



AUSCEO
news



OCTOBER/NOVEMBER 2001 ISSUE No. 63

EARTHQUAKE
research *shakes up our ideas*

fruitful
GROUND
geology & viticulture

*Pricing
policy
changed
for spatial
data*

WEB revamp
to improve access

PP 255003/00048

Also: Sedimentologists off to sea, aurora on show, heaps of new products...

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The grape vine responds in different ways to variations in soils and geology. Grape vines love growing in soils with a limestone base. Good Cabernets and Pinot Noirs are produced from grapes grown in a sandy red clay soil, while Chardonnay grapes respond well to lighter soils. See the article on the opposite page.

Photo: Arthur Mostead

GEOLOGY PROVES *fruitful* FOR VITICULTURE

- 'Ripe black cherry fruit overlaid with dark chocolate and violet flower perfume and just a little French oak for complexity'...

Amidst the floral descriptions and complexity of wine growing there is a simple fact: many of the best wines come from vines grown in soils on top of limestone.

Geoscience Australia's Dr Colin Pain and Australian National Botanic Gardens Curator, John Nightingale discussed the effect of geology and soils on viticulture in their public lecture at Geoscience Australia's Open Day in October.

- The underlying geology influences land use and what can be grown. This applies to many species including the grape vine (*Vitis vinifera*) which responds in different ways to variations in soils and geology.

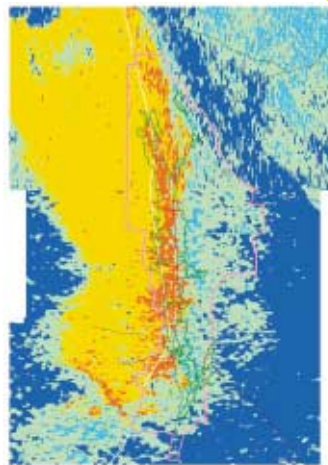
For example, in the northern part of Burgundy in France, the soil is mainly red-brown clay on impure limestone. This area is noted for the world's best Pinot Noir. In the southern part of the same area, there are much lighter soils. These soils lie on marls and marly limestone. Some of the world's best Chardonnays are produced in this region.

Australian wine areas

The story is similar in Australia. Wines are being produced in many parts of the country off soils that vary from red clay to weathered granite. Like France, though, the well-regarded wines tend to be from grapes grown in soils overlying limestone.

A very good Cabernet Sauvignon/Shiraz is produced from grapes grown in a sandy red clay soil (terra rossa) in the Coonawarra area. These terra rossa soils are found in a relatively small area, just 12–13 kilometres long and about two to three kilometres wide (figure 1). The soils range from a few centimetres deep to one metre deep, but always overlie limestone. 'Lesser' wines are also produced in the Coonawarra from vines that grow on black clay soils in the west and sandy soils in the south-east.

In the Claire Valley, just north of Adelaide, Rieslings are produced off clay loams overlying limestone that formed millions of years ago when the area was seabed. In the Geelong area a good Pinot Noir and Chardonnay are produced off similar soils with a limestone base, and Cabernet grapes are grown in deep, sandy gravels.



▲ **Figure 1.** Coonawarra radiometrics map. The better-drained soils are dominated by potassium (red areas). The vineyards that produce the very good Cabernet Sauvignon/Shiraz are located in these red areas, which are terra rossa soils on limestone. Image supplied by Doug Mackenzie for the Australia Wine and Brandy Corporation (unpublished report)



◀ Colin Pain (left) and John Nightingale pictured with some iron-rich soil and produce borne from such soil.

In Margaret River, Western Australia, outstanding Cabernet vines are grown on well-drained, iron-rich red soils, while a good Chardonnay comes from vines on soils derived from sand and from gravely alluvium.

Geology maps

Geology maps and geophysical tools are being used to locate particular soil and rock types for viticulture.

The radiometric map of the Coonawarra area demonstrates how geophysical tools can be used to locate better-drained soils (figure 1). Radiometrics are an airborne remote sensing tool that measures the natural radioactivity of potassium, uranium and thorium. In the Coonawarra area, the better-drained soils (red areas on figure 1) are dominated by potassium. The vineyards that produce the very good Cabernet Sauvignon/Shiraz are located in these red areas.

The radiometrics also show that the poorly drained soils are to the south (particularly to the east). There are some 'lesser' vineyards in that area.

Vine preferences

Grape vines have a deep, vigorous root system which needs a place to develop. In the right spot, vines can grow vigorously for a hundred years or more, producing good-quality grapes for wine production.

Vines are planted close together to create root competition, which forces the roots to go deep. This competition for limited nutrients and soil moisture yields the grapes that producers want.

Low-yielding crops of one to two tonnes per acre per year are preferred, although some quality-wine producers are happy with half a tonne per acre. Table grapes and grapes for dried fruit can yield 11 tonnes an acre. These grape varieties are grown in different soils, and are usually heavily fertilised and heavily irrigated.

Grape vines can grow in soils that other plants don't like. Although salinity and water logging affect grapes less than many other fruit trees, they won't thrive with rising water tables and increasing salinity. For commercial wine production, such areas should be avoided. Compact and impermeable soils also should be avoided.

Grapes prefer open, free-draining soil with the moisture held. The best soil allows rainfall to enter and percolate down into the lower levels of soil. The soil should hold enough moisture so that the vines do not become stressed during the heat of the Australian summer. This water balance is particularly important to wine varieties like Pinot Noir that need an even level of moisture right through the growing season.

Soil types

Clay content often indicates how much water the soil will hold, how workable it is, and how well it drains producing small, air-filled spaces. Soils with a lot of clay are heavy. They are very chemically active because of their enormous surface area compared to their bulk. If there is too much clay, the soil holds moisture and becomes water logged and gluggy.

Sand-dominated soils are light and they drain freely. They require frequent irrigation. Most of Australia's quality grapes are grown in deep, well-drained, water-holding soil without the use of irrigation. They rely on natural rainfall. The soils are deep enough to hold the water so that the vine can draw up moisture when needed.



The terra rossa soil preferred by grape vines is sometimes mixed with pockets of darker soil. These darker soils are much deeper clays and of much higher fertility.

Vines that grow in very dark soil produce abundant vegetative growth with large bunches of big grapes. The sun cannot penetrate these vines and warm the grapes so they take much longer to ripen. This results in a greener, more herbaceous character to the wine that is produced. In comparison, grape vines grown in terra rossa soil yield much smaller bunches and smaller grapes. These grapes ripen faster and produce a warmer, richer flavour in the wine.

Profile and chemistry

The soil influences the chemical content of wine. Observations in Australia and France suggest that the relatively high iron and manganese found in red soil favours red grapes, giving them more colour and tannins, and a more complex flavour. Elevated copper contents can also enhance wine colour.

Various chemicals in the soil influence vine health and output. Too much copper and aluminium can be toxic. If there is not enough copper and zinc, growth will be poor and the yield low. Nitrogen and phosphorous are fundamental for growth, and potassium is needed for fruit production. Deficiencies in potassium and nitrogen can cause leaf drop. If iron levels are too low the leaves will turn an abnormal yellow colour (develop chlorosis).

The composition of soil varies from vineyard to vineyard and in a vertical sense because of various biological, chemical and physical activities that have occurred over millions of years. The parent rock (the type of rock from which the soil was formed) and its reaction with the atmosphere, material blown in by wind or deposited by water, and the activities of roots and soil organisms determine soil composition and its suitability for growing grapes.

Grapes should be grown in soil with a pH of 5.5 to 6.5. In some marginal saline soils, gypsum is applied to change the calcium-sodium balance. But gypsified saline soil has a very poor structure for root growth. Fertilisers can be added to make up for nutritional shortfalls in the soil. Wine-quality grapes tend to require little fertilising, however, except in sandy infertile soils.

Other determinants

Wine production is a complex equation, and soil is not the sole determinant of wine quality. Grapes grow best in a warm, fairly dry, summer climate. Under these conditions many of the folage fungal diseases are avoided. The vines also need a number of frost-free days early in the growing season so that new growth is not destroyed.

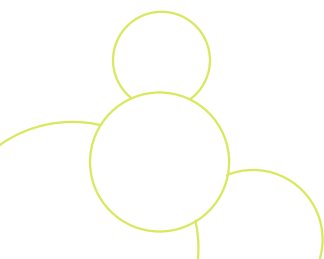
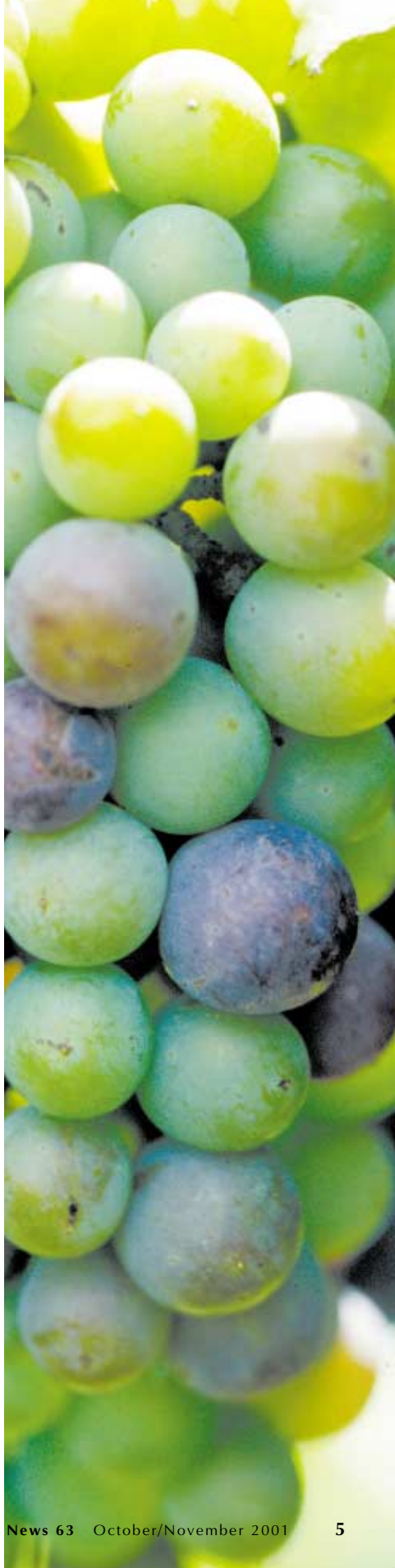
In Australia, vineyards should have a north-facing aspect to maximise the amount of sunlight available, and be planted away from cold, southerly winds. Slope (in the range of 0.33–6.7%) can be important to allow moisture and cold air to drain away from the vine, particularly in cold climates like Canberra and Tasmania.

Irrigation is not generally a benefit to good-quality wine production. But it is very important in areas for table grape production and dried fruits.

How the vine is established initially and pruned subsequently, pest and disease management, and the artistry of wine makers also influence vine health and wine production.



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EARTHQUAKE

research to shake Australia
out of COMPLACENCY

Wake up Australia. Nowhere in this vast land is the probability of an earthquake zero. Australia is tectonically 'alive'. In fact an earthquake of magnitude six, 20 kilometres from the central business district in one of Australia's major cities could cause more damage than one of the same magnitude near earthquake-prone San Francisco.

These concerns underlie research efforts in Geoscience Australia's Urban Geoscience Division. Research Group Leader (Geohazards and Risk), Dr John Schneider explains...

Australia is a stable continental region. It is far from the edges of tectonic plates, where most of the world's earthquakes happen.

On plate boundaries, fractured rocks and geological faults absorb earthquake energy. But when an earthquake travels from deep in the Earth and ruptures the geology within an old, sturdy continent like Australia, its seismic energy can travel far and damage a wide area at the surface.

On September 28 the Cadoux earthquake of magnitude 5.1 was widely felt 220 kilometres away in Perth, Western Australia. A similar earthquake outside San Francisco would not be felt because the relatively young geology and pre-existing faults in California would thwart seismic wave movement.

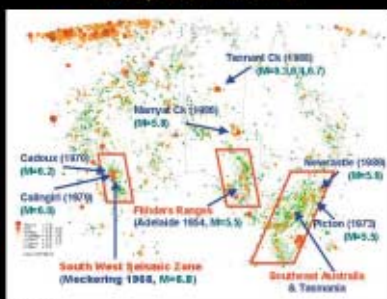
Earthquake areas

In Australia there are many seismically active areas including the South West Seismic Zone near Perth in Western Australia, the Flinders Ranges near Adelaide in South Australia, and south-east Australia (from Newcastle in New South Wales to Tasmania). All areas are within or near major urban centres. (See figure 1.)

Earthquakes seem to recur in the same places. But in Australia there are few historical records of earthquake events to confirm this observation. Geoscientists therefore face two problems. One is identifying the pattern of earthquakes in Australia. The other problem is forecasting whether any present-day pattern will be the same for the next few hundred years.



GEOSCIENCE AUSTRALIA
Earthquakes in Australia



www.ga.gov.au

▲ **Figure 1.** Historical earthquakes in Australia and locations of recent damaging earthquakes and key earthquake zones



Stress release

Geological stress causes earthquakes and the amount of stress released over an area or via a fault determines the magnitude. The Australian continent is being squeezed or compressed as it interacts with neighbouring plates. This interaction is creating compressive stress that is oriented to the north or north-east in the northern half of Australia, and east or south-east in the southern half. It is thought that most of this stress eventually leads to earthquakes.

The rates at which the Australian continent is deforming are quite small (a few tenths of a millimetre a year across the continent). But it is possible that in some locations the rates are higher. These locations would have an increased risk of earthquake damage.

Random or recurring

Earthquake occurrence is not random. Although earthquakes can happen anywhere in Australia, based on historical evidence they are more likely to occur just north of Adelaide and east of Perth, and in the highly populated south-east zone that includes the cities of Melbourne, Canberra, Sydney and Newcastle (figure 1). Earthquakes typically occur at depths of up to 15 kilometres in the Australian continent. Many recent ones of magnitude six to seven have ruptured the surface.

Most earthquakes are followed by aftershocks. These are of a lower magnitude than the main event and are the Earth's way of adjusting to the new geological arrangements and stresses. They help the Earth minimise overall stress. Sometimes there are foreshocks. These are harbingers for the biggest earthquake in the sequence.

Confusing phenomena

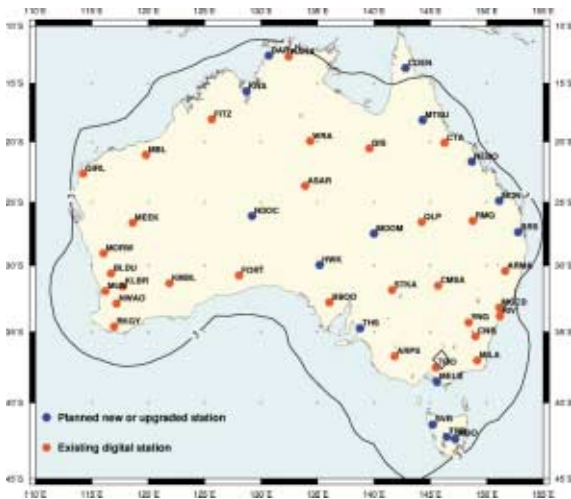
The 1941 Meeberrie earthquake, 600 kilometres north of Perth, with a magnitude of 6.9 is the largest earthquake recorded for the Australian continent. Australia experiences approximately two magnitude five (or greater) seismic events every year, 20 of magnitude four to five, and hundreds of magnitude three or lower. All of 3.5 or greater magnitude (and some smaller events within station range) are being recorded and located by Geoscience Australia's National Seismographic Network.

It is difficult to draw patterns and conclusions from these earthquake occurrences. Certain phenomena make it hard to determine whether the event is a transient effect or whether it is persistent.

Earthquake activity can turn on and turn off. For example, in the late 19th century over several years there were many tremors and several large earthquakes off north-east Tasmania. Suddenly, this activity switched off. Nowadays there are few tremors in the region.

Another phenomenon is a series of large earthquakes over a short period, where none was previously recorded—for example, the series of earthquakes (the largest with a magnitude of 6.5) that occurred on one day in January 1988 at Tennant Creek in the Northern Territory.

The third phenomenon is a swarm: a series of small, non-damaging seismic events with no identifiable main shock. A swarm was recorded near Cadoux some months prior to the September 28 earthquake. There is no direct evidence, however, that a major earthquake is related to a swarm.



▲ **Figure 2.** Geoscience Australia's National Seismographic Network that locates all 3.5 or greater magnitude earthquakes (and some smaller events within station range) within the contoured area. The network is being upgraded to capture all magnitude three or greater earthquakes.

Earthquake monitoring

The Cadoux earthquake was picked up and identified within a couple of minutes by the National Seismographic Network. At least three stations in the network recorded the same signal, making it noteworthy.

With any strong vibration, stations automatically assess the signal and transmit data to Geoscience Australia headquarters in Canberra. Computers analyse the character and strength of the signal (or the arrival time and amplitude) in relation to the nearest stations, to locate the earthquake epicentre and determine its magnitude.

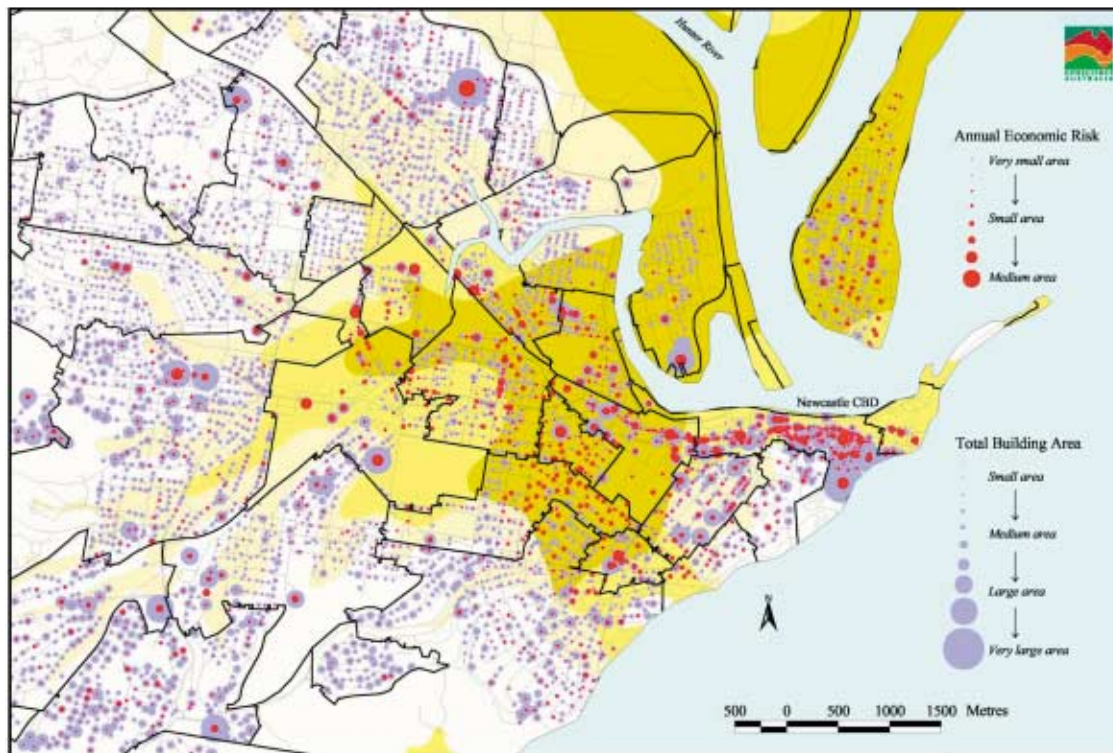
The network runs 24 hours a day and comprises 36 stations around the continent. It has been monitoring earthquakes in Australia and Antarctica since 1957. More stations are planned so that within the next year the network can locate any magnitude three or greater earthquake on the Australian continent (figure 2).

This is an important service for the Australian public and the media. Geoscience Australia responds to numerous phone calls and e-mails whenever a tremor is felt in Australia and posts a report on the web within an hour of confirming a major seismic event.

Field data

Immediately after the Cadoux earthquake was logged, geoscientists flew to the region and set up portable seismographs to record aftershocks. The equipment was in place for several days. Data collected has been added to Geoscience Australia's catalogue of earthquake events.

▼ **Figure 3.** Earthquake risk map of Newcastle based on the probability of all possible earthquakes and the expected repair costs. Red dots show relative building damage, while the blue dots show relative building values.





Geoscientists don't go into the field after small earthquakes. But the Cadoux earthquake was large enough to generate aftershocks that would provide valuable information not only about the main event, but also for further research.

Aftershocks cluster where the main event occurred. They can be used to identify a fault and show how seismic energy was propagated from the earthquake. The Cadoux data is also being used for geohazards research in Perth.

Geoscience Australia's Cities Project is carrying out a multi-hazard risk study of the Perth metropolitan area. The data provides accurate information (rather than educated speculation) about how seismic energy travels from earthquakes in the Perth region.

Historical evidence

Earthquakes occur on faults. Locating faults and determining their orientation in relation to stresses is crucial to understanding seismic activity. Historical evidence is important in this work.

Historical data is being gathered from isoseismal maps (earthquake intensity maps), reports in old newspapers and local council records, and from 40 years of earthquake recordings held in the Geoscience Australia catalogue. Some of the best evidence though is from the geologic record of past earthquakes. Unfortunately, there has been little research into paleo-earthquakes in Australia.

Scientists from the University of Western Australia and Geoscience Australia recently trenched the Hyden Fault in Western Australia. A bulldozer cut a four-metre-deep by 36-metre-long swath near the southern end of the scarp to look for offset and for fragments of broken rock and vegetation. The information gathered is being used to determine how many earthquakes were responsible for forming the scarp and when earthquakes occurred.

All data gathered (historical, folk memory, post-event information) about any aspect of earthquakes is being catalogued by Geoscience Australia to build an earthquake risk model. The model is being used in hazard risk assessments of major metropolitan areas such as Perth to predict the probability of an earthquake and its effects.

Risk analysis

There are two parts to earthquake risk analysis. The first part is determining the occurrence pattern (where, how big, and the likelihood of repeat episodes). The second part is determining the likely impact for a built-up area in the vicinity of the fault.

Earthquake occurrence will take decades to understand simply because of unexpected events and the paucity of historical data. Much of Geoscience Australia's current research into geohazards therefore focuses on the second part, determining the likely impact of an earthquake in an urban area.

Although physical characteristics of earthquakes elsewhere in the world provide insights into such events in the Australian continent, regional conditions make each earthquake different. Local conditions dictate how efficiently seismic energy travels from its origin in the Earth's crust to the surface. The thickness of the geology and variations in soils generate a different outcome for equivalent magnitude earthquakes in different parts of the world.

Theoretically and by inference from other areas around the world, geoscientists know about possible earthquake damage in Australia. But they are grappling with the level of structural damage to expect in various Australian cities.

A reinvestigation of the 1989 Newcastle earthquake by Geoscience Australia is the most comprehensive analysis of earthquake risk in Australia to date. Through computer simulation and such data as the earthquake magnitude, its location and epicentre, and maps of soil types and building locations, researchers are estimating and 'modelling' the vulnerability of buildings and other structures to earthquake shaking. (See figure 3.) Geoscience Australia collected data from 8000 residential and commercial buildings in and near Newcastle's central business district for its predictions. The data have been used to generate maps of likely damage to present-day Newcastle if another earthquake occurred. Further seismic activity is possible, considering Newcastle had five damaging earthquakes between 1837 and 1925, one in 1939 and another in 1989 (which has caused the most damage to date).

Urban development

If cities are built near faults, there are implications for urban planning and public safety. These include the location of critical facilities such as nuclear power plants and dams, and enforcing construction codes that ensure buildings can withstand earth shaking from moderately sized earthquakes. Buildings that suffer the most damage during earth tremors are those constructed of materials such as brick and masonry that have not been reinforced.

Australia's major cities are river cities. Early settlers chose these sites because they were natural ports and had plenty of fresh water. But they have been built on sediments, and these soils amplify the size of ground shaking.

The 1989 Newcastle earthquake of 5.6 magnitude was 12 kilometres from the central business district. The damage bill was more than 1.2 billion dollars. The area most affected was the CBD and other parts of the city along the river where the soft soils amplified the ground shaking.

Much of Sydney and Botany Bay are built on soft sediments, and the area has the highest concentration of significant civil infrastructure in Australia. The earthquake risk is not particularly high for this area. But due to the soils and the concentration of infrastructure, a magnitude 6.5 earthquake within 10 kilometres of Botany Bay would be catastrophic for Australia and the insurance industry. In fact, the world's major re-insurance companies list an earthquake in Botany Bay in the top 40 natural disasters worldwide.

Australian cities don't have to continue this pattern of development. With Geoscience Australia data about how earthquakes behave and how they are modified by shallow, sedimentary soils along river courses, governments and local councils can establish higher standards of construction practice and build critical infrastructure on 'safer' ground.

After all Australia is tectonically active, even though earthquakes of magnitudes greater than five are infrequent.

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BIOZONE TAXONOMY problems virtually solved

The Virtual Centre of Economic Micropalaeontology and Palynology (VCEMP) has just been established to document and define biozones used by oil, gas and coal explorers. Its taxonomy will at last bring consistency to terms and reference points used in exploration areas.

The Centre will also further the development of micropalaeontology (the study of microfossils) and palynology (the study of fossil spores and pollen) as scientific disciplines, and bolster their applicability in solving exploration problems.

Geoscience Australia established the Centre with the participation of the British Geological Survey as the European node of the Centre, the University of Western Australia, and industry consultants.

Biozone names

A biostratigraphic zone (biozone) includes all rocks laid down in a specific interval of time. During each time interval, different organisms and plants lived, decayed and became part of the sediments and rocks. Their fossil remains are used to define a biozone. In the oil, gas and coal industries, biozones provide the primary time and correlation data used in basin modelling, exploration and production.

Informal biozonation schemes are being used because many of the key species that define biozones are undescribed. Often they are referred to in reports submitted to government under the *Petroleum (Submerged Lands) Act (PSLA)* by alphanumeric codes. Unless users are in the same consulting group, others cannot check or apply the information.

In some cases, different consulting groups have various names for the same zone or the same name but with a different concept. This has the potential to confuse current and subsequent users of the data.

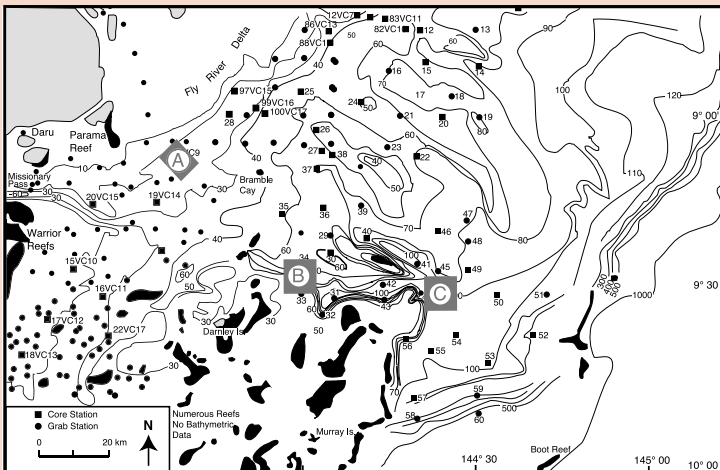
Under the PSLA, Geoscience Australia receives offshore company data (including biostratigraphic reports) which are repackaged for its use and summarised in STRATDAT, the Geoscience Australia database. STRATDAT provides the only time control used in Geoscience Australia's regional petroleum projects and by many exploration companies. The integrity of the biozone data, which includes definition of species used and their stratigraphic distribution, must be verifiable.

Verifiable data

The idea of a Virtual Centre was raised by Geoscience Australia early last year following discussions with industry and academia about the problem. The concept has been taken up by Australia's leading consultants who are keen to define and verify zonation schemes.

The Centre has deployed specialists from Britain and Australia to answer targeted problems. All data is now digital and will be incorporated in Geoscience Australia databases as quality-controlled information.

Sediment movement tracked in upcoming TORRES STRAIT cruise



On January 17 next year, the RV *Franklin* departs from Cairns harbour in north Queensland for 21 days in the Gulf of Papua with a team of sedimentologists and technicians led by Geoscience Australia's Dr Peter Harris and University of Sydney's Dr Michael Hughes. The team will be researching sediment dispersal in the Torres Strait.

Scientific objectives

A zone of high tidal current across the northern margin of the Great Barrier Reef is thought to be a corridor for sediment movement. Scientists plan to collect data that verifies sediment is being transported across the shelf.

While collecting this data, the scientists will document benthic biological communities associated with different substrates, and collect sediment cores to determine a time-line for cross-shelf terrigenous flux.

Location and methods

The general region of the proposed survey is the northern margin of the Great Barrier Reef and Fly River delta. Data will be gathered by high-resolution seabed mapping at strategic locations, in conjunction with seabed sampling and photography. Methods to be used include swath mapping, shallow

Data access

The Centre is having a profound effect on how palynological work is conducted. Already, the 14 studies that have been completed or are under way are digital. With the notable exception of the University of Western Australia, this has not happened before. Results of these studies, together with other Commonwealth Palaeontological Collections in palynology, will be available through the web.

Geoscience Australia has encouraged the use of digital capture technology by most consultants. With this data management tool, verification of zones/key species can take place on screen, thereby avoiding time-consuming reprocessing and rehandling of slide collections.

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VCEMP
Virtual Centre of Economic
Micropalaeontology & Palynology



Season's GREETINGS!

Wherever you are this festive season: may you experience peace and goodwill.



THANK YOU
for your readership
in 2001. We look forward
to your support next year.



For more information about the cruise
phone Peter Harris on +61 3 6226 2504
or e-mail P.Harris@utas.edu.au

high-resolution seismic surveying, suspended sediment sampling, current metering, and coring and grab sampling. Three areas will be mapped.

Area 'A' is located adjacent to the seaward margin of the Fly River delta. It has a fairly flat seabed, but previous sonar surveys indicate subtidal bedforms in the area.

Area 'B' is located among the northernmost reefs of the Great Barrier Reef, where a 100-metre-deep submarine valley crosses the shelf. This valley is the low-sea-level river channel of the Fly River. It is not known whether this is still a conduit for sediment transport.

Area 'C' is located at the seaward terminus of the palaeo Fly River channel. It should be the locus of low-sea-level sediment deposition. Sonar data show this area is characterised by 'drowned' reefs, Halimeda biostromes, and possible gas-escape features (pockmarks) on the seabed.

Tracks and stations

A current meter mooring will be deployed in area 'A' at the start of the survey. The proposed tracks are about 10 kilometres in length, and their spacing will vary depending on water depth.

Allowing for overlap and water depth, in area 'A' the line spacing will need to be about 75 metres where the depth range is 20 to 30 metres. Based on the survey results, 20 stations will be selected for collecting grab sediment samples, seabed photography and CTD deployment. At 10 of these stations a piston core will be taken. Work in area 'A' should take five days.



Because of water depths of 40–70 metres in area 'B' and 60–100 metres in area 'C', survey line spacing will be 250 metres. In each area it should take three days to run a series of 66 lines, 10 kilometres in length. Based on survey results, 20 stations will be occupied in each area for further sampling.

The ship will return to area 'A' to collect the current meter when the work in area 'C' is complete. RV *Franklin* will dock in Cairns on February 6.

Did you KNOW?

Photos: Chris Soames

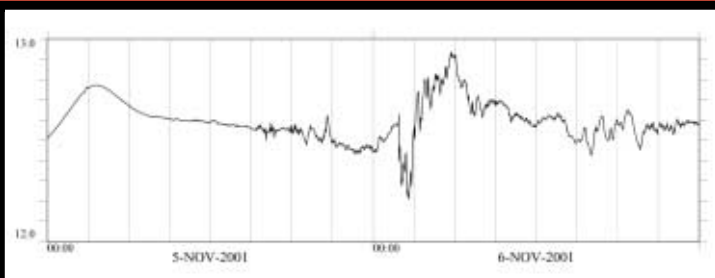
The aurora is a dynamic and visually delicate manifestation of magnetic storms on Earth, which are caused by the Sun.

Radiation and ejected material from the Sun energise electrons and ions in the Earth's magnetosphere. These particles enter Earth's upper atmosphere near the polar regions.

When the particles strike molecules and atoms of the thin, high atmosphere, they are energised and may glow when they release that energy. High-altitude oxygen (about 320 kilometres up) is the source of the rare, all-red auroras. At lower altitudes (about 100 kilometres up), oxygen produces a brilliant yellow-green—the brightest and most common auroral colour. Ionised nitrogen molecules produce blue light, while neutral nitrogen glows red. The nitrogens create the purplish-red lower borders and ripple edges of the aurora.

Rapid changes in magnetic field variations show that geomagnetic activity is above normal (see the normal magnetic activity from 00:00 to 15:00 on November 5 and the magnetic storm in progress on November 6). Sudden impulses (e.g. the spikes between 15:00 and 21:00 on November 5) indicate the onset of a magnetic storm, and that within several hours there will be an aurora.

For more information phone Liejun Wang on +61 2 6249 9620 or e-mail liejun.wang@ga.gov.au



▲ **Figure 1.** Magnetogram of declination data from the Canberra Observatory showing magnetic activity on November 5–6, 2001. (X-axis: universal time, three-hourly grid interval. Y-axis: in degrees)

Ingenuity HALVES RECORDING COSTS AND TIME

With some field work and a little ingenuity, Geoscience Australia's engineering staff has designed and built some terrific microtremor recording equipment that is being used by the Cities Project team in their assessments of earthquakes in Australia's urban areas.

When the Engineering Unit's David Pownall participated in a Cities Project survey of south-east Queensland, data had to be logged by hand on paper and positioning information had to be recorded on an ordinary street map. Data was later transcribed into computers at Geoscience Australia headquarters, so quality checks were made long after the survey was completed. Unfortunately, the positioning of measurement points was not accurate.

From his experience in airborne surveys and data acquisition methods, Mr Pownall was determined to develop a more automated method of gathering and storing data. With fellow staff member Tony Veness, he designed and constructed a prototype. Subsequently, five units were used in the Newcastle and Botany Bay surveys.

This phase-one unit employed a Global Positioning Satellite receiver (GPS). Site information was recorded on a laptop computer that eliminated manual recording. But the equipment only allowed rudimentary quality control. Data conversion and processing still took considerable effort on return to headquarters. Nevertheless, the equipment halved processing time.

Another drawback was the cumbersome equipment. The seismic recorder used to detect tremors was not ideal for this type of work. It had fixed data formats and minimal data storage. The overall acquisition system was not user friendly and required considerable operator training.



The seismic recorder was replaced by a laptop running a LabView application and a 24 bit four-channel analogue to digital converter. This has resulted in a 20% increase in the efficiency of data collection.

This version is half the cost of the previous system and enables real-time quality control of results. Contouring is used to detect anomalies in the data. As well, the equipment enables an overview of readings, which means survey staff can determine if the separation of measurement sites need to be changed to suit the survey area. At the end of each day, data is loaded onto a base PC and burnt onto a CD. All data is integrated with ArcView GIS.

To enable data processing to be carried out in the field one of the unit's engineers, Malcolm Gamlen, investigated Fast Fourier Transform (FFT). To do this, he wrote an application in MATLAB that enabled fast processing of data on a laptop. Geoscience Australia's Trevor Dhu has since enhanced the application. This has resulted in processing time being reduced from months to days so that survey staff can now return from the field with the final product.

This system has been successfully used in the recent Perth 2001 microtremor survey to record over 3000 data points.

For more details phone Cities Project GIS Manager, Greg Scott on +61 2 6249 9132 or e-mail greg.scott@ga.gov.au

EVENTScalendar

Compiled by Steve Ross

■ **PDAC 2002: Convention & International Trade Show**

Prospectors & Developers Association of Canada

10 to 13 March
Toronto, Canada

Contact: Prospectors & Developers Association of Canada, Floor 9,
34 King Street East, Toronto,
Ontario M5C 2X8, Canada

phone +1 416 362 1969

fax +1 416 362 0101

e-mail info@pdac.ca

www.pdac.ca

■ **AAPG 2002: Annual Meeting & Exhibition**

American Association of Petroleum Geologists

10 to 13 March
Houston, Texas

Contact: American Association of Petroleum Geologists, PO Box 979, Tulsa Oklahoma
74101-0979, USA

phone +1 918 560 2679

fax +1 918 560 2684

e-mail convene@aapg.org

www.aapg.org

■ **APPEA 2002: Conference & Exhibition**

Australian Petroleum Production & Exploration Association

21 to 24 April
Convention & Exhibition Centre, Adelaide

Contact: Julie Hood, APPEA Ltd,
GPO Box 2201, Canberra ACT 2601

phone +61 2 6267 0906

fax +61 2 6247 0548

e-mail feedback@appea.com.au

www.appea.com.au

■ **16th AGC-Geoscience 2002: expanding horizons**

Geological Society of Australia

30 June to 5 July
Convention & Exhibition Centre, Adelaide

Contact: Organising Committee, 16th AGC,
PO Box 6129, Adelaide SA 5001

phone +61 8 8227 0252

fax +61 2 8 8227 0251

e-mail 16thagc@sapro.com.au

www.gsa.org.au

■ **Applied Structural Geology for Mineral Exploration & Mining Symposium**

Australian Institute of Geoscientists

22 to 25 September
WMC Conference Centre, Kalgoorlie

Contact: Jocelyn Thomson, Australian Institute of Geoscientists, PO Box 606,
West Perth WA 6872

phone +61 8 9226 3996

fax +61 8 9226 3997

e-mail aig@aig.asn.au

HYDEN SCARP

research *cuts* through
notions about earthquakes



Most seismic hazard maps rely on the assumption that future large earthquakes will occur in the same regions as historic ones.¹ However many recent surface-faulting earthquakes in stable continental regions such as Australia have occurred in essentially aseismic areas—for example, the 1986 Marryat Creek and 1988 Tennant Creek earthquakes.²

Surface-rupturing faults in stable continental regions generally have episodes of activity separated by quiescent intervals of tens of thousands of years.^{3,4} On the human time-scale, the hazard posed by a single fault is therefore small.

If there are other potentially seismogenic faults in a region, the risk is greater. (Potentially seismogenic faults are those favourably oriented for movement in the current stress field.) Assessments of earthquake hazard therefore need to be based on comprehensive geologic data. It is important to know the number and distribution of potentially seismogenic faults, and their long-term behaviour patterns.

Palaeoseismology initiative

The science of searching for these potentially seismogenic faults, and of characterising and cataloguing recent fault movement, is known as palaeoseismology. Geoscience Australia's Neotectonics Project is collaborating with other researchers interested in exploring the palaeoseismicity of the Australian continent.

In July this year, Geoscience Australia structural geologist Dan Clark participated in a trenching investigation of the Hyden Fault scarp in Western Australia (figure 1). University of Western Australia geoscientists Professor Mike Dentith and Dr Karl-Heinz Wyrwoll initiated the project with a university research grant.

Hyden scarp

The Hyden scarp⁵ is approximately 300 kilometres east of Perth in a relatively aseismic part of the most seismically active area within the Australian plate—the South West Seismic Zone. A 36-metre-long by four-metre-deep bulldozer trench was excavated close to the southern end of the 30-kilometre-long and 2.5-metre-high northerly trending scarp. The structures revealed in the trench (and a previous United States Geological Survey trench³) indicate that one or two large, shallow earthquakes formed the scarp.

The fault's geometry is consistent with thrusting under east–west directed compression, similar to nearby scarps at Meckering, Calingiri and Cadoux. The Hyden Fault therefore is potentially seismogenic in the current stress field.

Empirical relationships developed to estimate the magnitude of prehistoric earthquakes in Australia² suggest that one magnitude 6.8 event or two magnitude 6.0 events are required to produce the observed fault length and scarp height at Hyden. These statistics are comparable to those for the 1968 Meckering earthquake,⁶ which resulted in extensive disruption to utilities and lifelines, and millions of dollars in damage.

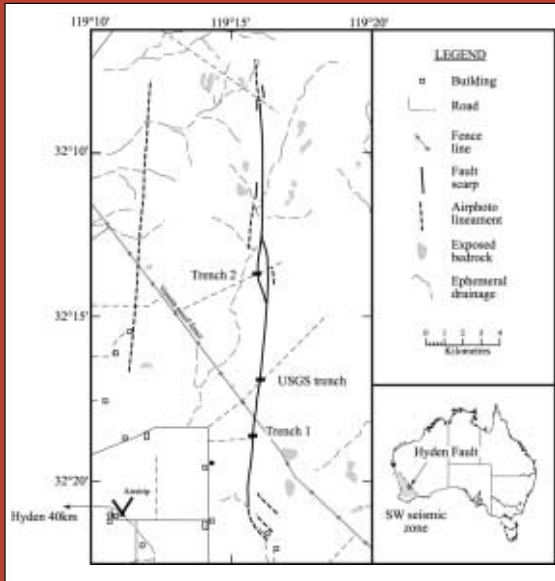
Call for research proposals for beyond

Submissions by FEBRUARY 18, 2002

The Australian National Seismic Imaging Resource (ANSIR) seeks bids for research projects for experiments in 2002 and beyond.

ANSIR is Australia's major national research facility in the earth sciences. It was created to encourage and assist world-class research and education in the field of seismic imaging of Earth. It operates a pool of state-of-the-art seismic equipment suitable for experiments designed to investigate geological structures from environmental and mine scale through to continental scale. ANSIR is operated jointly by the Geoscience Australia and the Australian National University.

ANSIR AUSTRALIAN NATIONAL SEISMIC IMAGING RESOURCE



▲ **Figure 1.** The Hyden Fault scarp showing the location of the trench (trench 1) and the USGS trench. A second trench was aborted after striking bedrock at 1.5 metres depth.

Further analysis

Ongoing research is trying to put quantitative constraints on the preliminary assessment. Terrain modelling, based upon four detailed spirit-levelling traverses, will be used to determine the most probable dip of the master structure underlying the scarp. With this information and new detailed aeromagnetic data, the research team can better estimate the in-section movement that would be needed to produce the scarp and the horizontal component of slip.

A selection from nine samples collected from the trench will be dated using optical luminescence methods in Beijing later this year. These results will help establish the number of movement phases represented by the exposed structures in the trench profile, and constrain the time(s) of faulting. The age data will also help correlate the structures in this trench with those described from the USGS trench, located four kilometres to the north (figure 1).

The dating, modelling and geophysical information will be used to derive an accurate estimate of the number and magnitude of surface-rupturing earthquakes that have occurred on the Hyden Fault. This information will provide insights into the long-term behaviour and activity patterns of the South West Seismic Zone faults. Such data will improve earthquake hazard assessments for the zone, which currently rely on the unproven assumption that future large earthquakes will recur in the same regions as historical events.

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2. McCue KF. 1990. Australia's large earthquakes and recent fault scarps. *Journal of Structural Geology*; 12:761–766.
3. Crone A, de Martini P, Machette M, Okumura K & Prescott J. 2001. Palaeoseismicity of aseismic Quaternary faults in Australia: Implications for fault behaviour in stable continental regions. *Bulletin of the Seismological Society of America*; submitted.
4. Crone A, Machette M & Bowman J. 1997. Episodic nature of earthquake activity in stable continental regions revealed by palaeoseismicity studies of Australian and North American Quaternary faults. *Australian Journal of Earth Science*; 44:203–214.
5. Chin RJ, Hickman AH & Thom R. 1984. Hyden 1:250 000 geological series explanatory notes. Perth: Geological Survey of Western Australia.
6. Gordon F & Lewis J. 1980. The Meckering and Calingiri earthquakes October 1968 and March 1970. Perth: Geological Survey of Western Australia, bulletin 126.
7. Featherstone W, Dentith M, Dent V, Wyrwoll K, Clark D & Yanchou L. 2001. Transfer of vertical geodetic control using only one GPS receiver: A case study from palaeoseismology; in prep.



For more information about the Hyden Fault scarp phone Dan Clark on +61 2 6249 9606 or e-mail dan.clark@ga.gov.au

EXPERIMENTS IN 2002

ANSIR equipment is available to all researchers on the basis of merit, as judged by an Access Committee. ANSIR provides training in the use of its portable equipment, and a field crew to operate its seismic reflection profiling systems. Researchers have to meet project operating costs.

Details of the equipment available, access costs and likely field project costs, as well as the procedure for submitting bids for equipment time are available on the web at <http://rses.anu.edu.au/seismology/ANSIR/ansir.html>. This web site also shows an indicative schedule of equipment for projects that arose from previous calls for proposals.

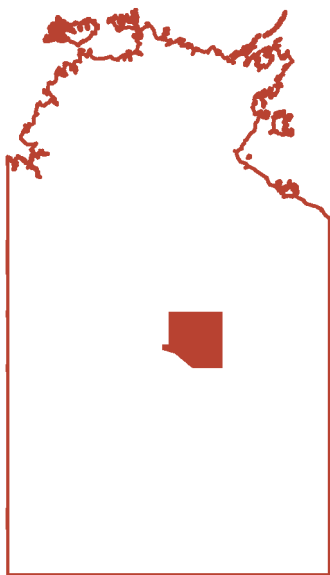
Over the next year, controlled source equipment will be used on both sides of the continent. People interested in proposing piggy-back experiments should contact the ANSIR Director for details of the scheduled experiments. The long-period portable instruments are in heavy demand; potential users are urged to submit bids at the earliest opportunity. Spare capacity on short-period portable instruments in 2002 is anticipated.

Researchers seeking to use ANSIR in 2002 and beyond should submit research proposals to the ANSIR Director (see right) by February 18, 2002.

Enquiries should be directed to:

- **Dr Barry Drummond** (for projects requiring ANSIR's seismic reflection equipment) ANSIR Director, GPO Box 378, Canberra ACT 2601. Tel. +61 2 6249 9381 or e-mail barry.drummond@ga.gov.au or
- **Prof Brian Kennett** (for projects requiring ANSIR's portable seismic recorders), Research School of Earth Sciences, Australian National University, Canberra ACT 0200. Tel. +61 2 6215 4621 or e-mail brian.kennett@anu.edu.au

TENNANT INLIER GRAVITY DATA FREE

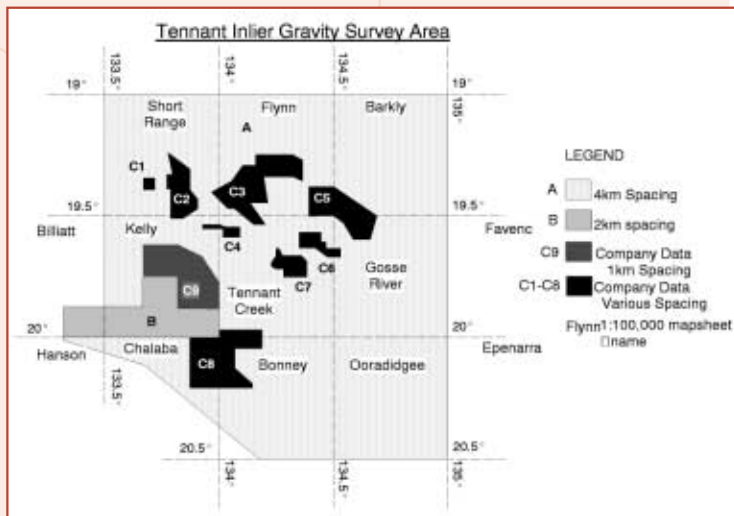


Point located gravity data for part of the Tennant Creek Inlier, Northern Territory is available free via e-mail or on CD-ROM to bona fide interested parties. The data set of 24 370 stations comprises newly acquired data (1605 gravity stations), existing data from companies (20 346 stations), and some previously released data from the National Gravity Database (2419 stations).

The gravity data set covers the entire Tennant Creek 1:250 000 sheet area and parts of the Bonney Well, Green Swamp Well and Lander River 1:250 000 sheet areas.

Geoscience Australia and the Northern Territory Geological Survey acquired the data as part of the National Geoscience Agreement.

The new gravity data were acquired in July this year. Giants Reef Mining and Normandy Mining supplied the company data which were acquired at various spacings in the years 1990–2001. The previously released data are from surveys conducted between 1960 and 1982.



To obtain a copy of the Tennant Inlier gravity data via e-mail or CD-ROM phone Peter Percival on +61 2 6249 9478 or e-mail peter.percival@ga.gov.au

BIG CHANGE FOR FUNDAMENTAL SPATIAL DATA

If you use fundamental spatial data, read on because the price of this data and access to it has changed due to a Commonwealth Government policy announced by the Minister for Industry, Science and Resources, Senator Nick Minchin on September 25.

Geoscience Australia data affected by the new Spatial Data Access and Pricing Policy include:

- geophysical coverages (magnetic, radiometric, gravity and elevation data);
- digital geology datasets;
- databases related to geochemistry, geochronology, mineral deposits, stratigraphy and petrography; and
- bathymetry and marine potential field data.

Whenever possible data will be provided free of charge over the internet. Otherwise products will be distributed at the marginal cost of transfer, which has been determined as \$99 per CD (includes GST). These new provisions will be phased in over six months.

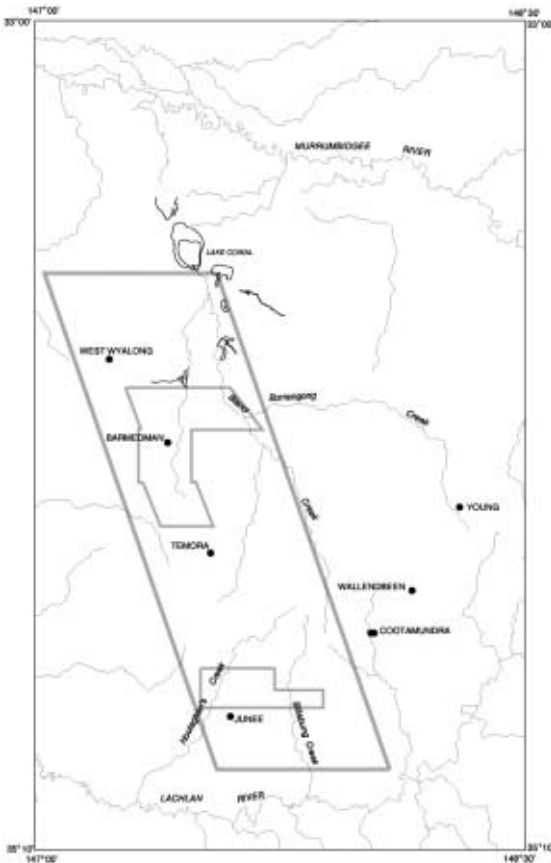
Data will not necessarily be sold in the current product format, but may be bundled into regional- or national-scale data sets. The two major product areas affected by this arrangement are geophysical data and digital geology.

The Magnetic Grid of Australia, the Gravity Grid of Australia and the Australian Gravity Database will be provided as entire data sets. Point-located magnetic, radiometric and elevation data, and grid data at higher resolutions will be provided on a project basis as defined in the Index of Airborne Geophysical Surveys (record 2001/14). There may be several projects on one CD, depending on the data density. Digital geology will be bundled into regions that are currently still being defined.

Delivery of products at marginal cost of transfer will not commence until February 2002. But the Sales Centre is taking orders for data from December 3. This arrangement will allow staff to prepare sufficient stock to meet demand.

For more information phone the Sales Centre staff on +61 2 6249 9519 or e-mail sales@ga.gov.au

TEMORA–JUNEE geophysical data package released



▲ Location of the two Gilmore Project AEM survey areas within the Cootamundra 1:250 000 map sheet

Airborne geophysical data from the Temora–Junee region in the Cootamundra 1:250 000 sheet area, New South Wales, were released by Geoscience Australia at the end of October as a package of five CD-ROMs.

The major part of this package is the earth conductivity data derived via EMflow conductivity depth imaging (CDI) and layered earth inversions (LEI) algorithms from 7700 line kilometres of TEMPEST electromagnetic and magnetic data. World Geoscience Corporation gathered the data from January to March 1999.

The survey was flown at 150-metre line spacing along east–west lines. The nominal terrain clearance was 120 metres for the transmitter, while the receiver was towed 100 metres behind and 55 metres below the aircraft.

The TEMPEST system operated at a 25 Hz base frequency with a square waveform, 10 ms pulse width and an average moment of 27 900 Am². The sample rate of the receiver was 13 μs, giving the system a bandwidth of 25 Hz to 37.5 kHz. The processed electromagnetic B field window amplitude data and magnetic data were released by Geoscience Australia in April 2000.

In addition to the TEMPEST data, the CD-ROM package contains point-located and gridded-magnetic and gamma-ray data from three 50-metre and 80-metre line spacing surveys flown by Kevron Geophysics in the Temora–Junee region.

The data in the package were acquired as part of a co-operative research project funded by the Bureau of Rural Sciences, CRC AMET, Geoscience Australia and CRC LEME. The package can be purchased for \$495 from the Geoscience Australia Sales Centre. Prices include GST but not postage and handling.

For more details about this five-CD package known as the 'Gilmore geophysical data package' phone Ross Brodie on +61 2 6249 9607 or e-mail ross.c.brodie@ga.gov.au

New work program reflects shift in emphasis

Minister for Industry, Science and Resources, Senator Nick Minchin announced in August that Geoscience Australia would shift its emphasis from surveying and mapping the Australian continent to finding geoscience solutions for issues and problems in urban centres, oceans and coasts, and regional and rural areas. The recently released Geoscience Australia Work Program for 2001–02 reflects this change.

While Geoscience Australia continues to promote resources exploration and investment in Australia, it is extending its work in natural hazards assessments, land management and the management of Australia's marine environment.

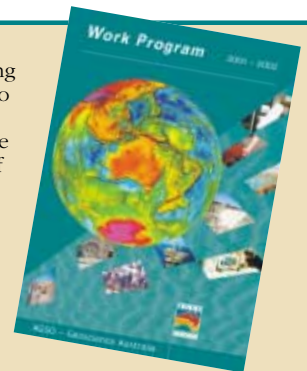
The Work Program summarises the 50 projects that Geoscience Australia is undertaking this year. These include the Law of the Sea project, which is defining the outer limit of the extended continental shelf around Australia and its territories, and Geoscience Australia's involvement in the CRC for Landscape Environment and Minerals Exploration where

regolith research is charting new territory. There is also the Perth Cities Project, which aims to improve the community's awareness of natural hazards and its capability to address the risks posed by those hazards.

Geoscience Australia plans to deliver nearly 200 items and services in the form of maps, data sets, databases, reports and advice to federal, state and local governments.

The Work Program is available from the web at www.ga.gov.au. A limited number is available in print.

For more details phone Gail Wright on +61 2 6249 9174 or e-mail gail.wright@ga.gov.au



Just released: Two new maps for the goldfields

Two new solid geology maps (Leonora solid geology 1:250 000 sheet, and Laverton solid geology 1:250 000 sheet) were released by Geoscience Australia in November. The maps are derived from interpretation of 400-metre line spaced aeromagnetic data and outcrop data from the 1:100 000 sheet mapping undertaken over the past decade.

The sheet areas cover parts of several greenstone belts: Agnew, Mount Clifford, Yandal–Murrin, Malcolm, Margret and Merolia belts. These highly prospective belts comprise approximately 25 per cent of the mapped area. Granite and gneiss account for most of the balance of the area's Archaean rocks.

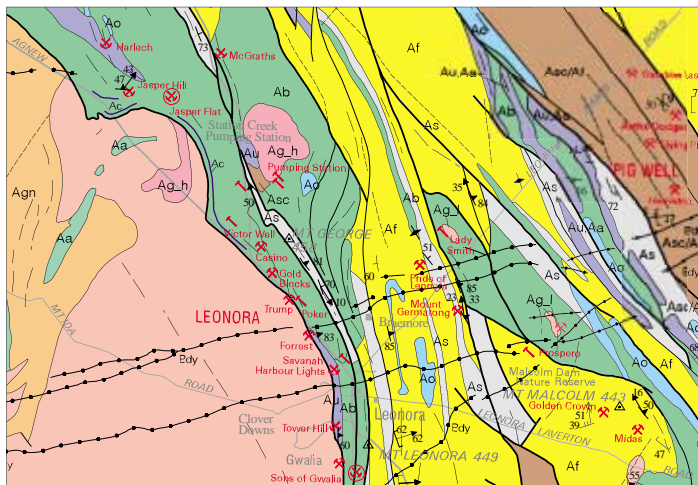
The greenstone belts are inferred to have formed over the time interval of 2710–2665 million years, with significant granite intrusion over the interval 2690–2640 million years. The greenstones are dominantly composed of basalts with subordinate intrusive equivalents, felsic volcanic rocks, and fine-grained to conglomeratic sedimentary rocks. Ultramafic rocks and banded iron formation occur throughout the sequences. Major faults or shear zones cross the map sheets and are aligned north to north-north-west; subordinate structures are less coherently oriented.

The Leonora and Laverton sheet areas host several major gold deposits at Sons of Gwalia, Emu, Tarmoola, Granny Smith, and Wallaby, nickel at Murrin Murrin, and rare-earth elements and phosphate at Mount Weld. Numerous smaller deposits (mostly gold, but also nickel, base metal and uranium) occur throughout the region. Most large gold deposits discovered to date are in greenstone, but there are significant deposits (e.g. Tarmoola and Granny Smith) that are largely hosted by granitic rocks.

The solid geology maps provide an invaluable plan of the distribution of prospective rocks and crosscutting faults for a region that crops out poorly. The maps also place known deposits in their regional context, which should greatly assist mineral exploration.

Paper copies of the Leonora and Laverton maps cost \$55 each (including GST) plus postage and handling. Digital data cost \$165 (includes GST). To purchase these products please complete the enclosed order form and fax or mail it to the Geoscience Australia Sales Centre.

For more information about the Leonora sheet, telephone Richard Blewett on +61 6249 9713 or e-mail richard.blewett@ga.gov.au. For details about the Laverton sheet, phone Alan Whitaker on +61 6249 9702 or e-mail alan.whitaker@ga.gov.au



SW PACIFIC PETROLEUM PROSPECTS ON CD



Information about petroleum prospects in the south-west Pacific—particularly the petroleum potential and data holdings of Vanuatu, Solomon Islands, Fiji and Tonga—has been released on CD. The information is drawn from the SOPAC (South Pacific Applied Geoscience Commission) Petroleum Data Bank, which is managed by Geoscience Australia.

The data bank has approximately 4200 seismic tapes and 1700 seismic sections and maps, collected by petroleum exploration companies and research vessels since 1972. This amounts to 45 000 line-kilometres of data.

Much of the data was gathered in the 1980s under a SOPAC Tripartite Project involving the United States, Australia and New Zealand. Australia's contribution to this program was several million dollars through AusAid, as well as a lot of support from research organisations such as Geoscience Australia.

The decision to store the SOPAC offshore hydrocarbon data at Geoscience Australia was made in 1988. Geoscience Australia was to provide storage and a person to administer the data. Funding was from AusAid through SOPAC. This arrangement has been reviewed several times and no changes have been made. Canadian aid agencies provided two professional staff to SOPAC for some years to find, catalogue and organise the data.

To date this year, four petroleum exploration companies and five institutions have requested information and data on petroleum prospects in the south-west Pacific. All data held in the data bank are open file.

A copy of the CD *Petroleum Prospecting South West Pacific 2001* costs \$40. This price includes postage and handling. There is no GST on this product. The CD can be ordered from the data manager, Peter Butler by phoning +61 2 6249 9475 or faxing +61 2 6249 9980.

For further information about the SOPAC Petroleum Data Bank contact Peter Butler as above or e-mail peter.butler@ga.gov.au

Regolith maps warrant another look at western NSW

The bedrock of the Barrier Ranges near Broken Hill has been popular for mineral exploration for more than 100 years. But in most of western New South Wales these same highly prospective rocks are covered by regolith. Because of this cover, the area is not attracting the exploration interest it warrants.

To encourage mineral exploration, CRC LEME has been supporting a systematic regolith-mapping program for the Broken Hill region. This has resulted in the release of three new detailed regolith-landform maps at 1:25 000 scale: Triple Chance, Redan, and Kinalung West–Quondong West. These maps complement the series of 1:25 000 geological maps produced by the Geological Survey of New South Wales.

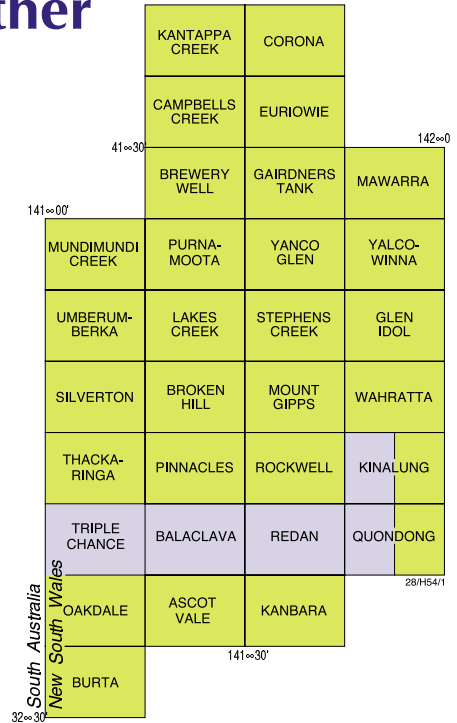
The Balaclava 1:25 000 regolith-landform map released last year was the first of the Broken Hill regolith-landform series. The popularity of this product prompted the three additional 1:25 000 maps, so that a set of adjoining maps is now available for a section of the southern part of the Broken Hill Domain and the northern Murray Basin (figure 1).

For exploration geologists this provides a representation of the location of potential geochemical sampling media, associated surficial dispersion pathways, and areas that can be treated similarly in exploration surveys and later data interpretation. The maps also provide valuable information about the landscape for land managers, including a detailed representation of soils, areas and types of erosion and sedimentation, and the dominant vegetation coverage.

A regional 1:100 000 regolith-landform map of the Broken Hill Domain and adjacent areas has also just been released. This map covers an area equivalent to the 1:100 000 Broken Hill bedrock stratigraphic map. The map shows the main regolith types and landform expressions for the region such as within the Mundi Mundi Plain, northern parts of the Murray Basin, a large part of the Eurioiwie Block, and the landscapes associated with Adelaidean rocks flanking the Broken Hill Domain.

The mapping program has been largely driven by the research of CRC LEME honours students. It is funded through CRC LEME by the Broken Hill Exploration Initiative (BHEI) and Discovery 2000. The release of more adjoining maps in the series is planned.

The regolith-landform maps (1:25 000 and 1:100 000 scale) cost \$55 each from CRC LEME in Perth. The price includes GST but not postage and handling. To purchase one of these maps phone Sue Game on +61 8 6436 8695 or e-mail susan.game@csiro.au.



▲ **Figure 1.** 1:25 000 regolith-landform maps released by CRC LEME (darker shaded area). The entire area is covered by the recently released 1:100 000 Broken Hill regolith-landform map.

For further information about these products and the mapping program phone Steve Hill +61 2 6201 5446 or e-mail hill@scides.canberra.edu.au.

CENTRAL AUSTRALIA metamorphic map on demand

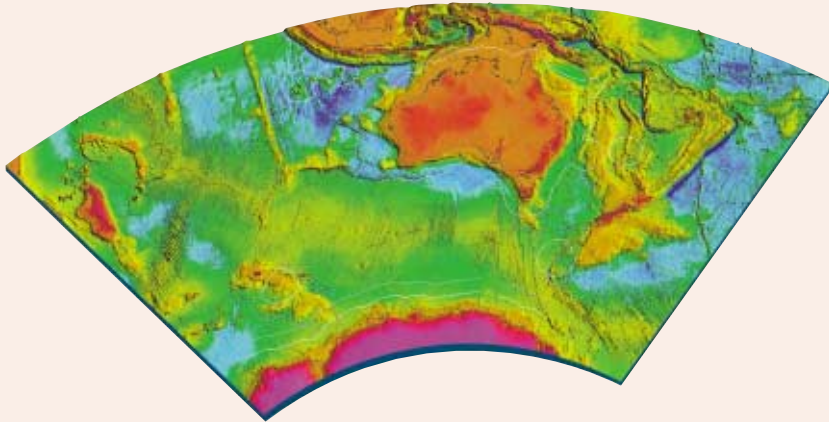
A metamorphic map of central Australia that covers the Arunta, Tanami and Tennant Creek regions has been produced by Geoscience Australia and the Northern Territory and Western Australian Geological Surveys as part of the North Australia Project. It is a compilation of published information, largely from 1:250 000 and 1:100 000 maps and explanatory notes, as well as unpublished data from geologists working in the area.

The map provides a useful overview of the distribution of metamorphism in central Australia. It depicts the 'dominant' metamorphic grade of rock units and shows in detail the generally high-grade Arunta Province, which has been extensively mapped by Geoscience Australia, NTGS and university geologists.

The map has been produced at 1:850 000 scale, to give best representation at A0 size. It is available as a print-on-demand product from the Geoscience Australia Sales Centre for \$49.50 (includes GST but not postage and handling). The map eventually will be available in digital form as part of the North Australian GIS dataset that is currently in preparation.

For more details phone David Maidment on +61 2 6249 9389 or e-mail david.maidment@ga.gov.au

UN Law of the Sea *made simple* in education resource



Australia is responsible under a United Nations Convention for part of three large oceans (Pacific, Indian and Southern), or approximately 11 million square kilometres of water. This responsibility involves proper management of coastline, water and seabed, and any resources such as fish and petroleum. It gives Australia the third largest fishing zone in the world, and a search and rescue area equivalent to one-ninth of the Earth's surface.

Many countries including Australia are examining the seabed and sub-floor in their territories to compile a submission to the United Nations that would extend their access to marine areas.

Geoscience Australia is about to release an excellent educational resource that looks at the scientific processes that Australia must carry out to make a UN submission to access an additional four million square kilometres of extended continental margin (e.g. areas near Heard and Macquarie Islands). Areas of extended continental margin may contain important economic resources.

Even though the 'Law of the Sea' resource is aimed at secondary teachers and students, it is the best product currently available that clearly outlines, in plain English, the United Nations Convention on the Law of the Sea (UNCLOS) and its development over time.

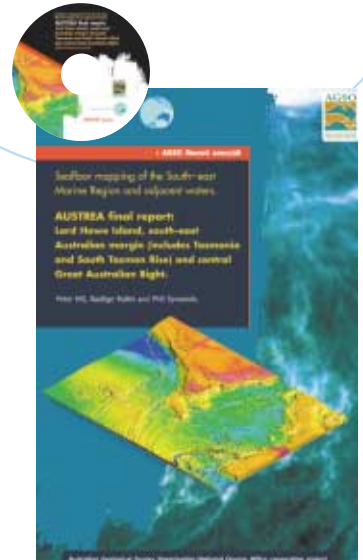
The resource describes how the various marine boundaries are defined under UNCLOS, and includes numerous maps and diagrams to illustrate the concepts involved. It outlines how Australia can apply the provisions of UNCLOS Article 76 in a submission to extend its access to marine areas. Three case studies (the North West Shelf, Antarctica, and orange roughy—a large, deepwater fish with low reproductive rates that is highly sought by the fishing industry) are included to outline the main elements of Australia's submission. A comprehensive glossary of relevant terms helps clarify concepts and content. And for those who wish to search further, there is a list of references and relevant web sites.

For teachers who are considering this product, the resource includes 108 pages of curriculum-linked teacher notes, student activities that can be photocopied, and suggested answers. Student activities are suitable for years eight to 12 students in such subject areas as geology, environmental science, general science, geography, maths and legal studies.

Law of the Sea: Teacher notes and student activities on Australia's offshore territory, or record 2001/38, can be purchased from the Geoscience Australia Sales Centre for \$16.50 (includes GST) plus postage and handling. To obtain a copy, please complete the enclosed order form and return it to the Sales Centre.

For further information about the content and applicability of the resource, phone Cindy Hann on +61 2 6249 9673 or e-mail cindy.hann@ga.gov.au

Seabed off SE Australia revealed in detail



LONG-AWAITED PALAEO MAPS AVAILABLE DIGITALLY

At last! The Palaeogeographic Atlas of Australia series is being released in digital format as a set of 10 CD-ROMs. The original compilation took place in the 1980s, but for funding reasons only six atlases (Cambrian, Ordovician, Silurian, Permian, Jurassic and Cretaceous) of the 10 Phanerozoic time periods were ever published.

The original atlases were compiled at 1:5 million scale using MicroStation CAD software. All 10 have been converted into a format compatible with GIS applications. The conversion was undertaken by Colin Johnson of Geoscience Australia with partial funding from the Australian Geodynamics Cooperative Research Centre.

Geoscience Australia completed two major seabed swath-mapping and geophysical surveys off south-east Australia and Macquarie Ridge early last year. Record 2001/08 is the final and very detailed report of the south-east Australian section of the two surveys (AUSTREA-1 and AUSTREA-2).

National Oceans Office and Environment Australia commissioned the AUSTREA surveys. They were designed to provide important new scientific information about the seabed in accord with Australia's Ocean Policy and Australia's Marine Science and Technology Plan. The work was done mainly for marine zone planning and management, but also for assessing seabed resources (e.g. petroleum, minerals and marine life).

Together the surveys swath-mapped about 260 000 square kilometres of seabed (which is more than three times the size of Tasmania) and collected about 21 000 kilometres of geophysical profile data, including 15 000 line-kilometres of reflection seismic data.

The south-east section of the surveys cover an area from Lord Howe Island in the east, to the central Great Australian Bight in the west, to the southern tip of the South Tasman Rise in the south.

Marine protected areas such as the Lord Howe Marine Park, the Benthic Protection Zone of the GAB Marine Park and the Tasmanian Seamounts were mapped, as were all major deep-sea trawl fisheries off Tasmania.

Among the output of these surveys are high-resolution maps and images of a large area of seabed over which only generalised bathymetry maps were previously available. Spectacular submarine landscapes have been recorded, showing deeply incised canyon systems, high cliffs, fields of volcanic cones, and large isolated volcanic seamounts.

AUSTREA-2 completely mapped Cascade Seamount, which in recent years has become a major orange roughy and dory trawl fishery, and found it to be a volcanic guyot 650 metres deep with a multitude of small volcanic cones on its flanks. Several large volcanoes, part of the Balleny hot-spot chain, were mapped on the eastern margin of the South Tasman Rise.

Multichannel reflection seismic and 3.5 kHz profiles provided information on the nature and depth of seabed sediments and sedimentary basins, with several potential petroleum basins indicated off Tasmania. Gravity and magnetic profiles produced additional information on the underlying geology, including basement rocks. Oceanographic data collected along the way will be used for further marine research.

The AUSTREA swath-bathymetry and backscatter data were merged with earlier surveys and data sets, including major multibeam surveys that have been conducted by Geoscience Australia since 1994. A regional interpretation of the merged data sets, in terms of major sea-floor structures and geological domains, has been completed. The primary and derived spatial seabed data sets can be further interrogated to predict the distribution of specific sedimentary facies and benthic habitats.

Record 2001/08, titled *AUSTREA final report: Lord Howe Island, south-east Australian margin (includes Tasmania and South Tasman Rise) and central Great Australian Bight*, by Hill, Rollet and Symonds costs \$33 (includes GST) plus postage and handling. The record comprises 85 text pages, 57 pages of maps and figures, and a CD for those who want to view the report digitally. To purchase a copy please complete the enclosed order form and return it to the Geoscience Australia Sales Centre.

For more information about the report or the AUSTREA surveys phone Peter Hill on +61 2 6249 9292 or e-mail peter.hill@ga.gov.au

The set of CDs contain:

- approximately 140 digital maps, metadata and documentation;
- ArcInfo coverages generated using ESRI ArcInfo version 7.2.1;
- Microsoft Powerpoint slide presentation.

The atlases are available as bundles of three or four, or as a set of 10 CD-ROMs from the Geoscience Australia Sales Centre. It is expected that eventually users will be able to download them directly from the web. For viewing ease, a simple animation of the maps in PowerPoint is available via the web (www.ga.gov.au).

Reference numbers and prices for the Palaeogeographic Atlas of Australia are as follows. Prices include GST but not postage and handling.

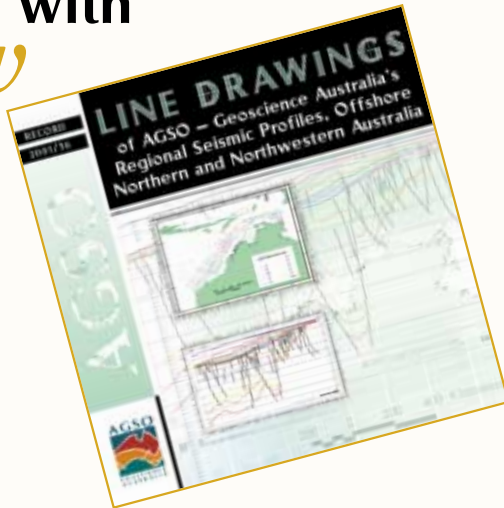
- Vols 1–3 Cambrian (#35842), Ordovician (#35841) and Silurian (#35840) – \$99;
- Vols 4–6 Devonian (#35843), Carboniferous (#35844) and Permian (#35845) – \$99;
- Vols 7–10 Triassic (#35846), Jurassic (#35847), Cretaceous (#35948) and Cainozoic (#35849) – \$99;
- Set of 10 CDs (#35880) – \$297.

The digital version of the Palaeogeographic Atlas of Australia will be of considerable interest to many people including the mineral and petroleum exploration industries, academic institutions and the general public. The GIS files allow users to build on what has been compiled, and the maps will be easy to update as new scientific data becomes available.

For more details about these products phone Russell Korsch on +61 2 6249 9495 or e-mail russell.korsch@ga.gov.au



GET A LINE on NW margin with *new* CD



For a rapid overview of the structural and stratigraphic architecture of the continental margin of northern and north-western Australia, grab this CD of line-drawing interpretations (record 2001/36), which has just been released by Geoscience Australia.

In the 1990s, Geoscience Australia recorded approximately 35 000 kilometres of regional, mostly deep (commonly 15s TWT record length), 2D seismic reflection data along the continental margin from North West Cape in the south to the eastern Arafura Sea in the north. The data were collected primarily to provide a structural and tectonic framework for petroleum exploration in the region, and as an aid to understanding the margin's geological evolution.

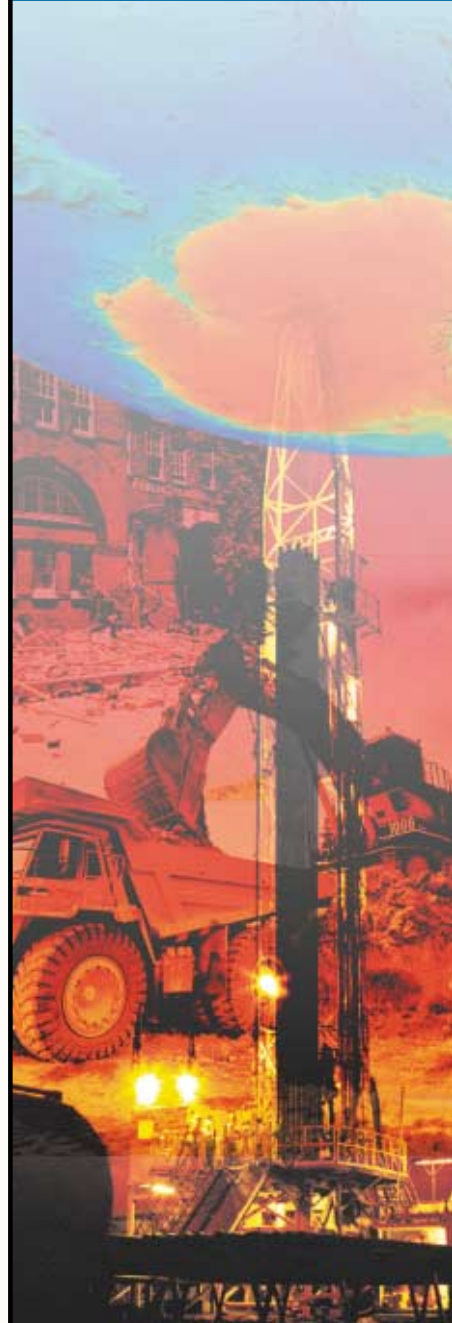
Record 2001/36 provides line-drawing interpretations of all 168 lines that make up the regional seismic grid. In addition to interpreted horizons and faults, the line drawings show ties to key petroleum exploration wells and line intersections. (Shot point locations are not included, however.)

The record complements the earlier release by Geoscience Australia of ASCII files of digital data of the interpreted horizons and faults. The line drawings are supplied as 'pdfs' and can be selected either by clicking on the desired line on a base map, or by selecting from a bookmark 'pick-list'. Each line drawing is also provided as a postscript file to assist with plotting.

Horizons that are routinely interpreted through the grid include: water bottom, late Miocene, base Miocene, mid-Oligocene, base Eocene, base Tertiary, Turonian, Aptian, Valanginian, base Cretaceous, Callovian, base Jurassic/top Triassic, mid-Triassic, near-top Permian, late Carboniferous, and 'basement'. These are supplemented by other horizons determined by the local geology; for example, mid-Carboniferous, intra-Devonian, and mid-/late Cambrian in the Arafura Basin, and early and mid-Carboniferous in the Petrel Sub-basin.

Record 2001/36: *Line drawings of interpreted regional seismic profiles, offshore Northern & Northwestern Australia* is available from the Geoscience Australia Sales Centre for \$50 (includes GST but not postage and handling). To purchase a copy please complete the enclosed order form and return it to the Sales Centre. Details of the costs involved in purchasing the seismic trace data that underlie the interpretations are available from Geoscience Australia's marketing agents, TGS-Nopec by phoning +61 8 9480 0021 or e-mailing rachelm@tgsnopec.com.au.

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



WEB - REVAMP

to *improve* access

The Geoscience Australia web site has been renovated. It is much more streamlined for faster searches and has improved access to online maps and data. Below is a taste of what to expect from the new site ...

www.ga.gov.au



Projects

All of Geoscience Australia’s scientific projects can be located under three areas: Geoscience for Urban Centres, Geoscience for Oceans and Coasts, or Geoscience for Rural and Regional Areas. A brief summary of every project is provided in one of these sections. Some projects have additional technical information that can be accessed through a summary page. New information about how projects are proceeding is listed on this summary page.

Projects can be accessed from the home page and the left-hand navigation bar that is displayed on all pages.

Data

If you are looking for online data, this section has a summary of all databases that Geoscience Australia has developed and maintains, and includes a link to the Petroleum Data Repositories, and the National Geoscience datasets. As more Geoscience Australia data comes online, it will be accessible through these pages.

Online maps

This section of the web enables users to develop maps online, download maps, and obtain fundamental datasets, either free of charge or for the cost of data transfer. The online maps are accessible from the home page, as well as from the relevant project pages.

Fact sheets

Fact sheets offer general information about a wide range of geoscience topics. These pages, written in non-technical language, explain the fundamental science behind Geoscience Australia research. The information will help non-geoscientists understand the relevance of geoscience to their work and lives.

Fact sheets are divided into themes and can be accessed by the left-hand navigation bar on most pages. The entire list of fact sheets is available through the education pages. New fact sheets are regularly added.





Subscribe

One of the newest features of the Geoscience Australia site is the automated subscriber service. There are 'subscribe' lists for minerals, oil and gas, hazards, *AUSGEO News* and many other topics.

Through this service, users can subscribe to a number of e-mail lists to keep up-to-date on project developments, new products, data releases and other news in areas of interest. Users can subscribe and unsubscribe automatically. Their details are private and secure.

The 'subscribe' feature can be accessed from the left-hand navigation bar on most pages.

Education

Information about Geoscience Australia's education services, including teacher workshops and resources can be found through these pages. A complete list of all fact sheets, including the more technical notes, is accessible through the education pages. As well, there are links for students to the 'Minerals Downunder' and interactive 'Remote Sensing' pages.

The education section can be accessed from a navigation bar at the top of every page.

Media

The media pages contain information about Geoscience Australia, specifically developed for journalists. Media releases, speeches and media events are listed in this section of the site. The 'Media Room' contains background information, images and other useful tools.

The media section is accessible through a navigation bar at the top of every page.

Library

Through this page, users can trawl through the extensive Geoscience Australia Library collection of journals, books and maps. There is also general information about the library's opening hours and facilities, and detailed information about its collections and how to access its reader services, including inter-library loans and literature searching.

The library page is accessed through a navigation bar at the top of every page.

Sales

The Sales Centre pages provide information about data and other products sold by Geoscience Australia. There is a direct link to an online catalogue as well as postage and handling details. There is also a page of Sales Centre 'specials'.

The Sales Centre is accessed through a navigation bar at the top of every page.

NATIONAL MAPPING

National Mapping (formerly AUSLIG) is a new division of Geoscience Australia and is linked to the home page. A visit to the National Mapping pages offers information about access to a wide range of spatial data.

The Geoscience Australia web site is worth a quick visit. Have a look around, and bookmark it. On the home page there is an online feedback form for user comments. Feedback about the renovated site is appreciated.

For more information about the Geoscience Australia web site phone Gary Lewis on +61 2 6249 9570 or e-mail gary.lewis@ga.gov.au