3D Geological Modelling of the Double Eagle - Black Thor Intrusive Complexes, McFaulds Lake Greenstone Belt, Ontario, Canada

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The Ring of Fire region in northwestern Ontario hosts many valuable magmatic ore deposits, including six major chromite and one significant Ni-Cu-(PGE) deposit within the central part of the McFaulds Lake greenstone belt. As part of the Geological Survey of Canada's Targeted Geoscience Initiative, a 3D geological model is under development to examine the subsurface architecture and structural disposition of the Double Eagle (DEIC) and Black Thor (BTIC) intrusive complexes that host these deposits. The 3D model is constrained by diamond drillhole datasets, regional geological maps and a revised structural interpretation based on high-resolution magnetic data. A total magnetic field grid of the latter was used to outline linear to curvilinear magnetic lows, refining the elements of a system of anastomosing shear zones previously identified from medium-resolution magnetic data. Structural fabrics in drill core combined with down-hole susceptibility data confirm that these shear zones overprint the contacts of the intrusive ultramafic rocks with the gabbroic rocks, felsic intrusive host rocks and mafic-dominated volcanic host rocks. The Frank shear zone (FSZ) and 3B shear zone, connected by a Y-shaped triple junction, generally follow the contact between the ultramafic and gabbroic rocks in both complexes. In the DEIC, the FSZ appears to offset the chromite and Ni-Cu-(PGE) deposits with a 1-1.5 km dextral displacement. To the south, the McFaulds shear zone overprints the contact between the intrusive ultramafic unit and the volcanic host rocks, and then transects the volcanic rocks, ferrogabbro intrusion and synvolcanic tonalite to the east-northeast. Altogether, these shear zones and intrusive contacts were re-interpreted in a preliminary 3D geological model by fitting 3D triangulated surfaces to their respective 2D map surface traces and drillhole constraints. The re-logging of select drill core intervals last summer validated this preliminary 3D model, which improved through subsequent iterations to refine the geometry of the 3D surfaces. The current version of the 3D model, in conjunction with assay data, is being used to develop high-resolution curvilinear grid models of chromite deposits within the intrusive complexes, enhancing knowledge of the mineralization process. The final 3D model will be employed to restore the DEIC and BTIC to their pre-deformation conditions. Unraveling the nature of deformation within the DEIC and BTIC in 3D space will help decipher the complex subsurface architecture of this magmatic system and provide critical insight into the spatial relationship of separate ore deposits within Double Eagle - Black Thor Intrusive Complexes.