PACE Copper Coompana Drilling Project

Drillhole CDP005

preliminary field-data report

Rian Dutch, Tom Wise, Mark Pawley, Luke Tylkowski, Amy Lockheed, Liz Jagodzinski, Sarlae McAlpine and Philip Heath

Report Book 2017/00041

PACE Copper

Australian Government
Geoscience Australia

Exploring for the Future
minerals | energy | groundwater

SOUTH AUSTRALIA

Government of South Australia
Department of the Premier and Cabinet

PACE Copper Coompana Drilling Project: Drillhole CDP005 preliminary field-data report

Rian Dutch, Tom Wise, Mark Pawley, Luke Tylkowski, Amy Lockheed, Liz Jagodzinski, Sarlae McAlpine and Philip Heath

Geological Survey of South Australia
Resources and Energy Group
Department of the Premier and Cabinet

December 2017

Report Book 2017/00041

Resources and Energy
Department of the Premier and Cabinet
Level 7, 101 Grenfell Street, Adelaide
GPO Box 320, Adelaide SA 5001
Phone +61 8 8463 3037
Email dpc.minerals@sa.gov.au
www.minerals.dpc.sa.gov.au

South Australian Resources Information Gateway (SARIG)
SARIG provides up-to-date views of mineral, petroleum and geothermal tenements and other geoscientific data. You can search, view and download information relating to minerals and mining in South Australia including tenement details, mines and mineral deposits, geological and geophysical data, publications and reports (including company reports).
map.sarig.sa.gov.au

Preferred way to cite this publication
Dutch RA, Wise TW, Pawley MJ, Tylkowski L, Lockheed A, Jagodzinski EA, McAlpine SRB and Heath P 2017. *PACE Copper Coompana Drilling Project: Drillhole CDP005 preliminary field-data report,* Report Book 2017/00041 Department of the Premier and Cabinet, South Australia, Adelaide.

CONTENTS

TABLES

FIGURES

PACE Copper Coompana Drilling Project: Drillhole CDP005 preliminary field-data report

Rian Dutch, Tom Wise, Mark Pawley, Luke Tylkowski, Amy Lockheed, Liz Jagodzinski, Sarlae McAlpine and Philip Heath

ABSTRACT

The Geological Survey of South Australia, in partnership with Geoscience Australia, is undertaking a regional pre-competitive geoscience research drilling program in the far west of South Australia called the Coompana Drilling Project. The Coompana Province, located between the western Gawler Craton to the east, the Musgrave Province to the north and the Madura Province to the west, is one of the least understood and explored geological provinces remaining on the Australian Continent. The region is completely covered by Neoproterozoic to Cenozoic sediments and there are no known basement exposures. Up to 18 new drillholes were planned as part of this project to intersect as many of the different geophysical domains as possible, as delineated from the recently acquired Coompana Magnetic survey and Coompana Gravity survey.

The primary objective of the Coompana Drilling Project is to obtain high quality drill core samples from the untested basement units beneath the Nullarbor Plain. The outcome of the Coompana Drilling Project will be to provide our stakeholders with new pre-competitive data and a geological framework that more clearly defines the geology and prospectivity in this region. This report provides the first release of the preliminary data collected on-site during the drilling of drillhole CDP005. This compilation includes well completion information, location and site access data, results of pre-drilling cover geophysics and depth estimates as well as the field geological logs and acquired down-hole geophysical data.

INTRODUCTION

PROJECT BACKGROUND

The Geological Survey of South Australia (GSSA), part of the Department of the Premier and Cabinet, in partnership with Geoscience Australia (GA) is undertaking a regional pre-competitive geoscience research drilling program in the far west of South Australia: The Coompana Drilling Project.

The GSSA and GA are committed to driving scientific understanding and discovery beneath post-mineralisation cover in South Australia through pre-competitive data capture and knowledge value-add. These goals are aligned with the objectives set out in the National Mineral Exploration Strategy and the UNCOVER Initiative.

The Coompana Drilling project forms a major part of, and is funded through, the Far West Discovery Program component of the South Australian Governments $20M *PACE* Copper initiative. Additional funding for the project comes from Geoscience Australia and the Australian Federal Governments Exploring for the Future initiative.

The Coompana Drilling Project is the next phase in a staged pre-competitive geoscience data acquisition program for the far west of South Australia which includes:

- The deep crustal seismic profile 13GA-EG1 (Eucla-Gawler seismic line). A collaborative project between the GSSA, GA, The Geological Survey of Western Australia and AuSCOPE.
- The Coompana airborne magnetic and radiometric survey. Currently the largest single survey in South Australia acquired by GA on behalf of the GSSA and funded through the *PACE* Frontiers initiative.
- The Coompana Gravity Survey. A regional 2, 1 and 0.5 km gravity survey to be acquired as part of the Far West Discovery Program component of the South Australian Governments *PACE* Copper initiative.

All data and reports associated with the Coompana Drilling Project and associated geophysical acquisitions is available from the GSSA Coompana Project website (http://minerals.dpc.sa.gov.au/geoscience/geological_survey/gssa_projects/far_west) and the South Australian Resources Information Gateway (https://map.sarig.sa.gov.au/).

PROJECT OVERVIEW

The Coompana Province is one of the least understood geological provinces remaining on the Australian Continent. The region is completely covered by Neoproterozoic to Cenozoic sediments and there are no known basement exposures. Limited previous exploration in the province resulted in 16 existing drillholes that intersect basement, only 8 of which are diamond holes (Fig. 1; Table 1). Because of these factors the geology and mineral prospectivity of the region is largely unknown.

Geographically, the Coompana Province is located under the Nullarbor Plain, across the SA/WA border. Geologically, the Coompana Province is situated at the nexus between the West, South and Northern Australian Cratons (Fig. 2), and may record the final amalgamation of the proto-Australian Continent during the Mesoproterozoic.

Due to the absence of basement outcrop, the newly acquired Coompana airborne magnetic survey (Fig. 3a) and Coompana gravity survey (Fig. 3b) have been used to sub-divide the Coompana Province into a series of domains with distinct geophysical characteristics (Fig. 4; See Wise, et al. (2015) for preliminary domain definitions based on the Coompana magnetic survey). These are interpreted to represent regions with distinct lithologies and geological histories. The aeromagnetic domains are consistent with the crustal blocks recognised in the 13GA-EG1 deep crustal seismic profile (Dutch, et al., 2016b). The SA Coompana Province also hosts a number of intriguing geophysical anomalies including the enigmatic Coompana Magnetic Anomaly (Fig. 3a; Wise, et al., 2015). This ~50 km wide deep seated remanently magnetised anomaly is associated with a low density signature (Fig. 3b). The cause and significance of this anomaly is currently unknown.

Drillhole locations (Fig. 4) have been planned to intercept as many of the different geophysical domains as possible. These domains include the moderate magnetic intensity, low density domains with a defined NNE trending fabric (Domain 1; Fig. 4) which likely represent the oldest protoliths in the region. Domain 2 is characterised by a variable, mottled magnetic signature with both high and low densities which may represent reworked basement by subsequent granitic intrusions (Fig. 4). Domain 3 includes the prominent NE trending line of magnetic intrusions that bisects the province (Fig. 4). Finally, there is the main remanently magnetised Coompana Magnetic Anomaly itself and a number of possibly associated smaller satellite intrusions located coincident and adjacent to the main magnetic anomaly, but which are associated with density highs.

Approximately 18 new drillholes were planned as part of this project to intersect the above domains and other structures seen in the geophysical data (Fig. 4). The drillholes are located in the far south-west of South Australia: south of the Trans-Australia Railway, east of the SA/WA border, west of a line ~130.00°E and north of the Eyre Highway (Fig. 5).

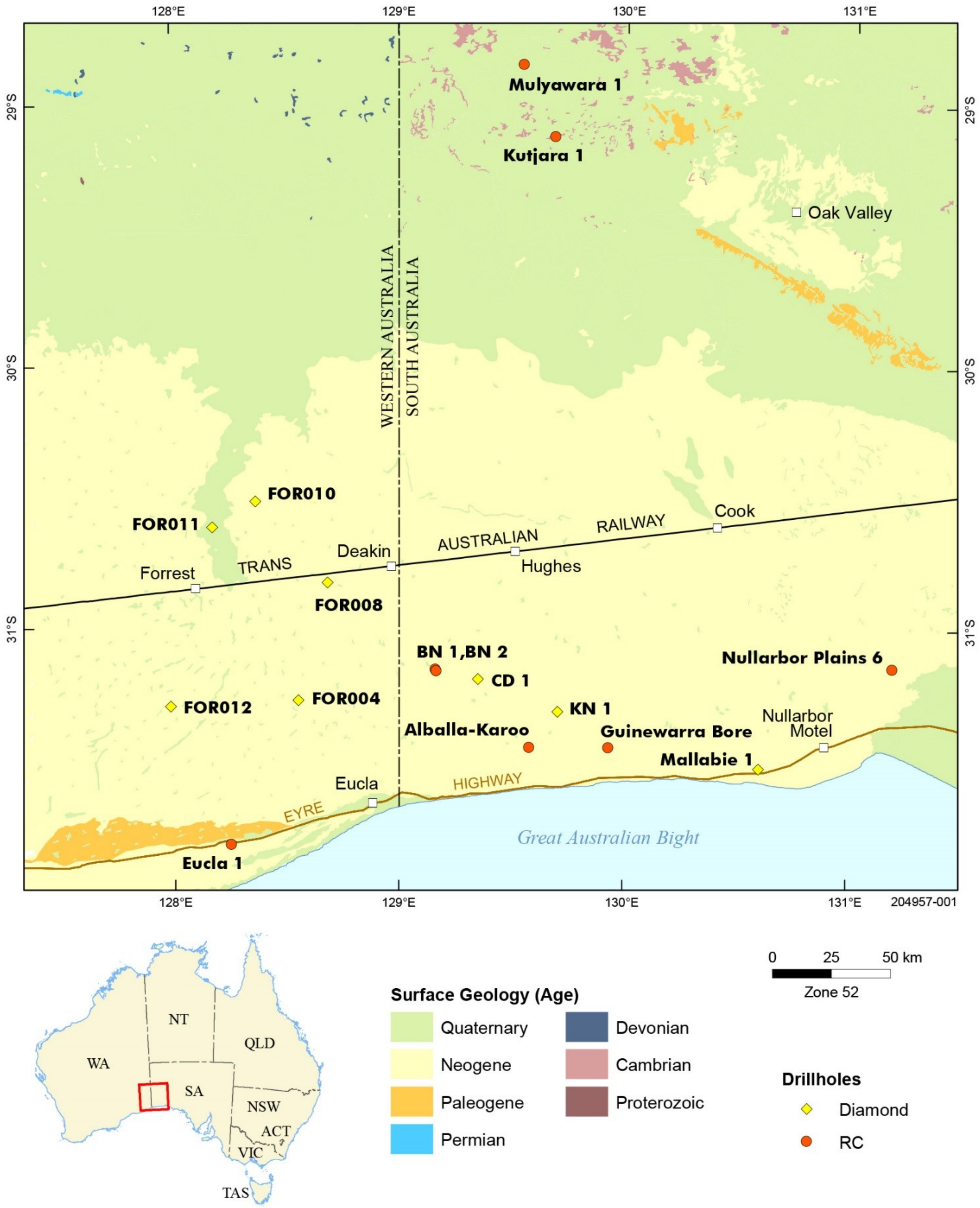

Figure 1. Location of the Coompana Province with existing drillhole locations on 2 million scale surface geology.

Table 1. Summary of basement-intersecting drillholes in the Coompana Province

Drillhole	Geology	Unit	Magmatic age (Ma)	Metamorphic age (Ma)	Geochron reference	Drillhole reference
Guinewarra Bore	Granitic basement					
Alballa-Karoo	Granitic basement					
Nullarbor Plains 6	Granitic basement					
FOR004	Granitic basement	Toolgana Supersuite	1613 ± 4; 1611 ± 7	1179 ± 10	1	2
FOR008	Granitic basement	Toolgana Supersuite	1613 ± 13; 1604 ± 6	1150 ± 10	1	2
Kutjara 1	Granitic basement	Toolgana Supersuite	1591 ± 11	1167 ± 7	3	4
Mallabie 1	Granitic basement	Undawidgi Supersuite	1505 ± 7		5	6
FOR012	Granitic basement	Undawidgi Supersuite	1499 ± 9		1	2
FOR011	Granitic basement	Undawidgi Supersuite	1488 ± 4	1174 ± 12	1	2
FOR010	Granitic basement	Undawidgi Supersuite	1487 ± 9		1	2
Mulyawara 1	Granitic basement	Moodini Supersuite	1168 ± 6		3	7
Eucla 1	Granitic basement	Moodini Supersuite	1140 ± 8		1	2
CD 1	Mafic volcanics and intrusives	Neoproterozoic volcanics	859 ± 66		8	9
BN 2	Mafic volcanics and intrusives	Neoproterozoic volcanics				10
BN 1	Mafic volcanics and intrusives	Neoproterozoic volcanics				10
KN 1	Mafic volcanics and intrusives	Neoproterozoic volcanics				11

References: 1. Wingate, et al. (2015); 2. Spaggiari and Smithies (2015); 3. Neumann and Korsch (2014); 4. Baily, et al. (2012a); 5. Wade et al. (2007); 6. Outback Oil Company NL (1969); 7. Baily, et al. (2012b); 8. Travers (2015); 9. The Shell Co. of Australia Ltd (1983); 10. Carpentaria Exploration Co. Pty Ltd (1982a); 11. Carpentaria Exploration Co. Pty Ltd (1982b).

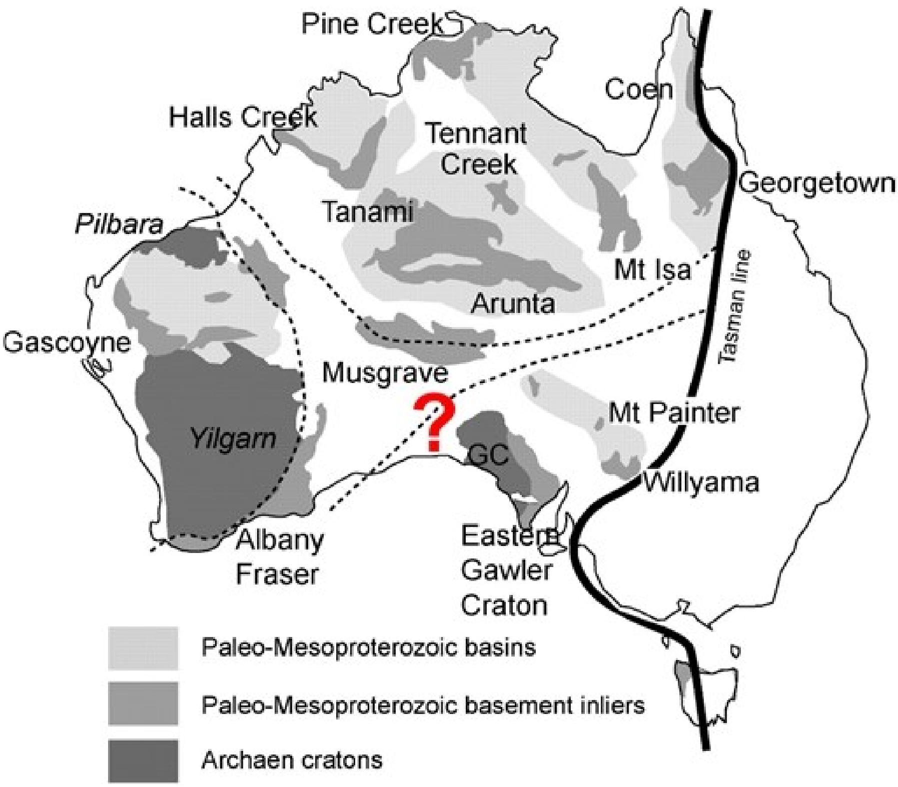

Figure 2. Map of Australia showing the old cratonic blocks that make up the continent (After Myers, et al., 1996)**.** The highlighted Coompana Province area beneath the Nullarbor Plain sits at the contact between the Yilgarn and Gawler (GC) cratons.

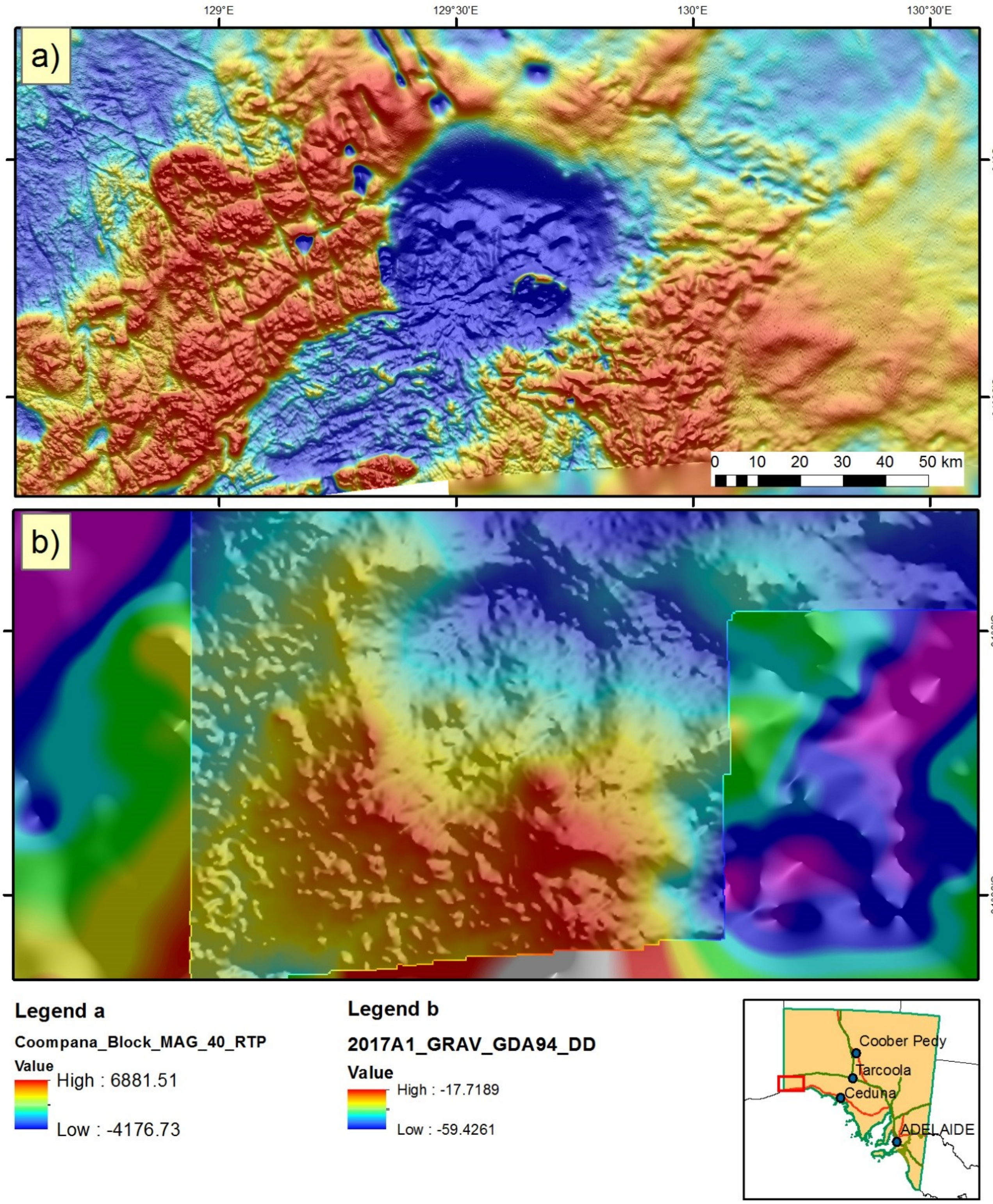

Figure 3. Newly acquired Coompana magnetic and gravity data. a) 200 m and 400 m line spaced Coompana RTP magnetic grid. **b)** 1 km and 0.5 km spaced Coompana gravity grid over regional onshore gravity data.

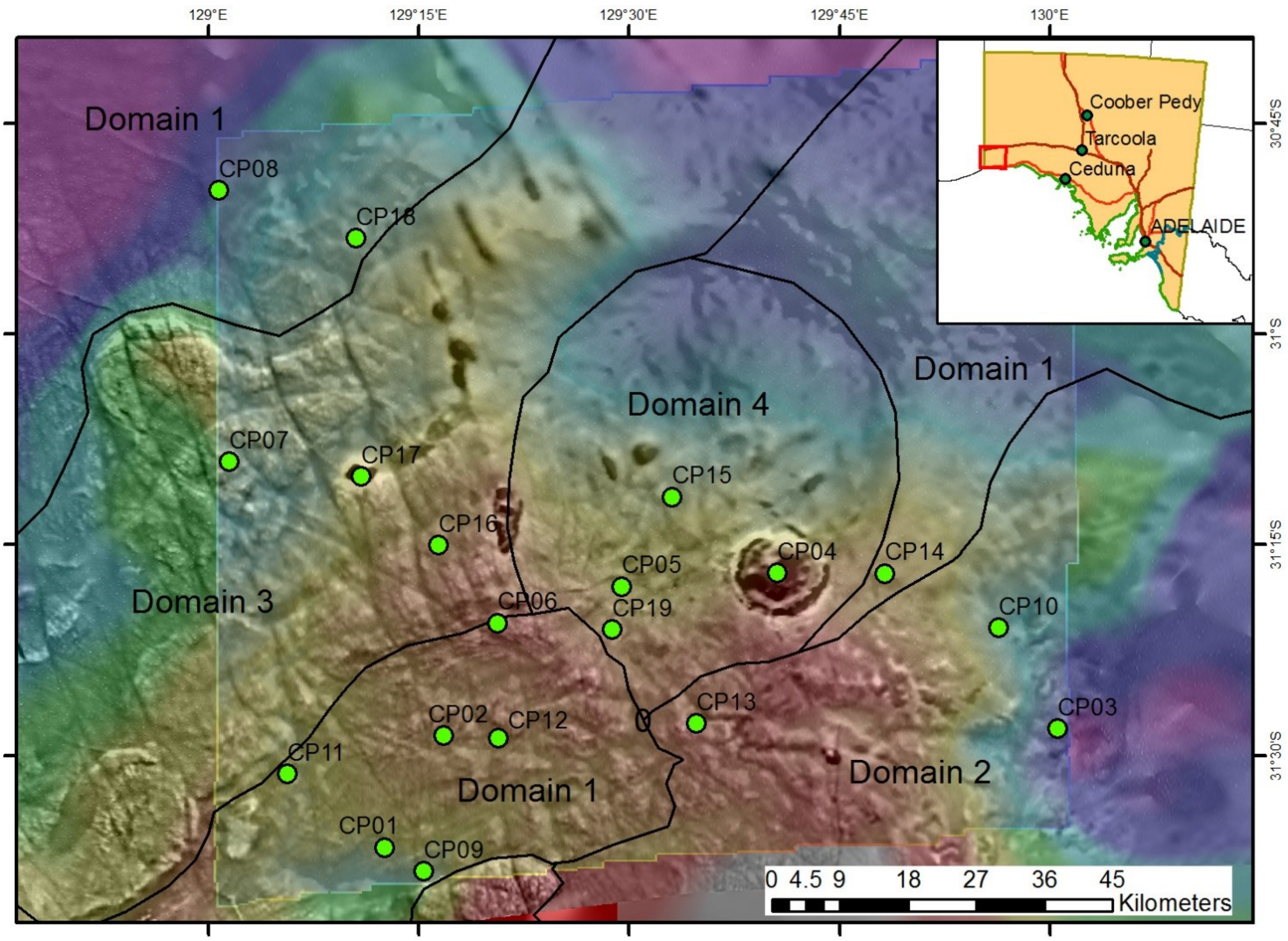

Figure 4. Coompana Province interpreted basement domains with planned drillhole locations. The image is a composite with Bouger gravity (colour) beneath grayscale 1VD total magnetic intensity (TMI). The interpreted domains are preliminary and based on both the TMI and gravity response and extend the preliminary domains proposed by Wise et al. (2015).

PROJECT OBJECTIVES

The primary objective of the Coompana Drilling Project is to address this lack of knowledge and test geophysically derived geological models by collecting high quality drill core samples from the untested basement units beneath the Nullarbor Plain. The outcome of the Coompana Drilling Project will be to provide our stakeholders with new pre-competitive data and a geological framework that more clearly defines the geology and prospectivity in this region.

The Project aims to:

- Undertake rigorous scientific analysis of the retrieved samples to improve our understanding of the stratigraphy and tectono-thermal history of the region, to generate a knowledge-framework to understand the geological significance and potential for different mineral systems in the buried basement rocks beneath the Nullarbor Plain.
- Provide new pre-competitive geological, geophysical and geochemical data in an under-explored greenfields area. This new data will be used to map cover thickness and character, identity possible distal footprints of buried mineralisation or mineralised terranes and estimate the depth to target source rocks which may have economic potential for various commodities.
- Be an exemplar for reducing exploration risk in challenging greenfields regions and provide generic work flows and understanding that will be applicable for exploration and discovery in the far west of South Australia, utilising a best practice approach to environmental protection and safety in this sensitive and logistically challenging area.

- Enhance each Project Parties organisational capabilities in drilling as a pre-competitive data product for research and industry through exposure to standard drilling technologies as well as innovative technologies where deemed appropriate.
- Allow use of the data by a broad range of State and Federal government agencies, researchers and private companies engaged in natural resources and water management.

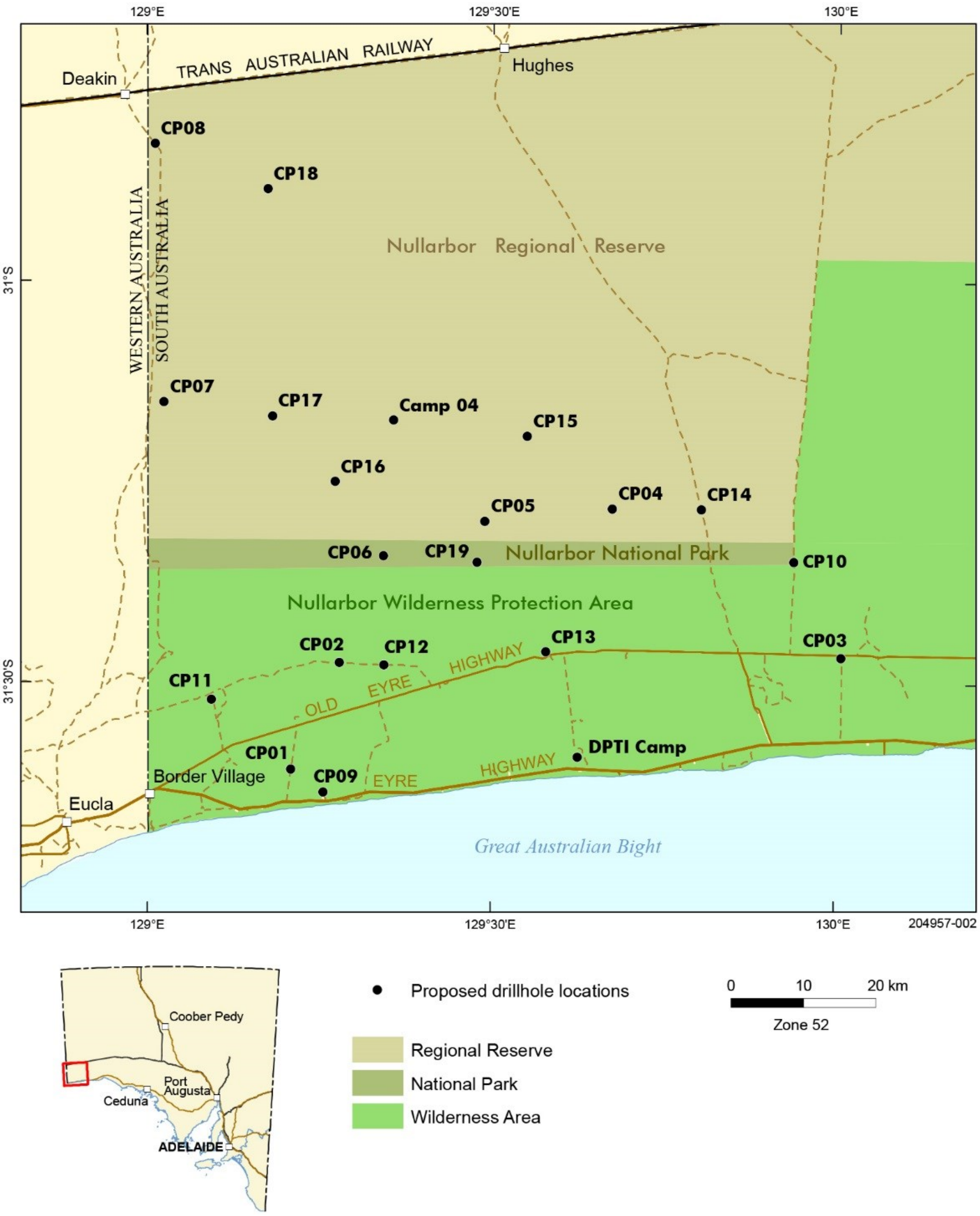

Figure 5. Topographic map of the Coompana area of interest showing proposed drillhole locations and different National Parks land tenure.

LAND TENURE, GEOGRAPHY AND ACCESS

The area of the planned Coompana Drilling project occupies three different land tenures (Fig. 5). Drill sites located south of a line -31.3°S fall within the recently proclaimed Nullarbor Wilderness Area, a single proclamation wilderness protection area. Drill sites located north of this line fall within the Nullarbor National Park and the Nullarbor Regional Reserve, both dual proclamation conservation reserves. The entire area is within the determined Native Title claim of the Far West Coast Aboriginal Corporation.

Access to the Coompana Drilling Project area is either via the Eyre Highway or the Trans-Australia railway access road. Access to the proposed drill sites is via established park roads (including the old Eyre Highway and Koonalda Station tracks), previous exploration tracks and some new tracks within the Regional Reserve. No new tracks will be created within the Nullarbor Wilderness Area.

The nearest populated centers are Eucla and Border Village located at the SA/WA border, the Nullarbor Roadhouse and Cook railway siding. The nearest major center is Ceduna, ~500 km east along the Eyre Highway

PURPOSE OF THIS REPORT

This report represents a progressive update and data release during the operational phase of the Coompana Drilling Project. The results presented here are preliminary in nature and are intended for reference purposes only. All care has been taken to ensure accuracy but this represents field data acquired at site and is subject to revision, updating and subsequent QA/QC processes.

GEOLOGICAL OVERVIEW

COVER SEQUENCES

The cover overlying the Coompana Province in the study area is interpreted to comprise three main packages; the Carboniferous-Permian Denman Basin, Jurassic-Cretaceous rocks of the Bight Basin and the Tertiary Eucla Basin.

Carboniferous-Permian Denman Basin

The Denman Basin is an intracratonic, north-northwest-trending, fault-bounded trough ~200 km long and between 20–70 km wide (Hibburt, 1995). The sedimentary package in the trough varies from 300 m thick in the north, to 1000 m thick in the south.

The basin is filled with Permian sediments that unconformably overly the basement, and are unconformably overlain by Cretaceous and Tertiary rocks. The rocks are glacial at the base, and up sequence are interpreted to represent progressive de-glaciation and glacio-eustatic marine transgression.

Jurassic-Cretaceous Bight Basin

The Jurassic-Cretaceous Bight Basin is a large, mainly offshore basin that extends along the southern Australian margin (Hill, 1995). The basin contains a Middle Jurassic to Late Cretaceous sedimentary succession that is unconformably overlain by the Eucla Basin.

LOONGANA FORMATION

The Early Cretaceous Loongana Formation is a sandy to shaly succession with a maximum thickness of 324 m (Hill, 1991; 1995). The unit has been formally described as “Cross-bedded feldspathic sandstone, locally conglomeratic, carbonaceous sandstone; glauconitic sandstone, siltstone, claystone and shale; commonly pyritic” (Geoscience Australia and Australian Stratigraphy Commission, 2017). The rocks are interpreted to represent an initial rift phase in a terrestrial low-sinuosity fluvial environment within isolated grabens of the developing rift valley (Hill, 1995).

MADURA FORMATION

The Early Cretaceous Madura Formation conformably overlies the Loongana Formation. The Madura Formation has a maximum thickness of 474 m, and has been formally described as “Carbonaceous or glauconitic sandstone, siltstone, and claystone and shale; commonly pyritic” (Geoscience Australia and Australian Stratigraphy Commission, 2017). The sediments were interpreted to have been deposited in a marine environment with limited circulation suggested by low-energy lacustrine conditions (Hill, 1995).

Tertiary Eucla Basin

The Tertiary Eucla Basin comprises a widespread, thin package of marine and terrestrial sediments that were deposited on the passive margin along southern Australia.

PIDINGA FORMATION

The lower unit is the Pidinga Formation. This is a 30–60 m thick package of carbonaceous, terrigenous clastic sedimentary rocks that were deposited in topographically low settings, such as palaeochannels and broader depressions (Benbow, et al., 1995). The Pidinga Formation has been formally described as “Interbedded, well-sorted, fine to coarse-grained carbonaceous sand and silt with minor lignite. Flood zone clays and lignite, fluvial/estuarine channel sands, gravelly (carboneous) coarse sands” (Geoscience Australia and Australian Stratigraphy Commission, 2017).

HAMPTON SANDSTONE

The Pidinga Formation is overlain by the Hampton Sandstone. This unit comprises quartz-rich sands that were deposited as lenses and sheets in marine, estuarine and fluvial environments (Benbow, et al., 1995). The Hampton Sandstone has been formally described as “Poorly sorted limonite-stained sandstone, typically quartz rich; includes subordinate gravel, conglomerate and siltstone” (Geoscience Australia and Australian Stratigraphy Commission, 2017).

WILSON BLUFF LIMESTONE

The Wilson Bluff Limestone overlies the Hampton Sandstone. The Wilson Bluff Limestone is <150 m thick east of the Coompana Block, increasing westwards to ~300 m thick in Western Australia (Benbow, et al., 1995). The unit has been formally described as “Wackestone, white to grey; skeletal mudstone; rudstone and minor packstone. Locally laminations and scour channels, infilled with coarser material” (Geoscience Australia and Australian Stratigraphy Commission, 2017). The limestone is interpreted to have been deposited during marine transgression on a drowned carbonate platform (Benbow, et al., 1995). This is the rock that forms the whitish cross-bedded and parallel-bedded unit in the lower parts of the Bunda Cliffs.

ABRAKURRIE LIMESTONE

The Abrakurrie Limestone is thin (generally <10 m thick) unit that overlies the Wilson Bluff Limestone, and forms a distinct yellow-brown band in the Bunda Cliffs (Benbow, et al., 1995). The Abrakurrie Limestone has been formally described as “Yellowish coarse-grained bryozoan calcarenite and calcirudite, distinctly cyclic, and contains numerous hardgrounds; locally dolomitized” (Geoscience Australia and Australian Stratigraphy Commission, 2017). The limestone is interpreted to have been deposited on partly to completely drowned platform (James and Bone, 1991).

NULLARBOR LIMESTONE

The Nullarbor Limestone is a 20–35 m thick unit that overlies the Abrakurrie Limestone, and forms the ‘lumpy’ brown, parallel-bedded unit at the top of the Bunda Cliffs (Benbow, et al., 1995). The unit has been formally described as “Limestone, bioclastic, micritic. Subtidal, platformal, above fair weather wave-base. Includes large benthic foraminifera and aragonitic material; well-cemented” (Geoscience Australia and Australian Stratigraphy Commission, 2017). The limestone is interpreted to have been deposited in a shallow platform setting, with the paucity of terrigenous material suggesting river systems carried little debris to the coast (James and Bone, 1991).

BASEMENT

Recent drilling by the Geological Survey of Western Australia (Spaggiari and Smithies, 2015) has begun to shed light on the evolution of the region, indicating a complex multi-phase history beginning with interpreted Paleoproterozoic oceanic crust formation. This was followed by magmatic events, associated with subduction and crustal reworking, throughout the Mesoproterozoic (Spaggiari and Smithies, 2015; Dutch, et al., 2016a; Kirkland, et al., 2017).

Isotopic constraints indicate the development of oceanic crust at c. 2000–1900 Ma. There is no direct geological evidence for this event (Kirkland, et al., 2017).

This was followed by widespread arc magmatism and recycling of the oceanic crust at c. 1610 Ma, which resulted in the Toolgana Supersuite (Spaggiari and Smithies, 2015). The Toolgana Supersuite comprises granitic to monzodioritic rocks with compositions that suggests a subduction-modified mantle source. In particular, the rocks appear to be derived from a mantle wedge or subduction-modified lithosphere (Wingate, et al., 2015; Kirkland, et al., 2017). In drill core, GSWA found the Toolgana Supersuite to include locally migmatitic monzodioritic to granodioritic to monzogranitic gneisses and metadolerites that have been metamorphosed to amphibolite facies (Spaggiari and Smithies, 2015). The Toolgana Supersuite is the same age as, and is geochemically and isotopically similar to, the St Peter Suite in the western Gawler Craton (Wingate, et al., 2015; Dutch, et al., 2016a).

The Toolgana Supersuite was followed by c. 1500 Ma extension and rift-related c. 1490 Ma Undawidgi Supersuite magmatism in the west. This supersuite includes metagranitic and possible bimodal metavolcanic rocks that are derived by melting of lower mafic crust and the introduction of a mantle component. They are also interpreted to include recycled Toolgana Supersuite material (Wingate, et al., 2015). In drill core, GSWA found the Undawidgi Supersuite to include: variably foliated metatonalites and metamonzogranites, which are locally gneissic and migmatitic; metamonzodiorites; and variably sheared/mylonitic felsic and mafic schists. The felsic schists are interpreted to have a monzogranitic or volcanic protolith (Spaggiari and Smithies, 2015). The Undawidgi Supersuite is similar in age to the granodiorite gneiss from Mallabie 1 to the east of the current project (Fig. 1; Wade, et al., 2007).

Major extension at c. 1200–1120 Ma resulted in crustal thinning and widespread reworking of the crust. Reworking included generation and intrusion of the widespread intraplate c. 1190–1140 Ma Moodini Supersuite (Spaggiari and Smithies, 2015). In the western Coompana Province, this supersuite comprises high-KMg shoshonitic magmas that are bimodal with mafic and felsic compositions. The compositions are interpreted to reflect deep melting of wet, oxidised modified mantle lithosphere, indicating that the western Coompana Province retained a thick lithosphere into the c. 1200–1120 Ma event. This contrasts with the Madura Province to the west, where compositions suggest highly extended, dry and reduced crust with little or no remaining lithosphere (Wingate, et al., 2015). In drill core, GSWA found the Moodini Supersuite to include: equigranular to porphyritic, massive syenogranites, shoshonites and monzogranites that form thin sheets that cut the earlier foliations at variable angles (Spaggiari and Smithies, 2015). The magnetotelluric data suggests that some of the crustal-scale structures and crustal blocks are conductive, representing significant fluid flow and magmatic processes, such as MASH zones (Thiel, et al., 2016). This extensional event in the Coompana Province (and Madura Province to the west) coincides with Stage II of the Albany–Fraser Orogeny to the west, and the Musgravian Orogeny to the north. This widespread event, which affected the crust between the Yilgarn, Gawler and North Australian cratons has been called the Maralinga Event.

BOREHOLE DATA

Site ID: CP15	
Hole ID: CDP005	
Easting (MGA z52J)	552558
Northing (MGA z52J)	6548802
Latitude (WGS84)	-31°11'37"
Longitude (WGS84)	129°33'06"
Elevation (m)	~ 100
Bore Spud Date	30/06/17
Bore Completion Date	24/07/17
Total Depth (m)	648.20m
Drilling Contractor	Boart Longyear Australia Pty Ltd
Drilling Supervisor Name	B Vandekamp/N Hodgetts
GSSA Drilling Coordinator Name	L Tylkowski/A Lockheed
On-site Geologist Name (Pre-collar)	L Tylkowski/A Lockheed
On-site Geologist Name (Diamond Coring)	T Wise/M Pawley

SITE ACCESS

CDP005 is located approximately 80km north-east of Border Village and approximately 45km north-west of Koonalda Homestead. The site is located along a pre-existing station track and can be accessed from the west by the Eyre Highway from Eucla along well-maintained access tracks to the Nullarbor Links Golf Course, and the Deakin Track, turning right on to the station track (approximately 60km from the golf course) and travelling approximately 65km east to reach CDP005. It can also be accessed from the east via the Eyre Highway (new and old) a station fenceline track, then travelling approximately 26km west along the station track. CDP005 is located within the Nullarbor Regional Reserve.

Land Tenure	Wilderness Area ☐	National Park ☐	Regional Reserve ☒
	DPTI ☐		
Associated PEPR	Coompana Stage 1 ☐	Coompana Stage 2 ☒	
Heritage Survey Undertaken	Yes ☒	No ☐	
DEWNR Permit Number	Q26618-1		

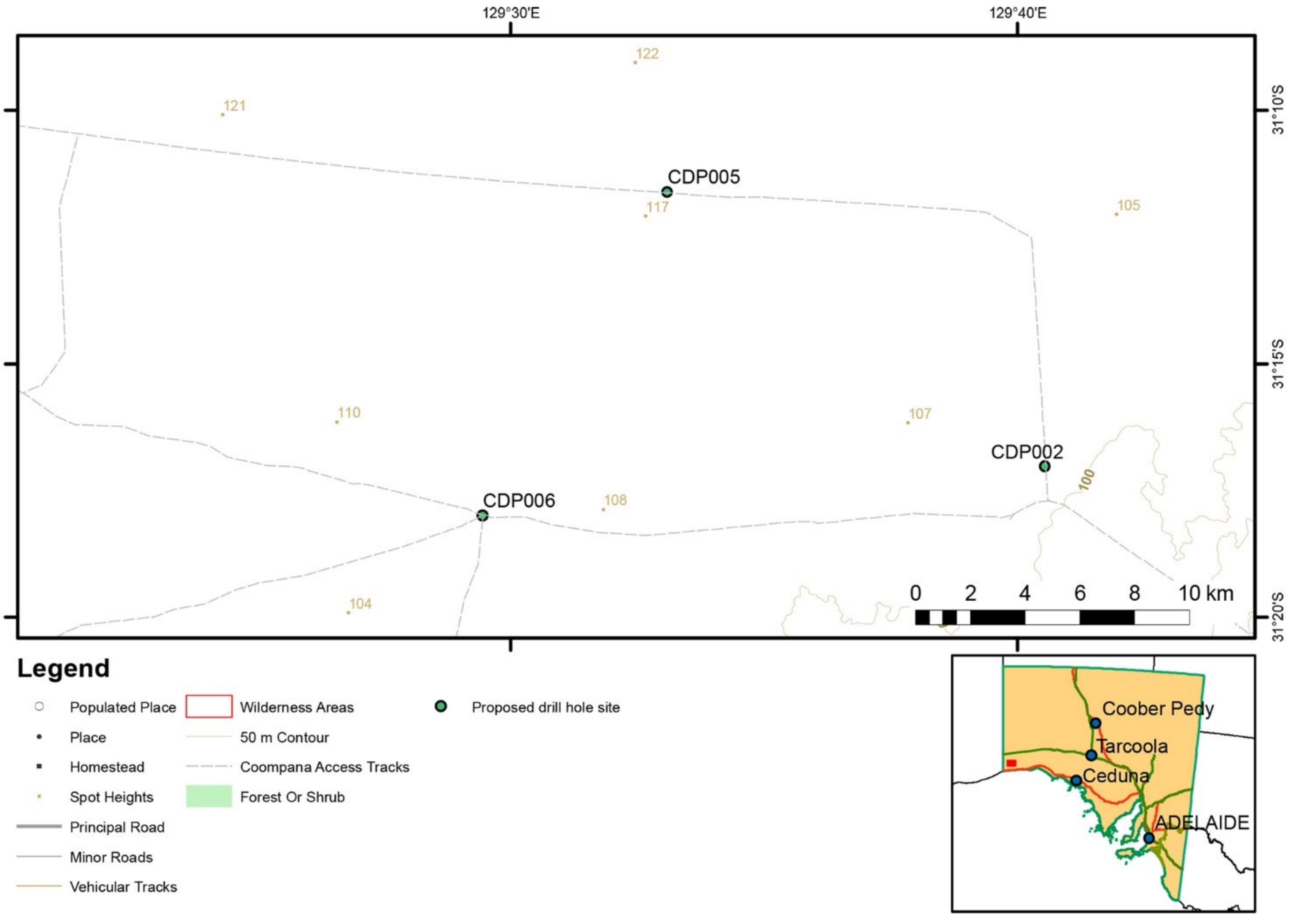

Figure 6. Site access map for CDP005 on 1:250 000 scale topographic map.

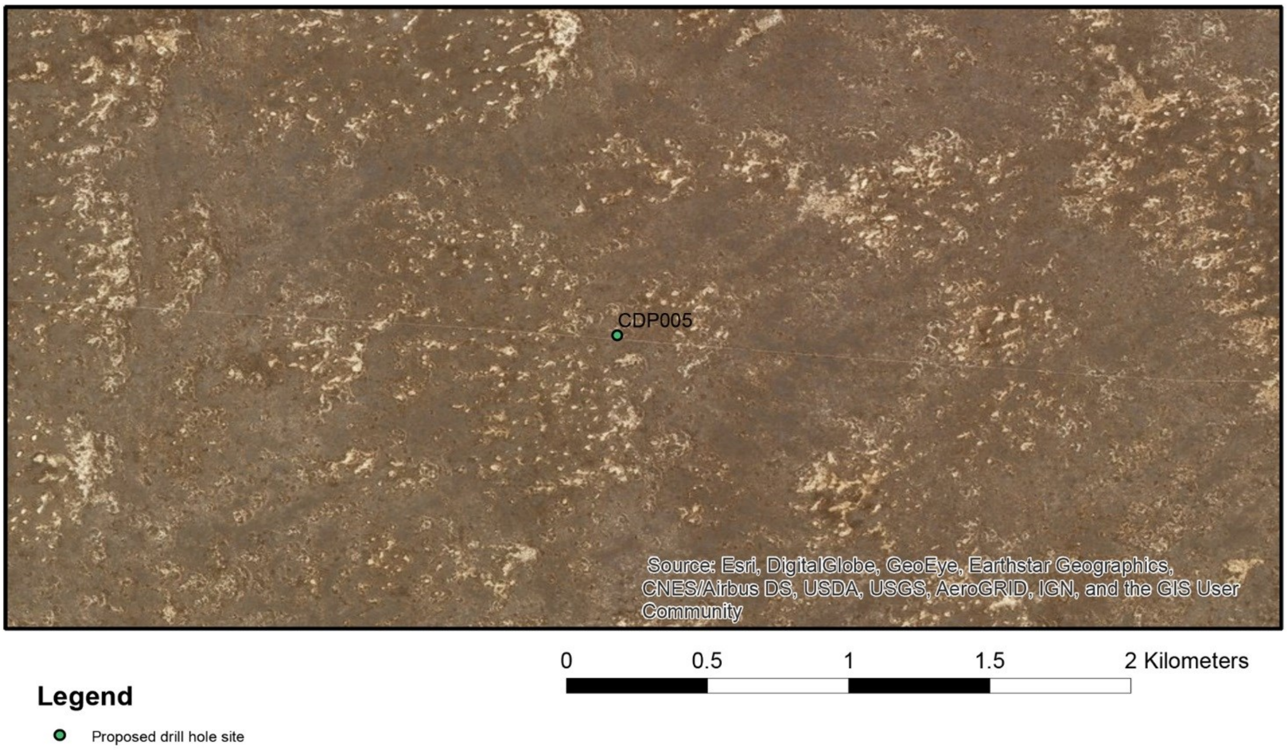

Figure 7. Orthoimage of site CDP005.

DRILLHOLE TARGET

CDP005 targets a geophysical zone that is dominated by the strongly reversely magnetised Coompana Magnetic Anomaly (Domain 4). This domain has a relatively low density signal compared to surrounding domains to the south and west. The area of the drillhole is characterised by a mottled magnetic signature similar to the magnetic plutons to the immediate west. Given the magnetic character this hole may represent either; shallow parts of the Coompana Magnetic Anomaly, a continuation of the magnetic plutons to the west with the magnetic signature dominated by the underlying reverse magnetism, or extrusive mafic volcanics intercepted in other nearby exploration holes.

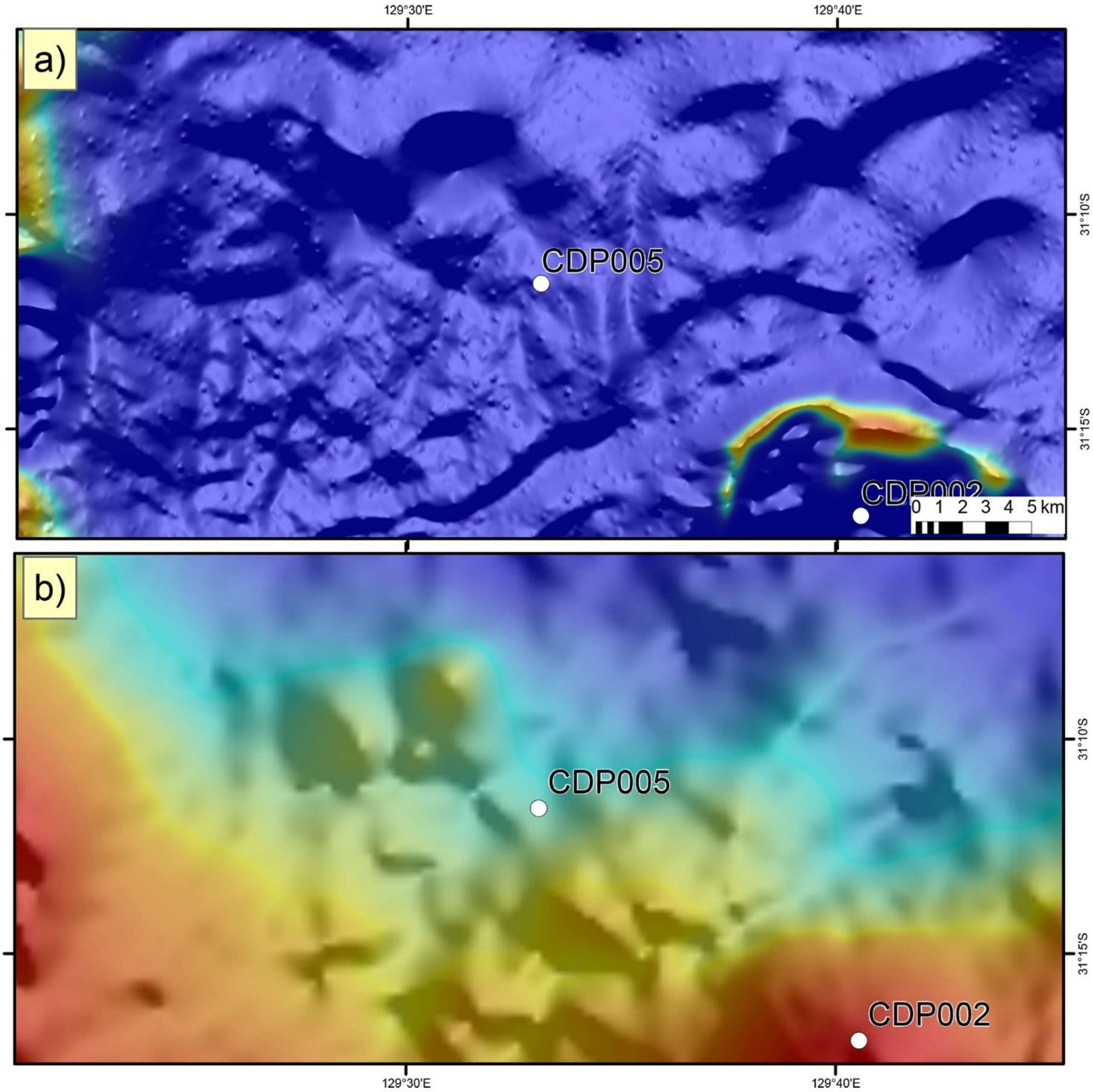

Figure 8. Site of drillhole CDP005 on a) RTP TMI and b) Bouger gravity.

DRILLING SPECIFICATIONS

<table>
<tr><td>Bore inclination (deg):</td><td colspan="4">-85°</td></tr>
<tr><td>Bore Azimuth (deg):</td><td colspan="4">000°</td></tr>
<tr><td rowspan="3">Pre-collar 1
Limestone</td><td colspan="2">From (m): 0</td><td colspan="2">To (m): 183</td></tr>
<tr><td>RC ☒</td><td>Mud rotary ☐</td><td>Diamond ☐</td><td>DTFR ☐</td></tr>
<tr><td>Rig Type</td><td colspan="3">8 ½” RC Tricone, Schramm T130</td></tr>
<tr><td rowspan="3">Pre-collar 2
Soft seds</td><td colspan="2">From (m): 183</td><td colspan="2">To (m): 451.60</td></tr>
<tr><td>RC ☐</td><td>Mud rotary ☒</td><td>Diamond ☐</td><td>DTFR ☐</td></tr>
<tr><td>Rig Type</td><td colspan="3">5 5/8” Tricone mud rotary, Schramm T130</td></tr>
<tr><td rowspan="2">Diamond Tail</td><td colspan="4">Length (m): 196.60</td></tr>
<tr><td>Rig Type</td><td colspan="3">UDR1200</td></tr>
<tr><td>Diamond Core size</td><td>PQ (85 mm) ☐</td><td>HQ3 (61.1 mm) ☒</td><td colspan="2">NQ2 (45 mm) ☐</td></tr>
<tr><td>Casing Specifications</td><td colspan="4">1st casing to isolate limestone. Cased to basement</td></tr>
<tr><td>Casing Notes</td><td colspan="4">1st casing is 6 5/8” to 183.0m, 2nd Casing PWT and HWT to 451.60m</td></tr>
<tr><td>Casing Retrieved</td><td>Pre-collar 1
Yes ☐ No ☒</td><td>Pre-collar 2
Yes ☒ No ☐</td><td colspan="2">Stratigraphic Hole ☐</td></tr>
<tr><td>Casing Retrieval Notes</td><td colspan="4">All HWT Casing was removed from the hole. The 6 5/8” remains in the borehole</td></tr>
<tr><td>Water Source</td><td>Eucla ☐</td><td>Border Village ☒</td><td>KN1 ☐ KN2 ☐</td><td>Other ☐</td></tr>
<tr><td>Borehole Abandonment</td><td colspan="4">Abandoned according to regulatory requirements: Yes ☒ No ☐</td></tr>
<tr><td>Borehole Abandonment Notes</td><td colspan="4">Bore hole abandoned by placing a van ruth plug at 200m and grouting up to 70m. This is to isolate the unconfined aquifer in the Wilson’s Bluff Limestone.</td></tr>
<tr><td>Additional Notes</td><td colspan="4"></td></tr>
</table>

PRE-DRILLING GEOPHYSICS AND DEPTH ESTIMATES

Prior to the commencement of drilling, a number of geophysical techniques were trialled to ascertain their effectiveness at determining the thickness and nature of the cover units overlying the Nullarbor basement rocks. This work was done in conjunction with GA and the CSIRO. A combination of Audio Magnetotellurics (AMT) passive seismic and active seismic (reflection and refraction) were undertaken at selected proposed drill sites prior to drilling. For details of the methodologies and full results the reader is referred to Gorbatov, et al. (in prep.), Holzschuh, et al. (in prep.), and Jiang, et al. (in prep.). In addition to acquiring new data, depth to magnetic basement estimates were calculated using the newly acquired Coompana airborne magnetic data. The reader is referred to Foss, et al. (2017) for the full methodology and results.

Depth estimate results

Thickness of Nullarbor/Wilsons Bluff limestone	
Method	**Depth (m)**
Nearby bores	182 (KN1 ~20km SE) 166 (KN2 ~11km E-SE)
AMT	
Passive Seismic	
Active Seismic	
Depth to Basement interface	
Method	**Depth (m)**
Nearby bores	340 (KN1 ~20km SE) >436 (KN2 ~11km E-SE)
Magnetic basement	194 – 574 (4 nearby solutions)
AMT	
Passive Seismic	
Active Seismic	
Depth Recorded from Drilling	
Base limestone cover	176
Basement interface	~434?
Pre-drilling micro-gravity undertaken	Yes ☒ No ☐
Recommendations	Hole location OK

Micro-gravity

The Nullarbor Plain is known for its large and numerous cave systems. Because of this aspect, prior to drilling a series of micro-gravity surveys were undertaken at each site in an attempt to locate the presence of large, blind, cavities that may be in the vicinity of the drill collar. The survey was undertaken using two Scintrex CG5 gravity meters on a regular grid pattern with stations spaced at 10 m intervals. The total gravity field was measured and then the regional trend has been removed in post-processing to highlight the near surface density variation. The results indicate areas of lower density in the near surface that may indicate the location of sub-surface cavities and allow the drill collar to be moved to avoid intersecting these. For a full account of the methodologies and results the reader is referred to Heath, et al. (2017).

The results for the survey around the CDP005 collar (Fig. 9) indicate a total variation in the gravity field of 0.28 mGal. The location of the collar (central point on Fig. 9) was determined to be clear of large cavities and ok to drill.

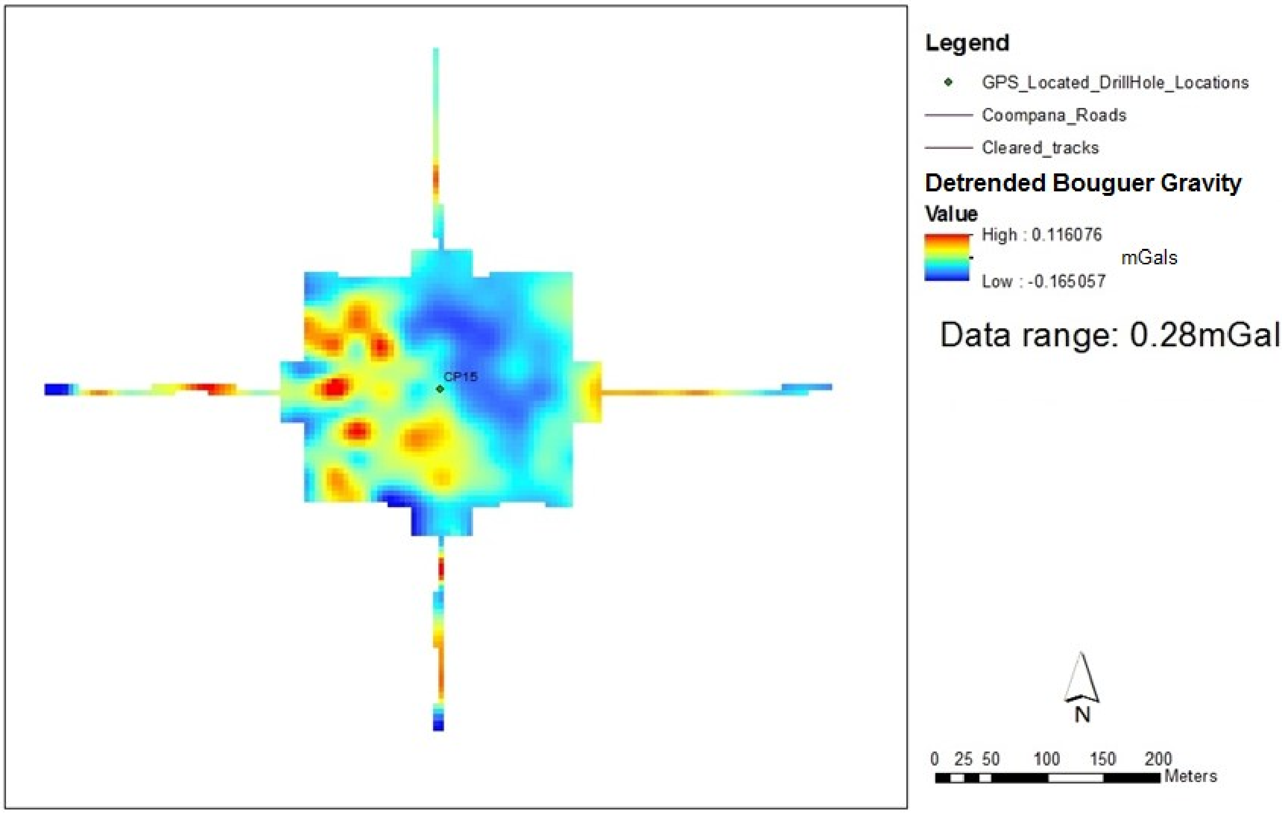

Figure 9. Microgravity survey of site CDP005 (CP015) showing a grid of the regionally de-trended isostatic gravity.

DOWN HOLE SURVEYS AND ANALYSIS

Directional survey required every 30m and EOH ☒	Multi-shot survey ☐ Single-shot survey ☒	Gyro ☐	
Core orientation required		Yes ☒Every Run No ☐	
Core Orientation Tool Used		Boart Longyear TruCore	
Downhole geophysical surveys planned		Yes ☒ No ☐	
Downhole geophysical surveys run		Yes ☒ No ☐	
Tru-scan XRF scanning run on core		Yes ☐ No ☒	
Survey Tool	**Method**	**Date**	**Run By**
Globaltech TruProbe	Wireline and In-rod	26/07/2017	T Hamon/P Clegg
Temperature Probe	Wireline in rods	25/07/2075	A Lockheed/T Wise

FIELD SUMMARY LOGS

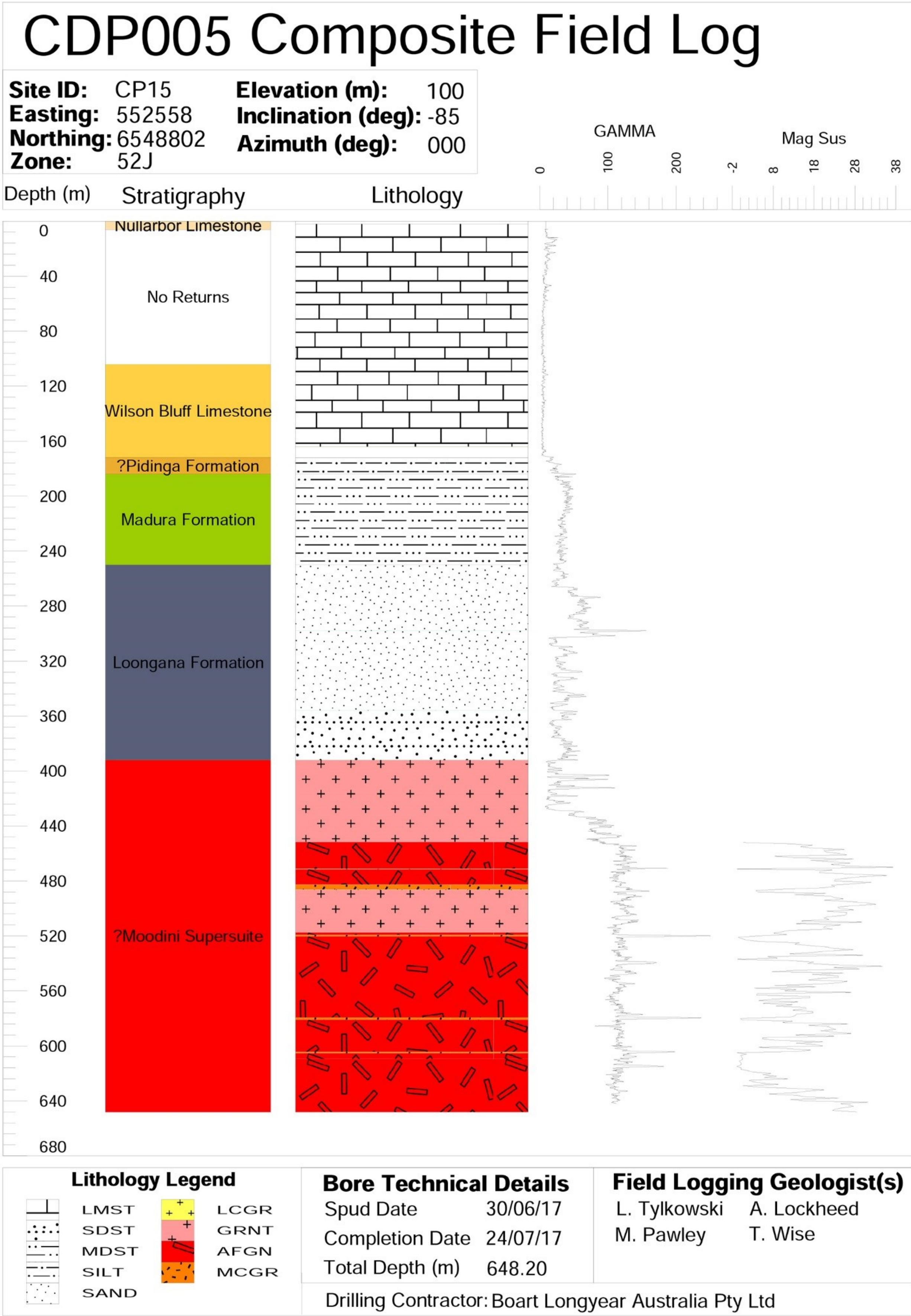

Figure 10. Summary graphic log of drillhole CDP005. Abbreviations; LMST limestone, SDST sandstone, MDST mudstone, SILT silt, SAND sand, LCGR leucogranite, GRNT granite, AFGN alkali-feldspar granite, MCGR microgranite.

BASEMENT LITHOLOGY DESCRIPTIONS

Megacrystic granite

The megacrystic granite (Fig. 11) is a pink-green coarse grained K-feldspar rich porphyritic granite with euhedra-subhedrall K-feldspar megacrysts to 5 cm. Many phenocrysts display Rapakivi textures, whilst poikolitic inclusions in concentrically-zoned phenocrysts are common. Quartz is present as ~5 mm rounded-spherical crystals in variable modal abundance, with interstitial K-feldspar. Biotite and magnetite are found commonly in association, occurring as clusters or blebs.

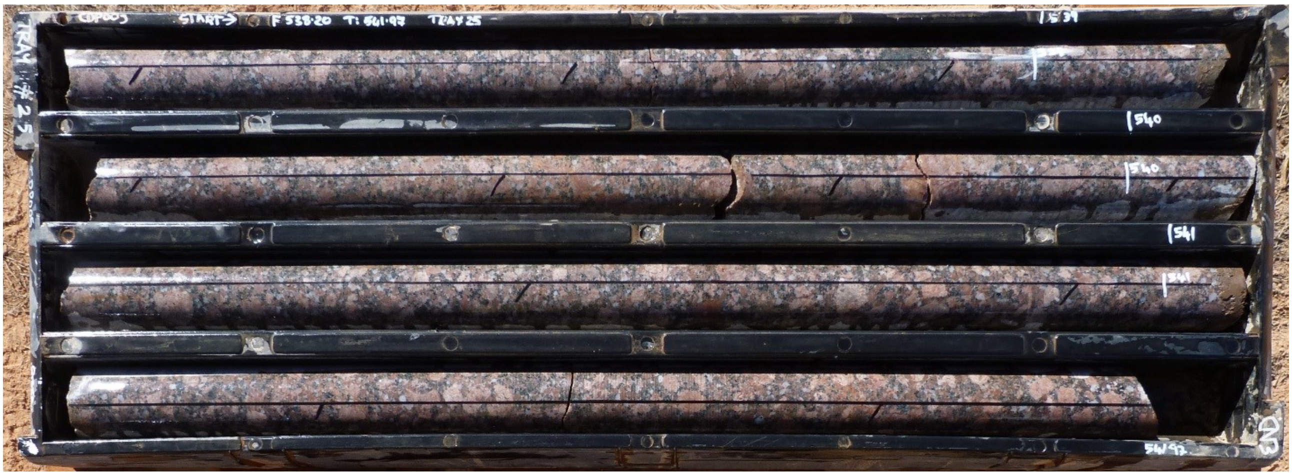

Figure 11. Representative core from CDP005 showing the megacrystic granite.

Mafic xenoliths 5 to 15 cm are scattered throughout the host megacrystic granite (Fig. 12).

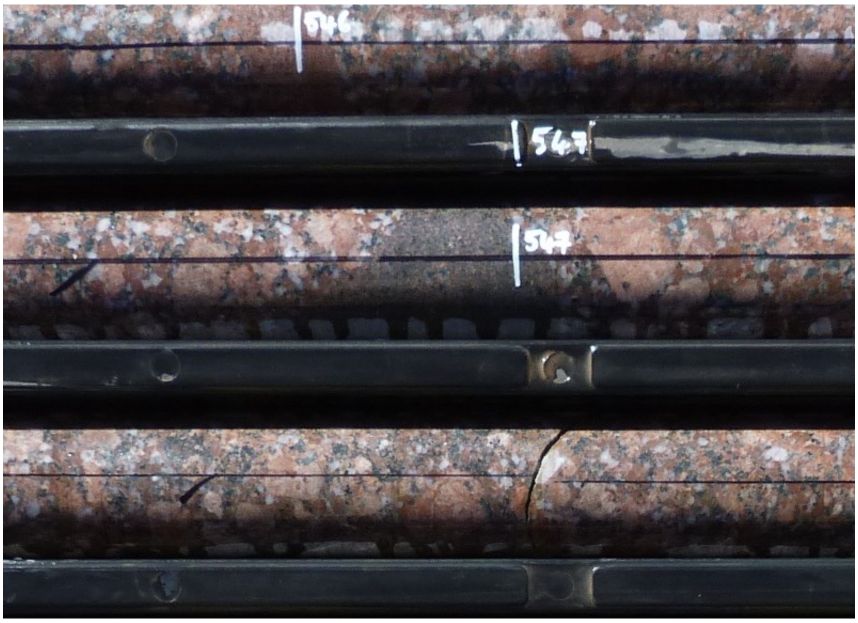

Figure 12. Core from CDP005 showing small mafic enclave/xenolith within megacrystic granite.

Sericite alteration is common mainly coating fracture planes, whilst pervasive K-feldspar (potassic) and hematite alteration is found throughout.

Microgranite

Pink, medium grained and equigranular microgranite occurs as transgressive sheets with sharp intrusive margins (Fig. 13). Microgranite sheets are up to 4 m wide within the host megacrystic granite. Relative proportions of quartz and feldspars are higher than the host granite, and biotite-magnetite associations are rare.

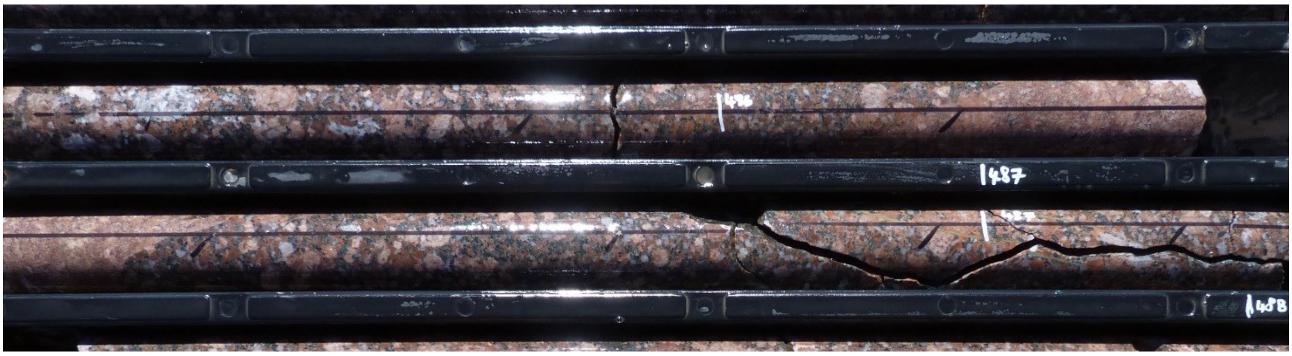

Figure 13. Representative core from CDP005 showing the intrusive microgranite.

ACKNOWLEDGEMENTS

The GSSA acknowledges the Mirning People, and the members of the Far West Coast Aboriginal Corporation, who are the traditional owners of this land. In particular Mr Clem Lawrie, Mr James Peel, Mr John Mungee, Mr Neville Miller and Mr Peter Miller are thanked for undertaking on-country site inspections. The GSSA would also like to acknowledge the hard and constructive work undertaken by staff of the Department for the Environment, Water and Natural Resources and the Alinytjara Wilurara Natural Resources Management (AWNRM) including the members of the Nullarbor Parks Advisory Committee, who provided the necessary approvals to undertake this project within the Nullarbor Parks.

REFERENCES

Baily T, Clark R, Rowland B and Nicolson J 2012a. *KUTJARA-1 Well Completion Report, Rodinia Oil (Australia) Pty Ltd.* Well Completion Report, 2011/000279. Department of Manufacturing, Innovation, Trade, Resources and Energy, South Australia, Adelaide.

Baily T, Clark R, Rowland B and Nicolson J 2012b. *MULYAWARA-1 Well Completion Report, Rodinia Oil (Australia) Pty Ltd.* Well Completion Report, 2011/000091. Department of Manufacturing, Innovation, Trade, Resources and Energy, South Australia, Adelaide.

Benbow MC, Lindsay JM and Alley NF 1995. Eucla Basin and palaeodrainage. In JF Drexel and WV Preiss eds, The geology of South Australia, Vol. 2, The Phanerozoic, Bulletin 54. Geological Survey of South Australia, Adelaide. pp. 178–186.

Carpentaria Exploration Co. Pty Ltd 1982a. EL 472 and EL 849 Bundulla progress reports for the period 24/5/79 to 19/10/82, Open File Envelope No. 3515. Department of Primary Industries and Resources South Australia, Adelaide.

Carpentaria Exploration Co. Pty Ltd 1982b. EL 503 and EL 905 Koonalda progress reports for the period 7/8/79 to 18/7/82, Open File Envelope No. 3604. Department of Primary Industries and Resources South Australia, Adelaide.

Dutch R, Reid A, Smithies HR, Payne J, Jagodzinski EA, Kirkland CL, Pawley M, Spaggiari CV and Preiss WV 2016a. Is Southern Australia bent? Recognition of a contiguous Palaeoproterozoic magmatic arc along the western margin of the Mawson Continent. In *Australian Earth Sciences Convention*, Geological Society of Australia Abstract No. 118, Adelaide.

Dutch R, Spaggiari CV, Doublier MP, Pawley M, Wise TW, Kennett BLN, Gessner K, Thiel S, Clark D and Holzschuh J 2016b. What lies beneath the Nullarbor Plain? Insights into the geology of the Coompana Province from deep crustal seismic reflection profile 13GA-EG1. In *Australian Earth Sciences Convention*, Geological Society of Australia Abstract No. 118, Adelaide.

Foss CA, Reed G, Keeping T, Wise TW and Dutch RA in prep. *Magnetic depth to basement mapping over the Coompana area*, Report Book 2017/00027. Department of the Premier and Cabinet, South Australia, Adelaide.

Geoscience Australia and Australian Stratigraphy Commission 2017. Australian Stratigraphic Units Database. http://www.ga.gov.au/products-services/data-applications/reference-databases/stratigraphic-units.html

Gorbatov A, Czarnota K and Dutch R in prep. *Cover thickness estimates in the Coompana Province, South Australia: Benchmarking the application of the passive seismic method*. Geoscience Australia, Canberra.

Heath P, Gouthas G, Irvine J, Krapf C and Dutch R 2017. *Microgravity Surveys on the Nullarbor*, Report Book 2017/00021. Department of the Premier and Cabinet, South Australia, Adelaide.

Hibburt JE 1995. Denman Basin. In JF Drexel and WV Preiss eds, The geology of South Australia, Vol. 2, The Phanerozoic, Bulletin 54. Geological Survey of South Australia, Adelaide. pp. 77–78.

Hill AJ 1991. Revisions to the Cretaceous stratigraphic nomenclature of the Bight and Duntroon Basins, South Australia. *Quarterly Geological Notes* 120:2–20. Geological Survey of South Australia, Adelaide.

Hill AJ 1995. Bight Basin. In JF Drexel and WV Preiss eds, The geology of South Australia, Vol. 2, The Phanerozoic, Bulletin 54. Geological Survey of South Australia, Adelaide. pp. 133–137.

Holzschuh J, Nicoll M, McAlpine SRB, Pawley MJ and Dutch R in prep. *Cover thickness estimates in the Coompana Province, South Australia: Results from the pre-drilling geophysics program – Reflection seismic.* Geoscience Australia, Canberra.

James NP and Bone Y 1991. Origin of a cool-water, Oligo-Miocene deep shelf limestone, Eucla Platform, southern Australia. *Sedimentology*, 38(2):323–341.

Jiang W, McAlpine SRB, Duan J, Kemp T, Pawley MJ and Dutch R in prep. *Cover thickness estimates in the Coompana Province, South Australia: Benchmarking and results from the pre-drilling geophysics program - Magnetotellurics*. Geoscience Australia, Canberra.

Kirkland C, Smithies R, Spaggiari C, Wingate M, de Gromard RQ, Clark C, Gardiner N and Belousova E 2017. Proterozoic crustal evolution of the Eucla basement, Australia: Implications for destruction of oceanic crust during emergence of Nuna. *Lithos*, 278:427–444.

Myers JS, Shaw RD and Tyler IM 1996. Tectonic evolution of Proterozoic Australia. *Tectonics*, 15(6):1431–1446.

Neumann NL and Korsch RJ 2014. *SHRIMP U–Pb zircon ages from Kutjara 1 and Mulyawara 1, northwestern South Australia*, Record 2014/05. Geoscience Australia, Canberra.

Outback Oil Company NL 1969. Mallabie 1 Well Completion Report, Open File Envelope No. 1172. Department of Primary Industries and Resources South Australia, Adelaide.

Spaggiari C and Smithies R 2015. *Eucla Basement Stratigraphic Drilling Results Release Workshop: Extended Abstracts*, Record 2015/10. Geological Survey of Western Australia.

The Shell Co. of Australia Ltd 1983. EL 747, EL 748 and EL 749 Bunabie Rockhole, Hughes and Nullarbor Plain progress reports andfinal report for the period 20/10/80 to 19/10/82, Open File Envelope No. 4046. Department of Primary Industries and Resources South Australia, Adelaide.

Thiel S, Dentith MC, Wise TW, Jingming D, Jessica S, Spaggiari CV, Pawley M, Dutch R and Gessner K 2016. Linking Western and South Australia – insights from magnetotelluric profiling. In *Australian Earth Sciences Convention*, Geological Society of Australia Abstract No. 118, Adelaide.

Travers D 2015. *Geochronology and Petrogenesis of Mafic Magmatism in the Coompana Province*, University of Adelaide, Adelaide.

Wade BP, Payne JL, Hand M and Barovich KM 2007. Petrogenesis of ca 1.50 Ga granitic gneiss of the Coompana Block: filling the 'magmatic gap' of Mesoproterozoic Australia. *Australian Journal of Earth Sciences*, 54(8):1089–1102.

Wingate MTD, Kirkland CL, Spaggiari CV, Smithies HR and England RN 2015. U-Pb geochronology of the Forrest Zone of the Coompana Province. In C Spaggiari and R Smithies eds, *Eucla basement stratigraphic drilling results release workshop: extended abstracts*, Record 2015/10. Geological Survey of Western Australia, pp. 37–40.

Wise TW, Pawley MJ and Dutch RA 2015. Preliminary interpretations from the 2015 Coompana aeromagnetic survey. *MESA Journal*, 79(4):22–30.