

Fieldnotes

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Department of Mines and Petroleum

Geological Survey of
Western Australia



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New information on the Windimurra and Narndee Igneous Complexes

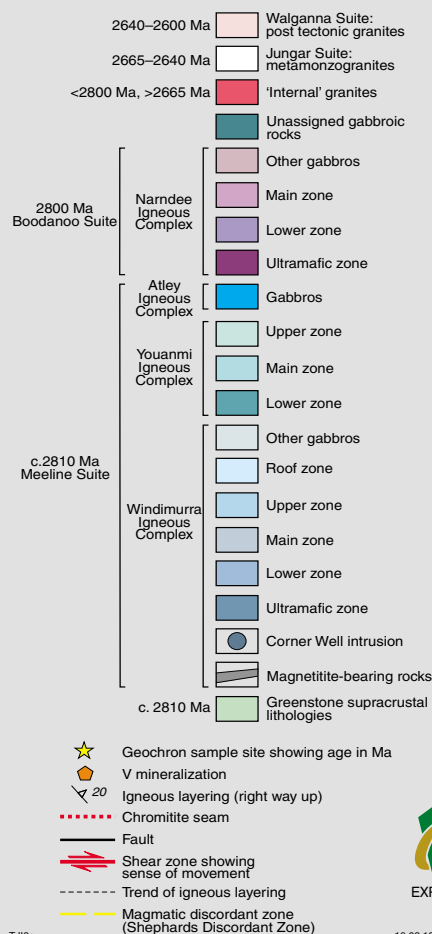
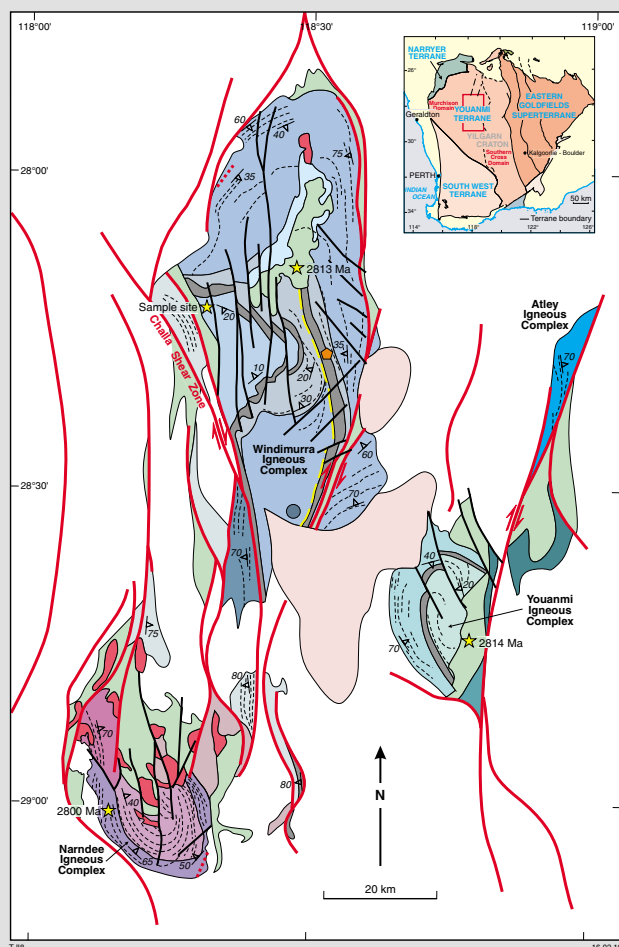
GSWA's program of geological mapping in the Murchison Domain of the Youanmi Terrane, which forms much of the northwestern part of the Yilgarn Craton, includes remapping of the Windimurra and Narndee Igneous Complexes. This work is being carried out as part of an Australian Research Council Linkage grant in collaboration with the Australian National University and Maximus Resources Limited.

Collectively, the areal distribution, thickness, and volume of mafic-ultramafic magma in igneous complexes in the Murchison Domain is similar to that in the 2.06 Ga Bushveld Igneous Complex, and represents a major addition of mantle-derived magma to the crust over

a 100-million-year period. All suites are demonstrably contemporaneous with packages of high-Mg tholeiitic lavas and/or felsic volcanic rocks in greenstone belts. The distribution, ages, and compositions of the earlier mafic-ultramafic rocks are most consistent with genesis in a mantle plume setting.

Mafic-ultramafic rocks in structurally dismembered layered intrusions comprise approximately 40% by volume of greenstones within the Murchison Domain. They may be divided into five components: the c. 2810 Ma Meeline Suite, which includes the large Windimurra Igneous Complex, the 2800 ± 6 Ma Boodanoo Suite, which includes

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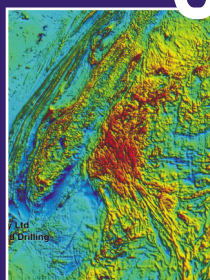
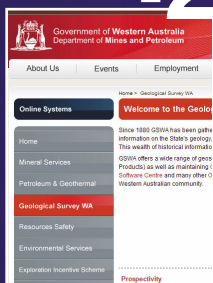
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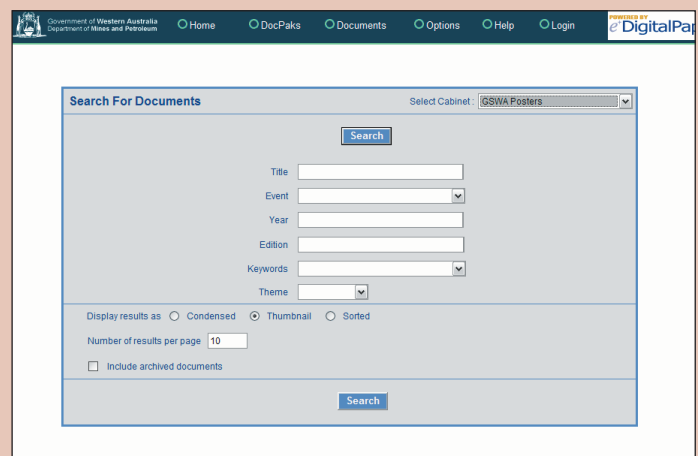
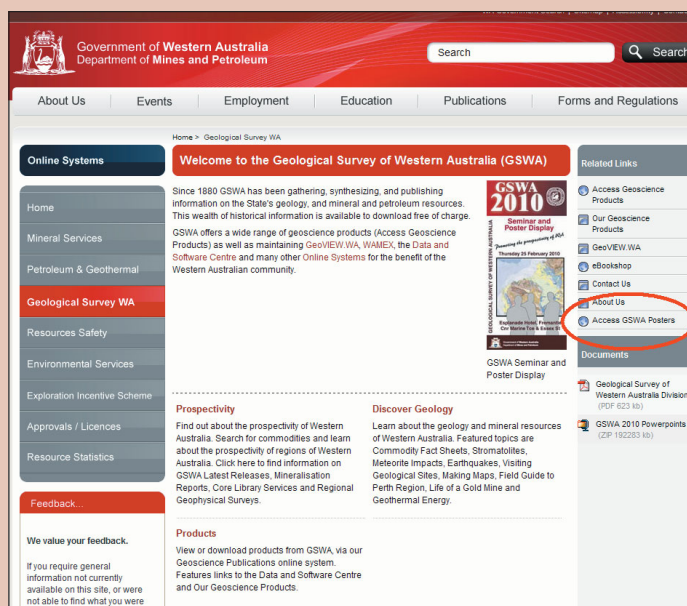
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New GSWA poster cabinet

The GSWA section of the DMP website has recently added a new searchable cabinet for GSWA posters. This allows users to search through the many GSWA posters from different events over the past few years. Like the GSWA Geoscience Products cabinet, this lets users view posters online or download them directly to a PC – it's simple!

Logon to the GSWA section of the DMP website at <<http://www.dmp.wa.gov.au/gswa>> then click on the button on the right hand side under Related Links to Access GSWA Posters (see below). The new GSWA Poster cabinet search page will open, where you can search by title, event, year, edition, and keyword, for fast access to any GSWA poster.



GSWA publications RSS feed

GSWA has its own RSS feed that frequently updates with all of the new publications released by GSWA (example above). The GSWA RSS feed can be accessed from the Subscriptions section of the DMP website or from its own page <<http://www.dmp.wa.gov.au/rss/rssgswa.xml>> where you can subscribe to the feed, adding it to your RSS reader, usually built into your web browser (such as Internet Explorer or Firefox). After doing this, each time you check your reader, you will see new publications as soon as they are released, with a link to view individual products.

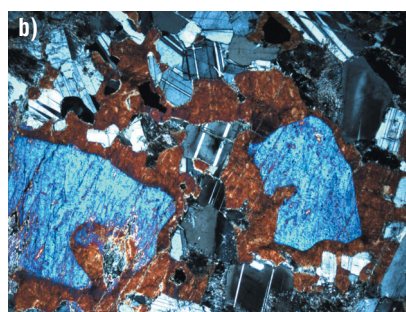
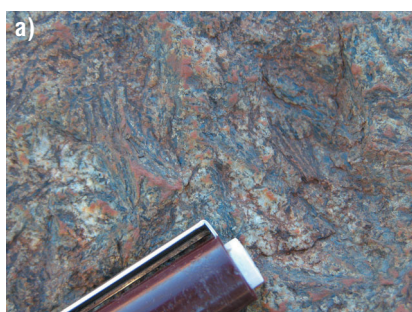
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the Narndee Igneous Complex, the 2792 ± 5 Ma Little Gap Suite, the c. 2750 Ma Gnanagoragoo Igneous Complex, and the 2735–2710 Ma Yalgowra Suite of layered gabbroic sills.

The intrusions are typically layered, tabular bodies of gabbroic rock with ultramafic basal units which, in places, are more than 6 km thick and up to 2500 km² in areal extent. However, these are minimum dimensions as the intrusions have been dismembered by younger deformation. In the Windimurra and Narndee Igneous Complexes, discordant

features and geochemical fractionation trends indicate multiple pulses of magma. These pulses produced several megacyclic units, each approximately 200 m thick. The suites are anhydrous except for the Boodanoo Suite, which contains a large volume of hornblende gabbro. They also host significant vanadium mineralization, and at least minor Ni–Cu–PGE mineralization.

For more information, contact Tim Ivanic (tim.ivanic@dmp.wa.gov.au).



(a) Photo of a Yalgowra Suite gabbro from Cue region.
(b) Thin-section photomicrograph of sample 191056 from the Narndee Igneous Complex in crossed-polars showing oikocrystic hornblende surrounding large clinopyroxenes. Width of field of view is 4 mm.

Message on a bottle

During recent fieldwork in the remote Western Australian Amadeus Basin, Peter Haines and Heidi-Jane Allen of GSWA's petroleum geology group were surprised to find a number of old but well-marked drillholes. The locations suggested stratigraphic drilling related to petroleum exploration, while artefacts at the sites and information from traditional owners dated the drilling to the late 1960s. Departmental databases drew a blank on exploration drilling this early in the area, so the question remained: who was responsible for this drilling, and why?

The key to this mystery was discovered on an isolated hilltop at the end of the field season — a bottle buried within a cairn of stones. Although discovered several kilometres from the nearest drillhole, the distinctly embossed cordial bottle was identical to some seen in campsite relics at one of the drill sites. Crudely scratched on the surface of the bottle was a name, a date in 1967, and an address in Texas, Queensland. After some detective work, Heidi found herself talking on the phone to the bottle-inscriber's 91-year-old mother, still a resident of southern Queensland. Soon after, the man himself, then a 21-year-old driller, now 63, made contact with the Amadeus team. Apart from amusing anecdotes of his time in the bush, the information he provided helped track down old lease maps and inadequately catalogued field geological reports by Australian Aquitaine Petroleum Pty Ltd. This information will be of considerable use to the current project. As yet, no departmental records of the actual drilling, which was undertaken by Compagnie Generale de Geophysique (CGG) contracted to Australian Aquitaine, have been found. The Amadeus team are keen to hear from anyone who knows the whereabouts of such data, or the cores that were drilled.

For more information, contact Peter Haines
(peter.haines@dmp.wa.gov.au).



A pole marks the site of drillhole CD5 in the Boord Ridges, Amadeus Basin.



Close up of the inscribed bottle.



Heidi Allen at the site of drill hole CD3.

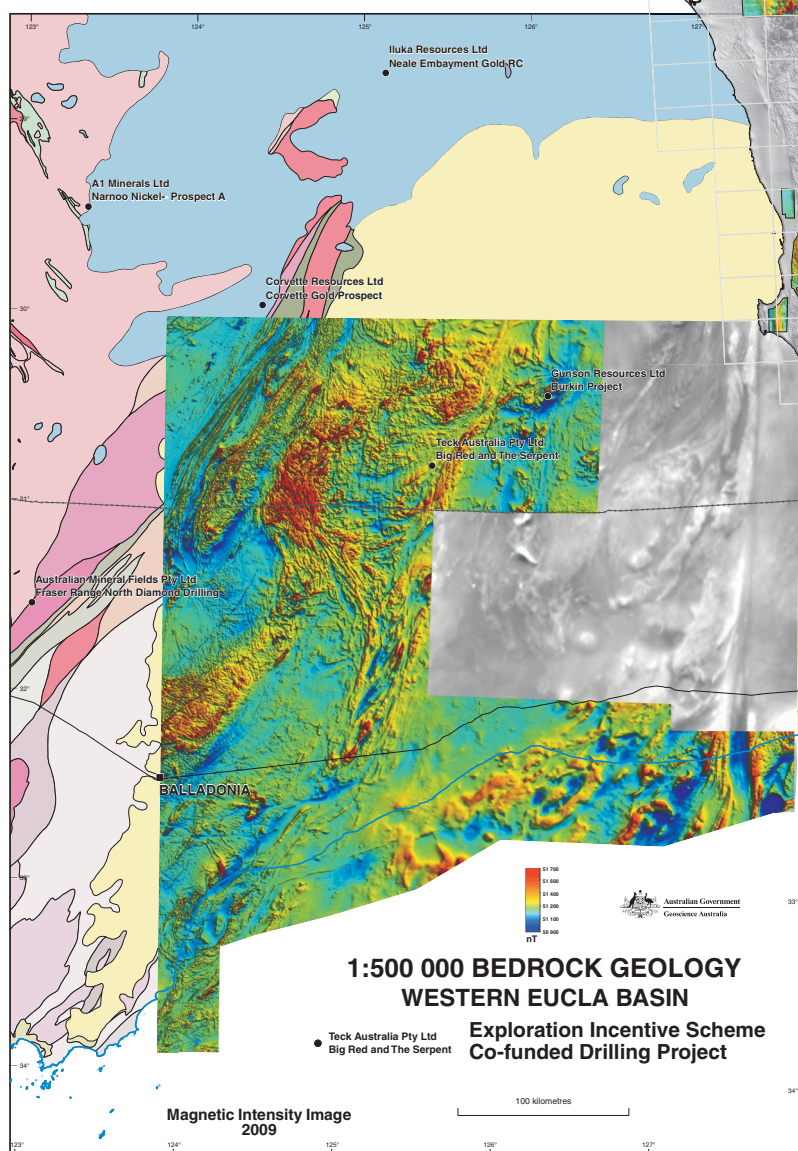
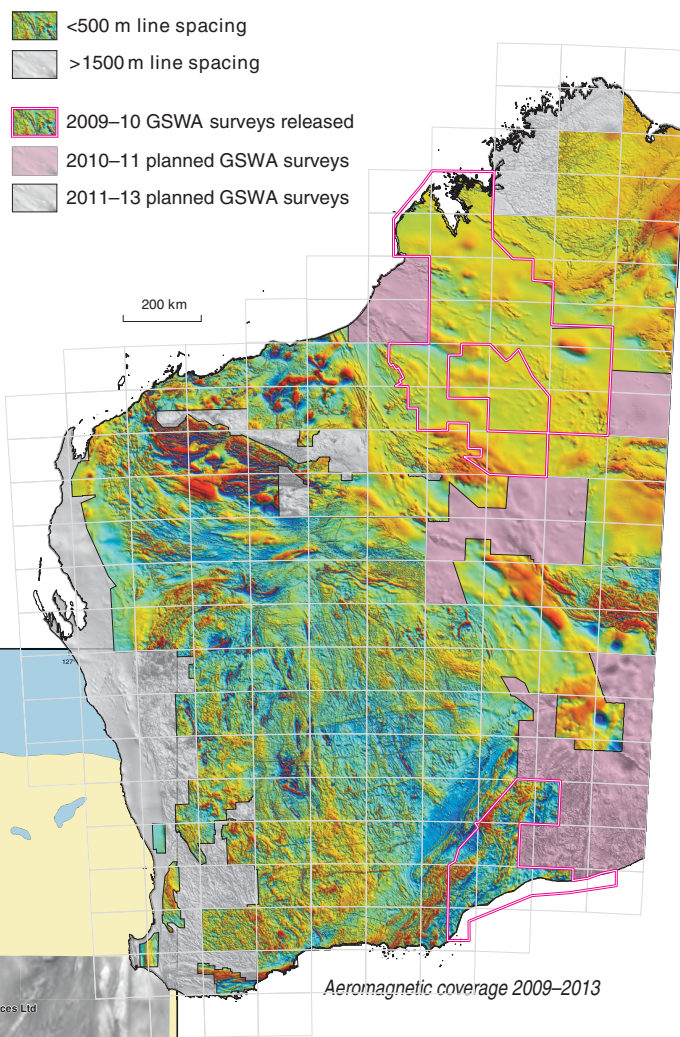


Rock cairn with bottle on top of a ridge of Sir Frederick Conglomerate west of the Sandy Blight Junction Track. 67 km to the south of CD5

EIS airborne geophysics programs target remote Western Australia

GSWA has released all nine regional airborne magnetic and radiometric surveys undertaken during 2009–10 under the Exploration Incentive Scheme (EIS). These were aimed at some of the most remote parts of Western Australia, and covered the central and northern Canning Basin and the western Eucla Basin.

The Canning Basin is under-explored in terms of its potential for the discovery of oil and gas, and the adjacent Proterozoic basement of the Paterson Orogen in the East Pilbara and the King Leopold Orogen in the West Kimberley are under-explored for mineral deposits. The western Eucla Basin was flown at zoom line spacing — half the usual spacing of GSWA's regional surveys. The images give a remarkably detailed picture of Proterozoic basement rocks buried beneath sand and relatively thin Cenozoic limestones.



Eucla magnetic intensity image

The regional airborne magnetic and radiometric surveys scheduled for the 2010–11 EIS program will complete the coverage of the Eucla Basin, and will extend coverage across the Officer and Gunbarrel Basins from the eastern margin of the Yilgarn Craton to the Musgrave Province. Further north, surveys will complete coverage of the Gunbarrel and Canning Basins, and will cover the Neoproterozoic of the Murraba Basin, which lies on the Northern Territory border between the Tanami and the Arunta.

More information on data access can be found on the Data and Software Centre at www.dmp.wa.gov.au/4895.aspx.

For more information contact Ian Tyler (ian.tyler@dmp.wa.gov.au).

Enhancing our understanding of crustal evolution and mineralization using Lu–Hf isotopes



Knowledge of crustal evolution is important for understanding mineralization, because juvenile addition of material from the mantle into the crust is often temporally associated with mineralizing events.

Lu–Hf isotopes can help answer two important questions regarding crustal evolution:

- When was material added to the crust?
- How did it get there — juvenile addition from the mantle or reworking of older crust?

Lutetium (Lu) is unstable and undergoes spontaneous decay to the stable form of hafnium (Hf). Owing to its close chemical affinity with zirconium, Hf is a significant component of zircons, which are ideally suited to dating using U–Pb isotopes. Zircon crystals have a very low Lu/Hf ratio which means that the Hf isotope composition measured today only requires a minor time correction to derive the value at its time of crystallization. Moreover, because zircons are remarkably robust, the Lu–Hf isotopes in zircon crystals are very resistant to disturbance and give the potential to decipher the geological evolution of even highly metamorphosed terranes. Hf isotope measurements in zircons are therefore ideal for characterizing the sources of magmatic rocks and the provenance of sedimentary rocks. In particular, when coupled with U–Pb geochronological data, the Hf isotopic composition of zircons provides information about the relative roles of juvenile mantle input or reworking of older continental crust.

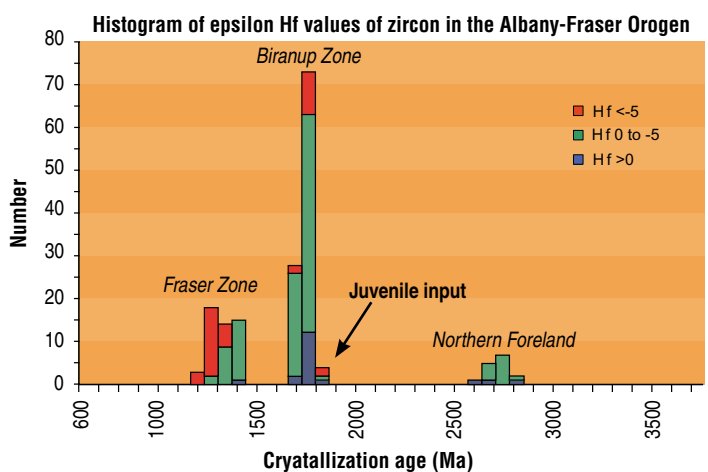
GSWA has recently commenced a program of Lu–Hf analyses of zircon crystals previously dated by U–Pb analysis. This program is funded through the Exploration Incentive Scheme (EIS) and aims to analyse about 1500 crystals from numerous samples each year for four years. The Lu–Hf analyses are undertaken by the Centre for Geochemical Evolution and Metallogeny of Continents (GEMOC) at Macquarie University. New Lu–Hf data can be downloaded through hyperlinked tables in GeoVIEW.WA (GSWA's web-based interactive geological map). GeoVIEW.WA permits searching for samples based on spatial or attribute features, and can be accessed at <http://www.dmp.wa.gov.au/geochron>.

Recent results demonstrate the value of this new isotope scheme. For example, results from the Albany–Fraser Orogen, along the southeastern margin of the Yilgarn Craton, show that a zone of 1700–1655 Ma magmatic rocks has some Hf isotope values similar to those of the Yilgarn Craton. However, many Hf values also range to considerably more depleted values, suggesting that there was juvenile addition of material to the Yilgarn crust at this time, and can be explained by back-arc rifting on the Yilgarn margin at c. 1680 Ma. This has important implications for enhancing the understanding of the geodynamic setting of gold mineralization (such as the Tropicana deposit) on the eastern Yilgarn Craton margin.

Over the next four years, GSWA's Lu–Hf program promises to deliver exciting new datasets which will develop our understanding of crustal architecture and geological evolution, and lead to better exploration targeting in the under-explored regions of Western Australia.



The laser ablation inductively coupled mass spectrometer (LA-ICPMS) system used at GEMOC for Lu–Hf analyses.



Stacked histograms for juvenile ($Hf > 0$), intermediate ($0 > Hf > -5$), and evolved samples ($Hf < -5$). The data represent three lithostratigraphic domains within the Albany–Fraser Orogen: the Biranup Zone, the Northern Foreland, and the Fraser Zone. The Biranup Zone displays a range of Hf values: from evolved signatures that are similar to the Yilgarn Craton or Northern Foreland, to considerably more depleted values that suggest juvenile addition to the crust.

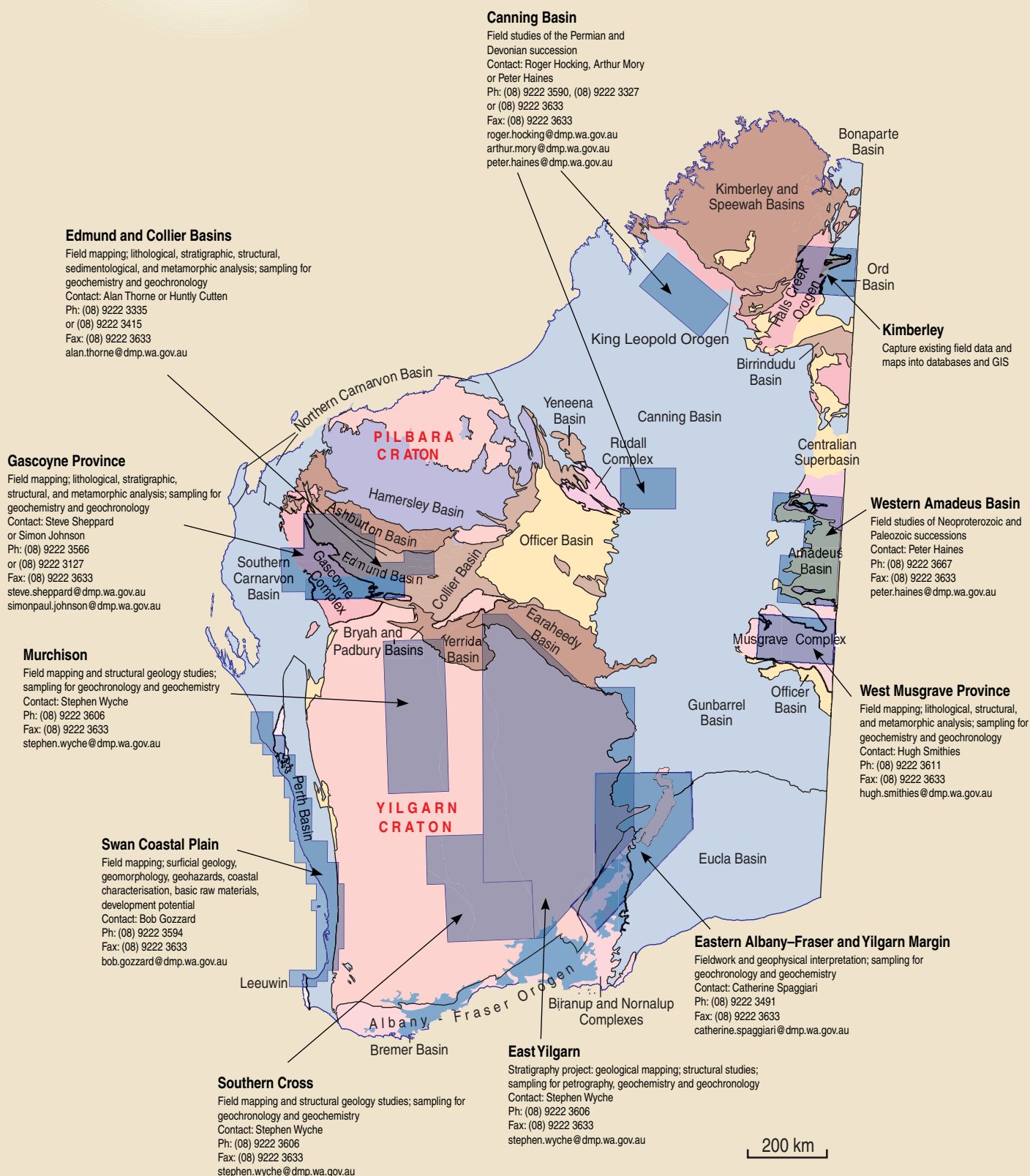


Drilling granite in the Albany Fraser Orogen to recover samples for Hf isotopic analysis

For more information, contact Michael Wingate (michael.wingate@dmp.wa.gov.au) or Chris Kirkland (chris.kirkland@dmp.wa.gov.au).



Where we are working



Western Australia regional geophysics surveys 2009–10: April 2010 update

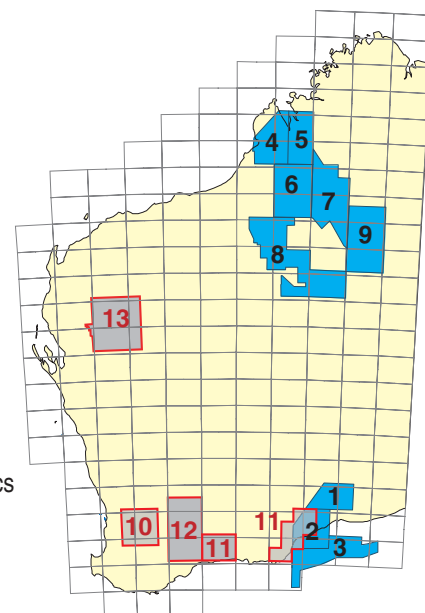
Data access

Download final data releases from the Geoscience Australia Data Delivery System at <www.ga.gov.au/gadds>.

Download preliminary and final grids and images from the GSWA website at <www.dmp.wa.gov.au/geophysics>.

Subscribe to the GSWA mailing list to keep informed of preliminary and final data release dates.

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



- Airborne magnetics and radiometrics
- Ground gravity

Airborne magnetic and radiometric surveys

ID	Area/Name	Lines	Size (line-km)	Status	Start	End	Release
1	Seemore 2009	200 m; E/W	90 400	Release	Jun-09	Sep-09	22-Oct-09
2	Naretha 2009	200 m; E/W	125 200	Release	Jun-09	Nov-09	04-Feb-10
3	Eucla Coast 2009	200–400 m; N/S	121 000	Release	Sep-09	Jan-10*	08-Apr-10
4	Broome 2009	400 m; N/S	76 200	Release	Jul-09	Sep-09	03-Dec-09
5	Yampi–Derby 2009	400 m; N/S	66 700	Release	Jun-09	Sep-09	05-Nov-09
6	Mt Anderson – McLarty Hills 2009	400 m; N/S	99 000	Release	Jul-09	Sep-09	17-Dec-09
7	Crossland–Noonkanbah 2009	400 m; N/S	111 900	Release	Aug-09	Nov-09	04-Feb-10
8	Central Canning 2009	800 m; N/S	91 700	Release	Jun-09	Aug-09	17-Dec-09
9	Cornish–Helena 2009	400 m; N/S	129 500	Release	Jun-09	Oct-09	17-Dec-09

Ground gravity surveys

ID	Area/Name	Spacing	Size (stns)	Status	Start	End	Release
10	Cunderdin 2009	2.0 km grid	7 494	Release	Jan-09	Apr-09	3-Sep-09
11	South Yilgarn Margin 2009	2.5 km grid	6 125	Release	Jul-09	Oct-09	25-Feb-10
12	Southern Cross 2010	2.5 km grid	6 300	Processing	Jan-10	Mar-10	Apr-10*
13	Gascoyne North 2010	2.5 km grid	7 400	Survey	Mar-10	May-10*	Jun-10*

Information current at: 12 April 2010

* Estimated date

AusGeo news

AusGeo news is Geoscience Australia's (GA's) quarterly online 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. Included here are topics of interest to Western Australia.

In March 2010 issue



Onshore Energy Program maintains momentum
Delivering data and improved scientific understanding



Preliminary Soil pH map of Australia
New dataset will support resource evaluation and environmental monitoring



AUSGeoid09: Converting GPS heights to AHD heights
Improving access to Australia's vertical datum

Click on <<http://www.ga.gov.au/ausgeonews/ausgeonews201003/>> to view AusGeo news and learn more about these stories.

■ RECORDS

2009/1 Geological Survey work program for 2009–10 and beyond

2009/16 Age and geochemistry of the Alcurra Suite and implications for orthomagmatic mineralization during the Giles Event
by HM Howard, RH Smithies, CL Kirkland, PM Evins, and MTD Wingate

2009/17 Procedure for legacy point and data capture
by S Sheppard, RE Green, TR Farrell, and L Kelly

2009/21 Hydrogeochemical mapping of northeast Yilgarn groundwater
by DJ Gray, RRP Noble, and N Reid

2009/23 Intracontinental orogenesis in the heart of Australia: Structure, provenance and tectonic significance of the Bentley Supergroup, Western Musgrave Block, Western Australia
by P Coleman

2009/24 Age constraints and structure of the Cohn Hill Shear Zone, Western Musgrave Block, Western Australia
by A Sen

2010/2 GSWA 2010 extended abstracts

■ NON-SERIES BOOKS

Overview of mineral exploration in Western Australia for 2008–09
by PB Abeysinghe and DJ Flint

2008–09 GSWA Annual Review

■ 1:100 000 GEOLOGICAL SERIES MAPS

STRAWBRIDGE 1:100 000 geological series map
by C Hall

FINLAYSON 1:100 000 geological series map
by PM Evins, HM Howard, RH Smithies, and WD Maie

■ 1:100 000 GEOLOGICAL EXPLORATION INFORMATION SERIES

Western Capricorn Orogen Geological Information Series update 2009
by AM Thorne

Murchison Geological Information Series 2009 update
by S Wyche

West Arunta Geological Exploration Package 2009 update
by C Spaggiari and IM Tylerr

■ STATE MAPS

Major resource projects Western Australia — 2010
by RW Cooper, PB Abeysinghe, DJ Flint, and J Haworth

Mines – operating and under development 2010 — Western Australia
by RW Cooper and DJ Flint

Aboriginal land, conservation areas, mineral and petroleum titles, and geology, Western Australia — 2010

■ NON-SERIES DIGITAL PRODUCTS

Exploration geochemistry of Western Australia — June 2009

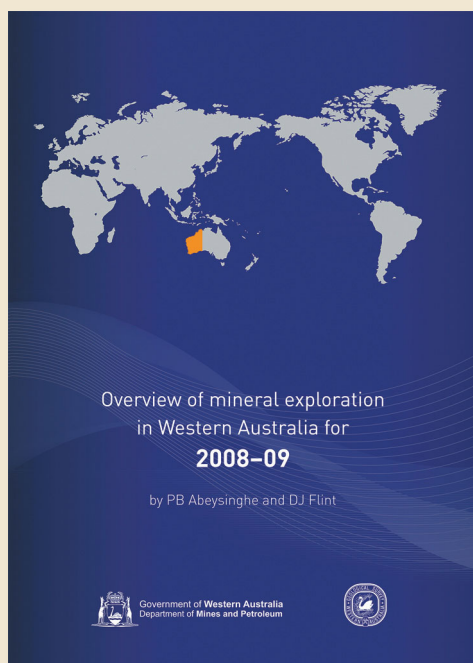
GSWA 2010 Seminar and Poster Display (CD)

Prospectivity of State Acreage Release Area L10–1, Lennard Shelf, Canning Basin

Prospectivity of State Acreage Release Areas L10–2 and L10–3, Bangemall Supergroup

Prospectivity of State Acreage Release Areas L10–4 and L10–5, Blake Sub-basin, Officer Basin

Prospectivity of State Acreage Release Area T10–1, Perth Basin

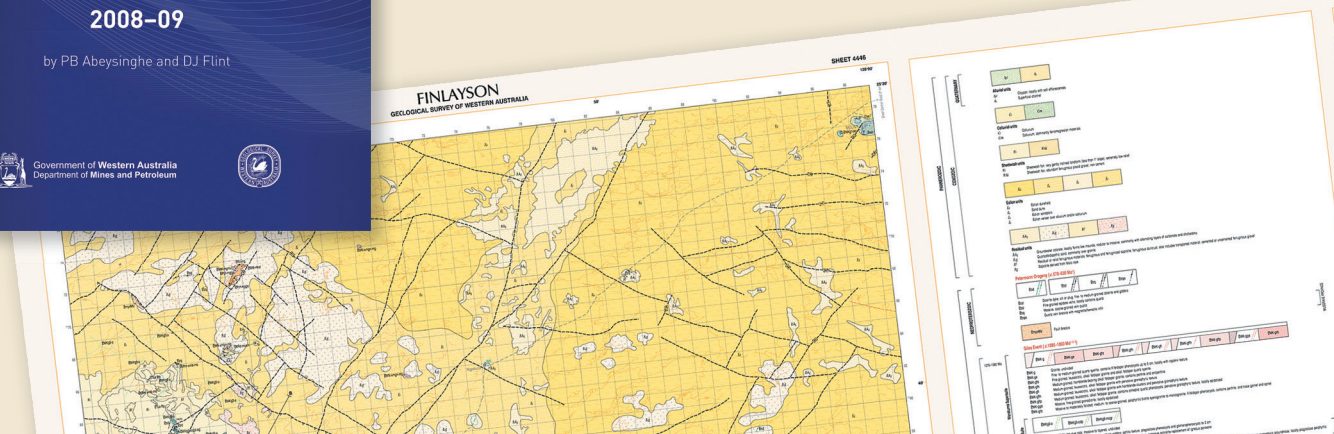


Overview of mineral exploration
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