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CRA EXPLORATION PTY. LIMITED

EL 35/92 ANDERSON'S CREEK, TASMANIA
ANNUAL REPORT FOR THE PERIOD ENDING
16th APRIL, 1994

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LICENCE HOLDER: CRA EXPLORATION PTY. LIMITED

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CIS Canberra
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CRAE Report No. 19644

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1. SUMMARY

The large size of the Anderson's Creek Ultramafic Complex, the high degree of serpentinization, and the presence of Ni-laterite at surface make the ACC a significant target for a bulk low-grade primary Ni resource. Work at EL 35/92 is investigating the development of primary Ni-sulphide accumulations in the absence of a systematic evaluation of this type in the past.

Geological mapping and reconnaissance rock chip sampling of the ACC was initiated during the reporting period. Best results from geochemical analysis of 48 rock chips were:

1.71% Ni	(3530513)
0.83% Ni	(3530520)
0.61% Ni	(3530522)

These samples were taken from the area north of Hinds Road and south of Barnes Hill. Enterprise Exploration Co. Pty. Ltd. recognised garnierite associated with rodingite in this location.

The major focus for exploration in 1994 will be systematic bedrock sampling in areas highlighted as prospective for Ni-sulphide mineralisation by previous work and CRAE investigations.

2. INTRODUCTION

EL 35/92 Anderson's Creek was granted on the 17th of April 1993 for an initial tenure of one year. The exploration licence encompasses an area of 62 sq km and is located on the Tamar 8215 1:100,000 map sheet as shown in Plan Tv 668. During the period under review, CRAE has a statutory obligation to expend $12,400. This report details all exploration activities conducted within EL 35/92 by CRAE during 1993.

Exploration activities by CRAE elsewhere in Australia have led to the recognition that certain types of ultramafic complex may host low-grade Ni mineralisation in a form that offers superior metallurgical characteristics to the conventional pyrrhotite-pentlandite ores. Whilst the mechanism to produce this style of mineralisation is not yet understood, serpentine development and low Fe may be key requirements.

The Anderson's Creek Ultramafic Complex crops out or is covered by residual laterite over an area of 12 sq km. BHP airborne magnetic data show the UM to have a strike extent of 19 km (Newman, 1965), covered to the north and south by post-Cambrian sediments. Residual laterites developed on the serpentinite are nickeliferous.

The large size of the ultramafic body, the high degree of serpentinization, and the presence of Ni-laterite at surface indicate the ACC to be a significant target for a bulk low-grade primary Ni resource. Work at EL 35/92 will investigates the development primary Ni-sulphide accumulations in the absence of a systematic evaluation of this type in the past.

An extensive track network exists in areas of RAP and Australian Heritage Act Registered Entry (AHARE). Exploration in these areas should not be limited by restrictions on access development. The location of RAP areas, AHARE areas, and other important land status classifications within EL 35/92 are shown on Plan Tv 669.

3. RECOMMENDATIONS

Review of previous work should be completed as a priority.

The program of mapping and reconnaissance rock chip sampling of the ACC should continue with the aim of identifying prospective areas and stratigraphy. The Ni : chalcophile ratio and PGE tenor of samples is probably the best indication of Ni-sulphide prospectivity. Petrology may aid in the identification-confirmation of Ni-sulphide mineralisation.

A program of systematic bedrock sampling in areas highlighted as prospective by previous work and CRAE investigations is the only way of ultimately testing the ACC for primary Ni-sulphide mineralisation.

4. REGIONAL GEOLOGY

4.1 Regional Geological Setting

The ACC occurs immediately east of the Badger Head Group quartzarenites, siltstones, and slaty mudstones (Gee & Legge, 1974). Cambrian slate and Ordovician Cabbage Tree Formation (sandstone) occur between Beaconsfield and Anderson's Creek as imbricate thrust slices juxtaposed with the Precambrian rocks by faulting (Gee & Legge, 1974). The ACC occurs close to the boundary between the Precambrian basement and the Cambrian and Ordovician sedimentary rocks. Gee and Legge (1974) postulate the intrusion of a layered complex into sedimentary rocks of Cambrian age, followed by later reintrusion along a line of structural weakness.

4.2 Geology of the Anderson's Creek Ultramafic Complex

The Anderson's Creek Ultramafic Complex consists of serpentinite, pyroxenite, and gabbro. Included in the ACC are several septa of metamorphosed greywacke-type sediments and small lenses of albitite (syenite consisting almost entirely of sodic alkali feldspar) and rodingite (gabbroic rock containing grossular and cpx) (Green, 1958). The ACC has been extensively serpentinized, this has obscured the original nature of some rocks. Geochemical analysis of rocks from the ACC indicate that peridotites and dunites form a substantial part of the ACC (Gee & Legge, 1974).

Cambrian ultramafic rocks outcrop over a length of 6.5 km with a maximum width of 1.5 km. BHP aeromagnetic data indicates that the ultramafic belt continues under a cover of Permian sediments over a length of 19 km with a maximum width of 4 km (Newman, 1965). Major rock types recognised by BHP (Anon., 1966) are:

Serpentinite
Composed predominantly of antigorite (platy) and seamed by irregular veins of chrysotile (fibrous). Serpentine ($Mg_3Si_2O_5(OH)_4$) is commonly formed by the *alteration of magnesium silicates; especially the hydration of ol, pyr, and amph.* Fe and Ni may substitute to some extent for Mg.

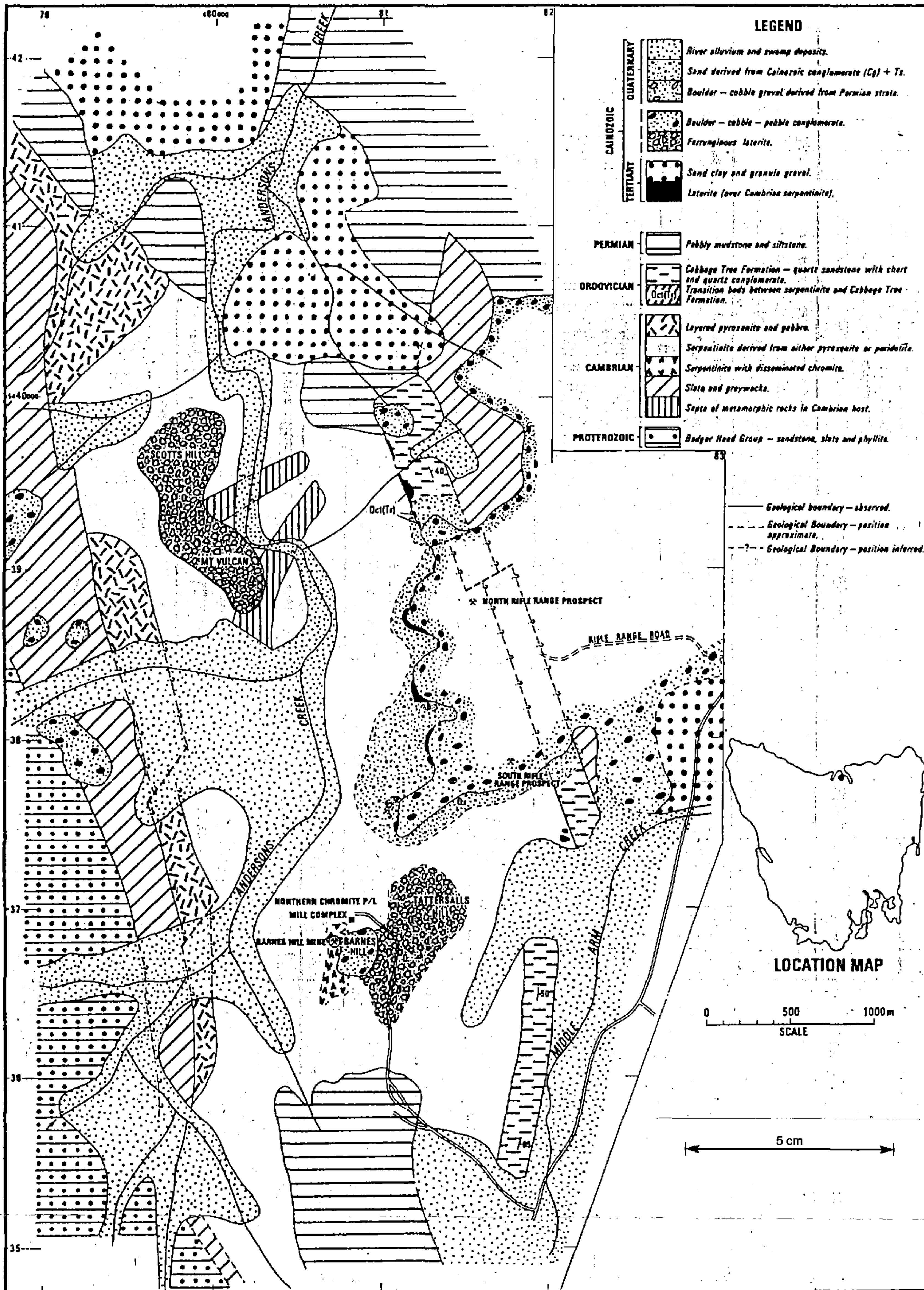

FIG. 1 Geology of the Andersons Creek-Barnes Hill area, Beaconsfield. (Summons etal, 1981)

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Two stages of mineralisation are recognised, intramagmatic disseminations of magnetite and chromite, and hydrothermal rèplacement of vein chrysotile by magnetite.

Pyroxene Gabbro
Occurs mainly in the NW sector of the ACC. The rock shows evidence of saussuritization (plagioclase alteration to epidote - syn serpentinization?) and contains ilmenite, pyrrhotite, and occasionally pentalandite, and chalcopyrite.

Pyroxenite
Outcrops in units up to 40 m wide throughout the serpentinite. The pyroxenite consists almost entirely of enstatite, bronzite or diallage, with rare olivine, chromite, magnetite, chalcopyrite and chalcocite. The diallage pyroxenite shows weak serpentinization.

Rodingite
Rodingite occurs south of Barnes Hill and is the product of lime metasomatism of coarse hornblende gabbro prior to serpentinization. Hornblende is probably the product of alteration of pyroxene during late magmatic stages of crystallisation.

Leucocratic Rocks
25 m bodies of sausseritized diorite consisting of pyroxene, amphibole, plagioclase, sericite, and secondary feldspar with coarsely crystalline amphibole and pyroxene remnants occur in association with hornblende gabbro. These rocks commonly occur south of Frenchmans Quarry.

Metamorphic Rocks
Septas of metamorphic rocks consisting of quartz, plagioclase and biotite and which show a gneissic lineation (biotite gneiss) occur within the ACC.

The distribution of major rock types is shown in Figure 1.

4.3 Lateritic Weathering

Two main periods of lateritization have occurred in the area, producing the older laterite (late Mesozoic to early Tertiary) and the younger laterite (middle Tertiary) (Summons et al., 1981).

Zeissink (1971) distinguished three zones within ferruginous laterite:

the upper ferruginous zone I	Fe_2O_3 > 30 mass percent
the intermediate smectite zone II	Fe_2O_3 15-30 mass percent
the bleached /weathered rock zone III	Fe_2O_3 < 15 mass percent

Secondary silica is commonly associated with the smectite group of clay minerals (zones II & III) in laterite profiles over UM complexes.

The older laterite consists of weathered serpentinite and smectite clays containing opaline and chalcedonic silica veinlets and thin plates which are coloured pale blue (Ni?), white, grey, green, brown, and black. These silica plates and veinlets form subrectangular to ovoid and meshlike boxworks with non-platelike masses of chalcedonic silica. This represents predominantly zone III with some nickeliferous basal zone II remnants of a previously intact ferruginous laterite. The older laterite is preserved at Barnes Hill and the Rifle Range area, and is capped by Tertiary sedimentary rocks (Summons et al., 1981).

The younger laterite (zone I) is developed at Tattersalls Hill and is superimposed on the Tertiary lower clay member, which overlies the older laterite (Summons et al., 1981).

The older laterite is the only ferruginous laterite of economic significance, because it contains lateritic nickel mineralisation (nickeliferous smectite).

5. MINERALISATION

The ACC has a long history of mining. The Tasmanian Charcoal Iron company first mined iron ore from ferruginous laterites on the summits of Scotts Hill, Mt. Vulcan, and Tattersalls Hill in 1872. Other mineral occurrences from the ACC exploited on a limited scale are asbestos, serpentinite, and ochre. Chromite bearing Cenozoic sediment was mined from Barnes Hill for foundry sands by Northern Chromite Pty. Ltd. in recent times.

Chromites occur as primary constituents in the ACC, and as erosional products derived from it in the Cabbage Tree Formation at Cabbage Tree Hill, and in Cenozoic sedimentary rocks. Cr spinels are relatively abundant within the ACC (up to 10%).

The sequence of events responsible for formation of the Cenozoic chromite rich sediments exploited at the Barnes Hill mine is as follows (Summons et al., 1981):

- Concentration of residual chromite by lateritic weathering of the ACC.
- Erosion, short distance transportation, and deposition producing the lower clay member (LCM).

The LCM has up to 50 mass percent disseminated heavy minerals, predominantly chromite, and is frequently stained by a pale blue (Ni stained kaolinite/chamosite - derived from Ni smectite in older laterite zone II).

- Concentration of disseminated chromite by wave action in a beach environment producing the chromite member (CM).

The CM has 20 to 80 mass % chromite, silica platelets and quartz, and constitutes the main ore horizon at the Barnes Hill Mine. With the second clay member, the CM also constitutes the ore horizon in the Rifle Range Prospect.

- Burial of these beach placers by the second clay member.

The locations of these horizons and interpreted Tertiary physiography are shown in Figure 2.

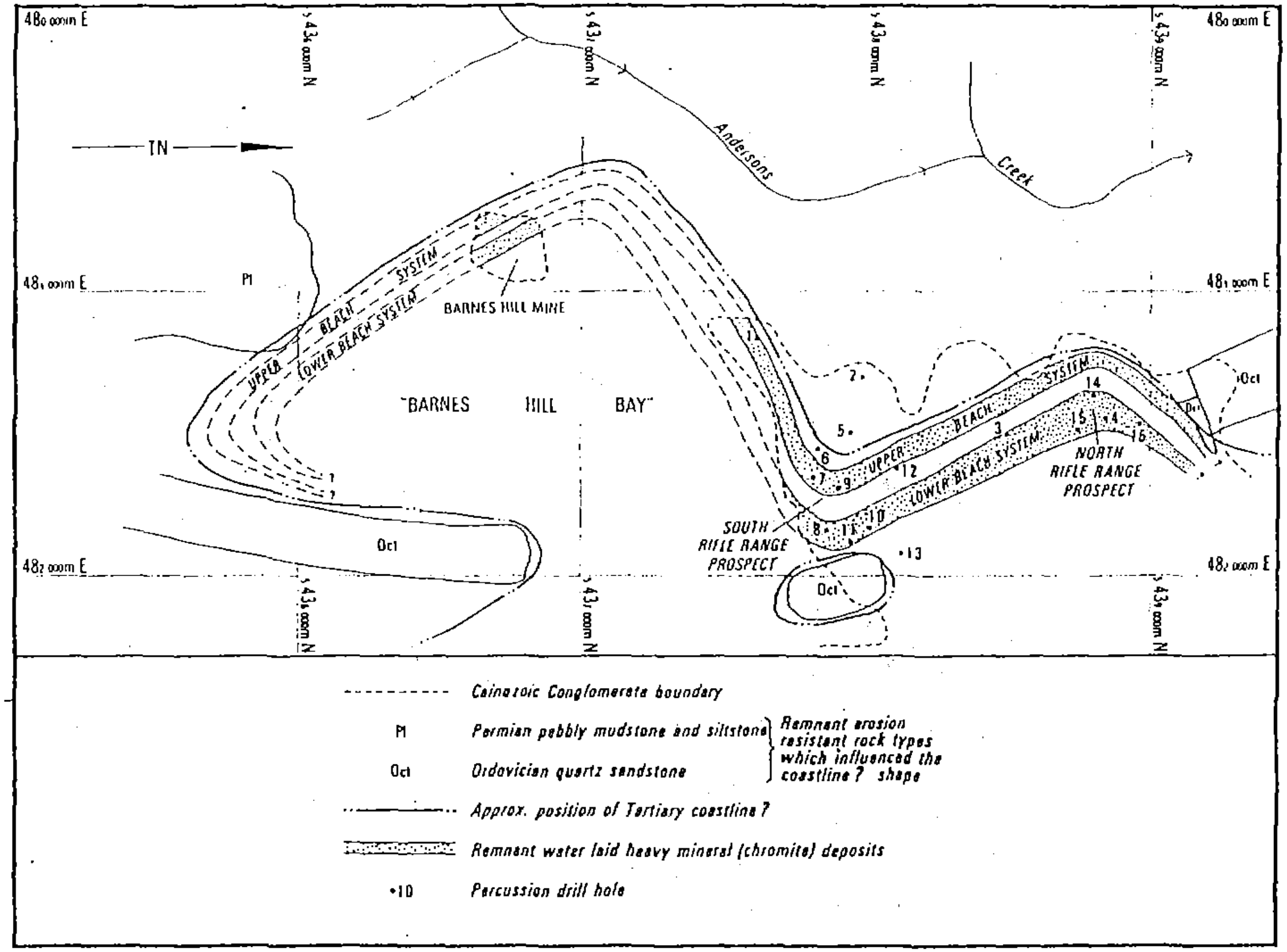

FIG. 2. Interpreted Tertiary coastline? physiography, Rifle Range-Barnes Hill area, Beaconsfield **Summons etal, 1981**

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6. PREVIOUS EXPLORATION

Ni in the Beaconsfield area was first recorded by Thereau (1883) from the old Victoria mine. This was later confirmed by Twelvetrees (1903), but no further investigations were undertaken until 1955.

Between 1955-1957 the Ben Lomond Mining Co. sampled Ni bearing serpentine from outcrop and pits sunk to hard rock. They discovered an - "enormous area of nickeliferous plastic clay of deep brown or yellowish colour with 1.75% Ni."; derived from the decomposition of serpentinite. In 1957, they entered an agreement with Enterprise Exploration to investigate this mineralisation.

Enterprise Exploration Co. Pty. Ltd. (EEC) (1957-58) produced a geology plan of the ACC. Mapping showed outcrop of garnierite (an apple green serpentine formed as an alteration product of Ni-rich peridotites) bearing serpentinite restricted to the area bounded by Hinds Road to the south, Ordovician quartzite to the east, and the Barnes Hill laterite to the north. Garnierite was mined as a Ni ore in New Caledonia, the USSR, and Australia. Rodingite outcrops nearly exclusively in this area.

EEC bored 147 auger holes in traverses across "unconcealed ultrabasics". 57 holes were augured into the garnierite bearing serpentinite area. Holes were located at 30 m intervals along three traverses. A further 90 holes were augured into other areas within the ACC at 60 m intervals along traverses totalling 4.8 km. Auguring sampled soil derived from the serpentinite; and where present, quartzite and laterite cover. With two exceptions, holes bottomed on hard rock. Whole samples were recovered and assayed for Ni, Fe, and Co (10 samples only) over selected intervals.

Best assay results were of samples taken from the garnierite bearing serpentinite area.

Line 1 (420 m)	16 holes	Best interval	1.25 m @ 1.83% Ni
		Average assay	0.96% Ni
Line 2 (465 m)	18 holes	Best interval	1.5 m @ 0.83% Ni
		Average assay	0.41% Ni
Line 3 (675 m)	23 holes	Best interval	1.25 m @ 1.3% Ni
		Average assay	0.52% Ni

Assay results of auger lines in other areas averaged below 0.3%. The best assay result was 0.5% Ni.

It is unlikely that the body of soil within the garnierite bearing serpentinite area exceeds 0.5 Mt @ 1% Ni. Ni mineralisation observed is a secondary accumulation formed in the soil profile over nickeliferous zones of the ACC.

Following mineralographic studies by the CSIRO, the Department of Mines drilled a single 49 m diamond hole to test for any nickel-rodingite association. Assay of samples from drilling yielded Ni values between 0.03% and 0.7% (Hughes, 1965). Elevated nickel was present as garnierite and was generally associated with rodingite.

In May 1965, AMEG Pty. Ltd. conducted an airborne proton magnetometer survey over an area including the ACC for BHP (Newman, 1965). Results from a preliminary survey including the ACC are shown on magnetic contour maps Sheet no.s 2 and 3 (155 m flying). Results from a more detailed survey over the ACC are shown on magnetic contour map Sheet no. 4 (NE-SW flight lines, 75 m terrain clearance, 400 m line spacings, 5 tie lines.).

Airborne magnetic data show a long line of large amplitude north trending anomalies coincident with mapped ACC ultramafics and Fe rich lateritic clays and pebbles. BHP interpreted several bodies of moderate susceptibility underlying surface material at shallow depth (Anon., 1966?). Follow-up ground magnetometer survey inspected Fe rich clays and gravels at Barnes Hill. Ground survey showed that laterite cover was strongly and non-uniformly magnetised, with variations of several thousand gammas over 5-10 m.

A 4000 gamma aeromagnetic anomaly (Line 20) coincident with Scotts Hill was investigated by ground magnetic survey and a single diamond drill hole DDH No.1. Drilling intersected serpentine with minor asbestos and magnetite veining from 95 m to 207 m EOH; Ni-sulphide mineralisation was not observed. Magnetite veining, although uneconomic, was sufficient to account for the magnetic anomaly. It is unclear whether the core was assayed.

A 325 sq km area was covered by BHP drainage sampling. Samples were assayed for leachable Cu, Zn, and Ni; and for total Mo (only one sample above background).

Nickel and chrome bearing laterites identified by previous investigations of the AAC were sampled by drilling and costeaning.

Mt Vulcan	4 bores	3 excavations
Scotts Hill	2 bores	2 excavations
Barnes Hill	5 bores	11 excavations

Holes were bored to depths between 6 and 25 m, and where possible bottomed in bedrock. Samples were taken at 1.5 m intervals and assayed for Fe, Ni, Cr_2O_3 and Co. Excavations were between 2 and 6 m deep and generally bottomed in laterite. Samples were taken from lithologically defined intervals and assayed for Ni and Co.

Chromite bearing gravels in the ACC were tested by pitting along lines. 99 pits were excavated along 17 lines. Pits were up to 3.5 m deep and where possible bottomed in bedrock. 315 samples were taken from lithologically defined intervals. Samples were assayed for Ni, Co, Pt (assay results not recorded), and Cr_2O_3.

In 1967 King Island Scheelite (1947) Ltd.commenced a detailed sampling program of the weathering profile. 37 diamond drillholes defined four areas of mineralisation totalling 6 Mt @ 1% Ni (0.7% Ni cut-off) and 0.06% Co. Mineralogical studies indicated the Ni to be bound to smectite clays and iron oxides within the saprolite zone.

Assay of fresh ultramafic from the drilling program indicated a general Ni content of between 0.2 - 0.3%, and up to 0.7%. Garnierite occurring with opaline silica along partings was observed in fresh ultramafic, particularly near rodingite occurrences (Gee & Legge, 1979).

In 1971-72 Allstate Exploration N.L. drilled 15 diamond drill holes totalling 2000 m to determine the extent of development of asbestos serpentine (also several thousand metres of trenching).

Compilation of previous workers data is continuing.

7. WORK UNDERTAKEN

During the reporting period, 48 grab outcrop and float rock chip samples were collected as part of a reconnaissance/orientation mapping and geochemical survey. Samples weighing 1-2 kg were sent to:

ALS where they were crushed, pulverised, and analysed for Au by PM219 (50 g fire - AAS/GFA), Cu Pb Zn Ag As Fe Mn Mo Bi Cr Co Ni S by IC586 (HF/HNO_3/HCl digest - ICP), and Au Pt Pd by PM 217 (50 g fire - AAS).
or
Analabs where they were dried, crushed, pulverised (GPO33) and analysed for Cu Pb Zn Ag Ni Co Fe Mn by GA140 (0.3 g aqua regia/perchloric acid digest - AAS) and As by HA140 (hydride generation - AAS). Samples with Ni > 0.4% were also assayed for Au Pt Pd by GG316 (50 g fire - AAS), and S by OM613 (Leco).

Rock sample locations are shown on Plan Tv 667. Sample ledgers with assay results are included in Appendix I.

Four rock chips submitted for geochemical analysis were selected for petrological description. Samples were sent to R.N. England for transmitted light thin section preparation and description. Petrological laboratory reports are included in Appendix II.

Best results from geochemical analysis of rock chips were:

1.71% Ni	(3530513)
0.83% Ni	(3530520)
0.61% Ni	(3530522)

These samples were taken from the area north of Hinds Road and south of Barnes Hill. EEC recognised garnierite associated with rodingite in this location.

Forty percent of rocks assayed had greater than 2% Ni. Poor assay results of other chalcophile elements and lack of visible Ni-sulphide mineralisation in these rocks is consistent with a silicate, and not sulphide Ni source.

8. ENVIRONMENT AND REHABILITATION

Activities conducted during the reporting period have had no impact on the environment. No rehabilitation was required.

Thureau, G.,	1883	Beaconsfield and Salisbury mining district, house of Assembly Pap. Tasm. 1883 (51).
Twelvetrees, W.H.,	1903	Report on the Mineral Resources of Beaconsfield and Salisbury, Mines Department, Tasmania.
Zeissink, H.E.,	1969	The mineralogy and geochemistry of a nickeliferous laterite profile (Greenvale, Queensland, Australia): Mineralium Deposita, v. 4, p. 25-36.

KEYWORDS

Nickel, Iron Ore, Laterite, Cambrian, Geology, Mineralisation, Rock Geochemistry, Ultrabasic, Chemical Analysis, Geological Mapping Detailed, Literature Review.

LOCATION

Launceston	1:250,000	SK55-4
Tamar	1:100,000	8215

LIST OF DPO'S

77203, 77205-207

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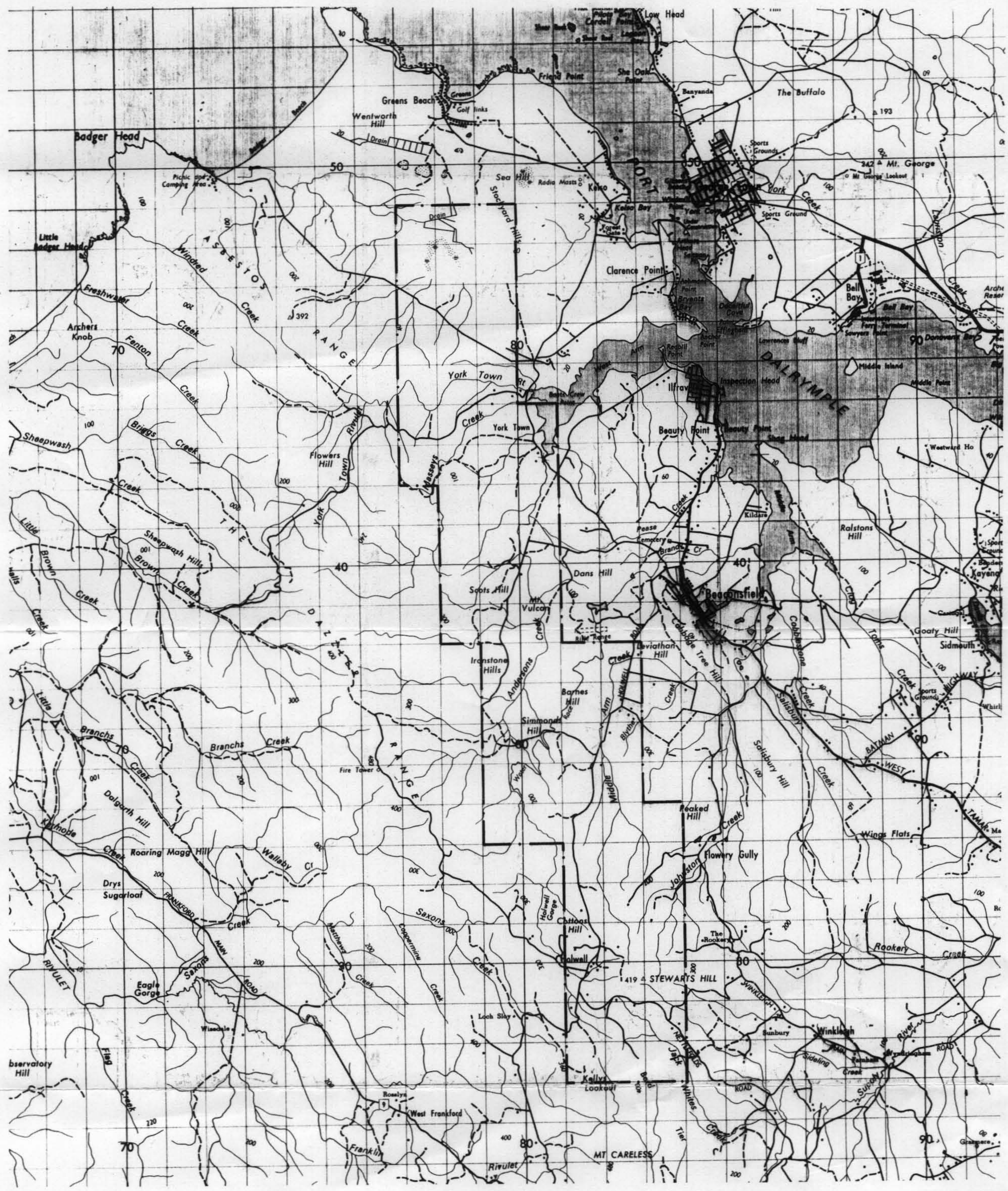

0	1	2	3	4	5	6	7	8	9	10km

5 cm

Mar. 1994

CRA EXPLORATION PTY. LIMITED

ANDERSON'S CREEK
EL 35/92
LOCATION PLAN

929014

Ref.: SK55-04	Scale: 1:100 000
Author: S. Maher	Report No.: 19644
Drawn: S. Brook	Plan No.: Tv 668

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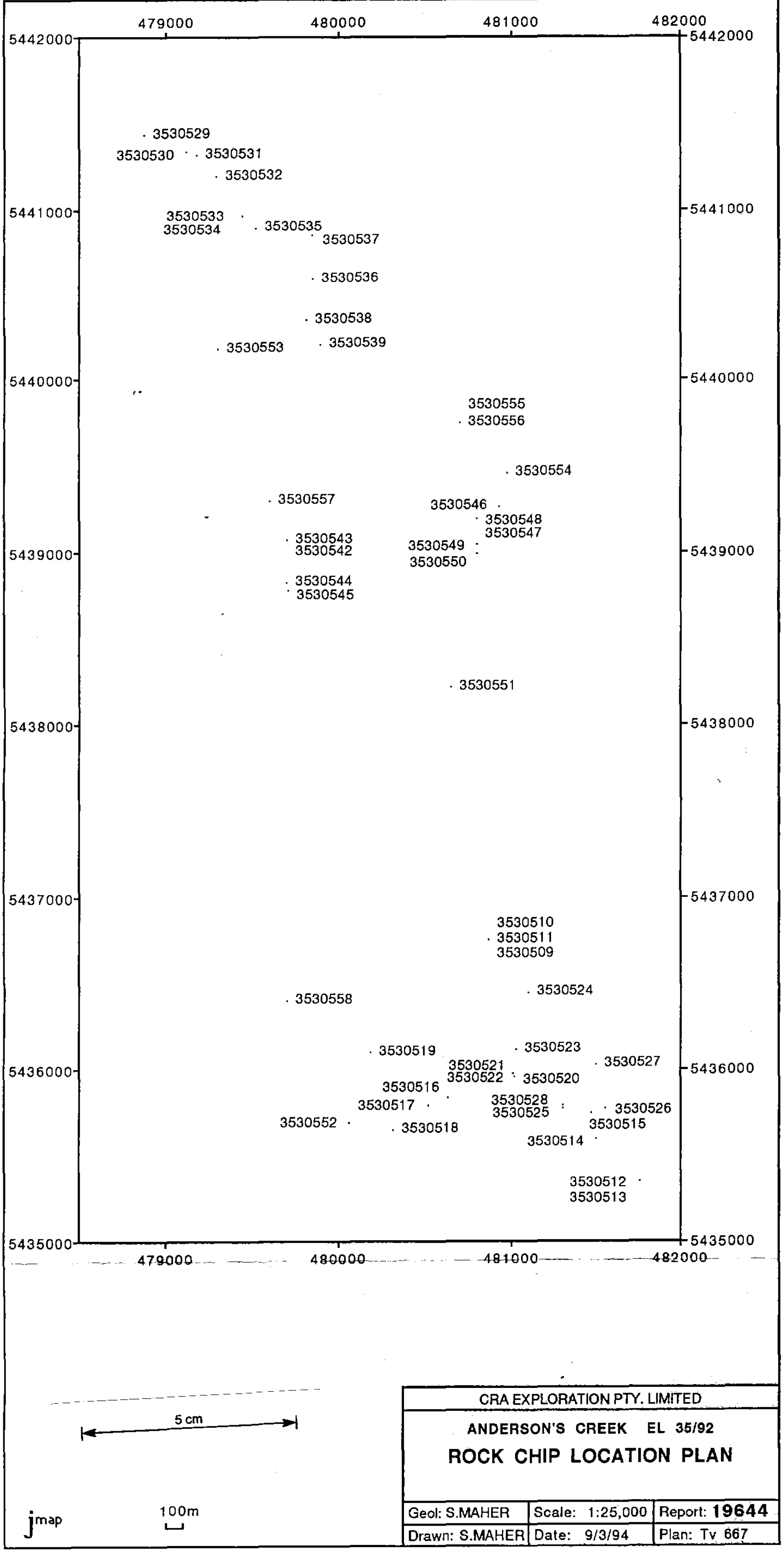
94-3553

CRA EXPLORATION PTY. LIMITED

ANDERSONS CREEK
EL 35/92
LAND STATUS PLAN

Ref.: Launceston SK5504	File: AndyCk /669
Scale: 1:25000	Date: March, 1994
Author: S. Maher	Report: 19644
Drawn: S. Brook	Plan No.: Tv 669



CRA EXPLORATION PTY. LIMITED		
ANDERSON'S CREEK EL 35/92		
ROCK CHIP LOCATION PLAN		
Geol: S.MAHER	Scale: 1:25,000	Report: **19644**
Drawn: S.MAHER	Date: 9/3/94	Plan: Tv 667

APPENDIX ONE

GEOCHEMICAL ROCK SAMPLE LEDGERS AND LABORATORY REPORTS

CRAE Exploration Pty Ltd GEOCHEMICAL SAMPLE LEDGER: ROCK

Project: ultramafic Ni
Tenement: EL 35/92
DPO: 77203

Map Sheets
250,000: SK55-3
100/25,000: 8215/4643-44, 4842-44.

Sampler: SM
Date: 24/9/93

SAMPLEno.	EASTAMG	NORTHAMG	EL	PROSP.	sampleTYPE	ROCKtype	NOTES
3530509	480875	5436750	35/92	BarnesHill	sel.grab-outcrop	unconsolidated chromite	Mine. Shore concerntrate of lateritic chromite. Includes lateritic silica flakes.
3530510	480875	5436750	35/92	BarnesHill	sel.grab-outcrop	blue clay	Unconsolidated azurite blue clay. Ni, Cu, Serp?
3530511	480875	5436750	35/92	BarnesHill	sel.grab-outcrop	green clay	Unconsolidated mallachyte green clay. Ni, Cu, Serp?

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	Ni	S	Bi	Au	Au PM	Pt	Pd	Cu	Pb	Zn	Ag	As	Fe	Co	Cr	Mn	Mo
Lab:	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS
Det.Limit:	5	10	5	0.001	0.001	0.01	0.01	5	5	5	1	1	0.01	5	10	10	5
Method:	IC586	IC586	IC586	PM219	CHECKS	PM217	PM217	IC586	IC586	IC586	IC586	IC586	IC586	IC586	IC586	IC586	IC586
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
3530509	174	1790	<5	0.054	0.042			618	946	2180	1	9	0.96	13	3830	121	<5
3530510	574	3570	<5	0.1	0.094			1520	2170	4020	2	37	3.64	37	1.53%	38	7
3530511	2300	541	<5	0.038	0.045			316	246	589	1	29	9.27	111	7050	50	<5

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929020

CRAE Exploration Pty Ltd GEOCHEMICAL SAMPLE LEDGER: ROCK

Project: ultramafic Ni | Map Sheets | Sampler: SM | UNITS
Tenement: EL 35/92 | 250,000: SK55-4 | Date: 12/10/93 | Det.Limit:
DPO: 77205 | 100/25,000: 8215/4643-44, 4842-44. | | METHOD

SAMPLEno.	EASTAMG	NORTHAMG	EL	PROSP.	sampleTYPE	ROCKtype	NOTES
3530512	481750	5435350	35/92		s.g.-float	Ordovician sandstone	From quarry off Hinds Rd. Purple stained ferruginous, coarse, quartz sandstone. FeO lined pits occur in 2mm laminae parallel to grainsize defined bedding.
3530513	481750	5435350	35/92		s.g.-subcrop	Serpentinised dunite	From W quarry off Hinds Rd. Amorphous lime green serpentinite with 1% Chromite, wispy seams of magnetite with prominent green haloes (zaratile?), and asbestos serp. veinlets. REP sample.
3530514	481500	5435600	35/92		s.g.-subcrop	Rodingite	From Hinds Rd. 15-20% hornblende/chl/px? in plag. 2% grossularite garnet (1-3mm). REP and PET sample.
3530515	481475	5435750	35/92		s.g.-outcrop	Rodingite	From Rodigite Tr. 40% hornblende/chl/px? (up to 7cm) in plag. Trace garnet in plag.. *Relatively prominent, strikes NW. Trace silver* metallic mineral occurs in seams (Ni silphide?). PET sample.
3530516	480630	5435840	35/92		s.g.-subcrop	Serpentinite	From Hinds Rd. Variably amorphous serpentinite. Primary mineralogy/textures absent. Cr-spinel 5-10%. Silver metallic wisps conc. in amorph. zones - magnetite/Ni sulphide? Prominent slickensides. PET sample.
3530517	480520	5435790	35/92		s.g.-subcrop	Serpentinite	From Hinds Rd. Variably amorphous *serpentinite. Primary mineralogy/textures absent. Cr-spinel 5-10%. Amorphous serp. haloe about* silver metallic vein stockwork - magnetite/Ni sulphide? Prominent slickensides and asbestos veinlets. PET sample.
3530518	480320	5435650	35/92		s.g.-outcrop	Serpentinised dunite?	From Hinds Rd. w/in laterite. Foliated, pervasively serpentinised dunite? Foliation subvertical 120-300. Prominent slickensides.
3530519	480180	5436100	35/92		s.g.-outcrop	Altered dunite	From Simmons Tr. Serpentinised dunite? Cr-spinel 3%. Calcite? and lime green "wet" mineral line partings. PET sample.
3530520	481020	5435960	35/92		s.g.-outcrop	Amorphous serpentine?	From Barnes Rd. *Transluscent amorphous relatively hard lime green mineral. Occurs as a 2cm vein in dunite.* PET sample.
3530521	481010	5435980	35/92		s.g.-outcrop	Serpentinised dunite	From Barnes Rd. Serpentinised dunite. 3% Cr-spinel (<1mm). Stockwork fracturing is lined by seams of magnetite/Ni sulphide, and has an amorphous serpentine haloe.
3530522	481010	5435980	35/92		s.g.-outcrop	Sheared dunite	From Barnes Rd. Highly strained, strongly serpentinised dunite. A strong foliation is developed in the rock, including boudins.
3530523	481030	5436120	35/92		s.g.-float	Tectonised serpentinite	From Barnes Rd. *Tectonised serpentinite, primary min/tex absent. Duck egg hellyerite? and green zaratite? line partings (possibly an* amorphous serpentine derivative).
3530524	481100	5436450	35/92		s.g.-outcrop	Pyroxenite	From Barnes Rd. Layered pyroxenite. Layering defined by crystal size (up to 2mm).
3530525	481300	5435780	35/92		s.g.-float	Gabbroid	From Rodingite Tr. 40% pyroxene/hnb/ch? (<1.5cm) in plagioclase.
3530526	481550	5435780	35/92		s.g.-subcrop	Garnierite bearing serpentinite	From Garnierite Tr. *Strongly serpentinised and extensively magnetite veined plagioclase peridotite? with relict plagioclase and* pyroxene. Garnierite occurs as green transluscent rossettes along partings. PET sample.
3530527	481500	5436030	35/92		s.g.-subcrop	Gabbroid	From Garnierite Tr. Pyr/hnbl/chl? (2-20mm) in, and being exsolved by? plagioclase. Magnetite/chromite disseminations in plagioclase <1%, <2mm. PET sample.
3530528	481300	5435790	35/92		s.g.-outcrop	*Garnierite bearing gabbroid*	*From Rodingite Tr. Gabboid with garnierite developed along partings.*
3530529	478880	5441440	35/92		s.g.-float	Layered gabbronorite	From Masseys Crk Rd. Plag. (50%) is interstitial to pyroxene (<1mm). Layering is defined by variations in mineral proportions.
3530530	479120	5441340	35/92		s.g.-float	Layered melagabbronorite	From Masseys Crk Rd. Plag. (15%) is interstitial to pyroxene (<2mm). Layering is defined by variations in mineral proportions. Silver 1mm chromite disseminations <1%.
3530531	479180	5441325	35/92		s.g.-float	*Dunite?*	*From Masseys Crk Rd. Weak to absent serpentinisation. 3% chromite disseminations. Possible dyke.*
3530532	479290	5441200	35/92		s.g.-float	Layered peridotite	From Masseys Crk Rd. Pyroxene and olivine rock. Layering (1-10cm) is defined by variations in mineral proportion.
3530533	479440	5440970	35/92		s.g.-subcrop	Layered leucogabbronorite	From Masseys Crk Rd. Plagioclase (80%) interstitial to pyroxene (<2mm). A weak layering is defined by variations in mineral proportions. Some magnetite veinlets. PET sample.
3530534	479440	5440970	35/92		*s.g.-subcrop*	*Albitite*	*From Masseys Crk Rd. Occur as boulders of plag., quartz, and K-feldspar.*
3530535	479520	5440900	35/92		s.g.-subcrop	Albitite	From Masseys Crk Rd. Plag., quartz, and light green mineral? have igneous textures. PET sample.
3530536	479850	5440590	35/92		s.g.-outcrop	Serpentinite	From Masseys Crk Rd. Strongly serpentinised rock - primary textures are obscured. Prominent magnetite veinlets and chromite disseminations (2%).
3530537	479850	5440850	35/92		s.g.-outcrop	*Serpentinite and garnierite?* vein.	From Masseys Crk Rd. Vein in strongly serpentinised pyroxenite (2mm).
3530538	479810	5440350	35/92		s.g.-outcrop	Layered pyroxenite	From Massey Crk Rd. Prominant layering of pyroxenite (4mm) and possible peridotite. Pitting reflects preferenial lateritic weathering of pyroxenes. PET sample.

	Cu	Pb	Zn	Ag	Fe	Fe	Mn	Mn	Ni	Ni	Co	As	S	Au	Au(R)	Pt	Pt(R)	Pd	Pd(R)
	ppm	ppm	ppm	ppm	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
	2	3	2	1	0.01	0.01	3	0.01	3	0.01	3	0.5	0.005	0.005	0.005	0.05	0.05	0.005	0.005
	GA140	GA140	GA140	GA140	GA140	GA104	GA140	GA104	GA140	GA104	GA140	HA140	OM613	GG316	GG316	GG316	GG316	GG316	GG316
SAMPLEno.																			
3530512	65	316	333	<1	-	37.7	505	-	589	-	406	65	-	-	-	-	-	-	-
3530513	4	<3	83	<1	4.42	-	663	-	-	1.71	682	1	0.01	<0.005	<0.005	<0.05	<0.05	<0.005	<0.005
3530514	3	4	58	<1	-	5.93	1956	-	120	-	26	1	-	-	-	-	-	-	-
3530515	5	<3	70	<1	-	5.72	2655	-	233	-	39	<0.5	-	-	-	-	-	-	-
3530516	3	<3	43	<1	4.01	-	325	-	2942	-	107	<0.5	-	-	-	-	-	-	-
3530517	2	<3	75	<1	-	9.44	924	-	2847	-	189	2	-	-	-	-	-	-	-
3530518	7	<3	45	<1	4.97	-	636	-	4116	-	189	<0.5	0.01	0.008	-	<0.05	-	<0.005	-
3530519	11	<3	28	<1	-	6.06	619	-	2633	-	113	<0.5	-	-	-	-	-	-	-
3530520	5	3	20	<1	2.2	-	1528	-	-	0.83	155	1	0.01	<0.005	-	<0.05	-	<0.005	-
3530521	5	3	30	<1	2.92	-	464	-	2859	-	95	1	-	-	-	-	-	-	-
3530522	3	3	29	<1	2.75	-	516	-	-	0.61	145	0.5	0.01	<0.005	-	<0.05	-	<0.005	-
3530523	5	<3	28	<1	4.15	-	541	-	-	1.24	239	<0.5	0.015	<0.005	-	<0.05	-	<0.005	-
3530524	3	7	32	<1	4.01	-	707	-	1464	-	95	1	-	-	-	-	-	-	-
3530525	3	3	100	<1	-	10.4	4185	-	504	-	83	0.5	-	-	-	-	-	-	-
3530526	5	3	138	<1	-	9.26	-	0.75	1949	-	171	0.5	-	-	-	-	-	-	-
3530527	5	6	41	<1	2.92	-	-	0.7	311	-	173	1	-	-	-	-	-	-	-
3530528	4	5	58	<1	3.66	-	3280	-	130	-	25	0.5	-	-	-	-	-	-	-
3530529	21	3	27	<1	2.91	-	502	-	154	-	30	<0.5	-	-	-	-	-	-	-
3530530	74	9	45	<1	3.83	-	504	-	56	-	27	3	-	-	-	-	-	-	-
3530531	2	4	38	<1	3.21	-	803	-	1665	-	138	<0.5	-	-	-	-	-	-	-
3530532	4	<3	48	<1	-	6.95	1565	-	1049	-	99	0.5	-	-	-	-	-	-	-
3530533	15	<3	27	<1	2.94	-	521	-	119	-	34	<0.5	-	-	-	-	-	-	-
3530534	12	<3	9	<1	1.73	-	1070	-	82	-	7	1	-	-	-	-	-	-	-
3530535	3	<3	18	<1	2.5	-	1169	-	331	-	47	0.5	-	-	-	-	-	-	-
3530536	4	<3	27	<1	-	6.28	291	-	1675	-	189	1	-	-	-	-	-	-	-
3530537	3	<3	28	<1	4.86	-	629	-	575	-	71	<0.5	-	-	-	-	-	-	-
3530538	4	<3	33	<1	-	7.04	715	-	1331	-	103	<0.5	-	-	-	-	-	-	-

929021

CRAE Exploration Pty Ltd GEOCHEMICAL SAMPLE LEDGER: ROCK

Project: ultramafic Ni
Tenement: EL 35/92
DPO: 77205

Map Sheets
250,000: SK55-4
100/25,000: 8215/4643-44, 4842-44.

Sampler: SM
Date: 12/10/93

UNITS
Det.Limit:
METHOD

SAMPLEno.	EASTAMG	NORTHAMG	EL	PROSP.	sampleTYPE	ROCKtype	NOTES
3530539	479890	5440210	35/92		s.g.-outcrop	Serpentinite	From Masseys Crk Rd. Strong serpentinisation obscures primary textures. Prominant magnetite veinlets are aligned in parallel seams. Chromite disseminations 1-2%.
[redacted]							
3530542	479700	5439070	35/92		s.g.-outcrop	Serpentinised tectonised peridotite?	From Tattersalls Rd. Strong serpentinisation and strain development obscures most primary textures. 5-10% chromite disseminations. Prominent asbestos serp./magnetite (70%) veins - 1cm.
3530543	479700	5439070	35/92		comp.-dump	Asbestos and magnetite	From Tattersalls Rd. Asbestos serpentine intergrown with magnetite (up to 90%) veins. Collected from Fe ore heap.
3530544	479700	5438830	35/92		s.g.-outcrop	Gabbronorite	From Tattersalls Rd. <4mm pyroxene (50%) in plagioclase.
3530545	479710	5438780	35/92		s.g.-outcrop	Serpentinite	From Tattersalls Rd. Strongly serpentinised magnetite rock at the margin of an Albitite unit. possible trace garnierite.
3530546	480930	5439270	35/92		s.g.-outcrop	Serpentinite	From Dans Hill Rd. Strongly serpentinised and tectonised - obscures primary textures. Prominent asbestos serp. veins and amorphous plag? alteration zones/veins? *Chromite disseminations 2%.*
3530547	480800	5439200	35/92		s.g.-outcrop	Serpentinised peridotite	From Dans Hill Rd. Relict pyroxene (4-40mm, 5-50%) within an amorphous serpentine (after olivine) groundmass. Chromite disseminations 2%. Magnetite veining common. PET sample.
3530548	480800	5439200	35/92		s.g.-float	Chromite layered serpentinite	From Dans Hill Rd. An amorphous serpentine (after olivine?) hosting layered chromite disseminations (up to 70%). PET sample.
3530549	480800	5439050	35/92		s.g.-outcrop	Pyroxenite	From Dans Hill Rd. 4mm pyroxenite with parallel, pitted, after garnierite? trails. PET sample.
3530550	480800	5438990	35/92		s.g.-subcrop	Serpentinised pyroxenite	From Dans Hill Rd. Strong serpentinisation (amorphous) almost obscures primary pyroxenite. Prominent asbestos serpentine and magnetite veining.
3530551	480650	5438220	35/92		s.g.-subcrop	Serpentinised pyroxenite	From Dans Hill Rd.

929022

SAMPLEno.	Cu	Pb	Zn	Ag	Fe	Fe	Mn	Mn	Ni	Ni	Co	As	S	Au	Au(R)	Pt	Pt(R)	Pd	Pd(R)
	ppm	ppm	ppm	ppm	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
	2	3	2	1	0.01	0.01	3	0.01	3	0.01	3	0.5	0.005	0.005	0.005	0.05	0.05	0.005	0.005
	GA140	GA140	GA140	GA140	GA140	GA104	GA140	GA104	GA140	GA104	GA140	HA140	OM613	GG316	GG316	GG316	GG316	GG316	GG316
3530539	4	<3	43	<1	-	8.36	492	-	1998	-	115	1	-	-	-	-	-	-	-
[redacted]																			
3530542	5	<3	99	<1	-	6.33	1170	-	2435	-	162	4	-	-	-	-	-	-	-
3530543	5	<3	28	<1	-	78	1214	-	868	-	326	28	-	-	-	-	-	-	-
3530544	6	3	26	<1	3.81	-	639	-	465	-	89	<0.5	-	-	-	-	-	-	-
3530545	7	3	51	<1	-	6.92	636	-	1890	-	93	<0.5	-	-	-	-	-	-	-
3530546	17	3	37	<1	-	7.03	666	-	1980	-	91	<0.5	-	-	-	-	-	-	-
3530547	6	<3	54	<1	4.63	-	2170	-	214	-	33	<0.5	-	-	-	-	-	-	-
3530548	8	4	31	<1	2.12	-	388	-	3110	-	99	<0.5	-	-	-	-	-	-	-
3530549	4	4	44	<1	-	6.62	1032	-	1667	-	86	<0.5	-	-	-	-	-	-	-
3530550	8	3	30	<1	3.16	-	424	-	1596	-	75	<0.5	-	-	-	-	-	-	-
3530551	5	<3	52	<1	4.83	-	910	-	1701	-	100	1	-	-	-	-	-	-	-

929023

CRAE Exploration Pty Ltd GEOCHEMICAL SAMPLE LEDGER: ROCK

Project: ultramafic Ni
Tenement: EL 35/92
DPO: 77206

Map Sheets
250,000: SK55-4
100/25,000: 8215/4643-44, 4842-44

Sampler: SM
Date: 15/10/93

SAMPLEno.	EASTAMG	NORTHAMG	EL	PROSP.	sampleTYPE	ROCKtype	NOTES
3530552	480060	5435700	35/92		s.g.-subcrop	Pyroxenite	From Simmonds Hill. 5mm pyroxenite. Emerald green (fresh) to duck egg blue (weathered) at margins. Weak serpentine development with prominant slickensides. Clear silica? along partongs.
3530553	479300	5440180	35/92		s.g.-outcrop	Layered peridotite	From Layered Tr. Layering defined by pyroxene proportion and size. Disseminated spinel 1%. PET sample.
3530554	480980	5439460	35/92		s.g.-float	Pyroxenite	From Dans Hill. Moderate serpentinization. 15% disseminated spinel.
3530555	480700	5439750	35/92		s.g.-outcrop	Sheared pyroxenite	From Dans Hill. Strong serpentinization with prominent slickensides and crysotile and magnetite veining. 5% Cr? spinel disseminations.
3530556	480700	5439750	35/92		s.g.-outcrop	Gossanous sheared pyroxenite	From Dans Hill. As for 555 but pervasively gossanous (relict laterite?).
3530557	479600	5439300	35/92		s.g.-subcrop	Rhyodacite?	From Scotts Hill. Igneous textured, fine quartz/biotite rock. PET sample.
3530558	479700	5436400	35/92		s.g.-outcrop	Sheared serpentinite	From Tattersalls Rd. Prominent slickensides, magnetite and crysotile veining.

LAB:	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS
Det.Limit:	5	10	5	0.01	0.01	0.01	0.01	5	5	5	1	1	0.01	5	10	10	5
Method:	IC586	IC586	IC586	PM217	PM217	PM217	CHECKS	IC586	IC586	IC586	IC586	IC586	IC586	IC586	IC586	IC586	IC586
	Ni	S	Bi	Pd	Pt	Au	Au PM	Cu	Pb	Zn	Ag	As	Fe	Co	Cr	Mn	Mo
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
SAMPLEno.																	
3530552	2190	83	<5	<0.01	<0.01	<0.01		<5	<5	26	<1	15	4.08	92	1970	489	<5
3530553	1130	116	<5	0.03	0.02	<0.01		<5	<5	20	<1	19	7.45	105	785	351	<5
3530554	2100	126	<5	<0.01	<0.01	<0.01		7	<5	108	<1	30	4.49	82	7110	1190	<5
3530555	2520	217	<5	<0.01	<0.01	<0.01		<5	<5	36	<1	12	2.66	83	981	211	<5
3530556	2620	447	<5	<0.01	<0.01	<0.01		14	32	137	<1	13	36.01	720	1470	6210	<5
3530557	92	5320	<5	<0.01	<0.01	<0.01		54	6	70	<1	8	5.61	32	329	575	<5
3530558	1620	172	<5	<0.01	<0.01	<0.01	<0.01	<5	<5	27	<1	17	3.9	81	1940	312	<5

929025

APPENDIX TWO

PETROLOGY LABORATORY REPORTS

929027

R.N.ENGLAND, CONSULTING GEOLOGIST

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11 Victor St.,
Cranbrook
(Townsville),
Queensland 4814,
AUSTRALIA.

November 29, 1993

Mr. Simon Maher,
CRA Exploration,
1/23 Bell St.,
Preston,
Victoria 3072.

INVOICE

Please treat this Faxed invoice as an original.

DPO No. 77207.

Preparation and petrographic notes for 4 samples from the Anderson's Creek Complex

$308

R.N.England

929028

DPO No. 77207. PETROGRAPHIC NOTES FOR 4 SAMPLES FROM THE ANDERSON'S CREEK ULTRAMAFIC COMPLEX, TASMANIA.

Prepared for Simon Maher, CRA Exploration Pty. Ltd..

3530514. Rodingite.

Prominent <5-mm blocky ?pyroxene subhedra are altered to aggregates of parallel c. 100-μm flakes of optically positive, aluminous chlorite which form subgrains in what is almost a single crystal. The rest of the rock, once mostly plagioclase, consists now of massive fine-grained (10-50 μm) grossular garnet and 20-400 μm prismatic anhedral, very pale pink vesuvianite. A 5-mm patch of 1-3 mm anhedral and prismatic vesuvianite may have replaced a single igneous crystal.

Patchy distribution of these phases and minor relics of the cleavages of the original igneous minerals indicate that the replaced rock was probably a coarse-grained gabbro (less likely a porphyry). Absence of Ti minerals suggests that it was a cumulate

Rodingites are gabbros which have reacted with low-T (200-400°), silica-undersaturated, high-pH, Ca-rich aqueous fluids formerly in equilibrium with serpentinite. The whiteness of the garnet indicates almost zero andradite component. This is because the serpentinising fluids that caused the alteration were buffered at extremely low f_{O2} by the assemblage olivine(Fo_{90})-serpentine-magnetite.

This rock is more silica deficient, but probably otherwise chemically similar to the more normal grossular-clinopyroxene dominated rodingite 3530528.

3530528. Rodingite.

The gabbro texture is well preserved in this rock, which once consisted mainly of 1-10 mm stubby prismatic and anhedral pyroxene(s) and tabular to interstitial plagioclase, with very minor clustered <0.5-mm Fe-Ti oxides. Abundant igneous clinopyroxene (or Ti-poor hornblende?) is altered epitaxially to a low-T, fibrous, more Ca-rich clinopyroxene intergrown with minor coarse, almost isotropic chlorite. Coarse chlorite intergrown with subordinate fibrous clinopyroxene is more likely to be after Ti-poor hornblende. Plagioclase, which was probably very calcic, is altered to masses of 10-50 μm grossular with very minor <0.2-mm interstitial vesuvianite. Fe-Ti oxides are now ilmenite mantled with very fine massive sphene.

The sample has broken along a >5-mm vein of <0.3-mm subhedral grossular, anhedral chlorite, and minor fibrous clinopyroxene. Minor <0.1-mm veinlets have similar assemblages.

The coarse original grain size suggests that the rodingite is derived from coarse pegmatoid gabbro as suggested by Gee & Legge (1979) on p. 36.

3530548. Serpentinised harzburgite.

Pyroxene (29%) forms 1-5 mm anhedra, epitaxially altered to lizardite. Lack of Ca minerals suggests that it was orthopyroxene. About 70% of the rock consisted of olivine with a grain size probably around 1 mm. All this has been altered to typical matted 50-200 μm lizardite, dusted with minor <0.1-mm magnetite. Olivine and orthopyroxene concentrate alternately in semi-continuous layers about 5 mm thick. Magnetite is much sparser in the orthopyroxene-rich layers, presumably because of their lower Fe content.

Equant anhedral 0.2-2 mm picrochromite (1%) is veined and mantled with "ferritchromit", a typical serpentinisation product.

3530557. Quartz-biotite-plagioclase-sillimanite-muscovite-plagioclase-pyrrhotite-graphite granofels.

I was in two minds about calling this rock a metamorphosed greywacke or granitoid. Gee & Legge (1979) indicate that this dilemma gas existed for more than 70 years. Most likely it was a tonalite first subjected to sericite-quartz alteration, and then high-grade metamorphism.

Blocky <1.5 mm plagioclase (25%) was heavily altered to sericite, but subsequent contact metamorphism has decomposed some of the sericite to fibrolite (μm-thick sillimanite fibres) and Kfeldspar. The few unaltered plagioclase subhedra are normally zoned in the range An_{50-30}. Tabular and anhedral <1-mm biotite (25%) is aligned in a moderate foliation or lineation: its deep red colour and black pleochroic halos around tiny zircon inclusions indicate a reduced, Fe-rich composition. 0.5-1 mm subround, moderately strained grains of quartz (45%) have prominent minor 20-100 μm inclusions of tabular, formerly sericitised plagioclase altered to aggregates of extremely fine ?fibrolite and ?Kfeldspar, and radiating tufts of fibrolite. The quartz grains are probably of metamorphic origin, though the shapes could be clastic. Their high abundance in a rock so rich in biotite suggests that silicification accompanied sericitic alteration.

Minor opaques tend to form c. 1-mm clusters. These are mostly anhedral <0.2-mm pyrrhotite (much of it retrogressed to pyrite) and <0.3-mm flaky graphite. Tabular 0.1-mm ilmenite inclusions in biotite are very minor.

A 3-mm single mafic phenocryst is altered to a mass of biotite and minor ilmenite. A single 4-mm blocky phenocryst of plagioclase is heavily altered to sericite, Kfeldspar, fibrolite, and a fine intergrowth of roddy andalusite and sericite (itself probably a retrograde alteration product of Kfeldspar).

Rare <0.2-mm Kfeldspar veinlets (in contact with fibrolite) do not seem to be retrograde.

Minor veils of vapour/gas inclusions in quartz may be methane (given the highly reducing mineral assemblage). The graphite may be a product of reaction of methane with tonalite which would almost certainly have been an I-type, i.e. relatively oxidised.

The andalusite-sillimanite-Kfeldspar-quartz assemblage indicates T = 650° and P = 3.5 kb for the metamorphism (Powell &

Holland, 1988). This pressure corresponds to about 11 km of oceanic crust. If the vapour/gas is methane in equilibrium with graphite at 660° and 3.5 kb, the f_{O_2} is $10^{-20.1}$, almost 2 log units below the quartz-magnetite-fayalite buffer and about 2 log units above magnetite-iron (calculations using equilibrium constants given in Barton, 1984). Such a fluid might be produced if mantle-derived CO_2 passed through partly serpentinised peridotite (e.g. 3530548).

It is not certain how the emplacement, sericitic alteration, interaction with highly reduced fluid, and subsequent high-grade metamorphism (accompanied by some strain) tie in with the history of the ultramafic rocks.

This sample answers well to the description of rocks in the metamorphic septa (Gee & Legge, 1979). The rare heavily altered phenocrysts and consistent blocky igneous shape of plagioclase favour Reid's 1919 identification as "granitoid rock" over Dave Green's honours mapping as greywacke. Graphite is more likely in greywacke, but generally not in such an immature one as this would have to have been. I think the peraluminous mineralogy and graphite are of hydrothermal origin, though quite possibly in two events, since a *hydrous* fluid derived from serpentinite would cause high-pH alteration more like that in the rodingites than low-pH sericitic alteration. The possible methane fluid inclusions suggest that the reduced fluid may have been introduced during the high-grade metamorphism.

The pyrrhotite may originally have been pyrite, formed with the original sericite in a typical low-pH magmatic-hydrothermal system.

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POWELL, R. & T.J.B.HOLLAND (1988). An internally consistent thermodynamic data set with uncertainties and correlations: 3. Applications to geobarometry, worked examples and a computer program. J. metamorphic Geol. 6, 173-204.

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