

Minjng Journal

Focus on nickel in Western Australia

Since the discovery of high-grade nickel deposits at Kambalda by Western Mining Corporation almost 50 years ago in 1966, Western Australia continues to be a significant force in the global picture of the nickel-cobalt industry. The industry has gone through a series of boom-bust cycles which involved periods of rapid growth, downturns forcing mine closures, and new discoveries followed by new developments.

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Mt Keith nickel mine in Western Australia. Image: Thiess

The past 20 years have seen significant changes in the nickel sulphide industry with new mines brought into production, and the growth of a new nickel-cobalt industry based on application of new

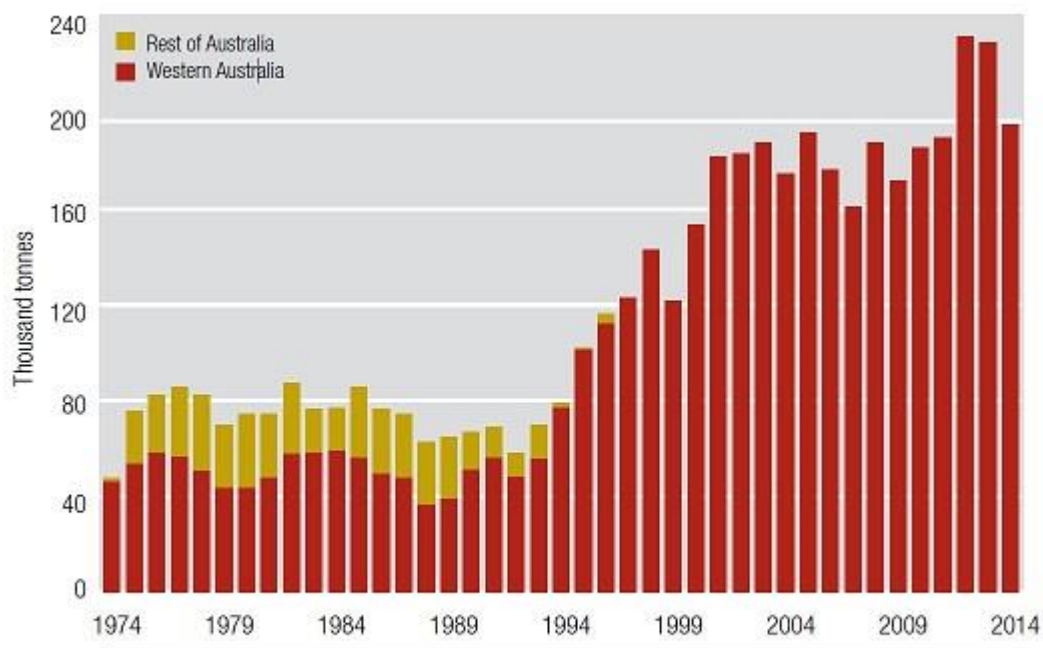
extractive technologies to Australia's vast lateritic resources. This has taken place against a background of highly volatile commodity prices and fluctuating global demand.

Development of the fledgling nickel industry, which included the construction by WMC of an integrated downstream processing capability, took place amidst the turmoil of the infamous Nickel Boom, a period of economic and investment madness that beset the Western Australian mining and investment industry from 1966 to 1971. Komatiite-associated nickel sulphides were previously unknown in Western Australia and poorly understood by most explorers. However, that did not stop them heading out in droves pegging vast tracts of country.

WMC led the way in unravelling the geological model, identifying 24 deposits in the Kambalda area, of which 15 had become producing mines by 1980.

The model, now well known, involves rivers of super-hot ultramafic lava creating their own channels on the seafloor and from which nickel-iron sulphide droplets precipitate forming linear deposits sometimes kilometres in length, with average nickel grades of 2% to 5%. It is highly relevant that this model continues to successfully guide deposit delineation drilling and mine extensional exploration to this day. Low-grade (0.6% Ni) but large tonnage deposits such as Mt Keith are also significant participants in the industry.

At its peak in 2013-14, production of nickel totalled 229,000 tonnes, of which 103,300t was from BHP Billiton which took over WMC in 2005.



Annual nickel mine production showing proportion from WA

Two factors came into play in the mid-1990s which changed the face of the nickel industry in WA.

The first factor was the rebirth of interest in nickel laterites and high-pressure sulphuric acid leaching (HPAL) which started in the early 1990s, and reached almost boom proportions by 1996 as companies scrambled to get enough ground to provide the large resources required for a laterite project. Subsequent development saw three operations come into production in quick succession. Currently two operations are in production (Murrin Murrin in the Eastern Goldfields and Ravensthorpe on the south coast, east of Albany) which are producing about 40% of WA's nickel total.

The second factor was a stream of new, mostly high-grade, discoveries of komatiite-associated nickel sulphide deposits by companies other than WMC who at the time controlled virtually all nickel production in the state. These included Emily Ann and Flying Fox Deeps in the Forrestania region south of Southern Cross, and the Cosmos, Silver Swan, Waterloo/Amorac and Mt Goode deposits in the North Eastern Goldfields. Some of these fed into the WMC infrastructure while others went their own way for downstream processing.

The strategic decision in 2000 by WMC to sell its Kambalda-Widgiemooltha mining assets to independent operators, with an offtake agreement to treat production, also made a major impact on the nickel market. This became a windfall for both buyers and the seller, with a backdrop at the time of rising metal prices and assured feed supply respectively. Despite limited reserves at the time of sale, virtually all new operators successfully applied previously defined geological models to significantly extend mine life by successful exploration.

The tholeiite nickel greenfields discovery story

While Western Australia's komatiite nickel mines are the type examples of the deposit style and world class in every sense, in a global context komatiite associated nickel only represents some 10% of global nickel sulphide production. The dominant deposit style globally for nickel sulphide are those deposits associated with voluminous basaltic mantle melt events known as Large Igneous Provinces, also classed as tholeiite associated deposits. Global examples are the true giants of the nickel sulphide world such as Noril'sk and Pechenga in Russia, Jinchuan in China and Canada's Voisey's Bay.

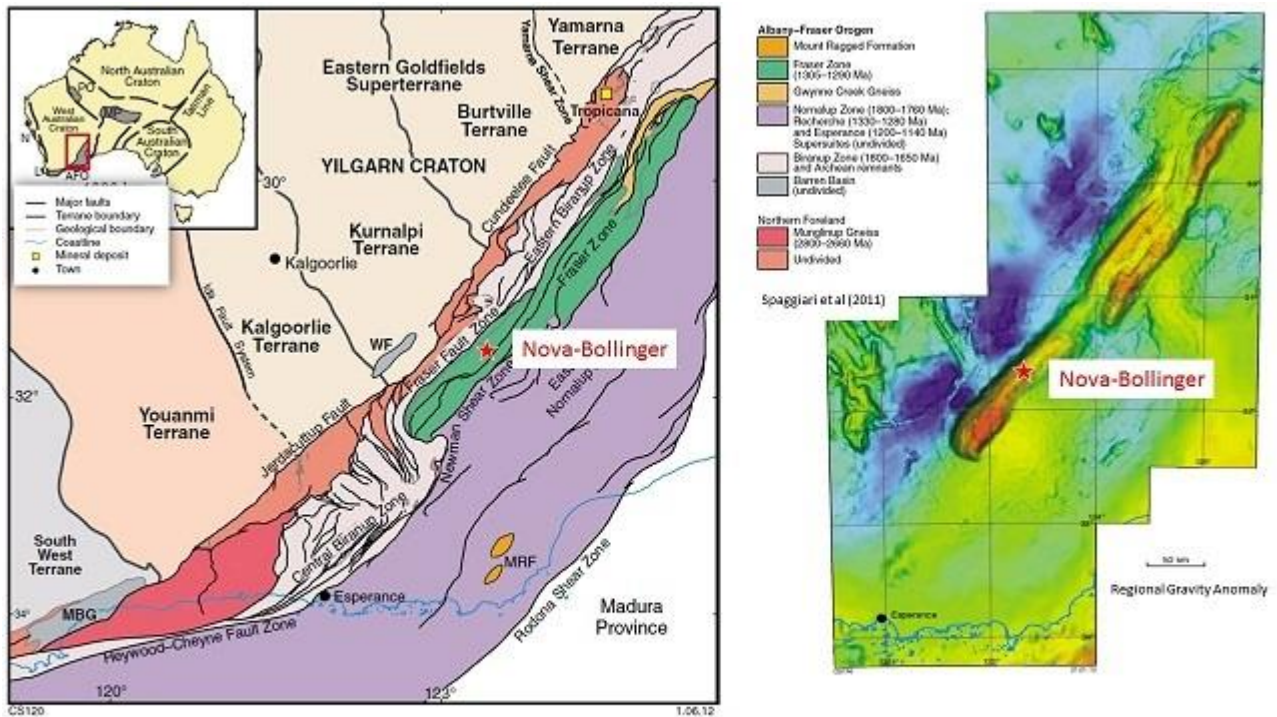
The bulk of historic exploration activity in Australia has been focussed on the search for komatiite systems in the Eastern Goldfields within the Yilgarn. It is the relatively recent greenfields discovery of tholeiite styles of nickel deposits in Western Australia that has shown that Australia is far from being a mature exploration environment for nickel.

The first tholeiite nickel deposit in Australia to be put into production was the Archean Radio Hill deposit in the West Pilbara south of Karratha, developed in the late 1980's by Italian firm Agip. Some poor decisions on mining methods chosen early in its history has led to a chequered production life with various operators, limited to during peak nickel price cycles. It is currently on care and maintenance.

The next tholeiite discovery and operation was the Sally Malay deposit in the Halls Creek Orogen of the East Kimberley, put into production in 2004 and currently operated as the Savannah Mine by Panoramic Resources. Initially thought to have a limited resource potential, good exploration and structural interpretation has led to a spate of discoveries of new resources at depth in structural offsets of the down-plunge continuation of the mine. This has significantly increased expected mine life.

Taking important knowledge gained from the opening to the West of the communist block deposits at Noril'sk and Pechenga in Russia, Jinchuan in China and the discovery of Voisey's Bay in Canada, opened new tracts of Australia with similar geological credentials for exploration for this type of deposit, with almost immediate success.

Applying these lessons during grassroots exploration by WMC in the West Musgrave Ranges led to the discovery of Nebo-Babel in 2000, currently owned and being assessed for development by Cassini Resources, which bought it from BHP Billiton in 2014. Similarly, applying the Canadian nickel lessons learned in Thompson and Voisey's Bay in the Albany Fraser Zone by Sirius Resources led to the recent Nova discovery in 2012, which is expected to be in operation by 2016, and has sparked a new nickel exploration boom that is still ongoing.



Geological and gravity maps showing the Albany Fraser zone and location of the recently discovered Nova-Bollinger deposit

Recognition of prospective belts across Australia for these styles of nickel deposits has opened the door for discovery. Advances in exploration technology, such as deep penetrating electromagnetics and deep drilling alternatives to traditional wireline, should mean that what has often previously been seen in some sectors as a mature environment for nickel discovery, fraught with difficulty searching under cover, should now be seen as a blank canvas with a wealth of potential.

There are many such exploration grassroots opportunities in a number of greenfield belts within Australia, and internationally for those companies willing to step offshore for exploration. Given many analysts predict a future return to nickel market deficits on a timeline comparable to the typical exploration discovery to mine production timeline, now is the time to be looking to make that discovery and reap any future market benefits.

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An expert in all aspects of nickel resource assessment and development in both laterites and sulphides, Mick Elias has 35 years' experience in the nickel industry conducting project generation and evaluation, exploration planning and management, development studies, open cut and underground mine geology, resource/reserve estimation, and resource economics. He has worked on the technical and financial evaluation of many nickel deposits throughout Australia and his international experience includes Cuba, Indonesia, Philippines, New Caledonia, Canada and Brazil.



Tony Donaghy is an internationally recognised expert in the global search for nickel and platinum group elements, with more than 20 years' experience covering all continents and all aspects of the industry – from leading continental-scale grassroots targeting exercises, through greenfields and brownfields exploration project design and execution, mining, property evaluation and due diligence, to board level strategy development and guidance.

