Emplacement of Sulfide Deposits in the Copper Cliff Offset Dike during Collapse of the Sudbury Crater Rim: Evidence from Magnetic Fabric Studies

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Abstract

Quartz diorite offset dikes in the country rocks surrounding the 1.85 Ga Sudbury impact structure were emplaced within fractures formed during hypervelocity impact, providing conduits for the injection of quartz diorite impact melts. The offset dikes host major Ni-Cu-PGE deposits, with the radial Copper Cliff dike hosting ~15 percent of the known Sudbury ore. The anisotropy of magnetic susceptibility of the Copper Cliff dike was studied to determine the nature of the fabrics that developed during emplacement of the quartz diorite and the associated sulfide bodies. The anisotropy of magnetic susceptibility reveals a predominantly northwest-southeast-striking, steeply dipping foliation and a steeply northwest- to vertically plunging lineation. The foliation along both the eastern and western sides of the dike is counterclockwise-oblique to the north-south to north-northwest–south-southeast-striking, vertically dipping dike margins. The magnetic fabrics in the dike are consistent with a component of strike-slip displacement during emplacement of the quartz diorite melt. The data are interpreted to indicate that the Copper Cliff dike acted as a melt-lubricated dextral transfer fault during collapse of the inferred inner rim of the central peak ring to accommodate ultra-high strain rate displacements on previously documented pseudotachylite-rich normal fault zones. Collapse may have caused injection of sulfide-rich melts into the Copper Cliff dike leading to the formation of Cu-Ni-PGE deposits. Collapse of the inner rim of the central peak ring is thought to have occurred too soon after the impact to allow for fractionation of the sulfides from the impact melt sheet. Therefore, it is suggested the sulfide-rich impact melts were derived principally from the target rocks.

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