RECENT ADVANCES IN UNDERSTANDING TECTONICALLY INDUCED CRATER FLOOR MODIFICATION AT SUDBURY: IMPORTANCE FOR THE IDENTIFICATION OF Cu-Ni SULPHIDE EXPLORATION TARGETS. U. Riller[1], M. Clark[2], I. Lenauer[3], T. Santimano[4]. [1]Institut für Geologie, Universität Hamburg, Bundesstrasse 55, 20146 Hamburg, Germany, [2]McMaster University, Hamilton, Canada. [3]SRK Consulting Inc. (Canada), Suite 1300, 151 Yonge St, M5C 2W7 Toronto Canada. [4]Deutsches Geoforschungszentrum, Telegrafenberg, C 122, 14473 Potsdam, Germany.

Introduction: Understanding post-impact shape change of the 1.85 Ga Sudbury Igneous Complex (SIC), the relic of a deformed impact melt sheet, and its host rocks, is paramount for Ni-, Cu- and PGE-mineral exploration. Respective mineral deposits related to the layered Main Mass of the SIC are found: at its base, notably in the Sublayer; in its immediate periphery; and in the physically connected so-called Offset Dikes. Together with the Main Mass, overlying melt-breccias of the Onaping Formation and post-impact sedimentary rocks form the Sudbury Basin. Non-cylindrical folding and northwest-directed reverse faulting of the Main Mass are commonly accepted as the main deformation processes that generated this fold basin. In detail, however, individual segments of the SIC, notably the North Range, the South Range and the East Range, and their respective host rocks deformed by different mechanisms. These mechanisms are delineated as follows, along with their implications for occurrence of specific mineral deposits.

The North Range: The North Range is considerably less deformed than the East Range and the South Range. The North Range was affected mostly by discontinuous deformation and solid-body tilting of less than 30° toward the SE [1]. Consequently, geometric relationships of lithological contacts in the North Range remained largely pristine and, thus, offer insight into the original crater floor geometry. Analysis of high-resolution topographic data [1] suggests that the North Range SIC is ponded due to the possible presence of a peak ring [2]. The topography of the final crater floor, i.e., after thermal erosion of target rock, is characterized by amplitudes of up to 400 m over wave lengths of hundreds of metres to a few kilometres, and amplitudes of up to 1500 m over a wave length of about 25 km. The crater floor depressions are spatially associated with a thickened Quartz Gabbro–Norite layer and Sublayer hosting economically important sulphide mineral deposits. This relationship points to a viable exploration strategy [3].

The East Range: In terms of first-order structure, the East Range is made up by two synclines, the NE-lobe and the SE-lobe, and an anticline in between. Spatial analysis of the strike of Paleoproterozoic dyke segments in host rocks indicates the location of the anticline, referred to as the West-Bay Anticline [4]. The anticline is characterized by abrupt plan-view thickness variations in the lower SIC and curved faults displaying significant strike separations and repetition of SIC contacts. Sublayer embayments and associated Offset Dikes likely served as zones of mechanical weakness, at which the higher-order folds localized under NW-SE shortening. Ore bodies in the East Range are, thus, expected to be displaced on discontinuities adhering to NW-SE shortening.

The South Range: Deformation in the South Range is highly heterogeneous, evident by the orientation of metamorphic mineral shape fabrics and folds as well as shortening directions inferred from brittle shear faults [5, 6, 7]. Overall, deformation involved simultaneous shearing on the South Range Shear Zone and variable tilting of the SIC and adjacent target rocks [5], which can be explained by trishear deformation [7]. This deformation mechanism can account for large rotation magnitudes of, and strain intensities in, the SIC as well as rather low rotation magnitudes and strains in adjacent host rocks. Thus, trishear deformation has important consequences for the downward projection of sulfide-rich zones in Offset Dikes.

During trishear deformation the plan-view geometry of the SIC likely changed from convex outward to concave inward [7]. This shape change imparted local contact-parallel shortening that caused corrugation of SIC contacts and thickness variations of individual SIC layers. Such variations have important ramifications for estimating the sulphide content at the base of the SIC. In particular the thickness of the felsic Norite, which is depleted in sulphides, relates to the sulphide concentration at the base of the SIC [3]. Thus, caution is required not to overestimate potential sulphide concentrations at the base of tectonically thickened SIC segments.

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