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Geometries of deformed granitoid inclusions in the Sudbury Igneous Complex of the Sudbury Impact Structure, Canada: Evidence for deformation during solidification of the impact melt sheet

Iris Lenauer and Ulrich Riller
McMaster University, Geography & Earth Sciences, Hamilton, Canada (lenauei@mcmaster.ca)

The Main Mass of the 1.85 Ga Sudbury Igneous Complex (SIC) occupies the central portion of the Sudbury Impact Structure and represents an impact melt sheet that resulted from hypervelocity impact into Archaean and Proterozoic target rocks. During cooling, the ca. 3 km thick melt sheet differentiated into layers of norite, quartz gabbro and granophyre and now hosts one of the world's largest Cu-Ni-PGE deposits. Meteorite impact occurred apparently during an ongoing orogeny, i.e., the ca. 1.89 to 1.80 Ga Penokean orogeny. However, structural evidence for this is still sparse

Dike-like, granitoid inclusions are exposed in the norite layer of the southern SIC. Here, sub-planar inclusions are folded and characterized by axial-planar cleavage. More specifically, fold mullions of the granitoid inclusions formed by layer-parallel NNW-SSE shortening. Cuspate-lobate geometries of the inclusion interfaces indicate that the granitoid inclusions were mechanically more competent than the norite host rock during ductile deformation of both lithologies. The contrast in mechanical strength between granitoid inclusions and norite host rock indicates ductile deformation at high temperature and low strain rates in the unconsolidated melt sheet. Shortening directions inferred from the geometry of the inclusions agree with those obtained from inversion of brittle-ductile faults from the same area, geometry of deformation in the metasedimentary strata of the Proterozoic target rocks and l-s mylonitic fabrics developed in the granophyre layer of the SIC and the overlying impact melt breccias. Collectively, these structural characteristics indicate that orogenic deformation in the Sudbury area occurred during cooling and solidification of the impact melt sheet.