Fieldnotes

Department of Industry and Resources

Geological Survey of Western Australia

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New insights: geology of greenfields areas in WA

The GSWA 2008 Seminar and Poster Display on 14 February covered the groundbreaking work being done by GSWA mapping teams in greenfields exploration areas of WA.

Gascoyne Complex

- A magnetotelluric (MT) survey (with researchers from the University of Adelaide) shows that the Glenburgh Terrane forms a continuous basement to the entire complex.
- Collision between the Yilgarn Craton and the combined Glenburgh Terrane and Pilbara Craton probably occurred during the 2000–1950 Ma Glenburgh Orogeny.
- There has been a prolonged history of intracontinental reworking throughout the Proterozoic, with a link between the repeated reactivation of major fault structures and mineralization.
- U–Pb dating of monazite (with researchers from the University of Western Australia and Curtin University) reveals events at c. 1250 Ma and c. 1000 Ma.

Musgrave Complex

- New geochronology reveals 1330–1300 Ma basement gneisses.
- The tectonic setting and intrusion level of the mafic–ultramafic intrusions of the c. 1070 Ma Giles Event need to be reassessed.
- A c. 620 Ma pegmatite dyke is similar in age to magmatism related to the Telfer Au–Cu deposit.
- The recognition of hydrothermal systems highlights the potential for Au mineralization.

Arunta Complex

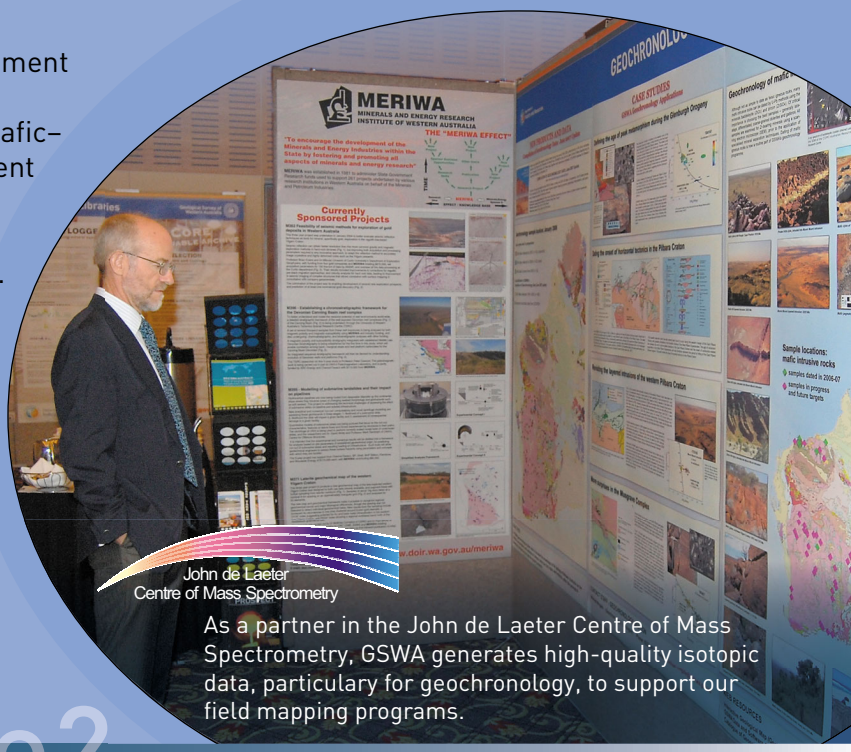
- A helicopter-assisted soil-sampling program shows this greenfields area may be prospective for iron-oxide–Cu–Au and layered intrusion Cr–Ni–PGE deposits.
- A new interpreted bedrock geology map is being prepared from geophysics, geochronology by NTGS, and rapid, targeted reassessment of bedrock mapping.

Yilgarn Craton

- The widely accepted accretion model of the Eastern Goldfields Superterrane may need modification.
- The Burtville Terrane appears to be much older than the rest of the Eastern Goldfields Superterrane, and may have affinities with the Youanmi Terrane to the west.

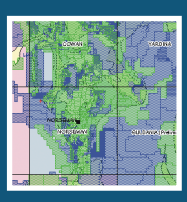
Seminar abstracts are available as GSWA Record 2008/2 and the presentations can be downloaded from the Geological Survey 'News and Events' page on the DoIR website (‹http://www.doir.wa.gov.au/GSWA/index.asp›).

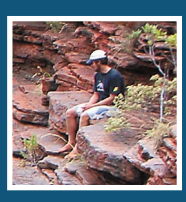
For further information, contact:
Ian Tyler (ian.tyler@doir.wa.gov.au)



As a partner in the John de Laeter Centre of Mass Spectrometry, GSWA generates high-quality isotopic data, particulary for geochronology, to support our field mapping programs.

What's inside?





Tips and news

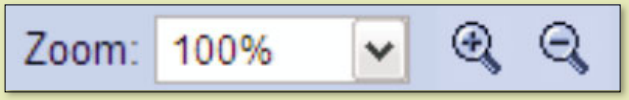
DigitalPaper

User tip #11

If you have recently accessed the WAMEX system to search company mineral exploration reports, or visited our website ‹http://www.doir.wa.gov.au/GSWA/publications›, you will know that we have a new document server for the delivery of our online documents. Here is the eleventh in a series of user tips to help you get the most out of DigitalPaper. Previous tips can be found in earlier editions of Fieldnotes, which are available online at the web address above.

Viewing maps using zoom and defining areas

DigitalPaper has been created to be simple and easy to use. You can view maps online using streaming technology, negating the need to download often extremely large map files. The interface has been created to allow users to view any section of a map in high detail using simple zoom functions. Users can copy any part of a map to the clipboard to use in other programs, or for printing.

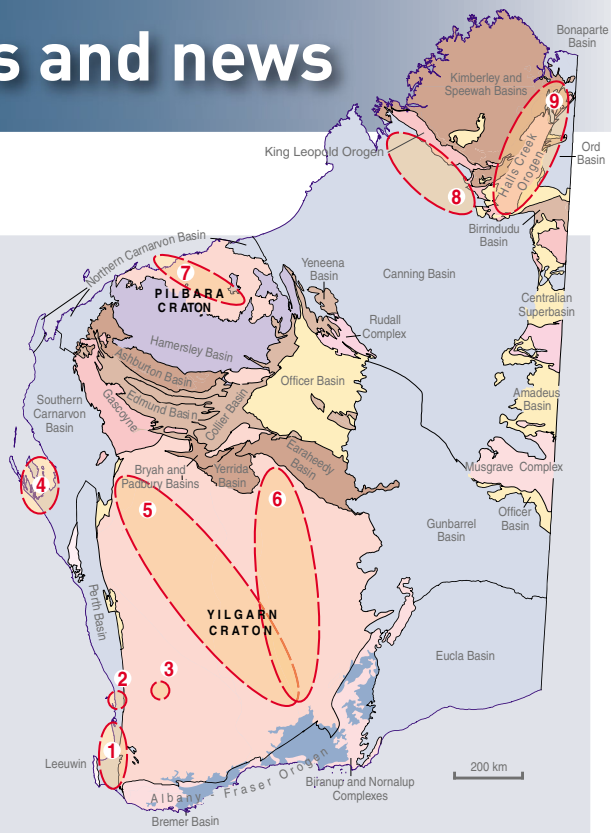


View After finding a map and pressing the View button on the top blue menu bar, the drop-down Zoom menu allows you to choose the percentage of zoom, while the + and – buttons allow you to zoom in and out of the document.

On the left side of the screen, there are several buttons that allow you to highlight sections of the map to perform functions.

- Pressing the Define Area button allows you to highlight any section of the map by clicking and dragging on it to choose the exact part you wish to zoom to.
- After defining the area, you can press the View Area button to zoom the selected area to view it in higher detail.
- The Copy Area to Clipboard button allows the user to move the selected area to other applications.
- The Print Area button sends the selected area to the printer.

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



The **2008 Australian Earth Sciences Convention** comes to Perth in late July 2008. GSWA will have a significant scientific presence at the conference, and will be highlighting work by GSWA geoscientists and their collaborators. In addition to this, GSWA is sponsoring field guides and providing leadership for most of the field excursions before and after the conference.

Some of the planned excursions are popular, tried and tested trips for which there is continuing demand, but others will showcase new work by GSWA and will take excursions to previously unvisited regions and sites.

Delegates can choose to:

1. Tour the mines and wines of southwestern Australia.
2. Join one-day geology, geomorphology and land use trips around the Perth metropolitan region.
3. Visit Meckering, the site of a major earthquake in 1969.
4. See Ordovician redbeds around Kalbarri and the Permian succession east of Geraldton.
5. Take a trip across the Yilgarn Craton from Kalgoorlie to west of Meekatharra.
6. Visit the geology and gold mines of the NE Goldfields.
7. Traverse the Pilbara Craton.
8. Take a trip to the Paleozoic rocks of the northern Canning Basin in the west Kimberley.
9. Join an excursion to the Proterozoic Halls Creek Orogen in the east Kimberley.

GeoVIEW.WA: More tools

New to GeoVIEW.WA

GeoVIEW.WA ‹http://www.doir.wa.gov.au/geoview› is a web-based tool that provides customers with the ability to view, query, and map a number of integrated State-wide geoscientific and related datasets online.

Publications search tool

The search tool allows you to find GSWA publications associated with a geographic region in WA. Draw a rectangle over the area of interest and a list of products overlapping that area will appear (Fig. 1).

Click on a selected publication to view the document in DigitalPaper ™.

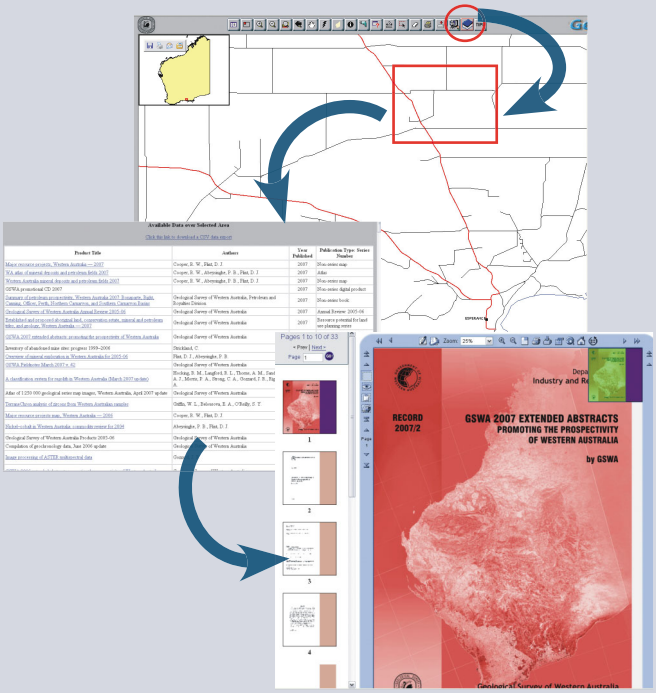
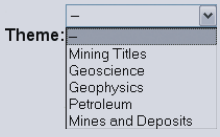


Figure 1. View the results in DigitalPaper ™

Theme-based viewing

The theme-based views (mining titles, geoscience, geophysics, petroleum, and mines and deposits,) allows users to quickly change between views for a particular area of interest.



There is no need to manually change the Table of Contents. By selecting a theme GeoVIEW.WA will automatically change the visible layers. You can still turn on other layers should you wish.

Figure 2 demonstrates how to move between thematic views over an area of interest. In this scenario, the user is viewing the geology, then moves to the tenement coverage, then the airborne geophysics index, and finally the mines and deposits view. Note the map extent has not changed.

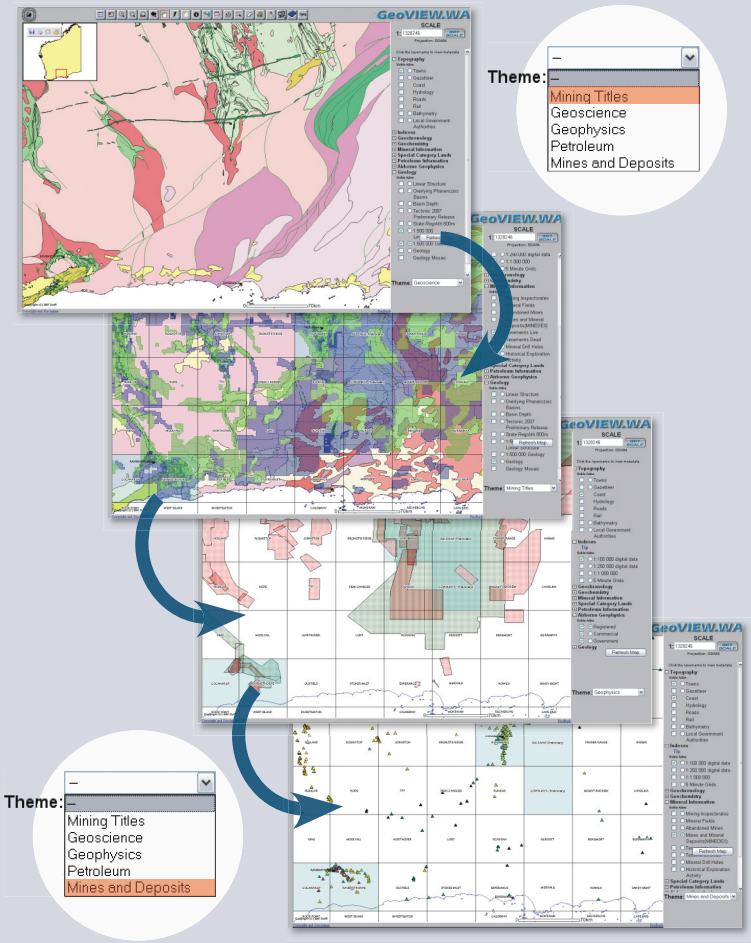


Figure 2. Easily move between thematic views via the pull down list

User tip #1

Data Download

GeoVIEW.WA provides two options for extracting digital data for use in your own system. Both methods provide a zipped file containing data layers, license agreement and associated metadata for downloading via the web.

- The first is through a data download page with a complete list of various State-wide datasets in either ESRI® shapefile or MapInfo® tab file formats.
- The second option extracts the visible data layers clipped to the map-view extent as an ESRI® shapefile.

For more information, contact:
Stephen Bandy (stephen.bandy@doir.wa.gov.au).

Western Arunta Orogen — GSWA's latest greenfields push

Last year, four GSWA geologists used a helicopter to help survey the western Arunta Orogen. We know very little about this area on the State border with the Northern Territory, so it is well suited to GSWA's drive to attract interest in greenfields areas for mineral exploration. In the mid-1990s Geoscience Australia did some reconnaissance work in the Mount Webb and Pollock Hills area, and hinted at the potential for mineralization including Olympic Dam-style iron-oxide–copper–gold (IOCG) mineralization. The GSWA study integrated regolith geochemistry and field observations, and our results further supported the potential for IOCG mineralization. The success of this recent venture was facilitated by the hospitality, cooperation, and guidance of the aboriginal community at Kiwirrkurra, and by their support in identifying sites of cultural sensitivity.

Recent work of the NTGS provided a framework for understanding the local geology. Their work has shown that the Orogen is divided into three complexes, two of which — the 1870–1710 Ma Aileron Complex and the 1690–1600 Ma Warumpi Complex — continue into Western Australia. These two complexes are separated by a series of linked faults, termed the Central Australian Suture (CAS), which is well-defined in aeromagnetic data. On the ground it is marked by mylonitic rocks. Just south of the suture, within the Warumpi Complex, the c. 1640 Ma dacitic Pollock Hills Formation volcanic rocks and Mount Webb Granite show variable strain, and, locally, intense hydrothermal alteration that disguises the original protolith.

Alteration styles and textures include brecciation, stockwork quartz veining, and potential alkali metasomatism.

Geophysics shows that the basement rocks have been disrupted by several episodes of faulting, commencing with formation of the CAS and related structures, and followed by periods of strike-slip and extensional faulting related to basin formation. Some structures are as young as those that offset rocks in the adjacent Canning Basin. The resulting series of fault blocks have displaced basement rocks by tens of kilometres. Some of these relatively young structures may link into older structures within the basement.

Alteration and hydrothermal veining in fault rocks

About 80% of the study area is covered by regolith, so a major part of the helicopter survey aimed at understanding the distribution and composition of this surface cover. Most of the regolith is sandplain, some with well-developed dunes. To be really useful, a regolith geochemistry dataset must include information about the thickness of the regolith and its relationship to the

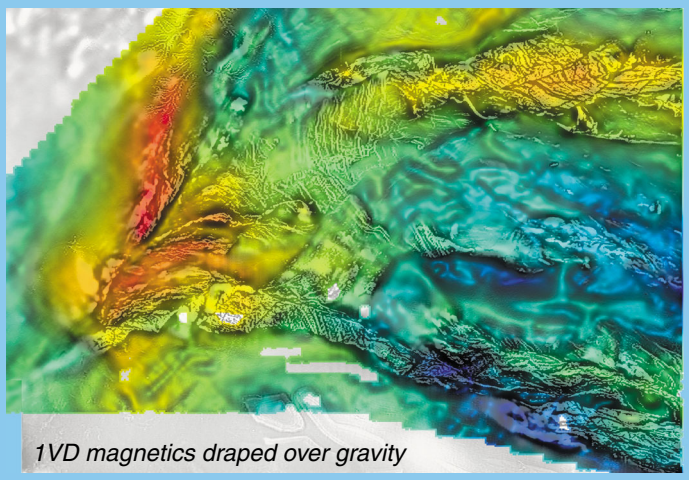
underlying bedrock. Regolith in road gravel quarries in the area is 1.5–2.0 m thick, and contains small fragments of the underlying bedrock as saprolite, saprock, or ferruginized lithic fragments. This is consistent with a previous exploration aircore drilling program in the Pollock Hills–Mount Webb area, which showed that the regolith–bedrock interface was at a depth of less than 6 m in 91% of the 731 holes drilled. This evidence and observations made at each of the 522 regolith sites at which regolith was sampled indicate that the sandplain cover is thin and largely locally derived.

Most regolith samples were collected from an east–west corridor from Pollock Hills to the WA–NT border, bracketing the area of potential mineralization previously described by Geoscience Australia's reconnaissance work, and including the CAS. Other samples were collected over areas of laterite in the northeast and centre of the survey area. The regolith geochemical data was released on 4th February 2008.

There are elevated values of Au (max. 29 ppb) scattered in regolith southeast of the survey area, and in the centre of the survey area. Elevated Au values in the southeast are associated with higher Au values in lag, strengthening the argument that the regolith is both thin, and of local derivation.

Gold, Cu and IOCG indicator indices have been plotted using standard scores. REE (La–Lu), chalcophile elements, and elements such as Ba, P, and Ni were cited by Williams et al. (2005; Economic Geology, 100th anniv. ed, p. 371–405) as common enrichment elements in IOCG deposits. Plots of these elements show a concentration of high values in the southeast and elevated values in the northeast and central parts. Some elevated values overlap with elevated Au values, and all elevated values coincide with areas where geophysics shows that the basement is close to the surface.

Regolith geochemistry has provided valuable new insights for the study area, and future work on the geochemistry and geochronology of basement and cover rocks will further clarify the geological and tectonic history of the western Arunta Orogen. Using a helicopter and combining geological and geophysical studies and regolith sampling in one targeted program is a new venture for GSWA, and early results from this program are very encouraging, so there will probably be more in the future.



1VD magnetics draped over gravity

For a free download of the regolith geochemistry data go to: ‹http://mapserver.doir.wa.gov.au/datacentre›.
For a download of the GSWA 2008 presentation on the Western Arunta Orogen along with geophysical images of the area in ECW format go to: ‹http://www.doir.wa.gov.au/GSWA›.
For more information, contact:
Geology and geophysics: Catherine Spaggiari (catherine.spaggiari@doir.wa.gov.au)
Geology and tectonics: Ian Tyler (ian.tyler@doir.wa.gov.au)
Regolith geochemistry: Paul Morris (paul.morris@doir.wa.gov.au)

Geotourism Conference update

The Inaugural Global Geotourism Conference comes to Fremantle between 17 and 20 August 2008 — an important event in this the International Year of Planet Earth (IYPE).

Geological Survey staff will present papers at the conference, including a keynote address by Phil Playford on 'Geological icons of Western Australia'.

GSWA is also providing leaders for field trips to Shark Bay, Kalgoorlie/Mount Magnet, and to several localities around Perth to look at the Tamala Limestone along the coast and the Archean granites and Proterozoic dolerite dykes in the hills.

Need more information? Wish to register your interest? See ‹www.promaco.com.au/2008/geotm›

Five new web map services

A Web Map Service (WMS) uses a standard set of input parameters to produce a map using a defined image format (generally PNG, JPEG). Several of these maps can be merged to produce a composite map even if the maps come from different sources.

These services allow the more advanced GIS user to stream data from our website to the desktop. This is a fantastic new service, especially for large or rapidly changing datasets like geology or tenements.

Web Map Services now available:
A range of data layers are available under each of the following headings.

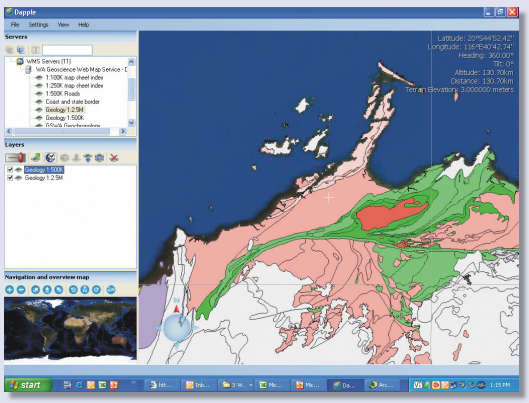
- WA Geoscience
- WA Mineral
- WA Petroleum
- WA Airborne geophysics
- WA Administration

All of these deliver online, real-time access to spatial information based on Open Geospatial Consortium's (OGC) implementation specifications for WMS.

Coming soon:

- WA Image

Details of the layers within each WMS and the associated URLs can be found on DoIR's Data Download Centre ‹http://mapserver.doir.wa.gov.au/datacentre/›



1:500 000 scale geology web map service being rendered using a product called Dapple ®

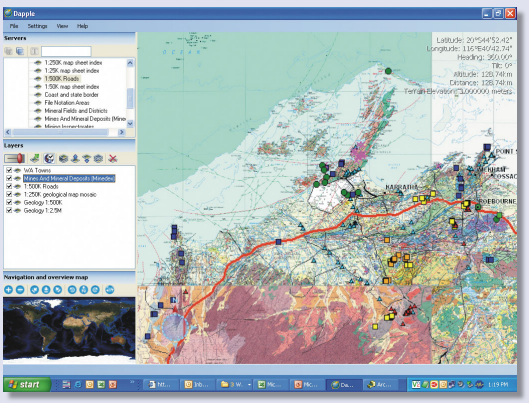


Image of the 1:250 000 scale geology mosaic with mines and mineral deposits overlayed.

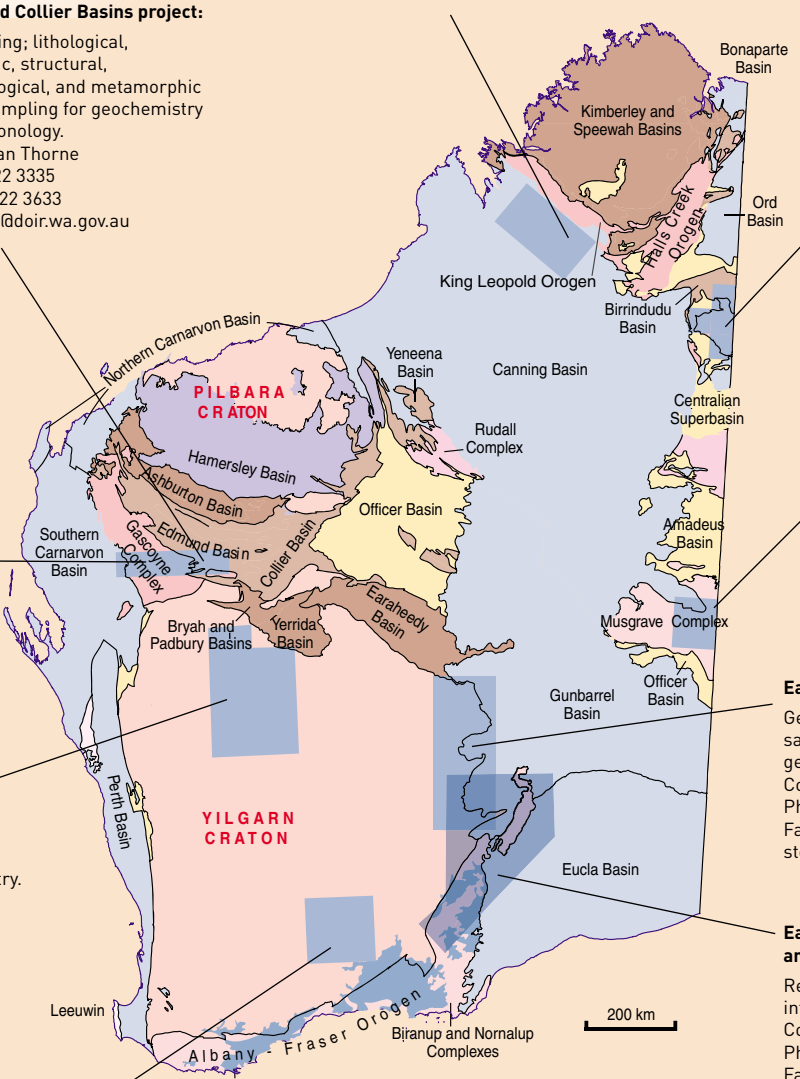
Where we are working in the field

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

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



Western Tanami project:

Field mapping; lithological, structural, and metamorphic analysis; sampling for geochemistry and geochronology.
Contact: Leon Bagas
Ph: (08) 9222 3221
Fax: (08) 9222 3633
leon.bagas@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

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; and sampling for petrography, geochemistry and geochronology.
Contact: Stephen Wyche
Ph: (08) 9222 3606
Fax: (08) 9222 3633
stephen.wyche@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

Eastern Albany–Fraser and Yilgarn Margin project:

Reconnaisance fieldwork and geophysical interpretation.
Contact: Catherine Spaggiari
Ph: (08) 9222 3491
Fax: (08) 9222 3633
catherine.spaggiari@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

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: Richard Langford
Ph: (08) 9222 3632
Fax: (08) 9222 3633
richard.langford@doir.wa.gov.au

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Product releases

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RECENT RELEASES

EXPLANATORY NOTES

Geology of the Mount Edgar 1:100 000 sheet
by IR Williams, and L Bagas
PDF on website ..... free of charge

OTHER BOOKS AND ARTICLES

GSWA Annual Review 2006–07
PDF on website ..... free of charge

The following articles from the Annual Review are available separately, free of charge, as PDFs on the website:

The search for Western Australia's geothermal resources by KAR Ghori

New evidence on the evolution of the Cue–Meekatharra area of the Murchison Domain, Yilgarn Craton
by MJ Van Kranendonk

GSWA 2008 extended abstracts: promoting the prospectivity of Western Australia
Record 2008/2 ..... $22.00
or available as PDF on website ..... free of charge

The following abstracts from Record 2008/2 are available separately, free of charge, as PDFs on the website:

Recent advances in our understanding of the Gascoyne Complex
by S Sheppard, SP Johnson, PB Groenewald, S Bodorkos, B Rasmussen, IR Fletcher, JR Muhling, and K Selway

Mineral systems in the Gascoyne Complex, Western Australia
by F Pirajno, S Sheppard, PB Groenewald, and SP Johnson

Growing reputation for Western Australia's dimension stone resources by JM Fetherston

Myths and mylonites — some new perspectives on the Proterozoic evolution of the west Musgrave Complex
by RH Smithies, P Evins, and HM Howard

OGC Web Map Service by NS D'Antoine

New exploration datasets for the western Arunta: could this be the next Olympic Dam?
by C Spaggiari, PA Morris, and IM Tyler

Granite–greenstone associations of the Yamarna–Irwin Hills region, northeastern Goldfields: the broader context
by SS Romano, M Pawley, CE Hall, MP Doublier, MTD Wingate, and S Wyche

Geodynamic evolution of the northeastern Murchison Domain, Yilgarn Craton by MJ Van Kranendonk

Land use geoscience — informing policy decisions in Western Australia
by W Ormsby, and FI Roberts

The Nifty–Kintyre–Duke Cu–U–Pb–Zn mineralizing events: links to the evolution of the Yeneena Basin, northwest Paterson Orogen
by D Maid ment, DL Huston, R Maas, K Czarnota, N Neumann, A McIntyre, and L Bagas

Geology, structure, and mineral resources of the Lake Violet 1:100 000 sheet, Western Australia
by AJ Stewart
Record 2007/21 as PDF on website ..... free of charge

Stream-sediment geochemistry from the southwest of Western Australia — a pilot study
by PA Morris
Record 2008/8 as PDF on website ..... free of charge

Overview of mineral exploration in Western Australia for 2006–07 by DJ Flint, and PB Abeysinghe
Book or available as PDF on website ..... free of charge

DIGITAL PRODUCTS AND DOWNLOADS

West Arunta regolith geochemistry data
In line with GSWA's aim to generate interest in greenfields areas, multi-element soil chemistry from the west Arunta region has recently been released by GSWA.
Download from website ..... free of charge

MAPS

1:100 000 geological series maps

MINERIE [SH 51-2, 3240] by PB Groenewald, and B Goscombe
Plotted map $11.00

BULDANIA [SI 51-2, 3333] by CE Hall, and B Goscombe
Plotted map $11.00

Other maps released recently

Western Australian mines — operating and under development, 2008 by RW Cooper, and DJ Flint
(Printed map; 1:2 500 000 scale) $11.00

Major resource projects 2008
by RW Cooper, and DJ Flint
(Printed map; 1:3 000 000 scale) ..... free of charge

Established and proposed aboriginal land, conservation estate, mineral and petroleum titles, and geology, Western Australia — 2008 by FI Roberts
(Plotted map; 1:2 500 000 scale) $11.00

AUSGEO news — Australian Government Geoscience Australia

AusGeo News is Geoscience Australia's (GA's) quarterly news magazine. Each issue comprises geoscience-related features, brief articles about GA's research and initiatives, news about geoscience products and spatial data, and a calendar of coming seminars and conferences.

AusGeo News December 2007 Issue No. 88
One article pertinent to Western Australia is:

Uncovering Proterozoic mineral wealth.
Research points to mineral deposit prospects

Click on ‹http://www.ga.gov.au/ausgeonews›
to view AusGeo News and learn more about these stories.

All publications published as PDF files can also be ordered from the Information Centre as laser-printed copies at the cost of printing and binding. Our printed publications are now also available free as PDF files on our website at **‹http://www.doir.wa.gov.au/GSWA/publications›**. Further details of geological publications and maps produced by the Geological Survey of Western Australia can be obtained at ‹http://www.doir.wa.gov.au/GSWA›.

Hardcopy publications including CDs and DVDs are available from the Information Centre, First Floor, Mineral House, 100 Plain St, East Perth, WA 6004, AUSTRALIA Phone: +61 8 9222 3459; Fax: +61 8 9222 3444
or can be purchased online from the bookshop at ‹http://www.doir.wa.gov.au›.