DEPARTMENT OF MINES AND ENERGY
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ORAPARINNA BARITE MINE - A SUMMARY

GEOLOGICAL SURVEY

by

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PLANS

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ORAPARINNA BARITE MINE, CENTRAL FLINDERS RANGES - A SUMMARY

ABSTRACT

The Oraparinna Barite Mine is the major producer of industrial grade barite in South Australia, with total output of 270 000 tonnes from 1940 to 1986. Prior to 1981, production was from open cuts, and shrink stopes above No's 1 to 4 underground levels. With the development of a 420 m long decline in 1981, subsequent production has been from development drives and leading stopes above No's 5 to 7 levels.

Barite is hosted by Late Proterozoic Brachina Formation siltstone within a sedimentary graben, structurally controlled by the Oraparinna Diapir. Barite infills open tensional shears, cross cutting bedding and parallel to the graben axial plane, striking northeast and nearly vertical. Barite veins in the Oraparinna Mine are 250m long and average 1 to 1.5 m wide. Lode intersections and terminations, which define the overall shape of the orebody, plunge 45° northeast.

Barite crystallized as large subparallel to radiating aggregates, which were subsequently sheared, recrystallizing in part as a finely foliated aggregate. Quartz and some calcite crystallized with the barite, and some calcite is a fine cross cutting veinlets.

Fluid inclusion temperatures indicate a temperature of 100-170°C for the mineralizing fluid, and sulphur isotope data indicates sulphate is marine; data is consistent with derivation of fluid and sulphate from enclosing sediments during compaction (Cawley, 1983).

INTRODUCTION

Oraparinna Barite Mine is near the eastern margin of the central Flinders Ranges, 500 km north of Adelaide and 190 km north of Port Augusta at the head of Spencer Gulf. For many years the mine has been the source of more than 50% of South Australia's barite production, including nearly 90% of industrial grade barite. Historically the mine has been the largest supplier of industrial grade barite in Australia.

The mine, comprising open cuts and 7 underground levels, is operated by Commercial Minerals Ltd. The company also operate a treatment plant at Quorn, 30 km northeast of Port Augusta.

Barite ($BaSO_4$) has a range of industrial uses including:

- flux in glass manufacture
- filler and extender in paint, paper, textiles, rubber and vinyl.

HISTORY

Oraparinna Barite Mine was first worked in 1940 by the Sturts Meadows Prospecting Syndicate.

From 1944 to 1946 the mine was operated by the Blinman Barytes Company, which subsequently changed its name to South Australian Barytes Pty Ltd (SABAR)

The mine and all assetts including the Quorn Mill were bought by Australian Barytes Ltd (ABAR) in 1977, and in March 1981 were resold to Steetley Industries Ltd.

In 1984, the Australian assetts of Steetley Industries Ltd were bought by Australian Anglo American Ltd, who subsequently reorganised the operations as Commercial Minerals Ltd.

GEOLOGICAL SETTING

The Oraparinna Barite Mine is hosted by Late Proterozoic Adelaidean siltstone of the Adelaide Geosyncline, within a sedimentary graben, 3 km northeast of the Oraparinna Diapir. Sediments were folded and faulted during the Late Cambrian/Early Ordovician Delamerian Orogeny and now dip approximately 45° to the northeast.

Wilpena Group sediments within the graben reach a maximum thickness of 4500 m, and include siltstone, sandstone and minor dolomite. These are overlain by Cambrian carbonates.

The graben is a fault bounded cone shaped sedimentary basin which has been structurally controlled by the Oraparinna Diapir. Movement of the diapir contemporaneously with sedimentation produced the graben boundary faults and a thickening of sedimentation in the graben centre. Subsequent diapir movement led to further faulting.

Barite infills open tensional shears which cross cut bedding. These are up to 300 metres long, 3 metres wide, and nearly vertical. Depth in most cases is unknown. Most strike approximately northeast - southwest, parallel to the graben axis. In many cases lode terminations plunge to the northeast, subparallel to the dip of the host rocks.

Oraparinna Barite Mine has been developed on the largest (No. 1) lode system within Brachina Formation siltstone approximately 100 m below the contact with ABC Range Quartzite. Five smaller lodes in Brachina Formation within 1 km of No. 1 lode system have been worked. Belsen Lode 500 m to the northeast, is higher in the sequence in Bunyeroo Formation at the contact with underlying ABC Range Quartzite.

MINE WORKINGS

Oraparinna Barite Mine comprises open cuts up to 25 m deep and 7 underground levels, summarised in Table 1.

No's 1 to 4 levels were worked from 1948 to 1981, and comprise 2m wide drives on ore, and equipped with rails. Ore was mined from shrink stopes above sub levels. Access to No 4 level is via internal shaft and winzes from No 3 level.

Until the mid 1950's, demand was for high grade barite only, and 36 000 tonnes of stained and undersize ore were dumped on site. In 1957, with assistance from the South Australian Government, a plant was established at Quorn, to beneficiate dump material and mine ore.

In the early 1970's, due to an increase in oil exploration and resultant demand for oil drilling grade barite, floor and roof pillars on No 1 and 2 levels were removed, and open cuts

almost broke through into stopes above No 2 level. In 1972, most stopes and drives above No 2 level, and more than half of the stopes above No 3 level, collapsed.

In 1981-2, Nos 5 to 7 levels were accessed by a decline, 4m by 4m, 420m long, with an average gradient of 1:6.7. The decline is in country rock, 10 m east of the lode system. The levels are approximately 8.5 m apart, 2 m by 2 m, and are driven on ore. Ore is removed from drives by low profile loader and transported to the surface by 18 tonne dump truck.

The roof and floor of on each level is drilled, and the roof is removed in 1.8 m slices. The floor pillars will be removed at a later stage. Modern equipment now allows this mine to be operated by 2 or 3 men.

TABLE 1

SUMMARY OF MINE DEVELOPMENT

LEVEL	Year Developed	Elevation (AHD)	Drives on ore (metres)	Access	Present Access-ability*	Comments
No. 1	1948	503	80	direct from hillside	0%	Floor and pillars stoped out.
No. 2	1948	480	445	direct from hillside	0%	Collapsed for northern half; floor and roof at entrance are stoped out.
No. 3	1962	433	410	entrance adit, 170m long	25%	Substantially collapsed; access to internal shaft has been maintained.
No. 4	1972	410	420	internal shaft and winzes from No. 3 level	90%	Stopes are open.
No. 5	1982	398	345	Decline	100%	Under development
No. 6	1982	385	285	Decline	100%	"
No. 7	1982	374	250	Decline	100%	"

Plus 180 m of driving on 1D lode on 3 sublevels

*i.e. % of drives that are open and accessible at end of 1987.

LODE STRUCTURE - No. 1 LODE SYSTEM

Figure 1 shows typical lode configuration.

The ore body is defined by 2 main lodes.

- 1A Lode, the westernmost lode, strikes east-northeast, dipping steeply north.
- 1C Lode, strikes northeast, dipping steeply south east.

The intersection of 1C and 1A lodes plunges 45° northeast, defining the overall plunge of the orebody. The northern termination of 1A Lode and the southern termination of 1A and 1C Lodes parallel this plunge. Link Lode and 1B Lode lie within this framework.

A fifth lode, 1D, was visible on the surface prior to mining (Gibson, 1957) but is now obscured, and has not been worked on levels 1 to 4. This lode was intersected in the decline, 45 m east of the main system and is worked separately.

The lode system extends northeast-southwest for 250 m, and the down plunge extent is unknown. Lodes average 1 to 1.5 m thick.

ORE GEOLOGY

Barite infills faults and fractures directly adjacent to, and obviously related to, the Oraparinna Diapir at numerous localities near Oraparinna Mine, in rocks ranging from basal Umberatana Group up to Wilpena Group. In places veins have been disrupted by movement of the diapir, indicating emplacement prior to final diapir movement in the Cambrian.

The competent, brittle ABC Range Quartzite is cut by numerous faults, whereas less competent Bunyeroo and Brachina Formations fractured to form tensional shears, subsequently infilled with barite. Minor drag folding in the host rock for 30 cm on both walls of the barite veins, and recrystallisation of barite with a mylonitic texture along to the lode, indicates minor movement subsequent to barite formation.

Barite veins include rafts of siltstone generally parallel to the vein; larger rafts have probably been displaced by only several metres.

At Belsen Lode on the ABC Range Quartzite - Bunyeroo Formation contact, the contact is displaced by 10m along the lode, evidence of fault movement. Other veins at Oraparinna show no evidence of faulting on this scale.

MINERALOGY

Barite varies in colour from transparent, to opaque white, light brown, or brownish grey, and is often brecciated or fractured with iron oxide staining. Quartz is up to 6% but little is visible in hand specimen; SrO up to 7.9% is recorded, but is included in the barite lattice, as no celestite ($SrSO_4$) has been recorded.

Petrology indicates that barite crystallised in open shears as large subparallel to radiating aggregates which were subsequently sheared and recrystallised in part as a fine foliated aggregate. Some barite crystallised in host rock breccia. Barite, quartz, and some calcite crystallised simultaneously and were subsequently cut by fine calcite veins, which in turn were partially replaced by iron oxides.

Geochemistry by Cawley (1983) provided the following data:

- variation is strontium content within and between lodes is used to deduce order of precipitation of barite; within each lode barite crystallised from the footwall to the hanging wall, and lodes crystallised in the order 1A, then 1B and Link, then 1C Lode.
- fluid inclusion homogenisation temperatures indicate temperature of mineralising fluid of 100-170°C, consistent with temperature of fluids expelled during compaction of sediments. Freezing temperatures indicate salinity of 24 equivalent weight% NaCl; salt is probably derived from the Oraparinna Diapir.
- sulphur isotope data from Linke Lode on the southern margin of the Oraparinna Diapir indicate sulphate is marine, and comparison with variation of sulphur isotope with age indicate an age of 630 ± 40 ma for the sulphate, consistent with derivation of sulphate from the enclosing sediments during compaction.

- variation in barium content in host rocks indicate that the host is depleted in barium and enriched in strontium adjacent to the veins. Orthoclase in the host rock siltstone contains 1000-6000 ppm barium, and alteration to sericite would release barium.

GRADE

Total sulphate $(Ba+Sr)SO_4$ varies from 91.9% to 99.8%, and specific gravity from 4.20 to 4.47 (cf 4.5 for pure barite). Quartz (SiO_2) is generally less than 2%, but up to 6.4%. Reflectance (R457 filter) varies from 70.6 to 90.9 and is generally between 80 and 88.

There is no significant difference in ore quality between lodes on the same level. Above No 2 level, SiO_2 averages higher than 2%.

All ore exceeds specification DFCP-3 of the Oil Companies Materials Association (UK) for oil drilling grade barite.

Most ore meets the American Society for Testing Materials, Specification D602-42, for barite used in pigments. Ore that does not meet specifications generally has high quartz or iron oxides. Contamination during mining can lower the product grade.

Commercial Minerals Ltd hold leases over other substantial deposits of lower grade barite suitable for oil drilling, and output from Oraparinna Barite Mine is all industrial grade.

PRODUCTION

Production from Oraparinna Barite Mine to 1986 totals 270 000 tonnes, of a total South Australian production of 551 000 tonnes.

First production was in 1940, and production exceeded 1000 tpa by 1946; from 1946 to 1958 production varied between 1 and 3 thousand tpa.

From 1952 to 1972 production was higher, ranging from 5 to 27 thousand tpa, with peak production in 1968-70. During this period of high production, much of the ore was used to supply the oil drilling market.

Production from 1973 to 1986 has been 2 to 5 thousand tpa.

RESERVES

Ore bodies above No 4 level contain 16 900 tonnes of measured and indicated ore, and 3500 tonnes of inferred barite. There are no plans to mine this ore.

Below No. 4 level (410 m AHD) reserves to 333 m AHD (prior to development of the decline and levels 5 to 7) were 58 200 tonnes indicated and 63 000 tonnes inferred (McCallum and Harris 1979), ie approximately 1500 tonnes per vertical metre.

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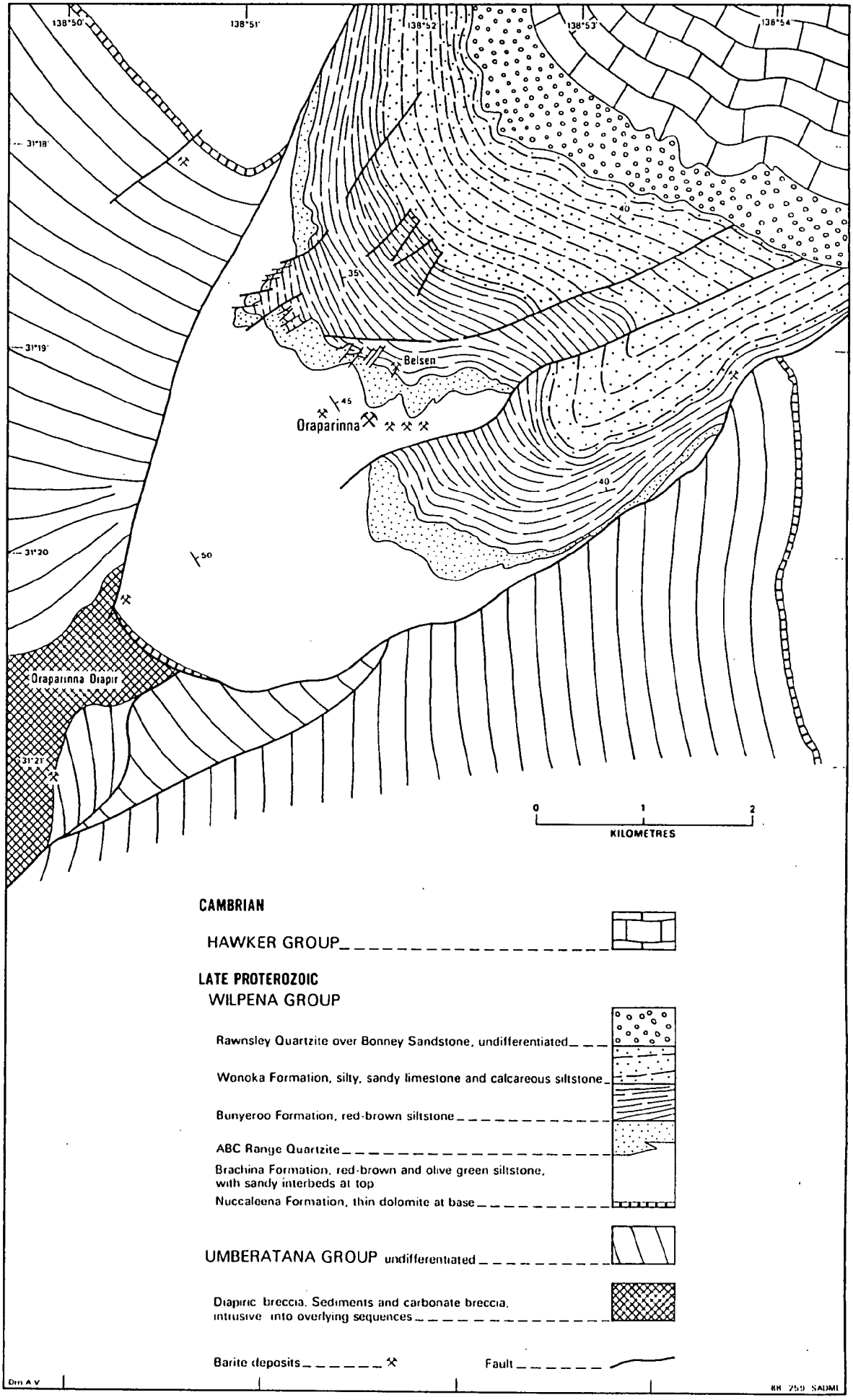

Figure 1

ORAPARINNA BARITE MINE
GEOLOGICAL SETTING

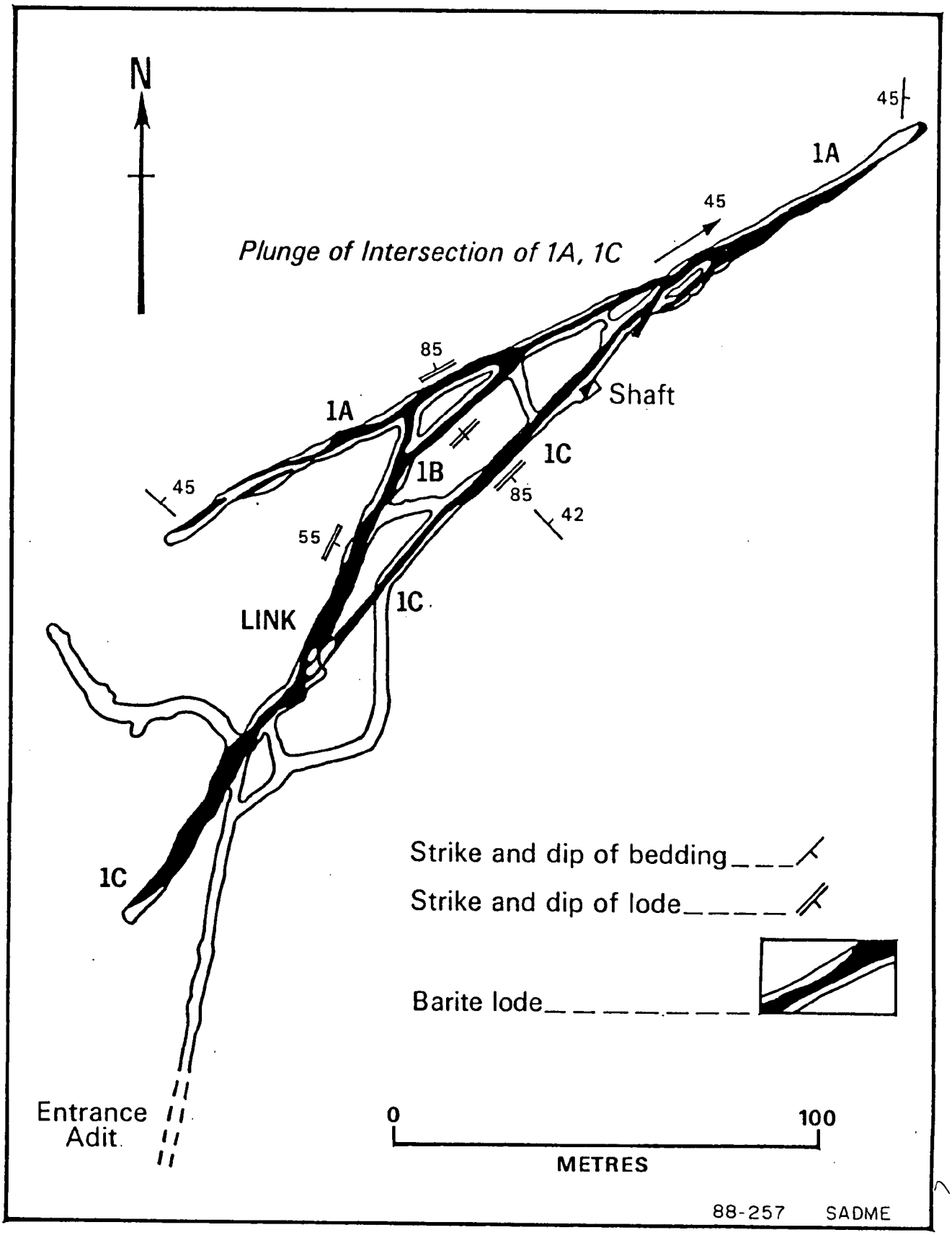

Figure 2

ORAPARINNA BARITE MINE
PLAN OF NO 3 LEVEL, 433m RL.