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U-Pb DATING OF A DIABASE DIKE RESOLVES THE PROBLEM OF MUTUALLY CROSSCUTTING RELATIONSHIPS WITHIN THE FRASER-STRATHCONA DEEP COPPER VEIN SYSTEM, SUDBURY BASIN

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Abstract

A geologic problem has been addressed in the Fraser-Strathcona Deep Copper mine, Sudbury, wherein diabase dikes and the chalcopyrite vein system have a mutually crosscutting relationship. In any situation where crosscutting relationships are mutual there is ambiguity, and it is important to independently test and verify the ages of the events in question, thus avoiding erroneous conclusions about the controls on mineralization. To this end detailed underground geologic mapping and U-Pb dating have been applied to a diabase dike that crosscuts the 1850 Ma Sudbury Igneous Complex and footwall Cu-Ni-PGE vein mineralization. The dike has a minimum 1.5 km strike length, 2.2 km dip length, and a width of 20 m. Where the dike cuts the Cu-Ni-PGE vein system there are (1) sharp contacts with the dike clearly cutting chalcopyrite veins, (2) laminated chalcopyrite-pyrrhotite-pentlandite veins along the hanging-wall or footwall contacts of the dike, and (3) back veining in the form of 0.5- to 2 m-wide remobilized sulfide veins and stockworks that cut the dike.

Magmatic zircons from the diabase have a concordant ²⁰⁶Pb/²³⁸U age of 506 ± 4 Ma, whereas abundant xenocrystic zircons have ages of 1810 to 1840 Ma and appear to have been derived from the Sudbury Igneous Complex. Magmatic titanite from the dike defines a highly discordant array of points with an upper intercept at 530 ± 21 Ma, although the titanite analyses are not precise. The discordance results from recent Pb loss, which may have been related to brittle fracturing and fluid infiltration during exhumation and mild deformation.

The diabase dike is interpreted to be part of the 500 to 600 Ma extension and rifting that formed the Ottawa-Bonnechere graben and related features during rifting of eastern North America prior to the opening of the Iapetus Ocean. It represents the youngest intrusive event within the post-impact geologic history of the Sudbury structure.

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