Mineral exploration expenditure up

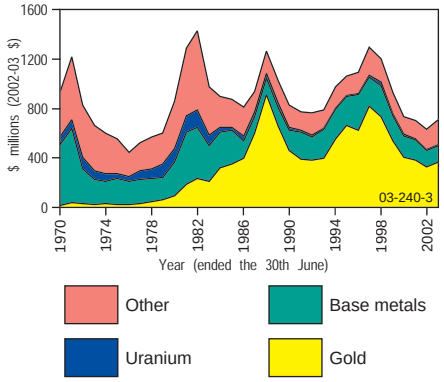
but Australia's share down

Australian mineral exploration is emerging from a 20-year low with expenditure in 2002–03 up 14 per cent on the previous year.

The latest Australian Bureau of Statistics figures indicate that Australia's mineral exploration expenditure in the 2002–03 financial year rose to $732.5 million (figure 1).

All states had increases, with the largest rises in Victoria (36%) and Queensland (23%). Western Australia continued to dominate with 57 per cent of mineral exploration spending (figure 2), mainly due to gold.

Gold attracted 51.7 per cent of exploration expenditure, followed by base metals (figure 3). There were increases in exploration for iron ore (up 77%) and coal (up 55%) but falls in mineral sands (down 18%), uranium (down 22%) and diamonds (down 16%).



▲ **Figure 1.** Australian mineral exploration expenditure in constant 2002–03 dollars, based on Australian Bureau of Statistics data deflated by Consumer Price Index.

Global exploration up

Global exploration increased significantly in 2003 to an estimated $US 2.4 billion according to the latest annual survey by the Metals Economics Group of Canada. The 26 per cent increase is the first increase since global mineral exploration budgets peaked in 1997 at an estimated $US 5.2 billion.

Australia maintained its place as the second largest exploration country behind Canada, but its share of world budgets fell from 17.6 to 15.5 per cent—the lowest share in more than 20 years.

Australia's standing slips

The increase in Australian mineral exploration budgets in 2003 was much smaller than the average and well below Canadian budgets which were up 49 per cent on 2002 figures.

The strong increase in Canadian exploration expenditure in recent years is attributed to the ongoing diamond boom, with continued discoveries of new kimberlite provinces and the development of new diamond mines, and increased domestic exploration by Canadian junior companies that were previously focusing their exploration offshore.

Increased capital-raising for mining and exploration in Canada, and the Investment Tax Credit for Exploration have boosted Canada's domestic mineral exploration.

On a regional basis, for the first time Australia was overtaken by Africa as an exploration destination (figure 4). Australia was fourth behind Latin America (23.6%), Canada (21.5%) and Africa (17.1%).

The African region increase was predominantly in South Africa. The 120 per cent increase in exploration on the previous year lifted South Africa into fourth place after Canada, Australia, and the USA on a country basis.

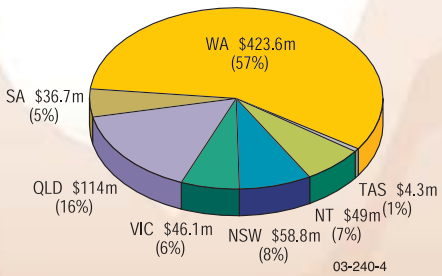
Exploration in South Africa was mainly for diamonds, gold and platinum.

Grass-roots exploration positive

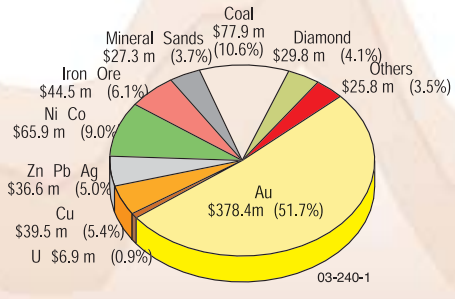
For budgets allocated to grass-roots exploration, Australia was second behind Canada and well ahead of the next three countries: Peru, the USA and Brazil. Canada and Australia together attracted 38 per cent of global grass-roots exploration.

Most (59%) grass-roots exploration in Australia was spent on the search for gold. This was followed by base metals (28%), and smaller amounts on diamonds and other commodities.

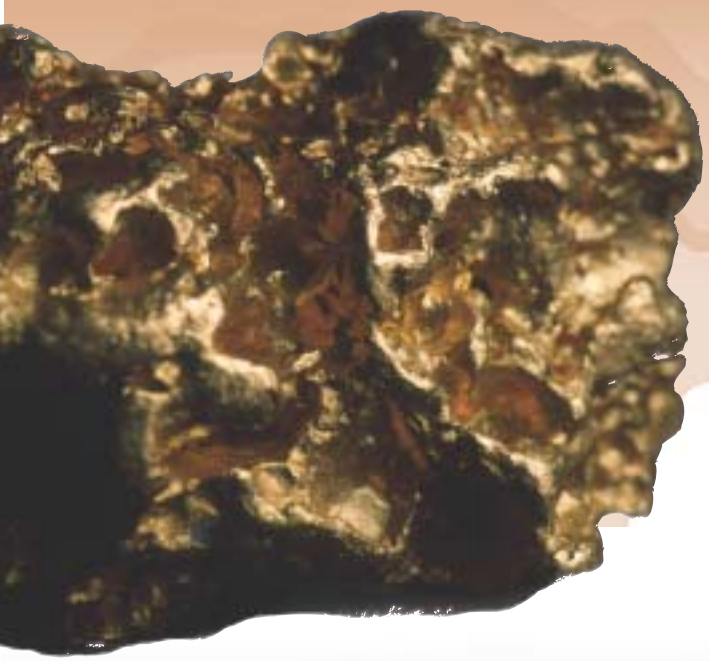
Diamonds were the main commodity in Canadian grass-roots exploration, attracting $US 85 million (36% of total grass-roots exploration), followed by gold (32%), and base metals (19%).

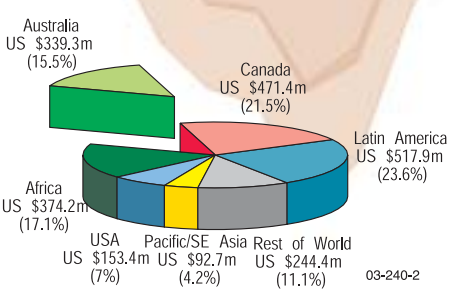


◀ **Figure 2.** Mineral exploration in Australia in 2002–03 by jurisdiction, based on Australian Bureau of Statistics data

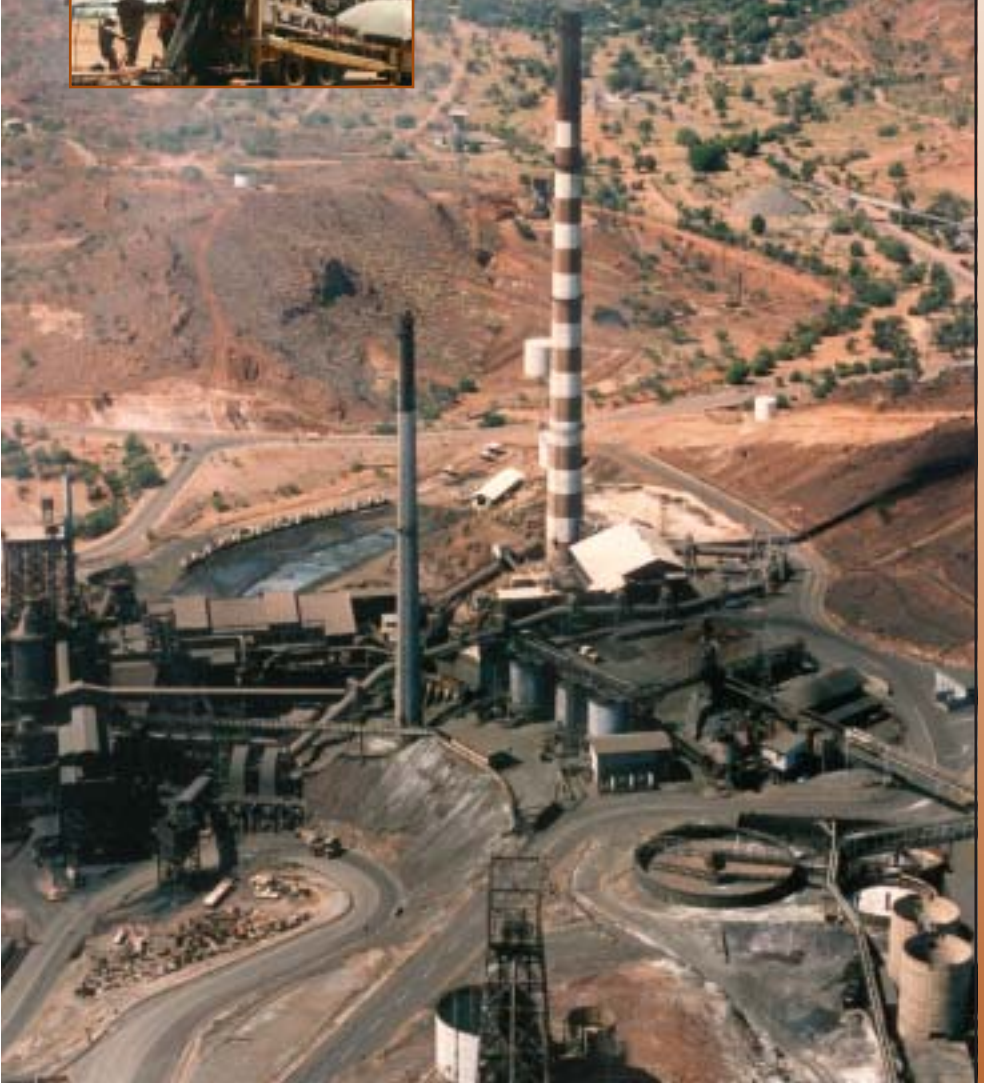


▲ **Figure 3.** Mineral exploration in Australia in 2002–03 by commodity, based on Australian Bureau of Statistics data





▲ **Figure 4.** Global mineral exploration budgets in 2003 according to the Metals Economics Group of Canada



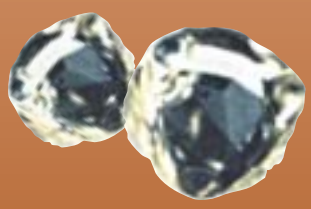
Outlook encouraging

Recent price rises, particularly in gold and nickel, and projected increases in other base-metal prices in the next 18 months should continue to strengthen global and Australian exploration activity.

This is good news for Australian mineral exploration as it emerges from an extended downturn in activity that saw a 45 per cent fall in exploration expenditure from a peak in 1996–97.

Geoscience Australia continues to aid the discovery of mineral resources and promote investment in Australia through its pre-competitive geoscience program which is conducted in partnership with state and territory geological surveys.

For more information phone Lynton Jaques on +61 2 6249 9745 or e-mail lynton.jaques@ga.gov.au



New maps to aid North West Shelf assessments

Some in the petroleum industry have suggested there is low probability of discovering new oily areas on the North West Shelf. They perceive the region to be a gas-prone province with few effective oil-prone source rocks*.

In response to industry comments, Geoscience Australia has been capturing the geochemical and age data for North West Shelf wells in its ORGCHEM and STRATDAT databases, and has compiled maps for offshore north-western Australia, which are available on CD.

The maps will facilitate a regional assessment of the source-rock potential, and provide a framework for studies of the region's petroleum systems.

For the Carnarvon to Arafura basins, there are maps of average source rock richness, quality and maturity for five Mesozoic time-slices (table 1).

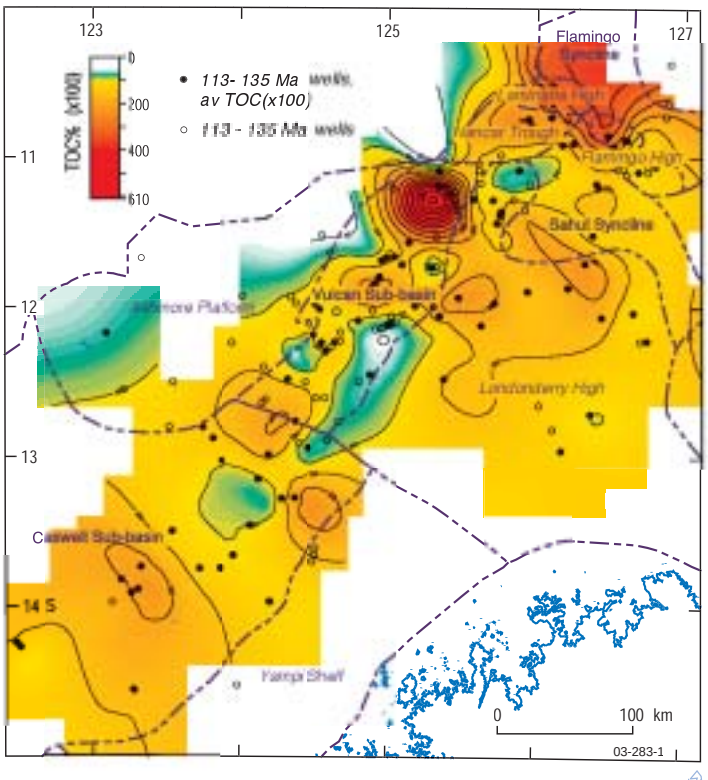
The maps were compiled at a scale of 1:3 million, and are supplemented by two-way-time isopach maps for each time slice derived from interpretation of Geoscience Australia's regional seismic grid of the area (approximately 35 000 line km).

Total organic carbon (TOC), Rock-Eval pyrolysis (S1, S2, S3, OI, HI, PI, BI, Tmax) and vitrinite reflectance (VR) data were extracted from the ORGCHEM and STRATDAT databases for each well in the region.

The value of each analyte was screened and validated to identify potential source rocks. TOC and Rock-Eval pyrolysis data were subdivided into shaly (0.5–10% TOC) and coaly (>10% TOC) samples.

Table 1. The five Mesozoic time-slices used for the North West Shelf maps

Aptian – Valanginian	113–135 Ma
Valanginian – base Cretaceous	135–141 Ma
Base Cretaceous – Mid-Callovian	141–163 Ma
Mid-Callovian – base Jurassic	163–205 Ma
Late Triassic	205–230 Ma



▲ **Figure 1.** Part of the source richness (TOC) map showing the northern Bonaparte Basin area for time slice 113–135 Ma

Grids and iso-contour maps of average shale source richness (figure 1), source quality (figure 2), and maturity (VR) were generated using Petrosys mapping software. The relatively minor number of coaly samples prevented regional mapping for those samples.

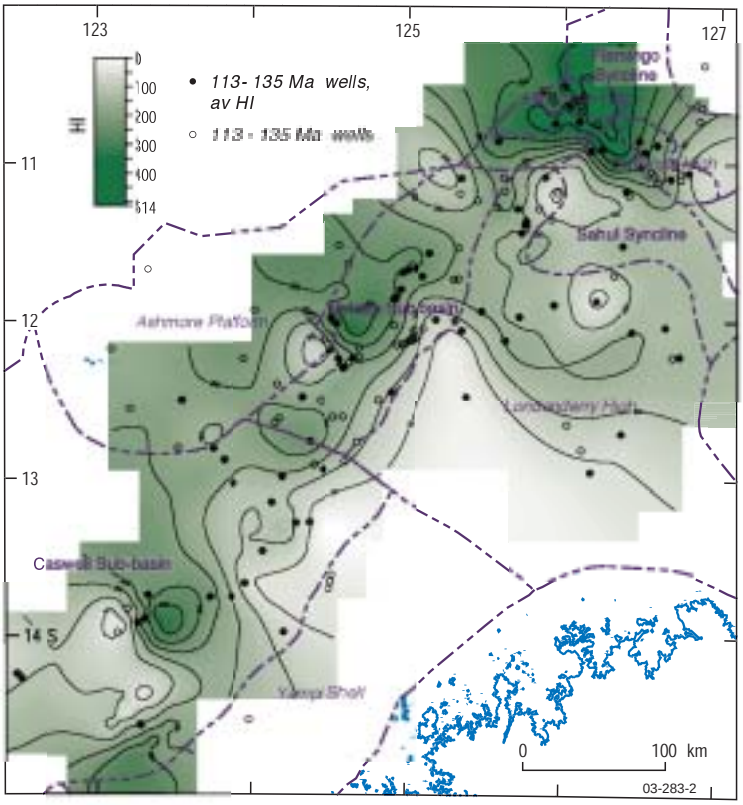
A series of cross plots of Rock-Eval pyrolysis data for each time slice was generated (figures 3 & 4). Each age unit included age and discreet Rock-Eval pyrolysis value(s) of all samples in that age range for every well in the selected region. The outputs were colour-coded according to basin/sub-basin and added to the maps.

The final maps show which wells provided data to construct that map, and all wells that penetrated rock units of a particular age.

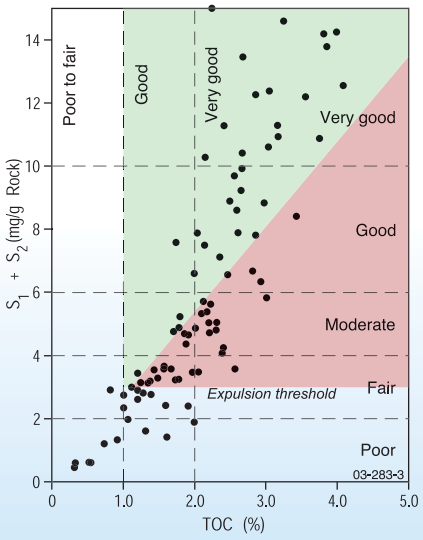
The map files are provided as pdf and eps plot files on the CD. The CD also contains Excel spreadsheets of the data used to generate the maps and cross plots, and describes how the sample values were screened to capture only valid data.

The initial suite of maps has highlighted gaps in the primary data set, which will be filled by additional sampling of some wells for geochemical analysis.

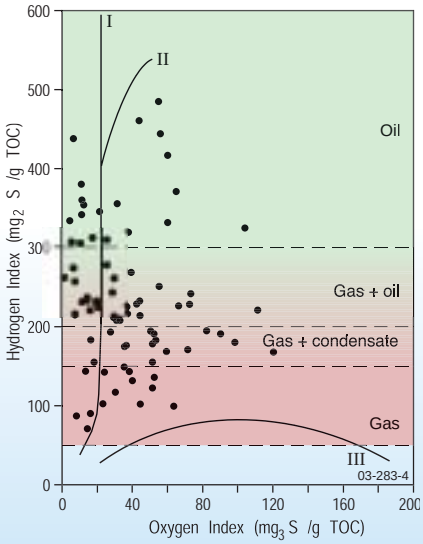
The age plots identified that the age range of the source rich intervals needs to be more tightly defined and the intervals re-mapped to better define the distribution of effective source rocks.



▲ **Figure 2.** Part of the source quality (HI) map showing the northern Bonaparte Basin area for time slice 113–135 Ma



▲ **Figure 3.** Cross plot (S1+S2 vs TOC) of Rock-Eval pyrolysis data for the area shown in figures 1 and 2



▲ **Figure 4.** Cross plot (HI vs OI) of Rock-Eval pyrolysis data for the area shown in figures 1 and 2

In the longer term, the time slices could possibly be linked to specific seismic sequences, and mapped regionally using seismic data sets.

*Longley IM, Buessenschuett C, Clydsdale L, et al. The North West Shelf of Australia—a Woodside perspective. In: Keep M & Moss S, eds. 2002. The sedimentary basins of Western Australia 3: Proceedings of the Petroleum Exploration Society of Australia symposium, Perth, 28–88.

For further information phone John Kennard on +61 2 6249 9204 or e-mail john.kennard@ga.gov.au

Extra functions for *geochronology* on-line

A map-based interface has been added to the OZCHRON database so that users have a context for their queries as they search for geochronology data and related field information.

From the home page (www.ga.gov.au/oracle/ozchron/), a user can select regions, lithologies, stratigraphic units and dating methods, and display the geochronology data against a variety of backdrops (geological regions or units, towns, and different-scale map sheets). The selected data are reported in tabular form that can be downloaded as a text file.

Hyperlinks on individual sample numbers in the report allow the user to examine more comprehensive sample information on screen. For samples with SHRIMP ages, a concordia diagram can be generated to further assess data quality.

Users can also filter, sort and group OZCHRON data prior to producing a time-space plot. This is an extension of the geochemistry plotting application known as Plot-It (reported in *AusGeo News 72*).

The time-space plots display all selected geochronology data for the user-defined terranes, which are grouped and colour-coded according to event type and geochronological method. Tables of data and plots can be downloaded for later manipulation and display.

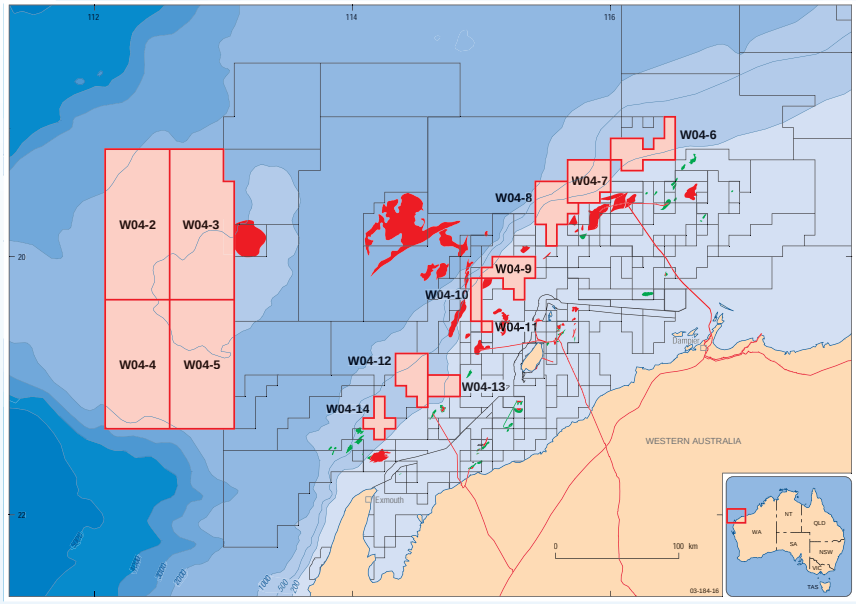
Plot-It requires Java Runtime Environment version 1.4.2 or above which is available as a free download. An on-line help manual is also provided.

OZCHRON is a national database of Australian geochronology managed and maintained by Geoscience Australia in collaboration with state and territory geological surveys.

For more information phone Geoff Tuckerman on +61 2 6249 9798 or e-mail geoffrey.tuckerman@ga.gov.au

Petroleum acreage opens to *exploration bids*

Figure 1. 2004 offshore release areas in north Western Australia



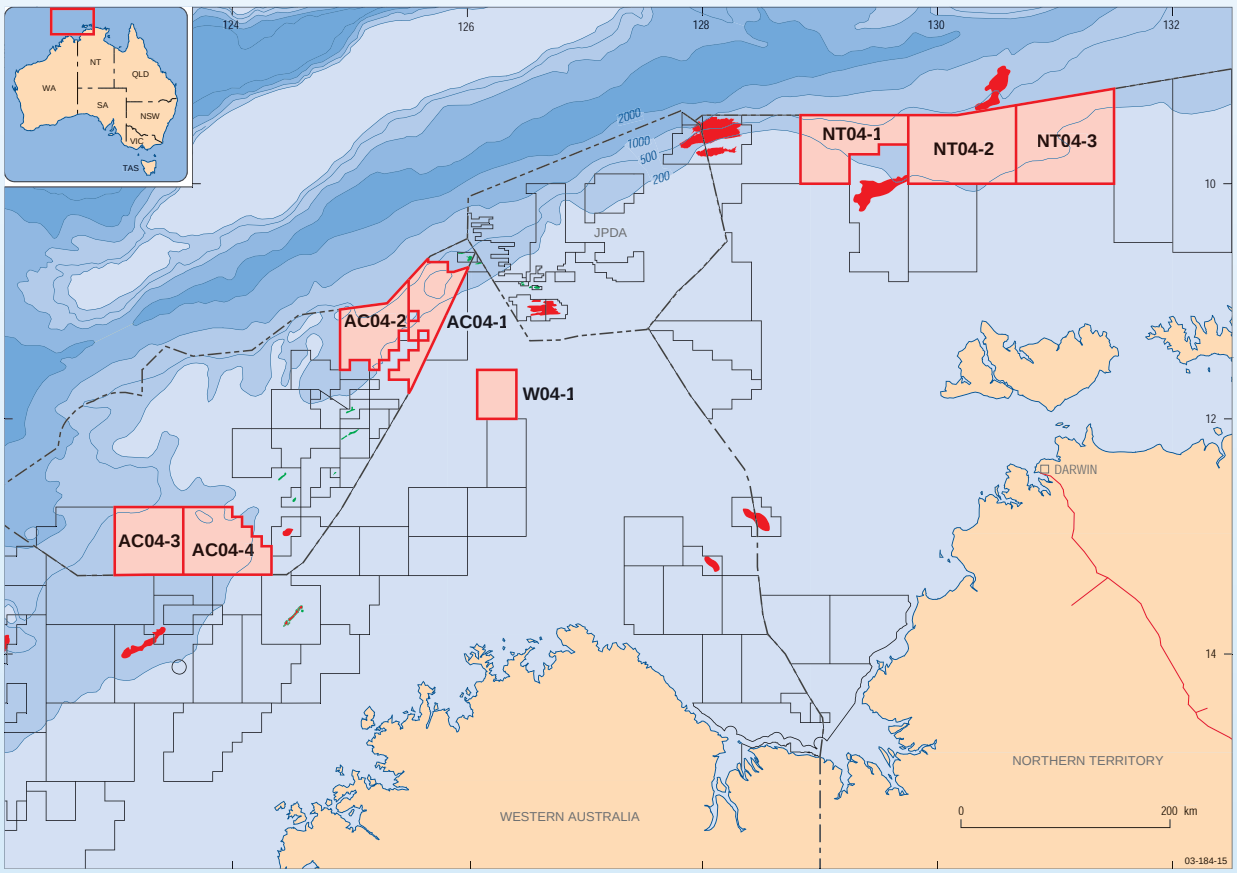
Australia's Offshore Petroleum Exploration Acreage Release for 2004 will be formally announced on March 29. Thirty-one areas in 13 different regions are proposed.

Closing dates for release bidding will be in September 2004 and March 2005, depending on the area's size and exploration maturity.

The release offers a variety of geological play types and ages in a range of water depths. The opportunities include:

- Large frontier blocks in deep-water areas — Exmouth Plateau and Houtman Sub-basin off Western Australia and the Port Davey Sub-Basin off south-west Tasmania (figures 2–4);
- Jurassic to Early Cretaceous sediments in shallow-water areas around known

Figure 2. 2004 offshore release areas in north-west Australia



hydrocarbon provinces — Browse and Bonaparte basins (figure 1);

- Shallow-water, under-explored basins close to existing infrastructures — Vlaming Sub-basin, and Otway and Bass basins (figures 3 & 4);
- Smaller blocks in shallow-water, producing areas — Exmouth and Barrow sub-basins and Outer Rankin Platform (figure 2).

2003 summarised

In March last year, 35 offshore exploration areas were released under the work program bidding system. Eighteen areas closed for bidding on September 25. To date, four permits have been awarded and a number of bids are still under consideration. The remaining 17 areas are available for bidding until March 25 this year.

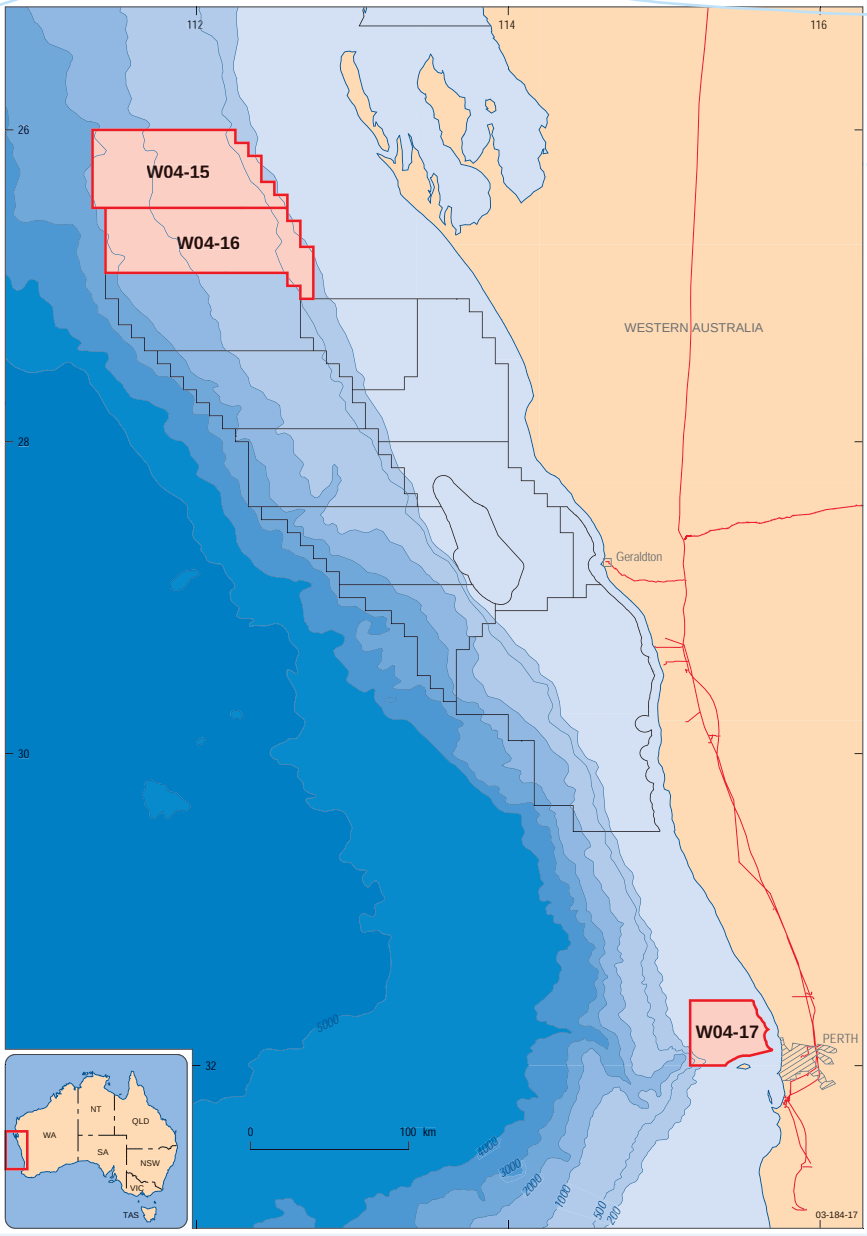
Since January last year, 25 new offshore exploration permits have been awarded under the Australian Government's Petroleum (Submerged Lands) Act, which covers the area from the three-nautical-mile territorial boundary to the limit of Australia's Exclusive Economic Zone. These permits result from the 2002 and 2003 releases and associated re-release program.

Over the next six years, the 25 permits involve more than 16 900 kilometres of 2D seismic surveying, nearly 2500 square kilometres of 3D seismic surveying, and 27 exploration wells. The estimated value of the exploration work is more than $455 million.

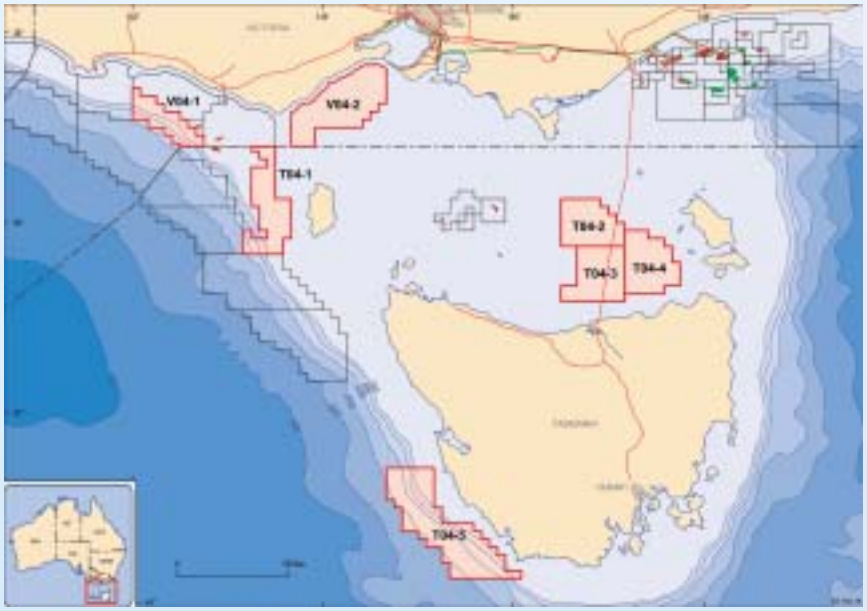
Reviewing acreage

Geoscience Australia has a number of products that could assist explorers in reviewing potential acreage. For details phone Jenny Maher on +61 2 6249 9111 or e-mail jenny.maher@ga.gov.au

For more information about Australia's offshore petroleum exploration and its administration e-mail: petroleum.exploration @isr.gov.au or visit the web at www.industry.gov.au/petexp



▲ **Figure 3.** 2004 offshore release areas in south Western Australia



▲ **Figure 4.** 2004 offshore release areas in south-eastern Australia

Better data hurries update of geomagnetic reference

Tradition was broken with the mid-epoch release of the latest revision of the International Geomagnetic Reference Field (IGRF), and it was due to the high-quality and large volume of satellite magnetic field data available.

The IGRF is a mathematical description of the Earth's main magnetic field. The model is used widely in studies of Earth's deep interior, crust, ionosphere and magnetosphere.

The production of the IGRF is an international effort that incorporates data from permanent geomagnetic observatories, and from land, airborne, marine and satellite surveys. Geoscience Australia contributes data from nine geomagnetic observatories in Australia and the Australian Antarctic Territory, and from 15 geomagnetic repeat stations in the Australian region.

This 9th generation of the IGRF includes the full set of Gauss coefficients for spherical harmonic models of the main geomagnetic field for five yearly intervals from 1900.0 to 2000.0, and a secular variation model for the period 2000.0 to 2005.0.

The epoch 2000.0 main field model is a spherical harmonic model to degree and order 13 (which translates as an improved spatial resolution for this model). Previous models for other five yearly epochs go to degree and order 10.

A model to degree and order 13 will map geomagnetic features to a minimum wavelength of approximately 3000 kilometres. Degree and order 10 models map the field to a wavelength of about 4000 kilometres. The secular variation model for 2000.0–2005.0 is a degree and order eight model (minimum wavelength of about 5000 kilometres).

Another improvement to the 2000.0 model sees the Guass coefficients quoted to an accuracy of 0.1 nanoTesla. Previous releases quoted main field coefficients to 1nT.

The 9th generation IGRF model was released at the International Union of Geodesy and Geophysics general assembly in Sapporo, Japan in July 2003. The full set of coefficients are available on line at www.iugg.org/IAGA/iaga_pages/pubs_prods/igrf.htm

An on-line, single-point calculator is available at www.geomag.bgs.ac.uk/gifs/igrf.html. Software to evaluate the 9th generation IGRF is available from Geoscience Australia.

For more information phone Andrew Lewis +61 2 6249 9764 or e-mail andrew.lewis@ga.gov.au

Ultimate reference

for Australian place names released

Gazetteer of Australia 2004 has just been released with a listing of more than 310 000 place names. All place names have the attributes listed in the table below.

Each year the Gazetteer of Australia gets bigger and better. Since its release in 1995, the number of place names included has increased by 10 000 a year on average.

This year's gazetteer has been improved by the addition of two auDA fields which flag place names that have certain restrictions within internet domain addresses. Web-site developers will find these fields particularly useful.

The data are now available in database format as well as the standard ASCII format.

The gazetteer is released annually on CD-ROM through the efforts of Geoscience Australia and the Intergovernmental Committee on Surveying and Mapping.

Place names are a daily part of life. We use them to tell someone where we live or work, and they remind us of the places we have seen, help us plan where we want to go, and to communicate with people. For a bit of fun, try the gazetteer crossword to test what you know about place names in Australia. The answers are on page 23.

Gazetteer data can be viewed free on-line through Geoscience Australia's Online Place Name Search at www.ga.gov.au/map/names.

To find out more or to purchase the *Gazetteer of Australia 2004* visit www.ga.gov.au/nmd/products/thematic/gaz.htm. Alternatively, phone the Geoscience Australia Sales Centre on 1800 800 173 (Freecall in Australia) or +61 2 6249 9966.

Record ID:	Unique identifier for each feature
Authority ID:	Custodian state or territory
State ID:	State or territory that the feature falls in
Name:	Name of the feature
Feature code:	Code indicating the type of feature
Status:	Indicates if the name is authorised
Variant name:	Variant or alternative name
Postcode:	Postcode of the locality
Concise Gazetteer:	Indicates if the feature is included in the Concise Gazetteer
Longitude:	Longitude in decimal degrees
Latitude:	Latitude in decimal degrees
100K Map:	1:100 000 scale map reference
auDA Reserved (new):	Indicates if the name may not be used in second-level domains in the .com and .net environment.
auDA Allocated (new):	Indicates if the name can be used in the act.au, nsw.au, nt.au, qld.au, sa.au, tas.au, vic.au, wa.au second-level domains by only community web-site portals that reflect community interests.

New 1:1 million **Geology of Australia** takes shape

The first parts of the digital 1:1 million scale outcrop geology coverage of Australia have been completed, and are available from the web at www.ga.gov.au/download/states.html.

These new 1:1 million compilations of Tasmania, Victoria and southern Queensland are parts of the national dataset that will replace the 1:2.5 million scale geology map of Australia. Compilations of New South Wales, northern Queensland, Northern Territory and South Australia are under way.

The national coverage will be completed by the end of 2005. It will provide an invaluable baseline dataset for regional and national evaluations of resource potential, environmental issues, and land use.

The dataset is primarily a digital tool for GIS applications. A printed version is not planned because a paper map of Australia at 1:1 million scale would be almost four metres tall, and the legend for several thousand stratigraphic units of Australia would be enormous.

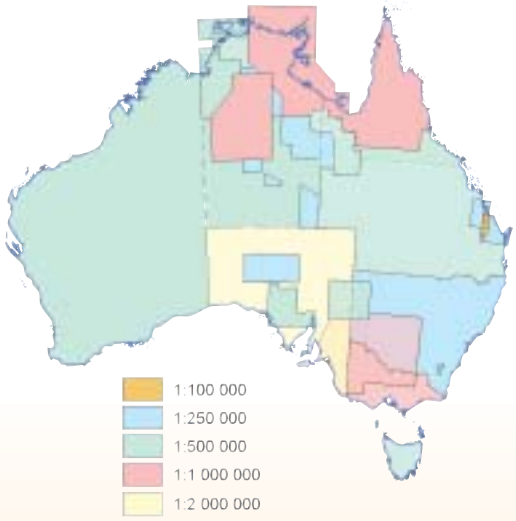
The new 1:1 million scale dataset is far more detailed than the existing geological map of Australia. Typically, source maps and digital datasets between 1:500 000 and 1:250 000 scale are being used to compile the 1:1 million dataset. Maps ranging in scale from 1:2 million to 1:100 000 have also been used for various parts (figure 1). Where possible, the latest geological mapping by state and territory geological surveys has been incorporated.

Current stratigraphic names and descriptions have been added to the digital dataset. In general, stratigraphic units are represented at about 'group' level for presentation at 1:1 million scale. Geological units are coded with their age and both detailed and summary lithological attributes, to provide users with a range of options for searching and displaying data (figure 2).

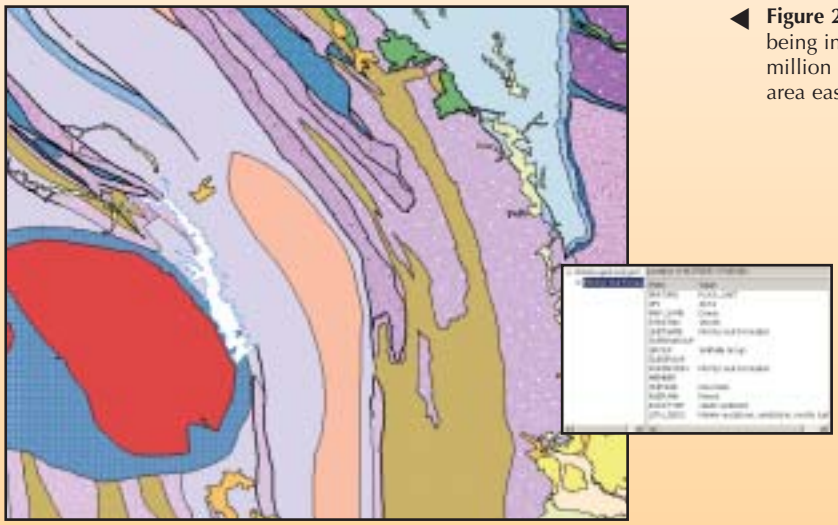
All rock unit codes and descriptions from the source maps are standardised for consistency in attribute descriptions. It is a major exercise to edge match and standardise line work and attribute information across map sheet and political boundaries, as the age of source data ranges from very recent to more than 30 years old.

When complete, the 1:1 million national geology dataset should be the first digital dataset to be delivered under a new National Geological Data Standard being developed by the Australian Government and state and territory geological surveys.

For more details phone Ollie Raymond on +61 2 6249 9575 or e-mail oliver.raymond@ga.gov.au



▲ **Figure 1.** Different scales of the source data being used to compile the 1:1 million geology of Australia.



◀ **Figure 2.** An example of the detail being incorporated into the new 1:1 million geology of Australia, for an area east of Melbourne.

Rail map release marks final link in interstate network

Rail was the premier method of land transport around the world in the 19th century, and Australia was no exception once the first public steam railway opened in Melbourne in 1854.

Soon each colony developed its own railway network. But with different gauge (width) tracks this was a problem as networks grew and joined.

When the Alice Springs to Darwin line opened in February 2004, all Australian capital cities and their ports were finally connected by a network of standard gauge track. This network, called the Interstate Rail Network, measures 9420 kilometres.

Geoscience Australia's National Mapping Division in conjunction with the Australasian Railways Association celebrated the milestone with the release of an impressive paper map, *Railways of Australia*. The map is a must for all rail enthusiasts and industries that rely on the nation's rail network.

The map reflects the importance of Australia's railways to the national economy. It contains photographs and graphics of travel times, freight volumes and other interesting statistics. The different gauges used across Australia are shown and there are insets of capital city urban networks.

Railways of Australia is the first map released in a revised series of NATMAP thematic maps. The Australasian Railway Association and Railscape provided photographs and narrative information for the map. The previous edition was published in 1981 and naturally there have been changes since then to Australia's railways.

For more information about the map, phone the Geoscience Australia Sales Centre on 1800 800 173 (Freecall in Australia) or +61 2 6249 9966.

Rail facts

More than a third of Australia's current domestic freight is transported by rail, including all the iron ore and most of the coal and grain produced in Australia. These three commodities comprise 20 per cent of Australia's exports and contribute more than $15 billion a year to the nation's income.

Australian urban rail networks carry more than 500 million passengers every year, including an average of 50 per cent of all peak period travel to city centres. At 1025 kilometres, Sydney's urban rail system is the largest urban rail system in the world. Melbourne's tram system is the world's third largest light-rail network.

Australia's long distance passenger routes include the Indian Pacific, the Overlander and the Ghan. The Indian Pacific travels 4352 kilometres from Sydney to Perth via Adelaide. The journey across the Nullarbor Plain includes 478 kilometres of straight track (the longest straight section in the world).

In June last year the high-speed Tilt Train began transporting passengers on the Brisbane–Cairns track to cut the time spent travelling the long distance. The Tilt Train travels at speeds of up to 160 kilometres an hour and 'tilts' on corners to maintain a higher speed.

In June 2001, BHP Billiton Iron Ore broke the world record for the heaviest train. It was also the world's longest train at 7.353 kilometres. The train weighed 99 732 tonnes and travelled 275 kilometres from the company's Newman and Yandi mines to Port Hedland, Western Australia. The train comprised 682 ore cars with 5648 wheels and was pushed by eight powerful diesel-electric locomotives.

Australia's rail industry is at the forefront in technology and expertise. It has systems to detect faults to wheels and bearings while moving, and GPS technology to track individual wagons which is quite important considering Australia has more than 44 800 kilometres of railroad.