DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 82/80
NILPENA BARITE DEPOSITS
GEOLOGICAL INVESTIGATIONS 1978-79
Out of Counties, Flinders Ranges

GEOLOGICAL SURVEY

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ABSTRACT

Nilpena barite deposits comprise No. 1 and No. 2 lode systems and Jim Crow lode on the western flanks of the Flinders Ranges.

No. 1 and No. 2 lode systems cross cut Brachina Formation siltstone on the western limb of the anticlinal Nuccaleena Dome whereas Jim Crow lode has been emplaced along bedding of Elatina Formation sandstone.

No. 1 lode system on ML 4537 consists of 5 individual lodes on a single structure. No. 2 lode system on ML 4649 consists of 4 lodes en echelon.

Indicated geological reserves of oil drilling grade barite to a depth of 5 m on developed lodes total -
No. 1 lode system 8 350 tonnes
No. 2 lode system 8 050 tonnes
Jim Crown lode is too small to be mined.

INTRODUCTION

Nilpena barite lodes were visited by J.G. Olliver, D.C. Scott (Geologist) and R.J. Harris (Technical Assistant) on 14 June 1975 during an inspection of barite deposits in the Flinders Ranges.

Nilpena No. 1 and 2 lode systems were mapped by stadia theodolite by J.G. Olliver, L.C. Barnes and P.P. Crettenden (Field Assistant) on 31 May and 1 June 1978. Subsequent mining development on No. 1 and 2 Lode systems was mapped by plane table by J.G. Olliver, L.C. Barnes, W.S. McCallum and T. Papanikolas (Field Assistant) on 28 June 1979. This report includes plans of barite lodes before and after mining.

Jim Crow lode was inspected on 28 June 1978 but not mapped. No. 1 and No. 2 lode systems were inspected briefly on 26 October 1980 by L.C. Barnes, R.S. Robertson (Geologist), P.P. Crettenden, and K.A. Salgo (Field Assistant) to document mine development since the 1979 mapping.

A total of 27 samples of barite were submitted to Australian Mineral Development Laboratories (AMDEL) for chemical analysis and determination of specific gravity and reflectance. Results are detailed in Appendix A.

Five petrological descriptions of barite are included in Appendix B and six petrological descriptions of country rock near Nilpena barite deposits from Leeson (1970), are included in Appendix C.

LOCATION AND ACCESS

Nilpena barite lodes are on Moolooloo Station, out of Counties, 20 km north of Parachilna, near the western margin of the central Flinders Ranges. The deposits lie within a Class C Environmental Area as defined in the Flinders Ranges Planning Area Development Plan (Fig. 1).

No. 2 lode system is on the southern and eastern banks of Bitter Springs Creek, a major stream channel draining onto Lake Torrens plain from the western flanks of the ranges, 5.5 km northeast of the abandoned Nilpena (or Blackfellows Creek) railway siding on the disused narrow gauge railway line (Fig. 2). No. 1 lode system is 1.5 km south of No. 2 system, and Jim Crow Lode is about 4.5 km to the northeast on the southern bank of Breakfast Time Creek, about 0.7 km southeast of Walters Well.

Before late 1978, No. 1 and No. 2 lode systems were reached by turning off the Hawker - Leigh Creek road at the old railway siding and following a station track 4 km northeasterly to where the track crossed Bitter Springs Creek, then along the creek bed easterly for 2 km to the western end of No. 2 lode system. A poorly defined track followed Bitter Springs Creek and several tributary creeks easterly, then southerly to Lyford's cut on 1 D lode (Fig. 3).

To provide access for modern mining equipment the leaseholder constructed a new access track in 1979 by following the track from the old railway siding easterly for 6 km to the western end of No. 1 lode sytem, then northerly for 1.5 km to No. 2 lode system (Fig. 2). These tracks provide access for conventional vehicles except after heavy rain.

Jim Crow Lode is reached by continuing along the northeasterly track from the old railway siding beyond Hunter Spring Well and Temple Bar Spring for a total distance of about 12 km. In places, this track which follows creek beds is poorly defined and rough, suitable only for 4 wheel drive vehicles.

The barite deposits are in gently undulating terrain, sparsely vegetated with stunted acacia and eremophila bushes and blue bush, whereas to the west, ABC Range Quartzite forms a prominent strike ridge (Plate 2). In contrast to most eucalypt lined creeks in the Flinders Ranges, Bitter Springs Creek supports thick stands of paper bark (Melaleuca sp). Several small springs in the creek provide permanent water in all but the driest seasons.

MINERAL TENURE

Table 1 lists Mineral Claims (MC) and Mineral Leases (ML) over No. 1 and No. 2 lode systems. Exact locations of mineral claims pegged before 1975 are unknown as claims were plotted on Departmental plans based on information supplied by the claim holder. Hence, the actual lode covered by claims before 1975 is not definite, and the areas of these early claims are only approximate.

MC 347 and 338 were pegged in September 1941 by E.A. Gill and H. Trezona over the northern part of No. 1 lode system, both lapsing in 1942. In 1945, Mrs. V.M.M. Lyford pegged MC 758 and 759 over the northern part of No. 1 lode system and MC 791 over the western part of No. 2 lode system. H. Trezona pegged MC 788 to the northeast of MC 759, probably over the northern extension of 1E lode, and the claim lapsed in 1946. The open cut on 1D Lode, known as Lyford's Cut, was worked in 1946. Claims held by Mrs. Lyford lapsed in 1968.

MC 719 pegged by H.M.F. Nickels, a director of Australian Barytes P/L (ABAR), in 1975 over No. 1 lode system, was converted to ML 4537 on 9/9/76. MC 730 over No. 2 lode system, was pegged by R.B. Reid in 1976, lapsed in 1977, and was repegged by his wife, S.A. Reid, as MC 864. MC 864 was converted to ML 4649 on 25/10/78.

ML 4537 was transferred to ABAR Holdings in 1977, then to several subsidiary companies before being sold, together with all of ABAR's South Australian assets to Steetley Industries Pty. Ltd. (Steetley) in 1981. ML 4649 was transferred to ABAR in 1979 and was also sold to Steetley.

ML 4537 and 4649 were both granted for 7 years, with right of renewal. The areas of 9.8 ha and 17.8 ha respectively are based on survey data on Figures 4 and 6.There is no record of any tenement over Jim Crow lode.

TABLE 1

MINING TENEMENTS, NILPENA BARITE DEPOSITS

No 1 Lode System

Tenement	Area (ha)	Holder	Lode	Registered	Terminated	Comments
MC 347	16	E.A. Gill	1D	8/9/41	10/9/42	Replaced by MC 758?
MC 338	16	H. Trezona	1D-1E	9/9/41	11/2/42	Adjacent to north of MC 347. Replaced by MC 759.
MC 758	16	V.M.M. Lyford	1D	6/8/45	9/2/68	
MC 759	16	V.M.M. Lyford	1D-1E?	6/8/45	9/2/68	
MC 788	16	H. Trezona	1E	2/11/45	5/11/46	Adjacent to north of MC 759.
MC 719	9.8	H.M.F. Nickels	1A-1E	24/11/75	11/9/76	Converted to ML 4537.
ML 4537	"	"	"	9/9/76	Expires 8/9/83	Transferred to ABAR Holding P/L, 9/12/77. Transferred to Matfor Mining P/L (ABAR subsidary), 28/7/78. Transferred to Hawbar Mining P/L (ABAR subsidary), 11/7/79. Transferred to Steetley Industries, 26/3/81.

No. 2 Lode System

Tenement	Area (ha)	Holder	Lode	Registered	Terminated	Comments
MC 791	16	V.M.M. Lyford	2A	10/11/45	4/7/68	
MC 730	17.8	R.B. Reid	2A-2D	12/11/76	12/1/77	Replaced by MC 864.
MC 864	17.8	S.A. Reid	2A-2D	30/9/77	25/10/78	Converted to ML 4649.
ML 4649	"	"	2A-2D	25/10/78	Expires 24/10/85	Transferred to Matfor Mining P/L, 23/2/79. Transferred to Hawbar Mining P/L, 11/7/79. Transferred to Steetley Industries Ltd., 26/3/81.

PRODUCTION

Barite production, as recorded in returns submitted to the Department of Mines and Energy, is listed in Table 2.

The only production before 1979 was 10 tonnes from 1D lode (Lyford's Cut) by Mrs. V.M.M. Lyford in 1946. The original open cut as mapped in 1978, measured 8 m by 4 m by 4 m deep (Fig. 4) with barite approximately 3 m thick. An inferred 400 tonnes of barite had been removed and several hundred tonnes remained in stockpiles on site in 1978.

In 1979, ABAR started development of open cuts on all of No. 1 lode system, and produced 602 tonnes.

In 1980, output from No. 1 lode system was supplemented by the opening of No. 2A lode. In the first half of 1981, ABAR then Steetley, continued production from No. 1 lode system. In the latter half of 1981 Steetley continued production from No. 1 lode system, and from 2A and 2D lodes.

Total production to December 1981 is 4 125 tonnes, just over half of which was mined in 1981.

TABLE 2

RECORDED PRODUCTION

NILPENA BARITE DEPOSITS

	No. 1 lode system		No. 2 lode system		TOTAL
	Tonnes	Operator	Tonnes	Operator	
1946	10	V.M.M. Lyford	-	-	10
1947-78	-	-	-	-	-
1979	602	ABAR	-	-	602
1980	798	"	650	ABAR	1 448
1981	1 265	ABAR-STEETLEY	800	STEETLEY	2 065
TOTAL	2 675		1 450		4 125

GEOLOGICAL SETTING

Nilpena barite deposits are on Beltana 1:63 360 map sheet (Leeson, 1966), on which the regional geological plan (Fig. 2) is based, in the southwestern corner of COPLEY (Coats, 1973). The geology of Beltana is detailed in Leeson (1970).

Barite veins have formed within a sequence of Adelaidean sediments of Upper Proterozoic age, on the western limb of a major anticlinal structure, the Nuccaleena Dome. No. 1 and No. 2 lode systems are hosted by Marinoan Wilpena Group sediments, which trend north northwesterly with moderate westerly dip. Jim Crow lode is within shallow northwesterly dipping Umberatana Group sediments.

Diapiric breccia, comprising disrupted Willouran sediments crops out in the Nilpena Diapir south southwest of No. 1 lode system and in the Greenwell Diapir to the east (off Figure 2).

Two major faults, Breakfast Time Fault and Nuccaleena Fault strike northeasterly across the Nuccaleena Dome, and the barite veins have been emplaced in similar fault structures subparallel to these.

Adelaidean sediments exposed near Nilpena barite deposits are, in ascending stratigraphic order,

Umberatana Group - undifferentiated on Figure 2, comprising,

- Enorama Shale — purple siltstone and thinly bedded grey green silty shale.
- Trezona Formation — grey - calcareous shale with some dolomite interbeds.
- Elatina Formation - purplish red sandstone and quartzite.

Wilpena Group

- Nuccaleena Formation - well bedded, cream weathering pink dolomite overlain by purple shale and interbedded dolomite.

- Brachina Formation, subdivided by Leeson (1970) into 3 members, the type section being along Bitter Springs Creek from 30°57'30" South, 138°25'30" East to 30°57'16" South, 138°27'21" East (see Fig. 2).
  - Moolooloo Siltstone Member: 100 m of basal red siltstone overlain by 500 m of well bedded unbanded drab olive green micaceous siltstone, with fine cross bedding.
  - Moorillah Siltstone Member: 400 m thick, buff to purple fine grained quartzite and sandstone interbeds at base, up to 10 m thick and interbedded with shale, some local conglomerate; overlain by massive, coarse grained, dark purple to red, banded siltstone, with some soft laminated siltstone interbeds, and some thin quartzite beds.
  - Bayley Range Siltstone Member: 250 m thick, drab olive green siltstone with occasional interbeds of hard grey weathering fine grained arkose.
- ABC Range Quartzite: clean white ortho-quartzite overlain by medium grained heavy-mineral banded feldspathic sandstone and drab siltstone.
- Bunyeroo Formation - dark red finely laminated dolomitic shale.
- Wonoka Formation: interbedded blue-grey limestone and siltstone.

- Pound Quartzite: massive to flaggy white orthoquartzite.

Six petrological descriptions from Leeson (1970) in Appendix C comprising 5 samples from Brachina Formation and one from ABC Range Quartzite at locations shown on Figure 2.

SITE GEOLOGY

Barite at Nilpena is contained within two main lode systems; each comprises numerous stringers and veins, with some sufficiently thick to be mined.

Both lode systems are within Brachina Formation, which dips 30^0 to 40^0 to the west or southwest. No. 1 lode system is entirely within Moorillah Siltstone Member, whereas No. 2 lode system extends from the thin sandstone at the base of Moorillah Siltstone Member in the east through to the middle of Bayley Range Siltstone Member in the west. ABC Range Quartzite crops out 250 m to the west.

Sandstone and quartzite interbeds at the base of Moorillah Siltstone are discontinuous, intertongueing with siltstone, and show displacement where cut by barite veins, indicating movement along the structures which contain barite.

The third barite vein, Jim Crow lode is hosted by purple and red sandstone of Elatina Formation.

Barite veins are of the infill open fissure type, having formed by precipitation of barium sulphate from hot aqueous solutions under moderate to high pressure. The barite infills numerous subparallel fractures, probably related to the nearby diapiric structures from which several major faults radiate. Barium rich solutions may have originated from the diapirs whilst the sulphate may be related to connate fluids derived from Adealidean sediments (Robertson 1981), barite being precipitated when barium-rich solutions mixed with sulphate-rich solutions.

NO. 1 LODE SYSTEM - A number of separate lodes and veins have been emplaced along a single continuous northeasterly trending fracture zone over a strike length of about 700 m.

Five individual lodes are recognised, designated 1A in the west to 1E in the east separated by either barren zones or thin, interconnecting barite stringers (Fig. 4). No plunge was recognized for any of the lodes.

1A lode, 38 m long, maximum thickness 3 m, dips 40-60^0 to northwest. Thin ferruginous barite extends for a further 20 m to the southwest (Fig. 5).

The Moorillah Siltstone Member - Bayley Range Siltstone Member contact is 20 m southwest of 1A lode.

The northeastern 8 m of 1A lode has a ferruginous band 0.8 m thick on the hanging wall with up to 20% iron oxides in the adjacent barite.

There was no development in 1978. By June 1979, a slot had been opened on the hanging wall, exposing barite to a depth of 5m but no barite had been mined when inspected in October 1980 although the hanging wall cut had been deepened.

1B lode, 40 m northeast of 1A - 38 m long, maximum thickness 2.5 m. The northeastern 10 m is composed mainly of iron oxides and ferruginous barite (Fig. 5). The lode was unworked in 1978. A hanging wall slot exposed about 2 m of barite in 1979 (Plate 1).

1C lode, 41 m northeast of 1B - 57 m long, maximum thickness of 2.5 m, dips 65-70^o to northwest, ferruginous for northeastern 12 m, and the southwestern 6 m contains calcite and ferruginous barite (Fig. 5). There was no development in 1978; a shallow hanging wall cut exposed about 1 m of barite in 1979 (Plate 1).

1D lode - 200 m northeast of 1C - the main lode is 27 m long, maximum thickness 3 m, dips 80^0 northwest; 10 m to the west a parallel vein is 30 m long, 0.5 m thick, with numerous thin inter-connecting stringers and veins (Fig. 5). The northeastern termination of the lode is now obscured by mullock.

Barite contains some ferruginous staining, but no major zones of ferruginous minerals. Float and thin veins of barite extend southwest for 34 m.

A barite vein, 0.5 m thick and 30 m long, is parallel and 10 m to the west and southwest. Several veins, generally less than 0.5 m thick but reaching 1.5 m thick, strike obliquely between the main lode and the vein to the east. There has been no development on these veins.

Lyford's cut, a steep sided open cut worked by hand (Plate 2), is at the northeastern end at the thickest part of the lode. The lode is 3 m thick in the cut, thinning to 1.3 m to the southwest. When remapped in 1979, a deep cut had been established on the footwall - southwestern-side, and a small cut on the hanging wall (Plate 2).

In October 1980, the footwall cut had been deepened.

A zone of brecciated and contorted siltstone up to 16 m thick with numerous thin barite and ferruginous veins extends northeast from 1D lode to 1E lode.

1E lode, 150 m northeast of 1D - 105 m long, maximum thickness 1.5 m, dip $70-80^0$ to northwest. 1E lode is a single almost continuous vein, with several areas of float with no outcrop, and several splits, up to 0.5 m thick, off the main lode in the southwestern 60 m. Thickness is generally between 1 and 1.5 m.

When mapped in 1978, the only workings were 4 pot holes, ranging in depth from 0.4 to 1 m. In 1979, an open cut had been developed on the hanging wall of the lode for the northeastern 30 m, northeast of a small creek, exposing the lode for 3 m vertically.

1E lode has no major zones of ferruginous minerals.

A thin ferruginous barite vein extends northeast for 30 m from 1E lode, then continuing for a further 20 m as a fault with no barite. The fault and vein displace quartzite interbeds at the base of Moorillah Siltstone Member sinistrally by 5 m.

NO. 2 LODE SYSTEM

Barite has infilled an en enchelon series of fractures over a strike length of about 1 200 m, forming 4 main lodes, designated from 2A in the west to 2D in the east and numerous subparallel veins and stringers (Fig. 6). Trend is east-northeasterly and dip is vertical to steep northwesterly. No plunge was determined for any of the lodes.

2A lode - 210 m long in total, with about 15 m of thin ferruginous barite at the western end and 45 m of highly ferruginous barite, up to 1 m thick at the eastern end (Fig. 6).

Within the central 150 m, barite is discontinuous with numerous anastamosing veins and stringers.

The western 80 m of the main lode comprises numerous veins and pods, generally 1 m or less thick, but up to 1.5 m.

A number of pods are ferruginous, with one pod of quartz, several metres long, at the join of two veins. The largest barite vein is 32 m long and between 1 and 1.5 m thick.

The main eastern mineable part of 2A lode is 75 m long, and for 65 m is between 2 and 6 m thick (Plate 3), with a footwall split, 20 m long, and 1 m thick. Dip is variable, ranging from

65^0 northwesterly to 75^0 southeasterly, but overall is steeply northwesterly.

A ferruginous band, 1 m thick, forms the centre of the lode for the eastern 30 m and extends further eastwards for 45 m from the end of barite outcrop. Strike of country rock near this vein swings from northwest to north on the northern side of the vein indicating the vein has displaced sediments dextrally.

In 1978, Steetley, under an agreement with the then leaseholder, S.A. Reid, drilled 13 holes with a track mounted rotary air percussion rig. Holes were numbered from 1 to 8 plus 2B, 2C, 2D, 7B and 8B (Fig. 6).

Drill logs are not available for Holes 2B, 2C, 2D and 7B. Drill logs for the remainder (Appendix D) cannot be correlated with surface geology.

There was no development when mapped in 1978. In 1979, an open cut was excavated on the hanging wall, exposing the lode 3.5 m vertically. By October 1980, the hanging wall cut had been extended and deepened, and a slot about 5 m deep developed (Plate 4).

The Bayley Range Siltstone Member - Moorillah Siltstone Member contact is 130 m east of 2A lode, and a number of thin veins are scattered for 200 m east of this contact. Most are less than 30 m long and 0.5 m thick, but 4 with lengths ranging from 15 to 25 m are between 1 and 1.5 m thick (Fig. 6). Orientation varies from northerly to easterly.

Most of these veins are highly ferruginous and none warrant development.

<u>2B lode</u> - This lode 430 m east of 2A lode is 50 m long and up to 1.5 m thick and dips 80^0 northwesterly.

The hanging wall is marked by a 0.3 m thick ferruginous zone, with a similar ferruginous zone along the southwestern 15 m of the footwall. The enclosed barite is generally less than 1 m thick, but reaches 1.5 m near the northeastern end (Fig. 6).

A thin barite vein continues intermittently for a further 55 m to the northwest.

There has been no development at 2B lode.

Thin scattered barite veins continue north-northeast towards 2D lode. A small pot hole has been developed on a 8 m by 1 m vein, 130 m to the northeast.

2C lode, 460 m east of 2A lode and 60 m southeast of 2B lode, 145 m long striking northeasterly and discontinuous, up to 2.5 m thick but extremely ferruginous.

At the southwestern thickest portion (Plate 5), from hanging wall (northwest) to footwall (southeast) the lode, 2.5 m thick, comprises:

- 0.4 m ferruginous barite
- 0.5 m ferruginous siltstone with some barite
- 0.8 m clean barite (sample P809/78)
- 0.8 m ferruginous barite.

To the northeast, the lode thins, retaining the ferruginous footwall and hanging wall contacts, and consisting solely of ferruginous minerals for the northeastern 50 m.

There has been no development on 2C lode.

Scattered veins of ferruginous barite generally less than 1 m thick crop out to the east and northeast.

2D lode - 190 m northeast of 2B lode, the main central part of 2D lode extends, with continuous outcrop, for 120 m, is up to 3.8 m thick and is vertical or dips 80^0 to the northwest. The lode extends intermittently southwesterly for 95 m, and northeasterly for 70 m beyond the limits of ML 4649.

The lode is ferruginous on the margins.

In the southwestern thickest part, over a length of 40m, from hanging wall to footwall the lode comprises -

0.5 m limonite and ferruginous barite

2-3.5 m barite

1 m limonitic siltstone, or brecciated siltstone

0.3 m limonite.

To the north east, the lode comprises scattered barite and ferruginous stringers for 15 m, then relatively clean barite with little or no ferruginisation for 65 m, thickness decreasing from 2 m to 1 m.

There was no development at 2D lode when mapped in 1979. By October 1980, an access track from Bitter Springs Creek had been constructed and a platform established on the hanging wall.

Ferruginous barite veins up to 1 m thick and 18 m long crop out for 100 m to the southwest. A hanging wall vein 25 m long and 1.1 m thick, crops out 8 m north of the northeastern end of 2D lode, and has ferruginous footwall and hanging wall contacts. This vein appears to offset a thin quartzite interbed.

The northeasterly continuation of 2D lode contains thin barite and offsets quartzite at the base of Moorillah Siltstone Member by 10 m sinistrally. A small barite vein 30 m south offsets the quartzite dextrally by 5 m, and another thin 60 m long vein, a further 50 m south, offsets the quartzite dextrally by 70 m.

JIM CROW LODE

Barite crops out over a distance of about 200 m, dipping 20-30^0 to the northwest concordant with the bedding of enclosing sandstone. In general, the lode is generally less than 0.1 m thick, reaching a maximum of 0.8 m at the northeastern end. The lode contains quartz and iron staining throughout. A few shallow pits had been dug on the eastern end.

BARITE QUALITY

PETROLOGY

Barite from Nilpena is typically coarse grained and varies from pure white to pink and grey with abundant ferruginous staining.

Many of the barite veins include ferruginous zones or banding, with many thin ferruginous stringers near the main lodes. Ferruginous minerals include geothite, limonite, brecciated limonitic siltstone, siderite, rare hematite, and ferruginous limonitic barite.

Five samples of barite, three from No. 1 lode system and two from No. 2 lode system were examined petrologically (Appendix B). However, chemical analyses of these samples, revealed that barite content has been under-estimated, and quartz and opaques over-estimated.

- Sample P806/78 of white barite with visible iron staining from the central part of 1E lode (Fig 5) is moderately deformed barite with opaque iron oxides infilling voids.
- Sample P807/78 of white, pink yellow, and grey barite from 1B lode (Fig. 5) contains 10% quartz and 5% very fine shale fragments, and the vein has been brecciated extensively and deformed. These effects have been masked partially by recrystallisation of the barite.

- Sample P808/78 from the eastern end of the main part of 2A lode (Fig. 6) contains 7% quartz intergrown with deformed and granulated barite, and 3% iron oxides infills fractures.
- Sample P809/78 from the clean barite in the centre of 2C lode (fig. 6) has brecciated barite with quartz and iron oxides introduced along fractures.

Large barite crystals have been deformed, and are enclosed by aggregates of finer deformed and granulated barite.

Quartz is disseminated, and intergrown with barite, in particular, with fine granulated barite.

Opaque iron oxides are disseminated either as angular void infillings, fracture infilling, or intergrown with fine granulated barite.

In some samples, shale fragments are disseminated throughout barite, and some have minor calcite inclusions within barite crystals.

The intergrown quartz and iron oxides may be difficult to remove by beneficiation.

CHEMICAL COMPOSITION

27 samples were submitted to AMDEL for chemical analysis and determination of physical properties; 16 samples from No. 1 lode system and 11 from No. 2 lode system.

Samples were either:

- chip samples across the lode.
- selected best white barite.
- grab samples of average grade material.

Results have been related to 3 specifications. Industrial grade specifications as described in the American Society for Testing Materials (ASTM) Specification D602-42 for pigments requires barite to be white and to contain:

- at least 94% $BaSO_4$
- not more than 0.05% Fe_2O_3
- not more than 0.2% soluble salts
- not more than 0.5% moisture and volatiles
- not more than 2% quartz, clays and foreign materials.

Whiteness is generally accepted as a measured brightness in excess of 90.

This is extremely high quality, and is not met by any of the grades produced at the Quorn Mill where all barite produced by Steetley is treated. The approximate specifications for A Grade and Standard Grade from the Quorn Mill, a more realistic specification with which to compare sample assays, is as follows:

- at least 94% (Ba + Sr) SO_4
- not more than 2% quartz
- not more than 0.15% Fe_2O_3
- brightness of 75 or better.

The Oil Companies Materials Association (UK) requires barite for oil drilling purposes to contain:

- at least 92% $BaSO_4$
- less than 250 ppm soluble alkaline earths, expressed as calcium.
- have a specific gravity of at least 4.2.
- several percent of iron oxide is permitted.

<u>No. 1 lode system</u>

Results are compared to specifications in Table 3 from details in Appendix A.

Most <u>chip and grab</u> samples meet oil drilling specifications. 1A, 1B and 1C lodes have excess SiO_2 or Fe_2O_3, and low total sulphate, despite satisfactory specific gravity.

TABLE 3

Sample No. Analytical	Petrological	Lode	Sample Type	(Ba + Sr)SO_4 Wt %	SiO_2 Wt %	Fe_2O_3 Wt %	Sp.Gr.	Brightness	Specification ASTM 602-42	Specification Oil Drilling	Quorn Mill
A5529/78		1A	Chip	91.5	1.18	5.15	4.38	45.5	Fail	Fail?	Fail
A5528/78	P807/78	1B	Grab	90.0	6.85	0.20	4.19	69.0	Fail	Fail?	Fail
A5527/78		1C	Grab	87.7	6.44	3.65	4.24	50.5	Fail	Fail?	Fail
A5526/78		1D	Stockpiles selected	98.7	0.44	0.03	4.44	90.2	Pass	Pass	Pass
A5525/78		1D	Stockpiles, chip	98.6	0.42	0.05	4.44	84.5	Pass?	Pass	Pass
A5522/78		1D	Stockpiles, chip	98.0	0.63	0.54	4.21	67.6	Fail	Pass	Fail
	P1853/75	1D	Stockpiles, grab	94.8	0.61	3.78	4.44	31.4	Fail	Pass	Fail
A1897/75		1D	Stockpiles selected	99.2	0.62	0.05	4.44	81.0	Pass?	Pass	Pass
A5524/78		1D	Grab	96.7	2.30	0.04	4.36	75.4	Fail	Pass	Pass
A5523/78		1D	Chip	95.5	1.05	2.16	4.39	50.0	Fail	Pass	Fail
A5521/78		1E	Stockpile, chip	98.6	0.52	0.06	4.43	85.9	Fail?	Pass	Pass
A5520/78		1E	Selected	98.6	0.78	0.04	4.41	90.0	Pass	Pass	Pass
A5519/78		1E	Chip	94.9	0.45	3.47	4.39	39.2	Fail	Pass	Fail
A5518/78		1E	Grab	98.9	0.21	0.32	4.42	73.3	Fail	Pass	Pass?
A5517/78	P806/78	1E	Selected	98.7	0.27	0.05	4.43	88.2	Fail	Pass	Fail
A5516/78		1E	Chip	97.4	0.69	0.42	4.40	65.1	Fail	Pass	Fail

Sample A5524/78 (1D lode) meets Quorn Mill specifications, and A5518/78 (1E lode) failed marginally. The remaining samples in general have excess Fe_2O_3 and corresponding low brightness.

Chip samples from stockpiles at 1D and 1E lode are better quality than chip samples across the lodes, in general exceeding Quorn Mill specifications. It is assumed that barite was hand sorted before stockpiling.

As expected, selected best samples from 1E lode (A5520/78 and A5517/78) were better quality, meeting Quorn Mill and ASTM 602-42 specifications.

Blending of barite from 1A, 1B and 1C lode with higher grade 1D or 1E lode will meet oil drilling specifications. Industrial grade barite could be won from 1D or 1E lode by selective mining.

No. 2 lode system

Results are compared with specification in Table 4 from details in Appendix A.

All chip and grab samples meet oil drilling specifications except A5535/78 from 2D lode which has excess Fe_2O_3 and SiO_2, low total sulphate, but acceptable specific gravity.

Only sample A5537/78 from 2D lode meets Quorn Mill specifications, although A5531/78 (2A lode) and A5539/78 (2D lode) fail only marginally. The remaining samples have either excess SiO_2, or excess Fe_2O_3 and corresponding low brightness.

No samples meet ASTM specification D602-42 for pigment grade barite.

Selected best samples from 2C lode and east of 2D lode almost meet Quorn Mill specifications; selected best from 2A lode exceeds Quorn Mill specifications, and selected best from 2D lode meets ASTM specifications for pigment.

TABLE 4

No 2 LODE SYSTEM
SUMMARY OF TESTING

Sample No. Analytical	Petrological	Lode	Sample Type	$(Ba + Sr)SO_4$ Wt %	SiO_2 Wt%	Fe_2O_3 Wt%	Sp.Gr.	Brightness	Specification ASTM D602-42	Specification Oil Drilling	Specification Quorn Mill
A5530/78		2A	Chip	93.7	2.00	2.90	4.36	43.9	Fail	Pass	Fail
A5531/78		2A	Chip	95.7	2.64	0.62	4.32	71.9	Fail	Pass	Fail?
A5532/78		2A	Chip	95.6	2.27	1.05	4.37	62.6	Fail	Pass	Fail
A5533/78		2A	Selected best	98.5	0.40	0.07	4.43	86.1	Fail?	Pass	Pass
A5534/78		2B	Chip	93.3	1.83	2.93	4.38	58.7	Fail	Pass	Fail
A5535/78		2C	Chip	90.7	4.15	2.17	4.29	54.0	Fail	Pass?	Fail
A5536/78		2C	Selected best	96.2	2.31	0.51	4.40	70.2	Fail	Pass	Fail?
A5537/78		2D	Chip	97.0	1.62	0.16	4.44	83.2	Fail	Pass	Pass
A5538/78		2D	Selected best	98.7	0.62	0.04	4.43	91.5	Pass	Pass	Pass
A5539/78		2D	Chip	95.7	1.51	0.93	4.38	67.5	Fail	Pass	Fail
A5540/78	East of 2D Lode		Selected Best	98.3	0.64	0.35	4.44	77.3	Fail	Pass	Pass?

In general, barite from No. 2 lode system is suitable for oil drilling with little industrial grade available, even with selective mining.

Jim Crow lode

No samples were examined petrologically nor analysed chemically. This lode provides a source of barite crystals for for mineral collectors (Plate 6).

ORE RESERVES

Ore reserves per vertical metre, detailed in Table 5 are based on measured outcrop area, and average specific gravity of 4.3. The plunge of the ore bodies, which could not be determined, does not affect reserves provided the crown and keel are parallel. Reserves are geological, and classed as indicated.

TABLE 7

INDICATED RESERVES

Lode	Area (m^2)	Tonnes/ Vert m	Barite Grade	To Depth of 5 m on Developed Lodes
1A	70	300	sub-oil	1 500
1B	40	170	sub-oil	850
1C	110	470	sub-oil	2 350
1D main	90	390	oil-ind.	1 950
1D west	70	300	-	-
1E main	80	340	oil-ind.	1 700
1E south	130	560	oil-ind.	-
Sub Total	-	2 530		8 350
2A main	300	1 290	oil	6 450
2B	30	130	oil	-
2C	50	210	oil	-
2D main	75	320	oil	1 600
2D north	85	370	oil	-
Sub Total	-	2 320		8 050
TOTAL	-	4 850		16 400

Barite grade as described above is:

'sub-oil' - lower grade than oil drilling grade.

'oil' - oil drilling grade.

'oil-ind' - oil drilling grade with some industrial grade.

CONCLUSIONS

Nilpena barite deposits are in the western central Flinders Ranges, on the western limb of the anticlinal Nuccaleena Dome.

No. 1 and 2 lode systems, which strike northeast and east northeast respectively, have infilled fractures in Moorillah Siltstone, and Bayley Range Siltstone, the middle and upper members of Brachina Formation, with a total length of 700 m and 1 100 m respectively. No. 1 lode system comprises 5 main lodes along a single structural trend, whereas No. 2 lode system comprises 4 main lodes en echelon.

Individual lodes range in thickness up to a maximum of 6 m, with lengths ranging from 27 m to 210 m. Most dip steeply to the northwest, with no measured plunge.

Many lodes have ferruginous footwall and hanging wall contacts, with ferruginous and siliceous zones within the barite. 1A, 1B and 1C lodes are poor quality, being slightly below oil drilling grade. 1D and 1E lodes are of oil drilling grade, and industrial grade could be won with selective mining. With blending, all barite from No. 1 lode system could be used for oil drilling purposes. All lodes within No. 2 lode system are oil drilling grade.

In 1979, open cuts had been opened on all five lodes of No. 1 lode system and on 2A lode.

Barite production to the end of 1982 totalled 4 125 tonnes, mostly from No. 1 lode system from 1979 to 1981.

Indicated geological reserves to a depth of 5 m as at June 1979 on the developed lodes are:

Lode	Tonnes
1A, 1B, 1C	4 700
1D	1 950
1E	1 700
2A	6 450
2D	1 600
Total	16 400

Jim Crow deposit, 4 km to the northeast, is of mineralogical interest only with transparent crystals of barite.

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Geologist

J.G. Olliver
Supervising Geologist

L.C. Barnes
Senior Geologist

WSMcC/JGO/LCB/GU

REFERENCES

Coats, R.P., 1973. COPLEY Map Sheet, Geological Atlas of South Australia, 1:250 000 series. Geol. Surv. S. Aust.

Leeson, B., 1966. *Beltana* Map Sheet, Geological Atlas of South Australia, 1:63 360 series. Geol. Surv. S. Aust.

Leeson, B., 1970. Geology of the *Beltana* 1:63 360 Map Area. *Rep. Invest., geol. Surv. S. Aust.* 35.

Mansfield, L.L., 1947. Barytes Mines, Blinman District, Near Nilpena Siding. *Min. Rev. S. Aust.* 84: 158.

APPENDIX A

PHYSICAL AND CHEMICAL ANALYSES OF 26 BARITE SAMPLES

Samples A5516/78 to A5540/78 from AMDEL report MD 4418/78 by L.J. Day.

Sample A1897/75 from AMDEL report MT148/76 by W.G. Spencer.

Sample P1853/75 from AMDEL report MT149/76 by W.G. Spencer.

CHEMICAL ANALYSES

No. 1 lode system

Sample No.	Lode	Type	$BaSO_4$	$SrSO_4$	Al_2O_3	SiO_2	Fe_2O_3	CaO	K_2O	L.O.I.	Soluble Alkali Earths as Ca.ppm.
A5529/78	1A	Chip	88.9	2.64	0.06	1.18	5.15	0.03	0.02	1.48	30
A5528/78	1B	Grab	88.6	1.35	0.68	6.85	0.20	0.11	0.24	1.84	40
A5527/78	1C	Grab	85.6	2.08	<0.05	6.44	3.65	0.02	0.01	2.16	10
A5526/78	1D, stockpile	Select. Best	95.6	3.08	<0.05	0.44	0.03	0.02	<0.01	0.44	15
A5525/78	1D, stockpile	Chip	95.5	3.06	<0.05	0.42	0.05	0.02	<0.01	0.24	15
A5522/78	1D, stockpile	Chip	95.1	2.92	<0.05	0.63	0.54	0.01	<0.01	1.08	25
P1853/75	1D, stockpile	Grab	92.1	2.68	0.02	0.61	3.78	0.05	<0.01	0.79	40
A1897/75	1D, stockpile	Select. Best	96.3	2.85	0.01	0.62	0.05	<0.01	<0.01	0.16	15
A5524/78	1D	Grab	92.8	3.92	<0.05	2.30	0.04	0.02	<0.01	0.79	10
A5523/78	1D	Chip	92.3	3.20	<0.05	1.05	2.16	0.06	<0.01	1.10	45
A5521/78	1E, stockpile	Chip	96.3	2.30	<0.05	0.52	0.06	0.04	0.01	0.41	25
A5520/78	1E	Select. Best	96.1	2.52	<0.05	0.78	0.04	0.02	<0.01	0.34	15
A5519/78	1E	Chip	91.4	3.48	<0.05	0.45	3.47	0.04	<0.01	1.28	35
A5518/78	1E	Grab	95.2	3.68	<0.05	0.21	0.32	0.01	0.01	0.19	30
A5517/78	1E	Select. Best	95.4	3.34	<0.05	0.27	0.05	0.02	0.01	0.12	30
A5516/78	1E	Chip	94.6	2.80	<0.05	0.69	0.42	0.03	0.01	0.38	25

CHEMICAL ANALYSES

No. 2 lode system

Sample No.	Lode	Type	$BaSO_4$	$SrSO_4$	Al_2O_3	SiO_2	Fe_2O_3	CaO	K_2O	L.O.I.	Soluble Alkali Earths as Ca.ppm.
5530/78	2A	Chip	91.6	2.08	<0.05	2.00	2.90	0.14	0.01	1.08	40
5531/78	2A	Chip	93.6	2.14	<0.05	2.64	0.62	0.04	<0.01	0.67	25
5532/78	2A	Chip	93.2	2.36	<0.05	2.27	1.05	0.05	0.01	0.63	45
5533/78	2A	Select. Best	93.8	4.74	<0.05	0.40	0.07	0.03	0.01	0.42	30
5534/78	2B	Chip	91.1	2.16	<0.05	1.83	2.93	0.02	<0.01	1.54	20
5535/78	2C	Chip	88.7	1.97	<0.05	4.15	2.17	0.02	0.01	1.79	25
5536/78	2C	Select. Best	93.6	2.60	<0.05	2.31	0.51	0.02	0.01	0.72	20
5537/78	2D	Chip	94.4	2.64	<0.05	1.62	0.16	0.02	0.01	0.45	10
5538/78	2D	Select. Best	95.6	3.08	<0.08	0.62	0.04	0.02	<0.01	0.38	10
5539/78	2D	Chip	93.6	2.14	<0.05	1.51	0.93	0.02	0.01	1.28	45
5540/78	East of 2D	Select. Best	95.0	3.28	<0.05	0.64	0.35	0.02	<0.01	0.41	10

PHYSICAL PROPERTIES

Sample No.	Lode	Type	Brightness R457	Yellowness R57-R457	Sp. Gr.
A5529/78	1A	Chip	45.5	21.4	4.38
A5528/78	1B	Grab	69.0	9.4	4.19
A5527/78	1C	Grab	50.5	22.6	4.24
A5526/78	1D, stockpile	Select. best	90.2	2.9	4.44
A5525/78	1D, stockpile	Chip	84.5	5.2	4.44
A5522/78	1D, stockpile	Chip	67.6	11.7	4.21
P1853/75	1D, stockpile	Grab	31.4	23.7	4.44
A1897/75	1D, stockpile	Select. best	81.0	8.5	4.44
A5524/78	1D	Grab	75.4	10.8	4.36
A5523/78	1D	Chip	50.0	20.2	4.39
A5521/78	1E, stockpile	Chip	85.9	6.4	4.43
A5520/78	1E	Select. Best	90.0	3.2	4.41
A5519/78	1E	Chip	39.2	21.9	4.39
A5518/78	1E	Grab	73.3	12.6	4.42
A5517/78	1E	Select. Best	88.2	3.8	4.43
A5516/78	1E	Chip	65.1	13.0	4.40
A5530/78	2A	Chip	43.9	12.9	4.36
A5531/78	2A	Chip	71.9	9.6	4.32
A5532/78	2A	Chip	62.6	12.0	4.37
A5533/78	2A	Select. Best	86.1	6.1	4.43
A5534/78	2B	Chip	58.7	17.3	4.38
A5535/78	2C	Chip	54.0	16.9	4.29
A5536/78	2C	Select. Best	70.2	14.7	4.40
A5537/78	2D	Chip	83.2	8.2	4.44
A5538/78	2D	Select. Best	91.5	3.6	4.43
A5539/78	2D	Chip	67.5	14.8	4.38
A5540/78	-	Select. Best	77.3	9.3	4.44

APPENDIX B

PETROLOGICAL DESCRIPTIONS OF 5 BARITE SAMPLES

From ADMEL report GS 4417/78 by F. Radke.

P806/78	1E Lode
P807/78	1B Lode
P808/78	2A Lode
P809/78	2D Lode

From AMDEL report MT 149/76 by W.G. Spencer

P1853/75	1D Lode, stockpile

Sample: P806/78; TS40416

Location:
Nilpena Barite Deposits

Rock Name:
Deformed barite

Hand Specimen:
A milky white rock consisting of large barite blades with angular, interstitial voids some of which are partially filled by black to reddish-brown iron oxides.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Barite	99
Opaques and semi-opaques	1

The sample consists mainly of very large barite crystals up to several millimetres in size which have suffered some deformation and marginal granulation. The barite crystals generally exhibit strained extinction and locally have broad, deformational lamellae. Most of the grain boundaries between the large barite crystals contain finer-grained (typical grain size 0.1 to 0.3 mm) barite produced by granulation and locally the granulation has been quite intense to produce patches up to several millimetres in size of finer-grained barite. The barite crystals themselves generally have a slightly turbid character produced by finely-divided micron-sized inclusions, at least some of which probably represents iron oxides, and this turbidity is generally slightly more pronounced near the margins of large barite grains.

Minor opaque to translucent reddish-brown iron oxides form angular void fillings up to 1 mm wide. Small, anhedral opaque grains generally below 0.05 mm wide, are also disseminated through the rock and minor opaques form discontinuous fracture and vein fillings generally below 0.05 mm wide.

This is an essentially monomineralic rock consisting of large barite crystals which has suffered a moderate degree of deformation.

Sample: P807/78; TS40417

Location:
Nilpena Barite Deposits

Rock Name:
Granulated and recrystallized barite

Hand Specimen:
A weakly-banded rock with a somewhat variable colour ranging from pale grey to pale red. Angular, greenish-grey coloured fragments up to a few millimetres wide are disseminated through the rock.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Barite	85
Quartz	10
Shale fragments	5
Opaques and semi-opaques	1

This sample consists mainly of a relatively fine-grained (typical grain size between 0.15 and 0.3 mm) barite mosaic comprised of slightly elongate barite crystals which exhibit a vague foliation. The banding noted in hand specimen is not visible in thin section, but is probably produced by slight variations in grain size as well as slight variations in proportions of intergrown quartz.

The quartz is disseminated through the rock as crystals up to 0.4 mm in size which generally exhibit anhedral, irregular shapes, although some quartz crystals with euhedral, prismatic shapes were also noted. Most of the quartz has a clear colour but a significant proportion has turbid brown cores most likely due to finely-divided iron oxide inclusions.

Angular shale fragments up to about 3 mm in width are disseminated through the rock and are comprised of finely-divided phyllosilicates (mainly sericite) which exhibit a well-developed foliation. These shale fragments locally show marginal alteration to translucent, reddish-brown iron oxides. Translucent to opaque iron oxides also form irregular, interstitial fillings.

This rock is considered to be a barite-rich rock which has suffered extensive deformation to produce finely granulated and recrystallized barite with a vague foliation. The shale fragments which are disseminated through the barite mosaic also indicate that the rock has suffered extensive brecciation and deformation, although for the most part the intense deformation has been masked by the recrystallization of barite.

Sample: P808/78; TS40418

Location:
Nilpena Barite Deposits

Rock Name:
Deformed barite

Hand Specimen:
A relatively coarsely crystalline rock with a variable colour ranging from dull white or pale grey to red. Limonitic patches up to about 1 mm in size are disseminated through the rock.

Thin Section:
An optical estimate of the consituents gives the following:

	%
Barite	90
Quartz	7
Opaques and semi-opaques	3

This sample consists mainly of relatively large (up to about 5 mm in size) deformed barite crystals intergrown with smaller amounts of quartz and opaque to translucent, reddish-brown iron oxides. The larger barite crystals generally exhibit strained extinction and locally broad, deformational lamellae. Barite granulation is pervasive along grain boundaries and locally it is quite extensive to produce fine-grained barite mosaics with a typical grain size of about 0.1 to 0.2 mm. This finer-grained barite is concentrated along grain margins, but also forms irregular patches up to several millimetres in size. The barite generally has a slightly turbid character produced by finely-divided, micron-sized inclusions (probably iron oxides), although locally the cores of some barite crystals have a slightly clearer, less turbid character.

Quartz crystals are disseminated through the rock and, in particular, tend to be intergrown with the finely granulated barite. The quartz crystals are generally below 0.5 mm in size and some exhibit euhedral to subhedral, prismatic shapes. The cores of a few quartz crystals contain finely-divided opaque inclusions which impart a somewhat turbid character to them.

Opaque to translucent, reddish-brown iron oxides are disseminated through the rock as anhedral grains and granular aggregates up to about 1 mm in size, as well as narrow fracture and vein fillings. Some quartz grains exhibit narrow margins of translucent iron oxides.

This is a barite-rich rock which has been deformed to produce localised, intense granulation. The deformation is similar or slightly more intensive than that exhibited by sample P806/78 (TS40416).

Sample: P809/78; TS40419

Location:
Nilpena Barite Deposits

Rock Name:
Barite breccia

Hand Specimen:
A brecciated rock consisting of angular barite fragments up to several centimetres wide cut by several fractures lined with ocherous, brown iron oxides.

Thin Section:
An optical estimate of the constituents gives the following:

	%
Barite	90
Quartz	5
Calcite	Trace
Opaques & semi-opaques	5

This sample consists of large barite crystals cut by fractures containing finely granular barite intergrown with iron oxides and quartz. The large barite fragments have an undeformed character, showing no evidence of strained extinction, but they are locally cut by narrow fracture zones along which granulation has occurred. Most of the barite has a relatively clear character, although finely-divided inclusions are present and locally impart a slight turbidity. Traces of calcite were also noted as small inclusions within barite, generally below 0.05 mm in size. These calcite inclusions typically exhibit irregular shapes. Both iron oxides and quartz are concentrated in the fractures, which are up to several millimetres wide. The quartz generally forms euhedral to subhedral, prismatic crystals about 0.5 mm in size, although some anhedral quartz grains are also present. Minor quartz also forms euhedral crystals totally included within some large barite crystals. The opaques generally have a translucent, reddish-brown colour and form narrow fracture fillings and interstitial fillings between the granular quartz and barite within fracture zones.

This is a barite-rich rock which has suffered some brecciation with the introduction of quartz and iron oxides along fracture zones.

Sample: FB92, P1853/75; TS 34395

Location:
Nilpena No. 1 Deposit. Beltana 1:63,360 sheet area.

Rock Name:
Intergrowth of white semi-translucent barite crystals the interstices between which are largely filled with goethite. (Country rock; Brachina Formation)

Hand Specimen:
This sample consists of an intergrowth of white semi-translucent barite crystals the largest of which are up to at least 2 cm long. The barite crystals are complexly interlocked and intergrown but there are voids between some of the crystals, the voids being typically between 2 mm and 1 cm across and largely filled with goethite.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Barite	90-95
Quartz	Trace-1
Goethite-limonite	5-10

The barite in this sample is coarsely crystalline with many of the crystals being at least 1 cm long. Crystals in contact have finely irregular margins and are complexly interlocked. The barite is relatively clear although there are "trails" of minute opaque and colourless inclusions adjacent to fractures and some cleavage planes. Other than the micro-fractures which are present in most of the barite crystals, and local undulose extraction, evidence of deformation in this sample is relatively slight.

Most of the interstices between the barite crystals are filled with goethite. These patches of goethite-limonite are angular in shape, up to 1 cm across and sometimes appear to have a cellular boxwork texture.

A few crystals of quartz are present in the sample. These are usually idiomorphic in shape, between 0.1 and 0.5 mm across and situated along the boundaries between the barite crystals.

This is a sample of white semi-translucent barite. It is coarsely crystalline and the crystals are largely interlocked with the gaps between the crystals being filled with goethite. The white colour of the barite is probably due to the disseminated minute colourless and opaque inclusions.

APPENDIX C

PETROLOGICAL DESCRIPTIONS OF 6 SEDIMENTARY ROCKS

From Leeson (1970)

P253/66 *Brachina Formation: Moolooloo Siltstone Member*

This rock is a greenish grey siltstone which, in hand specimen, exhibits cross-bedding, crenulations parallel to minor "folding" and at least three joint planes.

In thin section the rock is well sorted with the majority of grains in the upper silt size range. The major components are quartz, sericite, chlorite, ?biotite, finegrained ?rutile, ?zircon and opaques. Only occasional plagioclase feldspar grains could be distinguished in the quartz-rich groundmass. There is a marked lineation of the white micas indicating their detrital origin.

Cross-bedding is evident in thin section due to minor concentration of opaques and heavy minerals.

Cross-cutting quartz veins also transect the rock. Minor opaques and chlorite are associated with these quartz veins.

Evidence of any folding is absent and it is assumed that the crenulations seen in hand specimen result from load pressure on an uneven surface.

P254/66 *Brachina Formation: Moorillah Siltstone Member*

In hand specimen this rock is a buff coloured, fine-grained, sandstone exhibiting poorly developed cross-bedding.

The thin section consists essentially of a fine-grained porous quartz mosaic which has been cemented by silica overgrowths. Secondary sericite has developed along grain boundaries and in grains which were probably originally clay aggregates. Sorting is good and primary grain shapes were subrounded to rounded.

Tourmaline, rutile, zircon and opaques form nearly 10% of the rock putting the rock in the protoquartzite group. Cherty grains and occasional potash feldspar grains were also observed. Quartz grains commonly have strain lines through them caused by pressure welding of the sedimentary layer.

An indication of bedding in the rock is given by minor concentrations of opaques and other heavy minerals.

P255/66 *Brachina Formation: Moorillah Siltstone Member*

This rock is a dark mauve-brown in colour, fine-grained and well-bedded. White clay aggregates, easily visible in hand specimen, are set in the dark coloured background.

In thin section individual fine-grained quartz particles are well rounded, well sorted and these primary grains are coated with dark red iron oxides (hematite?). Secondary silica overgrowths have then cemented the grains into a compact mass. Occasional quartz grains reach the medium sand size range and most of the clay aggregates are of this size. This clay detritus forms up to 15% of some beds in the rock. Other indications of bedding are concentrations of secondary, orange coloured iron compounds in bands through the rock. Accessory amounts of opaque grains, tourmaline, zircon and rutile are also present.

The rock is a protoquartzite.

P256/66 *Brachina Formation: Moorillah Siltstone Member*

This rock is a somewhat lighter mauve colour with dark layers indicating various beds. It is classified as a protoquartzite.

The rock in thin section is very similar to P255/66. Composition, grain size, sorting, accessory minerals are all virtually identical to the previous rock. However, individual beds vary in the amount of iron oxide (hematite) coatings on the grains and quartz overgrowths make the rock very well cemented. Clay aggregates although present in much the same proportions as in P255/66 are more randomly scattered through the rock.

P257/66 *Brachina Formation: Bayley Range Siltstone Member*

This rock is a poorly sorted sandy siltstone which in hand specimen, is greenish-grey in colour. Bedding planes are only visible due to a colour variation.

The thin section contains poorly sorted sandy detritus up to 0.25 mm in diameter but most of the rock is silty material. This silt is mainly quartz, feldspar, and white mica as well as a certain amount of clayey aggregate which is now partly held together with secondary chlorite.

Opaques, red iron oxides and minor amounts of calcite are randomly scattered through the rock or vaguely related to bedding. Other heavy minerals such as zircon and rutile occur in accessory amounts.

P258/66 *ABC Range Quartzite*

This rock is a light grey, medium grained, massive sandstone in which clay aggregates (of sand grain size) are relatively common.

The thin section indicates that the rock is a fine-grained, well sorted protoquartzite containing less than 10% of opaques, tourmaline and clay aggregates, some of the latter being calcareous. Minor amounts of sericite have developed along grain boundaries after secondary silicification of the original rounded grains.

Accessory grains of rutile and zircon are also present in the rock.

Porosity is difficult to determine due to the clay fraction being a problem in the thin section preparation.

APPENDIX D

LOGS OF DRILL HOLES, 2A LODE.

Rotary air percussion holes drilled by STEETLEY in 1978. Drill logs supplied by S.A. REID.

HOLE No. 1	46° →292°
0-18.3 m	Red ironstone and slate.
18.3 m	End of Hole, water level.

HOLE No. 2A	50° →297°
0-17.7 m	Red ironstone and slate.
17.7 m	End of Hole, water level.

HOLE No. 2B, 2C, 2D	No logs available.

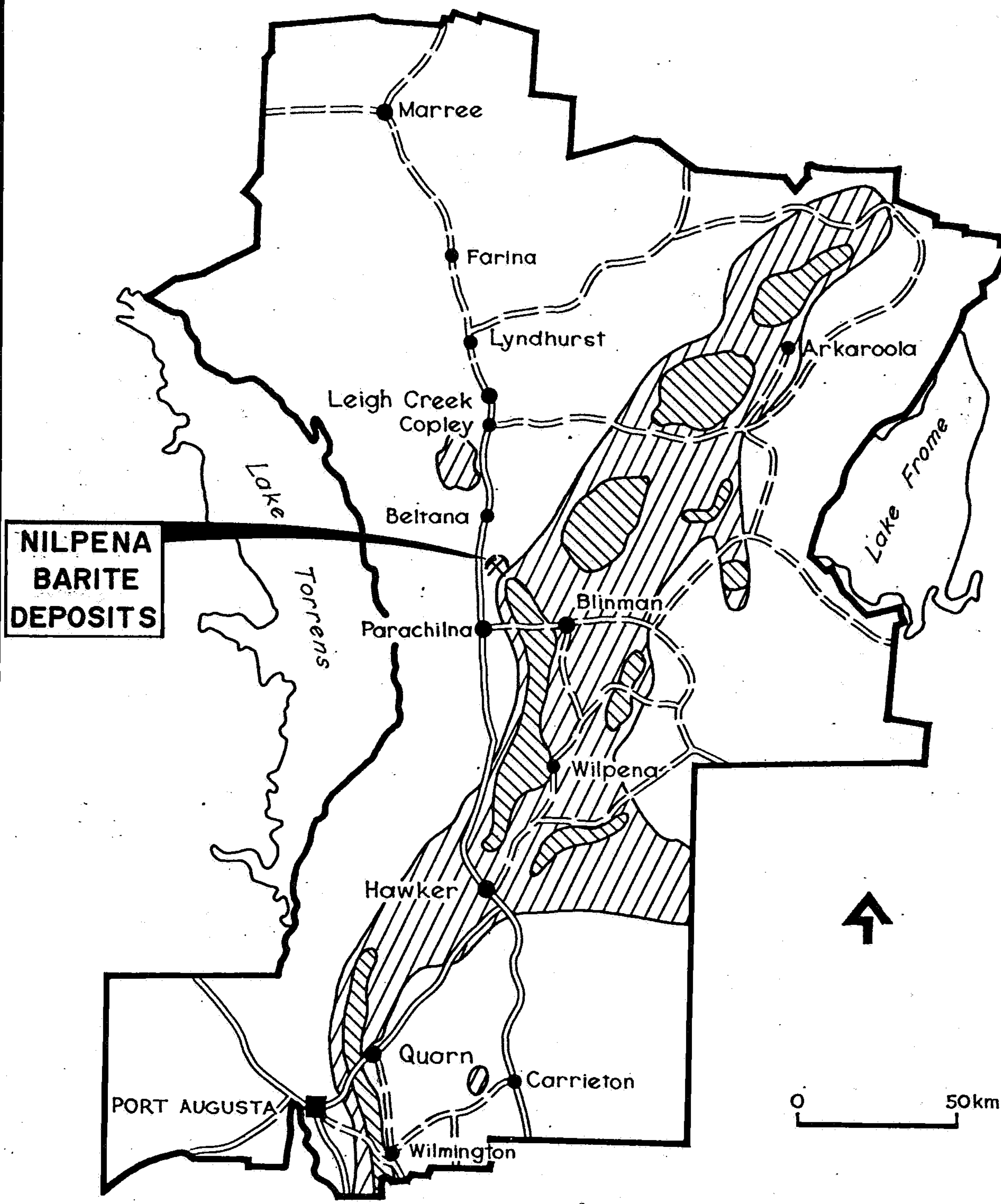
HOLE No. 3	48° →325°
0-11.6 m	Red ironstone and slate
11.6 m	End of Hole, water level.

HOLE No. 4	51° →316°
0-4.9 m	Traces of barite
4.9-11.6 m	Red ironstone
11.6 m	End of Hole

HOLE No. 5	55° →328°
0-2.4 m	Red dirt and slate
2.4-4.3 m	50% barite, 50% red ironstone and slate.
4.3-11.6 m	Red ironstone and slate, traces of barite.
11.6 m	End of Hole, water level.

HOLE No. 6.	48° →323°
0-6.1 m	Red ironstone and slate, traces of barite
6.1 m	End of Hole, Ground not drillable due to large voids.

HOLE No. 7A	48° →329°
0-6.1 m	Red ironstone and slate, traces of barite.
6.1 m	End of hole. Fractured with voids or caverns, no sample return.
HOLE No. 7B	No logs available.
HOLE No. 8A	45° →145°
0-12.2 m	Red ironstone and slate.
12.2 m	End of Hole.
HOLE No. 8B	40° →138°
0-9.2 m	Red ironstone and slate
9.2 m	End of Hole.



ENVIRONMENTAL AREAS

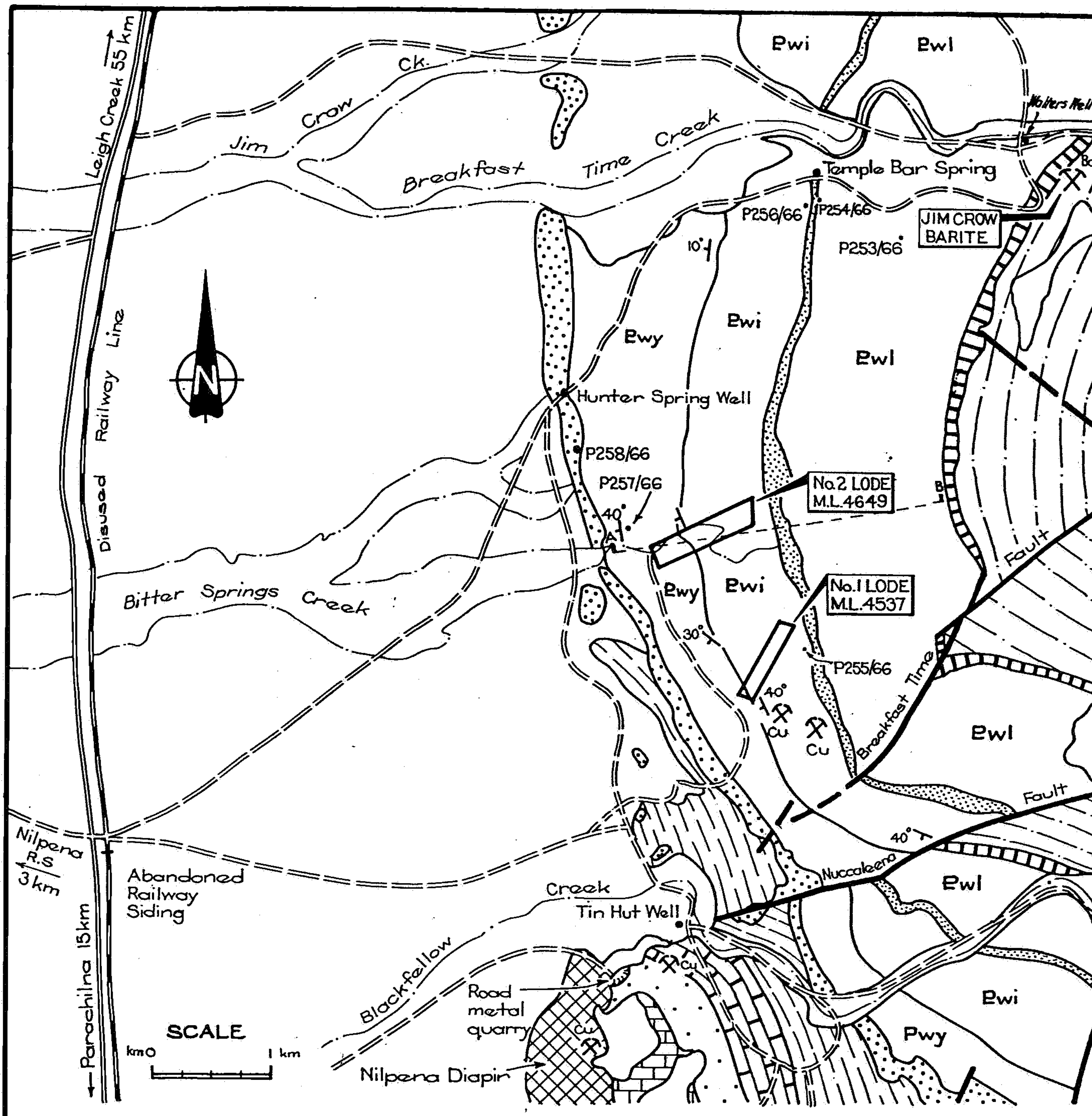
- Class A
- Class B
- Class C

- ● Country Township
- • Special Township
- Main road
- Secondary road

FIG 1

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

INDUSTRIAL MINERALS SECTION	Drn. W.S.K.	NILPENA BARITE DEPOSITS M.L. 4537 & M.L. 4649 LOCALITY PLAN	SCALE: 1:2 000 000
	Tcd. JW.		S16321
	Ckd.		
	Exd.		DATE: July '82



LEGEND

QUATERNARY — Undifferentiated - Alluvium sand, clay gravel.

CAMBRIAN — Undifferentiated - Sandstone, shale limestone.

WILPENA GROUP
- POUND QUARTZITE - Massive to flaggy white ortho-quartzite.
- WONOKA FM. - thin interbedded blue-grey limestone and siltstone.
- BUNYEROO FM. - Dark red finely laminated dolomitic shale.
- ABC RANGE QUARTZITE - Feldspathic sandstone and quartzite.

WILPENA GROUP
- BRACHINA FM. - Olive-green siltstone and sandstone.
  - Pwy BAYLEY RANGE SILTSTONE MEMBER.
  - Pwi MOORILLAH SILTSTONE MEMBER.
  - Pwl MOOLOOLOO SILTSTONE MEMBER.
- NUCCALEENA FM - Pink dolomite and purple shale.

UMBERATANA GP — Undifferentiated - Quartzite, siltstone and shale with minor dolomite.

WILPENA — Undifferentiated diapiric breccia.

..... Fault P255/66 ...... Petrological sample 40° .... Strike and dip of bedding.

A-----B .... Type section within Brachina Fm, Leeson 1970

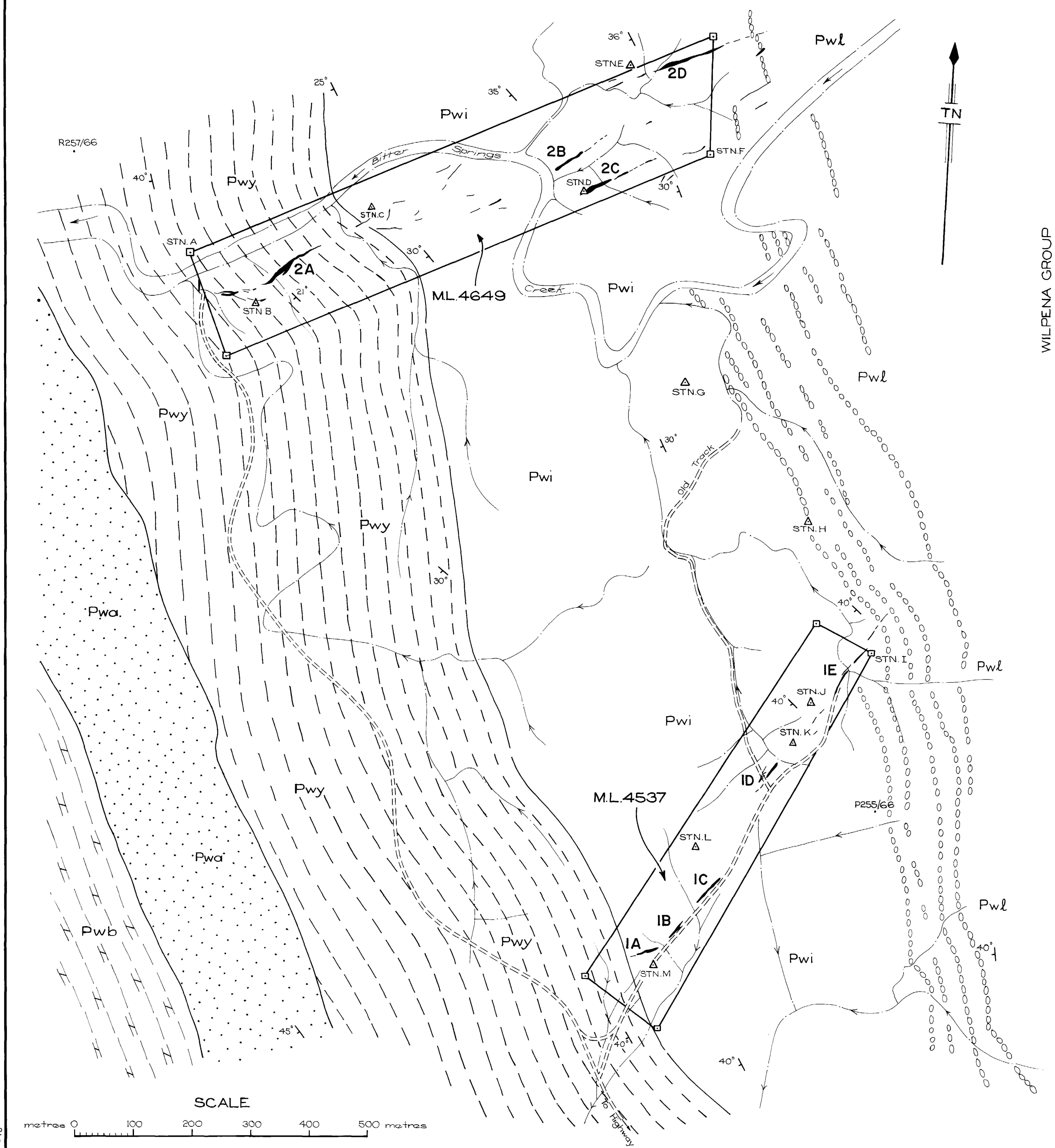
FIG. 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

NILPENA BARITE DEPOSITS M.L.4537 & M.L. 4649 REGIONAL GEOLOGY

COMPILED W. McCallum	C.D.O.	DATE
DRAWN J.W.	SCALE 1:50,000	
DATE July '82	PLAN NUMBER	
CHECKED	S16322	

2848



LEGEND

WILPENA GROUP

Pwb	BUNYEROO FORMATION. Dark red, finely laminated dolomite shale.
Pwa	ABC RANGE QUARTZITE. Feldspathic sandstone and quartzite.
	BRACHINA FORMATION.
Pwy	Bayley Range Siltstone Member. Olive-green siltstone with occasional hard grey fine grained arkose.
Pwi	Moorillah Siltstone Member. Massive banded purple to olive-green siltstone, with thin interbeds of laminated siltstone and sandstone.
	Buff to purple fine grained quartzite, with thin shale interbeds at base.
Pwℓ	Moolooloo Siltstone Member. Olive-green micaceous siltstone, cross bedded.

2D — Barite, with lode number.

30° — Strike and dip of bedding.

Creek.

Track.

Lease peg and lease boundary.

STN.D — Survey station.

R257/66 — Petrological sample (from Leeson, 1970).

FIG. 3

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

NILPENA BARITE DEPOSITS
M.L.4537 & M.L. 4649
Nº 1 AND Nº 2 LODE SYSTEMS
GEOLOGICAL PLAN

COMPILED W. McCallum
DRAWN J.W.
DATE July 1982
CHECKED
CDO DATE
SCALE 1:5000
PLAN NUMBER 82-347

2848

GEOLOGY AND DEVELOPMENT AS MAPPED IN JUNE, 1978

GEOLOGY AND DEVELOPMENT AS MAPPED IN JUNE, 1979

LEGEND

WILPENA GROUP

BRACHINA FORMATION

- Pwy — Bayley Range Siltstone Member. Olive-green siltstone with occasional hard, grey, fine grained arkose.
- Pwi — Moorillah Siltstone Member. Massive banded purple to olive-green siltstone, with thin interbeds of laminated siltstone, and sandstone. Buff to purple, fine grained quartzite, with thin shale interbeds at base of member.
- Barite outcrop with thickness in metres.
- Barite - inferred or float.
- Iron minerals, goethite, limonite, brecciated limonitic siltstone, rare hematite.
- Strike and dip of bedding.
- Strike and dip of barite.
- Contorted siltstone.
- Natural surface contour in metres.
- Lease peg and boundary.
- Survey station with elevation (Stn.J 295·8)
- Creek, tributary.
- Track.
- Quarry with height of face in metres.
- A5521/78 Analytical sample
- P806/78 Petrological sample.

NOTE :- Stadia survey by P.Crettenden, J.Olliver. Additional surveying, plane table, by J.Olliver, L.C.Barnes & W.S.McCallum. Datum for elevation is A.H.D. For enlargements see plan no. 82-319 (fig.5).

FIG. 4

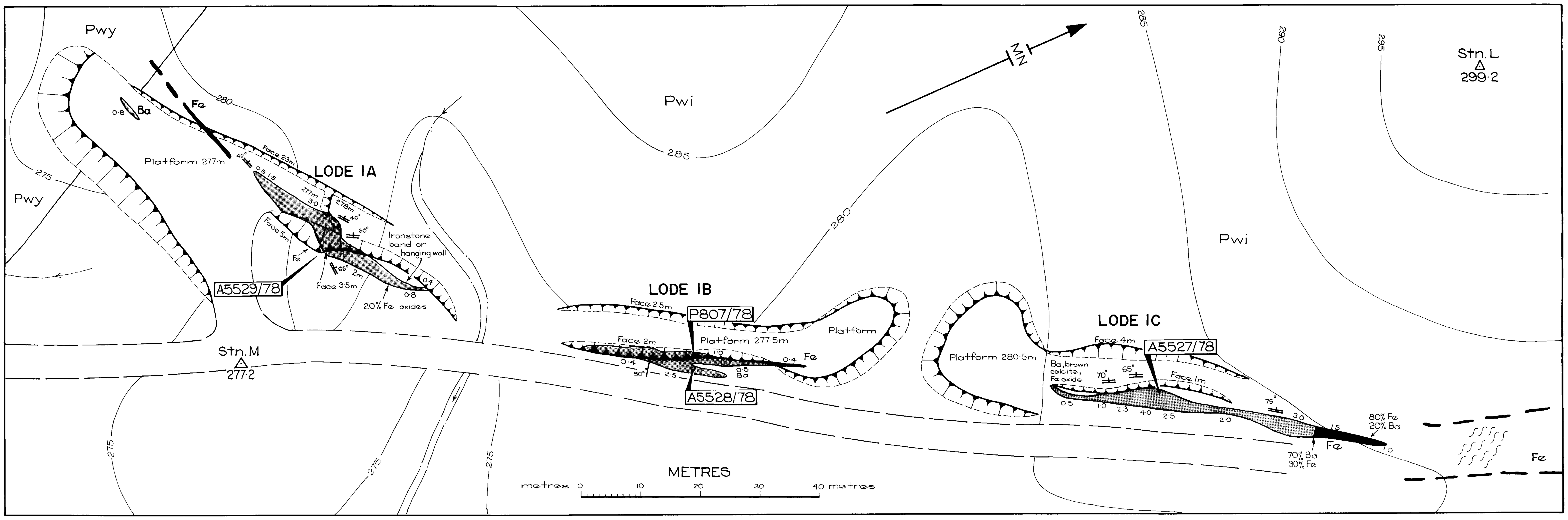
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

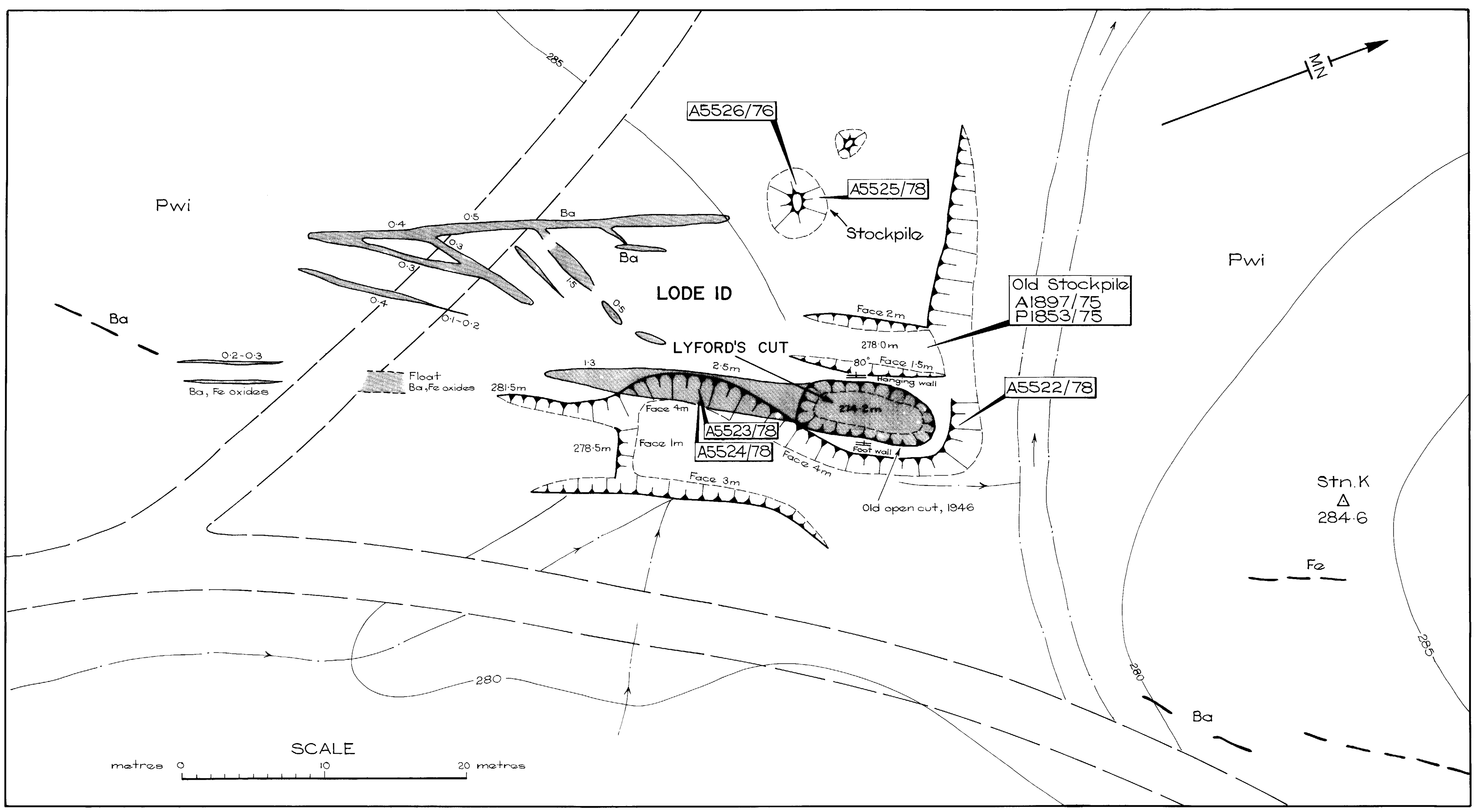
NILPENA BARITE DEPOSITS

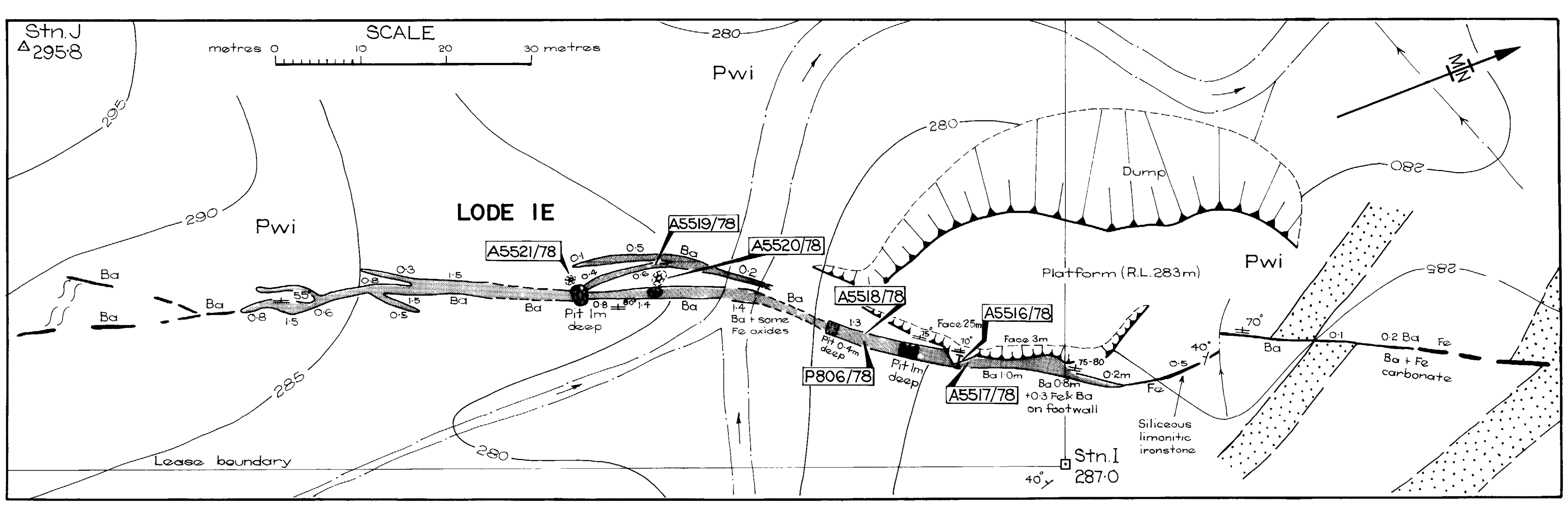
Nº 1 LODE SYSTEM - ML 4537

GEOLOGY AND DEVELOPMENT, 1978 & 1979

COMPILED	W. McCallum
DRAWN	J.W.
DATE	July '82
CHECKED	
SCALE	1:1000
PLAN NUMBER	82-348







LEGEND

WILPENA GROUP — BRACHINA FORMATION.

- Pwy — Bayley Range Siltstone Member. Olive-green siltstone with occasional hard, grey, fine grained arkose.
- Pwi — Moorillah Siltstone Member. Massive banded purple to olive-green siltstone, with thin interbeds of laminated siltstone and sandstone.
- Buff to purple fine grained quartzite, with thin shale interbeds, at base of member.
- Barite outcrop with thickness in metres.
- Barite - inferred or float.
- Iron minerals, goethite, limonite, brecciated limonitic siltstone, rare hematite.
- Barite and iron minerals intermixed.
- Strike and dip of bedding.
- Strike and dip of barite.
- Contorted siltstone.
- Natural surface contour in metres.
- Lease peg and lease boundary.
- Survey station with elevation.
- Creek and tributary.
- Track.
- Quarry, with height of face in metres.
- A5521/78 — Analytical sample.
- P806/78 — Petrological sample.

NOTE : Datum is A.H.D.

FIG.5

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

NILPENA BARITE DEPOSITS
Nº 1 LODE SYSTEM - ML 4537
GEOLOGICAL ENLARGEMENTS

COMPILED	W. McCallum
DRAWN	J.W.
DATE	July '82
CHECKED	
C.D.O. DATE	10-12-82
SCALE	1:500
PLAN NUMBER	82-349

2848


MN
Stn.A 241.3
Pwy
Pwi
Springs
Bitter
Creek
River Terrace
LODE 2A - SEE ENLARGEMENT BELOW
LODE 2D - SEE ENLARGEMENT BELOW
Stn C 251.9
StnB 244.4
Stn.E 268.4
M.L. 4649
LODE 2B
LODE 2C
STN.D 256.3
StnF 277.4
SCALE
metres 0 20 40 60 80 100 metres
ENLARGEMENT
LODE 2A
LODE 2D
LEASE BOUNDARY
A5534/78
A5535/78
A5536/78
P809/78
A5540/78
A5530/78
P808/78
A5531/78
A5532/78
A5533/78
A5536/78
A5537/78
A5538/78
metres 0 10 20 30 40 50 metres
metres 0 10 20 30 metres
LEGEND
WILPENA GROUP
BRACHINA FORMATION
Pwy
Bayley Range Siltstone Member. Olive-green siltstone with occasional hard, grey, fine grained arkose.
Pwi
Moorillah Siltstone Member. Massive banded purple to olive-green siltstone, with thin interbeds of laminated siltstone and sandstone
Buff to purple fine grained quartzite, with thin shale interbeds at base of member.
Barite outcrop with thickness in metres.
Barite - inferred or float.
Iron minerals, goethite, limonite, brecciated limonitic siltstone, rare hematite.
Barite and iron minerals intermixed.
Contorted siltstone, with approximate dip directions.
Quarry, with height of face in metres.
Natural surface contour in metres
Strike and dip of bedding.
Strike and dip of barite.
Creek, tributary.
Drillhole collar, with direction and declination.
Lease peg and boundary.
Survey station with elevation.
A5521/78 Analytical sample.
P806/78 Petrological sample.
NOTE: Stadia survey by P.P. Crettenden from S.F.B. 499 & 564. Datum is A.H.D.
FIG.6
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
COMPILED W. McCallum
DRAWN J.W.
DATE July, 82
CHECKED
C.D.O 10.12.82 DATE
SCALE 1:500
PLAN NUMBER 82-350
NILPENA BARITE DEPOSITS
No 2 LODE SYSTEM ML 4649
GEOLOGICAL PLAN AND ENLARGEMENTS

Plate 1. Nilpena 1B, and 1C Lodes. View northeast from 1A Lode. Northeast end of 1A open cut in foreground, 1B Lode in centre, and 1C in background, with lodes exposed on right hand side of open cuts. (June 1979). SLIDE NO. 22890.

PLATE 2. Nilpena 1D Lode. View southwest. Lyfords Cut is behind and left of survey peg, with deep footwall cut further left and small hanging wall cut to the right. Prominent strike ridge in background formed by ABC Range Quartzite. (June 1979). SLIDE NO. 23143.

PLATE 3. Nilpena 2A Lode. Before open cut. View west over main section of 2A Lode up to 6 m thick from near eastern end. (June 1978). SLIDE NO. 23144.

PLATE 4. Nilpena 2A Lode opencut. View northeast over open cut showing footwall and hanging wall platforms, deep slots on hanging wall and on the lode. Stockpile of barite centre left. Bitter Springs Creek is in the left background. (October 1980). SLIDE NO. 23145.

PLATE 5. Nilpena 2C Lode. View east near Station D. Barite outcrop is 2 m to 2.5 m wide, with ferruginous margins. (June 1978). SLIDE NO. 23146.

PLATE 6. Jim Crow Lode. Crystalline barite with dark iron oxide coating on edges. Crystals several centimetres across. (June 1979). SLIDE NO. 23147.