A Geological Survey of Western Australia Newsletter

October 2015 NUMBER 76

Fieldnotes

Government of Western Australia
Department of Mines and Petroleum

Geological Survey of Western Australia

Visit our Home Page at <www.dmp.wa.gov.au/GSWA>

ISSN 1325-9377
ISSN 1834-2272
ISBN (PRINT) 978-1-74168-652-4
ISBN (PDF) 978-1-74168-651-7

Building the crust of the Albany–Fraser Orogen

A whole-rock geochemical dataset (156 analyses) of granites from the Albany–Fraser Orogen, of which roughly half have also been dated using U–Pb zircon geochronology, allows identification of spatial and temporal changes in granite compositions. This information constrains models for the crustal evolution of the Albany–Fraser Orogen. Twelve granite age groups are identified, spanning crustal evolution events from the Archean to the c. 1140 Ma end of the Albany–Fraser Orogeny (Fig. 1). Throughout that period, the dominant geochemical and isotopic trend is to increasingly mask, although not destroy, the Archean heritage of the orogen through processes of crustal reworking and mantle-melt addition (Fig. 2). The prevailing tectonic regime likely involved crustal thinning, with periodic mid-crustal melting of various, originally deep crustal, source regions. At times, this was at unusually high crustal temperatures. Granites that formed at c. 1330 Ma, near the beginning of the Albany–Fraser Orogeny, have sampled source regions belonging to the Madura Province, which lies to the southeast of the Albany–Fraser Orogen. This magmatism most likely post-dates accretion of the c. 1410 Ma Loongana arc (Madura Province) to the Albany–Fraser Orogen.

See **Report 150 Building the crust of the Albany–Fraser Orogen; constraints from granite geochemistry** (available as a free download on the DMP eBookshop).

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

EXPLORATION INCENTIVE SCHEME

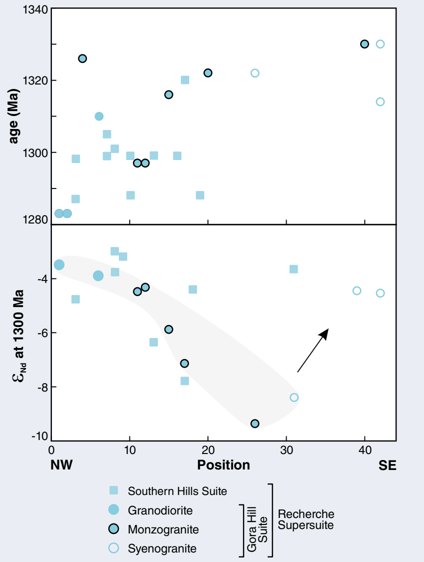


Figure 2. Geographical variation in Nd isotopic composition for granites formed during Stage 1 of the Albany–Fraser Orogeny. 'Position' refers to the relative order of samples, in a southeast direction, when their true position is extrapolated along northeasterly trending lines, on to the traverse line shown in Figure 1. Grey field shows the systematic trend to more radiogenic and younger intrusions to the northwest.

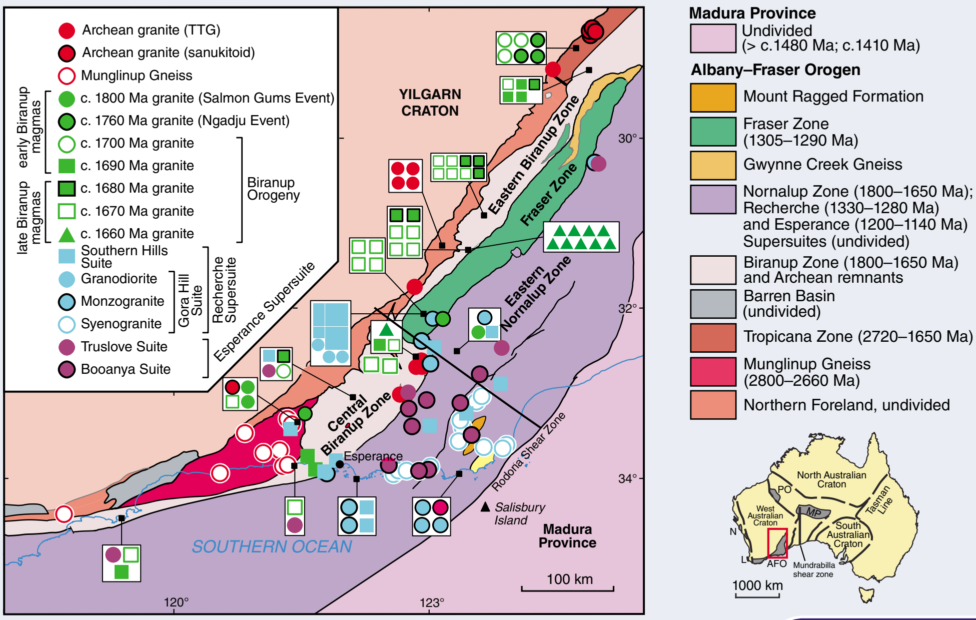
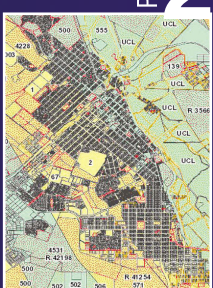
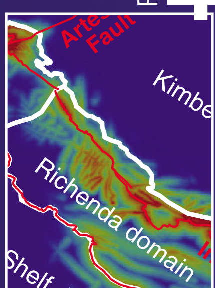


Figure 1. Simplified, pre-Mesozoic interpreted bedrock geology of the east Albany–Fraser Orogen showing the approximate location and geographical distribution of granite samples of the various granite groups

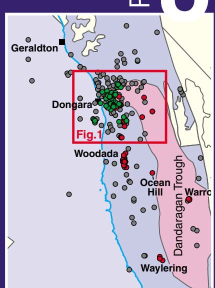
PAGE 2



PAGE 4



PAGE 8



What's inside?

New statewide cadastre available in GeoVIEW.WA

Recently the State Cadastral layer was added to GeoVIEW.WA. This layer, which is updated on a quarterly basis from Landgate's Spatial Cadastral Database, provides cadastral boundary information plus lot name, lot number and lot type (Fig. 1). The layer is symbolized based on Unallocated Crown Land, Other Reserves and Other Land Parcels (including freehold). Due to the size of the dataset, it is broken down into Perth Metropolitan Region and Regional Western Australia. It is also a cached dataset and has scale dependency applied. The scale dependency for the layer means it will only draw at scales when the user is zoomed in at a scale beyond 1:1 200 000 for the regional cadastral data and 1:100 000 for the metropolitan cadastral data. The scale dependency removes unnecessary clutter from the map when zoomed out and adds valuable details when zoomed in. These measures greatly assist in maintaining a rapid response time when drawing the detailed dataset.

Other datasets recently added to GeoVIEW.WA in the 'Land Use Planning' operational layer include basic raw material geoscientific data, plus lime, clay and sand, and gravel analyses. The next planned enhancement to GeoVIEW.WA is the inclusion of Landgate's composite aerial photograph of Western Australia.

To view these new datasets in GeoVIEW.WA, go to <www.dmp.wa.gov.au/geoview>.

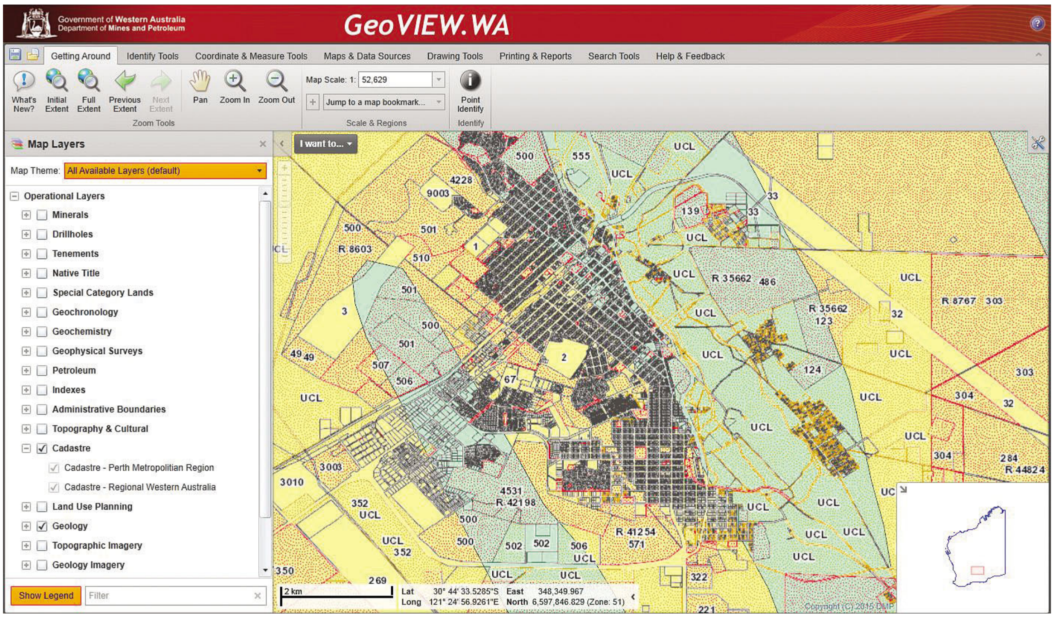


Figure 1. Castastral layers as displayed in GeoVIEW.WA

New and improved features for upgraded WAPIMS

A new version of WAPIMS online was launched at Petroleum Open Day on 4 September 2015.

Western Australian Petroleum and Geothermal Information Management System (WAPIMS) is a petroleum exploration database containing data on wells, geophysical surveys, titles and other related exploration and production data (Fig. 1).

The system also contains the Perth Core Library database. The core library is now the storage and sampling location for two-thirds of the core requirement, and one set of cuttings for all offshore jurisdictions around Australia together with the Western Australian State petroleum samples. They are now available for viewing and sampling by industry and a complete list is available in WAPIMS.

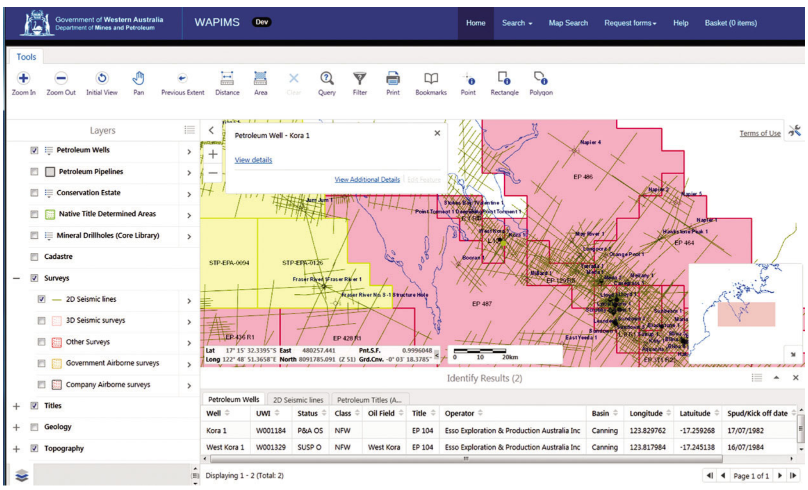


Figure 1. 'View details' to view and download data and documents relating to the selected row

Key features

- No registration required
- Easier to use search interface — find data more quickly and more easily than ever before
- Core Library data are now available
- WAPIMS is now compatible across all five major browsers (IE 9+, Chrome, Firefox, Safari and Edge)
- HTML 5 Map Search means the map can now be viewed on all platforms including a tablet
- New Request Forms allow you to request core cuttings and sampling via the website
- Links to DMP's PGR and NOPTA's NEATS databases

For more information, contact Felicia Irimies (felicia.irimies@dmp.wa.gov.au).

Temporal constraints on magmatism, metamorphism and mineralization in the Tropicana Zone, Albany–Fraser Orogen

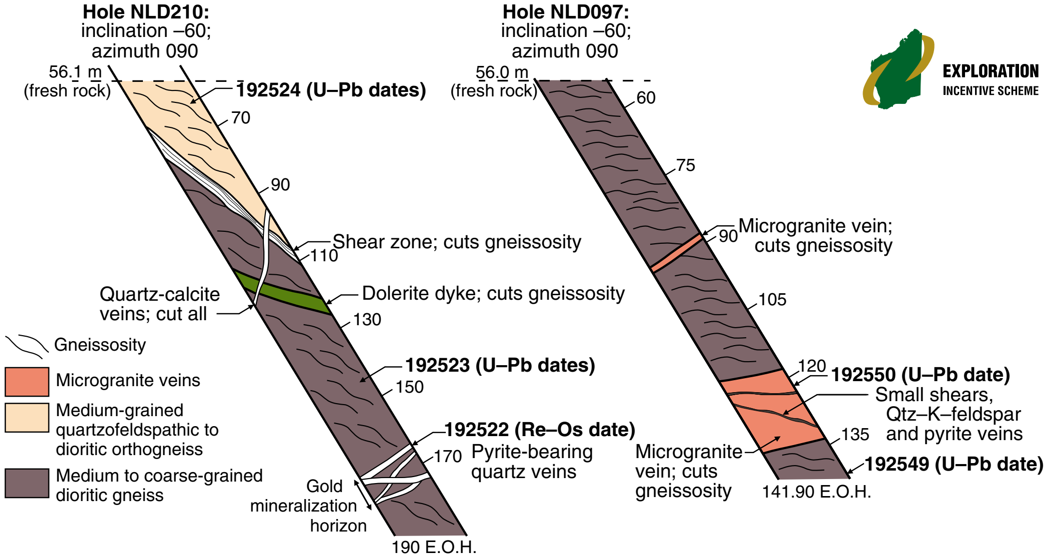


Figure 1. Schematic diagrams of the two diamond drillcores NLD210 (left) and NLD097 (right) from the Hercules Prospect, showing crosscutting relationships and locations of geochronology samples

Craton margins host significant lithospheric discontinuities that focus fluids and heat, and which, under favourable circumstances, may become mineralized corridors. Commonly, high-metamorphic-grade terrains are viewed as less prospective for gold mineralization than lower grade regions. However, the high-metamorphic-grade Tropicana Zone, located on the southeastern margin of the Yilgarn Craton within the Albany–Fraser Orogen, contains the significant Tropicana gold deposit. The Archean host rocks to the deposit, and similar rocks in the Hercules and Atlantis prospects to the northeast, are mid-amphibolite to granulite facies gneissic rocks with evidence of partial melting.

The Tropicana Zone includes distinctive granites classed as sanukitoids. Along with their distinctive compositions, the rarity of these rocks within any Archean craton suggests that their granitoid protoliths represent a single suite, emplaced during a single event. Due to the intense granulite facies overprinting of these rocks in the Tropicana Zone, determination of the magmatic protolith age for these sanukitoids is challenging (Fig. 1). Nonetheless, the best age estimate for this magmatism is 2692 ± 16 Ma, based on U–Pb analysis of the youngest zircons preserving textural evidence of growth within a viscous silicate melt. This result is older than the ages of most other sanukitoids within the Yilgarn Craton. Furthermore, the granulite-facies metamorphic zircon growth in the zone at 2718–2554 Ma is prolonged compared to elsewhere in the Yilgarn Craton. This may indicate that the Archean component of the Tropicana Zone reflects a deeper crustal level or a different part of the Yilgarn Craton, or both (Fig. 2). This is consistent with the interpretation that the Tropicana Zone includes a previously unrecognized piece of Yilgarn Craton crust that has been thrust a considerable distance to the northwest, over the Yamarna Terrane of the Yilgarn Craton. Granitic veins dated at c. 1780 Ma intruded into the Archean granitic gneiss indicate that the Tropicana Zone was close to its present position at or before c. 1780 Ma, given that similar Paleoproterozoic magmatic events are well known from adjacent units within the Albany–Fraser Orogen. Re–Os dating of pyrite coeval with one generation of gold mineralization in these rocks suggests an age of c. 2100 Ma. This mineralization event is distinct from major Proterozoic tectonothermal events known elsewhere in the Albany–Fraser Orogen. Sanukitoid magmas are well known for gold fertility and were likely the source of gold in the Tropicana Zone, which was subsequently remobilized and concentrated into brittle structures. Gold mineralization occurred after peak metamorphic conditions and is significantly younger than gold mineralization within the adjoining Yilgarn Craton.

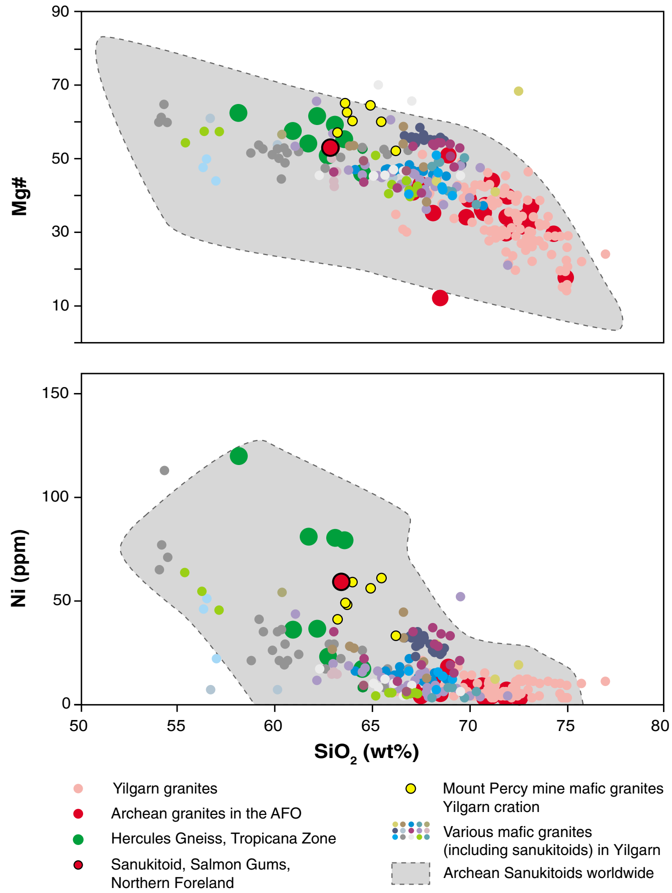


Figure 2. Compositional variation plots of Mg# and Ni versus SiO_2 of Hercules Gneiss drillcore samples in comparison to other Archean granites. Note elevated Mg# and Ni at SiO_2 = c. 60 wt% in the Hercules Gneiss are indicative of sanukitoid compositions.

See **Record 2015/5 Temporal constraints on magmatism, granulite-facies metamorphism, and gold mineralization of the Hercules Geniss, Tropicana Zone, Albany–Fraser Orogen** (available as a free download on the DMP eBookshop).

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

Mineral prospectivity of the King Leopold Orogen and Lennard Shelf: analysis of potential field data in the west Kimberley region

A new report by the Geological Survey of Western Australia (GSWA) in collaboration with the Centre for Exploration Targeting (CET) at The University of Western Australia (UWA), has investigated the mineral potential of the west Kimberley region. **GSWA Report 142** by MD Lindsay and others, represents the latest in a series that is undertaking a mineral systems analysis of underexplored Proterozoic provinces in Western Australia. The project is funded through the Exploration Incentive Scheme (EIS).

Emphasis was placed on identifying geological structures that may have importance for the mineral potential of the region. Subsurface structure was constrained through combined gravity and magnetic modelling along three transects. Crustal-scale faults were interpreted and investigated to determine their depth extent, because they may act as fluid conduits that localize mineralization. Crustal-scale features bound regions of different geological and geophysical character and might also control the formation of the oldest geological units. The Artesian Fault, identified during this study, is interpreted to extend from the Paperbark Supersuite into the Kimberley Basin.

The potential field interpretations and section models (Fig. 1) were linked to tectonic events and mineralization episodes in order to map the distribution of economically important regions using a knowledge-driven mineral systems approach to mineral prospectivity mapping. The mineral systems considered were 1) magmatic nickel sulfide, 2) carbonate-hosted base metals, 3) orogenic and epithermal gold (Fig. 2), 4) sediment-hosted stratiform base metals, 5) intrusion-related base metals (including tin–tungsten, iron oxide–copper–gold and copper–gold porphyry deposits). Prospectivity modelling shows that a geologically complex belt in the south of the Kimberley Basin, at the boundary with the King Leopold Orogen, is prospective for magmatic-related and hydrothermal mineral systems. In addition, a structural high on the Lennard Shelf is prospective for carbonate-hosted base metals, and parts of the King Leopold Orogen are prospective for sediment-hosted stratiform base metals. These results show that knowledge-driven modelling of mineral systems can be effective in identifying prospectivity in regional studies of underexplored areas.

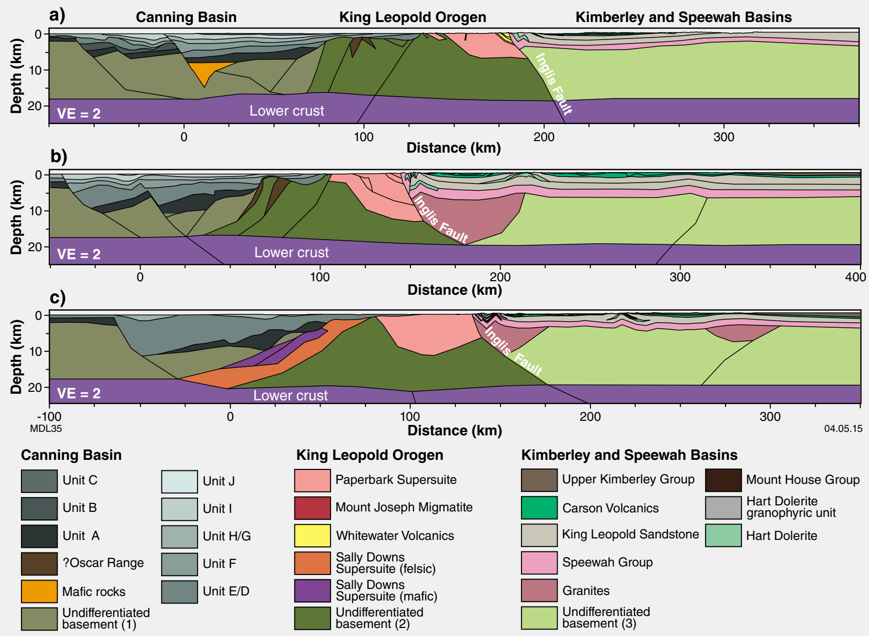


Figure 1. Geological interpretations of the upper crust for the three profiles using combined gravity and magnetic forward modelling

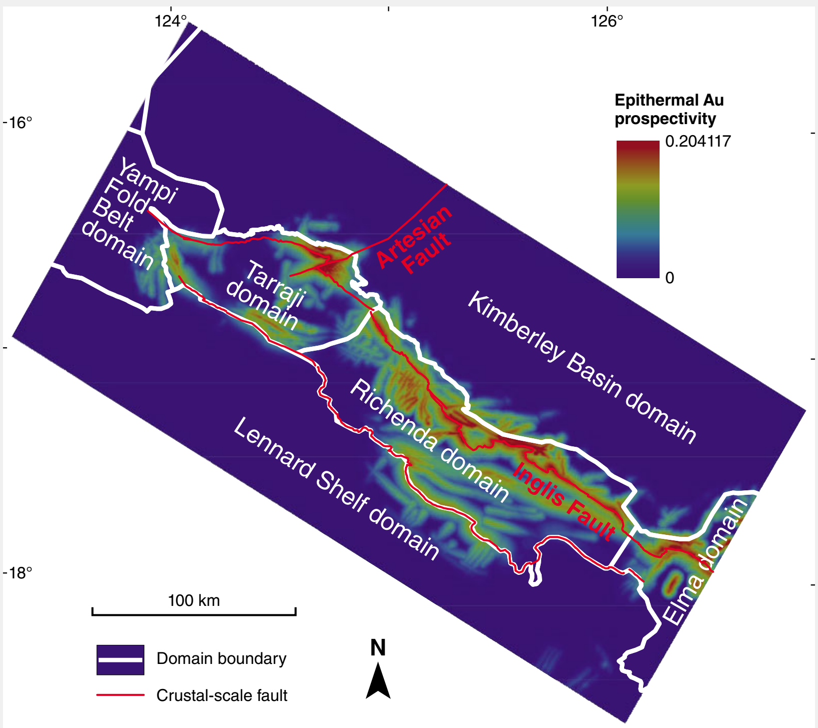


Figure 2. Fuzzy prospectivity model for the epithermal Au mineral system

GSWA Report 142 Mineral prospectivity of the King Leopold Orogen and Lennard Shelf: analysis of potential field data in the west Kimberley region is available as a free downloadable PDF from <www.dmp.wa.gov.au/ebookshop>.

For more information, contact Ian Tyler (ian.tyler@dmp.wa.gov.au).

New Hf isotopic data on the early Pilbara crust

The University of Western Australia

The 3530–3223 Ma East Pilbara Terrane of the northern Pilbara Craton evolved as a volcanic plateau above older continental crust. U–Pb and Sm–Nd isotopic evidence obtained over the past 20 years indicates that this pre-3530 Ma crust included material as old as 3800 Ma. One recent study interpreted Sm–Nd data, combined with Th–U–Pb systematics, to indicate the presence of enriched Hadean crust during the early evolution of the Pilbara Craton. Workers in other Archean cratons have suggested that felsic crust was globally widespread in the Hadean. However, relatively few pre-3500 Ma rocks are currently exposed on Earth's surface.

sedimentary facies of many of the sandstones indicate local derivation of detritus, and the zircon xenocrysts in the granites were most likely inherited from underlying older crust.

The Hf isotope compositions of the zircon grains analysed were interpreted to indicate that most of the older crustal components of the Pilbara Craton were extracted from near-chondritic mantle between 3700 and 3600 Ma. Previously reported rare detrital and xenocrystic zircons with $^{207}Pb/^{206}Pb$ ages between 3800 and 3700 Ma suggest the additional existence of minor >3700 Ma crust (Fig. 2). However, if older

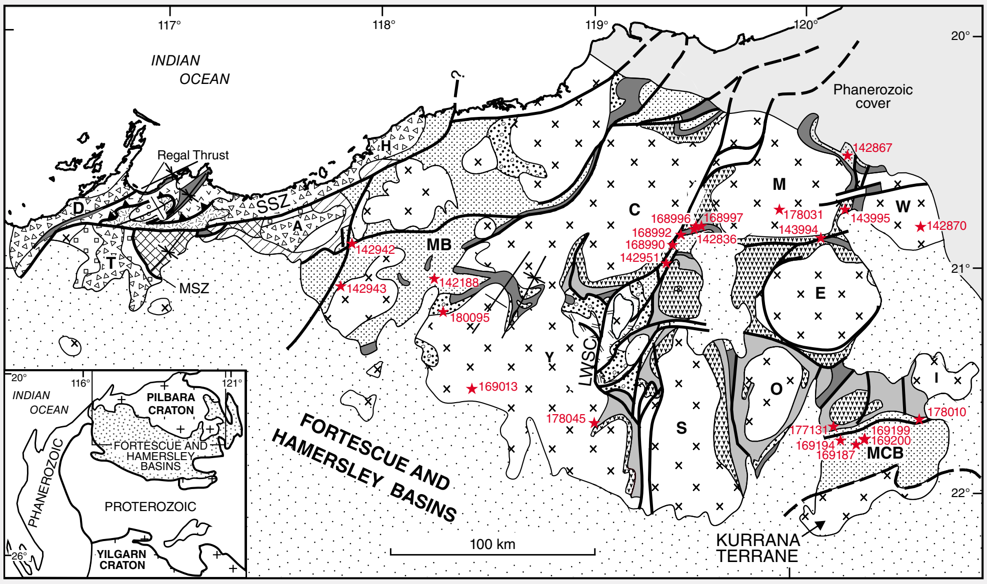


Figure 1. Simplified geological map of the northern Pilbara Craton showing the distribution of samples containing zircons older than 3550 Ma (maximum age of East Pilbara Terrane)

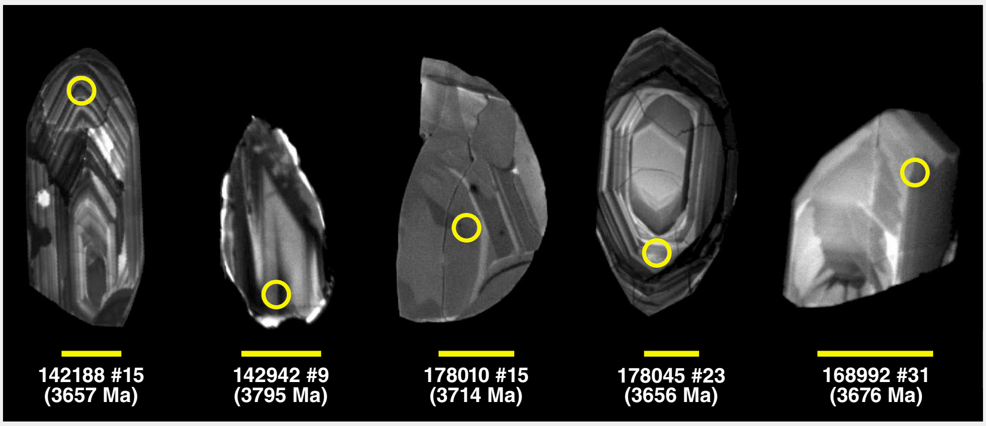


Figure 2. Cathodoluminescence images of selected old detrital zircons from the northern Pilbara Craton. The analytical site (open circle) and corresponding $^{207}Pb/^{206}Pb$ age for each zircon are indicated. The scale bar for each grain is 50 µm.

To seek additional evidence from the Pilbara Craton, a new study was undertaken by the Geological Survey of Western Australia (GSWA) in collaboration with Prof.Tony Kemp from The University of Western Australia in which Hf isotope data were obtained on the oldest Pilbara zircons identified using the U–Pb SHRIMP method. This dating program identified 174 zircon grains from 21 sandstone samples and 16 grains from two granite samples, all with $^{207}Pb/^{206}Pb$ ages >3550 Ma (Fig. 1). The new study used all the grains from the granites and about half the available grains from 12 of the sandstone samples. The crust was ever present in the Pilbara Craton it did not have input to the samples used in this study.

Report 151 Early evolution of the Pilbara Craton from hafnium isotopes in detrital and inherited zircons is available as a free download from <www.dmp.wa.gov.au/ ebookshop>.

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

Eucla basement stratigraphic drilling results — new geology,

The results of the Eucla basement stratigraphic drilling program were released at a public workshop on 10 September 2015, and public core viewings were held on 14 September 2015. Detailed work on the eight stratigraphic drillcores has provided a wealth of new data and new ideas, which were presented in 13 talks at the workshop. These talks, and the extended abstract volume which includes details of all drillhole locations and summary logs of the cores, are available for download at <www.dmp.wa.gov.au/eucladrilling>. All eight cores contain minor amounts of sulfide in most of the different rock generations and types encountered, which is surprising given the very large geographic distribution, and the fact that sulfides were not targeted. All cores also contain variable alteration. The results are encouraging, and suggest the possibility that these features could represent footprints of larger systems. Some key results are provided below.

The vast Nullarbor Plain covers an area of about 180 000 km^2 and in Western Australia hides the basement geology of the eastern edge of the Albany–Fraser Orogen, the Madura Province, and the Forrest Zone of the Coompana Province. The Geological Survey of Western Australia (GSWA) drilled three stratigraphic holes in the Madura Province and five into the Forrest Zone, providing about 1560 m of high-quality HQ diamond core of the basement, and RC chips and diamond core of the cover from selected sites.

The basin cover

Features affecting the evolution of the Eucla Basin and the Madura Shelf were presented in two talks. Marine geoscientist Mick O'Leary from Curtin University presented a talk titled 'Cenozoic records of dynamic topography, neotectonics and eustasy from the Eucla Basin', and sedimentologist Milo Barham, also from Curtin University, presented a talk titled 'Stratigraphical and geochemical analysis of pre-Cenozoic sediments beneath the Nullarbor Plain and implications for basin and margin evolution'. Techniques of drilling through the cover, and the lessons we have learnt, were presented by Paul Mander, Vice President of First Drilling, the company that carried out the mud-rotary and diamond drilling for the project. The complex cover sequences include sections of vuggy limestone, underlain by shale with horizons of loose sand. In the past, some drilling operations have abandoned holes and equipment, whereas we now have a much better understanding of the ground conditions, and how to plan for successful drilling campaigns.

The basement

The rest of the workshop was spent looking at the basement geology, the main aim of the project. The first four talks covered the Madura Province, which lies to the east of the Albany–Fraser Orogen. Several previously drilled, Exploration Incentive Scheme (EIS) co-funded and donated company cores have provided data leading to an interpretation of a c. 1400 Ma oceanic arc, the Loongana Arc (Fig. 1; Spaggiari et al., 2014, GSWA Report 133). Stratigraphic drillcore MAD002 has provided much insight into this interpretation as it contains fine-grained, laminated, lower amphibolite facies metabasalt with E-MORB to OIB geochemistry. We interpret this basalt as part of the proto-oceanic crust developed during continental margin rifting and development of an ocean-continent transition (OCT), on which the Loongana Arc formed much later. This type of setting has

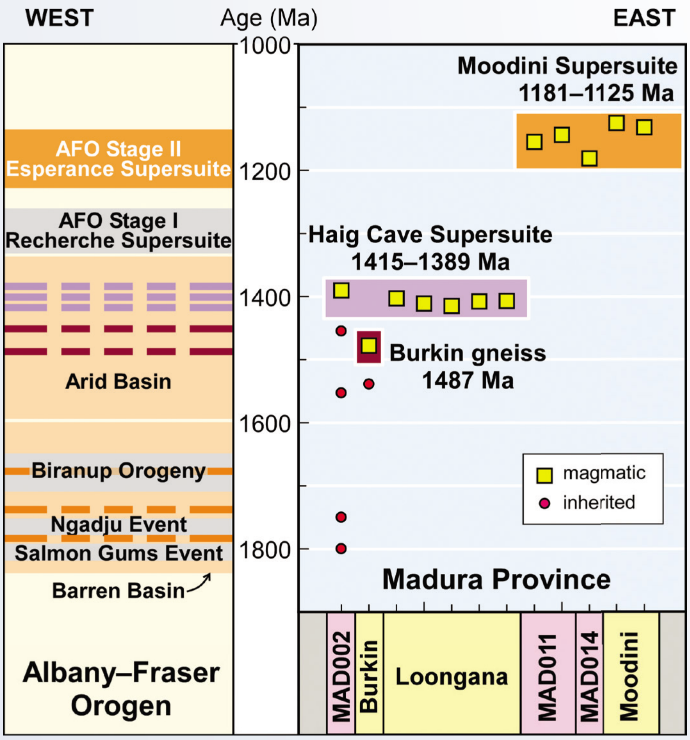


Figure 1. Summary of geochronology from the Madura Province and comparison to events in the Albany–Fraser Orogen

potential for VMS-style or exhalative type mineralization, and the presence of disseminated sulfides, stringers and veins with pyrite, pyrrhotite, and chalcopyrite with up to 2146 ppm Cu (GSWA 206770, 17cm ½ HQ core) is encouraging. The basalt is intruded by veins of adakitic leucogranite, dated at c. 1389 Ma, and probably relate to formation of the Loongana Arc, which has potential for subduction-related Ni and PGE. The basaltic and oceanic arc crust are interpreted as a large, relatively intact ophiolitic crustal slice accreted to the eastern margin of the continent along the Rodona Shear Zone. Additional relicts of older basaltic basement are found in drillcore MAD011, which contains c. 1145 Ma medium- to coarse-grained ferro-monzogabbro (High-KFe series Moodini Supersuite) with rafts or xenoliths of fine-grained basalt with N-MORB geochemistry. Both the Lu–Hf and Sm–Nd isotopic record indicates that juvenile oceanic crust was likely to have been extensive, and was initially formed at 2.0–1.9 Ga.

new prospectivity

The subsequent four talks looked at the Forrest Zone, which is interpreted as part of the Coompana Province that extends into South Australia, and links to the Gawler Craton. Drillcores FOR004 and FOR008 contain a range of c. 1610 Ma (Fig. 2) upper amphibolite to granulite facies diorite, monzodiorite, granodiorite and monzogranite gneisses interpreted as primitive arc, near primary melts of subduction-modified mantle and lower crust. They contain zones of dominantly chlorite–epidote–hematite or sericite–carbonate–albite–chlorite greenschist facies alteration, locally with chalcopyrite veinlets with up to 1154 ppm Cu.

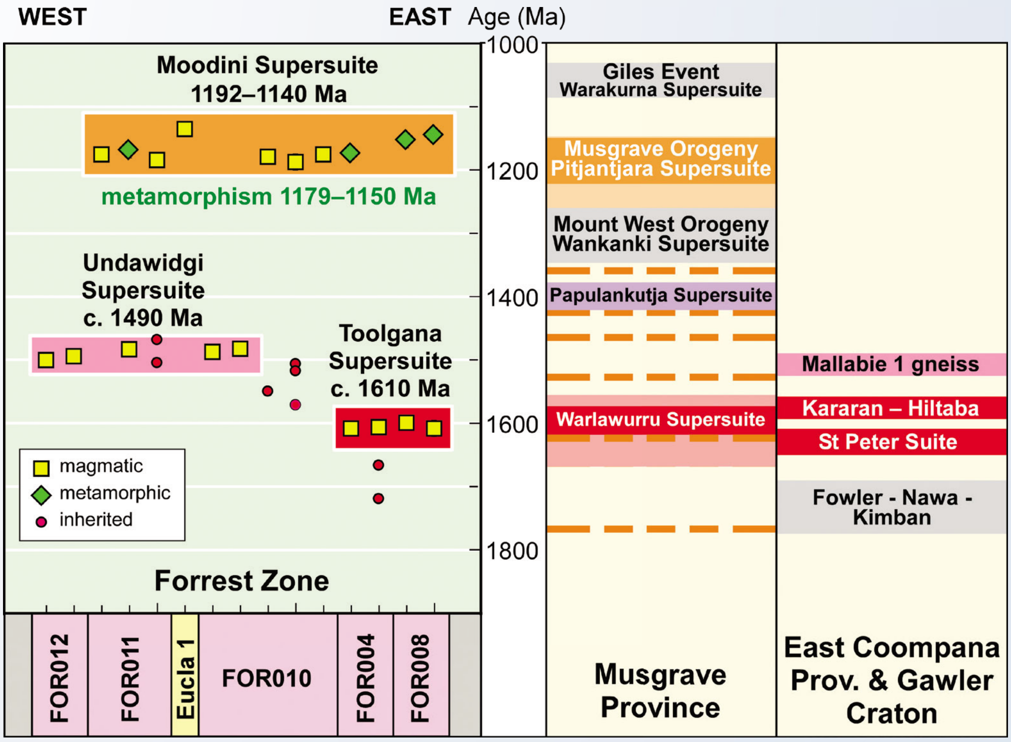


Figure 2. Summary of geochronology from the Forrest Zone, Coompana Province, and comparison to selected events in the Musgrave Province and Gawler Craton

Drillcores FOR012, FOR011 and FOR010 contain a variety of c. 1500 Ma, greenschist to lower amphibolite facies mafic to granitic rocks and felsic volcanic rocks interpreted as a high-K, rift-related suite formed by melting of lower mafic crust with the introduction of a mantle component, and recycling of the c. 1600 Ma primitive arc rocks, suggesting the potential for VMS-style mineralization. The presence of Cu in chlorite–epidote–sericite alteration is encouraging. These alkali-rich, magnetite-bearing high-level intrusives and volcanics possibly formed from melting alkali-metasomatized subduction-related crust, suggesting potential for IOCG.

FOR011 and FOR010 are intruded by c. 1180 Ma shoshonites, which comprise mafic to intermediate, fine- to medium-grained, hornblende–biotite metagranite and porphyritic to equigranular syenogranite. Shoshonites are regarded as prospective for intrusion-related Cu or Cu–Au and the Forrest Zone rocks show close compositional similarities with Cu–Au mineralized shoshonites in the Early Silurian Macquarie Arc in New South Wales. Dy/Yb ratios of shoshonites are initially high in the mafic magmas, but decrease rapidly with increasing silica suggesting a strong role for hornblende fractionation, although Eu-anomalies are typically not developed. This suggests the magmas underwent early water saturation. The syenogranites are late Si-rich shoshonites that are significantly altered, and contain pyrite–chalcopyrite–rare galena.

The shoshonites are part of a massive, high-T, melting event at c. 1225–1130 Ma that produced juvenile high-KFe, A-type magmas in the Forrest Zone and Madura Province, and extended as far as the Albany–Fraser Orogen and the Musgrave Province (Figs. 1 and 2). The evolution of these rocks reflects high-temperature melting of thinned primitive crust. The huge regional extent of this magmatism may relate to the presence of oceanic crust that was not completely destroyed by amalgamation of the West Australian Craton and the South Australian Craton, and remained relatively thin compared to its neighbouring cratons.

For more information, contact Catherine Spaggiari (catherine.spaggiari@dmp.wa.gov.au).

The Perth Basin — a renewed interest

Last year, AWE (Australian Worldwide Exploration) announced the Senecio and Waitsia discoveries, potentially the largest onshore conventional gas resource discovery in Western Australia since the Dongara discovery in the 1960s. They have added resources of 360 billion cubic feet (Bcf) of gas to the previous total of 429 (1C–Bcf) gas, and 203 (million bbl) of condensate/ oil (as of 2014 estimate). These and other new discoveries have led to an exploration rush in Western Australia's Perth Basin.

Petroleum exploration of the Perth Basin started in the early 1950s. Since then more than 309 onshore and 52 offshore wells have been drilled, resulting in about 20 commercial oil and gas fields and numerous other significant discoveries within

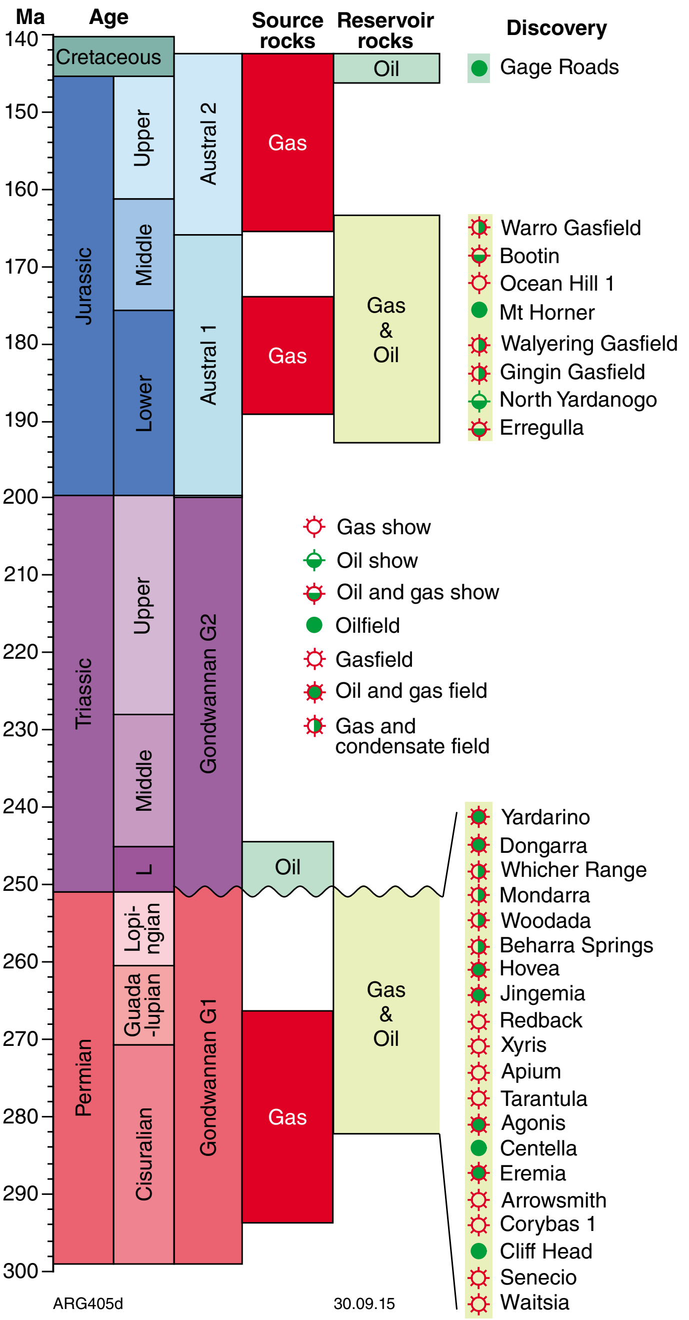


Figure 1. Perth Basin time-stratigraphy showing Superpetroleum systems, source and reservoir rocks, and petroleum discoveries

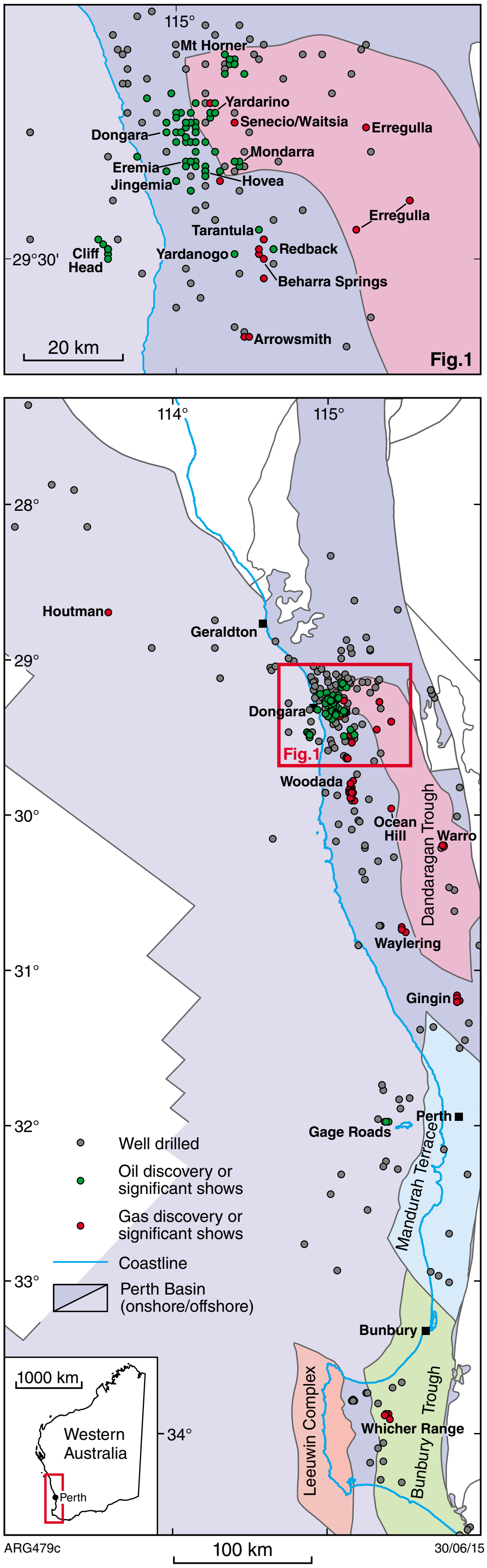


Figure 2. Map of the Perth Basin showing tectonic units, petroleum wells and discoveries

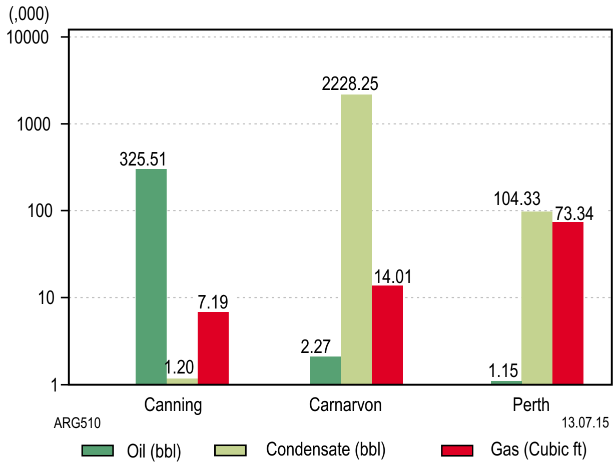


Figure 3. Petroleum production in Western Australian jurisdiction in 2014

tight sand (Figs 1 and 2). Oil and gas presently comes from conventional reservoirs — production in 2014 comprised more than 1155 barrels of oil, 104 324 barrels of condensate, and 7.335 billion cubic feet of gas — which are locally significant and indicates gas-condensate rich resources. The Perth Basin was the second largest producer of oil and gas within the Western Australian jurisdiction in 2014 (Fig. 3).

Petroleum geochemistry, organic petrology, apatite fission track analysis (AFTA), heat-flow data, subsurface temperatures, and other exploration data from the onshore Perth Basin have identified four petroleum systems: a Permian source (Whicher Range oil), Triassic source (Dongara, Erregulla, Mount Horner, and Yardarino oil); Jurassic source (Walyering oil); and Cretaceous source (Gage Roads oil).

Searches for the richest petroleum–shale plays in the Perth Basin started with encouraging results at Woodada Deep 1 and Arrowsmith 2, and a new Permian gas play at Senecio 3 (Waitsia discovery). The oil recovery from the Kockatea Shale in Arrowsmith 2 was the first proven shale–oil play in the Perth Basin. Currently, the Permian Carynginia Formation and the latest Permian–Triassic Kockatea Shale are the focus for exploration and research to evaluate the basin's tight-petroleum potential.

Petroleum resource estimates indicate significant tight sand/shale gas and oil resources — up to 25 trillion cubic feet (Tcf) of gas in the Permian Carynginia Formation, and up to 8 trillion cubic feet (Tcf) of gas with 500 million barrels of oil/condensate in the latest Permian–Triassic Kockatea shale (Fig. 4). In total, emerging shale plays have the potential to produce over 33 trillion cubic feet of gas and 500 million barrels of oil, which would offset decreasing production from conventional reservoirs of the Perth Basin.

Over the last 30 years, the US has enjoyed vast increases in production from thousands of wells backed by over 30 years of research. In comparison, geological and technological studies of Perth Basin resources are at an early stage as only a few wells have been drilled. Evaluation of these wells indicates viable petroleum resources of significant quantity with favourable geology. There is a well-developed infrastructure to explore and exploit these resources.

For more information, contact
Ameed Ghori (ameed.ghori@dmp.wa.gov.au).

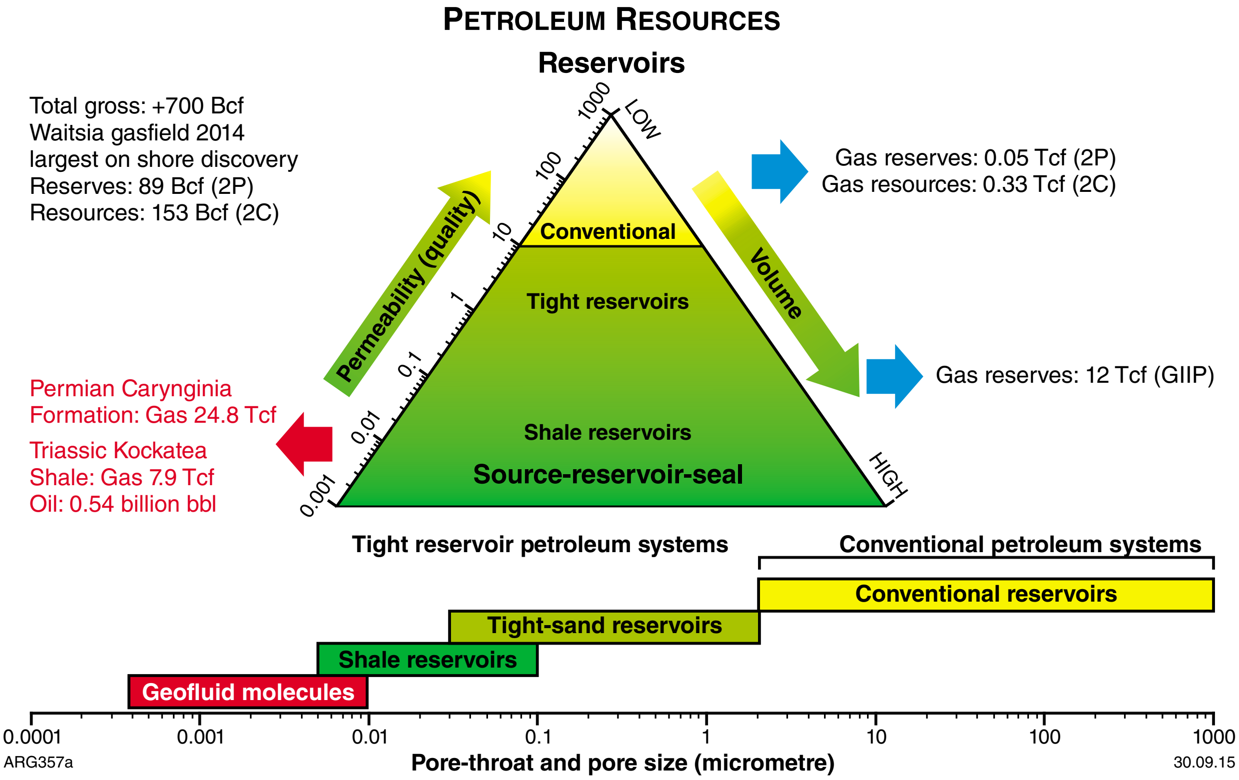


Figure 4. Estimated petroleum resources within conventional and tight reservoirs

Unlocking Australia's hidden potential — an industry roadmap

Western Australia's mineral wealth is dominantly based on world-class ore deposits, referred to as Tier 1 deposits, that were discovered in the 19th century (the Golden Mile – gold) and the 20th century (Mount Whaleback and Tom Price – iron ore; Kambalda – nickel; Telfer – gold and copper; and Argyle – diamonds, to name a few).

Near or at surface mineral deposits such as these, that can be discovered relatively easily, are increasingly more difficult to find. Exploration success relative to effort is declining. While there have been at least two Tier 1 discoveries this century, we need more.

Without Tier 1 discoveries in a range of commodities, international investors may perceive that Western Australia represents a mature exploration search space and direct their exploration expenditure elsewhere.

In 2010 the Australian Academy of Science dedicated its Theo Murphy High Flyers Think Tank to the issue of the decline in exploration success. The resulting report 'Searching the Deep Earth: A Vision for Exploration Geoscience in Australia' lead to the establishment of the UNCOVER Implementation Committee (www.uncoverminerals.org.au), which sought industry's help in identifying geoscience programs that could reverse this trend.

On 22 July 2015 in Perth, the Federal Minister for Industry and Science the Hon Ian Macfarlane MP and the Western Australian Minister for Finance; Mines and Petroleum the Hon Bill Marmion launched the AMIRA International P1162 Final Report 'Unlocking Australia's hidden potential: An Industry Roadmap — Stage 1' (Fig. 1). The Roadmap, facilitated by AMIRA International, builds on the work of the UNCOVER group and is the culmination of a cooperative effort between industry, the State and Territory geological surveys, CSIRO and globally recognized research leaders from The University of Western Australia (UWA) and Curtin University.

The Roadmap recognizes a number of issues that must be addressed which include characterizing and seeing through the cover of soil, sand and sedimentary basins that obscures 80% of the Australian continent's economic bedrock. Western Australia is particularly impacted by deep soil cover. Many of the suggested UNCOVER programs involve the pre-competitive geoscience undertaken by state geological surveys.

Western Australia has, in essence, already begun the UNCOVER process through the State Government's $130 million, eight-year Exploration Incentive Scheme (EIS), which has been aimed at pre-competitive geoscience data acquisition, particularly in underexplored, greenfields regions of Western Australia.

The Capricorn Distal Footprints Project, aimed at the underexplored Gascoyne and Mid-West regions, is a blueprint for UNCOVER projects. It is being run by Team WA as a collaboration between CSIRO, the Centre for Exploration Targeting at UWA, Curtin University and the Geological Survey of Western Australia, with a significant funding component coming from the State Government's Minerals Research Institute of Western Australia (MRIWA).

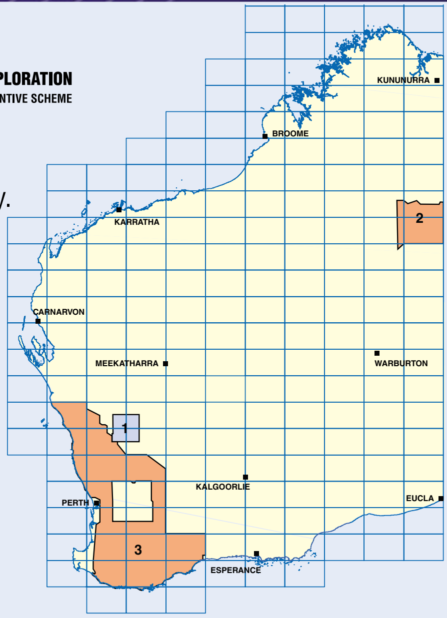
Unlocking Australia's hidden potential. An Industry Roadmap — Stage 1 is provided free of charge but under the conditions that publication of the Roadmap is prohibited, and any references/quotes from the Roadmap must acknowledge AMIRA International.

Figure 1. Final Report of the AMIRA International P1162 Roadmap — Stage 1. The Roadmap can be obtained free of charge by registering on the AMIRA International website (www.amirainternational.com/WEB/site.asp?section=activities&page=ExplorationUnderCover).

For more information, contact Rick Rogerson (rick.rogerson@dmp.wa.gov.au).

GSWA regional geophysics surveys: 5 October 2015 update

EXPLORATION INCENTIVE SCHEME



The latest release of GSWA regional geophysical surveys is the Ngururrpa gravity survey.

Data downloads

Final data releases from the Geophysical Archive Data Delivery System are at <www.ga.gov.au/gadds>.

Grids and images from the GSWA website are available from <www.dmp.wa.gov.au/geophysics>.

Airborne mag-rad surveys
Ground gravity surveys

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

Survey outline shapefiles are available online at <www.dmp.wa.gov.au/geophysics>.

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

ID	*Area/Name*	*Method*	*Configuration*	*Units*	*Status*	*Start*	*End*	*Release*
1	Yalgoo 2015	Mag-Rad	100 m; E/W	111 000 km	Processing	31/05/15	27/09/15	Dec-15*
2	Ngururrpa 2015	Gravity	Grid 2.5 km	4 964 stns	Released	10/05/15	13/06/15	30/07/15
3	SW Yilgarn 2015	Gravity	Roads 2 km	29 000 stns	Survey 54%	12/06/15	Jan-16*	Apr-16*

Mag-Rad = Magnetic/Radiometric — ** Estimated date*

Information current at: 5 October 2015

Spotlight on data packages

Limesand and limestone resources of southern Western Australia

This data package provides information on the potential availability of limesand and limestone that occur along the south coast of Western Australia between Denmark and Esperance and their hinterland. All main sources of limesand and limestone have been identified. Information about the quality of the limesand and limestone, including chemical analyses of carbonate samples, is also presented.

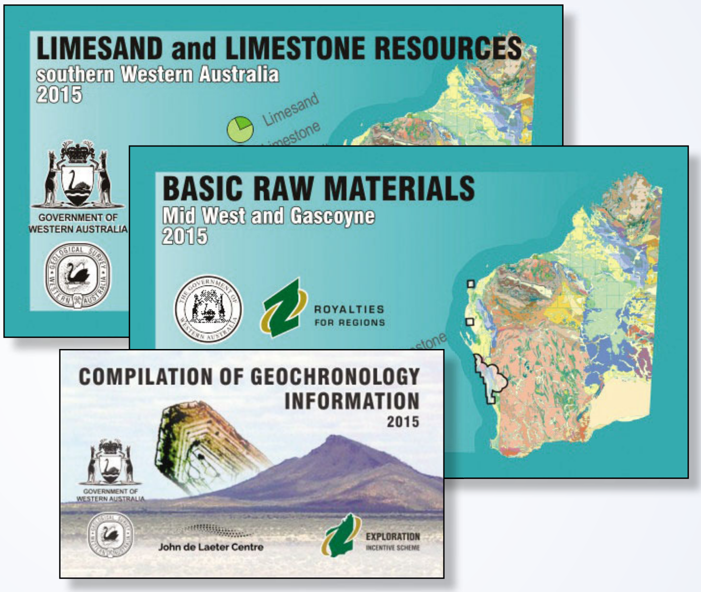
Mid West and Gascoyne, 2015: Basic raw material resources

This package provides information on the potential availability of basic raw materials (BRM) in the Batavia Coast and North Midlands subregions of the Mid West region, as well as regionally significant basic raw materials (RSBRM) in the Batavia Coast and North Midlands subregions of the Mid West region, and areas around Carnarvon and Exmouth. All main sources of BRM, which include sand, gravel, limestone, limesand and rock aggregate, have been identified, as have other major sites that are potential sources of these materials, taking into account high-level constraints such as National Parks, Class A Nature Reserves and coastal vulnerability.

RSBRM have been compiled from BRM mapping. This package identifies areas with the largest potentially available extractable quantities of sand, gravel, limestone, limesand and rock aggregate, taking into account depth to water table, mining constraints, and a range of high-level planning constraints such as local planning schemes with zones of residential, rural residential, rural small holding, special use, commercial and public purposes. Quality information of the BRM, including particle-sized distribution of granular samples and chemical analyses of carbonate samples, are also presented.

Compilation of geochronology information, 2015

This package contains information on the geochronology results obtained to June 2015 by the Geological Survey of Western Australia (GSWA), and to July 2007 by Geoscience Australia (GA).



To purchase data packages, go to DMP eBookshop, then to ‘Data packages’ under Categories, then choose from list.

For more information, contact
Daniel Then (daniel.then@dmp.wa.gov.au).

Product releases

Any prices include GST

ISSN 1325-9377 ISBN (PRINT) 978-1-74168-652-4
ISSN 1834-2272 ISBN (PDF) 978-1-74168-651-7

REPORTS

Report 152 Determining crustal architecture in the east Albany–Fraser Orogen from geological and geophysical data
by L Brisbout

Report 154 COBRA — Amadeus Basin Project: gravity and magnetic study of the western Amadeus Basin, Western Australia
by C Foss, JR Austin, and S Schmid

RECORDS

2015/6 GSWA Kimberley workshop 2014: extended abstracts
compiled by DW Maidment

2015/10 Eucla basement stratigraphic drilling results release workshop: extended abstracts
compiled by CV Spaggiari and RH Smithies

2015/13 Saying goodbye to a 2D Earth conference abstracts 2015
compiled by M Jessell and K Gessner

1:100 000 GEOLOGICAL SERIES MAPS

Yalgoo, WA Sheet 2241
by TJ Ivanic, J Li, Y Meng, L Guo, J Yu, SF Chen, S Wyche and I Zibra

GEOLOGICAL INFORMATION PACKAGES

West Tanami, 2015: Geological Information Package

GSWA database training 2015

The Geological Survey of Western Australia (GSWA) offers FREE training in its databases and online systems. The training is in the form of a presentation with hands-on interaction for most systems.

Topics include:

- navigating the Department of Mines and Petroleum's (DMP) website
- searching for geoscience publications
- downloading digital datasets using the Data and Software Centre
- searching for open-file mineral exploration reports using WAMEX
- searching the mineral drillholes and geochemistry databases
- bringing it all together with the interactive map viewer, GeoVIEW.WA and GeoMap.WA, a standalone GIS viewer for Windows.

KALGOORLIE

The Kalgoorlie training is open to anyone.
Venue: Room 102 (computer lab), Goldfields Institute of Technology, Centre for Engineering and Mining Training (CEMT), Australian Prospectors and Miners Hall of Fame, Kalgoorlie
Thursday 5 November

Register

To register for this free training, send an email to publications@dmp.wa.gov.au including your details (name, company name, telephone number), with the location and date of the training you wish to attend.

More information can be found at <www.dmp.wa.gov.au/training>.

How to join or leave GSWA's email list

To join our mailing list and receive our monthly newsletter with advice about training dates for 2016, please subscribe here <www.dmp.wa.gov.au/gswaenewsletter>.

The Geological Survey of Western Australia (GSWA) has released almost 5000 geological products including books, maps and data packages. These can be found on our website at <www.dmp.wa.gov.au/GSWApublications>.

Maps, USB data packages, and selected premium publications are available to purchase as hard copies via the online cart on the eBookshop at <www.dmp.wa.gov.au/ebookshop>. Alternatively, these products can be purchased from the Information Centre, First Floor, Mineral House, 100 Plain Street, East Perth, WA 6004, Australia, Phone: +61 8 9222 3459; Fax: +61 8 9222 3444.
Records, Reports, Bulletins and non-series books cannot be purchased in hard copy but are all available as PDFs to view, and as a free download.