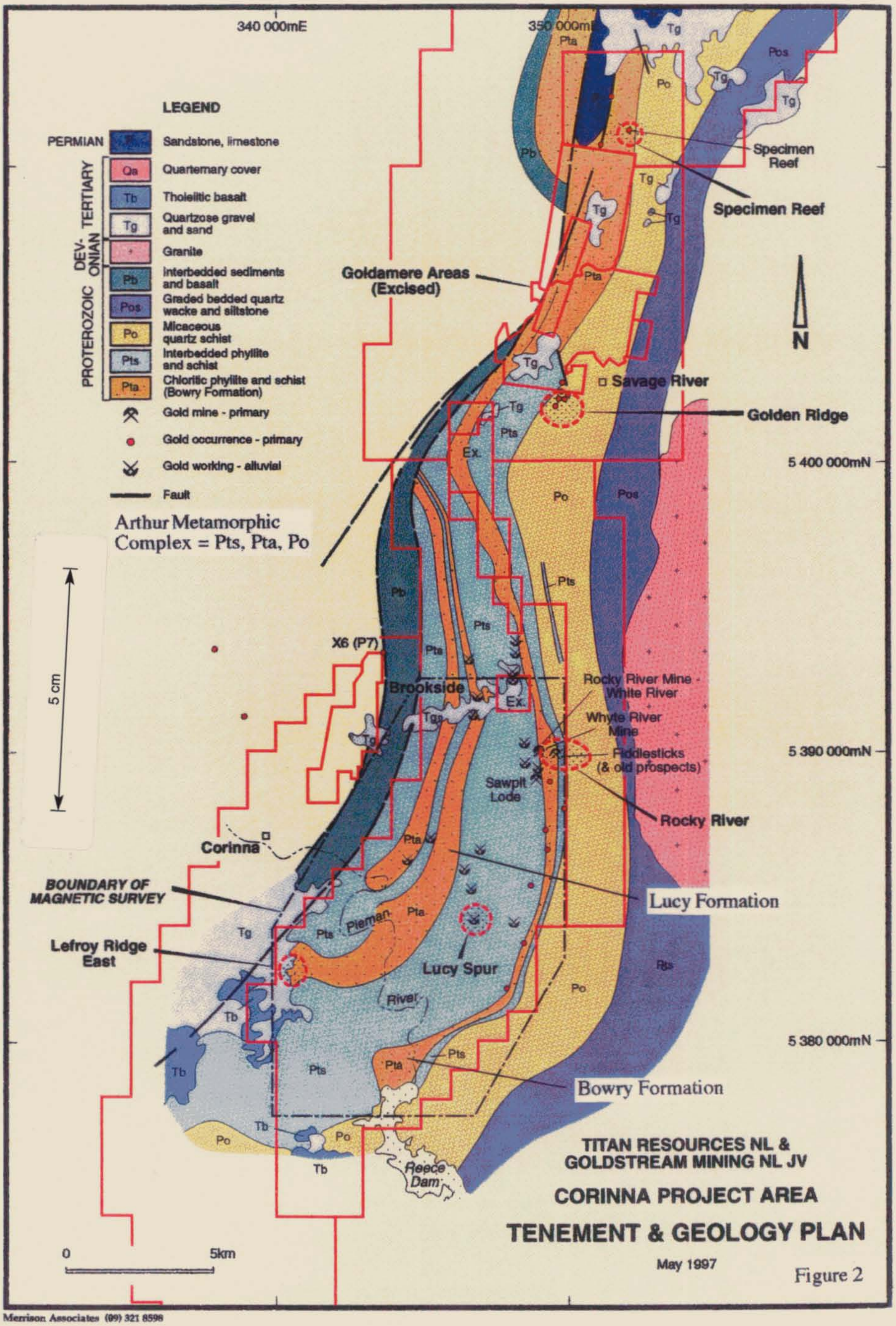

Figure 2

Merrison Associates (09) 321 8598

## 5.1 NOTES ON PETROGRAPHY

The consultant identifies the alteration assemblage in SCDDH1 as generally white mica and carbonate (siderite or ankerite), only describing silicification at 179m depth. The impression gained from independent logging is that silicification is fairly common in the main alteration intervals in both holes.

Two dominant vein types are recognised namely, quartz ±feldspar and carbonate (siderite/ankerite). The conclusion from independent core logging is that there are two subdivisions of the first type. There are pre main foliation veins which are boudinaged and there are post foliation white carbonate ±feldspar + quartz veinlets. The siderite/ankerite veinlets overprint both subdivisions.

Importantly, the consultant has identified as brannerite the mineral associated with gold in the high grade intersection in IMI/Savage Resources' drill hole SP1. Also, the high grade mineralisation is hosted by a siderite-ankerite vein. The low grade material in the SCDDH1 intersection with Specimen Reef was not described.

The consultant observes that the characteristics of alteration and gold mineralisation described for Specimen Reef have many similarities to those described for Archean to Proterozoic quartz-carbonate shear hosted gold deposits.

Consultant Rob Edwards found that the high grade intersection in SP1 gave a strong scintillometer response. However, scanning of the remainder of SP1, all of the other IMI/Savage Resources holes and SCDDH1 and 2 did not produce further responses.

Structural data is to hand which could fulfill the consultant's recommendation that the orientation of the carbonate veins be established with accuracy. However, it would take time to work up. The data relates to SCDDH1 in which the core was oriented, but not to SCDDH2 for which the 'spear' method of core orientation did not work effectively. First impressions are that the siderite-ankerite veins form a generally subparallel family in approximately the same orientation as Specimen Reef.

## 5.2 AIRBORNE GEOPHYSICAL DATA

The consultant found suggestions in the aeromagnetic data of a NE-SW trend which persists for up to 2km in either direction from the known position of Specimen Reef. There are also NW-SE trends in the data but these cross into late Palaeozoic rocks and Tertiary basalt (Plan 1) and thus, may be too young to relate to the mineralisation. Some treatments of the aeromagnetic data may suggest that alteration (loss of magnetic contrast) is restricted to the vicinity of the old workings.

Not much was derived from the airborne radiometric data. Some support for the NE-SW trend of the Specimen Reef zone was tentatively identified.

## 5.3 REGIONAL STREAM SEDIMENT SAMPLING

The Joint Venture has commenced a regional stream sediment survey of its tenements north of Savage River Mine. Panned concentrate, -40#(BCL) and -80# samples are being collected for each site. Sample types and analytical methods are detailed in Appendix 1 which also gives the analytical results for EL26/95. Sample locations and results are plotted in Plan 1.

Stream sediments in parts of EL26/95 are greatly disturbed as a consequence of historical prospecting and mining. Therefore, it is unlikely that the absolute analytical values of gold are comparable with values for undisturbed areas. However, the sampling provides a good indication of the distribution of gold bearing rocks.

Coarse gold (≥0.1mm) was returned in panned concentrates from Specimen Creek, McPhee Creek, Davis Creek, Kaysers Creek, a tributary of Broderick Creek (6034, etc), and the uppermost reaches of Broderick Creek (6010, etc). Descriptions of the panned concentrates (Appendix 3) show that the gold grains retain much of their original crystallinity and are unlikely to have travelled far. There appears to be no contamination by gold sourced from Tertiary gravel or from conglomerate in the Late Palaeozoic rocks.

Analytical values for gold in -40# (BCL) and -80# do not always correlate with the counts of coarse gold grains in panned concentrates. Nor do they always correlate with one another. Values for both fractions are notably high in Specimen Creek and relatively high in the tributary of Broderick Creek whilst the -40# value in upper Broderick Creek is relatively high.

Because Specimen Creek is so disturbed, the pan. con. and analytical values at the site of samples 6031-6033 must be regarded as artificial. The two relatively high value sites are probably closer to natural values. These sites are in streams which drain a formation of chloritic schist with minor phyllite, dolomite and interbanded amphibolite (Pac). Previous soil sampling by IMI/Savage Resources indicates that this formation is locally anomalous in gold with scattered fire assay soil values ranging 120-1680ppb (Plan 1).

Neither the Joint Venture's regional stream sediment sampling nor IMI/Savage Resources' soil sampling has done much to test the possible extensions of Specimen Reef. The interpreted 2km extension to the south west is largely within ABM's leases.

## 6.0 Conclusions

The Joint Venture's drilling programme has not returned promising gold values and indicates that the high grade intersection in SP1 is of very limited extent. The likely plunge direction of the lodes in the old mine was not tested by the drilling.

A substantial alteration system characterised by white mica and siderite/ankerite is present at Specimen Reef. There is an associated veinlet system characterised by white carbonate-quartz veinlets and by dominant siderite/ankerite veinlets. First impressions are that the latter veinlets form a sheeted system, subparallel to Specimen Reef. High grade gold associated with brannerite has been found in a very small part of the siderite/ankerite veinlet system.

Aeromagnetic interpretation suggests that Specimen Reef is within a north east trending structure which may extend for 2km in either direction from the old mine. The position and trend suggest that the structure is related to the Donaldson Fault, a major regional structure (Figure 3).

Soil sampling by IMI/Savage Resources indicates that the geological formation which is cut by the Specimen Reef structure is locally quite anomalous in gold. If fluids leaching such a formation were concentrated in the Specimen Reef structure, economic gold deposits might be formed. Therefore, further exploration of the structure is considered worthwhile, particularly to the south west where the structure appears to cut other rocks that are likely to be anomalous in gold.

The Donaldson Fault, Pieman Fault, Smithton Fault (Roger River Fault) and Henty Fault (Figure 3) may be members of a family of major regional structures with common geological processes operating in them. Other intersections by members of this group of faults with the AMC should be targeted for investigation.

## 7.0 Recommendations

The Joint Venture should map the possible extensions of the Specimen Reef structure with the aim of drilling the structure at a series of positions along its length. The mapping will entail stream sediment and soil sampling, geological mapping and geophysical work. An effective program would require access to ABM's leases.

There is scope for further drilling to test the down plunge position of the lodes in the old mine. This would require drilling from a point north east of the existing holes. Further to the north east IMI/Savage Resources established a soil anomaly (max 544ppb - Plan 1) but drilled south east to test it, rather than north west towards the reef. Further examination of their data should be undertaken to determine if drilling to the north west is justified.

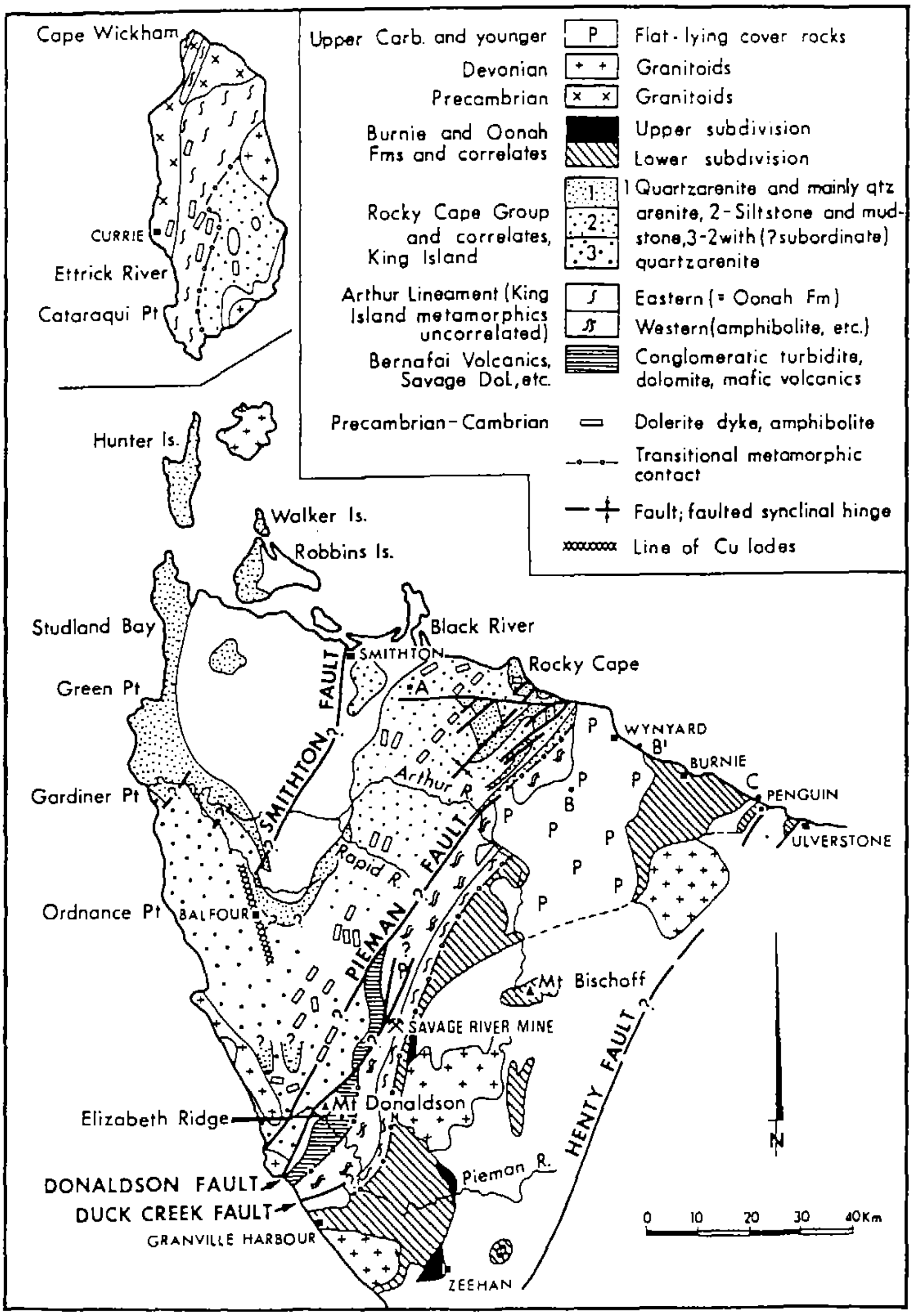


Figure 3 Proterozoic-Palaeozoic geology of northwest Tasmania (Turner, 1989). Also see Calver et al (1995).

5 cm

## 8.0 Environmental matters

No work requiring environment rehabilitation was undertaken during the reporting period. No rehabilitation of the SCDDH1 and 2 drill sites and tracks has been carried out.

## 9.0 References

Annett, R.W.; Shannon, C.H.C. 1987. Annual report on investigations within Exploration Licence 4/61, West Coast, Tasmania (September 1986-June 1987) Unpub. Rep. Savage Resources Ltd MRT Library TCR87-2683.

Newnham, L.A. 1996. EL26/95, Specimen Reef area, western Tasmania. Review of previous data. Appendix 1 of Turner, N.J. 1997. Exploration Licence No 26/95 Specimen Creek, western Tasmania. Annual Report to 6.3.97. Goldstream Mining NL and Titan Resources NL.

Turner, N.J. 1989. Precambrian in Burrett, C.F., Martin, E.L. (Editors) Geology and mineral resources of Tasmania. Special Publication Geological Society of Australia 15.

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**EL26/95: Annual Report to 6.3.99**

**APPENDIX 1**

REGIONAL STREAM SEDIMENT SAMPLE NUMBERS, AMG CO-ORDINATES AND ANALYTICAL DATA CONSISTING OF:

A -80# Au, Cu, Pb, Zn, Ag, As, Sb, Mo, Bi, U, V
B -40# BCL Au, Ag, Cu

**Sample Types**

Three samples were generated for each site. Representative gravel, sand and silt collected across the stream bed was sieved in the field to give around 2kg of -40# product. A subsample of this product was sieved to -80# in the laboratory. Pan. con. samples were derived from 9 litres of minus 4cm, active gravel collected in the stream bed. Pan. con. samples have not been analysed at this time.

**Laboratory Processing**

**Analabs**
Dry, fine pulverize ringmill -40# (S033), ditto for subsample plus sieve to -80# (S004); Au, Ag, Cu in -40# by 24hr cyanide leach solvent extraction, carbon rod (B689); Au in -80# by 30gm fire assay (F630); triple acid digest of -80# (G102) with Cu, Pb, Zn, Ag, As, Bi, Mo by AAS (A102); As by hydride generation AAS (H102); volatile element digest of -80# (G109) with Sb by hydride generation AAS (H109); pressed pill of -80# with U, V by XRF (X401).

195014

| 1A: -80# fire assay/acid digest/XRF | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Easting | Northing | Sample | Licence | Au | Au(R) | Cu | Pb | Zn | Ag | As | Sb | Mo | Bi | U | V |
| | | | Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | DL | 0.01 | 0.01 | 2 | 3 | 2 | 1 | 50 | 0.5 | 5 | 10 | 3 | 5 |
| | | | | | | | | | | 1 | | | | | |
| 352450 | 5411250 | 6009 | EL26/95 | 0.07 | - | 8 | 3 | 31 | <1 | 4 | <0.05 | <5 | <10 | <3 | 59 |
| 352550 | 5413825 | 6012 | EL26/95 | <0.01 | - | 7 | <3 | 20 | <1 | 3 | <0.05 | <5 | <10 | <3 | 16 |
| 351000 | 5410950 | 6030 | EL26/95 | 0.02 | - | 14 | 5 | 39 | <1 | 2 | <0.05 | <5 | <10 | 4 | 148 |
| 351250 | 5410900 | 6033 | EL26/95 | 1.18 | - | 30 | <3 | 128 | <1 | 5 | <0.05 | <5 | <10 | <3 | 190 |
| 351200 | 5412750 | 6036 | EL26/95 | 0.1 | - | 8 | 6 | 10 | <1 | <1 | <0.05 | <5 | <10 | 3 | 40 |
| 353100 | 5410010 | 6039 | EL26/95 | 0.01 | - | 9 | 4 | 7 | <1 | 1 | <0.05 | <5 | <10 | <3 | 39 |
| 353010 | 5410075 | 6042 | EL26/95 | <0.01 | - | 8 | 5 | 17 | <1 | 6 | <0.05 | <5 | <10 | <3 | 64 |
| 351150 | 5412825 | 6045 | EL26/95 | 0.04 | - | 8 | <3 | 13 | <1 | 2 | <0.05 | <5 | <10 | 5 | 56 |
| 351200 | 5410850 | 6048 | EL26/95 | 0.04 | - | 21 | 5 | 56 | <1 | 1 | <0.05 | <5 | <10 | <3 | 153 |
| 352750 | 5412000 | 6052 | EL26/95 | 0.02 | - | 5 | 4 | 8 | <1 | 2 | <0.05 | <5 | <10 | 4 | 17 |

| 1B: -40# BCL | | | | | | |
|---|---|---|---|---|---|---|
| Easting | Northing | Sample | Licence | Au | Ag | Cu |
| | | | Units | ppb | ppm | ppm |
| | | | DL | 0.05 | 0.01 | 0.01 |
| 352450 | 5411250 | 6008 | EL26/95 | 4.63 | <0.01 | 0.33 |
| 352550 | 5413825 | 6011 | EL26/95 | 27.5 | <0.01 | 0.43 |
| 351000 | 5410950 | 6029 | EL26/95 | 1.48 | <0.01 | 0.36 |
| 351250 | 5410900 | 6032 | EL26/95 | 377 | 0.02 | 2.54 |
| 351200 | 5412750 | 6035 | EL26/95 | 12.9 | <0.01 | 0.22 |
| 353100 | 5410010 | 6038 | EL26/95 | 3.1 | <0.01 | 0.75 |
| 353010 | 5410075 | 6041 | EL26/95 | 1.96 | <0.01 | 0.35 |
| 351150 | 5412825 | 6044 | EL26/95 | 0.97 | <0.01 | 1.34 |
| 351200 | 5410850 | 6047 | EL26/95 | 0.38 | <0.01 | 0.47 |
| 352750 | 5412000 | 6051 | EL26/95 | 2.18 | <0.01 | 0.53 |

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**EL26/95Specimen Creek: Annual Report to 6.3.99**

**APPENDIX 2**

ROCK CHIP SAMPLE NUMBERS, AMG CO-ORDINATES, DESCRIPTIONS AND ANALYTICAL DATA

**Laboratory Processing**

**Analabs**
Dry, jawcrush fine pulverize, ringmill (S033); Au by 30gm fire assay (F630); triple acid digest (G102) with Cu, Pb, Zn, Ag, Bi, Mo by AAS (A102); As by hydride generation AAS(H102); volatile element digest (G109) with Sb by hydride generation AAS (H109); U, V by XRF (X401).

| Easting | Northing | Sample | Job Number | Au | Au(R) | Cu | Pb | Zn | Ag | As | Sb | Bi | Mo | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Units | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm |
| | | | DL | 0.01 | 0.01 | 2 | 3 | 2 | 1 | 1 | 0.5 | 10 | 5 | 3 | 5 |
| | | | | | | | | | | | | | | | |
| 351325 | 5410850 | 4054 | BU014691 | 0.01 | - | 10 | 3 | 55 | <1 | 4 | <0.5 | <10 | <5 | <3 | 62 |
| 351150 | 5410825 | 4055 | BU014691 | <0.01 | - | 198 | <3 | 109 | <1 | 25 | 30 | <10 | <5 | <3 | 1122 |
| 351150 | 5410825 | 4056 | BU014691 | <0.01 | - | 4 | <3 | 5 | <1 | 2 | <0.5 | <10 | <5 | <3 | 41 |

| Sample Number | Description |
|---|---|
| 4054 | Granular quartz with patches and seams of limonite, drusy cavities. |
| 4055 | Goethite, cellular limonite, granular quartz, drusy cavities (mullock outside adits west of Specimen Reef). |
| 4056 | Pale granular quartz with cellular limonite patches. |

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**EL26/95 Specimen Reef: Annual Report to 6.3.99**

**APPENDIX 3**

MICROSCOPE EXAMINATION OF GOLD PARTICLES IN PANNED CONCENTRATE SAMPLES, SPECIMEN CREEK AREA, EL26/95.

by

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PO Box 77, Sorell
Tasmania 7172

The following scales are used for describing the physical characteristics of gold grains:

| CRYSTALLINITY | TRAVEL DAMAGE | COLOUR |
|---|---|---|
| complete | nil | pale |
| distinct | minor | medium |
| remnant | moderate | rich |
| nil | major | |

TO: NIC TURNER GOLDSTREAM MINING NL

FROM: HUGH NOLAN

DATE: 22-05-98

CORINNA PROJECT - SPECIMAN RIDGE

EXAMINATION OF PANNED CONCENTRATE STREAM SAMPLES. EXAMINATION UNDERTAKEN USING AN OLYMPUS 10-40x STEREO MICROSCOPE.

SAMPLE 6007 (352450e 5411250n)

Dominant hematite & magnetite.
Minor chalcopyrite,pyrite,rutile,epidote & mica.
No Tertiary gravel heavy minerals observed.

Gold x 6 particles

1 x 0.5mm distinct crystallinity medium colour
3 x 0.1mm complete crystallinity pale colour
2 x 0.1mm distinct crystallinity medium colour

SAMPLE 6010 (352550e 5413825n)

Moderate hematite & rutile.
Minor magnetite,mica & epidote.
No Tertiary gravel heavy minerals observed.

Gold x 5 particles

1 x 1.0mm distinct crystallinity medium colour
1 x 0.5mm complete crystallinity pale colour
1 x 0.5mm nil crystallinity medium colour
2 x 0.1mm distinct crystallinity medium colour

SAMPLE 6028 (351000e 5410950n)

Dominant hematite & magnetite.
Minor mica.
No Tertiary gravel heavy minerals observed.

Gold x 9 particles

2 x 0.5mm remnant crystallinity medium colour
1 x 0.3mm distinct crystallinity medium colour
1 x 0.3mm remnant crystallinity medium colour
5 x 0.1mm remnant crystallinity medium colour

SAMPLE 6031 (351250e 5410900n)

Dominant hematite & magnetite.
Moderate mica.
Minor epidote.
No Tertiary gravel heavy minerals observed.

Gold x 16 particles

1 x 2.0mm remnant crystallinity medium colour
1 x 0.5mm complete crystallinity pale colour
3 x 0.5mm distinct crystallinity medium colour
1 x 0.5mm remnant crystallinity medium colour
4 x 0.1mm complete crystallinity medium colour
6 x 0.1mm distinct crystallinity medium colour

SAMPLE 6034 (351200e 5412750n)

Dominant hematite.
Moderate pink garnet & rutile.
Minor magnetite,mica & pyrite.
No Tertiary gravel heavy minerals observed.

Gold x 5 particles

1 x 0.5mm nil crystallinity medium colour
2 x 0.5mm remnant crystallinity medium colour
2 x 0.1mm remnant crystallinity medium colour

SAMPLE 6040 (353010e 5410075n)

Dominant brown,gold,silver coloured mica.
Minor epidote,rutile,hematite & magnetite.
Trace chalcopyrite.
No Tertiary gravel heavy minerals observed.

No gold observed.

SAMPLE 6043 (351150e 5412825n)

Dominant Hematite.
Moderate mica & magnetite.
No Tertiary gravel heavy minerals observed

No gold observed.

SAMPLE 6046 (351200e 5410850n)

Dominant granular & specular hematite.
Significant magnetite.
Minor epidote & mica.
No Tertiary gravel heavy minerals observed.

Gold x 5 particles

1 x 0.5mm remnant crystallinity medium colour
1 x 0.1mm distinct crystallinity medium colour
3 x 0.1mm remnant crystallinity medium colour

SAMPLE 6049 (351750e 5411000n)

Dominant magnetite.
Moderate hematite & mica.
Minor pyrite,chalcopyrite & epidote.
No Tertiary gravel heavy minerals observed.

Gold x 9 particles

1 x 1.0mm nil crystallinity medium colour
5 x 0.1mm complete crystallinity
3 x 0.1mm distinct crystallinity

The medium to pale colour of all 0.1mm particles is masked by limonitic coating or tarnish.

SAMPLE 6050 (352750e 5412000n)

Dominant white quartz sands & mica.
Trace magnetite.
No Tertiary gravel heavy minerals observed.

No gold observed.

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**EL26/95: Annual Report to 6.3.99**

**APPENDIX 4**

ADDITIONAL DATA RELATING TO THE 1997 DIAMOND DRILLING PROGRAM.

A Locations of SCDDH1 and 2
B Summary Log for SCDDH2

## A Locations of drill holes SCDDH1 and SCDDH2

The IMI/Savage Resources drill hole SP13 was used as a reference for locating SCDDH1 and 2. Positions of the holes were located by tape and compass survey from the collar of SP13, SCDDH1 being 111m distant at 132° AMG and SCDDH2 43m distant at 132° AMG.

AMG co-ordinates and RLs for the collar points have been estimated from Plan 1 of Newnham (1996). Elevations derived from Plan 1 of this report are respectively 4m and 7m lower for SCDDH1 and SCDDH2.

The co-ordinates given for SCDDH1 in the annual report to 6.3.98 are revised here. However, the position of the hole in Plan 1 of that report remains the same.

| | SCDDH1 | SCDDH2 |
|---|---|---|
| Easting(m) | 252237 | 352184 |
| Northing(m) | 5410945 | 5410987 |
| RL(m) | 450m | 449m |

B: SCDDH2 Summary log

| Depth | **Lithology - Boundaries sub-parallel main foliation (S2), usually at low angle to core axis.** |
|---|---|
| | Weathering intense to 24m with broken, ochreous core; weathering patchy to 33m; minor weathering to 42.5m. |
| 0-13.5 | Fine grained, metamorphically laminated schist consisting of micaceous minerals and minor quartz. Milky quartz fragments 10-11m. |
| 13.5-17 | Poor recovery, milky quartz fragments. |
| 17-22 | Fine grained, relatively massive, unlaminated metamorphic rock. |
| 22-23.5 | Poor recovery, milky quartz fragments. |
| 23.5 | Becomes much less weathered. |
| 23.5-35 | Rock type A: Medium to dark grey, fine grained, metamorphically laminated, mica-minor quartz schist. Quartz vein boudins parallel to main foliation, locally developed crenulation cleavage. |
| 35-49.9 | Rock type B: Dark grey, fine grained, relatively massive metamorphic rock with <1% pyrite, boudins uncommon. |
| 49.9-60 | Rock type A. |
| 60-75.5 | Rock type B, with fine grained quartzite bands. |
| 75.5-81.6 | Rock type A. |
| 81.6-83.5 | Rock type B. |
| 83.5-85.4 | Rock type A. |
| 85.4-125.5 | Rock type B. |
| 125.5-165.5 | Rock type A, mostly altered. |
| 165.5-169.5 | Rock type B, mostly altered. |
| 169.5-180.5 | Rock type A, mostly altered. |
| | **Alteration - post main foliation (S2)** |
| 0-129 | Intervals of pale, creamy, fine grained, fairly uniform, undisruptive alteration with fairly sharp boundaries at 46.20-46.24, 64.52-64.54, 65.72-65.74, 65.84-65.87, 66.05-66.10, 66.83, 67.1, 70.05, 70.1, 71, 72.2-72.5, 80.85-81, 81.45-81.8, 85.1-85.7, 86.05-86.55, 86.76, 86.9-87.15,89.85-89.91, 90.6-90.66, 91.45-91.65, 92-92.35, 93-93.05, 93.2-93.35, 94.9-95.15, 95.86, 97.7-97.72, 97.8-97.85, 97.9-98.15, 98.3-98.35, 98.38-98.45, 98.55-98.65, 98.78, 99.23, 99.33, 100-100.2, 100.27-100.3, 100.78-100.94, 100.03-100.1, 109.74-110, 110.25-110.45, 110.65-110.75, 110.85-111, 111.8, 113.33, 114.6, 115-115.15, 115.5-116 (patchy), 116.9-117.9 (patchy), 120.6. |
| 129-179.9 | Cream alteration and grey, siliceous alteration widespread: 129-137 pervasive, 137-142 mostly altered; 142-150 patchy, 150-155.5 relatively unaltered except for thin interval at 152.1, 155.5-162.5 pervasive, 162.5-163 mostly altered, 163-167.2 pervasive, 167.2-169.8 patchy, 169.8-179.9 pervasive. |

| | |
|---|---|
| 179.9-180.5 | Relatively unaltered. |
| | **Veinlets - Post main foliation, pre and post alteration. Most veinlets at high angle to core axis.** |
| 0-43.4 | Veinlets very sparse or absent. |
| 43.4-68.5 | Veinlets mostly consist of quartz and white carbonate, buff carbonate (siderite) in a few, sparse veinlets; veinlets common in the intervals 43.4-43.7, 46-52, 57-57.2, 59.3-59.5, 62.5-68.5. |
| 70-89.9 | Veinlets common throughout though they comprise <10% of the core. Veins mainly white carbonate>quartz but siderite present in some. Examples: 80.95-10mm thick, siderite>white carbonate>pyrite; 85.4-6mm thick, white carbonate>quartz>siderite with one black, bladed grain (?hematite); 87.5-white carbonate and quartz>pyrite cut by siderite and pyrite veinlet. |
| 89.9-180.5 | Veinlets mostly contain siderite though there are still plenty of white carbonate and quartz veinlets. Examples: 89.9-5mm thick, pyrite>siderite; 94.85-20mm thick, white carbonate, siderite, pyrite, quartz and black, bladed mineral; 97-98 a few pyrite veinlets, 100.1-8mm thick siderite with minor pyrite; 110.85-20mm thick white carbonate and quartz with minor brown, bladed mineral and cut by siderite veinlets; 114.05-10mm thick white carbonate>quartz with pyrite and black bladed mineral, cut by siderite veinlets; 115.03-15mm thick, similar.<br>158.15-159.5 Shattered core, trace fuchsite; 161-166.6 - common milky quartz veins, minor pyrite, trace fuchsite, shattered core 163.5-164.<br>171.45-15mm Thick, quartz and pyrite with bladed mineral - black with brown surface; 173.4-10mm thick quartz and siderite with black bladed mineral, trace fuchsite; 173 - similar; 174.3 - milky quartz vein with black bladed mineral and trace fuchsite, cut by siderite veinlet; 179.2 - milky quartz vein with fuchsite, cut by siderite veinlets. |

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Goldstream - Titan Joint Venture

Corinna Project

**EL26/95: Annual Report to 6.3.99**

**APPENDIX 5**

COMMENTS ON AIRBORNE GEOPHYSICAL DATA EL26/95 SPECIMEN CREEK, WEST TASMANIA.

by

**D.E. Leaman**
Leaman Geophysics
3 Maluka St
Bellerive Tasmania
7018

195026

# *LEAMAN GEOPHYSICS*

Registered office:
3 MALUKA STREET, BELLERIVE, TAS. 7018
All correspondence to:
GPO BOX 320 C, HOBART, TAS. 7001
Telephone: (03) 6244 1233
Fax: (03) 6244 6674

May 19, 1998

Mr N.J. Turner,
65 Lochner Street,
West Hobart. Tas.

Dear Nic,

Please find attached my brief report and account.

There are distinct limits to what can be done with the data to hand. I am not sure that the Hanning Filter approach is the best. You might suggest that a continuation separation might be tried when the process people in Perth next play with the data. This would involve continuing the data to say 500 m and then subtracting the observed data from the continuation. This has the effect of enhancing detail and that is being lost at this stage. Some experiment would be called for in terms of just how far to continue. This is a workable, stable and reliable approach. The Hanning approach can be much more damaging to the data. Whether there are useful details is a separate question.

Regards,

David

Dr. D.E. Leaman

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# COMMENTS ON AIRBORNE GEOPHYSICAL DATA
# EL 26/95 SPECIMEN CREEK, W TASMANIA

for
Goldstream Mining NL & Titan Resources NL
by
D. E. Leaman

May 1998

SPECCK

Leaman Geophysics was asked to review the character of geophysical responses in the Specimen Creek area (EL 26/95, see Figure 1) in order to offer an opinion as to whether the reef (s) or related structures could be identified and, if so, what might be their possible extent.

Geophysical data, principally magnetics data but also some radiometric data, have been reviewed. Newnham (1996) notes that early geophysical work failed to produce any significant anomalies and observes that, in his opinion, there are no petrophysical features associated with the reef or host rocks. In view of the present request these are interesting comments. It is curious, then, that he goes on to state that collation and re-processing of data may be of value "in guiding the direction of future exploration".

The site lies within the Arthur Metamorphic Complex a little west of a suite boundary. Details of the local geology and possible controls on the reef are discussed by Newnham (1996).

Magnetic susceptibility data have been reported by Turner (1997b) for holes DH1 and DH2. These observations are of little use unless it is known how they should be scaled or what type of instrument was used. (This information should always be included in reports). It is assumed that the scale factor is either $10^{-3}$ or $10^{-5}$ SI. Typical values are about 0.2 units although a range of 34 units is noted for some parts of DH1. All variations occur within intervals which are generally less than one metre thick and the changes are not consistently associated with whole rock alteration. The thin, anomalous zones would not generate significant responses at the height of the airborne surveys.

Iron formations occur in the region and these generate some very large responses which swamp any relatively subtle features which might be associated with the reef or its host sequence.

Magnetic data were provided in three forms (from two surveys); a regional compilation based on government surveys and a helimag survey completed as part of exploration for EL 26/95 (see Turner, 1997a). An extract of the regional data is shown in Figure 2. The reef is located near 352 000 mE, 5411 000 mN and there are certainly regional suggestions that its NE-SW trend persists up to 2 km in each direction. This is indicated by the general break in anomaly patterns to the SW and the NE/SW offset of the margin of the metamorphic complex near 352 700 mE, as well as feature terminations, to the NE. These comments must not be read to imply that the reef can be mapped, rather that a significant structure or alteration axis, possesses a NE-SW trend and that the reef lies within or near it. The resolution of this data set allows few other comments about materials or features not directly associated with the sub N-S boundaries. The elements of a shear rhomb may be recognisable in the Specimen Creek area if other breaks in trend can be confirmed; these trend ENE and NW-SE. If this is indeed the case then the reef orientation is structurally controlled by relatively recent sinistral shears.

The regional data were also supplied in filtered form (Hanning filter) and this appears to support the more local conclusion in the region of the known reef. The NW-SE trending features are also evident. It is not clear whether a Hanning Filter is the best type of filter for this data and a direct continuation separation which avoids gradient enhancement might be better.

Figure 3 shows the basemap used as overlay in other diagrams (from Newnham, 1996).

Figures 4 and 5 present the more detailed helimag survey in both contoured and image forms. Figure 4 shows that the reef clearly occupies a disrupted zone but rounding of the contours tends to obscure the correlation. The anomaly terminations are more clearly seen in the half tone representation of the colour image (Figure 5) and the pattern would suggest that the feature extends at least 300 m to the SW of the reef outcrop. This figure also stresses the more widespread loss of magnetic contrast in the region within a radius of 250 m of the main workings. This correspondence might indicate a strictly limited alteration/mineralisation system.

Sharpe (1998) notes that a carbonate vein in hole SP1 hosts gold and brannerite. Other samples from hole SC1 do not contain brannerite. Even though the occurrence seems minor and unusual radiometric data were inspected in order to assess any possible regional effects or contributions which might involve subtler elements of local mineralogy.
Only regional radiometric data are available and these are shown in Figure 6 as total counts. There is a N-S bias in the presentation due to contouring across a wide line spacing (200 m). It is possible that a clear response association exists, especially in the area immediately east and south of the mine symbol, and that a gross change equivalent to the SW-NE magnetic trend is also present. Counts are moderately elevated SE of the prospect in the general location of SP1 but there is no evidence that this is in any way related to the limited volume of unusual vein mineralogy.

Although Newnham (1996) is correct when commenting that the petrophysical variations **as observed** are not significant there is little doubt that actual responses are substantial and that the sources must lie in the local rocks. Nothing found, however, in existing drill samples appears to account for what has been observed and a relatively wide (100-200 m) alteration axis is indicated. The reef lies within this system - as does most drilling. If this association is real then a structurally(?)-controlled alteration zone, probably including the reef, may persist at least one kilometre to both SW and NE of the main workings.

References:
Newnham, L.A., 1996. EL 26/95 Specimen Reef area, W. Tasmania. Review of previous data. Appendix 1 of Turner (1997a).

Sharpe, R., 1998. Petrographic investigation of the alteration and vein assemblages at the Specimen Creek Prospect, Arthur Mobile Belt, W. Tasmania. Report for Goldstream Mining NL & Titan Resources NL, April.

Turner, N.J., 1997a. Exploration Licence 26/95. Specimen Creek W. Tasmania. Annual report to 6/3/97. Report for Goldstream Mining NL & Titan Resources NL, October.

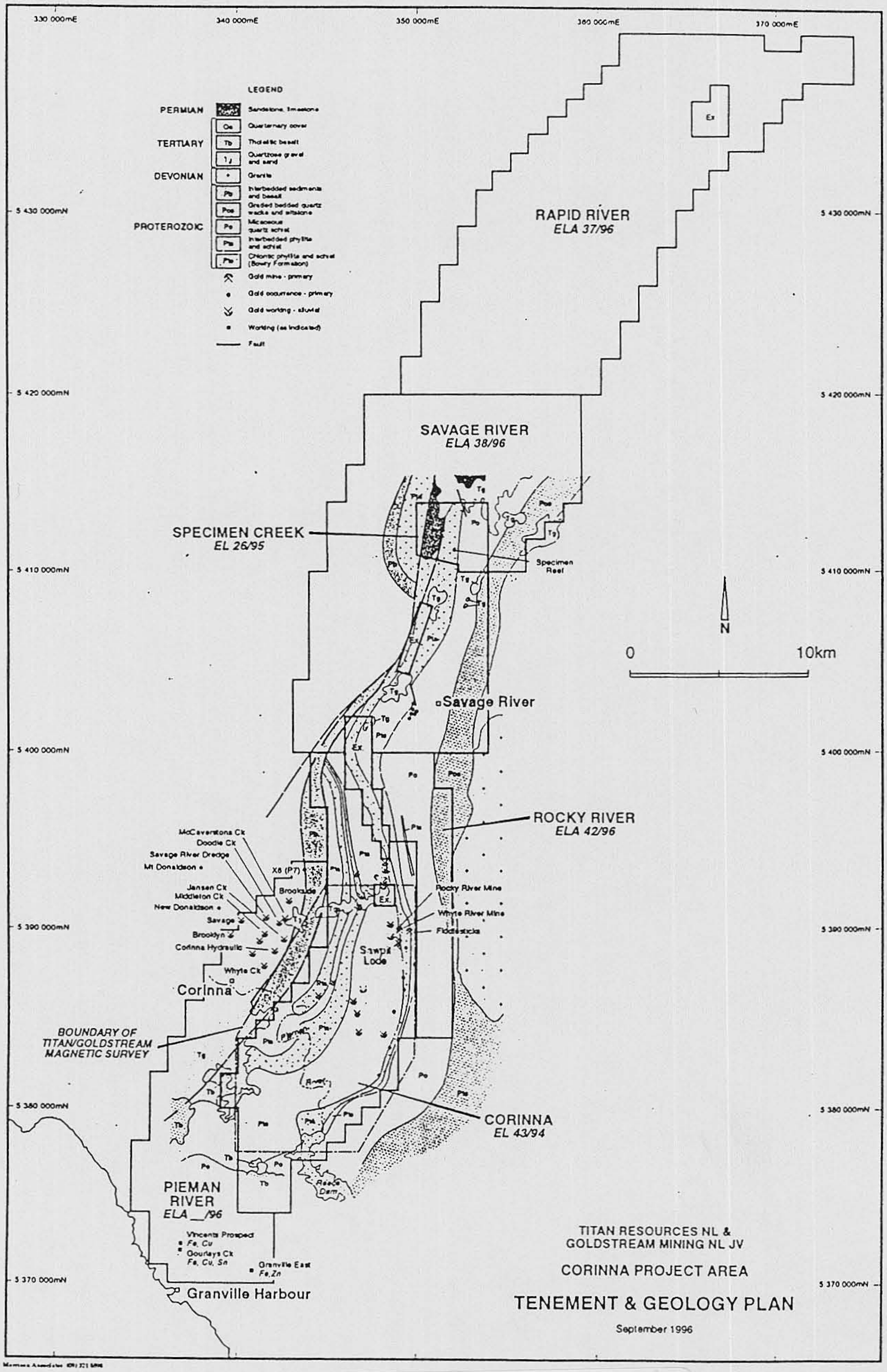
Turner, N.J., 1997b. Exploration Licence 26/95. Specimen Creek W. Tasmania. Annual report to 6/3/98. Report for Goldstream Mining NL & Titan Resources NL. December.

Report submitted on behalf of Leaman Geophysics by

Dr. D. E. Leaman, B.Sc.(Hons), Ph.D., F.Aus.I.M.M. May 19, 1998

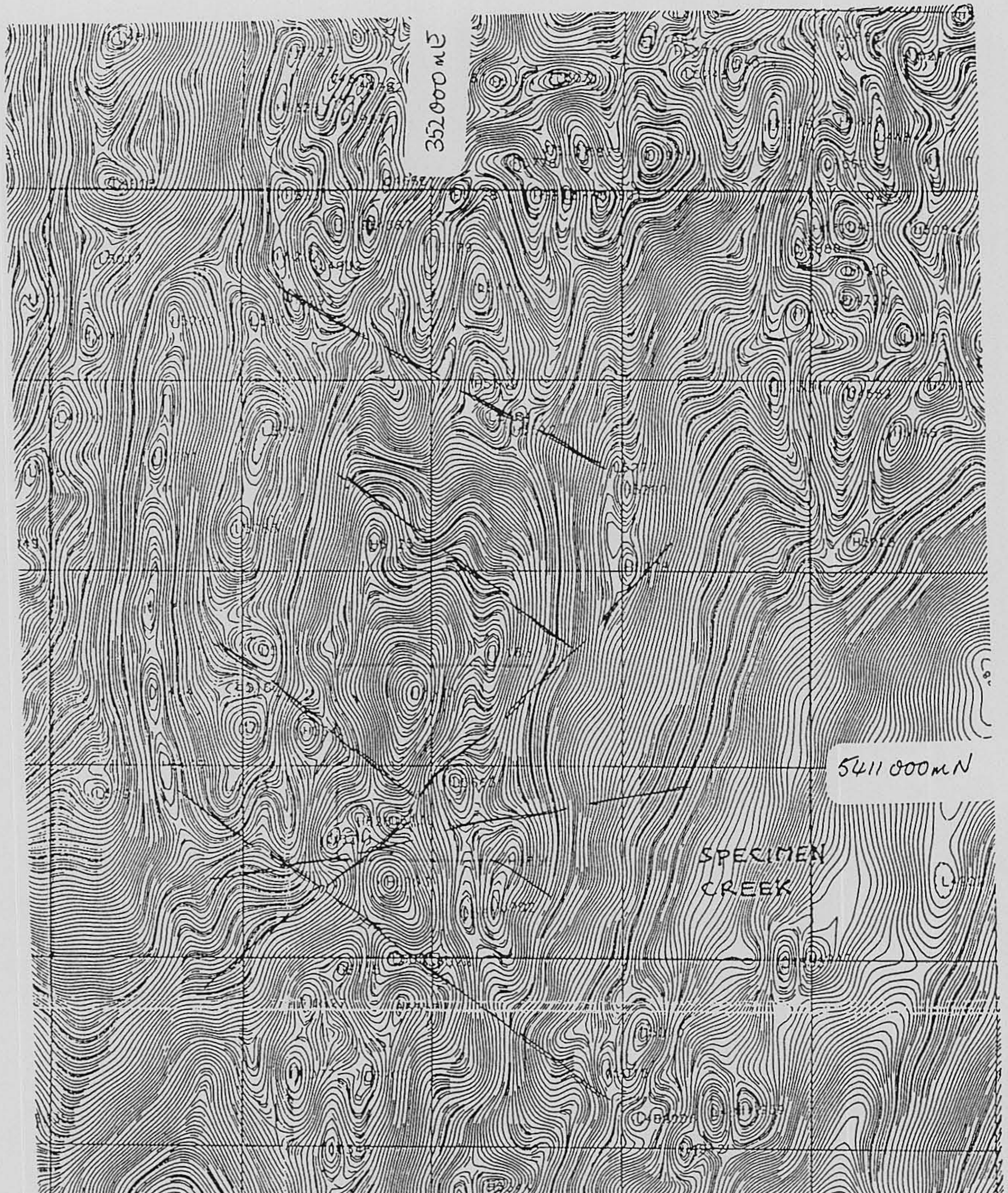
195030

Figure 1

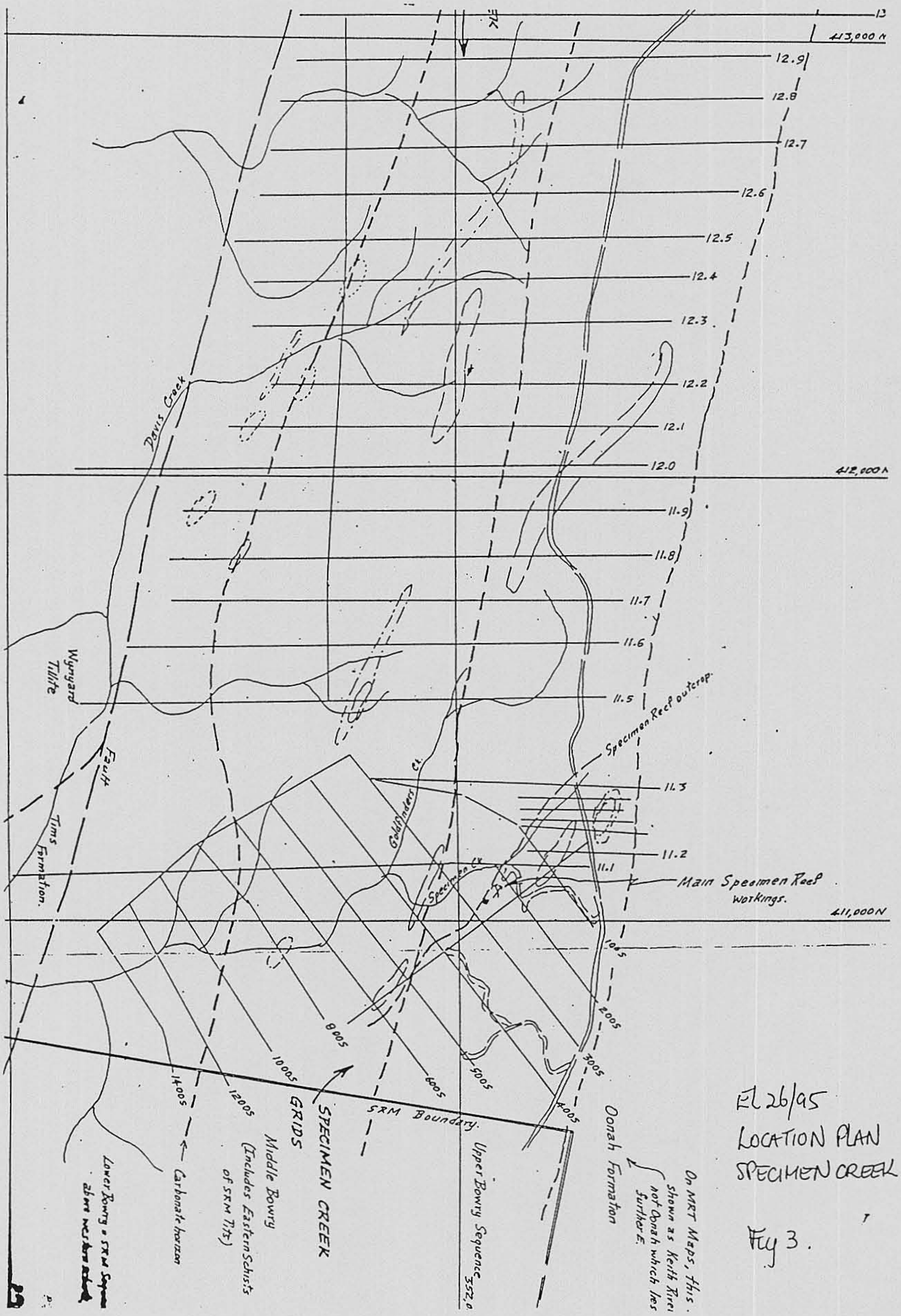



5 cm

195031


352000mE
5411000mN
SPECIMEN
CREEK
EL 26/95
Regional magnetics
Fig 2
5 cm

195032



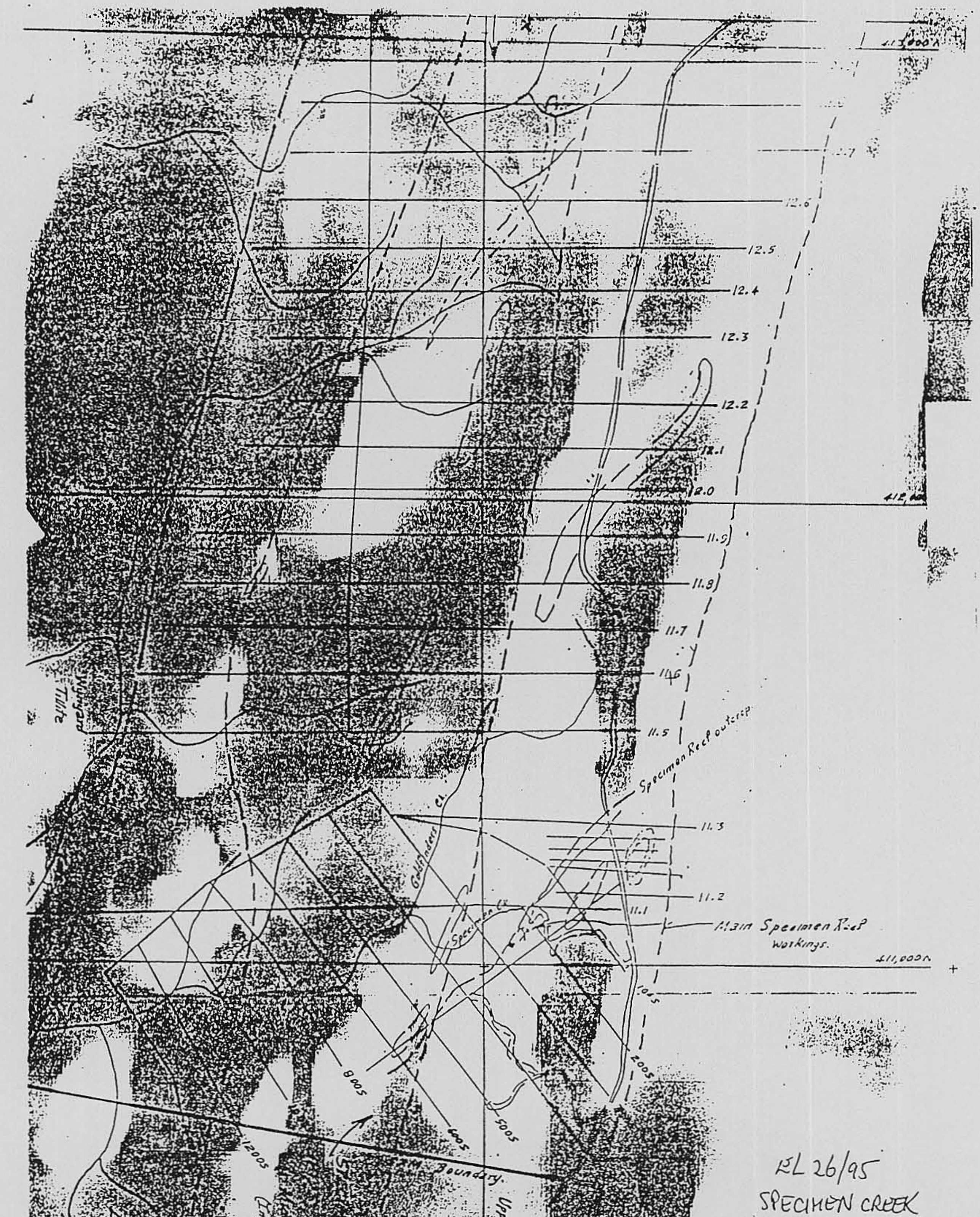

EL 26/95
LOCATION PLAN
SPECIMEN CREEK

Fig 3.

195033

352 000mE
5411 000N
EL 26/95
SPECIMEN CREEK
Helimag survey
Fig 4

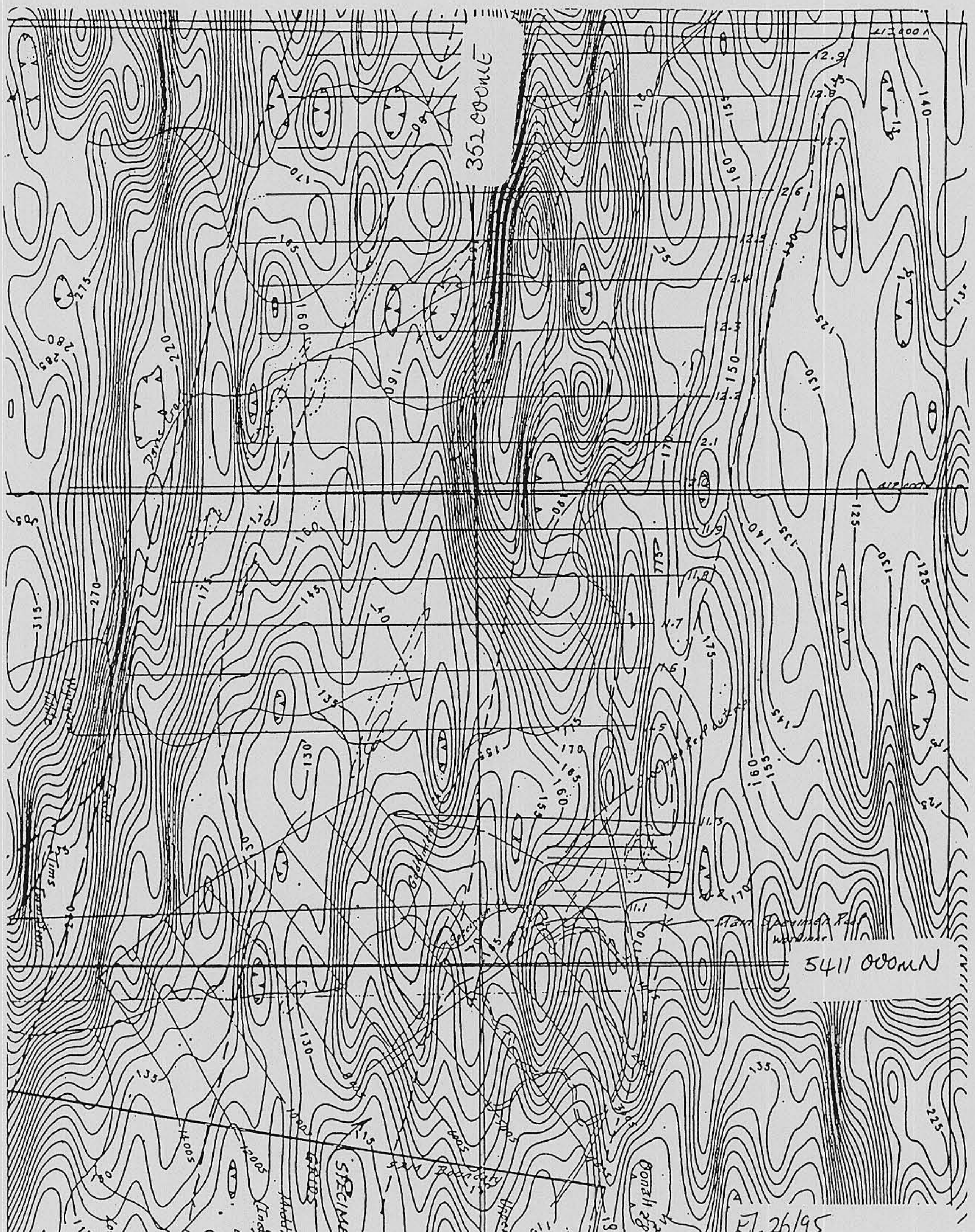
195034




EL 26/95
SPECIMEN CREEK
Helimag image

Fig 5

195035

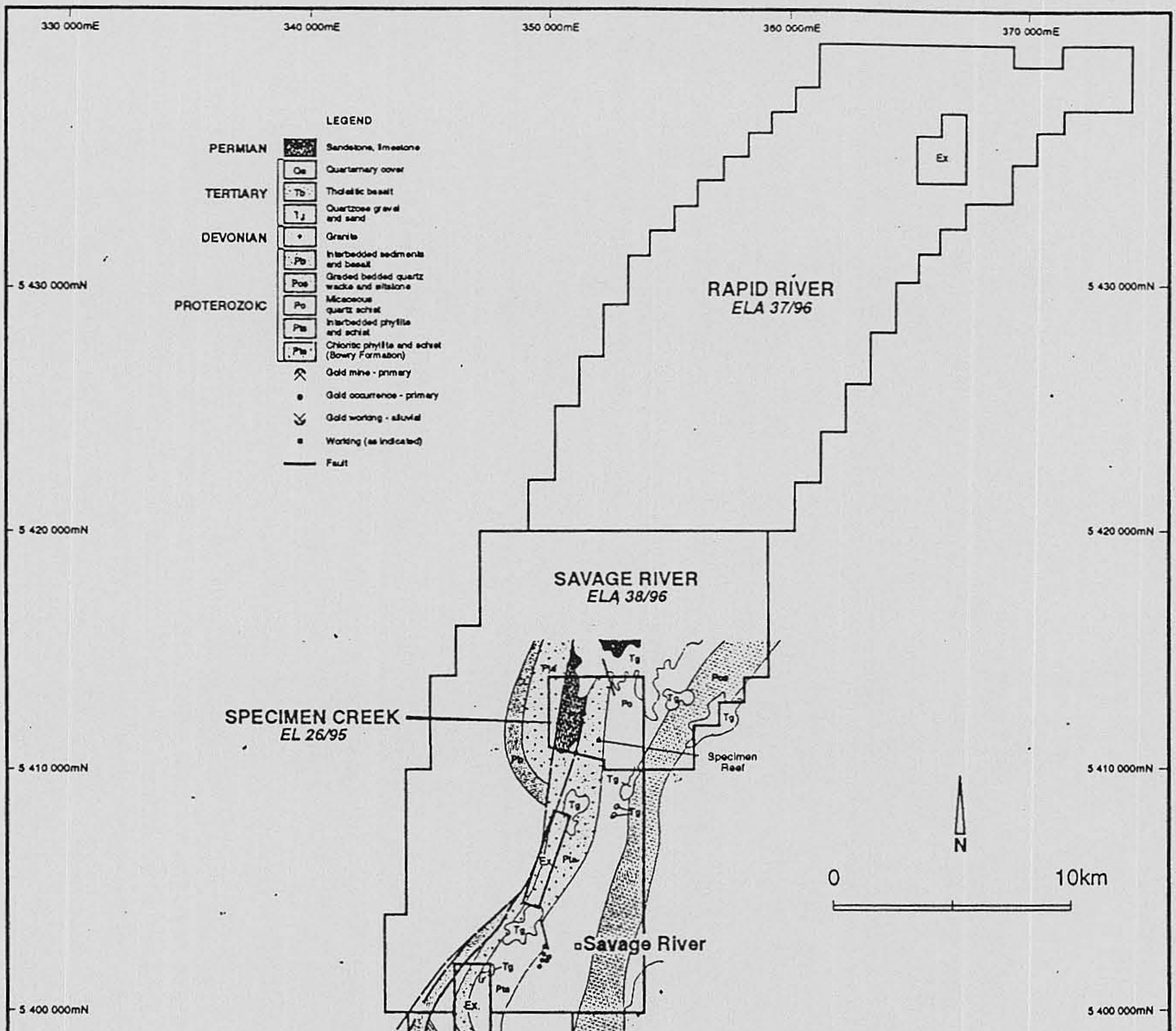



EL 26/95
SPECIMEN CREEK
Regional radiometrics

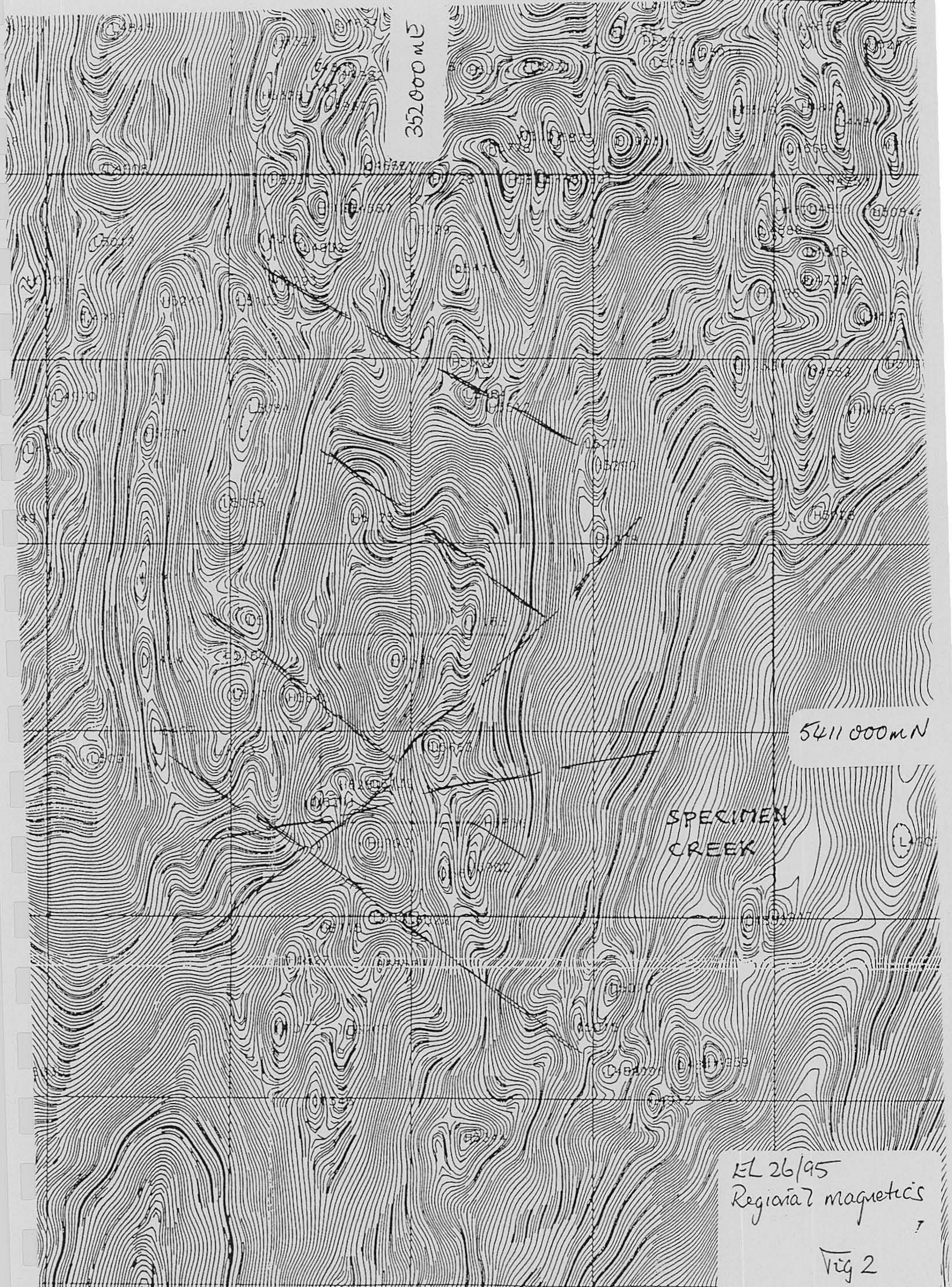
FIG 6

195036

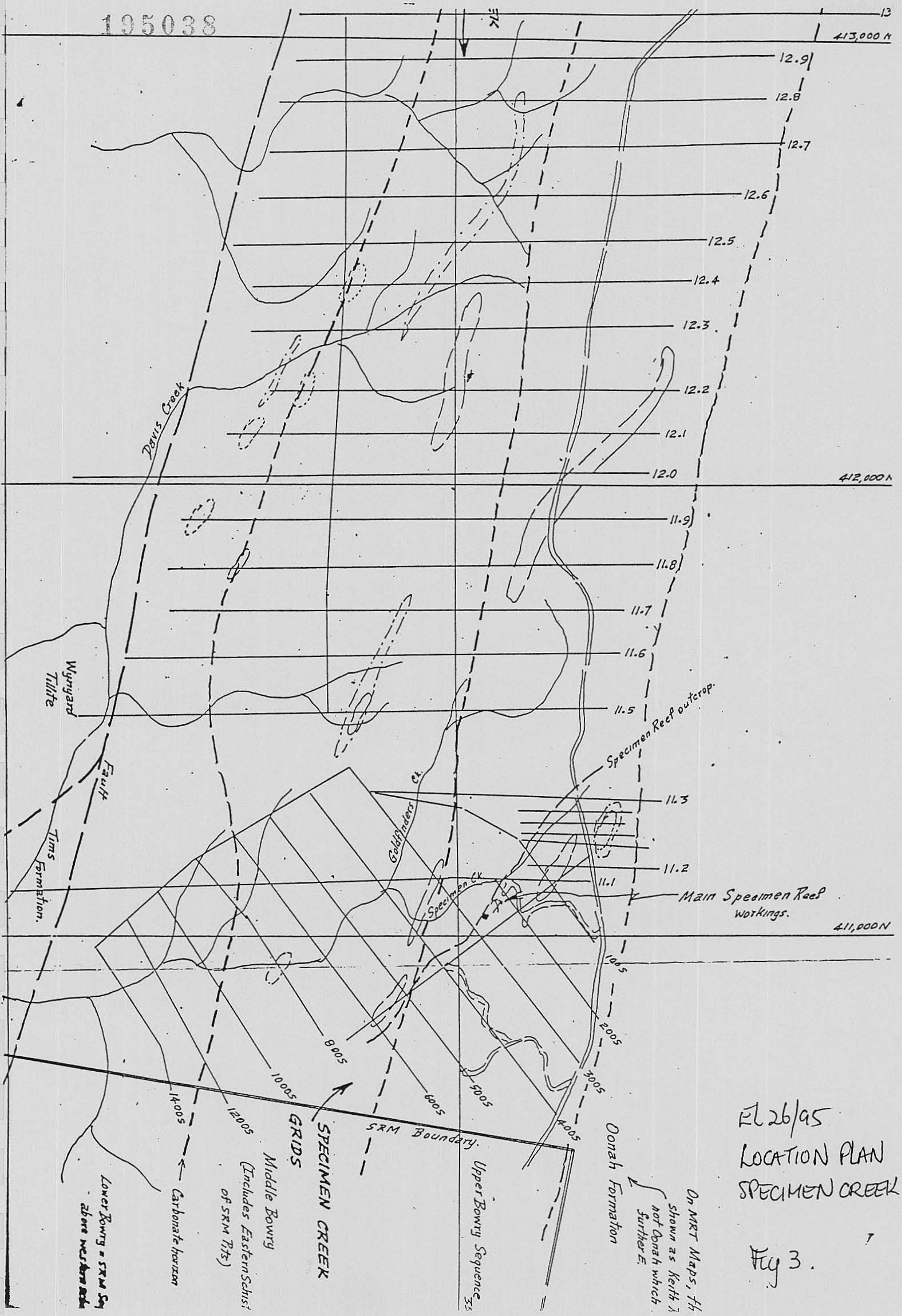
Figure 1



195037


352000mE
5411000mN
SPECIMEN
CREEK
EL 26/95
Regional magnetics
Fig 2

195038



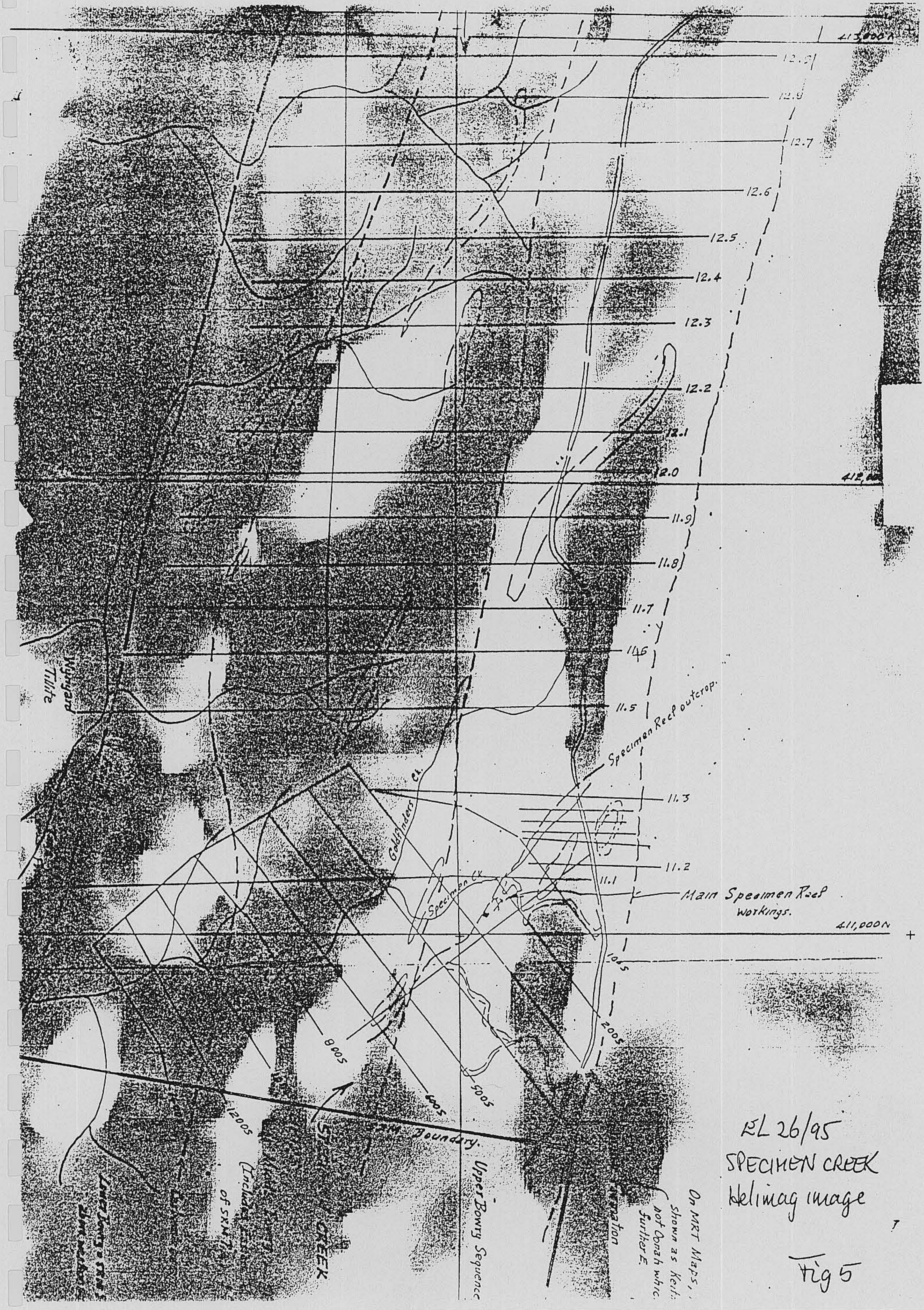

EL 26/95
LOCATION PLAN
SPECIMEN CREEK

Fig 3.

195039


352 000mE
5411 000N
EL 26/95
SPECIMEN CREEK
Helimag survey
Fig 4

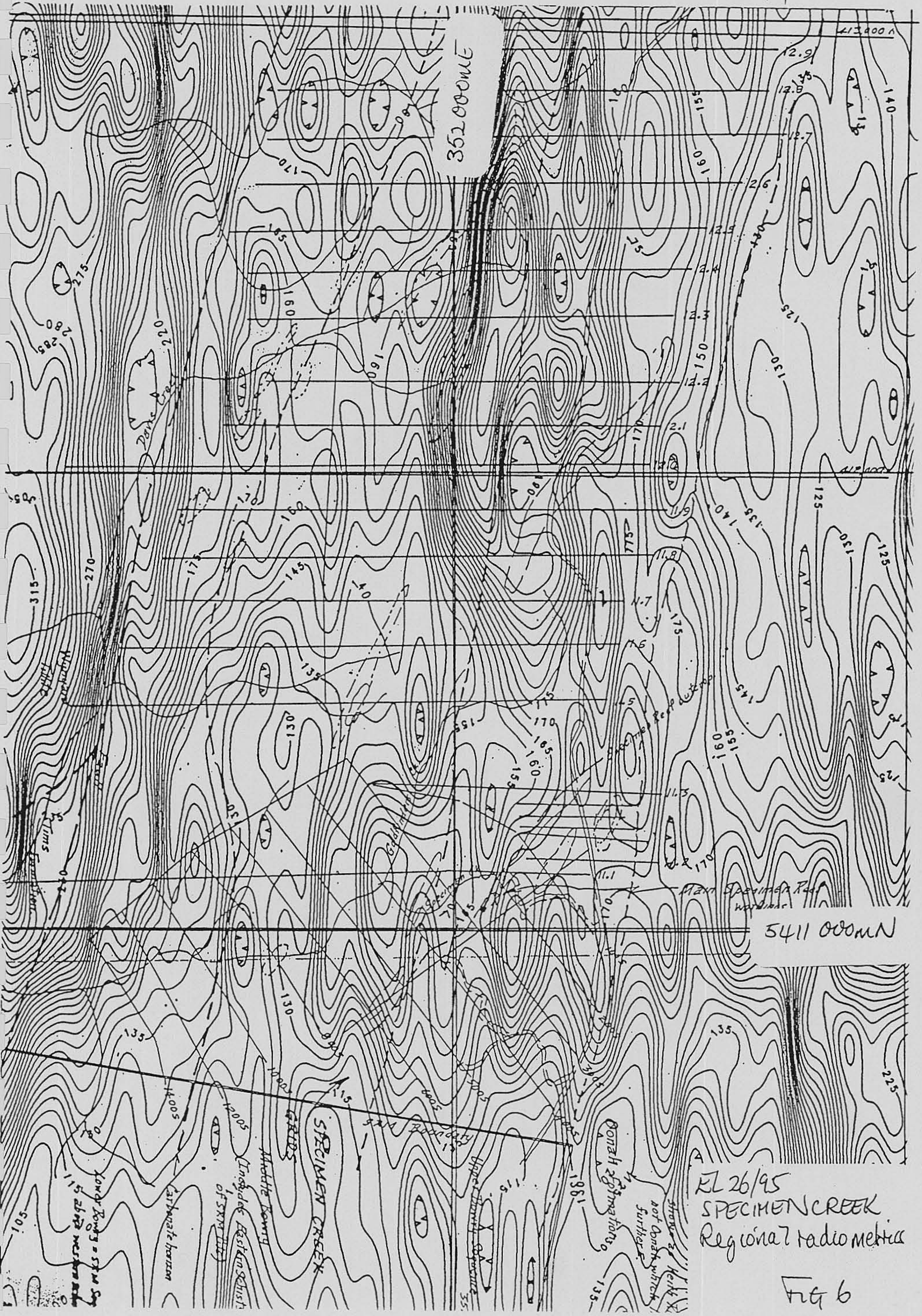
195040




EL 26/95
SPECIMEN CREEK
Helimag image

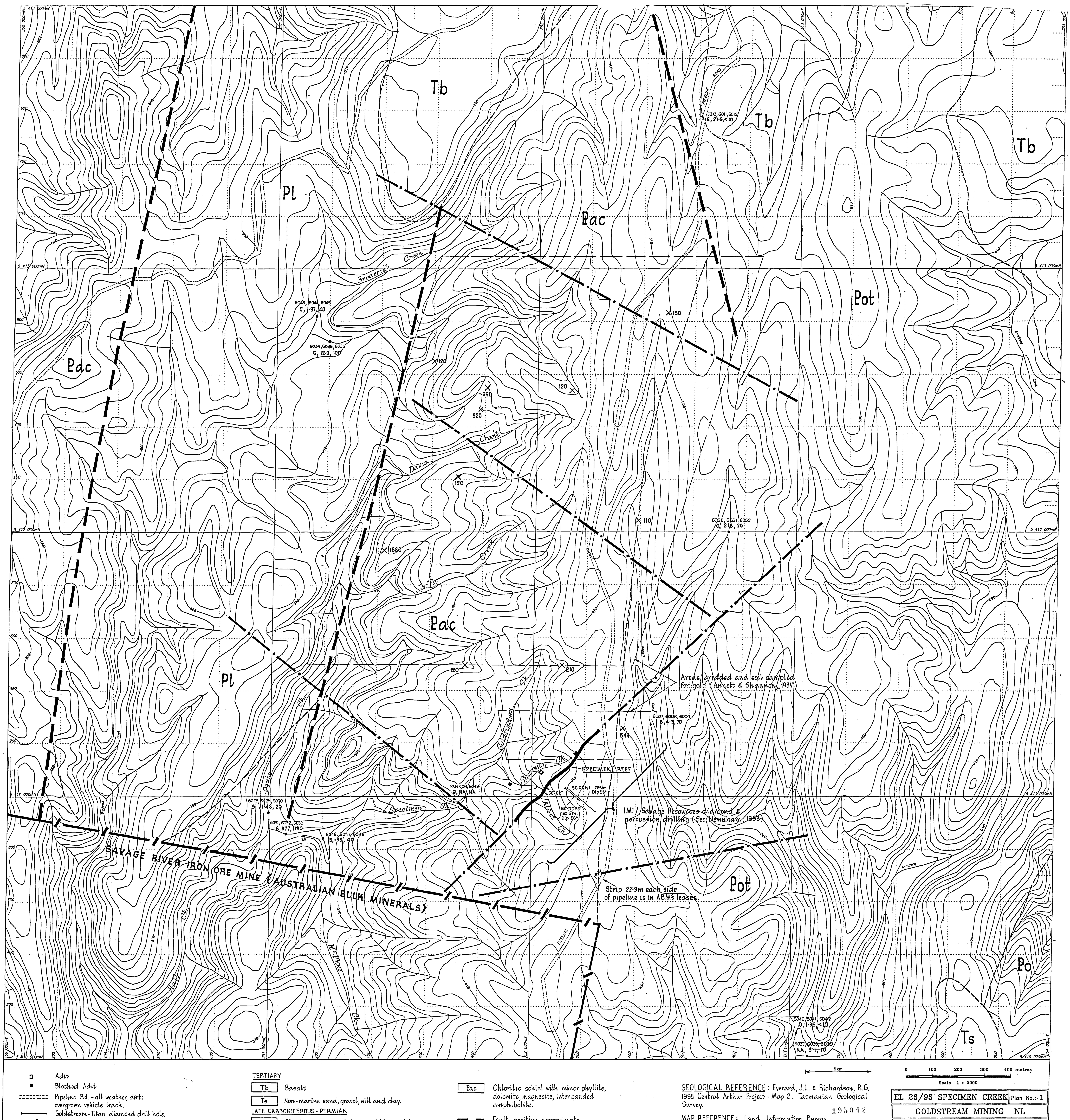
Fig 5

195041




EL 26/95
SPECIMEN CREEK
Regional radiometrics

FIG 6




Adit

Blocked Adit

Pipeline Rd. - all weather, dirt; overgrown vehicle track.

Goldstream-Titan diamond drill hole.

Lease boundary.

6028, 6029, 6030
9 1·48 20
Goldstream-Titan stream sed. samples. 6028 = ex 9 litre pan. con. with 9 grains gold ≥ 0·1 mm, 6029 = -40 # BCL with 1·48 ppb Au, 6030 = -80 # fire assay with 20 ppb Au

X120 Best fire assay soil values (ppb) obtained by IMI / Savage Resources. Represent small areas.

TERTIARY

| | |
|---|---|
| Tb | Basalt |
| Ts | Non-marine sand, gravel, silt and clay. |

LATE CARBONIFEROUS - PERMIAN

| | |
|---|---|
| Pl | Glaciomarine mudstone, pebbly mudstone, pebbly sandstone, minor limestone & oil shale. |

PROTEROZOIC

| | |
|---|---|
| Po | Quartzwacke turbidite. |
| Pot | Quartz mica schist, quartzite, phyllite, rare dolomite. |
| Pac | Chloritic schist with minor phyllite, dolomite, magnesite, interbanded amphibolite. |

Fault, position approximate.

Geological boundary, position approximate.

Trace of Specimen Reef ( Newnham, 1996)

Aeromagnetic feature ( Leaman, this report).

GEOLOGICAL REFERENCE : Everard, J.L. & Richardson, R.G. 1995 Central Arthur Project - Map 2. Tasmanian Geological Survey.

195042

MAP REFERENCE : Land Information Bureau, Tasmania. 1:25 000 Map Series, Donaldson 3441.

99-4288

ANNUAL REPORT – CORINNA
EL26/95 SPECIMEN CREEK
N J TURNER

5 cm

0 100 200 300 400 metres

Scale 1 : 5000

AMG North · Mag. North · 11.8°

| EL 26/95 SPECIMEN CREEK | Plan No.: 1 |
|---|---|
| GOLDSTREAM MINING NL | |
| Access, Drainage, Contours, Regional Stream Seds., Previous Soil Work, Geology. | Date: July 1998. |
| | Compiled: Nic Turner |
| | Drawn: Rocco Travierso, Peter Nankivell |
| | Scale: 1 : 5000 |
| Contractor: N.J. Turner Geological Services Pty. Ltd. | |

99-4288B

195043

# Report to Goldstream Mining N.L. and Titan Resources

## Petrographic Investigation of the Alteration and Vein Assemblages at the Specimen Creek Prospect, Arthur Mobile Belt, Western Tasmania

(confidential)

April, 1998

Robina Sharpe
CODES SRC

**Summary**

Based upon logging and petrographic constraints the major findings on drill hole SC1 are summarised by the following points:

- The wall rock is massive, homogeneous (metasediment?) and hosts ubiquitous quartz-K-feldspar±albite alteration. This alteration is likely to be synchronous with quartz-feldspar veins and predates regional pervasive cleavage (S2)
- The two main vein types are quartz-feldspar and carbonate. Carbonate veins cross cut quartz-feldspar veins as well as the penetrative cleavage (S2). Some earlier quartz-feldspar vein re-opened during carbonate vein formation. Carbonate veins form a sheeted vein complex around the site of Specimen Reef *and these veins are interpreted to host Au mineralisation in association with* x.
- Au mineralisation has two occurrences; 1) high grade electrum-carbonate-brannerite ($(U,Ca)(Ti,Fe)_2O_6$) veins in the alteration zone of Specimen Reef and 2) a disseminated, low grade occurrence at the Specimen Reef structure.
- Two cleavages defined by the alignment of phyllosilicate minerals are present and are 1)a penetrative cleavage varying from spaced to anastomosing (S2) and 2) a crenulation cleavage (S3). Both S2 and S3 are best developed within the alteration zone surrounding Specimen Reef. The S3 crenulation cleavage parallels carbonate vein orientations.
- A zone of pervasive disseminated white mica and carbonate alteration (~50 metres) surrounds the Specimen Reef. Carbonate veins are abundant in this alteration and both S2 and S3 have their strongest development through the wall rock in this alteration zone.
- The metamorphic mineral assemblage of quartz, feldspar, chlorite, white mica, carbonate and minor rutile, ilmenite and epidote is consistent with a greenschist metamorphic facies.
- Alteration haloes are frequently developed around carbonate veins. These alteration halos consist of carbonate and white mica and were developed during carbonate vein formation from fluids emanating in to the wall rock *via* cleavage planes.

## Introduction

Goldstream recently drilled the Specimen Creek Au prospect situated in the Arthur Mobile Belt of western Tasmania. Two holes (SC1 and SC2) were drilled to test a mineralisation corridor proposed by Newnham (1996). This Au mineralisation corridor was defined by the intersection of a regional penetrative cleavage with a northeast trending structure known as the Specimen Reef. Previous drilling in the vicinity of this corridor (drill hole SP1) intersected high Au grades (the highest of 0.2m at 910 ppm). However the recent drill hole SC1 returned Au values of 2 metres at 0.5 ppm between 189 and 190 metres. This grade coincides with a alteration zone (between 180 and 200 metres surrounding the site of Specimen Reef.

The results and interpretations presented in this report are the culmination of detailed logging of drill hole SC1, the petrological study of 18 selected drill core samples (SC1) and a Au-rich sample (SP1) provided by Mr Nic Turner. This investigation addresses the types and distribution of the alteration in the vicinity of Specimen Reef as well as controls, timing and association of alteration to Au mineralisation.

Drill core samples described in this report are:

| No. | Hole | Depth | comments |
|---|---|---|---|
| 1 | SC1 | 224.8 | least altered wall rock |
| 2 | SC1 | 217.2 | unusual quartz-hematite vein |
| 3 | SC1 | 208.5 | banded alteration and quartz-magnetite vein |
| 4 | SC1 | 200.9 | alteration halos around veins |
| 5 | SC1 | 196.9 | grey-siliceous alteration and quartz-fuchsite vein |
| 6 | SC1 | 186.3 | buff intense white mica-carbonate alteration |
| 7 | SC1 | 179.0 | carbonate veining and alteration halos |
| 8 | SC1 | 175.2 | buff carbonate-white mica alteration and carbonate veins |
| 9 | SC1 | 155.6 | pervasive strong chlorite-quartz-feldspar alteration |
| 10 | SC1 | 143.9 | buff alteration banding and carbonate veins |
| 11 | SC1 | 141.5 | white mica alteration and carbonate veins |
| 12 | SC1 | 138.9 | carbonate veins and alteration halos |
| 13 | SC1 | 121.1 | pyrite-quartz-feldspar vein and quartz-feldspar alteration |
| 14 | SC1 | 101.5 | quartz-feldspar veins |
| 15 | SC1 | 99.9 | intense chlorite alteration |
| 16 | SC1 | 95.2 | massive homogeneous wall rock |
| 17 | SC1 | 83.7 | massive wall rock with minor veining |
| 18 | SC1 | 62.8 | carbonate-quartz vein and alteration halo |
| 19 | SP1 | 160 | buff white mica alteration and electrum in carbonate vein |

Each petrographic description is presented in the following format:

sample number
hand sample description
assay data (where provided)
groundmass
structure
veins
alteration
mineralisation
mineralogy and modal abundance
photomicrographs

**Sample : DDH SC1 224.8m**

**Hand sample:** Light green-grey rock with pervasive strong siliceous-feldspar-chlorite alteration. The sample has a homogeneous texture and moderate foliation and represents the least-altered wall rock from the base of the drill hole (Plate 1a).

**Assay Data:** not supplied

**Groundmass:** Intensely silicified rock consisting of interlocking equant quartz grains (<200 µm) and K-feldspar (Plate 1b). The quartz has undulose extinction and forms quartz-K-feldspar ribbon textures; likely as a result of the penetrative cleavage. Larger quartz grains are uncommon and vary from tabular to subrounded (~300 µm) and are disseminated in the finer-grained equant quartz matrix. These grains may represent relict detrital quartz. Local recrystallisation of quartz and K-feldspar occur at grain margins. Minor albite grains (<200 µm) are uncommon and intergrown with K-feldspar.

**Structure:** A single closely spaced anastomosing cleavage is defined by the alignment of coarse-grained (<600 µm) fibrous chlorites (Plate 1b). The birefringence of chlorite is olive-green indicating a Mg-rich composition. Ribbon quartz veins are parallel and boudinaged by cleavage

**Veins:** Quartz veins (<1 mm) parallel to cleavage are boudinaged and discontinuous (ribbon quartz veins). The quartz veins contain of undulose deformed quartz that has been recrystallised to equant grains (<400 µm).

**Alteration:** Trace proportions of a poorly formed, anhedral carbonate (grains <300µm) occur within fibrous chlorite within zones of foliation. This carbonate may also occur in pressure shadows around pyrite grains. Rare epidote grains are rounded, less than 40 µm in size and occur as disseminations in the quartzo-feldspathic matrix.

**Mineralisation:**

pyrite: Trace proportions, euhedral recrystallised grains (<140 µm). Some pyrites contain micron-sized chalcopyrite inclusions.

ilmenite: Disseminated spongy aggregated grains (<50 µm) forming up to 1% modal in the quartz-rich groundmass.

chalcopyrite: Trace in pyrite and as less than 20 µm blebs in chlorite and carbonate.

rutile: Subrounded grains (<30 µm) form in chlorite adjacent to pyrite grains

**Mineralogy :**

| | | | |
|---|---|---|---|
| quartz | 55 % | ilmenite | <1% |
| K-feldspar | 35 | pyrite | trace |
| albite | 1-2 % | chalcopyrite | trace |
| chlorite | 8-10% | rutile | trace |

1995040A.

## Plate 1

(a) Green-grey massive homogeneous sandstone(?) with pervasive quartz-feldspar alteration. Sample from base of drill hole SC1 at 224.8 metres.

(b) Photomicrograph of (a) above showing the interlocking feldspar-quartz groundmass. Fibrous elongate chlorite grains are aligned through the groundmass, and define a penetrative, anastomosing fabric (S2).

(c) Bleached buff wall rock with cross cutting carbonate-albite-pyrite-hematite veins. The buff coloured wall rock results from disseminated carbonate through the equant quartz, K-feldspar groundmass. Sample from SC1 at 217.2 metres.

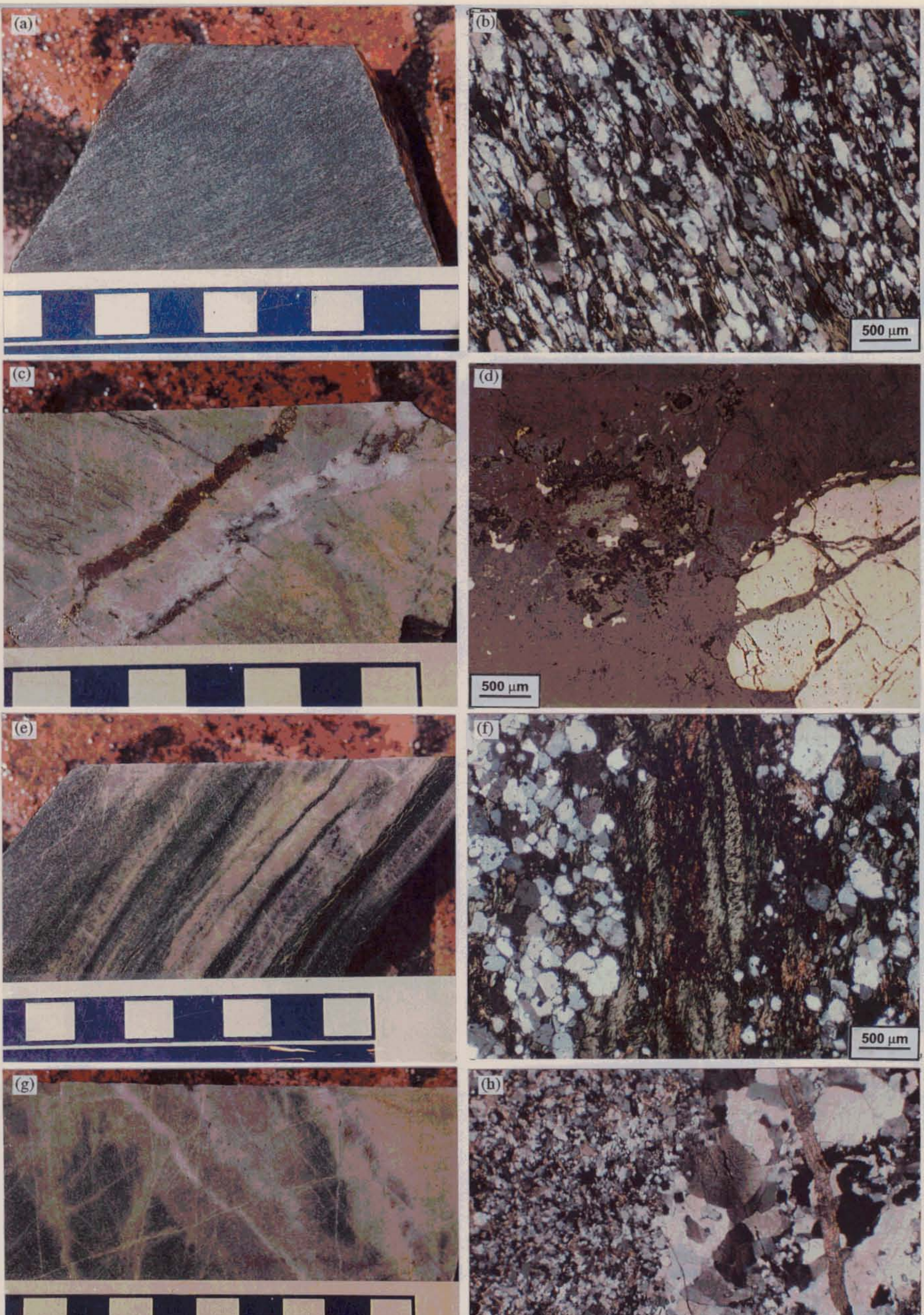
(d) Photomicrograph of (c). Recrystallised and fractured pyrite within the carbonate-albite-pyrite-hematite veins. These veins may also contain minor chalcopyrite (far left) and spongy poorly formed hematite (centre) within interlocking coarse-grained carbonate and albite (grey).

(e) Banded sample with alternating chlorite-rich and quartz-albite-rich bands. Quartz-albite bands host disseminated magnetite and carbonate. The bands vary from planar to discontinuous and are parallel to the S2 cleavage, which is best developed in the chlorite-rich bands. Sample from SC1 at 208.5 metres.

(f) Photomicrograph of (e). Chlorite band (centre) consisting of fine-grained chlorite that defined two cleavages (S2 and S3) and hosts minor disseminated carbonate. Quartz-albite bands have gradational contacts against chlorite bands and consist of equigranular quartz and albite grains.

(g) Grey-green wall rock hosting albite-quartz, quartz and carbonate veins that have well-developed peripheral alteration haloes. These alteration halos impart a buff colour to the wall rock, due to disseminated carbonate and/or white mica. The less altered wall rock (right) is massive and homogeneous. Sample from SC1 at 200.9 metres.

(h) Photomicrograph of (g). The wall rock consists of fine-grained interlocking quartz-feldspar that contains irregular anhedral disseminated carbonate. This carbonate is responsible for the buff alteration halo enveloping these veins. The albite-quartz vein (right) has sharp margins against the wall rock and consists predominantly of albite. Carbonate veins cut across the albite-quartz veins.


(a)
(b)
500 µm
(c)
(d)
500 µm
(e)
(f)
500 µm
(g)
(h)
500 µm
void incorrect exposures by taking meter readings before

**Sample : DDH SC1 217.2 m**

**Hand sample:** Bleached light yellow-cream rock with cross cutting red quartz-carbonate-hematite veins (Plate 1c).

**Assay Data**: not supplied

**Groundmass:** Equant interlocking quartz, K-feldspar matrix (grains <150 µm) with undulose extinction and some grain elongation parallel to cleavage.

**Structure:** The elongation of quartz and fibrous white mica delineates a spaced cleavage. Mottled poorly formed carbonate occurs within these white mica zones. Intensely quartz altered protolith with an early carbonate-albite-pyrite-hematite vein, all of which host a spaced penetrative cleavage defined by white mica.

**Veins:** Two mineralogically different vein types are identified and are 1) carbonate and 2) carbonate-albite-pyrite-hematite.

Carbonate: Carbonate veins are parallel to and inclined (65°) to cleavage. Two types of carbonate veins are identified:

1) Interlocking carbonate veins less than 1 mm wide with carbonate grains <500 µm in size. These veins do not host the spaced cleavage that is present in groundmass and are inclined at 65° to cleavage.

2) Discontinuous carbonate ribbon veins parallel to cleavage and less than 200 µm in thickness. These veins consist of interlocking, moderately formed carbonate and occur within white mica zones through the quartz groundmass.

The timing of 1) and 2) is likely synchronous and these veins post-dated cleavage, forming a finely developed carbonate vein stockwork through the quartz-rich host, which is associated with the disseminated carbonate through the quartzo-feldspathic groundmass.

Carbonate-Albite-Pyrite-Hematite Vein: This single vein is cross cut by the carbonate veins described above and is strongly dissected by the penetrative cleavage. The vein is 4 mm wide and hosts fractures that are healed by carbonate. Albite grains within the vein are fractured and form grains up to 300 µm in size near the margins of the vein. Pyrite within this vein is sieved by carbonate inclusions. Likely remobilisation of pyrite outward and away from the vein is indicated by the disseminated occurrence of euhedral pyrite in the quartz groundmass adjacent to the vein. Finely disseminated (micron-sized hematite and Fe-oxide grains) occur through the carbonate within this vein. This imparts a red colouration to the vein. Minor ilmenite is also disseminated through the vein.

**Alteration:** Pervasive disseminated anhedral and poorly formed carbonate occurs as disseminations through the quartz groundmass. Quartz also forms white halos around the carbonate-albite-pyrite-hematite vein is of quartz. Disseminated carbonate form a diffuse alteration parallel to zones of phyllosilicate alteration and cleavage.

**Mineralisation:**

pyrite : Euhedral pyrite (<400 µm) is disseminated within quartz-white mica. Pyrite grains are sieved by inclusions of carbonate and where fractured, fractures are healed by carbonate (Plate 1d).

chalcopyrite : Skeletal chalcopyrite occurs as elongate grains parallel to cleavage and at the grain boundaries of quartz and pyrite (Plate 1d). This indicates remobilisation of chalcopyrite.

**Mineralogy :**

| | | | |
|---|---|---|---|
| K-feldspar | 40 % | white mica | 5-8% |
| quartz | 15 % | pyrite | 1% |
| albite | 5 % | albite | 1% |
| carbonate | 30% | chalcopyrite | trace |

**Sample : DDH SC1  208.5 metres**

**Hand sample:** Banded wall rock alteration with alternating green chlorite and cream quartz-albite bands less than 2-5 mm wide (Plate 1e). Finely disseminated magnetite occurs within the quartz-albite bands.

**Assay Data**: not supplied

**Groundmass chlorite bands:** Consist of fine-grained chlorite (<20 µm), with a light-olive birefringence (Mg-rich). Interlocking chlorite bands define a closely spaced penetrative cleavage and a crenulation cleavage (Plate 1f). Chlorite bands are up to 5 mm wide and have gradational contacts against the light coloured quartz-albite bands. Poorly formed carbonate is common along cleavage planes and also as disseminated well-formed rhombs (<250 µm). These carbonate rhombs have haloes of poorly formed mottled carbonate. Fine grained white mica (<20 µm) is abundant in some of the chlorite bands and aligned parallel to the penetrative cleavage.

**Groundmass quartz-albite bands:** Interlocking quartz and albite (<300 µm in size) occur in association with minor disseminated carbonate rhombs (<500 µm). In these quartz-albite bands, carbonate can also occur interstitial and along grain boundaries. Minor chlorite is observed and albite grains are most common near the margins to the chlorite-rich bands (Plate 1f).

**Structure**: Two cleavages are identifies and are best developed within the chlorite bands because of more ductile deformation in these phyllosilicate rich domains. The penetrative cleavage (S1) is a closely spaced cleavage that parallels the orientation of the banding through the wall rock (Plate 1f). The second crenulation cleavage (S2) is inclined at 35° to the banding and to the penetrative cleavage.

**Veins:** Carbonate veins (<200 µm wide) form an anastomosing series of veins that are discontinuous, stepped and wispy. Veins are inclined at approximately 60° to the penetrative cleavage. These carbonate veins consist entirely of interlocking carbonate grains and cross cut the quartz-albite bands in the wall rock. However, although carbonate veins within the chlorite bands cut across the earlier penetrative fabric, they are themselves crenulated by the second cleavage. This indicates that carbonate veins are pre- or syn formation with respect to the crenulation cleavage.

**Alteration**: Minor disseminated carbonate occurs in the quartz-albite bands, with carbonate interstitial to quartzo-feldspathic grains.

**Mineralisation**:

pyrite: Trace proportions of subrounded grains less than 50 µm in size. Fractured pyrite grains may be hosted within carbonate veins.

magnetite: Less than 1% (trace). Well-formed, less than 100 µm, varying from granular to skeletal grains. Skeletal grains are the result of magnetite replacing carbonate with abundant inclusions of carbonate in magnetite reflecting incomplete replacement. Magnetite grains inherit skeletal rhombic forms after carbonate.

ilmenite/rutile: Disseminated grains through the quartz-albite groundmass form spongy irregular grains less than 50 µm in size.

**Comments**: The origin of the banding is uncertain. One possibility could be that quartz veining with albite margins, as identified elsewhere, was sub-parallel to a pre-existing cleavage as this cleavage is not well developed within them. However, there is no evidence to support that this banding was a precursor bedding.

**Mineralogy**:

| | | | |
|---|---|---|---|
| quartz | <5 % | white mica | 5 |
| K-feldspar | 40 % | magnetite | <1 |
| chlorite | 25 | | |
| albite | 15 | | |
| carbonate | 10 | | |

**Sample : DDH SC1 200.9 metres**

**Hand sample**: Grey-cream siliceous halo peripheral to white quartz vein and a light cream-yellow (white mica?) halo peripheral to a 1 centimetre white quartz vein (Plate 1g).

**Assay Data**: not supplied

**Groundmass:** Variably sized (<300 µm) interpenetrating quartz matrix with quartz having ragged margins and irregular anhedral shapes.

**Structure**: The lack of cleavage within this sample reflects the general absence of phyllosilicate alteration. White mica has a minor occurrence and forms fibrous disseminated grains generally at quartz margins.

**Veins**:

Albite-quartz vein: These veins (2-3mm wide) have sharp margins against the quartz wall rock and consist of well-formed albite (<500 µm) and quartz (anhedral) (Plate 1h). The albite-quartz vein is in turn veined and offset by carbonate (±white mica) veins. Quartz in the vein has undulose extinction patterns with minor disseminated and fractured euhedral pyrite. White mica also occurs as a minor vein constituent and is commonly present along grain boundaries.

White quartz vein: Large quartz vein filled by anhedral quartz up to 1 mm in size. Undulose extinction and subgrains are common. Subgrains developed at grain boundaries suggest local recrystallisation of quartz. This vein is in turn offset and crosscut by sets of carbonate veins that are less than 1 mm wide. Within the quartz vein, tabular up to 1 mm skeletal rutile grains occur and are hosted by quartz.

Carbonate veins: Discontinuous veins less than 200 µm wide, variably oriented through the sample. These veins consist entirely of fine grained carbonate and cut across the albite-quartz and quartz veins indicating their late stage development (Plate 1h).

**Alteration**: The difference in colour between the haloes around the two veins reflect the abundance of carbonate or white mica. Grey-cream alteration reflects disseminated carbonate, whilst the cream-yellow reflects disseminated white mica. Carbonate alteration occurs as disseminated well formed euhedra (<400 µm) that often contain abundant inclusions of quartz. These inclusions indicate their later formation in a quartz matrix resulting in the entrapment of quartz subgrains. Carbonate alteration is strongest peripheral to carbonate veins, particularly in the quartz-albite veins where carbonate replaces outward from the carbonate veins into the quartz-albite vein. Carbonate also forms irregular anhedral patches intermixed with variably oriented fibrous white mica. Rare disseminated epidote (<120 µm) also occurs in carbonate-quartz.

**Mineralisation**:

rutile: Tabular spongy grains hosted in the white quartz veins, cut by late stage carbonate veining.

chalcopyrite: Trace amounts as in fill of fractures in the white quartz veins indicating a remobilised occurrence.

ilmenite/rutile: Spongy irregular grains and aggregates disseminated in quartz.

pyrite: Trace amounts of disseminated euhedral pyrite, less than 50 µm in size.

**Mineralogy :**

| | | | |
|---|---|---|---|
| K-feldspar | 40 % | white mica | 3 % |
| carbonate | 20 % | rutile | 1 % |
| quartz | 30 % | | |
| albite | 4 % | | |

**Sample : DDH SC1 196.9 metres**

**Hand sample:** Cream bleached wall hosting narrow (<1 mm) carbonate veins and a single coarse-grained, white quartz vein (Plate 2a). A light green mineral occurs in the white quartz vein (fuchsite?). Disseminated pyrite occurs through the wall rock and veins.

**Assay Data**: <0.01 ppm Au, 15 ppm Cu, <3 ppm Pb, 19 ppm Zn, <1 ppm Ag, <1 ppm As

**Groundmass:** Massive quartz mosaic of fine-grained (<200 µm), anhedral interlocking quartz with minor small feldspar (albite) interstitial to quartz grains (Plate 2b).

**Structure**: No cleavage present

**Veins**:

carbonate: Carbonate veins are <1.2mm wide and consist of well-formed interlocking subhedral carbonate as well as finer-grained mottled anhedral carbonate meshworks (Plate 2b). These veins are late and cross cut the wider white quartz vein.

small quartz veins: These veins are less than 100 µm width and not visible in hand specimen. The small quartz veins are filled with undulose, interlocking elongate quartz grains that lie across the orientation of these veins, indicating syntaxial vein formation. These veins are in turn cross cut and offset (300 µm) by carbonate veins.

large white quartz vein: Quartz, carbonate, albite and pyrite vein with albite developed at the vein margins. Albite grains are less that 400 µm and corroded and fractured by carbonate. The inner parts of the vein consist of interlocking quartz that is strongly undulose and with grains of up to 3 mm in size and anhedral. Carbonate has replaced quartz along grain boundaries. A phyllosilicate mineral, possibly fuchsite, forms interstitial fibrous radiating decussate patches in quartz carbonate within the vein.

**Alteration**: Disseminated carbonate with well formed subhedral to euhedral grains that vary from micron-sized to 1.5 mm. Carbonate grains often contain rounded inclusion or subgrains of quartz and minor epidote (<30 µm). Disseminated white mica, less than 300 µm with fibrous radiating habit, occurs interstitial to quartz in the groundmass.

**Mineralisation**:

pyrite: forms disseminated euhedral, well-formed grains that may contain rounded inclusions of pyrrhotite (<10 µm) and chalcopyrite. Pyrites are less than 400 µm, fractured and contain minor quartz inclusions. The forms of these quartz grains is consistent with pyrite recrystallisation

rutile/ilmenite: spongy to well formed grains less than 80 µm. These grains are most abundant within the disseminated carbonate through the quartz groundmass.

**Mineralogy**:

| | | | |
|---|---|---|---|
| quartz | 50 % | pyrite | 1 % |
| K-feldspar | 35 % | chalcopyrite | trace |
| albite | 8 % | rutile | 1 % |
| carbonate | 5 % | white mica | 1 % |

## Plate 2

(a) Cream wall rock hosting narrow carbonate veins and a white quartz-fuchsite vein. Sample from SC1 at 196.9 metres.

(b) Photomicrograph of (a). The groundmass is a fine-grained interlocking mosaic of quartz and lesser albite. Disseminated anhedral carbonate and euhedral pyrite (opaque) occur in the groundmass. A planar carbonate vein consisting of large well-formed carbonate grains cuts the groundmass. One margin of this vein has smaller, anhedral carbonate along it.

(c) Strongly foliated, fine-grained buff coloured wall rock hosting a pervasive white mica alteration. Sample is from SC1 at 186.3 metres.

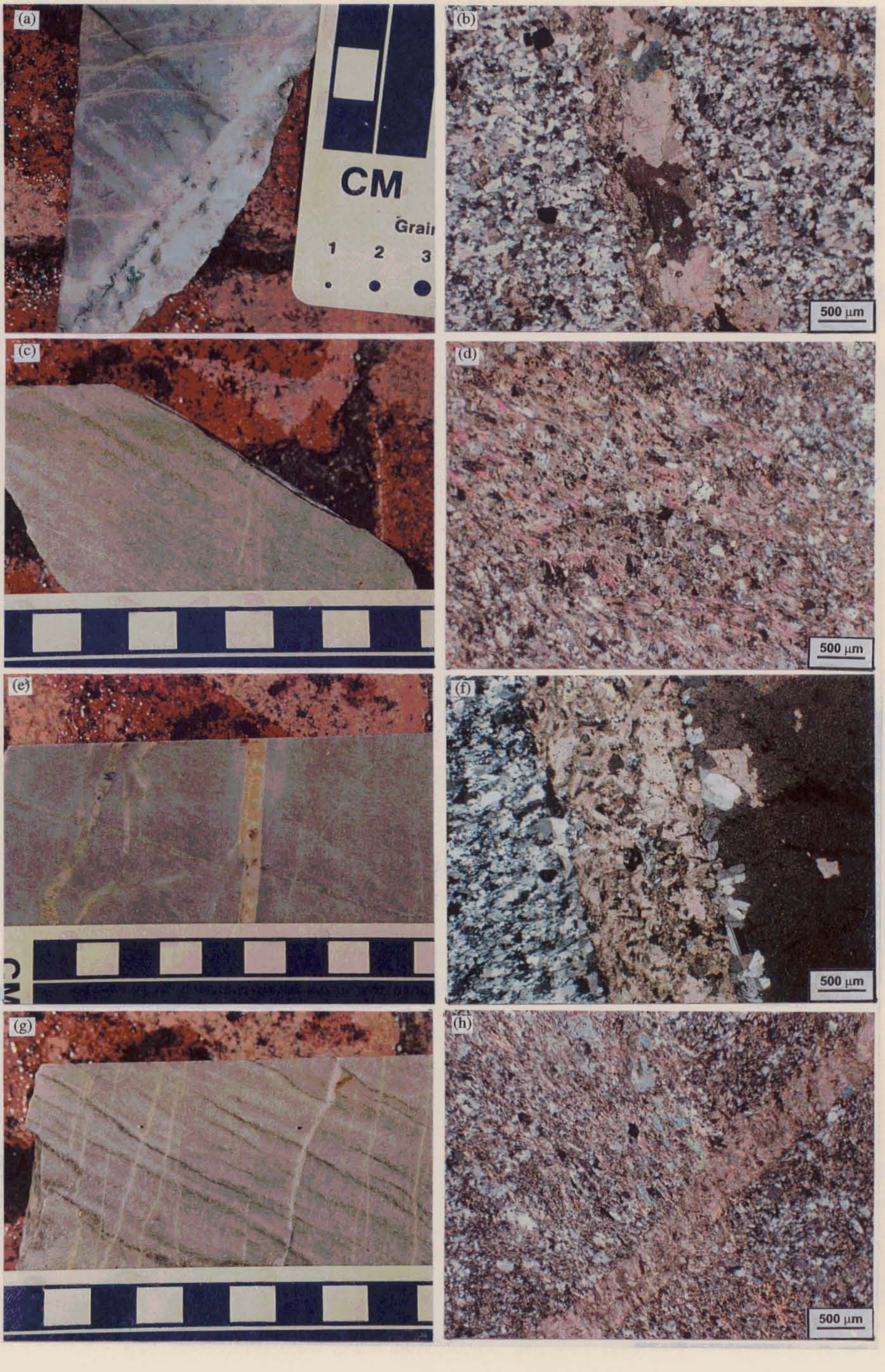
(d) Photomicrograph of (c). The groundmass is a mosaic of quartz that hosts an intense closely spaced cleavage (S2) delineated by white mica alteration. A weak crenulation cleavage (S3) is evident. Fine-grained pyrite (opaque) is disseminated through the quartz-sericite wall rock.

(e) Cream coloured wall rock with pervasive intense quartz alteration. A series of planar carbonate veins occur and host pyrite and magnetite. These veins cross cut and are parallel to the cleavage (S2). Sample is from SC1 at 186.3 metres.

(f) Photomicrograph of a carbonate vein margin in(e). The carbonate vein has an inner massive carbonate zone and an outer finer-grained carbonate zone. Between these two carbonate zones euhedral albite grains occur. The margin of the carbonate vein against the quartz-feldspar groundmass is sharp and planar.

(g) Buff coloured, pervasive intense white mica alteration of the wall rock. Wispy narrow carbonate veins cross cut cleavage. Sample is from SC1 at 175.2 metres.

(h) Photomicrograph of (g). The matrix is a fine-grained array of quartz and albite, which hosts a closely spaced intense cleavage (S2). This cleavage is defined by the alignment of fine-grained white mica. A planar carbonate vein cuts the groundmass and cleavage and consists of fine-grained , poorly formed carbonate. Disseminated carbonate occurs throughout the groundmass as poorly formed anhedral grains.


(a)
CM
1 2 3
(b)
500 µm
(c)
(d)
500 µm
(e)
(f)
500 µm
(g)
(h)
500 µm

**Sample : DDH SC1 186.3 metres**

**Hand sample**: Yellow-cream strongly foliated, fine-grained rock with pervasive white mica alteration (Plate 2c).

**Assay data**: <0.01 ppm Au, 27 ppm Cu, <3 ppm Pb, 78 ppm Zn, <1 ppm Ag, 42 ppm As

**Groundmass**: Consists of quartz with abundant white mica-carbonate (Plate 2d). Quartz is variably sized from a micron-size to larger grains of up to 1 mm. Inequant quartz grain sizes are suggestive of less severe recrystallisation effects in this zone. Some of the larger quartz grains are subangular to subrounded in shape, possibly detrital in origin, and are hosted within a white mica delineated cleavage. These quartz grains have undulose extinction with subgrains developed along the margins of larger grains, indicating local recrystallisation. Minor albite is developed interstitial to quartz.

**Structure**: A closely spaced undulatory fabric occurs throughout the sample and is defined by the alignment of white mica grains (<50 μm) (Plate 2d). Larger quartz grains (~1 mm) have cleavage wrapping by the white mica. Although this cleavage is ubiquitous through the sample, parallel zones of intense cleavage development are common where white mica is more abundant. These zones of white mica give a banded appearance to the sample and alternate with quartz-rich bands that have a texture similar to banding described in sample SC1 at 208.5 metres, except bands in this sample are white mica-rich. These white mica bands are less than 2 mm wide with gradational margins towards quartz-white mica bands. A second, weak crenulation cleavage is developed at 25° to the penetrative cleavage, within the white mica-rich bands (plate 2d). Dissection of the quartz±albite groundmass by this penetrative cleavage results in elongate bands of quartz.

**Veins**: Absent from this sample.

**Alteration**: White mica associated with cleavage is ubiquitous. Disseminated poorly formed carbonate occurs through the quartz groundmass as irregular grains, less than 100 μm in size, but more commonly occurs within the white mica-rich bands (Plate 2d).

**Mineralisation**:

pyrite: Disseminated grains less than 100 μm. Grains are well-formed and subhedral and mainly occur in the white mica bands.

rutile/ilmenite: Spongy to poorly formed grains (< 40 μm) generally within the white mica bands

chalcopyrite: Trace proportions. Grains are less than 10 μm in size and hosted within carbonate in the white mica bands

**Comments**: Possible replacement of white mica by carbonate in sericitic zones parallel to the cleavage and banding.

**Mineralogy**:

| | | | |
|---|---|---|---|
| quartz | 45 % | pyrite | trace |
| K-feldspar | 25% | chalcopyrite | trace |
| white mica | ~20 % | rutile | trace |
| albite | 2 % | | |
| carbonate | 5 % | | |

**Sample : DDH SC1 179.0 metres**

**Hand sample**: Light cream-green wall rock with pervasive intense siliceous alteration. Planar, less than 1 cm wide veins of carbonate cut across the wall rock and host disseminated pyrite and magnetite (Plate 2e). White alteration haloes enclose some of the carbonate veins.

**Assay data**: <0.01 ppm Au, 17 ppm Cu, <3 ppm Pb, 56 ppm Zn, <1 ppm Ag, <1 ppm As

**Groundmass**: The groundmass consists of interlocking quartz grains of variable sizes (<400 µm) and interstitial albite. Undulose extinction and alignment or elongation of the quartz-rich matrix is common and occurs parallel to cleavage. Recrystallisation of quartz to smaller subgrains is also common along quartz grain margins.

**Structure**: Disseminated white mica (<100 µm) is aligned parallel to and delineates a spaced cleavage through the quartz±albite groundmass.

**Veins**:

Carbonate: Carbonate veins have two types:

Type (1) veins that consist of well-formed, interlocking, large carbonate grains (<3 mm) which, host disseminated albite (<500 µm) at the vein margins (Plate 2f);

Type (2) veins that consist of poorly-formed, anhedral, mottled, inclusion-rich carbonate that forms a fine-grained (<300 µm) meshwork (Plate 2f).

Vein type (2) occurs along the margin of vein type (1) and is thus asymmetric, with sharp margins which likely indicate a repeated opening of the vein during carbonate deposition (Plate 2f). Elsewhere carbonate veins may contain bladed to acicular, variably oriented hematite (grains < 2mm). Hematite in these veins is within large interlocking carbonate grains. Carbonate veins cross cut cleavage and thus post-date cleavage formation. Carbonate veins can also lie parallel to cleavage with locally irregular margins suggestive that quartz recrystallisation post-dated carbonate veining.

**Alteration**: Alteration of the groundmass consists of disseminated subhedral to anhedral, well-formed carbonate grains (< 200 µm) in a quartz matrix. These carbonate grains commonly contain rounded inclusions of quartz. However, carbonate grains have irregular morphologies where they lie along grain junctions and boundaries.

**Mineralisation**:

pyrite: Occurs as disseminated subrounded to euhedral, well formed grains (< 300 µm) in the quartz-rich groundmass and as disseminations in the carbonate veins. Local embayment of pyrite grain margins by groundmass quartz is observed.

rutile/ilmenite: Forms micron-sized disseminations through the groundmass with spongy to granular grain forms.

**Mineralogy**:

| | |
|---|---|
| quartz | 50 % |
| K-feldspar | 35 % |
| albite | 2-5 % |
| carbonate | 5-8 % |
| white mica | 1 % |

**Sample : DDH SC1 175.2 metres**

**Hand sample**: Yellow-cream pervasive intensely white mica altered rock that hosts wispy carbonate veins (<1 mm) (Plate 2g). Darker bands (phyllosilicate-rich) define cleavage. In general, this sample is very similar to the sample from SC1 at 186.3m.

**Assay Data**: <0.01 ppm Au, 64 ppm Cu, <3 ppm Pb, 57 ppm Zn, <1 ppm Ag, 19ppm As

**Groundmass**: Variably sized meshwork (<400 µm) of quartz and albite.

**Structure**: Fine-grained white mica (<50 µm) defines an anastomosing cleavage, that forms bands of strongly cleaved rock with relict quartz-feldspar (Plate 2h). Cleavage also wrap some quartz grains.

**Veins**: Carbonate veins (20° to cleavage), are less than 1 mm wide and consists of well-formed interlocking carbonate grains to poorly formed anhedral carbonate (Plate 2h).

**Alteration**: Consists of minor disseminated mottled, poorly formed carbonate (Plate 2h).

**Mineralisation**:

pyrite: Disseminated pyrite euhedra of less than 50 µm grain size.

rutile: Granular to poorly formed spongy grains disseminated through the groundmass, but particularly abundant in the white mica-rich foliated zones.

chalcopyrite : Minor less than 10 µm-sized rounded chalcopyrite grains hosted with carbonate veins.

**Mineralogy**:

| | |
|---|---|
| quartz | 40 % |
| K-feldspar | 35-40 % |
| carbonate | 2-3 % |
| white mica | 20 % |
| chalcopyrite | trace |
| rutile | trace |

**Sample : DDH SC1 155.6 metres**

**Hand sample**: Grey-green fine grained wall rock with pervasive quartz-feldspar-chlorite alteration that hosts a 5 mm white quartz-feldspar vein (Plate 3a). Wispy mm-scale carbonate veins cut across this quartz vein. Both quartz and carbonate veins enveloping have light cream-yellow alteration haloes.

**Assay Data**: <0.01 ppm Au, 21 ppm Cu, <3 ppm Pb, 83 ppm Zn, <1 ppm Ag, 45 ppm As

**Groundmass**: Fine-grained schist with a homogeneous texture. The schist consists of a less than 100 µm meshwork of quartz, K-feldspar and lesser albite (Plate 3b). Pervasive chlorite-white mica alteration is interstitial to these grains.

**Structure**: Closely spaced, weakly anastomosing penetrative fabric defined by the alignment of white mica and chlorite. White mica is less than 50 µm with acicular forms, whilst chlorite is more decussate lath-shaped and less than 80 µm. The cleavage is strong and pervasive.

**Veins**:

Albite-K-feldspar-quartz-carbonate : Less than 5 mm veins consisting of and outer K-feldspar-albite-quartz zone and a massive inner carbonate zone (Plate 3b). The quartzo-feldspathic wall of the vein consist of grains that are perpendicular to the veins walls and fibrous indicating the vein original formed as a syntaxial quartz-feldspar vein. The inner carbonate zone has large (up to 2mm) carbonate grains that are anhedral to rhomb shaped and can also host subhedral albite grains (<400 µm). The mineral zonation in these vein is interpreted to represent a quartz-feldspar syntaxial vein that re-opened in its central area during the carbonate vein deposition. Consistent with this observation are smaller carbonate veins (<1-2 mm) that cut across the fibrous quartz outer vein but do not cross cut the inner carbonate core zone indicating similar timing of these carbonate veins.

**Alteration**: Alteration haloes are characterised by a lesser proportions of white mica and chlorite compared to the surrounding wall rock, but have abundant disseminated mottle, poorly formed carbonate alteration. These halos are most likely associated with diffuse alteration of the wall rock during carbonate vein formation.

**Mineralisation**:

pyrite: Disseminated subrounded to euhedral grains (<150 µm) in trace proportions, within the carbonate alteration zones of carbonate veins.

rutile/ilmenite: Granular to spongy grains (<20 µm) disseminated in the quartzo-feldspathic matrix.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 30 % | albite | 5 % |
| quartz | 35 % | chlorite | 2-5 % |
| white mica | 15% | rutile/ilmenite | trace |
| carbonate | 8 % | pyrite | trace |

## Plate 3

(a) Grey-green fine-grained wall rock with pervasive quartz-feldspar-chlorite alteration. Albite-quartz veins cross cut the wall rock, some of which have irregular alteration halos. Sample is from SC1 at 155.6 metres.

(b) Photomicrograph of (a). Planar carbonate-albite-quartz vein cross cutting a massive quartz, K-feldspar groundmass. The carbonate-albite-quartz vein is symmetric and has euhedral albite at the margins with an inner massive carbonate zone.

(c) Buff coloured, pervasive intense quartz-feldspar-white mica altered wall rock. Translucent quartz veins (<1 mm) are parallel to a spaced penetrative cleavage and are cross cut by carbonate-albite veins. Sample is from SC1 at 143.9 metres.

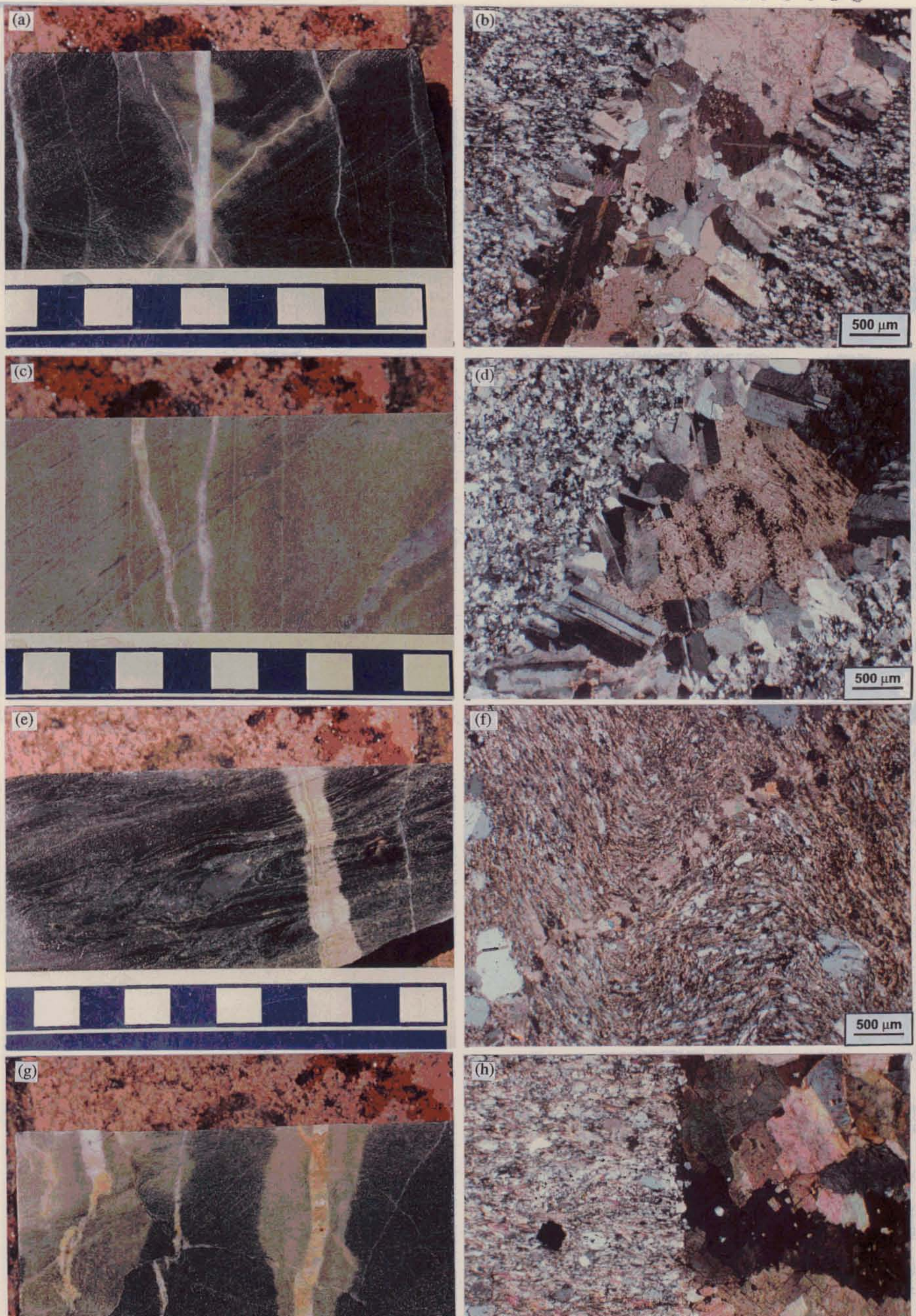
(d) Photomicrograph of (c). Carbonate albite veins have an outer margin of coarse-grained euhedral albite and an inner zone of massive carbonate. These veins have sharp margins to the groundmass, which consists of interlocking fine-grained quartz-K-feldspar.

(e) Dark green schist with pervasive intense chlorite-quartz-feldspar alteration. An intense foliation occurs in the wall rock that is parallel to the translucent quartz veins. Narrow undulatory carbonate veins cross cut this foliation and have buff coloured alteration halos. Sample is from SC1 at 141.5 metres.

(f) Photomicrograph of (e). Intensely developed cleavage associated with white mica and fine-grained anhedral carbonate. Wrapping of the foliation orientation is common. A narrow carbonate vein cuts across the cleavage. Large K-feldspar grains exist within the white mica-carbonate alteration.

(g) Massive grey-green wall rock hosting planar carbonate-albite veins, some of which have buff coloured alteration halos. Sample is from Sc1 at 138.9 metres.

(h) Photomicrograph of carbonate vein in (g). The carbonate vein consists of euhedral interlocking carbonate grains and has a sharp margin against the wall rock. The wall rock groundmass consists of fine-grained interlocking quartz-feldspar mosaic, and hosts a spaced cleavage that is delineated by white mica. Minor disseminated pyrite occurs in the groundmass (opaque).



(a)
(b)
500 µm
(c)
(d)
500 µm
(e)
(f)
500 µm
(g)
CM
(h)
500 µm

**Sample : DDH SC1 143.9 metres**

**Hand sample**: Light cream-yellow pervasive, intense quartz-feldspathic-white mica alteration. Clear mm-scale quartz veins are parallel to a penetrative foliation (Plate 3c). Two carbonate veins (< 3 mm) are locally undulatory to planar cut across the penetrative fabric in this sample.

**Assay data**: <0.01 ppm Au, 132 ppm Cu, <3 ppm Pb, 117 ppm Zn, <1 ppm Ag, 39 ppm As

**Groundmass**: Fine-grained meshwork of K-feldspar and quartz, with lesser albite. This mosaic contains grains less than 100 µm in size with white mica occurring interstitial to quartz and feldspar grains, generally along grain boundaries. Quartz and feldspar have strongly undulose extinction patters, but the groundmass has a relatively homogeneous texture.

**Structure**: Disseminated white mica grains (<80 µm) occur interstitial to the quartzo-feldspathic matrix. The alignment of white mica grains define a spaced, moderate intensity cleavage.

**Veins**: Two vein types are present in this sample and are:

(1) quartz veins: Quartz veins parallel the foliation throughout the sample and consist of interlocking anhedral quartz, less than 400 µm in size. These veins are less than 1 mm wide and have irregular margins against the quartzo-feldspathic matrix, most likely due to recrystallisation effects. Quartz in these veins is strongly undulose and the veins are weakly boudinaged with cleavage wrapping.

(2) carbonate veins: These veins consist of either carbonate or carbonate-albite minerals and cut across cleavage and the quartz veins. Carbonate±albite veins range in width from less than 200 µm up to 6 mm. Veins consisting entirely of carbonate contain well-formed, coarse-grained carbonate, whilst the carbonate-albite veins have an outer zone of euhedral albite (<400 µm grains) and an inner zone of massive anhedral interlocking carbonate up to 1 mm in size (Plate 3d). The albite rich margins have grains that radiate from the vein wall inward, and both the carbonate and carbonate-albite veins are interpreted to be contemporaneous due to their anastomosing relations.

**Alteration**: Finely disseminated, poorly formed anhedral carbonate (<100 µm) occurs as disseminations through the groundmass. Disseminated white mica also occurs.

**Mineralisation**:

pyrite: Disseminated subrounded to euhedral grains up to 200 µm in size occur within the quartzo-feldspathic groundmass and along carbonate±albite vein margins. Some pyrite grains contain chalcopyrite inclusions (<10 µm).

rutile/ilmenite: Spongy poorly formed grains less than 50 µm in size are disseminated through the groundmass.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 45 % | carbonate | 5-8 % |
| quartz | 20 % | rutile/ilmenite | 1 % |
| albite | 15 % | pyrite | trace |
| white mica | 8 % | chalcopyrite | trace |

**Sample : DDH SC1 141.5 metres**

**Hand sample**: Dark green schist with pervasive, intense chlorite-quartz-feldspar alteration of the wall rock. This alteration hosts a strong foliation that is parallel to clear quartz veins (Plate 3e). Narrow, undulatory carbonate veins have buff coloured white mica alteration haloes that envelop the carbonate veins. These alteration haloes can be up to 10 mm wide.

**Assay data**: <0.01 ppm Au, 103 ppm Cu, <3 ppm Pb, 135 ppm Zn, <1 ppm Ag, 9 ppm As

**Groundmass**: A quartz-K-feldspar groundmass is strongly dissected by both the cleavage and phyllosilicate alteration. Quartz and feldspar form interlocking massive to irregular anhedral masses against disseminated grains within a white mica matrix. Minor albite occurs interstitial to quartz and K-feldspar.

**Structure**: The main cleavage in this sample is an intensely developed crenulation cleavage, which cross cuts an early penetrative fabric. The crenulation cleavage is defined by arrays of white mica and chlorite alteration that form a banded texture through the quartzo-feldspathic groundmass. This banded texture results from alternating parallel bands of phyllosilicate (Plate 3f) and quartz-feldspar, with the later representing less altered bands within the groundmass. Crenulation cleavage offsets carbonate veins having well developed S-C fabrics in phyllosilicate-rich bands. The angle between the two cleavages is approximately 25° with the crenulation cleavage anticlockwise to the penetrative fabric (S2).

**Veins**: Two types of veins occur in this sample and are quartz veins and carbonate veins.

<u>quartz veins</u> : These veins are up to 8 mm wide and parallel to cleavage. Veins are boudinaged and have cleavage wrapping. Interlocking anhedral quartz in these veins has undulose extinction. Minor disseminated decussate white mica occurs at and around quartz grain boundaries (<100 µm in size and acicular). These quartz veins can host subhedral pyrite up to 1 mm in size, which contain chalcopyrite as inclusions (20 µm) or as fracture in fill within pyrite.

<u>carbonate veins</u>: These veins are continuous but undulatory and consist of well-formed euhedral to subhedral carbonate (Plate 3f), which cross cut quartz veins. These carbonate veins are up to 500 µm wide and are offset by up to 200 µm on slip planes parallel to cleavage. A dextral sense of displacement along the slip planes is indicated.

**Alteration**: Banding is differentiated by alternating phyllosilicate and quartz-feldspar bands and reflects an earlier alteration, which is deformed by the penetrative fabric. Disseminated carbonate in the alteration halo around carbonate veins imparts a buff colouration to these halos. The margins of these alteration haloes are gradational to alteration in the wall rock/groundmass. Fine-grained disseminated poorly formed mottle carbonate grains also occur as dissemination through the white mica bands.

**Mineralisation**:

<u>pyrite</u>: These grains occur within the quartz veins and also as dissemination within the quartz-feldspar groundmass. Pyrite grains are euhedral and less than 100 µm in size.

<u>chalcopyrite</u>: Occurs in trace proportions within pyrite as inclusions and fracture in fill. Chalcopyrite also occurs as irregular polycrystalline aggregates within quartz veins

<u>rutile/ilmenite</u>: These grains are less than 50 µm in size and have granular to anhedral spongy forms. Rutile and ilmenite occur as disseminations through the groundmass, but are particularly abundant in the white mica-chlorite rich bands. In this case rutile and ilmenite are aligned parallel to the foliation.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 15 % | albite | 4 % |
| quartz | 20 % | pyrite | trace |
| white mica | 30 % | rutile/ilmenite | trace |
| chlorite | 20 % | chalcopyrite | trace |
| carbonate | 10 % | | |

**Sample : DDH SC1 138.9 metres**

**Hand sample**: The wall rock in this sample is fine-grained and grey-green with pervasive quartz-feldspar-chlorite alteration that results in a massive homogeneous texture (Plate 3g). Carbonate veins cross cut the wall rock and are up to 5 mm wide, planar and have with a buff white mica-carbonate alteration halo enclosing the veins.

**Assay data**: <0.01 ppm Au, 14 ppm Cu, <3 ppm Pb, 162 ppm Zn, <1 ppm Ag, <1 ppm As

**Groundmass**: Fine-grained meshwork of quartz and feldspar grains (<300 μm) with irregular margins against phyllosilicates (white mica and chlorite) (Plate 3h).

**Structure**: Fine-grained (<50 μm) white mica and chlorite are aligned to and form a spaced undulatory cleavage through the sample.

**Veins**: Three types of veins are identified in this sample:

(1) <u>carbonate</u>: Carbonate veins are 5 mm wide and consist of large well-formed anhedral grains (Plate 3h) that are up to 2 mm in size and cross cut earlier syntaxial quartz(±carbonate) veins as well as foliation. Acicular lath-shaped carbonate occurs in one vein at the margin against the larger massive carbonate grains, which occupy the central portions of the vein. No mineralisation is observed in these veins.

(2) <u>quartz-carbonate</u>: Veins are less than 1 mm wide, planar and are filled with fibrous quartz oriented perpendicular to the vein wall (syntaxial development). Carbonate grains are well formed, less than 1 mm in size and occur as euhedral grains along the vein margin, possibly as a result of later replacement along this vein structure. The weak crenulation cleavage evident in the hand specimen consist of these crack-seal syntaxial quartz-carbonate veins.

(3) <u>quartz-albite</u>: Consists of interlocking quartz and albite (<300 μm in size) with the vein having ragged margins against the groundmass.

**Alteration**: The groundmass alteration in this sample is strong and consists of a disseminated array of white mica and chlorite, which is aligned to the penetrative cleavage. Notably, carbonate alteration in the wall rock away from the vein is minor. The alteration halo surrounding carbonate veins results form the absence of chlorite in this area peripheral to the vein, but is texturally indistinct from the adjacent wall rock.

**Mineralisation**:

<u>pyrite</u>: Pyrite grains (<100 μm) have subrounded grain forms and occur as disseminations in the quartz-feldspar-white mica groundmass. Pyrite also occurs in the alteration haloes surrounding carbonate veins as disseminations.

<u>rutile/ilmenite</u>: Acicular to granular shaped grains are common in white mica altered zones parallel to cleavage.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 20 % | | |
| quartz | 25 % | rutile/ilmenite | 1 % |
| albite | 5% | carbonate | 5 % |
| white mica | 25 % | pyrite | trace |
| chlorite | 15 % | | |

**Sample : DDH SC1 121.1 metres**

**Hand sample**: Dark green-grey pervasive chlorite quartz-feldspar altered wall rock sample with a massive homogeneous texture. This sample hosts sub-parallel undulatory pyrite-quartz-K-feldspar-carbonate veins (Plate 4a).

**Assay data**: <0.01 ppm Au, 111 ppm Cu, <3 ppm Pb, 87 ppm Zn, 1 ppm Ag, 14 ppm As

**Groundmass**: Fine-grained (<400 μm) mosaic of anhedral quartz, K-feldspar and albite in an intensely altered chlorite-white mica rich matrix. This is an unusual sample in the SC1 sample suite in that it contains abundant pervasive chlorite. Quartz and albite have chlorite white mica corroded margins and contain chlorite and white mica needles (<30 μm) disseminated within the feldspars.

**Structure**: Two strongly developed cleavages are evident. One is closely spaced and defined by aligned chlorite and white mica (S2), whilst the other consists of a strongly developed but spaced crenulation cleavage (S3) (Plate 3b).

**Veins**: A single vein occurs in this sample.

<u>albite-K-feldspar-quartz-pyrite-carbonate vein</u>: Massive vein up to 8 mm wide consisting of interlocking albite, quartz and pyrite grains and the vein has sharp margins to the groundmass (Plate 3c). Albite and quartz are less than 400 μm and pyrite, which generally occurs in the central parts of these veins, is up to 500 μm. in size. These veins cross cut the S3 cleavage, but are parallel to S2 and do not contain chlorite or white mica. The absence of S2 and S3 fabrics within these veins may result from the competency contrasts to the phyllosilicate rich matrix. Pyrite however, has well developed fibrous quartz pressure shadows indicating these veins have been deformed. Pyrite in these veins is subhedral and skeletal and may contain feldspar and chalcopyrite inclusions (Plate 3d). Chalcopyrite also forms at grain boundaries in these veins as does rutile and ilmenite.

**Alteration**: Strong chlorite alteration occurs through the matrix.

**Mineralisation**:

<u>pyrite</u>: Pyrite mainly occurs within the feldspar-quartz vein (Plate 3d), although minor pyrite does occur as disseminations away from the vein. These pyrite grains are well-formed and subrounded.

<u>rutile</u>: Rutile is best developed in the chlorite matrix with acicular to irregular spongy grains (< 50 μm) and also occurs as inclusions within K-feldspar in the groundmass.

**Comments:** Quartz-K-feldspar alteration of the wall rock is considered to be associated with early vein development and was probably syn-deformational. This is supported by the presence of rutile and phyllosilicate inclusions within the feldspar.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 30% | white mica | 10 % |
| quartz | 5 % | chlorite | 30 % |
| albite | 10 % | rutile | 1 % |
| pyrite | 2-3 % | chalcopyrite | trace |

**Plate 4**

(a) Green-grey massive wall rock with pervasive chlorite, quartz and feldspar alteration. A pyrite-albite-quartz±carbonate vein cuts across the wall rock. Sample is from SC1 at 121.1 metres.

(b) Photomicrograph of (a). Quartz-feldspar matrix hosting fine-grained white mica and chlorite that define a penetrative spaced cleavage (S2) and a crenulation cleavage (S3).

(c) Photomicrograph of (a). Gradational margin of a quartz-feldspar-pyrite vein against the the quartz-feldspar matrix.

(d) Photomicrograph as for (c) in reflected light. Pyrite shape varies from well formed to euhedral but also occurs as irregular grains between quartz and feldspar grains.

(e) Massive pervasive quartz-feldspar-chlorite wall rock alteration. Planar, cross cutting carbonate, albite-quartz veins occur through the groundmass. The albite-quartz vein is cross cut by the carbonate veins. Buff coloured alteration halos envelop these veins. Sample is from SC1 at 101.5 metres.

(f) Photomicrograph of (e). The wall rock is fine-grained and consists of quartz-feldspar. Alteration of the wall rock adjacent to the albite-quartz vein is white mica, chlorite and carbonate. The carbonate occurs as fine disseminations that parallel cleavage (S2). The albite-quartz vein has an irregular margin against the wall rock. The vein dominantly consists of large subhedral albite grains.

(g) Coarse-grained strongly foliated chlorite-rich schist. Sample is from SC1 at 99.9 metres.

(h) Photomicrograph of (g). Large K-feldspar grains in a fine-grained chlorite-white mica-rich matrix. This phyllosilicate matrix defines a closely spaced cleavage (S2), which wraps around the large K-feldspar grains. Note that the K-feldspar grains contain inclusions of fibrous chlorite-white mica and have ragged irregular margins.

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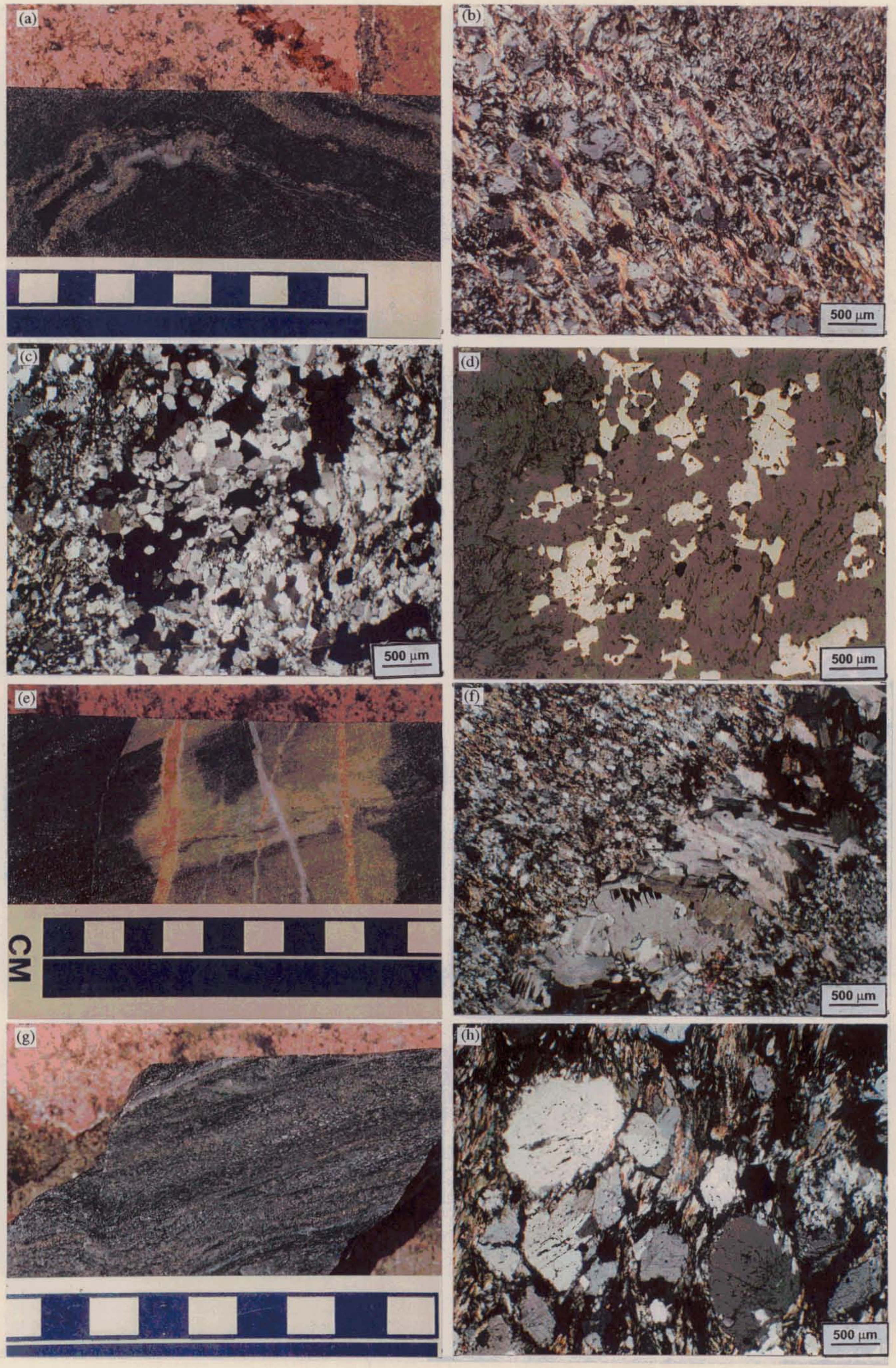

**Sample : DDH SC1 101.5 metres**

**Hand sample**: The sample has patchy alteration of the wall rock between grey-green pervasive quartz-feldspar-chlorite and buff pervasive white mica-rich alteration zones. The later forms haloes peripheral to carbonate-quartz-feldspar veins. These veins cross cut an alteration banding throughout the wall rock that is also parallel to foliation (Plate 4e).

**Assay data**: <0.01 ppm Au, 238 ppm Cu, 43 ppm Pb, 232 ppm Zn, 1 ppm Ag, <1 ppm As

**Groundmass**: Quartzo-feldspathic mosaic of anhedral grains less than 400 µm (Plate 4f). Some grains host rutile inclusions and have margins that are variable corroded by interstitial phyllosilicates.

**Structure**: Moderately formed penetrative cleavage delineated by the alignment of white-mica and carbonate, throughout the feldspathic matrix (Plate 4f).

**Veins**: Two types of veins are present in this sample:

carbonate: Planar veins less than 8 mm wide veins consisting of massive, well-formed anhedral carbonate. These carbonate grains are up to 2 mm in size and may contain relict corroded feldspar. White rims at the margins of some carbonate veins consist of variably oriented albite grains that are up to 1 mm in size. Two interpretations are possible; either the carbonate was deposited in a re-opened albite-rich vein or the albite-carbonate zonation in these veins indicates that albite deposition was followed by the inner filling of carbonate. The former case is preferred due to the replacement and corrosion of albite by carbonate.

albite-quartz veins: Less than 2 mm wide planar veins consisting of interlocking albite-quartz mosaics that are coarse-grained and up to 800 µm in size (Plate 4f). These veins have sharp to gradational margins against the groundmass, and are partially replaced by cross cutting carbonate veins and by carbonate surrounding or enveloping the carbonate veins. Albite-rich veins cross cut the foliation but may also parallel cleavage.

**Alteration**: Alteration haloes are the result of disseminated mottled anhedral carbonate grains disseminated through the groundmass peripheral to carbonate veins.

**Mineralisation**:

pyrite: Forms disseminations of subrounded to euhedral grains up to 800 µm in size and contain rutile inclusions.

chalcopyrite: Forms disseminated grains less than 30 µm in size with sub-rounded shapes in the quartzo-feldspathic groundmass.

rutile: Forms irregular shaped grains to well-formed acicular grains, all less than 100 µm in size. Rutile occurs as disseminations grains in the groundmass and as inclusions in feldspar.

**Comments**: Albite mainly occurs within veins whilst K-feldspar is dominant in the groundmass but may be intergrown with minor albite.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 50 % | white mica | 5 % |
| albite | 20 % | pyrite | trace |
| quartz | 5-8 % | chalcopyrite | trace |
| carbonate | 20 % | rutile | 1-2 % |

**Sample : DDH SC1 99.9 metres**

**Hand sample**: Coarse-grained strongly foliated phyllosilicate-chlorite rich schist (Plate 4g).

**Assay data**: <0.01 ppm Au, 87 ppm Cu, <3 ppm Pb, 214 ppm Zn, 1 ppm Ag, <1 ppm As

**Groundmass**: Predominantly K-feldspar groundmass that forms an interlocking mosaic with minor quartz. Uncommon disseminated larger K-feldspar grains occur (up to 1 mm) within a chlorite-rich matrix (Plate 4h). These larger K-feldspar grains have locally recrystallised fine-grained margins of K-feldspar-quartz (<50 µm) which form pressure shadows. Irregular margins to K-feldspar grains and cleavage wrapping is also common. Larger K-feldspar grains are commonly fractured with extensional fracture site filled by fibrous white mica and chlorite. Inclusions within these K-feldspar grains include acicular chlorite, white mica and rutile grains (Plate 4h).

**Structure**: Aligned fine-grained chlorite and white mica grains (<100 µm) define a closely spaced, locally undulatory strong cleavage in the groundmass (Plate 4h). White mica and chlorite are locally developed in pressure shadows and also wrap around feldspar grains. A weak crenulation cleavage 20° anticlockwise of the penetrative cleavage only occurs within intensely white mica altered zones.

**Veins**: No veins are present in this sample.

**Alteration**: K-feldspar alteration imparts a banded texture to the intensely chlorite-white mica altered zones. This banding is parallel to the penetrative cleavage.

**Mineralisation**:

pyrite: Disseminated euhedra less than100 µm in size, occur interstitial to large K-feldspar grains within the white mica-chlorite matrix.

chalcopyrite : Less than 20 µm rounded grains disseminated interstitial to K-feldspar in the white mica-chlorite matrix.

rutile: Forms disseminated tabular to rounded grains within K-feldspar and disseminations through the chlorite-white mica matrix.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 45 % | white mica | 15 % |
| quartz: | 5 % | rutile | trace |
| chlorite | 35 % | pyrite | trace |

**Sample : DDH SC1 95.2 metres**

**Hand sample**: Massive green-grey wall rock sample with a fine-grained homogeneous texture (Plate 5a). A planar 6 mm wide carbonate-quartz vein cross cuts the wall rock in this sample.

**Assay data**: <0.01 ppm Au, 112 ppm Cu, 4 ppm Pb, 30 ppm Zn, <1 ppm Ag, 6 ppm As

**Groundmass**: Massive interlocking quartz-K-feldspar groundmass with a grain size less than 400 µm (Plate 5b). Chlorite is interstitial to the quartz and feldspar groundmass and has a coarse grain size (up to 200 µm).

**Structure**: Chlorite alignment defines a weak cleavage, but generally the massive groundmass is dominant (Plate 5b).

**Veins**: Two vein types are identified in this sample:

quartz veins: Quartz veins have gradational margins against the groundmass. These quartz veins (< 200 µm wide) consist of interlocking quartz grains, which have local recrystallisation of quartz at the vein margin, which result in gradational contacts with the wall rock. In addition, quartz veins host parallel carbonate veins (<80 µm wide). Disseminated carbonate occur as within the quartz veins near the carbonate vein sites. This carbonate alteration emanates outwards away from the internal parallel carbonate veins within quartz veins suggesting that these veins re-opened or utilised pre-existing fractures.

carbonate veins: Carbonate veins are massive and filled by carbonate grains less than 2 mm that are well-formed and anhedral. These carbonate veins have minor albite and quartz along the margins (Plate 5c). These albite grains (<500 µm) are well formed and intergrown with carbonate (Plate 5c). Vein walls have locally irregular corroded boundaries suggestive of local recrystallisation of the matrix after vein formation. Cleavage does not cut these carbonate veins but is weakly developed near them. These carbonate veins also host large subhedral pyrite grains up to 1 mm in size that tend to occur near the vein margin.

**Alteration**: Minor disseminated rounded epidote grains (25 µm in size) occur. Chlorite alteration is weakly developed and occurs as disseminated chlorite through the quartz-feldspar groundmass.

**Mineralisation**:

pyrite: Pyrite grains (< 1 mm) are subrounded to euhedral and occur within the carbonate veins and as disseminations through the quartzo-feldspathic groundmass. Pyrite grains contain subrounded inclusions (<20 µm) of chalcopyrite.

rutile/ilmenite: Grains vary from well-formed subrounded to irregular poorly formed spongy grains, all less than 50 µm in size. Rutile and ilmenite occur as disseminations in through the quartzo-feldspathic groundmass.

**Mineralogy**:

| | | | |
|---|---|---|---|
| quartz | 65 % | pyrite | trace |
| K-feldspar | 20 % | albite | 2 % |
| chlorite | 10 % | rutile/ilmenite | 1 % |
| white mica | 2 % | chalcopyrite | trace |

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**Plate 5**

(a) Massive grey-green wall rock with a fine-grained homogeneous texture and a cross cutting carbonate vein. Sample is from SC1 at 95.2 metres.

(b) Photomicrograph of (a). The massive homogeneous wall rock consists of quartz and feldspar with chlorite interstitial to these grains. Alignment of the chlorite grains defines a weak cleavage (S3).

(c) Photomicrograph of (a). Carbonate vein with euhedral albite grains along the margin of the vein. The vein consists of massive interlocking carbonate and feldspar.

(d) Massive grey-green wall rock with strong pervasive quartz-feldspar-chlorite alteration. Weak penetrative cleavage (S2) and crenulation cleavage (S3) are evident, with the latter paralleling the direction of narrow carbonate veins. Sample is from SC1 at 83.7 metres.

(e) Photomicrograph of (d). The groundmass is a massive interlocking mosaic of quartz and feldspar. A weakly developed cleavage is defined by the elongation of quartz and feldspar grains. A narrow carbonate vein cross cuts this cleavage and consists of anhedral, poorly formed carbonate grains.

(f) Grey wall rock hosting a carbonate-feldspar-magnetite-hematite vein and a carbonate vein. The carbonate vein has a buff coloured alteration halo, whilst the carbonate-feldspar-magnetite-hematite vein is parallel to the penetrative cleavage. Sample is from SC1 at 62.8 metres.

(g) Photomicrograph of (f). The groundmass consists on interlocking quartz, K-feldspar and carbonate with minor chlorite and white mica. This photo highlights the abundance of carbonate in the buff coloured alteration halo enveloping the carbonate vein.

(h) Photomicrograph of (f). Carbonate vein which consists of large interlocking well-formed carbonate grains. A second carbonate vein parallels cleavage. Disseminated carbonate occurs through the quartz-feldspar groundmass and the groundmass dominantly consists of K-feldspar peripheral to the carbonate vein.

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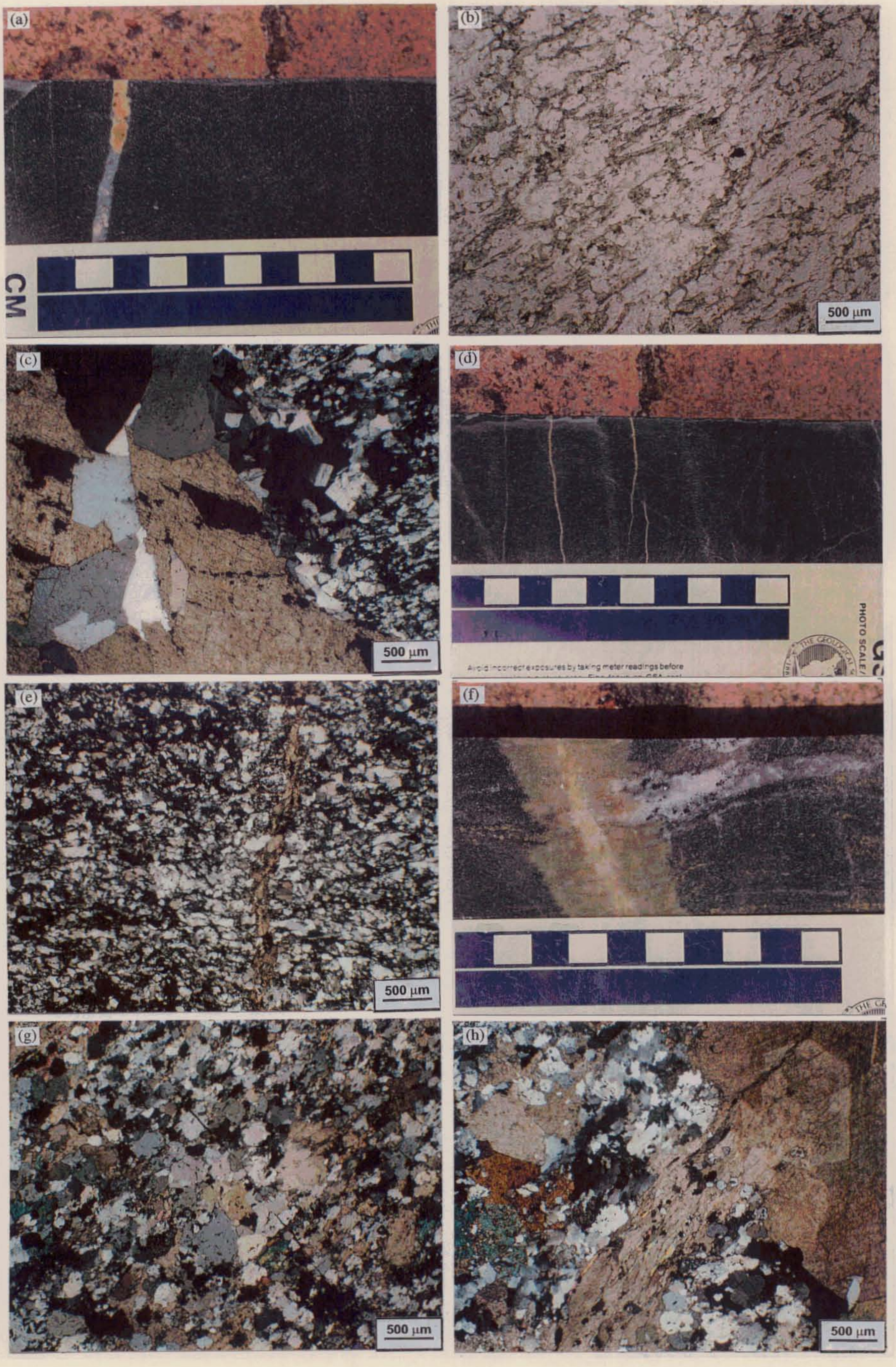
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(h)
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**Sample : DDH SC1 83.7 metres**

**Hand sample**: Massive grey green wall rock hosting a pervasive strong quartz, feldspar and chlorite alteration and a moderately developed penetrative cleavage (Plate 5d). A second cleavage is also present and very weakly developed parallel to narrow (<1 mm) discontinuous to planar carbonate veins

**Assay data**: <0.01 ppm Au, 119 ppm Cu, <3 ppm Pb, 19 ppm Zn, <1 ppm Ag, 2 ppm As

**Groundmass**: Fine-grained interlocking quartz-K-feldspar mosaic with minor interstitial albite and an average grain size of <200 μm (Plate 5e).

**Structure**: Weakly developed, spaced anastomosing cleavage delineated by the alignment of chlorite grains (< 50 μm in size). Although evident in hand specimen, the crenulation cleavage is not well defined in thin section. However local zones of cleavage rotation (~30°) are present and represent this very weak crenulation cleavage.

**Veins**:

carbonate: These veins are narrow (<400 μm wide) and consist of interlocking carbonate grains. Veins are planar and have locally irregular margins to the groundmass (Plate 5e). Additionally, carbonate veins parallel the zones where cleavage is rotated and thus parallel the interpreted crenulation cleavage.

**Alteration**: Minor disseminated and subrounded epidote grains (< 100 μm) occur in the quartz-feldspar groundmass. Minor mottled and poorly formed to well-formed carbonate grains (<300 μm in size) are also disseminated in the groundmass. Poorly formed carbonate grains have irregular shapes, which are elongate parallel to and along grain boundaries. Chlorite also forms a pervasive alteration.

**Mineralisation**:

pyrite: Forms disseminated subrounded grains (< 200 μm) in the groundmass.

chalcopyrite: Forms angular grains (< 50 um) that are disseminated through the groundmass. A single 500 μm aggregate of polycrystalline chalcopyrite occurs parallel to the penetrative cleavage.

rutile: Disseminated grains and aggregates (<100 μm in size) through the groundmass having spongy forms.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 45 % | rutile/ilmenite | 1% |
| quartz | 50 % | pyrite | trace |
| albite | 2-5 % | chalcopyrite | trace |
| carbonate | 2 % | | |

**Sample : DDH SC1 62.8 metres**

**Hand sample**: Vein sample consisting of a carbonate vein (1 cm) with a buff alteration envelop and a single carbonate-feldspar vein with hematite (Plate 5f). The carbonate vein has an alteration envelop that hosts disseminated pyrite, whilst the carbonate-feldspar vein has a grey-white alteration envelop.

**Assay data**: <0.01 ppm Au, 1338 ppm Cu, <3 ppm Pb, 30 ppm Zn, <1 ppm Ag, 9 ppm As

**Groundmass**: Interlocking K-feldspar rich matrix with minor interstitial quartz grains all of which, are less than 300 µm in size (Plate 5g).

**Structure**: White mica in the alteration halo around the carbonate vein is aligned and defines a spaced penetrative cleavage. Elsewhere the texture is massive and lacks any foliation.

**Veins**:

carbonate-K-feldspar: This vein consists of large, interlocking carbonate grains that are up to 3 mm in size and well formed (Plate 5h). Carbonate grains host k-feldspar, however K-feldspar is the dominant phase in the alteration halo that envelopes the vein. This carbonate-K-feldspar vein cross cuts cleavage in the alteration halo.

carbonate-feldspar-magnetite-hematite vein: This vein dominantly consists of K-feldspar with disseminated well-formed carbonate and minor quartz. Carbonate is also abundant as disseminations in the alteration halo around this vein. Magnetite has skeletal to idiomorphic shapes and form intergrowths or exsolution textures with hematite. Hematite (< 300 µm in size) typically replaces magnetite grains or forms rims around magnetite grains. Some bladed hematite up to 1-2 mm long also are hosted with carbonate.

**Alteration**:

Carbonate vein halo: Disseminated carbonate is abundant in this halo and occurs in associated with white mica (Plate 5g). These white mica grains vary from poorly formed to well-formed and are less than 300 µm in size. Disseminated white mica is commonly aligned parallel to cleavage. The matrix of this alteration halo consists of interlocking K-feldspar grains.

Carbonate-feldspar vein halo: Mottled poorly formed to well-formed carbonate in association with white mica forms this vein halo. White mica defines a penetrative cleavage in this alteration halo. Disseminated pyrite (<500 µm) and magnetite are also common within this halo and the former contains rounded chalcopyrite inclusions. Minor disseminated chalcopyrite (<50 µm in size) also occur within this alteration halo.

**Mineralisation**:

pyrite: Pyrite is abundant within the carbonate alteration halo and forms corroded subrounded grains and aggregate grains that are up to 1 mm in size. The individual pyrite grains however are less than 500 µm. Pyrite contains rounded inclusions of chalcopyrite and where fractured, grains in filled by carbonate and/or chalcopyrite. These fractures in pyrite represent extensional fracture sites that are perpendicular to the penetrative cleavage within the alteration halo.

magnetite: Occurs as disseminated grains that form intergrowths or exsolution textures with hematite.

rutile: Forms spongy grains (< 20 µm) grains disseminated in the groundmass.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 60 % | carbonate | 30 % |
| chlorite | 2 % | magnetite/hematite | 1% |
| quartz | 5 % | pyrite | trace |
| white mica | 5 % | chalcopyrite | trace |

**Sample : DDH SP1 160 metres**

**Hand sample**: A buff foliated wall rock (schist) with pervasive intense white mica alteration (Plate 6a). This sample is cross cut by a carbonate vein that hosts abundant Au and brannerite.

**Groundmass** : Intensely foliated white mica altered wall rock with minor grains of quartz and K-feldspar (< 300 µm) and which, are elongate parallel to the penetrative cleavage.

**Structure**: Intensely developed closely spaced planar cleavage. This cleavage is delineated by the alignment of white mica grains, all of which are less than 100 µm in size (Plate 6b and c).

**Veins**:

carbonate: planar veins less than 1 mm and consisting of interlocking, well-formed carbonate (Plate 6b and c). These veins host minor euhedral pyrite (up to 500 µm), which contain subrounded inclusions of chalcopyrite. The margins of the carbonate veins are locally irregular and may be offset by a small faults parallel to the cleavage.

carbonate-brannerite-Au veins: Well formed carbonate forms massive interlocking grains, which host brannerite (Plate 6d and e). Brannerite grains range up to 4 mm in size. The margin of this vein is sharp and planar. Disseminated pyrite occurs adjacent to this vein within the altered wall rock. Carbonate grains range up to 2 mm and are fractured. Brannerite is also fractured and has in situ jigsaw fit textures. This mineral is hard, opaque and isotropic having a very low reflectance. It is notable that pyrite is absent from this vein, but is common adjacent to the vein.

**Mineralisation**:

pyrite: Occurs adjacent to carbonate-brannerite-Au vein as subhedral grains that are less than 1 mm in size. Fractured pyrite grains are common and these fractures are in filled by carbonate and galena.

rutile: Disseminated rutile is ubiquitous through the white mica rich matrix. Rutile grains are less than 50 µm in size and have granular to spongy forms.

**Occurrence of Electrum:**

It is noteworthy that electrum only occurs within the carbonate-brannerite vein in the form of rounded to elongated grains that are up to 70 µm and elongate grains up to 400 µm long and 20 µm wide. The main occurrence of electrum within this vein is at the margins of and within fractures of brannerite, or as inclusions within brannerite that are always near its grain margins (Plate 6f and g). Electrum forms micron-sized trails in brannerite that define narrow (micron-sized) fractures in these grains (Plate 6f).

Electrum is also hosted within carbonate, along grain boundaries in the vein matrix (Plate 6g). In this case, electrum forms grains that are less than 50 µm in size and subrounded to subangular in shape. Minor electrum also occurs as inclusions within carbonate which have rounded shapes and are close to carbonate grain margins. The occurrence of electrum indicates its remobilisation to fracture sites and grains margins within the carbonate-brannerite vein. The bright deep yellow reflectivity of electrum indicates its a high Au content.

**Mineralogy**:

| | | | |
|---|---|---|---|
| K-feldspar | 15 % | X | 2 % |
| white mica | 60 % | pyrite | <1 % |
| quartz | 8 % | rutile | trace |
| carbonate | 10 % | | |
| Au | trace % | | |

## Plate 6

(a) A buff coloured, foliated wall rock (schist) with pervasive white mica alteration. An *electrum-carbonate-brannerite vein cuts the wall rock. Sample is from SP1 at 160 metres.*

(b) Photomicrograph of the wall rock in (a) in plane polarised light. The wall rock is intensely white mica altered and hosts a closely spaced, intense cleavage. The cross cutting carbonate vein consists of interlocking well-formed anhedral carbonate grains.

(c) as for (b) under crossed polarised light

(d) Photomicrograph of (a) under plane polarised light. The mineral brannerite is opaque and forms large grains that are fractured. Brannerite is hosted by interlocking well-formed, anhedral carbonate that is strongly fractured.

(e) as for (d) under reflected light. Electrum occurs within the brannerite grains within fractures.

(f) Photomicrograph of (a) showing the distribution of electrum within brannerite. Electrum predomiantly occurs as irregular shaped grains within fractures of brannerite.

(g) Photomicrograph of (a). Electrum is generally concentrated at the margins of brannerite, where it forms large grains. Smaller rounded electrum grains are disseminated within brannerite close to its grain margin or as disseminations within carbonate or along carbonate grain boundaries.

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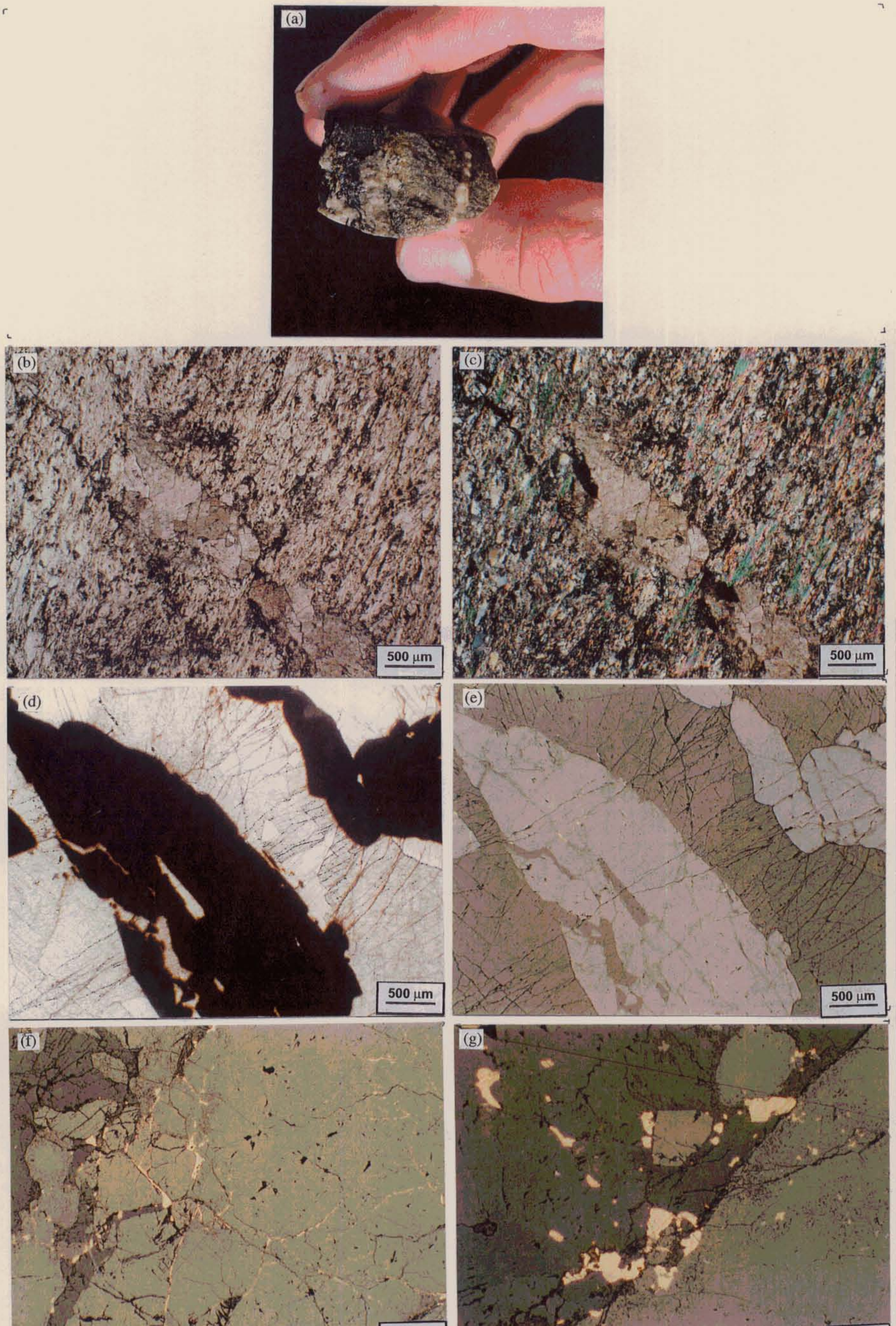

**Summary and interpretation of drill core logging**

Logging records of drill hole SC1 are given in Appendix 1. The wall rock intersected in SC1 is a massive homogenous metasediment and consists of interlocking mosaics of quartz, K-feldspar and minor albite. A disseminated pervasive alteration of chlorite and white mica varies from weak to strong alteration intensity and imparts a green-grey to buff colour respectively. Alteration banding, where present results from alternating bands that are rich in either chlorite or white mica and carbonate. Cleavage is well developed in zones of intense phyllosilicate alteration and this alteration is commonly associated with coarser K-feldspar grain sizes indicating a recrystallisation that probably post dated cleavage formation (metamorphic recrystallisation).

A parallel to anastomosing spaced penetrative cleavage (S2) dominates the structure within SC1. In less intensely altered massive wall rock, this cleavage is only moderately developed, whilst in intensely phyllosilicate altered parts of the core, the cleavage is intense and closely spaced. The S2 cleavage often parallels alteration banding and the inclination of this cleavage varies from 10° to 50° with respect to the core axis. A weak to moderate crenulation cleavage (S3) is also present and is best developed in the strongly phyllosilicate altered zones between 178 to 187 metres. This S3 cleavage varies from 70 to 90° with respect to the core axis indicating that it is not as steep as the S2 cleavage. The S3 crenulation cleavage commonly parallels carbonate veins and is considered to be parallel to the Specimen Reef alteration zone. A zone of rubble (near 189 metres) with striae on broken core surfaces is interpreted to represent a fault. Only one other fault surface was observed at 94 metres in SC1, with slikensides indicating reverse movement. Broad senses of movement determined from boudinage, grain rotation, vein displacement, and vein stepping structures also indicate reverse displacement.

Two dominant vein types occur in SC1:

(1) quartz±feldspar veins: This vein type consists of translucent to white coloured quartz veins up to 3 cm in width and contain feldspar as well as minor carbonate and chlorite. Other minerals within these veins include chlorite, pyrite, hematite and magnetite. These veins are commonly parallel to both alteration banding and S2 and may be boudinaged by S2. Quartz veins at high angles to the S2 cleavage are commonly crenulated or locally folded by S2, with S2 axial planar. Some of these quartz±feldspar veins show mineral zonation from quartz-feldspar near the vein margin to a carbonate-rich inner zone.

(2) carbonate veins: The carbonate in these veins is siderite or ankerite. These veins vary in width up to 1.5 cm, are commonly planar and at a high angle to the core axis. Nonetheless, these veins may also form fine wispy anastomosing stockwork veinlets. Alteration halos are common around these veins.

Carbonate veins consistently overprint and thus post-date the quartz±feldspar veins. The association between these two vein types and penetrative cleavage (S2) also supports this timing relationship. Carbonate veins cross cut the penetrative cleavage (S2) and lack deformational structures such as boudinage and crenulation, which occur within the quartz±feldspar veins.

Alteration haloes of white mica and carbonate generally occur peripheral to carbonate veins, but may also form around quartz±feldspar veins where they are veined by carbonate. Intense white mica and carbonate alteration also occurs from 181.8 to 193 metres in SC1. This forms part of a massive pervasive alteration of the wall rock around the zone inferred to be Specimen Reef. Elsewhere in the drill core, alteration banding of alternating white mica-carbonate and feldspar-chlorite bands occurs, which also parallels the S2 cleavage. The distribution of the alteration banding in SC1 could indicate strong cleavage control on the development of these alteration patterns. Pyrite forms disseminations within quartz±feldspar veins and disseminated pyrite is also associated with carbonate-white mica alteration.

**Summary and interpretation of petrographic observations**

Protolith alteration is intense in all SC1 samples and the nature of the original rock is unclear. The homogeneous massive character of the least altered wall rock in SC1 could indicate a sandstone precursor, however, no sedimentary features are apparent. Banding is a common feature through SC1.

The rhythmic parallel, planar style of this banding could reflect primary sedimentary features that have been subjected to later differential alteration.

Feldspar-quartz alteration is the most widespread alteration type and is a pervasive, intense alteration of the groundmass. The interlocking arrays of K-feldspar-quartz and minor albite grains (<400 μm size) impart a homogeneous lithological character to the wall rock in SC1. Groundmass recrystallisation is obvious where grains are equant. Other alteration minerals, such as white mica, chlorite and carbonate, overprint this K-feldspar-quartz alteration. The presence of fibrous chlorite inclusions as well as white mica and rutile within K-feldspar grains may indicate that this recrystallisation was syn-metamorphic.

Chlorite and white mica alterations have variable development, with white mica most abundant within the alteration interval associated with Specimen Reef. In this location, white mica forms a pervasive alteration that overprints and replaces the K-feldspar-quartz alteration, and in which S2 and S3 are defined. Alteration halos surrounding carbonate veins consists of poorly formed disseminated carbonate, which may form along the S2 cleavage within the alteration halo. There is little textural difference between the wall rock and alteration halo sites, with the exception of abundant disseminated carbonate in the alteration halos.

The timing of veins reviewed in the drill core summary is supported by petrographic observations. Quartz±feldspar veins host S2 cleavage and pre-date the formation of carbonate veins due to cross cutting associations. Quartz±feldspar veins may consist entirely of quartz or quartz-albite and contain minor minerals that include K-feldspar, pyrite, hematite and magnetite. Where these veins consist entirely of quartz, fibrous quartz textures indicate syntaxial vein formation. The carbonate veins cross cut and parallel to these earlier quartz±feldspar veins, with some quartz±feldspar veins having inner zone of carbonate. In this case, the inner carbonate zones are interpreted to be carbonate veins that used pre-existing quartz±feldspar filled fractures that re-opened during carbonate veining. Carbonate veins cross cut and post-date development of the penetrative cleavage S2. Pyrite most commonly forms euhedral to subrounded grains, which occur as disseminations through the quartz-feldspathic groundmass as well as in carbonate alteration halos peripheral to the carbonate veins. Chalcopyrite usually occurs in pyrite as inclusions, but also occurs as irregular disseminations in zones of strong chlorite-white mica alteration in strongly cleaved zones.

**What is Specimen Reef?**

Newnham (1996) described Specimen Reef as a narrow zone (<1 metre) of quartz, siderite and pyrite where Au, as electrum, is hosted in discontinuous short zones along the reef structure. The two auriferous occurrences at Specimen Reef are:

(1) high grade auriferous quartz, containing black sulphates (probably brannerite?) that were interpreted to be derived from weathered sulphides (Tunnel 1).

(2) white quartz-siderite veins with visible Au, pyrite and chalcopyrite with a sandstone hangingwall and slate footwall (Tunnel 2).

Recent drilling by Goldstream (SC1 and SC2) concurs with the interpretation of Newnham (1996) with Specimen Reef having a 050° strike and a shallow 40-50° east dip. Drill hole SC1 contains a zone of white mica-carbonate alteration that is characterised by abundant quartz±feldspar and carbonate veins. In drill hole SC1, the width of this alteration zone approximates 50 metres, with the most intense alteration and veining over a 25 metre zone below 172 metres. Newnham (1996) interpreted the orientation of the auriferous zones to be governed by the Specimen Reef structure and its intersection in the regional penetrative cleavage (S2). Thus a south to south-west plunge of the auriferous mineralisation was inferred based on the lineation intersection of Specimen Reef and cleavage. The recent drilling by Goldstream (SC1 and SC2) has tested this model and did not intersect high grade Au mineralisation. However Au anomalism in SC1 (2 metres at 0.5 ppm Au) occurs in a rubble/fault zone, which is interpreted to be the Specimen Reef structure and a well-developed alteration-vein system around this structure provide good encouragement.

**How is the Au hosted : controls on the distribution of Au**

Mr. Nic Turner provided a high grade Au sample from drill hole SP1 at 160 metres. Newnham (1996) interpreted Au mineralisation in SP1 to represent a second auriferous zone called Specimen Reef East. This sample consists of an intensely white mica altered, foliated wall rock with the occurrence of electrum restricted to a single carbonate-brannerite vein. Electrum is visible in hand specimen and electrum grains are up to 400 μm in size with elongate to rounded shapes. The distribution of electrum within this vein is predominantly fracture controlled, however electrum also occurs along grain boundaries of brannerite and carbonate. Electrum therefore has a locally remobilised occurrence within this vein. Notably, strong brittle fracture of minerals in this vein (and the adjacent wall rock) indicates late brittle deformation induced by faulting or shearing. Pyrite does not occur in this vein, but is disseminated adjacent to the vein in the white mica altered wall rock. These observations for the Au-rich SP1 sample are consistent with the reported occurrence of Au at Specimen Reef by Newnham (1996).

Although carbonate-rich veins are common in SC1, neither electrum nor brannerite were found. Additionally, the intense foliation observed in sample SP1 at 160 metres, is only comparable to the intense alteration zone in SC1 at approximately 186.3 metres. This alteration zone in SC1 is proximal to the inferred zone of Specimen Reef where a fault is recorded at approximately 189 metres and where Au grades are higher (0.5 ppm). It is noteworthy that a crenulation cleavage is also best developed in this locality and is 30° anticlockwise of penetrative cleavage.

Thus, although the electrum at Specimen Reef is hosted within carbonate veins, elevated Au grades are also associated with intensely foliated rock, suggestive of both vein and brittle fracture (fault) control to the distribution of Au mineralisation. Moreover, the deep bright yellow colouration of electrum in SP1 indicates low Ag contents and thus a electrum high fineness and likely indicates Au transportation by $Au(HS)^{2-}$ complexes.

**Analytical Results**

Carbonate and electrum grains were analysed using the SX50 electron microprobe at the CSL, University of Tasmania. Results are given in Table 1. These results indicate electrum in drill hole SP1 has a high Au content containing less than 1 wt.% Ag and that carbonate from both SC1 and SP1 are siderite but can contain up to 53 wt.% $MgCO_3$ which makes them transitional to magnesite. In addition $MnCO_3$ can reach up to 2.5 wt.%. Carbonate hosting Au in SP1 is identical to carbonate in SC1.

The composition of brannerite was qualitatively determined using the SEM and a spectra is given in Figure 1. The spectrum has a series of U peaks as well as peaks for Ti, Ca, O and a minor Fe peak. The elemental formula for brannerite is defined as (U, Ca, Ce)$(Ti, Fe)_2O_6$ but no Ce was detected in the brannerite from Specimen Creek indicating that a (U, Ca)$(Ti, Fe)_2O_6$.variety. Brannerite is a main uranium ore mineral and contains between 30 to 50% $U_3O_8$. Similar associations between Au and brannerite are reported from the Saskatchewan Region of Canada. In this region brannerite forms vein style uranium deposits, which may contain Au.

FIGURE 1

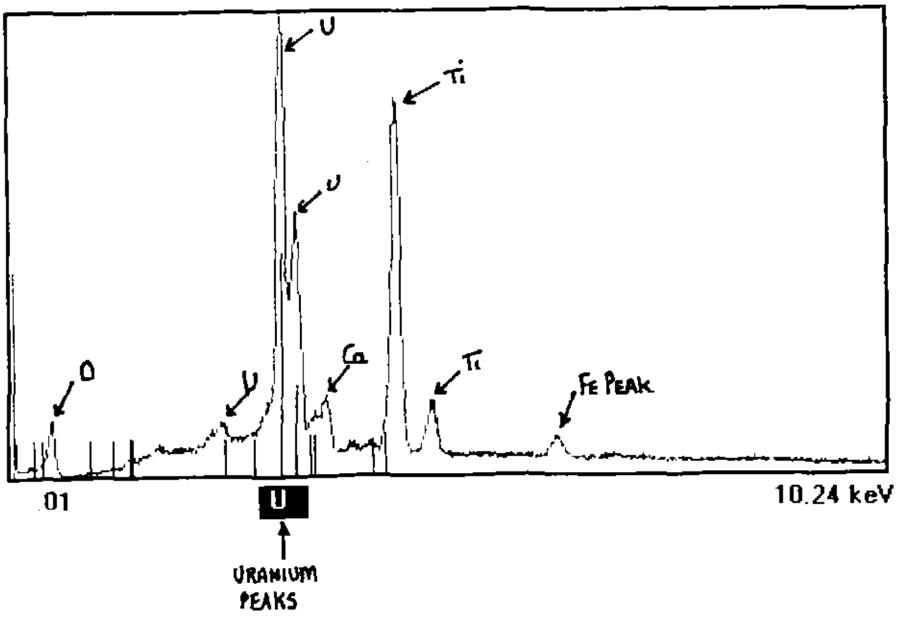

**Table 1: Electrum Microprobe Analyses (a) electrum from SP1 and (b) carbonate from SP1 and SC1**

**(a)**

| SP 1 | Description | Fe wt.% | Cu wt.% | Ag wt.% | Au wt.% | Hg wt.% | Total |
|---|---|---|---|---|---|---|---|
| 1 | Au in brannerite | 0.03 | 0.11 | 0.93 | 100.78 | 0.38 | 102.23 |
| 2 | Au in carb. | 0.16 | 0.15 | 0.97 | 100.96 | 0.70 | 102.93 |
| 3 | Au at brannerite margin | 0.00 | 0.13 | 0.98 | 100.00 | 0.87 | 101.99 |

**(b)**

| Sample | Description | $MgCO_3$ | $CaCO_3$ | $MnCO_3$ | $FeCO_3$ | $SiCO_3$ | Total |
|---|---|---|---|---|---|---|---|
| SP1 | carb.in Au vein | 37.63 | 1.13 | 2.02 | 59.87 | 0.10 | 100.75 |
| SP1 | carb.in Au vein | 37.23 | 0.83 | 2.34 | 60.77 | 0.01 | 101.18 |
| SP1 | carb.in Au vein | 34.51 | 1.05 | 2.51 | 63.81 | 0.05 | 101.92 |
| SP1 | carb.in Au vein | 37.81 | 0.61 | 2.06 | 60.90 | 0.01 | 101.39 |
| SP1 | carb.in Au vein | 34.59 | 1.37 | 2.61 | 62.08 | 0.12 | 100.78 |
| SP1 | carb vein (no Au) | 51.58 | 0.26 | 0.90 | 48.49 | 0.01 | 101.24 |
| SP1 | carb vein (no Au) | 53.14 | 0.27 | 0.87 | 47.36 | 0.05 | 101.69 |
| SC1 at 179m | carb vein | 31.81 | 0.10 | 1.23 | 68.83 | 0.04 | 102.02 |
| SC1 at 179m | carb vein | 35.82 | 0.25 | 1.62 | 62.97 | 0.01 | 100.67 |
| SC1 at 179m | carb vein | 30.74 | 0.27 | 1.54 | 67.50 | 0.04 | 100.09 |

## Conclusions

The presence of chlorite-white mica-K-feldspar-quartz-rutile assemblages is consistent with a greenschist metamorphic facies. Although quartz and K-feldspar alteration can be associated with diagenetic processes, it is more commonly related to regional alteration associated with metamorphism. The ubiquitous quartz-K-feldspar alteration of the wall rock in SC1, reflects a pervasive alteration that occurred prior to or during the formation of the S2 penetrative cleavage. The development of quartz±feldspar veins may have been contemporaneous with this quartz-K-feldspar wall rock alteration due to their similar mineralogies. Albite and K-feldspar alteration and veins indicates this alteration and veining formed from K-Na-Si enriched fluids. The occurrence of pyrite in quartz-feldspar veins would indicate these fluids were also iron bearing.

Carbonate veins consist almost exclusively of carbonate (siderite/magnesite) and their carbonate-white mica alteration haloes indicate a high water/rock ratio. Carbonate and quartz±feldspar veins differ in orientation, except where the later were re-opened and used as conduits and during the later phase of carbonate veining. Carbonate veins, including those that used former quartz±feldspar veins, can have enveloping alteration halos, which are developed in the wall rock proximal to the vein. These alteration halos occur adjacent to veins where the cleavage is strong to intense. These alteration haloes consist of carbonate and white mica and formed by the emanation of fluids along pre-existing foliation planes outward in to the wall rock from the central vein conduit. Differences in the intensity of the S2 cleavage broadly relate to the presence or absence of alteration haloes surrounding carbonate veins. Disseminated pyrite is common in these carbonate-rich alteration haloes and yet pyrite is not a common mineral in carbonate veins, suggest local remobilisation of pyrite within the wall rock.

Carbonate veins form a sheeted vein system in the alteration zone at Specimen Reef. These veins have a high angle to the core axis in SC1 and are interpreted to be parallel to Specimen Reef. In SC1, carbonate veins are likely related to development of the crenulation cleavage (S3), which is best developed in the alteration zone at Specimen Reef. This crenulation cleavage may be related to localised faulting at Specimen Reef (thrust faulting due to reverse movement indicators?). Therefore, it is possible that Specimen Reef represents a zone of late shearing or faulting, which led to the formation of carbonate veins and crenulation cleavage (S3). The crenulation cleavage S3 is 20-30° anticlockwise of the penetrative cleavage S2. Since S2 is steeply west dipping, S3 must be approximately parallel to the dip of the Specimen Reef structure. This is consistent with the orientation of the carbonate veins and sub-parallelism of the crenulation cleavage.

The association between the carbonate veins and the penetrative S2 cleavage fabric is crucial. Carbonate veins consistently cross cut the penetrative S2 cleavage and thus **S2 has not been a critical control on the orientation of carbonate veins. S2 formed prior to the formation of carbonate-Au bearing veins**. The ramifications of this timing relation is that the 'mineralisation corridor' identified by Newnham (1996) only defines the intersection of S2 with the Specimen Reef structure and alteration zone. The attitude of Au-bearing carbonate vein-hosted mineralisation is therefore unrelated to this lineation.

**Recommendations**

Information detailing the early underground workings at Specimen Reef is limited, particularly with regard to Tunnel No.3 where it is not clear if Specimen Reef was intersected or if mining (stoping) was undertaken. Newnham (1996) interpreted this paucity of information on the lower Tunnels (Numbers 3 and 5) to reflect a discontinuity of the Au-bearing veins and that Specimen Reef was becoming lensoidal and difficult to follow. Low Au values in drill hole SPC 14 suggest that the main reef shoot was missed. It could be considered therefore that the down dip continuity of the outcropping high grade Au zones has not been confirmed. If the Au vein structures are indeed discontinuous, the intersection in SP1, which is likely to have intersected a different Au-rich vein from those outcropping at surface, may indicate strike potential for parallel siderite-vein sets near the Specimen Reef structure.

Carbonate veins host Au mineralisation in SP1. The brittle deformation of carbonate and brannerite minerals in this vein is suggestive of a late brittle deformation event, in which electrum was locally remobilised to fracture sites within the vein. **Therefore, knowledge of the orientation of carbonate veins is critical to the orientation of the high grade Au mineralisation.** Based on the summary of Newnham (1996) and the orientation of veins in SC1, these carbonate veins may be parallel to the Specimen reef structure. However the possibility remains that orientations of these carbonate veins may be associated with extensional vein formation during a late brittle deformation event on the Specimen Reef structure. Additionally, the association between brannerite and Au is crucial and requires further evaluation to elucidate their relationship to mineralisation.

Prior to further work, it is strongly recommended that the orientation of carbonate vein sets be established. This is necessary to ascertain whether carbonate veins parallel the Specimen Reef structure or if they occupy a different extension-related orientation to this structure.

**Literature Summary**

The characteristics of alteration and Au-mineralisation described for Specimen Reef have many similarities to those described for Archean to Proterozoic quartz-carbonate shear hosted Au deposits (e.g.; Solomon et al., 1994 and Roberts, 1995). These similarities include the structural control on the style and timing of Au mineralisation as well as alteration mineralogy. Specimen Reef is a Au-only type of mineralisation having minor pyrite as disseminated in the altered wall rock. Base metals are generally not associated with this mineralisation, with the exception of small chalcopyrite inclusions in pyrite.

In vein Au deposits, structure is the most important factor controlling the occurrence, distribution and geometry of this Au mineralisation, with structure hosting Au reflecting late brittle movement or reactivation of pre-existing structures (Groves et al., 1988). The timing of Au mineralisation in these deposits can only be expressed relative to deformation and metamorphic events. Thus Au mineralisation is interpreted in vein deposits to be related to late deformation accompanying or outlasting peak metamorphism. Specimen Reef was a high strain zone as indicated by the intense development of the penetrative S2 cleavage proximal to Specimen Reef. This structural setting is ideal for the focussing of ore fluids by means of structurally induced permeability. Characteristically, shear and vein hosted Au deposits exhibit both brittle and ductile deformation (i.e. they consist of both shear and vein structures) in areas with greenschist metamorphism and may have considerable vertical extent (>1 km) (Roberts, 1995; Solomon et al., 1984; Sibson et al., 1988). This style of deposit includes Au-bearing veins that subparallel and which are genetically related shear zones.

Under conditions of greenschist metamorphic facies, wide zone of pervasive carbonate alteration are commonly associated with vein-shear hosted Au mineralisation. Metasomatic wall rock alteration normally introduces $CO_2$, $K_2O$, and $H_2O$, with local redistribution of $SiO_2$ and $Na_2O$. In greenschist settings, alteration overprints peak metamorphic assemblages and suggests wall rock alteration associated with Au mineralisation is related to late metamorphic events. Typically, shear-vein hosted Au is characterised by the association of an intense sericite, ankerite, siderite, pyrite alteration zone that contains minor rutile and magnetite and which, is surrounded by a broader zone of carbonatisation. Thus the mineralising fluids are likely metamorphic ore fluids (Groves et al., 1989).

In Archean and Proterozoic systems, Au-rich shear-vein deposits are interpreted to have formed from dilute $CO_2$-rich fluids that precipitated Au on reaction with Fe in the wall rock. This reaction results in the sulphidation of the wall rocks that accompanies a decrease in the activity of reduced sulphide in the ore fluid and results in Au deposition (Morrison, 1991). The resulting high Au fineness ($Au(HS)^{2-}$ transport complex) also results from this destabilisation due to sulphidation of the wall rock.

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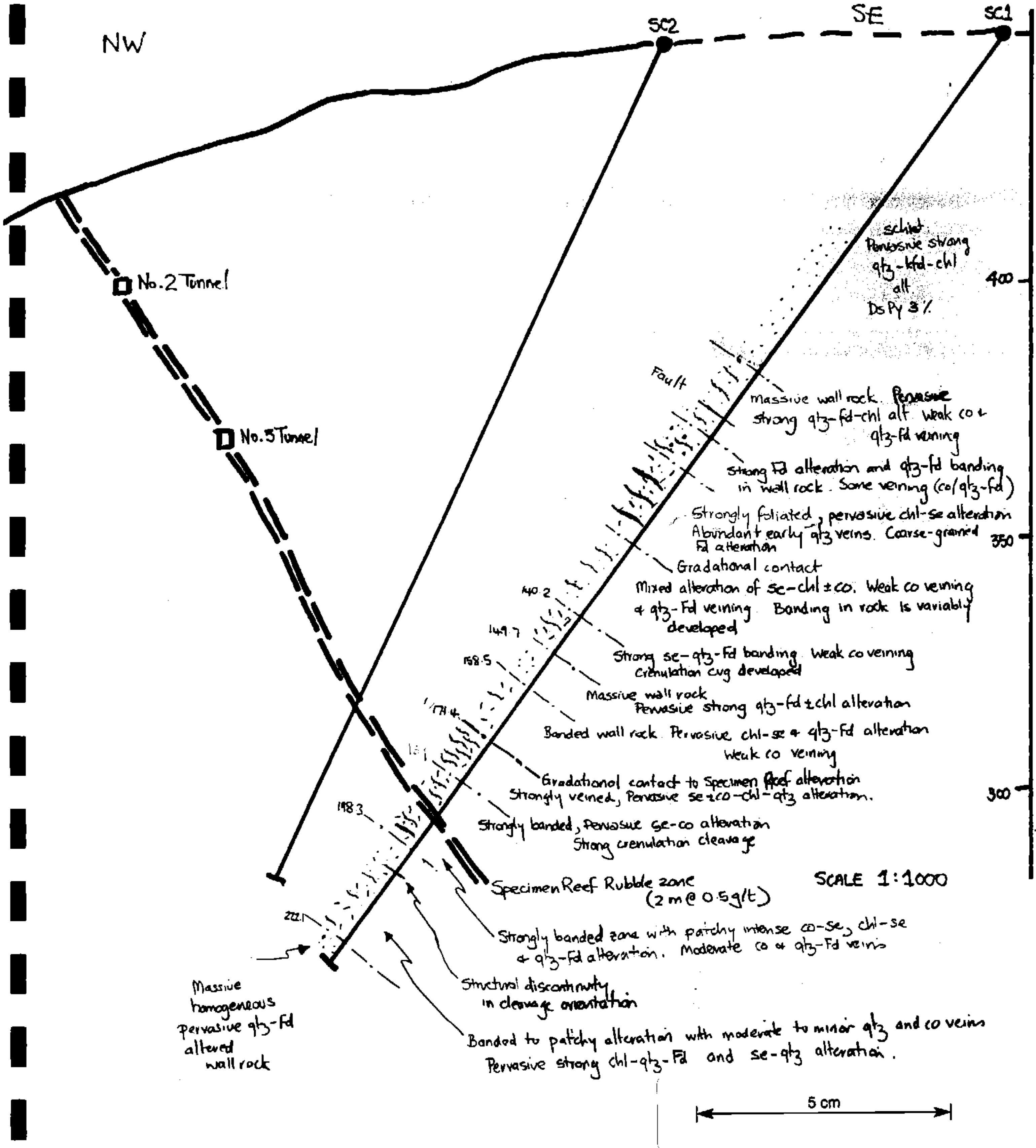
195081

# APPENDIX 1

Drill Hole SC1 logging and section

195082

# CROSS SECTION (NE VIEW)



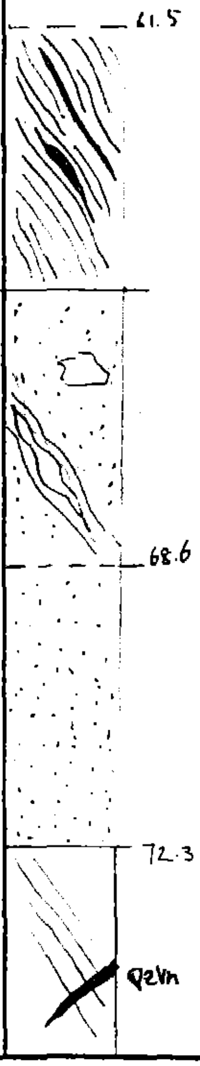
195083

# GRAPHIC DRILL LOG

LOCATION CO-ORDS

| HOLE ID: | |
|---|---|
| PAGE NO. | OF 8 |
| INCL: | LOGGED |
| SCALE: | |
| DATE: | |

| M | STRUCTURE | MUD LOG GRAINSIZE (mm) 0.06 0.5 2.0 8 32 MAX | SAMPLES | RL / AZ / DESCRIPTION |
|---|---|---|---|---|
| 53 | | | | |
| 54 | | | | |
| 55 | | | | broken + beaming with. |
| 56 | | | | |
| 57 | Bnd 30 | | | GnGy bnd/cvg P S Chl Si |
| 58 | | | | QzVn WhPk QzCo ±Py ± Hmt(Tr) // bnd, boundinage ±Cpy |
| 59 | | | | CoVns <1 to 3-4mm, can have upto 4cm halo/envelopes of Buff Si(Se) alt. Central fracture c̄ Co, w/Spy planar to narrow. |
| 60 | | | | DsPy <2 ∓ 1% |
| 61 | | 61.5 | | 61.5 Gradational contact interval. c.g + f.g wallrock in bands P S/I SiChl, Gn. Strong bnd/cvg. Abundant ds mgt Eu in co-rich bands in wall rock and Eu mgt/Hm in bnd// veins. Co-Qz(Pk) Early veins // bnd; boundiage. commonly c̄ mgt/hmt halos Hmt ~~Mgt~~ can be c.g upto 1cm needles in veins. Abund ds py // bnd and in co veins. ⊥'r C.Axis co vn, c.g with Buff halos xcut Co-Qz mgt Vns. Co vn <1-2mm. Ds Mgt/Hmt → Pk colouration. |
| 62 | 30 | | | |
| 63 | | | | |
| 64 | | | | |
| 65 | Bnd 40 | | | 64.9 Sharp/Grad (<1-3cm) alt contact. Intervals of intense Gy or Buff si alteration intermixed with P.S SiChl alt. wall rock. Ds Co Eu in P.I Si |
| 66 | | | | |
| 67 | | | | |
| 68 | | 68.6 | | 68.6 GyPk P.I Si interval with abund qtz veining. QzVns commonly Pk coloured Qz-Co (Rhodo?) ± FeTr, DsPy. Vein form irreg upto 3-4cm or planar <1cm. Veins can be planar & boudined. Wall rock bnd P I Si c̄ DS Hmt/Py & se-rich bands, Si-Se Buff alt tends to be out halo around GyPk Si - veined zones |
| 69 | 35 bnd | | | |
| 70 | | | | |
| 71 | | | | |
| 72 | Bnd/Cvg 40 | 72.3 | | 72.3 Sharp contact: alteration. GnGy fine-grained wall rock P S ChlSi DS Py 3-7% as ds & diffuse bnd// veins. Py Eu <1mm to 2-3mm. QzVn ⊥'r-70° C Axis QzCoMgtHmt Syntaxial fibres. Some c.g <1mm bands (met) // bnd in wall rock |
| 73 | | | | |
| 74 | | QzVn | | |
| 75 | | | | |



195084

# GRAPHIC DRILL LOG

LOCATION CO-ORDS

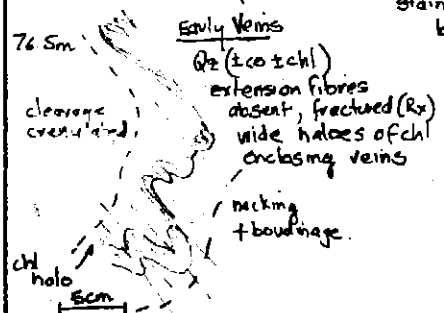
HOLE ID: SCDD1
PAGE NO. 2 OF 8

| M | STRUCTURE | MUD LOG / GRAINSIZE (mm) 0.06, 0.5, 2.0, 8, 32, MAX | SAMPLES | RL / AZ / DESCRIPTION | INCL: / SCALE: / DATE: / LOGGED |
|---|---|---|---|---|---|

75–82.2: Structure: 20°. Mud log: Ab-rich; Py in fol^n. Samples: ⇒ Reverse mvmt on cvg.

Green-gy p.s/I Chl-qtz Ds Eu Py (<1-2mm) ~3-5% schist; planar strong cvg. Poss. qtz (1-2mm) Banding of Ab-qtz-py ±cpy (tr) parallel to foliation. Bands <5mm, grad margins. Trails <1mm of discont py ∥ to foliation. Some Pk (K Fsd) staining associated with banding.

Host Rock has a consistent homogeneous texture.



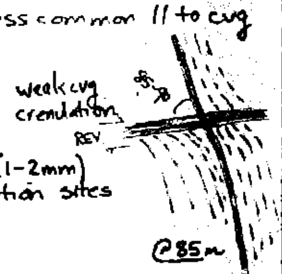

82.2 Alteration contact (Zone of Rubble)

82.2–97: Structure: main cvg; crenulation ?? (84); Vn (87); striae, F, sinistral (93–95); Vn (96). Mud log: qtz (85); 85 – P.I. Chl + early qtz – 86.4; 88.7–89 Chl-interval; 92.9 – P.S.Si + qtz vn – 94. Samples: 83.5; REVERSE MVMT ⇐ (check crenulation or down hole up); Bottom of hole down ⇐.

gy-gn massive zone containing up to 1m intervals of p.i.chl with early qtz veins. Wall rock alt p.s.qtz-chl pervasive mod cvg ∥ c.axis. (Possible crenulation cvg 90–40° CAxis? ∥ to veins ??). Finer grained than 75–82.2

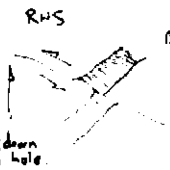
Veins 2 types in this interval (i) qtz (±co) (ii) co-rich

(i) Qz <1mm to 10-15mm, planar to undulatory, can be weakly cren by cvg (only in narrow vn's) Tre/syn
2 orientations most abund @ high angle to cvg, less common ∥ to cvg
Qz Veins may have minor co, ds EuPy + syntaxial fibres




c.f. 83.5m. crenulation zones as diffuse alt around cvg zones (1-2mm) se ?? ie veins developed @ crenulation sites of se alt ?? → crack seal.

(ii) co veins (±cp) 86.5m
sub∥, <1mm to 3-4mm wispy to planar, cut early qtz veins + poss qtz (i) veins
dilational sites + stepping
Can have irregular cream-wh patchy 2-4mm halos




92.9–94 – sub ∥ qtz vein's <1mm, stepped, undulatory in gy si wallrock, some <1mm si spotting in wallrock.

sparse syntaxial qtz-co veins
ds py 1-2%

195085

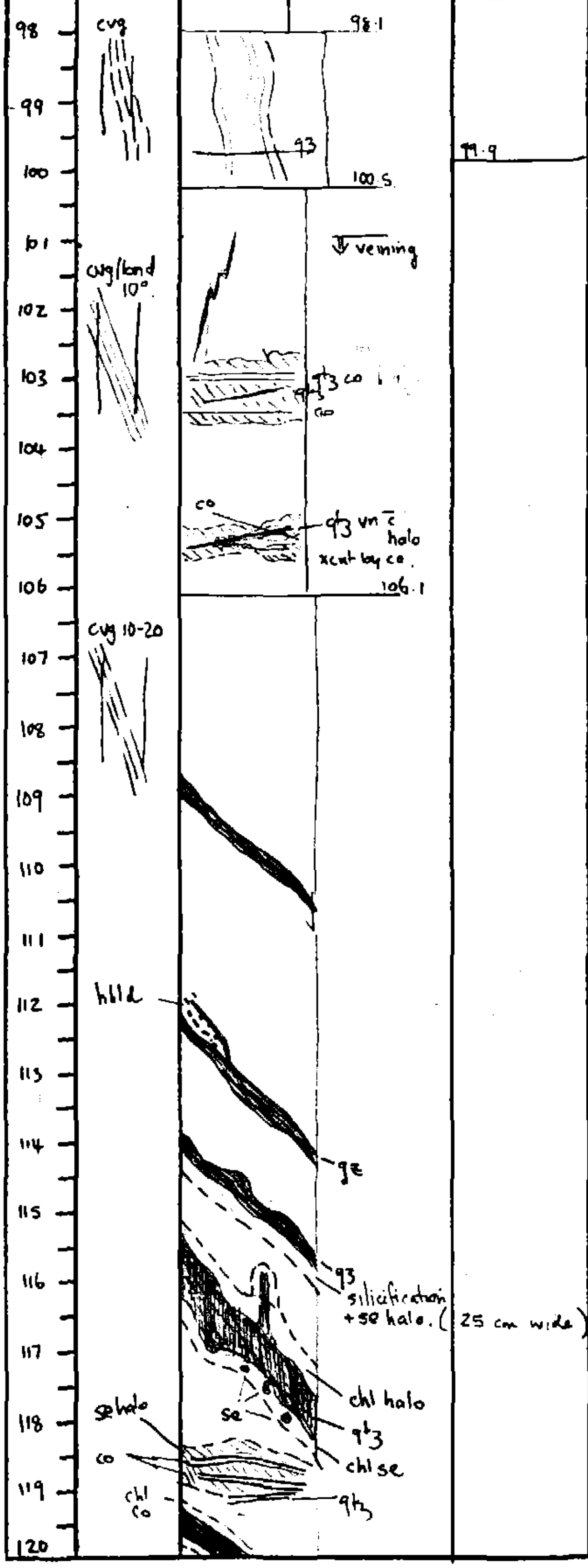
# GRAPHIC DRILL LOG

LOCATION CO-ORDS

HOLE ID: GCDD1
PAGE NO. 3 OF 8

| RL | AZ | INCL: | LOGGED |
|---|---|---|---|
| | | SCALE: | |
| | | DATE: | |

M | STRUCTURE | MUD LOG GRAINSIZE (mm) 0.06 0.5 2.0 64 32 MAX | SAMPLES | DESCRIPTION




c.g zone Ab <1-2 mm, banded c̄ bands mm wide. Bands of c.g Ab alternate with bands of chl-se. Bands // fol? undulatory. Ab appears to ovpt early qtz veins (⇒ met postdated cvg, early qtz vn??) Gy gn Ab-chl-se-amph??
Minor qtz (i) veins ⊥'r c axis (qtz (ii) veins post date met?)
Gradational transition to f.g wallrock 20cm.

Massive gn-gy homogeneous wall rock. Ds Ab (<1mm) P.S. Chl-qtz-Fd alt. (?). Some chl banding // cvg - phyllosilicate rich (1-2cm wide). Ds Py 1-3% elongate wisps in cvg.
Early qtz vn - cvg cren cut by co ± qtz veins (ii)
<10mm // to foliation. Fractures ⊥ to Vn.
<5mm veins, planar to wispy + undulose. Some with extension fibres ⇒ syntaxial. Co veins have halos from mm to 5cm wide envelopes
101m 102m irregular haloes & co veins have qtz rim (qtz (i) veins reopened ??) Vein controlled.
Haloes are pale or-bn (se, si, Fd?). grad to sharp contacts to wrock. (i) qtz veins also have haloes

Gradational contact to c.g Ab in wall rock (10cm).

m.g to c.g banded wall rock gn-gy. V.strongly foliated abund. phyllosilicate alt. (chl + se) Light bands are se.
Boudined <4mm qtz + py veins // to cvg. Elongate // cvg py wisps
At 107.8 py (80%) - qtz vein boudin.

EARLY QZ VN
Strongly qtz-co-chl (py) veining, with veins upto 30 cm wide. Qz in these veins is pk v.c.g (<2-3cm) + can contain Eu co (<1-0.5cm). Veins have a chaotic appearance with sharp margins to wall rock. Vein margins // to sub// to cvg and planar to irregular. Ds Py in qtz veins 1-5% Eu <0.5mm to aggregates upto 2-4mm. Distinctive pk quartz Pegmatite-Like.
Veins can have chl-co halos, some c̄ hornblende upto 2mm. Other veins have cream-coloured-gy silicification-se halos similar to co/qtz-co veins which may contain se (wths/musc)?
Not all qtz veins have a chl-co halos or margins

Qz Vn (i) Not common upto 3-4mm wide, planar, may be crenulated by cvg
Some ext fibres / syntaxial
cut by co veins.

CoVn (ii) Generally planar <5mm, sub//. Less commonly wispy veinlets may be hosted in altered wall rock with or without alteration halo. CoVn xcut Early qtz vn. Where vns (co) xcut early qtz vn alt. halo are also not developed.
ALT HALO: (poss. more freq where wall rock is homogeneous. upto 10cm wide zones around multiple veins, light cm-yw p SIL SeQz + DS py. Sharp to grad (1-5mm) contacts to wall rock. Some co-qtz veins have qtz @ margin (re-opened qtz vn)
co qtz qtz
Veins may have ext fibres

195036

# GRAPHIC DRILL LOG

LOCATION CO-ORDS

HOLE ID: SCD[illegible]
PAGE NO. 4 [illegible] 8

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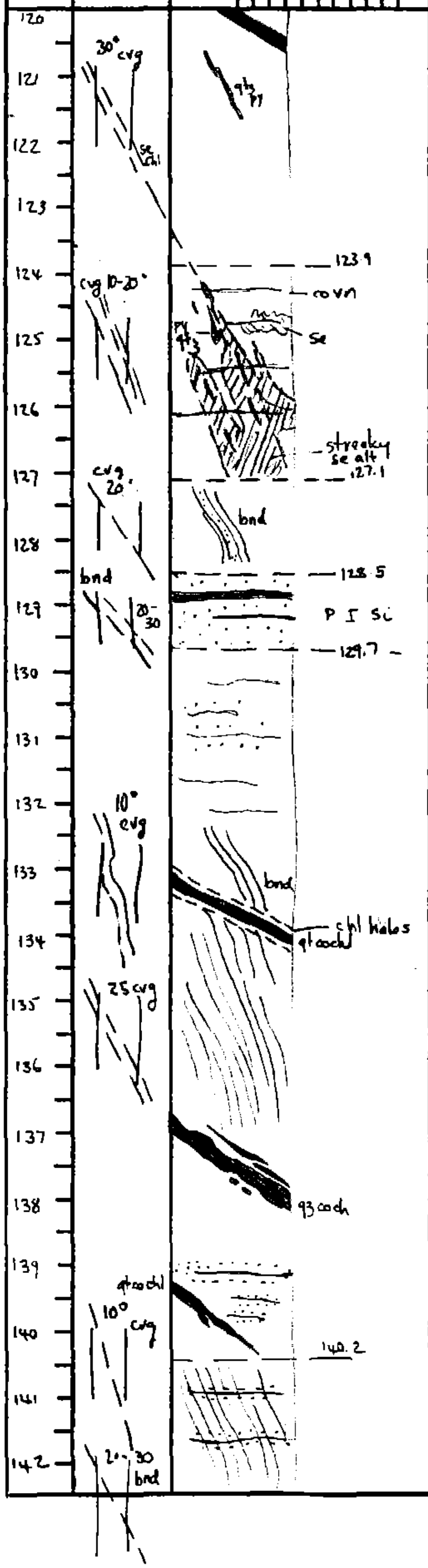
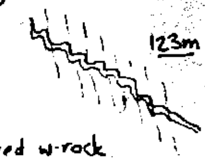



GnGy P S Chl±Se, se defining fol^n
Discontinuous irreg py-qtz veins subll fol^n
Minor <2mm qtz-co veins. Some qtz vn crenulated




Gradational contact 123.9 to more se-altered w-rock
Se±qtz alteration of GnGy wallrock.
Discont <1cm Py-Qz vns // to fol^n, boudined, pinch & swell vns.
Streaky cm-mm se alt., streaked out // to fol^n and also as halos around co-qtz veins.
CoQz Vn co vns upto 1cm (rarely contain acicular needles Hm) +qtz <1-2mm wide, syntaxial. Veins donot necessarily have se alt halos. (se±qtz).

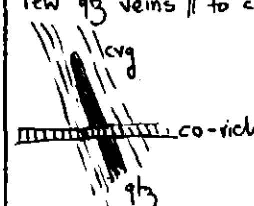
GnGy P S Chl-se ± (amp!) DSPy 1-2% Some banding chl-rich + Ab-rich <1 mm

Zone of intense silicification; sharp contacts pink-cm-wh Abund syntah-ext. qtz vn <2cm, ⊥'r c.Axis mineral. qtz-chl-hbl-py + pk mineral (hmt??). Wall rock pk si-Ab(?)-co(?) can be banded + ds py (bnd after met bnd.) Hbl <1-2mm Eu.
— qtz planar Xcut si alt.

Minor qtz veins <1mm with wk 1-2mm se halos, planar cont., subll. in gn-gy variably P.S. Chl to Ch-Si alt. Note paler halos around vein zones indicate ds, pervasive silicification to qtz vein's. Homogeneous wallrock wk vn.

Gradational contact to P.S. Chl banded wall rock, with bands of chl (blk) and Chl-Se (Gy) - Se(Musc) - chl possibly picking out an earlier alt. Banding // cvg and undulose in places.

Zone of banding, chl, chl-se // bnds <1-2cm + // to cvg Few qtz veins // to cvg. Co-rich vein cut qtz vn.




Narrow si alt zones gradational contacts in vein zones, planar sub// veins of co±qtz with grad 1-2mm se-si alt. halos

140.2 start of strong/mod veining
More strongly banded zone with common co±qtz vn <1-3mm wide with upto 8cm halos of se-qtz. Halos have sharp to ratty margins to Gn bnd wall rock some gradational. Halo's can be <1cm. Bnd in wall rock is preserved in se-Qz halos

195087

# GRAPHIC DRILL LOG

LOCATION CO-ORDS

HOLE ID: SC [illegible]
PAGE NO. 6 [illegible] 8

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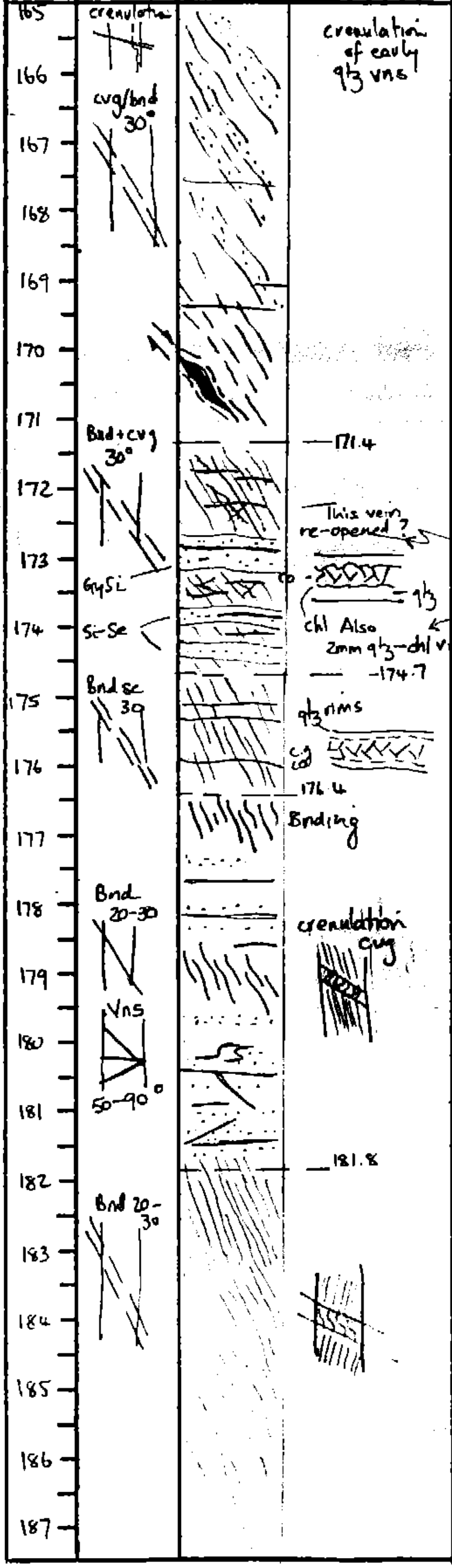


Boudin ⇒ REVERSE

Gn-Gy patchy alteration of chl-se and Gy-Pk si-ab? with pk si-ab patches from 1-2cm to 10cm wide with cvg/fol^ny // sharp boundaries. Weakly to moderately banded. Narrow <1mm se-rich planes developed b/w bands. DsPy 1-2% c̄ patchy occurrence. Some bands may be slightly coarser grained.

Weak qtz(I) veining ⊥'r c-axis <10mm c̄ si-ab^pk halos
Weak co(II) vns cm-yw si-se halos.
These (I) + (II) vn xcut si alt of wall rock in bands.

Boudinged early qtz veins // bnd.

171.4 Gradational contact 40cm

Gradational contact/alteration zone Lt gn P.S. SiChl alt. of fg wall rock. Alt. // to banding forming alt. [illegible]-bands of cm-yw se+si/si-se with Lt. gn wall rock. Up to 10cm wide zones of mas si-se alt c̄ preserved relict bnd (mainly qtz). Rare 10cm zone around qtz vn of Gy P.I Si alt. Abund veins: mainly co+qtz ± si-se halos. Vn <1-2mm planar // to wispy undulose, these having more irreg. orient, discont. co xcut bnd.

174.7 Gradational contact 10cm
Massive Cm-Yw rock. P I Si(Se) with banding of darker yw-gn se bands. Bands are sub// to folded and undulose <1mm wide in mass rock. Veins <5mm co/co-qtz/co-qtz py. Qz rims on some vn (re opened) sub// to undulose, planar. Vns xcut bnd
176.4m Gradational lower contact 20cm.
Fine grained Lt gn-gy massive wall rock. P S/I Si-Chl Alt. is locally variable from SiChl to ChlSi
Bnd/Fol sporadically developed + highlighted by alternating chl &/or se-rich bands.
Veining strongly veined Early qtz // banding, discont <5mm not common. py veins // bnd planar cont not common co(II) veins ⊥'r c-axis, syntaxial, planar, ext fibres, xcut py + early qtz vns. Co vns c.g acicular hm (rd) goethite. Co vein's occur in chl alt wall rock + se zones with some veins having halos. Veins have variable c.angles.
Crenulation cvg developed in se-alt. wall rock [see note book]
181.8 Alteration contact – Gradational ~20cm
Grad. contact marked by patchy chl + sise banding to mass si-se
Mass. Si-Se is also bnd with <1mm wh qtz bands alternating with cm-yw Si-Se bands. (<2-3mm). In patch alt it is the qtz (wh) bands that are chl-gn-rich with the sise bands. This patchy alt may have sharp & grad contacts
Crenulation cvg can be well developed – spaced

Strongly co (±qtz) veined, planar to wispy undulose veins. Commonly have ext fibres. <1-2mm. May also contain gn se grains.

banding becomes less prominent, decreasing intensity to MASS CmYw SiSe

195088

# GRAPHIC DRILL LOG

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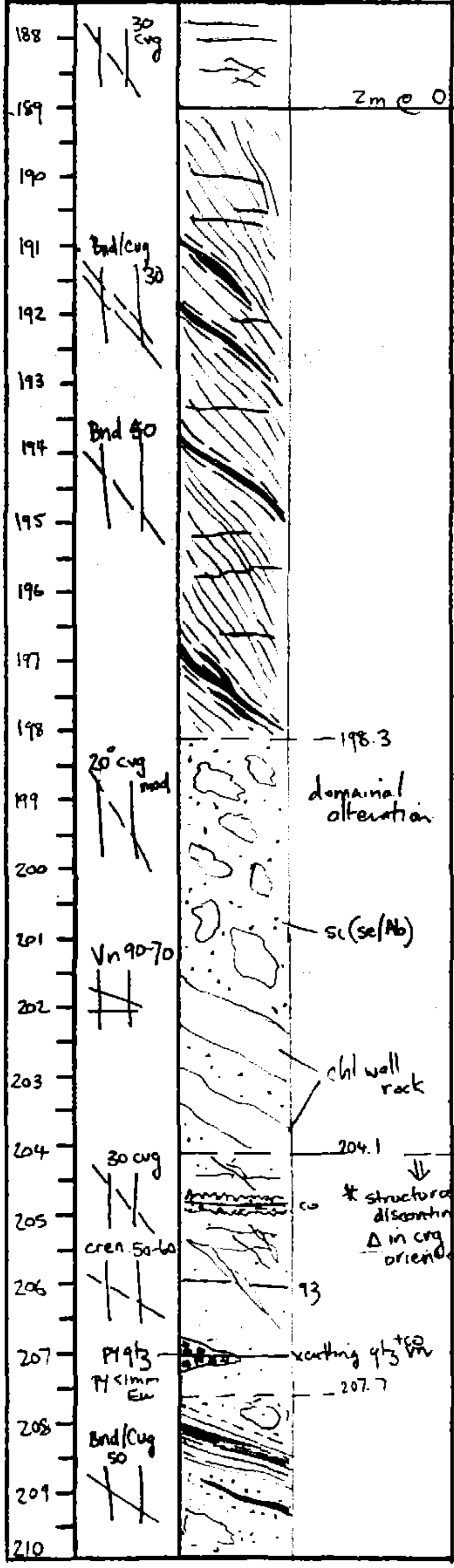
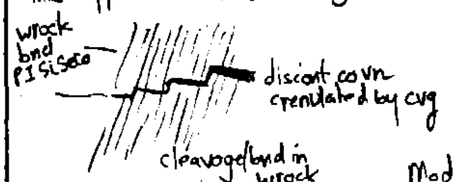



Mass. yw-cm rock. P. I SiSe Ds Py Eu 2%
Veins ‖ co (±qtz) or qtz (late) planar to discont. + irregular + wispy.
upto 10cm patch. Gy-Wh qtz zones

Top of Interpreted Specimen Creek Reef
↓ 189.65 Broken Rock Ds Py, P.S/I SiSe LtCmYw QtCoChlPy Vn.

Patchy alteration b/w (i) Lt. CmYw banded (alt. qtz, co, se bnd ‖ fol^n)
(ii) Dk. GyGn chl-se alt bnd c̄ sesi, qtz
(iii) Gy - mass Int. si alt.
can form mm-wide alternating bands or mass zones <10cm
Banding v strongly developed. Early qtz veins ‖ to bnd contain qtz-co-chl (se) (Fuchsite?) + py. Also sub‖ py-qtz bands. Veins upto 2cm, boudined c̄ cvg wrapping
Alternating bands in host can be <1mm to <4-5mm
Xcutting veins are co + co+qtz, can be planar but are more commonly undulose to discontinuous with minor offset or crenulation in cleavage

This appears as a broken zone of strong fol^n




The banding in the 189.6 to 198.3 appear to be carbonate (?) over silica alt. ??

Mod to wk co veining

198.3 Gradational contact.
Irregular patchy 'windows' of gn wall rock becoming more abundant c̄ decreasing in of si-se alt.
wall rock → Gn to LtGn P I/S Chl-Si. Has a homogeneous appearance. Mod fol^n
Alteration varies b/w a GyPk PISiAb and CmYw PISiSe
SiSe tends to have irregular ratty margins & the 2 alt. types can interdigitate
Vn Qz-(Hm? Bn acicular mineral) <5mm.
Abund <1mm co ±qtz wispy discont vns. Co veins may have se-si halos whilst qtz veins have Si-Ab (Pk) halos. Some Sesi bands are sub‖ to bnd weakly developed. Veins sub‖ planar, cont to discont
Strong crenulation cvg @ 201.1 in chl alt domain
Fu on some fractures or in QZ veins

(↓ decreasing alteration intensity)

204.1 ⊥r caxis Gradational contact over 1-2metres
Lt GnGy P. I SiChl wall rock massive, homogeneous cvg. - abundant crenulation cvg. - kink bands DsPy <1mm Eu <1%
Planar, variably oriented narrow <1-2m co veins & minor <1-2mm qtz veins ⊥r to high angle to c. axis. Some co vn have 1-2cm SiSe envelopes & qtz vns have 1-2mm Si halos co vns xcut qtz. Vn not always developed by maybe alteration plane Cvg rotates alot & in places is ⊥r to c axis similar to 86.m.

207.7 Gradational contact 10-20cm
Patchy Intense alt. c̄ windows/bands relict wall rock. Wall R. Lt may P I SiChl to ChlSeSi altered. 1-2cm lenticular Si bands with Ds HmMgt alternating c̄ chlse bands. (These could be vns) Upto 10cm zones of P.I Si PkGy & SiSe (B&F), PkGy si alt assoc̄ qtz vns. as halos or early qtz-co-hbl veins ‖ bnd with alt having sharp margins
SiSe alt more patchy to banded se & si rich alt around narrow se-co fractures and in wall rock

195089

# GRAPHIC DRILL LOG

LOCATION CO-ORDS

HOLE ID: Sc[illegible]
PAGE No: 5 [illegible] 8

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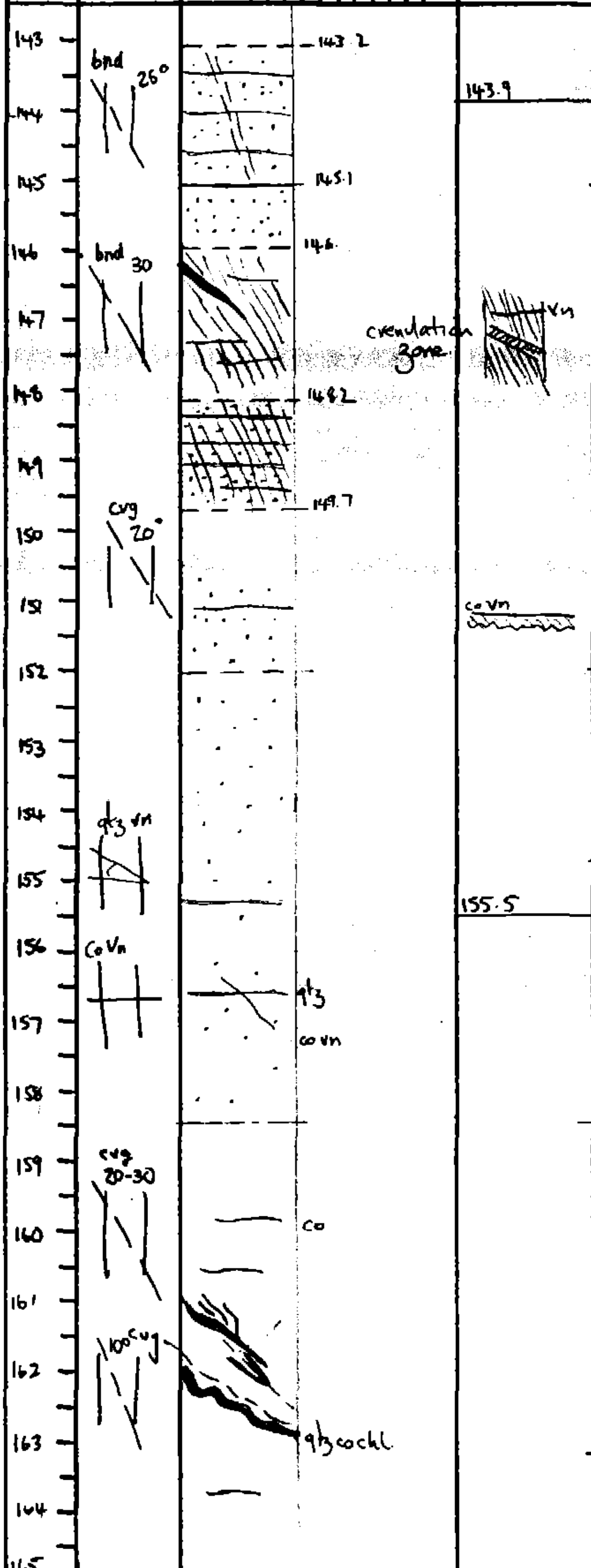



143.2 Gradational upper contact to sesilt. 20cm
Gn – P. I. Si some relict banding // to fol^n. Minor co±qtz planar vein's <1-2cm. Early band // qtz veins cut by later co vn. Minor Ds Py.

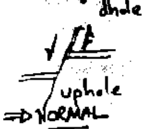
145.1 co vnd contact 2cm c.g co vn.
Bnd. P.I Si cm-Gy rock, intense si.

146 Gradational contact 10cm
Banded Gn-Gy P. S/I Chl-Se. Dk Chl bands GnGy Se bands Qz-Py discont boudins, strongly foliated // to bnd. Bnd rel f.g. Minor <mm wide co-qtz vn ⊥'r c axis, wispy discont. Abund muscovite. Vn (co±qtz) crenulated.

148.2 Gradational upper contact // bnd to se-si alt
Lt. cm banded contact si-se alt, boudins of qtz py // bnd increasing intensity, xcut by co-vn ± qtz. Cm-Gy alt pervasive int common planar // co-qtz veins with lighter coloured Gy-Pk halos <2cm. Banding preserved Se-rich bands.

149.7
Gn Gy less intensely foliated P. S. Chl Se, fol defined by se bands Ds Py 1% (streched in fol^n)
Massive, rel. homogeneous.
Weak veining co±qtz with assymetric halo cm si-se

152.1 Gradational contact 1m ↓ increasing si intensity
GyGn P.S. si-chl homogeneous rock. rare banding with minor Se-rich bands. Minor DsPy 1%
Common qtz and co-qtz veining
Qz veins minor offset, 2-4mm NORMAL consistent disp on veins. Can have irreg <5mm patchy qtz-albite (pkGy) alteration halo IE these differ from Si-Se halo of co veins. Veins < 2-3mm planar, parallel veins. Xcut by wispy syntaxial co. vn. Do not always have halos




CoVn
<5mm planar, paralled ⊥'r c.axis. Halos of si-se cm-yw, irreg with sharp margins to wall rock, envelop co ± qtz vn. Less abund than qtz vn. Co vn c.g and strongly xtaline. Mass to syntaxial.

158.5m Gradational contact over 1m to more chl-rich Chl-Se alteration

Gn-Gy p s chl-se alt, minor banding // cvg.
Discont py bands // cvg + bnd

Weak co veining.

crenulation cvg bands in P.S. SeChl alteration


Note: crenulation not // to co vn.

qtz co chl vn, boudinaged by cvg, cvg wraping, folding induced by cvg, sub // veins <2-3cm wide in main veins & <1cm in smaller discontinuous vns

195090

# GRAPHIC DRILL LOG

| HOLE ID: SC DD1 | PAGE NO. 8 OF 8 |
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LOCATION CO-ORDS

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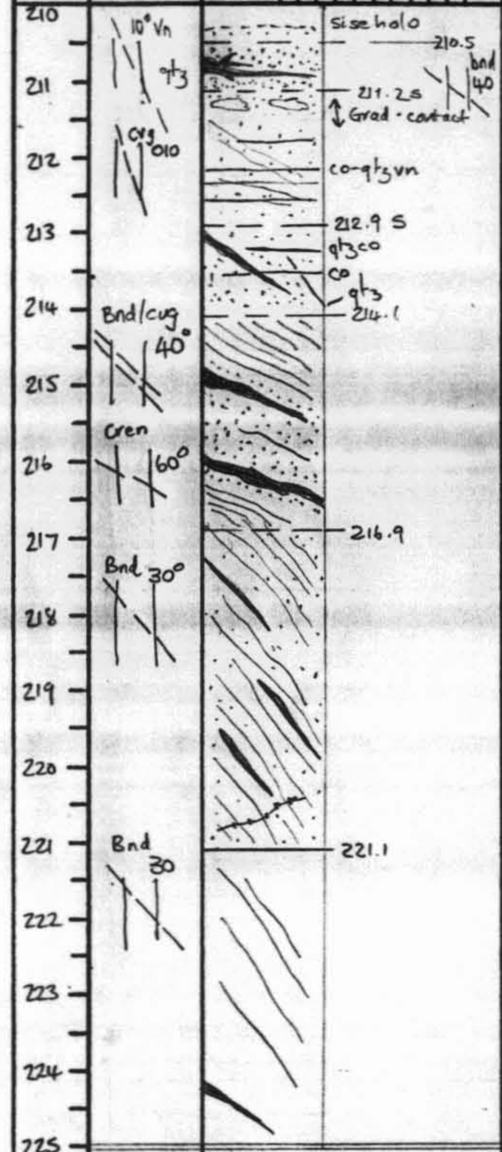


END OF HOLE

## DESCRIPTION

—210.5 Gradational contact 4 cm
Mass GyPp P. I Si with qtz vns (qtz ±co ±hm/mgt + Fu+Py)
—211.2 DS Mgt at qtz vn margins. Note se-si alt halo at margins of zone
Note orient B/W qtz vn + bnd (cren cvg dominant??)

Lt. Cm to Buff P. I. SiSe alt with patches of Lt. GnGy P. I SiChl alt. w/ poor & ratty margins. ⊥'r Coqtz vns <1–2mm co-qtz and qtz veins ⊥'r to c.axis planar; sub‖ in sise alt.

—212.9 knife sharp contact b/w si alt. styles.
GyPK P.I.Si. Larger veins are qtz co hm mgt Py Fu which cut qtz + co veins (LATER QzVeins??). Massive silicified zone

—214.1 Grad over 3–4 cm to alt. bnd wall rock.
Patchy alteration intermixed with banded wall rock, QzVeins ≤ 5cm can be ‖ to bnd or irregular. Qz Vn WhQz ±co ± acicular Hmt + Ga?? Hm finely ds at vein margins & larger grains 5mm in qtz. Veins can have envelopes upto 1 m of GyPK P. I Si alteration enclosing veins with minor bnd wall rock. Wall Rock Alternating cont/discont Gn (P I SiChl + P I ChlSe) & Buff (P I SiSe or P I/ SeSi) bands DS Py <2–3% in wrock. Cren. cvg 60°. Some of the Buff bands could also be co-rich. Minor co vn.
—216.9 Gradational contact over 3–4cm.
Lt CmBuff P. I SiSe altered wrock. Bnd denoted by SePy wispy bands (DsPy 2% Eu <0.5mm)
Qz veins Largest <1 to 2cm ‖ to bnd/cvg WhQz (±Tr Py Se) can be boudins in bnd wrock
Co Veins irreg, discont. (semi sigmoids) < 1mm variably oriented.
Unusual Vein Qz–Hm–Py 40° c. Axis with si 3–4mm halo in Banded SiSe wall rock.


—221.1 Gradational contact over 10cm
Lt. GyGn massive, homogeneous P. S. Si (Chl?) banding decreases in intensity away from contact.
DsPy <1% in bands. Banding highlight Chl alt. from Si alt.

QzVn 224.5 5cm WhQzChl (sub‖ to bnd)
Qz(±Py) Vn <1–2mm with 1–2mm wh si halos cut by late WhQz Vn
CoVn (±Py) Irreg to planar (≤1mm to 3mm) some have buff sise alt halos. Overall veining is Wk.