OUTOKUMPU EXPLORATION AUSTRALIA PTY LIMITED

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ANNUAL REPORT TO 3/8/91
EL 16/90 - DELORAINE

VOLUME 1 OF 2

For: Outokumpu Exploration Australia Pty Limited
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Date: 16 July 1991

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EL 16/90 - DELORAINE - ANNUAL REPORT TO 3/8/91
VOLUME 1: EXPLORATION PROGRESS REPORT - JULY 1991

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1. SUMMARY

A brief follow-up programme to assess the extent and VMS prospectivity of mafic igneous rocks in the Kentish Hill area has found that these include tholeiitic basalts similar to those of EoCambrian trough sequences elsewhere in Tasmania, unusual ultramafic cumulates of unknown affinity and a group of basaltic andesitic to andesitic lavas, shallow intrusives and volcaniclastic sediments. The andesitic group appears to have petrological similarities to Cambrian? Mt.Read type Volcanics and may have been erupted on to a local basement of EoCambrian? tholeiites but the previous, preliminary, interpretation that they are chemical correlates of the Que-Hellyer Volcanics is not substantiated by additional whole rock analytical data.

On the basis of small areal extent, low base metal values apart from occasional traces of native copper and the low sulphur - epidote dominated, vein associated alteration assemblage, the area is re-assessed as having an empirically low prospectivity for polymetallic volcanogenic massive sulphide deposits.

2. INTRODUCTION

EL 16/90 covers an area of 130 sq km between the Gog Range and Golden Valley in the vicinity of Deloraine in northern Tasmania. It was granted to Outokumpu Exploration Australia P/L and PanContinental Mining Ltd. (PanFin) in August 1990 and has been explored in joint venture by those companies for volcanogenic massive sulphide deposits.

The first phase of the exploration programme involved a review and compilation of the previous data, reconnaissance geological mapping and a trial stream sediment geochemical survey with a view to developing an improved lithostratigraphic interpretation of the Cambrian volcano-sedimentary sequence in the area and identifying the most prospective parts. (Herrmann, 1991)

Initial reconnaissance and very limited petrographic and geochemical studies of a small area of mafic volcanic rocks occurring near Kentish Hill, in the south eastern part of the licence, suggested that these rocks might be chemical correlates of the Footwall Andesites of the Que-Hellyer Volcanics. PanFin determined that additional reconnaissance mapping, sampling and petrographic/geochemical work should be undertaken in order to assess the extent and VMS prospectivity of this area of andesitic rocks.

This follow-up programme was carried out in April-May, 1991 and involved about 5 days of fieldwork (W.Herrmann), preparation and description of 31 petrographic thin sections (A.J.Crawford), wholerock major/trace element analyses of 19 rock samples and geochemical (Cu,Pb,Zn,Au etc.) analyses of an additional 22 rock chip samples.

This report presents and discusses the results of the follow-up work on the Kentish Hill area.
Due to delays in obtaining wholerock analyses (preliminary results of which were received only on 12 July, 1991) there has not been an opportunity for Dr. Crawford to examine the geochemical data and the conclusions presented here are based on my own inexpert assessment of the analyses. It is to be hoped that Dr. Crawford will be presented with an opportunity to interpret the analytical data along with his petrographic work and be able to elucidate the petrologic affinities of the Kentish Hill mafic rocks.

Acknowledgement

I am pleased to acknowledge a number of fruitful discussions with Dr. Tony Crawford and thank him for his interest in the petrology of these rocks.

OUTOKUMPU EXPLORATION AUSTRALIA P/L

EL 16/90 - Deloraine Exploration Licence

LOCATION PLAN

1:100000 scale

EL boundary

Boundary of Cambrian? sequence

State reserve

State forest

358005

Date: 7 March, [illegible] (W.Herrmann)

5 cm

FIGURE 1

470 000 E

5400 000 N

43/85

10/88

0064

3. PREVIOUS EXPLORATION

The exploration history of the EL 16/90 area was reviewed in my previous report (Herrmann, 1991) and the relevant aspects are briefly restated here for convenience:

At Kentish Hill, near Quamby Brook, low grade carbonates of copper were discovered at surface in 1921. Reid (1923) reported on the results of minor prospecting operations which indicated that the mineralization occurred in mafic rocks ("gabbro") and had grades of around 0.3% copper with minor gold, silver and nickel.
A total of six poorly conceived, vertical diamond drill holes were drilled (down the dip) on the prospect by the (local?) T.W.Davies Syndicate in 1970-71 but the best intersection was only weakly mineralized at 46.5m @ 0.18% Cu.

This prospect was subsequently unsuccessfully explored by Union Oil and later COMALCO as a possible Cyprus type copper occurrence.
Union Oil held the area as EL 15/75 during 1975-76 and carried out some B and C horizon soil sampling which indicated weakly anomalous copper, zinc and nickel.

COMALCO held the area as part of EL 17/76 and during 1978-79 carried out an exploration programme with the trifold objective of discovering tin-flourite skarn, Cyprus type copper or polymetallic volcanogenic massive sulphide deposits.

The exploration program included regional geological mapping at 1:20000 scale and comprehensive -80# stream sediment geochemical sampling with analyses for Cu,Pb,Zn and some Sn,W.
The geochemical work indicated low background levels for all basemetals with statistically determined thresholds at 54ppm Cu, 42ppm Pb and 94ppm Zn. A number of low order Cu anomalies were associated with the basic volcanics of the Kentish Hill area. The overall Pb maxima was 80ppm and the Zn maxima 320ppm. None of the "statistical" anomalies were regarded as likely to indicate significant mineralization but three of the best anomalies received additional follow up.
At **Kentish Hill** Comalco carried out gridding, geological mapping, magnetics, gradient array IP and limited C-horizon geochemical surveys. The magnetics showed that the basalts were strongly magnetic and occurred as discontinuous lenses. IP indicated weak resistivity lows along a basalt/shale contact but the lack of associated chargeability features suggested conductive shales rather than a sulphide deposit.
The soil geochemical data indicated a peak of 800ppm Cu with lower associated Zn, erratic Ni to 900ppm and low Pb over the basic volcanics.
It was concluded that the prospect had "a very remote possibility for economic Cyprus type mineralization". Drilling of two holes to test resistivity lows was recommended as a low priority but was never carried out.

4. GEOLOGY

Figure 2 depicts my geological interpretation of the Kentish Hill area. However, it must be stressed at the outset that geological exposure in the area is relatively poor and the map is substantially interpretative in respect to geological contacts and structural and depositional relationships.

The apparently oldest rocks in the area are regionally metamorphosed metasediments, probably of PreCambrian age. These outcrop in a number of locations along the Lake Highway and consist dominantly of foliated qtz-musc-biot psammo-pelitic schist (PCs) and massive to slightly micaceous metaquartzite (PCq). Near 471400E/5396200N the schist contains unusual disseminated small porphyroblasts of magnetite/hematite, (pet. sample no: 114046).

Near Flinty Rock the metasediments are, apparently disconformably, overlain by a northeastward fining unit of siliciclastic sediments (Css) which grades from a coarse breccia of angular metaquartzite and schist clasts at the base? (best, but not well, exposed 300m west of Flinty Rock) through pebbly conglomerate to coarse pebbly sandstone and sandstone. The coarser types appear to be restricted to within a few tens of metres of the base? of the unit with sandstone and pebbly sandstone predominant elsewhere. These are typically very siliceous, clean (well sorted) massive to faintly stratified quartz sandstones with or with out small well rounded matrix supported pebbly clasts of metaquartzite and characteristically containing minor but prominent detrital flakes of grey mica or schist. They appear to be composed entirely of materials of metasedimentary, probably PreCambrian, provenance. This lithotype is compositionally and megascopically identical to rocks (previously referred to micaceous sandy lithicwackes) which occur in the Mersey River to Needles area at the eastern end of the Gog Range, (Herrmann, 1991).

As noted by Dr.Crawford (App:I, pet. sample no: 114062) these siliciclastic sediments bear a considerable resemblance to the Sticht Range Beds and, in consideration of their apparent disconformable occurrence on PreCambrian? metasedimentary basement, a lithostratigraphic or, at least, structural correlation seems likely.

Northeast of Flinty Rock the sandstones appear to be interbedded or interfingering with muddy, sometimes laminated, sediments varying from shaley siltstone to fine sandy greywacke, (Csg). These typically weather to pale pinkish brown from an original dark grey or olive grey colour and are characterised by the presence of fine pearly flakes of detrital? mica on the bedding surfaces. They appear to have a mixed felsic? volcanic and metasedimentary provenance, perhaps dominantly the latter.

About 800m northwest of Flinty Rock these sediments include a

thin (weathered) unit of quartz phyric fine grained felsic tuffaceous siltstone. Near 471400E/5396300N, about 3km along strike to the northwest, a unit of quartz phyric felsic rhyolite or epiclastic tuff containing occasional rounded clasts of metaquartzite occurs between exposures of Precambrian? schist and micaceous sandstone, (pet. sample no: 114047) and may rest unconformably on the metasedimentary basement (although the contact here is obscured). In view of the close association between these felsic volcanics/volcaniclastics and sediments and the presence of metaquartzite clasts in both, the volcanics are regarded as an integral part of the sequence.
Similar felsic volcanics and siliciclastic sediments occur in an analogous structural position in the Back Peak Beds (near Cradle Mountain) which (likewise) appear to be correlates of the Sticht Range Beds, (Pemberton et al, 1991).

On the northeastern slopes of Kentish Hill the sediments are abruptly "succeeded" by mafic igneous rocks including altered ultramafics and tholeiitic and andesitic volcanics, intrusives and volcaniclastics.

The ultramafics occur in a partly weathered, strongly cleaved, almost schistose outcrop on the firebreak trail on the north slope of Kentish Hill (114064) and as occasional floaters near Mr. Sereda's boundary, (114050). These rocks have been petrographically described (App:I) as formerly consisting largely of clinopyroxene and olivine and termed wehrlite. The wholerock/trace element analyses (Table 1) confirm the ultramafic composition with low Si, Al and high Mg, Cr and Ni values.
On the basis of abundant clinopyroxene, rather than orthopyroxene which is more typical of the western Tasmanian "ophiolites", Dr.Crawford has suggested that these wehrlites may represent magma chamber cumulates associated with Mt.Read type vulcanism.

About 300m southeast of the wehrlite outcrop there is a single (known) outcrop of tholeiitic metabasalt (114032, 033) with a variable intensity of chl-qtz-actinolite and later chl-epidote-prehnite veinlets. The metabasalt is distinctly magnetic where not strongly altered. The rock is petrographically similar to tholeiitic basalts occurring in EoCambrian? sequences such as the Crimson Creek Fmn., Smithton Trough and Motton Spilite elsewhere in Tasmania and Dr.Crawford has confidently interpreted that the Kentish Hill occurrence is a correlate of these. A similar tholeiitic basalt (114017) occurs on the northern slopes of Magog about 18km to the northwest, (Herrmann,1991).
About 1.5km to the southeast near Mr.Nicholas' house there is a small outcrop of basaltic volcanolithic conglomerate (114042) composed of flattened clasts of quenched glassy tholeiitic? basalt in a sparse sandy matrix of augite crystals and fragments of devitrified glassy lava and granular epidote. Most interestingly, Dr.Crawford (App:I) has noted that the matrix

augite grains more closely resemble those from Mt.Read Volcanics rather than from EoCambrian tholeiites.
The wholerock analyses (Table 1) support the interpretation that these tholeiites are petrologically distinct from the ultramafics along strike and the basaltic andesites and andesites adjacent to the northeast. The nature of the contact with the latter is unknown (unexposed) although the character of the matrix in the volcanolithic conglomerate may (faintly) hint at a transitional-depositional relationship.

The southwestern boundary of the narrow strip of ultramafic and tholeiitic rocks against the clastic sediments is likewise not exposed. However, the wehrlite outcrop (114064) is very cleaved, virtually schistose, and may indicate that this boundary is a fault or major shear. The interpretation of a fault is supported by Comalco's 1978 gradient array IP survey which detected a string of linear, strike parallel, resistivity low anomalies along this contact.

To the northeast of the ultramafic/tholeiite strip lies a complex assemblage of basaltic andesites, andesites and intrusive equivalents which are poorly exposed as scattered float on the northeastern slopes of Kentish Hill and in a cluster of small outcrops between Quamby Brook and Bogan Road, northeast of Mr.Arnold's house.
These appear to fall into three compositional/textural categories:

1) Plagioclase-augite-olivine phyric basaltic andesites with a glassy, vesicular or fine crystalline matrix; apparently including pillow lavas, lava breccias and minor intrusive phases.
11) Plagioclase-augite phyric andesites and leuco-andesites with devitrified glassy matrices, most commonly occurring as lava breccias.
111) Plagioclase-augite bearing, fine to medium grained, holocrystalline dioritic rocks interpreted to represent small intrusive feeders equivalent to the volcanics (1 and 11) or possibly the core zones of thick flows or large pillows. [The original two samples (114019, 020) from the reconnaissance phase; upon which the Kentish Hill andesites were tentatively correlated with Que-Hellyer Volcanics, are of this intrusive category.]

All of these andesitic rocks have undergone burial metamorphism to transitional prehnite-pumpellyite / low greenschist facies and carry variably intense networks of chl-qtz-actinolite-epidote-prehnite veinlets, occasionally with traces of native copper or malachite. The glassier types particularly are commonly affected by patchy pervasive hematite-qtz-chl-epidote alteration associated with devitrification of the matrix. They are variably distinctly or non magnetic with the lack of magnetism not always correlated with intensity of alteration.

Table 3 presents a comparison of the major and trace element geochemical data from the Kentish Hill andesite suite and some published average values of Que-Hellyer Volcanics, (with major elements re-calculated volatile free).
It is evident that, although the "major" major elements are fairly similar for the two groups, there are significant differences in the contents of Na, K, P2O5 and Zr. The Kentish Hill andesites are a low-K suite whilst the Que-Hellyer Volcanics fall into the medium to high-K category.
This is (admittedly) a fairly superficial comparison but the geochemical data does not seem to substantiate a chemical correlation between the Kentish Hill andesitic suite and the Que-Hellyer Volcanics.

Along Bogan Road, immediately northeast of the zone of basaltic andesites and andesites, are a number of outcrops of well stratified volcaniclastic sediments ranging in grainsize from fine cherty siltstone to coarse lithic sandstone. The dominant lithic detrital grains are composed of quenched glassy andesitic to dacitic lavas which Dr.Crawford interprets (App:I) to have been derived from the local Kentish Hill andesite suite. A subordinate proportion, upto 10%, of the clastic grains are serpentinitic and amphibolitic and are interpreted to have been derived from ultramafic cumulates and boninitic lavas of "ophiolitic" association. Similar volcaniclastic sediments occur about 2.5km to the northwest at Maroney Road and again on forestry roads 1.5km further to the northwest. In the latter case the volcaniclastics appear to contain minor felsic volcanic detritus including quartz but PreCambrian? metasedimentary is characteristically absent from these sediments.
The andesitic to semi felsic volcanic and ultramafic derivation of these sediments is reflected in the wholerock analytical data by moderately high Mg, Cr and Ni values.

Typically, the contacts between the volcaniclastic unit and the adjacent rocks are obscured. However, in all three outcrop areas there is good sedimentary facing evidence (mainly grainsize grading) to indicate that the unit youngs to the northeast. This is consistent with facings in greywackes of mixed metasedimentary/felsic volcanic provenance which outcrop further north along Bogan Road and, in the absence of contrary evidence, it seems reasonable to assume that the andesitic volcaniclastics are an integral part of this sedimentary sequence. On the basis of compositional similarity, it can be postulated that the Kentish Hill basaltic andesite/basaltic andesite suite may also be part of the depositional sequence, with the volcaniclastics representing epiclastic reworking and deposition of the upper parts of a waning andesitic volcanic episode. By very tenuous further association (the MRV type augite grains in the matrix of the tholeiitic volcanolithic conglomerate: 114042) a depositional link between the EoCambrian? tholeiites and Kentish Hill andesites can be inferred. Perhaps the tholeiitic volcanolithic conglomerate represents an initial phase of andesitic deposition onto a

TABLE 1

Deloraine - EL 16/90; WHOLEROCK ANALYSES KENTISH HILL AREA

Sample No	Description	SiO2	TiO2	Al2O3	Fe2O3	MgO	MnO	CaO	Na2O	K2O	P2O5	LOI	Total	Ba	Cr	Zr	Ti/Zr	Zr/P2O5 (x10000)	MgO/TiO2	TiO2/P2O5	Ni	Cu	Pb	Zn	Sample No
114050	Ultra mafic cumulates	45.2	0.3	9.2	9.4	19.8	0.2	8.6	0.1	0.0	0.01	7.0	100.0	15	3000	9	233	600	57	23	844	251	<5	57	114050
114064	"	44.9	0.7	10.2	10.5	15.8	0.2	8.4	0.1	0.1	0.03	9.1	100.0	10	2650	30	130	909	24	20	910	102	<5	70	114064
	Mean	45.1	0.5	9.7	10.0	17.8	0.2	8.5	0.1	0.1	0.02	8.0	100.0	13	2825	20	182	755	40	22	877	177	0	64	
114032	Tholeiitic basalt	48.3	0.8	13.7	12.8	7.7	0.2	9.4	4.1	0.1	0.05	2.7	99.9	35	140	35	135	700	10	16	52	166	<5	70	114032
114042	Basaltic conglomerate	45.8	0.8	13.3	12.0	9.2	0.2	10.8	2.7	0.8	0.05	4.5	100.1	95	450	35	139	673	11	16	144	47	<5	67	114042
	Mean	47.0	0.8	13.5	12.4	8.4	0.2	10.1	3.4	0.5	0.05	3.6	100.0	65	295	35	137	687	11	16	98	107	0	69	
114031	Pl-Cpx-Ol Basaltic andesite	53.7	0.6	16.5	10.1	4.3	0.2	4.9	6.6	0.5	0.10	2.2	99.6	170	90	45	75	464	8	6	36	99	<5	79	114031
114035	" "	55.0	0.4	15.2	9.1	4.0	0.2	7.0	7.0	0.2	0.05	1.9	99.9	85	120	30	88	625	9	9	60	47	<5	36	114035
114037	" "	53.1	0.5	17.3	7.8	5.5	0.1	5.8	6.3	0.5	0.08	3.0	100.0	170	100	40	78	506	11	7	49	41	<5	56	114037
	Mean	53.9	0.5	16.3	9.0	4.6	0.2	5.9	6.7	0.4	0.07	2.3	99.9	142	103	38	80	532	9	7	48	62	0	57	
114036	" strong Ep alt.	52.8	0.4	14.8	8.3	3.1	0.1	14.6	0.8	0.3	0.04	4.3	99.6	100	220	25	91	568	8	9	71	15	<5	47	114036
114019	Pl-Cpx Andesite; intrusive	57.5	0.5	15.7	7.3	4.8	0.1	4.0	7.4	0.9	0.12	2.4	100.8		140	100	32	840	9	4					114019
114020	" "	55.0	0.6	15.7	9.5	3.8	0.2	4.3	8.9	0.0	0.14	2.2	100.4		20	65	59	474	6	5					114020
114027	" "	54.0	0.5	17.6	7.5	5.6	0.1	4.9	5.8	0.5	0.12	3.5	100.1	220	95	70	39	593	12	4	45	82	5	76	114027
114028	" "	50.9	0.6	16.4	10.4	6.2	0.2	5.1	6.2	0.6	0.13	2.9	99.6	180	95	70	55	543	10	5	40	52	<5	84	114028
114039	" "	55.1	0.6	16.6	7.0	6.4	0.1	3.8	6.3	0.9	0.11	3.0	100.0	280	150	130	26	1161	11	5	52	87	<5	69	114039
	Mean	54.5	0.6	16.4	8.3	5.3	0.2	4.4	6.9	0.6	0.12	2.8	100.2	227	100	87	42	722	10	5	46	74	2	76	
114026	PL-Cpx Andesite; extr, altd	58.1	0.6	14.2	11.2	3.3	0.2	3.5	7.2	0.2	0.12	1.5	100.2	110	35	55	70	455	5	5	23	279	<5	72	114026
114029	Leuco Andesite ?	57.0	0.8	16.2	10.3	2.1	0.1	3.0	8.4	0.2	0.19	1.6	100.1	75	25	80	63	421	3	4	17	410	<5	73	114029
114030	PL-Cpx Andesite; extr, fresh	55.1	0.8	16.4	11.3	3.5	0.2	2.1	8.0	0.3	0.20	1.8	99.8	150	15	90	56	446	4	4	22	59	8	96	114030
	Mean	56.7	0.8	15.6	11.0	3.0	0.2	2.9	7.9	0.3	0.17	1.7	100.0	112	25	75	63	440	4	5	21	249	3	80	
114043	Dacite	66.0	0.6	15.2	4.2	2.8	0.1	1.8	6.0	0.9	0.11	2.0	99.6	260	110	180	19	1698	5	5	50	255	<5	84	114043
114053	Andes/Dacite volcaniclastics	55.7	0.6	14.4	10.4	5.8	0.1	5.4	3.1	0.6	0.11	3.6	100.1	240	340	55	68	509	9	6	122	124	9	82	114053
114055	" "	51.4	1.1	14.7	11.7	6.8	0.2	4.9	3.3	0.5	0.06	4.4	99.0	170	300	45	143	738	6	18	105	131	<5	91	114055
114057	" "	57.2	0.5	13.5	8.9	5.5	0.1	3.4	4.4	1.7	0.07	4.8	100.1	350	270	40	78	541	11	7	77	66	5	72	114057
	Mean	54.8	0.7	14.2	10.3	6.0	0.1	4.6	3.6	0.9	0.08	4.3	99.7	253	303	47	96	596	9	10	101	107	5	82	
105665	Gog Diorites	55.8	0.7	15.0	9.5	5.0	0.2	7.0	2.7	2.3	0.15	2.0	100.2	650	110	100	43	685	7	5		25	<5	65	105665
105673		58.0	0.6	16.7	8.5	2.5	0.1	3.2	4.4	3.4	0.15	2.7	100.2	1500	50	120	32	789	4	4		10	5	50	105673
105683		55.6	0.8	17.4	8.4	2.2	0.1	3.0	8.7	2.2	0.17	1.8	100.2		20	110	41	651	3	4		40	5	90	105683
105694		60.7	0.7	14.8	7.3	3.5	0.1	5.3	2.7	2.9	0.16	2.2	100.3	850	70	150	28	920	5	4		20	15	35	105694
	Mean	57.5	0.7	16.0	8.4	3.3	0.1	4.6	4.6	2.7	0.16	2.2	100.2	1000	63	120	36	761	5	4		24	6	60	
114041	Silty lithic greywacke	70.8	0.6	10.4	6.3	3.3	0.1	0.6	1.3	1.9	0.09	4.3	99.5	840	280	130	28	1529	5	7	60	40	<5	82	114041

TABLE 2

Deloraine - EL 16/90; WHOLEROCK ANALYSES KENTISH HILL AREA
Recalculated Volatile Free

Sample No	Description	SiO2	TiO2	Al2O3	Fe2O3	MgO	MnO	CaO	Na2O	K2O	P2O5	LOI	Total	Ba	Cr	Zr	Ti/Zr	Zr/P2O5 (x10000)	MgO/TiO2	TiO2/P2O5	Ni	Cu	Pb	Zn	Sample No
114050	Ultra mafic cumulates	48.6	0.4	9.9	10.1	21.3	0.2	9.3	0.1	0.0	0.02			15	3000	9	233	600	57	23	844	251	<5	57	114050
114064	"	49.4	0.7	11.2	11.6	17.4	0.2	9.2	0.2	0.1	0.04			10	2650	30	130	909	24	20	910	102	<5	70	114064
	Mean	49.0	0.5	10.6	10.9	19.4	0.2	9.3	0.1	0.1	0.03			13	2825	20	182	755	40	22	877	177	0	64	
114032	Tholeiitic basalt	49.7	0.8	14.1	13.2	7.9	0.2	9.7	4.2	0.1	0.05			35	140	35	135	700	10	16	52	166	<5	70	114032
114042	Basaltic conglomerate	47.9	0.8	13.9	12.5	9.6	0.2	11.3	2.9	0.8	0.05			95	450	35	139	673	11	16	144	47	<5	67	114042
	Mean	48.8	0.8	14.0	12.9	8.8	0.2	10.5	3.5	0.5	0.05			65	295	35	137	687	11	16	98	107	0	69	
114031	Pl-Cpx-Ol Basaltic andesite	55.1	0.6	17.0	10.3	4.4	0.2	5.0	6.8	0.5	0.10			170	90	45	75	464	8	6	36	99	<5	79	114031
114035	" "	56.1	0.4	15.5	9.3	4.1	0.2	7.1	7.2	0.2	0.05			85	120	30	88	625	9	9	60	47	<5	36	114035
114037	" "	54.8	0.5	17.8	8.1	5.7	0.1	5.9	6.5	0.5	0.08			170	100	40	78	506	11	7	49	41	<5	56	114037
	Mean	55.3	0.5	16.7	9.2	4.7	0.2	6.0	6.8	0.4	0.08			142	103	38	80	532	9	7	48	62	0	57	
114036	" strong Ep alt.	55.4	0.4	15.5	8.7	3.3	0.1	15.3	0.8	0.3	0.05			100	220	25	91	568	8	9	71	15	<5	47	114036
114019	Pl-Cpx Andesite; intrusive	58.4	0.5	16.0	7.4	4.9	0.1	4.1	7.5	0.9	0.12				140	100	32	840	9	4					114019
114020	" "	56.0	0.7	16.0	9.7	3.8	0.2	4.4	9.1	0.0	0.14				20	65	59	474	6	5					114020
114027	" "	55.9	0.5	18.3	7.7	5.8	0.2	5.1	6.0	0.5	0.12			220	95	70	39	593	12	4	45	82	5	76	114027
114028	" "	52.6	0.7	17.0	10.8	6.4	0.2	5.3	6.4	0.6	0.13			180	95	70	55	543	10	5	40	52	<5	84	114028
114039	" "	56.8	0.6	17.1	7.3	6.6	0.1	3.9	6.5	0.9	0.12			280	150	130	26	1161	11	5	52	87	<5	69	114039
	Mean	56.0	0.6	16.9	8.6	5.5	0.2	4.5	7.1	0.6	0.13			227	100	87	42	722	10	5	46	74	2	76	
114026	PL-Cpx Andesite; extr, altd	58.9	0.6	14.4	11.4	3.4	0.2	3.5	7.3	0.2	0.12			110	35	55	70	455	5	5	23	279	<5	72	114026
114029	Leuco Andesite ?	57.9	0.9	16.4	10.5	2.2	0.2	3.0	8.6	0.2	0.19			75	25	80	63	421	3	4	17	410	<5	73	114029
114030	PL-Cpx Andesite; extr, fresh	56.3	0.9	16.7	11.6	3.5	0.2	2.2	8.2	0.3	0.21			150	15	90	56	446	4	4	22	59	8	96	114030
	Mean	57.7	0.8	15.8	11.1	3.0	0.2	2.9	8.0	0.3	0.17			112	25	75	63	440	4	5	21	249	3	80	
114043	Dacite	67.6	0.6	15.5	4.3	2.9	0.1	1.9	6.1	0.9	0.11			260	110	180	19	1698	5	5	50	255	<5	84	114043
114053	Andes/Dacite volcaniclastics	57.8	0.6	15.0	10.8	6.1	0.2	5.6	3.2	0.6	0.11			240	340	55	68	509	9	6	122	124	9	82	114053
114055	" "	54.3	1.1	15.5	12.4	7.2	0.2	5.2	3.5	0.5	0.06			170	300	45	143	738	6	18	105	131	<5	91	114055
114057	" "	60.1	0.5	14.1	9.3	5.7	0.1	3.6	4.6	1.8	0.08			350	270	40	78	541	11	7	77	66	5	72	114057
	Mean	57.4	0.8	14.9	10.8	6.3	0.2	4.8	3.8	1.0	0.08			253	303	47	96	596	9	10	101	107	5	82	
105665	Bog Diorites	56.7	0.7	15.3	9.7	5.1	0.2	7.1	2.8	2.3	0.15			650	110	100	43	685	7	5		25	<5	65	105665
105673		59.4	0.7	17.1	8.7	2.6	0.1	3.3	4.5	3.4	0.16			1500	50	120	32	789	4	4		10	5	50	105673
105683		56.4	0.8	17.7	8.5	2.2	0.1	3.1	8.8	2.2	0.17				20	110	41	651	3	4		40	5	90	105683
105694		61.8	0.7	15.1	7.5	3.6	0.1	5.4	2.8	2.9	0.17			850	70	150	28	920	5	4		20	15	35	105694
	Mean	58.6	0.7	16.3	8.6	3.4	0.1	4.7	4.7	2.7	0.16			1000	63	120	36	761	5	4		24	6	60	
114041	Silty lithic greywacke	74.3	0.6	10.9	6.6	3.5	0.1	0.6	1.4	1.9	0.09			840	280	130	28	1529	5	7	60	40	<5	82	114041

TABLE 3

COMPARISON OF WHOLE ROCK ANALYSES - Kentish Hill Andesites and Que Hellyer Volcanics

(Major elements recalculated volatile free)

Description	SiO2	TiO2	Al2O3	Fe2O3	MgO	MnO	CaO	Na2O	K2O	P2O5	LOI	Total	Ba	Cr	Zr	Ti/Zr	Zr/P2O5 (x10000)	MgO/TiO2	TiO2/P2O5	Ni	Cu	Pb	Zn
Average Kentish Hill Basaltic Andesite (114031, 035, 037)	55.3	0.5	16.7	9.2	4.7	0.2	6.0	6.8	0.4	0.08			142	103	38	80	532	9.1	7.2	48	62	0	57
Average Kentish Hill Andesite (114019,020,027,028,039,026,029,030)	56.6	0.7	16.5	9.5	4.6	0.2	3.9	7.5	0.5	0.14			169	72	83	50	617	7.5	4.6	33	162	2	78
Average Que-Hellyer Volcanics (After Corbett and Komyshan, 1989)																							
Lower Andesites & Basalts (n=9)	59.2	0.6	14.8	7.3	5.4	0.2	7.4	3.1	1.5	0.27			927	371	125	26	463	9.7	2.0	73	72	97	168
Mixed Sequence Andesites (n=4)	57.9	0.7	17.1	8.6	3.8	0.2	7.5	1.4	2.5	0.48			848	100	164	25	342	5.6	1.4	21	38	14	73
Upper Basalts & Andesites (n=7)	58.6	0.5	16.1	9.5	6.0	0.3	4.3	2.6	1.8	0.26			1927	457	142	22	546	11.3	2.0	81	60	11	198

tholeiitic basement with some reworking of the basement materials?

Speculative as these associations are, one is left with the suspicion that the Kentish Hill andesites are fairly low in the local Cambrian? sequence. A possible, very interpretative, diagrammatic cross section representing these relationships is inset on Figure 2.

5. DISCUSSION of VMS PROSPECTIVITY

The follow-up reconnaissance geological programme on the Kentish Hill mafic rocks has shown that:

1) They include a complex assemblage of:
   * Tholeiitic basalts similar to those occurring in Eocambrian? trough sequences elsewhere in Tasmania,
   * Ultramafics of unknown affinity but possibly representing magma cumulates associated with andesitic vulcanism,
   * Basaltic andesite to andesite lavas and associated minor intrusives with some petrographic similarities to Mt.Read Volcanics (notably olivine bearing similar to Hellyer basalts) but of uncertain correlation; probably not chemical correlates of Que-Hellyer Volcanics,
   * Volcaniclastic sediments derived primarily from the andesitic volcanics which they appear to overlie and containing a minor component of "ophiolitic" detritus.

11) The andesitic volcanics and intrusives are poorly exposed in an area about 500m wide x 2km strike length; they probably extend northwestward into Mr.Sereda's property (to which access was politely denied) but have not been detected west of Elmer's Creek.
The overlying? andesitic volcaniclastic sediments are known to outcrop over about 5.5km of strike length and appear to have a maximum thickness of about 500m.

111) All the mafic volcanic rocks, tholeiites and andesites, have undergone burial metamorphism to transitional prehnite-pumpellyite / low greenschist facies and carry minor to locally intense networks of two phases of chl-qtz-actinolite and chl-qtz-epidote-prehnite veinlets and veins. Patchy development of pervasive epidote-qtz-hematite alteration is common in association with local zones of more intense veining, most notably in the glassier varieties of andesite. Minor traces of native copper and malachite/azurite have been observed within veinlets. The "mineralisation" appears to be

associated with a highly oxidised hydrothermal system; no sulphides have been observed in the volcanic rocks. Minor traces of disseminated pyrite (<1%) have been observed in the andesitic volcaniclastic sediments and some of the greywackes and shaly siltstones further up the sequence (north along Bogan Road)

iv) Geochemical analyses of about 41 representative rock chip samples from all (but mainly mafic volcanic) lithotypes in the area indicate:

Copper: maximum 860ppm in a sample containing relatively abundant visible native copper; most samples with visible copper (eg:114026, 029) contain less than 500ppm Cu.

Lead: very low background, most samples less than 5ppm; maximum 72ppm in pervasively epidote altered andesite?

Zinc: low background; all samples less than 100ppm.

Gold: all samples below detection (0.008g/t)

Silver: " " " " (1g/t)

A preliminary (inexpert) assessment of the wholerock analyses of the Kentish Hill andesites suggests that they are not chemically analogous to the Que-Hellyer Volcanics. This is supported by their variably magnetic character; most unlike the Que-Hellyer Volcanics which have consistently low magnetic susceptibility. The hydrothermal alteration which has locally affected the mafic rocks of this area seems to have been associated with high oxidation state and the system is apparently devoid of sulphides. There is no evidence of the (sometimes extensive) sericite-qtz-pyrite, sodium depleted alteration zone characteristic of the footwall of most Tasmanian VMS deposits and in fact the Kentish Hill rocks seem to be unusually enriched in sodium.
The basemetal geochemical indications also are discouraging, apart from a few samples weakly enriched in copper.

Therefore, in respect of lithostratigraphic correlation, hydrothermal alteration and lead-zinc geochemistry it seems appropriate to assign the prospect a low polymetallic VMS prospectivity rating; qualified, of course, by the poor geological exposure and the limited investigations to date.

About all that remains is a string of untested low resistivity anomalies (without associated IP chargeability) which may be attributed to a possible faulted contact between sedimentary and mafic igneous rocks.

Nevertheless, there are some interesting and unusual rocks closely juxtaposed in a small area at Kentish Hill which, if better exposed, might have helped to unravel the Tasmanian Cambrian tectonic history.

6. REFERENCES

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Crawford, A.J.	1991	Report on petrographic suite from Kentish Hill area. (Appendix I in this report)
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APPENDIX I

Report on Petrographic Suite from Kentish Hill Area, EL 16/90

REPORT on PETROGRAPHIC SUITE from KENTISH HILL AREA

Below I list the main point that I believe are significant in interpreting the geology of this area.

1: The belt of Precambrian schists is believed by Monash people to represent one upthrust slice of an imbricate thrust duplex dipping N, and is probably very similar to the structure at the base of the Badger Head and Ulverstone Metamorphics.
2: The presence of a limited amount of tholeiitic basalts undoubtedly correlated with the Motton Spilite and lavas in the Crimson Creek Formation indicates complex local structure, especially at the faulted (?) boundary between the lower greywackes and the main andesitic lava unit. I interpret these basalts to be part of a thin fault slice along this contact.
3: Two aspects of the rocks examined indicate that consideration should be given to correlation of part of the mapped sequence with Sticht Range Beds. The coarse quartzite is very reminiscent of Sticht Range Beds sandstones (also agreed with by Andrew McNeill), while the quartz-phyric rhyolitic lava from further north is more typical of the quartz-phyric rhyolitic volcanics that overlie Sticht Range Beds along the eastern side of the main meridional-trending belt of Mount Read Volcanics. Could the greywacke unit, and the Flinty Rock Sandstone unit, be Sticht Range Beds correlates?
4: The plagioclase+augite+olivine-phyric basaltic andesites in this set are unique in my experience with the Mount Read Volcanics. While they are not petrographically identical to the Hellyer basalts and andesites, they certainly head in that direction compositionally, judging from the thin sections. The plagioclase+augite-phyric andesites in this set and their shallow intrusive equivalents, are best correlated probably with Que Footwall andesites. The compositional affinities of both groups of andesites should be checked by analyzing best-preserved representative samples.

I suggest analyzing any of the following samples for major elements and Zr, Cr.

Tholeiite 114032
Plag+cpx-phyric andesites 114028, 020, 027
Plag+cpx+olivine-phyric basic andesites 114048, 037, 031
Strange cumulates 114050, 064

The latter two samples are most puzzling. I have not seen rocks like them before in the MRV, and wonder if we are not seeing fault slices of relatively deep levels in the MRV stratigraphy.

If you or Ian Neuss have any questions regarding this interesting set of rocks, I would be most happy to discuss it with you. Just ring me at home or work.

SAMPLE NUMBER: 114020

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a plagioclase+augite-phyric fine-grained holocrystalline andesitic dyke rock.

* AJC appears to have confused hand specimens; this description applies to 114026

HAND SPECIMEN

This is a massive porphyritic andesite with patchy intense hematite alteration, and epidote-quartz veins containing native copper.

Magnetic

THIN SECTION:

This is a texturally beautifully preserved andesitic lava with clots of phenocrysts of albitized plagioclase and augite, with quite common and relatively large FeTi oxide microphenocrysts. The albite phenocrysts are 0.5-1.5mm long and make up about 10-15 modal% of this lava. They are elongate to blocky prisms, often with rows of chloritized glass inclusions parallel to crystal faces. Augite phenocrysts are fresh and almost always clustered in groups of three or four rather small equidimensional grains. They frequently contain microphenocrystal inclusions of FeTi of the same grainsize as the oxide microphenocrysts in the groundmass.

The groundmass of this sample was holocrystalline, and composed of a holocrystalline felted intergrowth of elongate albite laths and subordinate augite; it is peppered with tiny FeTi oxides. The most abundant and obvious alteration mineral in this sample is coarse granular yellow epidote. This occurs as overprinting patches and also as crystals growing into chlorite. A few acicular actinolite crystals are present in the chlorite patches that appear to fill fractures through the rock.

This is probably a shallow intrusive sample, judging by the holocrystalline though fine-grained groundmass. It may be related to andesites such as 114030 and 040, and coarser-grained andesitic-dioritic intrusives such as 114027 and 114039.

SAMPLE NUMBER: 114026

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a formerly glassy sparsely plagioclase+augite - phyric evolved andesitic lava that contains some xenolithic fragments of andesitic and dacitic lavas. It has suffered quite strong hematite-alteration of the altered glassy groundmass.

HAND SPECIMEN

This is a dark red very strongly hematite-altered andesitic lava. qtz-ep-chl veinlets with trace disseminated copper. Not magnetic

THIN SECTION

In thin section, it is clear that this sample is a lava breccia, although a large part of the sample consists of what might be considered as the 'host' lava, in which occasional diverse lithic fragments are included. The host magma is a sparsely plagioclase+augite-phyric formerly glassy andesite. Small (<1mm long) plagioclase an augite phenocrysts each made up a few modal% of this rock, although they tend to be concentrated in a few patches in the sample in far greater abundances. The plagioclase phenocrysts are elongate tabular albite, far more typical of andesitic than dacitic lavas (in which the plagioclase phenocrysts are typically blocky). The augite phenocrysts are fragmented and subhedral, but unaltered.

The groundmass of this sample was glass in which tiny plagioclase microlites had nucleated in some areas but not in others. The glass has devitrified unevenly, and been overprinted by strong hematite+quartz ± epidote alteration, producing a mottled texture. Hematite occurs as tiny granules scattered throughout the groundmass, rendering the dark red colour evident in hand specimen. Granular epidote and streaky green chlorite are also quite common in the altered groundmass.

Lithic fragments included in this rock are up to 2mm long and are mainly andesitic to dacitic lava fragments; they make up about 5 modal% of the sample, and are probably xenolithic with respect to the host lava.

The sparse amount of augite phenocrysts in this sample, and the texture suggest that it was originally a lava transitional from andesite to dacite.

SAMPLE NUMBER: 114027

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a plagioclase+augite-phyric holocrystalline dioritic dyke rock probably equivalent (ie a feeder?) to the andesitic lavas already described from this area (114019, 20).

HAND SPECIMEN

A grey-green plagioclase+mafic-phyric andesitic lava or shallow intrusive with calcite(?) veining. Not magnetic

THIN SECTION:

This is a relatively fine-grained holocrystalline dioritic shallow intrusive rock composed dominantly of intergrown laths of albitized plagioclase and subordinate augite. Phenocrysts of both albitized plagioclase and augite are present, but not abundant, and make up about 3 modal% of the sample; they are not much larger (max length ~2mm) than the average 'groundmass' feldspar and augite. Plagioclase phenocrysts are euhedral rather blocky elongate prisms charged with granular to fibrous inclusions of yellow epidote, bright green pumpellyite, and duller green chlorite. The intergrown plagioclase prisms making up much of the remainder of the rock show similar alteration, and diffuse bands up to about 7mm wide transect the rock, in which plagioclase is altered to an almost isotropic clayey material intergrown with dense sericite. Augite phenocrysts are fresh, euhedral prisms, less abundant than plagioclase phenocrysts, and they commonly contain small plagioclase lath inclusions. Augite in the groundmass of the rock is volumetrically far less important than plagioclase, probably making up only about 5-8 modal% of the sample. It is occasionally altered to pale green chlorite.

Interstitial areas between groundmass plagioclase prisms are filled by chlorite with minor epidote and pumpellyite; former FeTi oxides, also interstitial to the plagioclase laths, have altered to leucoxenitic aggregates.

The sample is transected by veinlets of prehnite to 4mm wide, and abundant small shears and fractures are filled by chlorite. The alteration assemblage (epidote-albite-chlorite-pumpellyite-prehnite and leucoxene, is typical of the prehnite-pumpellyite facies of burial metamorphism, and the rock shows no sign of local, hydrothermal alteration.

This is a shallow intrusive diorite, almost certainly a dyke equivalent of the plagioclase+augite-phyric andesites already described from the Kentish Hill - Quamby Brook area (eg. 114019, 20).

SAMPLE NUMBER: 114028

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a sparely plagioclase+augite-phyric andesitic dyke rock probably related to 114027, 30, 39 and 40.

HAND SPECIMEN

This is a weakly porphyritic dark grey massive andesitic to basaltic lava.

THIN SECTION:

In thin section, this sample is seen to be a weakly plagioclase+ augite-phyric andesitic lava or shallow intrusive with an almost holocrystalline but fine-grained groundmass. Small subhedral plagioclase phenocrysts (maximum length about 1.5mm) make up about 2-4 modal% of the sample, and have been albitized. Equidimensional augite phenocrysts are less abundant and even finer-grained, averaging around 0.3mm across, and often occur in small gabbroic clots with plagioclase. They sometimes have FeTi oxide microphenocrysts attached to their margins.

The groundmass of this sample is holocrystalline, and fine-grained, being composed of an intergrowth of elongate albite laths and augite plates, with interstitial FeTi oxides. The dominant alteration mineral is epidote, which occurs as granular yellow crystals intergrown with chlorite in small fractures and holes, and also as narrow veinlets. This rock is probably an andesitic dyke rock, and it is related texturally and mineralogically to samples such as 114027, 30, 39, and 40. It shows no sign of local hydrothermal alteration.

SAMPLE NUMBER: 114029

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a strongly hematite-epidote-altered plagioclase-phyric dacitic lava. Its protolith was very similar to dacite 114043.

HAND SPECIMEN

This is a massive dark brown porphyritic andesite lava with epidote veinlets

THIN SECTION

This sample is seen to be a strongly plagioclase-phyric dacitic lava in which mafic phenocrysts were rare or absent. Tabular albitized plagioclase phenocrysts make up about 20 modal% of the rock, and usually occur in multi-crystal clots, sometimes with more than ten crystals clumped together. Individual phenocrysts are rarely longer than 1mm, and show only weak sericite flecking.

The groundmass of this sample is strongly oxidized, and hematite-altered. It was originally vitrophyric, glass charged with plagioclase microlites; glass has been replaced by quartz, chlorite and pervasive very fine-grained hematite responsible for the dark red-brown colour of the hand specimen. Epidote-quartz-actinolite veinlets are common in this rock, and very fine-grained dirty brown epidote is common in the groundmass. Some of the fibrous amphibole in the veins is quite strongly pleochroic, almost to shades of pale brown-olive, suggestive of rather high temperatures (>400°C).

This sample is similar petrographically to 114043, except that it is less foliated and significantly more epidote+hematite-altered than 043. The precursor dacite lavas were, however, very similar, and might be from the same unit.

SAMPLE NUMBER: 114030
LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area
SUMMARY:

This is a monomict andesitic lava breccia composed of flow-textured plagioclase+augite-phyric glassy andesite that has suffered relatively strong hematite-epidote alteration.

HAND SPECIMEN

This is an andesitic lava breccia with abundant dark red hematitic alteration patches and dark fine-grained volcanic clasts rarely > 1cm.

THIN SECTION:

This rock is a plagioclase+augite-phyric andesitic monomict lava breccia composed of clusters of albite phenocrysts and subordinate augite phenocrysts in a variably-altered flow-textured vitrophyric groundmass. The feldspar phenocrysts are albitized plagioclase and make up around 10 modal% of the sample. They are euhedral to subhedral prisms rarely longer than 1mm, and generally occur as multi-crystal clots with slight sericite speckling. Augite phenocrysts, rarely more than 0.5mm long, make up less than 1 modal% of the sample, and are almost always fresh; however partial chloritization of the rims of some augite phenocrysts occurs. Former FeTi oxide microphenocrysts are altered to dark leucoxenitic material.

The groundmass of this sample varies from highly altered to only slightly altered, the intensity of alteration probably reflecting the amount of glass originally present in individual lava fragments. Highly glassy fragments probably cracking from the margins of the flow are now composed of abundant, aligned tiny albite microlites in an opaque matrix composed probably largely of hematite. More crystalline fragments are composed almost wholly of orientated. flow-aligned albite microlites, but small angular patches of bright yellow epidote are common in these fragments. In most instances, combined effects of devitrification and hematite alteration have made it difficult to define margins of individual fragments. Hematite alteration appears to have proceeded via fluid passage along fragment margins, then selectively invaded and replaced the more glassy fragments. The alteration assemblage in this sample was prehnite-pumpellyite grade, but of the more oxidized facies of that grade of regional metamorphism. The relatively intense hematite-epidote alteration indicates strongly oxidizing metamorphic or hydrothermal fluids, rather different from those that produced, for example, the alteration assemblages in 114019, 20 and 27, all of which had a similar primary mineralogy.

This is a monomict andesitic lava breccia, very similar in primary mineralogy (and probably composition) to andesites/diorites 019, 20 and 27.

SAMPLE NUMBER: 114031

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill

SUMMARY:

This is a shallow intrusive plagioclase+augite+olivine - phyric basaltic andesite or andesite correlated with lavas 114035, 36 and 37. It may be a feeder dyke to those lavas.

HAND SPECIMEN

This is a massive porphyritic andesitic lava with patchy intense hematite alteration and and narrow epidote veinlets.

THIN SECTION:

This is a beautiful feldspar+augite=olivine-phyric andesitic or basaltic andesite lava or shallow dyke rock. The dominant phenocryst phase is albitized plagioclase that makes up about 20-25 modal% of this sample; it is typically blocky prisms up to about 2mm long, more commonly intergrown with other plagioclase phenocrysts than not. Fresh augite phenocrysts make up about 3-5 modal% of this rock, and are generally smaller than 1mm long, subhedral and dominantly clustered in multi-crystal clots. Former olivine phenocrysts are slightly less abundant than augite, and have been totally replaced by hematite rims with epidote cores. They are euhedral prisms mainly from 0.5 - 1mm long.

The groundmass of this sample was holocrystalline, composed of an intergrowth of albitized plagioclase laths and relatively elongate greenish augite plates, with common interstitial tiny FeTi oxides. The alteration assemblage in this sample is albite-epidote-chlorite-quartz-actinolite. The actinolite is restricted to fibrous intergrowths in veinlet quartz. Epidote is abundant as yellow amorphous patches overprinting groundmass, and as polycrystalline grains pseudomorphing olivine. It also occurs growing into angular chlorite patches that are common in the groundmass and as fracture fillings. A few local patches of abundant fine-grained hematite pervading groundmass are present.

This sample is clearly related to andesites 114035, 36 and 37, and may be a feeder dyke to those lavas, since the texture of the groundmass in this rock is holocrystalline, unlike the foregoing lavas.

SAMPLE NUMBER: 114032

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill Area

SUMMARY:

This is an almost holocrystalline tholeiitic metabasaltic lava (from the centre of a relatively thick flow) or dyke rock best correlated with the Crimson Creek-type tholeiites from elsewhere in W Tasmania. It is petrographically and compositionally unlike the associated Mount Read-type calc-alkaline andesitic volcanics.

HAND SPECIMEN

This is a grey-green massive aphyric metabasaltic lava.

THIN SECTION:

This is an aphyric tholeiitic basalt texturally and mineralogically unlike basalts from the Mount Read Volcanics. AAgh! It is composed of a subophitic intergrowth of anhedral augite plates, narrow blade-like to lath-like albitized plagioclase phenocrysts, and abundant small equidimensional FeTi oxides. A few more blocky plagioclase (albite) microphenocrysts to about 1mm across are present and show slight to intense sericite alteration. Augite plates are occasionally replaced by green chlorite, and similar chlorite fills veins and dilational fractures up to several mm wide. Bright yellow granular epidote frequently occurs intergrown in vein chlorite, and in places, the chlorite veinlets grade into prehnite veinlets with text-book bowtie aggregates of clear prehnite. Small scale micro-brecciation zones are common in the rock, and produce granulation (but not recrystallization) of augite, and sericitization of plagioclase. The texture is almost holocrystalline and could be indicative of either a dyke rock, or a sample from the interior region of a thick flow.

This sample is undoubtedly unrelated to the other lavas and dyke rocks in this unit, which are essentially andesitic - dioritic. Rather, it has every petrographic characteristic of a typical Crimson Creek Formation tholeiitic basalt (or correlated Motton Spilite etc). It is important to know whether this rock is a fault slice, or a dyke in the andesite sequence. The texture is reasonable for a dyke rock. If it is a dyke, it may well correlate with the Henty Dyke Swarm tholeiitic basalts, best known from from immediately N of the (N) Henty Fault and unknown further S or east. However, Crimson Creek Formation tholeiitic basalts are typically from thick flows and subophitic textures are common in flow centres. The texture is inconclusive. This rock is clearly similar to 114017, from Magog, further W on the EL.

SAMPLE NUMBER: 114033

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill

SUMMARY:

This is a tholeiitic metabasaltic lava very similar to 114032.

HAND SPECIMEN

This is a massive, aphyric metabasaltic lava with abundant fractures filled by chlorite, quartz and a fibrous amphibole(?).

THIN SECTION:

This rock is essentially identical to 114032, except for the greater development of fracture-vein fillings. It was a tholeiitic basaltic lava, with more elongate and lath-like albitized plagioclase than 032, and also more abundant plagioclase and less augite than 032. Subophitic plagioclase has been albitized and is charged with fine-grained pumpellyite and chlorite. It contain sparse augite microphenocrysts (also unlike 032). Vein assemblages include calcite, calcite-chlorite-epidote, epidote-chlorite, quartz-chlorite -actinolite, and epidote alone. Interestingly, the epidote veinlets clearly crosscut and post-date the quartz-chlorite-actinolite veinlets. The fibrous mineral noted in veins in hand specimen is actinolite-tremolite. The metamorphic grade of this sample is close to the prehnite-pumpellyite facies transition.

This sample is obviously from the same tholeiitic sequence as the foregoing sample 114032, but it is clearly not from the same unit. This sample is probably more evolved (less MgO-rich), and has a more basaltic lava rather than basaltic dyke look about it. This would tend to suggest that sample 032 is from the core of a thick flow, rather than being a dyke rock.

SAMPLE NUMBER: 114034

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This sample was an andesitic lava or lava breccia that has been totally replaced by epidote and quartz.

HAND SPECIMEN

This is a dense epidosite with quartz veining and minor hematite development.

THIN SECTION:

The sole purpose of preparing a thin section of this sample was to determine the nature of the protolith that has been so obliterated by intense epidote replacement. Unfortunately, thin section examination shows that this textural and mineralogical obliteration was almost complete. Only a few shadowy textural relics pseudomorphed by epidote provide evidence that the sample was probably an andesitic lava or lava breccia with a microlitic groundmass. Several generations of epidote- quartz alteration have affected this sample, including a beautifully crystalline vein up to 1cm wide with large yellow pleochroic epidote prisms growing into quartz, and a messier, yellow-brown epidote that is more patchy and not restricted to veinlets.

SAMPLE NUMBER: 114035

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a formerly plagioclase+olivine+augite-phyric basaltic andesite or basaltic lava breccia.

HAND SPECIMEN

This is a brown, plagioclase-phyric andesitic to dacitic lava breccia with abundant chloritic veining.

THIN SECTION:

This is an unusual monomict plagioclase+augite+olivine-phyric basaltic andesite lava breccia in which the olivine phenocrysts have totally altered, plagioclase is albitized and augite is fresh. Plagioclase phenocrysts make up about 10 modal% of the rock and occur in multi-crystal clots up to 2mm across; they are euhedral except where intergrown with other plagioclase phenocrysts, and only slightly sericite-altered. Former olivine phenocrysts make up about 3-5 modal% of this sample and show conspicuous euhedral olivine crystal shapes, mainly less than 1mm long, with typical opaque rims, with the cores of former olivine crystal sites filled by either chlorite or epidote or both. Augite phenocrysts are mainly slightly larger than the olivine phenocrysts, but are probably also slightly less abundant. They are always fresh. Several small cognate gabbroic clots composed of intergrown olivine, augite and plagioclase are present.

The groundmass texture changes notably from fragment to fragment in this rock, although the fragment margins are generally rather indistinct. These changes relate mainly to size of the groundmass crystals of albite and fresh brownish augite, both of which occur as rather elongate prismatic laths with interstitial tiny Fe(Ti?) oxides. The major alteration assemblage in this andesite breccia is essentially albite-chlorite-epidote, with the latter mineral occurring as large patches that overprint the groundmass of the sample, and also as veinlets.

This rock is a monomict lava breccia probably of basaltic andesite affinities, judging by the former abundance of phenocrystal olivine. It may even approach a basaltic composition. Importantly, it is the first clearly Mount Read Volcanics-type lava I have seen outside the Hellyer basalts that retains unambiguous evidence for the former presence of phenocrystal olivine. I would like to analyze this sample in our laboratory.

SAMPLE NUMBER: 114036

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill

SUMMARY:

This is a formerly plagioclase+augite+olivine-phyric andesite lava similar to 114035, but showing intense epidote alteration that has totally replaced the groundmass and plagioclase phenocrysts.

HAND SPECIMEN

This is a greenish andesitic lava with altered phenocrysts of augite and plagioclase in a formerly glassy groundmass that is intensely altered and replaced by fine-grained epidote.

THIN SECTION:

This sample was probably originally fairly similar petrographically to 035. It was clearly augite+plagioclase-phyric, and a subset of altered phenocrysts now composed entirely of polycrystalline quartz were probably formerly olivine, although without the benefit of having seen 035, I probably would not have picked this. Plagioclase phenocrysts in this sample were quite large, up to 3mm across, and were mainly euhedral blocky prisms that are now intensely altered to fine-grained intergrowths of sericite and epidote. Due to the intense alteration of the groundmass of this sample, in which it becomes difficult to discern former plagioclase phenocrysts from groundmass, it is hard to estimate the original modal abundance of plagioclase phenocrysts,although I would say it was at least 12-15%. Augite phenocrysts are up to 2mm across, and are rather rounded euhedra, still fresh, and make up around 5 modal% of this rock. Former euhedral olivine phenocrysts were always smaller than 1mm long, and are replaced by polycrystalline quartz; they were modally less abundant than augite, and much less abundant than in 114035.

The groundmass of this sample was probably composed of plagioclase and augite laths with interstitial Fe oxides and altered glass, similar to that in 035. However, the groundmass has been totally replaced by fine-grained epidote that is almost isotropic in places. A few clots of coarser-grained epidosite composed of yellow granular epidote and quartz are present.

This rock was a plagioclase+augite+olivine-phyric andesite or basaltic andesite broadly similar to 114035, but showing a far more intense epidote-dominated alteration assemblage such as are typically developed adjacent to fluid conduits in highly oxidizing hydrothermal systems.

SAMPLE NUMBER: 114037

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a vesicular formerly plagioclase+augite+ olivine-phyric basaltic andesite very similar to 114035.

HAND SPECIMEN

This sample is a brown augite+plagioclase=phyric andesitic lava.

THIN SECTION:

This is a vesicular basaltic andesite lava with strong similarities to 114035. It was originally plagioclase+augite+olivine-phyric, although now plagioclase has been albitized, and olivine altered to chlorite and epidote. The texture of the sample is very similar to 114035, except that this sample is massive, rather than autobrecciated. Plagioclase phenocrysts are smaller and more abundant than in 035, making up about 15-18 modal% of the sample. They are mainly elongate blocky prisms to 1mm long showing weak sericite alteration. Augite phenocrysts are considerably less abundant (<5 modal%) and are fresh, rather broken and rounded crystals mainly 1-2mm across. Former olivine phenocrysts are mainly 0.5-1mm across, perfectly euhedral, and are replaced by opaque rims with epidote-chlorite cores. They make up about 3 modal% of this rock.

The groundmass of this rock was vitrophyric, being composed of tiny albite microlites in devitrified glass that is largely isotropic. Vesicles to 5mm diameter are undeformed and filled by chlorite; they are almost invariably lined by granular epidote crystals. The same assemblage fills dilational fractures and forms veinlets, and is sometimes accompanied by minor calcite.

This lava, probably originally a basaltic andesite, is clearly related to 035 and 036, although it is less altered on average than the previous two samples. The comments made for 035 regarding the affinities of that rock apply equally well to 037.

SAMPLE NUMBER: 114039

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a plagioclase+augite-phyric shallow intrusive andesitic to dioritic rock very similar to 114027.

HAND SPECIMEN

This is a dark green plagioclase+pyroxene-phyric andesitic to dioritic rock very similar in hand specimen to fine-grained diorite 114027.

THIN SECTION:

This is a holocrystalline andesite or diorite composed of subequal proportions of augite and albitized plagioclase phenocrysts in a groundmass dominated by tabular plagioclase and interstitial augite. The plagioclase phenocrysts were up to about 5mm long, and have been albitized then slightly sericitized. They are mainly elongate prismatic euhedral crystals, and show a size grade down to the typical 'groundmass' size, which is about 0.3-0.5mm. Augite phenocrysts are perfectly fresh subhedral to euhedral prisms rarely larger than 2mm long.

The groundmass of this sample is quite coarse and holocrystalline, being composed of intergrown blocky tabular albite, granular augite plates, minor leucoxenitized FeTi oxides and interstitial chlorite. Granular epidote is common in the groundmass, together with chlorite and minor secondary quartz. Occasional acicular actinolite crystals are growing in the chlorite patches.

This rock is definitely a shallow intrusive andesite or diorite, and is very similar to sample 114027 petrographically. It shows a metamorphic assemblage at the lower grade end of the greenschist facies, as indicated by the sparse actinolite.

0032

SAMPLE NUMBER: 114040

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a plagioclase+augite-phyric andesitic lava that has suffered strong hematite ± epidote alteration. It is very similar to sample 114030.

HAND SPECIMEN

This sample is a dark red hematite-altered andesitic lava breccia (autobreccia?) with fragments generally less than 1cm long.

THIN SECTION:

This sample is a strongly plagioclase-phyric andesitic lava breccia dominated by albitized plagioclase phenocrysts (~20 modal%) and around 2-4 modal% of fresh augite phenocrysts in a hematite-altered, formerly vitrophyric groundmass. The plagioclase phenocrysts are mainly 0.5-1.5mm long tabular prisms, often intergrown with one or two similar crystals; they are only very weakly sericitized. Augite phenocrysts are more equidimensional, fresh but abundantly fractured subhedral prisms. A few quite large FeTi oxide microphenocrysts (almost 0.5mm long) are present and altered to leucoxene.

The groundmass texture varies from fragment to fragment in this rock, and as in the lava breccias described above, fragment boundaries are often difficult to discern due to devitrification/crystallization of the glass and strong overprinting hematite±epidote alteration. The groundmass was vitrophyric, composed of abundant albite microlites, often showing flow alignment, and subordinate almost rounded augite granules, in glass that has been largely hematite-altered. Granular yellow epidote is common in the groundmass, and also forms veinlets and fracture fillings. Pale green chlorite charged with tiny hematite granules also occurs as fracture fillings.

This sample was a plagioclase+augite-phyric andesitic lava that suffered strong, and presumably localized hematite alteration. It is very similar to 114030.

0033

SAMPLE NUMBER: 114041

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a foliated greywacke derived dominantly from Precambrian pelitic metamorphics; it contains a minor amount of devitrified felsic lava fragments and detrital volcanic quartz. It is rather similar to typical Animal Creek greywackes.

HAND SPECIMEN

This is a grey quite strongly foliated sandstone with occasional flattened lithic clasts up to 5mm long.

THIN SECTION:

This is a foliated greywacke dominated by quartz-rich detritus from pelitic metamorphics, with a minor component derived from felsic volcanics. Framework clasts make up about 80% of the rock, and are mainly 0.5-2mm long. They are composed of about equal proportions of lithic fragments and rather angular mainly polycrystalline metamorphic quartz. Lithic clasts fall into three broad groups. Most distinctive are clasts composed of very fine-grained silica with occasional euhedral pyrite cubes. These are probably cherty. Quartz-mica schists are also abundant, and grade with less mica into deformed quartzites. The least abundant variety of lithic clasts are probably formerly glassy, devitrified felsic lava, lacking phenocrysts. Detrital muscovite grains aligned parallel or subparallel to the cleavage are abundant, and altered detrital Fe(Ti?) oxides are not uncommon..

The cleavage in this sample is fairly closely spaced but discontinuous and is defined by concentrations of insoluble oxides and dark carbonaceous(?) residues produced during pressure solution volume loss. The matrix of this greywacke is very fine-grained and irresolvable, and has been largely eliminated by pressure solution compaction of lithic clasts.

This sample is fairly typical of the Animal Creek Greywacke-type sediments derived in large part from the Precambrian, with only a minor component contributed from felsic volcanic sources. Similar lithic wackes occur in the Southwell Subgroup.

0034

SAMPLE NUMBER: 114042

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is an entirely volcanogenic conglomerate composed of detritus from the local andesite-dominated terrain, but also abundant quenched basaltic clasts dominated by devitrified glass with augite and olivine phenocrysts; these may be tholeiitic rather than associated with the local andesites.

HAND SPECIMEN

This is a volcanogenic conglomerate with rounded clasts of mafic or intermediate lavas to almost 3cm long. Some clasts were clearly hematite-altered prior to deposition. ?? — some show selvedges of alteration

THIN SECTION:

The clasts in this wonderful sample show a remarkable range of textural and compositional features. One of the most abundant clast lithologies is magnificent quenched glassy basalt in which swallow-tail plagioclase microlites are preserved in isotropic devitrified glass. These clasts may show phenocrysts of augite and occasionally altered olivine, and less commonly, strongly sericitized plagioclase phenocrysts. In more slowly-cooled lithologies, possibly from even the same flow(s), the groundmass glass has crystallized to intergranular-textured augite and plagioclase laths. A few clasts composed almost entirely of devitrified isotropic glass contain phenocrysts of only chloritized olivine. Many of the clasts resemble quenched Crimson Ck-type tholeiitic basalts rather than Hellyer or Que Rv-type basalts and andesites, although this is very difficult to judge when sample are so glassy.

The matrix of this conglomerate is composed of sand-sized grains of augite and devitrified glassy lava. The shape and size of the augite phenocrysts is more reminiscent of augites in typical Mount Read andesites and basalts than the tholeiitic basalts. Coarse-grained granular yellow epidote is abundant throughout the sandy matrix.

This volcanogenic conglomerate contains no detritus from the Precambrian pelitic rocks. Clasts are entirely volcanic, and may include a component derived from Crimson Creek Formation-type tholeiites, as well as detritus from the local andesites. I will polish another section of this and try to area scan clasts with the microprobe to check their affinities.

0035

SAMPLE NUMBER: 114043

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a weakly foliated abundantly plagioclase-phyric dacitic lava. It was originally similar to the protolith of sample 114029.

HAND SPECIMEN

This is a massive feldspar-phyric dark green dacitic to andesitic lava.

THIN SECTION

This is a feldspar-phyric dacitic lava with a weak foliation defined mainly by discontinuous bands of insoluble material concentrated by limited pressure dissolution of the sample. Small albitized plagioclase phenocrysts make up about 20-25 modal% of this sample and generally occur as multi-crystal clots of tabular subhedral crystals usually less than 0.5mm long. There were no mafic phenocrysts in this sample, although a few altered former FeTi oxide phenocrysts are present. An unusual feature of this rock is the presence of about seven or eight 1-3mm long formerly glassy lava fragments. These brown fragments are angular, contain rare small plagioclase microlites, and are composed of devitrified glass. They may represent fragments of the quenched rim of this lava incorporated into the lava during flow and convective overturn.

The groundmass of this rock is weakly foliated and composed of generally fine-grained quartz and feldspar mosaic intergrowths after devitrified glass. Occasional wavy chlorite lamellae parallel the foliation.

This sample was probably a dacitic lava, although the presence of abundant highly size-variable plagioclase phenocrysts and glassy lava fragments, coupled with the rather 'ignimbritic' look of the sample due to the weak foliation, initially suggests a crystal lithic tuff origin. The entire, mainly euhedral plagioclase phenocrysts, and the common multi-crystal clots thereof, suggest that it is unlikely that this is a tuff. Rather, it is a weakly deformed and foliated plagioclase-phyric dacitic lava.

0036

SAMPLE NUMBER: 114046

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a Precambrian quartz - two-mica schist with porphyroblasts of magnetite.

HAND SPECIMEN

This is pale brown mica schist with porphyroblasts of hematite or magnetite.

THIN SECTION:

This sample is a relatively fine-grained mica schist dominated by muscovite plates defining the schistosity, but with a significant amount of biotite and trails of quartz grains, and quite common and relatively large magnetite (hematite-replaced?) porphyroblasts The average grainsize of the muscovite is about 0.3mm; it is intimately interlayered with brown biotite flakes and angular quartz. Quartz layers commonly bulge out into lensoidal shapes and these are often associated with magnetite porphyroblasts, mainly subhedral and fractured, that are up to 2mm across. It is possible that the muscovite is retrogressive after biotite, although there is little evidence of textural disequilibrium or incomplete reactions.

This sample only records one period of deformation, in which the biotite and muscovite recrystallized to define the schistosity. The protolith was probably a ferruginous muddy sediment, although all primary texture has obviously been obliterated. This is clearly a Precambrian metamorphic rock, and has close counterparts in the Ulverstone Metamorphics.

0047

SAMPLE NUMBER: 114047

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a quartz-phyric strongly sericitized, foliated rhyolitic lava. It may be correlated with the quartz-phyric sequence that extends down the eastern side of the Mount Read Volcanics adjacent to the Sticht Range Beds.

HAND SPECIMEN

This is a foliated cream and pink quartz-phyric felsic lava.

THIN SECTION:

This is a strongly sericitized, rather foliated quartz-phyric rhyolitic lava. It consists of about 5-8 modal% of quartz phenocrysts that are up to 3mm across and vary from euhedral to angular and resorbed. Many crystals are euhedra that appear to have been fragmented in situ. Other quartz phenocrysts are highly angular crystal fragments, ranging down to less than 0.2mm across. A single angular lithic clast about 1cm long, composed of coarse-grained quartzite, with minor interstitial muscovite flakes, is present. A few possible former small feldspar phenocrysts are now replaced by intense clayey sericite aggregates.

The groundmass of this sample was undoubtedly glassy and then devitrified. It has crystallized to a microcrystalline intergrowth of quartz and possibly minor feldspar. The foliation produced in this sample is defined by bands of dense sericite that pervade the groundmass and wrap around quartz phenocrysts. They are so intensely developed as to leave only isolated pods of unsericitized groundmass. Sericitic bands are commonly sites of slight Fe-staining, presumably due to interaction with groundwater.

This is clearly a quartz-phyric rhyolitic lava; its relatively well-defined foliation and sericite development may indicate proximity to a major fault (perhaps between the 'Cambrian' sediments further NE and the 'Precambrian schists'). This type of lava is more typical of Tyndall and Southwell Subgroup than formations below the andesites in the MRV (whether the andesites are Que-Hellyer correlated or Central Volcanic Complex correlated). One important exception however, is the abundant quartz-phyric rhyolites that extend down the eastern side of the Mount Read Volcanics adjacent to the Sticht Range Beds. Corbett (pers. comm.) believes that these eastern quartz-phyric lavas may be as old as the Central Volcanic Complex, and not correlates of the Tyndall Group as generally believed.

0[illegible]8

SAMPLE NUMBER: 114048

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a plagioclase+augite+olivine-phyric basaltic andesite lava or shallow intrusive dyke rock related to samples 114031, 35, 36 and 37.

HAND SPECIMEN

This is a massive brown porphyritic andesitic lava with narrow epidote veinlets.

THIN SECTION

This sample was originally a plagioclase+augite+olivine-phyric andesitic lava very similar texturally and mineralogically to 114031, 35, 36 and 37. Plagioclase occurs as multi-crystal clots of rather ragged subhedral tabular prisms, and makes up around 20 modal% of the sample. It is albitized but not sericitized. Former augite phenocrysts are also more common as multi-crystal aggregates up to 2mm across. They show an unusual alteration style in which crystals become non-pleochroic pale brown, probably due to microscopic hematite granules forming in the sample due to strong oxidation-related alteration. Former olivine phenocrysts made up about 5 modal% of this sample and were euhedral, 0.5-1mm long and have been replaced by opacite rims with epidote interiors.

The groundmass of this sample was quite a fine-grained holocrystalline intergrowth of altered augite and albite laths, with interstitial altered FeTi oxides. The texture suggests that this may have been either a shallow intrusive dyke rock or from the interior portion of a relatively thick flow.

Veinlets of quartz-epidote, and quartz-epidote-fibrous actinolite transect the sample, and indicate a low greenschist facies of burial metamorphism. This sample is clearly related to lavas 114031, 35, 36 and 37, and is unusual in that olivine-bearing andesites are unrecorded from elsewhere in the Mount Read Volcanics.

0[illegible]9

SAMPLE NUMBER: 114049

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is an epidosite (epidote, quartz and hematite) in which textural evidence is preserved for a precursor gabbroic to dioritic mineralogy.

HAND SPECIMEN

This is a speckled brown strongly epidote-altered formerly andesitic lava or lava breccia(?).

THIN SECTION:

This rock is best classified as an epidosite, being composed almost entirely of epidote, quartz and hematite. However, despite the almost total replacement of the original mineralogy by these minerals, there is plenty of textural evidence left to indicate that this rock was originally a holocrystalline diorite or gabbro, composed largely of plagioclase and augite. Plagioclase laths were about 1-2mm long, and interlocked with similar sized plates of augite. The latter have been totally replaced by polycrystalline clots of weakly pleochroic rather pale yellow epidote. Quartz replaces plagioclase laths and is volumetrically subordinate to epidote. Hematite makes up about 5-8 modal% of this sample and is present as equidimensional euhedra, some of which probably faithfully replace primary FeTi oxides. Many hematite grains appear to have hydrated to limonitic - goethitic material.

This sample was probably a gabbro or rather augite-rich dioritic intrusive rock, similar in many respects, although perhaps a bit more mafic than samples 114027 and 114039.

SAMPLE NUMBER: 114050

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a most unusual weakly foliated former wehrlitic cumulate rock in which clinopyroxene is preserved, but olivine is entirely altered to chlorite. It is probably related to mafic Mount Read Volcanics-type magmatism.

HAND SPECIMEN

This is a foliated grey-green diorite of fine-grained gabbro.

THIN SECTION:

This sample is quite strongly foliated and altered, but relic clinopyroxene is common, and enough textural evidence is preserved to allow classification as originally a holocrystalline gabbroic rock. What I initially took to be clay altered tabular plagioclase prisms in the rock closer examination shows to be an unusual, almost isotropic chlorite. Occasional almost rounded inclusions of the same material occur in some clinopyroxene crystals, and strongly resemble former olivine inclusions. The sample is apparently feldspar-free, and textural evidence suggests that it may have been a cumulate wehrlitic rock composed of clinopyroxene (augitic) and olivine. A few red chromite grains are present, further supporting the mafic -ultramafic affinity. Augitic clinopyroxene occurs mainly as anhedral to subhedral grains broken by foliation and often interstitial to chloritized olivine. Tremolitic amphibole is present growing as acicular crystals in chlorite, and forming fringes on some augite grains.

This is an exceptionally unusual rock for sequences correlated with the Mount Read Volcanics. The lack of FeTi oxide grains and the apparent appearance of augite before plagioclase in the crystallization sequence (olivine having crystallized first) rules out any correlation with Crimson Creek Formation-type tholeiitic magmas. Rather, correlation is probably best made with mafic Mount Read Volcanics magmas, in which (eg Hellyer Basalts) olivine is followed by augite, then plagioclase in the crystallization sequence. The presence of relatively abundant augite probably dictates against any correlation with cumulates in the W Tasmanian ophiolites, which are orthopyroxene-dominated and generally augite-poor. I conclude that it is a magma chamber product of a relatively primitive Mount Read Volcanic basalt magma. It should be analyzed.

SAMPLE NUMBER: 114053

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a volcanogenic sandstone derived mainly from quenched submarine dacitic to andesitic lavas, and with a significant component of serpentinitic and amphibolitic clasts derived from the W Tasmania ophiolites.

HAND SPECIMEN

This is a massive dark green volcanogenic sandstone.

THIN SECTION

In many respects this sample is similar to volcanogenic sandstone 114055. It is framework-supported, the matrix having been winnowed out or eliminated during compaction. Lithic clasts dominate the detrital grains in this rock, and show closely adpressed grain boundaries due to pressure solution. By far the dominant lithic clasts are quenched andesitic to dacitic lavas, usually with aligned tiny microlites of albite, or spherulitic intergrowths of albite. Originally more glassy clasts, lacking quench crystallites, have devitrified to fairly even-grained intergrowths of quartz and albite, while brownish clasts composed of crystal-free devitirified glass are also common. Amphibolitic and serpentinitic clasts derived from ophiolitic orthopyroxene-rich cumulates and boninitic lavas are relatively common in this sample (compared to 114055), perhaps making up about 10 modal% of the clasts in the rock. Also notable are rounded clasts of polycrystalline detrital epidote. Detrital grains of blocky albite phenocrysts are much less abundant in this sample than 114055, and detrital volcanic quartz is absent in this rock.

This is clearly a volcanogenic sandstone derived dominantly from andesitic to dacitic submarine lavas, but with a notable component contributed from the ophiolites.

SAMPLE NUMBER: 114055

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a volcanogenic sandstone derived from a local andesite-dacite source; it has been disrupted by shaley dykelets (similar to pikelets but less tasty) of similar sourced material.

HAND SPECIMEN

This is a poorly bedded volcanogenic coarse sandstone with unusual irregular and possibly cross-cutting shaley layers.

THIN SECTION

This is a beautiful volcanogenic sandstone dominated by 0.5-2mm sized grains of detritus derived in large part from andesitic and dacitic lavas. It is essentially matrix-free. Most lithic clasts are devitrified glassy material, and abundant fragments are present of dacite with excellent quench textures defined by spherulitic to acicular plagioclase in devitrified glass. A few chlorite-serpentine-tremolite clasts may be derived from boninitic rocks in the ophiolites. The most abundant monomineralic grains are blocky albitized plagioclase to 2mm long, and fresh augite phenocryst debris, usually euhedra less than 1mm long. Also common are leucoxene-altered FeTi oxide phenocryst grains. Detrital volcanic quartz grains are present but quite uncommon.

The shaley material noted in the hand specimen is simply a finer-grained matrix-rich version of the sandstone, and is clearly intrusive through the sandstone. It probably was more water-rich and plastic during deformation of this sequence, and intruded through the host sandstone layers.

The provenance of this rock was entirely the local andesite+ dacite-dominated Mount Read Volcanics, with a minor input from an ophiolite source, and also from quartz-phyric lavas.

0043

SAMPLE NUMBER: 114056

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill

SUMMARY:

This is a foliated shaley siltstone derived from glassy felsic volcanics.

HAND SPECIMEN

This is dark brown-grey sedimentary rock composed of thicker (>1cm) shale layers with interbedded coarser silty layers.

THIN SECTION:

This weakly foliated rock is composed of interbedded shale and siltstone. The shale is generally too fine-grained and irresolvable to define its dominant mineral components, although recrystallized, devitrified glassy detritus may have been an important component. Occasional detrital quartz grains coarser than their matrix are notable, but it cannot be determined whether they are of volcanic or Precambrian (pelitic metamorphic) provenance. The most obvious feature of the shale is the foliation defined by acicular colourless actinolite and streaky sericite.

Interbedded in the shale are several layers of coarser silty detritus in which relic detrital grains are more easily identifiable. Most grains were of formerly glassy, almost aphyric felsic lavas that have devitirified to quartz-feldspar-sericite intergrowths, with blurring of clast margins occurring during pressure solution impaction and cleavage formation. Other clasts that are a significant component in this rock include angular volcanic quartz, and fragments of feldspar phenocrysts, as well as leucoxene-altered former FeTi oxide grains. As in the shaley layers, acicular to elongate prisms of actinolite define the cleavage with sericite. Chlorite and epidote are minor minerals in this sample,which is almost certainly derived in large part from felsic volcanics.

SAMPLE NUMBER: 114057

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill

SUMMARY:

This is a volcanogenic sandstone derived very largely from felsic glassy volcanics.

HAND SPECIMEN

This is a weakly foliated massive dark grey aphyric andesitic lava or lithic tuff/volcaniclastic.

THIN SECTION:

In thin section, this sample is clearly seen to be a foliated volcanogenic sandstone. Dominant clasts are 0.5-1mm-sized lithic fragments of aphyric to weakly feldspar-phyric formerly glassy dacitic to rhyolitic lavas. Most of these have been flattened or stretched during the deformation that produced the foliation. The foliation is defined by dark subparallel bands of very fine-grained leucoxenite-type mineral aggregates probably concentrated around clast margins during pressure solution accompanying deformation. A common clast type is composed of dacitic to andesitic devitrified glass charged with extremely fine-grained hematite, almost rendering the rock fragments isotropic. Other clast varieties include fairly angular detrital volcanic quartz, and more abundant blocky feldspar (albite) almost certainly derived from felsic volcanic host rocks. No Precambrian schistose clasts or polycrystalline quartz was noted in this sample. The sample is obviously derived in large part from a felsic volcanic terrain dominated by glassy lavas, including quartz-phyric lavas.

The regional metamorphic alteration assemblage in this sample is albite-chlorite-epidote-calcite-minor hematite, probably defining conditions of lowermost greenschist facies. Chlorite occurs as interstitial patches, calcite as quite abundant patches and veinlets, and epidote as uncommon granules, often associated with chlorite.

SAMPLE NUMBER: 114059

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a volcanogenic fine sandstone derived mainly from andesitic to dacitic lavas, but with a minor but significant component derived from ophiolitic cumulates.

HAND SPECIMEN

This is a fine-grained, massive dark green volcaniclastic sandstone.

THIN SECTION:

This is a poorly sorted rather fine-grained volcanogenic sandstone in which framework grains dominate, and matrix forms only a very small percentage of the rock (<10 modal%). Maximum clast size is around 1mm, but the average clast size is much less, closer to 0.2-0.3mm across. The clast population is largely composed of three varieties of clasts. Almost euhedral prismatic augite clasts make up about 20 modal% of the sample, and are almost certainly derived from the local andesitic lavas and tuffs. They are perfectly fresh. Blocky to tabular mainly euhedral plagioclase grains are more abundant (perhaps 30-35 modal%), and vary from slightly to strongly sericitized. They also show crystal shapes typical of the andesite-dacite lavas and pyroclastics in the Mount Read Volcanics. Lithic fragments make up about 40 modal% of the rock and show a large range in composition, mineralogy and texture. Most were glassy felsic lavas with sparse plagioclase phenocrysts. However, notable among the clasts are a number composed of intergrown tremolitic amphibole and minor chlorite or serpentine that resemble strongly altered boninitic cumulates from the W Tasmanian ophiolites. A few detrital red chromites are likely to be similarly derived. This has obvious implications for timing of regional tectonic events. Some detrital grains of epidote indicate that epidote alteration (presumably locally, of the andesite lava pile) preceded deposition of this rock. Epidote also occurs in the murky matrix of this sample, and probably grew post-depositionally during regional burial metamorphism. There is no detrital component in this sample from the Precambrian pelitic metamorphics, nor from quartz-phyric felsic lavas.

SAMPLE NUMBER: 114062

LOCATION: OUTOKUMPU DELORAINE EL 16/90 Kentish Hill area

SUMMARY:

This is a foliated quartzite produced by relatively high-strain related recrystallization of a coarse quartz sandstone. It shows strong similarities to Sticht Range Beds quartz sandstones.

HAND SPECIMEN

This is a foliated coarse-grained quartz sandstone or quartzite with occasional dark micaceous clots.

THIN SECTION:

This rock was originally a very clean sandstone composed dominantly of rounded quartz grains 2-7mm across, probably detrital biotite, with very minor matrix clay. The rock has suffered strong deformation, leading to total recrystallization of quartz, so that many intergrown polygonal crystals of quartz occupy sites of former rounded quartz grains or clasts, often growing across former clast boundaries into adjacent clasts. Only shadowy relics of former grain shapes can be discerned. The flakes of what was probably detrital biotite, as well as minor clayey matrix, have recrystallized to muscovite, that makes up about 5 modal% of this sample. A single half-cm sized clast of quartz-muscovite schist is clearly of Precambrian derivation, and hints that much of the other quartz originally in the sample may be similarly derived. I have never seen Mount Read Volcanics-derived quartz phenocrysts anything like as rounded as were the detrital quartz grains in this sandstone. The quite strong deformation fabric in this sample indicates that it is derived by very strong recrystallization-deformation of a siliciclastic coarse sandstone.

This quartzite, particularly in hand specimen, shows strong similarities to some Sticht Range Beds coarse quartz sandstones, especially the dark clots of micaceous material. The presence of a quartz-mica schist lithic fragment derived almost certainly from the local Precambrian sequence suggests that the rock is post-Precambrian.. It cannot be part of the Mount Read Volcanics-correlated sequence, and therefore the Sticht Range Beds may be an appropriate correlation..

SAMPLE NUMBER: 114064

LOCATION: OUTOKUMPU DELORAINE EL 16/90

SUMMARY:

This is a strongly foliated and altered formerly olivine gabbro, very similar to wehrlite 114050.

HAND SPECIMEN

This is a weathered, foliated dioritic or gabbroic intrusive rock.

THIN SECTION

This strongly altered and foliated sample is rather difficult to diagnose. It is composed of abundant large (av. 1-2mm across) plates of fresh augite intergrown with chlorite-serpentine(?) -actinolite after rather granular olivine, and isotropic brown messy stuff possibly after plagioclase. The strong but fairly widely-spaced foliation pervading this rock is defined by wavy chlorite that wraps around augite plates, and similar isotropic brown crud that replaces plagioclase. Textural obliteration is such that it is difficult to determine the original nature of this sample. However, the abundance and fairly coarse grainsize of the augite, the presence of rounded chlorite inclusions after olivine in some augite grains, and shadowy relic textural information suggest that this sample was an olivine gabbro. It is very similar to wehrlite 114050. In fact, if the low-birefringent material identified in 050 as chlorite were replaced by the brown crud in this sample, these two rocks would be remarkably similar. I assume that this was a quite primitive gabbroic dyke related to the Mount Read Volcanics. It should be analyzed.

APPENDIX II

Analytical Report - Rock Samples

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Phone (004) 31e837

14 Thirkell St. CODEE TAS 7320

Fax (004) 318890

ANALYTICAL REPORT No. 111060.60.08071

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO:

Outokumpu Exploration Aust Pty Ltd
Suite 2, Level 6
77 Pacific Highway
NORTH SYDNEY NSW 2060

ORDER No.	PROJECT
20244	EL 16/90

DATE RECEIVED	RESULTS REQUIRED
18/06/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No OF COPIES	TOTAL No. OF SAMPLES
5	11/07/91	1	41

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
A114025/65	RO Prep : GP006,GP009,GF018	Cu,Pb,Zn,Ag,Fe,Ni/GA140
A114025/65	RO Prep :	Au,Au(R),Au(S)/EE309
A114025/65	RO Prep :	Ba/GX401
A1140 & others	RO Prep :	Whole Rock Analysis/GX408
A1140 & others	RO Prep :	Cr,Zr/GX401

REMARKS

RESULTS TO

Mr W Herrmann
R.S.D. 1066
DEVONPORT TAS 7310

RESULTS TO

Outokumpu Exploration Aust Pty Ltd
Suite 2, Level 6
77 Pacific Highway
NORTH SYDNEY NSW 2060

RESULTS TO

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

0049

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.08071	11/07/91	20244	1 OF 5

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Ni	Au	Au(R)	Au(S)
1	A114025	122	<5	77	<1.0	5.17	25	<0.008	-	-
2	A114026	279	<5	72	<1.0	5.39	23	<0.008	-	-
3	A114027	82	5	76	<1.0	4.85	45	<0.008	-	-
4	A114028	52	<5	84	<1.0	5.92	40	<0.008	-	-
5	A114029	410	<5	73	<1.0	4.22	17	<0.008	-	-
6	A114030	59	8	96	<1.0	5.61	22	<0.008	-	-
7	A114031	99	<5	79	<1.0	6.14	36	<0.008	-	-
8	A114032	166	<5	70	<1.0	6.97	52	<0.008	-	-
9	A114033	153	<5	54	<1.0	4.19	40	<0.008	-	-
10	A114034	314	72	23	<1.0	7.15	26	<0.008	-	-
11	A114035	47	<5	36	<1.0	3.41	60	<0.008	-	-
12	A114036	15	<5	47	<1.0	4.80	71	<0.008	<0.008	-
13	A114037	41	<5	56	<1.0	4.44	49	<0.008	-	-
14	A114038	120	7	58	<1.0	4.49	50	<0.008	-	<0.008
15	A114039	87	<5	69	<1.0	4.08	52	<0.008	-	-
16	A114040	12	<5	46	<1.0	3.25	73	<0.008	-	-
17	A114041	40	<5	82	<1.0	4.55	60	<0.008	-	-
18	A114042	47	<5	67	<1.0	5.30	144	<0.008	-	-
19	A114043	255	<5	84	<1.0	2.96	50	<0.008	-	-
20	A114044	120	<5	86	<1.0	17.70	25	<0.008	-	-
21	A114045	485	<5	111	<1.0	30.70	33	0.013	-	-
22	A114046	232	<5	67	<1.0	6.47	37	<0.008	<0.008	<0.008
23	A114047	13	<5	9	<1.0	1.53	<5	<0.008	-	-
24	A114048	38	8	34	<1.0	4.88	57	<0.008	-	-
25	A114049	69	9	32	<1.0	9.22	39	<0.008	-	-

Results in ppm unless otherwise specified
T = element present but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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358050

358051

ANALABS

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.08071	11/07/91	20244	2 OF 5

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Ni	Au	Au(R)	Au(S)
1	A114050	251	<5	57	<1.0	4.82	844	<0.008	--	--
2	A114051	14	14	19	<1.0	4.39	40	<0.008	--	--
3	A114052	130	<5	91	<1.0	7.30	76	<0.008	--	--
4	A114053	124	9	82	<1.0	6.45	122	<0.008	--	--
5	A114054	132	<5	85	<1.0	6.66	108	<0.008	--	--
6	A114055	131	<5	91	<1.0	7.82	105	<0.008	--	--
7	A114056	112	<5	87	<1.0	6.79	95	<0.008	--	--
8	A114057	66	5	72	<1.0	5.30	77	<0.008	--	--
9	A114058	7	12	8	<1.0	0.63	<5	<0.008	--	--
10	A114059	100	<5	72	<1.0	6.24	86	<0.008	--	--
11	A114060	30	17	76	<1.0	3.75	172	<0.008	--	--
12	A114061	52	23	93	<1.0	5.75	55	<0.008	--	--
13	A114062	7	<5	9	<1.0	0.60	<5	<0.008	<0.008	--
14	A114063	154	<5	87	<1.0	7.20	94	<0.008	--	--
15	A114064	102	<5	70	<1.0	6.99	910	<0.008	--	--
16	A114065	860	<5	52	<1.0	4.15	40	<0.008	--	<0.008
17										
18										
19										
20										
21										
22										
23	DETECTION	2	5	2	1.0	0.01	5	0.008	0.008	0.008
24	UNITS	ppm	ppm	ppm	ppm	%	ppm	ppm	ppb	ppb
25	METHOD	GA140	GA140	GA140	GA140	GA140	GA140	GG309	GG309	GG309

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.08071	11/07/91	20244	3 OF 5

TUBE No.	SAMPLE No.	Ba	Cr	Zr	Al2O3	SiO2	TiO2	Fe2O3	MnO	Na2O
1	A114025	90	--	--	--	--	--	--	--	--
2	A114026	110	35	55	14.20	58.1	0.64	11.21	0.17	7.23
3	A114027	220	95	70	17.64	54.0	0.45	7.45	0.15	5.81
4	A114028	180	95	70	16.41	50.9	0.64	10.41	0.18	6.20
5	A114029	75	25	80	16.17	57.0	0.84	10.35	0.15	8.43
6	A114030	150	15	90	16.39	55.1	0.84	11.33	0.17	8.02
7	A114031	170	90	45	16.54	53.7	0.56	10.08	0.16	6.64
8	A114032	35	140	35	13.72	48.3	0.79	12.81	0.21	4.06
9	A114033	15	--	--	--	--	--	--	--	--
10	A114034	<10	--	--	--	--	--	--	--	--
11	A114035	85	120	30	15.18	55.0	0.44	9.10	0.19	7.02
12	A114036	100	220	25	14.79	52.8	0.38	8.32	0.12	0.80
13	A114037	170	100	40	17.25	53.1	0.52	7.85	0.13	6.32
14	A114038	80	--	--	--	--	--	--	--	--
15	A114039	280	150	130	16.61	55.1	0.56	7.05	0.14	6.33
16	A114040	55	--	--	--	--	--	--	--	--
17	A114041	840	280	130	10.37	70.8	0.61	6.25	0.05	1.33
18	A114042	95	450	35	13.29	45.8	0.81	11.97	0.20	2.74
19	A114043	260	110	180	15.16	66.0	0.57	4.21	0.08	5.95
20	A114044	310	--	--	--	--	--	--	--	--
21	A114045	3400	--	--	--	--	--	--	--	--
22	A114046	1100	--	--	--	--	--	--	--	--
23	A114047	750	--	--	--	--	--	--	--	--
24	A114048	60	--	--	--	--	--	--	--	--
25	A114049	20	--	--	--	--	--	--	--	--

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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0050

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358052

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.08071	11/07/91	20244	4 OF 5

TUBE No.	SAMPLE No.	Ba	Cr	Zr	Al2O3	SiO2	TiO2	Fe2O3	MnO	Na2O
1	A114050	15	3000	9	9.23	45.2	0.35	9.43	0.16	0.12
2	A114051	45	--	--	--	--	--	--	--	--
3	A114052	40	--	--	--	--	--	--	--	--
4	A114053	240	340	55	14.42	55.7	0.62	10.40	0.15	3.13
5	A114054	440	--	--	--	--	--	--	--	--
6	A114055	170	300	45	14.70	51.4	1.07	11.72	0.17	3.28
7	A114056	280	--	--	--	--	--	--	--	--
8	A114057	350	270	40	13.47	57.2	0.52	8.90	0.11	4.41
9	A114058	250	--	--	--	--	--	--	--	--
10	A114059	330	--	--	--	--	--	--	--	--
11	A114060	770	--	--	--	--	--	--	--	--
12	A114061	240	--	--	--	--	--	--	--	--
13	A114062	700	--	--	--	--	--	--	--	--
14	A114063	490	--	--	--	--	--	--	--	--
15	A114064	10	2650	30	10.17	44.9	0.65	10.53	0.16	0.15
16	A114065	120	--	--	--	--	--	--	--	--
17										
18										
19										
20										
21										
22										
23	DETECTION	10	5	5	0.05	0.1	0.01	0.01	0.01	0.05
24	UNITS	ppm	ppm	ppm	ppm	%	%	%	%	%	%
25	METHOD	GX401	GX401	GX401	GX401	OX408	OX408	OX408	OX408	OX408	OX408

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

T500

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.08071	11/07/91	20244	5 OF 5

TUBE No.	SAMPLE No.	CaO	K2O	MgO	P2O5	LOI
1	A114026	3.47	0.22	3.32	0.121	1.50
2	A114027	4.93	0.45	5.57	0.118	3.52
3	A114028	5.13	0.55	6.19	0.129	2.87
4	A114029	2.98	0.24	2.15	0.190	1.63
5	A114030	2.11	0.33	3.43	0.202	1.84
6	A114031	4.08	0.53	4.29	0.097	2.17
7	A114032	9.40	0.14	7.71	0.050	2.72
8	A114035	6.96	0.17	3.98	0.048	1.85
9	A114036	14.55	0.30	3.13	0.044	4.33
10	A114037	5.75	0.48	5.50	0.079	3.02
11	A114039	3.76	0.92	6.43	0.112	3.02
12	A114041	0.57	1.85	3.34	0.085	4.25
13	A114042	10.82	0.76	9.18	0.052	4.48
14	A114043	1.84	0.92	2.84	0.106	1.97
15	A114050	8.61	0.04	19.80	0.015	7.00
16	A114053	5.44	0.62	5.85	0.108	3.62
17	A114055	4.92	0.46	6.80	0.061	4.42
18	A114057	3.40	1.69	5.46	0.074	4.85
19	A114064	8.40	0.07	15.82	0.033	9.07
20						
21						
22						
23	DETECTION	0.01	0.01	0.01	0.005	0.01
24	UNITS	%	%	%	%	%
25	METHOD	OX408	OX408	OX408	OX408	OX615

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

APPENDIX III

Rock Sample Descriptive Data

outokumpu
EXPLORATION AUSTRALIA PTY. LIMITED

ROCK SAMPLE DATA FIELD SHEET

0053

PROJECT NAME EL 16/90 - DELORAINE - TAS
PROJECT No. _____

PROSPECT NAME KENTISH HILL AREA
PROSPECT I.D. _____
GRID I.D. _____

Sample Number	Field / Station Number	FIELD-GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	COMMENTS / ANALYSES (p.p.m.)
A (prefix)					T			
114025					BR	CP		Purplish (qtz-hem) altered f.g. andesite; 2% qtz-ep-chl veinlets
114026					"	"		1/4 graded sample of above with traces native Cu in veinlets.
114027					HF	"		Plag + pyroxene m.g. "diorite", rather fresh.
114028					BR	CP		Greenish gray feldspar phyric andesite, fresher than 114025.
114029					"	"		Purplish, feldspar glomeroporphyritic andesite. 1% veinlets ep. etc.
114030					"	"		Green/purplish gray f.g. glomeroporphyritic andesite, fresher than 114029
114031					"	"		Porphyritic basalt, possible pillow structures. Magnetic.
114032					"	"		Dark greenish grey f.g. "spilitic" basalt, minor ep-qtz veins. Magnetic
114033					"	"		Similar to 114032 but with more ep-qtz and actinolite veinlets. Actinolite veinlets post dated by epidote veinlets.
114034					HF	CP		Massive epidote + qtz altered mafic rock.
114035					"	"		Purplish altered f.g. phyric basalt.
114036					"	"		Similar to above with strong extensive vein/pervasive ep-qtz alt.
114037					"	"		Amygdaloidal f.g. phyric basaltic andesite, weakly epid alt. matrix
114038					"	"		Similar to 114037, possibly pillowed, with stronger epid. alt. of matrix.
114039					"	"		Feldspar + ferromag. phyric, non amygdaloidal andesite; pillow / core?
114040					"	"		Purplish altered mafic volcanic, moderate qtz-epidote veining.
114041	K40;				BR	CP		Dark grey slaty greywacke, 1% disem pyrite
114042					BR	CP		Pebbly conglomeratic basaltic breccia; serpentinite clasts but mostly glassy basalt; epidote alteration of matrix.
114043					BR	"		Cleaved feldspar rich diorite? 1.5m. wide dyke? in basalt, congl. trends ~350°! Malachite staining on joints.
~~114044~~								
114044					BR	CP		Sintery siliceous jasper/massive hematite
114045					HF	"		Siliceous/ferruginous semi gossan with relict fy and chlorite
114046					BR	"		Hematite porphyroblastic mica schist.

3580534

outokumpu
EXPLORATION AUSTRALIA PTY. LIMITED

ROCK SAMPLE DATA FIELD SHEET

0054

PROJECT NAME EL 16/90 - DELORAINE TAS.
PROJECT No. _____

PROSPECT NAME KENTISH HILL AREA.
PROSPECT I.D. _____
GRID I.D. _____

Sample Number	Field / Station Number	FIELD-GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	COMMENTS / ANALYSES (p.p.m.)
A(prefix)								
114047					BR	CP		Alt. phyric sericite schist after rhyolitic volcanic ? occasional rounded clasts of metaquartzite and angular clasts of mica schist.
114048	K7				HF	CP		Purplish fs. phyric basaltic andesite ? strong semi pervasive epidote alteration. Not magnetic
114049	K8				"	"		Greenish brown f.g. fs. phyric andesitic intrusive ?, strong pervasive epidote alteration and partly weathered but still strongly magnetic.
114050	K20				"	"		Green serpentinite/chlorite ? schist ex sheared mafic vole?
114051	K12				"	"		Green totally epidote-qtz altered mafic vole, relic fs phenocrts, non magnetic
114052	K13				"	"		Fragmental mafic volcanic, aphyric basalt ? extensive epid. alt. in part
114053	K5				"	"		Greenish grey andesitic lithic sandstone.
114054	K6				"	"		Thin bedded greenish grey clayey siltstone and f.g. andesitic lithic sandstone.
114055	K37				BR	CP		Pale grey m-c.g. andesitic lithic sandstone and interbedded clayey siltstone.
114056	K30				BR	CP		Thinly interbedded f.g. mafic volcanic lithic sandstone and purplish grey clayey siltstone.
114057	K31				HF	CP		Dk greenish grey mafic volcanolithic sandstone, weakly magnetic
114058	K22							Pebbly conglomeratic siliceous (micaceous) sandstone.
114059	K4							Pale greenish grey m-f.g. volcaniclastic siltstone.
114060	K10							Grey thinly laminated/sheared micaceous siltstone and f.g. wacke.

3580555

outokumpu
EXPLORATION AUSTRALIA PTY. LIMITED

ROCK SAMPLE DATA FIELD SHEET

0053

PROJECT NAME EL 16/90 DELORAINE - TAS
PROJECT No. _____

PROSPECT NAME KENTISH HILL AREA.
PROSPECT I.D. _____
GRID I.D. _____

Sample Number	Field / Station Number	FIELD-GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	COMMENTS / ANALYSES (p.p.m.)
A profis :								
114061	K41				BR	CP		Black slate
114062	K21				"	"		Coarse sandy micaceous/siliceous sandstone.
114063	K34				MF	CP		Greenish grey fine grained intermediate volcaniclastic siltstone.
114064	K11				BR	CP		Green grey foliated chlorite/serpentinite? schist, somewhat weathered.
114065					BR	CP		Purplish hematite altered andesite with abundant criss crossing veins of qtz - epidote etc. with fairly prominent fine disseminated native copper in veins, estimate: 500 ppm Cu.

3580056

10010

471 000 E
472 000 E
473 000 E
474 000 E
475 000 E
476 000 E
477 000 E
5397 000 N
5396 000 N
5395 000 N
5394 000 N
5393 000 N
5392 000 N

QUARRY BROOK ROAD
MARAWEY ROAD
LAKE HIGHWAY
BOGAN RD.
BOGAN ROAD
Elmer Creek
Quarry Brook
BOUNDARY EL 16/90
BOUNDARY OF EL16/90
FLINTY ROCK
KENTISH HILL
SEEBOA
ROWE
NICHOLAS
BARKER

114063
114064
114064, 065
114066
114055
114059, 059
114060
114061
114062
114063
114019
114027
114028
114029-031
114032-034
114035, 36
114037-039
114040
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114043
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114058

Esg
Eef
Ess
Eea
Eva
Evt
Eun
Ec
Qt
PCs
PEq
PEs

GEOLOGICAL REFERENCE:

QUATERNARY — Qt — Talus, largely derived from Permian sediments and Jurassic dolerite on slopes to east.

LATE CAMBRIAN–EARLY ORDOVICIAN? — Ec — Siliciclastic conglomerate; correlate of Owen Conglomerate

CAMBRIAN? — Esg — Micaceous greywacke, siltstone and shale.
48
Eef — Quartz phyric, rhyolitic epiclastic breccias and tuffaceous siltstone.
38
Ess — Siliciclastic conglomerate, pebbly sandstone and sandstone. Possible correlate of Strickt Range Beds.
Eea — Andesitic/Dacitic volcaniclastics; minor detrital component from ultramafic provenance.
22
Eva — Andesite – basaltic andesite; pillowed and brecciated lavas and associated shallow intrusives.
Eun — Altered ultramafic – wehrlite.

EOCAMBRIAN? — Evt — Tholeiitic metabasalt and volcanolithic conglomerate.
27

PRECAMBRIAN? — PEs — Qtz – muscovite – biotite psammo-pelitic schist.
PEq — Meta-quartzite

114... — Rock chip / petrographic sample locality.

LAKE HIGHWAY — KENTISH HILL — BOGAN RD.
A — A'
Eef? Esg? Esg Evt
Ec
PEs? Ess? Esg PEs Eva Eea Esg
SW — NE

DIAGRAMMATIC CROSS SECTION
SCALE 1: 10 000

91-3277.
358057

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DELORAINE - EL16/90 - TAS
KENTISH HILL AREA
GEOLOGICAL INTERPRETATION

SCALE: 1: 10,000

Compiled: [illegible] | Date: 7/91 | FIG: 2

5 cm

0056

358058

OUTOKUMPU EXPLORATION AUSTRALIA PTY LIMITED

Report No: R47.3
File No: 2.47.9
Filename: 247WH107.RT1

ANNUAL REPORT TO 3/8/91
EL 16/90 - DELORAINE

VOLUME 2 OF 2

For: Outokumpu Exploration Australia Pty Limited
77 Pacific Highway, NORTH SYDNEY NSW 2060

By: W. Herrmann, RSD 1066, DEVONPORT TAS 7310

Date: 16 July 1991

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EL 16/90 - DELORAINE - ANNUAL REPORT TO 3/8/91
VOLUME 2: EXPLORATION PROGRESS REPORT - MARCH 1991

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List of Plans
(in pockets)

1. SUMMARY

The first stage programme of exploration of EL 16/90 - Deloraine has involved the review of previous geological and exploration data, reconnaissance mapping, petrographic and geochemical studies of selected igneous rocks and a trial stream sediment geochemical survey.

This has enabled the tentative conclusion that the greater part of the dominantly sedimentary Cambrian ? sequence exposed in the licence is equivalent to the basal part of the Dundas Group, (= the Animal Creek Greywacke and Southwell SubGroup of the Que-Hellyer area). The upper most parts of the sequence, exposed in the far western and eastern parts of the licence include dacitic extrusives and intrusives which appear to be correlates of the Tyndall Group. The litho-stratigraphic correlations and lack of any significant known geochemical anomalies, alteration systems or mineralisation suggests a relatively low potential for volcanogenic massive sulphide deposits in these areas.

Petrographic and geochemical investigations of, a very few, samples of andesitic rocks from the Kentish Hill area, in the southeast part of the licence, indicate a chemical correlation with the Footwall Andesites of the Que-Hellyer Volcanics. Mafic volcanics occur in a 2.5 x 0.5 km zone here and are known to host minor copper mineralisation. On the empirical basis of the encouraging lithogeochemical correlation, this area may have moderate potential for volcanogenic sulphide mineralisation and suggestions for further investigation are provided.

2. INTRODUCTION

EL 16/90 covers an area of 130 sq km between the Gog Range and Golden Valley in the vicinity of Deloraine in northern Tasmania. It was granted to Outokumpu Exploration Australia P/L and PanContinental Mining Ltd. in August 1991 and is currently being explored in joint venture by those companies for volcanogenic massive sulphide deposits.

The first phase of the exploration programme has involved review and compilation of the previous data, reconnaissance geological mapping and a trial stream sediment geochemical survey with a view to developing an improved lithostratigraphic interpretation of the Cambrian volcano-sedimentary sequence in the area and identifying the most prospective parts.

This report presents and discusses the results of the programme to date and provides suggestions for limited further investigations.

3. PREVIOUS EXPLORATION

There has been no significant production of metallic minerals from the licence area and it contains only one minor historical prospect.

At Kentish Hill, near Quamby Brook, low grade carbonates of copper were discovered at surface in 1921. Reid (1923) reported on the results of minor prospecting operations which indicated that the mineralization occurred in mafic rocks ("gabbro") and had grades of around 0.3% copper with minor gold, silver and nickel.
A total of six holes were drilled on the prospect by the T.W.Davies Syndicate in 1970-71 but the best intersection was only weakly mineralized at 46.5m @ 0.18% Cu.
This prospect was subsequently unsuccessfully explored by Union Oil and later COMALCO as a possible Cyprus type copper occurrence.

The licence area has, during the past two decades been explored for volcanogenic massive sulphide deposits by several companies:

1973, ASARCO EL 7/73

ASARCO carried out a regionally extensive stream sediment sampling programme over much of the exposed Cambrian ? rocks between Wilmot and Golden Valley. The average sampling density was about two samples per square kilometre, sampling and analytical methods were not reported and the results comprising data for Cu Pb Zn Ag Mo CxCu (cold extractable) and CxZn were reported as plans only. A number of base metal anomalies were defined, mainly in the area to the west of Gog Range; some of these were subsequently followed up with "technical" success by CRAE.

1978-79 COMALCO, EL 17/76

COMALCO's exploration objectives were trifold: to discover deposits of the tin-flourite skarn, Cyprus copper or polymetallic VMS type. EL 17/76 covered the eastern two thirds of the present EL 16/90 east of the Mersey River.

The exploration program included regional geological mapping at 1:20000 scale and comprehensive -80# stream sediment geochemical sampling with analyses for Cu,Pb,Zn and some Sn,W.
The geochemical work indicated low background levels for all basemetals with statistically determined thresholds at 54ppm Cu, 42ppm Pb and 94ppm Zn. A number of low order Cu anomalies were associated with the basic volcanics of the Kentish Hill area. The overall Pb maxima was 80ppm and the Zn maxima 320ppm. None of the "statistical" anomalies were regarded as likely to indicate significant mineralization but three of the best anomalies received additional follow up.

At **Kentish Hill** Comalco carried out gridding, geological mapping, magnetics, IP and limited C-horizon geochemical surveys. The magnetics showed that the basalts were strongly magnetic and occurred as discontinuous lenses. IP indicated weak resistivity lows along a basalt/shale contact but the lack of associated chargeability features suggested conductive shales rather than a sulphide deposit.
The soil geochemical data indicated a peak of 800ppm Cu with lower associated Zn, erratic Ni to 900ppm and low Pb over the basic volcanics.
It was concluded that the prospect had "a very remote possibility for economic Cyprus type mineralization". Drilling of two holes to test resistivity lows was recommended as a low priority but was never carried out.

In the **Lobster Rivulet - Punch's Terror** area detailed follow up -80# and panned concentrate sampling was carried out in an attempt to verify initial Sn,W drainage anomalies but was largely unsuccessful. Investigation of boulders of magnetite in basic volcanics with anomalous Sn,W,Mo included reconnaissance magnetic traversing over three kilometres of strike near Lobster Rivulet and excavation of three costeans over the magnetic peaks. Sampling of the costeans indicated values of around 2500ppm W, 300ppm Sn and 1200ppm Cu associated with minor, discontinuous veins of magnetite in brecciated basic volcanics. A Devonian granitoid associated genetic model was favoured but the weak traces of mineralization were not considered worthy of further investigation.

1984-85 AMAX, EL 49/82

This EL covered the western quarter of the present EL 16/90 at Gog Range but also extended considerably to the northwest to the Beulah area.

AMAX's exploration objective was to discover massive sulphide deposits in the Cambrian? volcanics.
The exploration work commenced with a re-assessment of ASARCO's previous stream sediment geochemical data with some follow up soil/rock geochemical samping of Pb/Zn anomalies at East Gog and West Mersey which led to inconclusive but low geochemical results at the former and recognition of minor structurally controlled vein style at the latter.

A 360 line kilometre DIGHEM survey was flown over the entire EL. Several hundred "anomalous" responses were recorded; fifty-six of the best were followed up but none were found to be related to (recognizable) surface mineralization. Only two conductivity anomalies were identified within the present licence boundaries, these both appear to lie within the "upper" greywacke unit near the northern boundary just north of Amax's East Gog anomaly. Both were interpreted as H type broad surficial conductors probably attributable to weathering and were not followed up on the ground.

AMAX concluded that all drainage geochemical and DIGHEM anomalies had been adequately examined without locating any indications of economically significant mineralization and therefore considered that near surface VMS mineralization was unlikely to exist. AMAX unsuccessfully sought a joint venture partner to fund exploration for deeply buried deposits and finally relinquished the licence.

1988 Cyprus Gold Australia Corp. EL 37/87

Cyprus' objectives on EL 37/87, which encompassed that part of the Cambrian ? sequence now within EL 16/90, were focussed on discovery of gold deposits of metasomatic or volcanogenic type.

The work commenced with a literature search which outlined four areas warranting further investigation.
These were:

Lobster Rivulet
Gregory Road
Kentish Hill
Beefeater Hill

Cyprus carried out very limited reconnaissance and rock chip sampling over the latter two areas but no significant gold values were obtained. Poltock (1988) recommended follow up on the remaining two areas but this was evidently not carried out.

4. REGIONAL GEOLOGY

(ref: Figure 1)

In EL 16/90, rocks of presumed Cambrian age are exposed over about 30 km of strike length, between Gregory's Road and Golden Valley, in the core of an east to southeast trending broad antiform outlined by outward dipping parallel ridges composed of siliciclastic conglomerates and sandstones which are obvious lithologic correlates of the Denison Group (Owen Conglomerate etc.) and are presumed to be of late Cambrian-early Ordovician age. The siliciclastics are overlain to north and south by presumably substantial thicknesses of younger cover rocks including Permian terrestrial sediments, Jurassic dolerite sheets and Tertiary basalt flows.

Within the main antiformal "belt", a group of complexly deformed metasedimentary schists and quartzites, which are presumably of pre-Cambrian age and appear to represent the local basement, are discontinuously exposed in narrow strips immediately below the "Ordovician" unconformity along the north slope of Native Hop Hill and at Montana Road between Long Ridge and Needles Ridge. Further west at Lobster Rivulet, there is a narrow strip of basaltic volcanics (Cvb) in a similar structural position immediately below the siliciclastics cover. They appear to be of tholeiitic composition and (on the basis of AJCrawford's, 1991, petrographic and geochemical interpretation of a single sample of float) are correlated with the EoCambrian ? Crimson Creek Formation.

The rocks immediately to the north of the tholeiite occurrence are a generally north dipping and facing unit of variably micaceous, siliceous or volcaniclastic greywacke and siltstone. (Csg) A sample (A114018) of float from this unit ? has been identified (Crawford, 1991) as a volcanogenic sandstone of mixed ophiolitic and felsic to andesitic derivation and presumably represents the very base of the Cambrian ? sequence in this area. It is, strangely, devoid of metasedimentary preCambrian detritus but the associated rocks are very largely composed of such materials.

This "lower" greywacke unit includes, or is transitional upwards to, one or two thin, possibly graded, pebbly, sandy and silty felsic epiclastic units of mixed volcanic/metasedimentary derivation.
They are succeeded, upwards and northwards, by a distinctive unit of quartz rich sandy to conglomeratic lithicwacke (Css) which characteristically contains detrital mica and lithic grains of metaquartzite and pelitic schist indicative of a dominantly preCambrian metasedimentary derivation. It is typically thickly bedded to rather massive and only occaisionally well laminated. Sandy lithicwacke of this type is prominent to the east of Lobster Rivulet where the unit appears to substantially thicken and includes a couple of thin felsic epiclastic units.

I have not traced it westward of the Mersey River and, although it certainly occurs on the west bank, might be considerably thinned in this direction.
At the Mersey River this lithotype is overlain by another fairly thin unit of felsic epiclastic sediments varying from medium grained, quartz/feldspar crystal rich wackes to fine grained ash rich siltstones and apparently including a thin dacitic lava or lava breccia flow. (Cef) It appears to wedge out to the east.

This is overlain by a rather thick and areally extensive group of turbiditic micaceous greywacke, siltstone and shale. (Csg) These appear to be of mixed metasedimentary/volcanic ? provenance but locally include a few thin members of felsic epiclastics and pebbly conglomeratic mudstones. On the whole, they are of much finer grain size and muddy character than the underlying sandy lithicwackes and typically are thinly interbedded or laminated.
This "upper" greywacke unit is synclinally folded about an easterly trending axis which lies about 0.5km south of the confluence of Lobster Rivulet with the Mersey River.
A few kilometres further west, around Eel Hole Creek, this synclinal axis appears to have a moderate westerly plunge and the fold is outlined by a persistent unit of felsic epiclastic sediments, of about 250m thickness or greater, which overlies the greywackes with a probably transitional boundary. The felsic epiclastics vary in grain size from pebbly conglomerate, through sandy wackes to fine grained ashy siltstone, generally rather massive in the coarser types to thinly bedded in some of the finer siltstones and are variably poorly to well sorted. Several representatives of this unit (A 114004, 114011, 114013, 114014, 114015) have been described by Crawford, (1991) and are dominantly derived from felsic volcanics although some contain a significant mafic crystal component suggestive of a mixed andesitic/felsic source; the textures indicate a very local source and minimal transport distances. Some also include a minor component of detrital mica and/or quartz mica schist of metasedimentary provenance. A possible nearby source for the andesitic component of these rocks could be the "Beulah Formation" which outcrops a couple of kilometres to the north in a stratigraphic position immediately below the "upper" greywacke unit.

Towards the core of the syncline and presumably up sequence, the felsic epiclastics are succeeded by an extensive, apparently thick unit or pile of dacitic lavas. The typical dacite here contains phenocrysts of albitised plagioclase and quartz with lesser augite and sometimes hornblende and microphenocrysts of leucoxenised FeTi oxides and zircon in a fine quartz + albite mosaic derived from devitrification of a formerly glassy matrix. Most of the dacites appear to be extrusive but there is an intrusive phase of similar modal and chemical composition which outcrops just outside the western boundary of the EL; this has a holocrystalline ground mass and is similar to the "Bond Range porphyry".

All of the dacites, from this Gog Plantation area, have an unusually high Zr content in the range 400-480ppm. This high Zr is not evident in the two analyses of felsic epiclastics from the underlying unit (A 114011, 114013) which are composed largely of felsic volcanics without preCambrian detritus; this slender evidence suggests that the high Zr dacites may be from a distinct magmatic pulse emplaced fairly high in the stratigraphic sequence.

In the far western part of the licence the dacites and underlying felsic epiclastics appear to be intruded by several bodies of diorite or quartz gabbro. An identical rock type occurs in association with greywackes a couple of kilometres south of Punch's Terror in the north central part of the licence. These diorites have coarse holocrystalline textures indicative of slow cooling in a plutonic intrusion rather than a narrow dyke; nevertheless the western bodies appear to have a quite elongate outline and distribution (largely inferred from the distinctive DIGHEM/aeromagnetic anomalies associated with them) and are approximately aligned with the northwest trends of the regional penetrative cleavage and the series of faults which apparently displace both Cambrian and Ordovician sequences here. Locally developed along both the northern and southern margins of the main western body, at Gregory's Road, are zones of intense quartz + tourmaline + sericite alteration apparently affecting the margins of the diorite and the adjacent dacite and perhaps associated with hydrothermal breccia pipes.

In the central and eastern parts of the EL, east of Lobster Rivulet, the exposed Cambrian ? sequence is dominated by sedimentary rocks with felsic volcanics/volcaniclastics very subordinate and diminishing eastwards. I have done very little geological reconnaissance in this area but on the basis of what I have seen and the descriptions given by Pike (1973) and Komyshan (in Weste, 1978) the principal rock types are lithologically similar to the sandy lithicwacke and turbiditic greywacke assemblages of the Lobster Rivulet area.

Along the Lake Highway, between the Meander Road and Golden Valley, greywackes (Csg) appear to lie directly on the preCambrian metasedimentary basement; I haven't seen them but on the basis of their structural position and extrapolation from Lobster Rivulet it seems that these could be equivalent to the "lower" mixed greywacke unit of the former area. They are covered to the immediate northeast by a narrow strip of "Ordovician" siliciclastics preserved in the hinge of a tight horizontal syncline. Immediately north of the latter there occur micaceous sandy lithicwackes and conglomeratic sandstones which are similar to those near Lobster Rivulet (Css). At Kentish Hill they also appear to dip and face to the northeast and seem to be only a few hundred metres in thickness.

They are succeeded here by a thin strip of greenish grey micaceous siltstone of phyllitic appearance which is in turn succeeded to the northeast by a unit of mafic volcanics, volcaniclastics and shallow intrusives. These appear to be restricted to only few hundred metres thickness and about 2.5km strike length, petering out to the northwest and disappearing below younger cover rocks to the southeast.

Beyond the andesitic unit, to the northeast is a complex series of greywacke/siltstones and sandy lithicwackes (the lutite rich and arenite rich sequences of Pike, 1973). I have not seen these but the distribution of rock types and limited structural measurements on the 1:63,360 QUAMBY Geological Atlas Sheet, (Tas. Dept. of Mines, 1969) suggest a possible tight syncline/anticline couple as inferred in my Figure 1. If this interpretation is correct the mafic volcanics could occur near the hinge of the syncline, perhaps up sequence from the greywacke unit or in a restricted lense within the greywacke near the southern flank of the fold. This greywacke could be equivalent to the "upper" greywacke of the Lobster-Gog area (ie: above the sandy lithicwacke) and hence the mafic volcanics could be roughly eqivalent to some of the felsic epiclastics within or above the "upper" greywacke in the western areas. However, the sequences at the southeastern end could be depositionally and/or structurally more complex than that and the stratigraphic correlation of the mafic rocks remains fairly speculative at present.

North of my inferred anticline trending through Quamby Brook, most of the dips appear to be to the northeast and I have (without sighting them) tentatively correlated the dominant greywackes and a couple of included lenses of sandy lithicwacke and mudstone conglomerate with the "upper" greywackes of Lobster-Gog. Just south of Pumicestone Ridge this sequence seems to be overlain to the north by an assemblage dominated by matrix supported conglomerates and mudstones which includes a number of dacitic lava units.

A single specimen of dacite from this locality (A 114007) has proved to be of similar type to (though with slightly more hornblende and apatite perhaps indicating that it is slightly less evolved than) the dacitic lavas and intrusive of the Gog area. Likewise it has a high Zr content of 460ppm.
On the basis of my inference that these high Zr dacites represent a single ? distinct magma pulse emplaced at the top of the sequence as exposed at the Gog area, the similarity of the Pumicestone Ridge dacite tends to support the notion that the conglomerate unit here is also fairly high in the sequence and that there is general younging from southwest to northeast in this eastern part of the licence even though it may be complicated by fold and/or fault structures.

4.1 Regional Lithostratigraphic Correlations

Dr. Crawford (1991) has noted the likely correlation of tholeiitic basalt at Lobster Rivulet with the EoCambrian? Crimson Creek Formation. This presumaby forms part of the basement of the Cambrian? sequence here and may itself have been emplaced as part of an allocthonous sheet. The Cambrian ? sequence immediately north of this occurrence dips and faces north and a specimen of volcaniclastic sandstone from ? the "lower" greywacke unit near the presumed base of the sequence contains ophiolitic and chromite detritus. On this basis Crawford (op cit) tentatively suggests a correlation with the Animal Creek Greywacke. He also interprets a chemical correlation between the two samples of intrusive andesite from Kentish Hill and the Que Footwall Andesites (of the Que-Hellyer Volcanics).

Although the correlation of sedimentary units between Lobster Rivulet and Kentish Hill is uncertain it seems that the Kentish Hill andesites lie above the "lower" greywacke and either within/above the sandy lithicwacke unit or within/above the "upper" greywacke unit. Both alternatives agree fairly well with Crawford's (op cit) tentative correlation of "lower" greywacke with base of Animal Creek Greywacke. The second alternative would imply a correlation between the Kentish Hill andesites and the felsic epiclastics or dacitic lavas lying above the "upper" greywacke in the western part of the licence. Some of the felsic epiclastics here do contain some andesitic detritus but apparently extensive andesitic volcanics of the Beulah Formation occur just to the north of the western end of the licence in a stratigraphic position apparently below the "upper" greywacke. I do not have any expert opinion on the Beulah andesites but some analyses tabulated by Crawford (1989) in a report on Mt.Cattley andesites seem to indicate a possible correlation with Que Footwall andesites. In this case the "upper" greywacke and succeeding felsic epiclastics would be approximate equivalents of the Southwell SubGroup of the Hellyer area. This would agree with Crawford's (1991) opinion that vulcanism following the Que-Hellyer pulse was essentially felsic.
The dacites of the western part of EL 16/90 have been shown to have petrographic similarities to the Bond Range Porphyry which is associated with and intrusive into volcanics correlated with the Tyndall Group further to the southwest. The Gog and Pumicestone Ridge dacites are therefore probably Tyndall Group equivalents and younger than the Southwell SubGroup.

The diorites of the Gog area present a paradox. Low grade burial metamorphic assemblages in the diorites indicate that they are most likely of Cambrian ? age rather than post tectonic Devonian. They appear to intrude the "upper" greywackes near Punch's Terror and the dacites at Gog and would therefore appear to be younger than youngest parts of the Cambrian ? sequence exposed here.

However, Crawford, (1991) noted an impressive compositional similarity between the Gog diorites and the Kentish Hill andesites and concluded that the latter are shallow intrusive or extrusive equivalents of the former. If this is the case and the diorites and andesites are coeval, then the preceding lithostratigraphic correlations are untenable.
In order to preserve the shaky correlations inferred it could be suggested that the diorites are a younger phase of magmatism temporally unrelated to the Kentish Hill andesites but of coincidentally similar compositions.
Alternatively, as discussed by Crawford, (op cit) they may represent a crystal rich residual magma, which remained after the intrusion and eruption of the dacites, and was subsequently intruded into its own lava carapace.
A third possibility, (elaborated upon in discussion of the Kentish Hill copper mineralisation in section 5.1 below) could be that the two samples of shallow intrusive andesite upon which Crawford has based his correlation with the Que Footwall andesites are not comagmatic with the bulk of the mafic unit at Kentish Hill but represent instead some minor, younger intrusive phase. This case would accomadate the chemical similarity to the apparently young Gog diorites and would also unconstrain the lithostratigraphic correlations.

Although the chemical correlation of the Kentish Hill andesites with the Que Footwall Andesites is regarded as an encouraging result, it should be recognised that the correlation is based on only two samples which have not, as yet, been demonstrated to represent the bulk of the mafic volcanics there.

5. MINERALISATION AND ALTERATION TYPES

5.1 Shear related, vein style, possibly low temperature skarn type, magnetite + actinolite + quartz + K-feldspar mineralisation occurs in tholeiitic basalt at Lobster Rivulet. Comalco's costean and boulder sampling indicated low grade tin, tungsten, molybdenum and copper mineralisation in the magnetite rich parts; (upto about 500ppm Sn, 2500ppm W, 250ppm Mo and 3000ppm Cu).

5.2 At Kentish Hill, minor malachite/azurite mineralization occurs as disseminations in basic volcanics adjacent to the contact with phyllitic siltstone/slate and on cleavage traces in these sediments. Minor prospecting was carried out shortly after the discovery in 1921 and samples indicated low grades of copper ~0.3% and traces of nickel, gold and silver but no economic mineralisation was found. Poorly conceived diamond drilling carried out by the (local?) Davies Syndicate in 1971 intersected an interval of 46m @ 0.18% Cu (range 0.08-0.40% Cu) in one of six vertical holes drilled down the dip.

B and C horizon soil geochemistry by Union Oil and Comalco in the mid to late 1970s indicated spotty weak copper (max: 800 ppm Cu) nickel (max: 900ppm Ni) anomalies but low lead and zinc values. Magnetic survey indicated that the probable pillow lavas at the base (south) of the basic volcanic unit are strongly magnetic with an anomaly upto 2500nT above background. A Comalco gradient array IP survey indicated a resistivity low along the contact of slates and basic volcanics but no significant chargeability anomaly.

Crawford, (1991) has interpreted two intrusive andesites which I collected from this area, to be possible correlates of the Que Footwall andesites and has noted the chemical similarity with the Gog diorites. These samples were (deliberately) of the freshest rocks found in limited reconnaissance at Kentish Hill; most of the other mafic rocks are extensively sheared and/or altered to epidote-chlorite-quartz etc. assemblages. I am concerned by the strong magnetic anomaly which is quite uncharacteristic of the Que-Hellyer Volcanics; likewise the anomalous nickel and low lead, zinc does not seem to fit the Hellyer VMS model. It seems possible that the bulk of the basic volcanics at Kentish Hill are actually of some other affinity; the tholeiitic basalts, correlates of the Crimson Ck. Fmn. are a likely possibility. The diagnostic andesites may represent some minor, younger intrusive phase.

This needs further checking to determine if the volcanic assemblage as a whole can be correlated with the Que-Hellyer Volcanics. Comalco's mapping is not sufficient for this and the generally poor outcrop in the area may make it difficult to improve the picture but the further application of Dr. Crawford's convincing geochemical/petrographic interpretations may provide the key.

5.3 Intense quartz + tourmaline + sericite alteration occurs around the margins of the diorite body at Gregory's Road in the western part of the EL. The alteration zone/s appear to be of very local extent affecting the marginal phases of the diorite and the adjacent dacites and felsic epiclastics and may be partly associated with hydrothermal breccias. This was reported by R.Poltock (in: Vivian, 1984) to be anomalous in gold. However, of his six samples only one, the first of a batch, contained detectable gold at 0.24g/t. I have had analysed eleven samples of this alteration assemblage and only one contains detectable gold at barely anomalous 0.04g/t. This suggests that Poltock's original sample may have been contaminated (at the start of an analytical batch) or the gold is very erratically distributed.

Some of my samples are weakly anomalous (100-300ppm) in lead and others are faintly anomalous in tin (15-40ppm). At one location at the southern margin of the diorite on Gog Road, patchy pervasive chlorite alteration with minor limonite veinlets is anomalous in copper, lead and zinc (to 685, 1600, 475ppm respectively).

The mineralogy and localisation of these alteration types suggests a magmatic hydrothermal origin associated with the intrusion of the diorite. The absolute metal values are unimpressive and it is considered that this style of mineralisation does not warrant further investigation.

5.4 Silicified Fault Zones:

The AMAX West Mersey stream geochemical zinc/lead anomaly appears to be attributable to a northwest trending minor zone of brecciation and silicification occurring at or near the contact of felsic epiclastics and greywacke/siltstones. The alteration seems to be essentially siliceous and is associated with minor disseminations of pyrite. Chip sampling by AMAX indicated lead and zinc values upto 900ppm and 800ppm respectively but soil geochemical traversing indicated a very limited strike extent. This occurrence aligns on a northwest projection with the (AMAX) East Gog stream geochemical anomaly. Soil geochemical sampling here indicated spotty weak anomalies in the range 200-500ppm lead and 200-400ppm Zn.

These anomalies appear to be related to silicification and weak vein style mineralisation of local breccia/shear zones probably associated with the set of post Ordovician northwest trending faults and do not appear to warrant further investigation.

6. STREAM SEDIMENT GEOCHEMISTRY

AMAX (Vivian, 1984) carried out a wide spaced "bulk gold stream sediment" sampling survey which, while not providing systematic coverage of the Gog area did indicate a weak gold anomaly in a small tributary of the Mersey River, on the south bank about 1km downstream of the Lobster Rivulet confluence. The sampling and analytical methods were not stated but the results were tabulated as three columns of gold values, %Cn and dry weights of samples. The gold values thus reported for the stream sample in question were:

Au(1) 0.09
Au(2) 1.2
Au(3) 145
(reported as ppm Au but probably in ppb Au ?)

In order to check the significance of this apparent anomaly and to test the applicability of the method, the present joint venture explorers carried out a trial bulk gold stream sediment survey over the western part of EL 16/90 west of Lobster Rivulet. A total of 48 sites were sampled for bulk sediment (~2kg of -40#), panned concentrates and -80# sediments. The sampling procedures are detailed in Appendix II, analytical results in Appendix III and sample locations are shown on Figure 2.

The BLEG analyses range from below the detection limit of 0.01ppb to a maxima of 0.46ppb Au. The mean value is 0.13ppb and standard deviation is 0.11ppb.
None of these appear to be significantly anomalous.
(The values appear to compare with those of Au(1) reported by Amax although the apparently anomalous Amax stream was not resampled in this survey as it was found to be heavily overgrown with ferny vegetation, without a defined stream course and no active sediment.)

Despite the sampling difficulties (see Appendix II) the low BLEG results are supported by the panned concentrate gold analyses which are all below the detection limit of 0.008g/t Au. This is consistent with the lack of visible gold in all samples.

Although not exhaustive, the trial survey is considered to have provided an adequate coverage of the western area; the low results indicate a low potential for outcropping gold mineralisation in this part of the licence.

The -80# analytical data shows a little more character:

	Cu	Pb	Zn	Ag	Bi	Mn	Ba	As
	(in ppm)							
Mean	28	28	122	1	10	919	426	3
Std.Dev.	18	24	116	1	10	941	321	4
max.	90	155	545	3	40	4800	1650	20
min.	5	5	15	x	x	15	35	x
Anomaly Threshold (mean+2*std.dev.)	70	80	350	3	30	2800	1068	11

It is evident that the recent survey has re-identified the AMAX East Gog and West Mersey Zn(Pb) anomalies. Both of these were, more or less cursorily but probably adequately, followed up by Amax and appear to be attributable to weak vein style mineralization and silicification associated with northwest trending faults.

There is an isolated Pb anomaly in a northern tributary of Lobster Rivulet south west of Punch's Terror, (site no: 47, 155ppm Pb). This location was also weakly anomalous when sampled by Comalco in 1978 but the anomaly did not persist upstream and is thus of dubious significance. It is located at a picnic area and may reflect some contamination.

There is a cluster of weak Barium anomalies in tributaries of Garden of Eden Creek near the northern boundary; these are unsupported by base metal values. They occur in close proximity to a major (inferred) northwest trending fault and may be related to it.

It is concluded that the trial stream sediment survey has not indicated any new significant geochemical anomalies in the Gog area.
However, it is considered that stream sediment geochemistry has been an effective exploration method in this environment, on the basis that it has, here and further west around Cethana and Gowrie Park, detected occurrences of relatively weak base metal mineralisation.

7. DISCUSSION

The overall conclusion to be drawn from the fairly detailed stream geochemical surveys over the whole EL, Dighem over the northwestern part, previous apparently reasonably thorough reconnaissance mapping over the entire area and my own reconnaissance mainly of the western area, is that, with the possible exception of Kentish Hill, there are no significant near surface zones of alteration or mineralisation to indicate the presence of volcanogenic massive sulphide deposits.

Tentative lithological correlations suggest that the bulk of the Cambrian ? sequence in the licence is equivalent to the basal part of the Dundas Group (Animal Creek Greywacke and Southwell SubGroup of the Hellyer area) and the younger dacitic volcanics of the Gog and Pumicestone Ridge areas are equivalent to correlates of the Tyndall Group.
Shallow intrusive andesites occurring in the basic volcanic unit at Kentish Hill appear to be chemical correlates of the Que Footwall andesites and, problematically, are also rather similar to the diorites at Gog. However, I have some doubts about whether they are comparable to all of the basic volcanic rocks, and particularly the magnetic pillow basalts which host the minor copper mineralisation, at Kentish Hill.

In the absence of favourable geochemical or obvious lithostratigraphic targets over the greater central and western parts of the licence, I am unable to recommend a further detailed or precisely focussed exploration programme for these areas.

The interpreted chemical correlates of Que Footwall Andesites at Kentish Hill perhaps require further follow up. For this, I would suggest a programme consisting of:

* Further reconnaissance mapping and sampling in an attempt to improve knowledge of the structural/stratigraphic setting, the types and distribution of volcanic rocks and the style of copper mineralisation. Two to three weeks of geologist's time should be sufficient for this.

* Further petrographic and geochemical investigation by AJC of selected samples.

* Acquisition of 1984 BMR Aeromagnetic data contoured at 1:25000 scale for a "mapping" tool to assist geological interpretation.

The suggested programme should be considered in light of the following factors:

a) Outcrop in the area is not good and it may be difficult to acheive the above objectives at a surface reconnaissance level.
b) Although the logistic access is good the land at Kentish Hill is all privately owned, partly by APPM under forest plantations and partly by small farmers.

c) The known extent of mafic volcanics here is quite limited.

d) The results of previous prospecting and modern exploration of the copper occurrence in these rocks have not been particularly encouraging.

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APPENDIX I

Petrography and Significance of Rocks from the Deloraine EL 16/90

PETROGRAPHY AND SIGNIFICANCE OF ROCKS FROM THE DELORAINE EL 16/90

FOR OUTUKUMPU EXPLORATION
(ATTN WALLY HERRMANN)

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1/3/91

BACKGROUND

Deloraine EL 16/90 lies along the relatively poorly-known E-W trending section of the Mount Read Volcanics north of the Tyennan Region Precambrian pelitic metamorphics. As mapped during preliminary geological reconnaissance studies by Wally Herrmann for Outukumpu, lithostratigraphic units defined in the western part of the EL include, ranging from youngest to oldest:

UNIT 5: relatively coarse-grained intrusives ranging from dioritic to gabbroic compositions, that reach around 500m maximum thickness, and trend NW-SE; these intrude mainly the core of the felsic lavas of Unit 4. A small, separate occurrence of diorite further to the east (just south of Punch's Terror) is at a similar stratigraphic setting close to the core of the regional syncline:

UNIT 4: felsic intrusive and extrusive rocks, which Herrmann interprets as being volcanic and subvolcanic manifestations of the same magma body; these occur within the broad core region of a regional syncline:

UNIT 3: felsic pyroclastic and epiclastic rocks with interbedded argillites:

UNIT 2: a relatively thick (to 2000m ?) sequence of micaceous greywackes and siltstones, with abundant Precambrian-derived detritus and quite coarse -grained units dominant near the base:

UNIT 1: metabasic lavas occur below the unconformity at the base of the Owen Conglomerate correlates in the upper Lobster Rivulet and on the northern slopes of Magog, but their structural relationships with nearby greywackes remains unknown. They apparently host minor vein-type magnetite-tin-copper-tungsten mineralization.

Structurally, these units occur within a broad E-W trending syncline. Regional relationships suggest that the felsic lavas overlie the greywackes, since they occur in the core region of the syncline. The felsic lavas do not persist to the east, where greywackes make up most of the succession.

The region further east, around Quamby Brook and Golden Valley has only been mapped in a few preliminary traverses, and the details of the stratigraphy remain poorly known. However, Wally Herrmann suggests that the andesitic - basaltic rocks outcropping south of Quamby Brook might possibly be correlates of Unit 5 above.

PETROGRAPHY

Wally Herrmann selected twenty seven rocks thought to be representative of the regional stratigraphy, for thin sectioning and petrographic description. Major element and some trace elements were analyzed by ANALABS for most of the igneous rocks from this set (Table 1). The petrographic report is appended, and below, I offer some comments about the implications of the petrographic study for the regional correlation, mineralization and significance of these rocks.

UNIT 1: SAMPLE 114017

This is a petrographically distinctive sparsely plagioclase-phyric tholeiitic metabasalt identical to most Crimson Creek Formation tholeiitic metabasalts and their correlates (Smithton basalts, Motton Spilite, Double Cove basalts on Macquarie Harbour etc). The petrographic assignment is amply borne out by the available wholerock analysis, that shows the high TiO2 and Ti/Zr values typical of the Crimson Creek basalts and their correlates. It is a typical rift tholeiitic basalt, and definitely unrelated to the Mount Read Volcanics.

In the model for the tectonic development of this region proposed by Crawford & Berry (1991) and included herein, the Crimson Creek Formation and correlates in western Tasmania is believed to be formed during crustal attenuation and incipient rifting of the Rocky Cape block probably around 650-600Ma. This developing passive margin collided with the forearc region of a west-facing arc in the Middle Cambrian, resulting in emplacement of the so-called 'ophiolites' of western Tasmania. The Mount Read Volcanics are believed to be a post-collisional suite of high-K to shoshonitic lavas erupted, obviously, post-ophiolite emplacement.

In westernmost Tasmania, in the Smithton Trough, the Crimson Creek Formation correlates are in situ. Further east (closer to the site of collision), and also further south (eg in the Macquarie Harbour region), the Crimson Creek Formation correlates are almost certainly fault slices. Such allochthonous slices of basement occur at the Magnet mine near Mount Bischoff, within the Dundas and Dial Range Troughs (Motton Spilite), and significantly, at Connorville, well SE of the Deloraine EL. Emplacement of ophiolite sheets often involves basement slices being picked up and transported along with the ophiolite sheets (eg in Oman, PNG and Troodos).

The nature of the contact between the Crimson Creek Formation correlates and the overlying "Mount Read Volcanics - Dundas Gp' correlates in EL16/90 is not determined at present. However, sample 105680, apparently collected close to 114017, is a strongly deformed and intensely hydrothermally altered rock with skarn-like alteration. It may mark a major fault zone between basement tholeiites and the overlying Dundas Gp(?) correlates. Sample 114017 is absolutely distinct from the andesites (114019,020) from further east at Quamby Brook.

UNITS 2 and 3: VOLCANOGENIC SEDIMENTS and GREYWACKES

Sample 114018 is unusual in that it is a volcanogenic sandstone containing abundant ophiolite-derived detritus. On this basis, some tentative correlation may be made with the Animal Creek Greywacke (normally more micaceous than this), which is the unit in which the first appearance of ophiolite detritus occurs in W Tasmania. The Animal Creek Greywacke broadly marks the base of the Dundas Group.

Most other sandstones in this collection range from dominantly volcanogenic, often with glass shards (114016) and lacking Precambrian pelitic metamorphic detritus (114012, 13 and 14), through sandstones containing detritus from a mixed volcanic - metamorphic detritus (114015, 004), to detritus entirely derived from the metamorphics (105668 and 105677). From the data available, I can see no systematic change over the EL of the proportions of volcanic versus metamorphic detritus in these sandstones and greywackes. I think the most important fact emerging from these is the location of ophiolitic detritus near the base of the sequence.

UNIT 4: FELSIC LAVAS and SHALLOW INTRUSIVES

These are a series of shallow intrusive and extrusive dacitic to rhyolitic lavas that exhibit one very strange, and indeed unique, compositional feature, notably, their remarkably high Zr contents. Most felsic lavas within the Mount Read Volcanics have Zr contents from 200-250 ppm, and lavas with Zr greater than 300ppm are rare. I believe that this is primary, and real, and is not an analytical error, since the ANALABS Zr levels for the diorites and andesites are quite comparable with my own Zr data for similar rocks from this region.

The significance of this high Zr signature is difficult to pinpoint. It presumably reflects some local source effect (ie a high-Zr source). It may be significant, however, in terms of regional correlation. The only other recorded suite of high-Zr dacites and rhyolites in the Mount Read Volcanics come from the upper(most?) Central Volcanic Complex and basal Tyndall Group (indicating how useless the definition of the Tyndall Gp is!) lavasin the Jukes Proprietary prospect 9km SSE of Queenstown (M. Doyle, BSc (Hons) thesis, Univ of Tas, 1990). These Jukes Proprietary felsic lavas have somewhat higher TiO_2 and P_2O_5 than those at the western end of EL16/90, but share the same high Zr levels (to 450 ppm Zr). Significantly, the Jukes Proprietary high-Zr felsic lavas are associated with vein-style quartz-tourmaline-magnetite (±scheelite and pyrite) developed in strongly K feldspar-altered zones in the lavas. This mineralization is unambiguously Cambrian, as it is directly overlain by unaltered Owen Conglomerate that contains clasts of magnetite and hematite, and hematite-veined rhyolite derived from this alteration system. Doyle (1990) argues that the mineralization is linked to the roof hydrothermal system of a shallow Cambrian granite, such as the Darwin Granite.

UNIT 5: DIORITES: SAMPLES 114003, 105665, 105673, 105683, 105694

Sample 114003 is an intrusive dacite from within the elongate diorite intrusion at the west of the EL. It has a Ti/Zr value at 65% SiO2 of 18.7, considerably above that of other dacites in this study, and indicating with some certainty that it is unrelated to these rocks.

A bigger problem is whether 114003 is related to the diorites within which it apparently outcrops. Petrographically this is unlikely, but there exists quite a jump in fractionation stage from the cpx-rich diorites to this evolved shallow intrusive dacite, so is not ruled out totally. . On the basis of the available chemical data, it is still very difficult to judge whether or not 114003 and the diorites are comagmatic. Figure 1 shows that at least on the basis of Ti, Zr and SiO2 relationships, it is possible that 114003 is a more evolved phase of the dioritic intrusive complex, since it forms a continuation of the general diorite trend to higher SiO2 contents. Probably, rare earth element data would be required to prove or disprove this relationship, and this is not really worth doing. I think that given the mapping and sample location, combined with permissible evidence from trace element data, that 114003 is a dacitic phase.of the dioritic intrusion. It is finer-grained that the diorites and may well form a late marginal phase of the intrusion.

These dioritic intrusive rocks, except for 105683, all come from the long, relatively narrow body at the western end of the EL, where they appear to intrude dacitic lavas and shallow intrusives. Sample 105683 comes from an outcrop further east, but from a similar 'stratigraphic' location close to the core of the regional syncline.

These are all fairly evolved compositions, the most mafic (105665) having only 5% MgO. The two least evolved diorites have Ti/Zr values from 41-43, and these decrease with increasing differentiation to a value of 28 in the highest-SiO2 diorite (60%). **The data available are not definitive enough to say with certainty that the diorites are related or otherwise to the dacites that they intrude.** For example, it could be possible that the diorites represent the crystal-rich magma chamber fill of plagioclase and augite, fractionation of which produced the felsic lavas. Subsequent fracturing during cooling of the felsic lava-and shallow intrusive edifice may have squeezed out crystal-rich diorites to intrude its own lava carapace. Without detailed studies, this is hypothetical at best.

Two important questions pertaining to the diorites are:

1: are they related to the andesites 114119 and 120 that outcrop further east at Quamby Brook; ie: are the diorites shallow magma chamber complements of the regional andesites? and

2: are these distinctive diorites related compositionally to those outcropping in the Leven Gorge area around the former Geopeko Preston EL?

To answer question 1 above, rare earth elements would be most definitive, but are unavailable. However, some sensible conclusions can be gained from the available trace and major/minor element data.

	ANDESITES	DIORITES
%SiO2	55-58	55-61
%MgO	3.8-4.8	2.2-5
%TiO2	0.53-0.64	0.64-0.75
ppm Zr	95-100	100-150
%P2O5	0.12-0.14	0.15-0.16
MgO/TiO2	6-9.6	2.9-7
Ti/Zr	32-40	28-43
TiO2/P2O5	~5	4.3-5

Taking into account the fractionation of some of the above parameters with increasing differentiation (eg. MgO decreasing as SiO2 increases), there is an impressive similarity between the compositional fingerprints of the andesites and the diorites from EL 16/90. This strongly suggests to me that the andesitic lavas in the EL, such as those at Quamby Brook, are extrusive equivalents of the diorites.

To answer the second question, as to whether the diorites are comparable with those from the Preston EL, available data (non-proprietary data of AJC) for the Preston diorites are shown in Table 2 together with analyses for the Deloraine diorites. With the exception of sample 77998, which has 57% SiO2 and only 2% MgO, the Preston diorites are more differentiated than those from Deloraine. Comparison of trace element fingerprints should optimally be made between samples at a similar level of differentiation (eg similar SiO2 and MgO levels), thus samples 77998 (Preston) and 105683 (Deloraine) are compared. It is evident that the Preston diorites have somewhat higher TiO2 and P2O5 contents than the Deloraine diorites, and are therefore not strictly comagmatic, despite similar Ti/Zr values. The more evolved Preston diorites extend to higher Zr and P2O5 (and therefore probably slightly higher REE) levels. Despite these differences in trace and minor element compositions, it is quite reasonable to conclude that high-K andesites in this part of the Mount Read Volcanics belt are associated with comagmatic dioritic rocks representing shallow magma chamber complements to the extrusive andesites. Small differences in trace and minor element composition exist between andesites and diorites from Deloraine with diorites from the Preston area, but these may all be regarded as part of the same magmatic event.

REGIONAL CORRELATION OF THE ANDESITES AND DIORITES

The K2O contents of all the Deloraine diorites are greater than 2%, and the Preston diorites are greater than 3%, indicating that all these rocks crystallized from high-K andesitic magmas, that are fairly typical of the Mount Read Volcanics. It is useful to examine the affinities of the Deloraine andesite/diorite suite in comparison with the other major magmatic suites identified within the Mount Read Volcanics.

The Mount Read Volcanics consist of a number of magma suites of the orogenic basalt-andesite-dacite-rhyolite spectrum, each with distinctive compositional 'fingerprints'. Within the broadly N-S trending Central Volcanic Complex of the belt, two major magmatic suites have been identified. Group 1 are typical high-K andesites, dacites and rhyolites, and these are intruded by Group 2 hornblende-bearing andesites that are more enriched in P2O5 and light REE, and have lower TiO2 contents at any MgO or SiO2 level. The feldspar-phyric andesites of the Que River region (Que Footwall Andesites) form a third compositional group with diagnostic chemical characteristics broadly intermediate between those of the Groups 1 and 2 Central Volcanic Complex rocks, particularly at the andesitic stage of differentiation (Fig. 2). The most distinctive magma suite is represented by the Hellyer basalts, a large pile of shoshonitic basalts with relatively small volumes of andesitic or more felsic rocks in the sequence; a similar suite occurs in the Lynchford area, south and west of Queenstown.

The absence of basalts, particularly with the relatively high P2O5 and LREE levels that characterize the Hellyer basalts, preclude any correlation of the Deloraine suite rocks with the Hellyer basalts. Similarly, the discrimination diagrams shown in Figure 2 show clearly that the Deloraine lavas and dolerites do not correlate with the Group 2 Central Volcanic Complex hornblende-bearing generally intrusive andesites.

It is more difficult to correlate the Deloraine rocks with either the Central Volcanic Complex Group 1 lava suite or the Que Footwall andesites. Two REE patterns I have done for Preston diorites are likely to be close to, but probably slightly more LREE-enriched than the Deloraine diorites. These patterns (Fig. 3) show strong overlap with the REE field for the Que Footwall andesites, and the Central Volcanic Complex Group 1 andesites. Similarly, the discrimination diagrams in Figure 2 show that the Deloraine andesites and diorites have closest affinities with the Que Footwall andesites. This is emphasized by the fact that the Central Volcanic Complex Group 1 lava suite is overwhelmingly more felsic than andesite, with 'fresh' rocks with less than 55% SiO2 being rare indeed.

SUMMARY

The belt of Mount Read Volcanics extending east-west along the northern margin of the Tyennan block from the vicinity of Hellyer to Beulah, Deloraine and Quamby Brook contains abundant andesites (and diorites) compared to the north-south trending belt of Mount Read Volcanics south of Hellyer to Queenstown and beyond. Geochemical studies show that these andesites (and their shallow intrusive dioritic counterparts) are best correlated with the Que Footwall andesites compositionally. Basaltic and andesitic lavas with the pronounced shoshonitic affinities of the Hellyer basalts are unknown from the Beulah-Deloraine-Quamby Brook region.

Felsic lavas and shallow intrusives of dacitic to rhyolitic composition have remarkably high Zr contents (350-480ppm) and at least in this respect correlate with similar lavas in the Jukes Proprietary prospect south of Queenstown, that are associated with magnetite-quartz-tourmaline mineralization and strong K feldspar alteration. . The Jukes Proprietary lavas with high Zr occur at the top(?) of the Central Volcanic Complex, and basalt Tyndall Group lavas in this area. Since the high Zr contents of the felsic lavas probably represents a local source effect. there is no reason to demand time correlation of theses strange high-Zr dacites at either end of the Mount Read Volcanic Belt. More importantly, in both occurrences we see tourmaline alteration of undoubted Cambrian age. In EL 16/90 it occurs apparently at the margin of the dioritic intrusion into the high Zr felsic lavas. Similar tourmaline-magnetite alteration occurs at what is interpreted to be a faulted contact between Crimson Creek tholeiites and the Mount Read sequence on the northern slopes of Magog.

There are two scenarios for regional correlation that I consider possible:

1: Premise: The Deloraine andesites and diorites are time correlates of the Que Footwall andesites.

If the Deloraine rocks and the Que Footwall andesites were time correlates, then the basaltic-andesitic volcanic edifice responsible for the Hellyer basalts (that sit above the Que Footwall andesites in the Que-Hellyer area) clearly did not extend this far east. As the Hellyer basalts were erupting in fault-bounded troughs to the west, the Beulah-Deloraine area was receiving mixed volcanogenic and Precambrian-derived dominantly sandy detritus, with no component from the Hellyer basaltic eruptions. . The implication of this scenario is that the sequence mapped on EL 16/90 is a time equivalent of the Animal Creek Greywacke, with the Que Footwall andesites being represented in this section by andesites (Quamby Brook) and diorites, and no correlate of the Hellyer basalt being present this far east.

2: Premise: The Deloraine andesites and diorites are manifestations of the same general magmatic event that produced the Que Footwall andesites, but that they post-date the latter. In this scenario, the volcano-sedimentary sequence in the Deloraine-Quamby Brook area is correlated with the Dundas (Southwell Sbgp) Group occurring above the Que River Shale further west, with the diorites and correlated andesites representing a late phase of Mount Read Volcanic andesitic magmatism not known in the sections above the Que River Shale of the Que-Hellyer region.

I certainly prefer the first scenario, although I realize that it clashes with Wally Herrmann's 'first-guess' preferred correlation of the Deloraine sequence with the Dundas Group. I feel that all Mount Read Volcanics magmatism after the Hellyer basalt pulse was strongly felsic, and that the andesites and diorites of the Deloraine EL and Beulah area represent an unlikely shift back to more mafic magmatism. This is not to say that such a switch back to andesitic magmatism couldn't occur; I just prefer the correlation of this episode with the Que Footwall andesites, both temporally and compositionally.

A synthesis, albeit highly speculative, of this information is a follows. Broadly E-W directed regional block faulting possibly associated with ophiolite emplacement affected the Beulah-Deloraine region in the Middle Cambrian, and detritus washing off the ophiolite and Central Volcanic Complex was dumped into this marine basin(s). This stage of sedimentation is presumed to be broadly time-correlated with the Animal Creek Greywacke, further west. Felsic and andesitic magmatism occurred in locally developed centres, rather than regionally (as in the CVC), and is probably correlated best with the Que Footwall andesites, although the high-Zr dacites of the Deloraine area have no counterparts in the Que-Hellyer sequence. Nor are there correlates of the Hellyer basalts in the Deloraine-Beulah region. If this correlation is correct, then the stratigraphic sequence at Hellyer dominated by the Hellyer basalts, Que River Shale and thick Southwell Subgroup greywackes, is not present in EL16/90. An alternative interpretation, that the greywackes in EL 16/90 are correlated with Southwell Subgroup, and that the andesite-diorite suite transecting these sediments represents a late phase of andesitic magmatism not known from elsewhere in Tasmania's Cambrian, is considered less likely.

ALTERATION-MINERALIZATION

Of the samples examined, only two showed strong hydrothermal alteration (105680 and 105690). The latter, developed at the margin of the dioritic intrusion, has a quartz-tourmaline alteration assemblage. 105680 is a magnetite-actinolite-Kspar-quartz -chlorite skarn,

possibly developed along a major fault zone separating basement rocks from the Mount Read succession in the EL. No zone of strong K feldspar alteration is associated with the diorite intrusion and quartz-K spar alteration, at least from the samples I studied. . The remainder of the rocks examined have typical low grade burial metamorphism-related alteration assemblages (low greenschist to prehnite-pumpellyite facies) and show little evidence of significant hydrothermal alteration.

TABLE 1: Wholerock analyses of Deloraine rocks (ANALABS)

SAMPLE No	114003	114004	114005	114006	114007	114008	114009	114010	114011	114013	114017
LITHOLOGY	Intrus. Dacite	Sandstone	Dacite lava	Intrus. Dacite	Dacite Lava	Dacite Lava	Dacite Lava	Dacite Lava	Sandstone	Sandstone	Tholeiitic Bas
SiO2	65	57.3	66.8	66	68.7	69	67.4	66	58.6	72	48
TiO2	0.56	0.92	0.57	0.64	0.5	0.42	0.56	0.53	0.65	0.39	2.04
Al2O3	15.1	14.1	14.3	14.4	13.6	13.3	14	13.6	14.4	12.5	13.7
Fe2O3	6.46	10.3	6.78	6.8	4.73	6.37	6.04	6.34	7.64	4.28	13.7
MgO	0.9	4.35	1.1	1.4	0.85	0.85	0.95	1.05	3.65	1.15	6.9
CaO	0.98	4.94	0.13	0.29	0.63	0.15	0.38	0.05	4.47	0.74	9.46
Na2O	3.71	3.77	3.6	4.91	7.01	4.91	5.05	1.13	2.44	4.96	2.35
K2O	5.72	2.07	4.45	3.77	3.02	3.52	3.93	6.3	6.5	3.15	1.4
P2O5	0.112	0.106	0.067	0.117	0.078	0.065	0.089	0.032	0.189	0.054	0.166
Ignition Loss	1.97	2.18	2.26	2.02	0.92	1.12	1.43	1.98	0.98	1.13	1.8
TOTAL	100.49	100.04	100.06	100.35	100.04	99.71	99.83	99.21	99.72	100.35	99.52
Zr	180	100	440	450	460	400	480	450	130	200	110
Cr	10	45	15	25	30	25	9	9	25	25	190
Ti/Zr	18.65	55.15	7.77	8.53	6.52	6.29	6.99	7.06	29.98	11.69	111.16
Ti/Cr	335.72	122.56	227.81	153.47	99.92	100.72	373.02	353.04	155.87	93.52	64.37
TiO2/P2O5	5.00	8.68	8.51	5.47	6.41	6.46	6.29	16.56	3.44	7.22	12.29
Cr/P2O5	89	425	224	214	385	385	101	281	132	463	1145

SAMPLE No	114019	114020	105665	105671	105673	105677	105683	105690	105694
LITHOLOGY	Andesite lava	Andesite lava	Mafic diorite	Dacite lava	Diorite	V Altd Conglo	Diorite	Qt-tourm Altd	Diorite
SiO2	57.5	55	55.8	71	58	83.8	55.6	72	60.7
TiO2	0.53	0.64	0.72	0.41	0.64	0.45	0.75	0.59	0.71
Al2O3	15.7	15.7	15	14	16.7	8.95	17.4	16.4	14.8
Fe2O3	7.29	9.49	9.54	3.32	6.53	2.69	8.37	1.98	7.35
MgO	4.8	3.75	5	0.95	2.5	1.7	2.2	3	3.5
CaO	3.99	4.32	6.97	0.06	3.19	0.24	3.04	0.64	5.3
Na2O	7.39	8.9	2.71	4.26	4.42	0.32	8.69	0.43	2.72
K2O	0.93	0.04	2.3	3.97	3.36	0.05	2.19	0.14	2.89
P2O5	0.119	0.137	0.146	0.055	0.152	0.044	0.169	0.034	0.163
Ignition Loss	2.4	2.19	2.01	2.06	2.67	1.22	1.78	1.74	2.19
TOTAL	100.65	100.17	100.20	100.09	100.18	99.46	100.19	96.95	100.32
Zr	100	65 ~~95~~	100	380	120	140	110	120	150
Cr	140	20	110	10	50	45	20	50	70
		57.03							
Ti/Zr	31.77	~~40.39~~	43.16	6.47	31.97	19.27	40.88	29.46	28.38
Ti/Cr	22.70	191.84	39.24	245.00	76.74	59.95	224.61	70.74	60.81
TiO2/P2O5	4.45	4.67	4.93	7.45	4.21	10.23	4.44	17.35	4.36
Cr/P2O5	1176	140	753	182	329	1023	118	1471	429

TABLE 2: Comparison of analyses of Deloraine and Preston diorites									
	DELORAINE	DELORAINE	DELORAINE	DELORAINE		PRESTON	PRESTON	PRESTON	PRESTON
SAMPLE No	105665	105673	105683	105694		77998	77952	68328	78939
LITHOLOGY	Mafic diorite	Diorite	Diorite	Diorite		Diorite	Diorite	Diorite	Diorite
SiO2	55.8	58	55.6	60.7		57.00	64.1	64.3	67.1
TiO2	0.72	0.64	0.75	0.71		0.84	0.85	0.84	0.92
Al2O3	15	16.7	17.4	14.8		19.90	15.7	15.4	14.8
Fe2O3	9.54	8.53	8.37	7.35		7.12	7.83	7.47	6.86
MgO	5	2.5	2.2	3.5		2.00	2.32	2.25	1.2
CaO	6.97	3.19	3.04	5.3		4.06	0.55	0.86	0.48
Na2O	2.71	4.42	8.69	2.72		5.56	3.92	4.17	4.92
K2O	2.3	3.36	2.19	2.89		3.07	4.27	4.21	3.21
P2O5	0.146	0.152	0.169	0.163		0.24	0.37	0.33	0.45
Ignition Loss	2.01	2.67	1.78	2.19		2.95	2.91	2.47	1.8
TOTAL	100.20	100.16	100.19	100.32		100	100	100	100
Zr	100	120	110	150		117	185	182	213
Cr	110	50	20	70					
Ti/Zr	43.16	31.97	40.88	28.38		43	27.5	27.7	25.9

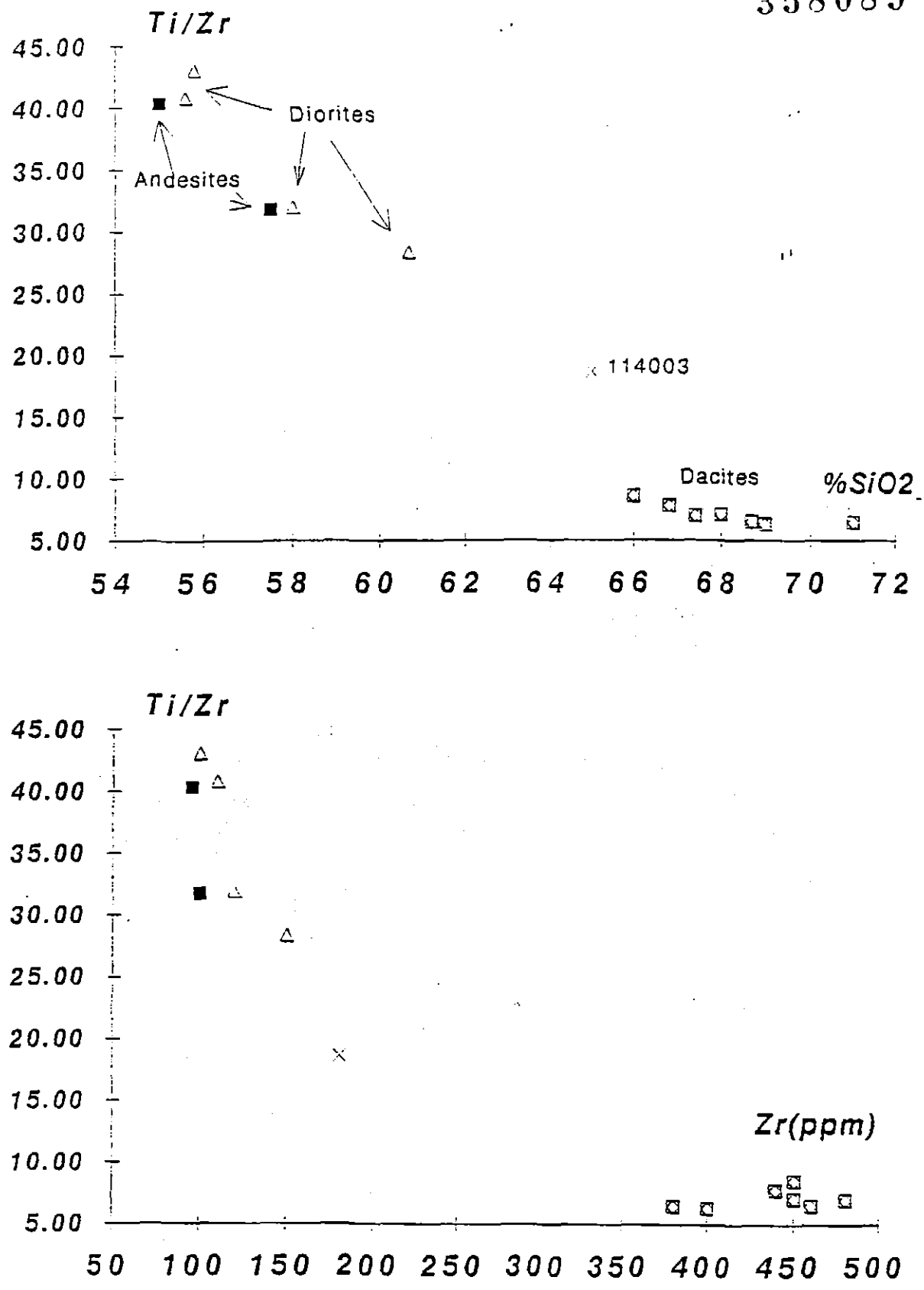

Figure 1: Ti/Zr - SiO2 (top) and Ti/Zr - Zr plots showing compositional spreads of the analyzed samples from EL 16/90. Note that intrusive dacite 114003 does not plot together with the other dacites (intrusive or extrusive) but falls at the SiO2-rich extrapolation of the compositional spread of the Deloraine diorites.

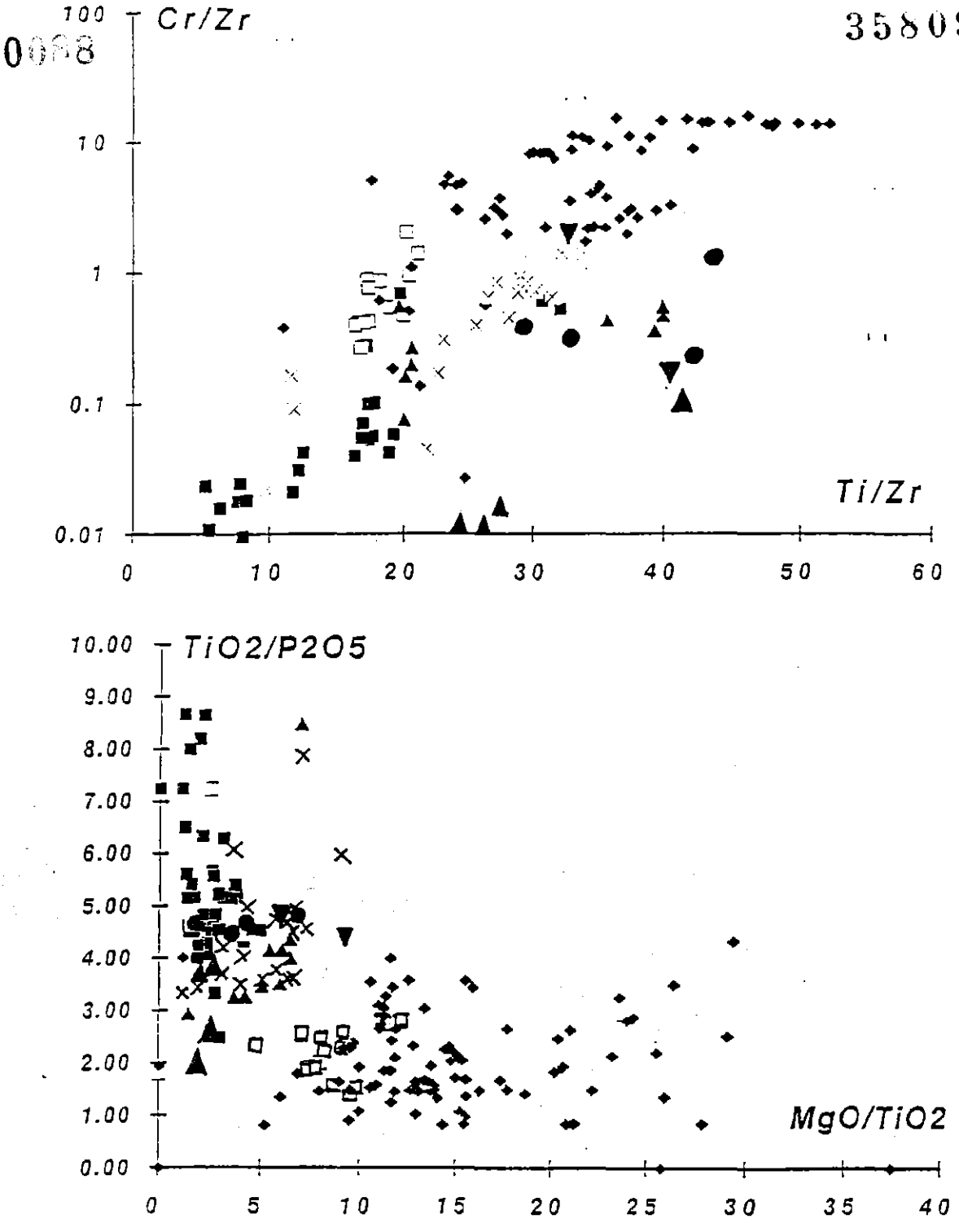

Figure 2: Element discrimination diagrams for Mount Read Volcanics showing compositional fields for :
Filled Diamonds = CVC Gp 1: Open Squares = CVC Gp 2
Crosses = Que Footwall Andesites Filled Squares = Hellyer Basalts
Small Filled Triangles = Mt Cattley MRDD-1 and 2 lavas
Large Filled Triangles = Preston diorites
Filled Circles = Deloraine diorites
Inverted Triangles = Quamby Brook andesites

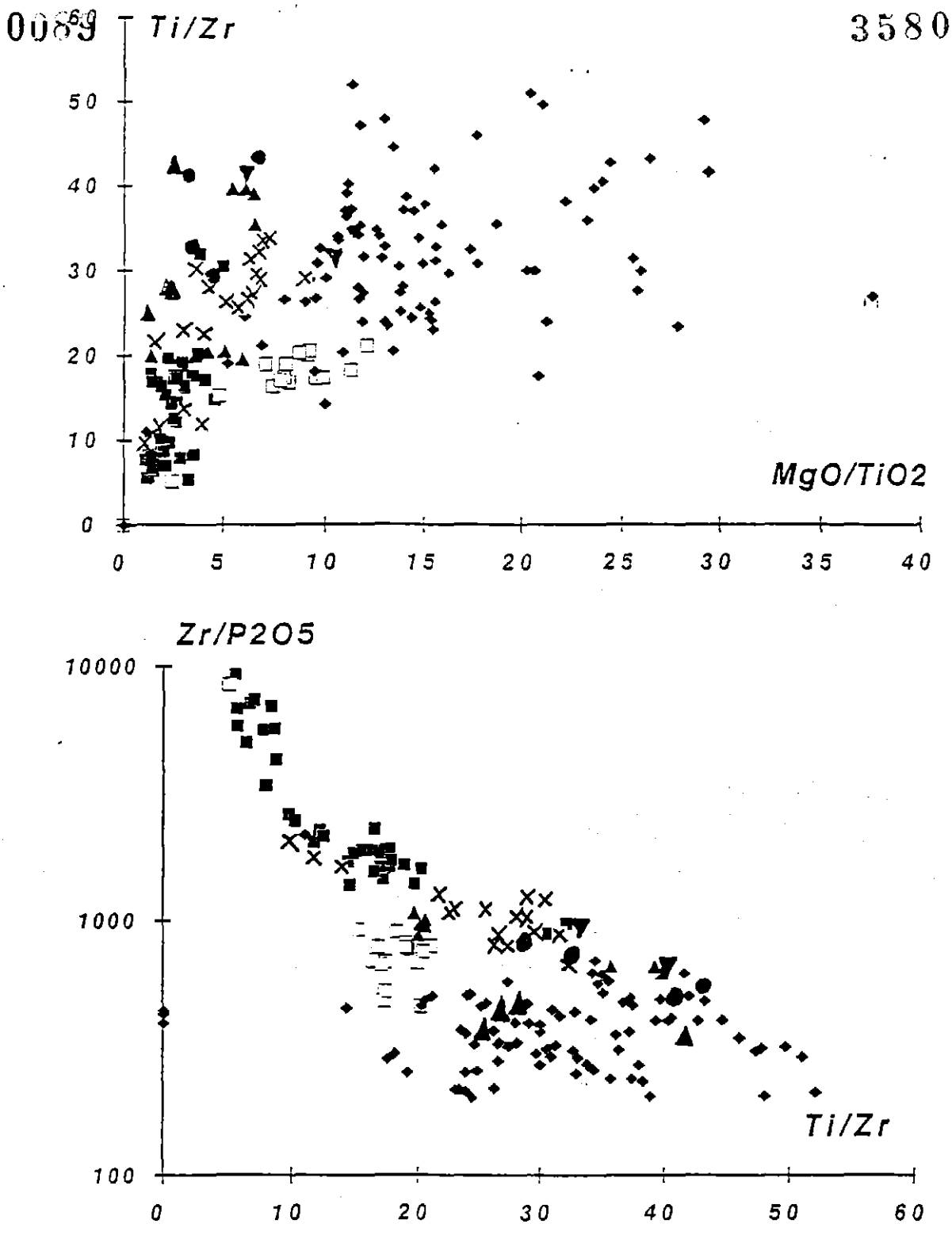

Figure 2 (continued): Element discrimination diagrams for Mount Read Volcanics showing compositional fields for :
Filled Diamonds = CVC Gp 1: Open Squares = CVC Gp 2
Crosses = Que Footwall Andesites Filled Squares = Hellyer Basalts
Small Filled Triangles = Mt Cattley MRDD-1 and 2 lavas
Large Filled Triangles = Preston diorites
Filled Circles = Deloraine diorites
Inverted Triangles = Quamby Brook andesites

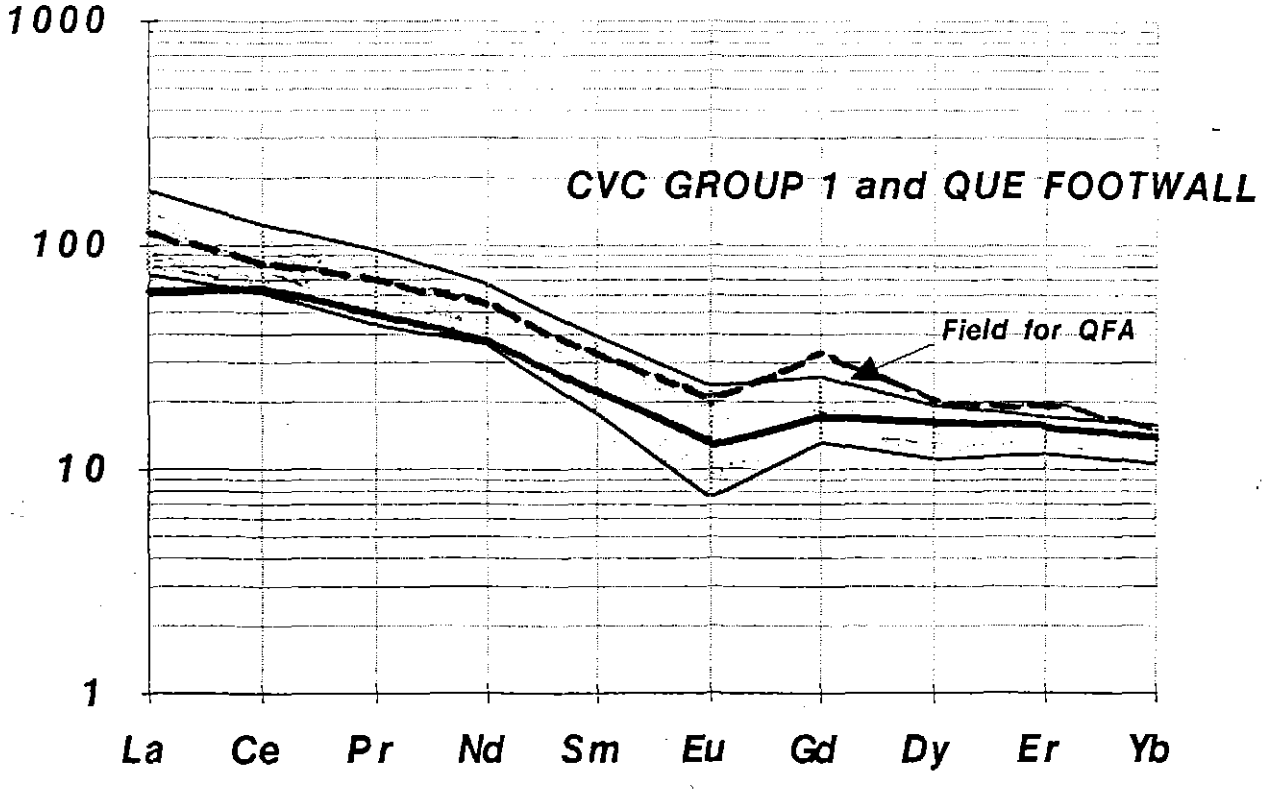

Figure 3: REE patterns for two diorites from the Preston EL near the Leven Gorge, showing the similarity to the field of REE patterns for the Que Footwall andesites

SAMPLE NUMBER: Deloraine 105665

SUMMARY: This is a relatively coarse-grained plutonic quartz gabbro or mafic diorite intrusive with a low greenschist facies metamorphic assemblage.

HAND SPECIMEN:

This is a holocrystalline dioritic intrusive rock with altered plagioclase and chloritized mafic phenocrysts up to 4mm long.

THIN SECTION:

This is a holocrystalline dioritic intrusive rock composed dominantly of 1-4mm long prisms of altered plagioclase and augite, with relatively abundant interstitial quartz (5-10 modal%) and myrmekite. The plagioclase crystals show ghost compositional zoning overprinted by fairly intense sericite alteration that renders it impossible to determine what percentage of the feldspar was plagioclase and what was Kspar. Ghost zoning and twinning suggests plagioclase was dominant. Clinopyroxene phenocrysts are quite large (2-4mm average), well-formed and appear to have crystallized largely before plagioclase. They are often twinned and fresh with cloudy finely-sieved rims showing incipient reaction and breakdown, or else are entirely recrystallized to a mosaic of actinolite that varies from equigranular to fibrous.

Between the large plagioclase and augite grains is a relatively large amount of interstitial primary quartz, sometimes showing myrmekitic intergrowth with altered feldspar. Primary ragged edged FeTi oxide grains are never bigger than 1mm across, and make up about 1-2 modal% of this rock.

This rock is an intrusive mafic diorite or quartz gabbro (leucogabbro), with a grainsize indicative a derivation from a plutonic intrusion rather than a dyke. It is more mafic than other Cambrian intrusives such as the Murchison Granite, and should be analyzed. The strong alteration of plagioclase and the low greenschist facies metamorphic assemblage prove a Cambrian, rather than a Devonian age.

SAMPLE NUMBER: Deloraine 105668

SUMMARY: This is a solution-brecciated fine sandstone derived entirely from Precambrian quartz-muscovite metapelites.

HAND SPECIMEN:

This is a dark grey monomict almost aphyric lava breccia with possibly false brecciation associated with strong calcite alteration.

THIN SECTION:

This sample is definitely a false-breccia, but not a lava breccia. Rather, it is a 'false-breccia'-textured sandstone that has been fragmented and soaked with silica-rich hydrothermal solutions. The original rock was a dark fine-grained sandstone derived almost entirely from Precambrian pelitic metamorphic detritus, including abundant quite large muscovite flakes and polycrystalline strained quartz. Lithic clasts of quartz-muscovite schist are also common, but rarely larger than 1mm across. The matrix of the sandstone is silty and very dark, perhaps due to abundant fine-grained carbonaceous material.

The groundmass of this sample is a very fine-grained but heterogeneous quartz-feldspar mixture with exceptionally convoluted grains boundaries between adjacent tiny grains. It is much cleaner and clearer than the matrix of the fragments, lacking the finely dispersed carbonaceous material. In some places the original sandstone appears to have been soaked by silica-rich solution, leading to recrystallization of the matrix, but no change to the detrital muscovite flakes.

This sandstone differs from the others examined for this report in that it appears to contain no volcanic detritus whatsoever. I have seen few sandstones that match this in the Mount Read Volcanics. Although many Animal Creek Greywackes contain abundant detritus from Precambrian sources, they usually contain some volcanic component. I have not examined petrographically many Southwell Subgroup greywackes, but understand that they include both volcanogenic and volcanic-poor sandstones.

SAMPLE NUMBER: Deloraine 105671

SUMMARY: This was a plagioclase+augite+quartz-phyric glassy dacitic lava identical in most respects to samples 114008 and 114009, and almost certainly derived from the same unit.

HAND SPECIMEN:

This is a brown plagioclase+mafic+quartz-phyric felsic lava.

THIN SECTION:

This rock is essentially identical to sample 114009, with a few very minor differences notably:

1: the chloritized augite phenocrysts in this sample are rather less common than in 114009;

2: chlorite is better developed in this sample, as small patches overprinting groundmass

3. the groundmass, originally glassy, has devitrified to a quartz-albite mosaic in which the albite is rather pinkish.

There is little doubt that this rock comes from the same unit as 114009 and 114008, and is a dacitic lava.

358096

SAMPLE NUMBER: Deloraine 105673

SUMMARY: This is an intrusive plagioclase-phyric diorite

HAND SPECIMEN:

This is a brownish andesitic shallow intrusive with common phenocrysts of strongly altered plagioclase and some chloritized mafic phenocrysts. Pale yellow epidote surrounds many altered phenocrysts.

THIN SECTION:

This is a holocrystalline dacitic or andesitic rock composed of around 5-7 modal% of strongly altered albitized plagioclase phenocrysts that are mainly 1-2mm long blocky prisms with strong sericite alteration and also abundant pale green chlorite and occasional epidote inclusions. Far less abundant were euhedral mafic phenocrysts, mainly around 1 - 1.5mm long that are totally altered to greenish yellow chlorite. These often contain well-formed but leucoxenitized former FeTi oxide microphenocrysts.

The groundmass of this rock was clearly holocrystalline and made up of dominantly blocky to tabular prisms of albitized plagioclase intergrown with anhedral albite and small altered FeTi oxide grains and chlorite after small prismatic mafics. Small clots of secondary quartz are quite common in the groundmass, and chlorite and granular patches of epidote overprint areas of groundmass; the epidote is commonly intergrown with patchy hematite.

This rock was an intrusive diorite, and is rather similar to 114003.

SAMPLE NUMBER: Deloraine 105677

SUMMARY: This was a conglomerate derived largely from pelitic Precambrian metamorphics (quartzites); it suffered strong tourmaline-quartz alteration during granulation and recrystallization of the matrix; whether this unusual alteration is associated with the adjacent Cambrian diorite, or with a hidden Devonian granitoid, remains unanswered.

HAND SPECIMEN:

This is a conglomerate containing clasts of quartzite and other fine-grained siliceous rocks to at least 1cm long, and abundant interstitial black chlorite.

THIN SECTION:

This sample in thin section shows a typical conglomeratic fabric, being composed mainly of large (to 1cm across) subrounded clasts of foliated micaceous quartzite that show 120° triple junctions between adjacent quartz grains, and are clearly Precambrian derived. Strained quartz and subordinate aligned plates of muscovite make up the clasts, which were originally quartzose muddy sandstones. Discrete large grains of fractured and strained reef(?) quartz are also present, as well as a few clasts of fine-grained silicified shales or siltstones. A single clast of quartz-phyric formerly glassy felsic lava is present, in which the groundmass has totally devitrified to very fine-grained quartz- feldspar mosaics. Margins of all clasts have undergone some pressure solution and possibly granulation, and subgrain recrystallized, almost chalcedonic quartz forms rims many clasts.

The matrix between the clasts in this rock is rather spectacular, being composed of dense felted masses and rosettes of strongly pleochroic tourmaline showing mid-olive green to colourless pleochroism. It is intimately intergrown with silica cement, and has clearly crystallized from fluids that soaked the matrix of this rock, possibly during granulation - deformation of the rock. The intense tourmaline-quartz alteration would almost certainly be related to Devonian granite hydrothermal systems according to conventional wisdom, although the location of this sample at the margin of a relatively coarse-grained dioritic intrusion of undoubted Cambrian age might suggest that such an implication is premature, and that tourmaline alteration could also be associated with Cambrian granitoid magmatism in W Tasmania.

SAMPLE NUMBER: Deloraine 105680

SUMMARY: This is a skarn-like rock composed of bands of green amphibole, chlorite, magnetite and hematite, quartz and Kspar; it was produced by strong hydrothermal alteration of a very deformed volcanogenic sandstone in a fault or shear zone, and may be related to a granite hydrothermal system.

HAND SPECIMEN:

This is an intensely altered banded dark green metavolcanic rock with irregular bands of hematite and/or magnetite crossing the sample.

THIN SECTION:

This is an exceptionally complex rock texturally and mineralogically. Only in one or two places in the section is there evidence preserved alluding to the nature of the protolith. I am almost positive that this rock was a fairly coarse-grained volcanogenic sandstone or lithic tuff, or else a very polymictic lava breccia. The few relic areas of least-altered rock are quite different albite-phyric felsic lava. However, quite common broken and sericitized discrete detrital grains (phenocrysts) of albite suggest that this was a volcanogenic sediment rather than a lava breccia.

The rock has been intensely altered, and the primary texture obliterated by a banded, heterogeneous alteration assemblage most reminiscent of low-temperature skarn. Subparallel bands mainly less than 5mm wide, of bright green chlorite, yellow-red oxychlorite, deeper green actinolite or actinolitic hornblende, sericitized albite and bands of intergrown magnetite, hematite and quartz, and magnetite and Kspar dominate the rock. Quite well-crystallized sphene occurs in both actinolite and chlorite. Magnetite(?) and more bladed hematite are the most coarse-grained minerals in the rock and occur intergrown with quartz and Kspar in bands and patches. Remarkably convoluted and very narrow veinlets of albite and quartz broadly parallel the mesoscopic banding, but occasionally transect it, and suggest that recrystallization of this rock occurred in a very plastic and highly deformed state. My summation is that this rock was a volcanogenic sandstone in a fault or shear zone that was subsequently permeated by high-temperature (relative to the usual prehnite-pumpellyite facies assemblages) solutions which soaked through the strongly deformed rock producing skarn-like waves and bands of minerals atypical of the regional metamorphism affecting this region, and possibly related to a granite hydrothermal system.

SAMPLE NUMBER: Deloraine105683

SUMMARY: This is a relatively coarse-grained slowly-cooled dioritic intrusive similar to 105665.

HAND SPECIMEN:

This is a dark green holocrystalline andesite or diorite dominated by 1-2mm long pale green altered plagioclase phenocrysts.

THIN SECTION:

This rock is a texturally and mineralogically very well-preserved dioritic intrusive dominated by abundant and large plagioclase phenocrysts and subordinate augite phenocrysts in a relatively coarse-grained groundmass of interlocking albite and augite. The plagioclase phenocrysts have been albitized and are mainly quite large 1-4mm-long tabular prisms with ragged grain margins that are intergrown with the groundmass; they commonly include very long narrow crystals of apatite. These are slightly to intensely sericite-altered. Fresh, clear augite phenocrysts make up about 3-5 modal% of this rock, and occur as intergrown crystals with small albite inclusions.

The groundmass of this sample is quite coarse-grained (o.2-0.5mm long crystals) and composed of anhedral to tabular plates of albite intergrown with stubby but well-formed augite crystals, anhedral to interstitial olive- to clear pleochroic hornblende and euhedral equidimensional prisms of FeTi oxides. Overprinting areas of groundmass is a complex assemblage of secondary minerals, including abundant pale green chlorite, bright blue-green pumpellyite and very minor calcite and epidote. Colourless prehnite occurs as fans and patches in chlorite, but is not common. The metamorphic assemblage is typical of the prehnite-pumpellyite facies of burial metamorphism of mafic and andesitic compositions.

This sample is quite clearly an intrusive and slowly-cooled diorite; mineralogically, it is quite reasonable to argue that it could be a slower-cooled variant of the same magma that crystallized to form 114019 (and probably 020), and it is obviously similar to diorite 105665.

SAMPLE NUMBER: Deloraine A105690

SUMMARY: This rock was originally a plagioclase-phyric dacitic lava that has suffered intense recrystallization with development of dominant quartz-sericite-tourmaline alteration assemblages. This may be related to a Devonian granite alteration system.

HAND SPECIMEN:

This is a speckled holocrystalline diorite(?) with several large blebs of black chlorite and tourmaline, and abundant smaller spots of paler chlorite(?) in a pinkish groundmass.

THIN SECTION:

This sample is extensively altered and recrystallized, to the extent that few clues as to the identity of the original rock remain. In the least altered areas of this section, large ghost plagioclase phenocrysts are still evident although totally replaced by sheaves of sericite; relic compositional zoning is still preserved, as reflected in growth orientations and intensities of sericite alteration. Most of these phenocrysts reach at least 2mm across and are well-formed prisms. In most of the rock the former plagioclase phenocrysts have been replaced by coarse-grained sericite, but in addition have suffered so much overgrowth of sericite that crystal outlines are not very evident, and now resemble semi-rounded blebs of sericite. The groundmass in this least-altered section of rock is clearly a fine-grained, possibly devitrified glassy material, ruling out that the rock is holocrystalline, as was judged from hand specimen examination. Throughout most of this sample, the groundmass has extensively recrystallized to relatively coarse-grained sugary quartz aggregates that show intimately sutured grain boundaries and exceptionally variable grainsize over short distances. Sericite is intergrown with the quartz, and is rather dusty cream-pink coloured, probably producing the pink matrix colour in the hand specimen. Sericite most commonly occurs as rosettes which show a sudden compositional change to very acicular needles of pale blue-green tourmaline on the outer margins of the rosettes, where the rosettes are intergrown with quartz. Several large patches (to 5mm across) composed of intergrown sheaves of tourmaline with distinctive blue - olive - clear pleochroism are present, and tiny tourmaline needles are common in secondary quartz.

This sample was probably originally a plagioclase-phyric dacitic lava. It has suffered intense recrystallization dominated by silica-sericite - tourmaline replacement of the devitrified glassy groundmass. Tourmaline alteration in my experience is associated with granite-related Devonian alteration in W Tasmania, and is not associated with the Cambrian hydrothermal systems responsible for the major VMS deposits.

SAMPLE NUMBER: Deloraine 105694

SUMMARY: This sample is a plutonic mafic diorite with augite replaced by actinolite; it is definitely derived from the same intrusion as 114665 from which it shows only trivial petrographic differences.

HAND SPECIMEN:

This is a speckled holocrystalline medium-coarse grained dioritic intrusive rock with strongly altered pale green feldspars and chloritized mafics in a brick red groundmass.

THIN SECTION:

This sample is a leucogabbro or mafic diorite almost identical to sample 114665. It was originally composed of quite large well-formed plagioclase (to 5mm across) and augite (1-4mm) crystals with abundant interstitial myrmekitic intergrowths and primary interstitial quartz. The main differences from 114665 are that:

1: this sample has totally actinolite-altered augite, unlike the commonly fresh augite in 11465;

2: epidote is a common alteration phase in this sample, but rare or absent in 665; this reflects the release of Ca from augite as it breaks down in this sample, and is relocated in epidote;

3: this sample has quite reddish-stained sericite in the myrmekite in the interstitial areas, and may indicate former Kspar rather than albite;

4: this rock certainly has more interstitial quartz and quartz-rich myrmekite than 665, sending it off more towards diorite than gabbro. It is however, unambiguously derived from the same body as 665, given your map and my petrographic description.

SAMPLE NUMBER: Deloraine 114003

SUMMARY: This is a plagioclase-phyric shallow-intrusive acid andesite or possibly dacite, unlikely to be related to the more mafic and clearly intrusive 105665 from nearby in this mapped intrusive unit.

HAND SPECIMEN:

This is a brown plagioclase-porphyritic felsic lava or fine-grained shallow intrusive rock.

THIN SECTION:

This is a plagioclase-phyric andesitic to dacitic rock composed of around 10-15 modal% of quite large (to 3mm long) albitized plagioclase phenocrysts that are mainly tabular prisms containing abundant granular epidote inclusions. The plagioclase phenocrysts occur as commonly in multi-crystal clots as individually. A few tiny chloritized mafic phenocrysts may have been augite, but constituted less than a fraction of one modal% of the rock.

The groundmass of this sample has a texture that is rather difficult to diagnose as to whether it is intrusive or extrusive. It is made up of anhedral plates of albite intergrown with less abundant well-formed laths, and common long narrow laths of chloritized augite or hornblende, and relatively large FeTi oxide microphenocrysts. My feeling is that this is a shallow intrusive rock, as the groundmass might have been expected to have a significant glass (albeit devitrified) if it were extrusive. The abundant epidote in this rock suggests to me that the rock was andesitic (ie plenty of Ca). It differs strongly, however, from 105665 from nearby in the same intrusion, in being more felsic, and much finer-grained. I would be surprised if these rocks were from the same intrusive body, unless it was quite strongly fractionated internally.

0191

SAMPLE NUMBER: Deloraine 114004

SUMMARY: This is a fairly coarse, dominantly volcaniclastic sandstone derived largely from felsic and intermediate volcanics, but including a clear Precambrian-derived component in the form o quartz-mica schists.

HAND SPECIMEN:

This is a mid-grey rather crystalline rock composed of abundant feldspar, fresh mafic phenocrysts and minor quartz.

THIN SECTION:

This sample is seen in thin section to be a totally framework supported, well-sorted, volcanogenic coarse sandstone containing virtually no matrix between 0.5-2mm long detrital grains of feldspar, quartz and mafics. By far the dominant detrital component is albitized plagioclase, that occurs as blocky sericitized phenocrysts with minimal rounding. Quartz grains are common, and are clearly derived from felsic volcanics or pyroclastics, as they often preserve a phenocryst face and have even extinction. They make up around 8-12 modal% of this sandstone. Two types of mafic grains are present. Twinned augite phenocrysts, probably from andesitic volcanics judging by the size and shape, are replaced by pale green fibrous actinolite and chlorite, but twin planes are commonly preserved. Far more common are phenocryst fragments of olive - pale brown - clear pleochroic hornblende, that again probably derive from andesitic lavas or shallow intrusives. Several lithic clasts composed of quartz-muscovite schist and quartz-biotite schist contrast with the dominant volcanic-derived detritus making up this sample, and are clearly of Precambrian derivation.

This rock has virtually no matrix, and framework grains abut and intrude each other indicating strong pressure solution occurred during lithification of this sample. Actinolite and chlorite, the latter in some quite large patches, occurs along grain boundaries, and indicate a low greenschist facies of metamorphism.

01[illegible]

SAMPLE NUMBER: Deloraine 114005

SUMMARY: This sample was a feldspar+quartz+augite-phyric dacitic to rhyodacitic lava with a glassy groundmass that has devitrified.

HAND SPECIMEN:

This is a brown felsic lava with phenocrysts of altered feldspar and quartz.

THIN SECTION:

This sample was clearly a glassy felsic lava with phenocrysts of albitized plagioclase, quartz, altered augite and leucoxenitized FeTi oxides. Former plagioclase phenocrysts, up to several mm long, are mainly well-formed tabular prisms with a sprinkling of sericite and chlorite. They make up around 5 modal% of this lava. Quartz phenocrysts are much less modally abundant, and are mainly rather rounded phenocrysts, some up to 3mm across. Former small augite phenocrysts make up around 1-2 modal% of this sample and are totally altered to yellow-green chlorite. Small microphenocrysts of FeTi oxide are not uncommon, and are altered to leucoxenitic material. Several quite large zircon microphenocrysts are present, as well as common small zircons.

The groundmass of this rock was originally glassy. It has devitrified to a mosaic intergrowth of quartz and albite, and fine-grained chlorite is sprinkled throughout the groundmass, occasionally occurring in dense clumps. Meandering veinlets of quartz, showing internal strain lamellae, cut the rock, but are always less than 2mm wide.

This dacitic lava is identical to 114008 and 9, and from the map is certainly part of the same lithostratigraphic unit.

SAMPLE NUMBER: Deloraine 114006

SUMMARY: This rock is a plagioclase+augite+quartz porphyritic intrusive dacite with strong similarities to the Bond Range 'porphyry'.

HAND SPECIMEN:

This is a well-preserved brown feldspar+mafic+quartz-phyric massive dacitic lava.

THIN SECTION:

This sample is a beautifully preserved rhyolitic to dacitic rock composed of around 5-8 modal% of plagioclase phenocrysts and a few modal% of each of quartz and chloritized mafics. The plagioclase phenocrysts are entirely albitized blocky to tabular prisms, up to 4mm across, and many are partially to totally replaced by fine-grained sericite. Quartz phenocrysts are anhedra and quite rounded and reacted. Former mafic phenocrysts were always less than 1mm long,and have shapes indicative of augite precursors. They have been replaced by strongly pleochroic green chlorite and possibly minor fibrous actinolite. Equigranular microphenocrysts of altered FeTi oxide are not uncommon, but less modally abundant than the altered mafic phenocrysts.

The groundmass of this rock was undoubtedly holocrystalline and glass-free. It is composed of interlocking laths of albitized plagioclase and subordinate anhedral quartz, with small chloritized augite crystals and tiny leucoxenitized FeTi oxide grains scattered liberally throughout the groundmass. This rock is probably dacitic in composition, and is clearly intrusive. It shows strong similarities to the Bond Range 'porphyry' and is probably from a similar intrusive sheet. It could equally as well be an intrusive analogue of lava 114009.

SAMPLE NUMBER: Deloraine 114007

SUMMARY: This is a plagioclase+quartz+augite+hornblende-phyric dacitic lava very similar to 114008 and 9.

HAND SPECIMEN:

This is a dark grey-green porphyritic felsic lava with phenocrysts of altered feldspar, quartz and altered mafics.

THIN SECTION:

This is a very well-preserved formerly glassy lava, broadly similar to 114008,9 and 5. It is composed of around 15 modal% of albitized plagioclase phenocrysts that are slightly sericite-altered, generally blocky crystals, up to 4mm across. These sometimes occur in multi-crystal clots; all are slightly rounded at the crystal margins. Quartz phenocrysts, mainly 1-2mm across, are also rounded and reacted, and all are fractured internally; they make up less than 5 modal% of this rock. Former mafic phenocrysts are of two sorts. The first is entirely replaced by calcite and subordinate chlorite, and could have been either augite or less likely perhaps, fayalitic olivine. These are small (<1mm long) prisms that make up less than 2 modal% of the rock. More abundant, perhaps making up around 4-6 modal% of this sample, are former mafic phenocrysts composed of strongly pleochroic green-clear-pale brown primary hornblende with intergrown chlorite and golden granular epidote. Leucoxenitized former FeTi oxide microphenocrysts are common, frequently intergrown with former augite. Small zircons are notable, and a difference of this rock from the other felsic lavas described herein is the presence of quite common apatite microphenocrysts.

The groundmass of this sample was originally glassy. It has devitrified to a very fine-grained intergrowth of quartz and feldspar that shows a mottled, 'snakeskin' texture defining a weak flow banding clearly not apparent in the hand specimen.

This is a dacitic lava that is essentially identical to the others described herein, although it contains slightly more apatite and hornblende than samples such as 114008 and 9. This may mean that it is slightly less evolved..

SAMPLE NUMBER: Deloraine 114008

SUMMARY: This sample was a plagioclase+augite+quartz-phyric dacitic lava, identical to 114009 except that this sample has a more silica-chlorite-altered formerly glassy groundmass.

HAND SPECIMEN:

This is a grey-green feldspar-phyric felsic lava with a more chloritic groundmass than some of the other felsic lavas examined in this group (eg 114009).

THIN SECTION:

This was originally a plagioclase+augite+quartz-phyric dacitic lava. It consists of around 10 modal% of quite large blocky (1-4mm) prismatic phenocrysts of albitized plagioclase that often have chloritized melt inclusion trains and sericite speckling. Chloritized augite phenocrysts are mainly less than1mm long, well-formed and make up only bout 1 modal% of this rock. Totally leucoxenitized small FeTi oxide microphenocrysts often occur adhering to augite phenocrysts. Quartz phenocrysts, also only 1-2 modal% of this lava, are rounded and reacted and occasionally contain small chloritized melt inclusions. This sample contains a notable abundance of well-formed prismatic zircon microphenocrysts, and would be useful for ion-probe dating when the opportunity becomes available.

The groundmass texture varies significantly across the slide, although always interpretable as derived from glass. It is mainly a patchy quartz-albite mosaic after devitrified glass, but varies in grainsize, and has an appearance suggesting to me some recrystallization or mild silicification. It is riddled with fine-grained chlorite, responsible for the grey-green colour of the hand specimen.

This sample is derived from essentially the same unit as 114009, and differs only in the different style of alteration of the formerly glassy groundmass.

SAMPLE NUMBER: Deloraine 114009

SUMMARY: The rock is a well-preserved plagioclase+augite +quartz+FeTi oxide-phyric, originally glassy dacitic lava.

HAND SPECIMEN:

This is a dark brown very well-preserved felsic lava with common phenocrysts of feldspar and chloritized mafics.

THIN SECTION:

This is a texturally very well-preserved plagioclase+quartz+augite - phyric dacitic to andesitic lava with a formerly glassy groundmass. It consists of around 5-8 modal% of albitized plagioclase phenocrysts, some of which reach 4mm long. Most are well-formed prisms with trains of chloritized melt inclusions. Quartz phenocrysts are smaller, much less abundant and often broken and/or highly reacted and resorbed. Former small mafic phenocrysts make up about 2-4 modal% of this rock. They are now replaced by chlorite, and are rarely longer than 0.5mm. Crystal shapes suggest augite precursors, although two crystals have shapes and appearances very suggestive of former biotite crystals. Leucoxene-altered FeTi oxide microphenocrysts are not uncommon, and often occur attached to small chloritized augite phenocrysts. Zircon grains (<<0.1mm long) are also quite common through the rock, usually in close association with the former FeTi oxide grains. Small cognate gabbroic inclusions composed of closely intergrown albite, chloritized augite and FeTi oxides are also present.

The groundmass of this sample was undoubtedly glassy. However, it has devitirified to a typical fine mosaic snowflake texture composed of intergrown quartz and albite, with a weak and discontinuous mesh of pale green chlorite pervading the groundmass.

The sample was clearly a plagioclase+augite+quartz+FeTi oxide-phyric dacitic lava, with minimal hydrothermal alteration and a weak burial metamorphic assemblage probably in the low prehnite-pumpellyite facies.

SAMPLE NUMBER: Deloraine 114010

SUMMARY: This was a plagioclase+sparsely augite+quartz-phyric dacitic lava with a totally glassy groundmass that has devitrified a quartz-albite mosaic intergrowth. It is essentially identical to 114008 and 114009.

HAND SPECIMEN:

This is a green-grey formerly glassy sparsely plagioclase-phyric felsic lava with a mottled streaky appearance on cut surfaces, typical of devitrifiec highly glassy felsic lavas.

THIN SECTION:

This sample is a beautifully preserved sparsely plagioclase+quartz+ augi -phyric dacitic lava in which the formerly entirely glassy groundmass has devitrified to an even-textured quartz-albite mosaic permeated by patchy meshes of very fine-grained chlorite. The rock is identical to 114009 and 114008, and is clearly derived from the same extrusive body or bodies.

SAMPLE NUMBER: Deloraine 114011

SUMMARY: This is a greenschist facies graded volcanogenic sandstone derived entirely from andesitic-felsic volcanic rocks, with a large crystal component, but few lithic clasts.

HAND SPECIMEN:

This is a dark green graded volcanogenic sandstone with beds from a few mm to more than 1cm thick, and several shaley interbeds.

THIN SECTION:

This is a relatively simple graded volcaniclastic sandstone, with most framework grains being detrital phenocrystal grains of blocky albite, volcanic quartz, and significantly, abundant olive-green pleochroic volcanic hornblende. Detrital quartz phenocrysts are mainly less than 1mm across and have reacted and patchy margins grading into the matrix. Plagioclase phenocrysts are totally sericitized, but have largely retained their phenocryst shapes, and could not hav been transported very far. Similarly, hornblende phenocrysts, mostly less than 1mm long, and showing strong olive-brown-clear pleochroism, could not have been far removed from their source. Leucoxenitized FeTi oxide microphenocryst are not uncommon in the coarser beds. No detritus derived from Precambrian pelitic metamorphics is present in this rock. Matrix constitutes only a few modal% of this sample, which is framework supported. Matrix is constituted by chlorite and green actinolite, indicating a greenschist facies of metamorphism. The discontinuous, notably graded bedding, the lack of rounding of plagioclase and hornblende that mechanically fragment with ease, and the mineralogy of this sample suggest that it formed as slumps from an andesite-dacite- rhyolite volcanic edifice. The abundant hornblende is interesting and invites comparison with hornblende+ plagioclase-phyric andesites that are common intruding Central Volcanic Complex sequences in the Crown Hill - Boulder Hill area. The greenschist facies of metamorphism is also notable.

SAMPLE NUMBER: Deloraine 114012

SUMMARY: This is a fine-grained immature volcanogenic sandstone composed dominantly of felsic ash that has devitrifed to quartz-albite±chlorite.

HAND SPECIMEN:

This sample is a pale olive green mottled fine volcanogenic sandstone.

THIN SECTION:

This sample is clearly a fine- to medium-grained volcanogenic sandstone The few modal% of detrital grain large enough to identify are angular albitize plagioclase derived from felsic volcanics. The remainder of this rock is composed of devitrified fine-grained glassy ash in which relic curved shard shapes are abundant. The glassy ash has devitrified to quartz, albite and yellowish chlorite. This sample was presumably erupted submarine, being enclosed as its source unit is (from the map) in sediments. Therefore, it wou be unlikely that the fine glassy ash from which this rock was largely constituted could have been deposited without reworking to some degree. I think, therefore, that it is best classified as a very immature tuffaceous fine sandstone, rather than a vitric crystal tuff. The presence of a number of quite large detrital sericite grains, possibly derived from the Precambrian pelitic metamorphics, supports this interpretation.

SAMPLE NUMBER: Deloraine 114013

SUMMARY: This is a volcanogenic sandstone derived entirely from a glassy, quartz and feldspar-phyric felsic volcanics and pyroclastics

HAND SPECIMEN:

This is a green-grey volcanogenic sandstone;maximum grainsize ~ 1mm.

THIN SECTION:

This is an immature, poorly-sorted volcanogenic sandstone, not nearly framework supported, composed of subequal proportions of detrital volcanic quartz and albite grains, often with one or more crystal faces preserved. Thes each make up around 7-10 modal% of the rock and average around 0.2-0.5mm diameter. Quartz phenocrysts also occur in felsic volcanic lithic clasts, usually less than 1mm across. Such porphyritic rhyolitic felsic clasts make up only about 2-4 modal% of the rock. Far more common as lithic clasts are devitrified aphyric pumice fragments that have in some instances, banded textures that appear ignimbritic. All formerly glassy fragments have devitrified to variably textured quartz-albite±chlorite fine-grained mosaics, the margins of which cannot be discerned from similar material in the matrix produced from devitrification of glassy ash. Chlorite patches and spots are no uncommon throughout the matrix, and in some cases probably represent alterec mafic phenocrysts.

This sample was derived entirely from felsic glassy volcanics, and contained a high proportion of juvenile glassy ash; no Precambrian-derived detritus is noticeable in this rock.

SAMPLE NUMBER: Deloraine 114014

SUMMARY: This is a juvenile coarse, poorly-sorted sandstone composed of crystal and lithic detritus derived from felsic volcanics set in a silty formerly glassy ash matrix that has devitrified and recrystallized as quartz and albite.

HAND SPECIMEN:

This is a reddish very poorly sorted volcanogenic coarse sandstone to conglomerate with some clasts of formerly glassy felsic lava up to several cm long.

THIN SECTION:

This is an exceptionally poorly sorted volcanogenic sandstone composed c detrital quartz and feldspar grains, and common clasts of felsic volcanic rocks. set in a matrix composed of abundant recrystallized ash and lesser comminuted detrital quartz and feldspar. Few of the former quartz or feldspar phenocrysts were larger than 2mm across. Feldspar is pinkish albitized plagioclase with slight to intense sericite speckling. Quartz phenocryst fragments are often quite angular and show marginal reaction with the groundmass that has clearly occurred during devitrification-recrystallization of the glassy matrix. Lithic clasts were almost all formerly glassy felsic lavas, some of which show good perlitic cracks and their own small albite phenocrysts. The largest clast is volcanogenic fine sandstone in which detrital muscovite probably from a pelitic metamorphic source is not uncommon.

The matrix of this sample was probably juvenile ash-dominated silt with a component of finely broken-up detrital feldspar and quartz. The matrix probably makes up around 30-40 modal% of this sample, and is recrystallized as quartz-albite ragged mosaics showing variable grainsize and texture over the slide. The matrix is overprinted in places by streaky green chlorite, or pools and patches of calcite. This rock is obviously derived from a local felsic volcanic source, and has a large formerly glassy ash component.

SAMPLE NUMBER: 114015

SUMMARY: This sample is a very juvenile tuffaceous siltstone originally composed of vitric shards and broken crystal fragments of quartz and albite, but with a minor component of detrital muscovite and zircon from pelitic metamorphics.

HAND SPECIMEN:

This is a massive dark green fine-grained volcanogenic siltstone or tuff.

THIN SECTION:

This is a fine-grained tuffaceous rock which is difficult to diagnose as a primary pyroclastic (vitric crystal tuff) or a slightly reworked tuffaceous sediment. The main identifiable framework grains are very angular small albite and volcanic quartz fragments, mainly less than 0.3mm long. In total, these make up around 5 modal% of this rock. Other grains able to be identified were relatively small often abraded (ie slightly rounded) zircon crystals, and a few strongly altered former FeTi oxide grains, and five or six detrital muscovite grains. These detrital(?) grains show no preferred concentration in layers, being scattered randomly throughout the rock.

The groundmass of this sample shows a distinctive texture indicative of its having originally been dominated by glassy ash. Abundant ghosts of former glassy shards are noticeable, being defined by concentrations of chlorite and secondary quartz and albite derived from devitrification of glass. Chlorite is quite abundant in the groundmass of this sample.

There is no doubt that this rock was composed probably more than 99% of glass and crystal fragments from felsic volcanic activity. However, the rare but significant presence of detrital muscovite and reworked zircons suggests to me that a small component derived from Precambrian pelitic metamorphics is intermixed in the glassy ash, and therefore the sample is better termed a felsic tuffaceous siltstone than a vitric crystal tuff.

SAMPLE NUMBER: Deloraine 114016

SUMMARY: This is a beautiful volcanogenic sandstone dominated by detrital volcanic albite and quartz with a silty ash matrix in which shard shapes are perfectly preserved.

HAND SPECIMEN:

This is a finely speckled medium-fine-grained volcanogenic sandstone with abundant detrital altered feldspar but indistinct bedding.

THIN SECTION:

This is a magnificent volcanogenic medium-grained and poorly sorted sandstone dominated by detrital crystals of dusty blocky albite, and only slightly less abundant volcanic quartz in a matrix dominated by silt-sized once-glassy ash containing abundant beautifully preserved glass shard shapes, despite devitrification to quartz and albite. Detrital albite grains have preserved broad phenocryst outlines, but are slightly rounded and have clearly been transported some distance. Quartz grains, however, are still angular, with phenocryst faces preserved. Totally altered equigranular former FeTi oxide phenocrysts are quite

common, but few convincing former mafic silicate phenocrysts were noted. Onl two or three lithic clasts are present, all being devitrified formerly glassy felsic lava. Matrix makes up about 15-20 modal% of this rock, and was clearly a silt-sized ash with minimal epiclastic (ie. reworked from existing volcanics) component. The rock is clearly derived entirely from a felsic volcanic source.

SAMPLE NUMBER: Deloraine 114017

SUMMARY: This is a distinctive sparsely plagioclase-phyric tholeiitic metabasalt identical to typical Motton Spilite, correlated with the Crimson Creek Formations basalts of the Dundas and Smithton Troughs. It has a low greenschist facies metamorphic assemblage.

HAND SPECIMEN:

This is a massive dark green very fine-grained sparsely plagioclase-phyric metabasaltic lava.

THIN SECTION:

This rock is a very sparsely plagioclase-phyric metabasalt with <1 modal% of plagioclase phenocrysts that are totally sericitized and rarely reach 1mm long set in a very uniform-textured groundmass composed of an intergranular to subophitic intergrowth of actinolitized augite and albitized plagioclase, with brown devitrified glassy mesostasis and tiny leucoxene-altered FeTi oxide granules throughout. Groundmass plagioclase laths are also largely altered to sericite, and narrow veinlets of sericite and chlorite cut the rock. Chlorite is notably sparse in the groundmass, in which pale green actinolite is the dominant mineral, after augite plates. A low greenschist facies assemblage (actinolite-albite-sericite-chlorite) is indicated.

This sample is a distinctive metabasalt, very different from any basalts that have seen from the Mount Read Volcanics. However, it shows striking similarities in texture and mineralogy to typical Crimson Creek Formation-correlated "Motton Spilites' from the Dial Range Trough. These are tholeiitic rift tholeiites and belong to the passive margin sequence onto which the ophiolites and Mount Read Volcanics were emplaced and erupted tens of millions of years after eruption of the rift tholeiites (see Crawford and Berry 1991).

SAMPLE NUMBER: Deloraine 114018

SUMMARY: This is a poorly sorted volcanogenic sandstone with abundant detritus derived from the mafic-ultramafic complexes (ophiolites) of W Tasmania, as well as abundant andesitic and more felsic rock fragments typically Mount Read Volcanics in nature. It presumably correlates with, or post-dates the Animal Creek Greywacke of further west.

HAND SPECIMEN:

This is a massive dark green volcaniclastic sandstone containing clasts of very fine-grained volcanic rock to around 0.7cm long in a dense sandy to silty matrix.

THIN SECTION:

This is a poorly-sorted immature volcanogenic sandstone composed of diverse angular to subrounded fragments of mafic and felsic volcanics that are framework supported, with minimal matrix. Some clasts are up to 1cm long, although most are 0.5-2mm long. Strong pressure solution has eliminated matrix and indented lithic clasts into one another. Clasts include: (i) some very distinctive rocks with dominant tremolite, both as pseudomorphs after orthopyroxene and after glass, and no plagioclase; these are clearly boninitic, and derived from the 'ophiolites', such as at Heazlewood and Serpentine Hill. A few coarse-grained chlorite-tremolite-albite fragments are definitely gabbroic, and are also very similar to gabbros in the ophiolites. Large red euhedral chromites further support the presence of a significant ophiolite-derived component in this sandstone. (2) Most other clasts are probably andesitic, and show abundant well-formed small prismatic plagioclase phenocrysts, mostly altered to sericitic aggregates, in devitrified glassy groundmasses. Former augite phenocrysts are chlorite altered and variably abundant, but always less modally abundant that plagioclase. Blocky albitized plagioclase phenocrysts, some up to 2mm across occur as discrete detrital grains, mainly strongly sericite altered. These are almost certainly derived from felsic volcanics or tuffs.

This volcanogenic sandstone is interesting in that it contains abundant material sourced from the ophiolites (mafic-ultramafic complexes), as well as material derived in large part from the andesitic and more felsic typical Mount Read Volcanics. It lacks any component from Precambrian sources, and in this respect differs strongly from typical Animal Creek Greywacke. However, as the Animal Creek Greywacke appears to be the first appearance of detrital chromite from the ophiolites in the Cambrian sedimentary section of W Tasmania, this Deloraine sandstone is presumably equivalent or younger than the Animal Creek Greywacke.

SAMPLE NUMBER: Quamby Brook 114019

SUMMARY: This is a formerly plagioclase+augite+hornblende - phyric andesitic shallow intrusive rock, reasonably interpreted from the same body as 114020 (from your map).

HAND SPECIMEN:

This is a grey porphyritic andesite lava with phenocrysts of altered plagioclase and mafics.

THIN SECTION:

This is a well-preserved plagioclase+augite-phyric andesite in which all calcic plagioclase has been albitized, but augite is quite fresh in the majority of cases. Plagioclase phenocrysts are tabular prisms mainly less than 2mm long that are lightly sericite-speckled, and make up around 10-12 modal% of this rock. Augite phenocrysts are colourless elongate to equidimensional prisms that are mainly fresh, but spots and veinlets of chlorite sometimes replace it especially on grain margins. A few primary hornblende phenocrysts replaced entirely or almost entirely by chlorite are obvious by their strong brown - pale green - clear pleochroic scheme, and the chlorite replacing primary hornblende contains common acicular colourless to pale green actinolite. These make up less than one modal% of this rock, but are significant in that hornblende andesites are more typical of intrusive rocks in the Central Volcanic Complex than within the lava pile itself (although this is a generalization). Unlike the more felsic lavas described in this report, the former FeTi oxides in this rock were small and evenly dispersed through the groundmass; they are totally altered to messy leucoxene.

The groundmass of this sample was almost certainly holocrystalline, and composed dominantly of interlocking small plates of albite with some interstitial quartz, and subordinate tiny altered augite and FeTi oxide grains. Epidote occurs as narrow meandering veinlets and dirty yellow almost amorphous patches overprinting areas of groundmass. The metamorphic assemblage in this sample is epidote-chlorite-actinolite- albite, typical of the greenschist facies of regional metamorphism. This is clearly an andesitic rock, although the groundmass texture is more likely to reflect a shallow intrusive origin than a lava. It is quite similar to 114020, although no relics of primary hornblende were seen in that rock; it is quite reasonable to argue that petrographically, samples 114019 and 020 are from a shallow intrusive andesite body, as marked on the map.

APPENDIX II

Stream Sediment Sampling Procedures

APPENDIX II

Stream sediment sampling procedures.

BLEG Gold Samples

These were collected from active stream sediments and consisted of about 2kg of -40# material screened wet in the field. Many of the streams have fairly high gradients and ephemerally high flows so that it was generally diffcult to obtain fine sediment and required the screening of of about 10 to 30kg of -2mm material which took an average of about 1.5 hours per sample.
Although potential heavy mineral trap sites were avoided where possible, in many cases the nature of the smaller streams was such that fine gravelly or sandy material was present only in small traps between boulders etc. It was evident that the energetic wet screening process resulted in the loss of a substantial proportion of fine material in suspension so that the resultant samples often were largely of relatively clean fine sand and silt with little clayey material.
The samples were analysed for gold by the BLEG method by Rapley Wilkinson Laboratories of Perth, W.A.

-80# Samples

These consisted of about 0.6kg of unprocessed finest available mud/silt/sand/gravel from active stream sediment. Laboratory preparation consisted of drying and screening to obtain a -80# fraction which was then analysed by AAS (101) for Cu Pb Zn Ag Bi Mn and XRF (401) for Ba and As by ANALABS of Burnie, TAS.
Again, it was often difficult to obtain fine sediments and most samples were dominantly of gravel and sand. However, there was apparently sufficient fine material present, for separation by dry screening, and only in a single case was insufficient -80# fraction obtained to run an XRF analysis.

Panned Concentrates

Samples consisted of one medium dish full (~2-3kg) of -2mm sediment collected from best available trap sites, panned down to a concentrate of about 15-30g, giving a concentration factor of around 100 to 200.
The concentrates were analysed, without further preparation, by ANALABS for gold by method 309 (fusion/AAS).

Stream sediment Sample Numbers

The sample numbers of the three types of samples from each site were synchronised so that the final two digits were similar. The third last digit (hundreds) of the sample number identifies the sample type; 100 series for BLEG, 200 series for -80# and 300 series for panned concentrates

ie: A114101...BLEG, 114201...-80#, 114301...panned concentrate.

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The samples were analysed for gold by the BLEG method by Rapley Wilkinson Laboratories of Perth, W.A.

-80# Samples

These consisted of about 0.6kg of unprocessed finest available mud/silt/sand/gravel from active stream sediment. Laboratory preparation consisted of drying and screening to obtain a -80# fraction which was then analysed by AAS (101) for Cu Pb Zn Ag Bi Mn and XRF (401) for Ba and As by ANALABS of Burnie, TAS.
Again, it was often difficult to obtain fine sediments and most samples were dominantly of gravel and sand. However, there was apparently sufficient fine material present, for separation by dry screening, and only in a single case was insufficient -80# fraction obtained to run an XRF analysis.

Panned Concentrates

Samples consisted of one medium dish full (~2-3kg) of -2mm sediment collected from best available trap sites, panned down to a concentrate of about 15-30g, giving a concentration factor of around 100 to 200.
The concentrates were analysed, without further preparation, by ANALABS for gold by method 309 (fusion/AAS).

Stream sediment Sample Numbers

The sample numbers of the three types of samples from each site were synchronised so that the final two digits were similar. The third last digit (hundreds) of the sample number identifies the sample type; 100 series for BLEG, 200 series for -80# and 300 series for panned concentrates

ie: A114101...BLEG, 114201...-80#, 114301...panned concentrate.

APPENDIX II

Stream sediment sampling procedures.

BLEG Gold Samples

These were collected from active stream sediments and consisted of about 2kg of -40# material screened wet in the field. Many of the streams have fairly high gradients and ephemerally high flows so that it was generally diffcult to obtain fine sediment and required the screening of of about 10 to 30kg of -2mm material which took an average of about 1.5 hours per sample.
Although potential heavy mineral trap sites were avoided where possible, in many cases the nature of the smaller streams was such that fine gravelly or sandy material was present only in small traps between boulders etc. It was evident that the energetic wet screening process resulted in the loss of a substantial proportion of fine material in suspension so that the resultant samples often were largely of relatively clean fine sand and silt with little clayey material.
The samples were analysed for gold by the BLEG method by Rapley Wilkinson Laboratories of Perth, W.A.

-80# Samples

These consisted of about 0.6kg of unprocessed finest available mud/silt/sand/gravel from active stream sediment. Laboratory preparation consisted of drying and screening to obtain a -80# fraction which was then analysed by AAS (101) for Cu Pb Zn Ag Bi Mn and XRF (401) for Ba and As by ANALABS of Burnie, TAS.
Again, it was often difficult to obtain fine sediments and most samples were dominantly of gravel and sand. However, there was apparently sufficient fine material present, for separation by dry screening, and only in a single case was insufficient -80# fraction obtained to run an XRF analysis.

Panned Concentrates

Samples consisted of one medium dish full (~2-3kg) of -2mm sediment collected from best available trap sites, panned down to a concentrate of about 15-30g, giving a concentration factor of around 100 to 200.
The concentrates were analysed, without further preparation, by ANALABS for gold by method 309 (fusion/AAS).

Stream sediment Sample Numbers

The sample numbers of the three types of samples from each site were synchronised so that the final two digits were similar. The third last digit (hundreds) of the sample number identifies the sample type; 100 series for BLEG, 200 series for -80# and 300 series for panned concentrates

ie: A114101...BLEG, 114201...-80#, 114301...panned concentrate.

APPENDIX IIIA

Analytical Geochemical Results: Rock Samples

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

358121

Phone (004) 31 [illegible]

14 Thirkell St. Ropee Tas 7320

Fax No. (004) 31 8894

ANALYTICAL REPORT No. 11060.60.07570

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO:

Outokumpa Exploration Australia Pty Ltd
Suite 2, Level 6
77 Pacific Highway
North Sydney NSW 2060

ORDER No.	PROJECT
20233/35	EL 16/90

DATE RECEIVED	RESULTS REQUIRED
03/12/90	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
9	08/01/91	1	50

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
Various	RO Prep: GP005,GP009,SP016	Cu,Pb,Zn,Ag,Fe/6A140
Various	PO	Au,Au(R1,Au(S)/6G309,Au/6AW,Au/Mt
Various	RO	Be,Bo,W,Mo,As/3X401
Various	RO	Cr,Zr/6I401
Various	RO	SiO2,TiO2,Al2O3,Fe2O3,MgO,MnO,CaO,Na2O,K2O,P2O5

RESULTS TO: Outokumpa Exploration Australia Pty Ltd
Suite 2, Level 6
77 Pacific Highway
North Sydney NSW 2060

REMARKS: DELORAINE EL16/90 Rocks.

RESULTS TO: Mr. Wally Herrmann
Outokumpa Exploration Australia Pty Ltd
GPO 1966
Devonport
Tas 7310

RESULTS TO:

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

0210

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	11060.60.07570	08/01/91	20233/35	1 OF 9

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Au	Au(R)	Au(S)	Na2O
1	A105660	135	90	70	<0.5	1.92	<0.008	-	-	
2	A105661	15	<5	15	<0.5	1.34	<0.008	-	-	
3	A105662	10	<5	20	<0.5	3.49	<0.008	-	-	
4	A105663	15	<5	20	<0.5	1.30	0.010	-	-	
5	A105664	25	<5	50	<0.5	4.64	<0.008	-	-	
6	A105665	25	<5	65	<0.5	4.99	<0.008	-	-	3.7
7	A105666	80	<5	350	<0.5	22.60	<0.008			
8	A105667	70	30	390	<0.5	18.00	<0.008			
9	A105668	30	30	160	<0.5	0.90	<0.008			
10	A105669	10	5	45	1.0	29.00	<0.008	-	-	
11	A105670	50	5	55	1.0	3.97	<0.008			
12	A105671	10	45	50	<0.5	2.31	<0.008	<0.008	-	4.2
13	A105672	15	5	70	<0.5	5.79	<0.008			
14	A105673	10	5	50	<0.5	5.96	<0.008			4.4
15	A105674	245	90	120	<0.5	4.65	<0.008	-	-	
16	A105675	50	200	20	1.0	0.58	<0.008	-	-	
17	A105676	45	210	20	1.0	0.79	<0.008	-	<0.008	
18	A105677	38	300	15	<0.5	0.76	<0.008	-	-	0.
19	A105678	15	10	15	<0.5	4.46	<0.008	-	-	
20	A105679	20	<5	25	<0.5	10.70	<0.008	-	-	
21	A105680	65	40	15	1.0	21.60	<0.008	-	-	
22	A105681	50	5	70	<0.5	8.20	<0.008	<0.008	-	
23	A105682	30	45	85	1.0	62.10	<0.008	-	-	
24	A105683	40	5	90	<0.5	5.88	<0.008	-	-	8.7
25	A105684	30	10	65	<0.5	4.05	<0.008	-	-	

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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358122

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07570	08/01/91	20233/35	2 OF 9

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Au	Au(R)	Au(S)	Na2O
1	A105685	325	15	170	<0.5	22.40	<0.008	–	–	–
2	A105686	35	55	200	<0.5	8.12	<0.008	–	–	–
3	A105687	25	105	40	<0.5	0.72	<0.008	–	–	–
4	A105688	15	10	20	<0.5	0.85	<0.008	–	<0.008	–
5	A105689	15	10	15	<0.5	0.82	<0.008	–	–	–
6	A105690	10	10	10	1.0	0.36	<0.008	–	–	0.43
7	A105691	10	10	10	1.0	0.26	0.040	–	–	–
8	A105692	15	5	10	<0.5	0.42	<0.008	–	–	–
9	A105693	20	<5	45	<0.5	9.00	<0.008	–	–	–
10	A105694	20	15	35	1.0	3.74	<0.008	–	–	2.72
11	A105695	25	75	475	1.0	11.90	0.015	–	–	–
12	A105696	130	1600	260	1.0	7.98	<0.008	–	–	–
13	A105697	60	350	85	<0.5	1.80	<0.008	–	–	–
14	A105698	20	25	170	<0.5	5.68	<0.008	–	–	–
15	A105699	20	5	90	<0.5	4.72	<0.008	–	–	–
16	A105700	15	<5	40	1.0	39.40	<0.008	–	–	–
17	A114001	15	<5	50	<0.5	10.60	<0.008	–	–	–
18	A114002	60	100	85	<0.5	6.22	<0.008	–	–	–
19	A114003	15	5	20	1.0	5.00	<0.008	–	–	3.71
20	A114004	–	–	–	–	–	–	–	–	3.77
21	A114005	–	–	–	–	–	–	–	–	3.60
22	A114006	–	–	–	–	–	–	–	–	4.91
23	A114007	–	–	–	–	–	–	–	–	7.01
24	A114008	–	–	–	–	–	–	–	–	4.91
25	A114009	–	–	–	–	–	–	–	–	5.05

Results in ppm unless otherwise specified
T = element present but concentration too low to measure
X = element concentration is below detection limit
– = element not determined

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T210

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07570	08/01/91	20233/35	3 OF 9

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Fe	Au	Au(R)	Au(S)	Na2O
1	A114010	–	–	–	–	–	–	–	–	1.17
2	A114011	–	–	–	–	–	–	–	–	2.44
3	A114013	–	–	–	–	–	–	–	–	4.96
4	A114017	–	–	–	–	–	–	–	–	2.35
5	A114019	–	–	–	–	–	–	–	–	7.39
6	A114020	–	–	–	–	–	–	–	–	8.90
7	A114021	30	10	50	1.0	5.00	<0.008	–	–	–
8	A114022	15	5	75	<0.5	4.64	0.010	–	–	–
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21	N.B. The recommended upper detection limit									
22	for Fe by method 6A140 is 25%.									
23	DETECTION	5	5	5	0.5	0.01	0.008	0.008	0.008	0.01
24	UNITS	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%
25	METHOD	6A140	6A140	6A140	6A140	6A140	6G309	6G309	6G309	6A10

Results in ppm unless otherwise specified
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358123

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07570	08/01/91	20233/35	4 OF 9

TUBE No.	SAMPLE No.	As	Ba	Cr	Mo	Sn	W	Zr	LOI	Al2O3
1	A105660	–	–	–	–	–	–	–	–	–
2	A105661	3	45	–	<3	15	<20	–	–	–
3	A105662	3	25	–	<3	15	<20	–	–	–
4	A105663	7	<10	–	<3	40	<20	–	–	–
5	A105664	–	–	–	–	–	–	–	–	–
6	A105665	<2	650	110	<3	4	<20	100	2.01	15.00
7	A105666	25	320	–	<3	4	<20	–	–	–
8	A105667	–	–	–	–	–	–	–	–	–
9	A105668	20	430	–	55	<3	<20	–	–	–
10	A105669	30	1100	–	<3	5	<20	–	–	–
11	A105670	–	–	–	–	–	–	–	–	–
12	A105671	–	–	10	–	–	380	2.06	14.00	
13	A105672	–	–	–	–	–	–	–	–	–
14	A105673	2	1500	50	<3	5	<20	120	2.67	16.70
15	A105674	–	–	–	–	–	–	–	–	–
16	A105675	5	150	–	<3	5	<20	–	–	–
17	A105676	5	25	–	7	6	<20	–	–	–
18	A105677	2	35	45	<3	5	<20	140	1.22	8.95
19	A105678	–	–	–	–	–	–	–	–	–
20	A105679	–	–	–	–	–	–	–	–	–
21	A105680	9	320	–	<3	35	<20	–	–	–
22	A105681	<2	390	–	<3	20	<20	–	–	–
23	A105682	15	60	–	3	4	<20	–	–	–
24	A105683	–	–	20	–	–	–	110	1.78	17.40
25	A105684	–	–	–	–	–	–	–	–	–

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07570	08/01/91	20233/35	5 OF 9

TUBE No.	SAMPLE No.	As	Ba	Cr	Mo	Sn	W	Zr	LOI	Al2O3
1	A105685	–	–	–	–	–	–	–	–	–
2	A105686	7	130	–	<3	4	<20	–	–	–
3	A105687	–	–	–	–	–	–	–	–	–
4	A105688	6	180	–	<3	4	<20	–	–	–
5	A105689	–	–	–	–	–	–	–	–	–
6	A105690	–	–	50	–	–	–	130	1.74	16.40
7	A105691	–	–	–	–	–	–	–	–	–
8	A105692	30	40	–	<3	5	<20	–	–	–
9	A105693	4	100	–	<3	4	<20	–	–	–
10	A105694	5	850	70	<3	<3	<20	150	2.19	14.80
11	A105695	–	–	–	–	–	–	–	–	–
12	A105696	–	–	–	–	–	–	–	–	–
13	A105697	8	80	–	<3	7	<20	–	–	–
14	A105698	–	–	–	–	–	–	–	–	–
15	A105699	–	–	–	–	–	–	–	–	–
16	A105700	–	–	–	–	–	–	–	–	–
17	A118001	–	–	–	–	–	–	–	–	–
18	A114002	–	–	–	–	–	–	–	–	–
19	A114003	<2	2750	10	<3	3	<20	190	1.97	15.1
20	A114004	–	–	45	–	–	–	100	2.18	14.1
21	A114005	–	–	15	–	–	–	440	2.26	14.3
22	A114006	–	–	25	–	–	–	450	2.02	14.4
23	A114007	–	–	30	–	–	–	460	0.92	13.2
24	A114008	–	–	25	–	–	–	400	1.12	13.3
25	A114009	–	–	9	–	–	–	480	1.43	14.4

Results in ppm unless otherwise specified
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X = element concentration is below detection limit
– = element not determined

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0232

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ANALYTICAL DATA

358124

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
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TUBE No.	SAMPLE No.	As	Ba	Cr	Mo	Sn	W	Zr	LOI	Al2O3
1	A113010	—	—	9	—	—	—	450	1.98	13.80
2	A113011	—	—	25	—	—	—	130	0.98	14.40
3	A113013	—	—	25	—	—	—	200	1.13	12.50
4	A113017	—	—	199	—	—	—	110	1.80	13.70
5	A113019	—	—	140	—	—	—	100	2.40	15.70
6	A113020	—	—	20	—	—	—	65	2.19	15.70
7	A113021	—	—	—	—	—	—	—	—	—
8	A113022	—	—	—	—	—	—	—	—	—
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21	R.e. the recommended upper detection limit									
22	for Fe by method Go140 is 25%.									
23	DETECTION	2	10	3	3	3	20	5	0.01	0.05
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%
25	METHOD	GX401	GX401	GX401	GX401	GX401	GX401	GX401	DH615	GX408

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07570	08/01/91	20233/35	7 OF 9

TUBE No.	SAMPLE No.	CaO	Fe2O3	K2O	MgO	MnO	P2O5	SiO2	TiO2	
1	A105660	—	—	—	—	—	—	—	—	
2	A105661	—	—	—	—	—	—	—	—	
3	A105662	—	—	—	—	—	—	—	—	
4	A105663	—	—	—	—	—	—	—	—	
5	A105664	—	—	—	—	—	—	—	—	
6	A105665	6.97	9.54	2.30	5.00	0.16	0.146	55.80	0.72	
7	A105666	—	—	—	—	—	—	—	—	
8	A105667	—	—	—	—	—	—	—	—	
9	A105668	—	—	—	—	—	—	—	—	
10	A105669	—	—	—	—	—	—	—	—	
11	A105670	—	—	—	—	—	—	—	—	
12	A105671	0.06	3.38	3.93	0.95	0.06	0.055	75.00	0.41	
13	A105672	—	—	—	—	—	—	—	—	
14	A105673	3.19	8.53	3.36	2.50	0.12	0.152	58.00	0.64	
15	A105674	—	—	—	—	—	—	—	—	
16	A105675	—	—	—	—	—	—	—	—	
17	A105676	—	—	—	—	—	—	—	—	
18	A105677	0.24	2.69	0.05	1.70	0.03	0.044	83.80	0.45	
19	A105678	—	—	—	—	—	—	—	—	
20	A105679	—	—	—	—	—	—	—	—	
21	A105680	—	—	—	—	—	—	—	—	
22	A105681	—	—	—	—	—	—	—	—	
23	A105682	—	—	—	—	—	—	—	—	
24	A105683	3.04	8.37	2.19	2.20	0.13	0.169	55.60	0.75	
25	A105684	—	—	—	—	—	—	—	—	

Results in ppm unless otherwise specified
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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
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TUBE No.	SAMPLE No.	CaO	Fe2O3	K2O	MgO	MnO	P2O5	SiO2	TiO2	
1	A105685	--	--	--	--	--	--	--	--	
2	A105686	--	--	--	--	--	--	--	--	
3	A105687	--	--	--	--	--	--	--	--	
4	A105688	--	--	--	--	--	--	--	--	
5	A105689	--	--	--	--	--	--	--	--	
6	A105690	0.64	1.98	0.14	3.00	0.01	0.034	72.00	0.59	
7	A105691	--	--	--	--	--	--	--	--	
8	A105692	--	--	--	--	--	--	--	--	
9	A105693	--	--	--	--	--	--	--	--	
10	A105694	5.30	7.35	2.89	3.50	0.11	0.163	60.70	0.71	
11	A105695	--	--	--	--	--	--	--	--	
12	A105696	--	--	--	--	--	--	--	--	
13	A105697	--	--	--	--	--	--	--	--	
14	A105698	--	--	--	--	--	--	--	--	
15	A105699	--	--	--	--	--	--	--	--	
16	A105700	--	--	--	--	--	--	--	--	
17	A114001	--	--	--	--	--	--	--	--	
18	A114002	--	--	--	--	--	--	--	--	
19	A114003	0.96	6.46	5.72	0.90	0.04	0.112	65.00	0.56	
20	A114004	4.24	10.30	2.07	4.35	0.22	0.106	57.30	0.92	
21	A114005	0.13	4.78	4.45	1.10	0.06	0.067	66.80	0.52	
22	A114006	0.25	6.30	5.77	1.30	0.16	0.117	66.00	0.64	
23	A114007	0.63	4.73	3.02	0.85	0.12	0.078	68.70	0.50	
24	A114008	0.19	6.37	5.52	0.85	0.07	0.065	69.00	0.42	
25	A114009	0.33	6.04	3.93	0.95	0.11	0.039	67.40	0.56	

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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3 5 8,125

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07570	02/01/91	20253/35	9 OF 9

TUBE No.	SAMPLE No.	CaO	Fe2O3	K2O	MgO	MnO	P2O5	SiO2	TiO2	
1	A114010	0.05	6.34	6.30	1.05	0.06	0.052	68.00	0.53	
2	A114011	4.47	7.84	6.50	3.65	0.15	0.189	58.60	0.65	
3	A114013	0.74	4.28	3.15	1.15	0.43	0.054	72.00	0.39	
4	A114017	9.46	13.70	1.40	6.90	0.23	0.166	48.60	2.04	
5	A114019	3.99	7.29	0.93	4.00	0.14	0.119	57.50	0.53	
6	A114020	4.32	9.49	0.04	3.75	0.19	0.137	55.00	0.64	
7	A114021	--	--	--	--	--	--	--	--	
8	A114022	--	--	--	--	--	--	--	--	
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21	N.B. The recommended upper detection limit									
22	for Fe by method 3A140 is 25%.									
23	DETECTION	0.01	0.01	0.01	0.05	0.01	0.005	0.05	0.01	
24	LIMITS	%	%	%	%	%	%	%	%	
25	METHOD	0X409	0X408	0X408	0X408	0X409	0X409	0X409	0X409	

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

APPENDIX IIIB

Analytical Geochemical Results: Stream Sediment Samples

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

Analabs - A Division of Inchcape Inspection & Testing Services

3581 27

Phone (004) 31 6833 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

ANALYTICAL REPORT No. 111060.60.07715

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO:

Outokumpa Exploration Australia Pty Ltd
Suite 2, Level 6
77 Pacific Highway
North Sydney NSW 2060

ORDER No.	PROJECT
20238	

DATE RECEIVED	RESULTS REQUIRED
30/01/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
6	27/02/91	1	51

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
A114201/249	SS Prep: GP006,GP018	Cu,Pb,Zn,Ag,Bi,Mn/GA101
A114201/249	SS	Ba,As/GI401
A114023/24	RC Prep: GP006,GP009,GP018	Cu,Pb,Zn,Ag,Bi,Mn/GA140
A114023/24	RC	Au,Au(R),Au(S)/GG309,Au/RAN,Au/Wt
A114023/24	RC	Ba,As/GI401

REMARKS

RESULTS TO
Mr. Wally Herrmann
Outokumpu Exploration Australia Pty Ltd
RSD 1066
Devonport
Tasmania 7310

RESULTS TO
Outokumpa Exploration Australia Pty Ltd
Suite 2, Level 6
77 Pacific Highway
North Sydney NSW 2060

RESULTS TO

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No	PAGE
	111060.60.07715	27/02/91	20238	1 OF 6

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Bi
1	A114023	-	<2	-	20	-	25	-	1	
2	A114024	-	<2	-	25	-	45	-	<1	
X 3	A114201	5	-	10	-	35	-	1.0	-	10
4	A114202	35	-	35	-	105	-	2.0	-	1
5	A114203	10	-	10	-	15	-	1.0	-	<1
6	A114204	20	-	15	-	50	-	<0.5	-	1
7	A114205	20	-	20	-	80	-	1.0	-	1
8	A114206	55	-	40	-	100	-	1.0	-	2
9	A114207	40	-	30	-	95	-	1.0	-	3
10	A114208	60	-	55	-	165	-	1.0	-	3
11	A114209	15	-	5	-	40	-	2.0	-	1
12	A114210	15	-	10	-	15	-	<0.5	-	3
13	A114211	10	-	10	-	20	-	1.0	-	<1
14	A114212	15	-	15	-	25	-	1.0	-	<1
15	A114213	15	-	20	-	40	-	<0.5	-	2
16	A114214	15	-	15	-	25	-	1.0	-	1
17	A114215	15	-	10	-	40	-	1.0	-	2
18	A114216	20	-	5	-	55	-	1.0	-	2
19	A114217	25	-	15	-	75	-	1.0	-	1
20	A114218	20	-	15	-	65	-	2.0	-	3
21	A114219	10	-	15	-	25	-	<0.5	-	2
22	A114220	10	-	15	-	20	-	1.0	-	2
23	A114221	10	-	15	-	30	-	1.0	-	<1
24	A114222	15	-	15	-	95	-	1.0	-	1
25	A114223	40	-	40	-	290	-	2.0	-	<1

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
- = element not determined

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

358128

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07715	27/02/91	20238	2 OF 6

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Bi
1	A114224	30	–	20	–	100	–	2.0	–	<10
2	A114225	40	–	15	–	100	–	2.0	–	10
3	A114226	10	–	10	–	60	–	1.0	–	10
4	A114227	15	–	20	–	165	–	1.0	–	10
5	A114228	25	–	30	–	90	–	1.0	–	10
6	A114229	90	–	25	–	110	–	3.0	–	10
7	A114230	30	–	40	–	310	–	2.0	–	<10
8	A114231	25	–	55	–	360	–	2.0	–	10
9	A114232	65	–	65	–	515	–	2.0	–	40
10	A114233	50	–	35	–	170	–	2.0	–	10
11	A114234	40	–	45	–	195	–	2.0	–	10
12	A114235	40	–	70	–	190	–	2.0	–	20
13	A114236	55	–	30	–	175	–	2.0	–	10
14	A114237	40	–	40	–	225	–	2.0	–	<10
15	A114238	30	–	60	–	265	–	2.0	–	<10
16	A114239	20	–	15	–	40	–	2.0	–	<10
17	A114240	20	–	35	–	170	–	1.0	–	10
18	A114241	35	–	20	–	80	–	1.0	–	<10
19	A114242	20	–	25	–	545	–	2.0	–	<10
20	A114243	10	–	15	–	55	–	1.0	–	<10
21	A114244	25	–	25	–	100	–	1.0	–	<10
22	A114245	40	–	20	–	110	–	1.0	–	<10
23	A114246	55	–	15	–	120	–	2.0	–	<10
24	A114247	20	–	155	–	75	–	1.0	–	<10
25	A114248	15	–	30	–	85	–	1.0	–	<10

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07715	27/02/91	20238	3 OF 6

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Bi
1	A114249	15	–	30	–	80	–	1.0	–	<10
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22	IS = Insufficient Sample									
23	DETECTION	5	2	5	5	5	2	0.5	1	10
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
25	METHOD	GA101	GA140	GA101	GA140	GA101	GA140	GA101	GA140	GA101

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

358129

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07715	27/02/91	20238	4 OF 6

TUBE No.	SAMPLE No.	Bi	Mn	Mo	Ba	As	Au			
1	A114023	<20	--	<5	25	<2	<0.008			
2	A114024	<20	--	5	55	<2	<0.008			
3	A114201	--	15	--	280	<2	--			
4	A114202	--	990	--	520	2	--			
5	A114203	--	160	--	130	<2	--			
6	A114204	--	300	--	300	<2	--			
7	A114205	--	295	--	500	<2	--			
8	A114206	--	55	--	65	2	--			
9	A114207	--	55	--	60	3	--			
10	A114208	--	50	--	40	2	--			
11	A114209	--	135	--	140	<2	--			
12	A114210	--	25	--	35	<2	--			
13	A114211	--	35	--	75	<2	--			
14	A114212	--	30	--	80	3	--			
15	A114213	--	685	--	180	<2	--			
16	A114214	--	110	--	150	<2	--			
17	A114215	--	635	--	1100	<2	--			
18	A114216	--	270	--	660	<2	--			
19	A114217	--	700	--	1300	2	--			
20	A114218	--	1800	--	1650	<2	--			
21	A114219	--	180	--	330	<2	--			
22	A114220	--	75	--	210	2	--			
23	A114221	--	40	--	200	2	--			
24	A114222	--	885	--	460	2	--			
25	A114223	--	1200	--	600	2	--			

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07715	27/02/91	20238	5 OF 6

TUBE No.	SAMPLE No.	Bi	Mn	Mo	Ba	As	Au			
1	A114224	--	890	--	500	4	--			
2	A114225	--	935	--	450	4	--			
3	A114226	--	310	--	320	<2	--			
4	A114227	--	1250	--	630	7	--			
5	A114228	--	2150	--	460	7	--			
6	A114229	--	1200	--	370	7	--			
7	A114230	--	2600	--	770	6	--			
8	A114231	--	2700	--	700	5	--			
9	A114232	--	1350	--	15	18	--			
10	A114233	--	950	--	390	4	--			
11	A114234	--	1600	--	610	8	--			
12	A114235	--	3100	--	560	20	--			
13	A114236	--	1150	--	430	7	--			
14	A114237	--	1900	--	550	10	--			
15	A114238	--	1700	--	520	6	--			
16	A114239	--	200	--	140	<2	--			
17	A114240	--	970	--	700	2	--			
18	A114241	--	885	--	300	5	--			
19	A114242	--	4800	--	890	15	--			
20	A114243	--	250	--	230	<2	--			
21	A114244	--	775	--	460	<2	--			
22	A114245	--	610	--	340	3	--			
23	A114246	--	885	--	410	6	--			
24	A114247	--	1650	--	260	2	--			
25	A114248	--	800	--	380	4	--			

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

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A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

358130

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07715	27/02/91	20238	6 OF 6

TUBE No.	SAMPLE No.	Bi	Mn	Mo	Ba	As	Au			
1	A114249	--	700	--	420	<2	--			
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22	IS = Insufficient Sample									
23	DETECTION	20	5	5	10	2	0.008			
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm			
25	METHOD	GA140	GA101	GA140	GX401	GX401	GG309			

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

APPENDIX IIIC

Analytical Geochemical Results: Panned Concentrate Samples

ANALABS
A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.
Analabs - A Division of Inchcape Inspection & Testing Services

Phone (004) 31 6833 | 14 Thirkell St. Cooee Tas 7320 | Fax No. (004) 31 8890

358132

ANALYTICAL REPORT No. 111060.60.07773

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

INVOICE TO:

Outokumpa Exploration Australia Pty Ltd
Suite 2, Level 6
77 Pacific Highway
North Sydney NSW 2060

ORDER No.	PROJECT
20239	EL 16/90

DATE RECEIVED	RESULTS REQUIRED
19/02/91	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
3	26/02/91	1	48

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
(A114,301/338,340/349	SS Prep: GP006	Au,Au(R),Au(S)/66309,Au/RAW,Au/Wt,Wt/9903

REMARKS

RESULTS TO
Outokumpa Exploration Australia Pty Ltd
Suite 2, Level 6
77 Pacific Highway
North Sydney NSW 2060

RESULTS TO
Mr. Wally Herrmann
Outokumpu Exploration Australia Pty Ltd
RSD 1066
Devonport
Tasmania 7310

RESULTS TO

AUTHORISED OFFICER

0131

ANALABS
A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07773	27/02/91	20239	1 OF 3

TUBE No.	SAMPLE No.	Au	Wt
1	A114301	<0.008	14.20
2	A114302	<0.008	6.72
3	A114303	<0.008	26.77
4	A114304	<0.008	18.30
5	A114305	<0.008	23.74
6	A114306	<0.008	24.95
7	A114307	<0.008	23.35
8	A114308	<0.008	17.32
9	A114309	<0.008	18.89
10	A114310	<0.008	28.65
11	A114311	<0.008	16.89
12	A114312	<0.008	23.27
13	A114313	<0.008	25.96
14	A114314	<0.008	27.79
15	A114315	<0.008	19.45
16	A114316	<0.008	19.47
17	A114317	<0.008	23.04
18	A114318	<0.008	17.92
19	A114319	<0.008	17.30
20	A114320	<0.008	18.73
21	A114321	<0.008	24.10
22	A114322	<0.008	15.65
23	A114323	<0.008	22.03
24	A114324	<0.008	22.80
25	A114325	<0.008	14.43

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
N = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

358133

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07773	27/02/91	20239	2 OF 3

TUBE No.	SAMPLE No.	Au	Wt							
1	A114326	<0.008	13.22							
2	A114327	<0.008	28.61							
3	A114328	<0.008	16.31							
4	A114329	<0.008	14.92							
5	A114330	<0.008	22.73							
6	A114331	<0.008	24.53							
7	A114332	<0.008	12.77							
8	A114333	<0.008	18.03							
9	A114334	<0.008	13.05							
10	A114335	<0.008	18.59							
11	A114336	<0.008	14.91							
12	A114337	<0.008	15.68							
13	A114338	<0.008	13.15							
14	A114340	<0.008	15.35							
15	A114341	<0.008	24.39							
16	A114342	<0.008	15.91							
17	A114343	<0.008	26.93							
18	A114344	<0.008	12.64							
19	A114345	<0.008	7.37							
20	A114346	<0.008	21.38							
21	A114347	<0.008	20.38							
22	A114348	<0.008	19.33							
23	A114349	<0.008	23.58							
24										
25										

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	111060.60.07773	27/02/91	20239	3 OF 3

TUBE No.	SAMPLE No.	Au	Wt							
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22	DETECTION	0.008	0.01							
23	UNITS	ppm	g							
24	METHOD	GG309	9903							
25										

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

APPENDIX IIID

Analytical Geochemical Results: BLEG Samples

358135

RapleyWilkinson Laboratories PTY LTD
Incorporated in Western Australia
59 Crocker Drive, Malaga, Western Australia 6062
Telephone: (09) 249 3499. Fax: (09) 249 3484

ANALYTICAL REPORT ON SAMPLES SUBMITTED BY / ON BEHALF OF

Client: Outokumpu Exploration Australia Pty Ltd.
1st Floor Burswood Crt,
141 Burswood Road,
Victoria Park WA 6100.

Attention to: W. Herrmann
Copies to:

Job No: 5197/291
Client order: 001302

Date samples received: 06/02/1991
Date results reported: 14/02/1991
No. of samples : 46
No. of report pages : 2

Elements analysed : Gold

Report codes: I.S. = Insufficient sample
SNR = Sample not received

.....
Issued on 14th Feb. 1991
H. Firns
Operations Manager

358136

Method : Bleg (Au)

Order : Despatch Sheet 20237 / 1302

Report : 5197/291

Sample Number	ppb Au
A 114101	0.15
A 114102	0.12
A 114103	<0.01
A 114104	0.14
A 114105	<0.01
A 114106	0.15
A 114107	0.08
A 114108	0.38
A 114109	0.09
A 114110	0.06
A 114111	0.12
A 114112	<0.01
A 114113	0.15
A 114114	<0.01
A 114115	<0.01
A 114116	<0.01
A 114117	<0.01
A 114118	SNR
A 114119	0.09
A 114120	<0.01
A 114121	0.28
A 114122	0.12
A 114123	0.16
A 114124	0.08
A 114125	0.18
A 114126	0.18
A 114127	0.04
A 114128	0.16
A 114129	SNR
A 114130	0.09
A 114131	0.28
A 114132	0.34
A 114133	0.08
A 114134	0.04
A 114135	0.04
A 114136	0.24
A 114137	0.46
A 114138	0.07
A 114139	0.23
A 114140	0.08

Detection Limit : 0.01

Method : Bleg (Au)

Order : Despatch Sheet 20237

Report : 5197/291

Sample Number	ppb Au
A 114141	SNR
A 114142	0.12
A 114143	0.09
A 114144	<0.01
A 114145	0.23
A 114146	0.34
A 114147	0.12
A 114148	0.16
A 114149	0.23

Detection Limit : 0.01

APPENDIX IV

Rock Sample (descriptive) Data

outokumpu
EXPLORATION AUSTRALIA PTY. LIMITED

ROCK SAMPLE DATA FIELD SHEET

PROJECT NAME DELORAINE
PROJECT No. EL 16/90

358139

PROSPECT NAME _____
PROSPECT I.D. _____
GRID I.D. _____

Sample Number	Field / Station Number	FIELD–GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	Est True Width (m)	Lithology	COMMENTS / ANALYSES (p.p.m.)
A 105161610	Gregory's Road				BR	CP		0.2	Barley white quartz veins in grey wacke / mudstone.	
105161611	"				MF	"			Silicified porph. dacite ± veins and semi pervasive patches of dark tourm. alt.	Faintly anomalous in Sn (upto 40 ppm)
105161612	"				"	"			Silicified f.g. felsic vole., intense brecciated ± semi massive infill of dark tourmaline	
105161613	"				"	"			Massive/radiating bundles of dark tourmaline, often leached.	
105161614	"				MF	"			M.g. porphyritic "diorite"	
105161615	"				BR	"			" " "	* Petrography + Whole Rock Analysis
105161616	"West Flersey Anomaly".				BR	"			Brecciated/limonite stained/veined f.g. siltstone and greywacke.	~20% Fe, weakly anomalous Cu, Zn
105161617	"				MF	"			Float of similar lithology to 105666.	(upto 80 Cu, 390 Zn)
105161618	"				MF	"			Brecciated/silicified felsic volcanic, ± minor disseminated Pyrite	Anomalous Mo (55 ppm) but not Sn, W. * Petrographic Description.
105161619	Creek				BR	"			Massive/porous/earthy limonitic ferricrete	29% Fe but low Cu Pb Zn
105161710	"				BR	"			Felsic qtz + feldspar porphyry ± strong sericite? alt. of fs. phenocrysts.	— Not anomalous.
105161711	"				"	"			Felsic porphyry — fresh.	* Petrography + Whole Rock Anal.
105161712	"				"	"			Felsic porphyry — fresh.	— Not anomalous

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ROCK SAMPLE DATA FIELD SHEET

PROJECT NAME DELORAINE
PROJECT No. EL 16/90

358140

PROSPECT NAME _____
PROSPECT I.D. _____
GRID I.D. _____

Sample Number	Field / Station Number	FIELD–GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	Est True Width (m)	Lithology	COMMENTS / ANALYSES (ppm)
A 110151617 13	Gregory's Road				BR	CP			Foliated porphyry ± strong epidote/chl. alteration of phenocrysts (fs.) Matrix fs apparently unaltered.	* Petrography + whole Rock Anal.
110151617 14	"				"	"			Foliated porphyry/lava?; bleached bleached to pale grey buff, altered? and oxidised	250 ppm Cu
110151617 15	"				MF	CP			Pervasively silicified foliated sediment? numerous veinlets of qtz + tourmaline, fs phenocrysts altd. to tourm/kaol/chl? Similar to 105675.	200-300 ppm Pb - not v. anomalous in Au, Sn, W
110151617 16	"				"	"				
110151617 17	"				"	"			Siliceous breccia, infilled with dark tourmaline (+ topaz?.)	* Petrog and Whole Rock Anal
110151617 18	Magog				BR	"			Sericitized foliated epiclastic ± fragments of (rounded) metasediment/banded qtzite and (angular) vitric tuff.	Not anomalous.
110151617 19	"				MF	"			Fg. glomeroporphyritic "basalt" fine veinlets epidote + pink k'spar? or pretinite? Strongly magnetic.	10.7% Fe. Not otherwise anomalous. (Sn not assayed)
110151618 10	"				"	"			Weakly altd. basalt ± narrow (5mm) veins of bluish qtz + tourm. +/- Mt.?.	21.6% Fe. 325 ppm Sn * Petrography.
110151618 11	"				"	"			Weakly altered basalt, epidote veinlets.	20 ppm Sn.

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ROCK SAMPLE DATA FIELD SHEET

0140

PROJECT NAME DELORAINE
PROJECT No. EL 16/90

358141

PROSPECT NAME
PROSPECT I.D.
GRID I.D.

Sample Number	Field / Station Number	FIELD–GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	Est True Width (m)	Lith-ology	COMMENTS / ANALYSES (p.p.m.)
A11015161812	Magoy.				HF	CP			Magnetic gravel. Oxidised Mt to sandy limonitic ? gravel/chips upto 2mm. Residual gravel in soil.	62% Fe
11015161813	Rundis Terror				HF	CP			Feldspar porphyrit ie "Diorite"	* Petrog. + whole Rock Assay
11015161814	"				"	"			" "	
11015161815	Ldg Aex Pint.				HF	CP			Bands of brecciated vein quartz cemented/amended by limonite, in mudstone/greywacke, possible minor Py boxworks. Oxidized.	22% Fe 325 ppm Cu.
11015161816	Cwagong 1				BR	CP			Weathered/clayey o/c of felsic tuff/breccia & rounded clasts of meta-quartzite.	
11015161817	"				HF	CP			Similar to 105686 but more siliceous.	
11015161818	"				"	"			Brecciated felsic volcanics & veinlets of dark tourmaline/intense stockwork.	None of these are significantly anomalous in Cu/Pb/Zn, Au, Sn etc.
11015161819	"				"	"			Intensely silicified (indeterminate) rock with inclusions of tourmaline replacing feldspar xtals.	
11015161910	"				"	"	1		Similar to 105699.	* Petrog + Whole Rock.
11015161911	"				"	"			Tourmaline schist, alt'd felsic porph.	0.04 g/t Au.
11015161912	"				"	"			" " "	

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ROCK SAMPLE DATA FIELD SHEET

PROJECT NAME DELORAINE
PROJECT No. EL 16/90

358142

PROSPECT NAME
PROSPECT I.D.
GRID I.D.

Sample Number	Field / Station Number	FIELD-GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	Est True Width (m)	Lith-ology	COMMENTS / ANALYSES (p.p.m)
AU105169 13	Gregory 1				HF	CP			Silicified felsic vole/porphyry locally brecciated with stockwork of fine limonitic veinlets.	Not anomalous.
AU105169 14	Gozo Road				BR	CP			"Monzo-Diorite"	* Petrog + Whole Rock Anal
105169 15	"				"	"			Weathered, locally pervasively chlorite altered (?) Diorite, patchy limonite veinlets. Altered marginal phase? Similar to 105695.	? weakly anomalous: Cu to 685 ppm Pb to 1600 ppm Zn to 495 ppm.
105169 16	"				"	"				
105169 17	"				HF	CP			Brecciated/silicified/tourmaline veined rock; ex felsic vole?	350 ppm Pb.
105169 18	"				RP	(Percussion Drill Chips)			Grey silicified felsic porph/vole. 2-3% disseminated pyrite from Drill Hole	Not significantly anomalous.
105169 19									As above.	
105169 20	Loc.								Spongy porous limonitic ferricrete	39.4% Fe Int low Cu, Pb, Zn.
AU105169 11	Loc				BR	CP			Patchy strong semi pervasive and veiny chlorite alteration in felsic porphyry.	Not significantly anomalous
105169 02	Loc.				HF	CP			Silicified/tourmaline altered felsic porphyry, often weathered.	100 ppm Pb.

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ROCK SAMPLE DATA FIELD SHEET

0145

PROJECT NAME DELORAINE
PROJECT No. EL 16/90

358143

PROSPECT NAME
PROSPECT I.D.
GRID I.D.

Sample Number	Field / Station Number	FIELD-GRID CO-ORDINATES E	N	R.L.	Samp Type	Samp Meth	Samp Length (m)	Est True Width (m)	Lith-ology	COMMENTS / ANALYSES (ppm)
A1111 41993	GOG				HF	CL.			Silica-epidote altered felsic porphyry or "Diorite"?	* Petrography + Whole Rock Anal. Anomalous Ba: 2350ppm.
A1111 41001	EL 16/90								Diorite	* PETROGRAPHIC * WHOLE ROCK
1111 41001 5	GOG								Felsic Porphyry / Intrusive ?	✓ ✓
1111 41001 6	"								" / "	✓ ✓
1111 41001 7	"								" / "	✓ ✓
1111 01018	"								Felsic Porphyry / Extrusive	✓ ✓
1111 01019	"								" "	✓ ✓
1111 01110	"								" "	✓ ✓
1111 01111	"								Felsic Pyroclastic	✓ ✓
1111 01112	WEST MERSEY								"	✓
1111 01113	GOG								"	✓ ✓
1111 01114	"								"	✓
1111 01115	"								"	✓
1111 01116	LOBSTER CUMMEY								"	✓
1111 01117	MACOG								Mafic Volcanic	✓ ✓
1111 01118	MACOG								"	✓
1111 01119	QUAFFEY.								"	✓ ✓
1111 01120	KENTISH HILL								"	✓ ✓
A1111 61012 11	Kentish Hill				HF	CP			Pervasively silicia/epidote altered porphyritic Andesite ??,	Not Anomalous Cu, Pb, Zn, Au
1111 AP1212	"				"	"				
1111 61012 12	"				"	"			Hematite stained mafic Volcaniclastic ± veinlets of qtz + epidote, rather weathered!	"

GEOLOGICAL REFERENCE

TERTIARY	57	Tb	Basalt
JURASSIC	10	Jdl	Dolerite
PERMIAN		P	undifferentiated sandstone, siltstone, shale, conglomeratic mudstone, tillite
LATE CAMBRIAN – EARLY ORDOVICIAN	14	Ɵc	Siliciclastic conglomerate and sandstone. = DENISON GROUP
MID-LATE CAMBRIAN?	12	Ɛd	Diorite, leucogabbro.
	41	Ɛvd	Dacitic, porphyritic extrusives
		Ɛid	Dacitic, porphyritic intrusive
	46	Ɛef	Volcaniclastic/epiclastic sediments: siltstone, sandstone, conglomerate. Mainly of felsic volcanic/pyroclastic derivation; commonly with minor component of metasedimentary and/or andesitic volcanic detritus.
	47	Ɛsc	Matrix supported conglomerate, conglomeratic mudstone; subordinate sandstone and siltstone.
	29	Ɛsg	Micaceous greywacke, siltstone and shale; dominantly of metasedimentary provenance but commonly with minor felsic volcaniclastic component.
	38	Ɛss	Micaceous sandstone and conglomeratic sandstone; usually quartz rich, arenaceous; dominantly metasedimentary provenance.
	22	Ɛva	Andesitic volcanics, shallow intrusives and volcaniclastics
EO-CAMBRIAN?	65	Ɛvb	Basaltic volcanics and possibly associated volcaniclastics. Tholeiitic composition = Eocambrian Crimson Ck Fm.
PRE CAMBRIAN	58	pƐ	Psammo-pelitic metasedimentary schists and metaquartzite

Quartz + tourmaline alteration

105665 Rock sample No: (Prefix A.....) and location

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DELORAINE
EXPLORATION LICENCE 16/90

REGIONAL GEOLOGICAL INTERPRETATION
(PRELIMINARY)

1:25000

0 500 1000 2000 metres

Compiled:	Date: 3/91	Dwg No.:
Report No.:	Map Ref.:	PLATE FIG: 1

5 cm

10012

LOCALITY MAP

INDEX TO ADJOINING MAPS

358145 91-3277.

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DELORAINE
EXPLORATION LICENCE 16/90
STREAM SEDIMENT SAMPLE LOCATIONS
AND -80# GEOCHEMICAL RESULTS

1:25000
0 5km 1000 2000
metres

Compiled: AP	Date: 3/91	Dwg No.:
Report No.:	Map Ref.:	PLATE No.: 2

5 cm

GEOLOGICAL REFERENCE

TERTIARY	Tb	Basalt
JURASSIC	Jdl	Dolerite
PERMIAN	P	undifferentiated sandstone, siltstone, shale, conglomeratic mudstone, tillite.
LATE CAMBRIAN - EARLY ORDOVICIAN?	Oc	Siliciclastic conglomerate and sandstone. = DENISON GROUP
MID-LATE CAMBRIAN?	Cd	Diorite, leucogabbro.
	Cvd	Dacitic, porphyritic extrusives
	Cid	Dacitic, porphyritic intrusive
	Cvf	Volcaniclastic/epiclastic sediments: siltstone, sandstone, conglomerate. Mainly of felsic volcanic/pyroclastic derivation, commonly with minor component of metasedimentary and/or andesitic volcanic detritus.
	Csc	Mafic to granitoid conglomerate, conglomeratic mudstone, subordinate sandstone and siltstone.
	Csg	micaceous greywackes, siltstone and shales; dominantly of metasedimentary provenance but commonly with accessory felsic volcaniclastic component.
	Css	micaceous sandstone and conglomeratic sandstone; usually quartz rich, arenaceous; dominantly metasedimentary provenance.
	Cva	Andesitic volcanics, shallow intrusives and volcaniclastics
EO-CAMBRIAN?	Cvb	Basaltic volcanics and possibly associated volcaniclastics. Tholeiitic composition = Backstairs Cristen Clen Form.
PRE-CAMBRIAN	pC	Pelitic-psammo-pelitic metasedimentary schists and metaquartzite

GEOCHEMICAL REFERENCE

- Stream Sediment Sample Location

Sample No. | Mn / Cu | Pb | Ba / Zn

-80# Geochemical results in ppm.
Cu Pb Zn Mn by AAS (ANALABS 101)
Ba by XRF (ANALABS 401)

Sample Numbers are prefixed A1142..

LEGEND

Built up area with commercial centre
Roads maintained for continuous public use — Primary road, Route number; Secondary road, Route number; Minor road, Route number
Roads of restricted use or access — Other roads, Bridge; Vehicular track, Gate
Walking track, Bridge
Railway, Station
Light railway
Power transmission line and pylon positions
Building, Feature of special interest, Ruin
Post office, Police station, Fire station, School
Caravan park, Camping ground
Rubbish disposal area, Cemetery
Trigonometric station, Spot elevation
Contour with value, Depression contour
Quarry or open cut mine
Broken rocky outcrop
Dense forest, Medium forest
Low dense vegetation, Duntreeve grass
Orchard, Pine plantation
Windbreak
Swamp, Land subject to flooding
Watercraft, Rapids
Indefinite shoreline or floodbank, Levee
Tidal rocks or ledge, Offshore rock
Lighthouse, Exposed wreck
Sand, Tidal reef
Saline coastal flat, Tidal flats
Jetty, Launching ramp

BOUNDARIES shown on this map are NOT authoritative. For full particulars please consult the Registrar General's Department in the Lands Department.
Property and land parcel boundaries are shown as at August 1981
Areas within proclaimed towns or less than two hectares are not depicted. To give a land parcel reference, state parcel number with municipal number
Municipality name
Municipality number
Municipality boundary
Ward name
Ward boundary
Town boundary
Reserve boundary
Property boundary, Land parcel boundary and number

PROJECTION: Universal Transverse Mercator (UTM).
HORIZONTAL DATUM: Australian Geodetic Datum 1966.
VERTICAL DATUM: Australian Height Datum (Tasmania) excepting offshore islands whose datum is mean sea level.
GRID: The Australian Map Grid based on Transverse Mercator Grid, Zone 55 (Australian Map Grid, Australian National Spheroid. Grid values are shown in full at the south west corner of the map.
CONTOUR INTERVAL: 10 metres with 50 metre index contours.

WORLD GEODETIC SYSTEM 1972: To convert co-ordinates from this system to Australian Geodetic Datum 1966, minimise the value of latitude by 5.2" and decrease the value of longitude by 6.2". To obtain height in mean sea level, satellite heights by 1 metre.

MAGNETIC VARIATION: True, Grid and Magnetic North are shown on the diagram in the south west corner of the Magnetic North is correct for 1981 and moves easterly about 0.1° every two years.

SCALE 1:25 000
1 millimetre represents 25 metres

10013

STREAM SEDIMENT SAMPLE TYPES AND LOCATIONS:

□	ASARCO	~ 1973-74	Stream Sediments : unspecified.	Cu, Pb, Zn, Mo, CxCu, CxZn, Ag
△	AUSTAMAX	~ 1983-84	-80# Stream Sediments	Cu, Pb, Zn, Ag, Ba, As
▲	AUSTAMAX	"	Bulk Gold / Stream Sediments	Au
○	COMALCO	~ 1978-79	-80# Stream Sediments	Cu, Pb, Zn (Sn, W in Lobster Rivt. area)
●	COMALCO	~ 1979	Panned Concentrates	Sn, W, Cu, Pb, Zn, Ag (F, in water samples)

Boundary of DIGHEM^{III} SURVEY — AUSTAMAX, 1984.

LOCALITY MAP

INDEX TO ADJOINING MAPS

LEGEND

PROJECTION: Universal Transverse Mercator (UTM).
HORIZONTAL DATUM: Australian Geodetic Datum 1966.
VERTICAL DATUM: Australian Height Datum (Tasmania) - mainly AHD63, locally where datum is mean sea level.
GRID: 1:25,000 Metric Grid. Zone 55 Universal Transverse Mercator Grid. Zone 55 Australian Map Grid. Australian National Spheroid. Grid values are shown in full at the south west corner of the map.
CONTOUR INTERVAL: 10 metres with 50 metre index contours.

WORLD GEODETIC SYSTEM 1972. To convert co-ordinates from this system to Australian Geodetic Datum 1966, increase the value of latitude by 0.2" and decrease the value of longitude by 2.7" (3 arcsec).

MAGNETIC VARIATION: True, Grid and Magnetic North are shown. The annual change in magnetic variation from Magnetic North is correct for 1981 and varies annually about 0.1° every few years.

SCALE 1:25 000
1 millimetre represents 25 metres

358146

91-3277.1

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DELORAINE
EXPLORATION LICENCE 16/90

LOCATIONS OF PREVIOUS GEOCHEMICAL AND GEOPHYSICAL SURVEYS.

SCALE 1:25,000
0 500 1000 1500 2000
metres

Compiled: [illegible]	Date: March '84	Dwg No.:
Report No.:	Map Ref.:	PLATE FIG: 3

5 cm