SOUTH AUSTRALIA

DEPARTMENT OF MINES AND ENERGY

OPEN FILE ENVELOPE NO. 8010

EL 1480, KALABITY
PROGRESS AND FINAL REPORTS FOR THE
PERIOD 8/4/88 TO 8/10/88

Submitted by

Clay & Ceramic Products Pty Ltd

1989

South Australian Department of Mines and Energy: 17/1/89

ENVELOPE 8010

TENEMENT: EL 1480, Kalabity

TENEMENT HOLDER: Clay & Ceramic Products Pty Ltd

CONTENTS

END OF CONTENTS

FIRST THREE MONTHLY REPORT ON E.L.1480, GRANTED BY THE SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

on 8/4/88 for SIX MONTHS.

Technical report and details of expenditure.

Report due: 8/7/88.

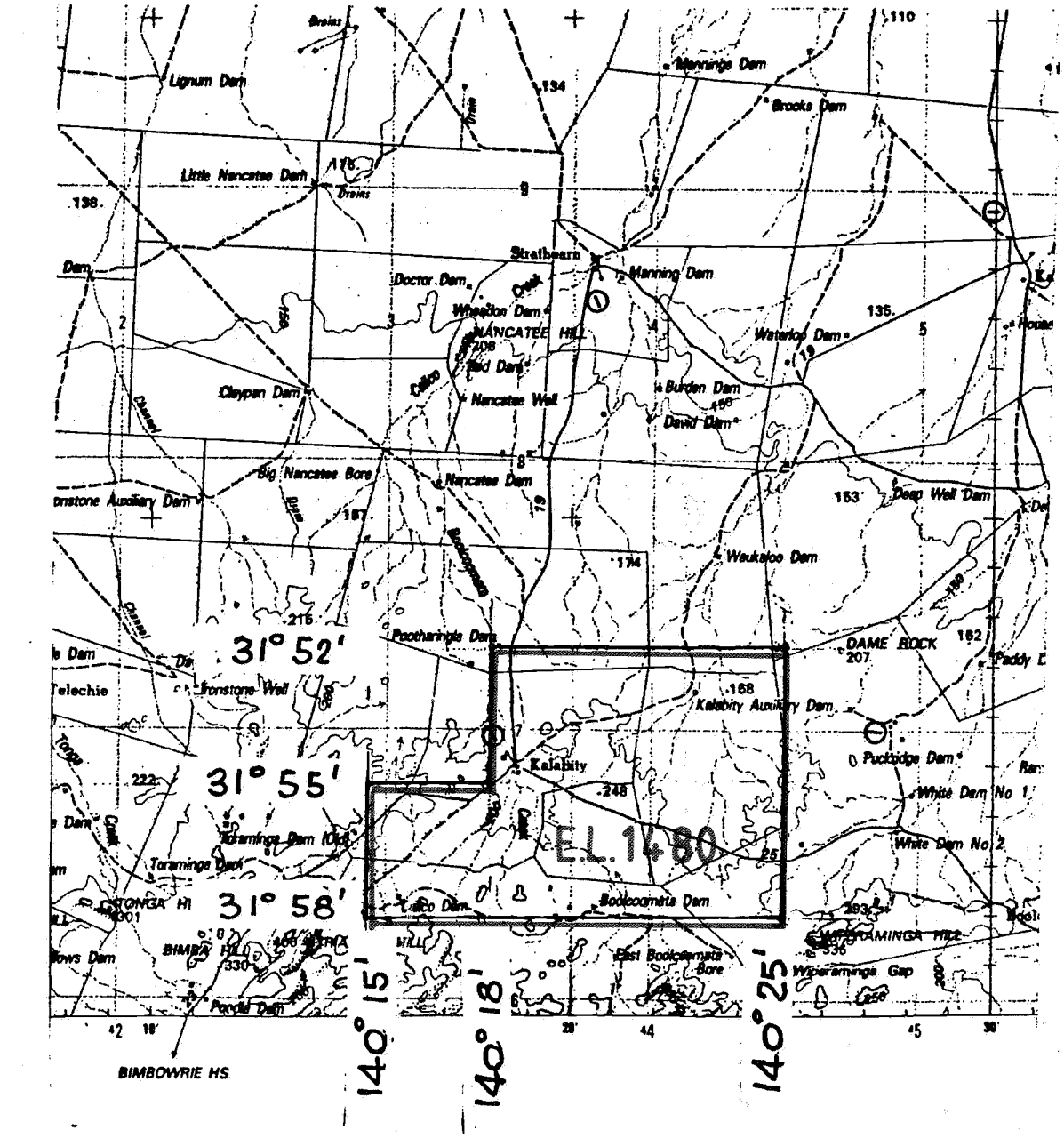
Keywords: andalusite, refractory , retrograde metamorphism

CONTENTS :

INTRODUCTION :

E.L.1480 was applied for on 11 Nov, 1987 and granted to Clay & Ceramic Products Pty. Ltd. on 8 April, 1988 for six months. The area of the title is approximately 132 km2 and covers much of the southern third of the pastoral lease "Kalabity" which is of 476 km^2. The location is indicated on the relevant part of the SH 54-14 1:250 000 sheet on the following page.

The primary purpose of the title is to locate and secure reserves of elevated alumina content mineral for use in high-performance industrial ceramics. Andalusite, in particular is sought because of its thermal properties, namely that it does not exhibit difficult volume changes during temperature elevation which characterise the other Al_2SiO_5 minerals.



SCALE 1:250 000

kilometres 0 5 10 15 20 25 30 35

HEIGHTS IN METRES. CONTOUR INTERVAL 50 METRES

SHEET SH 54-14
CURNAMONA
SOUTH AUSTRALIA
EDITION 1

APPLICANT : CLAY & CERAMIC PRODUCTS PTY. LTD.
DATE OF APPLICATION : 11 NOV 1987.
LOCALITY : APPROX. 45 km NORTH OF OLARY
AREA : 132 Sq. KILOMETERS APPROX.

GEOLOGICAL WORK CARRIED OUT ON THE E.L.:

Summary :

26/4/88 - 27/4/88.
Photocopying and reading relevant references (e.g. Campana & King, 1958, etc.) at the NSW Mineral Resources library and Macquarie University Library.

12/5/88 - 13/5/88.
Enquiries of appropriate officers of the Department of Mines and Energy at Parkside re andalusite, sillimanite, kyanite, felspar and beryl in the Olary region.

14/5/88 - 16/5/88.
At E.L.1480 at "Kalabity" pastoral lease.

18/5/88.
Vainly attempted to reach the known occurrences of kyanite at Radium Hill via "Cutana" and "Tepco". There are several locked gates, "keep out" signs, etc.

19/5/88 - 20/5/88.
At "Kalabity", prospecting accessible sites for andalusite.

26/5/88 - 27/5/88.
S.A.D.M.&E. - further enquiries re occurrence of suitable minerals and legal requirements for future title applications and requirements for future mining procedure.

28/5/88, 30/5/88, 31/5/88.
Travelling, procurement of vehicle, supplies, further prospecting and consideration of title applications, possible future mining and land rehabilitation considerations at "Kalabity".

1/6/88.
Interviewed officers of the S.A.D.M.& E. (geological and legal)

6/6/88, 7/6/88, 16/6/88, 17/6/88, 22/6/88, 23/6/88, 29/6/88, 30/6/88.
Laboratory work, as detailed on page 6.

GENERAL :

It was initially intended that the identification of published rock types be checked in the hope that this might lead to the discovery of previously unknown ocurrences of suitable mineralogy. During the week of the arrival of the writer, "Kalabity" received much of its expected annual rainfall, so only the region within walking distance of the homestead was examined in any detail. In fact, later field examination indicated that the area west of the "Kalabity" woolshed was highly prospective because the chiastolite present exhibited less retrogressive metamorphism than other occurrences. The retrogressive nature of the metamorphism exhibited in the pelitic schists in which the chiastolite occurs is shown by an abundance of margarite or "brittle mica". Margarite has similar density to andalusite, but is apparent as a micaceous coating on the most commonly occurring chiastolite cross material. The similarity in density is of importance in heavy liquid examination in that binocular microscope identification of sample following heavy medium separation is necessary.

SAMPLES :

Location No.1 :

Pieces of apparent chiastolite from northwest, southwest and west of "Kalabity" woolshed. Samples taken 14,15,16 May,1988. Chemical analysis, appendix.
Hand lens: faintly greasy lustre, similar to some (?aolian) quartz; orthogonal prism faces. Ubiquitous red-brown ironstaining is present as surface "dust". Very similar appearence to quartz except for the orthogonal cleavage fragments, colour, and obvious carbon crosses. One larger pale fragment has evidence of weathered out and extant tourmaline.The distinctive flesh-like colour of the andalusite gradually became apparent.

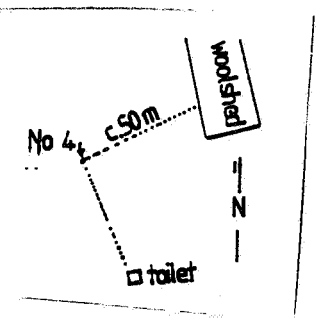
Location No.2 :

Sample from dry creek 100m east of the track about 150m from the shearers' quarters. Mostly 0.5 to 1.5mm sand. Minor 3cm fragments of black chiastolite-bearing pelitic schist. One 3cm piece of of translucent quartz was observed (from fracture pattern). The difference in hardness between chiastolite and quartz was not seen from any observation in this alluvium.

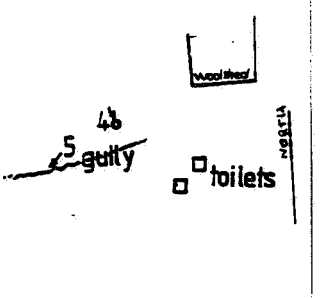
Location No.3 :

Sampled from the main track through the creek near the homestead. Sub-rounded ironstained translucent quartz sand.

Location No.4 : sketch.



Location No.5: sketch.



Sample taken from topsoil in which chiastolite occurs on the upper edge of the lip of the gully.

Location No.6 :

Sample taken from same spot in floor of gully. This is within the area described by the S.A.D.M&E. as "denuded by mineral collectors". As a check, the sand from the floor of the space between the shearers sleeping quarters was examined, and appears to be predominantly andalusite, as discerned by cleavage fragments.

Location No.7 :

Sampled from where the southernmost of the two tracks to the homestead crosses the creek. There appears to be chiastolite fragments in this.

Location No.8 :

Small sample taken for a hand lens check granitic rock beside the road just north of Olary.

Location No.9 : (samples numbered 9A &9B.)

K-felspar and beryl from the pegmatite 13.2.km south of shearers' quarters near Triangle Hill and the vermin proof fence (and the white concrete tank just west of the road.) A is the beryl and B the felspar. This prospect is 100m west of the road. Considerable quartz and mica, cut by a 50cm amphibolite band. The old excavation is about 2m deep x 30m x 10m.

Nos 10 to 20 : Numbers used for another project.

Location No.21 :

Samples of beryl and felspar from site 28 or 8 (in Olliver and Steveson, 1982.)

Location No.22 :

Felspar from same site.

Location No.23 :

Felspar from Boolcoomata. Discarded.

Location No.24 :

Felspar from pegmatite near shearers' quarters. (site 11, Olliver and Steveson,1982.

LABORATORY WORK.

In an attempt to gain some preliminary estimates of the potential commercial value of the "woolshed" sites, the small samples, expected to be representative of the andalusite concentrations at the outcrop and at various distances from *in situ* chiastolite and the graphitic schist containing it.
Several +20mm sized, 50 to 100g pieces of obvious chiastolite material from sample No.1. were sent to Fox Laboratories where chemical assay showed that these were in the vicinity of >55% alumina. At every stage of analysis with bromoform, an estimate of the andalusite was made using the binocular microscope and counting by whatever means seemed appropriate at the time.In practice, grains viewed under the 2.5 objective were pushed across a line ruled on the white stage and counted, according to the mineralogy. In this way percentages of the minerals thought to be present were quatified from estimates made. Some tentative budgets of production procedure were formulated using this crude data. Each of samples 2,3... were split to <50 g and put in bromoform, nominal density 2.85. "floats" and "sinks" were weighed. Any >20 mm material was crudely crushed. It is intended that sample nos 2,3,4,5,6,7 will be screened to examine the size distribution and that the relative andalusite contents will be estimated from binocular microscope examination.

Partly completed laboratory results:

Sample no.1 :

The sample was examined under low power (2.5x) of the binocular microscope. Part of the sample, of 10 to 50 mm chiastolite clasts, was hand crushed to -2.5 mm and quantitatively subjected to heavy liquid examination. Results are appended.

Sample no.3 :

as received mass	= 223.37 g
second quartering	= 15.55 g
floats	=15.01 g (96.52%)
sinks	=0.19g (1% of which about 10% is magnetite)

Sample no.4A :

first quartering	= 287.61 g

EXPENDITURE

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Field Geologist :

Accom.	$273.00
Consultancy	$2400.00
Tel.	$17.60
Fares	$366.05
Petrol	$124.42
Publications	$118.50
Other	$60.98
Food	$199.79
Car rental	$1,116.24
Subtotal:	$4,676.58

Heavy medium analyses per Ceramsearch Pty.Ltd.

Date	Time
6/6/88	4 hours
7/6/88	4 hours
16/6/88	6 hours
17/6/88	6 hours
22/6/88	8 hours
23/6/88	8 hours
24/6/88	8 hours
29/6/88	8 hours
30/6/88	8 hours
1/7/88	8 hours
2/7/88	3 hours
4/7/88	8 hours
Total	79 hours @ $75 = $5925.00

Fox Laboratories analysis invoice $82.50

TOTAL: $10,684.08

REFERENCES :

Campana, B. and King, D.,1958. Regional Geological and Mineral Resources of the Olary Province. *Bull. geol. Surv.S.Aust.*,34.

Olliver J.G. & Steveson,B.G. 1982. S.A. Department of Mines and Energy Report: Pegmatites in the Olary Region - Rept. Bk. 81/74.(unpublished)

Pitt,G.M. 1978. S.A. Department of Mines and Energy Report: Chiastolite in the Olary Province, South Australia.Rept. Bk.78/132. (unpublished)

APPENDIX:

1 :Chemical analysis of sample no.1.

Photocopy of Fox Laboratories report on following page.

2. Heavy liquid analysis of samples:

No 1.

Binocular microscope examination: 2.5x glassy, almost diaphanous, not at all micaceous. Rare orthogonal fracture faces observed.

In $CHBr_2$:
sample quartered until mass about 10g.
weight of sinks = 0.04 + 0.62 =0.66g
weight of floats = 4.68 + 7.93 + 8.17 = 20.78g
sinks/total = 0.66/ 21.44 = **3.1%**

No 2.

Grab sample.
mass = 13.39 g
total mass of sample remaining after heavy medium separation =13.27 g
sinks =0.62
sinks% =0.62/13.27 =**4.6%**

No 3.

Weight as received = 223.37g
second split, i.e. a 1/4 = 15.55g
dish = 48.27g
floats = 15.01g net
sinks = 0.19g net
experimental loss = 0.35g
sinks % = **1.25%**

FOX Laboratories
15 WHITING ST., ARTARMON, N.S.W., 2064
POSTAL ADDRESS: P.O. BOX 539, ARTARMON, 2064
Telephone: 439 6999 Fax: 02 439 5139

REPORT OF ANALYSIS

(ALL RESULTS IN PPM UNLESS OTHERWISE STATED)

CERAMSEARCH PTY LIMITED
20 HERBERT STREET
ARTARMON N.S.W 2064

JOB NO: 8806011
DATE REPORTED: 14/6/88.

SAMPLE NO:	%SiO2	%TiO2	%Al2O3	%Fe2O3	%MnO	%MgO	%CaO	%Na2O	%K2O	%P2O5
KC6-6	39.4	0.26	55.1	1.10	BLD	0.25	1.55	0.50	2.00	0.04
DETECTION LIMIT	0.1%	0.01%	0.1%		0.01%			0.1%		0.01
METHOD	ASA-1									

SIGNATORY..... Gwen Jarrell 8806011/1

016

Final Report on

E.L. 1480, granted by

THE SOUTH AUSTRALIAN

DEPARTMENT OF MINES AND ENERGY

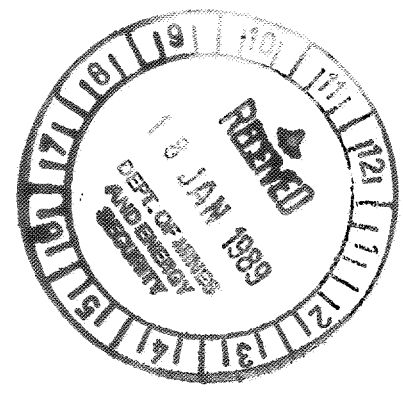
to
CLAY & CERAMIC PRODUCTS Pty Ltd.

on 8/4/88 for SIX MONTHS.

Technical Report and details of Expenditure.

E.L.Expiry date: 8/10/88.

Keywords: andalusite, refractory, retrograde metamorphism.



CONTENTS

Author: J.H.Callender, geological consultant.

INTRODUCTION:

E.L.1480 was applied for on 11 Nov, 1987 and granted on 8 April, 1988. The title covered approximately 132 km^2, largely contained within the pastoral lease, "Kalabity", owned by Millers Creek Pastoral Company Pty Ltd.

A summary of geological determinations made within the title area is outlined in the first three monthly report.

Copies of departmental title location maps are appended.

This region is known for occurrence of chiastolite, a variety of andalusite, Al_2SiO_5 which has been an important component of some refractory products for some years. Much of the andalusite originated in South Africa. This mineral is as refractory as sillimanite and kyanite but does not undergo as great a volume change on calcination. (At atmospheric pressures, andalusite is the stable phase at temperatures between 200°C and 800°C.)

LABORATORY STUDIES:

Samples obtained were studied by the Ceramsearch Pty Ltd laboratory with trial mixtures used in refractory products. Laboratory results from the trials of these products are recorded in the Ceramsearch Pty. Ltd. report which is attached (Lim, 1988).

GEOLOGICAL SUMMARY:

The greater part of the surface of the Exploration Licence is of Quaternary sediments, mostly psammitic quartz weathered from the early Proterozoic, metamorphosed rocks of the surficial parts of the Willyama inlier. These older metamorphics crop out on almost any elevated land. In general, the metamorphic rocks are coarser with less obvious pelitic bands here and there, and with less frequent, but more obvious pegmatites. The pelitic bands were easily seen as dark coloured zones across the graded roads after the unseasonal rain experienced in the area in 1988. The pegmatites are apparently commonly sites of mineralisation and commonly contain mine shaft remains, or at least small costeans. The pegmatites are rendered more prominent by white or pale mineral fragments scattered around the site as a result of trial shotfiring.

This is a known semi-precious gemstone area. It is sheep-grazing country but the station staff are aware of the occurrence of the crystallised chiastolite, known as "maltese crosses".

The andalusite exists within graphitic, pelitic schists. The andalusite is commonly affected by retrograde metamorphism in which the andalusite was transformed to a micaceous mineral, perhaps margarite or "brittle mica".(Hurlbut C.S. Jr.,1959) The more common rock types in the region are psammites, commonly quartzose and gneissic. The pelitic schist occurred within locality 15 (Olliver J.G. & Steveson B.G.1982) in bands up to two km wide. The country rock at felspar pegmatites at localities 15, 28, 30, and possibly 12 (13 km south of the woolshed) is a psammite.

Site 15 was examined and sampled. Samples of the soil with apparently eluvial chiastolite, creek fill (showing pieces of chiastolite) near the graphitic schist outcrop,and creek fill near "Kalabity" H.S. were selected to see what the yield of andalusite was at various distances from outcrop. At the time it was considered that the likelihood of >5% andalusite yield was low , and samples were examined to see if there was any indication that andalusite was present in greater than trace quantities.

The cleavage fragment shapes were considered to be a clue, although the hardness and lustre of andalusite is similar to that of quartz.
The colour of andalusite is a subtle but distinctive characterisic of which the writer became aware only after some time spent in examination.

The presence of beryl is not apparent at the four obvious pegmatites but beryl production is recorded at site 30, where not a trace was located. In fact the lack of outcrop of beryl is particularly noted in R/B 81/74 (Olliver J.G. & Steveson B.G.).

Although the field work coverage was not completed to the degree originally intended, it was considered that further time spent with this objective in view would not be as profitable as persevering with laboratory trials as described in the appended laboratory report.

MINING TITLE:

E.L.1480 expired on the 13th October ,1988, and a mineral claim applied for over the chiastolite bearing area near the "Kalabity" woolshed and adjoining the licence boundary.
Although the ceramic report is not encouraging, title was sought with the thought that perhaps some of the conclusions of the ceramic report may be successfully completed.

EXPENDITURE:

Geological consulting fees (paid to Callender and Forner)
(19/9/88) =$256.00
Fares and other field expenses paid:
=$235.50
Ceramsearch Laboratory: (ceramic work)

30/11/88	8 hours	
6/12/88	8 hours	
16/11/88	8 hours	
20/12/88	4 hours	
21/12/88	6 hours	
22/12/88	8 hours	
23/12/88	8 hours	
total	50 hours @	$75.00

=$3750.00

Ceramsearch Laboratory: (1480 samples)

14/7/88	1 hour	
5/9/88	4 hours	
18/10/88	8 hours	
19/11/88	8 hours	
23/11/88	4 hours	
24/11/88	2 hours	
	22 hours @	$75.00

= $1 650.00

subtotal:
= $5 891.50

Office services and supplies $843.00

Total = $6 734.50

Previously noted in First report : (8/7/88)
= $10 684.08

total = ~~$16 870.16~~
$17 418.58

RECOMMENDATIONS:

Lim (1988) recommended that

(a) An examination of this andalusite is made by comparing refractory performance at different temperatures; and further that its performance as mullite porcelain be examined.

(b) Pre - calcination of the material is considered.

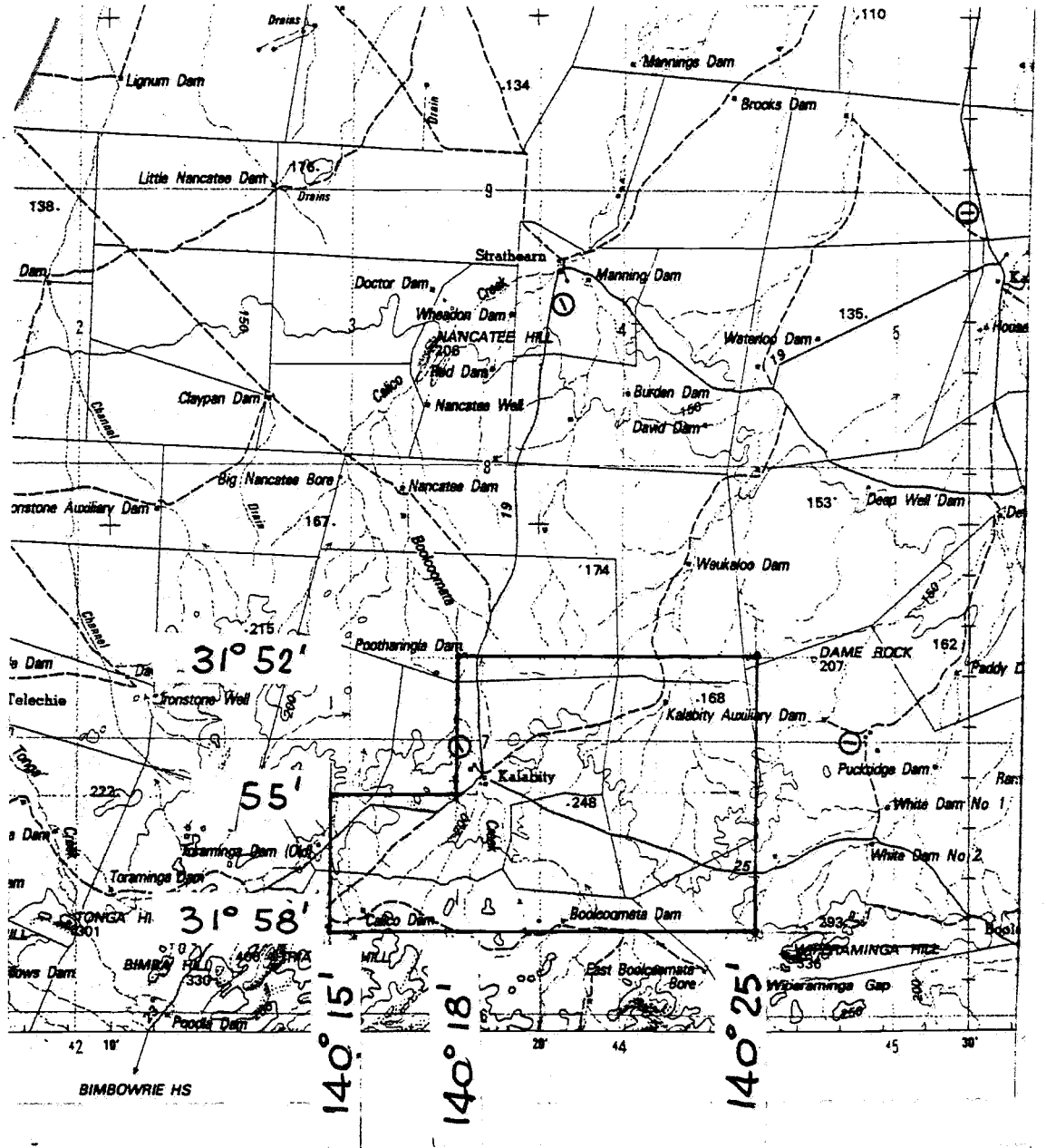
(c) Pre - washing with hydrochloric acid is considered.

Each of these suggestions sounds expensive; a cost-benefit study is initially recommended.

REFERENCES:

Callender J.H. 1988. First Three Monthly Report on E.L.1480, granted by the South Australian Department of Mines and Energy. (unpublished)
Hurlbut C.S. Jr. 1959, "Dana's Manual of Mineralogy", John Wiley, New York. 609 pp.
Lim N.W.1988. Andalusite Samples - Evaluation as a Refractory material. Ceramsearch Pty Ltd Report for Clay and Ceramic Products Pty Ltd. (unpublished).
Olliver J.G.& Steveson B.G. 1982. S.A.Department of Mines and Energy Report: Pegmatites in the Olary Region - Rept. Bk. 81/74. (unpublished).

13/1/89



SCALE 1:250 000

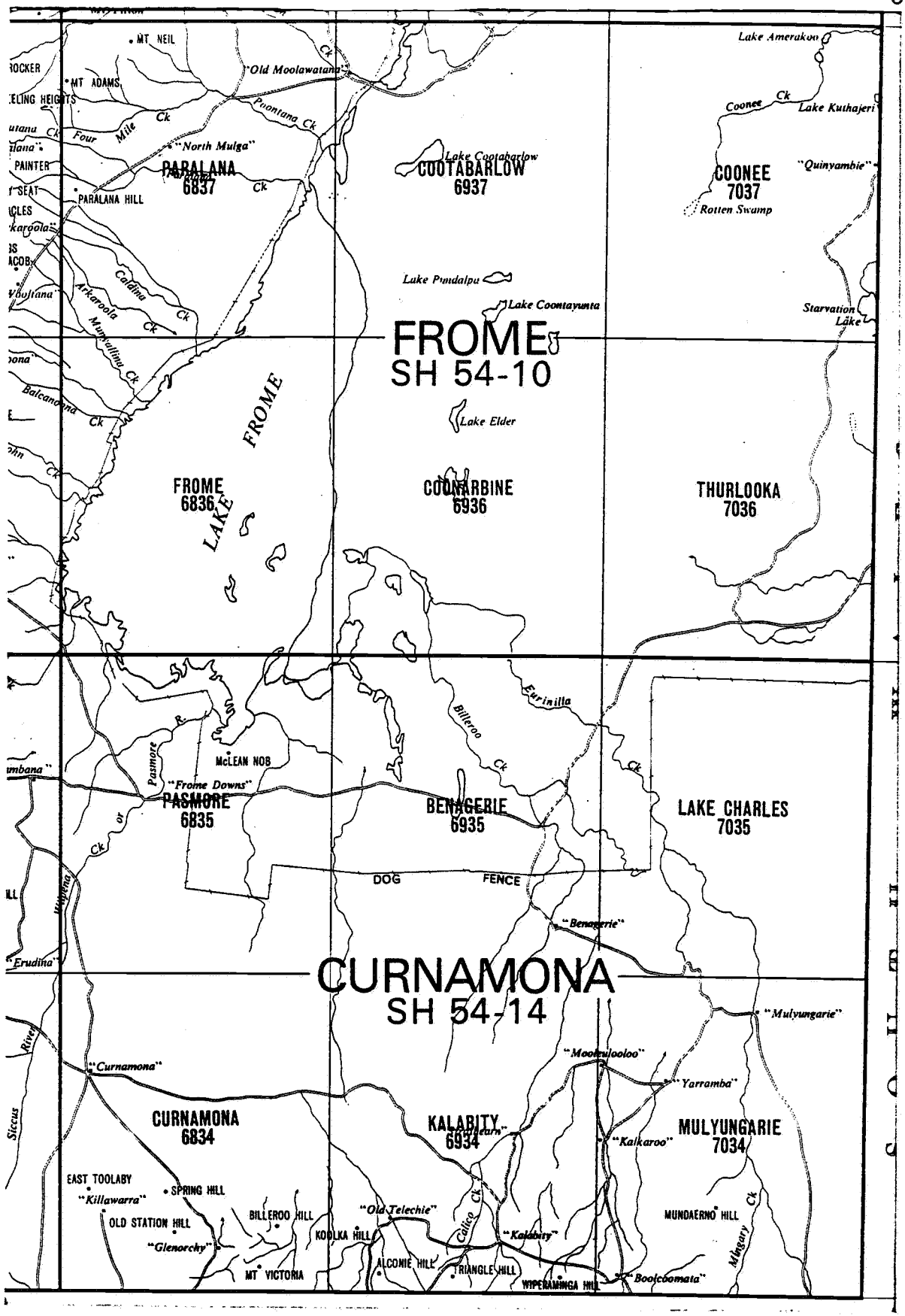
kilometres 0 5 10 15 20 25 30 35

HEIGHTS IN METRES. CONTOUR INTERVAL 50 METRES

SHEET SH 54-14
CURNAMONA
SOUTH AUSTRALIA
EDITION 1

APPLICANT : CLAY & CERAMIC PRODUCTS PTY. LTD.
DATE OF APPLICATION : 11 NOV 1987.
LOCALITY : APPROX. 45 km NORTH OF OLARY
AREA : 132 Sq. KILOMETERS APPROX.

MAP IDENTIFICATION PLAN



1:50 000 MAP REFERENCE

IV	I
WILMINGTON 6532	
III	II

SCALE 1:1,000,000

10 0 10 20 30 40 50 60 70 80 90 100

KILOMETRES

REPORT

CERAMSEARCH PTY LTD

A Ceramic Materials Research Laboratory

20 Herbert Street, ARTARMON NSW 2064

Telephone: 439 7355
Fax: 430 7497

REPORT TITLE:

Andalusite Samples - Evaluation as a Refractory Material.

Date 20-12-88

No of Pages 8

CLIENT:

Clay and Ceramic Products Pty. Limited

Client Reference

E.L. 1480

SUMMARY:

1. A sample of andalusite from South Australia is evaluated as a refractory raw material.

2. The physical properties, in particular the heavy sintering behaviour, indicate that the material may not be suitable for refractories.

3. In view of the sintering behaviour, this material may be suitable for the manufacture of high tension electrical insulators.

Contract Number

Project Superviser

Dr. N. W. Lim

ANDALUSITE SAMPLES- EVALUATION AS A REFRACTORY RAW MATERIAL

1. INTRODUCTION

A set of samples of andalusite (an aluminium silicate, Al_2SiO_5), from Kalabity, north of Olary, S.A. were submitted for evaluation by Clay and Ceramic Products Pty Ltd.

The samples are from an area of metamorphosed, (pelitic) rocks which had previously yielded a high alumina (Al_2O_3) value, indicating that the material could be a suitable replacement for imported andalusite for refractory use. This laboratory work is to evaluate the material for that purpose.

2. EXPERIMENTAL PROCEDURE

Mixtures were prepared according to the following formulations:

	1480/1	1480/2
Andalusite	45%	55%
BBR clay	10%	10%
Crestaplas	45%	35%
	100%	100%
Water	7%	7%

(a) The mixtures were hand blended and passed through a 1.40 mm screen after milling with a mortar and pestle. The resulting blend was used to fill a cylindrical (nominally 12mm diameter) cavity in the laboratory press. Cylinders for firing were pressed according to the following:

Sample	Forming pressure (kN)	Diameter (mm)	Length (mm)
1480/1	25.9	12.16	9.5
1480/1	23.6	12.15	29.51
1480/1	21.7	12.10	26.04
1480/2	19.5	12.11	13.22
1480/2	21.2	12.10	33.12
1480/2	18.3	12.12	31.24

(b) The samples were fully dried at 105°C and then fired at 1400°C with a three hour soak in the laboratory kiln.

(c) From the above six, the following fired samples were chosen for determination of cold-crushing strengths, porosity, bulk density and water absorption. The results are noted below.

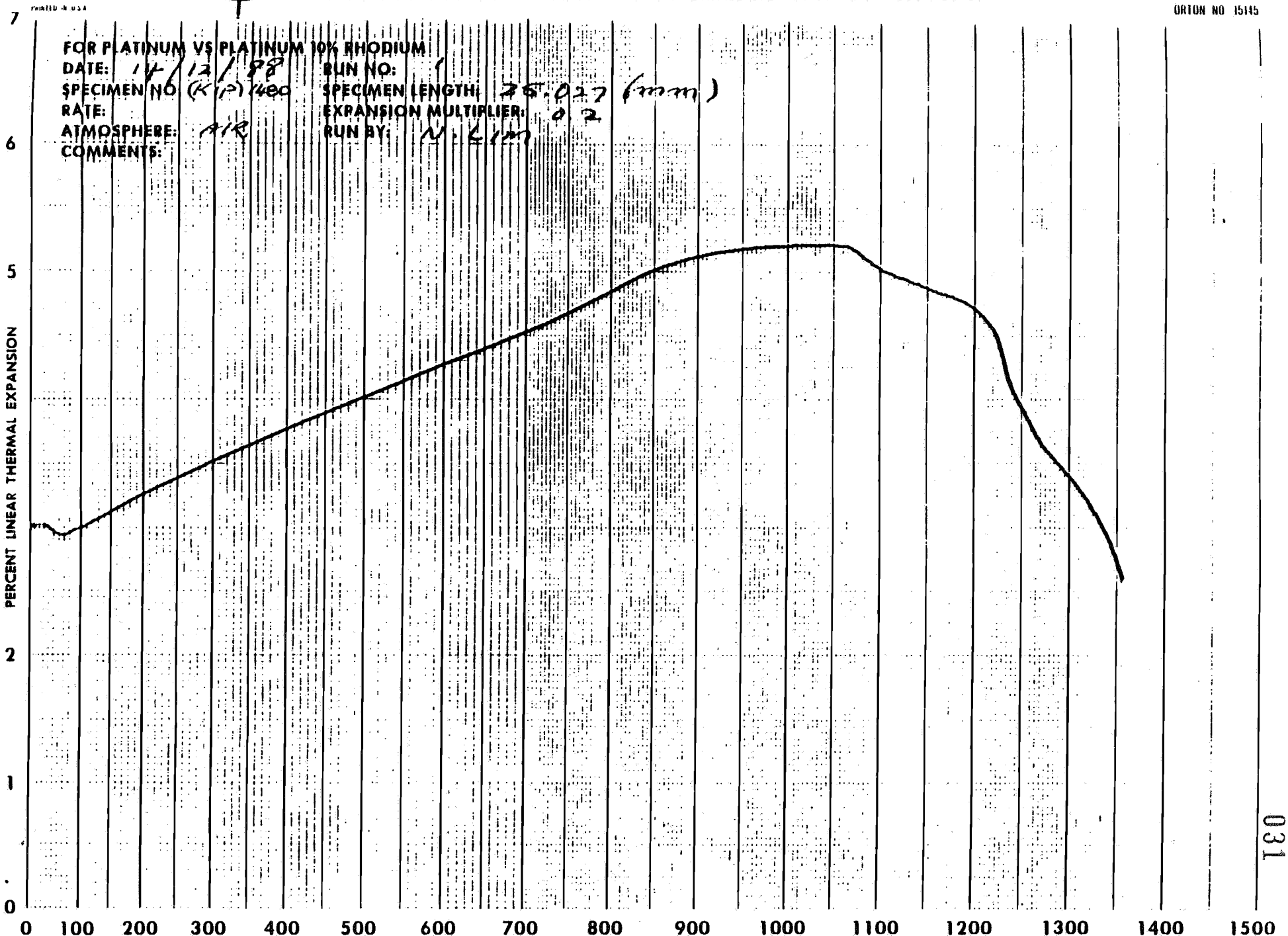
(d) One of the samples was tested for expansion by the dilatometer. The dilatometer curve, showing percent linear expansion versus temperature is reproduced in figure 1.

To prepare a dilatometer specimen, one of the sample pieces was ground until it was 25.39 mm in length. The piece was placed in the dilatometer and heated in air. The rate of heating was 0.5°C/minute to 1350°C and then at 0.5°C/minute back to room temperature.

(e) Three trial briquettes were pressed on a laboratory press. These briquettes have been kept as examples for macroscopic examination and no destructive tests were performed. One of the three briquettes (all are similar) is to be forwarded to the Department of Mines and Energy. The green measurements taken are reported in the following section.

Held by Mineral Resources Section. 20/1/89.

ORTON AUTOMATIC RECORDING DILATOMETER



CERAMSEARCH PTY LTD

FIGURE 1

031

3. RESULTS

The following physical properties are those obtained from current laboratory work:

TABLE 1

	andalusite refractory	38%alumina refractory	kiln furniture refractory
water absorption(%)	3.96	-	-
porosity(%)	9.17	28.41	28.89
cold crushing strength(mPa)	42.45	16.4	12 to 20
bulk density(g/cc)	2.33	1.81	1.58
thermal expansion(%)	0.44 @ 1080°C	~0.47 @ 1300°C	0.36 @ 1320°C
Al_2O_3	45.5%	38%	40%
Physical appearance	White/buff colour with obvious iron spotting on the surface. The surface is rough, presumably due to the presence of glassy phases which erupted at the surface; it is thought that this is due to the high lime content.		

These figures are the arithmetic mean of laboratory results.

Sample numbers 1480/1, 1480/1, 1480/1, 1480/2, 1480/2, 1480/2, were fired, re-numbered, re-measured and cold-crushing strengths determined as follows:

TABLE 2

Number	Diam. (mm)	Force (kN)	Calculated stress (MPa)
1480/1	12.00	4.4	38.4
1480/2	12.55	4.1	32.7
1480/3	11.35	3.5	34.16
1480/4	11.85	7.2	64.5

TABLE 3

Green measurements of briquettes pressed on a WALLBANK 353A 35ton production press (28/11/88).

Sample no.	x,mm	y,mm	z,mm	mass,g
1480/1	78.20	12.61	37.9	63.78
1480/1	78.30	20.02	38.65	115.06
1480/2	78.24	24.50	38.02	138.36

4. COMMENTS

(a) The physical appearance, especially the iron discoloration and the presence of the glassy phases, would present difficulties in selecting an appropriate refractory application for this raw material. A high lime content may be the source of these problems; therefore the refractoriness should be the subject of P.C.E. testing.

(b) Although the thermal expansion is reasonably low compared with a 38% alumina product, the fact that this only applies up to 1080°C poses a problem for refractory applications.(see Figure 1).

(c) The bulk density is unusually high compared to a 38% alumina product because the body was well sintered at 1400°C. This contention is supported by the experimental results which show a high cold-crushing strength, low porosity,low water absorption, each of which suggest a high alkali (in particular CaO) content.

(d) It is observed that the high sintering behaviour could be of value in electrical insulators. At 1200 - 1300°C, insulators require low porosity, low water absorption, high strength, and lower thermal expansion. The results obtained suggest that this andalusite could be of value in the manufacture of high tension ceramic insulators.

(e) The high alumina (Al_2O_3) content of this material is thought to indicate its potential usefulness in the manufacture of hard porcelain such as mullite porcelain.

(f) As shown in the above "Green measurements" (pressing data results), the mixtures prepared seem to be suitable for pressing.

5. RECOMMENDATIONS

(a) The andalusite material should be further examined under the context of a refractory mixture versus temperature and again further examination in the application of mullite porcelain.

(b) Calcination of this material should be considered as a means of removing unwanted alkali and rendering the iron content less deleterious to the refractoriness, not to say appearance.

(c) Consideration could be given to removal of lime and ferrous iron by washing with HCl.