Calculating phase equilibria for two proposed parental Sudbury magmas

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The major problem of the Sudbury impact structure is the origin of the *Sudbury Igneous Complex*. It includes the 2.5 km thick Main Mass consisting of mafic to felsic norites, a layer of oxide-rich quartz-gabbro, and granophyres. This body is interpreted to represent either a differentiated impact melt sheet, or a hybrid endogenic magma. Using the COMAGMAT model, equilibrium and fractional crystallization were computed at 1 atm with two proposed parental liquids - *SIC* (granohyres:norites=2:1) and *Quartz-Rich Norite*. The liquidus temperatures are 1120°C for the *SIC*, and 1180°C for the *QRN* melts. The crystallization sequence for *SIC* is: *Opx* → *Opx+Pl*→ *Opx+Pl+Aug* → *Opx+Pl+Aug+Mt*. For *QRN*, we observed *Ol* as the first phase. The calculated liquid lines of descent show that the *SIC* composition can produce ~70% of a residual melt containing > 67 wt% SiO_2. The quartz-rich norite magma can generate only 30% of such a "granophyric" liquid. These results would imply that fractionation of the *SIC* parent can potentially produce the huge observed mass of granophyres, constituting up to 2/3 of the Main Mass. We have numerically simulated *in situ* magma differentiation with regard to silica-rich melt, trapped as intercumulus material. Results of computations evidence that even in the case of the silica-enriched *SIC* parent, the total amount of "granophyres" does not exceed 12 vol% of the modeled Main Mass. These results indicate that under the assumption of a closed melt system evolution of the Main Mass, granophyres in *their present volume* did not originate by differentiation of the norites *in their presently known volume*.