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EL 1261 AND EL 1388

OUTALPA HILL

PROGRESS REPORTS TO LICENCE EXPIRY/SURRENDER FOR THE PERIOD 16/11/1984 TO 1/3/1988

Submitted by
Mico Australia Ltd
1987

Enquiries: Customer Services Branch
Minerals and Energy Resources
7th Floor
101 Grenfell Street, Adelaide 5000

Telephone: (08) 8463 3000
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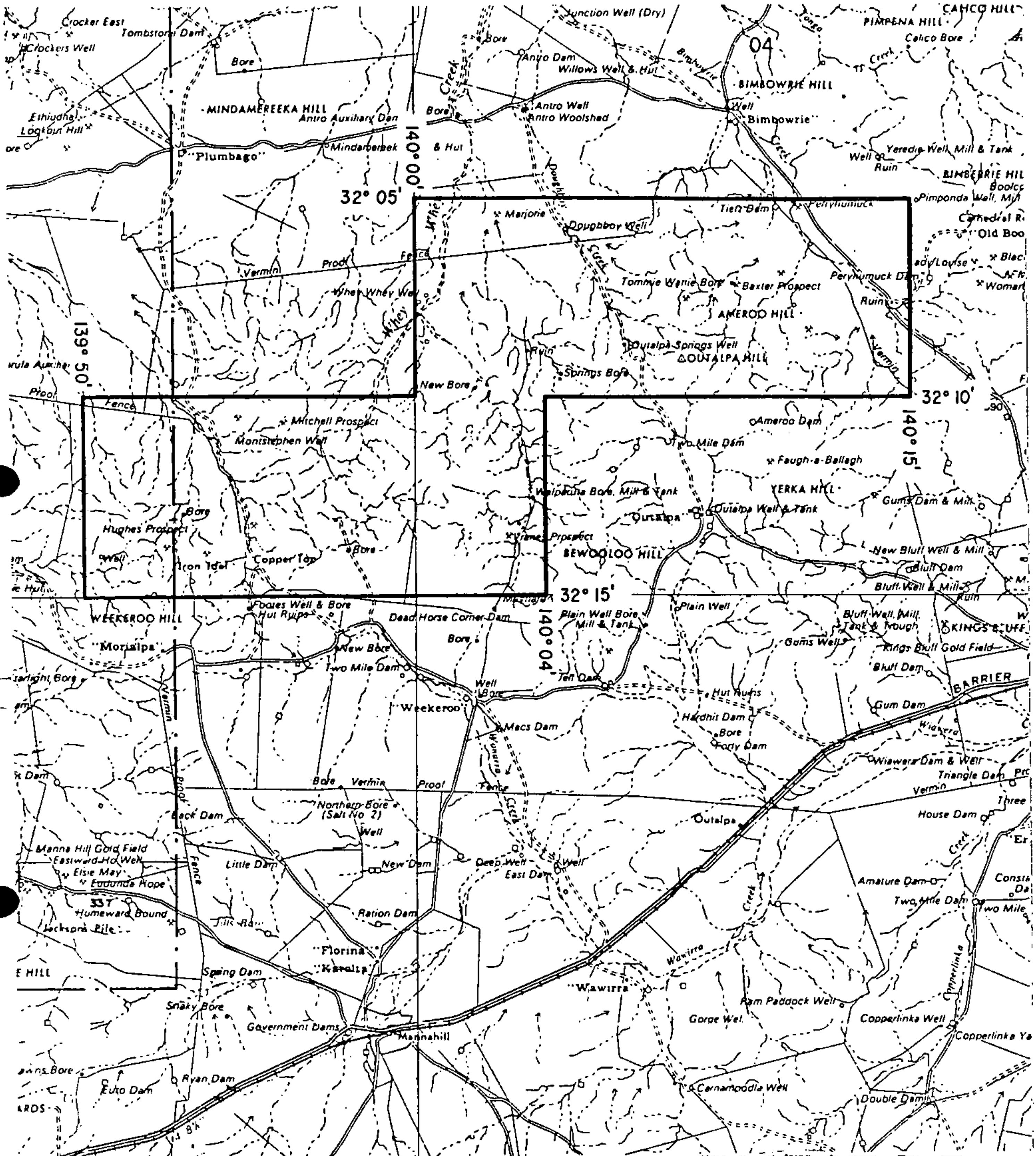
Government of South Australia
Primary Industries and Resources SA

SCHEDULE A



EXPIRED

SCALE 1:250,000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

REAPPLICATION
336/86

APPLICANT: MICO AUSTRALIA N.L.

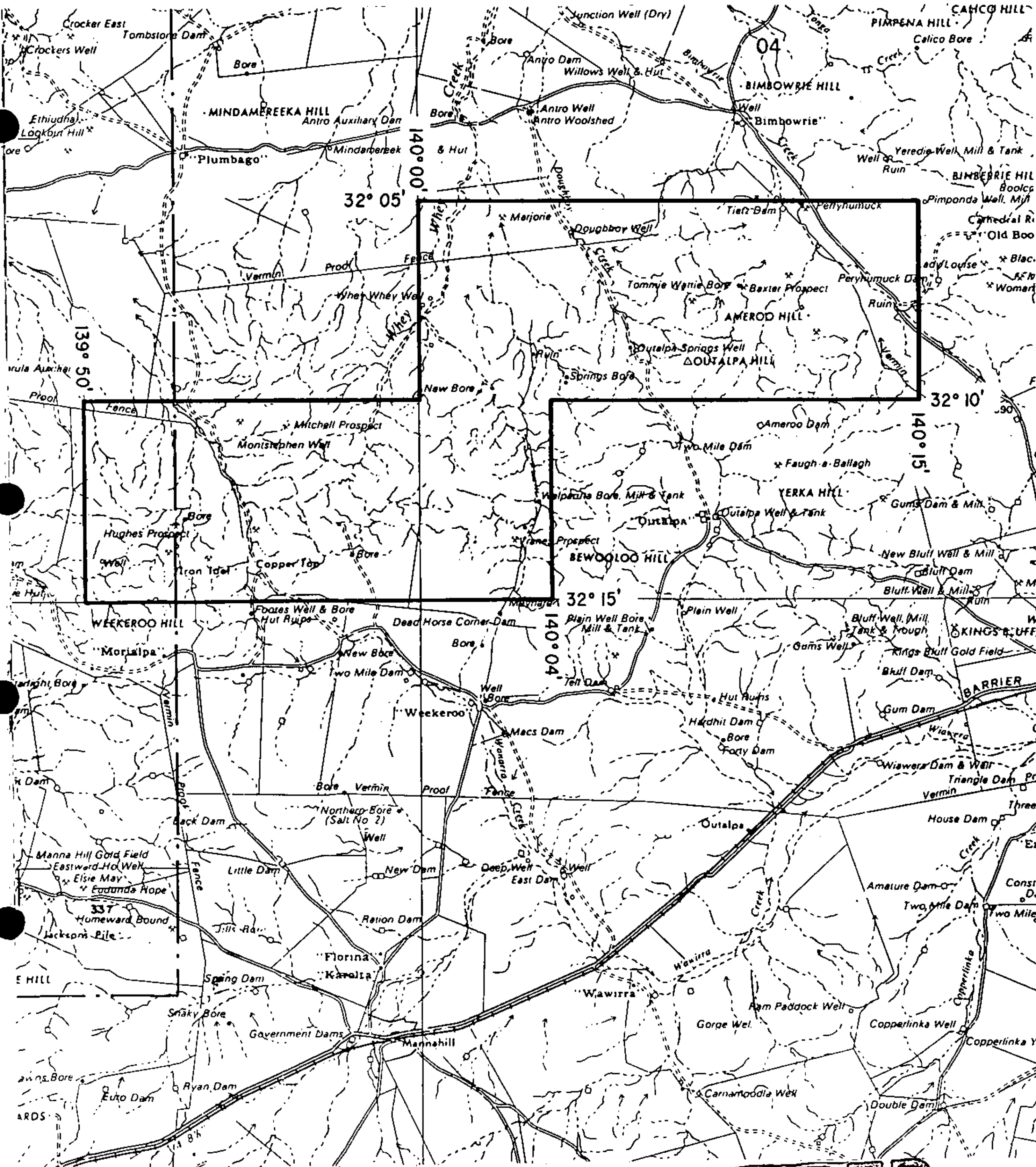
DM: 200/84 AREA: 421 square kilometres (approx.)

1:250000 PLANS: OLARY

LOCALITY: OUTALPA HILL AREA - Approximately 25 km northwest of Olary

DATE GRANTED: 16·11·84 DATE EXPIRED: 15·11·~~85~~ 86 EL No: 1261

SCHEDULE A



EXPIRED

SCALE 1:250,000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

APPLICANT: MICO AUSTRALIA LTD.

DM: 336/86 AREA: 421 square kilometres (approx.)

1:250000 PLANS: OLARY

LOCALITY: OUTALPA HILL AREA - Approximately 25 km northwest of Olary

DATE GRANTED: 2·3·87 DATE EXPIRED: 1·3·88 EL No: 1388

CONTENTS ENVELOPE 5968

TENEMENT: E.L. 1261 Outalpa Hill.

TENEMENT HOLDER: Mico Australia Ltd.

MICO AUSTRALIA LTD.

(INCORPORATED IN SOUTH AUSTRALIA)

135 WAYMOUTH STREET,
ADELAIDE, S.A. 5000
PHONE (08) 212-1377
TELEX: AA88909

27 March 1985

The Director General,
Department of Mines and Energy,
P.O. Box 151
EASTWOOD. S.A. 5063

Attention: Mr. I. Faulkes

Dear Sir,

Re: EL1261 - Outalpa Hill
Quarterly Report to February 15, 1985

EL1261, in the Outalpa Hill area was granted to Mico Australia Limited for a term of 1 year commencing on March 16, 1985. The Company's principal interest in exploring this area is to identify and define an andalusite and sillimanite resource suitable for commercial development. We refer you to our proposed programme of work as attached to our licence application.

Due to the Christmas Break and due to the season, we have not yet commenced work on the programme.

Our consulting geologist - Mr. M. Ware - will commence the field programme during this quarter. It is planned that the programme, as originally proposed, will be completed during the terms of the licence.

We apologise for the delay in submitting this quarterly report.

Yours sincerely,
MICO AUSTRALIA LTD.

M.W. UHLMANN
Director.

Geological and Ceramic Services Pty. Ltd.

004

21 GROVE STREET,
EDEN HILLS, 5050.
SOUTH AUSTRALIA.

TELEPHONE: (08) 278 7207

10th. July, 1985

South Australian Department of Mines and Energy
191 Greenhill Rd.,
Parkside. 5063

E.L. 1261. Outalpa Hill Area

Six Monthly Report. 16th., November, 1984 to 15th. May, 1985

Prepared for:
MICO AUSTRALIA LTD.
135 WAYMOUTH STREET,
ADELAIDE. 5000

By: Michael D. Ware.

Morialpa Sillimanite
White Hope

EXPLORATION LICENCE .1261. MICO AUSTRALIA LTD

1. LOCATION, MINERALIZATION AND INTEREST.

The E.L. area , situated as shown in figure 1., covers an area of Willyama Group muscovite-quartz schists and gneisses considered prospective for andalusite and sillimanite. Associated granitoids and pegmatites within the area are also of interest as possible sources of feldspar, mica and beryl.

A number of additional industrial minerals including barytes,talc, and fluorite are known to occur in the area and these , although not of primary interest, may attract some investigations.

Of the metallic minerals copper has been the more actively sought at locations such as the Perryhumuck, Ameroo,Walter Outalpa, Walparuta, Doughboy Well and Marjorie Mines and at the Hughes and Weekeroo Prospects. Lead has been reported from a few localities and a number of uranium and tantalum minerals are known from the north eastern portion of the area in the vicinity of Tommy Watty Bore.

Mineral production from within the E.L. includes approximately 7000 tonnes of andalusite and sillimanite from the Morialpa and Ameroo deposits, feldspar and beryl from a number of pegmatites near Ameroo Hill and small but unknown quantities of copper and barytes.

2. INVESTIGATIONS.

Some 65 reports, summaries , and notes relating to the area , including reports from previous Exploration Licence holders (Australian Gold and Uranium, Esso Minerals, Mines Exploration Pty. Ltd. , EZ Industries Ltd., Newmount, Murumba Minerals, Petrocarb Exploration, Comalco Exploration, International Nickel, Mt. Isa Mines, and Longreach Minerals), Mines Department reports, and sundry publications have been reviewed. References are appended.

Previous Exploration Licence holders were largely concerned with base metal and uranium potential in the area however despite extensive mapping, I.P., electromagnetic and ground magnetic surveys, soil sampling programmes and follow-up drilling, particularly in the Perryhumuck, Ameroo Hill, and Weekeroo/Walpuruta areas, economic mineralization has not been delineated and the explorers have derived little encouragment.

With regard to the Industrial Minerals, there has been little exploration at a company level other than an assessment of the fluorite potential within granite and amphibolite/scarn associations in the Weekeroo Hills area, undertaken by Comalco, and a survey with follow-up of the known sillimanite occurrences undertaken by Newbold General Refractories in the Morialpa and Ameroo areas. Additional to the reports relating to these activities the main bulk of information relating to the Industrial Minerals in the area comes from SADME reports concerning, in particular an appraisal of the feldspar and beryl resources therin, a few notes on chiastolite, barytes and corundum occurrences, a number of reviews of the sillimanite and andalusite occurrences, petrological descriptions mainly from compilations by D. Flint, and a limited creek sediment sampling programme for feldspar undertaken by Harris and Olliver. (SADME Rpt. Bk. 82/93)

3. CURRENT INVESTIGATION OF AREA.

Mapping has commenced in the south-west portion of the E.L. in the vicinity of the Morialpa Sillimanite deposits and preliminary samples have been submitted to Amdel for petrographic descriptions. (Report appended)

Preliminary mapping on a scale of 1:2000 has established the presence of a persistent muscovite-quartz schist horizon, some 500 to 600 metres in width over a 1.2 kilometre strike length, wherein sillimanite pods and lenses concordant with foliation, and apparently associated with quartz pegmatites, are concentrated. The prospective horizon is bounded to the north by a zone of massive gneisses and pegmatites and to the south by psammitic metasediments and pegmatites associated with multiple quartz reef development in some areas.

Within the prospective schist horizon sillimanite has been exposed by weathering resulting in blocks, up to an estimated 400 kilogrames, lying free at surface. Additional exposure of sillimanite has resulted from the establishment of numerous small pits, by former small scale prospectors and miners, and four larger pits which were established by bulldozing and costeaning during 1967. The largest pods now exposed are estimated to contain up to 100 tonnes of massive sillimanite ore.

4. Future Programme.

Although the sillimanite pods are individually of high grade, and in many instances capable of supplying ore for direct application, a method of detecting subsurface pods of minable size may not be readily available.

Thus, future mapping activity will concentrate upon the potential for establishing a sillimanite bearing schist which may be suitable for bulk mining and beneficiation. (15% Chiastolite schists in both South Africa and Brittany are bulk mined and processed economically at an overall 12% recovery of high grade andalusite.)

A petrological study of the schists, already commenced, will be extended during the term of the Licence in conjunction with further mapping and a creek sediment sampling programme.

Work in the Ameroo area is programmed along similar lines and a regional ground recognaissance survey over the potential schist horizon between the two areas is proposed.

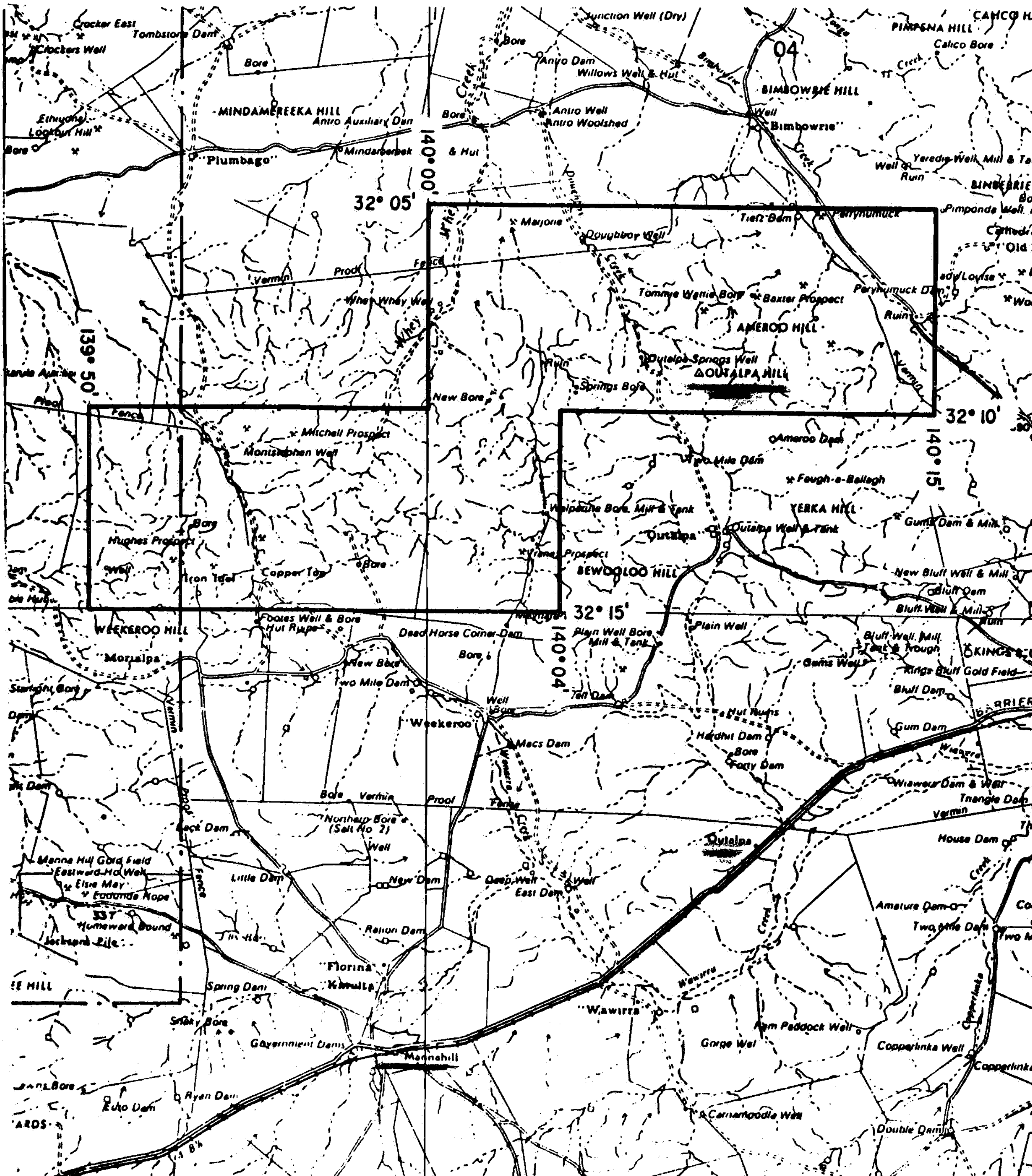
In view of the success of the creek sediment sampling for feldspar reported by Harris and Olliver (where 55% to 59% of creek sand analysed feldspar with the remainder predominately quartz) a follow-up programme in Whey Whey, Bimbowrie and Doughboy Creeks, and other major creeks draining the source pegmatites and gneisses, is to be undertaken.

Prepared for and on behalf of:
MICO AUSTRALIA LTD.

by,
Michael D. Ware
Geological And Ceramic Services Pty. Ltd.

July, 1985.

SCHEDULE A



SCALE 1:250,000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

FIGURE 1. OLARY E.L. 1261

AREA: 421 square kilometres (approx.)

1:250000 PLANS: OLARY

LOCALITY: OUTALPA HILL AREA — Approx. 25km N.W. of Olary.

Preliminary Mapping Morialpa Sillimanite
E.L. 1261.
July 1985
Legend
Quartz Pegmatites
Amphibolite
Sillimanite Pits
Sillimanite Float on Surface
0 50 100 Metres
Scale 1:2000
Major Zone of Pegmatites & Gneisses
Minor Schists
Schist + Qtz. Feld. Mus. Peg
3. Quartz Plagioclasite
20-100 Tonnes Sillimanite Exposed.
6x15x3 metres 60 Tonnes Sil. Ore Exposed
1 Mica Schist
Feldspar Pegmatite
MR 15603 5.3.67.
Claim Peg
Claim Pegs.
C2489 C2480 1.11.58
Sillimanite in Schists
Schists + Pegs.
Track
Pegmatites
Mica Schists
Quartz
Mus. Schists
Quartzite
Crenulated Mica Schists
Mica Schist.
13. Mus-Sillimanite Rock. (Sillimanite Retrograde)
Lease Peg
Zone of Schists + Pegmatites
MR 15608 5.3.67
MC2489 MC2480 1.11.52
Knotted Schists 10-400 Kg. Sillimanite Boulders at Surface
Vermin Proof Fence
Mus. Schists Minor Sillimanite
Knotted Schists + Pegmatites
Disused Track
Mica Schists
Spotted Mus. Schists
Quartz Feldspar Pegmatite.
Mica Quartz Feldspar Schist
15
Sillimanite Stockpile
Coarse Spotty Muscovite Schists Minor Sillimanite
Spotted Schists
Qtz. Feld. Peg.
4 Micaceous Quartz Feldspar Gneiss
White Hope Feldspar/Beryl Mine
Approximate Boundary with Sandy Sediments
Knotted Schists
Minor Sillimanite
Small Sillimanite pits over hill. (Concordant Pods)
Sillimanite at Surface Weathered out of Schists
Numerous Small Pods of Sillimanite
Quartz + Mica Schists
C2487 C2488
Knotted Schists

5968-1

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PETROGRAPHY OF EIGHT METAMORPHIC ROCKS

1. SUMMARY

Eight samples submitted for petrographic examination were given the following rock names:

Sample and Thin Section No.	Rock Name
1; TSC45383	Mica schist
3; TSC45384	Quartz plagioclasite
4; TSC45385	Micaceous quartzo-feldspathic gneiss
12; TSC45386	Mica schist
13; TSC45387	Muscovite-sillimanite rock
14; TSC45388	Mica schist
14A; TSC45389	Sillimanite
15; TSC45390	Micaceous quartzo-feldspathic schist

This suite of samples consist mainly of medium-grade metamorphic rocks comprised mainly of mica schists and micaceous quartzo-feldspathic schists. Sample 3 most likely represents a metamorphosed leucocratic plutonic igneous rock. Samples 13 and 143A are both sillimanite-rich rocks comprised largely of fibrous sillimanite. Retrograde alteration to muscovite is well developed in sample 13 and somewhat less developed in sample 14A. In sample 14A the development of chloritoid is associated with the alteration of sillimanite to finely divided muscovite/sericite.

2. PETROGRAPHY

Sample: 1; TSC45383

Rock Name:
Mica schist

Hand Specimen:
A well foliated rock containing large mica flakes intergrown with milky grey quartz-rich lenses.

Thin Section:
This sample consists mainly of a granoblastic quartz-rich mosaic intergrown with muscovite and biotite flakes which define a strong lepidoblastic foliation. Feldspar including polysynthetically twinned plagioclase and untwinned potash feldspar forms granular intergrowths with the feldspar within localized areas. Most of the quartz and feldspar mosaics tend to form slightly elongate, lenticular bodies separated by mica-rich bands.

The muscovite occurs as relatively large flakes up to several millimetres in size which are intergrown with well developed biotite flakes and as finely divided sericitic phyllosilicates. Some of the sericite is locally intergrown with the granular quartz but other sericite forms discontinuous lenses and bands. The biotite typically has a reddish-brown, intensely pleochroic colour and locally shows incipient alteration to a green chlorite.

This is a metasedimatary rock of lower amphibolite facies grade.

Sample: 3; TSC45384

Rock Name:
Quartz plagioclasite

Hand Specimen:
A massive rock comprised of dull white feldspar intergrown with milky grey quartz. Microchemical tests show that the rock contains no potash feldspar.

Thin Section:
This sample consists of large granular quartz bodies up to several millimetres in size intergrown with very large plagioclase crystals. The quartz bodies have a polycrystalline texture being comprised of large quartz crystals with xenomorphic shapes. Most of the quartz exhibits some evidence of deformation with the development of sutured grain margins, undulose, strained extinction and localized mild granulation.

The plagioclase forms weakly prismatic-shaped crystals which locally enclose anhedral quartz grains. Many of the plagioclase crystals are quite large possibly up to several centimetres in size. Much of the plagioclase contains inclusions of very finely divided muscovite/sericite which form moderately well developed flakes and could represent a recrystallized alteration product. Some slightly larger muscovite flakes also form interstitial intergrowths between plagioclase and quartz. The plagioclase has relatively low refractive indices indicating a sodic composition.

Traces of apatite form disseminated pristmatic crystals up to 0.3 mm long. The rock also contains traces of a bright green phyllosilicate which could be a chloritic material. Opaque to translucent iron oxides form disseminated grains as well staining along some fractures.

This is most likely a leucocratic plutonic igneous rock which has been subjected to metamorphic recrystallization.

Sample: 4; TSC45385

Rock Name:

Micaceous quartzo-feldspathic gneiss

Hand Specimen:

A very well foliated and banded rock containing some felsic pale tan coloured bands up to about 1 cm wide separated by darker grey coloured micaceous bands. Microchemical tests show that the felsic bands contain moderate amounts of potash feldspar.

Thin Section:

This sample consists mainly of a granoblastic quartz and feldspar mosaic intergrown with smaller amounts of biotite and minor muscovite. The quartz and feldspar form a mosaic with a typical grain size between 0.3 and 0.8 mm. The feldspar consists largely of untwinned potash feldspar along with smaller amounts of polysynthetically twinned plagioclase. The feldspar shows some alteration to finely divided sericitic phyllosilicates.

The biotite forms well developed flakes up to 0.4 mm long which have a brown, intensely pleochroic colour. The biotite flakes exhibit a strong lepidoblastic foliation and are locally concentrated within narrow bands which would represent the micaceous bands noted in hand specimen. Some well developed muscovite flakes are also intergrown with the biotite-rich bands.

This is a low to medium grade metasedimentary rock with a very well developed lepidoblastic foliation.

Sample: 12; TSC45386

Rock Name:
Mica schist

Hand Specimen:
A micaceous, well foliated rock with a greyish green colour.

Thin Section:
This sample consists mainly of muscovite flakes which exhibit a strong lepidoblastic foliation and are intergrown with smaller amounts of chlorite. Some of the muscovite flakes are quite large being up to a few millimetres in length but most muscovite forms much more finely divided flakes and very fine flaky aggregates. Although most of the muscovite is oriented along a single foliation direction evidence of other weakly developed foliation directions are present.

The chlorite is a pleochroic green variety with anomalous purple birefringence and forms moderately well developed flakes oriented both parallel to the major foliation direction and in lenses where it exhibits an orientation at a high angle to this foliation direction. It is considered likely that the chlorite represents a degraded biotite although no biotite remnants were observed. Very finely divided opaques are intergrown with the chlorite and tend to form fine lamellar structures along cleavage traces. Opaque to translucent iron oxides also form disseminated grains and aggregates through the rock. A small proportion of the translucent iron oxides have a euhedral character and could represent altered pyrite crystals.

Traces of tourmaline were noted locally as prismatic, pleochroic green crystals up to 0.8 mm long.

This is a relatively low-grade metamorphic rock comprised mainly of muscovite along with minor biotite and accessory tourmaline.

Sample: 13; TSC45387

Rock Name:
Muscovite-sillimanite rock

Hand Specimen:
A massive dull white to pale grey coloured rock containing localized disseminations of a fine-grained black mineral.

Thin Section:
In thin section this rock can be seen to consist mainly of sillimanite and muscovite/sericite which are unevenly distributed through the rock. The sillimanite forms very fibrous aggregates which form a felted mosaic within irregular patches up to several millimetres wide. The muscovite forms very finely divided flaky aggregates which in some areas form vein-like structures within the sillimanite and appear to be an alteration product of the sillimanite. Within localized areas very coarse muscovite flakes up to several millimetres in size are present but for the most part the muscovite forms very fine flaky aggregates.

Within one portion of the rock prismatic tourmaline crystals up to 3 mm long are present. This would represent the black disseminated mineral noted in hand specimen. The tourmaline has a pleochroic greenish-orange colour and shows vague concentric zoning. Most of the tourmaline is intergrown with coarse-grained muscovite or very finely divided muscovite.

Minor opaques are disseminated through the rock as small grains and aggregates which are typically intergrown with the muscovite.

This is considered to be an aluminous metasomatic rock comprised largely of sillimanite and minor tourmaline which shows a moderate degree of alteration of sillimanite to secondary muscovite/sericite.

Sample: 14; TSC45388

Rock Name:
Mica schist

Hand Specimen:
This is a medium to dark grey coloured rock with a well developed schistose foliation comprised mainly of relatively large biotite flakes. The rock exhibits an irregular slightly paler coloured zone with a finer grain size.

Thin Section:
This sample consists mainly of mica comprised largely of finely divided muscovite/sericite intergrown with larger chloritized biotite flakes. The paler coloured zone noted in hand specimen consists mainly of a felted, flaky aggregate of finely divided muscovite/sericite flakes. Minor small biotite which shows some chloritization is locally intergrown with this finely divided muscovite.

This zone is surrounded by an area comprised of larger mica flakes consisting mainly of chloritized biotite with some well developed muscovite flakes. The chlorite flakes consist of pale green, weakly pleochroic chlorite with anomalous purple interference colours but generally contain minor lamellar remnants of biotite. The muscovite tends to occur interstitially between the chlorite flakes and generally forms very well developed flakes although some finely divided muscovite aggregates are present. Finely divided opaque material is also intergrown with the chlorite.

Accessory apatite forms disseminated crystals up to 0.8 mm long which are intergrown both with the fine-grained muscovite/sericite-rich portion of the rock and with the coarser chloritized biotite-rich area. Traces of tourmaline were noted as small, pleochroic green prisms intergrown with the finely divided muscovite.

This is a schistose metamorphic rock with a somewhat variable mineralogy comprised mainly of chloritized biotite and finely divided muscovite/sericite.

Sample: 14A; TSC45389

Rock Name:
Sillimanite

Hand Specimen:
A greenish-grey coloured rock comprised of fibrous-textured crystals. The rock is transected by a narrow dark green to black vein.

Thin Section:
In thin section this rock can be seen to consist mainly of sillimanite which generally forms a felted, fibrous textured mosaic. Some large prismatic sillimanite crystals up to several millimetres in size are disseminated through the rock but these often grade into very fibrous, matted sillimanite.

The sillimanite is intergrown with some finely divided muscovite/sericite which forms irregular patches as well as narrow vein-like structures. The muscovite/sericite is locally intergrown with chloritoid which forms prismatic crystals up to several millimetres long which exhibit well developed polysynthetic twinning. The chloritoid in particular tends to be concentrated along a vein-like structure which would represent the dark vein noted in hand specimen.

This is a sillimanite-rich rock most likely of metasomatic origin which has been subjected to some retrograde alteration producing finely divided muscovite/sericite with moderate amounts of associated chloritoid. It is considered likely that the retrograde alteration is of hydrothermal origin.

Sample: 15; TSC45390

Rock Name:
Micaceous quartzo-feldspathic schist

Hand Specimen:

This is a well foliated rock containing pale grey lenticular bodies separated by undulose micaceous bands with a slightly darker colour.

Thin Section:

This sample consists mainly of granoblastic quartz and feldspar mosaics intergrown with well developed mica flakes which exhibit a strong lepidoblastic foliation. Both the quartz and feldspar tend to be concentrated in elongate lenses separated by mica-rich bands adding to the foliated character of the rock. Within these lenses the quartz and feldspar has a typical grain size of about 0.2 mm to 1 mm. The feldspar consists of both polysynthetically twinned plagioclase and untwinned potash feldspar.

The mica-rich bands consist of large muscovite and biotite flakes up to several millimetres long. Moderate amounts of finely divided muscovite/sericite are also locally present particularly marginal to some mica-rich bands. Muscovite/sericite also forms fine intergrowths with the granular quartz and feldspar lenses. The biotite shows some alteration to a pleochroic green chlorite with anomalous interference colours.

Traces of tourmaline form disseminated prismatic crystals up to 0.2 mm long which have a pleochroic green colour. Most of the tourmaline is intergrown with finely divided muscovite/sericite patches. Minor opaques are disseminated through the rock as small grains and aggregates which are generally intergrown with the muscovite and chloritized biotite.

This is a low to medium grade metasedimentary rock.

MICO AUSTRALIA LTD.

(INCORPORATED IN SOUTH AUSTRALIA)

135 WAYMOUTH STREET,
ADELAIDE, S.A. 5000
PHONE (08) 212-1377
TELEX: AA88909

27 August 1985

The Director General,
Department of Mines and Energy,
191 Greenhill Road,
PARKSIDE. S.A. 5063

Attention: Mr. I.G. Faulkes

Dear Sir,

Re: EL 1261 - Outalpa Hill

Expenditure Statement for Period Ended May 15, 1985

As previously advised, work commenced on this area during the second Quarter of the Licence Period. During that Quarter, a detailed literature review was undertaken to assess the work completed by previous title holders. As well, a preliminary mapping programme commenced and samples were submitted to Amdel for petrographic description.

A number of the tests associated with this work (including Amdel costs?) have not been billed. These costs will be reported in the Quarter ended August 15, 1985. The total expenditure in the period to May 15, 1985 was $7750 made up as:

(1) Literature Review - consultant costs ($5400)	
- copying etc. ($50)	$5450.00
(2) Field Work - geologist ($1200)	
- vehicle hire ($210)	
- accomodiation, meals, etc. ($90)	$1500.00
(3) Preparation of Reports ($800)	$ 800.00
	$7750.00

A report is being prepared for the Quarter ended August 15, 1985. An extensive field work programme is planned for the current Quarter.

Yours sincerely,

M.W. UHLMANN
For
Mico Australia Limited.

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2 SEP 1985
DEPT. OF MINES AND ENERGY SECURITY

MICO AUSTRALIA LTD.

(INCORPORATED IN SOUTH AUSTRALIA)

135 WAYMOUTH STREET,
ADELAIDE, S.A. 5000
PHONE (08) 212-1377
TELEX: AA88909

3 September 1985

Department of Mines and Energy,
191 Greenhill Road,
EASTWOOD. S.A. 5063

Attention: Mr. I.G. Faulkes

Dear Sir,

Re: EL 1261 - Outalpa Hill
Quarterly Report to August 15, 1985

You will find enclosed a copy of our quarterly report for the period ending August 15, 1985, on the above licence area. During this period, a field programme was completed and samples from the field were tested in the laboratory to assess the potential for linification? of the andelusite and siltemanite to a saleable refractory grade material. These laboratory tests were positive and field work is now planned with an aim to outline a large tonnage resource with the potential for economic bulk mining and linification.?

Expenditure on the licence area during this quarter was $10,240.00 as:

(a)	Field Work - mapping, sampling etc.	$3,800
(b)	Laboratory Testing - linification tests ?	$5,300
(c)	Analysis of Results and Report Writing	$1,140
		$10,240

beneficiation?

Field work is continuing on the Licence area.

Yours sincerely,

per [signature]

M.W. UHLMANN
for
Mico Australia Limited

RECEIVED
10 SEP 1985
DEPT. OF MINES AND ENERGY SECURITY
5968

Geological and Ceramic Services Pty. Ltd.

21 GROVE STREET,
EDEN HILLS, 5050.
SOUTH AUSTRALIA.

27th. August, 1985

TELEPHONE: (08) 278 7207

S.A. Department of Mines and Energy
191 Greenhill Rd.,
Parkside. 5063

Attention: Mr. I. Faulks.

E.L. 1261- 3rd. Quarter Report

Period : 16th. May-16th. August, 1985.

Prepared by : Michael D. Ware

for : Mico Australia Ltd.
135 Waymouth Street,
Adelaide. 5000

Contents : Field and Laboratory Data- Ameroo Area

Andalusite/Sillimanite Analyses.

Ameroo Sillimanite/Andalusite Occurrences. E.L. 1261.

Field Investigations.

Mapping and sampling was undertaken in the vicinity of the Ameroo sillimanite occurrences during the 3rd. quarter of the E.L. tenure. The occurrences are located 25 kilometres north-north-west of Olary with access via the Bimbowrie track and turn off at Tietz Dam. Target areas are within a belt of quartz mica schists striking approximately 330^0 and outcropping in two areas, separated by a large tract of alluvium cover, located from 5 to 8 kilometres south to south-west of Tietz Dam.

Four general localities are recognized as former small producers known as the Maggie, Tommy Watty, Ameroo West, and Ameroo North-West Claims.

The schists are metapelites consisting of quartz, muscovite, minor biotite and albite with or without sillimanite, andalusite, and garnet. Texturally the schists are complex in that they contain at least two and often three foliations in conjunction with post tectonic growths of muscovite and occasionally staurolite. Analyses supplied by Spry (1977) of schists from Tommy Watty bore suggest that the simple quartz muscovite schist may be poorer in alumina than the sillimanite bearing schists (16.6% compared with 17% to 26% Al_2O_3) but high in potash with 8.8% compared with 3% to 6.5% for most schists. This is possibly due to the presence of metasomatic post tectonic muscovite common throughout the region in varying quantities.

Coarse knotted andalusite schists to the west of Tommy Watty bore were found by Spry (1977) to contain andalusite (fresh and pretectonic to the foliation , contorted sillimanite and abundant post-tectonic muscovite . Chemically the rock correlates to a mineralogical composition of 70% andalusite or sillimanite, 20% muscovite,, 5% biotite and 2.5% quartz. Obviously the alumina is too high for a normal sediment and thus either the original sediment was highly aluminous or the rock has undergone alumina metasomatism.

Although andalusite is found as fresh crystals or remnents of original crystals it has been broadly established that retrogression to sericite is widespread. Further there is evidence that andalusite has in many instances been altered to varying degrees to sillimanite which in turn has been partially replaced by muscovite. Commonly the extent of seritization is confined to the edges of crystals or to fine fractures within the crystals and it is thus possibly related to the degree of fracturing of the host. Certainly large masses of fresh sillimanite (commonly fibrolite) and andalusite are present at the sites of former workings in the Ameroo area which show little evidence of sericitization although post-tectonic intergrowths of large muscovite crystals are common. This could be explained as regrowth of sericite.

At the Maggie Claim andalusite occurs within a near vertically dipping quartz muscovite schist in the vicinity of prominent quartz reefs and quartz/feldspar/tourmaline pegmatites. The host schist consists of garnet, andalusite, biotite, minor muscovite and chlorite, and a trace of epidote. The andalusite rather than being diseminated throughout the schist is possibly confined to elongate zones (a few mm. wide and tens of mm. long) wherein it accounts for 25% to 30% of the mineral constituents. The andalusite occurs as fine crystals, 0.2 to 0.5mm., intergrown with biotite and chlorite. The edges of the crystals are ragged with the boundaries marked by films of iron stained clay which appears to be a weathering product. Sericite occurs in very fine veins cutting some of the andalusite crystals which generally appear fresh, other than moderately weathered at the edges, and free of inclusions. The crystals do not appear to have suffered general and extensive retrogression.

Within the schist horizon ,which may be traced over a distance of approximately 700 metres and a width of 30 metres at the Maggie location, small individual pods of andalusite may be found free at surface or within a number of small pits thought to be the sites of former larger pods.

Dickinson (1943) and Campana and King (1958) refer to the Maggie claim as yielding near pure superficial andalusite boulders up to 100 kilogrames in weight which had weathered out of the schists. Production has however been small (possibly less than 50 tonnes) and appears to have been mainly confined to the free material or shallow workings on outcropping lenses generally over less than a 0.5 by 1.0 metre area and to a depth of approximately 0.5 metres.

Pods of andalusite occur at the Tommy Watty site which although in a different sequence of schist beds, within the same schist horizon, show similar characteristics and production record as the Maggie Claim. The site, 0.5 kilometres to the north, is associated with intrusive (pegmatitic) quartz and feldspar reefs with the massive andalusite pods typically occurring in close proximity to quartz reefs or lenses.

The Ameroo West deposits occur along the south westerly strike continuation of the Maggie Claim however although within the same schist horizon there is generally substantially more abundant sillimanite exposed at surface and a greater concentration of ore within a definable area.

The deposits consist of pods and lenses of intergrown sillimanite and andalusite within an extensively foliated and deformed mica schist sequence which rises steeply from the sandy alluvial plain between hills of granitoids, pegmatites, and gneisses. Individual pods, commonly from 0.5 to 1.5 metres long and 0.5 metres wide, of sillimanite occur over an area of 200 by 400 metres associated with numerous reefs of massive quartz, intermittent in outcrop, which transect the hillside.

A few hundred tonnes of sillimanite, some in boulders estimated at up to a tonne in weight, line the bed of a steep creek on the south side of the hill where they have presumably come to rest having eroded from the schists and rolled down the hill.

Campana and King (1958) refer to three former claims in the Ameroo West deposits wherein lenticular and blocky masses of intergrown andalusite and sillimanite measuring up to 2.7 metres in length cropped out at the margins of tourmaline bearing pegmatites and quartz segregations. These Claims although formerly productive (Barrie, 1966, reports production in the vicinity of Ameroo Hill, mainly from the Ameroo West deposits, amounted to 4713 tonnes of andalusite and sillimanite) show little evidence of having being worked other than in shallow gougings and only one small area where three narrow benches have been established appears to have been substantially prospected. A few tonnes of rich andalusite and sillimanite ore lies scattered over the benches.

Thin sections of the confining schists examined from this site shows approximately 10% andalusite to be present in association with quartz, muscovite, biotite, and minor amounts of staurolite, garnet and sillimanite. Generally the andalusite occurs in rich bands alternating with bands of quartz, biotite and muscovite or as coarse boudin crystals of andalusite intergrown with muscovite. It is interesting that in the schists examined andalusite predominates over sillimanite whereas in the field it is obvious that sillimanite predominates in the massive superficial ore.

Examination of the massive sillimanite/andalusite rock shows coarse fresh andalusite xenoblasts intergrown with bladed acicular sillimanite and minor muscovite and possibly feldspar. Staurolite is present within the sillimanite along the andalusite margins. The sillimanite is generally thought to be replacing andalusite.

Andalusite is present at the site described as the Ameroo North-West Claim, approximately 1 kilometre from the previous site, and at a number of sites not previously described in the literature lying to the east of the Claim. Samples from this area include; knotted schists with retrogressively altered andalusite, to sericite, enclosing new crystals of kyanite or muscovite; and massive andalusite showing a dusting of fine sericite, and fracture infills of sericite, and associated fibrous and flamboyant textured sillimanite.

The knotted schists consist essentially of quartz, muscovite and sericite, and biotite with small amounts of remanent andalusite, garnet and opaques. The knots,thought to be originally andalusite porphyroblasts, are commonly up to 2 by 1 centimetres in section and occupy 30% to 50% of the schist. They are almost completely altered to sericite and swathed by alligned plates of biotite and muscovite. The more massive material consists of andalusite crystals from 10 to 15mm. long separated by zones containing deformed masses of sillimanite and coarse grained muscovite. With the exception of the fine dusting of sericite, the andalusite crystals appear to be relatively fresh although extensively fractured with the fractures being filled with sericite.

Overall it appears that the andalusite has suffered a greater degree of sericitization in this area than material within schists to the south and it is considered probable that the degree has been influenced by the more extensive fracturing and broad deformation suffered by rocks in this area. Whether the degree of fracturing is localized is unknown.

Andalusite and Sillimanite Grade.

Olliver, 1973, compiled analyses of hand samples of andalusite and sillimanite from the Ameroo area. Results, presented in Table 1, generally indicate a grade of 47% to 54% Al_2O_3, 0.9% to 3.6% Fe_2O_3, and 38% to 43% SiO_2. By comparison pure andalusite or sillimanite theoretically contains 62.8% Al_2O_3, and 37.2% SiO_2.

To ascertain the potential for beneficiation a mixed sample of andalusite and sillimanite from the Ameroo area has been crushed to nominally 5 mm. and various size fractions examined. Results, as presented in Table 2, indicate that although some of the sillimanite is liberated in the 7 to 5 mm. range most of the grains show composite mineralogy above 2.8mm. At 1.4mm. most of the andalusite is liberated but sillimanite, estimated to comprise 40% to 50% of the sample still exists as composite grains.

At 0.7mm., 85% of the grains were liberated with composites being mainly quartz/tourmaline or mica, staurolite/quartz, sillimanite/quartz, or tourmaline/staurolite or mica. At 0.5mm. composite grains are similar to the above although the majority of the sillimanite has now been liberated.

Commencing with a 0.5 to 0.71mm. fraction products were separated at a specific gravity of 2.96 to yield 32.45% lights and a 67.55% heavy fraction. The heavy fraction was then further processed by electromagnetic separation and in a density column.

The electromagnetic separation produced a non-magnetic fraction of sillimanite and andalusite at a grade of 59.2% Al_2O_3, 37.8% SiO_2, 0.78% Fe_2O_3, and 1.03% K_2O. This product represented 43% of the original sample and 65% of the heavy mineral fraction.

The heavy liquid column separated seven fractions consisting of two lightest fractions of sillimanite and contaminants, an andalusite concentrate, three fractions of mixed sillimanite and andalusite, and a dense staurolite fraction. Of these the andalusite fraction represented the highest potential refractory grade material analysing 60.7% Al_2O_3, 0.75% Fe_2O_3, and 0.38% K_2O.This represented 19% of the original sample and 28% of the heavy mineral fraction.

The three mixed sillimanite and andalusite fractions were also of high grade although containing slightly greater quantities of potash and iron.

Together they represent a further 26% of the original sample and 39% of the heavy mineral fraction. Analyses of various fractions are presented in Table 3.

Discussion

Field investigations within the Ameroo area have confirmed the presence of an andalusite and sillimanite bearing schist horizon which warrants further investigation. Todate it has been established that the richer segregations of andalusite and sillimanite may be beneficiated to high grade materials which could command a refractory market and be competative in terms of quality with imported products. Reference is made to tables 3 and 4 for comparison between the products prepared under laboratory conditions from massive sillimanite/andalusite material from the Ameroo area and andalusite from S. Africa and Brittany. Both are commercial products derived by beneficiation of chiastolite bearing schists.

Although defined areas have been delineated within the Ameroo area wherein there are substantial concentrations of andalusite and sillimanite it is likely to be uneconomic to work these areas for this source of material exclusively.

Investigations are thus continuing throughout the E.L.to ascertain the potential for establishing a large source of andalusite bearing schist which may be worked in bulk as the basis of a processing operation.

References.

Barrie, J., 1966. Australian Mineral Industry. The Mineral Deposits. Dept. Nat. Dev. Bur. Min. Res. Geol. & Geophysics. Bull. 72. pg. 539

Campana, B., and King,D. 1958. Regional Geology and Mineral Resources of the Olary Province. S.A. Geol. Surv. Bull., Vol 34.

Dickinson, S.B., 1943 Andalusite Occurrence, North of Olary and Kyanite near Radium Hill. S.A. Min. Rev. No. 76, Pgs. 81-82.

Olliver, J.G., 1973. Sillimanite, Kyanite, and Andalusite- South Australia. D.M.E. Rpt. Bk. 73/296. pgs.1-10.

Spry, A.H. 1977. Petrology of the Olary Region. Amdel Report 1172 for S.A.D.M.E.

Table 1. Andalusite Analyses

	Ameroo# West	Ameroo West	Ameroo North-West	Ameroo North-West	Tommy Watty
SiO_2	39.2	43.3	38.7	41.8	39.5
Fe_2O_3	1.8	2.8	3.6	0.9	3.4
Al_2O_3	51.2	47.4	51.7	54.3	52.3
TiO_2	0.2	0.4	0.4	0.1	0.3
CaO	-	0.3	-	0.3	0.2
MgO	-	0.7	-	0.3	0.8
Na_2O	-	0.9	-	0.5	0.5
K_2O	-	4.1	-	2.2	2.2
L.O.I.	2.6	2.8	2.9	1.7	1.8

Olliver, J.G. 1973. Sillimanite, Kyanite and Andalusite- South Australia. D.M.E. Rpt. Bk. 73/296 Pg. 1-10.

Forbes, B. G. Sillimanite Deposits-Northwest of Olary. S.A. Min. Rev. 108. Pgs. 71-73.

Table 2. Size and Mineralogy. Ameroo Massive Ore.

Sizing	Mineralogy and Comments
-7+5mm.	Pink Andalusite, sillimanite, minor quartz and traces of staurolite and tourmaline. Some sillimanite liberated. Andalusite remains as mixed composite grains.
-5+4mm.	Mineralogy as above. Approximately 10% each of sillimanite and andalusite liberated.
-4+2.8mm.	Similar to above.
-2.8+1.4mm.	40-50% of minerals liberated.Majority of andalusite free. Estimate andalusite 20%, sillimanite 50%, quartz 15%, mica,staurolite, tourmaline 5%.
-1.4+0.71mm.	85% of grains liberated. Composites mainly quartz/tourmaline or mica, staurolite/quartz, sillimanite/quartz, tourmaline/staurolite or mica.
0.71-0.5mm.	Similar to above. All andalusite and majority of sillimanite liberated.

Table 3. Beneficiated Andalusite and Sillimanite.
Chemical Analyses.

SiO_2	37.1[a]	37.3[b]	37.3[c]	37.2[d]	37.8[e]
TiO_2	0.06	0.09	0.11	0.06	0.09
Al_2O_3	60.7	59.5	58.5	60.7	59.2
Fe_2O_3	1.02	1.37	1.44	0.75	0.78
MnO	0.01	0.01	0.01	0.01	0.01
MgO	0.24	0.04	0.42	0.18	0.21
CaO	0.07	0.12	0.07	0.08	0.11
Na_2O	0.15	0.18	0.21	0.11	0.22
K_2O	0.43	0.75	0.96	0.38	1.03
P_2O_5	0.02	0.08	0.04	0.03	0.05
L.O.I.	0.60	0.77	0.98	0.55	0.91
Total	100.4	100.2	100.0	100.1	100.4

Yield.	5.55	12.73	7.96	19.30	43.73	% of total sample.
	8.21	18.84	11.79	28.57	64.73	% of sub-sample.#

a,b,and c. Heavy liquid fractions >2.96s.g. Mixed sillimanite and andalusite.
d. Heavy liquid fraction >2.96s.g. Andalusite. (lower s.g. than above fractions.)
e. Electro magnetic separation. Non-magnetic fraction.
Fraction >2.96s.g. 67.55% of original sample.

Table 4. Andalusite. Commercial Products.

	Brittany * " Kerphalite." Grade KA %	Grade KB %	N.W. Transvaal* "Prusite" %
SiO_2	37.5-38.6	44.3-44.8	38.0
Al_2O_3	59.0-59.5	52.0-53.0	60.5
TiO2	0.20-0.28	0.25-0.30	0.12
Fe_2O_3	0.90-1.0	0.90-1.10	0.60
CaO	0.15-0.30	0.12-0.27	0.01
MgO	0.09-0.15	0.12-0.17	0.31
Na_2O	0.08-0.10	0.15-0.25	0.06
K_2O	0.15-0.35	0.25-0.40	0.12
L.O.I. 1000^oC.	0.30-0.70	0.70-1.10	0.4-0.6

* Published literature. - Kerphalite-Europe's own source of high alumina andalusite for refractories. 2nd. Ind. Mins. Int. Cong. Munich.1976.

* Weedons Minerals Pty. Ltd. Johannesburg, S. Africa.

To Security Clerk.

To Env 5968 Please

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MICO AUSTRALIA LIMITED

(23/9/85)

EL 1261 - OUTALPA HILL

WORK PROGRAMME FOR PERIOD TO NOVEMBER 15, 1985

The Company has spent approximately $18,000 on this Licence area in the 9 month period to August 15, 1985. A budget figure of $7,000 has been allocated for expenditure on the area during the current quarter.

A schist unit hosting the sillimanite pods has been identified and mapped. The next phase of the programme will focus on establishing the mineable grade of Al_2O_3 from this unit, and on confirming the ability to upgrade ore to saleable grade through simple gravity processes on a pilot scale.

Work Programme

The programme of work to November 15, 1985 has not yet been agreed. The consulting geologist - M. Ware - wishes to discuss the programme with Mr. J. Olliver at the Department of Mines and Energy before finalising plans. At this stage, it is expected that the work will involve:

- collection and preparation of a 200 to 300 kg sample of ore
- processing of sample through pilot plant to confirm that ore can be upgraded simply
- preparation of plan for bulk sampling of ore horizon to determine mineable grade

M. Uhlmann

Geological and Ceramic Services Pty. Ltd.

21 GROVE STREET,
EDEN HILLS, 5050
SOUTH AUSTRALIA

TELEPHONE: (08) 278 7207

18 November, 1985

Mico Australia Ltd.
135 Waymouth Street,
Adelaide.

E.L. 1261. OUTALPA HILL AREA.

Exploration Licence Summary Report.

Period. 16th. November, 1984 to 15th. November, 1985.

Prepared by. Michael D. Ware.

CONTENTS.

Outalpa Hill Area. E.L. 1261- 4th. Quarter Report.

OUTALPA HILL AREA. E.L. 1261- 4TH. QUARTER REPORT.

1. INTRODUCTION.

E.L. 1261, situated as shown in figure 1., was granted over an area of approximately 421 square kilometres for a term of 12 months expiring 15th. November, 1985.

The E.L. covers an area of WILLYAMA GROUP quartz mica schists and gneisses considered prospective for andalusite and sillimanite. Associated granitoids and pegmatites within the area are of interest as possible sources of feldspar, mica and beryl and sediments of the ADELAIDEAN SYSTEM underlain by Burra Group metasediments within the central portion of the E.L. are of posible interest for their copper mineralization.

A number of additional industrial minerals including barytes,talc, and fluorite are known to occur in the area and these , although not of primary interest, may attract some investigations.

Of the metallic minerals copper has been the more actively sought within the E.L. by previous investigators at locations such as the Perryhumuck, Ameroo,Walter Outalpa, Walparuta, Doughboy Well and Marjorie Mines and at the Hughes and Weekeroo Prospects. Lead has been reported from a few localities and a number of uranium and tantalum minerals are known from the north eastern portion of the area in the vicinity of Tommy Watty Bore.

Mineral production from within the E.L. includes approximately 7000 tonnes of andalusite and sillimanite from the Morialpa and Ameroo deposits, feldspar and beryl from a number of pegmatites near Ameroo Hill and small but unknown quantities of copper and barytes.

2. INVESTIGATIONS.

Investigations during the period have consisted of;

(a) Review of previous work.
(b) Mapping and Sampling of sillimanite/andalusite occurrences.
(c) Petrographic examinations of andalusite/sillimanite assemblages and confining schists and gneisses.
(d) Laboratory examination of andalusite/sillimanite assemblage to determine grade and possibililities for beneficiation.

3. REVIEW OF PREVIOUS WORK.

Some 65 reports, summaries , and notes relating to the area , including reports from previous Exploration Licence holders (Australian Gold and Uranium, Esso Minerals, Mines Exploration Pty. Ltd. , EZ Industries Ltd., Newmount, Murumba Minerals, Petrocarb Exploration, Comalco Exploration, International Nickel, Mt. Isa Mines, and Longreach Minerals), Mines Department reports, and sundry publications have been reviewed.

Previous Exploration Licence holders were largely concerned with base metal and uranium potential in the area however despite extensive mapping, I.P., electromagnetic and ground magnetic surveys, soil sampling programmes and follow-up drilling, particularly in the Perryhumuck, Ameroo Hill, and Weekeroo/Walpuruta areas, economic mineralization has not been delineated and the explorers have derived little encouragment.

With regard to the Industrial Minerals, there has been little exploration at a company level other than an assessment of the fluorite potential within granite and amphibolite/scarn associations in the Weekeroo Hills area, undertaken by Comalco, and a survey with follow-up of the known sillimanite occurrences undertaken by Newbold General Refractories in the Morialpa and Ameroo area.

Additional to the reports relating to these activities the bulk of information relating to the Industrial Minerals in the area comes from SADME reports concerning an appraisal of the feldspar and beryl resources therein, a few notes on chiastolite, barytes, and corundum occurrences, a number of reviews of the sillimanite and andalusite occurrences in the Morialpa and Ameroo Hill areas, petrological descriptions mainly from compilations by D. Flint, and a limited creek sediment sampling programme for feldspar undertaken by Harris and Olliver. (SADME Rpt. Bk. 82/93)

4. EXPLORATION WITHIN E.L. 1261

4.1 Morialpa Sillimanite Occurrences.

Location : Weekeroo and Morialpa Stations. Deposits located approximately 2 kilometres north-east of Weekeroo Hill and 15 kilometres north-west of Weekeroo homestead.

Reference : Olary Province 1:170000 Map. Bull. No. 34 Geol Surv. S.Aust. Latitude 32° 13' S, Longitude 139° 54' E.
Weekeroo Inliers. Dept. Mines Energy-S. Aust. Plan No. 79-357
Aerial Photographs. Dept. Lands S.Aus. Survey 2315 1:85000 scale, frames 058-060

Access : A rough track runs approximately 4 kilometres north from the Morialpa homestead to the south western leases previously known as the Morialpa West deposits. Better access is gained from Weekeroo property via Footes Bore and Well and turn off 1 kilometre before Copper Top into the Morialpa East deposits.

Previous Reports. : Campana, B. and King, D. (1958) Regional Geology and Mineral Resources of the Olary Province. Bull. Geol. Surv. S. Aust. No. 34, pg. 118.
Ridgway, J.E. and Johns, R.K., (1959) Sillimanite Deposits-Morialpa Station S. Aust. Min. Rev. No. 90, pg.117-119.
Olliver, J.G., (1973) Sillimanite, Andalusite, & Kyanite in South Australia. S. Aust. Dept. Mines. Rept. Bk. No. 73/296.

Occurrences & Exploration : Mapping was commenced in the vicinity of the Morialpa Sillimanite deposits with preliminary samples submitted to Amdel for petrographic descriptions. (Report appended).

Preliminary mapping on a scale of 1:2000 has established the presence of a persistent quartz muscovite schist horizon, some 500 to 600 metres in width, over a strike length of 1.2 kilometres, wherein sillimanite and andalusite is concentrated in pods and lenses generally concordant with foliation and associated with quartz pegmatites.

Within the prospective schist horizon sillimanite has been exposed by weathering resulting in blocks, up to an estimated 400 kilogrames, lying free at surface. Additional exposure of sillimanite has resulted from the establishment of numerous pits, by former small scale prospectors and miners, and four larger pits which were established by bulldozing and costeaning during 1967. The largest pods now exposed are estimated to contain up to 100 tonnes of massive sillimanite ore.

At times up to 10 mineral claims and leases have been pegged within the area with the majority adjoining and along strike of 220^0-240^0. Winning of material which is predominantly sillimanite, both fibrolite and massive forms, has largely consisted of gathering loose superficial ore or by mining a number of prominent outcrops where the material has been exposed by weathering of the relatively soft, friable, schists.

Only five of the outcrops have been investigated below surface to the extent of developing small pits 2 to 3 metres deep, up to 10 metres long and roughly 5 metres wide. These workings have produced minimal quantities of relatively pure sillimanite and a sillimanite/quartz/mica/ tourmaline rock which has largely been discarded.

Samples of sillimanite taken from the area by Olliver, (1968),were described as;

SA1/67-Morialpa East. Sample taken from buldozed pit. Hard massive sheared rock with curved fracture planes. Light pink to grey and white containing quartz, feldspar, muscovite, and sillimanite with occasional rods of tourmaline.

SA2/67-Morialpa East. Sample form pit. Gneissic quartz-muscovite-sillimanite rock banded black and white. Sillimanite as white contorted needles. Biotite and muscovite as flakes up to 6mm. with a few patches of coarser biotite and occasional small rods of tourmaline.

SA3/67-Morialpa West. Random bulk sample from outcrop. Blue grey to white bundles of sillimanite needles from 6 to 24 mm. long. Scattered flakes of muscovite, and rods of tourmaline.

These samples analysed;

	SA1/67	SA2/67	SA3/67
SiO_2	48.3	44.3	37.6
Fe_2O_3	1.5	6.4	8.6
Al_2O_3	37.3	35.7	43.7
TiO_2	0.3	0.8	1.0
CaO	0.3	1.25	0.5
MgO	0.65	2.35	3.15
Na_2O	1.15	0.90	0.40
K_2O	10.7	7.8	3.75
LOI	4.7	5.0	3.7

Samples SA1 and SA2/67 recorded softening points of 1460 and 1435^{0}C and fusion points of 1500 and 1475^{0}C respectively.

Schists confining the pods of sillimanite were sampled for petrographic examination. Reports pertaining to the samples, OL4-8 inclusive are presented in Appendix A.

The schists are generally simple assemblages of mica-quartz with varying amounts of feldspar, tourmaline, garnet, and occasionally sillimanite or remanents thereof, having being retrogressively altered to sericite. Both muscovite and tourmaline may contain fine needles of sillimanite however in none of the samples examined has sillimanite been present either in a completely fresh unaltered form, nor in substantial quantities which may suggest the possibility of beneficiation to yield a high grade product.

4.2 Ameroo Deposits.

The Ameroo andalusite/sillimanite deposits occur over a few square kilometre area to the north of Ameroo Hill, in the north-eastern portion of the E.L., on Outalpa Station. As a group they are related in their geological setting and historically as the main producers of sillimanite and andalusite from the Olary Province. Of particular interest as former producers of andalusite are deposits known as Maggie, Tommy Watty, Ameroo West, and Ameroo North-West, all located within a few kilometres of each other in a common quartz-mica schist horizon.

4.2.1. Maggie Claim.

Location : Approximately 3 kilometres west-northwest of Ameroo Hill on Outalpa Station.

Reference : Olary Province 1:170000 Map. Bull. No. 34 Geol. Surv. S. Aust. Latitude 32^{o} 7'S, Longitude 140^{o}10' 30"E.
Outalpa 1:63360 Map 836.
Aerial. Olary Svy 2004. 1:24800 Scale. Frame 129

Access : 25 kilometres north west of Olary via Olary-Bimbowrie road. Turn off to the west immediately after the second crossing of Bimbowrie Creek thence follow track to the south of Tietz Dam for approximately 5 kilometres past feldspar mine to prominent 040^{o} trending ridge. The prospect lies on the northern side and western end of the ridge near Tommy Watty bore.

Previous Reports : Dickinson, S.B. (1943) Andalusite Occurrence, North of Olary and Kyanite near Radium Hill. S.A. Min. Rev. No. 76, pg 81-82.
Campana, B. and King, D. (1958) Regional Geology and Mineral Resources of the Olary Province. S.A. Geol Surv. Bull., Vol 34, pg. 116

Occurrences & Exploration. : Dickinson refers to boulders of near pure andalusite at the Maggie Deposit, former ML2785, up to 100-150 kilogrames shed from small lenses of massive andalusite in schists and gneisses. "The lenses are generally less than 2 ft. (0.61m) thick and 6 ft. (1.83) long, and they appear to follow a definate band of rock." At the time of the report he estimated that approximately 75 tonnes of loose andalusite was immediately available as boulders and fragments and in addition approximately 50 tonnes of outcropping material.

Campana and King, refering to a Claim (M.C. 1670) to the north of the M.L. 2785 state that masses of andalusite up to 6 ft.(1.8m.) by 2 ft.(0.61m.) in cross section were exposed in mica schists near contacts with pegmatite dykes.

It is apparent that both Claims were worked to remove the superficial material and a number of shallow pits were sited on the exposed pods of andalusite which proved to be of limited depth. The andalusite lenses may be traced over a distance of 300 metres and within a schist zone 50 metres wide.

Within the zone the frequency of pods or lenses is variable but a few relatively rich pockets covering an area of roughly 5 by 20 metres may be isolated. To the north east and south west the schists are covered by sandy alluvial deposits which may obscure any further occurrences of andalusite.

The andalusite bodies are associated with small quartz and quartz/feldspar pegmatite bodies which are concordant with schistosity.

4.2.2 Tommy Watty Andalusite.

Location : Situated approximately 1 kilometre south west of Maggie Claim on southern flanks of the same ridge. Approximately 3 kilometres west northwest of Ameroo Hill.

Reference : Olary Province 1:170000 Map. Bull. No. 34 Geol. Surv. S. Aust. Latitude 32° 6' 30"S, Longitude 140°11'E.
Aerial. Olary Svy.2004 1:24800 Scale. Frame 129

Access : As for Maggie Deposit to 040° trending ridge thence 2 kilometres down south side of ridge.

Previous Reports. : Campana, B. and King, D. (1958) Regional Geology and Mineral Resources of the Olary Province. S.A. Geol Surv. Bull., Vol 34, pg. 116
Olliver, J.G. (1968c) Geological Investigations of Sillimanite, Andalusite and Kyanite in South Australia. Aust. Sill. Group Minerals Report No. 3- Newbold Gen. Ref. Ltd.

Occurrences & Exploration: Small andalusite workings may be traced over a distance of approximately 700 metres within a belt of quartz-mica schists approximately 30 metres wide which strike 040°. Large quartz veins cut through the schist and a prominent quartz/feldspar reef, concordant with foliation, appears to be directly related to the andalusite lenses.

The andalusite is pinkish, often translucent, and appears fresh in hand specimen. It is commonly intergrown with quartz and coarse muscovite.

A sample of the schist taken from a shallow pit which was presumably the site of an andalusite pod was examined in thin section.The schist is a quartz/mica/chlorite assemblage containing minor amounts of garnet and andalusite, a trace of epidote and some secondary iron oxide staining. Intergrown biotite and chlorite with lesser amounts of muscovite and minor quartz form the bulk of the rock with a sporadic distribution of 0.4mm. to 4mm. diameter garnet crystals containing inclusions of black opaque flakes. The andalusite occurs in a single elongate zone about 15mm. long and 1mm. to

2mm. wide which contains an estimated 25% to 30% of andalusite crystals between 0.2mm. and 0.5mm. in size. The crystals although slightly weathered along the grain boundaries, which are marked by fine films of orange to reddish-brown clay, do not show any appreciable alteration to sericite.

Coarse knotted schists from the area were found to consist of quartz, muscovite and sericite, and biotite with small amounts of remanent andalusite and minor staurolite, garnet and opaques. The knots were originally thought to be andalusite porphyroblasts up to 40mm. long and 10mm. to 20mm. in cross section which occupied from 30% to 50% of the original rock. The porphyroblasts, now almost entirely altered to sericite, are swathed by alligned biotite and muscovite containing augens of granoblastic quartz and occasionally feldspar.

Olliver, 1967, records sillimanite from Tommy Watty, former claim M.C. 1973, as hard, grey-blue to white with needles either in felted layers or irregularly arranged. A sample of the material analysed 52.3% Al_2O_3, 39.5% SiO_2, 3.4% Fe_2O_3, 0.3% TiO_2, 0.2% CaO, 0.8% MgO, 0.5% Na_2O_3, and 2.2% K_2O. The material had a fusion point above 1790°C.

Friable weathered material was recorded from an adjoining claim, M.C. 2983, which analysed 43% Al_2O_3, 45.2% SiO_2, and 2.7% Fe_2O_3.

4.2.3 Baxters South Sillimanite.

Location : Approximately 0.5 kilometres southwest from the Tommy Watty deposit.

Reference : Olary Province 1:170000 Map. Bull. No. 34 Geol. Surv. S. Aust. Latitude 32° 7' 20"S, Longitude 140° 10'E.
Aerial. Olary Svy 2004 1:24800 scale. Frame 129

Access : From Tommy Watty deposit.

Previous Reports. : None

Occurrences & Exploration: Lenses and pods of near pure fibrolite and massive crystalline sillimanite are exposed on the western side of the ridge within coarse mica schists and associated concordant quartz and quartz/feldspar pegmatites.

Sillimanite masses up to an estimated 200 kilogrames lie on the surface over an area of approximately 1 hectare where they have weathered out of the host schist.

The lenses are less than a metre long and 0.3 to 0.5 metres wide and in the majority of cases are isolated from each other by barren schist.

4.2.4. Ameroo West and Northwest Andalusite/Sillimanite Deposits.

Location : 6 kilometres west of Ameroo Hill. 2.8 kilometres southwest of Maggie Claim and 25 kilometres north-northwest of Olary. The deposits are located 8 kilometres, bearing 330^0, from Teitz Dam scattered over a 1 kilometre area on the side of a steep hill immediately north of a main mass of gneiss, schist, and granitoids.

Reference : Outalpa 1:63360. Map 836.Ameroo West; Latitude 32^0 8'S, Longitude 140^0 8' 30" E.;
Ameroo Northwest. Latitude 32^0 7' 30" S, Longitude 140^0 8' E.
Aerial. Olary 1:63360, Svy 2004. 1:24800 Scale. Frame 130.

Access : From Olary via Bimbowrie road to second crossing of Bimbowrie Creek thense west on track and follow to north of Teitz dam, past Tommy Watty Bore and over a broad sandy flat to base of hills.

Previous Reports : Forbes, B.G. Sillimanite Deposits-Northwest of Olary. Mining Review, S.A.D.M.E. Vol. 108 RB46/181 pg. 71-73
Campana, B. and King, D. (1958) Regional Geology and Mineral Resources of the Olary Province. S.A. Geol Surv. Bull., Vol 34, pg. 116
Winton, L.J. (1933) Fibrolite and Andalusite Occurrences. S.A. Min. Rev. No. 57. pg. 75-76
Barrie, J. (1966) Australian Mineral Industry. The Mineral Deposits . Dept. Nat. Dev. Bur. Min. Res. Geol. & Geophysics. Bull. 72 pg. 539

Occurrences & Exploration: Both andalusite and sillimanite has been worked from the Ameroo West deposits over a reported south-westerly strike continuation of the Maggie andalusite occurrence.

Campana and King (1958) refer to three former claims in the Ameroo West deposits wherein lenticular and blocky masses of intergrown andalusite and sillimanite measuring up to 2.7 metres in length cropped out at the margins of tourmaline bearing pegmatites and quartz segregations.

These Claims although formerly productive (Barrie,1966, reports production in the vicinity of Ameroo Hill, mainly from the Ameroo West deposits, amounted to 4713 tonnes of andalusite and sillimanite) show little evidence of having being worked other than in shallow gougings and only one small area where three narrow benches have been established appears to have been substantially prospected. A few tonnes of rich andalusite and sillimanite ore lies scattered over the benches.

The deposits (formerly MC902/903, M.L.2435) scattered over a steep hillside contain small lenses and pods of intergrown andalusite and sillimanite confined within a mica schist host which strikes at approximately 245^{0} and dips steeply toward the south-east.

Mineralized pods are seldom larger than 0.2-2 by 2 metres in size, are sporadic in distribution, although selected areas were observed wherein a high concentration of small (few hundred mm.) segregations occur, and are variably richer in either sillimanite or andalusite. Massive concordant quartz reefs, intermittant in outcrop, and quartz veins transect the hillside and appear to be related to the andalusite/sillimanite segregations over an area of approximately 200 by 400 metres.

A few hundred tonnes of sillimanite, some in boulders estimated at up to a tonne in weight, line the bed of a steep creek on the south side of the hill where they have presumably come to rest having eroded from the schists and rolled down the hill. An additional substantial tonnage, estimated in the vicinity of a few thousand tonnes, lies exposed on the hill slope.

In hand specimen the andalusite is pale pink, semi-translucent, and commonly forms individual crystals up to 6 cms. long. It is often associated with quartz, muscovite and minor amounts of fine staurolite crystals. The sillimanite is fibrous, forming acicular felted masses, or massive, hard, grey, blue, or white in colour and associated with significant quantities of muscovite, quartz, and traces of staurolite. In thin section the sillimanite/andalusite rock is seen to consists of coarse, essentially fresh, andalusite xenoblasts intergrown with bladed to acicular sillimanite and minor muscovite and feldspar. Staurolite is present as fine subhedral crystals within the sillimanite and along the margins of andalusite crystals.

Samples of schist taken from the floor of a shallow pit within a previously worked area were found to consist primarily of a quartz/ biotite/muscovite assemblage with or without feldspar. In one of two sections examined andalusite was present in lenticular bands 2mm. to 5mm. wide swathed in coarse muscovite containing fine swirling trains of sillimanite fibres roughly alligned with the foliation. Andalusite was judged to represent 10-20% of the section.

In the remaining sample, coarse (up to 2 cm.) boudin intergrowths of andalusite, partially sericitized, and muscovite were confined within trains of alligned biotite flakes which defined a weak foliation. Sillimanite was present as fine inclusions within the andalusite and muscovite. Relict crystals of andalusite consisting of an intermesh of sericite and traces of sillimanite were present in layers associated with a few percent of fine to medium sized idioblasts of garnet and staurolite. Fresh andalusite accounted for approximately 10% of the section.

A sample of schist taken away from the contact with a mineralized pod, (sample OL15-refer appendix), was essentially similar to the previously described schists although neither sillimanite nor andalusite were present. It is probable that sillimanite was originally present in the rock however it has been retrogressively altered to sericite which is present as elongate lenticular bodies and as minor acicular to fibrous fine inclusions within quartz grains. Other samples from the area, some of which contain traces of remnant sillimanite associated with muscovite and sericite after sillimanite, tend to confirm the general extent of retrogression in the area which has esentially affected all but the coarser and more massive andalusite and sillimanite, (samples OL12, OL17B-refer appendix), and some of the schists immediately adjacent to massive mineralized pods.

The Ameroo North-West deposit is located some 1 kilometre north-west from the Ameroo- West deposits. Forbes,(1959) reported the presence of coarsely crystalline material consisting of equal proportions of andalusite and sillimanite forming a lens in steeply dipping schists. The body was approximately 20 metres long and 6 metres wide and estimated to contain 1000 tonnes of mixed material which was analysed at 50.3% Al_2O_3, 37.6% SiO_2, and 3.6% Fe_2O_3.

In thin section the rock was described as a muscovite-andalusite-ottrelite-sillimanite rock consisting of large crystals of muscovite containing needles of sillimanite and in part replacing andalusite which shows extreme alteration and association with ottrelite, a brittle mica.

Recent examination of the site showed that the pod had been substantially worked-out by selectively hand picking the cleanest crystals and masses of andalusite and sillimanite.

Examination in thin section of the ore showed a combination of coarse fresh andalusite xenoblasts intergrown with bladed to acicular sillimanite intergrown with minor muscovite. Staurolite was present within the sillimanite and around andalusite crystal margins. Only minor patches of sericite were observed. The rock which had the appearance of a pegmatitic crystallization consisted of an estimated 40-50% sillimanite, 30-40% andalusite, 5-10% muscovite, 5-10% staurolite, and a few % of feldspar, biotite, and a trace of tourmaline.

In a second sample from the area kyanite was observed with sillimanite (fibrolite) which in places was altering to sericite. The kyanite post dates the sillimanite.

Schists from the area immediately adjacent to the segregation consist of aquartz-biotite-sillimanite-andalusite assemblage with andalusite grains, up to 5mm. in size, enclosing crystals of quartz which are crowded with sillimanite needles. The rock has a granoblastic texture of fine grained quartz with alligned flakes of biotite which sweep around knots of acicular sillimanite some of which is altering from andalusite. There is only minor evidence of retrogression. Andalusite accounted for 5-10% of the slide and sillimanite approximately 10%.

Knotted schists in close proximity to the andalusite segregation consist essentially of quartz, muscovite and sericite, and biotite with small amounts of remanent andalusite, garnet and opaques. The knots,thought to be originally andalusite porphyroblasts, are commonly up to 2 by 1 centimetres in section and occupy 30% to 50% of the schist. They are almost completely altered to sericite and swathed by alligned plates of biotite and muscovite.

Numerous small andalusite and sillimanite segregations are scattered over a square kilometre area between the Ameroo West and Northwest leases which have not been documented as the areas have not been held under a Lease or Claim. Many have been worked by shallow pits and virtually all produce material similar to the Ameroo West segregations with varying amounts of sillimanite, andalusite, muscovite, sericite, quartz, and traces of staurolite. Alteration of the sillimanite and andalusite to sericite varies between 10% and 30%.

4.2.5 Andalusite and Sillimanite Grade.

Olliver, 1973, compiled analyses of hand samples of andalusite and sillimanite from the Ameroo area. Results, presented in Table 1, generally indicate a grade of 47% to 54% Al_2O_3, 0.9% to 3.6% Fe_2O_3, and 38% to 43% SiO_2. By comparison pure andalusite or sillimanite theoretically contains 62.8% Al_2O_3, and 37.2% SiO_2.

To ascertain the potential for beneficiation a mixed sample of andalusite and sillimanite from the Ameroo area was crushed to nominally 5 mm. and various size fractions examined. Results, as presented in Table 2, indicated that although some of the sillimanite is liberated in the 7 to 5 mm. range most of the grains show composite mineralogy above 2.8mm. At 1.4mm. the majority of the andalusite is liberated but sillimanite, estimated to comprise 40% to 50% of the sample still exists as composite grains.

At 0.7mm., 85% of the grains are liberated with composites being mainly quartz/tourmaline or mica, staurolite/quartz, sillimanite/quartz, or tourmaline/staurolite or mica. At 0.5mm. composite grains are similar to the above although the majority of the sillimanite has now been liberated.

Commencing with a 0.5 to 0.71mm. fraction products were separated at a specific gravity of 2.96 to yield 32.45% lights and a 67.55% heavy fraction. The heavy fraction was then further processed by electromagnetic separation and in a density column.

The electromagnetic separation produced a non-magnetic fraction of sillimanite and andalusite at a grade of 59.2%

Al_2O_3, 37.8% SiO_2, 0.78% Fe_2O_3, and 1.03% K_2O. This product represented 43% of the original sample and 65% of the heavy mineral fraction.

The heavy liquid column separated seven fractions consisting of two lightest fractions of sillimanite and contaminants, an andalusite concentrate, three fractions of mixed sillimanite and andalusite, and a dense staurolite fraction. Of these the andalusite fraction represented the highest potential refractory grade material analysing 60.7% Al_2O_3, 0.75% Fe_2O_3, and 0.38% K_2O.This represented 19% of the original sample and 28% of the heavy mineral fraction.

The three mixed sillimanite and andalusite fractions were also of high grade although containing slightly greater quantities of potash and iron. Together they represent a further 26% of the original sample and 39% of the heavy mineral fraction.
Analyses of various fractions are presented in Table 3.

As a follow-up to the above test programme a 150 kilogramme bulk sample was staged crushed, sized from 4mm. down to 0.25mm. with the various size factions being examined and chemically analysed to assess the liberation characteristics of the material as a intermediate stage to undertaking pilot scale beneficiation trials. A report of the preliminary stage of investigations is appended.

Essentially the andalusite and sillimanite was substantially liberated at 1.5mm. and finer. Various size fractions examined registered basically the same chemical grade of material down to 0.5mm. below which fractions record an increase in iron content coincident with an increase in silica and decrease in alumina.

To upgrade the basic feed which contains approximately 55% andalusite and sillimanite, 20% mica, 18% quartz, and a balance made up of feldspar, tourmaline, staurolite, and possibly a trace of opaques it is necessary to remove the mica and iron bearing minerals and quartz. Possible avenues for consideration are Heavy Media Cycloning followed by Magnetic Separation in the coarser fractions (+0.5mm.) or flotation in the finer fractions (-0.5mm.).

5 DISCUSSION.

5.1 Ameroo Area

Host schists for sillimanite/andalusite mineralization within those areas investigated to the north and west of Ameroo Hill are metapelites consisting of quartz, muscovite, minor biotite and albite with or without sillimanite, andalusite, and garnet. Texturally the schists are complex in that they contain at least two and often three foliations in conjunction with post tectonic growths of muscovite and occasionally staurolite. Analyses supplied by Spry (1977) of schists from Tommy Watty bore suggest that the simple quartz muscovite schist may be poorer in alumina than the sillimanite bearing schists (16.6% compared with 17% to 26% Al_2O_3) but high in potash with 8.8% compared with 3% to 6.5% for most schists. This is possibly due to the presence of metasomatic post tectonic muscovite common throughout the region in varying quantities.

Although andalusite is found as fresh crystals or remanents of original crystals within segregations, and occasionally in immediately adjacent schists, it has been broadly established that retrogression to sericite is widespread. There is evidence that andalusite has in many instances been altered to varying degrees to sillimanite, which in turn has been partially replaced by muscovite. Commonly the extent of sericitization is confined to the edges of crystals or to fine fractures within the crystals and it is thus possibly related in part to the degree of fracturing of the host. Certainly large masses of fresh sillimanite (commonly fibrolite) and andalusite are present at the sites of former workings in the Ameroo area which show only minor evidence of sericitization although post-tectonic intergrowths of large muscovite crystals are common. This could be explained as a regrowth of sericite.

It appears probable that andalusite and sillimanite bearing schists, both knotted and medium to fine granoblastic types, were widespread in the Ameroo area however with few exceptions all of the schists examined to-date have suffered substantial retrogression. Thus at this stage although field investigations have confirmed the presence of an andalusite and sillimanite bearing schist horizon which warrants further investigation it is probable that within this schist horizon the only source of the minerals will be confined to segregations of relatively high grade material.

At this stage it has been established that the richer segregations of andalusite and sillimanite may be beneficiated in the laboratory to yield high grade materials which could command a refractory market and be competative in terms of quality with imported products. Reference is made to tables 3 and 4 for comparison between the products prepared under laboratory conditions from massive sillimanite/andalusite material from the Ameroo area and andalusite from S. Africa and Brittany. Both are commercial products derived by beneficiation of chiastolite bearing schists. Whether beneficiation on a commercial scale would be feasible or viable has yet to be determined.

It is estimated that in the vicinity of 2 thousand tonnes of material is exposed over the hillside at Ameroo West which could be available for beneficiation trials while exploration was continuing throughout the E.L. Winning of the material would however be difficult due to the steep and rugged terrain.

At this stage the real concentration of pods of mineralization throughout the schists in the Ameroo area, and in particular at Ameroo West, is unknown since there is no subsurface technique, other than bulldozing costeans and benches, suitable for establishing the presence and size of unexposed material. Reference to exposure is inconclusive since in addition to the unknown weathering factor there has been considerable redistribution of material down the slope at Ameroo West and further some 4000 tonnes (recorded) of superficial "ore" has been removed from the site.

Considering all data currently available it is unlikely to be economic to work the individual pods at Ameroo West as a feed source of andalusite and sillimanite unless specific schist beds are delineated suitable for bulk mining wherein massive mineralization is concentrated. Certainly in the field there are some indications that relatively rich horizons may be present and further consideration needs to be given to this aspect. It is reasonably well established that the alternative bulk source, schists containing fresh, finely disseminated andalusite and sillimanite, are unlikely to be present due to the widespread sericitization of the desired minerals resulting from general retrograde metamorphism of the original schists.

5.2 Morialpa Area.

Schists examined from this area do not contain significant proportions of sillimanite or andalusite and the massive segregations are less abundant, although over a larger area, than in the Ameroo area.

Samples of hand picked 'ore' analysed by Olliver are significantly lower in grade than the Ameroo material and it is apparent both in the field and from the analyses that there is substantial association with mica, quartz, feldspar and tourmaline in some of the material in the developed pits from where the samples were obtained.

It is estimated that in the vicinity of 1000 tonnes of predominantly sillimanite bearing rock is readily available from small stockpiles and pits at the former Leases and Claims and a relatively complete pod of high grade sillimanite which may yield up to 500 tonnes of material has been delineated.

Overall this area has less potential than the Ameroo occurrences and further exploration is likely to depend upon the outcome of investigations into beneficiation of the andalusite/ sillimanite rock and exploration within the remainder of the E.L.

Table 1. Andalusite Analyses

	Ameroo* West	Ameroo West	Ameroo North-West	Ameroo North-West
SiO_2	39.2	43.3	38.7	41.8
Fe_2O_3	1.8	2.8	3.6	0.9
Al_2O_3	51.2	47.4	51.7	54.3
TiO_2	0.2	0.4	0.4	0.1
CaO	-	0.3	-	0.3
MgO	-	0.7	-	0.3
Na_2O	-	0.9	-	0.5
K_2O	-	4.1	-	2.2
L.O.I.	2.6	2.8	2.9	1.7

Olliver, J.G. 1973. Sillimanite, Kyanite and Andalusite- South Australia. D.M.E. Rpt. Bk. 73/296 Pg. 1-10.

* Forbes, B. G. Sillimanite Deposits-Northwest of Olary. S.A. Min. Rev. 108. Pgs. 71-73.

Table 2. Size and Mineralogy. Ameroo Massive Ore.

Sizing	Mineralogy and Comments
-7+5mm.	Pink Andalusite, sillimanite, minor quartz and traces of staurolite and tourmaline. Some sillimanite liberated. Andalusite remains as mixed composite grains.
-5+4mm.	Mineralogy as above. Approximately 10% each of sillimanite and andalusite liberated.
-4+2.8mm.	Similar to above.
-2.8+1.4mm.	40-50% of minerals liberated.Majority of andalusite free. Estimate andalusite 20%, sillimanite 50%, quartz 15%, mica,staurolite, tourmaline 5%.
-1.4+0.71mm.	85% of grains liberated. Composites mainly quartz/tourmaline or mica, staurolite/quartz, sillimanite/quartz, tourmaline/staurolite or mica.
0.71-0.5mm.	Similar to above. All andalusite and majority of sillimanite liberated.

Table 3. Beneficiated Andalusite and Sillimanite.

Chemical Analyses.

SiO_2	37.1[a]	37.3[b]	37.3[c]	37.2[d]	37.8[e]	
TiO_2	0.06	0.09	0.11	0.06	0.09	
Al_2O_3	60.7	59.5	58.5	60.7	59.2	
Fe_2O_3	1.02	1.37	1.44	0.75	0.78	
MnO	0.01	0.01	0.01	0.01	0.01	
MgO	0.24	0.04	0.42	0.18	0.21	
CaO	0.07	0.12	0.07	0.08	0.11	
Na_2O	0.15	0.18	0.21	0.11	0.22	
K_2O	0.43	0.75	0.96	0.38	1.03	
P_2O_5	0.02	0.08	0.04	0.03	0.05	
L.O.I.	0.60	0.77	0.98	0.55	0.91	
Total	100.4	100.2	100.0	100.1	100.4	
Yield.	5.55	12.73	7.96	19.30	43.73	% of total sample.
	8.21	18.84	11.79	28.57	64.73	% of sub-sample.*

a,b,and c. Heavy liquid fractions >2.96s.g. Mixed sillimanite and andalusite.

d. Heavy liquid fraction >2.96s.g. Andalusite. (lower s.g. than above fractions.)

e. Electro magnetic separation. Non-magnetic fraction.

* Fraction >2.96s.g. 67.55% of original sample.

Table 4. Andalusite. Commercial Products.

	Brittany * " Kerphalite." Grade KA %	Grade KB %	N.W. Transvaal* "Prusite" %
SiO_2	37.5-38.6	44.3-44.8	38.0
Al_2O_3	59.0-59.5	52.0-53.0	60.5
TiO2	0.20-0.28	0.25-0.30	0.12
Fe_2O_3	0.90-1.0	0.90-1.10	0.60
CaO	0.15-0.30	0.12-0.27	0.01
MgO	0.09-0.15	0.12-0.17	0.31
Na_2O	0.08-0.10	0.15-0.25	0.06
K_2O	0.15-0.35	0.25-0.40	0.12
L.O.I. 1000°C.	0.30-0.70	0.70-1.10	0.4-0.6

* Published literature. - Kerphalite-Europe's own source of high alumina andalusite for refractories. 2nd. Ind. Mins. Int. Cong. Munich. 1976.

* Weedons Minerals Pty. Ltd. Johannesburg, S. Africa.

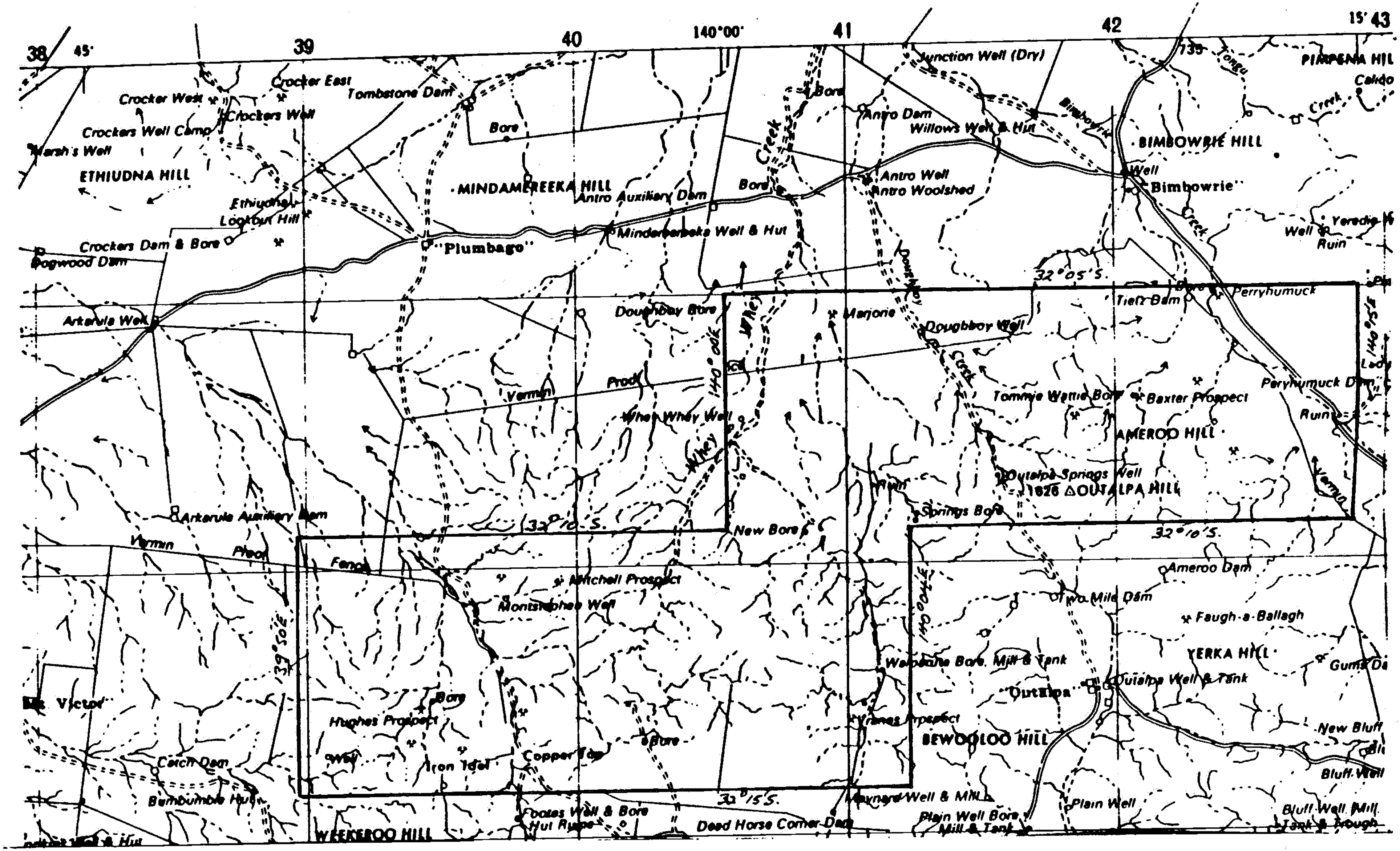
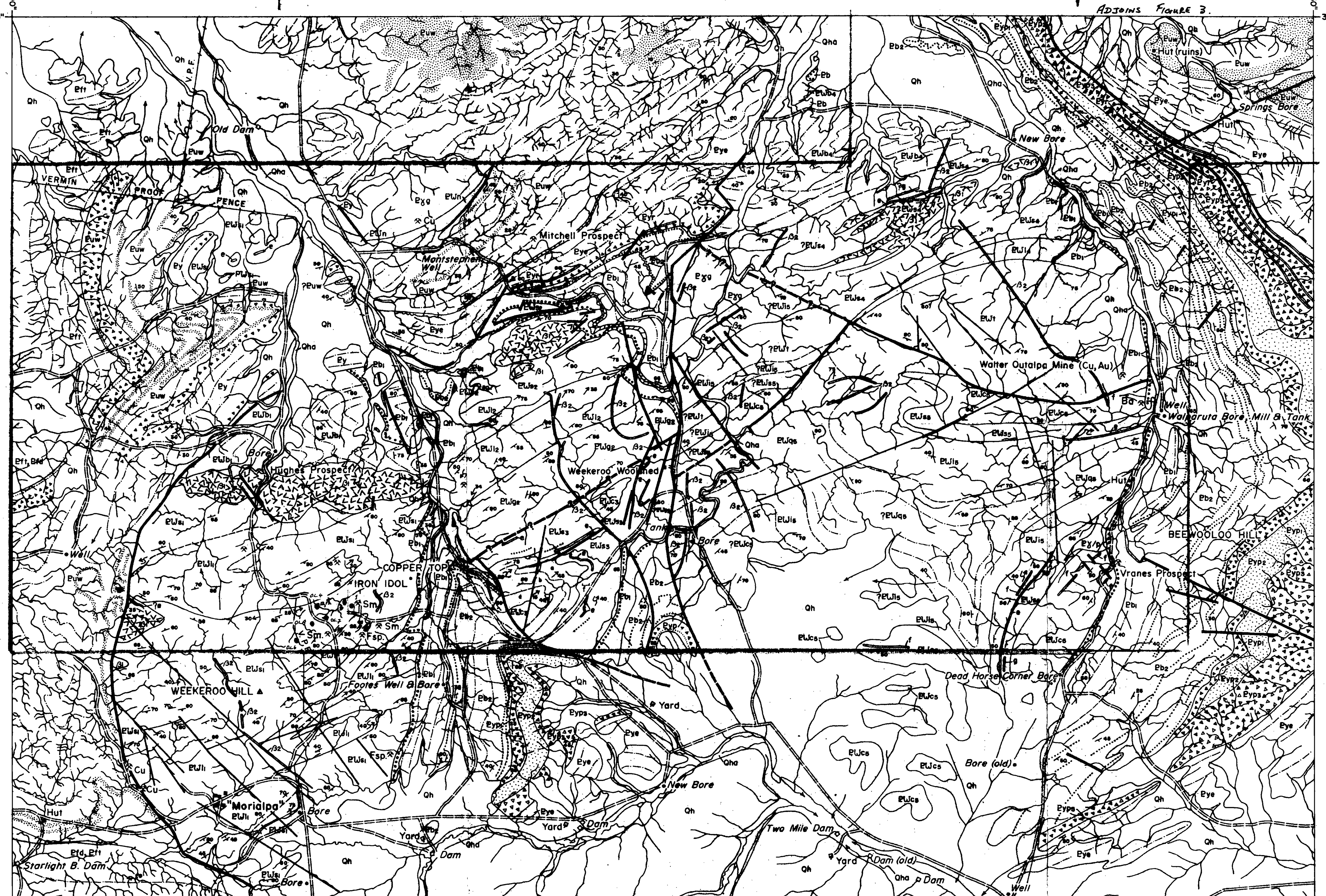


FIGURE 1. GENERAL LOCALITY. E.L. 1261   MICO AUSTRALIA LTD.



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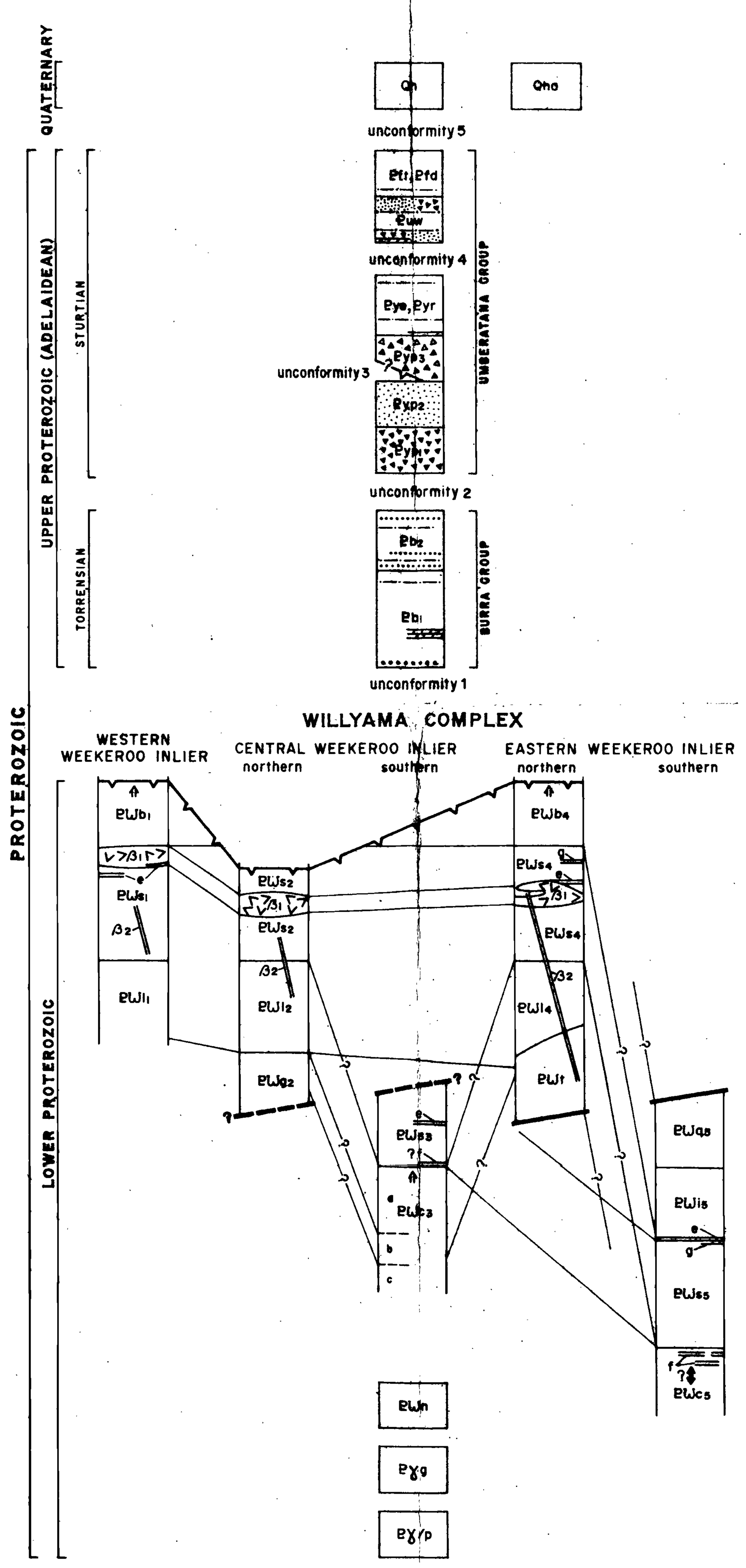


Qh: undifferentiated surficial units
Qha: creek-bed alluvium.

UMBERATANA GROUP
FARINA SUBGROUP
Ꝑft: Tapley Hill Formation, Ꝑtd: Tindelpina Shale Member.

Ꝑuw: Wilyerpa Formation: quartzite, siltstone, tillite, dolomite.

YUDNAMUTANA SUBGROUP
Ꝑye: Benda Siltstone: metasiltstone, minor diamictic layers. Thin, multiple layers of Braemar Iron Formation (Ꝑyr) at base: hematitic siltstone minor grey, pebbly dolomite
Ꝑyp: Pualco Tillite; Ꝑyp3: Member 3: diamictite, with crystalline basement clasts, greywacke matrix.
Ꝑyp2: Member 2: massive crossbedded quartzite.
Ꝑyp1: Member 1: diamictite with Burra Group and crystalline basement clasts in a quartzite matrix.

BURRA GROUP
Ꝑb2: Unit 2 (?) BELAIR SUBGROUP equivalent: quartzite, siltstone. (?) Saddleworth Formation equivalent green-grey siltstone, prominent quartzite at base
Ꝑb1: Unit 1 (?) Auburn Dolomite equivalent: dolomite, siltstone. Skillogalee Dolomite: dolomitic marble, sedimentary magnesite and intraformational breccias. Host to galena veins at Vranes Prospect. Aldgate Sandstone equivalent: basal conglomerate with overlying silty sandstone and greywacke.

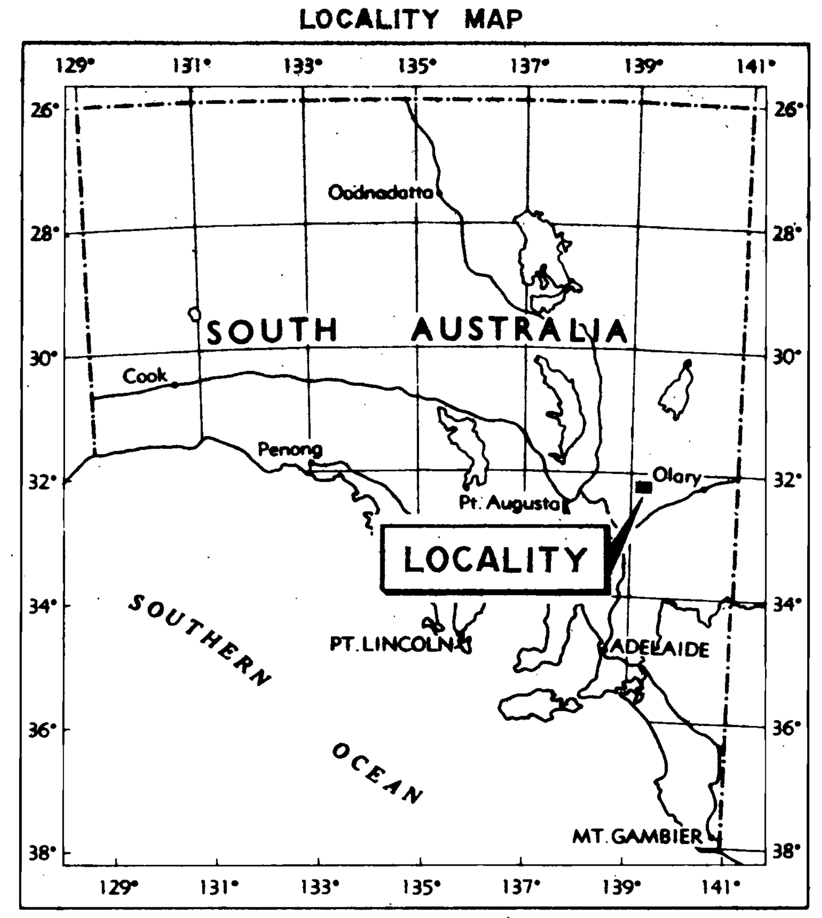
WILLYAMA COMPLEX
β2: amphibolite (metadolerite) dykes
ꝐWb1,4: bedded quartzite, quartz-muscovite schist
ꝐWqs: massive to well-layered quartzite and feldspathic quartzite.
ꝐWis: interlayered, well layered, quartz-feldspar gneiss and biotite gneiss, migmatitic in part.
β1: "Weekeroo amphibolites", interpreted as metamorphosed basaltic volcanic plug(s) possibly subaqueous extrusive in part.
ꝐWs1: aluminous muscovite schist in the north, grading south to higher grade, knotted aluminous schist of the ꝐWs5 and ꝐWs3 type.
ꝐWs2: muscovite schist with retrograde andalusite
ꝐWs3: knotted, aluminous, pegmatoid schist, minor calc-silicate horizon (e).
ꝐWs4: muscovite schist, graphitic schist (g) and garnet marble (e) near top.
ꝐWs5: knotted aluminous schist, with graphitic schist (g) and marble-calcsilicate horizon (e) near and at top.
ꝐWl1,2,4: well-layered quartz-feldspar gneiss and biotitic schist interlayers, minor quartz-feldspar gneiss with magnetitic laminae at top.
ꝐWc3a: feldspar-quartz gneiss, with fine, crossbedded magnetitic laminae.
ꝐWc3b: layered migmatitic gneiss.
ꝐWc3c: poorly layered aplitic to granitic gneiss (?≡ to ꝐWg2).
ꝐWcs: massive albitic and quartz-albite gneiss with fine, crossbedded magnetitic laminae, coarse disseminated magnetite, barite-iron formations (f), minor layered migmatite gneiss.
ꝐWg2: quartz-plagioclase granitic gneiss.
ꝐWt: quartz-plagioclase tonalite gneiss.
ꝐWn: undifferentiated gneiss and schist.
Ꝑγg: gneissic granitoids
Ꝑγ/p: granitoid-pegmatoid intrusives.
f: iron formation.
e: calcsilicate rocks.
g: graphitic schist.

Note: Willyama Complex legend takes the form of a diagram showing interpreted correlations between columns representing stratigraphies of each block or sub-block.

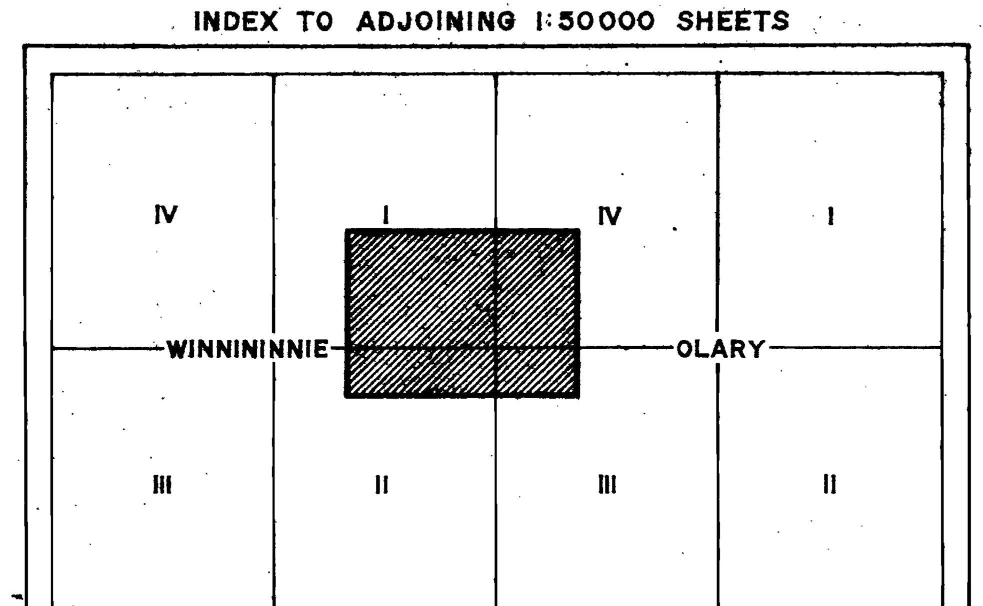
Attitude of foliation
Attitude of layering
Layering horizontal
Layering vertical
Fold plunge
Mine or prospect
Sillimanite ... Sm.
Andalusite ... Andal.
Feldspar (pegmatite) ... Fs.
Copper ... Cu.
Lead (galena) ... Pb.

Iron formation scree
Fault
Inferred fault
Lineament
Sedimentary structure, upward facing
Sedimentary structure, indeterminate facing
Correlation lines
Unconformity

LOCALITY MAP



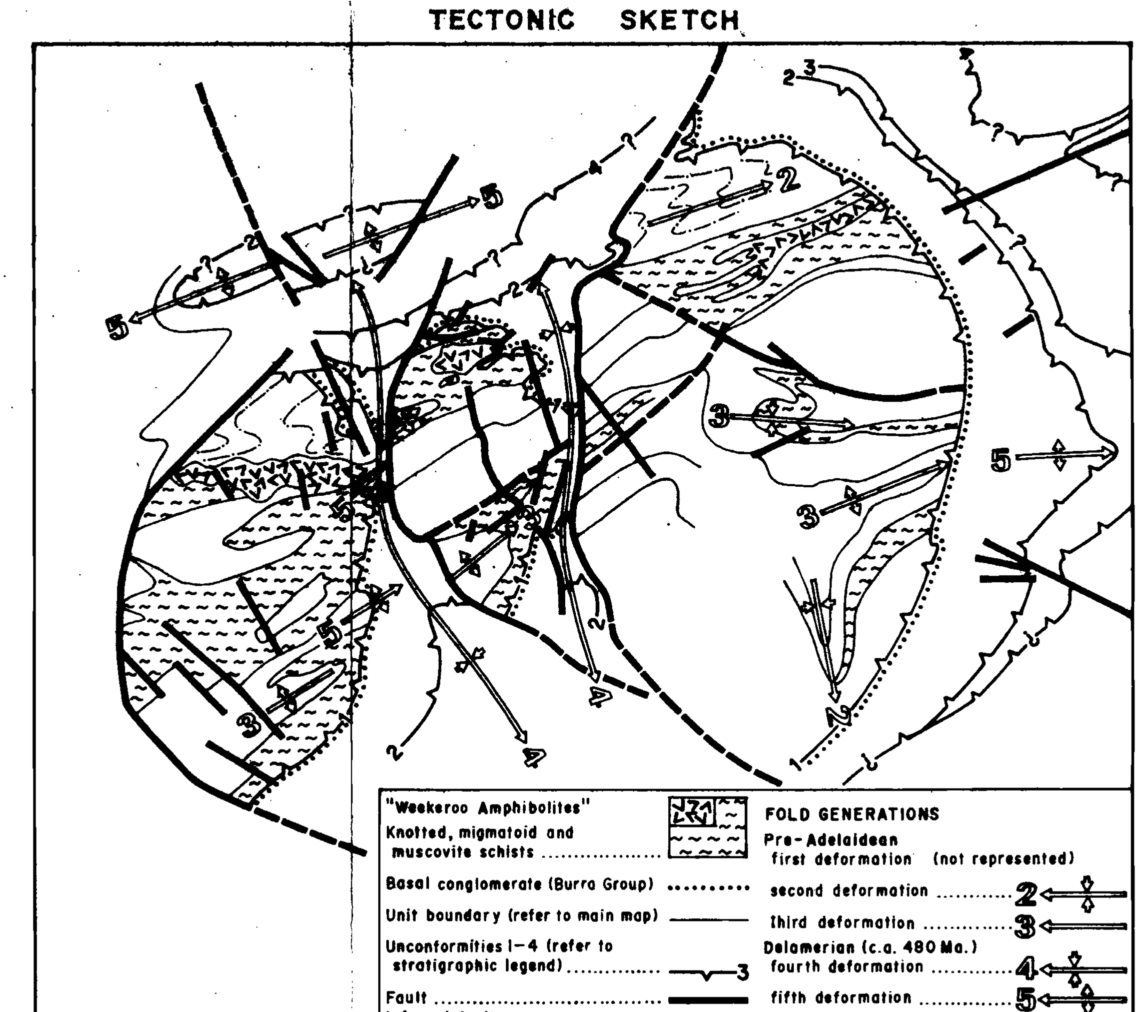
INDEX TO ADJOINING 1:50000 SHEETS



SCALE
1:50 000

KILOMETRES 1 0 1 2 3 4 5 6 KILOMETRES

TECTONIC SKETCH



5968-2

DEPARTMENT OF MINES AND ENERGY – SOUTH AUSTRALIA

GEOLOGICAL MAP OF THE

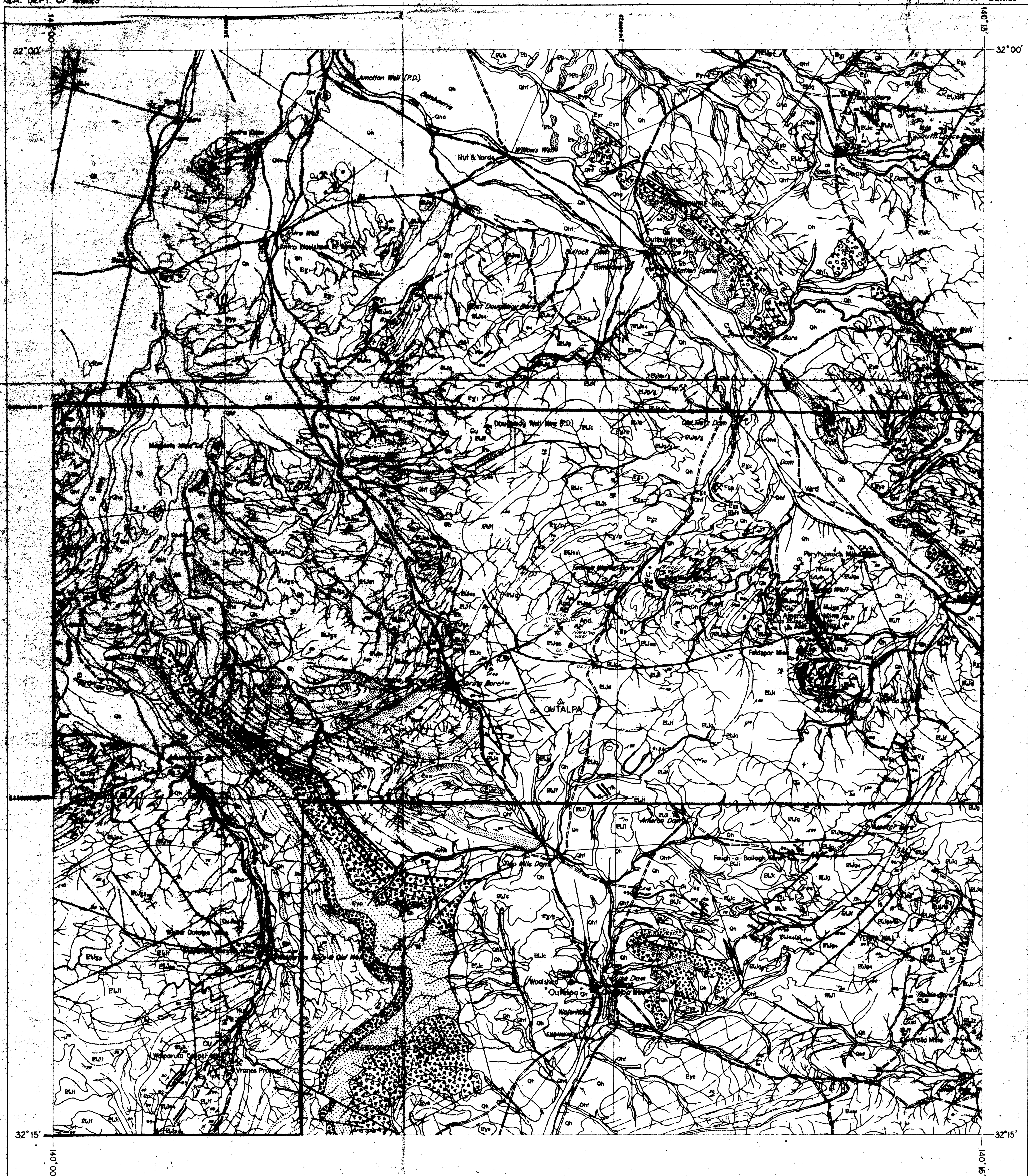
WEEKEROO INLIERS

COMPILED G.M. PITT	DRN J.R.	SCALE 1:50000	PLAN NUMBER
DIRECTOR GENERAL	CKD	DATE 9-5-79	79-357

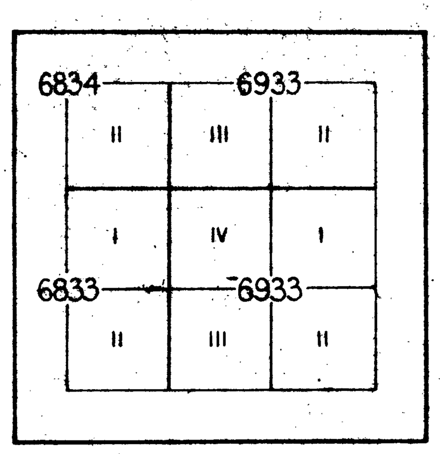
OUTALPA 6933 – IV

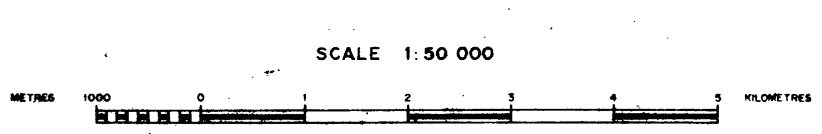
S.A. DEPT. OF MINES

1:50 000 SERIES



SVYS 171, 172, 176. FLOWN OCT. 1955. DEL. P.G.Y.





OUTALPA, BULLOO 1:50000

REFERENCE

SURFICIAL CAINOZOIC SEDIMENTS

QUATERNARY

Qhf	Flood plains fringing drainage lines, consisting of thin spreads of sand and clay overlying compacted gravelly and sandy clays of Qh unit.
Qh	Undifferentiated low-angle slope deposits and valley-fill plains of surficial clays sands and gravels overlying compacted red-brown sandy and gravelly clays representing a condensed sequence of POORAKA FORMATION, its equivalents and younger units.
Qha	Alluvial sands, clays and gravels of modern drainage channels.

unconformity

ADELAIDEAN SYSTEM

LATE PROTEROZOIC (ADELAIDEAN)

Puw	WILYERPA FORMATION: thick basal quartzite overlain by siltstone.

unconformity

STURTIAN — UMBERATANA GROUP

Pye	BENDA SILTSTONE: indurated metasiltstone with thin diamictic layers and interbedded quartzites; lenses of granite conglomerate. Thin, multiple horizons of BRAEMAR IRON FORMATION at the base: hematitic siltstone, often pebbly and associated with a characteristic grey, pebbly, micaceous dolomite.
Pyp3, Pyr	PUALCO TILLITE, Member 3: Diamictite with predominantly crystalline basement clasts in a greywache matrix. Thin inter-layers BRAEMAR IRON FORMATION facies (Pyr) near top. Lenses of massive (granitic) boulder diamictite interfinger with Benda Siltstone in the MacDonald Corridor.
Pyp2	Member 2: Massive, crossbedded quartzite.
Pyp1	Member 1: Pebble diamictite with a largely quartzitic matrix and clasts of Willyama Complex rocks and Burra Group quartzite, dolomite and (?) shale.
Pyo	OLD BOOLCOOMATA GRANITE CONGLOMERATE: granite-clast conglomerate, interpreted as a local talus derived from the Binberrie Granite, which it overlies unconformably. In faulted contact with all other Adelaidean units; stratigraphic position inferred by correlation to granite conglomerates in Pyp3 and lower Pye units.

unconformity

TORRENSIAN — BURRA GROUP

Pb3	(?) BELAIR SUBGROUP equivalent: interlayered quartzite and siltstone.
Pb2	(?) SADDLEWORTH FORMATION equivalent: predominantly greenish-grey siltstone.
Pb1	(?) AUBURN DOLOMITE equivalent: interbedded dolomite and ... the top. SKILLOGALEE DOLOMITE: dolomitic marble, sedimentary magnesite and intraformational breccias, minor sandstone and siltstones. Host to galena veins at Vranes Prospect. ALDGATE SANDSTONE equivalent: basal conglomerate, overlying silty sandstones, greywackes.

WILLYAMA COMPLEX

ACID INTRUSIVES

MIDDLE PROTERZOIC

Pγ	Undifferentiated granitoid bodies: granitic to granodioritic composition, and generally intrusive contact relationships.
Pγ1	ANTRO GRANITE, TRIANGLE HILL GRANITE (Pγ1): massive porphyritic adamellite to granite, commonly with aligned idiomorphic albite-mantled microcline phenocrysts up to 3cm. long. Regarded as a single body disrupted by the MacDonald Fault.
Pγ2-4	Adamellitic to slightly granodioritic intrusive granitoids at Mooleugere Hill, Binberrie Hill (BINBERRIE GRANITE) and Tietz Dam (Pγ2): poorly foliated and generally non-porphyritic; all regarded as parts of the same intrusive body. Adamellitic to slightly granodioritic granitoids at Nine Mile Gate (Pγ3) and Blue Dam (Pγ4): poorly foliated, generally non-porphyritic.
Pp	Pegmatoids: thin layer-parallel to discordant and/or podiform bodies. Primarily potassic or potassic-albitic varieties, with rare albitic types. Common accessories are tourmaline, and radio-active minerals (e.g. orthite). A number of generations are present, but not distinguished.

METAMORPHOSED BASIC IGNEOUS ROCKS

β	Undifferentiated hornblende- albite amphibolite: conformable bodies of igneous origin. Bodies south of "Old Boolcoomatta" and west of Ameroo Hill are possibly equivalent to β2.
β1	Discordant hornblende-albite metadolerite (amphibolite) dykes, original doleritic textures often preserved.
β2	WEEKEROO AMPHIBOLITE, DOUGHBOY AMPHIBOLITE: massive to breccious, predominantly hornblende-albite, semi-concordant to concordant amphibolites. Weekeroo body contains rare pillow structures and is interpreted as a probable subaqueous volcanic plug-extrusive complex of tholeiitic composition. Doughboy body occurs at approximately the same stratigraphic level and probably has a related origin.

ALBITE-RICH, FOLIATED GRANITOIDS

EARLY PROTEROZOIC

PWγ1	Granodiorite gneiss, west of Meningie Well, also minor small gneissic granodiorite bodies.
PWγ2	Lenticular, semiconcordant, magnetite-bearing adamellite and granodiorite at Perryhummuck Mine and Mt. Mulga-Drew Hill respectively, interpreted as the same body despite the apparent compositional difference.
PWγ3	Concordant to partly intrusive tonalite gneiss at Walparuta and Outalpa Springs, interpreted as the same body, disrupted by the Outalpa fault.

METASEDIMENTS AND METAMORPHICS

"OLARY SEQUENCE"

	schistose equivalents	gneissic equivalents	
Undifferentiated quartz-mica-plagioclase schist, minor quartzite.	PWs		
Pelitic quartz-muscovite schist, with very coarse andalusite generally retrogressed to massive pinite which encloses crystals of blue corundum.	PWs1	PWg1	Not recorded
Massive quartz-muscovite schist.	PWs2	PWg2	Not recorded
Interlayered quartz-muscovite schist and quartz-muscovite-plagioclase quartzite in which sedimentary structures are often well preserved.	PWs3	PWg3	Layered quartz-plagioclase-biotite gneiss, migmatoid in places.
Pelitic quartz-muscovite schist with tourmaline, staurolite, chloritoid and retrogressed andalusite and chiastolite porphyroblasts. Knotted aluminosilicate schist with tourmaline and garnet ("Ameroo Hill Schist"). Horizons of calc-silicate (e1-7, see below) near top and base, rarely within the unit; graphitic schist with chiastolite (PWs4g) and stratiform gossan horizon (g) near top or in base of PWs3 unit, in some areas.	PWs4	PWg4	Pelitic gneiss, containing andalusite, sillimanite and, rarely, kyanite.
Interlayered schist and (often highly albitic) quartzite.	PWs5	PWg5	Layered psammitic-pelitic gneiss with iron formation and related horizons (f1-3, a, q: see below "MARKER BEDS").
Massive homogeneous tonalite gneiss, conformable with adjacent schist sequence; probable non-mobilised equivalent of PWγ3 (see Rock Relation Diagram); underlain by PWc and PWf units (see gneissic to migmatoid equivalents).	PWg	PWq	Massive to layered, often reddish quartz-plagioclase-magnetite "quartzite", grading to leucocratic, granitic gneiss. Iron formations and, particularly, feldspathic variants thereof near top.
	PWc,f	PWb	Coarse-grained semipelitic biotite gneiss, minor interlayered quartz-plagioclase gneiss.

gneissic to migmatoid equivalents

PWc	Undifferentiated complex gneiss terrain incorporating and/or equivalent to other gneiss units.
PWo	Semipelitic migmatitic gneiss with characteristic steel-grey biotitic melanosome schlieren in a quartzo-feldspathic leucosomal matrix.
PWf	Massive to thickly layered feldspar-rich and feldspar-mica gneiss with a variable content of disseminated magnetite. Iron formations occur where magnetite content of gneiss is high. Lesser semipelitic to pelitic mica gneiss (PWb lithology) present but not mapped individually; rare concordant gneissic amphibolites in some areas.

MARKER BEDS

g	Stratiform gossan horizon
e1-7	Calc-silicate, calc-albitic albitic rocks e1: dark grey, fine grained laminated albite rock (hornstone of Campana and King, 1958), minor epidote, magnetite. e2: coarse-grained marble, often garnetiferous and/or containing disseminated or interlayered calc-silicate minerals. e3: stratiform breccias with albitic to albite-hornblende clasts in a predominantly hornblende matrix (e.g. Cathedral Rock). e4: stratiform breccias with both clasts (rounded) and matrix of quartz and albite with minor amphibole and iron oxides. e5: thin, evenly layered to laminated quartz-albite-epidote-hornblende rock. e6: "epidote quartzite" – medium grained, granoblastic-textured albite rock with lesser hornblende, epidote and quartz, and characteristic ptygmatic veins of hornblende. e7: coarse grained mono- or bi-mineralic rocks, e.g.: quartz-actinolite, garnet-epidote or wollastonite-diopside.
f1-3, a, q	Iron formation, facies variants and related or equivalent horizons f: iron formation, undifferentiated. f1: magnetite-sulphide-quartz-albite (non-baritic) iron formation. f2: barite-quartz-magnetite iron formation. f3: tremolitic iron formation. a: grey, medium to fine grained albite rock ("orthoquartzite") with minor disseminated magnetite and sulphide. q: quartz rock with minor disseminated sulphide and (?) magnetite.

NON-SEQUENCE GNEISS UNITS

PWm	Layered migmatitic biotite gneiss, forming a contact zone around PWγ3 and developed in PWg5 and PWs4.
PWx	Massive unlayered aplitic quartz-feldspar-biolite gneiss, probably near-anatectic.
PWz	Granitic migmatite consisting of predominant quartzofeldspathic leucosome and lesser disseminated biotitic melanosome.

GNEISS UNITS OF UNCERTAIN STRATIGRAPHIC RELATIONSHIP

PWl	Layered quartzite and quartz-plagioclase leucogneiss.
PWi	Layered, often migmatoid, quartz-plagioclase-biotite gneiss. PWi and PWl units appear to correlate with PWs3 on the basis of regional relationships.

5968-3

Rpt Bk 80/151

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

OUTALPA 6933-IV

PRELIMINARY GEOLOGY

COMPILED	GMP
DRAWN	PJW
DATE	10·5·80
CHECKED	
for C.D.O.	DATE 14/5/81
SCALE	1:50 000
PLAN NUMBER	81-345

APPENDIX A.

Petrographic Descriptions.

Morialpa Sillimanite.

Samples. 1,3,4,12,13,14,14A,15,OL4,OL5,OL6,OL7,OL8.

Ameroo Area.

Samples. OL12,OL15,OL17A,OL17B.

[illegible]

Sample No: [illegible]

Rock Name:
Mica schist

Hand Specimen:
A well foliated rock containing large mica flakes intergrown with milky grey quartz-rich lenses.

Thin Section:
This sample consists mainly of a granoblastic quartz-rich mosaic intergrown with muscovite and biotite flakes which define a strong lepidoblastic foliation. Feldspar including polysynthetically twinned plagioclase and untwinned potash feldspar forms granular intergrowths with the feldspar within localized areas. Most of the quartz and feldspar mosaics tend to form slightly elongate, lenticular bodies separated by mica-rich bands.

The muscovite occurs as relatively large flakes up to several millimetres in size which are intergrown with well developed biotite flakes and as finely divided sericitic phyllosilicates. Some of the sericite is locally intergrown with the granular quartz but other sericite forms discontinuous lenses and bands. The biotite typically has a reddish-brown, intensely pleochroic colour and locally shows incipient alteration to a green chlorite.

This is a metasedimatary rock of lower amphibolite facies grade.

Sample: 3: 19045384

Rock Name:

Quartz plagioclasite

Hand Specimen:

A massive rock comprised of dull white feldspar intergrown with milky grey quartz. Microchemical tests show that the rock contains no potash feldspar.

Thin Section:

This sample consists of large granular quartz bodies up to several millimetres in size intergrown with very large plagioclase crystals. The quartz bodies have a polycrystalline texture being comprised of large quartz crystals with xenomorphic shapes. Most of the quartz exhibits some evidence of deformation with the development of sutured grain margins, undulose, strained extinction and localized mild granulation.

The plagioclase forms weakly prismatic-shaped crystals which locally enclose anhedral quartz grains. Many of the plagioclase crystals are quite large possibly up to several centimetres in size. Much of the plagioclase contains inclusions of very finely divided muscovite/sericite which form moderately well developed flakes and could represent a recrystallized alteration product. Some slightly larger muscovite flakes also form interstitial intergrowths between plagioclase and quartz. The plagioclase has relatively low refractive indices indicating a sodic composition.

Traces of apatite form disseminated prismatic crystals [illegible] mm long. The rock also contains traces of a [illegible] green [illegible] which could be a [illegible] material. Opaque to translucent iron oxides form disseminated grains as well staining along [illegible] fractures.

This is most [illegible] plutonic igneous [illegible] which has been subjected to [illegible] recrystallization.

Sample: 4; TSC45385

Rock Name:
Micaceous quartzo-feldspathic gneiss

Hand Specimen:
A very well foliated and banded rock containing some felsic pale tan coloured bands up to about 1 cm wide separated by darker grey coloured micaceous bands. Microchemical tests show that the felsic bands contain moderate amounts of potash feldspar.

Thin Section:
This sample consists mainly of a granoblastic quartz and feldspar mosaic intergrown with smaller amounts of biotite and minor muscovite. The quartz and feldspar form a mosaic with a typical grain size between 0.3 and 0.8 mm. The feldspar consists largely of untwinned potash feldspar along with smaller amounts of polysynthetically twinned plagioclase. The feldspar shows some alteration to finely divided sericitic phyllosilicates.

The biotite forms well developed flakes up to 0.4 mm long which have a brown, intensely pleochroic colour. The biotite flakes exhibit a strong lepidoblastic foliation and are locally concentrated within narrow bands which would represent the micaceous bands noted in hand specimen. Some well developed muscovite flakes are also intergrown with the biotite-rich bands.

This is a low to medium grade metasedimentary rock with a very well developed lepidoblastic foliation.

Sample: 12; TSC45386

Rock Name:

Mica schist

Hand Specimen:

A micaceous, well foliated rock with a greyish green colour.

Thin Section:

This sample consists mainly of muscovite flakes which exhibit a strong lepidoblastic foliation and are intergrown with smaller amounts of chlorite. Some of the muscovite flakes are quite large being up to a few millimetres in length but most muscovite forms much more finely divided flakes and very fine flaky aggregates. Although most of the muscovite is oriented along a single foliation direction evidence of other weakly developed foliation directions are present.

The chlorite is a pleochroic green variety with anomalous purple birefringence and forms moderately well developed flakes oriented both parallel to the major foliation direction and in lenses where it exhibits an orientation at a high angle to this foliation direction. It is considered likely that the chlorite represents a degraded biotite although no biotite remnants were observed. Very finely divided opaques are intergrown with the chlorite and tend to form fine lamellar structures along cleavage traces. Opaque to translucent iron oxides also form disseminated grains and aggregates through the rock. A small proportion of the translucent iron oxides have a euhedral character and could represent altered pyrite crystals.

Traces of tourmaline were noted locally as prismatic, pleochroic green crystals up to 0.8 mm long.

This is a relatively low-grade metamorphic rock comprised mainly of muscovite along with minor biotite and accessory tourmaline.

Sample: 13: TSC45367

Rock Name:

Muscovite-sillimanite rock

Hand Specimen:

A massive dull white to pale grey coloured rock containing localized disseminations of a fine-grained black mineral.

Thin Section:

In thin section this rock can be seen to consist mainly of sillimanite and muscovite/sericite which are unevenly distributed through the rock. The sillimanite forms very fibrous aggregates which form a felted mosaic within irregular patches up to several millimetres wide. The muscovite forms very finely divided flaky aggregates which in some areas form vein-like structures within the sillimanite and appear to be an alteration product of the sillimanite. Within localized areas very coarse muscovite flakes up to several millimetres in size are present but for the most part the muscovite forms very fine flaky aggregates.

Within one portion of the rock prismatic tourmaline crystals up to 3 mm long are present. This would represent the black disseminated mineral noted in hand specimen. The tourmaline has a pleochroic greenish-orange colour and shows vague concentric zoning. Most of the tourmaline is intergrown with coarse-grained muscovite or very finely divided muscovite.

Minor opaques are disseminated through the rock as small grains and aggregates which are typically intergrown with the muscovite.

This is considered to be an aluminous metasomatic rock comprised largely of sillimanite and minor tourmaline which shows a moderate degree of alteration of sillimanite to secondary muscovite/sericite.

Sample: 14; 78C45368

Rock Name:

Mica schist

Hand Specimen:

This is a medium to dark grey coloured rock with a well developed schistose foliation comprised mainly of relatively large biotite flakes. The rock exhibits an irregular slightly paler coloured zone with a finer grain size.

Thin Section:

This sample consists mainly of mica comprised largely of finely divided muscovite/sericite intergrown with larger chloritized biotite flakes. The paler coloured zone noted in hand specimen consists mainly of a felted, flaky aggregate of finely divided muscovite/sericite flakes. Minor small biotite which shows some chloritization is locally intergrown with this finely divided muscovite.

This zone is surrounded by an area comprised of larger mica flakes consisting mainly of chloritized biotite with some well developed muscovite flakes. The chlorite flakes consist of pale green, weakly pleochroic chlorite with anomalous purple interference colours but generally contain minor lamellar remnants of biotite. The muscovite tends to occur interstitially between the chlorite flakes and generally forms very well developed flakes although some finely divided muscovite aggregates are present. Finely divided opaque material is also intergrown with the chlorite.

Accessory apatite forms disseminated crystals up to 0.8 mm long which are intergrown both with the fine-grained muscovite/sericite-rich portion of the rock and with the coarser chloritized biotite-rich area. Traces of tourmaline were noted as small, pleochroic green prisms intergrown with the finely divided muscovite.

This is a schistose metamorphic rock with a somewhat variable mineralogy comprised mainly of chloritized biotite and finely divided muscovite/sericite.

Sample: 14A: TSC45389

Rock Name:
Sillimanite

Hand Specimen:
A greenish-grey coloured rock comprised of fibrous-textured crystals. The rock is transected by a narrow dark green to black vein.

Thin Section:
In thin section this rock can be seen to consist mainly of sillimanite which generally forms a felted, fibrous textured mosaic. Some large prismatic sillimanite crystals up to several millimetres in size are disseminated through the rock but these often grade into very fibrous, matted sillimanite.

The sillimanite is intergrown with some finely divided muscovite/sericite which forms irregular patches as well as narrow vein-like structures. The muscovite/sericite is locally intergrown with chloritoid which forms prismatic crystals up to several millimetres long which exhibit well developed polysynthetic twinning. The chloritoid in particular tends to be concentrated along a vein-like structure which would represent the dark vein noted in hand specimen.

This is a sillimanite-rich rock most likely of metasomatic origin which has been subjected to some retrograde alteration producing finely divided muscovite/sericite with moderate amounts of associated chloritoid. It is considered likely that the retrograde alteration is of hydrothermal origin.

Sample: 15: TSC45390

Rock Name:
Micaceous quartzo-feldspathic schist

Hand Specimen:
This is a well foliated rock containing pale grey lenticular bodies separated by undulose micaceous bands with a slightly darker colour.

Thin Section:
This sample consists mainly of granoblastic quartz and feldspar mosaics intergrown with well developed mica flakes which exhibit a strong lepidoblastic foliation. Both the quartz and feldspar tend to be concentrated in elongate lenses separated by mica-rich bands adding to the foliated character of the rock. Within these lenses the quartz and feldspar has a typical grain size of about 0.2 mm to 1 mm. The feldspar consists of both polysynthetically twinned plagioclase and untwinned potash feldspar.

The mica-rich bands consist of large muscovite and biotite flakes up to several millimetres long. Moderate amounts of finely divided muscovite/sericite are also locally present particularly marginal to some mica-rich bands. Muscovite/sericite also forms fine intergrowths with the granular quartz and feldspar lenses. The biotite shows some alteration to a pleochroic green chlorite with anomalous interference colours.

Traces of tourmaline form disseminated prismatic crystals up to 0.2 mm long which have a pleochroic green colour. Most of the tourmaline is intergrown with finely divided muscovite/sericite patches. Minor opaques are disseminated through the rock as small grains and aggregates which are generally intergrown with the muscovite and chloritized biotite.

This is a low to medium grade metasedimentary rock.

SAMPLE: OL4: TSC45562

Rock Name:
Muscovite-Chloritoid Schist

Hand Specimen:
This is a greenish grey micaceous rock with a schistose texture.

Thin Section:
This metamorphic rock consists of bands of chloritoid and chlorite interlayered with patches of fine-grained muscovite and kaolinite. The chloritoid occurs as clusters of anhedral to euhedral elongated twinned crystals containing abundant very fine fibres. The chloritoid crystals are enveloped by a sericitic fine-grained muscovite matrix and, to a lesser extent, finely intergrown muscovite and ?kaolinite. Chlorite also occurs in bands and lenses of parallel-oriented flakes up to 9 mm in size with a pleochroic grey colour and anomalous birefringence. Muscovite flakes up to 0.3 mm in width also occur in these bands, with a minor proportion of the flakes containing needle-like sillimanite crystals. The fine-grained muscovite and kaolinite matrix also contains isolated patches of sillimanite needles as well as anhedral grains, 20 to 30 μm in size, of ?epidote. The ?epidote grains occur singly and in elongate clusters oriented parallel to the foliation.

This is a muscovite-rich metamorphic rock with a highly retrograded character represented by fine sericitic muscovite and well developed chloritoid. Traces of remnant sillimanite indicate an original higher grade than that represented by the present mineral assemblage.

SAMPLE: OL5: TSC45561

Rock Name:
Mica Schist

Hand Specimen:
This is a coarsely crystalline grey and light brown rock containing a few micaceous bands 1 cm in width. The rock possesses a mottled black and light greenish-brown weathering surface.

Thin Section:
The sample consists of large muscovite flakes and a few tourmaline crystals enclosed by a mass of sericite flakes containing opaque particles in poorly-defined patches. Tourmaline occurs as zoned crystals 3 to 7 mm in size enclosing muscovite and sillimanite inclusions. The sillimanite inclusions have a fibrous, acicular character and the muscovite inclusions form small flakes. Large muscovite flakes 3 to 20 mm in size contain moderately abundant very fine sillimanite crystals with fibrous to acicular characters. Patches of chlorite flakes up to 2 mm in size are concentrated adjacent to the tourmaline and muscovite flakes. The chlorite has a pleochroic green colour and anomalous firefringence. The micaceous bands consist of muscovite and iron-stained chlorite flakes with interstitial sericite.

This is considered to be a micaceous schist which contains abundant fine sericite of retrograde origins. Large muscovite flakes and tourmaline crystals contain fibrous sillimanite inclusions suggesting the original schist could have had a high sillimanite content.

SAMPLE: OL6: TSC45559

Rock Name:
Mica-Quartz Schist

Hand Specimen:
This is a grey foliated metamorphic rock with discontinuous mica and quartz-rich bands.

Thin Section:
This is a metamorphic rock consisting of quartz-rich lenses enclosed by layers with varying amounts of muscovite, biotite, quartz and plagioclase. The quartz-rich lenses are 2 to 3 cm in size and consist of granular quartz 0.5 mm in size with some grains crowded by needle-like inclusions. These lenses are extensively sericitised. On the boundaries of these lenses there are irregularly shaped masses of biotite occurring as smaller flakes in a sub-parallel orientation. This biotite has partially altered to chlorite, is stained by limonite and has been partially replaced by muscovite flakes containing opaque oxide particles. This alteration and replacement of biotite has also occurred in thin (0.5 mm wide) layers of biotite flakes with minor amounts of intergranular quartz. Muscovite also occurs as coarse flakes up to 1 cm lona and 5 mm wide oriented both parallel and obliquely to the orientation of the biotite flakes. These flakes enclose quartz and biotite masses. Plagioclase occurs as twinned unaltered grains in a few localized areas intergrown with quartz, biotite and muscovite.

This is a metamorphic rock with a well developed schistose foliation showing some retrograde sericitisation. No aluminosilicate minerals were noted although the quartz contains fine acicular inclusions which are thought to be muscovite/sericite possibly pseudomorphic after acicular sillimanite.

SAMPLE: OL7: TSC45560

Rock Name:
Mica-Quartz-Feldspar Schist with Pegmatitic Lens

Hand Specimen:
This is a grey micaceous foliated rock containing a cream-coloured coarsely crystalline band 2 to 5 cm wide.

Thin Section:
The area sectioned consists of a coarse-grained feldspar-quartz-muscovite igneous rock. Only a very small portion of the area sectioned contains the schistose layers, which consist of a semi-continuous band of parallel-oriented biotite flakes with interstitial elongated opaques and granular quartz. The biotite is pleochroic light brown to brown and has been partially altered to chlorite and replaced by muscovite flakes with opaque inclusions. The pegmatitic portion of the rock consists mainly of coarse crystals of quartz, K-feldspar, plagioclase and muscovite. The quartz occurs as inclusion free crystals with marked strain-induced undulose extinction and the K-feldspar occurs as large crystals some of which are perthitic and all of which are crowded with fine-grained muscovite and chlorite flakes. The plagioclase is unaltered, twinned and usually contains vermicular inclusions of quartz. Coarse muscovite flakes are intergrown with quartz on the margins with some development of myrmekitic intergrowth. Unaltered pleochroic light brown to brown biotite flakes occur interstitial to the muscovite flakes and with the flakes oriented almost perpendicular to the muscovite. The pegmatitic portions of the sample has a re-crystallized appearance with weakly poikiloblastic muscovite.

This is a schistose metamorphic rock containing a recrystallized coarser grained quartz and feldspar rich lens which also shows evidence of metamorphic recrystallization.

SAMPLE: OL8: TSC45566

Rock Name:
Mica-Chloritoid Schist

Hand Specimen:
This is abrownish-green schistose micaceous rock with muscovite porphyroblasts.

Thin Section:
This is a metamorphic rock consisting of sericite, muscovite, chloritoid, apatite, chlorite, garnet and sillimanite with rare tourmaline. The rock consists of contorted bands of chlorite, chloritoid, garnet and apatite separated and enveloped by sericite and fine-grained muscovite. The bands consist of chlorite flakes up to 1 mm in length containing equant to elongated anhedral apatite crystals 0.1 to 1 mm in size and bladed euhedral twinned crystals of chloritoid up to 1 mm in size. Garnet grains up to 1.5 mm in size are deeply embayed, corroded and rimmed by iron-stained chlorite. Afew large muscovite flakes 5 mm in width contain abundant needle-like sillimanite crystals. The sericite/muscovite mass contains abundant needle-like opaques often with a parallel orientation, as well as a few patches of needle-like sillimanite crystals. A few small corroded tourmaline grains are also present.

This is an upper greenschist facies grade metamorphic rock believed to be largely of retrograde origin due to the presence of very minor renmant sillimanite in muscovite flakes. This rock also has an anomalously higher apatite content.

SAMPLE: OL12: TSC45567

Rock Name:
Quartz-Mica Schist

Hand Specimen:
This is a black and grey micaceous rock with a schistose texture.

Thin Section:
This is a metamorphic rock consisting of quartz, biotite, muscovite, garnet and feldspar, with a preferred orientation strongly defined by muscovite and biotite flakes. The dominant mineral, quartz, possesses a granoblastic texture with cuspate boundaries between unstrained crystals, some of which contains numerous needle-like inclusions. The pleochroic dark to light brown biotite flakes penetrate into the quartz to a greater extent than the muscovite flakes, which are coarser and occur more in lenses. In these lenses the muscovite contains abundant needle-like sillimanite crystals and has been partially replaced by sericite. In quartz-rich lenses, plagioclase occurs as discrete grains and as a granophyric intergrowth with quartz. Both tourmaline and garnet occur as porphyroblasts of the order of 1 mm in size. The garnet is iron-stained along fractures and in parts contains numerous fibres.

This is a metamorphic rock of upper greenschist to amphibolite facies grade. At least some of the muscovite rich bands are retrograde after sillimanite and contain remnant sillimanite fibres.

SAMPLE: OL15: TSC45563

Rock Name:
Quartz-Mica Schist

Hand Specimen:
This is a micaceous metamorphic rock with a schistose texture and a folded banding comprised of alternating light brown and dark grey bands.

Thin Section:
This sample consists mainly of granoblastic quartz intergrown with mica flakes which exhibit a moderately well developed lepidoblastic foliation. The mica consists of large muscovite flakes as well as well developed biotite flakes and finely divided sericitic muscovite. The muscovite and biotite are at least locally concentrated in discontinuous bands and lenses which separate quartz-rich lenses. Minor amounts of feldspar including polysynthetically twinned plagioclase and untwinned potash feldspar are intergrown with the granoblastic quartz.

The well developed muscovite flakes are up to approximately 1 mm in size and at least locally exhibit ragged, weakly poikiloblastic textures. Much of the sericitic muscovite forms elongate lenticular bodies and minor acicular to fibrous textured sericite occurs as fine inclusions within quartz grains. It is considered possible that at least some of this sericite could represent completely altered sillimanite (especially fibrolite) particularly due to the presence of acicular inclusions in quartz. Some finely divided sericite is intimately intergrown with muscovite and appears to represent an alteration product of original large muscovite flakes.

The biotite has a pleochroic brown colour and is very fresh showing virtually no alteration to secondary minerals although locally it has a slightly darker reddish-brown oxidised character.

Traces of staurolite were noted as very small, prismatic crystals which are intergrown with mica. Minor epidote forms small disseminated grains and aggregates. Opaques are also disseminated through the rock as anhedral grains and aggregates up to 0.2 mm wide.

This is a schistose metamorphic rock of upper greenschist to lower amphibolite facies grade. The rock contains some retrograde sericite which locally forms fine, acicular inclusions within quartz possibly pseudomorphic after sillimanite suggesting that the present metamorphic grade could be largely of retrograde origin.

SAMPLE: OL17A: TSC45564

Rock Name:

Quartz-Mica Schist

Hand Specimen:

This is a mottled black, brown and cream-coloured micaceous rock with a schistose texture.

Thin Section:

This is a foliated metamorphic rock consisting mainly of quartz with smaller amounts of biotite and muscovite and traces of plagioclase, garnet, chloritoid and staurolite. The granoblastic quartz and plagioclase is intergrown with euhedral biotite and muscovite flakes. Acicular inclusions in quartz grains are common. The biotite is pleochroic dark to light brown. Muscovite also occurs as coarser flakes that envelope quartz grains. Many of these flakes contain sillimanite needles as well as patches of sericite. Fine acicular inclusions possibly of sillimanite or muscovite after sillimanite occurs in some quartz grains. Staurolite is uniformly distributed throughout the area sectioned, occurring as unaltered crystals 0.2 to 0.5 mm in size and as elongated clusters of crystals approximately 0.02 mm in size. Chloritoid is rare, occurring as unaltered, twinned crystals 1 mm in size and garnet occurs as unaltered porphyroblasts 2.5 mm in size enclosing quartz and staurolite grains.

This is a metamorphic rock similar to sample OL15 containing some remnant sillimanite as well as minor staurolite and garnet porphyroblasts in an essentially lower grade micaceous assemblage.

SAMPLE: OL17B: TSC45565

Rock Name:
Sillimanite-Muscovite Rock

Hand Specimen:
This is a massive rock with a pale to medium grey, mottled colour.

Thin Section:
This sample consists mainly of sillimanite intergrown with muscovite. Most of the sillimanite forms fibrous textured aggregates up to several millimeters long which at least locally have a contorted character. Only a small proportion of the sillimanite forms fine prismatic to acicular crystals.

Muscovite consists of very large muscovite flakes to several millimeters in size which enclose fibrous sillimanite inclusions and as very finely divided sericitic aggregates. The sericitic aggregates have irregular shapes and are generally intimately intergrown with sillimanite or occur marginal to sillimanite aggregates indicating they represent altered sillimanite.

Minor biotite is disseminated through the rock as well developed flakes up to 1.5 mm long which have a pleochroic brown colour. Much of the biotite tends to be associated with the sillimanite and at least locally contains sillimanite inclusions. Minor feldspar is also present as irregular crystals up to 1.5 mm wide which are typically intergrown with sillimanite. The feldspar is untwinned and is most likely a potash feldspar.

This is sillimanite rich rock containing large muscovite and biotite flakes which could be cogenitic with the sillimanite as well as much more finely divided sericitic muscovite which is considered to represent a retrograde alteration product of sillimanite.

APPENDIX B.

Preliminary Study. Beneficiation of Andalusite/Sillimanite.

Stage Crushing, Examination of Size Fractions, Chemical Analyses.

Recommendations for Metallurgical Feasibility Study.

13 November 1985

OD 3/1043/0

Mico Australia NL
135 Waymouth Street
ADELAIDE SA 5000

Attention: Mr M. Ware

Dear Sir,

BENEFICIATION OF ANDALUSITE

Enclosed is AMDEL Report T6169 which contains the results of size fraction assays and mineralogical examination of a sample of andalusite bearing material supplied by Mr Ware.

Although the andalusite is well liberated at particle sizes of 1.5 mm or smaller, the close specific gravities and similar magnetic and conductive behaviour of andalusite and quartz restrict the processes available for beneficiation.

Heavy medium cyclone processing offers one possibility for beneficiation of the andalusite, and we suggest that this be investigated using the HMC plant at AMDEL. This is a continuous plant rated at approximately 5 tph, although semi-batch tests to investigate separations at different specific gravities can also be carried out.

A series of three tests, separating 50 to 100 kg samples at different densities is suggested.

Feed samples will be crushed to a nominated topsize (eg. 2 to 4 mm) and the minus 0.5 mm fractions removed prior to HMC beneficiation. The products will be assayed (after screening at 2 mm if a coarser topsize is used) and the grade/recovery relationship established for each size fraction.

The concentrate from the best HMC test will be treated in a magnetic separator to reduce the iron content.

If losses of andalusite into the minus 0.5 mm fraction are considered to be excessive, flotation can also be investigated.

A budget estimate for a work programme covering the areas detailed above is $5000 to $7000. A firm quotation can be prepared if required after discussions to more closely define the objectives.

..../2

Although an HMC plant is a high capital item and would possibly not be economically feasible for a deposit such as the one being investigated, we are interested to explore the possibility of AMDEL undertaking the processing on a campaign basis using the 5 tph plant at Thebarton.

Please contact Mr Paul Capps (435733) if you wish to discuss this Proposal.

Yours faithfully,
THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Peter M. Cameron
Manager, Operations Division

PGC:jm
Encl.

1. INTRODUCTION

Mico Australia NL are examining an andalusite/sillimanite deposit in the mid-North of South Australia. Although relatively high grade pockets of the deposit could be selectively mined, any ore will require further beneficiation to achieve the desired grade of 50% Al_2O_3 or higher, with low iron content. The material also contains quartz, tourmaline, staurolite and muscovite.

Mr M. Ware for Mico, requested AMDEL to prepare a sample by crushing and screening, and to assay the resultant size fractions. The fractions were also to be examined mineralogically to determine the degree of liberation with particle size.

2. PROCEDURE AND RESULTS

The 'as received' sample of approximately 100 to 150 kg was stage jaw and gyratory crushed to pass 4 mm. Any rocks too large for the jaw crusher were set aside and excluded from this preliminary study.

Approximately 12 kg was riffled from the crushed material, and dry screened at 1.5, 1.0, 0.5 and 0.25 mm. The size fractions were sub-sampled for assay and for mineralogical examination.

Size fraction weights and assay data are shown in Table 1.

The Al_2O_3 grade decreased with decreasing particle size, whereas all other species assayed increased. Thus the minus 4 plus 1.5 mm fraction contained 38.3% Al_2O_3 and 55.7% SiO_2, compared with a calculated head grade of 35.8% Al_2O_3 and 57.3% SiO_2.

Quartz appears to be the major contaminant with a grade of 57.3% SiO_2. The levels of K_2O (2.0%) and Fe_2O_3 (2.11%) are due to the presence of muscovite and staurolite/tourmaline, and would account for a relatively minor proportion of the silica.

2.1 Mineralogical Examination of Size Fractions

Samples of the plus 0.25 mm size fractions were examined under a stereobinocular microscope and in thin section. Liberation of the andalusite/sillimanite appears to be better with the stereobinocular microscope because small intergrowths with muscovite, quartz, staurolite etc, that were apparent in thin section, were not observed.

The estimated degree of liberation for each size fraction, based on thin section examination, is as follows:

Particle size (mm)	Liberation of Andalusite/Sillimanite (%)
-4 + 1.5	~ 60
-1.5 + 1.0	~ 80
-1.0 + 0.5	~ 90
-0.5 + 0.25	> 95

The estimate for the minus 4 plus 1.5 mm fraction could still be high due to the sectioning effect causing composite particles to appear liberated.

3. DISCUSSION

The size fraction assays suggest that crushing to minus 1.5 mm followed by removal of the minus 0.5 mm fraction could result in some increase of the Al_2O_3 grade in the plus 0.5 mm product. However, the effect is minimal and could not be expected to provide sufficient concentration.

Assay data also indicates quartz to be the major contaminant of the andalusite/sillimanite, with iron contamination also present (as tourmaline). Both quartz and andalusite are non-magnetic and non-conducting minerals. Separation of the andalusite from quartz using magnetic or electrostatic separation would therefore not be feasible, although magnetic separation would possibly be suitable for reducing the iron content by tourmaline removal (depending on the structure of the tourmaline minerals present).

The specific gravity differential (andalusite 3.2, quartz 2.7) is generally too small for gravity concentration by equipment such as spirals or tables.

However it is possible that sufficient beneficiation could be achieved by concentration through a heavy medium cyclone (HMC). The high centrifugal forces applied to the particles enhance the separation process such that efficient concentration can be achieved with narrower specific gravity differentials than required for spirals. HMC beneficiation could process material down to 0.5 mm particle size.

It should be possible to separate andalusite from quartz by flotation, probably at low pH using a petroleum sulphonate collector. However, flotation would require a top size of 0.5 mm or less, a size smaller than originally indicated as the optimum for marketing of a beneficiated product.

4. RECOMMENDATIONS

It is recommended that a test programme be undertaken to examine the preparation of a concentrate of 50% Al_2O_3 grade or higher by HMC beneficiation to reject quartz followed by magnetic separation to remove iron contamination caused by tourmaline or carry over of heavy medium (ferrosilicon).

If the above process is demonstrated to be metallurgically feasible, the costs of batch processing the mine production at AMDEL can be considered.

TABLE 1 : SIZE ANALYSIS, MINUS 4 MM

	Particle Size (mm)					
	-4+1.5	-1.5+1.0	-1.0+0.5	-0.5+0.25	-0.25	Total
Weight (%)	67.46	10.93	1.05	8.91	11.65	100.00
Assays (%)						
Al_2O_3	38.3	35.0	34.5	28.5	28.1	35.8
Cumulative Al_2O_3	38.3	37.8	37.8	36.9	35.8	
SiO_2	55.7	57.8	59.3	64.2	60.5	57.3
TiO_2	0.14	0.14	0.14	0.15	0.21	0.15
Fe_2O_3	1.77	2.12	1.96	2.48	3.84	2.11
MnO	0.01	0.01	0.01	0.02	0.03	0.01
MgO	0.30	0.34	0.32	0.33	0.45	0.32
CaO	0.15	0.21	0.21	0.23	0.33	0.19
Na_2O	0.50	0.56	0.61	0.60	0.72	0.54
K_2O	1.97	1.75	2.06	2.06	2.34	2.00
P_2O_5	0.05	0.04	0.04	0.05	0.08	0.05
LOI	1.45	1.76	1.89	2.04	2.94	1.71
Distribution (%)						
Al_2O_3	72.1	10.7	1.0	7.1	9.1	100.00
SiO_2	65.6	11.0	1.1	10.0	12.3	100.00
TiO_2	63.4	10.3	1.0	9.0	16.3	100.00
Fe_2O_3	56.5	11.0	1.0	10.4	21.1	100.00
MnO	51.0	8.3	0.8	13.5	26.4	100.00
MgO	62.3	11.4	1.0	9.1	16.2	100.00
CaO	54.5	12.4	1.2	11.1	20.8	100.00
Na_2O	62.2	11.3	1.2	9.9	15.4	100.00
K_2O	66.5	9.6	1.1	9.2	13.6	100.00
P_2O_5	64.5	8.4	0.8	8.5	17.8	100.00
LOI	57.1	11.2	1.2	10.6	19.9	100.00

EXPLORATION LICENCE NO. 1388

Outalpa Hill
South Australia

QUARTERLY REPORT FOR THE
PERIOD ENDING
30 JUNE 1987

C.H.C. SHANNON

September 1987.

Mico Australia Limited

A. GENERAL INFORMATION

During the quarter, a field visit of the area by Company personnel was made.

Personnel

Henry Shannon	-	Senior Geologist
Colin Graham	-	Manager, Special Projects

Contractors

Analabs	-	Assays.

B. ANDALUSITE/SILLIMANITE PROSPECTS

1. Introduction

The licence area is structured around control of the scratch mines which have been the actual producers of andulusite and sillimanite boulders suitable for A1203 refractories. There has been a ready market for the local selected ore product.

The major producing area contains four named prospects in the vicinity of Tommy Watty bore on Outalpa Station, but with access via the Bimbowrie Station road. They are referred to collectively in the literature as the Ameroo Hill area.

The names in use are geographically inept and need some explanation. Maggie prospect is east across the flat from Tommy Watty Bore (the bore is not in use). Tommy Watty prospect is east northeast of Maggie considerably further away. Baxters South prospect is east not south of the Baxters open cut (which is south of Maggie and also quite close to Tommy Watty Bore); Ameroo West and Ameroo NW are west southwest of the bore, on opposite sides of a creek which has a fault along it. They are both some 6km west of Ameroo Hill.

The literature gives the impression that these are gouger type operations more or less worked out. The andalusite and/or sillimanite masses are developed in the country rock immediately adjacent to some intrusions of quartz or pegmatite, in zones of highly aluminous knotted schist in which the surplus A1203 segregated out into knots, however the metamorphic conditions changed so that the knots generally "retrogressed" to mica (some metasomatic introduction of alkalis is required for the reaction). The larger bodies constituting the gouger's ore resist the retrogression.

On the ground, remaining surface boulders do not look promising partly because the ground is mostly too rough to get a vehicle across because of the outcrop, although with more time better spots might have been found and with a backhoe much more ore would be accessible. Mines Dept. people emphasise that the surface has been greatly depleted.

2. Possibilities

The boulders have presumably been rolling down the hills to become incorporated in the hillwash and the basal gravel of alluvial flats. The best prospect for the transported boulder form of deposit would be Ameroo west/northwest. However the impression gained from the area as it now is is that even granting that there are boulders of andalusite rock in the alluvium and that they are exceptionally dense and hard there are an awful lot of other dense resistant boulders in with them.

Another possible approach is that the knots themselves still appear to consist of andalusite particularly at the Maggie prospect where the knots are large and common, up to 40% of the rock in places. Although Maggie is not listed as a big producer the comment is made that the specimen andalusite and sillimanite from the ore in this area do not show any retrogression; so this would be the best place to look for unspoiled andalusite in the knots.

The knots however do include small crystals of other minerals which might make the material useless even if the knots are free of retrogressive mica. The commercial South African product appears to be obtained by separating out andalusite knots from a similar looking schist.

Also in the vicinity of the Maggie prospect the creek beds contained an abundance of pebbles which were actually andalusite knots. These constituted a high proportion of the pebble grainsize division. It would seem likely that the alluvium could be screened then the pebbles sorted on a density basis to give an andalusite concentrate.

One caution is that to the north on Bimbowrie, on another group's ground, there is a classic locality for andalusite (the chiastolite variety) which may be a better proposition for the South African style of show or its alluvial/colluvial equivalents.

SAMPLE LIST

Samples collected from the Ameroo Hill group of prospects.

Samples marked * sent for petrological analysis.

Ameroo NW prospect, grab samples.

A8701* knotted schist, small andalusite knots with visible mica from retrogression

A8702* knotted schist, large andalusite knots

A8703 pink radiating andalusite from workings

A8704* aplite? quartzite? granular adalusite rock? - a light even grained rock of a different nature to obvious sandstones in the vicinity; tuff?

Ameroo West prospect, grab samples.

A8705 knotted schist, smaller retrograded knots.

A8706 knotted schist, larger knots.

A8707* mica-andalusite-sillimanite rock from contact body adjacent to quartz/pegmatite body.

Maggie extended area (includes parts of Tommy Watty and Baxters South)

A8708* knotted mica-andalusite schist with rather large knots comprising 50% of the rock. The knots include smaller crystals visible in hand specimen. The rock breaks across the knots which may be essentially pseudomorphs of sericite after andalusite.

A8709 knotted schist with similar granulated knots making up c. 20%.

A8710 big andalusite crystals from a contact ore situation.

A8711 scraps of knotted schist.

Maggie prospect

A8712* coarsely crystalline andalusite-sillimanite ore.

A8713* knotted schist with coarse knots of andalusite or pseudomorphs after andalusite.

A8714 scraps knotted schist

A8715 alluvial andalusite from Baxters area.

Note: Other information received implies that all knots in the area are severely retrogressed to mica with minor relicts within most crystals; however the Maggie prospect has had its "ore phase" material studied with no retrogression noted. If circumstances were such as to minimise retrogression in the ore phase material here it is possible that the knots in the surrounding schist are also mainly andalusite rather than micaceous pseudomorphs. This point is of particular interest.

COMMENTS ON PETROLOGY REPORT (Refer Appendix I)

A8701 "knotted schist, small ex-andalusite knots". As anticipated, the small obviously mica bearing pseudomorphs after andalusite were totally retrogressed from the original andalusite. The consultant would not commit himself to even the presence of andalusite in the original rock but the field evidence of euhedral crystal outlines is unequivocal: andalusite was present originally.

A8702 "knotted schist, large andalusite knots". The large knots in this specimen do contain relic andalusite plus segregations of fibrous andalusite which together make up 10-14% of the rock, but mixed micas, etc. which may make separation difficult or impossible. The relatively non-degraded character of the knots may be connected to the nearby outcrop of pink andalusite crystals previously collected as ore. Should this form of A1203 mineral prove extractable commercially and not confined to the close proximity of the contact zone style ore there is prospect of a major resource.

A8704 "aplite". The specimen was examined to check out if it was an aplite or something more interesting: it is an aplite.

A8707 "mica-andalusite-sillimanite rock; ore waste". This is a specimen of waste from a gouger's pit with higher than acceptable mica, largely because it is at the margin of the contact ore body that is gradational into the surrounding schist as opposed to the bettr material directly adjoining the quartz/pegmatite vein. It illustrates the traditional ore material of the area; andalusite plus sillimanite 35-50%. The sillimanite content is higher than anticipated.

A8708 "knotted schist, large andalusite knots". This specimen showed that preservation of andalusite in the knots of the knotted schist does exist in the area immediately east of the Maggie prospect. There are quite large volumes of this type of schist though the specimen was selected to illustrate a higher than usual content of andalusite or ex-andalusite knots (porphyroblasts), and this factor may have some connection with the survival of the andalusite. Alteration to sericite is given as 20% for the least altered and 90% for the most altered leaving unstated the average degree of alteration. The rock may contain a little less than 20% Al2O3 minerals.

A8712 "andalusite-sillimanite rock; ore". The specimen is representative of the hand picked ore produced by the gougers and containing about 80% Al2O3 minerals. The presence of kyanite is of interest since it is not supposed to exist in the area.

A8713 "knotted schist with large ex-andalusite knots". The specimen is representative of the country rock at the Maggie prospect and of all the coarse knot forms of originally andalusite bearing schists was considered the one most likely to contain relicts of andalusite yet it is described as wholly degraded to sericite.

Conclusions

The exercise confirmed that the material produced by gougers was indeed a rock consisting of 80% or so of Al_2O_3 minerals. The quantity of this style of material is apparently limited to the amounts suggested in Ware's report, which does not seem enough to be of much interest. The prospects of very much larger quantities of lower grade material from the knotted schists are enhanced by these results but the specimen from the Maggie prospect sounds a warning: The totally retrogressed-to-sericite condition could be normal after all. Recovery of Al_2O_3 refractory concentrate depends on a satisfactory recovery process which has to grind the whole rock. Satisfactory has to include a process which caters for the local water supply limitations for a wet process and/or the health problem potential of fibrous i.e. asbestos like sillimanite in a dry process, plus the extraction of the andalusite and sillimanite from the sericite and staurolite associated with it.

The knots that weather out of the schist and residual boulders would be expected to concentrate in a basal gravel under the alluvial flats. A concentrate of the knots could be screened out and further selecting for high density as the andalusite is denser than the sericite.

Recommendation

1)Get basic value parameters for the product to see if the lower grade bedrock and alluvial concentrations do have ore potential an marketability. If so-

2)Collect test samples for treatment to extract an andalusite/silliminite product using the extractable product as the measure of grade.

ANALABS
A Division of Macdonald Hamilton & Co. Pty. Ltd.
ANALYTICAL CHEMISTS

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P.O. BOX 210, BENTLEY, W.A. 6102

Analabs, 15-6-87

Cooee, 102

APPENDIX I

Tasmania,

908 0 07 106

Preparation of seven thin sections and

petrographic descriptions of seven rocks.

R Townend.

Sample A8701

Rock specimen "knotted schist,small andalusite knots with mica"

Thin section

Biotite	40-50%
Muscovite	40-50%
Quartz	<1-10%
Opaques	2-3%

This is a Biotite Muscovite Schist , containing a number of blasts of muscovite plus some biotite free aggregates of muscovite , some with orientation. The main fabric consists of the interlaminated schist with usually equal proportions of the two micas,but some areas have biotite dominant. Other constituents are normally only a few percent by volume,quartz and opaques.There is a discontinuous zone where quartz becomes major,of fine lineated texture within the micas. Otherwise the quartz is weakly dispersed throughout.

Ores are fine and sometimes in trails.The biotite has pleochroic haloes. The blasts of muscovite tend to be oriented. The masses of fine muscovite that lack a preferred fabric do not contain any palimpsests of andalusite , although it is a strong possibility that they are the result of replacement of the aluminosilicate.

Sample A8702

Rock specimen "knotted schist, large andalusite knots"

Thin section

Quartz	40-50%
Biotite	20-30%
Muscovite	5-7%
Sillimanite	5-7%
Andalusite	3-5%
Feldspar	
Sericite}	5-7%
Tourmaline	<1%
Opaques	<1%

This is a Quartz Biotite Muscovite Sillimanite Andalusite Schist. The major fabric consists of the fine even textured quartz biotite feldspar schist.This has a quartz of 0.1mm average,slightly lineated with smooth contacts and a very well oriented dark biotite. The feldspar is plagioclase , rarely twinned but usually showing an incipient alteration to sericite.

The above contains bands ,sometimes discontinuous(knots) composed of relic andalusite, sillimanite of the fibrolite variety, and coarser micas, both biotite and muscovite.The largest andalusite measures 3x1mm, marginally replaced by oriented muscovite, and containing fine oriented biotites.The sillimanite is mostly present as fibrous bunches that can be a monomineralic lens.Otherwise these lenses are closely allied to micas .Within a dual mica band, there is a concentration of tourmaline with subidioblastic crystals to 0.5mm , having a pale yellow /yellow brown dichroism.

Sample A8704

Rock specimen "aplite quartzite granular andalusite rock"

Thin section

Quartz	45 50%
Plagioclase	30-35%
K feldspar	10-15%
Biotite	3-5%
Chlorite	1%
Muscovite	1%
Opaques	<1%
Zircon	<1%
Monazite	<1%
Tourmaline	<1%

This is classified as an Aplite. It has a weak foliation due to the distribution of biotite in lines. The dominant fabric is a mosaic of quartz and two feldspars , whose interlocking even grained character can be described as saccharoidal, typical of aplites. The grainsize is between 0.07 and 0.15mm. There is an occasional concentration of plagioclase in narrow layers.

The plagioclase is usually slightly spotted with sericite. It is poorly twinned, and its composition is albite. . The K feldspar as shown by staining is evenly dispersed.The mica concentrations can be coarser than average and have chlorite and muscovite as the dominant phases. Ores are isometric , to 0.5mm exceptionally and were probably magnetite. Non opaque accessories are fine and rare.

The feldspar composition places the aplite in the Granite category.

Sample A8707

Rock specimen "mica andalusite sillimanite "

Thin section

Muscovite	25-35%
Sillimanite	25-35%
Biotite	
Chlorite)	10-15%
Andalusite	10-15%
Staurolite	5-7%
Chloritoid	5-7%
Quartz	<1%

This is a complex metamorphic assemblage that contains aluminosilicates from several distinct zones.The presence of chloritoid in a sillimanite bearing schist must be a rare occurrence, and is probably due to the chloritoid forming as a late non stress contact mineral. The lack of orientation of the mineral however is no guide, as this is also typical of regional chloritoid.

The schist fabric is due to the orientation of the sillimanite as a fibrolite type, also to local lenses of biotite part chloritised. The andalusite occurs as coarse equant blasts that are always surrounded by replacive muscovite, that are non oriented often millimetric flakes, but can also be much finer. The chloritoid and similar dimension staurolite always occur as idioblastic non oriented crystals of 0.1-0.3mm dimensions.They are never in contact with the sillimanite.The chloritoid has the usual iron rich composition with a trace of Mn.(SEM).

The breakdown of sillimanite or andalusite to give muscovite and staurolite is common, and the association of staurolite with chloritoid is known at the lower temperature limit of the stability of the former. Clearly the assemblage is a disequilibrium one , having both chloritoid and sillimanite preserved .Yet the assemblage appears to be regional as suggested by its appearence in a sample from the Maggie area, also a contact ?

Sample A8708

Rock specimen "knotted mica andalusite schist"

Thin section

Quartz	25-30%
Biotite	25-30%
Chlorite]	
Andalusite	
Sericite]	20-25%
Muscovite	10-15%
Plagioclase	10-15%
Sillimanite	5-10%
Staurolite	1-2%
Chloritoid	1-2%
Goethite	1%
Opaques	<1%

This is a Quartz Biotite Muscovite Plagioclase Sillimanite schist with porphyroblasts of andalusite. This andalusite is part sericitised. Also present within the andalusite are smaller non oriented crystals of staurolite and chloritoid.

The schist has well oriented micas enclosing quartz and untwinned feldspar of 0.1-0.25mm dimensions. The feldspar is plagioclase. The biotite is incipiently chloritised, and has fine opaques around its margins. The sillimanite occurs as oriented fibrolite bunches in the sericitic margins to the andalusite. The andalusites in the slide may exceed 5mm, and be 90% sericitised. The least altered are about 20% altered.

The staurolite and chloritoid are idioblastic and rather elongate within the sericitised andalusite. Fine opaques are slightly elongate and oriented through the andalusite.

The schist is clearly quite similar in the unusual association of chloritoid and sillimanite with the previous sample, although they are from different prospects

Sample A0712

Rock specimen ""andalusite sillimanite ore"

Thin section

Andalusite	
Sericite }	65-75%
Staurolite	10-15%
Sillimanite	5-7%
Kyanite	3-5%

The slide consist of very coarse andalusites partially replaced by sericite, and also hosting prismatic somewhat oriented staurolites, and locally kyanite. Sillimanite is mainly visible as a fibrolitic rim to one of the andalusites. The sericite replacement has an overall oriented fabric.

The formation of the kyanite is presumed to be due to inversion of sillimanite. It is found with staurolite and sillimanite in thermal aureoles

Sample A8713

Rock specimen " knotted schist with andalusite"

Thin section

Quartz	20-25%
Biotite	
Chlorite}	20-25%
"Andalusite"	
Sericite }	20-25%
Muscovite	10-15%
Staurolite	5-7%
Plagioclase	3-5%
Garnet	2-3%
Tourmaline	<1%

This is a Quartz Biotite Muscovite Garnet Schist containing totally sericitised andalusite blasts, with fine staurolite crystals without orientation commonly enclosed within the sericite. The schist has a typical lepidoblastic texture with well oriented biotite and lesser muscovite, the former part chloritised.The association varies in proportions and grainsize. There are linear quartzes to 1mm lengths where mica is deficient. There is minor plagioclase with the normal quartz fabric which have a 0.1-0.25mm smooth contact fabric.

There are some mica schist bands without quartz.These contain the occasional idioblastic garnet, that lacks silicate inclusions. The former andalusites are now represented by coarse patches of fine sericite.Within these patches there can be significant concentrations of fresh non oriented staurolite . These crystals are up to 0.5mm. Internally they commonly have a series of linear curved inclusions of unknown composition.

The staurolite is forming apparently from the breakdown of the andalusite, although this is more common with sillimanite.No sillimanite was seen and the relativly equant shape of the sericite masses supports an andalusite precursor.

PHOTO 1 A8701 BIOTITE MUSCOVITE SCHIST. NIC CROS. FIELD WIDTH 1.8MM

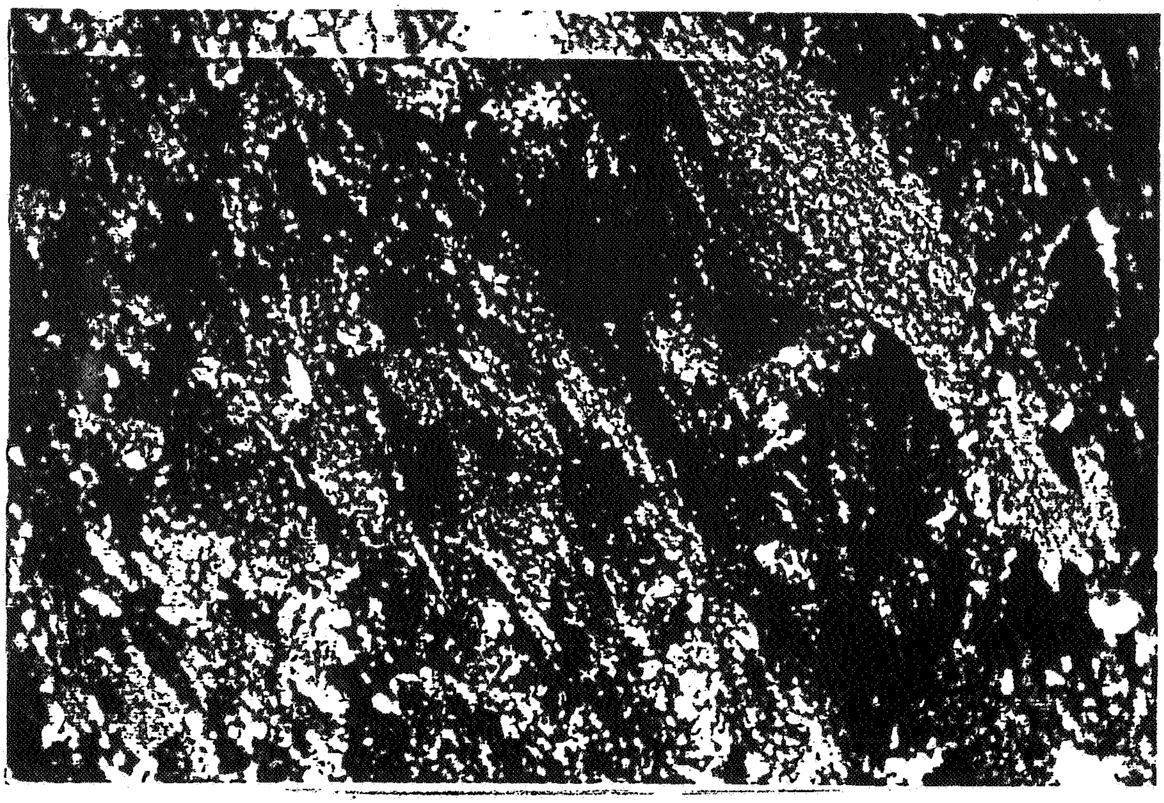
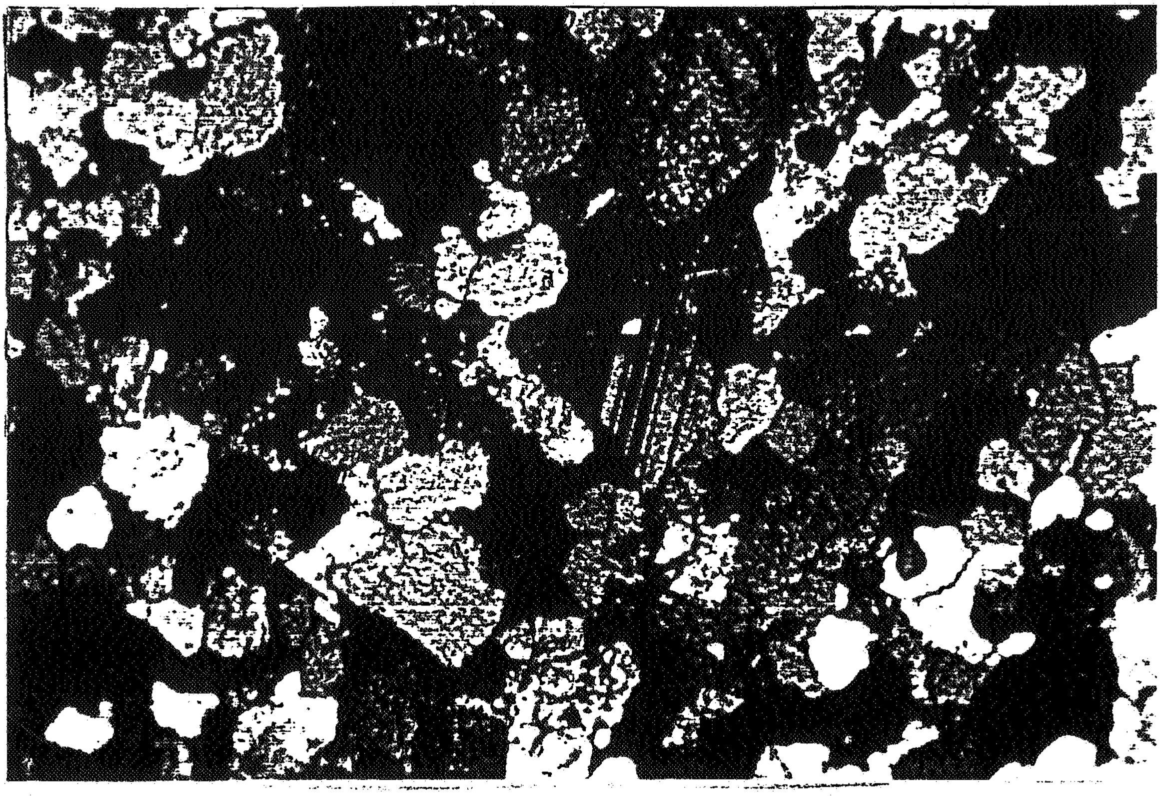


PHOTO 2 A8702 TOURMALINE CLUSTER WITH BIOTITE MUSCOVITE, AND SILLIMANITE FIBRES. NIC UNC. FIELD WIDTH 1.8MM

PHOTO 3 A8704 APLITE . NIC CROS, FIELD WIDTH 1.8MM



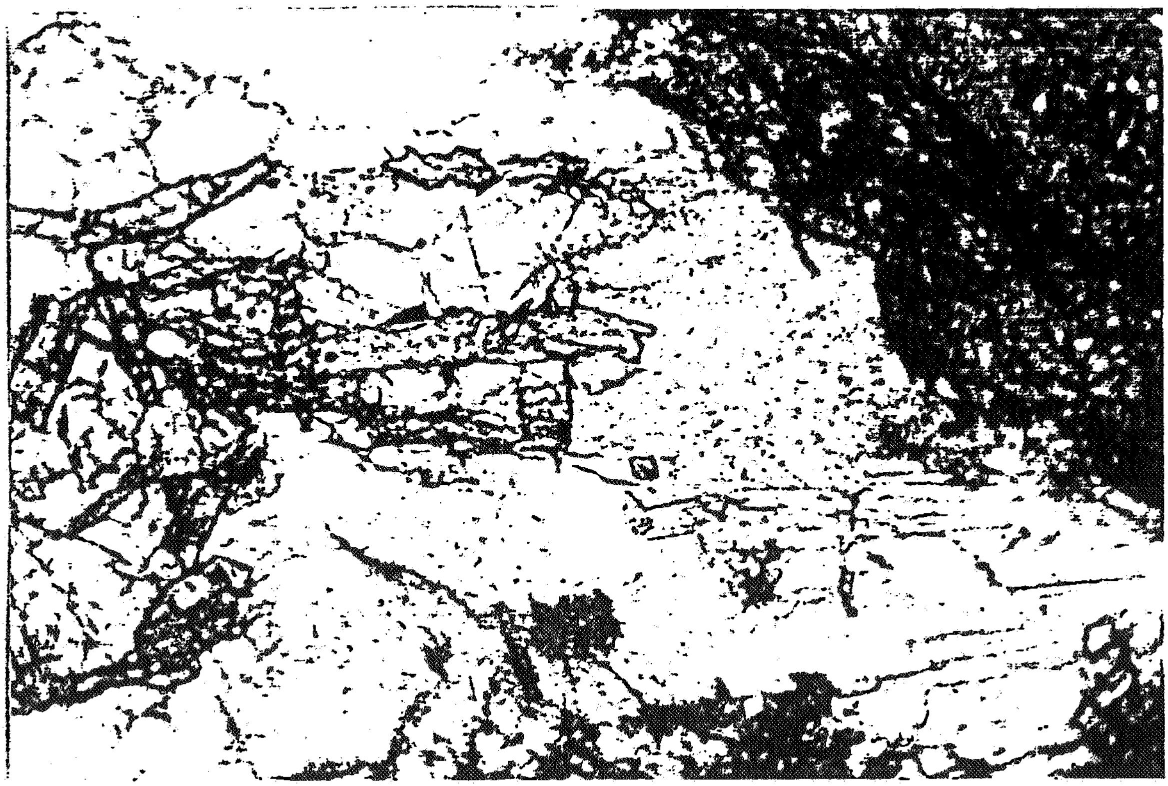
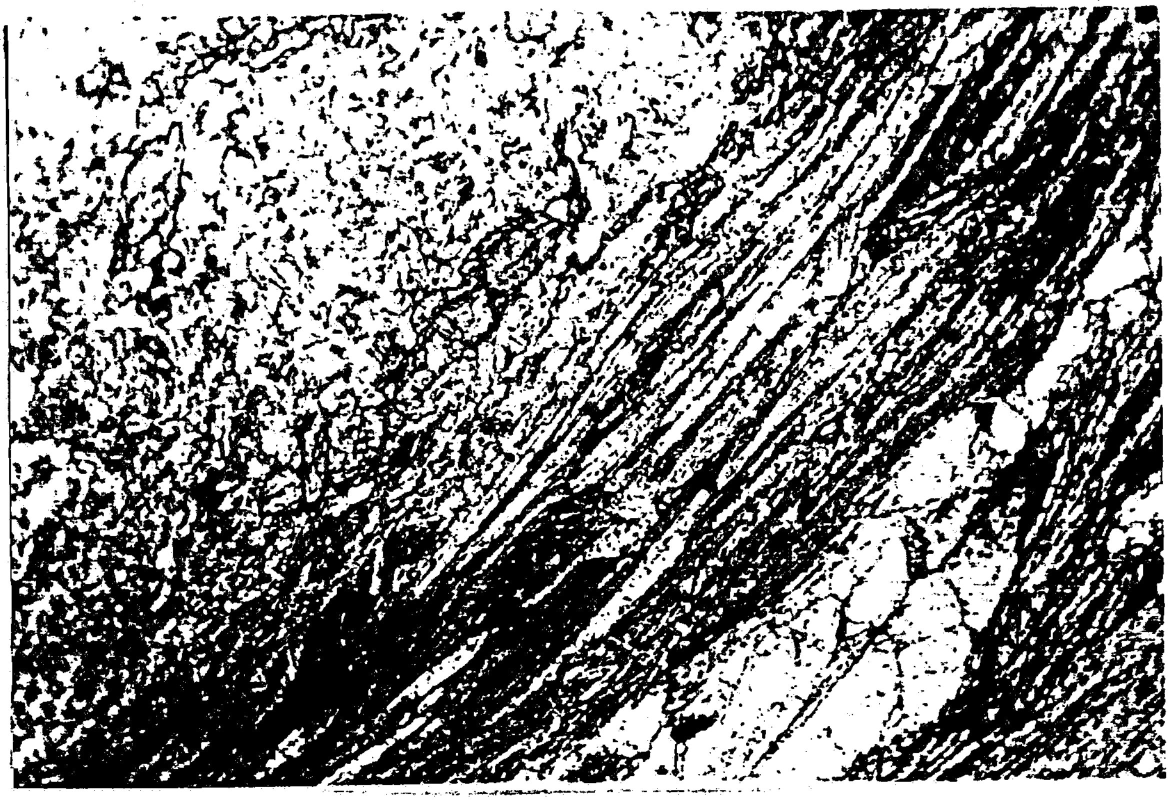


PHOTO 4 A8707 CHLORITOID IN SERICITE EX ANDALUSITE. NIC UNC.
FIELD WIDTH 1.8MM.

PHOTO 5 A8708 CHLORITOID IN SERICITE AFTER ANDALUSITE. CONTACT WITH QUARTZ BIOTITE FELDSPAR SCHIST. NIC CROS. FIELD WIDTH 1.8MM

PHOTO 6 A8712 SILLIMANITE BAND AT CONTACT OF ANDALUSITE CONTAINING STAUROLITES. NIC CROS. FIELD WIDTH 1.8MM

PHOTO 7 A8713 BIOTITE MUSCOVITE BAND CONTACT WITH SERICITIC ANDALUSITE CONTAINING STAUROLITE. NIC UNC. FIELD WIDTH 1.8MM



STATEMENT OF EXPENDITURE
E.L. 1388
OUTALPA HILL, SOUTH AUSTRALIA

1 April, 1987 to 30 June, 1987.

	COSTS	$
1.	Geological and Geophysical	462
2.	Drilling	-
3.	Logistics	3396
4.	Depreciation	10
5.	Administration	-
6.	Other	-
	Total	3868

D.S. ARCHER
Managing Director

Mico Australia Limited
Suite 1205, Level 12,
MLC Centre, Martin Place,
SYDNEY NSW 2000

Env. 5945

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EXPLORATION LICENCE NO.1388
OUTALPA HILL
SOUTH AUSTRALIA

QUARTERLY REPORT FOR THE PERIOD ENDING 1 SEPTEMBER 1987

Exploration activity during the quarter was confined to the dispatch of alluvial and hard rock samples of andalusite and sillimanite to the Company's consulting engineer for analysis.

Expenditure

Logistics	$ 275-00

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EXPLORATION LICENCE NO.1388
OUTALPA HILL
SOUTH AUSTRALIA

QUARTERLY REPORT FOR THE PERIOD ENDING 1 DECEMBER 1987

No Activity

Nil Expenditure.

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Incorporated in Tasmania

1 March 1988

The Director-General
Department of Mines and Energy,
South Australia,
FAX: 08 - 272 7597

Attention: Mr.R.K. Johns

Dear Sir

Exploration License No 1388 - REPT. p.e. 1 MARCH 1988

We understand that the above Licence expires today.

We wish to advise that we do not wish to renew the licence for a further term. We have formed this conclusion after a comprehensive geological assessment of the prospectivity of the area for andalusite and sillimanite minerals.

Our conclusions were that the two types of mineralisation present ie., hard rock and alluvial are likely to be uneconomic at any other than prospector scale of operation. It appears that the mineralisation in the hard rock has been removed by weathering and it would appear that the andalusite composition of the alluvial gravels is at such low concentrations that economic recovery is not possible. It is possible that boulders of andalusite and sillimanite are buried in the alluvium, however we do not know of any exploration technique that could outline them in advance. Disregarding the environmental impact of a gauging style of operation to locate such boulders, the speculative nature of such a search does not appear to us to be warranted.

We attach quarterly reports in respect of exploration on the licence for the periods ending 1st September and 1st December 1987.

Yours truly

D. S. ARCHER
Managing Director.