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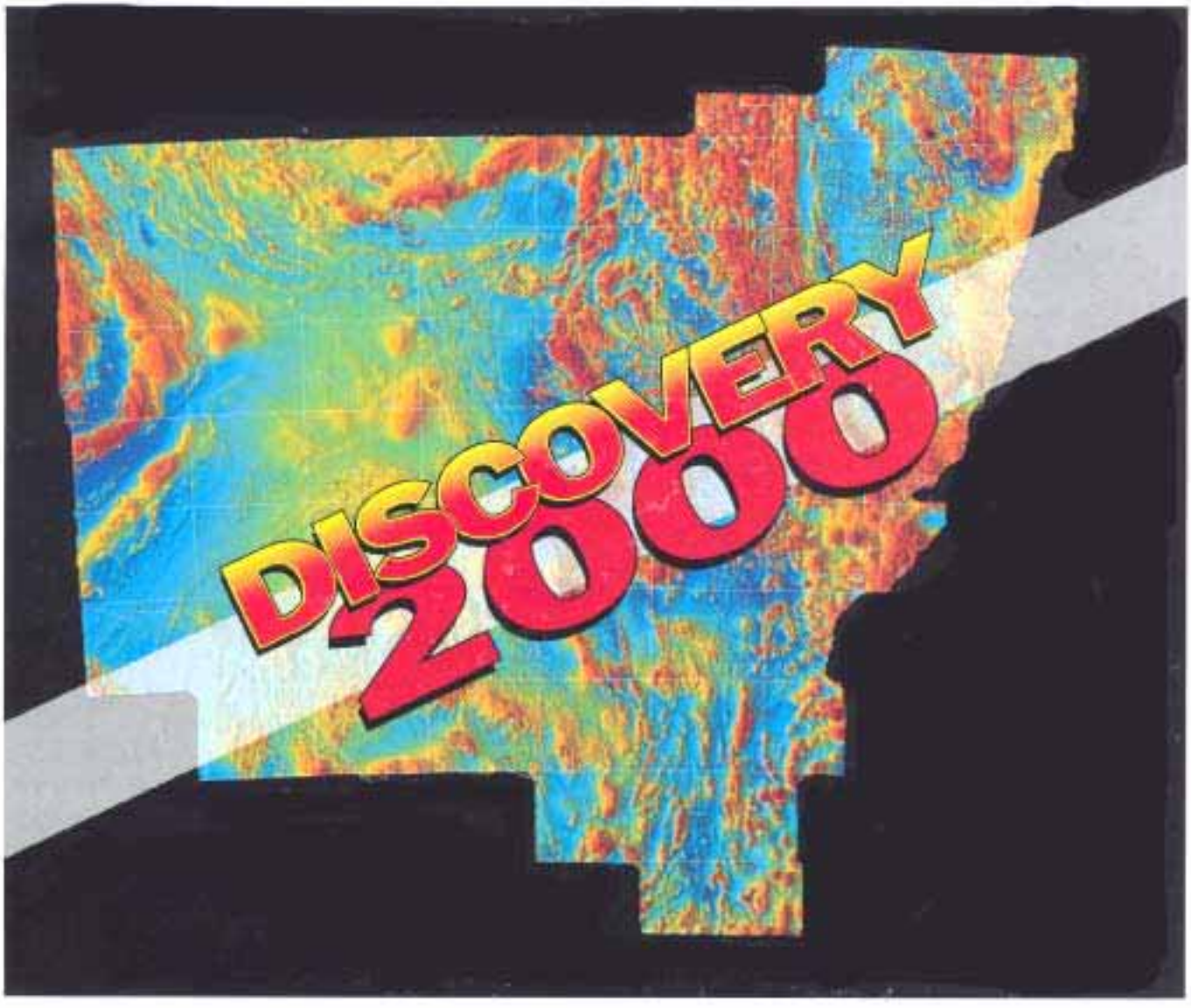

Special Feature

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Editors Desk

Yes dear reader, Preview is still alive and well. My sincere apologies for this late running combined October/December edition but for once this Editor's home and work committments left no time and energy for Preview in the latter 3 months of 1994. All this serves to prove the vulnerability of voluntary part-time services to the ASEG.

The plans for Preview (Issue No 50, p5) still stand however, and we look forward to an interesting array of articles this year including our August Conference Handbook edition. I will certainly be working to make Preview more sustainable and "bullet proof" with the assistance of our new Editorial board and hopefully the contributions of you the reader.

Please contact the Associate Editors or myself with stories, articles, news or ideas. Colour feature articles are especially welcomed and at $1,500 are exceptional value. Andrew Sutherland will gladly assist with advertising needs.

Thankyou to Denis Casey and Dave Robson of NSW Department of Mineral Resources for the colour feature article on NSW exploration initiatives. We welcome Steve Mudge's regular new mineral geophysics column Excitations. Bob Sheriff is the second person to feature in our Mentor series of articles. Ken McCrackens absorbing series on the IGES concludes with a "book review" of sorts some 63 years later!

May 1995 prove to be successful for your geophysical endeavours and for the ASEG.

Geoff Pettifer
Editor

Preview Deadlines

Issue	Deadline
February 1995	January 27 1995
April 1995	March 31 1995
June 1995	May 31 1995
August 1995	June 23, 1995
October 1995	September 29, 1995
December 1995	November 24, 1995

President's Piece

Los Angeles - The SEG 1994 Conference

I attended the SEG conference in Los Angeles as president of the ASEG late in October. It was an impressive event with about 4,500 delegates attending during the four days. The SEG, their permanent staff in Tulsa, and the local representatives in Los Angeles all need congratulating on what was a tremendously successful conference. The sheer size demanded careful and precise organising well before it happened and certainly during the running of the event.

I attended the SEG Council Meeting on the Sunday preceding the conference, representing the Australian Section, along with Norm Uren and Brian Evans. There were no contentious issues raised that would impinge on the ASEG but it was necessary that we were there mainly to show that we are involved. The combined ASEG/SEG conference in Sydney, 1997 was uppermost in our minds and the lobbying for this event began after the Council Meeting and continued most of the week. Tim Pippett, Bob Smith and Roger Henderson were also there and spoke to numerous people on behalf of the ASEG. I was fortunate to have time at the SE Asian breakfast to address the delegates (about 75), and tell them of our plans in 1997, as well as to advertise the Adelaide conference. We hope to have a strong SE Asian representation in 1997 and the preparation has to begin now. We are part of this region and there is a lot of geophysical activity in Indonesia (eg. see pg 48), The Philippines, Malaysia, China etc, which we should be aware of. We should encourage geophysicists from these countries to be much more involved with the ASEG.

The other side of the conference, was the technical component. I analysed the type of papers being presented and came up with the following results.

1. A general classification into petroleum, mineral, and engineering oriented papers provided the following figures:

Petroleum exploration related	= 318	83.5%
Mineral exploration related	= 35	9.2%
Engineering related	= 28	7.3%
Total number of papers	**= 381**	**100.0%**

2. An assessment was also made as to whether they dealt theoretical or practical aspects.

Theoretical aspects	= 243	63.8%
Practical aspects	= 138	36.2%
Total number of papers	**= 381**	**100.0%**

3. Finally, the papers were categorised on the type of geophysical method.

Seismic	= 323	85.0%
Magnetics	= 11	2.8%
Gravity	= 4	1.0%
IP	= 2	0.5%
EM	= 19	5.0%
Electrical	= 7	1.7%
Other methods (+computing)	= 15	4.0%
Total number of papers	**= 381**	**100.0%**

The conclusion drawn from these figures is that the conference was a success for a geophysicist in the petroleum industry whose prime interest lay in the development of theoretical aspects relating to petroleum occurences and seismic data acquisition or processing.

However, as most geophysicists in the USA are in petroleum search and this is the conference content they require - thus it was a successful conference. Attendance was 4500 (5000 were hoped for) and there were more exhibitors than last year in Washington. It confirms that the ASEG has the top conference for mineral geophysics and that engineering geophysics has yet to get off the ground (or on to the ground!) either at SEG or ASEG.

Was it worthwhile for the President of the ASEG to attend the SEG Conference? In my opinion, definitely yes! We are part of the SEG; we should be heard, and we should be more pro-active in expanding our membership in SE Asia. If we don't, the SEG will.

Finally, if anyone would like to read the full details of my visit to Los Angeles, the complete report is available from Janine Cross at the ASEG Secretariat.

Hugh Rutter
President

Preview - Next Issue

- *Mentor: Robert Sheriff (Continued)*
- *Real Time Intelligent Mine Seismicity Monitoring System*
- *Low level Helicopter Magnetics*

Executive Brief

We welcome Greg Blackburn to the ASEG Executive Committee to replace Greg Turner. Greg B. has a long and distinguished career in the petroleum industry and has served on the NSW branch committee. Watch out for Greg's profile in the next issue.

Arrangements for the ASEG Conference and Exhibition, Adelaide South Australia (3-6 September, 1995) are progressing well.

The Secretariat has moved office and now combines the functions of publishing coordination, Preview compilation and general business.

Mike Asten is looking at the issue of postage costs, particularly overseas postage. Costs have risen with no corresponding rise in the mailout charge to members. Package deals and other ways of reducing mailout costs, with no reduction in service or a member price rise, are being investigated.

There has been a surprisingly slow response to the offer of complete sets of Exploration Geophysics back issues. This offer is still available but may be reconsidered in the near future in light of storage costs.

There has been significant feedback regarding Hugh's attendance at the October SEG Conference (see President's report p 5).

The next city to host the Executive and when handover should occur has been discussed. At this stage, Brisbane, Adelaide and possibly Canberra are in the running with handover around March 1997.

We have received 4 active, 5 associate and 6 student membership applications.

Koya Suto has been working on a geophysics promotion slide set and text. Kim Forwood and Schlumberger are working on a geophysical experiment kit for school demonstrations.

1994 will be a hard act to follow in the oil patch: the year started on a high with the Elang-1 discovery in the Timor Gap and ended on an even bigger high (no pun intended) with the Laminaria-1 and Kakatua-1 discoveries in the same area. On behalf of the ASEG Executive, may I wish you a successful 1995 exploring, developing, studying, researching or in retirement.

Brenton Oke, Secretary

Treasurer's Trove

The Editor has given me some space this edition, but as Treasurer I don't have much to offer *(Editor's Note - I disagree)* - just a glorified book-keeper, really. Coming to write this as the chance does in the narrow space between the end of teaching and the exam marking at my University, I thought I'd turn this space over to some thoughts which follow on from Derecke Palmer in the August 1994 issue.

Geoscientists (and especially exploration geoscientists) have things of value even beyond the future of our own profession - curiosity, and optimism! We (and this time I mean "society") needs more curious, optimistic scientists (and technologists). If we can generate this curiosity among children, we'll probably get more geneticists, electronic engineers, agronomists, and topologists, as well as geophysicists, and we shouldn't be too narrow in looking to the future of our own industry. On the contrary, because the earth sciences are only a small subset of science, I argue that the best thing we can do is to encourage a positive view of science as the new century aproaches, because we can't exist in a scientific or technical vacuum.

We do have a good basis to start from. As Derecke has said, "See the World" is an attractive headline; when students learn that they can see their own surroundings in a new light, many respond very positively. Also, we've got the props to grab attention the gravity images, the seismic sections, the magnetometers which find buried treasure (well, waterpipes, anyway), and as Bob Whitely once remarked to me, we are all treasure hunters at heart!

If you get the chance to talk to people (school groups, Rotary, a scout group or your niece) about your profession, take it! but don't forget to point out that beyond the economic importance, and the technical achievements, there really is a "gee-whiz" in geophysics. If you aren't curious to find out things which no-one else has found, you probably wouldn't be in this game. I think *that* is the positive that I like to spread around.

Lindsay Thomas, Treasurer

ASEG Branch News

Victoria

There has been a personnel change within the Victorian Branch as the Secretary, Paul Basford, has moved to Tasmania, and Desmond FitzGerald & Associates will be filling in for Paul for the rest of the year.

Our September special guest speaker was Dr Aleksander Mendecki, founding and present Managing Director of ISS International in Welkom, South Africa. Dr Mendecki has a background in Rock Mechanics, Applied Mathematics and Geophysics and has worked as a researcher and lecturer in both Poland and Spain. His address was on new developments in mine seismicity which made an excellent sequel to Gary Gibson's talk of the previous month on seismicity in Australia.

A student night is planned for the very near future so interested members should keep an eye open for a finalised date. The student nights have always been a worthwhile event for both students and industry members alike, and a large turnout is expected.

On a similar note, 1995 postgraduate projects are in circulation around VIEPS (Latrobe, Melbourne, Monash Univerisities). Companies interested in offering good Hons/MSc projects (hopefully with financial support and access to data) are advised to act quickly.

Jim Cull, President

Queensland

Branch meetings have been scarce over the central part of the year. This has not been for lack of trying to find guest speakers. We had three speakers almost ready but they got away just as we were about to land them.

I would appreciate everyone who has possible speakers to keep the Branch executive informed so these opportunities don't slip through the net.

Our student night was held on 21 July at the University of Q'ld with two speakers presenting the results of their honours theses. John Donohue presented his results on inversion of time domain airborne EM data while Mick Sharry presented 2D and 3D magnetic modelling incorporating demagnetisation. Both presentations were of a high standard and both speakers fielded questions with confidence and an obvious understanding of their work. The Q'ld branch gave a vote of thanks to Steve Hearn to pass on to the department for producing high quality graduates.

On 16 November we had a talk from Cindy Stewart, a former employee of Enron Oil and Gas and also of Meridian Oil, USA. Cindy gave an interesting case history where 3D seismic improved the resolution and understanding compared with 2D seismic over the Kiva Oil and Gas Field in the Paradox Basin, USA.

By the time you read this, the Queensland Department of Minerals and Energy will have had their two day symposium at the end of November. More in the next issue.

The new year is shaping up quite well with three speakers already tentatively booked for February and March.

We have a possible branch meeting talk in late February from Bob Crasty on Radiometrics. We have yet to confirm this but are hopeful he can make the time.

Easton Wren is already booked to present a two day course on "AVO: A direct Hydrocarbon Indicator". The dates at this stage are not confirmed but are tentatively 20 and 21 March. Easton has also agreed to talk at a Branch meeting and we look forward to this. You still have time to think up some tricky questions. I known Easton is expecting them.

Expressions of interest and enquires for the course can be directed by Henk van Paridon at Crusader on (07) 221 6516 (or preferably by fax to (07) 221 2068).

It was good to hear that Joe Williams has bounced back from illness and has returned to lecturing duties. Joe has promised to present a paper on magnetics at a Branch meeting early in the new year. He says he is still drinking and is looking forward to making up for lost time.

The Q'ld Branch Christmas Dinner was be held on 17 December at Le Chalet, a little French restaurant.

The Executive of the Q'ld Branch would like to extend Season's Greetings to all ASEG members and wish everyone all the best for the New Year.

Wayne Stasinowsky, Secretary

South Australia

A near record turnout of 69 attended the August meeting of the local Branch, the Nostalgia Evening. This very successful event will go down as the success story of the year and indicates that the South Australian Branch of the ASEG is very much alive and growing. This is against the general industry trend and it could therefore be argued that the South Australian Branch is the premier branch of the ASEG. Special thanks to all those who were involved in making the evening entertaining and the huge success that it was. Also thankyou to MESA for sponsoring the evening.

As usual, the last few months of the year have been hectic with the normal round of Christmas drinks etc. In November the SA Branch held the annual Melbourne Cup lunch at Fontana Di Trevi restaurant. A good time

was had by all and a very very good time was had by some. In fact it was so good that Fontana Di Trevi has already been booked again for next year so pencil that one in your diary.

Later in November the annual students presentation evening was held at the National Centre for Petroleum Geology and Geophysics at the Thebarton Campus of the University of Adelaide. The presentations given were as follows:

Geraldine Teakle, Flinders University

Crosshole Seismic Study at Hunt Mine, Kambalda, WA

Craig Barnes, NCPGG

Development of the Petrel Field, Bonaparte Basin

Shane Squire, Adelaide University

Effect of Isotropic and Anisotropic Rocks on Swave Propagation

John Tesselaar, Adelaide University

A Geophysical Investigation of the Lake Harris Komatiite, SA

Samantha Bierbaum, Flinders University

Microtremor Analysis and Earthquake Hazard, SA

This year all presentations were of a very high standard and consequently judging for the Best Paper and Best Presentation awards was very difficult. Congratulations to Shane Squire and Geraldine Teakle for the Best Paper and Best Presentation respectively.

Thankyou to the NCPGG for sponsoring the evening.

Finally, the Christmas party was held at Rod Lovibond's place. For the first time in years, the weather was warm to hot for this evening event which made for perfect beer drinking conditions. Unfortunately, most people obviously weren't in a beer drinking mood and the keg was very slow to run dry. This caused all sorts of angst among the punters who were tipping a very early 'keg runout time' based upon the form of previous years. All except Jo Fitzgerald who picked a very late time for the keg. Thanks to Rod and family for all their time and effort in hosting the event.

Grant Asser, Secretary

ASEG Research Foundation

Since the last issue of Preview the following have contributed to the ASEG Research Foundation:

ASEG $15,000

Notice of ASEG Annual General Meeting and Election of Executive Committee

A combined Federal AGM/Victorian Branch AGM and social evening will be held on Tuesday 11 April, 1994 in Melbourne.

Date and Time: Tuesday 11 April, 1994 5.30pm for a 6.00pm start

Venue: Kelvin Club, Melbourne Place, Melbourne.

Federal AGM Agenda:

1. Welcome to members
2. Apologies
3. Minutes of the 1994 AGM
4. Matters arising from the minutes
5. President's report
6. Treasurer's report
7. Secretary's report
8. ASEG sub-committee reports
9. Election of office bearers for 1994
10. Items of general business
11. Close of meeting

Refreshments will be served prior to the meeting. The Federal AGM will be followed by the Victorian branch AGM, drinks and supper.

Incumbent Officers:

President:	Hugh Rutter	Geophysical Expl. Cons.
1st V. President:	Mike Asten	BHP Minerals
2nd V. President:	Robert Singh	Schlumberger Geoquest
Treasurer:	Lindsay Thomas	Melbourne University
Secretary:	Brenton Oke	BHP Petroleum
Committee:	David Gamble	Acacia Resources
	Andrew Sutherland	Schlumberger Seaco Inc
	Koya Suto	Pacific Oil and Gas
	Greg Blackburn	Blaackburn & Assoc
	Geoff Pettifer	Geological Survey of Vic

In accordance with Item 48 of the Article of Association, all incumbent officers of the Federal Executive shall retire at the AGM.

Nominations are sought for the above positions. Nominations are also sought the equivalent positions for State level. Such nominations must be received by the Secretary no later than 10th April. For practical reasons, nominees should reside in Melbourne.

Brenton Oke, Secretary

The Imperial Geophysical Experimental Survey - Revisited (Part 2): The Field Program

Ken McCracken
Jellore Technologies, Mittagong

(Editors Note: The concluding article of this 2 part series looks at the IGES field program and instrumentation. For Part 1 refer to Preview 51, page 11).

Introduction

The field program of the IGES commenced in Australia in mid 1928. Prior to this, the Director of the Survey, A.B. Broughton Edge, had visited suitable trial areas in all six states. In this he was guided and assisted by the State Mines Departments, and Geological Surveys. As a result of these visits, and consultations, eighteen test sites were selected, as summarised in Table 1 from the report of the IGES.

Two main field parties were established; "electrical" and "gravimetric"; that operated independently throughout Australia. Seismic studies were a "late starter" since it was initially thought that the equipment could not be procured in time. Once this was overcome, a seismic party commenced independent operations. Throughout the survey, magnetic measurements were made when appropriate by both the electrical and gravimetric field parties.

Electrical Surveys

The electrical/EM component of the IGES looks quite familiar to the modern practitioner. The methods used are all quite similar to those used within the past 20 years. The equipment was reasonably portable, and reasonable production rates were obtained.

Six different methods were tested:

- spontaneous polarisation,
- resistivity sounding,
- mapping equipotential surfaces (Figure 1)
- mapping the rate of change of potential with distance (Figure 2)
- the "Bieler-Watson" EM method - the measurement of the ellipticity of the EM fields inside a 400 x 400m horizontal loop, excited at 500 Hz (3 amps) (Figure 3), and
- vertical transmitter Loop EM, at 500 Hz and 60,000 Hz. (Figure 4)

Having a long personal history of fighting unco-operative equipment, I enjoyed reading the

State	Method used			
	Electrical	Gravimetric	Seismic	Magnetic
New South Wales	E. 1 Anembo *sulphide ores*	—	—	—
	E. 2 Captain's Flat *sulphide ores*	—	S. 2 Tallong *surface velocities and underground structure*	—
	E. 3 Leadville *sulphide ores*	—		—
	E. 10 Gulgong *gold deep-leads*	G. 3 Gulgong *gold deep-leads*	S. 1 Gulgong *gold deep-leads*	M. 5 Gulgong *gold sub-basaltic deep-leads*
Victoria	E. 4 Cooper's Creek *copper sulphides*	—	—	M. 2 Cooper's Creek *basic dyke*
	E. 7a Mallee *water horizons*	G. 1 Gelliondale *brown coal*	—	M. 1 Gelliondale *brown coal*
	E. 9 Laverton *brown coal*	G. 2 Lakes Entrance *oil structures*	—	—
Tasmania	E. 5 Zeehan *silver-lead sulphides*	—	—	—
	E. 6 Zeehan *copper-nichel sulphides*	—	—	—
	E. 6a Renison Bell *stanniferous pyrrhotite*	—	—	M. 3 Renison Bell *stanniferous pyrrhotite*
South Australia	E. 8a Moonta and Wallaroo *copper sulphides*	—	—	M. 4 Kadina *magnetic body*
	E. 11 Port Lincoln *graphite*	—	—	—
Western Australia	E. 7 Northampton *lead sulphide*	—	—	—
Queensland	E. 8 Chillagoe *copper-lead sulphides*	—	—	M. 6 Chillagoe *magnetite bodies*

Table 1 - I.G.E.S. Program of Field Work

I.G.E.S

Figure 1. Locating equipotential points

I.G.E.S.

Figure 2. Ratiometer in use with amplifier on the operators back.

descriptions of their equipment, and their trials and tribulations. Their non polarising electrodes, arrays, and EM receiving loops were not unlike those of today. Their electronics were limited to simple valve amplifiers (typical gain of about 5000) and that remarkably sensitive detector, the human ear. They had their problems - I liked this footnote regarding the problems of finding the null orientation of the EM ellipticity coil in the presence of harmonics of the transmitter frequency:

I.G.E.S.

Figure 3. The Bieler Watson double detecting coil in use.

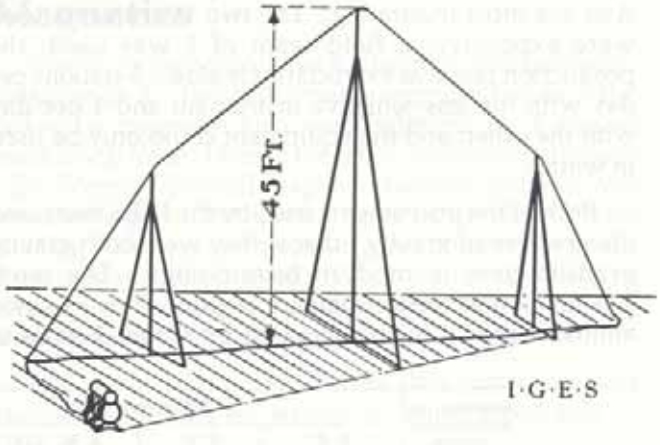

Figure 4. Large vertical loop used for low frequency work.

"the late Dr Bieler maintained that with practice it was possible to distinguish the harmonics from the fundamental and that he could always silence the latter and obtain satisfactory balance. Great difficulty was experienced by other officers of the Survey in training their ears to this degree of proficiency"

Electrical/EM trials were conducted at 14 different locations (Table 1). Like their modern counterparts, they had their successes and their failures. Thus

- at Gulgong (NSW) they sought to "determine the depth and thickness of a basalt member, and

Geological feature	Gish and Rooney	Electrode probe	Bore-hole evidence
	ft.	ft.	ft.
Thickness of overburden	25	30	24–40
Depth to bottom of basalt	140	140	120–160
Depth to bed-rock	160	—	180

Table 2 - Results of Gulgong resistivity field trials.

possibly the depth to bed rock". They used resistivity soundings, and their rather impressive results are given in Table 2.

- at Renison Bell (Tasmania), there was an extensive intercomparison of electrical methods. Thus Table 3 compares equipotential (EP), self potential (SP), electromagnetic (EM) and magnetic (M) measurements over 9 anomalous regions. The agreement between the methods was concluded to be most satisfactory.

The Tasmanian Department of Mines later drilled four of the most promising targets. Like many of their modern counterparts, three of them were "technical successes". The fourth - drilled on an "extremely large signal" intersected 5m of pyrrhotite - but only at a depth of 3m. I speculate that if the depth had been more like 30-50m, they would have still seen good anomalies, and perhaps the uptake of the technology in Australia would have been much faster.

Gravity Gradiometry

The gradiometric component of the IGES was undoubtedly the most expensive part of the survey. And the most frustrating. The two instruments used were expensive; a field team of 6 was used; the production rate was excruciatingly slow - 3 stations per day with the less sensitive instrument and 1 per day with the other; and the equipment could only be used in winter.

Both of the instruments used by the IGES measured the gradient of gravity - that is they were both gravity gradiometers in modern terminology. The more sensitive - the torsion balance (Figures 5 & 6) - was almost identical to that devised by Count Eotvos in

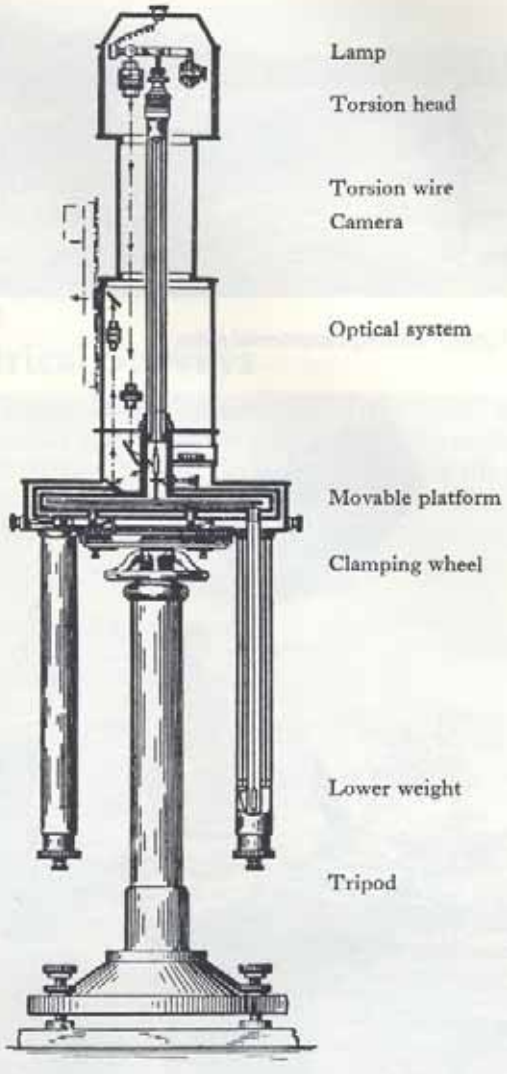

Figure 5. Oertling torsion balance; schematic.

Indication no. and reference beacons	Indication given by				Geology	Remarks
	E. P.	S. P.	E. M.	M.		
I 1 and 2	Strong	Not used	Not used	Strong negative anomaly	No surface indication of mineralization	The magnetic work confirms the south-western end of the equipotential indication
II 3	Fairly strong	Not used	Not used	Fairly strong	Pyrrhotite body visible in face of Luck's Workings	Good agreement between the two methods used. Indications correspond with known sulphide body
III 12	Indecisive	Not used	Not used	Fair	No sign of pyrrhotite. The anomaly occurs in old open-cut workings where oxidized ore existed	Indications very indefinite. The magnetic anomaly may be due to magnetite in the gossan
III A 6 and 7	Indecisive	No confirmation	No confirmation	Fair	No surface indication of mineralization	No satisfactory interpretation can be made
III B 8 and 9	Indecisive	Strong negative centre	Fairly strong	Strong	Pyrrhotite exposed in open-cut	Equipotential evidence indefinite but good agreement between the other methods
III D 10 and 11	Fair	Not used	Not used	Fair	Ironstone outcrop at south-east end of indication	Lodes are known to have been cut in this ground by an adit some 300 ft. below the surface
IV 13 and 14	Fair	Not used	Not used	Not used	No surface evidence of mineralization	An old adit is stated to have cut a lode here
VI A 17 and 18	Impossible to use owing to phase conditions	Not used	Fair	Strong	Pyrrhotite exposed in Old Mill Workings and at a point 100 ft. west-north-west of Bore-hole No. 37	These extensive indications, mostly in ground hitherto unexplored, are by far the strongest and most important obtained by the I.G.E.S. in this district
VI B 19, 20, and 21	Impossible to use owing to phase conditions	Not used	Very strong	Very strong	Little surface evidence. Pyrrhotite discovered near Beacon No. 21 as result of magnetic observations	

Table 3 - Comparison of results by different methods - Renison Bell, Tasmania.

I.G.E.S.

Figure 6. Transportation and erection of Oertling torsion balance.

1896. It had an rms error of 1 Eotvos ($=10^{-9}sec^{-2}$), however it's damping time was long (20 minutes); and measurements were required at 3 azimuths, and the production rate was very slow. Further, it was quite temperature sensitive.

The second instrument, the "gradiometer" (Figure 7), had been invented by a member of the IGES planning committee. It was more portable (it weighed 30kg); faster to use (3 hours per measurement); but was 4 times less sensitive.

The field surveys were of epic proportions. At the Gelliondale lignite deposit, 325 stations were occupied in an area of 2 x 4.2km, over a period of 6 months. At Lakes Entrance, two traverses of total length 14km, consisting of 63 stations, took 8 weeks to complete.

The aims of the gradiometer studies were: (a) to map the extent and thickness of the Gelliondale lignite seam, and in this they were successful. (b) to determine whether a granite outcrop extended beneath the prevailing sedimentary sequences at Lakes Entrance, and the conclusion was that it did not.

Looking back 70 years, the temptation is to ask "why did they bother?" The driving force was the need to secure sources of fossil fuels - petroleum - and lignite in Victoria. During the planning phase of the IGES, gravity gradiometry was the "technique of choice" (or was it last resort?) in petroleum exploration. Thus in the mid 1920's, some 170 torsion balance gradiometers (worth US$1m in 1925 dollars) were being used in oil exploration in Texas. However, technological change was about the engulf them, and the report of the IGES (1931) rather ruefully reports *"to a great extent, gravimetric work has now been superseded by the seismic method"*.

I.G.E.S.

Figure 7. Gradiometer with outer cover removed. The instrument was read inside a collapsible portable shed.

Magnetics

The instrumentation has a distinctly old-fashioned look (Figure 8). Two instruments were used -in each the unknown magnetic force was balanced by a known mechanical force. Thus in the most sensitive instrument - the Schmidt vertical magnetic balance, balance was obtained against the known force of gravity. Careful leveling was therefore necessary. An accuracy of about 5 nanoteslas was achieved. A base station was used to correct for the diurnal variation. The production rate was typically 12-16 stations per hour.

Not surprisingly, the results they obtained over substantial anomalies would be quite acceptable in 1994.

Figure 8. The Thalen-Tiberg magnetometer - the least sensitive instrument used.

Seismic Surveys

The IGES decided to investigate seismic methods part way through the main survey. The program was more experimental than for the other instruments, and there seems to have been a lot of "cut and try".

It is particularly interesting to note the 3 types of seismic sensor that were tried:

(a) an electromagnetic sensor similar in concept to the modern moving coil geophone. This was constructed by the University of Sydney,

(b) a seismic sensor based upon the principle of the carbon microphone, in which the acoustic pressure forced carbon granules together, thereby reducing the electrical resistance, and

(c) a hot wire sensor (Figure 9), in which mechanical amplification of the ground motion caused a puff of air to blow past a hot wire; causing it to cool down; thereby causing the current through it to change.

The signals were recorded on a six channel galvanometer, supplied by the British War Office. Time could be read on the photographic record to 1 millisecond. The recording equipment was housed in a portable 3 x 3m hut. It is recorded that *"the hut could be dismantled, loaded and unloaded from the truck, and re-established in working order at the next station within an hour"* (the seismic hut, and the truck are shown on the cover of the 51st issue of Preview).

The charges were loaded into holes dug with a crow bar. Up to 20kg of explosive were used in each hole.

Field trials were run at only two sites in NSW. Good results were obtained, and the final conclusions were very positive.

Interpretation

The IGES report provides a great deal of the basic theory we use today. Thus it is a very acceptable theoretical text on:

- the electrical resistivity method,
- gravity gradiometry, and
- magnetics.

It provides good forward models for simple geometries in each of these cases. It is quite remarkable how far the industry had progressed by 1931.

The Conclusions of the Survey

I let the authors of the IGES report state them.

"the experience of the Survey has shown that the outstanding applications for geophysical work in Australia are:

(1) Electrical surveys for base metal ores (principally sulphides) in Tasmania and in other parts of the Commonwealth where the salinity of the surface and underground waters does not preclude the use of electrical methods;

(2) Electrical surveys in saline water bearing districts with a view to determining the distribution and character of the underground water supplies;

(3) Gravimetric surveys in the brown coal fields of Victoria and South Australia;

(4) Magnetic surveys over the sub-basaltic tin and gold deep - beds in NSW, Victoria, and Tasmania, and

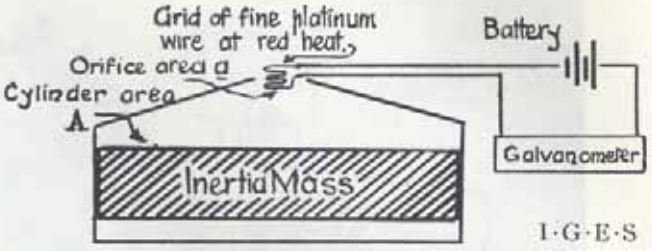

Figure 9. Principle of the hotwire seismometer.

(5) Seismic and gravimetric surveys in sub-alluvial gold and tin deep-lead areas".

In Retrospect

Looking at the IGES now, after 6 decades of developments in electronics, computing and theory, my most vivid conclusions are:

- while the equipment was primitive, its sensitivity was often almost comparable to its modern counterpart,
- the understanding of the "real life" problems was remarkably good. The effects of conductive overburdens; topography; the need for multiple frequency EM; were all there,
- there is only one big, major difference between then and now - namely - the computer based interpretation aids that are now the norm.

After the IGES

The IGES field work concluded in late 1929. The report was written in 1930 and published in 1931.

CSIR(O) did no further work in geophysics until 1970, when the division of Mineral Physics was established.

The mantle of geophysics was taken up in 1934 by a State-Federal body - the "Aerial, geological and geophysical survey of Northern Australia (AGGSNA)". Three of the IGES Geophysicists, Rayner, Thyer, and Richardson, were on its staff.

After several intermediate steps, AGGSNA evolved into the "Bureau of Mineral Resources, Geology, and Geophysics" (now AGSO) in 1946. Rayner from the IGES was the Chief Geophysicist. The BMR continued in the spirit of the IGES, evaluating geophysical techniques, and providing our first geophysical data base.

The IGES therefore had a profound effect upon both the organisation and technical aspects of our profession. It established a highly disciplined approach to the evaluation of geophysical technology, that remains with us today. It is a history of which we can all be proud.

(Editors Note: All figures for the two articles on the IGES are produced from: "The Principles of Geophysical Prospecting being the Report of the Imperial Geophysical Experimental Survey" Edited by A.R. Broughton Edge and T.H. Laby, Cambridge University Press, 1931).

Excitations

with
Steve Mudge
RGC Exploration Pty Ltd

Welcome to EXCITATIONS, the new exciting column that's guaranteed to excite all mineral geophysicists with it's exciting plethora of good, bad, and problem anomalies, novel and innovative ways of practicing 'the art' and in general a sharing of ideas taken straight from the front of the technology shock-wave.

To continually meet these expectations, I need your data, your results and your thoughts on techniques and geophysical methodology to make this column PREVIEW's great excitation for mineral geophysicists. Material published here is definitely not refereed, it'll be edited and shaped-up a bit by me and presented as a valuable professional contribution for other exploration geophysicists to share. Your contribution need only be a single anomaly of particular interest to you and that you feel may be of interest to others. Send it to me:

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Tel: (09) 422 8100
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with a few words of explanation, or just send the words describing that interesting, successful or problem technical item. All useful material will be presented with acknowledgments, or anonymously if you wish.

To get the excitement rolling, I'll present several items taken from my own files: displaying ratioed radiometric data - a potential trap for young players, and tidal gravity anomalies - always present but rarely seen.

Ratioing radiometric data

Ratioing multichannel data such as radiometrics can produce useful enhancements to the data that reveal true rock properties. However the geological resolution of this simple but powerful processing technique can be diminished when contoured or imaged without concern for the dynamic range of ratioed data.

Take for example a potassium (K) / Thorium (Th) ratio. A ratio of say 2.0, says that K is twice Th and it's inverse ratio of 0.5 tells us that K is half Th, or that Th is twice K. The interest here is that both ratios mean that one element has twice the level of the other; which one is the greater is an additional piece of information.

Contouring with a linear contour interval can severely diminish the resolution of the fractional values, those less than 1, because these values are not equally distributed like their inverse values (all greater than 1.0). A contour interval of say 0.5 will represent all values above 1.0 in increments of 0.5 but only one

interval less than 1.0 will be represented (0.5 or 1/2). Clearly one has to consider plotting two maps: K/Th and Th/K both with values greater than or equal to 1.0 to obtain the required, but equal, resolution.

Alternatively a single contour map of one ratio contoured with a non-linear contour interval for the fractional values could be attempted, but it would be messy to set up.

A simple solution to presenting the complete range of ratio values on a single map with equal resolution using a single contour interval is to convert or normalise the fractional values to a continuous linear distribution. The table shows the scheme:

Ratio (K/Th)	Normalised Ratio
etc	etc
4.0	4.0
3.0	3.0
2.0	2.0
1.0	1.0
0.5 (1/2)	0.0
0.33 (1/3)	-1.0
0.25 (1/4)	-2.0

Fractional values, those less than 1.0, are adjusted using the equation:

normalised ratio = 2.0-(1/ratio).

If you are using ER Mapper you can use its FORMULA facility to compute the normalisation as the image is displayed. With checks for zero values of the channels being ratioed, the FORMULA is:

IF INPUT1 = 0 OR INPUT2 = 0 THEN NULL

ELSE IF INPUT1/INPUT2<1.0 THEN

2.0-(INPUT2/INPUT1) ELSE INPUT1/INPUT2

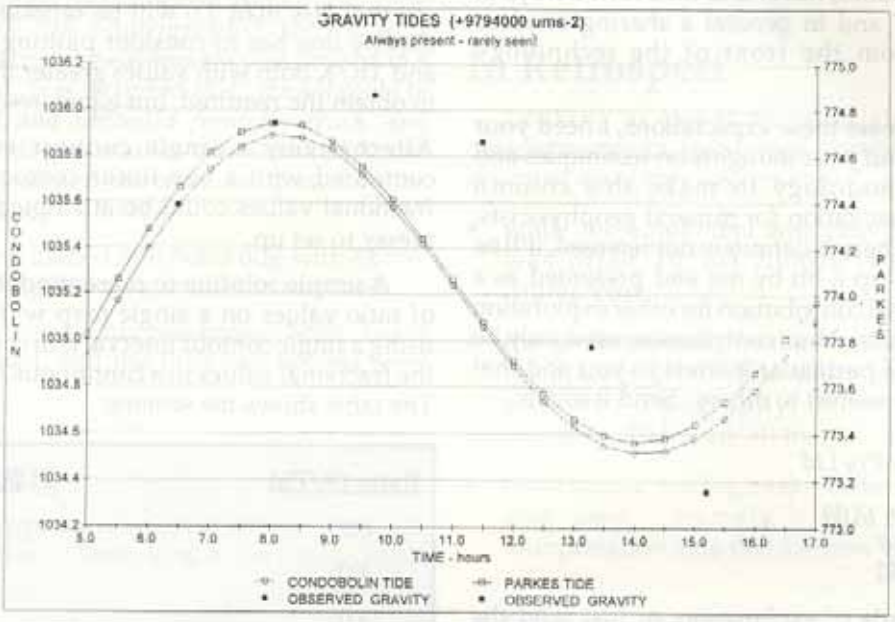
With ER Mapper you could call it NORMALISED_RATIO, and describe it as NORMALISED_RATIO_B1/B2. Now ratio your favourite channels, mine are K on BAND1 and Th on BAND2, and see all the information with the convenience of a single map or image.

Tidal gravity

Have you ever seen a tidal gravity anomaly? They're always in your data because the Moon is forever present and pulling on the Earth. Well, here's an example of the tidal response observed whilst making repeated base station ties between Condobolin and Parkes in NSW on 30th July 1991 (see below).

The two curves show the responses observed at each station over a 10 hour period. The calculated tidal responses, using Longman's equations (Longman, I.M.,1959, Jour of Geophys. Res., V64, 12, p2351-2355), are also shown. The graphs have been offset by the gravity difference between the two stations (approximately 262 ums²) and both tides are zero at 11.5 hours. The combined observations clearly show the tidal oscillation. Once the tidal correction is applied, the observations should reveal the instrument drift and the gravity difference between the two stations (plus any instrument and operator errors). I conclude that both the equations and the observations confirm that the Earth is being periodically stressed!

You can get the FORTRAN code for computing tidal corrections from AGSO or from this friendly writer. Happy Excitations!



ASEG 11th Conference & Exhibition News

Update Technical Program

The 1995 Conference looks like being a very good technical conference. The response to the Call for Papers was excellent. 164 paper synopses were received, from which 50 softrock and 62 environmental and hardrock papers were selected for presentation.

Considerable time was spent by the Technical Papers committee in selecting papers to ensure a well balanced program.

The program includes sessions on the following topics:

Hydrocarbons

- Case Histories
- Spectral/Wavefield
- Data Processing
- VSP's
- Acquisition
- Statics
- Modelling
- AVO

Coal/Mining

- Tomography
- Case Studies

Minerals

- Case Histories
- SAM
- Radiometrics
- Magnetics
- Radar
- Gold
- Gravity
- EM

Groundwater

Environmental

A number of poster synopses were also received. These largely represent very recent work with 'hot off the press' results. The poster presentations will be incorporated in the mainstream technical sessions.

It was pleasing to receive a number of paper and poster synopses from overseas. The countries included Canadia, U.S.A., Russia, South Africa, Nigeria, Japan, U.K. and Finland.

Keep 3-6 September 1995 free for a very technical conference in Adelaide.

Daniel Burns

Discovery 2000 - a NEW Beginning

Exploration Initiatives for New South Wales

In July 1994, the Premier, Mr John Fahey MP, announced that the NSW State Government would make available a total of $40 million over six years in new funding for the Department of Mineral Resources. This funding would be applied directly to the generation of regional geological and geophysical information for use by the mining and petroleum industries in their exploration programs in this state. The Government's initiative, which has been given the name **Discovery 2000**, is aimed at providing a major boost to the exploration industry. It anticipates a substantial return in due course as new discoveries are made because of the initiative, new mines are developed and, perhaps, the first ever commercial oil or gas production is developed in New South Wales.

The Discovery 2000 program, will be funded as follows:

Year 1	—	$10 million
Year 2	—	$8 million
Year 3	—	$7 million
Years 4-6	—	$5 million each year

As the Minister for Mines, the Hon Ian Causley MP, explained at the announcement of Discovery 2000, *'This initiative will involve application of high resolution airborne geophysics, selected drilling, geochemistry, age dating and geological mapping and interpretation for selected regions of the state. It will also allow state-of-the-art technology to be applied to the transfer of this information to the resources industry, other government agencies and the community.'*

The Department of Mineral Resources has been supplying geoscientific information to industry for over 100 years. However, in recent years other states have overtaken New South Wales in the application of modern technology to the mapping of minerals and petroleum resource potential.

The Department of Mineral Resources does not, of course, accept a pessimistic view of the State's exploration potential. The many old mines across much of the State bear testimony to its rich mining heritage. In addition, New South Wales has a vigorous mining industry with major base metal and gold mines throughout the State. The North Parkes mine, and other recent discoveries in the Lachlan Fold Belt of central New South Wales, confirm this as a major copper-gold province, the surface of which has barely been scratched.

Most of the previous discoveries were made from studies of outcropping rocks or those with shallow, superficial cover. However, in recent years, there have been rapid and dramatic developments in airborne geophysical methods such as aeromagnetics. Today's technology not only provides a much more detailed and reliable analysis of the earth's structural geology, but also enables us to 'see through' surface cover of sand, soil and younger rocks to the potentially mineralised rocks below. Such technology also has valuable applications in the search for petroleum. High quality regional aeromagnetics is the cornerstone of modern regional exploration and is the major component of **'Discovery 2000'**.

The question is sometimes asked, *'Why should the government be involved in mineral or petroleum exploration? Isn't that the business of companies?'* The program will generate information that is of a regional, pre-competitive nature and which is invariably the starting point for industry when it comes to consider exploring in an area. Leaving it to industry to generate such data would mean, at best, that only the very largest companies could participate and also that information would not be available to other companies.

The petroleum potential of New South Wales has not to date captured active industry attention as companies have concentrated on areas of known commercial production in other states. Gas and oil shows have been recorded from a number of sedimentary basins in the State but few of the wells drilled are valid tests, located on structures mapped by modern seismic techniques.

DISCOVERY 2000

MINERAL RESOURCES

NSW DEPARTMENT OF MINERAL RESOURCES

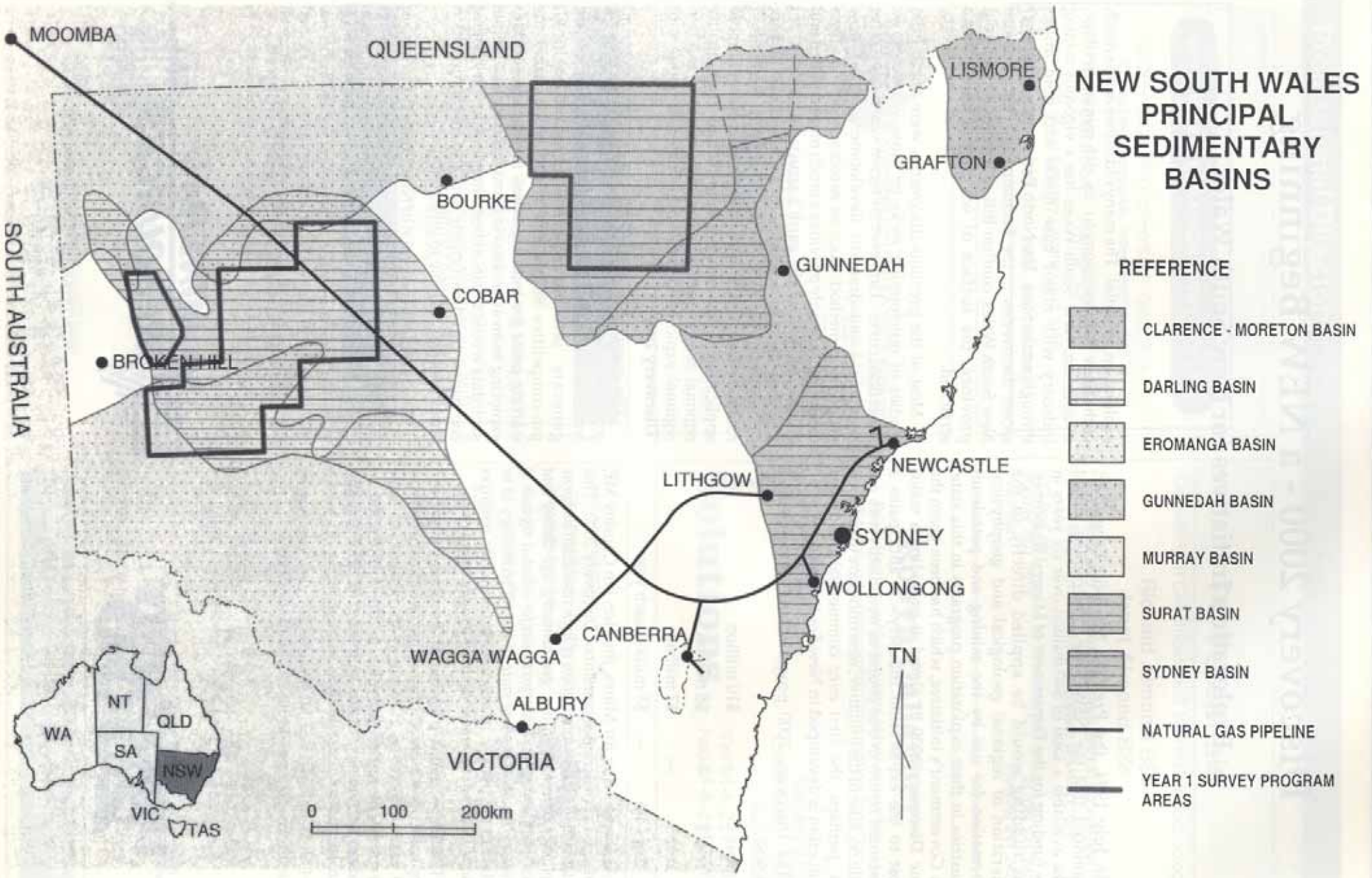


Figure 1. NSW principal sedimentary basins.

The Search for Oil and Gas in New South Wales

New South Wales is the only mainland State of Australia without commercial petroleum and natural gas production. The State covers an area of 801 600 km^2, of which about 60% is covered by sedimentary basins with petroleum resources potential, most of which remain virtually unexplored.

There have only been about 200 exploration and appraisal wells drilled in the whole of New South Wales compared to approximately 1 300 wells drilled in the Queensland portion of the Surat Basin alone. The unexplored Surat Basin provides a good example of New South Wales prospectivity — petroleum is obtained from the Queensland end of the Basin, and there is no reason why commercial oil fields could not be found in New South Wales, as oil fields 'do not obey' state boundaries.

Discovery 2000 programs will target those areas which have a limited exploration history but are considered to be prospective for petroleum, such as the Darling, Surat, Eromanga, Clarence-Moreton, and Gunnedah Basins (Figure 1). Exploration in the State has demonstrated that its sedimentary basins have suitable reservoir, source and seal rocks. It has also indicated that the source rocks are of suitable maturity for the generation of oil and gas (Figure 2). There have already been shows of oil and gas in most of New South Wales' sedimentary basins, with significant gas flows recorded in the Gunnedah/Surat, Sydney and Clarence-Moreton Basins.

In consultation with industry, the Department has developed a data acquisition program that will provide regionally significant information. This will assist petroleum exploration companies in focusing on prospective areas of lightly explored basins.

The proposed work program for petroleum has a specific objective: the provision of sufficient information on New South Wales sedimentary basins to attract increased exploration investment. The ultimate aim is to fully evaluate the petroleum prospectivity of the State, which hopefully will lead to petroleum discoveries and commercial petroleum production.

New information will be acquired on at least five basins:

- Darling
- Surat

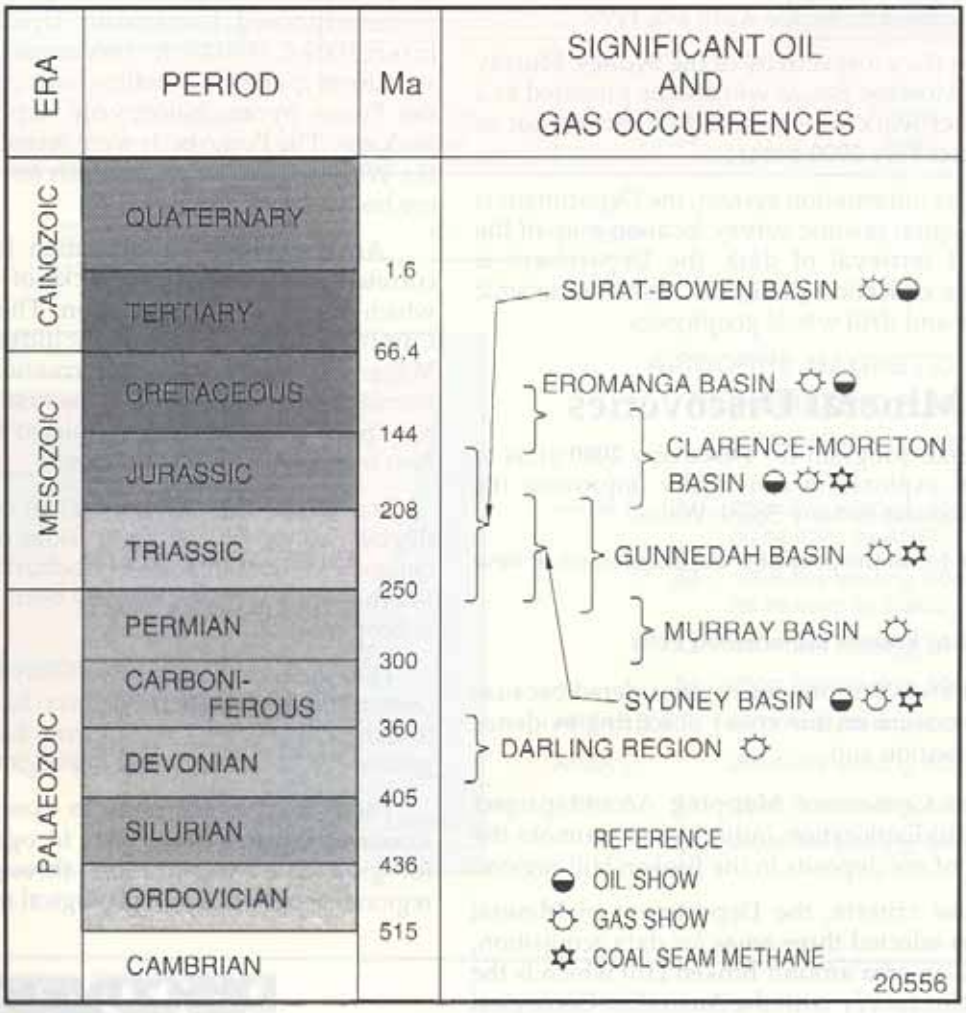


Figure 2. Significant oil and gas occurrences.

- Gunnedah
- Clarence/Moreton
- Eromanga.

The latest petroleum evaluation techniques will be used to investigate the State's sedimentary basins. These will include high resolution aeromagnetics and gravity and radiometric surveys to define basin geometry and tectonic regimes. The survey areas for Year 1 are shown in Figure 1. A complete review of the existing exploration data of each basin is also being undertaken which includes a review of mineral and water exploration. This will be followed by a geochemical analysis of relevant strata to evaluate reservoir and source rock distribution.

Encom Technology Pty Ltd has been awarded the contract to review the Darling Surat and Eromanga Basins. It has completed the Darling Basin study which has shown that sediments in the basin are thicker than previously interpreted but that diagenetic alteration is less than previously supposed. All of these reports will be sold by the Department of Mineral Resources.

The Department of Mineral Resources is preparing a petroleum prospectivity overview of New South Wales which will provide exploration and investment companies with a basis for evaluating the State's petroleum potential. The report will be available at the APEA Conference in Adelaide April 2-5, 1995.

Reports on the prospectivity of the Sydney, Murray and Clarence-Moreton Basins will also be prepared as a guide to further work which should be carried out as part of the **Discovery 2000** program.

As part of its information system, the Department is producing a digital seismic survey location map of the State. To aid retrieval of data, the Department is cataloguing its collection of seismic sections, seismic magnetic tape and drill whole geophysics.

Keys to Mineral Discoveries

The minerals program for **Discovery 2000** aims to boost mineral exploration activity by improving the geoscientific dataset of New South Wales.

The key factor in the project is the acquisition of new data for:

- extensions to known mineralised belts
- greenfield areas not previously considered because of poor exposure or thin cover obscuring evidence of mineralisation and
- a National Geoscience Mapping Accord project (Broken Hill Exploration Initiative) to promote the discovery of ore deposits in the Broken Hill region.

Using these criteria, the Department of Mineral Resources has selected three areas for data acquisition, in addition to an area around Broken Hill which is the subject of a joint survey with the Australian Geological Survey Organisation and the Department of Minerals and Energy, South Australia. The three areas, shown in Plate 1, are the Koonenberry Belt (Area A4), Northern Parkes (Area E) and Bourke (Area C).

The acquisition of high resolution airborne geophysical data is a major component of the program. Processed data from the airborne surveys will provide improved images of poorly exposed or thinly covered regions. This will allow enhanced interpretation of geophysical, geological and structural features leading to a better understanding of the total resource potential. Such new products will substantially improve the targeting of the mineral industry's exploration effort.

Opportunity for Greenfields Exploration

Koonenberry Belt - Area A4

The Koonenberry belt comprises the belt of Proterozoic and Palaeozoic rocks extending northwesterly from Scopes Range through to Tibooburra. The presence of extensive, albeit poorly studied, areas of deformed Proterozoic and Palaeozoic rocks, both in outcrop and under thin Mesozoic and Cainozoic cover, should be of exploration interest.

Potential deposit types:

The Ponto beds are a highly deformed and metamorphosed Proterozoic flysch sequence with intercalated tholeiitic volcanics. The Grasmere stratiform pyrite-magnetite-chalcopyrite deposit and the Ponto pyrite-chalcopyrite deposit occur in this package. The Ponto beds were recently correlated with the Willyama Supergroup which hosts the Broken Hill ore body.

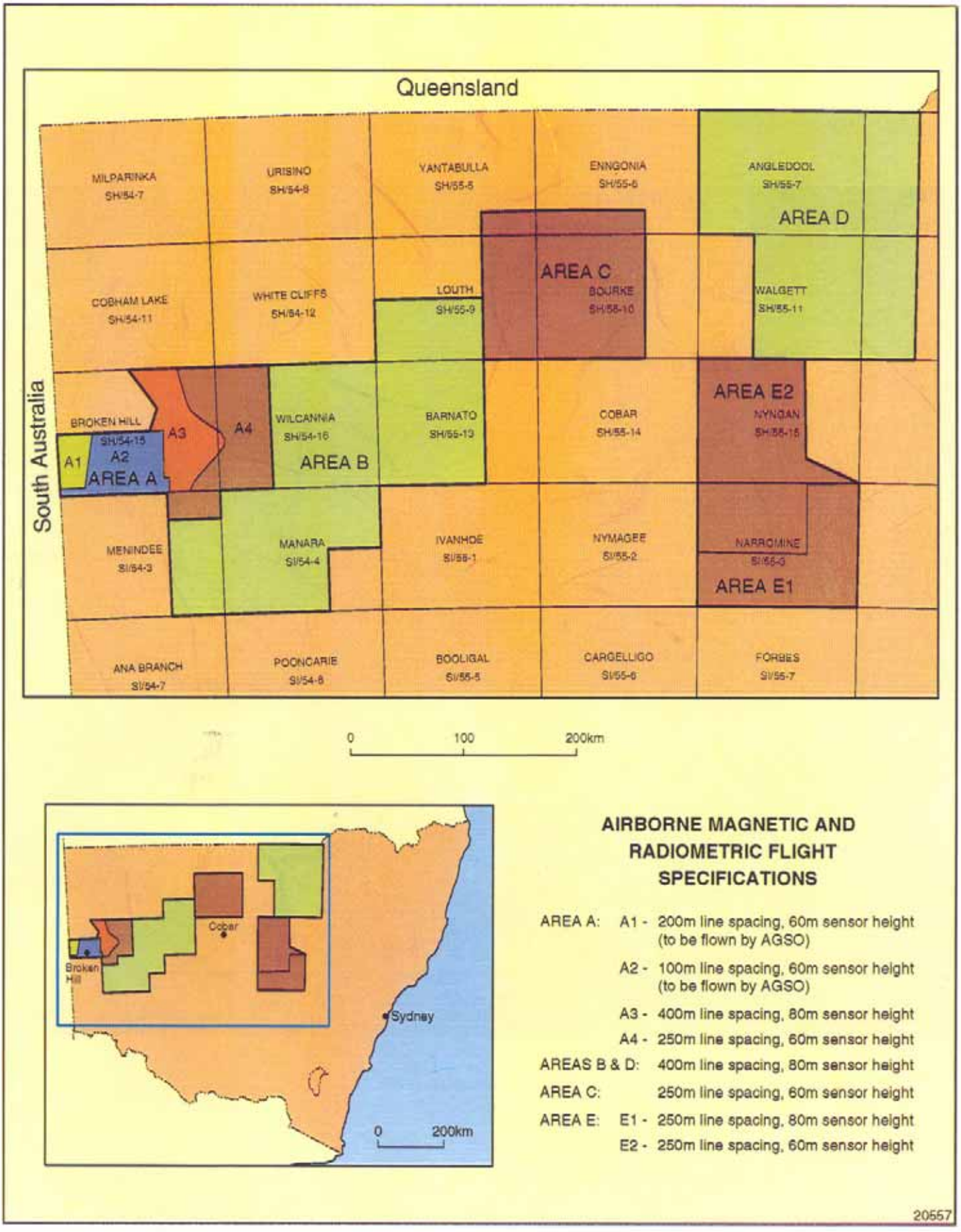
An alternative interpretation is that these beds correlate with Proterozoic rocks of eastern Tasmania which also host mineralisation. The Early to Middle Cambrian Gnalta Group includes the Mt Wright Volcanics, Cymbric Vale Formation and Coonigan Formation. The volcanics in the first two of these units may be of island arc type or related to rifting and may host massive sulphide deposits.

In addition, there is potential for economic diamond discoveries. Nephelinite intrusions occur in an arcuate belt extending from east of Tibooburra to Scopes Range. Micro-diamonds have recently been found in alluvials at Scopes Range.

The extension of the Stawell-Stavely greenstone belt (extending from western Victoria) has been interpreted to exist east of the Koonenberry Fault. Potential for greenstone-associated gold deposits thus also exists.

There is an opportunity to raise the status of the Koonenberry area from "terra incognita" to "attractive for greenfields exploration" through a program of regional geophysics and geological mapping.

DISCOVERY 2000



AIRBORNE MAGNETIC AND RADIOMETRIC FLIGHT SPECIFICATIONS

AREA A:	A1 -	200m line spacing, 60m sensor height (to be flown by AGSO)
	A2 -	100m line spacing, 60m sensor height (to be flown by AGSO)
	A3 -	400m line spacing, 80m sensor height
	A4 -	250m line spacing, 60m sensor height
AREAS B & D:		400m line spacing, 80m sensor height
AREA C:		250m line spacing, 60m sensor height
AREA E:	E1 -	250m line spacing, 80m sensor height
	E2 -	250m line spacing, 60m sensor height

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Plate 1: Airborne Magnetic and Radiometric Flight Specifications.

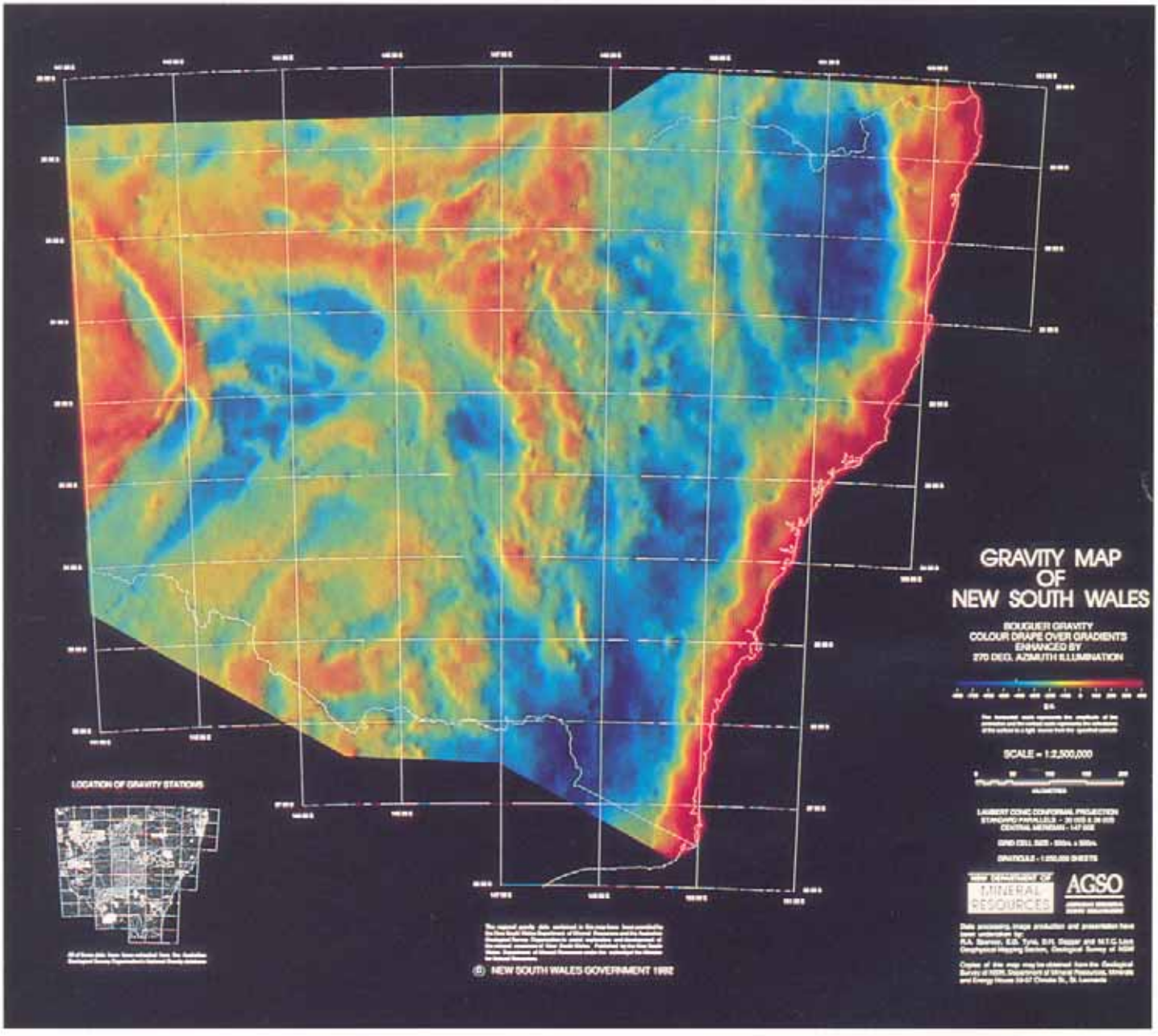


Plate 2: Gravity Map of NSW.

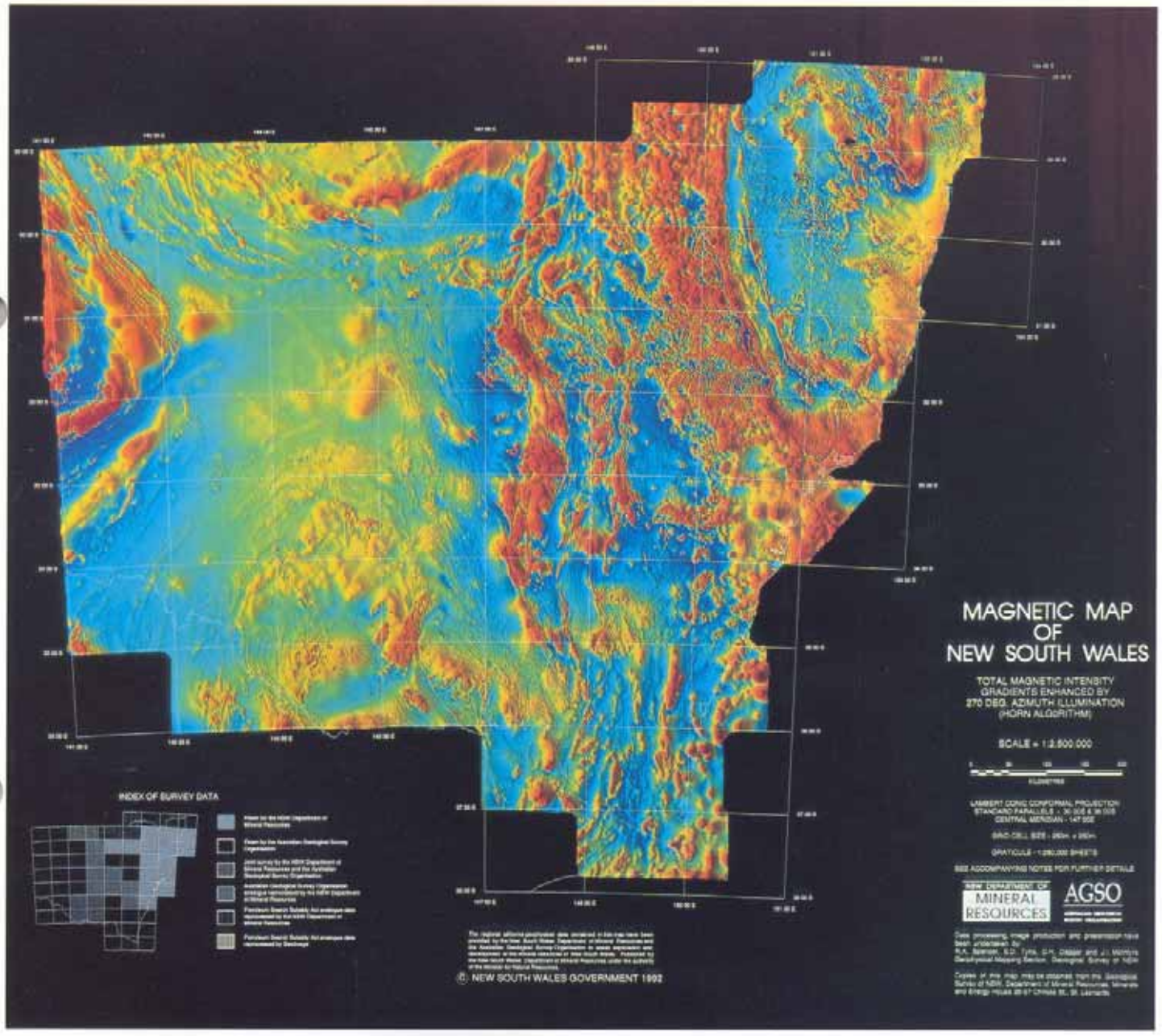


Plate 3: Magnetic Image NSW.

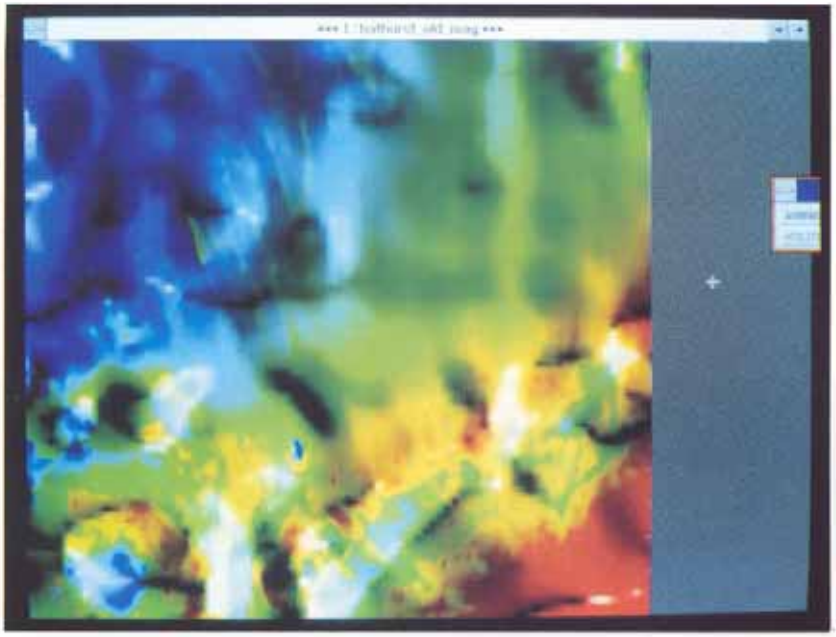


Plate 4 (a): Early Magnetic Image Bathurst Sheet.

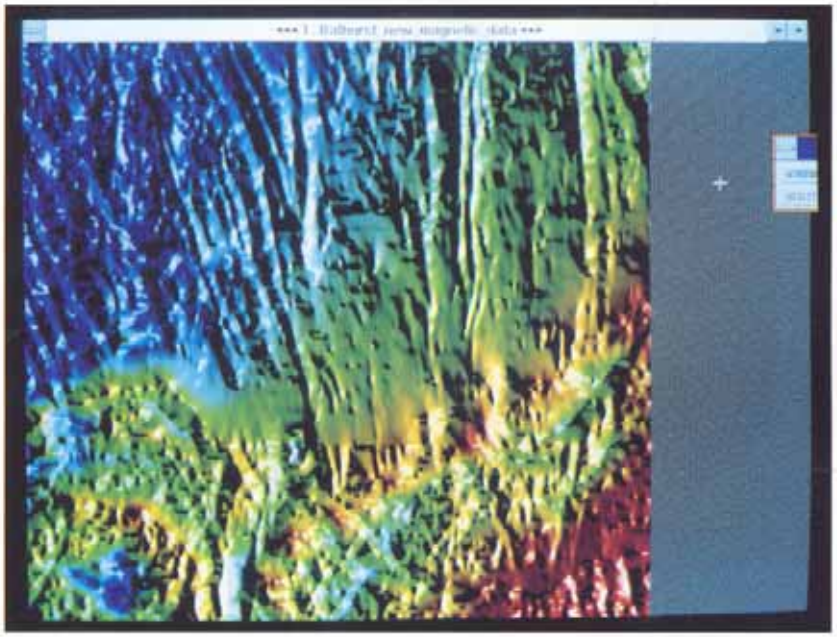


Plate 4 (b): Recent Magnetic Image Bathurst Sheet.

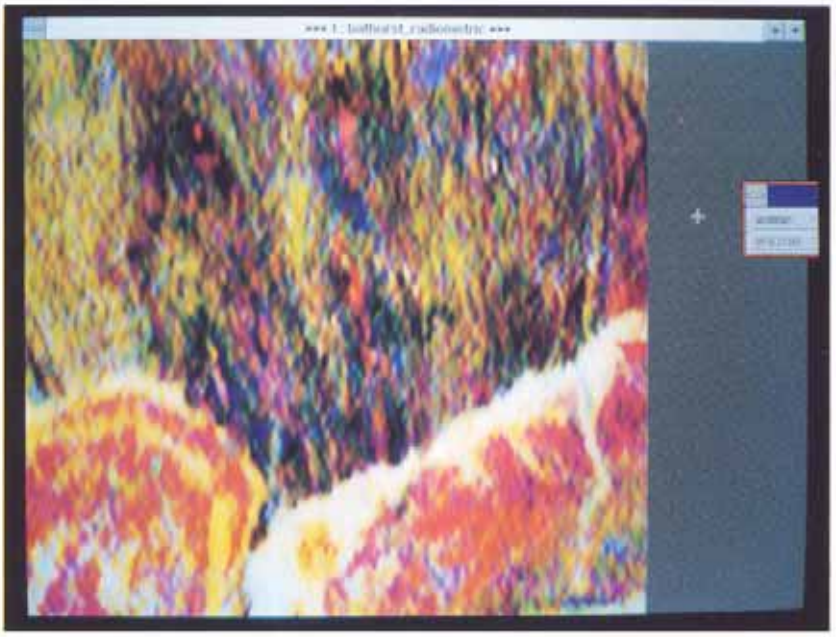


Plate 4 (c): Radiometric Image Bathurst Sheet.

A Porphyry Gold – Copper Province

Northern Parkes Project Area - Area E

The project area embraces the Narromine and part of the Nyngan 1:250 000 map sheets. The Narromine sheet area includes the important North Parkes mine as well as the significant Peak Hill gold deposit, and is regarded as one of the more prospective areas in the State.

Shoshonitic volcanic rocks hosts the important porphyry copper-gold deposits at North Parkes and Lake Cowal. These deposits are associated with late intrusions into the Ordovician shoshonitic volcanic pile.

The northern extension of these prospective rocks, however, is under substantial cover on the NYNGAN 1:250 000 sheet and the proposed high resolution airborne geophysics will dramatically improve knowledge of both the nature and extent of this highly attractive package of volcanic rocks.

Potential also exists for:

- Platinum group metals in Alaskan-type intrusives (eg Fifield)
- Cambro-Ordovician cupriferous-pyrite deposits (eg Girilambone Mine)
- Structurally-controlled volcanic-hosted gold (eg Peak Hill).

A Major Base Metal and Gold Province

Bourke Project Area - Area C

Area C includes the interpreted northern extension of the Darling Basin, which partly underlies the sedimentary cover of the Great Australian Basin. The Darling Basin includes rocks of the Cobar Supergroup, which host the important Elura, CSA and Peak orebodies. These major ore deposits are structurally focused along the eastern margin of this basin. Also supporting the interpreted northern continuation of the Darling Basin is the sporadic occurrence of poorly outcropping, possibly Early Devonian intermediate volcanics.

Furthermore, sediments intersected in drilling northwest of Mount Oxley are regarded as Cobar Supergroup. The lead isotope signatures of the sulphides from these prospects are typically Cobar-type and indicate a source in Cobar Supergroup sediments.

Potential mineralisation targets in the region include:

- Buried Early Devonian basins to the north and west of the Cobar Basin
- Buried northern extensions of ?Early Devonian volcanics and limestone, with possible pull-apart basins along the Darling River Lineament
- Synrift deposits below Early Devonian Shelf sediments
- Mineralisation along major faults
- Cambro-Ordovician cupriferous pyrite deposits (eg Girilambone Mine).

Broken Hill Exploration Initiative

The Broken Hill Exploration Initiative (BHEI) will be a special focus of **Discovery 2000** in the early years of the program. The BHEI is a joint venture between the New South Wales, South Australian and Commonwealth Governments and is intended to provide the mineral exploration industry with information that could lead to the discovery of major new mineral deposits in the region surrounding Broken Hill, both in New South Wales and South Australia. The ultimate objective is to ensure the long term prosperity of the major centres of Broken Hill, New South Wales, and Port Pirie, South Australia. The initiative will capitalise on technological developments of recent years, especially in the field of geophysics, to provide improved quality data to enhance knowledge of regional geology and structure, and thus the mineral resource prospectivity of the Broken Hill region. The BHEI has been established as a National Geoscience Mapping Accord project and will be jointly funded by the above three Governments.

The views of major exploration companies were canvassed at a seminar held in Broken Hill in May this year and the proposed program has greatly benefited from the discussions at that meeting and subsequent discussions with individual companies.

The New South Wales Department of Mineral Resources has been actively involved in geological and resource mapping in the Broken Hill area for many years. Its major initiative in the 1970s and 1980s resulted in the production of a world class 1:25 000 scale geological map coverage of the high grade metamorphic terrain of the Broken Hill Block. In addition, the Department's metallogenic mapping has provided an invaluable data set on mineral occurrences in the area.

The BHEI will build on these data sets to allow for improved definition of rock distribution and rock structure. Over the 3 year life of the BHEI the following work program is proposed for the New South Wales area of the Initiative:

- High resolution airborne magnetic and radiometric surveys over both the Proterozoic Willyama Complex and the Late Proterozoic and Palaeozoic rock groups to the east of Broken Hill (Koonenberry belt); these surveys have been completed and results are expected to be available by March 1995.
- Regional gravity surveys over the same area with appropriate station spacings, after a review of existing gravity.

- Regional geological mapping of the Proterozoic and Palaeozoic rocks outboard of the Broken Hill Block.
- Completion of the 1:25 000 scale geological and 1:50 000 scale metallogenic mapping over the Broken Hill Block.
- A program of geochronology over the Broken Hill Block and Koonenberry belt.
- Selective bedrock drilling and stratigraphic drilling to aid interpretation of the regional geophysics.
- Seismic transect(s) to provide an improved understanding of the third dimension.
- Enhancement of existing databases and development of new databases on mineral resources, geochemistry and mineral exploration to complement the quality geological data and newly acquired geophysical data.

In addition to hard copy maps and reports, the results of this extensive program will be made available as multiple digital datasets in GIS format.

The **Discovery 2000** Year 1 program is shown on Figure 3.

Geophysical Survey Details

To assist both the mineral and petroleum explorer to focus on the exploration potential in New South Wales, approximately 50% of available funds have been allocated for the collection of high resolution airborne magnetic and radiometric data. An additional 10% of funds have been allocated for the collection of high quality gravity measurements.

Airborne magnetic and radiometric surveys

Most of New South Wales is currently covered with regional aeromagnetic data read at a variable interline spacing of between 1600 m (predominantly) and 3000 m (Plate 3). The 1991 flying of the Bathurst 1:250 000 scale sheet at an interline spacing of 250 m identified the exceptional value of high resolution surveys.

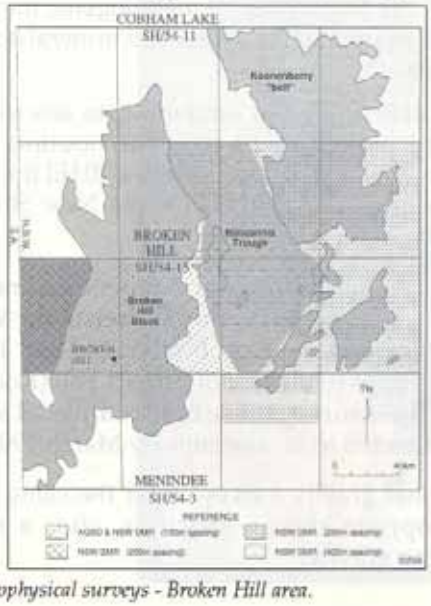


Figure 3. Geophysical surveys - Broken Hill area.

Plate 4 shows an extract of the Bathurst 1:250 000 sheet and illustrates the improvement in resolution in magnetic data in the 1991 250 m interline survey over the 1600 m interline survey flown in 1960. The complementary 1991 radiometric dataset (also shown on Plate 4) when combined with the 1991 magnetics provide the appropriate detail to support regional mapping.

It is now proposed to fly:

- 250 m line spacing surveys over areas of mineral interest.
- 400 m line spacing surveys over areas of sedimentary basins for petroleum exploration.
- 100 m line spacing surveys over the highly complex Willyama Complex in the Broken Hill area to complement existing detailed geological data.

High resolution airborne magnetic and radiometric surveys will be flown with a light aircraft at a survey speed of approximately 220 km per hour (130 knots). With the developments in image processing on high powered computers (Unix workstations), subtle changes of the earth's field can be detected and are important in defining structure. The regional surveys currently available were flown at a survey height of between 100 and 150 m and these subtle changes in the earth's magnetic field were not effectively recorded. To better record variations, it is important to fly closer to the magnetic source and in areas of subcrop and shallow cover, a 60 m survey height is planned. To ensure safe flying conditions in areas of variable terrain and over deep sedimentary basins, the survey height will be increased to 80 m.

The **Discovery 2000** magnetic surveys will be read with either a caesium or helium vapour optical absorption magnetometer with the sensor fixed to the tail of the survey aircraft. Either sensor will ensure resolution of the magnetic field to 0.01 nanoteslas whereas the previous proton precession magnetometer, used for most of the existing regional surveys have a resolution of 1 or 2 nanoteslas. As an optical absorption magnetometer can sample at a faster rate than a proton precession magnetometer, the earth's field, which was previously measured along lines at approximately every 25 m, can now be measured every 6 or 7 m. To support the recording of high resolution data, the position of the survey aircraft will be controlled with the use of Global Positional Satellite (GPS) navigation. By using GPS in a differential mode (one base receiver with a second receiver in the survey aircraft) all positions will be within 20 m and will represent a vast improvement on the previous air-photo location.

Airborne radiometrics will also be collected with the aeromagnetics. Currently the State coverage of radiometrics is incomplete and in many cases the available data has not been collected to the high standards now required. To help ensure that **Discovery 2000** surveys are collected to a high standard, it is proposed to record natural radioactivity using the full 256 channel spectrum. These measurements will be read with self-calibrating instruments (Exploranium GR 820 or equivalent) which

have only been installed in Australian survey aircraft over the past 9-12 months.

As it is proposed to fly large areas which may require several months to complete, it will be important that radiometric measurements are absolute and not relative. To help ensure absolute measurement, the background radiometrics will be monitored by regularly recalibrating the instruments on calibration pads and flight strips. To improve survey procedures and processing further, the Department has committed funding to assist the Australian Geological Survey Organisation (AGSO) in sponsoring a leading international consultant to study radiometrics in Australia in late 1994.

Airborne Geophysical Survey Details

Aero-magnetic and radiometric surveys have been awarded for all the specified areas in Discovery 2000's Year 1 program (see Plate 1). Survey flying commenced in January and will be completed by the end of April. It is expected that final products including both hard-copy images and digital data (Exabyte, DAT or CD ROM) will be available at low cost to industry in June 1995.

Year 1 flying will total about 480 000 line km (250 000 line km over specific mineral areas and 230 000 line km over specific petroleum areas). This will be in addition to the 50 000 line km survey data collected over part of the Broken Hill Block in November/December 1994 by the Australian Geological Survey Organisation (AGSO).

The following table lists the designated contractors and an estimate of the survey kilometres.

AREA	CONTRACTOR	APPROX SURVEY KM
A	World Geoscience Corp Ltd	45,000
B	Tesla Airborne Geoscience Pty Ltd	120,000
C	World Geoscience Corp Ltd	90,000
D	Geoterrex Pty Ltd	105,000
E	Kevron Geophysics	120,000
	TOTAL	480,000

Gravity Surveys

New South Wales is currently covered with part of the Australian-wide 11 km x 11 km network of gravity stations. Plate 2 is a gravity image of the State. Although this data assists in the mapping of major continental structures, it is too coarse to assist in regional geology and area selection for exploration. As an integral part of **Discovery 2000**, it is proposed to cover the regional project areas with regional gravity on a 4 x 4 km grid.

With the recent development of quartz-crystal controlled digital barometers (previously aneroid barometers were the industry standard) for controlled elevation and latitude and longitude control with Global Positional Satellite (GPS) navigation systems in a kinematic or trajectography mode, state-of-the-art technical specifications will ensure a quality dataset. As all positional errors are expected to be less than 1 m, the calculated gravity error will be less than 0.2 micrometres/sec^2. These new gravity surveys will be a substantial improvement over the existing helicopter gravity surveys (which have 10 or 20 micrometres/sec^2 error) and will provide a boost to explorationists.

Gravity Survey Details

The surveys, which have already started, are being read on a 4 km x 4 km grid and will have a position error of less than 35 cm. After consultation with AGSO, selected gravity stations from the National Gravity Database will be included as an integral part of the survey. Survey access will typically be by helicopter and all survey work will be completed by April. Final maps and digital data will be available at low cost to industry by June 1995.

The Department recently received a large gravity database over the Broken Hill area. This data is being evaluated and will be an integral part of future survey planning of this area.

The table below lists contractors for gravity survey areas and an estimate of gravity stations.

AREA	CONTRACTOR	APPROX NO. OF GRAVITY STATIONS
A	Geoterrex Pty Ltd	1,000
B	Geoterrex Pty Ltd	2,900
C	Surtec Geosurveys Pty Ltd	1,300
D	Surtec Geosurveys Pty Ltd	2,500
E	Surtec Geosurveys Pty Ltd	800
	TOTAL	8,500

The Optical Disk Project

Discovery 2000 is basically about data, its collection, management, assessment and dissemination. As discussed elsewhere, a major focus of **Discovery 2000** is the collection of new geoscientific data. However, the Department is already a major source of data on the geology and mineral resources of New South Wales. These existing data, when combined with the new data, will greatly enhance the knowledge of, and information on, the mineral development potential of New South Wales.

An existing and fundamental dataset is the Department's collection of unpublished technical reports and industry's exploration reports (Figure 4 shows the extent of current exploration activity). This dataset, the GS System, is an irreplaceable and valuable asset for the exploration industry. As part of the **Discovery 2000** initiative, it is proposed to significantly improve access to these reports and to alleviate problems inherent in their present form. The Department has commenced the process (planning and specification stage) of converting the collection into a digital (optical disk) format.

This conversion program will provide several significant benefits for users. These range from direct text searching of the reports, availability of digital copies and/or hard copy prints of reports on request and access to the reports at all regional offices of the

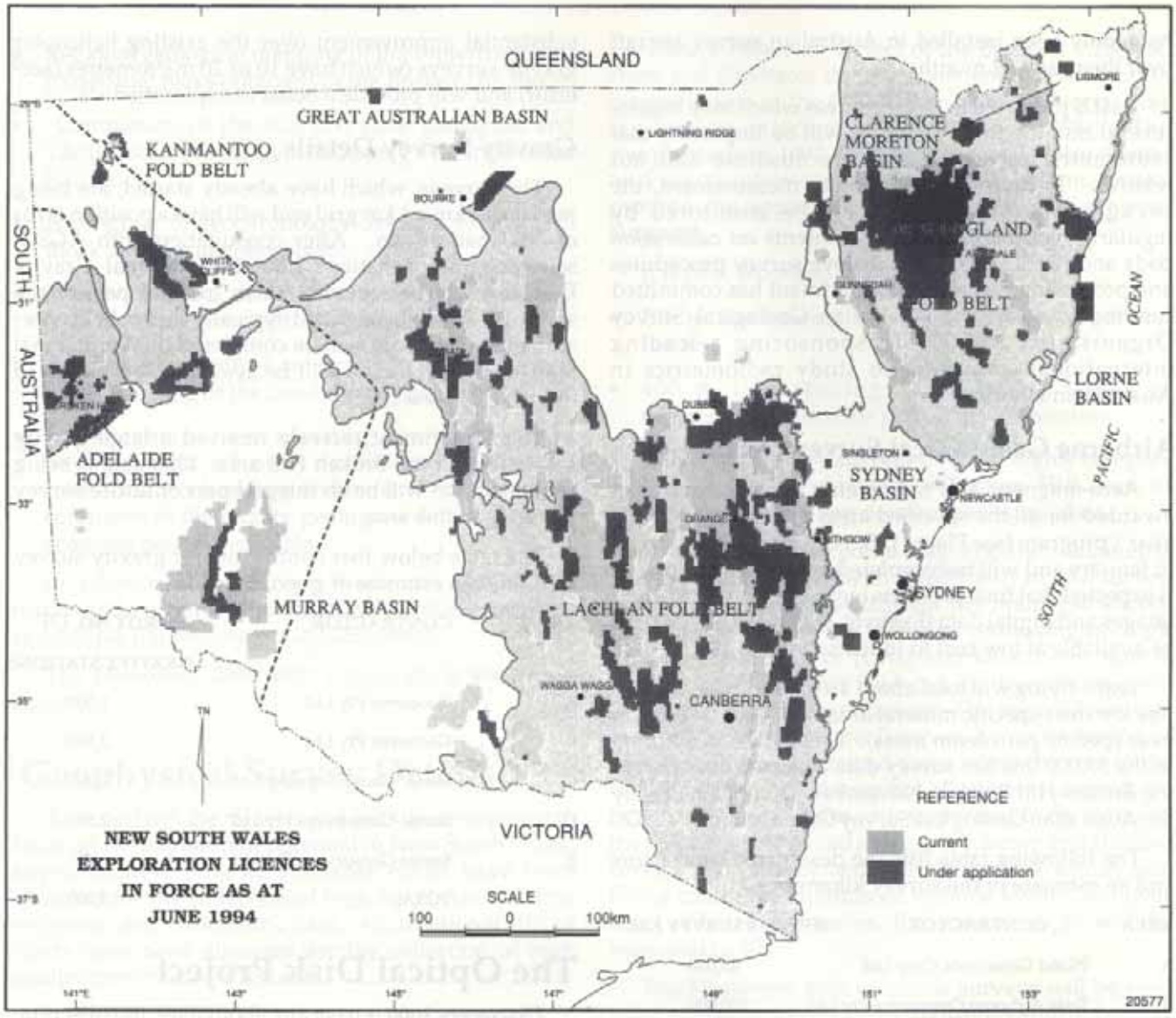


Figure 4. NSW Exploration Licences as at June 1994.

Department, to the possibility of purchasing the entire collection on a medium such as CD-ROM for use at the client's own offices.

In addition to the resulting service and product enhancements from the conversion to digital form, the Department will be able to upgrade its curatorial role and ensure the collection's integrity and completeness in future.

The GS System conversion project is to be undertaken in three phases:

1. Design and Tender: This involves system definition/specification and development of a tender document in consultation with users.

2. Implementation: System building, software and hardware acquisition, conversion and migration of up to two years of the most recent records.

3. Back conversion: Conversion and migration of the remaining records.

NOTE: It is important to realise that phases 1 and 2 are not independent of one another but are time dependent. Phase 3 will form part of the initial tender, timing would be the flexible component.

Phase 1 of the Optical Disk Project began in November 1994 with the appointment of OPTICON Australia as the Department's consultant to complete this phase. A project schedule has been developed with OPTICON, which provides for a survey of users (both external and internal) to define user needs; development of technical specifications and the tender document; the tender process and evaluation of responses.

Phase 1 will be completed by June 1995. Phase 2 will commence thereafter and Phase 3 should continue 1996-97.

For further details on the Discovery 2000 program contact its coordinator
Denis Casey
Tel: (02) 901 8511;
Fax: (02) 901 8520.

A Fortunate Life in Seismic

Robert E. Sheriff is Professor of Geophysics at the University of Houston. He formerly served as senior vice-president of Seiscom-Delta and held various geophysical positions at Chevron Oil Company. He is past recipient of the Virgil Kaufmann Medal, and has served SEG as First Vice-President and as Technical Program Chairman of the 46th Annual Meeting. He has written a number of books on various aspects of geophysics and edited Reservoir Geophysics, published by SEG. Dr Sheriff is an honorary member of SEG and the Geophysical Soceity of Houston.

Bob, visited Australia in 1993 as the Haydon Williams Fellow at Curtin University of WA. Preview caught up with him in Melbourne during a nationwide tour presenting his Reservoir Geophysics course and visiting ASEG branches.

Over a congenial meal, and the odd glass, John Denham and Geoff Pettifer managed to draw out some of Bob's experiences and thoughts on seismic, and a remarkable career in geophysics. After commendable patience on Bob's part, Preview brings you this discourse in the first of a two-part series of Mentor articles.

GEOFF: Bob, How did you first get into geophysics?

BOB: Well, it is all my wife Margaret's fault you see. I was educated to PhD level in physics and I never had a course in geophysics. I became a geophysicist principally because Margaret wanted to move to California and the only people who offered me a job there was the Standard Oil Company of California (now Chevron). They were setting up a research laboratory at La Habra, there being little education of geophysicists at that time (1946-50). Chevron said that it would be easier to teach geology to a physicist than teach physics to a geologist, so they recruited physicists to staff Chevron's geophysical research laboratory. I was one of about a half dozen physicists with PhD's, fresh from university having been involved in atom bomb research during the war.

We lasted 2 years in California and after 2 years I decided this is ridiculous, I am supposed to be doing geophysics research and I really do not have any idea how the oil industry works, what geophysics is all about, how it is carried out etc. I had read books but that does not give you a real description of the problems that are involved. So I went on a training mission with Chevron.

My training mission started off with their operations in the eastern US which in those days was everything east of the Rocky Mountains and was headquartered in New Orleans. So we moved to New Orleans for this short training mission which ended up lasting 25 years, at which time I retired from the company taking early retirement. My time with Chevron was never really planned, I just moved from opportunity to opportunity.

At one time I was Chief Geophysicist in charge of Chevron's Latin American geophysical operations out of San Fransisco (starting 1957). We stayed in San Francisco for a while, and a while in Trinidad as Chief Geophysicist with California Exploration (Chevron's overseas operational arm). We moved from there to

The Sheriff family system for international travel - Cartoon by Dave Edgerley, 1965

Australia because in 1961, Wapet was having a reorganization. In those days, Chevron took over management of WAPET. I was the second Chevron person to work under contract to WAPET.

At that time WAPET had essentially all of WA under concession. One of the things I did when the stock holding companies met, was to put up a map of our concession areas and then we had at the same scale maps of Texas, California, Oklahoma and Louisiana, the 4 big oil producing states in the US, to see how much larger the WAPET concession areas were than these US states combined. I had 5 years at WAPET, returning to Chevron's eastern state operations out of New Orleans.

I was there for 4 years and then moved to Houston, where I began teaching in Chevron's in-house educational program. At the same time I took on a part-time job at the University of Houston, with

Mentor - the rationale

mĕ'ntôr *n.* Experienced and trusted adviser. [F, f. L f. Gk *Mentór* adviser of the young Telemachus in Homer's *Odyssey* and Fénelon's *Télémaque* (root **men-* think)]

So says the Oxford Dictionary. In the Mentor series of articles we talk to prominent mentors and change agents in the field of geophysics to see what makes them tick and discuss their views on geophysics.

Chevron's permission, teaching in both capacities for several years. Then I took early retirement to work for Seiscom Delta for nearly 5 years, starting as senior Vice-President. I then moved to the University of Houston full-time as a tenured full professor and 14 years later I am still there. Margaret and I have 6 children all grown and left home. We live in a large house, surrounded by large pine and oak trees, on the levees of Buffalo Bayou. I love those trees. We are 15-20 Miles upstream along the bayou from the main Houston shipping channel. The bayou can flood when we have heavy rains (10" in one day).

GEOFF: What changes that have occurred in Australia since then, have struck you the most in your return visit?

BOB: One of the things that I talked about in a lecture in Perth was the changes in attitude to the environment. I showed a number of pictures taken in those early days of exploration and these showed that our attitude in the early 1960's in WAPET was to open up the country. The general attitude of people in Australia, at that time, was that the country was not worth much unless it was being used for something. In fact, WAPET was actively encouraged to build our seismic trails as roads across the country because that would offer people access into the country. It did not matter whether the roads went anywhere in particular. These roads were visible from the air. I was involved quite a bit with public relations in WAPET. We would fly the press over the country to show them all our marks on the landscape (shothole patterns, lines etc.). WAPET was very proud of the fact that it was the largest road builder in Australia at that time and we advertised that fact. The tracks we bulldozed then were much wider than we needed (up to 10 metres wide in many cases). In those days we were encouraged to do these things. We were proud of taking a role in opening up Australia.

Today, though by comparison, when you go into an area, you try to leave minimal impact on the area. We had a change of philosophy while I was here. It came about as a result of our exploration on Barrow island. Barrow Island was a rather unique habitat and we entered into exploration on the island with the objective of creating minimal impact and this is the first time we had made this type of approach. This was still rather extraordinary in terms of the industry at that time. Then WAPET hired a naturalist to guide our exploration to protect unique fauna. That began a different sense of approach. It did not begin instantly, of course, these things take time.

In general at that time there was no real consideration given to the environment. The land was there, and if it was not commercially productive, it was of no value and it was desirable to make it commercially productive. It was a different state of mind. It gripes me frankly to hear people talk about those wide scars we created out in WA. By today's standards they would be ... appalling ... I agree, but it is completely unfair to judge them by today's standards because by the standards of the time we were doing Australia a favour. We drilled many water wells, created many tracks to open up the country.

JOHN: You have had a long association with seismic research and I am interested in hearing your views on this subject. Firstly, the industry research into exploration seismology was initially, dominated by research concentrated on the Gulf Basin, a basin which is quite atypical when seen in a world-wide basin context. How do you see the early evolution in seismic technology in the US company research system and how was it influenced by the basins and problems of the day?

BOB: Certainly the Gulf Basin was important but your question labels the Gulf Basin as atypical. I would challenge that the Gulf Coast basin was atypical.....

L to R: WAPET employees Bob Denison, Francis Muir, Bob Sheriff, Ross McWhae and Charles Reynolds

JOHN: To give you a current example - 3D pre-stack depth migration. The big push in implementation of it is from the requirement to image sub-salt in the Gulf Basin. This has been the real driver behind turning this into a practical exploration tool would you not agree?

BOB: I would not even agree with that because up until very recently there have not been any prospects sub-salt in the Gulf. But it is in the North Sea that the prospects are sub-salt. This is a North Sea problem. In the Gulf coast it has not been a problem because the salt is so deep. Finally however in the Gulf we have gotten clear out into the Pleistocene sediments where work is going on now. So from a historical perspective the Gulf work is just the last phase of 3D pre-stack depth migration research.

JOHN: So where then do you think the bulk of exploration seismology research has been done?

BOB: There are two aspects, firstly the location of the laboratories and secondly, where it has been physically carried out? In the early days almost all of it was done in Oklahoma, central US. That's where the industry got started. Later the research location moved with different companies. Gulf Oil's research which was enormous was all done in Pittsburgh; Mobil's was done in Dallas, Chevron's was all done in California, Union's was done in California. The only early research in Texas was Humble Oil Co which grew into Exxon and that brought down the Carter Laboratories from Tulsa. Amoco's Research is still based in Tulsa.

The basin used for research depend on what particular research you were interested in. When I first got involved in this industry the biggest research effort Chevron was making was looking for reefs. This research was mostly concentrated around Alberta basins where reefs were being found at that time; the research was based in California but carried out in Canada. This was 1951-52 when reefs first really burst on the exploration scene as large potential fields. Chevron had been established mainly in California as the Standard Oil Co of California and their major fields were in California up until WW2. Chevron then developed large fields in the Gulf of Mexico.

Bob Sheriff and well head of Rough Range Well, WA - circa 1962.

Drill stem test, Barrow No 1 well.

The industry has always gone on fashion. There is one particular play that becomes very hot. Everybody seems to concentrate their efforts on that type of play. When that problem is solved or the interest moves elsewhere the efforts tend to switch. I think most of the companies, have behaved like sheep a lot, in terms of everybody going after the same type of play/research effort. When oil was first found in reefs, everybody wanted to know how to find oil in reefs and quite frankly we could not find oil in reefs in those very early days. Our early efforts at detecting reefs were very poor and there was serious debate about whether you could even see reefs in seismic data, which is a bit ridiculous because today reefs are among the more obvious features, in terms of barrier reefs, not in terms of small patch reefs.

... I think processing is doomed ...

JOHN: What are your views on the relation between data acquisition, processing and interpretation?

BOB: Well, I have many friends and colleagues involved in processing and I like to shock them by telling them that I think processing is doomed by being absorbed by acquisition on the one hand and by interpretation on the other hand. Let me give a definition of interpretation as I see it. By interpretation, I understand it to be determining the geological significance of seismic data. Once we have made processing more accessible, the interpreters will do more and more of their processing; they will not be satisfied with the rote processing we get away with today. They will want to do more specialized processing tailored for their specific geologic problem. So more and more, I see interpreters taking over the processing role.

At the same time we still have people acquiring data and field staff will be taking over more of the processing for quality control. So processing will be squeezed from both sides. Obviously we are not going to get rid of processors, but the actual choice of processing routines will be increasingly diverted away from processing as a separate entity.

JOHN: Can I suggest, following on from this, that a very large part of the processor's work today is knowing

how to run software and how to physically and logically manage large quantities of data.

BOB: I see a continuing, growing need to access more data at your work stations. An interpreter really ought to be able to access the geological database, the well database, to call up reservoir testing data to see how that relates to/affects the interpretation. This is all a very large database. All these databanks exist but cannot access each other on a really practical basis. So there is a tremendous need today for really making all the information available to the person who is doing the interpretation. By available, I mean on a very efficient basis. We can get to that data at present, but if something is too difficult to do, you just do not do it.

GEOFF: If your interpreter is doing all this data integration, presumably facilitated by better software and also managing the data and doing alternative processing, isn't that putting a lot on the interpreter? This also implies the computer workstation protocols and syntax will not clog up the mind of the interpreter.

BOB: Absolutely; it puts a lot on the interpreter. And of course I agree that many interpreters would not be able to cope with it, because there are interpreters of all degrees of efficiency. There are some who are very incisive people who really give considerable thought to the process. John's brother, Les Denham, is one of those outstanding people. There are a number of people in that class who really want to understand and look into the problem at depth. Of course there are many routine interpreters who will continue to do the lion's share of the interpretation but they will not do the critical interpretation. And of course all the software will have to be user-friendly. This is very important.

... We have notoriously missed predicting all of the major innovations ...

JOHN: What is the biggest change you have seen since you first started in geophysics?

BOB: Rather than answer the question directly, I would say I have seen many changes. The work of a geophysicist when I first started, mainly involved locating reflection events, picking records and deciding which events were bona fide reflections. The techniques that I first used consisted of plotting reflections on graph paper on a light table with a wavefront chart underneath. The graph paper method has long been obsolete, and the techniques that made them obsolete have since been obsoleted and so on.

I think the two most important changes are firstly the idea of the value of redundancy in the data, recording the same information in a number of ways to allow noise effects attenuation - in other words the common midpoint method. Secondly is the idea of digital processing. The digital concepts simplified life enormously for us when you think of convolution in terms of Wiener-Hope integrals, etc. With analog data everything is so unwieldy that you do not understand what you are doing. So we had no appreciation of what we were doing with our data until we began to deal with discrete data and time series rather than continuous analog data. That was a giant step forward.

JOHN: You are saying the step was not so much that we started dealing with our data digitally but the fact that this allowed us to think differently about our data?

BOB: Exactly! It gave us an insight, a new way of thinking. The idea of redundant data of course could not reach its fruition until we had digital processing so the two changes go hand in hand. The implementation occurred at about the same time. Initial efforts to try and deal with the digital world were very clumsy because we started off without any real appreciation of why we would be doing what we would be doing.

The basic concept then was, as I think it almost always is, that what you are going to be doing is just an extension of what you have been doing. Our thoughts and processes have always been severely limited in this way. The only thing we can think of doing is more of what we have been doing. We have notoriously missed predicting all of the major innovations. They have mostly occurred outside our mainstream of thought. They have all happened just suddenly. When we started off with reproducible recording, as we called it originally, the idea was that this would allow us to do in the laboratory what we could do in the field (ie, play around with filters and mixing), and not much more than that. All we thought of at the beginning was that the experimentation we did in the field we could now do in the laboratory more cheaply and extensively. The idea of statics and moveout did not come until we got moveable heads in analog processing systems.

JOHN: We move on now to the future of data processing. Two things come to mind. Firstly, 3D pre-stack migration is very much an experimental subject at the moment. Secondly, we have known for at least 20 years how we really ought to be processing data where you have significant lateral velocity variation. How soon is it going to become routine?

BOB: Regarding the first point, I may be as little naive in this but I am of the opinion that the pressure has been somewhat relieved by DMO processing. The emphasis on pre-stack migration is no longer to the same degree that it used to be. Now certainly if you want to process the data properly you must go "pre-stack"; I don't challenge that. The question is how much of an improvement do you get by pre-stack?

JOHN: I know of one recent pilot project. To put the problem in perspective, the project was looking at a not uncommon problem of a structure that has structural relief of less than 60 metres (not very many milliseconds). The magnitude in this particular case of the moveout on the reflection hyperbola was 180 msecs. Now even if we can get a stack where you can see the reflection, you have the problem that there is no way of deriving a velocity function which has any hope of converting the depth with sufficient accuracy.

BOB: I have felt for a long time that our biggest problem is one of velocity. We have several problems with velocity, one is we don't know the velocity with the degree of accuracy to which we need to know it, but also we don't even try to determine it as well as we could determine it. There's a lot we could do about velocity that we don't even bother to do simply because most often velocity analysis is done only to get better data and we sort of ignore all other reasons for trying to obtain velocity information. In particular I'm very much concerned with the lack of use of velocity data in interpretation. The time to depth conversion is one of those aspects. The efforts that we presently make in terms of trying to determine the velocities for use in migration are very primitive. You mentioned the hyperbolic moveout. Pre-stack migration is not a solution to non-hyperbolic moveout either. In many areas of the world, of course mainly in clastic basins, the velocity increases with sufficient regularity that the departure from hyperbolic moveout is not severe, it is not correct but it's not severe. But when you get rapid changes in the velocity gradient, it becomes very important.

I think the whole area of velocity: our understanding of velocity; our method of determining velocity; and the uses we make of velocity are all very primitive - compared to what we know we ought to be doing. And yet we're not doing very much about it. I think this is one of the areas in which there is a greatest opportunity for research advancement.

JOHN: In land acquisition the biggest variable is usually the ground to geophone coupling, followed by the weathering. In view of this how much does it matter in trying to improve geophones, for example? Are geophones a problem compared to geophone to ground coupling?

BOB: If I were a research director I would not invest very much money to improve geophones. I think the geophone is actually a very remarkable instrument, quite broad in dynamic range and really more than adequate for the purposes to which we put it. There are aspects of geophone research that I think do need developing. I think the idea of three component geophones, for example, is something that we will be doing more of in the future. We don't presently know what to do with the three component data that we do have, but we will learn. Certainly its going to give us a great deal of information that we're completely ignoring at the present time. I also agree with you that coupling is a problem.

JOHN: Do you have any ideas what to do about coupling?

What we really need is a good test in the field of whether or not we have not reasonable coupling, but uniform coupling. The important aspect is coupling every geophone in the same way. It's more important to have uniformity across the recording span. But we plant so many geophones today that how we are going to test all these geophones for their individual coupling boggles the mind.

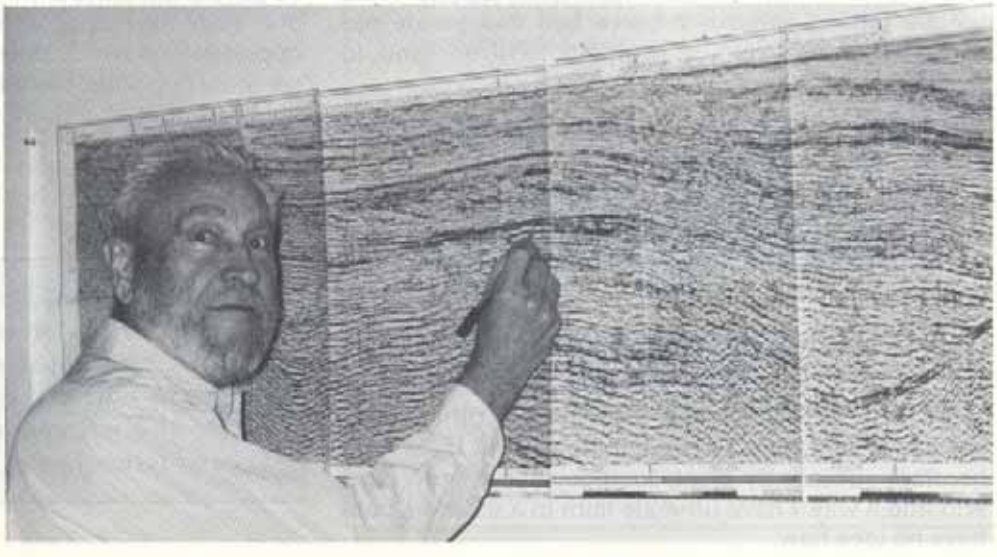
JOHN: But not impossible with computers perhaps?

GEOFF: Are you are talking about an "intelligent" geophone that can somehow sense its coupling and then the processing can correct for that?

BOB: Yes, the geophone needs to somehow sense its coupling. I think a step pulse method for instance has potential.

JOHN: It seems that we are approaching the limits of data density. We already use 2 ms time sampling, 12.5 m group spacing, 25 m line spacing, 25 m shot spacing and the maximum useful shot offset. In the light of earth absorption effects, what are the limits of sampling? Or is there a limit? Would you agree that we can we go further in view of the typical exploration depths?

BOB: What we need first is better resolution and better resolution necessarily requires higher frequency which therefore means more sampling, both in time and space because it involves spatial sampling as well as temporal. We need higher frequency content in order to obtain higher resolution, that's clear. I feel there must be a way of achieving it. I don't know how much we can gain, obviously there's a limit. We can certainly gain a factor of 2 to 1 over what we do today, nobody would doubt that. But can we gain 10 to 1 or 100 to 1. Therein lies the problem. We can go very much farther beyond where we are. We can certainly gain over where we are, although quite frankly I have no idea of how, but to gain a decade improvement I don't really see that.



Bob Sheriff, May 1994.

JOHN: How about the fact that the resolution for typical current seismic is limited as much by the bandwidth as as by the maximum frequency? If you take a typical marine gun for example, we get very little energy below about 8 Hz. It seems like it ought to be feasible to push that down at least another octave. Is this a way of improving resolution, because the advantage at the low end is, you don't have the problem of absorption?

BOB: You clearly need bandwidth to a certain point. But I don't see any major gain in bandwidth beyond a couple of octaves. If you have a couple of octaves of bandwidth, going to 4 or 5 octaves doesn't really buy you very much. So I don't think increasing the bandwidth is really the way to go. We somehow have to retain our bandwidth and go up in frequency.

GEOFF: The problem then with high frequency is that you have to put a lot more power into the higher frequencies.

BOB: You have to use some sort of non-linear system to get the higher frequency energy back. The problem of course is that it's expensive in terms of acquisition.

JOHN: In many of our areas in Australia, the basic problem is still record data quality not resolution. Probably for most of the areas we work in the basic problem of record quality seems to stem from a combination of problems (carbonate shelf, multiple noise, etc). Another thing, which is frequently unrecognised as being the source of the problem, is you have to look at what sort of reflection coefficient you are dealing with. Some of the things that we would really like to map have reflection coefficients which are disappointingly small ....

... Geophysicists today ... must continually adapt to change ...

BOB: Or are dominated by some other nearby large coefficients, like the coal problem you run into so often here, where you have coal measures in the middle of your hydrocarbon producing zones. The coal has such large contrasts and are so highly variable that you can't see the variations in contrast that are petroleum significant. This is a major problem, I have no thoughts whatsoever on how to deal with it quite frankly. What we are talking about is a curve ball that nature has thrown us. Its a major problem here on land in Australia.....

JOHN: It's a problem in the Gippsland and Bass basins offshore, for example.

BOB: .... Its not unique here. The same problem also occurs in a number of other oil provinces. This is one of the big problems in China in the lacustrine basins - coal and petroleum cohabitating.

JOHN: Today we are getting snowed under with data tapes. What are we going to do about it?

BOB: I have no ideas. However, a philosophic answer. Where there's a need, there's a way. If the need becomes sufficiently great, some ingenious individual will find a way. I have ultimate faith in a solution, but I have no idea how.

GEOFF: Who have been some of the influences and mentors in your career? I noticed your dedication to Neil Smith in the Dictionary of Geophysics.

BOB: First of all I would mention Lloyd Geldart, my first boss when I move to La Habra in 1950. Later Lloyd opened up a number of opportunities for me. Lloyd moved on to become Chief Geophysicist of Chevron and he is the one who brought me to California for the overseas operations.

GEOFF: This is L.P. Geldart, one of your co-authors of geophysics texts?

BOB: Indeed, I am still writing with Lloyd and have regular correspondence by fax with him. Lloyd has been a co-author on several books I have been involved with. Lloyd would be my first major influence. Neil Smith is certainly another. Neil was one time President of the SEG, Chief Geophysicist of Chevron and one of the people who encouraged me in particular in working in the professional societies, not that I needed much encouragement. It was nice to have somebody like Neil, high up in the Chevron management who was highly supportive of what I wanted to do. The third individual I would probably cite would be Milton Dobrin. I first met Milton in WA at the airport where we spent a few hours talking there between planes in the midnight hours. I had left a GSI field party to meet him and Milton, then with United, said he appreciated me leaving a GSI party to meet with him.

GEOFF: What advice could you give to a young geophysicist starting out today?

BOB: Geophysicists today must continually realise that changes occur and that one must continually adapt to change. The work of a geophysicist when I first became one was very different than it is today; not only have the techniques I used then been made obsolete, but what made them obsolete have in turn been made obsolete. It requires deliberate effort to continue to learn and to change ourselves in order to keep current. The basic concepts and thought processes we learn early continue to serve us well if we keep learning. We must be alert to our surroundings, to other disciplines which may have developed techniques we can apply, and to opportunities which may be developing. I personally see more opportunities today than I ever did in the past, but most of them require some adaption on our part.

NEXT ISSUE: Our conversation with Bob Sheriff continues, covering his perceptions of Australian geophysics and the ASEG and the changes in how US seismic research is carried out. He also reflects on a "second career" in the SEG and issues facing the SEG in the US.

ASEG Corporate Sponsor Profile

Earth Resource Mapping

Earth Resource Mapping (ERM) develops and markets software products designed to meet the demanding performance, flexibility, and data integration needs of today's earth scientists. Since 1989 ERM software has been helping people manage the earth in industries such as natural resource management, coastal and marine science, land use planning, defense mapping, and hydrocarbon and mineral exploration. Products include ER Mapper for image processing and data integration and ER Radar for radar and SAR data processing.

Earth Resource Mapping has three regional offices situated in the United States, Australia and the United Kingdom. The offices provide marketing and technical support to a network of 135 distributor offices who sell and support the ERM product line throughout the world. These distributors are chosen for their industry-specific expertise in diverse application areas.

The company is a private, unlisted company. Signficant shareholders include Hitachi Data Systems, as well as local investors and the founders. Superior products, coupled with responsiveness to customers unmatched in the industry, has enabled Earth Resource Mapping to grow by over 50% per annum. At the same time the company has been careful to nurture its ability to respond to customers needs, which it sees as vitally important.

The goal as a company has always been to make image processing easier to use as a tool, so that professionals of all skill levels and disciplines can effectively utilize the power of today's geoprocessing and remote sensing technologies. In addition, ERM are strongly committed to open software standards, to make it easier for our users to move data into and out of their products and to share data with other products.

The company's flagship product, ER Mapper, is an advanced digital image processing system created to help earth scientists integrate, enhance, visualize, and interpret their geographic data. In contrast to conventional "disk-to-disk" image processing products, ER Mapper features a breakthrough that allows truly interactive "real time" integration and processing of data. The point-and-click graphical user interface streamlines complex image processing tasks to provid a fast, flexible "what if" tool for earth scientists in all applications arenas. ER Mapper is available fully bundled for HP, Digital, IBM, Silicon Graphics and Sun workstations as well as for Windows NT and Windows 4.0 (Chicago) based PCs.

Earth Resource Mapping recently announced continued strong growth for the 1994 year with audited results showing a 95% growth in ER Mapper sales revenue.

Stuart Nixon, CEO, attributes the growth to the opening of the new European Region office and the expansion of the distributor network.

"We're deeply committed to our customers," says Stuart Nixon " - to being where they are to help them solve their mapping needs. We're determined to make our products fast, easy to use. And this, more than anything, has driven our growth".

Earth Resource Mapping also recently announced the imminent release of ER Mapper 5.0, which will include extensive new 3-D capabilities, customisable toolbars and enhanced classification. Simultaneously, they will be releasing ER Mapper for Windows NT and ER Radar, an advanced RADAR and SAR (Synthetic Aperture Radar) data processor.

SAR images are produced using an active microwave source. This means that images can be obtained at night as well as during the day. Also, since microwavé energy passes unhindered through clouds, SAR can obtain uninterrupted views of cloud-covered terrain. This is important in polar and tropical regions where obtaining cloud-free images is difficult. In addition, SAR can penetrate tropical forest canopies and image the terrain below.

ER Radar is seamlessly integrated with ER Mapper and features the same ease of use and power.

The ASEG values its association with and the support of Earth Resource Mapping.

ER Mapper

Helping people manage the earth

Contract Aeromagnetic Interpretation

Expressions of Interest

The Geological Survey of Western Australia, Department of Minerals and Energy, is seeking expressions of interest from experienced aeromagnetic interpreters to undertake an interpretation of data from a 400m line-spaced survey currently being carried out over the Peak Hill and Glengarry 1:250,000 sheet areas in Western Australia.

The interpretation will be based on 1:100,000 scale TMI and first vertical derivative profiles, contours and images for final presentation at both 1:100,000 and 1:250,000 scale (see description of new data release for the Sir Samuel 1:250,000 sheet in this issue). The data products should be available by the end of December 1994.

The project comprises a total of **fourteen** 1:100,000 sheets encompassing approximately 120,000 line-kilometres of data. At this stage it is preferred that the interpretation be done by a single person or group. Preference will be given to interpreters with experience in this area of Western Australia.

To register your interest in being considered for this contract, please contact:

David Howard, Department of Minerals and Energy, 100 Plain Street, East Perth, WA 6004

Tel: (09) 222 3331 Fax: (09) 222 3633 Internet: d.howard@dme.wa.gov.au

Seismic Window

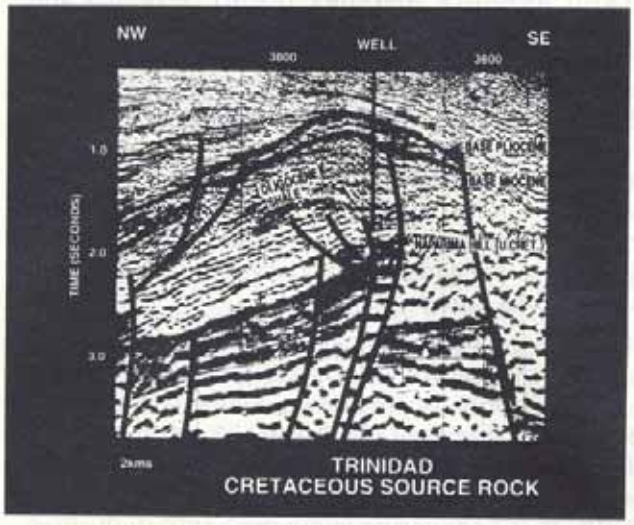
With

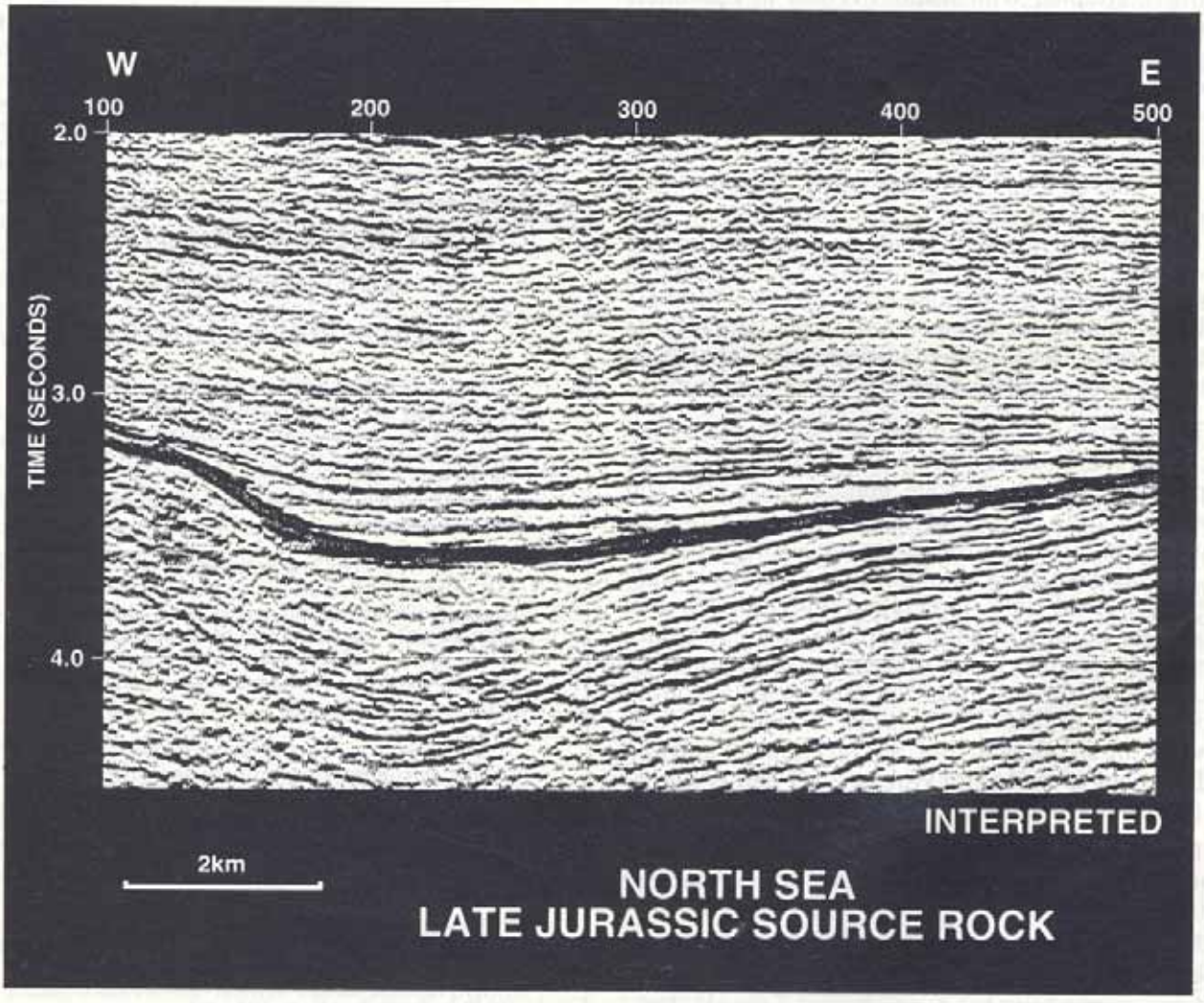
Rob Kirk
BHP Petroleum

Source Rocks on Seismic

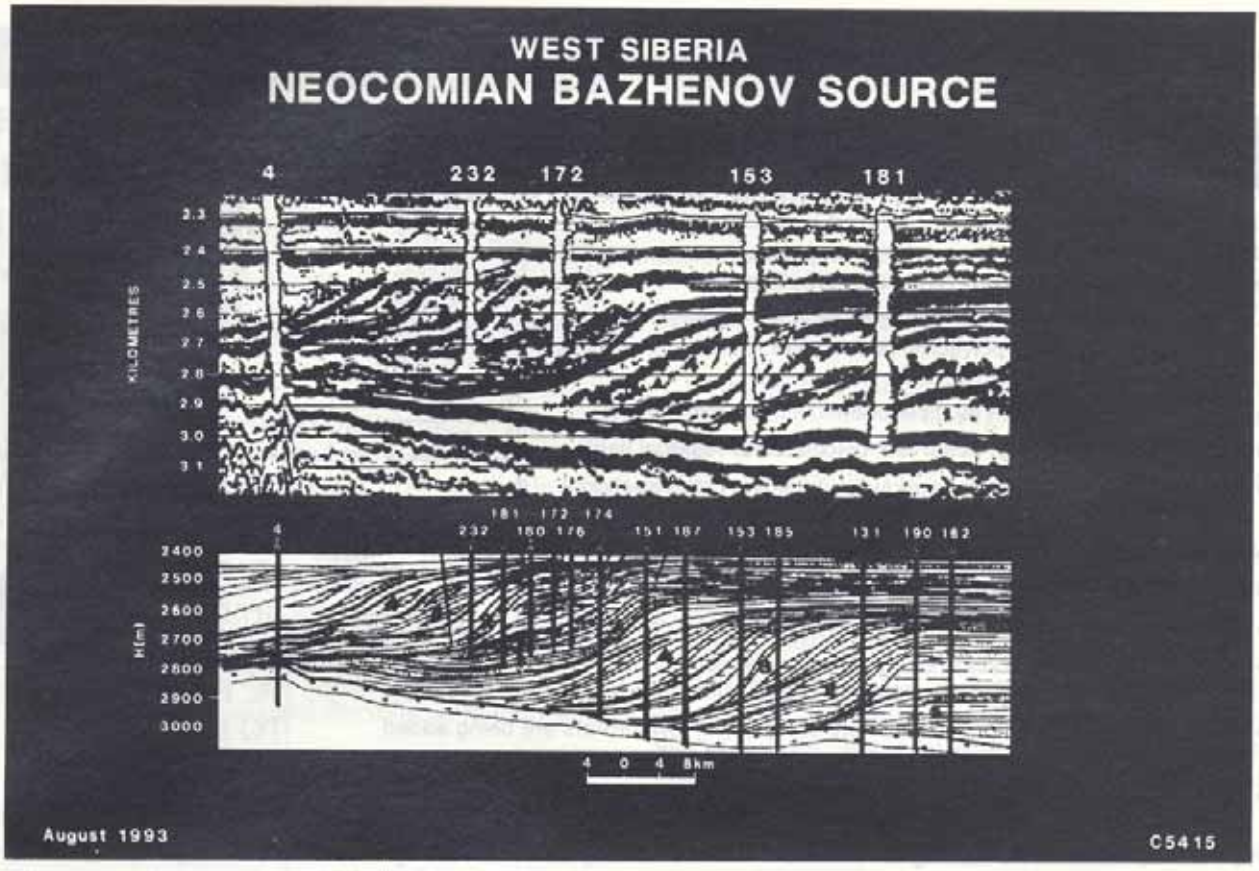
Three examples of source rocks facies are presented from Trinidad, the North Sea and Western Siberia.

This line shows one of the world's great source rocks. This is a Neocomian equivalent, in Trinidad, of Venezuela's La Luna source. Note the high amplitude, very low frequency characteristics of the organic rich facies. This unit did not stand out until sub-12 Hz frequencies were obtained.





This seismic line shows another of the world's great source rocks. This line is from the Central Graben of the North Sea and the source is the late Jurassic Kimmeridge Shale. The high gamma, low density and low sonic characteristics of the organic-rich facies produce the excellent reflection.



This line is from West Siberia and shows another of the world's great source rocks (continuous, low frequency, high amplitude event). This unit is the Neocomian Bazhenov - a high gamma, low sonic, low density bituminous shale with TOC values over 20%! The overlying prograding geometries represent three or more third order sequences. Many progrades have turbidites which act as stratigraphic traps in this area.

Geophysical Data Releases

Digital Elevation Models for Highland Rocks (NT), Bendigo (Vic) and Lissadell (WA).

Digital elevation models (DEMs) for the Highland Rocks (NT), Ballarat (Vic), Bendigo (Vic) and Lissadell (WA) 1:250 000 Sheet areas are now available. The models combine the latest elevation data and accurate positional information acquired during AGSO's recent surveys.

Data from Highland Rocks were acquired in 1993 on north-south lines flown 90m above the ground and spaced 500m apart. The differential GPS system sampled every 5s (350m) and the data were reduced to a 105m (3.5") grid.

The Ballarat and Bendigo DEMs were derived from data acquired by AGSO in 1993 and 1994 respectively. The surveys comprised east-west lines flown at 100m above ground level and at either 200m or 400m line spacing.

Navigation data for the aircraft were provided by the satellite Global Positioning System. This provided position information relative to the WGS 84 reference ellipsoid. The radar altimeter, which was sampled every second, provided the aircraft's ground clearance.

The raw elevation data were calculated every second (70m) and refer to height above the ellipsoid. These were processed and gridded to a 80m (3.0") cell size using Briggs minimum curvature technique.

The Digital Elevation model for the Lissadell (WA) 1:250 000 Sheet area has also been released. The flight lines were east-west, 400m apart and at 100m above ground level. The processing methods were the same as for the Bendigo Sheet area and the final data were gridded to a 90m (3.0") cell size.

The prices for these products for each Sheet area are as follows:

1:250 000 contours - $40 for dyelines, $120 for transparencies, $300 for coloured pixel image and $1,000 for point located and gridded digital data.

Duketon and Edjudina (WA) TMI pixel images

Colour and grey-scale image maps of the Total Magnetic Intensity have been released for the National Geoscience Mapping Accord 1:250,000 Sheet areas of Duketon and Edjudina. Both areas are in the Eastern Goldfields region of the Yilgarn Craton. Data for both areas were acquired by World Geoscience with AGSO and the Department of Minerals and Energy WA funding the Duketon survey. The basic data were acquired on E-W flight lines flown 80m above ground level and spaced 400m apart.

These TMI images were compiled from processed total-field aeromagnetic data from which the International Geomagnetic Reference Field has been removed. The profile data were gridded to a cell size of 80m using minimum curvature. The grid data were then processed in the spectral domain to remove asymmetries introduced by the inclination of the Earth's magnetic field (i.e. reduced to the pole).

Gradient enhancement of the colour image was achieved by modulating colour intensity and saturation, with pixel colours chosen from the natural palette (magenta high, blue low) using histogram equalisation.

A grey-scale image represents the first vertical derivative of the total magnetic intensity grid data, with automatic gain control applied to normalise the anomaly amplitudes.

Individual maps of each area can be purchased for $300 for the colour image, $250 for the grey-scale and $500 for both. Maps of the total counts radiometric image for Duketon are also now available at equivalent prices.

Bendigo (Vic) Airborne Geophysical Data

Airborne Geophysical data for four 1:100 000 Sheets (Mitiama, Echuca, Shepparton and Nagambie) of the Bendigo 1:250 000 Sheet area, Victoria (The Bendigo and Heathcote 1:100 000 Sheets will be released in early 1995).

The AGSO conducted an airborne magnetic and radiometric survey of the Bendigo 1:250 000 Sheet area, as part of the National Geoscience Mapping Accord (NGMA) from February 23 to April 25, 1994. Magnetic and gamma-ray spectrometric data sets were recorded on flight lines flown east-west and generally 400 metres apart. The Bendigo 1:100 000 Sheet and other selected areas were flown with a line spacing of 200m. The nominal ground clearance was 100 metres.

Prices for each of the 1:100 000 Sheet areas are as follows: maps of flight lines and profiles - $25 per dyeline, $45 per transparency; digital data (magnetic and radiometric) $2,080.

Tanami Vertical Derivative Maps

Colour and grey-scale pixel image maps are being released for the 1:250 000 Sheet areas of Highland Rocks and Mount Theo in the Northern Territory. These areas are in The Granites/Tanami region of Central Australia. Data for these maps were acquired by AGSO in 1994.

The basic data were acquired on N-S flight lines flown 90m above ground level and spaced 500m apart. Navigation was by the satellite Global Positioning System.

These TMI images were compiled from processed total-field aeromagnetic data from which the

International Geomagnetic Reference Field has been removed. The profile data were gridded to a cell size of 100m using minimum curvature. The grid data was then processed in the spectral domain to remove asymmetries introduced by the inclination of the Earth's magnetic field (i.e. reduced to the pole). Gradient enhancement of the colour image was achieved by modulating colour intensity and saturation, with pixel colours chosen from the natural palette (magenta high, blue low) using histogram equalisation. The grey-scale image represents the first vertical derivative of the reduced to the pole total magnetic intensity grid data.

The maps of each area cost $300 for the colour image, $250 for the grey-scale and $500 for both.

Dr David Denham, AGSO

Aeromagnetic Features Map Sir Samuel 1:250,000 (SG51-13)

Release date: 31 October 1994

Price: $25 per map

The Geological Survey of Western Australia, Department of Minerals and Energy, released a new geophysical map product in October 1994: an aeromagnetic features map based on the 400m line-spacing data from the 1993 AGSO aeromagnetic survey. The map is a representation of magnetic anomalies and anomaly trends; discordant linear anomalies; contacts between complex magnetic zones; and inferred discontinuities or breaks in the magnetic pattern based on disparity in trends, degree of anomaly linearity and change in magnetic texture.

The map is not intended to convey a geological interpretation of the aeromagnetic data; rather it is an interim stage between the data and a conventional interpretation. It is designed to complement the standard data products - profiles, contours and images - which have been released by AGSO. As such it may be considered as an interpretation work sheet which individual workers can use as a base for their own geological interpretations of the aeromagnetic data.

The compilation was carried out under contract by John Ashley of Southern Geoscience Consultants in Perth. The features were interpreted from 1:100 000 scale profiles, contours and images of TMI and the first vertical derivative. The line work was digitised in the Department and will be released initially as a series of black line on film overlays at 1:250 000 scale and 1:100 000 scale. A digital data product may also be made available at a later date.

The release of the Sir Samuel maps at this price is being made to gauge industry reaction to the concept. If a positive reaction is obtained, further maps may be issued during 1995 for the Duketon, Wiluna, Glengarry and Peak Hill 1:250 000 sheet areas.

To place orders or for further information contact:

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Tel: (09) 222 3331 Fax: (09) 222 3633
Internet: d.howard@dme.wa.gov.au

Obituaries

Sofie Macak

On 29 May 1994, Sofie Macak died after a short illness. Although only in her early twenties, Sofie's life had contained many highlights. Sofie studied at the University of Melbourne from 1987 to 1990 and was duly awarded a BSc. (Hons) majoring in Geology. After completing her undergraduate studies, she travelled to the USA where she worked for six months at the University of Berkeley in California. This included being an invaluable member of a palynological project research team. On the completion of this work team, Sofie returned to Australia to resume studying, this time at the National Centre for Petroleum Geology and Geophysics in Adelaide. At the time of her death, Sofie was completing an MSc. at the NCPGG and her research project involved seismic interpretation of the Long Island fault system on the North West Shelf. In December 1993, Sofie began work at Santos Ltd as a summer student and she continued to work part-time when the new University term began.

Sofie was not only gifted academically but also athletically having represented Australia in the Japanese martial art of Kendo.

Sofie will be sorely missed by her many friends and colleagues.

Grant Asser

Cris Frampton

Cris graduated from Cardiff University in Wales and joined Horizon Exploraiton in 1977 as one of the very high quality graduate intake of that year. He then spent a period of two years or so learning and applying the skills of marine and land seismic data processing in Horizon's Swanley, UK data processing office.

His rapid progress resulted in selection as a member of a very strong team sent to set up and run Horizon's first overseas processing centre in Buenos Aires. Until its closure due to the war with Argentina in 1982, this was probably the most successful overseas seismic processing venture ever undertaken by Horizon. Cris was responsible for the quality of the marine data processing and for much of the problem solving needed for the more difficult assignments.

On returning from Argentina he was well qualified by his academic background and experience for a period in Research and Development. In this area he did much useful work testing and developing the early methods of wavelet processing including the methods of synthesis of source wavelet, incorporating estimates of surface ghosts. He was strongly involved in the early developments of the related methods of seismic inversion, working with others on the software and performing much of the testing. The work carried out at this time laid the foundations for much of the present day technology in the areas of wavelet processing and seismic inversion.

Cris left Horizon in 1985 for a position at Britoil in Glasgow, Scotland.

Paul Haskey, Horizon Exploration

Cris was one of the original "Pioneers" when the Buenos Aires centre was opened in 1979, as Horizon Exploration's first overseas processing venture. He was a very popular member of the most fun-loving, hard working group of people I have ever worked with. On my trips back to Buenos Aires, people still tell stories involving Cris and his many pranks and he is remembered still with great affection, by all of us who worked with him - it is a tribute to his personality and kind nature.

Doug Alinson, SPT Houston, Texas

Cris worked at Britoil in the Geophysics Department for 18 months before being made redundant in a massive staff cutback in 1987. He returned to Kent for a position at GEC Avionics at Rochester. It was a complete career change and he started from scratch learning to program in 'C' in an aircraft hanger, devising tracker systems for fighter jets. Cris was never truly happy in this type of work although he gained much knowledge in the field of signal processing which was to be of great benefit in this future career. He left GEC in 1988 to co-found Waveform Pty in Perth, Western Australia selling seismic software packages and developing new programs. In 1991 Cris began to concentrate his efforts solely on ground probing radar techniques and finally set up his own company, Ground Radar Australia. Cris had found his niche and was truly content and confident in his work. He spent many hours developing the system, programs and foolproof methods of acquiring good field data. He worked closely with Prof Iain Mason of Oxford University and they spent hours bouncing ideas off each other on borehole radar techniques. Prof Mason writes 'It was his practice which, once he'd shown us, became the 'obvious' way of getting hold of good field data - in a sense he is still part of our team, his influence is still there."

His Ground Radar surveys took him to many desolate outback areas and diverse work situations. This included work for Police Forensic in the search for human remains, the burial sites on Rottnest Island, gold, coal and iron mines and the search for buried toxic waste. In April 1992 he went in search of the Mahogany Ship at Warnambool, Victoria. The Victorian Government had advertised a reward of $250,000 should the supposed Portuguese Caravel be uncovered. Always prepared to take big risks Cris spent three weeks with the help of students from Deakin University surveying acres of buried sand dunes. Apart from a

2,000 year old swamp the search was fruitless. However, much technical and field experience was gained as well as valuable friendships made with Prof. John Sherwood and colleagues at Marine Archaeology at Deakin. Cris remained convinced the ship was there and that improved interpretation techniques would eventually uncover it.

In late 1992 Cris began to suffer extreme bouts of fatigue and lacked concentration in his work. He was diagnosed with cancer of the pancreas in May 1993. He was told the disease was incurable but he wrote and faxed around the world to see if he could be part of experimental treatment programmes. In July 1993 he began a course of chemotherapy which had not yet been published in medical journals but which had been proven to extend life expectancy by six months. In December 1993 CT scans showed a "dramatic decrease" in the pancreatic tumour. Cris was able to embark on a couple of radar reprocessing assignments which gave him an enormous sense of achievement in his battle against the dreaded disease. However, by the end of January 1994 further tests showed the secondary tumours increasing and he died at home in March.

Throughout his entire life Cris had prided himself on producing accurate results. He was meticulous in the planning and execution of surveys and the processing and reporting of data acquired.

He will be much missed by his two sons Sam and Sebastian and his family and wide circle of friends all over the world.

Sally Frampton

During the period December 1990 to January 1993 Cris and I worked together on a Department of Aboriginal Site Project to delineate the extent of 19th Century burials on Rottnest Island, W.A. Throughout our collaboration his dedication to the project and thoroughness with detail earnt the respect of all. His death is a tragic loss, not only to his family but to his many friends who worked with him on this project.

His kindness in allowing the Department of Exploration Geophysics to use his Ground Probing Radar equipment for future research and training further perpetuates his memory at Curtin.

Vernon Wilson,
Department of Exploration Geophysics, Curtin University

The Indonesian Petroleum Association Presents an International Symposium on Sequence Stratigraphy in South East Asia

Venue: Jakarta, Indonesia
Dates: May 16 - 18, 1995

Organisation

The symposium will consist of 2 days of lecture sessions followed by a full day of poster sessions and workshops. Lecture sessions will comprise a presentation by lecture leaders and submitted papers. Poster and workshop presentations will emphasize "hands-on" interpretation of data from various sources, and they are intended to encourage audience participation. All sessions will be organised and directed by recognised experts in the field of sequence stratigraphy. As appropriate, field trips will be organised to precede or follow the symposium.

Papers will be presented on all aspects of sequence stratigraphy in Southeast Asia. Workshop or poster presentations may be linked to a lecture talk to fully develop ideas and to encourage discussion and participation. Suggested topics include sequence stratigraphic studies at all scales, in both clastics and carbonates, with an emphasis on exploration and development of hydrocarbons. Priority will be given to papers with direct relevance to South Eeast Asia.

Leaders

Lecture session leaders currently include George P. Allen, with Total Exploration and Production in Saint-Remy-Les-Chevreus, France, Henry W. Posamentier, with ARCO Exploration and Production Technology in Plano, Texas, and J. Fredrick Sarg, with Mobil in Dallas, Texas. Other leaders may be added as needed for particular sessions.

For Registration information and other details, contact the Indonesian Petroleum Association
Jl. M. Ikhwan Ridwan Rals 3, Jakarta 10110, Indonesia
or Fax: (62-21) 375 228

Organised by the IPA Committee on Sequence Stratigraphy and supported by PERTAMINA.

Membership

New Members

We welcome the following new members to the Society. Their details need to be added to the relevant State Branch database:

Tasmania

Anton RADA
Black Forest
Kettering TAS 7155

Western Australia

Luke MORTIMER
160 Swansea Street
East Victoria Park WA 6101

Robert SOMERVILLE
C/- Woodside Offshore Petroleum
1 Adelaide Terrace
Perth WA 6000

Jon COCKER
Loton House, Hale School
Wembley Downs WA 6019

Bob BURMAZ
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Balcatta WA 6021

Trent JULYAN
433 Warwick Road
Greenwood WA 6024

Dean CRIDDLE
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Warwick WA 6024

Christopher BISHOP
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Woodvale WA 6026

Christopher MacHUNTER
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Lesmurdie WA 6076

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Belmont WA 6104

Ian SIMON
CRA Exploration Pty Ltd
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Dennis ANESTOUDIS
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Willetton WA 6155

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Iestyn BROOMFIELD
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Magill SA 5072

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Olaf KLOSS
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Denis REY
Gencor African Exploration
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Artman NCOKO
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Tsakane 1548
Brakpan RSA

Change of Address

The following changes need to be made to the relevant State Branch database:

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Eastwood SA 5063
To: 40 Sheoak Road
Crafers SA 5152

Bruce FINLAYSON
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Netherby SA 5062
To: 16 Franklin Street
Adelaide SA 5000

Barry TAYLOR
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To: 6/2 Kyle Street
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PO Box 6383
East Perth WA 6892

Jon SUMNER
From: 218 Danpier Avenue
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Glen Waverley VIC 3150
To: Geology Department
Kambalda Nickel Mines
Western Mining Corp
Kambalda WA 6442

Mark FAWKES
From: Sons of Gwalia Ltd
PO Box 412
Aitkenvale QLD 4814
To: C/- Sons of Gwalia Ltd
Barricoat Mine
Post Office
Laverton WA 6440

Andrew C. DUNCAN
From: Aerodata
65 Brockway Road
Floreat WA 6014
To: 62 Vincent Street
Nedlands WA 6009

Victoria

Kunal CHAKRAVORTY
From: 40 Moorookyle Avenue
Oakleigh Vic 3166
To: 6/6 Marriott Street
St Kilda VIC 3182

Geoff DUNN
From: "Vivyan"
Stewarts Road
Kernot
South Gippsland Vic 3979
To: Flat 6, 14 Waverly Ave
Ivanhoe VIC 3079

Bhodan BURBAN
From: PO Box 860
Kenmore QLD 4069
To: Unit 15C, Sky Apart.
29 Queens Road
Melbourne VIC 3004

Simon CROSATO
From: Central Norseman Gold
PO Box 56
Norseman WA 6443
To: C/- F. Lindeman
Western Mining Corp
Exploration Division
PO Box 157
Preston Vic 3072

Jacob REBEK
From: CRA Exploration
1st Floor, 71 Ridge St
Gordon NSW 2072
To: Group Geologist
CRA Exploration
PO Box 8093
Preston VIC 3072

David GAMBLE
From: Shell Australia
1 Spring Street
Melbourne VIC 3000
To: Acacia Resources Ltd
GPO Box 4336PP
Melbourne VIC 3001

ACT

Jane MITCHELL
From: 22 Windsor Avenue
Alfredton Vic 3350
To: AGSO
Room 116
GPO Box 378
Canberra ACT 2601

Tasmania

Paul BASFORD
From: Pasminco Exploration
Level 17, 380 St Kilda Rd
Melbourne VIC 3004
To: Pasminco Exploration
PO Box 886
Burnie TAS 7320

Overseas

P.J. WOLTER
From: 76 Glenelg Street
Mt Pleasant WA 6153
To: 8B Norman Street
New Plymouth 4620
New Zealand

Vinay VAIDYA
From: C/- Digital Exploration
PO Box 203
Jolimont WA 6014
To: Blk 250, Ang Mo Kio Ave
#12-74, Singapore 2056
Republic of Singapore

Robert PICKERING
From: PO Box 862
Brooks Alberta
Canada T1R 1B7
To: PO Box 5631
High River, Alberta
Canada T1V 1M7

Resignations

David ROWLEY
41 Royal Avenue
Burnside SA 5066

Neil HUGHES
Pasminco Exploration
GPO Box 1291K
Melbourne VIC 3001

John STANLEY
Northside
Jordans Way, Jordans
Beaconsfield
Buckinghamshire HP9 2SP
UK

Kenneth EVANS
PO Box 427
Jabiru NT 0886

Prof John DE LAETER
Curtin University of Technology
School of Physical Sciences
GPO Box U1987
Perth WA 6001

Where Are They?

Does anyone know the new address for the following members?

Karen CHRISTOPHERSON
Last known address:
969 Gold Coast Highway
Princess IC Palm Beach QLD 4221

Michael ROONEY
Last known address:
4 Shadforth Street
Mosman NSW 2088

David DE PLEDGE
Last known address:
11 Bombard Street
Ardross WA 6153

Anastasia BOYLSON
Last known address:
37 Crase Street
Teneriffe QLD 4005

Michael SHARRY
Last known address:
21 Sundridge Street
Taringa QLD 4068

Tina Ann MANDER
Last known address:
PO Box 672
Nedlands WA 6009

Michael HOUSE
Last known address:
Unit 17, 159 Fairway
Crawley WA 6009

Graham BUBNER
Last known address:
CRA Exploration Ltd
PO Box 175
Belmont WA 6104

Amanda TULLY
Last known address:
31/1740 Pacific Highway
Wahroonga NSW 2076

Neil YOUNG
Last known address:
19 Playfield Street
East Victoria Park WA 6101

Graeme HAINES
Last known address:
Haines Surveys Pty Ltd
PO Box 65
Modbury North SA 5092

Calender of Events

March 1-3 1995

Petro Vietnam Conference
Ho Chi Minh City, Vietnam
For further details:
SPE: 214-952 9393

April 24-27 1995

8th SAGEEP Conference
Orlando, Florida, USA
For further details:
Tel: 303-771 6101

May 29-June 2 1995

EAEG 57th Annual Meeting & Exhibition/7th EAPG Conference
Glasgow, Scotland
For further details:
Tel: 31-3-404-62 640

August 20-24 1995

The First Latin American Geophysical Conference & Exposition
Rio de Janeiro
For further details:
A.H. Ross Jr.,
Technical Program Co-Chairman
RIO '95
SEG Business Office
PO Box 702740
Tulsa, OK USA 74170-2740
Ph: 918-493 3516
Fax: 918-493 2074

September 3-6 1995

ASEG 11th Geophysical Conference & Exhibition
Adelaide
For Conference Details see page18

March 25-29 1996

8th Australiasian Remote Sensing Conference
National Convention Centre, Canberra
For further details:
ACTS
GPO Box 2200
Canberra ACT 2601
Ph: (06) 257 3299
Fax: (06) 257 3256