

Fieldnotes



Department of
Industry and Resources

Geological Survey of
Western Australia



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ISSN 1325 9377
ISSN 1834 2272

ISBN 978-1-74168-144-4 (print)
ISBN 978-1-74168-143-7 (PDF)

Across the Yilgarn in five days

From 25 to 27 September 2007 a gathering of about 300 delegates attended the Kalgoorlie '07 conference to discuss developments in the understanding of geology of the Yilgarn Craton over the past ten years. Invited speakers presented talks on every aspect of Yilgarn geology from regional geology and landscape evolution to mineral systems and exploration targeting. Speakers came from a range of organisations such as Geoscience Australia, CSIRO, pmd*CRC, CRC LEME, the Centre for Exploration Targeting, other academic institutions, and a number of mineral exploration and mining companies. GSWA was well represented with presentations from Stephen Wyche, Martin Van Kranendonk, Catherine Spaggiari, Paul Morris, Franco Pirajno, Mike Wingate, and Tim Griffin.

GSWA also led two field excursions: a half-day excursion across the classic Kalgoorlie stratigraphy at Mount Hunt just south of Kalgoorlie, and a five-day traverse across the Yilgarn Craton from Menzies to the Jack Hills.

For the Yilgarn traverse 21 geologists set off from Menzies on the morning of 28 September. The excursion was led by Stephen Wyche and Catherine Spaggiari, and John Bunting, formerly with GSWA during the 1:250 000-scale mapping

era, now with JA Bunting and Associates. Those who lasted the distance travelled 1200 km, starting in the typical mafic-ultramafic greenstone stratigraphy of the Kalgoorlie Terrane of the Eastern Goldfields Superterrane, and ending at the discovery locality for the oldest known remnants of the Earth's crust yet found — the ancient detrital zircon locality in the Jack Hills.

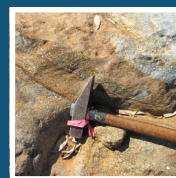
Along the way the excursion visited characteristic features of the various terranes within the Yilgarn Craton. Among these were craton-scale features such as the Ida Fault, the structure that separates the Kalgoorlie Terrane from the Youanmi Terrane, and the Edale Shear Zone, a major structure within the Youanmi Terrane. The well-studied Kurrajong Anticline ultramafic succession within the Kalgoorlie Terrane was visited, as were ultramafic successions in the Southern Cross and Murchison Domains of the Youanmi Terrane at Sandstone and Meekatharra respectively. In the largely featureless country that stretches between Sandstone and Meekatharra, excursion participants walked a well-preserved section of the vanadium-bearing Barrambie Intrusion, and were taken on a tour of the traces of the ancient Yarrabubba Impact Structure by John Bunting, who first recognized them for what they are. Finally, participants were able to examine the quartzite and

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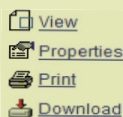


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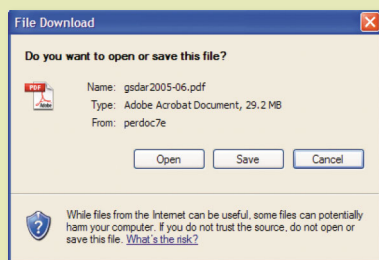
If you have recently accessed the WAMEX system to search company mineral exploration reports, or visited our Publications website <<http://www.doir.wa.gov.au/GSWA/publications>>, you will notice that we have a new document server for the delivery of our online documents. Here is the tenth in a series of user tips to help get the most out of DigitalPaper.

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For more information, contact Ryan Aston (ryan.aston@doir.wa.gov.au).



GSWA 2008 Seminar and Poster Display

Thursday 14 February 2008
Esplanade Hotel, Fremantle



GSWA's Seminar and Poster Display will again showcase to mineral and petroleum explorers early results of its ongoing work program. GSWA will also demonstrate current exploration data and software available online.

In addition to our regular mapping program update, focus will be on products from the WA Government's \$3 M per annum additional funding primarily for airborne geophysical surveys, regional gravity surveys and new geochronological data.

Throughout the day there will be geological presentations on GSWA activities and an extensive poster display. A feature of the day will be a panel discussion on the role and work programs of GSWA.

There will be talks from GSWA staff on topics such as the Gascoyne Complex, dimension stones, western Musgrave Complex, western Arunta Orogen and land use geoscience.

For more information, contact Nell Stoyanoff (nell.stoyanoff.wa.gov.au).

Across the Yilgarn in five days....continued from page 1
conglomerate that host detrital zircons up to 4.40 Ga old at Jack Hills, and compare them with quartzite that hosts 4.35 Ga zircons in the Maynard Hills, 350 km to the southeast, which they saw three days previously.

At Meekatharra, David Hollingsworth of Mercator Gold PLC presented a comprehensive overview of the Mercator operation, accompanied by a core display and visits to two of the company's openpits.

Excursion guides for all the Kalgoorlie '07 excursions, including the pre-conference trip that examined structural controls on gold mineralization led by Richard Blewett and Karol Czarnota of Geoscience Australia, can be downloaded from the GSWA website.

For more information, contact Stephen Wyche (stephen.wyche@doir.wa.gov.au).



Mineral Resources Bulletin 23 review

Mineral Resources Bulletin 23

Dimension stone in Western Australia Volume 1

Industry review and dimension stones of the Southwest region



Donnybrook Sandstone wall framing the entrance to Reconciliation Place, Canberra

Mineral Resources Bulletin 23 is the initial offering of a two-volume series that for the first time will cover the dimension stone resources of Western Australia. Volume 1 covers the historical and technical aspects of the industry followed by a description of the dimension stones of the State's Southwest region. Volume 2, due for completion later in 2008, will provide descriptions of dimension stone quarries and prospects from the southern, central and northern areas of the State.

Dimension stone is defined as natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size and shape suitable for use as building stone, ornamental stone, and monumental stone. Dimension stones mostly fall into six major commercial categories: granite and metamorphic equivalents, black granite, sandstone, limestone, marble, and slate. Other varieties include quartzite, trachyte, bluestone, basalt, and flagstone. Since the dawn of civilized society, man has accessed numerous rock types for use as dimension stone in many areas around the world.

As Perth and regional centres developed the search was soon underway to find local stone suitable for the construction of substantial stone buildings and other structures. Since that time the Southwest region of Western Australia, within a radius of 300 km from Perth, has been found to contain many high-quality and visually attractive dimension stones from the Archean Yilgarn Craton, Proterozoic Leeuwin Complex, and the Phanerozoic Perth and Southern Carnarvon Basins. Localities for all known dimension stones in the region are listed in this volume and geological settings examined. Currently, a number of these stones have found favour with architects, builders, landscape designers, and artisans. These include the spectacular Austral Juperana, a metamorphosed granitic rock ranging from pinkish beige to yellow gold, the Verde Lope granite with its very large pale green and pink

crystals, and the beautiful Donnybrook Sandstone, produced in a variety of shades and textures suitable for precision-cut blocks and slabs and intricate, high-quality carving. Also included is the high-grade Tamala Limestone, extending south from Geraldton through the economically significant outer Perth metropolitan area to the Bunbury area, with operations serving the building block industry.

Estimates for 2003–04 show that Western Australia was the largest producer of cut limestone blocks in Australia at over 0.23 Mt valued at approximately A\$4.57 million, with the State being Australia's largest dimension stone producer at almost 0.25 Mt, valued at approximately A\$7.81 million.

Volume 1 also contains a discussion on the history of the use and methods of extraction of dimension stone, as well as sections on technical properties, stone testing, petrography, processing, production trends, current and potential markets for local stone products, and conservation procedures.



Close-spaced percussion drilling subdividing a 25-tonne block of 'Austral Waterfall' dimension stone into useable-sized blocks at Bruce Rock quarry

For more information, contact Mike Fetherston (mike.fetherston@doir.wa.gov.au).



GSWA field activities show results

During the 2007 field season GSWA mapping teams were active in the Yilgarn Craton, the Gascoyne and Musgrave Complexes, the Granites–Tanami and Arunta Orogens, and the Edmund, Collier, and Canning Basins.

Yilgarn Craton

The Murchison team carried out mapping in the Mingah Range northwest of Meekatharra, the Weld Range, and the Cue area. New geochronological data from samples collected during the course of the mapping suggest that the greenstone successions in the Murchison Domain of the Youanmi Terrane represent a series of discrete magmatic events.

The East Yilgarn team continued mapping in the Mount Venn, Yamarna – Mount Gill, and Dorothy Hills greenstone belts, with the assistance of the Ngaanyatjarra Land Council, and new mapping commenced in the Irwin Hills greenstone belt. All these greenstone belts lie in the Burtville Terrane of the Eastern Goldfields Superterrane. A wide range of rock types have been mapped in the greenstone belts, but stratigraphic associations differ from those in the Kurnalpi and Kalgoorlie Terranes to the west. Greenstones in the Mount Venn area were deposited about 2770 million years ago, consistent with the observation that greenstones of the Burtville Terrane are typically older than those in terranes to the west.

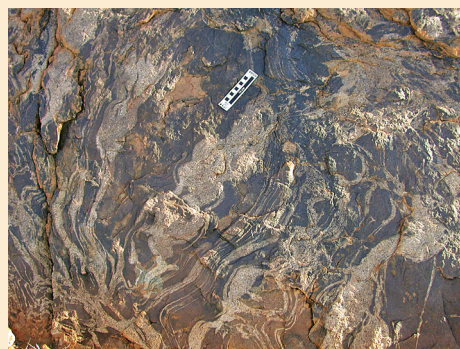


Carbonatite vein with fenitized halo in biotite monzogranite, Gifford Creek area, Gascoyne Complex

Gascoyne Complex

Fieldwork concentrated on the central part of the complex, where leucocratic granitic gneisses may represent a continuation of Archean–Paleoproterozoic granitic gneisses that form basement to the Gascoyne Complex south of the Chalba Shear Zone. If this interpretation is correct, it suggests that the same basement underlies the southern and central Gascoyne Complex, an interpretation in accord with a recent magnetotelluric (MT) survey across the complex [GSWA Record 2007/16].

Mapping has also confirmed the importance of previously identified Mesoproterozoic to Neoproterozoic reworking in the centre of the complex. In the northeastern part of the YINNIETHARRA 1:100 000 sheet, low- to medium-grade metasedimentary rocks of the c. 1680 Ma Pooranoo Metamorphics define a synclinal antiform and are overlain by low-grade metasedimentary rocks of the Edmund Group. These relationships imply an episode of recumbent folding after c. 1680 Ma, but before deposition of the Mesoproterozoic Edmund Group.



Granite swamping gabbro in the Giles Complex, Musgrave Complex

Musgrave Complex

The lithological range and age of gneisses that pre-date the 1220–1160 Ma Musgravian Orogeny differs either side of a major west-northwesterly trending structural zone, but it is unclear if the main structural component of that zone is the Petermann Ranges Orogeny-aged (c. 550 Ma) Mann Fault, or an earlier structure. Granites south of the zone are mainly 1330–1300 Ma in age, whereas 1220–1160 Ma Musgravian Orogeny granites dominate to the north.

Giles Complex (c.1075 Ma) magmatism is greater in volume, geographical extent, and duration, and shows much more complex interactions between mafic and felsic magmas and between magmatism and deformation (including mylonite development) than previously known. The layered Blackstone mafic intrusion (central-western Musgrave Complex) intruded the volcanic rocks of the lower Bentley Supergroup (also c. 1075 Ma) at the level of the Mummawarrawarra Basalt and was subsequently uplifted and partially eroded before deposition of the felsic volcanic rocks of the upper part of the supergroup. Although Musgrave Complex crust is typically thought to be very dry, hydrothermal alteration is a significant component of some Giles Complex-aged magmatic

Significant advances in field mapping in 2007

systems, which locally include subaqueous volcanic eruptions. All field relationships so far contradict earlier suggestions that Giles Complex-aged layered mafic-ultramafic bodies reflect deep crustal chambers.

Granites–Tanami Orogen

Mapping of the Paleoproterozoic rocks of the complex was completed. During the mapping a facies changes in the Paleoproterozoic Killi Killi Formation from metamorphosed flysch deposits (distal) to quartz-rich and pebbly psammite interbedded with metawacke (proximal) was recognized. The mapping has also shown that all granites on the WA side of the Granites–Tanami Orogen are S-types. Four dated samples of these granites have maximum ages of c. 1870 Ma; it is thought that all these ages may be xenocrystic, but further work is needed to verify this interpretation. In addition, the mapping shows that a large portion of what was previously included in the Mesoproterozoic Birrindudu Group is probably Neoproterozoic in age; as a consequence, the boundary between the Redcliff Pound Group and Wolfe Creek Basin is largely arbitrary.

Arunta Orogen

GSWA took advantage of a helicopter-assisted soil-sampling program based at the aboriginal community of Kiwirrkurra in the Gibson Desert to produce a new Interpreted Bedrock Geology map of the western Arunta Orogen. The Central Australian Suture (CAS) is a prominent feature in geophysical datasets, separating the 1860–1770 Ma Aileron Complex to the north, from the 1690–1630 Ma Warumpi Complex to the south. In the field both the CAS and a parallel structure to the south are marked by mylonitic rocks, and locally by tectonic breccias and quartz veining. Although the suture formed during the 1640–1630 Ma Leibig Orogeny, the structures have been reactivated, probably during the c. 550 Ma Petermann Ranges Orogeny and the 450–300 Ma Alice Springs Orogeny.

Edmund and Collier Basins

Fieldwork during 2007 has highlighted important similarities between the lower Edmund Group stratigraphy on the CANDOLLE 1:100 000 sheet and in the Jillawarra Sub-basin further to the east. Both areas are characterized by a thick (3 km and >1.5 km respectively) Irregully Formation that includes a diverse assemblage of shallow to deep marine-shelf dolomitic and siliciclastic rocks including dolomitic siltstones, sandstones, and stromatolitic dolostones. In the Jillawarra area these rocks have previously

been assigned to the Gap Well Formation and are host to significant base metal mineralization at Abra.

The Irregully Formation is unconformably overlain by dominantly siliciclastic sedimentary rocks of the Kiangi Creek Formation. On CANDOLLE the unconformity surface is overlain locally by thin, easterly derived, fluvial to shallow-marine sandstones. These are in turn succeeded by a thick, locally variable, stratigraphy of deeper marine mudstones and sandstones. In the Jillawarra area the Kiangi Creek Formation equates to the West Creek Formation, and comprises a lower unit of proximal fan delta sandstone and conglomerate overlain by deeper marine mudstone. The Tangadee Rhyolite is within the lower fan delta unit and has been sampled for further U–Pb zircon geochronology.

Mineral systems study

As part of a new initiative a mineral systems study to cover the Gascoyne Complex commenced in areas recently mapped by GSWA. This study will be



Cross stratified shallow marine sandstone body in the Irregully Formation, Edmund Group

integrated with geological mapping, with the aim of constructing descriptive and genetic models of ore systems in the complex. Building a mineral system genetic model provides insights into the geodynamic environment of ore formation and, importantly, allows a degree of predictability that can assist in exploration targeting.

Mineral systems examined during the field season include tungsten (scheelite) and magnetite skarns (Nardoo Well); rare metals (Ta, Bi, Be) and U in pegmatites (Morissey Hill and Mortimer Hill fields); Mo–Cu–W–Pb intrusion-related occurrences in shear zones (Minnie Creek Batholith); polymetallic quartz veins (Mangaroon and Mortimer Hills fields); and carbonatite-related REE and U (Gifford Creek Complex).

For more information, contact Steve Sheppard (steve.sheppard@doir.wa.gov.au).



National Geochemical Survey of Australia

New tool for mineral exploration

The National Geochemical Survey of Australia (NGSA) was established under the Australian Government's Onshore Energy Security Initiative to provide pre-competitive data and knowledge to support exploration for energy resources in Australia. In particular, it will improve the existing knowledge of the concentrations and distributions of energy-related elements such as uranium and thorium at the national scale.

The project is underpinned by a series of pilot geochemical surveys carried out in recent years by Geoscience Australia and the Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME) to test robust and cost-effective protocols for sample collection, preparation and analysis.

The survey was initiated because there is no complete geochemical coverage available for Australia. There are vast areas of the country (more than 60%) that lack any geochemical information. Also, where geochemical data are available, they are often not comparable as a result of:

- inconsistent sampling material;
- inconsistent sample-preparation methods;
- large differences in instrumentation used leading to variable lower limits of detection between datasets;
- lack of metadata on data quality;
- variable suite of elements analysed.

Some recent regional geochemical surveys have been carried out in parts of Australia, but no national coverage exists. Since the inception of the concept in the 1960s, regional geochemical surveys have proven to be a reliable tool for mineral exploration.

Project objectives

The objectives of the NGSA project are to:

- collect transported regolith samples at the outlet of large catchments covering over 90% of Australia;
- prepare and analyse the samples to extract the maximum amount of geochemical information (60+ elements);
- populate the national geochemical database with the resulting new data;
- compile an atlas of geochemical maps for use by the mineral exploration industry to identify areas of interest in terms of energy-related resources and other mineral commodities.



The first sample in Australia was collected late on a wet wintry afternoon outside Northam

Timeline

Planning started in the first half of 2007. Fieldwork, including initial training, commenced in mid-2007 and is expected to continue throughout 2007 and most of 2008 (the wet season prohibiting fieldwork in northern Australia for six months each year). Sample preparation will take place in 2008–09. Sample analysis is planned to occur in a single batch, most probably in 2009. Data analysis and reporting are planned for 2010 and early 2011. The project concludes on 30 June 2011.

Project outputs

- A National Geochemical Atlas of Australia.
- A series of reports on the geochemistry of all States and the Northern Territory by their respective geoscience agencies.
- Population of the OZCHEM geochemical database.

The NGSA will contribute to a series of reports on energy-related commodities including implications for geothermal resources, as part of the National Onshore Energy Security Initiative.

For more information, contact Paul Morris (paul.morris@doir.wa.gov.au).



Geophysics survey program

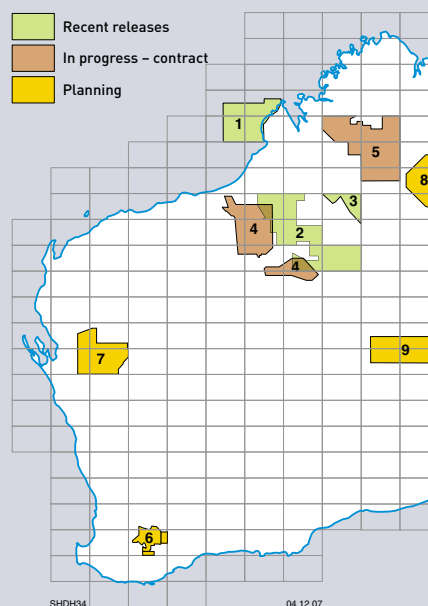
Western Australia regional geophysics surveys: Nov

Data access

Download final data releases from the Geoscience Australia Data Delivery System at <http://www.ga.gov.au/gadds>.
Download preliminary and final compilation grids and images from GSWA website <http://www.doir.wa.gov.au/GSWA> — Regional Geophysical Surveys page.

Subscribe to the GSWA mailing list (see <http://www.doir.wa.gov.au/GSWA> — News and Events page) to keep informed of preliminary and final data release dates.

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



ID	Name	Orgn.	Method	Specifications	Line-km	Status	Start	End	Release
Recent releases									
1	Canning Offshore 2007	GA	Mag	750 – 1500 m x 60 m; N/S	47 100	Complete	Jun-07	Aug-07	GADDs
2	Canning Basin SW 2007	GA	Mag-Rad	800 m x 80 m; N/S	103 200	Complete	Apr-07	Jul-07	GADDs
3	Canning Basin NE 2007								
Contracted or In progress									
4	Paterson 2007	GA	AEM	1, 2, 6 km x 121 m; E/W		Survey	Sep-07	May-08*	Jul-07*
5	South Kimberley 2007	GSWA	Mag-Rad	400 m x 60 m; N/S	163 000	Contract	Dec-07*	Jun-08*	Aug-08*
Planning									
6	Dumbleyung 2008	SWCC	Mag-Rad	100 m x 30 m; N/S – E/W	70 000	Tender	Feb-08*	May-08*	Jul-08*
7	Byro 2008	GSWA	Mag-Rad	400 m x 60 m; E/W	90 000	Planning	Apr-08*	July-08*	Oct-08*
8	West Tanami	GSWA	Gravity	2.5 km grid		Deferred	Pending land access negotiation		
9	West Musgrave	GSWA	Gravity	2.5 km grid		Planning	Pending land access negotiation		





Information current at: 9 November 2007 * Estimated dates

AusGeo News: for Western Australian readers

AusGeo News is Geoscience Australia's (GA's) quarterly news magazine. Each issue comprises geoscience-related features, brief articles about GA's research and initiatives, news about geoscience products and spatial data, and a calendar of coming seminars and conferences.

AusGeo News September 2007 Issue No. 87

Some of the articles pertinent to Western Australia are:

-  Promising results from Bight Basin survey. Samples show excellent source rock potential.
-  In search of the next hotspot. Project to boost exploration for bountiful, renewable energy.
-  Crucial petroleum data saved. Old data support rapid increase in exploration.
-  Energy Security Initiative updates. Accelerated industry access to data and progress report on several onshore surveys.

Click on <http://www.ga.gov.au/ausgeonews> to view AusGeo News and learn more about these stories.



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1:100 000 Geological Series

MOUNT EDGAR V. 2

PDF available on website.....free of charge

■ GEOLOGICAL INFORMATION PACKAGE

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(MOUNT PHILLIPS, EUDAMULLAH, MOUNT AUGUSTUS)

GIS dataset on DVD \$55 (inc. GST)

■ RESOURCE POTENTIAL FOR LAND USE PLANNING SERIES

Sand resource survey, Kalgoorlie region

PDF available on website.....free of charge

■ MINERAL RESOURCES BULLETIN

Dimension stone in Western Australia Volume 1

— Industry review and dimension stones of the Southwest region

Book and map available in hardcopy \$50 plus GST

PDF available on website..... free of charge

■ RECORDS

2007/14 Composition of the Bunbury Basalt (BB1) and Kerba Monzogranite (KG1) geochemical reference materials, and assessing the contamination effects of mill heads

2007/15 Stratigraphy and structure of the Kalgoorlie Terrane at Hannan Lake and Mount Hunt — a field guide

2007/19 Diversity of structurally controlled gold through time and space of the central Eastern Goldfields Superterrane — a field guide

2007/20 A geological traverse across the northern Yilgarn Craton — a field guide

PDFs available on website..... free of charge

IN PROGRESS

■ GEOLOGICAL MAPS

1:100 000 Geological Series

BULDANIA, COWALINYA, MARBLE BAR, MINERIE

■ RECORDS

2006/25 Stream-sediment geochemistry from the southwest of Western Australia — a pilot study

2007/16 Magnetotelluric investigation into the electrical structure of the Capricorn Orogen, Western Australia

2007/18 Mineral House 5th floor lift panels: Record of a reappraisal of the vertically sectioned and polished drillcore from the Brockman Iron Formation forming these panels

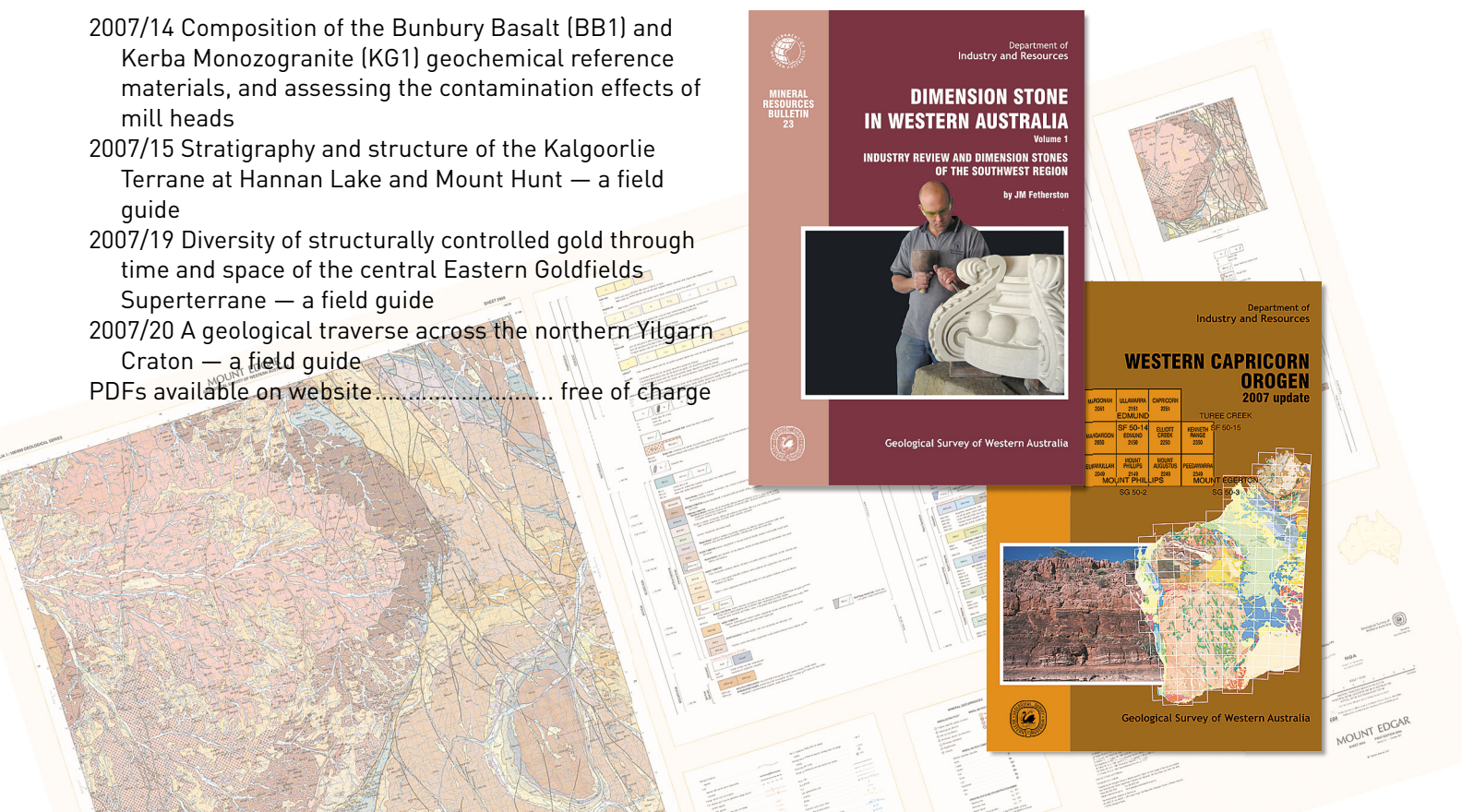
2007/21 Notes to accompany the Lake Violet 1:100 000 geology map, Western Australia

■ 1:100 000 GEOLOGICAL SERIES EXPLANATORY NOTES

YARDINA

■ MISCELLANEOUS PUBLICATIONS

GSWA Annual Review 2006–07



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Hardcopy publications including CDs and DVDs are available from the Information Centre, First Floor, Mineral House, 100 Plain St, East Perth, WA 6004, AUSTRALIA Phone: +61 8 9222 3459; Fax: +61 8 9222 3444 or can be purchased online from the bookshop at <http://www.doir.wa.gov.au>.