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New discoveries result from EIS Drilling Program

ROYALTIES FOR REGIONS
EXPLORATION INCENTIVE SCHEME

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GENERAL

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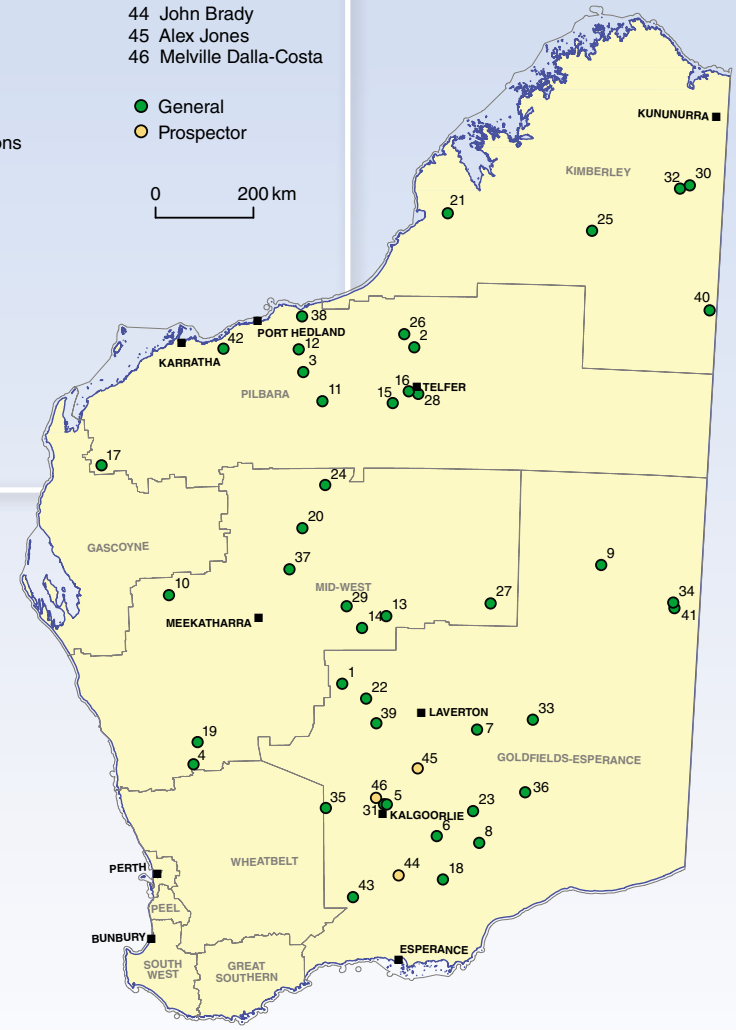

Figure 1. Locations of successful projects, Round 8

The list of successful applicants for Round 8 of the Exploration Incentive Scheme's (EIS) Co-funded Exploration Drilling Program has just been released. The Co-funded Drilling Program is the flagship program of the State Government Royalties for Regions-funded EIS. This showcases the State Government's continuing support for exploration of underexplored regional areas.

The Program provides incentives to drill in underexplored areas to ensure the continued economic prosperity of the State's resources industry, particularly in the current difficult financial environment being experienced by exploration companies. Now in its fifth year, this highly competitive drilling program offers two rounds of co-funding each year.

For 2014, there were 101 applications requesting $11.1 million in co-funding. Consequently this round was highly competitive resulting in grants totalling $5.6 million being offered to 46 projects, including three prospector projects.

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What's inside?

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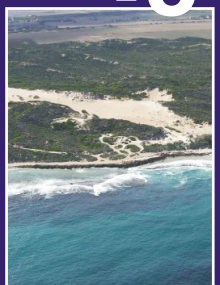


Mineral drillhole data accessible via GeoVIEW.WA

ROYALTIES FOR REGIONS
EXPLORATION INCENTIVE SCHEME

The Department of Mines and Petroleum (DMP) has released its Open-file Company Mineral Drillhole Database that contains over 2.2 million historic drillholes. The database will be used to aid mineral exploration in Western Australia.

Under the *Mining Act 1978*, companies submit annual mineral exploration reports some of which contain drillhole data. This information is made available when the reports are released to the public usually after a confidentiality period of five years.

The building of the database was funded by the Exploration Incentive Scheme (EIS) as part of Royalties for Regions. The brief was to release the drilling data that were submitted in digital format to DMP.

The database does not provide a comprehensive history of drilling in Western Australia. Reporting in digital format did not become compulsory until January 2007; hence, the data from 2007 onwards should be comprehensive. Digital reporting was first introduced in 2000 and companies who submitted their drilling data digitally were asked to use the mineral exploration reporting (MRT) templates designed by DMP to ensure all data were submitted in the same format. Therefore between 2000 and 2007, there may be drilling data available if submitted digitally. Some drilling data submitted in hard copy have been imported into the database where metadata were sufficient to enable import.

The drilling data available comprise a minimum of a collar file that has been validated against the tenement outline. Additional files such as assays, geology and surveys may also be available depending on the company's submission.

Access to these data is via the online spatial viewing application, GeoVIEW.WA. at <www.dmp.wa.gov.au/geoview>. Then select 'Access to GeoVIEW.WA' and from the toolbar select 'Search Tools'. The mineral drillhole database can be queried textually using a tenement number or spatially by an area of interest. The data available are exactly as the company submitted them; there has not been any validation of the data (Fig. 1).

The complete mineral drillhole database is available on external hard drives from DMP on request.

A similar database of the company surface sampling data, which to date contains seven million samples, will become available later in the year.

For more information, contact Ann Fitton (ann.fitton@dmp.wa.gov.au) or telephone +61 8 9222 3840.

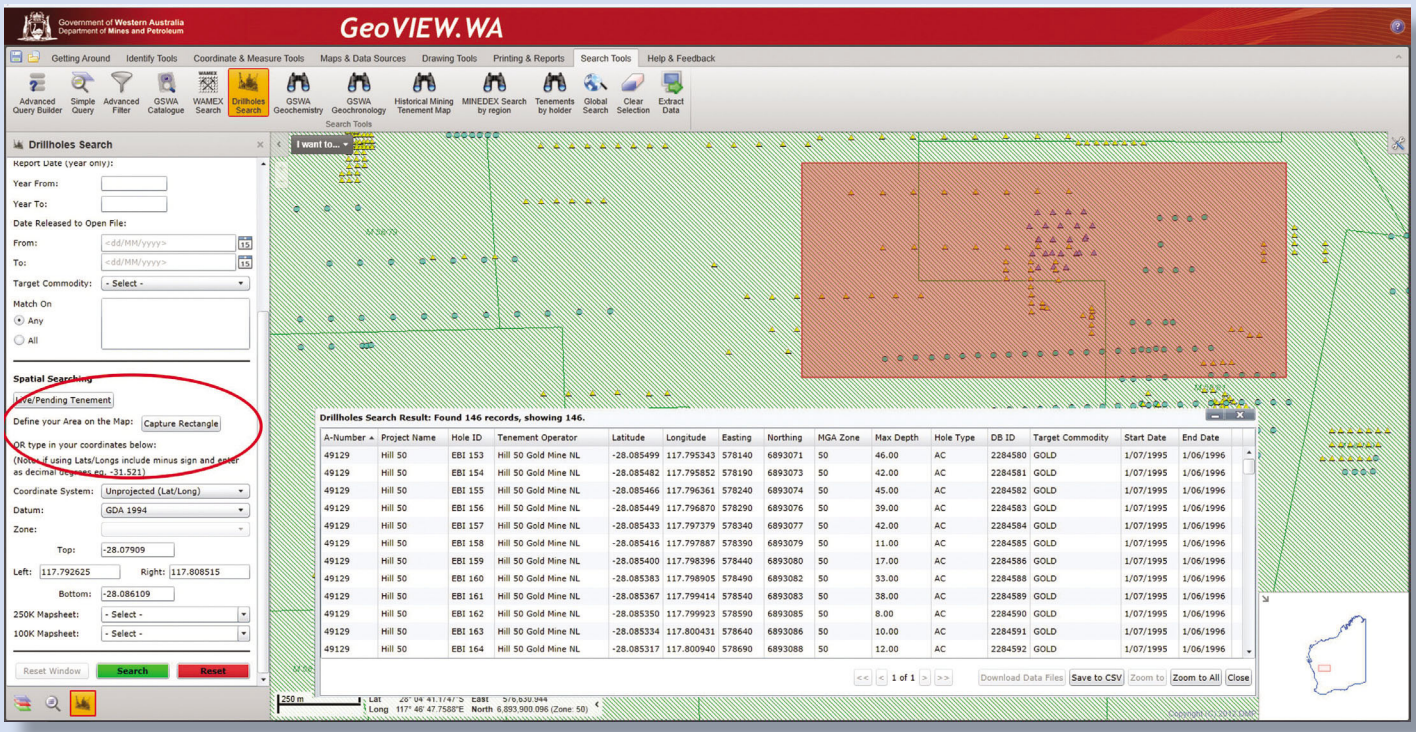


Figure 1. Results of a search by geographical area

continued from page 1

Applicant Name	Drilling Project Title	Target Commodities
Agnew Gold Mining Company	Agnew Strategic Stratigraphic	Au
Antipa Minerals	Corker Program	Au, Cu, Ag, Cu, Zn, Pb, W
Atlas Iron	Corunna Downs Regional Drilling	Fe
AusQuest Ltd	Bald Hill	Cu/Au/Ni
Barrick (Kanowna) Limited	Red Eye	Au;Cu;Mo
Black Raven Mining Pty Ltd	Erayinia VTEM Drilling	Au; Cu; Zn; Pb; Ag; Fe
Breaker Resources NL	Dexter	Au
Buxton Resources Limited	Zanthus Nickel Copper Project	Nickel and Copper
Cassini Resources Limited	West Musgrave	Ni; Cu; PGE
Complex Exploration Pty Ltd	Milly Milly Intrusion Byro East	Cu Ni PGE
Conglomerate Gold Exploration Pty Ltd	Beatons Creek Deep Drill Hole	Au
Conglomerate Gold Exploration Pty Ltd	Contact Creek Deep Drill Hole	Au
Cullen Resources Ltd.	Eureka - Southern	Au
Echo Resources Limited	Gladius Targets	Au
Encounter Resources	Fishhook Prospect	Cu, Co
Encounter Resources Ltd	Stirling	Cu-Au
Energia Minerals	Nyang	Uranium
Enterprise Metals Ltd	Plato Drilling	Ni, Cu, PGE
Hazelwood Resources	Southern Lights	W
Horseshoe Metals Ltd	Kumarina Deeps	Au, Cu, Zn, Pb
Iluka Resources Limited	Broome	Heavy mineral
Independence Group	Wilson Creek	Cu, Zn, Pb, Au, Ag
Kamax Resources Limited	Peninsula Project	Ni; Cu; PGE
Karlawinda Pty Ltd	Frankopan Exploration	Au
Kinloch Resources Pty Ltd	Mt Carson Project	Ni-Cu, REE
Ming Gold Ltd	Obelisk Prospect	Au; Cu; Ni; W; PGE
MRG Metals Ltd	East Yilgarn - Robert	Au; Ni; Cu; PGE
Newcrest Mining Limited	Matthew's Dome	Au
Newmont Jundee Operations	Jundee Deeps Drilling	Au
Northern Minerals Ltd	John Galt Project	Heavy Rare Earth Elements
Northern Mining Ltd	Kanowna Lights	Au
Panoramic Resources	Chasing the Savannah Intrusion	Ni, Cu, Co
Platina Resources Ltd	Rason Project	Au
Redstone Resources Ltd	Blackstone Range (Tollu)	Cu, Ni, Co
Reed Resources Ltd.	Mt. Finnerty	Ni-Cu-PGE
Rumble Resources Ltd	Fraser Range Project	Ni; Cu
Sandfire Resources NL	Doolgunna Project	Au/Cu
Segue Resources Ltd.	Pardoo Ni-Cu	Ni - Cu - PGE
St Barbara Limited	Poker Target	Au
Tanami Gold NL	Coyote Deeps 2014	Gold
Traka Resources Ltd	Tollu Project	Ni, Cu PGE and REE
Venturex Resources	Southern Hills	Cu; Zn, Pb
White Cliff Minerals Limited	Mt Glasse Nickel Prospect	Ni;Cu
John Brady	Princess Royal East	Gold
Alex Jones	Sparks Lease RAB drilling 2	Au
Melville Dalla-Costa	The Duke Project	Au

Figure 2. List of successful applicants for 2014, Round 8

Projects drilled with the support of the Program are showing significant results both economically and scientifically, with new discoveries being made every year. Some discoveries, such as Sirius' Nova discovery, are expected to become mines within a few years. Other discoveries, such as Beadell's West Musgrave Handpump discovery, were instrumental in promoting interest in a region which had previously been underexplored.

The Geological Survey of Western Australia's (GSWA) precompetitive geophysics and geochemistry information, and information released as a result of collaborative research projects with Western Australian universities and CSIRO, is being used by explorers to identify exploration targets.

The Co-funded Drilling Program provides refunds of up to 50 per cent of direct drilling costs with caps of $150 000 for a multi-hole project, $200 000 for a single deep hole, and $30 000 for a prospector's project.

The Program, which has significant industry support and is subject to probity audits to ensure a fair and transparent process, will open again for applications in late February 2014 for drilling projects to be undertaken in the 2014–15 financial year.

The Program encourages exploration drilling in areas that have mineral, petroleum or geothermal potential, and results in resource discoveries that will help ensure the future prosperity of Western Australia's resources sector.

Funding for this highly successful scheme, which has seen an increase in Western Australia's ranking as a destination of choice for explorers as measured by the world-renowned Fraser Institute Survey, has been extended until the end of June 2017.

In total, the government is providing $130.27 million to the EIS from 2008–09 to 2016–17.

Information acquired by the companies is publically released on the Department of Mines and Petroleum (DMP) website. This adds to the geological knowledge of the State, and reduces risk for subsequent explorers.

More information about the Co-funded Drilling Program is available at <www.dmp.wa.gov.au/eisdrilling> or contact Margaret Ellis (margaret.ellis@dmp.wa.gov.au).

New book highlights the geology of this unique area

The Geological Survey of WA's (GSWA) new Bulletin on the geology of Shark Bay outlines the results of geological and related research by a multidisciplinary team led by Phil Playford. It includes 436 colour photos and diagrams to illustrate the geology of this spectacular area. Other authors are Anthony Cockbain, Patrick Berry, Anthony Roberts, Peter Haines, and Brendan Brooke.

Shark Bay is divided into two arms of the sea by Peron and Nanga Peninsulas. Drilling has shown that Dirk Hartog Island is underlain by an anticline in Neogene rocks, and the peninsulas are similarly thought to be localized by anticlines. The Zuytdorp Cliffs define the southwest margin of the Shark Bay area, forming a fault-line scarp thought to have resulted from normal faulting during the Pleistocene and perhaps early Holocene.

Most of the land surface of the area is occupied by Holocene sand dunes — massive, seif, parabolic, transverse, barchan, and undulating dunes. Evaporite pans, known locally as 'birridas', are unique features of the area that have developed between transverse sand dunes.

The seawater in Shark Bay can be divided into oceanic, metahaline, and hypersaline salinity realms. As a result of its hypersalinity, Hamelin Pool lacks almost all of the gastropods, bivalves, algae, and seaweeds that grow in the oceanic parts of Shark Bay. As a result, stromatolites are able to thrive there, and have become renowned as the most extensive and diverse examples in the world. One small bivalve, *Fragum erugatum*, also flourishes in Hamelin Pool, because of the presence in its tissues of symbiotic photosynthetic algae that provide their host with energy through the products of photosynthesis.

A characteristic feature of the west coasts of Dirk Hartog, Dorre, Bernier, and Koks Islands, and the mainland coast at Point Quobba, is the occurrence of huge blocks of calcrete, weighing up to 700 t, on top of low coastal cliffs. Comparable blocks also occur along the northwest coasts of Legendre and Barrow Islands, and around the Kimberley coast. These deposits have resulted from the repeated impacts of mega-tsunamis over several thousand years.

Bullletin 146 The geology of Shark Bay is now available online at <www.dmp.wa.gov.au/gswapublications>. Copies of the hard copy book will be available for sale at a cost of $70 (including GST) after its ministerial book launch on 5 February 2014. Details for purchasing will be available from our online bookshop at <www.dmp.wa.gov.au/ebookshop> after that date.

For more information,
contact Phil Playford (phil.playford@dmp.wa.gov.au).

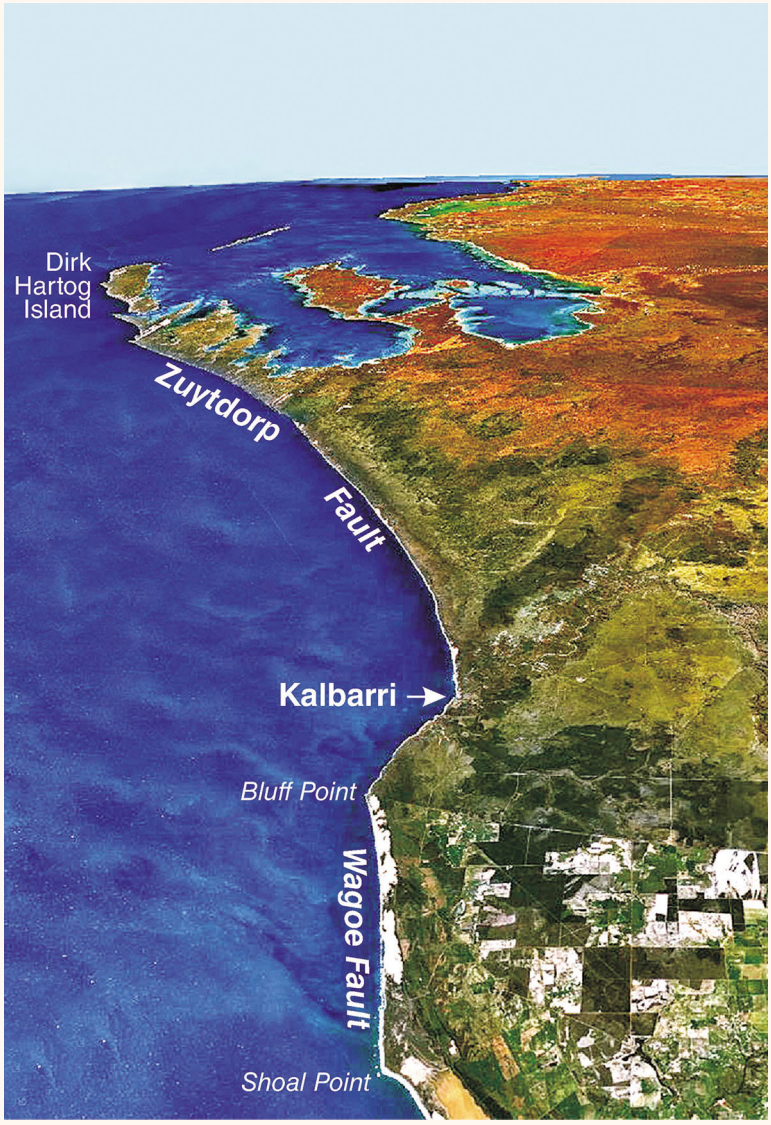


Figure 1. NASA World Wind image looking north over the Wagoe and Zuytdorp Faults towards Shark Bay

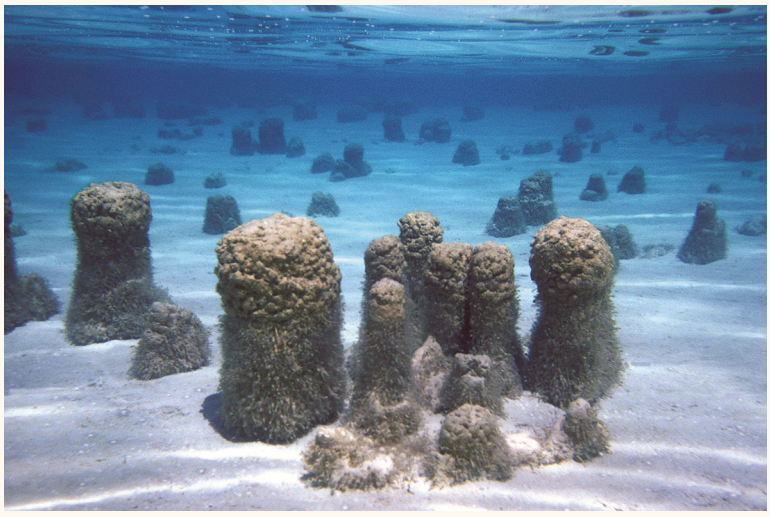


Figure 2. Columnar colloform-mat stromatolites, about 40 cm tall, in water about 1 m deep, beside the southeast coast of Hamelin Pool

Structure, stratigraphy and petroleum prospectivity of the Waukarlycarly Embayment, Canning Basin, Western Australia

The recent GSWA Record 2013/10 has recorded through geophysical interpretations, controlled by sparse geological information, that the Waukarlycarly Embayment (Fig. 1) developed through multi-phased subsidence during the Paleozoic. Initial rifting took place during the Cambrian, followed by rapid subsidence during the Early Ordovician and the Early Permian. This subsidence resulted in the deposition of a sedimentary succession up to about 4 km thick on the magnetic basement within a pair of en echelon half-grabens with opposite polarities. These half-grabens are separated by a median zone of flexure, which has undergone some transpression. The pre-Permian reflective section is divisible into five or six seismic intervals, each equivalent to a supersequence, as defined in the Canning Basin. The section is interpreted to unconformably overlie the acoustically opaque Lower Neoproterozoic Yeneena Basin succession. In the northern part of the southwestern half-graben the top of the acoustic basement is estimated to be up to 3.5 km deep, rising to a depth of about 3 km and 2.6 km respectively in the centre and southern parts of the Embayment. These estimates agree with basement models, using potential field data (Fig. 2).

The pre-Permian succession appears to be stratigraphically equivalent to the Lower Paleozoic section in the northern depocentre of the Samphire Graben, although its lowest part may be of late Ediacaran – early Cambrian age. Multi-phased extension has been the primary control on first-order seismic sequence architecture, and the intervals display disconformable or paraconformable contacts with each other. Thus, at least one Larapintine petroleum system is present in the Embayment. Source rocks were likely to have been deposited at the height of the Middle Ordovician marine transgression along the axis of

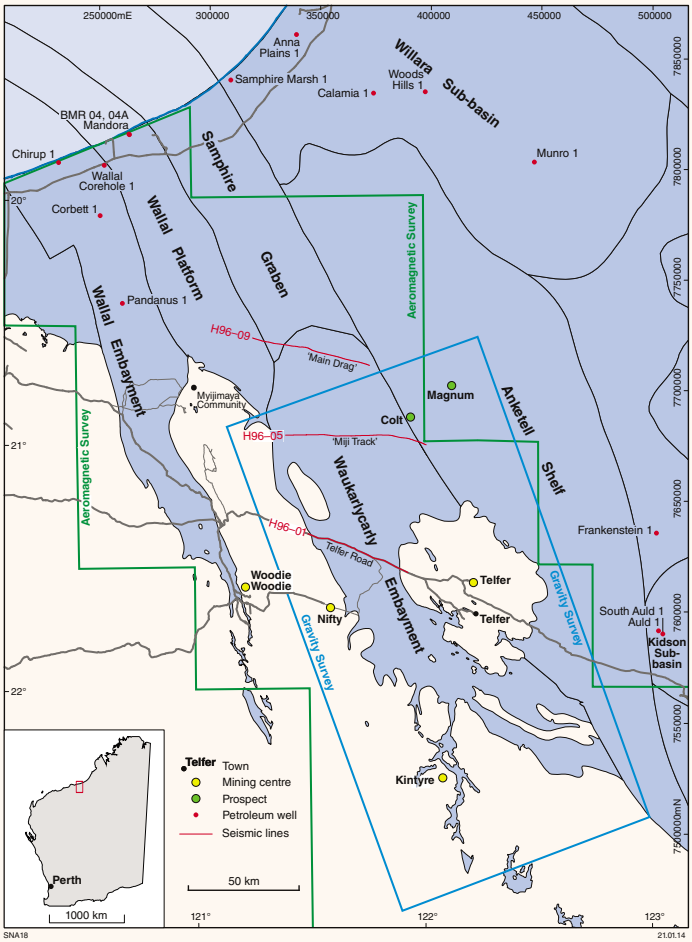


Figure 1. Location of the Waukarlycarly Embayment, petroleum wells, seismic lines and boundaries of high-resolution aeromagnetic and ground gravity surveys used for basement modelling shown in Figure 2

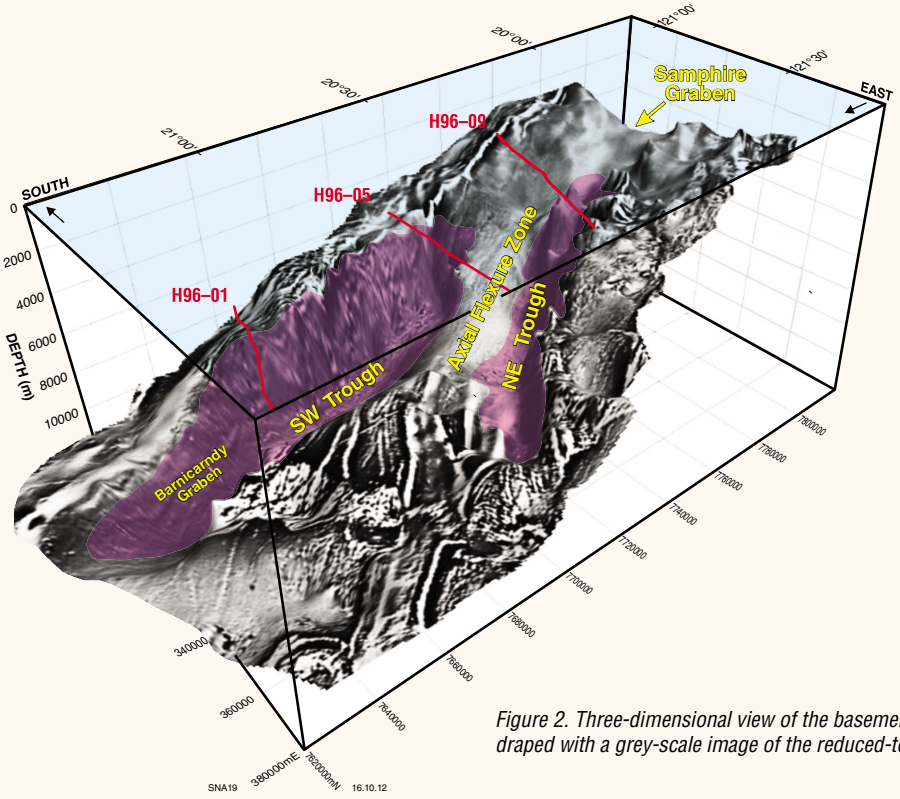


Figure 2. Three-dimensional view of the basement model, looking northwest. The top of the basement is draped with a grey-scale image of the reduced-to-pole total magnetic intensity data.

half-grabens, while reservoir facies were deposited around their margins. Rift-border faults and flower structures may have acted as migration routes or barriers to fluid flow. Possible elevated crustal paleo-heatflow during the early Paleozoic may have improved the chance of source rock maturity. However, the lack of large traps, uncertainty about timing of the charge relative to that of trap formation, and trap integrity degrade the prospectivity of the Embayment.

Record 2013/10 Structure, stratigraphy, and petroleum prospectivity of the Waukarlycarly Embayment, Canning Basin, Western Australia is now available online at <www.dmp.wa.gov.au/gswapublications>.

For more information, contact Norman Alavi (norman.alavi@dmp.wa.gov.au).

New shale plays revive exploration

Production of shale gas in the United States has changed that country's position from a gas importer to potentially, a gas exporter. As a consequence, this has stimulated exploration for shale-gas resources in Western Australia. The search started with Woodada Deep 1 (2010) and Arrowsmith 2 (2011) in the Perth Basin. These wells were used to evaluate shale-gas potential of the Permian Carynginia Formation and the Triassic Kockatea Shale. In addition, Nicolay 1 (2011) and Gibb Maitland 1 (2012) in the Canning Basin were used to evaluate the shale-gas potential of the Ordovician Goldwyer Formation. Estimated total shale-gas potential for these formations is about 288 trillion cubic feet (Tcf).

Other petroleum source rocks include:

- Devonian Gogo and Lower Carboniferous Laurel formations of the Canning Basin
- the Lower Permian Wooramel and Byro groups of the onshore Carnarvon Basin
- the Neoproterozoic shales of the Officer Basin.

The Canning and Perth Basins produce petroleum, whereas the onshore Carnarvon and Officer Basins are not currently producing. However, geochemical data provide evidence for petroleum source rocks, generation, and migration. Exploration is at a very early stage, and more work is needed to estimate shale-gas potential of all source rocks, and to verify estimated resources.

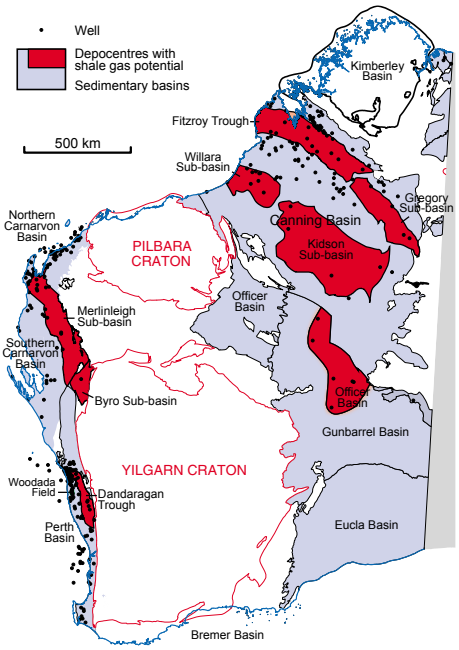


Figure 1. Depocentre with shale petroleum potential

During the last 15 years in the United States, over 102 000 successful gas production wells have been drilled using new drilling and production technologies. These new developments will significantly benefit exploration for shale gas in Western Australia. Western Australian shale-gas plays are stratigraphically and geochemically comparable to producing plays within the Upper Ordovician Utica Shale, Middle Devonian Marcellus Shale, Upper Devonian Bakken Formation, and Upper Mississippian Barnett Shale of the United States. While Western Australia is vastly underexplored, emerging self-sourcing shale plays have revived onshore exploration in the Canning, Carnarvon, and Perth Basins.

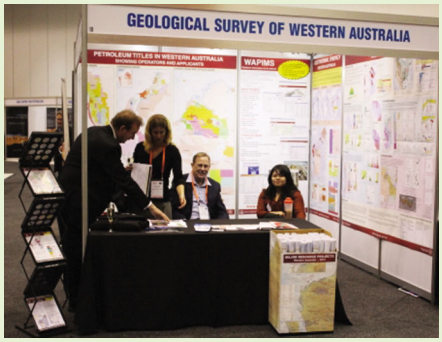
For more information, contact Ameed Ghori (ameed.ghori@dmp.wa.gov.au).

Basins Symposium expands horizons

'Expanding our horizons' was the inclusive theme of the West Australian Basins Symposium (WABS 2013) held at the Perth Convention Exhibition Centre, 18–21 August 2013. A total of 647 delegates representing industry (including both exploration and service companies), government agencies, and universities attended the Symposium. This was the seventh symposium on Western Australian sedimentary basins organized by the WA branch of the Petroleum Exploration Society of Australia (PESA), since the first meeting on the Canning Basin was held in 1984. The Basins and Energy Resources Group within the Geological Survey of Western Australian (GSWA) had a strong presence at the Symposium.

GSWA staff organized a **pre-conference excursion** to the Canning Basin on 12–17 August with 20 participants from companies and government agencies, and a pre-conference short course on petroleum systems and geochemistry on 16 August.

GSWA shared a **booth** with the Department of Mines and Petroleum's (DMP's) Petroleum Division. The booth displayed posters of State acreage release areas, and the shale gas prospectivity of the Canning, Southern Carnarvon, and Perth Basins. Information on exploration was available, and staff provided advice on petroleum tenements. A large display of historical maps and images in the Exhibition Pavilion attracted considerable attention. The display showcased GSWA's history of geological mapping in Western Australia.



Of the 66 oral presentations at the Symposium, 57 are available as papers on DVD. The **DVD containing these papers and posters** is available for viewing in the DMP library on the first floor of Mineral House, or it can be purchased from PESA WA branch (GPO Box T1786, Perth WA 6001) for $110 plus postage.

Four of the papers were authored by Basins and Energy Resources Group staff, who also contributed to two other papers and eight posters. See pages 22–26 of the Conference Handbook for presentations delivered, and pages 28 and 29 for posters prepared by GSWA staff at <www.wabs2013.com.au/pdf/WABS_Conference_Handbook.pdf >.

Gold targeting Atlas establishes strong gold associations

The Geological Survey of Western Australia (GSWA) has just released Report 125 Regional-scale targeting for gold in the Yilgarn Craton: Part 1 of the Yilgarn Gold Exploration Targeting Atlas by WK Witt, A Ford, B Hanrahan, and A Mamuse. This report forms the first part of a three-part Yilgarn Exploration Targeting Atlas (YETA). Parts two and three deal with district-scale and deposit-scale targeting, respectively. Report 125 provides quantitative analyses and assessments of 18 targeting criteria for gold exploration, applicable at the regional scale. The targeting criteria range from well-established targeting techniques such as proximity to regional faults, and fault intersections, to relatively new concepts that include proximity to fault vergence anomalies, domes, and late-stage basins. The Barrick gold deposit database was used to gauge gold endowment. Systematic examination of these regional targeting criteria has produced robust spatial statistics that establish strong associations of gold with the Mafic Group intrusions, regional fault density and regional fault bends. Some other targeting criteria were shown to provide an advantage compared to random exploration, but are less effective than the aforementioned criteria.

The results of this study suggest that the four most effective targeting criteria for gold in the Yilgarn Craton are:

- proximity to intrusions of Mafic Group intrusions
- elevated fault density
- proximity to regional fault bends
- the well-known preference for gold to be found in greenstone belts rather than in intervening areas of granite.

A fuzzy logic approach has been used to combine and weight the results of spatial analyses for these four criteria (Fig. 1). The resulting prospectivity maps demonstrate a good correlation between calculated prospectivity and MINEDEX deposit density (0.78 for the Yilgarn Craton and 0.53 for the Eastern Goldfields Superterrane). For the Eastern Goldfields Superterrane, an additional two targeting criteria (within domes and proximity to late-stage basins) were incorporated into the analysis to generate a prospectivity map. When used alone, the additional targeting criteria provide an advantage over random exploration. However, in combination with the four most effective criteria, they result in a deterioration of the spatial correlation with calculated prospectivity (from 0.53 to 0.28).

The results published in Part 1 of the YETA Atlas will be of interest to all prospectors engaged in gold exploration in the Yilgarn Craton and other provinces where orogenic gold might be expected.

However, the results should be carefully considered before application, in light of the limitations of some of the input data described in Report 125

Report 125 Regional-scale targeting for gold in the Yilgarn Craton: Part 1 of the Yilgarn Gold Exploration Targeting Atlas is now available online at <www.dmp.wa.gov.au/gswapublications>. There is an accompanying zip file which contains an extensive appendix. A USB containing the Report in PDF, appendix, data input and output shape files, and spreadsheets will also be released soon.

For more information,
contact Wally Witt (wally.witt@dmp.wa.gov.au).

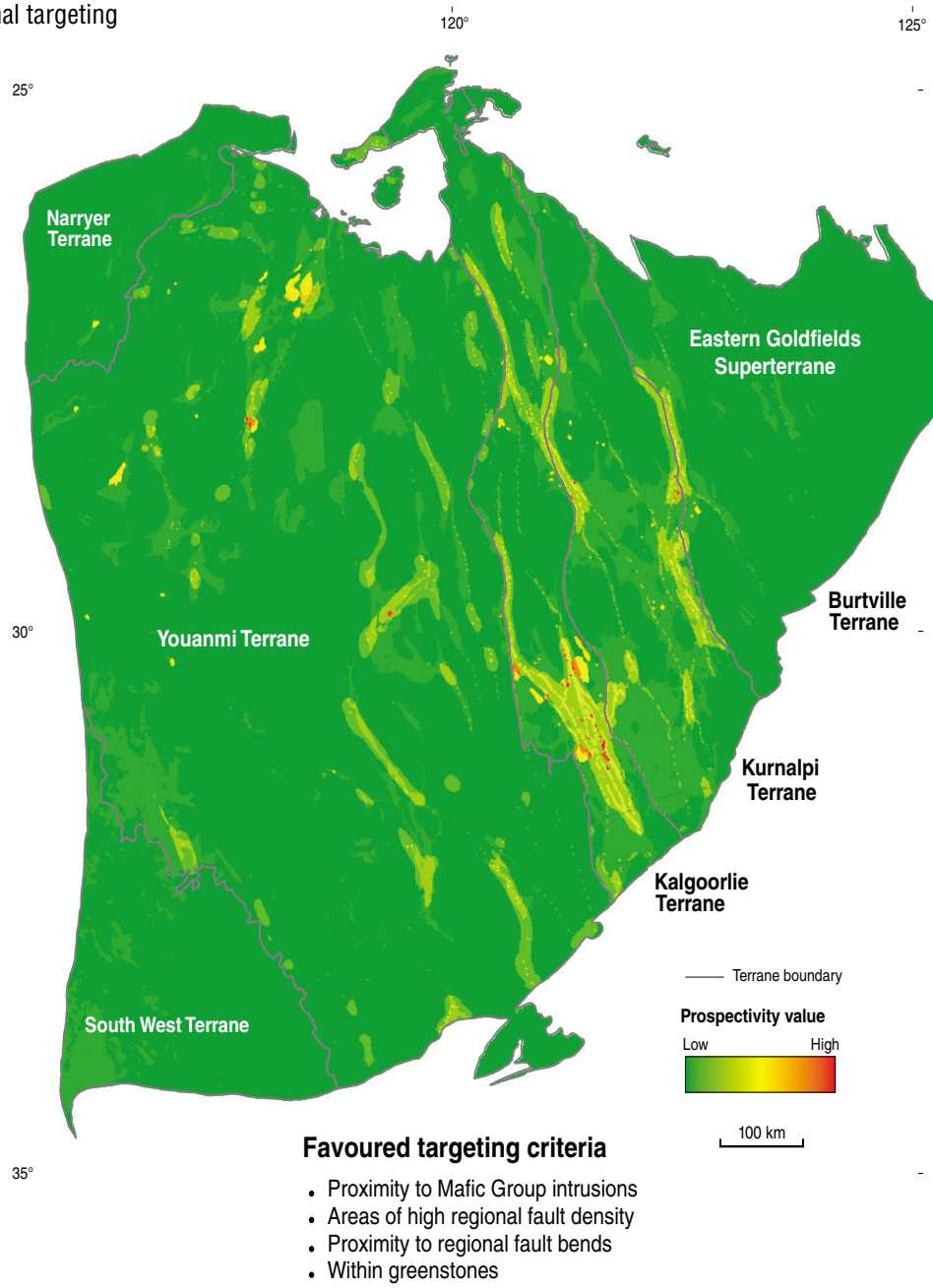


Figure 1. Yilgarn Craton prospectivity analysis using fuzzy logic and four favoured targeting criteria

Migration and impacts of limesand dunes in Western Australia

From August to November 2011, Josefine Bruch from the Dresden University of Technology, Germany, spent a three-month internship at the Geological Survey of Western Australia (GSWA). The internship, called the International Association for the Exchange of Students for Technical Experience (IAESTE), was founded in 1948 at Imperial College, London. IAESTE is an independent, non-profit organization that operates an exchange program for students to gain technical work experience.

Josefine documented the migration of limesand dunes and the factors that govern the migration rate of dunes. Migrating sand dunes pose a risk to existing infrastructure, so knowledge of dune migration rates provides valuable information in terms of resource and geohazard risk management.

The study area was a ca. 270 km-long and 5 km-wide coastal belt within the Perth Basin between Geraldton and Lancelin along the west coast of Western Australia. Due to the size of this area, it was necessary to focus the study on selected localities. The dune areas (all named after nearby locations) chosen for in-depth investigations included Southgate, Cape Burney, Dongara, White Point, Illawong, Coolimba, Green Head (North and South), Sandy Cape, Grey, Wedge Island (East and South), and Lancelin. Each of these sand dune complexes is developed within the Safety Bay Sand of Holocene age (Fig. 1).

The dunes in the area are made up of limesand predominantly comprising calcium carbonate and some magnesium carbonate. The sand is fine to coarse (0.37– 1.46 mm) and originates from the shell fragments of marine organisms (bryozoans, molluscs, foraminifera, and calcareous algae). Morphologically there are two different kinds of dunes in the study area — parallel and parabolic dunes. The parallel dunes formed as the result of drift of sand from offshore onto the beach. Through the recurring action of eolian transport and wave erosion, a series of dunes form parallel to the coastline. These dunes become stabilized by colonizing vegetation with the most stabilized dunes situated furthest inland. Onshore winds erode the dune chains forming gaps or 'blowouts', and result in parabolic dunes consisting of eroded sand. Other causes of erosion are the removal of stabilizing vegetation cover, either by human activity (deliberate burning, livestock grazing) or natural causes (fire, drought). The rate of movement of these parabolic dunes depends on various factors such as direction, frequency and speed of onshore winds, precipitation, temperature, type of vegetation cover, ocean currents, and morphology of the coastline. The convex 'nose' of these parabolic dunes migrates parallel to the direction of the onshore wind, and hence, indicates the prevailing wind direction (Fig. 2).

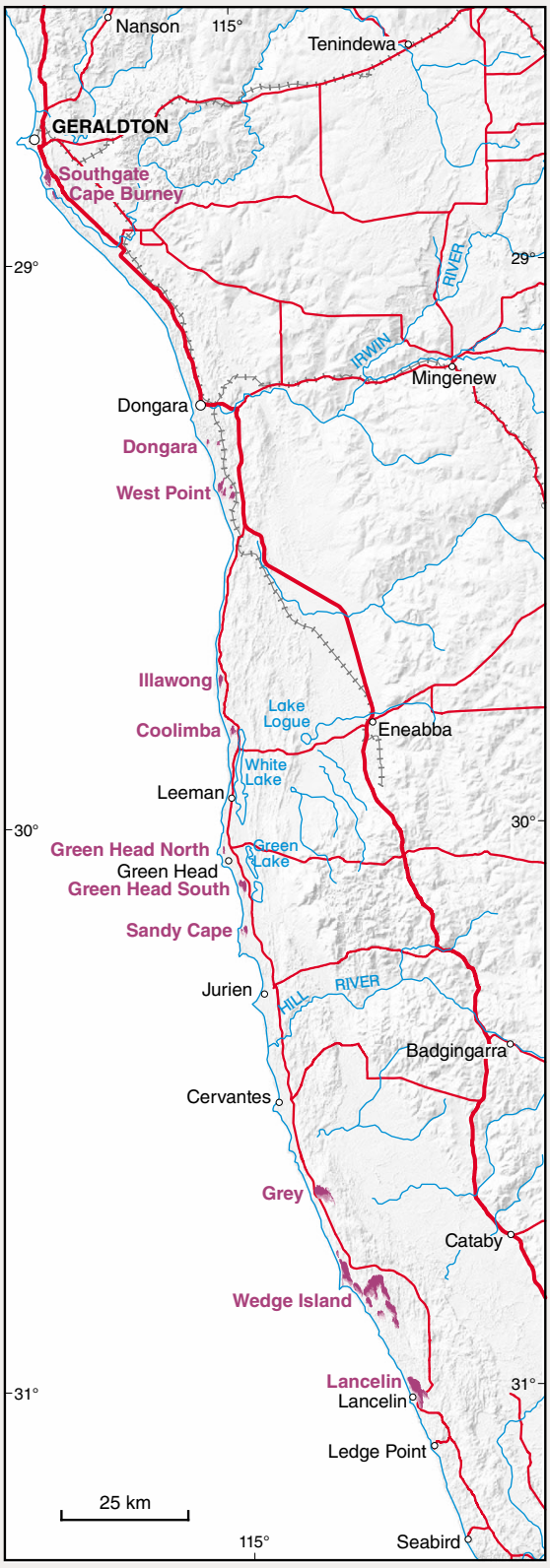


Fig. 1. Location of study area

Methodology

To investigate the migration rate of the limesand dunes in the selected dune areas, the methodology adopted was based on the analysis of data obtained from aerial photographs taken between 1960 and 2010, topographic maps, and Google Earth images. To document the dune movement, the (digitized) photographs, maps and images were analysed using ArcGIS and ArcMap geospatial processing software, which allowed the calculation of the average migration rate and total area of each dune on a year-to-year basis. The principle of this GIS-based approach is illustrated in Figure 3, showing consecutive images of the varying positions and extents of a sand dune between 1960 and 2010. The location and size of the dune for each observation year is summarized in the form of different-coloured polygons in the ArcGIS image.

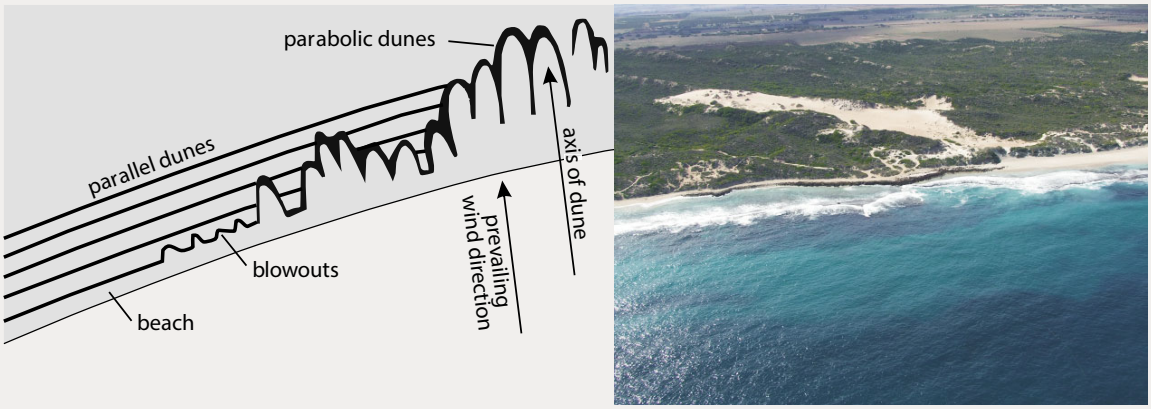


Figure 2. Parallel and parabolic dunes in Western Australia

Results

The results of the geospatial data analysis for each of the selected sand dune areas revealed that the migration patterns throughout the study area are not uniform from area to area. One of the few similarities between individual dune areas is that the prevailing direction of migration of all dunes in the study area is north, as a result of the strong southerly sea breeze. Apart from that observation, a picture of different dune migration patterns emerges for each area.

Calculating migration rates revealed that the dunes in Grey and Wedge Island North, respectively, move fastest in the entire study area, while the dune complex at Dongara East shows the slowest rate of migration. Nevertheless, data analysis of the migration rates across all dune areas shows a generally increasing trend between 1960 and 2010. Most of the dunes, except Dongara East and Coolimba, reached their highest migration rates during the period 2000–10. Illawong moved at a rate of 30.4 m/a between 2002 and 2006. This effect is attributed to lower precipitation during this period, and maxima in temperature during the El Niño years of 2003 and 2006.

Data analysis also revealed a strong positive correlation between dune migration rates and dune sizes. For example, Dongara East, which has the lowest of all migration rates, only measured 13 ha in 2010. Wedge Island East, on the other hand, which split from Wedge Island North during the period 1960–72, is the largest dune in the study area covering 1005 ha.

Impact

The movement of dunes impacts on local infrastructure. In some areas, such as Dongara West, Grey, and Green Head the effects are already visible; driftsand frequently covers the highway network. Other areas such as Southgate are likely to be affected within the next 12 years. Within the scope of resource and geohazard risk management, the principle aims are to:

- slow down or halt the migration of limesand dunes
- prevent the erosion of stabilized parallel dunes which causes mobile parabolic dunes.

These goals can be achieved through a range of measures, including the stabilization of the dune surface with different kinds of artificial materials, revegetation with native plants, mechanical extraction of limesand (limesand mining), and raising public awareness about the damaging impact of human activities in dune areas.

For more information,
contact Bernd Striewski (bernd.striewski@dmp.wa.gov.au) or Josefine Bruch (josefine.bruch@googlemail.com).

Figure 3. Migration of a sand dune (observation period 1960–2010)

Western Capricorn Orogen GIS update includes new maps and Explanatory Notes

ROYALTIES FOR REGIONS
EXPLORATION INCENTIVE SCHEME

The Western Capricorn Orogen: Geological Information Series 2013 is a comprehensive geoscience dataset covering thirty 1:100 000 geological map sheets in the Capricorn Orogen (Fig. 1). Three new map sheets (Lyons River, Mount Sandiman, and Jamindi) have been added since the Western Capricorn Orogen 2012 data release. For the first time, the package contains interactive Explanatory Notes for the Gascoyne Province. All these data can be viewed and queried using GSWA's GeoMap.WA software.

Included in the latest package are whole-rock geochemistry, GSWA field observations, petrography, and geochronology sites and information. There are also geophysical imagery, mineralization sites, and exploration information. The package contains remotely sensed imagery including Landsat satellite imagery, digital elevation model imagery from the Shuttle Radar Topography Mission, and ASTER data which includes 17 scenes extracted from the Statewide dataset released by CSIRO and GSWA in 2011 and 2012.

A major addition to the 2013 update has been the inclusion of interactive Explanatory Notes. These include full descriptions of 194 lithological units of the Gascoyne Province, as well as 19 tectonic events that have affected the Capricorn Orogen. The notes can be accessed through both text- and spatial-based queries of geological units on all polygon and line layers. Advanced search capabilities allow filtering based on geological ages and rock type / lithology. Reports on individual units or events (Unit or Event Report) or on groups of units (Overview Report) can be generated using textual searches. Embedded

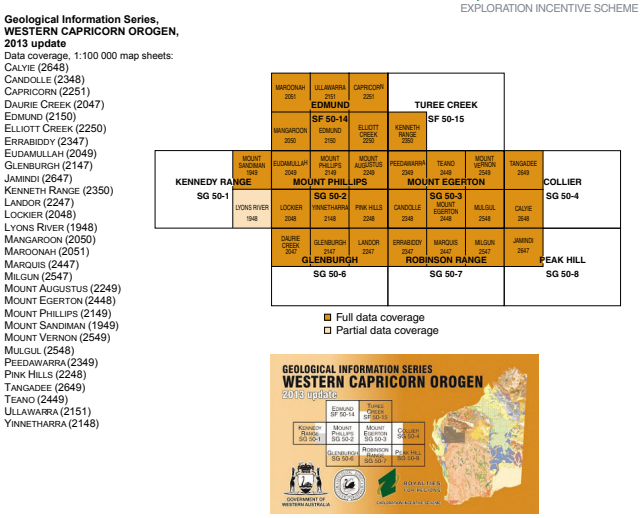


Figure 1. Location of 1:100 000 geological map sheets included in the GIS package

hyperlinks in these reports allow easy navigation to linked units or events, as well as documents such as geochronology reports.

New data in the 2013 update provide background geological information for several gold and base metal centres, including Horseshoe Lights and the Horseshoe Range which are hosted in Paleoproterozoic rocks of the Bryah Group, and Crawford and Cavity Well deposits which are hosted in Paleoproterozoic metasedimentary and igneous rocks of the Gascoyne Province.

For more information,
contact Simon Johnson (simonpaul.johnson@dmp.wa.gov.au).

New database training dates for 2014

The Geological Survey of Western Australia (GSWA) offers FREE training in its databases and online systems. The training is in the form of a presentation with hands-on interaction with most systems.

Topics include:

- navigating the Department of Mines and Petroleum's (DMP) website
- searching for geoscience publications
- finding digital datasets using the Data and Software Centre
- searching for open-file mineral exploration reports using WAMEX
- searching the mineral drillholes and geochemistry databases
- bringing it all together with the interactive map viewer, GeoVIEW.WA and GeoMap.WA, a standalone GIS viewer for Windows.

The morning session will be a basic introduction of how to use all the programs. During the afternoon session, participants will be able to get more in-depth practice using the programs with their own examples, and get some one-on-one advice about individual issues. A hands-on demonstration of the MRT

Software for preparing drilling and sampling data in the correct format for submission to DMP is available on request. The afternoon session assumes competent computer skills. You can attend one or both sessions.

PERTH

Mineral House,
ground floor training room,
100 Plain Street,
East Perth

- Thursday 6 March
- Thursday 12 June
- Thursday 30 October

KALGOORLIE

Goldfields Institute of Technology,
Centre for Engineering and Mining Training (CEMT),
Australian Prospectors and Miners Hall of Fame, Kalgoorlie

- Thursday 13 March
- Thursday 19 June
- Thursday 6 November

REGISTER

To register or find out more details, send an email to <publications@dmp.wa.gov.au> including your details (name, company name, telephone number), and the location and date of the training you wish to attend.
You can also visit <www.dmp.wa.gov.au/training> for updates.

GSWA regional geophysics surveys: January 2014 update

ROYALTIES FOR REGIONS
EXPLORATION INCENTIVE SCHEME

Data downloads

Final data releases from the Geophysical Archive Data Delivery System are available from <www.ga.gov.au/gadds>.

Preliminary and final grids and images from the GSWA website are available from <www.dmp.wa.gov.au/geophysics>.

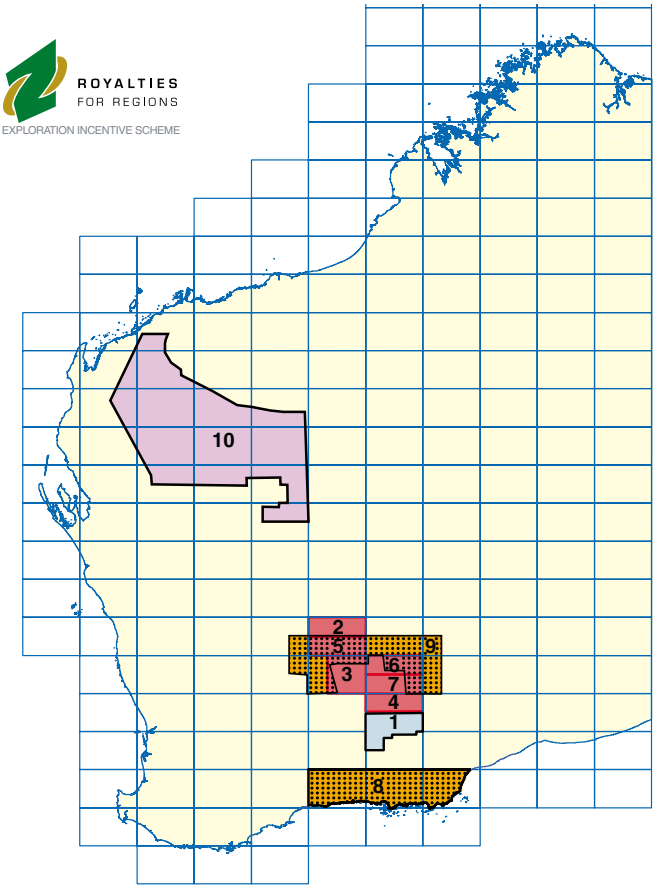
Subscribe to the GSWA eNewsletter for alerts about preliminary and final data release dates.

Airborne magnetic and radiometric surveys
'Goldfields 100 m' program

- Completed (2012–13)
- In progress (2013–14)

Other surveys

- Ground gravity surveys 2013–14
- Airborne EM surveys 2013–14



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

Airborne magnetic and radiometric surveys

ID	Area/Name	Line spacing and direction	Line-km	Contractor	Acquisition Start	Acquisition End	Current Status	Release Status[1] & Date
	2012–13 Program							
1	Widgiemooltha South 2012	100 m E-W	131 000	Thomson	Nov-12	Apr-13	Released	F: 6-Jun-13
	2013–14 Program							
2	Menzies North 2013	100 m E-W	92 000	GPX	Aug-13	Nov-13	Processing	Feb-14*
3	Kalgoorlie East 2013[2]	100 m E-W	122 000	Thomson	Aug-13	Apr-14*	Survey 71%	Jun-14*
4	Widgiemooltha North 2013	100 m E-W	92 000	UTS	Aug-13	Jan-14*	Survey 77%	Apr-14*
5	Menzies South 2013	100 m E-W	92 000	GPX	Nov-13	Apr-14*	Survey 17%	Jun-14*
6	Kurnalpi North 2013[2]	100 m E-W	92 000	Thomson	Oct-13	Apr-14*	Survey 23%	Jun-14*
7	Kurnalpi South 2013	100 m E-W	92 000	UTS	Jan-13	Apr-14*	Contract	Jun-14*

Ground gravity surveys

ID	Area/Name	Station spacing	Stations	Contractor	Acquisition Start	Acquisition End	Current Status	Release Status[1] & Date
8	Esperance 2013	2.5 km grid + 1 km road traverses	7 891	Atlas	Jul-13	Sep-13	Released	F: 24 Oct-13
9	Goldfields 2013	2.5 km grid	8 115	Atlas	Nov-13	Dec-13	Processing	Feb-14*

Airborne reconnaissance EM surveys

ID	Area/Name	Line spacing and direction	Line-km	Contractor	Acquisition Start	Acquisition End	Current Status	Release Status[1] & Date
10	Capricorn 2013 (TEMPEST) [3]	5 000 m; N/S (E/W in part)	29 000	CGG [3]	Oct-13	Jan-14*	Survey 70%	Jun-14*

Notes
*Asterisk indicates an estimated date (month/year) based on delivery information currently available. Subscribe to the newsletter for release alerts.

1. Release Status: F = final; P = preliminary
   (Preliminary releases are made on a case-by-case basis and consist of ecw images and ERMapper grids of partially processed or unchecked data.)
2. Kalgoorlie East and Kurnalpi North surveys have been combined for acquisition efficiency.
3. Contact CGG Aviation (Australia) directly regarding any requests for infill.

Colour legend — **Final data released** — **Prelim release or Final release date set** — **In progress**

Information current at: 5 January 2014

Product releases

Any prices include GST

ISSN 1325-9377 ISBN (PRINT) 978-1-74168-530-5
ISSN 1834-2272 ISBN (PDF) 978-1-74168-529-9

BULLETIN

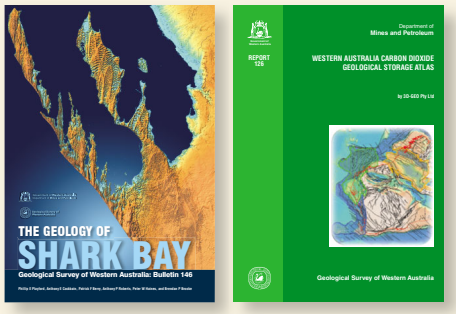
Bulletin 146 The geology of Shark Bay
by Playford, PE, Cockbain, AE, Berry, PF, Roberts, AP, Haines, PW, and Brooke, BP

Available after 5 February. Hard copy is $70; PDF free of charge

REPORTS

Report 125 Regional-scale targeting for gold in the Yilgarn Craton: Part 1 of the Yilgarn Gold Exploration Targeting Atlas
by Witt, WK, Ford, A, Hanrahan, B, and Mamuse, A

Report 126 Western Australia carbon dioxide geological storage atlas
by 3D-GEO Pty Ltd



RECORDS

Record 2013/3 HyLogger-3: Implications of adding thermal-infrared sensing
by Hancock, EA, Green, AA, Huntington, JF, Schodlok, MC and Whitbourn, LB

NON-SERIES BOOKS

GSWA Calendar 2014

Fieldnotes: A Geological Survey of Western Australia Newsletter October 2013 Number 68

GEOLOGICAL SERIES MAP 1:100 000

TAY WA Sheet 3032, 1:100 000 Geological Series map
by Romano, SS

PLATES

The following plates accompany Record 2013/6 Youanmi and Southern Carnarvon seismic and magnetotelluric (MT) workshop (preliminary edition)
by Wyche, S, Zibra, I, Ivanic, TJ, Chen, SF, Korsch, RJ, Wingate, MTD, and Blewett, RS

Plate 1A Geological interpretation of the northwest Yilgarn Craton (map)
by Ivanic, TJ, Zibra, I, Doublier, MP, and Wyche, S

Plate 1B Geological interpretation of the northwest Yilgarn Craton (reference)
by Ivanic, TJ, Zibra, I, Doublier, MP, and Wyche, S

Plate 2 Geological interpretation of the northwest Yilgarn Craton
by Doublier, MP, Romano, SS, and Johnson, SP

Plate 3 Geological interpretation of the Youanmi and Southern Carnarvon seismic lines 10GA–YU1, 10GA–YU2, 10GA–YU3, and 11GA–SC1
by Ivanic,TJ, Zibra, I, Doublier, MP, and Wyche, S

GEOLOGICAL INFORMATION PACKAGE 1:100 000

Western Capricorn Orogen, 2013 update: Geological Information Series

West Musgrave, 2013 update: Geological Information Series

NON-SERIES DIGITAL PRODUCT

Iron ore deposits of the Pilbara — 2013 update
by RW Cooper

Printed publications are available free as PDF files on our website at <http://www.dmp.wa.gov.au/GSWApublications>.
GIS files (ESRI and MAPINFO formats) for all maps published since 1991 are available as a free download from the Data and Software Centre.

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 products on CD, DVD, and USB 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>.