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Mapping mineral potential at continental to regional scales using a mineral system approach: Ni-Cu-PGE and IOCG systems in Australia

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The mineral systems concept was formulated originally for Proterozoic hydrothermal ore-forming systems by workers at the Australian Geological Survey Organisation (AGSO) [1]. Uptake and application of the concept is growing as its value in regional exploration targeting is increasingly recognised. The initial concept has seen many modifications and variations, one version of which is currently used in mineral potential assessments by Geoscience Australia, the successor to AGSO. For the practical purpose of mapping prospectivity at regional and continental scales a four-component mineral system scheme has been developed that focuses on the most critical and mappable factors. These involve: (i) sources of energy, (ii) architecture of fluid or magma pathways, (iii) sources of ore metals, and (iv) gradients in ore depositional physico-chemical parameters. The modified mineral systems scheme also explicitly incorporates the concept of an ore-forming time window [2]. The notion here is that only during restricted time periods did all the essential ore-forming processes operate at particular locations to form major ore deposits.

Most knowledge-driven and data-driven GIS-based assessments of mineral potential have been undertaken at regional scales and applied to hydrothermal systems, including previous Geoscience Australia studies of uranium and iron-oxide copper gold (IOCG) mineral potential. Here we describe a continental scale knowledge-driven assessment of a magmatic ore system, namely tholeiitic intrusion-hosted nickel-copper-platinum-group element (Ni-Cu-PGE) mineral systems [3]. Temporal constraints were also included using a new continental dataset documenting the spatial distribution through time of Australia's mafic and ultramafic magmatic events [4]. Conceptual and mappable criteria representing each of the four mineral system components were developed, based on a conceptual mineral system model. The GIS-based modelling involved 13 principal geological, geophysical and geochemical datasets and derivatives that are proxies for the conceptual and mappable criteria. Uncertainties were incorporated using fuzzy-logic-based criteria. The final map of prospectivity (Figure 1) combines all four mineral system components, which contributed equally to honour the principle that all mineral system components are needed for ore formation. The modelling successfully predicted the regions within

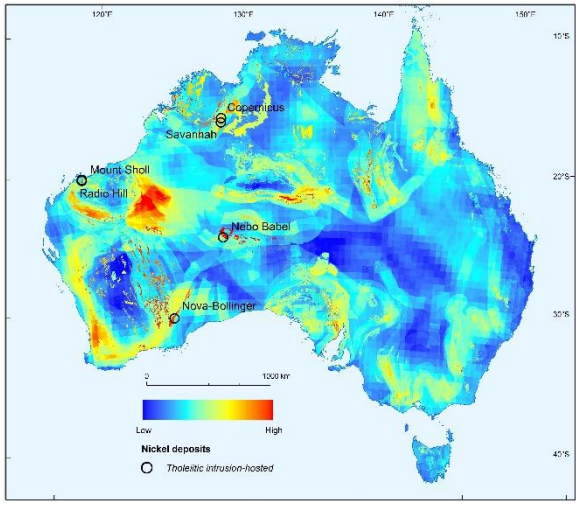

Figure 1: Map of potential for intrusion-hosted Ni-Cu-PGE sulfide deposits in Australia [3].

which the few known intrusion-hosted Ni-Cu-PGE deposits are located (Figure 1), and importantly also highlights many 'greenfields' regions worthy of follow-up by exploration companies.

References:

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