



Department of Energy, Mines,
Industry Regulation and Safety

Fieldnotes

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Ellendale

From diamonds
to the unknown

The Wyalkatchem earthquake swarm

Wells of data at your fingertips

GSWA rock classification scheme



GSWA
Open Day
2024



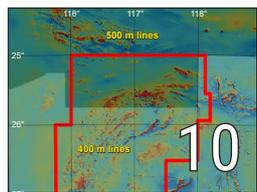
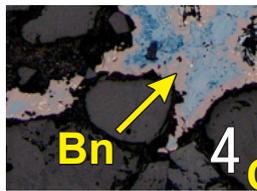
Geological Survey of
Western Australia

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Acknowledgement of Country

The Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) respectfully acknowledges Aboriginal peoples as being the traditional custodians of Western Australia. We acknowledge the enduring connection Aboriginal people continue to share with the land, sea and sky through both their ancestral ties and custodianship to Country. We pay our respect to Elders both past and present, and acknowledge the value brought to our department through the collective contribution of Aboriginal and Torres Strait Islander peoples across Western Australia.

Access publications

All publications

Download maps, reports and digital information free from our [website](#).

Hard copies

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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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: The GSWA and MIWATCH teams at the Ellendale E4 open pit



Ellendale: from diamonds to the unknown

In response to challenges arising from the increasing need for critical minerals and a circular economy, the Geological Survey of Western Australia (GSWA) are collaborating with the Mine Waste Transformation through Characterisation (**MIWATCH**) group, based at the University of Queensland, to characterise mine waste at selected sites across Western Australia.

In August 2024, a team from GSWA joined colleagues from MIWATCH to sample mine waste at the Ellendale mine in the Kimberley region. Ellendale, an abandoned diamond mine now under the care of GSWA's **Abandoned Mines Program**, is famous for the Fancy Yellow diamonds produced there between 2002 and 2015. The diamonds at Ellendale are hosted by lamproite, an ultramafic igneous rock that intruded Devonian and Permian sedimentary rocks and erupted at the surface at about 22–18 Ma. The lamproites at Ellendale have a distinctive chemistry, which is enriched in light rare earth elements, nickel, titanium, phosphorus, barium and fluorine, making them an interesting target for secondary prospectivity. The team from GSWA learned methodologies from MIWATCH collaborators and discussed project outcomes, which include geochemical and mineralogical characterisation of different types of mine waste.

In September, a GSWA–MIWATCH team will be applying this knowledge to a reconnaissance trip at the Nifty copper mine in the Paterson Orogen, supported by Cyprium Metals, where we will plan a future waste characterisation program.

For more information email [GSWA](mailto:gswa@gswa.gov.au).



Samples from a tailings storage facility at Ellendale recovered by hand augering

Ellendale E9 pit



The Wyalkatchem earthquake swarm



Australian Government
Geoscience Australia



The Wheatbelt of Western Australia lies in what is known as the South West Seismic Zone (SWSZ), an area which regularly experiences small earthquakes. But every so often, a larger event can hit the headlines. Remember the magnitude 6.5 Meckering earthquake in 1968? Maybe you felt the two earthquakes that happened in the Lake Muir area in September and November of 2018? Or more recently, the three shocks with magnitudes greater than 4 that hit the community of Arthur River in January and February 2022? Since then, two moderately sized earthquakes have occurred near Gnowangerup. This year, it has been the turn of Wyalkatchem to be the centre of an ongoing swarm of seismic activity.

Since May of this year, 59 earthquakes have been recorded in the Wyalkatchem area. Most of these are registered as having a magnitude of between 2 and 3. Since the National Earthquake Alerts Centre (NEAC) in Canberra only publish events of magnitude greater than 2, this means that there have probably been a lot more smaller earthquakes which have gone unreported. They all originate from a specific location which happens to be just to the south-east of Wyalkatchem. This is enough for this grouping of seismic activity to be called a swarm of earthquakes.

However, on 18 August, two earthquakes with a magnitude greater than 4, shook the Wyalkatchem region. That is large enough to be significant regarding collection of data for engineering and scientific purposes. Recently GSWA, together with the Department of Fire and Emergency Services (DFES), have procured a set of monitoring instruments, specifically designed for aftershock monitoring for occasions such as these. These kits comprise a broadband seismometer to measure weak ground shaking, an accelerometer to measure strong ground motion, a digitiser, and a modem with antenna to transmit the data in real time to a data server. Three of these kits were rapidly deployed by GSWA to the Wyalkatchem area. They were augmented by an additional five sets of instruments from Geoscience Australia (GA), who happened to be in Western Australia at the time. The GSWA data are being sent to the Seismological Research Centre in Melbourne. From there, GA, who run the NEAC, accesses the data and adds it into its alerting system to accurately locate any aftershocks. This equipment has been purchased out of a grant awarded to GSWA and DFES from the National Disaster Risk Reduction Grant Program.



GSWA seismologist Reza Ebrahimi installing a rapid deployment kit to monitor the Wyalkatchem earthquake swarm

There are a few permanent earthquake monitoring stations in Western Australia. However, the earthquake locations calculated based on this sparse network can be up to 20 km in error, depending on the local coverage and data availability. If earthquake activity happened in a populated area, and emergency services were needed, the location of any aftershocks should be known to much greater accuracy to direct emergency services to where they are needed most and to inform the residents of the likelihood of continuing damage. Hence, rapid deployment aftershock monitoring kits are used to better locate these swarms of smaller events. In the unfortunate likelihood that a larger earthquake occurs, these kits will record valuable strong-motion data from rare stable continental region earthquakes, making these data globally significant.

This is the first real use of the rapid deployment kit newly purchased by GSWA and a good demonstration of cooperation between GSWA, DFES and GA.

For more information email [GSWA](mailto:gswa@gswa.wa.gov.au).

Insights into the Officer Basin's potential for sediment-hosted copper

Sediment-hosted copper (SedCu) deposits supply roughly one quarter of the world's copper, with notable Western Australian examples within the well-explored Yeneena Basin. However, much of the neighbouring Officer Basin remains underexplored and undervalued with respect to copper.

Conceptually, the Officer Basin is a fit for the SedCu model, with evidence for the necessary mineral system components. To test this notion, WAMEX and WAPIMS reports from the Officer Basin were reviewed for SedCu indicators, leading to the re-evaluation of multiple Officer Basin drillholes housed within GSWA's Core Library. New observations and selective sampling revealed promising results at depths of approximately 550 m or less.

For example, a review of drillhole OB002, originally drilled for potash, revealed unreported chalcopyrite within a dolomitic edgewise conglomerate of the Woolnough Member (Fig. 1). Further down hole was a Cu-enriched (291 ppm Cu) very fine-grained sandstone to siltstone in a reduced interval within an oxidised zone of the Lower Browne Formation.

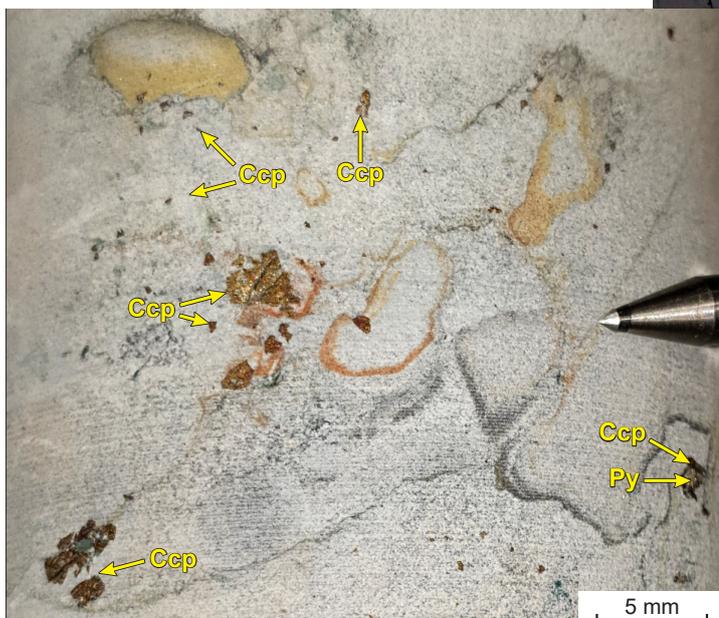
Vug-hosted sulfides, previously logged as pyrite, within Steptoe Formation dolomite of GSWA Empress 1A, displayed >1000 ppm Cu (pXRF), indicating the presence of Cu sulfides. Assays of the host dolomite are low in absolute Cu, but showed anomalous Co (22 ppm), V/Sc (up to 101) and Cu/Sc (up to 57) – values far higher than dolomite not associated with sulfide-rich vugs in Empress 1A or other Officer Basin samples.

Previously unsampled, partially black siltstone intervals within the Kanpa Formation of GSWA Lancer 1 were recorded with up to 404 ppm Cu, 7.65 ppm Ag, and V/Sc of 20.

A chemostratigraphic study by Chemostrat and Geoscience Australia on GSWA Vines 1 assayed a core chip sample with 1007 ppm Cu. Further GSWA review and sampling of this section of drillcore highlighted a Cu-enriched interval of the Wahlgu Formation between 334 and 350 m depth, near the unconformity with the Lungkarta Formation. Assays yielded values up to 3210 ppm Cu and 7.22 ppm Ag. Thin sections taken from the sandy low clast diamictite host showed post-depositional bornite–chalcocite–chalcopyrite assemblages (Fig. 2).

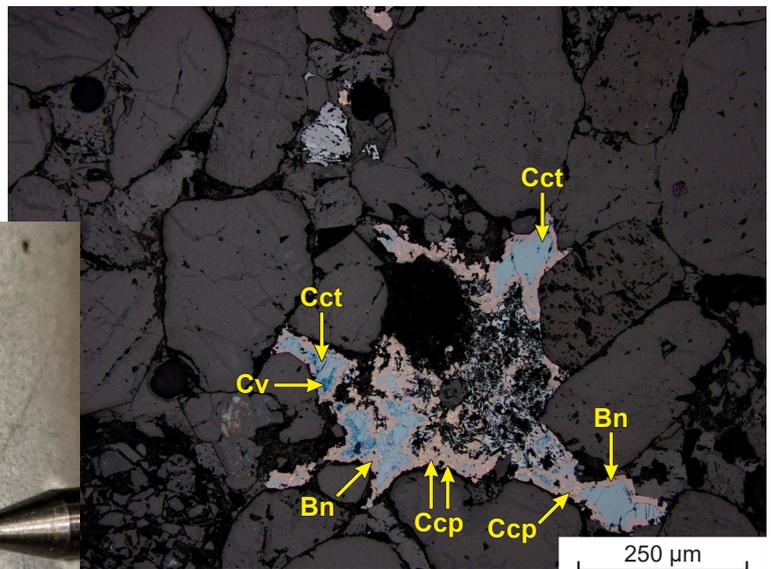
These findings suggest the presence of a SedCu system within the Officer Basin, opening the possibility for a new copper province. They also highlight the value of new investigations on archived drillcore and legacy data. This preliminary study is to be followed up with further work by GSWA to unlock the copper prospectivity of Western Australia's sedimentary basins.

For more information, email [Matt Clarke](mailto:Matt.Clarke@gsa.gov.au).



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Figure 1. Example of tarnished disseminated chalcopyrite within dolomitic edgewise conglomerate of the Woolnough Formation, OB002 drillhole. Abbreviations: Ccp – Chalcopyrite, Py – Pyrite

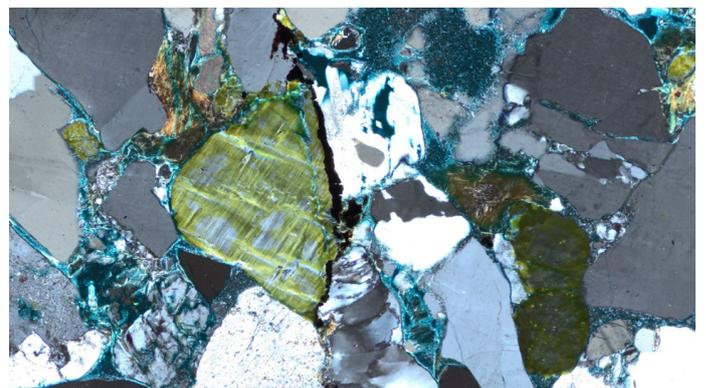
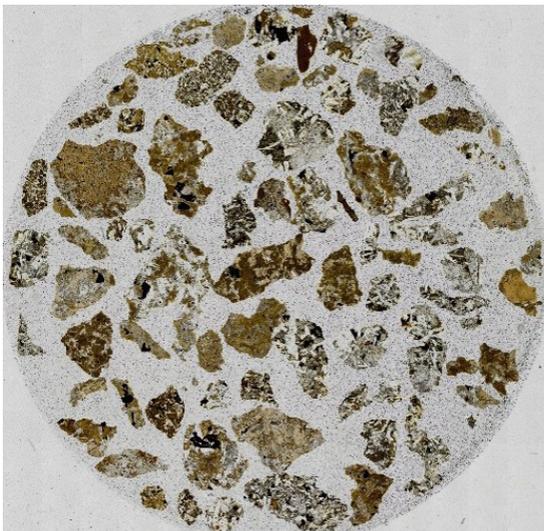
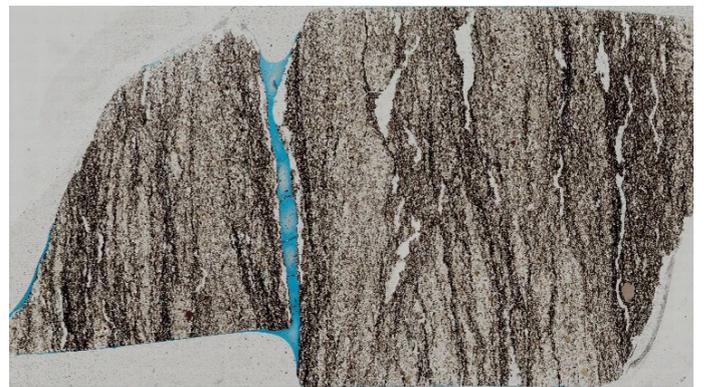
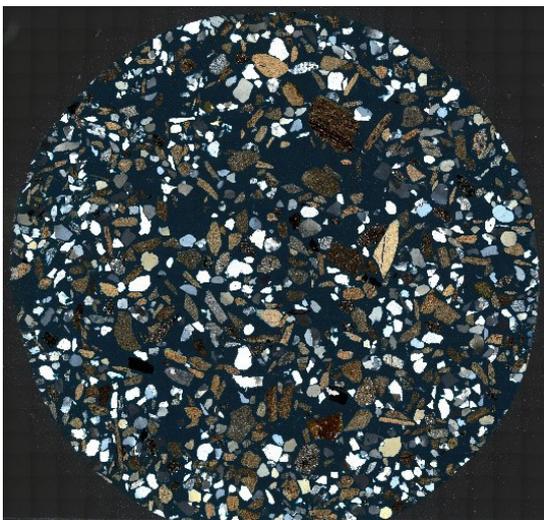
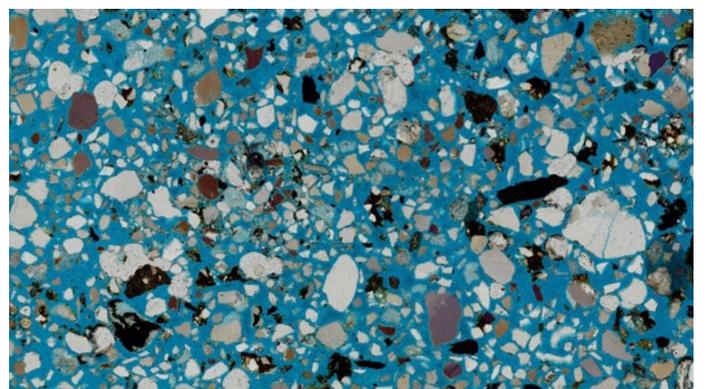
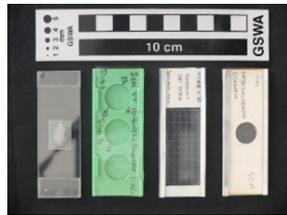


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Figure 2. Polished thin section image in reflected light from the GSWA Vines 1 drillhole at 340 meters, showing a copper sulfide mineral assemblage (bornite-chalcocite-chalcopyrite±covellite) within Wahlgu Formation sandstone. Abbreviations: Bn – Bornite, Ccp – Chalcopyrite, Cct – Chalcocite, Cv – Covellite

Wells of data at your fingertips

The Geoscience Data Transformation Program has successfully supplied advanced thin section scanning capability to GSWA. Thin sections from 32 Perth Basin wells in the GSWA Petroleum Collection have been scanned and are available via the Western Australian Petroleum and Geothermal Information Management System (WAPIMS). The Olympus VS200 scanner produced more than 1,000 high-resolution RAW images and JPEG previews that are uploaded into MS Azure cloud storage. In addition, more than 15,000 analogue petroleum-related seismic lines from 10 Western Australian basins have been digitised into high-resolution image files. Over 1,000 have been vectorised into SEG Y format that can be used in petrotechnical applications. These were uploaded into MS Azure and are also available via [WAPIMS](#).



Access [WAPIMS](#), or email the [Geoscience Data Transformation Program](#) team for more information.

GSWA rocks! The revised GSWA rock classification scheme

Unified, standardised and externally aligned terminology defining key scientific terms and relationships is crucial to ensure effective data use and sharing. Within its Geoscience Data Transformation Program, GSWA is publishing a series of vocabularies to ensure the data underpinning its systems/databases are FAIR (findable, accessible, interoperable, and reusable).

As part of this body of work, the *GSWA rock classification scheme* that covers the lithological nomenclature used within the organisation to map and code bedrock units in Western Australia has been revised and released as a vocabulary. The fundamental premises of the existing scheme (Tyler et al., 2004) are unchanged:

- the scheme provides consistent terminology and coding within GSWA, for use during field work, core logging and to interpret map units (Fig. 1), and is based on internationally recognised schemes (except for pyroclastic rocks)
- is informed by Western Australian geology
- primarily relies on features observable in rocks at **outcrop scale, in hand specimens, and in thin sections**, i.e. with very few exceptions, no chemical or textural/geometry terms are included.



Figure 1. Unconformity between cleaved siltstone of the June Hill Volcanics and conglomerate at the base of the overlying Cardo Group at June Hill. Geologists for scale

The vocabulary includes 55 rock types (primary and metamorphic equivalents) and 666 lithologies, of which 95 are new to the scheme (Fig. 2). Notably, the latter include a full range of microgranitic rocks that with the addition of a porphyritic qualifier will allow description of 'porphyries' (a textural term that does not constitute a lithology). Additional sedimentary lithologies cover for a wider range of grain sizes, sandstone compositions, and iron-formation types. Gaps for felsic igneous rocks (and metamorphic equivalents) were filled (e.g. quartz latite/trachyte, trondhjemite, metamazonzodiorite). The scheme has also been expanded for hydrothermal rocks (e.g. fenite, rodingite), fault rocks and impactites.

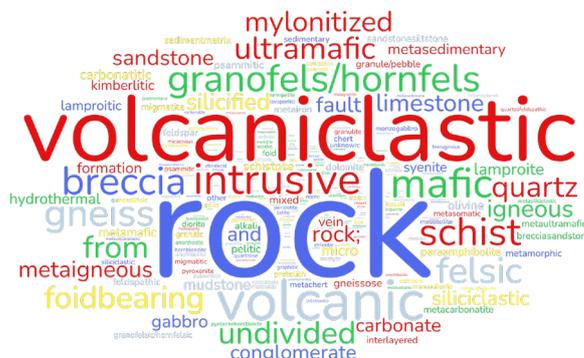


Figure 2. A word cloud of GSWA rock types and lithologies

The *GSWA rock classification scheme* vocabulary includes a concept scheme detailing the approach and providing relevant references. Each term (concept) in the vocabulary has a definition, alternate label(s) if appropriate (e.g. flint for chert), and a notation (i.e. a lithological code). Definitions were largely compiled from authoritative sources and the Glossary of Geology (5th edition, revised; Fig. 3). Notations in the vocabulary do not cover the full spectrum of qualifiers used by GSWA to categorise map units, and an update of the GSWA Code Builder application to match this vocabulary will be completed after a companion vocabulary for regolith materials is finalised.

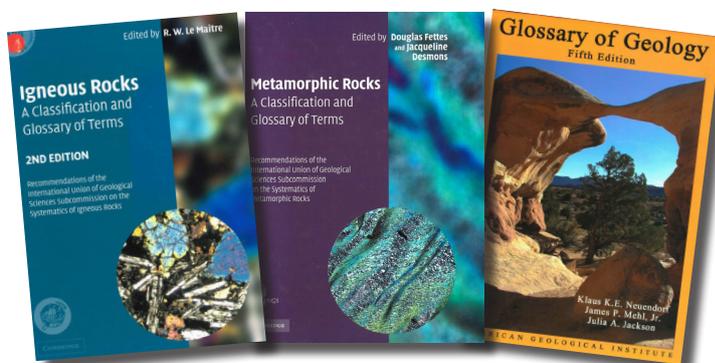


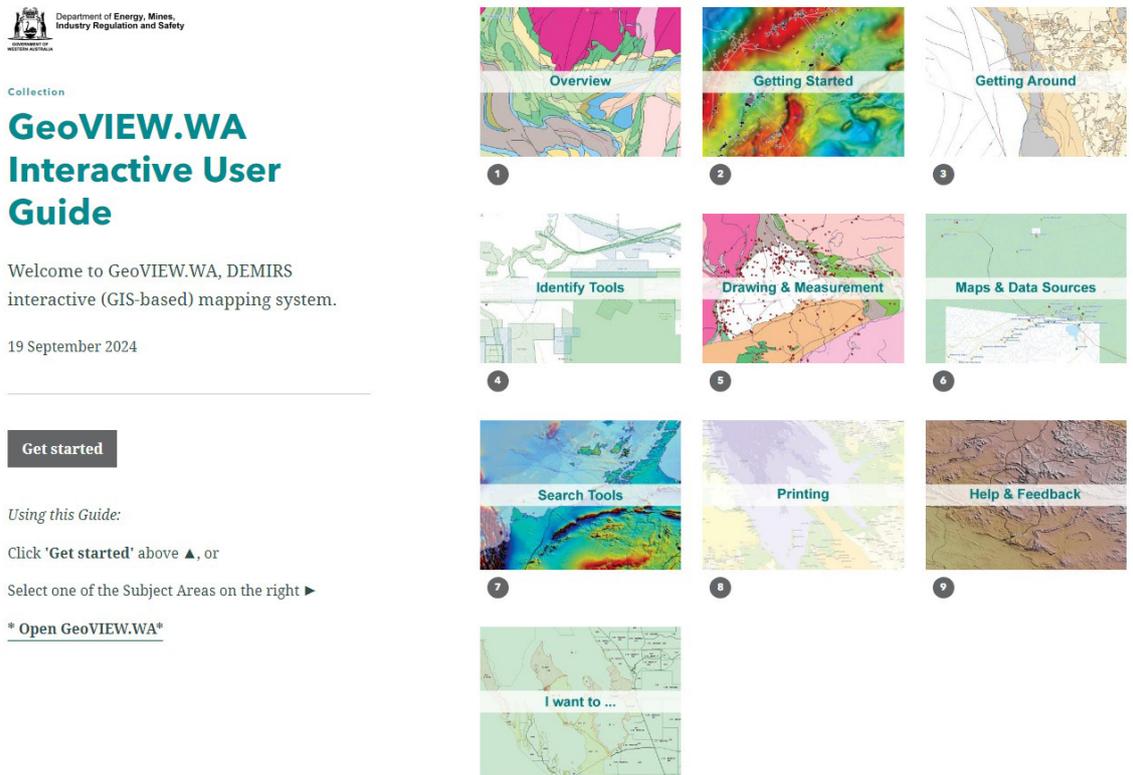
Figure 3. Authoritative sources used for GSWA rock type and lithology definitions

GSWA rock classification scheme can be viewed and downloaded in different formats. It provides the geological community with an expanded reference for, and explanation of, current rock codes used in GSWA mapping/logging and digital products.

GSWA public vocabulary registry. Each vocabulary in the registry is compiled and reviewed by GSWA's subject matter experts, with or without external consultation, and edited prior to publication; a governance process ensures vocabularies can be updated should the need arise. A *Search* tab allows interrogation for individual terms within single, multiple or all published vocabularies.

For more information, email [GSWA vocabularies](#).

Navigating GeoVIEW.WA: a new interactive user guide



GeoVIEW.WA is an interactive (GIS-based) online mapping system which runs on all browsers via desktop, tablets, and mobile devices. The site allows the user to view, search, and investigate:

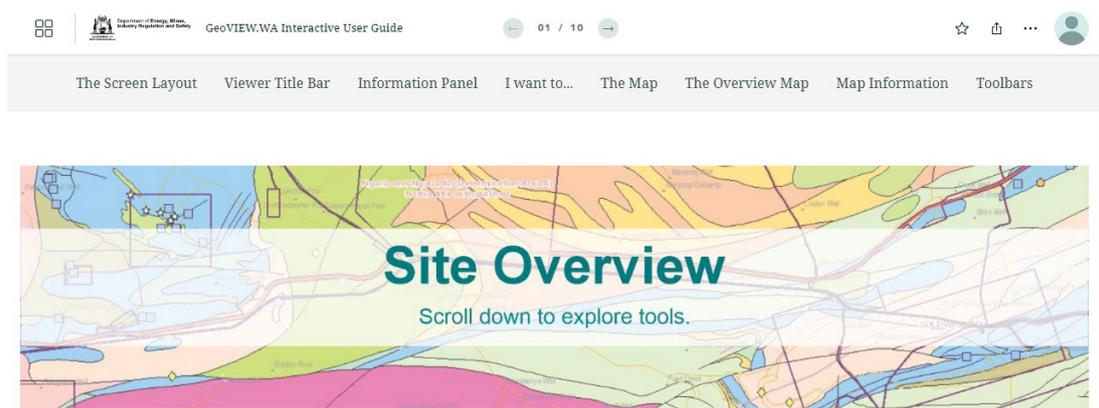
- geological data
- mineral and petroleum exploration data
- mines and mineral deposits
- petroleum wells
- mining leases and tenements
- and much more ...

GeoVIEW.WA is made up of many tools with a variety of functionalities, some simple and others more complex. Currently there is the *Quick Reference* and *User Guide* located in the *Help & Feedback* menu tab which are very useful, but the new interactive user guide takes tutorials to the next level.

The **GeoVIEW.WA Interactive User Guide** is presented using ArcGIS StoryMaps, it does not only explain how to navigate the site, but also how to use the applications with the help of a series of videos. The tutorial videos give the user the basics they need to get started, as well as demonstrations on using more complex tools and functionalities.

In this StoryMap Collection made up of ten stories (*Subject Areas*), you will find all instructional content including guides for new users, in-depth video tutorials for specific features, and tips for using GeoVIEW.WA. Navigate between Subject Areas by selecting them in the Main Navigation bar. To navigate within a Subject Area, either continue scrolling through the story or select the topics from the Topic Navigation bar.

For further information email GeoVIEW.WA.





Discover future-focused geoscience

Join GSWA at the 26th GSWA Open Day on Friday, 15 November 2024 at Pan Pacific Perth.

This annual conference brings you face-to-face with Western Australia's leading geoscience organisation. You will gain new insights on groundbreaking geoscience, be the first to discover new world-class data, and network with the industry, government, and academia. Tickets to GSWA Open Day have sold out every year since 2021 – this annual conference is one that you do not want to miss.

GSWA Open Day continues to grow, garnering unprecedented attention across Western Australia and beyond. This year, we have curated an exceptional program featuring a wide range of geosciences, valuable networking opportunities, and updates on major GSWA initiatives that will help shape the future of our State.

Inspiring thought leaders Nicole Roocke of the Minerals Research Institute of Western Australia, and Andrew Heap from Geoscience Australia, will provide guest keynotes. Their ongoing collaboration with GSWA strengthens research, development, and world-class geoscience across the country. The afternoon will feature special guest Professor Ken Collerson, who will present on a recent regolith-hosted heavy rare earth discovery.

These kinds of discoveries underscore the importance of GSWA's mapping and precompetitive geoscience data acquisition in supporting future exploration.

GSWA presentations will include the launch of the new CO₂ Storage Atlas of Western Australia, a key initiative aligned with the Western Australian Government's priority to facilitate CO₂ sequestration. Team WA Array will engage in a fireside chat to candidly discuss their ambitious passive seismic program. In the afternoon, our expert geoscientists will share insights into the various other programs GSWA is actively pursuing.

Whether you are a seasoned geoscientist, an early-career professional, a passionate student, or an industry representative seeking to expand your knowledge base, GSWA Open Day 2024 promises to be an enriching and transformative experience. Let's get together to shape a better future through the power of knowledge, exploration, and collaboration.

Get your **tickets** before 5 pm on Friday 8 November 2024!

How to access

For more information, visit **GSWA Open Day 2024**, or email **Sabrina Bednarski**.



(l-r) Michele Spencer, Executive Director, Geological Survey and Resource Strategy Division (GSRSD), Richard Sellers, Director General DEMIRS, Jeff Haworth, former Executive Director GSRSD, and Andrew Chaplyn, Deputy Director General DEMIRS at GSWA Open Day 2023

Product releases

• PUBLICATIONS •

Report 247 Imaging the geometry of paleovalleys in the southwest region of Western Australia: linking basement and cover

Jakica, S, Duuring, P, González-Álvarez, I and Porter, JK

Report 254 Palynology overview of southwest Western Australia

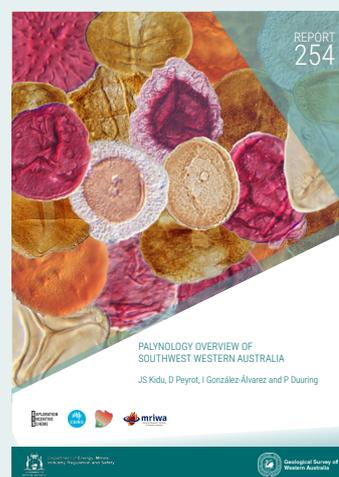
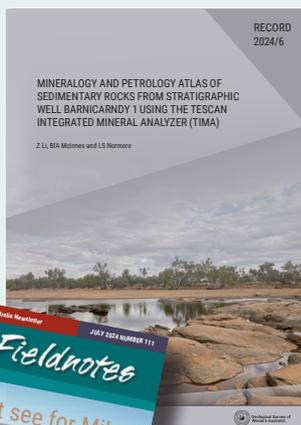
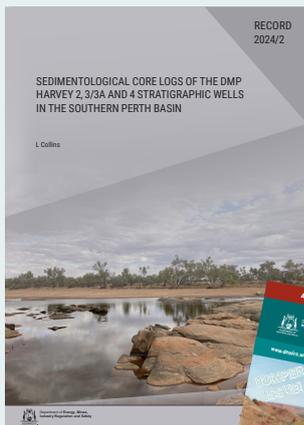
Kidu, JS, Peyrot, D, González-Álvarez, I and Duuring, P

Record 2024/2 Sedimentological core logs of the DMP Harvey 2, 3/3A and 4 stratigraphic wells in the southern Perth Basin

Collins, LM

Record 2024/6 Mineralogy and Petrology Atlas of Sedimentary Rocks in stratigraphic drillhole Barnicarndy 1 using the Tescan Integrated Mineral Analyzer (TIMA)

Li, Z, McInnes, BIA and Normore, LS



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DEMIRS Data Essentials applications training November 2024

Attend in-person training sessions across seven DEMIRS applications and databases

- GeoMap.WA
- GeoVIEW.WA
- Mineral Titles Online (MTO) and TENGGRAPH Web
- Mines and Mineral Deposits (MINEDEX)
- Mineral exploration reports (WAMEX) and Exploration drilling and surface geochemistry database (Drillholes)
- Western Australian Petroleum and Geothermal Information Management System (WAPIMS)

Register for individual sessions that suit your needs across two days:
Tuesday 12 and Wednesday 13 November, 2024

Register

When you **register**, include your details (name, company name, telephone number), with the name, location and date of the training you wish to attend. See the **training page** on our website.