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3-D GEOLOGICAL MODELLING OF THE DOUBLE EAGLE AND BLACK THOR INTRUSIVE COMPLEXES, MCFAULDS LAKE GREENSTONE BELT, ONTARIO

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SUMMARY OF RESEARCH ACTIVITIES

The Geological Survey of Canada's Targeted Geoscience Initiative is developing a 3D geological model of the Double Eagle (DEIC) – Black Thor (BTIC) intrusive complexes of the 'Ring of Fire' intrusive suite (Fig. 1) in northwestern Ontario. The 3D model is constrained by diamond drillhole datasets, geological maps and a revised structural interpretation based on drillcore re-logging and high-resolution magnetic data. The total magnetic field, together with its 1st vertical and magnetic tilt derivatives, were used to outline linear to curvilinear magnetic lows corresponding to a system of anastomosing ductile shear zones (Fig. 2a). This structural interpretation provides a refinement of previous interpretations from publicly-available medium-resolution magnetic data. Mylonitic fabrics observed in drill core (Figs. 4 and 5) combined with magnetic susceptibility drill core measurements (Fig. 2b) confirm that these shear zones overprint the primary intrusive contacts (Fig. 3) of the DEIC and BTIC ultramafic rocks with granodiorite and mafic-dominated volcanic host rocks, as well as, the intrusive contacts with gabbroic rocks within the intrusive complexes (Fig. 1). In the DEIC, the FSZ appears to displace the chromite- and Ni-Cu-(PGE)-bearing ore zones by 1-1.5 km in an apparent dextral sense, which is consistent with the offset of gabbroic and mafic volcanic units further east (Fig. 7a). The final 3D model will be employed to reconstruct the DEIC and BTIC to their pre-deformation configuration (Figs. 7b and c). This structural restoration will help to decipher the complex subsurface architecture of this magmatic system and its spatial relationship with the main mineralization events.

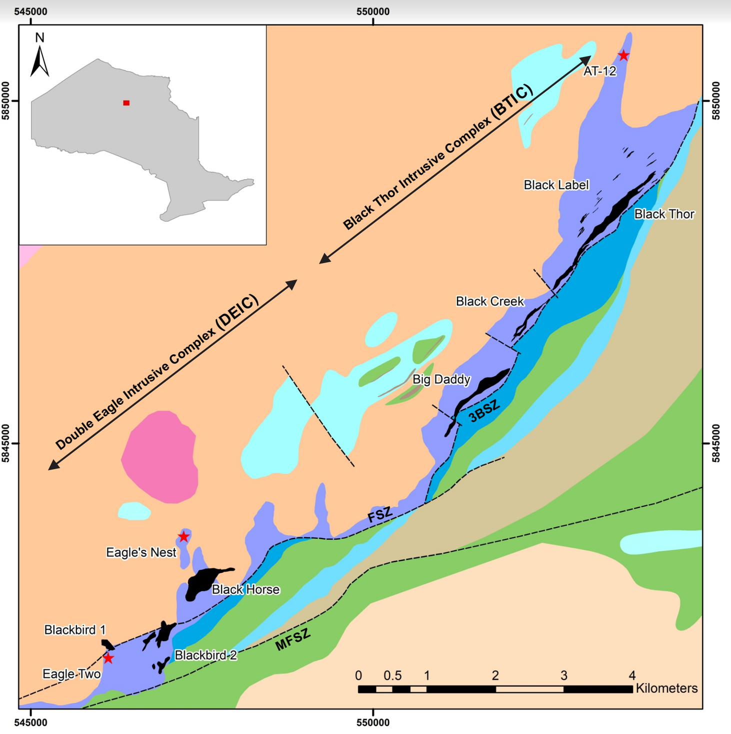


Fig 1. Geological map of the central part of the McFaulds Lake greenstone belt re-interpreted after Metsaranta and Houlé (2017). The chromite deposits are the surficial representation of the respective ore zones lying at and below the surface. FSZ = Frank shear zone; 3BSZ = 3B splay of the FSZ; MFSZ = McFaulds Lake shear zone.

MAGNETIC DATA & SUSCEPTIBILITY

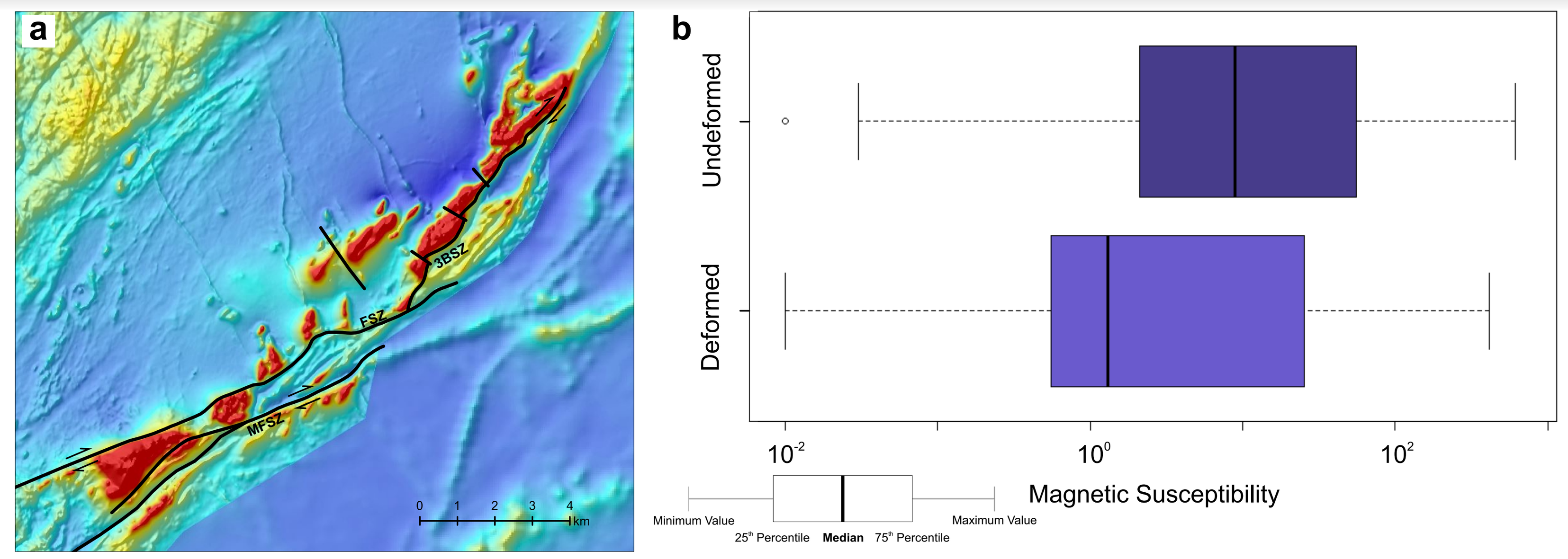


Fig 2. a) Colour-relief-shaded high-resolution magnetic data (gridded from 75 m line spacing) overlain with the revised structural interpretation. b) Box plots showing the variation in drillcore magnetic susceptibility measurements between undeformed and deformed intervals of ultramafic rocks. The latter may have experienced oxidation of magnetite due to intense shearing.

STRUCTURAL RESTORATION

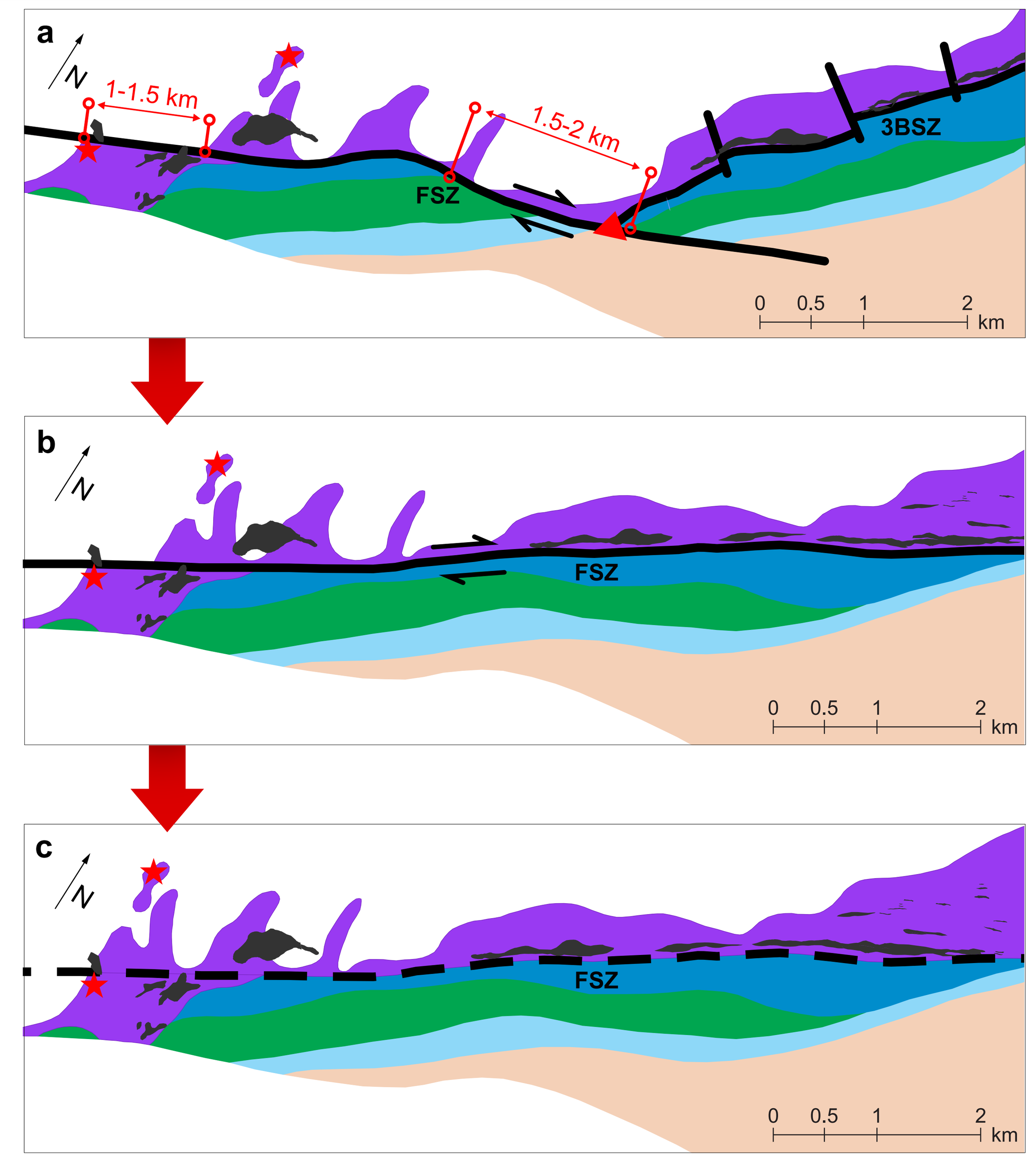


Fig 7. Conceptual restoration of deformation of the DEIC and BTIC showing the current structural configuration (a), restoration along the splay (b) and pre-deformation configuration (c). The restored rock units and surface projected sulphide mineralization (red stars) suggest an offset of approximately 1.5 km with a dextral component of displacement. Note: chromite deposits are surface projections of subsurface mineralization, therefore displacement of the Black Horse chromite deposit does not occur as it lies in the footwall of the FSZ.

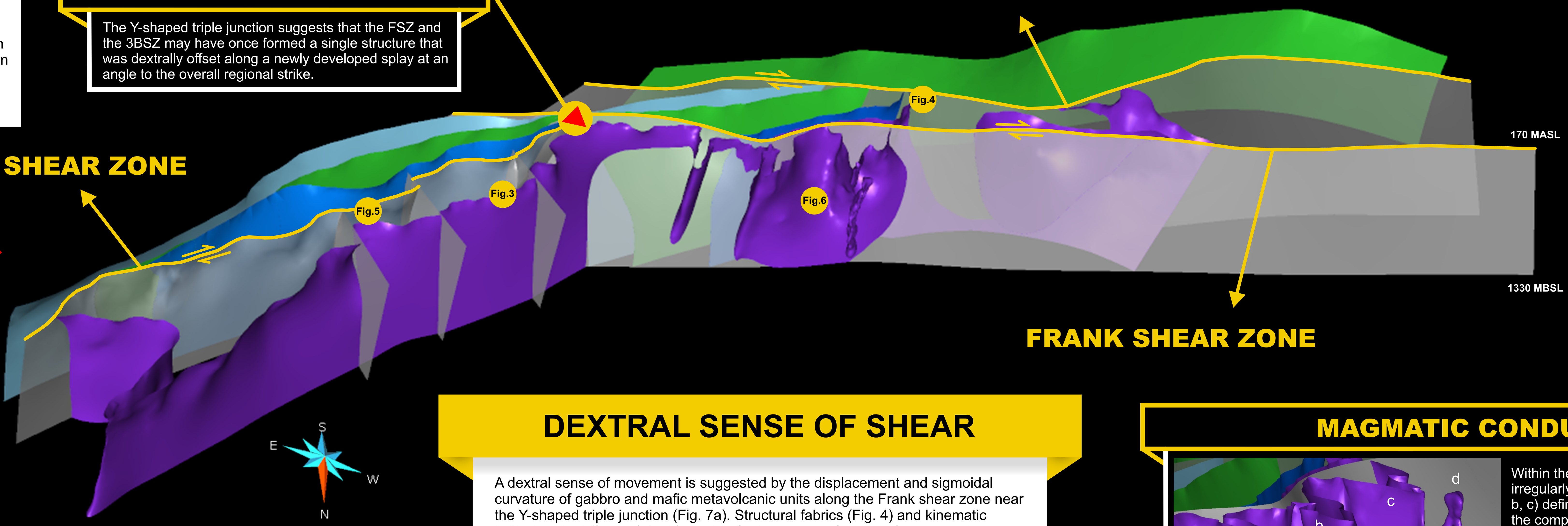
Y-SHAPED TRIPLE JUNCTION

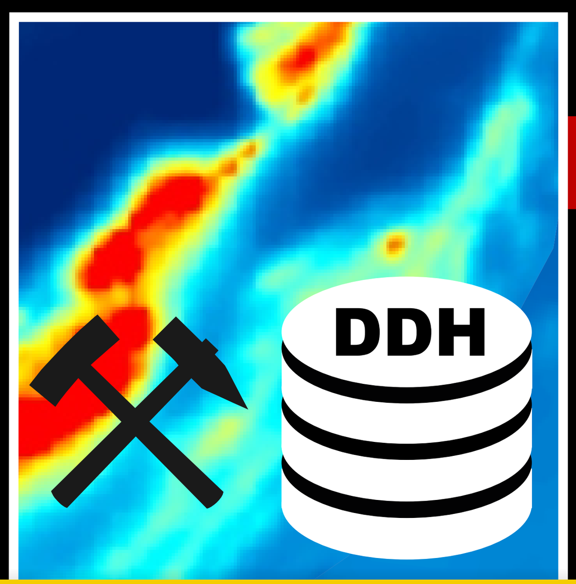
The Y-shaped triple junction suggests that the FSZ and the 3BSZ may have once formed a single structure that was dextrally offset along a newly developed splay at an angle to the overall regional strike.

MCFAULDS LAKE SHEAR ZONE

3B SHEAR ZONE

FRANK SHEAR ZONE





CONSTRAINTS

- Drill logs from exploration claims compiled into a thematic and systematically encoded database during the initial phase of research.
- Geological map compilations (Metsaranta and Houlé, 2017; Metsaranta et al., 2015).
- Interpretation of high resolution magnetic survey data.
- Re-logged drill core intervals that were selected to verify contact relationships between specific units and validate the structural interpretation.

CONTACT PRESERVATION

Fig 3. Sharp primary intrusive contact between granodiorite (left) and serpentinized peridotite (right) with preserved medium grained cumulate texture (pseudomorphic pyroxene and olivine). Drillhole FW-08-06 at 103.51 m.

DEXTRAL SENSE OF SHEAR

A dextral sense of movement is suggested by the displacement and sigmoidal curvature of gabbro and mafic metavolcanic units along the Frank shear zone near the Y-shaped triple junction (Fig. 7a). Structural fabrics (Fig. 4) and kinematic indicators in drill core (Fig. 5) provide further support for dextral movement throughout the DEIC and BTIC.

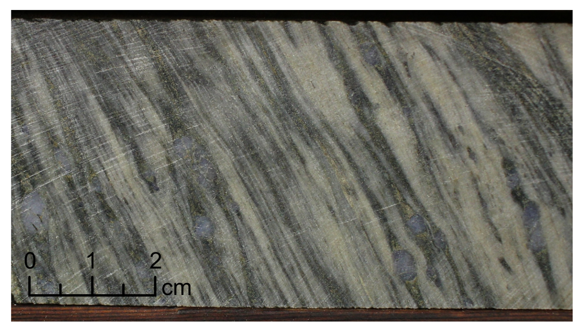


Fig 4. Mylonitized felsic volcanic rock interval within the mafic-dominated volcanic unit. The mylonitic foliation is defined by coarse blue-grey quartz porphyroclasts wrapped by fine grained light bands of carbonate and quartz and dark bands of chlorite and biotite. Drillhole NOT-08-1G079 at 423.8 m.

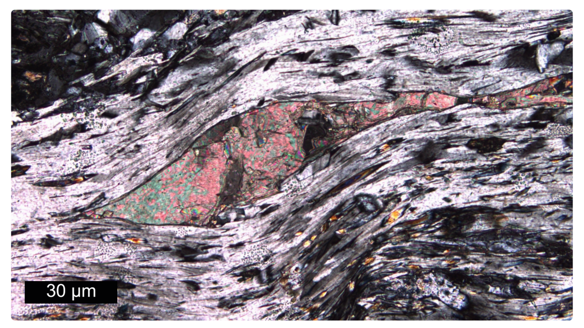


Fig 5. Intensely sheared and altered fine-grained ultramafic phyllonite. The strong foliation and crenulation fabric are defined by serpentine and tremolite. The asymmetrical shape of boudinaged calcite vein suggests displacement with a dextral component of shear. Drillhole BT-10-143B at 228.46 m.

MAGMATIC CONDUITS

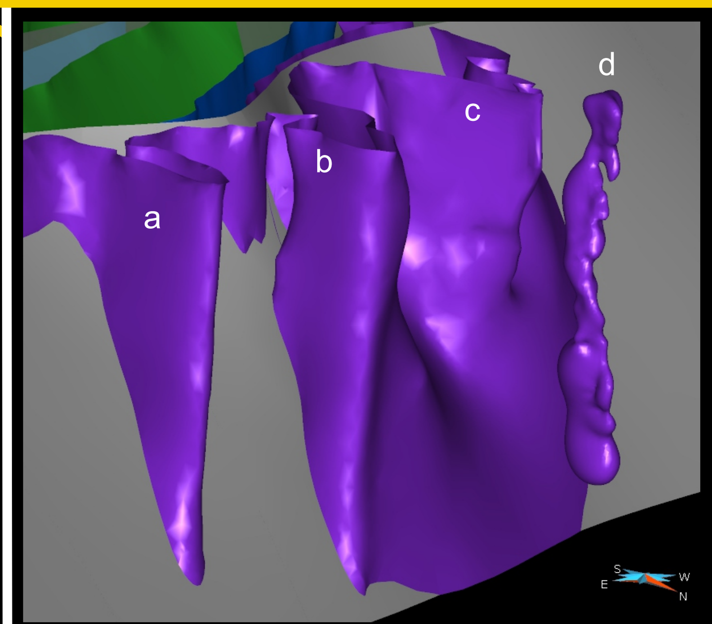


Fig 6. A 3D perspective of the Double Eagle intrusive complex showing the known subsurface architecture of the ultramafic lobes (a, b, c) and the Eagle's Nest conduit (d).

Within the DEIC there are three irregularly shaped ultramafic lobes (a, b, c) defining the northern contact of the complex with the granodiorite host rocks (Figs. 1 and 6). The boundaries of these ultramafic lobes are well defined on the high-resolution total magnetic field grid (Fig. 2a), however, only lobe 'c' is well constrained by drillhole data. Due to a lack of drilling, the structure of lobes 'a' and 'b' have been determined exclusively from magnetic data and their subsurface architecture remains undefined. Comparing the surficial expression of all three lobes, their analogous shape and orientation suggests that lobes 'a' and 'b' could also represent magmatic conduits similar to conduit 'd', which hosts the Eagle's Nest Ni-Cu-(PGE) deposit.

REFERENCES

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MORE INFO

Laudadio, A.B., Schetselaar, E., Houlé, M.G,. and Samson, C., 2018. 3D geological modelling of the Double Eagle – Black Thor intrusive complexes, McFaulds Lake greenstone belt, Ontario; in Targeted Geoscience Initiative: 2017 report of activities, volume 2, (ed.) N. Rogers; Geological Survey of Canada, Open File 8373, p. 35–41. https://doi.org/10.4095/306599

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