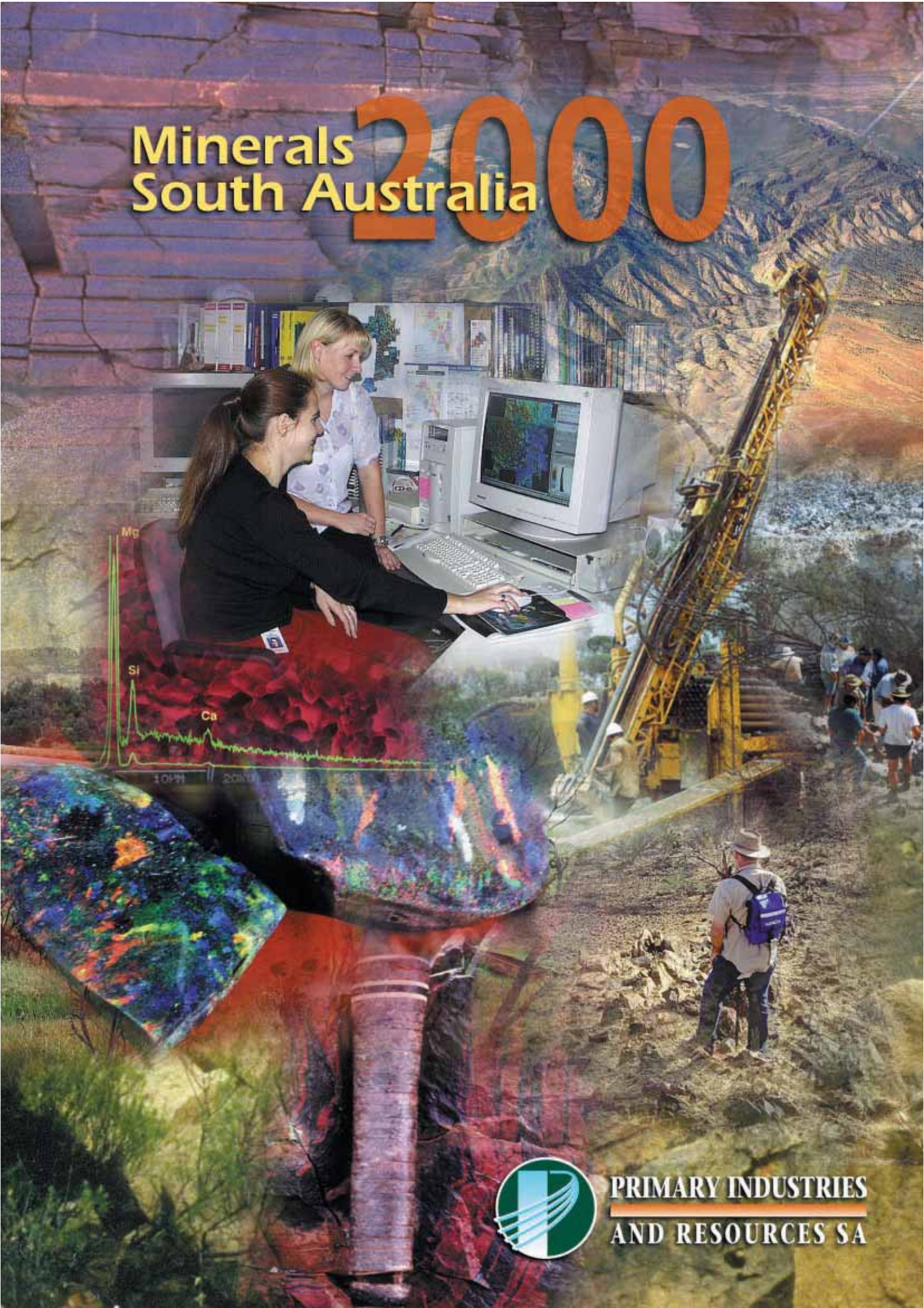
Minerals South Australia 2000



PRIMARY INDUSTRIES AND RESOURCES SA

INTRODUCTION

This is the first issue of an annual overview of the minerals industry in South Australia, summarising current production and examining some of the emerging trends. It is a prototype, so we would appreciate your feedback on its content.

The issue also includes the PIRSA Mineral Resources Group report to the industry, a synopsis of our strategic 5-year plan and an outline of key achievements for the year.

Overall, the year has been hectic, culminating in considerable input into the deliberations and response to the Resources Task Force recommendations. Notwithstanding this, I am delighted to report on some key achievements which are detailed further in *Minerals South Australia 2000*.

To achieve the vision for the industry articulated in the Resources Task Force Plan will require a greatly heightened level of mineral exploration activity over the next 5–10 years. I look forward to Government and industry working in partnership to achieve these noble aims.

Key elements of the Resources Task Force recommendations are already part of Government business, but greater focus and urgency will be given to them. Of greatest importance is resolving complex issues surrounding land access, especially Native title and Aboriginal heritage. I am pleased to report that an across agency negotiating team has been established to develop an Indigenous Land Use Agreement with all key stakeholders. Further, Government is considering ways of creating an Aboriginal Heritage Authority to expedite the heritage clearance process but at the same time protecting the important heritage sites for indigenous people.

Of great significance has been the agreement reached with Anangu Pitjantjatjara on accelerating the approval of exploration licences in the Musgrave Block and on undertaking an airborne geophysical survey of the WOODROFFE map area. Of course we were delighted with the reproclamation of Yumbarra Conservation Park to allow for exploration of that much-discussed magnetic anomaly.

Refocusing TEISA into drilling and 1:100 000 scale mapping was also given high priority by the Resources Task Force. Plans are in place to allow this to happen, although I would comment that PIRSA already undertakes its base mapping at 1:100 000 scale, or in even greater detail. As you can see from this report, new maps have been published and mapping concluded in some key areas.

Although a number of other important recommendations were made by the Resources Task Force, the most significant of these relates to streamlining Government processes, an issue that has always been high on the Premier's agenda, and PIRSA's as well. In this respect, we are making every effort to establish PIRSA as the one window to Government for the minerals industry. I am pleased to note that a memorandum of understanding was reached with the Environment Protection Authority (EPA) during the year, and some of our staff are in the process of being accredited through EPA training sessions.

I hope you will have taken the opportunity to visit our updated website which is quite impressive. Of particular interest to explorers is that PIRSA is developing an electronic tenement lodgement system which should be running by the latter part of 2000.

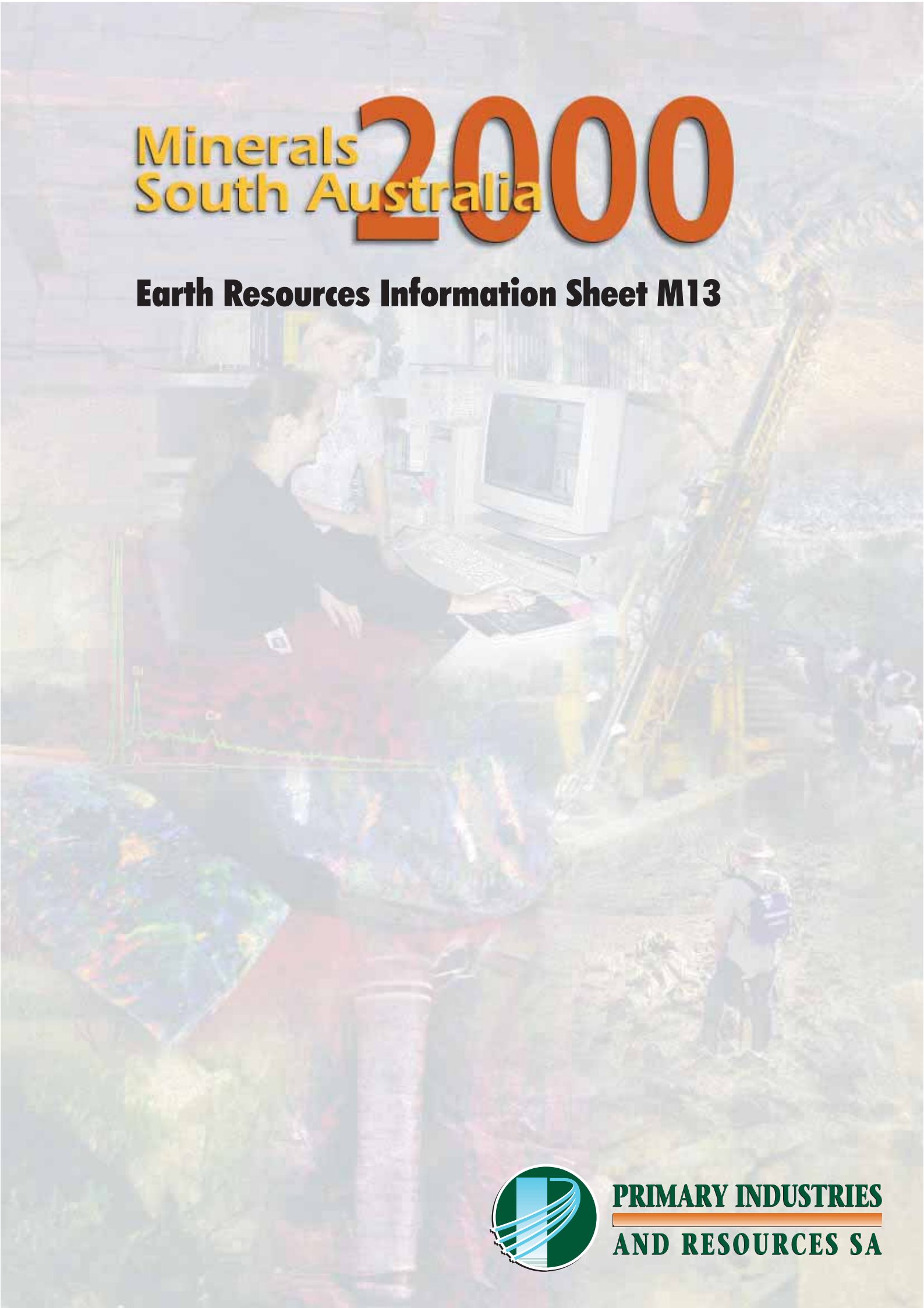
Finally, we have a large number of initiatives in place, all designed to foster mineral activity in South Australia. We would welcome your comment on these and your participation where there is mutual advantage.

I wish you every success for 2000.

Neville Alley
Director, Mineral Resources Group
Primary Industries and Resources South Australia

Minerals South Australia 2000

Earth Resources Information Sheet M13



PRIMARY INDUSTRIES AND RESOURCES SA

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SECTION 1: SOUTH AUSTRALIA'S MINERAL INDUSTRY

MINERAL INDUSTRY OVERVIEW

In brief

Emergent positive trends linked to mineral commodity price recovery, growth in exploration expenditure levels, impact of TEISA pre-competitive exploration work and significant corporate decisions in the second half of 1999 suggest an encouraging outlook for the South Australian mineral exploration sector despite a subdued exploration scene in early 1999. Olympic Dam Cu–U–Au–Ag mine output is nearing operational capacity of 200 000 t/year copper at year's end following commissioning earlier in 1999 of the $1.94 billion expansion, and uranium projects (Beverley Mine development and Honeymoon feasibility study) are proceeding quickly.

Recent corporate takeovers, strategic alliances and asset disposals have the potential to influence the short and medium-term trends in exploration, mining and mineral processing in the State. Significant shifts in commodity focus by some of the long-standing mineral industry investors have become evident, and the recent entry of two global mining houses to South Australia has signalled confidence in the mineral prospectivity of the State.

Commodity prices

Global commodity prices have experienced sustained upswings in recent months for major base metals and in recent weeks for gold, inducing a re-casting of strategies by exploration companies with cash reserves. Significant changes in commodity prices that occurred during 1999 include a 30% rise in the spot gold price (from US$250/oz to hit US$330/oz), a doubling of the nickel price (to reach US$7200/t), and substantial increases in spot prices for copper (peaking recently at US$1800/t) and zinc (peaking at US$1200/t mid-year).

Mineral exploration

The Australian Bureau of Statistics (*Actual and expected private mineral exploration Australia, June quarter 1999*) recorded that mineral exploration spending in South Australia for the June quarter 1999 ($12.8 million) reached the highest quarterly level for the last eight quarters. In addition, during 1998–99, there has been a diversification in South Australia away from purely gold exploration targets with expenditure growth on copper, copper–gold and heavy mineral sand targets. It is expected that this broader based target strategy will be maintained in an industry wide sense.

Corporate

Recent strategic decisions taken by Australian and overseas majors have resulted in significant long-term investment commitments by new entrants to the South Australian minerals exploration sector. The most significant developments include MIM joint-venturing Redfire Resources tenements at Burra, and Billiton's strategic alliance with Minotaur over tenements on the Stuart Shelf and Curnamona Province. Canadian nickel miner Falconbridge has taken up large areas in the western Gawler Craton to pursue a nickel exploration strategy. Aggressive corporate takeover bids, including one by South Africa's Anglogold targeting a gold mining company with significant exploration interests in South Australia, have also been publicised.

BHP's decision, announced on 6 October 1999, to sell the Whyalla Steelworks has induced a paradigm shift in the prospects for the State's iron ore exploration, mining and steelmaking sectors. Opportunities may emerge for development of alternative sources of high-grade iron ore located elsewhere in the State to supplement the Middleback Range raw materials resources, in order to underpin any new owner's long-term investment at Whyalla.

Targeted Exploration Initiative South Australia (TEISA)

Now in the second year of the four-year program, TEISA targeted minerals programs have resulted in aerial geophysical surveys being completed over Eyre and Yorke Peninsulas, in the Mannum region, east of Oodnadatta, and in the Woomera and Coober Pedy areas. Over 179 000 line kilometres have been flown. Fifteen mineral exploration companies have participated in the TEISA surveys by funding additional flight lines to obtain detailed information over prospective targets. AGSO completed an

BHP Whyalla Steelworks, with the City of Whyalla in the distance. *(Photo 46673)*

airborne geophysical survey over the Parachilna–Orroroo region early in 1999. A ground-based gravity survey was completed in the Curnamona Province.

Mineral production trends in South Australia

The value of minerals produced over the four financial years to 1997–98 (Table 1) has shown 10% growth over the period, reaching $607 million in 1997–98. In 1998–99, there was a significant reduction to $553 million as a result of lower commodity prices. The outlook is for total value of production for 1999–00 to show a substantial increase as the impacts of the Olympic Dam expansion and commissioning of the Beverley uranium mine begin to be felt.

Table 1 *South Australian minerals output value ($million) for 1994–95 to 1998–99.*

	1994–95	1995–96	1996–97	1997–98	1998–99
Metallic minerals	323.4	379.4	328.1	354.6	318.8
Industrial minerals (inc. coal)	106.8	89.4	105.3	111.0	94.7
Construction materials	64.7	63.9	76.9	82.7	80.8
Natural sand products	19.0	16.1	16.2	17.5	18.3
Clay products	2.0	1.7	1.9	2.4	2.7
Opal (estimate)	38.5	40.5	39.9	38.9	38.0
Total	**554.4**	**591.0**	**568.3**	**607.1**	**553.3**

Source: PIRSA, ABS

Resource developments

Two mine development projects are subject to feasibility studies — SAMAG's magnesite and magnesium metal proposal and the Honeymoon *in situ* leach operation.

During 1999, the Resolute Ltd – Dominion Mining Ltd joint venture (Gawler Joint Venture) proposed the sinking of a $4 million exploration shaft on the Challenger gold deposit to assess its potential by underground drilling, and recover bulk samples. With the mid-year decline in gold price, the shaft sinking proposal was deferred, but the recent price recovery may induce the partners to review their deferral decision.

Commissioning of the 25 t locomotives and section of the track. *(Photo 46508)*

Outlook

With the recovery of mineral commodity prices and a return of industry optimism and investor confidence, there is a strong possibility that cash-strapped junior explorers, who play a crucial role in mineral exploration in South Australia, may now be able to raise equity funds for exploration purposes.

The preparation of the Premier's Resources Task Force Report and Plan is indeed timely, given that there is now an environment of growing industry optimism. To capitalise on the expected expansion of mineral industry investment, early implementation of its recommendations will be crucial to the prospects of medium and long-term mineral exploration growth in the State.

South Australia has a marginally competitive advantage over the other States, especially in the areas of land access and data capture, and it is important that the State expedite the next steps to consolidate this advantage.

Interior view of the Central Control Building, Olympic Dam Mine. *(Photo 46507)*

Table 2 *South Australian resources production for 12 months ended 30 June 1999.*

	Quantity (t)	Value ($)	12-month total ($)
Petroleum products			
Natural gas (Gm^3)	4.19	415 625 024	
Caroline 1 CO_2 well	25 953	3 866 943	
Ethane (t)	18 986	2 420 472	
Condensate (kL)	448 758	70 563 012	
Crude oil (kL)	560 004	81 335 026	
LPG	403 718	94 066 250	**667 876 727**
Mineral products			
— refined			
Copper	83 772	191 619 953	
Gold (kg)	961	14 024 416	
Silver (kg)	8 297	2 197 128	
Uranium oxide	1 979	83 591 560	**291 433 057**
— mineral ores and concentrates			
Iron ore	2 733 150	24 598 341	
Lead ore	5	3 810	
Zinc ore	3 677	2 799 905	**27 402 056**
Coal			
Black coal	2 702 618	42 633 210	**42 633 210**
Industrial minerals			
Barite	13 740	861 808	
Cement shale	7 105	56 840	
Dolomite	1 014 895	10 199 001	
Feldspar	1 453	39 313	
Foundry sand	53 510	1 151 433	
Gypsum	1 601 298	4 975 163	
Jade (kg)	2 577	12 884	
Kaolin	2 594	268 652	
Limesand	24 982	261 385	
Limestone			
Agricultural	45 623	631 916	
Cement	1 609 386	12 738 490	
Chemical	610 667	11 784 250	
Fines	4 900	147 000	
Whiting	1 166	58 300	
Magnesite	1 079	39 019	
Mica (damourite)	841	111 278	
Micaceous haematite	95	39 500	
Peat	4 629	197 625	
Phosphate	843	2 572	
Salt	574 226	4 744 108	
Semi-precious and ornamental stones (kg)	10	20	
Silica	126 146	3 041 048	
Sillimanite	17	1 158	
Talc	8 428	716 098	**52 078 861**
Construction materials	10 017 032	80 830 967	**80 830 967**
Natural sand products	2 403 371	18 335 716	**18 335 716**
Clay products	577 410	2 682 636	**2 682 636**
Opal production estimate		37 964 200	**37 964 200**
Total mineral value			**$1 221 237 430**

MAJOR MINERAL COMMODITIES

METALS

Copper

Western Mining Corporation (WMC) has completed a two-year $1.94 billion expansion project ahead of schedule at the Olympic Dam Cu–U–Au–Ag mine, which was officially opened on 26 March 1999 by the Prime Minister, John Howard. Production capacity (Table 3) has been significantly increased and it is now Australia's largest capacity underground mine and one of the top 15 copper producers in the world. Features of the expansion include:

- an automated electric haulage system and new crusher station
- a new 275 kV powerline from Port Augusta to Roxby Downs
- a new autogenous mill incorporating the latest grinding technology
- a new smelter
- an enlarged hydrometallurgical plant
- a third haulage shaft, the Sir Lindesay Clark Shaft.

Table 3 *Olympic Dam annual production capacity.*

	Pre-expansion	Current
Ore treated (t)	3 000 000	9 200 000
Copper (t)	85 000	200 000
Uranium oxide (t)	1 700	4 600
Gold (kg)	930	2 430
Silver (kg)	11 200	26 400

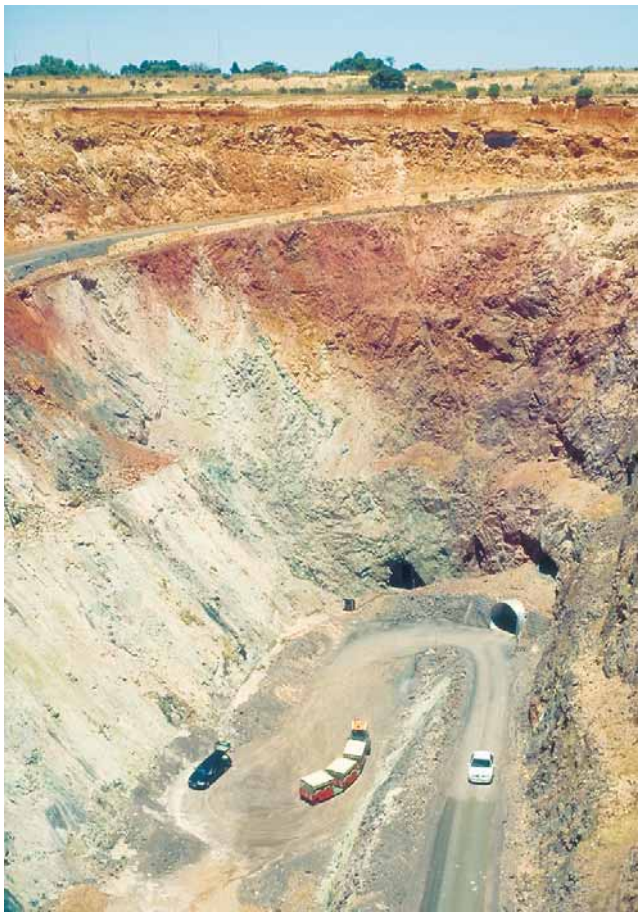
Since 1987, Mount Gunson Mines Pty Ltd has been heap leaching oxidised ore at Mount Gunson, and in 1998 recovered 535 t of high-grade copper cement for the production of cupric oxide at the Adchem Australia Pty Ltd processing plant in Burra.

Casting copper anodes in the original Olympic Dam refinery. (Photo 44156)

Selected mines and minerals in South Australia.

Dual wheel casting system in the new smelter building, Olympic Dam Mine. *(Photo 46509)*

The Wheal Hughes copper mine at Moonta, which closed in 1993, was officially opened as a tourist mine by Senator Robert Hill, Federal Minister for the Environment, on 29 November 1998. The site includes a WMC-sponsored visitor centre, with information panels produced by PIRSA in conjunction with WMC, South Australian Chamber of Mines and Energy (SACOME) and Council of the Copper Coast.



View of Wheal Hughes open cut and entrance to underground tourist mine near Moonta. *(Photo 46546)*

The Curnamona Province is proving to be prospective for gold–copper mineralisation, with the Willyama Supergroup Bimba Formation and calc-albite units being major targets. Encouraging prospects include White Dam, Kalkaroo and Dome Rock.

The Pasminco Aust. Ltd – Werrie Gold Ltd joint venture over the Benagerie Ridge magnetic complex has recently intersected 12 m at 3.67% Cu and 1.93 g/t Au from 318 m in diamond-drillhole BEN 1051 at the North Portia prospect.

Gold

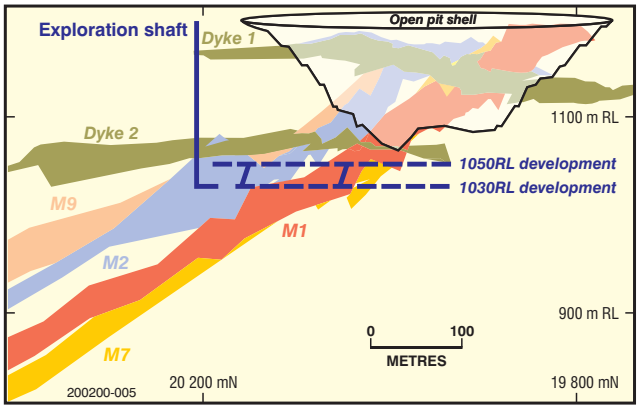
Olympic Dam Mine is the State's major producer, yielding 961 kg in 1998–99. Small amounts (<0.3 kg) were also produced from the alluvial Teetulpa Goldfield.

At the Mongolata Goldfield, Byles Mine, worked between 1930 and 1949, is now operated as an underground tourist mine and periodically worked for gold specimens.

On the Gawler Craton, the Gawler Joint Venture announced, then deferred, a $4 million feasibility study of the Challenger prospect that includes a 170 m exploration shaft. At least 12 shallow northerly plunging mineralised zones, open at depth and containing indicated and inferred resources totalling 503 362 oz of gold, have been outlined.

Other significant prospects on the Gawler Craton include:

- Tunkillia (Helix Resources NL and Acacia Resources Ltd), where gold mineralisation, hosted by Hiltaba Suite granite, is associated with demagnetised areas of the Yarlbrinda Shear Zone and indicated by gold-in-calcrete. Tomahawk, in the central Tunkillia calcrete gold anomaly, has returned drill intersections of 3 m at 5.79 g/t Au from 100 m (LRC 326), 2 m at 2.62 g/t Au from 63 m (LRC 341), and 7 m at 1.47 g/t from 99 m (LRC 342).



Schematic of proposed open pit and underground development at Challenger (courtesy Resolute–Dominion JV).

- Nuckulla Hill (Equinox Resources NL), where Sheoak, Myall and Bimba targets are located within a 1–2 km demagnetised zone along the Yarlbrinda Shear Zone and defined by gold-in-calcrete anomalies.
- Weednanna (Acacia Resources Ltd and Western Metals Resources Ltd), where drilling has partly defined a mineralised lens extending for ~1 km within Palaeoproterozoic Hutchison Group banded iron formation (BIF). Drill intersections include 13 m at 6.0 g/t Au from 88 m (98WDRC 44) and 6 m at 18.6 g/t Au from 129 m (98WDRC 49).

In the Curnamona Province, Pasminco Aust. Ltd – Werrie Gold Ltd joint venture has identified numerous prospects associated with gravity troughs within the Benagerie Ridge magnetic complex. Gold occurs in supergene zones at the top surface of deeply weathered basement and as primary veins within Willyama Supergroup metasediments broadly equivalent to Bimba Formation. Prospect highlights include:

- Portia, where an inferred resource, for 'base of Tertiary' eluvial mineralisation, of 270 000 t at 7 g/t Au has been outlined in a zone 1–10 m thick, 50–200 m wide and 600 m long at the unconformity surface. Basement drill intersections include 6 m at 42.2 g/t Au, 15 m at 4.83 g/t Au and 3 m at 212.6 g/t Au.
- Shylock, with drill intercepts of up to 13 m at 4.83 g/t Au from 90 m.
- Lorenzo, with drill intercepts of 12 m at 3.24 g/t Au from 87 m and 2 m at 42.5 g/t Au from 90 m.

At the White Dam prospect, Mount Isa Mines Ltd, Western Metals Resources Ltd and Normandy Minerals Ltd have located a substantial body of stratabound gold–copper mineralisation within Willyama Supergroup biotite–leucocratic gneiss. Drill intersections include 72 m at 2.61 g/t Au and 0.37% Cu from 14 m (WD 71), including 14 m at 7.19 g/t Au from 65 m.

Lead–zinc–silver

Pasminco Ltd has completed a four-year, $33 million upgrade of the Port Pirie Smelter which has raised annual lead output capacity by 11% to 250 000 t and doubled the silver production capacity to 450 t, together with 40 000 t of zinc, 4000 t of copper and 600 kg of gold. The smelter is the world's largest integrated lead–zinc producer and third largest silver producer. Smelter feed is mainly sourced from Pasminco's Broken Hill, Elura (NSW) and Rosebery (Tas.) Mines, and BHP's Cannington Mine (Qld).

The State's mine production of lead, zinc and silver is small; in 1998, 15 t of lead were produced by Aureate Gold NL from a small operation at the Baratta Silver–Lead Field; 3188 t of willemite zinc ore were produced from Pasminco's Aroona deposit, and 10 430 kg of silver were produced from the Olympic Dam Mine.

Although lead–zinc–silver mineralisation is widespread in a variety of geological environments, a major resource has yet to be developed in South Australia. Significant exploration prospects include:

- Meninnie Dam, where an inferred resource of 1.7 Mt at 5% Pb, 8% Zn and 100 g/t Ag has been outlined within Palaeoproterozoic Hutchison Group marble and carbonate-facies BIF on the southern Gawler Craton.
- Hunters Dam, Blue Dam – Meningie Well, Putt's Well, Ram Dam, Ballara, McBrides and Benagerie Ridge are located in the Curnamona Province, with the favourable hosts being albitic metasiltstone, marble and calc-silicate of the Bimba Formation and the underlying calc-silicate suite.
- Angas (Playford Resources NL – Western Metals Resources Ltd) in the Cambrian Kanmantoo Trough where an inferred resource of 1 Mt at 10% Zn, 4% Pb, 60 g/t Ag and 1 g/t Au has been outlined within Tapanappa Formation quartz–mica–garnet–andalusite–staurolite–gahnite schist.

Iron ore

Production in the 12 months to June 1999 was 2 733 150 t of high-grade haematite ore from deposits owned by BHP Steel Pty Ltd in the Middleback Range. The ore is railed to Whyalla where most is processed into pellets and used as feedstock to the blast furnace at BHP's steelworks, although a significant proportion is shipped to Port Kembla (NSW). Production is from three open-cut mines in the

Southerly aerial view of the Pasminco Port Pirie Smelter complex, with the city of Port Pirie in the background. (Photo 47079)

South Middleback Range, mainly from Iron Duke, but also from deposits immediately to the north and along strike at Iron Duchess and Iron Knight. Since 1915, production of ore from the Middleback Range has amounted to over 200 Mt. The remaining resources of high-grade ore are estimated at 26.4 Mt, giving an expected life of 10 years at the current production rate.

On 25 May 1999, BHP produced the first steel from its new $83 million billet caster. Whyalla Steelworks is now established as the primary source of steel billet for the rod, bar and wire mills at Newcastle (NSW) and will annually supply 750 000 t via National Rail.

BHP Steel has announced plans to divest those parts of its steel business that do not fit its long-term strategy. The divestment program includes the Whyalla Steelworks, with the iron ore mines considered to be part of the package. BHP anticipates asset sales in 12–18 months. The Whyalla Steelworks produces long products — steel processed into products such as structural and universal beams for the building industry, and rail line and steel sleepers. Steel is also sold as slabs and a range of structural products.

During 1995–96, PIRSA, as a joint venture partner in the South Australian Steel and Energy (SASE) Project, identified significant resources of low-grade, magnetite-rich BIF in the region of the Phillipson coal deposits. Exploration at Hawks Nest prospect identified seven neighbouring, near-surface strike ridges of magnetite-rich, Palaeoproterozoic BIF with a combined resource of 600 Mt to 130 m depth, grading 35% Fe. Preliminary beneficiation testwork by fine grinding and wet magnetic separation gave a high-grade magnetite concentrate. Since then, plans have been progressed for a demonstration pig iron plant as a forerunner to the construction of a full-scale facility. The equity partners in the demonstration plant were Meekatharra Minerals, Ausmelt Ltd and PT Krakatau Steel. The Federal Government has granted $6.5 million as research and development assistance towards the test facility which will cost ~$14.5 million to build and operate. Ausmelt's technology for pig iron manufacture has been established in small-scale pilot studies, and the demonstration plant will provide technical information for a 2.5 Mt/year commercial plant.

BHP employees watch as five strands of liquid steel are poured into Whyalla Steelworks' new $83 million billet caster. (Photo 46834)

Meekatharra Minerals has recently signed an agreement to purchase most of Ausmelt's interest in the SASE Project, taking its ownership to 90%, which will enable early construction of the demonstration plant.

Prospects for further discoveries of high-grade haematite ore in the Middleback Range are limited. Resources of low-grade ore in the range are very large, although they are currently not considered economic. The global iron and steel industry is highly competitive, but the Whyalla Steelworks is well prepared for future success under new ownership.

The PIRSA Mineral Resources Group has been actively reviewing the iron ore resources of South Australia with results soon to be published in a brochure titled *South Australia's iron ore resources*. The report identifies that the State's major iron ore resources are low-grade ores in BIF and iron-rich skarns. In terms of the future of the SASE Project, the report identifies the northern Gawler Craton as a major iron ore province containing potentially enormous resources of low-grade, magnetite-rich ore. There are large resources of iron ore in the Middleback Range, in Archaean magnetite-rich iron formation 180 km to the southwest at Warramboo, and potential deposits in magnetite-rich skarn rocks of northern Yorke Peninsula.

ENERGY MINERALS

Coal

The Leigh Creek Coalfield, owned by Flinders Power Pty Ltd (formerly part of the power generation arm of ETSA), is currently the only operational coal mine in South Australia. The coal is mined by open-cut methods and railed 270 km south to the Northern and Thomas Playford Power Stations at Port Augusta, which supply ~30% of South Australia's electricity. Coal production totalled 2.7 Mt in 1998–99.

There has been a worldwide drop in the price of coal in recent years. Significant recent industry influences in Australia have seen the trend towards natural gas fired power stations with lower greenhouse gas emissions, the introduction of cogeneration technology and establishment of the national electricity market on the East Coast of Australia. These have all contributed towards cost reduction pressures amongst coal and electricity producers. Like many other Australian power producers, Flinders Power has made significant changes to reduce costs and maintain competitiveness, including:

- Commencing in 1995, strip mining is being replaced by terrace mining (MESA Journal 1, p.17–19). This innovative method, developed in-house by Flinders Power, has been successfully implemented in the main seam pit and is in the process of being introduced in the Upper Series mining area.
- Re-fleeting with larger trucks and a larger shovel in 1996–97 to reduce mining costs and increase efficiencies.
- Workplace restructuring and other cost-control projects which have resulted in substantial savings, improved plant performance and major reductions in workforce numbers.
- Restructuring of coal freight arrangements to reduce costs.

In 1997, the Department of Mines and Energy Resources (MESA, now PIRSA), in conjunction with Flinders Power, engaged an external consultant to undertake a conceptual study to estimate the cost of producing oil from the Leigh Creek overburden. The study examined the economic potential of the project over a range of probable operating and capital costs likely to be incurred. Results indicated that an oil shale operation is not presently an economically viable proposition, and no further work is planned by PIRSA.

Elsewhere in South Australia, Meekatharra Minerals Ltd is continuing the assessment of coal from the Arckaringa and Phillipson Coalfields for electricity generation and pig iron production as part of the SASE Project.

Flinders Power has continued its research programs into assessment of coal utilisation technologies and combustion testing of coal from Bowmans and Lochiel lignite deposits, with a view to the future development potential of these energy assets. This work is largely being undertaken via Flinders Power's participation in the Cooperative Research Centre (CRC) Clean Power from Lignite. One of the main objectives of this CRC is the development of cost-competitive high-efficiency power generation technologies for low-rank coals. When implemented, these technologies will result in substantial greenhouse gas reductions from low-rank coal power generation.

Over the last three years, Flinders Power has undertaken a significant rehabilitation project on the margins of the trial pit at Bowmans. Since pit construction in 1980, a combination of erosion processes and weak soils has caused the pit margins to become unstable and unsafe. The stabilisation–rehabilitation work, including a significant revegetation program, has restored the site to a stable and safe condition. The program is 90% complete, with the remaining work scheduled for the 1999–00 financial year.

Flinders Power has been granted exploration tenure over the Kingston lignite deposit in the State's South-East, with a view to reassessment of its potential use as a fuel source for power generation.

Uranium

WMC produced 1979 t of uranium oxide valued at $83.6 million during 1998–99 from Olympic Dam; uranium is a byproduct of copper mining.

Heathgate Resources has been accumulating yellow cake on site at Beverley in the Frome Embayment since field leach trials began in January 1998. A mineral lease was granted after approval of the EIS in May 1999, at which time the on-site yellow cake became the property of Heathgate Resources. Since then, the company has re-commissioned the pilot plant to produce yellow cake while the full size plant is under construction. Commercial production is planned to commence in 2000.

Southern Cross Resources Australia Pty Ltd conducted field leach trials at Honeymoon during 1998 and is preparing an Environmental Impact Statement for approval prior to granting of a mineral lease.

Beverley uranium trial in situ *leach plant.* *(Photo 46768)*

INDUSTRIAL MINERALS

Barite

World production is ~7 Mt/year, about one-half of which comes from China. South Australia, which produced 13 740 t in 1998–99, is Australia's largest producer.

Over 160 barite deposits or occurrences have been documented in South Australia, with a total recorded production of ~680 000 t. All but a few are of the open-fracture infill type hosted by Adelaide Geosyncline rocks in the Mount Lofty and Flinders Ranges.

The only South Australian mines in current production, Oraparinna and Dunbar in the Flinders Ranges, are

associated with the Oraparinna Diapir. Both are operated by Normandy Industrial Minerals.

Production commenced in 1940 at Oraparinna, 500 km north of Adelaide, and Normandy Industrial Minerals has operated the deposit since 1984. The mine, comprising eight underground levels, works a system of 1–2 m wide veins which have developed in tensional fractures within Adelaidean Wilpena Group sediments. Ore is trucked 160 km to a treatment plant at Quorn where three industrial grades of barite are produced for use in surface coatings, plastics fillers and mould coatings at Olympic Dam. Some A and Standard grade material is trucked to Gillman in suburban Adelaide for fine milling.

The Dunbar deposit, 15 km southeast of the Oraparinna Mine, is worked by open cut on a 30 m wide subparallel vein system ~500 m in length. Individual veins up to 9 m wide have been exposed. Most Dunbar ore is used in the production of oil-drilling grades of barite, but some is used to feed a magnetic separation plant at Quorn which produces a super-white AA industrial grade.

Production levels, largely determined by oil drilling activity, have recovered from the 1994 low of 4960 t, but it is anticipated that reduced activity in the Timor Sea will result in 1999 calendar year production being less than the 13 705 t produced in 1998.

Dolomite

South Australia, which produced 1 014 895 t in 1998–99, is Australia's main producer of industrial grade dolomite. The largest producers are BHP at Ardrossan and Iron Prince, and ACI at Tantanoola in the State's South-East.

The largest dolomite mining operation in Australia is at Ardrossan on northern Yorke Peninsula, where BHP operates a quarry, crushing plant and ship-loading facility. Production was 858 802 t in 1998. Lump ore is used mainly as a flux in basic oxygen steelmaking at Whyalla, Port Kembla and Newcastle, and as a refractory material at Whyalla. One quarter of production is exported to Japan. The quarry is located in dolomitic Kulpara Formation of the Early Cambrian Hawker Group.

At the Iron Prince Mine, Katunga Dolomite has been exposed beneath the Lower Middleback Jaspilite; the principal impurity is iron which may comprise up to 30% of the rock. In 1998, BHP mined 159 988 t for flux for pelleted iron ore at Whyalla.

ACI operates a quarry in an irregularly dolomitised zone within bryozoal limestone of the Oligo-Miocene Gambier Limestone near Tantanoola. Quarried rock is screened, crushed and blended to give a -3 mm product with an average grade of 42% $MgCO_3$. Glass-grade product is trucked to Pilkington (Aust.) Ltd's plants in Sydney and Melbourne for use as flux in the manufacture of plate glass. Agricultural dolomite is produced as byproduct. Total 1998 production was 64 171 t.

A steady demand is anticipated for glass-grade dolomite, but the greatest influence on the overall production will be the level of iron and steel production.

Graphite

No production of graphite was recorded from South Australia during 1998–99. Coarse flake graphite was produced during 1990–93 after re-opening of the Uley Mine, 18 km west-southwest of Port Lincoln. Uley was placed on care and maintenance in 1993 following a sharp decline in the world price for graphite during 1992. Recovery of prices over the past two years has encouraged mine owner, Eagle Bay Resources NL, to seek a joint venture partner to recommence mining and processing operations. Interest has been expressed from German and Chinese producers and, in October 1999, Eagle Bay announced an agreement with Harbin Liumao Carbon Technical Development of China to undertake plant refurbishment and production trials. Indicated resources at Uley are 2.9 Mt grading 13% graphitic carbon, including 1.5 Mt at 15% graphite. Uley is part of a much larger resource contained within the Mikkira Graphite Province in which ~350 Mt at 6–7% graphite have been inferred from geophysical surveys and drilling of five prospects.

Annual world production of graphite is ~0.7 Mt, of which more than half comes from China. Fluctuation in output from China has the potential to significantly influence world prices. Further exploration and development of the Mikkira resource is largely dependent on securing export markets. Expanded demand for natural flake graphite would positively impact on developments at Uley. For refractories, this is largely dependent on growth in the steel industry or reduction in the costs associated with manufacture and installation of carbon-magnesia refractories.

Gypsum

Worldwide production exceeds 100 Mt/year. South Australia's output of 1.6 Mt/year accounts for about half of Australia's production, and supplies most of Australia's domestic plaster product requirements, whilst the growing Western Australian industry is largely directed towards South East Asian export markets.

Agricultural gypsum is being increasingly used to treat sodic soils, symptoms of which are waterlogging, increased runoff, poor water storage, surface crusting, and problems with cultivation and erosion. Production of agricultural gypsum has trebled during the last six years to 235 000 t in 1998.

Amended Regulations to the *Agricultural Chemical Act 1955* became effective on 30 September 1999, so that South Australian gypsum fertiliser products supplied either in bulk or in bags must now be labelled according to minimum gypsum, calcium and sulphur contents, size

grading, and sodium content. Fertiliser gypsum will have a 15% moisture content upper limit. Four grades of fertiliser gypsum (Premium, Grades 1, 2 and 3) have now been specified.

Gypsum has been deposited in two distinct evaporitic environments in arid or semi-arid areas of the State:

- coastal salinas situated in interdunal corridors of the Quaternary beach dune system
- continental playas underlain by relatively impermeable sandy clay in enclosed inland depressions.

Coastal salinas contain the largest reserves, but continental playas and their associated lunette deposits provide most of the State's agricultural gypsum.

Lake MacDonnell, with a resource of ~500 Mt, is Australia's largest gypsum mine and produced over 1.2 Mt in 1998. The deposit has been operated by Gypsum Resources of Australia Pty Ltd since 1984, when CSR Ltd and Boral Ltd combined their separate operations. The deposit comprises ~1 m of gypsarenite at 93% $CaSO_4.2H_2O$ overlying ~5 m of selenite at 94–96% $CaSO_4.2H_2O$. Gypsum as mined has a salt content which is too high for plaster manufacture, so it is stockpiled on site for several years to allow leaching by rainwater. It is then railed 64 km to a 160 000 t stockpile at Thevenard for loading on ships by conveyor.

Waratah Gypsum Pty Ltd produced 32 771 t of plaster-grade gypsum in 1998 from a coastal deposit at Spider Lake on southern Yorke Peninsula, which contains a resource of 2.4 Mt.

David Linke Contractor Pty Ltd produced 107 000 t in 1998 from an indicated 9 Mt contained within a substantial undefined inland playa resource near Blanchetown. Two grades at ~93 and 88% $CaSO_4.2H_2O$ are produced at the associated Nuriootpa screening plant and marketed for cement and plaster manufacture and for agricultural use, respectively.

Near Cooke Plains, variable tonnages (60 595 t in 1998) of gypsite and gypsarenite are produced for agricultural use in South Australia and the Eastern States. The indicated resource of 2 Mt is contained within a lunette on the side of a samphire swamp.

Significant tonnages of agricultural gypsum (2.5–25 000 t) are also mined from inland playa deposits near Meningie, Lochiel, south of Burra and at Lake Malata, west of Cummins on Eyre Peninsula.

Demand for plaster and cement-grade gypsum is expected to remain steady, but continued growth in the demand for agricultural gypsum is predicted. In anticipation of this, there has been an increase in exploration for new agricultural gypsum deposits, with six exploration licences (EL) current for the commodity in late 1999.

Loading gypsum at the Cooke Plains deposit for transport to New South Wales. *(Photo 46772)*

Heavy mineral sand

Heavy mineral sand exploration has seen a recent resurgence within the Murray Basin. Exploration expenditure increased to more than $1 million in 1998–99, and will continue to climb as resource drilling commences at several localities.

The Murray Basin is a major Tertiary depocentre for heavy minerals within the Parilla–Loxton Sands. The South Australian portion of the basin is currently almost covered by EL, with Steiner Holdings Pty Ltd in joint venture with Murray Basin Minerals NL holding significant acreage. Other companies with ground include Basin Minerals NL, Redfire Resources NL, Strand Minerals NL and Yardarino Mining NL.

Previous exploration by Aberfoyle Resources Ltd intersected significant heavy mineral accumulations in the Mindarie–Mercunda area. Recent exploration by Murray Basin Minerals NL has greatly improved the resources base for this area to an inferred resource of 16.6 Mt at 3.1% heavy minerals.

In the Eucla Basin, previous exploration by National Mineral Sands, Swan Reach NL and Peko Exploration Ltd outlined the Immarna prospect, which comprises two heavy mineral strandlines with mineralisation in two distinct horizons. Exploration by BHP Minerals outlined anomalous zones within the Ooldea Range, with the mineral assemblage comprising predominantly ilmenite and zircon, with minor rutile. Several companies hold extensive Eucla Basin tenements which offer potential for interested companies to explore for heavy minerals within a joint venture agreement.

PIRSA is acquiring 400 m line spacing, 50 m elevation aeromagnetic data over the Chowilla area in the northern part of the Murray Basin as part of TEISA to encourage exploration.

Kaolin

Mixed kaolin–sillimanite ore is mined by Normandy Industrial Minerals near Williamstown in the Mount Lofty Ranges**.** This unique high-alumina kaolin is sold for manufacture of refractories and ceramic insulators. Reserves are limited and annual ore production averages 5000 t. High-grade kaolin is selectively mined at Birdwood by Adelaide Brighton Cement Ltd for manufacture of specialty white cement. The company also supplies Normandy Industrial Minerals with kaolin which is milled at Normandy's Gillman plant for filler grades for paint and rubber. Small tonnages of silty kaolin from Woodside and Birdwood are supplied to the Beverley plant of Thermal Ceramics Australia Pty Ltd for refractory clay blends.

Approximately 50 000 t of semi-plastic kaolin are mined annually, principally from pits at Golden Grove and One Tree Hill. The clay is used mostly as a plastic component in brick-clay blends, but small tonnages from One Tree Hill are also used as a refractory bond clay.

Company exploration on northwestern Eyre Peninsula has outlined large resources of high-grade kaolin to the southwest of Poochera and in the Calca–Chilba area; these are currently held under tenement by Normandy Industrial Minerals. Limited access to high-quality water required for beneficiation of the kaolin may restrict the scale of any development.

Limestone

Portland cement is one of the largest industrial uses of limestone, with the world now consuming ~1.5 billion tonnes per year. South Australian industrial and agricultural limestone production in 1998–99 totalled 2 271 742 t.

The 300 m thick Penrice marble deposit in the Barossa Valley, mined by Penrice Soda Products, is on the near-vertical eastern limb of a southerly plunging, partly overturned anticline. The high-grade central part of the marble formation is 95–98% $CaCO_3$, and is flanked by lower grade zones. The 1998 production was 726 757 t, of which ~0.5 Mt of the highest grade material were railed to the Osborne plant for soda ash production. The balance was used in Adelaide Brighton Cement Ltd's Angaston cement works, and for lime manufacture, whiting and agricultural lime; 487 000 t of quarry products were also produced.

In 1925, the Adelaide Cement Co. Ltd commenced quarrying at Klein Point, 6.5 km south of Stansbury on eastern Yorke Peninsula to supply limestone to its Birkenhead plant. In 1971, this company amalgamated with the South Australian Portland Cement Co. to form Adelaide Brighton Cement Ltd, and the Klein Point deposit continued to be the new company's most important limestone source. Production in 1998 was 1 681 639 t of Port Willunga Formation fossiliferous limestone, with total carbonate content in the 85–92% range. The flat-lying 30 m thick limestone unit is mined by ripping and dozing, although some blasting of hard bands is required. The material is blended, hammer milled to -25 mm and shipped daily to Birkenhead in the purpose-built *Accolade II* bulk carrier.

ACI Resources Ltd has worked the Caroline limestone deposit, 25 km southeast of Mount Gambier, since 1979. The deposit is in the marine Oligo-Miocene Gambier Limestone. At Caroline, the limestone is exceptionally white, contains a significant silt-sized and finer carbonate fraction, and is low in deleterious non-carbonate materials such as sand, silt, clay, dolomite, flint, iron and manganese. The deposit is mined by elevating scrapers, and crushed and milled on site before dispatch by road to Australian Glass Manufacturers Co. in Melbourne; 37 817 t of glass-grade limestone were produced in 1998. Small quantities are also sold for agricultural uses.

At Parham, 65 km north of Adelaide, unconsolidated Holocene shellgrit beach deposits up to 3 m thick of St Kilda Formation are mined by scraper and screened, dried and crushed on site using a hammer mill and roll crusher. Product is trucked to Adelaide for glass manufacture at Australian Glass Manufacturer's Croydon plant; 36 433 t of glass-grade material were produced in 1998.

Magnesite

Small amounts of magnesite (<1500 t/year) are produced by Normandy Industrial Minerals from Proterozoic sedimentary magnesite at its Myrtle Springs Quarry, northwest of Leigh Creek, and by Fertico Pty Ltd from a residual deposit near Robertstown. Production is mainly for agricultural fertiliser and rockwool manufacture.

Worldwide interest in magnesium metal, encouraged by forecasts of increased demand by vehicle manufacturers, has seen several new projects proposed for metal production using magnesite. SAMAG Ltd (80% Pima Mining NL, 20% Resource Finance Corporation) was formed to progress a proposal for magnesium metal production based on South Australian Proterozoic sedimentary magnesite resources. During 1998–99, Pima Mining completed an extensive program of fully cored drillholes on prospects at Pug Hut, Termination Hill, Witchelina and Mount Hutton. Over 500 Mt of cryptocrystalline magnesite, as persistent thin magnesite conglomerate interbedded with dolomite, have been outlined. Development proposals have focused on the Mount Hutton prospect, 32 km by road northwest of Leigh Creek. A magnesium metal plant with an initial production capacity of ~50 000 t/year is proposed for Port Augusta.

Salt

The Australian annual production of ~8 Mt is dominated by Western Australia. The South Australian production of

534 796 t in 1998 has declined from a record high of 946 063 t in 1989. All of the State's salt is produced by solar evaporation of sea water or saline lake water. The most important use of salt in South Australia is as feedstock for the manufacture of soda ash by the Solvay process.

ICI began salt production at Dry Creek in 1940 and, after almost 50 years, sold the operation to Penrice Soda Products in 1989. The saltfields cover ~4000 ha near the coast north of Adelaide. Salt water is pumped from the sea at two pumping stations 20 and 30 km north along the coast from the final crystallising area. Harvested salt is redissolved and pumped as brine to Osborne for manufacture of soda ash; the 1998 production was 334 458 t.

Salt has been produced by solar evaporation of seawater at Price on eastern Yorke Peninsula since 1919. The operation, run by Cheetham Salt Ltd, comprises 1064 ha of evaporators and crystallisers, and a processing plant which produces bagged and packaged salt for industrial and household use. The 1998 production was 80 540 t. Bulk salt is sent to Cheetham's Geelong refinery (Vic.), or shipped to overseas markets in New Zealand and South East Asia from BHP's loading facilities at Ardrossan.

Salt has been produced at Lochiel since 1912. It is dissolved from saline mud by winter rains which then fill the 1500 ha inland Lake Bumbunga. The brine is pumped into three 25 ha crystallisers, from which Cheetham Salt Ltd produced 5996 t in 1998.

At Lake MacDonnell, salt is produced by solar evaporation of brine which seeps into a shallow lake through porous coastal dunes, or is pumped from the nearby gypsum operations. The 1998 production from 71 ha of crystallising pans was 67 666 t. Salt is either processed and bagged on site at Cheetham's plant, or railed in bulk 64 km to Thevenard for shipment to markets in South East Asia and New Zealand, or to the company's plant in Geelong.

BHP began salt production by solar evaporation of seawater at Whyalla in 1951. In 1979, Pacific Salt Pty Ltd built a processing plant on site and in 1988 took over production. In 1998, 46 136 t were produced from 240 ha of brine ponds and 20 ha of crystallisers.

Sillimanite–kyanite–andalusite

A small and irregular production of sillimanite and kyanite is reported from Normandy Industrial Mineral's Williamstown Mine. Sillimanite is present as remnant patches within kaolin ore bodies. These are separated during mining and screening. Selection of ore for sale requires hand sorting of separated lump ore. All product is sold for refractories or ceramic manufacture.

Talc

Australian talc production of ~120 000 t/year is dominated by Western Australia, with South Australian production averaging ~6000 t/year. Talc occurs in three main localities in South Australia, at Mount Fitton in the northern Flinders Ranges, in the Mount Lofty Ranges, and on Eyre Peninsula.

The Mount Fitton deposits, the largest and highest grade of all the South Australian deposits, are 130 km northeast of Leigh Creek, and have been mined continuously since 1945. Recorded production to 1998 totals 415 000 t. The leases are currently held by Normandy Industrial Minerals.

More than 40 individual deposits are known over an area of ~60 km^2. Talc is hosted by the Adelaidean Balcanoona Formation, a pale grey dolomite and dolomitic marble unit. The larger deposits are generally 10–15 m wide, more than 20 m thick and several hundred metres long.

In 1997, Normandy Industrial Minerals temporarily ceased mining and embarked on a ten-year program of re-screening and hand sorting ore from the large waste dumps which have accumulated over the 55-year mine life. Four grades are produced: QS, super white paint grade; J & J, pharmaceutical grade; medium-grade coloured talc; and low-grade impure talc. The 1998 production was 5500 t.

In the Mount Lofty Ranges, the Gumeracha deposits which have yielded ~180 000 t of mostly second and third grade talc since 1901 now have only very small intermittent production. On Eyre Peninsula, the only production for 20 years has been small quantities of grey and green talc mined for carving and ornamental purposes by Gemstone Corporation of Australia from a deposit near Cowell.

DIMENSION STONE

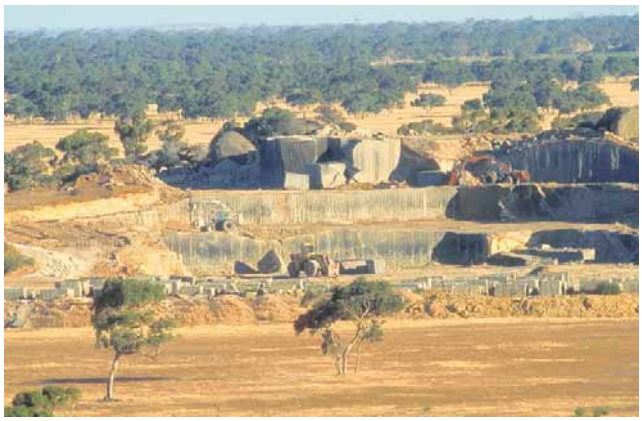
Granite

South Australia is Australia's largest producer of granite, from quarries on northern Eyre Peninsula and a zone extending from the eastern Mount Lofty Ranges to the South-East. The State's production has more than doubled during the 1990s, from 8329 t in 1991 to 18 989 t in 1998. The discovery of new varieties on Eyre Peninsula should see this trend continue in coming years.

The major granite dimension stone quarries on Eyre Peninsula are located in plutons of anorogenic Hiltaba Suite granite. These granites have distinctive red or pink colours due to abundant minute iron oxide inclusions within the plagioclase and K-feldspar. The best known is *Calca Red* granite which has been quarried since 1975 from near Streaky Bay. During the early 1990s, quarries were opened near Minnipa to produce varieties marketed as *Desert Lilac* and *Desert Ruby*, and a quarry in a coarser grained variety was opened near Wudinna to produce *Desert Rose*. *Calca Red* and *Desert Rose*, quarried by AustralAsian Granite Pty Ltd, accounted for almost all of Eyre Peninsula's 1998 production.

New varieties of red banded granite have been recognised in Palaeoproterozoic Minbrie Gneiss near Elbow Hill, 16 km southwest of Cowell. A quarry was opened in one of these in 1999, and the stone is being marketed as *Royal Mahogany*.

A variety of Delamerian (early Palaeozoic) granites crop out in the eastern Mount Lofty Ranges and in the South-East. Australia's largest 'granite' quarries are at Black Hill near Mannum, where three operators mine an igneous rock of gabbroic composition which, although not technically a granite, is marketed as *Austral Black Granite* or *Imperial Black Granite*, depending on the visibility of igneous layering in the final product. Combined production from the Black Hill quarries in 1998 was 10 620 t, 56% of the State's total granite production. An unusual green granite marketed as *Balmoral Green* has been produced from Padthaway in the South-East since 1991.



Balmoral Green quarry near Padthaway in the South-East. *(Photo 46757)*

The South Australian stand at the 1999 Carrara Stone Industry Fair, Italy. *(Photo 46831)*

Slate

The *Mintaro Slate* quarries, opened in 1856 in Mintaro Shale, are among the oldest continuous quarrying operations in Australia. Slate deposits in Tapley Hill Formation at Willunga (*Willunga Slate*) produced almost 30 million roofing shingles and 60 000 t of paving and walling stone from four quarries until their closure in the 1930s. Two have been re-opened in recent years and now supply a range of tiles and veneers, sawn building blocks and paving material. Stone for paving and walling applications is produced from quarries in Tapley Hill Formation at Spalding (*Broughton River Slate*), Oladdie (*Flinders Slate*), and Jones Hill in the far northern Flinders Ranges (*Parachillna Slate*).

In South Australia, the term 'bluestone' describes a sedimentary rock, generally siltstone, used for walling. The earliest quarries to produce this type of material (*Glen Osmond Bluestone*) were opened in Belair Subgroup shale during the early years of the colony. Since the 1960s, a resurgence of interest in the use of bluestone has resulted in the opening of quarries in one particular horizon within the Cambrian Tapanappa Formation; *Kanmantoo Bluestone* and *Wistow Bluestone* are now used extensively for walling and paving stone.

Sandstone

Sandstone has been used extensively as a building material for both domestic and public buildings in Adelaide. Adelaide's largest sandstone quarries, producing *Mount Lofty Sandstone*, were opened in Aldgate Sandstone near Stirling in the 1880s, and supplied large quantities of stone for domestic construction, particularly during the 1920s and 1930s. Sawn sandstone from Basket Range was popular in the 1950s but was gradually replaced by softer, more cheaply sawn stone from Kapunda, Brinkworth and Manoora during the early 1960s. Since the resurgence of interest in natural building materials, *Basket Range Sandstone* is again available.

Limestone

The best known of the Tertiary fossiliferous limestones is *Mount Gambier Stone*, which is produced from two northwesterly trending lines of quarries in the Marte area, 10 km west of Mount Gambier. Over 1 Mt of ashlars have been produced, with peak production being during the building boom of the 1950s when one-third of all houses built in metropolitan Adelaide by the SA Housing Trust were of Mount Gambier Stone. The stone is light, porous, even textured, and pale cream or white. Blocks of stone are cut from quarry floors by self-propelled circular saws with tungsten carbide tipped teeth. A variety of ashlar sizes, shapes and finishes are available.

CONSTRUCTION MATERIALS

In 1998–99, 13 Mt of construction materials were produced in South Australia, comprising 10.01 Mt of

crushed rock products, 2.40 Mt of natural sand products, and 0.58 Mt of clay products. The total ex-quarry value of these raw materials was conservatively estimated to be $100 million. The construction industry is cyclical, and production levels have varied over the last 15 years from a high of 16.48 Mt in 1988 to a low of 11.32 Mt in 1995. Construction materials are relatively low-cost products and, as transport costs are a major component of the final delivered price, sources are sought as near as possible to where materials are required. Consequently, a wide range of materials with diverse geological origins are used throughout the State.

Crushed rock aggregate

In the Mount Lofty and Flinders Ranges, sedimentary rocks, principally quartzite, dolomite and limestone of Neoproterozoic or Cambrian age, are the most important sources of aggregate, but shale and siltstone are widely used in the construction of unsealed roads. Port Lincoln derives most of its aggregate supplies from a quarry in Palaeoproterozoic Lincoln Complex granite. Mesoproterozoic acid volcanic rocks of the Gawler Range Volcanics suite are important sources of rail ballast north of Tarcoola, and road-sealing aggregate at Kingoonya and northern Eyre Peninsula. Quaternary basalt deposits supply the Lower South-East with aggregate from the Mount Schank and Mount McIntyre Quarries. One of the most widespread materials used extensively for road building throughout the State is calcrete of Quaternary age. This material is particularly important on western Eyre Peninsula and in the Riverland where alternatives are not available.

Supplies for the Adelaide metropolitan area come from two rock types of Adelaidean or Cambrian age:

- carbonate, including dolomite, dolomitic limestone and limestone
- quartzite, including sandstone and arkose.

Although a large range of products is made from both rock types, they are not fully interchangeable. For example, all of Adelaide's road sealing aggregate comes from carbonate rocks which bond more readily with bitumen than does quartzite. The quartzite quarries produce a relatively higher proportion of rubble, filling and quarry sand products and a lower proportion of screenings than carbonate quarries. Carbonate aggregates have been steadily increasing their market share in Adelaide to ~60%. It was only 6% in 1951.

Natural sand

Most regional centres have small pits to cater for local requirements. Dry creek beds are a common source of concrete sand in country areas including northern Spencer Gulf, with Holocene dune sand being widely used for packing, filling and garden applications. Holocene beach ridge deposits of St Kilda Formation supply Port Lincoln, and Pleistocene Bridgewater Formation beach deposits are mined near Comaum in the South-East. Thick deposits of predominantly shoreface facies from the Tertiary Parilla–Loxton Sands are mined from exposures in the Murray River cliffs near Berri and Paringa in the Riverland.

Most of metropolitan Adelaide's annual requirements come from fluviolacustrine deposits of Tertiary age located on the eastern flank of the St Vincent Basin at Maslin Beach, Golden Grove, and Gawler–Sandy Creek. During 1991, a MESA mapping and drilling program between Bute and Ardrossan on northern Yorke Peninsula defined a 60 km long section of a palaeochannel containing sand tentatively correlated with the North Maslin Sand. Pits in these deposits now supply >10% of the metropolitan market.

Clay

Metropolitan Adelaide's supply of industrial clay comes from two main sources; weathered shale deposits of Adelaidean Saddleworth Formation and Woolshed Flat Shale, and fluviolacustrine white plastic clay deposits in Tertiary sedimentary basins.

Golden Grove is the centre of the clay brick industry in South Australia and accounts for >80% of the State's clay brick manufacture. Production is from two modern brick plants operated by PGH and Nubrik, located close to major deposits of clay in the same Extractive Industry Zone as the sand pits. The bulk of clay used in brick blends is won from deposits of deeply weathered Adelaidean shale on the eastern flank of the Tertiary Golden Grove Embayment. The shale is blended with white plastic sedimentary clay which occurs as interbeds within the Tertiary sand sequence to increase green strength of brick clay blends, improve extrusion characteristics and reduce firing temperatures. During recent years, increasing use has been made of reclaimed fine tailings from sand washing operations.

Total clay consumption in the metropolitan brick industry in 1998 was 0.27 Mt, with an additional 0.17 Mt being used in cement manufacture.

PRECIOUS STONES

Diamond

Exploration during 1998 included work by Tiger International on its joint venture ground in the Hawker–Springfield Basin region. During 1998, sampling of the basin margin produced 56 diamonds, the largest of which was 0.34 ct. Several other indicator mineral anomalies have been discovered in the vicinity of the Springfield Basin and north at Calabrinda Creek. Trenching has not found any further diamonds but has confirmed indicator anomalies.

Trenching at the headwaters of Calabrinda Creek where abundant diamond indicator minerals were found in sediments thought to be sandy tuff. (Photo 46793)

Indicator minerals from the Springfield Basin. Most are pyrope garnet, but the green minerals are chromite (centre right) and chrome diopside (centre bottom). The largest grain is 3 mm across. (courtesy Poseidon Ltd) (Photo 46771)

There has been no commercial production of diamonds in South Australia.

Opal

Estimated production of opal in South Australia for 1998–99 was $38 million, slightly less than the previous year's estimate of $40.3 million.

Production at Lambina increased from less than $1 million to more than $5 million at the expense of Coober Pedy, $18.2 m down to $16.1 m, and Mintabie, $17.2 m down to $14 m. Intensive exploration and mining has taken place in 1999 since negotiations of a Native title access agreement.

Andamooka production did not change significantly.

Jade

Production of nephrite from the Cowell area during 1998–99 was 2577 kg valued at $12 884. Gemstone Corporation has made progress on marketing jade with joint venture partner Royal Selangor of Malaysia which is producing ornate pewter and combining it with nephrite from Cowell, provided as cut and polished tiles to Royal Selangor for assembling and marketing memorial urns.

COMPANY MINERAL EXPLORATION ACTIVITY

Expenditure by companies on mineral exploration licences for calendar year 1998 was $42.5 million, a 20% decrease on 1997 (Table 4). Company exploration drilling, a key indicator of exploration activity, has decreased by nearly 60% from a record 635 000 m in 1997 to 260 000 m in 1998 (Table 5).

The level of activity measured in terms of expenditure and drilling was significantly lower than recorded in 1997 and reflects the reduction in exploration spending due to low commodity prices, the inability of smaller explorers to raise equity funds on the sharemarket, and the increasingly complex path that explorers have to negotiate to satisfy Native title requirements.

As at 31 December 1998, 152 licensees held 413 licences, with 319 415 km^2 (32%) of the State under EL. These measures of activity are 10–20% lower than for the previous year, indicating reduced exploration in the State. The number of new licences granted decreased from 227 to 100.

Exploration activity was again dominated by the search for gold and copper–gold deposits in the Gawler Craton and Curnamona Province. Gold exploration expenditure fell by nearly 50% to $14.4 million from last year's record of $27.3 million, due to a significant decrease in activity in the Gawler Craton. Expenditure on copper–gold exploration showed a slight increase from $13.4 to $17.0 million as a result of increased activity in the Curnamona Province.

Exploration expenditure for lead–zinc remained at a relatively low level of $2.1 million, with activity mainly in the Olary–Broken Hill region of the Curnamona Province, and Kanmantoo Trough of the Adelaide Geosyncline.

Uranium exploration and deposit evaluation expenditure accounted for $3.9 million, with activity still focused on deposits suited to *in situ* leaching in the Frome Embayment of the Curnamona Province.

Diamond exploration expenditure was $1.7 million, with major programs in and around the Springfield Basin in the Adelaide Geosyncline, and in the Abminga region in the State's far north.

Iron ore expenditure fell from $2.7 to $0.6 million due to reduced exploration in the Middleback Range and only

limited reconnaissance exploration elsewhere on Eyre Peninsula.

Exploration was also conducted for industrial minerals, including heavy mineral sand, magnesite, gypsum, kaolin, dimension stone, coloured oxide and micaceous haematite. During late 1998, significant exploration and evaluation programs were commenced for heavy mineral sand in the Murray Basin and for magnesite in the northern Flinders Ranges. This will result in substantial levels of expenditure in 1999.

The Gawler Craton commanded nearly 50% of the exploration expenditure in the State ($20.2 million) but experienced a substantial 45% decrease on 1997 due to a sharp decline in gold exploration.

In direct contrast, exploration expenditure in the Curnamona Province increased by 60% to $16.4 million because of intensified exploration for copper–gold, and a maintained level of uranium exploration in the overlying sediments of the Frome Embayment.

Increased expenditure in the Adelaide Geosyncline ($3.7 million) was attributed to increased exploration for diamonds, lead–zinc–silver and copper–gold.

Due to land access impediments arising from Native title and Anangu Pitjantjatara (AP) Lands issues, exploration expenditure in the Musgrave Block in the State's far northwest remained low, with ~$0.5 million spent on the search for nickel, platinum, copper–gold and lead–zinc.

In 1998, South Australia accounted for 4.5% of the total annual Australian mineral exploration expenditure, exceeding only Victoria with 4.2% and Tasmania with 1.3% (ABS Catalogue 8412).

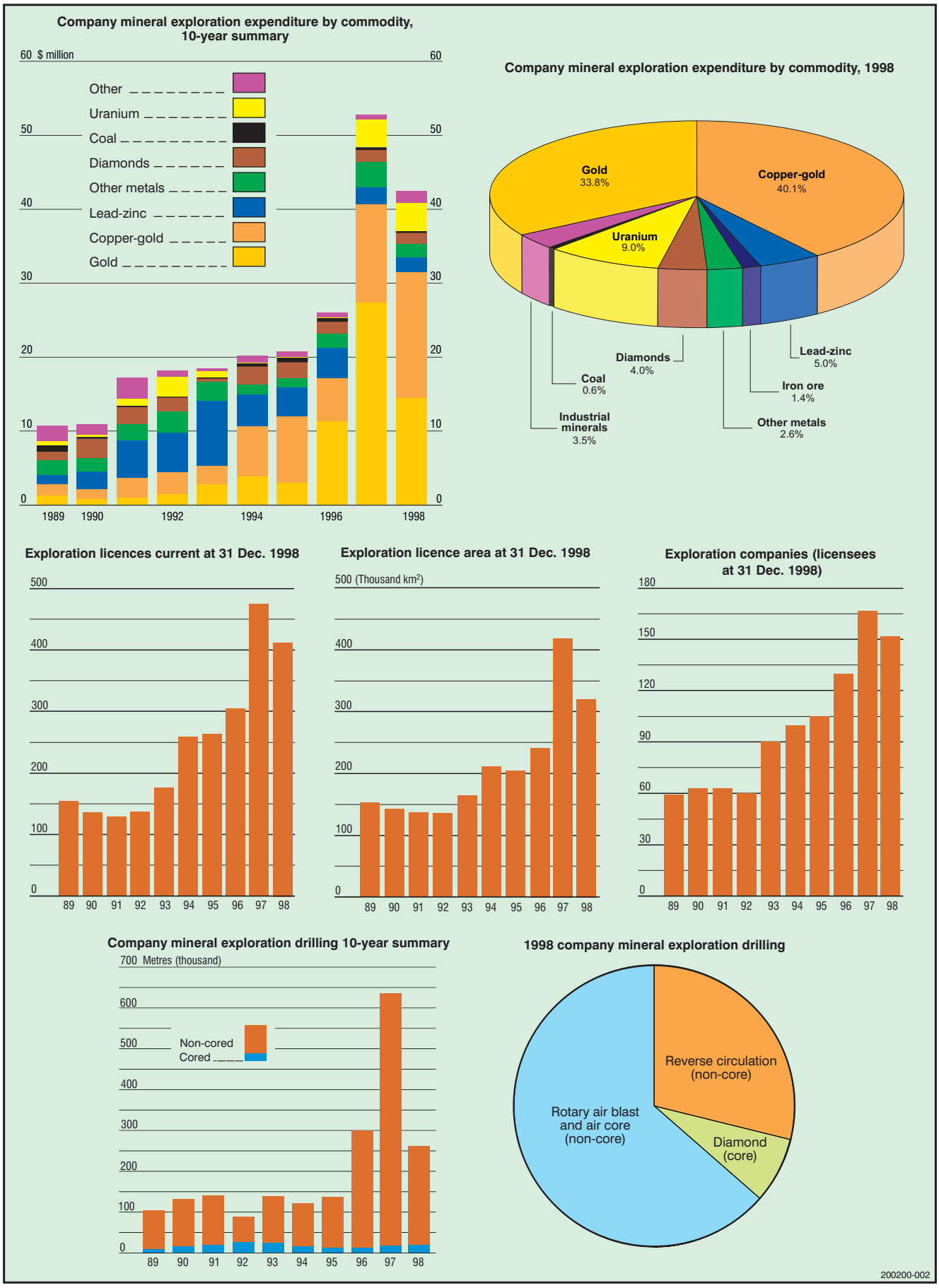
Table 4 *Company mineral exploration expenditure in South Australia ($'000), 10-year summary.*

Year	Total	Metals				Diamond	Coal	Uranium	Other
		Gold	Copper–gold	Lead–zinc	Other metals				
1989	10 782	1 340	1 415	1 257	2 092	1 133	921	538	2 086
1990	10 949	755	1 340	2 355	1 875	2 657	252	350	1 365
1991	17 194	988	2 702	5 031	2 250	2 257	203	959	2 804
1992	18 153	1 408	2 934	5 363	2 977	1 884	129	2 646	812
1993	18 488	2 639	2 681	8 717	2 558	504	193	890	306
1994	20 240	3 894	6 797	4 312	1 261	2 550	447	20	959
1995	20 789	2 165	9 835	3 948	1 178	2 186	646	68	763
1996	26 011	11 300	5 934	4 018	1 870	1 665	520	93	611
1997	52 750	27 267	13 412	2 269	3 347	1 679	139	4 081	556
1998	42 461	14 375	17 028	2 104	1 685	1 684	241	3 854	1 490

Note:
1. The above figures record expenditure (dollars of the day) reported to PIRSA for the calendar year. The figures are derived from reports submitted to PIRSA as a regulatory requirement for EL.
2. 'Metals' includes 'major metals' (Cu, Pb, Zn, Sn, Al), 'precious metals' (Au, Ag, PGE) and 'steel industry metals' (Fe, Cr, Co, Mn, Mo, Ni, W, V, Nb).
3. 'Other' includes 'industrial minerals', gemstones other than diamond, heavy mineral sand and 'specialty metals' (Mg, Ti, Be, REE, Zr, Hf, Hg, Se, Te, Ga, Ge, Ta, Rh, Cd, Sb, Li, Bi, In).

Table 5 *Geological province expenditure, exploration drilling and other measures of activity, 5-year summary.*

	1998	1997	1996	1995	1994
Geological province expenditure ($'000)					
Gawler Craton	**20 211 873**	37 276	16 727	9 955	9 877
Curnamona Province (includes Frome Embayment)	**16 435 388**	10 663	4 979	5 189	2 759
Adelaide Geosyncline (includes Stuart Shelf)	**3 736 203**	2 992	2 718	4 278	5 514
Other	**2 077 890**	1 819	1 587	1 367	2 090
Exploration drilling (m)					
Cored	**19 623**	18 115	12 120	13 067	14 213
Non-cored	**240 497**	616 435	288 383	124 512	107 463
Total	**260 120**	634 550	300 503	137 579	121 676
Other measures (as at 31 December '98)					
Number of EL	**413**	475	314	265	260
Area of EL (km^2)	**319 415**	416 650	240 000	203 880	210 338
Number of licensees	**152**	167	130	105	100



South Australian company mineral exploration statistics.

South Australian quarterly mineral exploration licence statistics.

MINING LEGISLATION HIGHLIGHTS

Statutes Amendments (Mining Administration) Bill 1998

The Bill, which came into operation on 1 April 1999, established Mining Native Title Registers in both the *Mining Act 1971* and *Opal Mining Act 1995*. It also introduced new fees for services which were previously provided free of charge to industry, including the advertising of EL applications, EL renewals, special approval applications, Safety Net Deeds and the lodgement of mining Native title agreements for registration.

Mining (Private Mines) Amendment Bill 1998

This Bill establishes a new legislative regime in the Mining Act for the proper management and control of mining operations on private mines by introducing mine operations plans. It also introduces wider environmental controls than those afforded by the *Environment Protection Act 1993* but will not limit or derogate the powers of that Act.

To provide the community with a level of assurance that operations on private mines will meet appropriate community expectations, the Bill will provide for community participation in development of objectives and criteria of new mine operations plans.

The Bill was passed by the Lower House of Parliament without amendment on 28 July 1999, and by the Legislative Council, also without amendment, on 16 November 1999.

Royalty provisions

Amendments to the Mining Act which are currently being progressed include changing the 'assessed value' of a commodity on which royalty is determined from the delivered value to the ex-mine value. This will disallow the inclusion of freight and handling costs downstream from the mine which unfairly inflate the assessed value for royalty purposes. Other amendments include penalties for late or non-payment of royalties (as a percent of royalty due) and to allow assessment of royalties to be determined other than according to weight or volume of minerals recovered, for example on an energy value in the case of coal (similar to Victoria). All proposed amendments will be subject to consultation with relevant stakeholders.

National Competition Policy Legislation Review

This review is being undertaken in compliance with an obligation on the South Australian Government under clause 5 of the Competition Principles Agreement. This agreement is one of three signed by the Commonwealth, State and Territory Governments in April 1995, all of which give effect to the National Competition Policy.

The obligation contained in clause 5 of the Competition Principles Agreement concerns the review and, where appropriate, reform of existing legislation which restricts competition unless:

- the benefit of the restriction to the community as a whole outweigh the costs; and
- the objectives of the legislation can only be achieved by restricting competition.

To satisfy the requirements of clause 5, the following documents are being reviewed by a Review Panel:

Mining Act 1971

Mining Regulations 1998

Opal Mining Act 1995

Opal Mining Regulations 1997

Mines and Works Inspection Act 1920

Mines and Works Inspection Regulations 1998.

Consultation will be undertaken with relevant stakeholders, with the review expected to be finalised in March–April 2000.

For further information on any of the above, contact Bob Wildy, Manager, Minerals Policy and Registration (ph. 08 8463 3092), or Laura Johnston, Mining Registrar (ph. 08 8463 3099).

EXTRACTIVE AREAS REHABILITATION FUND

Table 6 lists the EARF projects approved during 1998–99, and the major projects are discussed below. Table 7 summarises the EARF by financial year from 1992–93.

Private Mine 272

Located 1 km southeast of Murray Bridge within developing residential and recreational areas. The proposal addressed the final rehabilitation of 4.5 ha of land disturbed in the extraction of limestone for road construction, sand and concrete aggregate over a 30-year period.

Approval was granted on 28 October 1998 for expenditure of $248 470 to return the disturbed site to its pre-mining land use of grazing.

Extractive Mineral Lease 5544/5

A major black granite block production zone located 1 km north of Black Hill Post Office. The proposal addressed the commencement of progressive rehabilitation of 4.5 ha of land disturbed in the extraction of black granite.

The proposal was declined as the tenement did not have an up to date Approved Development Program which satisfactorily described the extraction and rehabilitation of the site. The proponent was requested to submit a new development program prior to resubmitting for funds to commence progressive rehabilitation of the disturbed areas of the tenement.

Table 6 *Extractive Areas Rehabilitation Fund — project approvals 1 July 1998 to 30 June 1999.*

Application date	Applicant	Tenement	Eligibility	Amount ($)	Approval date	Timeline	Comment
14/11/95	R.J. Wescombe	PM 272	a	248 471	28/10/98	n/a	Final rehabilitation
21/3/96	Calca Quarries	EML 5544/5	a	82 180	6/10/98	n/a	Project refused
22/3/96	G. Tarca	PM 287	a	92 800	1/9/98	n/a	Progressive rehabilitation
1/9/97	DC Mallala	EML 5890	a	18 756	27/8/98	n/a	Progressive rehabilitation
25/10/97	CSR Readymix	PM 206	a	15 942	23/11/98	n/a	Progressive rehabilitation
9/3/98	J. Kruse	PM 301	b	29 888	14/4/99	n/a	Screening
19/4/98	R. Ottway	EML 4566	a	3 000	24/7/98	19/6/98	Progressive rehabilitation
22/4/98	Boral Resources SA Ltd	EML 5547	a	20 640	29/7/98	22/6/98	Design for final rehabilitation
1/5/98	V.P. Cross	EML 5997	a	31 513	27/7/98	1/7/98	Progressive rehabilitation
8/5/98	Southern Quarries	PM 163	a	3 800	29/7/98	8/7/98	Design for final rehabilitation
8/5/98	Rocla Quarry Products	PM 76	b	8 000	22/7/98	8/7/98	Design for environmental improvement
8/5/98	Rocla Quarry Products	PM 20	b	8 000	22/7/98	8/7/98	Design for screening
25/5/98	GGEZ	Various	c	7 110	24/7/98	25/6/98	To finalise project
4/6/98	F. Copelands	EML 5771	a	3 410	29/7/98	4/7/98	Design for progressive rehabilitation
12/6/98	CSR Readymix	PM 27	a	8 000	28/7/98	12/7/98	Videotaping of rehabilitation
16/6/98	Orlando Wyndham Group	EML 5845	a	16 776	29/7/98	16/8/98	Final rehabilitation
7/8/98	D. Pitt	EML 3394	a	24 878	5/11/98	7/11/98	Design for progressive rehabilitation
7/8/98	Rocla Quarry Products	EML 5320	a	6 200	4/11/98	7/11/98	Design for final rehabilitation
31/8/98	B. Farmer	EML 5726	a	12 519	22/4/99	31/9/99	Final rehabilitation
14/9/98	SE Auto Club	PM 134	a	8 780	21/5/99	14/12/98	Final rehabilitation reimbursement
29/9/98	D. McCrabb	EML 3218	a	11 959	11/11/98	29/11/98	Progressive rehabilitation
1/10/98	D.M. Davies	PM 57	a	9 900	5/1/99	1/11/98	Design for final rehabilitation
1/10/98	M. Goss	EML 5633	a	23 670	7/1/99	1/11/98	Progressive rehabilitation
12/10/98	City of Onkaparinga	EML 2569	a	12 000	23/10/98	12/11/98	Remedial works
15/10/98	R.L. Maul	EML 5399	a	15 890	12/1/99	15/11/98	Progressive rehabilitation
24/10/98	L.M. Stone	EML 5519	a	14 197	15/1/99	24/11/98	Progressive rehabilitation
26/10/98	B. Bruhn	PM 153	a	68 968	5/3/99	26/12/98	Progressive rehabilitation
27/10/98	Stafford and Earl Building Stone Co.	PM 125	a	24 890	19/1/99	27/11/98	Progressive rehabilitation
27/11/98	J. Poulos	EML 5441	a	5 418	18/1/99	27/1/98	Progressive rehabilitation
12/12/98	CSR Readymix	PM 197	a	5 000	7/1/99	12/1/99	Design for progressive rehabilitation
21/12/98	Southern Quarries	PM(A) 243	a	8 800	29/1/99	21/3/99	Design for progressive rehabilitation
4/1/99	H.C.L. Harvey	EML 4402/3	a	8 465	28/1/99	4/2/99	Design for progressive rehabilitation
4/1/99	A.G. Philips	EML 5406	a	6 450	28/1/99	4/2/99	Design for final rehabilitation
17/1/99	G. Tarca	PM 287	a	12 269	12/4/99	17/3/99	Additional costs incurred
23/1/99	CSR Readymix	PM 197	a	23 856	22/4/99	23/3/99	Design for progressive rehabilitation
27/1/99	J.L. Berrett	PM 274	a	4 000	29/1/99	27/2/99	Design for progressive rehabilitation
27/1/99	J. Nemen	EML 4882	a	7 410	22/4/99	27/2/99	Design for progressive rehabilitation
11/2/99	G. Grieves	EML 5543	a	4 000	25/6/99	11/5/99	Final rehabilitation
11/2/99	K. Leenders	EML 5385	a	8 000	25/6/99	11/5/99	Final rehabilitation
11/2/99	J. Cotaris	EML 5504	a	1 100	25/6/99	11/5/99	Progressive rehabilitation
8/3/99	Fargo Transport	EML 4141	a	47 330	22/4/99	8/5/99	Progressive rehabilitation
21/3/99	V.R. Hage	EML 3245	a	3 006	11/5/99	21/5/99	Progressive rehabilitation
22/3/99	E.P. Quarry Consultants	Various	c	2 230	23/3/99	22/4/99	Research work on slimes
24/4/99	K&G Construction	PM 110	a	24 220	23/6/99	24/5/99	Progressive rehabilitation
Total	**44 applicants**			**$1 003 691**			

The *Mining Act 1971* provides for the operation of the EARF and defines the following:

a To rehabilitate land disturbed by mining operations for the recovery of extractive minerals, and

b Implement measures designed to prevent, or limit, damage to or impairment of any aspect of the environment by mining operations for the recovery of extractive minerals, and

c Promote research into methods of mining engineering and practice by which environmental damage or impairment resulting from mining operations for the recovery of extractive minerals may be reduced.

Private Mine 125

Located 5 km southwest of Mount Gambier at Compton, the major limestone building block production zone. The proposal addressed the continuation of progressive rehabilitation of another 1.5 ha of land disturbed in the extraction of limestone building blocks, limestone rubble and agricultural limestone.

Approval was granted on 19 January 1999 for expenditure of $24 980 to return the disturbed site to its original land use of grazing.

Extractive Mineral Lease 4141

Located 4 km northwest of Echunga within a rural environment. The proposal addressed the commencement of progressive rehabilitation of ~1.1 ha disturbed by mining for the extraction of clay.

Approval was granted on 22 April 1999 for expenditure of $47 330 to return the disturbed site to its original land use of grazing.

Extractive Mineral Lease 5997

Located 12 km southwest of Strathalbyn within a rural environment. The proposal addressed the commencement of progressive rehabilitation of ~6.25 ha disturbed by mining for the extraction of sand.

Approval was granted on 27 July 1998 for expenditure of $31 513 to return the disturbed site to its original land use of grazing.

Private Mine 153

Located 5 km southwest of Mount Gambier at Compton, the major limestone building block production zone. The proposal addressed the continuation of progressive rehabilitation of another 1.1 ha of land disturbed in the extraction of limestone building blocks, limestone rubble and agricultural limestone.

Approval was granted on 5 March 1999 for the expenditure of $68 968 to return the disturbed site to its original land use of grazing.

Private Mine 287

Located 2 km northeast of the Cockatoo Valley Post Office within a rural and tourist environment. The proposal addressed the final rehabilitation of 4 ha of land disturbed in the extraction of various grades of sand over a 40-year period.

Approval was granted on 7 September 1998 for expenditure of $92 800 to return the disturbed site to its original land use of grazing and cropping.

OPALFIELD ACTIVITY

The most significant event which occurred in the South Australian opal mining industry during the 1998–99 financial year was registration of the Lambina Native Title Agreement.

Rehabilitation of sand quarry, PM 27. *(Photo 46788)*

The Lambina Pastoral Lease, 230 km north of Coober Pedy and 60 km east of the Stuart Highway in the State's far north, had yielded sporadic amounts of precious opal since the 1930s. The South Australian Opal Miner's Association Incorporated (SAOMAI), in collaboration with the Mineral Resources Liaison Unit, determined that the only way to expand mining at Lambina was to negotiate a suitable agreement with the Antakirinja and Yankunytjatjara people, the traditional landowners who have a Native title claim over the area.

An agreement was signed on 1 June 1998 and subsequently registered by the Mining Registrar on 7 July 1998 in accordance with Part 7 of the *Opal Mining Act 1995*.

In February 1998, there were 15 claims operating at Lambina which had been registered before the High Court's *Wik* decision. By July that year, there were a further 200 claims pegged in the area which were all waiting to be registered. When the Lambina Native Title

Table 7 *Extractive Areas Rehabilitation Fund annual reports.*

Year	Receipts ($)	Expenditure ($)	Number of projects	Approval amounts	Balance
1998–99	887 000	885 000	43	922 574	3 700 000
1997–98	1 025 000	790 000	33	1 330 010	3 700 000
1996–97	810 000	750 000	47	510 154	4 100 000
1995–96	826 000	876 000	24	612 768	4 800 000
1994–95	950 000	623 000	38	1 108 000	4 900 000
1993–94	1 089 000	1 055 000	28	862 743	4 600 000
1992–93	923 000	185 000	21	626 467	4 600 000

Agreement came into operation, the PIRSA Mineral Registration Branch gave priority to those outstanding 200 precious stones claims and worked closely with SAOMAI to determine which claims could be registered. All claim applicants who wished to mine at Lambina were obliged, by virtue of the Native Title Agreement, to enter into a Deed of Consent with SAOMAI which effectively bound them to the terms of the Lambina Agreement.

Signing of the Lambina Native Title Mining Agreement by representatives of the Yankunytjatjara Council, Antakirinja Land Management Aboriginal Corporation and SAOMAI. *(Photo 46347)*

Lambina precious opal. *(Photo 39443)*

Table 8 indicates the extent of opal mining activities in South Australia as at 30 June 1999.

Table 8 *South Australian opal mining activities, 30 June 1999.*

Location	Area of diggings (km^2)	Number of claims
Andamooka	263	297
Coober Pedy	4954	687
Mintabie	213	271
Lambina	169	317
Total	**5599**	**1572**

SECTION 2: MINERAL RESOURCES GROUP, PIRSA

ACTION PLAN

OUR VISION

Mineral Resources is the key PIRSA Group within the Government of South Australia for facilitating mineral exploration and development, focusing on increasing the prospectivity of the State and ensuring responsible development of its mineral resources within an ecologically sustainable framework.

'Mineral Resources Group — delivering prosperity to South Australia by fostering a competitive, expanding and responsible minerals industry'

OUR BUSINESS

The Mineral Resources Group manages the State's mineral resources on behalf of the people of South Australia.

The Group's focus is on influencing and ensuring that management and development decisions take into account the needs of the community and future generations.

Our business is focused on achieving major objectives in four main areas.

- Promotion of mineral exploration and development.
- Provision of geoscientific information and advice.
- Regulation of the exploration, mining and rehabilitation activities of the mining industry.
- Facilitation of new projects, policy development and support for the mining industry.

OBJECTIVES

Promotion of mineral exploration and development in South Australia

- Investigate options for making land more accessible for exploration, including low-impact exploration and the review of all relevant legislation.

  Action
  - Take a more active role in the facilitation and mediation process within Native title legislative parameters.
  - Liaise with other States on legislation amendments to attain low-impact exploration.

- Accelerate the rate of exploration and increase the prospectivity of targeted areas by means of the TEISA program.

  Action
  - Complete the four-year program effectively and on time.
  - Provide industry with the resultant geoscientific data in quality formats.

- Provide industry with new opportunities for mineral exploration and development and establish South Australia nationally and internationally as a priority destination for mining investment.

Robinson Shaft head frame, Olympic Dam. *(Photo 44018)*

  Action
  - Provide industry with innovative geoscientific concepts and data packages.

- Continually review South Australia's geology and mineral resource potential using newly acquired geoscientific information, from both in-house research programs and lodged company exploration data.

  Action
  - Undertake geological surveys, drilling, and conduct in-house geological modelling to determine highly prospective target areas.

- Provide timely, certain and cost-effective access to land for exploration and mining purposes.

  Action
  - Through indigenous land-use agreements or amendments to Native title legislation, define and facilitate low-impact exploration and simplify negotiation procedures.

- Identify and promote mineral development opportunities within Aboriginal lands in the interests of the Aboriginal people and general community.

  Action
  - Adopt consultative and negotiating roles with Aboriginal people.
  - Accelerate exploration and Government geosurveys in AP Lands.

- Educate the public of South Australia on the importance of mining in their everyday lives, the job prospects the industry can generate, and how the future prosperity of the State can be enhanced.

  Action
  - Provide relevant information to schools and develop a community affinity with the industry through PIRSA's media and marketing teams.

Provision of geoscientific information and advice to the mining industry

- Ensure effective provision of high-quality, readily accessible geoscientific and mineral resource

Kimberlite field excursion, Springfield Basin, 1999. (Photo 47145)

information, databases and advice to all our stakeholders.

Action
- Provide high-quality geoscientific data and the best possible delivery systems to encourage exploration investment in South Australia.
- Maintain skilled and experienced professional staff to deliver high-level technical knowledge to industry.

- Ensure best practice in the collection, review and management of all relevant geoscientific and mineral production data acquired through statutory reporting requirements.

  Action
  - Establish a high-quality management system for the collection and easy access to all data required under mineral regulatory regimes.

- Ensure that skills, techniques and geoscientific knowledge developed within Group personnel are made available to industry.

  Action
  - Arrange seminars, workshops, field excursions and collaborative programs with industry.

- Improve mineral industry technical competence by participating in or supporting research programs that will provide critical data and innovative solutions.

  Action
  - Collaborate with industry, research organisations and other Government agencies to develop exploration concepts, models and technologies, and identify areas of new resource potential.

Regulation of exploration, mining and rehabilitation activities

- Achieve responsible mineral development by applying an appropriate policy and regulatory framework for resource management, based on ecologically sustainable principles.

  Action
  - Review policy relating to regulatory regimes to ensure that efficient and timely procedures are maintained.

- Ensure that the regulatory framework complies with National Competition Policy guidelines.

  Action
  - Review all mining legislation and amend where necessary for compliance.

- Ensure the provision of efficient and timely tenement administration services.

  Action
  - Develop a quality management system for the processing of tenement applications and mining approvals required under the relevant regulatory regimes.
  - Establish an electronic process for the lodgement of EL applications.

- Review mining legislation to ensure that it provides adequate safeguards for sustainable development with minimal ‘red-tape’ and disruption to industry.

  Action
  - Adopt a legislation review policy to maintain clarity and transparency of purpose and full accreditation by the Commonwealth.

- In cooperation with other corporate Groups, establish an Environmental Management System (EMS) with appropriate guidelines for industry to follow in minimising environmental impacts and ensure good rehabilitation practice.

  Action
  - Implement the Minerals EMS as authorised by the Environment Steering Committee and monitor results.

Facilitation of new projects, policy development and support for the mining industry

- Establish the Minerals Group as the 'window' into Government for the fast tracking of all application approvals associated with exploration and mining development in South Australia.

  Action
  - Facilitate consultation with other Government agencies and, where appropriate, negotiate with other agencies on behalf of industry.
  - Develop memoranda of understanding and agreements, where appropriate, with other State and Commonwealth agencies.

- Implement strategies and establish processes that reduce delays and remove impediments in establishing new mineral developments in South Australia.

  Action
  - Develop the South Australia Mining Plan to identify impediments to mineral development, and address these issues in partnership with industry.

- Increase the State's competitive edge for attracting mineral investment funds nationally by the provision of authoritative policy advice to Government on all exploration and mining development issues.

  Action
  - Provide quality and timely advice to Government on the minerals industry.
  - Actively participate in mineral industry seminars, conferences and other forums and contribute to State and/or Commonwealth discussion groups.

- Establish effective management systems and adopt best business practice to meet stakeholder and customer needs in the creation of mineral wealth for the benefit of all South Australians.

  Action
  - As an essential part of policy development, maintain an up to date review of the systems and/or practices adopted both nationally and internationally.

In situ *leach trial plant, Honeymoon uranium project.* *(Photo 45927)*

ACHIEVEMENTS AND FUTURE PROGRAMS

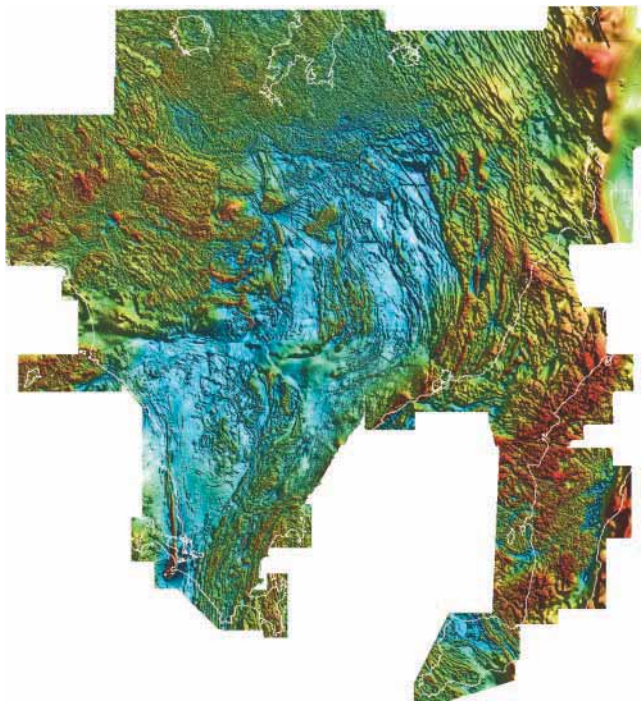
TEISA

The South Australian Government has signalled its continuing confidence in the ability of the mining sector to play a key role in the State's economic growth by committing $23.2 million, to be spent over the years 1998–02, on the Targeted Exploration Initiative (TEISA), a phased, regional exploration strategy for minerals, petroleum and groundwater.

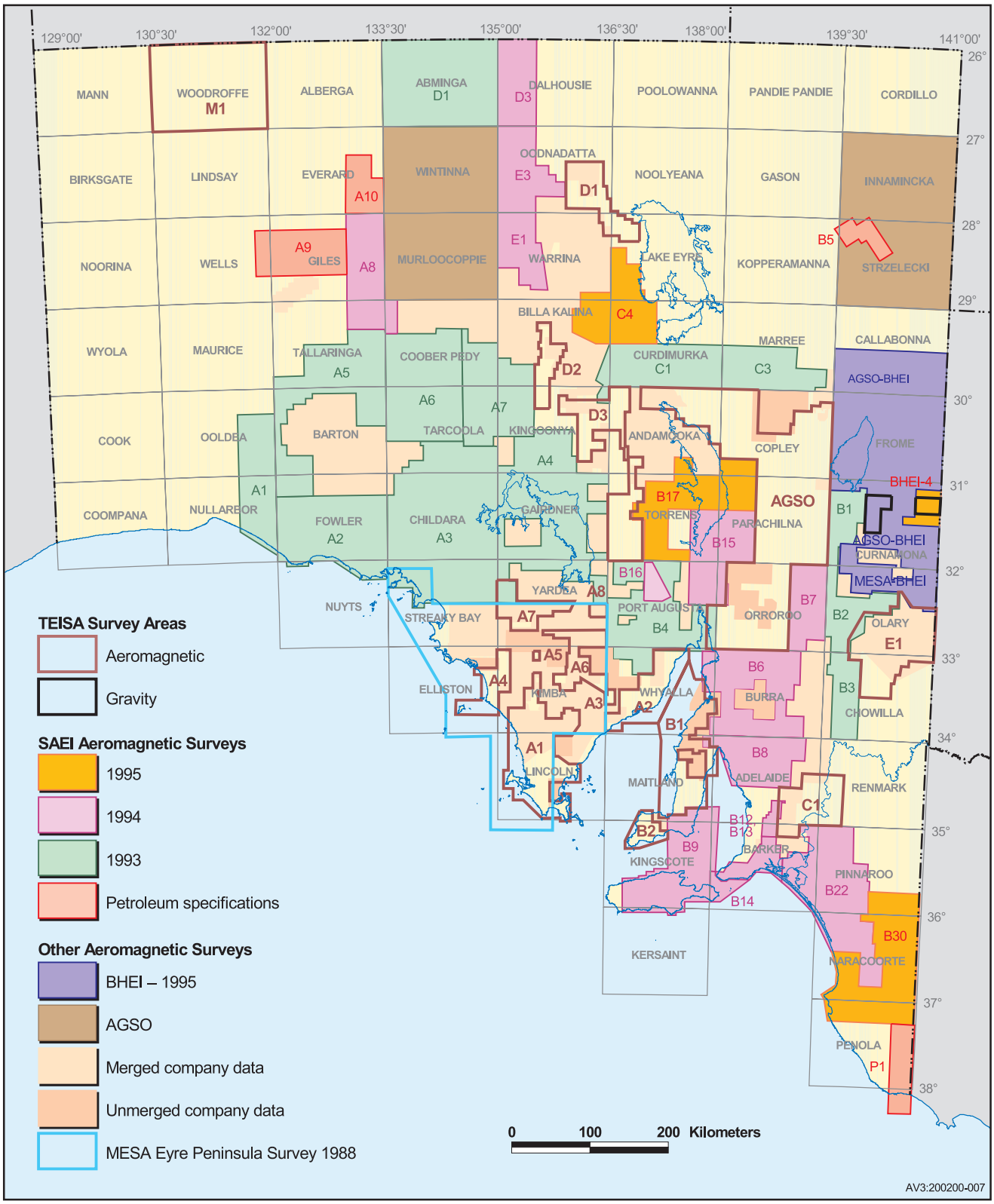
This strategy is providing comprehensive, accurate and relevant geoscientific data that will encourage private companies to focus their exploration efforts on prospective areas in South Australia in preference to the other States and offshore. The initiative comprises $10 million over four years to fund large-scale geoscience data acquisition along with $3.3 million/year to support ongoing research and Geological Survey programs within PIRSA that are the basis of the TEISA Program.

The targeted areas are the *Musgrave Block* (a geological province in the AP Lands), *Southern Gawler Craton* (including Eyre and Yorke Peninsulas), eastern *Adelaide Geosyncline*, *Curnamona Province* and areas of South Australia's key *Sedimentary Basins* (including the Murray and Cooper Basins).

Over 179 000 line kilometres of airborne geophysical data have been flown since the start of TEISA in July 1998.



1999 southern Gawler Craton TMI merge.



TEISA, SAEI and detailed aeromagnetic surveys in South Australia.

Southern Gawler Craton — airborne geophysical surveys

The Southern Gawler Craton surveys (TEISA Areas A1–8 on Eyre Peninsula and B1–3 on Yorke Peninsula) were flown by Kevron Geophysics Pty Ltd. Up to two aircraft were involved, based at Port Lincoln, Wudinna and Whyalla. Over 108 700 line kilometres were flown at 400 m line spacing. Eight mineral exploration companies participated in the surveys acquiring detailed infill and extension flight lines, generally at 200 m line spacing. The release of digital data and magnetic and radiometric images has generated considerable interest and a significant increase in applications for new EL is anticipated.

Mannum (Kanmantoo) — airborne geophysical survey

The Mannum airborne survey (TEISA Area C) over the Mannum to Swan Hill region was acquired by Australian Geophysical Surveys (AGS) during April 1999. The survey of 15 588 line kilometres took two and a half weeks to complete, using a Cessna Caravan aircraft. The survey specifications were 400 m line spacing (east–west) and 80 m survey height; 200 m infill was acquired for two tenement holders, covering almost half of the survey area.

The interpretation of newly acquired TEISA data has led to new insights into the geology of Cambrian basement beneath the western margin of the Murray Basin. This area has potential to host base metals and gold mineralisation, as well as the possibility of platinum and palladium (rare precious metals) deposits.

Stuart Shelf and Oodnadatta — airborne geophysical surveys

The Stuart Shelf (D2, 3) and Oodnadatta (D1) surveys were flown by World Geoscience Corporation. Up to two aircraft, based at Woomera, flew 53 700 line kilometres. This remote and significantly under-explored region of South Australia offers significant potential for Olympic Dam-style deposits.

Flinders Ranges — airborne geophysical survey

Tesla Airborne Geoscience completed the Flinders Ranges airborne survey in early March, acquiring a total of 132 938 line kilometres of data over the northern Flinders Ranges on behalf of the Australian Geological Survey Organisation (AGSO) as part of the National Geoscience Mapping Accord and TEISA.

Curnamona — gravity surveys

Gravity surveys have been completed over two areas north of Olary in the Curnamona Province. Field operations by Daishsat Pty Ltd acquired 1036 gravity stations on a 1 x 1 km grid. This has provided further information on the geological setting at the Portia and associated prospects (Pasminco – Werrie Gold Joint Venture).

1999–00 program

Year 2 of TEISA will see the emphasis move from airborne surveys to ground-based geological mapping, gravity sampling and reconnaissance drilling to 'see' through the cover materials and identify favourable host rocks and structures for mineralisation.

Chowilla — airborne geophysical survey

The Chowilla airborne geophysical survey (Area E) commenced in November 1999, to be flown by Tesla Airborne Geoscience. The flight specifications of 50 m above ground with 200 m line spacing have been designed to assist the search for mineral sand as well as permit regional assessment of basement to the Murray Basin. The survey includes over 53 000 line kilometres of magnetic, spectrometric and topographic data.

Musgrave Program — airborne geophysical survey (AP Lands)

Flying of the WOODROFFE 1:250 000 map area in the northwest of the State, which has seen limited mineral exploration access in recent decades, will commence in late 1999. This large survey, involving the flying of 96 000 line kilometres at 80 m above the ground, has been negotiated with AP, the traditional owners, who are keen to partner the Government in developing ways to increase job opportunities, develop infrastructure and generate prosperity in their lands.

Other TEISA projects planned later for the Musgrave Program include regional bedrock drilling, acquisition of remotely sensed imagery (satellite data, aerial photography and aerial spectrometry) and geological mapping. All projects will involve extensive consultation.

The Deputy Premier and Minister for Primary Industries, Natural Resources and Regional Development has stated 'A significant proportion of the TEISA funding will be directed towards geoscientific surveys on the AP Lands in the far northwest of the State, in cooperation with the Aboriginal landowners. Exploration and subsequent mineral discoveries and developments in this part of the State, which is arguably the last major unexplored Australian mineral province, will increase job opportunities and prosperity for the people living in these areas.' (Press release, 28 May 1998)

Gawler Craton — drilling project

About 70 drillholes will be completed in the Childara region north of Ceduna and a further 50 holes will be drilled in a traverse over southern Eyre Peninsula. Work commenced in November 1999. These regions are prospective for a wide range of mineralisation styles, but the thick blanket of sandy and calcareous sediments has reduced effective exploration. Drilling will assist interpretation of airborne geophysical data.

Gawler Craton — groundwater assessment

This is a project to improve the knowledge of groundwater resources in fracture zones (lineaments) and Permian and Tertiary palaeochannels in the northwestern Gawler Craton. Fieldwork to acquire 20 km of Transient EM (TEM) data is complete, with three sites in fracture zones selected for test drilling.

Geological Survey

The Geological Survey Branch collects, manages and interprets geoscientific information (including geological, biostratigraphical, geophysical and remote sensing data) and provides geoscientific advice and data to Government, industry and the community to encourage and assist exploration, responsible development and sound land-use planning.

A new draft version of the State 1:2 000 000 scale geological map is now available digitally and as hardcopy. The State SA_Geology digital coverage, a compilation of the best regional geological mapping for each area, is 95% complete. A statewide collection and database of all petrological thin sections held by PIRSA is being assembled; 9000 sections have already been entered onto the database from an estimated 20 000 held.

Dolerite dykes of the Palaeoproterozoic Tournefort Dyke Swarm intruding Palaeoproterozoic Lincoln Complex gneissic granite, west of Cape Tournefort, southern Eyre Peninsula. (Photo 41263)

Curnamona Province (including Broken Hill Exploration Initiative)

The Curnamona Province Program incorporates the Broken Hill Exploration Initiative (BHEI) which aims to provide a new generation of geoscientific data for the Broken Hill – Olary region as a basis for more effective mineral exploration by industry, and to help secure the future of Port Pirie and Broken Hill. The BHEI is a joint program involving PIRSA Mineral Resources Group, NSW Department of Mineral Resources and the Commonwealth Government through AGSO.

Detailed geological mapping of the Willyama Supergroup and intrusives is underway in several areas:

- Preliminary mapping has been completed on the four 1:25 000 areas on the eastern half of Mingary 1:100 000; mapping is in progress in the western half.
- Geological mapping is close to completion on Winininnie 1:100 000.
- Outcrop mapping and solid geology interpretation of the Mulyungarie 1:100 000 map area has been completed.
- Solid geology interpretations have been completed for the Kalabity, Benagerie, Lake Charles, Coonarbine and Thurlooka 1:100 000 map areas, and these have been combined to form a 1:250 000 scale compilation of the highly prospective Benagerie Ridge.
- Preparation of the CALLABONNA 1:250 000 map for publication is nearly complete.

Collaborative research is in progress on geochronology and geochemistry of the Willyama Supergroup and intrusives (with AGSO and ANU-PRISE), copper–gold mineralisation and associated alteration (AGSO) and regional lithostratigraphy (University of New England). Widespread felsic volcanic horizons, often sulphide rich, have been identified.

A conference and associated field workshop on the Olary area was held at Broken Hill in October 1998 to share information on recent developments in the region. Strong industry participation was a feature of this conference.

Gawler Craton

Geological mapping and compilation of the LINCOLN and MAITLAND 1:250 000 map areas has been completed. Airborne geophysical data acquired as part of the TEISA Program will be used to interpret basement geology of the sediment-covered portions of these areas. Mapping of CHILDARA is in progress. Explanatory Notes were compiled for YARDEA.

Planning is underway for regional bedrock drilling programs on LINCOLN and CHILDARA. Geoscientific advice on the prospectivity of the Yumbarra Conservation Park was given to numerous interested parties.

Collaborative research involving mapping, geochemistry and geochronology is in progress on the Gawler Range Volcanics (with CODES, Tasmania), Hiltaba Suite granitoids (University of Adelaide), mineralisation in the Yarlbrinda Shear Zone (CODES) and tectonic history of the craton (ANU–PRISE).

Sedimentary Terranes

A State palaeochannels map has been completed and is available in digital or hardcopy form. Compilation of the OOLDEA and MARREE 1:250 000 map areas is near completion. Explanatory Notes for GILES have been

completed. Geological mapping is in progress on WINTINNA.

A poster on 'Late Cainozoic lacustrine shoreline sediments, western Murray Basin', highlighting the potential of these sediments for heavy mineral sand exploration, was presented at the Murray Basin Mineral Sand Conference in Mildura.

A study showing the use of Ostracods for recognising transgressive horizons within the predominantly non-marine Eumeralla Formation in the Otway Basin has been completed. Foraminiferal and palynological investigations for a sequence stratigraphy study of the Gambier Basin are 40% complete. Palynological analyses were undertaken to support a number of Departmental programs, including CHILDARA and LINCOLN drilling, MARREE geological mapping and the North West Gawler Craton palaeochannel study, as well as those to assist with mining company exploration.

The Mineral Resources Group laboratory, including biostratigraphy facilities, has been relocated to 101 Grenfell Street and upgraded; 15 000 records were added to the biostratigraphy database.

Collaborative research (with University of Adelaide) is in progress on the palaeochannels draining the northwestern Gawler Craton to better understand their geology, economic potential and effect on exploration techniques.

Adelaide Geosyncline

The PARACHILNA 1:250 000 geological map and accompanying Explanatory Notes were published. Geological mapping is in progress on the Clare and Jamestown 1:100 000 map areas on BURRA 1:250 000; BURRA is now 80% complete. Mapping on ADELAIDE and BARKER 1:250 000 map areas has concentrated on the Cambrian Kanmantoo Group on the Angaston and Milang 1:50 000 map areas. Mapping and geochronological studies of volcanics and intrusives associated with the Kanmantoo Group are showing a more diverse history than previously recognised. A study is also underway on structural and stratigraphic controls on mineralisation in the Kanmantoo Group.

Revisions have been made to the stratigraphic subdivision and nomenclature of the Adelaide Geosyncline, and aspects of the tectonic history of the Clare region have been reinterpreted. A major paper has been submitted to the international journal *Precambrian Research* on the Adelaide Geosyncline and its significance in Neoproterozoic continental reconstruction.

Regolith

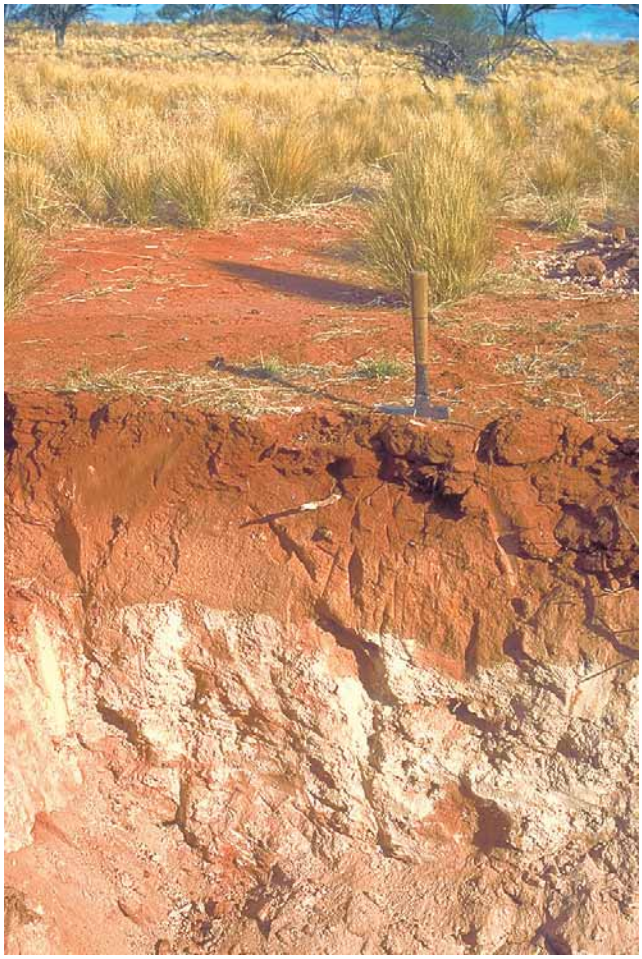
PIRSA, in cooperation with the CRC on Landscape Evolution and Mineral Exploration (CRC-LEME), is undertaking geological and geochemical investigations of regolith in the Gawler Craton to assist industry mineral exploration. This group is now located in offices at the Glenside Core Storage facility.

Final client reports have been prepared for Birthday and Boomerang gold prospects. Papers have been published on silcrete as a potential exploration sampling medium, exploration in the Mount Gunson area using regolith geochemistry, and relationship of gold exploration and aeolian dust in the Gawler Craton.

Collaborative research is in progress on the Challenger gold prospect, Moonta copper district, Mount Gunson copper deposit, Glen Osmond silver–lead deposits, and thermoluminescence dating of dunes in the Ooldea and Barton Ranges.

Lyn Broadbridge with part of the South Australian Geological Survey Palaeontological Collection. (Photo 46828)

Regolith profile at Cattle Grid Mine, showing Quaternary units overlying the cross-bedded Whyalla Sandstone. (Photo 45300)



Regolith profile at the Windabout prospect showing red-brown sandy clay overlying a pale calcareous and gypseous clayey horizon. Pit depth is 0.9 m. (Photo 45313)

Geoscientific information systems and services — geoscientific databases, remote sensing, mineral geophysics

Significant improvements were made to the SA_GEODATA (Oracle) database structure including implementation of graphical user interfaces for components such as the drillhole database. A major restructure of the mineral deposits database and integration with SA_GEODATA is near completion. Automated processes for production of components of geoscientific data sets were developed. A process to enable direct entry of field observations to a database on hand-held computers is under development.

A total of 1048 exploration drillholes from 127 reports were added to the drillhole database.

Agreement was researched with other State and Federal geoscience agencies for a common format for receipt of company exploration data in digital form.

Landsat 5 TM coverage is now available for the entire State. Several avenues for the use of new forms of remote sensing data to assist geological mapping and mineral exploration are being investigated. In particular, airborne hyperspectral (HyMap) data have assisted exploration for magnesite in the Willouran Ranges.

Other services and information provided during 1999 included:

- A total of 153 requests for mineral geophysical data were received and processed.
- A new State total magnetic intensity merge is 25% complete.
- Seventeen relinquished company data sets were verified and added to the airborne geophysical database.
- The MAPINFO database of airborne geophysical surveys has been updated.
- A paper was presented at the Australian Society of Exploration Geophysicists Conference on the use of 256 channel radiometrics in geological mapping.
- An upgrade of the State gravity database, including incorporation of company data, upgrade of information on gravity base stations and transfer of hardcopy records to digital, is underway.
- Extensive support was provided for the planning and implementation of TEISA geophysical data acquisition.

1999–00 program

State

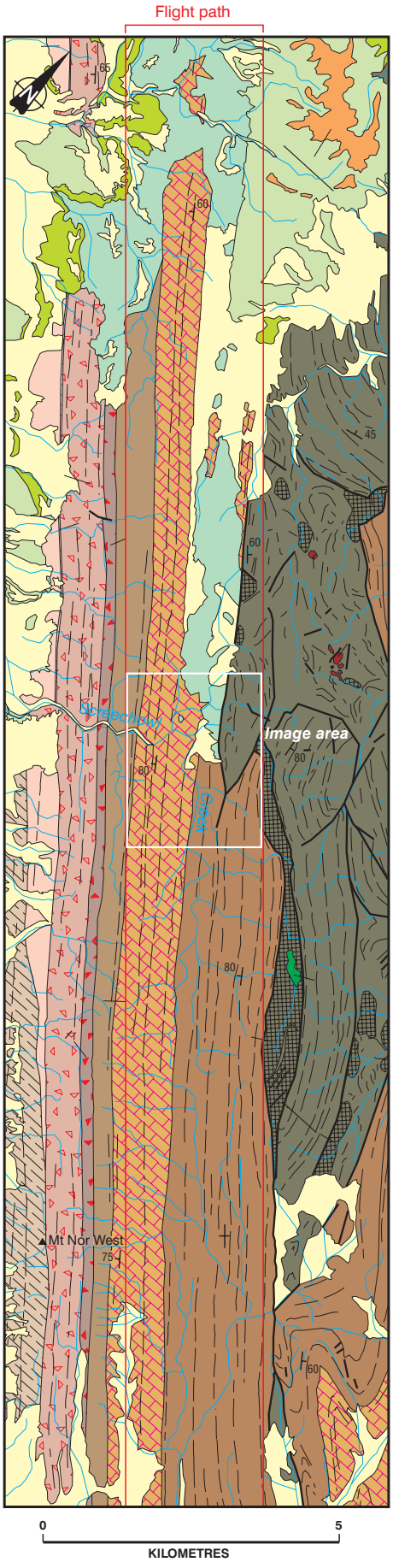
- Complete the new version of the State 1:2 000 000 geological map.
- Commence compilation of the new version of the State 1:2 000 000 tectonic and basins maps.

Curnamona Province

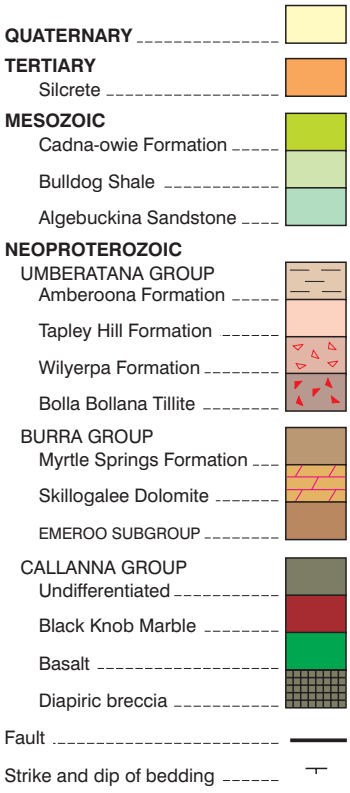
- Mingary 1:100 000 geological mapping — complete the eastern 1:25 000 maps and preliminary map for the whole area.
- Winnininnie 1:100 000 geological mapping — complete the three northeastern 1:25 000 maps.
- Curnamona Province 1:500 000 solid geology — complete the new version.
- BHEI 2000 Conference and associated field excursions, May 2000.

Gawler Craton

- CHILDARA 1:250 000 geological mapping — complete the six 1:100 000 maps.
- LINCOLN and MAITLAND 1:250 000 maps — complete.
- Collaborative research projects: final report on Hiltaba Suite geochemistry; interim report on the Gawler Range Volcanics.



Magnesite-rich packages appear pale blue (arrowed) on the HyMap image



Geology of the western Willouran Ranges showing part of the HyMap flight path and false colour HyMap image.

Sedimentary Terranes

- OOLDEA 1:250 000 map – complete.
- WINTINNA 1:250 000 map – complete the six 1:100 000 geological maps.
- CALLABONNA 1:250 000 map – publish the geological map (along with the Curnamona Province map).
- Complete the reports on lower Tallaringa and Garford Palaeochannels, and sequence stratigraphy of the Gambier Basin.

Adelaide Geosyncline

- Clare, Hallett, Bundaleer and Angaston 1:50 000 geological maps — complete.
- MARREE 1:250 000 geological map — complete (with Sedimentary Terranes).
- KINGSCOTE 1:250 000 geological map — publish.

Regolith

- Boomerang and Birthday gold prospects — complete the client reports.
- Publish regolith investigation results in appropriate publications and venues.

Geoscientific information systems and services

- Digital receipt of company exploration data — establish and implement standards for South Australia.
- Palmtop field observation system — implement.
- Landsat TM data — implement Web active search engine.
- Hyperspectral data — process and interpret HyMap data for Tarcoola and Brukunga.
- Hyperspectral projects in the Mount Fitton test area (HyMap, ASTER, OARS) — in collaboration with CSIRO.
- Establish digital State gravity base station database.
- Merge 256 channel radiometric grids for Gawler Craton.
- Re-grid State magnetics at a finer mesh size — complete 50% of the State.

Mineral Assessment

Company exploration

Assistance was provided to the exploration industry via information sheets, guidelines and verbal advice to facilitate mineral exploration. Cooperation between industry, Department for Environment, Heritage and Aboriginal Affairs (DEHAA) and PIRSA in regard to mineral exploration in parks and reserves has ensured acceptable exploration and rehabilitation practices. A total of 147 EL applications were assessed and 311 EL renewals processed. Over 400 mineral exploration technical data reports were processed. Almost 140 applications for exploration work approvals on EL were processed within target time. South Australia's percentage of Australian mineral exploration expenditure accounted for 4.5% in 1998, up from 3.9% in 1997 (ABS).

Environmental monitoring — Pinkawillinnie Conservation Park

Adelaide Resources NL and joint venture partner Cyprus Amax (Aust.) Corporation conducted an extensive exploration drilling program in the Pinkawillinnie Conservation Park. The park is jointly proclaimed under the National Parks and Wildlife Act, and allows exploration and mining to take place provided that the conservation values of the park are maintained. Government (PIRSA and DEHAA) and company staff were involved throughout the program to ensure that appropriate operational and rehabilitation methods were applied. Ongoing monitoring of the rehabilitation will provide valuable environmental management information which will be applied elsewhere in the State.

Drilling in Pinkawillinie Conservation Park. (Photo 47065)

Pinkawillinie drillsite; plastic liner minimises dispersion of dust and cuttings into the surrounding environment. (Photo 47067)

Mineral exploration rehabilitation implement

Following compliance monitoring activities (June 1998) and subsequent discussions with officers from DEHAA and industry representatives, an opportunity was identified where PIRSA could assist the mineral exploration industry by developing a ripping and/or scarification tool which could be towed behind a standard 4WD vehicle. It was envisaged that the tool could reduce the need and cost of using heavy equipment in many cases, and enable rehabilitation to be done in a more progressive manner. Since July 1998, Mineral Assessment Branch, through Botten Engineering Services, has successfully developed an implement in consultation with representatives of DEHAA and the minerals industry (see MESA Journal 13, p.34–35). Trials have been conducted by PIRSA and exploration companies with encouraging results.

Ongoing monitoring of site regeneration rates will be continued by PIRSA, and further trials and use by companies is encouraged. One unit is currently available from PIRSA for companies to trial (for up to one week), with another available from Adelaide-based Botten Engineering Services for hire at reasonable rates. For purchase or hire details contact Don Botten (ph. 08 8281 9449 or (ah) 08 8265 3547).

Ripper/scarifier set up and ready for use (in jacked-up position). (Photo 46538)

Yellabinna Regional Reserve rehabilitation project

In response to a MESA commissioned audit (1995) of mineral exploration impacts in the reserve area since proclamation (1990), funding was made available to the then MESA and DENR (now PIRSA and DEHAA) to undertaken restoration of environmental impacts (e.g. open and cased drillholes, open sumps, compacted tracks and campsites) at some current sites, and older sites which do not meet current rehabilitation standards. Due to a significant increase in EL applications in the region in 1996 (as a result of a SAEI data release), direct restoration work (such as rehabilitation of tracks) was postponed, with work concentrating on assessing and mapping areas of impact within the 2 522 700 ha reserve. By early 1999, areas requiring restoration had been identified and prioritised by PIRSA and DEHAA, and a significant rehabilitation program of the main areas was completed in June–July.

This program was undertaken by private contractors and involved the use of a 966D loader and ripping and scarification equipment. Work included the removal of rubbish, filling in of sumps and excavations, removal of drill casings and closure of open drillholes, ripping and scarification of compacted areas associated with old camp and drill sites, and closure of access track entrances by ripping, sign posting or disguising. Photopoints were set up at a number of locations to monitor regeneration. In general, the tracks closed off were already at various stages of regeneration and it was not considered necessary to rip great distances. Exploration companies can apply to re-open tracks for specific projects (through the DEF process) with the proviso that these be reinstated on completion of the project to a condition which will facilitate regeneration.

Some tracks earmarked for future closure are still in use by exploration companies and these will remain open. A second phase of work is planned to complete restoration of the remaining lower priority areas in the current financial year.

AP liaison

On-going liaison with AP continued with a view to increasing the level of mineral exploration and development on AP Lands which take in ~10% of South Australia. Several constructive meetings have taken place involving AP, SACOME and EL applicants. Agreement was reached with AP on accelerating EL processing and flying the WOODROFFE map area. TEISA funds have now been committed to provide administrative assistance to AP in processing EL applications and to undertake the WOODROFFE airborne geophysical survey.

MINDEP-SA — the mineral deposit database

The database has been reprogrammed from a character-based system to graphic user interface (GUI) system, i.e. a mouse-driven windows interface. The system has been added to PIRSA's corporate geoscientific information system (SA_GEODATA) and will provide a comprehensive summary of the State's mineral deposits.

Resampling of core and ore from Brukunga Mine

A total of 50 ore samples from waste rock dumps at the mine and ~700 cuttings from diamond-drillcore located to the north and south of the mine were sampled during May 1999 by the Mineral Assessment Branch.

Sampling was completed to upgrade existing background geochemical data collected during the 1970s from diamond-drillholes intersecting the Nairne Pyrite Member of the Talisker Calc-siltstone. It is anticipated that the sampling will help determine if a relationship exists between the base metal content of the ore and waste beds, respectively.

The sampling will also serve to demonstrate if treatment of waste rock dumps for removal of gold is viable. Preliminary analysis of geochemical values obtained suggests that this is unlikely.

Delineation of Mount Compass sand resources

A program of 64 reverse circulation (RC) drillholes totalling 2463 m was undertaken near the township of Mount Compass to assess sand resources in the area.

The dominant lithology intersected was subrounded to rounded, fine to medium fluvioglacial sand of Permian age, with reworked Tertiary sand intersected at the top of many holes.

Mount Compass is an important source of glass sand. The ACI Glenshera pit supplies Australia's largest container glass plant at West Croydon (suburban Adelaide) with over 100 000 t/year of sand. Sieve sizing analyses and preliminary beneficiation studies carried out on samples from the RC drilling program indicate that there is considerable potential to prove up additional deposits of glass sand. Five areas have been identified which warrant follow-up drilling and testing.

The area contains large resources of sand for garden, filling and packing purposes, but the sand is generally too fine for use in concrete. This lack of coarse concrete sand highlights the importance of the Extractive Industry Zone at Maslin Beach as the only major source of coarse construction sand south of Adelaide.

Sand exploration drillhole MC 54, with Mount Compass township in background. (Photo 46833)

Report on physical properties of Adelaide construction sand

A report was released detailing the physical properties including grain size, grain roundness, colour and fines content of a suite of 56 samples collected from all major currently producing sand pits in the outer metropolitan area. The primary purpose was to provide the State Heritage Branch with an authoritative database of the types of sand available for use in mortar, plaster and render. It will be used in providing advice to tradespeople and owners of heritage properties on the design of mortars for use in conservation or renovation of older buildings. The report is also available for use by the wider construction industry, and will become an important historical record of construction sand in use in 1999. The last comprehensive sampling program of this type which provides such an historical 'snapshot' of metropolitan construction sand was done by the Department of Mines in 1965.

Assessment of Eyre Peninsula granite resources

A report detailing the characteristics of 157 Hiltaba Suite granite outcrops on northern Eyre Peninsula was released as a CD database in 1998. It has been well received by the dimension stone industry, and further developments are being monitored by Mineral Assessment Branch.

Assessment of Gawler Range Volcanics for porphyry dimension stone

At the request of PIRSA's Industry Development Group, porphyritic rocks in the southern Gawler Ranges were assessed for the potential to support an industry similar to the Italian porphyry industry. The northern Italian deposits have strongly developed axial plane partings at spacings of 30–100 mm, and minimal cross-jointing. A range of splitting machines has been developed to efficiently exploit this material, but these would not be appropriate for the Gawler Range Volcanics which has strongly developed regional joint sets, cooling joints, and closely spaced incipient jointing. Most of the porphyritic Hiltaba Suite granite variants in the southern Gawler Ranges are also unsuitable, but one outcrop with potential for block production has been identified. No further work by PIRSA is warranted.

Evaluation of sandstone resources — Eyre Peninsula and Mid North

Olliver Geological Services was engaged as a consultant to assess the potential for development of sandstone deposits in the Mid North and Eyre Peninsula. Over 30 localities were documented, with recommendations made for further work on seven deposits.

Kimberlite field trip

A four-day kimberlite trip, organised jointly with Tiger International, was undertaken in February 1999 by 18 staff

from PIRSA, Tiger International, Rio Tinto Exploration and Minotaur Gold. The trip commenced with a visit to the PIRSA Core Library to examine kimberlite core and diamonds from Echunga, Argyle, South Africa and the New England district. The tour covered kimberlites at Truro, Terowie and Eurelia (micro-diamonds), and the diamond-bearing and indicator mineral areas of the Springfield Basin and to the west of Hawker. Most of these fall within the G2 corridor of O'Driscoll, a corridor which extends to the Abminga kimberlite pipe field near the Northern Territory – South Australian border.

Gemstones

In May 1999, Joanne Hough and Jack Townsend attended the 53rd Annual Gemmological Association of Australia (GAA) Conference held in Chiang Rai (northern Thailand), and visited sapphire mines in Laos, Kanchanaburi (western Thailand) and Chantaburi (southeastern Thailand). Jack Townsend also visited the Royal Selangor company in Kuala Lumpur, which is using South Australian nephrite jade in pewter animals on a nephrite base and ornate pewter designs with nephrite sides for memorial urns. These items were to be on display in the USA at an exhibition in late 1999. A certificate of authentication has been provided to Gemstone Corporation stating that nephrite jade from Cowell has been used in making the memorial urns assembled in Malaysia by Royal Selangor.

Opal

Assistance has been given to Marijan Anic, a miner and opal cutter from Andamooka who has been working for about five years on a treatment and coating of opalised sandstone to produce and use the product in fine jewellery, and mosaic and tile applications. The Department loaned a programmable furnace to control temperatures for his testing of the heat treatment of opalised sandstone to deposit carbon in pore spaces and enhance the colour of the stone. In addition, PIRSA described the finished product and its properties, and published articles in both the *MESA Journal* and *Australian Gemmologist*.

Magnesite resources

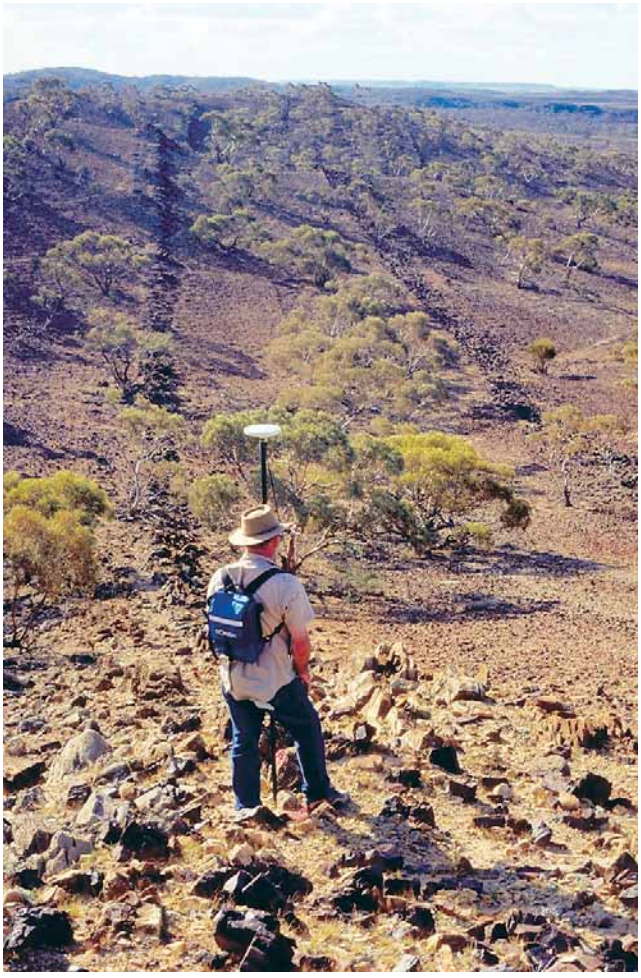
Mapping magnesite resources in the Willouran Ranges confirmed continuity of the main magnesite units from Screechowl Creek to West Mount Hut, a distance of ~18 km. A presentation on Proterozoic magnesite resources in South Australia was given at the 14th Australian Geological Convention. Technical advice and data were provided to Pima Mining NL on PIRSA field activities, and a report was prepared in conjunction with CSIRO on the nature of boron in sedimentary magnesite.

Bentonite potential of Murray Basin clay

Infrared analysis was used to investigate the clay mineralogy of drillhole samples from the South Australian

Treated Andamooka opalised sandstone. *(Photo 47146)*

portion of the Murray Basin held in the Department's Core Library. Intervals targeted for industrial-grade bentonite clay were Blanchetown Clay and the top of the



Field mapping of magnesite beds near Screechowl Creek. *(Photo 46343)*

Parilla–Loxton Sands. Thirty holes recorded the presence of smectite clays but further examination at CSIRO showed these were essentially mixed layer illite–smectite clays of little commercial value.

Uley graphite

Reports were received from CSIRO Refractories Centre Australia on a review of graphite markets and comparison of Uley graphite with similar material from Canada and China. The results confirm that Uley graphite is of equivalent quality to graphite widely accepted by the international refractories industry. An investigation into the nature of weathering at the Uley Mine and its impact on graphite grade and quality was commenced with support and supervision of a student honours project (David Pugh, Earth Sciences, Flinders University). Widespread nontronite (Fe-smectite) alteration at the pit was investigated further in collaboration with CSIRO Land and Water. A paper was prepared for publication on Uley nontronite, and bulk samples were provided to the Clay Source Repository in the United States as reference clays for research.

1999–00 program

Company exploration

Mineral exploration in the State will be facilitated through effective and efficient processes and regulation. Guidelines and procedures will be revised, the graticular system for EL designation will be introduced, and guidelines will be prepared and procedures established for receipt of digital company exploration data.

Aboriginal liaison

Further negotiations are planned with AP to effect policy changes in processing EL applications which will lead to an acceleration of mineral exploration on AP Lands. On-going liaison will continue with other Aboriginal groups throughout the State regarding Aboriginal heritage, land access and opal mining leases.

MINDEP-SA

Numerous improvements, including an imaging facility, are in progress to ensure that the system is user friendly. A major effort will be implemented to add new data and upgrade the present data to provide a comprehensive mineral deposit database that will be a valuable asset to private industry, the public and PIRSA.

Mineral potential map of South Australia

A mineral potential map of South Australia is proposed to facilitate land-use planning by State and Local Government and exploration target selection.

Mineral publications

Several major publications will be updated this year including the handbook *Geology and mineral resources of South Australia* and *Mineral exploration and development in South Australia*. Updating of the handbook *Opal: South Australia's gemstone* will also commence. *Minerals South Australia 2000* is intended as a precursor to a more detailed annual commodity and industry review.

Commodity studies

On-going properties, product, and market research will continue on various South Australian industrial minerals including kaolin, graphite and magnesite. Detailed commodity reviews on South Australia's iron ore and uranium resources will be published, and commodity reviews on magnesite, graphite and diamond will be updated.

Agri-mineral investigations

Production of agricultural gypsum in South Australia has trebled during the last six years. Amended regulations to the *Agricultural Chemical Act 1955* mean that South Australian gypsum fertiliser products must now be labelled according to minimum gypsum, calcium and sulphur contents, size grading, and sodium content. To assist the gypsum producers position their products in line with the new regulations, Mineral Resources Group will sample gypsum mine stockpiles or working faces during the first half of next year, and samples will be analysed by the CSIRO Land and Water Laboratories at Waite Campus. It is envisaged that in future years the focus on agri-minerals will extend to aglime and dolomite.

Review of extractive mineral resources for the Adelaide market

A review of existing sources, consumption and future requirements will commence in 2000 to assist in long-term planning for the supply of construction materials for the Adelaide market.

Minerals Policy and Registration

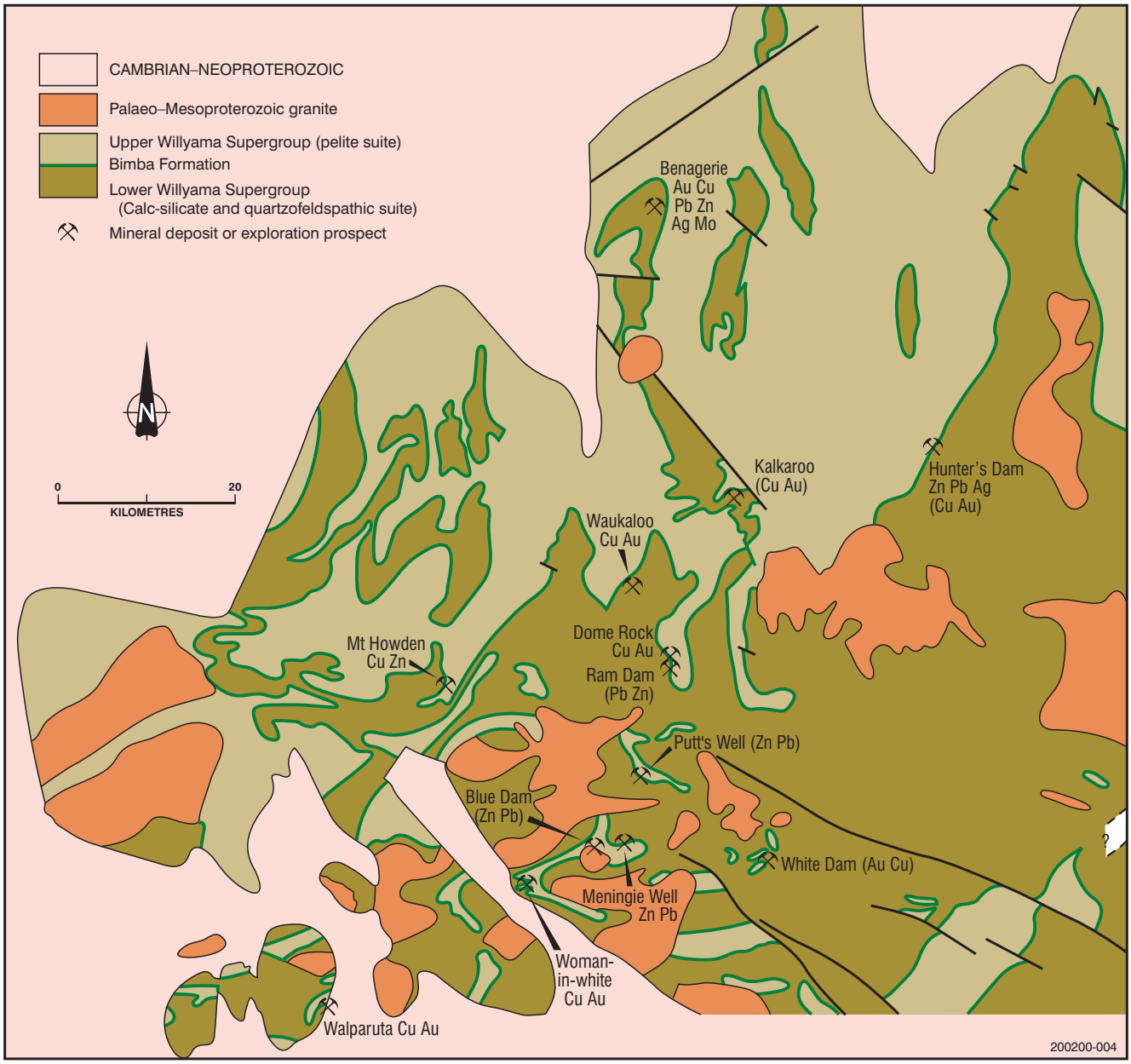
Royalty provisions

The Mining (Royalty) Amendment Bill 1999 was approved by Cabinet on 8 November 1999 for introduction to Parliament. The amendments will clarify the way in which royalty is determined and introduce penalties for late or non-payment of royalties.

National Competition Policy legislation review

A review panel has been formed to look at the following legislation in terms of the Competition Principles Agreement:

- *Mining Act 1971*
- Mining Regulations 1998
- *Opal Mining Act 1995*
- Opal Mining Regulations 1997



Distribution of mineralisation in the southern Curnamona Province.

- *Mines and Works Inspection Act 1920*
- Mines and Works Inspection Regulations 1998.

A desktop review is also being carried out on the *Roxby Downs (Indenture Ratification) Act 1982*.

These reviews are being carried out with expert assistance from Crown Law, and are expected to be completed by the end of the year.

Opal Mining Act and Regulations

A review of the Act and Regulations has commenced, with submissions due to be lodged with PIRSA by 26 November 1999. A discussion paper for circulation will then be prepared.

Offshore Minerals Bill

The Offshore Minerals Bill 1999 was passed in the Lower House on 8 July 1999. The Bill seeks to establish a legislative regime to govern mineral exploration and mining in South Australia's coastal waters, and mirror Commonwealth legislation applying in adjacent Commonwealth waters. Debate commenced in the Upper House on 9 November 1999.

Website

Information on the Branch's activities, together with details of legislation, forms and fees, have been reviewed and uploaded onto the Web for ease of access by clients around the world.

Electronic lodgement of applications

A business plan has been submitted for funding to introduce the electronic lodgement of EL applications. This will ensure that South Australia keeps pace with other States and Territories which are planning similar systems, and will allow clients to apply for licences and to define the geographic location and extent of their licence application using online mapping tools.

Native Title Working Group

A joint Crown Solicitor's Office and PIRSA Native Title Working Group was formed to discuss issues raised as a result of the Statutes Amendments (Native Title No. 2) Amendment Bill 1998 currently before State Parliament.

Municipal Council of Roxby Downs

A framework and criteria have been established for a consultation process to examine the practicability of a fully elected council for the Local Government authority at Roxby Downs. A report on the examination is expected to be received during the first half of 2000.

Olympic Dam — major expansion facilitated

The Branch has facilitated all approvals necessary for WMC Resources' $1.94 billion expansion of its Olympic Dam Mine and processing facilities. The expansion was achieved in a world-class time of less than three years and with minimal effect on production, which has increased towards the nominal annual rate of 200 000 t of copper, plus associated uranium, gold and silver.

Beverley Uranium Project

The Beverley Uranium Project received Commonwealth approval in January 1999. The mining lease, associated miscellaneous purposes licences and extractive minerals leases were granted by the State in April 1999, allowing the project to progress to the next stage of constructing a commercial-scale *in situ* leach (ISL) uranium extraction plant on site. The lease conditions include a broad range of measures which ensure that uranium can be safely mined with very high standards of environmental protection.

It is expected that commercial mining of the Beverley deposit will begin in 2000. Once the plant reaches full annual production of ~1000 t of uranium oxide, the project will provide direct employment for 119 staff, generate export income of ~$30–40 million/year, give rise to ~275 jobs in service and supply industries (primarily in South Australia), and generate payroll tax and royalties which will total ~$1 million annually.

Honeymoon Uranium Project

The Honeymoon field leach trials have progressed well, and provided the proponents and Government with valuable environmental information, operating data and experience. Southern Cross Resources Australia has indicated that its environmental impact statement for the Honeymoon project will be presented to Government by late 1999.

Resources Task Force (RTF)

A baseline paper was prepared and forecasts of exploration expenditures and output values to 2020 were undertaken as the basis for the writing of vision and mission statements after establishment of the RTF. With finalisation of the Task Force Report, PIRSA's responses to the report have been identified, including ranking of program priorities, assessment of existing programs, cost estimations and administrative requirements.

Promotion

Promotional activities included the preparation of copy and advertising for *The Advertiser* resources feature of 25 September 1999, and presentations to international investors. Conference preparations in train include PDAC 2000 (international focus), Resources Week 2000 (State focus), and Mining 2000 (national focus).

Services to industry

The Gypsum Industry Association of South Australia has been assisted by the introduction of new production statistical categories to conform with new statutory product standards. Supply and demand trend analyses will be of particular use to agricultural gypsum producers.

Economic and policy input was provided to assist the Challenger shaft sinking proposal.

Mineral production statistics

Refinements to production statistics presentations have been implemented. Analysis of exploration and production statistics are provided to a range of clients including the Premier and SACOME.

ANZMEC

Management of ANZMEC business, including briefings for Ministerial Council and SCO meetings and preparation of submissions (Ralph Review of Business Taxation), has continued.

1999–00 program

Future programs will include the upgrading of the environmental provisions of the Mining Act and other amendments required to achieve accreditation by the

Commonwealth to enable implementation of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Administrative amendments to the Mining Act will also be undertaken in consultation with all stakeholders, together with finalisation of the review of the Opal Mining Act and Regulations.

During 2000, greater emphasis will be placed on assisting the exploration and mining industry with land access issues including Native title, Aboriginal heritage, and the introduction of low-impact exploration activities. Liaison with the Crown Solicitor's Office and DEHAA will be undertaken in an effort to achieve these aims. In addition, it is anticipated that the Government's Land Access Policy, which is currently being drafted, will be adopted by Cabinet by mid-2000.

New policies will be developed to facilitate the 'one window' approach by streamlining the Group's approvals processes with other Government agencies, thereby providing the industry with faster responses to new project proposals and initiatives.

Mining Operations

Compliance services

Mining operations must comply with the Regulations under the *Mining Act 1971* and *Mines and Works Inspection Act 1920* to ensure that mining activities are carried out to acceptable standards. In addition, special conditions on mining tenements are designed to protect the environment from any adverse impacts of mining. All mines must be operated in accordance with an Approved Mining Program which includes mine plans, measures to ameliorate the environmental impacts created by mining, progressive and final rehabilitation, and mine closure.

Mining operations are inspected for compliance at regular intervals and prior to renewal, transfer, expiry or cancellation. The holders of mining tenements (except extractive mineral leases) are required to enter into a bond prior to commencing to ensure that the obligation to rehabilitate land disturbed by mining is satisfied. During the year, 38 mining programs were approved, 757 mining tenement inspections were undertaken, and eight bonds totalling $26 500 were lodged.

Eighty-eight per cent of the 757 operating mine and quarry sites inspected complied; 77% of the 94 which did not comply have now been rectified.

Tenement assessments

The Tenement Assessment Section is responsible for ensuring that mining tenement applications are adequately assessed in accordance with the requirements of the Mining Act. This includes determining the appropriateness of mining and rehabilitation proposals to describe the proposed operation, its feasibility, and appropriate after-use, any significant environmental concerns, and appropriate terms and conditions for the lease.

Pursuant to the Mining Act, the Minister in determining the granting of a tenement shall give proper consideration to the natural beauty and amenity of the area, flora and fauna, historical or Aboriginal items, or any other factor considered appropriate in the particular case. The Minister is required to invite comment from members of the public and to circulate the proposal to the landowner and council in the area. The proposal is also circulated to various Government departments for specialised advice.

In some instances, applications are referred to the Development Assessment Commission for consideration with reference to consistency with the planning objectives and principles of the relevant planning zone in which the application is located.

In the year ended 30 June 1999, of the 32 mineral tenement applications and four miscellaneous purpose licence applications assessed, seven special approvals and two applications were refused. Significant proposals included an extension to the Iron Duchess open pit in the Middleback Range, and granting of a mineral lease at Beverley Uranium Project which followed an Environmental Impact Assessment process including extensive public consultation.

Opalfields administration

Between 1 July 1998 and 30 June 1999, the four PIRSA Opal Field Offices conducted 4260 inspections of mining tenements. The inspections highlighted that 277 tenements were improperly pegged and/or pegs did not contain the required registration data as required by opal mining legislation. Required labour conditions were not adhered to and were therefore not in compliance with opal mining legislation on 163 tenements. A series of second inspections conducted after a four-week period revealed that 329 tenement holders obeyed the compliance letters sent but 88 did not; tenement pegs were confiscated in the latter.

At Lambina, 195 rehabilitation inspections were conducted to ensure compliance with Article 8 of the Native Title Mining Agreement. Between 7 July 1998 and 30 June 1999, the number of claims registered rose from ~200 to 317. Monitoring of mining activities commenced on 7 July 1998 and, after 10 months, it was decided that interest in the new diggings would not decline and that all signatories of the Native Title Mining Agreement were working together and abiding by the articles therein.

During the 1998–99 financial year, PIRSA opal field offices issued 1256 precious stones prospecting permits (PSPP), registered 12 opal development leases (200 x 200 m), 272 extra large opal mining claims (200 x 100 m),

Opal mining at Lambina, 1998. *(Photo 47147)*

1205 large claims (100 x 100 m) and 455 small claims (50 x 50 m), processed 1102 registration renewals and 763 cancellations of unwanted registered claims, and issued 131 permits to miners for the purchase of explosives.

Cabinet supported the decision to re-open the Marla office of the Mining Registrar on 1 July 1999 to provide a more convenient registration service for South Australian Opal Miners Association Incorporated (SAOMAI) miners operating at Lambina.

EARF Project assessment panel

Following Ministerial approval of the Extractive Areas Rehabilitation Fund (EARF) Guidelines in February 1998, a Project Assessment Panel was established, comprising membership from Government, SACOME and the South Australian Employers' Chamber of Commerce and Industry to assess large projects over $100 000. The panel has already assessed five major rehabilitation projects.

Brukunga Mine site

PIRSA has the responsibility for managing remedial operations at Brukunga, which includes the ongoing operation of the water treatment plant to neutralise acid water draining from the site into Dawesley Creek. In response to concerns raised by community groups at Brukunga, the use of biosolids, which are used in conjunction with clay topsoil for capping the tailings and waste rock, was suspended. Liming the flats along the creek and fencing to exclude stock from contaminated creek waters commenced. The Brukunga Remediation Board, formed to replace the Brukunga Taskforce, met three times. A number of remedial actions to reduce acid drainage from the mine site were put in place, and plans for others were formulated.

Penrice Crown Agreement

On 1 September 1998, a Crown Agreement was executed between the Premier and the Minister for Mines and Energy, Penrice Soda Products Pty Ltd and Penrice Holdings. The Penrice Special Mining Enterprises (SME) Agreement, which forms part 3 of the Crown Agreement, was ratified by the Governor on 3 September 1998. The agreement recognises that the Penrice Soda Product Pty Ltd salt operations are of major economic significance to the State, and contains details of obligations on behalf of the company and the State Government while providing security for future operations.

The Brukunga acid leachate holding ponds (foreground) with the tailings dam wall and rehabilitated tailings dam behind, 1996. *(Photo 45909)*

SASE Project

The joint venture agreement between Meekatharra Minerals Ltd, Ausmelt Ltd, PT Krakatau Steel and the State Government was re-negotiated to enable corporatisation of the SASE Project and transfer of the State's obligations to a side agreement between the Minister and the new company, SASE Pty Ltd. The aim of the project is to construct a commercial plant south of Coober Pedy which will utilise the coal and iron ore resources in the region to produce 2.5 Mt/year of pig iron for the export market.

1999–00 program

Public risk

The hazard identification stage of a risk management program for derelict mine sites in the North East Pastoral Area will commence.

Beverley uranium mine

The mining and rehabilitation program for the Beverley ISL operation will be assessed, with consequent approval ensuing when the program meets all regulatory requirements.

Challenger gold deposit

Facilitation of approvals will be provided to allow development of an exploration shaft and underground openings at Challenger to enable detailed definition and evaluation of the gold resource.

SASE Project

Construction and commissioning of the 2.5 t/hour pig iron demonstration plant to be built at Whyalla will be facilitated, and the agreement between the State and SASE Pty Ltd will be administered.

Port Pirie tailings

The Group is to finalise an agreement between the State and Pasminco, and complete the long-term rehabilitation plan for the site.

Mine inspection

Inspection procedures are to be reviewed and rationalised to ensure compliance with the Regulations under the Mining Act and Mines and Works Inspection Act.

Brukunga Mine site isolation study

In early 2000, a pre-feasibility engineering study will be let for tender to evaluate the diversion of Dawesley Creek water past the Brukunga mine site. If the study indicates that the proposal is practical and capital is available for implementation at a cost estimated to be in the order of $1.5–2 million, the works are expected to completely prevent future downstream pollution seeping from the site.

Olympic Dam

The Roxby Downs indenture and mining operations at Olympic Dam will be administered.

Penrice

The Group will administer the Penrice Consultative Committee, and ensure that obligations under the Penrice Crown Agreement are carried out.

EARF

The Group will administer and manage the EARF, and provide support for the Project Assessment Panel.

FUNCTIONS AND CONTACTS

DIRECTORATE

Role

- Provide leadership, strategic planning, administrative, human resource and financial support for the Mineral Resources Group, and high-level, timely policy advice to PIRSA and Government on the minerals industry.

Director Mineral Resources — Neville Alley

- manage the Mineral Resources Group at Executive level
- provide leadership, strategic planning and policy direction
- provide advice to the Chief Executive
- provide advice to the Minister, Government (State and Federal)
- liaise with industry and research organisations
- liaise with the community (including Aboriginal).

Executive Assistant — Marion Reedman

- provide administrative support to the Director
- provide human resource management support to the Mineral Resources Group.

Finance Manager — Alan Finch

- provide budgetary, finance and accounting support
- provide administrative and strategic planning.

Manager TEISA Minerals Program — Pru Freeman

- manage and administer the TEISA programs
- manage airborne geophysical, regional gravity and bedrock drilling surveys
- provide strategic planning and policy advice.

Coordinator Airborne Geophysics — Domenic Calandro

- manage aerial geophysical data processing and provision
- design airborne surveys.

Research and Administrative Officer — Joe Cappella

- coordinate the Group's performance management
- provide OHS&W planning and administration
- provide administrative and strategic planning support to the Group.

Contacts

Geoscientists	Phone	Title	Projects and/or expertise
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Pru Freeman freeman.pru@saugov.sa.gov.au	8463 3091	Senior Geologist	Management and administration of TESIA programs
Dom Calandro calandro.dom@saugov.sa.gov.au	8463 3051	Senior Geophysicist	Coordinator airborne geophysics
Administrative			
Alan Finch finch.alan@saugov.sa.gov.au	8463 3040	Accountant	Business manager
Joe Capella cappella.joe@saugov.sa.gov.au	8463 3111	Administrative Officer	Executive support, OH&SW
Marion Reedman reedman.marion@saugov.sa.gov.au	8463 3032	Administrative Officer	Executive Assistant to the Director

www.minerals.pir.sa.gov.au

GEOLOGICAL SURVEY

Role

- The Geological Survey Branch collects, manages and interprets geoscientific information and provides geoscientific advice and data to Government, industry and the community to assist exploration, responsible development and sound land-use planning.
- Branch activities include regional geological mapping, geophysics, remote sensing, biostratigraphy, regolith studies and geoscientific information services. Current programs and a selection of current projects are listed below.

Statewide geology and administration — Stuart Robertson

- statewide geological investigations, maps and databases
- promotion of State mineral prospectivity
- advice to Government and Branch administration.

Adelaide Geosyncline and Kanmantoo Trough — Wolfgang Preiss

- regional geological mapping and publication of Explanatory Notes
- solid geology interpretation and GIS modelling of the Kanmantoo Trough and concealed basement to the Murray Basin
- regional stratigraphic and tectonic studies.

Curnamona Province — Colin Conor

- regional geological mapping and publication of Explanatory Notes
- geological interpretation, history and metallogenesis of the Curnamona Province in conjunction with NSW Department of Mineral Resources and AGSO.

Gawler Craton — Sue Daly

- regional geological mapping and publication of Explanatory Notes
- regional bedrock drilling
- regional studies including tectonic history, Gawler Range Volcanics, Hiltaba Suite geochemistry, and geochronology.

Regolith (in cooperation with CRC-LEME) — Malcolm Sheard

- regolith — geochemical and mineralogical characterisation, regolith mapping of the Gawler Craton
- development of efficient procedures for mineral exploration through understanding of regolith development processes and landscape evolution, and their effects on the surface expression of concealed mineralisation.

Sedimentary terranes — Marigold White

- regional geological mapping in sedimentary terranes and publication of Explanatory Notes
- microfossil dating to correlate sedimentary rocks, supporting Departmental mapping and industry exploration programs
- laboratory services (including palaeontological laboratory services), palaeontological computer database
- palaeochannel studies.

Geoscientific information systems and services — Alan Mauger

- maintenance and development of digital (SA_GEODATA, SA_Geology) GIS/Oracle geoscientific databases in cooperation with other PIRSA Groups
- management and provision of geophysical data for the State
- management and development of remote sensing data for use in exploration in South Australia.

Contacts Fax: (08) 8463 3089

Geoscientists	Phone	Title	Projects and/or expertise
Stuart Robertson robertson.stuart@saugov.sa.gov.au	8463 3055	Branch Manager	Branch administration, geology and mineral potential of the State, databases, mineral deposits
Peta Abbot abbot.peta@saugov.sa.gov.au	8463 3067	Senior Geologist	Kanmantoo Trough, geophysical basement interpretation, image processing, gemstones
Andrew Burtt burtt.andy@saugov.sa.gov.au	8463 3072	Senior Geologist	Geological mapping, Kanmantoo Trough, GIS modelling, image processing
Domenic Calandro calandro.domenic@saugov.sa.gov.au	8463 3051	Senior Geophysicist	Coordinator airborne geophysics, TEISA airborne geophysics
Colin Conor conor.colin@saugov.sa.gov.au	8463 3061	Principal Geologist	Geological mapping — structural, geotechnical, metamorphic. Cu–Au metallogeny — Curnamona Province, eastern Gawler Craton, Musgrave Block
Wayne Cowley cowley.wayne@saugov.sa.gov.au	8463 3076	Senior Geologist	Geological mapping (currently BURRA), digital databases (geological monuments, type sections, stratigraphic units, GIS map symbols), Gawler Craton, Adelaide Geosyncline and general State geology; Convenor, State Stratigraphic Nomenclature Subcommittee
Sue Daly daly.sue@saugov.sa.gov.au	8463 3066	Senior Geologist	Geological mapping, geochronology, geochemistry and tectonics of the Gawler Craton, Precambrian ore genesis
George Gouthas gouthas.george@saugov.sa.gov.au	8338 0079	Geologist	Regolith terranes, data management and analysis, PIMA, chemistry, SA_GEODATA
Steve Hore hore.stephen@saugov.sa.gov.au	8463 3046	Geophysicist	Gravity data processing
Greg Jenkins jenkins.gregory@saugov.sa.gov.au	8463 3074	Senior Geologist	Coordinator GIS and SA_GEODATA, Adelaide Geosyncline mapping
Alan Mauger mauger.alan@saugov.sa.gov.au	8463 3062	Senior Geophysicist	Spectral geology, remote sensing
Rosie Maughan maughan.rosie@saugov.sa.gov.au	8463 3050	Geophysicist	Geophysical data processing, Website coordinator
Jim Painter painter.jim@saugov.sa.gov.au	8463 3079	Senior Geologist	Drillhole database, heavy mineral sand, Murray Basin
Stephen Petrie petrie.stephen@saugov.sa.gov.au	8463 3065	Geologist	Petrology (thin section) database, SA_GEODATA
Wolfgang Preiss preiss.wolfgang@saugov.sa.gov.au	8463 3077	Chief Geologist	Adelaide Geosyncline, Delamerian Orogeny, Curnamona Province; geological mapping, Precambrian palaeontology, stratigraphy and tectonics
Gary Reed reed.gary@saugov.sa.gov.au	8463 3044	Senior Geophysicist	Statewide airborne magnetic and radiometric data processing and interpretation
Trina Reif reif.trina@saugov.sa.gov.au	8463 3049	Geophysicist	Geophysical data processing, GIS
Paul Rogers rogers.paul@saugov.sa.gov.au	8463 3039	Senior Geologist	Regional mapping: Murray, Eromanga and Officer Basins
Andrew Rowett rowett.andrew@saugov.sa.gov.au	8463 3037	Senior Geologist	Palaeontology, palynology, Tertiary palaeochannels, palaeoenvironments and climates, Tertiary sedimentary basins
Michael Schwarz schwarz.michaelp@saugov.sa.gov.au	8463 3084	Geologist	Southern Gawler Craton geology, geophysical basement interpretation, structural and metamorphic geology
Malcolm Sheard sheard.malcolm@saugov.sa.gov.au	8338 0073	Senior Geologist	Gawler Craton, regolith characterisation (regional and local), geochemistry, mineral dispersions, weathering processes, volcanology, engineering geology, hydrogeology, soils
Andrew Shearer shearer.andrew@saugov.sa.gov.au	8463 3045	Senior Geophysicist	Coordinator State gravity database
Vicki Stamoulis stamoulis.vicki@saugov.sa.gov.au	8463 3068	Geologist	Remote sensing, Landsat processing
Liliana Stoian stoian.liliana@saugov.sa.gov.au	8463 3036	Geologist	Palynology, Tertiary deposits, sedimentology, biostratigraphic database
Michael Szpunar szpunar.michael@saugov.sa.gov.au	8463 3075	Geologist	Olary regional mapping
Marigold White white.marigold@saugov.sa.gov.au	8463 3060	Senior Geologist	Palaeontology; foraminiferal biostratigraphy; regional mapping; Eromanga and Lake Eyre Basins; Tertiary sedimentary basin stratigraphy; Gambier Basin
Wenlong Zang zang.wen-long@saugov.sa.gov.au	8463 3081	Senior Geologist	Eastern Gawler Craton geology, palaeontology, sedimentology, sequence stratigraphy, basin analysis, Adelaidean to Quaternary geology
Collaborative researchers			
Bao Hong University of Adelaide Palaeochannels Project	8463 3038	Research Geologist	Sedimentary Terranes Program, northwestern Gawler Craton palaeochannels
Technical staff			
Alan Appleton appleton.alan@saugov.sa.gov.au	8463 3042	Technical Officer	Technical assistance, geophysical information
Lyn Broadbridge broadbridge.lyn@saugov.sa.gov.au	8463 3041	Technical Officer	Biostratigraphy Laboratory Manager, fossil collection curator, biostratigraphic database, technical duties
Administrative staff			
Deb Johnson johnson.debbie@saugov.sa.gov.au	8463 3034	Administrative Officer	Administrative support, Group purchasing officer, Brukunga Remediation Board

MINERAL ASSESSMENT

Role

- Encourage and promote mineral exploration and development in South Australia.
- Administer and regulate mineral exploration in South Australia.
- Increase public awareness of mineral exploration and mining practice and its benefits to the community.

Minerals (general) — Warwick Newton

- management, administration and personnel
- advice to Government
- public enquiries, preparation of information brochures
- project evaluation
- community (including Aboriginal) liaison
- land access
- identification of new mineral development opportunities
- identification of mineral exploration opportunities.

Resource assessment — Max Pain

- extractive industry and land-use planning
- resource evaluation
- commodity reviews
- commodity and product research.

Company exploration — George Kwitko

- regulation, assessment and monitoring of mineral exploration
- environmental compliance monitoring
- facilitation of mineral exploration work approvals.

Mineral potential — Brian Morris

- development of mineral deposit database
- mineral potential mapping
- development of exploration concepts, models and techniques.

Contacts

Geoscientists	Phone	Title	Projects and/or expertise
Warwick Newton newton.warwick@saugov.sa.gov.au	8463 3136	Manager	Management, mineral exploration, project evaluation, Aboriginal liaison
Max Pain pain.max@saugov.sa.gov.au	8463 3137	Principal Geologist – Resource Assessment	Extractive minerals, industrial minerals, dimension stone
George Kwitko kwitko.george@saugov.sa.gov.au	8463 3133	Principal Geologist – Company Exploration	Company exploration; regulation, assessment and monitoring
Brian Morris morris.brian@saugov.sa.gov.au	8463 3127	Principal Geologist – Mineral Potential	MINDEP database, metallogenic studies, base metals, gold, kimberlites
John Keeling keeling.john@saugov.sa.gov.au	8463 3135 mob 041 781 3448	Principal Geologist – Industrial Minerals	Collaborative CSIRO commodity research, industrial minerals
Jack Townsend townsend.jack@saugov.sa.gov.au	8463 3115	Senior Geologist, Gemmologist	Diamonds, opal, jade, gemmology, uranium exploration
Marc Davies davies.marc@saugov.sa.gov.au	8463 3132	Senior Geologist	MINDEP database, iron ore
Alistair Crooks crooks.alistair@saugov.sa.gov.au	8463 3134	Senior Geologist	Curnamona Province geology and mineralisation
Gary Ferris ferris.gary@saugov.sa.gov.au	8463 3123	Senior Geologist	Gawler Craton mineralisation, heavy mineral sand, building stones
Joanne Hough hough.joanne@saugov.sa.gov.au	8463 3124	Senior Geologist, Gemmologist	Gawler Craton, Adelaidean and Kanmantoo Trough mineralisation, gemstones, South Australian mineral deposits Website
Rob Shaw shaw.rob@saugov.sa.gov.au	8463 3129	Senior Geologist	Company exploration – compliance monitoring and work approvals, coal
Jeff Valentine valentine.jeff@saugov.sa.gov.au	8463 3131	Senior Geologist	Company exploration, technical reporting, gypsum, graphite
Justin Gum gum.justin@saugov.sa.gov.au	8463 3126	Senior Geologist	MINDEP database, metallogenic and mineral potential studies, Kanmantoo Trough, GIS modelling sedimentology, geochemistry
Technical staff			
Rob Larkins larkins.rob@saugov.sa.gov.au	8672 5800 mob 0419 863 855	Liaison Officer	Aboriginal liaison, exploration mining
Peter Crettenden crettenden.peter@saugov.sa.gov.au	8463 3120	Senior Technical Officer	Ground geophysics, GPS, Micromine applications
Mark Flintoft flintoft.mark@saugov.sa.gov.au	8463 3119 mob 040 939 5169	Technical Officer	Field and camp logistics, field surveys, exploration monitoring and rehabilitation
Neil Gray gray.neil@saugov.sa.gov.au	8463 3118	Technical Officer	Rock sample database, field surveys, exploration monitoring and rehabilitation
Stephanie Thorpe thorpe.stephanie@saugov.sa.gov.au	8463 3128	Environmental Officer	Company exploration, EMS mineral resource activity (environmental monitoring)
Clerical staff			
Jane Washington washington.jane@saugov.sa.gov.au	8463 3130	Clerical Officer	Administration, purchasing
Trish McGuire mcguire.trish@saugov.sa.gov.au	8463 3095	Records Officer	Company mineral records and files

MINERAL POLICY AND REGISTRATION

Role

- To provide an exploration and mining legislative and policy framework to ensure security of tenure, facilitate access to land, and deliver assessments and advice on these issues to Government, industry and the community.

Policy and registration (general) — Bob Wildy

- management, administration and personnel
- advice to Government on land access issues
- public enquiries
- mineral production statistics
- mineral royalties and royalty assessment.

Policy and economics — Fred Cook

- policy development and advice
- mineral economics
- mining industry review, promotion and assessment.

Administration and liaison — Ken Wigglesworth

- ANZMEC administration
- Australian Bureau of Statistics liaison
- project investigation.

Facilitation — Sam Walker

- new project facilitation
- administration major projects.

Mineral registration and Mining Registrar — Laura Johnston

- administration of *Mining Act 1971* and *Opal Mining Act 1995*
- processing of tenement applications – mineral and opal
- provide advice on the provisions of the mining legislation
- represent the Director of Mines in the Warden's Court
- production statistics and collection of royalties
- Native title matters.

Contacts

	Phone	Title	Expertise
Bob Wildy wildy.bob@saugov.sa.gov.au	8463 3092	Manager	Royalty assessment, policy advice
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Sam Walker walker.sam@saugov.sa.gov.au	8463 3088	Senior Policy Officer	Facilitation of major projects
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Karyn Calandro calandro.karyn@saugov.sa.gov.au	8463 3082	Project Officer	Project facilitation, EPBC review
Doug Fitzjohn fitzjohn.doug@saugov.sa.gov.au	8463 3083	Project Officer	Special projects, records management
John Brazel brazel.john@saugov.sa.gov.au	8204 1767	Senior Project Officer	Special projects, indenture administration

MINING OPERATIONS

Role

- The principal role of the Mining Operations Branch is to regulate the South Australian mining industry in accordance with legislative requirements, and in a manner which minimises impact on the community. This is done by:
    - regularly inspecting mining operations
    - administering and regulating opal mining in the State
    - providing professional advice to Government, industry and the community on matters relating to mining
    - administering the EARF
    - coordinating the rehabilitation of disused mine sites.

Mining operations (general) — Roger Mathews

- management and Branch coordination
- advise the Minister on matters relating to mining
- statutory approval of mine operation plans and development programs
- compliance with the State's mining legislation.

Mining operations and special projects — Serge Caplygin

- Olympic Dam Mine
- compliance — major mines and quarries, central, northern and northeastern region
- evaluation of mine operation plans for major operations
- security deposits (bonds) for operating sites
- administration of the SASE Project
- coal development advice
- Penrice Crown Agreement and Consultative Committee.

Mining operations — Olando Puccini

- opal fields
- iron ore and coal mines
- compliance — major mines and quarries, southern and western regions
- evaluation of mine operation plans for major operations
- security deposits (bonds) for operating sites
- special projects.

Brukunga — Ray Cox

- Brukunga Mine treatment plant
- Brukunga remediation projects.

Contacts

Engineers	Phone	Title	Projects and/or expertise
Roger Mathews mathews.roger@saugov.sa.gov.au	8463 3113	Manager, and Chief Inspector of Mines	Management, Ministerial advice, legislation, approvals
Serge Caplygin caplygin.serge@saugov.sa.gov.au	8463 3056	Chief Engineer	Special projects, inspections, legislative compliance
Ray Cox cox.ray@saugov.sa.gov.au	8463 3117	Principal Mining Engineer	Brukunga Mine site plant
Olando Puccini puccini.olando@saugov.sa.gov.au	8463 3122	Regional Mining	Inspections, legislative compliance, rehabilitation
Garry Wardle wardle.garry@saugov.sa.gov.au	8463 3108	Senior Mining Engineer	Tenement applications, mining proposals, environmental impact, rehabilitation bonds
Hans Bailiht bailiht.hans@saugov.sa.gov.au	8463 3107	Tenement Assessments Officer	Tenement applications, mining proposals, environmental impact, rehabilitation bonds
Technical staff			
Rino Mattiazzo mattiazzo.rino@saugov.sa.gov.au	8463 3106	Rehabilitation Officer	EARF, mine rehabilitation, mining proposals, bonds
Area officers			
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Steve Silvester silvester.steve@saugov.sa.gov.au	8849 2376	Area Officer, Auburn	Compliance inspections, southern area, Security deposits (bonds) for operating sites
Peter Talbot talbot.peter@saugov.sa.gov.au	8651 2194	Area Officer, Peterborough	Compliance inspections, southern area, security deposits (bonds) for operating sites
Dean Carbine	8651 2194	Area Officer, Peterborough	Compliance inspections, southern area, security deposits (bonds) for operating sites
Clerical staff			
Joe Cappella cappella.joe@saugov.sa.gov.au	8463 3111	Senior Administrative Officer	EARF payments, budgets, administration, projects, Executive support
Linda Taylor taylor.linda@saugov.sa.gov.au	8463 3112	Administrative Officer	Secretarial, ordering supplies, travel, Board of Examiners
Brukunga Mine treatment plant			
Peter Grindley grindley.peter@saugov.sa.gov.au	8388 5627	Mine Site Supervisor	Brukunga Mine site operation and maintenance
Mark Seifert	8388 6527	Senior Plant Operator	Plant operation and maintenance
Opal fields			
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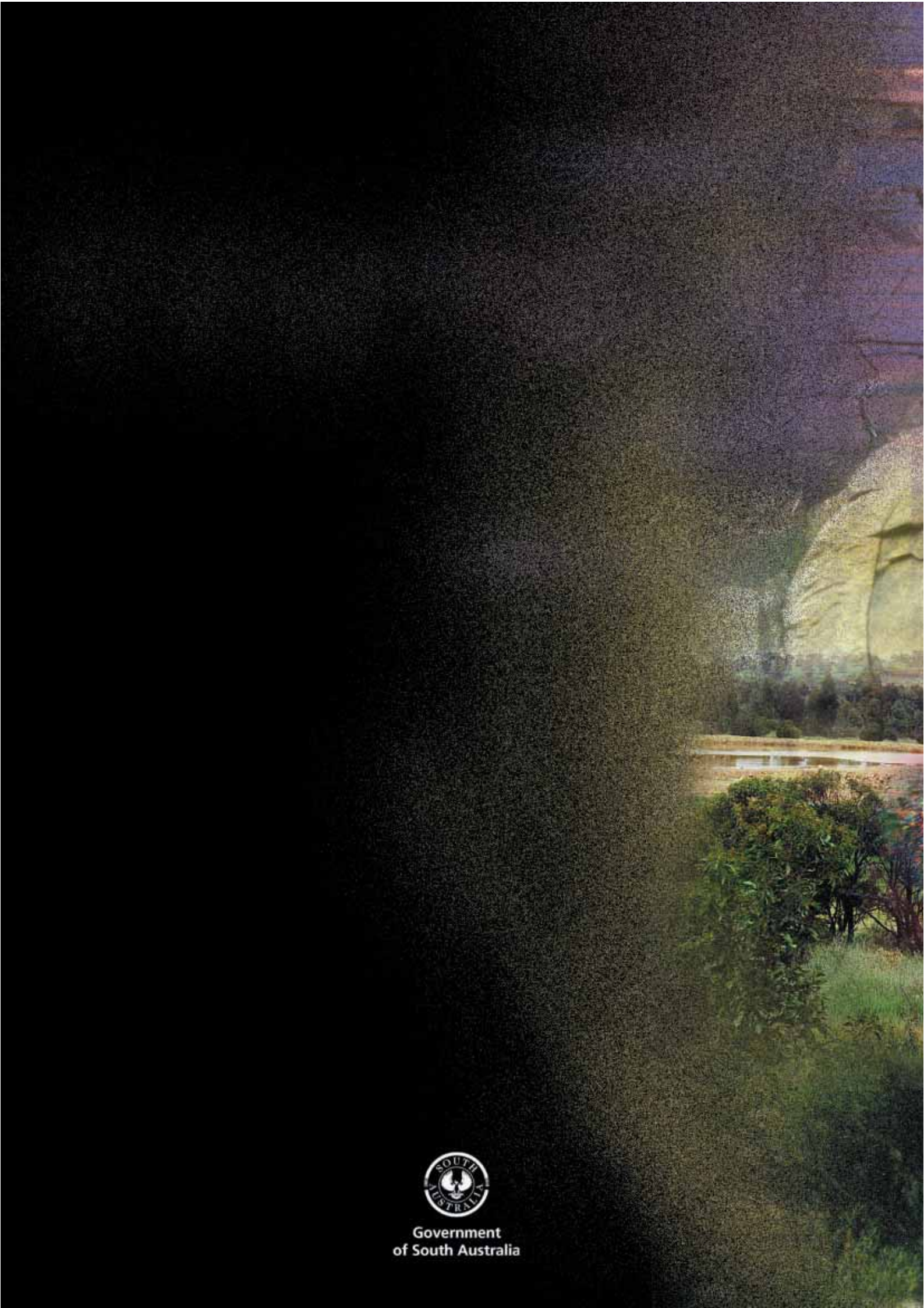
Steve Sigler sigler.steve@saugov.sa.gov.au	8670 5042	Area Officer, Mintabie	Opal mining compliance and rehabilitation
Jim Safta safta.jim@saugov.sa.gov.au	8672 7017	Area Officer, Andamooka and Stuart Creek	Opal mining compliance and rehabilitation
Deanna Trenham trenham.deanna@saugov.sa.gov.au	8672 5800	Senior Regional Clerk,Coober Pedy	Opal field administration, issuing permits, registering and renewing claims
Geoff Price price.geoffa@saugov.sa.gov.au	8670 5042 8672 7017	Clerk, Mintabie and Marla	Opal field administration, issuing permits, registering and renewing claims
Karen Jones	8672 5800	Relief Clerk, casual	Opal field administration, issuing permits, registering and renewing claims



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