



# INVESTMENT OPPORTUNITIES NICKEL

# Ni

Year 2018

<b>Sales value</b> 	<b>Tonnes sold</b> 	<b>Exports</b> 	<b>Direct employees</b> 	<b>Investment projects</b> 	<b>Production world ranking</b> 
<b>\$2610 m</b>	<b>149 642 t</b>	<b>\$2615 m<sup>1</sup></b>	<b>5698</b>	<b>\$2847 m<sup>2,3</sup></b>	<b>6th</b>

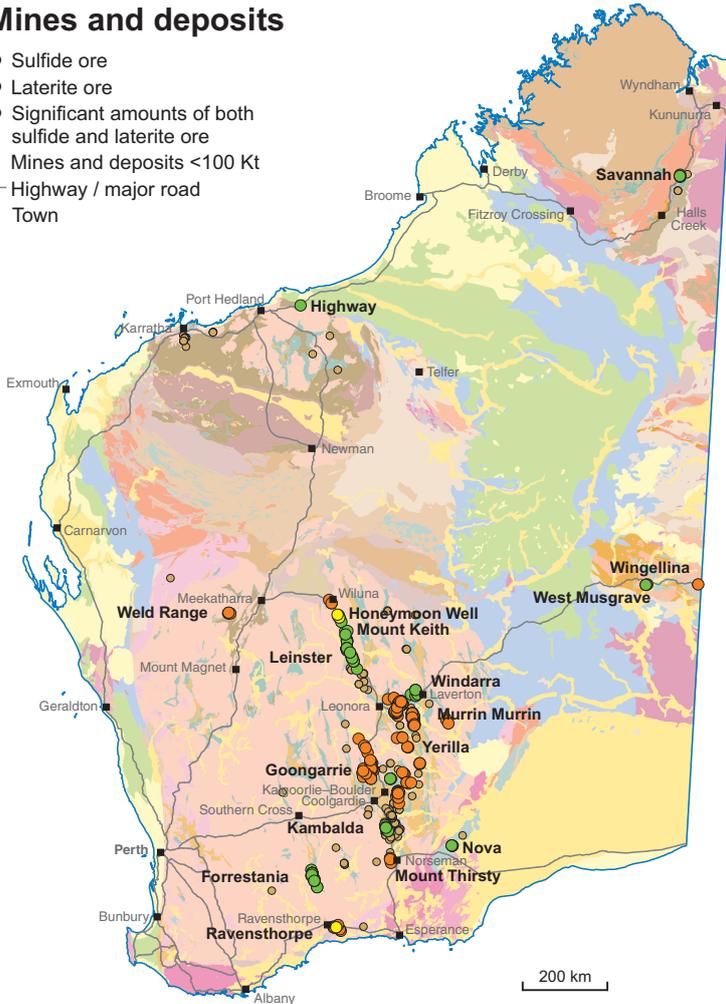
<sup>1</sup> may include Ni mined <2018

<sup>2</sup> Ni, Cu, Zn

<sup>3</sup> includes projects 'possible' to 'under construction'

## Mines and deposits

- Sulfide ore
- Laterite ore
- Significant amounts of both sulfide and laterite ore
- Mines and deposits <100 Kt
- Highway / major road
- Town



## Western Australia hosts world-class nickel deposits

- Current resources for Western Australia of 34 million tonnes contained nickel
- Production of 149 642 tonnes of nickel (metal and concentrate) in 2018
- Improving nickel prices have encouraged the reopening and further development of several nickel mines, such as Savannah (Panoramic Resources) and Cosmos (Western Areas)
- Exploration continues across the State, with updated mineral resource estimates reported for Quicksilver (Golden Mile Resources), Nebo-Babel (Oz Minerals Ltd / Cassini Resources Ltd) and Mt Thirsty (Barra Resources Ltd / Conico Ltd).

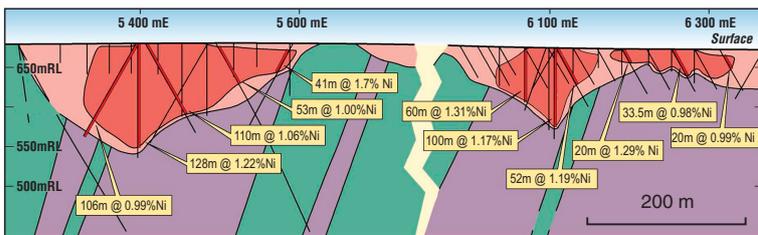
## Areas in Western Australia prospective for nickel

**Ultramafic rocks (komatiite and peridotite):** examples include Kambalda, Mount Keith, and Leinster. This mineralization style dominates historic production

**Mafic-ultramafic intrusions:** (similar to Voisey's Bay in Canada, Bushveld Complex in South Africa and the Thomson mine in the Cape Smith belt of Canada): Archean examples occur in the Pilbara and Yilgarn Cratons. Proterozoic examples occur in the Fraser Range area (Albany-Fraser Orogen), Lamboo Province (Halls Creek Orogen) and in the Musgrave Province

**Mafic intrusives related to Large Igneous Provinces (LIP):** similar to Noril'sk-style mineralization. Potential areas include dolerite sills in the Edmund, Collier, Officer, Kimberley, Speewah, and Hamersley Basins, as well as large areas of flood basalt in the East Kimberley

**Lateritic deposits in regolith (residual and supergene):** developed over weathered mafic-ultramafic rocks of the Archean Yilgarn Craton and Proterozoic Musgrave Province (Wingellina)

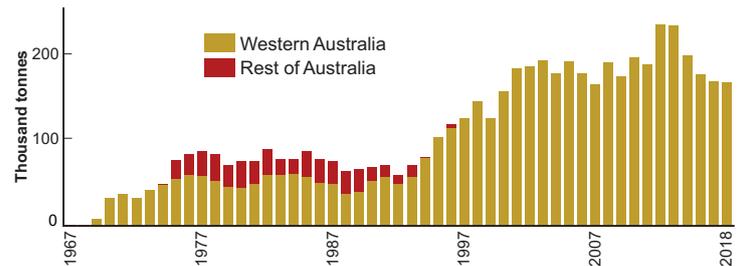


Source: Metals X Ltd

- Oxide mineralization >0.5% Ni
- Weathered clays <0.5% Ni
- Ultramafic
- Gabbro

Weathering profile and geological cross-section, Wingellina nickeliferous laterite, Musgrave Complex

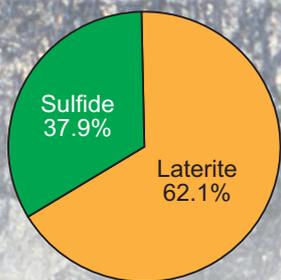
## WA nickel production vs rest of Australia



Source: Department of Mines, Industry Regulation and Safety (DMIRS) and Department of Industry Innovation and Science (DIIS)



Nickel resources by mineralization style\*



\* calculated from projects in table below

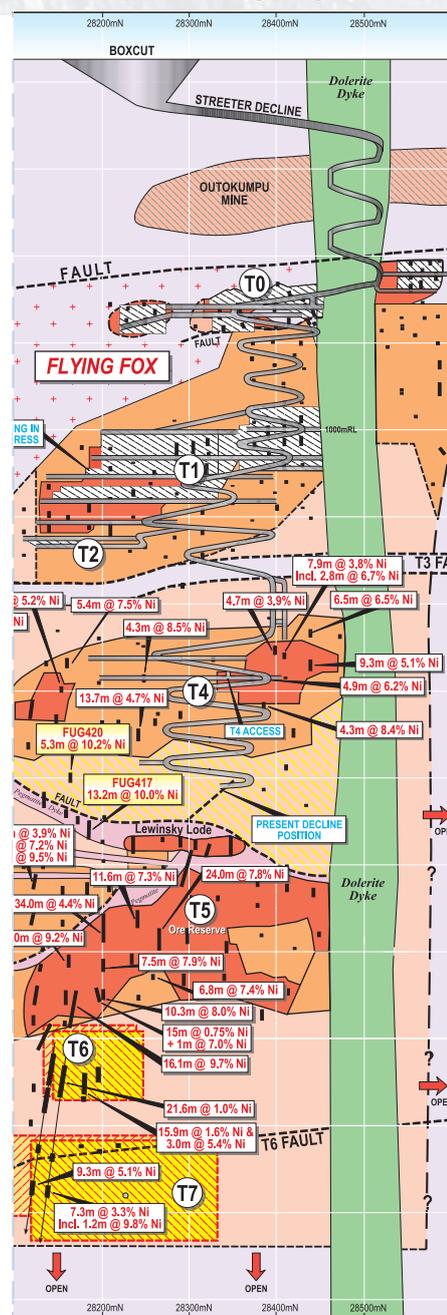
Top producers 2018  
(% of total production in Western Australia)

BHP Billiton	43%
Glencore	25%
Independence Group	18%
Western Areas	13%

Nickel projects with resources >100 Kt contained metal

Project	Project owner	Ore (Mt)	Av. Grade (%Ni)	Contained metal (Kt)
Honeymoon well	Noril'sk	524.20	0.764	4005.26
Mt Keith	BHP Billiton (Nickel West)	682.00	0.581	3960.10
Weld Range – Range Well	Ausinox	385.30	0.64	2465.92
Kalgoorlie Nickel Project – West	Ardea Resources	349.90	0.687	2404.04
Murrin Murrin	Glencore	230.90	0.995	2298.29
Leinster	BHP Billiton (Nickel West)	228.36	0.882	2013.00
Wingellina <sup>M</sup>	Metals X	215.84	0.905	1952.49
Ravensthorpe	First Quantum Minerals	307.30	0.583	1792.05
Avalon	Wingstar Investments	169.80	0.826	1403.02
Cawse	Wingstar Investments	176.49	0.691	1219.51
Kalgoorlie Nickel Project – East	Ardea Resources	145.70	0.809	1178.70
Siberia JV	Eastern Goldfields / Ardea Resources	163.30	0.67	1089.79
West Musgrave <sup>M</sup>	Oz Minerals / Cassini Resources	239.00	0.351	838.50
NiWest	GME Resources	67.10	1.039	696.89
Yerilla	Ardea Resources	90.80	0.76	689.91
Wilconi	A-Cap Resources / Blackham Resources	80.50	0.77	619.85
Cosmos	Western Areas	63.34	0.946	599.04
Forrestania	Western Areas	26.02	1.717	446.60
Carlingup – Nindilbillup	Australasian Mining	51.01	0.572	291.57
Nova-Bollinger <sup>A</sup>	Independence Group	13.24	2.05	271.36
Savannah <sup>H</sup>	Panoramic Resources	13.21	1.65	218.34
Canegrass	Nickelore	29.60	0.71	209.28
Julia	Wingstar Investments	25.93	0.743	192.66
Black Hills	Western Resources / Zetek Resources	30.00	0.64	192.00
Silver Swan – Black Swan	Poseidon Nickel	30.84	0.621	191.57
Jericho	BHP Billiton (Nickel West) / Noril'sk	31.00	0.59	182.90
Quicksilver	Golden Mile Resources	26.30	0.645	169.65
Pardoo–Highway <sup>P</sup>	Caeneus Minerals	50.00	0.3	151.70
Windarra	Poseidon Nickel	9.68	1.53	147.61
Kalgoorlie Nickel Project – Siberia – Black Range	Ardea Resources	26.92	0.544	146.53
Mt Thirsty	Barra Resources / Conico	26.60	0.52	139.03
Mt Edwards	Neometals	7.40	1.691	125.02
Norseman	Galileo Mining	25.10	0.488	122.41
Kurnalpi – Grey Dam	Carnavale Resources	14.60	0.75	110.12
Pyke Hill	Cougar Metals	10.50	0.99	103.74

Flying Fox, Forrestania  
Interpreted long projection



Source: Western Areas NL

Resource reporting codes vary  
Tectonic unit is Yilgarn except: <sup>A</sup> Albany–Fraser Orogen, <sup>H</sup> Halls Creek Orogen, <sup>M</sup> Musgrave Province, <sup>P</sup> Pilbara Craton

Laterite Sulfide Laterite + sulfide