

Fieldnotes



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

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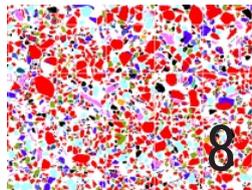
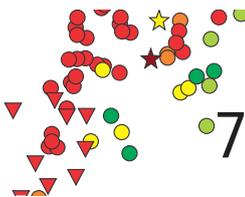
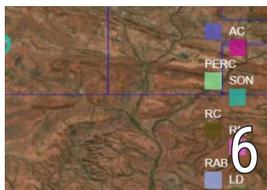


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Fieldnotes

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.

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GSWA publishes a vast amount of pre-competitive geoscience information on the State, contributing to billions of dollars' worth of resources for exploration and development. To find more information about publications and maps we publish, go to our [website](#).



Cover image: Road across the Nullarbor Plain



Forging a pathway for geoscience

Like the Geological Survey of Western Australia (GSWA) itself, GSWA Open Days have a proud history. Every year, we have hosted a one-day event to showcase our latest and greatest – usually at the Esplanade Hotel in Fremantle, usually in February. Every year, we've filled the room with information displays, given presentations on our research updates, and have also hosted a separate Petroleum Day. The impacts of the COVID-19 pandemic have given us the opportunity to look at how we have done things in the past – sometimes we need to look back at where we have been to figure out how we can go forward.

We have gone a little off-script this year. Leading into planning for the GSWA Open Day 2021, we decided to commit to three major concepts: forging a pathway for geoscience, inspiring young professionals, and engaging successfully with industry. If you have ever attended an Open Day before, you will find some elements are the same, but that many others have been adapted or are entirely new. First of all, we have moved from Fremantle to the Hyatt Regency Hotel in Perth, our event date is now Friday 12 November, and we have dropped our ticketing fee from \$130 to \$50 (including GST). These decisions were key when considering ways to make this event more accessible to our stakeholders. Allow us to take you through the day...

Doors open at 08:30 am for you to arrive, and pick up your pass (and something extra!). The ways that we are choosing to display information have been altered, and we are very keen to see what you think – some posters, some digital content, and plenty of networking! Our Executive Director, Jeff Haworth, and then the Minister for Mines and Petroleum, Bill Johnston, will kick things off from 09:00 am before we lead into our first

session. The GSWA strategic outlook will better inform you of who we are, what we do, and where we are going. During the breaks, you will have the opportunity to liaise with GSWA online systems professionals who will be on hand to lead you through our renowned databases WAMEX, WAPIMS, and MINEDEX. There will also be the occasion to examine our breakthroughs in photogrammetry, 3D geology, and drone technology.

Our second session will give you the latest research outputs to come out of the Accelerated Geoscience Program. All of our speakers are leaders in their specific themes. You will be able to ask questions of these presenters, and any others, through a third-party app on your personal device. After lunch, a series of short talks will enlighten you on some of our significant research outputs. This selection of presenters have the kind of expertise that can only be finely tuned at an organization like ours.

For the first time, we are hosting an industry-wide panel to discuss the direction of geoscience over the next 10 years. We have carefully curated this incredible group of geoscience experts and industry representatives, to bring you a truly rare experience. If you make it this far in the day, you may as well stay for the sundowner too! Every session at the GSWA Open Day 2021 will be fully interactive – you will be invited to participate in session Q&As, live polls and reviews that will help us evaluate the day as a whole.

The GSWA Open Day 2021 will be an open day like no other! If you've already purchased your tickets, that's great news. If you haven't yet, please [register](#) and we'll see you in November.

For more information, contact [Sabrina Bednarski](#) or visit our [website](#).



#GSWA2021

Figure 1. GSWA Open Day 2019

Perth Gem and Mineral Show

Flawless networking rocks inaugural show

A handful of geologists sharing a passion for mineralogy, gemmology and geoscience resulted in the inaugural Perth Gem and Mineral Show (PGMS) held in September this year.

The PGMS provided a space for mineral collectors, hobbyist prospectors and industry professionals to discover, collect and learn about Australia's mineral heritage and the multitude of scientists, business owners and craftsmen that have built their lives around it.

While vastly different in scope and scale, these industries and individuals are all tied to Australia's complex and unique mineral reserve. With the participation of the critical geoscience sector, mineral assemblages and specimen pieces have been mapped,

interpreted and unearthed in ways never before seen, and it is important that these pieces of earth's history are preserved and acknowledged.

The Geological Survey of Western Australia, within the Department of Mines, Industry Regulation and Safety, was a sponsor for the event which was organized by the Mineralogical Society of Western Australia. Curtin Stadium hosted more than 50 exhibitors at 140 tables, and was attended by over 3000 people all interested in the variety of rocks on display.

For more information, contact **Angela Riganti**.



Explanatory Notes search tools

ENS online in six simple steps

The Geological Survey of Western Australia's (GSWA) Explanatory Notes System (ENS) integrates lithostratigraphic relationships with tectonic units and events recognized in Western Australia. This digital repository allows incremental updates with new data and refined interpretations, providing a seamless, up-to-date summary of the geology of Western Australia.

The database can be accessed via the revamped ENS Search Tools, found under the Search tab in the main **GeoVIEW.WA** toolbar (#1 in Fig. 1). They offer:

- Weekly updated information
- Easy-to-navigate spatial and textual query interfaces (#2), with combined searches also possible. Step-by-step help documentation is provided in the initial window for each module
- Customized queries for single or multiple parameters (e.g. name, code, age, rank, etc.), or spatial searches by map sheet, tenement, polygons or coordinates (#3). Different tabs in the result window highlight the unit/events on each statewide geology layer that meet the selection criteria (#4). An 'All ENS records' tab returns all units from the database, including those without a spatial expression
- Two types of report:
 - » Unit – for a single unit (#5a)
 - » Overview – a stratigraphically sorted list of the selected unit/event and all its associated children (#5b). Overview reports are available as a table of contents or as fully expanded reports.

If the unit write-up is not complete, a partial report is nonetheless provided that includes defining parameters. Hyperlinks to related units and events generate other reports on-the-fly, and the reference list links directly to GSWA publications.

Explanatory Notes reports can be exported as PDF, or Microsoft Word and Excel documents (#6).

For more information, contact [Angela Riganti](#).

GeoVIEW.WA
Search Printing Help & Feedback

1. Search Tools: Lithstrat Unit Search, Tectonic Unit Search, Event Search

2. Search Options: Textual Search, Spatial Search

3. Search Criteria: By Mapsheet, By Tenement, By Polygon, By Coordinates

4. All ENS Records Table:

RANK	ROCK TYPE	LITHSTRAT NO.	GEOLOGICAL CODE
564		815	P_-WKal-o
565		816	P_-WKal-od
566		818	P_-WKal-oon
567		819	P_-WKal-orj
568		820	P_-WKal-owq
569		821	P_-WKal-owaq

5a. GSWA Explanatory Notes: Alcurra Dolerite (P_-WKal-o)

5b. Alcurra Dolerite - Lithostratigraphic unit overview

6. Export Options: Word, Word 2003, Excel, PowerPoint, PDF

Figure 1. Screenshots of ENS search tools

New information on updated website

The Geological Survey of Western Australia (GSWA) has launched a new website that allows exploration companies' surface and downhole geochemistry, extracted from WAMEX reports, **to be viewed on screen** or downloaded in single, pivoted tables. The Help Guide explains how to do this.

Company analyte column headings as supplied in submitted datasets were programmatically matched to standard analyte names in a 'match table'. Scripts were run on the original database to harmonize the company analyte names to the matched standard analyte names, and to recalculate assay values in the company-supplied units of measure as ppm. Locations are in Lat/Long GDA94.

It is important to note that the data in the tables have been extracted from the Mineral Drillholes Database which stores the assay data as supplied by mining and exploration companies. There has been no quality control carried out on the actual results.

Currently, corrections have not been made to suspect units of measure values and it would be appreciated if apparently anomalous data could be reported to the **WAMEX team**.

For more information, contact **Julia Thom**.

Limit: 5 | Mapsheet: All | Hole Type: All | Company: All | Tenement ID: All | Boundary 1: Lat/Long(-24) | Boundary 2: Lat/Long(-25) | [Clear](#) | [Download All](#)

Collars / Sites

Show 5 entries | Search:

anumber	companyholeid	company	latitude	longitude
42068	MJGC45	Western Mining Corporation Ltd	-24.785583504697797	118.20923085017215
42068	MJGC44	Western Mining Corporation Ltd	-24.78287470089024	118.20920458740977
42068	MJGC43	Western Mining Corporation Ltd	-24.781068831124315	118.20918708102104
47674	WRC9	Renison Ltd	-24.607866192296	118.113731391385
47674	WRC8	Renison Ltd	-24.6325431806811	118.137117496099

Showing 1 to 5 of 5 entries | 1 row selected | [PDF](#) [Excel](#) [CSV](#) [Get Assays](#)

Figure 1. WAMEX Geochem, Search by Polygon

Assays

Show 5 entries | Search:

companyholeid	companysampleid	fromdepth	todepth	attributecolumn	attributevalue	units	dsc	dhgeochemid	aid
MJGC45	AB767267	0	2	Ag	1.5	ppm		50327233	2243759
MJGC45	AB767267	0	2	As	25	ppm		50327233	2243759
MJGC45	AB767267	0	2	Co	10	ppm		50327233	2243759
MJGC45	AB767267	0	2	Cu	75	ppm		50327233	2243759
MJGC45	AB767267	0	2	Fe%	15.1	%		50327233	2243759

Showing 1 to 5 of 355 entries | [PDF](#) [Excel](#) [CSV](#)

Figure 2. WAMEX Geochem, Results displayed in a pivot table

Assays Pivoted

Show 5 entries | Search:

companyholeid	companysampleid	fromdepth	todepth	Ag_PPM	As_PPM	Co_PPM	Cu_PPM	Fe_PPM	Mn_PPM	Pb_PPM	Zn_PPM
MJGC45	AB767267	0	2	1.5	25	10	75	151000	930	20	110
MJGC45	AB767268	2	4	1.5	20	30	75	115000	1250	22	120
MJGC45	AB767269	4	6	1	10	25	50	67000	350	10	180
MJGC45	AB767270	6	8	1	10	25	50	48000	560	12	130
MJGC45	AB767271	8	10	-1	5	20	45	49000	255	6	140

Showing 1 to 5 of 46 entries | [PDF](#) [Excel](#) [CSV](#)

Good reservoir potential for future carbon sequestration at South West Hub

In September 2021, Deidre Brooks, Manager Energy Geoscience, gave a presentation on the Geology of the South West Hub Carbon Capture and Storage (CCS) Research Project at the CCS Workshop associated with the AEGC 2021 conference.

The Department of Mines, Industry Regulation and Safety (DMIRS) led the South West Hub CCS Research Project to obtain precompetitive geological and geophysical data and to investigate ways to reduce the uncertainty around the suitability of the site for future CO₂ sequestration. Over 2 km of core was acquired from the four Harvey wells drilled between 2012 and 2015. Combined with a comprehensive set of wireline logs, this core provides an excellent dataset for reservoir, pressure, flow and geomechanical studies.

The target injection reservoir is the Wonnerup Member of the Late Triassic Lesueur Sandstone. Harvey 1 is the only South West Hub well that penetrates the full 1500 m thickness of the Wonnerup Member where it is generally a massive course-grained sandstone with favourable porosity and permeability for CO₂ sequestration. CSIRO (2018) interprets the Wonnerup Member deposited in a high-energy mainly braided fluvial-to-shallow marine environment. CSIRO clearly demonstrates a strong facies control on the porosity and permeability (Fig. 1). Overprinting this facies control is the depth and temperature related influence causing mechanical compaction and increased diagenesis with depth (Fig. 2). The storage concept is containment of the injected CO₂ without a traditional structural trap and seal. Modelling predicts that about 45% of the CO₂ is residually trapped and 55% is contained due to solubility trapping.

All reports and research results are available as free downloads from the DMIRS [WAPIMS database](#).

References

- CSIRO 2018, The Lesueur: Deposition, Rocks, Facies, Properties: Project 7-0115-0240 Final report CSIRO Report: EP181193.
- Kennedy, M 2015, Petrophysical Interpretation of the Harvey Wells, A Report by ODIN Reservoir Consultants For Department of Minerals and Petroleum, DMP/2015/3.

For more information, contact [Deidre Brooks](#).

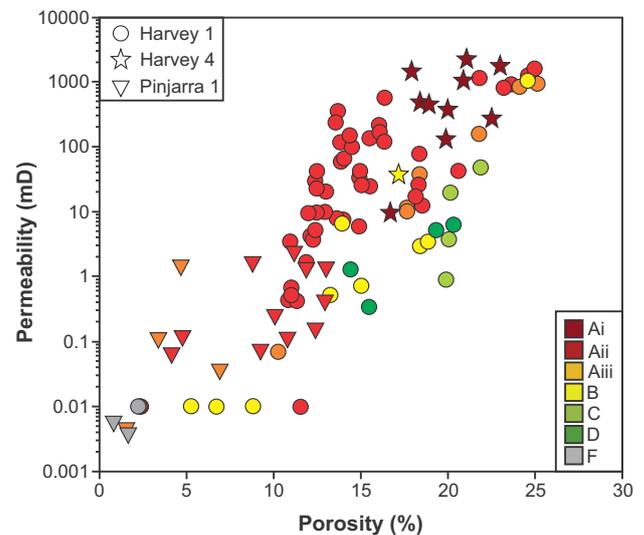


Figure 1. Facies control on porosity and permeability, determined from helium-injection core plugs from Harvey 1, Harvey 4 and Pinjarra 1. Porosity vs permeability plot colour coded by facies type. The high-energy channel-fill and bar forms have the best porosity and permeability (red and orange points), whereas the overbank or swampy deposits and crevasse splays have the worst reservoir quality (grey points) (CSIRO, 2018)

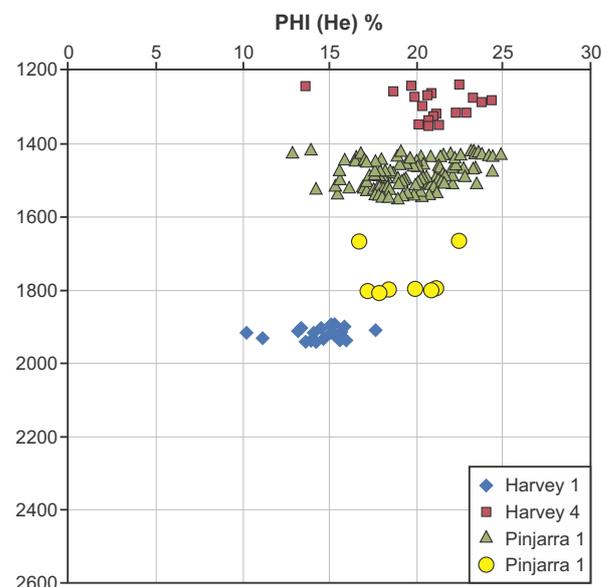


Figure 2. Measured Porosity-Permeability data for the Wonnerup Member cored in the Harvey wells (Kennedy, 2015)

New tool for targeting mineralization

The Minerals Research Institute of Western Australia (MRIWA) Project No. M0448 **4D evolution of WA ore systems: rutile – pathfinder to ores** presents the results of statewide collection, preparation and characterization of rutile grains from multiple types of mineralized and barren rock sources. Carried out by researchers at the John de Laeter Centre at Curtin University, this project aimed to uniquely identify rutile (TiO_2) (Fig. 1) trace element chemistries in order to establish a method to determine rutile provenance with application to metals exploration.

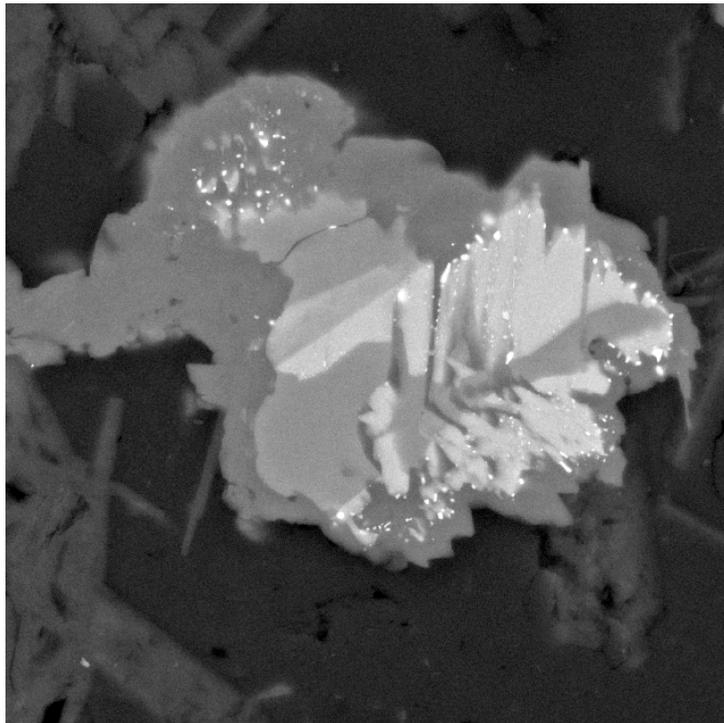


Figure 1. Image of a zoned, high-W rutile from Au mineralization, breaking down to titanite and scheelite

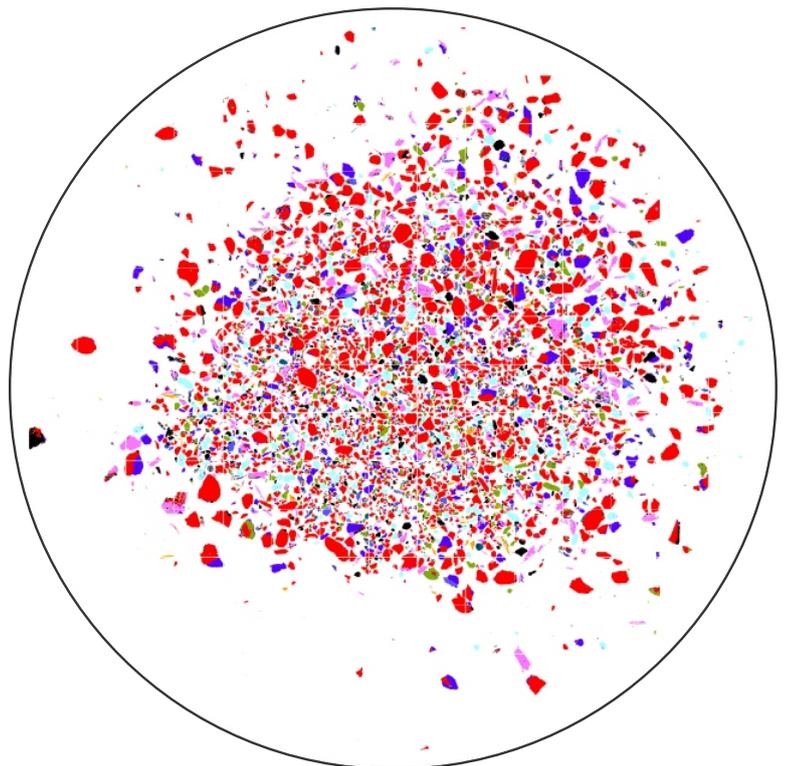
The lack of bedrock exposure in Western Australia presents a challenge to exploration, highlighting the need to see through cover to identify potential for mineralization. Rutile remains chemically unchanged through transport and long periods in sediment and detrital rock (Fig. 2). An important finding for this project is that the trace element signature of rutile can determine whether its parent rock formed in a mineralizing or a barren system. Additionally, the chemical fingerprint of rutile associated with Au mineralization, similar to that of Kalgoorlie and Big Bell, is distinct and can be identified using multivariate analytical techniques and machine learning. This highlights the potential use of rutile in Au exploration and provides geologists with a new tool to efficiently target their search for undiscovered mineralization.

MRIWA Report no. 448 **4D evolution of WA ore systems: rutile – pathfinder to ores** by N McNaughton, B McInnes, N Evans, F Jourdan, C Talavera and JK Porter is available online.

For more information, contact [Jen Porter](#).



Figure 2. Tescan Integrated Mineral Analyzer (TIMA) image of a heavy mineral separate from a sandstone with TiO_2 grains shown in red



Potential of subsurface hydrogen storage under the microscope

A new strategy called the Western Australian Renewable Hydrogen Strategy, is defining the areas of focus for the development of the hydrogen industry. The strategy includes exports, remote applications, hydrogen blending in natural gas networks and transport. The Western Australian Government established a dedicated Renewable Hydrogen Unit as an initiative to coordinate the State's work on growing the industry. The Subsurface Hydrogen Storage project is one of these initiatives to identify locations suitable for hydrogen storage. Stage 1 of the project is a Literature Review and Scoping Study which was completed by RISC on 30 August 2021.

The Literature Review of several subsurface storage options focused on depleted oil and gas fields and the potential to create salt caverns in the State. RISC screened 23 depleted fields and identified seven as good candidates to investigate further as part of Stage 2 of the project which will deal with 3D modelling.

The global subsurface hydrogen storage industry is at an embryonic stage. The subsurface storage of hydrogen is currently limited to a handful of caverns manufactured by dissolving the salt by pumping water. There are currently no depleted oil or gas fields used to store pure hydrogen. In spite of the infancy of the industry, there are many published articles related to hydrogen as it is becoming a major enabler for companies and countries to reach their net zero greenhouse gas emission aspirations and targets.

The Geological Survey of Western Australia is preparing a Report with RISC entitled **Hydrogen Storage Potential of Depleted Oil and Gas Fields in Western Australia Literature Review and Scoping Study** which will be available on the DMIRS eBookshop soon.

For more information, contact [Deidre Brooks](#).

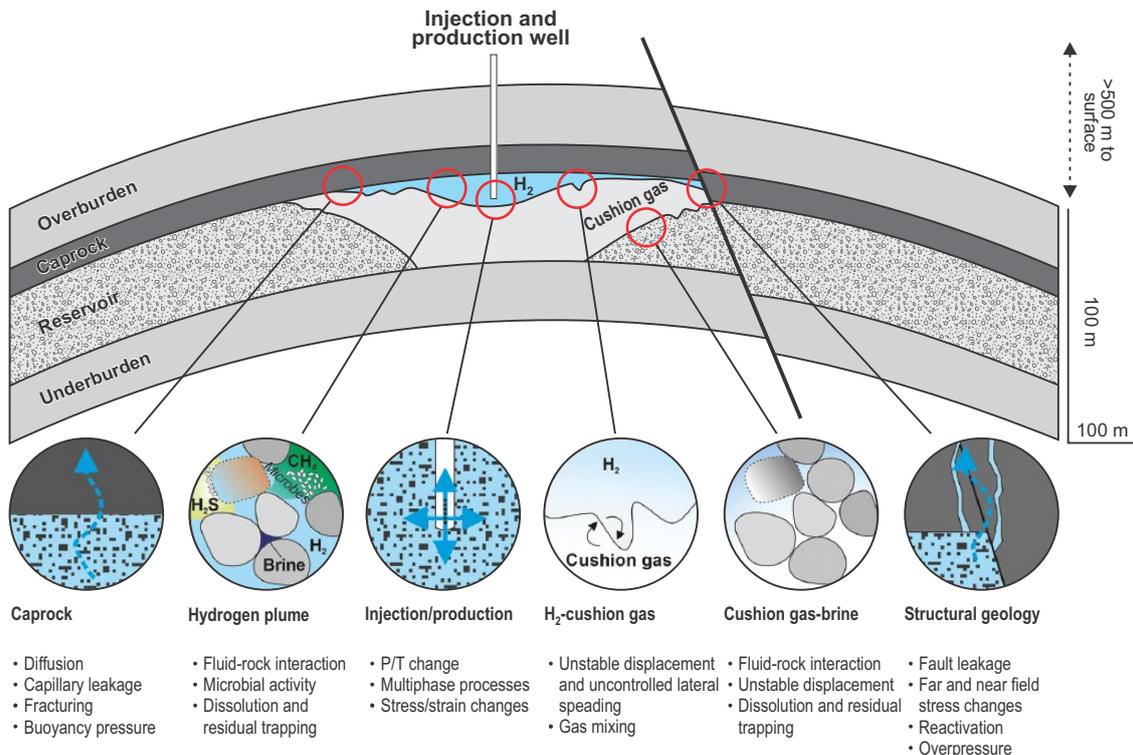


Figure 1. Uncertainties of hydrocarbon storage in porous media (Source: Enabling large-scale hydrogen storage in porous media, Niklas Heinmann et al. in Energy Environmental Science and Engineering, 2021)

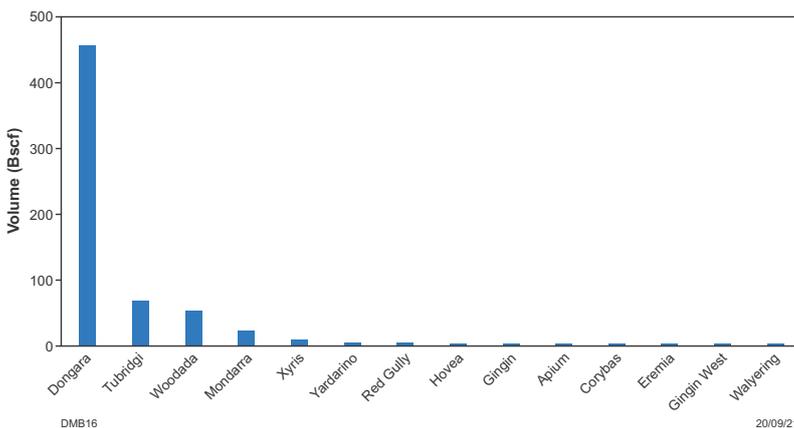


Figure 2. Depleted oil and gas fields in Western Australia with potential for hydrogen storage

Product releases

• DATA PRODUCTS •

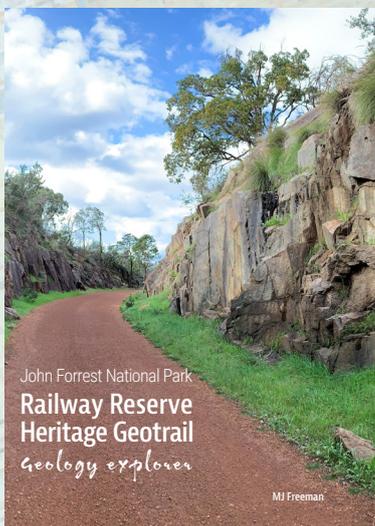
Compilation of metamorphic history information

• BOOKS •

GSWA calendar 2022



John Forrest National Park Railway Reserve Geotrail – Geology explorer
by Freeman, MJ



Record 2021/1 Geological Survey work program 2021–22

Report 217 Regional petrophysics Paterson Orogen 2020–21

by Markoski, M, Trunfull, J and Bourne, B

Report 218 Regional petrophysics Eucla basement 2020–21

by Markoski, M, Trunfull, J and Bourne, B

Report 219 Regional petrophysics West Arunta 2020–21

by Markoski, M, Trunfull, J and Bourne, B

• ONLINE •

3D geomodel of Western Australia, 2021

by Murdie, RE



GEO
MAP.WA

GEO
VIEW.WA

TEN
GRAPH
WEB

MINE
DEX

WAMEX

DRILL
HOLES

DATES Thursday 18 November 2021
Thursday 28 April 2022

SCHEDULE

- 09:00 – 10:00 **GeoMap.WA**
- 10:00 – 12:00 **GeoVIEW.WA** and **TENGRAPH Web**
- 12:00 – 13:00 Lunch
- 13:00 – 14:00 Minerals and Mineral Deposits (**MINEDEX**)
- 14:00 – 15:00 **Mineral exploration reports (WAMEX)** and **Exploration drilling and surface geochemistry database (Drillholes)**

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