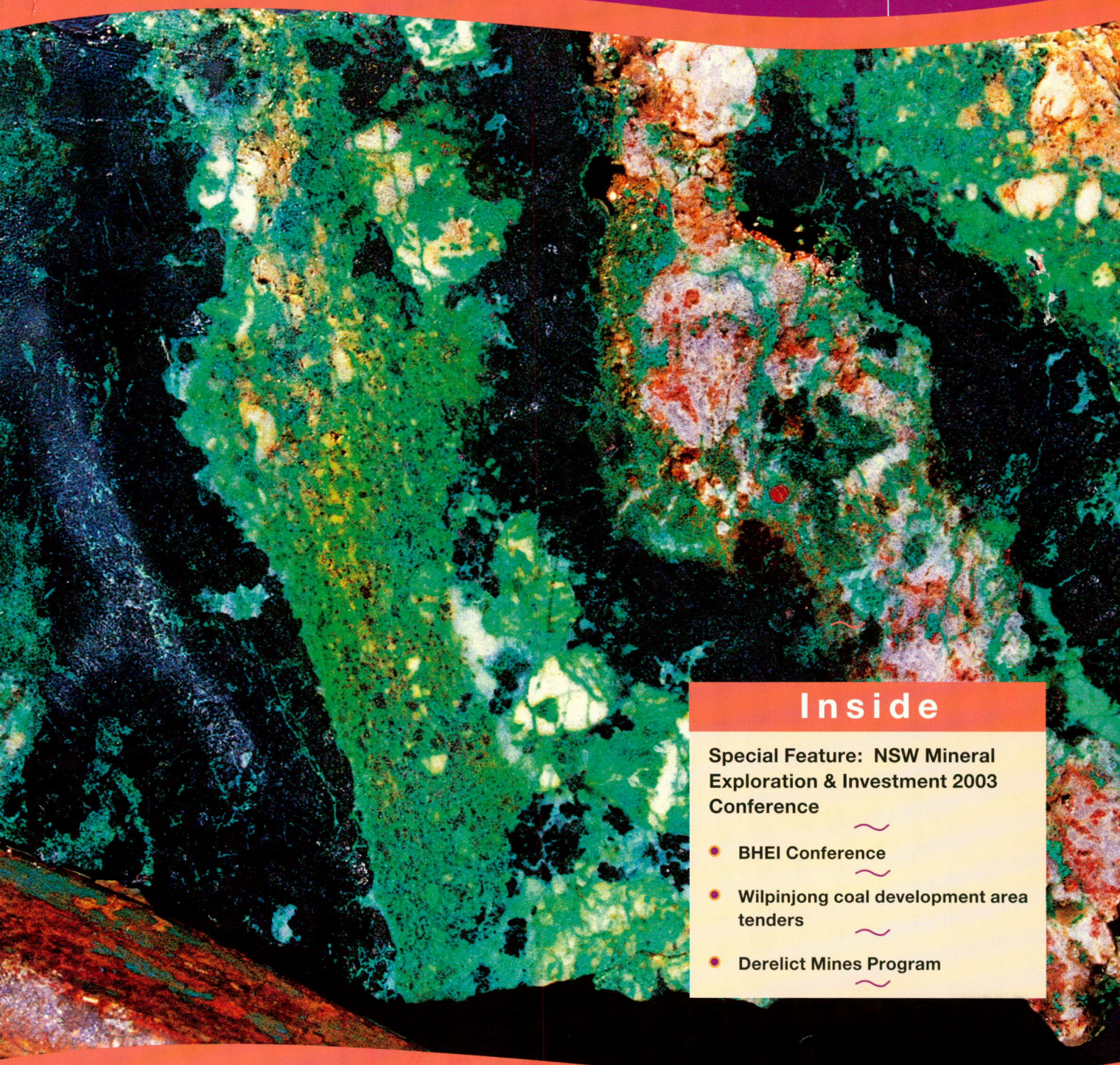


Minfo

New South Wales Mining and Exploration Quarterly

No 79

September 2003



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Special Feature: NSW Mineral
Exploration & Investment 2003
Conference

- BHEI Conference
- Wilpinjong coal development area
tenders
- Derelict Mines Program

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Quartz chalcopyrite bornite breccia (ore) from the
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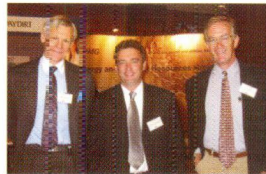
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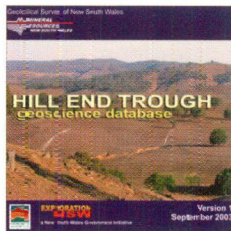
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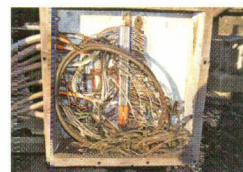
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KERRY HICKEY MP
MINISTER FOR MINERAL RESOURCES

It has been six months since the Premier appointed me Minister for Mineral Resources and I am enjoying every facet of my portfolio responsibilities.

My role as Minister is to encourage exploration and development by assisting and promoting industry, ensure we meet community expectations on the environment and protect the safety and wellbeing of our State's 15 000 mineworkers.

Safety is the Carr Government's number one priority for the minerals and petroleum industries. This is an unequivocal message and one I am determined to get across as Minister.

I am pleased with the Department's hard work in progressing the Government's safety agenda. The implementation of regulations under the Coal Mines Health and Safety Act 2002 is on track. Similarly, I am introducing legislation for the metalliferous and extractive industries during this Parliamentary session.

This is the first major overhaul of minerals industry safety laws in more than 20 years. It involves close consultation with workers, unions, industry, and safety experts. It is only by working together that we will save lives and prevent workplace injuries.

Our environment is another of my major priorities and a particular focus of the Carr Government. Both government and industry must deal with the legacy of less-enlightened times. We have a responsibility to people across the State to repair derelict mine sites. Abandoned mines scar our landscape and feed the public perception that mining is a dirty industry.

While I know that much good work is being done, the industry is only as good as its worst performer in the eyes of the community. Since becoming Minister I have visited many mines, both coal and metalliferous. I know what industry is doing and what can be achieved.

Environmental performance is crucial to future growth. While I believe that real change is occurring, industry must demonstrate its credentials to the wider community. It is imperative that mining companies lead the way, and not merely respond to regulatory obligations.

During the past eight years, the Carr Government has approved 27 mining projects, worth \$2.6 billion. These projects created more than 2,400 jobs – mostly in regional New South Wales.

We compete aggressively for new investment, new business and new jobs. In a highly competitive international market, New South Wales is recognised for our vast minerals and petroleum wealth and solid economic, political and legislative base.

However, this year is unlikely to be a 'boom' year. The value of NSW mineral production for 2002/03 is likely to be close to \$6.8 billion, some 11 percent lower than in 2001/02.

The Carr Government's continued support of geological advances through our seven year, \$30 million Exploration NSW program is making a real difference to our ability to attract and sustain investment and development.

The Department continues to provide leading-edge information by combining the latest technology with its dedicated and experienced Geological Survey team. Exploration NSW gives industry the tools to fully explore the exciting potential for new petroleum, mineral sands, metals and minerals developments.

With a number of new coal and mineral projects and extensions in the pipeline, minerals industry employment is forecast to remain relatively stable in the year ahead.

Total mineral exploration expenditure in New South Wales for the June quarter increased to \$16.5 million. This is the best quarterly result since March 1999 and reflects strong activity at a number of projects. This improvement in exploration expenditure is expected to continue in 2004.

I look forward to working hard with you for the continued prosperity and best practice of our industry.

Two hundred and seventy people involved in the mining industry attended the Department's highly successful NSW Mineral Exploration & Investment 2003 Conference in Sydney in May

There is good reason for optimism in the minerals industry. Several industry executives gave encouraging presentations regarding exploration potential in various target areas of the State.

In his welcome address, Minister for Mineral Resources Kerry Hickey cited that, in 2001-02, the State's mineral and metals exports generated \$7.7 billion, 34% of the State's merchandise exports.

The Carr Government's \$30 million, seven-year Exploration NSW initiative has entered its fourth year, having already covered 70% of the State with aeromagnetic and radioelement survey information. With this new information, exploration companies can target areas with the best potential for discovering rich resources and attracting investment for mining projects.

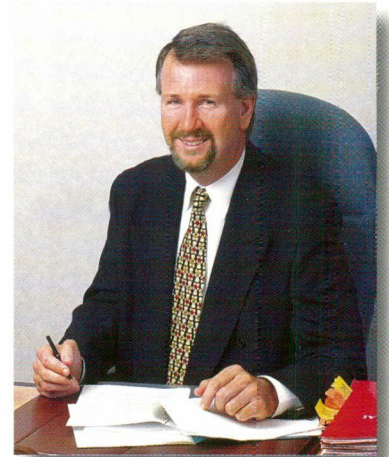
This issue profiles the success of recent surveys conducted by the Department using funds from Exploration NSW – as well as proposed new surveys for 2003-04. The Broken Hill area has been the site for the application of groundbreaking new technology, FALCON™, to conduct an airborne gravity gradiometry survey. This is the first such survey funded by a government anywhere in the world.

The NSW Government remains committed to ensuring that mining companies adhere to strict environmental conditions, both during active mining and in rehabilitation once mining is complete. The Government also continues its commitment to the ongoing Derelict Mines Program to assist in rehabilitating various older derelict mines in the State. This issue provides details of projects which have been allocated funds for the 2003-04 year.

The NSW Government continues to demonstrate its commitment to mine safety by hosting and running regular mine safety courses and seminars and by distributing safety handbooks directly to miners and mine managers.

In particular, the Department's small mines campaign and the opal miners' safety courses at Lightning Ridge have been highly successful in educating miners and those involved in the industry.

To further reinforce its commitment to improving mine safety, the Department again co-hosted with the NSW Minerals Council the annual Occupational Health and Safety Conference which was held this year at Sydney Olympic Park. Minister Kerry Hickey opened this important industry event, the focus of which was the major OH&S legislative reforms that are now progressing through Parliament.



Alan Coutts

Exploring and investing in NSW

The NSW Government showcased a range of new exploration and mineral developments, products and opportunities at the Department of Mineral Resources major biennial event, NSW Mineral Exploration & Investment 2003 Conference.

This year's Conference was very successful. Held on May 22 and 23 at Sydney's Four Seasons Hotel, the conference attracted 270 delegates from Australian and international exploration, mining and investment companies, financial and legal advisers, consultants and mining service companies and government and media representatives.

The Minister for Mineral Resources, Kerry Hickey, opened the conference and emphasised the Carr Government's strong support for a robust minerals sector – a vital part of the State's economic strategy – which accounts for about 34% of the State's merchandise exports, valued at \$7.7 billion in 2001–2002. The Government has committed \$30 million to the ongoing Exploration NSW program, which is creating a premier geoscience framework for exploration investment, and advancing mineral and petroleum exploration in the State.

The Minister also launched a major new product, the Mineral Projects of New South Wales, Australia (2003) map. The map identifies all operating mines and exploration/advanced projects in the State on a base showing the State's major structural geological units. The map also shows the location of relevant infrastructure, including roads, rail, ports, major electricity transmission lines, gas pipelines, power stations and oil refineries, and major minerals processing plants. The map will benefit all involved in the State's minerals sector and should prove very popular with investors. It should also be very useful to parties involved in land use planning and development generally in NSW.

Each day of the Conference had a different theme. Day 1 had the theme "Exploring in New South Wales" and featured:

- keynote address by Patrick Garver, Executive Vice President & General Counsel, Barrick Gold, on "Why Barrick is investing in NSW"



Conference delegates from government and industry enjoying Day 1 reception at the Four Seasons Hotel.



Minister for Mineral Resources Kerry Hickey (centre) with conference delegates.

- Exploration NSW update – the NSW Government's \$30 million exploration initiative
- advancing petroleum and coal seam methane exploration in NSW
- protecting natural resources values in NSW
- special session on the Broken Hill region – including presentations by Perilya, Consolidated Broken Hill and Platsearch
- special session on the Lachlan Fold Belt – including presentations by Alkane Exploration, Golden Cross Resources and Pasminco (Elura Mine).

Day 2 had the theme "Projects and Investing in New South Wales" and featured:

- keynote address by Mr Bob Cameron, Managing Director, Centennial Coal, on "Growing a resources company in NSW"
- management initiatives for maximising resource development returns
- overview of mineral resource development in NSW
- the NSW electricity industry – where to from here?
- natural gas developments in the Gunnedah Basin
- future development potential at Cadia and Northparkes, Murray Basin mineral sands update
- project updates, including Mineral Hill, Ultra Clean Coal, Tritton and new CSA Cobar discoveries.

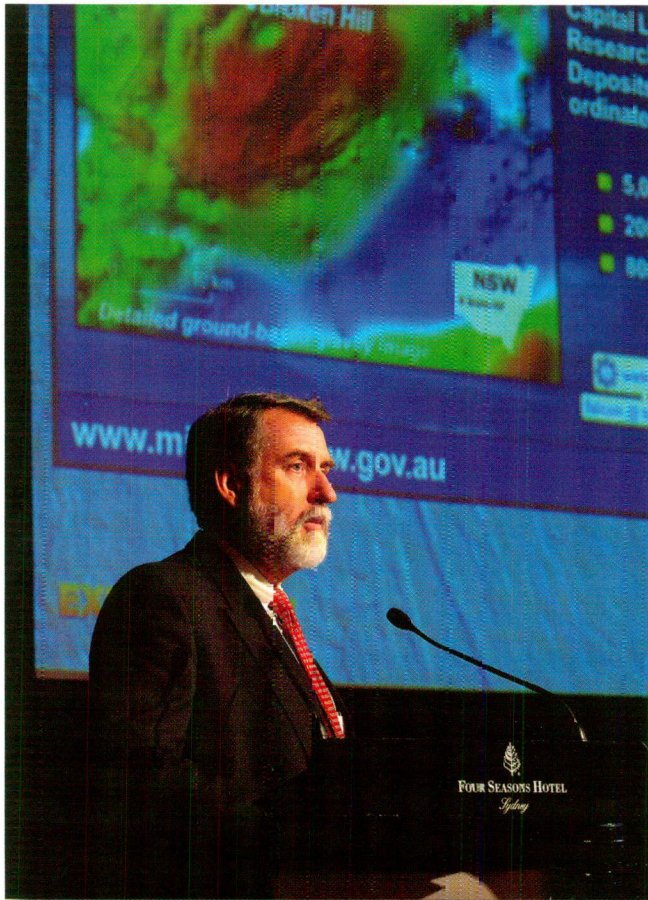
The adjacent conference exhibition featured displays from the Department of Mineral Resources, Surpac Minex Group, Golden Cross Resources Ltd, Fugro Airborne Surveys, Hellman & Schofield Pty Ltd, CRC LEME, Maptek Pty Ltd, Geoservices Pty Ltd, Australia's Paydirt and KPMG.

The strong attendance and positive nature of presentations at the conference augurs well for continued minerals investment and development in New South Wales.

The Conference package is available from the Department; phone (02) 9901 8269.

Exploration NSW – creating a premier geoscience framework for exploration investment

Dr Ted Tyne, Director, Geological Survey of NSW, Department of Mineral Resources



“Exploration NSW projects aim to deliver high-quality geoscience data.”

New South Wales is acknowledged globally as a province with an outstanding endowment of mineral and energy resources. In the past few years, the recognition of the State’s mineral wealth has been further boosted by discoveries of world-class porphyry copper-gold systems and other mineral deposits in the Lachlan Fold Belt and by the identification of a major mineral sands province in the Murray Basin. New South Wales is the home of the Broken Hill orebody – the world’s largest Pb-Zn deposit and a region that retains high potential for further major discoveries. The State’s rich endowment of coal resources has now been further augmented with the recent initial development of extensive coal seam methane resources.

Exploration NSW, launched in July 2000, is the NSW Government’s seven-year \$30 million initiative to promote a sustainable mineral and petroleum exploration industry in the State. Exploration NSW programs aim to enhance the State’s framework of geological, geophysical and mineral resources mapping and information. A cornerstone of the initiative is the generation of new geoscience data and mapping coverages, using the

latest exploration technologies, to further enhance understanding of the State’s mineral wealth.

Exploration NSW commitments over the period July 2000 to June 2003 have involved a total project expenditure of \$13.5 million, with the major emphasis on:

- mineral exploration in the Broken Hill region;
- petroleum exploration in the western sedimentary basins of the State;
- mineral exploration in the Lachlan Fold Belt and New England Fold Belt; and
- statewide exploration and geoscience information delivery.

Exploration NSW – minerals and petroleum projects

Exploration NSW projects aim to deliver high-quality geoscience data and knowledge-based products to promote mineral and petroleum exploration investment – in the State’s established mineral provinces and prospective sedimentary basins.

Figure 1 (on the following page) illustrates the State coverage of current and recent Exploration NSW mineral and petroleum projects in the Broken Hill region, Lachlan and New England Fold Belts and in the Surat/Bowen, Darling and Murray Basins.

The Broken Hill region continues to be a focus for Exploration NSW projects which are further supported by the geoscience contributions from the Commonwealth and South Australian government under the Broken Hill Exploration Initiative. The release of new products, application of new techniques and research collaboration with Cooperative Research Centres and CSIRO has substantially enhanced the exploration attractiveness of this region. New explorers have recently been attracted by potential for the discovery of Mount Isa-style copper-gold deposits.

Recent Broken Hill collaborative studies, project results and new mapping products include:

- a new Broken Hill GIS package on CD, including the latest geological and regolith mapping, geophysical and remote sensing datasets and extensive exploration and whole-rock geochemical datasets;
- studies of the age of the Broken Hill ore sequence yielding a correlation with the age of host sequences in the Mount Isa region;
- a review of the Broken Hill copper-gold potential, resulting in the identification of new exploration concepts and new exploration targets;
- new geological maps and datasets covering the Koonenberry region;
- trialling of new airborne survey technology with the acquisition of a HYMAP™ hyperspectral survey

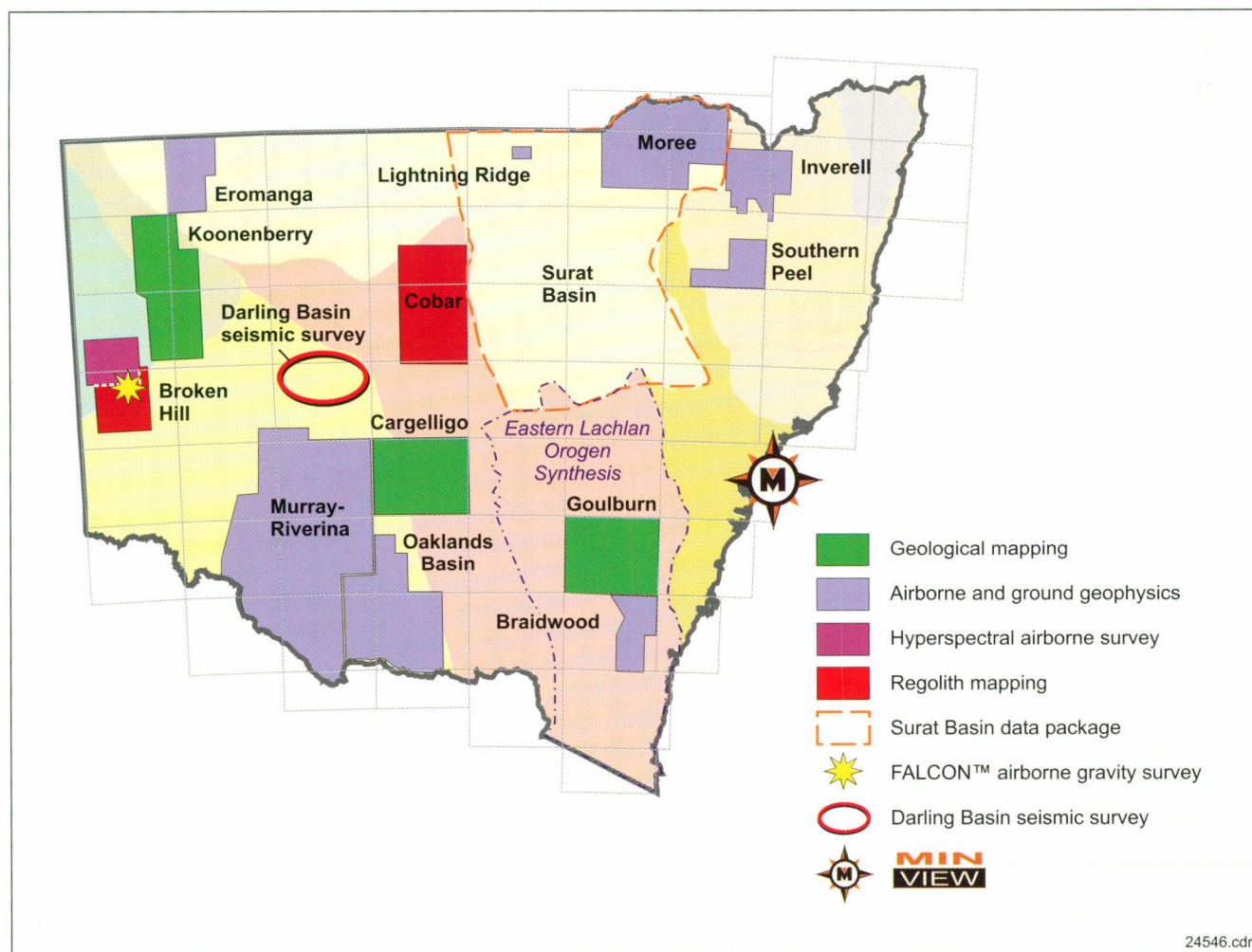


Figure 1. Exploration NSW coverage of geoscience projects 2001-03.

covering an area of 4000 square kilometres, the largest survey of this type in Australia;

- collaborative project with the Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME) to produce new regolith maps over the entire Broken Hill Block; and
- collaborative project with the Cooperative Research Centre for Predictive Mineral Discovery (*pmd**CRC) to undertake an airborne gravity survey using the FALCON™ technology over the Broken Hill lode zone and immediate host sequence.

In other regions of the State, Exploration NSW minerals and petroleum projects have been committed to the State's Far West, Central West and New England regions. This commitment has delivered the following major achievements:

- completed coverage of 70% of the State's area with high-quality airborne magnetic and radiometric surveys, 150 000 square kilometres of coverage having been added over the past three years;
- new regional mapping and mineral resource assessment, drilling and geochemical surveys and data releases over the mineral-rich rocks from the

Central Lachlan Fold Belt (Lake Cargelligo to Cobar and Bourke in the central north of the State) and the Eastern Lachlan Fold Belt (Goulburn region);

- new mineral resource mapping and data releases covering the western area of the New England region; and
- new airborne and seismic geophysical surveys, and data packages, to stimulate petroleum exploration in the vast sedimentary basins of the State, particularly in the Surat/Bowen Basins in the north of the State and over the Darling Basin in central NSW.

Exploration NSW – statewide projects

Exploration NSW has been committed over the past three years to State-wide compilations of geological mapping, historical exploration results and exploration geochemical and drilling data. A key focus has been the delivery of the State's geoscience databases to industry and government through CD packages and internet services. Major advances have been achieved with launches of:

- the world-leading DIGS internet service, which provides global access to the State's open-file exploration results, any particular type of data and company exploration reports covering the past 125 years; and

- the MinView internet service, which provides on-line map viewing of the State's exploration and mining titles and geology and other geodata coverages.

New geophysical coverages – a record year

NSW has maintained a strong program of airborne and ground geophysical investigations of the State's mineral provinces and sedimentary basins, using the latest advances in data acquisition and processing technologies. The past twelve months has been a year of record achievements in geophysical mapping.

A recent coup for NSW was completion of an airborne gravity gradiometer survey of the Broken Hill area. This is a first use of this technology by any government anywhere in the world. Exploration NSW project teams worked closely with the *pmd**CRC to coordinate the Broken Hill gravity survey which involved exclusive access to the BHP Billiton FALCON™ technology.

The FALCON™ airborne gravity gradiometer survey data, when combined with existing high-resolution gravity data, existing databases and the 3D geological modelling techniques developed by *pmd**CRC and its participants, will revolutionise understanding of the Broken Hill deposit and its regional setting. The survey covered 1000 square kilometres and included the Broken Hill Line of Lode, Little Broken Hill, the Pinnacles, Copper Blow and Galena Hill. First images were displayed at the BHEI Conference held in Broken Hill on July 7-9, 2003.

Another recent major achievement for NSW is the application over the entire Broken Hill Block of the HYMAP™ hyperspectral airborne technology. This HYMAP™ survey is the largest of its type conducted in Australia and has produced a detailed and rich dataset that may very well contain the "key" to another Broken Hill deposit.

About 70% of the State is now covered with high-resolution airborne magnetic and radiometric survey data. In 2002-03 Exploration NSW provided \$5 million for new geophysical surveys and geological mapping coverages, including a total of 220 000 line km of new high-resolution magnetic and radiometric datasets.

A recent airborne magnetic and radiometric survey completed in southwestern NSW covers the Oaklands Basin (within or below the eastern part of the Murray Basin). This region is largely underexplored but has potential for both significant conventional petroleum and coal seam methane resources. Survey data are being integrated into a digital data package on CD-ROM to be released in September 2003.

The State's largest-ever airborne geophysical survey, over the Murray-Riverina region, has now been completed (figure 1). New maps and images from this survey were displayed for the first time at the Conference. These new survey data will be of immense benefit to mineral exploration, conservation management and salinity mapping in the region. The airborne survey is a collaborative venture, with contributions from Exploration NSW and the NSW Resource and Conservation Assessment Council (RACAC).

New airborne magnetic and radiometric datasets acquired over the Inverell and Glen Innes region in northern NSW in mid-2002 have now been integrated into a GIS data package on CD and were released at the conference. The package includes geophysical images, a geological interpretation, exploration datasets, mineral occurrences, stream-sediment and grab-sample geochemistry, drillhole localities, tenements and previous company exploration report abstracts.

Exploration NSW – the latest geoscience information releases

A record number of new geoscience maps and CD packages were released at the Conference, including:

- Mineral Projects of New South Wales, Australia (2003) map;
- Eastern Lachlan Orogen Geological Synthesis and Geoscience Information CD Package;
- Inverell Geoscience Information CD Package;
- Goulburn 1:250 000 Mapping Program – Geoscience Information CD Package;
- Brigalow Belt South Geoscience Information CD Package;
- NSW Industrial Minerals Database CD Package;
- East Coobar Drilling and Regolith Studies – report on CD;
- Surat/Eowen Basin Petroleum Geoscience Information CD Package; and
- Murray-Riverina Geophysical Survey Data and Image Release.

Exploration NSW – future geoscience programs

The forward work program and directions for Exploration NSW from 2003 to 2007 will include various packages and services.

- Active promotion of the State's mineral and petroleum exploration opportunities, particularly in western NSW.
- Developing on-line access to the State's comprehensive digital geological and mineral system coverages.
- Challenging program of new regional geological and mineral systems mapping in areas of prospective yet concealed rocks in the north of the State.
- Major mineral mapping synthesis of the eastern and central Lachlan Orogen and the New England orogen.
- Further high-resolution airborne and ground geophysical surveys using the latest technology to deliver a complete geophysical coverage over all prospective mineral and petroleum provinces.
- Major studies over the State's sedimentary basins which have potential for petroleum and coal seam methane, using high-technology seismic profiling and drilling to support comprehensive 3D basin analysis and predictive modelling.
- Major synthesis and 3D predictive modelling of the Broken Hill and Curnamona region in collaboration with *pmd**CRC and the BHEI.

Cadia Valley Operations – still further development potential

Tim Lehany, General Manager, Cadia Valley Operations, Newcrest Mining Limited



“Cadia Valley Operations is the second-largest gold-producing site in Australia.”

Newcrest Mining Limited is now the largest remaining publicly listed Australian gold mining company. Newcrest has wholly owned operations at Cadia Valley in NSW and Telfer in the Pilbara, WA. Newcrest also has joint venture interests in operations at Gosowong in Indonesia, Boddington in southwest of WA and Cracow in Queensland. Telfer is currently undergoing a major one billion dollar redevelopment. Operations at Gosowong and Boddington are in hiatus and the Cracow project is expected to start underground development later this calendar year.

Cadia Valley Operations (CVO) is the second largest gold-producing site in Australia after the Super Pit operation in Kalgoorlie. Copper is also produced at CVO, making it easily the largest gold-mining site in Australia in terms of total revenue. CVO is now the production centre of gravity for Newcrest and will remain so for the next two years until the Telfer redevelopment is commissioned.

CVO consists of:

- a large low-grade open pit mine, producing 17 Mtpa of gold-copper ore;
- a large underground sublevel caving mine producing 5 Mtpa of higher grade gold-copper ore;
- an ore treatment complex with separate high- and low-grade streams treating 22 Mtpa of ore feed from the mines; and
- shared surface infrastructure, including concentrate handling facilities, tailings storage facilities and water supply and storage structures.

Total investment in CVO is \$900 million. This financial

year CVO will produce in excess of 650 000 ounces of gold and 60 000t of copper.

Based on current reserves, the operation of the Cadia Hill open pit mine will be complete 10 years from now, with the Ridgeway underground mine life extending to 2013. The development strategy for CVO is twofold:

1. to maximise value from current reserves by improving operational efficiency and metal recovery; and
2. to extend reserves and mine life in the medium term (and in one case the long term) through resource definition programs on the current mining leases and in the longer term through exploration on joint-ventured tenements to the east and southeast of the current mining leases.

Medium-term projects and resource definition programs

Open-pit mining of a small satellite orebody called Cadia Extended commenced in January 2003. This ore source will supplement mill feed from the main pit during a period of particularly high waste stripping activity over the next four years.

Drilling is currently underway on the depth extension of the Ridgeway orebody – known as Ridgeway Deeps. This program is confirming depth extension of a greater footprint extent than previously modelled. The aim of this program is to prove up sufficient ore at depth to justify relocating the underground crushing station deeper in the mine to ensure that Ridgeway produces at 5 Mtpa into the future.

Other potential near-mine exploration targets are being tested as potential feed sources for the high-grade mill into the future.

Long-term projects and exploration programs

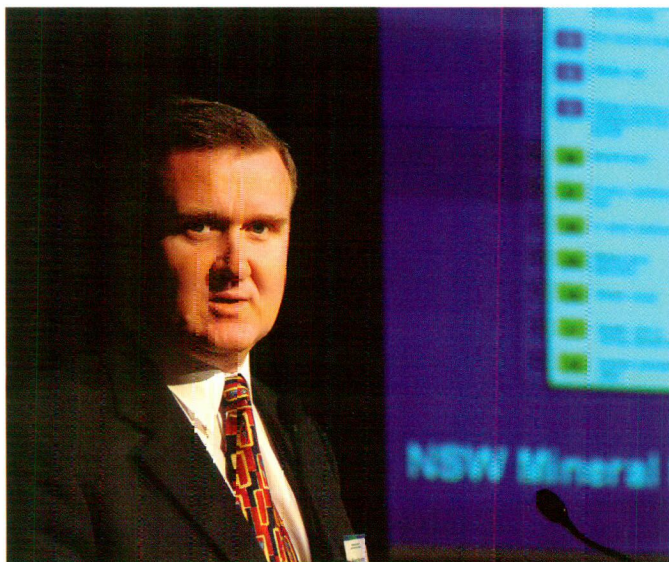
A large mineralised complex known as Cadia East lies to the east of the current Cadia Hill open pit on an existing CVO mining lease. Resource estimates for Cadia East and a high-grade part of a system called Cadia Far East have been generated from surface drilling programs. This system will be the focus of ongoing study and has the potential to be a very large orebody. Ongoing mine-based resource definition is expected to increase the resource and improve the conversion ratio to reserves.

Newcrest's Regional Exploration group is also actively exploring ground to the south and southeast of the mining leases in joint venture with Barrick and Climax Resources. This is all very prospective country that has hosted historic mining activity, including the Junction Reefs Mine. The area has not previously been tested by modern exploration for Cadia-style mineralisation.

The Cadia East complex and off-lease greenfields exploration represent a significant opportunity to grow CVO's metal endowment within the catchment area of the established infrastructure. ■

CSA Mine – uncovering buried treasure

Richard Morland, General Manager, CSA Mine, Cobar Management Pty Ltd



“A new climate based on sustainability.”

Background

The CSA Mine is an icon of Cobar, central NSW. The mine, 10 km northeast of Cobar, was discovered in 1871. Since 1965, it has been operating almost continuously, though experiencing very cyclic behaviour in terms of performance and profitability.

A watershed in the mine's history occurred in 1999 when Cobar Management Pty Ltd (CMPL) took control of the operation, following its closure in 1997-98, by Ashanti Gold.

A new business model

CMPL adopted a very different philosophy from that under which the mine had operated until 1997. Until that time, the mine had been operating at over 1 million tonnes per year (Mtpa), but at head grades of 2-3% Cu, or less. This reflected a 'tonnes mentality' very common amongst a number of mining companies, and reflected an acceptance of dilution as a natural consequence of large-scale mechanised mining.

CMPL adopted a strategy which paid much closer attention to wallrock dilution and excavation stability, opting for a production rate of around 500 000 tpa, but at head grades of more than 5% Cu.

Faith in hand with this small tonnage philosophy came a reduction in fixed costs, through a smaller equipment fleet and fewer people, but achieving metal output almost as high as that achieved with the higher ore production of previous years. The business model was based on utilising existing plant infrastructure – very little new capital was required to restart the operation.

In addition much good work was begun in the area of workplace culture. A new climate based on sustainability was created, with a focus on safety improvement, best practice environmental performance, and a move

away from the restrictive labour practices of the past. Contractors were employed for all core mining activities, and a move to contract labour in the ore-processing area followed in 2000, following its success in the mine.

1999 and 2000 were good years with high metal output, high productivity and high metal prices

But problems were looming.

Backfill and stope failures

The last quarter of 2000 revealed the first signs that the CSA Mine would live up to its reputation of being 'difficult'.

A high-grade stope failed late in the year, continued to cave, and set off a chain of events that resulted in a steadily declining performance over the next 12 months. This circumstance arose from stress-related ground activity not anticipated in the feasibility study for the new CSA.

The 2001 year saw the operation just achieve its budget in terms of ore output, but development, backfilling and operating costs were unsatisfactory, due to the ongoing effects of the stope failure, and protracted attempts to recover from its consequences. The mine failed to make a profit or any positive cashflow in the last six months of that year.

By the end of 2001, the mine was out of ore, and things were looking grim.

2002 – back to basics

The 2002 year was one of recovery and consolidation, with the aim of bringing the mine operations back under control.

The factors that were at the heart of the mine problems in 2001 were:

- inadequate planning;
- inability to place backfill;
- inadequate rock mechanics input to the operations;
- inappropriate organisational structure; and
- poor execution of strategy.

The mine plan was completely revamped, with a reduction from an initial ore production target of over 700 000 tonnes, to a more realistic target of 550 000 tonnes.

The organisational structure was overhauled, with a division into three functional areas – Mining, Ore Processing, Site Services – and a clear definition of accountabilities for the leaders in each of the areas.

Accountability for decisions was placed back into the hands of CMPL, moving away from the 'management by committee' approach that had been enshrined in some of the contractor relationships until that time.

Importantly, a focus was retained on 'in mine' exploration drilling. This was done to ensure that a start was made on collecting the data required for the resource definition, crucial to developing a long-term plan for the operation.

Performance improved steadily through 2002 as the various initiatives took effect.

By year's end the operation had achieved record ore production, record mine development, record safety performance, and near-record concentrate production since the beginning of CMPL operations.

Further, the mine and mill employees had joined CMPL, and the financing of the underground equipment fleet had been restructured, to enable CMPL to take ownership of the fleet in early 2003, for a fraction of the cost of new equipment.

A substantial improvement in costs was achieved, and the infrastructure in the mine and mill had received much-needed maintenance without 'blowing the budget'.

The operation returned to monthly profitability in July 2002. The full year result in EBITDA terms was above the line, but there was a small net loss after depreciation and tax. Nevertheless, the result was significantly ahead of expectations.

It was notable that the revenue generation capability of the mine had been restored through a commitment to better planning, communication and execution of strategy.

Significantly, the 'in mine' exploration program had allowed the first JORC-compliant resource and reserve statement to be compiled by July 2002, setting the scene for the completion of a draft life-of-mine plan by December 2002.

Buried treasure

Critical to the ongoing success of the operation is identification and quantification of additional sources of feed. Underground exploration drilling has revealed a significant extension of the main copper-bearing lenses in the QTS North ore system. These lenses are semi-continuous to a depth of nearly two km below the surface, and are increasing, in grade and width, with depth.

In addition, drilling is revealing other lenses previously disregarded, or not of interest due to their characteristics. These lenses are improving with depth, providing confirmation of the potential of the existing mine.

The reserves/resources position as of July 2002 was as follows:

| | | |
|--------------------|-------------|---------|
| Proven Reserve | 710 090 t | @ 6.01% |
| Probable Reserve | 1 328 236 t | @ 6.62% |
| Indicated Resource | 198 000 t | @ 5.84% |
| Inferred Resource | 4 969 000 t | @ 3.90% |

A further amount of 6.96 Mt @ 3.68% Cu had been identified, but was unable to be categorised due to the sparse information available from drilling.

These results point to an 'embarrassment of riches', of sorts. Of course, the conversion of this potential into a viable business still requires detailed work, and successful execution of plans. In addition, substantial conversion of resource category material into mineable reserves is required, though there exists a high level of confidence about the conversion ratio, based on experience to date.

Looking ahead

The CSA 'near mine' setting and surrounding tenements is highly prospective for repetitions of CSA-style mineralisation, as well as mesothermal (Peak-style) gold mineralisation.

Data generated by previous operators has been incorporated into a GIS database which is the cornerstone for current exploration activity. Further development of the geological model for the CSA mine will be a high priority and provide additional near-mine exploration targets.

Underground potential

Underground exploration in 2003 will focus on deep resource confirmatory drilling and exploration for mineralisation parallel to existing lenses. Generation of targets in the underexplored upper levels of the mine will also be undertaken. Extensions of, and additions to, upper level underground resources offer the best chance of low-cost additions to metal output. There is great confidence that such extensions to the resources will be identified.

Surface potential – the next CSA?

CMPL holds about 300 km² of exploration ground surrounding the existing operation. This ground has not been explored in a systematic fashion for many years, due to operational and corporate issues associated with the CSA Mine. CMPL has committed itself to a systematic evaluation of this ground, utilising modern exploration techniques, basic fieldwork, and an assessment of previous work carried out by Ashanti, Rio Tinto, Golden Shamrock Mines, and others.

The prospects on the CSA leases have the potential for Cu, Pb, Zn and Au mineralisation. Five styles of mineralisation are recognised and will be targets of surface exploration in 2003, and onwards.


- Repetitions of CSA-style base metal mineralisation in the CSA Siltstone along the CSA Fault.
- Peak-style mineralisation Au with or without base metal mineralisation, associated with the Peak Fault and hosted in the Chesney Formation.
- Billigoe–Mount Drysdale-style Au mineralisation associated with northeast-trending structures developed in the hinges of anticlines.
- Structurally hosted quartz–gold veins associated with major structures such as the Rookery Fault.

The CSA Mine is in 'elephant county'. Exploration tenements border the Peak Gold Mine to the south, and Elura to the north. This area contains the right rocks and right structure to host more potential mines.

The best is yet to come

Currently identified resources have resulted in an estimate of a greater metal volume in the ground than has been extracted from the CSA Mine in the last 37 years.

A combination of vision and a clear operating strategy has seen reinvigoration of the mine in the last 12 months.

Strong corporate support, development of a sustainable business model for the operation, and an ongoing commitment to exploration within the current operations and in the highly prospective tenements surrounding these operations, may mean that the best years of the historic CSA Mine are still to come. 

Why Barrick is investing in New South Wales

Patrick Garver, Executive VP and General Counsel, Barrick Gold Corporation

I'm probably not the first to tell you that I find a lot of similarities between your country and Canada. On some levels, we have parallel lives...both our countries share similar historical roots, similar legal and political systems, and we have both grown into vibrant multicultural societies. We both have our own unique and often colorful take on the King's English.

But most importantly, for our discussion today, we share a common mining heritage. Mining is at the historical root of your success as a nation, and ours. My topic is "Why Barrick is Investing in New South Wales". The explanation is simple. Over time NSW's long experience with mining has contributed to the development of not only the mining expertise among your citizens, but also to the establishment of institutions, laws, and practices here in NSW's that facilitate and protect that investment.

At Barrick, we are proud to be one of the largest gold producers in Australia. But we are still relative newcomers. We arrived, as you may know, with the Homestake merger in late 2001.

When we proposed to merge with Homestake, we had our eyes on Australia and the future of mining in Australia. We were attracted to Australia and to NSW for a number of reasons.

First and foremost, Australia has vast mineral resources – and the next chapter in defining and developing their potential remains to be written.

You have a great mining tradition – mining expertise that is among the best in the world. You have well-educated, hard-working employees; not to mention a living standard and quality of life that is extremely attractive.

NSW has a well-developed physical infrastructure – roads, water, power and the like – that facilitates development of new projects.

NSW also offers a well-established legal, political and fiscal infrastructure – one that has managed to remain relatively stable and transparent at the same time that it has evolved to reflect contemporary values and needs.

Barrick

But first I want to tell you a bit about Barrick. I think that the more you get to know about us, the more you'll see why Barrick and Australia make such a good fit. It will also help put in context some of my comments about why



"Australia is one of our four targeted areas."

– in the global universe that Barrick finds itself operating – we like Australia and NSW as much as we do.

On the operational side, Barrick is one of the world's largest gold producers.

Barrick's estimated production for 2003 is between 5.4 and 5.5 million ounces. Including Australia, it has significant operations in seven countries on four continents – Canada, the United States of America, Peru, Chile, Argentina and Tanzania.

We employ more than 7000 people – and Barrick is a large, liquid gold stock. Our market cap is US\$9.7 billion, with an average daily trading value of US\$50 million. Our balance sheet is "A" rated, with US\$1.1 billion in cash and no net debt. Which gives us the resources to develop projects – like our Cowal project here in NSW – properly.

Barrick is placing an increasing and significant emphasis on exploration. This year we have what we believe to be the largest exploration budget of any gold company in the world – some \$US100 million on exploration and corporate development initiatives. And, I might add, Australia is one of our four targeted areas for those expenditures.

Thanks to our acquisition of Homestake, we are well established in Western Australia. We have a 50% interest in the Super Pit there which, as you know, is the largest gold mine in Australia. We also operate three mines: Plutonic, Lawlers and Darlot, which are in the Yilgarn district. In 2002 in Australia we produced more than 925 000 ounces of gold. We employ some 1500 people

in Australia. We will employ even more when the Cowal project here in NSW begins development.

I will come back to Cowal, which is a key building block in our future and I'll explain where it fits in – and I'll also bring you up to date on some exciting new progress at Cowal. But first, let me tell you briefly what else is new with Barrick at other places around the world where we are active:

Bulyanhulu

First let's start with Africa. Our most recently developed new mine is the Bulyanhulu project in Tanzania in east Africa. It just finished its first calendar year of production, producing some 356 000 ounces of gold in 2002. Bulyanhulu is our first project in Africa. While we still have some more work to do at Bulyanhulu, we are delighted with the initial results, and feel we have established an important presence on the African continent. We are presently evaluating a second Tanzanian project, known as Tulawaka, and should make a decision whether to proceed later this year.

Alto Chicama

In April 2002, we announced the discovery of a significant gold deposit at our Alto Chicama Project in Peru. Initial resources were estimated to be 3.5 million ounces, and have grown to a mineable reserve of 6.5 million ounces at year-end. And we believe there is more room to grow.

We estimate that Alto Chicama will produce half a million ounces per year, at an average cash cost over the first decade of US\$130 per ounce. Capital costs are projected at US\$300 to US\$350 million. This year, a focus of the project is to complete a comprehensive Environmental Impact Statement as a predicate to moving forward with development.

Pascua/Veladero District

Another extremely promising area is in the Pascua/Veladero District, straddling the border between Argentina and Chile in the Andes mountains in South America. It's one of the largest undeveloped gold districts in the world, with more than 25 million ounces of gold reserves.

Veladero

The most immediate project in that District is our Veladero project in Argentina. There, access road and camp infrastructure construction have already commenced. Capital cost estimates for the entire project are US\$425 million.

Veladero's mineable reserves are now estimated at 9.4 million ounces. Production is expected to average 530 000 ounces per year. Veladero is scheduled to commence production in early 2006.

Pascua-Lama

A second project in the district is Pascua-Lama. That project is our most significant undeveloped property

– with reserves of some 16.9 million ounces of gold and 594 million ounces of silver. We plan to turn our focus to Pascua-Lama once Veladero is well underway. We have previously estimated that Pascua-Lama will ultimately add some 800 000 ounces per year to our production profile.

Mining investment in NSW

Barrick has properties, exploration or development projects, or operating mines in some two dozen countries.

As recently seen here in Australia, the gold industry has been consolidating. Those companies that remain standing – like Barrick – necessarily become increasingly global in their reach. This globalisation forces daily focus onto factors that affect exploration and mining investment decisions.

There has been a lot of work done in the academic world to try to identify the factors that are most important to the decisions of mining companies as to where they spend their investment dollars. This obviously has been of considerable interest to many, particularly developing, countries that recognise and covet the many positive impacts of mining investment. Indeed, the late 80s and the 1990s saw scores of developing countries come up with new mining codes, and new laws and policies governing foreign investment, foreign exchange and taxation, to try to attract new mining investment.

So, what are the factors that influence mining investment decision-making? And how does NSW stack up?

The first criterion, of course, is geological potential. This is not something that government policy makers have control over. Australia stacks up here very well indeed.

After geologic potential, there are several criteria that stand out:

- security of tenure;
- consistency of mineral policies;
- ability to predetermine environmental policies;
- ability to achieve fiscal and tax stability for the life of an investment; and
- a transparent and predictable rule of law.

On almost all of these criteria, NSW does very well.

It is quite possible, however, that some may take the virtues of public policy in NSW for granted – and that would be a mistake. Sometimes it is useful to reflect on the issues that are not present here in NSW, to appreciate the competitive advantages that exist here. As a company doing business all over the world, I can tell you about issues that are not on the radar screen here:

- transparency in the judicial system;
- a non-discriminatory foreign exchange regime;
- the ability to repatriate profits; and
- the ability to raise external financing.

All are huge issues in many of the other countries that make up the world's gold industry in 2003.

Obviously, there have been issues in Australia that make the investment waters murky and uncertain. You are more familiar with them than I am, but issues like proper treatment of Aboriginal land claims, mining industry taxation, and mining royalties in Western Australia certainly come to mind. But even in your ongoing progress resolving these difficult policy issues Australia has acquitted itself relatively well. And that is not something that one can, or should, take for granted. Finding appropriate solutions to difficult public policy issues is a commodity perhaps more rare than gold.

Corporate social responsibility

I have already talked about where we operate, or plan to operate. Now I'd like to focus on how we operate.

We have been taking a cold, hard look at all aspects of our activities at Barrick, to see where we can improve and reach new standards. And I have to tell you, wherever we operate, one of the most important issues for global companies like ours is corporate social responsibility, in terms of the environment and in terms of working with the communities in which we operate.

It is much, much more than a matter of merely aspiring to "do the right thing", although this certainly comes into the equation too. For us at Barrick, corporate responsibility is also a guiding principle because it is our calling card.

It works like this: when we come to a new country or region to explore or develop a property, we bring with us our reputation and track record. These guide us in our day-to-day decisions, but they also guide the communities and leaders we hope to work with in their decisions – the decision as to whether we will be welcome.

We seek to build community trust in every aspect of what we do. We keep an open door to the communities we share, and encourage any and all stakeholders to meet and discuss the issues that matter to them. And we work from the bottom up. In other words the communities themselves help define the social development programs that we implement – rather than having standardised programs imposed by some distant "head office."

We invest in communities and community building. And we believe that there is a compelling business case for that investment.

Let me mention a few examples of Barrick's community investments.

- At Bulyanhulu in Tanzania, for example, we have spent more than US\$6 million (and invested some 240 000 person hours) on job training, built medical clinics and schools and installed a water pipeline that serves some 30 000 people.
- At our flagship Goldstrike Property in Nevada, in the US, home to the Betze-Post and Meikle mines, our

operations have donated more than US\$11 million over the last decade to the state's communities and charities.

- At the Eskay Creek Mine in British Columbia, Canada, we attribute our success to the strong community relationships we have built, including the local Tahltan communities, whose Traditional Territories encompass the mine site.

Since shortly after its establishment 20 years ago, Barrick's policy has been to donate 1% of annual pretax income of the company as a whole to local community causes. This is in addition to what we contribute to the local infrastructure or pay in taxes, royalties, duties, payroll; and the like. A couple of modest local examples: donations from operations here in Australia sent a Western Australian team of Aboriginal students to attend the national Aboriginal student games; our donation at Plutonic helps keep the Royal Flying Doctor Service serving remote communities in the outback; and we have recently contributed to the construction of a new aged-care nursing home in Kalgoorlie. We are proud to give something back to the communities – in terms of donations, training, education – and environmental stewardship.

In this respect, I am also proud to share with you the fact that Barrick and Homestake have received scores of environmental awards and commendations at our mines around the world, including the prestigious US President's Council on Environmental Quality award. We're also pleased to be the holders of a 2001 Golden Gecko Award, presented to Australian operations by the Western Australian Government for environmental excellence in the resource industry; and a Certificate of Merit, presented to the Plutonic Mine for excellence in environmental management.

Cowal

I have been going through all this because, as I said earlier, I want to spend some time in particular discussing Cowal, and providing a broader context for my comments on that important project.

Barrick's Cowal Gold Project is north of West Wyalong, and 350 km west of Sydney. It's an advanced development project that we acquired in the Homestake merger in 2001. The project itself was acquired earlier that same year by Homestake from Rio Tinto.

Last year, drilling and engineering studies continued at Cowal to optimise the project and update the feasibility study that was already underway. A revised feasibility study is expected fairly soon.

To date over 300 new drillholes have been completed (102 000 m) – designed to infill previous drilling, particularly in the deeper parts of the ore body; to collect samples for metallurgical testing; and for engineering and

hydrological studies. At the peak late last year there were 12 drills at work on the Cowal property, currently there are five. We are also progressing on final permitting matters, including a number of ancillary licenses and permits that are conditions of the development consent.

Today I can announce that we are one step closer to making the Cowal project a reality for Barrick and for NSW.

I am pleased to tell you that Barrick Australia Limited and the Wiradjuri Condobolin Native Title Claim Group have reached an important agreement relating to the development of Cowal – an agreement that will ensure that wide-ranging benefits flow to the Wiradjuri community, all while respecting and promoting their cultural heritage.

Under our agreement, Barrick will support the Claim Group to establish the Wiradjuri Condobolin Corporation to deliver benefits to the Wiradjuri Community, as well as to provide cultural heritage services to Barrick and others operating in Wiradjuri Condobolin country.

A joint Education, Training and Business Development committee will be established. Barrick will also provide funding for multiple scholarships and apprenticeships and for pre-employment training.

To help build community understanding of Wiradjuri culture, Barrick will provide an annual grant for the establishment of a Centre for Wiradjuri Studies, and will help create a keeping place and transportable display about the Wiradjuri Condobolin people.

Community support

Richard Weston, Cowal Gold's Resident Manager, described this agreement as bringing us closer to commencing the Cowal Gold project – and the benefits it will bring to the entire region. Percy Knight, a spokesperson for the Wiradjuri Condobolin community, described the agreement as “a new beginning”.

And we think they're both right.

We are thrilled that the community supports what we are doing – it underscores to us that our attention to environmental and community concerns is the right way to go. I hope you will become familiar with the details of our project and agree that we are taking the right approach.

Subject to the approval of the board and final permitting, construction is expected to begin at Cowal in the second half of 2003, with production start-up planned for mid-2005. We project capital costs of US\$180 million to bring Cowal into production.

When we go ahead at Cowal, we will do so according to the strong safeguards that are in the Environmental Impact Statement and Development Consent, as well as

additional measures that we identify along the way that lessen the impacts of our development. I'll give you some examples of what we are doing.

One of the issues Barrick discovered was the degraded condition of the Red River Gum habitat, due to historic land use practices. The company is working with the Lake Cowal Foundation, which includes several important environmental organisations, to plant some 40 000 native seedlings. It's part of a broader regeneration project that will also be used to develop future mine rehabilitation strategies.

Some innovative measures to lessen our environmental footprint at Cowal have been developed. For example, exploration drilling achieves zero fluid discharge, thanks to a system that eliminates the need for excavating sumps beside the drill rigs. Instead, water from several drills flows to a centralised holding tank, where sediments settle before the water is returned to the drills.


Your inspectors from the NSW Department of Mineral Resources have commended Barrick for this environmental innovation.

Strategies have been developed to capture and reuse stormwater and to recycle water from the tailings storage facilities and ore processing areas. The effectiveness of all our environmental management systems is being monitored, to ensure that as much as can be done is done to protect water quality, minimise noise and dust, protect wildlife and restore habitat.

An independent panel, which Barrick is funding, and which includes arms-length experts, will monitor the environmental measures taken at Cowal. The panel will provide independent environmental audits of the project and will prepare an annual State of the Environment Report. A second group, the Community Environment Monitoring Consultative Committee, will also monitor the project.

I'm delighted to tell you that your own government authorities are working with us in a thorough and professional manner, consistent with the laws of NSW. These authorities have been tough – but, most importantly, they also have been fair, responsive and entirely transparent – which is all an investor – or the public – can ask.

Government cooperation is important – and welcome. But it is not enough.

Barrick's experience indicates that the most important cooperation necessary to make projects like Cowal a success is to gain the confidence and support of the community. But this is not something that can ever be taken for granted – it has to be worked on continually, throughout the life of a mine project. It has to be earned – over and over again. 

New mineral potential at Broken Hill

Barry Cahill, Operations Director, Perilya Limited

The Broken Hill lead-zinc-silver mine in western NSW was acquired by Perilya in May 2002. After recruiting a new workforce, operations recommenced in July with production scheduled to reach 2.4 million tonnes of ore and 450 000 tonnes of concentrate per year. Perilya has undergone tremendous change in the past 12 months and today is Australia's largest independent zinc miner. Broken Hill has the potential to generate cash flows for at least 10 to 15 years and provides Perilya with an outstanding opportunity for growth.



"Broken Hill offers exciting potential."

The transformation from medium-sized gold mine to owner of one of Australia's largest underground base metal mines has been successfully completed and concentrates production targets are currently being met and in some cases exceeded. Concentrates produced from Broken Hill are a premium product containing grades of 50% zinc in zinc concentrate and 70% lead in lead concentrate. Off-take agreements on normal commercial terms have been established with Pasminco for three years and provide for 50% of zinc concentrate to be delivered to the Risdon smelter in Tasmania and 80% of the lead concentrate to the lead smelter at Port Pirie in South Australia. Korea Zinc has agreed to buy the remaining 50% of zinc concentrate production at commercial rates on a long-term contractual basis. First lead and zinc concentrates were shipped to Pasminco in July 2002 and first zinc concentrates were delivered to Korea Zinc in September 2002.

Broken Hill is one of the largest lead-zinc mine areas in the world, having been discovered in 1883, with major production since 1885. During that time it has produced

over 200 million tonnes of high grade ore. The mine has a large and well-defined resource base allowing Perilya to schedule mine production for nine years at an annual rate of 2.4 million tonnes. Potential to expand reserve tonnages and increase grades is realistic and achievable. At the time Perilya began operating the mine, estimated reserves were 11 million tonnes at 7.7% Zn, 4.0% Pb and 42 g/t Ag within a total resource base of 26 million tonnes at 9.6% Zn, 5.5% Pb and 57 g/t Ag. The assumptions used for dilution and grade factoring, in converting resource grades to reserve grades, were considered conservative by Perilya. The increasing grade of the operation, subsequent to Perilya improving aspects of the mine, has shown this consideration to be correct.

As well as quoted resources, "Additional Mineralisation" (more than 31 million tonnes at Southern Operations alone) consists of mineralisation previously classified as resource but downgraded because cost structure, access issues and other factors made it uneconomic to extract. Perilya is in the process of reviewing this mineralisation and a component of it will be reclassified as resources and reserves – indeed some of the mineralisation has already been mined as part of Perilya's revised schedule.

Perilya is running the operation to optimise profit, which has put the emphasis on minimising dilution rather than maximising tonnes. Metal production is currently on target from approximately 90% of the planned production tonnes. Due to improved stope design better grades are being mined than anticipated and reduced dilution, through better mining practices, is being achieved. Head grades since December have been 10-15% above the plan, which was based on historical resource to reserve grade conversion factors, and 30-40% higher than the head grade achieved in the year prior to Perilya taking over the operation.

As expected, it has taken time to turn the operation in a different direction. For example:

- the mine plan had very little flexibility at recommencement of mining;
- stopes developed and stocks drilled prior to Perilya taking ownership were locked into the schedule and had to be mined as-is; and
- improving mine geology understanding and mining practice has taken time, but efforts in this regard are now starting to take effect, with a very satisfactory result being the increased head grade to levels not seen at the mine since 1994.

Perilya is also commencing the North Mine Project, with decline access from No. 1 open pit allowing mining of stoping blocks in the old North Mine 3 Lens. The project preparation has commenced with all mining approvals received. The commencement of the project is another milestone in Perilya's plan. The project will provide

an alternative ore source to allow the whole site more flexibility and allow material to be mined that would have otherwise been considered uneconomic.

As Perilya settles in the project is looking a lot more robust than it did at purchase eight months ago and project risk is reducing by the day. There is still a lot of room for improvement, and work is continuing at optimising cash flow from the operation. Improvements in safety performance, services costs including electricity and water, and supply savings are continuing to reduce costs. Improved mine and mill efficiencies, along with upgrades to site facilities, continue to be implemented, resulting in productivity increases. Alternative treatment methods are also being investigated to increase revenue.

Attractive growth prospects for Perilya stem from the satisfactory progress achieved so far at Broken Hill, and from continuing operational improvements and excellent exploration opportunities. Although Broken Hill already has a large resource base and a minimum nine-year mine life, exploration success has the potential to significantly improve project economics and therefore cash flow. As well, exploration success would improve operational flexibility, further reduce risk, and extend mine life.

From an exploration viewpoint, Broken Hill offers exciting potential. The Broken Hill mine is in high-grade metamorphic rocks of the Early Proterozoic Willyama Supergroup in the Broken Hill Block. The ore deposit, consisting of six or more distinct lode horizons, is generally stratabound, with intense structural modification along

shears and related folds causing complex ore geometries and upgrading of mineralisation. The complexity of the deposit makes it an attractive exploration play, and potential exists for structural repetitions of various ore lenses. A comprehensive review and reinterpretation of 115 years of exploration and mining data is being undertaken. An understanding of the geological controls on ore formation is critical for targeting new mineralisation and extensions to old ore bodies, both in the near-mine environment and on a regional scale.

Reinterpretation of the Broken Hill Southern Operations is underway, and has yielded significant potential in a number of locations. As this work progresses through the rest of the mine, generation of additional exploration targets is expected. After completion of the near-mine reinterpretation, exploration will move to step-out targets, utilising the understanding obtained from the near-mine work, and subsequently to other prospects on the mine leases.

Perilya's regional mining and exploration tenements cover 678 square kilometres of prospective terrain. Compilation of the extensive exploration and mining databases for the entire tenement package is in progress and has so far identified targets at Little Broken Hill and Potosi. Greenfields targets are expected to emerge throughout the exploration licences.

Broken Hill has a great future and the realisation of new mineral resource potential will see this world-class operation continue for many more decades.

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New exploration breakthroughs at Broken Hill

Lindsay Gilligan, Assistant Director (Minerals Assessment),
Geological Survey of NSW, Department of Mineral Resources

The Broken Hill silver-lead-zinc ore body is arguably the world's largest accumulation of base metals. The pre-mining size of this fabulous deposit is estimated to have been 280 million tonnes of 20 percent combined lead-zinc. Since discovery in 1883 the Broken Hill Line of Lode has produced over \$70 billion of metal. The Broken Hill deposit stands out as a giant ore body by world standards and yet it is only one of thousands of known mineral occurrences in the Broken Hill region. The potential for additional substantial discoveries is excellent and accordingly the NSW Government's Exploration NSW initiative has a major focus on the region.

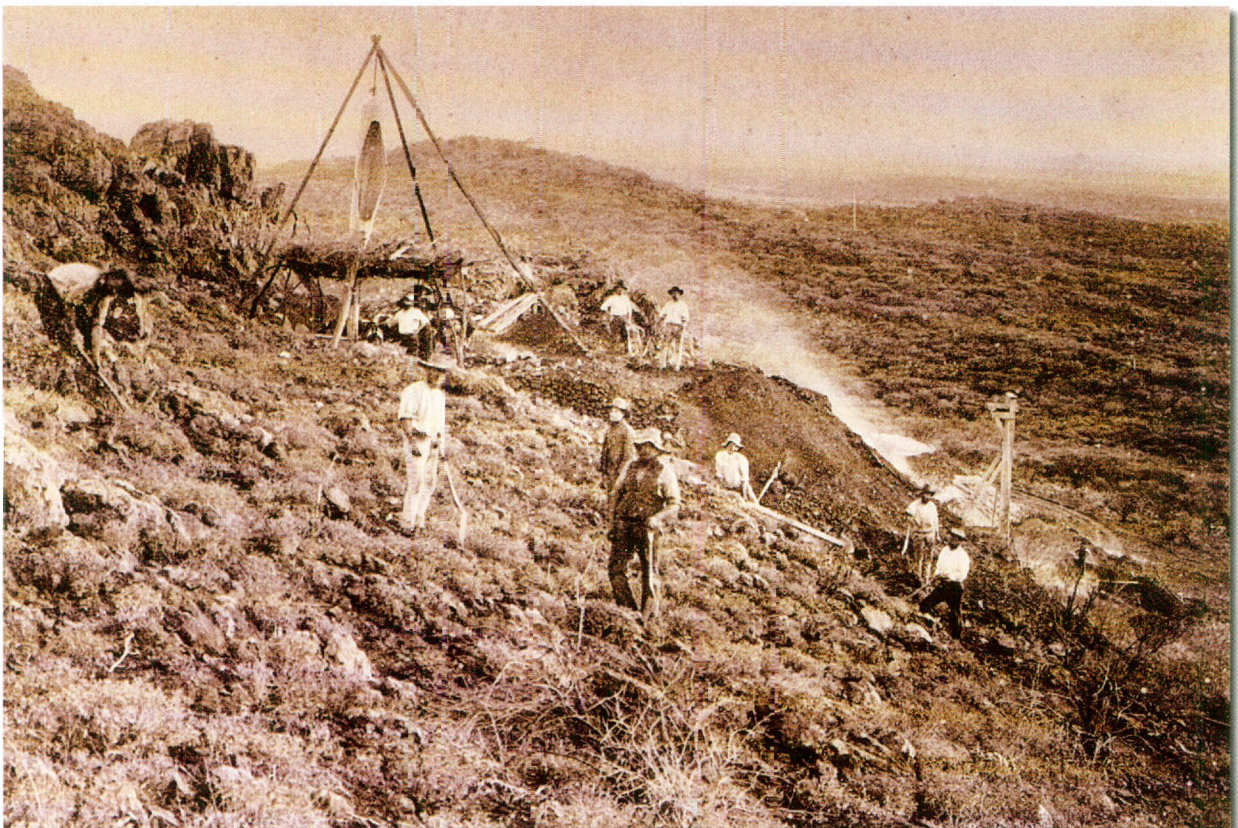
The complexity of the Broken Hill geology demands a cooperative effort to fully appreciate the nature of controls on mineralisation and provide a knowledge framework for exploration in the region. In the mid-1990s, the South Australian, Commonwealth and NSW Governments launched the Broken Hill Exploration Initiative (BHEI). The purpose of the initiative was to stimulate new exploration in the Broken Hill region and across the border in South Australia. This initiative has proved an outstanding success producing vast new datasets and knowledge and generating industry enthusiasm for exploration in the Broken Hill region. This important collaborative initiative among the three governments has

been renewed under the auspices of the National Geoscience Agreement. More recently the Cooperative Research Centres for Landscape, Environments and Mineral Exploration (CRC LEME) and Predictive Mineral Discovery (pmd**CRC*) have joined the BHEI.

Results of recent exploration and research in the Curnamona Province have dramatically increased opportunities for explorers in the Broken Hill region.

The new geophysical coverages, new hyperspectral mapping, regolith science, research on structure and controls on mineralisation, geochronology and isotopic studies have taken understanding of the Broken Hill mineral systems to a new level. Furthermore, the information coverages available over the Broken Hill region set a new global standard. They include: detailed lithostratigraphic and regolith mapping coverages; metallogenic mapping; high-resolution airborne magnetic and radiometric data; exploration datasets (drilling and geochemistry); detailed gravity data; high-resolution hyperspectral mapping; and, now, airborne gravity data.

Exploration NSW is also improving geoscience and mineral exploration databases to ensure that results of the extensive exploration work at Broken Hill are available to new explorers.



Karl Rasp's shaft on the Line of Lode at Broken Hill circa 1883.

Exploration NSW is supporting CRC LEME – which has enhanced research into mineral exploration in the regolith at Broken Hill. Exploration NSW is also sponsoring coordinated research in the Broken Hill region under the pmd*CRC, with a focus on determining the three-dimensional structure of the Broken Hill Block.

In 2002, Exploration NSW funded a state-of-the-art, airborne HYMAP™ hyperspectral survey which maps the mineral composition of rocks and soil. Results of the survey will lead to new mineral exploration opportunities in the Broken Hill area. Processing of this vast dataset will allow detailed mapping of alteration systems which are key vectors to mineralisation.

A more recent highlight was the completion in March this year of an airborne gravity gradiometry survey over the Broken Hill area. This survey used the revolutionary FALCON™ system, which has been developed by BHP Billiton. The release of this Broken Hill data in 2003 is the first public release of any FALCON™ survey data. This survey was conducted in collaboration with pmd*CRC and will contribute to the refinement of a three-dimensional model of the Broken Hill Block originally developed as a project between Pasminco and Fractal Graphics. Understanding of the third (as well as the fourth) dimension is critical to predict the likely depositional sites for major mineral systems in three-dimensional space. This is the frontier for modern mineral exploration.

Recent Exploration NSW geochronology studies have provided an insight to the fourth dimension of Broken Hill geology. The stratigraphic sequence developed by the Department of Mineral Resources has now largely been validated and calibrated. The Paragon Group, at the top of the Broken Hill sequence, is now known to be a time equivalent of the Isa Superbasin, spanning the ages of the host rocks to the Mt Isa and McArthur River orebodies. The fine-grained, originally organic-rich facies of the Paragon Group has similarities with Isa Superbasin facies. Stratabound Pb–Zn anomalies have been detected in the Paragon Group at a time-equivalent position to the Mount Isa Pb–Zn orebody. Furthermore, correlations between various levels of the Broken Hill and Olary stratigraphic sequences are now firmly established, including correlation between the base metal- and tungsten-bearing Bimba Formation of the Olary Block and the zinc-tungsten-bearing Ettlewood Calc-Silicate Member some 500 m stratigraphically below the Broken Hill orebody.

Detailed lead isotope studies supported by Exploration NSW are setting the various mineral deposit types in the Broken Hill region into the above chronostratigraphy. This work will further refine the mineral systems correlations with the Proterozoic of northern Australia, particularly the Mount Isa–MacArthur River–Century group of world-class deposits.

Studies supported by Exploration NSW have underlined the important iron oxide–copper–gold potential in the Broken Hill region. The occurrence of such deposits is now well-established and the region offers tantalising opportunities for deposits similar to Ernest Henry.



Mining at Broken Hill in the late 1990s.

The Pinnacles deposit is the second largest known accumulation of Broken Hill type mineralisation in the region. Lead isotope data indicate that the Pinnacles mineralisation is distinctly different from the main Broken Hill deposit in that it is gold-rich and some 10 million years older. This is a key finding because it demonstrates that there is yet another stratigraphic position in the Broken Hill rock sequence at which one can expect to discover major zinc–lead accumulations. Drilling by Pasminco and the leaseholder, Pinnacle Mines Pty Ltd, has established the existence of substantial zinc–lead–gold mineralisation. Recent (2002) deep intersections obtained by the leaseholder include 6.4 m @ 11.16% Zn, 1.38% Pb and 0.63 g/t Au and 2.5 m @ 12.58 g/t Au, both in the Lower Zinc Lode.

In summary, the major exploration opportunities in the Broken Hill region include:

- Broken Hill Type (BHT) silver–lead–zinc deposits;
- Pinnacles-age gold-rich BHT deposits;
- Mount Isa - age equivalent sediment-hosted lead–zinc deposits;
- iron oxide–copper–gold systems (Ernest Henry type);
- platinum group metals; and
- early Palaeozoic porphyry and VHMS deposits.

The sixth Broken Hill Exploration Initiative Conference was held in Broken Hill in July 2003. Highlights of the conference included the latest information on Exploration NSW projects, including geochronology, lead isotopes, the FALCON™ airborne gravity survey, and interpretation of the Broken Hill Block hyperspectral survey – complemented by a range of additional significant exploration and research results (see pp. 24 ff.).

A new phase of the mining history of Broken Hill has been embarked upon – with new entrants on the Line of Lode, new information, new opportunities and a major commitment by governments, industry and research organisations to create a revitalised mining industry in this birthplace of Australia's industrial development. ■

Protecting natural resources values in NSW

**Lindsay Gilligan, Assistant Director (Minerals Assessment),
Geological Survey of NSW, Department of Mineral Resources**

Land access is a key issue for the exploration and mining industry. An important factor in global investment decision making is the impact that legislation and government policies have on access to land. The influential Canadian Fraser Institute, for example, publishes an annual review of jurisdictions across the world and their impediments to exploration investment. Land access is a key measure reported. Australia has been fortunate to rate well internationally on this scorecard – but this is an area where perceptions are critical and modest setbacks can be interpreted poorly by the global industry.

To be internationally competitive for global exploration investment it is essential for jurisdictions such as NSW to ensure that there is maximum reasonable land access for exploration purposes and that the rules are clear, consistent and not subject to constant change.

NSW has the potential for a wide variety of mined commodities that will be required by the community well into the future. The Department of Mineral Resources has an obligation to ensure that government is fully informed by a strong knowledge base in its land-use decision making. The whole-of-government land-use planning processes in NSW are concerned with protecting natural values and achieving a sustainable future for the NSW community. Inappropriate development should be guarded against, as should precluding access to needed resources for the benefit of generations to come. Continued access to critical resources is a part of ensuring a sustainable future.

Modern society has developed a substantially improved understanding of the natural environment and the need to maintain biodiversity. Society also has an ever-increasing need for mined products for both wealth creation and utility purposes. Mines and associated industries are also part of the State's industrial and economic infrastructure. There is an expectation by the community that government will both protect areas of high conservation value and ensure that appropriate land is available for uses such as agriculture, forestry, mining, urban development, roads, electricity transmission lines etc. Inevitably there will be overlaps where high mineral value land has conservation values or other land-use demands. In such cases, conservation reservation and inappropriate local and regional planning can be threatening processes to mineral resource access.

“Protecting natural values” is common parlance in the natural resources “industry”. These natural values are usually those that relate to conservation values, soil degradation, salinity etc. It is curious that despite their



“Continued access to critical resources is a part of ensuring a sustainable future.”

undoubted “naturalness”, mineral resources are frequently excluded from discussions and considerations of “natural resources”. Mineral resources are natural values that also need to be protected because of their immense economic and utility value to the community.

The past decade has seen a quantum change in the way resource access has been managed in government in NSW. Science coverages, the knowledge base, the scope of assessments, whole-of-government processes and conservation mechanisms have all matured in line with the realities of the global mineral resources sector.

Routine referencing processes

Prior to the 1990s, the Department of Mineral Resources could only react to land-use proposals put by other government agencies and local government. As a matter of course government agencies and local government referenced the Department proposals that could influence resource access. These included proposed new National Parks, utilities corridors, new Local Environmental Plans etc. This system was not comprehensive.

In 1996, the Premier directed that a more formal referencing process be developed for proposals for National Parks declaration. This would involve all relevant agencies being referenced as well as the NSW Minerals Council. This referencing process has now been expanded to include properties proposed for purchase by National Parks and Wildlife Service (NPWS) and the Dunphy Wilderness Fund.

Planning assessments

In the mid-1990s the Department was given the opportunity through regulation under the *Environmental Planning and Assessment Act 1979* to map areas of important mineral value in Local Government areas and notify councils accordingly (Section 117 notifications). This has been an important tool in protecting resources from inappropriate planning, especially extractive resources. The overhaul to regional planning in the State promised through the Government's Plan First initiative should provide further opportunities for access to mineral resources to be accorded the appropriate consideration in Local Government planning.

Strategic assessments

The Department in more recent times has developed a more proactive and strategic approach to land-use planning. This has ensured that mineral resource issues are considered early in the decision making process, thus having a greater influence on land-use outcomes. These processes involve bilateral and multilateral engagement across Government agencies.

In the early 1990s, the Government at the time created the Natural Resources Audit Council (NRAC) with a brief to conduct a series of regional "audits" of public lands across the State, beginning with the upper north east region. This allowed the Department to develop sophisticated geographic information system (GIS) capability for mineral deposit potential modelling. Perhaps even more importantly, this process enabled the Department to develop the capability to create and manipulate large geoscience datasets to support the exploration industry under the Discovery 2000 and Exploration NSW initiatives.

Forest assessments

In 1995, the NSW Government established the Resource and Conservation Assessment Council (RACAC) to coordinate land assessments and address competing demands for land in the State. Its first task was to provide the NSW inputs to the Commonwealth/State Regional Forest Agreement (CRA/RFA). The objective of the CRA/RFA process was to develop both a comprehensive, adequate and representative reserve system of forests and an ecologically sustainable, value-added and secure native forest timber industry. Assessments and agreements were developed for the Eden, North East and Southern forests of New South Wales.

Comprehensive Regional Assessments generated unprecedented scientific information, which can be used not only by forest stakeholders but also by local councils, Government agencies and the public. As part of these assessments, the mineral resource potential of the forest regions was analysed. The methodology adopted follows that developed by the United States Geological Survey, and has been used for mineral resource assessments of public lands in North America and elsewhere. The study was jointly undertaken by the Department and

the Bureau of Resource Sciences (BRS) (and subsequently AGSO, now Geoscience Australia). The knowledge-based process identifies geological units (referred to as tracts) that are favourable for particular types of mineral deposits and estimates the likelihood of occurrence of mineral resources.

The forest assessment process proved to be an especially valuable model for addressing complex multilayered land-use issues. It also ensured that minerals issues informed the conservation and forest management outcomes.

Western Regional assessment

More recently, the Government embarked on a major program of regional assessment of western NSW, using this model, to guide future planning and encourage partnerships to protect the environment. The Brigalow Belt South Bioregion (BBSB) was the first area to be assessed under the Government's Western Regional Assessment (WRA) initiative (see *Minfo* 77-78). The process of developing future land management options for the BBSB has now been completed. Consideration of the coal and gas potential of the Bioregion had a significant bearing on the options developed and presented to Government.

These whole-of-government assessment processes are generating extraordinarily valuable new datasets across the State. These datasets include new geoscience coverages of both surficial and solid geology, as well as regional mineral potential mapping. Only recently completed was the largest airborne high-resolution geophysical survey yet flown in the State. This magnetic and radiometric survey covered much of the Riverina Bioregion in southwestern NSW, and was jointly funded by Exploration NSW and RACAC. These geoscience datasets underpin effective land-use planning and sustainable natural resource management.

The Department and NPWS are also collaborating in a very productive strategic relationship to deal with areas where the Service is seeking to grow its conservation reserve system. This bilateral cooperation allows the Department to help guide conservation area growth.

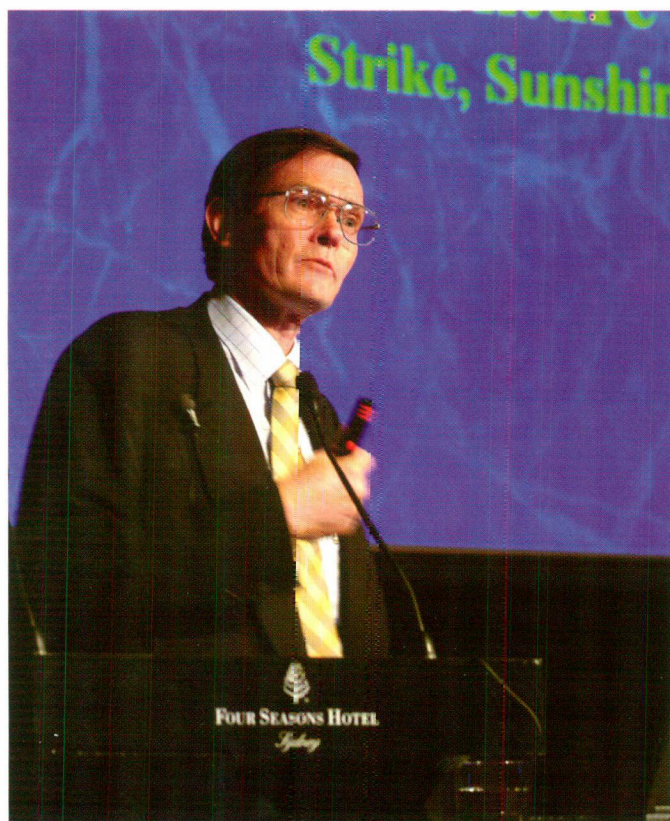
State conservation areas: a way forward

The above CRA/RFA process also spawned a new mechanism for addressing conservation protection and mining. In 2001, this resulted in a new category of conservation reserve (State Conservation Area – SCA) being created under the *National Parks and Wildlife Act 1974* for the dual purposes of protecting conservation values and permitting mineral and petroleum exploration and production. The Government has very clearly stated that exploration and mining are expected to happen within SCAs.

The SCA category provides wins for the minerals and petroleum industries, the environmental movement, and the community at large. This reserve type will be essential to resolve some of the more intractable land use debates and will be particularly valuable in the west of the State. Government agencies are working with key stakeholders to develop environmental guidelines for the management of exploration activities in SCAs. ■

Advancing petroleum and coal seam methane exploration in New South Wales*

Dr Ray Shaw, Consulting Petroleum Geologist



"NSW will see a significant shift towards CSM production."

New South Wales currently obtains virtually all of its petroleum requirements from interstate or overseas sources and it is the only mainland state in Australia without large-scale gas production and reserves. The development of any indigenous gas resources would provide not only investment and long-term employment opportunities to regional NSW, it would also increase competition in gas supply, increase surety and dependability in supply and encourage market growth – and assist NSW consumers through reduction in transmission costs. Additionally, it would assist in the lowering of greenhouse gas emissions.

From the petroleum and coal seam methane (CSM) standpoints, the large coal reserves within NSW have had both positive and negative effects. With its extensive Permian coal-bearing sequences in the Sydney, Gunnedah, southern Bowen and Gloucester Basins, the State has been at the forefront of CSM exploration since its significance was recognised in Australia, some 10 to 15 years ago. However, with nearly 95% of the State's energy having been historically derived from coal, the impetus to find conventional gas and oil accumulations was never as great as in those states lacking coal resources.

**Edited extract from Dr Shaw's presentation at the Mineral Exploration & Investment 2003 Conference.*

Petroleum explorers within NSW largely deserted the state following the discoveries at Moonie in Queensland and Gidgealpa in South Australia, with only modest exploration returning spasmodically in the 1970s and 1980s.

The State Government introduced a number of measures to foster and promote exploration. The first was a State royalty holiday for five years, then increasing incrementally for a further five years to a maximum of 10% on any production from new petroleum discoveries. The second was special funding to assess and promote the State's mineral and petroleum resource potential – initially with the Discovery 2000 initiative from 1995 and subsequently the current Exploration NSW initiative, from 2000. In the past eight years, some \$10 million has been spent on these initiatives on acquisition of new petroleum data, the results of which, in conjunction with exploration data acquired by a number of junior explorers, forms the basis for the following review of the prospectivity for conventional petroleum.

Prospectivity for conventional petroleum

With 60% of onshore NSW covered by sedimentary basins, including the major Permian coal-bearing Sydney Basin, Gunnedah Basin and southern extension of the Bowen Basin, the potential for petroleum discoveries is good, based on exploration results in similar Permian coal-bearing basins in other parts of onshore Australia. For example, the Permian coal-bearing Cooper Basin is Australia's largest onshore petroleum province whereas the comparable Permian coal-bearing Bowen and Perth Basins are each significant petroleum producing provinces in Queensland and Western Australia, respectively.

Although difficult terrain, land access issues and sprawling urbanisation impede conventional petroleum exploration within the Sydney Basin, recent industry and government activities highlight the prospectivity of the Sydney Basin, Gunnedah Basin and NSW's portion of the Bowen Basin.

In the Gunnedah Basin, exploration by Eastern Star Gas Limited in PEL 238 has dispelled the perception that there is not adequate source rock, nor suitable reservoir, to host commercial conventional petroleum occurrences. In an announcement in February 2003, Eastern Star Gas said it would lodge an application to the NSW Department of Mineral Resources (DMR) for a 21-year production licence on their Conarah Gas Field, which has proven and probable reserves of 11.3 PJ. This will be the first conventional petroleum production licence issued within the State. Gas will be used to supply a new 10 MW generating station at

Narrabri with electricity sold to Country Energy. Current reserves will be sufficient for 10 years and produce gross revenues of about \$50 million over the life of the project. Although the Coonarah Gas Field is small, its discovery proved the existence of an active petroleum system, and one which is anticipated to have also sourced and charged numerous other conventional gas targets which Eastern Star Gas has identified within PEL 238.

The Coonarah Gas Field lies on one of several transverse structural zones (accommodation zones) which the DMR, as part of an Exploration NSW review study of the southern Bowen–Surat Basins, has recognised as perhaps playing an instrumental role in controlling not only sedimentation and maturity trends but also fluid flow during the uplift of the eastern Australian highlands. By analogy, other accommodation zones, recognised by the DMR in the less-explored southern Gunnedah Basin region, are now considered attractive fairways for future exploration – especially given that they also lie adjacent to depocentres containing some of the Basin's thickest coal measure sequences.

The same DMR review identified a number of exploration targets in the NSW portion of the Bowen Basin that have similarities with producing fields in southeastern Queensland, including the Moonie Oil Field. It also recognised a potentially deeper sedimentary section, one possibly containing mature oil-prone source rocks, apparently missed by explorers working in the area during the 1970s and 1980s. If this deeper section is confirmed, its presence may go a long way towards rebutting the general industry view that the NSW portion of the Bowen Basin is too shallow, lacks adequate source and/or is immature for the generation of hydrocarbons. Particular mention is made of Eastern Star Gas' exploration efforts in helping to rebut this view. The company has undertaken significant exploration programs in PEL 6 (see Petroleum Titles map) over a number of years, including the recent acquisition of seismic data, the results of which have greatly assisted the DMR in developing a new perspective on the NSW portion of the Basin.

Onshore, however, it is likely that it is the Western Division of the State, dominated by the Darling Basin, that holds the greatest conventional petroleum potential. Covering an area of nearly 80 000 km², the Darling Basin is the largest and deepest basin in NSW. Being located adjacent to principal mining centres, such as Broken Hill and Cobar, an emerging heavy mineral sands industry centred around Wentworth, and traversed by the Moomba to Sydney gas pipeline, its strategic importance is clearly apparent. Moreover, it contains sequences that are of similar age to Queensland's Adavale Basin, which hosts the Gilmore Gas Field. Nevertheless, and with only some 1650 km of modern seismic coverage within its area, major explorers have largely ignored the Darling Basin. No petroleum wells have been drilled in the Basin for more than 20 years. Indeed, of the 17 wells drilled in the early

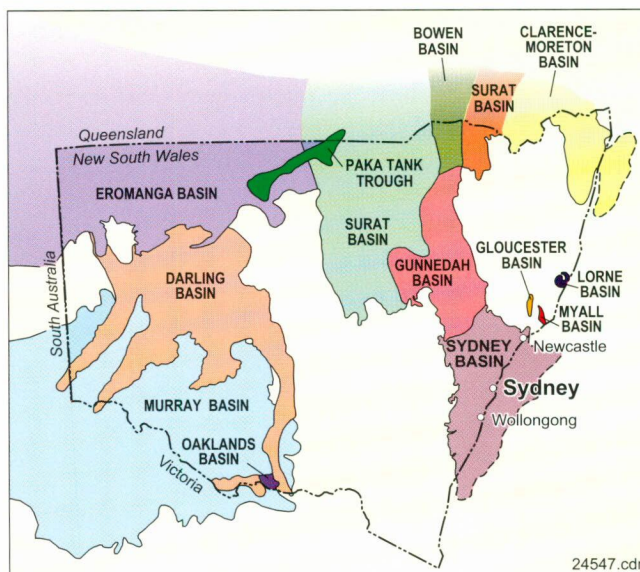


Figure 1. NSW sedimentary basins.

exploration history of the Basin, none were valid tests of petroleum traps, most wells being sited without the aid of adequate, or with no, seismic control.

Funding through the Discovery 2000 and Exploration NSW State Government initiatives have attempted to ameliorate the paucity of exploration data through acquisition of new regional geophysical datasets (gravity, magnetic and radiometric), as well as specific studies focused on providing data and results resolving fundamental issues that might, in turn, attract greater industry interest.

To date, these DMR activities have highlighted how little is really known of this region. New exploration data have yielded significant and somewhat unexpected results. These in turn justify the view that the Darling and adjacent Eromanga Basins have very significant upside potential. Already previously undocumented Cambro-Ordovician source rocks forming a possible infrabasin have been identified in the Koonenberry region. Several bituminous seeps and an oil seep have been identified and analysed, and large areas of shallow Eromanga Basin aquifers, charged with gas, have been mapped. In March 2003 the DMR acquired 160 km of seismic data at a number of key locations within the Darling Basin aimed at providing information on the nature of the sedimentary rocks, with their history of deposition and structural evolution.

Offshore petroleum potential

The lack of both historical data and recent exploration activity in the offshore areas of NSW have conspired to provide an undeserved perception of low prospectivity. During the 1990s there were no offshore NSW petroleum exploration permits. Currently there is only one title PEP 11, held by the junior explorer Bounty Oil and Gas NL. This compares with over 200 offshore permits throughout the rest of Australia.

There is a paucity of data in the offshore region of the State.

- There are no offshore petroleum wells between the offshore Gippsland Basin in Victoria and the offshore Capricorn Basin in Queensland. Accordingly, there is no direct subsurface geological control of any portion of the NSW margin.
- Much of the offshore NSW margin is covered with only reconnaissance oceanographic seismic data recorded by the Bureau of Mineral Resources 30 years ago. Most of these data were never computer processed. The bulk of industry marine seismic data is concentrated offshore in the Sydney Basin, where it was recorded in the 1970s and 1980s. The data is of limited value because of its poor quality and navigation control. The most recent marine seismic survey was recorded in 1992 by Santos and Ampolex and comprised only 500 km of 2D data. No detailed in-fill 2D nor 3D seismic data, has ever been recorded off New South Wales.

As a consequence of this lack of data, it has proved difficult to attract industry interest. The widely held industry view is that the NSW margin, lacks adequate sedimentary cover, is too narrow, and dominated by non-economic basement to warrant serious attention. There are, however, positive geological facts that dispel these perceptions regarding the State's offshore prospectivity.

- The geological evolution of the NSW margin is part of the same continental breakup which formed the highly petroliferous offshore Gippsland Basin, which hosts giant oil and gas fields. Although much of the prospective synrift rocks were believed to have been transported away to the east, on the Lord Howe Rise, following breakup of the NSW margin, changes in breakup trajectory suggest that northern NSW and southern Queensland margins may include fragments of synrift preserved across their continental slope.
- The offshore New South Wales margin encompasses offshore extensions of the adjacent onshore coal-bearing Sydney Basin and Clarence-Moreton Basin. Coal-bearing sequences in both basins are known to increase in thermal maturity towards the margin, where they would be capable of generating hydrocarbons within the older Mesozoic and Palaeozoic sequences.

In 2000-2001 the DMR reprocessed a small, 30-year-old marine seismic survey, as well as some oceanographic seismic survey data recorded across the continental shelf of the offshore Clarence-Moreton Basin. Reprocessing using modern seismic software confirmed the presence of a previously unknown significant thickness of sedimentary rocks which may pre-date the breakup of the margin, and hence be Clarence-Moreton Basin equivalent rocks, or alternatively represent younger synrift rocks formed as part of the Tasman Sea rifting and breakup. The presence of these rocks, overlain by at least a 1 km thickness of prograding Tertiary marine cover, provides a burial history setting which greatly increases the

chance of petroleum generation and preservation in the offshore. It clearly rebuts the view that the margin has only limited, thin sedimentary cover and highlights the need that serious consideration be given as to whether the NSW margin may contain remnants of the Gippsland analogues.

The examples of recent exploration success in the offshore Otway and the Perth Basins, both previously perceived by industry to have low prospectivity, provides some hope for junior offshore explorers, like Bounty Oil and Gas in the offshore Sydney Basin. However, exploring offshore NSW is expensive – its relatively remote location relative to the main areas of offshore activity gives rise to large mobilisation and demobilisation costs for both seismic and drilling vessels.

Prospectivity for coal seam methane

Because of its large coal deposits, NSW has attracted considerable attention for coal seam methane (CSM) exploration. Initially, very significant expenditures were made in the Sydney Basin by Amoco and in the Gunnedah Basin by First Forcenergy and Sourcenergy. These companies, together with the coal mining industry and stratigraphic coal drilling by the DMR, provided a significant database from which a number of active CSM exploration programs have emerged. Fortunately, as a new industry, CSM explorers have been able to obtain venture capital, with companies such as Sydney Gas, Eastern Star Gas, Arrow and Sunshine Gas all raising funds through initial public offerings on assets which were largely CSM-based. The result has led to a much more vibrant level of activity within the State, compared to their conventional petroleum counterparts.

CSM exploration is being actively pursued in most NSW sedimentary basins containing coals buried at depths ranging between 200 m and 1000 m.

Unlike conventional petroleum exploration, it is not so much the discovery of the resource but rather the development which is the key issue for CSM. In recent years in both NSW and Queensland, drilling and development costs have been reduced, and production techniques have been significantly refined, making CSM production more viable. Currently the Sydney, Gunnedah, Bowen and Gloucester Basins represent the main areas of CSM exploration activity within NSW.

In the Sydney Basin, Sydney Gas has projects in two areas: Camden, about 50 km to the southwest of the CBD; and in the Hunter Valley, approximately 140 km to the northwest. The Camden project is being developed in two stages. This \$100 million project will take a number of years to reach full development, but has already been awarded State Significant Development status.

Stage 1 is complete and includes 28 production wells. The treatment plant was opened by Premier Carr on April 30, 2001, and has been selling gas (around 2 PJ per year) to AGL since May 2001. The associated petroleum production leases (PPLs 1 and 2) are the first such leases awarded in NSW.

Stage 2 will see the production of 10 PJ of gas annually. Initially 40 new wells will be drilled and a second, much larger, treatment plant is expected to be commissioned in late 2003. A further 60 wells are expected to be completed and linked to the new treatment plant by the end of 2003. A gas sales agreement was signed with AGL in December 2002 for up to 10 PJ of gas per year for 10 years. Gas will be transported via a short spur line to the main Moomba to Sydney pipeline.

In the Hunter Valley, the NSW Government signed a Deed of Agreement with Sydney Gas in July 2002 to undertake a feasibility study of the commercial production of CSM around Singleton and Muswellbrook. Preliminary assessment of the Hunter region indicates that the resource potential is as encouraging as in the Camden project.

In the Gunnedah Basin a joint venture between First Sourcenergy and Eastern Star Gas focuses most CSM activity on their exploration acreage PEL 238. Between March 1998 and February 1999 the joint venture expended some \$30 million on the drilling of 15 wells, the acquisition of 484 km of seismic data, two cavity completions and seven hydraulic fracture stimulations. Within the licence CSM resources had been estimated at over 18 000 PJ. Pilot tests were conducted at Bohena and Wilga Park and production testing is continuing on one well in the Bohena field.

With the apparent growing success of CSM and conventional gas exploration in PEL 238, a number of explorers applied for surrounding open acreage. Work by the DMR has recently identified the westernmost portion of the Gunnedah Basin, west of the Rocky Glen Ridge, as having potential for CSM with a number of potential coal-bearing depocentres being identified and delineated during the past two years. In the southern Gunnedah Basin, Australian Coalbed Methane holds interests in a number of areas (PELs 1, 10 and 12). Currently all of the coal-bearing portions of the Gunnedah and Bowen Basins are under title by junior explorers seeking both conventional gas and CSM opportunities.

In the Gloucester Basin, a joint venture by Molopo and AJ Lucas Coal Technologies is evaluating the development of the Stratford Prospect area, previously held by Pacific Power. Nine fully-cored exploration wells drilled on this prospect have been used to estimate some 90 PJ of methane. Over the next three years, work will proceed to evaluate the extent of this resource with a view to producing gas for Newcastle industry.

In the Clarence-Moreton Basin, Jurassic and Triassic coals have been targeted, again with limited success, with Molopo and Arrow holding licences. More recently, a number of licences (PELs 435, 436, 438, 439 and 440) has also been granted in the Murray Basin where relatively immature coals are present in the Tertiary section. Exploration for CSM is currently at an early stage.

Although CSM production in NSW is currently limited, one needs look no further than the experience in Queensland to see its potential. Based largely on the Jurassic and Permian coal deposits, both of which extend into NSW, proven plus probable reserves in excess of 1000 PJ are already identified, enough to supply the current Queensland market for over 10 years. Origin Energy estimates potential for over 25 000 PJ of recoverable CSM in Queensland. Recently, companies such as Origin Energy have paid about \$45 million to acquire interests in CSM fields in the Bowen Basin. In South Australia, Santos is now exploring in joint ventures in shallow portions of the Cooper Basin, previously largely ignored because the coals and attendant geological conditions were considered unfavourable for conventional petroleum exploration.

Based on interstate experience, NSW will see a significant shift towards CSM production and reduction in reliance on interstate gas supplies over the coming years. This trend may be substantially accelerated if circumstances develop which also foster greater exploration by conventional petroleum explorers. ■

BHEI 2003: Curnamona Province – realising the potential

Exploration NSW highlights, such as the recently-concluded Broken Hill FALCON™ airborne gravity survey, featured at the successful sixth Broken Hill Exploration Initiative Conference (BHEI 2003) held in the Silver City from July 7-9, 2003. Over 160 registrants from industry, government and research institutions attended.

About BHEI

The Broken Hill Exploration Initiative (BHEI) is a collaborative venture between the NSW Department of Mineral Resources, Primary Industry and Resources South Australia and Geoscience Australia in support of increased mineral exploration in the Curnamona Province.

Also associated with the BHEI are the Cooperative Research Centres for: Landscape Environment and Mineral Exploration (CRC LEME) and Predictive Mineral Discovery (*pmd**CRC). The NSW Government is supporting geoscience programs under the BHEI through its Exploration NSW initiative, which is a seven-year \$30 million program to promote increased mineral and petroleum exploration investment in NSW. The BHEI initiative has proved to be an outstanding success, producing vast new datasets and knowledge and generating industry enthusiasm for exploration in the Curnamona region.

International promotion of exploration investment is now an essential element of the States strategy for a sustainable exploration and mining industry. The States join Commonwealth each year at the Prospectors and Developers Association of Canada Conference (PDAC) in Toronto, Canada. The Curnamona Province and its exploration opportunities were featured at the 2003 PDAC.



Displays at the BHEI Conference.



Photo credit: Guy Fleming

Professor Ross Large of the Centre for Ore Deposit Research puts the Line of Lode in a global context.

The BHEI conferences are key events for the release of new breakthroughs in mineral exploration-related research in the Broken Hill region and adjacent areas in South Australia.

The challenge for the BHEI is to turn the excellent datasets over the Broken Hill region and adjacent areas in South Australia into understanding that will inform and excite explorers in the 21st century. To assist with planning for future BHEI projects *pmd**CRC and CSIRO are conducting an audit and gaps analysis to identify additional key information and knowledge required to attract increased exploration investment to the Curnamona Province.

A new Departmental publication entitled *Mineral Deposits of the Northern Broken Hill Block* was also released at BHEI 2003. This publication represents the final product from the intensive geological and metallogenic mapping program conducted by the Geological Survey over the Broken Hill region in the 1970s and 1980s (see this *Minfo*).

Conference Summary

Session 1: Willyama in context: the big picture

This session dealt with continental reconstruction, geochronology, correlations between Curnamona and Mt Isa, and geochemical fingerprinting of the depositional history.

Peter Betts and David Giles presented their latest account of continental reconstruction of Palaeoproterozoic

Australia. Their main theme was that tectonic setting cannot be understood by examining only fragments of the picture, e.g. the outcropping Broken Hill Block. A bigger picture is needed. The reconstruction model for the Palaeoproterozoic may represent a significant breakthrough and attracted much interest.

Rod Page and co-authors summarised the state of knowledge of geochronology of the Broken Hill and Olary Blocks, and showed new data fresh from the SHRIMP ion probe. Mark Fanning, Graham Teale and Stuart Robertson summarised the most recent geochronology of the Mount Painter Inlier, suggesting that a sequence containing similar rocks and mineralisation to the Willyama Supergroup was deposited after 1600 Ma (million years ago). The comparison with Page's zircons from the Redan area left open the possibility that the ubiquitous 1560–1600 Ma zircons at Mt Painter might be metamorphic, and the sequence may indeed be Willyama Supergroup.

Barney Stevens, Richard Barratt and Colin Conor used geochronology, geochemistry and, to an extent, sedimentary facies, to indicate that the Paragon Group in the Curnamona Province is prospective for a Mt Isa type Pb–Zn orebody. Karin Barovich showed that trace element and isotope geochemistry supports the stratigraphic and geochronological correlations between Broken Hill, Olary and Mt Isa. A sharp break in geochemical character at

Presenters at BHEI Conference

Adelaide University – Karin Barovich, Lachlan Rutherford, Andreas Schmidt Mumm
Australian National University – Mark Fanning
Centre for Ore Deposit Research – Ross Large
Consolidated Broken Hill Ltd – Ian Plimer
CRC LEME – Steve Hill, Dirk Kirste, Ian Lau, Kylie Foster
CSIRO – Joanna Parr, Rob Hewson, Tim McConachy
Euro Exploration Services – Chris Anderson, Geoff McConachy
Geological Survey of Canada – John Lydon
Geoinformatics Exploration Australia – Russell Mason
Geoscience Australia – Richard Lane, Roger Skirrow, George Gibson
Iowa State University – Paul Spry
Melbourne University – Maurizio Tonelli
Monash University – Peter Betts, Matt Noble, Caroline Forbes
NSW Department of Mineral Resources – Lindsay Gilligan, Barney Stevens, Peter Lewis, Richard Barratt, Kingsley Mills, Tim Sharp, Mark Dawson, Peter Buckley
Perilya Ltd – Iain Groves
Platsearch – Bob Richardson
*pmd*CRG* – Rod Page, John Greenfield
Primary Industries and Resources, SA – Colin Conor, Stuart Robertson, Wolfgang Preiss
Southern Cross Resources – Mark Randell
Teale & Associates – Graham Teale
University of NSW – Geoff Taylor
University of Wyoming – Susan Swapp

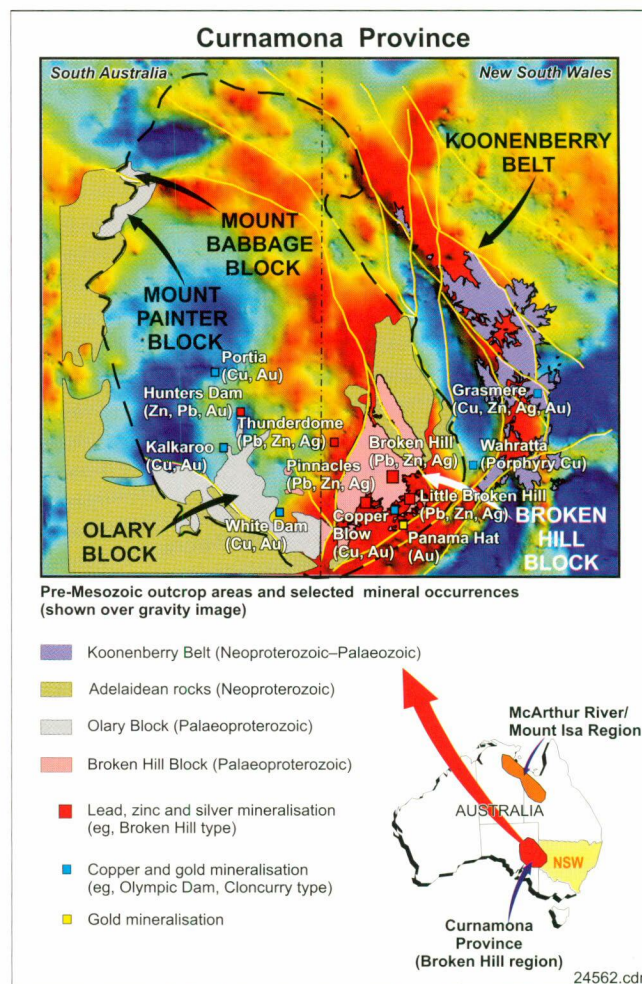


Figure 1. Important mineral occurrences in the Curnamona Province.

around 1655 Ma indicates a major change in the source of sediments.

Stuart Robertson and co-authors described the state of mapping and geological investigations in the South Australian portion of the Curnamona Province, highlighting aspects of a new version of the Curnamona 1:500 000 interpretation map.

Session 2: Pb–Zn–Ag, the future of the Line of Lode, finding more

With Broken Hill the world's largest lead–zinc–silver orebody, this session was a major focus for researchers and industry.

Ross Large led with an analysis of Broken Hill type deposits and the nature of the fluids from which they formed. Talks from representatives of Perilya Resources and Consolidated Broken Hill Ltd focussed the audience's attention. Iain Groves and Chris Mroczek described how Perilya is confident of extending mine life well beyond 2011. Ian Plimer gave an account of the various types of mineralisation in the old South mine, and highlighted the recent resource definition drilling by Consolidated Broken Hill Ltd on the Western Mineralisation.

John Greenfield and co-authors reviewed the many theories on the origin of the Broken Hill orebody. Paul Spry

and co-authors outlined progress in a project studying the garnet- and gahnite-rich "lode" rocks associated with mineralisation in the Willyama Supergroup, and attempts to find whether these can be used to distinguish economic deposits from small, uneconomic deposits. Joanna Parr and co-authors released the latest lead isotope data, indicating that some Broken Hill type deposits in the Broken Hill Block are older than others and that in both the Broken Hill and Pinnacles ore deposits, there are variations in lead-isotope ratios.

Barney Stevens presented a new model for the origin of the Broken Hill orebody and the smaller Broken Hill type deposits, based on combining new lead isotope data, with field observations from the Broken Hill district. John Lydon described the huge Sullivan Pb-Zn deposit in British Columbia, comparing it with Broken Hill, and outlined concepts regarding its origin. Such concepts may have application at Broken Hill.

Session 3: Opportunities Around the Curnamona Margins

This session highlighted geological and exploration activities in younger rocks surrounding the Curnamona Province.

Kingsley Mills presented an account of the tectonic history of the Koonenberry region, northeast of Broken Hill, with emphasis on an interpretation of the results an AGSO (now Geoscience Australia) deep seismic line across the region. A feature was discussed about the apparent contradiction of the Koonenberry Fault dipping moderately west in the seismic section, but vertically in outcrop exposures. Tim Sharp and Peter Buckley followed with a focus on the Bancannia Trough and its volcanic basement.

Wolfgang Preiss presented an account of the Adelaidean Nackara Arc, southwest of the Curnamona Province, including the exciting recent discovery of volcanic centres near Oodla Wirra. Mark Randall and Colin Skidmore presented a very impressive computer graphics display of Southern Cross Resources' work relating Tertiary uranium channels at Honeymoon to basement geology and topography.

Session 4: Regolith – raising the profile

This session mainly featured the results of work by CRC LEME.

Steve Hill outlined how regolith studies have improved exploration opportunities in regolith-covered areas – in particular the refinement of calcrete sampling techniques, the use of silcrete sampling, the potential use of leaves of plants with extensive root systems, and the use of regional hydrogeochemistry. Palaeolandscape studies at Tibooburra indicate that the alluvial gold was derived from the south (see this *Minfo*).

Dirk Kirste outlined the results of the regional hydrogeochemistry studies, showing areas with exploration potential, indicated by base metal contents and by sulphur isotope ratios. Ian Lau and co-authors demonstrated the application of remote spectral data to regolith mapping in the Olary area. Kylie Foster described progress in the preparation and publication of the 1:25 000

series of Broken Hill regolith maps, illustrating her talk with examples and exploration opportunities from the Warratta map sheet area. Mark Dawson described how a PIMA spectral analyser was used to distinguish clayey regolith formed by leaching of bedrock, from overlying transported clayey regolith at the Kalkaroo gold prospect.

Session 5: Willyama tectonic evolution – models, data, research

This session comprised presentations on the metamorphic and structural history of the Willyama Supergroup, the rocks which make up the Broken Hill and Olary Domains.

Maurizio Tonelli and co-authors and Martin Hand and co-authors presented results from different techniques of direct dating of metamorphic minerals. Encouragingly, both lead isotope dating and samarium-neodymium dating techniques produced metamorphic garnet dates compatible with metamorphic zircon dates. Both techniques also documented later events. Susan Swapp and Ron Frost presented new measurements of metamorphic temperatures and pressures, suggesting that the rocks south of Broken Hill airport reached 840°C, and that there was an early, high-pressure metamorphic event.

Christopher Clark and co-authors explained the spectacular breccias consisting of albite-rich fragments in a matrix of actinolite, found in the Olary district. They proposed that the breccias formed as a result of albitising fluids derived from uplift and cooling between D2 and D3 deformations.

George Gibson and Karol Czarnota proposed a model in which a major detachment at the top of the Broken Hill Group played a role in mineralisation. Matt Noble and co-authors discussed the role of high-grade shear zones in the Curnamona Province. Caroline Forbes and Peter Betts described three-dimensional fold shapes from the Allendale area, which may be very useful in understanding the overall geometry of the Broken Hill Block.

Session 6: Curnamona – new exploration opportunities

The emphasis in Session 6 was on exploration for gold and copper in the Curnamona Province and on exploration away from the well-known areas.

Roger Skirrow outlined the characteristics of the major iron oxide-copper-gold deposits of the world, and showed that suitable fluids to produce these deposits were present in the Curnamona Province during the Olarian Orogeny. The missing ingredient so far is a suitable trap site. Graham Teale followed on with a review of all of the significant known copper-gold mineralisation styles in the South Australian part of the Curnamona Province. Richard Barratt presented the results of a program of gold sampling from Broken Hill Block prospecting pits and from new Pinnacles mine drill core. In the Pinnacles drill core some of the highest gold values are not in sulphide-rich intervals. Richard Barratt emphasised the wide range of deposit types in which gold is found.

Graham Teale and Adrian Brewer described the encouraging South Koolka copper-gold prospect north-northwest of Olary as a skarn, although the granite is

not apparent. The complex alteration history was described in detail. Chris Anderson and Geoff McConachy presented their review of copper-gold opportunities in the Broken Hill Block, based largely on geophysical patterns. The Redan area featured prominently as a prospective area.

Bob Richardson outlined the activities of Platsearch and joint venturers in the Curnamona Province, and emphasised the need for persistence in this very prospective province. Examples were given of extensive mineralised systems at Quinyambie and Callabonna in the remoter parts of the Curnamona Province, intersected by very few drillholes.

Colin Conner investigated "exhalite" occurrences in the Olary district, and suggested that banded iron formation near Blue Dam might indicate the presence of upper Broken Hill Group rocks, previously thought to be absent from that district.

Sessions 7 to 10: Information, 3D model, airborne exploration techniques, the future

These were short sessions on finding orebodies in the data, the Broken Hill 3D model, finding orebodies from the air, and directions for the future.

Peter Lewis and Kevin Capnerhurst described the data available in digital format, gaps in information, and future plans. Russell Mason and co-authors demonstrated the Pasmenco three-dimensional model of the geology of the Broken Hill Line of Lode and of the Broken Hill Block. Richard Lane outlined the preliminary interpretation of the recent FALCON™ airborne gravity survey of the Broken Hill area. For industry representatives this was one of the highlights.

Geoff Taylor outlined the ground follow-up designed to utilise the enormous quantity of data derived from the HYMAP™ hyperspectral survey. Rob Hewson and co-workers showed how ASTER satellite imagery is being applied to basement and regolith mapping in the South Australian part of the Curnamona Province.

The conference was wound up with a talk from Tim McConachy and co-authors on an audit of geoscientific information available on the Curnamona Province, and gaps in that information base. This final presentation formed the basis for a panel discussion on what geoscience surveys and studies were required over the Curnamona region to further promote exploration investment in this exceedingly metal-rich province.

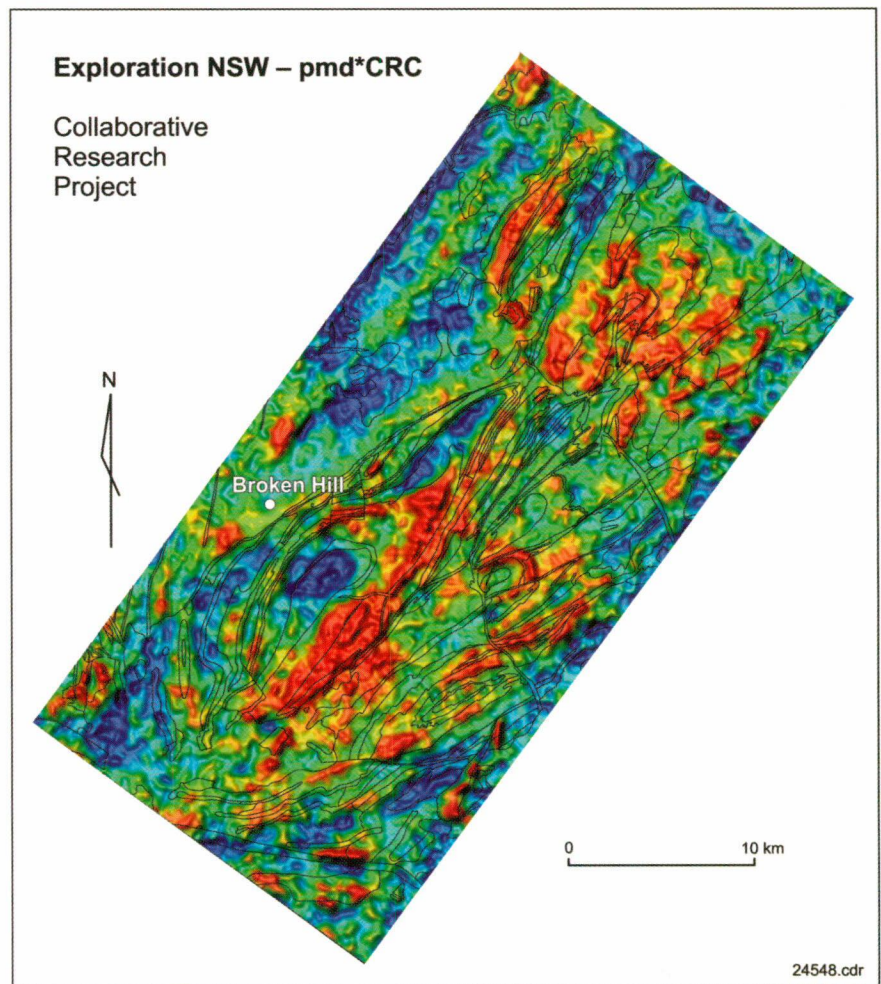


Figure 2. Image of the FALCON™ airborne gravity survey over Broken Hill (showing geological boundaries in black).

Excursions

Excursions were conducted in association with the BHEI 2003 Conference. A pre-conference excursion focused on the mineral deposits in the Broken Hill and adjacent Olary region. A post-conference excursion examined the new mapping developments in the Koonenberry region.

Professor Ian Plimer, a director of Broken Hill Consolidated Ltd, conducted a series of half-day excursions into the open pits on the old South Mine CML7. The trips combined the mining history, geology and mineralogy of the deposit, and an up-to-date account of a recent evaluation.

Drill core was on display prior to the conference at the Perilya Limited core yard. Featured were drill cores from each of the Zinc Lodes of the Broken Hill orebody, core from copper, gold and platinum prospects in the Broken Hill district, and core from a range of copper-gold and lead-zinc prospects in the South Australian part of the Curnamona Province.

The BHEI2003 conference abstracts (Record 2003/13) are available from the Geoscience Australia website – www.ga.gov.au

For more information contact Lindsay Gilligan, Assistant Director (Minerals) on (02) 9901 8301 or Barney Stevens, Principal Research Scientist on (08) 8088 9329.

New Lachlan Orogen maps unveiled at SMEDG meeting

The Department of Mineral Resources unveiled its latest geological maps and CD-ROM packages on the Lachlan Orogen at a technical forum organised by the Sydney Mineral Exploration Discussion Group (SMEDG) on June 19, 2003.

The presentations (and map displays) described detailed mapping at 1:100 000 scale for the Goulburn and Cargelligo 1:250 000 projects. Field mapping for the Cargelligo map sheet is complete, with geological notes due to be published in 2004.

Field mapping for the Goulburn project has now been completed for five of the six 1:100 000 component map sheets. As part of the Lachlan Orogen synthesis project, new insights into the Hill End Trough were also presented.

Cargelligo region

Results of the detailed geological mapping, petrology, palaeontology and age dating have identified and characterised areas of economic interest. The main mineralising events are:

- late Early Silurian emplacement of granites with related tin-tungsten and base metals
- Late Silurian-Early Devonian rifting and silicic volcanism and formation of sediment-hosted base metal deposits
- Middle Devonian and Early Carboniferous deformation and remobilisation of gold and base metals into structurally-controlled sites
- Tertiary uplift and erosion to form placer deposits (eg, tin) and Cainozoic weathering to form residual magnesite and dolomite deposits.

On display were preliminary outcrop geology and basement geology plots for the Cargelligo 1:250 000 map sheet, Ungarie 1:100 000 and Rankins Springs 1:100 000 map sheets. Geoscience data packages were also promoted and are now available on CD covering the Cargelligo, Tullibigeal and Ungarie 1:100 000 map sheet areas with packages for the Merriwagga, Rankins Springs and Hillston 1:100 000 map sheet areas to be released in September 2003.

Goulburn region

Highlights of the Goulburn mapping included:

- resolution of the complex Late Silurian-Early Devonian volcanic and clastic stratigraphy in the Goulburn region;
- recognition that the Middle to Late Silurian volcanic and clastic rocks of the Hill End Trough and Nganawal Basin (Captains Flat area) formed in a continuous marine basin, thus expanding the area prospective for volcanic-hosted copper-lead-zinc-silver-barite-gold deposits; and

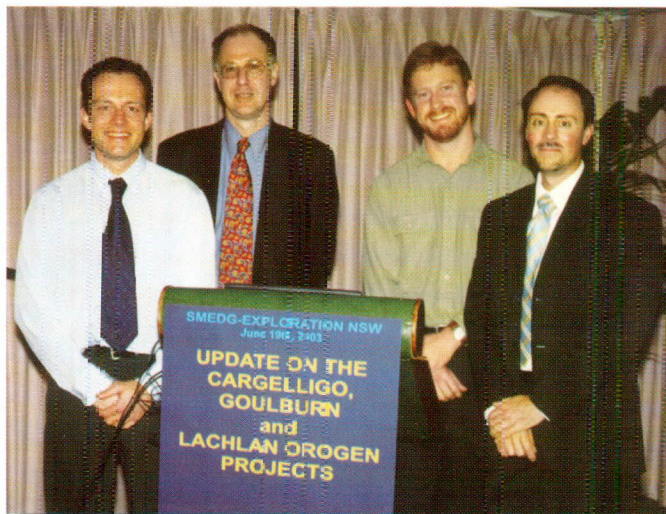


Photo credit: Guy Fleming

Presenters Jeff Vassallo, Dick Glen, Owen Thomas and Gary Cclqhoun at the SMEDG meeting.

- new insights into the structural evolution of the region which involved several episodes of large-scale folding and thrust faulting.

The recently released surficial and bedrock geology maps for the Goulburn 1:100 000 map sheet were on show, together with information on the Geoscience Data Packages on CD for the Eoorowa, Crookwell, Goulburn and Gunning 1:100 000 map sheets.

Lachlan Orogen Synthesis

The findings of the first phase of the Lachlan Orogen Synthesis project were also outlined at the meeting. This synthesis project aims to integrate mineral systems data with new geological data to better understand the tectonic development of the Lachlan Orogen. The new Hill End Trough research results are part of this project.

Hill End Trough

New findings presented on the structural evolution and mineralisation of the Hill End Trough in central western NSW revealed that large areas of the Trough are more prospective for gold than previously believed.

A key outcome is the identification of a regional biotite-grade cleavage that is related to an early ramp style thrust event that transported the Hill End Trough to the southeast prior to the development of the major upright meridional fold set. This early event was linked to previous studies of the chemistry and structural location of gold deposits to suggest that the early event may be a primary mineralising stage or created fluid corridors for later mineralisation.

Results of this work are summarised in the recently released Hill End Trough CD (See separate article in this *Minfo*)

For more information, contact David Robson, Acting Assistant Director, Regional Geology and Exploration Geoscience, on (02) 9901 9342.

Publication of the Mineral Deposits of the Northern Broken Hill Block

The NSW Department of Mineral Resources has released *Mineral Deposits of the Northern Broken Hill Block*, the fifth and final publication of the series entitled *Metallogenic Studies of the Broken Hill and Euriowie Blocks New South Wales Bulletin 32 (5)*:

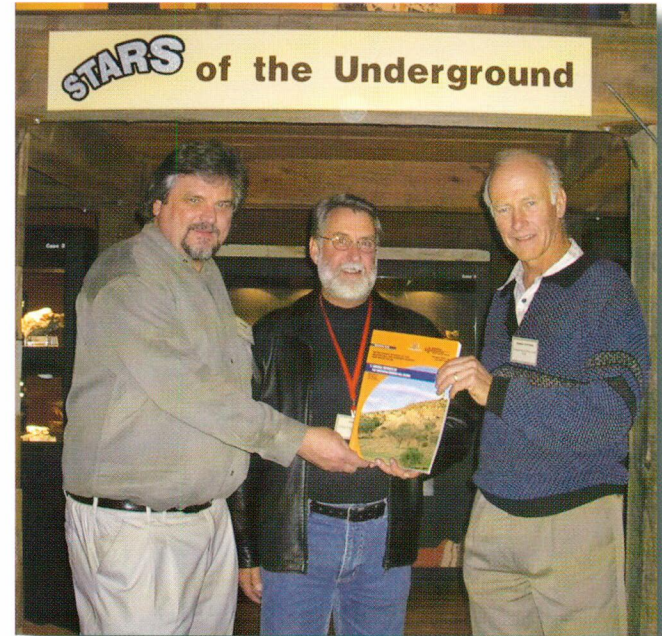
The Broken Hill Block is host to the famous Broken Hill Lode, whose wealth built the city of Broken Hill and launched one of the world's Australia's major mining companies – BHP Billiton.

Broken Hill type deposits continue to be the prime exploration target in the area. The program of metallogenic study undertaken in the 1970s and 1980s involved a detailed inventory and classification of the mineral deposits of the Broken Hill Block. This program was conducted in tandem with the Department's detailed 1:25 000 geological mapping of the Broken Hill region.

The metallogenic study documented thousands of small- to medium-sized deposits containing a very broad range of commodities. These include various styles of stratigraphically controlled deposits with lead, silver, zinc and tungsten as major commodities. A range of gold-rich deposits also occurs in the area but have not always received the amount of exploration investigation they warrant.

The complex metamorphic and structural history of the Broken Hill Block has led to the generation of a wide range of epigenetic deposit types, including the famous silver-rich sideritic veins of the Apollyon Valley, Mayflower and Maybell and pegmatite-hosted tin deposits in the Yanco Glen area.

Information on deposits will provide clues to the nature and distribution of more substantial exploration targets. The limited spatial distribution of many deposit types indicates that significantly different processes operated in different parts of the Block and that many of these require further investigation. For example, there are no "typical" Broken Hill or Thackaringa type deposits west of



Rob Barnes, Ted Tyne and Barney Stevens at the launch of the Broken Hill North Metallogenic Notes at BHEI 2003.

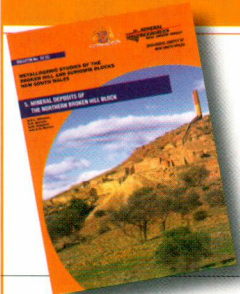
the Apollyon Valley retrograde schist zone but other styles of stratiform and vein mineralisation are present.

This publication accompanies the Broken Hill Block North metallogenic map (1:50 000). The map covers generalised lithological and stratigraphic interpretations and shows the locations and classification of deposits.

The new volume is available from the NSW Department of Mineral Resources, St Leonards for \$66.00.

For further information contact Barney Stevens, Principal Research Scientist (Broken Hill) or Rob Barnes, Acting Principal Geologist, Metals and Exploration, (08) 8088 9329.

Mineral Deposits of the Northern Broken Hill Block



- A major publication on the mineral occurrences of the northern Broken Hill Block.
- Final publication from major Geological Survey projects in the 1970s and 1980s.
- Provides a review of more than 1300 mineral occurrences and their geological setting.

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Minfo 79, September 2003

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Release of the Hill End Trough geoscience database CD

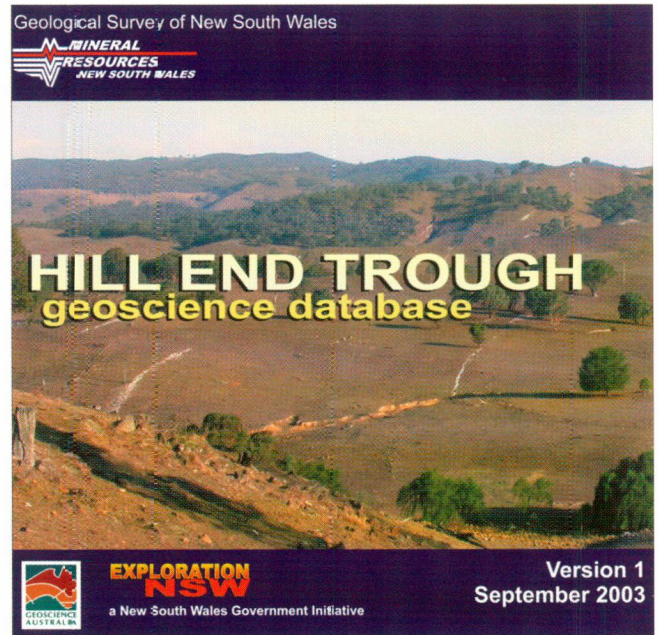
The Hill End Trough is a deformed Late Silurian to Early Devonian back-arc basin that has produced approximately \$2.3 billion worth of gold and has been a prime area of exploration in NSW since the 1850s. The main exploration targets are structurally controlled nuggetty gold in quartz like those at Hill End, Stuart Town and Hargraves and base metal sulphide deposits such as at Lewis Ponds.

The Hill End Trough geoscience data package is a compilation of the results of a project on the regional geology, tectonics and mineralisation of the Hill End Trough in the eastern Lachlan Orogen, New South Wales. This project forms part of the Exploration NSW synthesis of the Lachlan Orogen.

The GIS package on CD contains several features.

- Customised geoscience projects in ArcView and MapInfo formats, containing seamless geology, geophysical images, cross sections, point data sets and supporting geographical data.
- A 3D gravity basement model.
- A series of scientific papers highlighting the most up-to-date research on the region (listed below).

For further information contact Jeff Vassallo, phone (02) 9901 8343 or Richard Glen phone (02) 9501 8346.



NEW SCIENTIFIC PAPERS INCLUDED ON THE HILL END CD

Hill End Trough: genesis and fill. G. H. PACKHAM, University of Sydney.

Stratigraphy, sedimentation and palaeogeography of the Capertee High and eastern Hill End Trough, northeastern Lachlan Orogen. G. P. COLQUHOUN, NSW Department of Mineral Resources.

Hill End Trough time: integrating biostratigraphic zonation and isotopic age dating. D. POGSON & I. PERCIVAL, NSW Department of Mineral Resources.

Structural pathways and locations of gold in the Hill End Trough, eastern Lachlan Orogen, NSW. J. J. VASSALLO, R. A. GLEN & V. DAVID, NSW Department of Mineral Resources.

The Hill End Trough at Hill End: a thermal model. G. H. PACKHAM, University of Sydney.

Three-dimensional extension of the Hill End Trough based on the modelling of the regional gravity data. V. DAVID, R. A. GLEN & R. SPENCER, NSW Department of Mineral Resources.

Volcanic-sedimentary setting and genesis of the Lewis Ponds polymetallic massive sulfide deposits. M. W. AGNEW, Centre for Ore Deposit Research, University of Tasmania.

A review of the Hill End Mineral System, NSW, Australia. P. M. DOWNES, NSW Department of Mineral Resources, & P. K. SECCOMBE, University of Newcastle.

Mineralisation associated with the Hill End Trough. P. M. DOWNES, NSW Department of Mineral Resources.

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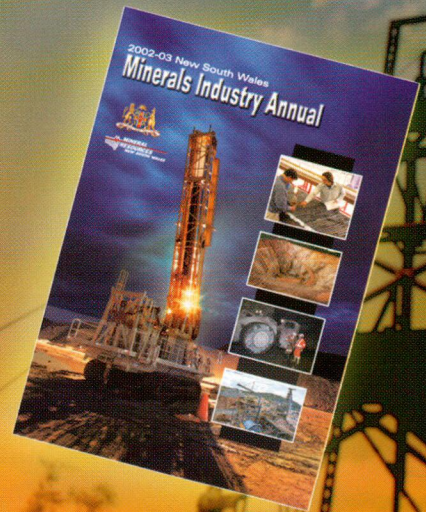
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Minfo 79, September 2003

Tibooburra-Mt Arrowsmith geophysical-geological interpretation map

The Department of Mineral Resources has released a solid geology interpretation map covering the Tibooburra-Mt Arrowsmith region of northwestern NSW. The interpretation is based on Exploration NSW airborne magnetic and radiometric surveys, regional gravity data and outcrop geology. This 1:250 000 scale map interprets the geology and structure of a 28 000 km² area within the Milparinka and Cobham Lake standard 1:250 000 map sheet areas, and extends from Koonenberry Mountain north to the Queensland and west to the South Australian borders. This region has potential for the discovery of significant gold and diamond deposits.

Over much of the area, bedrock is concealed by Mesozoic sedimentary rocks and Cainozoic sediments, including a dunefield. Aeromagnetic and gravity maps give clues to what lies beneath the sediments and sedimentary rocks. In particular, it is possible to project from outcropping areas to areas of non-outcrop. Information was also obtained from the few scattered exploration drillholes and water bores.

Figure 1 is a simplified version of the map, showing 12 colour-coded zones, based on known geology and observed geophysical signatures. Some of these zones are bounded by major faults; others have less distinct boundaries. Figure 1 shows prominent geophysical features portrayed on the 1:250 000 map. Linear magnetic features, generally trending north-northwest, are common. More rounded features, mostly representing intrusions, are less common. Most of the magnetic anomalies have a positive magnetic response. On the map, but omitted from Figure 1, are contours at 50 m intervals, showing depth to the base of Mesozoic cover.

The geophysical patterns reveal an extensive system of cross-cutting north- to north-northeast trending faults throughout the central and southern parts. The interpreted faults link segments of known faults that crop out at Mount Browne and in the Mt Arrowsmith Inlier.

Gold has been mined from areas between Mt Browne and Tibooburra. The gold occurs in reef deposits in phyllites of the New Bendigo Zone, and in Mesozoic and Cainozoic sedimentary units overlying the Tibooburra Magnetic, New Bendigo and Milparinka Zones. There is a spatial association of gold with granites of the Tibooburra Magnetic Zone, and with the cross-cutting regional fault system.

Following is a description of the various zones, from southwest to northeast.

The rocks in the far southwest are interpreted as a continuation of the Palaeoproterozoic Willyama Supergroup and Neoproterozoic Adelaidean rocks known further south. They appear to be overlapped by the eastern margin of the Early Cambrian Arrowie Basin.

The Paradise Platform contains no outcropping rocks. It is most likely occupied by a thin Mesozoic sequence overlying Devonian sedimentary rocks, in turn overlying older basement. The older basement appears to be intruded by substantial granitic bodies. Water bores emit flammable gas in at least two places on the Paradise Platform.

The Bancannia Trough contains a thick sequence of Devonian sedimentary rocks and some probable Cambro-Ordovician units, overlying very magnetic basement.

The non-outcropping Mundilpa Zone abuts the termination of the Bancannia Trough, but appears to be entirely different, its geophysical signature suggesting a Palaeozoic fold belt, with at least one large granite intrusion.

The narrow Tiramina Zone is a zone with low magnetic intensity, no outcrop and no diagnostic information.

In the southern part of the Koonenberry Zone, there is extensive outcrop of Neoproterozoic, Cambrian and Ordovician rocks mapped at 1:100 000 scale. The interpretation map shows substantial extensions of the alkaline Mt Arrowsmith Volcanics, north and northwest of Mt Arrowsmith. The Koonenberry Zone is bounded to the east by the Koonenberry Fault, a structure with a strike length of hundreds of kilometres.

The only outcrops in the Milparinka Zone are the Mt Poole, Mt Browne and Gorge Inliers, consisting of Cambrian phyllite, cleaved sandstone and rhyolitic tuff, with some dioritic intrusions.

The New Bendigo Zone exhibits a number of major faults slicing through Cambrian or Ordovician phyllite, metasandstone and very minor granule conglomerate, diamictite, limestone and phosphate rock. Both the Milparinka and New Bendigo Zones appear to be truncated against the Koonenberry Fault to the south. In the New Bendigo Zone the Warratta and New Bendigo Faults show signs of relatively recent movement, and Mt Browne Fault is seismically active in the Milparinka Zone.

The Kayrunera Zone comprises mostly low magnetic and low density, deformed turbidites of the Teltawongee beds.

The Tibooburra Magnetic and Mt Wood Zones are considered parts of the Thompson Fold Belt, whereas the zones to the west and southwest are mostly parts of the Delamerian Fold Belt. The boundary between the two fold belts may be the Olepoloko Fault, which appears as a major, moderately southwest-dipping feature on a seismic cross-section, or it may be the southwestern boundary of the poorly defined Perimpa Zone. The latter boundary appears to transect a deeply buried, very strongly reversely magnetised body of unknown origin. The Perimpa Zone also contains part of a mysterious gravity high which extends across the Tibooburra Magnetic Zone into the Mt Woods Zone. The Tibooburra Magnetic Zone contains Cambrian or Ordovician phyllite and metasandstone, intruded by Siluro-Devonian granites. The geophysical data indicate much more granite than can be seen in outcrop. A feature of the non-outcropping Mt Woods Zone is a series of bullseye magnetic anomalies interpreted as diatremes. A similar magnetic feature, the Gum Creek diatreme in the Tibooburra Magnetic Zone, was drilled through a cover of 414 m of Mesozoic sedimentary rocks. Radiometric dating of other diatremes in the region gave ages of Permian and Triassic.

The new map (in hard copy) is available for \$55.00 (email: orders@minerals.nsw.gov.au). The aeromagnetic data are available from Mike Hallett, Acting Chief Geologist, on (02) 9501 8371.

For more information about the geology of the area, contact Kingsley Mills (08) 8088 9321, or Barney Stevens (08) 8088 9529.

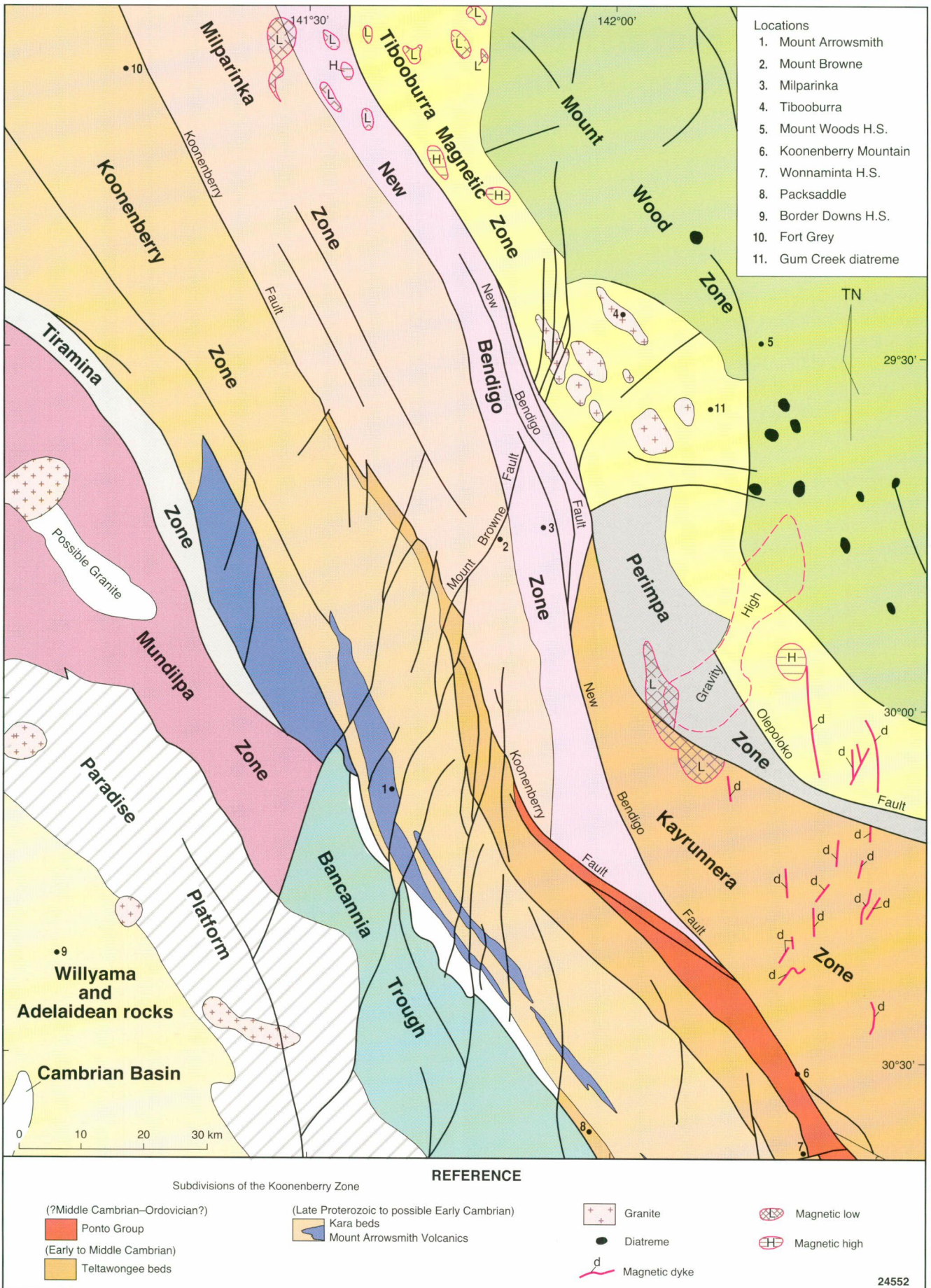


Figure 1. Tibooburra–Mt Arrowsmith geophysical–geological interpretation map.

Regolith mapping and landscape evolution models in gold exploration

Although the extensive regolith cover traditionally has been seen as an impediment to mineral exploration in the Tibooburra-Milparinka region of far northwestern NSW, there are few regions where mineralisation and its exploration are so intimately linked with regolith and long-term landscape evolution. The region hosts significant gold deposits, most of which are associated with Mesozoic and Cainozoic sediments deposited as a part of the region's landscape development. Recent research by the Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME) is helping to develop a regional regolith and landscape framework that will greatly assist mineral exploration in the region. CRC LEME's activities in the west of NSW are being supported through the NSW Government's Exploration NSW initiative.

Geology

The Tibooburra Inlier is the northernmost of several small basement inliers in the area (figure 2). Exposed bedrock of the area consists of early Palaeozoic metasediments and late Silurian to Devonian intrusions. None of the bedrock of the Tibooburra Inlier has been found to host extensive gold mineralisation (possibly because it does not host gold, or else reflects the need for more detailed geological study of the area). Mesozoic sedimentary units of the Eromanga Basin flank and overlie parts of the Tibooburra Inlier, which are then overlain by Cainozoic sediments from the Lake Eyre Basin. Considerable conflict and uncertainty exists in the literature relating to the stratigraphic context and recognition of many of these sediments. Recent fossil finds and field mapping associated with this study suggests that there has been extremely liberal lithostratigraphic correlation across the region, with many of the areas of ancient sediments closer to the Tibooburra Inlier predating the Palaeogene Eyre Formation (probable Jurassic-Early Cretaceous equivalents) rather than being a part of it.

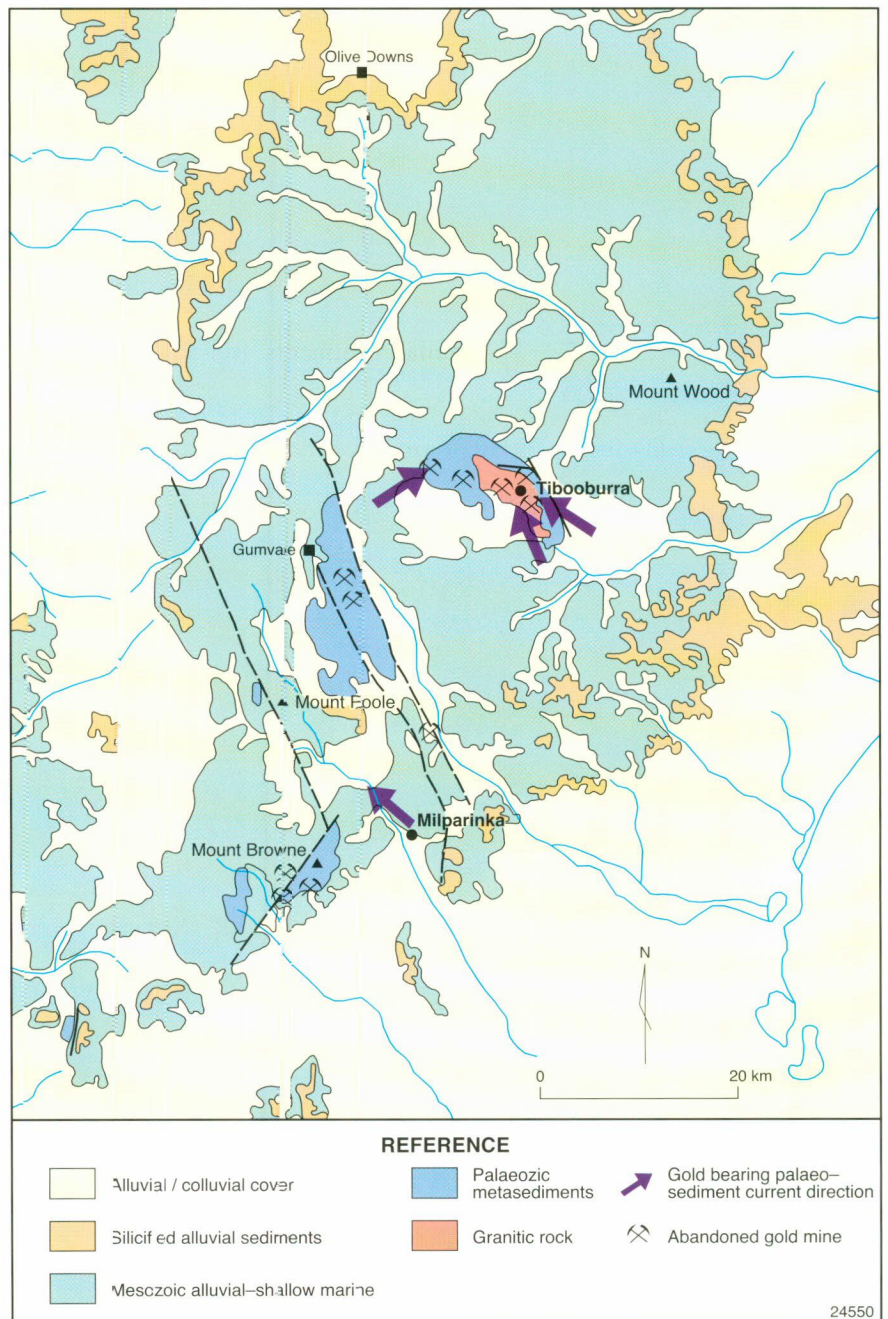


Figure 1. Location of Tibooburra Inlier, northwestern NSW.

Regolith-landforms

The regolith-landforms of the Tibooburra Inlier have been mapped at 1:25 000. This map is available through the CRC LEME website (<http://crlceme.org.au>).

Variably weathered bedrock is most extensively exposed on the rises and hills throughout the Tibooburra Inlier, and in sections where it underlies sedimentary cover. Assorted alluvial, colluvial, and aeolian sediments

are widespread across the region, particularly flanking the hills and rises of the Tibooburra Inlier. Ancient sediments (alluvial and marginal marine origins) are widespread around the margins of the Inlier, and at several sites over the central part of the Inlier. Alluvial sediments are mostly associated with the contemporary drainage network, and as minor eroded exposures in elevated landscape positions. Contemporary alluvial deposition occurs within alluvial channels and flanking depositional plains, drainage depressions, outwash fans and swampy depressions. Colluvial sediments are widespread across the area, particularly flanking hills and rises, and extending across the adjacent lowlands. The most widespread colluvial deposits are associated with shallow overland flow and may form a thin cover on erosional hills and rises or extensive sheetflow fans. Aeolian sediments are very extensive across the area where they variably mantle most of the landscape and form extensive sandplains and linear dunefields in low-lying settings, particularly flanking the Inlier.

Regolith carbonate accumulations (RCAs), including calcretes, are limited in their distribution in the region, mostly occurring as hardpan coatings along the interface between slightly weathered bedrock and transported regolith. RCAs near the Tibooburra goldfields have up to 69 ppb gold. Disseminated powder regolith carbonate accumulations are associated with many of the ancient transported regolith materials, particularly in sediments with calcareous cements, and in the overlying aeolian sediments. Ferruginisation is associated with some weathered bedrock exposures. Ferruginised sediments are very common in the ancient transported regolith and typically form low rises or prominent breaks in slope on hills. Silicified regolith is most prominent on rises and low hills composed of ancient transported regolith, and is a common detrital component of surface lags on sheetflow fans and deposits flanking the Inlier.

Some mineral exploration implications

The main input of gold to the area has been largely associated with ancient sediments such as those that now immediately flank and overlie parts of the Tibooburra Inlier. At the time of deposition these sediments were more extensive across the area of the Inlier, with the valleys between bedrock rises acting as 'traps' for gold. Palaeocurrent indicators in these sediments are highly variable (consistent with their proposed marginal marine to alluvial origins). However, in some of the more gold-rich locations there are broad indications of source areas to the south. The occasional occurrence of volcanoclastic bedrock clasts within these sediments may also help define their source and associated transported gold. It is very likely that the primary gold source for these sediments is in an area presently covered by regolith and basin sediments. These ancient sediments have since been reworked throughout the landscape history into alluvial and colluvial deposits that in many cases have further concentrated the gold (eg, The Granites diggings).

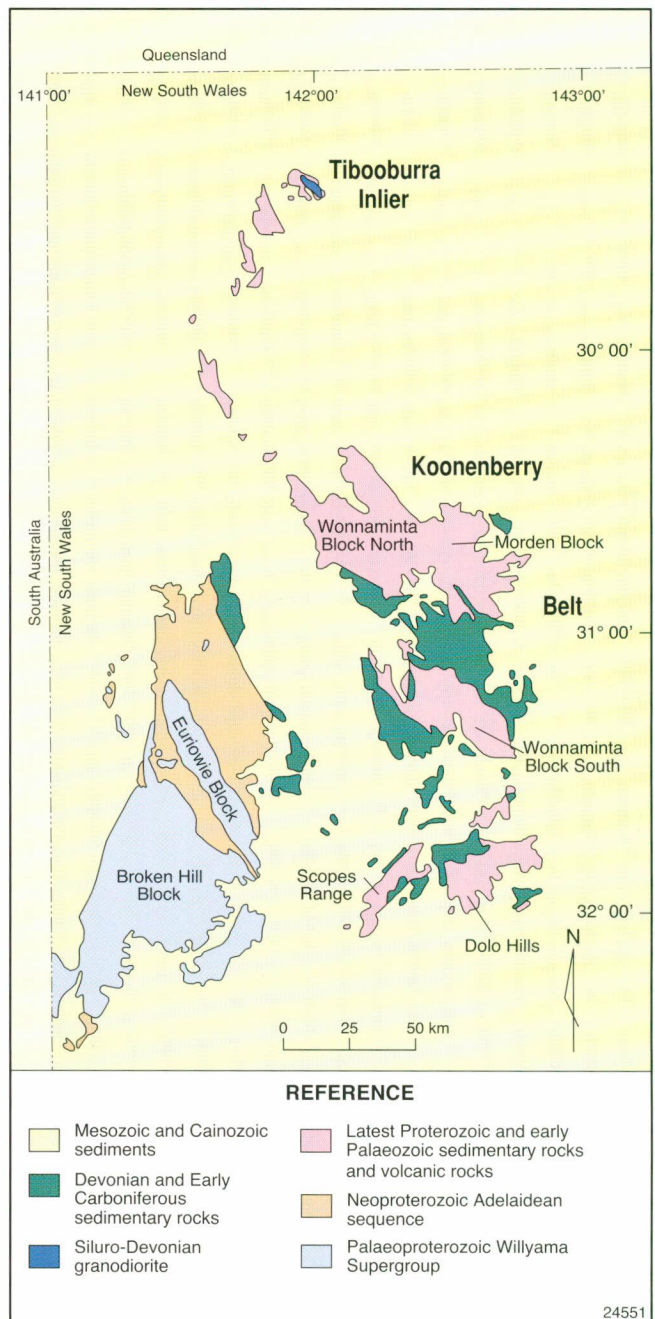


Figure 2. Area of Koonenberry geological map showing location of Tibooburra Inlier.

Cainozoic tectonics are a major component of the regolith and landscape evolution. Tectonic activity along regional structures, such as the Wahratta Fault to the southwest, has had important implications for regional palaeogeographic reconstructions and changes in dispersion pathways from areas south of Tibooburra since the Mesozoic.

Ongoing research in the area is further refining the regional regolith and landscape evolution models closely related to defining the source area and gold redistribution. The development of suitable exploration tools such as calcrete, silcrete, ferricrete, soil and biogeochemical sampling media are also being developed.

For more information, contact Steve Hill, phone (08) 8303 4540.

Exploration Licences granted to June 2003

| No | Min Div'n* | Holder | Expiry date | Area* Min Grp# | No | Min Div'n* | Holder | Expiry date* | Area* Min Grp# |
|------|------------|--|-------------|----------------|------|------------|-----------------------------|--------------|----------------|
| 6061 | SY | Smith, Adam, Michael, Nerida and Simon | 05.03.2005 | 4 U 1 | 6075 | OR | Herreshoff Holdings P/L | 07.05.2005 | 96 U 2 |
| 6062 | OR | Limestone Mining Ltd | 05.03.2005 | 12 U 2 | 6077 | OR | Herreshoff Holdings P/L | 07.05.2005 | 50 U 2 |
| 6063 | BH | Platsearch NL | 10.03.2005 | 40 U 1 | 6073 | OR | Herreshoff Holdings P/L | 07.05.2005 | 74 U 2 |
| 6064 | OR | Triako Resources Ltd | 20.03.2005 | 20 U 1 | 6079 | OR | Herreshoff Holdings P/L | 07.05.2005 | 19 U 2 |
| 6065 | OR | Love, John | 20.03.2004 | 1 U 1 | 6080 | OR | Compass Resources NL | 14.05.2005 | 100 U 1 |
| 6066 | OR | Climax Australia P/L | 26.03.2005 | 3 U 1 | 6081 | SY | Adanak Explorations P/L | 18.05.2005 | 8 U 1 |
| 6067 | OR | Bohuon Resources P/L and Southern Cross Exploration NL | 08.04.2005 | 25 U 1,2 | 6082 | SY | Adanak Explorations P/L | 18.05.2005 | 20 U 1 |
| 6068 | OR | Equigold NL | 10.04.2005 | 53 U 1 | 6083 | OR | Hibernia Gold P/L | 18.05.2005 | 4 U 1 |
| 6069 | OR | Mudgee Stone Co P/L | 10.04.2005 | 1 U 2 | 6084 | OR | Falcon Minerals Ltd | 19.05.2005 | 148 U 1 |
| 6070 | BH | Broken Hill Operations P/L | 27.04.2005 | 25 U 1 | 60E5 | OR | Alkane Exploration Ltd | 19.05.2005 | 21 U 1 |
| 6071 | OR | Mudgee Dolomite & Lime P/L | 27.04.2005 | 8 U 2 | 60E6 | BH | Golden Cross Operations P/L | 28.05.2005 | 23 U 1 |
| 6072 | BH | Sipa Exploration NL | 30.04.2005 | 14 U 1 | 60E7 | OR | Golden Cross Operations P/L | 02.06.2005 | 91 U 1 |
| 6073 | IN | Cluff Minerals (Aust) P/L | 01.05.2005 | 14 U 6 | 60E8 | OR | Triako Resources Ltd | 02.06.2005 | 36 U 1 |
| 6074 | CH | Zulu Gold Mining P/L | 05.05.2005 | 7 U 1 | 60E9 | CO | Pasminco Australia Ltd | 17.06.2005 | 68 U 1 |
| 6075 | CO | Love, John | 05.05.2005 | 2 U 1 | 6090 | OR | Compass Resources NL | 19.06.2005 | 67 U 1 |
| | | | | | 6091 | OR | LFB Resources NL | 23.06.2005 | 15 U 1 |
| | | | | | 6092 | OR | Templar Resources Ltd | 25.06.2005 | 64 U 1 |

REFERENCE

| | | | | | |
|-----|---------------|----|----------|----|-------------|
| *AR | Armidale | CO | Cobar | SI | Singleton |
| BH | Broken Hill | IN | Inverell | SY | Sydney |
| CH | Coffs Harbour | OR | Orange | WA | Wagga Wagga |

*U = Graticular system units

* = ELs with passed expiry dates may either be subject to renewal applications or continue by virtue of "flow-on" applications.

- # Group 1 - Elemental minerals, metallics
 Group 2 - Elemental minerals, non-metallic
 Group 5 - Clay minerals
 Group 6 - Diamond, corundum, ruby sapphire
 Group 10 - Mineral sands



Consolidated Broken Hill Ltd

ABN 27 309 423 858

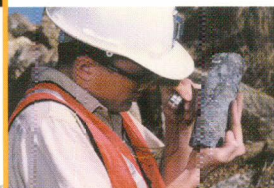


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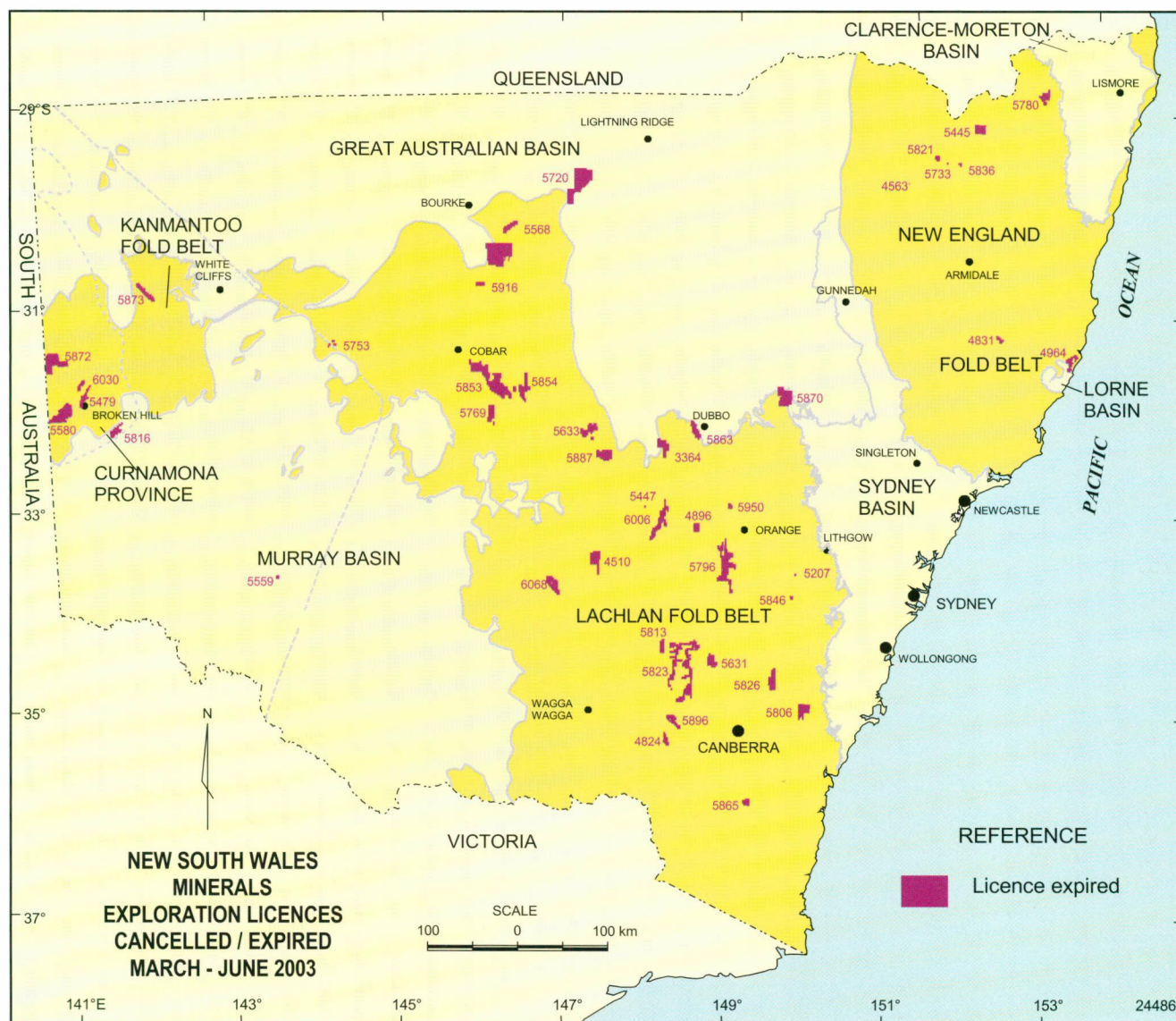
Endeavor Project

- Production of zinc and lead concentrates commenced mid September 2003 at Cobar following purchase of Elura Mine from Pasminco
- Mine Improvement Plan designed to
 - increase zinc metal output from 85,000 to 100,000 tonnes per year
 - reduce costs to 32 US cents per lb zinc equivalent
 - double mine life to +9 years
- Reserves of 13mt @ 7.9% Zn, 4.7% Pb and 49g/t Ag

Broken Hill

- 16,100m drilling programme completed at Broken Hill
- Resources of 16.7mt @ 5.4% (Zn+Pb), 26g/t Ag outlined on Western Mineralisation
- Follow up drilling of high grade shallow zinc lodes planned

Exploration Licences Cancelled/Expired June 2003



Summaries of terminated Exploration Licences

Final reports received between March 2003 and June 2003.

EL 3127

Cluff Minerals (Aust) P/L

Location: 15 km SW of Inverell

Objective: Diamond

A volcanoclastic, diatreme model for diamond formation was evaluated by a program of drilling, mapping, petrology, geophysics, heavy mineral separation, petrology and tunnelling in the main area of Copeton deep leads. Various prospects were tested by bulk sampling; open cuts were subsequently developed and mining commenced on Mining Leases within the licence.

ELs 3364, 3685

Climax Australia P/L

Location: 30 km S of Narromine

Objectives: Epigenetic and intrusion-related gold, copper

Aeromagnetic data highlighted a large, circular magnetic complex in non-outcropping Ordovician rocks. Soil sampling, RAB drilling and ground magnetic surveying were followed by aircore, reverse circulation (RC) and diamond drilling at

a number of prospects, giving widespread anomalous results. Encouraging intersections included 2 m at 1.42 g/t Au.

EL 4054

Lachlan Valley Granite Supplies P/L

Location: Forbes

Objective: Granite dimension stone

A large ton of granite was drilled to access fresh rock. Polished samples were promoted in Australia and Italy without generating market interest.

EL 4824

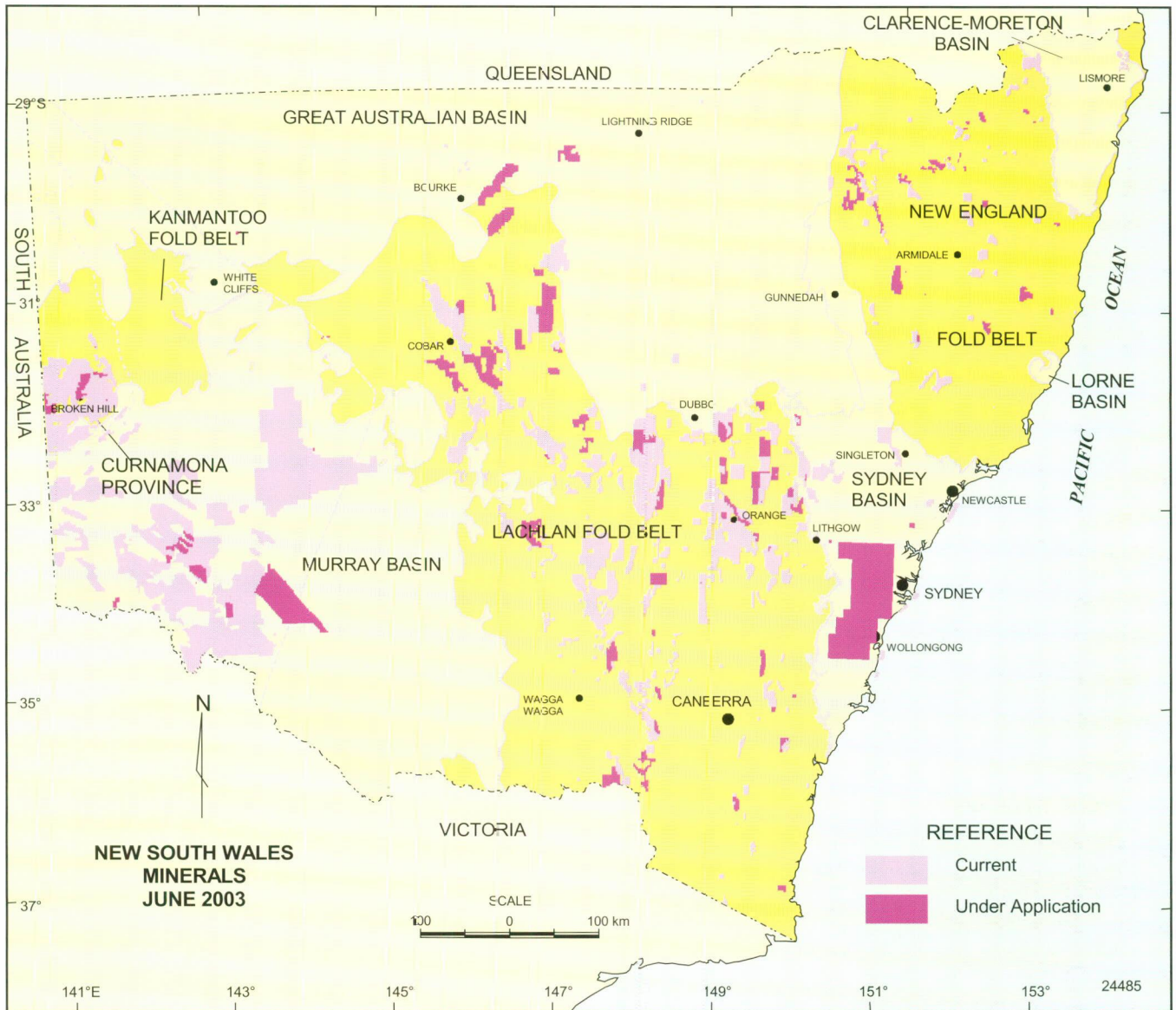
Vulcan Mines P/L

Location: 8 km S of Tumut

Objectives: Gold and base metals

An airborne magnetic survey identified targets associated with the Gilmore Suture. Follow-up ground transient electromagnetic (TEM) surveying failed to identify significant anomalies. Resampling of previous drillcore identified massive chalcopyrite-magnetite at the Basin Creek group of prospects

Exploration Licences in force June 2003



Summaries of terminated ELs to June 2003 (continued)

and silica-pyrite-adularia alteration at the Main Ridge prospect. The latter mineralisation is regarded as epithermal and rock grab samples assayed up to 3.2 g/t Au.

EL 5440 **Mount Conqueror NL**
Location: 8 km E of Gilgunnia
Objective: Gold

Exploration was focussed on a zone of Devonian sedimentary rocks with anomalous gold. Previous drilling had tested anomalies in soil-covered areas. Mount Conqueror drilled two RC holes to test anomalous gold in rock chips on the northern flank of Mount McKellar. Results were disappointing, with a best intersection of 1 m at 0.23 g/t Au.

EL 5568 **Carrington Holdings P/L**
Location: 50 km ESE of Bourke
Objectives: Tin and industrial minerals

Exploration focussed on the oxide zone of the 3KEL deposit at Doradilla which contains an estimated 1 Mt at 1.2% Sn. The tin is present as ultrafine oxide and the objective was to establish an effective ore-sorting technique. Testing of rotary air blast (RAB) drill samples achieved a head grade improvement to 2.8% Sn, falling short of the 5% required for matte fuming. The area was also investigated for talc and clays, without encouraging results.

EL 5581 Rimfire Pacific Mining NL**Location:** 40 km SSW of Forbes**Objective:** Gold

Exploration was focussed along the Parkes fault system where Ordovician metasediments are intruded by syenites. Known gold mineralisation is associated with quartz veins, phyllic alteration and anomalous arsenic and mercury. Stream sediment, rock chip and soil geochemistry gave only low values.

EL 5633 Black Range Metals P/L**Location:** 13 km SW of Tottenham**Objectives:** Platinum and lateritic nickel-cobalt

The licence covered Alaskan type zoned ultramafic intrusive complexes. Two areas of previously identified laterite were tested by RC drilling. Mineralised laterite was intersected at the Hylea Intrusive Complex (eg, 15 m at 0.73% Ni, 0.17% Co and 1 m at 18.55 g/t Pt). At the Bulbodney Creek Ultramafic Intrusive Complex the Co-Ni values were low but platinum results were encouraging (eg, 16 m at 4.3 g/t Pt).

EL 5672 Tatama P/L**Location:** 20 km ESE of Quirindi**Objectives:** Zeolites

Follow-up work was carried out on a zeolite resource indicated by previous exploration and drilling. A bulk sample gave low cation exchange capacity results.

EL 5706 Rimfire Pacific Mining NL**Location:** 50 km E of Tenterfield**Objective:** Gold

This licence covered the Lionsville-Solferino goldfield. A review of the data identified four reefs as drilling targets but no further work was done.

EL 5745 LM Alpen**Location:** 55 km WNW of Griffith**Objective:** Gypsum

A small area thought, on landholder advice, to contain gypsum was drill-tested by shallow (1 to 4 m) auger holes. No gypsum was encountered.

ELs 5826 & 5908 Golden Cross Operations P/L**Location:** 23 km W of Goulburn**Objectives:** Gold and base metals

The licences covered Silurian felsic volcanic rocks and incorporated a number of volcanogenic deposits, including the Gurrundah barite deposit. Reconnaissance sampling and geological compilation (including support of a student thesis) identified areas with mineralisation and alteration up to 5 sq km. Another application has been lodged over the area.

EL 5865 Golden Cross Operations P/L**Location:** 26 km N of Cooma**Objectives:** Gold and base metals

A review concluded that previous drilling did not fully test identified targets and that potential for further work existed. No further exploration was conducted.

EL 5870 MIM Exploration P/L**Location:** 15 km E of Dunedoo**Objectives:** Porphyry copper and gold

Circular magnetic features associated with porphyry phases of the Carboniferous Gulgong Granite were of particular interest. Reconnaissance evaluation identified minor alteration at the Leadville and other historic workings, but did not find evidence

of widespread potassic alteration or disseminated pyrite. One circular magnetic feature remains untested.

EL 5872 Platsearch NL**Location:** 50 km NNW of Broken Hill**Objectives:** Base and precious metals

Review and re-interpretation of previously acquired data allowed correlation with stratigraphic units that are mineralised in the Dome 1 and Dome 5 areas in an adjacent licence. PlatSearch was unable to secure funding for drilling of these relatively deeply covered extensions.

EL 5873 Platsearch NL**Location:** 170 km NNE of Broken Hill**Objectives:** Shear zone copper, gold and silver

Reconnaissance geology and gossan and calcrete sampling identified weak base metal anomalism in ironstones hosted by Cretaceous sandstone. This was interpreted as remobilisation from underlying Cambrian Kara beds into faults. No further work was completed.

EL 5887 Triako Resources Ltd**Location:** 25 km N of Fifield**Objectives:** Gold and copper

Exploration was for stockwork mineralisation in Ordovician Girilambone Group metasediments, with particular interest in a magnetic anomaly over a quartz-veined chert unit. Stream sediment geochemistry was followed by soil and rock sampling in two areas. The best result was 0.34 g/t Au with 0.16% Cu in sulphidic chert breccia at the Sarsfield prospect.

EL 5934 D. Timms**Location:** 40 km W of Cowra**Objective:** Gold

The licence covered the historic Warradering gold workings in a porphyry dyke. RC percussion drilling of the dyke gave encouraging intersections, eg 5m at 4.02 g/t Au. Dump sampling gave grades to 34.5 g/t Au, suggesting potential for small, high-grade deposits.

EL 5943 Minerals Corporation Ltd**Location:** 10 km NW of Ashford**Objective:** Limestone

A literature survey suggested that tonnages of high-grade limestone would be insufficient to warrant further exploration.

EL 6030 Broken Hill Operations P/L**Location:** 22 km NNW of Broken Hill**Objectives:** Base and precious metals

The licence was consolidated into a new application. No exploration was conducted during its brief tenure.

Reports to remain confidential

Reports to remain confidential due to "flow-on" tenement applications:

ELs 5479, 5559.

Final reports not yet received

At the time of compilation, final reports had not been received for the following licences terminated between March 1, 2003, and June 30, 2003.

ELs 4510, 4563, 4896, 4964, 5185, 5207, 5445, 5447, 5580, 5631, 5720, 5753, 5769, 5796, 5806, 5813, 5821, 5823, 5836, 5846, 5853, 5854, 5897, 5975, 6006.

Important New South Wales Mineral Projects

| Name | Commodities | Location | Resource |
|---|---|--|---|
| GOLD | | | |
| Adelong Project (Challenger deposit) | Gold | Adelong | 307 000 t at 4.9 g/t Au (2002) |
| Cadia East, Cadia Far East, Cadia Extended* and Ridgeway Deeps deposits | Gold, copper | 21 km SSW of Orange | 300 Mt at 0.46 g/t Au, 0.37% Cu (Cadia East) 70 Mt at 0.4 g/t Au, 0.21% Cu (Cadia Extended) 130 Mt at 1.3 g/t Au, 0.41% Cu (Cadia Far East) (2002) |
| Cowal Project (Lake Cowal, Endeavour 42) | Gold | 40 km NE of West Wyalong | 68.9 Mt at 1.3 g/t Au (2003) |
| Iodide South Project (Mineral Hill) | Gold, copper | 65 km NNW of Condobolin | 260 000 t at 4.3 g/t Au, 3.2% Cu (2003) |
| Northparkes extension (E48 deposit) | Copper, gold | 27 km NW of Parkes | 22.6 Mt at 1.2% Cu, 0.5 g/t Au (2002) |
| *Perseverance deposit (Cobar Goldfield Project) | Gold (copper) | 8 km SE of Cobar | 0.4 Mt at 9.2 g/t Au and 1.4% Cu (2001) |
| Tomingley [Wyoming] prospect | Gold | 12 km N of Peak Hill | 1.58 Mt at 2.01 g/t Au (2002) |
| SILVER & BASE METALS | | | |
| Bowdens prospect (Bowdens Gift) | Silver (lead, zinc) | 25 km ESE of Mudgee | 59 Mt at 43.8 g/t Ag, 0.22% Pb, 0.31% Zn (2001) |
| Kempfield prospect | Silver, barite (lead, zinc, gold) | 25 km S of Blayney | 9.36 Mt at 57 g/t Ag, 0.50% Pb, 0.89% Zn, 26.4% BaSO ₄ in three deposits (2001) |
| Rasp Mine Project CML 7 Project (Western Mineralisation) | Lead, zinc, silver | Broken Hill | 16.7 Mt at 3.2% Zn, 2.2% Pb, 26 g/t Ag (2003) |
| Tritton Copper Project (Eonnie Dundee) | Copper (gold, silver) | 22 km SW of Girilambone | 9.689 Mt at 2.67% Cu, 0.23 g/t Au, 9.93 g/t Ag (2003) |
| INDUSTRIAL MINERALS | | | |
| Dubbo Zirconia Project (Toongi) | Zirconia, yttrium tantalum, niobium | 20 km S of Dubbo | 83 Mt at 1.9% ZrO ₂ , 0.04% HfO ₂ , 0.14% Y ₂ O ₃ , 0.45% Nb ₂ O ₅ , 0.03% Ta ₂ O ₅ , 0.72% Rare Earth Oxides to 100 m depth (2000) |
| Ginkgo Project | Rutile, zircon, ilmenite (leucoxene) | 170 km SE of Broken Hill (Murray Basin) | 184 Mt at 3.2% HM (2002) |
| Snapper prospect | Rutile, zircon ilmenite (leucoxene) | 175 km SE of Broken Hill | 99.5 Mt @ 5.4 HM (2002) |
| Fringle Project (Cylinder, Karra and Finigans Tank deposits) | Rutile, zircon, ilmenite (leucoxene) | 90 km E of Mildura (Murray Basin) | 189 Mt at 3.7% HM (2002) |

*Last entry as mining has commenced

These important exploration and mining projects may proceed to development within the next three years. All information is based on non-confidential company reports and published data.

The information is updated as developments arise.

For more information, contact Lindsay Cohen, Minerals Liaison Officer, on (02) 9901 8654 or fax (02) 9901 8493.

| Resource Status | Proposed Mine Type | Operator | Project Status |
|--|---------------------------------|---|---|
| Resource – in situ (Indicated + Inferred) | Opencut & underground | Golden Cross Resources Ltd | Feasibility study completed. Seeking development finance. |
| Resource – in situ (Inferred) | Opencut & underground | Newcrest Mining Ltd | Further drilling continuing at deposits. Conceptual mine planning studies underway for Cadia East and Cadia Far East. |
| Reserve – mineable (Proved + Probable) | Opencut | Barrick Gold of Australia Ltd | Mining Lease granted in June 2003. Infill drilling continuing. Construction scheduled to start late 2003. |
| Resource – in situ (Inferred) | Underground | Triako Resources Ltd | Incline to be constructed from the existing Eastern Ore Zone decline. Production scheduled for March 2004. |
| Reserve – mineable (Probable) | Underground | Rio Tinto Ltd | E48 development undergoing economic and technical review. Evaluation drilling underway. |
| Reserve – mineable (Probable) | Underground | Peak Gold Mines P/L (Purchased by Wheaton River Minerals Ltd) | Underground drive (800 m) from the Peak Gold Mine to the Perseverance deposit completed. Development of the Perseverance deposit underway. |
| Resource – in situ (Indicated + Inferred) | Opencut & underground | Alkane Exploration Ltd | Three prospect areas identified over 1.5 km. Resource definition drilling commenced February 2003. New resource assessment planned for completion late 2003. |
| Resource – in situ (Indicated + Inferred) | Opencut & possible u/g | Silver Standard Resources Inc. | Evaluation of infill drilling results underway. Feasibility and EIS studies ongoing. |
| Resource – in situ (Measured + Indicated + Inferred) | Opencut (heap leach) | Golden Cross Resources Ltd | Prefeasibility study continuing. Further drilling underway. |
| Resource – in situ (Indicated + Inferred) | Underground | Consolidated Broken Hill Ltd | Mining plan provides for a two million tonne pa underground operation. Bankable feasibility to be completed by mid-2004 and production planned for end of 2004. |
| Reserve – mineable (Proved + Probable) | Underground | Tritton Resources Ltd | Development consent granted in September 1999. Feasibility study completed in May 2003. Construction scheduled for late 2003. |
| Resource – in situ (Indicated + Inferred) | Opencut | Alkane Exploration Ltd | Mining Lease application lodged. EIS and feasibility studies completed. Second-generation demonstration pilot plant testing and optimisation studies scheduled. |
| Reserve – mineable (Proved + Probable) | Opencut (dredging) | BeMaX Resources NL | Mining Lease granted and development consent for mineral separation plant approved. Construction possible in 2005. |
| Resource – in situ (Measured) | Opencut (dredging) | BeMaX Resources NL | Mining Lease application lodged June 2002. Bankable feasibility study underway has extended project life to in excess of 25 years. Planning Focus September 2003. |
| Resource – in situ (Indicated + Inferred) | Opencut (dredging & dry mining) | Murray Basin Titanium P/L | Drilling and environmental studies in progress and bulk sampling program approved. Mining Lease Application lodged. Development Application and EIS likely in 2003 and start-up likely in 2006. |

Wilpinjong coal development area

Tenders closed August 22, 2003.

In December 2002, the Minister invited tenders for an Exploration Licence for the Wilpinjong coal development area. When tenders were opened and declared on August 22, 2003, two tenders had been received. The tenderers are Xstrata Coal Australia Pty Limited (a member of the Xstrata Coal Group), and Wilpinjong Coal Pty Limited (a wholly-owned subsidiary of Excel Mining Limited).

The Wilpinjong tender area contains potential opencut coal resources and is located approximately 15 km southeast of the village of Ulan in the Western Coalfield (figure 1).

The successful tenderer must obtain all necessary approvals to build, own and operate a mine that will supply coal to Macquarie Generation for a long-term fuel supply, including a fixed price for the first five years of supply.

As the reserve area is estimated to contain more coal than is required to satisfy the Macquarie Generation contract, the successful tenderer must also use reasonable endeavours to contract with Delta Electricity and Eraring Energy for the supply of coal from the area.

In a separate process tenderers must specify to Macquarie Generation a price per gigajoule of coal offered to Macquarie for the supply of 484 million gigajoules during the first five years of the contract, and to specify a price per gigajoule of coal for the supply of various tonnages of coal for later mining periods exclusive of the cost of mining operations.

Coal exploration has been conducted within the Wilpinjong area since the early 1950s. This work established the presence and continuity of the Ulan seam, enabling direct comparison of quality and working sections with an adjacent operational colliery. Exploration within the general area was initiated by the (then) NSW Department of Mines in 1950, followed by the Joint Coal Board (JCB) in 1951-52, a joint venture program in 1977 between the JCB and the Department of Mines and an extensive borehole program undertaken by Energy Recycling Corporation between 1979 and 1981.

In 1992, the NSW Department of Mineral Resources conducted a preliminary exploration program aimed at validating existing raw coal quality data, and at providing an indication of the washability characteristics of the potential working sections within the Ulan seam. In 1998, the Department undertook a further program to enhance the knowledge of the raw and clear coal characteristics of the seam. To further complement the knowledge and understanding of the deposit, an airborne magnetic and radiometric survey was undertaken during late 2000, which suggested that there were no significant igneous intrusions in the tender area.

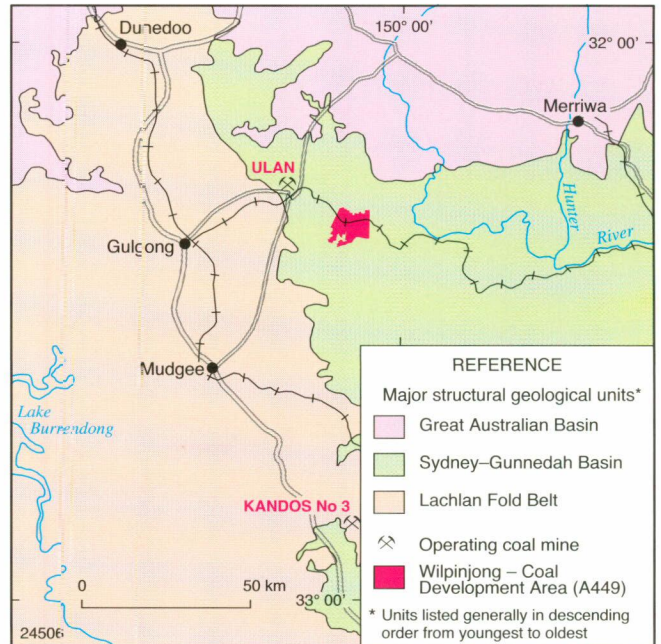


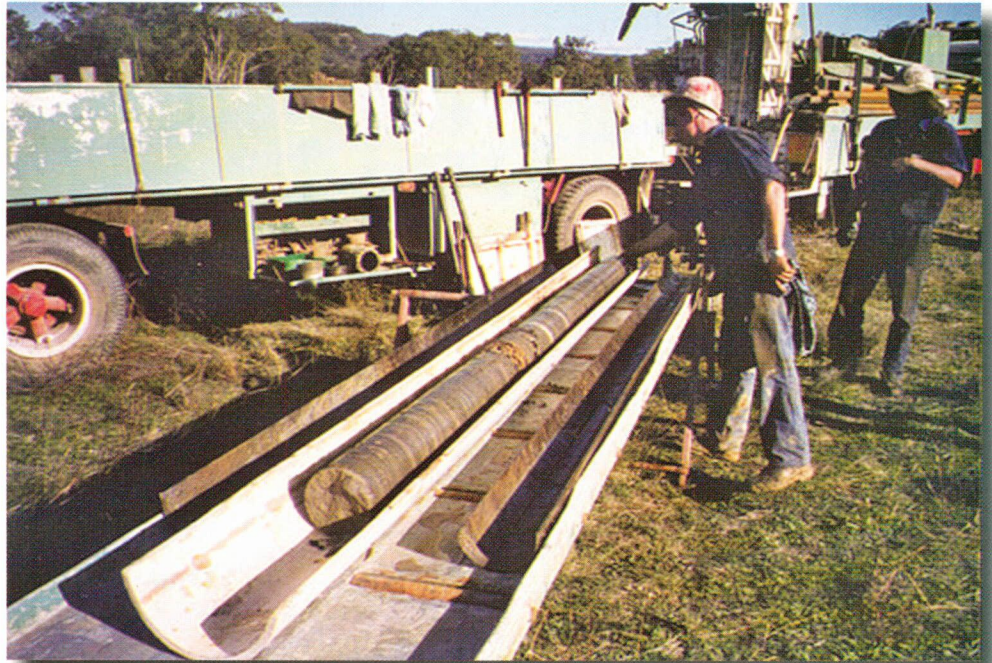
Figure 1. Ulan area map showing Wilpinjong coal development tender area.

A program involving the drilling of 59 cored and rotary holes was initiated to improve the understanding of the deposit. This program was completed in July 2002 and provided better definition of the distribution of oxidised coal at shallow depth and resulted in a reduction of approximately 20 million tonnes from the earlier estimates to a new resource estimate of 170 million tonnes in situ. All data gained from this program were incorporated into the database for the Wilpinjong area.

Additionally, in February 2003 the Minister for Mineral Resources advised potential tenderers that export of up to 20% of production from the Wilpinjong deposit would be permitted, provided there was no sterilisation of domestic coal resources. To facilitate this request and to provide tenderers with sufficient data to canvass both a domestic contract and a possible limited export thermal market scenario, the Department undertook a Stage 5 large diameter (150 mm) core drilling program, funded by Macquarie Generation. A & B Mylec Pty Ltd were contracted by the Department as industry-recognised experts to design and oversee the analytical procedure for the Wilpinjong cores. This treatment procedure enabled tenderers to evaluate all possible working sections on a run of mine (ROM) and beneficiated basis, to ascertain their ability to produce coal at ash levels suitable for both domestic and export markets.

The Stage 5 program involved the drilling of six large diameter holes (150 mm) sited so as to give a representative

spatial distribution of the available working sections and their quality variation across the deposit. This program was designed so that adequate sample mass would be generated for the extensive testing on the potential working sections under investigation. A key element of this program was a desire to be able to delineate the washability characteristics of the Wilpinjong area through the undertaking of core pre-treatment and float/sink testing on a large number of potential working sections. Core pre-treatment involved drop shattering all samples, dry size distribution, wet tumble and wet size distribution. Size analysis was a key element in the planned design of the program to help determine the desirable characteristics of a coal pre-preparation plant. For each sample, the +16 mm, -16+2 mm and -2+0.125 mm material was recombined and subjected to washability testing.



Large diameter core from Stage 5 Wilpinjong drilling.

A digital terrain model to two-metre accuracy was obtained to assist in the delineation of seam sub-crop and overburden volumes.

For further information, contact Kim Bayly, Geologist, Coal and Petroleum Resource Assessment, on (02) 9901 8534, or Garth Holmes, Acting Assistant Director, Resource Development, on (02) 9901 8480.

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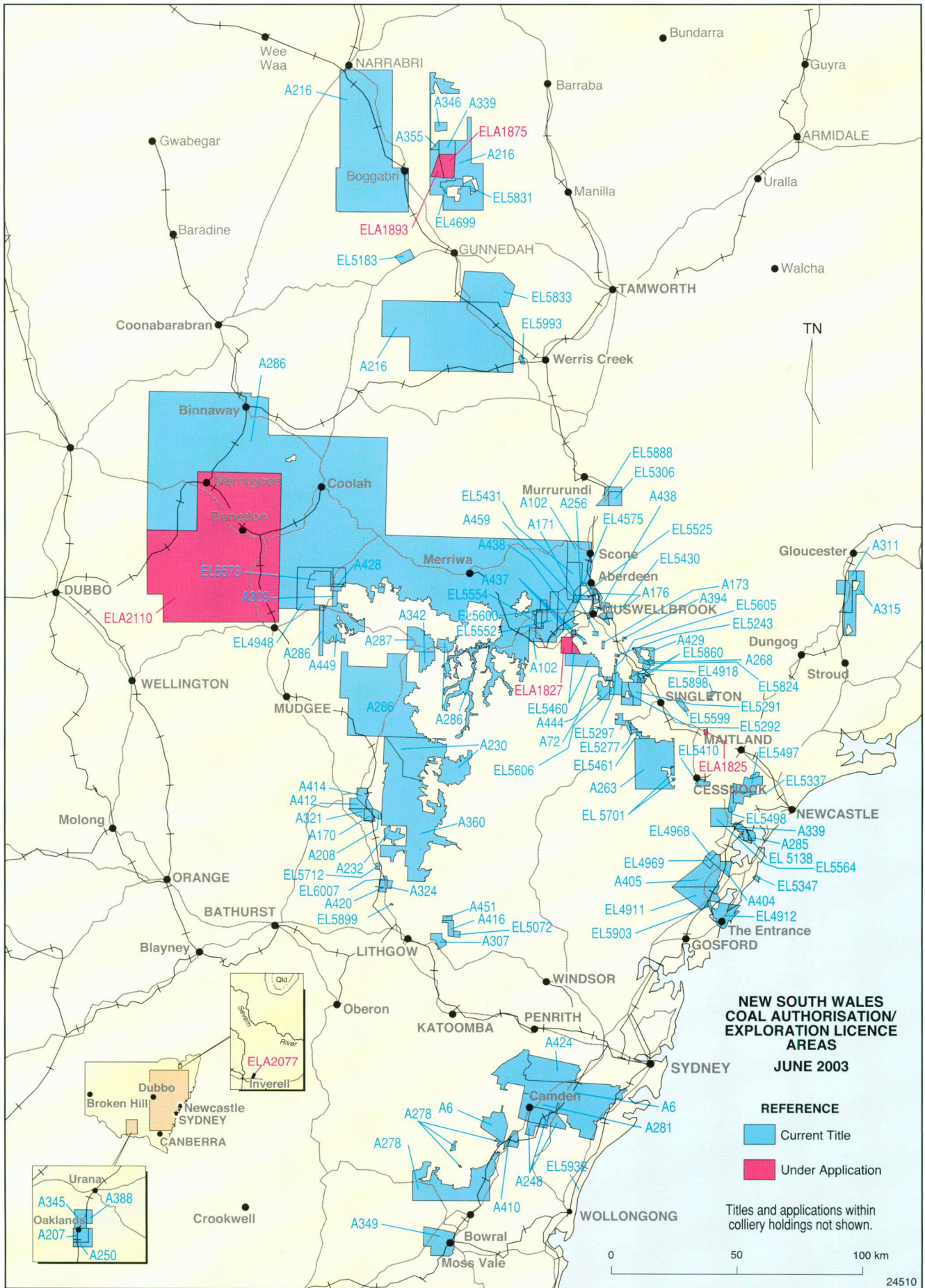
Coal Authorisations/Exploration Licences* June 2003

| No. | Holder | Nearest Town | No. | Holder | Nearest Town |
|------|--|----------------|------|--|----------------|
| A6 | Department of Mineral Resources | Campbelltown | 4918 | White Mining Ltd | Ravensthorpe |
| A72 | Novacoal Australia P/L | Jerrys Plains | 4948 | Department of Mineral Resources | Ulan |
| A81 | Navidale P/L | | 4968 | Centennial Mandalong P/L | Wyee |
| | Toyota Tsusho Mining(Aust) P/L | | 4969 | Centennial Mandalong P/L | Wyee |
| | DIA Coal Mining P/L | Camberwell | 5072 | Coalex P/L | Lithgow |
| A102 | Department of Mineral Resources | Muswellbrook | 5138 | Centennial Newstan P/L | Awaba |
| A170 | Genders Mining P/L | Capertee | 5183 | Namoi Mining P/L | Gunnedah |
| A171 | Mount Arthur Coal P/L | Muswellbrook | 5243 | Novacoal Australia P/L | Ravensthorpe |
| A173 | Anglo Coal (Drayton Management) P/L | Muswellbrook | 5277 | Saxonvale Coal P/L | Warkworth |
| A176 | Muswellbrook Coal Co. Ltd | Muswellbrook | 5291 | Coal & Allied Operations Ltd | Warkworth |
| A208 | Genders Mining P/L | Capertee | 5292 | Coal & Allied Operations Ltd | Warkworth |
| A216 | Department of Mineral Resources | Gunnedah | 5297 | Ravensthorpe Operations Ltd | Ravensthorpe |
| A23C | Department of Mineral Resources | Rylstone | 5306 | Bickham Coal Co. P/L | Murrumbidgee |
| A232 | Airly Coal P/L | Capertee | 5337 | Newcastle Coal Co. P/L | Seahampton |
| A24E | Illawarra Coal Holdings P/L | Menangle | 5410 | Coalmine Consulting P/L | Cessnock |
| A250 | Oaklands Coal P/L | Oaklands | | Enviro-Mining P/L | |
| A256 | Anglo Coal (Dartbrook) P/L | | 5417 | Coal & Allied Operations P/L | Warkworth |
| | Marubeni Thermal Coal P/L | | 5418 | Coal & Allied Operations P/L | Warkworth |
| | Showa Coal (NSW) P/L | | 5430 | Mount Arthur Coal P/L | Muswellbrook |
| | Ssanyong Resources P/L | Aberdeen | 5431 | Muswellbrook Coal Co. P/L | Bunnah |
| A263 | Department of Mineral Resources | Wollombi | 5460 | Anglo Coal (Saddlers Creek) P/L & others | Muswellbrook |
| A278 | Department of Mineral Resources | Mittagong | 5461 | Saxonvale Coal P/L | Broke |
| A281 | Department of Mineral Resources | Camden | | Nippon Steel Australia P/L | |
| A285 | Department of Mineral Resources | Toronto | 5497 | Excel Equities P/L | West Wallsend |
| A286 | Department of Mineral Resources | Gulgong | 5498 | Callaghans Creek Holdings P/L | Seahampton |
| A287 | Anglo Coal (Bylong) P/L | Bylong | 5525 | Anglo Coal (Dartbrook) P/L & others | Muswellbrook |
| A307 | Hartley Valley Coal Co. P/L | Lithgow | 5552 | Centennial Hunter P/L | Denman |
| A309 | Department of Mineral Resources | Ulan | 5554 | Mount Arthur Coal P/L | Muswellbrook |
| A311 | Gloucester Coal Ltd | Gloucester | 5564 | Hunter Valley Coal Processing P/L | Mulbring |
| A315 | Gloucester Coal Ltd | Gloucester | 5573 | Ulan Coal Mines Ltd | Ulan |
| A321 | Genders Mining P/L | Capertee | 5595 | Henry Walker Group Ltd | Singleton |
| A324 | Lithgow Coal Co. Ltd | Ben Bullen | 560C | Muswellbrook Coal Co. Ltd | Muswellbrook |
| A342 | Anglo Coal (Bylong) P/L | Bylong | 560E | Coal & Allied Operations P/L | Black Hill |
| A349 | Anglo Coal (Sutton Forest) P/L | Sutton Forrest | 5701 | Earth Technics P/L | Singleton |
| A355 | Idemitsu Boggabri Coal P/L | Boggabri | 5712 | Lithgow Coal Co. Ltd | Cullen Bullen |
| A360 | Department of Mineral Resources | Rylstone | 5824 | Consol Energy Australia P/L | Glennies Creek |
| A388 | Oaklands Coal P/L | Oaklands | 5831 | Whitehaven Coal Mining P/L | Boggabri |
| A394 | Liddell Tenements P/L | Muswellbrook | 5833 | Department of Mineral Resources | Gunnedah |
| A404 | Centennial Mandalong P/L | Morisset | 5860 | White Mining Ltd | Glennies Creek |
| A405 | Hunter Valley Energy Coal P/L | Cooranbong | 5883 | Callaghans Creek Holdings P/L | Thornton |
| A410 | Tahmoor Coal P/L | Picton | 5888 | Bickham Coal Co. P/L | Scone |
| A414 | Charbon Coal P/L | | 5892 | Centennial Mandalong P/L | Wyee |
| | S K Australia | Kandos | 5898 | Specialty Coal P/L | Greta |
| A420 | Lithgow Coal Co. Ltd | Ben Bullen | 5899 | Lithgow Coal Co. P/L | Portland |
| A423 | Hunter Valley Coal Corporation | Ravensthorpe | 5903 | Hunter Valley Energy Coal P/L | Wyong |
| A424 | Department of Mineral Resources | Campbelltown | 5932 | GPC Bellambi P/L | Wollongong |
| A428 | Department of Mineral Resources | Gulgong | 5965 | Mount Arthur Coal P/L | Muswellbrook |
| A429 | Hunter Valley Coal Corp. P/L | Singleton | 5967 | Whitehaven Coal Mining P/L | Boggabri |
| A435 | Coal & Allied Operations P/L | Singleton | 5983 | Oaklands Coal P/L | Oaklands |
| A437 | Mount Arthur Coal P/L | Muswellbrook | 5993 | Creek Resources P/L | Werris Creek |
| A438 | Bengalla Mining Co. P/L | Muswellbrook | 6007 | Lithgow Coal Co. P/L | Portland |
| A444 | Construction Forestry Mining & Energy Union | Singleton | 6047 | Department of Mineral Resources | Muswellbrook |
| A449 | Department of Mineral Resources | Ulan | | | |
| A450 | Saxonvale Coal P/L | Bulga | | | |
| A451 | Coalex P/L | Lithgow | | | |
| A459 | Coal & Allied Operations P/L | Aberdeen | | | |
| 4470 | Illawarra Coal Holdings P/L | Camden | | | |
| 4574 | Anglo Coal (Dartbrook) P/L and others | Muswellbrook | | | |
| 4575 | Anglo Coal (Dartbrook) P/L and others | Muswellbrook | | | |
| 4699 | Whitehaven Coal Mining P/L | Boggabri | | | |
| 4911 | Hunter Valley Energy Coal P/L | Wyee | | | |
| 4912 | Hunter Valley Energy Coal P/L | Wyee | | | |

*Authorisations and Exploration Licences over colliery holdings are not listed.

Exploration Licence Applications

| ELA No. | Mining Division | Applicant |
|---------|-----------------|-------------------------------------|
| 1825 | Singleton | Hunter Enviro Mining P/L |
| 1951 | Singleton | Ellemy Management P/L |
| 2054 | Orange | Centennial Springvale P/L & another |
| 2077 | Inverell | Renison Bell Holdings P/L |
| 2110 | Orange | Department of Mineral Resources |



Coal Mining Proposals August 2003

| Company | Location | Coal Type | Mine Type | Development Stage |
|----------------------------------|---|--------------------|-----------------------|-------------------|
| Anglo Coal | Saddlers Creek, 15 km southwest of Muswellbrook | Thermal | Underground & opencut | A |
| BHP Billiton | Wyong, northwest of Wyong | Thermal | Underground | A |
| Centennial Coal Company Ltd | Clarence extension | Thermal | Underground | B |
| Centennial Coal Company Ltd | Anvil Hill, north of Denman | Thermal | Opencut | A |
| Coal & Allied Operations Pty Ltd | Mourt Pleasant, 6 km northwest of Muswellbrook | Thermal/ coking | Opencut | C |
| Liddell Coal Operations Pty Ltd | Liddell expansion | Thermal | Opencut | C |
| Newcastle Coal Co | Tasman, 18 km south of Maitland | Thermal | Underground | B |
| Oceanic Coal Aust Ltd | Westside Extension, 26 km southwest of Newcastle | Thermal | Opencut | D |
| Specialty Coal | Great Greta Extended, 20 km east of Singleton | Thermal | Underground & opencut | A |
| Wambo Coal Pty Ltd | Wambo Extension, 15 km west of Singleton | Thermal | Underground & opencut | B |
| Warkworth Mining Ltd | Warkworth Extension, 15 km southwest of Singleton | Thermal | Opencut | B |
| White Industries | Ashton, 12 km northwest of Singleton | Thermal | Underground & opencut | D |
| Whitehaven Coal Mining Pty Ltd | Belmont, 25 km north of Glendah | Thermal | Opencut | B |
| Xstrata Coal Australia | Glendell, 17 km northwest of Singleton | Thermal | Opencut | E |
| Xstrata Coal Australia | Ravensworth West extension | Thermal | Opencut | C |

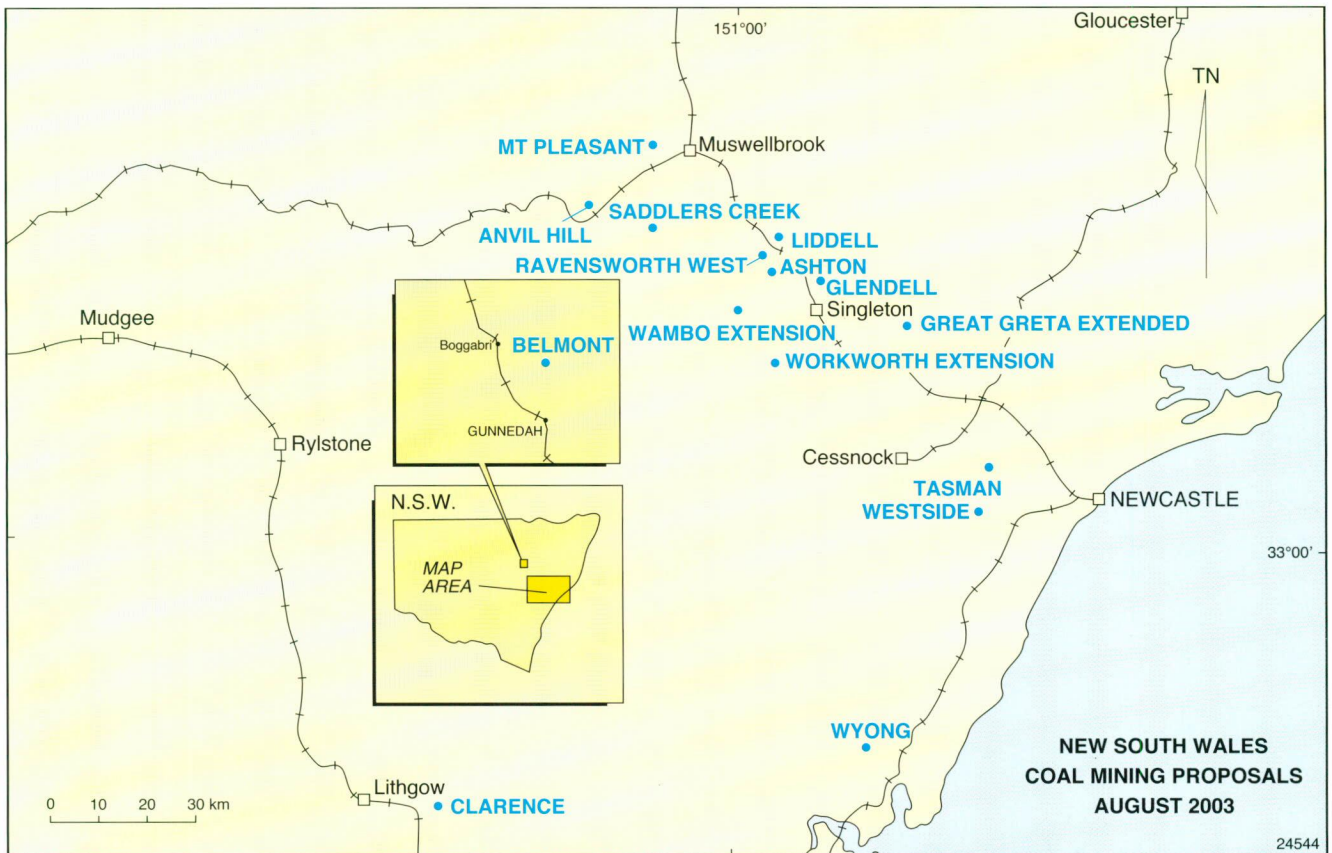
For further information contact Garth Holmes, Acting Assistant Director, Resource Development, on (02) 9901 8480 or fax (02) 9901 8493.

NOTES:

Stages defined:

- A - Environmental and preliminary feasibility studies.
- B - Development application lodged environmental impact statement completed.
- C - Development consent determined.
- D - Coal lease granted.
- E - All government approvals obtained.

*Development stage has advanced since publication of the previous schedule.

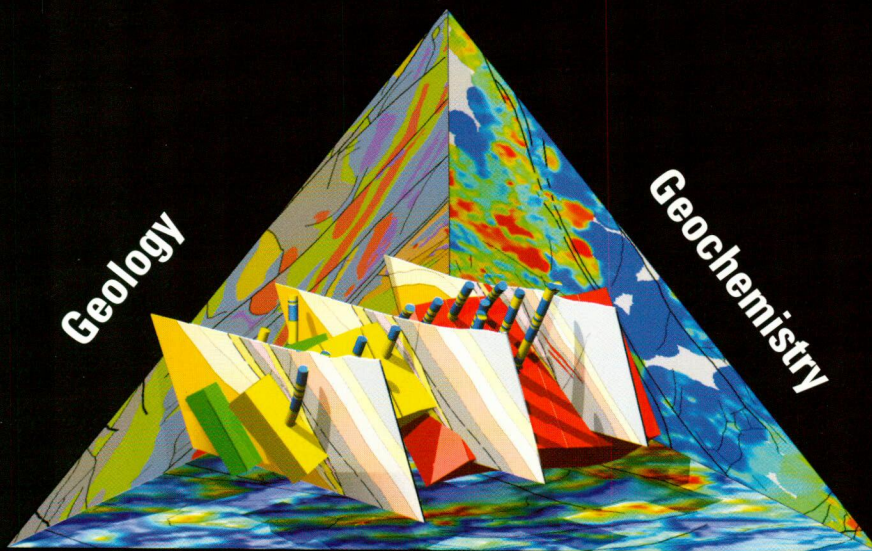


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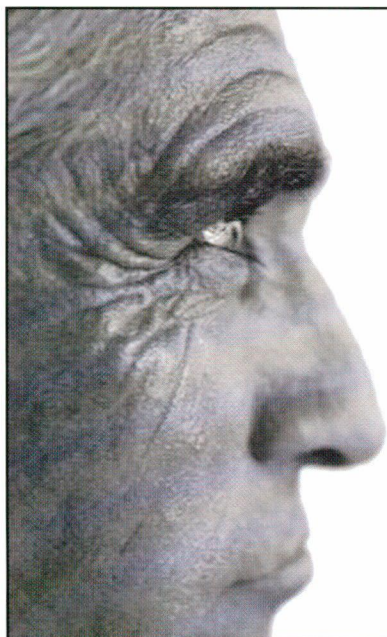
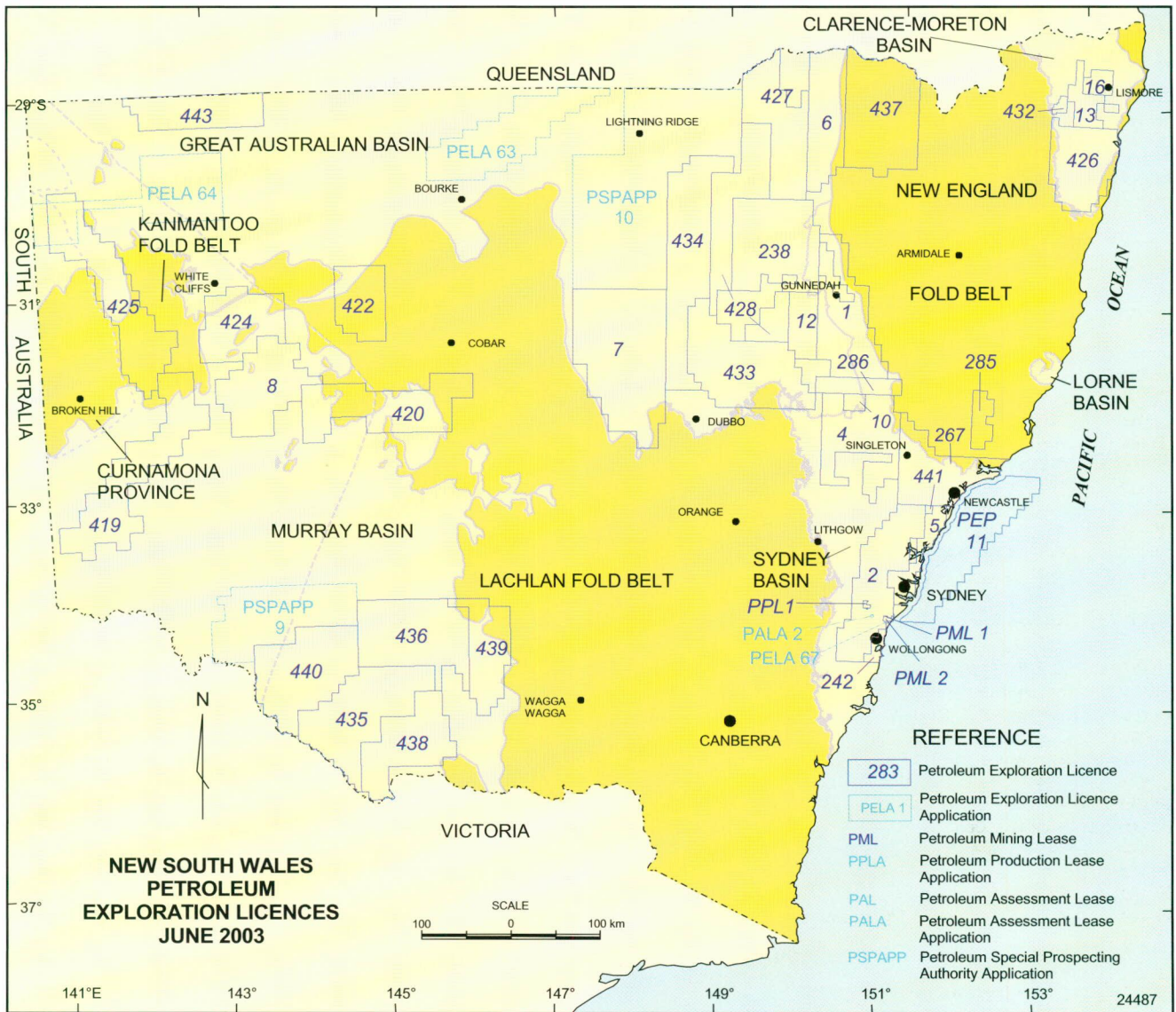


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Petroleum titles June 2003

| PETROLEUM EXPLORATION LICENCES | | | |
|---|--|-----------------------|------------------|
| No. | Holder | Area (no. of blocks)* | Expiry Date# |
| PEL1 | Australian Coalbed Methane P/L | 96 | 10.02.2005 |
| PEL2 | Sydney Gas Operations P/L | 108 | 28.03.2005 |
| PEL4 | Sydney Gas Operations P/L | 96 | 10.11.2005 |
| PEL5 | Sydney Gas Operations P/L | 30 | 10.11.2005 |
| PEL6 | Eastern Energy Australia P/L | 82 | 08.12.2005 |
| PEL8 | Eastern Star Gas Ltd | 101 | 24.06.2007 |
| PEL10 | Australian Coalbed Methane P/L | 6 | 10.02.2005 |
| PEL12 | Australian Coalbed Methane P/L | 31 | 26.09.2007 |
| PEL13 | Molopo Australia NL | 22 | 19.05.2006 |
| PEL16 | Metgasco P/L | 11 | 12.11.2005 |
| PEL238 | Eastern Star Gas Ltd | 123 | 02.08.2007 |
| PEL267 | Sydney Gas Operations P/L | 92 | 19.01.2004 |
| PEL285 | Molopo Australian NL & other | 18 | 15.04.2005 |
| PEL286 | Australian Coalbed Methane P/L | 24 | 10.02.2005 |
| PEL419 | GO Resources (Aust) P/L | 140 | 19.12.2003 |
| PEL420 | GO Resources (Aust) P/L | 97 | 19.12.2003 |
| PEL422 | Eastern Star Gas Ltd | 108 | 01.02.2004 |
| PEL424 | Eastern Star Gas Ltd | 6 | 01.02.2004 |
| PEL425 | Black Rock Petroleum NL | 140 | 26.02.2004 |
| PEL426 | Molopo Australia NL | 83 | 20.04.2004 |
| PEL427 | Strike Oil NL | 97 | 20.05.2004 |
| PEL428 | Strike Oil NL | 108 | 14.09.2004 |
| PEL432 | Arrow Energy NL | 6 | 21.12.2006 |
| PEL433 | Eastern Star Gas Ltd | 140 | 13.02.2007 |
| PEL434 | Eastern Star Gas Ltd | 140 | 13.02.2007 |
| PEL435 | Australian Coalbed Methane P/L | 140 | 18.03.2004 |
| PEL436 | Australian Coalbed Methane P/L | 132 | 18.03.2004 |
| PEL437 | Pangaea Oil & Gas P/L | 140 | 06.05.2007 |
| PEL438 | Pannonian International Ltd & others | 98 | 20.08.2007 |
| PEL439 | Magnum Gold NL | 73 | 23.10.2004 |
| PEL440 | Magnum Gold NL | 133 | 23.10.2004 |
| PEL441 | Sydney Gas Operations P/L | 1 | 10.11.2005 |
| PEL442 | Apex Energy NL | 10 | 26.02.2008 |
| PEL443 | Harlow Australia P/L | 71 | 23.01.2009 |
| PEL444 | Apex Energy NL & Sun Resources NL | 26 units | 03.04.2009 |
| PETROLEUM SPECIAL PROSPECTING AUTHORITY | | | |
| PSPA 7 | Australian Coalbed Methane P/L | 200 | 30.10.2003 |
| OFFSHORE PETROLEUM EXPLORATION PERMIT | | | |
| PEP 11 | Bounty Oil & Gas NL | 129 | 23.03.2006 |
| PETROLEUM PRODUCTION LEASES | | | |
| | | Area km ² | |
| PPL 1 | Sydney Gas (Camden) Operations P/L | 48 | 01.09.2023 |
| PPL 2 | Sydney Gas (Camden) Operations P/L | 93.92 ha | 09.10.2023 |
| * Total area, ie, area available plus exclusions where relevant. In New South Wales, one block equals approximately 5 minutes of latitude by 5 minutes of longitude and is approximately 75 km ² | | | |
| # Title continues where valid renewal application has been lodged. | | | |
| PETROLEUM EXPLORATION LICENCE APPLICATIONS | | | |
| No. | Applicant | Area (no. of blocks) | Application Date |
| 63 | New South Wales Oil P/L | 118 | 21.09.2001 |
| 64 | New South Wales Oil P/L | 127 | 21.09.2001 |
| 68 | B.N.G. P/L | 140 | 19.08.2003 |
| PETROLEUM SPECIAL PROSPECTING AUTHORITY APPLICATIONS | | | |
| PSPAPP 9 | Australian Coalbed Methane P/L | 133 | 19.03.2002 |
| PSPAPP10 | Australian Coalbed Methane P/L & other | 343 | 14.05.2003 |
| PETROLEUM ASSESSMENT LEASE APPLICATION | | | |
| PALA 2 | Endeavour Coal P/L | 869.4 ha | 23.05.2001 |



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Minfo 79, September 2003

Derelict Mines Program's funds for 2003-04

The NSW Government has allocated approximately \$1.6 million to the Derelict Mines Program for 2003-04. The Derelict Mines Committee, which includes officers from the Department of Mineral Resources, Environment Protection Authority, Department of Lands and the NSW Minerals Council, oversees the Program. The Committee has determined the strategic direction for the program and has agreed on individual projects for the

year based on environmental and safety risks posed by the mines.

The Committee will review and assess the progress of individual projects early in 2004. The Committee may make modifications to the Program to ensure the most appropriate expenditure of funds.

For more information, please contact James Brisebois, Derelict Mines Coordinator, (02) 9901 8473.

2003-04 EXPENDITURE PROVISIONS FOR NEW PROJECTS

| PROJECT / MINE SITE | ACTIVITY | BUDGET PROVISION |
|---------------------------------|--|------------------|
| Lake George Mine | Completion of environmental assessment of processing area. Remedial works at the processing and loading areas. | \$220 000 |
| Bexhill Brickworks | Safety works and removal of dangerous structures. | \$150 000 |
| Lightning Ridge Opal Fields | Rehabilitation of derelict shafts and subsided areas. | \$37 000 |
| Halls Peak Mines | Stage 1 erosion and sediment control works. Sealing of dangerous mine openings. | \$254 000 |
| Webbs Consol Mine | Rehabilitation of contaminated tailings dumps and construction of sediment and water management structures. | \$270 000 |
| Mount McDonald | Bat surveys and capping of dangerous mine openings. | \$20 000 |
| Hill End Stage | Ground truthing of desktop mine survey and preliminary safety works. | \$25 000 |
| Glen Davis | Capping of exposed oil shale chitter (waste material), construction of sediment controls and gating of open mine workings. | \$64 000 |
| Montreal Goldfields | Safety fencing and capping of shafts. | \$20 000 |
| Collisons Silver Mine | Environmental site assessment and remediation action plan. | \$75 000 |
| CSA Excised Areas | Project management of CSA excised area rehabilitation project. | \$68 000 |
| *AUSRIVAS Study | AUSRIVAS* study of derelict mines across NSW. | \$45 000 |
| Burruga Copper Mine | Environmental site assessment and remediation action plan. | \$75 000 |
| Derelict Mines Database Surveys | Site inspections and completion of database sheets for numerous mines across NSW. | \$50 000 |
| | Emergency and minor works. | \$100 000 |


*AUSRIVAS – Australian Rivers Invertebrate Assessment Scheme (assesses river health by the number of insects and small animals present.)

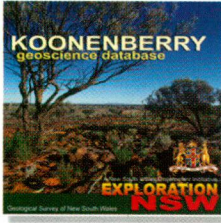


Figure 1. Location map showing derelict mine projects and mine sites proposed for rehabilitation.

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Minfo 79, September 2003

| | |
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| Post this form with your cheque, money order or credit card details to: NSW Department of Mineral Resources, PO Box 536, St Leonards NSW 1590 or ph (02) 9901 8268; fax (02) 9901 8247; or email: orders@minerals.nsw.gov.au | Company: _____ Name: _____ Contact Details: _____ Address: _____ Credit Card: _____ Total Cost: _____ Signature: _____ Expiry Date: _____ |
|---|---|

Ex Approval to Ex Certification

By 2010, approvals for electrical equipment will fully adhere to a uniform certification process. Currently, the Department of Mineral Resources approves how electrical equipment is used in NSW underground coal mines. Over the next several years, there will be gradual implementation of a certification program based on Australian and international standards. "Ex" means explosion-related standard. "Approval" refers to the Chief Inspector of Mines' OK. "Certification" is the international to certify equipment meets the "Ex" standard.

For NSW coal mining, the process change came into effect on January 1, 2003. The next stage of approval will require that electrical explosion-protected equipment to hold a "certificate of conformity".

The change will place the duty of care with mine operators, equipment manufacturers and suppliers consistent with the *Occupational Health and Safety Act 2000*. It will also involve legislative change for adoption of the National Standard for Plant.

The evaluation process for electrical apparatus in NSW coal mines hazardous zones will continue. Such equipment must be certified by nationally recognised organisations such as TestSafe in NSW and SIMTARS in Queensland. There will be an additional element surveillance of manufacturers to ensure apparatus manufactured is certified.

DMR safety officers will join the national certification management committee, which will be working towards the goal of a high-integrity certification process in which industry can have confidence.

DMR officers will also participate on Australian Standards committees for explosion-protected apparatus



Photo credit: I. Lee

Sharing information leads to improved safety.

and personnel competencies, and in the areas of design, testing, selection, installation, inspection, maintenance, overhaul and repair. They will develop a structured program for assessing how mines are managing explosion-protected apparatus at their sites. This program is designed to cover the entire life cycle of electrical apparatus. The enforcement policy of the NSW Government will be used to ensure correction of any deficiencies.

These changes will bring the NSW coal mining industry in line with both the Queensland coal mining industry and all other industries in Australia.

For further information, contact John Waudby, Senior Inspector of Electrical Engineering on (02) 4942 2300. ■

Detailed analysis of electrical incidents

The results of a study into electrical incidents by the Injury Risk Management Research Centre (IRMRC) at the University of New South Wales indicates that equipment not fit-for-purpose due to inadequate design or equipment damage is the most common cause of electric shock incidents in mining. The IRMRC reported its findings recently to the Mine Safety Advisory Council.

The NSW Department of Mineral Resources contracted the IRMRC to analyse trends of mining incidents recorded in DMR's COMET safety database. This database incorporates information from Coal Mines Insurance and WorkCoverNSW.

The study, "Analysis of the causes of electrical shock incidents in mining in NSW", examined 110 electric shock incidents in COMET.

Most of the cases studied had several contributing causes, but poor or inadequate design was a factor in 55.1% of incidents and the sole cause in 14.4%. Equipment breakage was a factor in 46.2% of the incidents. Mine worker behaviour played a minor role in these incidents. In most cases, the person made contact with equipment that was already electrically unsafe.

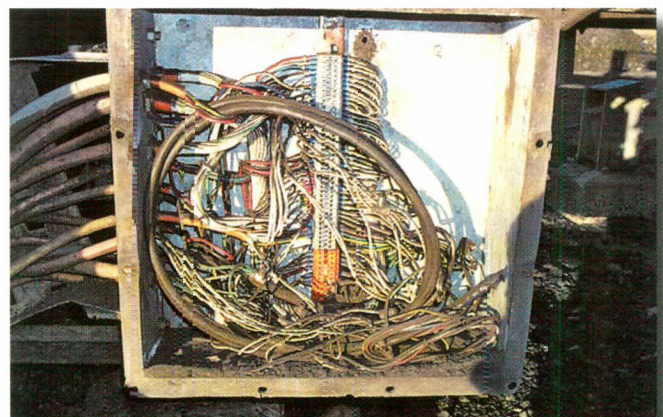


Photo courtesy: I. Lee

Poor standards of maintenance contribute to risk.

Patterns identified by the study highlight directions for prevention of electric shock incidents in mining. Audits, reviews and maintenance could have prevented almost all the studied incidents.

The Electric Incident report can be found on the NSW Department of Mineral Resources website: www.minerals.nsw.gov.au then click on Safety. ■

Tariff concessions on imports for mining

AusIndustry, the Australian Government's business unit in the Department of Industry, Tourism and Resources, provides a range of incentives for Australian businesses to foster investment and become more innovative and internationally competitive.

One of these incentives, the Enhanced Project By-law Scheme [EPBS], supports the development of significant projects in the mining, resource processing, food processing, food packaging, manufacturing, agriculture and gas supply industry sectors and Australian participation in those projects.

Tariff duty concessions on eligible goods used in the projects are available where the project has in place and implements a satisfactory Australian Industry Participation Plan and the eligible goods are not produced in Australia.

Eligible goods include functional units; machinery connected to perform a process; procurement packages; a number of the same type of equipment used across a project; pipes, pipelines, conveyors and flowlines and stainless steel materials used to produce these goods.

As at June 30, 2003, applications in respect of more than 60 projects involving investment of around \$22 billion were under consideration for support under the Scheme. These projects are in fields as diverse as coal mines, dairy processing and alumina production.

Comalco's Queensland Alumina Refinery was among the first projects accepted into the EPBS, opening the way for it to apply for concessions on a wide range of equipment such as bauxite grinding and steam-generating machines, control rooms and electric motors. This equipment will be used in its project, in conjunction with a wide range of locally sourced materials and equipment, to develop the first greenfields alumina project worldwide in more than a decade.

Eligibility criteria for EPBS concessions include those summarised here.

- **Sector Eligibility:** Concessions apply to the mining, resource processing, food processing, food packaging, manufacturing, agriculture and gas supply sectors.
- **Expenditure Threshold:** Total project expenditure on eligible goods [both imported and local] must be \$10 million or more.
- **Availability of Goods:** Duty concessions only apply to imported goods that are not produced in Australia, or are technologically superior to existing Australian goods. The customer must demonstrate the 'superiority' of the imported eligible goods through an independent, written technical assessment to AusIndustry.
- **Satisfactory AIP Plan:** Customers must submit and commit to an Australian Industry Participation Plan which demonstrates how the customer intends to provide full, fair and reasonable opportunity to Australian industry to participate in all aspects of the project.

- **Prospective in Nature:** Applications must be lodged with AusIndustry before eligible goods, which are subject of the EPBS application, are imported.

The application process has two stages:

- Stage 1 – project acceptance, and
- Stage 2 – implementation report.

AusIndustry has offices in every State and Territory capital and in 14 regional locations across Australia. Through this office network, AusIndustry delivers around 25 products with a total value of about \$1.7 billion to some 9000 customers every year around Australia.

Application forms for the EPBS together with Policy and Administrative Guidelines are available from the AusIndustry website: www.ausindustry.gov.au.

For further information on the EPBS, contact Helen Palmer, Assistant State Manager, NSW office, (02) 9226 6034 or Norm Lynch, Customer Service Manager, (02) 9226 6029.

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Exploration Licence policies revised

The Department of Mineral Resources has revised its policies in relation to renewal of Exploration Licences and policy on applications over existing titles in order to assist exploration companies in their tenement management.

Policy for Exploration Licences renewal

There are no substantive changes to the previous policy. Exploration Licences are usually granted for a period of two years, after which time they can be renewed for a further term (usually two years), with the opportunity for subsequent renewals. Normally, Exploration Licences are required to be reduced by 50% on each renewal (Section 114[6] of the *Mining Act 1992*). This is to ensure that exploration ground is 'turned over' and made available for other explorers to apply their own concepts, skills or technologies to such areas.

The Department's Exploration Titles Committee (ETC) oversees the renewal process. This Committee is chaired by the Director, Resources Planning and Development and includes representatives from the Geological Survey, the Titles program and the Environment Unit.

Renewal of Exploration Licences

For an exploration licence to be renewed the following criteria in relation to exploration activity should be satisfied.

1. The expenditure and reporting conditions of the licence have been satisfactorily met.
2. The licence area has been explored effectively.
3. A satisfactory proposed program for the renewal period has been submitted.

Where these criteria are not fully satisfied other extenuating factors may be taken into account in considering renewals. Example are summarised below.

- Circumstances beyond the control of the holder have delayed satisfactory exploration, eg Native Title procedural requirements.
- A change in exploration concepts will result in a substantial increase in exploration activity.
- Exploration has been delayed while the holder has justifiably focused work on an adjacent title.
- An explorer has made a significant investment in the project area in the recent past and further exploration is imminent.
- There is a need to hold ground adjacent to an existing mine or development project for longer-term exploration objectives.

However, licences will only be renewed on the basis of extenuating factors if the Department is satisfied that this is in the best interests of development of the State's mineral resources. Note that a proposed transfer of a licence to another party does not normally constitute an extenuating factor as referred to above.

Special circumstances

Section 114(6) of the Mining Act provides that an Exploration Licence may be renewed for more than 50% of its area if "special circumstances" exist.

The criteria for establishing that special circumstances exist are:

1. the conditions of the licence have been satisfactorily complied with (as outlined above);
2. the full area of the licence has been explored effectively; and
3. the proposed program satisfactorily covers the full area to be renewed.

If any of these criteria are not met, extenuating factors may be taken into account but only if the Department is satisfied that this is in the best interests of development of the State's mineral resources. The quality of the previous performance on the licence and the quality of the proposed program carry particular weight in determining extenuating factors for "special circumstance" renewals.

Special circumstances do not need to be demonstrated if the licence is of four units or less.

It must be emphasised that Exploration Licences are for active mineral exploration. If a resource has been identified and no further significant exploration is envisaged, other forms of title are available.

New applications

The Department will not allow a licence holder to circumvent the renewal policy by applying for a new licence to cover a licence, or areas of a licence, where renewal is not justified. Any such application by the previous holder (or by substantially the same interests as the previous holder) will normally be refused.

Policy on EL applications over existing titles

The *Mining Act 1992* allows for Exploration Licence applications to be lodged over existing licences for the same group of minerals. However, there is no clear guide to the appropriate timing for such applications to be successful and determination of these applications in the past has often been dependent on the timing of administrative actions taken by the Department.

The following policy provides a clear time framework within which the exploration industry can operate.

- If an Exploration Licence application is lodged over land affected by an existing Exploration Licence (for the same group of minerals) the applicant must obtain written consent from the holder and lodge it within 14 days of the date of the application.
- If a valid consent is not lodged within 14 days, then, unless the Departmental delegate is satisfied that

exceptional circumstances exist, the application will be refused if wholly affected by the existing licence, the area of the existing licence will be excluded, under Section 17 of the *Mining Act*, from the application if the licence only partly affects the application.

- If an Exploration Licence applicant will not, because of exceptional circumstances, be able to obtain and lodge a valid consent within 14 days, the applicant should give details of those circumstances in writing at the time of lodging the application.

- However, if the existing licence or any part of it ceases to have effect within the 14 day period the requirement for consent for that area no longer exists and the application can proceed for the available area.

- If the applicant lodges a valid consent within the 14 day period the application can proceed for the whole area.

For further information contact Lindsay Gilligan, Assistant Director, Minerals on (02) 9901 8301 or Jon Hawke, Assistant Director, Titles on (02) 9901 8508. ■

STOP PRESS: Mining Regulation 2003

On September 1, 2003, *Mining Regulation 2003* commenced under the *Mining Act 1992*.

The Regulation includes the following:

- makes provision with respect to the new Mine Safety Advisory Council to be established and will advise the Minister on occupational, health and safety in mines; and

- amendments to clarify the penalty notices of the Regulation, and the requirement for submission of diagrams for newspaper publication to be included with the application for titles has instead been included within relevant application forms.

A full listing of what the Regulation now deals with can be accessed via the Legislation Section of the Department of Mineral Resources web site (www.minerals.nsw.gov.au) ■

New native title procedures apply to mining proposals within the Western Division

The tenure for the majority of land within the State's Western Division comprises western lands leases. Since the Wik decision, uncertainty existed as to whether western lands leases extinguished native title. Because of this uncertainty, the NSW Government adopted a conservative approach, requiring all future act grants within the Western Division to go through the right to negotiate provisions of the Commonwealth Native Title Act 1993 (*CNTA*), before mining or exploration activities could be conducted on possible native title lands.

The High Court decision in August 2002 on the *Wilson v Anderson* matter has now removed the uncertainty concerning the status of native title over western lands leases. The High Court, in a majority decision, ruled that perpetual western lands leases extinguish native title. The implication of this decision is that for almost all exploration and mining proposals within the Western Division, there will no longer be a need to go through the Section 29 right to negotiate provisions of the CNTA. In the Western Division of NSW native title will have been extinguished in land where there is or was a perpetual western lands lease. Only small isolated parcels of Crown land within the division may be subject to native title.

Exploration Licence applications throughout the State, including the Western Division, will continue to

be granted with the native title condition. This condition specifies that a licence holder must not prospect on any land or waters on which native title exists without the prior written consent of the NSW Minister for Mineral Resources. Request for consent will trigger the Section 29 right to negotiate process.

Should applicants wish to have a licence granted without the native title condition then a comprehensive title search over the entire application area must be undertaken on the current and/or historic land tenure. This search must also be accompanied by legal advice supporting the view that native title has been extinguished throughout the licence area.

There is no change to the native title process for mining proposals. Here the responsibility remains with the applicant to provide supporting information on the extinguishment of native title. This proof may be in the form of supplying details of freehold properties or lands wholly the subject of perpetual western lands leases.

Further information on the native title process for future act grants of exploration and mining titles within the Western Division may be obtained by contacting Vince Fallico, Project Officer, Titles, on (02) 9901 8478. ■

Publications released through August 2003

General Industry Publications

- 2002-03 New South Wales Minerals Industry Annual \$49.50
- 2003 Coal Industry Profile \$60.50
- Investmin No. 17 August 2003 free
- Investmin No. 16 May 2003 issue free
- Quarterly Notes No. 114 \$3.30, free on subscription
- *Minfo* No. 77-78 \$5.50
- Bulletin 32(5): Mineral Deposits of the Northern Broken Hill Block \$66.00
- Broken Hill North Metallogenic Map \$33.00

Safety Publications and Products

- Mine Safety Update August 2003 issue free
- Minerals Industry Safety Handbook \$30.00
- Small Mines Safety Management Kit \$35.00
- MDG 40 Guideline for hazardous energy control (isolation or treatment) \$33.00
- MDG 1030 Guidelines for raiseboring operations \$33.00
- MDG 2005 Electrical technical reference for the approval of power winding system \$33.00

Maps and Geoscience Products

- Mineral Projects New South Wales, Australia Map (2003) free

Provisional 1:100 000 Geological Maps (print on demand)

- Eoorowa, Gunning, Merriwagga, Nuchea, Tullibigeal, Wonnaminta and Woodburn \$55.00 each

Preliminary Maps (CD-ROM)

- Warwick/Tweed Heads 1:250 000 Metallogenic Map \$55.00 map, \$110.00 CD-ROM

Geoscience Products (CD-ROM packages)

- Broken Hill Geoscience Database \$110.00
- Potential for Cu-Au systems in the Broken Hill Block \$22.00
- Koonenberry Geoscience Database \$110.00
- NSW Industrial Minerals Database \$110.00



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NSW Department of Mineral Resources

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