

# Fieldnotes



Government of Western Australia  
Department of Mines and Petroleum

Geological Survey of  
Western Australia



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## Seismic and MT in the northern Yilgarn Craton

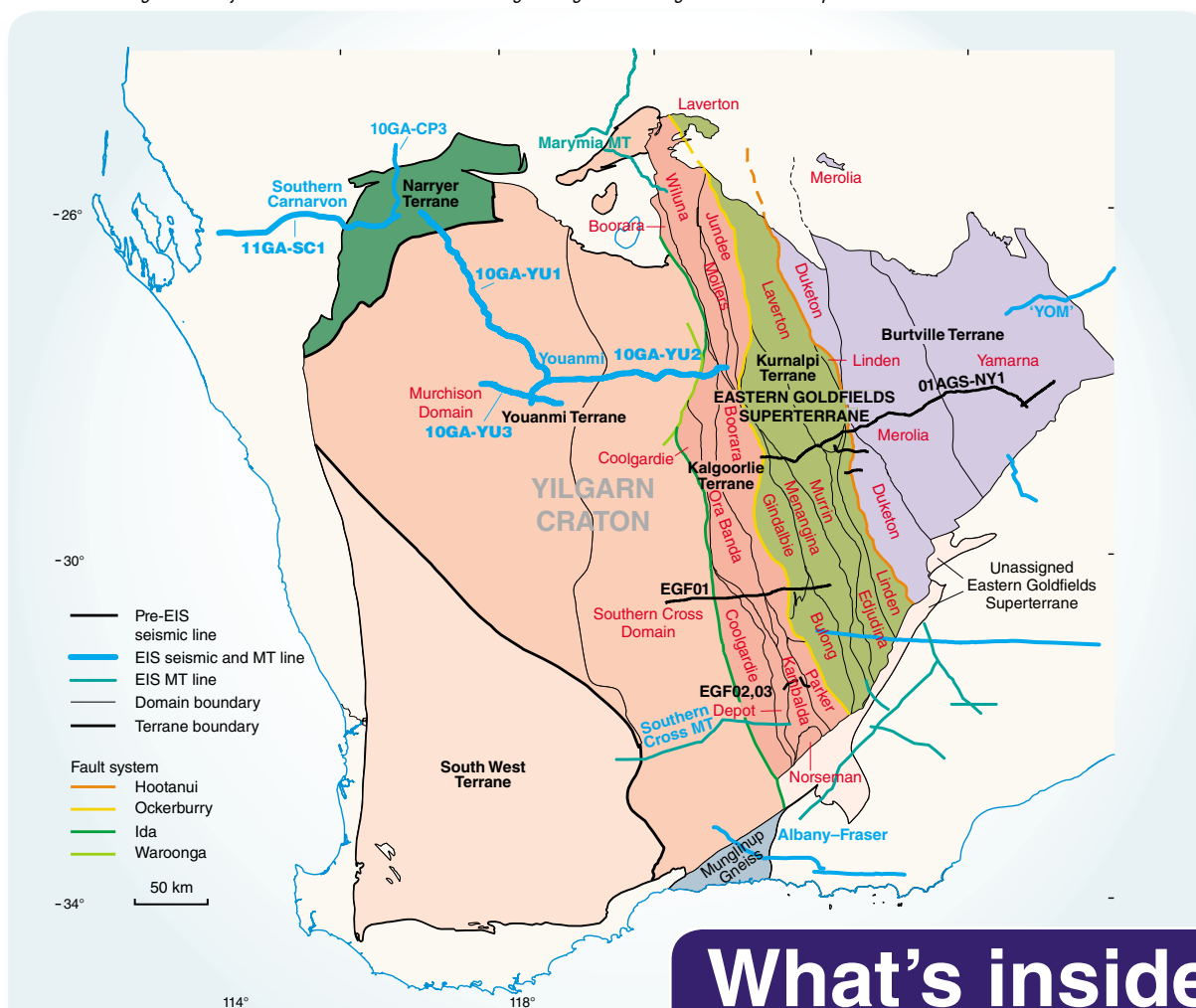
Interpretations from the 2010 Youanmi seismic and magnetotelluric (MT) and 2011 Southern Carnarvon seismic surveys were presented at a well-attended workshop at Mineral House on 27 February 2013. The Youanmi surveys, 10GA-YU1, 10GA-YU2 and 10GA-YU3, were acquired through the Geological Survey of Western Australia (GSWA) Exploration Incentive Scheme (EIS), and the Southern Carnarvon survey (11GA-SC1) was acquired through the Geoscience Australia (GA) Onshore

Energy Security Program in conjunction with the EIS. Processing of the data was carried out by GA.

The Youanmi lines traverse the northern Yilgarn Craton from the Narryer Terrane in the northwest, across the Youanmi Terrane, to the Kalgoorlie Terrane in the west of the Eastern Goldfields Superterrane. The Southern Carnarvon line crosses the onshore Southern Carnarvon Basin and passed into the Narryer Terrane

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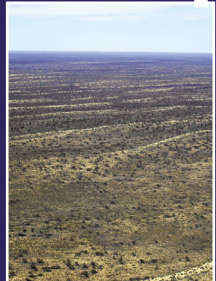
Figure 1. Major tectonic subdivisions in the Yilgarn region showing locations of deep-crustal seismic and MT lines



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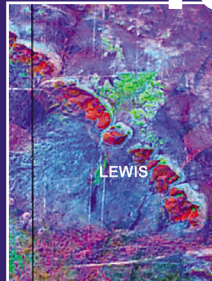
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## YILGARN CRATON – OFFICER BASIN – MUSGRAVE PROVINCE SEISMIC and MT WORKSHOP

PERTH 19 June 2013

### NEW RESULTS TO BE RELEASED

This one-day workshop will present the results of new seismic reflection and magnetotelluric data collected along the Yilgarn Craton – Officer Basin – Musgrave Province seismic traverse in Western Australia. The workshop will be led by Geoscience Australia, the Geological Survey of Western Australia, and the Centre for Exploration Targeting.



Wednesday 19 June 2013

Mineral House, 100 Plain Street, East Perth

**FREE** – Registration is required as limited places available

Contact: Deenikka (08) 9222 3634 [deenikka.preedy@dmp.wa.gov.au](mailto:deenikka.preedy@dmp.wa.gov.au)



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## *Free training* — Kalgoorlie —

**Come to a free workshop  
and learn about:**

– GSWA Web systems –

– GeoMap.WA –

– Mineral exploration Reports (WAMEX) –

– GeoVIEW.WA –

– Mines and mineral deposits (MINEDEX) –



Government of Western Australia  
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Joe Lord Core Library, corner  
Broadwood and Hunter Streets,  
West Kalgoorlie

**Thursday 16 May**

**9.30 am – 12.45 pm  
and 1.30 – 3.30 pm**

*The morning session is an overview of all programs.  
At the afternoon session, participants practise using  
their own examples and have one-on-one training.*

To register, email your details to  
<[publications@dmp.wa.gov.au](mailto:publications@dmp.wa.gov.au)>.

**[www.dmp.wa.gov.au/training](http://www.dmp.wa.gov.au/training)**



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to link with line 10GA-CP3 of the 2010 Capricorn seismic survey (Fig. 1). Results and interpretations based on the surveys, along with details of the acquisition parameters, a review of the regional geology, a discussion of the nature of the lithosphere in the vicinity of the seismic lines and an interpretation of potential field data in the region, as well as interpretive plates (Fig. 2), are presented in GSWA Record 2013/6. A preliminary version is available online at: <<http://www.dmp.wa.gov.au/gswapublications>>.

Significant findings from the traverses include:

- Identification of a distinctive lower crustal fabric in the Youanmi Terrane, the Yarraquin Seismic Province, which differs from the lower crust underlying the Eastern Goldfields Superterrane to the east and the Proterozoic terranes and orogens to the north west.
- Imaging of a sharp, flat-lying Mohorovičić discontinuity (Moho) at a uniform depth of about 31–33 km under the Youanmi Terrane. The Moho deepens to 36 km under the Eastern Goldfields Superterrane, consistent with previous seismic surveys.
- Recognition of the Ida Fault, the boundary between the Youanmi Terrane and the Eastern Goldfields Superterrane, as a moderately east-dipping, deeply penetrating structure, which appears to have been intruded by the Lawlers Tonalite in the vicinity of the Agnew–Lawlers gold deposits. Early

structures in this area have been overprinted by east-directed thrusts of the Waroonga Shear Zone.

- Imaging of the Wattle Creek Shear Zone as a major, deeply penetrating structure in the Mount Magnet and Cue areas of the Murchison Domain. The seismic images also show east-directed, west-dipping thrusts in this area which clearly overprint the earlier west-dipping, more deeply penetrating structures.
- Imaging of the Windimurra Igneous Complex in three orientations which show it to have the form of a shallow, funnel-shaped cone, which reaches a maximum depth of about 9.9 km in the vicinity of the seismic lines. These images will be used, in conjunction with potential field data, in the development of a 3D model.
- Images that show the Yalgar Fault to be the main structure separating the Narryer Terrane from the Youanmi Terrane. Although it may be a fundamental early structure, movement on the Yalgar Fault and nearby Cargarah Shear Zone, including major thrusting, continued into the Proterozoic Eon. The Darling Fault, which separates the Narryer Terrane from the Pinjarra Orogen in the middle and lower crust, was also imaged.

For more information, contact Stephen Wyche ([stephen.wyche@dmp.wa.gov.au](mailto:stephen.wyche@dmp.wa.gov.au)).

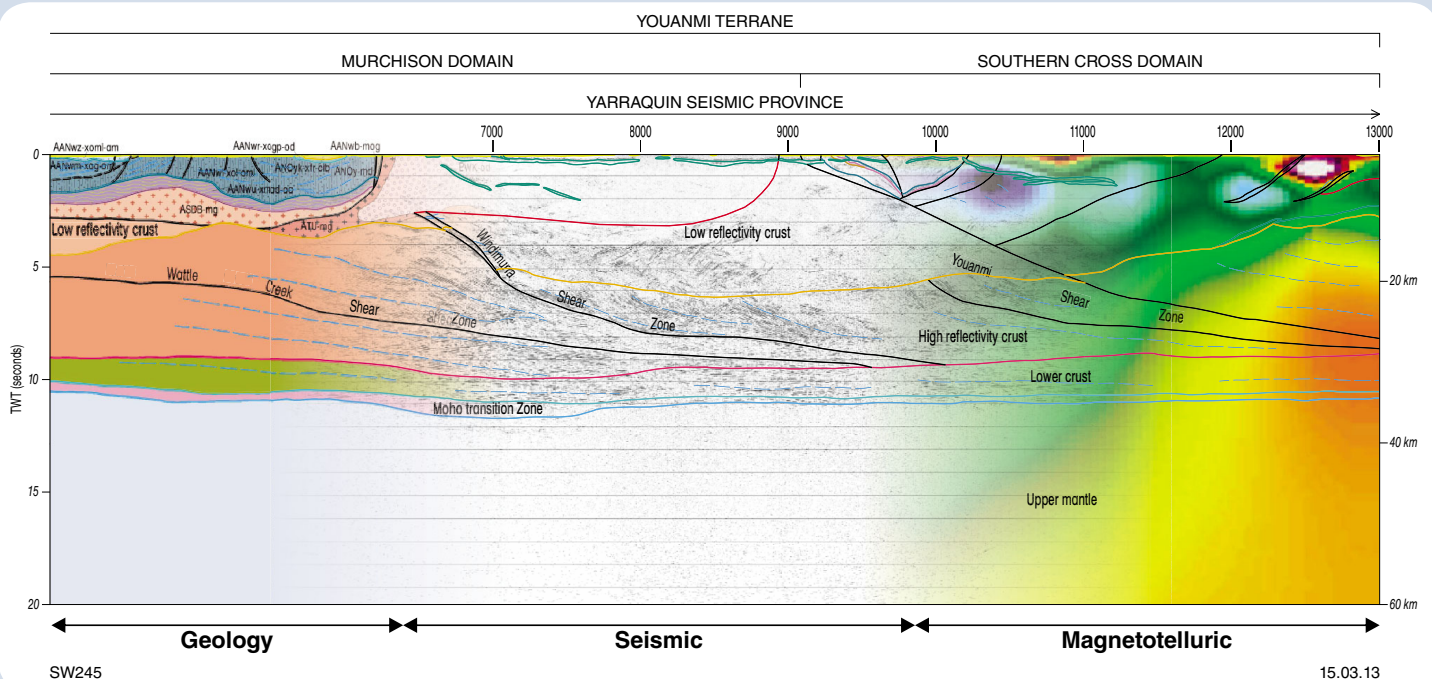


Figure 2. Composite cross section from 10GA-YU2 showing interpreted geology and seismic and MT images

## Fine-fraction geochemistry of regolith — exploring for mineralization and tracing bedrock through regolith

Mineral explorers are increasingly taking up ground in 'greenfields' areas, where there is potential for, but little proof of, economic mineralization. Typically, these areas are characterized by extensive and commonly thick regolith cover or sedimentary successions, which effectively mask bedrock and bedrock-hosted mineralization. In most cases, the type and distribution of bedrock lithologies rely on interpretation of geophysical data (e.g. radiometrics, gravity, seismic) supplemented by open-file drilling data. The latter are usually scattered and of low volume. Drilling data and interpretive regolith-landform mapping — using remotely sensed data such as Landsat TM, ASTER, digital elevation models (DEM), and orthophotos — have shown that regolith can be both tens of metres thick and allochthonous, so that it is not genetically related to the underlying bedrock. Thus, geochemical analysis of regolith itself is unlikely to help in a better understanding of either bedrock-hosted mineralization or bedrock type.

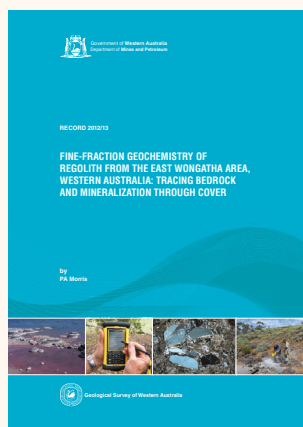


Figure 1. Cover of Record 2012/13

In the east Wongatha area on the eastern margin of the Yilgarn Craton where it abuts both the Albany–Fraser Orogen and Gunbarrel Basin, GSWA has carried out regional geochemical surveys over an area of approximately 12 500 km<sup>2</sup>, analysing 835 samples collected at a density of 1 per 16 km<sup>2</sup> for a variety of elements. The area is typical greenfields, characterized by minimal outcrop (approximately 3%) and extensive regolith, around 70% of which is sandplain, in large part eolian (Fig. 2). As regolith is unlikely to represent weathering of the underlying bedrock, geochemical analysis focused on the more chemically active part of the regolith, the <50 µm (silt, clay) fraction, which had the potential to carry any bedrock- or mineralization-derived material as loosely bound or bonded components. By using a partial digest (aqua regia), this component could be removed for analysis without including the potentially barren sand fraction.

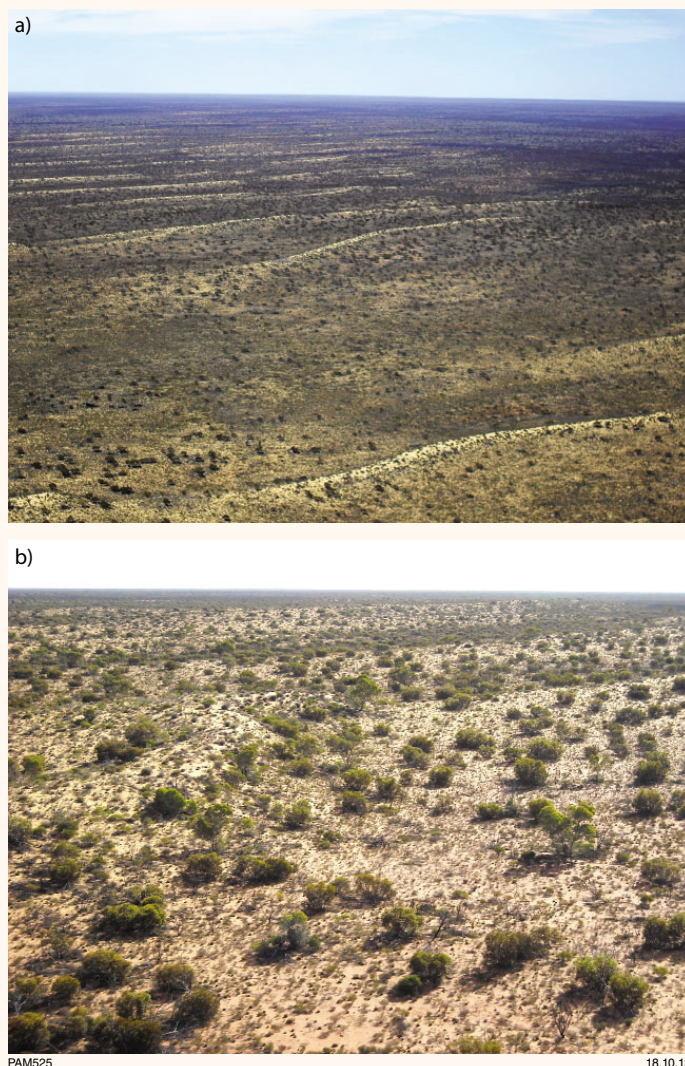
The results of the program, published as GSWA Record 2012/13 and reported in GSWA Record 2013/2, show that fine-fraction chemistry can delineate particular bedrock types; for example, concentrations of elements such as Cr, Ni and V outline the observed and likely extent of Yilgarn Craton greenstones. The distribution of fine-fraction gold shows anomalous concentrations over greenstones or their likely extension, as shown by aeromagnetic data, including where greenstones are buried by Paleozoic sedimentary rocks of the Gunbarrel Basin. Anomalous concentrations are also found in relation to known unconformity-hosted mineralization on the edge of the Gunbarrel Basin. Gold concentrations of 50 samples following deionized water digestion show a good correlation with aqua regia gold, suggesting the gold is either ultra-fine or water soluble.

The geochemical data from this program are available on CD with Record 2012/13, or as a free download from <<http://www.dmp.wa.gov.au/geochem>>.

Regolith sampling in a pit at one location in sandplain shows that the concentration of anomalous gold at the surface, detected in the regional program, increases with depth to 1.8 m (GSWA Record 2013/2).

The east Wongatha study shows that bedrock-hosted mineralization gradually 'leaks' gold which migrates vertically and accumulates over time in regolith, and that the fine fraction of regolith in areas of thick and transported cover may have potential as a sample medium in terms of detecting bedrock-hosted mineralization. However, the mechanism of vertical element migration is currently unclear.

For more information, contact Paul Morris ([paul.morris@dmp.wa.gov.au](mailto:paul.morris@dmp.wa.gov.au)).



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Figure 2. Oblique aerial photographs of typical sandplain-dominated country of the east Wongatha area



# Revised classification scheme for regolith in Western Australia

The importance of a consistent approach to classification of regolith and the lack of a nationally available regolith classification scheme led GSWA to formulate its own regolith classification scheme in 2001 (GSWA Record 2001/4). The scheme has universal application for GSWA, in that it can be applied throughout the diverse geological terrains of Western Australia. With ongoing use of the scheme, two revisions have been undertaken (GSWA Record 2005/10 and Record 2007/8); the recently released GSWA Record 2013/7 is the third revision. The most recent publication preserves many of the existing regolith codes, as well as introducing new ones, and makes recommendations on the correct use of codes. It also introduces a more comprehensive glossary, and includes a recommended approach to compilation of interpretive regolith-landform maps. The latter is an outcome of the increased availability and use of high-quality, remotely sensed datasets, such as Landsat TM, digital elevation models (DEM), radiometrics, and ASTER.

GSWA's regolith classification scheme is based on recording the composition and physical characteristics (e.g. grain size, sorting) of regolith, and placing the regolith in an idealized landform profile. The basis of the scheme is eleven primary codes, one of which covers outcropping rock, one in situ regolith or relict material from previous landforms, and nine codes to cover reworked and redistributed regolith (i.e. depositional regime regolith). Each of these primary codes can be further subdivided using a series of secondary and tertiary codes, and qualifiers to indicate landform and composition, parent bedrock composition, and cement type. A numerical qualifier of the primary code indicates relative degree of consolidation or cementation, which in many cases, is related to regolith age. Preservation of codes throughout the four versions of this record means that the most recent version can be used with previously published maps, as well as for the compilation of new maps.

Extension of earlier versions of this scheme to include comment on compilation of regolith maps reflects the increasing importance of understanding the composition of regolith, and the distribution of different regolith types. Regolith accounts for over 80% by area of some map sheets of Western Australia. In 2010–11 approximately 82% of the State's mineral production (principally iron ore, coal, bauxite, gold, mineral sands), worth more than \$63 billion was derived from regolith (although much of the iron ore is derived from Proterozoic regolith). In relation to GSWA's mapping and mineralization program, in areas of thick and contiguous cover, regolith is often the only guide to the composition of underlying bedrock, in that some regolith develops in situ, and preserves characteristics of the underlying parent bedrock. However, regolith of a similar nature may

reflect the eroded remnants of a previous landscape, and bear no genetic relationship to the underlying bedrock; thus, careful mapping and field checking are important.

Where regolith is exposed in the third dimension (Fig. 2), there is the opportunity to examine regolith stratigraphy and regolith age, both of which can provide important information on landscape evolution and climatic change. In relation to mineral exploration, greenfields areas, increasingly the locus of exploration activity, are characterized by extensive regolith cover, and an understanding of the distribution of different regolith types is important in terms of planning regional geochemical surveys, and interpreting their results.

For more information, contact Paul Morris ([paul.morris@dmp.wa.gov.au](mailto:paul.morris@dmp.wa.gov.au)).

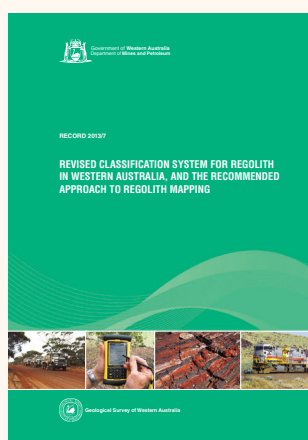


Figure 1. Cover of Record 2013/7

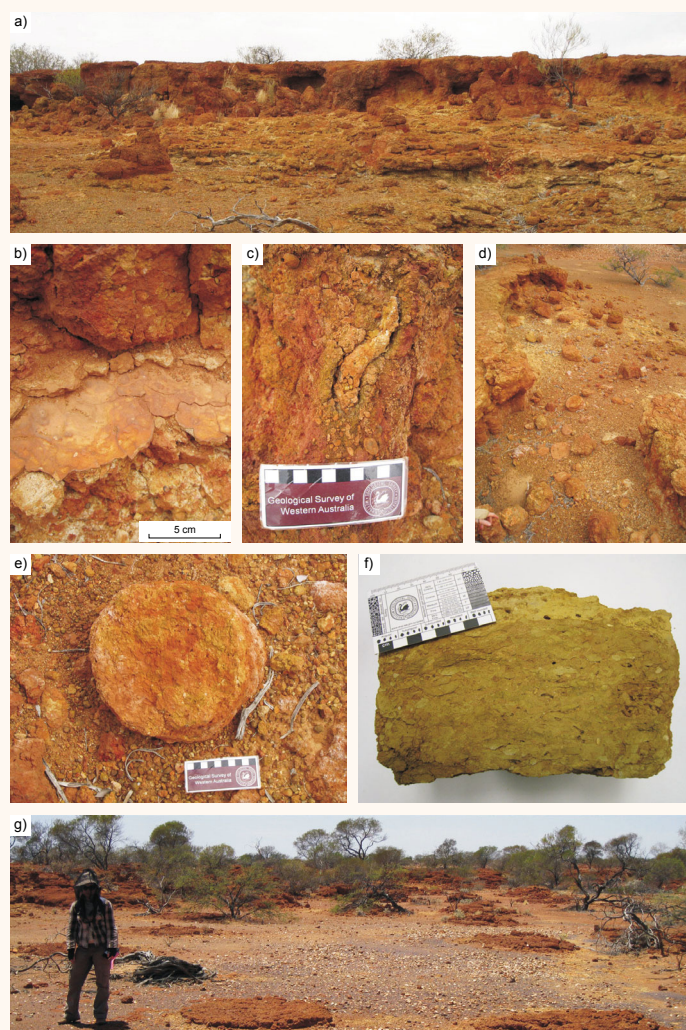


Figure 2. Regolith exposed in breakaway, Mt Phillips map sheet of (SG50-2), from Krapf (2011; GSWA Record 2011/22, figure 25)

Outcrop views of Unit B measured section at Locations 2 and 3, First Bore locality: a) exposures along breakaway; b) thin mudcracked layers on top of bedding surfaces; c) root cast filled with calcrete and calcrete nodules; d) semiround to round, cylindrical 'tree stump-like' weathering features; e) detail of d) showing the top of a weathering feature; f) dissected sample of e) revealing internal complexity caused by different types of burrows (scale bar: 8 cm); g) large concentric weathering features, probably representing paleo-ant nests



# Yilgarn Craton – Officer Basin – M

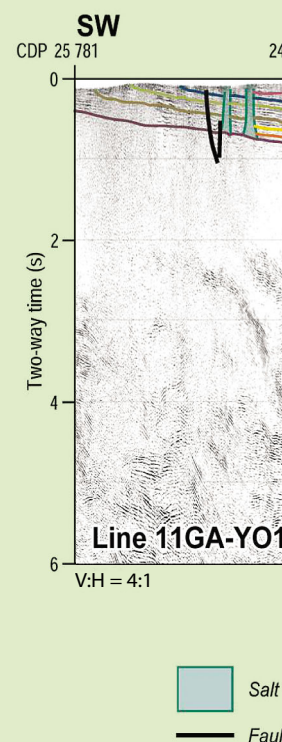
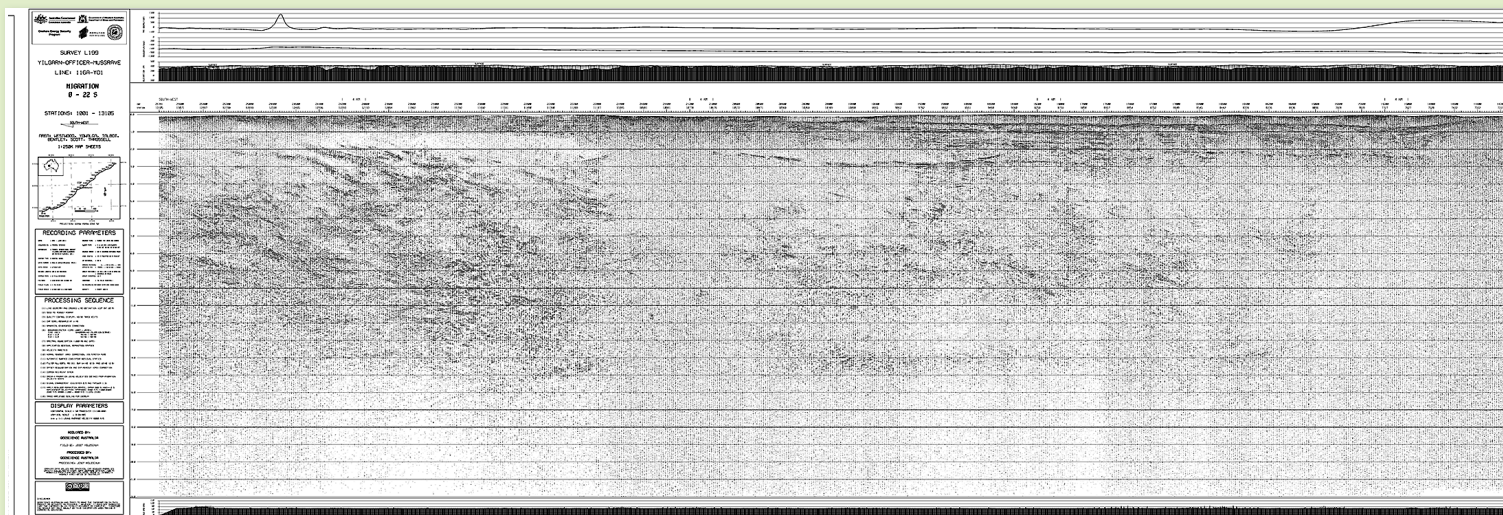


Figure 1. Geological interp.

Carr et al., 2012, Structural and Stratigraphic

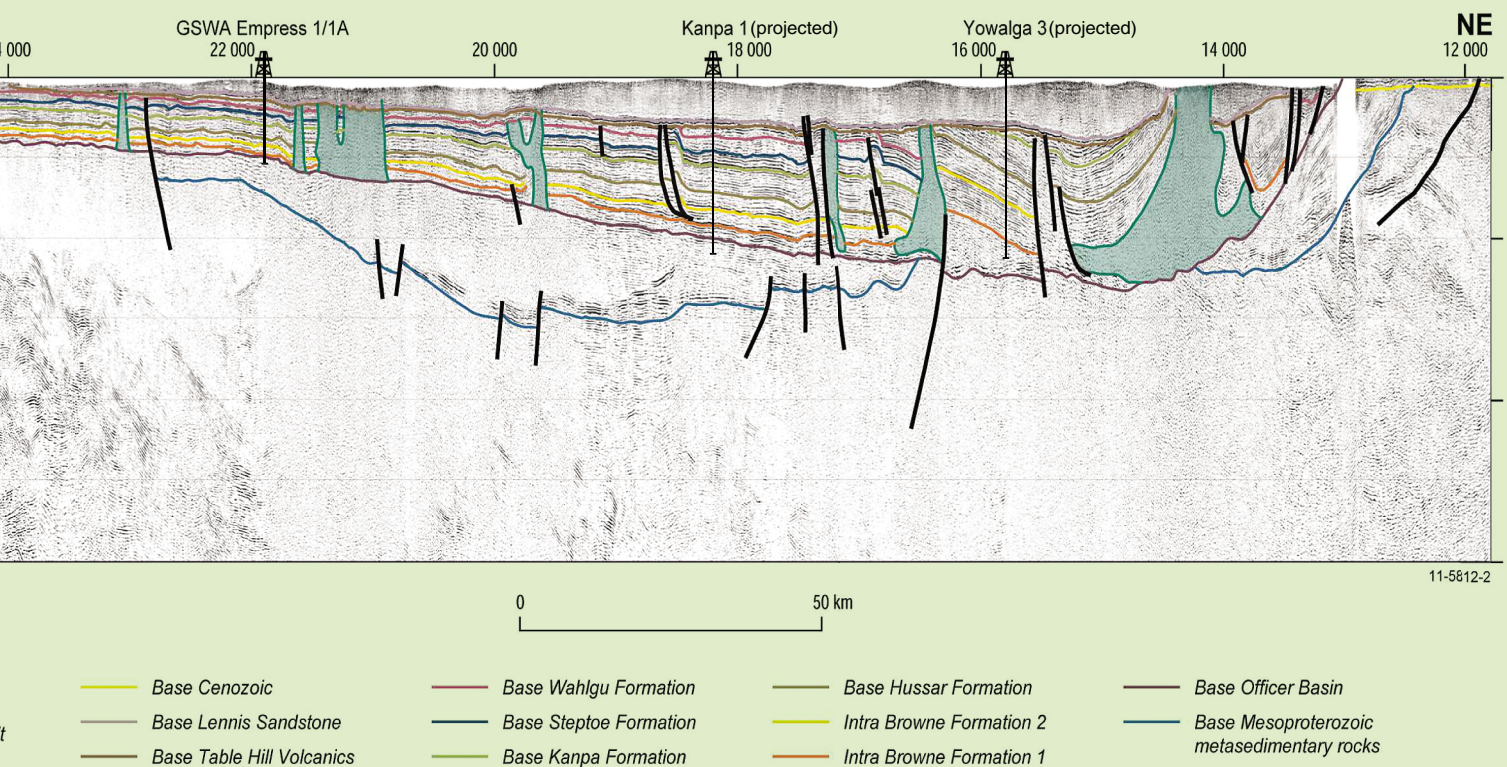
The primary objective of the Yilgarn – Officer – Musgrave deep seismic reflection survey was to image the western Officer Basin, one of Australia's under-explored frontier sedimentary basins. In addition, this survey has gathered new data to improve the understanding of the eastern Yilgarn Craton and its boundary with the Musgrave Province.

The survey was jointly funded by GA through its Onshore Energy Security Program (OESP) and GSWA through the Exploration Incentive Scheme (EIS). It was designed to gather pre-competitive geophysical data to expand the scientific knowledge for water resources, potential geothermal sites, oil and gas prospectivity, and mineral exploration potential.





# Musgrave Province (YOM) survey



Interpretation of migrated seismic section 11GA-YO1 across the western Officer Basin displayed with a vertical to horizontal scale of 4:1, assuming an average crustal velocity of 6000 ms<sup>-1</sup>

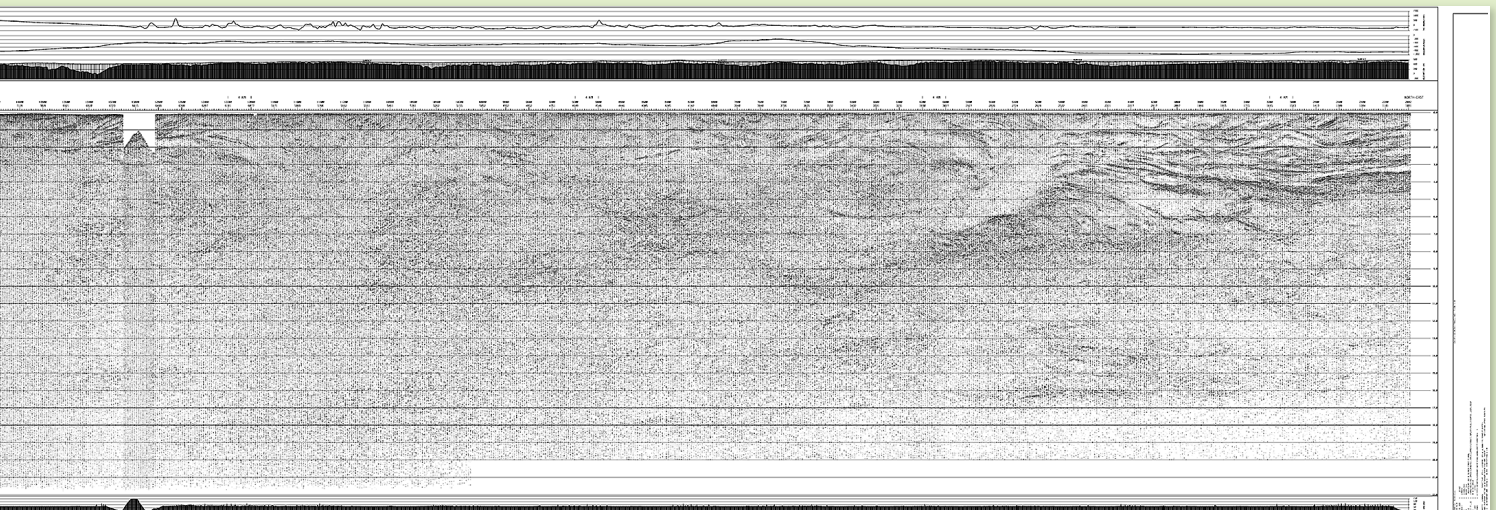
Geological architecture of Western Australia's frontier onshore sedimentary basins: the Western Officer and Southern Carnarvon Basins; APPEA Conference 2012, extended abstracts.

These data supplement the 2010 Youanmi deep crustal seismic reflection and MT survey and the 2001 north Yilgarn deep crustal seismic survey. Combined, these will create a comprehensive dataset that crosses most of central Western Australia.

The data released comprise images of the preliminary migrated seismic line cross sections, together with ArcMap GIS shapefiles

of the seismic shot points and the common depth points (CDP) shown on the cross section images.

For more information, contact Hugh Smithies ([hugh.smithies@dmp.wa.gov.au](mailto:hugh.smithies@dmp.wa.gov.au)).





## Japan/GSWA collaborative DXCL drilling project

The recently released GSWA Record 2012/14 describes the first stage of the Dixon Island – Cleaverville Drilling Project (DXCL) at Cleaverville Beach between Karratha and Roebourne (Fig. 2). The drilling was part of a collaborative project between Japanese researchers and GSWA, and was funded by several organizations in Japan. The project leader, Dr Shoichi Kiyokawa (Department of Earth and Planetary Sciences, Kyushu University), has undertaken geological investigations on the Dixon Island – Cleaverville area since 1990. Dr Kiyokawa and his research team have interpreted the succession at Dixon Island and Cleaverville to be a Mesoarchean island arc succession that was accreted onto the northwest margin of the Pilbara Craton. They had previously dated the lower part of the succession (Dixon Island Formation) at  $3195 \pm 12$  Ma which, if their interpretation of the tectonic setting is correct, would make this one of the world's oldest examples of a well-preserved island arc succession. Surface sampling several years prior to the DXCL drilling indicated that the formations contain organic carbon and structures resembling microfossils.

Although the geological succession is exceptionally well exposed, especially on Dixon Island, it has been subjected to extensive near-surface alteration, particularly silicification. This poses a serious problem for advanced petrologic, geochemical, paleontological, and isotopic investigations, so drilling was conducted to provide 'fresh' samples from beneath the near-surface alteration. Drilling of three diamond holes, CL1, CL2, and DX, confirmed that the effects of modern weathering extend

to depths of approximately 50 m, but that at greater depths various primary features, such as fresh pyrite nodules, are preserved (Fig. 3). In areas where the dominant lithologies at the surface are chert and banded iron-formation the main lithology encountered at depth is very finely laminated shale. Most of the shale is black (organic- and/or pyrite-rich) but reddish shale, interpreted to be the result of oxidation of iron minerals along faults and minor shear zones, is very common to depths of about 80 m. Other rock types in the cores include grey-white chert and fine-grained sandstone, with very minor felsic volcanoclastic rocks and cross-bedded siltstone.

Half the drillcore from the DXCL project was exported to Japan, and the remaining half was retained at the GSWA Core Library. Initial results from research in Japan have included geochemical evidence for modern-style biogeochemical cycling of C, N, P, S, Fe and Mo, implying significant oxygen in the atmosphere and oceans at c. 3200 Ma. Other results briefly reported have included zircon ages in the Cleaverville Formation at Cleaverville Beach. The maximum depositional age is interpreted to be c. 3100 Ma, but the rock also contains detrital zircon grains as old as 3700 Ma. This supports previous interpretations that the depositional setting for the Cleaverville Formation was epicontinental.

For more information, contact Arthur Hickman ([arthur.hickman@dmp.wa.gov.au](mailto:arthur.hickman@dmp.wa.gov.au)).



Figure 1. Diamond drilling at the CL1 and CL2 sites, Cleaverville Beach



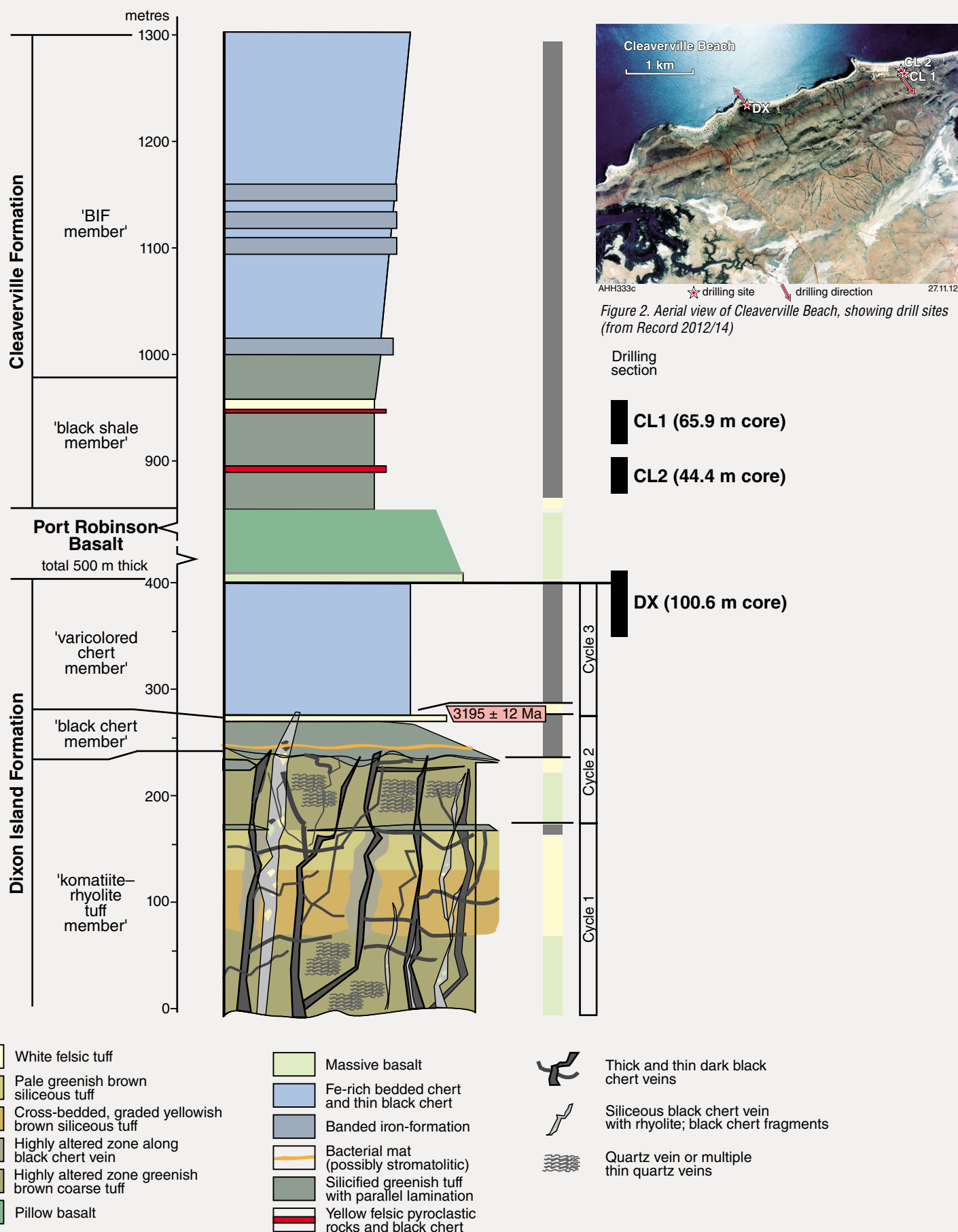


Figure 3. Stratigraphic column through the succession at Cleaverville (from Record 2012/14)

## West Tanami 1:100 000 Geological Information Series, 2012 update

GSWA recently released the 2012 update of the West Tanami 1:100 000 Geological Information Series package, available on a thumb drive and comprising more than 8 GB of data.

The west Tanami bedrock geology is composed of Paleoproterozoic granitic and metasedimentary rocks (Killi Killi and Stubbins formations) of the Granites – Tanami Orogen, Meso- and Neoproterozoic sedimentary rocks (Birringdudu and Redcliff Pound groups), and Paleozoic–Mesozoic sedimentary rocks. All units are variably weathered and eroded. The extensive regolith coverage characteristic of the west Tanami area has meant there is little direct evidence of the extent of different bedrock types. Known mineralization (principally gold, but also uranium, and base metals) is largely confined to the SLATEY CREEK and WATTS map sheets, but mineralization extends onto BALWINA. Gold deposits are spatially related to siliciclastic metasedimentary rocks of the Killi Killi and Stubbins formations.

Since the first release of a digital data package for this area in 2007, there has been an increase in both the amount and type of data, and the extent of coverage provided by GSWA. Both the 2007 and 2012 packages covered seven 1:100 000 scale map sheets in the west Tanami, an area of almost 18 000 km<sup>2</sup>. Detailed regolith-landform mapping was only available for WATTS in the 2007 data release, whereas the 2012 release comprises mapping for the BALWINA, KEARNEY, LEWIS, SLATEY CREEK and WATTS 1:100 000 map sheets, with previously published data for the WOLFE CREEK and STURT CREEK sheets. Digital coverage includes geological mapping (e.g. 1:100 000 surface geology, interpreted bedrock geology at scales up to 1:2 500 000), point observations and data (geochemistry, geochronology, field observations, mines and mineral deposits), geophysical images and indexes, and topographic and remotely sensed data, e.g. ASTER, Landsat TM, digital elevation model (DEM). The ASTER data include 17 scenes extracted from a State-wide dataset released by CSIRO and GSWA in 2011 and 2012. The combination of Landsat TM

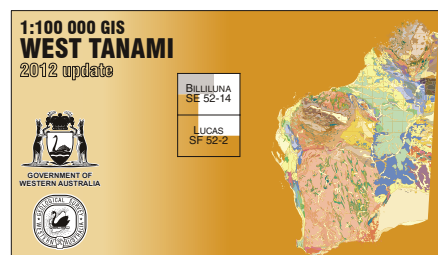


Figure 2. Cover of digital package

and ASTER coverage, along with DEM and point observations from DMP's WAROX database has been supplemented with existing geological mapping to generate a regolith-landform layer. The west Tanami area is characterized by approximately 8% outcrop, with almost 33% of the regolith consisting of sandplain, some of which supports eolian dunes. Identification of residual regolith units (i.e. those resulting from in situ weathering of bedrock, ranging from <1% on Lewis and Slatey Creek, to 15% on Balwina) and colluvium have been important outcomes of this mapping, as both units are developed on or close to bedrock.

The use of remotely sensed data for mapping areas of residual and transported regolith in the west Tanami area are shown in Figure 1, where the Landsat TM 754 image shows arcuate outcrops of the Lewis Granite and the Lewis Range Sandstone on KEARNEY and LEWIS, flanked by well-developed alluvial fans. Polygonal areas are fire scars. The Landsat image allows separation of alluvium derived from granite (bright green) from that derived from sandstone (blue). In the centre of the image, playa terrain related to lake systems is shown as bright green, indicating clay-rich and iron-poor regolith.

For more information, contact Nadir de Souza Kovacs ([nadir.desouzakovacs@dmp.wa.gov.au](mailto:nadir.desouzakovacs@dmp.wa.gov.au)).

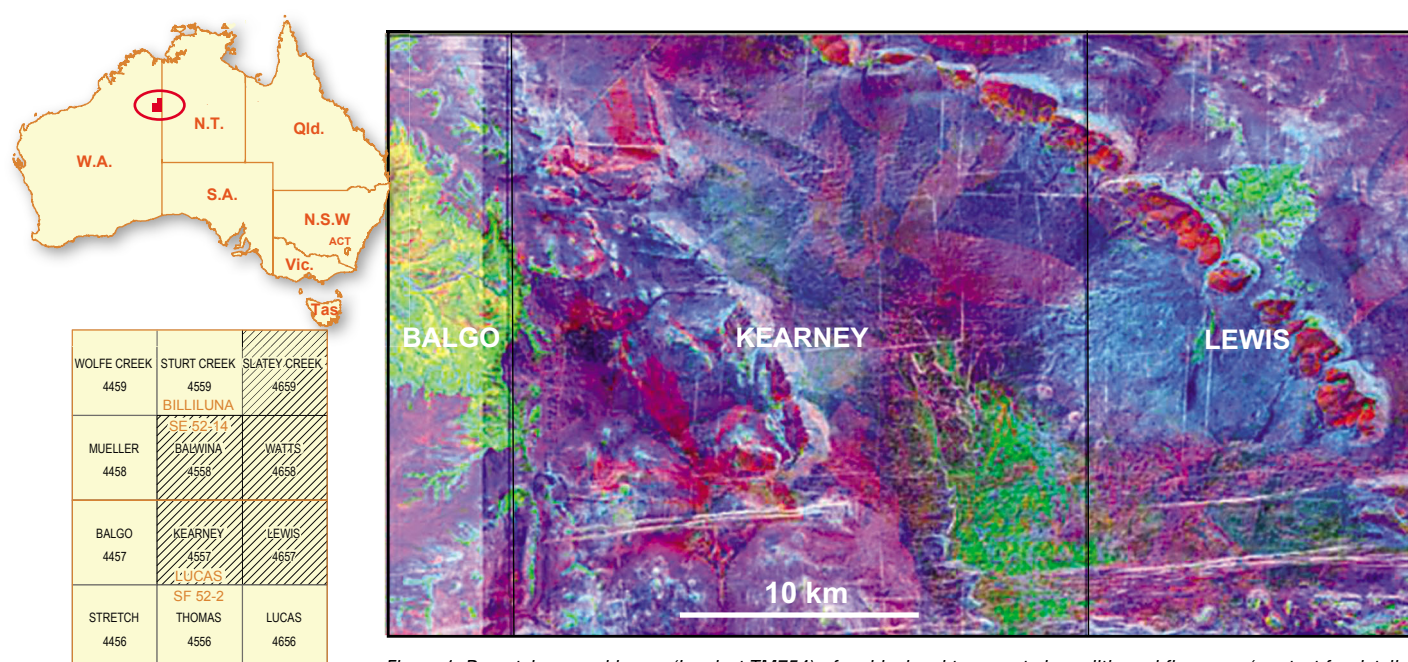


Figure 1. Remotely sensed image (Landsat TM754) of residual and transported regolith, and fire scars (see text for details)



## Western Australia regional geophysics surveys: April 2013 update

### Data downloads

Final data releases from the Geophysical Archive Data Delivery System at <[www.ga.gov.au/gadds](http://www.ga.gov.au/gadds)>.

Preliminary and final grids and images from the GSWA website at <[www.dmp.wa.gov.au/geophysics](http://www.dmp.wa.gov.au/geophysics)>.

Subscribe to the GSWA eNewsletter for alerts of preliminary and final data release dates.

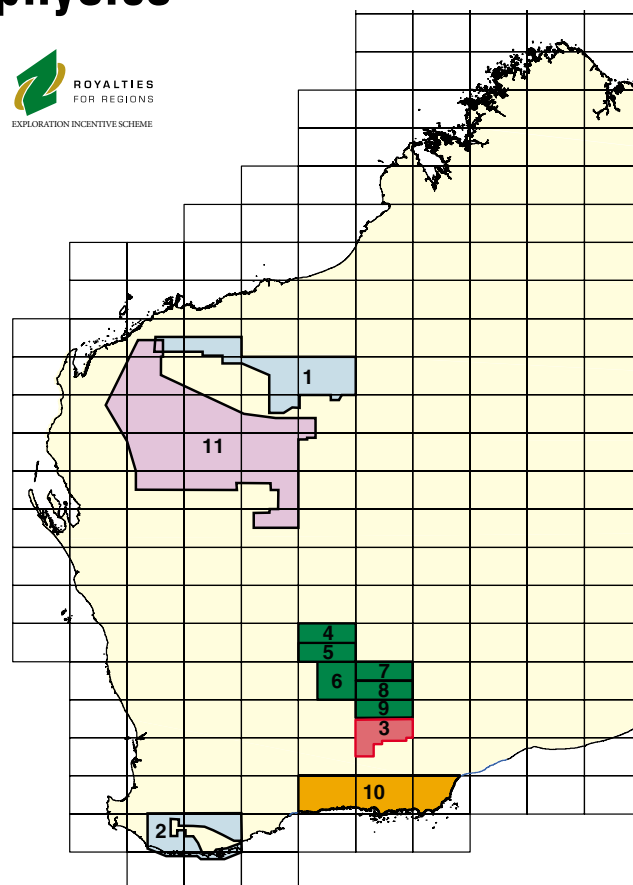
### Airborne magnetic and radiometric surveys

- Airborne surveys 2011–12 (in progress)
- Airborne surveys 2012–13 (in progress)
- Proposed 'Goldfields 100 m' program

### Other surveys

- Ground gravity surveys 2013–14
- Airborne EM surveys 2013–14

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



### Airborne magnetic and radiometric surveys

ID	Area/Name	Line spacing and direction	Line-km	Acquisition Start	Acquisition End	Current Status	Preliminary Release <sup>1</sup>	Final Release
<b>2011–12 Program</b>								
1	South Pilbara 2012	400 m; N-S	134 000	Jun-12	Jan-13	Pre-release	—	2-May-13*
2	Mt Barker 2011	200 m; N-S	123 000	Apr-11	Jan-13	Pre-release	22 Feb 2013	24-Apr-13*
<b>2012–13 Program</b>								
3	Widgiemooltha South 2013	100 m E-W	130 000	Nov-12	Apr-13*	Survey 95%	—	Jul-13*
<b>Proposed 'Goldfields 100 m' Program (2013–14 +)</b>								
4	Menzies North	100 m E-W	720 000	TBD	TBD	Proposal		
5	Menzies South	100 m E-W	720 000	TBD	TBD	Proposal		
6	Kalgoorlie East	100 m E-W	720 000	TBD	TBD	Proposal		
7	Kurnalpi North	100 m E-W	720 000	TBD	TBD	Proposal		
8	Kurnalpi South	100 m E-W	720 000	TBD	TBD	Proposal		
9	Widgiemooltha North	100 m E-W	720 000	TBD	TBD	Proposal		

### Ground gravity surveys

ID	Area/Name	Station spacing	Stations	Acquisition Start	Acquisition End	Current Status	Preliminary Release <sup>1</sup>	Final Release
10	Esperance 2013	2.5 km grid	9 000	TBD	TBD	Planning		

### Airborne reconnaissance EM surveys

ID	Area/Name	Line spacing and direction	Line-km	Acquisition Start	Acquisition End	Current Status	Preliminary Release <sup>1</sup>	Final Release
11	Capricorn 2013	5 000 m; N/S	29 000	TBD	TBD	Planning		

#### Notes

\* Asterisk indicates an estimated date based on delivery information currently available. Subscribe to the newsletter for release alerts.

1. Preliminary releases are made on a case-by-case basis and consist of ecw images and ERMMapper grids of partially processed or unchecked data.

#### Colour legend



Data released



Release date set



In progress



Under consideration

## RECORDS

Record 2012/13 Fine-fraction geochemistry of regolith from the east Wongatha area, Western Australia: tracing bedrock and mineralization through cover  
*by Morris, PA*

Record 2012/14 Preliminary report on the Dixon Island – Cleaverville Drilling Project, Pilbara Craton, Western Australia  
*by Kiyokawa, S, Koge, S, Ito, T, Ikehara, M, Kitajima, F, Yamaguchi, KE, and Suganuma, Y*

Record 2012/15 Reading deep time: radiogenic isotope geochronology  
*by Kirkland, CL and Wingate, MTD*

Record 2013/2 GSWA 2013 Extended abstracts — promoting the prospectivity of Western Australia

Record 2013/5 Petrogenesis of gabbros of the Mesoproterozoic Fraser Zone: constraints on the tectonic evolution of the Albany – Fraser Orogen  
*by Smithies, RH, Spaggiari, C, Kirkland, CL, Howard, HM, and Maier, WD*

Record 2013/6 Youanmi seismic and magnetotelluric (MT) workshop 2013: extended abstracts, Preliminary edition  
*Compiled by Wyche, S, Ivanic, TJ, and Zibra, I*

Record 2013/7 A revised classification system for regolith in Western Australia, and the recommended approach to regolith mapping

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*by Riganti, A, Wallace, D, Fadadu, BC, Canham, DM, Gavni, KKR, and Hocking, RM*

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Fieldnotes: A Geological Survey of Western Australia Newsletter: January 2013 Number 65

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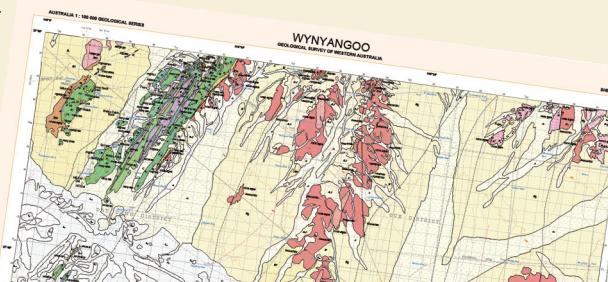
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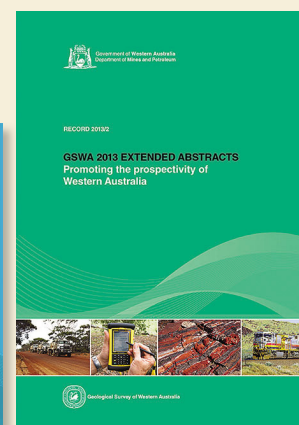
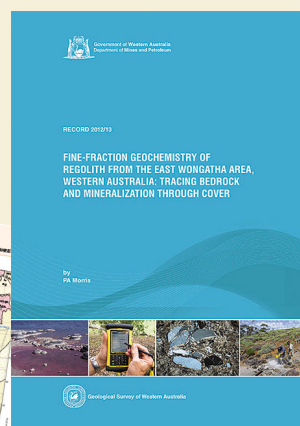
Murchison Geological Information Series 2012 update  
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