MANGANESE

Critical mineral potential of South Australia

Peter Keller, Carmen Krapf,
Adrian Fabris and Alicia Caruso

SOUTH AUSTRALIA

Government of South Australia
Department for Energy and Mining

Department for Energy and Mining
Level 4, 11 Waymouth Street, Adelaide
GPO Box 320, Adelaide SA 5001
Phone +61 8 8463 3000
Email dem.minerals@sa.gov.au
dem.petroleum@sa.gov.au
www.energymining.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

Acknowledgement of Country
As guests on Aboriginal land, the Department for Energy and Mining (DEM) acknowledges everything this department does impacts on Aboriginal country, the sea, the sky, its people, and the spiritual and cultural connections which have existed since the first sunrise. Our responsibility is to share our collective knowledge, recognise a difficult history, respect the relationships made over time, and create a stronger future. We are ready to walk, learn and work together.

Preferred way to cite this publication
Keller P, Krapf C, Fabris A and Caruso A 2024. *Manganese. Critical Mineral potential of South Australia*, Report Book 2024/00004. Department for Energy and Mining, South Australia, Adelaide.

Manganese

Critical Mineral potential of South Australia

Peter Keller, Carmen Krapf, Adrian Fabris and Alicia Caruso

Geological Survey of South Australia, Department for Energy and Mining

April 2024

Report Book 2024/00004

CONTENTS

TABLES

FIGURES

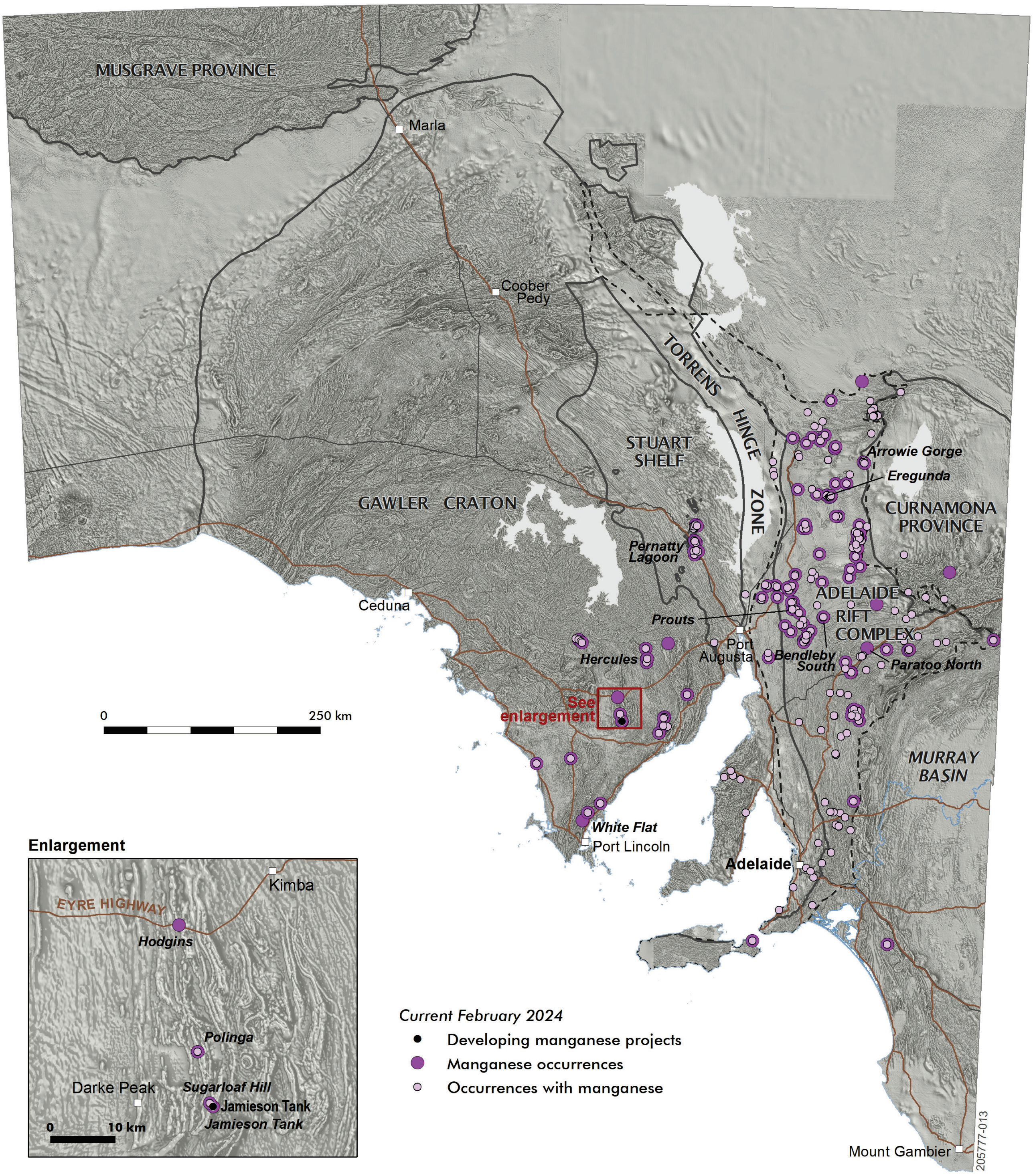

Figure 1. Occurrences of manganese and occurrences with associated manganese in South Australia. (205777-013 PDF 6.2 MB)

Manganese

Peter Keller, Carmen Krapf, Adrian Fabris and Alicia Caruso

Manganese (Mn) constitutes about 0.1% of the earth's crust making it the 12th most abundant element (Cannon 2014). Global manganese resources stand at around 1.7 Gt with total world production at 20 Mt (Schnebele 2023). South Africa contains 70% of the world's Manganese resources and supplies 30% of current world demand (Schnebele 2023). Australia holds significant reserves estimated to be about 90 Mt with the total Australian production in 2022 being 4.8 Mt of manganese ore (Department of Industry 2022). with most of it supplied from Groote Eylandt, Northern Territory (NT) and Woodie Woodie, Western Australia (WA) (Summerfield, 2021). Over 300 minerals contain manganese, but the main ore minerals mined are; cryptomelane, hausmanite, manganite, *psilomelane*, pyrolusite, rhodochrosite, romanechite and todorokite.

USES

Manganese is predominantly used in the production of steel and alloys. After steel, the second largest demand is in production of electrolytic manganese dioxide and manganese metal, which are used in the production of rechargeable electric vehicle (EV) batteries. Manganese exploration has increased as the demand for EVs and battery storage technology continues to grow (Summerfield 2021). Manganese is also used extensively as a fertiliser additive, for animal feed, welding rods, water treatment chemicals, industrial chemicals such as a colourant for car undercoat paints, textiles, bricks, frits, glass and tiles. The product 'manganese violet' is used for coloration in cosmetics, glazes used by artists, plastics and powder coating (Cannon et al. 2017).

ECONOMIC DEPOSIT TYPES

The principal deposit types for manganese are:

- Sedimentary/stratiform
- Supergene
- Hydrothermal.

SEDIMENTARY/STRATIFORM

When manganese enriched seawater becomes oxic, manganese carbonate or oxide can precipitate on the sea floor, depending on local conditions. Extensive manganese deposits formed from such enriched sediments have been accumulating in the Earth's sedimentary basins from 2.5 Ga ago. These deposits can also have an exogenic and/or endogenic sediment source such as black smokers (Kuleshov 2011). The level of oxygen in the ocean, often dictates whether iron is precipitated with manganese or not. The Kalahari manganese deposits in South Africa are enriched in iron while those on Groote Eylandt, Australia, are iron depleted (Cannon et al. 2017). In these relatively euxinic conditions, low-iron deposits are thought to have formed in shallow water on continental shelves with stratified oceans in which deeper waters are suboxic to anoxic, but not sulfidic. This type of ocean water is the reservoir or source from which manganese deposits can be formed and manganese-rich sediments can be precipitated. Consequently, manganese beds are often interlayered with other sediments typical of those settings. A modern equivalent of such an environment is the Black Sea (Cannon et al. 2017). Manganiferous sedimentary deposits with iron-rich strata are commonly seen in Precambrian banded iron formation (BIF) sequences around the world. These include the manganese deposits of the Kalahari district in South Africa, and the Urucum mining district in Brazil. The hallmark of such deposits is the presence of iron - manganese-rich layers, where the ocean was enriched with both iron and manganese but differentiated from each other in periods where subtle changes in the oxidation state or acidity of the ocean water occurred and were then deposited through coastal upwelling onto the continental margin. In some cases, secondary enrichment by hydrothermal processes has increased manganese grades as evidenced in the Kalahari deposits (Cannon et al. 2017).

SUPERGENE ENRICHMENT

Many manganese deposits have ores that have undergone secondary or supergene enrichment through intense chemical weathering of manganese-rich rocks or regolith at the surface. Soluble ions such as iron, aluminium and manganese with humic acids released by the decomposition of organic matter often result in the deposition of an aluminium and iron-rich laterite in the upper weathered zone (Pracejus et al. 1988). When the weathered profile attains sufficient thickness, the upper zone is depleted of manganese, where it can precipitate in the lower zone of the weathered profile. Examples of these deposit types include: Moanda in Gabon, Central Africa, Molango in Mexico, Minas Gerais district in Brazil (Roy 1997) and Groote Eylandt, Australia (Pracejus et al. 1988).

These types of deposits are frequently seen in tropical regions where the combination of intense rainfall, vegetation and topography allow the oxidation and precipitation of manganese oxides such as pyrolusite, cryptomelane, romanechite, *psilomelane*, hausmannite and manganite (Cannon et al. 2017). Supergene manganese deposits can be divided into four sub categories (Kuleshov 2011).

- **Residual deposits:** rich cappings of manganese oxides/hydoxides often overlying sedimentary deposits resulting from leaching of surface manganese carbonates (Roy 1997).
- **Pisolite/oolite deposits:** formed in shallow marine environments where tidal agitation can accumulate layers of chemically precipitated minerals around a nucleoid from the supersaturated water. These may cement together in a matrix of clays and earthy oxides (Frakes and Bolton 1984).
- **Infiltrational deposits:** concentration of minerals formed by the dissolution of manganese compounds that are free to migrate with meteoric waters some distance from their source (Brown et al. 2022).
- **Karst deposits:** associated with the leaching and redeposition by surface meteoric waters creating spaces within carbonate-rich rocks where manganese can accumulate (Varentsov 2013).

HYDROTHERMAL

Hydrothermal concentrations of manganese, although widespread, usually occur as small or medium-sized deposits (Kuleshov 2011). These deposits are often stratabound, but may also occur as irregular bodies and epithermal veins in a large variety of host rocks (Roy 1997).

Hydrothermal manganese deposits often display similar characteristics to hydrothermal vent systems, such as volcanic-hosted massive sulphides and occur in mid-ocean ridge and subduction zone settings, including back-arc basins, small inter-arc basins, fore-arc terraces and basins and trenches adjacent to continental plate margins. The deposits are mostly hosted in sedimentary rocks (radiolarian chert, volcaniclastic rocks and hemipelagic rocks) overlying island-arc type basalts, andesite, dacite, and rhyolite (Roy 1997). In these areas, shallow magmatism most likely drives convection of seawater through the crust. Manganese is subsequently scavenged from source rocks and transported in solution by hot, reduced, modified seawater. Fluids released at vent sites interact with surrounding cooler seawater and trigger the precipitation of Mn oxides and precious metals (Brown et al. 2022).

Vein-type hydrothermal deposits are hosted mainly in volcanic rocks of wide-ranging compositions as well as in a variety of sedimentary rocks of different ages. Deposits rich in manganese minerals derived from terrestrial hot springs are common but rarely economic. The veins show diverse manganese mineralogy (Roy 1997).

Low-temperature veins consist of pyrolusite, cryptomelane, psilomelane, hollandite and todorokite, whereas those from higher temperature solutions, produce braunite, bixbyite, hausmannite, huebnerite, rhodonite, bustamite, tephroite, rhodochrosite and alabandite. Barite, fluorite, calcite and quartz are characteristic accessory minerals (Roy 1997).

OCCURRENCES IN SOUTH AUSTRALIA

While there are 181 references to manganese occurrences throughout South Australia, however only a few have been economically exploited for manganese. These occurrences are distributed across the state (Figure 1), but the most significant occurrences to date are situated within the Adelaide Rift Complex and the Stuart Shelf. However, there is significant potential for BIF related manganese resources in the Middleback Ranges on Eyre Peninsula. Most of the historical production of manganese in South Australia is supergene enriched, with their primary origin being a sedimentary/stratiform type.

ADELAIDE RIFT COMPLEX

Several small manganese prospects extend in a line to the southeast of Euralia in the Flinders Ranges including the Whaleback (MinDep no. 6287), Wilson and Party (MinDep no. 6296), Coomooroo (MinDep no. 6011) and Bendleby South (MinDep no. 5979) deposits, which have all formed between Umberatana Group members, the Tarcowie Siltstone and the calcareous Etina Formation (Gregory 1988). These beds extend for a considerable distance but there is no drillhole data to evaluate the full extent of manganese mineralisation. The Eregunda Mine (MinDep no. 6350) and the adjoining Bungoola deposit (MinDep no. 6335) located approximately 15 km east of Blinman in the Flinders Ranges, produced minor amounts of supergene ore that consisted of a breccia of earthy manganese oxides occuring along a fault between the Hawker Group members, the Bunkers Sandstone and basal Wilkawillina Limestone (Ward 1943; Hosking et al. 1968). Between 1940–1941, 2146 t of manganese ore was mined at the Bendleby South deposit (Scott 1970). The area also hosts minor copper and silver mineralisation and is proximal to a cluster of kimberlite intrusions located to the southeast of the Eurelia Kimberlite Field (MinDep no. 9817). Olympio Metals is exploring this district for REE mineralisation on interpreted carbonatite intrusions (Olympio Metals 2023).

The Arrowie Gorge prospect (MinDep no. 2141), situated approximately 70 km to the northeast of Blinman, occupies a similar stratigraphic niche to the Eregunda Mine, with a contact between the Wilpena Group Wonoka and Bunyeroo formations. The area contains several deposits of low-grade manganese ore being a manganiferous iron-oxide gossan capping a contact with the Tea Tree Fault. The fault is also associated with some minor copper mineralisation. Apart from small replacement-like pockets of higher-grade material in limestone, overall grade was <10% Mn, and ~40% Fe, with total gossan resource estimated at <305,000 tonnes. The manganiferous ironstone is a surface feature with an average thickness of 1.2 m. The ironstone can be massive, banded or brecciated with MnO-rich botryoidal and colloform masses replacing limestone (Fairburn 1964).

Prouts Mine (MinDep no. 5988) is situated about 45 km east of Quorn in the Flinders Ranges. It has formed on the limb of a regional syncline and produced approximately 15,000–20,000 t of manganese ore in the late 1800s from four parallel lodes between 0.6–2.75 m in thickness. It has been interpreted to be a sedimentary/stratiform deposit, where manganese accumulated on the shelf under shallow marine conditions in the Neoproterozoic during the middle to late Marinoan glacial period (Gregory 1988). Pacifico Minerals has suggested an alternative model involving hydrothermal fluids moving through prominent structures being responsible for controlling the distribution of Co-Cu-Mn mineralisation (Pacifico Minerals Ltd 2018). The surface outcrop has a strike length of ~150 m with the main ore minerals being pyrolusite, manganite and *psilomelane*. In 2018, a surface sample of ore was assayed at 49.8% Mn and also returned a cobalt value of 0.0113% (Pacifico Minerals Ltd 2018).

There are several other manganese occurrences in the district, some producing small amounts of ore. These include Yanyarrie Station (MinDep no. 6298) 157 t, Old Cudlamudla (MinDep no. 6020) >20 t, Etna (MinDep no. 6041) 2 348 t and Watts Sugarloaf (MinDep no. 6282) >20 t. There is no drillhole data available from any of these occurrences. The Muttabee deposit (MinDep no. 6138), 35 km northeast of Wilmington in the Flinders Ranges, is regarded as a karst-type replacement deposit where the contents of a cavernous contact between shale and dolomite has been replaced with leached manganese from marls above and the dolomite itself. Production between 1940–1950 amounted to 2,047 t with an average grade of >50% Mn (Ridgeway 1951).

In 2018, Pacifico Minerals Ltd analysed some surface ore samples, with one sample returning a value of 53.5% Mn, 0.86% Co, 0.35% Cu and 0.21% Zn (Pacifico Minerals Ltd 2018).

To the northwest of Yunta on the Barrier Highway lies the Paratoo North manganese prospect (MinDep no. 9248), which features a large gossanous zone formed by the weathering of weakly pyritic and diapiric dolomite within the Curdimurka Subgroup. The gossan was mapped for ~1,580 m along strike. In 2013, Australian Mining Ltd identified thin bands of fine-grained manganese oxide up to 2 cm thick for a distance over 1 km. The Paratoo copper/ rare earth deposit (MinDep no. 1927) is situated 3.5 km to the southeast.

To the south of Yunta is the Thanksgiving prospect (MinDep no. 799). In 1997, Lynus Gold NL identified quartz-carbonate-chlorite veins and breccias in the Wonoka Formation dolomite associated with iron and manganese oxides. Small-scale manganese production occurred during WWII. Assays of vein material also returned values of up to 1,850 ppm Cu and 3,000 ppm Co, which is likely adsorbed to the iron/manganese mineralisation.

STUART SHELF

The Pernatty Lagoon manganese field, approximately 115 km north of Port Augusta within the Stuart Shelf, has historically been the largest single producer of manganese in South Australia with 34,000 t of ore at a grade of 40–55% mined between 1915–1949 (Johns 1968). There are a number of occurrences incorporated into the field including the main Pernatty workings (MinDep no. 3091), Big Cut (MinDep no.8351) and Far Northern (MinDep no. 6903). Located on the western shores of the normally dry saline lagoon, the orebodies trend in a northwest direction forming irregular masses and nodules in residual clay by the weathering of the manganiferous lower Tapley Hill Formation and (where present) Brighton Limestone (Johns 1968). The workings are mostly shallow surface excavations extending from the shoreline zone into the lakebed itself. Along the western boundary of the main Pernatty workings lies a hematite-rich zone interspersed with manganese representing a reaction front for solutions to precipitate (Williamson 1987).

Williamson (1987) postulates the source of the manganese as primary, as the result of weathered Beda Basalt (flood basalt) being eroded into the shallow sea where manganese laden waters precipitated onto the carbonate platform. Later Cenozoic exposure of the carbonate rocks resulted in further weathering and supergene enrichment into the manganese oxides pyrolusite and cryptomelane. Furthermore, Williamson suggests the possibility of further manganese accumulations on the westerly margins where similar shallow lagoonal facies may have formed, trapping manganese rich water in a restricted shelf environment (Williamson 1987). In 1986 the remaining resource estimate was ~167,500 t at 19.6% with a cut-off grade of 10% Mn (Paterson 1986). Other minor deposits in the vicinity include Sweet Nell East (MinDep no. 8353), Sundowner (MinDep no. 6933) and Mona Lena (MinDep no. 6910) from which both copper and manganese ore was produced. Although there has been widespread drilling carried out in the area, it remains highly prospective for manganese, barite, copper, and cobalt mineralisation.

GAWLER CRATON

On the Eyre Peninsula, manganese is associated with BIFs that make up the iron ore deposits of the Middleback Ranges (Miles 1955). The Rock Valley deposit (MinDep no. 5031), 20 km SW of Tumby Bay, is hosted in Hutchison Group BIF with a strike length of around 5 km and a width of 15 m. It was drill tested in a diamond drillhole, which penetrated 60 m of weathered BIF with grades ranging from 10–15% Fe and intersecting a 6 m interval of massive manganese oxide (Robinson 1965). The Jamieson Tank prospect (MinDep no. 4898), 60 km northwest of Cowell, is a manganiferous BIF within the Lower Middleback Jaspilite (Middleback Group; Szpunar et al. 2011) with a strike length of 10 km. Exploratory drilling by ChemX Materials (2023) established a manganese resource of 13.1 million tonnes at 5.7% Mn within five separate bands of manganiferous rock (Duffy 2023). Several other prospects in the vicinity including Polinga (MinDep no. 8823), Hodgkins (MinDep no. 9016), and Sugarloaf Hill (MinDep no. 9326), make this district highly prospective.

The Hercules (MinDep no. 6639) and Hercules East prospects (MinDep no. 10002) west of Lake Gilles, have been interpreted to be part of the Palaeoproterozoic Middleback Subgroup comprising

BIF and the Katunga Dolomite units (Ironclad Mining Ltd 2014). Exploration undertaken by Ironclad Mining Ltd at Hercules East indicate the manganese mineralisation is possibly structurally controlled, and hypogene in nature with subsequent supergene overprint, principally as pyrolusite (Ironclad Mining Ltd 2014). Manganese mineralisation at the Pier Dam prospect (MinDep no. 8503), 12 km to the north, is similar, with shear-hosted mineralisation having a strike length of over 8 km. The source of the manganese in these deposits is assumed to be the Katunga Dolomite (Ironclad Mining Ltd 2014). Drilling at Hercules East by Ironclad in 2014 gave varying results of between 20–30% Mn from mineralised zones between 7 and 22 m wide at depths between 49–76 m. A combined exploration target of between 7–9.7 Mt grading 15–22% Mn at Hercules East and Piers Dam was envisaged for these prospects (Ironclad Mining Ltd 2014).

25 km north of Port Lincoln, the White Flat prospect (MinDep no. 255) is hosted in the Warrow Quartzite, part of the Paleoproterozoic Darke Peak Group, where a resource estimate of 10–15 Mt at 45% Mn has been delineated. The manganese is likely a result of weathering and replacement of host rocks with cryptomelane comprising about 30% of the available manganese (Johnson 1981).

PROSPECTIVITY IN SOUTH AUSTRALIA

A summary of the key deposit types associated with manganese and potential areas of interest within South Australia is shown in Table 1. The Eyre Peninsula appears to offer good opportunities for large-scale extraction of shallow manganese ores associated with local BIFs and carbonate units (Middleback Group). The Pernatty Lagoon deposits have been the largest producer of manganese ores in South Australia. Further exploration for shallow supergene deposits under cover is also warranted, given a similar and extensive depositional environment. The Adelaide Rift Complex hosts several occurrences that could prove profitable given their high-grade and shallow nature, with further exploration potential along strike at stratigraphic margins.

Table 1. Summary of deposit types which may be enriched in manganese and regions of interest in South Australia with potential for these deposits.

Key deposit types	Regions of interest in South Australia
Principal sources:	
Sedimentary/stratiform	• Stuart Shelf – Pernatty Lagoon (Tapley Hill Formation) • Adelaide Rift Complex – Boolcunda district (Umberatana Group)
Supergene	• Adelaide Rift Complex – Arrowie Gorge (Wilpena Group) • Gawler Craton – Middleback Ranges (BIF, Middleback Group) • Stuart Shelf – Pernatty Lagoon (Tapley Hill Formation)
Hydrothermal	• Adelaide Rift Complex – Yunta district (Curdimurka Subgroup)

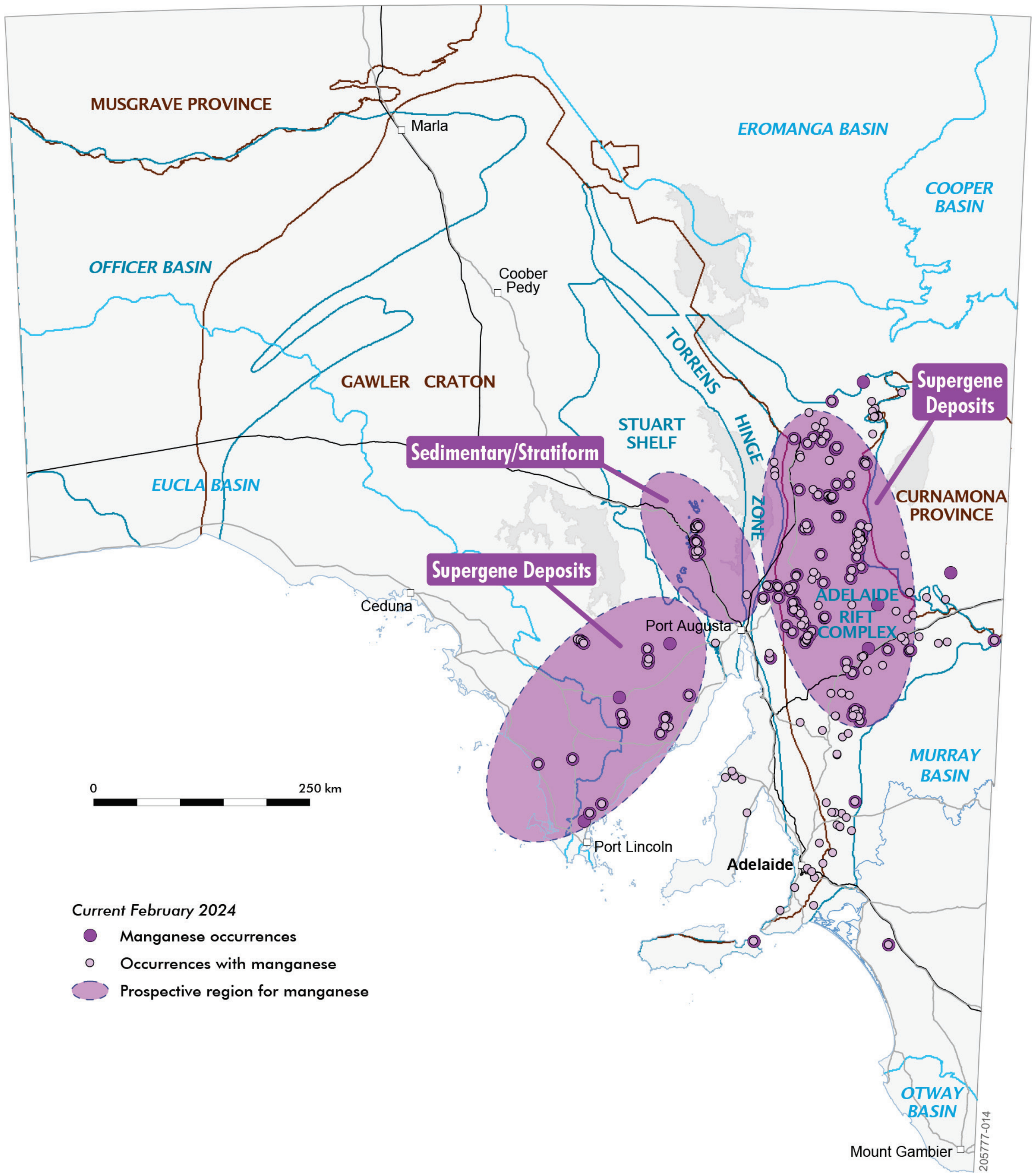

Figure 2. Location of South Australia's manganese occurrences and characteristic manganese forms. (205777-014 PDF 189 KB)

REFERENCES

Australian Department of Industry Science Energy and Resources 2022. 2022 Critical Minerals Strategy. https://www.australiaminerals.gov.au/__data/assets/pdf_file/0008/120797/2022-critical-minerals-strategy.pdf

Brown HYL 1908. *Record of the Mines of South Australia*. (4th ed.). Adelaide,

Brown T, Duuring P, Morin-Ka S & Strong CA 2022. Manganese: a mineral systems analysis. In (p. 14). Perth, Western Australia: Geological Survey of Western Australia,

Cannon WF 2014. *Manganese—It Turns Iron Into Steel (and Does So Much More)*. United States Geological Survey, https://pubs.usgs.gov/fs/2014/3087/pdf/fs2014-3087.pdf

Cannon WF, Kimball BE & Corathers LA 2017. Manganese. In Schulz KJ, DeYoung J, J. H., Seal II RR, & Bradley DC (eds.), *Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply.* pp. L1-L28.

Duffy A 2023. ChemX rolls out maiden Jamieson Tank manganese resource. In, *The West Australian*. Perth

Fairburn WA 1964. Arrowie Gorge Manganese Prospects: Wertaloona Station*Report Book*

Frakes LA & Bolton BR 1984. Origin of manganese giants: Sea-level change and anoxic-oxic history,. *Geology* 12 (2): 83-86

Gregory CT 1988. *The geology and origin of sedimentary manganese from the Boolcunda, Etna and Muttabee deposits, central Flinders Ranges, South Australia*. Honurs, Thesis B.Sc. Hons. University of Adelaide.

Hosking AJ, Donovan PR, Fidler R, Kelly AJ & Allchurch PD 1968. Oraparinna. Progress reports to licence surrender for the period 1/12/1967 to 9/4/1969., Open File Envelope 00965. Asarco (Aust.) Pty. Ltd., Adelaide.

Ironclad Mining Ltd. 2014. Wilcherry Hill, Manganese Hercules and Pier Dam Independent Technical Review. *ASX Release*. https://announcements.asx.com.au/asxpdf/20140520/pdf/42pqcc52x6fsjm.pdf

Johns RK 1968. *Geology and Mineral Resources of the Andamooka-Torrens Area*, Bulletin 41. Department of Mines, South Australia p. 142

Johnson PD 1981. Manganese at White Flat. Report Book 81/00066. Department of Mines and Energy, South Australia.

Kuleshov VN 2011. Manganese deposits: Communication 1. Genetic models of manganese ore formation. *Lithol Miner Resour,* 46, 473–493. https://doi.org/10.1134/S0024490211050038

Miles K.R 1955. *Geology and iron ore resources of the Middleback Range area.*, Bulletin 33. Geological Survey of South Australia, Adelaide

Olympio Metals 2023. *Euralia Project*. Accessed 22/12/2023. https://olympiometals.com.au/eurelia-project/

Pacifico Minerals Ltd. 2018. 2018 Annual Report. https://boabmetals.com/wp-content/uploads/2023/01/20180928AR.pdf

Paterson HL 1986. Manganese Resource Assessment, Pernatty Lagoon, South Australia. In Department of Primary Industries and Resources (ed.) (pp. 2675-2705). Unpublished

Pracejus B, Bolton BR & Frakes LA 1988. Nature and development of supergene manganese deposits, Groote Eylandt, Northern Territory, Australia. *Ore Geology Reviews* 4 (1-2): 71-98

Ridgeway JE 1951. Muttabee Manganese Deposit*Report Book*. 29/00063

Robinson WB 1965. Geological report no. 2 on the Rock Valley Creek jaspilite, Hd Koppio, southern Eyre Peninsula, *Report Book*. 61/00121. p. 12

Roy S 1997. Genetic diversity of manganese deposition in the terrestrial geological record. *Geological Society, London, Special Publications* 119 (1): 5-27

Schnebele EK 2023. Manganese. In United States Geological Survey (ed.) *Mineral commodity summaries 2023*. https://pubs.usgs.gov/periodicals/mcs2023/mcs2023-manganese.pdf

Scott IF, Chadwick, E.R. 1970. Eurelia. Progress and annual reports to licence expiry/renewal for the period 23/6/1969 to 22/6/1970., Open File Envelope 01123. Department of Mines, South Australia

Summerfield D 2021. Australian Resource Reviews: Manganese Ore 2020, Canberra, Australia. https://www.ga.gov.au/scientific-topics/minerals/mineral-resources-and-advice/australian-resource-reviews/manganese

Szpunar M, Hand M, Barovich K, Jagodzinski E & Belousova E 2011. Isotopic and geochemical constraints on the Paleoproterozoic Hutchison Group, southern Australia: Implications for Paleoproterozoic continental reconstructions. *Precambrian Research* 187 (1-2): 99-126

Ward KL 1943. Manganese Mine, Flinders Range,*Mining Review 76*. pp. 72-79

Williamson G 1987. *The geology and origin of manganese deposits at Pernatty Lagoon, South Australia*. Thesis B.Sc. Hons. University of Adelaide.

RELATED LINKS

Manganese webpage
https://www.energymining.sa.gov.au/industry/minerals-and-mining/mineral-commodities/manganese

South Australian commodity resource information (SARIG)
http://map.sarig.sa.gov.au/MapViewer/StartUp/?siteParams=DashboardWidget%7CcommoditiesIndicators

Critical Minerals South Australia dashboard
https://www.energymining.sa.gov.au/industry/geological-survey/gssa-projects/critical-minerals-south-australia/south-australias-critical-minerals-dashboards

Critical Minerals South Australia project
https://www.energymining.sa.gov.au/industry/geological-survey/gssa-projects/critical-minerals-south-australia

South Australia's Mineral Deposit (MinDep) database
https://minerals.sarig.sa.gov.au/MineralDepositSearch.aspx

APPENDIX

OCCURRENCE DATA

Combined data available from South Australia's Mineral Deposit (MinDep) database as displayed in Figure 1 (as at December 2023).
Click to open attachments panel.