3D geological modelling of the Double Eagle - Black Thor intrusive complexes, McFaulds Lake greenstone belt, Ontario, Canada

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As part of the Geological Survey of Canada's Targeted Geoscience Initiative, our team is developing a 3D geological model of the Double Eagle and Black Thor intrusive complexes that host major chromite and Ni-Cu-PGE deposits in the 'Ring of Fire' region in northern Ontario. The 2.73 Ga ultramafic to mafic Double Eagle and Black Thor intrusive complexes occur within the 2.83-2.70 Ga McFaulds Lake greenstone belt (MLGB) in the Superior craton. They consist of elongate ultramafic-dominated intrusions attaining an apparent thickness up to 3 km over a strike length of 15 km. Both complexes exhibit a komatiitic affinity with thick lower ultramafic sequences composed of dunite, lherzolite, websterite, and chromitite that host the Cr-(PGE) and Ni-Cu-PGE mineralization overlain by a thinner mafic upper sequence composed mainly of melanogabbro, mesogabbro, and leucogabbro with lesser anorthosite. The 3D geological model will be constrained using representative lithological contacts as marker horizons that have been identified from existing industry drill log descriptions and subsequent re-logging of select diamond drill holes by the Ontario Geological Survey and the Geological Survey of Canada. The development of a diamond drill hole database, with a systematic hierarchical encoding of lithology through the harmonization of drill log descriptions from the various claims, will help in establishing hole-to-hole correlations of laterally-persistent unit contacts and key structures within the study area. Structural information from the drill logs and high-resolution airborne magnetic surveys will provide added interpretative support. For areas exhibiting intense alteration, supplementary information will be derived from lithogeochemical analyses. The geological model will be built by integrating all of these constraints in a 3D modelling environment using GOCAD 3D modelling software. Algorithms and techniques to generate 3D surfaces representing intrusive, stratigraphic, and tectonic contacts include GOCAD's internal discrete smooth interpolation (DSI) algorithm, cross-section compilation using the Sparse plugin of GOCAD's mining suite, and implicit modelling approaches. This 3D geological model will provide critical insights into the architecture of the intrusive complexes and the spatial relationships between separate mineralization events. It will enhance our understanding of the magmatic plumbing system, which contains the magmatic sulfide and chromite mineralization, by integrating and interpreting the available industry exploration datasets in the context of a single multi-commodity ultramafic to mafic magmatic ore system.