Geological Society of Australia Earth Sciences Student Symposium South Australia

PROGRAM AND ABSTRACT PROCEEDINGS

MINOTAUR EXPLORATION

Government of South Australia
Department for Energy and Mining

CONTENTS

WELCOME TO GESSS-SA 2020

Welcome to the annual Geological Society of Australia Earth Sciences Student Symposium (GESSS-SA). We are pleased to have you join us at the Alere Function Centre in the Flinders University Bedford Park Campus and online via livestream.

This event is an opportunity for Honours and Postgraduate students to come together and present their research to the public and wider scientific community. This experience is valuable for students who wish to develop their communication skills, network with their peers and professional geoscientists as well as develop their early careers.

South Australian students have a global impact on earth science research, with projects and collaborations being conducted in all corners of the globe. We are excited for our presenters to showcase their work with topics covering igneous, sedimentary and metamorphic geology, palaeontology, archaeology, ecology, geotourism and environmental sciences.

We sincerely thank our sponsors for their support in making this year's conference possible and we hope to continue these partnerships in the future.

Thank you for your participation and we hope you enjoy GESSS-SA 2020.

GESSS-SA 2020 Committee

GESSS-SA 2020 COMMITTEE

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Minotaur Exploration Ltd (ASX:MEP) is an Adelaide-based ASX-listed mineral exploration company – a dedicated copper-gold explorer with a focus on Iron Oxide Copper-Gold (IOCG) style targets and Iron Sulphide (ISCG) variants. Their research is directed to locating 'blind' deposits masked by cover rocks, relying on a variety of geophysical techniques across selected geological terranes to 'see' through the cover and generate targets for drill testing.

The more expensive drill test phase is often undertaken in conjunction with a farm-in partner to ameliorate risk and expenditure. Regions of focus within Australia for copper-gold mineralisation include the Cloncurry terrane of western Queensland and South Australia's Gawler Craton. Minotaur is currently in the midst of a period of intense exploration drill testing activity in the Cloncurry region, as well as greenfield target generation in the Gawler Craton.

Minotaur also holds development-ready resources of industrial minerals – kaolin, halloysite, gypsum and silica sand. Research into new technology and applications for the natural nanotube halloysite is now being translated into exciting new commercial opportunities.

Minotaur has encouraged and assisted numerous geology and geophysics students through work experience and vacation employment placement and has maintained a small graduate employment program over its +20 year life in Adelaide. Through its discovery of Prominent Hill in 2001, more recent discoveries in Cloncurry, and the imminent development of the Poochera kaolin-halloysite deposits on Eyre Peninsula, Minotaur has contributed significantly to the growth and prosperity of Australia.

Find out more about what we do at www.minotaurexploration.com.au

MINOTAUR EXPLORATION

SPONSOR: DEPARTMENT OF ENERGY AND MINING

The strategic intent of the Department for Energy and Mining is to deliver affordable, reliable and secure energy supplies in a transitioning national energy market while responsibly unlocking the value and opportunities of our mineral and energy resources. DEM's Energy Resources Division manages the State's petroleum resources as the lead agency facilitating ecologically sustainable petroleum exploration and development. Its operations cover the full cycle – investment attraction through provision of geoscientific data, regulation through policy and legislation, and optimisation of royalty income streams.

DEM's Mineral Resources Division is committed to developing the state's resource wealth to benefit South Australians. The Division drives forward growth and sustainable development of South Australia's minerals and energy assets within a world's best regulatory framework. The work supports the vision of growing the mineral sector's reputation as a leading resource investment destination, and encompasses leading-edge regulation, environmental assessment and royalty administration to provide good outcomes for the South Australian economy and community.

Find out more about what we do at energymining.sa.gov.au

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GENERAL INFORMATION

Registration

Registration will open at 8:30. Please ensure that you have registered online prior to the event.

Oral Presentation

Talks will be 12 minutes long with 3 minutes of question time. Presentations will be live-streamed for the audience attending virtually.

Poster Presentation

Presenters will have 1 minute to introduce their work beforehand. Please arrive early to ensure adequate time to set up your poster.

Catering

Morning tea, lunch and afternoon tea will be served. Drinks and snacks will also be served during the mentoring and poster sessions.

Mentoring Session Workshop

Roundtable discussions between students and professional mentors will be held at 13:30.

Conference Walking Tour

The excursion will showcase key geological sites on the Flinders Campus such as outcrops of the Neoproterozoic global glaciation. This walking tour will be held at 17:50.

Conference Dinner

The conference dinner and drinks will be held at The Tavern at 6:30 PM. Please register for the dinner prior to the event.

GESSS-SA 2020 PROGRAM

TIME	PROCEEDINGS	
8:30 – 9:00	***Registration***	
9:00 – 9:10	Introduction and Acknowledgment of Country	
9:10 – 9:20	**Elinor Alexander,** *Department of Energy and Mining*	Diamond Sponsor Talk
9:20 – 9:30	**Dr. Tony Belperio,** *Minotaur Exploration*	Diamond Sponsor Talk
9:30 – 10:00	**Dr. Margaret Shanafield,** *Flinders University*	Stepping Into The Water: A Career In Something That Should Be Important To Everyone!
TIME	**SESSION 1**	
10:00 – 10:15	**Georgina Virgo,** *University of Adelaide*	Descending Into The "Snowball": Improving Interpretations Of Tonian And Cryogenian Palaeoenvironments With Detailed Sedimentontology And Geochemistry
10:15 – 10:30	**Natasha N. Nagle,** *Flinders University*	Sediment Fingerprinting: Identifying Sedimentological Characteristics And Formation Processes At Late Pleistocene Archaeological Sites In SE Asia And Sahul
10:30 – 10:45	**Isaac A.R. Kerr,** *Flinders Univesity*	Old And New Fossil Material Reveals Fascinating Diversity In The Cervical Vertebrae And Hindlimbs Of Giant Kangaroos Of The Australian Pleistocene Genus Protemnodon
10:45 – 11:15	***Morning Tea***	
TIME	**SESSION 2**	
11:15 – 11:30	**Ellen K. Mather,** *Flinders University*	Extinct Eagles And Kin Of Australia; Unearthing The Hidden Diversity Of The Past
11:30 – 11:45	**Monica Jimenez,** *University of Adelaide*	Controls On Gravity-driven Normal Fault Geometry And Growth In Stacked Deltaic Settings: A Case Study From The Ceduna Sub-basin
11:45 – 12:00	**Adrienne Brotodewo,** *University of South Australia*	Zircon As An Exploration Tool
12:00 – 12:15	**Renée Tamblyn,** *University of Adelaide*	The Emergence Of Eclogites Linked To Global Arc Chemistry Change At 2 Ga
12:15 – 12:30	**Asika Dharmarathna,** University of Adelaide	Lake Geochemical Response To Decadal Scale Climate Variability; Evidence From A 150 Year Sediment Record From Lake Surprise, Victoria
12:30 – 13:30	***Lunch***	

GESSS-SA 2020 PROGRAM

TIME	SESSION 3	
13:30 – 15:30	Mentoring Session Workshop	
15:30 – 16:00	***Afternoon Tea***	
TIME	**SESSION 4**	
16:00 – 16:20	**Prof. Peter Betts,** *Monash University*	Changing The Geoscience Narrative To Improve The Way We Are Perceived By The General Public
16:20 – 16:40	Poster Presentation Introductions	
16:40 – 17:40	Poster Presentations	
17:40 – 17:50	***Closing Remarks and Prize Announcements***	
17:50 – 18:30	Conference Walking Tour and Post-Conference Dinner	

SOCIAL MEDIA

We encourage delegates to use the hashtag **#GESSSSA** on Facebook, Instagram and Twitter to share your experience of the day!

ORAL PRESENTATION ABSTRACT VOLUME

DESCENDING INTO THE "SNOWBALL": IMPROVING INTERPRETATIONS OF TONIAN AND CRYOGENIAN PALAEOENVIRONMENTS WITH DETAILED SEDIMENTONTOLOGY AND GEOCHEMISTRY

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The Tonian–Cryogenian transition represents a period of significant physiochemical change in Earth history. It involved variations in oceanic and atmospheric oxygenation, significant changes in the biosphere, tectonic reorganisation, and the onset of the global 'Sturtian' glaciation. Tonian and Cryogenian sedimentary rocks in the Adelaide Superbasin, South Australia (SA), represent some of the most significant and well-exposed sections of this interval globally, recording major environmental shifts through distinct variations in lithology and isotope chemistry. Although this transition is geologically significant, it remains enigmatic due to a distinct lack of comprehensive, contemporary Tonian–Cryogenian research in South Australia.

We present robust palaeoenvironmental interpretations for a complete pre- to post- glacial succession near Copley in the northern Flinders Ranges, SA. During fieldwork, a ~3km sedimentary log was measured for facies and sequence stratigraphic analyses, and 350 samples were collected for elemental and isotopic geochemical analyses. Our study reveals multiple regressive-transgressive cycles, recorded by deltaic rippled and cross-stratified sandstones, through lagoonal intraclastic magnesite and stromatolitic carbonates, to subtidal laminated siltstone and platform carbonates. These pre-glacial formations are unconformably overlain by subglacial to ice contact pebbly diamictites with quarzitic and dolomitic interbeds, which grade into proglacial laminated mudstone and sandstone with dropstones. We suggest that these facies reflect glaciomarine conditions. The post-glacial formation consists of subtidal laminated shales and carbonates, reflecting widespread transgression after the glaciation. Elemental chemistry, along with C- and Sr-isotope analyses support preservation of primary basin water chemistries for significant parts of the preglacial sequence. Furthermore, radiogenic (87/86) and stable (88/86) Sr-isotope data are interpreted to reflect a restricted setting analogous to the modern Coorong lagoon. This high-resolution study presents new palaeoenvironmental insights into a key Tonian–Cryogenian succession, which sheds light in our understanding of how the world descended into one of the most severe glaciations ever recorded.

Key words:
Neoproterozoic, Tonian, Cryogenian, Adelaide Superbasin, sedimentology, geochemistry

SEDIMENT FINGERPRINTING: IDENTIFYING SEDIMENTOLOGICAL CHARACTERISTICS AND FORMATION PROCESSES AT LATE PLEISTOCENE ARCHAEOLOGICAL SITES IN SE ASIA AND SAHUL

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Sediment fingerprinting utilizes a combination of Earth Sciences techniques, including but not limited to chemical and mineralogical identification, morphological analysis, and geomorphological survey to identify specific characteristics of and reconstruct processes related to the sourcing, deposition, and subsequent alteration of sediments of interest. Utilized in the environmental sciences [1], sediment fingerprinting has been shown to be of use in geoarchaeological contexts [2], but wider exploration of this technique as it pertains to questions of archaeological significance, particularly in humid tropical climates, has yet to be extensively conducted. My research within the Disperscapes geoarchaeology project seeks to use sediment fingerprinting to generate unique identifiers for sediments found at different key Late Pleistocene (c. 127 - 12 kya) archaeological sites in SE Asia and Sahul and their surrounding catchment areas to answer questions of archaeological interest, specifically in regards to identifying how landscape change affects the way archaeological sediments are formed and deposited. This also helps provide a more localized data set for use in the reconstruction of environments Late Pleistocene hominins would have interacted with, thus placing our human ancestors back in their associated contexts.

In doing so, we work to present a more accurate representation of local, dynamic Late Pleistocene landscapes, while also vastly increasing the available context through which we can interpret past human behaviors, thereby better equipping archaeologists to understand past peoples and their cultures.

Key words:
geoarchaeology, sediment fingerprinting, paleoenvironment, Late Pleistocene, hominin dispersal, Southeast Asia, Sahul

References:

[1] Haddadchi, A. et al. (2013). International Journal of Sediment Research, 28(4): 560-578

[2] Woodward, J.C., et al. (2001). Geoarchaeology: An International Journal, 16(5): 501-536

OLD AND NEW FOSSIL MATERIAL REVEALS FASCINATING DIVERSITY IN THE CERVICAL VERTEBRAE AND HINDLIMBS OF GIANT KANGAROOS OF THE AUSTRALIAN PLEISTOCENE GENUS *PROTEMNODON*.

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Prior to their extinction around 40,000 years ago, the robust and enigmatic kangaroo species *Protemnodon brehus* and *P. roechus* Owen, 1874 (Marsupialia: Macropodidae), found in open woodland and forest deposits from the Australian Pleistocene, were among the largest kangaroos ever at ~100–170 kg. These taxa are very poorly delimited, having been described from isolated fossil jaw fragments [1,2] which rely on slight differences in tooth size and on highly variable characteristics of the molars and premolars. As part of a taxonomic review of the genus *Protemnodon*, 3D surface scans and photographs were taken of over 700 dental and skeletal specimens of *Protemnodon* from 13 museums in four countries. Digital measurements were collected and the data visualised in PCAs and morphometric plots, while detailed morphological comparisons were made. These analyses found that the ostensibly diagnostic dental dimensions and characteristics did not reliably separate material of *P. roechus* and *P. brehus*, rendering them taxonomically invalid. However, a profound disparity was found in the hindlimbs and cervical (neck) vertebrae of specimens with indistinguishable dentition previously assigned to *P. brehus* and *P. roechus*, particularly in material from South Australian deposits Green Waterhole Cave (GWC) and Lake Callabonna (LC). Specimens from LC possessed long, gracile hindlimbs, proportionally similar to the arid-adapted, fast-hopping red and grey kangaroos, while those from GWC possessed shorter, more robust hindlimbs, adapted for slower hopping over shorter distances. Interestingly, while the generic type species, *Protemnodon anak*, was found to possess the longest cervical vertebrae in the subfamily Macropodinae, GWC specimens possessed the shortest and broadest cervical vertebrae and LC specimens again possessed similar proportions to modern kangaroos. This similarity in dentition, and thus diet, juxtaposed with divergence in limb and neck proportions has interesting implications for our understanding of the effects of diet and habitat on the evolution of locomotion in kangaroos.

Key words:
Palaeontology, vertebrate fossils, Lake Callabonna, Green Waterhole Cave, Macropodidae, *Protemnodon*, taxonomy.

References:

[1] Owen, R., Philosophical Transactions of the Royal Society, 1874. **164**: p. 245–288.
[2] Bartholomai, A., Memoirs of the Queensland Museum, 1973. **16** (3): p. 309–363.

EXTINCT EAGLES AND KIN OF AUSTRALIA; UNEARTHING THE HIDDEN DIVERSITY OF THE PAST.

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In the present day, Australia is home to seventeen species of Accipitridae (eagles and hawks). However, there are currently only two fossil species confidently assigned to this family in the Australian fossil record, both of which are described based on a single bone. In addition to this, there are multiple fossils believed to be accipitrids that have yet to be described. This presents a major limitation on our understanding of the evolution and history of Accipitridae in Australia. In this presentation, we discuss two new fossil species of Accipitridae, one from the middle to late Pleistocene (700–60 thousand years ago) and the other from the late Oligocene (24 million years ago). The fossil from the late Oligocene is remarkably well preserved, comprised of 63 bones across the skeleton of a single individual, and is the oldest known accipitrid from Australia. The fossil material from the Pleistocene, while not associated, reveals the existence of a large accipitrid that only recently went extinct. Both these fossil species were compared to their living relatives in morphology-based comparisons and phylogenetic analyses using combined morphological and molecular data. This has revealed that the Oligocene fossil species cannot be directly assigned to any living lineage of Accipitridae, while the Pleistocene fossil species belongs to a lineage commonly known as the Old-World vultures, which are not present in modern-day Australia. These fossils show that the past diversity of Australia's eagles and hawks was greater than what is present today, and also have important implications for the global evolution of Accipitridae as a whole.

Key words:

Palaeontology, Oligocene, Pleistocene, Accipitridae, Phylogeny, Australia

CONTROLS ON GRAVITY-DRIVEN NORMAL FAULT GEOMETRY AND GROWTH IN STACKED DELTAIC SETTINGS: A CASE STUDY FROM THE CEDUNA SUB-BASIN

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The kinematics of gravity-driven normal faults exerts a critical control on petroleum systems in deltaic settings, but have not been extensively examined. The Ceduna sub-basin is a passive margin basin containing two stacked late Cretaceous delta systems that detach on shale layers of Albian-Cenomanian and Turonian-Coniacian ages, respectively. Here we present evidence for spatially variable fault growth styles based on interpretation of the Ceduna–3D seismic survey and the application of multiple methods for quantifying fault kinematics. We identified three fault growth styles: (1) Faults that continuously grow between the Cenomanian and Santonian, located throughout the study area. (2) Faults that evolved between the early Cenomanian and the Maastrichtian and can be geographically separated into three areas according to the thickness of the Albian-Cenomanian detachment layer. Northern faults display maximum growth at the Cenomanian and lowest growth towards the Maastrichtian with possible quiescence in the Turonian. In the central study area faults show two dip linkage intervals between (a) Cenomanian and Coniacian-late Santonian and (b) Coniacian-late Santonian and late Santonian–Maastrichtian fault segments, respectively. Southern faults exhibit a dip-linkage interval between Cenomanian-early Santonian and late Santonian-Maastrichtian fault segments, and a reactivation interval between the late Santonian and Campanian. (3) Listric faults that continuously grow between the Santonian and the Maastrichtian with maximum growth at the late Cenomanian followed by a slower growth rate until the late Maastrichtian. These findings can be used to predict the spatial and temporal evolution of gravity-driven normal faults in regard to how the detachment layer displaced basinwards in similar deltaic systems.

Keywords:

Structural geology, Delta systems, Kinematic analysis, Growth faults, Ceduna Sub-basin

ZIRCON AS AN EXPLORATION TOOL

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Zircon preserves chemical signatures that reflect crystallisation environments and post-crystallisation modification and can preserve geochemical signatures that can be related to porphyry Cu mineralisation [1]. However, the use of zircon as a pathfinder for other commodities, such as iron oxide-copper-gold (IOCG) deposits, is limited [2].

The Gawler Craton, South Australia, preserves a complex geological history dating back to the late Archean. The ca. 1600-1570 Ma time slice represents a major period of mineral genesis, magmatism, deformation and metamorphism that resulted in the formation of a large IOCG province along the eastern Gawler Craton that includes Olympic Dam, Prominent Hill and Carrapateena. Within the Gawler Craton, zircon has commonly been used for dating or isotopic purposes. However, limited research has focused on the geochemistry of zircon, its variability between igneous suites and its use as a pathfinder mineral towards IOCG deposits.

In this study, new zircon geochemical data is presented for igneous suites that preserve evidence of variable potassic and hematite alteration associated with hydrothermal activity during IOCG mineralisation at ca. 1600-1570 Ma. Assessment of zircon chemistry within these igneous units shows that there are characteristic enrichments and depletions in trace and REE chemistry in samples that have undergone variable degrees of alteration. The variations in zircon chemistry between unaltered and altered samples is attributed to chemical modification by F-rich hydrothermal fluids that altered the host rocks and was associated with IOCG mineralisation. These distinct geochemical characteristics recognised in zircon suggests the potential of zircon as a pathfinder for IOCG deposits in the Gawler Craton.

Key words:
Zircon, Geochemistry, Mineralisation, Gawler Craton, accessory Mineral, IOCG Mineralisation

References:

[1] Lu et al. 2016: Soc. Eco. Geo. Vol 19
[2] Courtney-Davies et al. 2019: Min. 2019, 9, 364

THE EMERGENCE OF ECLOGITES LINKED TO GLOBAL ARC CHEMISTRY CHANGE AT 2 GA

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The thermal state of the solid Earth determines the interactions between the mantle and the crust. The only way to probe the thermal conditions of the ancient Earth is from the mineralogical and geochemical record of thermally-driven processes, i.e. metamorphism and magmatism. The generally accepted model for the thermal budget of the Earth balances heat accumulated from accretion and the decay of heat producing elements, and indicates an overall cooling trend from ca. 3 Ga to present, encompassing the emergence of modern plate tectonics. The geological record however indicates this simple cooling model may not hold true. Thermally sensitive metamorphic mineral assemblages, such as eclogites, emerge in the rock record transiently from 2.2–1.8 Ga, and disappear again until ca. 0.8 Ga. Coincident with this transient emergence of eclogite, the global record of arc granite chemistry also shows significant step changes, most notably decreased Sr and Eu and increased Y and rare earth element concentrations, from 2.0–1.8 Ga, both of which point to a global increase in thermal gradients that intersected granite genesis. We suggest these changes occurred as the secular cooling of the mantle and crust was reversed by a net increase in the spatial extent of continental crust between 2–1.8 Ga, resulting in thermal insulation of the mantle. The following 1.2 billion years on Earth was dominated by a warm, insulated mantle and crust, maintained by stable continental volumes, which eventually cooled to allow the second emergence and widespread preservation of eclogites from ca. 0.8 Ga until present. While novel, this idea combines unrelated global petrological and geochemical datasets to explore the sensitivity of switches in the thermal evolution of the solid Earth.

Key words:
Eclogites, mantle temperature, thermal insulation, secular cooling,

LAKE GEOCHEMICAL RESPONSE TO DECADAL SCALE CLIMATE VARIABILITY; EVIDENCE FROM A 150 YEAR SEDIMENT RECORD FROM LAKE SURPRISE, VICTORIA

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South-east Australia has experienced prolonged multi-year droughts that have severe impacts on environment and society [1]. The scarcity of well-dated, highly-resolved paleoclimate records from the region [2] means knowledge about low frequency climate variability is limited. Stable isotopes preserved in lake sediments are a useful tool for reconstructing past climate and environmental conditions. Here we present a sub-decadally resolved climate reconstruction using sediments from Lake Surprise, western Victoria, utilising geo-elemental variation (ITRAX µXRF), stable oxygen isotope analysis of both endogenic carbonates and cellulose, and stable carbon and nitrogen isotope from the bulk sediment. We will establish a well-dated chronology using ^{210}Pb and $^{239/240}$Pu dating for recent sediments and radiocarbon dating for older sediment. In order to reconstruct the past climate reliably, it is important to understand the lake's contemporary processes [3]. Therefore, to track the modern hydrology of the lake, modern sedimentation and precipitation rates are monitored regularly. Overall the project aims to establish a high resolution climate record through Holocene and identify the drought frequency using elemental and isotope proxy records. In this presentation, we mainly explore the relationship between sediment elemental and stable isotope variability by comparing sediment data with instrumental climate data for the last 150 years, as an initial step towards the main project. Proxy data-climate comparison suggest that lake's carbonate deposition is dominant during wet climate conditions, mainly due to in-lake processes including enhanced primary productivity and eutrophication. In contrast, drier periods are depleted in Ca due to the organic matter decomposition in highly stratified lake. Our results indicate that natural rainfall variability, is a dominant factor in controlling the in-lake processes.

Key words:
Holocene, stable isotope, lacustrine sediment, isotope mass balance model

References:

[1] Tweed, S., Leblanc, M., & Cartwright, I. (2009). *Journal of Hydrology*, *379*(1-2), 41-53.
[2] Tyler, J. J., Mills, K., Barr, C., Sniderman, J. K., Gell, P. A., & Karoly, D. J. (2015). *Quaternary Science Reviews*, *119*, 94-105
[3] Jones, M. D., & Dee, S. G. (2018). *Quaternary Science Reviews*, *202*, 19-29.

POSTER PRESENTATION ABSTRACT VOLUME

CONSTRAINING ALTERATION IN THE BURIED BENAGERIE RIDGE, CURNAMONA PROVINCE SOUTH AUSTRALIA

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The Curnamona province, situated at the border between SA and NSW is a piece of Paleoproterozoic crust that is separated from the Gawler craton by the Adelaide Rift Complex. This geological region is highly prospective for a variety of mineralisation types, including the Pb-Zn-Ag (e.g. the world class Broken Hill deposit), and iron-oxide copper gold (IOCG) (e.g. Kalkaroo and Portia deposits) [*Conor and Preiss*, 2008]. The Benagerie ridge volcanic suite (BVS) sits in the centre of the province and is a correlative of the Gawler Range Volcanics (GRV), host of the world class Olympic Dam IOCG deposit [*Wade et al.*, 2012]. The province has undergone multiple episodes of deformation, with the most important events considered to be the ~1600 Olarian Orogeny and the ~500 Delamerian orogeny [*Conor and Preiss*, 2008], with some evidence for ~830 Ma dyke emplacement [*Wingate et al.*, 1998]. Additionally, multiple episodes of alteration and mineralisation have occurred, particularly regional scale albitisation [*Skirrow et al.*, 1999]. Limited direct constraints exist on the timing of these episodes, with most thought to have occurred prior to the Olarian Orogeny.

LA ICP MS elemental and isotopic mapping, combined with LA ICP MS U-Pb geochronology, and geochemistry provide insight into multiple episodes of post-Olarian fluid alteration, including ~820 Ma albitisation and mineralisation in the BVS. We further demonstrate the utility of U-Pb geochronology applied to hydrothermal apatite, titanite, calcite and magnetite to constrain the timing of episodes of fluid alteration.

Key words:
Curnamona, geochronology, alteration

References:

[1] Conor, C. H. H., and W. V. Preiss (2008). *Precambrian Research*, *166*(1-4), 297-317.
[2] Skirrow, R., R. Maas, and P. M. Ashley (1999). *AGSO Research Newsletter*, *31*.
[3] Wade, C. E., A. J. Reid, M. T. D. Wingate, E. A. Jagodzinski, and K. Barovich (2012). *Precambrian Research*, *206-207*, 17-35.
[4] Wingate, M. T. D., I. H. Campbell, W. Compston, and G. M. Gibson (1998). *Precambrian Research*, *87*, 135-159.

POST-HILTABA METAMORPHISM ON THE YORKE PENINSULA: CONSEQUENCES FOR DEPOSIT PRESERVATION OR POTENTIAL FOR NEW MINERALISATION IN THE GAWLER CRATON?

Mitchell J. Bockmann[1,2], Martin P. Hand[1,2], Laura J. Morrissey[3,1], Justin L. Payne[4,3,1], Graham Teale[5], Colin Conor[4] and Rian Dutch[6,2]

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The Yorke Peninsula in the southern Gawler Craton is a highly prospective region for Iron-oxide–Copper–Gold (IOCG) mineralisation, as it hosts the historically significant Moonta and Wallaroo mines and more recently discovered Hillside deposit. Despite extensive evidence for early Mesoproterozoic hydrothermal fluid activity and great potential for mineralisation, the Yorke Peninsula is incredibly understudied with modern analytical techniques.

Here we present evidence for high *T/P* metamorphism from the Yorke Peninsula at *c.* 1555 Ma, with peak metamorphic constraints of *c.* 3.5 kbar, 660°C and *c.* 4.2 kbar, 700°C from two samples taken approximately 35km apart. In addition, monazite U–Pb geochronology also provides evidence for shear zone activation at this time, along with possible evidence for re-activation of the Pine Point Fault as young as 1500 Ma; significantly post-dating mineralisation at the Hillside deposit. Apatite U–Pb cooling ages from these rocks provide relatively young ages between 1460–1400 Ma, indicating that these rocks remained at elevated temperatures for an extended period following the metamorphic peak, supporting a prolonged time at depth that is consistent with thinned continental crust and implying that the south-eastern Gawler Craton was in an extensional setting after the Hiltaba Event. This post-Hiltaba activity is distinct from metamorphism and deformation associated with the Hiltaba Event, which is also recorded within the south-eastern Gawler Craton, but typically with lower thermal gradients. The metamorphism reported in this study has long been assumed to be linked to the Hiltaba Event, along with much of the Mesoproterozoic magmatism, deformation and mineralisation on the Yorke Peninsula. The results of this study highlight the need for more rigorous investigation on the timing of events on the Yorke Peninsula, with emphasis on the influence of this event on understudied mineralisation in the region (e.g. Moonta–Wallaroo).

Key words: Gawler Craton, Yorke Peninsula, Kararan Orogeny, Hiltaba, metamorphism, U–Pb geochronology, P–T modelling, tectonics.

GENESIS OF THE MOUNT NOVIT Zn-Pb PROSPECT, NORTHERN AUSTRALIA: EVIDENCE FROM GEOLOGY, MONAZITE GEOCHRONOLOGY AND SPHALERITE GEOCHEMISTRY.

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The Mount Novit Zn-Pb prospect represents an accumulation of sub-economic Zn-Pb mineralization situated approximately ~20 km south of Mount Isa. As opposed to the nearby world-class Mount Isa, Hilton and George Fisher Zn-Pb deposits, Zn-Pb mineralization at Mount Novit is situated to the west of the regional-scale Mount Isa Fault, and is hosted by the stratigraphically older Moondarra Siltstone. Detailed core logging and petrology reveals the presence of multiple stages of hydrothermal veining/alteration: (1) Albitization; (2) Biotite alteration; (3) Coarse-grained dolomite-quartz veining; (4) Pre-mineralization calcite-dolomite-quartz veining/alteration; (5) Zn-Pb mineralization and (6) Post-mineralization veining. Zn-Pb mineralization occurs as polymetallic matrix-dominated breccias, and regularly replaces pre-mineralization calcite-dolomite-quartz veining/alteration.

In-situ monazite U-Pb geochronology was completed on two textural varieties of monazite. Fine-grained subhedral to anhedral (<50 µm) monazite is located in regions dominated by biotite-rich alteration, and produced a mean weighted $^{207}Pb/^{206}Pb$ age of 1509 ± 14 Ma (MSWD = 0.81). This age is interpreted to represent the reactivation of the dominant S_2 fabric during D_4 deformation of the Isan Orogeny. Coarse-grained (>500 µm) monazite occurs within re-crystallized regions of granoblastic quartz, and is coeval with ore-stage Zn-Pb mineralization. Coarse-grained monazite yields a mean weighted $^{207}Pb/^{206}Pb$ age of 1481 ± 6 Ma (MSWD = 1.00), suggesting that Zn-Pb mineralization occurred synchronous with, or slightly postdates D_4 deformation of the Isan Orogeny.

Sphalerite from Mount Novit has a low concentration of Ge and Ga, and a relatively high concentration of In. This is suggestive of derivation from a fluid with a magmatic-hydrothermal affinity, as opposed to a basil brine with no magmatic affinity. Using the GGIMFis geothermometer [1], sphalerite from Mount Novit is estimated to have formed at 346 ± 35°C, comparable with estimates of 343 ± 44°C from the nearby Mount Isa Cu-Zn-Pb deposit [2].

Key words:
Mount Novit, Zn-Pb mineralization, Mount Isa, Sphalerite Geochemistry, Ore Genesis

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THE INFLUENCE OF CLIMATE ON FIRE AND ECOLOGY ON KANGAROO ISLAND OVER THE PAST 5000 YEARS

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Fire has long been a familiar and important part of Australian ecosystems. However, anthropogenic climate change has heralded major shifts in fire regimes, negatively impacting ecosystems. These effects are only expected to worsen in coming years, but there remain difficulties with projecting fire regime trajectories and their environmental impacts, partly due to a lack of historical data on centennial to millennial timescales. This study aims to address this problem by investigating lake sediments on Kangaroo Island, including returning to classic sites studied previously. We have collected several lake sediment cores from Lashmar's Lagoon on eastern Kangaroo Island, reaching a maximum depth of 7.39 metres, likely representing the past ca. 5000 years. We have further plans to collect additional cores from Grassdale Lagoon in the far west of the island in early 2021. We will be conducting high-resolution charcoal, sedimentary ancient DNA (*sedaDNA*), pollen and geochemical analyses on these cores to elucidate the complex interactions between climate, fire and the environment. Our study site, Kangaroo Island, is a unique opportunity in Australia as it is believed to have been largely uninhabited and unmanaged by Aboriginal people for millennia. Our results could therefore offer important insights into ecological baselines and the effects of cessation of Aboriginal management on ecosystems. It is our aim that this new knowledge of the past be applied to inform present-day bushfire predictability and ecological management and restoration.

Keywords:
Palaeoclimatology, palaeoecology, fire history, *sedaDNA*, pollen, geochemistry, Kangaroo Island, lake sediments

APATITE FROM THE VULCAN PROSPECT, SOUTH AUSTRALIA: GEOCHRONOLOGY AND TRACE ELEMENT BEHAVIOUR

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The Vulcan prospect is a hematite-rich brecciated iron oxide copper-gold (IOCG) prospect within the eastern Gawler Craton, South Australia, 30km northeast of the massive ca. 1590 Ma Olympic Dam IOCG system. Hydrothermal apatite is abundant within metamorphic clasts and in the altered and mineralised rock. In-situ geochronology and trace element analyses of gangue minerals including apatite and florencite from 41 thin sections across the Vulcan prospect were investigated to determine the timing of mineralising events, changes in fluid chemistry, and to evaluate the similarities and differences between Vulcan and IOCG deposits in the eastern Gawler Craton.

Apatite U-Pb geochronology and trace element analysis reveal three populations of grains with distinct rare earth element (REE) trends and corresponding ages. Coarse-grained apatite from hematite-sericite dominated lithologies produced ages of 461 Ma, 510 Ma and 544 Ma, coincident with the Delamarian orogeny, probably representing cooling during this period. Fine-grained vein-hosted apatite within massive hematite lithologies produced ages of 985 Ma and 1095 Ma, coeval with the late stages of the Musgravian orogeny and indicating at least a thermal control on the Gawler Craton. Apatite associated with magnetite-chlorite lithologies produced ages of 1522 Ma, 1543 Ma and 1611 Ma within error of ca. 1580 Ma Hiltaba Suite felsic magmatism and ca 1586 Ma molybdenite-related mineralisation at Vulcan [1].

Trace element analysis indicates early apatite grains are light REE enriched and trace element signature shifts to LREE-depleted, middle REE-enriched with late apatite growths. LREE likely remobilised into florencite, possibly attributed to a shift from alkaline to acidic fluid conditions as previously documented at Olympic Dam. Comparison of the history of trace element behaviour in apatite and geochronological constraints between Vulcan and the Olympic Dam deposit suggest that the two mineralising systems share a similar history.

Keywords:

IOCGs, apatite geochronology, REE behaviour

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STUDY OF ERUPTION MECHANISM PYROCLASTICS DEPOSITS OF BANTEN TUFF (QPVB) IN PANCANEGARA AND ITS SURROUNDING USING GRAIN-SIZE DISTRIBUTION AND COMPONENT ANALYSIS

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Banten Tuff (Qpvb) is a pyroclastic deposit that is quite important in the western tip of Java. Banten Tuff (Qvpb) is quite important because it has a very broad distribution which almost covers the entire area of Banten. In the middle of Banten Tuff's (Qvpb) distribution, there is a caldera in a rectangle shape which has an area of 13.7 km x 6.5 km. However, there is still no research that explains when and how was the eruption processed (happened). This research was done around Pancanegara area, Serang, Banten Province. The method used by this research is qualitative method (geological mapping) and quantitative method (Grain-size Distribution and Component Analysis). More than 10 outcrops are produced and have been described in detail. The description of the outcrops produced a tephra-stratigraphy correlation in four eruption facies units, which each of the unit has different distribution and component. The four eruption facies are grouped into three eruption phases. From the three eruption phases, produce an eruption history with six eruption episodes which two of the episodes as a pause is created.

Keywords:
Banten Tuff (Qpvb), a caldera, grain-size distribution, component analysis, tephra-stratigraphy, facies units, eruption phase, eruption history.

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RECONSTRUCTING LOCAL ENVIRONMENTS OF EARLY *HOMO SAPIENS* SETTLEMENT IN SOUTHEAST ASIA & AUSTRALIA VIA GEOCHEMISTRY APPLICATIONS.

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Terrestrial palaeoenvironmental proxies recovered from Southeast Asia (SEA) and Australia during the Late Pleistocene (130,000-11,700 years), currently lack consistent chronologies. Even less incorporate how these environmental changes influenced early *Homo sapiens* behaviours. As this area is now established to have been traversed and occupied by *Homo sapiens* as early as Marine Isotope Stage (MIS) 5 (130,000-80,000 years BP). Understanding local environmental conditions they settled in is essential for the advancement of Southeast Asian Pleistocene geoarchaeology and our understanding of past human-environmental relations. The overpowering humidity of the tropics serves as culprit for the rapid degradation of valuable archaeological remains. However, stable isotopes and lipid biomarkers are known for their resilience to degrading and microbial processes. Leaf wax stable isotopes and their biomarkers from archaeological cave settings will be extracted and analysed to infer local environmental parameters across sites in Sunda, Wallacea and Sahul. It is anticipated these biomarkers will infer the vegetation type in the stratigraphic sequence. Coupled with radiocarbon (^{14}C), luminescence and/or Uranium-Thorium dating, dates of sediment will be refined within the Late Pleistocene and the vegetation will be used to determine the prevailing environmental conditions in and around the cave sites and how these may have influenced periods of cave occupation/non-occupation. As a part of the ARC funded research project Disperscapes, the ambition of my research project is to create the first cross-site chronology of its nature in SEA and Australia. Sites in which data have been taken to date include: Tam Pà Ling, Laos, Laili Cave, Timor-Leste and Cloggs Cave, Victoria. Results will contribute to the beginning of this geochemical technique as a method of reconstructing local site environments for Late Pleistocene SEA and Australia.

KEY WORDS
Southeast Asia, Late Pleistocene, *Homo sapiens*, local environments, stable isotopes, lipid biomarkers, reconstruction

DISTAL FOOTPRINTS OF THE ALICE SPRINGS OROGENY PRESERVED IN PALEOPROTEROZOIC NORTHERN AUSTRALIA: AN APPLICATION OF MULTI-KINETIC THERMOCHRONOLOGY IN THE PINE CREEK OROGEN AND ARNHEM PROVINCE

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The Precambrian Pine Creek Orogen and Arnhem Province represent two of the oldest basement terrains in northern Australia and are often considered to be devoid of major tectonic or deformational activity since the cessation of regional metamorphism in the Paleoproterozoic [1]. A major caveat in the current hypothesis of long lived structural inactivity is the absence of published low-temperature thermochronological data and thermal history models for this area. This study presents the first apatite U–Pb, fission track and (U–Th–Sm)/He data for igneous samples from both the Pine Creek Orogen and Arnhem Province, complemented with apatite geochemistry data acquired by electron microprobe and laser ablation mass spectrometry methods, and presents detailed multi-kinetic low-temperature thermal history models. Low-temperature thermal history models for the Pine Creek Orogen and Arnhem Province reveal a distinct phase of denudation coeval with the Paleozoic Alice Springs Orogeny in central Australia [2], suggesting that this orogenic event impacted a larger area of the Australian crust than previously perceived. Low-temperature perturbations observed in northernmost Australia are consistent with widespread mid-Paleozoic denudation is preserved across both the North Australian Craton and South Australian Craton, indicative of a cratonic scale thermal event during north-south shortening via the Alice Springs Orogeny. Additionally, minor localised Mesozoic thermal perturbations proximal to the Pine Creek Shear-Zone record evidence for Mesozoic reactivation contemporaneous with modelled mantle-driven subsidence and the onset of sedimentation in the Money Shoal Basin, while the Arnhem Province samples demonstrate no evidence of Mesozoic thermal perturbations.

Keywords:
Thermochronology, Alice Springs Orogeny, intraplate orogenesis

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RECONSTRUCTING THE LATE PLEISTOCENE CLIMATE SEQUENCE AT ALEXANDRA CAVE, NARACOORTE, USING SINGLE-GRAIN OPTICALLY STIMULATED LUMINESCENCE DATING AND PALAEOENVIRONMENTAL PROXIES

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The drivers of the Australia-wide megafaunal extinction during the late Pleistocene remains poorly resolved. Hypotheses include individual or synergistic combinations of climate fluctuations, human impacts through hunting or habitat alteration by landscape burning. Moreover, the relationship between extinction dynamics and long term glacial - interglacial timescales is not yet understood. Using a series of complementary geochronology, palaeoecological and geochemical techniques on a sedimentary sequence in Alexandra Cave, Naracoorte, this study provides improved reconstructions of past climates in south-east South Australia around the time of megafaunal extinction. Ten luminescence dating samples constrain the age of the sedimentary sequence to 17.7 – 106.3 ka. Palaeoenvironmental reconstructions undertaken using charcoal, carbon isotopes and geochemical analysis reveal high fire frequency and precipitation during Marine Isotope Stage (MIS) 5, while MIS 4 and the Last Glacial Maximum were arid, with low fire frequency. MIS 3 was wet, with little fluctuation in the environment, with the exception of a change in biomass burning at 36 – 50 ka. These findings suggest that climate change likely played a minor role in the demise of megafauna locally, whereas changes in fire regime could have acted as a more significant driver or consequence of megafauna extinction.

Key words:
Luminescence dating, charcoal, pollen, *Sporormiella*, Alexandra Cave, Naracoorte, megafauna extinction

DETRITAL ZIRCON GEOCHEMISTRY AND PROVENANCE OF NEOPROTEROZOIC ROCKS FROM THE SOUTH MOUNT LOFTY RANGES IN THE ADELAIDE SUPERBASIN

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The Adelaide Superbasin contains sedimentary rocks that preserve chemical and sedimentological evidence for major changes in the biosphere, atmosphere and climate that occurred during the Neoproterozoic. Yet many major questions about the age of the stratigraphy, the contemporaneity of lithostratigraphic changes across the length of the basin and source of sediment within it remain unknown. I present new detrital zircon U–Pb and Hf isotope data from the South Mount Lofty Ranges region of the Adelaide Rift Complex within the Adelaide Superbasin. Minimising gaps in geochronology throughout the Burra, Umberatana and Wilpena groups of the Adelaide Superbasin.

U-Pb ages along with Hf isotopes broadly indicate the Gawler Craton and Curnamona as important provenance regions for the Burra group, and a Musgrave and Albany Fraser provenance for sediments of the Umberatana and Wilpena groups. The source of the Belair Subgroup was found to diverse from that of older Burra Group formations and reflect a new siliciclastic source. The stratigraphy of the Mount lofty Ranges does not directly match that of the northern Flinders Ranges and these results provide means to test their temporal correlation. Comparisons have also been made against existing data to indicate that lithostratigraphy is not likely to be coeval over the length of the entire rift complex. These results contribute to both local and global efforts to gain a detailed understanding of the interaction between tectonics and significant changes to the earth system during this time.

Keywords:
Detrital zircon, Provenance, Zircon REE, Burra Group, Umberatana Group, Neoproterozoic, Adelaide Superbasin, U-Pb, Hf, Geochronology

KELUD VOLCANO POTENTIAL AND THREATS BASED ON THE GEOLOGICAL EVOLUTION AFTER THE 2014 ERUPTION IN SUGIHWARAS, NGANCAR, KEDIRI AND SURROUNDINGS

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Kelud Volcano is one of the most active strato volcanoes in Indonesia. On February 13, 2014, eruption happened with volcanic material as high 17 km reaching ±200 million m^3 volume. The impact changes the shape of the crater and caused volcanic ash rain in some areas like Kediri to Bandung. Geological conditions of Kelud Volcano after the eruption in 2014 are known with some potentials in geo-sciences, geo-economics, geo-tourism, and culture aspect which can be used for human prosperous and survival. The study was conducted in Kelud Volcano of Sugihwaras, Ngancar, Kediri, East Java Province. The research method taking primary data which included geological mapping, rock, crater lake water sampling and collecting geo-tourism potential. The secondary data are taken from the early researcher. Then a laboratory analysis performed to know potential aspects of geo-sciences, geo-economics, geo-tourism and culture aspect. Based on the result, the research area was included in the central – proximal volcanic facies. Geomorphology of the research area is volcanic landscapes. The geological structure consisted Sugihwaras normal right slip fault W – E, Sumbersari normal right slip fault NW – SE, Ngobo normal left slip fault NE – SW. Geochemical analysis of crater lake water obtained pH of 3 sample with a value of 6.93, 6.76 and 7.33. Based on the analysis the type of rock is intermediate (andesite-basalt) and has volcanic steam heat water sulfate fluid. After the eruption in 2014, Kelud was produced a potential that can be utilized in aspects like geo-tourism at the top of volcano which have 69,768**%** in. There are also materials like sand and andesite rock that can be exploited. The negative potential are mass movements, volcanic eruptions, earthquakes and “lahar” floods. Based on these aspects, Kelud has potential to become a geosite that can be used as natural museum and field laboratory.

Key words:
Kelud volcano, eruption, evolution, potentials, threats

A COUPLED RADIOGENIC ($^{87}Sr/^{86}Sr$) AND STABLE ($\delta^{88/86}Sr$) STRONTIUM ISOTOPE APPROACH TO RECONSTRUCT PAST CHANGES IN WATER MIXING AND SAILINTY IN THE COORONG LAGOON, SOUTH AUSTRALIA.

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Coastal lagoons represent an interface between terrestrial and marine ecosystems that are sensitive to natural and human-induced environmental changes. The Coorong Lagoons in South Australia are part of the terminal hydrological system of the Murray Darling Basin catchment. This study explores novel geochemical analytical approaches to trace palaeo-hydrological changes in water-source mixing and to provide plausible palaeo-salinity variations within the Coorong Lagoons. Specifically using radiogenic ($^{87}Sr/^{86}Sr$) and stable ($\delta^{88/86}Sr$) strontium isotopic signatures, along with elemental ratios (such as Mg/Sr) to observe these changes by proxy. Modern and fossil carbonate archives of micro-bivalve *Arthritica Helmsi* and water chemistries of the Coorong Lagoon can provide important clues to reconstruct past hydrological changes to the system such as European settlement. Fossil water geochemical signatures are determined from fossil shells, calibrated through a comparison between modern shells and waters to infer past water characteristics such as palaeo-salinity. The acquired data and modelling suggest that there were two main sources of waters contributing to the Coorong South Lagoon; (i) seawater derived from the Southern Ocean and (ii) fresh/brackish water derived mostly from Salt Creek. Together these two water sources can explain most of the variability observed in $^{87}Sr/^{86}Sr$, $\delta^{88/86}Sr$ and Mg/Sr data in studies of carbonate shells and inferred palaeo-lagoon waters. This multi-proxy approach allowed an estimate of minimum plausible palaeo-salinity range in the Coorong South Lagoon, without the influence of carbonate precipitation and/or evaporation. The results indicate palaeo-salinities in the South Lagoon as low as 10-15 PSU (practical salinity units). Finally, results of this study also confirmed that over the last ~3275 years the waters in the Coorong South Lagoon were never 'typical' ocean waters, but rather complex mixtures of continental freshwaters with variable seawater inputs.

Key words:

Strontium, Isotopes, Water Mixing, Salinity, Coorong Lagoons, *Arthritica Helmsi*

COMPARING LIBS AND XRF RAW DATA FOR LITHOGEOCHEMICAL ANALYSIS USING THE WAVELET TESSELLATION METHOD

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Laser Induced Breakdown Spectroscopy (LIBS) and X-ray Fluorescence (XRF) are common analytical techniques utilised for mineral and rock analysis. In this study, we compare the rapid analysis of raw LIBS and XRF geochemical data for lithological discrimination using a new wavelet tessellation method ('Data Mosaic'; CSIRO). The wavelet tessellation method for boundary detection allows multi-scale domaining of drill hole data into lithogeochemical units over a continuous range. The method generates two-dimensional scale-space plots with hierarchical boundaries that resembles a traditional geological log, enabling rapid visual comparison. A test rock-block comprising 22 rock-slabs (pseudostratigraphy) of various compositions (Ca- to Mg-rich marbles; mafic- to alkali-rich granitoids) was analysed along the same transect by LIBS and XRF at high resolution (each analysis corresponding to ~0.36 mm) for Al, Ca, Fe, K, Mg and Si. Multi-scale lithogeochemical pseudo-logs were generated using the wavelet tessellation method. Comparison with visual (traditionally) developed logs of the rock-slab stratigraphy shows that distinction between major lithologies (granitoid and marble) and associated sub-lithologies (Mg- and Ca-rich marbles; mafic to alkali-rich granitoids) were possible using both LIBS and XRF raw data. The classified plot produced with LIBS data displays boundaries that are more similar to "real" boundaries in the test rock-block and grouped similar lithologies more effectively than XRF. This is likely due to the better performance of LIBS for the analysis of light elements. Overall, the wavelet tessellation method can be effectively applied for rapid generation of lithogeochemical pseudo-logs using raw LIBS or XRF data. Pseudo-logs generated from LIBS geochemical data appear to better discriminate lithologies in this study. Finally, the utilisation of LIBS data can be preferred for lithogeochemical classification due to its better capability of analysing light elements, commonly present in rocks.

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Key words

Lithogeochemistry, geological logging, wavelet tessellation, LIBS, XRF

AGE, TECTONIC GEOGRAPHY AND PROVENANCE OF THE RENNER GROUP, GREATER MCARTHUR BASIN, NORTHERN AUSTRALIA

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The informally termed greater McArthur Basin is a Paleoproterozoic to Mesoproterozoic multiphase basin system that records a billion years of Earth's history within the Northern Territory. Sedimentary successions that make up the basin preserve evidence for events that surround the basin during its formation. In this study we present LA-ICP-MS detrital zircon U–Pb, Lu–Hf and REE data that provide new constraints on the Renner Group and reveals provenance variations that exemplify the evolution of the basin. Using the youngest, near-concordant, zircon grains, the maximum depositional age for each formation is determined. The maximum depositional age for the Gleeson Formation has been constrained to being deposited after 1600 ± 42 Ma. Whereas the grains from the Sweetwater Member, Grayling Member and Powell Formation provide maximum depositional ages of 1624 ± 37 Ma, 1554 ± 77 Ma and 1714 ± 50 Ma, respectively. Age variations within stratigraphy propose a subtle change from older, Paleoproterozoic sources to additional input from younger sources. Formations in the Renner Group record age peaks that are consistent with rocks of the Aileron Province, Mount Isa Inlier and the Gawler Craton. By comparing U-Pb and Lu-Hf data, the Renner Group correlates with the Roper Group (McArthur Basin), South Nicholson Group (South Nicholson Basin) and the Tijunna Group (Birrindudu Basin). In particular, the Powell Formation of the Renner Group is equivalent to the Bessie Creek Sandstone of the Roper Group, and shares similarities with the Wondoan Hill Formation of the Tijunna Group. Whereas the Grayling Member, Sweetwater Member and Gleeson Formation are equivalent to the older formations of the Lower Roper Group such as the Arnold Sandstone and Crawford Sandstone. We suggest that the variation in provenance records the exhumation and exposure of these regions as a result of intracratonic rifting and magmatism from 1.5 – 1.4 Ga. The increase in 1860–1650 Ma detritus suggests uplift of the Arunta region.

Key words:

Renner Group, Tomkinson, Northern Territory, U-Pb, Hf, zircon, geochronology, tectonic geography

IN-SITU Rb–Sr AND ELEMENTAL FINGERPRINTING OF SEDIMENTARY AND IGNEOUS ROCKS

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The Rb–Sr isotopic system has previously been used to date the deposition of shales as well as crystallisation of igneous rocks. Traditionally, the daughter and parent isotopes from beta decay system chronometers such as ^{87}Rb–^{87}Sr could not be differentiated through conventional mass spectrometry. Instead, the method commonly involves an arduous process of whole-rock digestion and column chromatography. This required large sample volumes and assumes that all the species that were dated share the same Sr isotopic composition at the time of formation. These limitations have caused the technique to wither in recent years.

However, new developments in mass spectrometry instrumentation has allowed for these limitations to be overcome. It is now possible to rapidly and accurately evaluate the fingerprints of shales and igneous rocks while maintaining their textural context on a micro-scale. This study targeted shales and mafic rocks from different geological periods to emphasise the applicability of this novel technique.

Key words: shale, igneous, in-situ, geochronology

GRAPHIC ILLUSTRATOR: SPACED OUT STUDIO

Spaced Out Studio is an Adelaide-based private atelier focused on creative design and illustration. As a freelance artist, I have helped create fresh and unique concepts for prints, signage, business logos, and branding. My workshop looks to bring ideas to life while keeping the process simple, direct, and client-oriented.

With the help of the Organising Committee, a design was developed for GESSS-SA 2020 that is unique to South Australian geology. In this work, our state coastline carves a mountain range profile underneath the night sky. This artistic take is inspired by Digital Terrain Models along with major mines, quarries, and mineral deposits from South Australia. These aspects all combine to form the illustration's dark and starry nebula.

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Nha-Uyen Tran