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Applying the plume–LIP paradigm to exploration across diverse commodity systems

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The association between plume-generated LIPs and magmatic sulphide Ni-Cu-PGE deposits has long been recognized with prominent examples such as the Norilsk ores of the Siberia Traps LIP. Our previous work (Ernst and Jowitt, 2013, 2017) expanded the links between LIPs and metallogeny to include a wider range of orthomagmatic deposits, and also hydrothermal deposits (linked to fluid and heat produced by LIPs), LIPs as barriers to fluid flow or reactive zones, laterites rich in Al, Ni, Co produced LIP weathering (and weathering of related carbonatites), and indirect links between LIPs and distal orogenic ore deposits through the plate tectonics framework. Herein we broaden the link to a wider range of ore deposit types by assessing the dynamic effects due to LIP-related mantle plumes, and the metallogenic implications of the resulting geologically “sudden” stress and topographic changes.

We consider two aspects, plume-related stress-change and topographic effects, above the mantle plume, and distal effects related to plume head push. Above the plume head the themes are: 1) a rapid 90-degree stress transition from plume-driven uplift to plume head spreading that can explain emplacement of chonoliths (major type of mineralized magmatic sulphides) 2) regional plume uplift constraining the orientation of hydrothermal vein systems, and 3) plume uplift causing minor tilting of sedimentary basins, changing the flow of mineralized brines and contributing to sediment-hosted ore deposits. 4) local vertical ascent of plume material through overlying thick lithosphere allowing heat and fluids to cause crustal mineralization. Distal stress changes are due to spreading of the plume head against cratonic roots, plume-head push, causing changes in plate movement leading to distal convergence-related mineralization (gold and potentially porphyry systems).