

Fieldnotes



Government of Western Australia
Department of Mines, Industry Regulation
and Safety

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Executive Director appointed

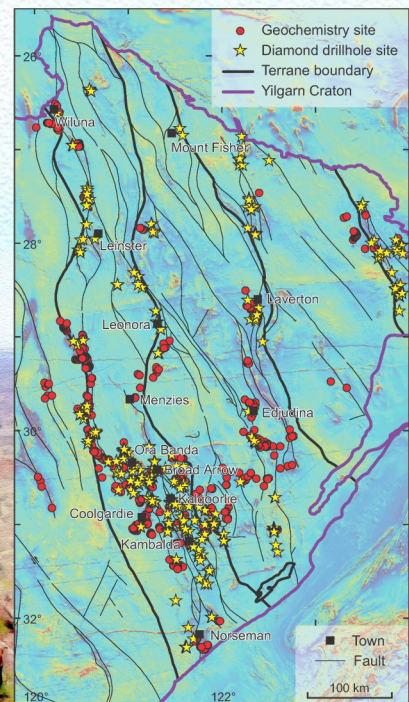
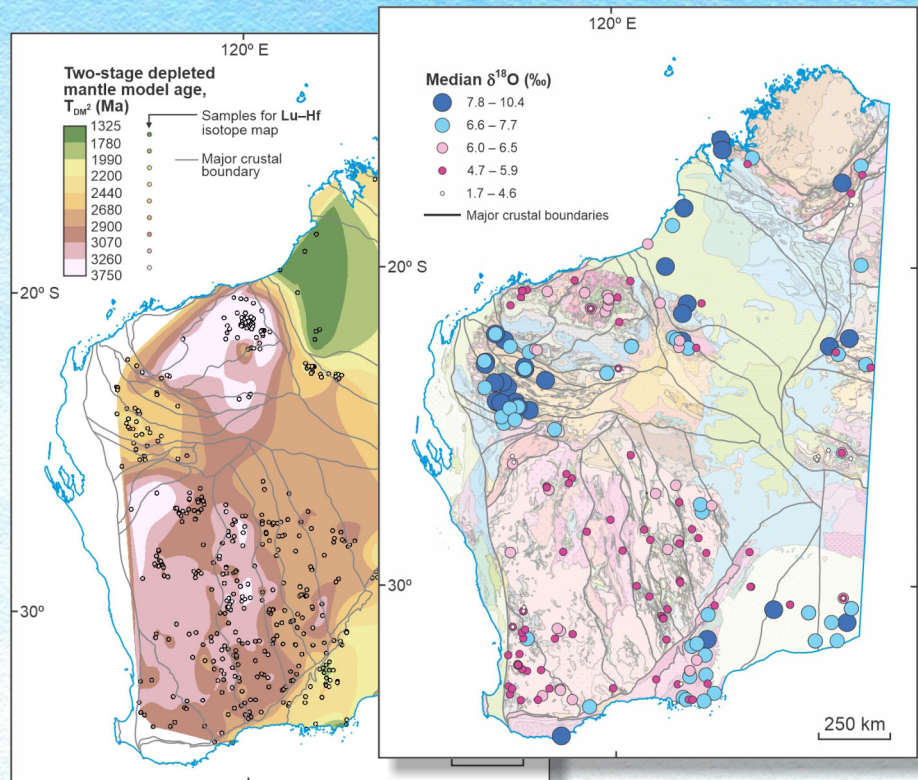
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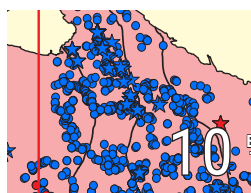
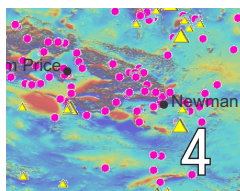


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Maps, USB data packages and various premium publications are available to purchase as hard copies from the eBookshop or the First Floor counter at Mineral House, 100 Plain Street, East Perth WA 6004. An online cart and payment system is in place. Records, Reports, Bulletins and other non-series books cannot be purchased in hard copy but are all available as PDFs to view and download free of charge.

Fieldnotes

Fieldnotes is a free digital-only quarterly newsletter published by the Geological Survey of Western Australia (GSWA). The newsletter provides regular updates to the State's exploration industry and other geoscientists about GSWA's latest work, programs, products and services.

Access Fieldnotes by:

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Cover image: Snapshot of work for the last three months



Executive Director appointment

Michele Spencer appointed new Executive Director for the Geological Survey



Michele Spencer has been breaking ground as the new Executive Director, Geological Survey and Resource Strategy (GSRS). She took over the role in August 2022.

Michele joined the Department of Mines, Industry Regulation and Safety in 2019 as Director Mineral and Energy Resources. She brings with her a wealth of multi-commodity experience across exploration, mine geology, resource development, strategic planning and business development in national and international markets.

With Michele at the helm, a focus for GSRS will be investigating how the division can facilitate the diversification of Western Australia's economy.

'We will be looking at the ways geological data can benefit various sectors and, more broadly, the community,' Michele said.

In the long term, the division will continue to work towards the key priority areas of the **GSWA Strategy 2030**. This includes:

- implementing the **Geoscience Strategy** and the **Data Transformation Strategy**
- progressing the world-class **WA Array** project and the **Geoscience Data Transformation Program**.

In the short to medium term, the focus will be ensuring the division is in the best possible position to deliver on its vision and strategies, by looking at its most valuable resource – its people.

'Strengthening our team is a key priority area which requires us to look at how we can build capacity, adapt and respond better to change, and be at the forefront of science.'

Michele brings significant knowledge and experience to GSRS as a subject matter expert. Complementing her broad technical knowledge and understanding of the sector is a strong ability to engage and manage stakeholders – a skill she attributes to her time working overseas.

'During my time working in Vietnam, I learnt how critical stakeholder management is to the successful delivery of a project,' she said.

'Navigating different cultural, socio-political and language differences within a developing country was both challenging and rewarding.'

Now in State Government, Michele has a strong team around her to help navigate this landscape and achieve department objectives.

'I continue to learn every day from the talented people around me.'

Please join us in welcoming Michele to the role.

For more information, contact **Michele Spencer**.

Chairing Session 1 at GSWA Open Day 2021



New ways to access Mineral Resource and Ore Reserve estimate data


Mineral Resource and Ore Reserve estimates are critical datasets for mining and State development. The Geological Survey of Western Australia (GSWA) releases spatial layers and detailed reports for estimate data that are updated daily.

Reports provide estimate data totalled by estimate category (Mineral Resource or Ore Reserve) and status (Proven, Probable, Measured, Indicated, or Inferred) and reporting code compliance. Report *Mineral Resource and Ore Reserve Estimates by Commodity* provides a total estimate value for Western Australia. Report *Mineral Resource and Ore Reserve Estimates by Project* provides detailed estimate values for Projects (Fig. 1). Report *Mineral Resource and Ore Reserve Estimates by Site* provides detailed estimate data for individual sites.

Spatial layer *Resource Estimates by Project* includes estimates for all commodities throughout Western Australia (Fig. 2). Custom spatial layer *Resource Estimates by Project (Gold)* presents Western Australian gold projects by relative estimate size (Fig. 2). We will continue to produce custom spatial layers for more commodities.

Access reports using the online system: **MINEDEX** (dmirs.wa.gov.au). Spatial layers and data extracts are available for download from the **Data and Software Centre**. Data extracts include related information such as project exploration and mine status, ownership, and geological and spatial areas. Spatial layers can be viewed using GSWA's free interactive geological map **GeoVIEW.WA**.

For more information, contact mindex@dmirs.wa.gov.au.



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WESTERN AUSTRALIAN MINERAL RESOURCE AND ORE RESERVE ESTIMATE TOTALS BY PROJECT


MINEDEX

MINEDEX - REP01

Table 1 – Total Mineral Resources and Ore Reserves for Western Australia by Commodity and Project

This table shows the total mineral resources and ore reserves for each MINEDEX Project.
Totals may include estimates that are not compliant with industry standard reporting codes.
Total mineral resources and total ore reserves must not be combined.

Project		Mineral Resources			Ore Reserves				
Project Code	Project Name	Ore Quantity (million tonnes)	Average Grade (gram/tonne)	Contained Commodity (kilogram)	Commodity	Ore Quantity (million tonnes)	Average Grade (gram/tonne)	Contained Commodity (kilogram)	Commodity
J00102	Golden Mile	545.97	1.56	850,453.80	Gold	280.85	1.28	359,820.70	Gold
J02786	Mallina Gold	225.05	1.24	279,148.20	Gold	0.00	0.00	0.00	Gold
J04673	Gruyere	400.44	4.75	769,042.92	Gold	44.43	4.75	447,757.90	Gold
J00134	Granny Smith								



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WESTERN AUSTRALIAN MINERAL RESOURCE AND ORE RESERVE ESTIMATE TOTALS BY PROJECT

MINEDEX

MINEDEX - REP01

J02419	Thunderbox								
J00186	Tarmoola - Kibb								
J02241	Carosue Dam								
J00292	Paddington - I								
J00226	Marvel Loch -								
J01703	Sunrise Dam								
J00156	Mt Magnet								

Table 1 – Total Mineral Resources and Ore Reserves for Western Australia by Commodity and Project

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Project Code	Project Name	Ore Quantity (million tonnes)	Average Grade (gram/tonne)	Contained Commodity (kilogram)	Commodity	Ore Quantity (million tonnes)	Average Grade (gram/tonne)	Contained Commodity (kilogram)	Commodity
J00102	Golden Mile	545.97	1.56	850,453.80	Gold	280.85	1.28	359,820.70	Gold

This table comprises 1 row(s).

Table 2 – Total Mineral Resources and Ore Reserves for Western Australia by Commodity, Project and Estimation Category

Project Code	Project Name	Commodity
J00102	Golden Mile / KCGM	Gold

(C) Total Compliant and Unclassified

	Ore Quantity (million tonnes)	Average Grade (gram/tonne)	Contained Commodity (kilogram)	Estimate Date	Reporting Code(s)
Measured mineral resources (Compliant + Unclassified) ¹	122.98	0.70	86,083.20	31/03/2022	JORC2012
Indicated mineral resources (Compliant + Unclassified) ²	268.95	1.87	503,877.00	Multiple	JORC2012
Inferred mineral resources (Compliant + Unclassified) ³	154.05	1.69	260,493.60	Multiple	JORC2012
Proven ore reserves exclusive of mineral resources (Compliant + Unclassified) ⁴	0.00	0.00	0.00		
Probable ore reserves exclusive of mineral resources (Compliant + Unclassified) ⁵	0.00	0.00	0.00		
Proven ore reserves as inclusive subset of mineral resources (Compliant + Unclassified) ⁶	122.98	0.70	86,083.20	31/03/2022	JORC2012
Probable ore reserves as inclusive subset of mineral resources (Compliant + Unclassified) ⁷	157.87	1.73	273,737.50	Multiple	JORC2012
Are there Supplementary estimates for this Project?	No				

This table comprises 1 Project(s).

Figure 1. MINEDEX Resource Estimates by Project report for Western Australian gold projects provides a listing of all gold projects by Mineral Resource and Ore Reserve volume (Table 1), and a breakdown for each project by estimate category, estimate status, and reporting code compliance (Table 2)



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- Resource Estimates
- Resource Estimates by Project (Gold)
 - ▲ 0 – 30 000 kilograms
 - ▲ 30 000 – 150 000 kilograms
 - ▲ 150 000+ kilograms
 - Resource estimates by Project

250 km

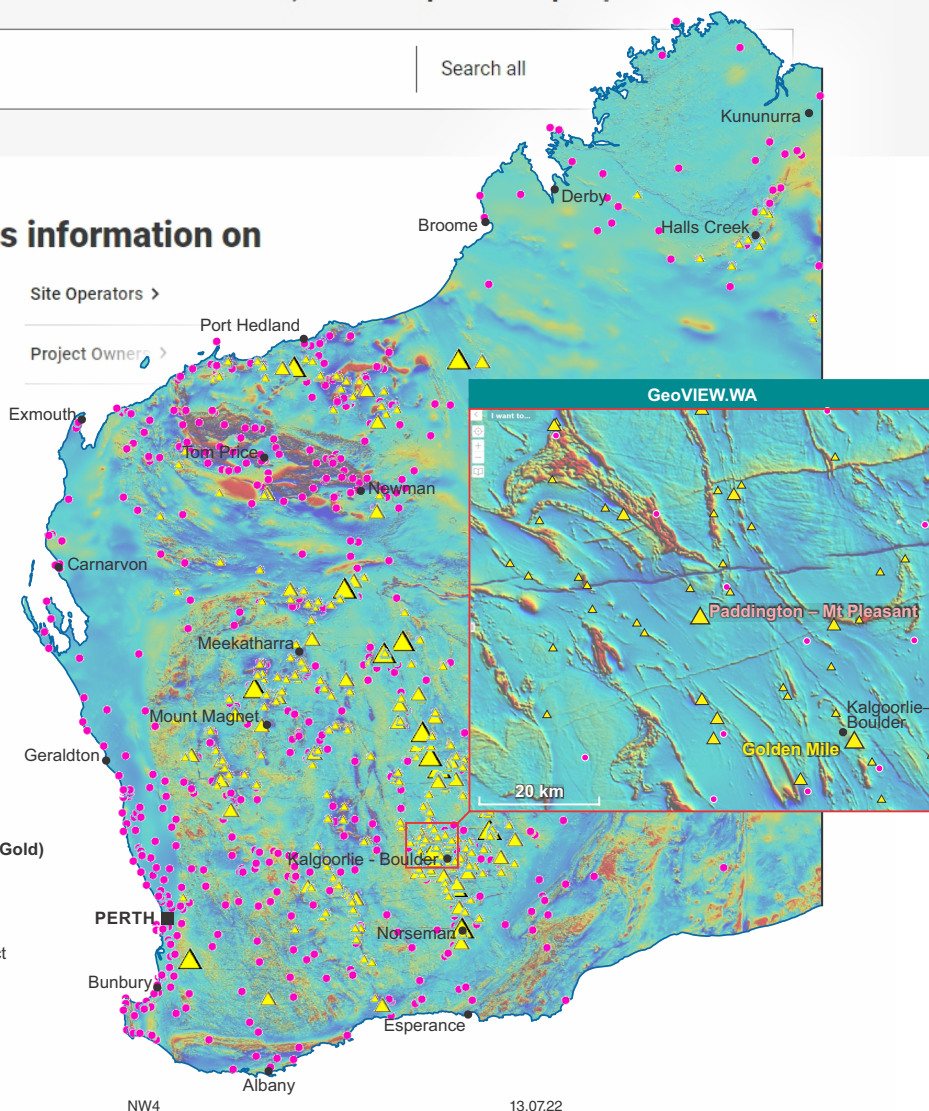


Figure 2. Spatial layers Resource Estimates by Project and Resource Estimates by Project (Gold) shown on regional aeromagnetic data. Inset map for the Kalgoorlie area. Data for the two labelled deposits is reported in Figure 1

Oxygen, Lu–Hf and Sm–Nd isotope maps

Crustal evolution unravelled by isotopes

The 2022 versions of the statewide oxygen, lutetium–hafnium (Lu–Hf), and samarium–neodymium (Sm–Nd) isotope maps of Western Australia are now released in GeoVIEW.WA (Fig. 1). These isotope maps continue to provide new insights into the architecture and evolution of continental crust, highlighted by two recent publications in the journals *Nature* and *Geology*.

The oxygen isotope map reveals that changes in the oxygen isotope values of Pilbara granitic rocks occurred at the same time as the accumulation of spherule beds, which are high-energy deposits formed during meteorite impacts. This provides the first empirical evidence that giant meteorite impacts may have been responsible for the creation and growth of Earth's earliest continental crust. See the [article](#) in *Nature*.

EXPLORATION
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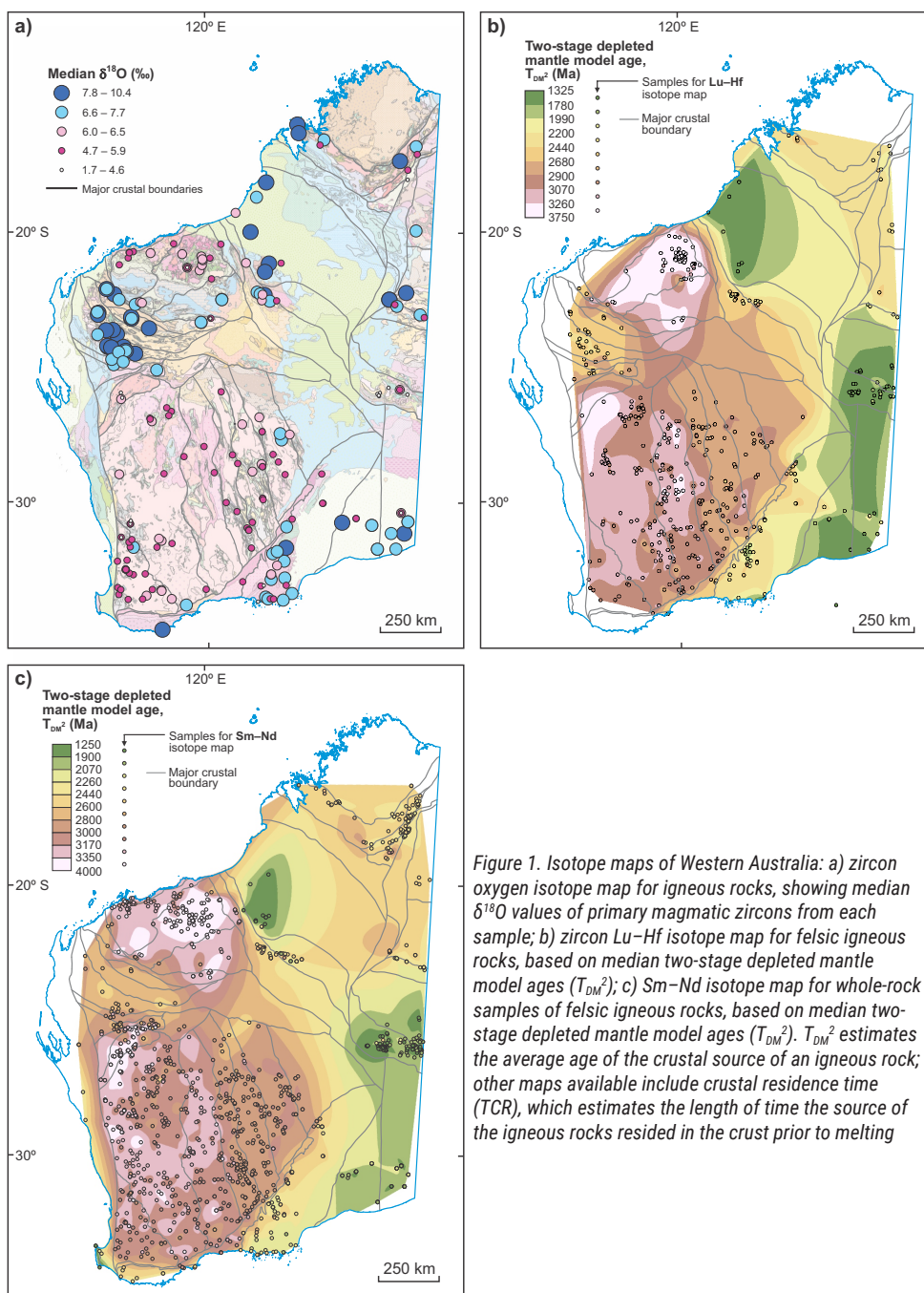


Figure 1. Isotope maps of Western Australia: a) zircon oxygen isotope map for igneous rocks, showing median $\delta^{18}\text{O}$ values of primary magmatic zircons from each sample; b) zircon Lu–Hf isotope map for felsic igneous rocks, based on median two-stage depleted mantle model ages (T_{DM}^2); c) Sm–Nd isotope map for whole-rock samples of felsic igneous rocks, based on median two-stage depleted mantle model ages (T_{DM}^2). T_{DM}^2 estimates the average age of the crustal source of an igneous rock; other maps available include crustal residence time (TCR), which estimates the length of time the source of the igneous rocks resided in the crust prior to melting

The Lu–Hf isotope map potentially solves the most significant missing link in understanding the assembly of Proterozoic Australia. It shows that Percival Lakes Province (PLP) is distinct from neighbouring older West, North, and South Australian Cratons (WAC, NAC and SAC). The PLP is part of a 1700×400 km block of Proterozoic lithosphere that lacks evidence of Archean provenance and includes reworked remnants of Mesoproterozoic oceanic lithosphere that survived WAC–NAC–SAC convergence. These findings suggest that the WAC, NAC and SAC never completely collided during Proterozoic assembly of Australia. See this [open access paper](#) in *Geology*.

How to access

Zircon oxygen isotope map of Western Australia, Zircon lutetium–hafnium isotope map of Western Australia, and Samarium–neodymium isotope map of Western Australia are available as free downloadable PDFs from the Department of Mines, Industry Regulation and Safety (DMIRS) eBookshop. The isotope datasets are best accessed using [GeoVIEW.WA](#) or can be downloaded from the [Data and Software Centre](#) via Datasets – Statewide spatial datasets – Geochronology & Isotope Geology.

For more information, contact [Yongjun Lu](#).

Portable XRF adds value to HyLogger core logs

Downhole geochemical assaying is used for a variety of purposes, including lithological classification and vectoring towards mineralization. Portable X-ray fluorescence (pXRF) analysers enable cheap, simple and non-destructive collection of geochemical data in real time, ideal for incorporation into core scanning and logging workflows. The Geological Survey of Western Australia (GSWA) recently acquired a Vanta pXRF to supplement HyLogger-3 scanning at the Perth Core Library, capable of accurate measurement of 39 geologically important elements between Mg and U to parts-per-million levels with 40-second collection times.

GSWA Record 2022/11 details exploratory work to routinely integrate GSWA HyLogger-3 hyperspectral mineralogy with downhole assays collected via GSWA Vanta pXRF (Fig. 1) – valuable for validating and mapping complex mineralogy, and capturing geochemistry from historical and petroleum core. Consistent and unbiased collection of low-density measurements was found to accurately reproduce downhole geochemical trends provided by time- and cost-intensive laboratory assay techniques. Application of advanced algorithmic modelling techniques to HyLogger-3 hyperspectral data were successful in



further transforming these low-resolution pXRF assays into high-resolution (centimetre scale) models of downhole chemistry.

Collection and provision of assay data from the GSWA Vanta pXRF is offered as a complimentary service for materials stored at the core library facilities, alongside mineralogical analysis using the GSWA BTX-II benchtop X-ray diffractometer (see www.dmirs.wa.gov.au/gswacorelibraries).

How to access

GSWA Record 2022/11 Portable XRF analysis in the Joe Lord and Perth Core Libraries – methodology and case studies by MJ Wawryk and EA Hancock is available as a free downloadable PDF from the Department of Mines, Industry Regulation and Safety (DMIRS) eBookshop.

For more information, contact **Michael Wawryk**.



Figure 1. HyLogger operator (Eddie Rogers) capturing Vanta pXRF assay data at the Perth Core Library to complement HyLogger-3 mineral scans

John Forrest geotrail adapted for your phone

The **John Forrest National Park Geotrail**, originally released by the Geological Survey of Western Australia in 2021 as a book, has been adapted and recompiled for mobile devices. This short geotrail is now available in the *Everythere* app alongside previous GSWA tours for **Rottne Island – A geology guide** and **Finding geology in Perth City**.

Ten waypoints have been created along the nearly 4 km western section of the Railway Reserves Heritage Trail from Swan Terrace – Pechey Road carpark to the National Park picnic area (Fig. 1). These waypoints use all seven of the original stops in the Railway Reserve Heritage Geotrail book, adding a locality at the start of the trail and splitting two of the other stops.

The app uses a phone's GPS service to identify when the user is within about 50 m of a marked locality. This activates the waypoint and alerts the geotourist that there's something of note to be explored. The tour is displayed on the phone's default map app and shows the distance to the next waypoint once a locality is completed.

Waypoints were chosen to introduce non-specialists to a few key features of the geology and landscape of the Perth Hills. These include:

- exposures of granitic rocks and dolerite dykes in the rail cuttings (Fig. 2)
- typical weathering effects
- the evolving valley profile of Jane Brook
- how granitic tors form
- aspects of the geology related to construction of the railway.

Figure 1. Waypoints, map, text and introduction screens for the John Forrest geotrail in the Everythere app

Text has been optimized for the mobile phone platform and, together with carefully curated photos, this results in short, succinct explanations that help the visitor recognize the described feature.

Trail data can be downloaded from the app to your phone before leaving home, meaning that the tour and its waypoints can be followed even when the cellular signal is poor or absent.

Release of this geotrail through a third-party app expands the range and accessibility of geotourism products GSWA has produced. Other previously published or future geotrails may be adapted for mobile devices as appropriate.

How to access

Download the **Everythere** app from Apple App Store or Google Playstore and open **John Forrest National Park Geotrail**. Download the complete John Forrest geotrail book from the Department of Mines, Industry Regulation and Safety (DMIRS) **eBookshop**.

For more information, contact **Stephen White**.



Figure 2. John Forrest National Park geotrail rail cutting through granitic rock close to waypoints 2 and 3 in the app

The enduring attraction of pearls

The lure and lustre of Western Australian pearls is the latest StoryMap in the Geological Survey of Western Australia's online series.

Text from Chapter 13 Pearls, shells and other organic gems, in **Mineral Resources Bulletin 25 Gemstones of Western Australia (second edition)** has been updated and expanded, and the content adapted for the online format.

This necessitated additional information on the environment in which the host molluscs for pearls, principally certain species of oyster, thrive (Fig. 1), and specifics of how pearls form. The growth of this organic gem is highlighted as an example of biomineralization. We have included a brief history of the industry (Fig. 2) and collaborated with the Western Australian Museum to add a section on the history of Aboriginal pearl shell hunters. The museum also provided a fabulous image of the 2000-year-old Brremangurey pearl (Fig. 3).

We have sourced new images for this format and have included an interactive map showing all the locations for growing pearls in Western Australia.

This story of the Western Australian pearl industry is an immersive experience for amateur geologists, gemmologists and anyone interested in this prized organic gem.

We will continue to develop other content from this highly successful book by repurposing the information from other chapters for the online platform.



Figure 2. Pearl divers, Australia, 23 March 1939. Conditions were probably very similar in 1850 to those depicted in this image. Courtesy ACP Magazines Ltd, photographic archive, State Library of New South Wales, ON 388/Box 026/Item 063

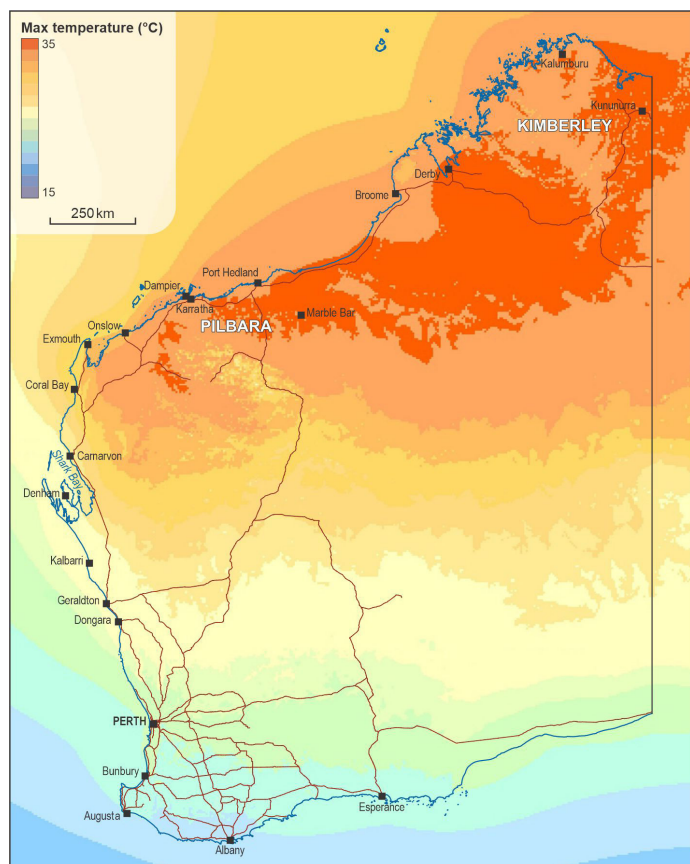


Figure 1. Maximum temperatures across Western Australia averaged over 20 years from 1986 to 2005. The warmest regions on land from the Kimberley to the Pilbara are mirrored by warm, shallow seas from the Kimberley coast right around to Shark Bay



Figure 3. Brremangurey pearl. Courtesy Wunambal Gaambara © Western Australian Museum

How to access

The lure and lustre of Western Australian pearls is available to view via the Department of Mines, Industry Regulation and Safety (DMIRS) [eBookshop](#) or view directly in the [StoryMap environment](#).

For more information, contact [Robin Bower](#).

EIS projects add high-quality lithogeochemistry data to region

The latest annual data releases, related to two of the Geological Survey of Western Australia's (GSWA) Yilgarn Craton projects, continue to build our existing inventories of high-quality lithogeochemistry of mafic and felsic rocks throughout the craton.

These two projects aim to provide detailed coverage of modern, high-quality, major and trace element data, supporting isotopic data and the geological/stratigraphic context related to the greenstone belts of the Eastern Goldfields Superterrane (GSWA Record 2022/8) and to the granitic rocks of the Yilgarn Craton more generally (GSWA Record 2022/9) (Fig. 1).

Together, 2717 new analyses have been added. The Yilgarn granite dataset contains only those samples collected or reanalysed specifically for the Yilgarn Granite Project. The dataset includes whole-rock major and trace element data (including Li) primarily covering granitic lithologies including high-level (subvolcanic) felsic intrusive rocks (commonly referred to as 'felsic porphyry'). It also includes some mafic igneous rocks, such as lamprophyres and quartz-gabbroic rocks, where a comagmatic relationship with felsic derivatives can be established or realistically inferred.

The 2022 release of the Yilgarn granite dataset includes 1994 new analyses. The majority of these are of powders from Geoscience Australia's granite dataset, specifically reanalysed for the Yilgarn Granite Project. The Eastern Goldfields Superterrane greenstone data contains only those samples collected or reanalysed for the

Eastern Goldfields greenstone geochemical barcoding project, primarily covering supracrustal igneous lithologies, including high-level (subvolcanic) intrusive rocks and volcanoclastic rocks. Most samples for the greenstone barcoding project are from diamond drillcore.

Also recently released, GSWA Report 226 (Geochemical characterization of the magmatic stratigraphy of the Kalgoorlie and Black Flag Groups – Ora Banda to Kambalda region) uses the barcoding project data to establish a lithochemical barcode for greenstone sequences broadly between Ora Banda and Kambalda.

How to access

These two Records are available as free downloadable PDFs from the Department of Mines, Industry Regulation and Safety (DMIRS) eBookshop.

GSWA Record 2022/8 Eastern Goldfields geochemical barcoding project – notes to accompany 2022 data release
by Lowrey, JR and Smithies, RH

GSWA Record 2022/9 Yilgarn Granite Project – notes to accompany 2022 data release
by Lowrey, JR, Smithies, RH and Champion, DC

For more information, contact **Hugh Smithies** or **Jack Lowrey**.

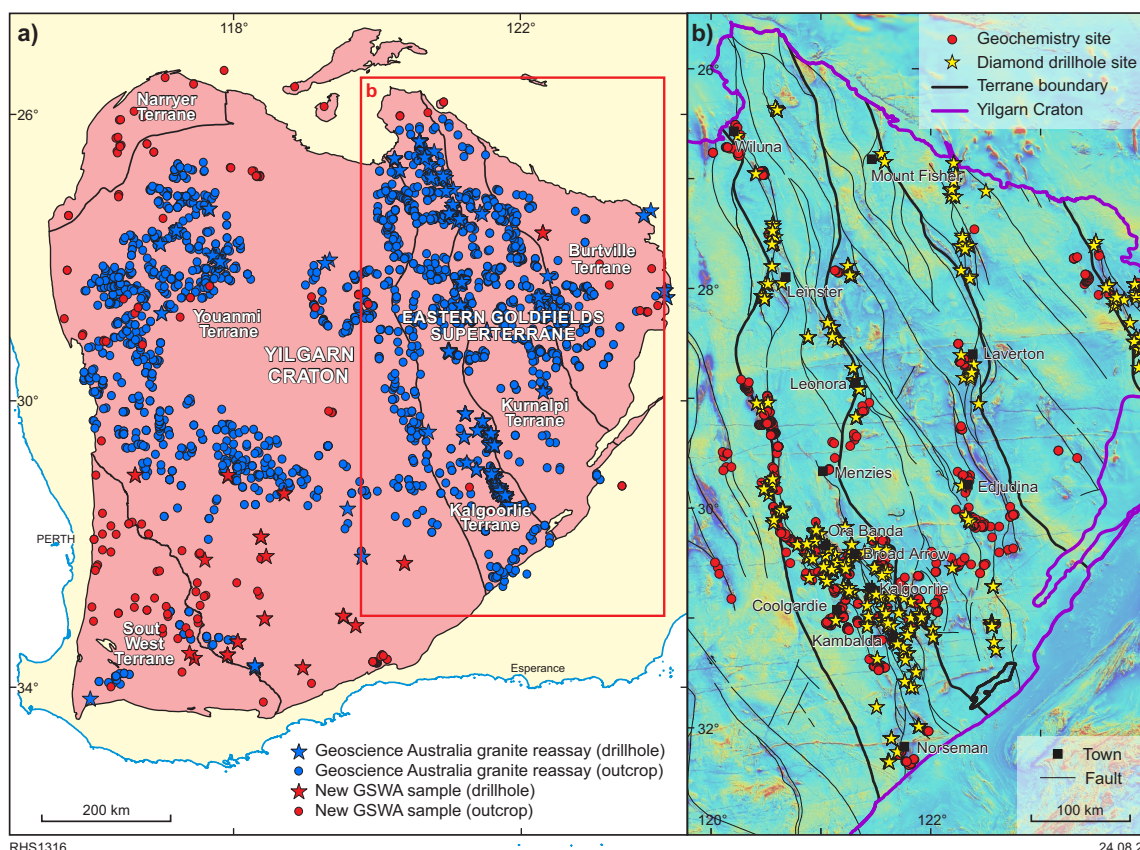


Figure 1. Lithogeochemical project overview: a) Yilgarn Granite Project area and sample localities. Note that many sites represent the location given for several samples; b) aeromagnetic image of the Eastern Goldfields Superterrane showing the locations of samples collected for the Eastern Goldfields geochemical barcoding project. Note that many sites represent the location of a diamond drillhole, cores from which commonly produced several samples

Product releases

• REPORTS •

Report 215 Geochronology of metasedimentary and igneous rocks in the Lamboo Province, Kimberley region: reassessing collisional geodynamic models

by Maidment, DW, Lu, Y, Phillips, C, Korhonen, FJ, Fielding, IOH, Wingate, MTD, Kirkland, CL, Murphy, R, Tilhac, R, Poujol, M and Zhao, J

Report 233 Critical metals in laterite related to pegmatite mineral systems of the western Yilgarn Craton (Li, W, Sn, Ta, REE)

by Otto, A, Lampinen, H, Pinchand, T, Huntington, JF and Noble, RRP



• RECORD •

Record 2022/11 Portable XRF analysis in the Joe Lord and Perth Core Libraries – methodology and case studies

by Wawryk, M and Hancock, EA

• ONLINE PRODUCTS •

Metamorphic history information, 2022

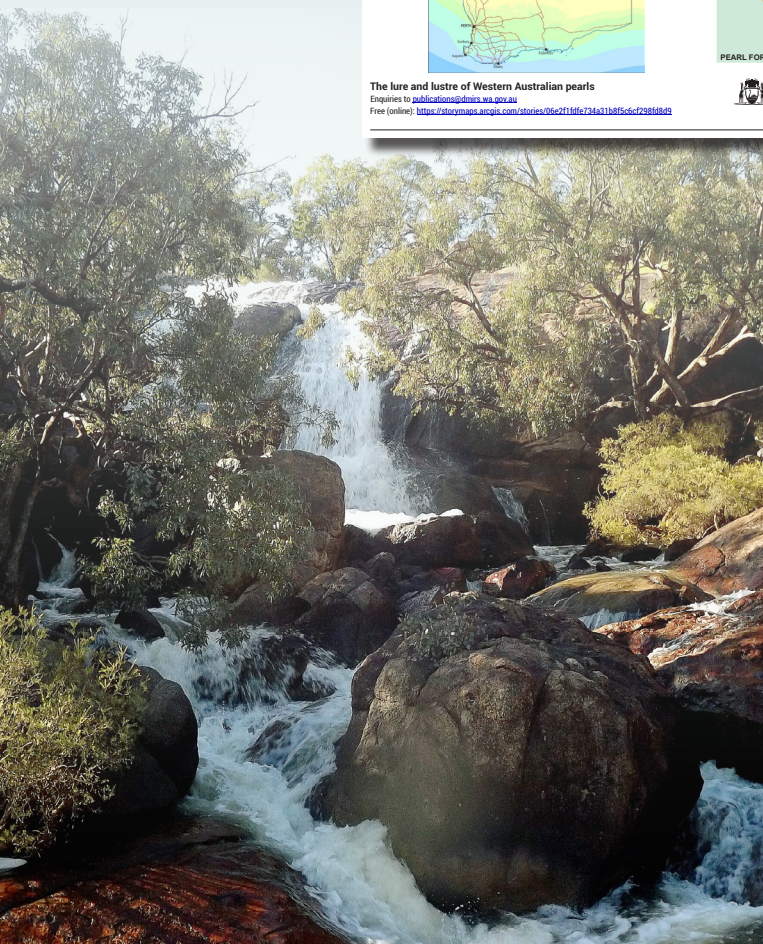
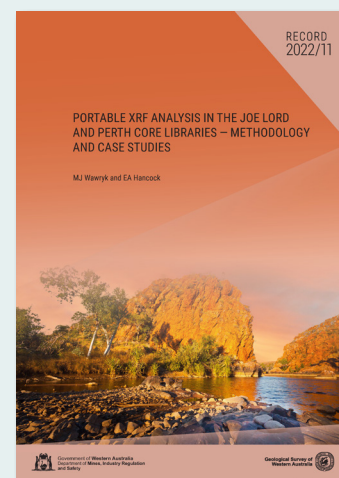
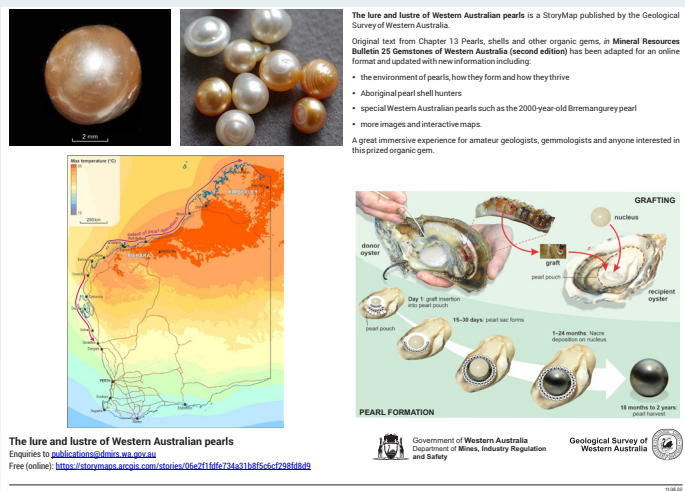
John Forrest National Park Geotrail

(Download the **Everywhere** app from Apple App Store or Google Playstore)

by White, SR

The lure and lustre of Western Australian pearls

Compiled by Bower, RS



DMIRS DATABASE TRAINING 2022–23

10 NOVEMBER 2022 & 27 APRIL 2023

- GeoMap.WA
- GeoVIEW.WA and TENGGRAPH Web
- Mines and Mineral Deposits (MINEDEX)
- WAMEX & Drillholes
- WAPIMS

www.dmirs.wa.gov.au/training