

# The New South Wales Government's Discovery 2000 — Geophysical Surveys and their Effect on Exploration

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## ABSTRACT

During the first two years of the New South Wales Government's six-year 'Discovery 2000' Exploration Initiative budget, approximately \$9 million was spent on the acquisition and processing of over 850 000 line kilometres of airborne magnetic and radiometric data, and 14 000 gravity stations. Both mineral- and petroleum-prospective areas were targeted, covering an area of over 200 000 square kilometres — equivalent to 26% of the State.

The minerals industry has been provided with new high resolution geophysical datasets which constitute a world-class product. Airborne surveys have been read at low-altitudes at close interline spacings. The airborne data have been released in combination with a greatly improved density of gravity stations over all areas and limited seismic reflection data over sedimentary basins. The resultant high resolution data have assisted, and will continue to assist, selection of new exploration project areas. Already there is a significant increase in the level of new exploration.

Keywords: New South Wales Government, aeromagnetic survey, radiometric survey, gravity, GPS

## INTRODUCTION

The Discovery 2000 program began in 1994 and is planned to finish in the year 2000. The New South Wales Government has provided, and proposes to continue, funding for the generation of regional geological and geophysical information for use by the mining and petroleum industries. Discovery 2000 is aimed at providing a major boost to the exploration industry, and anticipates a substantial return in due course with new discoveries, development of new mines and, perhaps, the first major oil or gas discovery in New South Wales.

## METHODOLOGY

During the first two years of Discovery 2000, nine areas were covered by high resolution geophysical surveys (Figure 1). This included acquisition of combined aeromagnetic and radiometric surveys and the upgrade of the existing gravity stations at 11 km x 11 km, to a new 4 km x 4 km grid. The surveys have been progressively released to industry at a low price.

### Airborne geophysics

For dominantly mineral-prospective areas, the interline spacing for airborne surveys was 250 m with a survey altitude of 60 m. In petroleum-prospective areas, the interline spacing was 400 m, with a survey altitude of 80 m. As strike directions vary over the petroleum-prospective areas, the tie line/survey line ratio was kept to 1:5 compared to the industry standard ratio of 1:10. The additional tie lines also helped to ensure a very low noise level in the final datasets.

Navigation of the fixed-wing airborne surveys was controlled by Global Positional Satellites (GPS), and 95% of the flightline locations and survey altitudes were within 2 m and 10 m, respectively, of planned positions.

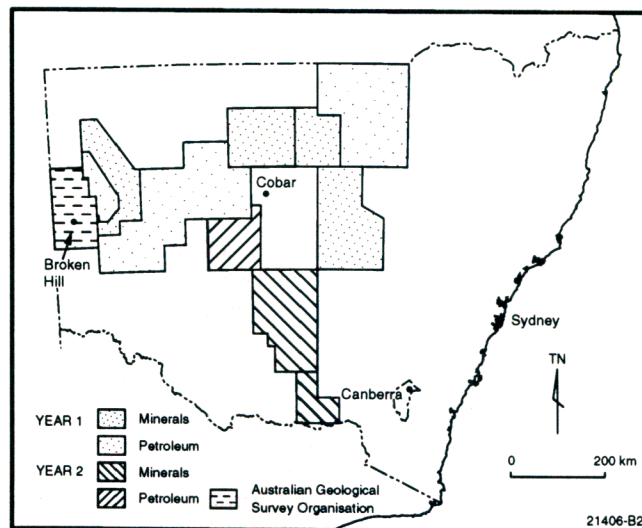


Figure 1. Outline of Discovery 2000 geophysical coverage

### Gravity

To assist in the overall understanding of the different lithologies and regional structure, the gravity station readings over all survey areas were read on a 4 km x 4 km grid. To have a minimal impact on landholders a helicopter was used to efficiently gather these data.

As an integral part of any gravity survey the elevation accuracy of a gravity station determines the overall accuracy of the survey. To ensure accurate heights the Discovery 2000 program completed the largest GPS survey ever undertaken anywhere in the world with 'state-of-the-art' dual frequency, real-time differential GPS receivers. These receivers and the accompanying software have revolutionised the positional accuracy of gravity surveys. For instance, 95% of the repeat elevations from reoccupied stations were reported to be within 10 cm. For regional surveys, the specifications for the Discovery 2000 gravity surveys have ensured unprecedented accuracy and the data will form a strong framework to facilitate future infill.

### Seismic

Over 250 line kilometres of high resolution seismic surveys were undertaken over three sedimentary basins. A total of four traverses were recorded with Vibroseis, using either 120-fold or 240-fold stacking with a 3-second or 5-second recording interval.



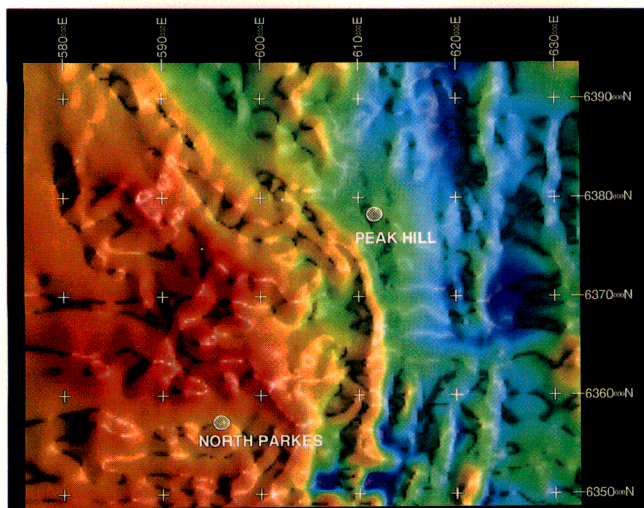


Figure 2. Previous regional aeromagnetic coverage over Northparkes/Peak Hill (AGSO data).

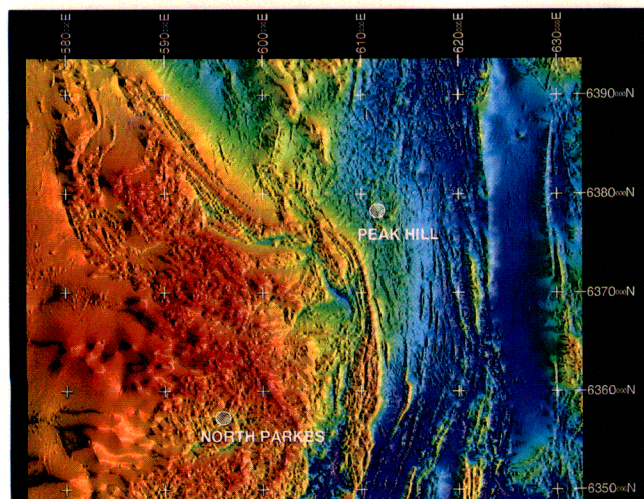


Figure 3. Discovery 2000 aeromagnetic coverage over Northparkes/Peak Hill.

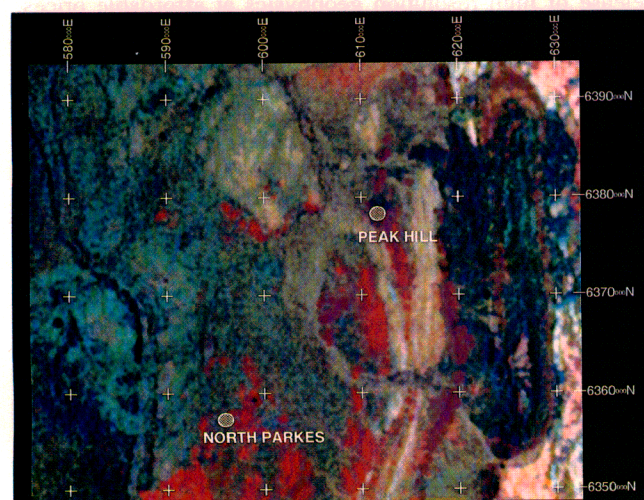


Figure 4. Discovery 2000 radiometric coverage over Northparkes/Peak Hill.

## RESULTS

The new high resolution geophysical datasets have provided industry with a world-class product.

For example, in the mineral-prospective area of Northern Parkes, which hosts the Northparkes cluster of porphyry copper-gold deposits (reserves of over 70 million tonnes

averaging approximately 1.3% copper and 0.6 g/t gold), the new airborne data represents a tenfold increase in resolution over the previously available data. Except for a 1960 reconnaissance aeromagnetic survey (1.5 km interline spacing), barely 10% of the area was covered with company surveys. An extract of this dataset for the Northparkes and Peak Hill area is shown in Figures 2, 3 and 4. Figure 2 shows regional aeromagnetic data flown in 1960; Figure 3 shows the higher resolution aeromagnetic data obtained with the recent Discovery 2000 survey (displayed as an equivalent colour stretch range to the regional data in Figure 2); and Figure 4 shows the Discovery 2000 radiometric data (no such data were acquired with the 1960 regional survey), with the K/Th/U radioelements shown as a red/green/blue ternary image.

The Department has completed a first pass interpretation of this dataset using a synthesis of the known geology with colour images of the total magnetic intensity (TMI), grey-tone images of the 1st and 2nd vertical derivatives, and colour images and contours of the radiometric and gravity data. To encourage further the explorer, the Department completed computer-depth analyses, potential-field computer modelling, downhole logging and a physical property database.

Another high priority area requiring 'modern' high resolution geophysics was the Bourke Project Area. Although most of the geology in this area is masked by relatively 'thin' cover, Palaeozoic sequences with significant mineral potential, can be interpreted to extend into this area. For instance, to the south of the Project area lies the Early Devonian Cobar Basin, which hosts the Cobar group of mines (eg, Elura, CSA, The Peak, McKinnons Tank, etc.) which had a premine resource of well over 150 million tonnes of gold, copper, lead, zinc and silver mineralisation. To the southeast of the project area lies Honeybugle, which is the most northerly of the known Alaskan style ultramafic intrusive complex, and the Girilambone copper district. Together they had a premine resource of over 26 million tonnes of significant copper mineralisation. Existing geological and geophysical information suggests that many of the mineralised Palaeozoic units and structures strike generally north or north-northwest, under Mesozoic and Cainozoic cover.

The new generation geophysics has now strongly indicated that much of the Ordovician through to Devonian stratigraphy continues well into the Bourke Project Area. This fact has led to a ten-fold increase in exploration activity.

CD-ROMs have now been released for the Northern Parkes, Bourke and Cargelligo/Narrandera Project survey areas. The CD package includes outcrop geology, bedrock interpretation, depth to basement, rock chip and ground water geochemical data, location of mineral occurrences, and a large collection of geophysical images (eg, TMI, ternary radiometric and Digital Terrain Model images, together with gravity and TMI colour contour plots).

When examining the Exploration Licence Applications (ELAs) for the Northwest Lachlan Foldbelt of New South Wales (Figure 5), there have been surges of applications concurrent with the data releases of the major geophysical surveys. Over the past 12 months the level of exploration expenditure within New South Wales, has increased from \$65 million to over \$90 million.

Besides the mineral prospective areas, analysis of the high resolution aeromagnetic and gravity datasets have revealed many new geological features in the sedimentary basins. Combined with recently acquired seismic data and the reinterpretation of existing seismic data, new structures within the basins have been located and even the basin



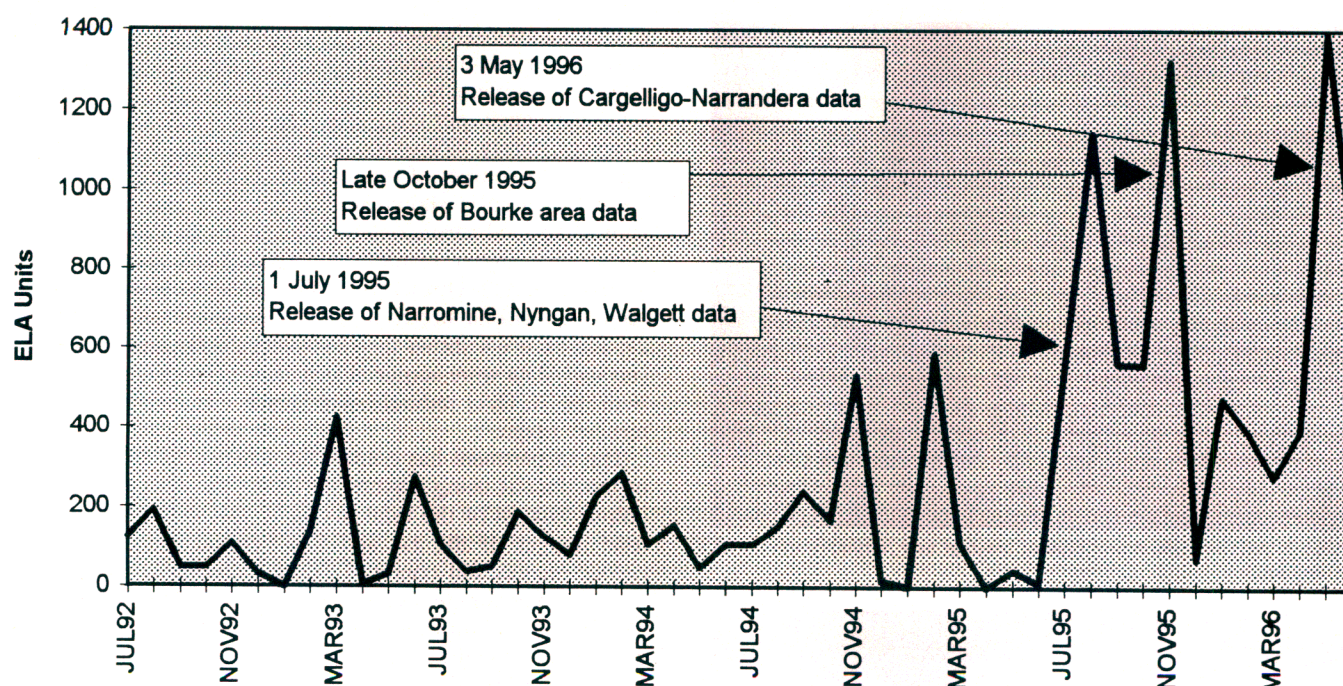


Figure 5. Northwest Lachlan Foldbelt — ELA Activity.

shapes have been redefined. Tectonic features can be identified and include normal and thrust faults and large horst and rifted blocks. Such tectonic features could provide suitable structures for the entrapment of petroleum. Both large and small structural features have now been mapped over large regional areas. Combined with the recent but limited seismic refraction surveys, the mapping has directly led to a greater understanding of the basins.

The Darling Basin, for instance, contains all the major ingredients for successful petroleum exploration but lacks definitive information on source rocks and their thermal maturity. Early Devonian marine sequences are regarded as the best potential source rock interval and although this unit is known to be widespread there are few subsurface intersections. Those wells with intersections are located on structural highs and have unacceptable seismic data which cannot be integrated into existing seismic datasets and extrapolated into deeper, more prospective parts of the basin.

Acquisition by the Department of new high quality seismic data using vibroseis (240-fold, 12.5 m group interval and 12.5 m source interval) represents the first modern high-fold seismic data to be recorded within the Darling Basin. From the interpretation of the aeromagnetic and gravity data, the seismic lines were positioned over structural highs where Early Devonian sedimentary rocks

occur at the surface, or are near-surface. The aim was to position relatively shallow (1000 m) stratigraphic wells to penetrate areas with minimum overburden so that the source rock potential and thermal maturity of the complete Early Devonian sequence could be assessed. The Department recently completed a 1100 m stratigraphic drillhole and the results have already provoked new thought and re-examination of the regional stratigraphy.

### CONCLUSIONS

The New South Wales Government's Discovery 2000 exploration initiative for minerals and petroleum, and its release of high resolution geophysics at affordable prices, has provided industry with a once-in-a-generation opportunity for major discoveries. The State has already seen a major boost in the level of exploration, and as 'value added' products are progressively released, a series of new discoveries is anticipated.

### ACKNOWLEDGMENTS

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