Spectroscopic analysis of yellow diamond

MY Lai[a], and T Stachel[a]

[a] Earth and Atmospheric Sciences, University of Alberta, AB, Canada

The spectroscopic features of 211 yellow diamonds from Ekati (Northwest Territories, Canada) and Chidliak (Hall Peninsula, southern Baffin Island, Canada) were studied to investigate the optical centers that cause their colors.

The color of diamond, as perceived by human eye, is a result of light absorption or emission by optical centers, which are defects in the diamond lattice caused by impurities, deformation or irradiation. The most abundant impurity in diamond is nitrogen, due to its similar ionic radius and charge compared to carbon. Nitrogen-related defects are the essential causes for yellow diamonds. The concentration and aggregation states of nitrogen are the controlling factors for the hue and saturation of yellow coloration. With the aid of a Fourier Transform Infrared (FTIR) spectrometer, the nitrogen content of diamond can be accurately detected.

Diamonds are classified into Type I (with significant amounts of nitrogen) and Type II (nitrogen content below the detection limit of FTIR). Currently, there has been no record of any yellow diamond classified as Type II, supporting the fact that nitrogen is a crucial factor causing this coloration. Nitrogen can appear in diamond in different aggregation states: C-centers (single substitutional nitrogen atoms), A-centers (pairs of two nitrogen atoms) and B-centers (rings of four nitrogen atoms surrounding a vacancy).

Followed by deconvolution of the nitrogen absorption region in IR spectra, the abundance and relative proportion of these centers can be calculated, which in turn unveil the residence temperature (for a given residence time) of diamonds in Earth's mantle. In combination with the characterization of other material properties of diamond, such as morphology, the results of this study are useful for assessing the environment for crystallization and mantle residence of yellow diamonds from Ekati and Chidliak.

Corresponding author: meiyan1@ualberta.ca