

# Geology, Mineralization, and Emplacement of the Whistle-Parkin Offset Dike, Sudbury\*

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## Abstract

The Whistle-Parkin dike is a 12-km-long radial offset dike located in the northeast sector of the 1.85 Ga Sudbury impact structure. The dike is connected to the Sudbury Igneous Complex via a 0.5-km-long, 250-m-wide embayment. The Whistle segment of the dike narrows to a width of approximately 30 m and extends for about 1.5 km from the complex, where it is cut by the Post Creek fault zone. This fault displaces the dike 2 km to the northwest, beyond which it continues as the Parkin portion of the dike. The Parkin segment extends a further 10 km north-northeast. The dike and genetically associated embayment are comprised of numerous rock types. These include the sublayer, radial breccia, mafic sulfide-bearing breccia, inclusion-rich quartz diorite, and inclusion-poor quartz diorite. Economic Ni-Cu-PGE mineralization is found in association with the sublayer, mafic sulfide-bearing breccia, and inclusion-bearing quartz diorite phases. Rare earth element (REE) data reveal that the dike lithologies are representative of bulk Sudbury Igneous Complex melt.

We propose a multistage emplacement mechanism for the dike. The breccia units, including the inclusion-bearing quartz diorite phase, were forcefully injected laterally into an impact-generated radial crack during the excavation stage of crater formation. Subsequent early modification processes facilitated the intrusion of inclusion-poor quartz diorite, particularly along the dike margins. Inclusion-poor quartz diorite emplacement may have been gravitationally driven from the overlying impact melt sheet. Later stage modification (i.e., final transient cavity collapse) caused decoupling of the Whistle and Parkin dike segments via faulting. This occurred concurrently with the settling of the sublayer unit and associated economic sulfides into the embayment and main dike segments.

\*University of New Brunswick Planetary and Space Science Centre contribution 25.

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