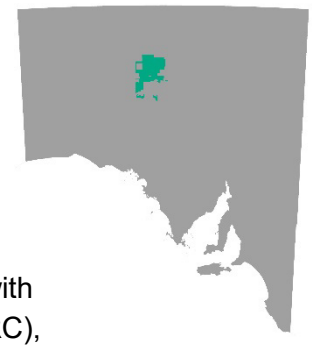

Northern Gawler release areas

Introduction

The Geological Survey of South Australia (GSSA), in collaboration with the Cooperative Research Centre for Mineral Exploration (MinEx CRC), have an ongoing National Drilling Initiative (NDI) project in the northern Gawler region of South Australia. The GSSA is providing the exploration industry with new data and new constraints on the geological framework and mineral prospectivity of the Gawler Craton basement rocks beneath the regolith cover, Jurassic-Cretaceous Eromanga Basin and Permian-Carboniferous Arckaringa Basin. Field data for Northern Gawler drilling can be accessed and interacted with on the South Australian Drilling Atlas.

The focus of the Northern Gawler NDI project is to characterise different basement rocks and metamorphic history, in addition to refining and characterising basin cover. These data will be used to provide critical context to the newly launched 1st Edition SA Geology.

The Northern Gawler project area is situated in the Gawler Craton (Figure 1), occupying approximately 14,545 km^2, predominantly on pastoral land over the Billa Kalina, Coober Pedy, Murloocoppie and Warrina 250k map sheets.

Previous exploration in the Northern Gawler region has targeted a diverse suite of commodities including opal, coal, celestite, copper, gold, and heavy mineral sands, with increasing interest in base and precious metals in recent years. Most of the legacy drilling the Northern Gawler comprises shallow aircore and auger programs targeting gold, copper and base metals. Of the 67 basement intersecting drillholes within the Northern Gawler project area, only 38 have diamond core with 8,064.33 m stored at the South Australia Drill Core Library. Basement rock intersected in legacy drillholes include Archean to Paleoproterozoic metasedimentary and metaigneous rocks, and Mesoproterozoic igneous rocks, that have experienced multiple metamorphic events during the Paleoproterozoic and Mesoproterozoic (Table 1).

In late 2023, a Section 15 gazettal was placed over the northern Gawler Craton region in South Australia. The initial phase of this project consisted of regional geochronology and mapping studies using legacy drillholes, to integrate into the South Australian Discovery Mapping (SADM) project, released as the 1st Edition SA Geology. Drilling for the Northern Gawler NDI commenced in October 2024, with 6 sites drilled by the MinEx CRC developed Coiled-Tubing (CT) Rig, operated by DIG CT Pty Ltd. The drilling revealed deformed plutonic and metasedimentary rocks (Table 2) with evidence of polymetamorphism and controls on thickness and location of Permian and Cenozoic sedimentary basins in the Nawa Domain and Mabel Creek Ridge (Figure 2). There are 16 ERA blocks being released as a result of relinquishment of the Section 15 gazettal (Table 1; Figures 3, 4 and 5).

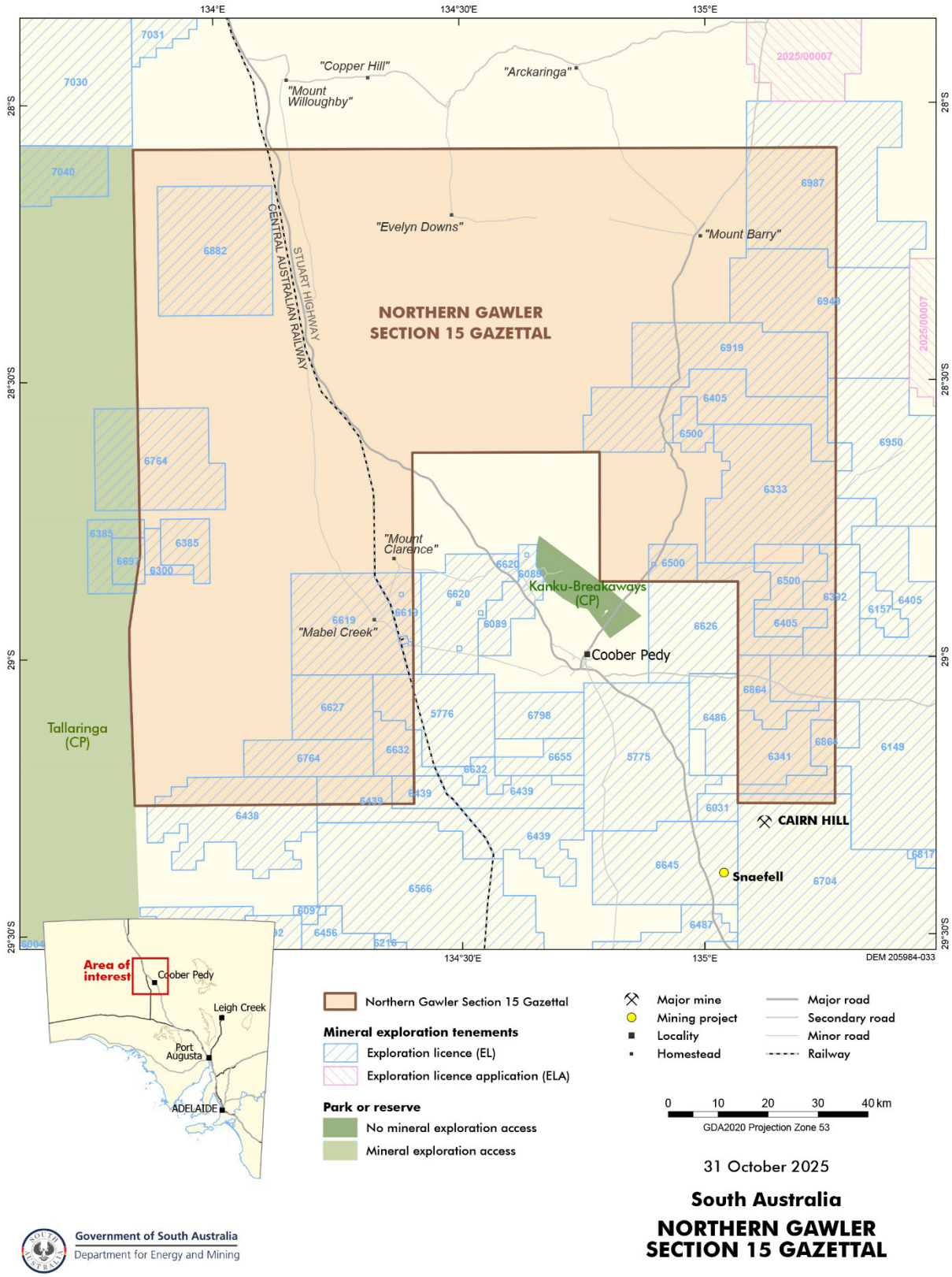

Figure 1. Location of the Northern Gawler Section 15 Gazettal in relation to mineral exploration tenements and parks or reserves.

Table 1. Summary of ERAs from the Section 15 Northern Gawler National Drilling Initiative, including depth to basement estimates, basement intersecting drillholes and geological constraints (actual and interpreted).

ERA block number	Area (km^2)	Depth to Basement (m)	Basement intersecting drillhole		Known/interpreted geological constraints	
			Name	Number	Basement lithology	Interpreted geology
ERA 002003	803	500–1150	MOUNT FURNER 1	5145	Metasedimentary gneiss; quartz, feldspar, biotite ± garnet, sillimanite; amphibolite facies, locally migmatitic; detrital population ca. 1740 Ma, metamorphism at ca. 1730 Ma.	*Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and schists: low magnetic signature; moderate magnetic signature and low gravity signature; high magnetic signature and high gravity signature; well layered, high magnetic signature, high gravity signature.
ERA 002004	746	100–300	96MABEP 8 CR92 3 CR93 3 CR94 1	177195 151359 188827 190070	Granofels, garnetiferous, quartz-K felspar-biotite (magnetite) gneiss, with common magnetite & quartz-magnetite-BIF bands to 6 m thick; minor schist & quartzite; highly weathered.	*Mount Woods Complex (Skylark Metasediments)* Metasediments, psammitic, pelitic, quartzofeldspathic, calcsilicate, magnetite-enriched. Amphibolite to granulite facies metamorphism. Detrital ages include ca. 1750 Ma and ca. 1850 Ma. Metamorphism interpreted ca. 1590 Ma. *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses, migmatites and schists; interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma.
ERA 002005	1056	300–750	NDING_05	393050	Magnetite-bearing quartz-K-feldspar-biotite ultra-mylonite; detrital population ca. 2510 Ma. Highly magnetic, porphyroclastic quartz-K-feldspar-biotite mylonite; magmatic age ca. 1750 Ma.	*Mulgathing Complex* Felsic orthogneiss (granitic; migmatitic); interlayered bands of plagioclase + quartz-rich leucosomes (of tonalitic composition) and biotite + hornblende-rich melanosomes. *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and schists: low magnetic signature; well layered, high magnetic signature, high gravity signature.
ERA 002006	828	300–1000	–	–		*Mulgathing Complex* Felsic orthogneiss (granitic; migmatitic). *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and migmatites; interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma. *Hiltaba Suite* Mafic to felsic plugs.

ERA block number	Area (km^2)	Depth to Basement (m)	Basement intersecting drillhole		Known/interpreted geological constraints	
			Name	Number	Basement lithology	Interpreted geology
ERA 002007	985	200–300	–	–		*Mulgathing Complex* Granite or granitic gneiss *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and migmatites interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma.
ERA 002008	691	50–200	–	–		*Tidnamurkana Volcanics* Basalt, metamorphosed amygdaloidal; porphyritic rhyolite; minor epidosite, phyllite and tremolitic marble. U-Pb ages 1789–1774 Ma. *Peake Metamorphics* Paragneiss, quartzitic, pelitic and calcsilicate; basalt, amygdaloidal; rhyolite, porphyritic; diorite; pegmatite. 1789–1733 Ma. *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses, migmatites and schists; interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma. *Peter Pan Supersuite* Amphibolite; locally deformed and metamorphosed. *Hiltaba Suite* Granite, syenite, quartz monzonite, granodiorite, monzodiorite: coarse, megacrystic to equigranular, to fine-grained, granophyric, equigranular or porphyritic. Undeformed to locally strongly deformed. Minor mafic to ultramafic intrusive rocks.
ERA 002009	990		GOMA DH4 NDING_04	252739 393049	Fine-grained feldspar-biotite granite; medium grained, equigranular k feldspar-quartz-plagioclase-biotite granite. Weak to no foliation, red hematite staining; medium to coarse grained foliated quartz-feldspar-biotite orthogneiss or granite. K feldspar-quartz dominant, hematite-sericite altered granite; paragneiss; detrital	*Mulgathing Complex* Felsic orthogneiss (granitic; migmatitic); interlayered bands of plagioclase + quartz-rich leucosomes (of tonalitic composition) and biotite + hornblende-rich melanosomes. *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses, schists and migmatites; weakly magnetic; low magnetic signature; well layered, high magnetic signature, high gravity signature; interleaved iron-rich and iron-poor layers and lenses;

ERA block number	Area (km^2)	Depth to Basement (m)	Basement intersecting drillhole		Known/interpreted geological constraints	
			Name	Number	Basement lithology	Interpreted geology
					population at c. 2530 Ma; metamorphism at c. 1520 Ma. Migmatitic Garnet-Magnetite-bearing Quartz-K-feldspar-Biotite gneiss; magmatic age c. 1730 Ma.	detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma. *Karkaro Granite* Granite, biotite-bearing, equigranular to alkali feldspar porphyritic, unmetamorphosed. Magmatic age ca. 1450 Ma.
ERA 002010	782	150–300	NDING_01 NDING_02 AD 1 G3 DDH 1 NC9405	393046 393047 202016 188825 185595	Biotite-K-feldspar-Quartz-Magnetite gneiss; magmatic age ca. 1720 Ma; metamorphism at ca. 1580 Ma. Migmatitic Garnet-Magnetite-bearing Quartz-K-feldspar-Amphibole-Biotite gneiss; magmatic age ca. 1720 Ma; metamorphism at ca. 1575 Ma. Plagioclase rich igneous rocks, biotite amphibolite and biotite-plagioclase-quartz schist. Minor chalcopyrite in narrow zones; metamorphism at ca.1730 Ma, 1590 Ma and 1560 Ma. Quartz-biotite-feldspar-amphibole gneiss.	*Undifferentiated Early Paleoproterozoic* Schist, quartz-feldspar-mica; argillite; rhyolite, porphyritic, fine grained; limestone; siltstone; felsic volcanics; sandstone, medium to coarse grained, poorly sorted; amphibolite; dolerite; basalt. 1772–1735 Ma. Metasedimentary gneisses, migmatites and schists; interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma. Meta-mafic lithic clastic rock; comprising metamorphic clinopyroxene, plagioclase, magnetite, with retrograde clinozoisite, chlorite, epidote, sericite. *Hiltaba Suite* Granite, syenite, quartz monzonite, granodiorite, monzodiorite: coarse, megacrystic to equigranular, to fine-grained, granophyric, equigranular or porphyritic. Undeformed to locally strongly deformed. Minor mafic to ultramafic intrusive rocks.
ERA 002011	589	200–250	08RDMC01 AM/PB3 96MABEP 6 96MABEP 7	241761 140743 177193 177194	Undeformed, alkali granite. Foliated leucogneiss; detrital population ca. 1705 Ma; metamorphism at ca. 1640 Ma.	*Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and migmatites; interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma.
ERA 002012	969	200–350	08RDMC03 08RDMC04	241762 241763	Mafic to intermediate paragneiss and pelite; ca. detrital population 1745 Ma, metamorphism at ca. 1700 Ma and ca. 1630 Ma.	*Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and migmatites; weakly magnetic; interleaved iron-rich and iron-poor layers and lenses; detrital population ca. 1740 Ma, metamorphosed ca. 1720 Ma and ca. 1580–1560 Ma. *Hiltaba Suite* Granite, syenite, quartz monzonite, granodiorite, monzodiorite: coarse, megacrystic to equigranular, to fine-grained, granophyric, equigranular or

ERA block number	Area (km^2)	Depth to Basement (m)	Basement intersecting drillhole		Known/interpreted geological constraints	
			Name	Number	Basement lithology	Interpreted geology
						porphyritic. Undeformed to locally strongly deformed. Minor mafic to ultramafic intrusive rocks.
ERA 002013	374	100–1000	PD87LW 5 PD87LW 6 WALLIRA 1	132036 132037 5055	Weathered quartz-feldspar-biotite gneiss with minor talc.	*Mulgathing Complex (Christie Gneiss)* Gneiss with migmatitic layers, paragneiss, carbonate, calcsilicate, quartzite. Age (U-Pb) 2437±11 Ma. With banded iron formation. *Mount Woods Complex (Skylark Metasediments)* Metasediments, psammitic, pelitic, quartzofeldspathic, calcsilicate, magnetite-enriched. Amphibolite to granulite facies metamorphism. Detrital ages include ca.1750 Ma and ca.1850 Ma. Metamorphism interpreted ca.1590 Ma. *Hiltaba Suite* Granite, syenite, quartz monzonite, granodiorite, monzodiorite: coarse, megacrystic to equigranular, to fine-grained, granophyric, equigranular or porphyritic. Undeformed to locally strongly deformed. Minor mafic to ultramafic intrusive rocks.
ERA 002014	226	100–500	–	–		*Mulgathing Complex (Christie Gneiss)* Gneiss with migmatitic layers, paragneiss, carbonate, calcsilicate, quartzite. Age (U-Pb) 2437±11 Ma. With banded iron formation. *Mount Woods Complex (Skylark Metasediments)* Metasediments, psammitic, pelitic, quartzofeldspathic, calcsilicate, magnetite-enriched. Amphibolite to granulite facies metamorphism. Detrital ages include ca. 1750 Ma and ca. 1850 Ma. Metamorphism (amphibolite to granulite facies) interpreted ca. 1590 Ma. *Hiltaba Suite* Granite, syenite, quartz monzonite, granodiorite, monzodiorite: coarse, megacrystic to equigranular, to fine-grained, granophyric, equigranular or porphyritic. Undeformed to locally strongly deformed. Minor mafic to ultramafic intrusive rocks. Mafic to felsic plugs.
ERA 002015	772	850–2950	–	–		*Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and schists: low magnetic signature; moderate magnetic signature and low gravity signature; high magnetic signature and high gravity signature; Metasedimentary gneiss; quartz, feldspar, biotite ± garnet; metamorphism at ca. 1720 Ma.

ERA block number	Area (km^2)	Depth to Basement (m)	Basement intersecting drillhole		Known/interpreted geological constraints	
			Name	Number	Basement lithology	Interpreted geology
ERA 002016	617	650–1300	–	–		*Mulgathing Complex* Granite or granitic gneiss *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and schists; low magnetic signature, low gravity signature *Hiltaba Suite* Mafic to felsic plugs.
ERA 002017	845	600–1650	–	–		*Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and schists: low magnetic signature, low gravity signature; moderate magnetic signature and low gravity signature; high magnetic signature and high gravity well layered, high magnetic signature, high gravity signature. Metasedimentary gneiss; quartz, feldspar, biotite ± garnet, sillimanite; amphibolite facies, locally migmatitic; detrital population ca. 1740 Ma, metamorphism at ca. 1730 Ma.
ERA 002018	918	250–700	NDING_06	393051	Migmatitic Quartz-K-feldspar-Biotite gneiss, with pervasive secondary chlorite, hematite, and sulphides; magmatic age ca. 1730 Ma.	*Mulgathing Complex* Felsic orthogneiss (granitic; migmatitic); interlayered bands of plagioclase + quartz-rich leucosomes (of tonalitic composition) and biotite-hornblende-rich melanosomes; Granite or granitic gneiss. *Undifferentiated Early Paleoproterozoic* Metasedimentary gneisses and schists; well layered, high magnetic signature, high gravity signature; Metasedimentary gneiss; quartz, feldspar, biotite ± garnet, sillimanite; amphibolite facies, locally migmatitic; detrital population ca. 1740 Ma, metamorphism at ca. 1730 Ma.

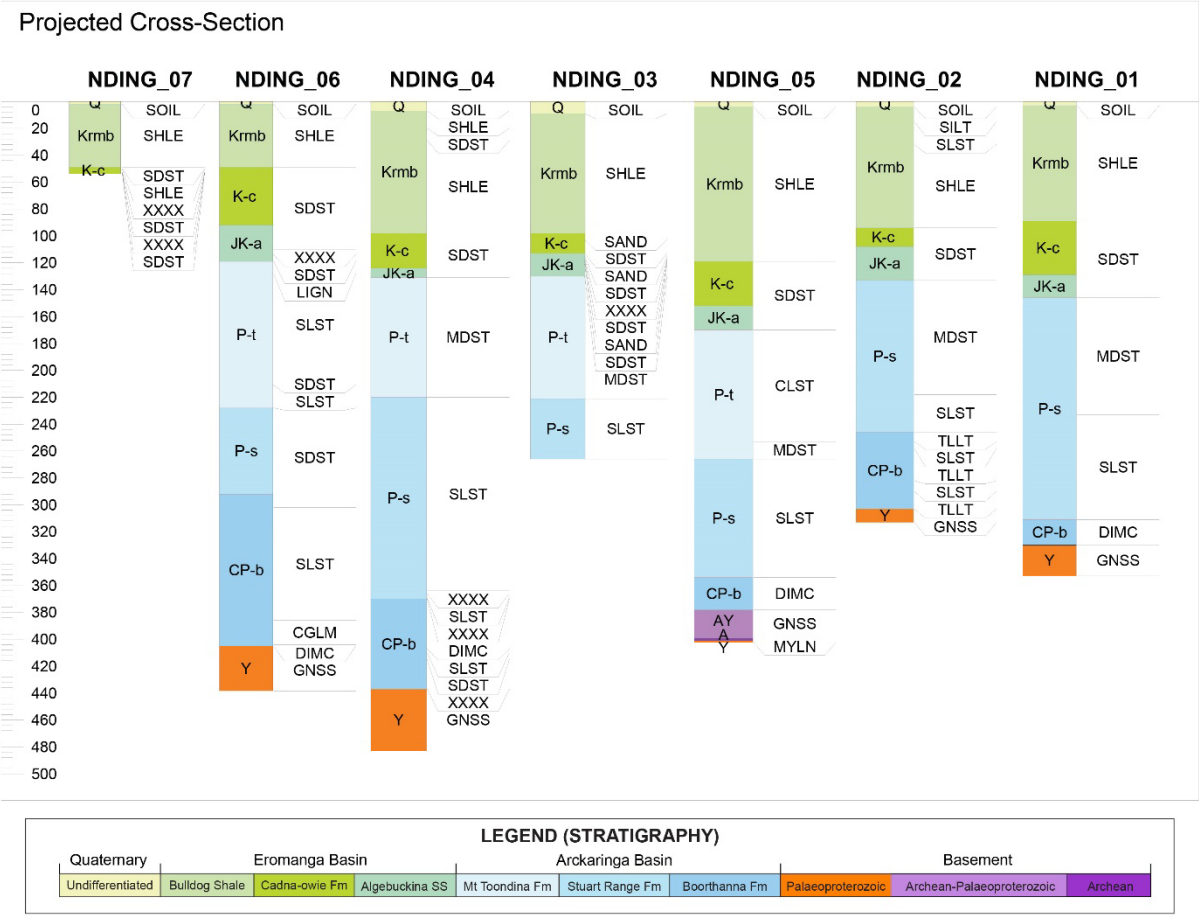

Figure 2. Projected N-S oriented cross section through the Northern Gawler NDI drillholes, displaying depth of cover sequences and stratigraphy.

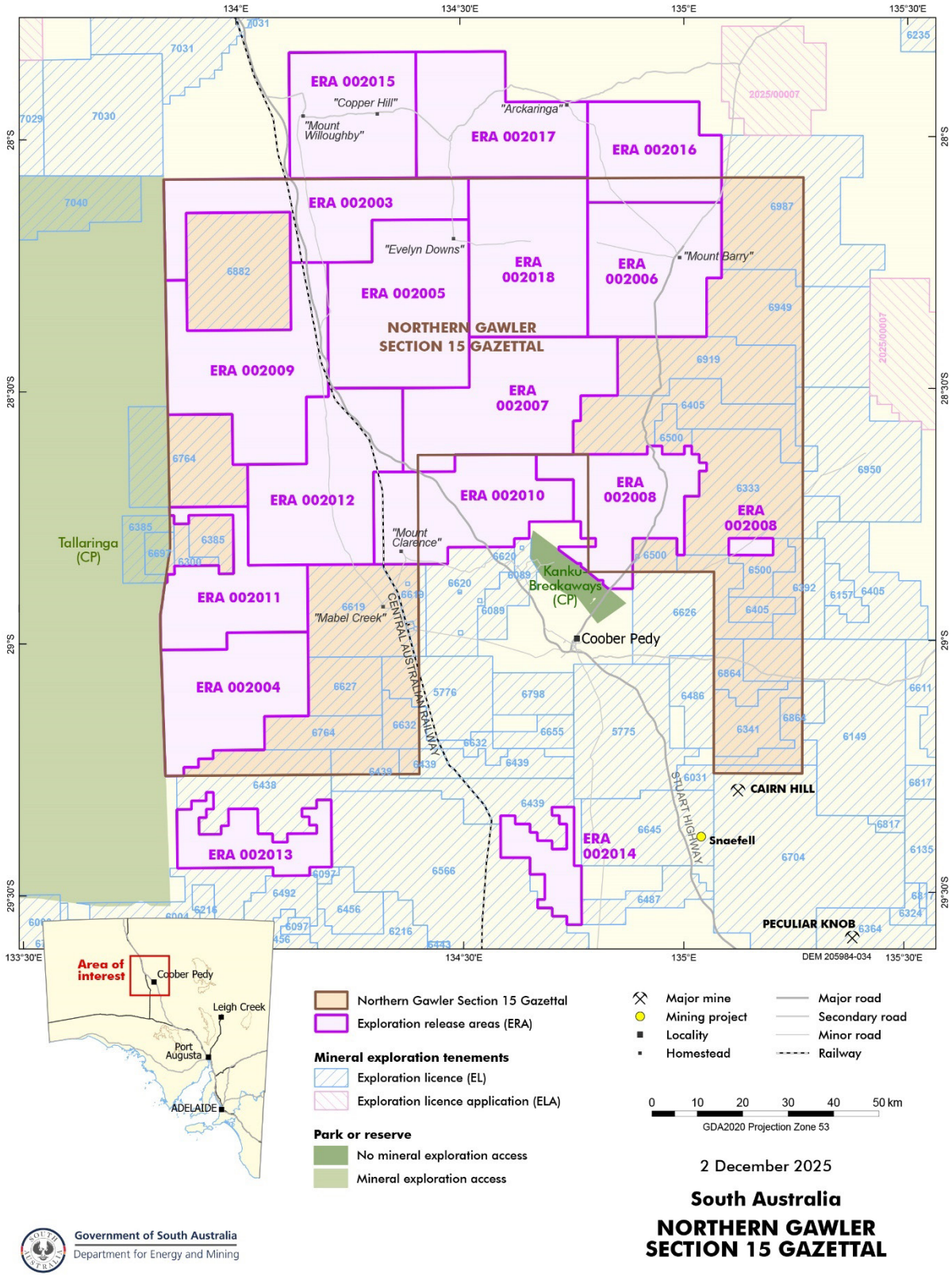

Figure 3. Proposed Exploration Release Areas (ERAs) into sixteen blocks, as part of the relinquishment of the Northern Gawler Section 15 Gazettal.

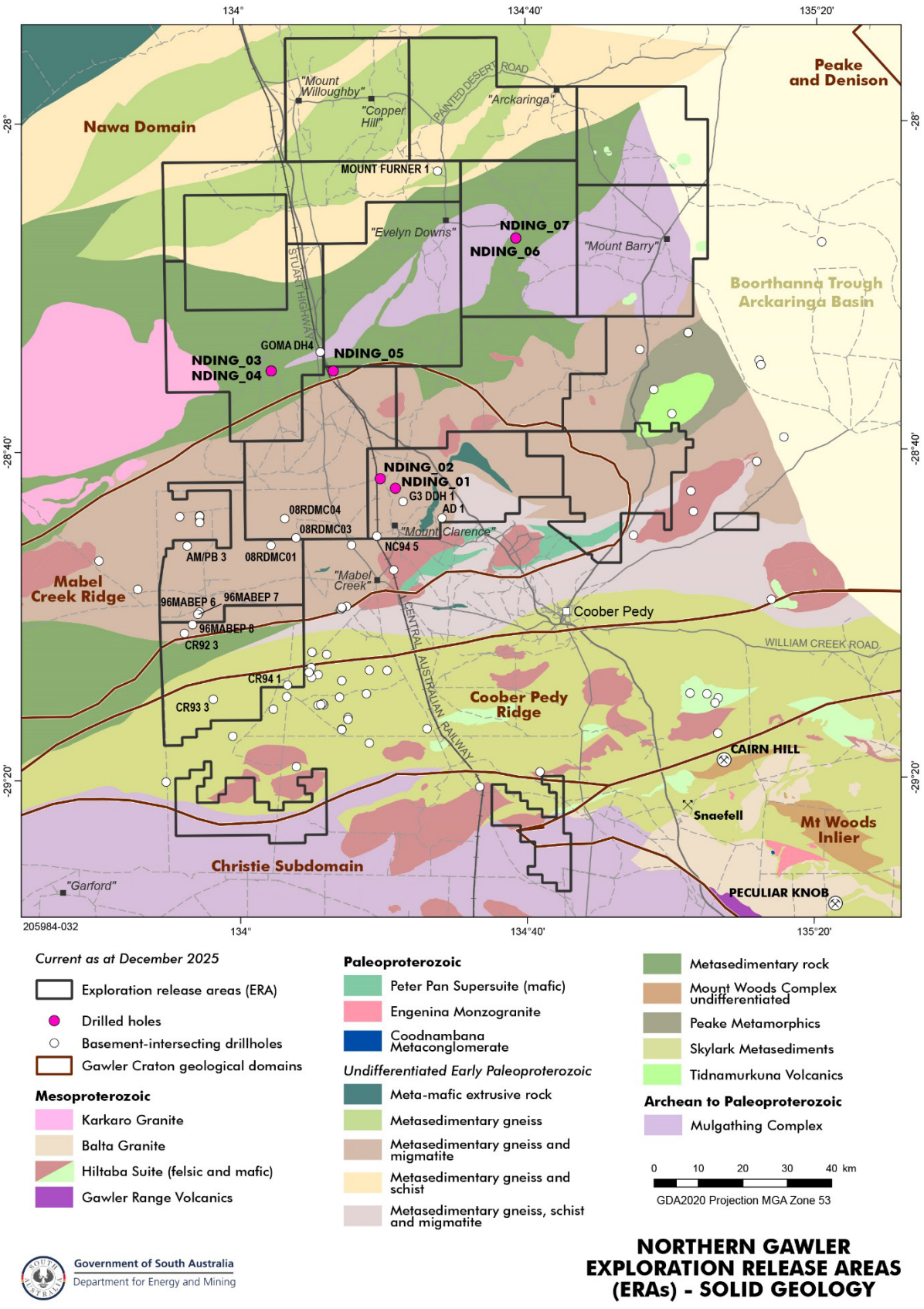

Figure 4. Interpreted solid geology based on 1st Edition SA Geology mapping for the Northern Gawler Craton area, shown with outlines of the proposed sixteen ERAs.

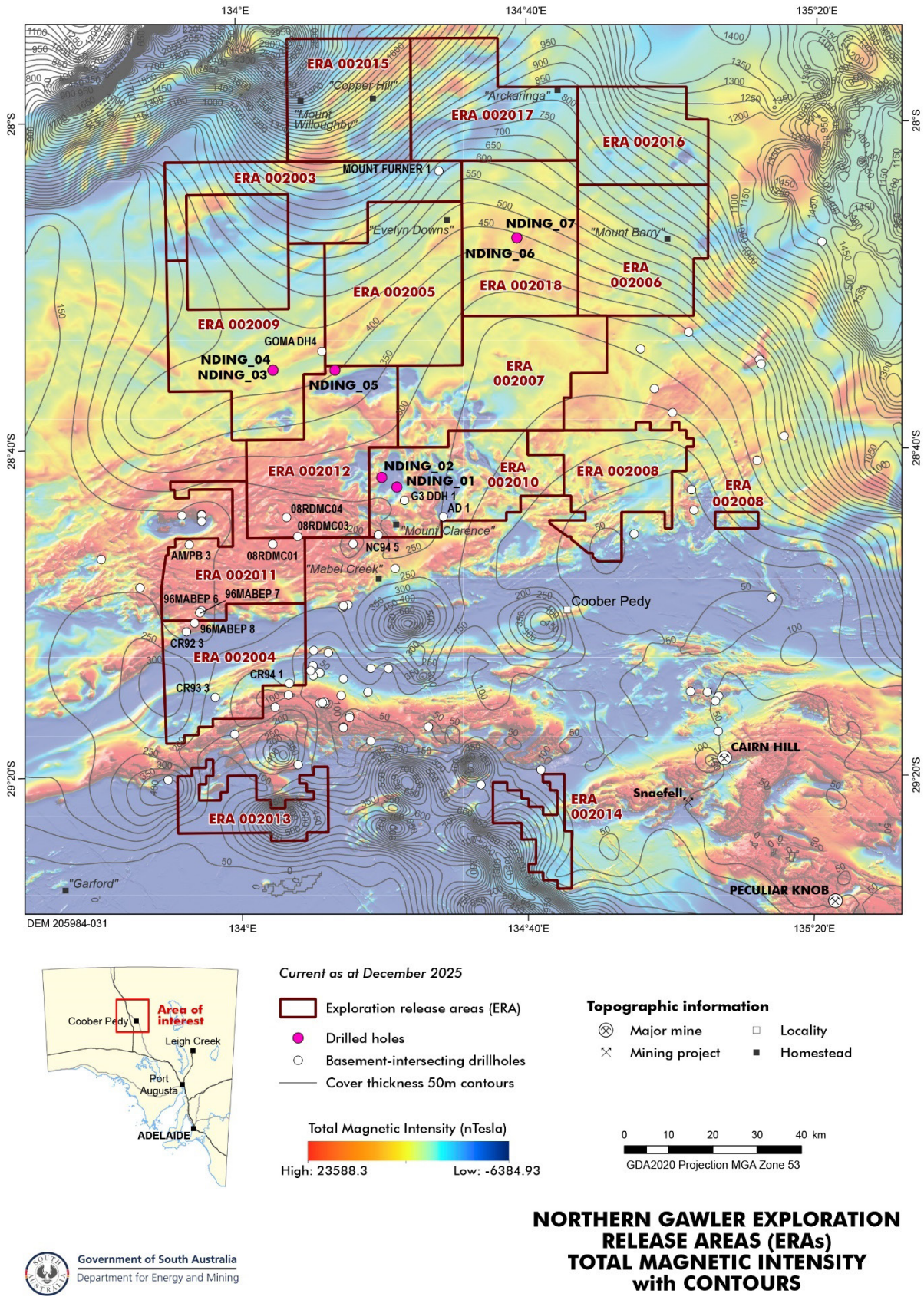

Figure 5. Total Magnetic Intensity image for the Northern Gawler Section 15 Gazettal, with depth to basement at 50 m contours, shown with outlines of the proposed sixteen ERAs.

Mineral prospectivity

Potential exists for multiple deposit styles across the 16 exploration release areas (ERAs), shown in Figure 3, in the Northern Gawler region. Cover sequences of the Eromanga and Arckaringa basins are known hosts to commodities such as coal, and opal, with confirmed occurrences in the Evelyn Downs and Mabel Creek Ridge areas. The region has also seen limited but targeted exploration for heavy mineral sands, particularly in paleochannel settings and silcrete horizons. Despite historical interest, the Northern Gawler region remains underexplored for base and precious metals. The integration of new geochronological, lithological, and structural data from the NDI program and the newly launched 1st Edition South Australian Geology via SARIG is expected to enhance targeting strategies across the ERAs.

The focus of recent NDI drilling was to characterise the basement geology and cover sequences of the region to investigate the potential for base and precious metal deposits hosted in the basement, and U-(REE) hosted in the Permian and Jurassic-Cretaceous sedimentary sequences. Basement lithologies intersected in NDI drillholes (see Table 2) include polymetamorphosed gneisses and mylonites with magmatic crystallisation ages ranging from ~1720 Ma to ~1750 Ma, and metamorphic overprints as young as ~1480 Ma. More regionally, evidence for Paleoproterozoic basin development with a long thermal history of amphibolite-granulite facies metamorphism suggests the potential for Broken Hill Type (BHT) base metal systems in the Northern Gawler Craton. Specifically, in BHT systems the transition from quartzofeldspathic-dominant lower stratigraphy to psammopelitic and pelitic sequences in upper stratigraphy is a control on mineralisation. The Mabel Creek Ridge in the northern Gawler Craton represents a transition from clastic-dominated quartzofeldspathic facies to Fe-rich pelitic facies to the south. Coupled with this, ironstone-associated Cu-Au deposits tend to occur in BHT districts. Fe-Cu-Au mineralisation present in the Mt Woods Domain to the southeast also opens the possibility of` potential Fe-Cu-Au systems in the region. Further to this, the potential for Cairn Hill-style mineralisation is also supported by high-temperature deformation and metamorphism along major shear zones at ca. 1490 Ma, allowing for introduction of Cu along large structures during younger thermal activity.

Permian sedimentary rocks intersected in the NDI drillholes include siltstone, mudstone, sandstone and diamicite, forming part of the lower Arckaringa Basin. Sandstone and conglomeritic sandstone within the Arckaringa Basin are prospective for sandstone-hosted uranium. Jurassic to Cretaceous sedimentary rocks intersected in the NDI drillholes include sandstone and shale of the lower to mid Eromanga Basin. While the upper Eromanga Basin has significant potential for sandstone-hosted and paleochannel related uranium deposits, the Algebuckina Sandstone is a potential host for sandstone-hosted uranium mineralisation and heavy minerals (emerging Titanium target). The base of the Algebuckina Sandstone is also known for (locally occurring) placer gold deposits.

Table 2. Summary of NDI drilling in the Northern Gawler project area.

Drillhole	**Cover thickness** (m)	**Basement lithologies**	**Age** (Ma)
NDING_01	330	Gneiss: Biotite, K-feldspar, Quartz, Magnetite, gneissic, medium- to coarse-grained, greyish blue, unweathered Mabel Creek Ridge	1720.2 ± 5.3 Ma (magmatic crystallisation) 1578.8 ± 3.1 Ma (metamorphic)
NDING_02	303	Gneiss: Quartz, Feldspar, Biotite, Magnetite, migmatitic, fine- to medium-grained, dark grey, unweathered Mabel Creek Ridge	1723.6 ± 4.2 Ma (magmatic crystallisation) 1723 ± 20, 1586.6 ± 8.7 Ma, 1576.6 ± 3.8 Ma (metamorphic)
NDING_03	N/A (drillhole abandoned in cover at 266 m)		
NDING_04	437	Gneiss: Biotite, K-feldspar, Quartz, Magnetite, gneissic, medium- to coarse-grained, greyish orange pink, unweathered Nawa Domain (southwest)	1730.8 ± 5.5 Ma (magmatic) c. 1580 Ma (resetting?)
NDING_05	378	399–401 m: Mylonite: Biotite, Quartz, Feldspar, Magnetite, porphyroclastic, fine-grained, dark grey, unweathered 401–402.5 m: Mylonite: Quartz, K-feldspar, Biotite, Magnetite, porphyroclastic, fine-grained, greyish orange pink, unweathered Nawa Domain (southwest)	c. 2510 Ma (maximum depositional) 1751.4 ± 3.6 Ma (magmatic crystallisation) c. 1480 Ma (metamorphic)
NDING_06	438	Gneiss: Biotite, Feldspar, Quartz, gneissic, medium- to coarse-grained, pale reddish brown, moderately weathered Nawa Domain (southeast)	1730.1 0± 4.4 Ma (magmatic crystallisation)
NDING_07	N/A (drillhole ended in core at 53.70 m)		

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More information

- Department for Energy and Mining
- MinEx CRC
- South Australian Resources Information Gateway (SARIG)