

## Nickel Sulfide Prospectivity of Australia: A Mineral Systems GIS Model

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Tholeiitic intrusion-hosted nickel sulfide deposits are highly sought after exploration targets due to their potential size and co-product platinum-group elements and copper. The Noril'sk-Talnakh (Russia), Voisey's Bay (Canada), and Jinchuan (China) deposits are world-class examples. Although Australia holds the largest economic resources of nickel in the world, its nickel resources are mainly sourced from komatiitic-hosted and lateritic deposits. Known resources of tholeiitic intrusion-hosted nickel sulfides are relatively small, with Nebo-Babel and Nova-Bollinger in Western Australia the most significant examples. Given the abundance of tholeiitic igneous rocks in Australia, this important deposit type seems to be underrepresented when compared to other continents with similar geology.

To support the discovery of world-class nickel sulfide deposits in Australia, Geoscience Australia has recently undertaken a continental-scale GIS-based prospectivity analysis for tholeiitic intrusion-hosted deposits across Australia. This analysis exploits a suite of new digital datasets recently released by Geoscience Australia. For example, the analysis utilizes the Australian Mafic-Ultramafic Magmatic Events GIS Dataset which places mafic and ultramafic rocks across Australia into 74 coeval magmatic events based on geochronological data. Whole-rock geochemistry of mafic and ultramafic rocks has been used to differentiate between magma series and discriminate between different magmatic events and units within those events. Other new datasets include crustal domain boundaries derived from both deep crustal seismic data and neodymium depleted mantle model age data as well as a coverage of the minimum thickness of mafic rocks in the crust derived from the Australian Seismogenic Reference Earth Model.

This continental-scale GIS-based nickel sulfide prospectivity analysis uses a mineral systems approach to map the four essential components of ore-forming mineral systems; (1) *sources* of ore constituents, (2) crustal and mantle lithospheric *architecture*, (3) *energy sources* or drivers of the ore-forming system, and (4) *gradients* in ore depositional physico-chemical parameters. These four components are combined into a prospectivity map using weights-of-evidence GIS-based techniques, with the most prospective areas across the continent occurring where all components are present. The mineral systems approach allows for the identification of a much larger footprint than the deposit itself, and can be applied to greenfield and/or undercover areas.

The results highlight areas that contain known tholeiitic intrusion-hosted nickel sulfide deposits, such as the Musgrave and Pilbara Provinces, as well as regions that do not contain any known deposits, such as the southern margin of the Arunta Province in the Northern Territory, the Mount Isa Province in Queensland, and the Paterson Province in Western Australia.