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Fieldnotes

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Western Australia — a top-ranked destination for mineral investment

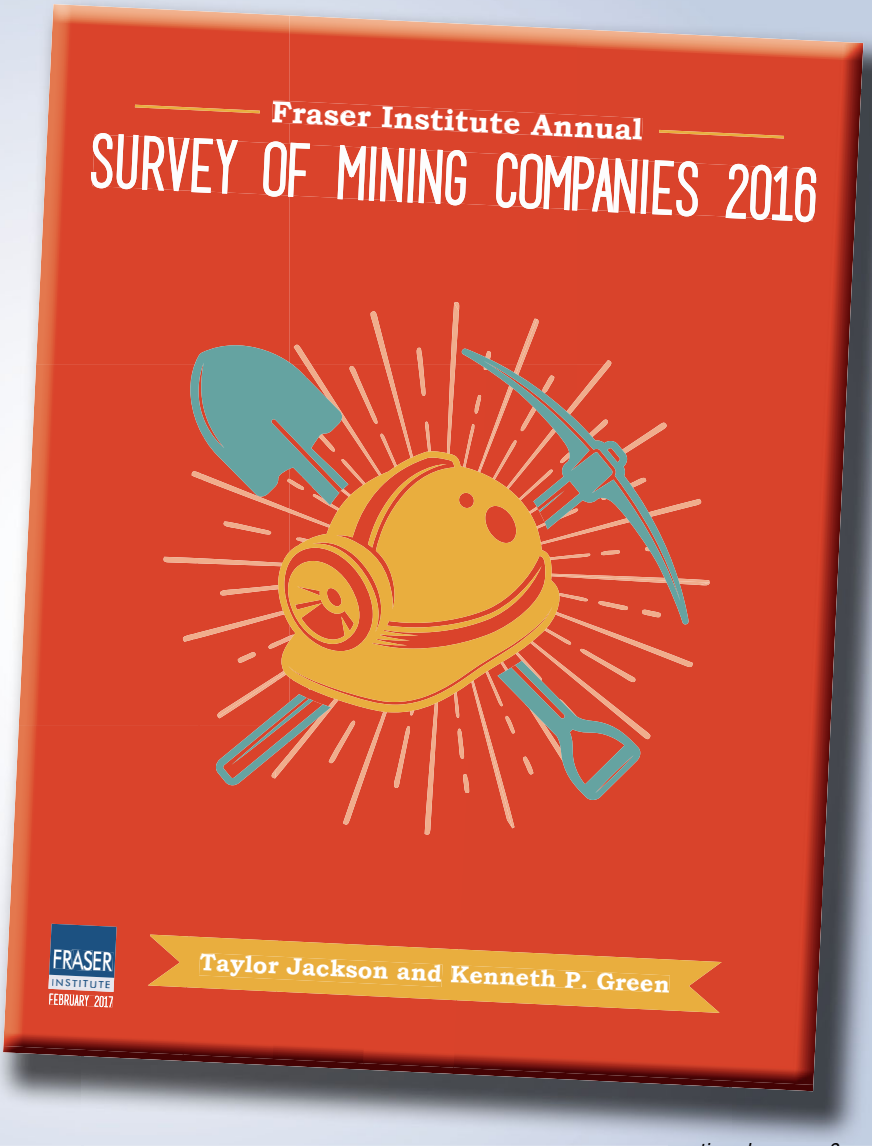
Western Australia once again achieved outstanding rankings in the latest Fraser Institute 2016 worldwide survey of mining companies.

Key results for Western Australia included:

- Third place in the overall Investment Attractiveness Index
- First place in Best Practices Mineral Potential Index
- First place in Geoscience Databases
- Ninth place in Policy Perception Index
- First place in certainty with respect to administration, interpretation and enforcement of regulations.

Western Australia's results in the 2015 and 2016 surveys of mining companies worldwide are the best ever achieved by the State.

The survey was undertaken in late 2016 by the Fraser Institute, an independent, non-partisan Canadian policy think-tank — and the release was timed to coincide with the Prospectors and Developers Association of Canada (PDAC) conference in March 2017 — attended by around 25 000 people. The Fraser Institute ranked 104 jurisdictions, including each of the Australian states and Canadian provinces (Fig. 1). Companies that participated in the survey accounted for exploration expenditure of US$2.7 billion in 2016 and US$3.2 billion in 2015, representing about 35% of estimated global non-ferrous mineral exploration in each of the two years.



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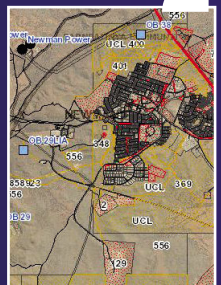
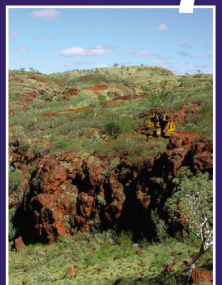
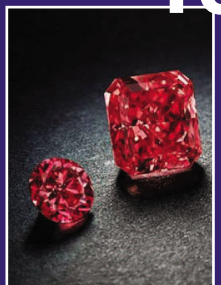
What's inside?







WA Geology revamped

A new version of the WA Geology application was released in February 2017 in time for the GSWA Open Day. WA Geology is an online (GIS-based) mapping system for mobile devices. You can query and view geoscience and resource information of Western Australia and identify the rocks and mineral resources at a given location. The recent upgrade contains the following additional data and functionality:

- 125 layers of information to view, including aerial photograph imagery
- addition of maps and data sources — you can now upload data in CSV, Excel, Shapefiles, File Geodatabase, and KML file formats
- ability to filter the contents of layers using simple search or advanced filter tools
- addition of more search tools to find a mining tenement by holder, search for MINEDEX points by region, or extract data
- addition of drawing and measuring tools to measure distances and area, and plot a map coordinate
- ability to share a project or print a map
- the 'I want to…' button is available
- geolocation was resolved; you can now find, track, and follow your location.

The recent upgrade closes the gap between WA Geology and GeoVIEW.WA. The following functions are not available in WA Geology at the moment:

- GSWA Catalogue search
- WAMEX search
- Drillhole search
- Geochemistry search
- ENS search

To run WA Geology, cut and paste the following link into the web browser of your mobile device: www.dmp.wa.gov.au/WAGeologyViewer.

For more information, contact Neville D'Antoine (neville.d'antoine@dmp.wa.gov.au).

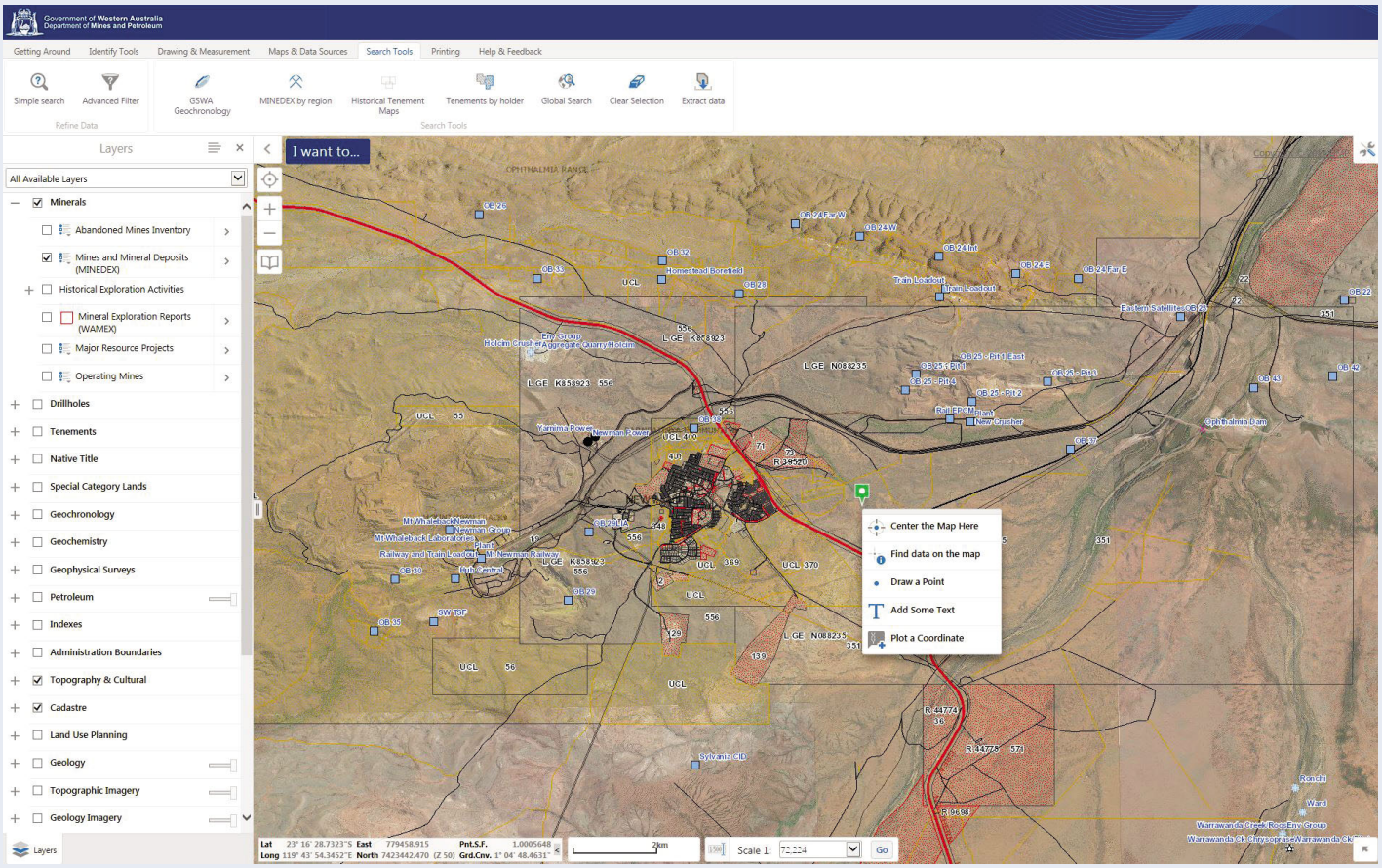


Figure 1. Additional functionality of WA Geology

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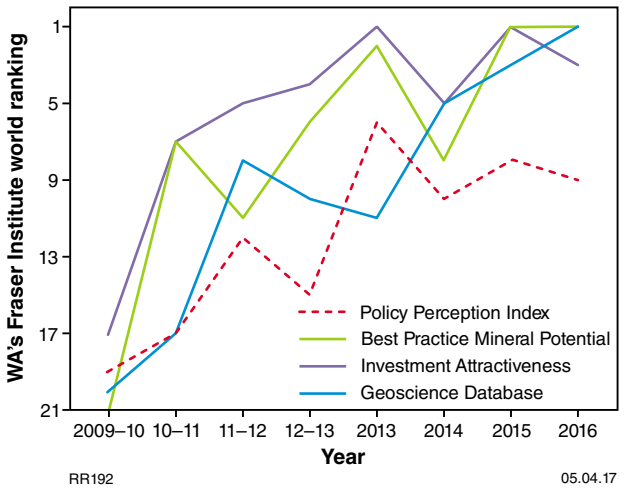


Figure 1. Western Australia's Fraser Institute global rankings since 2009 in the indices for overall Investment Attractiveness, Best Practices Mineral Potential, Policy Perception, and Geoscience Databases

Investment Attractiveness Index: 'Investment attractiveness' is the 'headline' performance measure. Western Australia's absolute score in the Investment Attractiveness Index in 2016 actually improved compared with 2015, but the State was displaced from first to third place in the relative rankings by Saskatchewan and Manitoba (whose absolute scores improved by more). Western Australia's performance is still very strong and the State has been ranked in the top five jurisdictions for six successive years.

The Investment Attractiveness Index is a combination of the Best Practices Mineral Potential Index and the Policy Perception Index which also corresponds to the weightings of factors that survey respondents use in making their investment decisions. As Western Australia's ranking in the Best Practices Mineral Potential Index is high, then Western Australia's ranking in the composite index is also high, but is weighted down by the State's lower ranking in the Policy Perception Index.

Best Practices Mineral Potential Index: this measures the mineral potential of jurisdictions, assuming their policies are based on 'best practices' so is best regarded as rating the region's 'pure' mineral potential or where the geology encourages or does not deter investment. Western Australia, for the second year in a row, ranked the top jurisdiction in the world — a great achievement.

Geoscience Databases: improvement of geoscience data handling within the Department of Mines and Petroleum (DMP) and delivery of that data to industry has been an area of focus over the last eight years of the Exploration Incentive Scheme (EIS). The State's efforts have now been recognized internationally with Western Australia rewarded with its first ranking in global geoscience databases in 2016.

Policy Perception Index: this is another composite measure and represents the extent that government policies encourage or deter exploration and investment from the viewpoint/perception of an exploration manager. Western Australia's Policy Perception Index ranking was ninth globally, down slightly from eighth in 2015 (Table 1).

Another measure where Western Australia was ranked first globally was in **Least uncertainty concerning the Administration, Interpretation and Enforcement of Existing Regulations**.

Western Australia's improvement in investment attractiveness is most welcome and comes at a time when all countries are competing for a share of a reduced pool of equity funding for exploration. The improvement in our State's investment attractiveness is the result of a number of factors including an increased focus on improving approval timelines, a large increase in the amount of pre-competitive geoscience information, and the efforts of a public service that understands resource exploration and development.

For more information, contact Trevor Beardsmore (trevor.beardsmore@dmp.wa.gov.au).

Table 1. Fraser Institute's Policy Perception Index — relative ranking of just the Australian states and territories with respect to each other, since 2006–07. The 2016 relative ranking of the Australian states and territories with respect to the total of 104 jurisdictions ranked by the Fraser Institute for the Policy Perception Index are shown in parentheses in the column for 2016

Fraser Institute ranking	*2006–07*	*2007–08*	*2008–09*	*2009–10*	*2010–11*	*2011–12*	*2012–13*	*2013*	*2014*	*2015*	*2016*
1	SA	SA	SA	SA	SA	NT / WA	WA	WA	WA	WA	WA (9)
2	QLD	TAS	NT	NT	WA	SA	SA	SA	SA	SA	SA (21)
3	TAS	NT	WA	WA	NSW	QLD	NT	NT	TAS	NT	NT (22)
4	VIC	WA	NSW	NSW	NT		VIC	QLD	NT	QLD	TAS (32)
5											QLD (36)
6											VIC (42)
7	WA										NSW (66)

Deep-marine rocks provide a link between the Kimberley and Tanami regions

New mapping and geochronology of the Eastern Zone of the Lamboo Province, Halls Creek Orogen, has led to a revision of the local tectono-stratigraphy. These data suggest an extensive turbidite system existed along the western margin of the North Australian Craton (NAC) linking coeval rocks in the Halls Creek Orogen and Granites–Tanami Orogen.

The Eastern Zone is exposed in the north-northeasterly trending Halls Creek Orogen in the east Kimberley region where it records magmatism, volcanism and sedimentation associated with extension of the western margin of the NAC. The Eastern Zone consists of the possible rift-related 1912–1904 Ma Sophie Downs Suite unconformably overlain by the 1904–1834 Ma Halls Creek Group and intruded by the c. 1835 Ma Woodward Dolerite.

Sedimentation in the Halls Creek Group began with fluvial, lacustrine and broadly shallow-marine rocks (including the newly defined Brim Rockhole Formation), containing detrital zircons dominated by Archean age components. These rocks are unconformably overlain by tidally influenced shallow-marine units with intercalated mafic volcanic rocks. Extension and subsidence of the western margin of the NAC led to deposition of deep-marine volcano-sedimentary rocks in the 1856–1834 Ma Olympio Formation. The Olympio Formation contains detrital zircons dominated by Paleoproterozoic age components indicating a different provenance to most of the underlying shallow-marine and fluvial units. Detrital zircon age components and Hf-isotope compositions suggest a correlation between the Olympio Formation and Killi Killi Formation in the Granites–Tanami Orogen. These data indicate an extensive turbidite system existed on the western margin of the NAC from c. 1856 to 1834 Ma, and the well-constrained timing of sedimentation forms a reference point for regional correlations.

This Report is a collaboration between the Geological Survey of Western Australia, University of Tasmania, Geoscience Australia and The University of Western Australia.

Report 164 Geology of the Eastern Zone of the Lamboo Province, Halls Creek Orogen, Western Australia is available as a free download from DMP's eBookshop at <www.dmp.wa.gov.au/ebookshop>.

For more information, contact Chris Phillips (christopher.phillips@dmp.wa.gov.au).

Figure 1. Tightly folded metadolomite, dolomitic metasandstone and dolomitic metasiltstone in the Brim Rockhole Formation. Photograph taken north of the Brim Anticline, looking south

Historical Paleontology Reports now available online

The Geological Survey of Western Australia (GSWA) is the custodian of more than 100 years of paleontological data, including publications and physical collections. A key part of this legacy dataset is the GSWA Paleontology Reports, which represent nearly 40 years of biostratigraphic research across Western Australia.

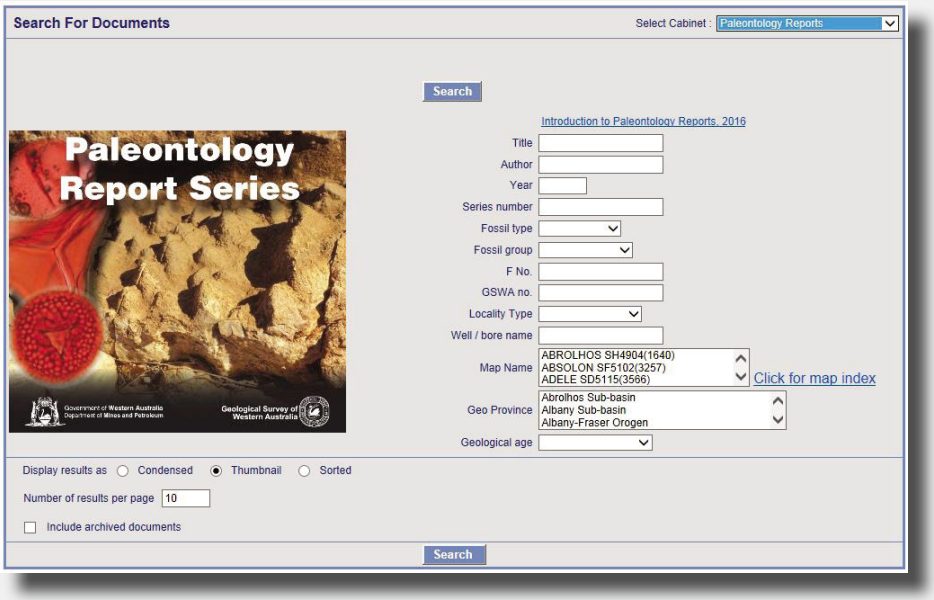
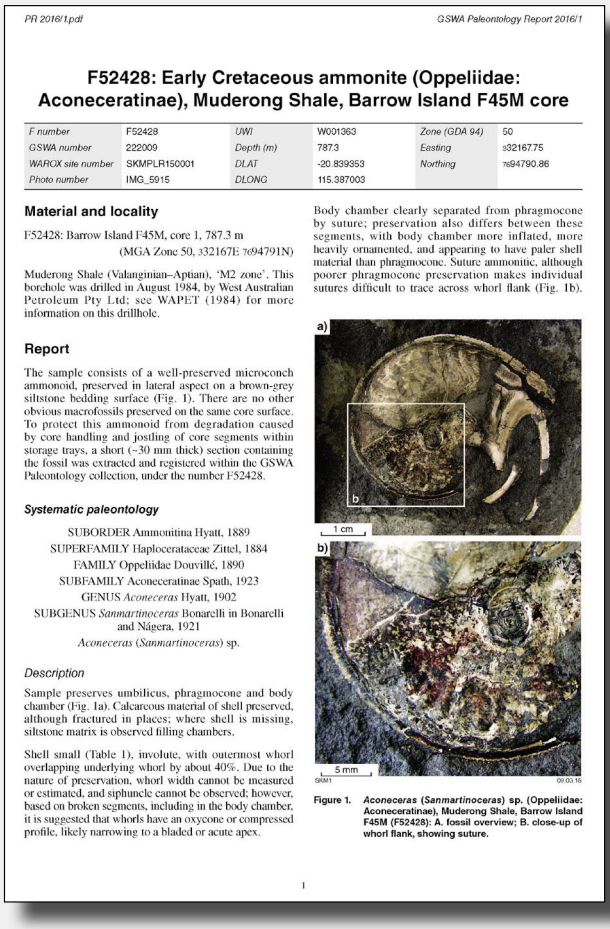


Figure 1. Online search page for GSWA Paleontology Reports

A total of 1818 reports were written by GSWA paleontologists between 1962 and 2000, covering a wide range of geological ages, fossil groups, and geographic regions. Included are reviews listing all described taxa within Western Australia (at the time of compilation) for each geological era or period, of which only the Permian volume was formally published. Originally intended only for departmental use, the reports were never formally typeset, resulting in some inconsistencies in spelling and style. Despite this variability in presentation, the basic data contained in the reports remain a valuable resource for paleontological and biostratigraphic studies across the State, including onshore petroleum and mineral exploration studies. Further value is added by the curation of most reported samples within the GSWA Paleontology collection, allowing material to be reinterpreted if required.

The Paleontology Reports were previously scanned and made available as a digital data package in 1996; however, many of the original scans were of poor quality. To improve the accessibility of this information, the legacy Paleontology Reports were recently rescanned at high resolution using optical character recognition, or were manually retyped where the original report was difficult to read. The reports are now available as free downloads through the Department of Mines and Petroleum (DMP) website, using the same digital publication platform used by GSWA to deliver Records, Reports, and other documents (Fig. 1). As of early 2017, the legacy reports are only accessible via this text-based search page, with plans for spatial searching using GeoVIEW.WA in the near future.


PR 2016/1.pdf GSWA Paleontology Report 2016/1

F52428: Early Cretaceous ammonite (Oppeliidae: Aconeceratinae), Muderong Shale, Barrow Island F45M core

F number	F52428	*UWI*	W001363	*Zone (GDA 94)*	50
GSWA number	222009	*Depth (m)*	787.3	*Easting*	332167.75
WAROX site number	SKMPLR150001	*DLAT*	-20.839353	*Northing*	7694790.86
Photo number	IMG_5915	*DLONG*	115.387003		

Material and locality

F52428: Barrow Island F45M, core 1, 787.3 m (MGA Zone 50, 332167E 7694791N)

Muderong Shale (Valanginian–Aptian), 'M2 zone'. This borehole was drilled in August 1984, by West Australian Petroleum Pty Ltd; see WAPET (1984) for more information on this drillhole.

Report

The sample consists of a well-preserved microconch ammonoid, preserved in lateral aspect on a brown-grey siltstone bedding surface (Fig. 1). There are no other obvious macrofossils preserved on the same core surface. To protect this ammonoid from degradation caused by core handling and jostling of core segments within storage trays, a short (~30 mm thick) section containing the fossil was extracted and registered within the GSWA Paleontology collection, under the number F52428.

Systematic paleontology

SUBORDER Ammonitina Hyatt, 1889
SUPERFAMILY Haplocerataceae Zittel, 1884
FAMILY Oppeliidae Douvillé, 1890
SUBFAMILY Aconeceratinae Spath, 1923
GENUS *Aconeceras* Hyatt, 1902
SUBGENUS *Sanmartinoceras* Bonarelli in Bonarelli and Nágera, 1921
Aconeceras (*Sanmartinoceras*) sp.

Description

Sample preserves umbilicus, phragmocone and body chamber (Fig. 1a). Calcareous material of shell preserved, although fractured in places; where shell is missing, siltstone matrix is observed filling chambers.

Shell small (Table 1), involute, with outermost whorl overlapping underlying whorl by about 40%. Due to the nature of preservation, whorl width cannot be measured or estimated, and siphuncle cannot be observed; however, based on broken segments, including in the body chamber, it is suggested that whorls have an oxycone or compressed profile, likely narrowing to a bladed or acute apex.

Body chamber clearly separated from phragmocone by suture; preservation also differs between these segments, with body chamber more inflated, more heavily ornamented, and appearing to have paler shell material than phragmocone. Suture ammonitic, although poorer phragmocone preservation makes individual sutures difficult to trace across whorl flank (Fig. 1b).

a)
b
1 cm
b)
5 mm
SAM1
01.03.16

Figure 1. ***Aconeceras (Sanmartinoceras)*** **sp. (Oppeliidae: Aconeceratinae), Muderong Shale, Barrow Island F45M (F52428): A. fossil overview; B. close-up of whorl flank, showing suture.**

1

Figure 2. The new series of GSWA Paleontology Reports

Along with the online release of legacy Paleontology Reports, a new series of Paleontology Reports is also being launched (Fig. 2). These reports are intended to present new basic paleontological data, particularly materials or sites related to active GSWA projects. The first of these reports was published in 2016 and is available via the Paleontology Report search page.

Access to the Paleontology Reports search page, and general information on paleontological and biostratigraphic studies at GSWA, is available at <www.dmp.wa.gov.au/Paleontology>.

For more information, contact Sarah Martin (sarah.martin@dmp.wa.gov.au or paleontology@dmp.wa.gov.au).

Developing an Explorer's Tool Kit

Rising iron ore prices from 2007 to 2011 impelled exploration for banded iron-formation (BIF)-hosted iron deposits in Western Australia beyond the main mining centres of the Hamersley Basin, to the smaller but high-grade (>55 wt% Fe) iron ore deposits in the Yilgarn and Pilbara Cratons. Genetic models for BIF-hosted iron deposits were initially strongly influenced by studies in the Hamersley Basin, but more lately incorporated results from the Yilgarn Craton. Now the iron deposits of the Pilbara Craton (Fig. 1) have been examined, providing a statewide perspective on iron ore styles and genesis. This latest work documented the characteristics of the Pilbara iron deposits, developed models for their genesis, and identified exploration tools for their discovery.

The Pilbara Craton contains about 11% of Western Australia's reported iron resources, the bulk occurring in primary BIF and supergene-enriched BIF-hosted iron deposits. Primary magnetite iron deposits have most of the estimated resources, but the higher recovery costs from fine grinding commonly render them subeconomic. Supergene-enriched BIF deposits are higher grade and the preferred target for exploration. The main hosts to these deposits are the BIF of the 3022–3016 Ma Cleaverville Formation. These BIF are relatively thick (up to 1 km) and more iron rich (31–39 wt% Fe) compared with BIF units in the Pyramid Hill, Paddy Market and Cardinal Formations. The BIF-hosted iron deposits mostly occur where BIF is thickened in kilometre-scale fold hinges and are intersected by shear zones or fault zones (e.g. Corunna Downs, Wodgina, and Pardoo districts). Intense hypogene alteration along these shear/fault zones produced narrow (<10 m wide), steeply dipping magnetite ± hematite ± quartz mineralized zones in which primary iron contents were upgraded to 37–55 wt% Fe (Fig. 2a). These hypogene iron deposits are mostly still subeconomic, with Wodgina being a notable exception (Fig. 2b). Hypogene iron zones are overprinted by broader and higher grade supergene goethite ± martite mineralization that extend from surface to depths of about 100 m. Supergene-altered BIF is chemically distinct from primary BIF, being relatively enriched in Fe, loss on ignition content, P, Zn, and Ni and depleted in SiO_2. Other geochemical trends, such as possible enrichments in Cu, Co, As, Mn, Ca, Mg, Pb, U and Ba, are district-specific and appear to depend on the extent of fluid interaction with neighbouring country rocks (e.g. shales, mafic or ultramafic rocks). Oxidation of magnetite in supergene goethite–hematite deposits (Fig. 2c) caused demagnetization that is evident in first vertical derivative aeromagnetic data.

The origin of Pilbara BIF-hosted iron deposits begins with deposition of the Cleaverville Formation BIF within the Gorge Creek Basin at c. 3020 Ma, followed by fold-thickening and localized shearing and hypogene fluid flow along fold limbs during the c. 2950–2940 Ma North Pilbara Orogeny, to produce narrow hypogene magnetite-rich mineralized zones. Supergene enrichment of BIF by meteoric fluids took place from c. 70–50 Ma when northern Western Australia was located at higher latitudes and experienced a wet climate. Northern Western Australia's subsequent shift to lower latitudes and a semi-arid, strongly seasonal climate translated to restriction of supergene fluids to centralized fault pathways in BIF and, hence, less extensive supergene alteration zones.

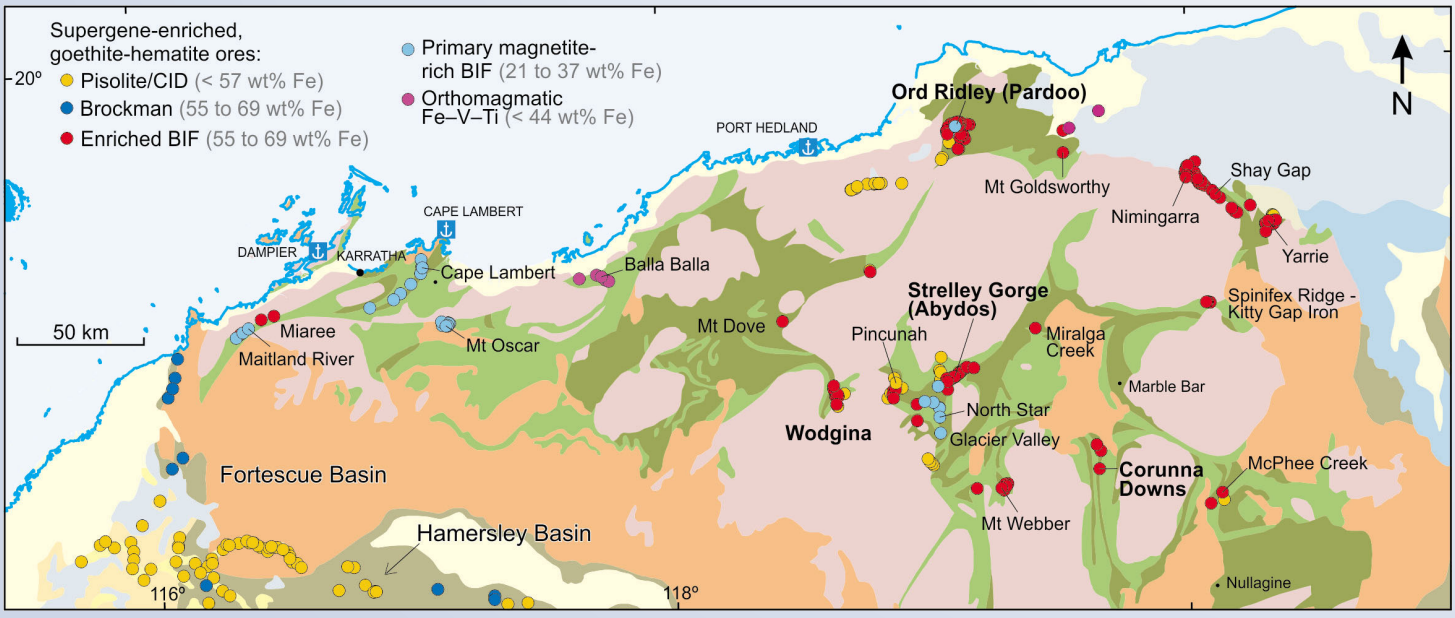


Figure 1. Iron deposit styles in the northern half of the Pilbara Craton. Iron occurrences are sourced from DMP's MINEDEX database, June 2016. Geology is sourced from the 1: 2.5 million 2016 geological map of Western Australia. Green polygons represent greenstone belts and pink polygons indicate granites. Other colours represent Proterozoic and Phanerozoic rocks that surround the Pilbara Craton

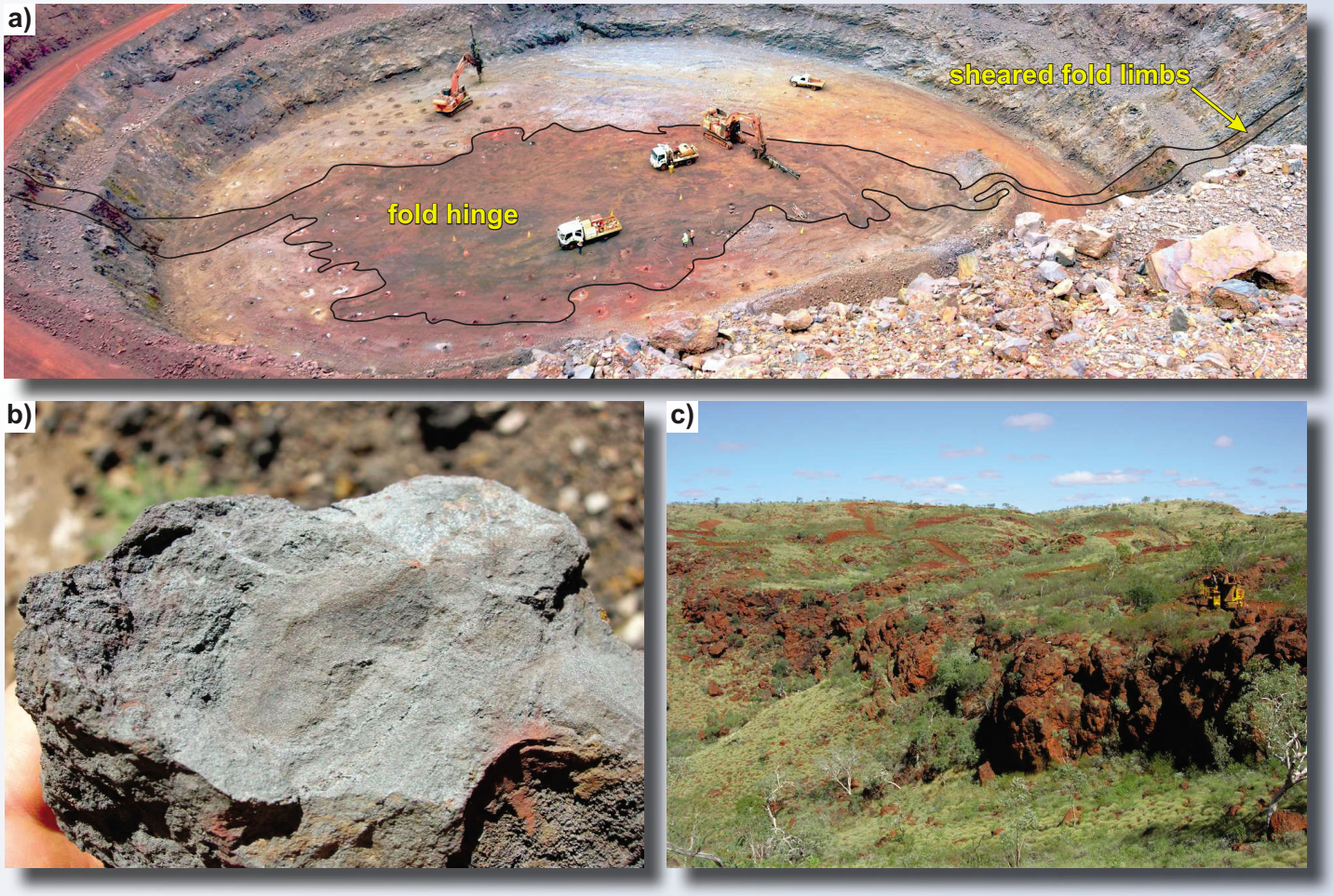


Figure 2. Examples of supergene-modified hypogene and supergene mineralization in the Pilbara Craton: a) Alice Extension pit in the Pardoo camp showing a folded hypogene magnetite-rich orebody that is overprinted by supergene goethite–martite alteration; b) hand specimen of supergene goethite ± martite ore from the Anson pit in the Wodgina camp; c) near-surface, >20 m-thick, subhorizontal layer of high-grade supergene goethite ± martite mineralization at the Corunna Downs prospect

An iron ore exploration strategy for the Pilbara Craton, therefore, requires the integration of mapping, geochemical, and geophysical data. Mapping using remote sensing and field observations can identify fold hinges and intersecting damage zones that thickened BIF and provided mineralizing fluid pathways to localize hypogene magnetite mineralization that may form standalone deposits. Interpreting geochemical gradients in a district will first require establishing baseline chemistry for BIF and country rocks. Chemical variations away from these baseline signatures are potentially useful vectors to deposits within that particular district. Coincident demagnetized zones and gravity lows may correspond with supergene cavity- and goethite-rich deposits, but should be validated with mapping and geochemical data to avoid false-positive exploration targets.

The new understanding of Pilbara BIF-hosted iron ore genesis guides the collection of exploration data, but can also be improved as exploration progresses. As for the Hamersley Basin and Yilgarn Craton, the greatest opportunity for new discoveries of iron ore in the Pilbara lies in detecting covered deposits, which will most likely be accomplished by testing conceptual targets derived from the new mineral systems model and tested by drilling and remote exploration data.

This study was a collaborative project coordinated by the Minerals Research Institute of Western Australia (MRIWA), involving Atlas Iron Ltd Pty, the Centre for Exploration Targeting (CET) at The University of Western Australia, RWTH Aachen University, and the Geological Survey of Western Australia (GSWA).

The outcomes from this project have been published in **Report 163 MRIWA Report Project M426: exploration targeting for BIF-hosted iron deposits in the Pilbara Craton, Western Australia**, which is available for download from the DMP eBookshop at <www.dmp.wa.gov.au/eBookshop>.

For more information, contact Paul Duuring (paul.duuring@dmp.wa.gov.au).

Status of regional aerogravity surveys in Western Australia

Data from the 38 000 line-km East Kimberley 2016 regional aerogravity survey were released on 23 February 2017. The survey area covers some 84 000 km^2 and encompasses much of the Halls Creek Orogen and parts of younger basins to the north and east (Fig. 1).

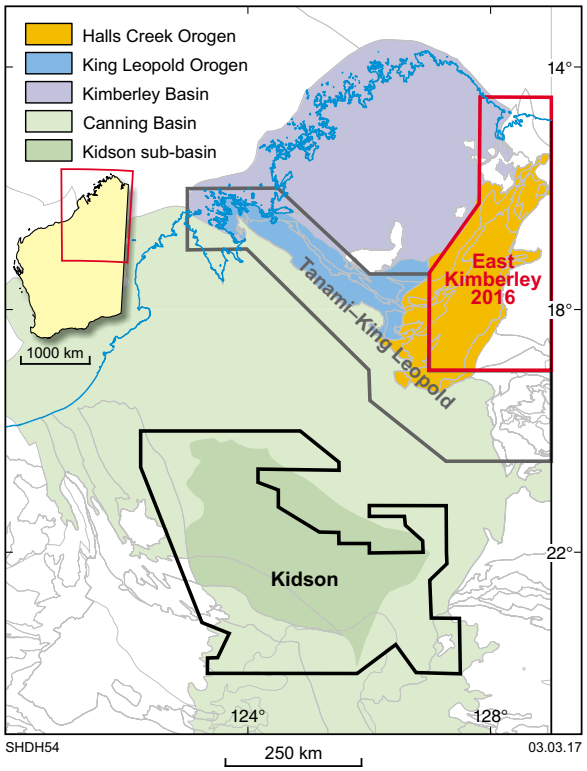


Figure 1. Location of aerogravity surveys

The survey was funded as part of the Government of Western Australia's Exploration Incentive Scheme (EIS). It was the first airborne gravity survey to be contracted by the Geological Survey of Western Australia (GSWA) and Geoscience Australia (GA) as part of the Western Australia Reconnaissance Gravity Project. The data were acquired by Sander Geophysics Ltd over a period of eight weeks between 8 October and 4 December 2016.

Survey lines were flown east–west at 2.5 km line spacing (25 km tie-lines) at a nominal height of 160 m above ground level. With an along-line spatial wavelength resolution of 5 km, the survey configuration provides equivalent 2D spatial resolution with the 2.5 km grid of ground data that have been acquired from helicopter-assisted surveys in the southern and western parts of Western Australia since 2009. The precision (repeatability) of the Bouguer gravity data after filtering with a 100 second low-pass filter is 0.54 mGal — estimated from 18 separate passes along a 50 km test line.

A data package including georeferenced images and the operations report is available from <geodownloads.dmp.wa.gov.au/downloads/geophysics/71156.zip>. Located data and grids can also be downloaded from the Australian Geophysical Archive Data Delivery System at <www.ga.gov.au/gadds>.

The located dataset at 2 Hz (about 25 m samples) includes unfiltered and uncorrected raw gravity — gravimeter acceleration minus aircraft acceleration — so that users can apply their own corrections and filters.

The new data have been incorporated into the WA State gravity 400 m-cell compilation grid that is available from <www.dmp.wa.gov.au/geophysics>. Figure 2 shows the added resolution of the new airborne data in 'before-and-after' images.

GSWA and GA are planning two new aerogravity surveys also at 2.5 km line spacing for implementation in the 2017 flying season between May and October with data release anticipated for early 2018. The following proposed survey areas are shown in Figure 1:

- The Tanami–King Leopold project area of about 110 000 km^2 (50 000 line-km) in the southern Kimberley, contiguous with the East Kimberley survey area and extending from the Billiluna region near the border with the Northern Territory to Derby in the west
- The Kidson project area of about 155 000 km^2 (70 000 line-km) over the Kidson sub-basin in the central Canning and covering parts of the Gibson and Great Sandy Deserts.

Program plan updates are published at <www.dmp.wa.gov.au/geophysics>.

For more information, contact <geophysics@dmp.wa.gov.au>.

This info-item also appears in ASEG Preview Issue #187, April 2017.

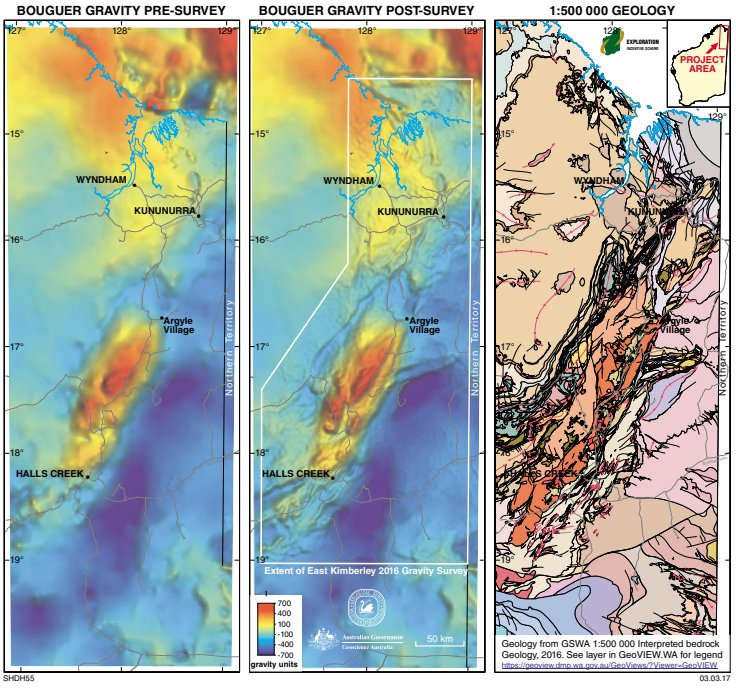


Figure 2. East Kimberley aerogravity survey results

Updated gravity compilation map for Western Australia

An updated gravity compilation map for Western Australia is now available. This dataset combines onshore Bouguer gravity anomalies with offshore free-air gravity anomalies for Western Australia (Fig. 1a).

Ground data over the continental region has been extracted from the Australian National Gravity Database (ANGD). The ground data has been merged with 13 publicly available airborne vertical gravity (AG) and airborne gravity gradiometer (AGG) surveys acquired at various line spacings. These include the recently flown Geological Survey of Western Australia/Geoscience Australia (GSWA/GA) East Kimberley 2016 regional airborne gravity survey, acquired at a line spacing of 2.5 km and covering an area of approximately 84 000 km^2 (Fig. 1b).

The latest 400 m grid in ER Mapper format, along with geo-referenced images in JP2 and KMZ formats, is available for download from <www.dmp.wa.gov.au/geophysics>.

For more information, contact John Brett (john.brett@dmp.wa.gov.au).

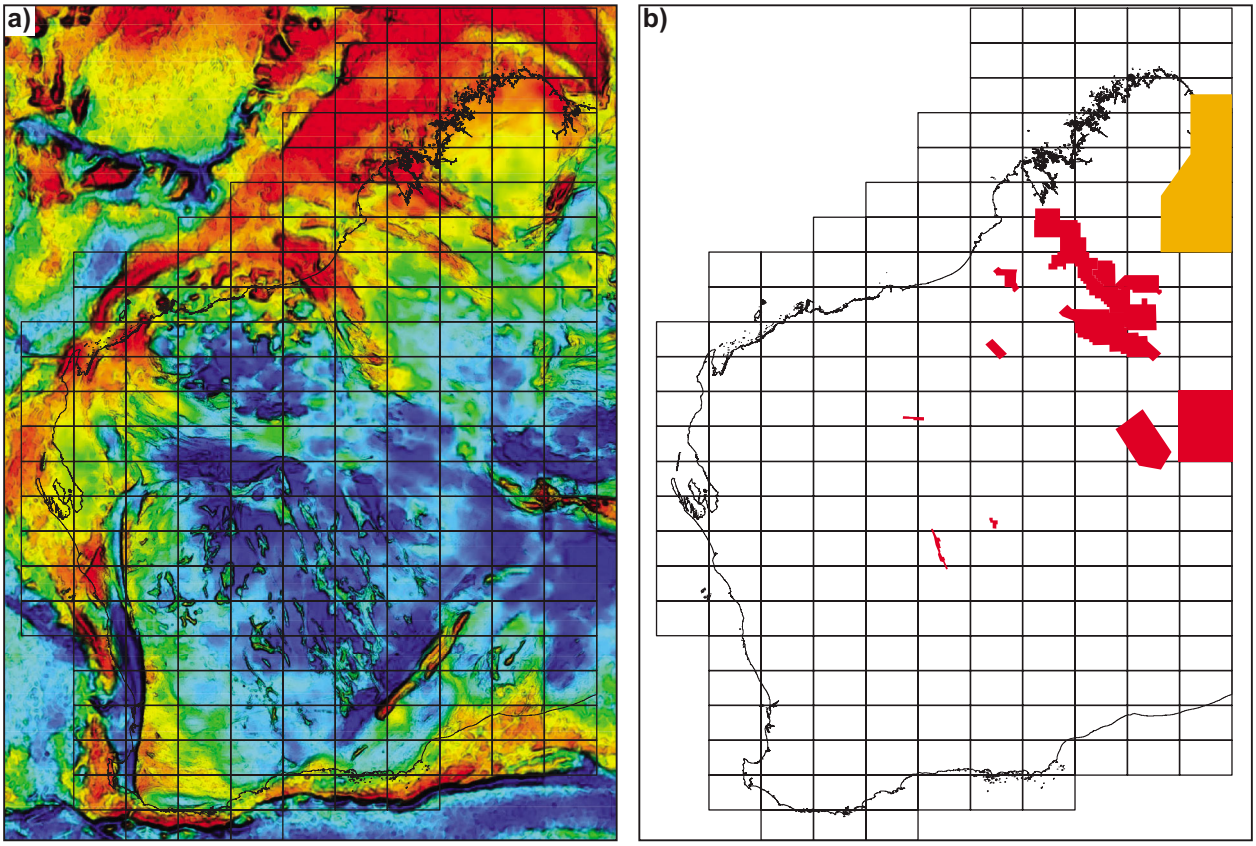


Figure 1. Gravity compilation: a) image of 400 m compilation gravity grid of Western Australia; b) publicly available AG and AGG surveys included in the compilation (East Kimberley 2016 AG survey shown in orange)

GSWA online database training

Find out how to access geoscience data online and understand our systems at this **FREE** training course. Systems include:

• WAMEX • GeoVIEW.WA and WA Geology online • GeoMap.WA • TENGRAPH Web • Data and Software Centre • Mineral drillholes and geochemistry databases • Department of Mines and Petroleum's (updated) website

For more information go to <www.dmp.wa.gov.au/training>.

Perth

Two sessions: **mining companies/geologists** (morning), and **prospectors** (afternoon).

- **Thursday 1 June**
- **Thursday 26 October**

Kalgoorlie

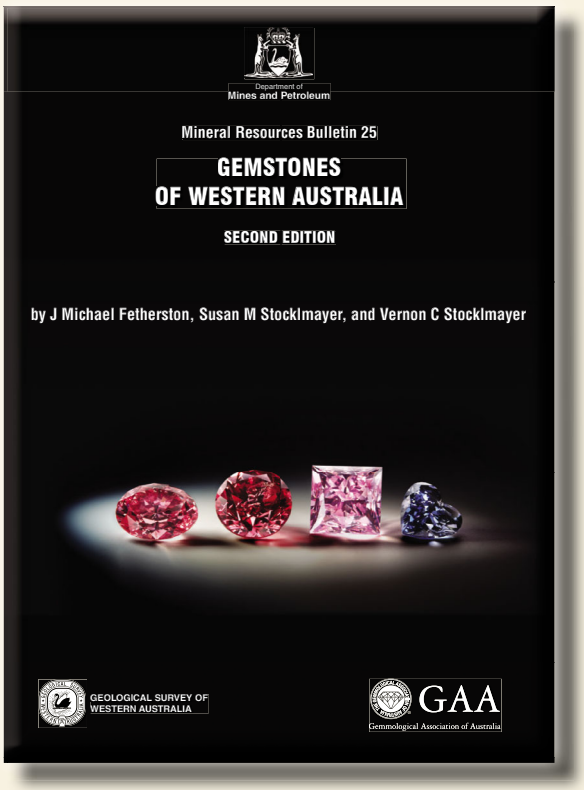
- **Thursday 8 June**
- **Thursday 16 November**

To register send an email to **publications@dmp.wa.gov.au** including your name, company, telephone number, with the location and date of the training you wish to attend. For the Perth session, please indicate whether you wish to attend the prospector or mining geologist training.

Second edition of Gemstones of Western Australia now available

Since the discovery of diamonds in the Kimberley region of Western Australia, the mining and processing of these precious gems has developed into one of the State's major industries. Less well known is that Western Australia contains a plethora of other gemstones, decorative stones and ornamental stone used for sculptural purposes.

A collaborative project between the Geological Survey of Western Australia (GSWA) and the Gemmological Association of Australia (GAA) produced Mineral Resources Bulletin 25 Gemstones of Western Australia in 2012. This publication systematically organized and discussed the history and quality of virtually all known occurrences of gemstones and ornamental stones in Western Australia. This Bulletin forms the first major work on the subject of gemstones found in the State.



Blue lepidolite mica interspersed with white albite feldspar and grey quartz, Carlaminda Blue quarry, Yalgoo area (courtesy Glenn Archer)

Faceted rare and valuable fancy red diamonds from the Argyle Diamond Mine (© Rio Tinto 2014)

The second edition of Gemstones of Western Australia is an updated version published in 2017 in response to public demand following depletion of copies of the 2012 edition.

What is in the revised book?

The second edition has been updated and expanded to include additional occurrences of emerald, opal, agate, chalcedony, organic gems, tiger eye jasper, aragonite, cordierite, black jade, mookaite, fuchsite, jasper, Munjina and Print stones, together with numerous, new and colourful gemstone images.

How to access the book

A printed copy of **Mineral Resources Bulletin 25 Gemstones of Western Australia second edition** by J Michael Fetherston, Susan M Stocklmayer, and Vernon C Stocklmayer is available for $55 (including GST). To buy a hardcopy, please email <bookshop@dmp.wa.gov.au>. Order five or more copies and get the books for a special discounted price of $40 per copy.

Alternatively, go to <www.dmp.wa.gov.au/ebookshop> to download a free PDF.

For more information, contact <publications@dmp.wa.gov.au>.

GSWA regional geophysics surveys: 18 April 2017 update

Data downloads

Located data — Geophysical Archive Data Delivery System <www.ga.gov.au/gadds>.

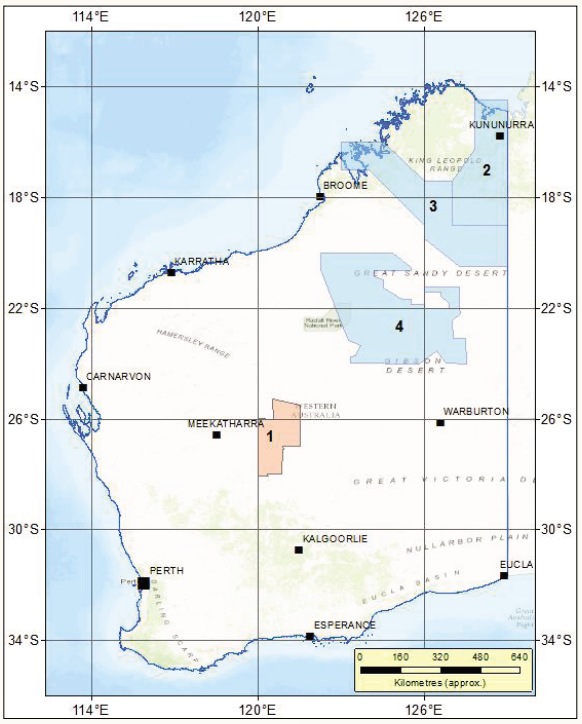
Grids and images — search in GeoVIEW.WA under Government Surveys layers.

Subscribe to the GSWA eNewsletter for alerts of preliminary and final data release dates. Go to <www.dmp.wa.gov.au/gswaenewsletter>.

Survey outline shapefiles are available online at <www.dmp.wa.gov.au/geophysics>.

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

EXPLORATION INCENTIVE SCHEME



ID	Area/Name	Method	Configuration	Size	Status	Start	End	Release
1	Wiluna 2016	Gravity	Grid 2.5 km	4 454 stns	Released	20-08-16	21-09-16	24-11-16
2	E Kimberley 2016	Air Grav	2500 m, E-W	38 000 line-km	Released	08-10-16	04-12-16	23-02-17
3	Tanami – King Leopold 2017	Air Grav	2500 m, N-S	50 000 line-km	Contract	(May-17)	(Oct-17)	(Jan-18)
4	Kidson 2017	Air Grav	2500 m, N-S	70 000 line-km	Confirmed	(May-17)	(Oct-17)	(Jan-18)

Information current at: 18 April 2017

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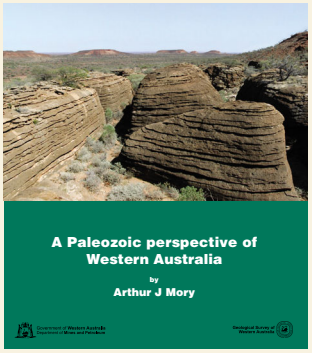
Third book in 'Western Australia unearthed' series released



In the Geological Survey of Western Australia's (GSWA's) new publication **A Paleozoic perspective of Western Australia**, author Arthur Mory has used a series of statewide time slices to illustrate the depositional and structural history of the onshore Paleozoic basins. These time slices are based on regional correlations underpinned by biostratigraphic and paleontological studies from more than 800 wells drilled in the Phanerozoic rocks of Western Australia.

He recognizes four main phases of basin evolution, commencing with Cambrian intracratonic sag followed by three rift phases of Ordovician – Early Devonian, Middle Devonian – mid-Carboniferous, and latest Carboniferous–Permian age.

This is the third volume to be released by GSWA under the banner of 'Western Australia unearthed', following **The birth of supercontinents and the Proterozoic assembly of Western Australia** and **Australia goes it alone — the emerging island continent 100 Ma to present**.

The books are aimed at trainee and professional geologists, especially newcomers to Western Australia. With colourful images and quality graphics, the books set out current ideas on the geological history of Western Australia providing an introduction to the geology and economic potential of the diverse terrains that make up the State.

A Paleozoic perspective of Western Australia by AJ Mory is available for $33 (including GST). To buy a hardcopy, please email <bookshop@dmp.wa.gov.au>. Alternatively, go to <www.dmp.wa.gov.au/ebookshop> to download a free PDF.

For more information, contact Arthur Mory (arthur.mory@dmp.wa.gov.au).

Product releases

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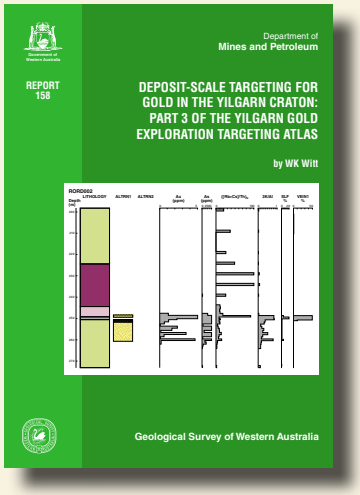
ISSN 1834-2272 ISBN (PDF) 978-1-74168-749-1

MINERAL RESOURCES BULLETIN

MRB 25 Gemstones of Western Australia second edition *Print copy $55 (inc. GST)*
by Fetherston, J, Stocklmayer, SM and Stocklmayer, VC

REPORTS



Report 158 Deposit-scale targeting for gold in the Yilgarn Craton: Part 3 of the Yilgarn Gold Exploration Targeting Atlas
by Witt, WK

Report 165 VMS mineralization in the Yilgarn Craton, Western Australia: a review of known deposits and prospectivity analysis of felsic volcanic rocks
by Hollis, S, Yeats, CJ, Wyche, S, Barnes, SJ and Ivanic, TJ

Report 166 Thermo-mechanical evolution of orogeny in the Musgrave Province
by Walsh, A

Report 161 Geochronology from the Rudall Province, Western Australia: implications for the amalgamation of the West and North Australian Cratons *Plus accompanying downloadable zip files*
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RECORDS

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by Rowe, ML

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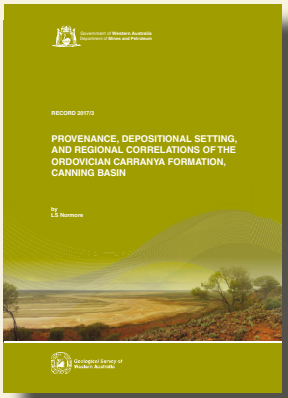

Record 2017/6 TARGET 2017, Perth Australia: abstracts
edited by Wyche, S and Witt, WK

NON-SERIES BOOKS

WA unearthed: A Paleozoic perspective of Western Australia *Print copy $33 (inc. GST)*
by Mory, AJ

1:100 000 GEOLOGICAL SERIES MAPS

Wonyulgunna, WA Sheet 2848

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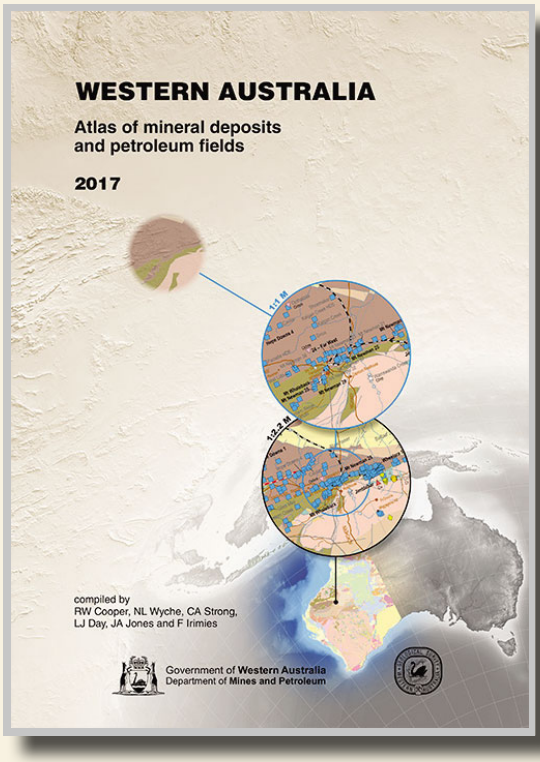

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Maps, USB data packages, and selected premium publications are available to purchase as hard copies via the online cart on the eBookshop at <www.dmp.wa.gov.au/ebookshop>. Alternatively, these products can be purchased from the Information Centre, First Floor, Mineral House, 100 Plain Street, East Perth, WA 6004, Australia, Phone: +61 8 9222 3459; Fax: +61 8 9222 3444.
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