DISCOVERY OF NEW OFFSET DYKES AND INSIGHTS INTO THE SUDBURY IMPACT STRUCTURE.

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Introduction: Offset dykes are part of the Sudbury Igneous Complex (SIC) which is interpreted as impact melt within the Sudbury impact structure [1].

In recent years, while exploring for Ni-Cu-PGE deposits, Wallbridge Mining Company Limited (Wallbridge) has mapped significant extensions to the Hess, Ministic, and Manchester Offset dykes; has identified the new Trill and Cascaden Offset dykes; and has identified several new types of dykes of possible SIC affinity including the Pele granophyre dykes, several quartz gabbro dykes and several pyroxenite dykes (Figure 1).

The geometry of these new dykes around the SIC and their observed field relationships provide new insights into the formation of the Sudbury impact structure and raise significant new questions.

Background: The SIC melt sheet forms a large differentiated body consisting of an upper granophyre layer underlain in sequence by quartz gabbro, norite, the lower ore bearing sublayer, and the underlying ore bearing Offset dykes. The Offset dykes fill radial and concentric fractures around the SIC and are traditionally separated into quartz diorite and inclusion quartz diorite phases that vary compositionally between quartz monzodiorite, granodiorite, and tonalite [1].

Discussion: The original pre-erosional extent of the crater and SIC is not known. The Foy and Hess Offsets show continuity in the field indicating that the radial and concentric Offset dykes were emplaced during one event [2]. If the dykes originate from the SIC, both likely intruded downwards into the footwall rocks from an overlying and now eroded portion of the crater and SIC, rather than through outward injection.

Small apophyses of the Offset dykes gradually terminate into pre-existing conjugate joint fractures suggesting passive intrusion and stoping of wall rocks, rather than forceful injection.

Inclusion free and at least two variants of inclusion bearing quartz diorite are observed in the Offset dykes. There appear to be gradational contacts between pyroxene, amphibole-biotite, and biotite bearing phases, which occur both with or without magnetite. Inclusion bearing phases contain inclusions of quartz diorite and are mostly associated with disseminated to massive Ni-Cu-PGE sulfide; however, mineralized examples of inclusion free quartz diorite do occur. The Offset dykes range from medium grained in thicker sections, to glassy and aphanitic within chilled margins and narrow aphosyses which are often spherulitic.

Several new types of dykes of possible SIC affinity have been identified. The Pele dykes are texturally and compositionally similar to the upper granophyre of the SIC, the quartz gabbro dykes resemble the middle quartz gabbro layer of the SIC, and a series of pyroxenite dykes resemble exotic pyroxenite inclusions described within the sublayer of the SIC [3].

The timing relationship of the new types of dykes is unclear. In particular, any mechanism for tapping of the upper granophyre and quartz gabbro layers for intrusion into the footwall rocks may provide constraint on the cooling history and/or the nature of the overlying now-eroded portions of the SIC.

Mafic to ultramafic inclusions within the sublayer have been much discussed and the identification of similar dykes in the footwall with mapped strike lengths of >5 km is noteworthy. These dykes may represent an ultramafic component to the SIC not previously documented.

Finally, the curvature of the concentric Hess Offset dyke may constrain the centre of the original crater to somewhere near the Copper Cliff Offset dyke to the south of the SIC, providing a possible constraint on the original size of the impact structure.

References: [1] Ames, D.E., and Farrow, C.E.G. (2007) GAC, SP5, 329-350. [2] Pilles, E. A., Osinski G. R., Grieve R. A. F., Smith, D. A., and Bailey, J. M. (2013) *this volume* [3] Lightfoot, P.C., Doherty, W., Farrell, K., Keays, R.R., Moore, M., and Pekeski, D. (1997) *OGS OFR*, 5959.

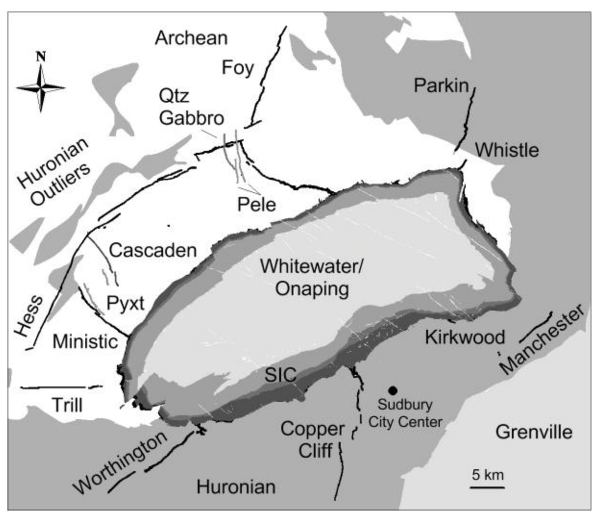

Figure 1. Impact related dykes at the Subury structure.