

New data supports Ceduna Sub-basin acreage release

The Australian Government's 2009 release of offshore petroleum exploration acreage includes six large areas in the Ceduna Sub-basin of the Bight Basin. Over the last four years, the Bight Basin has been a focus of studies by Geoscience Australia's Southern Frontiers Project aimed at improving understanding of the petroleum prospectivity of the basin. These studies have provided pre-competitive data and information that underpins the 2009 acreage release (figure 1). A key component of the project was the Bight Basin Geological Sampling and Seepage Survey, which used the Marine National Facility vessel RV *Southern Surveyor*. The results of this survey have recently been released as Geoscience Australia Record 2009/24.

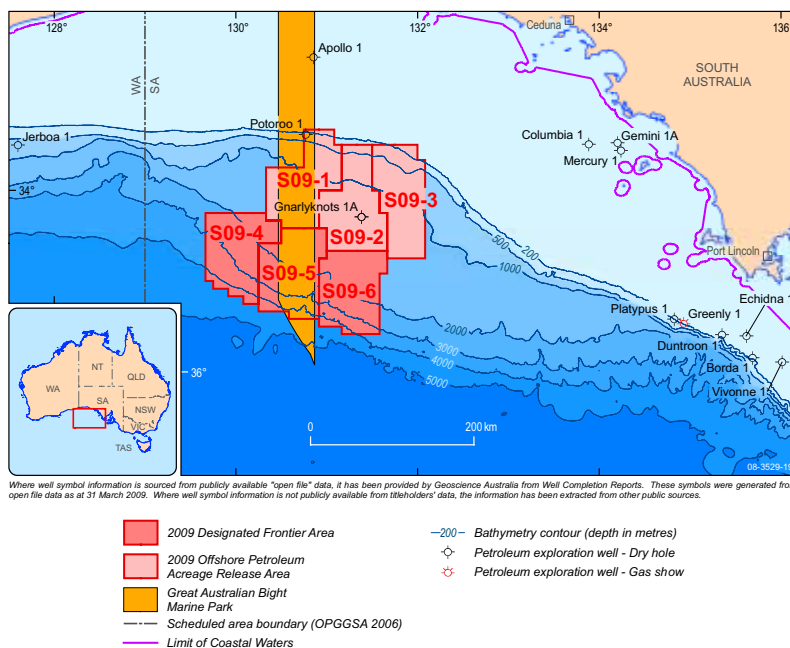


Figure 1. Location of the Bight Basin Release Areas S09-1 to S09-6 included in the Australian Government's 2009 release of offshore petroleum exploration areas.

A highlight of the Bight Basin survey was the collection of Cenomanian-Turonian organic-rich rocks from the northwestern edge of the Ceduna Sub-basin. Geochemical analyses have characterised these marine shales as world-class, oil-prone potential source rocks. These rocks, though predicted to occur, had not been sampled prior to this survey, so previous perceptions about the source rock potential of the basin have changed significantly. Record 2009/24 provides details of the samples collected during the survey and focuses on the organic geochemical and biostratigraphic analysis of these rocks.

To complement Record 2009/24, a presentation summarising the results of 3D petroleum systems modelling in the Ceduna Sub-basin is also available for download. The modelling, undertaken using Schlumberger Petromod® software, utilised new compositional

kinetics from organic-rich rocks obtained by the Bight Basin survey to model maturation, generation and expulsion of hydrocarbons from a Cenomanian-Turonian marine source rock. Albian-Cenomanian marine source rocks and Cenomanian coaly source rocks were also modelled. The results of the study suggest that the Ceduna Sub-basin has experienced several phases of hydrocarbon generation, expulsion and accumulation.

To further support the Bight Basin acreage release, Geoscience Australia has also released a report on the seabed environments of the Ceduna Sub-basin, containing information on geomorphology, physical oceanography, sediments, ecology and seascapes for the area (Geoscience Australia Record 2009/09). The report is designed to assist explorers by providing information on a broad range of environmental issues that may impact on hydrocarbon exploration in the Sub-basin.

A major goal of the Southern Frontiers Project was to improve the understanding of the evolution and geology of the southern Australian margin as a whole. The southern margin includes the well-explored, hydrocarbon-producing Otway and Bass basins, as well as the frontier, but highly prospective, Bight Basin. Taking a margin-scale approach—examining regional and plate-scale controls

and drivers—has provided insights into basin evolution. This work has involved collaborations with university researchers and consultants in a range of studies focusing on the big picture.

Two major products that document the results are:

- *Australian Southern Margin Synthesis*. This study entailed a tectonostratigraphic compilation and synthesis of Australia's southern margin basins. The report was prepared by FrOG Tech Pty Ltd and utilised the results of Geoscience Australia's southern margin basin studies over the past 10 years. It includes analysis of the tectonic and stratigraphic development of the Bight Basin (including the Bremer Sub-basin) as well as the Otway, Gippsland, Sorell and Bass basins.
- *South Australia-Antarctica Conjugate Rifted Margins report*. This study, undertaken by Nick Kusznir (University of Liverpool), involved 3D inversion of satellite gravity data incorporating a lithosphere thermal gravity anomaly correction. This technique was used to determine total crustal thickness, the thickness of residual continental crust, and the degree of continental lithospheric thinning for the southern Australian and Antarctic conjugate rifted margins and adjacent oceanic regions.

These reports and set of grids for the Rifted Margins report can be downloaded through the Geoscience Australia website.

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Related websites/articles

Bight Basin Geological Sampling and Seepage Survey (Geoscience Australia Record 2009/24)

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=68689

Results of 3D petroleum systems modelling in the Ceduna Sub-basin

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=69485

Revealing Archean mafic-ultramafic magmatism and mineral prospectivity across Australia

Geoscience Australia has recently released two web-based map sheets that show the continental extent and age relationships of Archean mafic and ultramafic rocks, and associated mineral deposits. These maps will be of interest to explorers searching for nickel, platinum-group elements, chromium, titanium, vanadium, and cobalt.

The Archean Eon (~4000 to 2500 million years ago or Ma) represents a part of the Earth's history that is noteworthy for the widespread occurrence of unusual olivine-rich ultramafic rocks called komatiites, which contain world-class deposits of nickel sulphides.

Ceduna Sub-Basin:

Environmental Summary
(Geoscience Australia Record 2009/09)

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=65838

Australian Southern Margin
Synthesis

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=68892

South Australia - Antarctica

Conjugate Rifted Margins report

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=68655

South Australia - Antarctica

Conjugate Rifted Margins grids

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=68656

Regional Petroleum Geology of
Australia - Southern Australia

www.ga.gov.au/oceans/rpg_SthrnAust.jsp

2009 offshore petroleum
exploration areas (Department of
Resources, Energy and Tourism)

www.ret.gov.au/resources/upstream_petroleum/offshore_petroleum_exploration_in_australia/2009/Pages/default.aspx

AusGeo News 87: Promising
results from Bight Basin survey

www.ga.gov.au/ausgeonews/ausgeonews200709/bight.jsp

Eoarchean (~3730 Ma: AME 1) to the late Neoarchean (~2520 Ma: AME 26) were identified. This mafic-ultramafic magmatic event series is based on several hundred published age measurements, of which over 95 per cent are derived from recent uranium-lead dating of zircon and baddeleyite.

The Archean mafic-ultramafic magmatism event series commenced in the northwest Yilgarn Craton, with 3730 ± 6 Ma Eoarchean gabbroic rocks from the Manfred layered complex. These are the oldest dated rocks in Australia with the next oldest mafic-ultramafic rocks from the Pilbara Craton.

Mafic-ultramafic magmatic events became more widespread in the early Neoarchean with several samples of similar ages from the Yilgarn and Pilbara cratons, Hamersley Basin, and Sylvania Inlier. The national Archean mafic-ultramafic magmatic record concludes in the late Neoarchean with two isolated magmatic events (AME 25–2560 Ma and AME 26–2520 Ma) in the Gawler Craton.

The colour-coding of mafic and ultramafic rock units by their age of magmatism on Sheet 1 provides a visual cue to the spatial and temporal correlations of magmatic units at province and continental scales. A Time–Space–Event Chart highlights three significant periods of mineralisation associated with mafic-ultramafic magmatism.

They are:

- ~2925 Ma—platinum-group elements+nickel+copper (Munni Munni Intrusion: AME 8) and nickel+copper+platinum-group elements (Radio Hill Intrusion: AME 8)
- ~2800 Ma—titanium+vanadium (Windimurra Intrusion: AME 11)
- ~2705 Ma—nickel+copper±platinum-group elements associated with komatiitic rocks (Kambalda-Wiluna region: AME 19).

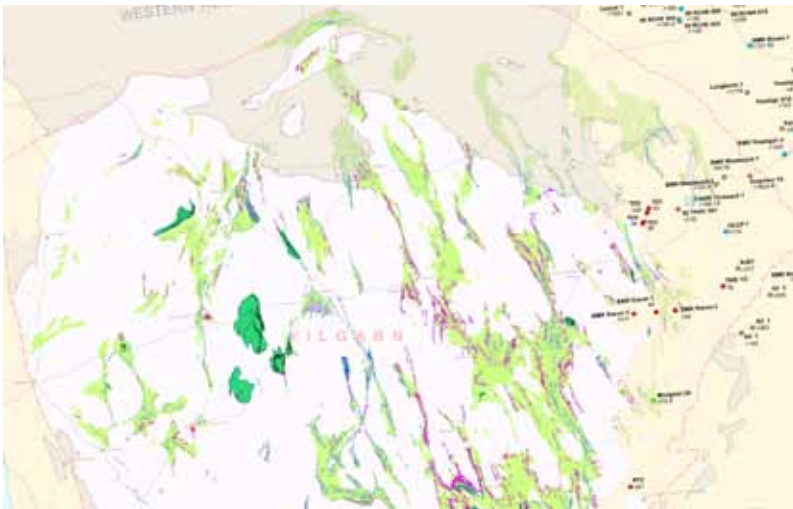


Figure 1. A section of the new 1:3 000 000 scale map of Australian Archean Mafic-Ultramafic Magmatic Events: Yilgarn Craton, Western Australia (Sheet 2 of 2). The Archean greenstone sequences containing potentially mineralised komatiitic rocks are depicted by a green screen for outcrop and stipple for undercover. Based on interpretations of aeromagnetic data, these rocks occur under shallow cover and younger sedimentary basins near the northeastern margin of the Yilgarn Craton.

Significant high-grade nickel sulphide deposits (such as Spotted Quoll, Flying Fox, Maggie Hays) in the Southern Cross Domain in the Yilgarn Craton are hosted by poorly dated komatiitic sequences that are most likely older (~3000 Ma to ~2800 Ma) than those identified in AME 19. The nickel deposits in the Kambalda-Wiluna region (AME 19) are very similar to nickel sulphide deposits (~2700 Ma) in the Abitibi Belt of Canada, but Australia appears to lack analogues of similar age to the ~2585 Ma Great Dyke of Zimbabwe that hosts economic platinum-group elements-bearing chromitites.

Sheet 2 focuses on the interpreted distribution and characterisation of economically important Archean mafic-ultramafic rocks in the Yilgarn Craton. In particular, it shows potential new areas of komatiitic rocks, indicated under shallow alluvial cover and younger sedimentary basins (figure 1). Elsewhere in the craton these rocks host significant resources of nickel, copper, and the platinum-group elements. The komatiitic rocks have been assigned to seven broad groups on the basis of their interpreted range of emplacement ages and Al_2O_3/TiO_2 ratios. This sheet also shows nickel resource endowment and the crustal neodymium (a rare-earth element) model ages of the Yilgarn Craton.

The new map sheets, when used in association with the *Australian Proterozoic Mafic-Ultramafic Magmatic Events*

map published in 2008 (Geoscience Australia Record 2008/15), summarise the temporal and spatial evolution of Precambrian mafic-ultramafic magmatism in Australia. Together these maps provide a national framework for investigating under-explored and potentially mineralised environments, and assessing the role of mafic-ultramafic magmatism in the dynamic evolution of the Australian continent.

Related websites/articles

Australian Archean Mafic-Ultramafic Magmatic Events Map (Sheets 1 and 2)
www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=69347
Australian Proterozoic Mafic-Ultramafic Magmatic Events in Australia (Sheets 1 and 2)
www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=66114
AusGeo News 91: Revealing Proterozoic mafic-ultramafic magmatism in Australia
www.ga.gov.au/image_cache/GA11649.pdf

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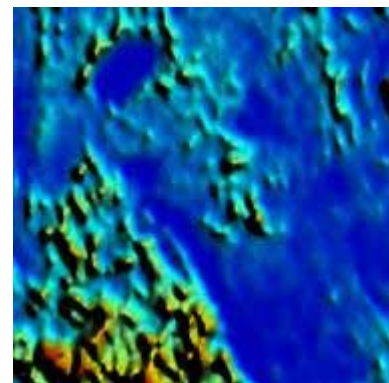
Guide to using the 1:5 000 000 map of Australian Proterozoic mafic-ultramafic magmatic events (Geoscience Australia Record 2008/15).
www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=66624

New geophysical datasets released

Datasets from two geophysical surveys, which will be a valuable tool in assessing the mineral potential of the Pine Creek–Rum Jungle area in the Northern Territory and the Cunderdin area in Western Australia, were released in September 2009.

The Pine Creek–Rum Jungle airborne electromagnetic survey covers the Pine Creek Orogen. The survey covers much of the Pine Creek 1:250 000 sheet area and surrounds to the west and south. It was conducted under Geoscience Australia's Onshore Energy Security Program. The survey data can be obtained free online through the Geoscience Australia website or can be purchased on DVD from the Geoscience Australia Sales Centre.

The Cunderdin regional gravity survey covers the Perth, Kellerberrin, Pinjarra and Corrigin 1:250 000 sheet areas. The survey was managed by Geoscience Australia on behalf of the Geological Survey of Western Australia. The Cunderdin data have been incorporated into the national gravity database. The point-located and gridded data for this survey can be obtained free online using the Australian government's Geophysical Archive Data Download System (GADDS).



For more information

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Table 1. Details of the Pine Creek-Rum Jungle airborne electromagnetic survey.

Survey	Date	1:250 000 map sheets	Line spacing/ terrain clearance/ orientation	Line km	Contractor
Pine Creek – Rum Jungle (TEMPEST®)	October 2008 – May 2009	Cape Scott (part), Pine Creek (part), Mount Evelyn (part), Port Keats (part), Fergusson River (part), Katherine (part)	1600 m and 5000 m, 120 m (aircraft), 90 m (sensor), east - west	20 825	Fugro Airborne Surveys Pty Ltd

Table 2. Details of the Cunderdin gravity survey.

Survey	Date	1:250 000 map sheets	Station spacing/ orientation	Stations	Contractor
Cunderdin (WA)	February – April 2009	Perth (part), Kellerberrin (part), Pinjarra (part), Corrigin (part).	500 m and 2000 m east – west	7 100	Daishsat Pty Ltd

Related websites

Pine Creek-Rum Jungle TEMPEST AEM Survey, NT, 2009

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=69229

Geophysical Archive Data Delivery System (GADDs)

www.geoscience.gov.au/gadds

Geological Survey of WA

www.dmp.wa.gov.au

Geoscience Australia – Onshore

Energy Security Program

www.ga.gov.au/minerals/research/oesp/index.jsp

Shark Bay World Heritage Area features in new map

The remote Shark Bay World Heritage Area in Western Australia is ideal for visitors interested in discovering unique and diverse wildlife and observing nature at its best. There are 34 species of mammals, 120 species of reptiles and more than 245 species of land-based, wading and migratory birds that live along the shoreline. It is also an important area for the reintroduction of threatened species.

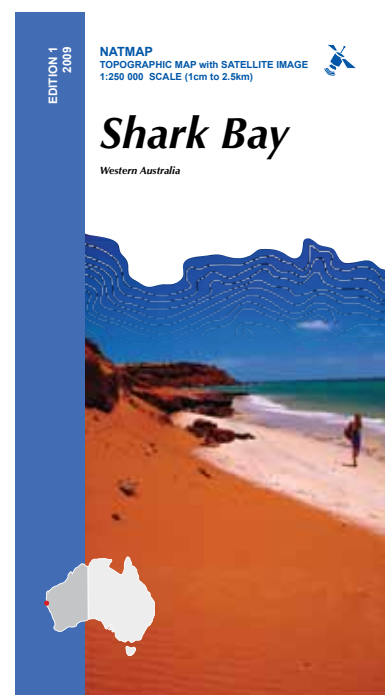
The Shark Bay region is the focus of a new 1:250 000 scale topographic map recently released by Geoscience Australia. The map includes Francois Peron National Park, Shark Bay Marine Park and the coastal zone from Carnarvon in the north to about 35 kilometres south of Hamelin Pool. The reverse side of the map depicts the same area using a satellite image with an overlay of major roads as well as insets featuring the towns of Carnarvon and Denham.

Shark Bay has the largest area of seagrass (over 4000 square kilometres) and twelve seagrass species – the most recorded in any one place in the world. Hamelin Pool contains the most diverse and abundant examples of stromatolites in the world. Stromatolites, which are evidence of one of the oldest life forms on Earth, first appeared some 3 500 million years ago.

Francois Peron National Park covers approximately 52 500 hectares in the northern part of the Peron Peninsula. The National Park, which has become one of the most important natural areas in Australia, and is home to many rare and endangered species, is under the care of the Western Australian Department of Environment and Conservation.

The Department of Environment and Conservation contributed information during the compilation of the map. Information was also supplied by Australian Government agencies, including the Department of the Environment, Water, Heritage and the Arts.

The maps are available from the Geoscience Australia Sales Centre and map retailers.



**For more information or
to order a copy visit**

www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=68756