

Structural and Metamorphic History in the South Range of the Sudbury Footwall, Ontario, and its Implications for Low-Sulfide PGE Mineralization

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The 1.85 Ga Sudbury Igneous Complex (SIC), which is interpreted as a fractionated impact melt sheet, is host to several world-class nickel-copper-platinum group element (Ni-Cu-PGE) and PGE-rich deposits. The PGE-rich systems are found in the thermally metamorphosed and brecciated country rocks underlying the SIC, and are subdivided into two overlapping types of mineralization: sharp-wall Cu-Ni-PGE veins and low-sulfide PGE mineralization. Although less common, the low-sulfide end-member represents an economically significant style of mineralization, and is the least understood type of deposit in the area. Most of the current knowledge on low sulfide PGE-rich systems is based on the North and East Ranges of the Sudbury structure. Consequently, this thesis study was undertaken to better understand low sulfide PGE deposits in the South Range that has undergone a more complex deformation and metamorphic history, resulting in a strong overprint on mineralization. Host rocks to the SIC in the study area consist of Archean granitic rocks, sedimentary rocks of the Huronian Supergroup, and numerous gabbroic sills and dykes. At least some of the deformation and metamorphism in the South Range occurred during long-lived, pre- and post-SIC, orogenic events. Structures attributed to at least two deformational events (D_1 - D_2) were identified during detailed outcrop-scale mapping and sampling in the Drury Township along the south rim of the SIC. First, a NNE-SSW compressional event (D_1) produced isoclinal F_1 folds with a strong axial planar S_1 foliation overprinting 2.22 Ga Nipissing mafic intrusives. Syn-tectonic staurolite and chloritoid porphyroblasts within the Huronian sedimentary rocks indicate upper greenschist to amphibolite grade conditions during D_1 . A second deformation event (D_2) is represented by a strong, north-trending, crenulation cleavage dextrally displacing the earlier fabric. The cleavage either formed during E-W compression or sinistral shear, as previously reported elsewhere in the South Range. A strong, steeply dipping stretching lineation (L_2) is recorded across the township within all rock types including the pseudotachylitic impact-generated Sudbury breccia, indicating that D_2 is a post-impact event. Characterizing the multiple deformation events that affected the Sudbury structure and determining their relative timing with respect to mineralization is key to enhancing our understanding of the mechanical, metamorphic, and/or hydrothermal processes involved in formation of these deposits. Ultimately, the results of this study will contribute to the development of genetic models for low-sulfide PGE mineralization in the South Range of the SIC.