The importance of National Geoscientific Data Policy and Geological Surveys in Mineral Exploration Success - the Australian Experience.

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ABSTRACT

In 50 years, Australia has progressed from a relatively poor, under-developed country, with no oil or gas production and few producing mines, to a wealthy nation that is among the world's leading mineral and hydrocarbon producers and exporters. The key to that success has been the ready availability of geological and geophysical data and its creative use by geoscientists in Government and industry. The National and State Geological Surveys have been key players in that success, through their organization and distribution of data from past exploration work, and through their own mapping and interpretation projects. Fundamental to this has been Government willingness to adequately fund the Geological Surveys in their data management and mapping programmes. That is a fundamental lesson for other Governments seeking to attract mineral exploration activity.

There is a tendency among officials in many countries to view mineral and petroleum exploration data as a national asset, to be kept secret or sold at a high price. The Australian experience demonstrates that this approach is not in the best interests of the country. Exploration carries very high risks and the chance of success increases with the number of exploration ventures. The best way for a country to increase exploration interest and activity is to distribute their data as widely and cheaply as possible.

The Geological Survey is the key national organization for the collection, storage and distribution of geoscientific data. They can play a fundamental role in the creation of national wealth by stimulating and assisting exploration, but only if they are adequately funded to for their mapping and other programmes. Long term planning is essential, integrated with training programmes so that the Survey geoscientists develop the capability and experience the nation will need.

The Australian experience shows that the wealth of a nation can be dramatically increased within a generation by the discovery and development of its geological resources. It also shows that those national geological resources are not all in the ground, but include the national geoscience database and Geological Survey organizations and professionals. A nation that seeks to rapidly discover and develop its in-ground resources will greatly enhance the chance of success by developing its geological database and professionals.

INTRODUCTION

The discovery of mineral resources has become a symbol of national wealth for many people in developing countries. This is especially the case with petroleum, which is seen as providing almost instant fortune to the national coffers and local population.

The exploration process is not understood by the general public or their political leaders. There is a widespread conviction in many countries that vast mineral resources are present and easy to find and develop. Discoveries in neighboring countries are seen as

proof of that local potential, irrespective of geological differences of major importance. Where cautious optimism would be an appropriate, an almost arrogant presumption of resource wealth develops.

It is too rarely appreciated that mineral exploration in all its forms relies on geological data and its creative use by geoscientists. That data will come from past work or from surveys by the national Government-funded geoscientific organizations such as a Geological Survey or a Petroleum Department. The collection, organization and distribution of that data by the Geological Surveys and adequate funding for those organizations is a key to the mineral exploration success.

This paper has been developed from a presentation by the writer, 'Maximizing the value of the national geological database: Give it away free – The Australian Experience', presented at the Ethiopian Ministry of Mines and Energy Millennium Conference, Addis Ababa, 10 August 2007. That presentation focussed principally on the importance of the availability of geoscientific data to stimulate exploration. However, the important role of the national geoscientific bodies in collecting, analyzing and distributing that data was also strongly emphasized.

This paper discusses the importance of both national geoscientific data policy and Geological Surveys in the mineral exploration cycle and the creation of national wealth by mineral discoveries and development. Both are discussed in the context of the Australian experience, which offers lessons for countries working today to increase their mineral exploration activity. .

Definition of 'Data'

The data under discussion in this paper is not confidential company technical data. It is the data in the files of various Government geological organizations such as a Geological Survey or a Petroleum Department In essence, it is the National Geological Database (NGD); all the geoscientific data ever collected, with one fundamental cavat: it excludes the confidential part of that database pertaining to existing permits and licence areas.

The data in the NGD would include, for example, the following.

- Vintage data from past company surveys
    - Photogeological and geological mapping
    - Gravity, magnetic and radiometric data
    - Seismic data and interpretations
    - Drilling results
- Data from Government surveys
    - Geological mapping
    - Geophysical surveys
        - Airborne magnetic, gravity and radiometric data
        - Ground gravity and magnetic survey data
        - Seismic surveys

- Government sponsored research work
    - Universities
    - Commissioned projects

These data are the property of the Government or, more precisely, the nation, and must be used to provide maximum value to the nation and its people. The question is how best to maximize that value.

Classification of data.

In most countries, there are three schools of thought about the classification, confidentiality and distribution of data – what might be called a national geoscientific data management policy. These schools are commonly in conflict, and different schools may prevail at different times.

1. **Data is seen as a national asset and must be kept secret.**
   Data is usually kept under lock and key, and access is denied to national and international explorers and researchers, including government geoscientists. This is less common now that it used to be, but vestiges of this approach still remain in government agencies in many countries. The double inefficiency of this approach is that data cannot neither attract new explorers nor help those already exploring to optimize their chance of success. Exploration funds are wasted repeating past work, including the mistakes and the nation's chance of discoveries is diminished.

2. **Data is seen as a national asset and must be sold at high prices**
   Data is seen to be valuable proprietary property of the nation , being either the results of past company work or actually funded by the Government. The value of this data for guiding future exploration is acknowledged but companies wishing to explore in the area are expected to pay a high price for the data, up to actual survey costs. In this approach the scientific value of the data is seen as less important than the economic value for income generation. The data play only a limited role in attracting companies to the country.

3. **Data is seen as a national asset that has value only when it is used to stimulate and assist new exploration.**
   The maximum value of the data is achieved by distributing it as widely and freely as possible, to maximize the exploration interest in the country and optimize the chance for economic mineral and petroleum discoveries.

This paper contends that the relative value of these three data management systems can be expressed as shown in Table 1 below.

Data management policy	Relative $ value to nation
Secret	**Zero**
Income-generating	**Thousands**
Freely distributed	**Millions**

Table 1. Relative potential value to nation of the common data management policies

There is no doubt that the third approach – the free dissemination of data as widely as possible – is the key to exploration success and national economic growth. The Australia experience over the past 50 years is reviewed below to demonstrate this point.

Many people find the notion of maximizing value by giving the data away freely to be a paradox. Surely, they will argue, it is better to take as much income as possible from sale of the data, rather than risk zero income if the exploration programmes are unsuccessful. Certainly, there is risk: the dissemination of data is no guarantee of exploration success. But the broader the distribution of data, the greater the number of people who see it, the more exploration ideas that are stimulated, and the greater the chance that one of those ideas will be successful.

It should be noted that the term 'free data', as used in this paper, accepts that Government agencies will charge a nominal amount to cover the cost of data storage, retrieval and reproduction.

The Australian Olympic Dam example.

The discovery of the Olympic Dam ore deposit in South Australia is the archetypal example of how access to data leads to discoveries which return value to the nation 100-fold or 1000-fold. At Olympic Dam it may actually be closer to a million-fold.

In the early 1970s, the Australian company Western Mining Corporation (WMC) commenced exploration for Proterozoic copper deposits using a new exploration model based on the leaching of copper from continental tholeittic basalts by hydrothermal fluids moving up major fault zones, and deposition of the copper in the overlying Proterozoic sediments. (Haynes, 2006).

The first exploration task was simple: buy the inexpensive 1/250,000 Government geological maps of Australia. These maps showed Proterozoic tholeites and sediments in the Flinders Ranges area of South Australia. Co-incidentally, the (then) Australian Bureau of Mineral Resources[1] had been provided with Government funding to conduct reconnaissance gravity and magnetic surveys of potentially prospective areas, including the Flinders Range area. They released this information to the public as preliminary line

[1] The Australian 'Geological Survey' was originally called the Bureau of Mineral Resources and is now know as Geoscience Australia

compilations and WMC used them to prepare their own contour maps, reproduced on Figure 2..

The WMC team noted ‘several extensive and high amplitude Bouguer gravity and magnetic anomalies’ in their area of interest and speculated that they might indicate ‘fault-bounded basement uplifts containing thick sequences of altered basalts’ (Haynes, 2006). The Olympic Dam anomaly was selected for drilling because it was shallowest feature. The first well found rich copper mineralization with the first well and following wells soon confirmed a world-class mineral deposit.

The proven reserves at Olympic Dam were estimated in 2006 as 4.5 Billion tones at 1.1% copper, 2.2% silver, 0.5% gold and 0.2% uranium. Annual production was 200,000 tonnes of copper, 4000 tonnes of uranium and 80,000 ozs of gold. Total revenue from Olympic Dam for Australian people in 2006 was A$1 billion (US$800 million). Current owners BHP Billiton have recently announced a US$6 billion expansion of the operation, to lift annual production to 500,000 tonnes of copper, 15,000 tonnes of uranium and 500,000 ozs of gold by 2013. Revenue to Australia will then be of the order of US$2 billion/year.

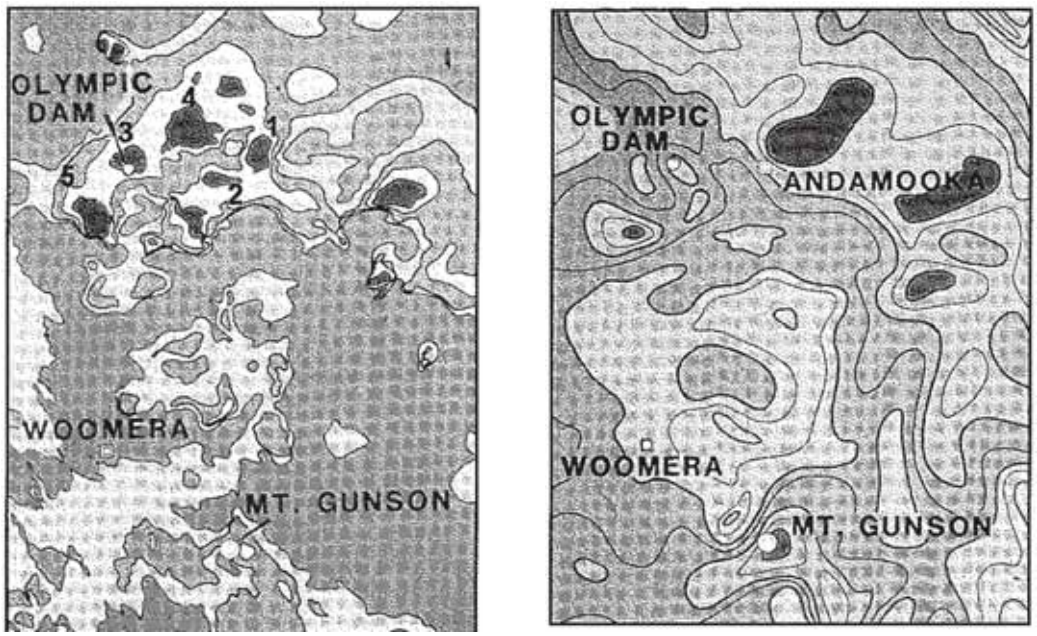

Figure 1. Western Mining 1974 Total Magnetic Intensity (left) and Bouguer Gravity (right) maps based on surveys by the Australian Bureau of Mineral Resources, showing the Olympic Dam anomalies (Haynes, 2006)

It is worth noting that the WMC geophysicist concluded that the Olympic Dam gravity anomaly did not ‘fit’ the altered basalt model they were exploring, but he recommended it should be drilled anyway. The data had helped WMC pursue one idea, and led them to another idea altogether – a common occurrence in the process of discovery, but possible here only because the regional data were available.

The investment of Australian people public funds on the geophysical surveys at Olympic Dam has been repaid many times over. Obviously, not all surveys lead to an Olympic Dam discovery, but the principle is the same: past data can be the guide to mineral discoveries of enormous value to the nation.

Data as Exploration Driver

The dissemination of data as widely as possible is the greatest stimulus there is to increased exploration.

This comment was made by a manager of Rio Tinto, one of the world largest mining companies, in a presentation to the Australian parliamentary investigation into declining exploration activity in Australia (Commonwealth of Australia, 2003). Rio Tinto has a market capitalization of about US$100 Billion, based on successful mineral exploration and development projects, so their perspective on this subject merits serious consideration.

Why is data the key to exploration activity? Because regional data is the fundamental tool at the generative stage of the exploration cycle. The Generative Stage is the first step towards a commercial mineral venture; it will be followed by the Exploration Stage and, if that is successful, by the Pre-development and Development stages (Williams, 1996).

During the Generative Stage, companies use public data to identify potential prospective areas. The corollary of this is that access by companies to publicly available data will determine where companies will explore. In simple terms, exploration geologists in offices all over the world make decisions every day about where to recommend exploration. To select those areas and justify their recommendation to management, they need regional geological data. If they have no data from an area, they are unlikely to recommend it; instead, they will choose an area for which data are available.

The lesson for Government is very clear: if you want to maximize the chance that explorers will come to your area, you must get your data out there and available for those explorers to use.

The provision of data to assist exploration has been the key to the Australian exploration success story. It should be noted, however, that it is not the data alone that is the key. The critical factor is the efficient organization and distribution of the data by the Geological Surveys. Critical to that, of course, is Government willingness to adequately fund the Geological Surveys.

The National and State Geological Surveys have been fundamental to the emergence of Australia as a wealthy nation and a world leader in mineral production (Richards, 1993). In other words, Australia's success in mineral and petroleum exploration can be linked to funding the geological surveys in regional mapping initiatives. That is a fundamental lesson for other Governments seeking to attract mineral exploration activity.

The Australian Experience.

Australia is an affluent society today, the result of its being a world leader in mineral production. Australia is the leading world producer for lead, diamonds and heavy minerals zircon; it is the second leading producer for zinc, nickel, uranium; third, for gold and iron; fourth, for copper and coal (Hogan, 2003).

It is too often forgotten that this has been achieved in just 50 years. In the 1950s, Australia was a relatively poor society, still struggling out of the post-World War 2 depression. There were a few big producing mines but all had been discovered decades earlier, and there was virtually no mineral exploration occurring. There were no oil and gas discoveries and no systematic exploration. There was no regional mapping by Government geologists and very limited funding for the Geological Surveys. Added to which, the potential was seen to be low, especially for oil and gas, and there was little international interest in Australian exploration.

The transformation from that undeveloped country in only two generations shows what can be achieved in that time frame, and should serve as both guide and encouragement for developing nations today.

The essential first step was the decision by Australia's political leaders, greatly influenced by State and Federal geological organizations, to aggressively stimulate exploration. Nationwide mapping programmes were introduced. For the next 40 years the Australian mapped fifteen 1/250,000 scale map sheets every year. Nationwide reconnaissance geophysical surveying was initiated. The data were released to companies as soon as completed for nominal costs.

To encourage oil exploration, the Federal Government introduced a 33% subsidy for oil exploration surveys and drilling, on the condition that the data were made public after six months. This assisted all the companies to develop their regional understanding.

Vast new areas were opened up for mineral and petroleum exploration and many major mineral discoveries followed. The big success for the petroleum industry was the move offshore in the 1960s. The first wells offshore Victoria in southeast Australia found over 6 Tcf of gas and 2 billion barrels of oil, and gave Australia oil self-sufficiency for decades. The first three wells drilled offshore Western Australia in the early 1970s found approximately 20 Tcf of gas. That gas was uncommercial then but today, combined with the many discoveries since, is the resource base for a world-scale LNG export industry to China and Japan, as well as local domestic and industrial markets.

Ironically, the Australians then abandoned this policy and moved away from supporting exploration efforts. This was not a single uniform policy change nationwide and had different expressions at different times at national and state level. The reasons were many and complex and the details are beyond the scope of this brief review. At a national

level there was some co-incidence with the election in the early 1970s and mid 1980s of Labour Governments, traditionally less supportive of business and industry – though this is far from a complete causative link. There was also the influence of the change to more anti–business public attitudes through those decades, a phenomenon in most Western societies, mainly driven by the environmental movement.

The fact is that there has always been opposition in Australia to the use of public funds to support industry, perhaps especially the oil industry. This opposition is both within the public and within Government and the civil service, especially Treasury and the Ministry of Finance. In the 1980s economic rationalism came into vogue, and was supported by this group. 'User pays' was their motto: if the companies want regional data, let them pay for it – and pay full price. The price of data increased dramatically. For example, in neighbouring New Zealand, which went through a similar metamorphosis, a Geological Survey report on the Taranaki Basin that might have been $50-100 a few years earlier was offered to companies for $5000.

These changes in the 1980s and 1990s saw a major decrease in Government support for exploration in Australian and a major decrease in funding for the nation's geoscience organizations. The result was a progressive loss in exploration investment, activity and success. The decline in exploration was most pronounced among small companies, called 'junior explorers' by the Australians and widely recognized as the key to a dynamic exploration industry.

The small companies and consultants couldn't afford the increased costs of data and soon moved out of Australia, looking for less costly projects elsewhere. Big companies, though they could afford the higher costs, found better support in other countries and increasingly turned to projects outside Australia.

Exploration is Australia declined nationwide. In Western Australia (WA), for example, annual mineral exploration expenditure dropped 60% through the 1990s. Income growth from mineral royalties slowed and, with few new mineral discoveries to provide future royalties, the long-term loss of national income was soon very clear to all.[2]

Federal and State governments held formal enquiries into the exploration decline in the late 1990s and early 2000s. Geological surveys, companies and consultants all gave evidence. The management of the Geological Surveys were key witnesses and presented a case focussed on the importance of low cost access for companies to regional data. *If you sell data for $5000 instead of $50, fewer people see it. Fewer people means fewer*

[2] There were other causes at play, it must be admitted, notably the recognition of 'native title' by the Australian High Court in 1992, giving Australian Aboriginal 'tribes' control over access to remote areas of the country and limiting access by exploration companies. This is commonly cited by critics of government funding of data collection as the real reason for the decline in exploration. It is probably more precise to see the impact of 'native title' as superimposed on a decline that started for the other reasons so briefly mentioned here.

ideas, means fewer new permits, means fewer discoveries, means less income to Government

This case was supported by studies in Australia, Canada and elsewhere of the value of the national geological data base in stimulating exploration. Detailed discussion is beyond the scope of this paper but several examples will suffice to show the argument:

1. A questionnaire sent to mineral and petroleum companies in Western Australia (Fardon et al, 2002) revealed that the 90% of the companies believed that government geoscience data had contributed directly or indirectly to their discovery of economic mineral deposits, with the collective in-ground value of US$80 billion;
2. In South Australia (SA), an assessment of the financial benefit over the next 20 years of modern mineral discoveries, including Olympic Dam, suggested that the proportion of that income attributable to the availability to companies of regional geoscience data was of the order of US$3.6 billion (Blight, 2003).
3. Analyses by the Australian Bureau of Agriculture and Resource Economics (Hogan, 2003) showed that an increase of Government expenditure of $100 million on exploration-stimulus over 5 years led to new discoveries and additional Govt revenue from royalties and taxes of $1.5 billion over the next 20 years;
4. Canadians statistics suggested that every $1MM of Govt funding to Geological surveys for regional surveys led to $5 MM of private exploration expenditure which led to discoveries worth $125 MM (Hogan, 2003).

Fortunately for the Australian people, the Geological Surveys won the argument, both nationally and within the States. The Federal Government inquiry concluded that the key to stimulating exploration was the easy availability of regional data. They also concluded that the best way to do that was to provide increased funding to the State Geological Surveys and the national Geoscience Australia organization. New geological and geophysical mapping programs were initiated and existing programs got better funding. Regional geophysical surveying - the most cost-effective way of understanding bedrock geology – was a priority: 2.5 million line kilometers of airborne data have been collected, along with 100,000 land gravity stations in 2002-6 (Richardson et al, 2007).

The major increase in exploration in Australia in recent years can be traced in large part to successful arguments by the Geological Surveys and others for increased funding to allow new and expanded programmes to collect regional geological and geophysical data. New discoveries have already been made and will provide benefits in years to come by way of royalties, taxes, and employment.

The following section discusses several of the recent initiatives in Australia and looks at early evidence for their success.

The South Australian PACE Example

In 2002-3, the Division of Mineral and Energy Resources, Primary Industries and Resources South Australia, (PIRSA) recognized that exploration expenditure in South Australia was stagnating. The long term average annual expenditure stood at $30 million, essentially the same as it had been for a decade (Figure 2). They concluded that the South Australia's prospectivity was underappreciated by exploration companies, and they devised and implemented a Plan for Accelerating Exploration (PACE) in 2004.

PACE had very specific objectives: increasing annual expenditure to $100 million as soon as possible and maintaining that level, and increasing annual production and processing to $4 billion by 2014. Details of the PACE initiative and its themes and results can be found on PIRSA website.

PACE has eight themes, aimed at collecting new geological, geophysical and geochemical data, and making it and all vintage data freely available by downloading from the website or for nominal reproduction costs. Over 1 million pages of historical open-file data were scanned and put on-line. PACE also included direct subsidizing of small companies for a portion of their drilling costs in frontier areas.

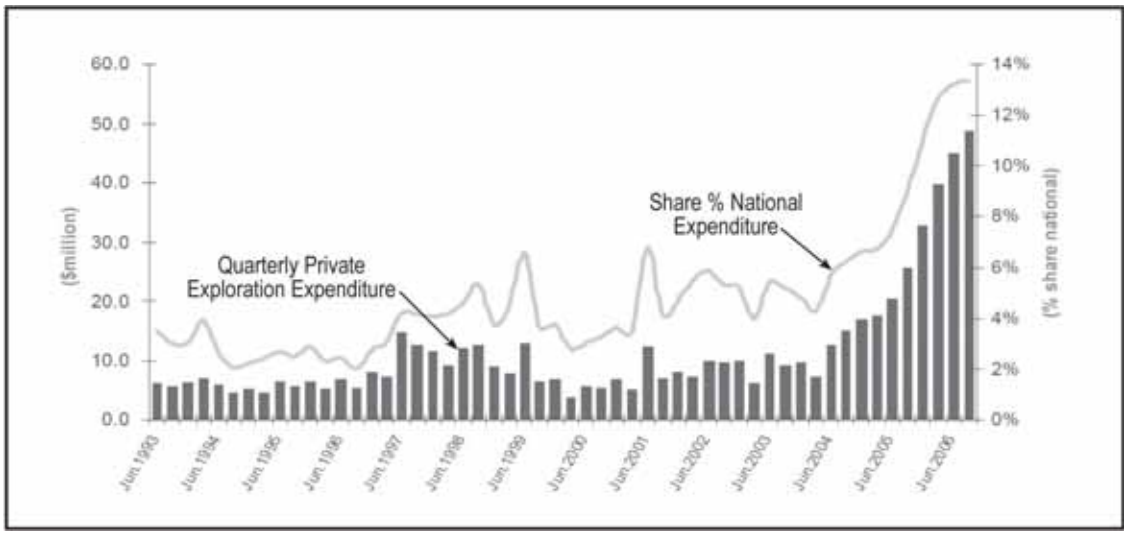

Figure 2. South Australian private exploration expenditure and share of national expenditure, 1993-2006 (Heathersay, 2007)

The results were immediate and quite spectacular. Exploration soared in 2005/6 as shown on Figures 2 and 3, the latter also showing that the increased expenditure in SA was far ahead of the rate of increase in exploration in Australia overall. Within two years of its introduction, PACE had given SA the highest share ever of the national expenditure.

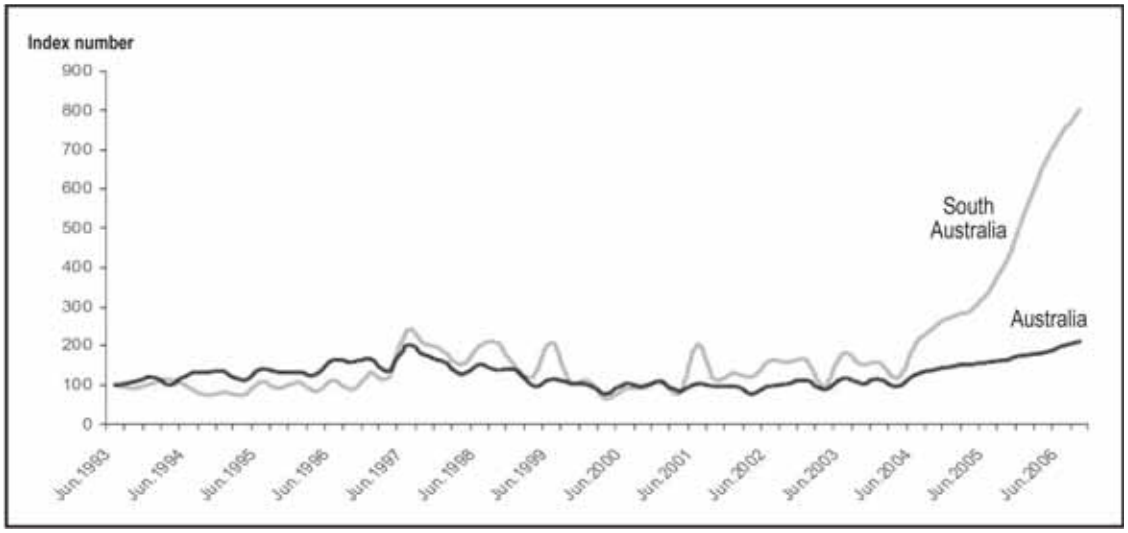

Figure 3. South Australian and Australian annual change in exploration expenditure, indexed to 1993 (Heithersay, 2007).

The impact of the increased exploration is clearly illustrated by reference to mineral exploration tenements. Figure 4 shows the exploration tenements in South Australia in January 2004, just prior to the launch of PACE, and two years later in April 2006. Much of that stimulus came from detailed high sensitivity airborne surveys over the region, building on a program that actually started in 1994.

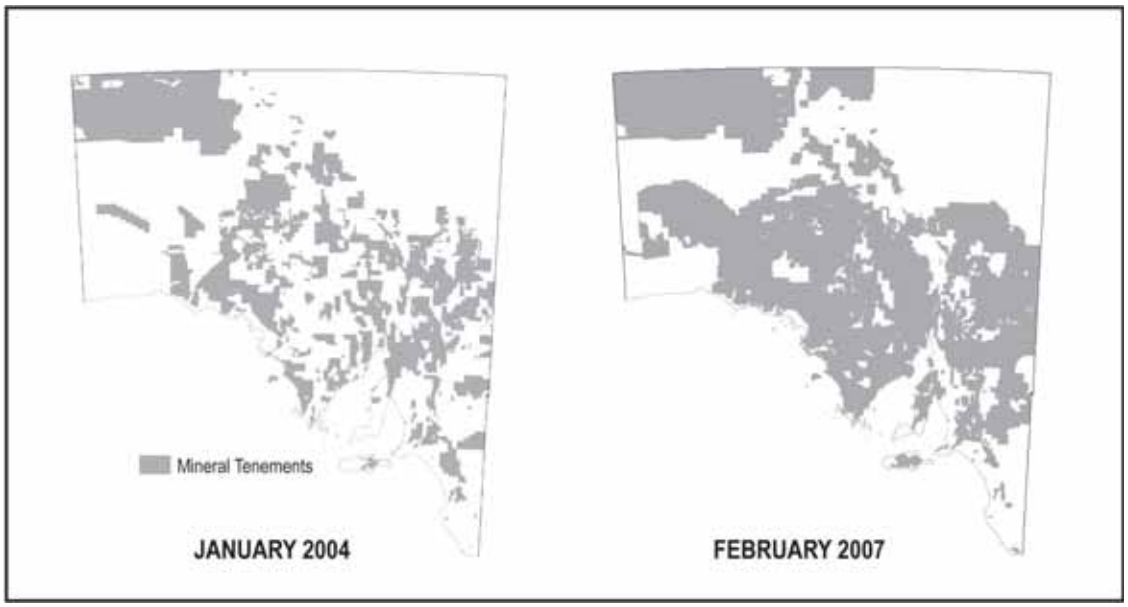

Figure 4. Mineral tenement maps of South Australia from January 2004, before PACE commenced, and February 2007, showing the dramatic increase in area under licence achieved in the two years. (Sykes, 2007)

It deserves noting that the success of PACE and the renewed exploration effort is mainly because of small companies, called 'junior explorers' by the Australians The 'juniors' drive the exploration in new, so-called 'greenfield' areas, while the larger companies focus increasingly on their development projects and so-called 'brownfields' exploration in adjacent areas, around those projects, seeking add-on reserves. The brownfield exploration often yields major new reserves and national wealth but, from the national perspective, it does so from within known mineralization areas: it is the 'greenfields' exploration by junior companies that provides the discoveries that reveal new mineral provinces[3].

The success of PACE is continuing. Figures released in June 2007 by the Australian Bureau of Statistics show a decrease nation-wide in mineral exploration expenditure in first quarter of 17.6%, relative to 2006. By contrast, South Australia enjoyed an increase in spending of $7.4 million (12.4%) - the only state not to experience a decline in year-on-year expenditure. Rice (2007) quotes the Australian Association of Mining and Exploration companies as saying that SA has increased its share of the national expenditure from less than 10% a few years ago to over 18% today.

The Queensland Initiative

While PACE has been presented here as the archetypal example of successful Australian State Government stimulation of exploration by increased funding for Geological Survey programmes, it is not meant to infer that other State Government as not pursuing similar initiatives, albeit not as successfully at the moment as the South Australians. The Australian States 'compete' against each other for the exploration dollar, every bit as fiercely as Australia competes nationally against other mineral-rich countries such as Canada and Brazil. All States have their initiatives to stimulate exploration and attract companies. The State Geological Surveys are the main players in designing those initiatives, 'selling' the concept to their Minister and Cabinet, and then implementing the programmes.

In Queensland, for instance, when the Federal Government withdrew funding from regional mapping programmes in 1982, the Queensland Geological Survey (QGS) convinced the State Government to fund the regional mapping programmes. Fundamental to their case were several clear and significant correlations between exploration activity levels and both the statewide 1/250,000 mapping programme and the second-pass detailed mapping of the main mineralized areas (Day, 1995):

1. The initiation of QGS mapping in an area was sufficient to attract company interest and exploration activity;
2. The initiation of second-pass detailed mapping caused a marked increase in exploration activity in that area; and

[3] There is a tendency in some developing countries to dismiss the juniors and focus on the larger companies. The history of exploration in countries such as Australia and Canada would argue against this approach.

3. The activity in the detailed mapping areas then remained at relatively high levels, especially when regularly encouraged by discoveries and ongoing Government mapping and studies.

Based on this argument by the QGS, the Queensland Government approved funding for the Regional Geological Mapping Program (RGMP), to provide detailed re-mapping in the most geologically promising areas. This project was designed in consultation with exploration companies to ensure priority areas were targeted and maximum gain was derived from each effort. When Federal funding resumed in 1993, the QGC initiated the Geomap 2005 program, a 12-year mapping project to update all geological maps in mineralized areas, to ensure that no maps are older that 20 years, and to add airborne geophysical data wherever possible.

Mineral royalties and taxes are a major component of the Queensland State income. With the exception of the giant deposits found at Mt Isa and Hilton in the 19th Century, all of Queensland's producing mines and oil and gas fields were undiscovered 50 years ago, and many have been found in the past 25 years. The geoscientific work by the Queensland Geological Survey, and the commitment of the State Government to provide the necessary funding for that work, have been very important factors in that success.

Federal Oil exploration Initiatives

As a result of the Government enquiries in 2000/1, the Federal Government has significantly increased funding to Geoscience Australia, particularly for petroleum-related activities. This has been driven by the rapidly declining oil reserves in Australia and the reality of the impending high import bills for crude oil.. Australia is fortunate to have giant gas deposits to sell as LNG, offsetting some of the oil import costs, but the aim is to stimulate exploration and find new oil fields.

Geoscience Australia has been provided with funds to conduct seismic surveys in seemingly less prospective frontier areas and make related regional studies available to industry to encourage exploration in these areas. Tax concessions have also been introduced for companies exploring in frontier areas.

Data accessibility is a fundamental element of the new GA initiative. All offshore seismic digital data is being reformatted onto high density media, and sold for nominal reproduction costs. At the same time, all company and survey reports, going back 50 years or more, are now available by either down-loading free on-line or, for larger reports, on DVD for $10-20 dollars

Figure 5 shows the dramatic leap in the vintage seismic data obtained by companies from GA since the new availability policy was introduced in 2004. Those data are used for regional studies and evaluations, commonly with extensive reprocessing. The nexus here is the same: easier access to data leads to more studies, leads to more new ideas, leads to

more exploration and discoveries in Australia in coming years – and that means more income for the Australian people.

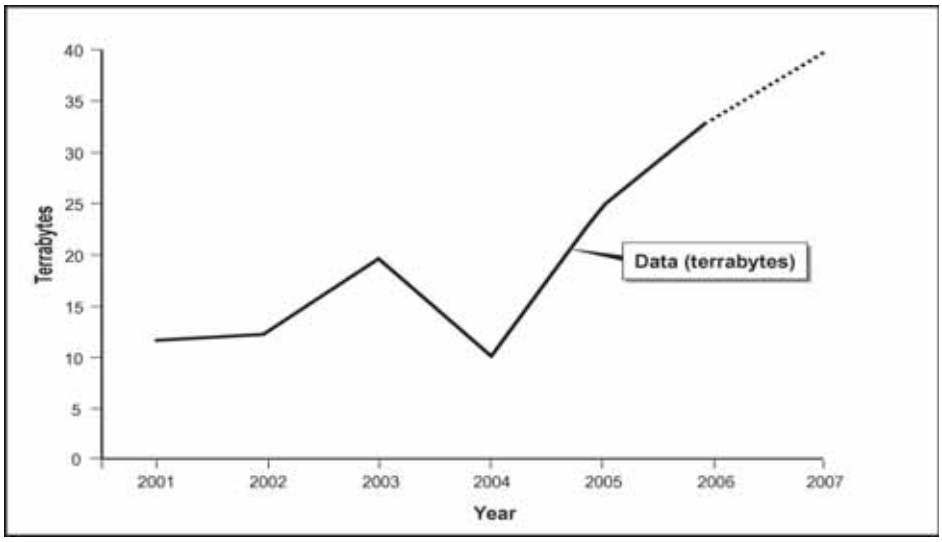

Figure 5. Annual volume of seismic data obtained by industry from Geoscience Australia for interpretation and reprocessing projects. (solid line, actual; dashed line, projected). Courtesy of Clinton Foster, Geoscience Australia)

Lessons from the Australian Experience

Many factors determine exploration activity in a country, some within and some outside the influence of the Government and its geological agencies. External forces include global commodity prices, exchange rates, market growth, and the availability of finance. Internal factors, albeit largely outside the direct influence of the geological agencies, include taxation regimes, access to land, and the regulatory framework.

The ultimate controlling influence on exploration success will be the prospectivity of the region. While this seems obvious enough, it is rarely acknowledged how much the geological past controls the economic future of many regions and nations. The Australian story has been phenomenally successful, because that continent has proved richly endowed with many natural resources. Not all regions are as fortunate, and caution is warranted in any assessment of unexplored areas.

At the same time, however, optimism is essential in such assessments. The prospectivity of a region can only be revealed by exploration and the Australian experience offer lessons for countries needing to stimulate exploration for their mineral and hydrocarbon resources. In that context, it bears noting that the Australian geological surveys have faced conditions not unlike those challenging geological surveys in countries such as Ethiopia. The nation is vast, the number of trained geologists is few, and funding is always difficult to obtain.

The lessons of the Australian experience fall into three categories: data access, geological surveys and funding initiatives.

The easy availability of geological data

- The best way to stimulate exploration is to make regional geological and geophysical data freely available, whether it is from past exploration or new surveys funded by Government;
- Nation-wide geological and geophysical mapping programmes are the fundamental elements of national data-base
- The data must be well organized, with original safely secured, and copies readily retrieved and quickly distributed to interested companies.
- The availability of the data must be widely advertised by presentation at and participation in international conferences.

The importance of Geological Surveys

- Geological Surveys are the scientific arm of the Ministry responsible for mineral resources, potentially one of the greatest wealth generators for a nation;
- They are the key national organization for the collection, storage and distribution of geoscientific data;
- Long term planning is required, with 5-year, 10-year and 20-year plans guiding all planning, training and scientific initiatives;
- Proper training for the geoscientists is essential, to develop the capability and experience the nation needs;
- Adequate funding by Government is imperative;
- The corollary is that the Geological Survey management has a responsibility to educate the political leaders on the critical role of the national geoscientific data-base and the Geological Survey organizations in stimulating exploration activity.

The necessity of adequate funding

- Achieving the funding necessary to properly run a national Geological Survey is not easy;
- In Australia it has required constant effort by the Geological Survey management to present their case to Government, especially to their Minister;
- Success requires the active support of the Federal or State Minister involved, taking the case for funding to Cabinet and arguing against the opposition that will inevitably come from Finance, Treasury and other sections of Government[4];

[4] Indicative of the ongoing struggle for funding, the Australians call data collected by Geological Surveys 'pre-competitive data'; that is, data collected before the companies compete for blocks with work program bids. Former Director of the South Australian Office of Mineral and Energy Resources, David Blight (2003) described it as a 'cumbersome but nevertheless descriptive term (that) helped counter any argument from, essentially, Treasury, against funding of programmes that would assist companies' exploration'.

- Funding has proved easier to obtain when linked to specific projects, rather than just general survey activities. For example, mapping in a prospective area should be a separate budget item, not part of survey operating funds (Bight, 2003);
- The development of collaborative links with organizations such as university geoscience departments, and the joint application for project funding has also proved successful in Australia.
- Establishing working groups involving exploration companies can help in the design of projects and ensure maximum stimulation for exploration.

Developing countries usually cannot afford to finance extensive mapping programmes. Modest programmes can be funded internally but accelerated programmes will need external funding such as could be available through the World Bank and other agencies. The challenge is the same: to compete for those dollars against other projects within the country and in other countries. Meeting those challenges is deserving of the efforts of all in the geoscientific community, especially those within the Government organizations

The Australian experience shows that the wealth of a nation can be dramatically increased within a generation by the discovery and development of its geological resources. It also shows that those national geological resources are not all in the ground, but include the national geoscience database and Geological Survey organizations and professionals. A nation that seeks to rapidly discover and develop its in-ground resources will greatly enhance the chances by developing its geological database and professionals.

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