Regional Geologist, Smithers **Date Approved:** 2005.09.22 **Off Confidential:** 2005.12.31

ASSESSMENT REPORT: 27688 **Mining Division(s):** Liard

Property Name: Spectrum

Location:

NAD 27	**Latitude:**	57 41 00	**Longitude:**	130 29 00	**UTM:**	09	6394212 411550
NAD 83	**Latitude:**	57 40 59	**Longitude:**	130 29 07	**UTM:**	09	6394395 411436
NTS:	104G09W						
BCGS:	104G068						

Camp:

Claim(s): Red Dog, Red Dog 2-4, Hawk 1-2, Camp, Red, Pink

Operator(s): Trans Pacific Mining
Author(s): Salfinger, Rod

Report Year: 2005

No. of Pages: 109 Pages

Commodities Searched For: Gold, Silver, Copper

General Work Categories: GEOL

Work Done: Geological
GEOL Geological (35.0 ha;) No. of maps : 26 ; Scale(s) : 1:1000, 1:2000
PETR Petrographic (8 sample(s);)

Keywords: Triassic-Cretaceous, Edziza Spectrum Volcanic Complex, Basalts, Dacites, Tuffs, Pyrite, Gold, Chalcopyrite, Arsenopyrite, Sphalerite, Pyrrhotite, Reserves

Statement Nos.: 4029581

MINFILE Nos.: 104G 036

Related Reports: 02735, 03501, 07000, 07586, 08853, 10117, 13243, 19364, 20861, 22838

Report on resource, geology and petrographic surveys: Spectrum Properties, B.C.

Claims:	**Red Dog**	-	**Tenure 221652**
	Red Dog #2	-	**Tenure 221665**
	Hawk #1	-	**Tenure 221747**
	Hawk #2	-	**Tenure 221748**
	Pink	-	**Tenure 221803**
	Red	-	**Tenure 221804**
	Camp	-	**Tenure 221813**
	Red Dog #3	-	**Tenure 222131**
	Red Dog #4	-	**Tenure 222132**

Mining Division: **LIARD**

NTS Location: **104G068, 104G078**

Latitude-Longitude: **57° 41' North, 130° 29' West**

Owner of Claims **Seeker Resources Corp 100%**
Owner Number 146527

Operator: **Trans Pacific Mining Ltd**
1700 - 1185 West Georgia Street
Vancouver BC V6E 4E6

Email: rsalfinger@tpmining.com

Consultant: **Mining Associates, Mason Geoscience**

Author of Report **Rod Salfinger**

Date submitted: **31 March, 2005**

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1. INTRODUCTION

1.1 Location and access

The Spectrum property is located in northwestern British Columbia on the eastern edge of the coastal mountains approximately 1,100 km north of Vancouver. It is approximately 25 km west of the Stuart Cassiar Highway just west of Nuttlude Lake. The property forms part of the Spectrum Range of mountains and is within the Mount Edziza Recreational Area. The geographic coordinates of the property are latitude 57° 41' north and longitude 130° 29' west.

The Spectrum property covers the eastern side of a small flat-topped mountain including its northern, eastern and southern flanks. Elevations range from 800 to 2,500 metres above sea. Topography varies from high alpine grass meadows to densely wooded pine and spruce forests in the lower levels.

Past exploration campaigns have gained access by a dozer track (not used since 1978) from the Stuart Cassiar Highway on a bush track that was capable of handling drill rigs and heavy equipment. Full road access is planned from an extension of the Willow Creek forestry road which terminates some 16 km to the south of the Spectrum property. The proposed road will follow the eastern edge of Kakiddi Lake which occupies a wide open valley.

Present access to the Spectrum Property is by helicopter air access. An airstrip (currently overgrown with brush) is located next to Nuttlude Lake on the eastern boundary of the property, or by helicopter from the nearby village of Iskut (25 km east). An all-weather airport is located at the township of Dease Lake some 90 km to the north of Spectrum.

1.2 Property Information

The Spectrum resources are hosted in a near vertical vein system in steeply dipping altered volcanics. Vein widths vary from 1 to 10 metres and are enclosed within a 50 to 70 metre wide fracture zone. The deposit consists of 2 quartz carbonate veins running parallel to 2 porphyry veins. The surrounding volcanic host rocks show strong propylitic alteration indicating the presence of a major intrusive. It is believed that the porphyry veins of the Spectrum deposit may be the upward projections of a much larger porphyry system.

Past drilling results have displayed increasing Gold grade to depth. This trend is evidenced by high gold grades at the "East Creek zone" which is believed to be the northern "on strike" extension of the main Spectrum zone. At this location which is 1,250 metres north and 800 metres lower than the main Spectrum outcrop, past drilling has revealed very good grades per tonne over a width of 2.6 metres.

Claims held:

Tenure Number	**Claim Name**	**Units**	**Area**	**Mining Division**	**Work Recorded to Date**	**Status**	**Tag No.**
221652	RED DOG #1	2	50.0	Liard	1999-09-30	PROT	9561
221665	RED DOG #2	15	375.0	Liard	2002-04-09	PROT	10444
221747	HAWK #1	18	450.0	Liard	2002-02-21	PROT	37304
221748	HAWK #2	20	500.0	Liard	2002-02-21	PROT	37305
221803	PINK	20	500.0	Liard	2000-10-31	PROT	48211
221804	RED	20	500.0	Liard	1999-10-31	PROT	48206
221813	CAMP	12	300.0	Liard	2002-04-09	PROT	49127
222131	RED DOG #3	10	250.0	Liard	2000-08-06	PROT	72580
222132	RED DOG #4	8	200.0	Liard	1999-07-16	PROT	72579

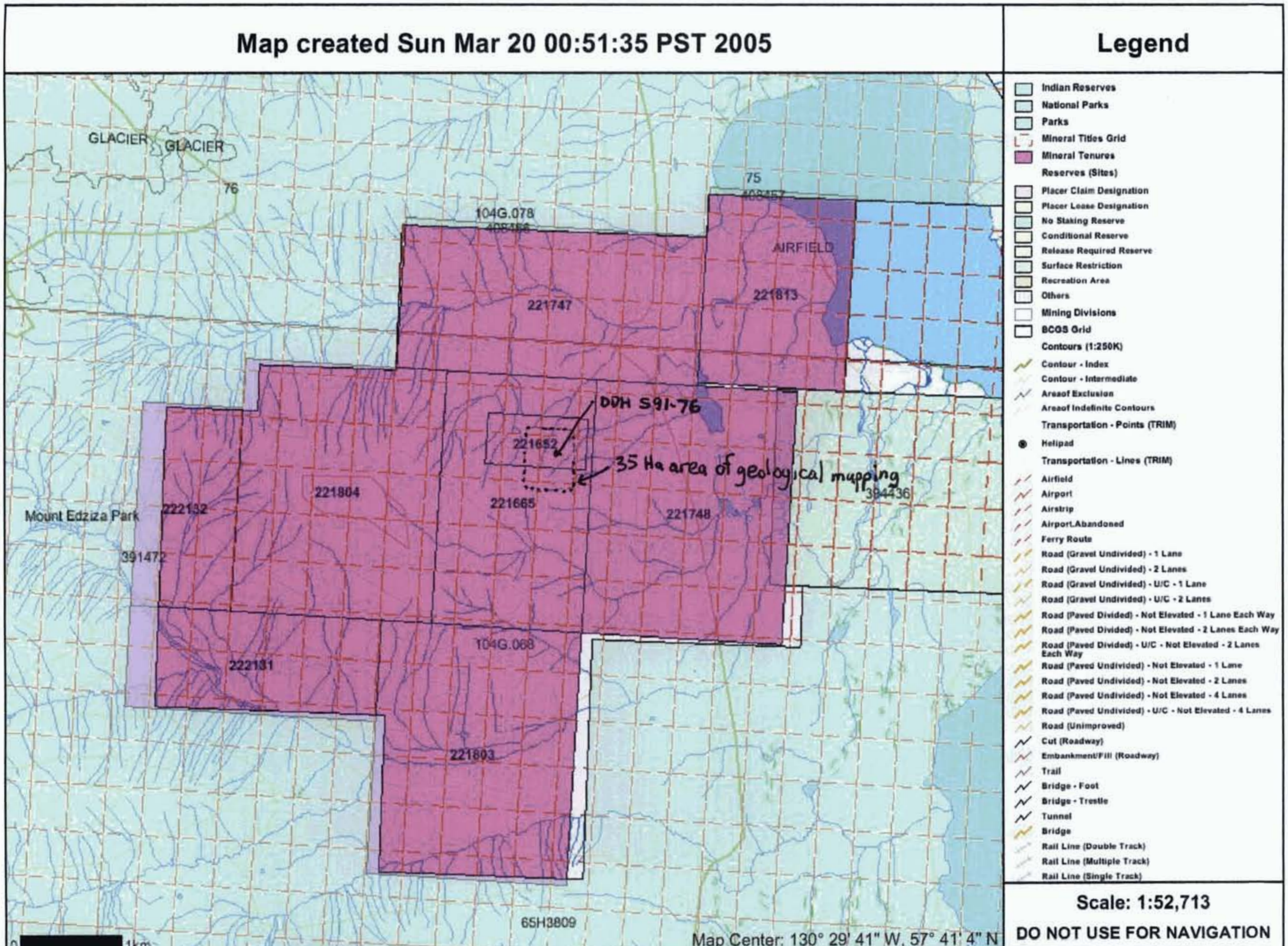


Fig. 1 **CLAIM LOCATION**: 221652 Red Dog, 221665 Red Dog, 221747 Hawk #1, 221748 Hawk #2, 221803 Pink, 221804 Red, 221813 Camp, 222131 Red Dog #3, 222132 Red Dog #4 Claims owned by Seeker Resources (FMC No 146527)

1.3 Summary of work done

Work on the Spectrum Claims outlined in this report includes:

- entry of project assay data into electronic format using Surpac - load and validate data base
- construction of a new topographic DTM;
- construction of a new model cap 10 metres below surface topography;
- correlate drill data in 3D;
- mark monsonite intervals and model as a 3D solid;
- attempt to create block model and fields;
- estimate gold grades by three zones;
- report and validate results;
- 3D representation of blocks for designing and guiding future drilling;
- creation of a new geological model;
- Petrographic description of drill core;
- Geochemical analysis and auto radiographs for rock samples from drill hole S91-76; to determine presence of potential radio active components;
- detailed petrological study of drill core rock samples to determine genesis of gold deposition in order to guide future exploration drilling programs.

2. TECHNICAL DATA AND INTERPRETATION - GEOLOGICAL AND PREPARATORY WORK

2.1 Purpose

The purpose of the work program was to create a new geological model to help guide future exploration and to determine the presence of potentially injurious compounds in the mineralization which may adversely affect a future mining operation.

2.2 Results

2.2.1 Resource model

The results of the resource model are best summarized in the Mining Associates'

Report of May 12, 2004 which is hereby attached as Schedule "A" to this report.

The MA Report puts the Spectrum Project resources into JRC format and based on a cut-off grade of 5 g/t au, gives a resource of 474.615 tonnes at 11.4 g/t Au for a total contained metal content of 173,555 oz Au. By reducing the cut-off grade to 2 g/t a contained metal content of 255,659 oz Au at 6.05 g/t Au is derived.

2.2.2 Petrolographic description - Petrological study

The petrographic study indicated that previous interpretations of Spectrum geology were inaccurate and misleading, in particular the interpretation of the QC zone as being a quartz carbonate vein system has now been challenged and a new concept of the genesis of gold bearing mineralization derived.

In particular the QC system is now seen as a in-fill solution process with two phases of mineralization being derived from a larger pluton at depth with the mineralized in-fill solutions being structurally controlled by shear zones parallel to the existing gold bearing porphyry intrusive. This gives greater confidence for mineralization to extend to depth and points to the opportunity of a large shear zone structure that may exist at depth.

The results of the Petrographic description - Petrological studies are best provided in the Mason Geoscience Reports of 17 December 2003 and 21 May 2004 which are hereby attached as Schedule "B" and Schedule "C" to this report.

2.2.3 Geochemical and Autoradiograph study

The petrographic study revealed unknown minerals suspected to be radioactive components which could prove detrimental to a future underground mining operation. The study concluded that small U bearing radioactive grains occur in trace amounts in one of the eight studied samples. Thorium is in low abundance in all samples <2ppm - 11ppm Th. Uranium was also in low abundance <2ppm - 11ppm

The results of the Geochemical and Autoradiograph study is best provided in the Mason Geoscience Reports of 23 August 2004 which is hereby attached as Schedule "D" to this report.

2.2.4 Targets and exploration program (2005)

The new resource model gives greater confidence to future drilling and in particular focuses extended drilling in the horizon bounded by 9700 N to 10,000 N on strike with existing mineralization at between 9850 E and 9900 E. below RL 1400 Z where it is believed the greatest chance for continuing high grade mineralization will occur.

3. ITEMIZED COST STATEMENT

Contract / Consultant / Own Cost	Task and Products	Rate per day	Total Cost C$
Taylor Wall invoice for Mason Geoscience P/L Report	Petrograhic Study	$400	$538.75
Mason Geoscience invoice Report	Petrological Study	$400	$4,684.37
Mason Geoscience invoice Report	Autoradiograph study	$400	$1,733.63
Mining Associates Report	Resource calculation. Resource modeling	$400	$9362.74
Trans Pacific Mining	Report writing compilation	$920 x 1	$920
		TOTAL	$17,239.49

4. AUTHOR'S EXPERIENCE & QUALIFICATIONS

This report is compiled and prepared by Rod Salfinger. Mr Rod Salfinger is from a family with three generations of mining history. Employed in the mining industry for the past 20 years. Studied Geology at Monash University then transferred to mining engineering at RMIT and is an experienced mine manager and development contractor who has managed and operated a number of underground mines in Far North Queensland (Kitchener and West Orient), located 100 Km south west of Cairns. Mr Salfinger has been on the Spectrum site on a number of occasions and is personally familiar with the project.

Signed by

Rod Salfinger

Rod Salfinger 31 March 2005

Schedule A

Mining Associates

Mining Associates Pty Ltd
ACN 106 771 671
Level 5, 80 Albert Street
PO Box 224 Albert Street
Brisbane, Qld 4002
AUSTRALIA
email: avigar@aeq.com.au
Tel: +61 (0)7 3012 8320

3012 · 8499.

Mr Rod Salfinger
Trans Pacific Mining
71 Northern Avenue
MENTONE VIC 3194

RE: Spectrum Resource Review

12 May 2004

1. Introduction

Mining Associates (MA) have conducted a review of the Mineral Resource Estimates of the Spectrum Property, BC, Canada for Trans Pacific Mining Limited at the request of Mr Vic Wall of Taylor Wall and Associates (TWA). The work program, which commenced on the 8th and was completed on the 19th of December 2003, consisted of the following

- Review of existing reports, plans and sections
- Entry of data into electronic format
- Validation of drill data against drill logs and laboratory sheets
- Review of the geological setting and models
- Review and update of past resource estimates
- Completion of a new resource estimate
- Validation and reporting

The work described in this report is all based on historical data as supplied by TWA. No site visit or in-depth validation of the data has been undertaken.

JORC Statement - The information in this report that relates to Mineral Resources Estimates is based on information compiled by Mr Andrew Vigar, who is a Fellow of The Australasian Institute of Mining and Metallurgy and is employed by Mining Associates Pty Ltd. He has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 1999 Edition of the "Australasian Code for Reporting of Mineral Resources and Ore Reserves". Mr Vigar consents to the inclusion in the report of the matters based on their information in the form and context in which it appears.

Forward-Looking Statements - Estimates of Mineral Resources are inherently forward-looking statements, which being projections of future performance will necessarily differ from the actual performance. The errors in such projections result from the inherent uncertainties in the interpretation of geologic data, in variations in the execution of mining and processing plans, in the ability to meet construction and production schedules due to many factors including weather, availability of necessary equipment and supplies, fluctuating prices and changes in regulations.

Disclaimer - The opinions expressed in this report have been based solely on the information supplied to MA by TWA. MA has exercised all due care in reviewing the supplied information. Although MA has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are reliant on the accuracy of the supplied data. MA has relied on this information and has no reason to believe that any material facts have been withheld, or that a more detailed analysis may reveal additional material information. MA does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

2. Results

The results for the resource estimates using a lower cut-off grade of 5 g/tAu are tabulated in Table 1 below. This lower-cut-off grade is considered by MA as appropriate for a resource (vs reserves) estimate for a deposit of this style in this location. MA would expect that a slighly high value would eventually be used for the mining reserve.

The resource category under JORC to be applied by MA at Spectrum at this stage is wholy Inferred. There is no doubt that the presence of significant mineralisation at Spectrum has been confirmed in a number of drill-holes but the correlation of these intercepts in both plan and section is somewhat problematic, both for the current work and previous studies. A general correlation can be seen in the various views shown in the Appendix but direction confirmation on a mine-able scale is still unclear with several possible interpretations vying for recognition. The issue becomes one of the reliability of the estimated tonnes and grades and the reflection of this in the quoted numbers. The overall mineralised zone is clear but the corrlation of individual high-grade veins with-in these will require confimatory drilling and/or mine development and sampling.

JORC states that "Mineral Resource estimates are not precise calculations, being dependent on the interpretation of limited information on the location, shape and continuity of the occurrence and on the available sampling results. Reporting of tonnage and grade figures should reflect the order of accuracy of the estimate by rounding off to appropriately significant figures and, in the case of Inferred Mineral Resources, by qualification with terms such as 'approximately'. An 'Inferred Mineral Resource' is that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which may be limited or of uncertain quality and reliability."

Table 1 MA Resource Estimates over 5 g/tAu by zone and grade

Resource by zone over 5 g/tAu					Above Cut Off			
Zone	Range	Volume	Tonnes	Au g/t	Cut off	tonnes	g/t	ounces
500	5.0-10.0	8900	23585	7.89	5	41,340	12.69	16,869
	10.0-15.0	3200	8480	12.34	10	17,755	19.07	10,885
	15.0-30.0	3500	9275	25.22	15	9,275	25.22	7,521
	30.0-60.0	0	0	0.00	30	0	0.00	0
	60.0-999.0	0	0	0.00				
	Sub Total	**15600**	**41340**	**12.69**				
SOUTH	5.0-10.0	30000	79500	6.26	9	124,020	9.68	38,612
	10.0-15.0	4300	11395	11.78	10	44,520	15.80	22,620
	15.0-30.0	12500	33125	17.19	15	33,125	17.19	18,305
	30.0-60.0	0	0	0.00	30	0	0.00	0
	60.0-999.0	0	0	0.00				
	Sub Total	**46800**	**124020**	**9.68**				
NORTH	5.0-10.0	72100	191065	7.06	9	309,255	11.87	118,070
	10.0-15.0	19200	50880	12.15	10	118,190	19.65	74,683
	15.0-30.0	18900	50085	20.46	15	67,310	25.33	54,806
	30.0-60.0	6500	17225	39.47	30	17,225	39.47	21,858
	60.0-999.0	0	0	0.00				
	Sub Total	**116700**	**309255**	**11.88**				
ALL	5.0-10.0	111000	294150	6.91	9	474,615	11.37	173,552
	10.0-15.0	26700	70755	12.11	10	180,465	18.65	108,188
	15.0-30.0	34900	92485	19.77	15	109,710	22.86	80,632
	30.0-60.0	6500	17225	39.47	30	17,225	39.47	21,858
	60.0-999.0	0	0	0.00				
	Grand Total	**179100**	**474615**	**11.37**				

The resources above a cut-off grade of 5 g/tAu may be stated as

Inferred Resource of 475 thousand tonnes at an average grade of 11.4 g/tAu.

A comparison of the current MA2003 estimates with those done earlier by Columbia and Orcan on essentially the same data set (see table 2) shows the level of agreement expected for a resource at the Inferred stage. At the cut-off of 5 g/t Au, grade estimates range from 9.4 to 10.3 g/t Au, tonnage from 475 Kt to 614 Kt and contained ounces from 174 Koz to 244 Koz. Using a cut-off grade of 10 g/tAu, the corrected Columbia estimates and the current MA 2003 estimates are almost identical.

Table 2 Comparison of Spectrum Resource Estimates

Spectrum Project Resource/Reserve Estimates						
	in-situ			diluted 20%@0.2 g/tAu		
	tonnes	g/tAu	ozAu	tonnes	grade	ozAu
over 5 g/tAu						
Columbia 1991	614,000	12.3	243,598	736,800	10.3	244,388
Orcan 1991	593,000	11.3	215,057	711,600	9.4	215,820
MA 2003	474,615	11.4	173,555	569,538	9.5	174,165
over 10g/tAu						
Columbia 1991	289,600	18.7	173,647	347,520	15.6	174,020
Orcan 1991	274,900	15.9	140,440	329,880	13.3	140,793
Columbia corr. 2003	217,000	15.4	107,302	260,400	12.9	107,581
MA 2003	180,465	18.6	108,189	216,558	15.6	108,421

The differences in the estimates relate to the different estimation methods used and the corrections applied to the first Columbia estimates. Orcan used an upper cut where Columbia did not, but larger extrapolation distances relative to the 25m used in the MA2003 estimate.

A perusal of the model (see Appendix), and the categorisation as Inferred, highlight the large gaps in knowledge based on the current drill spacing. MA would expect that closer spaced data will confirm continuity in some of these areas thus future estimates based on this additional data will have increased available tonnage without reducing the grade. Further extrapolation of the current data is not only unsupported by the available data, it would have the effect of "smearing" the grades and producing lower than realistic average grades for this style of narrow-vein, high grade deposit.

The grade-tonnage profile of the deposit at various cut-off grades (undiluted) in figure 1 shows a rapid rise in tonnage using cut-offs below 4 g/tAu. The effect of mining dilution should be remembered, with expected grades of 10 to 30% below the undiluted resource grades shown below. To achieve a mill grade of around 10 g/tAu, a resource cut-off grade of about 5 or 6 g/tAu is suggested.

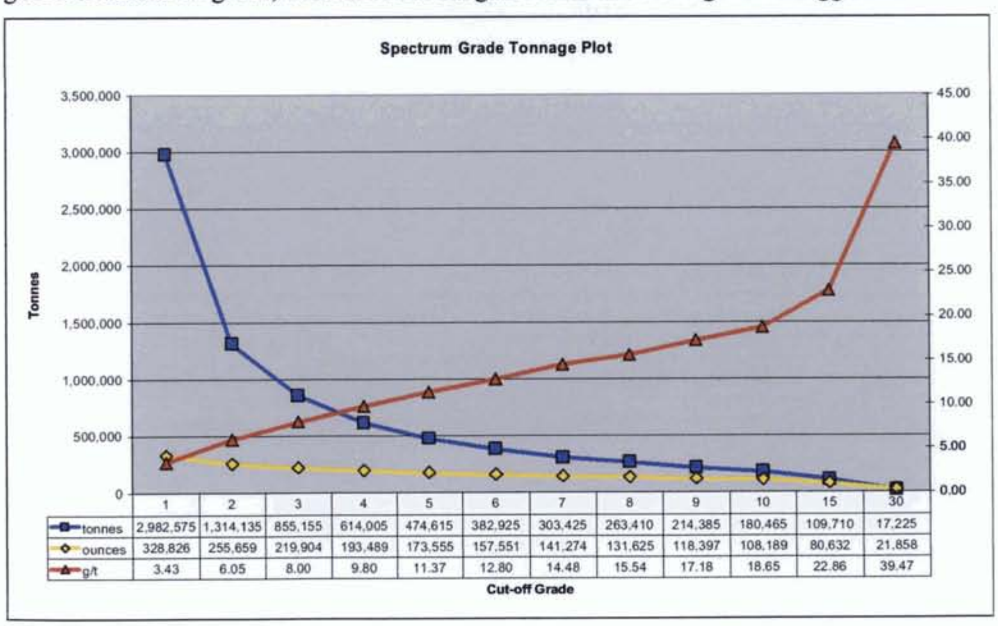


Figure 1 Grade - Tonnage plot of MA resource model above various cut-off grades (x axis).

3. Background

The Spectrum property is located in north-western British Columbia about 25 kilometres west of highway 37 at Kinaskan Lake on the eastern boundary of Mount Edziza Provincial Park (Figure 2) and 35 km east of the Stewart-Cassair Highway. The Spectrum area is bound on 3 sides by the Park but on the east by a Mineral Reserve which may allow access for project development.

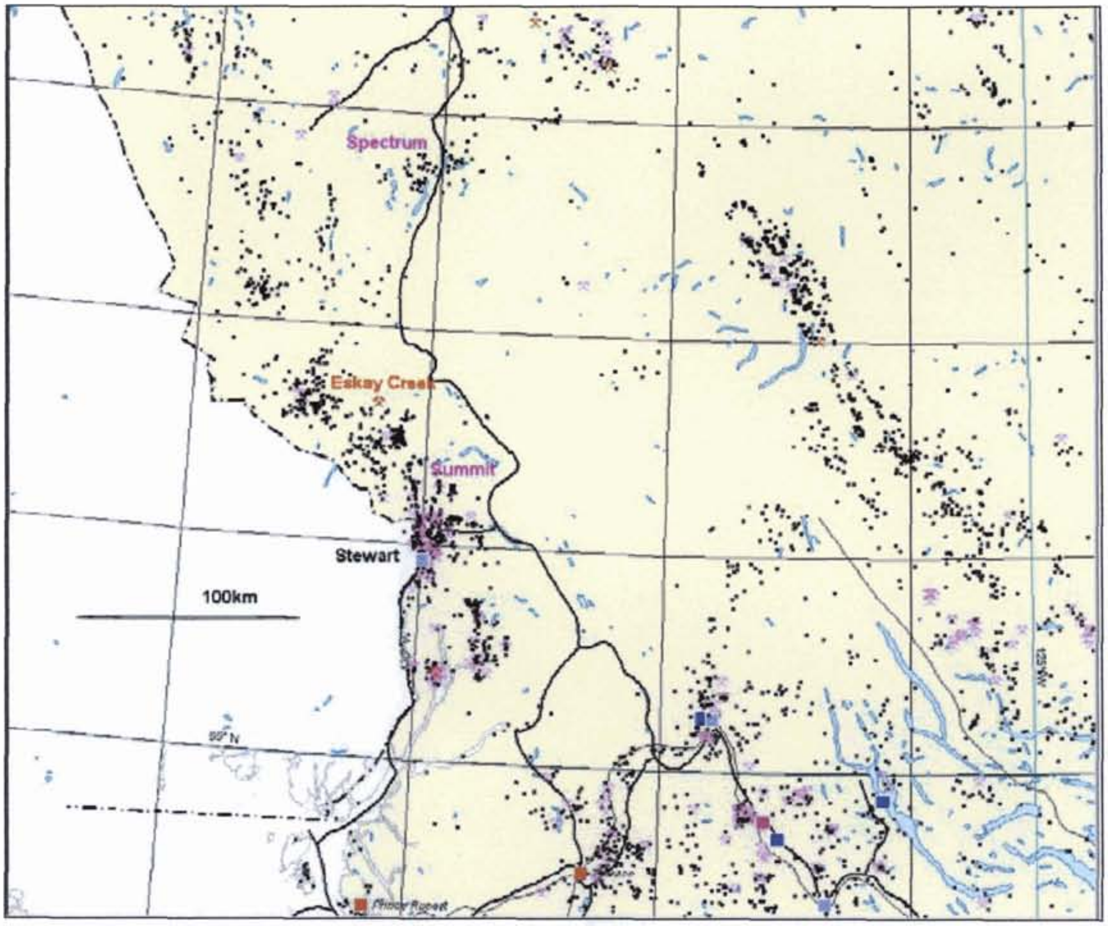


Figure 2 Location of the Spectrum property in north-western BC.

The Spectrum Claims (221652, 221665, 221747, 221748, 221803, 221804, 221813, 222131 and 222132, registered to Arkaroola Resources Limited) lie within the Laird Mining Division at about 57° 41' North and 130° 29' West.

Access to the properties is via air or water across Nuttlude Lake. A 550m disused airstrip is located in the extreme north-east of the property. There is no current road access, the nearest being a forestry road about 12km to the south.

The past work on the Spectrum project, upon which this review is based, is summarised below

1957 - Earliest work was by Torbit Silver Mines on the Hawk vein at the north end of the property.

1967 – restaked by Shawinigan Mining and Smelting Company, drilled x-ray holes on the Hawk vein.

1969 – Spartan Explorations staked the Spectrum claims to cover the newly discovered porphyry copper occurrence south-west of Nuttlude Lake.

1970 – Mitsui Mining and Smelting Company Ltd conducted geochemical and geophysical surveys.

1970 – Imperial Oil Limited (IOL) optioned the property and conducted geological mapping, additional geochemical and geophysical surveys.

1973 – IOL drilled 4 holes for 463m.

1975 – The Red Dog claims were staked by Racicot Syndicate who optioned them to Canex Placer, they dropped the option in 1977

1997 – The Northair Group optioned the claims

1978 - added the Pink and Red claims, carried additional geological mapping and geochemistry.

1979 – added the Camp claim, built a 4x4 road to the prospects and drilled 28 holes for 3,232m. Also completed 313m of underground development and 9 underground diamond drill holes on the Hawk vein.

1984 – Cominco optioned the property, carried out soil sampling and geophysics.

1988-89 – Cominco drilled 10 holes for 1,199m.

1987-89 – Moongold Resources conducted a small program of geochem and ground geophysics.

1990 – Columbia Gold Mines Ltd optioned the property from the Northair Group. Trenching and drilled 20 holes for 2,363m. Identified the main mineralised zones at Spectrum.

1991 – JV with Eurus Resources Corp. 24 holes for 3,992m to define reserves on the QC and Porphyry zones and explore other peripheral zones. Orcan calculated geological reserves (resources) and Columbia converted to reserves.

1992 – Eurus withdrew, Columbia drilled 6 holes for 710m on the 500 Colour and East Creek. Limited prospecting program for northerly extensions of the main zones.

Cumulative drilling to the end of 1992 was 92 holes for 11,960m. No drilling has been carried out since 1992.

4. Past Resource Estimates

The Spectrum Claims contain several gold prospects but Drilling and Resource Estimation work to date has been focused on the "Red Dog" or Spectrum Main areas, mainly included in Claims 221652 and 221665. There have been two complete resource estimates in the past, both conducted in 1991.

The results for both of these are compared with the current estimates in table 2 and discussed below.

Resource estimate by Columbia August 1991.

A preliminary resource estimate was completed by the Columbia geological team in-house. Gold mineralisation was indentified in a series of northerly trending, sub-vertical silicified zones bounded by bands of brittle fracture. The zones are from 1 to 15 metres wide and host one ore more high-grade sections.

The gold is reported to occur as free gold within a siliceous matrix accompanied by pyrite and minor arsenopyrite, chalcopyrite, sphalerite, scheelite and traces of molybonite. Metallic assay techniques have been used in evaluating most mineralised zones.

The mineralised zones were interpreted on cross-sections and a resource table generated with each drill intercept given a true-width, strike and dip dimensions and average grade. SG (Dry tonnage factor, in situ) used was 2.65 (from tables, text states 2.7). Estimates were stated at cut-off grades of 5 g/tAu, 10 g/tAu with and without 20% dilution.

The resource estimates were validated as part of this current study and a number of errors found in the calculation of true widths and average grades. An upper cut of 62 m*g/tAu was also applied. The results of this correction are shown in table 3.

Table 3 Columbia estimates and corrections

Corrected Columbia over 10g/tAu						
		in-situ		diluted 20%@0.2 g/tAu		
	tonnes	g/tAu	ozAu	tonnes	grade	ozAu
Columbia raw	289,600	18.7	173,647	347,520	15.6	174,020
Corr.True Width	217,000	18.6	129,767	260,400	15.5	130,046
Corr. Grade	217,000	18.3	127,883	260,400	15.3	128,162
Cut 62mgms	217,000	15.4	107,302	260,400	12.9	107,581

Resource estimate by Orcan for Columbia September 1991.

A detailed follow-up on the preliminary estimates was also done by Orcan for Eurus in September 1991. This was a full estimate from scratch and not directly comparable with the previous estimate.

Steep westerly dipping structurally controlled veins over an area 2,500 by 1500m were identified. The veins contained visible gold, arsenopyrite, pyrite and minor sphalerite within a calc-silicate gangue. Disseminated pyrite and chalcopyrite occur in mineralised portions of the monzonite and adjacent altered andesites. No obvious geological controls such as alteration, structure, or lithology were identified.

Set of irregular spaced sections to match the drill spacings, vertical and east-west, were used for interpreting the ore zones. The sections were drawn with the surface profile and drilling colour coded assays and broad geological features such as silicification, pyrite content and visible gold occurrences. It was found that assays were the most significant (and often the sole) factor for correlation and continuity of zones. Narrow zones of higher grade, exhibiting some continuity in both strike and dip, were defined by the use of higher grade assays. However Orcan felt that their validity was somewhat questionable on the basis of current data and knowledge about the deposit and that overall geological continuity was poor. Level plans drawn at 1,500, 1550 and 1600 levels to confirm the interpretation.

A total of 205 individual ore blocks were outlined on a final set of 1 to 500 scale plans and estimates based on dimensions and grades of drill hole assays in each block. A cut-off of 5g/t over a minium true width of 1.5m was used to define the resource areas, a higher grade core of +10 g/tAu was contained within this outer zone. Basic statistics indicated 2 populations, one up to 7 g/tAu, then up to 40 g/tAu with a small polultaion over this. Orcan implemented an upper cap at 50 m*g/tAu.

Orcan classified resources as indicated or inferred based on distance from a drill hole assay and continuity along strike and dip. Indicated had a maximum of 10m from a drill assay but at least 2 or more geological intercepts. Inferred up to 50m from a drill hole, one intercept, or 40m beyond the indicated. Some small areas bejond 50m to close internal gaps. SG was stated as 2.7.

Overburden depth on some sections is considerable, about 30m in many holes.

5. Database

The topography was digitised from one of the old Columbia plans and rendered as a 3D digital terrain model.

The 1991 reports state that all drill core is stored in a shed at grid coordinates 9968N and 9960E. Core for the entire length was split, and analysed for gold and copper by Min-En Labs in North Vancouver, BC. Zones with visible gold were assayed by the metallic assay method whereby both the coarse and fine products of a 120 mesh screening were assayed and the results combined to determine the gold content. Drill intersections, recognised as geologically as gold zones, but not containing visible gold, were analysed by standard assay techniques. All remaining core was analysed by rock geochemical methods.

Three main analysis methods were used

Geochemical Analysis Certificate - RG – AAS gold, units are ppb with 1ppb detection limit. Samples are dried, crushed and pulverised in a ring mill, 5 grams is weighed, cindered in porcelain cruicible @800 degrees c for 3 hours, transferred to a beaker and digested using aqua regia, diluted to volumes, gold extracted to MIBK and analysed using AAS.

Assay Certificate - RA - Standard gold – Gold fire assay with AAS finish, units are g/tonne and oz/ton gold with 0.01 g/t detection limit. Sample is dried and crushed to 1/8 inch, a 300 to 400 gram riffle split sample is taken, pulverised in a ring mill to 95% passing 120 mesh. The samples are fire assayed using one assay ton sample weight. The samples are fluxed, fused, the metal beads transferred to new glassware, dissolved in aqua regia, volume diluted and mixed. The gold is extracted to MIBK and analysed using AAS.

Metallic Assay – RM - Screen Fire Assay — Screen at 120 mesh, fire assay fractions separately, units are g/tonne and oz/ton gold with 0.01 g/t detection limit

A number of samples were analysed by ICP for a range of elements in units of PPM including Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Sr, Th, U, V, Zn, Ga, Sn, W and Cr.

A number of the drill holes, selected at random, were then validated against the laboratory assay sheets in the old reports. No errors were found, although there was some confusion where several assay methods and/or repeats had been used. A selection of the 30 highest assay results showed all correctly entered based on the Metallic assay result. A check was made on the assayed intervals in hole S90-46 from 30 to 64m down-hole. The Assay certificates were checked against the Columbia drill ledgers. This hole was chosen at random from a sub-set of those containing gold assays greater than one ounce per ton, was drilled in August 1990 and logged by JJ Hylands. Hand-written records are in good condition, including hole location, grid position (No survey on field sheet, later survey within one metre of planned grid location), elevation, brunton collar survey at collar, acid dip only at end, summary geology log, detailed strip log and sample by sample summary ledger with assay and met Au. The main gold zone from 45.7 to 53.3m (7.6m) returned results of 10.3 ppm Au from RG geochem assay, 7.2 g/t Au from RA standard gold and 17.7 from RM Metallic Gold.

The database used was entered from the original log data into spreadsheets and then loaded into an access database with validation checks for drill hole naming, duplicate entries, overlapping samples and values out of range. The results were then visualised and checked for obvious errors in plan, section and 3D rotation. The trench data was similarly loaded into a separate database, but trench traces were pressed onto the topography.

The drill data and trench data were composited to one metre down-hole intervals for analysis and estimation.

Omni-directional variography was carried out on the composited drill data. Figure 3 shows a reasonable variogram with a maximum range of 30m and high nugget, the numbers are the numbers of pairs used at each point.

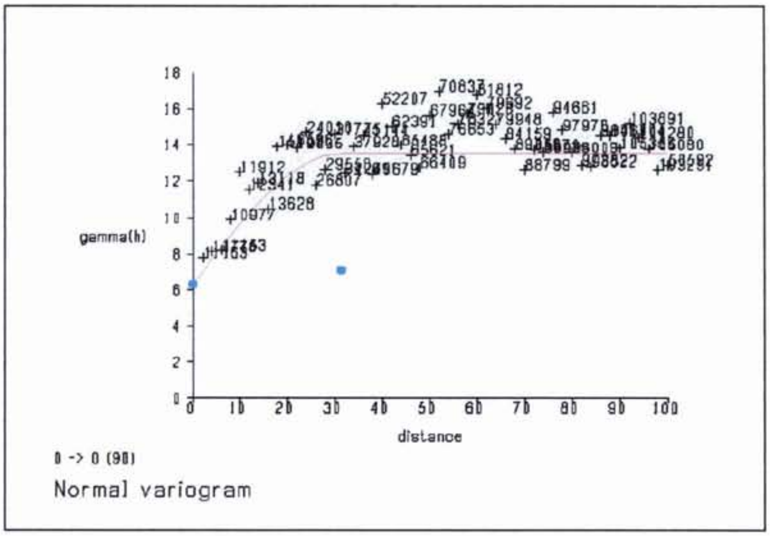


Figure 3 Omnidirectional variogam

6. Methodology

The methodology used for the current resource estimates may be summarised as follows, all work was undertaken using Surpac Vision version 4

1. Load and validate database
2. Calculate values for gold grades using an upper cap of 62 m*g/tAu
3. Construct a topography DTM
4. Make a model cap by moving topography down 10m
5. Composite drill data too 1m down-hole
6. Display and validate data
7. Mark monzonite intervals and model as a 3D solid
8. Attempt correlation of drill data in 3D
9. Create block model and fields
10. Estimate the gold grades by 3 zones
11. Report and validate results

The individual blocks are then combined across the model. The method for this is that we combine all the blocks across the resource model in the horizontal direction for each of the areas (north, south and 500) separately. We then have a combined total meterage, average grade across this combined width and also the ounces of gold contained in this panel. The contained ounces is based on a panel volume, tonnage and grade. The panel volume is 10m high, 10m long and the width of the combined blocks. The formula (using block model terminology) is

Panel volume = x size (10) * z size (10) * x size (combined reef width)

This converted to tonnage use a volume factor (dry) of 2.65 t/m3

Panel tonnage = panel volume * 2.65

This is converted to the gold ounces contained in each panel by multiplying by the gold grade in g/tAu then dividing by 31.1035 to convert to contained ounces

Panel ounces = panel tonnage *panel grade / 31.1035

7. Parameters

The parameters used for the MA resource estimates are shown in Table 4.

Table 4 Resource Estimation Parameters

System	Surpac Vision Ver 4.1G			
Block model		Y	X	Z
	origin	9450	9675	1300
	extents	625	256	400
	max	10075	9931	1700
	cell size	10	1	10
	rotation	nil		
Domain limits		Y	X	Z
	NORTH	above 9670	above 9750	below topo-10m
	SOUTH	below 9670		below topo-10m
	500		below 9750	below topo-10m
Data	Composites	1m downhole composites		
	Data points	5823		
	Type	Drill data only		
		all drill data for holes above 43		
		selected mineralised intervals only for 1 to 42		
	Upper cut	62 metre*Aug/t		
Method	Inverse distance squared			
Informing samples		NORTH	SOUTH	500
	min	1	1	1
	max	30	30	30
	quadrants	no	no	no
	# holes	no	no	no
Search criteria	Major azimuth	105	80	80
	dip	-90	-90	-90
	tilt	0	0	0
	Major dist	30	30	30
	semi-major dis	30	30	30
	minor dist	1	1	1
Discretisation		1,1,1	1,1,1	1,1,1
Surface effect	excluded 10m below topography			
Dry tonnage factor	2.65			
Added dilution	nil			

The block model results in plan and section, with the zone areas and above 5 g/tAu, are shown in figure 4 and in more detail in the Appendix

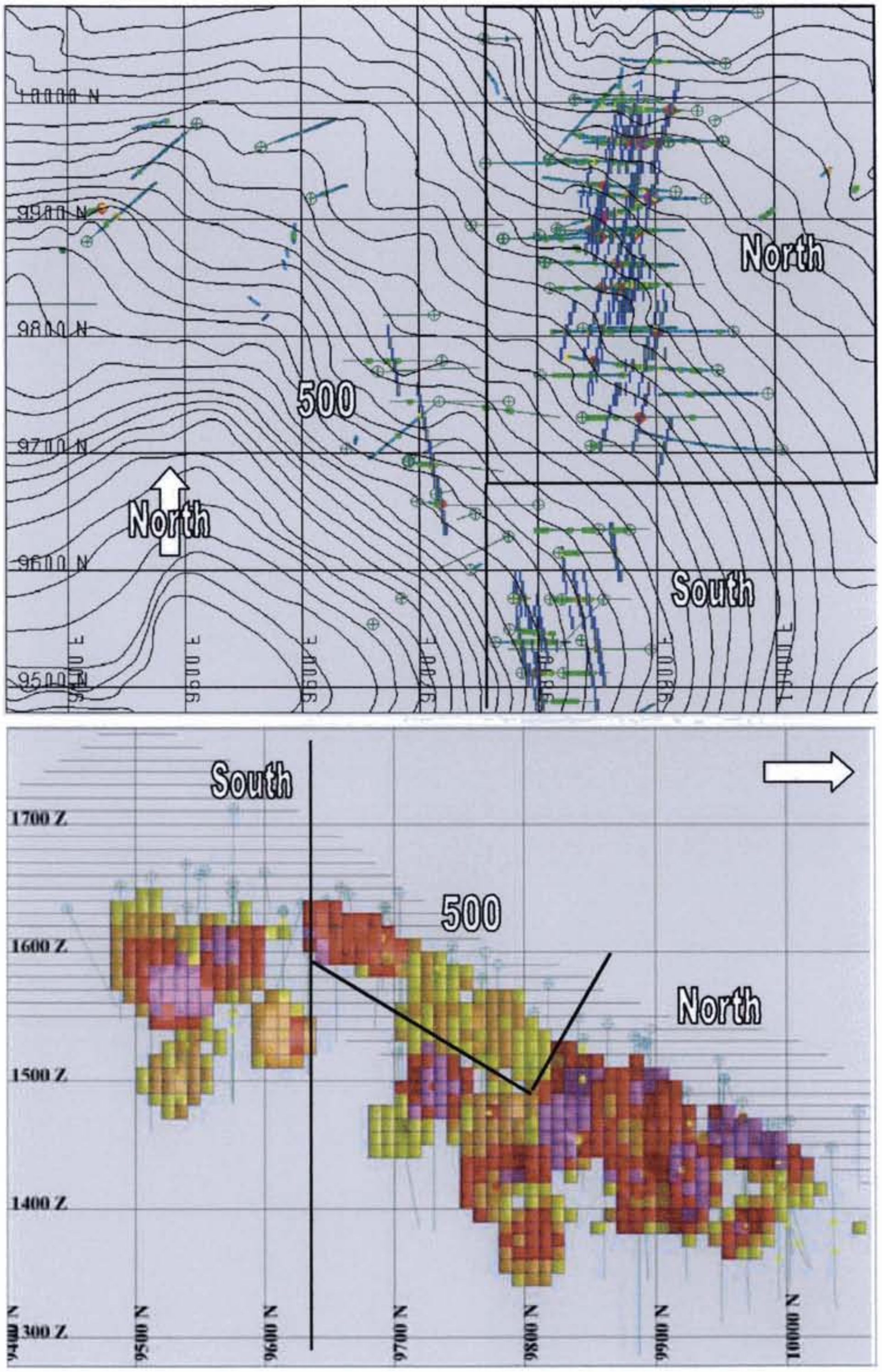


Figure 4 Plan and long section showing drill data and resource blocks over 5 g/tAu.

8. References

Budinski D R and Adamson R S, 1994. Exploration Proposal for the Spectrum Project, for Columbia Gold Mines Ltd, June 1994. 19 pages. By Orcan Mineral Associates Ltd

Hylands, JJ 1991. Summary Report on the 1990 Exploration Program, Spectrum Property, Columbia Gold Mines Ltd, Jan 1991. 49 Pages; Plus Appendices A to F in 3 Volumes; Volume 1 – Report, Appendix A "Analytical Procedures Min-En Labs", Appendix B "Analytical Certificates, Geochemistry", Appendix C "Trench Sample Ledgers"; Volume 2 – Appendix D "Diamond Drill Hole Logs and Sample Ledgers, Holes 43 to 62 incl."; Volume 3 - Appendix E "Analytical Certificates Core Samples", Appendix F "Analytical Certificates Rock Samples".

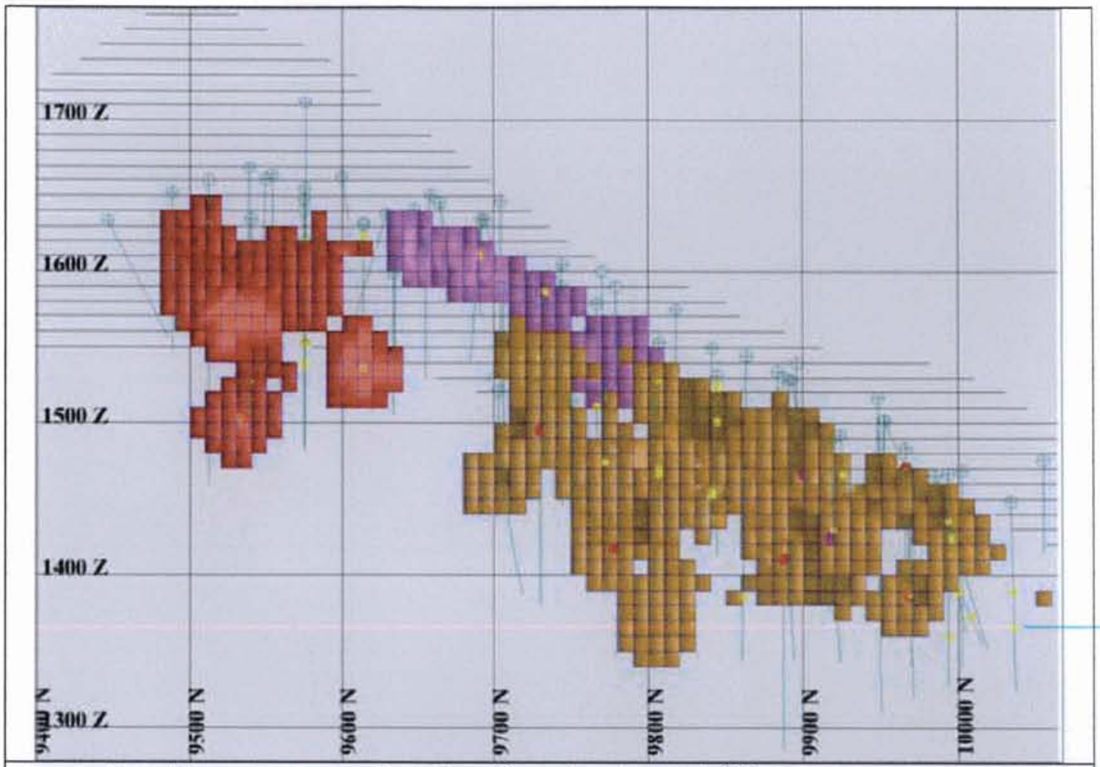
Kilby, D.B., Casselman S and Roberts W.J., 1991. Report on the 1991 Exploration Program Spectrum Project Columbia-Eurus Joint Venture (Spectrum and Hawk Properties) for Columbia Gold Mines Ltd, November 1991. 72 Pages; Plus Appendices I to IV in 3 Volumes; Volume 1 – Report, Appendix I "Geological Reserve Calculations for the Spectrum Property; by Columbia Gold Mines Ltd.", Appendix II "Geological Reserve for the Spectrum Gold Deposit; by Orcan Mineral Associates Ltd"; Volume 2 (in two binders) – Appendix III "Diamond Drill Hole Logs and Sample Ledgers, Holes 63 to 86 incl."; Volume 3 - Appendix E "Geochmeical Analytical Procedures and Assay Certificates", Appendix F "Analytical Certificates Rock Samples".

Norman, GP 1992. Report on the 1992 Exploration Program on the Spectrum Project, (Spectrum and Hawk Properties) for Columbia Gold Mines Ltd, November 1992. 32 Pages in One Volume with 3 Appendices; Appendix I "1992 Drill Hole Logs and Sample Ledgers, Holes 87 to 92 incl."; Appendix II "1992 List of Analytical Results, Min-Rn labs", Appendix III "Min-En Analytical Techniques".

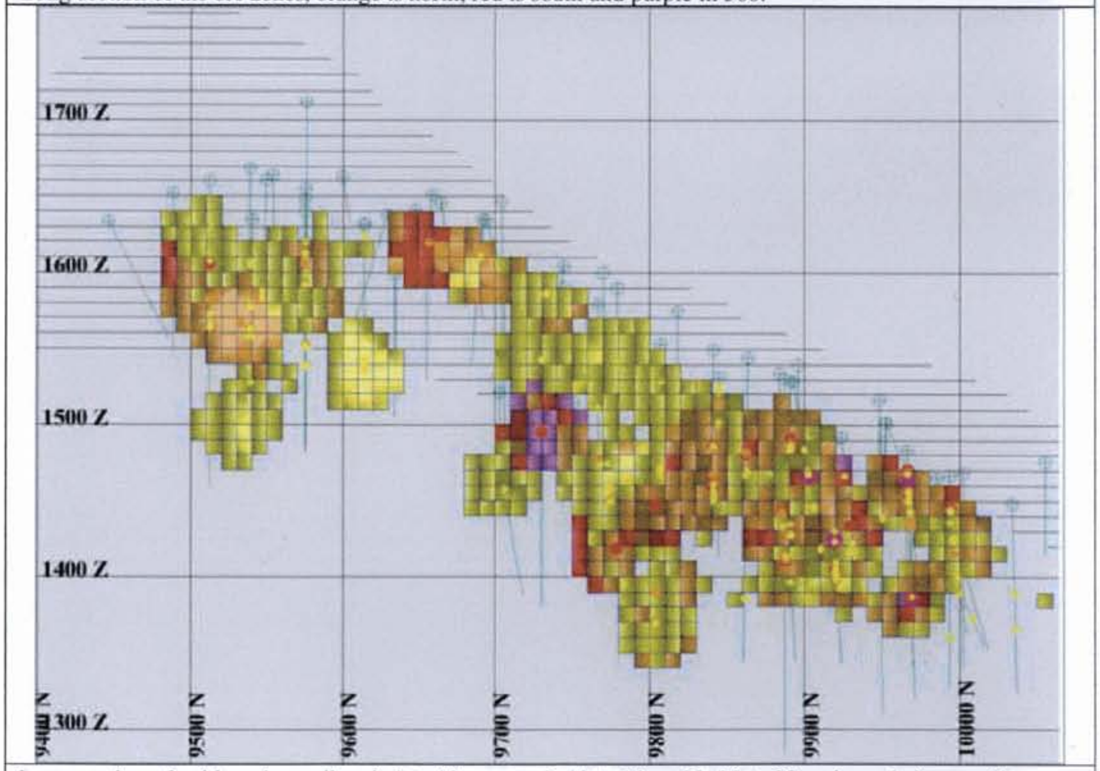
Saunders, CR and Budinski DR, 1991. Geological Reserves for the Spectrum Gold Deposit, Iskut Area, British Columbia, 14 Pages, for Erus Resource Corporation by Orcan Mineral Associates 25 September 1991.

Appendix A

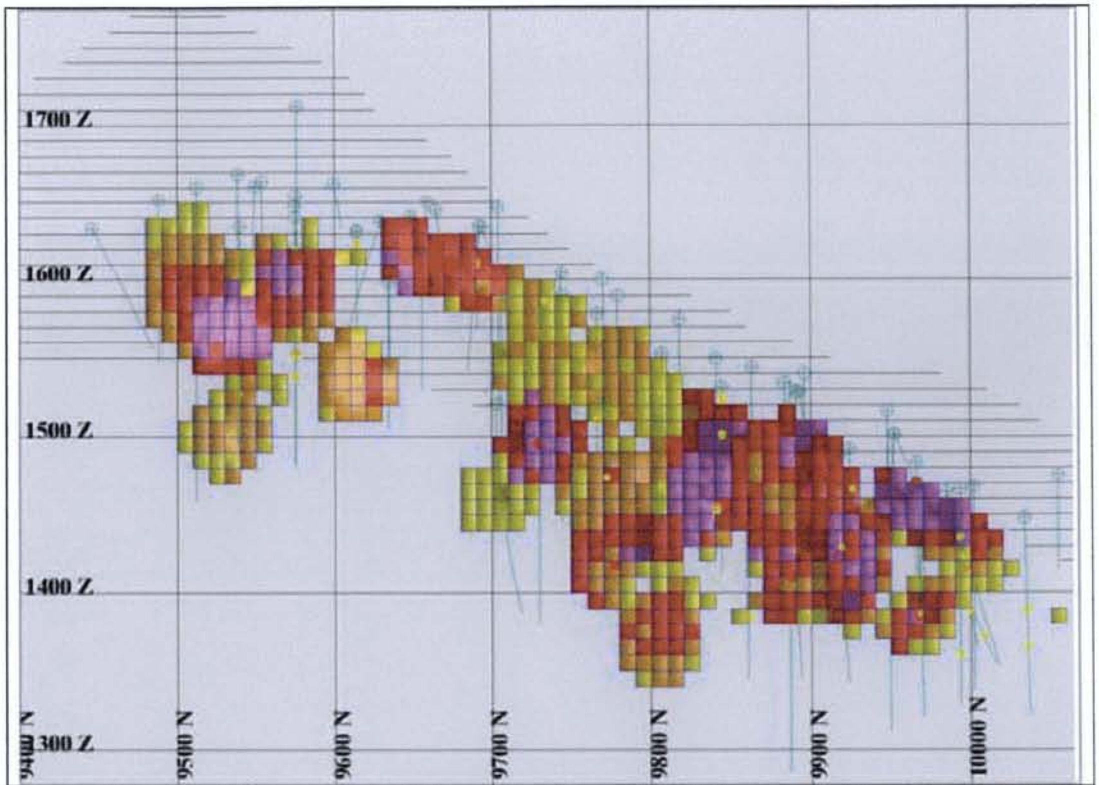
Views of the combined resource models.



Long section of the ore zones, orange is north, red is south and purple in 500.



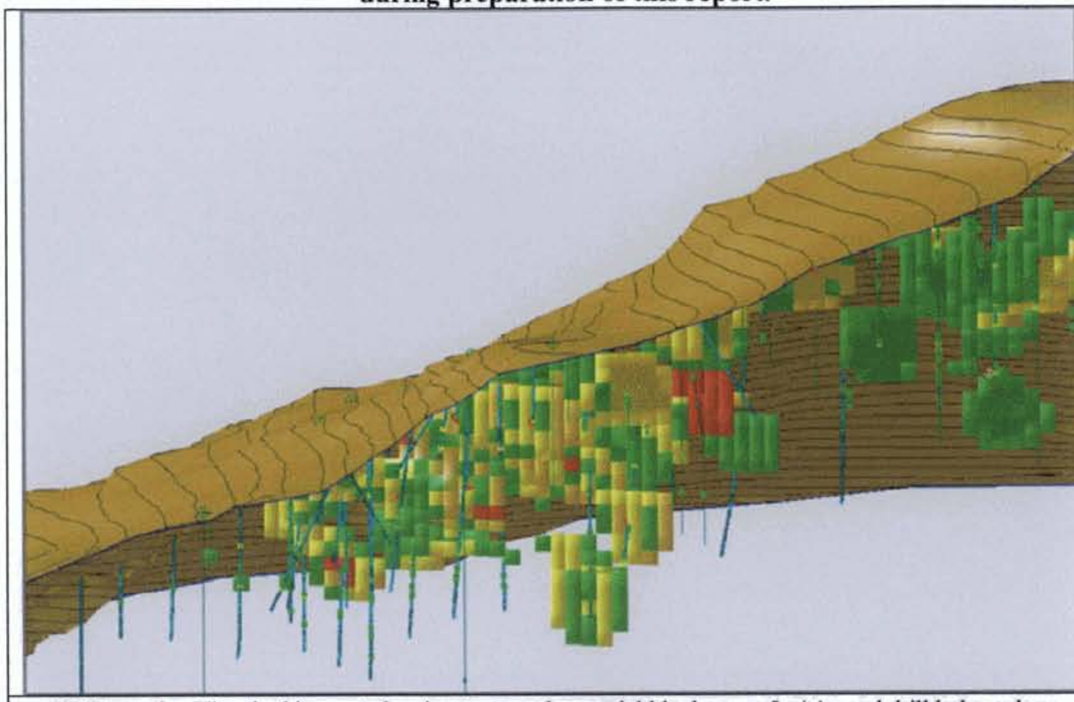
Long section of gold grades, yellow is 5 to 10, orange is 10 to 20, red is 20 to 30 and purple is over 30



Long section of combined ounces per 10x10 panel, yellow is 40 to 100, orange is 100 to 200, red is 200 to 500 and purple is over 500

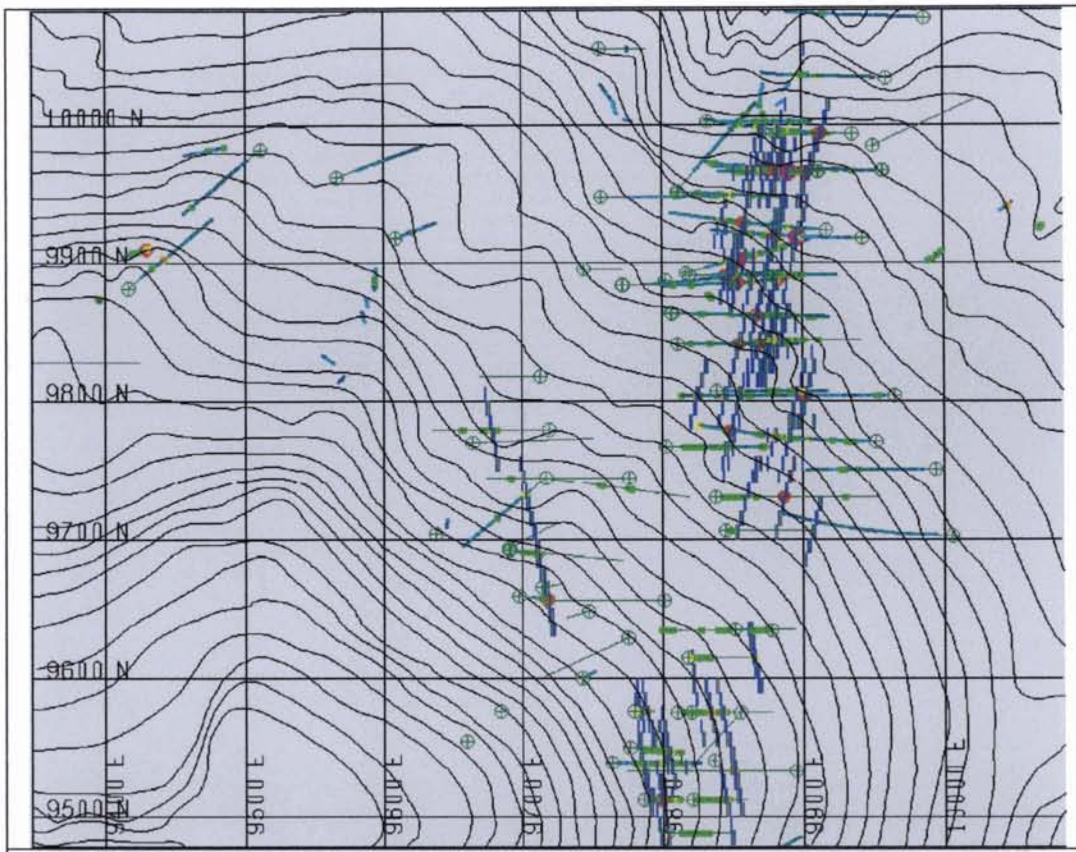
Appendix

Views of the surface topography, drilling, resource model and monzonite body as defined during preparation of this report.

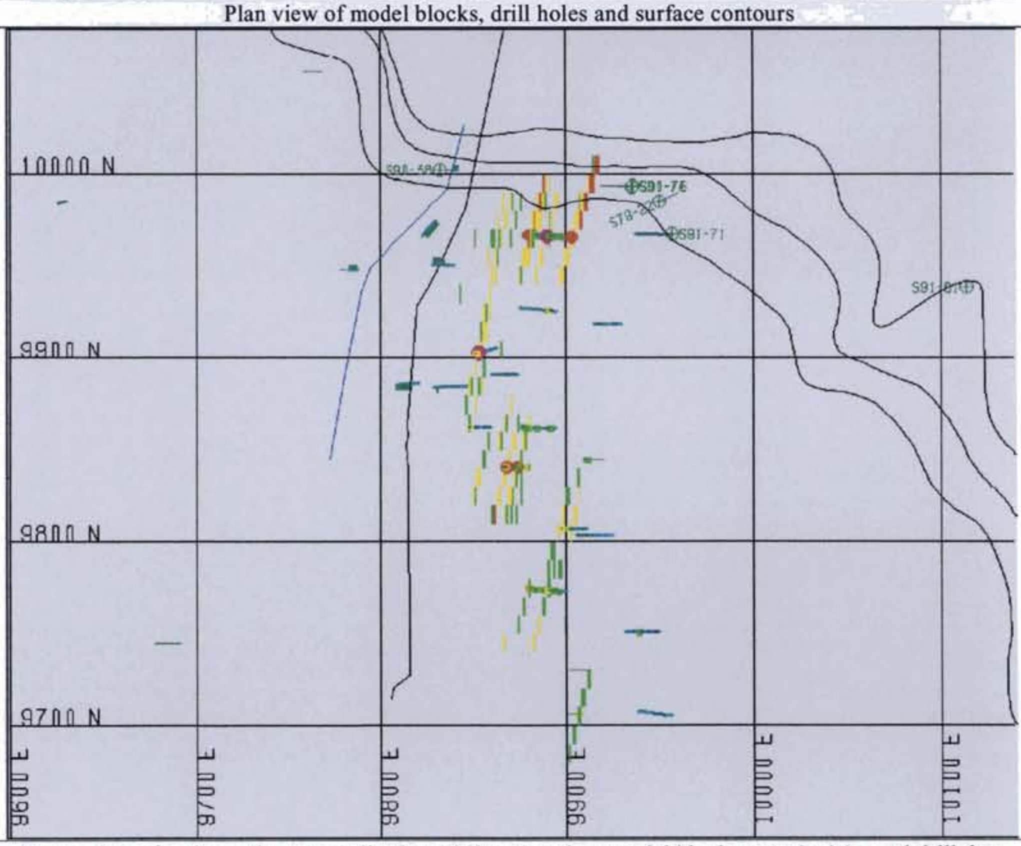


3D Perpective View looking east showing topography, model blocks over 5 g/tAu and drill holes colour coded for grade

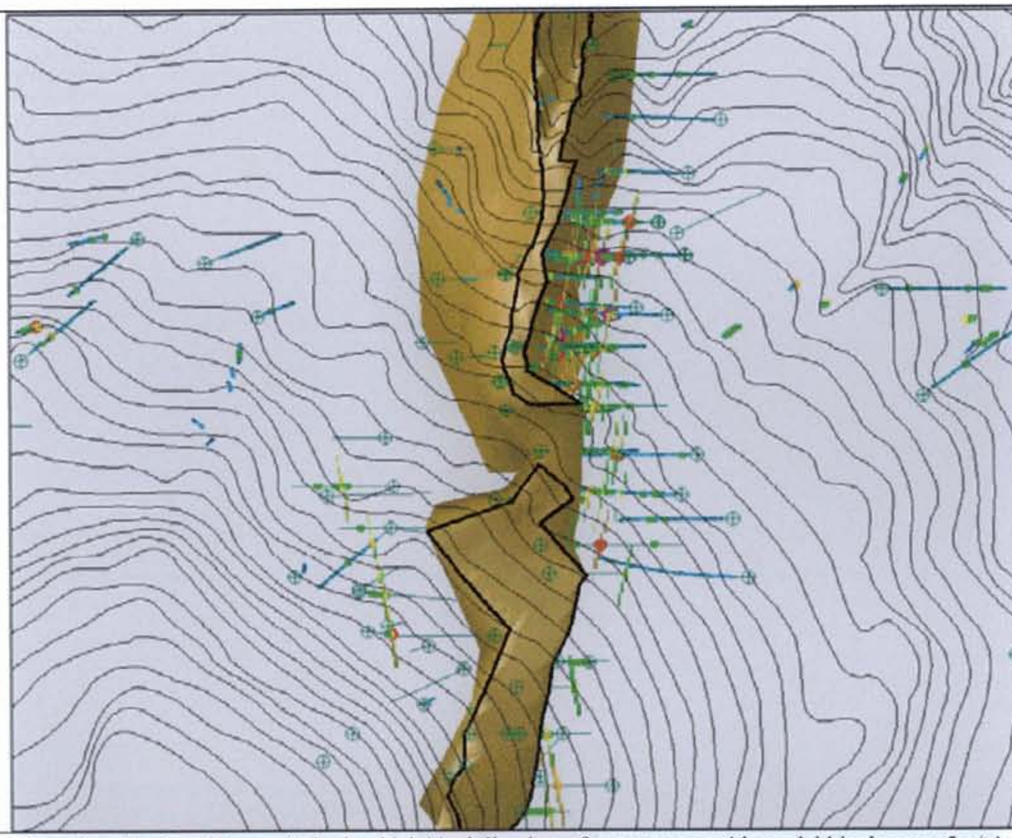
Colour coding legend for drill and block model gold grades



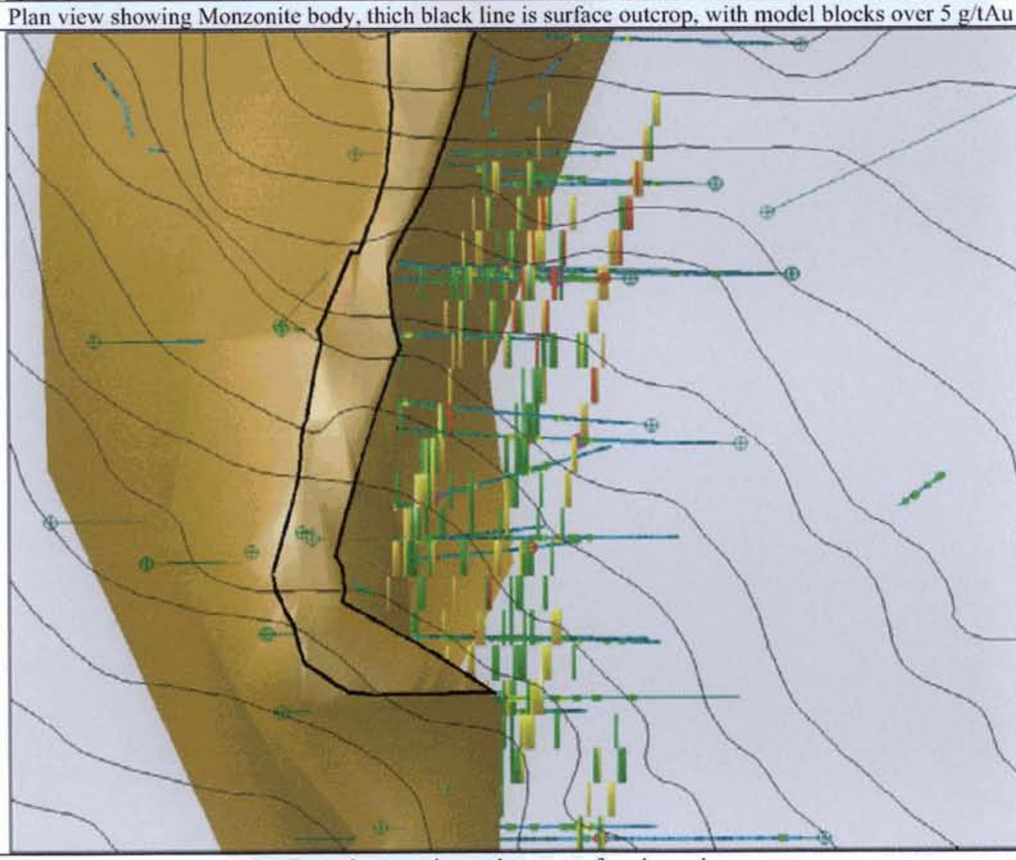
Plan view of model blocks, drill holes and surface contours



Zoom view of main northern area sliced at 1460m elevation, model blocks over 5 g/tAu and drill data

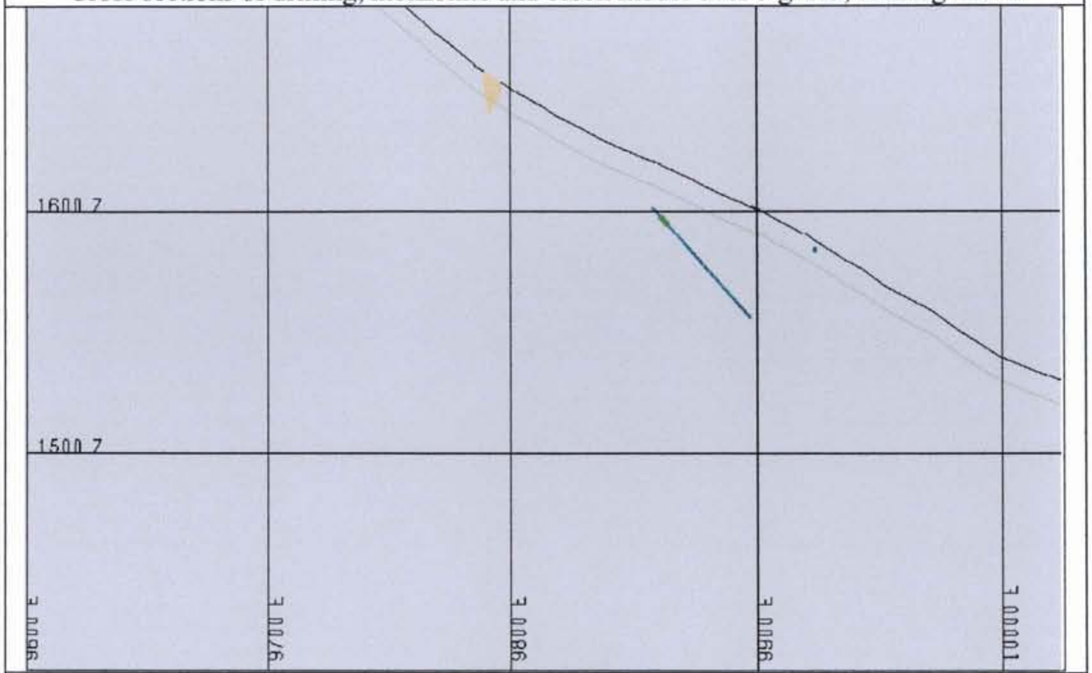


Plan view showing Monzonite body, thich black line is surface outcrop, with model blocks over 5 g/tAu



Zoom in on main northern are of prvious view.

Cross sections of drilling, monzonite and block model over 5 g/tAu, looking North



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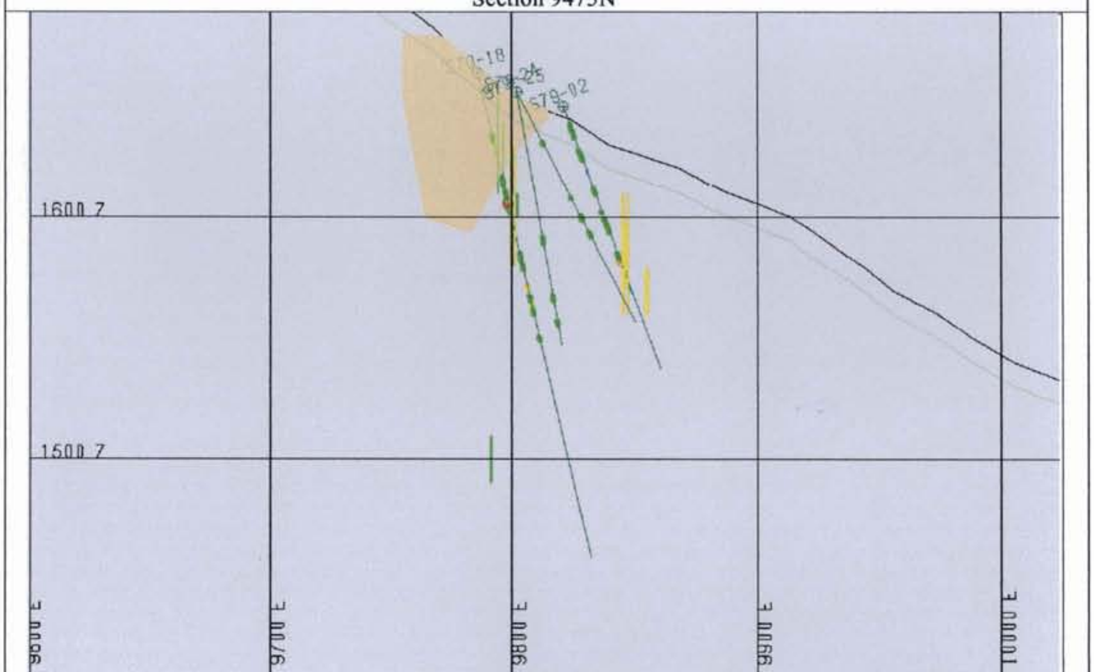

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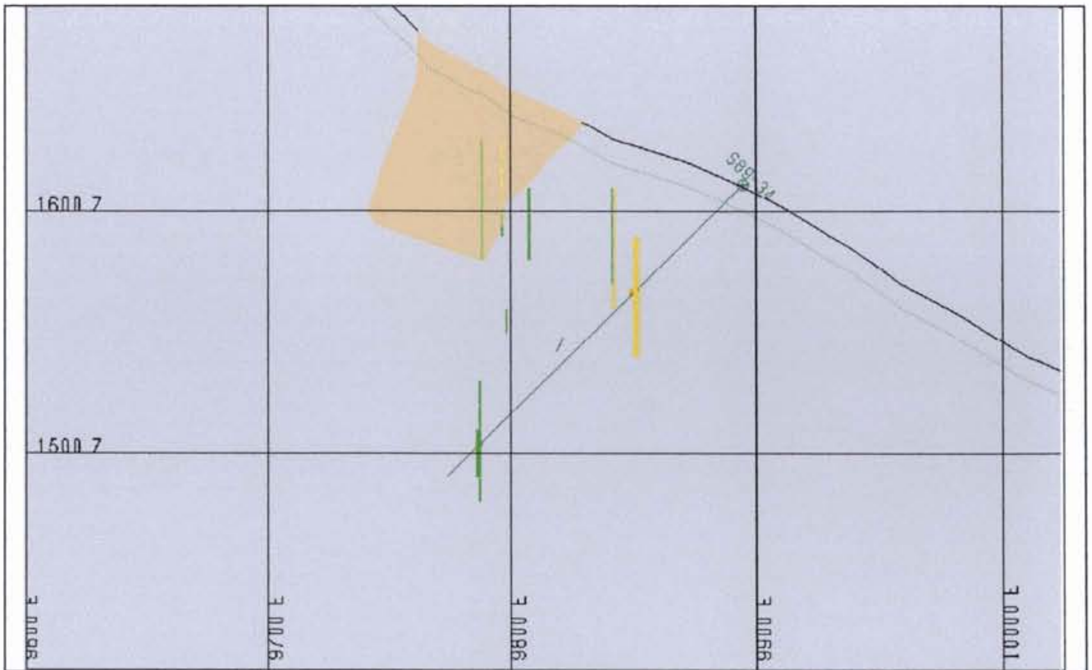

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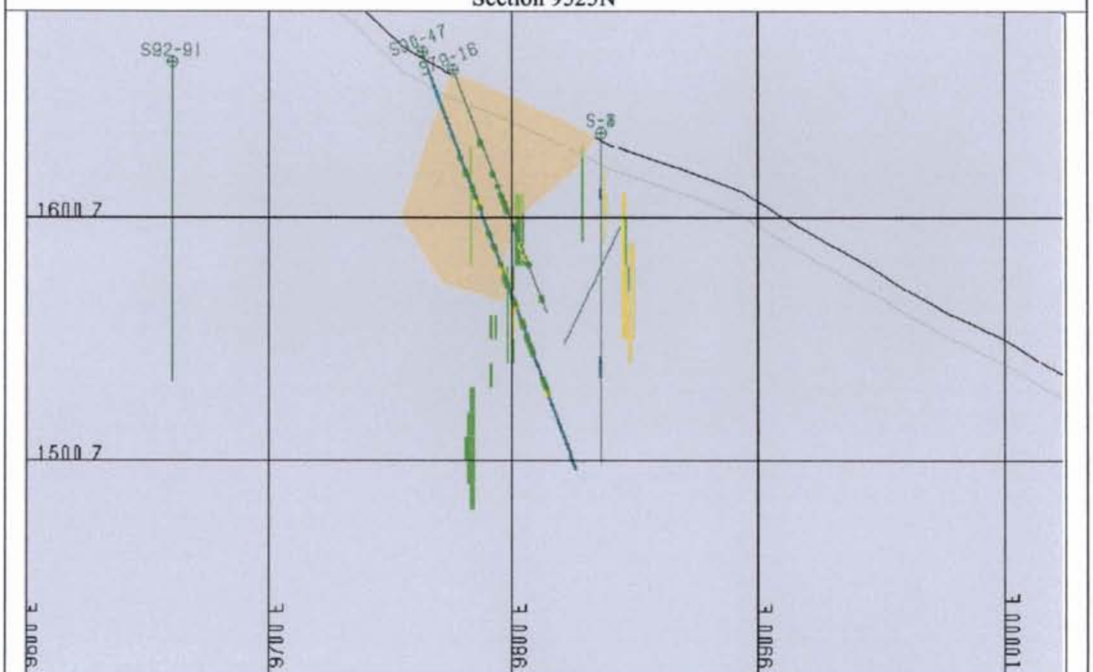

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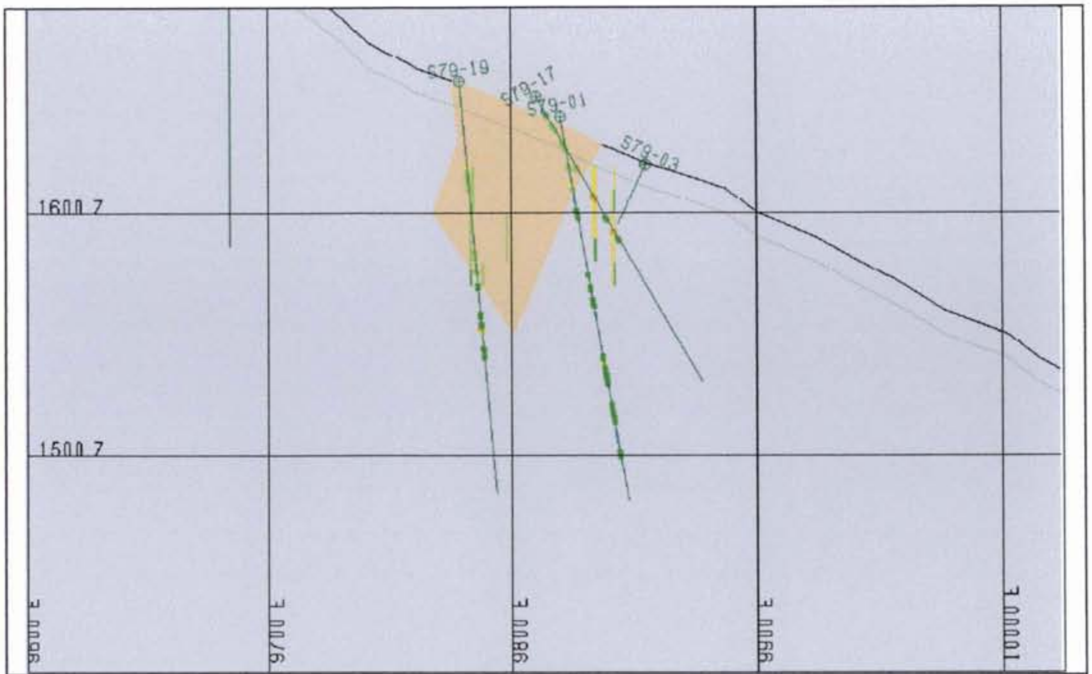

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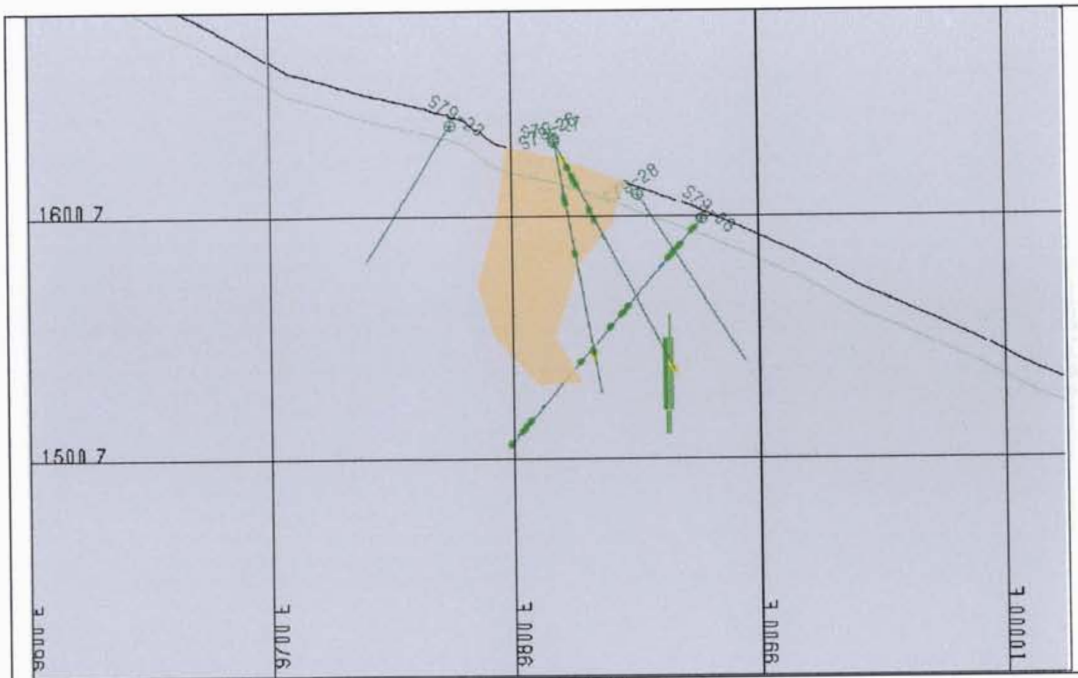

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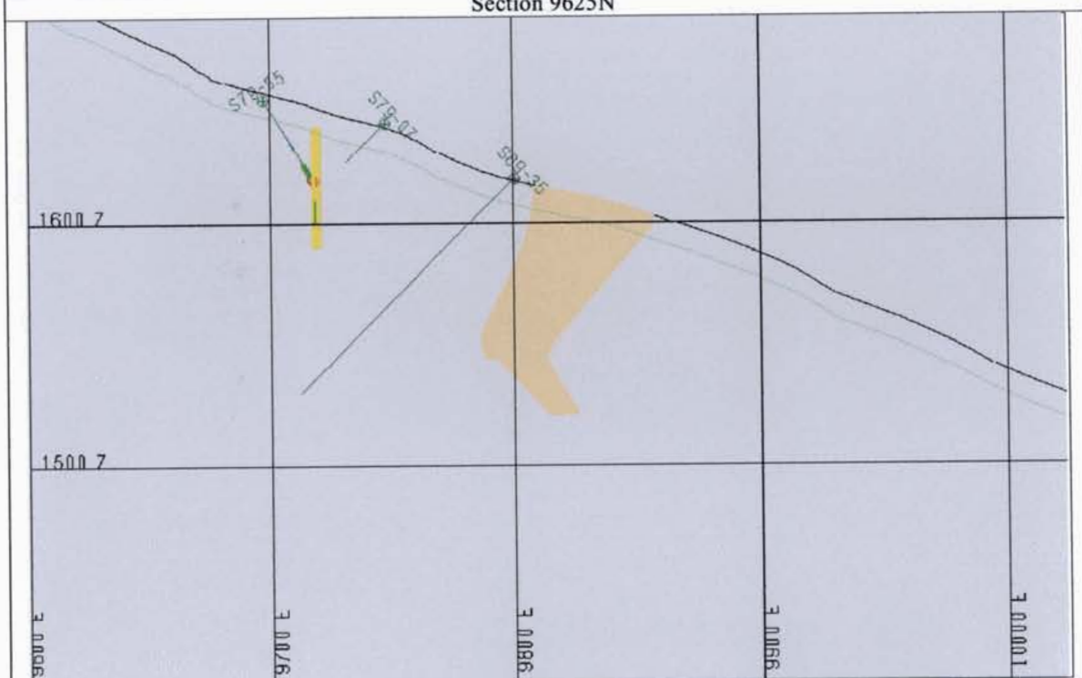

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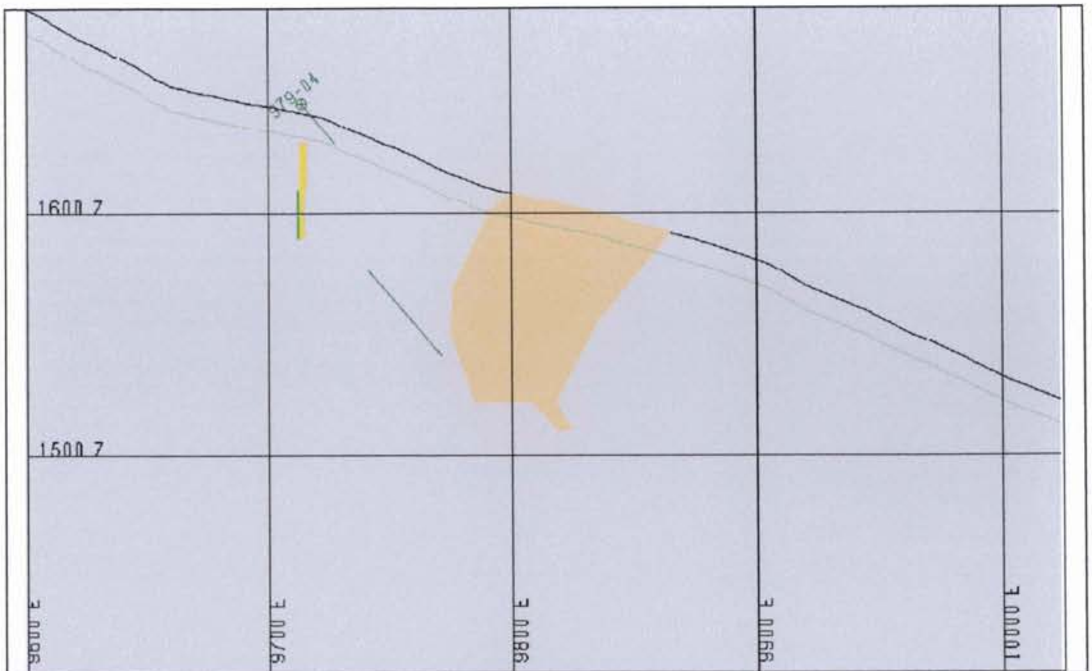

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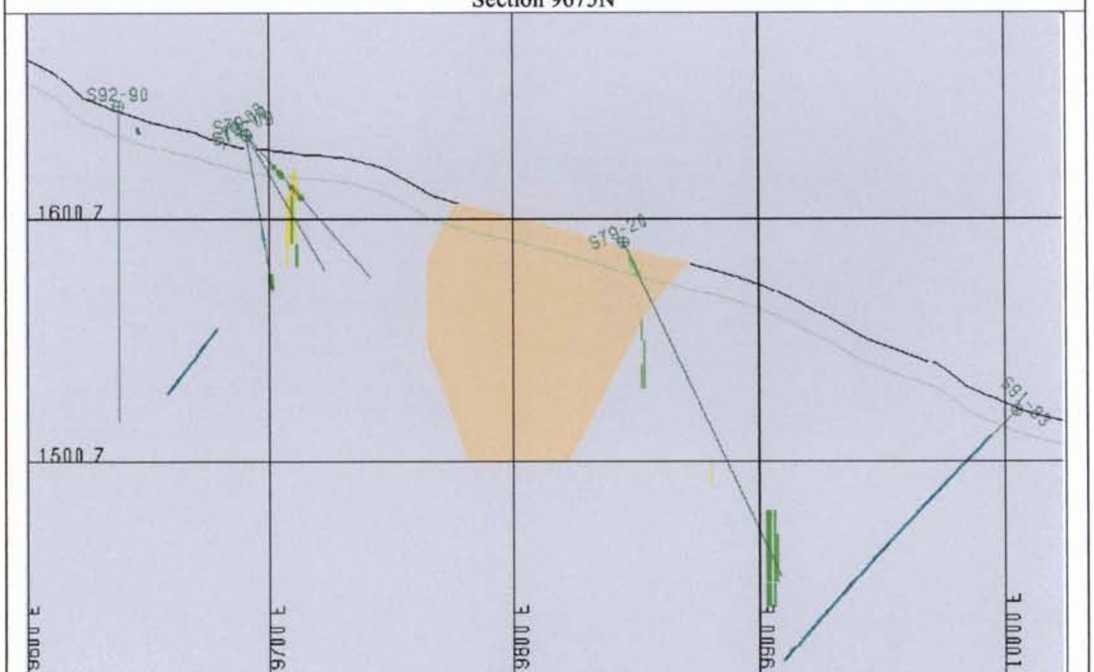

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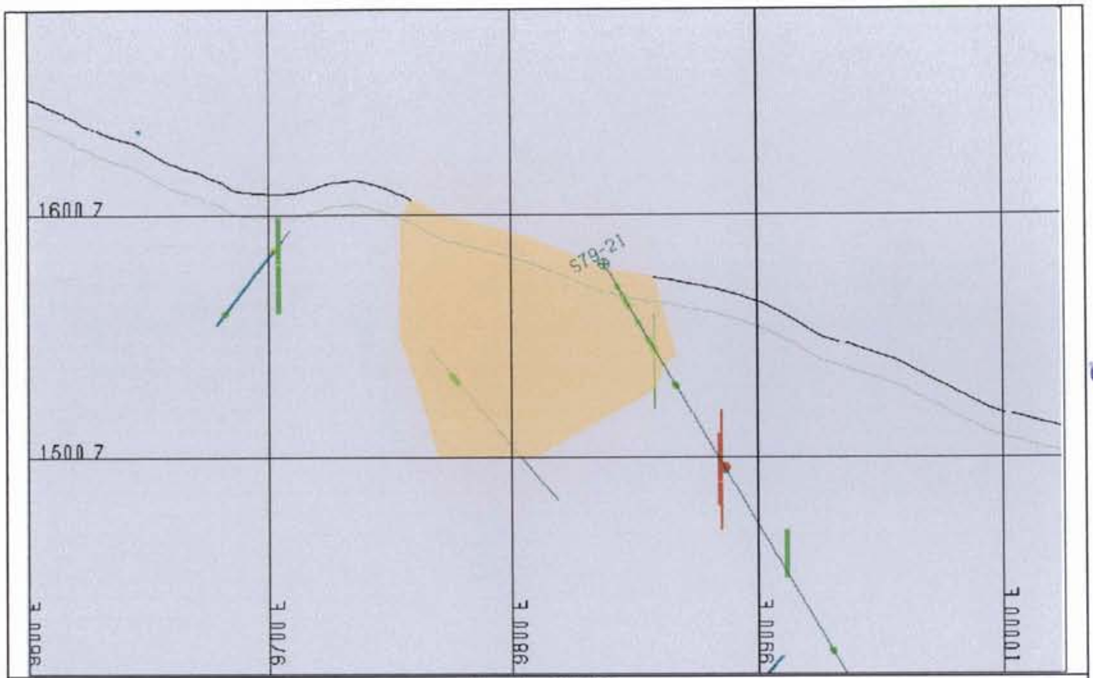

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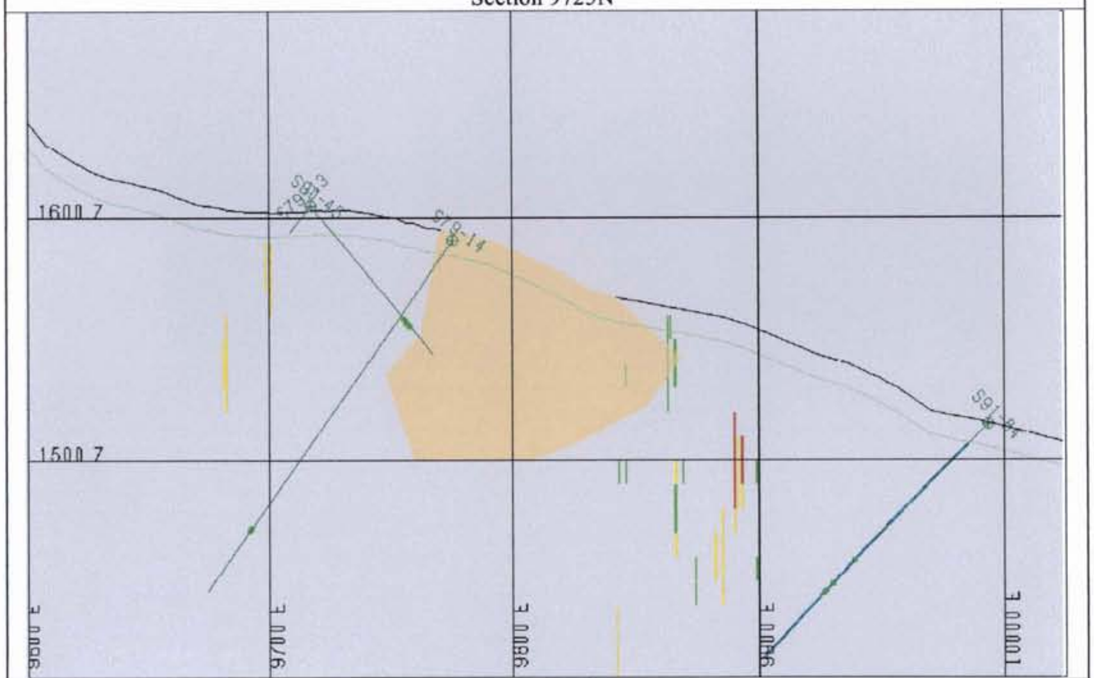

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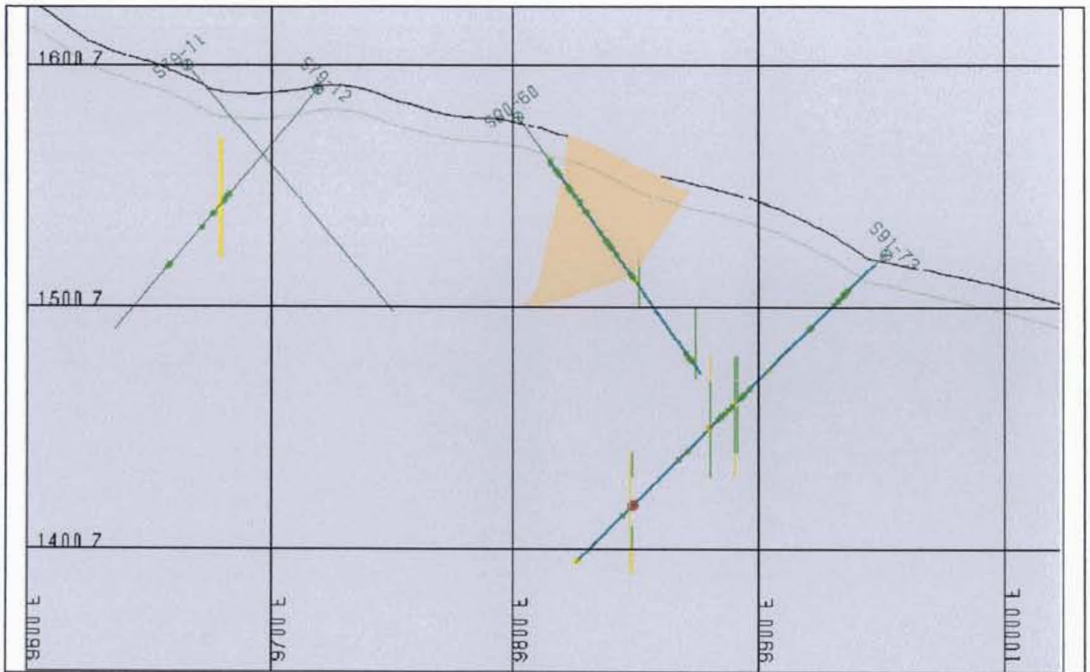

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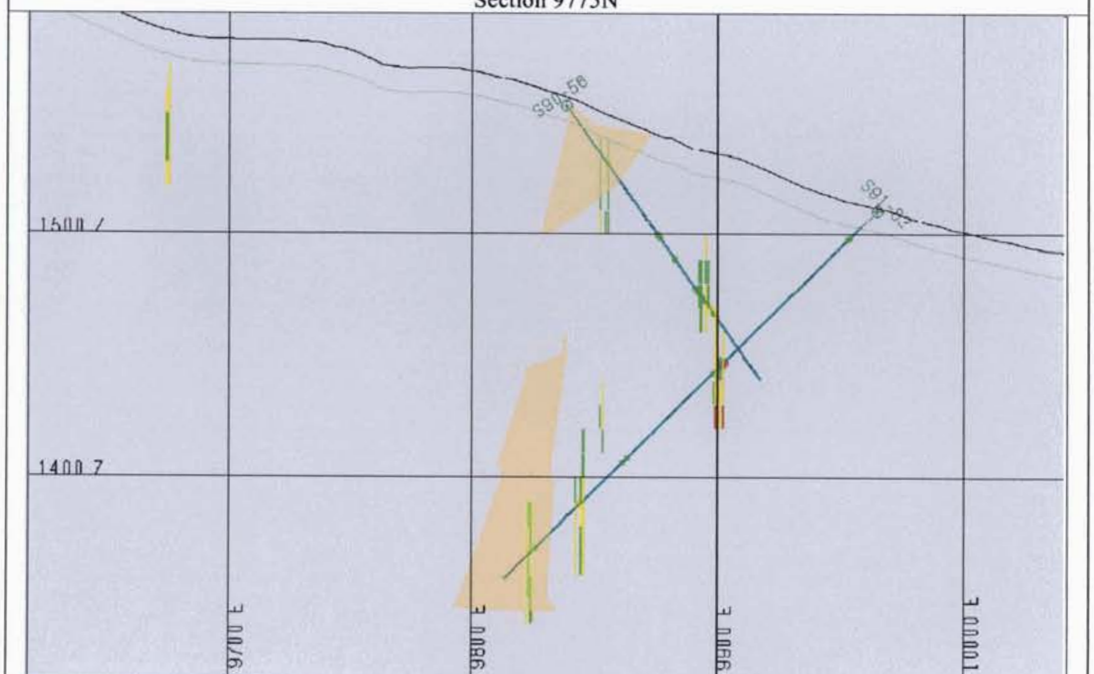

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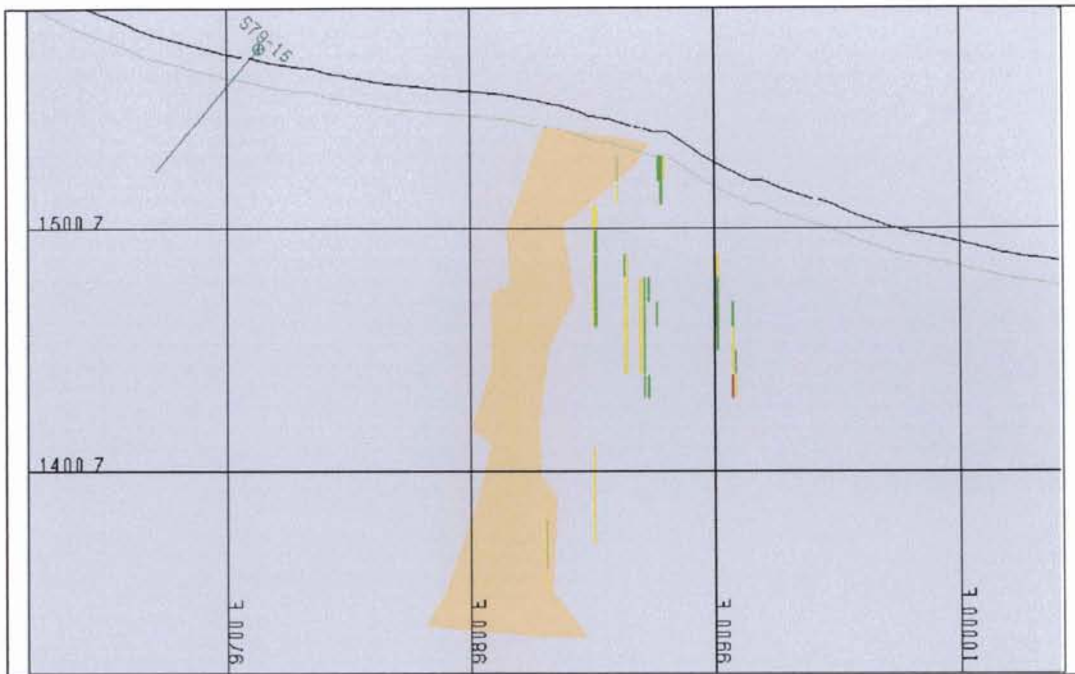

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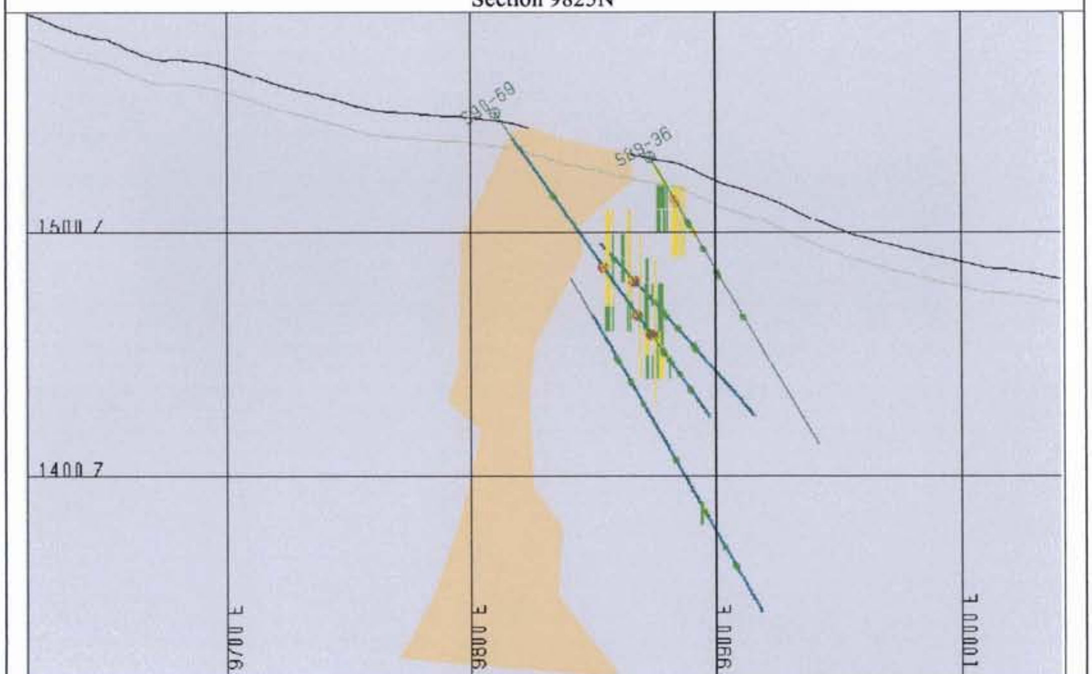

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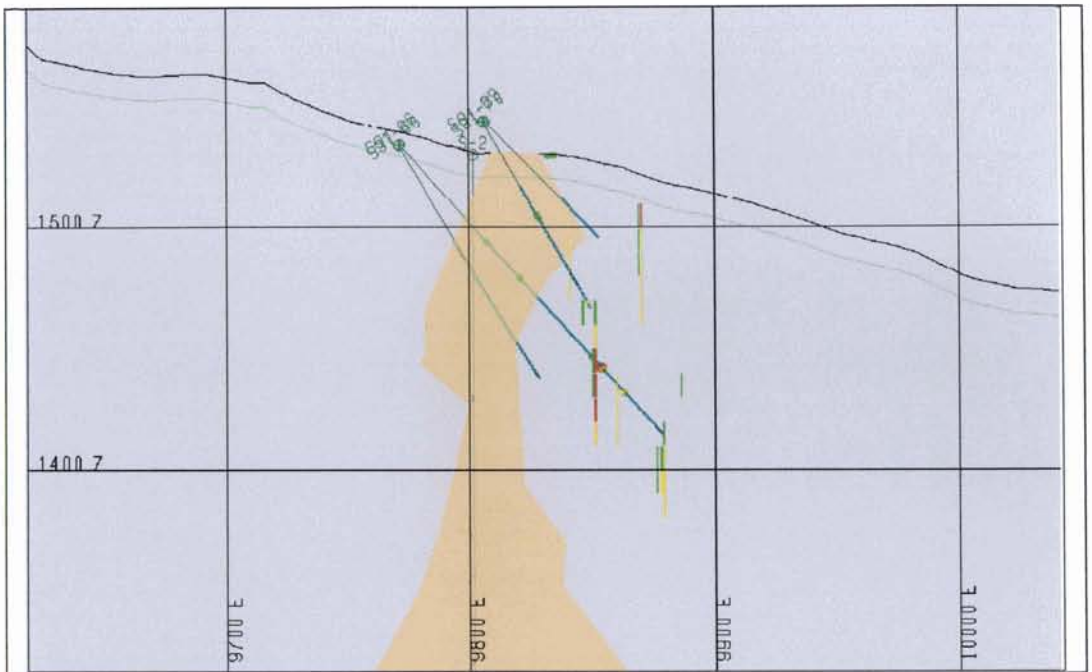

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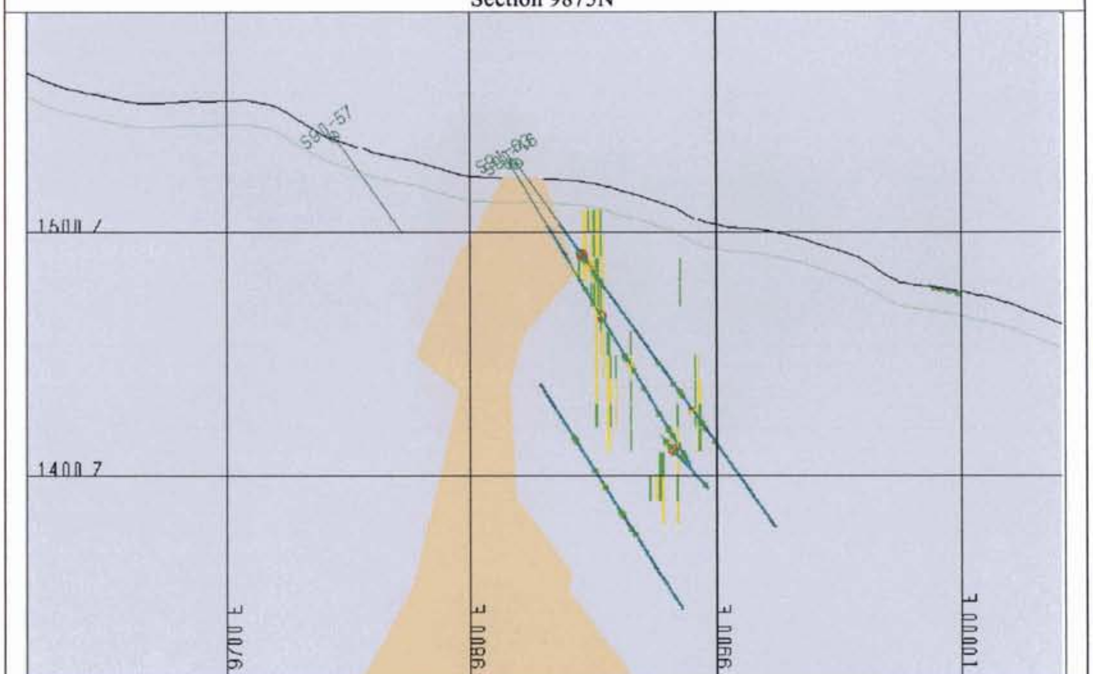

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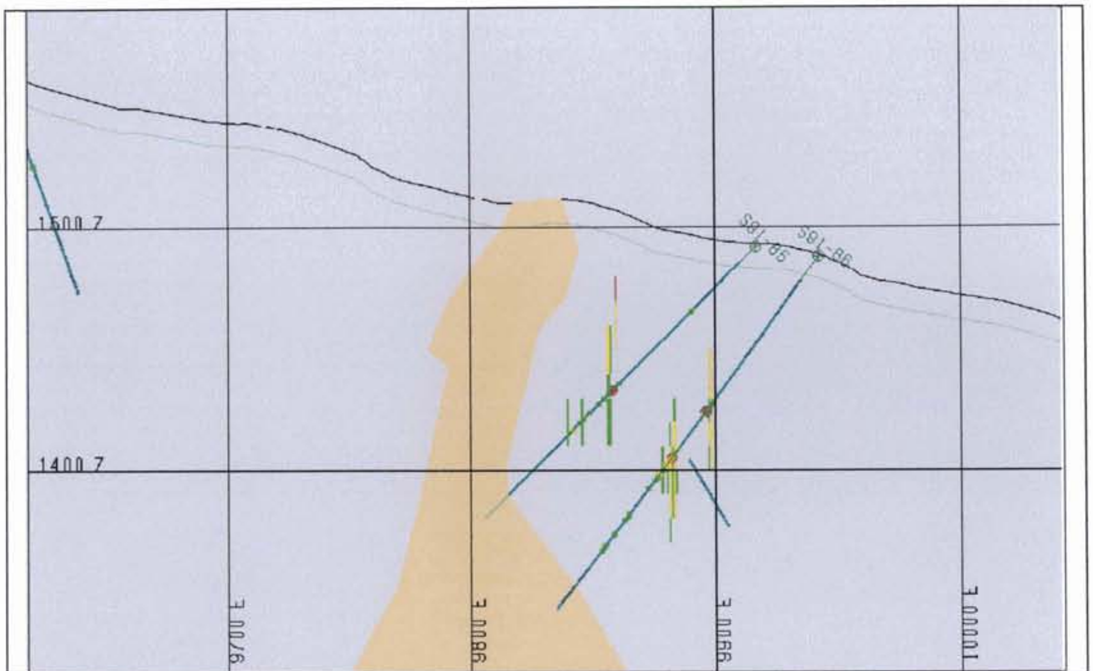

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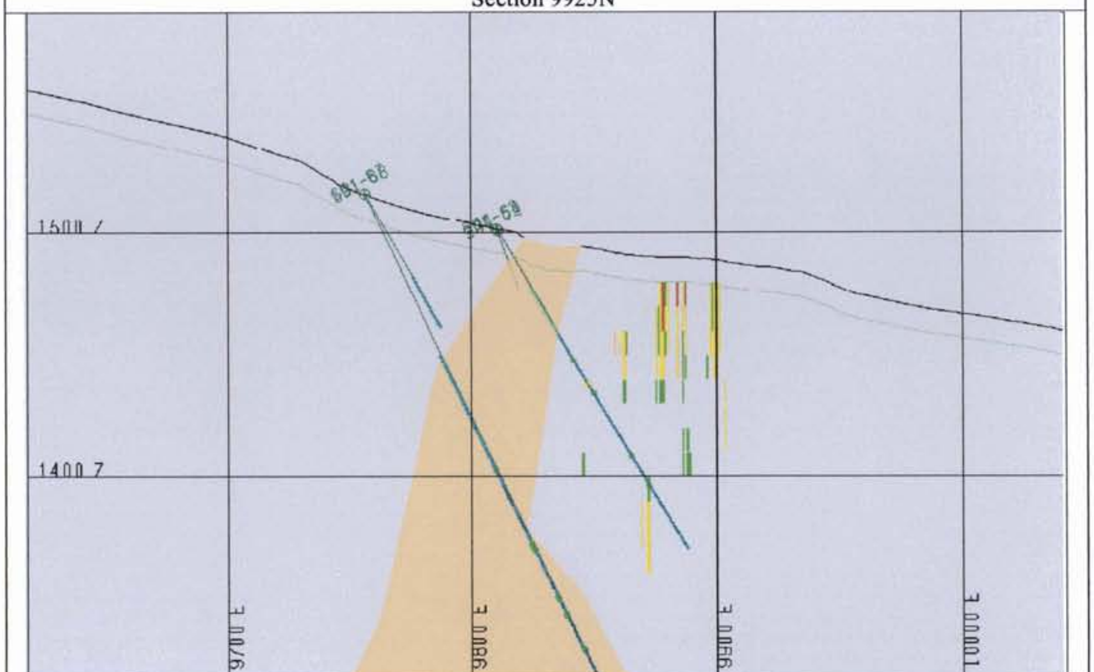

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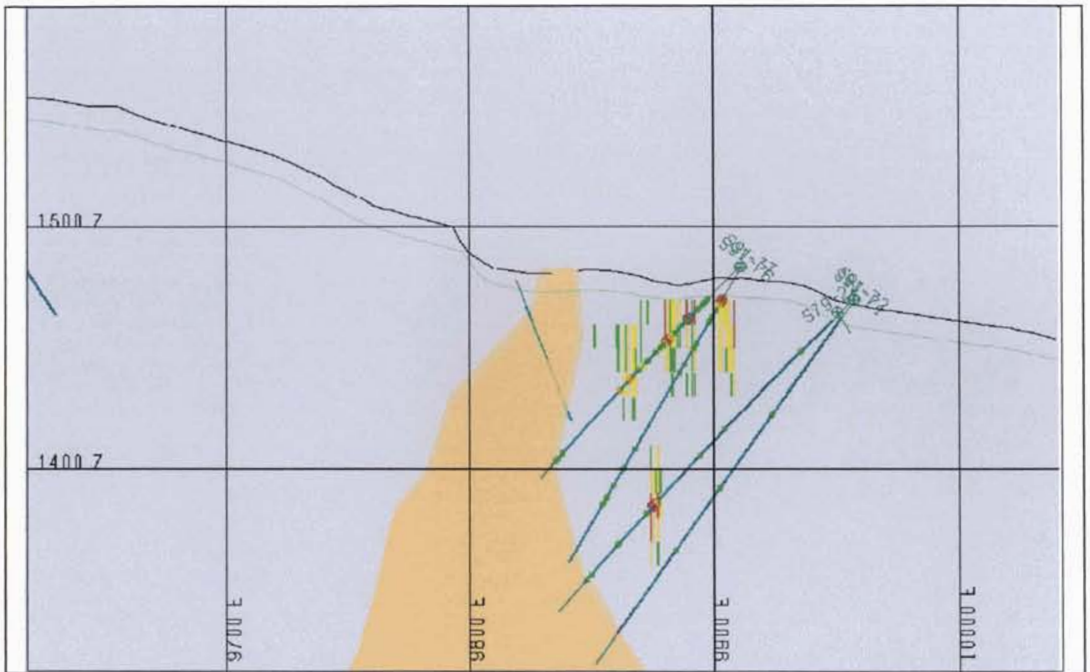

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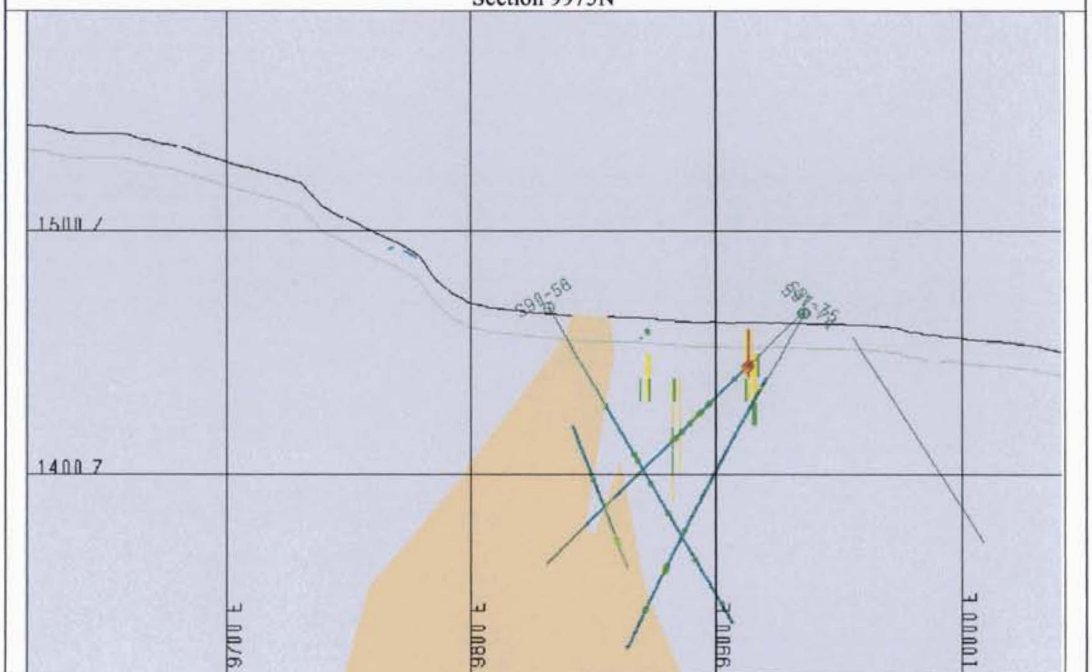

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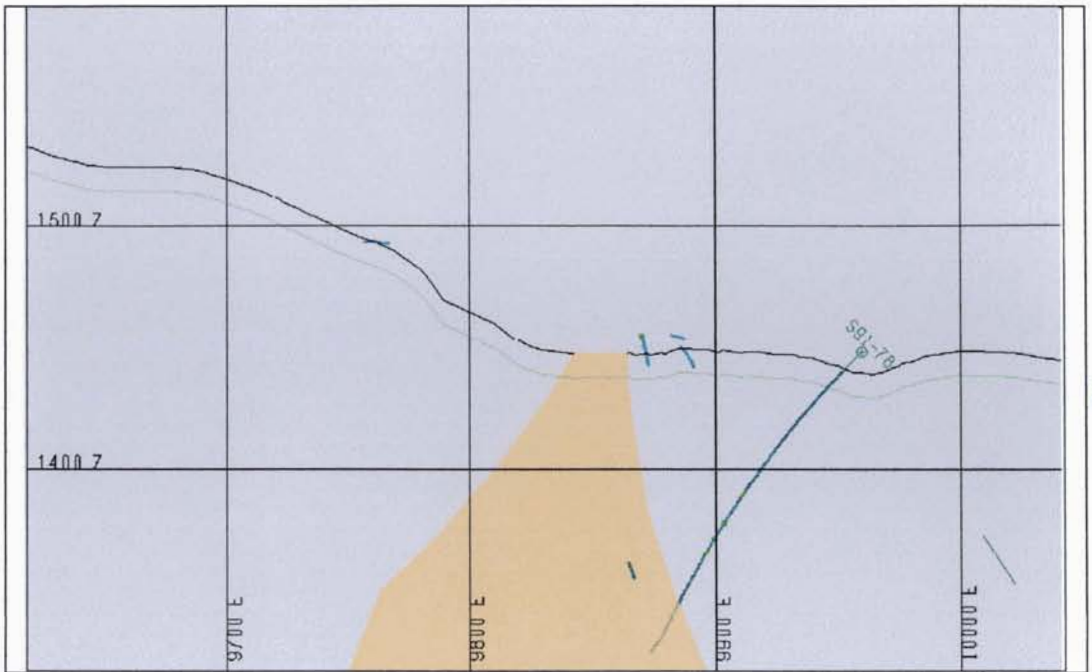

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Schedule B

Mason Geoscience Pty Ltd

Petrological Services for the
Minerals Exploration and Mining Industry

ABN 64 140 231 481 ACN 063 539 686

Postal: PO Box 78 Glenside SA 5065 Australia
Delivery: 141 Yarrabee Rd Greenhill SA 5140 Australia
Ph: +61-8-8390-1507 Fax: +61-8-8390-1194
e-mail: masongeo@ozemail.com.au

Petrographic Description of Drill Core Sample 91.76/34933 (British Columbia, Canada)

REPORT #	**2933**
CLIENT	**Taylor Wall & Associates Pty Ltd**
ORDER NO	**Telephone request, 10 December 2003**
CONTACT	**Dr Vic Wall**
REPORT BY	**Dr Douglas R Mason**
SIGNED	
	for Mason Geoscience Pty Ltd
DATE	**17 December 2003**

Petrographic Description of Drill Core Sample 91.76/34933 (British Columbia, Canada)

SUMMARY

1. Rock Samples

- A portion of drill core, labelled 91.76/34933, from British Columbia (Canada) has been studied using routine optical petrographic and mineragraphic methods, supplemented by staining of the section offcut for K-feldspar.

2. Brief Results

- **The mineralogy** of the rock is (in approximate order of decreasing abundance): arsenopyrite, K-feldspar, sericite, calcite, pyrite, chlorite, and trace quartz, chalcopyrite, rutile, apatite and native gold.

- **A fragmental texture** is defined by irregularly shaped high-intensity altered wallrock fragments, now composed mainly of sericite + K-feldspar + arsenopyrite + chlorite, in a matrix dominated by arsenopyrite + K-feldspar + pyrite + other minor minerals including native gold. The native gold occurs as inclusions within arsenopyrite, and also as intergrowths with other minerals including K-feldspar and sericite.

- **Genesis of the rock** is considered to have evolved through stages of intense brecciation of unknown silicate wallrock, invasion by a large volume of mineralising hydrothermal fluid, and consequent intense alteration of wallrock fragments and cementation in the mineralised breccia matrix.

1 INTRODUCTION

A drill core sample, labelled 91.76/34933, was received from Dr Vic Wall (Taylor Wall & Associates, Spring Hill, Qld) on 12 December 2003.

In telephone discussion, it was indicated that the sample originates from a gold prospect in British Columbia, developed as a subvertical body in wallrocks marginal to a porphyry intrusion.

Particular requests were:

i) To polish the sawn surface of the sample on which numerous black marks encircle gold grains.

ii) To provide a macrophotograph of the polished slice.

iii) To prepare a polished thin section and combined petrographic/mineragraphic description.

iv) To provide a colour photomicrograph of the native gold.

Brief preliminary petrographic comments were provided to Dr Wall on 12 December 2003. This report contains the full results of this work.

2 METHODS

The drill core sample was examined in hand specimen. Black circles, drawn by the client, were noted on the sawn surface. At the laboratory of Pontifex & Associates Pty Ltd (Rose Park, South Australia), a slice was cut parallel to the original sawn surface, and the sawn surface was polished. A polished thin section was prepared from the remnant core sample.

At Mason Geoscience Pty Ltd conventional transmitted and reflected polarised light microscopy was used to prepare the combined petrographic and mineragraphic descriptions.

Preliminary petrographic observations suggested that K-feldspar was present. For confirmation, the section offcut was stained for K-feldspar using the conventional sodium cobaltinitrite method. The offcut was etched in HF for ~10 seconds, rinsed in water, covered with freshly made saturated solution of sodium cobaltinitrite for ~30 seconds, and finally rinsed. This procedure generates a bright yellow stain where K-feldspar occurs in the rock. The results are given under Hand Specimen description in the petrographic description.

3 PETROGRAPHIC DESCRIPTIONS

The combined petrographic and mineragraphic description is provided in the following pages.

SAMPLE : **91.76 / 34933 (British Columbia, Canada)**

SECTION NO : 91.76 / 34933

HAND SPECIMEN : The drill core sample represents a massive fine-grained dark grey rock through which is distributed abundant fine-grained lustrous metallic grey sulphide (arsenopyrite). An indistinct patchiness, defined by more and less abundant sulphide, appears to represent a fragmental texture. Tiny bright grains of native gold are sparsely disseminated through the rock, with a tendency to occur in the general vicinity of white irregularly oriented thin fractures.

The section offcut accepted a positive yellow stain for K-feldspar, confirming it occurs abundantly through the rock as small grains irregularly distributed in indistinct patches.

ROCK NAME : **Arsenopyrite-K-feldspar-sericite-calcite altered breccia**

FIG. 1: SAMPLE 91.76/34933. Polished surface of drill core slice, oblique view. Grains of native gold are present, but cannot be discerned in the high lustre of the abundant arsenopyrite (metallic white).

FIG. 2: SAMPLE 91.76/34933. Reverse (unpolished) surface of drill core slice, oblique view. Small grains of native gold (bright metallic yellow) are observable, especially near the thin white fracture at upper left.

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Arsenopyrite	40	Alteration / breccia matrix / veinlets
K-feldspar	33	Alteration / breccia matrix
Sericite	15	Alteration (after ?wallrock fragments)
Calcite	10	Alteration / veinlets
Pyrite	1	Alteration / breccia matrix
Chlorite	<1	Alteration / breccia matrix
Quartz	Tr	Alteration / breccia matrix
Chalcopyrite	Tr	Alteration / breccia matrix
Rutile	Tr	Alteration / breccia matrix
Apatite	Tr	Alteration / breccia matrix
Native gold	Tr	Alteration / breccia matrix

In polished thin section, this sample displays a granular texture, with irregular distribution of minerals.

Arsenopyrite is abundant, forming small subhedral grains and dense granular aggregates. Much is concentrated in areas that appear to define the breccia matrix, but some also occurs in poorly-defined discontinuous veinlets.

K-feldspar is the other principal mineral, occuring as equant subhedral to anhedral clear grains that mostly occur intergrown with arsenopyrite in the inferred breccia matrix areas. Indistinct crystallographically controlled patches in the K-feldspar suggest that it may be adularia. Some K-feldspar also occurs as granular aggregates through subrounded areas that possibly represent severely altered ?wallrock.

Sericite occurs in moderate amount as small randomly oriented flecks and dense mats of those flecks. In places, larger ragged plates are also present in the finer-grained mats. Most of the sericite is concentrated in the subrounded areas inferred to represent completely altered ?wallrock fragments, but some sericite also occurs as tiny flecks elsewhere through the rock.

Calcite is present in moderate amount as small anhedral grains that are mostly concentrated in discontinuous veinlets. It also forms ragged aggregates in the severely altered ?wallrock fragments.

Pyrite occurs in minor amount as anhedral grains and aggregates, restricted to a limited area. It is absent throughout most of the rock.

Chlorite occurs in minor amount as ragged aggregates, mostly in the altered ?wallrock fragments. The aggregates are composed of minute drab green flakes that are randomly oriented in the aggregates.

Quartz is present in trace amount as clear small angular grains in textural equilibrium with K-feldspar in the breccia matrix areas.

Chalcopyrite occurs in trace amount as small angular grains that tend to occur in the dense sericite mats in the altered ?wallrock fragment sites.

Rutile forms tiny granules irregularly sprinkled through the altered ?wallrock fragments, and also forms larger stumpy prisms in equilibrium textural relationship with arsenopyrite and K-feldspar in the breccia matrix areas.

Apatite occurs as small equant crystals with typical high relief and low birefringence. It occurs mostly in the K-feldspar grains and aggregates.

Native gold occurs as ovoid grains within arsenopyrite, and as ragged grains intergrown with K-feldspar, sericite and arsenopyrite in breccia matrix. The bright yellow colour of the native gold suggests it has a moderately high fineness.

INTERPRETATION :

The mineralogy and microtextures of this sample are consistent with the following interpretation:

1. Wallrock of unknown (?silicate) composition suffered brecciation and invasion by a large volume of hydrothermal fluid.

2. Wallrock fragments were replaced by, and the matrix was sealed by, the assemblage arsenopyrite + K-feldspar + sericite + calcite + minor pyrite + chlorite + trace quartz + chalcopyrite + rutile + apatite + native gold. Irregularly oriented discontinuous fractures were filled variably by calcite and dense arsenopyrite. The matrix was dominated by arsenopyrite + K-feldspar with minor native gold, and the ?wallrock fragments were replaced mainly by sericite + calcite.

A number of features suggest that the alteration occurred under relatively low-temperature conditions:

i) The type of K-silicate: K-feldspar rather than biotite is the dominant K-silicate phase.

ii) The microstructure of K-feldspar: K-feldspar displays indistinct patchiness suggestive of adularia.

iii) Nature of chlorite: chlorite occurs as ragged aggregates, each composed of poorly crystallised tiny randomly oriented flecks.

FIG. 3: SAMPLE 91.76/34933 (Macrophotograph of polished thin section, 2.7 cm left to right; Film 1 / Frame 1)
This view of part of the polished thin section illustrates the fragmental texture of the rock, emphasised by concentration of arsenopyrite (black grains) in matrix which encloses sericite-K-feldspar altered lithic fragments (colourless).

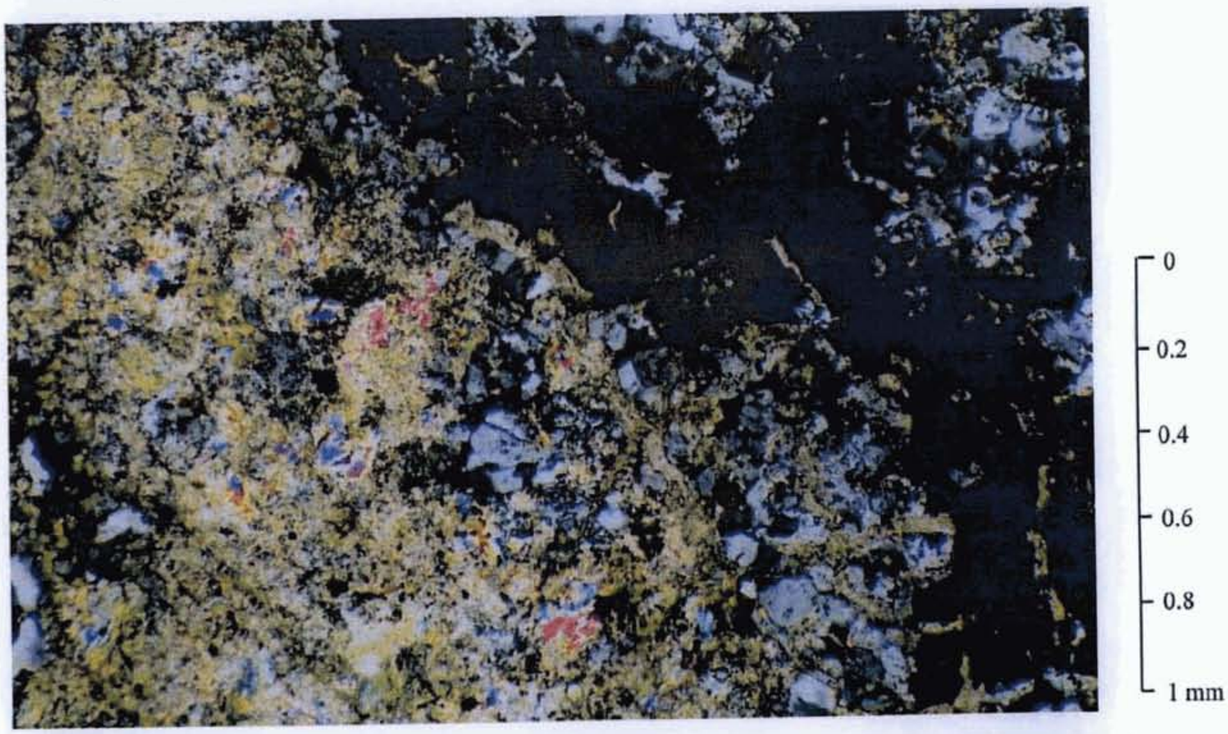


FIG. 4: SAMPLE 91.76/34933 (Photomicrograph, transmitted light, crossed polarisers, x5, Film 1 / Frame 6)
This view captures part of an altered lithic fragment (left) now composed of a dense mat of fine-grained sericite (yellows, pinks) and lesser K-feldspar (grey to white). Breccia matrix (upper right) is composed of abundant opaque grains (mostly arsenopyrite) intergrown with K-feldspar (grey to white).

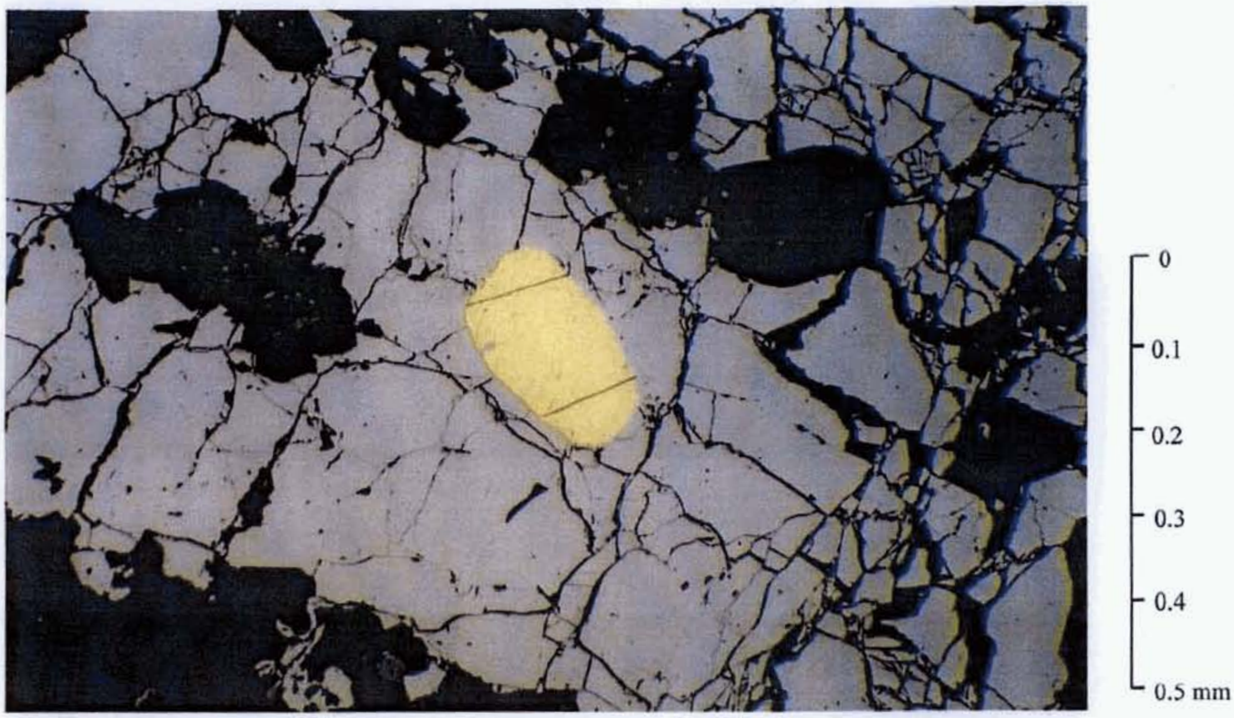


FIG. 5: SAMPLE 91.76/34933 (Photomicrograph, reflected plane polarised light, x10, Film 1 / Frame 2)
This view illustrates the occurrence of a grain of native gold (bright yellow) enclosed within arsenopyrite (off-white) in the breccia matrix. Most of the black grains are K-feldspar.

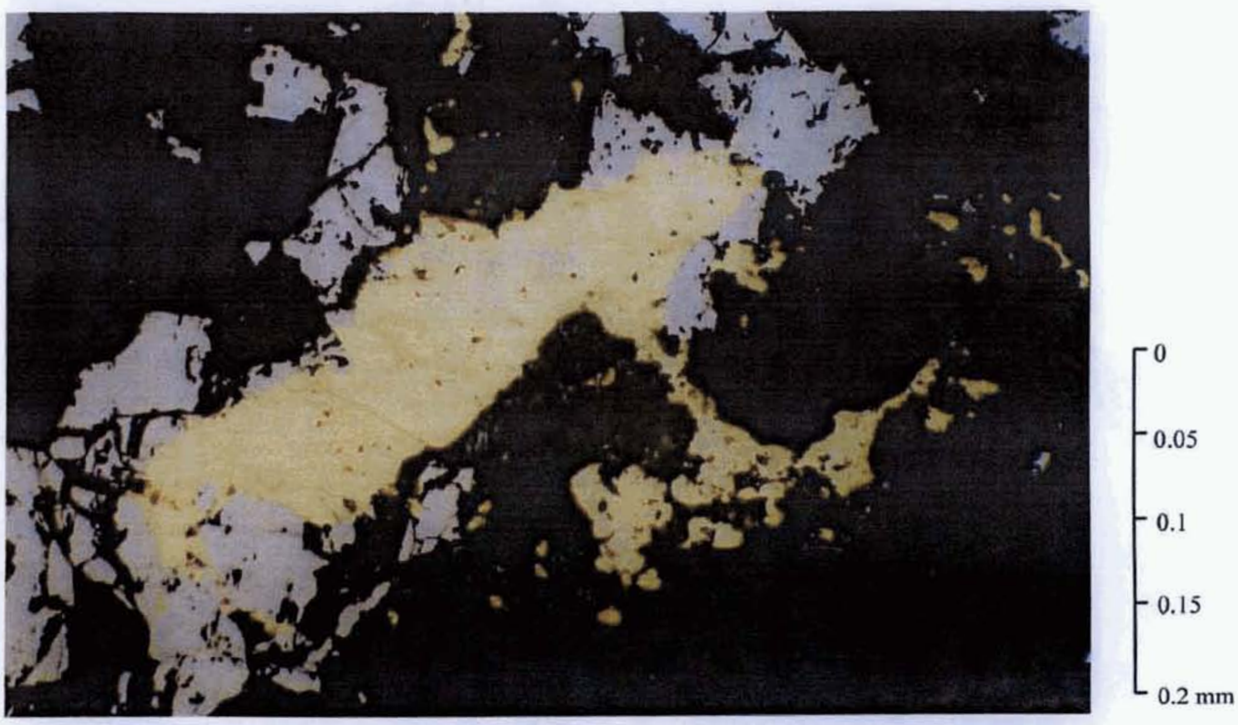


FIG. 6: SAMPLE 91.76.34933 (Photomicrograph, reflected plane polarised light, x20, Film 1/ Frame 5)
This view captures a ragged grain of native gold (bright yellow) that is intergrown variably with arsenopyrite (off-white) and non-opaque gangue minerals (K-feldspar, sericite).

Schedule C

Mason Geoscience Pty Ltd

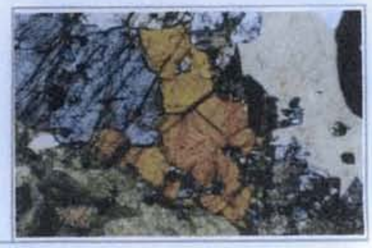
Petrological Services for the
Minerals Exploration and Mining Industry

ABN 64 140 231 481 ACN 063 539 686

Postal: PO Box 78 Glenside SA 5065 Australia
Delivery: 141 Yarrabee Rd Greenhill SA 5140 Australia
Ph: +61-8-8390-1507 Fax: +61-8-8390-1194
e-mail: masongeo@ozemail.com.au

Petrological Study of Eight Drill Core Rock Samples from Drill Hole S91-76 at the Spectrum Gold Deposit (British Columbia, Canada)

REPORT #	**2979**
CLIENT	**Trans Pacific Mining Ltd**
ORDER NO	**Telephone discussion, R. Salfinger, 5 May 2004**
CONTACT	**Mr Rod Salfinger**
REPORT BY	**Dr Douglas R Mason**
SIGNED	Doug Mason
	for Mason Geoscience Pty Ltd
DATE	**21 May 2004**



CONTENTS

Petrological Study of Eight Drill Core Rock Samples from Drill Hole S91-76 at the Spectrum Gold Deposit (British Columbia, Canada)

SUMMARY

1. Rock Samples

- A collection of 8 rock samples from drill hole S91-76 at the Spectrum Gold Deposit (British Columbia, Canada) has been studied using petrographic and mineragraphic optical methods, supplemented by staining of section offcuts for K-feldspar.

2. Brief Results

- *A summary of rock names and mineralogy* is provided in TABLE 1.
- *Primary rock types*
  - **Intermediate ?igneous rock** is considered to be the likely precursor rock for all samples. No primary minerals or textures are preserved to aid identification, owing to high intensity hydrothermal alteration (see below). The rock is considered to have formed part of the volcanogenic regional stratigraphic sequence (Stuhini Group).
- *Hydrothermal alteration*
  - **Hydrothermal alteration** has affected the rock body in two stages: initial pervasive potassic (biotite-stable) alteration, and a later potassic (K-feldspar-stable) overprinting event.
  - **Initial potassic (biotite-stable) alteration** resulted from invasion of the rock body by relatively hot, K-bearing hydrothermal fluid. This generated a pervasive alteration assemblage of plagioclase + biotite (Mg-rich phlogopitic composition) + minor apatite + rutile. It is possible that minor sulphide (?chalcopyrite) formed as part of this event, but subsequent overprinting alteration has partly obscured the earlier assemblage. No veins are observed as part of this event.
  - **Fracturing and associated potassic (K-feldspar-stable) hydrothermal alteration** affected the rock body, overprinting the precursor biotite-stable assemblage. This represents the principal mineralising event. Widely-spaced thin fractures up to several millimetres wide formed a network which allowed invasion by a significant volume of hydrothermal fluid. The fractures were filled and sealed by assemblages dominated by K-feldspar, with varied accompanying minerals including sulphides (pyrite, chalcopyrite, arsenopyrite, sphalerite, marcasite, pyrrhotite as small inclusions in pyrite and arsenopyrite), quartz, calcite, chlorite, and scheelite. Wallrock adjacent to the fractures suffered strong replacement by K-feldspar, chlorite, sericite, dolomite, quartz, pyrite, chalcopyrite, sphalerite, rutile/anatase, apatite, marcasite, scheelite, native gold and pyrrhotite (as inclusions in pyrite). The paler grey colour of the selvedges observed in hand specimen is attributable to the high abundance of K-feldspar with accompanying chlorite and carbonate, in contrast with the dark brownish green colour of the precursor biotite-altered rock. Overprinting of the biotite event by the K-feldspar event is confirmed by progressive replacement of biotite by chlorite towards fracture fillings. The mineralogy of the fracture fillings and wallrock alteration indicate that the mineralising fluid contained abundant dissolved components (CO_2, S, Fe, Cu, Zn, As, W, Au), and was cooler compared with the earlier biotite-stable event as indicated by identification of adularia as the K-feldspar phase, subhedral to euhedral crystal forms of quartz, very fine-grained nature of

chlorite aggregates in veins, and presence of fine-grained marcasite as subparallel microgranular trails in some larger pyrite and chalcopyrite grains.

- **Late calcite fracture fillings** cut the earlier minerals and structures. This brittle fracturing event generated thin, discontinuous, sharp-walled fractures which were filled mainly by calcite, with local minor marcasite, chlorite, sphalerite, pyrite and chalcopyrite. Dominance of calcite results in their white colour in hand specimen, with strong visual contrast against grey-green altered hostrock. This is considered to represent the final stage of the mineralising event.

- **The mineralised structural zone** studied in this work represents fractured and altered wallrocks with only a minor volume of thin fracture fillings and veinlets. Thick (centimetre- to metre-scale) space-filling veins are absent. This is consistent with deformation of structurally weak intermediate volcanogenic host rocks with resulting minimal dilation of the rock body, which nevertheless allowed invasion by large volumes of hydrothermal fluid.

3. Comments on Genesis of Spectrum Gold Deposit

- **Source(s) for hydrothermal fluids** are likely to be intrusion(s) at depth beneath the Spectrum Deposit. This speculation is consistent with the presence of early high-temperature biotite-stable potassic alteration, and with the metal budget (Fe > Cu > Zn > As > W > Au) of the later cooler K-feldspar-stable potassic alteration. Orthomagmatic hydrothermal fluid containing the indicated metals, together with sulphur, are likely to be generated by crystallisation of moderately oxidised calc-alkaline magma(s). **The inferred location of likely fluid source(s) located at depth allows the possibility that the currently observed mineralised zones extend to depth.**

- **Monzonite porphyry dyke**, as mapped in the Spectrum Deposit, most likely represents magma that was injected upwards from a larger intrusive complex at depth. Petrologic study of the dyke may provide evidence for operation of appropriate magmatic processes that generated the inferred orthomagmatic fluids responsible for the Spectrum alteration events.

- **Mineralised structural zones**, located to the east (QC Zone + Porphyry Zone) and west (500 Colour Zone) of the monzonite porphyry dyke, display orientations that suggest they may merge at depth. This may provide two important **targets for exploration**: the possible **intersection zone** of the two structural zones where fluid flow was higher, and brittle fracture zones in monzonite porphyry which may have generated mineralised **stockwork zones or sheeted vein sets** in the structurally competent and isotropic intrusive body.

TABLE 1: SUMMARY OF ROCK NAMES AND MINERALOGY

SAMPLE	ROCK NAME	MINERALOGY*		
		Primary**	Alteration***	Veins***
S91-76, 27.4m	Calcite-sulphide fractured, high-intensity K-feldspar-sericite-carbonate-chlorite-sulphide overprinted, biotite altered intermediate rock	-	Bio; Kf, ser, chl, dol, qtz, cpy, py, sph, rut, apa, mrc, po	Kf, chl; Cal, mrc, sph
S91-76, 27.55m	Calcite fractured, quartz-sulphide-calcite veined and high-intensity K-feldspar-sericite-carbonate-chlorite-sulphide altered intermediate rock	-	Kf, ser, chl, dol, qtz, py, cpy, rut, apa	Qtz, py, cal, chl, Kf, cpy, sph; Cal, py, cpy
S91-76, 28.4m	Pyrite-arsenopyrite-K-feldspar-calcite veined and high-intensity K-feldspar-sericite-chlorite-carbonate altered intermediate rock	-	Kf, ser, chl, dol, apa, rut, py, cpy	Py, asp, Kf, chl, cal, cpy, qtz, po; Cal, py, chl
S91-76, 28.5m	Diffusely veined and high-intensity K-feldspar-sericite-sulphide-chlorite altered intermediate rock	-	Kf, ser, cal, qtz, chl, asp, py, sph, mrc, cpy, apa, rut	Kf, cal, qtz, asp, py, sph, mrc, cpy; Cal
S91-76, 42.5-42.6m	Thinly veined and high-intensity K-feldspar-sericite-chlorite-sulphide overprinted, biotite altered intermediate rock	-	Bio; Kf, ser, chl, qtz, py, cpy, sph, apa, rut	Kf, qtz, shl, chl, py, cpy, sph; Cal
S91-76, 42.6-42.7m	High-intensity K-feldspar-sulphide-calcite-scheelite altered intermediate rock	-	Kf, cal, qtz, chl, ser, py, shl, cpy, sph, apa, rut/ana, gld, unk	-
S91-76, 44.2m	Thinly calcite fractured, K-feldspar-pyrite veined and low- to high-intensity K-feldspar-chlorite-sericite-sulphide overprinted, biotite altered intermediate rock	-	Bio, pla, rut, apa; Kf, chl, cal, py, cpy, po	Kf, py, qtz, chl, cpy, po; Cal
S91-76, 44.55m	K-feldspar-quartz-sulphide veined and low- to high-intensity K-feldspar-sericite-chlorite overprinted, biotite altered intermediate rock	-	Bio, apa; Kf, ser, chl, py, cpy, rut	Kf, qtz, py, chl, asp, po

NOTES:
*: Minerals are listed in each paragenesis according to approximate decreasing abundance.
**: Only primary minerals currently present in the rock are listed. Others may have been present, but are altered.
***: Earlier parageneses are separated from later parageneses by a semicolon.

Mineral abbreviations:
Ana = anatase; apa = apatite; asp = arsenopyrite; bio = biotite (phlogopitic); cal = calcite; chl = chlorite; cpy = chalcopyrite; dol = dolomite; gld = native gold; Kf = K-feldspar (adularia); mrc = marcasite; pla = plagioclase; po = pyrrhotite; py = pyrite; qtz = quartz; rut = rutile; ser = sericite (fine-grained white mica); shl = scheelite; sph = sphalerite; unk = unknown mineral (possible ?uraninite).

1 INTRODUCTION

The writer visited Mr Rod Salfinger at the office of Trans Pacific Mining Ltd (Moorabbin Airport, Melbourne, Victoria) on 7 May 2004. The purpose of the visit was to introduce the writer to aspects of the Spectrum Gold Deposit (British Columbia, Canada), in particular to inspect drill core from drill hole S91-76 and to discuss aspects of the deposit with Mr Salfinger.

Particular requests were to provide a petrographic study of rock samples from drill hole S91-76, and to discuss the results in the context of the deposit.

Excerpts from this report were provided by email to Mr Salfinger on 23 May 2004. This report contains the full results of this work.

2 METHODS

2.1 Office Visit

At the Moorabin office of Trans Pacific Mining Ltd, background for the Spectrum Deposit was provided by Mr Salfinger, including a PowerPoint presentation covering aspects of the physical location of the deposit, exploration data including drill hole locations and geological maps and sections, and statistical evaluation of ore grades through the deposit. The writer was also given access to a range of sections, maps and reports on the Spectrum Deposit.

Most of the available time was devoted to hand specimen examination of two trays of drill core from drill hole S91-76, which had intersected sulphide-gold mineralisation in the QC Zone. Notes were made regarding physical characteristics of the rocks, and eight samples were taken for petrographic and mineragraphic study.

2.2 Petrography and Mineragraphy

The samples were marked for preparation of polished thin sections, which were obtained from an external commercial laboratory (Pontifex & Associates Pty Ltd, Rose Park, South Australia).

At Mason Geoscience Pty Ltd conventional transmitted and reflected polarised light microscopy was used to prepare combined petrographic and mineragraphic descriptions.

Nomenclature for hydrothermal alteration in this report adopts the following conventions:

i) *Style* of alteration refers to the distribution of alteration minerals. Relatively uniform distribution of alteration minerals is referred to as *pervasive* alteration, but commonly involves *selective replacement* of particular precursor minerals. *Vein-controlled alteration* involves space-filling deposition of minerals, but may also involve *selvedge alteration* of wall rock adjacent to veins.

ii) *Type* of alteration refers to the broad mineral assemblage: thus *propylitic* alteration is characterised by assemblages of chlorite, epidote, and carbonate; *phyllic* alteration generates assemblages of sericite, quartz, and pyrite; *potassic* alteration is characterised by development of alteration K-feldspar and/or biotite, with implications for a significant degree of potassic metasomatism; *argillic* alteration is dominated by clay minerals; *low-sulphidation epithermal* alteration commonly is characterised by quartz, K-feldspar (adularia), calcite, clays, pyrite and native gold/electrum; *high-sulphidation epithermal* alteration (including *advanced argillic* alteration) is characterised by assemblages of quartz, clays (kaolinite/dickite, illite), sericite, alunite, barite, hematite, pyrophyllite, andalusite, diaspore, corundum, zunyite, Al-P sulphates, pyrite, enargite/luzonite, chalcocite, covellite, bornite, native gold/electrum. **Note that only potassic alteration (albeit in two stages) is identified in this rock suite.**

iii) *Intensity* of alteration refers to the extent of development of the alteration minerals: *low-intensity* alteration is characterised by good preservation of some primary minerals and most primary textures; *medium-intensity* alteration results in complete replacement of all primary minerals, but some primary textures are preserved to allow identification of the precursor rock; *high-intensity* alteration results in complete destruction of primary minerals and textures, causing difficulty in identification of the precursor.

Macrophotographs were taken of each sample as a physical record, and macrophotographs were also taken of selected section offcuts stained for K-feldspar. Selected colour photomicrographs were taken to illustrate mineralogical and microtextural features of the rocks, and are included in the petrographic descriptions.

2.3 Staining for K-feldspar

Preliminary petrographic observations suggested that K-feldspar was present in all samples. For confirmation, each section offcut was stained for K-feldspar using the conventional sodium cobaltinitrite method. Each offcut was etched in HF for ~10 seconds, rinsed in water, covered with freshly made saturated solution of sodium cobaltinitrite for ~30 seconds, and finally rinsed. This procedure generates a bright yellow stain where K-feldspar occurs in the rock. The results are provided in Section 4, and are also given under Hand Specimen description in the individual petrographic descriptions.

3 DRILL CORE OBSERVATIONS

Brief drill core observations for Boxes 2 and 5 from drill hole S91-76 are recorded in TABLE 2.

TABLE 2: OBSERVATIONS FROM DRILL CORE S91-76, 25.0-30.1m AND 40.0-45.5m

DEPTH	OBSERVATIONS	PETROGRAPHY SAMPLE
S91-76, BOX 2 (25.0-30.1m)		
25.4m	Breccia (early) composed of paler fragments in dark green matrix with fine-grained sulphides. No thin carbonate fractures.	-
26.21m	Breccia (late), composed of angular mineralised fragments in pale cream to white sulphide-free matrix.	-
26.3m	Thin carbonate fractures cut mineralised altered rock (no relationship between thin fractures and distribution of sulphides).	-
26.9m	Minor thin cream carbonate fracture fillings cut by later abundant thin white carbonate fractures, which cut earlier mineralised breccia host rock.	-
27.0m	Earlier thin cream veins are cut by later thicker white veins ~2 cm thick. No sulphides in vein. Abundant sulphides in altered wallrock not related to thick white vein.	-
27.4m	Minor thin white fractures cut patchy altered and indistinctly banded wallrock with only minor disseminated/patchy sulphides. No sulphides apparent in thin white fractures or in their selvedges.	YES
27.55m	Indistinct early pale brown-grey veins cut green altered wallrock. Some sulphides in and near the veins, which are cut by minor thin white fractures (lack of sulphide in the fracture fillings).	YES
27.9m	Pale pinkish patches and abundant disseminated sulphides, with local brownish mineral in diffuse patches (?biotite, ?sphalerite). Only trace late thin white fractures.	-
28.0m	Thick cream vein ~2 cm thick, cut by minor thin white fractures, and cuts strongly sulphidised altered host rock. No relationship between mineralisation and cream or white fractures or veins.	-
28.3m	Diffuse pale fractures and pale selvedges which cut dark green altered wallrock. Note arsenopyrite concentrated in these early fractures.	-
28.4m	Indistinct banding of fine-grained sulphides, pale brownish cream K-feldspar, and darker bands. Cut by trace late thin white fractures.	YES
28.5m	Diffuse fracture network with pale brownish cream alteration selvedges (K-feldspar), with relict darker wallrock kernels. Note arsenopyrite + dark mineral (?sphalerite) + cream ?feldspar/?scheelite fills late diffuse pore spaces. Only trace late thin white fractures.	YES
29.25m	Abundant disseminated sulphides (pyrite + arsenopyrite) in strongly altered dark hostrock. Minor thin cream veinlets and thin white veinlets.	-
29.26-29.45m	Abundant sulphides (disseminated and diffuse veinlet network) cut altered wallrock. Minor thin white fractures.	
29.5-29.7m	Abundant disseminated sulphides (pyrite, arsenopyrite) in dark hostrock, cut by 2 generations of late veins: i) thicker complex breccia and vein (includes dark ?sphalerite, pale cream ?feldspar/?scheelite), and ii) Later thinner carbonate-quartz veins.	-
29.8m	Breccia (dark green fragments in paler grey matrix) cut by abundant thin white fractures.	-

cont...

TABLE 2: OBSERVATIONS FROM DRILL CORE S91-76, 25.0-30.1m AND 40.0-45.5m (cont.)

DEPTH	OBSERVATIONS	PETROGRAPHY SAMPLE
S91-76, BOX 5 (40.0-45.5m)		
41.45-41.50m	Diffuse network of thick felsic fractures + selvedges (vein-like appearance) with dark green relict hostrock kernels. Sulphides fill fractures in felsic 'veins', and pyrite is abundant in altered dark kernels. Trace thin white fracture fillings.	-
41.65m	Diffuse paler brownish grey 'veins' and dark green altered wallrock. Variable abundance of sulphides in wallrock.	-
42.0-42.15m	Abundant disseminated sulphides in altered grey hostrock. Minor patches of white to pale cream mineral (?carbonate, ?scheelite)). Minor white veins. Small grains of visible gold circled in black pen by others. Trace thin white fracture fillings.	
42.5-42.6m	Dark brownish grey altered wallrock cut by indistinct paler 'vein' network ± abundant sulphides. Trace thin white fractures.	YES
42.6-42.7m	High intensity alteration of hostrock: grey, diffuse pale cream patches (?carbonate, ?scheelite) ± interstitial dark ?sphalerite.	YES
42.7m	Diffuse pale grey 'vein' network, with each 'vein' composed of a central thin sulphidic fracture filling (pyrite), cutting dark brownish green altered wallrock with disseminated sulphides. Only trace thin white late fracture fillings.	-
43.4m	Much of the rock is composed of diffuse pale grey 'vein' network, with minor relict dark brownish green altered wallrock ± variable sulphides. Trace thin white fracture fillings.	-
44.2m	Diffuse pale grey selvedges flank thin sulphidic fractures (ie 'vein'-like appearance). Moderately abundant sulphides (pyrite) disseminated in dark green altered wallrock.	YES
44.40m	Moderately abundant sulphides (pyrite + arsenopyrite) in diffuse pale grey 'vein' cutting dark brownish green altered wallrock. Trace thin white fractures.	-
44.55m	Diffuse pale grey selvedges flank thin sulphidic fractures, giving 'vein network' appearance, cutting dark brownish green altered wallrock.	YES
44.60m	Similar to above (network of diffuse pale grey selvedges around thin sulphidic fracture fillings)	-
44.80m	Abundant disseminated sulphides (pyrite) in altered pale grey to green rock.	-
44.85m	Thinly fractured and grey pale altered rock. Dark brownish green distal altered wallrock.	-
44.90m	Diffuse pale grey alteration selvedges around thin sulphidic fractures. Dark brownish green altered host rock. Trace thin white fracture fillings.	-

4 RESULTS OF STAINING FOR K-FELDSPAR

Each section offcut was stained for K-feldspar (see section on Methods). The results are given in TABLE 3, and are repeated under hand specimen description in the petrographic descriptions.

TABLE 3: RESULTS OF STAINING FOR K-FELDSPAR

SAMPLE	RESULT*	COMMENT
S92-76, 27.4m	Positive	Fine-grained K-feldspar forms a mosaic pervasively through most of the rock, but is absent from some patches or bands.
S92-76, 27.55m	Positive	Fine-grained K-feldspar occurs in dense patches, and locally is concentrated along selvedges of sulphide-rich veins.
S91-76, 28.4m	Positive	Fine-grained K-feldspar occurs abundantly in indistinct patches and bands throughout the rock.
S91-76, 28.5m	Positive	Abundant fine-grained K-feldspar occurs pervasively through the rock.
S91-76, 42.5m	Positive	Abundant fine-grained K-feldspar occurs in diffuse patches through the rock.
S91-76, 42.6m	Positive	Moderately abundant fine-grained K-feldspar occurs in diffuse patches through the rock.
S91-76, 44.2m	Positive	Minor K-feldspar occurs as diffuse fine-grained selvedges along thin sulphidic fractures. It is absent from most of the rock.
S91-76, 44.55m	Positive	Fine-grained K-feldspar occurs in moderate abundance as diffuse selvedges marginal to sulphidic fractures. It is absent from darker kernels.

FIG. 1: SAMPLE S91-76, 44.55m (Macrophotograph of section offcut, stained for K-feldspar, dry, bar for scale; Film 3 / Frame 10). This view illustrates lowest intensity of development of K-feldspar (stained yellow) in diffuse selvedges marginal to thin indistinct sulphidic fractures (oriented NE-SW, at bottom left, and across centre). Relict kernels of precursor rock (bottom, top right) contain much biotite from the earlier potassic alteration assemblage.

FIG. 2: SAMPLE S91-76, 28.5m (Macrophotograph of section offcut, stained for K-feldspar, bar for scale, Film 3 / Frame 7). This view illustrates development of abundant K-feldspar (stained yellow) pervasively through the altered rock. A large ragged grain of sphalerite (black, centre left) forms part of the alteration and fracture filling assemblage.

5 PETROGRAPHIC AND MINERAGRAPHIC DESCRIPTIONS

The combined petrographic and mineragraphic descriptions are provided in the following pages. The descriptions are presented in order of down-hole depth.

SAMPLE : **S91-76, 27.4m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 27.4m

HAND SPECIMEN : The drill core rock sample represents dark brownish grey rock (now preserved only as minor ragged or wispy kernels) that is pervaded by pale pinkish cream patches of vein-like bodies with associated thin fractures filled by minor lustrous sulphides. Cutting the rock are minor thin discontinuous brittle fractures filled mostly by white calcite, but locally containing minor lustrous sulphide along margins.

The thin white fracture-fillings and veinlets effervesce strongly in reaction with dilute HCl, suggesting they are filled by calcite.

The section offcut accepted a positive yellow stain for K-feldspar, indicating it occurs as a fine-grained mosaic pervasively through most of the rock, but is absent from some patches or bands.

ROCK NAME : **Calcite-sulphide fractured, high-intensity K-feldspar-sericite-carbonate-chlorite-sulphide overprinted, biotite altered intermediate rock**

FIG. 3: SAMPLE S91-76, 27.4m (Macrophotograph of sawn drill core, wet, bar for scale; Film 3 / Frame 1)
Late brittle fractures (white) are filled mainly by calcite, with minor sulphides (marcasite, sphalerite) along some fracture filling margins (left margin of fracture filling at lower right). Dark patches represent relict kernels of precursor biotite-altered hostrock, overprinted by the paler K-feldspar-rich assemblage.

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
High-intensity K-feldspar-sericite-carbonate-chlorite-sulphide overprinted, biotite altered intermediate rock		
K-feldspar	60 (0-80)	Alteration / replacement veinlets
Sericite	20 (Tr-80)	Alteration
Chlorite	10 (3-35)	Alteration / fracture fillings
Carbonate (dolomite)	5	Alteration
Quartz	2	Alteration
Chalcopyrite	1	Alteration
Pyrite (includes marcasite, trace pyrrhotite)	1	Alteration
Sphalerite	<1	Alteration
Rutile	Tr	Alteration
Apatite	Tr	?Relict of precursor alteration
Biotite	Tr	Relict of precursor alter'n (inclus. in pyrite)
Late calcite-sulphide fracture fillings		
Calcite	94	Fracture filling
Marcasite	5	Fracture filling
Sphalerite (pale yellow)	<1	Fracture filling

In polished thin section, this sample displays a patchy pervasive alteration texture, cut by late thin sharp fracture fillings.

High-intensity K-feldspar-sericite-carbonate-chlorite-sulphide overprinted, biotite altered intermediate rock retains no primary minerals or textures. K-feldspar is abundant in most areas, forming an inequigranular replacement mosaic. It is absent from large areas where fine-grained sericite forms a dense massive replacement mat with associated small flakes of drab yellowish-green chlorite concentrated in patches and in indistinct trails of varied orientation. The chlorite is peppered by minute rutile granules, suggesting it formed by replacement of a precursor Ti-bearing phase (ie biotite, but no biotite is preserved; a single tiny pleochroic orange flake of biotite is observed within a pyrite aggregate). Ragged grains and aggregates of dolomite are irregularly scattered through the rock, and display the typical strong double refraction of this phase. Minor small aggregates of pyrite and associated marcasite are sparsely scattered. Apatite occurs in trace amount as small subhedral blocky crystals, possibly preserved from a precursor alteration assemblage.

Large ragged replacement patches are irregularly scattered through the rock. They are composed of anhedral to subhedral terminated crystals of clear quartz, large anhedral grains of chalcopyrite and physically associated pyrite with some fine-grained intergrowths of marcasite, anhedral small grains of sphalerite, ragged patches of subradiating yellowish-green chlorite, and local small aggregates of K-feldspar grains. Rare small ragged inclusions of pyrrhotite are observed within larger pyrite grains.

Late calcite-sulphide fracture fillings display sharp contacts with wallrock. They are filled mostly by anhedral grains of calcite, with sulphidic aggregates of granular marcasite and anhedral pale yellow sphalerite concentrated along vein walls.

INTERPRETATION :

This sample is considered to have evolved through a complex series of events. From earliest to most recent, these are:

1. Formation of hostrock
An unknown hostrock, possibly of intermediate volcanogenic origin, formed as part of a regional rock sequence.

2. Initial potassic (biotite-stable) hydrothermal alteration
The hostrock suffered strong pervasive potassic alteration, generating an assemblage containing biotite and accessory apatite. Other phases in this assemblage (eg ?plagioclase, ?sulphide, ?rutile) which may have been present have been obscured by subsequent events. The presence of this early potassic assemblage is confirmed by the occurrence of aggregates and trails of biotite (now replaced by chlorite + rutile), by the rare preservation of tiny biotite flakes in later sulphide aggregates, and by the preservation of blocky apatite grains that appear to be inconsistent texturally with the later alteration assemblage.

3. Overprinting potassic (K-feldspar-stable) hydrothermal alteration
This is the principal mineralising event. Different hydrothermal fluid invaded the already altered hostrock, possibly along a network of thin fractures. This resulted in strong pervasive replacement by the assemblage of K-feldspar + sericite + chlorite + dolomite + minor quartz + chalcopyrite + pyrite (with trace pyrrhotite inclusions) + marcasite + sphalerite + rutile. At this time, ragged replacement patches formed, and are composed of a coarse-grained assemblage of quartz + chalcopyrite + pyrite + marcasite + sphalerite + K-feldspar + chlorite.

4. Late fracturing and calcite-sulphide veinlet rock
The rock body suffered brittle fracturing, with filling of the fractures by calcite + minor marcasite + sphalerite. This assemblage suggests that this late fluid was cooler than that responsible for the principal mineralising event (see 3) above).

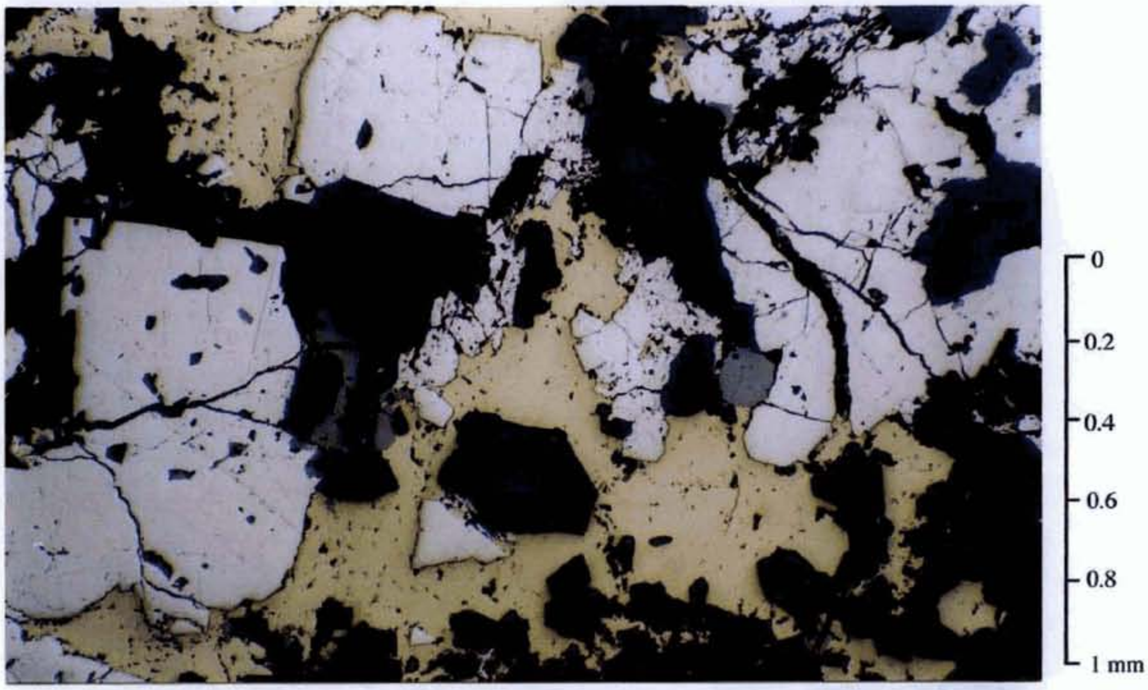


FIG. 4: SAMPLE S91-76, 27.4m (Reflected plane polarised light, x5, Film 2 / Frame 1A)
This view from a vein illustrates occurrence of ragged grains of chalcopyrite (yellow), blocky pyrite crystals (white), and minor sphalerite (small medium grey grains, centre left, centre right). Dark grey grains are quartz and chlorite.

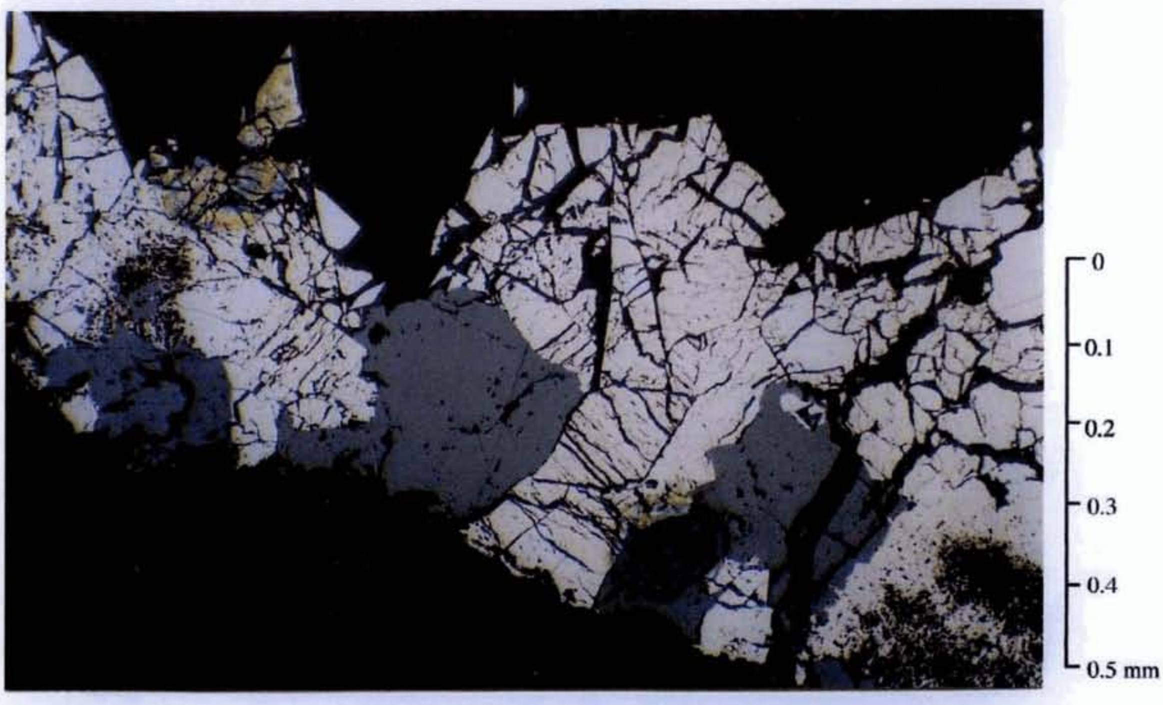


FIG. 5: SAMPLE S91-76, 27.4m (Reflected plane polarised light, x10, Film 2 / Frame 2A)
This view is taken from a late brittle fracture filling, and illustrates the occurrence of granular marcasite (white, cleaved) and sphalerite (medium grey) that have crystallised along the margin (bottom left) of the fracture. The sulphide grains have grown inwards into the fracture, with associated large calcite grains (top of view).

SAMPLE : **S91-76, 27.55m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 27.55m

HAND SPECIMEN : The fine-grained rock contains indistinct early pale brown-grey vein-like bodies or patches that cut drab greenish-brown altered wallrock. Some sulphides occur in and near the veins, which are cut by late minor discontinuous thin white fractures (lack of sulphide in the fracture fillings).

The section offcut accepted a positive yellow stain for K-feldspar, confirming fine-grained K-feldspar occurs in dense patches, and locally is concentrated along selvedges of sulphide-rich veins.

ROCK NAME : **Calcite fractured, quartz-sulphide-calcite veined and high-intensity K-feldspar-sericite-carbonate-chlorite-sulphide altered intermediate rock**

FIG. 6: SAMPLE S91-76, 27.55m (Macrophotograph of sawn drill core, wet, bar for scale; Film 3 / Frame 2)
Minor late thin discontinuous fractures are filled mainly by calcite (white), and cut hostrock that has suffered strong pervasive alteration by abundant K-feldspar (pale brownish cream) with associated fractures filled by lustrous sulphide (pale metallic silvery colour, centre left, lower right).

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
High intensity K-feldspar-sericite-carbonate-chlorite-sulphide altered intermediate rock		
K-feldspar	24 (0-80)	Alteration
Sericite	48 (5-80)	Alteration
Chlorite	20	Alteration / fracture fillings
Carbonate (dolomite)	5	Alteration / fracture fillings
Quartz	1	Alteration
Pyrite	Tr	Alteration / fracture fillings
Chalcopyrite	Tr	Alteration
Rutile	Tr	Alteration
Apatite	Tr	Alteration
Quartz-sulphide-calcite veins		
Quartz	48	Vein filling
Pyrite (includes minor marcasite, pyrrhotite)	40	Vein filling
Calcite	5	Vein filling
Chlorite	5	Vein filling
K-feldspar	Tr	Vein filling
Chalcopyrite	1	Vein filling
Sphalerite	Tr	Vein filling
Late calcite fracture fillings		
Calcite	99	Fracture fillings
Pyrite	Tr	Fracture fillings
Chalcopyrite	Tr	Fracture fillings

In polished thin section, this sample displays a fine-grained pervasive alteration texture in hostrock, and space-filling textures in veins.

High-intensity K-feldspar-sericite-carbonate-chlorite-sulphide altered intermediate rock retains no primary minerals or textures. K-feldspar forms small anhedral grains that are mainly concentrated in wide selvedges marginal to veins. It is absent from altered hostrock distal from veins, where sericite forms a fine-grained massive replacement mat accompanied by small aggregates and fracture fillings of drab yellowish chlorite, and ragged aggregates and fracture fillings of dolomite. Quartz occurs in minor amount as scattered small granular aggregates. Sulphides (small ragged pyrite and chalcopyrite grains) are very sparsely scattered through the rock. Apatite is present in minor amount as small equant subhedral to anhedral grains. Rutile forms tiny granules that are locally concentrated in ragged chlorite aggregates (probably after precursor alteration ?biotite but none is preserved for confirmation), and rutile also forms larger scattered subhedral small crystals.

Quartz-sulphide-calcite veins display massive space-filling textures. Quartz occurs as randomly oriented subhedral terminated prismatic crystals, some laced by inclusions of thin calcite plates. Pyrite is abundant, forming subhedral blocky crystals and dense ragged aggregates, some with minor small patches of fine-grained marcasite which displays its characteristic whitish colour and strong anisotropism. Uncommon angular pyrrhotite inclusions (with characteristic pale pinkish brown colour and moderate anisotropism) are observed in the larger pyrite grains. Calcite occurs as anhedral grains in interstices between quartz and pyrite grains, and commonly is closely associated with chlorite which occurs as very fine-grained dense aggregates of drab yellow-green flecks. Chalcopyrite and deep red sphalerite occur in minor amount as local small ragged grains. K-feldspar occurs as small blocky crystals, but only in local areas at margins of veins.

Late calcite fracture fillings display sharp contacts, and are discontinuous. They are filled almost entirely by anhedral large calcite grains, with local small pyrite crystals and small ragged chalcopyrite grains.

INTERPRETATION :

This sample is considered to have evolved through the following stages, from earliest to latest:

1. Formation of primary rock
An unknown primary rock formed. It may have been of intermediate volcanogenic origin, as supported by the general absence of quartz, evidence of pervasive replacement of precursor silicate minerals (mainly ?feldspar), and presence of a minor Ti content as indicated by consistent presence of minor alteration rutile.

2. Initial potassic (biotite-stable) hydrothermal alteration
The rock was invaded by relatively hot hydrothermal fluid, resulting in strong pervasive alteration of potassic type. Biotite and possibly ?apatite formed in this assemblage, but other minerals (probably ?plagioclase) have been obscured by subsequent events.

3. Later potassic (K-feldspar-stable) hydrothermal alteration
This is the principal mineralising event. The rock suffered fracturing and invasion by hydrothermal fluid that most likely was cooler than the previous fluid. This resulted in filling of open fractures by space-filling vein assemblages of quartz + pyrite (with trace marcasite, pyrrhotite) + calcite + chlorite + trace K-feldspar + chalcopyrite + sphalerite. Wallrock suffered replacement by the assemblage K-feldspar + sericite + chlorite + dolomite + minor quartz + pyrite + chalcopyrite + rutile, and thin fractures were filled by chlorite + dolomite ± pyrite. K-feldspar formed abundantly in selvedges marginal to veins, and sericite + chlorite formed distally from veins. A relatively lower temperature for this event, compared with event 2 above, is indicated by the presence of K-feldspar (adularia) as the stable K-silicate phase in contrast with biotite in the previous event, the terminated shapes of vein quartz, and the very fine-grained massive form of the chlorite.

4. Late calcite fracture fillings
Thin discontinuous fractures were filled by calcite + trace pyrite + chalcopyrite.

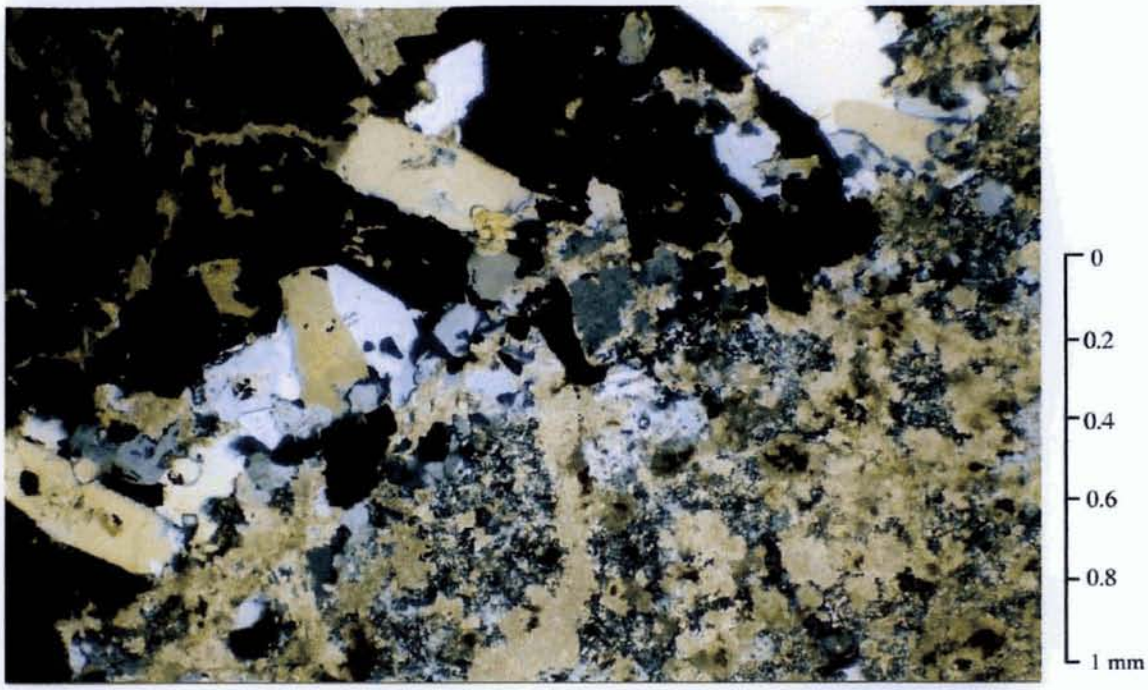


FIG. 7: SAMPLE S91-76, 27.55m (Transmitted light, crossed polarisers, x5, Film 2 / Frame 3A)
This view captures the contact (oriented NE-SW) between vein filling (top left) and strongly altered wallrock (bottom right; bright dolomite, dull grey K-feldspar). In the vein, note the euhedral prismatic shapes of quartz crystals (white, pale yellow) with fine-grained interstitial opaques (pyrite). These textures are consistent with relatively low-temperature conditions of formation.

SAMPLE : **S91-76, 28.4m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 28.4m

HAND SPECIMEN : The rock is characterised by indistinct veining or banding of fine-grained sulphides, pale brownish cream K-feldspar-rich domains, and darker greenish bands. The rock is cut by minor late thin white fractures.

The section offcut accepted a positive yellow stain for K-feldspar, confirming fine-grained K-feldspar occurs abundantly in indistinct patches and bands throughout the rock.

ROCK NAME : **Pyrite-arsenopyrite-K-feldspar-calcite veined and high-intensity K-feldspar-sericite-chlorite-carbonate altered intermediate rock**

FIG. 8: SAMPLE S91-76, 28.4m (Macrophotograph of sawn drill core, wet, bar for scale; Film 1 / Frame 6)
Minor late thin fractures are filled by calcite (white, bottom). The rock has suffered strong pervasive alteration to abundant K-feldspar (pale drab brownish cream to greenish colour) in association with sulphide-filled fractures (oriented NE-SW, near centre and lower right, abundant lustrous silvery sulphide).

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
High-intensity K-feldspar-sericite-chlorite carbonate altered intermediate rock		
K-feldspar	63	Alteration
Sericite	20	Alteration
Chlorite	10	Alteration
Carbonate (dolomite)	5	Alteration
Apatite	Tr	Alteration
Rutile	Tr	Alteration
Pyrite	Tr	Alteration
Chalcopyrite	Tr	Alteration
Pyrite-arsenopyrite-K-feldspar-calcite veins		
Pyrite	49	Replacement veins
Arsenopyrite	30	Replacement veins
K-feldspar	10	Replacement veins
Chlorite	5	Replacement veins
Calcite	5	Replacement veins
Chalcopyrite	Tr	Replacement veins
Quartz	Tr	Replacement veins
Pyrrhotite	Tr	Replacement veins
Late calcite-sulphide-chlorite fracture fillings		
Calcite	93	Fracture fillings
Pyrite	5	Fracture filling
Chlorite	2	Fracture fillings

In polished thin section, this sample displays a pervasive massive alteration texture in host rock, and granular alteration textures in replacement-type veins.

High-intensity K-feldspar-sericite-chlorite-carbonate altered intermediate rock retains no primary minerals or textures to aid identification of the primary rock. K-feldspar is abundant, forming small anhedral grains in granular mosaic texture. It is most abundant in the selvedges marginal to the sulphide-rich veins.

Sericite is moderately abundant, occurring as tiny randomly oriented flecks that form dense mats in the host rock. The sericite is most abundant in large patches distant from the sulphide-rich veins.

Chlorite is present in moderate amount as tiny drab yellow-green flakes concentrated in small ragged patches and indistinct discontinuous trails or fracture fillings. Much of this chlorite appears to have formed by replacement of precursor fine-grained biotite, as indicated by the presence of tiny granules of rutile.

Carbonate occurs in minor amount as ragged grains and aggregates scattered irregularly through the rock. The strong double refraction supports identification as dolomite.

Apatite is present in minor amount as small equant grains with characteristic optical properties: colourless, moderate relief, low birefringence. The occurrence of many small apatite grains in the K-feldspar-rich mosaic areas suggests that the apatite formed together with the K-feldspar.

Rutile forms small deep red grains and stumpy lath-like crystals.

Trace amounts of pyrite and chalcopyrite are very sparsely and irregularly distributed through the rock.

Pyrite-arsenopyrite-K-feldspar-calcite veins display diffuse contacts with host rock. Together with the granular textures, this suggests that these veins formed by a replacement mechanism rather than a space-filling mechanism.

Pyrite is abundant, forming subhedral cream grains and granular aggregates. Arsenopyrite occurs in close association with the pyrite, forming subhedral to euhedral rhombic crystals with typical white colour and anisotropic optical behaviour. K-feldspar occurs as small blocky colourless crystals enclosed within the abundant sulphides. Chlorite is present in minor amount as tiny drab yellow-green flecks that form uniformly fine-grained dense aggregates. Calcite similarly occurs between the sulphide grains, forming sparry grains some of which contain aggregates of the very fine-grained chlorite. Chalcopyrite occurs as uncommon small ragged grains.

Pyrrhotite occurs in trace amount as discrete small laths in some of the larger calcite grains, and also as tiny ragged inclusions in some of the larger pyrite crystals.

Late calcite-sulphide-chlorite fracture fillings cut and offset the thicker sulphide-rich veins described above. They are sharp-walled but thin, and are filled by anhedral calcite grains, granular pyrite aggregates, and fine-grained drab yellow-green chlorite aggregates.

INTERPRETATION :

This sample is considered to have evolved through different stages, from earliest to latest:

1. Formation of primary rock
An unknown primary rock, possibly of intermediate volcanogenic origin, formed as part of a regional rock sequence.

2. Initial potassic (biotite-stable) hydrothermal alteration
The rock body suffered strong pervasive alteration of potassic type. Fine-grained biotite formed in moderate abundance, as fine-grained scattered aggregates and as fillings along indistinct and variably oriented fractures. All of the biotite has been replaced in response to subsequent events (see below). Other minerals (eg ?plagioclase) formed with the biotite, but have been overprinted by the later event.

3. Overprinting potassic (K-feldspar-stable) hydrothermal alteration and veining
This is the principal mineralising event. The rock body suffered further fracturing and invasion by hydrothermal fluid. This resulted in development of diffuse replacement veins of pyrrhotite + arsenopyrite + K-feldspar + chlorite + calcite + trace chalcopyrite + quartz + pyrrhotite. At this time, the host rock suffered strong pervasive alteration to the new assemblage of K-feldspar + sericite + chlorite + dolomite + trace apatite + rutile + pyrite + chalcopyrite. The K-feldspar developed in greater abundance in the selvedges of the sulphidic replacement veins, and sericite + chlorite formed more abundant distant from the veins. Further brittle fracturing caused slight dislocation of the earlier veins, and circulation of hydrothermal fluid resulted in filling of the fractures by calcite + pyrite + chlorite.

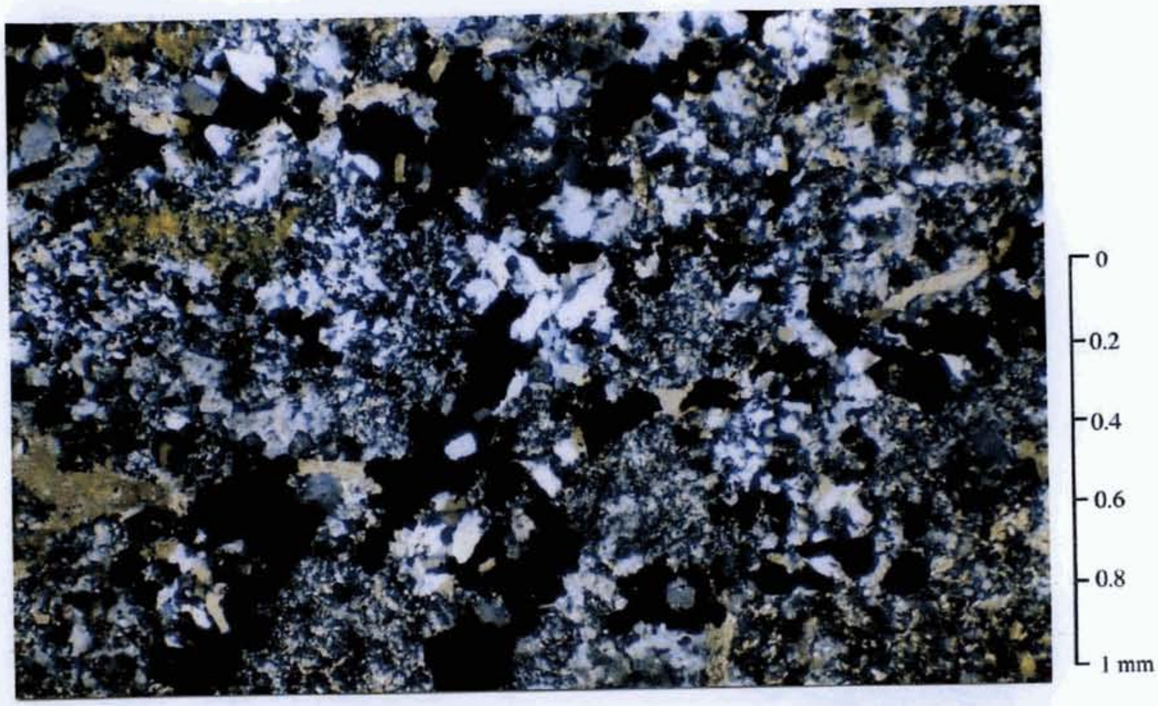


FIG. 9: SAMPLE S91-76, 28.4m (Transmitted light, crossed polarisers, x5, Film 2 / Frame 8A)
This view of high-intensity altered hostrock illustrates scattered ragged grains of opaques (chalcopyrite, black), quartz (white grains), fine-grained K-feldspar (grey), and ragged chlorite patches (yellowish green, top left).

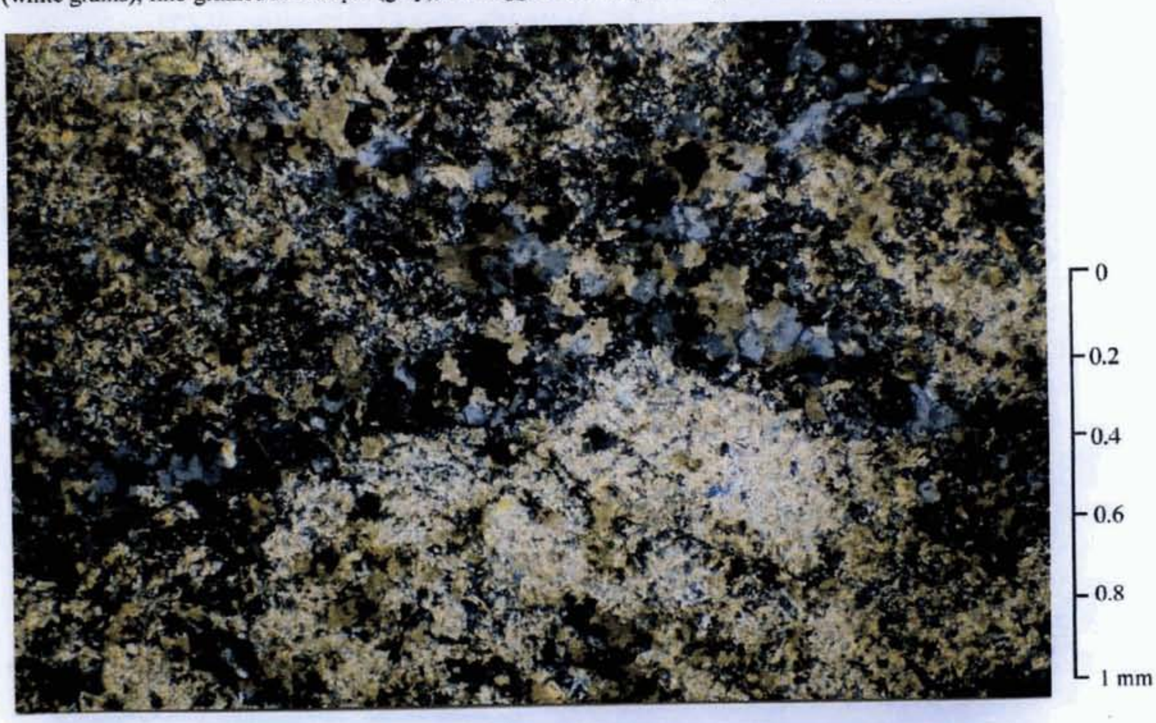


FIG. 10: SAMPLE S91-76, 28.4m (Transmitted light, crossed polarisers, x5, Film 2 / Frame 4A)
This view illustrates thin fractures (oriented NE-SW and SE-NW) sealed by small K-feldspar grains (dull grey). Strongly altered wallrock is now composed mostly of abundant sericite (tiny bright flecks).

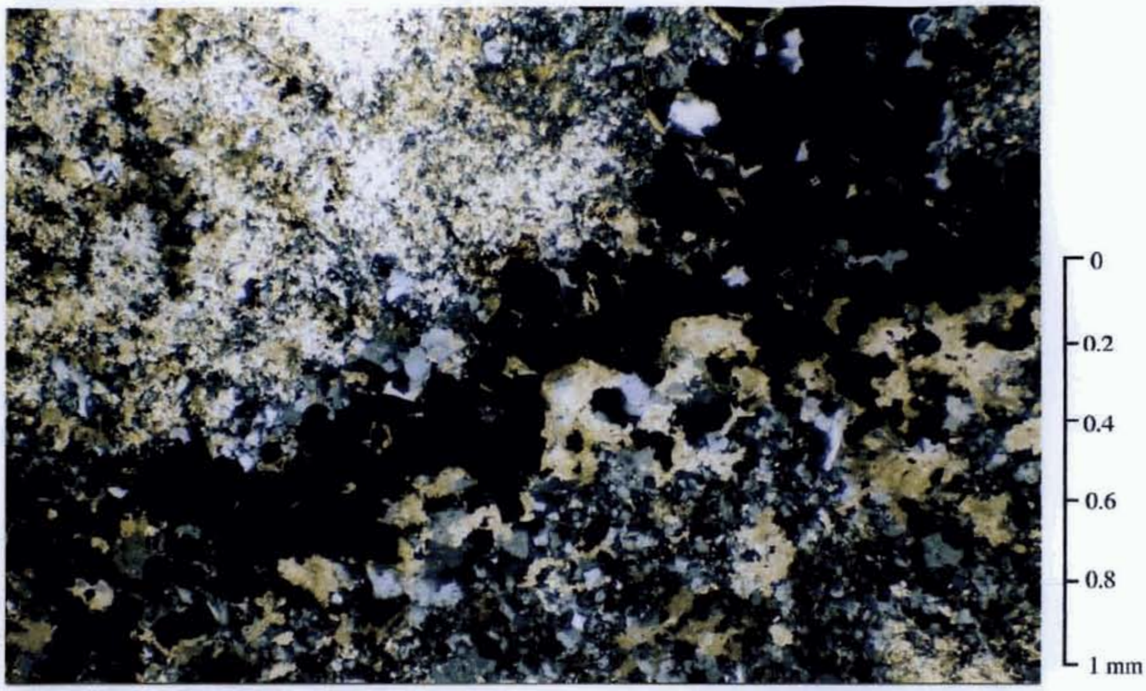


FIG. 11: SAMPLE S91-76, 28.4m (Transmitted light, crossed polarisers, x5, Film 2 / Frame 5A)
This view captures a diffuse vein (oriented NE-SW) that is filled mainly by opaques (pyrite, black) with minor K-feldspar (grey). Wallrock is replaced variably by sericite (bright tiny flecks, top left) and K-feldspar (small grey grains, bottom right).

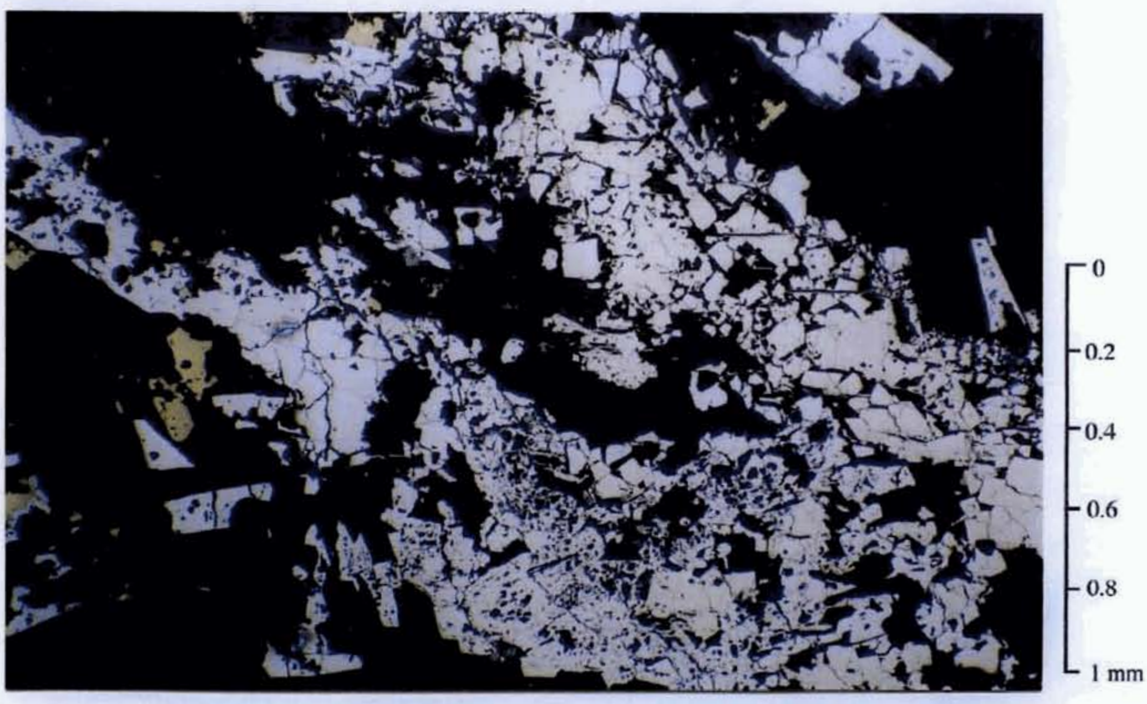


FIG. 12: SAMPLE S91-76, 28.4m (Reflected plane polarised light, x5, Film 1 / Frame 6A)
This view is taken from a diffuse vein (oriented NW-SE) filled by intergrown arsenopyrite (white) and pyrite (cream), with minor chalcopyrite (yellow, centre left).

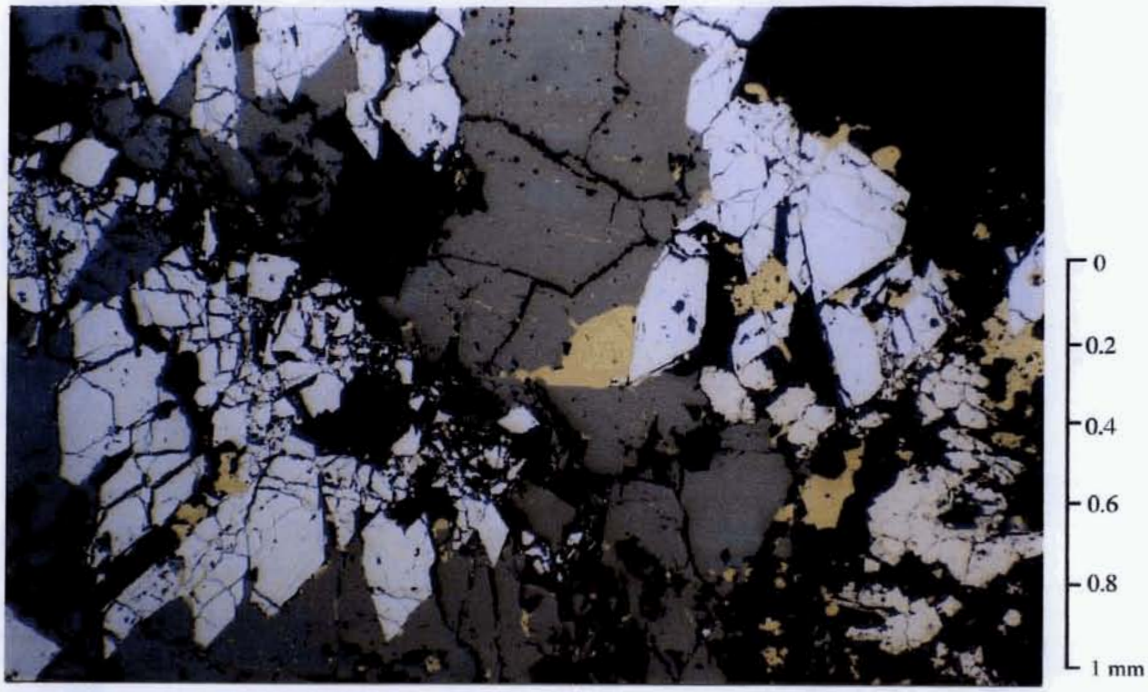


FIG. 13: SAMPLE S91-76, 28.4m (Reflected plane polarised light, x5, Film 2 / Frame 7A)
This view is taken from within an indistinct vein, and illustrates the occurrence of sphalerite (grey ragged grains), arsenopyrite (rhombic white crystals), minor chalcopyrite (yellow ragged grains), and pyrite (ragged cream grains, lower right). Black grains are quartz and calcite.

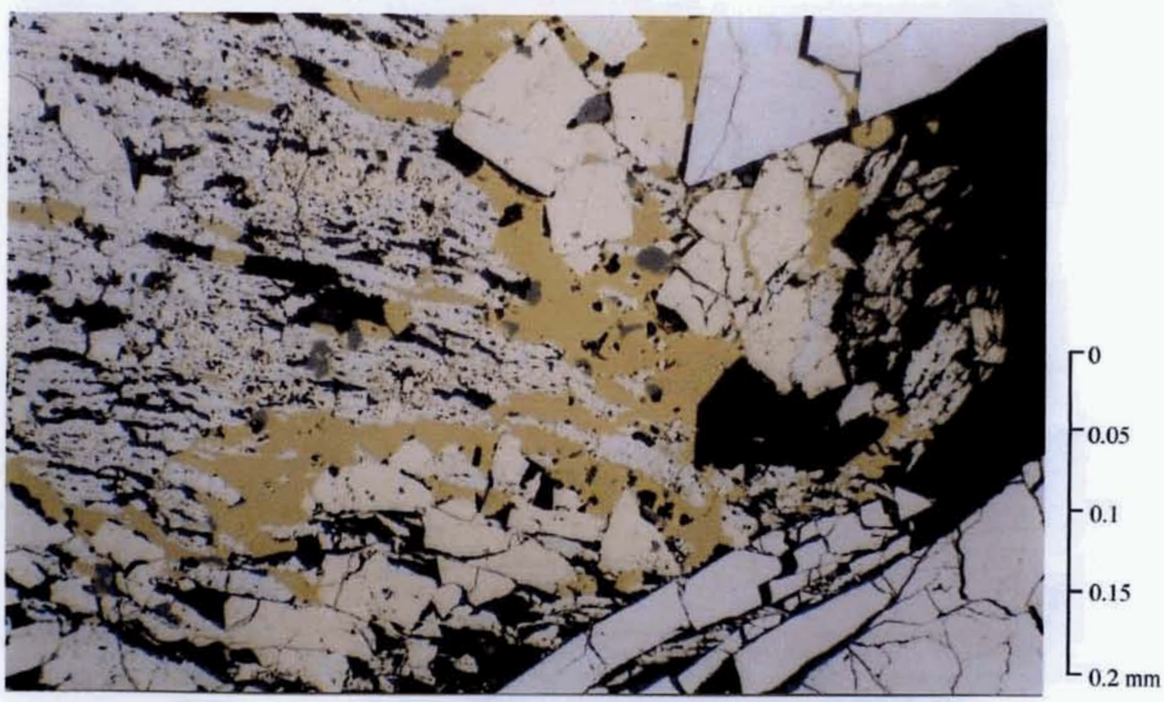


FIG 14: SAMPLE S91-76, 28.4m (Reflected plane polarised light, x20, Film 2 / Frame 9A)
This view illustrates the occurrence of fine-grained microgranular trails of marcasite (white, left) that occur within a large patch of chalcopyrite (yellow), with associated pyrite (cream crystals, centre top) and arsenopyrite crystals (white, top right, bottom right). The presence of marcasite supports lower-temperature conditions of formation.

SAMPLE : **S91-76, 28.5m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 28.5m

HAND SPECIMEN : A diffuse fracture network is accompanied by pale brownish cream alteration selvedges (K-feldspar), with relict darker wallrock kernels. Note arsenopyrite + dark mineral (?sphalerite) + cream ?feldspar/?scheelite fills late diffuse pore spaces. Only trace late thin white fractures.

The section offcut accepted a positive yellow stain for K-feldspar, confirming abundant fine-grained K-feldspar occurs pervasively through the rock.

ROCK NAME : **Diffusely veined and high-intensity K-feldspar-sericite-sulphide-chlorite altered intermediate rock**

FIG. 15: SAMPLE S91-76, 28.5m (Macrophotograph of sawn drill core, wet, bar for scale; Film 1 / Frame 7)
Minor late thin fractures (white, filled mainly by calcite) cut hostrock that contains irregularly oriented fractures filled by sulphides (lustrous metallic silvery grey colour, centre left) and associated strong pervasive alteration dominated by K-feldspar (drab paler brownish cream colour).

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
K-feldspar	38	Alteration / vein filling
Sericite	33	Alteration
Carbonate (calcite)	10	Alteration / vein filling / late thin fractures
Quartz	3	Alteration / vein filling
Chlorite	2	Alteration / fracture filling
Arsenopyrite	7	Alteration / vein filling
Pyrite	2	Alteration / vein filling
Sphalerite	2	Alteration / vein filling
Marcasite	1	Alteration / vein filling
Chalcopyrite	1	Alteration / vein filling
Apatite	Tr	Alteration
Rutile	Tr	Alteration

In polished thin section, this sample displays a pervasive fine-grained alteration texture, with indistinct veins of varied orientation.

K-feldspar is abundant, forming small anhedral grains in granular mosaic texture in large areas, and as larger granular aggregates at margins of indistinct sulphide-rich vein. Small equant anhedral apatite grains tend to be concentrated in the K-feldspar mosaics.

Sericite is moderately abundant. It occurs as tiny randomly oriented flecks that form dense replacement mats after host rock. The sericite is most abundant distant from the sulphide-rich veins, and appear to represent altered host rock less affected by veins.

Carbonate (calcite) occurs as small ragged grains concentrated in indistinct veins with K-feldspar. It also occurs as ragged grains irregularly distributed through altered host rock. Late thin sharp fractures of varied orientation are filled by sparry grains of calcite: these fracture fillings clearly cut earlier large grains of arsenopyrite, pyrite, sphalerite and chalcopyrite.

Quartz occurs in local areas as large anhedral to subhedral grains. Elsewhere it forms smaller grains intergrown with sulphides in indistinct vein-like structures.

Arsenopyrite is moderately abundant, forming subhedral elongated crystals that tend to be concentrated in sulphide-rich indistinct veins. Closely intergrown with the arsenopyrite are less abundant cream pyrite crystals, fine-grained dense aggregates of marcasite, large anhedral grains of sphalerite (speckled by minute chalcopyrite inclusions), and larger discrete ragged grains of chalcopyrite.

Chlorite occurs as tiny drab yellow-grain flakes that are concentrated in small scattered patches through the altered host rock, and also concentrated in thin fracture fillings.

Rutile occurs as tiny granules sprinkled through the altered host rock areas. Locally the rutile granules are loosely concentrated in equant clouds which appear to represent sites of altered precursor Fe-Ti oxide grains.

INTERPRETATION :

This sample may have formed as an intermediate volcanogenic rock. Irregular distribution of subsequent alteration minerals allows the precursor rock to have been a compositionally heterogeneous silicate rock, possibly a fragmental andesitic rock.

Initial fracturing and invasion of the rock by hydrothermal fluid may have generated a potassic alteration assemblage containing biotite, but most of the textures and mineralogy of that assemblage have been destroyed by subsequent events.

Fracturing and invasion of the rock by abundant hydrothermal fluid resulted in pervasive alteration and replacement along indistinct fracture network. This generated the new assemblage of K-feldspar + sericite + calcite + quartz + chlorite + arsenopyrite + pyrite + sphalerite + marcasite + chalcopyrite + apatite + rutile. The sulphides, together with K-feldspar, quartz and calcite, formed in highest abundance along indistinct veins of apparent replacement origin. Sericite and chlorite formed mostly in altered host rock distant from the replacement veins.

Late thin fractures cut the earlier alteration minerals, and were filled by calcite.

SAMPLE : **S91-76, 42.5-42.6m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 42.5-42.6m

HAND SPECIMEN : The drill core rock sample is composed of dark brownish grey altered wallrock cut by an indistinct paler 'vein' network associated with fine-grained abundant sulphides. Late thin white fractures cut the earlier structures: their strong effervescent reaction with dilute HCl confirms that they are filled mainly by calcite.

The section offcut accepted a positive yellow stain for K-feldspar, confirming abundant fine-grained K-feldspar occurs in diffuse patches through the rock.

ROCK NAME : **Thinly veined and high-intensity K-feldspar-sericite-chlorite-sulphide overprinted, biotite altered intermediate rock**

FIG. 16: SAMPLE S91-76, 42.5-42.6m (Macrophotograph of sawn drill core, wet, bar for scale; Film 1 / Frame 8) Irregularly oriented and discontinuous fractures are filled mainly by sulphide (lustrous metallic silvery-yellow colour), and are associated with pale greenish cream (K-feldspar-rich) alteration selvedges. Relict kernels (dark green) contain abundant biotite from precursor alteration event. Minor late thin fractures are filled by calcite (white).

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Biotite (phlogopitic)	15	Relict alteration 1
K-feldspar (adularia)	44	Alteration 2 / vein filling 2
Sericite	20	Alteration 2
Chlorite (drab yellow-brown, colourless)	8	Alteration 2 / vein filling 2
Quartz	5	Alteration 2 / vein filling 2
Pyrite	5	Alteration 2 / vein filling 2
Chalcopyrite	Tr	Alteration 2 / vein filling 2
Sphalerite	Tr	Alteration 2 / vein filling 2
Apatite	Tr	Alteration 2
Rutile	Tr	Alteration 2
Scheelite	Tr	Vein filling 2
Calcite	1	Late fracture fillings 3

In polished thin section, this sample displays a fine-grained pervasive alteration texture, with indistinct veins in a network through the rock.

Biotite is moderately abundant, occurring as small randomly oriented flakes that form a dense mat in large areas of altered host rock distant from veins. The biotite is pleochroic from orange to colourless, and therefore is most probably phlogopitic in composition. The biotite flakes are diffuse relict flakes that have suffered moderately severe replacement (Mg-rich) by fine-grained sericite, and elsewhere by fine-grained chlorite.

Two types of chlorite are distinguished:

i) Fine-grained drab yellow-green chlorite pervades the biotite-sericite relict host rock areas, and similar chlorite also is concentrated in ragged aggregates in the indistinct veins

ii) Coarser flakes of colourless chlorite (Mg-rich) form aggregates in some of the veins.

K-feldspar is abundant, forming small anhedral grains concentrated in granular aggregates in the selvedges marginal to indistinct veins. The K-feldspar forms the paler 'vein' network observed in the hand specimen. Some K-feldspar also occurs in the indistinct veins, where it forms subhedral to euhedral small rhombic crystals with patchy internal microstructure (adularia).

Quartz occurs as large anhedral grains concentrated in the indistinct veins that form a network cutting the rock.

Pyrite occurs as subhedral crystals and dense massive aggregates that are concentrated in the indistinct veins. Lesser pyrite occurs as ragged replacement aggregates scattered through the altered hostrock.

Chalcopyrite is present in trace amount as small ragged grains scattered through the altered host rock and also in the indistinct veins. Sphalerite similarly occurs as ragged grains in both host rock and veins: its deep red colour suggests it has an Fe-rich composition.

Apatite occurs as small anhedral equant grains that are irregularly sprinkled through the K-feldspar-rich selvedges marginal to the indistinct veins.

Rutile is present as small deep yellow-red granules scattered through the altered host rock.

Scheelite occurs in trace amount as anhedral grains that occur in textural equilibrium with K-feldspar, chlorite, quartz and sulphide in indistinct veins. The scheelite displays its typical optical properties: colourless, very high relief, moderately high birefringence.

Calcite forms anhedral grains that fill thin discontinuous fractures and veinlets that cut all earlier structures.

INTERPRETATION :

This sample may have formed as an intermediate silicate rock, but all primary minerals and textures have been destroyed by subsequent alteration which appears to have occurred in two events:

1. Initial potassic alteration generated a large amount of biotite (phlogopitic) alteration as a dense replacement mat. Other minerals most likely formed at this time, but have been obscured by later events.

2. Continued fracturing and invasion by cooler hydrothermal fluid resulted in strong pervasive alteration and filling of indistinct veins by the new assemblage of K-feldspar + sericite + chlorite + quartz + pyrite + chalcopyrite + sphalerite + apatite + rutile + scheelite. In detail, earlier alteration biotite was partly replaced by sericite + chlorite + minor sulphides, and indistinct veins were filled by quartz + K-feldspar + pyrite + chlorite + chalcopyrite + sphalerite + scheelite.

3. Late thin fractures were filled by calcite.

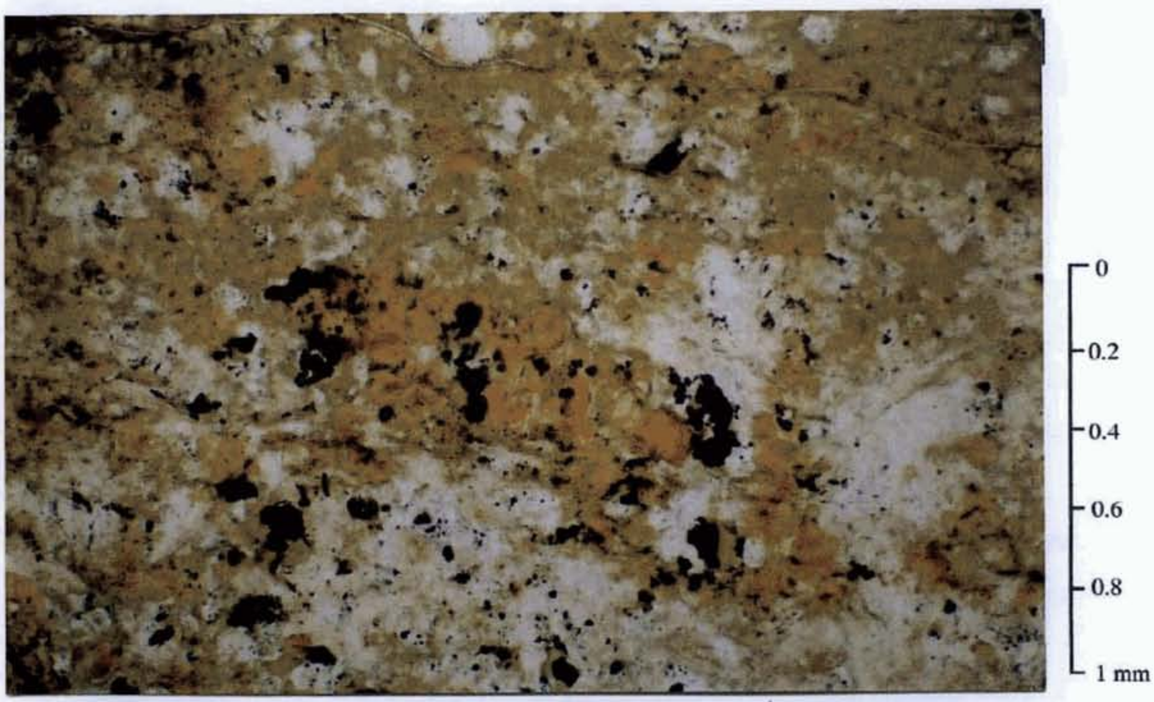


FIG. 17: SAMPLE S91-76, 42.5-42.6m (Transmitted plane polarised light, x5, Film 2 / Frame 11A)
This view of altered wallrock illustrates the presence of relict phlogopitic biotite (orange flakes) of the initial potassic alteration event, overprinted by lower-temperature alteration to chlorite (drab green), sericite (colourless), and minor opaques (pyrite, chalcopyrite).

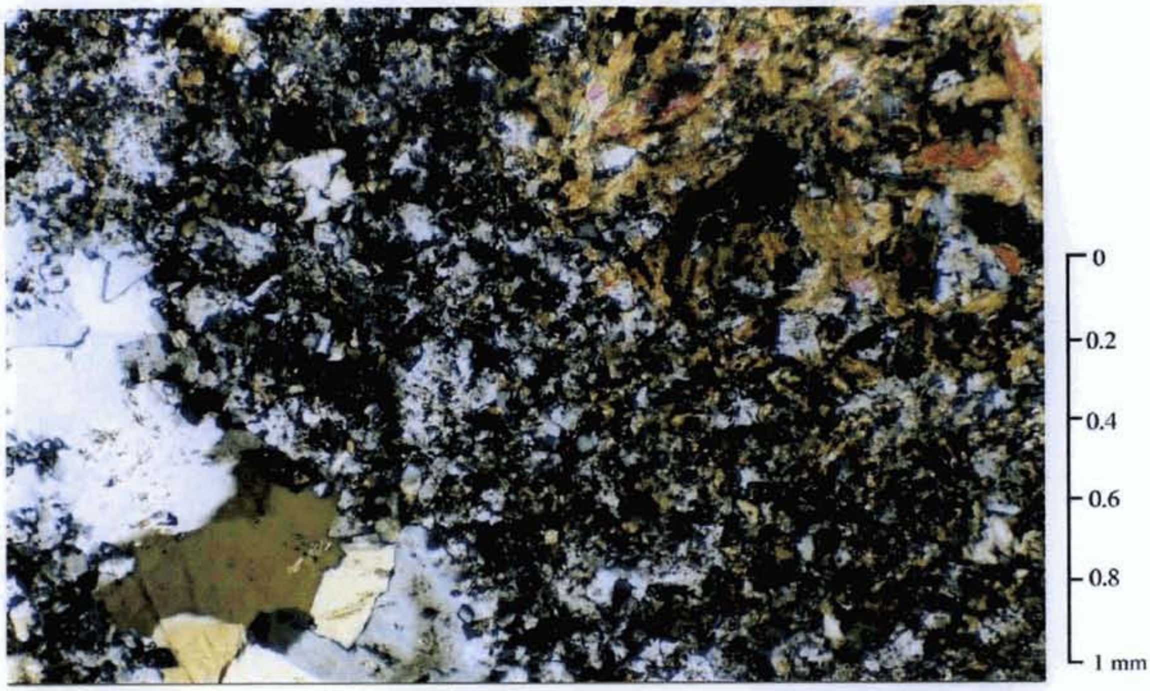


FIG. 18: SAMPLE S91-76, 42.5m (Transmitted light, crossed polarisers, x5, Film 2 / Frame 13A)
This view captures a vein (bottom left) filled by quartz (pale yellow, white) and K-feldspar (grey grains). Note the proximal alteration of wallrock to a fine-grained mosaic of K-feldspar (grey grains), and distal alteration sericite (top right, bright flakes). A trace of precursor alteration biotite is preserved at top right, but cannot be readily distinguished in this view.

SAMPLE : **S91-76, 42.6-42.7m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 42.6-42.7m

HAND SPECIMEN : The drill core sample represents high intensity alteration of hostrock composed of indistinct patches of pale grey material (K-feldspar), diffuse pale cream patches and local blocky grains (scheelite), with local interstitial dark ?sphalerite.

The sample effervesces strongly in reaction with dilute HCl, confirming calcite is abundant pervasively through the rock.

The section offcut accepted a strong positive yellow stain for K-feldspar, confirming it occurs as a fine-grained mosaic throughout the rock.

ROCK NAME : **High-intensity K-feldspar-sulphide-calcite-scheelite altered intermediate rock**

FIG. 19: SAMPLE S91-76, 42.6-42.7m (Macrophotograph of sawn drill core, wet, bar for scale; Film 1 / Frame 9) Strong pervasive alteration has generated moderately abundant scheelite (cream colour, ragged to blocky patches at bottom left, bottom right) with associated aggregates of sulphides (lustrous metallic silvery yellow colour, centre, top centre), abundant K-feldspar (pale greenish cream colour), and calcite (white) filling indistinct fractures (centre).

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
K-feldspar (adularia)	50	Alteration
Calcite	12	Alteration
Quartz	10	Alteration
Chlorite (brownish green, colourless)	10	Alteration
Sericite	3	Alteration
Pyrite	5	Alteration
Chalcopyrite	3	Alteration
Sphalerite	1	Alteration
Scheelite	5	Alteration
Apatite	Tr	Alteration
Rutile / anatase	Tr	Alteration
Native gold	Tr	Alteration
Unknown (?uraninite include. metamict alt'n)	Tr	Alteration

In polished thin section, this sample displays an inequigranular pervasive alteration texture, with local coarser-grained patches.

K-feldspar is abundant, occurring as equant anhedral grains in granular mosaics, and as euhedral rhomb-shaped crystals. The crystal shape and presence within individual crystals of internal crystallographic patches of varied orientations confirms identification as adularia.

Calcite is moderately abundant, forming large anhedral grains in coarser-grained areas, and smaller grains and granular aggregates elsewhere.

Quartz occurs as local large anhedral to subhedral grains up to ~2 mm in size. Locally, the quartz grains display euhedral crystal terminations.

Chlorite is moderately abundant. Most occurs as very fine-grained drab brownish green aggregates distributed throughout the rock. They tend to occupy interstitial patches between K-feldspar and quartz grains. Rarely, colourless chlorite (Mg-rich) forms platy to subradiating aggregates in the centre of dark chlorite aggregates.

Sericite is present in minor amount as tiny randomly oriented flecks that form large patches on the scale of many millimetres.

Pyrite is moderately abundant. It forms subhedral blocky crystals and massive aggregates in the coarser-grained areas, and forms fine-grained amoeboid aggregates intergrown with finer-grained K-feldspar and chlorite.

Chalcopyrite forms ragged grains of variable size, mostly in the coarser-grained areas where it is intergrown with quartz, K-feldspar and other minerals.

Sphalerite is uncommon, but locally forms large anhedral grains in the coarser-grained patches. It displays a dark red colour (Fe-rich composition), and contains minute chalcopyrite inclusions.

Scheelite is moderately abundant, forming large equant subhedral crystals and angular anhedral grains in the coarser-grained patches with quartz and K-feldspar. The scheelite displays the characteristic optical properties of this phase: equant crystal forms, colourless, lack of cleavage, moderate birefringence, uniaxial positive interference figure (3 obtained from 3 different appropriately oriented grains).

Apatite is present in trace amount as small stumpy subhedral crystals with typical optical properties (crystal forms, colourless, moderate relief, lack of cleavage, very low birefringence, parallel extinction). Most of the apatite occurs in the granular K-feldspar aggregates.

It appears that two TiO_2 phases are present: rutile occurs as dark yellow-red granules in loose aggregates and as discrete euhedral prismatic crystals, and possible anatase occurs as equant blocky small crystals that display the typical variegated blue-colourless colours (not tourmaline).

Native gold has been observed as a single ragged grain ~100 µm in size. Its bright yellow colour suggests a moderately high fineness (ie significant Ag content). The native gold occurs in one of the coarser-grained patches in association with chlorite, sphalerite, chalcopyrite, K-feldspar and quartz. Nearby lies a small equant opaque grain (possibly ?uraninite) that displays severe replacement by metamict material, leaving relict kernels of the primary unknown phase. Rare other grains of this phase are observed elsewhere through the rock.

INTERPRETATION :

This sample may have formed as an intermediate rock of uncertain origin, but identification of the primary rock remains uncertain owing to the complete pervasive alteration that has destroyed all primary minerals and textures.

Invasion of the rock by a significant volume of hydrothermal fluid resulted in complete pervasive replacement by the assemblage K-feldspar + calcite + quartz + chlorite + sericite + pyrite + chalcopyrite + scheelite + sphalerite + trace apatite + rutile/anatase + unknown (?uraninite) + native gold. Coarser-grained patches were dominated by quartz + calcite + sulphides + scheelite. A relatively low to moderate temperature for this event is inferred from the tendency for quartz to display euhedral crystal forms, the very fine-grained nature of the chlorite aggregates, and the presence of adularia as the K-feldspar phase.

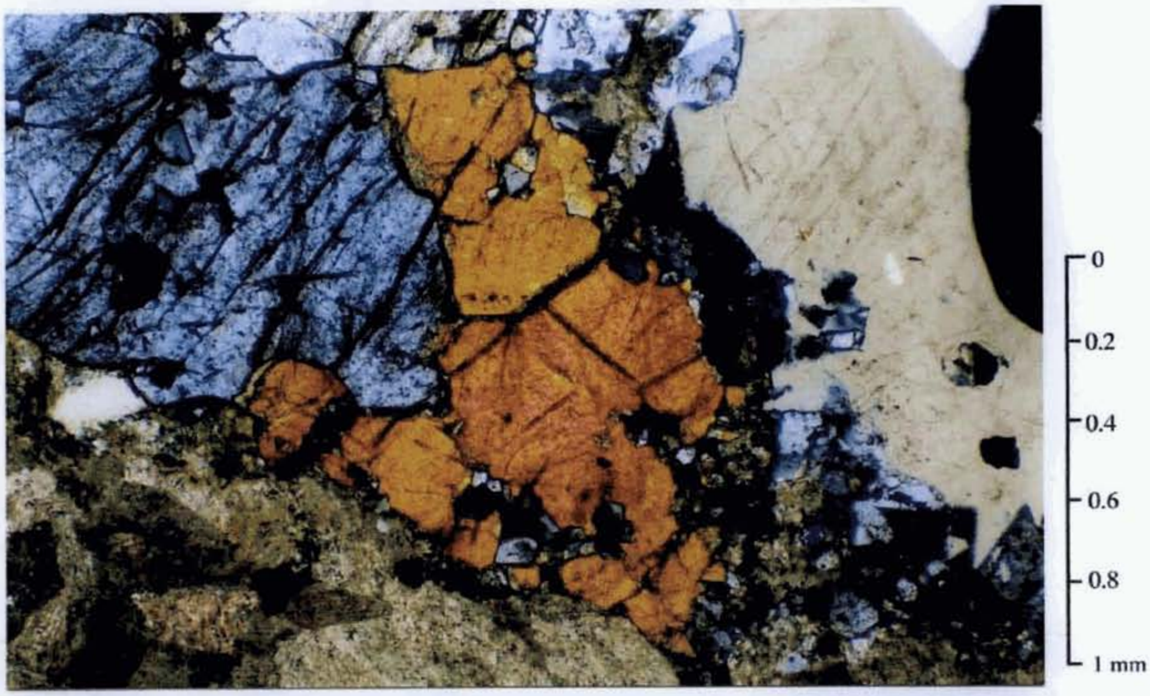


FIG. 20: SAMPLE S91-76, 42.6m (Transmitted light, crossed polarisers, x5, Film 2 / Frame 14A)
This view illustrates occurrence of large grains of scheelite (orange, dull grey at upper left) in association with quartz (large white grain, top right) and large calcite grains (bright pastel colours, bottom left). Note the presence of small grains of K-feldspar (grey) between the scheelite and quartz grains.

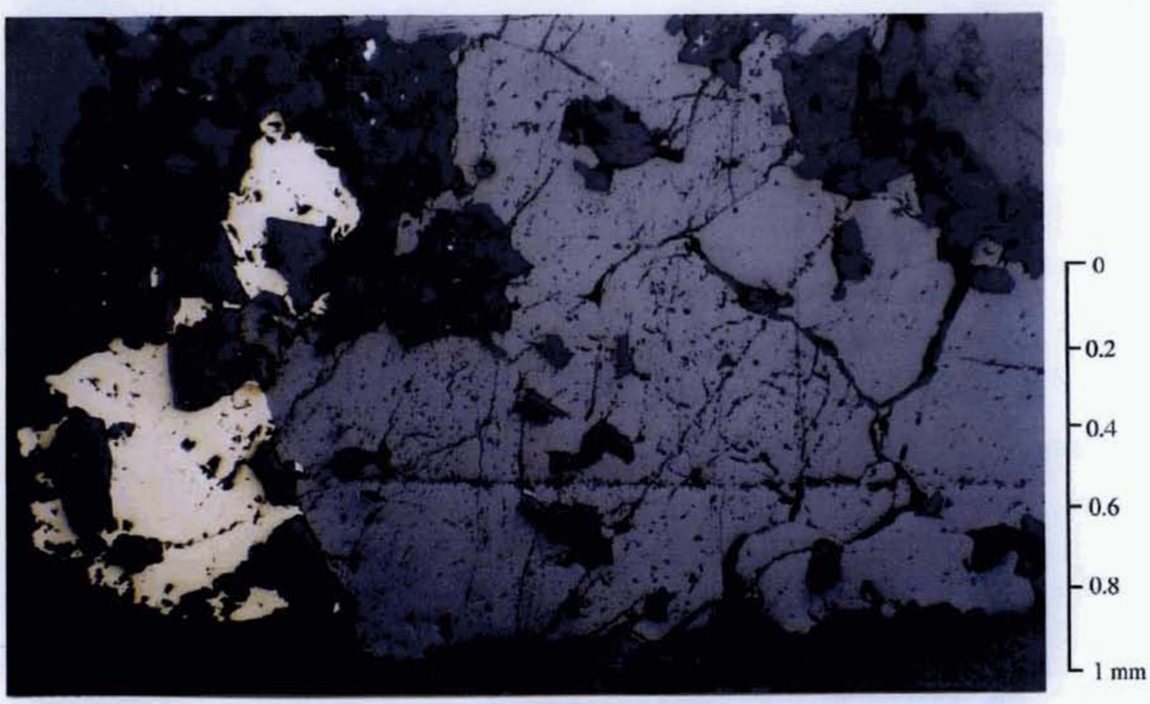


FIG. 21: SAMPLE S91-76, 42.6m (Reflected plane polarised light, x5, Film 2 / Frame 17A)
This view illustrates the close association between chalcopyrite (yellow) and scheelite (large pale grey grain, occupying most of the right part of field of view).

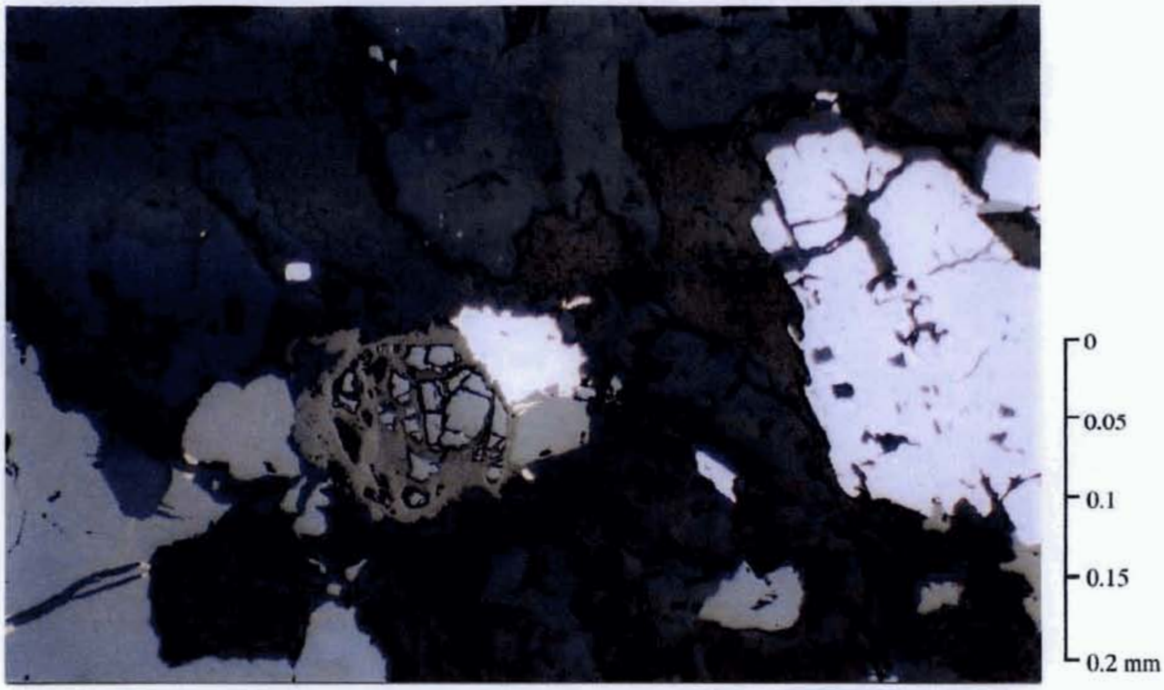


FIG. 22: SAMPLE S91-76, 42.6m (Reflected plane polarised light, x20, Film 2 / Frame 15A)
This view captures a grain of native gold (very bright pale yellow, centre) that lies in close association with a metamict unknown grain (dull grey equant kernels at left of native gold), arsenopyrite (white, far right), and sphalerite (pale grey, bottom left). Dark background minerals include quartz and chlorite.

SAMPLE : **S91-76, 44.2m (Spectrum Deposit, B.C., Canada)**

SECTION NO : S91-76, 44.2m

HAND SPECIMEN : The drill core sample represents a fine-grained massive drab dark brownish green rock, cut by thin sulphidic fractures about which are developed wide (1-2 cm) but diffuse paler brownish grey selvedges (K-feldspar-rich). Uncommon thin discontinuous brittle fractures are filled by white calcite.

The section offcut accepted a positive yellow stain for K-feldspar, indicating minor K-feldspar occurs as diffuse fine-grained selvedges along thin sulphidic fractures. It is absent from most of the rock.

ROCK NAME : **Thinly calcite fractured, K-feldspar-pyrite veined and low- to high-intensity K-feldspar-chlorite-sericite-sulphide overprinted, biotite altered intermediate rock**

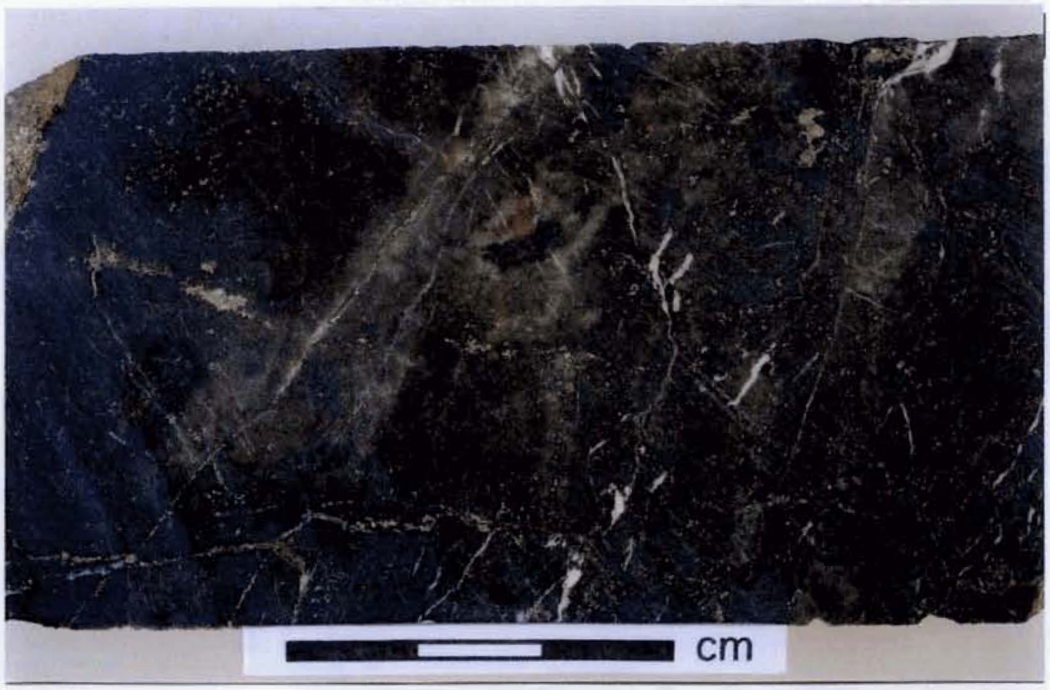


FIG. 23: SAMPLE S91-76, 44.2m (Macrophotograph of sawn drill core, wet, bar for scale; Film 3 / Frame 3)
Widely spaced thin fractures (oriented NE-SW, centre left, centre right) are sealed by sulphides (lustrous metallic colour) and are selvedged by K-feldspar (pale drab greenish cream colour). Dark brownish green kernels of relict hostrock (top left, bottom left, centre left, far right) contain abundant biotite of the precursor alteration event. Minor late thin discontinuous fractures are filled by calcite (white).

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Low- to high-intensity K-feldspar-chlorite-sericite-sulphide overprinted, biotite altered intermediate rock		
Biotite (phlogopite)	0-60	Relict alteration 1
Plagioclase	0-40	Relict alteration 1
Rutile	Tr	Alteration 1
Apatite	Tr	Alteration 1
K-feldspar	Tr-80	Alteration 2
Chlorite	0-15	Alteration 2
Calcite	3	Alteration 2
Pyrite (with trace pyrrhotite inclusions)	2	Alteration 2
Chalcopyrite	Tr	Alteration 2
K-feldspar-pyrite veins		
K-feldspar	56	Vein filling
Pyrite (with trace pyrrhotite inclusions)	40	Vein filling
Quartz	2	Vein filling
Chlorite (colourless)	2	Vein filling
Chalcopyrite	Tr	Vein filling
Late calcite fracture fillings		
Calcite	100	Fracture fillings

In polished thin section, this sample displays varied replacement alteration textures in host rock, and granular vein textures.

Low- to high-intensity K-feldspar-chlorite-sericite-sulphide overprinted, biotite altered intermediate rock displays mineralogies that vary from most-altered to least-altered with distance from veins.

Least-altered rock occurs distant from veins, and represents the dark brownish green hostrock observed in hand specimen. It is composed mostly of abundant small randomly oriented flakes of biotite in which the orange to colourless pleochroism suggests an Mg-rich composition (ie phlogopitic), and blocky to anhedral plagioclase grains now partly to severely replaced by optically continuous albite pervaded by tiny sericite flecks. Rutile forms tiny deep yellow-red granules concentrated in small clouds (probably altered Fe-Ti oxide grains). Scattered throughout are ragged small replacement patches of intergrown K-feldspar, calcite and minor pyrite and chalcopyrite.

Most-altered rock occurs in diffuse selvedges marginal to K-feldspar-pyrite veins. K-feldspar forms a granular mosaic, chlorite occurs as very fine-grained drab brownish green patches, calcite forms ragged grains and aggregates. Other minerals occurs in varied minor amounts: small pyrite grains and aggregates, small ragged chalcopyrite grains, turbid Ti-phase aggregates (rutile), and tiny anhedral equant apatite grains.

K-feldspar-pyrite veins are thin (<2 mm wide), display varied orientations in a widely-spaced intersecting network, and display diffuse contacts with altered wallrock. K-feldspar forms anhedral to euhedral grains, pyrite occurs as subhedral grains and massive aggregates, chlorite occurs as colourless (Mg-rich) aggregates, calcite forms local aggregates, quartz occurs as uncommon clear grains, and chalcopyrite occurs as uncommon ragged grains. A trace of pyrrhotite occurs as small ragged inclusions in some of the larger pyrite grains, and marcasite also occurs in larger pyrite grains as subparallel trails of microgranular aggregates.

Late calcite fracture fillings are thin, discontinuous, and varied in orientation. They are filled entirely by anhedral calcite grains.

INTERPRETATION :

The mineralogies and microtextures of this sample are interpreted as follows, from earliest to latest event:

1. Formation of primary intermediate rock
An intermediate igneous rock, possibly of andesitic composition, formed as part of the regional stratigraphic sequence. All primary minerals and most primary textures have been destroyed by subsequent events.

2. Initial potassic (biotite-stable) hydrothermal alteration
The rock was invaded by hydrothermal fluid that was relatively hot and K-bearing. This resulted in strong pervasive replacement by the potassic alteration assemblage of plagioclase + biotite + trace rutile + apatite. Most primary textures were destroyed, but local concentration of biotite in small blocky aggregates is thought to reflect primary ferromagnesian crystal sites, and small loose clouds of microgranular rutile represent altered Fe-Ti oxide grains.

3. Fracturing and associated potassic (K-feldspar-stable) hydrothermal alteration
The rock suffered widely-spaced thin fracturing and invasion by a significant volume of cooler hydrothermal fluid along those fractures. This resulted in filling of the fractures by the assemblage K-feldspar + pyrite + minor calcite + chlorite + trace chalcopyrite, and strong selvedge alteration to the microgranular assemblage of K-feldspar + chlorite + minor calcite + pyrite (with trace pyrrhotite as inclusions) + chalcopyrite. Earlier formation of the precursor biotite-stable assemblage is indicated by the progressive replacement of biotite with distance from the K-feldspar-sulphide fracture fillings.

4. Late calcite fracture fillings
Final brittle fracturing resulted in filling of discontinuous thin fractures by calcite.

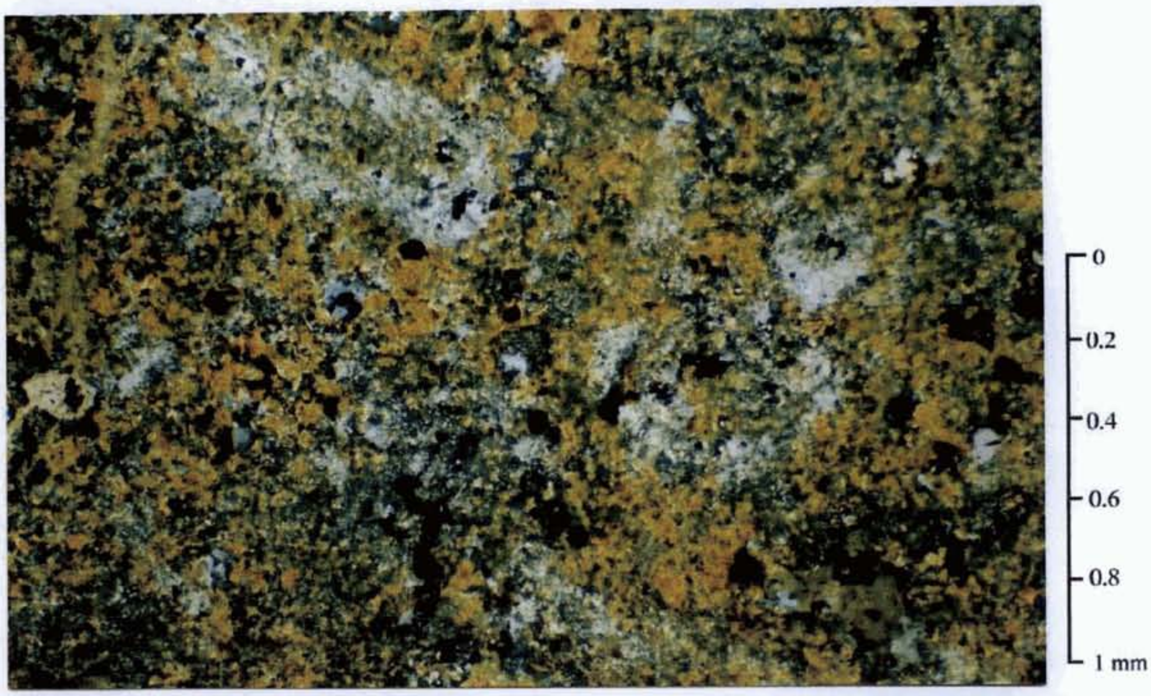


FIG. 24: SAMPLE S91-76, 44.2m (Transmitted light, crossed polarisers with condenser, x5, Film 2 / Frame 18A)
This view illustrates the initial potassic alteration assemblage, composed of abundant fine-grained biotite (orange flakes) and plagioclase grains (grey). In most samples of this suite, this assemblage has suffered partial (see FIG. 25 below) to complete overprinting by subsequent lower-temperature K-feldspar-stable potassic alteration.

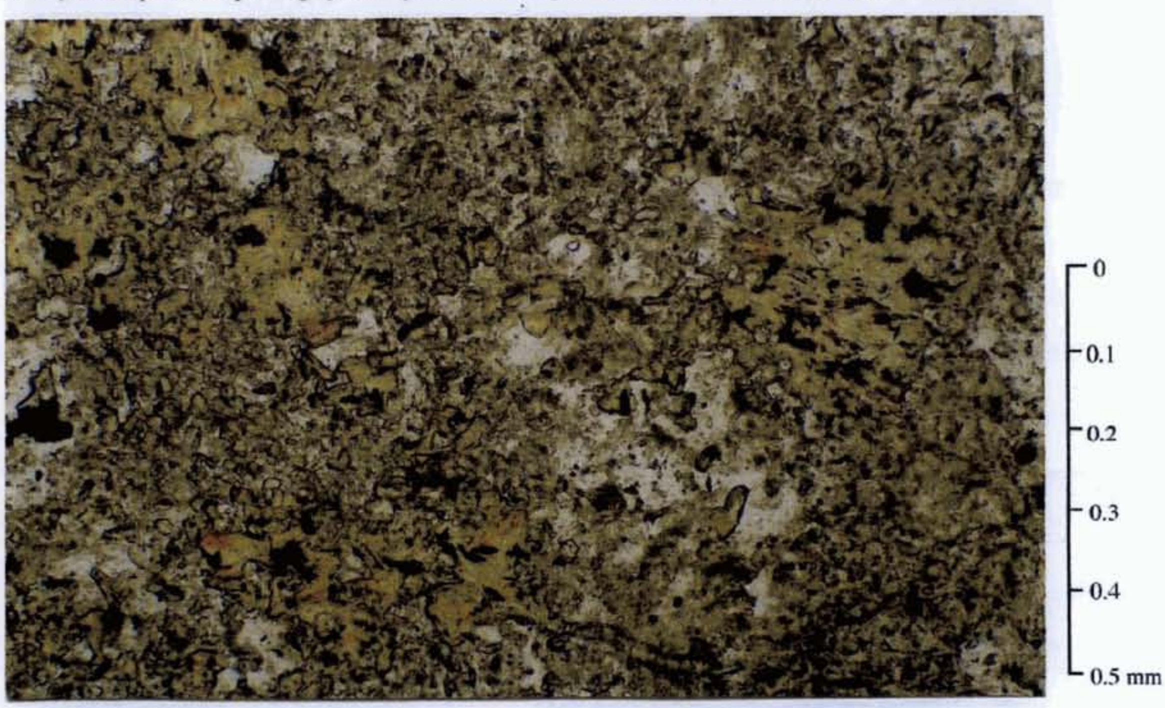


FIG. 25: SAMPLE S91-76, 44.2m (Transmitted plane polarised light, x10, Film 2 / Frame 19A)
This view illustrates partial overprinting of the initial potassic alteration assemblage by the later assemblage. Chlorite (drab green) has almost completely replaced precursor biotite (brown), leaving traces of biotite in places.

SAMPLE : S91-76, 44.55m (Spectrum Deposit, B.C., Canada)

SECTION NO : S91-76, 44.55m

HAND SPECIMEN : The drill core sample represents a fine-grained dark brownish green rock, cut by a widely-spaced network of thin sulphide-filled fractures mantled by pale grey (K-feldspar-rich) alteration selvedges.

The section offcut accepted a positive yellow stain for K-feldspar, indicating fine-grained K-feldspar occurs in moderate abundance as diffuse selvedges marginal to sulphidic fractures. It is absent from darker hostrock kernels.

FIG. 26: SAMPLE S91-76, 44.55m (Macrophotograph of drill core, curved surface, wet, bar for scale; Film 1 / Frame 12). This view illustrates intersecting thin fractures (oriented N-S, E-W) sealed by fine-grained lustrous sulphide (metallic silvery colour) and selvedged by K-feldspar (pale greenish cream). Relict dark brownish green hostrock kernels (top left, bottom left, centre, right) contain abundant biotite from a precursor alteration event. Note that the mineralised fracture fillings are very thin, and most of the width of the pale 'veins' is actually alteration selvedge.

ROCK NAME : K-feldspar-quartz-sulphide veined and low- to high-intensity K-feldspar-sericite-chlorite overprinted, biotite altered intermediate rock

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Low- to high-intensity K-feldspar-sericite-chlorite overprinted, biotite altered intermediate rock		
Biotite	0-60	Relict alteration 1
Apatite	Tr	Relict alteration 1 / alteration 2
K-feldspar	Tr-80	Alteration 2
Sericite	0-35	Alteration 2
Chlorite (drab brownish green, colourless)	0-15	Alteration 2
Pyrite	1	Alteration 2
Chalcopyrite	Tr	Alteration 2
Rutile	Tr	Alteration ?1/?2
K-feldspar-quartz-sulphide veins		
K-feldspar	63	Vein filling
Quartz	30	Vein filling
Pyrite (trace pyrrhotite inclusions)	5	Vein filling
Chlorite	1	Vein filling
Arsenopyrite	1	Vein filling

In polished thin section, this sample displays a pervasive alteration texture in two stages, with space-filling and replacement vein textures.

Low- to high-intensity K-feldspar-sericite-chlorite overprinted, biotite altered intermediate rock displays two different assemblages with distance away from veins.

Distant from veins, biotite is moderately abundant, occurring as randomly oriented small flakes pleochroic from orange to colourless (ie Mg-rich, phlogopitic composition). Sericite is moderately abundant, forming tiny flecks in pervasive mosaics that appear to have replaced precursor ?feldspar (probably plagioclase) but none is preserved. A trace amount of rutile occurs as tiny granules concentrated in scattered blocky clouds that most likely represent thoroughly altered precursor Fe-Ti oxide crystals. Apatite forms subhedral larger prismatic grains. Pyrite occurs as scattered small ragged grains and small aggregates, and chalcopyrite occurs as small ragged grains.

Closer to veins and in vein selvedges, K-feldspar forms a mosaic of anhedral small grains. Chlorite occurs both as very fine-grained drab brownish green aggregates, and as colourless flakes that appear to have formed by replacement of precursor biotite flakes. Pyrite forms small subhedral crystals and granular aggregates, and chalcopyrite occurs as scattered small ragged grains. Rutile occurs as turbid microgranular aggregates. Tiny colourless apatite grains are irregularly sprinkled through the K-feldspar mosaic.

K-feldspar-quartz-sulphide veins are thin (<2 mm wide) and appear to form a widely-spaced network. They are filled by large anhedral grains and smaller euhedral rhombic crystals of K-feldspar (adularia as indicated by crystal forms), large colourless anhedral grains of quartz, subhedral to anhedral pyrite grains and aggregates, uncommon subhedral crystals of arsenopyrite, minor colourless flakes and patches of chlorite. A trace of pyrrhotite (with characteristic pale pinkish brown colour and anisotropic optical behaviour) occurs as small ragged inclusions within larger pyrite grains.

INTERPRETATION :

This sample most likely formed as an intermediate igneous rock, but all primary minerals and textures have been destroyed in response to alteration in two stages.

Initial invasion of the rock by relatively hot, K-bearing hydrothermal fluid resulted in strong pervasive replacement by the potassic alteration assemblage of biotite + ?plagioclase + trace apatite + rutile. Further fracturing and invasion by cooler K-S-Fe-Cu-As-bearing hydrothermal fluid resulted in filling of thin fractures by K-feldspar + quartz + pyrite (with trace pyrrhotite inclusions) + chlorite + arsenopyrite, and accompanying selvedge alteration of adjacent wallrock to form K-feldspar + sericite + chlorite + trace pyrite + chalcopyrite + rutile. Replacement of precursor biotite by chlorite and precursor ?plagioclase by K-feldspar produces the paler colour of the selvedges, in contrast with the darker brownish green colour of the biotite-rich precursor alteration assemblage.

6 DISCUSSION

6.1 Hydrothermal Alteration Assemblages

Two distinct hydrothermal alteration assemblages (parageneses) are identified in this work: early potassic (biotite-stable) alteration, and later potassic (K-feldspar-stable) alteration. Characteristics of these two alteration assemblages are given in TABLE 4.

TABLE 4: ALTERATION PARAGENESES AND CHARACTERISTICS

CHARACTERISTIC	EARLY POTASSIC PARAGENESIS	LATE POTASSIC PARAGENESIS	
Relationship to mineralisation	Pre-mineralisation	Syn-mineralisation	Post-mineralisation
Alteration type	Potassic	Potassic	-
Alteration style	Pervasive	Fracture selvedge	-
Mineralogy* of hostrock alteration	Bio + pla + minor apa + rut + possible others	Kf + ser + chl + dol + py + apa ± qtz ± asp ± cpy ± sph ± shl ± gld ± rut ± ana ± mrc ± unk ± po	-
Mineralogy of thin fracture fillings / veinlets	[None observed]	Kf ± chl ± cal ± qtz ± py ± cpy ± asp ± sph ± shl ± mrc ± po	Cal ± chl ± py ± mrc ± sph ± cpy
Inferred fluid temperature	Relatively high (biotite stable; T>~350°C)	Relatively low (biotite unstable; T<~350°C)	Very low (marcasite stable)
Inferred fluid solutes	K, ?S, ?Cu	S, K, CO_2, Fe, Cu, Zn, Ca, As, W, Au	CO_2, Ca, S, Fe, Zn, Cu

* For key to mineral abbreviations see footnotes for TABLE 1.

The early potassic (biotite-stable) assemblage is preserved as dark kernels in some of the samples of this suite (see TABLE 1; samples S91-76, 42.5m; 44.2m; 44.55m), and textural evidence of the assemblage is preserved in wallrock that has suffered partial replacement by the later assemblage. Biotite is abundant, forming randomly oriented small replacement flakes whose orange to colourless pleochroism suggests an Mg-rich (phlogopitic) composition. Mostly the biotite is diffusely disseminated through the rock, but in places it is concentrated in blocky aggregates which appear to represent precursor ferromagnesian crystals, possibly igneous crystals in an intermediate volcanogenic rock, and elsewhere the biotite is locally concentrated in discontinuous thin trails. Plagioclase is the other principal mineral in this assemblage, forming subhedral crystals and anhedral grains. Minor apatite occurs as blocky subhedral prismatic crystals and anhedral grains that are somewhat coarser grained than the biotite. Rutile occurs in minor amount as small granules that locally are concentrated in blocky diffuse aggregates which appear to represent thoroughly altered precursor Fe-Ti oxide grains. Other minerals (eg ?chalcopyrite) may have formed part of this assemblage, but have been obscured by the effects of the later event.

The later potassic (K-feldspar-stable) assemblage formed in highest intensity in selvedges marginal to fractures and thin veinlets that form a widely spaced network. Alteration of this event has been described in a previous petrographic report on a single sample (see Mason, 2003). In some samples, the alteration is developed in selvedges several millimetres to ~1 cm wide, with preserved dark kernels of the precursor biotite-stable assemblage. Other samples have suffered complete pervasive replacement by the K-feldspar-stable assemblage (see TABLE 1; samples S91-76, 27.4m, 27.55m, 28.4m, 28.5m). K-feldspar is the principal mineral, forming small equant anhedral grains in a dense granular mosaic that occurs most abundantly marginal to the fracture fillings. Sericite occurs as tiny flecks in dense mats that have replaced plagioclase of the precursor assemblage, and is most abundant in places distant from fracture fillings. Chlorite forms small ragged dense aggregates of tiny yellowish-green flecks, but also forms very pale green to colourless (ie Mg-rich) replacements of precursor biotite flakes with associated tiny granules of rutile. Dolomite is present as ragged grains and aggregates. Apatite occurs as small equant subhedral to anhedral grains. Quartz forms local large anhedral clear grains and subhedral crystals in possible replacement patches. Disseminated sulphides include blocky crystals, amoeboid grains and granular aggregates of pyrite, subhedral crystals and aggregates of arsenopyrite, ragged grains and aggregates of chalcopyrite, similarly large ragged grains and aggregates of sphalerite whose dark red colour suggests an Fe-rich composition, large subhedral crystals of scheelite, and uncommon ragged grains of bright yellow native gold. Marcasite occurs locally as fine-grained trails or aggregates within larger pyrite grains, and pyrrhotite occurs as tiny ragged inclusions in pyrite and arsenopyrite and rare inclusions in calcite. Rutile forms small deep yellow-red crystals, and some anatase forms small equant crystals with typical blue to colourless variegated colour. Rare small equant grains that display severe metamict alteration possibly represent ?uraninite (see sample S91-76, 42.6m).

Thin fracture fillings and veinlets up to several millimetres wide formed as part of the K-feldspar-stable event. They are filled by anhedral grains and euhedral rhombic crystals of K-feldspar (adularia), clear anhedral to subhedral quartz crystals, anhedral interstitial calcite grains, fine-grained dense aggregates of drab yellow-green chlorite and aggregates of colourless chlorite flakes, subhedral crystals and dense granular aggregates of pyrite (some with tiny inclusions of pyrrhotite and some with trails of fine-grained marcasite), euhedral crystals and aggregates of arsenopyrite (some with tiny pyrrhotite inclusions), ragged grains of deep red sphalerite, ragged grains of chalcopyrite, and equant to angular grains of scheelite.

The overprinting relationship between the later K-feldspar-stable assemblage and the earlier biotite-stable assemblage is observed in areas of the rock distant from the later K-feldspar-stable veinlets, where particular observations are recorded:

i) Precursor biotite flakes and aggregates clearly display partial to complete replacement by very pale green to colourless (Mg-rich) chlorite, with associated tiny granules of Ti-phase material (rutile);

ii) Precursor plagioclase displays partial to complete replacement by fine-grained dense mats of sericite;

iii) Small replacement patches of calcite + K-feldspar ± pyrite ± chalcopyrite are sparsely scattered through the relict biotite.

The lower-temperature nature of the later K-feldspar-stable assemblage is supported by a number of observations:

i) Presence of adularia (rhombic crystal shapes, internal crystallographic patchiness) rather than orthoclase as the K-feldspar phase;

ii) Presence of chlorite rather than biotite as the stable Fe-Mg phyllosilicate phase;

iii) Presence of subhedral to euhedral crystal forms of quartz in the veinlet fillings and in local alteration patches. In contrast, quartz textures commonly are granular at higher temperatures in mesothermal systems;

iv) Presence of marcasite as fine-grained trails in larger pyrite crystals, and as granular aggregates in late calcite-rich fracture fillings;

v) Presence of some anatase as the stable TiO_2 phase.

6.2 Fracturing, Veining, and the Mineralised Fracture Zone

Significant observations in this work in relation to the presence and nature of structures, including fractures and veins, include the following:

i) No fractures, fracture fillings or veins have been observed as part of the early biotite-stable potassic event. At this time, invasion of the rock body by hydrothermal fluid appears to have been pervasive in nature, possibly aided by thin discontinuous fractures that were obliterated by the ensuing strong pervasive alteration.

ii) During the subsequent K-feldspar-stable event, a network of thin fractures formed presumably in response to local deformation, and were utilised as a conduit system by the hydrothermal fluid. Thin veinlets formed along the fractures, with associated development of K-feldspar-rich alteration selvedges. In some samples, strong pervasive alteration developed throughout the rock body. It is notable that wide space-filling veins did not form as part of this event.

iii) Late thin discontinuous fractures were filled by calcite, with only minor other minerals. These fractures cut all earlier structures, and their white colour in hand specimen stands in strong contrast with the dull greenish grey hostrock, ensuring that they are the most visually distinctive feature of the rock. They are considered to have formed as a late stage of the K-feldspar-stable principal mineralising event, as supported by the presence of fracture filling minerals (calcite, marcasite, pyrite, sphalerite, chalcopyrite) that also were part of the mineralising stage.

An important result of these observations is that the mineralised zone mapped to the east of the monzonite porphyry intrusion (Sorbara, 1996) may be referred to as 'an altered fracture zone'. It is misleading to describe this mineralised zone as containing 'veins 1-6 m wide' (Sorbara, 1996): it is the writer's view that those 'veins' actually represent a concentration of pale K-feldspar-rich alteration selvedges that mantle a fracture network, and have not formed as wide space-filling veins. Although this zone has suffered significant fracturing and invasion by a large volume of mineralising fluid, it appears that there has been minimal dilation (ie generation of open space).

6.3 Some Comments on Spectrum Mineralisation

6.3.1 Extension of mineralisation to depth

In the present work, higher-temperature biotite-stable alteration is identified as an early event, and has been overprinted by later lower-temperature K-feldspar-stable alteration/mineralisation event. If it is accepted that the hydrothermal fluids were fed from an intrusive body (or bodies) at depth, then it is likely that both types of alteration may extend to depth. The structural distribution of those alteration types remains conjectural, depending on the orientation of the structural conduits (fracture zones) and the location of the fluid source.

6.3.2 Extension of structures to depth

Two principal mineralised structural zones have been mapped in the Spectrum Deposit: a thicker eastern zone (containing the QC Zone and Porphyry Zone), and a thinner western zone (500 Colour Zone) (Sorbara, 1996). The general NNE-SSW trend of the eastern zone and the NNW-SSE trend of the western zone may allow those zones to intersect at depth. Such a zone of intersection would present a major exploration target, because it may represent a zone of confluence of mineralising fluids where mineralisation tenor may increase in response to higher fluid volumes in a single conduit (ie fracture zone).

6.3.3 Potential for stockwork or sheeted vein mineralisation in porphyry

It is unknown to the writer whether mineralisation has been recorded in the monzonite porphyry intrusion. However, this body might provide exploration targets if it has been intersected by the mineralised fracture zones. Whereas the fracture zones have failed to provide any significant open space development in the structurally weak volcanogenic rocks, those same fracture zones are likely to generate brittle open fractures and breccia zones in the more competent porphyry, allowing for development of different styles of mineralisation including stockwork mineralisation or sheeted vein mineralisation.

6.3.4 Origin of mineralising fluid

The structural zones at Spectrum have been invaded by two different fluids, an earlier hotter metal-poor fluid and a later cooler metal- and S-rich fluid. It is considered likely that both fluids were derived from cooling intrusion(s) at depth beneath the Spectrum Deposit.

The earlier hotter fluid contained abundant K, and may also have contained minor CO_2, S, Fe and Cu. Such a fluid is common in porphyry-type systems, and represents segregation, expulsion and uprise of an orthomagmatic hydrothermal fluid from a crystallising magma.

The cooler later mineralising fluid may have originated from the same pluton, possibly by separation of further orthomagmatic fluid at a later stage of crystallisation of the magma, allowing more sulphur and metals to be partitioned into the residual fluid. Alternatively, the mineralising fluid may have been derived from a different intrusive body, and fortuitously invaded the same structural zone as the precursor higher-T fluid.

The metal budget of the Spectrum Deposit (Fe > Cu > Zn > W > Au; apparent high W/Mo) is consistent with derivation of an orthomagmatic fluid from a moderately oxidised calc-alkaline magma. Useful information on the nature of the magmas in the area could be obtained from a petrologic study of the monzonite porphyry intrusion located between the eastern and western mineralised structural zones. Sorbara (1996) mentions that the porphyry varies in composition ('granite, granodiorite, quartz monzonite, monzonite'): if true, this could imply that differentiation processes appropriate for generation of an orthomagmatic fluid occurred in a pluton at depth, with subsequent uprise, entrainment and emplacement of the varied products of those differentiation processes. Further, Sorbara (1996) suggests that alteration zoning is observed in the porphyry, from potassic alteration in the centre (K-feldspar, biotite, sericite) to propylitic alteration outwards (chlorite, epidote, sericite, carbonate). If this is substantiated by petrological studies, it could provide direct evidence that those magmas were associated with production of orthomagmatic fluid(s).

7 REFERENCES

Mason D.R. 2003. Petrographic Description of Drill Core Sample 91.76/34933 (British Columbia, Canada). 17 December 2003. Internal report for Trans Pacific Mining Ltd.

Sorbara J.P. 1996. Summary Report on Spectrum Property for Crocodile Resources (DCC) Ltd.

Schedule D

Mason Geoscience Pty Ltd

Petrological Services for the
Minerals Exploration and Mining Industry

ABN 64 140 231 481 ACN 063 539 686

Postal: PO Box 78 Glenside SA 5065 Australia
Delivery: 141 Yarrabee Rd Greenhill SA 5140 Australia
Ph: +61-8-8390-1507 Fax: +61-8-8390-1194
e-mail: masongeo@ozemail.com.au

Geochemical Analyses and Autoradiographs for Rock Samples from Drill Hole S91-76 (Spectrum Deposit, British Columbia, Canada)

REPORT #	**2990**
CLIENT	**Trans Pacific Mining**
ORDER NO	**Email, R. Salfinger**
CONTACT	**Mr Rod Salfinger**
REPORT BY	**Dr Douglas R Mason**
SIGNED	Doug Mason
	for Mason Geoscience Pty Ltd
DATE	**23 August 2004**

Geochemical Analyses and Autoradiographs for Rock Samples from Drill Hole S91-76 (Spectrum Deposit, British Columbia, Canada)

SUMMARY

1. Rock Samples

- A suite of 8 drill core rock samples from drill hole S91-76 (Spectrum Deposit, British Columbia, Canada), previously studied using petrographic and mineragraphic methods, has been studied for the presence of radioactive minerals using whole-rock geochemical methods and autoradiograph methods.

2. Brief Results

- *Geochemical analyses*
  - Each of the 8 samples was analysed for U, Th, As and Rb.
  - Uranium is low in abundance (<2 ppm – 10 ppm U) in 7 of the 8 samples. It reaches its highest abundance (58 ppm) in sample S91-76, 42.6-42.7m, in which uncommon small radioactive grains were previously observed during petrographic/mineragraphic study. The coincidence of the highest U assay and the presence of the radioactive grains strongly suggests that these grains are U-bearing.
  - Thorium is low in abundance in all samples (<2 ppm – 11 ppm Th).
  - Arsenic is anomalous (~74-240 ppm As) in 6 of the 8 sulphide-bearing samples, and is very high (~2.5-3.3% As) in samples that contain significant amounts of arsenopyrite.
  - Rubidium is moderately abundant (~150-250 ppm Rb) in all samples, consistent with pervasive early biotite-stable alteration.
- *Autoradiographs*
  - In seven of the 8 samples, no radioactive response was detected.
  - In sample S91-76, 42.6-42.7m, a few small radioactive grains were detected, sparsely and irregularly scattered through the sample.
- *Conclusions*
  - Small U-bearing radioactive grains occur in trace amount in 1 of the 8 studied samples.
  - Their presence in one sample suggests that the mineral formed as part of a primary fragmental volcanogenic rock, not as part of the subsequent biotite-stable and K-feldspar-stable alteration events which pervasively modified the primary rock.
  - The precise nature of the U-bearing phase has not been confirmed. This would require SEM-probe work.

1 INTRODUCTION

During routine petrographic and mineragraphic studies of mineralised drill core samples from drill hole S91-76 (Spectrum Deposit, British Columbia, Canada), a radioactive and potentially U-bearing mineral was observed in sample S91-76, 42.6-42.7m (see Mason D.R., 2004: Petrological Study of Eight Drill Core Rock Samples from Drill Hole S91-76 at the Spectrum Gold Deposit, British Columbia, Canada. Mason Geoscience Report No. 2979 for Trans Pacific Mining, 21 May 2004).

Subsequent email discussion with Mr Rod Salfinger (Trans Pacific Mining, Melbourne, Victoria) and Dr Vic Wall (Taylor Wall & Associates, Brisbane, Qld) confirmed that additional work was required to establish the abundance and distribution of the potential U-bearing mineral.

To follow up this work, the suite of previously-studied rock samples from drill hole S91-76 was received from the Melbourne office of Trans Pacific Mining on 17 June 2004.

Preliminary results of this work were forwarded by email to Mr Salfinger and Dr Wall on 6 July and 12 July 2004. This report contains the full results of this work.

2 METHODS

2.1 Whole-Rock Analysis for U, Th, As and Rb

Subsamples of each of the 8 samples were submitted for grinding and analysis for U, Th, As and Rb. These elements were selected for analysis for the following reasons:

i) Uranium was required in order to determine the total abundance of U, possibly contributed by the radioactive mineral previously observed.

ii) Thorium was selected for analysis in order to determine whether the mineral was also Th-bearing.

iii) Arsenic was selected for analysis in order to confirm the abundance of As in the mineralised drill hole, where arsenopyrite was previously observed to vary dramatically from sample to sample.

iv) Rubidium was selected in order to confirm the likely presence (or prior presence) of biotite, a potential Rb-bearing mineral.

The samples were despatched to Amdel Laboratories (Thebarton, South Australia) for geochemical analysis by X-ray fluorescence methods. The full results are given in APPENDIX 1.

2.2 Autoradiographs

Autoradiographs were specified in order to positively identify the physical location of radioactive minerals in the samples. Each of the section offcuts previously used for thin section study were submitted to Amdel Laboratories (Thebarton, South Australia) for autoradiograph preparation using the planar sawn surface of each section.

3 RESULTS OF WHOLE-ROCK ANALYSIS

The results for whole-rock analysis for U, Th, As and Rb are given in TABLE 1.

TABLE 1: ANALYSES FOR U, TH, AS AND RB

ELEMENT	U	Th	As	Rb
UNITS	ppm	ppm	ppm	ppm
SCHEME	XRF1L	XRF1L	XRF1L	XRF1L
DETECTION LIMIT	2	2	1	1
S91-76 27.4m	10	<2	130	250
S91-76 27.55m	<2	10	135	190
S91-76 28.4m	<2	<2	33200	170
S91-76 28.5m	3	8	25700	190
S91-76 42.5-42.6m	2	<2	240	200
S91-76 42.6-42.7m	58	6	170	170
S91-76 44.2m	<2	8	98	155
S91-76 44.55m	<2	11	74	220

Examination of the results in TABLE 1 indicate:

i) Uranium is low in most samples, in the range <2 ppm to 10 ppm. In sample S91-76, 42.6-42.7m, uranium abundance reaches the highest value of 58 ppm. This is the sample in which a few grains of potentially radioactive mineral had been previously observed. The highest abundance of U in this sample confirms that the unknown radioactive mineral is U-bearing.

ii) Thorium is low in abundance, ranging from <2 ppm up to 11 ppm.

iii) Arsenic is anomalous in all samples. It is relatively low (~74–240 ppm) in sulphide-bearing samples which lack arsenopyrite, but is very high (~2.5–3.3%) in samples in which arsenopyrite occurs in significant amount.

iv) Rubidium is moderately abundant, in the range ~150—250 ppm. This is consistent with the presence of precursor abundant biotite in all samples, now overprinted by the present alteration and mineralisation assemblage (see previous petrographic report).

3 RESULTS OF AUTORADIOGRAPHS

Examination of the autoradiographs indicates the following:

i) Seven out of the 8 samples produced autoradiographs free of any radioactive grain effects (FIG. 1). It is considered that radioactive grains are absent from these samples.

ii) One of the samples (S91-76, 42.6-42.7m) produced an autoradiograph in which small radioactive grains are scattered sparsely and irregularly through the sample. These are the small radioactive grains previously observed during petrographic study.

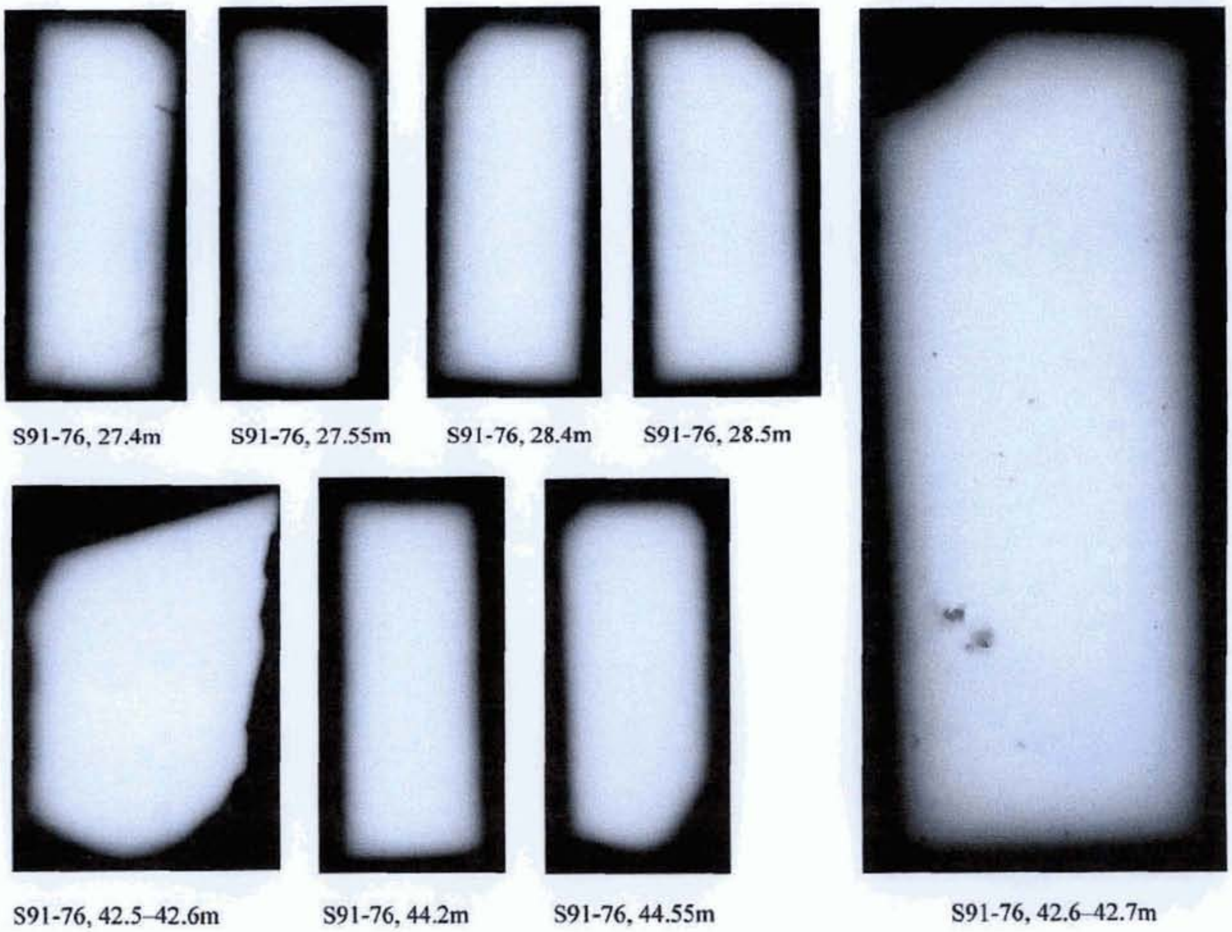


FIG. 1: Scanned images of autoradiographs for thin section offcuts from drill hole S91–76. Offcuts are all 75 mm in longer dimension. Note small dark spots indicating presence of trace radioactive minerals in sample S91-76, 42.6–42.7m (enlarged image at right)

4 DISCUSSION

Geochemical assays and autoradiographs for 8 samples previously studied by petrographic and mineragraphic methods have confirmed that a small number of radioactive grains are present in sample S91-76, 42.6-42.7m. The absence of those grains from other samples appears to suggest that they are present in only limited part(s) in the mineralised rocks.

The radioactive mineral may have formed during one of three principal stages in the evolution of the rocks:

i) It may have formed as part of the K-feldspar-stable potassic mineralisation assemblage. If so, the mineral most probably would have formed widely throughout the altered and mineralised rocks, comparable with the K-feldspar and the sulphide mineral distributions. This is not observed: in contrast, the mineral has been confirmed only in 1 out of 8 samples. It is therefore considered unlikely that the mineral belongs to the mineralisation assemblage.

ii) It may have formed as part of the biotite-stable early potassic alteration assemblage. This event pervasively modified the rocks, and therefore the radioactive mineral most likely would have been widely distributed if it formed in this assemblage. It is considered unlikely that the mineral formed during this event because of the limited distribution of the radioactive mineral.

iii) It may have formed as part of the primary assemblage of the precursor rock. This is considered the most likely origin of the mineral. If the host rocks formed as fragmental volcanogenic rocks, then there may have been some opportunity for sorting of heavy minerals (eg Fe-Ti oxide minerals, zircon) during deposition, allowing particular horizons to contain heavy mineral accumulations.

The radioactive mineral remains unidentified at this stage. It would require SEM-probe work for positive confirmation of the mineral type.

APPENDIX 1: LABORATORY REPORTS FOR WHOLE-ROCK ANALYSIS AND AUTORADIOGRAPHY

The original reports from Amdel are provided in the following pages.

www.amdel.com

MINERAL CHEMISTRY

Amdel Laboratories Ltd
PO Box 338
Torrensville Plaza SA 5031
ABN 71 009 076 555

Telephone (08) 8416 5300
Facsimile (08) 8234 0321

Dr Doug Mason
Mason Geoscience Pty Ltd
PO Box 78
GLENSIDE SA 5065

FINAL ANALYSIS REPORT

Your Order No:

Our Job Number: 4AD1763

Sample rec'd: 22/06/04

Results reported: 06/07/04

No. of samples: 8

Results apply to sample(s) as submitted by the client.

Report comprises a letter and report pages: 1 to 1

Method	Description	Started	Analysed	Authorised

Approved:

for
Alan Ciplys
Manager, Geoanalytical Central Region

Report Codes:
N.A. - Not Available
L.N.R. - Listed But Not Received
I.S. - Insufficient Sample

Distribution Codes:
CC - Carbon Copy
EM - Electronic Media
MM - Magnetic Media

*** Please Note ***

1) The results for elements 'Al, Ba, Cr, Ti, W, Zr, Sn' by code IC3E digest are acid soluble only, and results may be semi-quantative.
'K' values > 1% by code IC3E may bias low due to the insolubility of potassium perchlorate.

2) For scheme IC4, Total 'Fe' is analysed but is calculated and reported as 'Fe2O3'

Job: 4AD1763
O/N:

Final

ANALYTICAL REPORT

SAMPLE	U	Th	As	Rb
S91-76 27.4M	10	<2	130	250
S91-76 27.55M	<2	10	135	190
S91-76 28.4M	<2	<2	3.32%	170
S91-76 28.5M	3	8	2.57%	190
S91-76 42.5-42.6M	2	<2	240	200
S91-76 42.6-42.7M	58	6	170	170
S91-76 44.2M	<2	8	98	155
S91-76 44.55M	<2	11	74	220
UNITS	ppm	ppm	ppm	ppm
DET.LIM	2	2	1	1
SCHEME	XRF1L	XRF1L	XRF1L	XRF1L
UPPER SCHEME			XRF2	

amdel
www.amdel.com

A.B.N. 30 008 127 802

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Telephone (Aust): (08) 8416 5200
(Int): 61 8 8416 5200
Facsimile (Aust): (08) 8352 8243
(Int): 61 8 8352 8243

Gate 1 Brown Street
Thebarton
South Australia 5031
AUSTRALIA

PO Box 338
Torrensville Plaza
South Australia 5031
AUSTRALIA

9 July 2004

Mason Geoscience Pty Ltd
PO Box 78
GLENSIDE SA 5065

Attention: Doug Mason

REPORT N909PE04

AUTORADIOGRAPHY OF 8 SAMPLES

YOUR REFERENCE:	Request of 21 June 2004
SAMPLE IDENTIFICATION:	Numbered 1-8 (S91-76 @ 27.4m, 27.55m, 28.4m, 28.5m, 42.5-42.6m, 42.6-42.7m, 44.2m and 44.55m)
DATE RECEIVED:	23 June 2004
PROJECT MANAGER:	Frank Radke

Peter G Hayward
Manager, Mineral Processing

FR : msm

1. INTRODUCTION

Eight rock offcuts were received from Mason Geoscience Pty Ltd for autoradiography to determine the location of radioactive minerals.

2. PROCEDURE

The rock chips were lapped to produce flattened surfaces and placed on X-ray film, which was then exposed to give outlines of the rock chips. The rock chips were exposed to the X-ray film for 90 hours and the film developed.

The autoradiographs and rock chips were returned on 9 July 2004.