SPATIAL INFORMATION FOR THE NATION

AUSGEO news

SEPTEMBER 2002 ISSUE No. 67

NATURALISTE PLATEAU
a continental fragment

Sea change
for marine geoscientist

MORE TO SEA
with *new* surveys

PP 255003/00048

Also: New benthic mapping method, more products from gold territory, four new marine reports...

AUSGEO News
September 2002
Issue no. 67

Editor Julie Wissmann

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Geoscience Australia continues its research offshore to gain a better understanding of the sea-floor and determine possible areas for a submission to the United Nations on the extended continental shelf. See articles on pages 6, 11 and 14, as well as product news.

***Photo:** Australian Picture Library/John Carnemolla*

In 1952, Bureau of Mineral Resources (now Geoscience Australia) volcanologist Tony Taylor received the George Cross—an award for 'acts of the greatest heroism or of the most conspicuous courage in extreme danger'—for his work during the eruptions of Papua New Guinea's Mt Lamington in 1951. These eruptions killed about 3000 people and the impact could have been more devastating except for Taylor's alerts to rescue workers, based on his daily visits to the crater and overnight camps at the base of the volcano to measure activity.

For almost 21 years Taylor continued to study and document volcanic activity in PNG and nearby regions in the Pacific, often at great personal risk. Much of his groundbreaking work published in the late 50s, particularly on the Lamington eruption, remains the most complete and authoritative analysis of pyroclastic flows and the growth of lava domes.

On August 19, 1972, Taylor died during fieldwork on Manam volcano in PNG. But the Rabaul Volcanological Observatory (RVO), that BMR sent Taylor to re-establish in 1950 after Allied bombing in World War II, continues to provide a vital service for community safety.

To celebrate Taylor's legacy, on August 19 in Canberra, Geoscience Australia, the RVO, and PNG High Commission launched a series of 10 public-awareness posters about volcanic hazards in PNG and the role of the RVO. These were produced at Geoscience Australia as part of an AusAID project and will be used at the RVO for visitor and community education.

Taylor's wife, son, daughter and grandson attended the launch in Geoscience Australia's headquarters.

These posters are a small part of the vital, behind-the-scenes role that Geoscience Australia plays in community safety from natural hazards.

Inside this issue you will see that we have just launched a major report on earthquake risk in Newcastle and Lake Macquarie, and that we are continuing our research into earthquake activity in south-west Western Australia. You will also see that we have established another GPS station in the south Pacific, on Betio Island, so that neighbouring countries can obtain precise measurements of land motion and determine rises in absolute sea level, which could affect their islands.

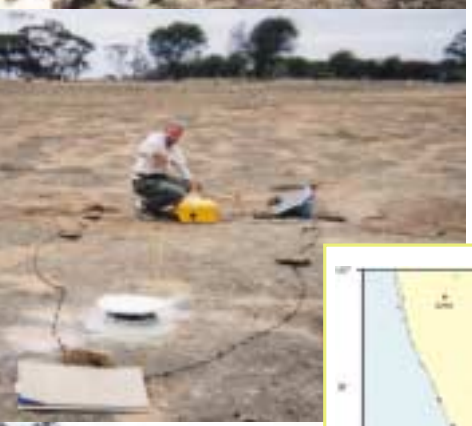
Comment

Neil Williams

NEIL WILLIAMS
CEO Geoscience Australia

Photo: Australian Picture Library

TEMPORARY MEASURES
for long-term signs of strain



Just how stressed is Australia? There is one way to find out and that involves setting up temporary stations in Australia's most seismically active area and taking some very accurate measurements using Geoscience Australia's GPS (global positioning satellite-system) network, then coming back in two years and five years and taking the same measurements.

In May this year, Geoscience Australia seismologists and colleagues from Western Australia and New Zealand measured the precise position of 49 locations spread over a 250 by 400 kilometre wheat-growing area of Western Australia that has been Australia's most seismically active region for 30 years. These measurements set the base level for comparisons in coming years.

'Earthquake activity in the south-west seismic zone in Western Australia is more active than many areas of New Zealand', says Geoscience Australia seismologist, Dr Mark Leonard.

'But in Australia you don't get the dramatic movement in the Earth's crust and the mountain building seen in comparable seismically active areas elsewhere in the world', he says.

Since September 28 last year, more than 18 thousand earthquakes (most of them aftershocks) have been recorded in the area, near the town of Burakin.

Earthquakes indicate where Australia is deforming. The measurements taken at the 49 stations should show the size, direction, and whether deformation is uniform over the region or constrained to a narrow fault zone.

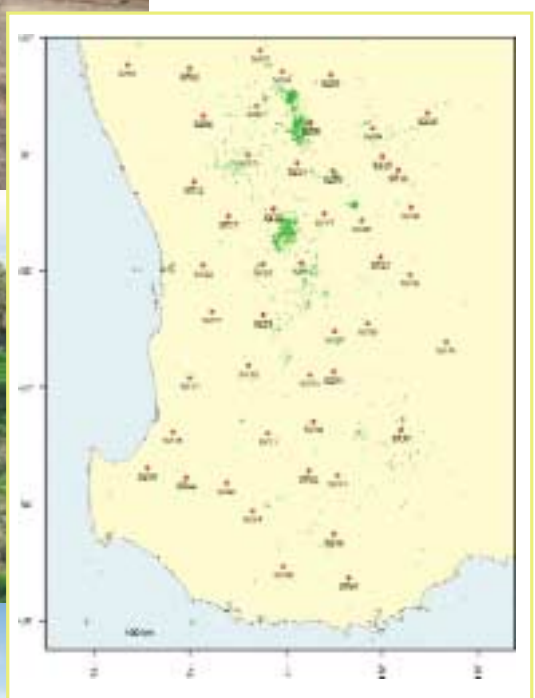


Figure 1. The red dots show the GPS stations that were 'occupied' for a week in May. The green dots indicate known earthquakes in the region.

Teachers: For ideas on how to use this article in the classroom see www.ga.gov.au/education

Leonard says that elsewhere in the world where scientists have looked for evidence of deformation, such as in New Zealand, Canada and Japan, it has been found.

But Australia is an ancient continent with a thick layer of soil and sediment in places that readily covers evidence of earthquakes. Any evidence that has surfaced, such as a fault or scarp, is often quite weathered and difficult to study.

'We know that the southern half of Australia is being squeezed in an east–west direction from borehole stress measurements and studying earthquakes that have broken the crust', says Leonard.

'But we don't know how much the Australian continent is being deformed by this pressure, and whether the deformation is uniform or only in certain areas.

'We may find that there is just one narrow strip running down the middle of the earthquake zone that is deforming, or that deformation is less than we can measure', he says.

Geoscience Australia had five stations in the region that took measurements for three weeks in May. The other 44 stations were 'occupied' for one week.

Each temporary station, which looks like a stainless steel plate the size of a bread and butter plate with an antenna attached, was

cemented into a rock. When the survey was completed, the antenna was removed.

Despite overcast weather, wildlife chewing on cables and some battery failure, quality baseline measurements were obtained and are stored by Geoscience Australia in readiness for the next survey or when the stations are 'reoccupied'.

Leonard is certain that in two and five years' time, they will have enough suitable data to detect even tiny regional strain rates.

'We should be able to take two points, 100 kilometres apart on either side of the earthquake zone and see if they have moved possibly as little as a tenth of a millimetre over the years', he says.

Earthquakes can occur in a region for decades and then disappear. If deformation is a less than half a millimetre over five years, Leonard says the current frequency of earthquakes in the south-west seismic zone has to be 'short-lived'.

'They can't go on at the current rate for hundreds or thousands of years, because there would not be enough deformation', he says.

'If we can't see any deformation, then seismicity in the region must be episodic.'

The GPS survey of Western Australia's south-west seismic zone was undertaken by Geoscience Australia, in collaboration with the New Zealand Institute of Geological and Nuclear Sciences, and Western Australia's Department of Land Administration, Curtin University and the University of Western Australia.

The GPS network allows direct measurement of both the absolute and relative movement of stations. Using temporary GPS stations overcomes the large spacing between permanent stations (1000–1500 km), and will help resolve whether areas of high seismicity are deforming more than areas of low seismicity. Traditional surveying methods used up to the mid-1990s had an unacceptable margin of error for calculating relative deformation and could not determine very small changes.

The survey is part of Geoscience Australia's Neo-tectonic Earthquake Hazard program, which is trying to better define and understand earthquake occurrence in Australia and build a more accurate seismic map of Australia. The existing seismic map, produced in 1990, shows past earthquakes and assumes that they will occur again in the same areas.

For more information phone Mark Leonard on +61 2 6249 9357 or e-mail mark.leonard@ga.gov.au

Let's have a look: Parramatta Park State School Year 5 student, Stephen Wilesmith dons 3-D glasses to examine Geoscience Australia's latest education resource, a colourful map of Queensland. Photo by Pasco Rogato, courtesy of the *Cairns Post*

New perspective of state map

Cairns primary school students gained a new perspective of their state, when a 3-D map of Queensland produced by Geoscience Australia, was launched at Parramatta Park State School on July 16.

The map shows Queensland's key geological features on land and offshore, including mining areas, the world's largest sand-island (Fraser Island), reefs, extinct undersea volcanoes and deep abyssal plains.

Warren Entsch, Parliamentary Secretary to the Minister for Industry, Tourism and Resources, who launched the map says that it allows Queensland children to see ancient geological formations in a very new light.

'When the map is viewed with 3-D glasses, the elevations of the land mass and ocean depths are striking', he says.

Land terrain is from Geoscience Australia's digital elevation model; the sea-floor was modelled from the organisation's bathymetric database and satellite data. The 3-D effect was created by hill shading, using sun-angle elevated at 45 degrees from the north-east.

The map is being distributed to schools, libraries and educational and community groups across Queensland through state and federal members of parliament. A copy of the map is available free of charge from Geoscience Australia's Communications Unit.

The 3-D glasses and Queensland map are a couple of the many resources produced by Geoscience Australia's education team aimed at encouraging children to enjoy studying the Earth and learning about their country.

For more information phone Mary Walsh on +61 2 6249 9236 or e-mail mary.walsh@ga.gov.au

Sediment origin focus of next MARINE SURVEYS

Geoscience Australia scientists join two separate marine expeditions on the *Southern Surveyor* in the first half of next year to resolve a couple of questions about sediments that have geoscientists puzzled.

The first expedition will try to find the offshore volcanic rocks that provided eastern Australia with volcanic-rich sediments. The second plans to unravel reasons why sediment in the Gulf of Carpentaria is predominantly from land instead of from marine organisms.

The 21-day expedition in the Norfolk Basin in February and March 2003 primarily will focus on the origin of volcanic-rich sediments found in the thick sequences of the Gippsland, Otway and Eromanga basins. It is thought that subduction and volcanism east of Australia in the Cretaceous and early Cainozoic (120–45 million years ago) created these sediments. However, rocks that match the composition and age of these sediments have not been found on nearby land or dredged from sea-floor ridges.

Professor Tony Crawford of the University of Tasmania will lead the expedition. He hopes to determine the extent and location of Cretaceous subduction, and whether the New Caledonia Basin developed as a backarc basin to a missing volcanic arc.

Dr Neville Exon and his four-member Geoscience Australia team will target continental basement rocks and Cretaceous to Miocene sediments of the micro-continental ribbons in the region. Scarps of the Norfolk–New Caledonia Ridge, the Three Kings Ridge, and in-between ridges will be dredged. Sites for dredging will be based on swath-maps and seismic profiles gathered during the FAUST-2 Geoscience Australia–French expedition in December 1999.

The second expedition in the Gulf of Carpentaria focuses on the sources and sinks of sediment in Australia's largest area of continental shelf. In this region, land-derived sediment predominates over calcareous material derived from marine organisms, which is unusual for Australia's continental shelf. A major aim of the expedition is to gain a better understanding of seabed habitats and processes that can affect them.

Acoustic seabed mapping, seabed and sub-seabed sampling, as well as oceanographic observations will be used to compile data about local processes and environments in the region over the past 20 thousand years. The 33-day expedition, planned for May and June 2003, will be led by Geoscience Australia's Dr Peter Harris.

Many previous marine geoscience expeditions involving Geoscience Australia scientists were carried out on the research vessel *Franklin*. This vessel has been decommissioned as the 'national facility' and replaced by a larger ship, the *Southern Surveyor*. The *Southern Surveyor* is being upgraded by CSIRO Marine Research to increase its geoscience capabilities, add new facilities for fisheries and environmental research, and provide more opportunity for multidisciplinary research.

University geoscience research cruises make up the remainder of the *Southern Surveyor* program early next year.

For more information about the planned marine surveys phone Neville Exon on +61 2 6249 9347 or e-mail neville.exon@ga.gov.au

National Atlas agreement signed

The National Atlas project is a joint Geoscience Australia and Minerals Council of Australia initiative, with the assistance of $50 000 from the Commonwealth Government's Regional Minerals Program.

The core components of the National Atlas will be on-line by June 2003. These include small-scale interactive maps and links to related internet sites with up-to-date, regional and location-specific data and visuals. Satellite imagery and other thematic coverages (e.g. agriculture, transportation infrastructure, climate, environment, geology, population, energy reticulation and water) will be added progressively to help users in their analysis and assessment of commodity-specific issues.

The atlas will be an authority on minerals and mining in Australia (historical, scientific, economic, societal and environmental) and a 'virtual' showcase of the industry for global audiences. It will provide answers to the many inquiries Geoscience Australia and the Minerals Council receive from the public, investment bankers, insurance brokers and risk consultants to the mining industry, regarding basic mining industry research, resource development, and technical matters about processing.

All smiles after formalising funding arrangements. Pictured (left to right) at the launch of the National Atlas project on July 8 in Geoscience Australia's Canberra headquarters: Mitch Hooke (Chief Executive, Minerals Council of Australia), John Hartwell (Head, Resources Division, Department of Industry, Tourism and Resources), seated, Chris Pigram (Chief, Minerals and Geohazards, Geoscience Australia), and Neil Williams (CEO, Geoscience Australia).

For more information phone Bill McKay on +61 2 6249 9003 or e-mail bill.mckay@ga.gov.au

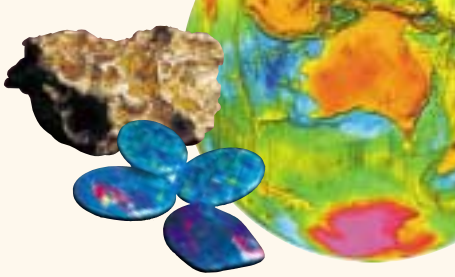
Public place for satellite IMAGERY

Geoscience Australia became a little part of Australian history on July 22 when a four-metre high mosaic of its Landsat-7 imagery of Australia went on permanent display in Commonwealth Place, a new area for the public between Old Parliament House and Lake Burley Griffin in Canberra.

Prime Minister John Howard officiated at the unveiling of the first part of Commonwealth Place—a public arena with an open grassed area for community gatherings, concerts and celebrations. Visitors see the Landsat-7 mosaic as they follow the sandstone walkway to the main arena.

The mosaic is divided into nine vertical slivers, reproduced on toughened glass with a light source behind it to accentuate the diverse colours. The Australian Greenhouse Office commissioned the mosaic, which was produced by Geoimage.

The huge mosaic attracts the attention of all that pass along the walkway, and will no doubt increase public awareness of satellite imagery and remote sensing.



Earth science, *a public affair*

Earth Science Week is an international event for the public that runs from October 13–19 this year, and Geoscience Australia is coordinating the Australian activities.

Australia's official launch is mid-week with a nationwide KIDS QUAKE on October 16. Outside Parliament House in Canberra, about 100 primary school children will jump continuously for two minutes. The effect will be recorded on one of Geoscience Australia's seismographs to demonstrate the science of monitoring earthquakes.

Geoscience Australia will also host three terrific public lectures on Sunday, October 13 with topics covering other worlds, our restless world, and the ancient world.

Australian National University Professor Ross Taylor will discuss the search for new planets. As a NASA employee, Taylor carried out the initial analysis of the first lunar sample returned to Earth, and has worked on models of the origin, composition and evolution of the moon.

Geoscience Australia volcanologist, Dr Wally Johnson will no doubt attract a diverse audience with his talk about geohazards (earthquakes, landslides, volcanoes) and their impact on communities. Young Australian of the Year and Assistant Curator of Palaeontology at the Queensland Museum, Scott Hucknull will be a crowd-pleaser with his talk and examples of ancient vertebrate.

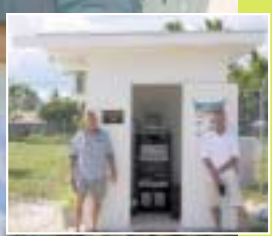
To top off Earth Science Week celebrations, Geoscience Australia's Education Centre will be hosting a series of 'volcano-making' workshops for schools, special interest groups (e.g. scouts) and after-school care programs.

Earth Science Week has been celebrated in Australia for the past three years. It aims to help the community understand the importance and impact of earth science in everyday life.

For information about Earth Science Week, including ideas on how to celebrate the week and what activities are planned, visit the Geoscience Australia web site (www.ga.gov.au/about/events/esw2002.jsp).

The National Library, National Gallery, National Museum of Australia, Canberra Museum and Gallery, Australian Reptile Centre, Questacon, Australian Botanical Gardens, CSIRO and the Deep Space Tracking Station at Tidbinbilla have events during the week. Tasmania and New Zealand are also participating through the Geological Society of New Zealand and the Centre for Ore Research at the University of Tasmania.

For more information phone Jeanette Holland on +61 2 6249 9731 or e-mail jeanette.holland@ga.gov.au



New station in *Pacific network*

The Kiribati continuous GPS (global positioning satellite-system) station officially opened at Betio Island on Saturday, August 3, is the latest station in the south Pacific GPS network, which Geoscience Australia is helping to set up as part of an AusAID-funded project.

Twelve stations are being combined with tide gauges to enable Pacific island nations to monitor climate and sea-level changes. Records indicate a rise in global sea level of up to 30 centimetres in the past century, but these may not be reliable because there are large discrepancies among measurements taken from various tide gauges.

The GPS network will provide precise measurements of land motions to help determine absolute sea-level rise and whether any islands in the Pacific are likely to be affected.

The Kiribati station was fully operational from August 4. Geoscience Australia's Bob Twilley and Steve Yates, who helped set up the station, were among more than 80 government officials, diplomats and invited guests at the opening. Australia's Ambassador for the Environment (Chris Langman), Kiribati Minister of Environment and Social Development (Kattoatika Tekee), the Australian High Commissioner (Colin Hill), and the British and Japanese High Commissioners were among the invited guests.

Other stations in the south Pacific network are on Papua New Guinea, Fiji, Samoa, Tonga, Tuvalu and Cook Island. The next one will be established on Vanuatu in September.

The GPS data collected by the network are transferred daily via the internet to Geoscience Australia's Geodesy unit.

For more information phone Bob Twilley on +61 2 6201 4346 or e-mail bobtwilley@auslig.gov.au, or visit the web (www.auslig.gov.au/geodesy/spslcmp/)

EVENTScalendar

Compiled by Steve Ross

GeoInsight workshops & seminars for emergency managers & the spatial information community

AusIndustry Technology Diffusion Program (Commonwealth Government)

August to mid-October

All Australian capital cities and some regional centres

Contact: Karen Baskerville, Technik Group, GPO Box 184, Hawker ACT 2614

phone +61 2 6254 3911

fax +61 2 6254 7949

e-mail geoinsight@technik.com.au

www.geoinsight.net.au

West Australian Basins Symposium Conference & Exhibition

Petroleum Exploration Society of Australia

20 to 23 October

Burswood Convention Centre, Perth

Contact: PESA Ltd (Western Australian Branch), PO Box 721, West Perth, WA 6872

phone +61 8 9276 3258

fax +61 8 9375 7636

e-mail pesa.sec@bigpond.au

www.pesa.com.au

Mining 2002 International Convention & Trade Exhibition

Mining 2002

30 October to 1 November

Carlton Crest Hotel, Brisbane

Contact: Mining 2002, PO Box 607, West Perth, WA 6872

phone +61 8 9485 1166

fax +61 8 9481 8023

e-mail abbie@verticalevents.com.au

www.mining2002.com.au

Coast to Coast 2002—Source to Sea

Coastal Council of New South Wales & Queensland Government Environmental Protection Agency

4 to 8 November

Twin Towns Services Club, Tweed Heads

Contact: Sally Brown Conference Connections, PO Box 108, Kenmore Q 4069

phone +61 7 3201 2808

fax +61 7 3201 2809

e-mail sally.brown@uq.net.au

www.coastal.crc.org.au/coast2coast2002

Minerals Exploration Seminar 2002

Geoscience Australia

20 November (Perth), 26 November (Canberra)

Novotel Langley (Perth), Geoscience Australia headquarters (Canberra)

Contact: Joy Dunn, Geoscience Australia, GPO Box 378, Canberra ACT 2601

phone +61 2 6249 9364

fax +61 2 6249 9965

e-mail joy.dunn@ga.gov.au

www.ga.gov.au

NEW LOGGER at core of sediment studies

▲ **Figure 1.** Main components of the GEOTEK multi-sensor core logger

▶ **Figure 2.** Processed data from the GEOTEK multi-sensor core logger

Geoscience Australia and the Antarctic Cooperative Research Centre have acquired a GEOTEK multi-sensor core logger (figure 1) as the latest tool for determining environmental proxies in sediments. Cores recovered from any sedimentary environment can be analysed. The logger is proving valuable for studies of the marine environment, rivers and lakes, and an important tool for environmental management.

Data generated by the logger have been applied to Quaternary sediments in Australia to:

- assess the influence of terrigenous sediment on the development of fringing reefs in the Great Barrier Reef marine park over the past 10 thousand years;
- assess the influence of recent catchment clearance on the nutrient loadings to estuaries in south-west Western Australia;
- develop a high-resolution chronology of global climate and sedimentary environments east of Tasmania for the past 300 thousand years; and
- assess the contribution of high-salinity shelf water from Antarctica to global ocean circulation over the past 10 thousand years.

The logger produces high-resolution (~0.5 cm) records of bulk density, p-wave velocity, and magnetic susceptibility from split- and whole-sediment cores (figure 2). From these data, the processing software calculates acoustic impedance and porosity.

When used with high-resolution age data, bulk density data provide very accurate mass accumulation rates for sedimentation. The logger's magnetic susceptibility information is a good proxy for terrigenous sediment inputs in marine sediments. And acoustic impedance data can be used with seismic information to correlate lithologic changes and sub-surface reflectors over large areas.

The GEOTEK multi-sensor core logger is housed in the School of Geography and Environmental Studies at the University of Tasmania. It is available for commercial and collaborative use.

For more about the logger and its applications for geoscience research phone Andrew Heap on +61 3 6226 7674 or e-mail andrew.heap@ga.gov.au

New ACOUSTIC METHOD sounds promising for benthic mapping

New acoustic-based equipment being tested for mapping the bottoms of lakes, estuaries and coastal waterways is showing promise because it is less labour intensive than traditional benthic mapping methods, and can be used in difficult conditions in water depths from half a metre to 2000 metres. It is also easily mounted on the side of a small boat.

Owner of the new equipment, the Canadian company Quester Tangent Corporation, and Geoscience Australia and its collaborators in the CRC for Coastal Zone, Estuary and Waterway Management tested the new system in mid-June in Wallis Lake, a large wave-dominated estuary on the central New South Wales coast.

The new system (QTC View Series 5) can discriminate among seabed types based on their acoustic characteristics. It collects acoustic backscatter signals, and analyses and classifies features of the reflected signal. The QTC system also provides high-resolution bathymetric data. This information is potentially useful for mapping and monitoring benthic habitats, mapping sediment types, and as an indicator of fisheries productivity.

In areas of high turbidity and dangerous conditions, such as the macro-tidal coasts and estuaries of northern Australia where it is difficult to use traditional methods that rely on diving and remote video, the QTC system has a lot of potential.

The Wallis Lake field trials were conducted from a small converted oyster punt. The transducer (the device for transmitting and receiving acoustic signals, with a 42° x 16° beam-width) was mounted over the side of the boat.

The system captures data at speeds of up to five megahertz, and has a dynamic range to handle the high amplitudes of very shallow water echoes. The echo sounder and transducer were linked to a laptop computer for data acquisition and processing. For accurate monitoring of the position of the boat, a differential GPS (global positioning satellite-system) facility was also linked to the computer.

The fundamental echogram can be captured as base data, which minimises signal processing. This gives the QTC classification software the capacity to undertake an unsupervised 'principal components analysis' of a large number of recorded echogram parameters.

'Ground-truthing' the mapped areas to assess the effectiveness and consistency of the acoustic classification was integral to the field trials. This involved grab sampling and coring of bottom sediments, visual descriptions and photographs of substrate features, and identification of benthic vegetation.

'Ground-truth' data are currently being compared with acoustic data using a GIS (geographic information system) of the lake. Initial results show that soft muddy substrates with burrows, firm mounded substrates, marine sands and seagrass beds each provide unique and mappable acoustic signatures. A more detailed analysis of results, including a GIS of Wallis Lake, will be available later in 2002.

Wallis Lake was ideal for evaluating the QTC system because it has a diverse range of estuarine environments, including significant areas of relatively 'pristine' estuarine habitat, as well as tourism and oyster farming industries. Parts of it are well known because it has been the focus of recent work by Geoscience Australia's Coastal Waterways Management project, which studied sources of organic sediment and measured sediment denitrification rates and efficiencies.

Participants in the QTC field trials in Wallis Lake included Brendan Brooke, David Ryan, John Ryan and Colin Tindall (Geoscience Australia), Chris Elliot and Rick Pearson (Quester Tangent), Joanne Wilson and Peter Evans (NSW Department of Land and Water Conservation), John Penrose (Curtin University) and Gerard Tuckerman (Great Lakes Council).

For more information phone Brendan Brooke on +61 2 6249 9434, e-mail brendan.brooke@ga.gov.au or phone David Ryan on +61 2 6249 9257, e-mail david.ryan@ga.gov.au. A full technical description of the QTC system is available via the web (www.marine.questertangent.com/m_pr_qtcv.html).

'I like going to sea. Often we sail across areas where no-one has been before so anything we collect is new, original and useful.'

SEA CHANGE

for **Aussie geoscientist**, with UN DUTIES

At least 30 nations are combing their seaboards and charting the continental margin more than 200 nautical miles from their coastlines, planning to make submissions for seabed jurisdiction well beyond their exclusive economic zone. The United Nations through its Commission on the Limits of the Continental Shelf has brought on this bout of sea fever.

Russia has completed its surveying and analysis, and made a submission late last year for seabed in the oil-rich Arctic Ocean and parts of the Bering and Barents seas. Countries such as India, Brazil, Great Britain, Ireland, Norway and New Zealand are following suit. Australia is also involved.

On June 24 in New York, Geoscience Australia's Phil Symonds became one of an international team of 21 commissioners, who over the next five years will examine and judge submissions that could forever change some countries' maritime boundaries.

The enormity of this responsibility is not lost on Symonds.

'The boundary that the Commission recommends to the United Nations is final and binding and indicates what resources, environments, and sea-floor jurisdiction that country will control forever more', he says.

Once Australia lodges a submission, and the Commission accepts it, roughly 60 per cent of Australia's jurisdiction will be under the ocean. Australia's land area is 7.7 million square kilometres. It stands to gain about four million square kilometres of seabed and subsoil (called the extended continental shelf) beyond its 200 nautical mile exclusive economic zone. This will give Australia the right to manage the environment and any resources in that extended domain, including minerals, petroleum and any organisms that live on or beneath the sea-floor.

But a country must support its claim for additional jurisdiction with rigorous geoscientific data and analysis, to prove that its continental landmass extends under the ocean beyond the 200 nautical mile zone. It must ensure its submission meets the requirements of Article 76 of the United Nations Convention on the Law of the Sea, which sets out the rules for defining the extended continental shelf.

All members of the Commission on the Limits of the Continental Shelf are scientific specialists in such fields as geology, geophysics, hydrography and geodesy, and will readily disregard flawed arguments in submissions.

Australia has one of the biggest areas of continental shelf in the world, and it won't miss the boat because of Geoscience Australia's Law of the Sea project, which is headed by Phil Symonds.

The 14-member Law of the Sea team is preparing the rigorous scientific data required for any claim Australia might make. Through surveying, seabed sampling and use of satellite imagery, they are trying to define the foot of the continental slope and from here measure that point in the ocean where there is a change from continental rocks to oceanic rocks.

'The extended continental shelf is not based on a single distance measurement from the coastline, but on a whole series of other technical information such as the shape of the sea-floor and the thickness of sediment', says Symonds.

'Water depth, gravity, magnetic, seismic, all the usual geophysical data sets will be crucial… You have to show how data were gathered and interpreted, what equipment was used, and how the new outer limit meets the rules of Article 76, to satisfy the Commission.'

Australia's submission will be quite complex and require multiple sets of data for nine separate areas because of the island territories that comprise Australia. Symonds can help prepare Australia's submission, but he cannot serve on the seven-person sub-Commission that assesses the information and makes a recommendation to the full Commission.

The Law of the Sea project began in 1994, when the Convention on the Law of the Sea came into force. Not all of the 138 countries that are 'party' to the Convention have an extended continental shelf. Some are landlocked and don't have a maritime border. All 138 parties elect the commissioners. Australia nominated Symonds, but in his commissioner role he does not represent Australia.

Symonds has led the Law of the Sea project since it was set up. But 32 years ago he did not expect to be a marine geoscientist and that one day he could say, 'I helped set Australia's boundaries'.

He began his science career as a cadet geophysicist in Tasmania, Australia's southernmost state, using gravity techniques to study granites. In 1970, the Bureau of Mineral Resources (now Geoscience Australia) began a survey of the whole continental margin off Australia. BMR was looking for bright, young geoscientists and by serendipity, Symonds was signed on. He has been hooked ever since.

'I like going to sea. Often we sail across areas where no-one has been before so anything we collect is new, original and useful', he says.

'It is much harder to be original and useful in physics and chemistry where people have been working on problems for years and years. By comparison, marine geoscience is exciting because people want the information that you've got because it is new and it's all there is.'

But it is not all plain sailing. Seas can turn sour, equipment fails, and the scientists, technicians and crew on board weather horrible moments.

Symonds says his worst survey was in the Great Australian Bight in the early 70s.

'We had engine failure in a raging storm and couldn't turn the ship for five days. All we could do was head south into a sea that I would never have believed possible.

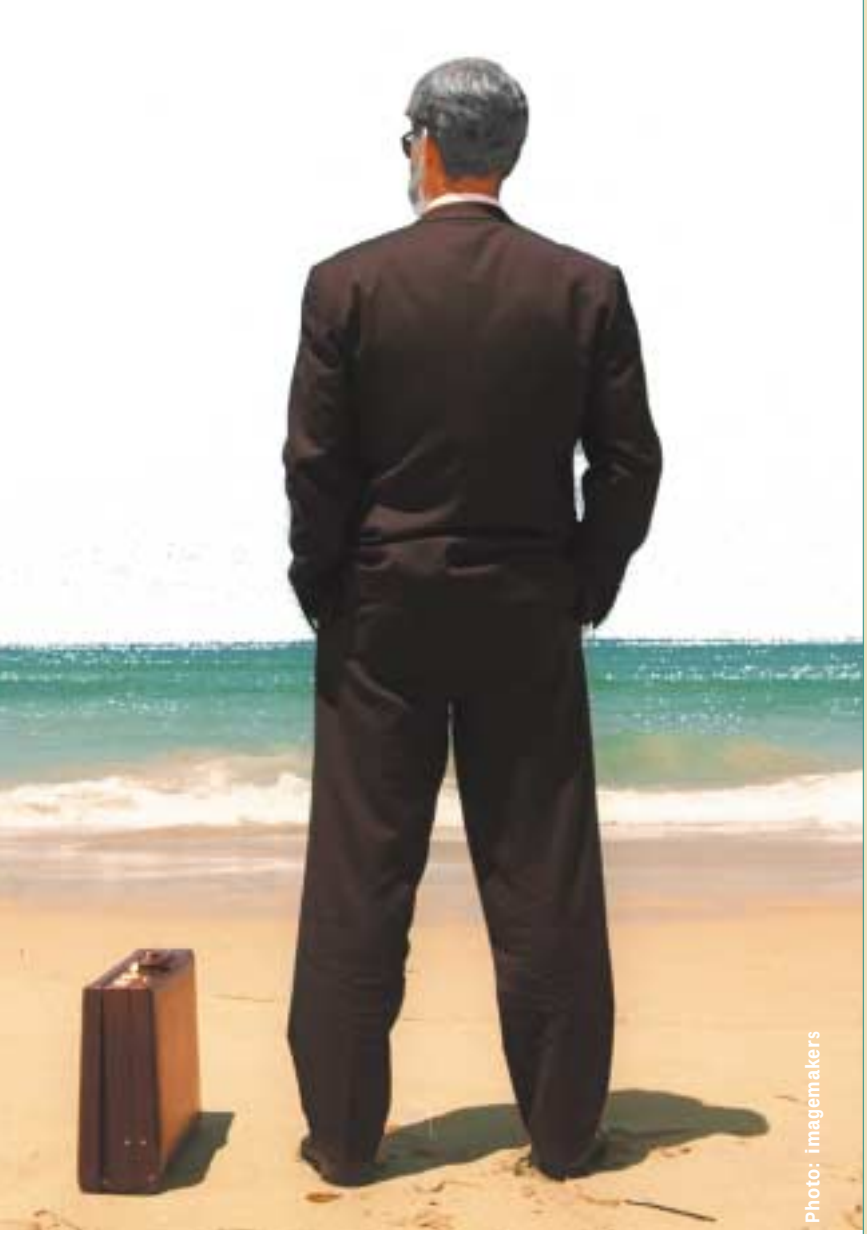


Photo: imagemakers

'I had my suitcase packed and my life jacket on the whole time.' He is at a loss to explain why he decided to pack his suitcase.

'My logic was flawed, but I was prepared', he says, now able to laugh at the peril.

Symonds says that most of his team has faced tough conditions at sea, particularly those that surveyed the Kerguelen Plateau off Heard and McDonald islands and those doing seismic surveys off Antarctica.

'Fifty to 60 degrees south can be a pretty horrible part of the world when you are in very rough seas and among icebergs that have broken off the Antarctic margin.'

Symonds says that to get the maximum amount of data, the ship works round the clock, even when there is no visibility and the icebergs have to be picked up on radar.

There are spectacular moments also, particularly encounters with wildlife. Symonds remembers one survey studying the foundations of the Great Barrier Reef when a whale shark roughly the same size as the 24-foot ship swam underneath.

Symonds has been the principal scientist on many surveys, which has put him in charge of the research, what equipment is used, and where the ship goes. This role requires a thorough understanding of the science, an ability to quickly interpret data, as well as skilful negotiation with captain and crew to constantly alter plans.

'Even though tracks are defined prior to setting out, over the 25 to 30 days we often adjust plans based on what we find on the previous survey line', he says.

Symonds has participated in a number of French, German and American (USA) marine expeditions along Australia's margins, and carried out joint surveys with New Zealand. He has been heavily involved in the international Ocean Drilling Program as chair of the Australian ODP Scientific Committee. He has advised Mauritius and New Zealand on extended continental shelf work, and visited Argentina for discussions on Australia's experiences. Recently, he was appointed a Visiting Professorial Fellow, Centre of Maritime Policy in the law faculty at Wollongong University—an unusual appointment for a geoscientist.

The life of a marine geoscientist can be hard on partners and families, even though most surveys are only three to four weeks' duration. Symonds went to sea within two weeks of the birth of his second child. And he recalls his wife, Teresa, informing him when he was in the middle of the Coral Sea, that a red-back spider was found in their young daughter's cot and that she might have been bitten. None of this, however, has deterred the father of four.

Symonds hasn't had much time to go to sea recently, though, and in the next few years that will be left to his team.

But Symonds has good reason to keep his suitcase packed, because two or three times a year for the next five years he is off to the United Nations offices in New York. In between, he will keep watch over Australia's frontiers by combing through data his team gathers, and advising Australian government officials responsible for Australia's jurisdiction on findings.

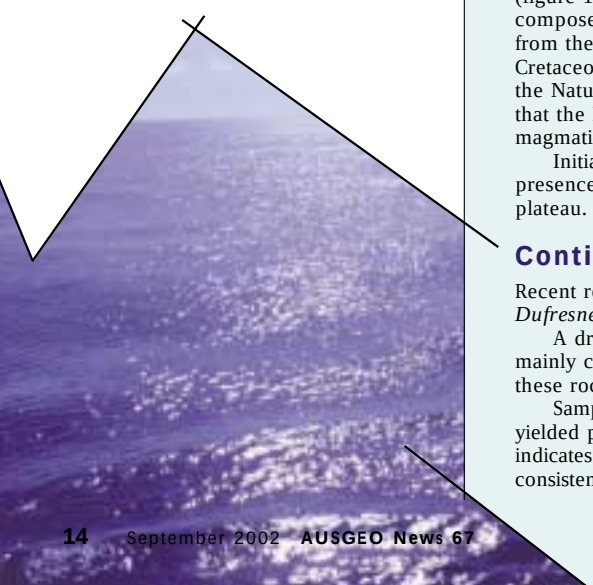
Countries that ratified the Convention in 1994 had until November 16, 2004 to make submissions for an extended continental shelf. This has been extended to 2009. Australia is working to the original deadline.

For more information phone Phil Symonds on +61 2 6249 9490 or e-mail phil.symonds@ga.gov.au

NATURALISTE PLATEAU, a continental fragment

The Naturaliste Plateau is located on the continental slope about 260 kilometres off the south-western tip of the Australian mainland (Capes Leeuwin and Naturaliste). It has been described in scientific literature as a volcanic province, formed by excessive magmatism during rifting of Eastern Gondwana around 120–130 million years ago.

A recent study by Geoscience Australia shows that the Naturaliste Plateau and the adjacent Naturaliste Trough are structural elements of the West Australian basin system, and may be related to one of Australia's oil provinces. Geoscience Australia's Irina Borissova explains.



The Naturaliste Plateau is about 90 000 square kilometres in area, and extends roughly 400 kilometres east–west and 250 kilometres north–south in water depths of 2000 to 5000 metres. The eastern half of the plateau is in Australia's exclusive economic zone. The western half lies in an area of Australian 'extended continental shelf' under the terms of the United Nations Convention on the Law of the Sea (figure 1).

Geophysical and geological data were acquired in the region in the 70s and early 80s. The data include a widely spaced grid of seismic lines, two deep-sea drilling program (DSDP) holes and one dredge site. Previous studies based on these data suggest that the Naturaliste Plateau is composed mostly of basaltic rocks overlain by Cretaceous to Recent sediments, and therefore petroleum prospectivity was rated very low.

A Geoscience Australia study of the Naturaliste Plateau, which integrated geophysical data (seismic, gravity and magnetic) with dredge-sample data collected by the French in 1998, suggests otherwise.

Oceanic origin

Two DSDP holes were drilled on the Naturaliste Plateau in the early 70s (figure 1). Volcaniclastic conglomerates at the base of one hole were composed of tholeiitic basalts, and similar composition rocks were dredged from the north-western slope of the plateau. Add this information to Early Cretaceous plate-tectonic reconstructions of the Indian Ocean that showed the Naturaliste Plateau close to the Kerguelen hotspot, and it was concluded that the Naturaliste Plateau is a Large Igneous Province with a thick magmatic crust formed above a major mantle plume.

Initial analysis of the seismic data collected in the 70s showed the presence of pre- break-up rift basins, suggesting a continental origin of the plateau. But these findings were often ignored.

Continental origin

Recent results from a large sampling program by research vessel *Marion Dufresne* in the Diamantina Zone in 1998 has changed thinking.

A dredge sample from the southern slope of the Naturaliste Plateau mainly comprised metamorphic rocks. Petrographic analysis and dating of these rocks show that they are largely Cambrian gneisses.

Samples taken from the Diamantina Zone south of the Naturaliste Plateau yielded peridotites at many locations. Geochemical analysis of these rocks indicates that they are similar to peridotites from continental margins, which is consistent with a continental origin for the Naturaliste Plateau.

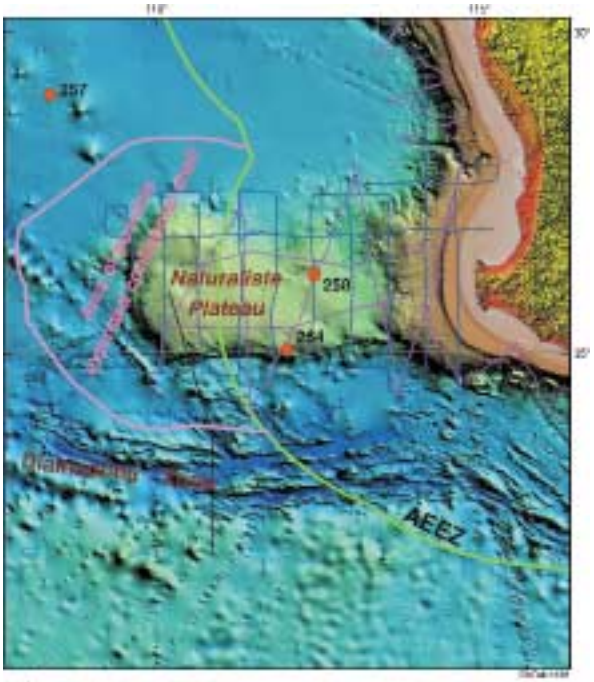


Figure 1. Bathymetric image of the Naturaliste Plateau region showing the location of seismic lines used in the Geoscience Australia study, and the DSDP sites. The green line shows Australia's exclusive economic zone (AEEZ) and the pink line indicates the preliminary outer limit of extended continental shelf.

A re-examination of basaltic rocks previously recovered from the Naturaliste Plateau shows that they are similar to the Bunbury Tholeiitic Suite (132–122 Ma) on mainland Australia.

Geoscience Australia's recent framework study of the Naturaliste Plateau area suggests that basement beneath most of the plateau and the Naturaliste Trough contains extensional structures typical of continental margins. The two major basement types identified are seismically highly reflective basement and faulted and folded laminated basement. On the southern margin of the plateau, gneisses were dredged from seismically highly reflective basement. Laminated basement has never been sampled, but may represent Palaeozoic sediments.

Basins

There are many small rift basins on the Naturaliste Plateau (figure 2). The largest is in the south-eastern part of the plateau (Southern Rift Basin, figures 2 & 3). It consists of several en-echelon rift segments, and gradually widens to the south-east. Sediment thickness in individual segments is up to 2.5 kilometres, but the segments are fairly narrow (about 5–10 km wide).

The largest sedimentary basin in the Naturaliste Plateau area lies beneath the Naturaliste Trough. It has been interpreted as a separate basin, the Mentelle Basin, rather than part of the Perth Basin. The regional unconformity at the top of the basin's syn-rift section has been correlated to the Valanginian break-up unconformity in the Perth Basin. The basin fill is likely to contain Late Jurassic to Early Cretaceous sediments.

Rift systems in the Naturaliste Plateau, Naturaliste Trough and the shallow basement to the east (figure 2) probably formed in the Middle Jurassic to Early Cretaceous. Structurally they represent a transition from the Permian–Early Cretaceous rift systems in the Perth Basin on the Western Australian continental margin, to the Late Jurassic–mid-Cretaceous rift systems of the Bight Basin on the southern margin.

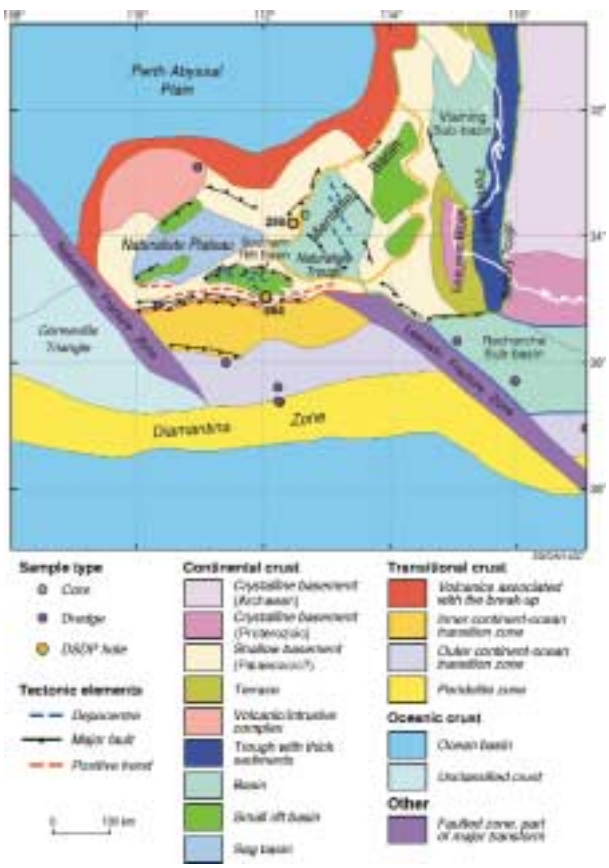


Figure 2. Tectonic provinces and structural elements of the Naturaliste Plateau region

Petroleum

The study area lies adjacent to the southern Perth Basin, which has proven petroleum systems. Depocentres in the southern Perth Basin (Vlaming Sub-basin, Bunbury Trough) contain up to 10 to 15 kilometres of sediments. Depocentres in the Naturaliste Plateau, however, typically contain less than three kilometres of sediment fill confined within narrow grabens. Sediment thickness in these depocentres is marginal for hydrocarbon generation.

The western Mentelle Basin (beneath the Naturaliste Trough) is the largest depocentre in the study area and contains four to five kilometres of sediment. It includes about a kilometre of Early Cretaceous sediments and at least 1.5 kilometres of Jurassic section (figure 3). Based on the southern Perth Basin, source rocks are likely to occur in lateral equivalents of Middle–Late Jurassic Yarragadee Formation and Early Cretaceous Parmelia Formation.

Overburden above the Cretaceous section is insufficient for petroleum generation. Jurassic source rocks may be within the oil window, however. The Early to Late Cretaceous section could be represented by marginal- to shallow-marine sediments, and contain sealed reservoirs.

Water depth is the biggest deterrent to petroleum exploration in the Naturaliste Plateau region. Most of the plateau and the Mentelle Basin lie in more than 2500 metres of water. But if oil has been generated in the Naturaliste Trough area from the Mentelle Basin, it is likely to have migrated to the east where traps may occur in much shallower water depths.

A more detailed petroleum system analysis of the region may upgrade the petroleum potential of the Mentelle Basin.

For further information phone Irina Borissova on +61 2 6249 9658 or e-mail irina.borissova@ga.gov.au, or phone Barry Bradshaw on +61 2 6249 9035 or e-mail barry.bradshaw@ga.gov.au

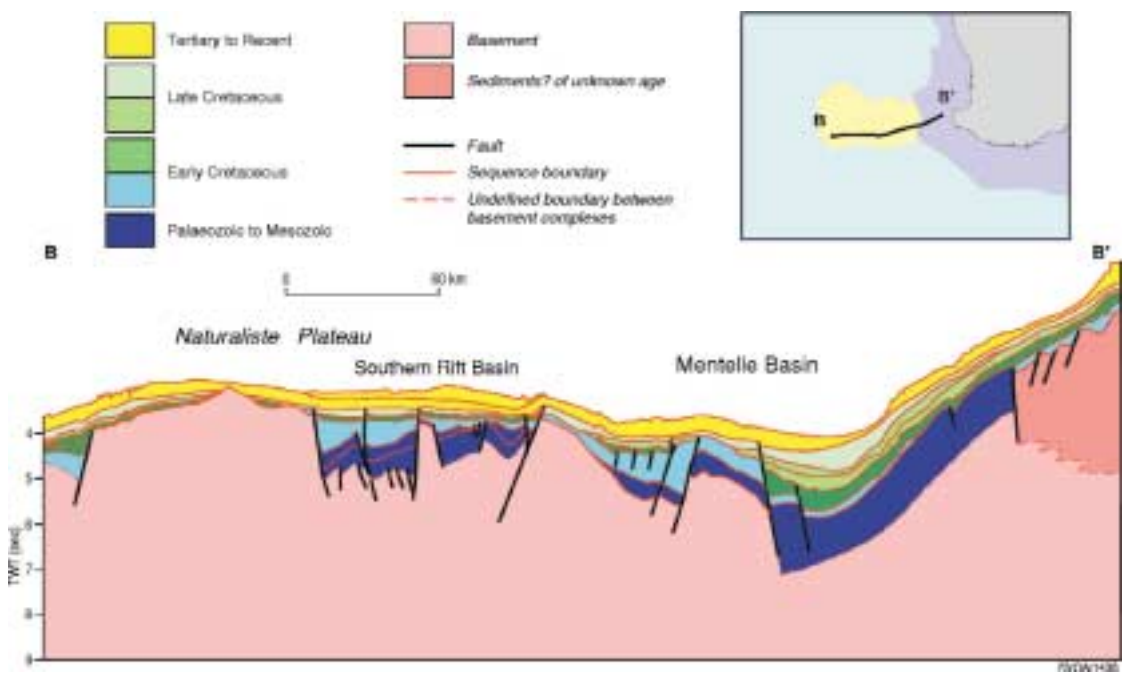


Figure 3. West to east cross-section through the Naturaliste Plateau based on interpreted Shell 'Petrel' seismic line, N325

Marine records reveal much about eastern Australia offshore

Geoscience Australia has released four records detailing recent marine surveys off south-east Australia and in the Norfolk Ridge–Three Kings Ridge region. These surveys were carried out to improve understanding of the geological development of this vast area for Regional Marine Planning, to help assess frontier petroleum potential, and for data that may be needed for a submission to the United Nations Commission on the Extended Continental Shelf.

The evolution of south-east Australia and the south-west Pacific is complex, because over the past 100 million years, the region has experienced many geological events that broke continents apart and shaped the present-day land and sea-floor. The four records help clarify what happened and in what sequence based on recent seismic, sampling and coring programs in the region.

FAUST survey (records 2001/27 & 2002/08)

The FAUST-2 Australia–France sea-floor mapping survey concentrated on the Norfolk Ridge–Three Kings Ridge region and an area within the eastern part of Australia's 200 nautical mile exclusive economic zone around Norfolk Island. The survey area is about 500 kilometres from the nearest plate boundary. An area of about 186 000 square kilometres was mapped.

The western section of the survey, directly east of Norfolk Island, reveals an eastward-directed spur of the Norfolk Ridge that dips into a sea-floor covered by many small volcanoes. In the central section, the sea-floor is more subdued and appears to run perpendicular to the Cook Fracture Zone. The eastern section reveals a prominent north–south trough that is flanked by seamounts and steep scarps. A broad terrace separates it from the main axis of Three Kings Ridge.

The northern section is dominated by the central axis of the steeply flanked Cook Fracture Zone. In some places there are perpendicular ridges, suggesting sea-floor spreading. The Cook Fracture Zone is a very young feature and the area is experiencing movement (supported by several recent earthquakes at the northern tip of Three Kings Ridge). There was no evidence for the extension of the Cook Fracture Zone into the South Fiji Basin. It appears to be an oceanic fault that separates the South Fiji Basin to the north from the Forster Basin to the south.

Three dredges of the sea-floor in different places during the survey revealed mantle-derived rocks and volcanic material with large amounts of silica, carbonate and manganese precipitation. The resource potential for the region appears to be limited to manganese. Hydrocarbon deposits are unlikely between the Norfolk and Three Kings ridges because of restricted sedimentary thicknesses and tectonic activity.

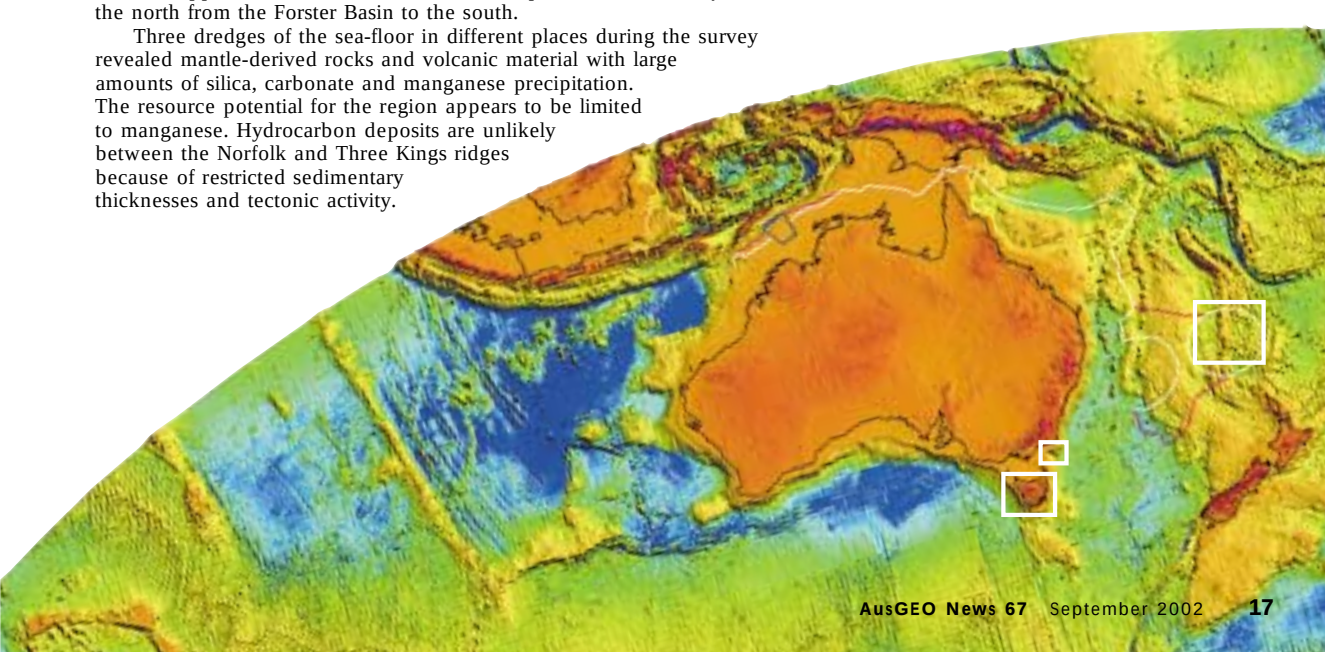
Franklin surveys (records 2002/06 & 07)

Franklin cruise FR11/98 focused on obtaining sediments from three canyons, the shelf and upper slope, and basin floor of the deep waters of the Gippsland Basin.

The oldest rocks and sediments, dredged from three sites just inside the ocean–continent boundary, are volcanic. They were laid down during Tasman Sea rifting.

Rocks about 90–74 million years old were recovered in 11 dredges on the outer continental margin. They come from beds of sandstone, siltstone and mudstone (and their weathered variants). They are burrowed and mottled and contain ferruginous nodules, traces of fossils, ripple marks and plants. Marine macrofossils are generally absent. The rocks were deposited rapidly in coastal and marine environments, in the rift involving eastern Australia, Lord Howe Rise, and the Gippsland Basin. Palynology shows that the silts and clays were the first to be deposited, in a deep freshwater lake, which subsided as the Tasman Sea advanced about 90–86 million years ago. The upper layers are deep marine carbonates and muds.

Marine calcareous rocks, younger than 33 million years were recovered from eight dredges. Traces of microplankton were found, suggesting deep-water deposition.



Franklin cruise FR3/01 comprised a seismic survey and sampling program off east Tasmania, and a sampling program in Bass Strait and the Otway Basin. The emphasis was on recording rift and drift sedimentation and oceanic changes over the past 100 million years.

The eight seismic transects across the east Tasmanian margin show rugged basement relief and evidence of widespread volcanic activity related to break-up and later activity within the Australian plate. Thick pockets of sediment (about two kilometres) are present on the margin, but they lie in water deeper than 1500 metres.

The sampling program shows changes with increasing water depth. Sediments from the shelf and upper slope include muddy sand, clayey sandstone, siliceous sandstone and calcarenite (part of the limestone that is widespread off St Helens). Deeper down the slope, granite, arkose, metasediments, conglomerate, quartz sandstone and gritty mudstone were recorded. The granites are 400–350 million years old, like those onshore along the east coast. Volcanic rocks and conglomerate form a basement block in deeper water (about 3750 metres) on a ridge off north-east Tasmania.

Cores from Bass Strait prove there was an ancient lake north of Devonport. At the base of the deepest piston core (8.11 metres) was evidence of benthic life and mollusc debris, but no marine life such as plankton. Rare planktic forams, molluscs and bryozoa were found in sediments deposited as late as 0.5 million years ago.

The Otway Basin program cored sediments deposited in the upper slope and in the base of two canyons to provide answers to the slumping evident in canyon walls. Microfossil information shows that slumping is localised and does not include shelf sediments with their molluscs and bryozoa, and that the oldest sediments sampled may be as old as 0.5 million years.

Availability

The four Geoscience Australia records titled as follows provide a wealth of information on the geology and structure of south-east Australia and its eastern margin:

- Record 2001/27: Collaborative Australia–France multibeam sea-floor mapping survey—Norfolk Ridge to Three Kings Ridge region, FAUST-2 preliminary results;
- Record 2002/06: Basement rocks and younger sediments on the south-east Australian continental margin—RV *Franklin* cruise FR3/01;
- Record 2002/07: Cretaceous volcanogenic and Miocene calcareous strata dredged from the deepwater Gippsland Basin on RV *Franklin* research cruise FR11/98;
- Record 2002/08: Geological and morphological framework of the Norfolk Ridge to Three Kings region.

Record 2001/27 costs $44 (includes GST) plus postage and handling; records 2002/06–08 cost $33 each (includes GST) plus postage and handling. The records are available from the Geoscience Australia Sales Centre.

For more information phone Neville Exon on +61 2 6249 9347 or e-mail neville.exon@ga.gov.au

Latest index of airborne geophysical surveys *released*

The sixth edition of the Index of Australian Government (federal and state/territory) Airborne Geophysical Surveys has just been released, in hard-copy and digital formats. This edition provides a more comprehensive coverage of surveys than last year's version.

The index (Geoscience Australia record 2002/16) summarises the major specifications of more than 890 airborne surveys. Information about surveys prior to 2001 has been updated. New surveys from various government exploration initiatives and ongoing airborne survey work have been added.

Index data files (in AEROMAP, ESRI Shape and MapInfo TAB formats) that show the coverage of Geoscience Australia and state/territory government airborne magnetic and radiometric surveys over Australia have been updated to April 30 this year.

Colour index maps (scale 1:10 million) showing the coverage of Geoscience Australia and state/territory government airborne magnetic, radiometric and gravity surveys over Australia are also available as on-demand products. These maps discriminate between surveys with flight line spacings of 500 metres or less, and the more regional surveys. The state/territory borders and the names of the 1:250 000 sheet areas are shown on these maps.

Geoscience Australia record 2002/16 and the digital data cost $22 each (includes GST); the discount price for purchasing both is $33 (includes GST). Each index map costs $11 (includes GST). All incur a postage and handling fee.

Copies of the record, digital data and index maps can be purchased from the Geoscience Australia Sales Centre. These products can also be downloaded free from the Geoscience Australia web site.

For further information phone Murray Richardson on +61 2 6249 9229 or e-mail murray.richardson@ga.gov.au

STRATIGRAPHIC NAMES DATABASE IMPROVED

Recent changes to the Australian Stratigraphic Names Database (ASND) improve on-line access, and allow users to tap into previously inaccessible definition card data.

The ASND is the national authority on stratigraphic names in Australia. The Bureau of Mineral Resources (now Geoscience Australia) established the National Register of Stratigraphic Names in 1949, to help geoscientists working with the 'new' Australian Code of Stratigraphic Nomenclature. Until 1979, however, it was maintained as a card-file index.

Since then various upgrades, including an Oracle database, have refined the level of information collected and made available for each stratigraphic unit.

Geoscience Australia recently added a number of simple on-line forms to the stratigraphic name and bibliographic queries already available on-line. The forms allow users to reserve a stratigraphic name; complete unit definitions on-line; notify database staff of references with stratigraphic information; and make general enquiries or provide corrections or additions.

Unit definitions, the definitive information for a stratigraphic unit, were only available as hard copy and relatively inaccessible to most users. Geoscience Australia recently converted the cards to digital data, so they now can be accessed on-line.

Users can still search for a stratigraphic name with the existing query form. But a new field allows the user to view the available data if the unit is defined and has a definition card.

Geoscience Australia will continue to improve access to bibliographic reference and descriptive information available for Australian geological units. Sequence stratigraphic units and necessary unnamed units will soon be included in the database. This will create a thorough and comprehensive lexicon, a unique code for GIS polygons, and an informative data link available for all Australian geoscientists.

For further information phone Donna Cooper on +61 2 6249 9491 or e-mail donna.cooper@ga.gov.au, or visit www.ga.gov.au/oracle/stratnames.html

The ASND is a great place to start your research. If you are working on a specific geological unit or in a specific area, you can use the ASND bibliographic search to find a comprehensive list of references related to that unit or area.

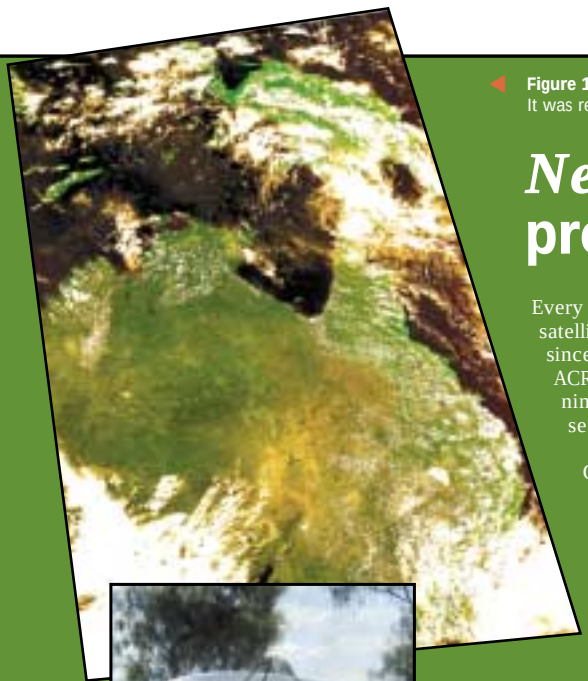


Figure 1. The first test image shows the eastern portion of Australia. It was received from NOAA-16 on April 17 at 2.49 p.m. AEST.

New antenna increases product range

Every NOAA (National Oceanic and Atmospheric Administration) satellite pass over Australian territory has been available to users since April this year, when a new antenna at Geoscience Australia's ACRES facility in Alice Springs began operating. Previously, a single nine-metre antenna serviced all requests for satellite remotely sensed data.

The new antenna, dedicated to capturing NOAA data, allows Geoscience Australia to acquire day- and night-time passes from three NOAA satellites (numbers 12, 15 and 16). It is now the primary source of NOAA imagery of the Australian region. Without the new antenna, users could only download data and images from NOAA-16 day-time passes from the web.

Geoscience Australia can now offer an increased range of NOAA AVHRR (advanced very high-resolution radiometer sensor) products. Geoscience Australia's NOAA download page (acs.auslig.gov.au/noaa_data) lists the new range. Night-time passes are clearly identified by the black and white Quick Look image using the thermal band four. An additional enhancement is the provision of more detailed information in the metadata files, which are also available for download.

Because of the high disk-space requirements to store processed data, NOAA AVHRR products are only available for free download for seven days after acquisition. NOAA AVHRR data have been available free on-line since January 2002.

For more information phone Gypsy Bhalla on +61 2 6201 4232 or e-mail gypsybhalla@auslig.gov.au

Good news for Landsat data users

Geoscience Australia's Landsat data is more accessible and affordable than ever with reduced prices for ortho-corrected products, and the availability of double and triple scenes. This welcome news is due to processing changes and efficiencies, and the Commonwealth Government's policy on the price of spatial data.

The introduction of double and triple scenes for Landsat data is the result of recent enhancements to the processing system. And the larger product size means cost savings, because of production efficiencies and the reduced need to mosaic data. For example, the price per square kilometre for a path-oriented triple scene is nearly 40 per cent less than for a path-oriented full scene.

The price of a full-scene, ortho-corrected product has been reduced by $360 to a level similar to the old, system-corrected Map Image price. This is possible through Geoscience Australia's investment in the Ground Control Points (GCP) project, which is increasing product positional accuracy while decreasing production time.

The Commonwealth Government Policy on Spatial Data Access and Pricing requires Landsat products, as a whole, to be sold at a price that recovers the full cost of distribution. The price of a full-scene Path Image product therefore has increased by $100. There is also a very slight increase in the prices of map-oriented, smaller scenes. On the whole, though, Landsat products are still sold well below their full cost of distribution.

Other points to note about the new pricing structure for Landsat products include:

- Path Image and Map Image prices are now the same (for the same scene size), in recognition of similar production efforts;
- the price differential between a Path Image full scene and an ortho-corrected full scene has fallen from $760 to $300; and
- the Map Image price for MSS products has been reduced to $595, so that Path Image and Map Image MSS prices are similar.

These new products and cheaper prices make Geoscience Australia's huge Landsat (MSS, TM and ETM+) archive more accessible and cost effective.

For more information phone ACRES satellite operation services on +61 2 6201 4107 or e-mail acres@ga.gov.au

Single scenes from Y2K Mosaic on offer

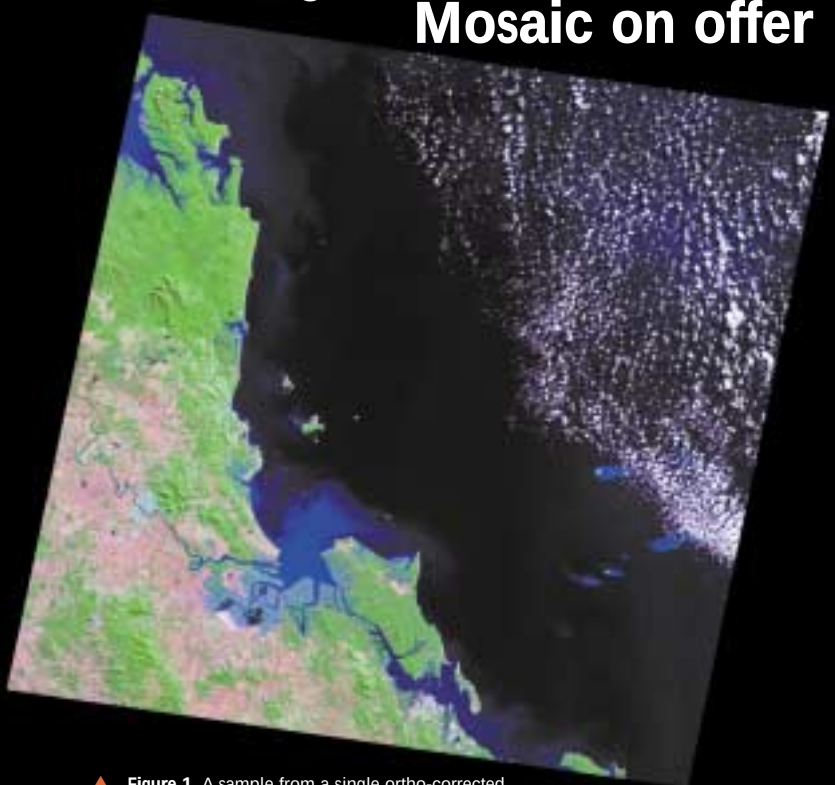


Figure 1. A sample from a single ortho-corrected scene from the Y2K Mosaic showing the Fitzroy River as it snakes inland towards Rockhampton along the Queensland coast.

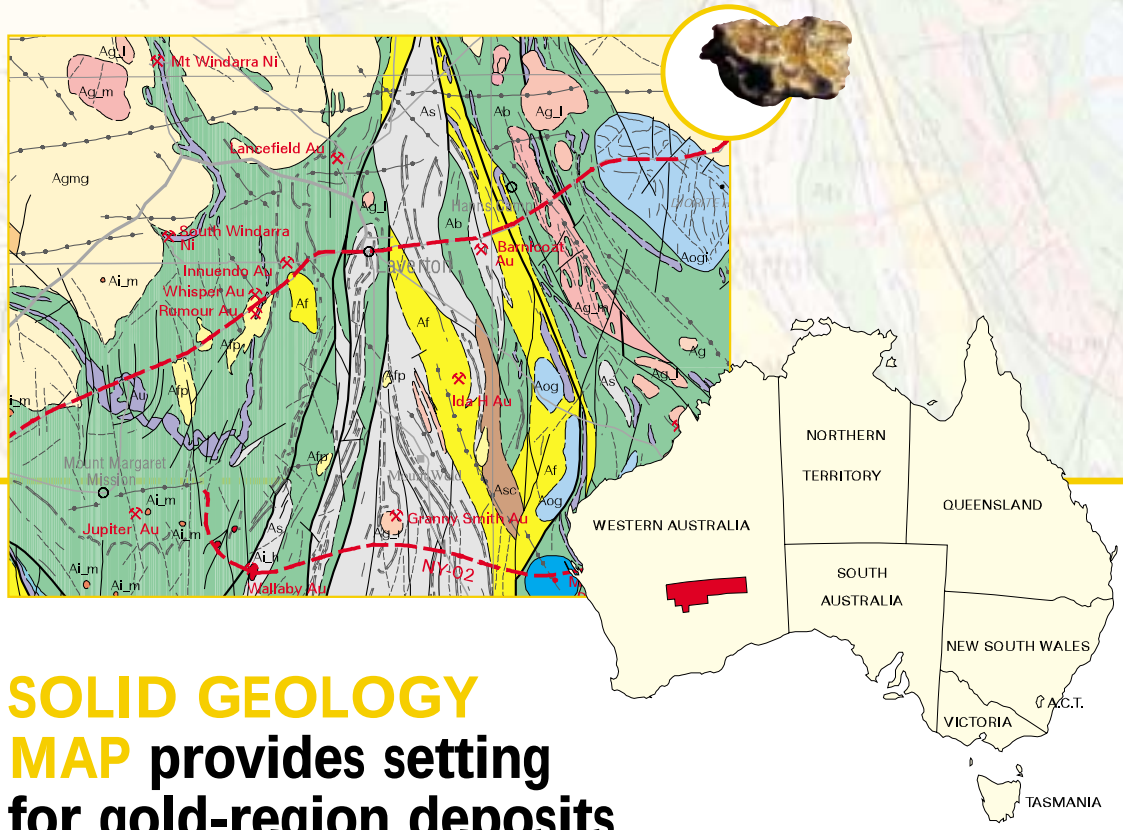
All the individual scenes used to create the Australian Greenhouse 'Year 2000 Mosaic' are now available as ortho-corrected single scenes, for less than the cost of an equivalent Landsat product from Geoscience Australia. Previously, the data were available only as a mosaic covering approximately each 1:1 million map-sheet tile.

The individual scenes result from work done last year by the Australian Greenhouse Office as part of the National Carbon Accounting System, which is using satellite data to examine the link between greenhouse gases and land cover across Australia over a 20-year period.

The Australian Greenhouse Office acquired 369 path-oriented, system-corrected, Geoscience Australia Landsat-7 images and produced an ortho-corrected Y2K Mosaic. The images for the mosaic were acquired between July 1999 and September 2000.

Each single scene from the mosaic retails for $1080, which is half the regular retail price for a standard Geoscience Australia (ACRES) ortho-corrected single scene. Larger tiles from the mosaic have been available for some time.

More details about the single scenes and tiles from the Y2K Mosaic are available via the web (www.auslig.gov.au/acres/prod_ser/).



SOLID GEOLOGY MAP provides setting for gold-region deposits

Geoscience Australia's new, solid geology map of the Leonora to Neale region in the Eastern Goldfields of Western Australia is an initial step towards developing a 3-D model of the area, and provides a basis for analysing seismic reflection lines acquired in 2001.

West of 123º E, the solid geology was compiled at 1:100 000 scale. Aeromagnetic data (400–200 metre line-spaced) and gravity data (4–2 kilometre station-spaced) were integrated with outcrop mapping conducted under the National Geoscience Mapping Accord. Geoscience Australia acquired the Leonora and Laverton aeromagnetic data in joint projects with the Geological Survey of Western Australia. Fugro Airborne Surveys provided data for parts of the Menzies and Edjudina sheets.

Interpretation of aeromagnetic data and geological sheets east of 123º (Rason and Neale sheets) was undertaken at 1:250 000 scale.

The map has a simplified geological legend because many lithological variants are not discriminated in aeromagnetic data, which provide the primary information in extensive areas of cover.

The greenstones of the region are composed of basalt with successively lesser amounts of felsic volcanic, sedimentary and ultramafic rocks, as well as deformed dolerite and gabbro intrusions. Layered intrusions, late dykes and many small intrusions of unknown affinity are also evident. Numerous granite plutons intrude the greenstone pile and, to a lesser extent, the large areas of undivided gneiss-migmatite-granite and banded granitic gneiss.

Several regional-scale faults and shear zones transect the mapped area, which include from west to east: Ida/Waroonga shear zones, Mount George/Ockerburry fault system, Kilkenny shear zone, Celia shear zone, Laverton shear zone and Yamarna shear zone. Some of these structures may have played an important role in widespread gold mineralisation by providing crustal-scale, plumbing systems.

The main seismic line acquired in 2001 (01AGSNY1), crosses many of the structures. It begins just west of Leonora and terminates about 100 kilometres east of the Yamarna shear zone. The line traverses much of the dismembered, greenstone-rich Norseman–Wiluna Belt (Leonora–Laverton) in the west, as well as more intact crust with less greenstone to the east (Laverton–Yeo Lake).

Significant deposits in the mapped area include Emu, Tarmoola, Sons of Gwalia, Wallaby, Lancefield, Granny Smith and Sunrise Dam (Au), Windarra and Murrin Murrin (Ni), Teutonic Bore (base metals), and Mount Weld (P and rare-earth elements). The solid geology map places these and many other deposits in geological context.

The solid geology has been released as a 1:500 000 hard-copy map, and as digital data (ArcInfo covers and export files) suitable for use at 1:250 000 scale. Paper copies of the 'Leonora–Neale transect solid geology' map cost $55 each (including GST) plus postage and handling. A digital version costs $99 (includes GST) on CD, or may be downloaded free from the web (www.ga.gov.au/download). The products are available from the Geoscience Australia Sales Centre.

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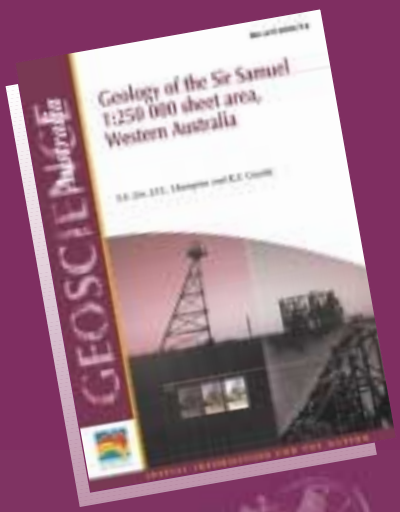

New report describes Sir Samuel geological features

Bounding the rich Eastern Goldfields of Western Australia is the Sir Samuel 1:250 000 map-sheet area. To aid mineral exploration, Geoscience Australia has just released a report (Geoscience Australia record 2002/14) that describes features shown in the geological map of this area.

The Sir Samuel 1:250 000 sheet area can be divided into three major greenstone belts that are separated by large areas of granitoid. They are from west to east, the Agnew–Wiluna, Yandal and Dingo Range greenstone belts. The western Agnew–Wiluna greenstone belt can be further divided into three greenstone areas: Yakabindie, Agnew and Mount Keith–Perseverance.

Yakabindie comprises layers of Kathleen Valley Gabbro overlain by tholeiitic Mount Goode Basalt. Agnew comprises a lower sequence of metamorphosed ultramafic, mafic, felsic, volcanic and sedimentary rocks, which is exposed in the Lawlers and Leinster Anticlines. The upper sequence, exposed in the Mount White Syncline area, consists of metabasalt, metagabbro and metasedimentary rocks. In the Perseverance area, metamorphosed ultramafic, mafic, felsic volcanic and sedimentary rocks extend north to the west of Mount Pasco.

The southern Yandal greenstone belt mainly consists of mafic and some ultramafic rocks (Bronzewing–Mount McClue, Hartwell, Yandall and Darlot areas) and felsic volcanic rocks (Ockerburry Fault Zone and Spring Well area). The Dingo Range Antiform is interpreted to be a refolded earlier fold of banded iron formation/chert, ultramafic and mafic rocks.

The western part of the Sir Samuel sheet is largely granitoid, with an 18 kilometre wide belt of highly deformed and gneissic granitoid west of the Waroonga Shear Zone. The southern Yandal greenstone belt is separated from the Agnew–Wiluna greenstone belt by granitoid and gneiss (20–40 kilometres wide). This interval includes the Koonoonooka monzogranite, and a highly deformed zone of interleaved granitoid and greenstone west of the Mount McClure Fault.

A large area of deformed granitoid and gneiss separates the Yandal and Dingo Range belts. The granitoids are primarily monzogranite with minor granodiorite, syenogranite and quartz syenite.

There were three major deformation events in the granite-greenstones. The first deformation event produced flattened pillow structures in basalt, and some tight isoclinal folds. Compression during the second event produced the north-north-west greenstone belt trends, and faults, shear zones and folds. Regional metamorphism occurred during this event.

The third event was largely concentrated along major shear zones. It shaped the region's current architecture, particularly the position of some north-east-trending structures. Granitoid intrusion occurred during each event and throughout the metamorphic history of the Sir Samuel area.

The area contains significant gold and nickel mineralisation. Mineralisation is mainly hosted in metamorphosed basalt and gabbro, metasedimentary rocks and (locally) in granitoids. Gold mineralisation is associated with shear zones and quartz veins. Significant gold deposits include Bronzewing and Darlot–Centenary (Yandal), and New Holland, Genesis and Bellevue (Agnew–Wiluna). Nickel deposits include Perseverance and Rockys Reward at Leinster, as well as Mount Keith. Deposits of copper, corundum, uranium and tin also have been found.

Printed copies of *Geoscience Australia record 2002/14: Geology of the Sir Samuel 1:250 000 sheet area, Western Australia* by Liu, Champion and Cassidy are available from the Geoscience Australia Sales Centre for $33 each (includes GST) plus postage and handling. A digital (pdf) version is free from the Geoscience Australia web site (www.ga.gov.au/download/publications.html).

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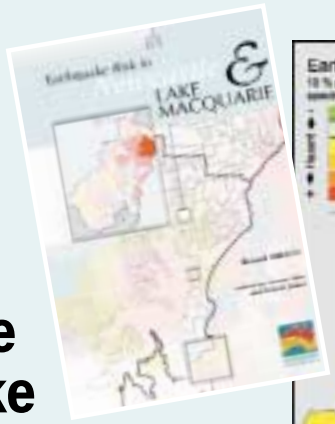

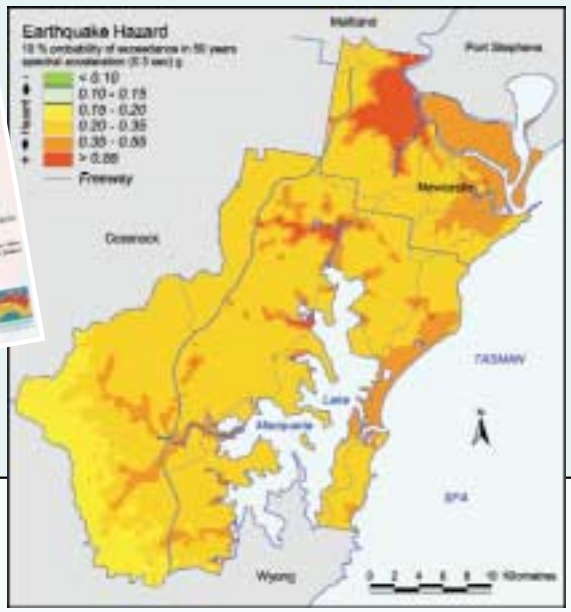

Cut the losses, Newcastle earthquake risk report

At 10.27 a.m. on December 28, 1989, an earthquake measuring 5.6 on the Richter scale shook Newcastle, Australia's sixth most populous city. This moderate-magnitude earthquake claimed 13 lives and caused extensive damage to buildings and other structures. The event demonstrates that moderate-magnitude earthquakes, which occur frequently in Australia, can affect Australian communities.

In response, Geoscience Australia conducted an earthquake risk assessment of Newcastle and Lake Macquarie. The report, *Earthquake risk in Newcastle and Lake Macquarie* was launched by Parliamentary Secretary to the Minister for Industry, Tourism and Resources, Warren Entsch in Newcastle on September 12.

This work is the most advanced and comprehensive assessment of earthquake risk published for any Australian community. It suggests mitigation options that can minimise the impact of earthquakes and reduce losses.

Risk assessment

Risk assessment involves understanding the likelihood of earthquakes occuring, as well as their potential impacts.

Events that have an impact like the 1989 Newcastle earthquake are thought to be relatively rare and have estimated return periods of about 1500 years. The Australian Standard for Earthquake Loading is based on more common events. It requires that normal structures in the Newcastle region be constructed to withstand earthquake shaking with a return period of approximately 500 years.

Geoscience Australia's work suggests that the level of shaking from an event in Newcastle and Lake Macquarie with a return period of 500 years could be greater than that currently suggested by the Australian Standard.

Risk reduction

It is not possible to prevent an earthquake, but steps can be taken to minimise the impact. Geoscience Australia has suggested several mitigation options that may be appropriate for the Newcastle and Lake Macquarie region.

Most earthquake risk is from moderate-sized earthquakes within 30 kilometres of the study region. This suggests that authorities responsible for planning and response to earthquakes should also deal with moderate-sized events, rather than focusing solely on larger but much rarer earthquakes. Individual earthquake risk assessments for key facilities (such as police, fire and ambulance stations, and hospitals) that provide essential services following an earthquake should also be considered.

The single, most important, long-term factor in reducing economic losses and casualties from earthquakes in Newcastle and Lake Macquarie is probably good building practice. The ability of buildings to withstand and hence minimise the impact of earthquakes relies upon the quality of the construction and the type of materials used.

The results of the Geoscience Australia risk assessment will be valuable to anyone interested in understanding the nature of earthquake risk in Newcastle and Lake Macquarie. With an accurate and realistic understanding of the risk posed by earthquakes, local and state government emergency managers and planners, as well as the finance, construction and insurance industries, can take appropriate steps to minimise the impact of earthquakes. This will help make the two communities safer and will contribute to their future social and economic development.

The results also have implications for earthquake risk in larger Australian cities such as Perth, Sydney, Melbourne and Adelaide. This is due to a number of factors, including similarities between the earthquake hazard in Newcastle and Lake Macquarie and other parts of Australia, and similarities in building construction types.

Earthquake risk in Newcastle and Lake Macquarie comprises an overview booklet and a CD that presents the work in detail. The set costs $38.50 (includes GST) plus postage and handling. It is available from the Geoscience Australia Sales Centre.

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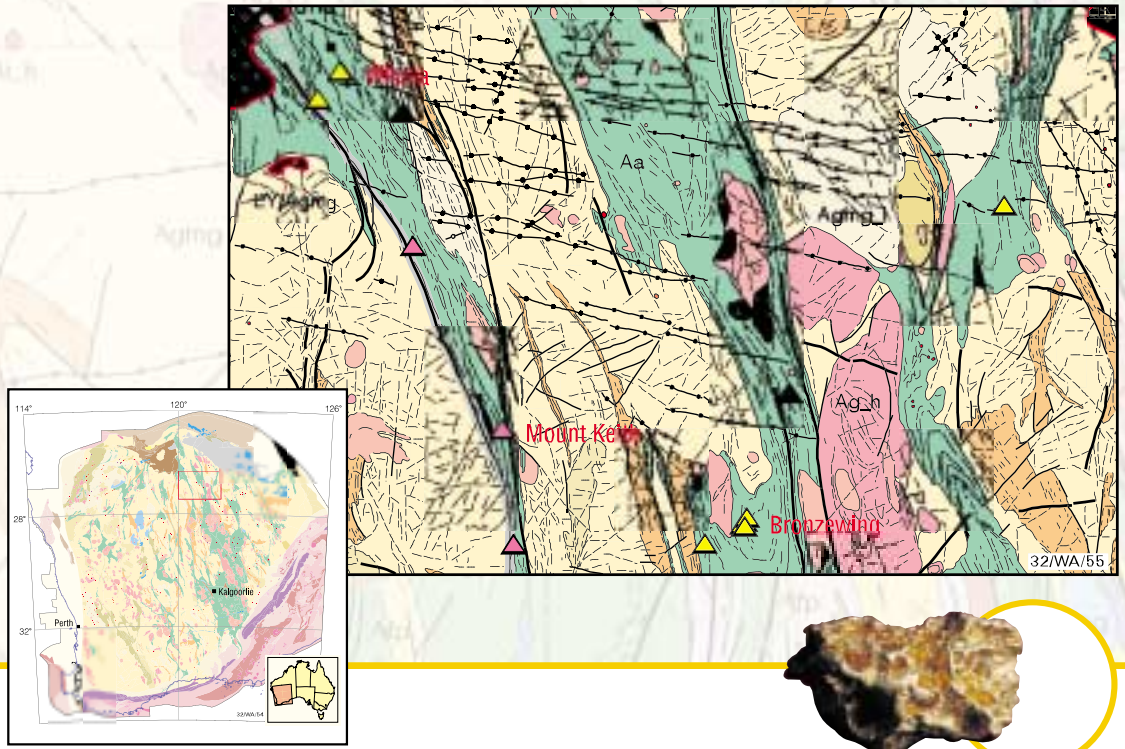

YILGARN aeromagnetic interpretation available

Geoscience Australia has just released an aeromagnetic interpretation of the Yilgarn Craton in south-western Australia to provide a geological context for the Yilgarn's many significant deposits of gold, nickel, base metals, aluminium, uranium, tin and tantalum.

The Yilgarn Craton has been divided into five, regionally distributed, geophysical map units: highly prospective greenstone, sinuous gneiss, undivided gneiss-migmatite-granite, banded gneiss, and granite plutons. The last three units comprise about 80 per cent of the craton. These units correlate with rocks that are dominated by granitic compositions. Also present are layered intrusions, dykes and many small intrusions of unknown affinity, as well as numerous faults. The larger faults cutting greenstone belts may have provided crustal-scale plumbing for the region's numerous gold deposits.

World-class or significant mineral deposits in the Yilgarn include the Golden Mile, Boddington, Plutonic and Sons of Gwalia (Au), Mount Keith, Agnew and Kambalda (Ni), Golden Grove (base metals), Jarrahdale (Al), Yeelirrie (U), and Greenbushes (Sn and Ta).

The interpretation defines eight, province-sized domains, which are composed of various mixes of the geophysical map units. The boundaries of these domains appear to mark significant changes in crustal composition or deformational history. Boundaries between extensive areas of intermittent Archaean outcrop and more continuous, 'transparent' basin cover are shown, as is the sub-surface distribution of greenstone and granite in areas of basin cover.

Details of the structure of the Albany–Fraser Province are provided. Thrusting of this province during the Proterozoic caused deformation and demagnetisation of the southern and south-eastern margins of the Yilgarn Craton.

The interpretation draws on data from the National Airborne Geophysical Database (Geoscience Australia) and multi-client data sets provided by Fugro Airborne Surveys and De Beers Australia Exploration/Pitt Research. The interpretation has been released as a 1:1.5 million hard-copy map and as digital data (ArcInfo covers and export files) suitable for 1:1 million scale.

Paper copies of the Yilgarn Craton aeromagnetic interpretation map cost $55 each (including GST) plus postage and handling. A digital version costs $99 (includes GST) on CD, or may be downloaded free from the web (www.ga.gov.au/download). The products are available from the Geoscience Australia Sales Centre.

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