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Developments in FTIR spectroscopy of diamonds and better constraints on diamond thermal histories

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Fourier Transform Infrared (FTIR) spectroscopy is a commonly-used technique for investigating diamonds. It gives the most useful information if spatially-resolved measurements are used [1]. In this contribution we discuss the best way to acquire and present FTIR data from diamonds, using examples from Murowa (Zimbabwe), Argyle (Australia) and Machado River (Brazil). Examples of FTIR core-to-rim line scans, maps with high spatial resolution and maps with high spectral resolution that are fitted to extract the spatial variation of different nitrogen and hydrogen defects are presented. Model mantle residence temperatures are calculated from the concentration of A and B nitrogen-containing defects in the diamonds using known times of annealing in the mantle. A new, two-stage thermal annealing model is presented that better constrains the thermal history of the diamond and that of the mantle lithosphere in which the diamond resided. The effect of heterogeneity within the analysed FTIR volume is quantitatively assessed and errors in model temperatures that can be introduced by studying whole diamonds instead of thin plates are discussed. The kinetics of platelet growth and degradation will be discussed and the potential for two separate, kinetically-controlled defect reactions to be used to constrain a full thermal history of the diamond will be assessed.

[1] Kohn, S.C., Speich, L., Smith, C.B. and Bulanova, G.P., 2016. FTIR thermochronometry of natural diamonds: A closer look. Lithos, 265, pp.148-158.