The Foy Offset Dike, Sudbury impact structure, Ontario, Canada

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The extent of the Foy Offset Dike is controlled by a radial fault/fracture which is connected by a widened neck, known as the embayment, to the 1.85 Ga Sudbury Igneous Complex (SIC). The Foy Offset Dike is known to be the longest structure of its kind, extending ~37 km northwards into the Superior Province. Main dike lithologies, away from the embayment, comprise a polymict impact melt breccia enclosed within an igneous groundmass of granodioritic composition. The embayment groundmass is of quartz dioritic (QD) composition. Substantial ore reserves, associated with the dike, could become the subject of future mining operations. For this reason it may prove important to understand the circumstances under which these deposits were formed.

Various lithologies have been identified within the dike and embayment. These lithological variations have subtle and discreet geochemical differences. The ratio of inclusions to melt has also been quantified using point count analysis on various outcrops. Collectively, these data can be used to interpret the emplacement mechanism of the dike.

Radial dikes are only found at Sudbury and at no other impact structure. As such they require a unique set of conditions in which to form. We believe radial dike emplacement is not likely produced during the excavation stage since other craters do not possess such features. Also, pressures upon excavation are not conducive to the opening of fractures and melt injection. We propose a novel interpretation for the Foy, as a radial dilation fracture that was generated during the rebound of the collapsing transient cavity during the modification stage of cratering.

The inclusion-poor margins are interpreted to be the result of a depressed crystallization temperature associated with increased water content from wall rocks. This efficiently aids the assimilation of inclusions. We interpret embayment rocks as a captured differentiate from the evolving SIC. The geochemical signature of the main dike rocks represent the bulk chemical composition of the target rocks. The proportions of inclusion lithologies and their distribution with strike are inconsistent with lateral injection from the SIC outwards, as has previously been interpreted. The dominant inclusion lithology is representative of the adjacent host rock. Crater scaling equations suggest that the Sudbury structure could be the largest meteoritic impact on Earth.