Open File Envelope No. 6453

EL 1308

KALABITY

PROGRESS AND FINAL REPORTS TO LICENCE EXPIRY FOR THE PERIOD 3/10/85 TO 2/10/86

Submitted by
PNC Exploration (Australia) Pty Ltd
1986

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Facsimile: (08) 8204 1880

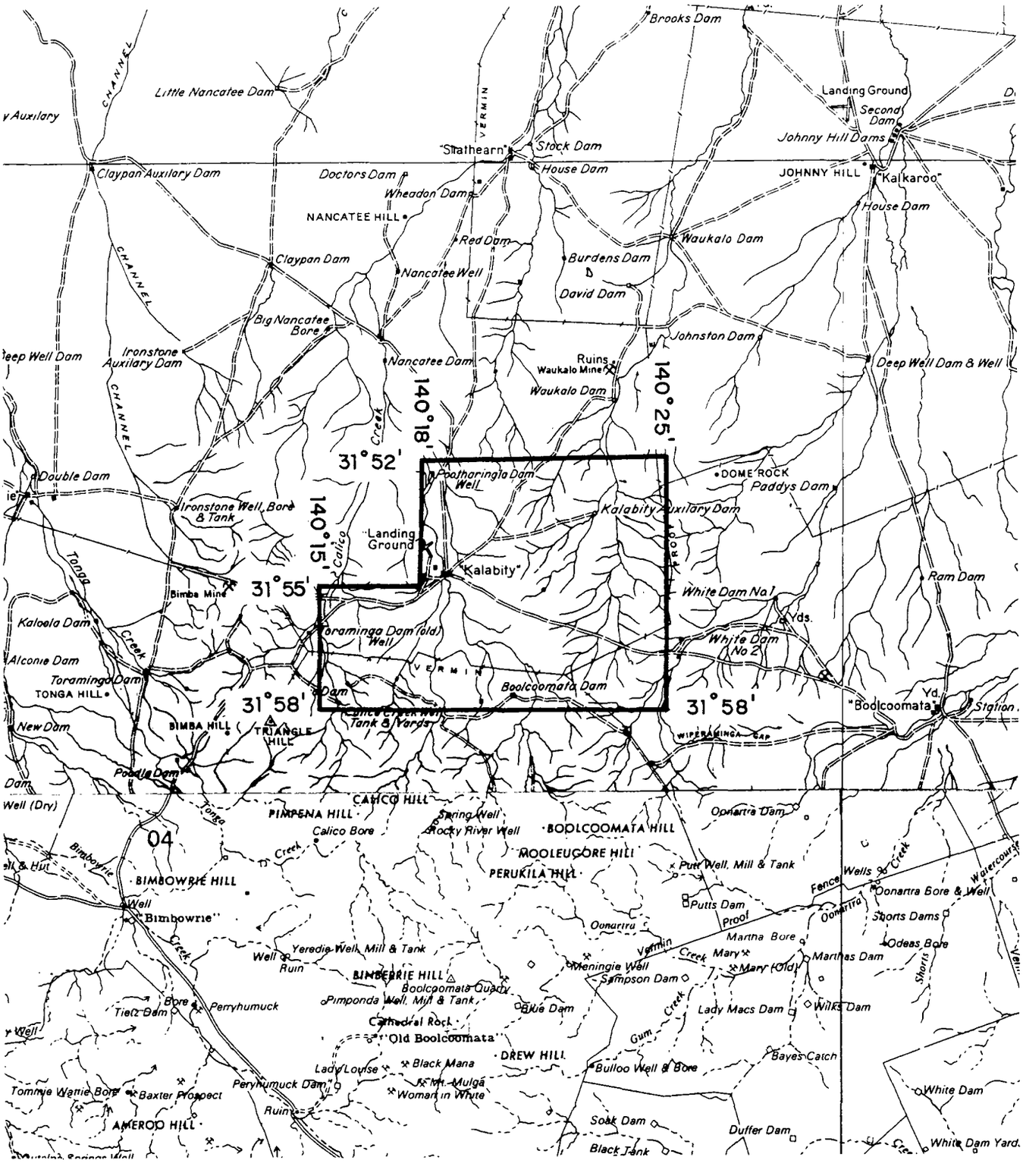
PRIMARY INDUSTRIES AND RESOURCES SA

CONTENTS ENVELOPE 6453

TENEMENT: E.L. 1308 Kalabity.

TENEMENT HOLDER: PNC Exploration Australia Pty. Ltd.

SCHEDULE A



EXPIRED

SCALE 1:250,000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

APPLICANT: PNC EXPLORATION (AUSTRALIA) PTY LTD

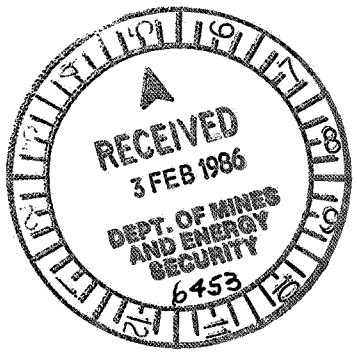
DM: 147/85 AREA: 149 square kilometres (approx.)

1:250000 PLANS: CURNAMONA

LOCALITY: KALABITY AREA – approximately 40 km north of Olary

DATE GRANTED: 3·10·85 DATE EXPIRED: 2·10·86 EL No: 1308

REPORT FOR QUARTER ENDING 3RD JANUARY 1986 EXPLORATION LICENCE 1308 KALABITY AREA CURNAMONA 1:250,000 SHEET



PNC EXPLORATION (AUSTRALIA) PTY. LTD.
SYDNEY OFFICE
JANUARY, 1986

No field work was undertaken during this quarter.

STATEMENT OF EXPENDITURE
QUARTER ENDING 3RD JANUARY 1986
EXPLORATION LICENCE 1308
KALABITY AREA
CURNAMONA 1:250,000 SHEET

PNC EXPLORATION (AUSTRALIA) PTY. LTD.
SYDNEY
JANUARY, 1986

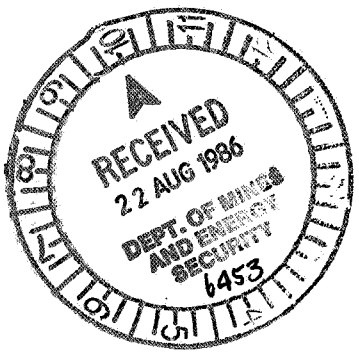
No expenditure was incurred during this quarter.

QUARTERLY REPORT AND STATEMENT OF EXPENDITURE FOR QUARTER ENDING APRIL 2ND, 1986 EXPLORATION LICENCE 1308 CURNAMONA 1:250,000 SHEET

No field work was undertaken and no expenditure incurred during the quarter ending April 2nd, 1986.

PNC EXPLORATION (AUSTRALIA) PTY. LTD.
SYDNEY OFFICE

REPORT FOR QUARTER
ENDING 2ND JULY, 1986
EXPLORATION LICENCE 1308
KALABITY AREA
CURNAMONA 1:250,000 SHEET
SOUTH AUSTRALIA



PNC EXPLORATION (AUSTRALIA) PTY. LTD.
SYDNEY

JULY, 1986

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LIST OF ACCOMPANYING PLATES

1. INTRODUCTION

Exploration Licence 1308 was granted to PNC Exploration (Australia) Pty. Ltd. for a period of one year commencing 3rd October, 1985, with a minimum expenditure requirement of $32,000.

The tenement is situated 60 km north of Olary and encompasses an area of approximately 150 square kilometres.

A Location Map is given in Figure 1.

2. COMPLETED PROGRAMME

Colour aerial photography at 1:87,000 scale and black and white enlargements at 1:25,000 scale were obtained from the Department of Lands.

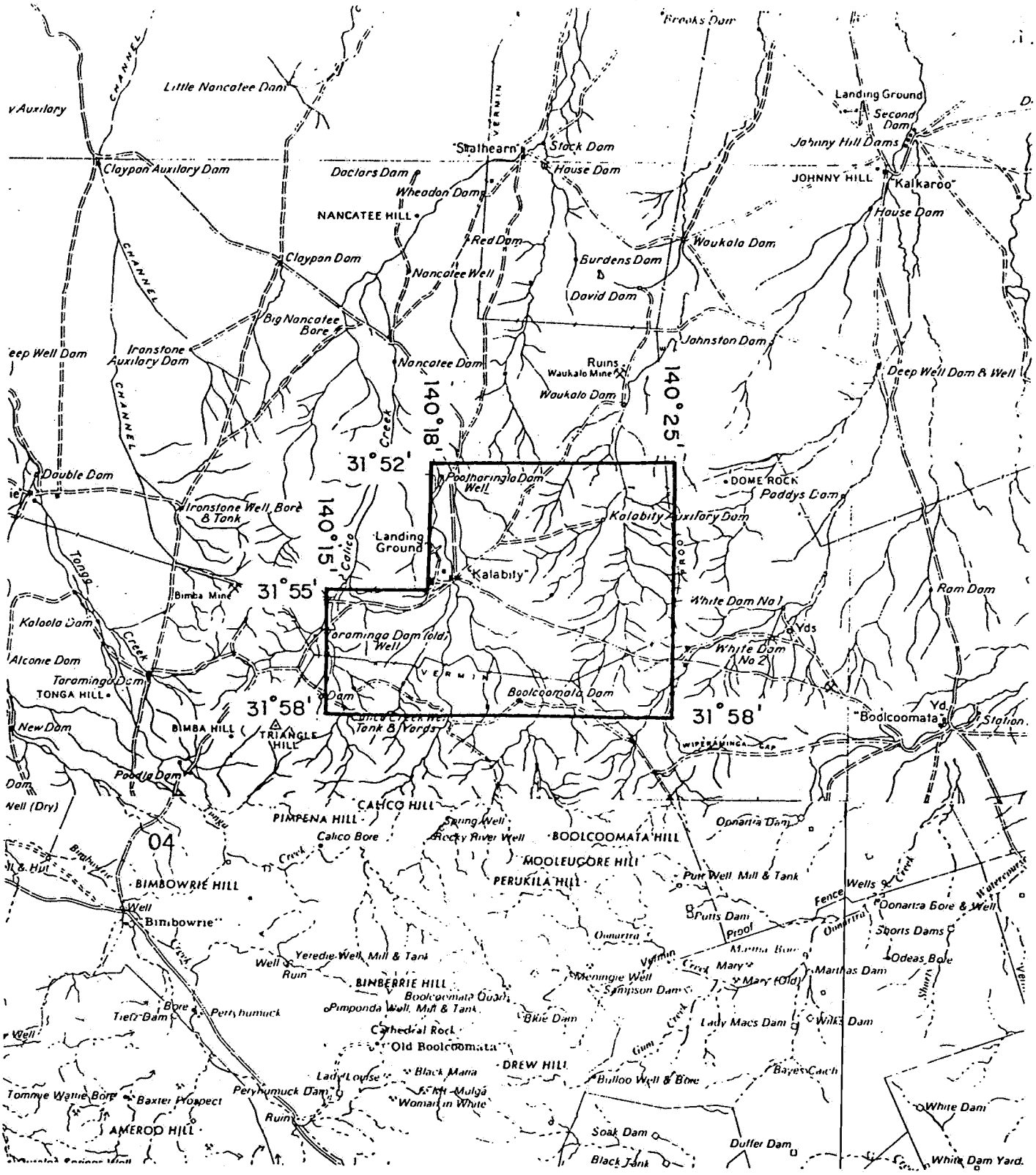
Gravity and magnetic data from open file reports and SADME surveys were obtained from SADME on magnetic tape. A corrected, contoured Bouger Gravity Map for the Curnamona 1:250,000 Sheet has been produced by Geospex Associates Pty. Ltd. (Plate 1).

Preliminary 1:25,000 scale geological mapping has been undertaken. Twenty four (24) petrographic and twelve (12) assay samples were collected, with anaysis for U, Th, Ce, La, Nb using XRF and for Cu, Pb, Zn, Co by AAS, being carried out by Comlabs Limited. Petrographic reports have not yet been received from Pontifex and Associates Pty. Ltd. but will be included in the next Quarterly Report together with the assay results..

3. RESULTS

Geology

The general structure of the Kalabity area is that of a broad north-easterly closing antiform. Lithologies vary from quartz-feldspar-biotite gneiss in the core of the antiform to a gneiss sequence

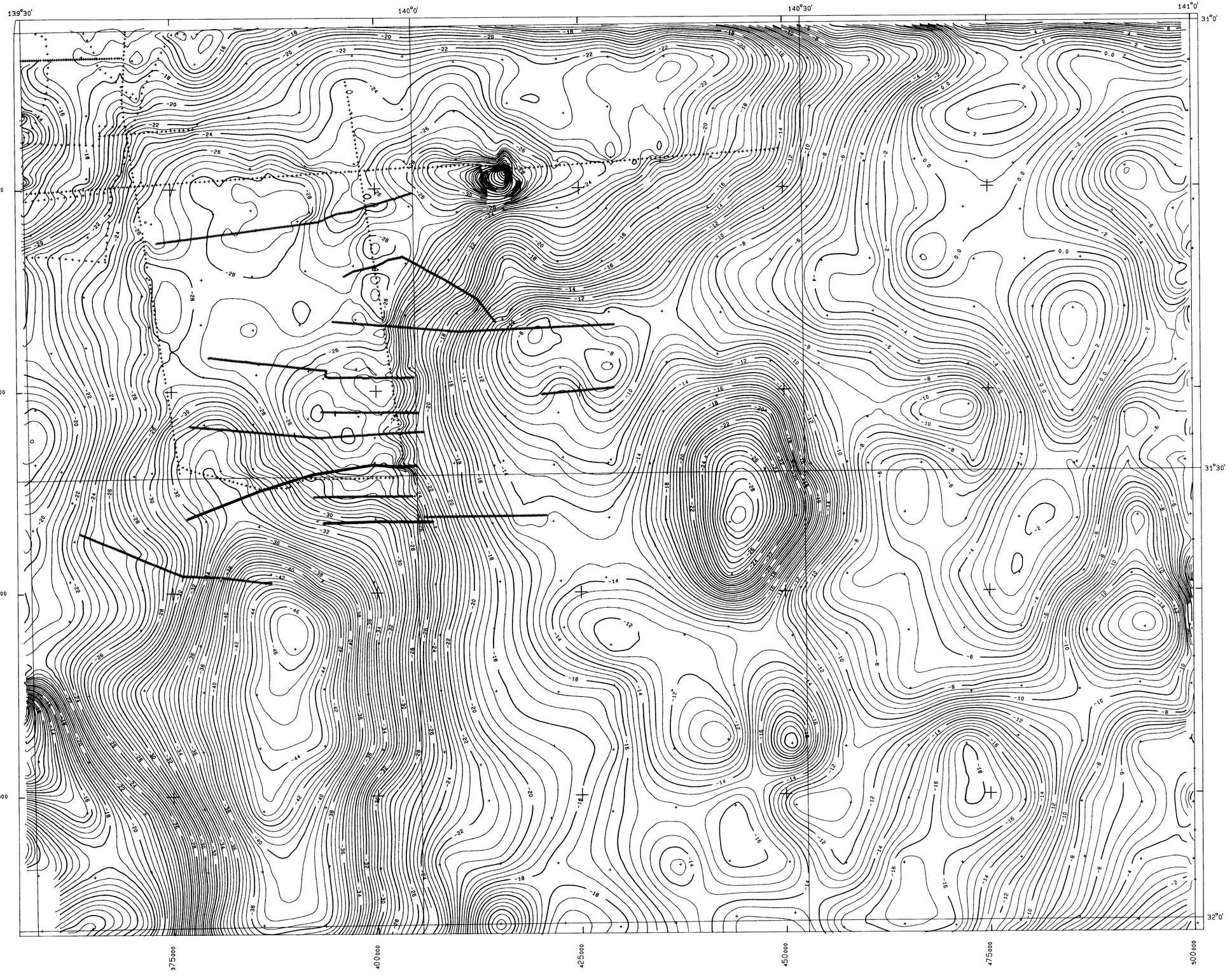


SCALE 1:250,000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

Figure 1: Location Map, EL 1308

NOTE: There is no warranty that the boundary of this Exploration Licence is correct in relation to other features on the map. The boundary is to be ascertained by reference to the Australian Geodetic Datum.



N

Bouguer density = 2.67 g/cc
Contour interval = 0.50 mgal

SCALE
1: 250000

0 5 10 15 20
km km

PNC EXPLORATION (AUSTRALIA) PTY LTD

CURNAMONA (S.A.)
BOUGUER GRAVITY
6453-1

PLATE 1

Compiled by:	Date: 20-MAY-86
Drawn by: Geospex	Drawing No.:

containing quartz-albite rocks, albite-calcsilicate rocks, quartz-biotite-albite schists and chiastolite schists. Further mapping is required to establish the stratigraphy.

Radiometric Anomalies

Two prospects discovered by airborne radiometrics conducted by EZ/Newmont in 1968 (GK1 & GK4), were re-located and sampled, as were several lesser airborne anomalies.

The GK1 Prospect is situated 9 km NW of Kalabity. Several shallow costeans have been dug across the contact between pyrite-silica altered graphite-chiastolite schist and quartz-muscovite-sericite "phyllites" of a northerly trending retrograde shear zone. A thin quartz-muscovite-feldspar dyke (?) with trace monazite returned a maximum reading of 6,000 cps (Mount Sopris SC-132). The prospect has been fully explored following completion of 2 drillholes in 1969.

The GK4 Prospect lies 1 km WNW of Kalabity. Spot radiometric anomalies of up to 2,500 cps occur in a narrow quartz-feldspar ± pyrite felsite dyke intruding graphite-chiastolite schist. All pyrite (?) has been weathered to hematite/limonite. The "prospect" is only very small (< $1m^2$) and needs no further work. A small iron-stained patch of schist 100m to the south returned 750 cps. Sample 3453 is located within a steep gully and is interpreted as being due to surface scavenging.

A radiometric anomaly discovered 2 km SW of Kalabity was investigated by a shallow pit. A quartz-feldspar ± iron oxides felsite dyke (?) of 2,000 cps was sampled. Conspicuous patches (up to $1cm^2$) of a yellow radiating fibrous mineral are possibly a zeolite.

Three additional airborne anomalies were located and found to be due to unfoliated muscovite granite. Maximum radiometry is only 750 cps.

4. PROPSOED PROGRAMME

Further geological mapping and footborne scintillometry at 1:25,000 scale will be carried out.

FINAL REPORT
QUARTER ENDING 2ND OCTOBER, 1986
EXPLORATION LICENCE 1308
KALABITY AREA
CURNAMONA 1:250,000 SHEET
SOUTH AUSTRALIA

PNC EXPLORATION (AUSTRALIA) PTY. LTD.
SYDNEY
OCTOBER, 1986

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1. INTRODUCTION

Exploration Licence 1308 was granted to PNC Exploration (Australia) Pty. Ltd. for a period of one year commencing 3rd October, 1985, with an expenditure requirement of $32,000.

The tenement is situated 60km north of Olary and encompasses an area of approximately 150 square kilometres.

A Location Map is given in Figure 1.

2. COMPLETED PROGRAMME

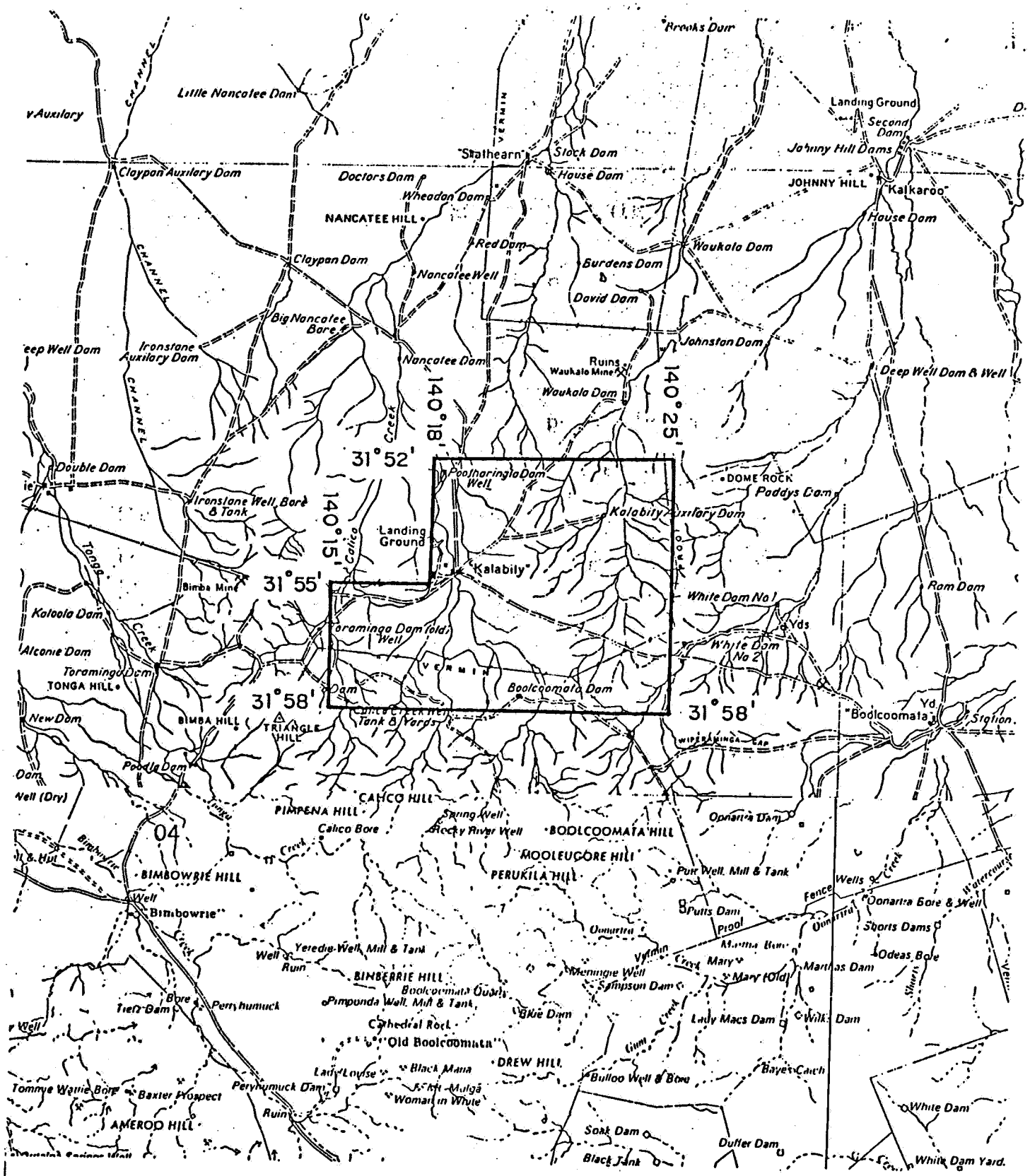
A summary of exploration conducted during the first three quarters is given below:

Colour aerial photography at 1:87,000 scale and black and white enlargements at 1:25,000 scale were obtained from the Department of Lands.

Gravity and magnetic data from open file reports and SADME surveys were obtained from SADME on magnetic tape. A corrected, contoured Bouguer Gravity Map for the Curnamona 1:250,000 Sheet was computer generated by Geospex Associates Pty. Ltd.

Preliminary 1:25,000 scale geological mapping and inspection of known radiometric anomalies were undertaken. Twenty five (25) petrographic and twelve (12) assay samples were collected; with analysis for U, Th, Ce, La, Nb using XRF and for Cu, Pb, Zn, Co by AAS being carried out by Comlabs Services Pty. Ltd. The Petrographic Report (Pontifex and Associates Pty. Ltd.) and the analytical results were received during the final quarter and are given in Appendix 1 and Table 1 respectively.

Further 1:25,000 scale geological mapping and rock sampling was completed during the final quarter. Twenty (20) petrographic

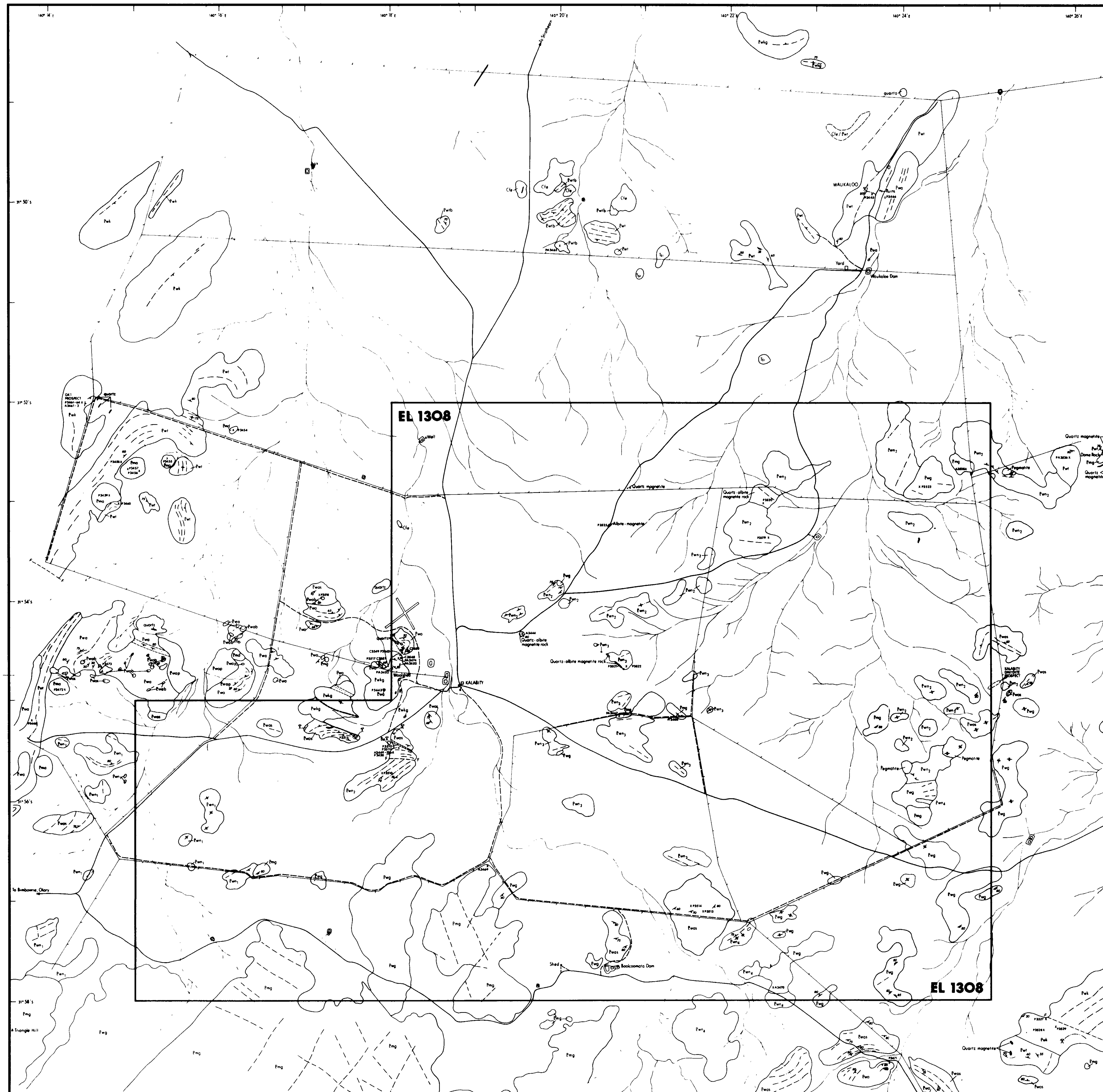


SCALE 1:250,000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

FIGURE 1: LOCATION MAP

NOTE: There is no warranty that the boundary of this Exploration Licence is correct in relation to other features on the map. The boundary



LEGEND

CAINOZOIC

Cfe	Siliceous Ironstone
Tsi	Tertiary Silcrete

POST TECTONIC INTRUSIVES

Pma	Adamellite, leucoadamellite
Pmd	Quartz - dolerite
Pmg	Muscovite granite

SYN TECTONIC INTRUSIVES

Pwg	Foliated granite, biotite ± muscovite granite with abundant pegmatite

LOWER PROTEROZOIC

Pwk / Pwkg	Dark coloured, aluminous, often carbonaceous quartz - mica ± andalusite schists and sillimanite gneiss. Pwkg Basal graphitic porphyroblastic chiastolite schist
Pwt / Pwtb	Quartz - albite - biotite schist (meta siltstone) with laminated albite - calc silicate rock and laminated albite magnetic rock. Pwtb Calc silicate breccia.
Pwa	Laminated, brecciated and porphyroblastic albite - calc silicate rock with subordinate quartz - albite - biotite schist and gneiss
Pwab	Albite - calc silicate breccia
Pwap	Porphyroblastic calc silicate rock
Pwas	Saccharoidal albitites (albite - quartz ± biotite ± magnetite) interbedded with quartz feldspar - mica gneiss (often with porphyroblastic muscovite).
Pwn4	Granitic gneiss, minor biotite
Pwn3	Coarsely banded biotite gneiss, minor quartzite and quartz - albite - magnetic rock
Pwn2	Quartz - feldspar - biotite ± muscovite gneiss with quartz - albite - microcline rock and amphibolite
Pwn1	Psammitic and psammopelitic gneiss

- Copper Prospect
- Fence
- Road
- Track
- Ephemeral watercourse
- Interpreted fault
- Dams and drains
- Homestead
- Trend line
- Shear zone
- Ironstone
- X P3515 Petrographic sample
- X A3468 Assay sample

6453-2

1 0.5 0 1 2
Kilometres

1: 50 000

PNC EXPLORATION (AUSTRALIA) PTY LTD

EL 1308
KALABITY
GEOLOGY

compiled M Dunn	date September, 1986
drawn V Russell	drawing no

PLATE 1

samples were submitted to Pontifex and Associates Pty. Ltd. and brief reports can be found in Appendix 2. Six (6) rock samples were assayed by Comlabs Services Pty. Ltd. as in previous programmes. Analytical results are presented in Table 2.

Four (4) EXT size 2cm diameter cores were also collected from EL 1308 using a small lightweight coring machine. The cores were forwarded to Sydney University for petrophysical laboratory evaluation of dry bulk density, magnetic susceptibility, electrical conductivity and Induced Polarisation Frequency Domain parameters. Preliminary data appears as Table 3.

3. RESULTS

3.1 REGIONAL GEOLOGY

In general terms the Olary Block consists of multiply deformed high grade metamorphic and subordinate igneous rocks which are unconformably overlain by Adelaidean sediments. The metamorphic sequence is equivalent in age (Early to Mid-Proterozoic) and general stratigraphy to the Willyama Supergroup of the Broken Hill Block in N.S.W. The intrusive rocks are represented by both syntectonic and post tectonic granitoids.

Unassigned greywacke, siltstone, quartzite and gabbro north of Kalabity Station may represent a depositional episode between the Willyama Supergroup and the Adelaidean.

The Adelaidean sequence consists of gently deformed and metamorphosed sediments (greenschist facies) ranging from basal Willouran Group, Burra and Umberatana Groups, to the Wilpena Group at the top. Distinctive glacial tillites of the Umberatana Group overly basement rocks across an angular unconformity alongside the Olary-Kalabity Road.

No formal, defined stratigraphy has been published for the Olary

Block despite extensive systematic geological mapping in the Kalabity-Glenorchy-Outalpa areas. An E.Z./Newmont Joint Venture commenced a $6\frac{1}{2}$ year exploration programme within the region in 1966. This was followed by an extensive programme by Esso Australia Ltd. of $12\frac{1}{2}$ years duration terminating in 1984.

The following sections on stratigraphy and metamorphism are largely a collation of recent key data from unpublished Esso open file reports and field notes from the Eighth Australian Geological Convention held in Adelaide, February, 1986 (contained in Geology of the Broken Hill-Olary Region, B.P.T. Stevens, et al, 1986). Consequently brief summaries of the known stratigraphy to date, have been included to aid in the understanding of the geology of EL 1308.

3.2 STRATIGRAPHY

Recent interpretation by Esso has divided the Kalabity area into six stratigraphic suites; lithological descriptions are given below:

i) "Composite Gneiss/Migmatite Suite"

Undifferentiated composite gneiss, migmatite and abundant quartz-feldspar-biotite gneiss. Well bedded psammite with pegmatitic segregations.

ii) "Lower Albite Suite"

Leucocratic quartz-albite psammopelitic gneisses which range from aplitic textured albite-quartz rocks to coarser grained albitic quartzites. The quartzites grade into layered albite rocks. Magnetite and biotite content is variable throughout.

iii) "Mixed Middle Schist/Gneiss Suite"

A thin unit of muscovite-quartz-feldspar± biotite gneiss with muscovite porphyroblasts and lesser quartz-mica schists (probable retrograde variant).

iv) "Upper Albite Suite"

"Calc-silicate feldsparites", often finely laminated. The calc-silicate bearing albite rich rocks can be up to 500m thick and often contain epidote and less commonly diopside and actinolite. Minor but important lithologies are sulphide bearing ironstones and calc-silicate breccias, both of which are sometimes weakly radioactive.

v) "Bimba Suite"

This is a highly variable rock suite but the most common lithology is pyritic quartz-sericite-feldspar schist. Distinctive marker horizons include banded garnet-epidote quartzites, massive pyrite-pyrrhotite lenses, bedded marble and quartzite and massive chlorite or actinolite rocks at the top of the suite. Possible acid flows and tuffs have also been reported. This suite is the principal target for base metal exploration. Attempts have been made to correlate the calc-silicates of the "Bimba Formation" with the Ettlewood Calc-Silicate Member at the base of the Broken Hill Group. Even if this correlation is validated there are no equivalents of the Hores Gneiss (host to the Broken Hill mines) in the "Bimba Formation".

vi) "Pelitic Suite"

The base of this suite is generally defined by a graphitic quartz-muscovite schist often containing sillimanite needles or chiastolite. This grades into the most common rock type in this suite, a pelitic gneiss composed of quartz, feldspar, muscovite with occassional red garnet, tourmaline, sillimanite and andalusite. Only rare pegmatitic segregations are found in this suite.

3.3 MORPHOTECTONIC HISTORY

Within the Olary Block five phases of deformation have been recognised within three major phases being Pre-Adelaidean (Olarian Orogeny) and two during the Cambro-Ordovician (Delamerian Orogeny). The Olarian Orogeny occurred between 1850 and 1540 MA. The main features are summarised in figure 2. The first two deformations were associated with pro-grade metamorphism which reached a peak grade represented by upper amphibolite facies rocks. The third deformation was accompanied by retrograde metamorphism and initiated the shear zones (blastomylonite) which are extensively developed throughout the Olary Block.

Intrusive granitoid bodies accompanied each phase of deformation although the majority in the Olary region are syntectonic with the third phase of deformation. These granitoid bodies range in composition from granite/aplite to granodiorite, adamellite, leucoadamellite and alaskite. Prior to the Adelaidean period, block faulting occurred and the major shear zones such as the MacDonald Shear Zone were initiated. During the Delamarian Orogeny the Adelaidean rocks were subjected to widespread greenschist facies metamorphism.

3.4 GEOLOGY, KALABITY AREA

A 1:25,000 scale geological map using uncontrolled aerial photography as a base has been prepared (Plate 1.). This map provides sample locations for petrographic and analytical work.

A brief summary of salient lithological groupings in the Kalabity area is given below together with a suggested correlation with the Esso units:

MORPHOTECTONIC SUMMARY - OLARIAN OROGENY

METAMORPHIC EPISODES		M1 Prograde, high temp. - mod. pressure, regional metamorphism and anatexis		M2 Anatexis, retrogression		M3 retrogression
DEFORMATIONAL EPISODES		D1 F1 bedding plane foliation, recumbant isoclinal folding	D2 F2 isoclinal folding, axial plane cleavage	D3 F3 open to tight upright folding, axial plane cleavage		blastomylonites
SUMMARY	WILLYAMA SEDIMENTATION	Formation of gneisses and schists	Start of anatexis-melting of gneisses in situ	Large scale anatexis, high temp-low pressure	Peak temp. local extreme melting e.g. Crokers Well	Dolerite intrustion Cratonization Erosion. Possible enhanced D3 and D4 structures.

FIGURE 2 (After Esso, 1980)

UNIT	ESSO UNIT	LITHOLOGY
Pwn	Lower Albite Suite	quartz-biotite-feldspar gneiss containing quartzite and albitic quartzite, amphibolite and minor acid volcanic
Pwas	Middle Schist Suite	porphyroblastic (muscovite) schist and saccharoidal albitite
Pwa	Upper Albite Suite	laminated albitic calcsilicate including porphyroblastic and brecciated varieties
Pwt	Bimba Suite	interbedded quartz-biotite-albite schist and calcsilicate
Pwk	Pelitic Suite	aluminous pelitic schist (biotite-andalusite-quartz schist, sillimanite gneiss, with extensive areas of graphite-chiastolite schist (Pwkg)

Intrusives

Intrusive rocks consist of syntectonic (Pwg) and post tectonic (Pg) granitoids. The former are distinguished on the basis of weak to strong foliation and a higher biotite content. Compositions range from muscovite rich leucoadamellite to leucogranite, adamellite and granodiorite.

Structure

Exploration Licence 1307 is located over the core of a north easterly trending anticlinal structure some 10 to 15 kilometres in width. A major fault striking east-south-east located just south of Kalabity Homestead and passing through Wiperaminga Hill is reflected in the airborne geophysical data and airphotography.

No detailed structural mapping was undertaken.

3.5 RADIOMETRIC ANOMALIES

Two prospects discovered by airborne radiometrics conducted by EZ/Newmont in 1968 (GKI & GK4), were re-located and sampled, as were several lesser airborne anomalies.

The GK1 Prospect is situated 9 km NW of Kalabity. Several shallow costeans have been dug across the contact between pyrite-silica altered graphite-chiastolite schist and quartz-muscovite-sericite "Phyllites" of an northerly trending retrograde shear zone. A thin quartz-muscovite-feldspar dyke (?) with trace monazite returned a maximum reading of 6,000 cps (Mount Sopris SC-132). The prospect has been fully explored following completion of 2 drillholes in 1969.

The GK4 Prospect lies 1 km WNW of Kalabity. Spot radiometric anomalies of up to 2,500 cps occur in a narrow quartz-feldspar ± pyrite felsite dyke intruding graphite-chiastolite schist. All pyrite (?) has been weathered to hematite-limonite. The "prospect" is only very small ($< 1m^2$) and needs no further work. A small iron-stained patch of schist 100m to the south returned 750 cps. Sample 3453 is located within a steep gully and the anomalous uranium is interpreted as being due to surface scavenging.

A radiometric anomaly discovered 2 km SW of Kalabity was investigated by a shallow pit. A quartz-feldspar ± iron oxides felsite dyke (?) of 2,000 cps was sampled. Conspicuous patches (up to $1cm^2$) of a yellow radiating fibrous mineral are possibly a zeolite.

Three additional airborne anomalies were located and found to be due to unfoliated muscovite granite. Maximum radiometry is only 750 cps.

The "Kalabity Davidite Prospect" was discovered just within the eastern boundary of Kalabity Station (approximately 9.5 km east of Kalabity Homestead).

Abundant davidite crystals of up to 5 cm^2 occur scattered throughout milky quartz float in a blue-bush covered valley. A zone of anomalous radioactivity (with a background in excess of 300 cps and approximately 25 metres wide) extends for 250 metres on a trend of 060°M. Numerous spot highs associated with davidite crystals at surface return anomalies of up to 9,000 cps; with many in the 1000 to 2,500 cps range.

Pegmatitic milky quartz and magnetite/ilmenite veins are ubiquitious intrusives into nearby basement gneisses.

Assay results (Table 2) from two detrital davidite samples returned 2% and 4% U with 700 ppm and 1250 ppm Th respectively. Sample Number 3509 has a U/Th ratio of 32 to 1 and could be described as "pure davidite". (The maximum uranium content that the davidite crystal lattice will accommodate is 4.4%).

It is interesting to note that this prospect was not detected by earlier airborne radiometric surveys.

4. CONCLUSIONS

The geological mapping has failed to locate any targets warranting further exploration for uranium. In addition the base metal potential is downgraded by the absence of "Bimba Suite" equivalents within the tenement.

Future exploration will be concentrated within the nearby Glenorchy area. Exploration Licence 130% expired on 3rd October, 1986.

REFERENCES

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TABLE 1

ROCK SAMPLE ASSAY RESULTS

KALABITY AREA

E.L. 1308

SAMPLE	U	Th	Ce	La	Nb	Cu	Pb	Zn	Co
3449	8	110	180	80	10	9	8	8	4
3450	4	<4	70	50	2	10	8	6	<4
3451	65	4	50	70	5	12	24	7	<4
3452	175	22	100	70	16	28	14	12	<4
3453	110	22	120	50	14	145	26	200	50
3462	8	28	130	80	24	7	12	18	<4
3465	4	28	80	40	22	7	8	4	<4
3467	65	140	170	90	28	26	20	34	6
3468	145	250	430	210	60	28	40	26	<4
3469	10	100	140	80	20	10	14	50	<4
3470	24	125	200	110	16	18	16	40	<4
3474	18	90	40	30	50	260	28	14	<4
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1	XRF1	XRF1	AAS	AAS	AAS	AAS

TABLE 2

ROCK SAMPLE ASSAY RESULTS

KALABITY AREA

E.L. 1308

SAMPLE	U	Th	Ce	La	Nb	Cu	Pb	Zn	Co
3507	2.00%	700	9450	1.46%	600	270	7100	85	34
3508	100	46	90	80	26	22	28	24	6
3509	4.00%	1250	1.53%	2.60%	1400	16	1.35%	150	34
3526	1000	20	440	640	40	12	220	26	8
3530	690	16	<20	40	34	4	190	210	38
3531	65	28	90	90	32	10	38	42	26
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
SCHEME	XRF1 XRF2	XRF1	XRF1 XRF2	XRF1 XRF2	XRF1	AAS1	AAS1 AAS1A	AAS1	AAS1

TABLE 3.

PETROPHYSICAL DATA RECORD SHEET

PRELIMINARY

Date: 23.9.86

Reference: PNC Lot 86/1
OLARY PROJECT
M. Dunn / D. Pratt

D.W. Emerson, Dept. Geology & Geophysics
The University of Sydney, NSW. 2006
Phone: (02) 692 2031 692 2912

029

15 samples
2 cm core 20/5/86

Samples No.			Textural: density D.B.D. g/cc	Textural: apparent porosity P_A %	Physical Properties — Magnetic: mag. suscept. k cgs x 10^{-6}	J_{IND} = kF, F=0.58 Gauss	'raw' J_{NRM} remanence MF	I_{NRM} degrees incl.	Q_n J_{NRM}/J_{IND}	Elec. I.P.: 0.1 Hz ρ Ω m	0.1 Hz φ phase lag milliradians
3538			2.70	4.2	7000	4060	3531	-78°	0.9	2061	-20
3539			2.62	1.9	700	406	414	-63	1.0	2254	-9
3540			2.95	3.1	40	23	3	+31	0.1	514	-5
3541			2.66	2.5	→0		9	-29		1593	-16
3542			2.66	3.6	4200	2436	16,240	+17	6.7	1204	-11
3543			2.83	1.6	3000	1740	613	-30	0.4	1896	-12
3544			2.50	4.0	→0		101	-61		3296	-5
3545			2.64	6.5	4000	2320	45202	-18	19.5	588	-11
3546			2.76	1.3	20	12	52	-15	4.5	4145	-16
3547			2.91	4.2	60	35	123	+24	3.5	443	-12
3548	Y	↑	2.52	1.9	→0		1	+31		661	-69
	I	8									
3549	—	0	2.69	4.9	25	15	0.5	-42	0.03	3218	-6
	B	3									
3550	A	1	2.68	3.4	170	99	86	+11	0.9	3316	-13
	L	L									
3551	A	E	2.74	0.2	2000	1160	2109	-8	1.8	49920	-11
	K	↓									
3552			2.62	1.1	→0		0.2	-19		9855	-15

Comments:

k cgs x 4π → SI, 1 MG = 1 nA/m SI

1. Porosities cited ∴ part of DBD measurement
2. Remanence inclinations need check reference to core "UP" markings, -ve incl. ≡ UP
3. EM conductivities negligible — tested inductively @ 2.5 Meg Hz.
4. Galvanic S/I.P. — cores vacuum saturated with 60 cm top water (soaked 2 weeks)

APPENDIX 1

PETROGRAPHIC REPORTS

3442-3474 (Not inclusive)

3442 : biotite-quartz-sericite schist; probably a retrograded sillimanite schist (metapelite); rare crystals of green zoned tourmaline.

This is a dark coloured schist with prominent poikiloblasts of biotite to 2mm in size, with extremely fine exsolved rutile. These are scattered through a heterogeneous matrix composed of variable proportions of fine metamorphic granulose quartz, sericite and/or muscovite, in a lenticular arrangement with lenses 1-15mm wide.

The quartz-rich areas consist of a mosaic of quartz grains about 0.3mm in size, with about 15% interstitial sericite. Vein-like lenses of coarser quartz, to 2mm in grainsize, are up to 3mm wide. Rare zoned green tourmaline crystals occur between the quartz and white mica-rich areas.

The white mica occurs in two habits:

(1) coarse poikiloblastic grains enclosing residual fibrolitic sillimenite and biotite, and

(2) schistose fine sericite possibly derived from sillimanite ± alkali felspar, and locally enclosing minor quartz.

These appear to represent two distinct steps in the retrogression of this rock.

Rare very small grains of opaque oxides accompany some biotite.

3443 : layered mostly fine crystalline quartz-albite rock; minor scattered actinolite lesser epidote and sphene.

At least 60% of this rock consists of albite, as a layered metamorphic granular aggregate, 0.2 to 0.5mm grain size in most layers but 1 to 5mm in some intercalated layers. Quartz (15% of the whole rock) is scattered with sympathetic grain size including, coarse layer-vein or lenses associated with the coarser albite.

Ragged poikiloblastic-intergranular crystals of actinolite (10%), lesser epidote (5%) are scattered, mostly in the fine grained areas, but actinolite also accessory apatite also occur in the coarser albite layers.

Small (0.1 to rarely 0.8mm) euhedral crystals of sphene (1-2%) have a layered albeit irregular distribution.

This rock appears to be a metasediment, probably albite-metasomatised.

3445 : fine layered and very fine grained; biotite-?albite schist; disseminated magnetite; lesser scattered grains of epidote, microcline, and muscovite (metasediment)

This rock is fine layered, very fine grained and quite strongly schistose, with most of the grains less than 0.1mm in size, except for some scattered magnetite and epidote grains. It consists of biotite (25%) and magnetite (7-10%) in slightly different concentrations in different layers, within a fine grained felspathic mosaic with rarer quartz. The stained offcut indicates 5% potassium felspar, but this is not distinguishable in thin section. Some coarser layers with grains to 0.2mm, appear to lack potassium felspar. Some finer grained layers have over 10% muscovite as small strongly schistose flakes.

Epidote (2-3%) is mostly confined to coarser lenses, and layers as grains to 0.5mm long, rarely in lenses to 2mm long.

This rock appears to have been a calcareous metasiltstone.

3446 : fine grained biotite-muscovite-felspar schist, with completely sericitised (retrogressed) poikiloblasts (metapelite).

About 60% of this rock consists of a very fine grained schist with an average grain size of about 0.05mm. A weak to moderate schistosity is defined by biotite (15%) and muscovite (20-25%), in a felspathic (or quartzofelspathic?) micromosaic, with accessory minute crystals of rutile and green tourmaline. The stained offcut indicates some K-spar in this mosaic.

Patches of sericite, with some coarser muscovite, to 5mm diameter, are derived from irregular poikiloblasts (15%) of uncertain type, probably andalusite or cordierite. The stained offcut (and the petrography) also indicates patches of micricrystalline microcline incorporated in these sericitised poikiloblasts.

Rare oxidised opaque grains to 1mm long (?pyrite) are enclosed in muscovite.

3. OTHER IGNEOUS AND META-IGNEOUS ROCKS.

3450 : albite pegmatite

coarse albite	75%
recrystallised albite	20-25%
accessories :	opaque oxide, clay ex biotite, zircon, epidote.

This rock is dominated by coarse anhedral to bladed albite grains up to 20mm lcng, with patches of recrystallised albite 0.2-1mm in grain size. Small scattered zircon and oxidised opaque oxide grains are present and clays after biotite occur locally in patches with or without epidote.

4. METASEDIMENTS

3452 : graphitic biotite-andalusite-quartz schist.

andalusite+alteration products	10%
altered biotite	15%
sericite	10%
graphite	5%
quartz	60%
jarosite	2%
rutile	trace

This rock has scattered large euhedral crystals of andalusite (variety chiastolite) to over 30mm in size set in a quartz-sericite schist with abundant very fine grained graphite and altered smaller porphyroblasts of andalusite and biotite.

The smaller andalusite porphyroblasts commonly have pink (?manganese rich) cores and colourless rims. Alteration of the andalusite appears to have taken place in two stages :

(1) veins of possible margarite and coarse white mica (?paragonite or muscovite) and:

(2) marginal alteration to sericite.

The biotite is altered to clays $\pm$ jarosite and is commonly accompanied by retrograde (?) muscovite. Some of the jarosite in this rock may be after sulphides as the breakdown of sulphide would be the easiest way to supply sulphur to form the jarosite.

3452 continued:

The matrix has fine sericite and graphite as well as elongate quartz-grains 0.2-0.5mm in size. The quartz grains are elongate parallel to their C-axes which lie parallel to the schistosity defined by the sericite.

Accessory rutile is common especially in the altered biotite.

3453 : biotite-muscovite graphite-quartz schist

altered biotite	25%
muscovite	5%
fine sericite	15%
graphite	5-10%
quartz	45-50%
rutile	trace

The porphyroblasts in this rock are altered biotite (clay + limonite + leucoxene) 0.5 - 2mm long and retrograde muscovite flakes to 1mm long. The matrix is a graphitic sericite rich quartzite with, as in 3452, a strong preferred orientation of both sericite and quartz. The quartz has its C-axes in the schistosity.

Small tufts of sericite in the matrix may have been clots of fibrolitic sillimanite but this is not clear.

3454 : metamorphosed leucocratic quartz dolerite.

plagioclase		65%
hornblende		15%
quartz		5%
magnetite		10%
sphene		3%
accessories	:	apatite, epidote, limonite after pyrite.

Plagioclase laths 2-4mm long are the dominant components of this rock, together with hornblende replicas of irregular pyroxene grains 0.5-4mm long and abundant magnetite and sphene. Quartz grains to 1mm in size locally occur in crudely granophyric intergrowths with the felspar. Accessories include apatite; epidote and limonite after small (0.05mm) pyrite cubes.

1.1 Leucoadamellite to leucogranite

3455 : muscovite rich inequigranular leucoadamellite

Muscovite	10%
quartz	25-30%
potassium felspar	30-35%
plagioclase	30%

accessories : opaque oxide + leucoxene + rutile + apatite

This is an inequigranular leucoadamellite with grains 0.3 - 3mm in size. Muscovite flakes to 3mm are common and are mostly interstitial to quartz, with a subhedral almost bipyramidal aspect in some areas. Fine sericite is present in the felspar and rare limonitic clays may be after biotite.

3456 : muscovite rich biotite-bearing inequigranular adamellite.

biotite	3-5%
muscovite	10%
quartz	25%
potassium felspar	35%
plagioclase	25%
accessories :	apatite, opaque oxides, limonite after pyrite, zircon.

This is a fine grained (0.1 - 2mm grain size) inequigranular adamellite with phenocryst-like recrystallised quartz patches with a tendency to a bipyramidal habit. The quartz has undulose extinction and the muscovite has sharply defined narrow kinks indicating minor deformation.

3457 : inequigranular leucogranite

biotite	1-2%
muscovite	<1%
quartz	20-25%
potassium felspar	50-55%
plagioclase	20-25%
accessories : rutile, apatite	

This is an inequigranular generally fine grained (0.2 - 1.5mm grainsize) leucogranite similar in texture to 3456, with quartz tending to a microphenocrystal-bipyramidal habit, but poor in mica. The titanium phase is rutile, which also occurs in 3455, but not in 3456.

3458 : quartzite with fresh and altered calc-silicate and vein quartz.

quartz	65-75%
sericite+epidote ex plagioclase	25%
garnet ± epidcte	0-10%
sphene	trace - 1%

This rock is basically a quartzite with calcareous impurities metamorphosed to felspar, garnet and epidote. Felspar appears to have been the most widespread mineral other than quartz, but has been altered to sericite and fine cloudy clinczoisite. Grains of garnet to 4mm long, commonly enclosing epidote are common adjacent to the lenses of vein quartz in the rock. Lenses of epidote and patches of brown clay, possibly after pyroxene also occur in these areas. The sphene occurs with the garnet or in localised lenses.

The vein quartz occurs as lenses to 8mm wide of grains up tc 4mm in size.

3459 : muscovite rich inequigranular leucogranite.

biotite	2-3%
muscovite	10%
quartz	25-30%
plagioclase	35%
potassium felspar	25%
accessories :	apatite, opaque oxides, limonite after pyrite.

This is a finer grained rock than 3456-7 with grains 0.2-1mm in size. Plagioclase is generally the only mineral over 0.5mm in size with quartz aggregates outlining possibly bipyramidal grains similar to those in the preceding rocks.

3460 : weathered calc-silicate rock with hornblende and epidote plagioclase and quartz.

hornblende	10% (including weathered)
epidote	5%
quartz	20%
plagioclase	55-60%
accessories	: magnetite, apatite, sphene

This sample has a crudely layered arrangement of fresh to limonitised poikiloblasts of hornblende and epidote 0.5-2mm in diameter in a heterogeneous quartz-felspar mosaic or aggregate. The mosaic areas have grains about 0.1mm in size whereas in irregular areas to 20mm or more in size. There are irregular felspar grains to 2mm with small (0.1mm) quartz inclusions. Magnetite is the main accessory (5%) as anhedral to poikilitic grains to 0.4mm in size. Sphene is moderately abundant (2%) and there is minor apatite.

Microfaults cutting the rock are commonly lined by epidote.

1.2 Muscovite-plagioclase suite

3461 : tourmaline-bearing albitic aplite.

muscovite	2%
tourmaline	5%
plagioclase ?(albite)	90-95%
rutile (ex ilmenite)	1-2%

This is an even-grained aplitic rock with plagioclase (?albite) grains about 0.05-0.2mm in size, patches of muscovite to 1mm composed of flakes to 0.5mm and disseminated short prisms (<0.1mm long) of colourless tourmaline. Rutile occurs as granular pseudomorphs after ilmenite to 0.5mm long. Thin veins of clays, sericite (with a shearing related schistosity) and quartz-prehnite cut the rock.

3462 : altered porphyritic or porphyroblastic rock with abundant albite and sericite.

muscovite + sericite	40%
quartz	10%
?albite	50%
rutile (ex ilmenite)	1-2%

In this rock sericite occurs as fine grained pseudomorphs of anhedral phenocrysts or porphyroblasts to 5mm in diameter (15%). Sericite and coarser muscovite are scattered through the rock (25%), but the origin of this mica is not clear. The bulk of the rock is granular albite and minor quartz with grains 0.1-0.3mm in size, with granular rutile after ilmenite plates to 0.5mm lcng, as in 3461.

5. MISCELLANEOUS ROCK TYPES

3463 : quartz-albite rock with muscovite rich and muscovite-poor zones, intensely hematite veined.

quartz	15%
albite	40-45% (muscovite rich)
	70-75% (muscovite poor)
muscovite	30% (muscovite rich)
hematite (vein network)	10%
opaque oxide	1-2%
limonite after pyrite	trace

This sample is possibly related to the muscovite bearing granitoids (group 1) but is highly altered and weathered. A limonitised vein with scattered limonitised pyrite divides the rock in to a muscovite rich portion and a muscovite-poor portion.

The muscovite rich portion has abundant decussate muscovite in patches to 2mm replacing anhedral grains with no residual patches of the original mineral. The remainder consists of albite grains about 0.5mm in size, quartz grains about lmm in size and abundant intergranular hematite.

3464 : altered coarse probably rhombohedral mineral (?carbonate or ilmenite) with minor quartz; altered to a probable jarosite group mineral.

The dominant constituent of this rock is a very fine grained yellow jarosite like mineral with textures indicating coarse original grains with rhombohedral cleavage or exsolution planes. This mineral may have been siderite or ilmenite, for example, or perhaps a sulphide but its nature is not clear. Minor quartz occurs in ragged lenses to 4mm long mostly controlled by the cleavage or exsolution in the original coarse grains. Small patches of a clear granular jarosite group mineral are present.

The exact nature of the secondary mineral may need to be checked by X-ray diffraction and/or chemical analysis.

3465 : garnet-bearing clinopyroxene-quartz-felspar calc-silicate

The bulk of this sample is a fine grained essentially felspathic mosaic with scattered grains of clinopyroxene and magnetite (5-10% each). Petrograde fibrous amphibole occurs on the pyroxene and accessory apatite.

Garnet occurs as scattered lenses to 15x5mm commonly with crystal-lined cavities possibly representing weathered out carbonate. Minor clinopyroxene and tremolite occur in and adjacent to the garnet.

Narrow veins in the rock have been metamorphosed, one set to garnet and another set to clinopyroxene and trace hornblende. Spongy margins on the garnet lenses may have originally had the same mineralogy as those veins metamorphosed to garnet.

3466 : chlorite-magnetite-quartz-felspar rock with minor sphene

This rock is essentially a quartzofelspathic mosaic with most grains smaller than 0.05mm. Irregular coarser patches are present with grains about 0.2mm in size and vein-like finer grained areas are also present to lmm wide. About 15% magnetite is scattered as crystals and grains to 0.5mm in size and about 5% sphene + trace rutile occurs as poikiloblastic patches to 0.7mm in diameter. Shreds of fine grained chlorite are scattered locally enclosing limonite and possibly cuprite.

Accessory apatite is present and there are rare small possible zircons.

3467 : muscovite bearing inequigranular leucoadamellite

biotite	2%
muscovite	6%
quartz	25%
potassium felspar	30%
plagioclase	35%

accessories : opaque oxide 4%; zircons, rutile (in biotite).

A relatively coarse leucoadamellite, this rock has a grainsize of 0.4-4mm. The largest grains being plagioclase. The quartz has undulose extinction and a tendency towards a bipyramidal-resorbed (sub-volcanic) habit. Opaque oxide grains are unusually abundant in this sample and it is probably magnetic at depth.

3471 : layered calc-silicate with layers variously rich in green to colourless amphibole, clinoyroxene and epidote with quartz and/or plagioclase.

This sample has mesobands 10-20mm wide on which are superimposed microbands 0.2-2mm wide, alternately rich and poor in a (quartzo)felspathic mosaic. The other components in the various layers are:

(1) green hornblende as weakly poikiloblastic laths about 0.5mm long, with traces of biotite and ilmenite
(2) granular clinopyroxene and epidote enclosed in poikiloblastic grains and parallel bundles of colourless to very pale green amphibole minor sphene is present and the proportions of epidote and clinopyroxene vary widely between the different mesobands. Blue tourmaline is a rare accessory and apatite is present in trace amounts.
(3) granular green amphibole and epidote with accessory apatite and sphene.

The proportions of quartz in the mosaic vary widely from 0-40% and the felspar varies from fresh to altered with finely divided clinozoisite as the main alteration product.

3472 : leucoadamellite

muscovite	<1%
quartz	25%
potassium felspar	35%
plagioclase	40%
accessories	apatite

This is a coarse granular leucoadamellite with a grain size of 2-6mm including some coarsely perthitic microcline and irregularly intergrown felspars. It appears to be close to a minimum melt composition.

3473 : retrogressed quartz-biotite-plagioclase-microcline-sillimanite schist with retrograde sericite and muscovite.

This is a strongly layered schist with laminae 1-4mm wide alternately rich in quartz, biotite and felspar and sericite after fibrolitic sillimanite + minor biotite. The quartzofelspathic mosaic has a grainsize of 0.2-1mm with plagioclase. Partly to completely atlered to sericite, greater subordinate to quartz and alkali felspar in most of the layers. Biotite is common as flakes 0.2-2mm long defining a layer-parallel schistosity. Muscovite and orange tourmaline occurs as probably retrograde products as flakes to 1mm and irregular prisms to 3mm respectively. The biotite has adjusted to retrogression by exsolving rutile.

The fibrolitic sillimanite lenses are totally altered to fibrous sericite with patches of rutile indicating former embedded biotite flakes.

Quartz and alkali felspar occur in some of these lenses.

3474 : limonite stained albite rock with sericite lenses and veins containing quartz, limonite, albite and jarosite.

quartz	15%
albite	70%
limonite/hematite	10%
sericite/muscovite	5%
jarosite	1-2%

Most of this rock is hematite or limonite clouded granular albite with grains generally 0.1 - 0.2mm in size, with scattered oxidised opaque oxide grains. An irregular lens of sericite separates the albite-limonite rock from a quartz vein with limonite and jarosite, coarse albite to 3mm grain size and minor sericite lenses. Other veins contain quartz lenses surrounded by coarse albite with hematite, limonite rich cores and clear rims, and minor carboante.

Limonite boxworks and limonite lined cavities to 5mm in size occur in the veins.

APPENDIX 2

PETROGRAPHIC REPORTS

3510-3529

3510

Layered quartz-muscovite gneiss, with minor biotite and plagioclase, accessory scattered magnetite.

Plagioclase	10 %
Muscovite	35 %
Biotite	7 %
Chlorite	3 %
Quartz	45 %
Opaque oxides	2 %

A compositional/metamorphic and partly tectonic layering in this rock is defined by slightly folded thin bands and laminae rich in muscovite, alternating with laminae rich in quartz, all about 2-4 mm thick.

Grains of stressed plagioclase, about 1-3 mm in size, occur locally in the quartz-rich layers, and minor biotite (altered to ?vermiculite) and chlorite occur in the muscovite-rich laminae. The micas are mostly coarse, with flakes 0.5 to 2 mm in length, oriented along and across the foliation, but areas of fine sericite are also present.

The quartz is deformed and occurs variably as rounded and ragged grains. Opaque oxide grains, probably magnetite, are scattered and up to 2 mm in size.

This rock is tentatively interpreted as a meta(gneissic) granitoid.

3511 Laminated quartz-plagioclase-biotite-muscovite schist; accessory opaque oxides and sillimanite.

Quartz	40 %
Muscovite	40 %
Biotite	5 %
Plagioclase	7 %
Opaque oxides	5 %
Limonite after pyrite	tr.
Sillimanite	tr.

This is a finer-grained, more schistose equivalent of No. 3510, with most grains 0.2 to 1 mm in size. It is also distinctive in that it contains very minor residual sillimanite in the muscovite.

Layering is less obvious and on a finer scale of 0.2 to 1 mm. Biotite is slightly less abundant, but opaque oxides (oxidised magnetite) are more abundant (5 %), and there is a trace of limonite after pyrite, and rare zircon grains.

The quartz is more evenly granular, but the feldspar finer-grained.

This may be a metasediment (pelitic fine sandstone), or possibly a tectonisedk and metamorphically reconstituted, fine- to medium-grained granitoid.

3512 Massive to weakly schistose magnetite-quartz-sericite-chlorite rock with minor epidote and biotite (metadolerite).

Quartz	40-45 %
Sericite	20 %
Chlorite	30-35 %
Magnetite	12 %
Epidote	tr.
Biotite	tr.
Leucoxene	tr.
Apatite	tr.

This rock is extensively altered to secondary minerals (including secondary quartz) as noted above, but a relict, somewhat schistose doleritic texture is more or less preserved. Part of this preservation is by sericite, as decussate fine-grained pseudomorphs of feldspar laths, 0.5 to 2 mm long. These occur in a heterogeneous, weakly schistose quartz-chlorite matrix, probably derived partly from pyroxene and partly from granophyre.

A little biotite is present in the more chloritic areas, and epidote and apatite occur in trace amounts. Opaque oxides are abundant in lenses to 1.5 mm in size, together with minor leucoxene.

3513

Retrogressed (pelitic)-psammitic schist with sericite, muscovite and altered biotite (minor residual sillimanite in muscovite).

Quartz	60-65 %
Muscovite	7 %
Sericite	20 %
Biotite	10 %
Sillimanite	tr.
Opaque oxides	tr.

This is a layered meta-pelitic sandstone, with quartz sand grains 0.2 mm, 0.3 mm and 0.3 to 0.6 mm in size, in different layers.

The coarsest layer contains relatively more abundant, altered ('bleached') biotite, and coarse fresh muscovite, than the other layers, and has some large patches of sericite, possibly after feldspar. The sericite in the other layers is interstitial to the quartz grains, as is the more or less poikiloblastic muscovite and altered biotite. These intergranular micas appear to represent metamorphosed pelitic detritus.

Two layers rich in coarse muscovite and/or fine sericite are present. The coarse (retrograde) muscovite generally has minor residual sillimanite enclosed in it, whereas the sericite contains scattered opaque oxide grains and rare zircons.

3514

Sericite-muscovite-plagioclase schist with minor quartz; prominent poikilitic biotite; accessory opaque oxides and sillimanite.

Quartz	5 %
Plagioclase	60 %
Muscovite	3 %
Sericite	10 %
Biotite	15 %
Sillimanite	2 %
Opaque oxides	5 %

This is a relatively massive, but none the less schistose rock, with scattered unoriented coarse biotite flakes, 1-3 mm long (very obvious in hand specimen). These biotites contain abundant small radioactive inclusions. Muscovite flakes, in part poikilitic, are also scattered and are about 1 mm in size. Sericite patches are elongate along the layering/foliation, and usually contain minor to abundant sillimanite. This sericite thus appears to be retrograde after sillimanite. Some of the biotite contains relatively minor sillimanite.

These micaceous components occur in a vaguely layered, metamorphic granular aggregate of plagioclase, with grains 0.3 to 1 mm in size, showing weak zoning. Minor granular quartz is also present as patches to 2 mm in size, and opaque oxide grains, about 0.2 mm in size, are disseminated.

3515

Crenulated and strongly laminated/ lineated quartz-sericite-biotite schist, with minor sillimanite.

Quartz	7 %
Sericite + muscovite	80 %
Biotite	5 %
Sillimanite	3 %
Opaque oxides	5 %

This rock is divided into laminar domains representing the limbs of crenulation folds, about 5 mm in width. Some of the domains consist of coarse poikilitic quartz grains to 4 mm long, enclosing biotite, muscovite and sericite, and the other domains consist of sericite enclosing minor to very minor sillimanite and ?opaque oxides or ?oxidised filamentous pyrite.

The sericite-rich areas appear to be high-strain domains, which have lost quartz, and the quartz inter-areas are low-strain domains.

3516

Foliated/layered to massive, fine crystalline leuco-adamellite-aplite, with minor biotite and muscovite.

Quartz	25 %
Microcline	35 %
Plagioclase	30-35 %
Biotite	6 %
Muscovite	2 %
Opaque oxides	2 %
Zircon	<1 %

This rock consists of a vaguely layered, rather inequigranular, but mostly fine to medium allotriomorphic aggregate of plagioclase and microcline in subequal amounts, together with subordinate quartz. These minerals, forming the granular mosaic, have a grainsize of about 0.2 to 0.8 mm.

Minor biotite defines a weak schistosity, which emphasizes the layering, and is locally accompanied by muscovite.

Accessory opaque oxides are scattered, and there is minor limonite after pyrite. Accessory zircon and traces of possible monazite are present.

3517 Massive, extremely fine-grained magnetite-epidote-?albite-biotite-microcline, low-grade (hornfelsic?) rock.

Magnetite	5 %
Epidote	7 %
Biotite	25 %
Microcline	40-45 %
Plagioclase (?albite)	15 %
Muscovite	5 %

This very fine-grained (0.1 mm or smaller) rock consists of a rather diffuse, massive and more or less hornfelsic aggregate of dominant microcline and subdominant biotite.

Albite or sodic plagioclase, epidote and opaque oxides, are similarly fine, thus often difficult to distinguish, and have a fairly even distribution throughout. Some epidote occurs in very small lenses with biotite, and minor muscovite in more albite-rich areas of the rock, where there are also thin veins of microcline or adularia.,

This rock appears to represent a lower metamorphic grade than the samples described above.

3518

Quartz-sericite-muscovite-biotite schist (?meta-pelitic sandstone).

Quartz	40 %
Sericite	25 %
Muscovite	20 %
Biotite	15 %
Sillimanite	tr.
Zircon	tr.
Tourmaline	tr.

This rock is dominated by a patchy, loose-packed aggregate of quartz grains, 0.1 to 0.3 mm in size, with extensive, also patchy, intergranular biotite and sericite, and large, locally poikiloblastic muscovite flakes, locally enclosing sillimanite, and/or quartz. Rare poikiloblastic prisms of pale green tourmaline are scattered and enclose quartz gcrains.

Fine opaque oxide grains, possibly of secondary origin, occur locally ion the sericite and in some of the biotite flakes, and there are rare zircons.

3519

Fine-grained, weakly layered amphibolite (meta, fine-grained, basic igneous rock).

Plagioclase	45 %
Hornblende	40 %
Opaque oxides	10 %
Quartz	5 %
Altered biotite	tr.
Apatite	tr.
Epidote	tr.

This rock has a weakly layered, fine granuloblastic, metamorphic texture, composed of essential dark green, iron-rich hornblende, and granular plagioclase in subequal amounts, with a grainsize of 0.2 to 0.8 mm.

Opaque oxides and quartz are evenly scattered as minor components, and there is accessory apatite. Rare flakes of altered biotite, and rare small epidote patches are also present.

3520

Layered, but massive, microgranuloblastic quartz-albite rock, with scattered coarse poikiloblasts of microcline; accessory disseminated fine magnetite and biotite.

Quartz	40 %
Albite	40 %
Microcline	15 %
Biotite	2 %
?Magnetite	2 %
Muscovite	tr.

Much of this rock consists of quartz-albite micro-mosaic with a grainsize of 0.1 to 0.3 mm; with minor equally fine disseminated magnetite, locally defining a weak layering.

However, there are large scattered poikiloblasts of microcline, optically continuous between fine quartz grains which they enclose for up to 10 mm. The enclosed quartz is similiar to that in the bulk micro-mosaic, albeit somewhat more rounded, and without the accompanying albite (the albite presumably being substituted for by the K-spar).

Minor biotite is locally weakly schistose, and there are scattered patches and small flakes of muscovite.

3521

Fine layered, but fairly massive, micro-granuloblastic magnetite-quartz-albite rock; scattered coarser patches of quartz may be a relict porphyritic characteristic; minor muscovite and limonite after pyrite.

Quartz	20 % *
Albite	70 % *
Magnetite	10 %
Muscovite	1 %
Limonite + jarosite + pyrite	1 %
Leucoxene	tr.

(*as most of the albite is untwinned it is difficult to distinguish between the quartz and albite in this thin section.)

Most of this rock is a fine-grained (0.12 mm) polygonal micro-mosaic of albite and quartz, essentially the same as in 3520. Rather than the poikiloblasts in that other rock however, there are scattered larger quartz grains, to 2 mm maximum diameter, forming about 10 % of the rock, and these appear to represent possible original volcanic phenocrysts, e.g. in a lava or tuff.

Accessory opaque oxide grains, apparently oxidised magnetite, are disseminated and about 0.1 mm in size. There are rare patches where the quartz is enclosed in poikiloblastic muscovite. Accessory crystals of pyrite to 2 mm size are mostly altered to limonitic clays and/or jarosite, or is leached out. Intergranular films of secondary limonite are common, and rare leucoxene is scattered.

3522

Weakly layered to massive, fine granuloblastic quartz-albite rock; minor scattered biotite, accessory fine magnetite; also minor 'knots' of sericitised sillimanite.

Quartz	20 %
Albite	70 %
Retrogressed sillimanite	5 %
Biotite	3 %
Magnetite	2 %
Muscovite	1 %

This rock has a similar texture and composition to 3520 and 3521, but it is coarser, with grains commonly up to 0.5 mm. This mosaic consists mostly of twinned albite, making the distinction between albite and quartz easier.

Lenses of knotted, fibrolitic sillimanite to 8x4 mm were formerly present, but have been replaced by fibrous to platy muscovite. Rare sillimanite is prerserved only in the cores of the larger clots, and these appear to have been set in patches of quartz grains, larger than those in the mosaic (up to 0.8 mm long).

Biotite, partly altered to chlorite, occurs as patches, to 2 mm in diameter, of poikilitic flakes, usually together with minor muscovite. Opaque oxide grains (apparently oxidised magnetite) are scattered, but are smaller and less abundant than in No. 3521.

3523

Muscovite-biotite microgranodiorite transitional to micro-adamellite; metamorphically partly recrystallized to a weakly foliated and inequigranular rock.

Quartz	25 %
Plagioclase	40-45 %
Microcline	20-25 %
Biotite	5 %
Muscovite	3 %
Opaque oxides	2 %

This is a somewhat inequigranular, but essentially fine-grained rock composed of an allotriomorphic to granuloblastic aggregate of quartz, plagioclase and microcline, from 0.2 to 2 mm in size. Muscovite occurs as random euhedral to poikiloblastic flakes, 1 to 4 mm in size, generally enclosing quartz, and is probably a late-stage (?deuteric) mineral. The biotite, however, occurs mostly as thin elongate flakes up to 4x0.4 mm, with a weak preferred orientation.

Opaque oxides are scattered, and there is minor very fine sericite, particularly in the plagioclase, which is also clouded by clays.

3524

Massive potassic calc-silicate rock, composed essentially of microcline and diopside.

Microcline	30 %
Diopside	65 %
Actinolite	5 %
Limonite after pyrite	tr.
Apatite	tr.

Granular to poikiloblastic diopside, with a grainsize of 0.2 to 2 mm, occurs in irregular aggregates in variable concentration, enclosing, or set in, fine grains and mosaic-like aggregates of microcline.

Zoned small prisms and fibrous aggregates of tremolite-actinolite are scattered, and are at least partly of retrograde origin. Small limonite pseudomorphs after pyrite and rare apatite crystals also have a random distribution.

The overall texture of the rock indicates possible fracturing of a weakly layered, possible original impure dolomitic facies, with the pervasive introduction of potassium to form the microcline (combining with indigenous clays?).

3525

Weakly layered to massive micro-mosaic (microgranuloblastic) magnetite-quartz-albite rock, with minor scattered coarser quartz crystals (?ex phenocrysts).

Quartz	15-20 %
Albite	75 %
Magnetite	7 %
Muscovite	tr.

This sample is similar to No. 3522, is composed of a massive albite-dominated, polygonal-textured micro-mosaic, with scattered single and rare composite quartz crystals about 1 mm in diameter, which have a fairly clearly bipyramidal habit. This quartz crystal form, and their distribution, suggest that they were formerly volcanic phenocrysts.

Magnetite grains, about 0.2 mm in size, are disseminated; they appear to be oxidised; and locally there are partly leucoxenised opaque oxide grains.

Some magnetite also occurs along the margins of disrupted, recrystallized quartz veins, and there are rare flakes of muscovite.

3526 : massive, medium grained albite rock, (albitite);
minor scattered magnetite, rutile, rarer muscovite.

albite	90%
magnetite	5%
rutile	3%
muscovite	1%
apatite, zircon	trace

This sample is dominated by a massive aggregate of randomly interlocked, essentially unaltered plagioclase laths, 1 to 3mm long, not particularly stressed, but commonly with weakly sutured intergranular boundaries.

Rutile, magnetite, minor apatite, and rare zircon occur in the interstices; lesser muscovite is randomly distributed. A vein cutting the rock consists dominantly of rutile and quartz, with minor muscovite and magnetite and rare limonite pseudomorphs of pyrite.

3527 : fine, weakly graphitic, quartz sericite schist, crenulated, lineated, and fractured, with minor biotite and chlorite in disruption areas.

quartz	55-60%
muscovite	35-40%
graphite	2-3%
biotite	1%
chlorite	2%
oxidised opaque grains	trace
tourmaline	1%

This is a fine grained quartz sericite schist, with recrystallised quartz grains about 0.1mm in diameter forming a compact mosaic, crowded with schistose muscovite flakes 0.05 to 0.3mm long. Fine graphite is disseminated throughout and rare pale-orange tourmaline is scattered.

The schist is finely laminated on a scale of about 0.2 to 0.5mm, with alternating sericite-rich and quartz-rich laminae. These laminae are folded into a complex pattern of crenulations commonly formed about stylolite-like fractures along which graphite has been concentrated.

Small lenses rich in quartz, chlorite and minor biotite occur adjacent to these fractures, with rare chloritic lamellae extending parallel to the lamination in the schist, accompanied by minor coarse muscovite.

Rare oxidised and leucoxenised opaque grains occur in the quartz-biotite-chlorite domains and in to the fracture zone.

3528 : graphitic micaceous quartzite with large retrogressed andalusite porphyroblasts.

quartz	45-50%
muscovite	15%
biotite	2%
graphite	1%
retrogressed porphyroblasts	35%
tourmaline	trace
altered opaque oxides	trace

This is a highly porphyroblastic schist the matrix of which is a fine quartzite with minor graphite, and minor to abundant muscovite, defining a schistosity. Minor altered biotite also occurs as poikiloblasts to lmm long, and there are scattered leucoxenised/limonitised opaque oxide grains about 0.2mm in size.

Large porphyroblasts are up to 25mm long consist of altered to dense fine grained sericite which enclose scattered flakes of chloritoid, and/or margarite in various proportions, and some coarser white mica flakes, particularly around the margins. Rare coarse tourmaline is present in fractures between porphyroblasts with quartz and white mica. These porphyroblasts are interpreted to be retrogressed andalusite.

A lens of coarse granular quartz about 4mm across is attached to one of the altered porphyroblasts.

3529 : folded and crenulated, graphitic micaceos quartzite, with retrogressed chiastolite porphyroblasts.

quartz	70%
sericite + muscovite(in matrix)	10%
altered biotite	3%
graphite	2%
retrogressed porphyroblasts	15%

This rock is similar to 3529, but the matrix is much more strongly quartzitic, and the porphyroblasts, though less abundant, are better formed and have a chiastolitic arrangement of fine graphite inclusions.

The matrix is dominated by an inequigranular quartz mosaic with grains 0.05 to 0.5mm in size, with scattered chloritised, graphite-rich biotite flakes about 1mm long with finely disseminated graphite and sericite defining a folded layering. A layer or lens of coarse muscovite flakes (to 4mm long) is present and is aligned at a high angle to the overall trend of the layering in the rock, as are the component muscovite flakes and the trails of graphite flakes enclosed in them.

Coarse muscovite and/or lenses of chlorite also occur around the porphyroblasts. These porphyroblasts are up to 25 x 10mm and are retrogressed to fine sericite incorporating scattered larger flakes of margarite. The margarite can be identified by its lower birefringence and strong multiple twinning.

Limonite is common in the altered biotite flakes, and in the chloritic lens around one of the porphyroblasts.

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STATEMENT OF EXPENDITURE
QUARTER ENDING 2ND OCTOBER, 1986

EXPLORATION LICENCE 1308

CLASSIFICATION		COST
Geological		
air photography & data acquisition	1,746	
geophysical consultant	500	
		2,246
Personnel		
technical staff	7,700	
field assistant	7,226	
		14,926
Logistics		
travel and accommodation	1,484	
freight	101	
technical and camp supplies	180	
food and provisions	402	
fuel	214	
repairs and maintenance	880	
		3,261
Technical Services		
drafting, printing	1,219	
chemical assay	688	
petrology	2,115	
		4,022
Rental		
vehicle	373	
storage	100	
		473
Depreciation		
vehicles	235	
equipment	175	
		410
TOTAL		25,338