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PORTAL



**QUICK
DOOR**
to geoscience

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Also: Under cover work in Gawler, doubt about extinction theory, AGSO changes name...

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From November 8, you can access Commonwealth and State geoscience information and data via a single door or 'portal'.

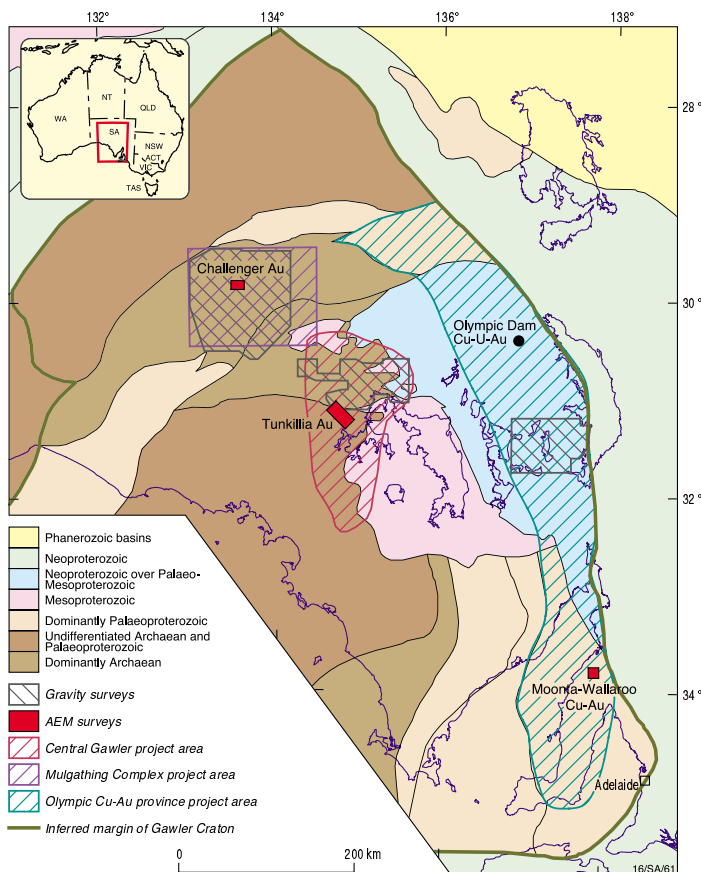
The portal doesn't store data. Rather it links existing services and information for users. See page 6.

Cover design: Karin Weiss

UNDER COVER

work in Gawler to penetrate mineral *secrets*

On the surface, much of the Gawler Craton in South Australia is typical Australian outback: dust, low scrub and flies. But some 300 metres below the surface near the eastern margin of the craton is Olympic Dam, a world-class copper-uranium-gold deposit that is more than five kilometres long and two kilometres wide. This huge quantity of minerals stimulates thoughts that the region may have further large deposits.



▲ **Figure 1.** Tectonic domains of the Gawler Craton, showing project areas, AEM surveys, and recent gravity surveys (geology courtesy of MER and J. Teasdale)

Sub-surface deposits like Olympic Dam are not discovered by chance. Rigorous geoscience research led Western Mining Corporation to drill Olympic Dam. Surveys, mapping, field work and geochemical analysis precede such finds.

Gawler Craton project

In July 2000, scientists from AGSO – Geoscience Australia and South Australia's Office of Minerals and Energy Resources (MER) began work that hopefully will lead to major sub-surface copper, gold and nickel finds in the Gawler region. The Gawler Craton Minerals Promotion Project is a three-year research program gathering and analysing data and information to determine what regional-scale processes formed ore and preserved economic-sized mineral deposits.

The project focuses on three areas: the Olympic Dam copper-gold province, central Gawler, and the area around the Challenger gold deposit (figure 1).

The Gawler's main problem is that in most places, 100 to 300 metres of weathered rock and sediment (or regolith) covers basement rock, making it an unremarkable landscape and difficult to locate deposits. Consequently, large areas of the Gawler Craton are poorly explored.

Olympic Dam province

The primary focus of Geoscience Australia's efforts is the metallogenic belt that includes Olympic Dam. This belt contains many (but variably)



copper-gold and iron mineralised hydrothermal systems.

Geoscience Australia is undertaking lithostratigraphic studies including uranium-lead dating (for verifying rock ages) to come up with a new interpretation of the basement geology and its evolution. From this research, a three-dimensional crustal model will be developed. It will be tested with a proposed seismic transect in the mid-stage of the project.

The distribution of alteration-mineralisation is being documented along the length of the Olympic Dam province, from the Mt Woods Inlier, through the Olympic Dam region, to the Moonta-Wallaroo district. Early results indicate that high-temperature potassic-iron-calcic alteration styles and high-salinity fluids may be more significant than previously acknowledged. Development of 'vectors to ore' criteria, and discrimination of fertile versus barren systems, are key objectives of this work.

Central Gawler

In the central Gawler Craton, MER is focusing on the mineral potential (nickel, copper, platinum group elements and gold) of Archaean (>2.5 billion-year-old) komatiites and associated mafic rocks in the Harris greenstone belt. As well, a PhD study is looking at the relationship between magmatism (granitic and volcanic activity) and copper-gold mineralisation that occurred roughly 1590 million years ago.

Challenger area

The Challenger gold deposit, in the north-west Gawler Craton, is one of numerous gold prospects discovered since 1995. It lies within granulite facies rocks that date back some 2.5 billion years. Much of the Challenger region is buried under a thin, Cainozoic (65 million-year-old) or younger cover, making the regional- and district-scale controls on gold ore formation and its location virtually unknown.

Research in the Challenger region therefore focuses on identifying the 'ingredients' of the ore-forming systems. This will involve re-interpreting aeromagnetic data, acquiring new gravity data, outcrop mapping, drill hole logging, new geochronology, and petrological studies.

AEM data

Airborne electromagnetic surveys were flown in areas of known gold and base metal mineralisation to test the method's suitability for 'looking' through the regolith. The surveys cover the Challenger gold deposit, the Tunkillia gold prospect, and the East Alford prospect in the Moonta-Wallaroo district.

First-pass interpretations of AEM data are promising. For example, in the Moonta-Wallaroo district AEM data show the distribution of a distinctive clay alteration zone that overprints higher temperature hydrothermal alteration. Near the Challenger gold deposit, the AEM data accurately map large palaeochannels. Subsequent drilling has shown these to be a viable water source for mine development (figure 2).

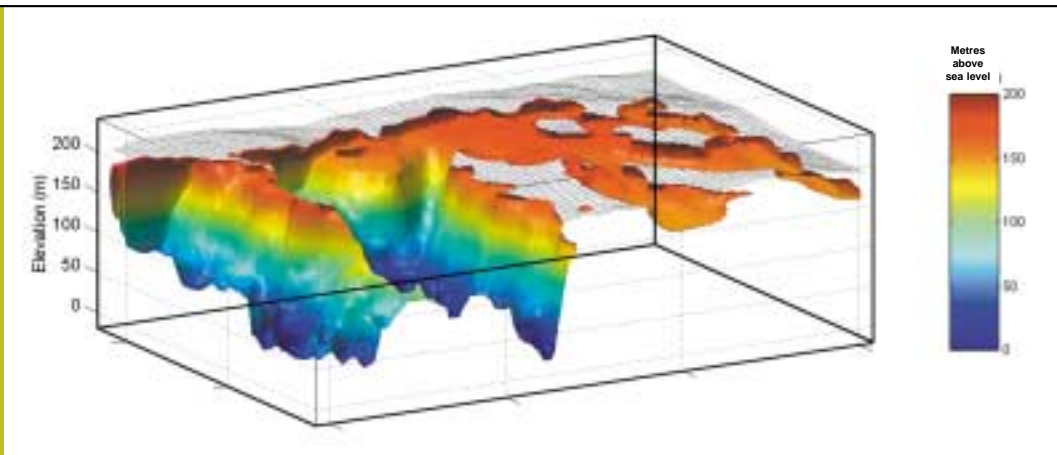
The AEM data also clearly identify the Yarlbirinda shear zone that hosts gold in the Tunkillia district. And the overlying regolith and groundwaters have yielded AEM responses that partly explain the observed patterns of calcareous geochemical anomalies.

In conjunction with other geophysical, geological and geochemical data, AEM data will be used to develop three-dimensional models of how metal dispersed from bedrock sources through the regolith. New drill-hole data (including reconnaissance drilling completed at East Alford) will also be used to build and test the models.

To date, 5845 line-kilometres of AEM survey data, and accompanying magnetic and elevation data have been released (figure 1). First-pass interpretations of the AEM data by the project team, a consultant, and exploration license holders will be available as a series of reports.

Gravity data

Geoscience Australia and MER, under the auspices of the Targeted Exploration Initiative South Australia (TEISA), released new gravity datasets for the three study areas on July 24.



▲ **Figure 2.** A sub-surface 'topographic' model of the Challenger gold district, derived from airborne electromagnetic data. Elevation is in metres above sea level. The grey mesh shows the surface is quite unremarkable. The coloured areas show regolith and sediments of variable thickness covering much of the unweathered, 2.5 billion-year-old basement rock (uncoloured area). Gold deposits lie in the fresh rock and partly within the regolith. Image courtesy R. Lane (Fugro Airborne Surveys)



▲ **Figure 3a.** An excerpt from the solid geology interpretation of the northern Moonta-Wallaroo copper-gold district, Yorke Peninsula (width approximately 60 km). Features include shears/faults (black lines), 1.6 billion-year-old granites (red, pink), magnetic hydrothermal alteration zones (purple), and 1.7 billion-year-old metasediments and metavolcanics (grey, green). The coastline is shown as a blue line.

▲ **Figure 3b.** This image is the same area of Yorke Peninsula as figure 3a. It shows the thickness of the regolith. Depths are based on drill-hole information: purple-pink shows outcrop and very shallow cover; in blue areas the cover is more than 100 metres thick.



The Mulgathing survey (4 km x 2 km station spacing) was designed to define the extent of hidden Archaean mafic rock packages, and to better image the major crustal structures in the Challenger gold deposit region. In the central Gawler, the Harris Lake survey (4 km x 1 km and 2 km x 1 km station spacing) mapped covered segments of Archaean komatiite and mafic sequences, which are MER drilling targets.

The southern Olympic survey (2 km x 2 km and 4 x 4 km station spacing) covered extensions to a major regional gravity anomaly in the Pernatty Lagoon area of the Stuart Shelf. Recent announcements of encouraging copper-gold intersections around Mt Gunson indicate that this area is of increasing and significant prospectivity.

Seismic workshop

A proposed program to acquire deep seismic data in the Gawler Craton was discussed at a workshop in Adelaide on July 24. Seismic data will be integral to developing predictive models of selected ore-forming systems. A number of reflection line options were canvassed, including one across the northern Olympic province.

Solid geology and other data

Moonta-Wallaroo is one of Australia's oldest mining districts. Because of extensive cover, its potential for Ernest Henry style copper-gold and related deposits has not been fully realised. Investigations so far have centred on documenting alteration character, distribution and timing, and structural controls on hydrothermal activity.

A new interpretation of the geology of the northern Moonta-Wallaroo district has been completed (figure 3a). The interpretation, based on existing and new TEISA aeromagnetics, shows for the first time the off-shore extensions of the Proterozoic (2.5 billion to 545 million year old) geology of Yorke Peninsula. The accompanying image (figure 3b, an excerpt from a new depth-to-basement digital dataset) shows the thickness of the regolith, which ranges from a few metres to more than 100 metres.

Other work includes a preliminary re-interpretation, at 1:250 000 scale, of the basement geology of the Mulgathing region (figure 1).

For more information about the Gawler Craton Project, phone Roger Skirrow on +61 2 9249 9442 or e-mail roger.skirrow@agso.gov.au, or see the project web site at <http://www.agso.gov.au/pdf/minerals/Gawler.pdf>

◀ The Gawler Craton Project team (from Geoscience Australia and Minerals and Energy Resources) photographed against a back drop of columnar jointed Yardea Dacite during a field excursion in the Gawler last year.

PORTALS

quick door to all ge

Time and money would be saved if there was a quick means of tapping into every reliable source of geoscience information in Australia. If only the web browser, with a couple of general words such as 'minerals' or 'earthquakes', would open the door to all geoscience agencies and their information, and then allow you to explore and combine maps and data from the different groups.

....That wish is becoming a reality.

AGSO – Geoscience Australia, in collaboration with other Commonwealth and State agencies, is building two web portals: one to government geoscience information and another to disaster management information.

geoscience.gov.au, the entry point to Commonwealth and State geoscience information, will be launched on November 8 this year at Mining 2001 in Melbourne.

Geoscience portals

The portals won't store data. Instead they will link existing

services and information for users. The portals will be a single doorway (or entry point) to internet content on a theme such as 'geology'. They will include a search tool, links collated by topic experts, and some capacity for clients to customise the site to suit their needs.

Online boom

Use of Geoscience Australia's online services during the first half of 2001 increased rapidly, with page-view hits reaching 100 000 a week in the early part of the year, and averaging twice the weekly hit rate of last year. Up to 5000 individual users access Geoscience Australia's online services in any given week.

No doubt other geoscience agencies are experiencing a similar increase in demand. Users tap into dozens of dynamic data layers behind the usual agency descriptions and static project pages. They access real-time data from geophysical observatories, online geological information systems (GIS), databases, catalogues and products.

They also process simplified geophysical and satellite imagery. Much of the data is free, or can be purchased through online eCommerce systems.

Delivery complexity

The difficulty in managing and delivering geoscience information rises with the increase in volume and types of data used by geoscientists, and the complexity of processing that data.

The ability to integrate disparate systems into a single, simple user interface is a great strength of the web browser environment. It provides an opportunity to reduce the load on users in managing their data. For this reason, most major geoscience data suppliers have implemented web interfaces for their main data holdings.

The logic of the internet suggests that the next stage is to enable users to integrate data and information from different sources and providers. Such integration tasks are commonly done using portal technology.

AGSO – Geoscience Australia URLs

- www.agso.gov.au/map—online web mapping and image processing
- www.agso.gov.au/databases—databases
- www.agso.gov.au/databases/catalog/agsoecat.html—products database
- www.agso.gov.au/geoscience/national—national datasets homepage
- www.agso.gov.au/geophysics/geomag—real time geomagnetic data
- www.agso.gov.au/databases/npd/—petroleum data repository

reality

....That wish is becoming a reality.....

Geoscience agencies

As more geoscience data providers come online, it is timely to build portals that should not only help eliminate service duplication, but offer users faster access to a wider range of geoscience information.

Information access

A number of information access initiatives are underway in Australia. The Australian Spatial Data Infrastructure, Commonwealth customer-focused portals, State government entry points and agency sites are all components of an emerging national information infrastructure. Thematically focused portals have the potential to tie these initiatives together.

Sites will use common portal technologies, such as search engines designed to trawl specific servers, user customisation options, and collections of URLs linking similar content. Because of the spatial nature of much geoscience information, distributed web mapping systems are also being developed.

Already, prototype systems are integrating spatial geoscience data from multiple agencies. An example of AGSO – Geoscience Australia data and data from other Commonwealth agencies merged into a single interface is shown in figure 1.

Distributed web mapping systems allow map layers from online GIS systems on different servers to be overlain on the fly—provided the servers adhere to a common protocol. At present, Geoscience Australia and some other Commonwealth agencies are using internet map servers that comply with the OpenGIS protocol. There is an increasing number of such map servers, both in Australia and internationally.



Figure 1. Integrating data from AGSO – Geoscience Australia and other Commonwealth agency servers into a single interface

As the technology matures, the capacity of portals to provide access to databases and product catalogues will increase.

Access management

Managing access to the high-volume, complex data used in geosciences will require a lot of provider collaboration. Otherwise, the burden on clients to discover, acquire, integrate and manage data will be too onerous.

The government geoscience portal will be coordinated by the Government Geoscience Information Policy Advisory Committee. A prototype has been built (see figure 2) showing the basic functions of the proposed site. A production version is under construction.

Once the portal is launched on November 8, it will be continually upgraded as new agency services come online.



Figure 2. Homepage and splash page of the government geoscience portal prototype

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MICRO-ORGANISM uncertainty casts doubt on the **X**tinction theory

A riddle about a 250 million-year-old micro-organism that flourished during a period of mass extinction on Earth is being probed under an electron microscope in Canberra by Dr Mike Stephenson, visiting British palynologist at AGSO – Geoscience Australia.

At the boundary of the Permian and Triassic periods, enormous numbers of living organisms died out. One micro-organism (*Reduviasporonites*) did the opposite, however. It increased in huge numbers. Dr Stephenson is trying to describe the nature of the micro-organism to explain why it suddenly became so common.



'We have a name for it, but we just don't know what it is', he says.

Dr Stephenson is interested in this micro-organism because it is a major reference for correlating the ages of rocks and sediments that may house petroleum. Australia has the larger type of *Reduviasporonites* that flourished 250 million years ago. It, rather than the smaller and older (30 million years older) relatives found in the United States, marks the Permian-Triassic boundary.

Fungus

Dr Stephenson says that *Reduviasporonites* was a very common micro-organism during the period of mass extinction, so many scientists have decided without proof that it was a fungus.

'In theory, if there was mass extinction you would expect fungi to thrive on the multitude of dying things', says Dr Stephenson.

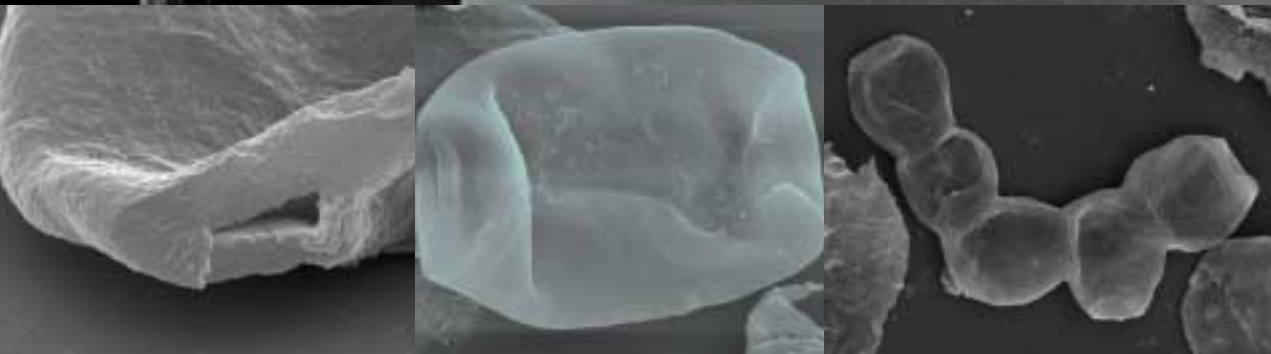
'Equally you could argue that if a fungus was the most common organism, then loads of living things must have been dying out.'

To establish facts, Dr Stephenson has been drawn from his petroleum stratigraphy work at the British Geological Survey to Australia for a month to study the micro-organism in detail.

He has looked at the structure of thousands of specimens and photographed hundreds down an electron microscope to describe their shapes and composition. Parallel to his research, the chemical make-up of some specimens is being studied at Geoscience Australia and the Australian National University.



▲ Visiting British palynologist Dr Mike Stephenson pictured in one of the Geoscience Australia laboratories.



Theory questioned

Early results from geochemical analysis suggest that *Reduviasporonites* is an alga. And because algae do not live on dead things, the micro-organism may not be integral to mass extinction.

Dr Stephenson says that if this finding proves correct, it is puzzling why an alga would become so common in a period of adverse conditions for life.

'If these are algae, they were probably opportunistic and responded to conditions that suited them', he says.

'Global sea level or climate changes or some major adverse event that killed almost everything else, for some strange reason encouraged the growth of these micro-organisms.'

Dr Stephenson says that *Reduviasporonites* was not a particularly specialised organism, however, because it colonised both marine and non-marine environments and its remains are found in many kinds of rocks. It occurred before and after the extinction period, but not in huge numbers.

The remains being studied are not fossils in the usual sense. Rather they are the actual outer part of the micro-organism—a tough organic polymer that has withstood time.

But *Reduviasporonites'* time on Earth was limited and it seems to have died out soon after the extinction period. It varied in size from 20 to 200 microns, and grew in chains—some comprising many thousand individuals.

Dr Stephenson hopes his research at Geoscience Australia helps determine whether this ancient micro-organism was an alga or a fungus, but he makes no promises.

'When you are dealing with something so old and so different from anything alive nowadays it is difficult to be conclusive', he says.

Nevertheless, geochemical analyses are being finalised, photographs compiled in a database, and findings will be discussed with biologists before results are published later this year.

For further information, contact Clinton Foster at AGSO – Geoscience Australia by phoning +61 2 6249 9447 or e-mailing clinton.foster@agso.gov.au. Contact Mike Stephenson at the British Geological Survey by e-mailing m.stephenson@bgs.ac.uk



AROUND the divisions

'VIBROSEIS' TRUCKS RUMBLE THROUGH GOLD TERRITORY

ANSIR 'vibroseis' trucks are in the Eastern Goldfields in Western Australia during August and September recording seismic lines, the results of which should increase what is known about the crustal architecture of the Laverton-Leonora region. Both reflection and refraction data will be gathered.



The seismic reflection will give us the geometry of what the crust is like in terms of granite-greenstone pieces and the upper, middle and lower crust. The refraction will give us a better idea of potential rock types', says AGSO - Geoscience Australia geologist, Dr Bruce Goleby.

Crustal architecture is key to determining potential mineral systems, in particular how ore-bearing rocks might have formed and moved minerals through the crust as the region evolved over millions of years.

To gather the reflection data, the 'vibroseis' trucks and cables will start in the west and head east. Additional lines will be done depending on industry requests.

The major line will cover more than 250 kilometres. It will start near Leonora (very close to the Sons of Gwalia mine), head eastwards to Laverton, and on to White Cliffs and Yamarna.

Exploration companies have asked for additional work in the Laverton Tectonic Zone, around Lake Carey between Sunrise and Granny Smith mines.

As well, the Geological Survey of Western Australia is keen to extend the line from Yamarna and go into the Officer Basin where it links with the Yilgarn.

Using short-period recorders and either mine or controlled-source blasts as energy sources, ANSIR hopes to take a crustal profile between Laverton and Leonora.

'Offset to about 120 kilometres, it should let us 'see' all the way down through the crust to the mantle to give us velocity information in that area', says Dr Goleby.

The blasts will send waves of vibration through Earth's crust. The recorders will pick up variations in the speed of the waves as they pass through different rock types. The wave velocities therefore should show changes in crustal composition and help ANSIR determine rock origin (e.g. in the mantle, reworked in the crust).

The recorders used for refraction will also do some 'passive listening'. They will be left in the field until the 'vibroseis' trucks come rumbling past, to record the energy generated by the trucks.

'The energy should be recorded to about 40 or 50 kilometres, which will give us a lot more information about the near-surface structure of the area', says Dr Goleby.

Members of Geoscience Australia's seismic team carried out pre-survey testing and debugging in the last week of June.

The reflection and refraction data will be processed in Canberra at Geoscience Australia. The first results should be released in late January.

For more details phone Bruce Goleby on +61 2 6249 9404 or e-mail bruce.goleby@agso.gov.au

China, Australia agree on geological information swap



AGSO - Geoscience Australia CEO, Neil Williams shakes hands with the China Geological Survey Director-General, Ye Tianzhu after both signed an agreement for their organisations to undertake possible joint projects and exchange scientific and technical knowledge.

The agreement, or Memorandum of Understanding, was signed at Geoscience Australia's Canberra headquarters while Mr Ye Tianzhu and other members of a Chinese delegation were visiting Australia and New Zealand earlier this year.

Mr Ye Tianzhu was accompanied by Mr Zhou Yongqing (Deputy Director, Qingdao Institute of Marine Geology), Mr Wang Baoling (Director, Chief Geoscientist's Office), Mr Fan Chunfu (Director, Planning and Finance Branch), Mr Jiang Shijin (Chief, International Activities), and Mr Ma Yan (Deputy Director, Department of Science and Technology).

Geoscience Australia geologist, Dr Songfa Liu (far right) helped proceedings and provided interpretation when necessary.



Road name *salutes* GREAT geologist and public servant

AGSO – Geoscience Australia's founder and first chief executive was acknowledged during public service centenary celebrations in June by giving the road that winds around the organisation's purpose-built Canberra headquarters his namesake: Sir Harold Raggatt Drive.

Scientists, politicians, former AGSO executives, and Sir Harold's grandchildren huddled along the drive on a bleak wintry morning to honour the geoscientist who did much to put Australia's geology on the map and build an inventory of the country's mineral wealth.

'In a time when Australia was dominated by rural industry, Sir Harold's vision was to make our country a great mining nation', says Parliamentary Secretary Warren Entsch.

'As a geologist, he was aware of Australia's mineral potential and knew that systematic mapping of our continent's geology was the key to developing its resources.'

Mr Entsch says that Sir Harold's maps are among the best examples of regional geological mapping of Australia during the 1940s, and that he was a pioneer in the use of aerial photography in geological surveys. His work in the Camarvon Basin in Western Australia prompted the nation's first oil exploration.

It was the Second World War, though, that turned the government's attention to minerals.

'The government wanted an inventory of our strategic minerals and it was Sir Harold who drew together the expertise for the Minerals Resources Survey', says Mr Entsch.

This group was the nucleus of the Bureau of Mineral Resources (Geoscience Australia's predecessor), which Sir Harold directed from 1946–51.

In 1951 Sir Harold became Secretary of the Department of National Development. He became a consultant to the United Nations in 1960, and was knighted in 1963. By his retirement in 1965, his vision for Australia was a reality.

Enormous quantities of bauxite, iron ore and manganese were discovered, as were the first commercial oil fields. As well, there was the promise of large-scale development of natural gas.



Above: Parliamentary Secretary Warren Entsch (left) and Sir Harold Raggatt's grandchildren Evan and Helen Lindsay unveil one of the road signs that acknowledges a geological great.



Right: The final duty, and a lot fun for Sir Harold's grandchildren Lindsay (left) and Helen (right), was sharing a large cake with ceremony guests.

His legacy includes a complete air photo of Australia, a nearly completed series of base maps on the 1:250 000 scale, and a growing set of geology maps at the same scale.

Sir Harold was also deeply involved in many organisations that helped build Australia, such as the National Coal Research Advisory Council, Australian Water Resources, Snowy Mountains Authority, the Forestry Council, the Aluminium Production Commission, and the Australian Atomic Energy Commission.

'The Australian public and the geoscience profession were very well served by Harold Raggatt', says Mr Entsch.

Sir Harold's granddaughter, Helen Lindsay, offers the human side to the man who died when she was a child.

'He had endless reserves of patience and good humour, and enthusiasm for everything we did', she says.

'One day he would be playing on the floor with us and the next he would be addressing an important United Nations committee.'

This humour and enthusiasm was evident even in young Harold who, as his sister Edith wrote in her memoirs, was always one for ideas:

'Sir Harold's grandmother (our mother's mother) was a rather formidable lady, but not without a sense of humour. She was expected one day and Harold rigged up a large pipe on a rock in the garden, commanding a view of the gate. He had decided to salute grandma on her arrival.

'The moment she appeared at the gate, he threw a match into the pipe which had been stuffed with crackers. The resounding boom and impressive flash he found most gratifying.

'Grandma was at first inclined to lecture him on the sins of the rising generation but, on hearing his explanation, was most flattered about receiving a royal salute.'

The fresh signage on the road around world-class geoscience facilities that were built 30 years after Sir Harold's death in 1968 is a humble salute to the pioneering geologist who made such in-roads into helping Australia develop its great mineral resources. 🗺️

BIOTA-SEDIMENT LINKS, SUBJECT OF BASS STRAIT STUDY

The links between the biota and seafloor sediment processes in Bass Strait are being investigated by Museum Victoria in a study sponsored by AGSO – Geoscience Australia. The results will give Geoscience Australia some key scientific information for developing a 'bio-regionalisation' of south-eastern Australia.

The government's key management goal for the marine environment is the protection and preservation of biodiversity. Knowledge of the spatial distribution and abundance of biota therefore is crucial. It is impractical to survey and map the distribution of benthic biota in such a large marine area. So environmental managers have begun to investigate the use of proxies to predict the occurrence of different assemblages of benthic organisms. (For example, rocky substrates tend to support a different benthic assemblage than a muddy floor.)

A major issue for environmental management in Australia is that so much essential, basic data has yet to be collected. Much of the marine biota around Australia remains poorly known or undescribed.

Seafloor geological data is more abundant, but its distribution can be patchy.

Few studies have attempted to link the physical, chemical and biological processes that control and characterise environments.

Study samples

The samples on which the study is based were collected during an extensive survey of Bass Strait fauna by Museum Victoria and the Victorian Institute of Marine Sciences from 1979–1983. Eighteen years later, this survey remains the most comprehensive collection of marine invertebrates from Bass Strait.

Quantitative samples were taken from 220 stations throughout the strait using trawls, dredges and grabs. Relevant ecological data collected include latitude and longitude, depth, substrate descriptions, sediment size and carbonate analysis.

Geoscience Australia is providing an analysis of the related geological environment.

One of the fundamental factors affecting the distribution and diversity of marine life is geology—the form of the seabed, the bathymetry, whether the seafloor is rock or unconsolidated sediment, and its nature or composition. The type of substrate (sediment or rock) is a primary control on the distribution of particular benthic species, and often on the composition of the community.

Analysis

To begin the study, the Museum will complete the identification and analysis of the Bass Strait biota. It then will develop a habitat scheme for the Bass Strait benthic fauna using multivariate statistical techniques. The next stage will be an analysis of the geological and biological data to determine links between the two.

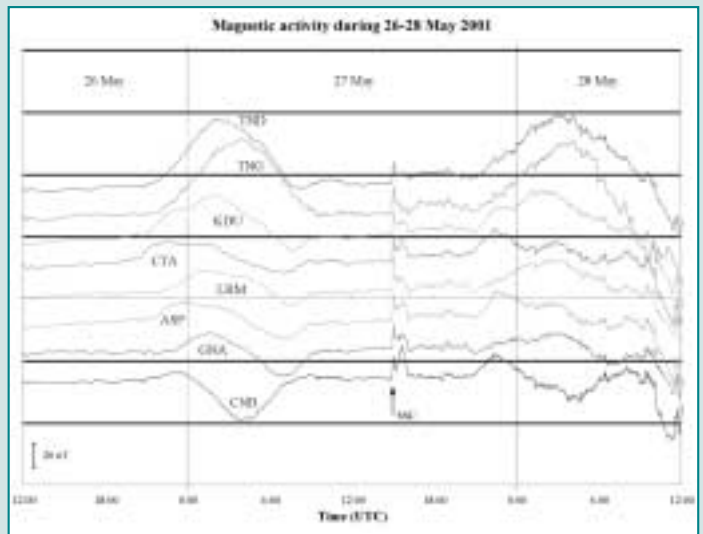
For further information about the progress of the study phone Vicki Passlow on +61 2 6249 9558 or e-mail vicki.passlow@agso.gov.au

Prelude before Sun whips up a storm

Variations in the horizontal component of the Southern Hemisphere's magnetic field, as traced by magnetograms at Australian and Indonesian observatories, show when the Sun is about to generate a magnetic storm on Earth (see figure 1).

The initial part of the traces (between 12:00 on May 26 and 15:00 on May 27) show the smooth, regular daily variations, which depend principally on the station's latitude. This is called the solar quiet variation. The heating and cooling of Earth's ionosphere causes the variation.

But at 15:00 on May 27, there is a sudden 20 nanotesla increase in the magnetic field in just a few minutes. This phenomenon, termed a storm sudden commencement (SSC), is the result of a shock-front of high-energy particles from the Sun striking and compressing Earth's ionosphere. Quite often this is a prelude (as in this case) to magnetic storm activity. Such events are more common during solar maximum conditions when solar flare frequency is greatest.



▲ **Figure 1.** Magnetograms from eight Southern Hemisphere magnetic observatories (arranged in latitude order) warn of heightened solar flare activity and a possible magnetic storm.

For more details phone Adrian Costar on +61 2 6249 9254 or e-mail adrian.costar@agso.gov.au

AGSO name change reflects wider role

It's official. The Australian Geological Survey Organisation is now AGSO – Geoscience Australia.



Senator Nick Minchin, Minister for Industry, Science and Resources, congratulates AGSO – Geoscience Australia (formerly the Australian Geological Survey Organisation) on a name change that better describes its vital role for Australia.



All smiles for officials at the name-changing ceremony: (from left) Parliamentary Secretary Warren Entsch, AGSO – Geoscience Australia Deputy CEO Trevor Powell and CEO Neil Williams, and Senator Nick Minchin, Minister for Industry, Science and Resources

On August 7, Senator Nick Minchin, Minister for Industry, Science and Resources, officiated at a name-changing ceremony for Australia's leading geoscience research and information agency at Parliament House in Canberra.

The name change better reflects the organisation's widening role from that of mapping and surveying the Australian continent to providing geoscience solutions for issues and concerns in Australia's offshore and on-shore areas.

'Natural hazard assessment in urban centres, good land-management practices in rural and coastal areas, and proper management of our marine environments all require geoscience input at a fundamental level', says Senator Minchin.

Senator Minchin says the organisation would continue its vital role in promoting resources exploration and investment in Australia. But Government would also look to Geoscience Australia for input into such community concerns as water and air quality, agricultural viability and best practices for Australia's biodiversity.

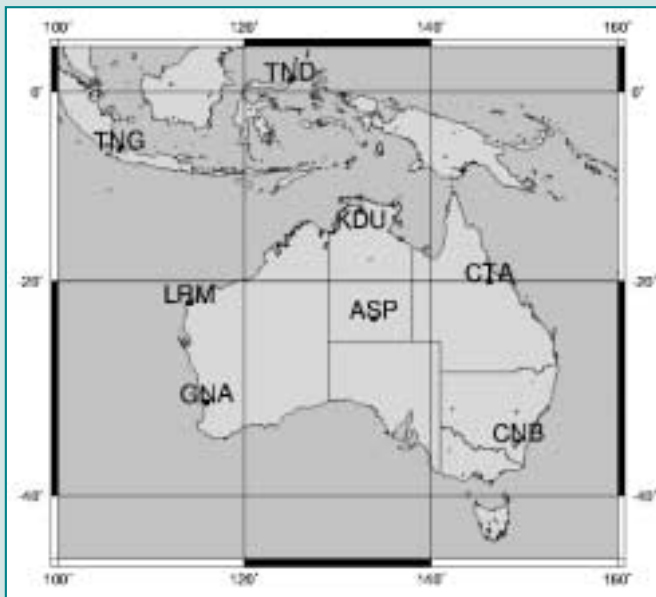
'Geoscience Australia can provide research and information that helps the Government make appropriate and effective decisions about resource usage, environmental management, and what's best for the well being of all Australians', he says.

Senator Minchin says that the Government's support of Geoscience Australia is part of an overall Science and Innovation Strategy, which will ensure that Australia continues to be world-competitive in science and technology.

With the name change, demarcation of Geoscience Australia's three research divisions (Minerals, Petroleum and Marine, and Urban Geoscience) is less defined.

New research output categories of Urban Centres, Regional and Rural Areas, and Oceans and Coasts allow for more cross-divisional and multi-disciplinary research so that Geoscience Australia can meet the broad demands being asked of the organisation.

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



▲ Figure 2. Observatory locations in Australia and Indonesia

Good geomagnetic data from Indonesia, with observatory upgrades

Indonesian geomagnetic observatory operations have improved thanks to two AusAID-funded Government Sector Linkages Projects (GSLP) recently completed by AGSO – Geoscience Australia.

Two of the three Indonesian geomagnetic observatories have undergone work. Tondano (TND) in northern Sulawesi is now a modern digital computer-based geomagnetic observatory, and operations at the recently upgraded Tangerang Observatory (TNG) near Jakarta have been improved.

The GSLP work required Geoscience Australia staff (from the geomagnetism group and the Engineering Services Unit) to provide geomagnetic training, expertise, and observatory equipment to the Indonesian Government's Meteorology and Geophysical Agency (BMG).



▲ Ibrahim Limer, of Indonesia's BMG, takes magnetic measurements at Tangerang observatory with one of the new absolute magnetometers provided as part of the GSLP projects.

Stage one involved two weeks' training for three BMG officers at Geoscience Australia's Canberra headquarters in October last year.

The training concentrated on geomagnetic data analysis and processing techniques. One week was spent at the Canberra Magnetic Observatory to become familiar with observatory operations, and to take delivery of the new absolute magnetometers provided as part of the project.

The second stage involved installation of new geomagnetic field monitoring, recording, calibration and processing equipment at Tondano Observatory, and training local staff in the operation and maintenance of the new equipment. This stage was completed in May 2001 by two Geoscience Australia staff during a three-week trip to Indonesia.

Good-quality, calibrated digital geomagnetic data from Tondano Observatory has since been flowing into Geoscience Australia.

The work benefits Australia, Indonesia and the international community. New observatory data will improve the quality of global magnetic field models over the Indonesian region, and provide important information for geomagnetic and space weather research, navigation, and mineral exploration in the region.

The projects had a total budget of \$160 000. They built on the success of an earlier Geoscience Australia–AusAID GSLP in geomagnetism that concentrated on survey operations and upgraded magnetic variometer instrumentation at the Tangerang Observatory.

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

EVENTScalendar

Compiled by Steve Ross

■ 4th International Archaeon Symposium

Geoconferences–AIAS

24 to 28 September

University of Western Australia, Perth
Contact: Jocelyn Thomson, AIAS
Secretariat, Box 80, Bullcreek WA 6149

phone +61 8 9355 2164

fax +61 8 9355 2164

e-mail jaytee@iinet.net.au

■ Earth Science Week

*Australian activities coordinated by
AGSO – Geoscience Australia*

7 to 13 October

Educational and scientific
institutions across Australia

Contact: Jeanette Holland,
AGSO – Geoscience Australia,
GPO Box 378,
Canberra ACT 2601

phone +61 2 6249 9731

fax +61 2 6249 9990

e-mail jeanette.holland@agso.gov.au

■ Mining 2001 International Convention & Trade Exhibition

Mining 2001

7 to 9 November

Royal Exhibition Building, Melbourne

Contact: Mining 2001,
PO Box 607,
West Perth, WA 6872

phone +61 8 9485 1166

fax +61 8 9481 8023

e-mail info@mining2001.com.au

■ Eastern Australasian Basins Symposium 2001

*Petroleum Exploration Society
of Australia*

25 to 28 November

Hilton on the Park, Melbourne

Contact: Miriam Way, EAB Symposium,
PO Box 660, Carlton South Vic 3053

phone +61 3 9662 3166

fax +61 3 9662 3662

e-mail miriamw@ausimm.com.au

■ NewGenGold 2001 Conference & Exhibition

*Australian Mineral Foundation Inc,
Keith Yates & Associates Pty Ltd*

26 & 27 November

Burswood Convention Centre, Perth

Contact: Conference Secretary,
Australian Mineral Foundation,
63 Conyngham Street, Glenside, SA 5065

phone +61 8 8379 0444

fax +61 8 8379 4634

e-mail newgengold@amf.com.au



Historical setting for gem of mineral conferences: *Mining 2001*

This year is the 150th anniversary of gold discovery in Australia. And what better way to mark the occasion than to hold Australia's major mineral resource conference, Mining 2001, during Mining Week in Victoria—the state that 150 years ago, attracted prospectors, explorers and fortune seekers to the Ballarat goldfields.

Mining 2001 will be held from November 7–9 in Melbourne's Royal Exhibition Building (which 100 years ago, in 1901, was the venue for the first sitting of federal parliament). AGSO – Geoscience Australia is a major supporter of Mining 2001 and sponsors the conference's exploration program.

Exploring Australia program

The Exploring Australia program will cover a range of issues in mineral exploration science. Topics include:

- ✓ innovation and successful exploration;
- ✓ advanced technologies—leading the way to a new generation of discoveries;
- ✓ geoscientific issues relating to Australia's potential to host new gold, base metal, PGM, mineral sand and tantalum deposits.

A paper on Australia's potential to host more diamond deposits will be presented during the Mining 2001 Diamond Day.

The Exploring Australia program will interest exploration managers and geoscientists wanting to enhance their company's prospects.

Geoscience portal launch

The Australian geoscience web portal will be launched by AGSO – Geoscience Australia on the second day of Mining 2001 during the Exploring Australia program. The portal provides a single entry point to the geoscience web sites of Australian government agencies. Facilities will be set up at the conference for delegates to try out the portal.

Diamond Day

This day is a must for anyone with an interest in this valuable



Photo: RANS Management/Museum Victoria

A little Australian history: inside the rather grand Royal Exhibition Building, which in 1901 was the venue for the first sitting of federal parliament and in 2001 will showcase Australia's mineral resources.

Trade display

A trade display featuring 88 booths will be held in conjunction with the conference. More than 80 per cent of booth spaces have already been taken with three months to go. Exhibitors include AGSO – Geoscience Australia and State/Northern Territory geological surveys, exploration and mining companies, and the finance and services sectors.

Registration discount

Mining 2001 registration costs \$990. But if you complete the registration form inserted in this issue of *AusGeo News* and fax or mail it to Mining 2001 your registration will cost \$880 (a discount of \$110 off the normal registration price). For Mining 2001 contact details turn to the events calendar on page 14.

Keep up to date with arrangements for Mining 2001 and details of speakers as they become available by visiting the conference web site at www.mining2001.com.au.

Venue for Mining 2001: Melbourne's Royal Exhibition Building



Photo: RANS Management/Museum Victoria

commodity. As well as talks by local and international diamond companies, there will be presentations on Australia's diamond potential and the marketing of diamonds.

Other events & talks

Mining 2001 will also feature a number of keynote addresses on such topics as world metal markets, finance, risk, and mergers and acquisitions. Listed Australian resource companies and major Australian and international minerals companies will make presentations.

Another feature of the conference will be the Women in Mining breakfast. This is an opportunity to recognise and celebrate the role women have played in the industry. The Victorian Department of Natural Resources and Environment will release its latest geoscientific datasets during the conference.

AGSO – Geoscience Australia
**hydrocarbon
work**

ATTRACTS DELEGATE
ATTENTION



Delegates were drawn to AGSO – Geoscience Australia's booth at the annual Australian Petroleum Production and Exploration Association (APPEA) conference where Dr Geoff O'Brien (far right) was demonstrating the latest in hydrocarbon seepage research.

The Geoscience Australia booth provided a stage to promote digital databases, products and images from the North West Shelf and the frontier basins of the Southern Margins, South Tasman Rise and Lord Howe Rise.

Geoscience Australia's work towards the Acreage Release areas that were announced at APPEA was incorporated in the Department of Industry, Science and Resources booth.

The Geoscience Australia and ISR booths were among 56 industry and technical displays at APPEA's 2001 Annual Conference and Exhibition held in the Hotel Grand Chancellor, Hobart, from April 8–11.

Geoscience Australia scientists presented the results of their work in a number of conference sessions, including Deepwater Frontiers, Organic Geochemistry, and Acreage Release.

For further information phone Trevor Powell on +61 2 6249 9471 or e-mail trevor.powell@agso.gov.au

BAD BREAK

for art proves *fertile* for

When the Australian National Gallery lent one of its treasures, the Ambum Stone, to an art exhibition in France last year, it fell while being placed on display and broke into three main pieces.

The pieces of this prehistoric stone sculpture from Papua New Guinea were roughly glued together and after exhibition returned to National Gallery conservators in Canberra for proper repair.

'This was a tough break for art, but a good break for science', says Dr John Bain, one of the AGSO – Geoscience Australia geologists asked to analyse the broken Ambum Stone before repair.

The interior of the sculpture, which differed from the coated and weathered exterior, was exposed by the breakage.

Gallery conservators pieced together not only stone, but also data from geologists, anthropologists and other scientists about a very rare artefact of a people long gone.

Little known

The 25-centimetre-high Ambum Stone fits comfortably in an adult human hand. Anthropologists believe the Ambum Stone depicts a foetal echidna, and that the sculpture was used in fertility rituals.

It was found in 1962 in a cave in Yambu-clan territory in the Ambum Valley in the western highlands of PNG. Shortly after discovery, it was bought by a private European collector.

No-one knew its age, and little is known about its original owners because there is no cultural continuity between the sculpture's maker and present-day inhabitants of the area where it was found.

Similar stone sculptures that might put the Ambum Stone in a cultural or historical context are very rare.

Science informs art

With the Ambum Stone interior exposed, Gallery conservators wanted to know its geological composition in the hope of linking the sculpture to the area where it was found. Geoscience Australia was approached for answers.

Dr Bain spent time from 1966–71 mapping areas of PNG, and knows the geology of the region where the Ambum Stone was found. He examined the broken pieces under stereoscopic microscope and organised an infra red spectral analysis.

He found that the Ambum Stone is a fine-grained crystalline rock, probably an altered andesitic lava or crystal tuff, and that its outer layer seems to be several coatings of white clay material.

As well, tiny rootlets were found in a small fracture. This discovery led to further research at the Australian National University, and eventually answered the biggest question of all: the age of the Ambum Stone.

Age determined

Ms Beata Tworek-Matuszkiewicz, Senior Conservator of Objects at the National Gallery, says that plant roots penetrated a small crack some time after the sculpture was lost or discarded by its owners.

'The sculpture broke partially along an old crack, exposing the plant roots and giving us an opportunity to carbon date the organic matter', she says.

Ms Tworek-Matuszkiewicz says it was a 'shot in the dark' because the plant roots may have been only 50 years old.

But the organic matter proved to be 3.5 thousand years old.

'That means the Ambum Stone has to be at least that age and possibly much older, which fits nicely with what anthropologists know about the makers of this stone sculpture', she says.

science

For historical comparison, the Ambum Stone (dated 1508–1438 BC) was sculptured just after the Egyptian pyramids were built. Its owners would have lived in the Ambum Valley at the same time as the Cycladic culture was in the Mediterranean and the Olmec civilisation was in Central America.

Although research into the background of the Ambum Stone continues, already the Ambum analyses have established an important benchmark in human history for anthropologists and archaeologists.

Location match

Ms Tworek-Matuszkiewicz says the Ambum Stone was probably created near the Wabag-Mt Hagen area where it was found because its composition fits with the geology of the area.

The volcanic Mt Hagen could have caused the hydrothermal alteration evident in the rock and the large amount of calcium in the surface layer could be explained by nearby limestones and wet, swampy conditions.

Dr Bain says the rock from which the Ambum Stone was sculptured is abundant around Mt Hagen, but to be certain about the rock's origin, either chemical analysis or petrographic examination is needed. Both methods would destroy a small part of the sculpture and therefore were not tried.

Returned to display

Ms Tworek-Matuszkiewicz and fellow conservator Gloria Morales have lovingly repaired the sculpture so that the damage does not deter Gallery visitor appreciation. The Ambum Stone is back on permanent display in the National Gallery in Canberra.

The Gallery bought the sculpture in 1977 from a private collection. The PNG Public Museum and Art Gallery was offered the sale ahead of Australia, but declined.



▲ The Ambum Stone, a 3.5 thousand-year-old sculpture of a foetal echidna, was carved in the western highlands of Papua New Guinea. The sculpture belongs to the National Gallery of Australia.



▲ Dr John Bain studies a broken piece of Ambum Stone to determine its geological make-up.

For further information contact Beata Tworek-Matuszkiewicz, who is on exchange as a senior lecturer at Canberra University, by phoning +61 2 6201 2632 or e-mailing tworek@scides.canberra.edu.au ↗



DOES FAIRWAY HOUSE HYDROCARBONS? REPORT PROVIDES CLUES

Record 2001/31 deals with ongoing activities involving the Fairway Basin, a frontier sedimentary basin that straddles French and Australian territory on the north-eastern Lord Howe Rise. This Cretaceous–Tertiary basin has some petroleum prospectivity, even though water depths are mostly 1500–3000 metres.

The Fairway Basin contains thick packages of sediment with numerous sediment diapirs, and a bottom-simulating reflector (BSR) that extends across much of the basin—perhaps indicating substantial amounts of CH₄ as gas hydrate and free gas.

The big question is whether the gas in the basin is biogenic and from shallow depths, or thermogenic from great depth. If it is the latter, the basin has considerable petroleum potential.

As part of the ZoNéCo 5 survey, run on behalf of the New Caledonian government, 13 piston cores were taken in the shallow sedimentary section to help assess the gas and petroleum potential of the basin. A general report on this cruise was in *AusGeo News* number 56.

The four to 7.5 metre-long cores, from water depths of 1250–2753 metres, contain stiff nannofossil ooze. The maximum age at the base of cores is less than 800 000 years. The sediment typically grades downward from greyish-orange to very pale orange, and then to yellowish-grey, very light grey or white. Thin black horizons are presumably composed of pyrite.

The changes in colour are related to variations in magnetic susceptibility (MS) and pore water SO₄²⁻. Pale and grey zones generally have low MS punctuated by MS highs, and low pore water SO₄²⁻ concentrations. Methane was detected in most sediment samples, although in trace levels. The presence of ethane, propane and higher hydrocarbons suggests that gases in

the basin indeed have a thermogenic component.

The best explanation for the colour, MS and SO₄²⁻ profiles is that iron has been remobilised under anoxic conditions. Ferric iron in solid oxyhydroxide phases and SO₄²⁻ in pore waters have been converted to dissolved ferrous iron and sulphide. Some of this iron and sulphur has then re-precipitated as pyrite or magnetite (the MS spikes).

The overall process may be driven by CH₄ from underlying gas hydrate deposits. Upward fluxes of CH₄, perhaps of thermogenic origin, induce anaerobic CH₄ oxidation in shallow sediment, a process that consumes SO₄²⁻. As a consequence, unexpectedly shallow redox fronts occur.

Longer cores with less-oxidised sediment, less SO₄²⁻ and more gas, are needed to better understand

MACKAY TOWNSHIP ASSESSED FOR NATURAL HAZARD RISK

Community risk in Mackay: A multi-hazard risk assessment is a report about natural hazard risk in the Queensland coastal town of Mackay. The report is an assessment of the Mackay community's vulnerability to severe winds and storm tide from tropical cyclones, flooding of the Pioneer River, and earthquakes.

AGSO – Geoscience Australia's Cities Project and the Bureau of Meteorology conducted the assessment in cooperation with Mackay City Council and the Queensland Department of Emergency Services.

The report comprises a full-colour booklet (an overview) and CD-ROM (300 pages of comprehensive information). It:

- assesses the levels of natural hazard in Mackay and the elements that are at risk;
- generates damage assessments for various scenarios using a database of building types;
- ranks suburbs for their contribution to overall community vulnerability and for their exposure to the various hazards;
- determines total risk for each suburb by hazard;
- compares community risk from the various hazards.

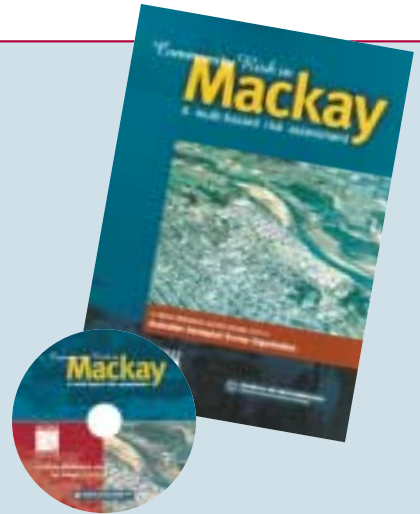
Assessment results

Mackay has a high level of residual risk from severe wind, storm tide and river flooding. In regard to earthquakes, there is significant but much less residual risk.

Mackay has a moderate level of risk from hazard events that occur relatively frequently (i.e., those with an average recurrence interval or ARI of 50 years or less). Events in this range will cause some property loss and put lives at risk.

Flooding, cyclonic wind and storm tide events with an ARI of 100 years or more will cause significant economic harm and potentially some loss of life.

In these rarer and more extreme events, the magnitude of risk will be increased by the loss of critical facilities and the impact on business activity (especially in Central Mackay, North Mackay, Mackay Harbour, Paget and West Mackay). For the Mackay community, which relies on disaster-sensitive industries such as agriculture and tourism, there will be a long recovery and restoration period.



Older areas are most vulnerable and most at risk to the impacts of floods, cyclones and earthquakes. The suburbs of Bucasia and Beaconsfield are at significant risk from wind, storm tide and earthquake, but not flooding.

Pioneer River floods pose the greatest geohazard risk to Mackay. In the ARI = 100 year scenario, 18 per cent of buildings would have over-floor flooding and numerous key facilities would be inundated. The likelihood of levees being breached is high. Evacuations would need to commence well before the water reached the top of the levees.

sediment, water and gas in this region. It is hoped that such longer cores will be taken on future expeditions in cooperation with French scientists.

AGSO – Geoscience Australia record 2001/31 by Dickens, Exon, Holdway, Lafoy, Auzende, Dunbar and Summons, titled *Quaternary sediment cores from the Southern Fairway Basin on the northern Lord Howe Rise (Tasman Sea)*, costs \$44 (including GST). The record comprises 25 pages of text, and includes 13 figures and 13 plates that illustrate all the cores. It will be released at the end of August.

To buy a copy, complete the enclosed order form and fax or post it to the Sales Centre.

For further information about the Fairway Basin phone Neville Exon on +61 2 6249 9347 or e-mail neville.exon@agso.gov.au

Severe wind and storm tide from tropical cyclones would affect older buildings (about two-thirds of buildings in Mackay), because they are not constructed to modern wind-resistant design standards.

If an earthquake occurred (based on a 475-year ARI scenario as specified by the Australian earthquake loadings standard), about 16 per cent of Mackay buildings would sustain damage—although most damage would be slight.

Purchase details

The booklet and CD-ROM *Community risk in Mackay: A multi-hazard risk assessment* (AGSOCAT 35315) edited by Middelmann and Granger can be bought from the Sales Centre for \$38.50 (includes GST) plus postage and handling.

The Mackay assessment is the second in a series of multi-hazard risk assessments of Australian towns and cities by AGSO – Geoscience Australia. The first was the Cairns study released in late 1999.

For further information about the Mackay report phone Miriam Middelmann on +61 2 6249 9240 or e-mail miriam.middelmann@agso.gov.au

CAVES KIT: *Fascinating facts brought to light*

Did you know that Australia has about 10 000 known caves? And that Western Australia has caves with the world's biggest salt stalactites and stalagmites, the longest straw stalactite (6.37 metres or the length of about 31 drinking straws end to end) and a cave chamber that has enough floor space to park a thousand cars?

These and other fascinating facts are published in *Discovering Caves*, an education kit produced by AGSO – Geoscience Australia. The kit is being taken up by schools, national parks and tourist operations across Australia because it offers accurate geological, heritage and conservation information.

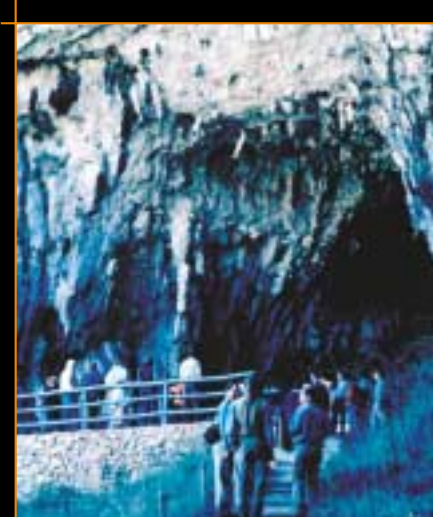
Aimed at upper primary and lower secondary school students, the kit comprises a full-colour poster map of Australia showing the distribution of Australian caves and photographs of every show cave in Australia. The kit also includes 18 generic fact sheets on cave features and cave management, and a series of activity sheets.

AGSO – Geoscience Australia, Jenolan Caves Reserve Trust, Careys Cave and the National Parks and Wildlife Service initiated the kit. It was produced by Geoscience Australia's Education Unit in conjunction with the Australasian Cave and Karst Management Association, Australian Speleological Federation and the Ian Potter Foundation.

If you want to learn some amazing facts (e.g. about a lava tube cave that is 27 times as long as an Olympic swimming pool, and the blind, white cave creatures that grow slowly, live long and produce few young), buy a copy of this modestly priced kit.

Discovering Caves costs \$16.50 (includes GST) plus postage and handling. The poster, titled 'Discovering caves in Australia', can be purchased separately for \$8.80 (includes GST). To buy these products please complete the enclosed order form and fax or mail the form to the Sales Centre.

For more information about the kit phone Gary Lewis on +61 2 6249 9570 or e-mail gary.lewis@agso.gov.au



Latest releases

Airborne geophysical & gravity data

WESTERN AUSTRALIA

Londonderry-Drysdale. AGSO – Geoscience Australia has released pixel image maps of the Drysdale and southern half of the Londonderry 1:250 000 sheet areas—both in the Kimberley region, which is known to contain kimberlite pipes and traces of diamonds.

Survey flight lines were flown north–south at 80 metres above ground level and spaced 800 metres apart. Magnetic data were sampled approximately every seven metres and gamma-ray spectrometric data every 70 metres.

Product prices are as follows: Colour TMI map \$161.85, greyscale \$134.90, colour TMI and greyscale \$269.80, gamma-ray \$161.85, and digital image data \$323.75 per map.

Sandstone. Geoscience Australia and GSWA have released the airborne magnetic and gamma-ray spectrometric data for the Sandstone 1:250 000 sheet area. The Sandstone sheet is in the northern Southern Cross province of the Yilgarn Craton—a region prospective for gold. Calcrete-hosted uranium also occurs in paleochannels in the region. The Sandstone sheet coverage comprises four surveys and more than 71 600 line kilometres of data.

Product prices for TMI and gamma-ray point located data and grids are as follows: for 1:100 000 sheet area \$2630 (PLD) and \$630 (grid); for 1:250 000 sheet area \$14 860 (PLD) and \$3450 (grid).

Laverton-Leonora. Digital point located gravity data is now available for the Laverton and adjoining 1:250 000 sheet areas in the Eastern Goldfields. The survey comprises 3055 new gravity stations spaced over approximately 47 800 square kilometres of the Youanmi, Leonora, Laverton, Rason, Barlee, Menzies, Edjudina and Minigwal 1:250 000 sheet areas. Data were acquired from September to December 2000.

The complete survey data set (3055 new stations) is \$12 220; a selection costs \$4 a station.

QUEENSLAND

Cairns-Georgetown. Pixel image maps of airborne magnetic and gamma-ray spectrometric data from the Cairns to Georgetown geological regions of north Queensland have been released. The maps cover three areas, namely:

- most of the Mosman 1:250 000 sheet area and the southern part of the Cooktown 1:250 000 sheet area;
- most of the Atherton 1:250 000 sheet area; and
- the eastern two-thirds of the Gilberton 1:250 000 sheet area.

Data for these maps were acquired by the Queensland Department of Natural Resources and Mines between July and November 1999 on east–west flight lines spaced 400 or 200 metres apart. Terrain clearance was 80 metres with a sample interval of approximately seven metres for the magnetic data and 70 metres for the gamma-ray data.

Product prices are as follows: Colour TMI map \$161.85, greyscale \$134.90, colour TMI and greyscale \$269.80, gamma-ray \$161.85, and digital image data \$323.75 per map.

NEW SOUTH WALES

Broken Hill. A new 1:250 000 scale colour airborne gamma-ray spectrometric ternary image map covering six 1:100 000 sheet areas of the Broken Hill and Menindee areas (Corona, Fowlers Gap, Broken Hill, Taltingan, Thackaringa and Redan) has been released. Data for most of the map area was acquired at 60 metre height on lines spaced either 100 or 200 metres apart. Infill areas in the north-east of the map area were flown at 80 metres height on flight lines spaced 250 metres apart. The pixel map provides a useful overview of the radiometric character of the Broken Hill region. The map costs \$215.80.

SOUTH AUSTRALIA

Woodroffe. Airborne magnetic, gamma-ray spectrometric and digital elevation model data from the Woodroffe 1:250 000 sheet area are now available. Data are from last year's survey over the 1:100 000 sheet areas of Caroline, Davenport, Woodroffe, Crombie, Carbeena and Eunyarinna. Flight lines were flown north–south at 80 metres above ground level and spaced 200 metres apart. Magnetic data were sampled approximately every seven metres and gamma-ray spectrometric data were sampled approximately every 70 metres.

Product prices are as follows: at 1:250 000 scale, the map (TMI/dose rate/DEM contours) costs \$43.15 (dyeline) or \$129.50 (transparency); TMI/gamma-ray/DEM data cost \$100 (PLD on two CD-ROMs) or \$50 (grid on CD-ROM).

Purchasing details

Prices listed above include GST, but not postage and handling. Point located data (PLD) and grids can be purchased from Peter Percival by phoning +61 2 6249 9478 or e-mailing peter.percival@agso.gov.au. For maps, complete the enclosed order form and fax or post it to the Sales Centre.

For further information about these products phone or e-mail Peter Percival as shown above. ☒

Notes on Laverton sheet released

A new edition of explanatory notes for the Laverton 1:250 000 geology sheet has just been released by the Geological Survey of Western Australia. The notes are a comprehensive report on outcrop mapping by AGSO – Geoscience Australia during the National Geoscience Mapping Accord, describing rock types, structure, metamorphism and major mineral deposits in the Laverton area.

New edition maps Mineral deposits on magnetic image of Australia

If you are after a good map of Australia's mineral deposits, AGSO – Geoscience Australia has released the second editions of two 1:5 million scale national maps. These large maps (930 mm x 820 mm) show mineral deposit information on a grey-scale magnetic image of the continent.

One map illustrates mineral deposits by age of formation and the other broadly classifies mineralisation according to deposit type. On each map, areas of mainly Phanerozoic basin cover that are essentially unmineralised are superimposed as a green or orange stipple.

Both maps have been fully revised. They not only show the distribution, age, and types of mineral deposits in Australia, but reveal extensions to prospective areas concealed beneath sedimentary basin cover.

The maps are simplified, spatial representations of selected attribute information from Geoscience Australia's mineral deposit database (OZMIN). The deposit-type map places Australia's major deposits in 20 categories based on their geological setting and general deposit characteristics. The age-of-formation map has been simplified into 21 categories according to era and period (e.g. Cainozoic, Palaeozoic, Jurassic and Ordovician).

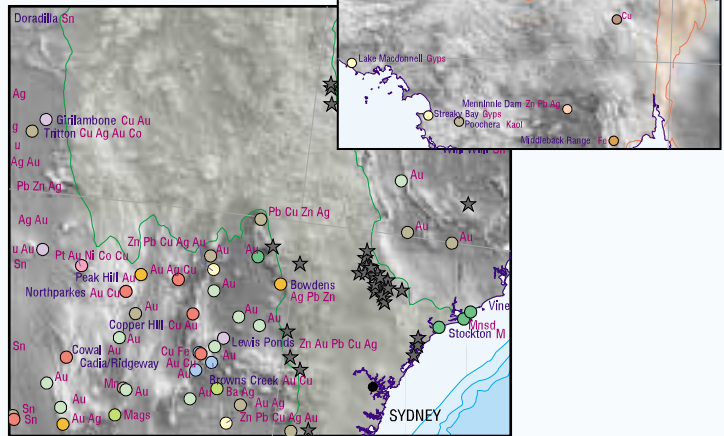
Australia's mineral endowment is a direct result of its geological evolution. Mineral deposits have been discovered and mined predominantly where the major crustal elements that make up Australia are exposed and not obscured by younger sedimentary basins and regolith

Laverton is approximately 250 kilometres north of Kalgoorlie in Western Australia's Eastern Goldfields. Greenstones underlie about 40 per cent of the sheet area, mainly in the south. The greenstones were deposited 2700–2665 million years ago as mafic to ultramafic volcanic rocks with subordinate intrusive equivalents, felsic volcanic rocks, and fine-grained to conglomeratic sedimentary rocks.

The sheet area has some 200 known mineral deposits, most of them gold, the largest being Granny Smith (149 t) and Wallaby (132 t). Other deposits include Murrin Murrin (lateritic nickel) and Mount Weld (phosphate, rare earths, niobium and tantalum). Most gold deposits discovered to date are in greenstone, but there are significant deposits in granitic rocks (e.g. Granny Smith).

The notes are designed to accompany the second edition Laverton 1:250 000 outcrop-geology map. The map and notes as a set are available from the GSWA Information Centre (phone +61 8 9222 3459 or www.dme.wa.gov.au) for \$15 (includes GST) plus postage and handling.

For more information about the Laverton notes and map phone Alan Whitaker on +61 2 6249 9702 or e-mail alan.whitaker@agso.gov.au



materials. The magnetic image shows the extent of these elements and major structures beneath the sedimentary basin cover. It is a grey-scale total magnetic intensity image of Australia that has been enhanced using a sun angle illumination from the north-east.

For greater detail about each deposit and its relationship to infrastructure, these maps should be studied in conjunction with the map 'Australia's mines and major mineral deposits' produced at the same scale by Geoscience Australia in April 2000. The infrastructure map was produced for and is available through the Minerals Council of Australia. It covers 61 commodities (including coal) and illustrates more than 900 of Australia's major current and historic mines and undeveloped mineral deposits.

The laminated, print-on-demand, second edition maps 'Australian mineral deposits by age of formation' (AGSOCAT 33285) and 'Australian mineral deposits by deposit type' (AGSOCAT 33286) are available from the Sales Centre for \$77 each or \$132 for both (including GST). To order the maps please complete the enclosed order form and post or fax it to the Sales Centre.


For more information about the maps phone Greg Ewers on +61 2 6249 9580 or e-mail greg.ewers@agso.gov.au

GRAVITY ANOMALY GRID OF THE AUSTRALIAN REGION

AGSO – Geoscience Australia has released a digital gridded gravity anomaly data set of the Australian region. The grid combines accurate on-shore gravity measurements, and a sub-sample of the offshore levelled marine gravity traverses with satellite data used in areas where there is no marine data.

The cell values represent simple Bouguer anomalies at a density of 2.67 tm^3 on-shore and free-air anomalies offshore. The grid covers the area extending from 8° to 48°S and 108° to 162°E . The grid cell size is 0.5 minutes of arc, which is equivalent to about 800 metres.

The grid was generated in a two-pass process (1.5 minutes then 0.5 minute) from a composite file containing 815 000 land observations, 1.5 million marine values and 2.2 million satellite values.

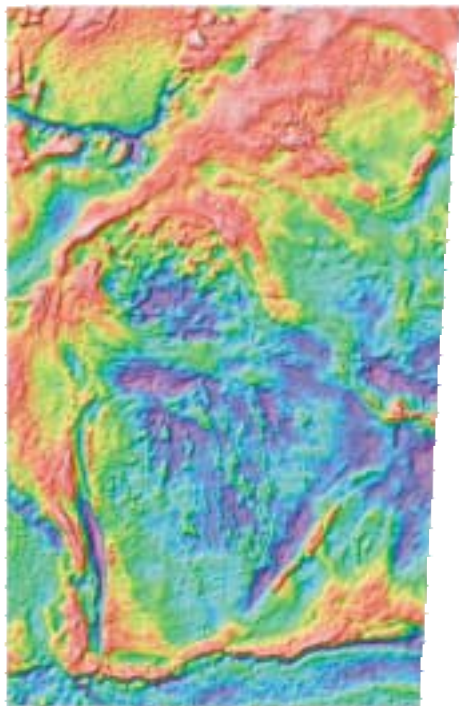
The digital grid is available in ASCII BIL format and ERMMapper format on CD-ROM. The price of the grid is \$2722.50 (including GST). To buy a copy of this product please complete the enclosed order form and fax or post it to the Sales Centre. 


GRAVITY ANOMALY MAP OF WESTERN AUSTRALIA

In late August, AGSO – Geoscience Australia and the Geological Survey of Western Australia (GSWA) will release a gravity anomaly pixel map of Western Australia and the adjoining marine area.

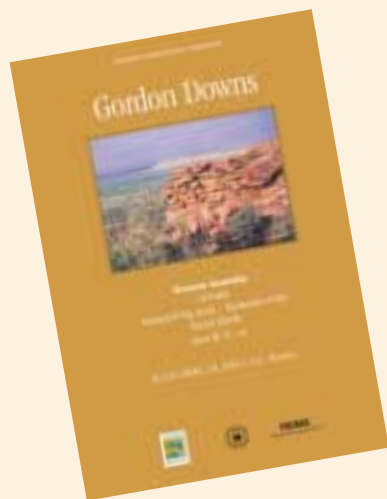
This map combines 230 000 on-shore gravity observations, spaced between 11 kilometres and 50 metres, with 1.9 million levelled offshore values along ship traverses.

Satellite-derived anomalies are used in areas where there is no marine coverage. Recently acquired gravity data from the GSWA geochemical-gravity surveys and surveys in the Eastern Goldfields are included. The 1:2.5 million-scale, colour image shows Bouguer anomalies at a density of 2.67 tm^3 on-shore and free-air anomalies offshore. The data were gridded onto an 800 metre mesh in a two-pass gridding process.



This map complements the previously released geological, magnetic anomaly and topography maps of the state at the same scale and projection. The map will cost \$54.45 (includes GST) plus postage and handling. It will be available from the Sales Centre. 

GORDON DOWNS geological map and notes



A second edition, geological map of the Gordon Downs 1:250 000 sheet area (SE 52-10; lats. $18-19^\circ\text{S}$; longs. $127.5-129^\circ\text{E}$) and explanatory notes have been released by AGSO – Geoscience Australia and the Geological Survey of Western Australia (GSWA). This is the final geological map produced by Geoscience Australia for the National Geoscience Mapping Accord project on the East Kimberley, northern Western Australia.

The litho-printed map shows considerably more detail than the first edition published 34 years ago. It reflects major revisions to the stratigraphy, and the integration of detailed geological mapping with whole-rock geochemistry, U-Pb zircon geochronology, satellite imagery (Landsat), airborne magnetic and gamma-ray spectrometric data, and gravity data. The map surrounds include a comprehensive stratigraphic and symbols reference, a north-west to south-east geological cross section, and a 1:1 million scale map emphasising solid geology and structure.

The explanatory notes by Blake, Warren and Tyler are a detailed description of the geology supported by five line-drawings and 39 colour photographs. The notes include sections on stratigraphy, structural geology, geochronology, geological history, geophysics, and economic geology. Definitions of new and revised stratigraphic names are given in an appendix.

Gordon Downs geology

The Gordon Downs sheet area contains:

- Palaeoproterozoic rocks of the Halls Creek Orogen in the west;
- parts of the Neoproterozoic Wolfe Basin and Palaeozoic Ord Basin to the east;
- Mesoproterozoic rocks of the Birrindudu Basin in the south and south-east; and
- late Archaean rocks of the Browns Range Dome in the far south-east.

The prospective Palaeoproterozoic rocks in the Halls Creek Orogen range in age from ~1910 Ma (Ding Dong Downs Volcanics) to ~1800 Ma (Kimberley Group). They include metamorphosed sedimentary and igneous rocks that have potential for gold, base-metal sulphides, rare-earth elements, and uranium mineralisation.

Economic lode- and alluvial-gold deposits occur in close proximity to alkaline volcanics of the Butchers Gully Member in the lower part of the Olympio Formation, and also close to contacts between the Olympio Formation and underlying Biscay Formation.

Calcareous rocks and felsic volcanics of the Biscay Formation and Koongie Park Formation are associated with sub-economic copper-lead-zinc deposits of possible volcanogenic massive sulphide type. Major orogenic events occurred during the Palaeoproterozoic (Halls Creek Orogeny), Mesoproterozoic (Yampi Orogeny), Neoproterozoic (King Leopold Orogeny), and Palaeozoic (Alice Springs Orogeny).

The sheet area is crossed by the north-north-east trending Halls Creek Fault, a major strike-slip structure that extends as far north as Darwin.

Neighbouring areas

Geological maps and commentaries for the recently released Ruby Plains (4460) and Halls Creek (4461) 1:100 000 sheets, which form the western component of the Gordon Downs 1:250 000 sheet, are described in *AusGeo News* 49 and 53, respectively. Geological maps for some of the 1:100 000 and 1:250 000 sheet areas adjacent to Gordon Downs are available from Western Australia's Department of Minerals and Energy.

Purchase details

The Gordon Downs map and notes package costs \$53.95 (includes GST). A digital version of the geological map (ARC/INFO, and other formats on request) costs \$110 (includes GST). To buy one of these products please complete the enclosed order form and post or fax it to the Sales Centre.

The new Gordon Downs map and explanatory notes will be of considerable interest to mineral explorers, and to those involved in assessing the mineral potential of the under-explored East Kimberley, traditional owners and local pastoralists, students and tourists.

For more information about the East Kimberleys phone Dean Hoatson on +61 2 6249 9593 or e-mail dean.hoatson@agso.gov.au



▲ Cuesta-forming Eliot Range Dolomite overlain to left (east) by recessive Moonlight Valley Tillite and Ranford Formation and scarp-forming Mount Forster Sandstone, HALLS CREEK. (DH Blake)

▼ View of Mount Barrett, HALLS CREEK, from the north. Rocks of the Koongie Park Formation (hornfels) and Shepards Bore Plutonic Complex exposed below the eastern crest are overlain unconformably by King Leopold Sandstone, Kimberley Group, dipping gently westwards. (DH Blake)



▲ Cliffs capped by flat-lying Gardiner Sandstone, Birrindudu Group, west of the Browns Range Dome, GORDON DOWNS. Scattered exposures of shale at the base of the cliffs show the capping sandstone belongs to the upper part of the formation. (DH Blake)



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