DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

ENVIRONMENT AND RESOURCES DIVISION

TARCOOLA-ALICE SPRINGS STANDARD GAUGE RAILWAY BALLAST SUPPLIES

UTAH BORE DOLERITE DEPOSIT

SUPPLEMENTARY DRILLING OF QUARRY SITE

Client: Commonwealth Railways

by

DOUGLAS NICHOL
GEOLOGIST
NON-METALLICS SECTION

20th August, 1973

Rept.Bk.No. 73/192
G.S. No. 5197
D.M. No. 561/73

MICROFILMED

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ABSTRACT

A Precambrian dolerite dyke near Utah Bore has been selected as a source of railway ballast and was previously mapped and tested by deep diamond drilling.

Supplementary diamond drilling of the surface zone of the dyke and petrographic examination of drill core samples has shown that near surface dolerite is unweathered and overburden, although thin, may range up to 1.5 metres in depth. Alteration products are present in the finer grained dolerite of the contact zone casting doubt on the suitability of this portion of the dyke for ballast.

At least 150 000 cubic metres of rock suitable for ballast are available from the central portion of the dyke to a depth of approximately 17 metres within a defined quarry area.

Further large quantities of similar material are available in depth and lateral extension.

INTRODUCTION

The narrow gauge Central Australia Railway is to be replaced by a standard gauge track between Tarcoola and Alice Springs (see locality plan No. 72-705).

The Commonwealth Railways requested the Department of Mines to locate sources of railway ballast along the South Australian section of the route.

Nichol (1972) appraised a dolerite deposit near Utah Bore by mapping and diamond drilling and recommended further shallow drilling to investigate surface weathering. The deposit is located only 800 metres east of the proposed railway route.

Three diamond drill holes were pegged by the writer on 10th May, 1973 and this report describes the results of the drilling programme.

Petrographic examinations of diamond drill core samples were made by the Australian Mineral Development Laboratories. The results are referred to in the text of this report and the full petrographic descriptions comprise Appendix B.

GEOLOGICAL SETTING

The Utah Bore area lies 22 kilometres south-east of De Rose Hill H.S. on an extensive plain about 400 metres above sea level. The surface, which is covered by sand dunes and sand spread, is channelled by the Alberga drainage system.

The area is underlain by Precambrian crystalline basement of the eastern Musgrave Block. The rocks which crop out are predominantly granitic gneisses which display well developed foliation striking northerly and dipping at moderate to steep angles. The gneisses are cut by shear zones, pegmatite veins and dolerite dykes. Detailed descriptions of these rock types are given by Sprigg *et al.* (1959) and Coats (1963).

UTAH BORE DOLERITE DEPOSIT

Previous Investigation

Mapping, diamond drilling and laboratory testing of core samples indicated that the dolerite deposit contained at least 300 000 cubic metres of rock suitable for railway ballast, in two potential sites 300 metres apart (Nichol, 1972).

The deposit comprises a dolerite dyke cutting granitic gneiss country rock (see plan No. 72-634). The dolerite is grey in colour and consists of dark pyroxene and pale laths of plagioclase in subophitic texture with minor amphibole, mica, apatite and opaques and traces of alteration products. The dyke has an apparent surface width of 60 to 80 metres, a true thickness of 37 metres and a traceable length of almost 2 kilometres. Dip varies between 35° and 75° northwards.

Two inclined diamond drill holes (DU1 and DU2 on plan No. 72-634) determined the subsurface attitude of the dolerite body for reserve calculations and provided material for laboratory testing.

Los Angeles Abrasion and Sodium Sulphate Soundness losses on representative dolerite samples are 17 per cent and 0.3 per cent respectively.

Petrographic examination of drill core samples showed the bulk of the dyke to be suitable for ballast. However alteration products are present in the finer grained dolerite of the contact zone in sufficient quantity to cast doubt on the suitability of this portion of the dyke.

Further diamond drilling was recommended to investigate the untested surface zone of the deposit once the quarry site had been selected from the two alternatives.

Drilling

Following consultation with D. Smith, Trans Australia Railway Maintenance Engineer, Commonwealth Railways, area 2 shown on plan No. 72-634 was chosen for the quarry site.

Supplementary diamond drilling was undertaken to check thicknesses of overburden, to provide samples from the proposed quarry area for qualitative inspection and from the upper zone for petrographic examination to investigate weathering effects.

The following three diamond core drill holes were completed in a programme totalling 54.60 metres.

Hole No.	Inclination	Depth
DU 3	vertical	16.31 metres
DU 4	vertical	18.69 metres
DU 5	70°	19.60 metres

Hole locations are shown on plan No. 73-567 . Geological logs showing all sample locations are included in Appendix A.

The dolerite intersected is similar to that in DU 1 and DU 2 confirming that high quality ballast is available in the proposed quarry area.

High core loss of about 90 per cent in the top 1.5 metres of each hole precludes a description of the material in this zone. Core loss may be due either to grinding of hard rock core prior to installation of casing or to the material being relatively weak. Although overburden is believed to be thin it may in fact reach 1.5 metres in thickness.

Testing and Reserves

Petrographic examination of selected diamond drill cores (see Appendix B) showed that dolerite at 1.3 metres depth in DU 4 is unweathered confirming that the medium-coarse grained dolerite which comprises the bulk of the dyke contains no deleterious minerals. However the dolerite is altered in minor shear zones particularly in the fine grained marginal portion of the dyke.

Quarry outlines are shown on the accompanying plans (73-567, 73-568). With the rejection of contact zone and zones of possible alteration associated with transverse faulting, (less than 10% of the dyke) quarrying to a depth of about 17 metres will provide the required in situ volume of 150 000 cubic metres.

SUMMARY AND CONCLUSIONS

A dolerite dyke intruding Precambrian crystalline basement in the vicinity of Utah Bore will provide a source of high quality ballast adjacent to the proposed Tarcoola-Alice Springs standard gauge railway route.

Earlier appraisal showed that sufficient quantity of material was present under an untested surface zone.

Supplementary diamond drilling of the surface zone has confirmed that the bulk of the dyke is suitable for railway ballast. The nature of the overburden has not been determined due to poor core recovery but its thickness is no greater than 1.5 metres.

Petrographic investigation of drill cores showed that the near surface dolerite is unweathered. The fine grained marginal zones

of the dyke which contain alteration products may be unsuitable.

An in situ volume of 150 000 cubic metres can be obtained within 17 metres of the surface and has been outlined on the accompanying plans (73-567, 73-568).

Additional large quantities of similar material exist at depth or in the adjacent site to the west.

Douglas Nichol

20th August, 1973
DN:IA

DOUGLAS NICHOL
GEOLOGIST
NON-METALLICS SECTION

REFERENCES

Coats, R.P., 1963. The Geology of the Alberga 4 mile Military Sheet. *Rept. Invest. geol. Surv. S. Aust.*, 22: 22 pp.

Nichol, D., 1972. Tarcoola-Alice Springs Standard Gauge Railway. Ballast Supplies. Utah Bore Dolerite Deposit. Dept. Mines unpublished report RB.72/184.

Sprigg, R.C., Wilson, B., and Coats, R.P., 1959. ALBERGA 4 miles to 1 inch geological map, *geol. Surv. S. Aust.*

A P P E N D I X A

EXPLANATORY NOTES AND LOGS OF DIAMOND DRILL HOLES

APPENDIX A

EXPLANATORY NOTES AND LOGS OF DIAMOND DRILL HOLES

EXPLANATORY NOTES ON DRILLING PROCEDURES

Equipment

A Mindrill type F.20 diamond drilling machine was used.

All core was drilled size NMLC, nominal diameter two inches. "N" type stationary inner tube core barrels were used, fitted with bottom discharge bits and split inner tubes.

Storing and marking of core

Cores were stored in wooden trays, each compartment of which has been designed to contain one metre of core. The boxes were marked with consecutive compartment numbers at one end and the drilled depths from the surface in metres at the other.

The core was boxed in this manner at the drill site, being placed in its appropriate place in the box as soon as it was extracted from the core barrel. Aluminium depth markers were placed at the end of each run. The measured depth of the hole in metres from the surface was painted on the side of the core box and on the core. Timber blocks of appropriate length indicate core not recovered (red blocks) and core removed for testing (yellow blocks).

The core has been stored at the Department of Mines, Drilling and Mechanical Branch, Dalgleish Street, Thebarton, South Australia, and is available for inspection.

NOTES ON DIAMOND DRILL LOG SHEETS

The logs have been plotted on a vertical scale of one centimetre = two metres (1:200).

The description given on the log sheet refers only to materials recovered as core. Core may be lost by being ground away during the drilling process; it may usually be inferred that such material was relatively weak but this cannot be assumed necessarily to be the case since even solid rock can be ground away and lost under some conditions.

To the left of the graphic log is a geological description of the materials sampled. This includes:-

Geological age)
) Printed vertically
Rock Unit name)

Nature and type of material

Classification of the rock substance in terms of its porosity, its condition and its hardness has been shown graphically, in the appropriate columns. Such classification has been based on a qualitative estimate only.

P-sample numbers (e.g. P295/78) shown in the column headed "Structures" on the logs refer to petrographic descriptions presented in Appendix B.

DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. DU3

SERIAL No. 654/73

PROJECT: TARCOOLA – ALICE SPRINGS RAILWAY BALLAST SUPPLIES

FEATURE: UTAH BORE DOLERITE DEPOSIT

LOCATION: UTAH BORE-DE ROSEHILL H.S

PLAN REFERENCE: 73-567, 73-568

COORDINATES: —

ANGLE FROM HORIZ.: 90° DIRECTION: →

DESCRIPTION OF CORE	LOG	DEPTH (m.)	POROSITY AND CONDITION (HP P MP SP NP / Fresh, Decomposed, Weathered, Altered, Not applicable)	HARDNESS (VS S MH H VH)	STRUCTURES	CORE LOSS	CASING	DEPTH (FT.)
PRECAMBRIAN CRYSTALLINE BASEMENT								
NO CORE RECOVERED								
MEDIUM GRAINED DOLERITE					P294/73			
MEDIUM GRAINED DOLERITE		2			strongly jointed			
MEDIUM GRAINED DOLERITE		4			moderately jointed			
					P296/73			
MEDIUM GRAINED DOLERITE		6			strongly jointed			20
		8						
MEDIUM GRAINED DOLERITE		10			Poorly jointed			
		12						40
		14						
		16						
END OF HOLE 16.31m.								60

POROSITY TERM

HP Highly Porous
P Porous
MP Moderately Porous
SP Slightly Porous
NP Non Porous

CONDITION TERM

Fresh
Decomposed
Weathered
Altered
Not applicable

HARDNESS TERM

VS Very soft
S Soft
MH Moderately Hard
H Hard
VH Very Hard

MINERAL RESOURCES DIVISION

DRILL No. DD 24 — LOGGED D. NICHOL
TYPE MINDRILL E20 — DATE 28 MAY '73
DRILLER D. WHITE — TRACED G.M.
START 11 MAY '73 — CHECKED A.E.
FINISH 13 MAY '73

SHEET 1 OF 1 — DRG No. S/0337 Aa

P.F. No. S9411 MB

DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE Nº DU4
SERIAL Nº 655/73

PROJECT TARCOOLA - ALICE SPRINGS RAILWAY BALLAST SUPPLIES
FEATURE
LOCATION UTAH BORE · DE ROSE HILL H·S
PLAN REFERENCE 73-567, 73-568
COORDINATES —
ANGLE FROM HORIZ. 90° DIRECTION

DESCRIPTION OF CORE	LOG	DEPTH (m.)	POROSITY AND CONDITION	HARDNESS	STRUCTURES	CORE LOSS	CASING	DEPTH (FT.)
PRECAMBRIAN CRYSTALLINE BASEMENT			HP P MP SP NP	VS S MH H VH				
NO CORE RECOVERED								
DOLERITE FRAGMENTS					S-655/73			
NO CORE RECOVERED		2						
DOLERITE FRAGMENTS								
NO CORE RECOVERED								
DOLERITE FRAGMENTS								
		4						
		6						20
		8						
		10						
Coarse-medium grained dolerite		12			Moderately jointed			40
		14						
		16			poorly jointed			
		18						60
END OF HOLE 18·69 m.		20						
								80

POROSITY TERM	CONDITION TERM	HARDNESS TERM
HP Highly Porous	Fresh	VS Very soft
P Porous	Decomposed	S Soft
MP Moderately Porous	Weathered	MH Moderately Hard
SP Slightly Porous	Altered	H Hard
NP Non Porous	Not applicable	VH Very Hard

MINERAL RESOURCES DIVISION

DRILL Nº DD 24	LOGGED D. NICHOL
TYPE MINDRILL F20	DATE 28 MAY 1973
DRILLER D. WHITE	TRACED G.M.
START 14 MAY 1973	CHECKED A.E.
FINISH 16 MAY 1973	
SHEET 1 OF 1	DRG Nº S/0338 Ba

P.F. Nº S9411 MB

DEPARTMENT OF MINES · SOUTH AUSTRALIA

HOLE Nº DU 5
SERIAL Nº 656/73

LOG OF DIAMOND DRILL HOLE

PROJECT TARCOOLA – ALICE SPRINGS RAILWAY BALLAST SUPPLIES
FEATURE UTAH BORE DOLERITE DEPOSIT
LOCATION UTAH BORE : DE ROSE HILL
PLAN REFERENCE 73-567 73-568
COORDINATES —
ANGLE FROM HORIZ. 20° DIRECTION 213° (TRUE)

DESCRIPTION OF CORE	LOG	DEPTH (m.)	POROSITY AND CONDITION	HARDNESS	STRUCTURES	CORE LOSS	CASING	DEPTH (FT.)
PRECAMBRIAN CRYSTALLINE BASEMENT								
NO CORE RECOVERED								
DOLERITE FRAGMENTS		2			← P297/73			
NO CORE RECOVERED								
DOLERITE FRAGMENTS					← P298/73			
NO CORE RECOVERED								
DOLERITE FRAGMENTS								
NO CORE RECOVERED		4						
MEDIUM GRAINED DOLERITE					strongly jointed			
		6						20
		8			← P301/73			
MEDIUM GRAINED DOLERITE		10						
		12			poorly jointed			40
		14						
		16						
FINE GRAINED DOLERITE		18			moderately jointed ← P299/73			60
GRANITE GNEISS					← P300/73			
		20						
END OF HOLE 19·60 m								80

POROSITY TERM		CONDITION TERM		HARDNESS TERM	
HP	Highly Porous		Fresh	VS	Very soft
P	Porous		Decomposed	S	Soft
MP	Moderately Porous		Weathered	MH	Moderately Hard
SP	Slightly Porous		Altered	H	Hard
NP	Non Porous		Not applicable	VH	Very Hard

MINERAL RESOURCES DIVISION

DRILL Nº DD 24
TYPE MINDRILL F30
DRILLER D. WHITE
START 11 MAY '73
FINISH 12 MAY '73
LOGGED D. NICHOL
DATE 28 MAY '73
TRACED G.M.
CHECKED A.F.

SHEET 1 OF 1
DRG Nº S/0339 Ra

PF Nº 59411 MB

A P P E N D I X B

PETROGRAPHIC DESCRIPTION OF SAMPLES

The Australian Mineral Development Laboratories,

Adelaide, South Australia

Report MP 4958/73 and 5001/73, June 1973

Petrology by R.S. Cooper

EXAMINATION OF FURTHER DOLERITE AND GNEISSIC SAMPLES AND DISCUSSION OF THEIR SUITABILITY FOR RAILWAY BALLAST

1. INTRODUCTION AND SUMMARY

Eight samples were submitted by Mr. Douglas Nichol of the Mines Department for petrographic description and discussion of their suitability for railway ballast. The samples, seven of dolerite and the other of a gneiss-like rock, had come from drill-holes 3, 4 and 5 in the Utah Bore Dolerite Deposit. This is in the Alberga 4-mile sheet area and the railway for which this deposit is potential ballast is the new Commonwealth Tarcoola-Alice Springs line.

Earlier reports on samples from this deposit (MP5750/72 and MP6051/72) had mentioned the presence of montmorillonite as an alteration product in the dolerite. Five of the samples in this suite (P294/73 to P298/73) appear to be reasonably fresh and if they contain montmorillonite it is in trace amounts (less than 1%).

Sample P301/73 is from a depth of about 7 metres and it is less satisfactory being sheared and more heavily altered than the near surface samples. Sample P299/73 is from close to the contact of the dolerite with the underlying gneiss and it is finer-grained, markedly sheared, and more altered than any of the other dolerite samples. The alteration of the dolerite close to the gneiss has been mentioned in earlier reports and is apparently a persistent feature in this dolerite deposit. Sample P300/73 is of the underlying gneissic rock. In this rock there is some fracturing and more alteration than in the dolerite, and the conclusion is that for ballast the dolerite is preferable to the gneiss near the dolerite contact. Furthermore, the upper part of the dolerite would appear to be more suitable than the dolerite at depth.

2. PETROGRAPHIC DESCRIPTIONS

The following samples will be considered together because of their essential similarity:

Sample	Position in Drill-holes		Thin Section No.
P294/73	DU 3	1.45 metres	30600
P295/73	DU 3	5.28 metres	30601
P296/73	DU 4	1.80 metres	30602
P297/73	DU 5	1.80 metres	30603
P298/73	DU 5	2.90 metres	30604
P299/73	DU 5	18.85 metres	30605
P301/73	DU 5	7.24 metres	30607

Rock Name:

Dolerite

Hand Specimen Description:

These sections of drill-core consist of grey-green to grey-brown, fine to medium grained igneous rock. Jointing is evident in P294/73 and P296/73, but the jointing has withstood the stresses of drilling. Shear zones, marked by finer more homogeneous rock, are apparent in P295/73, P299/73 and P301/73.

Thin Section:

A visual estimate of the constituents gave the following:

	Vol %	
Clinopyroxene (augite)	30-40	
Plagioclase (labradorite)	50	
Opaques (including goethite)	2-3	
Chlorite	<5	
Amphibole	Trace	
Mica	Trace	
Carbonate	<5	
Quartz	5	
Sheet silicates (talc, ?clay, ?serpentine, sericite)	<5	(more in P299/73 and P301/73)

The rocks are composed principally of clinopyroxene and plagioclase and the texture is generally sub-ophitic, tending to ophitic where there are aggregates of clinopyroxene.

The pyroxene crystals range in size from 0.2 mm to 1 mm. They are pale brown in thin section and are probably augite. Slight alteration of the pyroxene is widespread and the alteration products present include green coloured amphiboles (hornblende and actinolite), green and brown biotite-like micas, green chlorite, iron oxides, presumably goethite, and rare patches of phyllosilicate-like phases, possibly talc or clay.

The plagioclase, in contrast to the pyroxene, is generally unaltered and appears to be labradorite. It occurs as lath-shaped crystals up to 2 mm long.

The opaques occur as equant, sometimes slightly skeletal grains up to 0.5 mm across. Alteration is most pronounced in the rocks at the contact between opaque grains and pyroxene crystals. From the appearance of the opaque grains and the nature of the alteration products, the opaques are probably largely titaniferous magnetite.

In most of the thin sections there is a little quartz in the interstices between the dominant pyroxene and plagioclase crystals.

In Sample P295/73, which is sheared, examination of the thin section shows that the shear-planes as well as containing broken fragments of pyroxene and plagioclase crystals also contain a carbonate mineral and a little chalcedonic or opaline silica. The shear planes in P299/73 and P301/73 contain carbonate and a sheet silicate phase, possible sericite.

These rocks are all reasonably fresh dolerites, the most altered being P299/73, which as well as being finer grained and sheared contains the greatest evidence of alteration. This latter sample comes from close to the greater alteration of this dolerite has been pointed out in earlier reports (MP5750/72).

Specimen P300/73, TS 30606

Hand Specimen Description:

This Section of drill core is grey-green coloured and medium grained. It is weakly foliated and more irregularly textured than the dolerite samples. Flakes of biotite up to 2 mm across are present.

Thin Section:

A visual estimate of the constituents gave the following:

	%
Potash feldspar	35
Plagioclase	25
Quartz	30
Biotite	Trace -1
Chlorite	1-2
Amphibole	3-4
Carbonate	1-2
Sericite/?clay	1-2
Opaques	1-2
Apatite	Trace
Zircon	Trace

The rock has a xenoblastic-granular texture and is weakly foliated. The dominant minerals are potash feldspar, quartz, and plagioclase.

The potash feldspar occurs as fresh, equant grains up to 3 mm across, and is untwinned. However, most grains are distinctive because they are microperthitic.

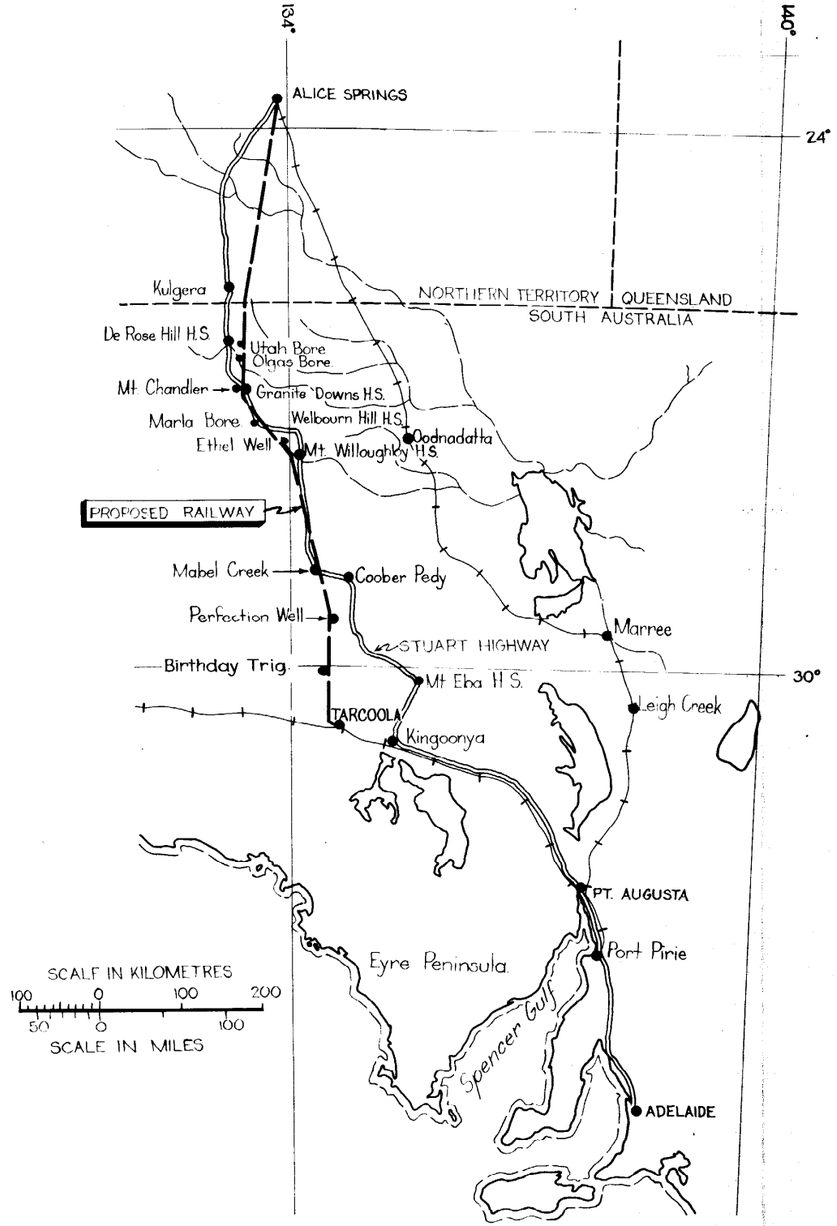
The plagioclase occurs as equant grains up to 2mm across. The composition of the plagioclase appears to be oligoclase/andesine (less calcic than that in the dolerite) and it is largely unaltered except for minor sericite and carbonate lining cleavage planes and fractures. Where potash feldspar and plagioclase abut there are frequently intergrowths of quartz and sodic plagioclase (myrmekite).

Opaques occur as equant grains up to 0.7 mm across.

The original ferromagnesians in the rock have been nearly completely replaced. What was probably once hornblende or pyroxene is now represented by patches of pale green tremolite/actinolite, carbonate, ?sericite and chlorite. Former brown biotite, in the form of flakes up to 0.8 mm long, has been largely chloritized and altered to goethite along cleavages and fractures, but some fresh biotite remains.

Trace amounts of the accessory minerals apatite and zircon are present in this rock and two narrow joints visible in the thin secioned area of the rock were seen to be filled with calcite.

In this rock alteration is more pronounced than in the dolerites and it is potentially less suitable on these grounds for railway ballast.



	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale: 1:6 000 000 approx.
Compiled: D Nichol	TARCOOLA – ALICE SPRINGS RAILWAY	Date: 11-8-1972
Drn. S.J.C. Ckd. A.F.	BALLAST SUPPLIES	Drg. No. 72-705 Ba
	LOCALITY PLAN	

SCALE IN METRES

20 0 20 40 60 80 100

AREA 2

DU3

DU2
45°

P374/72

DU4

P375/72

BASE

DU5
70°

54 76 35 55 45 35

387 388

A C B D A1 B1 C1 D1

N

LEGEND

- float / outcrop
- Dolerite
- Granite gneiss
- Proposed quarry outline
- Diamond drill hole reference number and angle of inclination — DU2 45°
- Petrographic sample location and number — P724/73
- Survey peg
- Section line — B
- Contour (in metres) — 387
- Geological boundary—position known
- Geological boundary—inferred
- Fault—position known
- Fault—concealed
- Strike and dip of metamorphic foliation — measured — 35
- Strike and dip of metamorphic foliation—vertical
- Strike and dip of joints—measured — 35
- Strike and dip of joints—vertical

73–567 MRR139

D. Nichol

S.A. Department of Mines

△CBM 1155

N

AREA 1

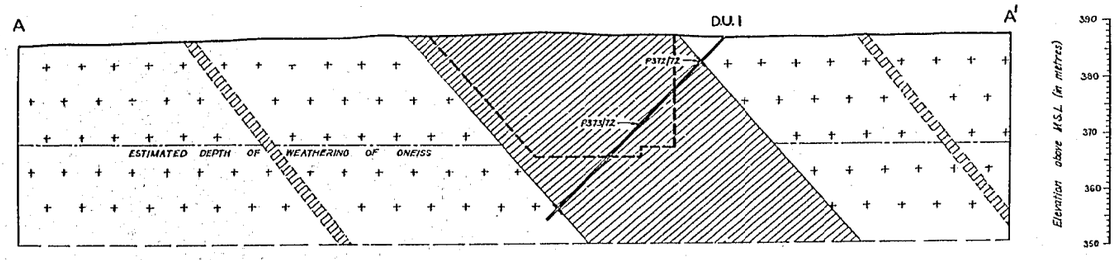
AREA 2

DU.1 45°

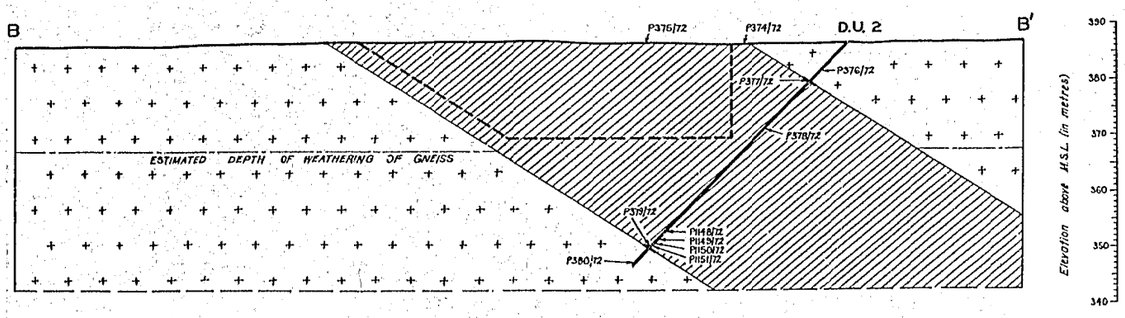
DU.2 45°

TP 1

SECTION A A'



SECTION B B'



SCALE 1:500 (SECTIONS ONLY)

SCALE IN METRES

10 0 10 20 30 40 50

10 0 50 100 150

SCALE IN FEET

SCALE IN METRES

100 0 100 200 300

100 0 500 1000

SCALE IN FEET

LEGEND

- Proposed quarry outline
- Section line
- Diamond drill hole, reference number and angle of inclination
- Petrographic sample location and number
- Survey Peg
- Contour (in metres)
- Dolerite outcrop
- Dolerite float
- Granite gneiss
- Pegmatite vein
- Geological boundary – position accurate
- Geological boundary – inferred
- Dolerite outcrop boundary
- Fault – position accurate
- Fault – concealed
- Strike and dip of metamorphic foliation – measured
- Strike and dip of metamorphic foliation – vertical
- Strike and dip of joints – measured
- Strike and dip of joints – vertical

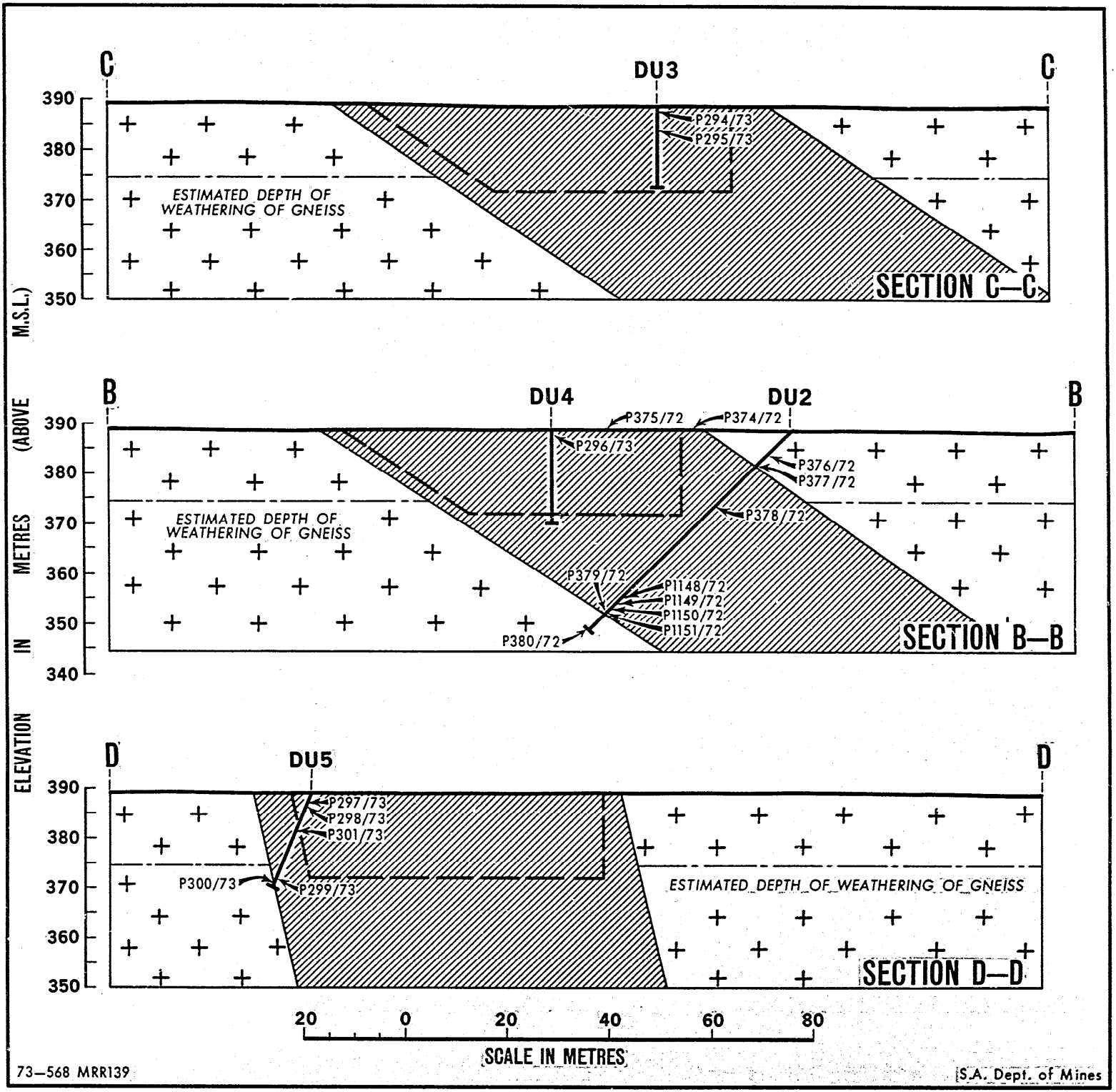
Datum: Mean Sea Level Port Adelaide, based on CBM 1155

Survey by Neil Edwards 9-5-72 to 16-5-72.
Stadia Field Books 161, 181. Level Book 429.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

TARCOOLA — ALICE SPRINGS RAILWAY
UTAH BORE DOLERITE DEPOSIT
GEOLOGICAL PLAN AND SECTIONS

NON-METALLIC MINERALS SECTION	GEOLOGIST	Drn. D.N	SCALES 1:2500 (orig.)
		Tcd. D.I.M	72-634
		Chd. I.K.M	Ba
Director of Mines	SEN. GEOLOGIST	Encl.	DATE: 3rd AUGUST 1972



73—568 MRR139

S.A. Dept. of Mines