DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept. Bk. No. 81/104 ORAPARINNA BARITE DEPOSITS, McRAE DEPOSITS. MLS 4393 AND 4975 AND MC 1420 Out of hundreds, county Taunton

GEOLOGICAL SURVEY

by

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MINERAL RESOURCES SECTION

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Frontispiece. View east to Loves Mine Range, from Linkes Lode on Wilpena-Martins Well road. Wilyerpa Formation quartzite crops out as prominent strike ridges in frontal range, whilst Mount Caernarvon Greywacke Member of the Tapley Hill Formation forms background range. White scar at centre left, on lower slope of frontal range is working at McRae No. 1 Lode. (June, 1979)

Neg. No. 32484

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ORAPRINNA BARITE DEPOSITS, McRAE DEPOSITS ML 4393, 4975 and MC 1420

ABSTRACT

McRae Barite Deposits are located 10 km southwest of the Oraparinna Barite Mine, on the western flank of Loves Mine Range in a Class B Environmental Area of the Flinders Ranges.

The southern deposit, No. 1 lode, has a discontinuous strike length of 200 m with an average thickness of 1.5m. The barite has been emplaced along a fault, which displaces steeply dipping quartzite and siltstone of the Wilyerpa Formation. Approximately 4 500 tonnes of industrial and oil drilling grade barite have been mined from this deposit. Indicated reserves are 5 200 tonnes with inferred reserves of 36 500 tonnes. As mined, silica and iron content exceed Industrial Grade specifications, although most current production is being sold as Industrial "B" Grade.

No. 2 lode has also been emplaced along a fault. The unworked deposit crops out over a strike length of 160m, with a maximum thickness of 2.5m, an average thickness of 1.5m, and inferred reserves of 15 500 tonnes. Barite quality is superior to No. 1 lode, and meets all industrial grade specifications except for iron content. Benefication may improve the quality.

INTRODUCTION

As part of a program of mapping barite deposits within and adjacent to the Oraparinna Diapir, McRae Deposits were sampled and mapped by stadia survey in 1978.

F.J. McRae held leases over two deposits, but only the southern lode, designated McRae No. 1, has been worked. This lode was initially mapped and sampled by L.C. Barnes, R.J. Harris (Technical Assistant) and P.P. Crettenden (Field Assistant) on 5th and 6th April 1978. Seven analytical samples and six petrological samples were submitted to the Australian Mineral Development Laboratories (AMDEL).

The unworked McRae No. 2 lode, was mapped and sampled by the authors with W.S. McCallum (Geologist), R.J. Harris and P.P. Crettenden on 6th and 7th March 1978. Six analytical samples and four petrological samples were submitted to AMDEL.

Duplicate analytical samples from both deposits were taken on 28th November 1979 to clarify some anomalies in results from the first suite. Petrological descriptions are included in Appendix A, results of physical and chemical testing are detailed in Appendix B.

The plan of the workings at No. 1 lode was updated by P.D. Johnson and W.S. McCallum on 2nd December 1979 using tape and compass traverses.

LOCATION AND ACCESS

McRae Deposits are located about 22 km northeast of Wilpena Chalet and about 10 and 10.5 km south-southwest of the Oraparinna Barite Mine, out of hundreds, county Taunton, on Willow Springs Station in the Flinders Ranges (Fig. 1). Adelaide is about 490 km to the south. The deposits are in a Class B Environmental Area, as defined in the Flinders Ranges Planning Area Development Plan, about 1.5 km east of the eastern boundary of the Flinders Ranges National Park (Fig. 2). McRae Deposits are situated in picturesque hilly country, thickly vegetated with native pines, mallee eucalypts and acacia, on the western flank of Loves Mine Range. This range rises up to 800 m above sea level with spectacular quartzite walls standing up to 30 m above the surrounding slopes (see Frontispiece and Plate 1).

The face of Loves Mine Range is drained by narrow, deeply incised creeks, which flow westerly towards the Flinders Ranges National Park, where the gently rounded low hills are about 600 m above sea level.

PLATE 1. McRae Deposits - No. 1 Lode.
View eastwards from main workings, 670 m bench in foreground. Easternmost pit in mid distance, massive, boldly outcropping, Wilyerpa Formation quartzite on skyline. Fault displaces barite lode, from yellow compressor on 680 m bench, 20 m to the left. (June, 1979).
Neg. No. 32485

Access from Hawker is northwards along the Blinman road, with 55 km of sealed road to the Wilpena turnoff, then a further 17.4 km of well graded unsealed road to the turnoff to Martins Well. This road is followed for 0.9 km to a small weighbridge opposite the old Appealinna Mine, whence a track leads eastwards for 5 km, past Hall and Vincent Lodes (McCallum, 1980) to a gate in the eastern boundary fence of the national park. From here, the northerly trending graded track is followed for 4.5 km, past the entrance to Bowering Lodes (Townsend and Barnes, 1981) to the campsite at McRae Deposits. All tracks are negotiable to all vehicles, except after heavy rain.

Alternative access is provided by a four wheel drive vehicle track, turning off the Hawker - Oraparinna Barite Mine road, 9.5 km from the mine. This track leads southerly, along the eastern boundary of the national park, for a distance of 7 km to the campsite.

From the camp, a steep track leads 0.7 km east-southeasterly to the workings at the No. 1 Lode (Fig. 4). The main part of the No. 2 Lode can only be reached on foot from a track that terminates against a quartzite rampart, 0.5 km east of the camp.

MINERAL TENURE

NO. 1 LODE

Mineral Claim (MC) 192 was pegged by F.J. McRae on 26th May 1973 and subsequently registered on 13th June 1973. The claim was converted to Mineral Lease (ML) 4393, covering 4.5 ha. on 7th August 1974. ML 4393 has been renewed for a further 7 years to 6th August 1988. The area of ML 4393, based on the stadia survey, is 1.9 ha. This adjustment in lease area was registered on 9th August 1978, the lease holder being entitled to a reduction in rental.

Subsequent to mapping, M.G. Coad pegged MC 1277, of 2.5 ha, abutting the northern boundary of ML 4393. This claim was registered on 14th January 1981. A lease application was lodged on 30th June 1980, and ML 4975 was granted on 21st September 1981 for a term of 7 years.

NO. 2 LODE

MC 141, pegged by F.J. McRae on 11th February 1973, was registered on 26th February 1973. ML 4318, covering 19.5 ha, was granted on 29th November 1973 for a term of 7 years. The area of ML 4318, based on the stadia survey is 3.9 ha and this adjustment was registered in the Lease Register on 9th August 1978. The leaseholder did not apply for renewal and ML 4318 expired on 28th November 1980.

MC 1420 was pegged by G.L. Maslen and registered on 29th April 1981. The claim is shown on Departmental records as covering the same ground as the former ML 4318. (Throughout this report MC 1420 is referred to as ML 4318).

MINE WORKINGS AND PRODUCTION

Both deposits lie within a Class B Environmental Area as defined in the Flinders Ranges Planning Area Development Plan. Within such areas, the following criteria for mining applies.

"Any mining activites should be carried out so as to minimise their effects on the scenic and natural qualities of this area".

Apart from a small pit 1 m across and 0.5 m deep in the centre of No. 2 Lode (Plate 6) and a shallow pit and bulldozer scrape at the northern end, (Fig. 8) all mining activities have been confined to No. 1 Lode (Fig. 5).

The access track to No. 1 Lode leads to a bench, at the 656 m level, cut into the hillside below the main workings.

The 670 m level bench extends for 50 m alongside the lode. Barite has been mined from a 2 m to 4 m deep trench, dipping moderately northwards following the lode. From the bottom of this trench, several pits, and two shallow inclined shafts have been dug, following the barite down-dip beneath the quartzite hanging wall (Plate 2). Shafts No. 1 and 2 have been joined by a short drive, along the lode, 7.5 m below the shaft collars. At the eastern end of the 680 m level bench, a pit 15 m long, 5 m across and 2 m deep has been dug. A small open cut has been developed east of, and slightly above, the eastern end of the 680 m bench whilst another cut links the 680 m bench to the 670 m bench. Chutes from the upper benches convey broken ore to the 656 m bench for cartage. Several steep access tracks link the benches, and these tracks and the spoil pushed over the edge of the benches are visible from the main Wilpena - Martins Well road (Frontispiece).

The western extremity of the No. 1 Lode has been explored with a shallow pit, adjacent to the access track, 160 m west of shaft No. 1.

Production from No. 1 Lode, based on returns submitted to the Department of Mines and Energy, is listed in Table 1.

TABLE 1

BARITE PRODUCTION (tonnes) - MCRAE NO. 1 LODE

Year	Oil Drilling Grade	Industrial Grade (approx.)	Total
1974	304	63	367
1975	319	155	474
1976	538	-	538
1977	231	-	231
1978	191	105	291
1979	-	-	-
	1 583	323	1 906

Since the middle of 1978, M.G. Coad has worked No. 1 Lode, mining underground under an arrangement with the leaseholder. This production has not been recorded by the Department, but is estimated at 1 300 tonnes, mostly Industrial Grade, to December 1979.

GEOLOGICAL SETTING

The accompanying regional geological plan (Fig. 1) is adapted from PARACHILNA (Dalgarno and Johnson, 1966). The geology of the area around McRae Deposits, as shown on Figure 3, is based on mapping of the southern and eastern margins of the Oraparinna Diapir by W.S. McCallum, D.C. Scott, J.T. Valentine and P.D. Johnson in 1978 and 1979, and Oraparinna (Dalgarno and Johnson, 1965).

McRae Deposits are located on the eastern margin of the Oraparinna Diapir, on the contact between diapir and overlying Umberatana Group sediments of Sturtian age. Diapiric rocks comprise disrupted and brecciated Willouran sediments, with numerous rafts of younger Adelaidean rocks and large masses of

volcanics, predominantly dolerite or dolerite altered to amphibolite.

Diapiric rocks have brecciated and disrupted Adelaidean sediments in contact with diapir, resulting in an irregular boundary between diapir and cover rocks as shown on Figure 3. Many large rafts of Adelaidean sediments up to several hundred metres in length, are incorporated in the diapir adjacent to the contact.

Along Loves Mine Range, the Oraparinna Diapir is mostly in contact with Wilyerpa Formation (Yudnamutana Subgroup), although in places along the range, notably near McRae No. 2 Lode, the underlying Holowilena Ironstone, comprising red hematitic shale, is in contact with the diapir. Wilyerpa Formation includes thinly bedded siltstone, sandstone, arkosic sandstone, arkosic quartzite, and tillitic sandstone, and is overlain by Tapley Hill Formation (Umberatana Group), a monotonous sequence of brown and blue-grey laminated siltstone which includes basal Tindelpina Shale Member and Mount Caernarvon Greywacke Member.

Adjacent to the diapir, Adelaidean rocks are disrupted and disorientated with variable dips, but away from the diapir Wilyerpa Formation is vertical and strikes uniformly north-northeast clearly defined by quartzite interbeds which crop out as spectacular quartzite walls along Loves Mine Range (see Frontispiece).

SITE GEOLOGY

ROCK UNITS

Geology of McRae Deposits is shown on Fig. 4.

The topographically subdued area around the camp is composed mainly of diapiric breccia which crops out poorly, being everywhere obscured by quartzite scree and outwash from Loves

Mine Range. Where exposed, mainly in creeks east of the camp, and immediately west of No. 1 Lode, the breccia comprises intensely brecciated dolomitic siltstone, with a few quartzite and dolomite blocks, in a soft calcareous matrix.

Immediately south and east of the camp, a large mass of dark grey-green amphibolite crops out boldly, forming a rounded hill. This rock, petrologically similar to amphibolite at Bowering Lodes (Townsend and Barnes, 1981) and Southern Lode, (McCallum and Johnson 1981) is derived by extensive alteration of an original igneous rock, either dolerite or coarse grained basalt. The origin of these amphibolite masses is uncertain. They appear to be restricted to the diapir, and do not intrude overlying Adelaidean sediments, and presumably, are large rafts of disrupted igneous rock within the breccia. At McRae Deposits, the amphibolite mass is in contact with the overlying Adelaidean rocks about 400 m southeast of the camp.

The contact between diapiric breccia and the overlying Adelaidean sediments, which at McRae Deposits trends roughly north-south, is highly irregular with lobes of breccia penetrating Adelaidean sediments, notably at the western end of No. 1 Lode.

Rocks overlying diapiric breccia, in ascending stratigraphic order comprise:-

. basal, massive boldly outcropping grey dolomite. This rock, which is not everywhere present, is of uncertain stratigraphic relationship, and may be equivalent to Burra Group dolomite elsewhere in the Flinders Ranges.
. massive quartzite, about 20 m thick, containing numerous pebbly bands with occasional pebbles and cobbles of quartz and granite, with some underlying siltstone. This quartzite,

possibly equivalent to the lower tillite of the Umberatana Subgroup, is, in places in contact with the diapiric breccia. If the basal dolomite is part of the Burra Group, the pebbly quartzite overlies the dolomite unconformably.

. dark purple siltstone 10-50 m thick which crops out poorly. This siltstone, the lateral equivalent of Holowilena Ironstone, a conspicuous thin hematitic siltstone and ironstone unit that crops out sporadically around the diapir, is best exposed in creeks west of No. 2 Lode. The southerly continuation of this purple siltstone band is not known.

. Wilyerpa Formation, a sequence of interbedded quartzite and siltstone. The quartzite beds, which crop out boldly, vary in thickness from 1 m to 15m, with considerable variation along strike. Quartzite is generally medium to coarse grained, although occasional pebbly layers are present, and is moderately to strongly indurated. The quartzite beds have resisted erosion to form a series of blocky walls, in places up to 30 m high, across the hillside. The interbedded siltstone, which crops out poorly in valleys between the quartzite walls, comprises yellow-brown and grey, thinly bedded, strongly cleaved siltstone.

STRUCTURE

The basal dolomite, overlying pebbly quartzite, and Holowilena Ironstone trend north-south and are vertical. The overlying Wilyerpa Formation trends north-northeasterly, with strike varying from 010^0 to 035^0 and dips vertically or steeply east and west. The discordance in trends between the basal part of the succession and Wilyerpa Formation suggests a slight angular unconformity between Holowilena Ironstone and Wilyerpa Formation in this area.

The following four prominent joint planes are well developed within Wilyerpa Formation quartzite, and breakage along them during weathering produces the rectangular quartzite scree that covers the area.

- Strike 170° dip 20°E
- Strike 075° dip 65°S
- Strike 110° dip 35°N
- Strike 065°-090°, dip 25-35°

The fourth joint direction appears to be the best developed and in several places, sinistral and dextral movements along these planes have produced displacements of 3-6 m in the quartzite beds.

Many of the joint planes have thin skins of milky and drusy quartz developed whereas those joint planes showing displacement are infilled with barite. The No. 1 and No. 2 lodes are emplaced along faults showing sinistral displacement of the quartzite beds, whereas immediately south of No. 2 Lode, two similar faults showing dextral movements are infilled by thin veins of pink barite in several places.

THE BARITE LODES

Both No. 1 and No. 2 Lodes have been emplaced along faults, striking approximately east-west and dipping at shallow to moderate angles northerly. The lodes are mainly within Wilyerpa Formation, but in both cases, the western end of the lode is enclosed by older rocks.

The barite lodes of the open infill fissure type, have formed by precipitation of barium sulphate from hot aqueous solutions under moderate to high pressure. A probable source is

PLATE 2. McRae Deposits - No. 1 Lode.
View westwards of western end of main workings, 670 m bench. Shaft No. 1 marked by posts. Hanging wall, massive quartzite and sandstone, footwall left foreground. Barite lode bifurcates at western end. (June, 1979)
Neg. NO. 32486.

PLATE 3. McRae Deposits - No. 1 Lode
Barite lode in main workings, showing mottled pink, grey and white character. Note intensely jointed massive quartzite in hanging wall.
(June, 1979)
Neg. No. 32487

barium rich solutions from the diapir, emanating originally from either evaporitic sequences within the breccia, or from the amphibolite masses.

No. 1 Lode

The lode crops out around the side of a hill over a length of about 200 m (see Fig. 5). In many places, outcrop is obscured by quartzite scree and soil, although it is presumed that the lode pinches out in places.

The barite has been emplaced along a fault striking 120-135° (M) and dipping northeast at about 45° which disrupts enclosing quartzite beds, causing an average horizontal displacement of 25 m.

45 m east-southeast of survey Station I (Fig. 5), a prominent thick quartzite that has been folded but not disrupted, is cut by a thin vein of barite, presumed to be the easternmost extent of No. 1 Lode. From here, the vein can be traced westwards with intermittent outcrop for about 120 m, then more continuous outcrop, to beyond the western boundary of ML 4393.

At the western end of the 680 m bench, a northerly trending fault displaces the lode about 8 m sinistrally (Plate 1). Intensely brecciated barite is sheared along this fault. At the western end of the 670 m bench, the barite lode splits into two, the southerly vein having a more shallow dip of about 30° (Plate 2 and Fig. 5). Further west, the vein crops out poorly and the structure is hard to follow. Small pods of barite can be traced through an intensely brecciated zone of quartzite and siltstone to a point 130 m west of No. 1 shaft where 5 m of barite, dipping 60° south is exposed on the northern side of the access track. 30 m further west another remnant of the lode is exposed cutting the basal dolomite. Adjacent to the barite vein, dolomite is

PLATE 4. McRae Deposits - No. 2 Lode
View eastwards from campsite to No. 2 Lode on slopes of Loves Mine Range. Barite stockpiles in foreground; oil drilling grade on left industrial grade on right. (March 1979)
Neg. No. 32488

PLATE 5. McRae Deposits No. 2 Lode
View northwestwards over the Oraparinna Diapir from 20 m north of Station C. Barite vein in massive quartzite dips about 30° to magnetic north below sharp hanging wall contact. (March, 1979)
Neg. NO. 32489.

silicified to a massive ferruginous silcrete (RS 201 Appendix B).

Similar silicified fault zones cut the dolomite north and south of the barite lode. Further west, all traces of the lode are lost in a zone of intense brecciation.

No. 2 Lode

The lode crops out around the side of a steep rocky hill, as shown on Figure 8. The dip of the vein averages 28° northwards comparable to the hill slope, exaggerating the apparent thickness of barite (Plate 6).

Wilyerpa Formation host rocks comprise massive coarse grained to pebbly quartzite and interbedded siltstone, striking 010°-020° and dipping very steeply east or west. The lode is emplaced along a low angle fault that sinistrally displaces quartzite beds by an average of 5 m.

Where exposed, the footwall and hanging wall contacts are sharp and regular, (Plates 5 and 6) although at the northern end of the lode, large masses of botryoidal goethite and blocks of quartzite mark the hanging wall contact (Plate 7).

The main section of the lode crops out almost continuously over a distance of 160 m, from survey Station A to 20 m north of Station D (Fig. 8). Southeast of Station A, a few small pods of barite are exposed, although the fault structure can be traced for almost another 100 m.

To the north, the lode continues as a thin skin on the footwall quartzite to 90 m north of Station D where the vein is about 0.1 m thick. Further north and west, outcrop is obscured by quartzite scree. Near Station F, about 70 m of barite is exposed as a skin down the hill slope, and in a small excavation at the side of the track. This barite skin, with a maximum thickness of 0.2 m, is emplaced in a joint plane with the same

PLATE 6. McRae Deposits - No. 2 Lode
View eastwards from Station C. Geologist on right stands on smooth quartzite footwall which dips 22° from centre right of photo to lower left corner. Small pit on lode in centre of photo. (March, 1979)
Neg. NO. 32490

PLATE 7. McRae Deposits-No. 2 Lode.
View northerly station D down dip of lode. Massive botryoidal goethite, near hammer head marks contact between barite and quartzitic hanging wall. (March, 1979)
Neg. No. 32491

orientation as the main lode, and is presumed to be the northerly extension of the lode. Barite veins, only a few centimetres thick, infill joints of other orientations within the excavation.

A few scattered thin veins of varying orientation occupy joints and fractures in brecciated quartzite and siltstone about 100 m northwest of Station F outside ML 4318.

Between Stations C and D (Fig. 8), several thin barite veins, of limited lateral extent, split from the main lode along more steeply dipping joint planes.

In general, the lode dips northerly at 28° except between Stations A and B where it strikes 160° (M.N.) and dips about 30°E into the hillside. The lode appears to have this orientation over an outcrop length of only 8 m, and it is presumed that this change in orientation is of limited lateral extent.

Cross sections A, B, C and D (Fig. 9) show that the lode lenses out to the southeast and northwest. Maximum thickness is 2.5 m near Station C and average thickness, between stations A and D, is about 1.5 m.

BARITE QUALITY

SAMPLING

A representative suite of samples, comprising 8 from No. 1 Lode and 6 from No. 2 Lode were submitted in 1978 to AMDEL for chemical analysis. Because of some anomalies arising from these results, duplicate samples were collected and submitted in 1979. All analytical and petrological samples are described below.

No. 1 Lode

Sample locations are shown on Figure 5.

TABLE 2

DESCRIPTION OF SAMPLES McRAE NO. 1 LODE

Sample No.	Location	Description
A5250/78) A3295/79)	Eastern end of lode.	Chip sample across vein
A5251/78) A3296/79)	Small eastern pit.	Composite chip sample
A5252/78) A3292/79) P621/78)	Upper bench main quarry	Selected banded pink-cream barite (0.1 m thick).
A5253/79) A3293/79)	Upper bench main quarry	Selected banded pink-white barite (0.5 m thick)
P620/78		Dark pink barite from vein margin.
A5254/78) A3294/79) P619/78)	Upper bench main quarry	Selected grey banded barite (0.5 m thick)
A5255/78) A3298/79) P618/78)	Drive near No. 1 shaft	Composite selected best.
A5256/78 A3299/79	Drive near No. 1 shaft	Composite selected oil drilling grade
A5257/78	Oil drilling grade stockpile near camp	Chip sample
A3297/79	Small stockpile near chutes	Grab sample
A3300/79	Drive between No. 1 and No. 2 shafts.	Grab sample typical ore.
P622/78	Eastern end of 670m bench	Selected grey and brown barite
6635RS201	Western extremity of lode	Silicified dolomite? with barite from silicified fault zone.

No. 2 Lode

Sample locations are shown on Figure 8.

TABLE 3

DESCRIPTION OF SAMPLES McRAE NO 2 LODE

Sample No.	Location	Description
A2824/78	5 m southwest of Station A	Chip sample across vein.
A3286/79 P451/78		Selected typical.
A2825/78 A3287/79	10 m east of Station B	Chip sample across vein
A2826/78 A3288/79	Central part of lode near Station C.	Chip sample across lode
P452/78		Selected typical.
A2827/78 A3289/79	Northern part of lode 20 m north of Station D	Chip sample across lode.
A2828/78 A3290/79	20 m north of Station D	Selected best white
A5262/78	Small pit on northern extremity of lode near Station F	Selected translucent barite
P454/78	20 m north of Station D Hanging wall of lode.	Barite - geothite rock

CHEMICAL ANALYSES

Results

All barite analyses are tabulated in full in Appendix B, and summarised in Tables 4 and 5.

No. 1 Lode

TABLE 4

SUMMARY OF CHEMICAL ANALYSES - McRAE NO. 1 LODE

Sample No.	$BaSO_4$	$SrSO_4$	$(Ba+Sr)SO_4$	SiO_2	Fe_2O_3	Sp.gr.	Refl
A5250/78	94.6	2.04	96.64	1.95	0.46	4.40	66
A3295/79	90.0	1.30	91.30	5.38	2.31	4.26	39
A5251/78	92.0	1.82	93.82	4.98	0.29	4.33	70
A3296/79	95.5	1.60	97.10	2.28	0.26	4.33	69
A5252/78	95.0	1.75	96.75	1.56	0.11	4.36	69
A3292/79	96.0	2.70	98.70	0.78	0.09	4.35	69
A5253/78	96.5	1.34	97.84	1.15	0.06	4.42	82
A3293/79	96.0	2.00	98.00	1.47	0.05	4.34	82
A5254/78	80.5	1.22	81.72	12.00	4.70	4.21	33
A3294/79	74.5	1.70	76.20	17.99	4.14	4.02	33
A5255/78	97.0	0.77	97.77	1.18	0.03	4.45	83
A3298/79	96.0	1.50	97.50	1.83	0.11	4.31	81
A5256/78	85.4	0.80	86.20	6.50	5.30	4.31	33
A3299/79	88.5	1.00	89.50	8.33	0.92	4.13	46
A5257/78	91.7	1.80	93.50	5.20	0.23	4.34	73
A3297/79	96.5	1.20	97.70	2.00	0.06	4.34	79
A3300/79	96.0	1.50	97.50	2.34	0.10	4.32	67

No.2 Lode

TABLE 5

SUMMARY OF CHEMICAL ANALYSES -MCRAE NO. 2 LODE

Sample No.	$BaSO_4$	$SrSO_4$	$(Ba+Sr)SO_4$	SiO_2	Fe_2O_3	sp.gr.	Refl
A2824/78	94.7	2.00	96.70	0.60	1.05	4.41	63.1
A3286/79	95.5	2.20	97.70	0.51	0.78	4.35	61.3
A2825/78	96.1	1.72	97.82	0.30	0.43	4.42	71.7
A3287/79	97.0	1.50	98.50	0.46	0.90	4.35	63.3
A2826/78	95.5	2.90	98.40	0.75	0.22	4.42	76.7
A3288/79	95.5	2.50	98.00	0.78	0.46	4.36	69.2
A2827/78	97.3	1.58	98.88	0.85	0.09	3.99	73.1
A3289/79	96.5	2.00	98.50	0.91	0.10	4.39	69.6
A2828/78	97.3	1.62	98.92	0.40	<0.02	4.43	69.3
A3290/79	98.0	1.50	99.50	0.40	0.02	4.39	86.7
A5262/78	93.0	6.15	99.15	0.05	0.21	4.45	88.9
A3291/79	94.5	2.70	97.20	1.12	0.65	4.33	60.2

Discussion

Although most anomalies in the 1978 results have been clarified by duplicate sampling, problems remain, particularly with specific gravity which should be accurate to ±0.01. The following anomalies remain.

A5251/78, sp.gr. of 4.33 is too high for 4.98% SiO_2 compared to A3296/79

A5254/78, sp.gr. of 4.21 is too high for 12.00% SiO_2 compared to A 3294/79.

A2827/78, sp.gr. of 3.99 is far too low for 0.85% SiO_2

A3290/78, sp.gr. of 4.39 is too low for 0.40% SiO_2

Specific gravity determinations in 1979 are generally too low e.g. A3298/78 sp. gr. of 4.31, whereas based on 1.83% SiO_2 the theoretical sp. gr. should be at least 4.4.

"Reflectance" of only 69.3 for sample A 2828/78 with 98.9% $(Ba+Sr)SO_4$ and <0.02% Fe_2O_3 is anomalously low.

Specifications

The American Society for Testing Materials (ASTM) Specification D602-42 requires barite to be white and to contain-

- at least 94% $BaSO_4$ ie (Ba + Sr) SO_4
- not more than 0.05% Fe_2O_3
- not more than 0.2% soluble salts
- not more than 0.5% volatiles
- not more than 2% quartz, clays and foreign materials.

Locally, Industrial Grade barite is subdivided according to Reflectance, or degree of whiteness into the following grades.

Grade	Reflectance
A	<89.5
Standard	>86
B	>82
C	<82

The U.K. Oil Companies Materials Association Specification DFCP-3 requires barite for oil drilling purposes to:

- contain at least 92% $BaSO_4$ ie (Ba+Sr) SO_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 are permitted.

The quality of barite can be upgraded to some extent at Quorn Mill.

No. 1 Lode

Barite from this lode is characteristically mottled or banded white, cream, pink and grey (Plate 3), with both hanging wall and footwall contacts marked by several centimetres of dark pink barite.

Petrographic examination of samples shows the barite to be extensively deformed and granulated, probably resulting from movement along the fault subsequent to emplacement of the barite vein. Fine grained quartz, carbonate (subsequently replaced by iron oxides) and reddish brown iron oxide have been deposited within granulated zones in the barite, causing the grey, brown and pink banding. Finely divided micron sized opaque and/or fluid inclusions in the barite produce the cream or salmon pink barite typical of this deposit. The dark grey mottled barite results from concentration of iron oxides, unlike Matthews Lode 12km to the northeast, where the grey mottled colouration is due mainly to numerous inclusions (Olliver et al 1976).

Although most samples contain more than 94% total sulphate, barite is generally too siliceous, and contains too much iron, to satisfy industrial grade specifications. Excluding the highly siliceous, limonitic barite (sample A5254/78), quartz content ranges from 0.8% to 5.4% averaging 2.5% whilst the variable iron content ranges from 0.03% to 2.3%.

Selected samples of banded pink and cream (A5252/78, A3292/79) and banded pink and white (A5253/78, A3293/79) barite from the top 1.1m of the lode in the upper bench of the quarry, and selected "best" samples from underground (A5255/78, A3298/79) almost satisfy industrial grade specifications, the iron content being generally slightly above the specified maximum of 0.05%, resulting in lower reflectance. Beneficiation at the Quorn Mill

removes some of these iron oxides, resulting in acceptable reflectance. Most pale coloured barite can be marketed as Industrial "B" Grade.

Grey and brownish coloured barite contains significantly higher amounts of quartz, up to 18%, and iron up to 5.3%. At Quorn, material slightly below oil drilling specifications (A5256/78, A3299/79) can be upgraded to that specification and most grey coloured-barite from No. 1 Lode can be marketed as oil drilling grade (Plate 4). However, the highly discoloured grey and brown barite (A5254/78, A3294/79) contains too much quartz and iron and would have to be discarded.

No. 2 Lode

Colour is a dense milky white with minute amounts of black and reddish brown iron oxides on cleavage faces and in fractures. Petrographic examination has shown the barite to be much less deformed than barite from No. 1 Lode, although some granulation of barite crystals, particularly along vein margins suggests minor movement of the fault following emplacement. Trace amounts of iron oxides are concentrated within these granulated areas, lining grain boundaries and fractures, although some iron oxides are present as very finely divided inclusions within the barite, and replacing original carbonate.

The barite contains significantly less silica and iron than No. 1 Lode.

All samples met industrial grade specifications except for iron content an reflectance. The iron content varies from 0.02 to 1.05% with and average of 0.4% which is well above the specified limit of 0.05%. Very small variations in iron content resulted in marked variations in reflectance eg A2825/78 with 0.43% Fe_2O_3 and reflectance of 71.7 compared with its duplicate

sample A3287/79 with 0.9% Fe_2O_3 and reflectance of 63.3. Removal of iron oxide, the only significant contaminant, would produce high grade material, eg selected best sample A3290/79 with 0.02% Fe_2O_3 and reflectance of 86.7. As the iron oxide is coating cleavage faces, crushing followed by washing in caustic solution should remove most of the iron. Large masses of botryoidal goethite at the vein margins, particularly near the hanging wall (Plate 7), should be removed by selective mining.

MINE DEVELOPMENT AND RESERVES

Calculation of ore reserves, as at 2nd December 1979, are detailed in Appendix C and summarised below.

No. 1 Lode

Mapping showed 62% outcrop along the length of the lode suggesting pinching and swelling. Reserves were reduced by 38% to allow for areas with no outcrop.

Indicated reserves are confined to a 10m downdip projection of the lode from the underground workings, as shown in the cross sections, Figures 5 and 6. Inferred reserves have been projected to creek level, at 640 m. Reserves in tonnes are as follows.

	Indicated	Inferred
Inside ML 4393	1 500	14 000
North of ML 4393	3 700	22 500

MC 1277 abuts the northern boundary of ML 4393 and covers most of the outlying reserves.

No. 2 Lode

As this barite vein dips parallel with the hillslope, open cutting is the best method of initial development. Mapping showed 67% outcrop along the length of the vein, within the area proposed for development. Reserves were reduced by 33% to allow

for areas with no outcrop, which are assumed to indicate where the vein has pinched out.

The limits of total inferred reserves are arbitary. The eastern boundary was chosen as the line perpendicular to strike from the end of barite outcrop near survey station A. Creek level (680 m) was considered a convenient downdip limit.

An open cut, as shown on the plan (Fig. 8) and the sections (Figs. 9 and 10), was designed to be within ML 4318, which has since lapsed. For the proposed open cut, inferred reserves are 7 000 tonnes of barite with 22 000 tonnes of quartzite and siltstone overburden.

A further 4 000 tonnes of barite are inferred within ML 4318 down-dip outside the limits of the proposed open cut, and another 4 500 tonnes inferred down dip outside ML 4318.

Underground methods will be required to mine the down dip portion of the lode, as overburden thickens.

A new tenement would have to pegged, abutting ML 4318 (now MC 1420) to the east, to cover that portion of the lode outside ML 4318.

CONCLUSIONS

At McRae No. 1 Lode, a barite vein crops out discontinuously over a strike length of 200 m with an average thickness of 1.5 m. The vein is emplaced along a fault striking 130^0 and dipping 45^0 northeasterly into the hillside which cuts steeply dipping Wilyerpa Formation quartzite and siltstone of Adelaidean age. Indicated reserves are 5 200 tonnes, with inferred reserves of 36 500 tonnes. Silica and iron contents exceed Industrial Grade specifications, however rigorous hand selection followed by benefication at the Quorn Mill removes most impurities, and much of the current production is being sold as Industrial "B"

Grade. Most of the discoloured barite from this deposit is suitable for oil drilling purposes.

At McRae No. 2 Lode, barite crops out almost continuously over 160 m, with an average thickness of 1.5 m and a maximum thickness of 2.5 m. The vein infills an arcuate low angle fault, with a strike of 065-090^0 and a dip of 25-35^{0}N, almost coincident with the hillslope. Vertically dipping Wilyerpa Formation quartzite and siltstone striking at 020^0 (M), have been displaced about 5 m along the fault. 7 000 tonnes are inferred in an area suitable for open cut mining with a further 8 500 tonnes inferred downdip and eastwards from the proposed open cut. The barite meets all industrial grade specifications except for iron content and reflectance. Crushing followed by washing and/or scrubbing should remove surface iron oxide coatings and significantly improve quality.

Another tenement should be pegged on the eastern side of ML 4318 (now MC 1420) to enable expansion of mining down dip should the lode maintain thickness and quality during open cutting.

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APPENDIX A

Petrography of Samples from McRae's Barite Deposits.

Extracted from

GS 3873/78 by Frank Radke
P618/78 - P622/78 No. 1 Lode

GS 3570/78 By Frank Radke
P451/78 - P454/78 No. 2 Lode

GS 2864/80 By Sylvia Whitehead
6635 RS 201

Sample: P451/78; TS40045

Location:

McRae Barite Deposits - No. 2 Lode. Selected sample of typical barite from south end of lode, near Station A.,

Rock name:

Barite

Hand specimen:

A milky white rock with well developed parting or cleavage surfaces. Brown to reddish-brown iron staining is well developed along some of these fracture surfaces.

Thin section:

An optical estimate of the constituents gives the following:

	%
Barite	98
Opaques & semi-opaques	2

This is essentially a monominerallic rock comprised of granular barite with a variable grain size. Large barite crystals up to 5 mm in size are separated by much finer grained (typical grain size between 0.05 and 0.5 mm) barite most likely produced by granulation. The barite crystals have a clear character but do contain abundant fluid inclusions below 0.01 mm in size. Grain boundaries and fractures are lined with opaque to semi-opaque iron oxides and a yellowish-brown fibrous mineral which could represent either iron stained clay or jarosite. Minor opaque to translucent brown iron oxides also form irregular patches up to 0.3 mm in size.

Sample: P452/78; TS40046

Location:

McRae Barite Deposits-No. 2 Lode. Selected sample of typical barite from central part of lode, near Station C.

Rock Name:

Barite

Hand specimen:

A massive milky white rock with well developed cleavage traces. Black to reddish-brown opaques are concentrated along fracture and cleavage traces and locally form vein like structures up to several millimetres wide.

Thin Section:

An optical estimate of the constituents gives the following:

	%
Barite	98
Opaques and semi opaques	2

This thin section is comprised of one large optically continuous barite crystal. The crystal contains small fluid inclusions generally below 0.01 mm in size and some inclusions of opaque to translucent reddish brown iron oxides up to 0.1 mm in size. Minor opaque and translucent iron oxides also form narrow linings along cleavage traces.

The thin section also contains another large optically continuous barite crystal and the contact between these two barite crystals contain some finer grained barite with a typical grain size between 0.2 and 1 mm. Also within this contact region opaque to translucent reddish brown iron oxides are concentrated as interstitial fillings and vein like structures.

The thin section also includes a large patch comprised mainly of translucent reddish-brown iron oxides which exhibits an internal structure indicating it has replaced a mineral with well developed rhombohedral cleavage such as a carbonate. Replacement of various carbonates by iron oxides has been described in many previously examined sections from the Oraparinna Barite Mine.

Sample: P453/78; TS0047
Location:

McRae Barite Deposits No. 2 Lode. Selected sample, best white barite from northern end of lode, 20 m north of Station D.

Rock Name:

Barite

Hand specimen:

A massive, milky white rock.

Thin section:

This sample is comprised almost exclusively of barite with only trace amounts of opaque to translucent reddish-brown iron oxides which form anhedral, disseminated grains below 0.05 mm in size and narrow discontinuous fracture fillings. Most of the thin section is comprised of a large, optically continuous barite crystal but locally the sample has suffered granulation particularly along vein like structures. The barite crystal is cut by several narrow vein like structures. The barite crystal is cut by several narrow veins below 0.1 mm wide which contain finely granular barite. Also the margins of the thin section contain some areas of granular barite with a well developed mortar texture. For the most part the barite is very clear but it does contain some finely divided inclusions at least some of which represent opaque material.

Sample: P454/78; TS40048

Location:

McRae Barite Deposits-No. 2 Lode. Piece of barite-goethite rock from north end of lode, 20 m north of Station D.

Rock Name:

Barite-Goethite rock

Hand specimen:

A massive rock consisting of milky white to pale pink barite intergrown with dark brown iron oxides (probably goethite). The iron oxides tend to form irregular void fillings with a well developed radial texture.

Thin section:

An optical estimate of the constituents gives the following:

	%
Barite	45
Quartz	3
Jarosite	2
Goethite	50

The thin section was cut to include both barite and goethite. The barite occurs mainly as large crystals with a clear character although they do contain some finely divided fluid inclusions. In thin section the goethite has a translucent reddish colour and its radial, fibrous texture is still, easily visible.

Near the margins of the goethite rich patches quartz crystals and remnants of barite are intergrown with the goethite. Most of the quartz crystals exhibit somewhat modified prismatic shapes showing evidence of marginal replacement by goethite. The quartz crystals are up to 1.5 mm in length and virtually all exhibit some sort of remnant prismatic shape. The barite near the margins of the fibrous goethite forms irregular grains up to 1 mm in size which show evidence of marginal replacement by limonitic materials particularly along cleavage traces.

Some narrow vein like structures of fibrous brown material is intergrown with the barite and could represent jarosite filled veins and fractures.

Sample: P618/78; TS40192

Location:

McRae Barite Deposits-No. 1 Lode; Selected sample of best white barite, main-workings near No. 1 shaft.

Rock name:

Mildly deformed barite

Hand specimen:

A milky white coloured rock consisting of large, bladed barite crystals up to several centimetres long. Ocherous to opaque iron oxides are concentrated along some fracture surfaces and also form small, disseminated grains generally below 1 mm in size, some of which exhibit iron stained coronas.

Thin section:

An optical estimate of the constituents gives the following:

	%
Barite	95
Quartz	3
Opaques and semi-opaques	2

This sample is comprised mainly of barite, which forms large, elongate bladed crystals which show some evidence of deformation, particularly granulation around grain margins. This granulation produces interstitial, finer grained barite aggregates (typical grain size between 0.1 and 0.8 mm) intergrown with granular quartz. Virtually all of the quartz in this rock is concentrated within these granulated, interstitial areas.

The barite has a moderately clear colour but does contain abundant, disseminated opaque to translucent reddish-brown iron oxides inclusions which are typically about 0.02 mm in size, with some larger inclusions up to 0.05 mm in size. Opaque to translucent reddish-brown iron oxides are also concentrated in the granulated areas as small grains and patches up to 0.5 mm long. Some of these iron oxides have vague rhomb shapes suggesting that they could represent completely replaced carbonate crystals.

This is an essentially monomineralic rock comprised mainly of barite which has suffered some deformation to produce granulation along crystal margins with the introduction of quartz and possible carbonate in these granulated areas. This carbonate has been completely replaced by limonitic iron oxides.

Sample: P619/78; TS40193

Location:

McRae Barite Deposits-No. 1 Lode. Grey banded barite from upper bench, main quarry.

Rock Name:

Deformed barite

Hand specimen:

A massive rock consisting of angular, dull white barite patches separated by reddish-brown limonitic patches and intergranular veinlets.

Thin section:

An optical estimate of the constituents gives the following:

	%
Barite	85
Quartz	5
Opaque and semi-opaques	10

This sample consists mainly of large barite crystals generally between 1 and 5 mm long which show evidence of deformation, in particular, marginal granulation. The granulation has produced areas of finer grained barite which has a variety of grain sizes ranging from about 0.5 mm down to 0.05 mm. In most cases, this granulated barite occurs along grain margins, but locally narrow fractures along which barite granulation has occurred penetrate through larger barite crystals.

Both opaque to translucent reddish-brown iron oxides and quartz is concentrated with the finer grained barite areas. There appears to be two generations of quartz within these areas with some quartz also having a finely granulated character and other quartz forming well developed crystals up to 0.2 mm in size. Some of these larger quartz crystals exhibit well developed prismatic shapes, but most have anhedral shapes.

One portion of the thin section contains somewhat less deformed-appearing bladed barite crystals up to several millimetres long. The angular interstices between these barite blades is filled with opaque to translucent reddish-brown iron oxides. Locally minor quartz or interstitial granulated barite also occurs between the well developed barite blades. This bladed barite most likely represents recrystallized barite from after the major phase of deformation.

This is a barite-rich rock with one highly deformed and granulated area and another area with well developed barite blades containing interstitial granulated barite along with iron oxides and minor quartz. It is considered that the relatively undeformed barite blades most likely grew after the major deformation which produced the granulated barite.

Sample: P620/78; TS40194

Location:

McRae Barite Deposits-No. 1 Lode. Selected sample of pink barite from margin of vein, upper bench main quarry.

Rock Name:

Barite

Hand Specimen:

A massive, pink to salmon coloured rock. A few disseminated chalcopyrite grains up to about 1 mm in size were noted on a freshly cut surface and exhibit dark rims which most likely represent supergene copper sulphides (chalcocite and/or covellite). Some disseminated black grains could represent completely replaced chalcopyrite. On the weathered surface small limonitic spots which most likely represent completely oxidised disseminated sulphides were noted.

Thin section:

An optical estimate of the constituents gives the following:

	%
Barite	90
Quartz	10
Opaque and Semi-opaques	1

This sample consists mainly of small barite crystals which generally exhibit a somewhat plumose character, although locally they have a finely granular texture. Most of the barite in this rock forms elongate crystals about 0.3 mm long, but one portion of the sample contains much larger barite crystals up to several millimetres long. The finely granular barite represents granulated barite, while the plumose and larger bladed crystals most likely represent recrystallised barite which could have been produced essentially contemporaneously with the deformation. Most of the barite in this rock has a somewhat turbid character due to finely divided micron-sized inclusions which could represent opaque or possibly fluid inclusions.

Clear quartz crystals fill angular interstices generally below 0.2 mm in size located between the small barite crystals. Microcrystalline, cherty quartz is also concentrated in narrow bands where they are generally intergrown with granulated barite. This microcrystalline, cherty quartz generally has a somewhat pink, turbid colour most likely produced by finely divided inclusions of iron oxide.

Opaques are disseminated through the rock as anhedral to subhedral grains up to 0.5 mm in size. A few translucent, dark reddish-brown limonitic grains, which most likely represent oxidised sulphides, were also noted.

This is a barite-rich rock with a somewhat unusual fine grained, plumose texture which also shows evidence of deformation in localised granulation.

Sample: P621/78; TS40195

Location:

McRae Barite Deposits-No. 1 Lode; banded pale pink and cream barite, upper bench main quarry.

Rock Name:

Deformed barite

Hand specimen:

A somewhat banded rock consisting of pink to salmon coloured barite-rich bands up to several centimetres wide with dark grey to brown iron oxide-rich bands contain small, angular barite fragments generally below 1 mm in size.

Thin Section:

An optical estimate of the constituents gives the following:

	%
Barite	85
Quartz	10
Opaques & semi-opaques	5

This is a rock containing bands with highly variable mineralogies and the above mineral proportions largely reflect the fact that the thin section was cut to include mainly a barite-rich band with only a relatively small amount of darker, iron oxide-rich bands.

Most of this rock consists of angular, fragmental-appearing patches of plumose barite, somewhat similar to the barite of sample (620/78 9TS40194) separated by a fine grained (typical grain size between 0.05 and 0.15 mm) of granular barite. The granulated barite contains vein-like intergrowths of cherty, microcrystalline quartz which are generally below 0.1 mm wide. Opaque to translucent reddish-brown iron oxides are also concentrated in these granulated regions as small grains below 0.1 mm in size. Minor opaque to translucent reddish-brown iron oxides are also disseminated through the rock as anhedral to subhedral grains, some of which occur as inclusions within plumose barite patches.

Most of the barite has a slightly turbed character due to finely divided micron-sized inclusions which most likely represent either opaque material and/or fluid inclusions.

The iron oxide-rich band contains angular barite fragments up to about 1 mm in size which generally lack the finely plumose texture noted throughout most of this sample. These barite fragments are cemented by iron oxides intergrown with finely granular quartz and finely granulated barite. Some clear quartz grains up to 0.2 mm in size are also present within this limonite-rich band.

This is a barite-rich rock similar to sample P620/78, which has suffered more extensive deformation to produce a more highly granulated texture.

Sample: P622/78; TS40196

Location:

McRae Barite Deposits-No. 1 Lode; Grey and brown banded barite, main workings.

Rock Name:

Quartz vein in barite

Hand specimen:

A massive rock consisting of relatively coarse grained, milky white barite with a milky grey quartz vein several centimetres wide. The quartz-rich vein contains interstitial intergrowths of ocherous, limonitic material as bands which, in particular, tend to be concentrated near the contact of the vein with the barite. The middle of the quartz vein contains numerous small vughs into which prismatic quartz crystals penetrate.

Thin section:

An optical estimate of the constituents gives the following:

	%
Quartz	50
Barite	35
Opaques & semi-opaques	15

This thin section was cut to include mainly the quartz-rich vein with a limonite-rich contact and some marginal barite and the above list of mineral proportions does not necessarily reflect the mineralogy of the hand specimen as a whole.

Most of this sample is comprised of a quartz-rich mosaic consisting of euhedral to subhedral quartz grains generally about 0.5 to 5 mm in size. The quartz crystals exhibit euhedral to subhedral shapes with concentric bands oriented parallel to the crystal faces defined varying amounts of finely divided micron-sized inclusions. The angular, interstitial areas between these quartz crystals are generally filled with barite or finely granular quartz and barite intergrowths. A few well developed barite blades are present in this quartz-rich vein and generally exhibit broken shapes. Minor interstitial iron oxides also occur within the core of the quartz-rich vein but most of the iron oxides are concentrated as interstitial fillings near the margin of the vein.

The thin section includes one barite-rich margin of the quartz vein. The barite in this area forms large bladed crystals intergrown with interstitial translucent to opaque iron oxides. Locally, the barite has a granulated, deformed texture.

This sample includes a quartz-rich vein within a moderately deformed barite-rich rock.

Sample: 6635 RS201; TS42804 (large)

Location:

McRae Barite Deposits - No. 1 Lode - western end.

Descriptive Information:

Silicified ?dolomite with barite vein.

Hand Specimen:

A fine-grained siliceous rock which in some zones are stained dark orange to brown by iron oxide and variations in this staining define thin laminations and layers varying in thickness from less than 1 mm to about 2 mm. These layers and laminations have been locally folded and fractured and there are some disturbed and brecciated zones.

When closely examined small iron oxide pseudomorphs after pyrite crystals generally less than 1 mm in size can be seen scattered throughout the rock and there are a few very small zones of grey silicified rock in which the pyrite has not been oxidized.

Along one side of the sample there is a vein of coarsely crystalline, white barite.

Thin Section:

Mineral Assemblage	%
Secondary quartz	>90
Oxidized pyrite	2-3
Sericite	1-2 (more locally)
Barite	1-2
Carbonate inclusions	trace
Tourmaline	Minor trace

The rock is now composed predominantly of very fine-grained secondary quartz with a few slightly coarser-grained patches and this quartz has crystallized across pre-existing rock. The only minerals of the former rock which have been preserved are small flakes of muscovite or sericite, a few very small grains of tourmaline and the scattered small crystals of pyrite or oxidized pyrite, many of which are less than 0.1 mm in size. The darker laminae noted in the hand specimen contain higher concentrations of iron oxide and some also have higher concentrations of sericite. It is almost certain that some of the sediment replaced by quartz was shale and although it is possible that dolomite was also present no conclusive evidence to prove this was found. In the small zones in which pyrite has not been oxidized the very fine-grained to microcrystalline quartz contains up to 5% of very small mica or sericite flakes, scattered crystals of pyrite and there is one grain of tourmaline 0.1 mm long.

Towards the edges of these zones a little of the pyrite has been replaced by jarosite and outside of these zones the pyrite has been replaced by reddish-brown iron oxide and much of the mica or sericite has been stained by iron oxide.

At some stage the rock has been deformed by folding and fracturing but it is not absolutely certain whether this occurred before or after the main episode of silicification as there has certainly been a later generation of quartz which crystallized after the deformation.

The deformed and fractured zones contain some coarser-grained quartz filling fractures and interstices and associated with this quartz there are varying amounts of barite, most of which has crystallized in voids which are lined by projecting quartz crystals or it has filled interstices between quartz crystals. Barite has also filled a few small voids from which pyrite or oxidized pyrite was leached. Some of this coarse-grained quartz contains a few tiny inclusions of carbonate which were not found in the finer-grained quartz replacing the finely laminated sediment. It is therefore possible that there was once some carbonate in interstices in these deformed and fractured zones.

Adjacent to the coarse-grained barite vein there is a zone of breccia in which there are angular clasts of coarse-grained barite and also of the very fine-grained silicified rock and some moderately large euhedral quartz crystals.

The clasts of barite and silicified rock are surrounded by a thin film of iron oxide or iron oxide-stained clay and the breccia has been cemented by a later generation of quartz.

Conclusion

This is a silicified thinly bedded or laminated, pyritic sediment some of which was almost certainly shale and no conclusive evidence could be found to show whether or not dolomite was originally present. The sediment has been deformed and fractured and in the fractured zones there is coarser-grained interstitial quartz and veins of quartz associated with a little barite. There has been another episode of fracturing and clasts of coarse-grained barite and silicified rock are cemented by a late generation of quartz.

APPENDIX B

Chemical Analysis and Physical Properties of barite from McRae Deposits.

Extracted from
MD 3875/78 by Lyn J. Day
A5250/78-A5257/78 No. 1 Lode
A5262/78 No. 2 Lode

MD 3565/78 by Lyn J. Day
A2824/78-A2828/78 No. 2 Lode

MD 3072/80 by Lyn J. Day
A3286/79-A3300/79 No. 1 & 2 Lodes.

PROCEDURES

Samples were analysed by X-ray fluorescence spectrometry. Portions were milled by mortar and pestle to less than 75 micrometres for brightness determination by Zeiss Elrepho electric reflectance photometer. Brightness quoted is the difference between R457 and R57 values. Specific gravities were determined using 25 millilitre specific gravity bottles with tetrachloroethylene. Entrained air was removed by evacuation. Individual temperature corrections were applied.

RESULTS

Results are given in Table 1 -

APPENDIX B

TABLE 1

CHEMICAL ANALYSES AND PHYSICAL PROPERTIES-BARITE FROM McRAE DEPOSITS

Sample No.	$BaSO_4$	$SrSO_4$	SiO_2	Fe_2O_3	Al_2O_3	CaO	K_2O	LOI	Soluble	Alkaline Earths as Ca ppm	Reflectance	Yellowness	sp.gr.
No. 1 Lode													
A5250/78	94.6	2.04	1.95	0.46	<0.05	0.10	<0.01	0.57	50	4.40	65.7		13.1
A3295/79	90.0	1.30	5.38	2.31	0.04	0.04	0.05	0.39	35	4.26	39.2		16.3
A5251/78	92.0	1.82	4.98	0.29	<0.05	0.03	0.03	0.49	55	4.33	70.5		13.2
A3296/79	95.5	1.6	2.28	0.26	0.02	0.09	0.05	0.07	15	4.33	68.7		10.7
A5252/78	95.0	1.75	1.56	0.11	0.09	0.28	0.05	0.82	65	4.36	69.3		10.6
A3292/79	96.0	2.7	0.78	0.09	0.05	0.03	0.06	0.18	20	4.35	69.1		14.5
A5253/78	96.5	1.34	1.15	0.06	<0.05	0.08	0.01	0.32	60	4.42	81.9		6.9
A3293/79	96.0	2.0	1.47	0.05	0.02	0.03	0.04	0.0	20	4.34	82.4		7.6
A5254/78	80.5	1.22	12.0	4.70	<0.05	0.10	<0.01	1.29	60	4.21	32.7		21.1
A3294/79	74.5	1.7	17.99	4.14	0.08	0.03	0.02	1.55	35	4.02	33.4		23.7
A5255/78	97.0	0.77	1.18	0.03	<0.05	0.02	<0.01	0.57	70	4.45	83.5		5.8
A3298/79	96.0	1.5	1.83	0.11	<0.01	0.03	0.05	0.07	20	4.31	80.7		8.7
A5256/78	85.4	0.80	6.50	5.30	<0.05	0.06	0.04	1.53	70	4.31	32.8		18.6
A3299/79	88.5	1.0	8.38	0.92	0.07	0.03	0.05	0.35	20	4.13	46.3		15.9
A5257/78	91.7	1.80	5.20	0.23	<0.05	0.02	<0.01	0.58	25	4.34	73.2		9.6
A3297/79	96.5	1.2	2.00	0.06	0.01	0.03	0.05	-0.01	25	4.34	79.2		7.3
A3300/79	96.0	1.5	2.34	0.10	<0.01	0.03	0.05	0.03	45	4.32	67.5		8.2
No. 2 Lode													
A2824/78	94.7	2.00	0.60	1.05	0.13	0.02	0.03	0.63	21	4.41	63.1		13.3
A3286/79	95.5	2.2	0.51	0.78	0.06	0.03	0.05	0.46	20	4.35	61.3		16.5
A2825/78	96.1	1.72	0.03	0.43	0.04	0.02	0.01	0.34	14	4.42	71.7		11.0
A3287/79	97.0	1.50	0.46	0.90	0.03	0.03	0.05	-0.10	10	4.35	63.3		15.0
A2826/78	95.5	2.90	0.75	0.22	0.07	0.02	0.02	0.45	19	4.42	76.7		7.6
A3288/79	95.5	2.5	0.78	0.46	0.01	0.03	0.06	0.52	10	4.36	69.2		12.8
A2827/78	97.3	1.58	0.85	0.09	0.04	0.01	0.01	0.31	7	3.99	73.1		10.0
A3289/79	96.5	2.0	0.91	0.10	<0.01	0.03	0.06	0.06	15	4.39	69.6		9.6
A2828/78	97.3	1.62	0.40	<0.02	0.04	0.01	<0.01	0.28	12	4.43	69.3		14.6
A3290/79	98.0	1.5	0.4	0.02	<0.01	0.03	0.05	0.29	10	4.39	86.7		5.0
A5262/78	93.0	6.15	0.21	0.02	<0.05	0.64	0.01	1.67	40	4.45	88.9		5.3
A3291/79	94.5	2.7	1.12	0.65	0.10	0.03	0.06	0.12	20	4.33	60.2		16.7

APPENDIX C

McRae Barite Deposits - Reserve Calculations

TABLE 1
RESERVE CALCULATIONS - McRAE NO. 1 LODE

SECTION	Distance of Influence(m)	Indicated Sectional Area (m^2)	Indicated Volume (m^3)	Inferred Sectional Area (m^2)	Inferred Volume (m^3)
A in M.L.	-	nil	-	nil	-
out/M.L.	-	nil	-	nil	-
B in M.L.	8	9	72	nil	-
out/M.L.	8	16	56	86	688
C in M.L.	10	nil	-	nil	-
out/M.L.	10	48	480	48	480
D in M.L.	10	nil	-	nil	-
out/M.L.	10	40	400	42	420
E in M.L.	10	7	70	nil	-
out/M.L.	10	7	70	38	380
F in M.L.	10	20	200	4	40
out/M.L.	10	nil	-	94	940
F in M.L.	5			24	120
out/M.L.	5			94	470
G in M.L.	20			20	400
out/M.L.	20			36	720
H in M.L.	20			38	760
out/M.L.	20			81	1620
I in M.L.	20			56	1120
out/M.L.	20			44	880
J in M.L.	20			24	480
out/M.L.	20			45	900
K in M.L.	20			29	580
out/M.L.	20			20	400
L in M.L.	20			86	1720
out/M.L.	20			25	500
TOTAL Within ML 4393			342		5220
Outside ML 4393			1006		8398

Mining in Shafts 1 & 2 and the crosscut to 2/12/79 removed an additional 650 tonnes of indicated ore outside of M.L. 4393

Indicated Reserves (rounded down to nearest 100 tonnes)

Within M.L. 342 x 4.4 = 1 500 tonnes
Outside M.L. (1 006 x 4.4) - 650 = 3 700 tonnes

Barite outcrops over 62% of the area from sections G-L.

Inferred reserves for this area are: (rounded down to nearest 500 tonnes)

Within ML 4393 - $5\,220 \times \frac{62}{100} \times 4.4 = 14\,000$ tonnes

Outside ML 4393 - $8\,398 \times \frac{62}{100} \times 4.4 = 22\,500$ tonnes

TABLE 2
RESERVE CALCUALTIONS - McRAE NO. 2 LODE

SECTION		Sectional Area (m^2)	Distance of Influence (m)	Volume (m^3)
E	Overburden	43	12.5	537
	Inferred (O/C)*	2	12.5	25
	Inferred	30	12.5	375
F	Overburden	92	25	2300
	Inferred (O/C)	20	25	500
	Inferred	31	25	775
G	Overburden	138	25	3450
	Inferred (O/C)	40	25	1000
	Inferred	24	25	600
H	Overburden	51	25	1275
	Inferred (O/C)	20	25	500
	Inferred	28	25	700
I	Overburden	60	25	1500
	Inferred (O/C)	14	25	250
	Inferred	12	25	300
J	Overburden	2	12.5	25
	Inferred (O/C)	8	12.5	100
	Inferred	11	12.5	140

TOTALS: Overburden 9100 m^3 (S.G. 2.4)
Inferred within open cut 2375 m^3 (S.G. 4.4)
Inferred outside open cut 2890 m^3 (S.G. 4.4)

The barite vein outcrops over 67% of the area considered above, consequently reserves are reduced by 33%.
*Inferred reserves within proposed open cut.

OVERBURDEN - To nearest 1000 tonnes.
9100 x 2.4 = 22000 tonnes

INFERRED RESERVES WITHIN OPEN CUT. (Rounded down to nearest 500 tonnes)

$$2375 \times \frac{67}{100} \times 4.4 = 7000 \text{ tonnes}$$

INFERRED RESERVES OUTSIDE OPEN CUT. (Rounded down to nearest 500 tonnes)

$$2890 \times \frac{67}{100} \times 4.4 = 8500 \text{ tonnes}$$

INFERRED RESERVES OUTSIDE OPEN CUT, WITHIN ML 4318
Approx 45% of 8 500 tonnes
Approximately 4 000 tonnes.

INFERRRED RESERVES OUTSIDE OPEN CUT, OUTSIDE ML 4318
4 500 tonnes.

GEOLOGY FROM PARACHILNA 1:250000 SHEET.

PALAEOZOIC
QUAT. — Superficial deposits.
Cambrian — UNDIFFERENTIATED: Wilkawillina Lst. Parara Lst. Bunkers sst., Oraparinna Shale, Billy Creek Formation.

PROTEROZOIC
Adelaide System
- POUND QUARTZITE: White quartzite and red feldspathic sandstone.
- WONOKA FORMATION: Calcareous shale and flaggy limestone.
- BUNYEROO FORMATION: Purple and green dolomitic shale.
- A.B.C. RANGE QUARTZITE.
- Pw — BRACHINA FORMATION: Greenish grey siltstone with lenticular sandstone interbeds.
- NUCCALEENA FORMATION: Brown weathering purple dolomite.
- ELATINA FORMATION: Pink sandstone and feldspathic greywacke.
- TREZONA FORMATION: Grey shale with interbeds of purple limestone.

PROTEROZOIC
Adelaide System
- ENORAMA SHALE: Purple weathering green shale.
- ETINA FORMATION: Sandy-limestone and grey shale.
- WOCKERAWIRRA DOLOMITE.
- Pu — TAPLEY HILL FORMATION: Blue grey laminated siltstone.
- Mount Caernorvon Greywacke Member.
- WILYERPA FORMATION: Arkosic quartzite and siltstone. Includes Holowilena Ironstone
- Dolomite, dolomitic siltstone and breccias.

Fault.

TURLEY LODE — Barite Deposit.

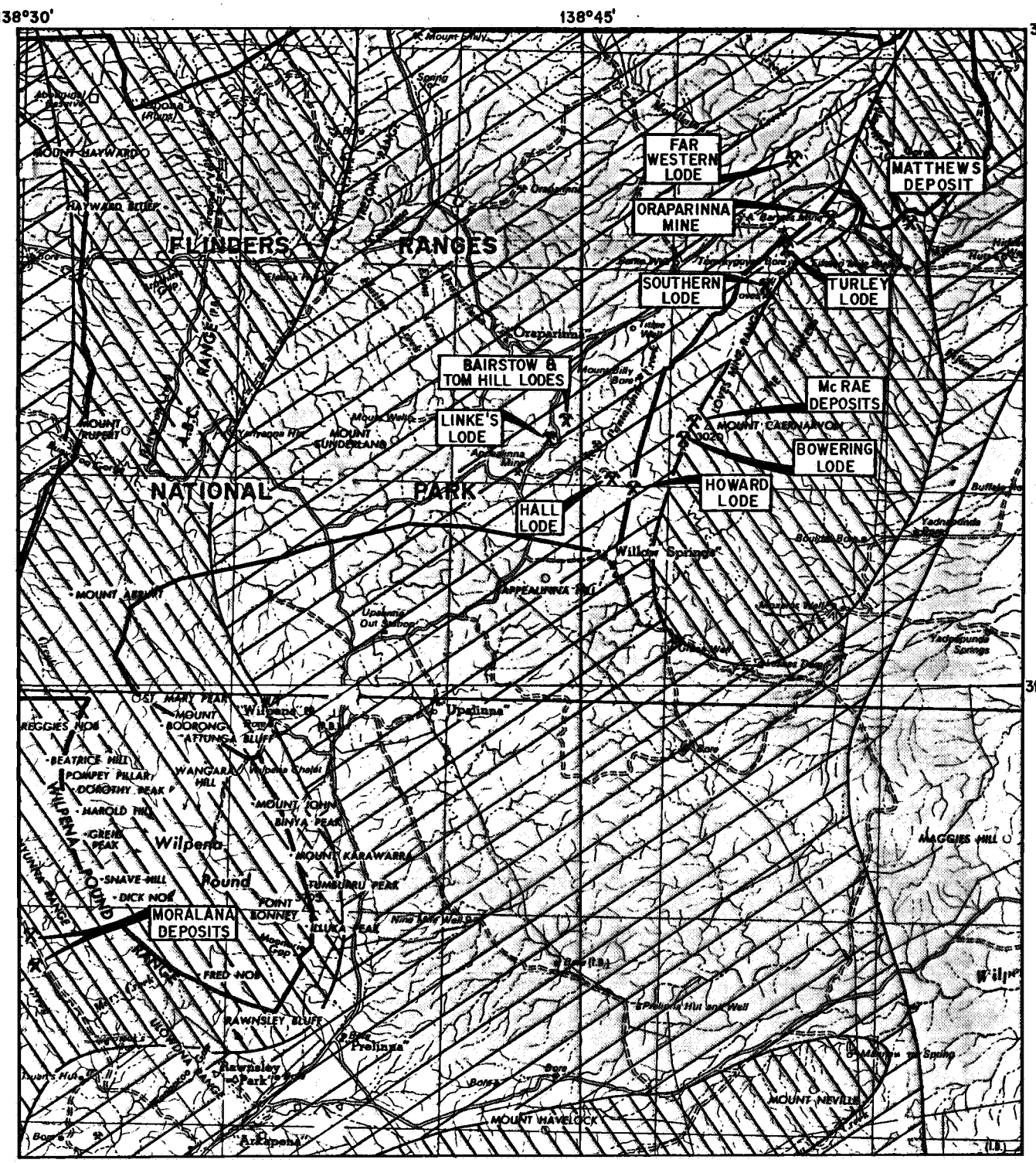
SCALE 1:250 000

km. 5 0 5 10 km.

FIG. 1

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: 1:250000
COMPILED: L. Barnes.	BARITE DEPOSITS — ORAPARINNA DIAPIR	DATE: 29-5-78
DRN: G.J.T. CKD:	LOCATION & REGIONAL GEOLOGY	PLAN NUMBER S13421

538



ENVIRONMENTAL AREAS

CLASS A | CLASS B | CLASS C

Flinders Ranges National Park Boundary.

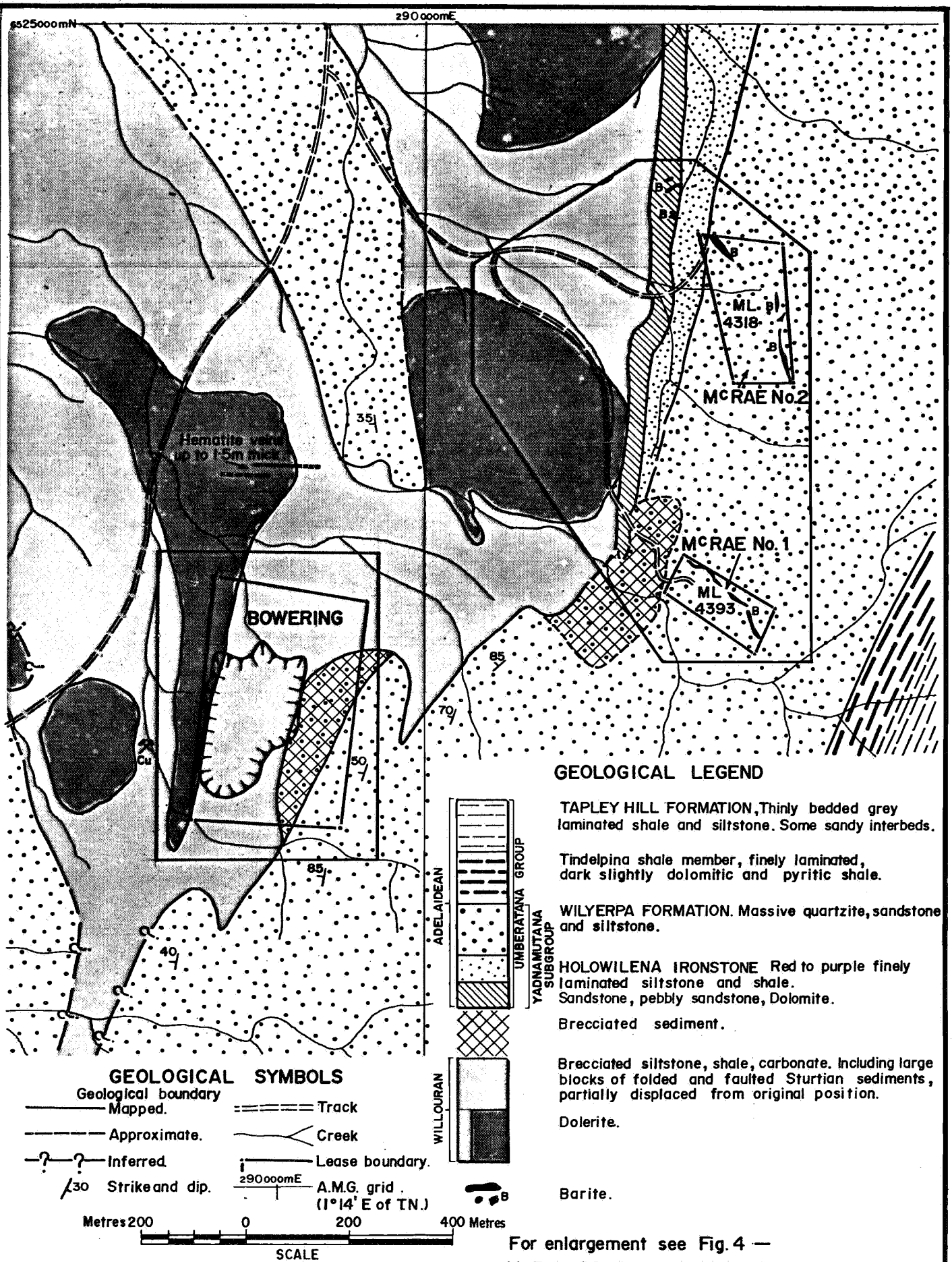
SCALE 1:250 000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

FIG. 2

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: 1:250 000
COMPILED: R. Harris.	BARITE DEPOSITS — ORAPARINNA DIAPIR	DATE: 29-3-79
DRN: G.J.T. CKD:	PLANNING AREAS & NATIONAL PARKS	PLAN NUMBER S13954

598



For enlargement see Fig. 4 — McRAE 80–430, BOWERING 81–343

FIG. 3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED P.J.

C.D.O. 12-11-81 DATE

DRAWN S.R.

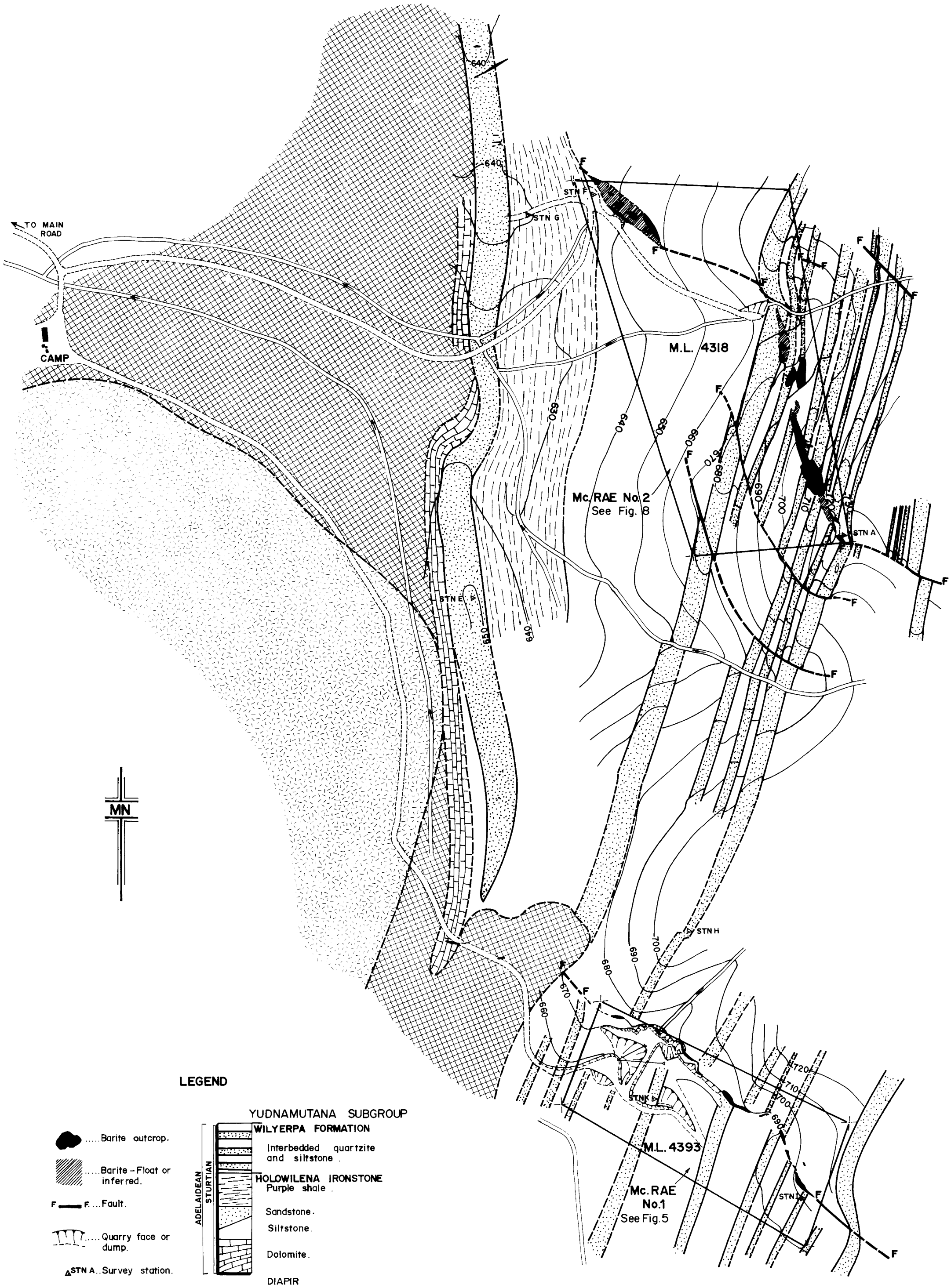
SCALE 1:10000

DATE 1/7/81

CHECKED

PLAN NUMBER S15623

McRAE AND BOWERING BARITE DEPOSITS
GEOLOGICAL PLAN



LEGEND

- Barite outcrop.
- Barite – Float or inferred.
- F — F ... Fault.
- Quarry face or dump.
- △STN A .. Survey station.
- 670 ..... Contours in metres (approx. A.H.D.)
- Creek
- Track
- Lease peg.
- Geological boundary Accurate
- Geological boundary Approximate.

M.L. 4393 Mineral Lease.

YUDNAMUTANA SUBGROUP

ADELAIDEAN — STURTIAN

WILYERPA FORMATION
Interbedded quartzite and siltstone.

HOLOWILENA IRONSTONE
Purple shale.

Sandstone.

Siltstone.

Dolomite.

DIAPIR

WILLOURAN

Breccia.

Dolerite.

FIG. 4

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

Mc RAE BARITE DEPOSITS

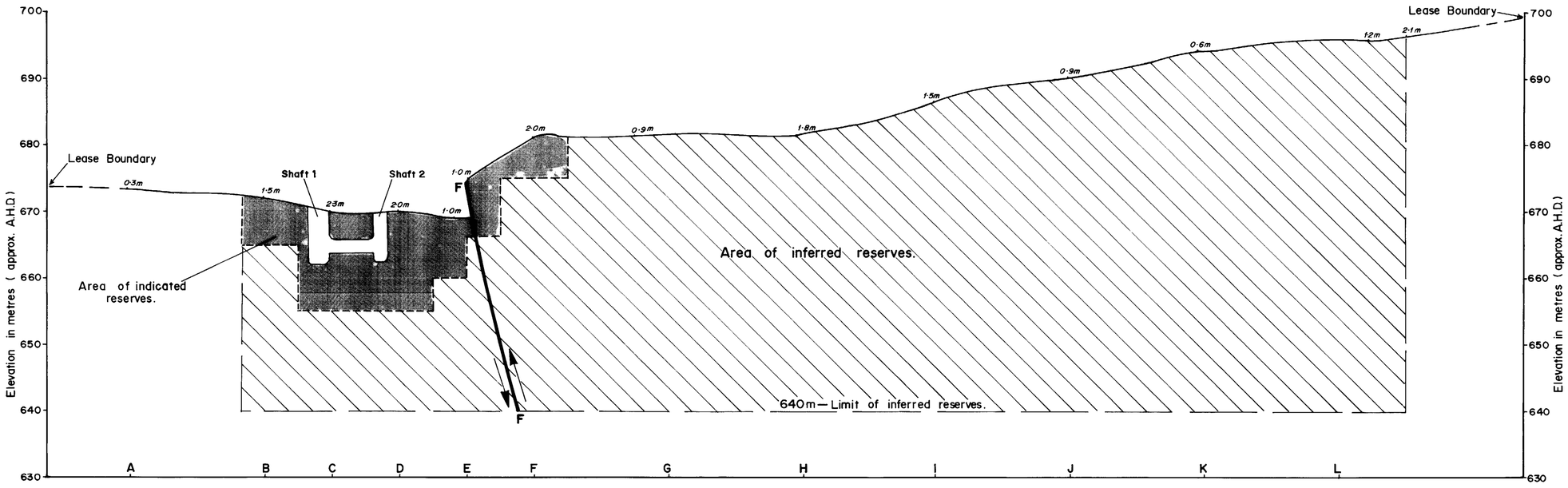
GEOLOGICAL PLAN

COMPILED	P.J.
DRAWN	S.R.
DATE	20/6/80
CHECKED	
C.D.O.	15-12-81 DATE
SCALE	1:2500
PLAN NUMBER	80-430

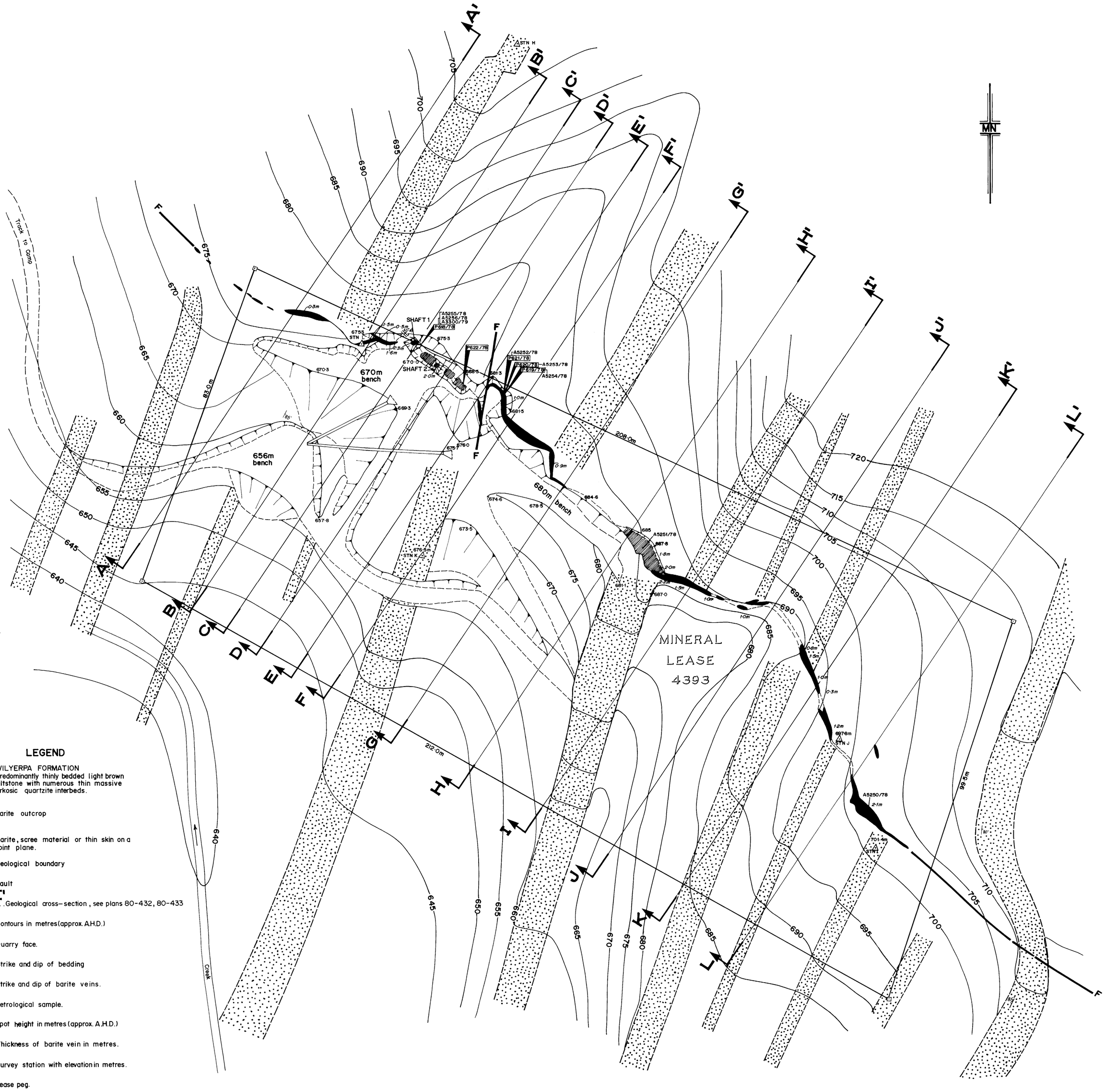
1969

NORTHWEST

SOUTHEAST



PROJECTED LODE SECTION



LEGEND

- WILYERPA FORMATION (STURTIAN) — Predominantly thinly bedded light brown siltstone with numerous thin massive arkosic quartzite interbeds.
- Barite outcrop
- Barite, scree material or thin skin on a joint plane.
- Geological boundary
- F — F. Fault
- E — E'. Geological cross-section, see plans 80-432, 80-433
- 670. Contours in metres (approx. A.H.D.)
- Quarry face.
- 80°. Strike and dip of bedding
- 45°. Strike and dip of barite veins.
- P620/78. Petrological sample.
- 684.6. Spot height in metres (approx. A.H.D.)
- 1·2m. Thickness of barite vein in metres.
- 697·1 STN A. Survey station with elevation in metres.
- Lease peg.
- A5250/78. Analytical sample.

METRES 10 0 10 20 30 40 50 METRES

SCALE

Geology: L.C. Barnes, P. Johnson, R.J. Harris.
Stadia Survey: P.P. Crettenden (S.F.B. 585)
Datum: Bunkers 1:50 000 Topo sheet approx. A.H.D.
Note: Mapped on 5/4/78, updated Nov. 79

FIG.5

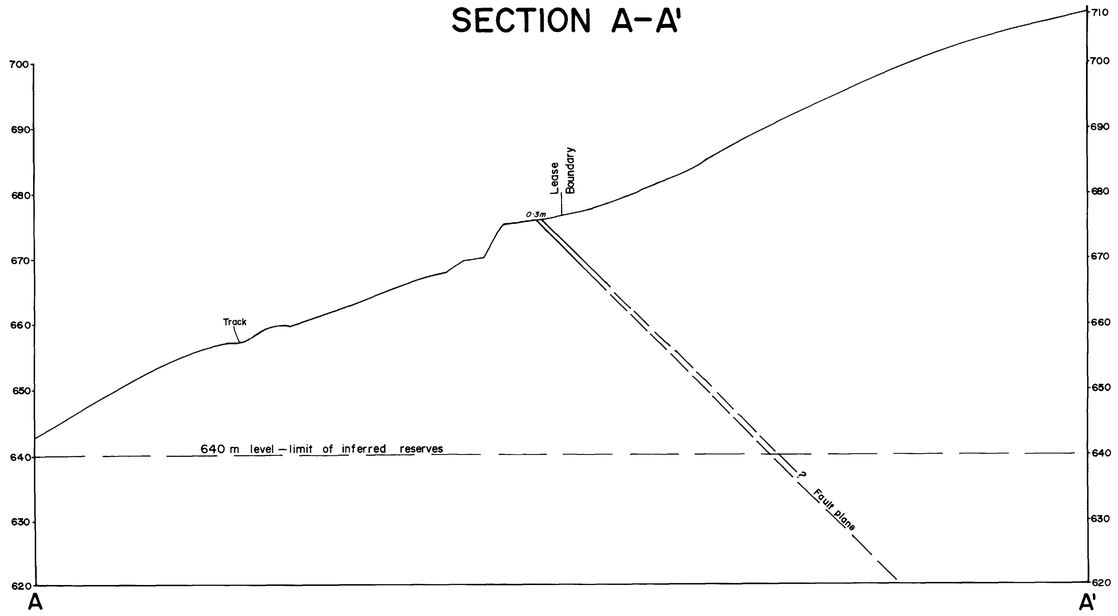
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Mc RAE BARITE DEPOSITS
No.1 LODE M.L. 4393
GEOLOGICAL PLAN AND SECTION

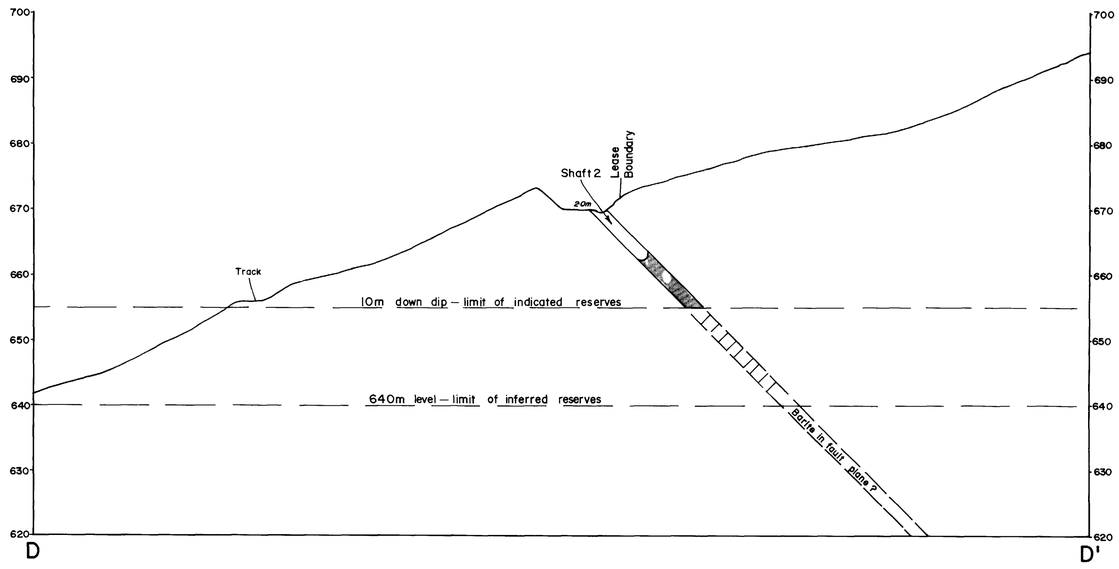
COMPILED	P.J.
DRAWN	S.R.
DATE	25/6/80
CHECKED	
C.D.O	15·12·81 DATE
SCALE	1:500
PLAN NUMBER	80-431

1969

SECTION A-A'

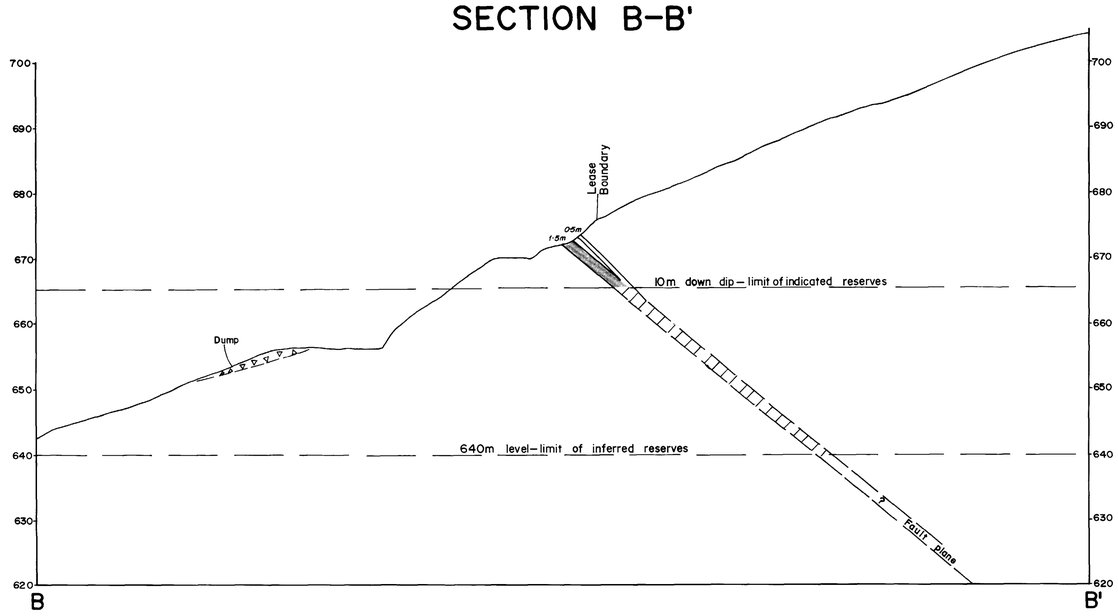


SECTION D-D'

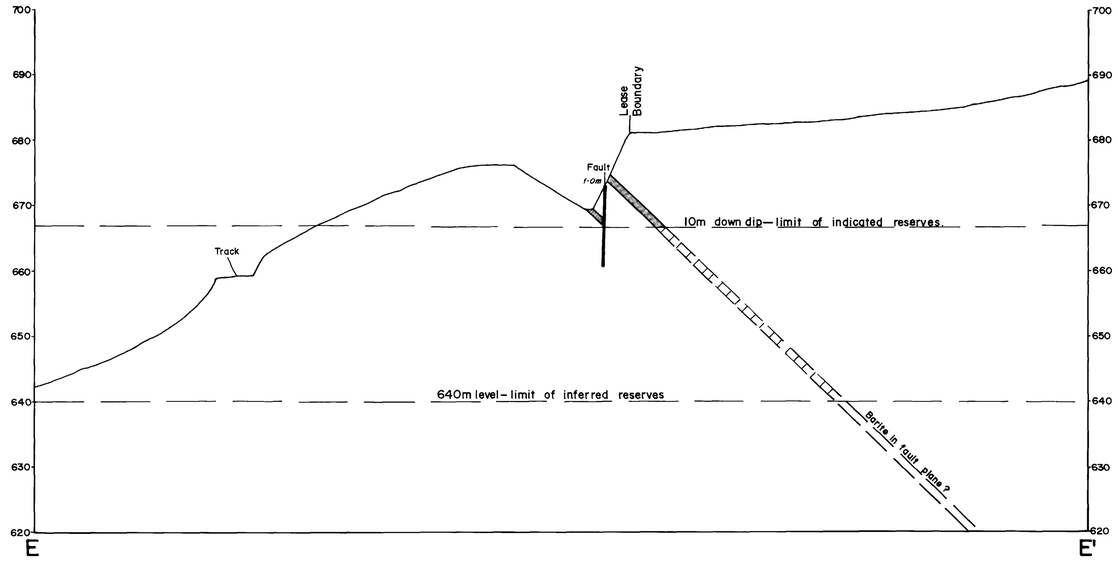


ELEVATION IN METRES (Approx. A.H.D.)

SECTION B-B'

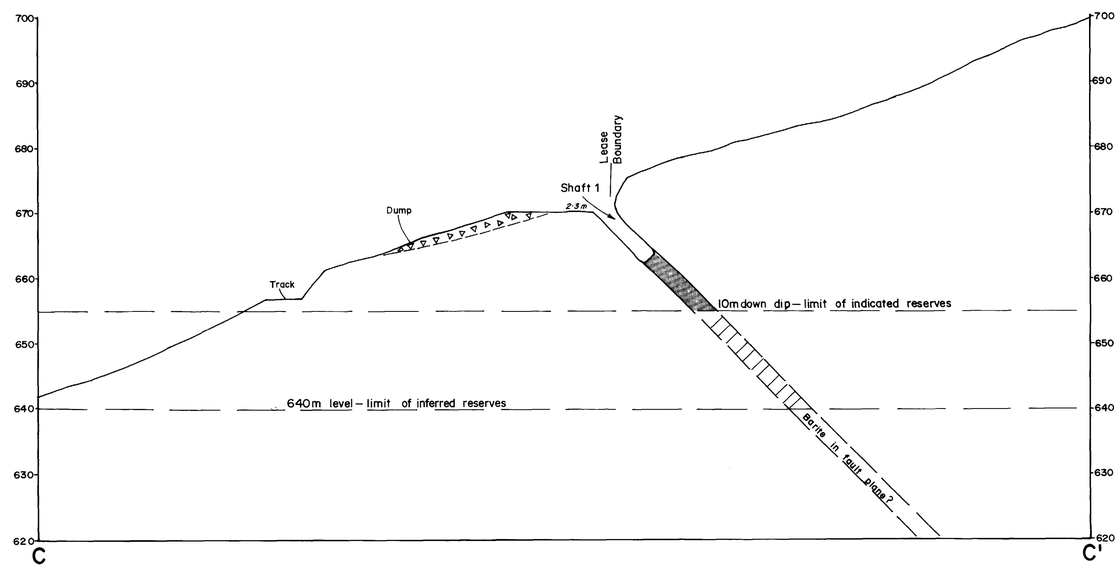


SECTION E-E'

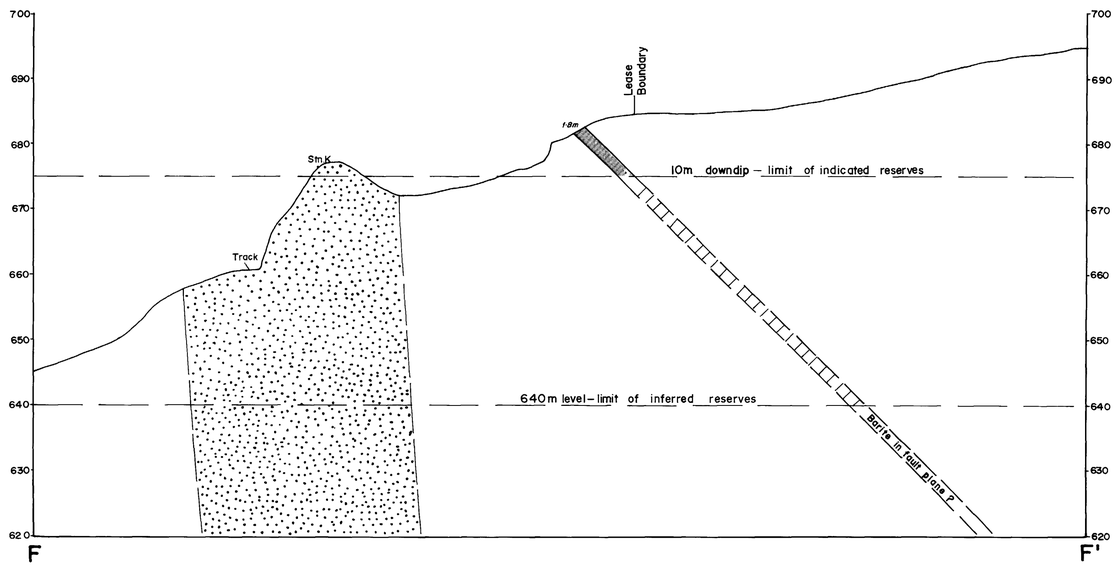


ELEVATION IN METRES (Approx. A.H.D.)

SECTION C-C'



SECTION F-F'



ELEVATION IN METRES (Approx. A.H.D.)

LEGEND

2·0m ... Thickness of barite vein in metres.

STURTIAN — WILYERPA FORMATION
Predominantly thinly bedded light brown siltstone with numerous thin massive arkosic quartzite interbeds.

Barite – Indicated reserves.

Barite – Inferred reserves.

SCALE
METRES 10 0 10 20 30 40 50 METRES

NOTE – For location of sections see plan 80–431

FIG. 6

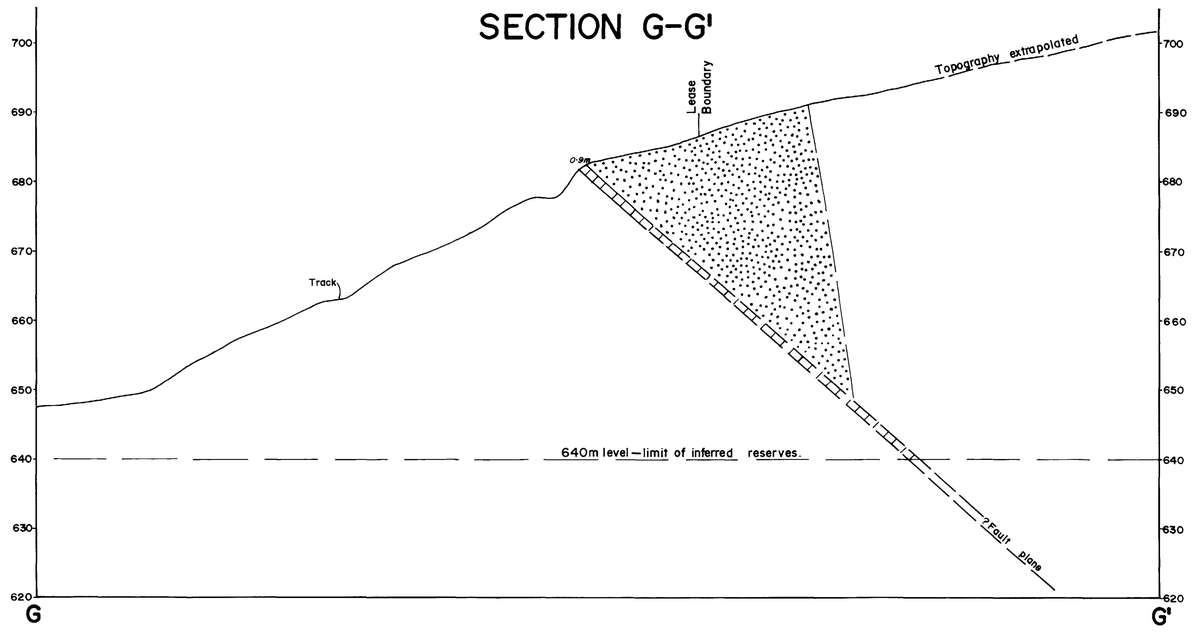
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Mc RAE BARITE DEPOSITS
No.1 LODE M.L. 4393
GEOLOGICAL SECTIONS A-F

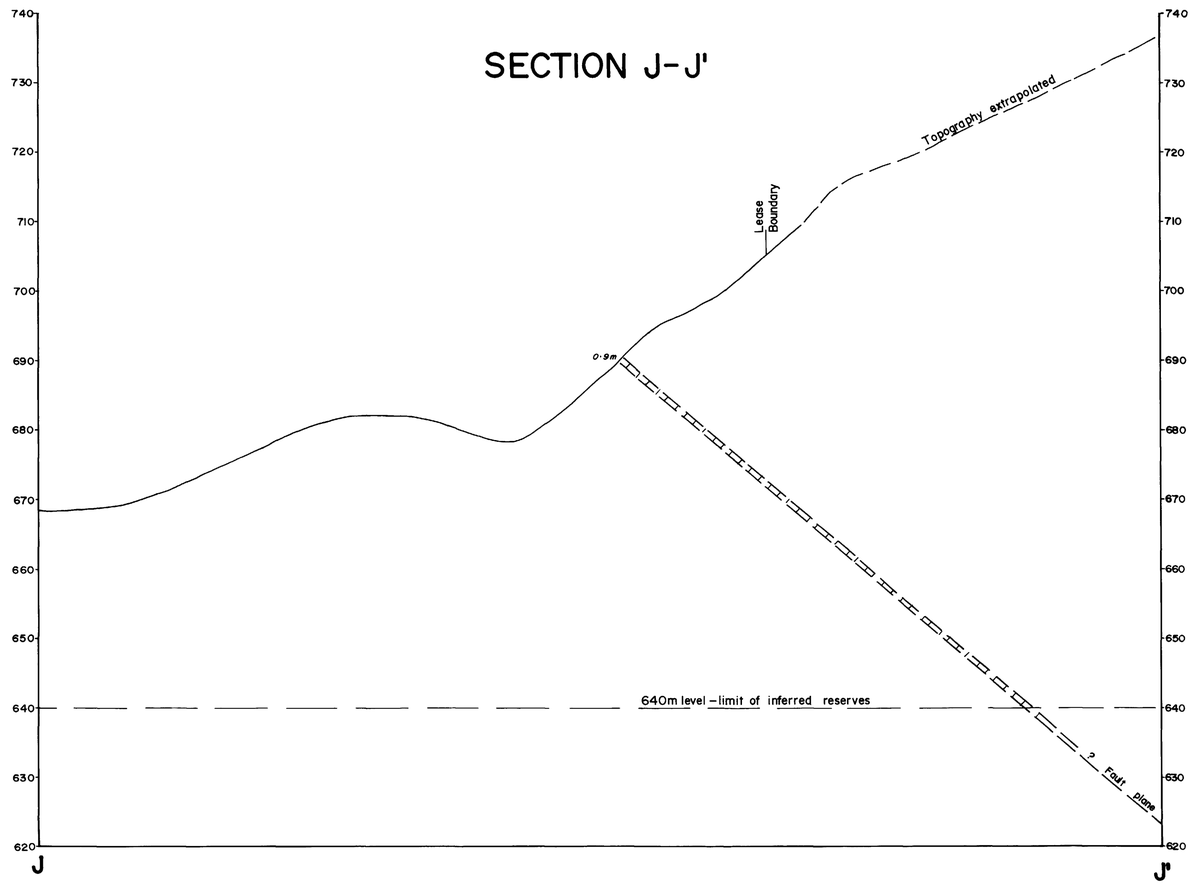
COMPILED	P.J.
DRAWN	S.R.
DATE	2/7/80
CHECKED	
C.D.O. DATE	15/12/81
SCALE	1:500
PLAN NUMBER	80-432

1969

SECTION G-G'

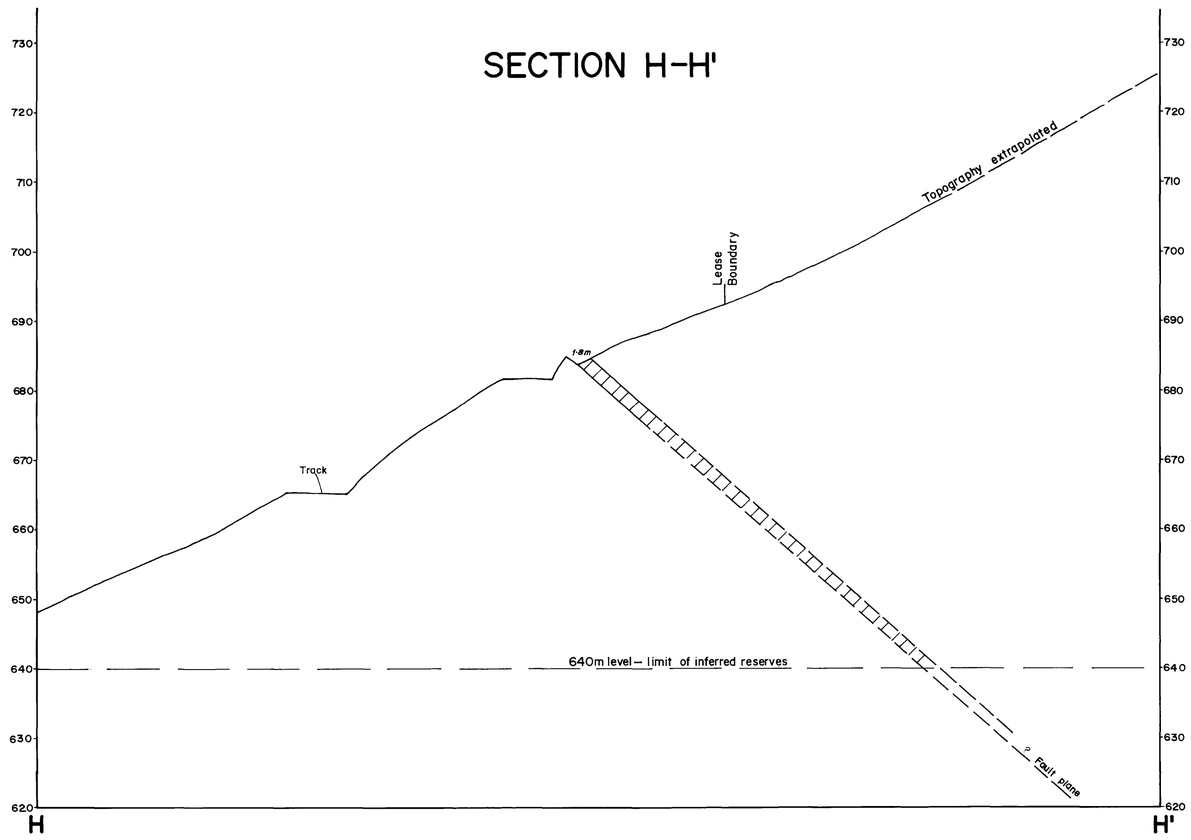


SECTION J-J'

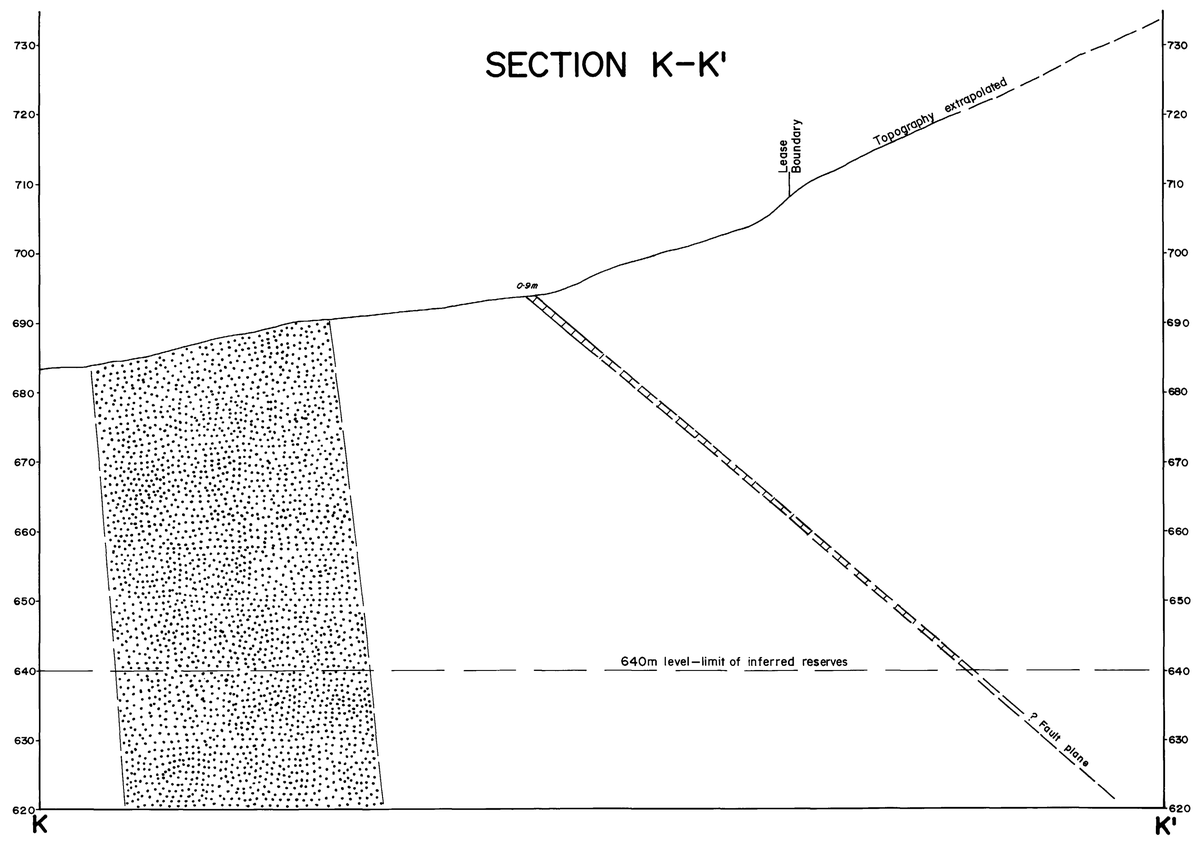


ELEVATION IN METRES (Approx. A.H.D.)

SECTION H-H'

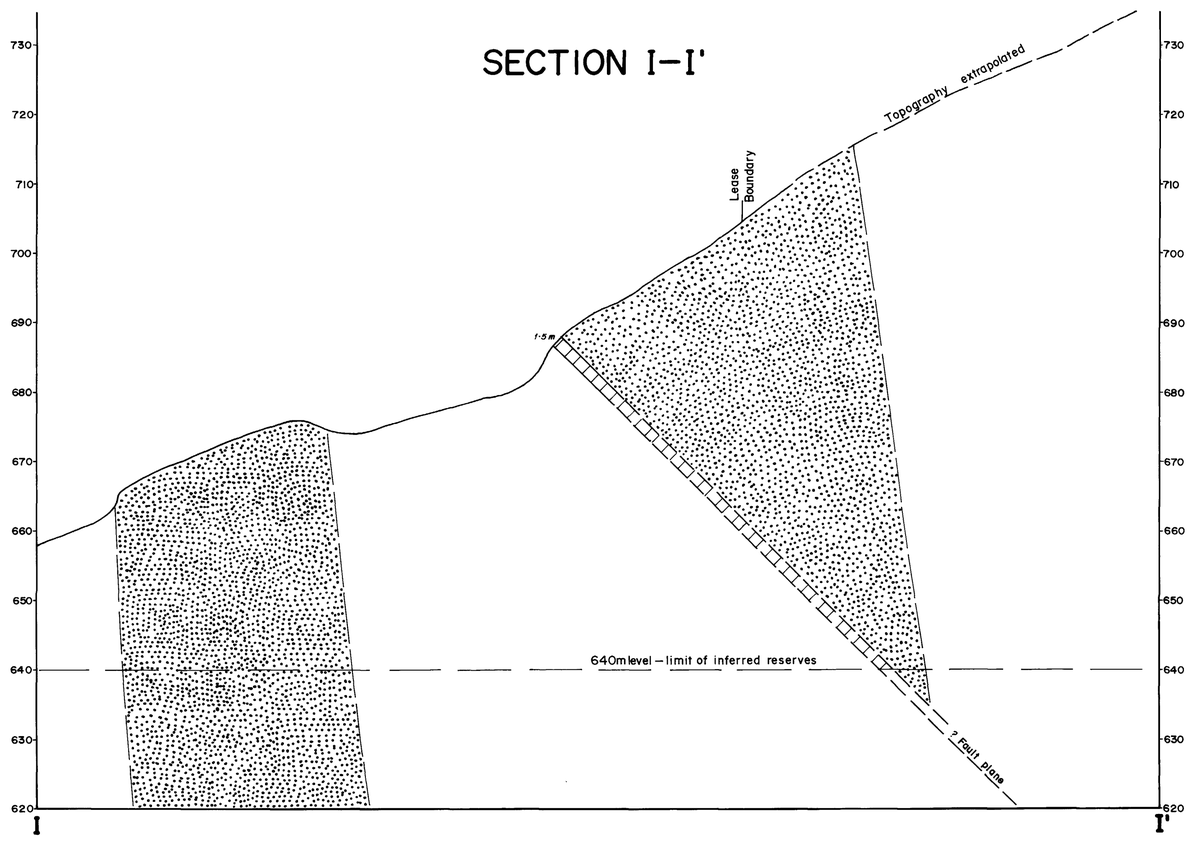


SECTION K-K'

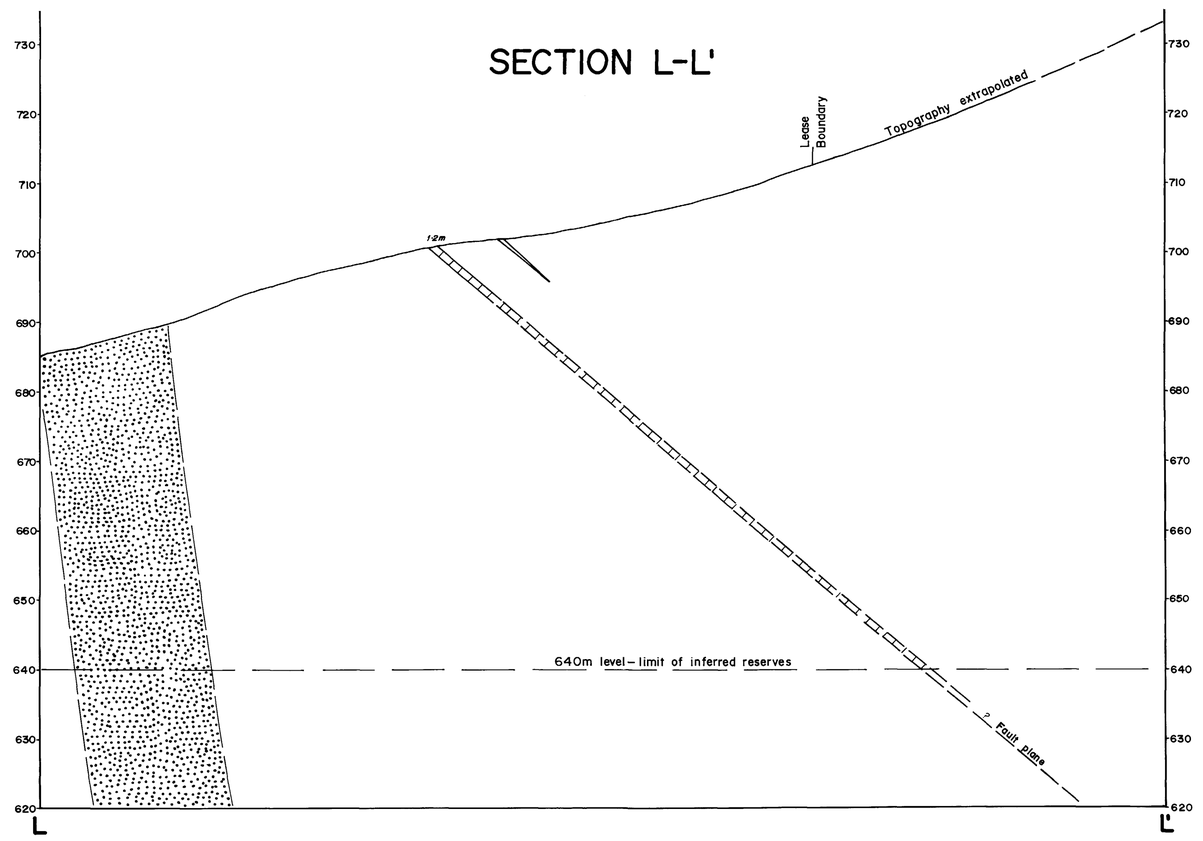


ELEVATION IN METRES (Approx. A.H.D.)

SECTION I-I'



SECTION L-L'



ELEVATION IN METRES (Approx. A.H.D.)

LEGEND

2·0m ...Thickness of barite vein in metres.

SILURIAN — WILYERPA FORMATION
Predominantly thinly bedded light brown siltstone with numerous thin massive arkosic quartzite interbeds.

Barite — Indicated reserves.

Barite — Inferred reserves.

SCALE
METRES 10 0 10 20 30 40 50 METRES

NOTE- For location of sections see plan 80-431

FIG.7

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

McRAE BARITE DEPOSITS
No.1 LODE M.L. 4393
GEOLOGICAL SECTIONS G-L

COMPILED	P.J.
DRAWN	S.R.
DATE	7/7/80
CHECKED	
C.D.O	12-12-81 DATE
SCALE	1:500
PLAN NUMBER	80-433

1952

MINERAL LEASE
4318

STN.F
637·1m

A5262/78

Track

Creek

Barite vein 0·15–0·2m

Thickness 0·3m

P454/78

A2828/78
P453/78

A2827/78

Limit of inferred reserves.

STN.D
693·4m

2·0m

A2826/78

P453/78

STN.C
709·6m

STN.B
716·1m

A2825/78
across vein

STN.A
723·7

A2824/78

P451/78

M.N.

LEGEND

STURTIAN
WILYERPA FORMATION
Predominantly thinly bedded light brown siltstone with numerous thin massive arkosic quartzite interbeds.

Purple finely laminated fissile shale.

Barite outcrop.

Barite, scree material or thin skin on a joint plane.

Geological boundary.
Accurate.
Approximate.

Fault.
F—F Accurate.
F---F Approximate.

A—A' Geological cross-section, see plans 78-886, 80-474

650 Contours in metres
Datum - approx. A.H.D.

Quarry face.

20° Strike and dip of barite vein.

32° Strike and dip of bedding.
Inclined
Vertical

20° Strike and dip of joint.

A2823/78 Analytical sample.

P453/78 Petrological sample.

△ STN.D 693·4m Survey station with elevation in metres.

⊡ Lease peg.

Approximate extent of open cut, with proposed quarry face.

1·2m Thickness of barite vein in metres.

SCALE
Metres 10 0 10 20 30 40 50 Metres

Geology by L. Barnes, W. McCallum and P. Johnson.
Stadia Survey by R.J. Harris and P.P. Crettenden.
(S.F.B. 582 & 585)
Mapped on 6,7 March 1978

FIG. 6

DEPARTMENT OF MINES AND ENERGY – SOUTH AUSTRALIA

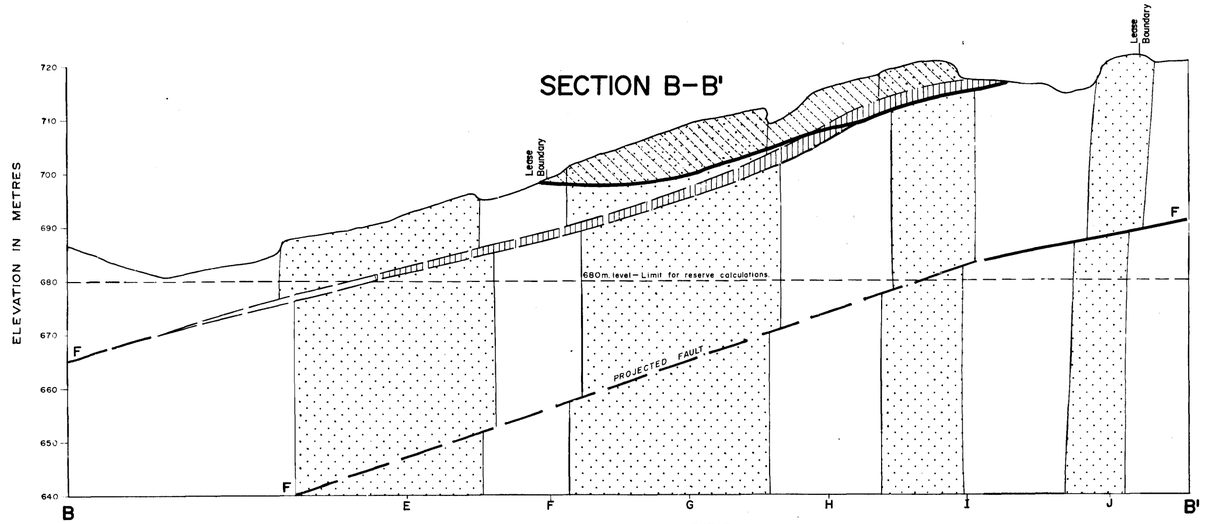
McRAE BARITE DEPOSITS
No.2 LODE M.L. 4318
GEOLOGICAL PLAN

	CO... P.Johnson	DR G.J Thorpe	SCAL 1:500	PLAN NUMBER
DIRECTOR GENERAL		CKD	DAT Nov. 1978	78-832

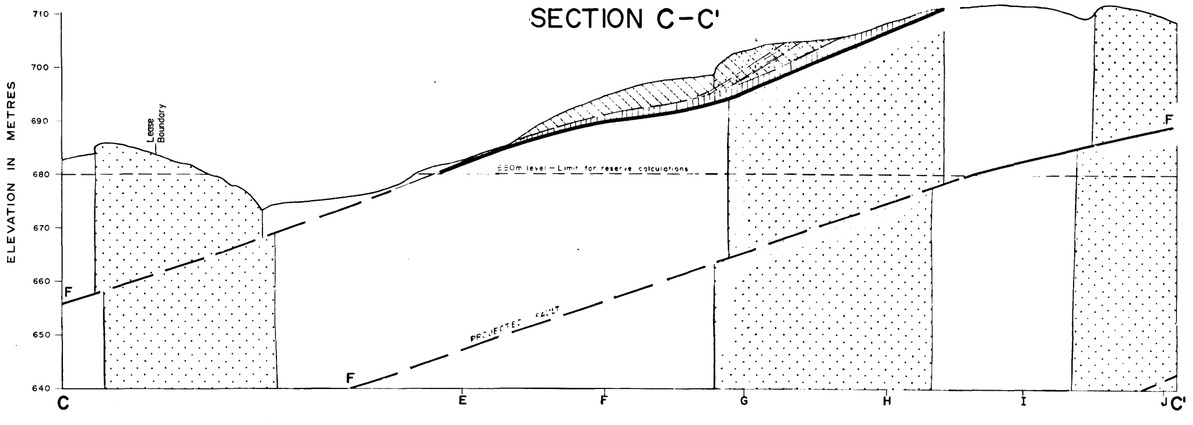
19-2

SECTION A-A'

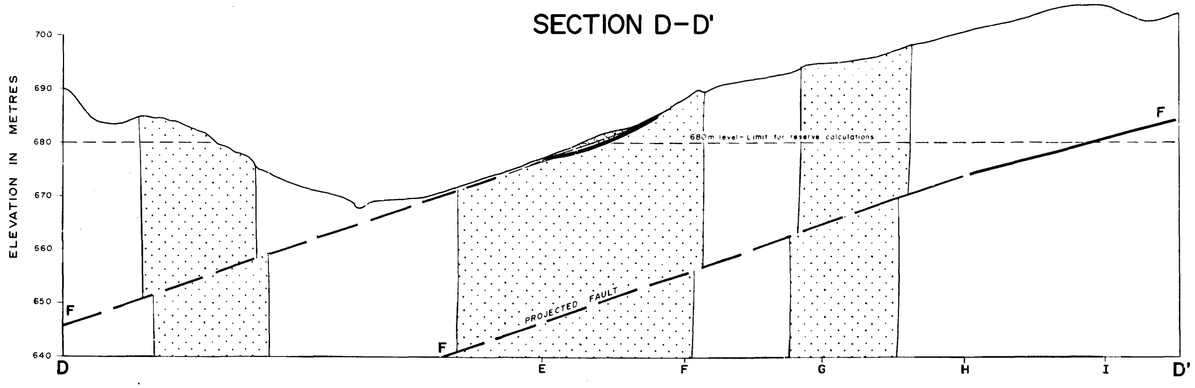
SECTION B-B'



SECTION C-C'



SECTION D-D'



LEGEND

STURTIAN — WILYERPA FORMATION. Predominantly thinly bedded light brown siltstone with numerous thin massive arkosic quartzite interbeds.

Barite – inferred reserves.

Barite – not included in reserve calculations.

Overburden.

Approximate extent of open cut.

F — F Fault

H Intersection with other sections

Datum – Approx. A.H.D.

For location of sections see plan 78-832

SCALE

METRES 10 0 10 20 30 40 50 METRES

FIG.9

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

McRAE BARITE DEPOSITS No.2 LODE M.L. 4318

GEOLOGICAL SECTIONS A-D

DRAWN P.J.

DATE 14-7-80

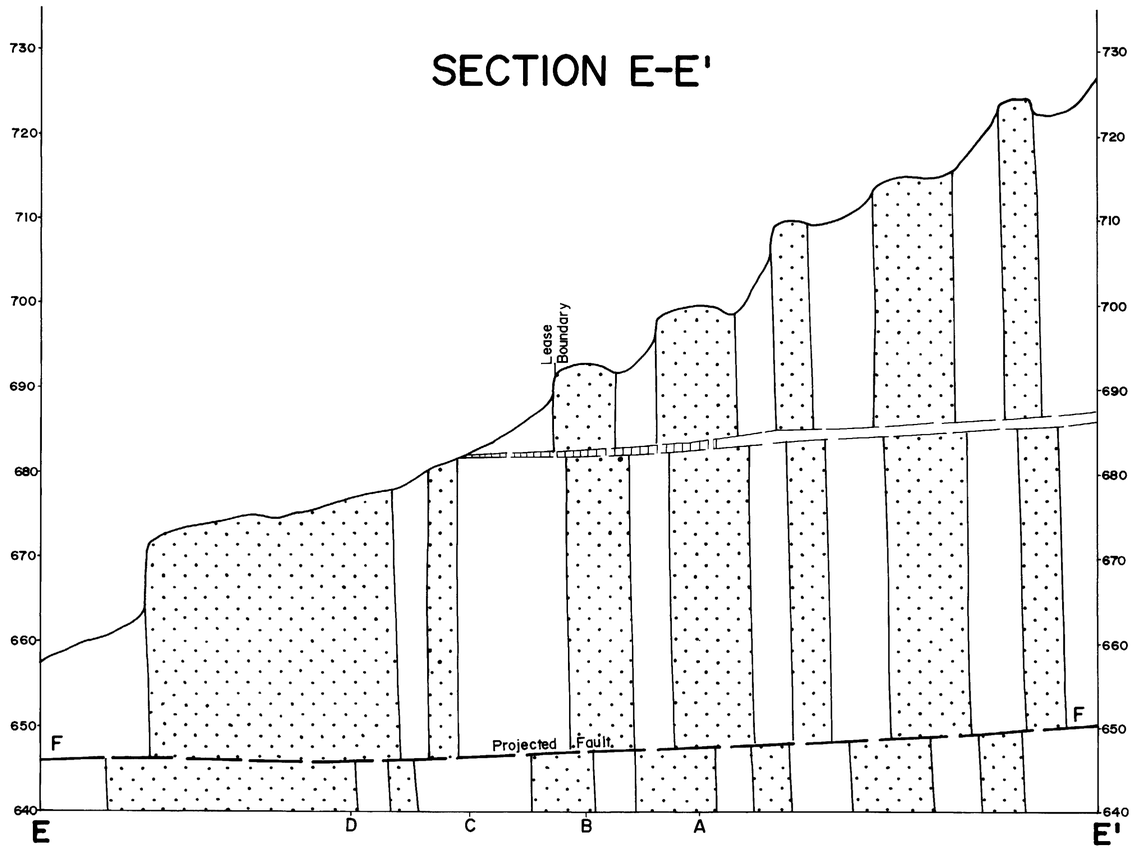
APPROVED

DATE

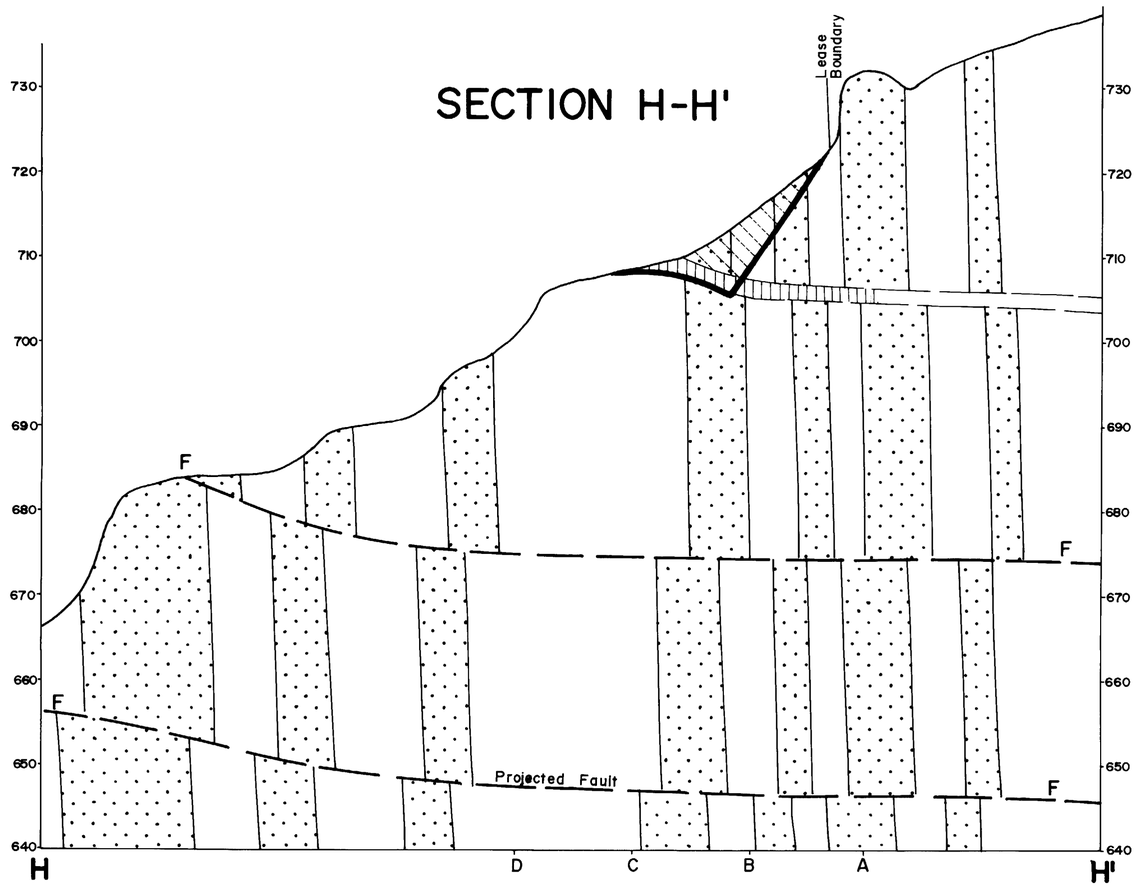
SCALE 1:500

PLAN No. 78-886

SECTION E-E'

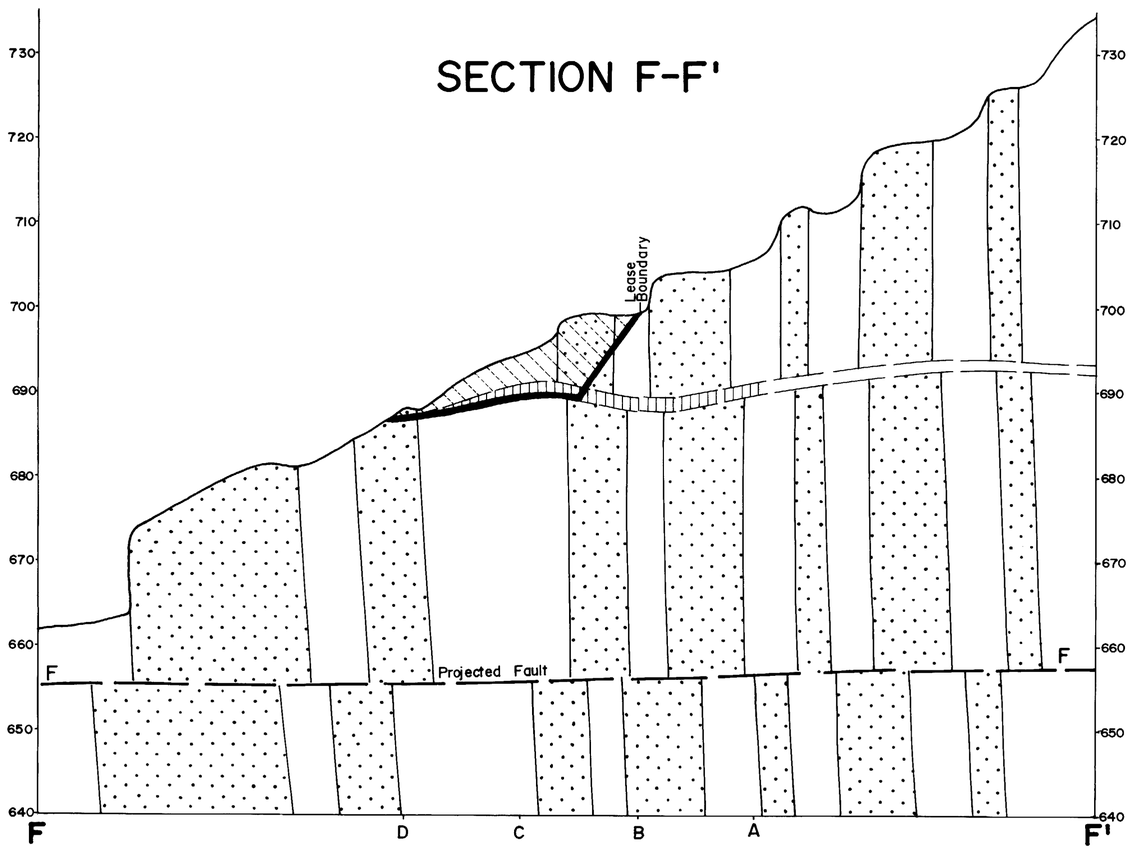


SECTION H-H'

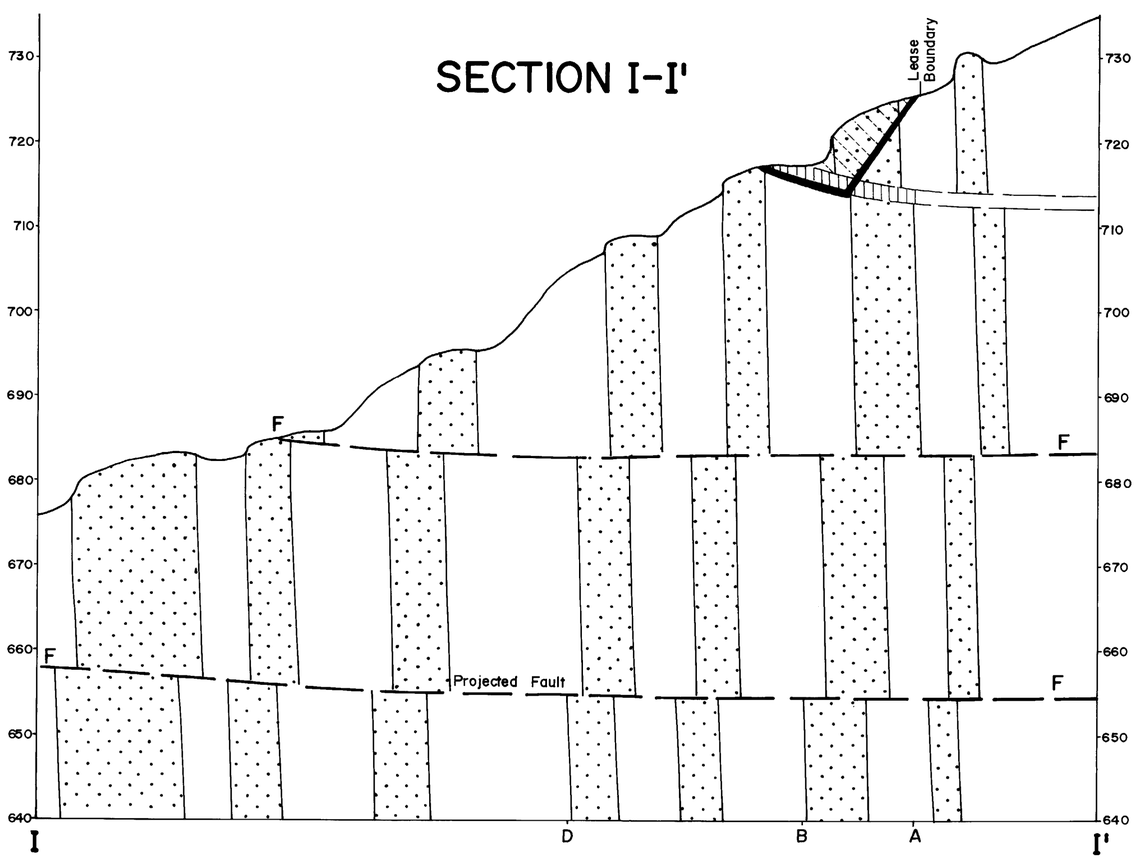


ELEVATION IN METRES

SECTION F-F'

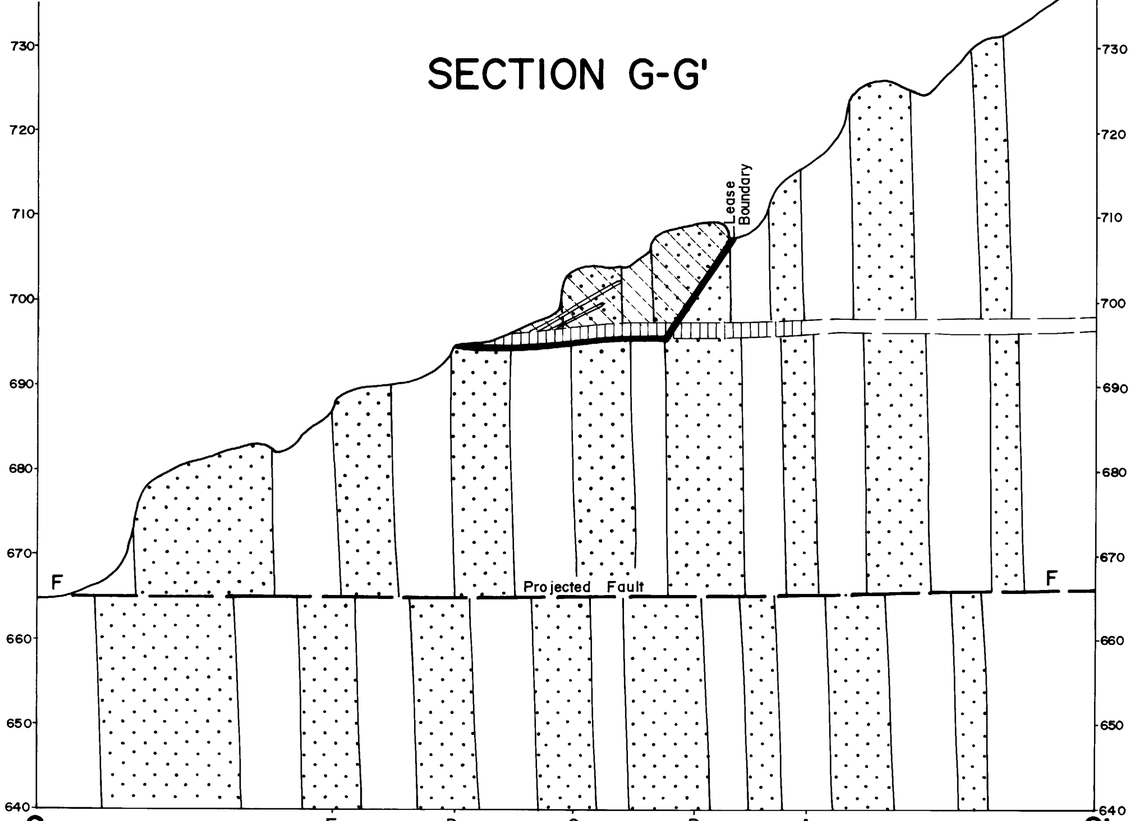


SECTION I-I'

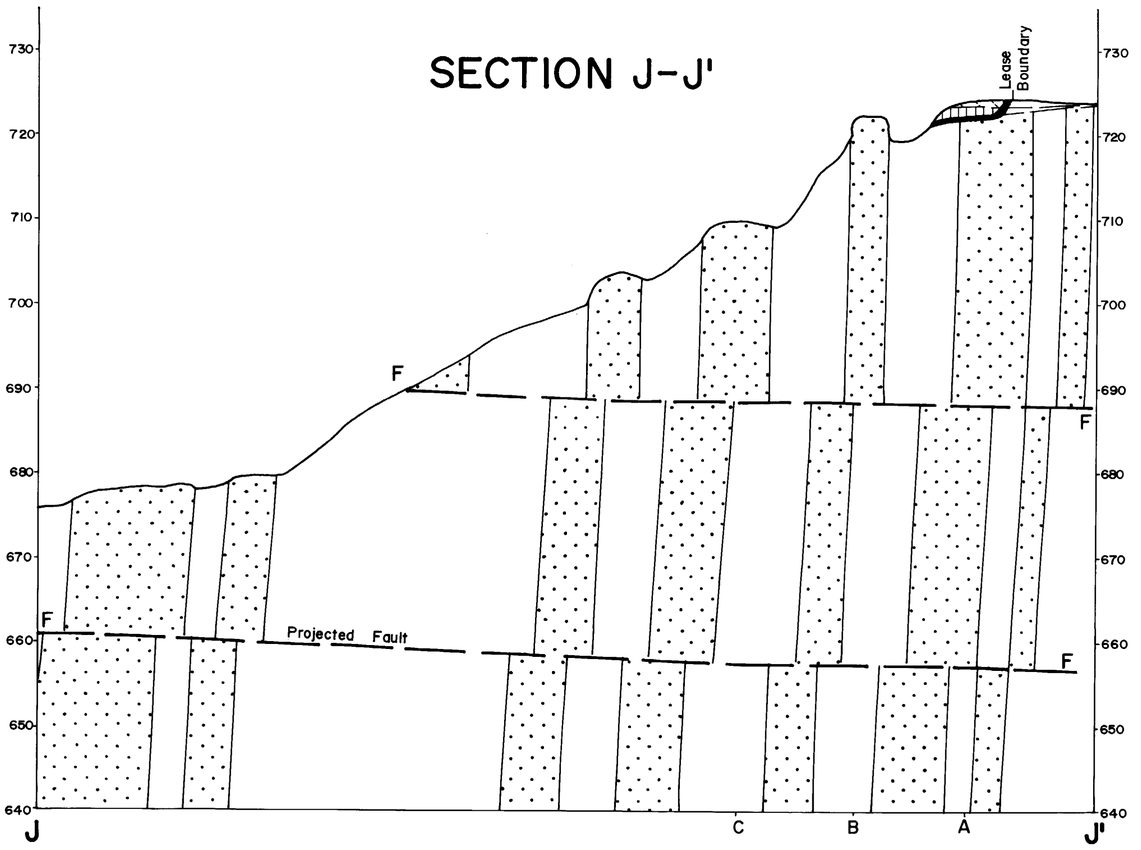


ELEVATION IN METRES

SECTION G-G'



SECTION J-J'



ELEVATION IN METRES

LEGEND

STURTIAN — WILYERPA FORMATION
Predominantly thinly bedded light brown siltstone with numerous thin massive arkosic quartzite interbeds.

Barite — inferred reserves.

Barite — not included in reserve calculations.

Overburden.

Approximate extent of open cut.

F F Fault.

H Intersection with other sections.

SCALE
METRES 10 0 10 20 30 40 50 METRES

Datum — Approx. A.H.D.

For location of sections see plan 78-832

FIG. 10

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

McRAE BARITE DEPOSITS
No.2 LODE M.L. 4318
GEOLOGICAL SECTIONS E-J

COMPILED	P. J.
DRAWN	S. R.
DATE	17/7/80
CHECKED	
C.D.O.	15 · 12 · 81 DATE
SCALE	1:500
PLAN NUMBER	80-474

1983