

HOUSE OF REPRESENTATIVES  
STANDING COMMITTEE ON INDUSTRY,  
SCIENCE AND RESOURCES

23 JUL 2002

RECEIVED

House of Representative  
on Industry and Resources Mr. John Anderson  
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Submission No: 31 THE GAP QLD 4061  
Date Received: 23 JULY 2002 Ph. 07 33009535  
Secretary: B. Folkes 20<sup>th</sup> July 2002

Committee Secretary,  
Standing Committee on Industry and Resources,  
House of Representatives,  
Parliament House,  
CANBERRA ACT 2600

Dear Sir/Madam,

Re:- Submission to the Inquiry into resources exploration impediments

I resubmit the enclosed paper with figures and attachments for the Committee's consideration.

I overlooked the deadline date until the last day. As I have had considerable involvement in the minerals exploration industry as a corporate and industry representative, I felt I had comments to offer of interest to the Committee. I submitted previously prepared material by email on Friday 19<sup>th</sup> July. However my Powerpoint files were incompatible with the computer available and you will have received incomplete figures.

I therefore provide this hardcopy as a better record of my submission. Note I have made some minor additions and corrections to the main text.

Yours Sincerely,



John Anderson

Enclosure - Submission

# **INQUIRY INTO RESOURCES EXPLORATION IMPEDIMENTS**

## **SUBMISSION TO THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON INDUSTRY AND RESOURCES**

### **Selected comments and examples of Impediments from a minerals explorer**

**JOHN ANDERSON**

19<sup>th</sup> July, 2002

#### **Introduction**

This submission is presented by an Australian minerals explorer of 26 years experience who has taken an active Industry-wide role in promoting exploration. As a former General Manager of Australian exploration for a major mining company and with considerable involvement with Industry and research bodies, the author has encountered the commercial, technical, statutory and community challenges and impediments that have been mounting against the Industry since the early 1990's. Since that time, the author has been keen not to be part of a generation that loses the valuable wealth-creating front-end of the mining industry.

The submission is a belated decision and as such is a brief commentary on a collection of tables, diagrams and attachments that the author had produced for various fora over the past four years. The submission is made to ensure the views of a grassroots practitioner balance the submissions of representative and government bodies.

#### **Context of this submission**

The principal challenges to minerals exploration in decreasing order are:-

- Resource replenishment
- Ability to predict and explore for blind resources particularly beneath cover.
- Land access to parks and native title claimed areas especially where ineffectively regulated.
- Attraction of risk capital.
- Exploration and commercial challenges in remote and poorly infrastructured regions.

The following discussion will give examples of the first three challenges primarily coming from the author's recent Queensland experience. The author presented a paper to the Townsville conference of the Australian Institute of Geoscientists in 2000 outlining the

challenges in Queensland that have compounded since that time. The abstract is included as **Attachment 1**. The diagrams included with this submission are mostly updates of the illustrations presented in 2000.

The capital issue is not in the author's expertise. The fourth challenge is touched on in **Attachment 2** from the socio-political angle but is largely a market issue for bulk mineral commodities and not discussed further.

## **Resource replenishment**

**Figure 1** tabulates \$4bn of recent mining investment in northern Queensland. Although this is perceived as a boom for a healthy industry, much of the foundation for the investment is resources discovered in the forties, fifties and sixties. Most of the new developments, including the newer discoveries made in a magnetics-based exploration surge around 1991, only have 10 to 20 years life.

A conveyor of discoveries is required to maintain the resulting industrial complexes however these are not forthcoming. To rely on third world production to meet Australia's resource needs is both commercially and morally wrong if Australia is to lead in wealth generation and resource/environmental management.

## **Ability to predict and explore for blind resources**

The prime contributor to the lack of discovery over the past ten years has been the inability to predict the location of new blind resources even in pedigree belts. **Figure 2** shows the restriction of known resources (in this case copper) to areas of outcropping geology (not shown but coincides with the occurrence pattern) where direct evidence enabled location by historical prospecting or provided lead-ins for the application of remote sensing technology to locate nearby shallow repetitions. **Figure 3** is an indication of the difficulty in discovering deep resources particularly away from brownfields sites. The majority of greenfields discoveries in the modern exploration era have been of resources that peak within 100m of the surface. A major exception is the Olympic Dam discovery as early as 1976 but for which there is no parallel since.

The Industry's reliance on broadacre "pre-competitive" data in the covered areas is therefore very strong. Such data can have significant impact on the private exploration expenditure within a jurisdiction as shown for South Australia in **Figure 4**. The State's share of the national minerals exploration spend increased from 2.3 to 4.9% after the their SAEI program made a delayed but important contribution to the Gawler Craton "rush" in 1997. The additional data permitted more confident prediction of favourable lithologies and structures to reduce the increasing risk of pegging and negotiating access for expensive exploration.

## **Land Access**

**Figure 5** shows a contrary impact for Queensland with the State's hesitant and awkward response to management of Native Title, resulting in the freezing of exploration titles to the effect of having only 13% of exploration grants and applications available for exploration access early in 2001 (**Figure 6** – source MIM Exploration). The impact would have been worse if the State did not have some significant brownfields sites such as Mount Isa to maintain exploration momentum during the period.

The result was Queensland has lost about 7% share or \$60-80M per annum of the national exploration spend since 1996 (Figure 7), an issue that still requires fixing if Queensland is to retain a longer term position as a resource developer.

Access to dual declaration parks is another issue that needs the preparation and acceptance of protocols for responsible access and development. Urban and agricultural development at the park boundaries have already caused significant impacts that could be better managed with more resources rather than taking the easy option of blaming lower impact exploration access and banning subsequent mine development.

## **Conclusion**

Australia has a major decision to make on whether it remains a responsible developer of its own minerals and energy resources by meeting the challenges presented to the future discovery and management of the country's resources. The alternative is to ignore wealth creation and the maintenance of 9% of our GDP by relying on third world economics and environmental practices to supply our resource needs.

A better discovery rate is needed to maintain the resource base from ten to fifteen years time. The main challenges are land access and resource prediction and delineation. The efforts thusfar in resolving land access issues and providing an aggressive research environment have been insufficient. Fiscal concerns had led private companies and governments to limit necessary funding on basic issues in the past due to expediency and user pays philosophies. This cannot continue on matters of national importance such as the resource base of the country's wealth.

## Figures

1. Using up our resource legacy - e.g. Northwest Queensland
2. Reliance on outcrop information – Australian copper deposits (after AGSO)
3. Poor ability to explore at depth – Modern greenfields base metal discoveries in Australia
4. Initiative Benefits – South Australia
5. Other Impacts – Queensland
6. Queensland – Accessible area (2001)
7. Queensland's loss of national (minerals) exploration spend

## Attachments

1. Exploring in Queensland – an overview *Australian Institute of Geoscientists NQEM 2000 Symposium – Abstract (2000)*
2. An example of strategic theme setting- Nomination of Priority Research Themes relating to Regional Development and the Minerals and Energy Sectors *Submission – National Research Priorities (June 2002)*

*John Anderson 19/7/02.*

FIGURE 1

## Using up our resource legacy e.g. North Queensland

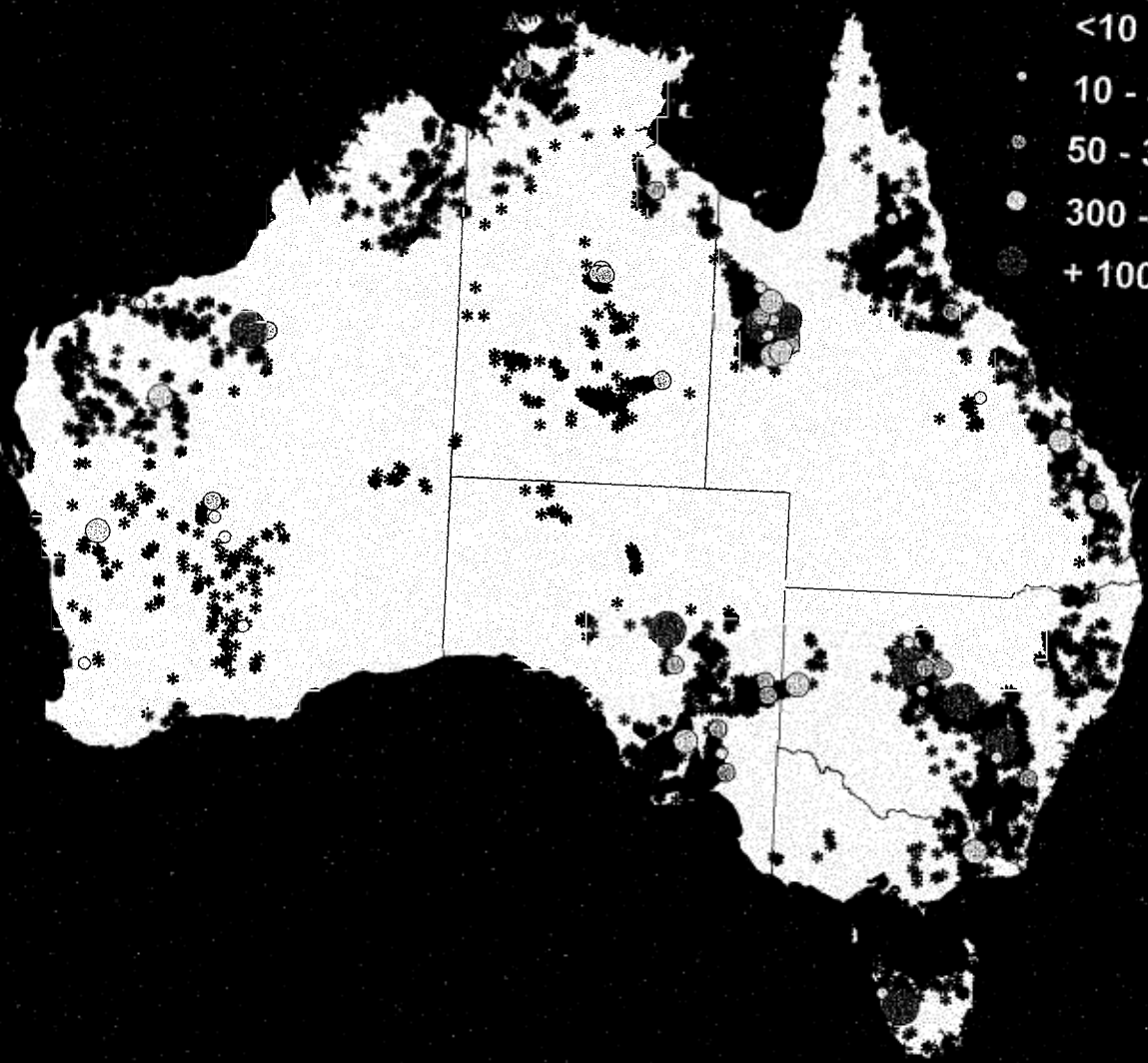
<u>Deposit</u>	<u>Approx. Resource</u>	<u>Capital (\$M)</u>	<u>Discovered</u>
Mt Gordon	6mt @ 6-7% Cu	125	1927/1997
George Fisher	97mt @ 14% Pb + Zn	170	1948/1969
- Lead Smelter		100	
Highway	1.2mt @ 6.3% Cu	37	1953
Enterprise	54mt @ 4% Cu	327	1954/1965
- Copper Smelter		243	
- Acid Plant		75	
- CRL		61	
Phosphate Hill	103mt @ 23.4% P <sub>2</sub> O <sub>5</sub>	700	1966
Pajingo expansion	4.2mt @ 14.6g/t Au	48	1983/1995
Osborne underground	11.4mt @ 2.9% Cu 1.1g/t Au	65	1989
Cannington	47mt @ 15% Ph+Zn	498	1991
Century	108mt @ 13% Ph + Zn	780	1991
Ernest Henry	155mt @ 1.1% Cu 0.5g/t Au	315	1991

FIGURE 2

# Reliance on outcrop information e.g AUSTRALIAN COPPER DEPOSITS

Total  
contained Copper

- <10 k tonne
- 10 - 50 k tonne
- 50 - 300 k tonne
- 300 - 1000 k tonne
- + 1000 k tonne



# Poor ability to explore at depth

## MODERN GREENFIELDS BASE METAL DISCOVERIES IN AUSTRALIA

### Principal Discovery Technique and Depth to Top

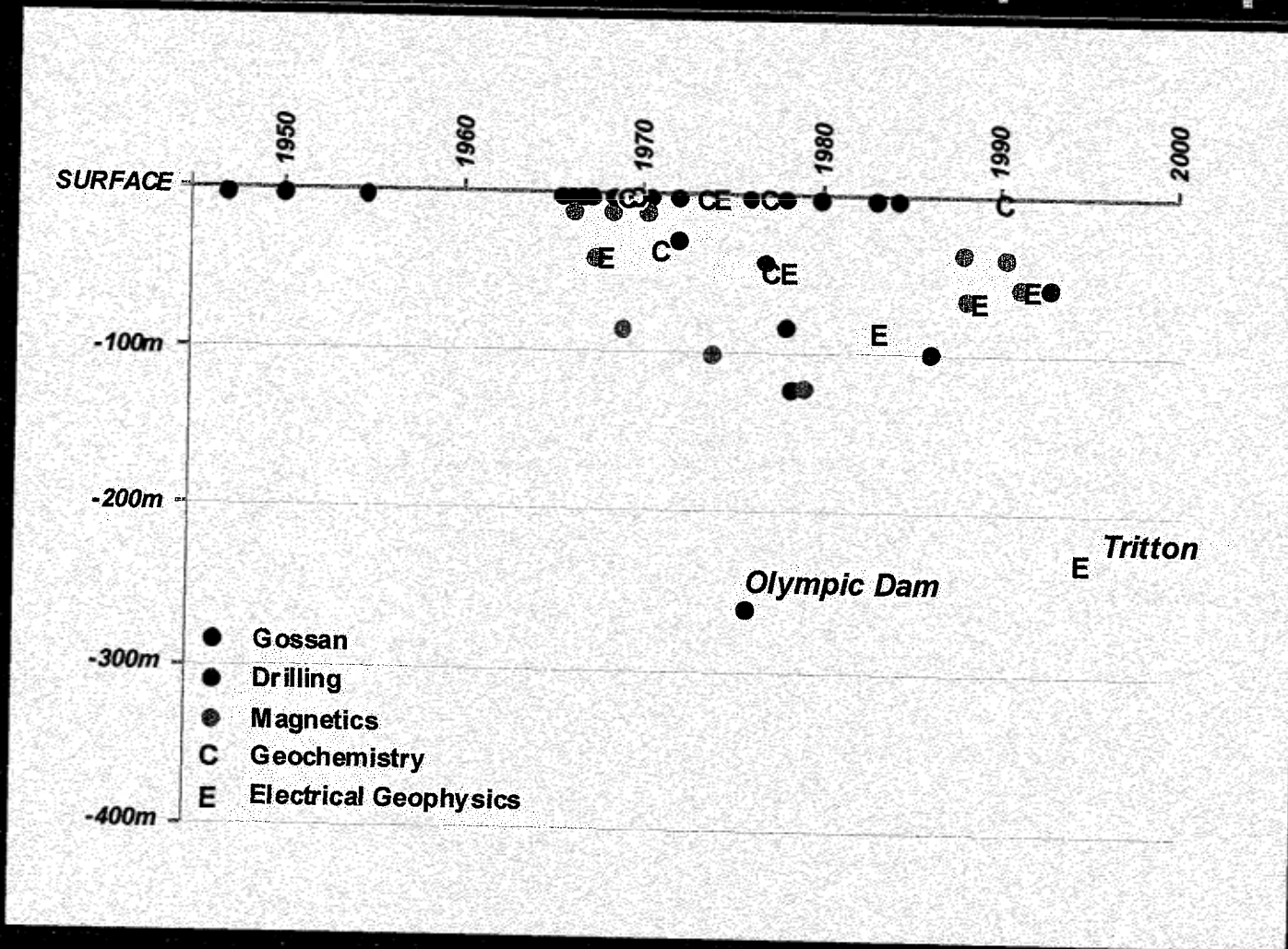


FIGURE 3

# INITIATIVE BENEFITS – Exploration Expenditures

## South Australia

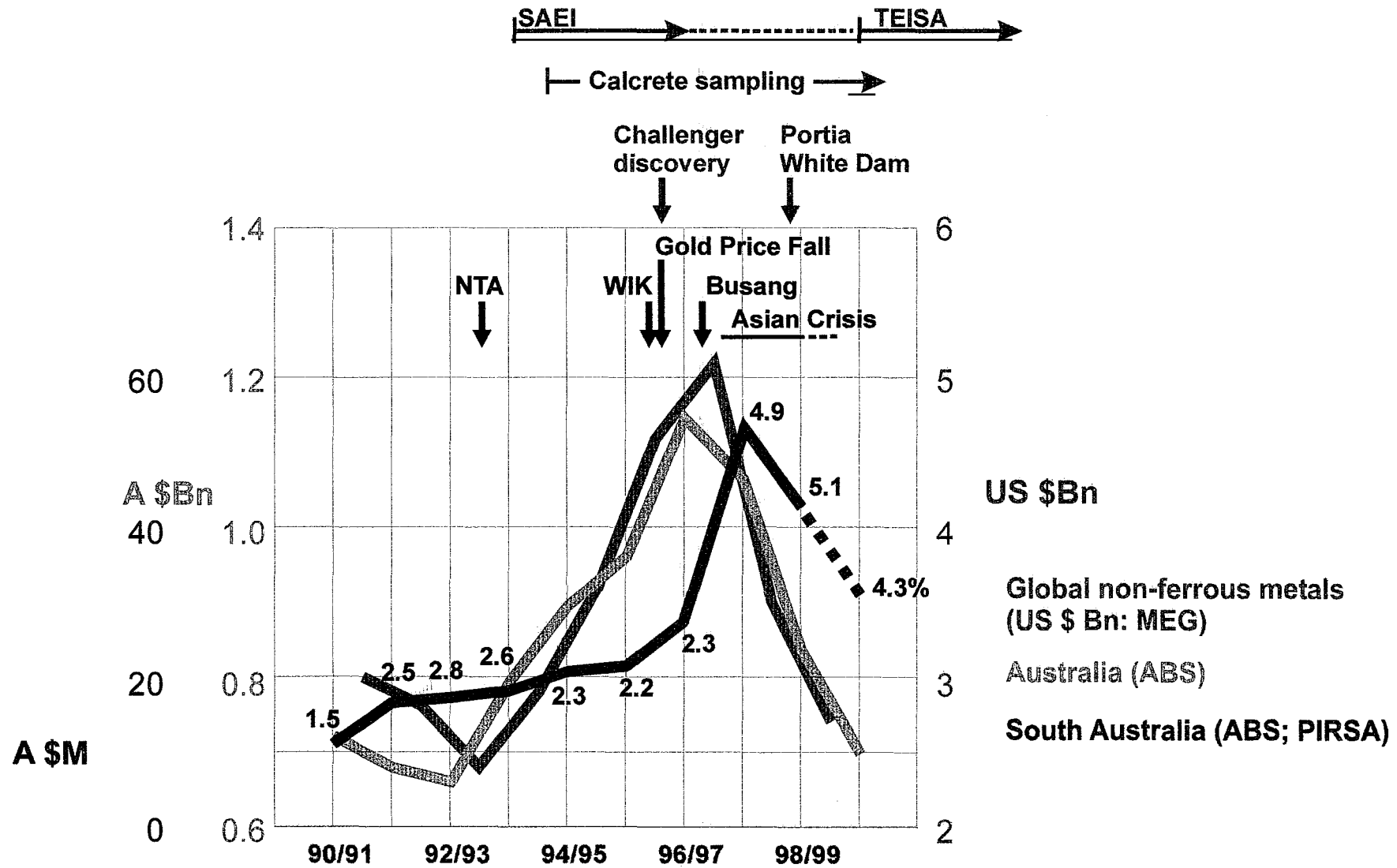


FIGURE 4



**FIGURE 5**

# OTHER IMPACTS – Exploration Expenditures e.g Queensland

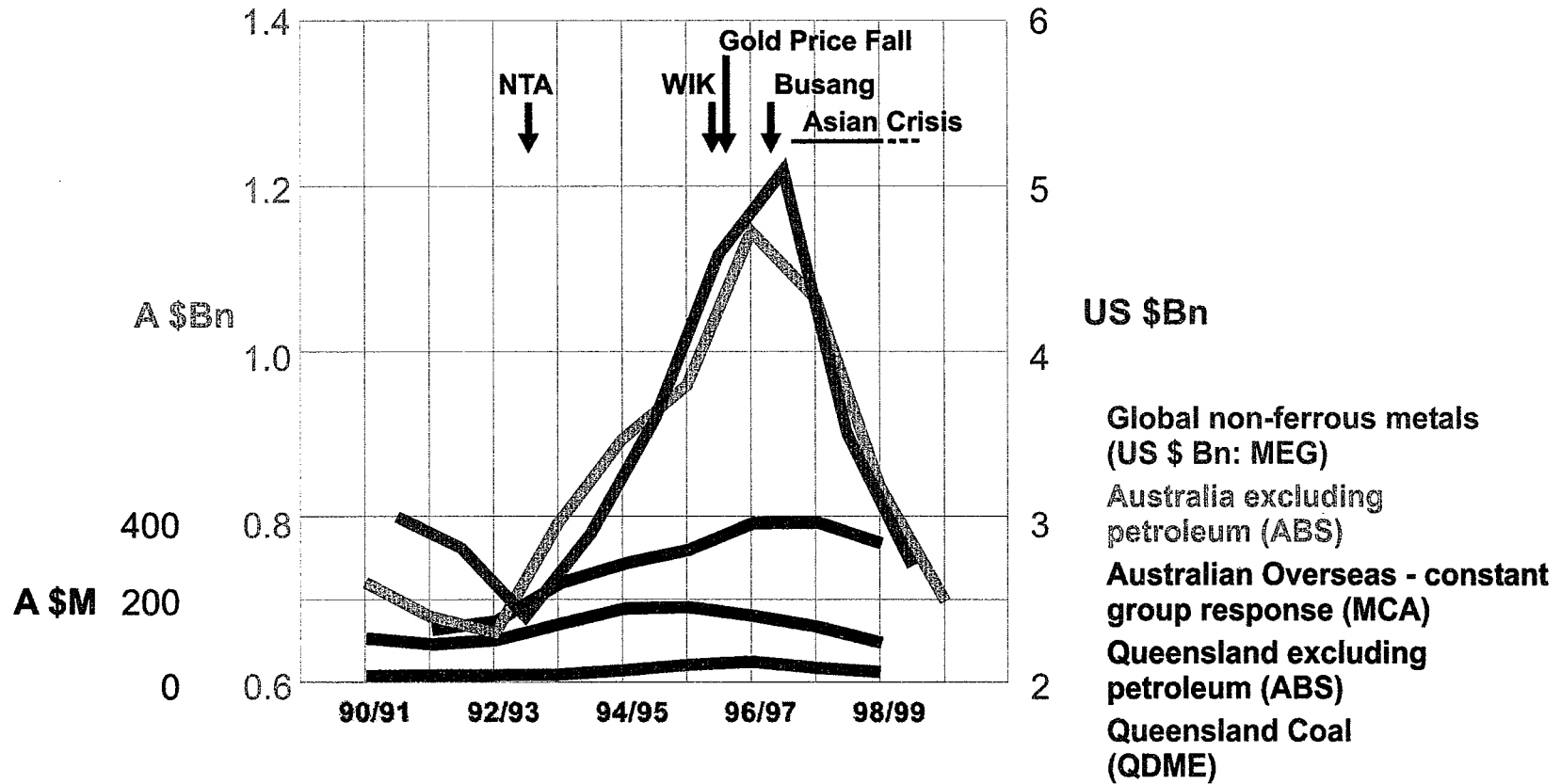
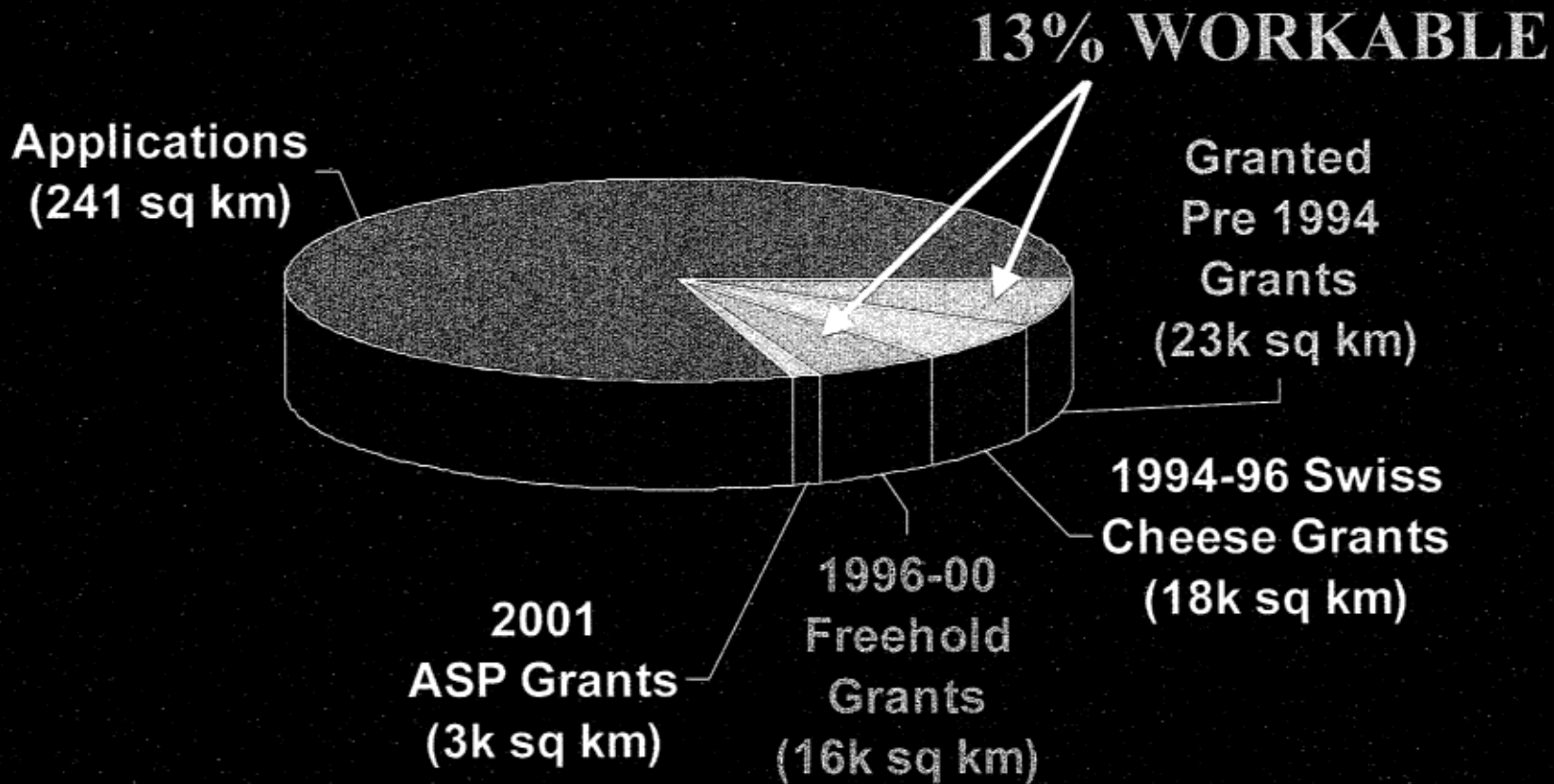


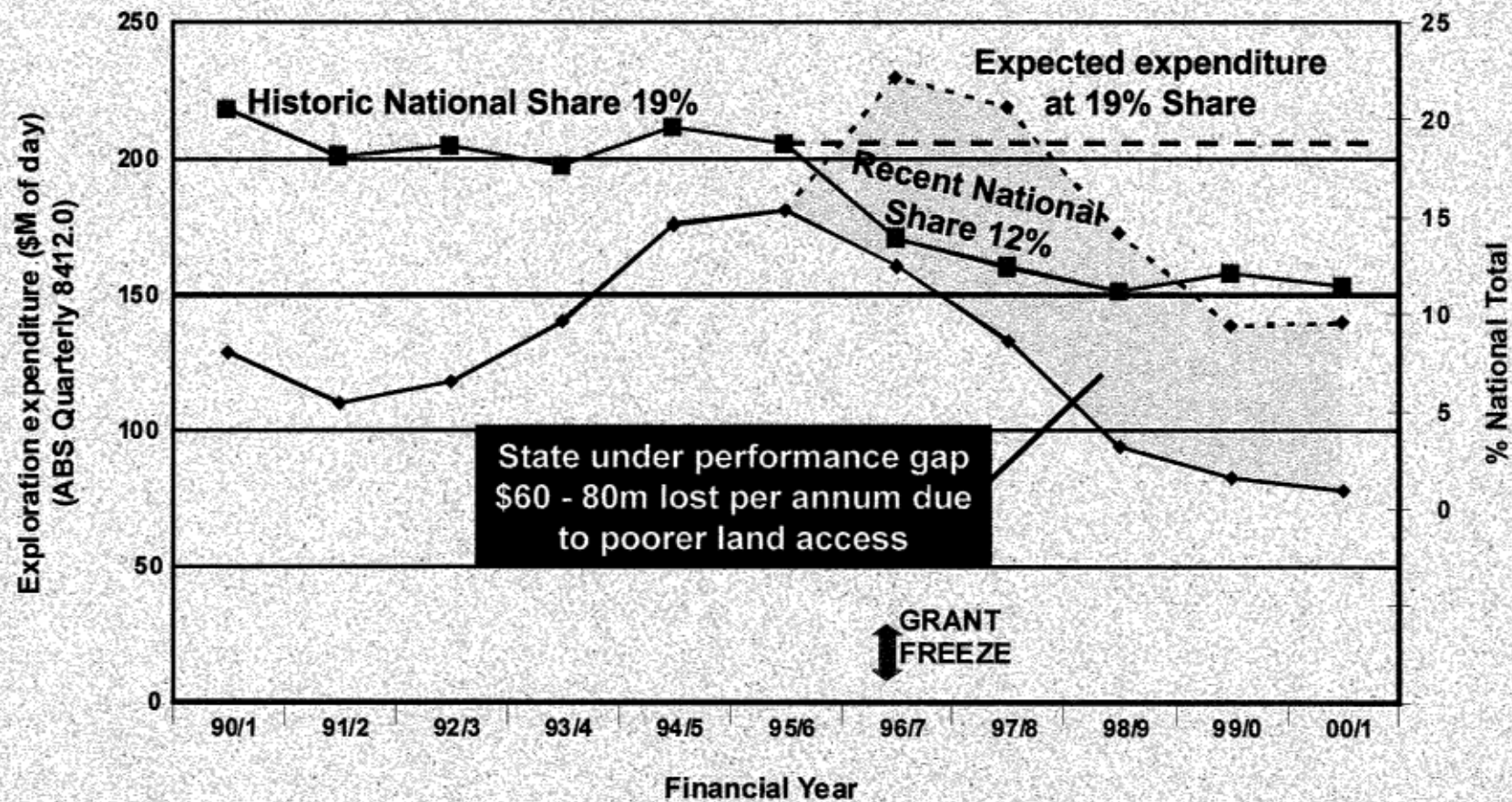
FIGURE 6

# Queensland - Accessible Area



**FIGURE 7**

# Queensland's loss of national exploration spend Minerals and Coal



John Anderson 2001

*NQEM 2000 Symposium***Exploring in Queensland – an overview**

John Anderson

M.I.M. Exploration Pty Limited

**Introduction**

The year 2000 presents ongoing challenges to Queensland's waning mineral exploration industry. Most are related to global or national conditions but some are specific to this State.

The challenges confront all participants including the un(der)-employed geoscientists and other staff affected by the halving of the State's annual exploration expenditure since 1996; the teams retained to make new discoveries that have not been readily forthcoming since 1995, while managing ever-increasing land access restrictions and compliance requirements; the companies considering the value of exploration within their drive for cost efficiencies and shareholder value; and the Government in establishing an attractive framework for re-investment that will benefit the longer term health of the State.

**Resource Base**

As a mining state Queensland makes an important contribution to Australia's globally competitive minerals resource base, producing \$7bn worth of minerals each year. This production will grow as the State has seen an unprecedented phase of resource investment over the past few years particularly with \$4bn of capital expenditure in the northwest mining-industrial complex.

These investments largely capitalised on established resources discovered near Mount Isa prior to the eighties and on the flurry of discoveries in the Mount Isa Inlier between 1988 and 1992. Although these investments and resources will underpin 10 to 20 years of production, the State needs more discoveries and follow-up investment to underpin the mining industry beyond the first decade of the new millennium.

**The Exploration Downturn**

The required level of exploration is not being achieved due to a number of economic, statutory and technical impediments. The attached figure compares exploration expenditure in Queensland with national and global figures. Commodity prices, investor confidence and the need to address Native Title had simultaneous impacts of restricting funding and access for exploration. By comparison with national expenditures, Queensland should have achieved \$35m of additional exploration in 1996/7. Since then, the 43% decrease in Queensland expenditure is disproportionate to the 27% national decrease. Expenditure on the State's coal exploration peaked later in 1997 in keeping with the national profile probably because of a higher proportion of available tenure.

**Key Drivers and Challenges**

The drivers and challenges for mineral exploration are analysed below in a sequence that reflects the basic needs: - funds, access, responsibility and the ability to discover.

*Commodity Prices*

ABARE recently forecast a short term rise in metal prices over the next two years. There is no certainty in gold price movements. However in the longer term, while the mining industry remains a price taker, the competition through cost efficiencies in operations will expand lower grade reserves and maintain pressure on prices.

### *Investor Confidence*

The resources sector has been reduced by the investment community to about 16% of total market capitalisation in Australia. The principal cause is the investment fashion for abandoning the old production economy of low long term yields for speculation in the new information technology economy. This is compounding a lack of faith in investment returns from exploration, both as equity funding for pure exploration juniors and as corporate investment in exploration divisions.

### *Company Strategies*

In this investment environment, the exploration strategies of major companies are diverse as many companies seek new corporate direction. Some companies, MIM notable among them, maintain exploration teams to support established resource positions in Queensland. Other majors have severely curtailed their metals exploration in the State after long and successful campaigns and have variously established clawback farmouts or database alliances with juniors. Large mostly overseas companies have entered the northwest seeking advanced base metal prospects. There is an accelerated push by many majors to farm into and deep drill ground held by unfunded juniors. Many junior companies are converting to Internet and software businesses in response to investor interest.

It is difficult to quantify the increased brownfields bias with figures variously reported as 25 to 50% of expenditure on near-mine exploration. It is generally accepted that gold discoveries in Australia are becoming more brownfields and driven by larger companies in established belts such as the Yilgarn, Tanami and Tennant Creek. The most recent examples in Queensland are the Mount Wright-Sarsfield discoveries by MIM at Ravenswood during 1992-5, the Vera-Nancy discovery by Normandy-Battle Mountain at Pajingo in 1995 and the emerging discoveries near Cracow by Newcrest-Sedimentary Holdings.

### *Native Title*

The State has the challenge of offering competitive land access that meets the Right to Negotiate requirements of the Federal Native Title Act. There has been a four-year freeze on the granting of Exploration Permits until these procedures are in place. As an interim action, the DME commenced granting "Swiss cheese" EPs underlain by Freehold Titles in June 1999 at a rate of 10 per month. 1200 EPMA's are ungranted, representing over 60% of the area of the State targeted by explorers.

The Native Title (Queensland) State Provisions Amendment Act was passed in 1999 but will not be enacted unless it passes review by both Houses of Federal Parliament. A provisional guide on the intended application procedures was issued by the DME in December. The major issue for explorers is the definition of "Low Impact" exploration, a concept introduced after Industry lobbying to attract a minimum level of consultation for first pass exploration including drilling. Under Federal direction, the definition does not include the clearing of access tracks. This will preclude geophysical surveys and drilling from "Low Impact" conditions in most of Queensland's prospective terrains. Consultation for "High Impact" permits to ensure that target definition and testing can proceed early in programmes will require time and costs that may be prohibitive in some areas.

### *Compliance*

There is a move away from "self regulation". For internationally sensitive areas such as indigenous matters and environment, the Federal Government is enacting umbrella legislation that seeks consistent parallel legislation from the states to ensure compliance with treaties, covenants and conventions. The State Government is also applying statutory measures to

forefront issues such as safety performance. New codes and regulations will soon be in place for Queensland explorers to implement and manage; i.e.: -

- Regulation of the new Mining and Quarrying Safety and Health Act will be operating by September. It requires companies including explorers to have risk management systems and to nominate responsible Site Senior Executives, with provision for penalties.
- The Mining Environmental Protection Policy is nearing final draft. Regulation of prescribed procedures for exploration activities will transfer to the EPA.
- A revised model for new Indigenous Cultural Heritage Legislation is available for public comment. The draft includes public site registers and the requirement for cultural heritage management plans.

Issues for the wider mining industry of extended shifts and drug and alcohol testing present challenges for exploration in remote locations. The Industry is particularly seeking improved safety for drill operations through new rod-handling technology.

#### *Public Value*

Australia is far more reliant on subsoil resources for its wealth than any of her peers in the twenty wealthiest countries. The support of the broader community is requisite both inside and outside mining regions. Education programmes are widely applied by Industry bodies throughout the country however media reports on persistent overseas incidents of mine pollution are understandably presenting a strong negative image to the average Australian. This presents the Industry in Australia with the challenge of communicating its responsible behaviour, technological leadership and contribution to the nation.

#### *Skills Base*

Australia's pool of professional geoscientists decreased from an estimated 5,300 in 1996 to 2,600 late in 1999. This trend is likely to continue with 12.4% of the State's registered geoscientists currently unemployed and many more under-employed. Education, employment and human resourcing within our cyclic Industry remain vexed questions. The State's tertiary institutions are participating in an initiative of the MCA Education Taskforce for the national integration of post-graduate training that will meet the future needs of our Industry.

#### *Ideas and Technology*

There has been a paucity of discovery in Queensland since the base metal discoveries driven by new aeromagnetic data through to 1992 and the brownfields gold discoveries to 1995. The expenditure downturn is not the sole reason. The Industry is still challenged by even thin cover. Nearly all of the past greenfields discoveries peak within 60m of the surface. We remain too reliant on magnetics for target selection.

The next step change in models and technology will discover the population of economic deposits that peak below 60m depth. This is overdue, however the reduction in greenfields exploration and research will constrain developments. Queensland, with its pedigree and extensive shallow cover, is an attractive place for the application of these impending advances. MIM, with its new MIMDAS acquisition and interpretation system, is a leader in geophysical targeting technology. Current collaborative research on basin architecture, source rocks and fluid flow in the Isa Inlier will improve 3D geological models that will enable better placement of deep searching technology over targets.

#### *Precompetitive Data*

For all the above reasons, the need for Queensland to compete with over 100 countries and many more jurisdictions for the exploration dollar has become even more acute.

In the face of the Australia-wide trend of reducing public expenditures through policies such as "User Pays" and downgrading Geological Surveys, the Queensland Government is addressing the need to maintain data and idea generation through its Prospectivity Plus Initiative. It is in the Industry's interest to support and advise the DME on stimulating exploration into the next upturn.

### **Current Activity**

Under the freeze on tenure grants, many exploration ideas are being warehoused under applications. Exploration is continuing on granted EPs under relaxed renewal and reduction conditions that ensure some land remains accessible to greenfields exploration.

Progress is being made by companies exploring brownfields gold sites such as Ravenswood, Pajingo, Gympie and Cracow. Base metals exploration is also focussed on minesites including the Isa Valley and Lady Loretta. New results were recently reported from established prospects at Mount Margaret and Mount Garnet. Some greenfields base metal exploration continues on pre1997 EPMs primarily in the districts surrounding the Mount Isa, Century, Cannington and Ernest Henry operations.

### **The Future**

There is potential for another exploration boom in Queensland, but we cannot rely on the State's pedigree to stimulate it. When the technology investment bubble bursts; when responsible land access becomes possible at reasonable cost for the majority of the State; and when the step change in our ability to explore occurs; then exploration opportunities, efficiencies and funding will increase. Whether these key drivers coincide to maximise the result for the State and its explorers is in many hands.

March 2000

### **References**

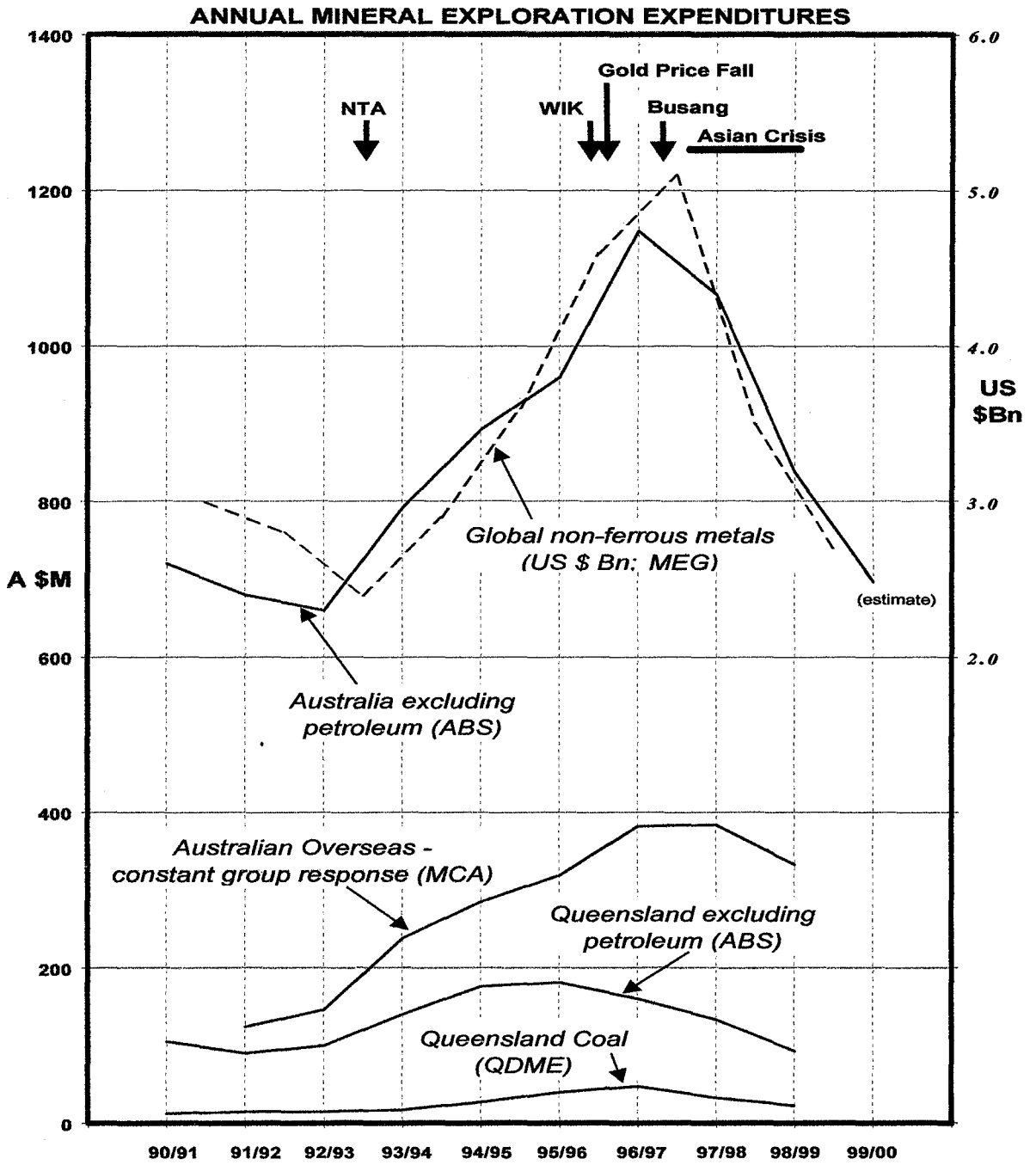
Department of Mines and Energy 1999 *Queensland Minerals and Energy Review 1998-1999*

Department of Mines and Energy December 1999 *Native Title Procedures – Manual for Applicants for Exploration Tenements*, Provisional Edition.

J B Were and Son December 1999 *The J B Were Junior Miners Review*

Sheard S N (M.I.M. Exploration Pty Ltd) 1999 *Innovation in Geophysics*, J B Were Conference (Melbourne)

[www.aig.asn.au](http://www.aig.asn.au)





**NATIONAL RESEARCH PRIORITIES**

SUBMISSION TO THE CONSULTATION PANEL

**An example of strategic theme setting –  
NOMINATION OF PRIORITY RESEARCH THEMES RELATING TO  
REGIONAL DEVELOPMENT AND THE MINERALS AND ENERGY  
SECTORS**

JOHN ANDERSON

7<sup>th</sup> June, 2002**Introduction**

This submission arises from participation in the consultation meeting held by the NRP panel at Brisbane on 6<sup>th</sup> June. It is submitted on the request of panelist Professor Melissa Little to record the writer's comments pursuant to the geoscience theme raised by colleagues Vic Wall and Peter Stoker. The submission is an outline of a practical strategic theme connecting resource research with regional development. It has geoscience aspects but does not purport to represent the spectrum of geoscience research in the context of the NRP.

**Context of this submission**

With the short timeframe and existing SET priorities, it is perceivable the consultation phase of the NRP process will focus on the high-tech research audience at the expense of relevant strategic issues in the wider community. It is acknowledged that consultation meetings will be held in some regional centres although these often coincide with other NRP consultation meetings. The Issues Paper proposes a "whole-of-government" approach to research prioritisation, however this would be better couched as "whole-of-community".

After discussing the consultation process, the panel requested nominations for priority themes. The nominations offered at the meeting ranged from umbrella objectives such as "Sustainable Australia" (already nominated by the Issues Paper) to discipline proposals such as the "Geosciences" one and on to more specific or parochial research issues.

The panel strove to identify graspable themes at intermediate levels that linked research opportunities to national priorities. A scheme was used to classify the nominations from 10 for the highest-level national themes to 1 for specific research ideas. The nominations of "Coastal Management" and "Regional Health Disparities" were two examples that appeared to be aiming at the right level of useful themes. The writer felt with more time a better prioritisation tree could be developed to extract practical themes.

## **Strategic Framework**

Building on the panel's hierarchy, the following framework identifies the priorities of minerals and energy research in the context of the Government's objectives and criteria for economic, social and environmental management.

### **Level 10 - National Objective**

***A globally competitive, responsible and respected Australia***

### **Level 9 - National Strategy**

***Sustainable Development with wealth and health generation***

### **Level 8 - National Priority**

#### ***Resource Inventory and Management***

The nation's resources from which real growth is generated are:-

HUMAN RESOURCES, INTELLECT, CULTURE, INFRASTRUCTURE, ATMOSPHERE, WATER, BIORESOURCES, LANDFORMS, SOIL, ENERGY, MINERALS

All our activity and industry, whether social services, tourism, education, high technology, agriculture, power, metal production etc., depend on these resources to some usually great degree. It is requisite the understanding and maintenance of these resources have high-level priorities.

### **Level 7 - Priority Themes**

At this level, priority themes can be developed on geographical and strategic grounds that will have varying human, environmental, developmental and technological emphases. A simple breakdown could be:-

- The ***Continental Shelf and Antarctica*** requiring strategic research and management to meet ownership requirements.
- The ***Coastal Fringe*** with the population mass, environmental pressures and best resources for education and the nano-, bio- and IT frontier-tech sciences.
- The ***Interior*** (Inland, Outback) offering primary resources and the challenges of economic and environmental viabilities and social conditions.

The marine/coastal environments and social/health issues were prominent in the meeting discussion and the frontier-tech areas have well publicised attention within the ARC scheme. The following priority is nominated to gain balanced consideration for resources and the Interior.

**Level 6 Nominated Priority****Minerals and Energy Resources to underpin Regional Development****Opportunities**

The mining and energy industries account for about 50% of export income, 9% of GDP and 4.5% of employment. They are proven robust foundations of this country. In conjunction with agriculture, these industries produce wealth from the interior using disproportionately less human and infrastructure capital than is available on the urbanized coastal fringe.

In contradiction to the recent Old Economy labels, the Australian mining and energy industries are world leaders in technological applications, exporting technology at increasingly significant rates. The industries have high-tech challenges and opportunities of strategic interest to this country but also have the expertise and research base to meet and capitalise on these challenges and opportunities.

A whole-of-community approach is needed to maximise the country's appreciation and use of the interior. Responsible development is the optimum avenue for the employment, cultural preservation and well-being of our outback communities.

The opportunities are therefore:-

- To sustain resource inventory and export income.
- Technological innovation towards more efficient production and value-adding processing.
- To increase regional development, employment and well-being.
- Global leadership in safe and environmentally sensitive resource exploitation.

**Challenges**

The main threat is failure to sustain identified resources that are be economically recoverable in a globally competitive environment and that provide the operational laboratories for additional advances in resource technology and management to be made in this country.

The following outline the challenges of the minerals sector. The writer perceives similar medium-term resource challenges for the energy industries although these are not in his areas of experience.

**Challenge 6a – Sustaining the Mineral Resource Inventory**

Australia attracts the largest minerals exploration expenditure, including a substantial amount of overseas capital, of all the countries in the world. This reflects Australia's potential, technology and stability. However there has been a global trend of diminishing exploration and discovery rates for minerals due to the decreasing opportunities for shallow easy-to-find resources in accessible safe countries. This problem is particularly evident in Australia as the pioneering phase of our mining history draws to a close with 100 year deposits like Broken Hill petering out.

We face the challenge of exploring for new resources under the extensive cover of the country's ancient land surface and doing so in a responsible and least intrusive manner

under increasing environmental and cultural concerns and land access strictures. Since modern mineral exploration commenced in the nineteen fifties, exploration technologies have evolved by necessity from the initial prospecting for outcropping deposits to geochemical detection of near-surface haloes, then to remote sensing of buried deposits with geophysical techniques. There was a spate of smaller resources found ten years ago by simpler magnetic geophysics that detected deposits within 100m of the surface and these are mostly developed and will be exhausted within 10 to 15 years.

The 1975 discovery of the Olympic Dam deposit demonstrated giant deposits are present at depth. However, as the discovery of blind resources has become more challenging, it is evident the Industry is not developing the technology to discover deeper resources at the rate required to replenish the inventory. Analysis will show our resource base is declining and is dominated by deeper or technologically challenging resources. We may lose capacity to produce base metals at the current level within ten years. Australia's gold production is already declining due to deposit exhaustion.

The accurate prediction and rapid definition of resources with minimal and definable environmental and cultural disturbance are desirable goals with major benefits to the nation and local communities.

### ***Challenge 6b – Deep Mining Technology***

By corollary, another challenge and opportunity is the ability to extract and process deeper resources (once discovered) in the most economic and least environmentally intrusive way.

Technological and infrastructure innovations are being developed to exploit shallow secondary deposits such as magnesite, nickel laterites and mineral sands with qualified success thusfar. Ventilation, rock control and driverless machine technology have extended the depth of base metal mining currently to 1.5km but only where high-grade ore and mining infrastructure are immediately available.

Continuous hardrock mining is the next major research goal and minimally intrusive insitu leaching is forecast to be possible within 50 years.

Mineral resources identified overseas may accommodate the shortfall but Australia should not pass on part of its wealth potential and environmental or social challenges to Third World countries when we can lead by example, capitalise on our own opportunities and develop efficient and globally beneficial extraction, processing and environmental technologies.

### **Priority Actions**

There are therefore three key research and development challenges:-

***Priority Action 6a - Develop Predictive and Exploration Technologies to discover the deeper resources*** that are statistically forecast to be available but are undetected to date. This priority is already recognised by the CSIRO Glass Earth concept and the CRCs for Predictive Mineral Discovery and Landscape Evolution, Minerals and Environment. However the priority should be elevated within the regional theme to a National Research Priority. There is an urgency to re-establish the ore reserve base within the next ten years to meet current operational/export levels.

**Priority Action 6b - Develop Mining and Processing Technologies to enable remote or preprocessed extraction with minimal environmental disturbance and maximum safety.** These efficiencies will make the extraction of lower-grade ore at greater depths possible so that use of our resources is maximised. There will be analogies with reservoir engineering for the petroleum industry. Australia has the need and is in the best position to research and develop this globally important stepchange in mining approach and optimum resource use.

**Priority Action 6c – Planning for the Regional Development of the Interior.** This is where societal and humanities research could be better integrated with SET based research on water, soil and landform conditions and resources. The research would continue to apply the predictive outcomes of Action 6a to prioritise prospective terranes, address the sensitivities of the cultural and physical environment, and identify the infrastructure shortfalls and benefits to local communities.

As with the Alice Springs-Darwin railway and Regional Minerals Programmes, the Federal priority needs to be maintained here to support the States' attempts to promote their interiors and provide seamless borders for geographically-defined research.

### **Conclusion**

This submission is a preliminary statement of important themes and priorities that can be detailed and clarified in expert submissions. Geoscience is a large component requiring comment by the relevant representative bodies, universities, CRCs, CSIRO, Geological Surveys and Geoscience Australia.

It is clear the government recognises the priorities of regional and resource development by the support exemplified in the Alice Springs – Darwin Railway, CRCs and RMPs. These priorities must be retained, integrated and elevated as a National Research Priority.