Targeted exploration of mafic-ultramafic intrusions in LIP plume centre regions using gravity and magnetic field methods: Case studies at the 1.27 Ga Mackenzie, 1.38 Ga Kunene-Kibaran, 0.13-0.08 Ga High Artic and 0.06 Ga Deccan plume centres

JA Blanchard[1], RE Ernst[1], C Samson[1]

[1] Dept. of Earth Sciences, Carleton University, Ottawa, Ontario;

We provide a detailed geophysical investigation of mafic-ultramafic intrusions associated with Large Igneous Provinces (LIPs), with a focus on intrusions within the plume centre region (i.e. within approx. 500 km from a plume centre), where there is a higher probability that Ni-Cu-PGE deposits will form given the high melt volumes generated by the plume. The layered intrusions identified in this study are major intrusions linked with LIPs that are generally deep-seated intrusions, but these can feed smaller, younger and shallower intrusions and can have implications for Ni-Cu-PGE exploration in LIP plume centre regions. Based on a reconnaissance study of geophysical anomalies in 18 plume centre regions and detailed geophysical modelling in four of these, we develop a new protocol for identifying and linking buried mafic-ultramafic intrusions with LIPs using gravity and magnetic data. This protocol consists of searching for large (>30 km diameter), high amplitude (> +30 mgal and/or ± several hundreds of nT), and circular to oval-shaped anomalies that are located within 500 km of a plume centre. Additionally, there are distinct geometries observed within these centres that can be used to link buried intrusions with a given LIP. Mainly, these are circumferential distributions, in which multiple intrusions circumscribe the plume centre with a radius of 200-500 km, and linearly-aligned intrusions emplaced along rift systems, which in some cases converge towards the plume centre and which can be used to better define the plume centre location. Eleven geophysical anomalies are selected for modelling based on the criteria outlined above, and are linked with the following four LIPs: the 1.27 Ga Mackenzie LIP, Northwest Territories, the 1.38 Ga Kunene-Kibaran, Africa, the 0.13-0.08 Ga Ma High Arctic LIP, Circum Arctic, and the 0.06 Ga Deccan LIP, India. The anomalies are modelled using forward modelling and inversion of gravity and magnetic data, complimented with crustal information from seismic data, and provide quantitative information on the structure and composition of the underlying LIP-related layered intrusions.