

Targeted Ni-Cu-PGE exploration in Large Igneous Provinces: modelling layered intrusions in plume center regions using potential field data

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Large Igneous Provinces (LIPs) are becoming increasingly important for the mining industry as the association between LIPs and mineral deposits becomes more apparent. In particular, studies suggest a robust link between layered mafic-ultramafic intrusions that host valuable Ni-Cu-PGE deposits and LIPs, indicating that these should be primary exploration targets. Furthermore, it has been recently proposed that layered intrusions within a few hundred kilometers of the plume center are the most prospective. Mafic-ultramafic intrusions are often associated with prominent gravity and magnetic anomalies, allowing for their delineation using potential field geophysical methods. In this study, we assessed the plume center regions of 17 LIPs and have catalogued possible layered intrusions in approximately half of these. Their associated anomalies were selected based on their nearness to the plume center, and their magnitude, size and shape. The first type of anomaly is the more common occurrence of a large gravity high adjacent to the plume center, typically associated with a magnetic high, which is believed to be due to the presence of a layered mafic-ultramafic intrusion (e.g., 1270 Ma Mackenzie LIP, Canada). The second type of anomaly exhibits a large magnetic high coincident with a weak gravity signature, which is interpreted to be the expression of a mainly mafic intrusion (e.g., 130-80 Ma High Arctic LIP, Ellesmere Island, Arctic Canada). The catalogued anomalies are being further studied to constrain their size, shape and depth, as well as their internal compositional structure based on joint modelling of gravity and aeromagnetic data. Preliminary modelling of a +700 nT sub-circular magnetic anomaly with a diameter of ~60 km, likely linked with the High Arctic LIP, infers the presence of an intrusive body that extends to a depth of approximately 15 km and is composed of an upper felsic component and a lower mafic component, with intermittent magnetite-rich horizons. Systematic modelling of the catalogued anomalies associated with plume centers will help quantify the proportions of felsic, mafic and ultramafic components in each intrusion. This will be a guide to a better understanding of the magmatic plumbing system of LIPs as well as the economic potential of such layered mafic-ultramafic intrusions proximal to plume centers.