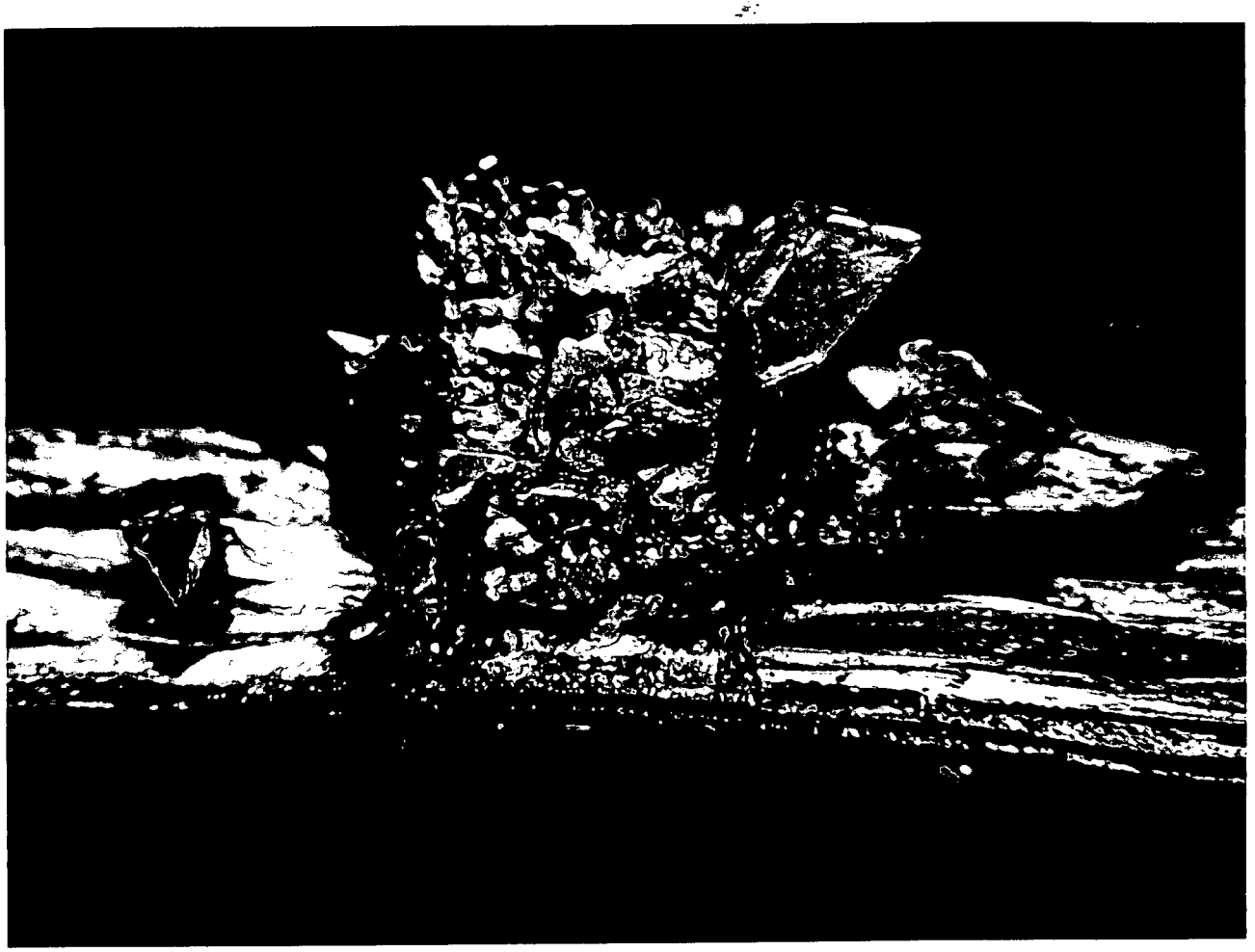
DEPARTMENT OF MINES AND ENERGY

SOUTH AUSTRALIA



MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

SUMMARIES

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 91/66

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS - SUMMARIES

GEOLOGICAL SURVEY

By

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- SUMMARIES -

ABSTRACT

Ten South Australian mineral deposits with resources and/or production of gold of 1 tonne or over are summarised in this report. By far the largest is the Olympic Dam Cu, U, Au, Ag deposit with a measured and indicated resource of 283 tonnes Au and an inferred resource of 1200 tonnes Au. All other known South Australian deposits are about 3 tonnes or less.

Olympic Dam, Moonta (Cu with minor Au), Wallaroo (Cu with minor Au) and Tarcoola are hosted by Early to Middle Proterozoic rocks of the Gawler Craton. The other six deposits are located within the Adelaide Geosyncline. Old Echunga, Jupiter Creek, Teetulpa, Waukaringa and Deloraine are hosted by Adelaidean sediments and overlying Tertiary - Recent alluvium. Barossa occurs within an Early Proterozoic (?) inlier of the Geosyncline and in overlying alluvium.

INTRODUCTION

This report summarises information on mineral deposits in South Australia with resources and/or production of gold of 1000 kg or over. Preparation of the report was in response to a request to SADME from the Bureau of Mineral Resources, Geology and Geophysics (BMR) for information on South Australian gold deposits for inclusion in their mineral deposits (MINDEP) database. BMR have issued reports derived from the MINDEP database on gold deposits of Western Australia (Mock et. al., 1987), Queensland (Mock et. al., 1988) and New South Wales (Mock, 1989).

Format of the summaries is generally to suit the MINDEP database with modifications in accordance with SADME requirements. Production figures are for gold metal unless labelled as bullion.

REFERENCES

Mock, C.M., Elliott, B.G., Ewers, G.R. and Lorenz, R.P., 1987. Gold deposits of Western Australia: BMR data file (MINDEP). *Bureau of Mineral Resources, Geology and Geophysics, Australia. Resources Report 3.*

Mock, C.M., Lorenz, R.P. and Elliott, B.G., 1988. Gold deposits of Queensland: BMR datafile (MINDEP). *Bureau of Mineral Resources, Geology and Geophysics, Australia, Resources Report 4.*

Mock, C.M., 1989. Gold deposits of New South Wales: BMR datafile (MINDEP). *Bureau of Mineral Resources, Geology and Geophysics, Australia, Resource Report 6.*

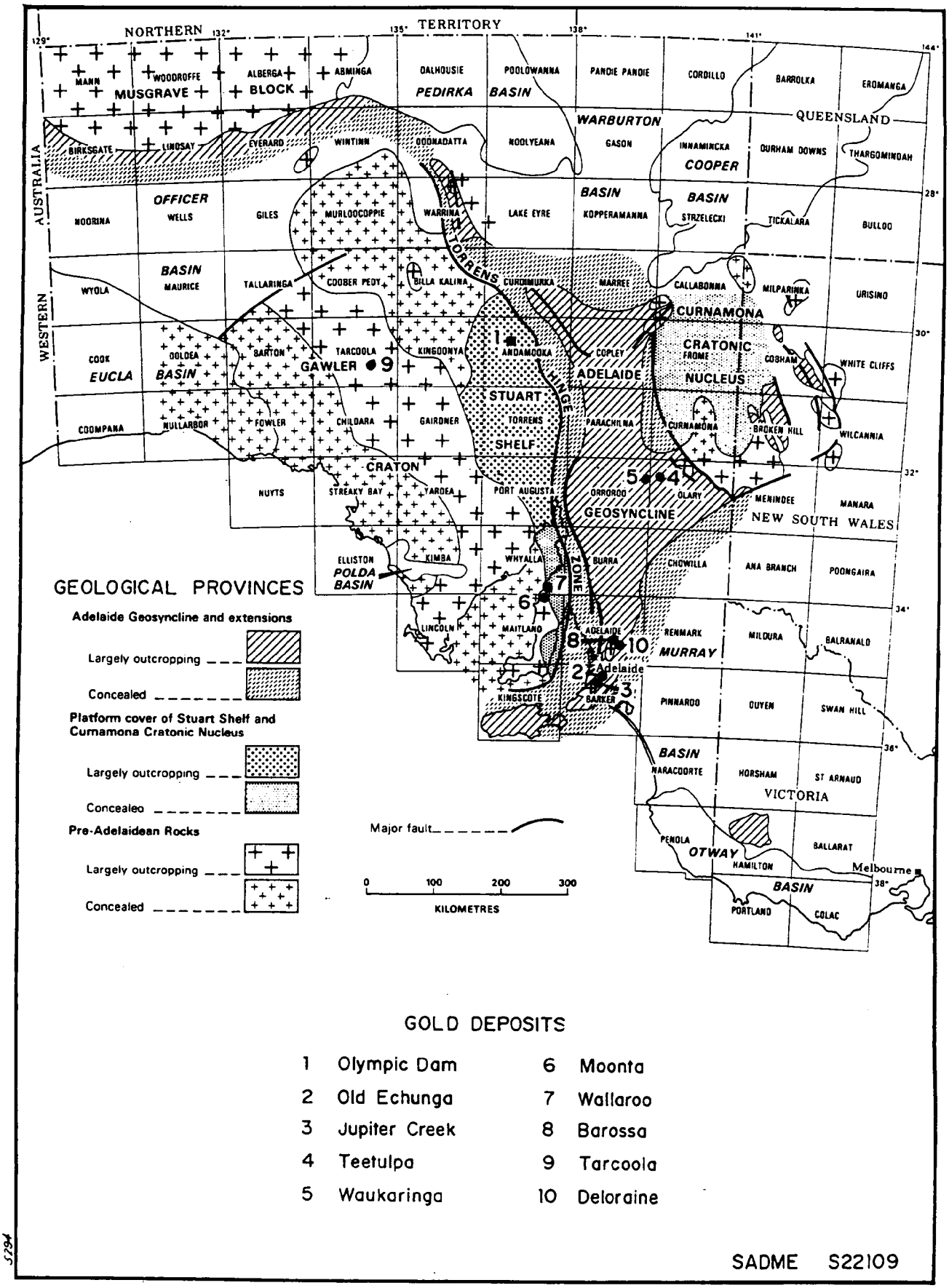


Figure 1. Locations of major gold deposits in South Australia.

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: Olympic Dam

SYNONYM: Roxby Downs

MINE NAME: Olympic Dam

OREBODY NAME: Olympic Dam

LOCATION
1:250 000 Sheet - Name ANDAMOOKA No. SH 53-12
1:100 000 Sheet - No. 6237
MEIS No. 5

AMG Coordinates
681 302 mE
6 630 732 mN
(Zone 53)

Location-Comments: Reference point - Whenan Shaft, Fig. 2. AMG Co-ordinates were supplied by WMC.

COMMODITIES:
Major Cu, U_3O_8, Au, Ag
Minor Rare earths - not currently exploited. Fe - Olympic Dam is a major iron resource but no extraction of iron is planned.

STATUS: Operating

DEPOSIT TYPE: Breccia hosted copper-uranium-gold deposit.

GEOLOGICAL SETTING:

1. Province Gawler Craton
   Stratigraphy: Unnamed
   Lithology: Hydrothermally altered granite-hematite dominated breccia complex.
   Relationship: Host to mineralisation.
   Age: Middle Proterozoic.

2. Stratigraphy: 'Olympic Dam suite' (Informal name)
   Lithology: The undeformed granitic rock enclosing the mineralised breccias has been described as a pink-red alkali feldspar-rich granite (Olympic Dam Operations, 1988) or a quartz-syenite (Mortimer et. al. 1988).
   Relationship: The mineralised breccias occur entirely within the undeformed granite.
   Age: Middle Proterozoic. 1613 ± 20 Ma U-Pb zircon age (Mortimer et al., 1988).

Mineralisation Setting Olympic Dam 3

The Olympic Dam deposit is situated within Middle Proterozoic rocks of the northeastern part of the Gawler Craton beneath undeformed Adelaidean and Cambrian platform sediments of the Stuart Shelf. A major northerly and northwesterly trending structural feature, the Torrens Hinge Zone, is the eastern boundary of both the Gawler Craton and the Stuart Shelf about 50 km east of the deposit. The deposit straddles a west-northwest trending photo lineament corridor at the intersection of a major north-northwest trending gravity lineament and lies within a zone of near coincident regional magnetic and gravity highs (O'Driscoll, 1982).

Beneath the Stuart Shelf sequence the Gawler Craton predominantly consists of deformed granite rocks and metasediments which are partly overlain by extensive undeformed felsic volcanic units. At Olympic Dam an undeformed batholithic complex, informally known as the 'Olympic Dam suite', intrudes the deformed granitic rocks and subcrops over an area of approximately 1200 km^2. The 'Olympic Dam suite' ranges in composition from quartz monzodiorite to granite. The deposit and its host breccias occur entirely within an alkali feldspar-rich granite member of the suite. The granite is hydrothermally altered in the vicinity of the deposit and it forms a local basement high, the apex of which is centred on the hematite-rich core of the deposit. This apex is overlain by a minimum thickness of approximately 260 m of Stuart Shelf sediments, whereas depths to basement increase to 400-500 m only several kilometres away.

The mineralisation is hosted by a hydrothermally altered granite-hematite breccia complex which is surrounded by relatively unbrecciated granite. The margins of the breccia complex are irregular, gradational and not accurately known. However, on the basis of widely spaced drilling the complex appears to be approximately circular in outline and perhaps 5-6 km in diameter.

The majority of breccia fragments are either altered granite and granite derived mineral grains or a variety of hematite rich lithologies. Hematite-quartz breccia is also recognised. Minor but locally abundant clast types include mafic and felsic intrusives and extrusives (including tuffs) and fragments of vein-type assemblages such as barite, siderite, fluorite and quartz.

Clasts vary widely in size and angularity but most are subangular to angular and less than 0.2 m in diameter. Larger blocks on the scale of metres or tens of metres occur and these are mostly granite or finely laminated sandstones, siltstones and tuffs. Some breccia bodies contain localised layering, generally diffuse or wispy. The layering can rarely be traced for more than several metres before merging into homogeneous breccia.

Hematite-quartz breccias predominate in the central core of the deposit. These breccias are typically devoid of significant copper and uranium mineralisation but locally may contain ore grade gold. The granitic and hematitic breccia types are complexly intermingled away from the central core. Granitic breccias and zones of relatively unbrecciated granite predominate towards the outer margins of the complex.

Breccias are intruded by mafic and felsic dykes of various ages. Diatreme fabrics are preserved in several areas.

This description is mainly derived from Olympic Dam Operations (1988).

Mineralisation Description

Mineralisation has an areal extent exceeding 20 km^2 and vertical thicknesses varying from tens to hundreds of metres. Maximum vertical thickness found is 350m (Roberts and Hudson, 1983).

The orebody is made up of a large number of individual ore zones. The more hematite-rich breccias are most strongly mineralised. In general the ore minerals are most abundant in breccia matrices, although mineralised clasts are observed. In some instances mineralised zones have been brecciated and incorporated in an unmineralised matrix.

Mineralisation consists of medium-grained disseminated copper sulphides and fine grained disseminated pitchblende. The principal copper sulphides are chalcocite, bornite and chalcopyrite.

The distribution of these sulphides is complex but conforms to a consistent pattern. The higher grade ore zones consist of disseminated chalcocite and bornite and they tend to occur higher in the deposit above lower grade chalcopyrite mineralisation. Higher grade uranium-rich areas contain pitchblende-rich veinlets as well as finer disseminations. Significant concentrations of the rare earth elements lanthanum and cerium occur with most copper-uranium mineralisation. Some discrete zones of gold mineralisation have also been outlined.

This description is mainly derived from Olympic Dam Operations (1988).

STYLE/FORM: Discordant

MORPHOLOGY: Irregular

NATURE OF MINERALISATION: Breccia

TEXTURE: Disseminated

DIMENSIONS AND ORIENTATION: Area: 20 km^2 (minimum)
Vertical Depth: 10 m (minimum)
350 m (maximum)

MINERALOGY

Ore: Chalcopyrite, bornite, chalcocite; uraninite (as pitchblende), coffinite, brannerite; gold (free).

Gangue: Hematite, quartz, barite, siderite, fluorite, bastnaesite, florencite.

ALTERATION

All alteration assemblages within the deposit appear to be hydrothermal in origin. The rocks have not been metamorphosed, nor does there appear to have been any significant weathering of the breccias beneath the unconformity. Fresh granitic clasts may be preserved in a highly altered matrix, but many breccias are pervasively altered. Within the breccia complex granitic material has been variably and extensively sericitised and hematised, locally chloritised or silicified and, very rarely kaolinised. Hematitic and hematite-quartz breccias are also locally silicified and carbonate alteration is present in the northeastern part of the breccia complex.

The host granite is hydrothermally altered in the vicinity of the deposit (Olympic Dam Operations, 1988).

RESERVES/RESOURCES

	Million tonnes	Cu (%)	U_3O_8 (kg/t)	Au (g/t)	Ag (g/t)	Classification and Comments
1. Copper-uranium	450	2.5	0.8	0.6	6	Measured and indicated resource. Includes proved Ore Reserve of 11.2 mt.
	11.2	3.1	1.2	0.3	11.2	Proved ore reserve. Includes calculated mining dilution. Included in measured and indicated resource tonnage.
2. Gold Mineralisation (Olympic Dam Operations, 1988; Newton et al, 1988)	2.3	0.3	0.1	5.8	1.5	Measured and indicated resource.
3. Copper-uranium-gold	2000	1.6	0.6	0.6	3.5	Inferred resource (Roberts & Hudson, 1983; Newton et. al., 1988). Includes all measured and indicated resources and proved ore reserves.

Total metal in 1 and 2 - Measured and indicated resource in both orebodies.

Cu	U_3O_8	Au	Ag
11.3 million tonnes	360 000 tonnes	283 000 kg	2 700 000 kg

PRODUCTION (Sales)

Period	Commodity	Amount
1988	Cu	4 678 tonnes
	U_3O_8	123.66 tonnes
1989	Cu	28 585 tonnes
	U_3O_8	521.28 tonnes
	Au	323 139 gms
1990	Cu	41 853
	U_3O_8	1 722.03 tonnes
	Au	702 451 gms
	Ag	1 716.929 kg

CAPACITY (Planned annual production)

Cu	U_3O_8	Au	Ag
45 000 tonnes	1 900 tonnes	840 000 gms	17 262 kgs

MINING METHODS

Underground mining. Stoping is by conventional post-fill sub-level open stoping. The Whenan Shaft and a service decline provide access and ore and mullock haulage.

DISCOVERY/HISTORY

The Olympic Dam copper-uranium-gold-silver deposit was discovered by Western Mining Corporation Ltd in 1975. Initial impetus for exploration of the area was provided by a conceptual model which related formation of stratabound copper deposits to solutions which had acquired copper during oxidative alteration of basalts.

The Olympic Dam site was selected for drilling because of the presence of near coincident gravity and aeromagnetic anomalies. Tectonic studies also indicated that the site lies at the intersection of a broad west-northwest trending photo-lineament and a major north-northwest trending gravity lineament.

Diamond drillhole RD1, 400m west of Olympic Dam, was commenced on 14 June 1975 and completed at 411.1 m on 30 July 1975. Analysis showed a 38 m interval between 353 and 391 m with 1.05% Cu, 4.0 g/t Ag, 0.29 g/t Au. Some subsequent drillholes provided further encouraging assays but others were virtually barren.

Drillhole RD10, 900 m northwest of Olympic Dam was completed on 25 November 1976 at 529 m. A 170 m intersection in hematitic and granitic breccia between 348 and 518 m averaged 2.12% Cu and 0.59 kg/t U_3O_8. This intersection confirmed the potential of the deposit and follow-up drilling commenced in 1977. By mid-1979 the vast extent of the deposit was realised.

In July 1979 a joint venture agreement was announced between Western Mining Group (51%) and BP Group (49%) to evaluate and develop the deposit and intensive delineation drilling was commenced. By the end of 1985, over 540 km of surface and underground drilling had been completed, comprising over 700 surface drillholes totalling 234 km of core and 218 km of open hole drilling, and about 900 underground diamond drillholes totalling 90 km.

On 8 December 1985, the joint venturers announced their commitment to the development phase of the Project.

Principal reference - Newton, Wilson and Harris (1988).

OWNERSHIP

All current tenements are held in the names of wholly owned Western Mining Corporation Ltd subsidiary WMC (Olympic Dam Corporation) Pty Ltd (formerly Roxby Mining Corporation Pty Ltd) (51%) and BP Minerals (Roxby Downs) Pty Ltd (49%). The JV is managed by WMC (Olympic Dam Operations) Pty Ltd (formerly Roxby Management Services Pty Ltd).

COMPILER R S ROBERTSON DATE: JULY 1990

REFERENCES

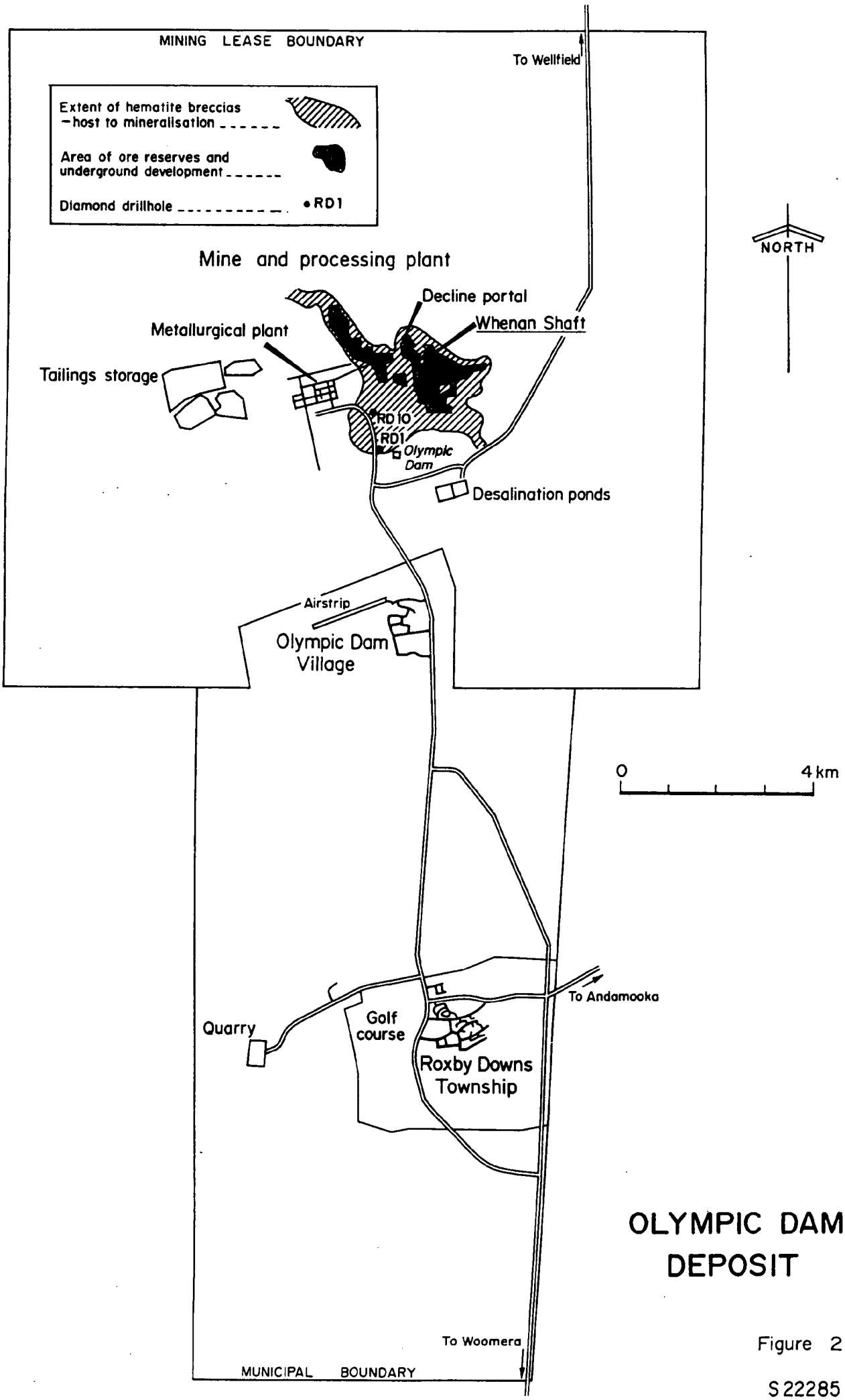
Mortimer, G.E., Cooper, J.A., Paterson, H.L., Cross, L., Hudson, G.R.T. and Uppill, R.K., 1988. Zircon U-Pb dating in the vicinity of the Olympic Dam Cu-U-Au Deposit, Roxby Downs, South Australia. *Economic Geology,* 83:694-709.

Newton, A.W., Wilson, M.A., and Harris, J., 1988. Olympic Dam - The First Decade. *Mineral Resources Review, South Australia,* 156: 5-26.

Olympic Dam Operations, 1988. Geology and Mining Technical Handbook, Issue 1. *Olympic Dam Operations,* Roxby Downs.

O'Driscoll, E.S.T., 1982. Patterns of discovery - the challenge for innovative thinking. *Petroleum Exploration Society of Australia Journal,* 1: 11-31.

Roberts, D.E. and Hudson, G.R.T., 1983. The Olympic Dam copper-uranium-gold deposit, Roxby Downs, South Australia. *Economic Geology,* 78: 799-822.



OLYMPIC DAM DEPOSIT

Figure 2

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Department of Mines and Energy – South Australia

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: OLD ECHUNGA DIGGINGS

SYNONYM: CHAPEL HILL

MINE NAMES: Alluvial Chapman's Hill, Chapman's Gully, Chapel Hill, Windlass Hill, Bell's Hill Rush, Christmas Rush, Poor Mans Hill, New Rush, Hough's Alluvial diggings.
Reef Echunga Mine (Echunga Quartz Blow), Big Ben, Hall's Tunnel, Golden Reef, Non Pareil, Sandercock's Prospect, McLarty's Leader, Chapman's Gully North, Hall's New Find, South Echunga, Non Pareil Extended.

MINING FIELD: ECHUNGA GOLDFIELD

LOCATION:

1:250 000 Sheet-Name	BARKER No SI 54-13
1:100 000 Sheet-No.	6627
Hundred Kuitpo	Sections 715 (Echunga Mine), 407, 394, 395, 393, 642, 396 et. al.
Mining Field	Echunga Goldfield
AMG co-ordinates	296 850mE 6 115 450mN (Zone 54)
Location Comments	Reference point for coordinates is the Echunga Mine as shown on Fig. 3.

COMMODITIES: Major Au Minor Diamonds

STATUS: Abandoned

DEPOSIT TYPE: Alluvial gold in Tertiary and Quaternary sediments and gold in quartz-ironstone veins in Adelaidean rocks.

GEOLOGICAL SETTING

1. Province: Adelaide Geosyncline
   Stratigraphy: Aldgate Sandstone-Burra Group
   Lithology: Micaceous sandstone and arkose with heavy mineral laminations and interbedded sandy shale and siltstone.
   Relationship: Host to vein mineralisation.
   Age: Adelaidean.

2. Province: Adelaide Geosyncline
   Stratigraphy: Woolshed Flat Shale - Burra Group.

Lithology: Carbonaceous siltstone and shale with finely disseminated sulphide (pyrite-pyrrhotite), lenticular quartzite.
Relationship: Host to vein mineralisation.
Age: Adelaidean.

3. Stratigraphy: Unnamed
Lithology: Conglomerate and sand, partly ferruginous with abundant heavy minerals.
Relationship: Host to alluvial gold
Age: Tertiary?

4. Stratigraphy: Unnamed
Lithology: Sand, silt and gravel of present drainage channels and soil.
Relationship: Host to alluvial gold.
Age: Pleistocene to Holocene.

Mineralisation Setting

The Old Echunga deposit is located on folded and block faulted, low grade (biotite zone) metasediments of the Burra Group within the Adelaide Geosyncline. The Echunga 1:50 000 geological sheet (Belperio, 1985) shows bedrock in the area to comprise Aldgate Sandstone overlain in the south east part of the diggings by Woolshed Flat Shale. Aldgate Sandstone is overlain in the southeast part of the diggings by Woolshed Flat Shale. Aldgate Sandstone, the basal unit of the Adelaidean sequence in the Mt Lofty Ranges region, is micaceous sandstone and arkose with heavy mineral laminations and interbedded sandy shale and siltstone. Woolshed Flat Shale consists of carbonaceous siltstone and shale with finely disseminated pyrite-pyrrhotite. These two units host the vein mineralisation at Echunga. Adelaidean rocks in the area have been deeply weathered, kaolinised and bleached beneath an irregular Tertiary(?) land surface.

Dissected remnants of Tertiary (?) fluvial sediments overlying the Adelaidean rocks comprise a basal cobble conglomerate, pebble conglomerate and sand, ferruginous in part. The heavy mineral fraction of these sediments contains abundant staurolite suggesting a source in higher metamorphic grade rocks to the east (Lewis, 1984). These sediments and Pleistocene to Holocene alluvium of the present drainage system and soil are host to most of the gold mineralisation at Echunga.

Mineralisation Description

Lewis (1984) states that the bulk of gold production came from Quaternary sand, silt and gravel along present drainage channels. Nuggets, mostly less than 1 oz, were common. 'Placer' gold was also found in the Tertiary conglomerate, mostly in the basal conglomerate in basin shaped hollows in the bedrock. The Tertiary is up to 16m thick. The gold was flaky west of Diggings Road. East of the road (Chapel Hill-Windlass Hill) the Tertiary is thinner (<4m) and the gold hackly and crystalline probably due to remobilisation during weathering.

Gold was also produced from ferruginous, pyritic quartz veins in weathered, kaolinised sandstone, shale and siltstone of the Aldgate Sandstone and Woolshed Flat Shale. Lewis (1984) states that the gold was patchy with the richest pockets occurring at shallow depth perhaps due to supergene enrichment.

Over 50 alluvial diamonds have been found, the largest recorded being 5¼ ct. All diamonds were found in the Forest Reserve (Sec 393) according to Lewis (1984). Sas and Gates (1981) reported the finding of one micro diamond from the processing of 75 tonnes of 'old tailings'. Imbrication of cobbles and cross bedding in the Tertiary sediments suggest a flow direction from the northeast.

Drew (1984); Gerdes (1988); Passmore (1959); Lewis (1984); Sas and Gates (1981).

NATURE OF MINERALISATION: Vein, detrital

DIMENSIONS: Area about 1km^2

PRODUCTION: Au 3 100kg (100 000 oz) Estimated by Drew (1984).

WORKINGS AND MINING METHODS:

The workings mainly comprised shallow shafts and pits. There was some reef and 'deep lead' mining to depths of about 12m. Dredging was carried out in 1909 at National Dam.

DISCOVERY/HISTORY:

Gold at Echunga was first found by William Chapman in 1852. The most intense alluvial 'rushes' took place from 1852-1855. Other periods of activity included the 1860's, 1880's, 1900's and 1930's. Drew (1984) summarises the history of the Echunga Goldfield.

From 1979 to 1981 a group of companies carried out exploration, principally for diamonds, of the Old Echunga Diggings comprising 'gravel' sampling and examination of heavy mineral contents followed by costeaning and processing through an on site concentration plant of 75 tonnes of 'old tailings'. (Sas, 1981). CRA held an exploration licence over the area from 1982 to 1984 and carried out further limited gravel sampling and assessment of Old Echunga as part of a regional search for diamonds (Lewis, 1984).

OWNERSHIP/TENURE:

Most of the Old Echunga diggings west of Diggings Road are on a Forest Reserve exempted from the operation of the Mining Act and placed on the Register of State Heritage Items and are therefore unavailable for mining.

REMARKS: For the purpose of this summary the Old Echunga diggings are those shown on Fig. 4 in Drew (1984). Scattered workings to the north such as those at Biggs Flat and in the Mylor and Hahndorf areas are excluded, as are the Jupiter Creek diggings which are listed separately. All are regarded as part of the Echunga Goldfield. Information on geology, mineralisation and production for all the Echunga Goldfield is sparse.

COMPILER: R S ROBERTSON DATE: JULY 1990

REFERENCES

Belperio, A.P., 1985. Echunga map sheet. *South Australia. Geological Survey. Geological Atlas 1:50 000 Series,* sheet 6627-1.

Drew, G.J., 1984. The Echunga Goldfield. Geology, history and selected newspaper readings. *South Australia. Department of Mines and Energy. Report Book,* 83/42.

Gerdes, R.A., 1988. Geophysical appraisal of the Echunga District, with reference to mineralisation. *Mineral Resources Review, South Australia,* 156: 27-35.

Lewis, P., 1984. Fifth quarterly report on Echunga EL 1048, SA for the period ending 19 January 1984, for CRA Exploration Pty. Ltd. *South Australia. Department of Mines and Energy. Open file Envelope,* 4944 (unpublished).

Passmore, R.J., 1959. The Echunga Goldfields. Secs. 332, 375, 418, 493, 695. Hd. Kuitpo. Co. Adelaide. *South Australia. Department of Mines. Report Book,* 48/137.

Sas, Z. and Gates, T., 1981. A report on the Echunga Exploration Programme conducted by Britas Diamonds N.L., Exploration Licence 493. *South Australia. Department of Mines and Energy. Open file Envelope,* 3563 (unpublished).

ECHUNGA GOLDFIELD

OLD ECHUNGA DIGGINGS

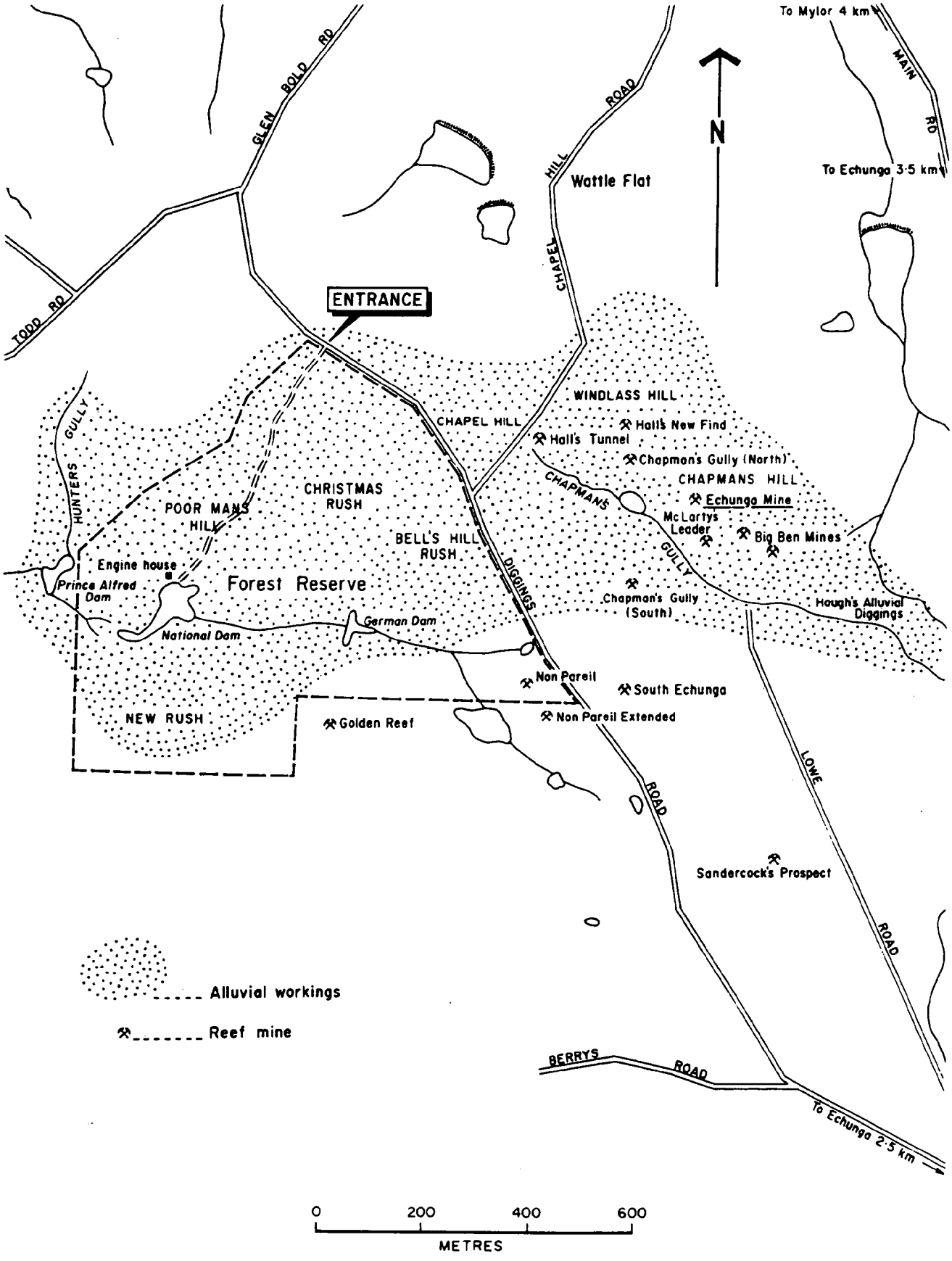


Figure 3

DEPARTMENT OF MINES AND ENERGY— SOUTH AUSTRALIA

S 22286

SOUTH AUSTRALIAN MINERAL DEPOSITS

MAJOR GOLD DEPOSITS

DEPOSIT NAME: JUPITER CREEK DIGGINGS

MINE NAMES: Alluvial Long Gully, White Gully, Fosters Gully, Peg Leg Gully, Surface Point, Golden Point, Dead Horse Gully, Battery Creek, White Point.

Reef Phoenix, Caledonian, Beatrice, Excelsior, State Express, Crystal Mine, Jupiter, South Crystal Mine, New Phoenix, Burgess Claim, Prince of Wales, Ophir, Fergusson, Inkermann, Sebastopol, Burgess Prospect, Reefing Prospect, Wattle Blossom, Rose Bud, Walters, Brogan's Shafts, Swan's Shaft, National, North Crystal Caledonian, Hunt's Shaft, Sexton's Shaft, Crest of the Wave, Ophir South, Florence Maud, Victoria, Burgess Shaft, Star of Jupiter.

MINING FIELD: ECHUNGA GOLDFIELD

LOCATION:

1:250 000 SHEET NAME	BARKER NO SI 54-13
1:100 000 SHEET	6627
Hundred	Kuitpo
Section	356, 355, 335, Pt 332, 963, 330.
AMG Coordinates	294 750mE 6 113 050mN (Zone 54)
Location Comments	Reference point - Beatrice Engine Shaft on Fig 4. The Jupiter Creek Diggings are about 3km southwest of the Old Echunga Diggings.

COMMODITIES: Major Au

STATUS: Abandoned

DEPOSIT TYPE: Alluvial gold in Tertiary and Quaternary sediments and gold in quartz-ironstone veins in Adelaidean rocks.

GEOLOGICAL SETTING

1.	Province	Adelaide Geosyncline
	Stratigraphy	Aldgate Sandstone - Burra Group
	Lithology	Micaceous sandstone and arkose with heavy mineral laminations and interbedded sandy shale and siltstone.
	Relationship	Host to vein mineralisation
	Age	Adelaidean

2. Stratigraphy Unnamed
   Lithology Conglomerate & sand, partly ferruginous
   Relationship Host to alluvial gold
   Age Tertiary

3. Stratigraphy Unnamed
   Lithology Conglomerate and sand, partly ferruginous
   Relationship Host to alluvial gold
   Age Pleistocene to Holocene

Mineralisation Setting

The Jupiter Creek diggings are located on folded and block faulted, low grade (biotite zone) metasediments of the Burra Group within the Adelaide Geosyncline. The Noarlunga 1:50 000 geological sheet (Forbes, 1983) shows bedrock in the area to comprise Aldgate Sandstone, the basal unit of the Adelaidean sequence in the Mt Lofty Ranges region. Aldgate Sandstone is micaceous sandstone and arkose with heavy mineral laminations and interbedded sandy shale and siltstone. This unit hosts the vein mineralisation at Jupiter Creek. Adelaidean rocks in the area have been deeply weathered, kaolinised and bleached beneath an irregular Tertiary (?) land surface.

Dissected remnants of thin (<3m) ferruginous, sandy conglomerate of Tertiary (?) age overly Aldgate Sandstone. Pleistocene to Holocene sand, silt and gravel occur on hillsides and along modern drainage channels. These units host alluvial gold at Jupiter Creek.

Mineralisation Description

Alluvial gold occurred in sediments in modern drainage channels and throughout the thin veneer of Tertiary conglomerate (partly reworked?) which cover the hillsides. Particularly rich areas were within alluvium of minor gullies on the eastern side of Long Gully and some areas of cemented, reworked (?) conglomerate. Lewis (1984) states that the bulk of Jupiter Creek gold production came from Quaternary sediment along modern drainage channels. These sediments were said to be particularly rich in nuggets.

Gold was also mined from irregularly gold bearing lodes comprising small veins of gossanous and ferruginous quartz with bands of kaolinitic clay in sandstone and shale. Reef mining appears to have been of greater importance than at Old Echunga.

Drew (1984); Gerdes (1988); Lewis (1984); Passmore (1959); Sas and Gates (1981).

NATURE OF MINERALISATION Vein, detrital

DIMENSIONS: Area - about 0.5 km^2

PRODUCTION: 1868-1989 Au Estimated 930 kg (30 000 oz) (Drew, 1984).

WORKINGS AND MINING METHODS:

The alluvial workings comprised shallow pits and shafts to a maximum depth of 5m. Dredging of alluvium was carried out in the period 1905-1907 but proved to be uneconomic due to lower than expected grades. Several dams remain along Long Gully from this activity. Underground reef mining took place in numerous shafts and adits to the east of Long Gully. Deepest shaft recorded was the Phoenix Mine main shaft at 66m. Reef mining appears to have been of greater importance than at Old Echunga.

DISCOVERY/HISTORY:

Gold at Jupiter Creek was first discovered in July 1868 by Thomas Plane and Henry Saunders. The main alluvial rush was in the period 1868-1871. Reef mining took place in the periods 1869-71, 1884-1890 and in the 1930's. Bulk treatment of alluvium by dredging was attempted by a company in the period 1905-1907.

OWNERSHIP/TENURE:

The majority of the diggings are on a Forest Reserve and are exempted from the operation of the Mining Act and placed on the Register of State Heritage Items and are therefore unavailable for mining.

REMARKS: For the purpose of this summary the Jupiter Creek diggings are those shown on Fig. 6 in Drew (1984). Jupiter Creek is regarded as part of the Echunga Goldfield. Information on geology, mineralisation and production for all the Echunga Goldfield is sparse.

COMPILER: R S ROBERTSON DATE: JULY 1990

REFERENCES

Drew, G.J., 1984. The Echunga Goldfield. Geology, history and selected newspaper readings. *South Australia. Department of Mines and Energy. Report Book,* 83/42.

Forbes, B.G., 1983. Noarlunga map sheet. *South Australia. Geological Survey. Geological Atlas 1:50 000 Series,* sheet 6627-IV.

Gerdes, R.A., 1988. Geophysical appraisal of the Echunga District, with reference to mineralisation. *Mineral Resources Review, South Australia,* 156: 27-35.

Lewis, P., 1984. Fifth quarterly report on Echunga EL 1048, SA for the period ending 19 January 1984, for CRA Exploration Pty. Ltd., *South Australia. Department of Mines and Energy.* Open file Envelope, 4944 (unpublished).

Passmore, R.J., 1959. The Echunga Goldfields. Secs. 332, 375, 418, 493, 695. Hd. Kuitpo Co. Adelaide. *South Australia. Department of Mines. Report Book,* 48/137 (unpublished).

Sas, Z. and Gates, J., 1981. A report on the Echunga Exploration Programme conducted by Britas Diamonds NL. Exploration Licence 493. *South Australia. Department of Mines and Energy. Open file Envelope,* 3563 (unpublished).

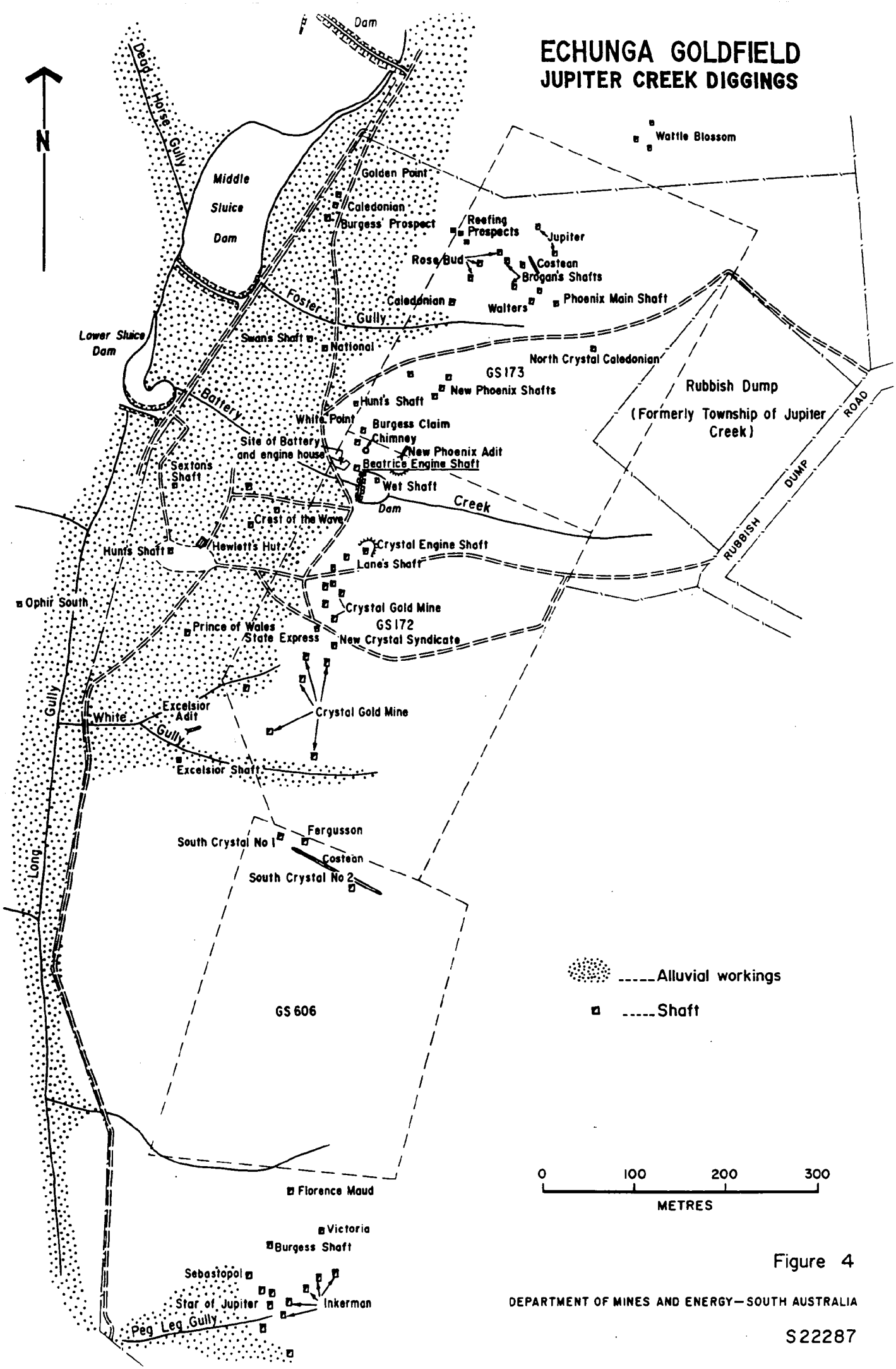


Figure 4

DEPARTMENT OF MINES AND ENERGY—SOUTH AUSTRALIA

S22287

SOUTH AUSTRALIAN MINERAL DEPOSITS

MAJOR GOLD DEPOSITS

DEPOSIT NAME: Teetulpa

MINE NAMES:

Alluvial — Brady's Gully, Goslin's Gully, Windlass Hill, Dam Gully, Birthday Gully, Poverty Gully, Ironclad Gully, Duffers Flat, One Man's Flat, Campbell's Hill, Cemetery Gully, Deep Gully, Strawbridge Gully, Brennan's Gully, Flack's Gully, Wakefield Gully, Murphy's Gully, Salt Creek.

Reef — Adelaide Jubilee, Aurifera, Ben Lomond, Blue Star, Blue Star Central, Brady, Colleen Brawn, Cosmopolitan, East Ironclad, East Ironclad Extended, Edward Parry, Empress Victoria, Enterprise, Evening Star, Great Ironclad, Great Ironclad Extended, International, Isle of Axholme, J.C. Bray, Jubilee, Lion, Londonderry, Morning Star, Morning Star South, Parnell, Prince Consort, Prince Consort South, St. Patrick, Scotchman, Teetulpa, Teetulpa United, Victory, White Cross, Struck Oil, Warrior Extended, Golden Star, Three Star, Alliance, Great Warrior, Nonpareil.

MINING FIELD: Teetulpa Goldfield

LOCATION:

1:250 000 Sheet	OLARY No. SI 54-2
1:100 000 Sheet	6833
MEIS No.	C
AMG Co-ordinates	376 690 mE 6 429 550 mN Zone 54

Location-Comments — Reference point is the Teetulpa United 'A' shaft shown on Fig. 5, plan 86-541 and Front Office plan 838A. This is approximately at the centre of the alluvial and reef workings.

COMMODITIES: Major Au

STATUS: Operating

Comments — Some mining activity on 14 leases and 2 claims covering most of the field.

DEPOSIT TYPE: Alluvial gold in Quaternary sediments and gold in quartz-sulphide veins in Adelaidean Tapley Hill Formation.

Teetulpa 2

GEOLOGICAL SETTING:

1. Province: Adelaide Geosyncline
   Stratigraphy: Tapley Hill Formation
   Lithology: Well laminated siltstone
   Relationship: Host to vein mineralisation
   Age: Adelaidean

2. Stratigraphy: Unnamed
   Lithology: Poorly sorted silty gravel
   Relationship: Host to alluvial gold
   Age: Quaternary

Mineralisation Setting

The goldfield lies near the keel of the gently west plunging Waukaringa Syncline, toward the eastern closure. Flaggy, well laminated, blue-grey to green siltstone and dark graphitic and pyritic shale of the Upper Proterozoic Tapley Hill Formation host the quartz-carbonate-sulphide veins.

Reef workings are mainly located on a dominant set of veins which strike 340° and dip 70-80° to the east. These veins average 0.3 m and are up to 1.0 m wide. A second set of essentially east-west veins of massive white quartz 1-2 metres wide is devoid of any sulphide mineralisation and non-auriferous. A third set comprises greyish coloured, sulphide bearing quartz veins striking 070-080° with gentle to moderate southerly dips, often concordant with bedding. These veins have been opened up to shallow depths by the old miners. The auriferous veins, the 340° set, are post deformational and usually cut and displace the east-west syndeformational veins.

Most gold production was from alluvial sediments, the gold derived from erosion of the quartz-carbonate-sulphide veins. The main alluvial sediments exploited represent fossil stream channels of poorly sorted, silty gravel cut by the meandering modern drainage channels.

Isolated on the sides of the present day valleys are remnants of the older channels such as Windlass Hill (Horn & Fradd, 1986).

Mineralisation Description

The gold bearing veins comprise quartz, calcite, siderite, ironstone (gossan), hematite and pyrite with minor chalcopyrite, galena and bismuth. Brown (1908) stated that the gold was difficult to see due to the ferruginous nature of the lode material and the fineness of the gold. Sampling by Horn & Fradd (1986) suggested an irregular distribution of gold in the quartz-ironstone veins with a maximum value of 34 ppm Au but with many values less than 0.5 ppm. Despite the number of reef workings, production appears to have been small.

Horn & Fradd stated that alluvial gold was found mainly in 'sandy wash' near the base of the alluvium. Bell (1987), reporting the results of bulk testing of the alluvium, also indicated that gold was concentrated near the contact between alluvium and bedrock. Bell stated that the gold is coarse grained and that treatment of large tonnages is necessary to properly assess grades. Numerous nuggets were found during alluvial mining. The largest recorded nugget, 'The Joker', found in Brady's Gully, weighed 925.5 gms. Sprigg (1968) recorded that a feature of the alluvial fields was the frequent encrustation of nuggets by limestone and iron oxides.

NATURE OF MINERALISATION: Vein, detrital

DIMENSIONS: Area about 20 km^2 (5 km north-south by 4 km east-west)

MINERALOGY:

Ore	Gold (free)
Gangue	Quartz, calcite, hematite, limonite, siderite, pyrite, chalcopyrite, galena, arsenopyrite, bismuth and manganese.

RESERVES/RESOURCES

	Cubic metres m^3	Au g/m^3	Classification Comments
Alluvial Gold	870 000	1.8	Inferred resource of alluvial gold (Horn & Fradd, 1986)
" "	700 000	0.3	Inferred resource of alluvial gold (Bell, 1987)

PRODUCTION

Period	Commodity	Amount gms	Comments
1886-1908	Au	2 400 000	Using Brown's (1908) estimate of 300 000 pounds worth of Au & assuming a price of £3 17s per oz.
1970	"	840	Recorded in production returns to SADME
1982	"	20	"
1983	"	53	"
1985	"	2	"
1986	"	130	"
1987	"	421	"
1988	"	9 396	"
1989	"	379	"
1990	"	288	"
Total (estimated)		2 400 000	(Rounded to 2 sig. figs.)

WORKINGS AND MINING METHODS

Early alluvial mining comprised surface fossicking and the sinking of pits and shallow shafts to the base of the alluvium. Lack of water necessitated dry fossicking for coarse gold fragments until water supplies were established to enable washing. Dry fossicking became a feature of the Teetulpa goldfield.

There are numerous underground workings on the steeply dipping reefs although these appear to have produced only a minor proportion of total production. Most shafts were in the 10-20 m depth range with deepest being 55 m.

DISCOVERY/HISTORY

Alluvial gold was discovered at Teetulpa on 5 October 1886 by Thomas Brady and Thomas Smith. Within the first four weeks following discovery, the number of diggers on the field increased to 2 000 and at its peak the population was estimated at 4 000 - 5 000. Most mining took place in the year following discovery.

The first reef mining claims were pegged in October 1886 but little work was done until 1887. Most reef claims had ceased operation by late 1890. Further attempts at underground mining were made in 1911, 1913 and 1934.

Between 1966 and 1986 several companies and the SA Dept of Mines and Energy carried out limited reconnaissance sampling and mapping at Teetulpa (Collins, 1978; Curtis, 1985; Horn & Fradd, 1986; Kopcheff, 1971; Mayer, 1981; Martins, 1978; Seymour, 1983; Sprigg, 1968; Wyatt, 1984). In 1986 Western Mining Corporation carried out geochemical sampling (soil traverses, rock chip and stream), IP, Sirotem and ground magnetic surveys and reverse circulation drilling (16 holes) (Paterson, 1986). In 1987-88 Thomdrill Pty Ltd drilled 28 shallow holes to search for alluvial gravels in Brady's and Strawbridge's Gullies (Thomdrill Pty Ltd., 1988).

Since 1982 small scale mining using sluices has been carried out by four leaseholders. In 1987 Gold & Mineral Exploration NL undertook systematic bulk testing of alluvial sediments in Brady's Gully, Strawbridge Gully and Deep Gully using a wet jig plant (Bell, 1987). This work suggested a considerably lower Au grade than that estimated by Horn & Fradd.

TENEMENTS/OWNERSHIP

Tenement	Owner	Status
ML 4978	Mainwood RM	Current (as at October 1990)
ML 5038	Raymond MD	" "
ML 5039	" "	" "
ML 5142	South JB	" "
ML 5200	Fry MR & Seymour DL	" "
ML 5337	Dennis PA & BJ	" "
ML 5443	Fry MR	" "
ML 5470	Couper ED	" "
ML 5471	Lasseters Gold PL	" "
ML 5485	" " "	" "
ML 5486	" " "	" "
ML 5532	Rogers EC	" "
ML 5546	Lasseters Gold PL	" "
ML 5550	" " "	" "

COMPILER R.S. Robertson DATE: October 1990

REFERENCES

Bell, L.A., 1987. Progress report - Teetulpa alluvial testing programme for Gold and Mineral Exploration NL. *South Australia. Department of Mines and Energy. Open file Envelope* 8196 (unpublished).

Brown, H.Y.L., 1908. *Record of the mines of South Australia.* 4th edition. Government Printer, Adelaide, pp.315-317.

Collins, B., 1978. Fluid inclusion studies of gold-bearing quartz veins from South Australian goldfields, Progress Report No. 4. AMDEL. *South Australia. Department of Mines and Energy. Open file Envelope,* 2585 (unpublished).

Curtis, J.L., 1985. Relinquishment report on exploration licence 1226, Teetulpa area, South Australia, CSR Minerals. *South Australia. Department of Mines and Energy. Open file Envelope* 5023 (unpublished).

Horn, C.M. and Fradd, W.P., 1986. Historical and geological review of Teetulpa Goldfield. *South Australia. Department of Mines and Energy. Report Book,* 86/92.

Kopcheff, J.T., 1971. Report on the reconnaissance exploration of SML 488, Mount Victor area of South Australia for Property and Mineral Exploration Ltd. *South Australia. Department of Mines and Energy. Open file Envelope,* 1649 (unpublished).

Martins, J.J., 1978. Geochemical exploration for gold, Waukaringa-Teetulpa area. *South Australia. Department of Mines and Energy. Report Book,* 78/102.

Mayer, T.E., 1981. Final report on the relinquished portions of Mannahill EL 530, South Australia, period 12/9/79-8/1/81. *South Australia. Department of Mines and Energy. Open file Envelope,* 4059 (unpublished).

Paterson, H.L., 1986. EL 1322, Teetulpa. Progress and final reports from 24/3/86 to 23/12/86 for Western Mining Corporation Ltd. *South Australia. Department of Mines and Energy. Open file Envelope,* 6711 (unpublished).

Seymour, D.L., 1983. Quarterly reports for the periods ending 31 March, 30 June, 30 October, 1983 for Jarmand Minerals and Explorations Pty Ltd., EL 1098, Teetulpa Goldfield. *South Australia. Department of Mines and Energy. Open file Envelope,* 5023 (unpublished).

Sprigg, R.C., 1968. Report on an inspection and brief investigation of the Teetulpa Goldfield, SML 156 for Geosurveys of Australia Pty Ltd *South Australia. Department of Mines and Energy. Open file Envelope,* 949 (unpublished).

Thomdrill Pty Ltd, 1988. EL 1413, Teetulpa Goldfield. Progress and final reports from 17/7/87 to 23/5/88. *South Australia. Department of Mines and Energy. Open file Envelope,* 6935 (unpublished).

Wyatt, D.H., 1984. Final report EL 1164, Mannahill South Australia, Austamax Resources Limited, October, 1984. *South Australia. Department of Mines and Energy. Open file Envelope,* 5211 (unpublished).

TEETULPA GOLDFIELD

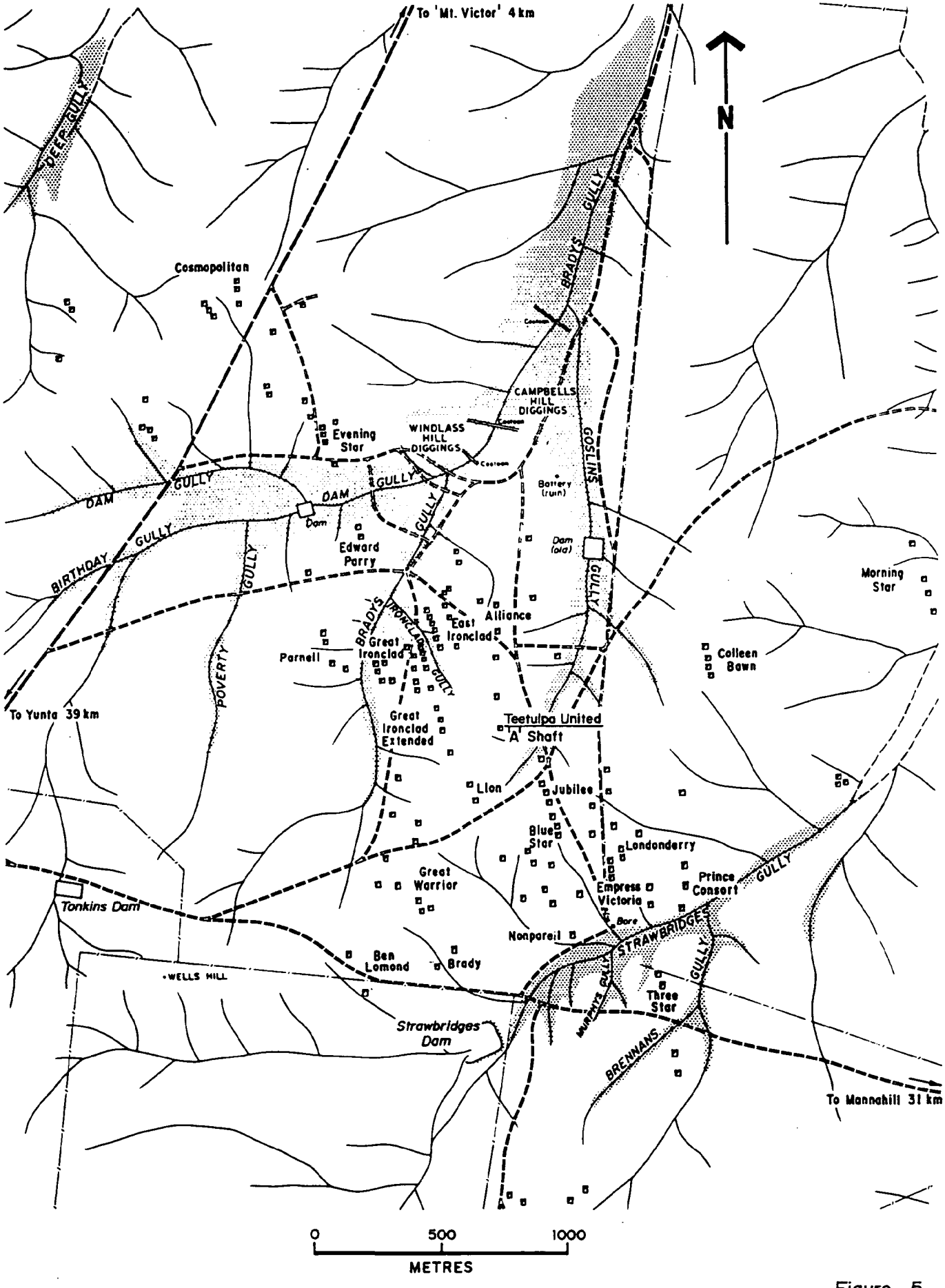


Figure 5

Department of Mines and Energy – South Australia

S 22288

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: Waukaringa

MINE NAMES: Alma-Victoria, Triumph, West Alma, West Alma Extended, Sebastopol West, Sebastopol, Alma Extended, Balaklava West, Mid Alma, Balaklava (East Alma), Shepherds, West Waukaringa (New West Waukaringa), Waukaringa Consolidated, Waukaringa, Great Extended Waukaringa.

OREBODY NAMES: Main Reef, South Reef, Middle Lode, Upper (Pug) Lode.

MINING FIELD: Waukaringa Goldfield

LOCATION:

1:250 000 Sheet	ORRORO No. SI 54-1
1:100 000 Sheet	6733
MEIS No.	A
County Lytton	Section 1012
AMG Coordinates	353580mE 6426630mN Zone 54
Location-Comments	Reference point is the Victoria Shaft (Alma-Victoria Mine) (Fig. 6).

COMMODITIES: Major Au

STATUS: Operating — Comments Retreatment of tailings dumps currently in progress.

DEPOSIT TYPE: Gold in stratabound quartz-ironstone-pyrite veins in Adelaidean Umberatana Group sediments.

GEOLOGICAL SETTING:

1.

Province	Adelaide Geosyncline.
Stratigraphy	Tapley Hill Formation
Lithology	Grey siltstone and slate with carbonate bands.
Relationship	Host to vein mineralisation.
Age	Adelaidean.

2.

Province	Adelaide Geosyncline.
Stratigraphy	Cox Sandstone Member (of Tarcowie Siltstone)
Lithology	Fine to medium grained feldspathic sandstone with siltstone interbeds.
Relationship	Host to vein mineralisation.
Age	Adelaidean.

3. Province — Adelaide Geosyncline.
   Stratigraphy — Tarcowie Siltstone
   Lithology — Grey siltstone, sandy in part.
   Relationship — Host to vein mineralisation.
   Age — Adelaidean.

Mineralisation Setting

Waukaringa Goldfield is on the northern flank of the Waukaringa Syncline, the central fold of nine northeasterly trending anticlines and synclines on the eastern portion of the ORROROO sheet area (Binks, 1968). The Waukaringa Syncline contains a sequence of Umberatana Group rocks, from Appila Tillite up to Waukaringa Siltstone. Workings extend for 10 km along the northern flank of the syncline.
Gold-bearing quartz veins occur mainly within or on the contacts of the Cox Sandstone Member, a feldspathic sandstone at the base of Tarcowie Siltstone and immediately overlying Tapley Hill Formation. Veins are also found within the Tapley Hill Formation and Tarcowie Siltstone.

Breccias associated with a lineament on the eastern nose of the Waukaringa Siltstone and at the top of the Tapley Hill Formation are suggested as channelways for gold-bearing fluids. (Townsend and Horn, 1988).

Mineralisation Description

The gold-bearing reefs comprise concordant quartz-ironstone-pyrite veins which dip 32° south-southeast.

The biggest producer of gold was Main Reef, usually developed at the contact of the Cox Sandstone and underlying Tapley Hill Formation. Main Reef comprises quartz and sulphides, dominantly pyrite and arsenopyrite, with minor chalcopyrite, covellite and pyrrhotite. Above the water table, sulphides are oxidised to limonite or goethite. Lode thickness was greatest in the 'ore shoot' at the Alma-Victoria Mine where it averaged 2-3m. A southwesterly plunging drag fold probably increased the width and gold content of Main Reef here.

South Reef, in the middle of the Cox Sandstone Member, is predominantly a quartz reef with minor ironstone. Middle lode, mostly quartz-pyrite, occurs in the middle of the Cox Sandstone Member at Alma Extended only and is probably equivalent to South Reef. Upper (or Pug) Lode is sheared black clay between Cox Sandstone and overlying Tarcowie Siltstone at Alma Extended.

Average grade recorded for all Waukaringa ore was 24.5 g/t Au.

Fluid inclusion studies by AMDEL (Collins, 1978) on Waukaringa samples indicated a temperature of formation of 250-300°C with some results up to 480°C. (Townsend & Horn, 1988).

Waukaringa 3

STYLE/FORM: Stratabound, concordant

MORPHOLOGY: Tabular

NATURE OF MINERALISATION: Vein

MINERALOGY: Ore: Gold (free).
Gangue: Quartz, pyrite, arsenopyrite, chalcopyrite, covellite, pyrrhotite, limonite, goethite.

ALTERATION:

Hydrothermal alteration is minimal in both ore zone and country rock. Only traces of sericite were observed at Alma-Victoria. Above the water table, ore is oxidised to limonite or goethite, forming yellow-brown ochreous quartz claystone or ironstone. (Townsend and Horn, 1988).

RESERVES/RESOURCES:

Mine	Tonnes	Grade (g/t Au)	Type	Classification	Comments
Alma-Victoria	3 500	7.0	In situ underground.	Measured Resource	At Alma-Victoria in pillars above water level at 3 level.
Alma-Victoria	40 000	3.0	Tailings	Indicated Resource.	
Alma Extended	1 080	1.47	Tailings	Indicated Resource.	
Alma Extended	880	4.15	Dump	Indicated Resource	

(Morris, 1985; Wildy and Horn, 1986; Townsend and Horn, 1988).

PRODUCTION:

Period	Tonnes(Ore)	Au-Bullion	Recovered Grade (Bullion)	Comments
1873-1983	58 226	1 426 665g	24.5 g/t	(Fradd, 1986)
1984-June 1990	No production recorded			
Dec. 1990		6 348g		Tailings retreatment
Total		1 433 013g		

WORKINGS/METHODS

Main workings extend from Triumph (Day Dawn) in the west to the Balaklava (East Alma) in the east. Mining was underground, mainly utilising inclined shafts. Most extensive workings are at Alma-Victoria, which comprises 1800m of driving and extensive stoping on 14 levels, and Alma-Extended. Batteries operated at both these sites and at a third locality to the west, adjacent to Battery Creek.

DISCOVERY/HISTORY:

Waukaringa Goldfield was discovered in 1873 by a shepherd, J. Watson, while panning in Salt Creek. Subsequent mining extended mainly to the east with the Alma-Victoria and Alma Extended the most important workings. Alma-Victoria produced about 95% of gold recovered from the field.

Work in Alma Victoria and its battery ceased in 1894. Tailings were retreated in 1899 and the mine worked for short periods during 1903-31, 1940-45, 1958, 1966, 1969 and 1980-81.

The Alma Extended mine and battery operated from 1880 to 1882 and 1910 to 1911.

Geological investigations have included diamond drilling (2 holes) (SADME, 1917), percussion drilling (16 holes) (Tucker, 1970) and costeaning (Mayer, 1981). Morris (1985) and Wildy and Horn (1986) investigated reserves and treatment methods for tailings at Alma-Victoria and Alma Extended. An attempt to treat the tailings using gravity concentration at this time was unsuccessful. Townsend (1987) and Townsend and Horn (1988) reported the results of detailed mapping and sampling and diamond drilling (8 holes) near Alma-Victoria.

Tailings are currently (November, 1990) successfully being treated using cyanidation and carbon in pulp extraction.

TENEMENTS/OWNERSHIP:

Tenement	Owner	Status
ML 5569	Workman MD	Current as at 7/11/90
ML 5570	" "	" "
ML 5571	" "	" "
ML 5572	" "	" "
ML 5623	" "	" "
ML 5624	" "	" "

COMPILER R.S. ROBERTSON DATE November 1990

REFERENCES

Binks, P.J., 1968. ORROROO map sheet. *South Australia. Geological Survey. Geological Atlas 1:250 000 Series* SI 54-1.

Collins, B., 1978. Fluid inclusion studies of gold bearing vein quartz - Amdel progress report 3. *South Australia. Department of Mines and Energy. Open File Envelope*, 2136 (unpublished).

Gee, L.C.E. (Compiler), 1917. Government diamond drilling operations, No. 1 and No. 2 Bores, Alma Mine. *Mining Review, Adelaide*, 26: 22-24.

Fradd, W.P., 1986. Waukaringa Goldfield - history of mining and ore processing, 1873-1983. *South Australia. Department of Mines and Energy. Report Book*, 86/71.

Mayer, T.E., 1981. Final report on relinquished portions of Mannahill EL 530, SA 12 September 1979 to 8 January 1981, for CRA Exploration Pty Ltd. *South Australia. Department of Mines and Energy. Open file Envelope*, 4059 (unpublished).

Morris, B.J., 1985. Waukaringa Goldfield-appraisal of gold tailings. *Mineral Resources Review, South Australia*, 155: 72-73.

Townsend, I.J., 1987. Waukaringa Goldfield geological investigations, 1983-1985. *South Australia. Department of Mines and Energy. Report Book.* 86/71.

Townsend, I.J. and Horn, C.M., 1987. Results of SADME diamond drilling, Waukaringa Goldfield, 1985. *South Australia. Department of Mines and Energy. Report Book*, 87/39.

Townsend, I.J. and Horn, C.M., 1988. Geological appraisal of Waukaringa Goldfield. *Mineral Resources Review, South Australia*, 156: 75-87.

Tucker, D.H., 1970. Waukaringa Mines area. Reconnaissance ground magnetometer survey carried out for R.M.C. Minerals. *South Australia. Department of Mines and Energy. Open file Envelope*, 1240 (unpublished).

Wildy, R.L. and Horn, C.M., 1986. Treatment of gold tailings, Waukaringa Goldfield. A review of operations and metallurgical investigations, 1983-1985. *South Australia. Department of Mines and Energy. Report Book*, 86/3.

WAUKARINGA GOLDFIELD

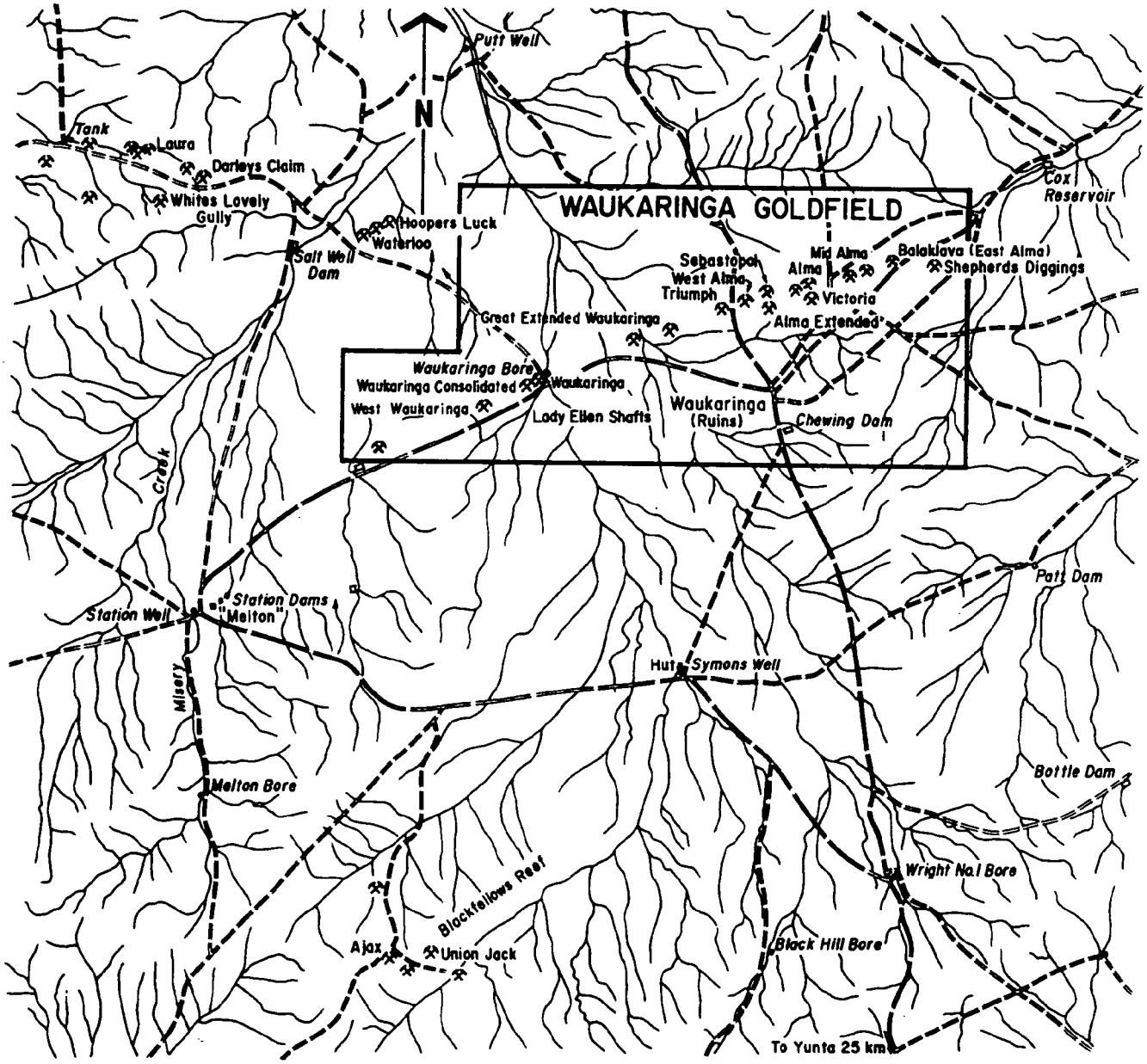


Figure 6

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

S22289

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME	Moonta
MINE NAMES	OREBODY NAMES
Kooroona	35 Unnamed
Wilkawatt	36 Unnamed
Hamley	3 Eastern Lode (York Lode)
"	17 Karkarilla Lode
"	5 Beddome's Lode
"	8 Green's Lode
Moonta Mines	1 Elder's (Taylor's) Main Lode
"	2 Elder's (Taylor's) West Lode
"	3 York Lode
"	4 Treuer's Lode
"	5 Beddome's Lode
"	6 Hogg's Lode
"	7 Harvey's Lode
"	8 Green's Lode
"	9 Young's Lode
"	10 Musgrave's Lode
"	11 Buchan's Lode
"	12 Ferguson's Lode
"	13 Macdonnell's Lode
"	14 Hancock's Lode
"	15 Halls Lode
"	16 Alice Lode
Yelta	18 Wearing's Lode
"	19 Hancock's Lode
"	20 Yelta Main Lode
"	21 Tuxford's (Tank) Lode
"	22 Eastern Lode
North Yelta	23 North Yelta Lode
"	24 Euko Lode
Mid Moonta (New Mid Moonta,	25 Mid Moonta Lode
Moonta Central)	26 Unnamed (southern) Lode
Wheal Hughes	27 Wheal Hughes (under development, 1990)
"	28 Unnamed (Hancock's Shaft)
"	29 Unnamed (Andrew's Shaft)
	30 Unnamed (centre of Sec 2054)
Wheal James	31 Paramatta Lode
Paramatta	31 Paramatta Lode
Challa	32 Unnamed
Poona (Mattapara)	33 Poona Lode
Parrara	34 Unnamed

MINING FIELD — Moonta - Wallaroo

LOCATION

1:250 000 Sheet-Name MAITLAND No. SI 53-12
1:100 000 Sheet-No 6429
MEIS No MMF
Hundred Wallaroo Sections Numerous
AMG Coordinates740 840 mE
6 225 940 mN Zone 53

Location - Comments References point for AMG coordinates is Taylor's Shaft on Elder's (Taylor's) Main Lode (Moonta Mines) from plan 82-664 (Fig. 7). AMG grid lines 738 000mE, 744 000mE, 6 224 000 mN, 6 230 500 mN (the approximate boundaries of plan 82-664) are used as the boundaries of the deposit.

COMMODITIES — Major Cu Minor Au, Ag

STATUS
Poona Mine (Poona Lode) operating
Wheal Hughes (Wheal Hughes Lode) operating
All others - abandoned

DEPOSIT TYPE — Copper sulphides associated with quartzose and pegmatitic veins infilling numerous fractures in Moonta Porphyry.

GEOLOGICAL SETTING
Province Gawler Craton - Moonta Subdomain
Stratigraphic Name Moonta Porphyry
Lithology Meta-feldspar porphyry
Relationship Host to mineralisation
Age Early Proterozoic ca 1740 Ma (U-Pb zircon, Fanning et. al 1988).

Mineralisation Setting

The Moonta deposit is situated in the Moonta Subdomain on the eastern margin of the Archaean to Middle Proterozoic Gawler Craton. Principal lithologies in the Moonta-Wallaroo area include a schist-gneiss-quartzite-amphibolite sequence, the Doora Schist, and the Moonta Porphyry. The relationship between these two units is uncertain but Parker (1987) considers them to be of similar age.

The Moonta Porphyry, the host to all the Moonta mineralisation, is a rhyolitic meta-feldspar porphyry, deformed and partly recrystallised. A foliation, defined by chlorite replacing biotite, is variably developed. Fanning et. al. (1988) have determined a U-Pb zircon age of 1737 + 5 Ma for the Moonta Porphyry. The porphyry body has an irregular tear drop shape extending from Moonta (town) to within a few kilometres of Kadina.

The lodes occupy a series of fractures forming an arcuate zone and trending north-northeast in the south to northeast in the north. Dips are 40° to 65° to the northwest. Jack (1917) describes the lodes as occurring along three main zones of weakness along concentric arcs. The lodes are tabular features usually bifurcating to the southwest or arranged en echelon.

Mineralisation Description

Gangue mineralogy of the lodes varies from predominantly quartzose to pegmatitic in composition. Major minerals are quartz, K-feldspar, tourmaline, chlorite and hematite with lesser biotite, apatite, fluorite, sericite pyroxene arid epidote. Hematite has replaced primary magnetite.

Sulphide mineralisation within the lodes was predominantly coarse grained and massive. Some sulphide also occurred as stringers and disseminations within the porphyry host rock. Jack (1917) states that the mineralisation was more disseminated where the host rock was more schistose.

Chalcopyrite was the predominant primary sulphide mineral present, with lesser bornite and pyrite. Molybdenite, gold and uraninite were present in very minor amounts. Jack (1917) stated that 'bornite occurs to a considerable depth and appears to have been a primary ore' but that 'it was present in large bodies in many of the lodes at moderate depths, and may have been in past due to processes of secondary sulphide enrichment.' He also stated that pyrite was relatively scarce but that the proportion of pyrite to other sulphides appears to have increased with depth. Jack suggested a paragenetic sequence as follows:

(1) hematite and pyrite
(2) pyrite, chalcopyrite and bornite
(3) chalcopyrite and bornite

Mineralisation was irregularly distributed within the lodes and economic ore tended to be confined to steeply pitching, pipe-like bodies formed where cross cutting shears intersected the lode fractures (Dickinson, 1942). Vertical extent of the orebodies varied from 100m to 700m and stope widths from 3m to 8m.

Secondary (supergene) processes considerably altered the mineralogy and distribution of metal in the lodes. Jack had no access to the enriched zones which were mined out at the time of his investigation but the description he gleaned from old miners and from Brown (1908) is in accord with recent observation of the Poona Mine open cut (1988-1990).

The lodes had a pronounced zone of supergene sulphide enrichment capping the orebodies. Chalcocite (Cu_2S) and similar species were the major supergene minerals, found, with lesser covellite (CuS), coating chalcopyrite and bornite. Chalcocite was also found as discrete, powdery masses. Djurleite ($Cu_{31}S_{16}$) was common at the Poona open cut and digenite (Cu_9S_5) was also identified.

Cuprite, tenorite, native copper and lesser malachite and azurite were found above the secondary sulphide zone. Envelopes of kaolin and alunite occurred around the caps of the orebodies. These are probably due to alteration of the host rock in the weathering profile by acidic groundwater rather than primary hydrothermal alteration. Pring (1988) give a comprehensive list of minerals found at Moonta.

Assays at Poona found considerable gold enrichment in the secondary sulphide zone and surrounding clay envelope. It is not known if this enrichment was present in the other Moonta lodes.

Jack (1917) and Brown (1908) described a 10-20 m deep, leached zone within weathered Moonta Porphyry virtually barren of copper mineralisation, overlying the enriched caps of all the Moonta orebodies. Within a few metres of the surface above the lodes was a zone of rich atacamite with minor cuprite hosted by red-brown Pleistocene(?) clay. Location of this atacamite zone was the means by which most of the Moonta lodes were found. The Poona open cut exposed similar near-surface atacamite, leached and enriched zones.

A study of the Poona orebody by Janz (1990) suggested the following paragenetic sequence for primary minerals:- magnetite (altered to hematite) - pyrite - chalcopyrite - bornite - hematite. She interpreted fluid inclusion data in quartz and mineral assemblages to indicate a temperature of formation for the mineralisation of ~ 325°C. Sulphur isotope analyses were suggestive of a magmatic source for the mineralising fluids.

MORPHOLOGY Tabular

NATURE OF MINERALISATION:
Vein (major), multiple veins (minor)

TEXTURE Massive (major) Disseminated (minor)

MINERALOGY

Primary Ore Major-Chalcopyrite, bornite, Minor-gold
Gangue Major-Quartz, K-feldspar, tourmaline, chlorite, hematite. Minor-Biotite, apatite, fluorite, sericite, pyroxene, epidote, molybdenite, uraninite.

Secondary Ore Chalcocite, djurleite, digenite, covellite, cuprite, tenorite, native copper, malachite, azurite, atacamite.
Gangue Kaolin, alunite, limonite.

ALTERATION

Jack (1917) referred to pronounced zones of 'contact metamorphism' in the wall rock a few inches either side of the lodes and describes pyroxene developed at the contact. Otherwise there is little information on wall rock alteration of the old Moonta lodes. Janz (1990) described considerable wall rock alteration at the Poona open cut comprising chlorite, epidote, tourmaline, sericite (minor), silica, kaolinite and alunite. Kaolinite and alunite are likely to be products of supergene processes.

RESERVES/RESOURCES

Reserves at Moonta were virtually exhausted at the close of mining in 1923. Ward (1933) reported that in 1923 70 000 tonnes of 3.8% Cu ore remained in isolated blocks and Stillwell (1931) reported additional ore in Taylors Lode comprising 16 000 tonnes of 6% Cu. Sporadic small-scale mining up to 1938 may have removed some of this ore.

Exploration by WMC (1985-87) defined the following ore reserve at Poona.

Mine	Tonnes	Garde	Classification	Comments
Poona	206 000	6.45% Cu 1.8 g/t Au	Probable ore reserve	Now partly mined out by 1988-90 open cut mining (Western Mining Corporation, 1987).

PRODUCTION

Period	Crude Ore Tonnes	Grade (recovered) Cu%	Au(g/t)	Cu Tonnes	Au-kg	Comments
1861	44 000(est)			2025		Hand dressed ore sent to Swansea Wales
1861-1923	4 795 000	3.28	0.34	157 378(est)	1 630(est)	Main period of mining and smelting
1923-33	1 300(est)			120(est)		Small scale mining
1933-38	19 000(est)	2.03	0.33	385(est)	6.26(est)	Concentration mill
1970-81	-	-	-	444(est)	26.26(est)	Treatment of Devon Conc. Plant tailings.
1988-90	129 877	4.8	1.63	6 253	211.43	Poona Mine Open Cut
Totals	4 984 000t	3.34	0.38	166 600t	1870kg	

Comments. These production figures are based on the combined figures for Moonta and Wallaroo of Flint (1985) modified as follows:

- 3928 tonnes Cu metal sourced from Mt Cuthbert, Queensland have been subtracted from the 1861-1923 total
- Dressed ore tonnages and grades were used to allocate 1861-1923 Cu metal production (copper tonnes (ex smelters) in Table 1 of Flint (1985)) to Moonta and Wallaroo separately.
- Au production was calculated using crude ore tonnages and assuming 0.34 g/t recovery for both Moonta and Wallaroo.
- Production for 1923-33, 1933-38 and 1970-81 has been allocated to Moonta and Wallaroo using the same proportions as the 1890-1923 figures for Cu.

WORKINGS/METHODS

The Moonta and Wallaroo mines were large even by modern standards. Mining of the lodes was by underground methods with inclined shafts following the dip of the lodes and extensive driving and stoping of the more mineralised areas. Deepest workings at Moonta were on Elder's Main Lode where Taylor's Shaft was sunk to 770m depth and stoping was carried out to 695m. Mining methods were labour intensive and use of mechanical aids such as jackpicks did not become widespread until after 1900. Total length of underground workings at Moonta and Wallaroo approximated 150 km.

The coarse grained nature of the mineralisation enabled hand dressing of the ore. From 1861 onwards most Moonta ore was smelted at the Wallaroo Smelters.

Recent mining at Poona was by conventional open cut methods. Ore is crushed on site then trucked to a flotation plant at Kadina where a concentrate is produced. Some supergene ore was sufficiently rich to enable direct shipping for smelting without concentration. Further mining at Poona is to be carried out underground using a decline from the base of the open pit.

DISCOVERY/HISTORY

Copper mineralisation on northern Yorke Peninsula is thought to have been discovered in 1859 at the site of the Wallaroo Mines by a shepherd, James Boor. In 1861 another shepherd Patrick Ryan discovered copper minerals in a wombat hole near Moonta. The Moonta Mining Co began operations in 1862 and by 1876 dividends had totalled one million pounds. Mining at Moonta and Wallaroo played a large part in the economy of South Australia. In 1889 the Moonta Mining Co amalgamated with the Wallaroo Co to form the Wallaroo and Moonta Mining and Smelting Co Ltd.

Low copper prices and other problems forced the closure of the mines in 1923 although the smelters continued operations on stockpiled ore until 1926. Small scale mining was carried out in the late 1920's and early 1930's. A flotation concentration mill operated from 1933 to 1938 during a government subsidised mining scheme. From 1970 to 1981 slimes dumps from the old Devon Concentrating Plant were retreated (Drexel, 1982; Flint, 1985).

Intensive exploration of the Wallaroo-Moonta region was carried out between 1959 and 1987, mostly as a joint venture between Western Mining Corporation Limited and North Broken Hill Limited. Exploration included geophysics (I.P., airborne and ground magnetics, gravity, TEM), geochemical drilling (approx. 30 000 auger holes), percussion drilling (339 holes) and diamond drilling (250 holes). Several bodies of mineralisation were located during this work.

Moonta 7

Tenure for the region was purchased by Moonta Mining NL, a joint venture between the AMALG Syndicate and Melita Mining NL, and from late 1988 to mid 1990 open cut mining was carried out on an orebody adjacent to the historic Poona Mine. This orebody was discovered by WMC using TEM and follow-up percussion and diamond drilling. The flotation plant, established by Moonta Mining at Kadina adjacent to the Devon Plant tailings, is currently treating stockpiled Poona ore. Underground mining of the remainder of the Poona orebody will commence soon.

WMC also found mineralisation at Wheal Hughes, 2 km south of Poona, using TEM and drilling. Stripping of overburden has commenced at this site preliminary to open cut mining.

TENEMENT/OWNERSHIP

Tenement	Owner	Status	Comments
ML 5524	Moonta Mining NL	Current	Poona Mine
EML 5525	Moonta Mining NL	Current	Poona Mine
ML 5696	Moonta Mining NL	Current	Wheal Hughes
EL 1669	Moonta Mining NL	Current	Exploration Licence 1160km^2

COMPILER R S ROBERTSON DATE DECEMBER 1990

REFERENCES

Brown, H.Y.L., 1908. *Record of the mines of South Australia.* 4th edition. Government Printer, Adelaide, p 140.

Dickinson, S.B., 1942. The structural control of ore deposition in some South Australian copper fields. *South Australia. Geological Survey. Bulletin*, 20: 7-37.

Drexel, J.F., 1982. Mining in South Australia - a pictorial history. *South Australia. Department of Mines and Energy.* Special Publication, 3.

Fanning, C.M., Flint, R.B., Parker, A.J., Ludwig, K.R. and Blissett, A.H., 1988. Refined Proterozoic evolution of the Gawler Craton, South Australia, through U-Pb zircon geochronology. *Precambrian Research* 40/41 : 363-386.

Flint, D.J., 1985. Moonta Wallaroo Mining Field production statistics 1860-1938. *Mineral Resources Review, South Australia*, 155 : 76-77.

Jack, R.L., 1917. The geology of the Moonta and Wallaroo mining district. *South Australia Geological Survey. Bulletin* 6.

Janz, J., 1990. The mineralogy and paragenesis of the Poona Mine copper deposit. *Flinders University (South Australia). B.Sc.* Honours thesis (unpublished).

Johnson, W., 1965. Copper and lead ore deposits of South Australia. *In*: McAndrew, J. (Ed.), *8th Commonwealth Mining and Metallurgical Congress*. Vol. 1. Geology of Australian Ore Deposits.

Parker, A.J., 1987. Archean to Middle Proterozoic mineralisation of the Gawler Craton (including the Stuart Shelf region) South Australia. *South Australia. Department of Mines and Energy. Report Book* 87/84.

Plimer, I.R., 1980. Moonta-Wallaroo district, Gawler Block, South Australia. A review of the geology, ore deposits and untested potential of EL 544. *South Australia. Department of Mines and Energy. Open file Envelope*, 6999.

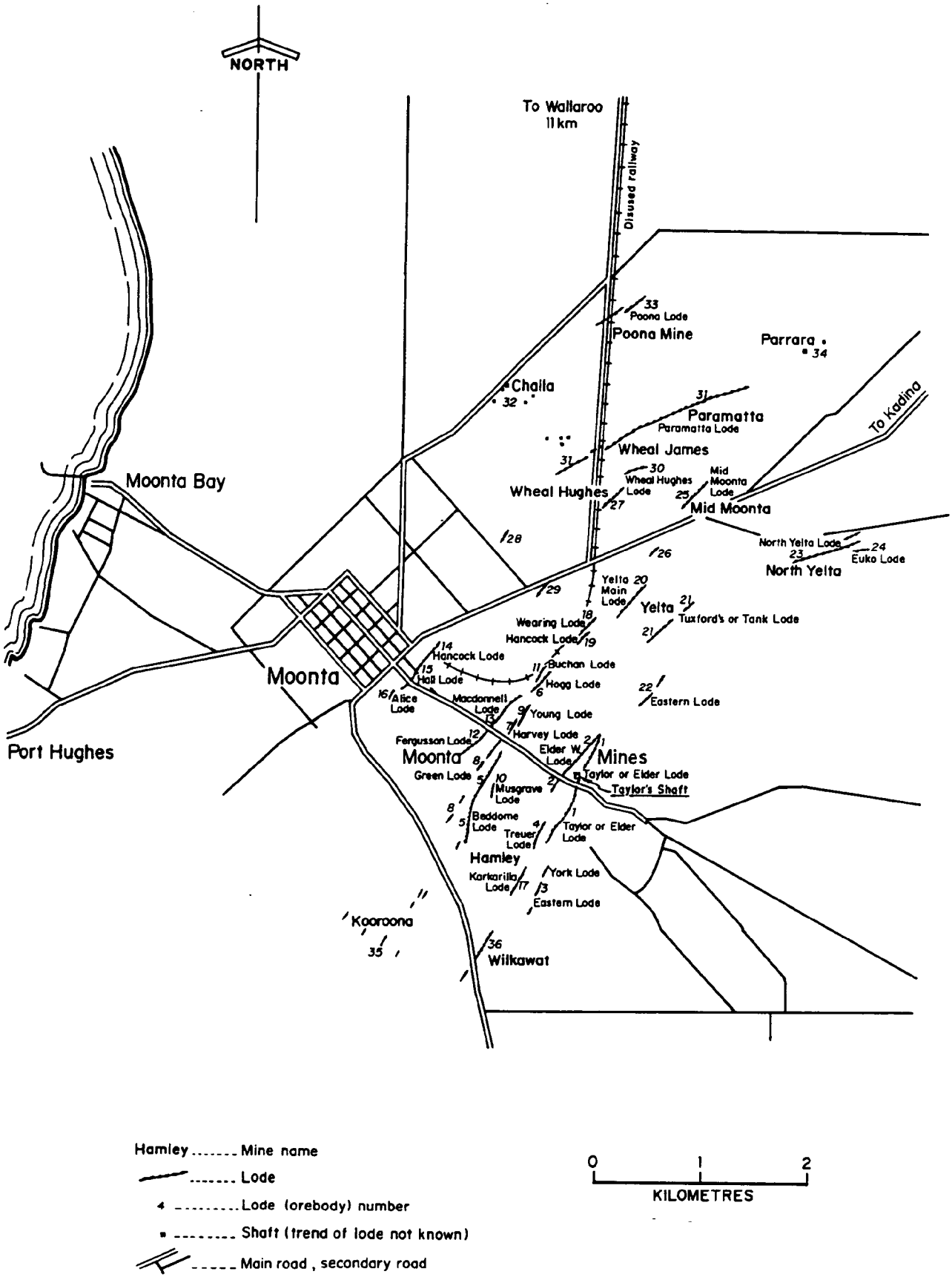
Stillwell, F.L., 1931. The southern extension of Taylor's Lode system at Moonta. *Mining Review, Adelaide*, 54: 91-98.

Ward, L.K. 1933. Copper deposits of South Australia. *In*: Copper resources of the world. *16th International Geological Congress*, Washington, 1933.

Western Mining Corporation Ltd, North Broken Hill Ltd, Broken Hill South Ltd, 1981. SML's 37, 42, 59, 87, 624, EL's 32, 170, 249, 347, 544, Moonta. Reports for the period 1/9/60 to 25/10/81. *South Australia, Department of Mines and Energy. Open file Envelope*, 6999 (unpublished).

Western Mining Corporation Limited, 1987. Moonta Joint Venture, South Australia. Project Information Brochure. *South Australia. Department of Mines and Energy. Open file Envelope*, 7001 (unpublished).

Western Mining Corporation Ltd, North Broken Hill Ltd, Broken Hill South Ltd, 1988. EL's 962, 1394, Moonta. Reports for the period 9/2/82 to 12/3/88. *South Australia. Department of Mines and Energy. Open file Envelope*, 7001 (unpublished).



Moonta copper deposit — location of mines

Figure 7

SADME S22240

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: Wallaroo

SYNONYMS: Wallaroo Mines

MINE NAMES: See over

OREBODY NAMES: See over

MINING FIELD: Moonta - Wallaroo

LOCATION:
1:250 000 Sheet Name WHYALLA No. SI 53-8
1:100 000 Sheet No 6430
MEIS No. WMF
Hundred Wallaroo, Kadina Sections Numerous
AMG Coordinates 749 130m E
6 237 780m N Zone 53

Location Comments Reference point for AMG coordinates is Taylor's Shaft on the Wallaroo Main Lode from plan 82-665 (Fig. 8). AMG grid lines 746 000m E, 754 000m E, 6 234 500 m N, 6 241 000m N (the approx boundaries of plan 82-665) are used as the boundaries of the deposit. The Wallaroo deposit is adjacent to the township of Kadina.

COMMODITIES Major Cu Minor Au, Ag

STATUS All abandoned

DEPOSIT TYPE Copper sulphides associated with quartz, biotite and carbonate veining in structurally controlled (?) lodes within Middle Proterozoic Doora Schist.

GEOLOGICAL SETTING
Province Gawler Craton - Moonta Subdomain
Stratigraphic Name Doora Schist
Lithology Mica schist, amphibolite schist, quartzite, gneiss
Relationship Host to mineralisation
Age Early Proterozoic

Wallaroo

MINE NAMES	OREBODY NAMES
Wallaroo Mines	1 Wallaroo Main Lode (includes Hughe's, Young's, Taylor's and Elder's Shaft workings)
"	2 North Young Lode *
"	3 Milne Lode *
"	4 North Mair (Harvey) Lode *
Matta (Matta Matta)	5 Stirling's Lode
"	6 Matta Lode
Devon (Devon Consols)	7 Devon Lode
"	
Kurilla	8 Hall's Lode
"	9 Morphett's Lode
Duryea	10 Duryea Lode
Doora (Sec 129)	11 Unnamed
South East Doora (Sec 1339 & road)	12 Unnamed
South Doora	13 Unnamed
Wallaroo Extended	14 Unnamed (Sec 160c)
" "	15 Unnamed (Sec 1600)
New Mount Lyell Consols Wallaroo Copper Mine (Bingo, Wallaroo Central, North-East Matta)	16 Unnamed
New Cornwall	17 Engine Shaft (Sismey's) Lode
"	18 Elizabeth (Lucas) Lode
Wandilta	19 Wandilta Lode
Kadina	19 Wandilta Lode
Unnamed	20 West Doora (WMC (1988))
Unnamed (Sec 1614, Hd. Wallaroo)	21 Unnamed

Most names are from Jack (1917) except for *- names from Dickinson (1942), Fig 10.

Mineralisation Setting

The Wallaroo deposit is situated in the Moonta Subdomain on the eastern margin of the Archean to Middle Proterozoic Gawler Craton. Principal lithologies in the Moonta-Wallaroo area include a rhyolitic, meta-feldspar porphyry, the Moonta Porphyry and the Doora Schist, host to the Wallaroo mineralisation. The relationship between these two units is uncertain but Parker (1987) considered the Doora Schist to be of similar age to the ca 1740 Ma Moonta Porphyry (Fanning et. al., 1988).

Doora Schist comprises mica schist, amphibolite schist, quartzite, gneiss and iron formation. Plimer (1980) stated that the Doora Schist has been metamorphosed to amphibolite facies and intensely deformed in at least two phases of deformation. He also describes widespread minor feldspathisation, scapolitisation and silicification which appear to be unrelated to mineralisation.

Lode directions appear to be less consistent than at Moonta. Jack's (1917) plan shows the near-vertical Wallaroo Main Lode trending about 110° overall. The Devon, Morphett, Hall and Duryea lodes to the south are nearly parallel, with trends of about 100°. Dickinson (1942) suggested that these lodes are truncated by a shear zone trending about 045°. Lodes at New Cornwall and Wandilta trend about 145-150°. Directions of other lodes are less clear from Jack's work but appear to vary from about 135° to 180°. Some lodes are arranged in an en echelon pattern. Despite the differences to the Moonta lode pattern, Dickinson considered the Wallaroo lode structures to be the result of the same deformation process.

Mineralisation Description

Major metallic minerals at Wallaroo were chalcopyrite, pyrite and pyrrhotite with minor galena, sphalerite, ferberite, scheelite, molybdenite and gold. Gangue minerals comprised quartz, coarse biotite, feldspar, tourmaline, apatite, fluorite, amphibole, pyroxene, siderite, calcite, dolomite, rhodochrosite, scapolite, chlorite, muscovite and sericite. Smaltite was found in the Kurilla lode and was probably present in the Wallaroo Main Lode.

Jack (1917) reported that the Wallaroo lodes were 'metasomatic replacements of the country rock, shattered along definite planes' rather than 'injections of pegmatitic material along clean-cut fissures' as at Moonta. The lodes appear to have often comprised zones of veinlets and disseminated mineralisation rather than large discrete veins. Fragments of schistose country rock were common within veins. The carbonate minerals, galena and sphalerite postdated chalcopyrite, pyrite and the other gangue minerals.

Despite the less well defined nature of the lodes, orebodies were more persistent than at Moonta. The Main Lode was stoped for a length of 1000 m and to a maximum depth of 850 m.

Jack gave little information on secondary copper mineralisation present at Wallaroo, stating that much the same secondary minerals were found as at Moonta. He wrote 'that notable deposits of atacamite' were ' understood to have been absent at Wallaroo'. However Brown (1908) described atacamite and minor 'green carbonate' in the limestone over the lodes. Beneath were red and black copper oxides and then grey and black sulphides. Pring (1988) described a suite of copper minerals at Wallaroo similar to that at Moonta. Jack's section of the Main Lode suggests no near surface barren zone was present at Wallaroo.

MORPHOLOGY Tabular

NATURE OF MINERALISATION
Vein, multiple veins

TEXTURE Massive, disseminated

MINERALOGY

Primary Ore Major - Chalcopyrite Minor-Gold.
Gangue Pyrite, pyrrhotite, galena, sphalerite, ferberite, scheelite, molybdenite, quartz, biotite, feldspar, tourmaline, apatite, fluorite, amphibole, pyroxene, siderite, calcite, dolomite, rhodochrosite, scapolite, chlorite, muscovite, sericite, smaltite
Secondary Atacamite, malachite, cuprite, chalcocite, gypsum, paratacamite, tenorite ?, native copper.

ALTERATION

Little information is available on wall rock alteration at Wallaroo. Johnson (1965) states that 'wall rock alteration in the Wallaroo group is more extensive' (than at Moonta) but gives no details. Plimer (1980) describes widespread minor metasomatic alteration of the Doora Schist comprising feldspathisation, scapolitisation and silicification but this alteration appears to be unrelated to mineralisation.

RESERVES/RESOURCES

Several years production were available when the Wallaroo Mines closed in 1923. All reserves were in the deepest workings. Reserves in 1923 comprised:

Tonnes Ore	Grade	Classification
250 000	3.87% Cu	'Proved'-Measured Resource?
270 000	3.81% Cu	'Possible'-Inferred Resource?

(Flint, 1985; Ward, 1933).

Small quantities of this ore may have been exploited in the period 1923-38.

Western Mining Corporation (1987) reported reserves at West Doora in a series of stacked en echelon lenses as follows:

Tonnes Ore	Grade	Classification	Comments
2.7 million	2.1% Cu	Indicated resource	In numerous lenses, to 300m depth.

Morris (1988) reported reserves of tailings at the Devon Concentrating plant site as follows:

Tonnes Ore	Grade	Grade	Classification
968 500	0.51% Cu	0.20 g/t Au	Indicated resoruce

PRODUCTION

Period	Crude Ore Tonnes	Grade Cu%	(Recovered) Au(g/t)	Cu Metal Tonnes	Au kg	Comments
1860-1923	4 195 000	4.08	0.34	171 185	1426	Main period of mining & smelting
1923-1933	2 000(est)			240(est)		Small scale mining
1933-1938	28 000(est)	2.62	0.43	736(est)	11.98(est)	Concentration mill
1970-1981	-			849(est)	50.21(est)	Treatment of Devon Concentrating Plant tailings
Totals	4 230 000	4.09	0.35	173 000	1490	

Comments. These production figures are based on the combined figures for Moonta and Wallaroo of Flint (1985) modified as follows:

- 3928 tonnes Cu metal sourced from Mt Cuthbert, Queensland have been subtracted from the 1861-1923 total
- Dressed ore tonnages and grades were used to allocate 1860-1923 Cu metal production (copper tonnes (ex smelters) in Table 1 of Flint (1985)) to Moonta and Wallaroo separately.
- Au production was calculated using crude ore tonnages and assuming 0.34 g/t recovery for both Moonta and Wallaroo
- Production for 1923-33, 1933-38 and 1970-81 have been allocated to Moonta and Wallaroo using the same proportions as the 1890-1923 figures for Cu.

WORKINGS/METHODS

The Moonta and Wallaroo Mines were large even by modern standards. Mining of the lodes was by underground methods with inclined shafts following the dip of the lodes and extensive driving and stoping of the more mineralised areas. Deepest workings at Wallaroo were in the Wallaroo Main Lode where Taylor's Shaft was sunk to 851m and stoping was carried out to 741m. Mining methods were labour intensive and use of mechanical aids such as jackpicks and air hoists did not become widespread until after 1900. Total length of underground workings at Moonta and Wallaroo approximated 150 km.

The coarse grained nature of the mineralisation enabled hand dressing of the ore. From 1861 onwards ore was treated at the Wallaroo smelters. From 1911 to 1923 the Devon Concentrating Plan, a sulphide flotation plant, treated 1 649 736 tonnes of ore from Wallaroo and Moonta producing 622 726 tonnes of dressed ore for the Wallaroo smelters (Drexel, 1982; Flint, 1985; Morris, 1988).

DISCOVERY/HISTORY

Copper mineralisation on northern Yorke Peninsula is thought to have been discovered in 1859 at the site of the Wallaroo Mines near the township of Kadina by a shepherd, James Boor. The first ore was shipped to Port Adelaide in 1860. Mining at Wallaroo and Moonta played a large part in the economy of South Australia. In 1889 the Moonta Mining Co. amalgamated with the Wallaroo Co to form the Wallaroo and Moonta Mining and Smelting Co Ltd.

Low copper prices and other problems forced the closure of the mines in 1923 although the smelters continued operations on stockpiled ore until 1926. Small scale mining was carried out in the late 1920's and early 1930's. A flotation concentration mill operated from 1933 to 1938 during a government subsidised mining scheme. From 1970 to 1981 slimes dumps from the old Devon Concentrating Plant were retreated (Drexel, 1982; Flint, 1985).

Intensive exploration of the Wallaroo-Moonta region was carried out between 1959 and 1987, mostly as a joint venture between Western Mining Corporation Limited and North Broken Hill Limited. Exploration included geophysics (I.P., airborne and ground magnetics, gravity, TEM), geochemical drilling (approx. 30 000 auger holes) percussion drilling (339 holes) and diamond drilling (250 holes). Mineralisation at West Doora was located during this work.

Tenure for the region was purchased by Moonta Mining NL, a joint venture between the AMALG Syndicate and Melita Mining NL. Since late 1988 ore has been mined from the Poona Mine near Moonta and concentrated at a flotation plant adjacent to the old Devon Plant tailings at Kadina. Moonta Mining have also carried out further drilling at West Doora.

Wallaroo 8

TENEMENT/OWNERSHIP

Tenement	Owner	Status	Comments
EL 1669	Moonta Mining NL	Current	Exploration License 1160 km^2
MPL 35	Moonta Mining NL	Current	Miscellaneous Purposes Lease for Kadina treatment plant
ML 5695	Moonta Mining NL	Current	Tailings dump adjacent Kadina plant.

COMPILER R.S. ROBERTSON DATE FEBRUARY 1990

REFERENCES

Brown, H.Y.L., 1908. *Record of the mines of South Australia.* 4th edition. Government Printer, Adelaide, p.140.

Dickinson, S.B., 1942. The structural control of ore deposition in some South Australian copper fields. *South Australia. Geological Survey Bulletin*, 20: 7-37.

Drexel, J.F., 1982. Mining in South Australia - a pictorial history. *South Australia. Department of Mines and Energy.* Special Publication, 3.

Fanning, C.M., Flint, R.B., Parker, A.J., Ludwig, K.R. and Blissett, A.H., 1988. Refined Proterozoic evolution of the Gawler Craton, South Australia, through U-Pb zircon geochronology. *Precambrian Research* 40/41 : 363-386.

Flint, D.J., 1985. Moonta-Wallaroo Mining Field production statistics 1860-1938. *Mineral Resources Review, South Australia*, 155: 76-77.

Jack, R.L., 1917. The geology of the Moonta and Wallaroo mining district. *South Australia. Geological Survey. Bulletin* 6.

Morris, B.J., 1988. Appraisal of Wallaroo Mine Tailings, Kadina. *South Australia. Department of Mines and Energy.* Report Book, 88/25.

Johnson, W., 1965. Copper and lead ore deposits of South Australia. In: McAndrew, J. (Ed.), *8th Commonwealth Mining and Metallurgical Congress.* Vol. 1. Geology of Australian Ore Deposits.

Parker, A.J., 1987. Archaean to Middle Proterozoic mineralisation of the Gawler Craton (including the Stuart Shelf region) South Australia. *South Australia. Department of Mines and Energy. Report Book* 87/84.

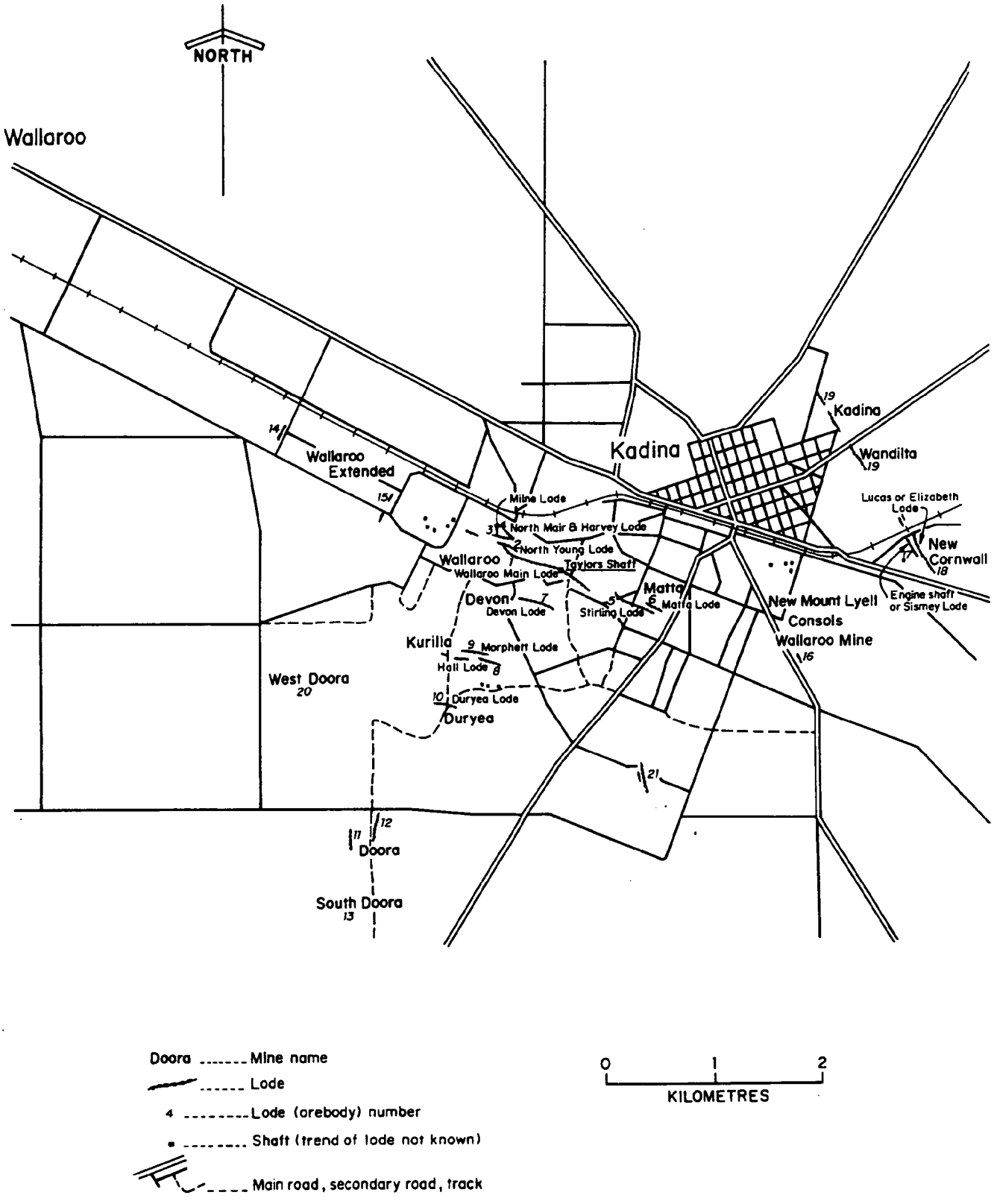
Plimer, I.R., 1980. Moonta-Wallaroo district, Gawler Block, South Australia. A review of the geology, ore deposits and untested potential of EL 544. *South Australia. Department of Mines and Energy. Open file Envelope*, 6999.

Ward, L.K., 1933. Copper deposits of South Australia. In: Copper resources of the world. *16th International Geological Congress*, Washington, 1933.

Western Mining Corporation Ltd, North Broken Hill Ltd, Broken Hill South Ltd, 1981. SML's 37, 42, 59, 87, 624, EL's 32, 170, 249, 347, 544, Moonta. Reports for the period 1/9/60 to 25/10/81. *South Australia. Department of Mines and Energy. Open file Envelope*, 6999 (unpublished).

Western Mining Corporation Limited, 1987. Moonta Joint Venture, South Australia. Project Information Brochure. *South Australia. Department of Mines and Energy. Open file Envelope*, 7001 (unpublished).

Western Mining Corporation Ltd, North Broken Hill Ltd, Broken Hill South Ltd, 1988. EL's 962, 1394, Moonta. Reports for the period 9/2/82 to 12/3/88. *South Australia. Department of Mines and Energy. Open file Envelope*, 7001 (unpublished).



Wallaroo copper deposit — location of mines

Figure 8

SADME S22241

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: Barossa

MINE NAMES:

Alluvial (& Deep Leads) Spike Gully, Cotter's Hill Lead, Edward's Rush, Enterprise, Goddard's Hill, Green Hill Gully, Hatche's Hill Lead, Red Hill Lead, Simmons Lead, Victoria Hill, White Lead, Bullocky Gully, Gollops Gully, Hissey's Gully, Moonta Gully, Moonta Hill, Nuggety Gully, Two Speck Gully, Sim's Rush, Yatta Hill Rush, Afghan Hill, Kapunda Hill, Jone's Hill, Cooper's Hill, Camp Hill, Walkerville Gully, McRobie's Lease, Sailor's Rush, Excelsior, Barossa Deep Lead.

Reef Moonta Hill, Barossa Junction, Barossa Treasure, Belle of Barossa, Lady Pearce, Lady Pearce Extended, Mc Robies, Menzies Barossa (Royal Phoenix), Menzies Barossa North (Horseshoe Bend), Red Hill, Victoria Reef, Wheal Francis, Royal Phoenix North, West Barossa, Eldorado, Wheat Para, L'Esperence.

MINING FIELD: Barossa Goldfield

LOCATION:

1:250 000 Sheet Name ADELAIDE No. SI54-9
1:100 000 Sheet No 6628
Hundred Barossa Section 192 (original find) & many others.
AMG Coordinates 301450mE
6163950 mN (Zone 54)

Location- Comments Reference point is the approximate site of the first gold discovery in Spike Gully as shown on plan 80-282 (Fig. 9). AMG coordinates are derived by scaling from the Barossa 1:50 000 topographic map.

COMMODITIES: Major Au Minor Cu

STATUS: Abandoned

DEPOSIT TYPE: Alluvial gold in Tertiary and Quaternary sediments and gold in quartz-ironstone veins in pre-Adelaidean Barossa Complex.

Barossa 2

GEOLOGICAL SETTING:		
	Province	Houghton Inlier (inlier to the Adelaide Geosyncline)
1.	Stratigraphy	Barossa Complex
	Lithology	Schist and gneiss
	Relationship	Host to vein mineralisation.
	Age	Early Proterozoic?
2.	Stratigraphy	Unnamed
	Lithology	Conglomerate and sand, ferruginous in part
	Relationship	Host to alluvial gold
	Age	Tertiary
3.	Stratigraphy	Unnamed
	Lithology	Alluvium of present drainage channels
	Relationship	Host to alluvial gold
	Age	Pleistocene to Holocene

Mineralisation Setting

The Barossa Goldfield is situated in the northern end of the Houghton Inlier, one of five Early Proterozoic(?) basement inliers in anticlinal cores within Adelaidean sediments in the Mt Lofty Ranges. The basement rocks, known as the Barossa Complex, are entirely high-grade metamorphics, but have been affected by Delamerian, and possibly pre-Adelaidean, retrograde metamorphism and shearing. (Preiss, 1987).

Forbes (1979) showed lithologies in the southern part of the Houghton Inlier as deformed augen gneiss and augen schist with lesser phyllonitic mica schist, quartzite, quartz-feldspar-mica gneiss and feldspar -actinolite rock. Campana (1953) showed the Barossa Goldfield area as comprising mica schist, quartz schist and gneiss.

To the west of the Goldfield, Barossa Complex rocks are unconformably overlain by Adelaidean Burra Group sediments. Barossa Complex and Adelaidean rocks in the area have been deeply weathered beneath a Tertiary(?) land surface.

Dissected remnants of Tertiary fluvial sediments cap weathered basement rocks. These sediments comprise sand, clay and conglomerate, often partly iron cemented.

Gold was found both in the Tertiary and Quaternary sediments and the underlying Barossa Complex.

Mineralisation Description

The majority of gold production at Barossa appears to have been alluvial gold from the Tertiary and Quaternary sediments. There has been no systematic study of gold distribution but gold was apparently concentrated in basal gravels immediately overlying weathered bedrock. Depths to this horizon varied with topography. Deepest alluvial workings were 20-25 m depth. Richer patches had a very limited area. Gold was also found in alluvium of present drainage channels.

Gold was also found within Barossa Complex rocks associated with veins of quartz and hematite up to 1.5 m wide. Distribution of gold within these veins appears to have been very irregular. Brown (1908) reported that, at Menzies Barossa, gold was found in small veins and crossveins not in the larger lodes and he stated that this was a feature of the Barossa district. Minor copper mineralisation was also associated with the vein system in some places.

Very few of the alluvial or reef workings are now accessible and there is very little information available on the nature of mineralisation.

NATURE OF MINERALISATION Vein, detrital

DIMENSIONS Area about 3 km^2 (alluvial and reef workings)

PRODUCTION Au 3 100 kg (100 000 oz) Estimated by Drew (in preparation)

WORKINGS AND MINING METHODS:

Alluvial workings comprised shallow pits and shafts whose depth was dependant on the depth of Tertiary sediment above the basal gravel. Deepest workings were about 25m depth. Drives were often in kaolinised bedrock leaving the basal gravel exposed near the roof. The gold bearing sediments were commonly cemented by iron oxide, necessitating crushing before extraction of the gold.

Reef workings were confined to the southwest corner of the Goldfield. Workings consisted of shafts, adits and a few open cuts. The main shaft at Menzies Barossa was the deepest recorded at 65m.

DISCOVERY/HISTORY:

The Barossa Goldfield was discovered in October 1868 by Job Harris and party in Spike Gully. Within weeks an estimated 5 000 people were on the field engaged in shallow alluvial and deep lead mining. At this time the field was said to average 1 to 2 oz of gold per tonne of washdirt. Small nuggets to 1 oz were reported. Major activity was in the period 1868 to 1870.

Further alluvial mining took place in 1887-1889, the 1890's and 1930's. The last alluvial claim was worked on Goddards Hill in the late 1960's.

Little reef mining took place until 1894 when operations commenced at the Lady Pearce and Royal Phoenix. In 1897 these were renamed the Menzies Barossa, a 40 head battery and a large amount of other machinery were installed and extensive shaft sinking and driving were undertaken. However there was insufficient grade and quantity of ore to support this scale of operation and the company went into liquidation. By 1900 all reef mining at Barossa had ceased.

There has been no systematic exploration of the Barossa Goldfield area.

OWNERSHIP/TENURE:

Virtually all the Barossa Goldfield is unavailable for mining. The southern portion is part of the Para Wirra Recreation Park. The remainder has been reserved from the operative provisions of the Mining Act to preseve significant historical mining areas.

REMARKS:

For the purpose of this summary the workings shown on plan 80-282 are regarded as the Barossa Goldfield with the exception of Malcom's Barossa copper and gold mine (Sec. 424 Hd. Barossa) which is hosted by Adelaidean sediments in contrast to the Barossa Complex rocks which host the Barossa Goldfield. Information on geology, mineralisation and production for the Goldfield is sparse.

COMPILER R.S. Robertson Date: February, 1991.

REFERENCES:

Brown, H.Y.L., 1908. *Record of the mines of South Australia.* 4th edition. Government Printer, Adelaide, pp 202-209.

Drew, G.J., in preparation. Goldfields of South Australia.

Forbes, B.G., 1979. Onkaparinga map sheet. *South Australia. Geological Survey, Geological Atlas 1:50 000 Series*, sheet 6628-11.

Preiss, W.V., 1987. Basement to the Adelaide Geosyncline. *In*: Preiss, W.V. (Compiler), The Adelaide Geosyncline - Late Proterozoic stratigraphy, sedimentation, palaeontology and tectonics. *South Australia. Geological Survey. Bulletin*, 53:35-41.

Campana, B., 1953. *Gawler* map sheet. *South Australia. Geological Survey. Geological Atlas 1:63 360 Series.*

BAROSSA GOLDFIELD

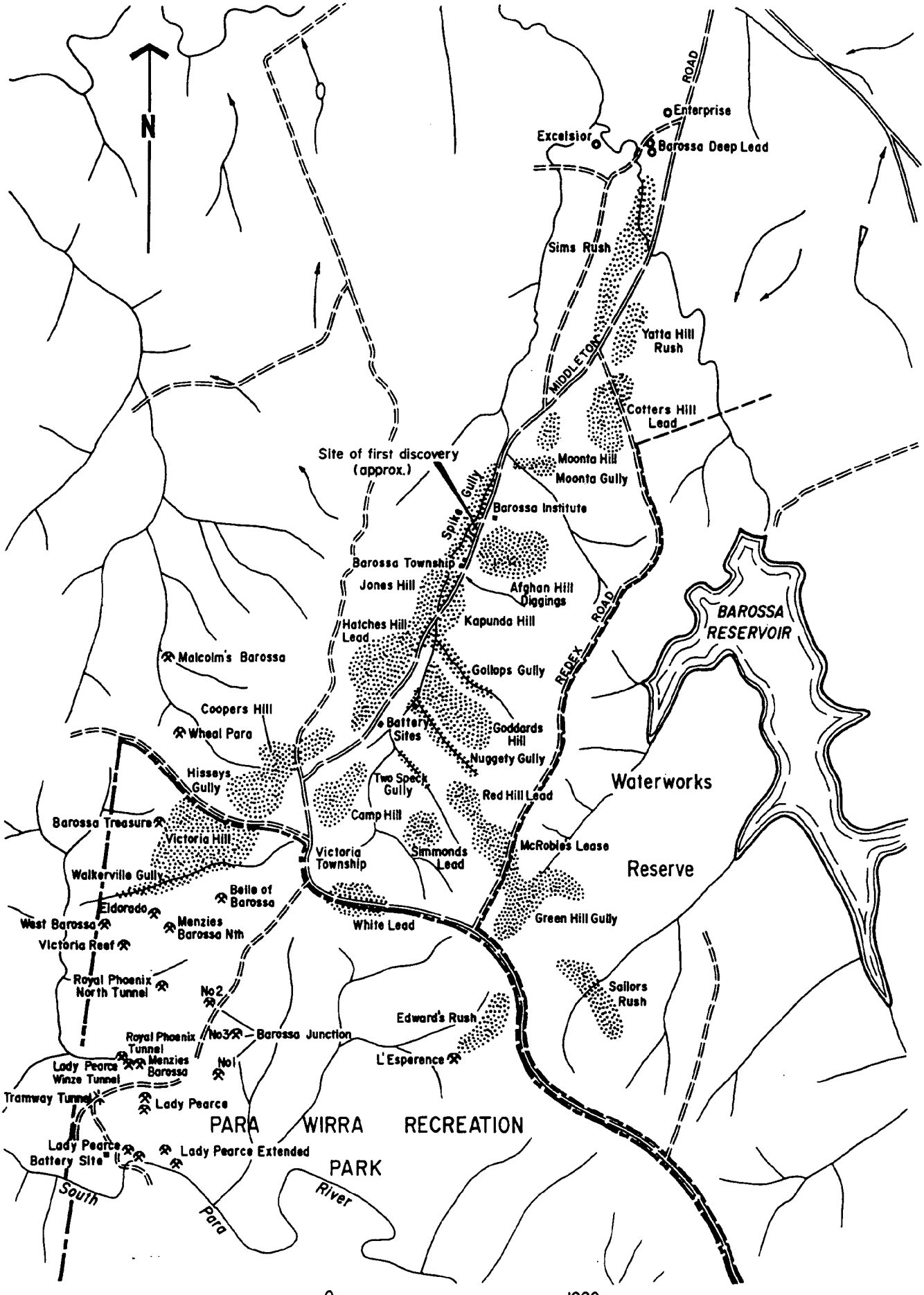


Figure 9

DEPARTMENT OF MINES AND ENERGY— SOUTH AUSTRALIA

S22290

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: Tarcoola

MINE NAMES:	OREBODY	NAMES
Tarcoola Blocks	Dedmans	Reef
	Ninnes	"
	Minnis	"
	McKechnies	"
	Fabians	"
	Imperial	"
	Sullivans	"
	Sullivans No. 2	"
	Wards	"
	Western Branch	:

All Nations
Associated
Blue Duck
Bohun
Coorabin
Curdnatta
Dark Hill
Day Dawn (Day Dawn United)
Eclipse
Enterprise (Hisgroves)
Evening Star
Excelsior
Federal
The Gem
Golden Hope
Golden Victory
Government Mine
Hidden Treasure
Lade Jane

MINE NAMES (contin)
Last Resource
Lease 1027
Lone Hand
Malcom's
May Day
Morning Star
New Chum (Gallipoli)
Proprietary
Royal George
Shamrock
Silver Lead Mine
Southern Cross
Tarcoola Enterprise
Tarcoola Gem
Tarcoola Lucky Hit
Tarcoola Perseverance
Tarcoola Proprietary
Tarcoola South
Tarcoola United

MINE NAMES (contin)
Tarcoola West
Thistledome
Warrigal
Warrigal East
Warrigal North
Warrigal South
Welcome Home
Western Exploration Syndicate
White Hope
Wilgena Associated
Wilgena Enterprise
Wilgena Syndicate
Wondergraph

LOCATION:
1:250 000 Sheet - Name TARCOOLA No SH 53-10
1:100 000 Sheet - No 5836
MEIS No. A
AMG Coordinates 455 400 mE
6 602 250 mN (Zone 52)

Location Comments: Reference point is the Main Shaft of the Tarcoola Blocks Mine (Fig. 10). AMG coordinates were derived by scaling from the Tarcoola 1:100 000 geological base plan.

COMMODITIES: Major Au Minor Ag

Tarcoola 2

STATUS: Prospect

DEPOSIT TYPE: Gold in quartz veins cross cutting Mid Proterozoic Tarcoola Formation sediments and in altered younger granite.

GEOLOGICAL SETTING:

1. Province: Gawler Craton - Wilgena Subdomain
   Stratigraphic Name: Tarcoola Formation
   Lithology: Quartzite, carbonate, siltstone, grit
   Relationship: Host to mineralisation
   Age: Middle Proterozoic, ca 1600 Ma

2. Province: Gawler Craton - Wilgena Subdomain
   Stratigraphic Name: Hiltaba Suite granite
   Lithology: Granite
   Relationship: Host to mineralisation
   Age: Middle Proterozoic, ca 1580 Ma.

Mineralisation Setting

Tarcoola Goldfield occurs in the Wilgena Subdomain of the Gawler Craton within folded sediments of the Middle Proterozoic (ca 1600 Ma) Tarcoola Formation. Tarcoola Formation has been divided into three members. Basal Peela Conglomerate Member is an arkosic grit with banded iron formation fragments. The Fabian Quartzite Member contains thin laminated carbonates overlain by quartzite and carbonaceous, pyritic, micaceous quartzite and siltstone. The overlying Sullivan Shale Member comprises carbonaceous and pyritic quartzites and carbonaceous siltstone. East of the mine are interbedded dacitic and andesitic tuffs.

Tarcoola Formation is folded along east-west trending axes and the goldfield is on the southern limb of an easterly trending anticline. Hiltaba Suite granite, ca. 1580 Ma, has intruded Tarcoola Formation with a contact approximately parallel to the strike of the sediments.

Large subvertical to vertical gold-bearing quartz reefs cross cut the sediments and were emplaced following development of tension fractures, generally perpendicular to strike, by the intrusion of the granite. The granite is locally very chloritic, may contain abundant sulphides and has been mined for gold.

All units, including the quartz reefs, are intruded by dacitic and andesitic dykes which contain detectable gold. (Daly et al., 1988; Daly, 1985).

Tarcoola 3

Mineralisation Description

Gold bearing quartz reefs are up to 2 m wide, 250 - 300 m long, with a vertical extent of at least 100 m and contain abundant xenoliths of quartzite and carbonaceous siltstone. Reefs were narrower within thick bedded quartzite and broader within thin bedded carbonaceous siltstone and quartzites. Quartz veins were richer in gold where they cross cut carbonaceous siltstone.

Sampling by Martins (1974) and drilling reported in Flintoft and Horn (1989) indicate a halo of gold enrichment in country rock around quartz veins. This halo was associated with quartz- chlorite-pyrite alteration of the country rock.

The reefs have erratic gold values both laterally and vertically and contain both very fine grained and coarse gold. Many small gold bearing, quartz veins occur between the major reefs.

The ore contains Ag as well as Au, pyrite and locally abundant sulphides of Cu, Pb, Zn and As.

The Tarcoola Blocks Mine was by far the largest producer of gold in the Tarcoola Goldfield.

Gold has also been mined from the Hiltaba granite, the Curdnatta, White Hope and Government mines being the largest producers.
(Daly et. al., 1988).

MORPHOLOGY:	Tabular	
NATURE OF MINERALISATION:	Vein	
MINERALOGY:	Ore	Gold
	Gangue	Quartz, galena, sphalerite, pyrite, chalcopyrite.
ALTERATION:	Baily (1989) records that the (Tarcoola Formation) wallrock around auriferous quartz veins is commonly altered with a metasomatic mineral assemblage of pyrite-chlorite-quartz.	

RESERVES/RESOURCES:

Tonnes Ore	Grade (g/t Au)	Type	Classification	Comments
260 000	3.7	In situ	Measured & indicated resource	Last Resource area, (BHP Gold, 1989)
4 000	10.0	"	Indicated resource?	Welcome Home mine (Flintoft & Horn, 1989)
29 100	1.88	Tailings	Indicated resource	Two tailings dumps at Tarcoola Blocks Mine (Horn & Fradd, 1985a).
29 250	2.18	Tailings	Indicated resource	Tailings dump at Tarcoola State Battery (Horn & Fradd, 1985b).

PRODUCTION:

Period	Tonnes (Ore)	Au-Bullion	Recovered Grade (g/t)	Comments
1901-1986	63 703	2 387 000	37.47	(Daly et. al., 1988)
1987	25	174	6.96	Sullivans Reef - P. Philip-Harbutt
1988	20	18	0.9	" "
1989	15	338	22.53	" "
Total	63 763	2 387 530	37.44	

WORKINGS/METHODS:

Most mining at the Tarcoola Goldfield was by underground methods. The Tarcoola Blocks Mine workings, the largest at Tarcoola, comprised a 152 m underlie shaft and a 111 m vertical shaft with extensive work on three levels. Reefs mined included Fabian, McKechnie, Western Branch, Ward's, Sullivan, Dedman and Imperial. Elsewhere on the field workings were developed down to the static water level at about 30 m depth.

Batteries operated at both the Tarcoola Blocks Mine (1901-1912) and the Tarcoola State Battery.

DISCOVERY/HISTORY:

Alluvial gold was found at Brown's Hill and the east end of Tarcoola Hill in 1893 (Brown, 1908), and led to the discovery, in April 1900 by Ward & Fabian of rich gold-bearing vein quartz (Fabian's Reef). Ward and McKechnie Reefs were found soon afterwards and the Tarcoola Blocks Company was established. Soon other companies were formed, reefs found and further leases taken up.

Gold production commenced in May 1901. By 1912 the Tarcoola Blocks Mine had produced 1.39 tonnes Au from 35 230 tonnes of ore. By June 1918, however, the mine had ceased operations.

Subsequent activity throughout the goldfield was limited and sporadic. Limited mining activity and production from the Tarcoola Blocks took place in 1934, 1947-52, 1970 - 1974 and 1978-1989.

Underground mapping was carried out by Ridgway & Johns (1949) and Ridgway (1951). Martins (1974) reported on extensive sampling on all levels.

In May 1986 Tarcoola Gold Ltd signed an option agreement with the current lessees of the Tarcoola Block Mine, P. and P.B. Philip-Harbutt. All work undertaken by Tarcoola Gold Ltd including 138 reverse circulation drill holes, 37 underground diamond drillholes, face sampling and bulk sampling is summarised in Flintoft & Horn (1989). The option agreement terminated in May 1989.

(Daily et. al., 1988; Flintoft and Horn, 1989).

TENEMENTS/OWNERSHIP

Tenement	Owner	Status	Comments
ML 4650	P & P.B. Philip-Harbutt	Current	Imperial, Wards, Sullivans No. 1-4, Welcome Home, Paxton-Wolfe reefs.
ML 4667	P & P.B. Philip-Harbutt	Current	
ML 5179	" "	"	Main Shaft (Tarcoola Blocks), Fabian, McKechnie, Western Branch reefs.
ML 5300	" "	"	Lady Jane Portion of Wards
EL 1460	Aberfoyle Resources Ltd and BHP Gold Mines Ltd	"	Exploration Licence - includes all of Tarcoola Goldfield not in Mineral Leases. Now purchased by Queens Road Mines.

COMPILER R S ROBERTSON DATE February, 1991

REFERENCES:

Bailey, D.G., 1989. Report on Phase 1 RC drilling. *In*: Flintoft, M.W. and Horn, C.M., 1989. Compilation of exploration data available on the Tarcoola Blocks Goldmine, Tarcoola, South Australia. *South Australia Department of Mines and Energy. Report Book*, 89/88.

BHP Gold, 1989. Report to shareholders. Reserves and resources. *The Broken Hill Proprietary Company Limited*, Melbourne, p.14.

Brown, H.Y.L., 1908. *Record of the mines of South Australia.* 4th edition. Government Printer, Adealide, pp. 284-292.

Daly, S.J., 1985. TARCOOLA map sheet. *South Australia Geological Survey. Geological Atlas* 1:250 000 Series, sheet SH53-10.

Daly, S.J., Horn, C.M. and Fradd, W.P., 1988. Tarcoola Goldfield. *South Australia Department of Mines and Energy.* Report Book, 87/130.

Flintoft, M.W. and Horn, C.M., 1989. Compilation of exploration data available on the Tarcoola Blocks Goldmine, Tarcoola, South Australia. *South Australia. Department of Mines and Energy. Report Book,* 89/88.

Horn, C.M. and Fradd, W.P.., 1985a. Appraisal of gold tailings at Tarcoola Blocks Mine. *South Australia. Department of Mines and Energy. Report Book,* 85/41.

Horn, C.M. and Fradd, W.P., 1985b. Appraisal of gold tailings at Tarcoola State Battery and Cyanide Works. *South Australia. Department of Mines and Energy. Report Book,* 85/18.

Martins, J.J., 1974. Final report, Tarcoola project, South Australia, for Emperor Gold Mines Ltd. *South Australia, Department of Mines and Energy.* Open file Envelope, 2506 (unpublished).

Ridgway, J.E., 1951. Tarcoola Goldfield - Tarcoola Blocks Mine. *Mining Review, Adelaide,* 91:117-129.

Ridgway, J.E. and Johns, R.K., 1949. Fabian (Tarcoola Blocks) Gold Mine. *Mining Review, Adelaide,* 88: 170-194.

TARCOOLA GOLDFIELD

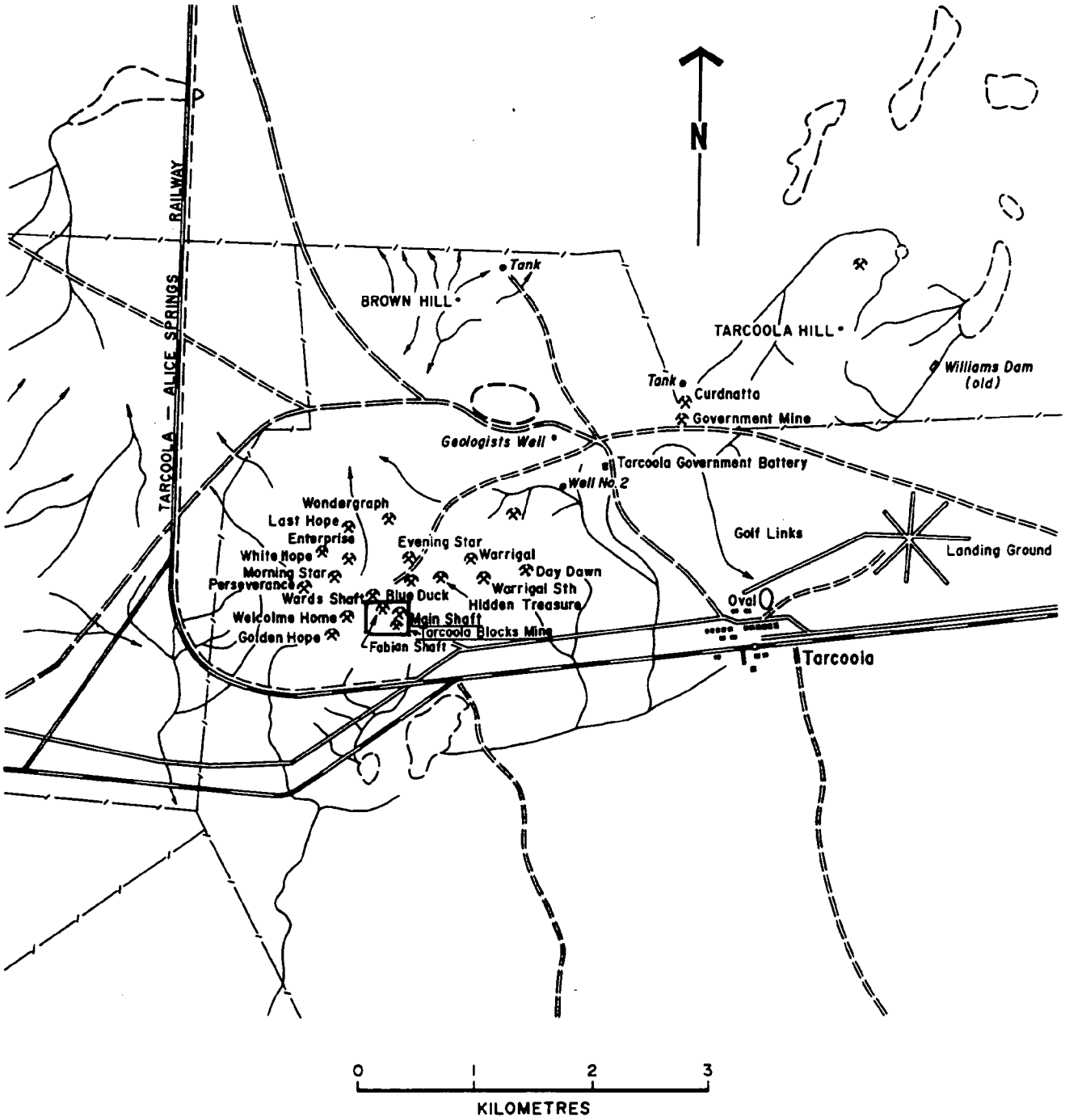


Figure 10

DEPARTMENT OF MINES AND ENERGY – SOUTH AUSTRALIA

S22291

MAJOR SOUTH AUSTRALIAN GOLD DEPOSITS

DEPOSIT NAME: Deloraine

SYNONYM: Day Spring

MINE NAMES: Deloraine, Deloraine South (Deloraine Blocks, Prairie Deloraine), Deloraine North (Deloraine Blocks), Deloraine Queen, Deloraine King, Deloraine Central.

OREBODY NAMES: Deloraine

MINING FIELD: Deloraine Goldfield

LOCATION:

1:250 000 Sheet Name ADELAIDE No SI 54-9
1:100 000 Sheet No 6628
MEIS No
Hundred Para Wirra Section 1602,2,1548,3,680,1547.
AMG Coordinates 306940mE
6152960mN (Zone 54)

Location - Comments

Reference point is the Main Shaft at the Deloraine Mine (Fig. 11). AMG coordinates are derived by scaling from the Barossa 1:50 000 topographic map.

COMMODITIES: Major Au Minor Cu, Ag

STATUS: Abandoned

DEPOSIT TYPE: Gold and copper sulphides in quartz veins in fissures and crush zones in Adelaidean Burra Group sediments.

GEOLOGICAL SETTING:

Province	Adelaide Geosyncline
Stratigraphic Name	Castambul Dolomite ? - Burra Group
Lithology	Interbedded quartzite, phyllite, calcareous siltstone, marble & dolomite
Relationship	Host to mineralisation
Age	Adelaidean

Mineralisation Setting:

The Deloraine deposit is located in folded and faulted Burra Group sediments of the Adelaide Geosyncline. The Onkaparinga 1:50 000 geological sheet (Forbes, 1979) shows the host rock as Castambul Dolomite (Skillogalee Dolomite equivalent), trending north-south and dipping steeply east, fault bounded immediately to the west by Aldgate Sandstone.

Deloraine 2

The deposit is situated 1 km east of Early Proterozoic Barossa Complex rocks of the Houghton Inlier. The major north-south trending Kitchener Fault is about 0.8 km east of the mine. This fault is the western boundary of sillimanite zone metamorphism in Adelaidean rocks.

Outcrop is poor in the area of the workings but reports by Ward (1914) and logs of diamond drillholes (Robertson, 1976) suggest the host rocks are interbedded quartzite, phyllite, calcareous siltstone, marble and minor dolomite.

Mineralisation Description:

The Deloraine mineralisation comprised gold, pyrite and copper sulphide bearing quartz veins occupying fissures and crush zones. The lode in the main Deloraine shaft dipped eastward at 40-65° and trended north-south overall, approximately concordant with the host rock, although showing marked local variation. Lode widths varied from a few centimetres to 1.5 m.

The quartz lode contained free gold, pyrite, limonite, covellite, chalcocite and native copper together with calcite and barite. Some chalcopyrite was found at depth. Gold content in the lode was irregular but was greatest where secondary copper minerals, particularly covellite, were most abundant. Average recovered grade of ore was 19.6 g/t. The Deloraine lode was followed to 180 m depth where some gold was still present although irregular and of low grade. Stoping was carried out for about 250 m along the line of lode.

Wallrock adjacent to the lode was sericitised. Disseminated pyrite was present through the host rock but appears not to have been spatially related to the quartz veins.

At Deloraine North, 0.5 km north of the Deloraine main shaft, very irregular gold mineralisation was found in a system of quartz veins infilling a crush zone. No copper minerals were present.

Deloraine North, Deloraine and Deloraine South are likely to all be controlled by the same structure, probably a north-south strike fault, although poor outcrop makes this difficult to establish.

Limited soil and rock sampling indicated significant gold and copper mineralisation is confined to the quartz lodes.

(Ward, 1914; Robertson, 1976).

Deloraine 3

STYLE/FORM: Concordant

MORPHOLOGY: Tabular

NATURE OF MINERALISATION: Vein

MINERALOGY: Ore — Gold, covellite, chalcocite, native copper, chalcopyrite.
Gangue — Quartz, calcite, pyrite, limonite, barite.

ALTERATION: Ward (1914) reported that wallrock adjacent to the lode was sericitised.

RESERVES/RESOURCES:

Tonnes Ore	Grade g/t Au	% Cu	Type	Classification	Comments
35 400	3.62	0.23	Tailings	Indicated resource	Morris (1981). 25 000 t of this has since been removed for treatment.
10-15 000	3.62	0.23	Tailings	" "	Horn (1988). Estimate of tailings remaining on site. Further unknown amount of tailings removed since then.

PRODUCTION:

Period	Tonnes (Ore)	Gold Bullion (grams)	Recovered Grade Au g/t	Comments
1912-1939	48 300	926 000	19.2	Figure from Morris (1981) less production from several other small mines in the area.
1980-1982	25 200 (tailings)	20 000		Treatment of Deloraine tailings at Palmer cyanide plant.
Dec '82 check with S.T.				
1988	1 000 (tailings)	2 000		Treatment of Deloraine tailings off lease (ML 5449)
Total	48 300	948 000	19.6	

In addition Deloraine tailings at Palmer have been retreated by a dam leaching process by ACH Gold Pty. Ltd. and a copper-gold concentrate recovered. No production records are available (Horn, 1988).

WORKINGS/METHODS:

The main Deloraine lode was mined underground. Driving extended for about 300 m along the line of lode and the deepest shaft was 180 m depth although most stoping was at higher levels. Several stamp batteries operated on site between 1912 and 1939.

At Deloraine North a shaft was sunk to 107 m but most of the small production tonnage was from shallower levels. Other minor workings were excavated at Deloraine South (Prairie Deloraine), Deloraine King and Delaine Queen (both north of Deloraine) to try to locate continuations of the lode.

DISCOVERY/HISTORY:

Gold was first discovered on Deloraine Creek in 1909 by Messrs. Hewlett & Scanlon (Mathews, 1909). A shaft sunk on this site was 180 m south of what was to become the main shaft. Work at Deloraine ceased in 1920. In 1922 limited mining resumed at Deloraine and at Deloraine North.

From 1932 to 1935, the Department of Mines drilled eight diamond drillholes at Deloraine. There was considerable production from Deloraine from 1937 to 1939 and the mine was profitable in this period. Underground operations ceased in August 1940.

Robertson (1976) reported on limited soil and rock chip sampling at Deloraine and also summarised the 1932-1935 diamond drilling. Morris (1981) surveyed and sampled the tailings dump and reported on metallurgical testing.

In 1981-82 Deloraine Gold Mines N.L. transported about 25 000 tonnes of tailings to Palmer and used a carbon-in-pulp process to extract about 0.8 g/t of Au. This company went into receivership in May 1982. Subsequently the tailings at Palmer were treated by a dam leaching process by ACH Gold Pty. Ltd. and an unknown quantity of copper-gold concentrate recovered. Further gold has since been produced from the tailings remaining at Deloraine.

TENEMENTS/OWNERSHIP:

Tenement	Owner	Status	Comment
ML 5388	D. Genat	Current as at February 1991	Main Deloraine workings.

REMARKS:

Small diggings in the area north of Deloraine such as Birthday Gift, Uraparinga (Clark's Find), Pearce's Find and Sheoak Ridge, about which there is little geological information, are not considered part of the Deloraine deposit.

COMPILER: R.S. Robertson DATE: March 1991

REFERENCES:

Forbes, B.G., 1979. Onkaparinga map sheet. *South Australia. Geological Survey. Geological Atlas 1:50 000 Series*, sheet 6628-11.

Horn, C.M., 1988. Review of gold tailings in South Australaia. *Mineral Resources Review, South Australia*, 156:57-64.

Mathews, W.H., 1909. Day Spring, near Kersbrook. *Review of Mining Operations in South Australia*, 10: 21-22.

Morris, B.J., 1981. Appraisal of gold tailings - Deloraine Goldfield. *South Australia. Department of Mines and Energy.* Report Book, 81/3.

Robertson, R.S., 1976. Report on Deloraine Mine. *South Australia. Department of Mines and Energy.* Report Book, 76/57.

Ward, L.K., 1914. Report on the Deloraine Gold Mines, N.L. *Review of Mining Operations in South Australia* 19: 36-39.

DELORAINE and GUMERACHA GOLDFIELDS

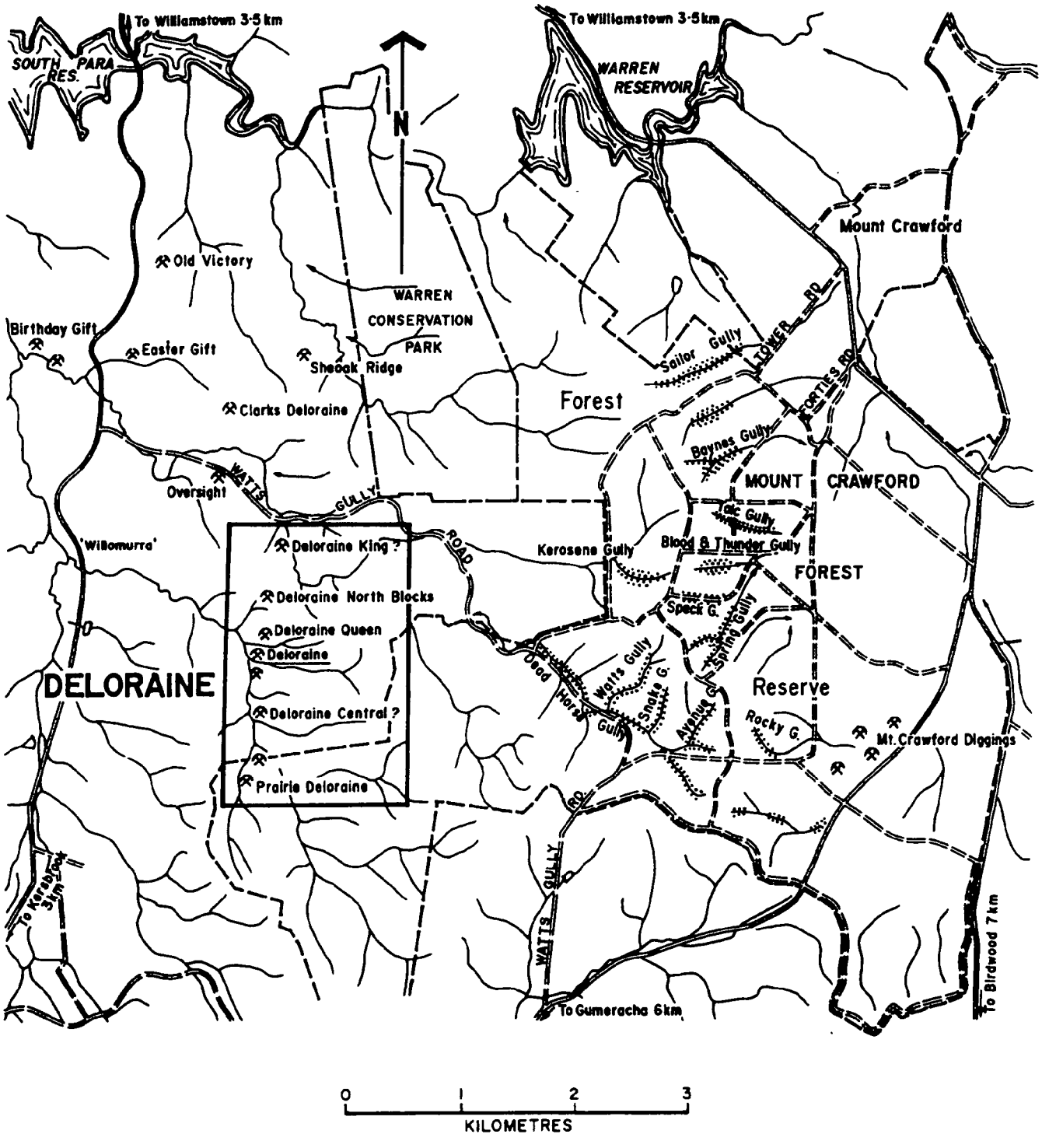


Figure 11

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

S22292