

Fieldnotes



Government of Western Australia
Department of Mines and Petroleum

Geological Survey of
Western Australia



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Co-funded Exploration Drilling Program 2011–12



Applications open 24 February 2011

The Co-funded Exploration Drilling Program is the signature program in the five-year, \$80 million Exploration Incentive Scheme (EIS). After two very competitive rounds of applications, where co-funding of over \$8 million was offered to support 97 projects, GSWA will again be calling for applications, beginning on 24 February 2011, for the 2011–12 round of co-funding. Applications must be made online and will close on 25 March 2011.

In 2011–12, the co-funded drilling program will, on a competitive basis, continue to preferentially fund high-quality, technically and economically sound proposals that promote new exploration concepts and new exploration technologies.

Once again there will be some minor changes to guidelines for the 2011–12 round of funding, and these are included below.

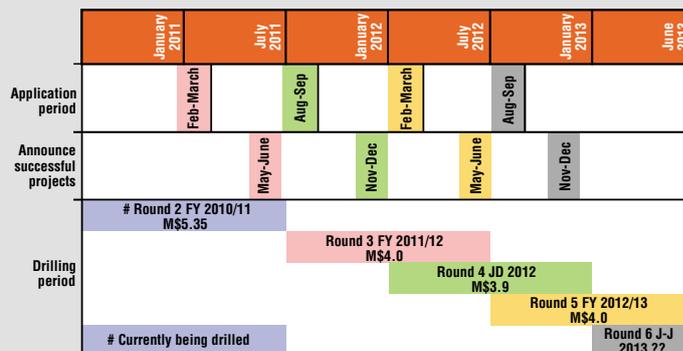
The conditions under which applications will be accepted are:

- Applications are open to explorers in all commodities including geothermal energy in Western Australia.
- Co-funding will be up to 50% of direct drilling costs. In the general category the cap is \$200 000 for a single deep hole program or \$150 000 for a multi-hole program. In the prospectors category the **cap has been increased to \$30 000***. Prospectors may apply within the general category but the prospector's category is open only to *bona fide* prospectors.
- **Only one application per mineral tenement / combined reporting group, geothermal exploration permit or petroleum exploration permit, or drilling reserve will be accepted per application round***.
- Second and subsequent applications from an applicant are handicapped if one application is successful.

*denotes changes introduced this year

- Applications will only be accepted via the online application system.
- **Two application rounds per year***.

From this year, there will be two rounds of applications advertised per year to assist companies with better planning of their programs. Each drilling round will be 'stand-alone' and projects will have to be completed in the 12-month period relating to the application. Grants will not be able to be 'rolled over' to the next application period.



More detailed explanations of all the conditions governing the EIS Co-funded Drilling Program can be found on the DMP website at www.dmp.wa.gov.au/EISdrilling.

The changes to the program have been instituted as a result of industry feedback, and were supported by the Co-funded Drilling Advisory Committee, which is made up of industry body representatives.

The program is highly competitive and successful applicants are determined in an exhaustive evaluation of the criteria, which are required to be addressed in the online application system. The evaluation is undertaken by an independent panel of exploration geologists who have significant industry experience in Western Australia.

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Exploration drilling in the Eucla (photograph courtesy Gunson Resources)

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New viewer for Windows

GSWA has released GeoMap.WA, its new Geographical Information Systems (GIS) viewer for Windows.

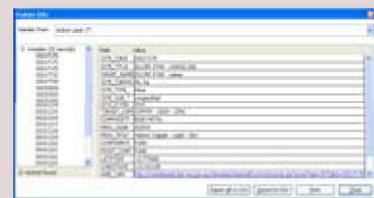
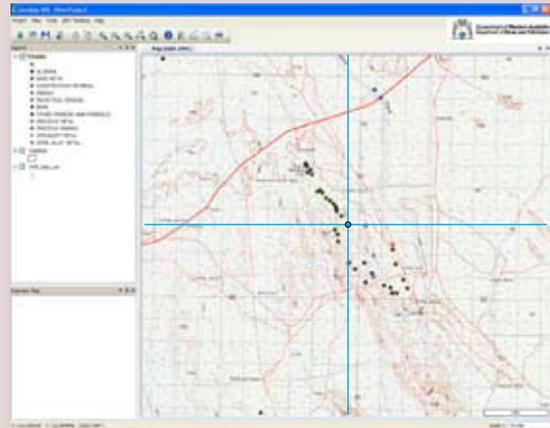
GeoMap.WA is provided free on GSWA digital GIS data packages, or can be downloaded from the Data and Software Centre <www.dmp.wa.gov.au/datacentre>.

GeoMap.WA allows users without GIS software on their computers to view, query, print, and integrate GIS data formats and raster products such as maps, air photos, and satellite images (see figure).

Rather than providing data displayed on maps, users can select the data themes, choose a geographical region, and view spatial and text data through one easy-to-use tool.

The GeoMap.WA tool provides support for ESRI Shapefile and MapInfo TAB vector data files, and GeoTIFF, ECW, and JPEG2000 raster image files, on-the-fly map reprojection, and GPS connectivity. GeoMap.WA also provides the ability to join user-defined database tables related to the GIS layers to perform spatial analysis using users' linked data.

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



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The panel representatives are members of professional geoscience bodies, and are required to abide by confidentiality and conflict-of-interest guidelines to ensure the highest level of integrity in the handling and evaluation of applications.

Previous assessment panels have developed a marking template (the highest level of which is detailed in the criteria section of the online application system) to ensure consistency in the evaluation process. Applications are evaluated independently by at least two members of the team, and any applications are re-evaluated where there is a statistically significant variation in marks assigned independently. The final score assigned to an application is the average of the marks assigned.

This process has been, and will continue to be, scrutinized by an independent probity auditor to ensure that it is transparent and fair. The probity auditor reviews the process of dealing with applications during the evaluation period, from receipt through to the announcement of successful applications.

Important dates for the 2011–12 Co-funded Drilling Program	
24 February 2011	Opening date for lodgement of drilling proposals
25 March 2011 (5 pm Perth time)	Closing date for lodgement of drilling proposals
Week commencing 20 June 2011	Announcement of successful proposals
20 June 2011 – 30 June 2011	Co-funded Drilling Agreements signed by applicants and DMP
30 June 2012	Last date for acceptance of interim reports and invoices for 2011–12 drilling projects
30 September 2012	Last date for acceptance of final report (including core) for 2011–12 drilling projects

For more information contact:
Margaret Ellis, Coordinator Exploration Incentive Scheme,
08 9222 3509 (margaret.ellis@dmp.wa.gov.au)
or see the website at <<http://www.dmp.wa.gov.au/EISdrilling>>.



Government of **Western Australia**
Department of **Mines and Petroleum**



Promoting the prospectivity of WA

Geological Survey Open Day
24 February 2011
8.00 am – 5.00 pm
Esplanade Hotel, Fremantle

This is a great opportunity to hear presentations on the latest results from GSWA's geoscience programs and see demonstrations of the online databases.

Activities and results of the \$80 million Exploration Incentive Scheme (EIS) will be outlined, including the launch of Round 3 of the Government Co-funded Exploration Drilling program.

Throughout the day there will be geological presentations and an extensive poster display. This seminar will follow the RIU Explorers Conference held 22–23 February 2011 at the same venue.

Register online at
www.dmp.wa.gov.au/gswa2011



For further information, call
(08) 9222 3168

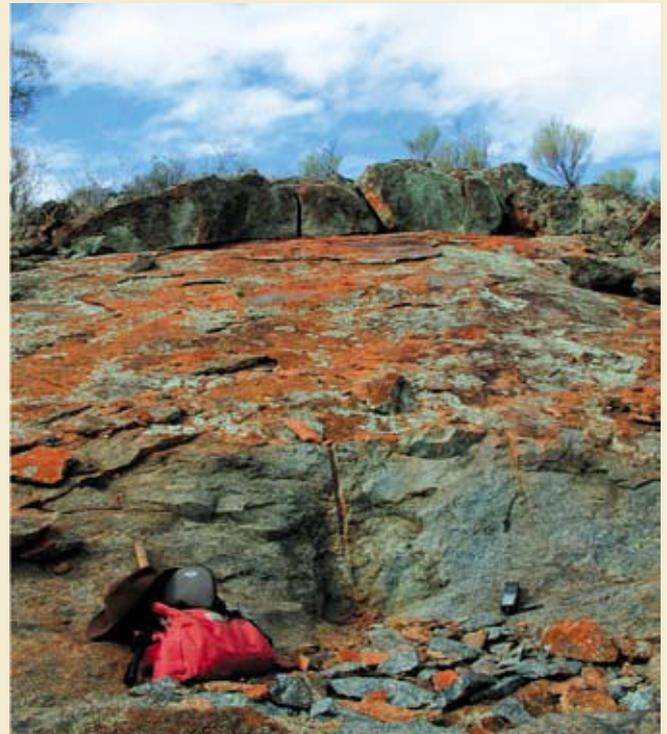
New geochronological constraints on the age of greenstone magmatism across the Yilgarn Craton

Until recently, greenstones in the northern Southern Cross Domain, part of the Youanmi Terrane within the Archean Yilgarn Craton, were regarded as representing a 3.0 Ga mafic succession followed by a cycle of felsic magmatism and sedimentation at 2.7 Ga. This assumption was largely based on lithological similarities with and/or tectono-structural histories comparable to the adjacent Murchison Domain, as well as isotopically distinct signatures from other terranes of the Yilgarn Craton (based on Sm–Nd isotopes).

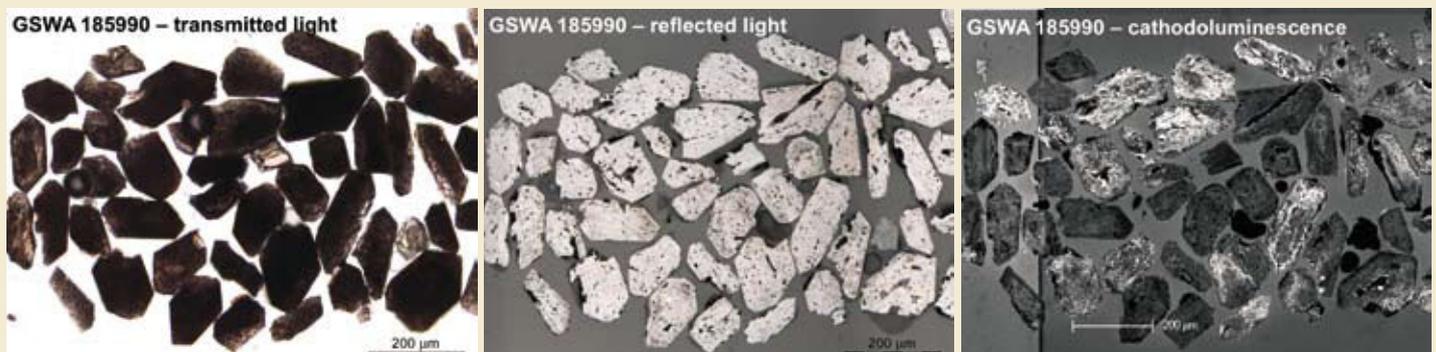
New SHRIMP geochronology from the Grass Flat Gabbro, one of the best preserved mafic sills of the region, has yielded a mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of 2796 ± 6 Ma. The date was obtained from a late-stage felsic zone within a leucogabbro horizon in the upper part of the sill. Leucogabbro horizons are characterized by sparse, acicular clinopyroxene crystals, up to 20 cm long, in a medium- to coarse-grained, plagioclase-rich matrix.

This date has important implications for the mafic magmatic history of the northern Southern Cross Domain. It revises the minimum age for the mafic greenstone sequence from c. 2732 Ma to c. 2796 Ma, and raises questions about the accepted division of greenstone magmatism into 3.0 Ga mafic and 2.7 Ga felsic cycles in this region.

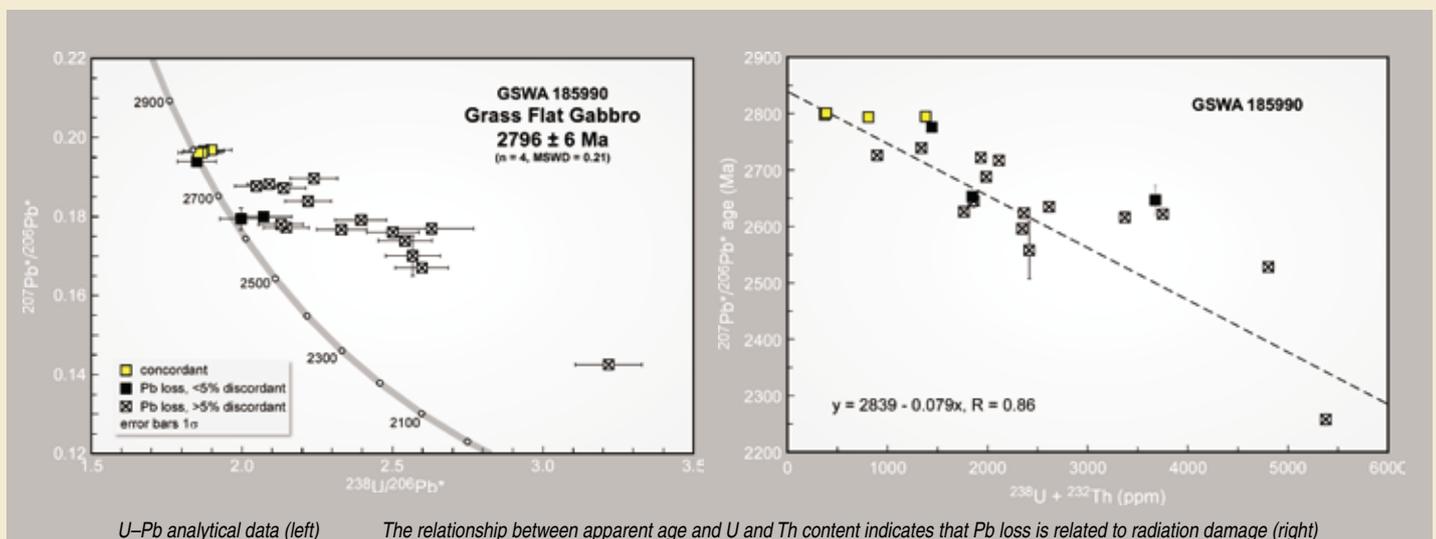
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Grass Flat Gabbro outcrop at 708660E 6721020N.



Zircons in Grass Flat Gabbro sample GSWA 185990 (above) are variably metamict and strongly altered



U–Pb analytical data (left)

The relationship between apparent age and U and Th content indicates that Pb loss is related to radiation damage (right)

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The 2796 ± 6 Ma date also extends the known distribution of an important stage of Yilgarn crustal development previously unidentified in this part of the craton. The Murchison Domain to the west and Burtville Terrane in the eastern part of the Eastern Goldfields Superterrane (and possibly the southern part of the Southern Cross Domain) also have this common element in their magmatic histories between c. 2820 and 2710 Ma. Thus the new date shows that the c. 2820–2800 Ma mafic magmatism, identified elsewhere in the craton, is also present in the northern part of the Southern Cross Domain. The Grass Flat Gabbro exhibits geochemical affinities with some layered intrusions of the adjacent Murchison Domain, with a chemical signature consistent with derivation from Meeline Suite anhydrous magmas (like those that formed the Windimurra Igneous Complex). The Meeline Suite in the Murchison Domain was emplaced between c. 2820 and c. 2800 Ma, within error of the age of the Grass Flat Gabbro.

Mafic to ultramafic magmatism between c. 2820 and c. 2800 Ma is becoming more widely recognized, with U–Pb and recently acquired Lu–Hf zircon data also showing a conspicuous 2.8 Ga juvenile crustal addition across the Yilgarn Craton. The new 2796 ± 6 Ma age for intrusion of the Grass Flat Gabbro shows that c. 2820–2800 Ma mafic magmatism in the northern part of the Southern Cross Domain was contemporaneous with similar magmatism in quite disparate parts of the craton, and supports the proposition that there was a common history over a large part of the craton prior to c. 2800 Ma. The c. 2820–2800 Ma widespread mafic magmatic event has been ascribed to the development of a large-scale mantle plume.

For more information, contact Angela Riganti (angela.riganti@dmp.wa.gov.au).

GeoTourism: Western Australia unearthed — the virtual tour

Western Australia unearthed is a new series of guide books and maps published by GSWA for travellers who want to know about the landscapes and rocks of the State, how they formed, and where to find them. An exciting new addition to this series is the **virtual tours!**

The first product to have a virtual tour is *Discovery trails to early Earth — a traveller's guide to the east Pilbara of Western Australia*. Download a virtual tour of the

six trails for use in Google Earth software (<http://gswadata.dmp.wa.gov.au/gswadata/kml/Pilbaradiscoverytrails/GSWAPilbaraTrails.kmz>).

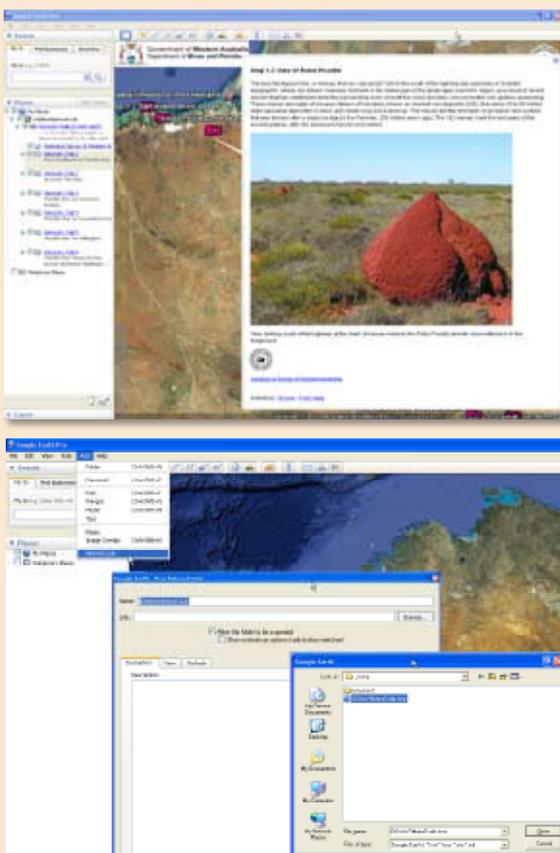
Google Earth supports custom KMZ files for viewing data. The virtual tour KMZ file includes photos and descriptions of geological icons that are easily browsed in the Google Earth mapping interface.

To get started, you will need to download Google Earth. The basic version of the software is freely available on Google's website.

How to use the Google Earth Viewer:

1. Download the Pilbara Trails KMZ from the GeoTourism: Western Australia unearthed web page <<http://www.dmp.wa.gov.au/803.aspx>> (click on 'Download a virtual tour' under *Discovery trails to early Earth — a traveller's guide to the east Pilbara of Western Australia*)
2. Click Save (to hard drive)
3. Start Google Earth, click 'Add', 'Network link'
4. Browse to the saved KMZ file and press 'Browse', 'Open', 'OK'
5. This will load the virtual tour into My Places in Google Earth
6. Check the box next to the icon you've just saved to make it visible, double click on the network link, and Google Earth will zoom to the locality
7. Click on the icon in the map interface to see photos and descriptions.

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



HyLogger capable of detecting hydrocarbon intervals

Routine scanning of petroleum drillcore using the HyLogger at Perth's Core Library indicates its capacity to detect hydrocarbon intervals, essentially providing a new tool for petroleum explorers.

Spectral data from Hovea 3 core, drilled in the northern Perth Basin to examine the Triassic–Permian boundary and the uppermost Permian reservoir section, included an unusual spectral signature for some sandstone intervals. The signature was initially interpreted by The Spectral Assistant (TSA) HyLogger software as 'plastic' — a response often associated with plastic core trays. Normally with such a response the HyLogger operator either rescans the core using different background settings, or sets up shields to mask reflected light from the plastic trays. For the Hovea 3 core, neither approach made a difference to the unusual spectral signature. Further examination showed that the 'plastic' intervals matched the oil leg from the reservoir section in the well.

The diagnostic absorption wavelength intervals for hydrocarbon are 1725–1732 nm and 2305–2310 nm (Fig. 1). In addition,

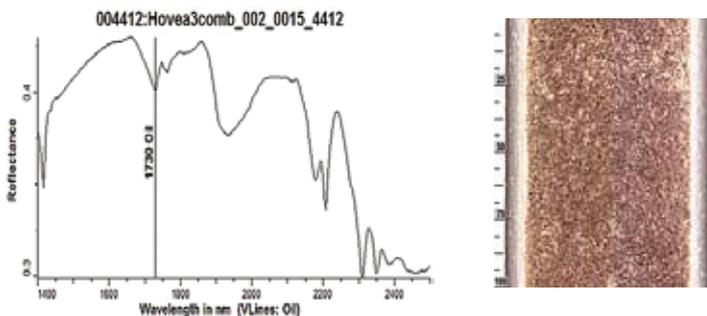


Figure 1. Mixed spectrum of dickite ($Al_4Si_4O_{10}(OH)_8$) and hydrocarbon collected from 10 mm sample of oil-stained sandstone

Clark (2010) reported another absorption peak associated with hydrocarbons at 1200 nm, but in Hovea 3 it is very weak and probably represents a very high level of hydrocarbon saturation. Using hydrocarbon absorption peaks for a TSG (The Spectral Geologist software) plot, the oil intervals for Hovea 3 were compared with core gamma and minipermeametry data (Fig. 2). The addition of albedo and colour histograms created using TSG clearly highlights the oil-bearing interval (1992–2019 m) within the sandstone succession. Dickite is recognized by TSA as the dominant clay mineral within the sandstone interval below 1992 m.

It is important to apply the search tool to both the 1730 and 2308 nm absorption features, as the use of just one of these intervals could be misleading (for example, some smectites and carbonates have diagnostic absorption features at 2305–2310 nm). In addition, various substances used for marking or wrapping core can yield a 'hydrocarbon' signature from the HyLogger. Therefore, these features should be masked prior to scanning core.

The HyLogger oil search was also applied to core from Sally May 2, Cliff Head 6, and Turtle 1, and confirmed the oil-bearing intervals evident from visual inspection (including under ultraviolet light) and as reported by the companies, although different thresholds were set up for each case.

Although this is a new discovery for the HyLogging technology, the use of spectroscopy in detecting hydrocarbons is well known. Nevertheless, this discovery shows that further research on spectral analysis of oil saturation, hydrocarbon type, and the influence of host rocks, is warranted. In particular, experimental work is required to determine the lower limit of oil detection by the HyLogger.

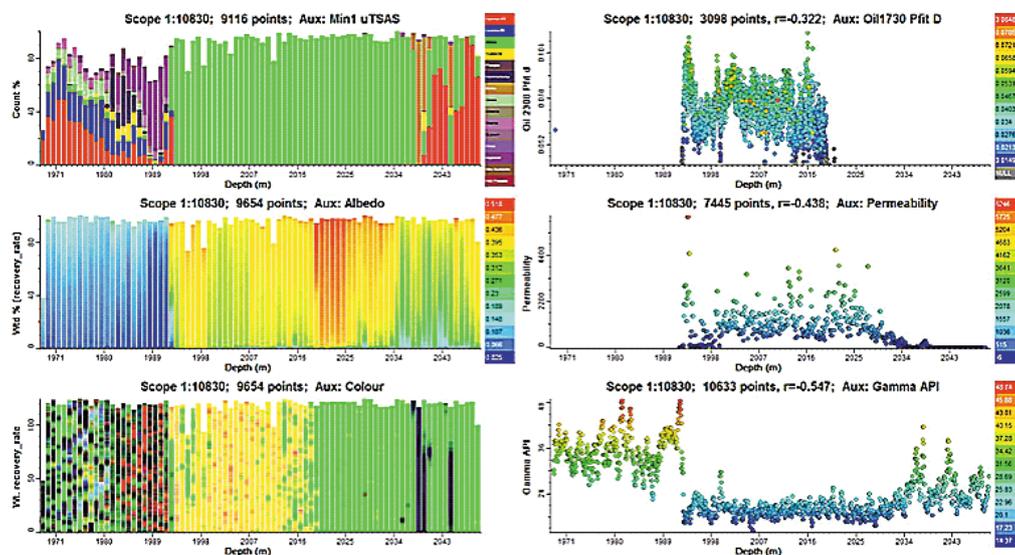


Figure 2. TSG graphic logs for Hovea 3 core (counts per 1 m core) showing a) distribution of main minerals; b) albedo; c) enhanced colour of the core; d) oil intervals interpreted from absorption peaks at wavelengths 1730 nm and 2308 nm; e) permeability; f) core gamma (API). Data for e) and f) are from the well completion report.

This work was conducted using the NVCL HyLogging System with the HyLogger operator Andrew Doepel. Jon Huntington (CSIRO) and Arthory Mory (GSWA) assisted with the data interpretation.

For more information, contact Lena Hancock (lena.hancock@dmp.wa.gov.au).

The State's coal future looks bright

Although coal was first discovered in 1846 in Western Australia on the Irwin River, the first commercial discovery was at Collie in 1883. Mining commenced with the extension of the railway to the town in 1898. Despite ongoing exploration and a number of discoveries from the 1960s to the 1980s, Collie is the only producing area in the State. The combined output from the two producing companies is approximately 6.5 Mtpa, of which the majority is used for electricity generation, with lesser amounts for industrial uses and a small but expanding export component.

The hiatus in coal exploration activities during the 1990s reflected a combination of the ability of the then available resources to meet local requirements, low coal prices, and a lack of export potential. Increasing world energy demands — and therefore coal prices — and the development of alternative technologies have now seen the level of activity increase substantially, particularly in the last two to three years, to the extent where exploration licences cover most prospective areas. Current activities include both greenfields exploration and the economic evaluation of more advanced projects. A number of companies are currently targeting relatively under-explored but prospective Permian strata in the Canning Basin. Renewed exploration is also taking place in areas containing previously discovered coal deposits, including the northern Perth Basin, the Southern Perth Basins, Vasse Shelf, and Boyup and Wilga Sub-basins, and the Eucla Basin.

Advanced projects targeting traditional coal extraction methods are being considered at Osmington (underground, Vasse Shelf), Eneabba (opencut with an associated power station, northern Perth Basin) and a potential export highwall trench mining operation near Camballin in the Canning Basin. A proposed coal-to-urea plant near Collie has recently received conditional environmental approvals, with construction likely to commence in 2011. This operation will use approximately 2.5 Mtpa of opencut mined coal to produce 2.1 Mtpa of urea, largely for export through the Bunbury port.

Non-conventional coal uses are also being evaluated east of Dongara, in the northern Perth Basin, where a resource with an estimated 194 Mt (74 Mt Indicated, 119 Mt Inferred) of sub-bituminous Jurassic coal is being assessed as an Underground Coal Gasification (UCG) project. Two separate Coal-to-Liquids (CTL) projects are under evaluation in the Eucla Basin north of Esperance. These two projects are based around large Eocene lignite deposits discovered during the 1980s, with current evaluation concentrating on upgrading information on the resource and application of conversion technologies.

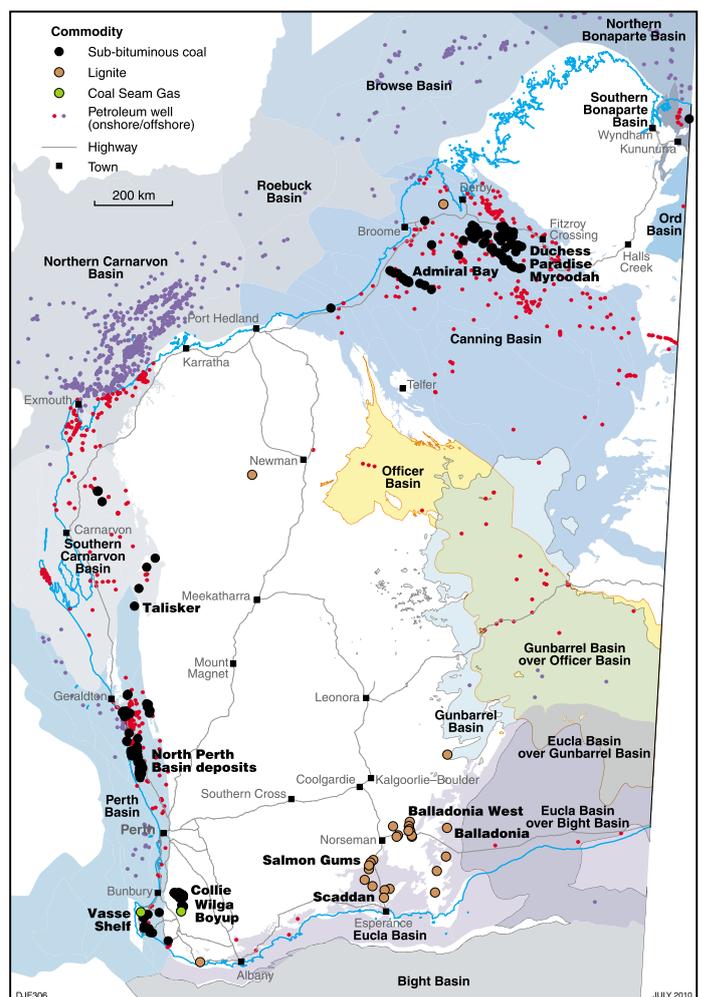
Over the past year, GSWA has concentrated on making available a large number of historical coal reports via WAMEX. Many of these reports were from exploration completed during the late 1960s through to the early 1990s, prior to the digital reporting requirements. With this phase now largely complete, the next stage is to create a GIS database of historical exploration data that will include coal drilling, coal quality, and historical resource outlines. In addition, it is planned to review the current geological descriptions of the coal basins, and compile an

up-to-date resources inventory; however, some resource estimates pre-date the establishment of the Joint Ore Reserves Committee (JORC) Code.

For more information, contact Alan Millar (alan.millar@dmp.wa.gov.au).



Irwin River Coal Measures seam is about 1 metre thick



Location of coal occurrences — details are available online in the Mines and Minerals Deposits database (MINEDEX) and viewed via GeoVIEW.WA

Western Australia regional geophysical surveys 2010–11: October update

Data access

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

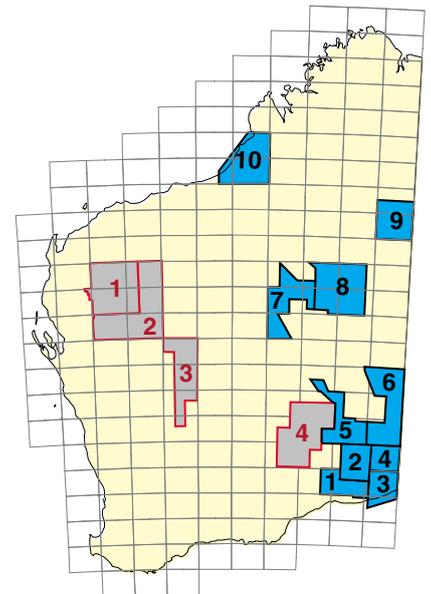
Download preliminary and final grids and images from the GSWA website at <www.dmp.wa.gov.au/geophysics>.

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 survey
 Ground survey



Airborne magnetic and radiometric surveys

ID	Area/Name	Lines	Size (km)	Status	Start	End	Release
1	Madura 2010	200 m; E/W	102 000	Survey	Jul-10	Dec-10*	Mar-11*
2	Loongana 2010	200 m; E/W	113 000	Survey	Jun-10	Nov-10*	Feb-11*
3	Eucla 2010	200 m; N/S	88 000	Survey	Jul-10	Nov-10*	Feb-11*
4	Forrest 2010	200 m; N/S	75 000	Survey	Jun-10	Sep-10	Dec-10*
5	Jubilee 2010	200 m; N/S	180 000	Survey	Jun-10	Jan-11*	Apr-11*
6	Waigen–Mason 2010	400 m; N/S	113 000	Survey	Jun-10	Jan-11*	Apr-11*
7	Madley–Herbert 2010	400 m; N/S	95 000	Survey	Jul-10	Nov-10*	Jan-11*
8	Morris–Cobb 2010	400 m; N/S	125 000	Survey	Jul-10	Dec-10*	Mar-11*
9	Stansmore 2010	200–400 m; N/S	114 000	Survey	Jul-10	Nov-10	Feb-11*
10	Lagrange–Munro 2010	400 m; N/S	103 000	Contract	Sep-10	Feb-11*	May-11*

Ground gravity surveys

ID	Area/Name	Spacing	Size (stns)	Status	Start	End	Release
1	Gascoyne North 2010	2.5 km grid	7 292	Release	Mar-10	May-10	15-Jul-10
2	Gascoyne South 2010	2.5 km grid	9 700	Contract	Aug-10	Oct-10	Feb-11*
3	Sandstone 2010	2.5 km grid	6 300	Contract	Aug-10	Dec-10*	Feb-11*
4	Albany–Fraser North 2010	2.5 km grid	9 200	Contract	Oct-10*	Dec-10*	Feb-11*

Information current at: 1 Nov 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.

December 2010 Issue No. 100



Archean gold mineral systems in the eastern Yilgarn Craton
New knowledge to assist area selection and targeting



Survey of Kalgoorlie earthquake damage
Assessing the vulnerability of older buildings



Future directions for mapping in Geoscience Australia
Demand for more intelligent and specific data



The real science experience
Promoting awareness of the geosciences



A chronicle of change
AusGeo News celebrates 20 years

Click on <<http://www.ga.gov.au/ausgeonews/ausgeonews201012/>> to view AusGeo news and learn more about these stories.

MINERAL RESOURCES BULLETIN

Mineral Resources Bulletin 24 Dimension stone in Western Australia, Volume 2 — Industry review and dimension stones of the southern, central and northern regions
by JM Fetherston

REPORT

Report 109 Kinematics of bidirectional extension and coeval NW-directed contraction in orthogneisses of the Biranup Complex, Albany Fraser Orogen, Southwestern Australia
by M Barquero-Molina

RECORDS

2010/3 Evolution of active plate margins: West Pilbara Superterrane, De Grey Superbasin, and the Fortescue and Hamersley Basins — a field guide
by AH Hickman, RH Smithies, and IM Tyler

2010/4 North East Yilgarn Biogeochemistry Project — MERIWA
by N Reid, M Lintern, R Anand, T Pinchand, Dj Gray, RP Ryan, G Sutton, and R Jarrett

2010/6 Redefining the Giles Event within the setting of the 1120–1020 Ma Ngannatjarra Rift, west Musgrave Province, Central Australia
by P Evins, RH Smithies, HM Howard, CL Kirkland, MTD Wingate, and S Bodorkos

2010/8 GSWA core library services: radioactive core storage, handling, and transport — standard operating procedure

2010/10 The 3426–3350 Ma Strelley Pool Formation in the East Strelley greenstone belt — a field and petrographic guide
by D Wacey, N McLoughlin, CA Stoakes MR Kilbrun, OR Green, and MD Brasier

2010/16 Procedure for legacy point and data capture (2nd edition)
by S Sheppard, L Kelly, TR Farrell, and RE Green

2010/17 The GSWA NVCL Hylogger: rapid mineralogical analysis for characterizing mineral and petroleum core
by EA Hancock

2010/19 A time transect through the Hadean to Neoproterozoic geology of the Western Yilgarn Craton — a field guide
compiled by MJ Van Kranendonk, TJ Ivanic, S Wyche, SA Wilde, and I Zibra

2010/21 Three and a half billion years of life on Earth: a transect back into deep time
by MJ Van Kranendonk

2010/22 Geothermal energy potential in selected areas of Western Australia (Officer Basin)
by Hot Dry Rocks Pty Ltd

2010/23 Geothermal energy potential in selected areas of Western Australia (Browse Basin)
by Hot Dry Rocks Pty Ltd

2010/24 Geothermal energy potential in selected areas of Western Australia (Bonaparte Basin)
by Hot Dry Rocks Pty Ltd

2010/26 5IAS Controls on giant mineral systems in Yilgarn Craton — a field guide
by T McCuaig, J Miller, and SW Beresford

GEOLOGICAL MAPS

DAURIE CREEK 1:100 000 Geological Series map
by SP Johnson

Roadworks in St Georges Terrace linked to new GSWA book



You may have noticed the extensive roadworks taking place in the city centre. The good news is the Perth City Council has elected to repave the pedestrian walkways with a Western Australian building stone, Verde Austral, a green granite from the Norseman region. This decision is linked to the release of a new publication by Mike Fetherston on building stones in Western Australia.

Dimension Stones of the Southern, Central Western, and Northern Regions (Volume 2), is the conclusion of a three-year study of dimension stone that covers natural rock material cut into blocks

and slabs for use in the building, street and landscape design, and monumental stone industries. Over 120 dimension stone sites in the State, extending from Esperance on the south coast to the Kimberley region in the far north, were investigated for inclusion in this publication. Major rock types include granite and metamorphic rocks, black granite, marble, and sandstone, together with a variety of minor stones. This detailed study highlights for future developers the extensive resources of high-quality dimension stones available in accessible areas of the State.

To purchase either volume for \$55, go to GSWA's eBookshop on <<http://www.dmp.wa.gov.au/ebookshop>> or access either volume as a free PDF at <www.dmp.wa.gov.au/gswapublications> and search in Title 'Dimension Stone'.



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. Almost all printed publications are now also available free as PDF files on our website at <<http://www.dmp.wa.gov.au/GSWApublications>>. Further details of geological publications and maps produced by the Geological Survey of Western Australia can be obtained at <<http://www.dmp.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.dmp.wa.gov.au/ebookshop>>.