

Fieldnotes



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

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100 km

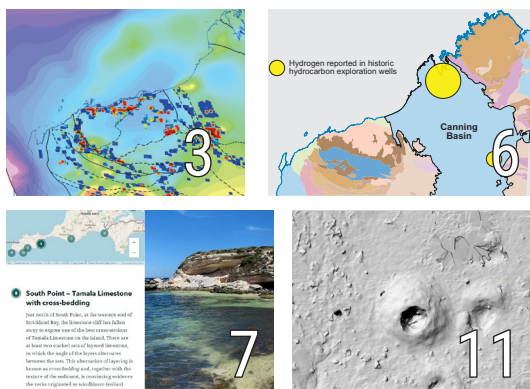


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Fieldnotes

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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Cover image: Interpretive spatial data layers available through the AGP



New geoscience data products to increase State mineral and energy prospectivity

EXPLORATION
INCENTIVE
SCHHEME

AGP

Accelerated Geoscience Program

The Geological Survey of Western Australia's (GSWA) Accelerated Geoscience Program (AGP) was developed in direct response to the COVID-19 pandemic, in order to aid economic recovery and stimulate the exploration industry. The program was designed to synthesize and deliver new interpretive datasets across all areas of geoscience, in key regions across the State, in particular in areas with new or emerging mineral potential.

The datasets were designed to:

- provide geological insights into the composition and fertility of the State's bedrock geology, particularly in areas where the rocks are buried by extensive cover such as that in the Southwest and Far East Yilgarn Craton
- increase our understanding of the State's potential energy resources, including low carbon technology and geothermal projects
- catalogue the known critical mineral resources of the State, to better understand the mineral systems in which they occur, and understand their associated alteration systems.

To aid this program, GSWA also focused on improving its databases, in particular the Western Australian Mineral Exploration (WAMEX) company geochemistry database, as well as providing accessibility to the online WAMEX reports. The WAMEX drillholes database was harmonized and is now publically accessible [online](#). More than 260 000 WAMEX reports have been digitally captured which are accessible and searchable through an [elastic search](#).

So far, the AGP has delivered over a hundred new interpretive datasets (Fig. 1), comprising 1080 new spatial data layers. Some of these data layers have been published online as GIS layers in GSWA's online data portals GeoVIEW.WA, Mineral Systems Atlas and WAPIMS (Energy Systems Atlas; Fig. 2), and are available for download through the Data and Software Centre.

All data layers are now available within three, standalone Geological Exploration Packages (GEP):

- **Southwest Yilgarn Geological Exploration Package**
- **Far East Yilgarn Geological Exploration Package**
- **Critical Minerals Geological Exploration Package (Fig. 3)**

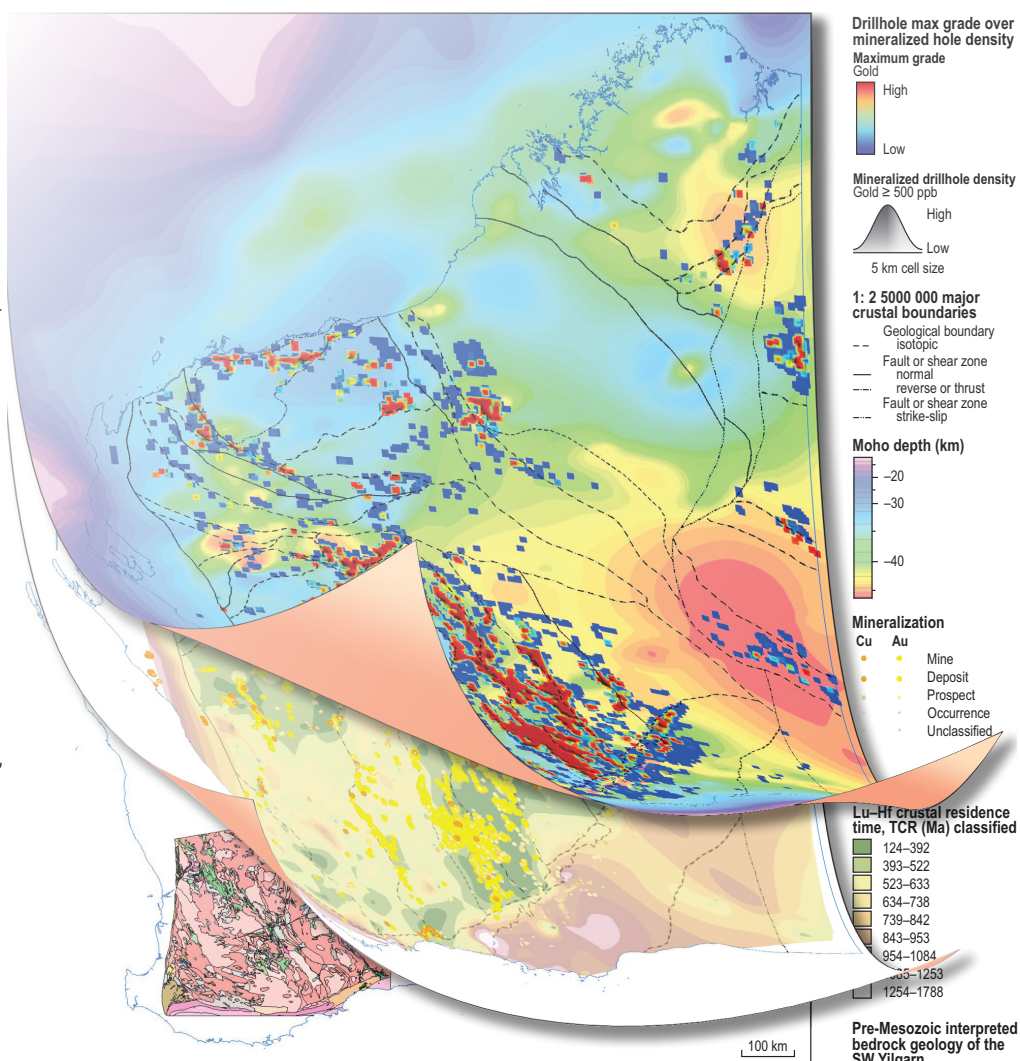


Figure 1. A selection of the new, interpretive spatial data layers available through the AGP that will help the exploration industry find the next generation of deposits

Selected highlights include:

- Pre-Mesozoic interpreted bedrock geology of the Southwest Yilgarn
- 1:250 000 major crustal boundaries of Western Australia
- Whole rock Sm–Nd, and zircon Lu–Hf and Oxygen isotope maps of Western Australia
- Maximum grade in-hole drilling data
- 1:100 000 regolith geology regimes of Western Australia

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Accelerated Geoscience Program, 2021

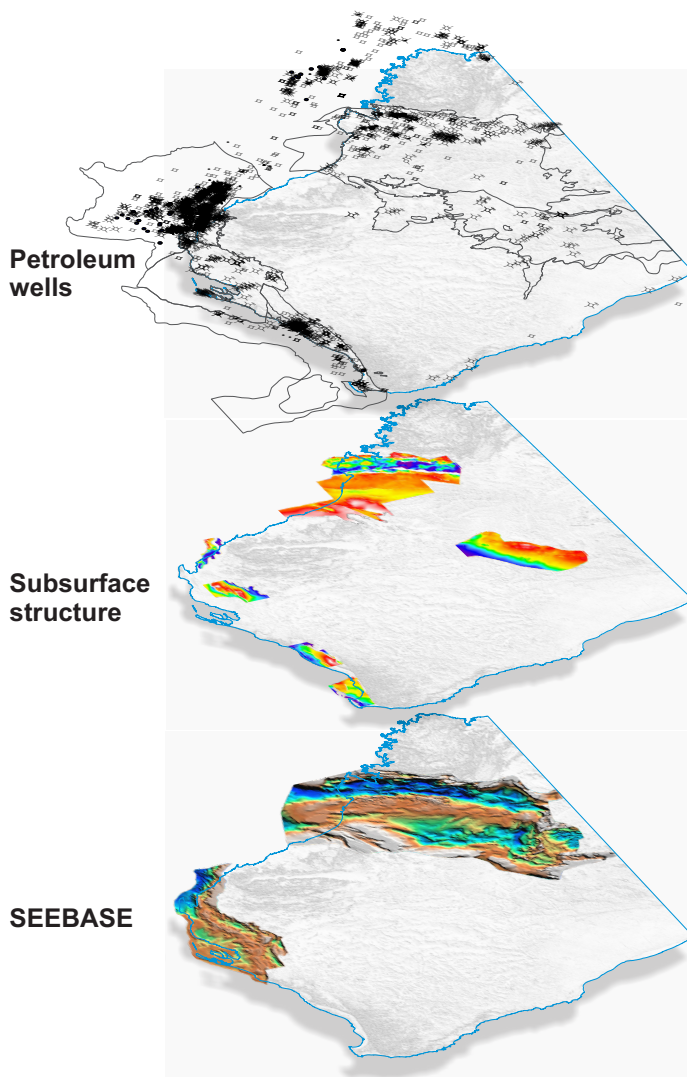


Figure 2. The Energy Systems Atlas is an interactive online mapping tool containing a series of layers displaying geological data captured from legacy GSWA, well completion reports and other industry reports

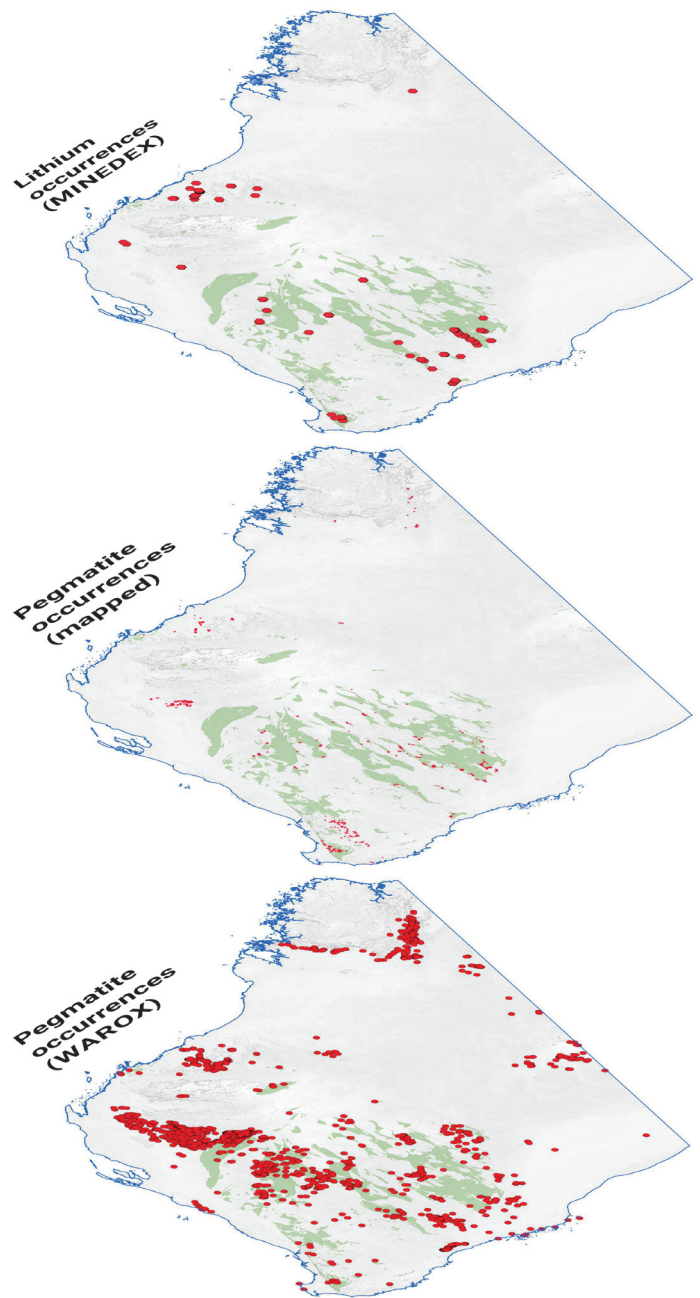


Figure 3. Selected map layers from the Western Australian Critical Minerals data package – pegmatite and lithium occurrences on greenstones and shuttle radar terrain map

- Outcrop geology map of Western Australia
- Western Australian near-surface geochemistry
- State mineralization sites for 21 commodities
- Subsurface structure maps, Western Australian basins
- Well correlations, Phanerozoic and Neoproterozoic basins of Western Australia

These three USB packages are freely available from the First Floor front counter at Mineral House.

For more information, go to our [AGP web page](#) or contact [Michele Spencer](#).

Significant update to Mineral Systems Atlas this year

The Mineral Systems Atlas has been significantly updated for 2021, with the addition of data packages for the following:

- 'rare-element pegmatite' and 'layered intrusion-hosted vanadium' mineral systems
- the State 1:500 000-scale Tectonic Units map
- two derivative layers showing the distribution of large igneous provinces (LIP) and greenstone belts in Western Australia.

The Mineral Systems Atlas is an online, interactive, map-based platform (Fig. 1) that delivers tailored data layers relevant to Western Australian mineral deposits. Layer content is defined using a Mineral Systems Analysis approach and is derived from primary Geological Survey of Western Australia (GSWA)

databases using dynamic queries that ensure automatic and seamless updating of layers whenever new data are added to the primary databases. The complementary Mineral Systems Atlas Guide (Fig. 2) documents all aspects of the creation of the constituent map layers, and the relationships between primary and derived data.

Individual mineral system data packages can be downloaded in a variety of GIS formats from the [Data and Software Centre](#), via links in either the Mineral Systems Atlas or the Guide.

The Atlas and its explanatory Guide can be accessed via the [GSWA web page](#).

For more information, contact the [Mineral Systems Atlas team](#).

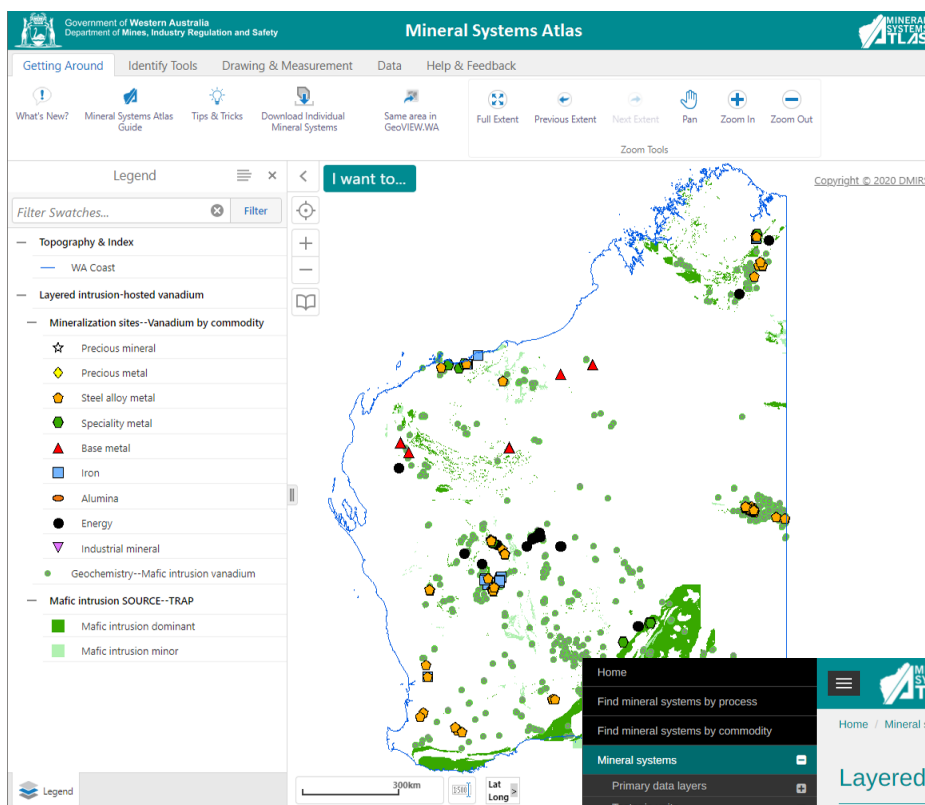
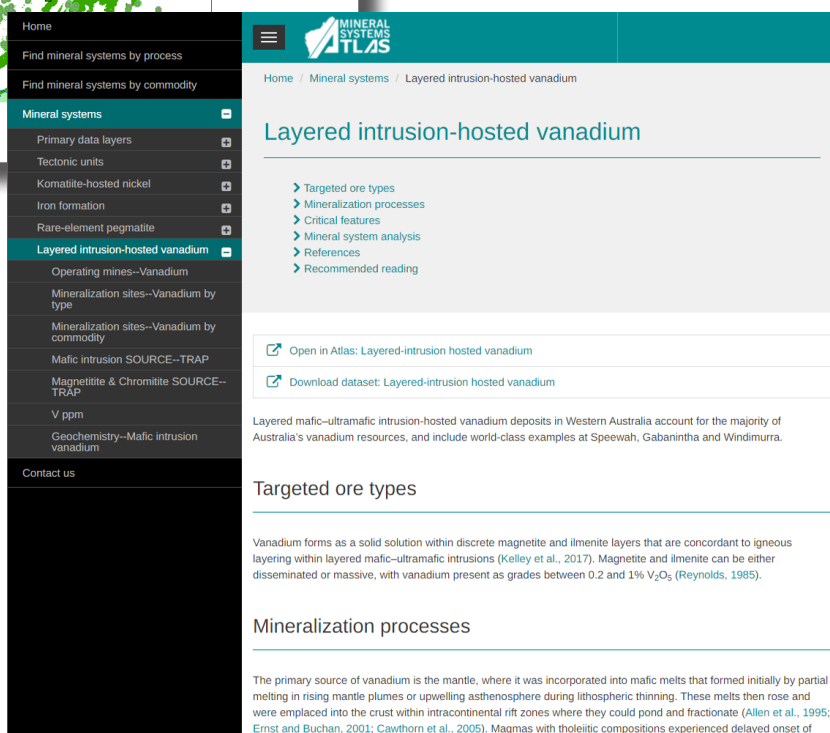


Figure 1. Screenshot of the Mineral Systems Atlas portal, showing three layers available for the layered intrusion-hosted vanadium system: a) mineralization sites symbolized by the main commodity extracted at the mine site; b) all geochemistry samples corresponding to mafic intrusion rocks; c) mafic intrusions found in Western Australia

Figure 2. Screenshot of the Mineral Systems Atlas Guide showing the newly released layered intrusion-hosted vanadium system. The Guide complements the GIS platform by describing the derived data layers, explaining the reasoning behind their inclusion in the mineral system



A potential energy source?

There is currently much discussion around hydrogen as a clean zero-carbon fuel, with most debate centred on so-called green hydrogen, created by electrolysis using non-fossil fuel energy, or blue hydrogen, created from methane, with the waste carbon dioxide captured and stored. But is it possible that economic accumulations of natural molecular hydrogen could exist in the Earth's crust?

The recent discovery of the Bourabougou field in Mali, Africa, where shallow wells are flowing 98% pure hydrogen, and are currently used for small-scale local power generation, is very encouraging. Surface hydrogen seeps have been reported in a number of countries and in different geological environments, and accidental discoveries of hydrogen while drilling for other commodities have been reported worldwide. On the continents, the 'kitchen' for the 'hydrogen system' is most likely situated

deep within cratonic basement, with a number of mechanisms proposed including radiolysis of water and oxidation of iron-rich rocks by water contact. Hydrogen thus generated at depth can migrate upwards via faults and fractures and has the potential to accumulate in porous reservoirs within overlying basins. Subsurface hydrogen is often associated with anomalous helium, the latter produced by radioactive decay in the crust.

Here in Western Australia, the Geological Survey of Western Australia (GSWA) has begun to investigate areas where hydrogen has been reported in gas analyses from historic hydrocarbon exploration wells (Fig. 1). While there are not many hydrogen-bearing wells based on these old reported locations, it must be noted that equipment capable of detecting hydrogen is rarely used during exploration. The source of such hydrogen is unclear in specific cases, and in some it could be an artefact. However, several lines of evidence are consistent with it being geological in most cases. Avenues for research include fluid inclusion studies from archived core and cuttings, and the search for surface hydrogen seeps near these wells using sensitive gas monitoring equipment.

For more information, contact **Peter Haines**.

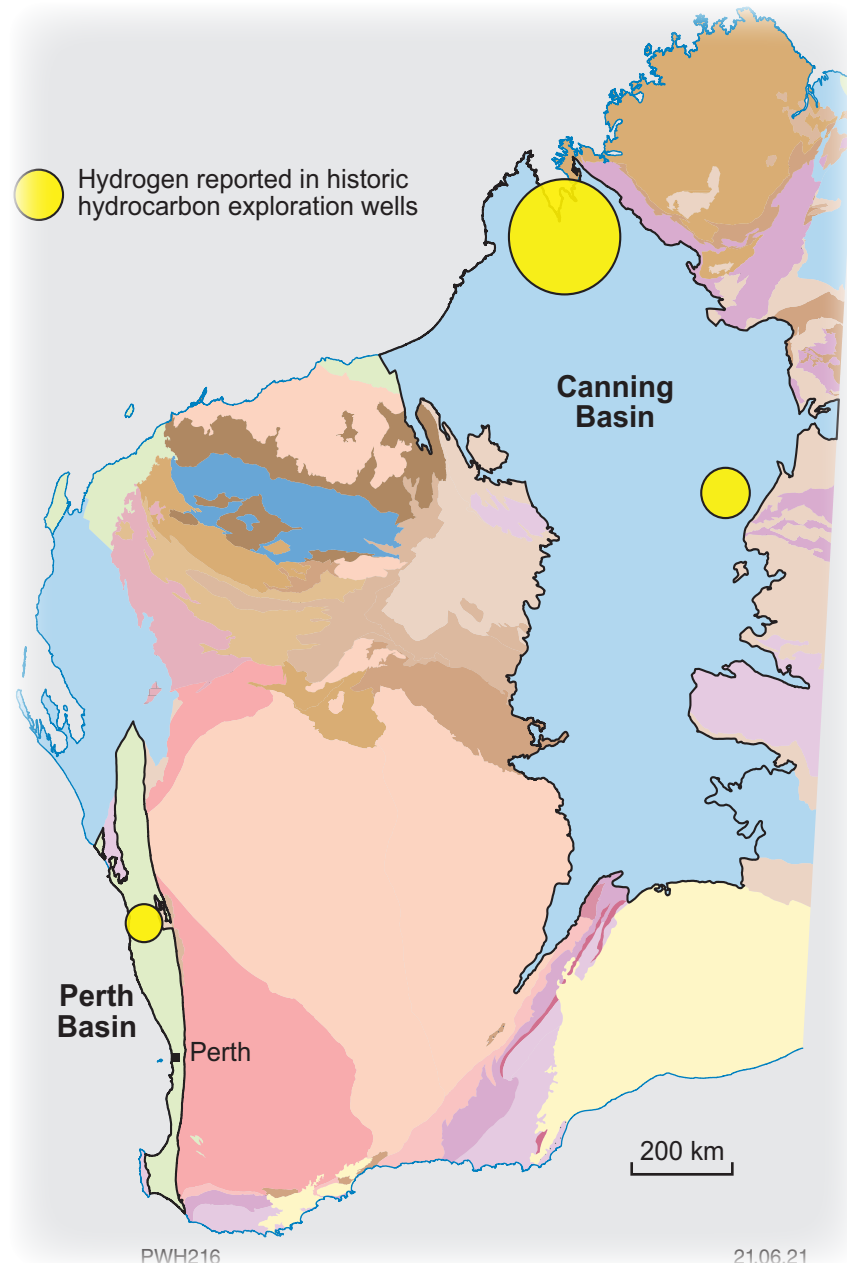


Figure 1. Map of onshore areas in the Canning and Perth Basins where some historic wells have reported hydrogen from gas analyses

Wadjemup / Rottnest Island StoryMap

Take a virtual dive into Western Australia's geology

Wadjemup / Rottnest Island is a popular recreation and holiday destination 18 km off the coast of Perth, Western Australia. It is the subject of the first release of an exciting new venture by the Geological Survey of Western Australia (GSWA) to make geoscience popular using innovative and interactive platforms.

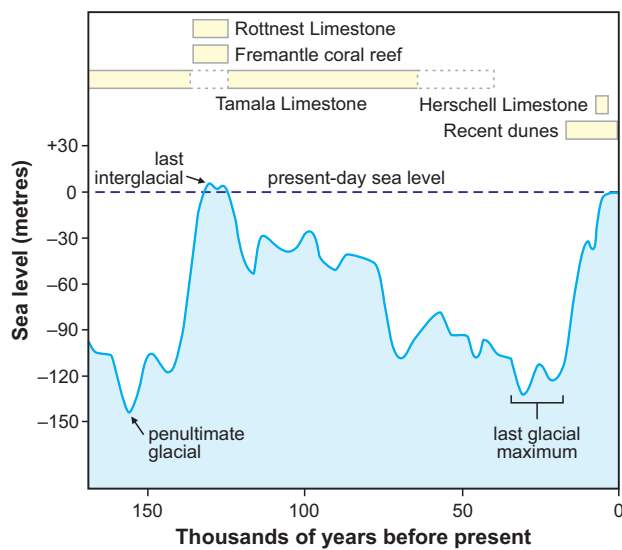
The GSWA Discover Geology team is adapting and repurposing previous GSWA publications to suit the ArcGIS StoryMaps online platform. This browser-based format hosts stories using text, dynamic maps and multimedia content to create virtual tours that are accessible to everyone with an internet connection.

StoryMaps will embed the geoscience in the context of its historical, cultural, environmental and recreational settings, reflecting a growing public interest in geotourism. Stories will be increasingly interactive, employing video, 3D models and animations, and technologies such as augmented reality, to create lively and engaging experiences.

The Rottnest StoryMap is a journey through the island's geology and landscape over the past approximately 150 000 years. Using an interactive map, the virtual visitor explores 11 sites where clues pieced together from geological and coastal features build a picture of rapidly changing marine and terrestrial environments. The narrative these features reveal is matched to the global sea-level curve for the past several hundred thousand years of natural climate change (Fig. 1). Sea level has fluctuated as polar ice caps have waxed and waned, and the impact of these global changes is recorded locally in the rocks of Rottnest (Fig. 2).

View the Wadjemup / Rottnest Island StoryMap [online](#).

For more information, contact [Stephen White](#).

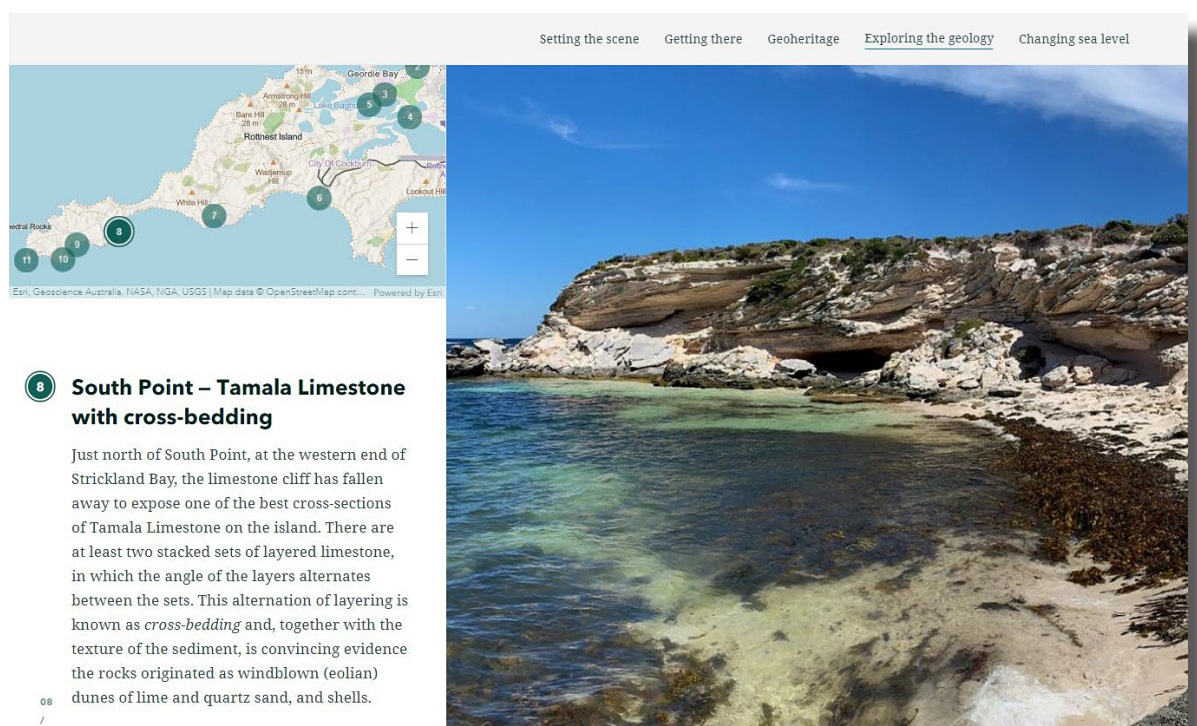


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Figure 1. Ages and paleoenvironments for the sedimentary deposits are a good match for glacial maxima and minima, and the global paleo-sea level curve

Figure 2. (below) Navigation using the interactive locality map, succinct text and crisp photos help virtual visitors immerse themselves in the story



Regional petrophysical data acquisition



In 2020–21, the Geological Survey of Western Australia (GSWA), in collaboration with Terra Petrophysics, began a regional petrophysical data acquisition project. This pilot project aims to characterize the physical properties of the sampled rock types, stratigraphic units, alteration and mineralization to assist with the planning and interpretation of geophysical surveys.

In Phase 1 of the project, petrophysical data were collected from 1642 samples from greenfields Exploration Incentive Scheme (EIS) core from the Paterson Orogen, West Arunta and Eucla basement (Fig. 1). The data from the northern Paterson Orogen show promising results including the effect of weathering on chargeability and resistivity (Fig. 2a), the possible use of magnetic susceptibility and chargeability in defining mineralization (Fig. 2b) and the large spread of acoustic impedance values (Fig. 2c).

In Phase II of the project, petrophysical data are currently being collected from 2000 samples from EIS and company core from the Kalgoorlie and Yamarna Terranes of the Eastern Goldfields Superterrane (Fig. 1). The Kalgoorlie Terrane dataset includes mineralized and unmineralized core, and an almost complete section through the Kalgoorlie Group stratigraphy, from the Kambalda Komatiite to the Lower Black Flag Group.

The physical properties acquired include:

- Magnetic susceptibility
- Remanent magnetization
- Wet and dry bulk density
- Apparent porosity
- Sonic velocity (P-wave velocity)
- Inductive conductivity
- Chargeability and galvanic resistivity.

How to access

Petrophysical data are released as spreadsheets accompanied by a report, and are publicly available in **MAGIX**, which is accessible through GeoVIEW.WA. The Paterson Orogen, Eucla basement and West Arunta datasets have been released as a **downloadable zip file**.

For more information, contact **Lucy Brisbout**.

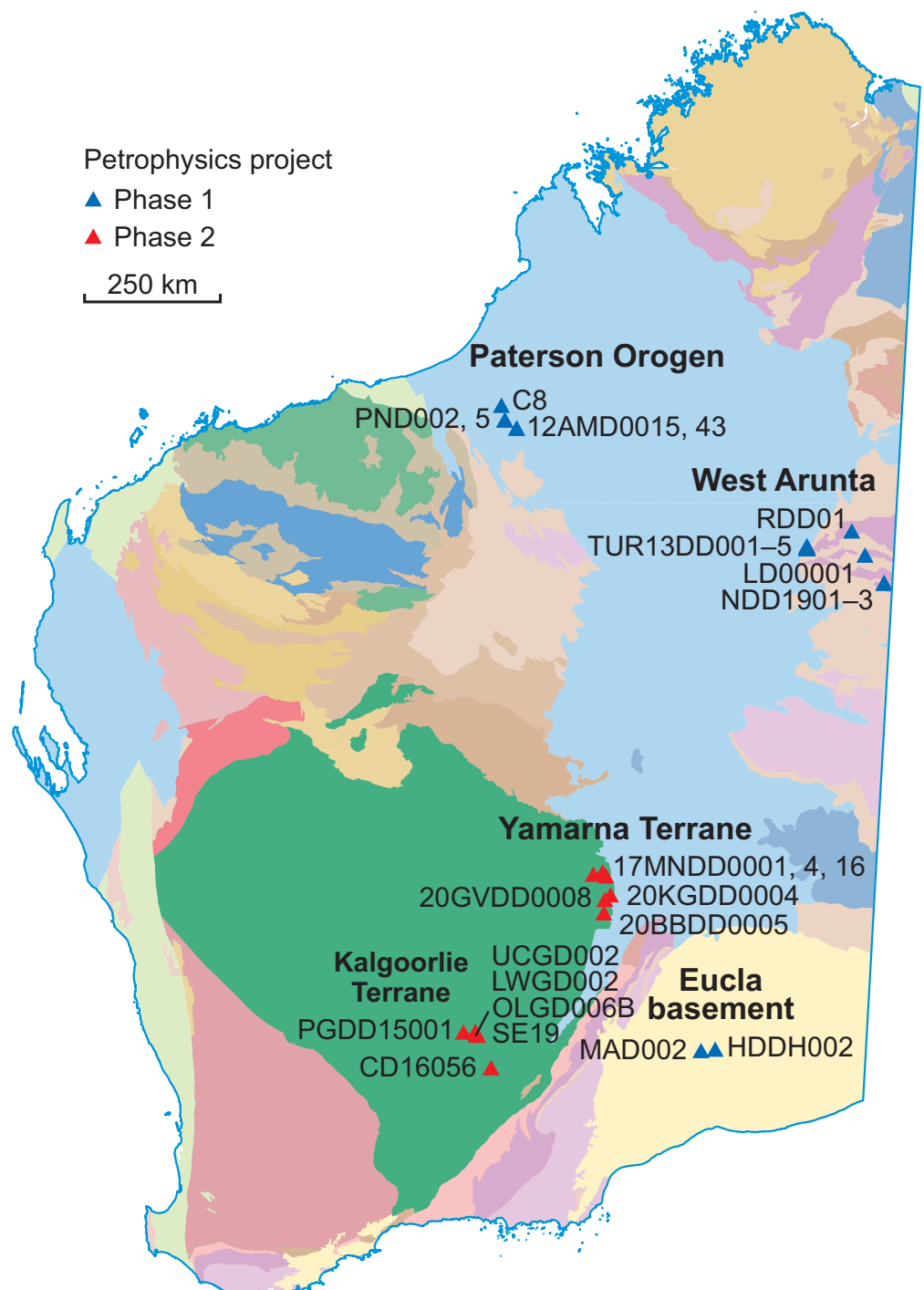


Figure 1. Drillcores sampled in Phase I and II of the regional petrophysics project – shown on 1:10 000 000-scale tectonic units map

Petrophysics

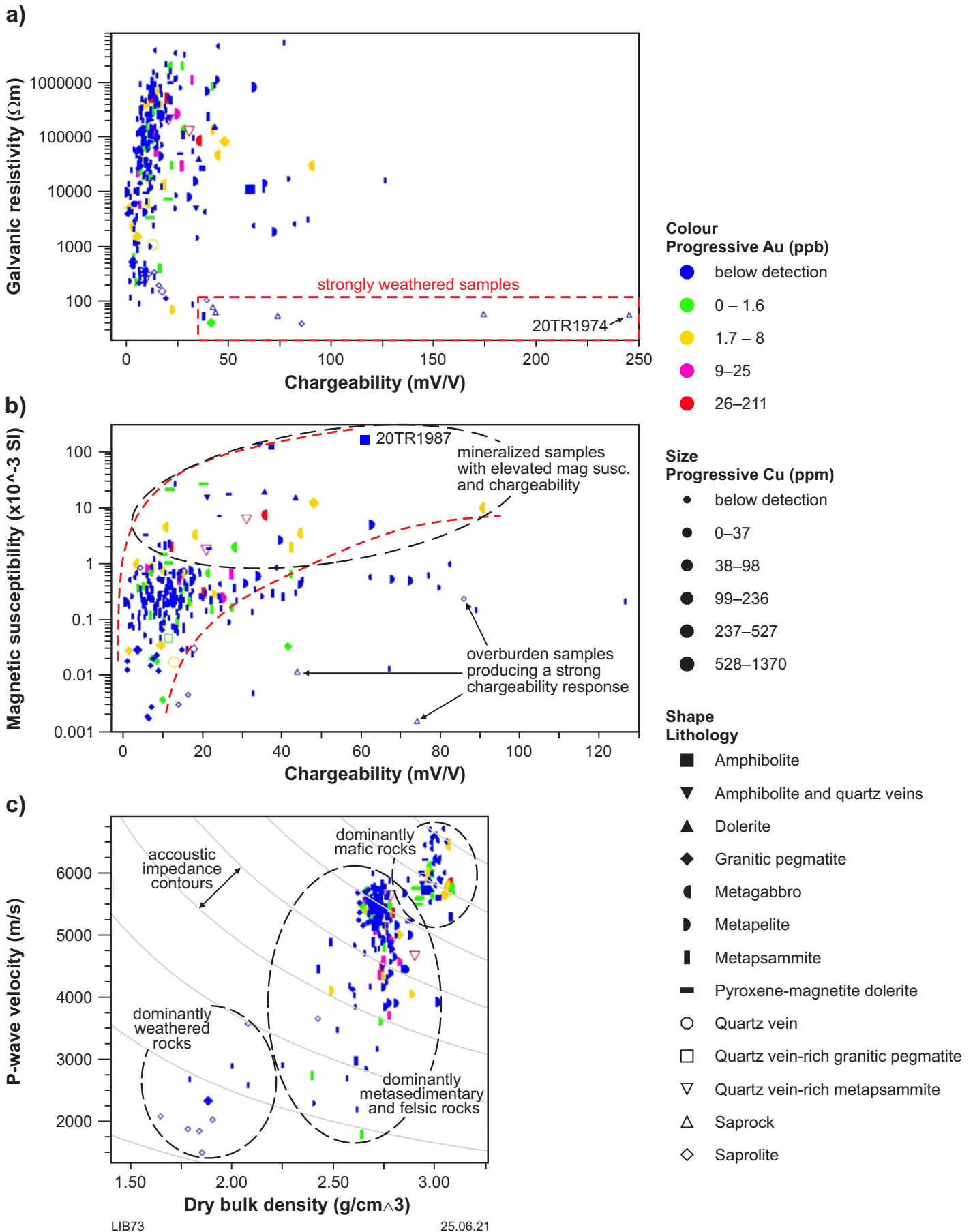


Figure 2. An example of petrophysical data collected from the Paterson Orogen: a) the effect of weathering on chargeability and galvanic resistivity (both properties imaged in IP surveys); b) mineralized samples with elevated chargeabilities and susceptibilities (imaged in aeromagnetic surveys); c) populations of weathered, felsic and metasedimentary rocks, and mafic rocks in density (imaged in gravity and reflection seismic survey) vs P-wave velocity (imaged in reflection seismic surveys) graphs

What is the Abandoned Mines Program?

Mineral exploration and extraction have been important activities economically in Western Australia since the late 1800s. More than a century of mining has resulted in a significant number of abandoned mine workings across the State that present risks to communities and the environment. Following extensive stakeholder consultation, the *Mining Rehabilitation Fund Act 2012* (WA) (MRF Act) was enacted requiring mining tenement holders to pay an annual levy into a central fund, known as the Mining Rehabilitation Fund (MRF), which is utilized by the State Government to fund the rehabilitation of abandoned mine sites.

The Abandoned Mines Program (AMP) was established to deliver the management and/or rehabilitation of abandoned mine sites funded through the MRF. Money in the principal fund can be used to rehabilitate abandoned mine sites where a tenement holder, who has contributed to the fund, fails to meet their rehabilitation obligations. Interest generated from the fund is spent on administration of the MRF and the AMP, and the rehabilitation of historically abandoned mine sites that existed prior to the introduction of the MRF Act. An example of the work currently being undertaken by the AMP involves using imagery to locate characteristics (Fig. 1) to inform the development of effective rehabilitation methods and to locate abandoned shafts near Bulung to ascertain the number (Fig. 2).

For more information, contact the [Abandoned Mines Program team](#).

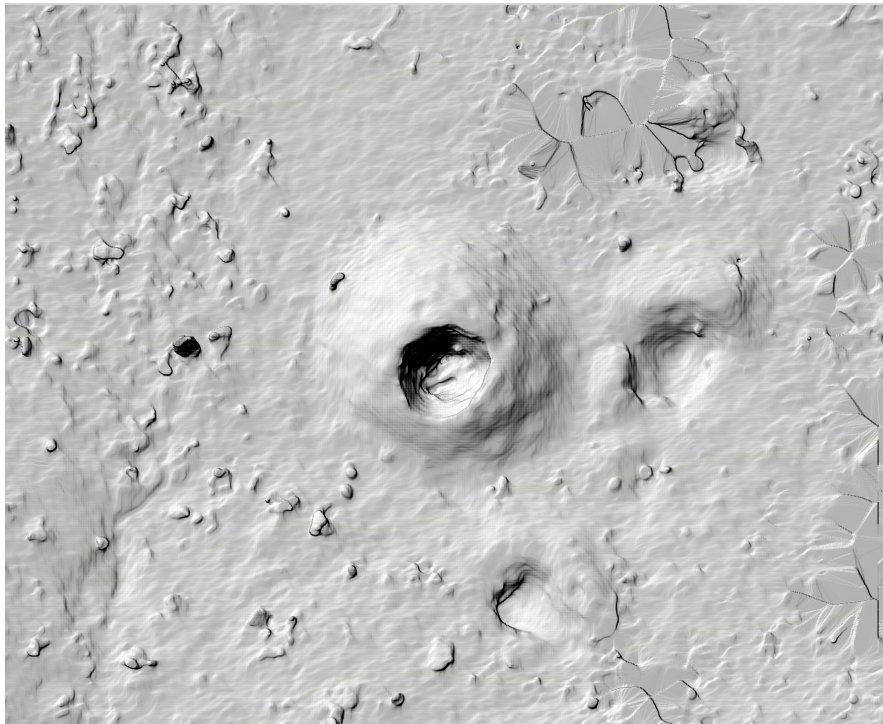


Figure 1. Aerial imagery used to map abandoned shaft characteristics

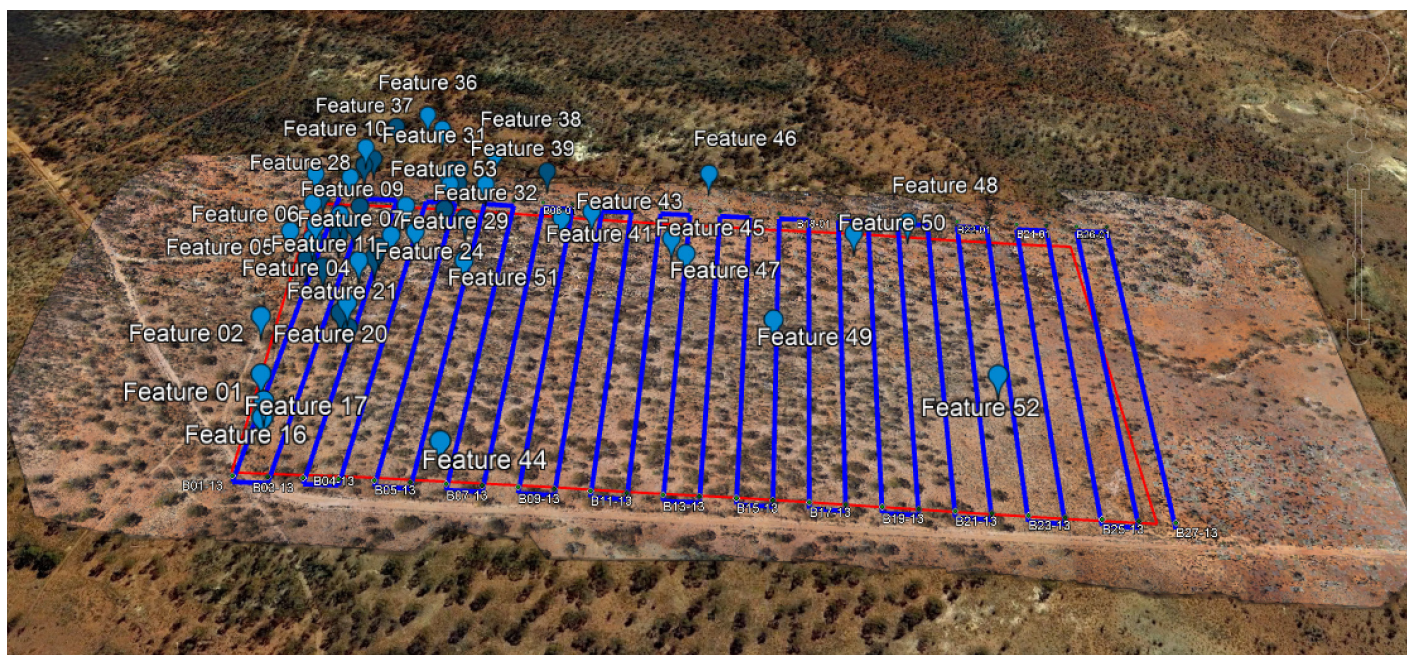


Figure 2. Aerial imagery used to map abandoned shafts near Bulung, east of Kalgoorlie

Product releases

• DATA PRODUCTS •

GSWA Geochronology

Public index of geophysical surveys in MAGIX database

• BOOKS •

Report 213 Reservoir quality of Permian sandstones of the onshore northern Perth Basin – an assessment using HyLogger spectral data and petrography

by Copp, I

Report 216 Kidson Sub-basin Seismic Survey – a panorama of the southern Canning Basin

by Zhan Y and Haines, PW

Record 2021/4 Accelerated Geoscience Program abstracts, 2021

Record 2021/5 Eastern Goldfields greenstone geochemical barcoding project – notes to accompany 2021 data release

by Lowrey, JR, Smithies, RH and Grech, L

Record 2021/6 Yilgarn Granite Project – notes to accompany 2021 data release

by Lowrey, JR, Smithies, RH and Champion, DC

Record 2021/7 Applying geophysics for 3D paleochannel imaging in the Gascoyne Province, Western Australia

by Jakica, S, Brisbourn, L and de Souza Kovacs, N

GSWA Paleontology Report 2021/1 Preliminary paleontological summary of Barnicarndy 1 stratigraphic well, Canning Basin

by Allen HJ, Haines, PW, Martin, SK and Phillips, C

GSWA Paleontology Report 2021/2 Preliminary conodont studies of Barnicarndy 1 stratigraphic well, Canning Basin

by Zhen, YY, Allen, HJ and Martin, SK

GSWA Paleontology Report 2021/3 Paleontological assessment of a purported 'fossil forest' located on the northern edge of Wangine Lake

by Allen, HJ, Krapf, CBE and Martin, SK

An Economic Assessment of the Exploration Incentive Scheme: 10 years from 2009 to 2020

by Fogarty, JJ

• ONLINE •

Wadjemup / Rottnest Island – geology explorer

Mineral Systems Atlas – 2021 update

by Morin-Ka, S, Beardsmore, T, Duuring, P, Guiliamse, JN and Burley, L

Sally May 2, Canning Basin: Digital Core Atlas

by Dent, LM, Normore, LS and Symonds, A

• MAPS •

Mineral deposits and major petroleum projects Western Australia – 2021

by Sargent, SN, Wyche, NL, D'Ercole, C, Jones, JA, Murray, SI and Strong, CA

