

Fieldnotes



Department of
Industry and Resources

Geological Survey of
Western Australia



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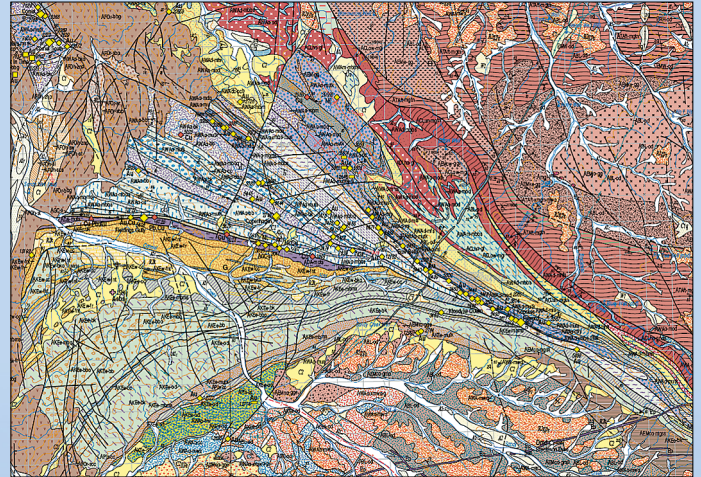
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Marble Bar map release marks end of an era

The June release of the Marble Bar 1:100 000 geological series map not only marked the end of 1:100 000 scale geological series map production from the Pilbara Craton mapping project, but it was a particularly significant event for its two authors, Arthur Hickman and Martin Van Kranendonk. For Arthur, Marble Bar was the area where he started his GSWA mapping career early in 1972. The systematic lithological mapping required for geological series maps has always provided opportunities to explore stratigraphy, tectonic history, and mineral potential, and in 1972 the geology of the east Pilbara was still very poorly understood. Between 1972 and 1976, GSWA

remapped the east Pilbara and parts of the west Pilbara, and by early 1978 the results had been written up in the manuscript for GSWA Bulletin 127 (published in 1983).

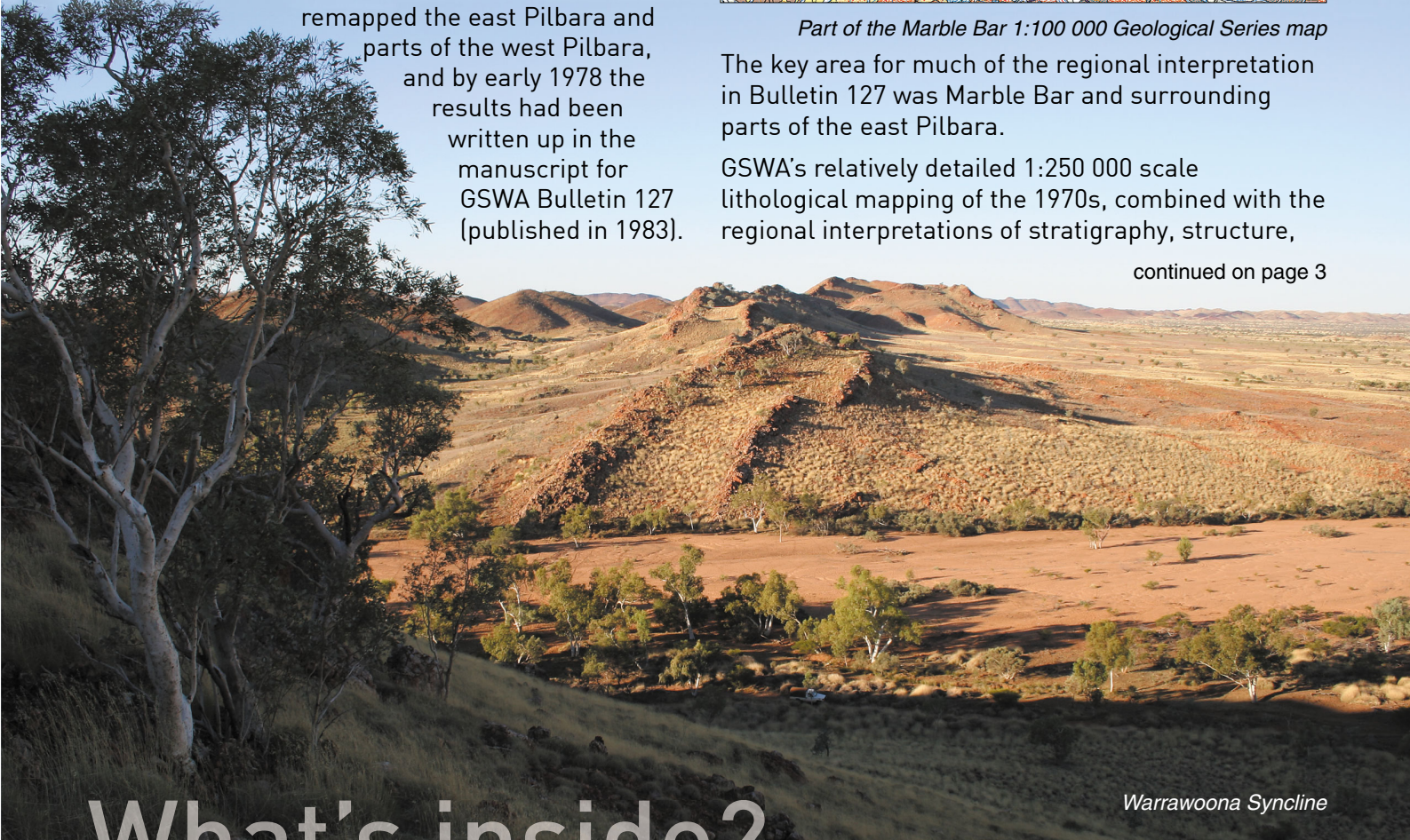


Part of the Marble Bar 1:100 000 Geological Series map

The key area for much of the regional interpretation in Bulletin 127 was Marble Bar and surrounding parts of the east Pilbara.

GSWA's relatively detailed 1:250 000 scale lithological mapping of the 1970s, combined with the regional interpretations of stratigraphy, structure,

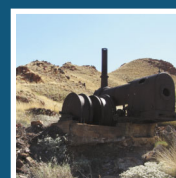
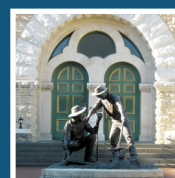
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Warrawoona Syncline

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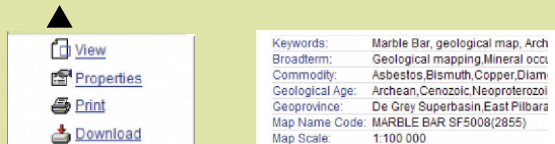




DigitalPaper User tip

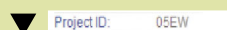
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A Project ID field has recently been added to all geoscience publications in DigitalPaper so each publication can be searched for directly on the Document Search page. If you have any issues finding specific documents, you may contact the GSWA via <www.doir.wa.gov.au> to find out if the document is available.

For more information, contact Ryan Aston (ryan.aston@doir.wa.gov.au).

Geological walks near Mineral House

There are several geologically interesting locations very near Mineral House in East Perth and surrounding areas. So if you feel like a breath of fresh air and a bit more geological knowledge about Perth city, head out at lunchtime and investigate this fascinating environment.

Queens Gardens

These small, inner-city heritage gardens form an oasis of green. They are landscaped over a former clay pit — a fine example of sequential land use.

The clay pit and adjoining brickworks supplied bricks for many of Perth's earliest buildings.

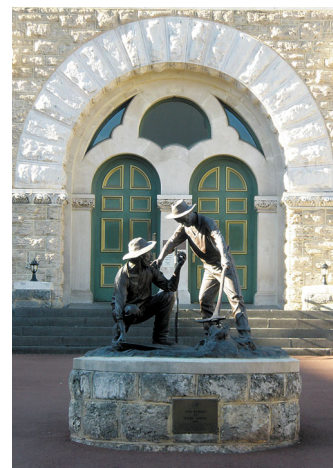
Dated 1899, the gardens were part of the gentrification of Perth following the heady gold-rush days of the early 1890s. The deepest parts of the former clay pits are now the lakes, where the clay forms a natural seal to retain the water. The former quarry walls have been contoured to form slopes for spring bulb displays.



A reproduction sculpture of Peter Pan was gifted to Perth's children to celebrate Western Australia's centenary.

Perth Mint

This fine heritage building of Quaternary Tamala Limestone is home to the Perth Mint. It is one of Perth's most impressive Colonial-era buildings and is registered with the National Trust. The Mint opened in 1899, minting firstly gold sovereigns, then later copper coins and shillings for the war effort. It now mints and markets gold, silver, and platinum Australian legal tender coinage to investors and collectors worldwide. A heritage building, gold bullion, precious-metal souvenirs, and a real gold pour (liquid gold metal poured into an ingot) combine to make the Perth Mint one of the city's premier tourist attractions. ■





Marble Bar map release

continued from page 1

and crustal evolution in Bulletin 127, provided a better geological framework for mineral exploration and for university-based geoscientific research. One consequence was that by 1993 several researchers had found evidence to challenge a number of the stratigraphic and tectonic interpretations in Bulletin 127. Accordingly, GSWA and Geoscience Australia (then the Australian Geological Survey Organization) set up the Pilbara Craton mapping project to remap the entire northern half of the Pilbara Craton at 1:100 000 scale, and to undertake more advanced studies of the region's structure and mineralization. In 1994, Martin Van Kranendonk commenced a study of Pilbara structural evolution at the University of Newcastle, and in 1997 he joined GSWA's Pilbara Craton team to complete his investigation of the North Shaw 1:100 000 geological map sheet. From 1997 to 2003 Martin continued his geological mapping of the east Pilbara and has now published extensively on the area. Therefore, the release of Marble Bar, the final piece in the east Pilbara jigsaw, was also an important milestone for Martin.

The Marble Bar area is now internationally recognized as providing our best window on early Archean geological processes and the evolution of life 3500 million years ago. Though many researchers from other organizations have contributed to this recognition, GSWA's mapping and establishment of a regional geological framework

for more specialized studies, have undoubtedly played a major role in revealing the geological importance of the area. Discoveries made during the mapping of Marble Bar 1:100 000 included the observation that the 3460 Ma mafic volcanics of the Apex Basalt (suggested by some workers to be a remnant of Archean oceanic crust) were fed by a dolerite dyke swarm that intruded extensional fractures in an underlying 3500–3465 Ma granite-greenstone terrain. Additionally, the dyke swarm is radial around a 50 km-diameter granite-greenstone dome (Mount Edgar Dome), indicating that extension was related to domal uplift. Improved structural evidence was also found on Marble Bar to support the long-standing diapiric tectonic model in which large-scale crustal doming resulted from inverted density stratification and partial convective overturn. An intriguing new concept to come from the Marble Bar mapping was that the 3180 Ma Dalton Suite of layered mafic-ultramafic intrusions was intruded along deeply faulted contacts between the domes. This indicates that crustal extension during the major 3220–3165 Ma rifting event in the Pilbara Craton was not, as previously supposed, confined to the extreme northwest and southeast margins of the craton.

For more information, contact Arthur Hickman (arthur.hickman@doir.wa.gov.au).

Geology and old mine workings, Marble Bar sheet



Columnar Rhyolite, Wyman Formation rear Camel Creek (3.3 Ga)



Old workings and equipment at the Klondyke Queen gold mine, Warrawoona



Old workings at Klondyke Queen



ARC linkage grant sees cooperative projects blossom

GSWA has been involved in successful applications for three Australian Research Council Linkage grants. The projects, which all started in July 2008, cover subjects from either end of the geological time-scale, ranging from Archean gold, platinum, nickel and iron deposits in the Yilgarn Craton to petroleum exploration in the Devonian of the Canning Basin. These represent an ongoing program of geoscience research projects that involve cooperation between universities, CSIRO, industry and GSWA geologists.

Chronostratigraphic framework for the Devonian Canning Basin – A multidisciplinary record of environmental change

The Devonian reef complexes of the Canning Basin are justifiably famous in the geological world, as spectacularly exposed fossil reefs, with cross sections through them exposed in Windjana and Geikie Gorges, and fore-reef to basinal deposits exposed so that fabrics, textures and structures can be seen in ways that are impossible in modern reefs. The reefs provide analogues and guides for petroleum exploration of carbonate systems worldwide, particularly Canada and Asia, and have been the subject of research by GSWA for nearly 50 years.

One of the continuing problems in the Devonian reefs has been precise correlation between rocks from the reef platform, and rocks from the front of the platform (fore-reef and slope) and basinal deposits. Fore-reef to basinal deposits can be precisely dated from conodont fossils, but these are virtually absent on the platform, so the platform is poorly dated. Many events that affected the platform (such as small sea-level falls) are poorly constrained, and their effects in deeper water areas are difficult to assess because of the uncertain correlation. During deposition of the reefs, one of the 'Big Five' mass extinctions took place (at the Frasnian/Famennian boundary), and the climate in northwest Australia was starting to change from warm to cool, heralding continental glaciation in the Carboniferous. The extinction, and the progressive change in climate, is recorded in the reefs.

The ARC linkage grant seeks to redress this lack of correlation, and improve our understanding of events such as the Frasnian/Famennian extinction, and of global climate change, by unravelling the internal relationships within the reef complexes through precise dating. Detailed oriented sampling

and gamma-ray logging of sections throughout the outcrop belt of the reefs, and from selected mineral core, will enable paleomagnetic dating, biomarker and isotopic analysis directed at detecting trends in the environment during development of the reefs, and improved correlation between platform, slope and basinal rocks. Results from sampling in 2007 have been very promising. The outcomes will also be used as a yardstick and model against which prospective reefs elsewhere in the world can be compared.

The linkage grant is between the University of WA, Curtin University of Technology, Chevron Australia, ARC Energy, MERIWA, and GSWA, with additional funding by Chevron through WAERA. Geoscientists from California Institute of Technology (Caltech), the University of Washington, and Chevron's Energy Technology Company in California are also part of the project. GSWA's contribution is primarily in the provision of expert field knowledge of the reefs, and field support.

For more information, contact Roger Hocking (roger.hocking@doir.gov.wa).



Joe Kirschvink (Caltech) – drilling is dirty business



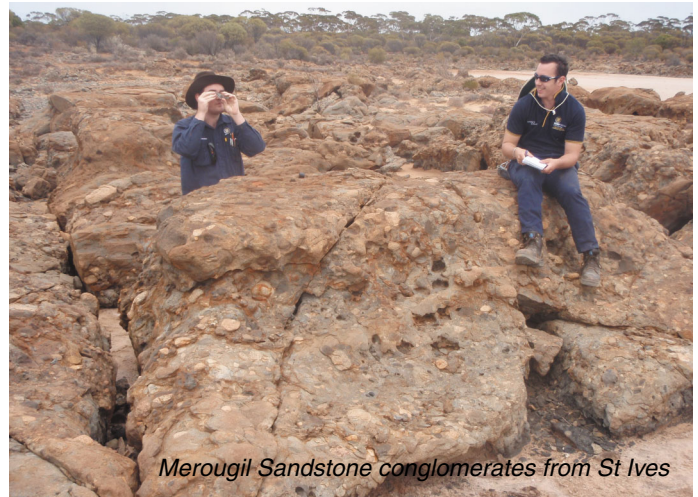
Joe Kirschvink and Sara Peek (Caltech) drilling paleomagsamples

Understanding the stratigraphic and structural architecture of late Archean basins and the context of their gold deposits

Gold mined from Archean rocks of the Yilgarn Craton contributed about \$4 billion to Australia's export earnings in 2006, yet production levels were 40% lower than in 1997 and almost all current deposits will be exhausted within the next 15 years unless major new discoveries are made. The potential to make new discoveries remains high, but will require explorers to find gold deposits that are hidden below the surface. This requires a robust scientific understanding of how the deposits formed and a clear knowledge of the three-dimensional geological architecture of the rock units that host them. In the past 20 years, the presence of thick units of coarse continentally derived sedimentary rocks, referred to as Archean 'late basin' successions, have been used by explorers to make many new discoveries because of their close spatial association with the known gold deposits (e.g. Agnew, Kanowna Belle, Sunrise Dame and Wallaby). Several modest discoveries have been made in rocks from older volcanic basins, such as the Black Flag Group at St Ives, that were previously thought to be unprospective.

Regardless of the age of the basin units or the composition of the rock fragments comprising them, uncertainty about the internal architecture and spatial distribution of late Archean volcanic and sedimentary units has resulted in a poor understanding of the relationship between basin evolution and gold mineralisation. This ARC linkage grant between Monash University, Gold Fields Limited and GSWA will undertake a multidisciplinary investigation of the regional-scale three-dimensional (3D) architecture of several late Archean basins and their gold deposits to determine when mineralisation occurred relative to evolution of the numerous basins sequences. These new data will form the basis for 3D numerical models to test important hypotheses on the formation of major Archean gold deposits, such as whether particular structures associated with the evolution of the basins acted as conduits for fluids associated with gold mineralisation, and/or if certain rock layers provided impermeable caps to trap the metal. Results of this work will be of interest to all explorers seeking major Archean gold deposits in Australia and elsewhere in the world.

For more information, contact Catherine Spaggiari (catherine.spaggiari@doir.wa.gov.au).

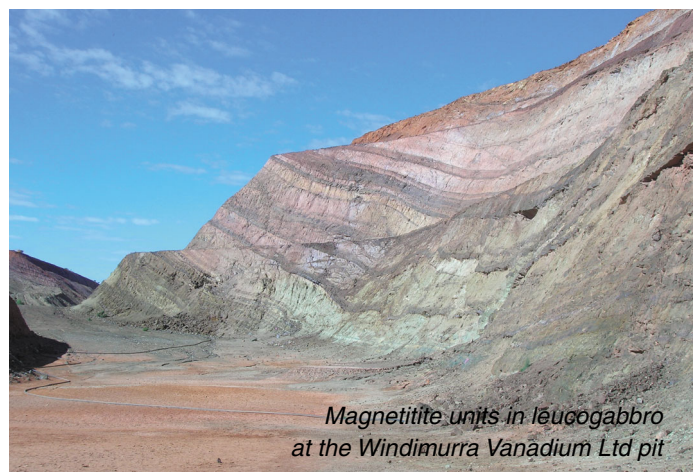


Merougil Sandstone conglomerates from St Ives

The Windimurra-Narndee Layered Complexes, Western Australia

Mineral resources are a major export earner for Australia. If Australia is to continue benefiting from the current minerals boom then new reserves must be continuously found as existing reserves are mined out. The Windimurra-Narndee complexes represent a relatively new exploration target for platinum, nickel, and iron ore. Identification of a new mineral field in the Murchison region of Western Australia would be very good for the regional (and national) economy. Furthermore, advancing Australia's understanding of large mafic-ultramafic intrusive systems will further raise international regard for the Australian academic community, mineral explorers and geological surveys. The results of this ARC linkage grant between the Australian National University, Maximus Resources and GSWA will help Australian mining companies better explore similar terranes.

For more information, contact Stephen Wyche (stephen.wyche@doir.wa.gov.au).



Magnetite units in leucogabbro at the Windimurra Vanadium Ltd pit



Where we are working in the field



Edmund and Collier Basins project:

Field mapping; lithological, stratigraphic, structural, sedimentological, and metamorphic analysis; sampling for geochemistry and geochronology.
Contact: Alan Thorne
Ph: (08) 9222 3335
Fax: (08) 9222 3633
alan.thorne@doir.wa.gov.au

Gascoyne Complex project:

Field mapping; lithological, stratigraphic, structural, and metamorphic analysis; sampling for geochemistry and geochronology.
Contact: Steve Sheppard
Ph: (08) 9222 3566
Fax: (08) 9222 3633
steve.sheppard@doir.wa.gov.au

Murchison project:

Field mapping and structural geology studies; sampling for geochronology and geochemistry.
Contact: Stephen Wyche
Ph: (08) 9222 3606
Fax: (08) 9222 3633
stephen.wyche@doir.wa.gov.au

South Yilgarn project:

Field mapping and structural geology studies; sampling for geochronology and geochemistry.
Contact: Stephen Wyche
Ph: (08) 9222 3606
Fax: (08) 9222 3633
stephen.wyche@doir.wa.gov.au

Canning Basin project:

Field studies of the Permian and Devonian succession.
Contact: Roger Hocking, Arthur Mory or Peter Haines
Ph: (08) 9222 3590, (08) 9222 3327 or (08) 9222 3667
Fax: (08) 9222 3633
roger.hocking@doir.wa.gov.au
arthur.mory@doir.wa.gov.au or
peter.haines@doir.wa.gov.au

Western Amadeus Basin project:

Field studies of Neoproterozoic and Paleozoic successions.
Contact: Peter Haines
Ph: (08) 9222 3667
Fax: (08) 9222 3633
peter.haines@doir.wa.gov.au

West Musgrave Complex project:

Field mapping; lithological, structural, and metamorphic analysis; sampling for geochemistry and geochronology.
Contact: Hugh Smithies
Ph: (08) 9222 3611
Fax: (08) 9222 3633
hugh.smithies@doir.wa.gov.au

East Yilgarn project:

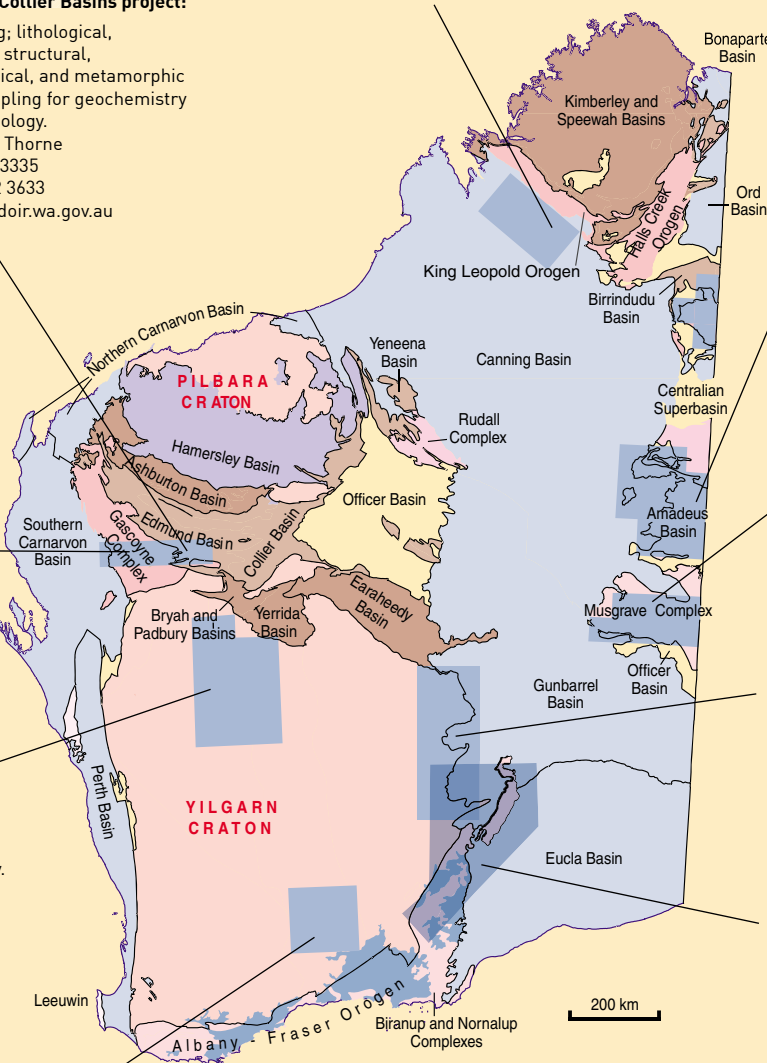
Geological mapping; structural studies; sampling for petrography, geochemistry and geochronology.
Contact: Stephen Wyche
Ph: (08) 9222 3606
Fax: (08) 9222 3633
stephen.wyche@doir.wa.gov.au

Eastern Albany-Fraser and Yilgarn Margin project:

Reconnaissance fieldwork and geophysical interpretation.
Contact: Catherine Spaggiari
Ph: (08) 9222 3491
Fax: (08) 9222 3633
catherine.spaggiari@doir.wa.gov.au

National Geochemical Survey of Australia (NGSA):

[whole of WA]
Collect transported regolith samples at the outlet of large catchments throughout WA for the National Onshore Energy Security Initiative; ongoing until December 2008.
Contact: Paul Morris
Ph: (08) 9222 3345
Fax: (08) 9222 3633
paul.morris@doir.wa.gov.au





Geophysics surveys

Western Australia regional geophysics surveys: September 2008 update

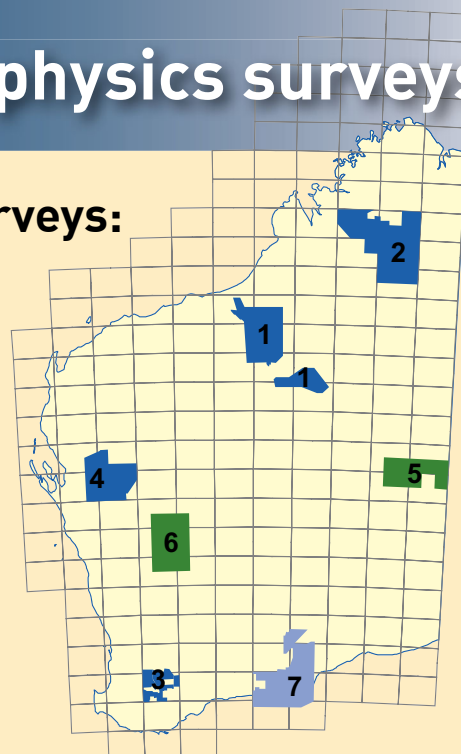
Data access

Download final data releases from the Geoscience Australia Data Delivery System at <www.ga.gov.au/gadds>. Download preliminary and final grids and images at <www.doir.wa.gov.au/geophysics>.

Subscribe to the GSWA mailing list at <www.doir.wa.gov.au/GSWA> to keep informed of preliminary and final data release dates.

For more information, contact David Howard (david.howard@doir.wa.gov.au).

In progress
Airborne
Gravity
Planning
Airborne



ID	Area/Name	Origin	Method	Specifications	Size	Status	Start	End	Release
In progress or under contract									
1	Paterson 2007	GA	AEM	1, 2, 6 km x 121 m; E/W	29 000 km	Survey	Sep-07	Aug-08*	Dec-08*
2	South Kimberley 2007	GSWA	Mag-Rad	400 m x 60 m; N/S	163 000 km	Survey	Jan-08	Aug-08*	Dec-08*
3	Dumbleyung 2008	SWCC GSWA	Mag-Rad	100 m x 30 m; 400 m x 60 m N/S	70 000 km	Survey	Mar-08	Sep-08*	Dec-08*
4	Byro 2008	GSWA	Mag-Rad	400 m x 60 m; E/W	90 000 km	Processing	Apr-08	Jul-08	Oct-08*
5	West Musgrave 2008	GSWA	Gravity	2.5 km grid	4 000 stns	Released	May-08	Jul-08	7-Aug-08
6	Windimurra 2008	GSWA	Gravity	2.5 km grid	5 200 stns	Survey	Aug-08	Sep-08*	Dec-08*
Planning									
7	Esperance – Balladonia 2008	GSWA	Mag-Rad	400 m x 60 m; E/W	120 000 km	Contract	Sep-08*	Feb-09*	May-09*

Information current at: 26 August 2008

* Estimated date

Kalgoorlie sterilization drilling



GSWA recently completed a RAB sterilization drilling program over a 200 ha area adjacent to Anzac Drive on the outskirts of West Kalgoorlie. The drilling was undertaken

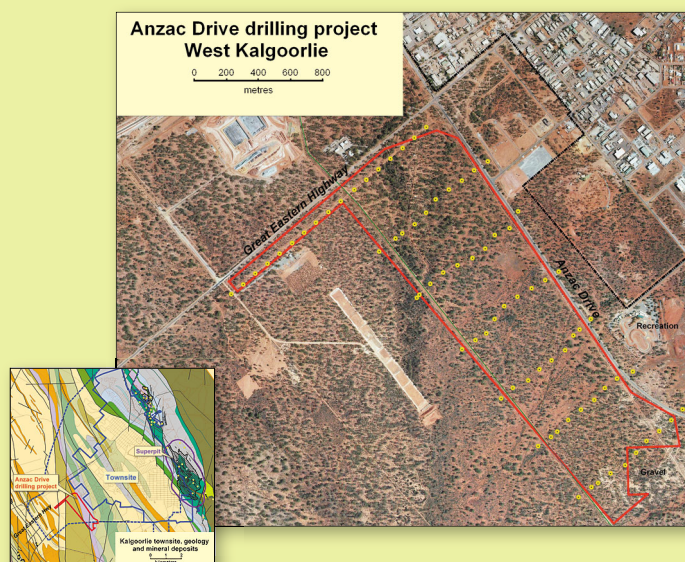
on behalf of LandCorp. The area is prospective for gold and is urgently required for expansion of the West Kalgoorlie industrial area.

Drilling commenced in early July and the main phase of drilling involving about 80 drillholes was completed within eight days. All drill cuttings have been sampled for gold and arsenic, and samples of bedrock have been analysed for Co, Cu, Ni, Pb, Sb, W and Zn. Weathered to fresh bedrock was encountered at depths ranging from 12 to over 100 metres. Main rock types encountered included ultramafics, felsic volcanics and volcanoclastics, porphyry, shale (locally graphitic) and basalt.

A report with conclusions concerning mineral potential and recommendations concerning the proposed release of the area for industrial development is in preparation. GSWA geologists

Chris Kojan and Michelle Pigott were assisted by contract geologist Tony Venables and GSWA field assistant Patrick Kaupert. Thanks also to Ivor Roberts for additional backup and support during the drilling and to staff at GSWA Kalgoorlie office for the use of a vehicle and office facilities.

For more information, contact Chris Kojan (chris.kojan@doir.wa.gov.au).



Product releases

All prices include 10% GST

RECENT RELEASES

■ GEOLOGICAL MAPS

MARBLE BAR 1:100 000 Geological Series SH50-8 (2855)
by AH Hickman and MJ Van Kranendonk

NEARANGING 1:100 000 Geological Series SH51-9 (2937)
by A Riganti

DUNDAS 1:100 000 Geological Series SI51-2 (3232)
by CM Doyle and S Wyche

PDFs on website free of charge

■ RESOURCE POTENTIAL FOR LAND USE PLANNING SERIES

**Resource potential for land use planning
Shire of Ravensthorpe (1:250 000)**
by CJ Kojan

PDF available on website free of charge

■ RECORDS

2008/9 AESC Field Guide: Structural and metamorphic controls on gold through time and space in the Central Eastern Goldfields Superterrane — a field guide
by K Czarnota, RS Blewett, and B Goscombe

2008/10 AESC Field Guide: Mines and Wines of Southwestern Western Australia — a field guide
by MJ Freeman and MJ Donaldson

2008/11 AESC Field Guide: Geology of the Kalbarri and Mingenew areas — a field guide
by AJ Mory and RM Hocking

2008/12 AESC Field Guide: Kalgoorlie, Youanmi and Narryer Terranes of the Yilgarn Craton — a field guide
by S Wyche and C Spaggiari

2008/13 AESC Field Guide: Archean crustal evolution and mineralization of the northern Pilbara Craton — a field guide
by AH Hickman

2008/15 Regional review of the 3426–3350 Ma Strelley Pool Formation, Pilbara Craton, Western Australia
by AH Hickman

2008/18 AESC field guide: Paleozoic geology of the Canning Basin
by RM Hocking, PE Playford, P Haines, and AJ Mory

PDFs available on website free of charge

■ MISCELLANEOUS PUBLICATION

Summary of petroleum prospectivity, Western Australia 2008: Browse, Canning, Officer, Perth, Northern Bonaparte, Northern Carnarvon, Southern Bonaparte and Southern Carnarvon Basins
by JH Haworth

PDF available on website free of charge

■ DIGITAL PRODUCTS

West Tanami 2008 update (BALWINA and SLATEY CREEK)
1:100 000 geological information series
by L Bagas

Mineral occurrences and exploration activities of the North Murchison area
by I Ruddock and EPW Peiris

Distribution and chemistry of a 500 Ma igneous event within and beyond Western Australia
by PA Morris

Eastern Canning SMT project
by JH Haworth

Merged Canning well logs
by JH Haworth

WEST ARUNTA 1:250 000 interpreted bedrock geology data
by IM Tyler

WEST ARUNTA 1:100 000 Geological Exploration Package
by C Spaggiari

DVD datasets \$55.00

Compilation of geochronology information 2008 update
by M Wingate and C Kirkland \$22.00

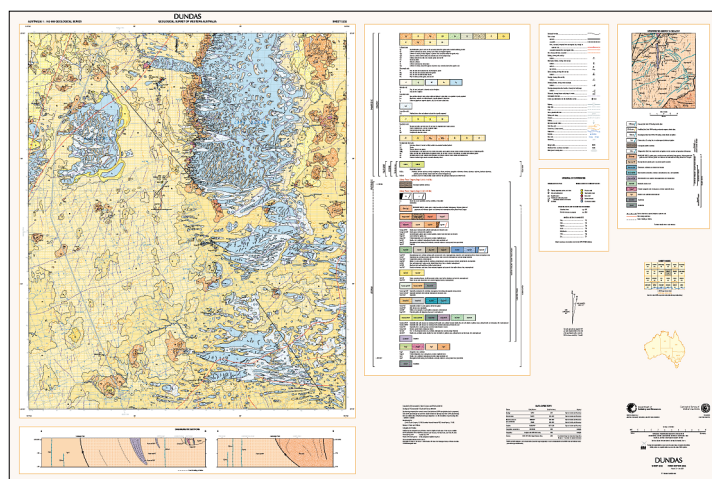
Western Australian geothermal acreage release 2 August 2008
compiled by MK Stevens

Western Australian petroleum acreage release, September 2008
compiled by RH Bruce

Prospectivity of state acreage release areas L08–8 to L08–10, Broome Platform, Munro Arch, Kidson Sub-basin, Anketell Shelf and Waukarlycarly Embayment, Canning Basin
compiled by JH Haworth

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or can be purchased online from the bookshop at <http://www.doir.wa.gov.au/ebookshop>.