Stable Isotope and Nitrogen Content Analyses of Victor Mine Diamonds

Mitchell Galarneau, Thomas Stachel, Richard Stern

We studied 19 Type I (i.e. nitrogen bearing) diamonds from the Victor Mine, of the Jurassic Attawapiskat kimberlite field, in the James Bay Lowlands of Northern Ontario. These analyses were undertaken to understand the growth modes of Victor Mine diamonds. Initially, for all 19 samples the total nitrogen content and the aggregation stage of nitrogen was analysed using FTIR (Fourier Transform Infrared) spectroscopy and CL (cathodoluminescence) images were obtained via SEM to gather information about zonation patterns. Based on this work, seven diamonds were selected for more detailed SEM imagery, FTIR spectroscopy, and SIMS (secondary ion mass spectrometer) analysis. The SIMS analyses yielded the isotopic composition of carbon (δ13C) and nitrogen (δ15N), and the nitrogen concentration along analytical transects.

The overall compositional trend of the diamonds corresponds to smoothly decreasing nitrogen contents from core to rim, suggesting a single growth event. Some samples contained well defined areas of low to no nitrogen (Type II diamond) that may represent inclusions of an older generation of diamond. In three diamonds, such nitrogen poor/free zones occurred around mineral (garnet) inclusions, suggesting that these mineral inclusions actually relate to an earlier phase of diamond formation. Based on the SIMS stable isotope and nitrogen content analyses, the growth mode of Victor diamonds seems less complex than anticipated, yet future research will need to be done to confirm this.