DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENVIRONMENT & RESOURCES DIVISION

MORALANA BARITE DEPOSITS - SOUTHERN LODE

SECOND REPORT

Section 16, Hd. Moralana, Co. Hanson
(South Australian Barytes Ltd.)

by

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22nd April, 1975

Rept.Bk.No. 75/58
G.S. No. 5593
D.M. No. 646/73

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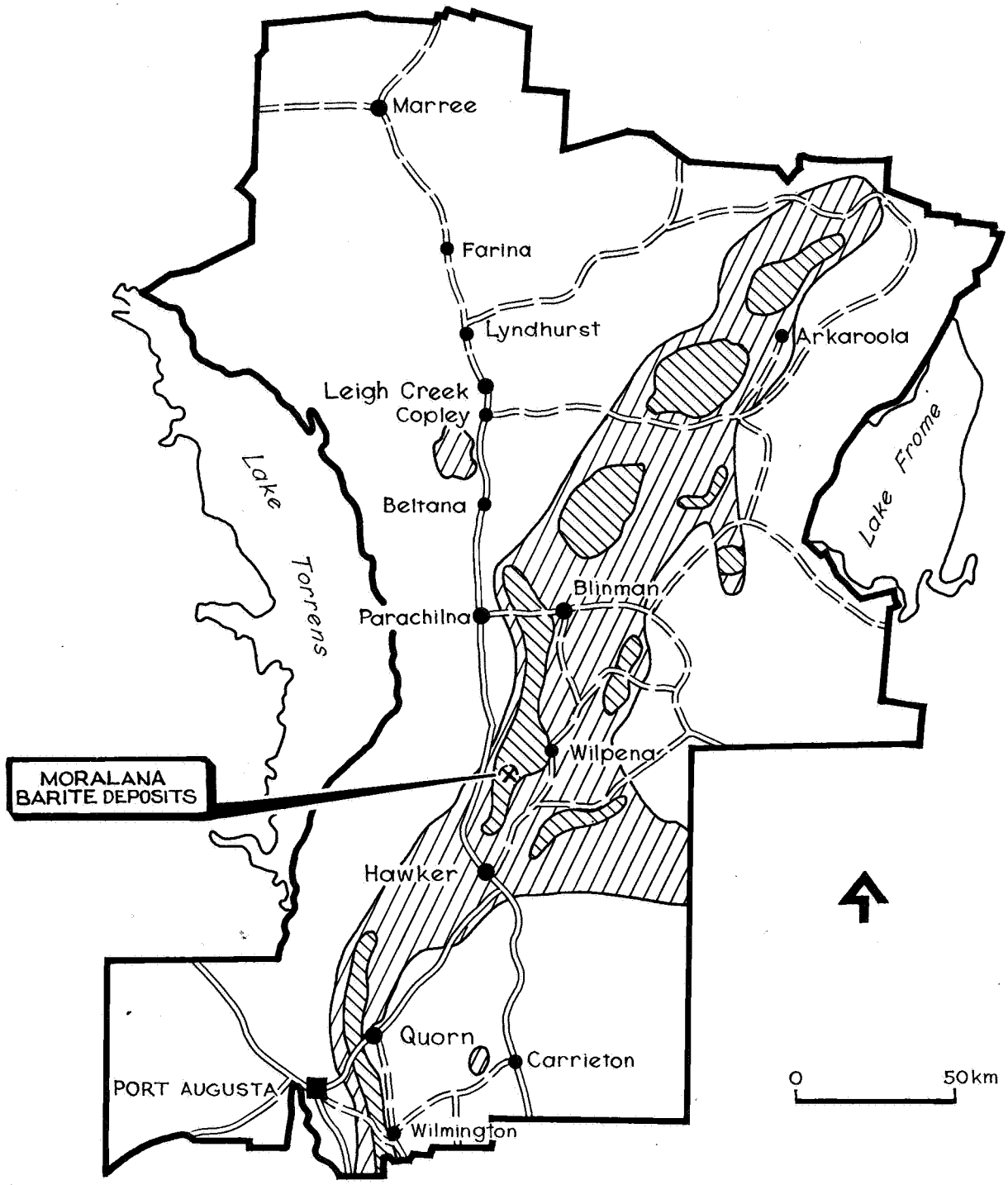

ENVIRONMENTAL AREAS

- Class A
- Class B
- Class C

- Country Township
- Special Township
- Main road
- Secondary road

FIG 1

DEPARTMENT OF MINES — SOUTH AUSTRALIA

INDUSTRIAL MINERALS SECTION	Drn. J.O.	FLINDERS RANGES PLANNING AREA	SCALE: 1:2 000 000
J.G.OLLIVER	Tcd. J.W	MORALANA BARITE DEPOSITS	S11452
	Ckd. A.F.	LOCALITY PLAN	
	Exd.		DATE: 18th April '75

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(South Australian Barytes Ltd.)

ABSTRACT

The Southern Lode of the Moralana Barite Deposits in the picturesque Moralana Valley produced 19 820 tonnes of barite for oil drilling purposes from a mine output of 43 730 tonnes during 1969-1972.

Barite and associated iron minerals have formed in a fault zone within shale and siltstone of the Brachina Formation. The bulk of the barium was probably derived from the enclosing rocks whereas much of the iron originated from hydrothermal activity related to emplacement of the nearby diapir.

The iron content of the estimated 7 000 tonnes of barite rock remaining above the 380 metre level is too high to satisfy oil drilling specifications.

As the workings lie in a Class A Environmental Area as defined in the Flinders Ranges Planning Area Development Plan, rehabilitation is required to ensure minimum permanent disturbance to the area.

INTRODUCTION

Mineral Claim 199 was registered by South Australian Barytes Limited (SABAR Ltd.) on 22 May, 1973 to cover the former Mineral Lease 3513, part of the Moralana Barite Deposits.

In this report, the term Southern Lode has been used to distinguish this lode from others, 1 to 2 kilometres to the north.

Following gazettal of an application to convert MC 199 to a mineral lease, an objection was received from the Nature Conservation

Society of South Australia. The basis of the objection was that the deposit lies in a Class A area as defined in the Flinders Ranges Planning Area Development Plan. This plan, which was authorised on 8th February, 1973 states the following criteria for mining operations in a Class A Environmental Area -

> "No mining activities should take place in these areas except in localities where mineral deposits are of paramount significance and their exploitation is in the State or National interest. These localities are: the western face of the Ranges near Depot Creek; the western face of the Heysen Range; portion of Moralana Valley; portion of the Mount Hack and Mount Uro areas; portion of the Stirrup Iron Ranges; portion of the east Gammons; the Mount Painter-Freeling Heights area, and such other localities as may from time to time be determined. Mining in these localities should only take place under the most stringent conditions following precise delineation of the sites concerned by planning regulations."

The accompanying geological plan (Fig. 4) and geological sections (Fig. 5) are based on a stadia theodolite survey by R.G. Harris (Field Assistant) and the author on 17 and 18 October, 1974, plotted onto the original plans and sections of Blissett (1970).

The appendix contains the results of chemical analysis and specific gravity determinations by The Australian Mineral Development Laboratories for two chip samples across the barite lode.

LOCATION

The Moralana Barite Deposits are located in section 16, Hundred Moralana, County Hanson, on Arkaba Station, 32 km north of Hawker.

Access is via the unsealed Moralana Scenic Road for 15 km westwards from the sealed Hawker-Blinman road. The turn-off is 22 km

PLATE IBKM008 MORALANA BARITE DEPOSITS, SOUTHERN LODE, 17 October, 1974

Workings looking westwards from Moralana Scenic Road.

north-east of Hawker. Alternatively, the deposit may be reached from the Hawker-Leigh Creek Road at the Moralana Creek crossing (see Fig. 3).

The workings on the Southern Lode, about 500 metres west of the Scenic Road are visible to persons travelling south-easterly along the road (see Plate IBKM008).

The terrain surrounding the deposits is hilly and drained by tributaries of the northerly flowing Moralana Creek. The Moralana Valley, between Wilpena Pound to the east and Elder Range to the west contains numerous stands of native pine trees. However, the ridge at the Southern Lode supported relatively few trees (see Plate 8906) prior to the commencement of mining operations.

MINERAL TENURE

The Southern Lode has been held since 1939 as detailed in Table 1 and has been referred to previously also as either the Arkaba or Bunbinyunna deposit.

The relationship of the three current tenements viz. ML 3535, ML 3536 and MC 199 to the existing workings is shown on Fig. 2.

Actual areas covered by the tenements are listed in Table 2.

TABLE 2

Area of Tenements, Moralana Southern Lode

Tenement	Calculated Area (hectares)	Registered Area (hectares)
ML 3535	10.6	15.6
ML 3536	6.7	10.5
MC 199	10.4	15.0

An additional condition on ML 3513 was that the lessee was to restore the land to the satisfaction of the Minister of Mines under Section 53, VI of the Mining Act (1930-1962).

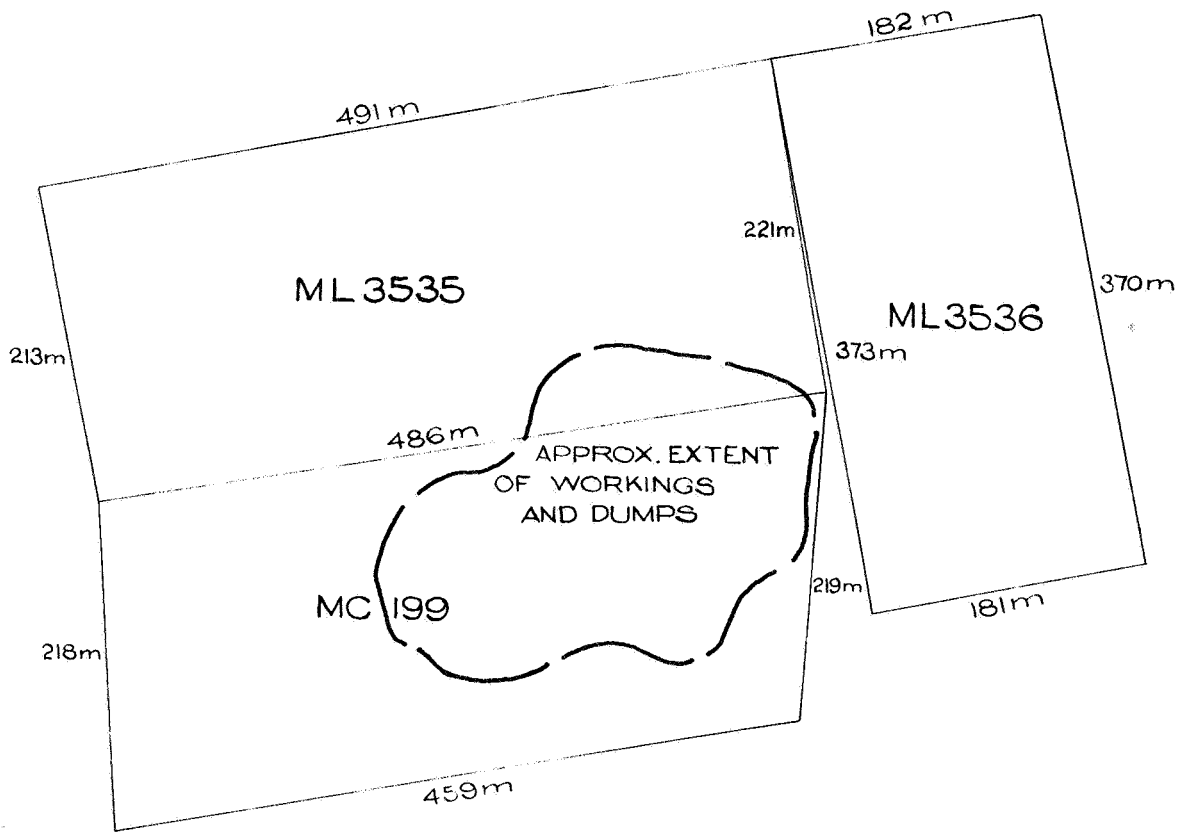

FIG. 2

DEPARTMENT OF MINES — SOUTH AUSTRALIA

INDUSTRIAL MINERALS SECTION	Drn. J G	MORALANA BARITE DEPOSITS SOUTHERN LODE MINING TENEMENTS S.A. BARYTES LTD.	SCALE: 1 : 5000
J. G. OLLIVER GEOLOGIST	Tcd. J W		S11453
	Ckd. AF		
	Exd.		DATE: 24th Oct' 74

TABLE 1

Mineral Tenements, Moralana Southern Lode

Tenement No.	Registered	Holder	Hectares	Expired
MC 16153	28.10.39	B.H.P. Co. Ltd.	16	Converted to ML 2849
ML 2849	1. 1.43	B.H.P. Co. Ltd.	16	surrendered 28.8.51
MC 5290	9.12.68	M.E. Jarvis	15.2	Transferred to SABAR Ltd. on 22.4.70 and converted to ML 3513.
ML 3513	1. 4.70	SABAR Ltd.	15.2	Expired 31.3.73.
MC 6350	8. 6.70	SABAR Ltd.	15.6	Converted to ML 3535
MC 6351	8. 6.70	SABAR Ltd.	10.5	and 3536 respectively.
ML 3535	1. 7.70	SABAR Ltd.	15.6	Renewed, due to
ML 3536	1. 7.70	SABAR Ltd.	10.5	expire on 30.6.78.
MC 199	22. 5.73	SABAR Ltd.	15.0	Application for lease lodged on 21.5.74.

The exploitation of the Moralana Barite Deposits is considered to be in the State or National interest. Accordingly, the locality has been specified in the Flinders Ranges Planning Area Development Plan as "portion of Moralana Valley" where mining "should only take place under the most stringent conditions following precise delineation of the sites concerned by planning regulations."

THE WORKINGS

An area of about 4.5 hectares, including dumps, has been disturbed by mining. Lateral extent is 270 metres east-west by 200 metres north-south. Most of the workings are confined to the eastern half of MC 199 although dumps and storage areas extend northwards into ML 3535 (see Fig. 2, Fig. 4 and Fig. 5).

On the northern flank of the ridge, a bench about 170 metres long has been established at the 390 metre level. The face reaches a maximum height of 24 metres between sections C-C' and D-D' (Fig. 5) where the bench at the 399 metre level no longer exists. The area between sections D-D' and E-E' has been filled with rubble to the 399 metre level (see Plate IBKM013).

At the western end, 10 metres west of Station G, a slot up to 7 metres wide and 14 metres deep has been excavated to the 380 metre level. Unstable slabs of country rock overhang along the northern face in places (see Plate IBKM014).

Benching along the southern flank of the ridge enabled a series of relatively narrow barite lodes to be mined. (see sections E-E' and F-F').

Material from the working face was transported to the screening plant on the northern side of the workings (see Plate IBKM015). The

PLATE 8906 MORALANA BARITE DEPOSITS, SOUTHERN LODE, September, 1968

General view eastwards before mining

PLATE IBKM010 MORALANA BARITE DEPOSITS, SOUTHERN LODE, 17 October, 1974

General view eastwards at completion of mining

boulders and fragments of barite passed over the screens into trucks on the lower bench (384 metre level) whilst the softer, friable shaly country rock broke up and passed through the screens for removal by front end loader to the dump area to the east.

PRODUCTION

A total of 597 tons (equivalent to 607 tonnes) was produced from the Moralana Deposits from 1945 to 1949 by the B.H.P. Co. Ltd. mostly from the northern lodes.

M.E. Jarvis obtained 148 tons (150 tonnes) during 1969 from the Southern Lode.

From 1970 to 1972 SABAR Ltd. raised 43 580 tonnes of crude barite, of which 38 500 tonnes was delivered to Quorn for milling. Milled barite totalled 19 670 tonnes representing an overall recovery of 51 percent barite. The balance of 5 080 tonnes between crude barite raised and barite delivered to Quorn remains as fines mixed with country rock in the dumps east of the screening plant. There is no stockpile of lump barite.

GEOLOGICAL SETTING

The accompanying regional geology plan (Fig. 3) is based on PARACHILNA (Dalgarno and Johnson, 1966). The stratigraphic succession for the Adelaidean sediments of Precambrian age in the area is detailed in Table 3 from Forbes, 1972.

PLATE IBKM013 MORALANA BARITE DEPOSITS, SOUTHERN LODE, 18 October, 1974

Main workings looking westwards from Survey Station A. Upper face reaches a height of 15 m and lower face 9 m. Barite has been removed from slot which has been partly backfilled.

TABLE 3

Stratigraphic sequence, Moralana Area

Wilpena Group	Pound Quartzite	- Reddish and white feldspathic sandstone and quartzite, minor shale.
	Wonoka Formation	- Grey limestone and flaggy dolomitic shale.
	Bunyeroo Formation	- Reddish, or sometimes greenish-grey, siltstone and shale.
	ABC Range Quartzite	- White, flaggy, laminated, fine grained feldspathic quartzite.
	Brachina Formation	- Greenish and pale reddish siltstone, minor sandstone, feldspathic greywacke.
	Nuccaleena Formation	- Laminated, yellowish-brown weathering, pale reddish brown dolomite.
Umberatana Group	Elatina Formation	- Pale reddish feldspathic sandstone and pebbly siltstone.
	Enorama Shale	- Green-brown-grey, laminated dolomitic shale.
	Etina Formation	- Grey, dolomitic shale, sandy and oolitic limestones, feldspathic quartzite.

The barite lode being investigated has formed within a vertical fault zone extending eastwards from a diapiric mass which has pierced a major periclinal structure (Blissett, 1970). The area lies between the syncline of Wilpena Pound to the east and a north-easterly trending syncline to the west.

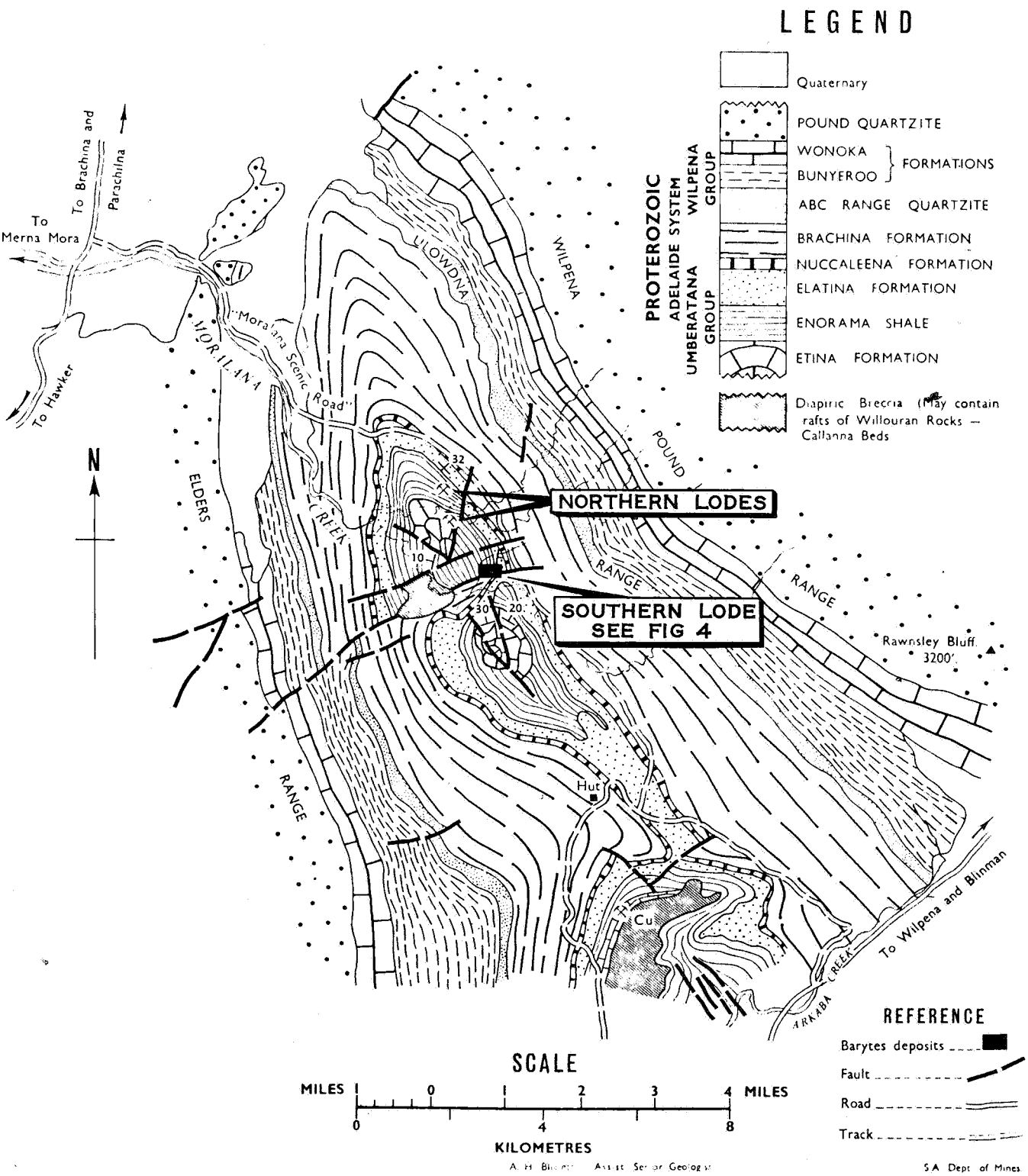

FIG 3

INDUSTRIAL MINERALS SECTION	**DEPARTMENT OF MINES — SOUTH AUSTRALIA**	Scale : 1:125 000
Compiled J.G.O.	MORALANA BARITE DEPOSIT	Date : April 1975
Drn A.F. Ckd A.F.	LOCATION AND REGIONAL GEOLOGY	Drg. No. S11454

750—8.74 F332 C

Other faults radiate from the diapir. In particular the barite lodes to the north are located along a north-north-easterly fault zone (see Fig. 3).

GEOLOGY OF THE SOUTHERN LODE

Country Rock

The lowest formation mapped in the lease area (see Fig. 4) consists of purplish-weathered green and grey silty and dolomitic shales of the Enorama Formation. Bands of finely cross-bedded siltstone and fine grained sandstone are common in the upper part. This formation is restricted to the northern side of the barite lode and has been folded into an anticline. The lower face east of the screening plant exposes contorted and drag folded beds (see Plate IBKM015).

The overlying three units outcropping south of the barite lode, dip gently to the north. A synclinal core of Elatina Formation on the northern side of the lode (see section F-F' Blissett, 1970) has been removed by quarrying.

Hard pink and purplish sandstone and feldspathic greywacke of the Elatina Formation crops out on the ridge in the south-eastern corner of MC 199. The upper portion of this unit is dolomitic.

Dolomitic sandstone and sandy dolomite of the Nuccaleena Formation form an arcuate yellowish brown outcrop near the southern end of sections A-A' and B-B'. To the east, the bed is obscured by talus and dumps but also is expected to lens out in places.

The youngest formation is brownish-weathered purple and green shale and siltstone of the Brachina Formation with thin interbeds of sandstone.

PLATE IBKM015 MORALANA BARITE DEPOSITS, SOUTHERN LODE, 18 October, 1974

Screening plant and loading facilities. Folded and contorted shales of the Enorama Formation are exposed in the bench faces.

Barite Mineralisation

A variable mixture of barite-goethite-hematite has formed along a major east-west fault zone. Originally, craggy outcrops up to 12 metres wide extended almost continuously along the ridge for 250 metres (Blissett, 1970 Fig. 6 and Plates 8888 and 8906). Dip is vertical to steep either north or south.

The barite is coarsely crystalline, off white with yellow or pink staining. Goethite and micaceous hematite occur as brown and black lenses and irregular zones throughout, with a concentration at the extremities of the lode in MC 199.

Although, the bench floors are largely obscured by debris, overall the barite lodes thin with depth (see sections). The only significant quantity of lode material remaining extends either side of Station G and on the western end of the workings. Width reaches a maximum of 5 metres. The lode contains almost equal amounts of barite and iron minerals. Sample No. 420/74 is regarded as typical of this material whereas sample No. 421/74 represents the patch richest in barite. Relatively narrow lenses extend eastward into ML 3536.

Fluid inclusions in the barite indicate a very low temperature of formation (Reid, 1969). Only $BaSO_4$ lines, no $SrSO_4$ lines were produced during X-ray diffraction. Hence, strontium is present in solid solution substituting for barium ions (Reid, 1969).

Barite derived from the enclosing Brachina Formation has been deposited in open fissures often related to diapiric structures. The Southern Lode at Moralana is relatively high in iron content compared to the Northern Lodes further from the diapir.

A similar decrease in iron contamination away from the diapir occurs at Oraparinna.

PLATE 8888 MORALANA BARITE DEPOSITS, SOUTHERN LODE, September, 1968

Craggy outcrop of massive barite.

QUALITY OF BARITE

The seven samples collected by previous workers before 1974 (see Table 4) were selected from outcrops of relatively clean barite whereas Sample Nos. A420/74 and A421/74, are chip samples taken by the author across the lode remnants in the workings. Widths are 2.0 metres and 3.0 metres respectively and sample locations are shown on Fig. 4. Results of analyses of all samples are summarised in Table 4.

Both Samples No. A420/74 and A421/74 fall outside Specification DFCP-3 of the Oil Companies Materials Association (U.K.) which requires barite for oil drilling purposes to

- contain at least 92% $BaSO_4$
- have a specific gravity of at least 4.2
- contain less than 250 ppm soluble alkaline earths expressed as calcium.

Several percent of iron oxides is permitted.

TABLE 4

Summary of Analyses

	Chemical Content(%)					
	S.G.	$BaSO_4$	$SrSO_4$	$(Ba+Sr)SO_4$	Fe_2O_3	SiO_2
Ward (1940)						
A	-	-	-	94.30	1.97	2.40
B	-	-	-	95.99	1.56	1.68
Reid (1969)						
AK 1	-	-	3.95	-	-	-
AK 2	-	-	4.83	-	-	-
AK 3	-	-	4.64	-	-	-
Blissett (1970)						
A 854/68	4.36	97.00	1.50	98.50	1.05	0.20

Blissett (1970) contd.

A 855/68	4.34	94.00	3.35	97.35	0.11	0.88
A 420/74	4.14	58.1	0.74	58.84	30.4	2.69
A 421/74	4.31	88.1	1.62	89.72	6.15	1.21

RESERVES

Assuming no diminution in depth, the barite lode was estimated to contain 25 400 tonnes of barite to a depth of 6 metres with a further 3 600 tonnes from outcrop (Blissett, 1970).

Reserves calculated from the present survey amount to an estimated 1 000 tonnes of barite-goethite-hematite rock indicated above the 390 metre bench east of Station G and a further 6 000 tonnes of material inferred above the 380 metre bench in the same area. Samples A 420/74 is representative of this material whereas Sample No. 421/74 is a zone with above average barite content.

The barite lode continues below the floor of the workings but sub-surface testing either in the form of inclined diamond drill holes or exploratory shaft sinking is required to determine quality and outline reserves. Barite mineralisation may be controlled by the Brachina Formation. In this case, the lode would be expected to lens out at the base of contact of this Formation and the underlying Nuccaleena Formation dolomite (estimated to approximate the 360 metres level on section C-C').

Deeper mining by open cut will necessitate the removal of enormous quantities of overburden and underground mining is not warranted as little high quality industrial grade barite can be expected.

PLATE IBKM014 MORALANA BARITE DEPOSITS, SOUTHERN LODE, 18 October, 1974

Western end of workings. Northern (left hand) face is 14 metres high with overhanging slabs of country rock.

CONCLUSIONS

A total of 43 730 tonnes of barite rock was mined from the Southern Lode of the Moralana Barite Deposits from 1969 to 1972. From this 19 820 tonnes of milled barite for oil drilling purposes were produced from 39 650 tonnes delivered to Quorn for treatment.

Rigorous hand sorting would have been necessary to select high grade barite suitable for pigments and other industrial applications.

The barite and associated goethite and hematite occurs in a vertical fracture zone related to a diapiric structure to the west. The probable source of barium was the enclosing shale and siltstone of the Brachina Formation, a unit of the Wilpena Group of Adelaidean sediments of Precambrian age.

Approximately 7 000 tonnes of barite are inferred to remain in the western portion of the workings above the 380 metre level. However, this material does not meet oil drilling requirements.

Deeper exploration or mining is not justified.

The site requires rehabilitation to reduce the impact on an area of high scenic quality. Photographs taken before mining provide an opportunity to restore the site close to its original condition.

22nd April, 1975
JGO:IA

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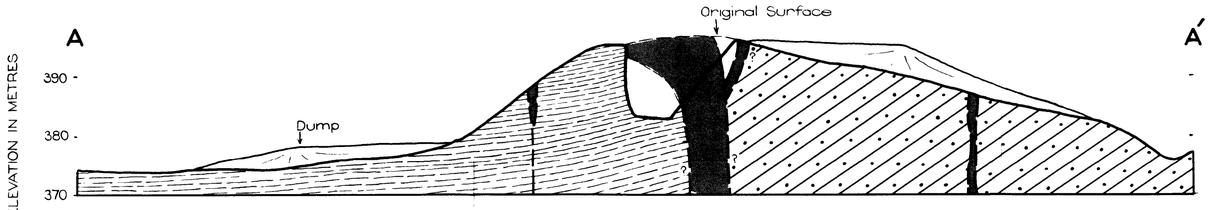
A P P E N D I X

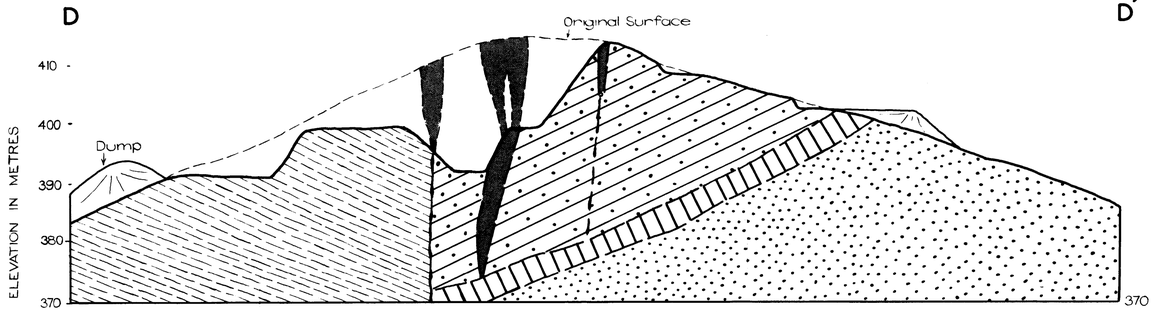
RESULTS OF LABORATORY TESTING

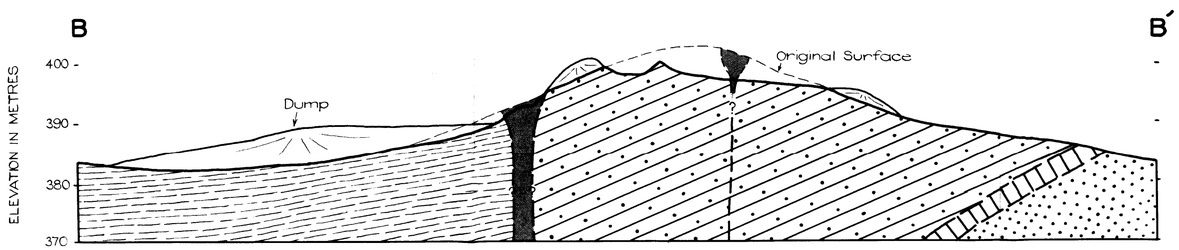
AMDEL REPORT AN1660/75

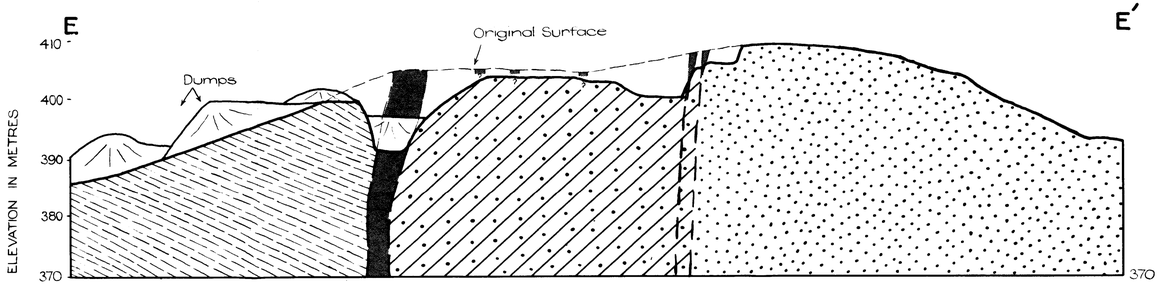
	Sample No.	
	A420/74	A421/74
Specific Gravity	4.14	4.31
Chemical Analysis (%)		
$BaSO_4$	58.1	88.1
$SrSO_4$	0.74	1.62
Fe_2O_3	30.4	6.15
SiO_2	2.69	1.21
Al_2O_3	1.46	0.74
Ignition Loss	5.40	1.57
TOTAL	98.7	99.4
Soluble Alkaline Earths as Ca(ppm)	100	40

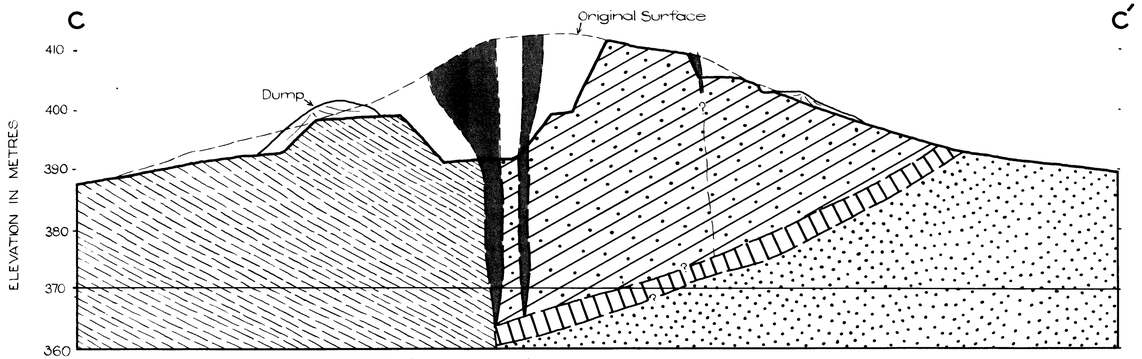
To Moralana Scenic track
N
DUMP
Bench 384m
Screening Plant
Bench 390m
Bench 399m
DUMP F
Δ301·6
Bench 380m.
Bench 390m
A420/74
A421/74
Bench 390m
Bench 399m
390m Bench
Bench 401m
Bench 405m
Bench 399m
Bench 405m
Bench 405m
About 0·4m barite and ironstone
Δ304·8
About 0·5m
370
375
380
385
390
405
410
415
420
395
400
LEGEND
RECENT
Soil, talus, downwash alluvium
ADELAIDEAN
WILPENA GROUP
BRACHINA Fm. - Purple and green shale and siltstone.
NUCCALEENA Fm - Yellow-brown dolomitic sandstone & sandy dolomite
UMBERATANA GROUP
ELATINA Fm. - Pink and purple sandstone and feldspathic greywacke
ENORAMA Fm. - Purple weathered green and grey silty and dolomitic shales.
Fault breccia.
Rich in iron.
Barite lode including lenses and masses of goethite and hematite
Survey Station F RL in metres (AHD)
Fence.
Corner post.
Track.
Strike and dip of bedding.
Dump.
Anticline axis.
Sample location
For Geological Sections see plan no 75-446
Stadia Survey by R.J.Harris
SCALE IN METRES
0 10 20 30 40 50 60
DEPARTMENT OF MINES — SOUTH AUSTRALIA
MORALANA BARITE DEPOSIT
SOUTHERN LODE - GEOLOGICAL PLAN
MC 199 SABAR LTD.
INDUSTRIAL MINERALS SECTION
J.G. OLLIVER GEOLOGIST
Compiled J.G.O
Drn. J.W
Ckd. A.F.
Scale: 1:500
Date: 18th April 1975
Drg. No. 75-445
Director of Mines
6534-1

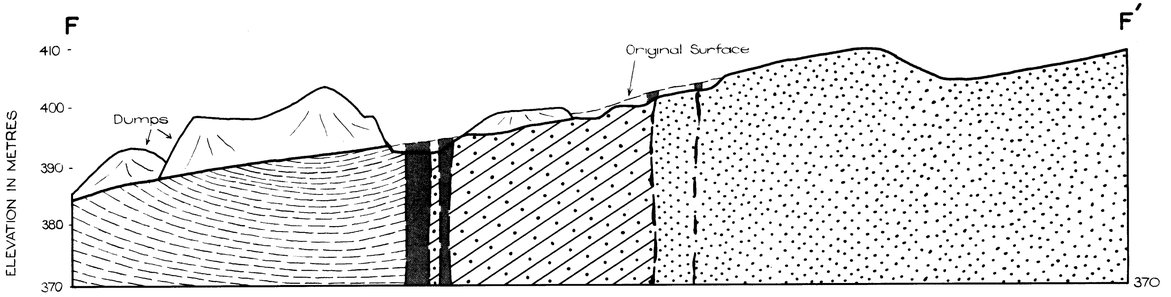












For Geological plan and Legend see Plan No: 75-445

DEPARTMENT OF MINES — SOUTH AUSTRALIA

MORALANA BARITE DEPOSIT SOUTHERN LODE GEOLOGICAL SECTIONS MC 199 SABAR LTD.

INDUSTRIAL MINERALS SECTION	J.G. OLLIVER GEOLOGIST	Compiled J.G.O	Scale: 1:500
			Date: 18th April '75
Director of Mines		Drn. J.W. Ckd. A.F.	Drg. No. 75-446

G534-1