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Isomekes: A fundamental tool to determine the formation pressure for diamond-inclusion pairs

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Because diamond is almost chemically pure carbon and extremely chemically inert, the structure and chemistry of diamond reveals very little about its conditions of formation. Much of what is believed about the genesis and distribution of diamond in the Earth's mantle has therefore been deduced indirectly from the characterisation of its mineral inclusions. The possible depths of entrapment of an inclusion within a host phase (and hence the depth of growth of the host diamond) can be determined if (1) the final pressure of the inclusion can be measured, (2) the Equations of State (EoS) of the host and inclusion phases are known, and (3) the elastic interaction between the host and inclusion can be calculated without gross assumptions. Given knowledge of all three, an isomeke line in P-T space (from the Greek "equal" and "length", Adams et al. 1975) can be calculated. The isomeke defines the conditions at which the host and inclusion would have had the same P, T and volume, and thus represents possible entrapment conditions.

The recent application (Nestola et al. 2011; Howell et al. 2012) of in-situ diffraction techniques to the measurement of entrapped inclusions provides accurate final inclusion pressures. We have reformulated the elasticity problem so that, unlike previous work, these calculations can be performed with any form of equation of state and thermal expansion, and are not restricted to linear elasticity or just invertible EoS. This alone has significant advantages in the precision of the calculated depths of formation. Numerical calculations have been performed with a new module of EoS routines (Angel et al. 2014) that has been added to the publicly-available CrysFML library. The question remains as to what uncertainties in calculated depths of formation arise from uncertainties in experimentally-determined EoS. We will present two geologically-relevant examples, for olivine and garnet in diamond. Our calculations show that there is still a clear need for experimental data of higher accuracy. For example, for the case of garnet in diamond the uncertainties in published thermal expansion coefficients of garnets (from 2.0 to 2.6*10-5 K-1) and in the bulk modulus of diamond (442 to 446 GPa) lead to uncertainties in calculated depths of inclusion entrapment of the order of 30km. Larger errors arise from the use of incorrect forms of EoS.

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Adams HG, Cohen LH, Rosenfeld JL (1975) Am Mineral 60:574–583
Angel RJ, Gonzalez-Platas J, Alvaro M (2014) Z Kristallogr, submitted.
Howell, D, Wood, IG, Nestola, F, Nimis, P, and Nasdala, L (2012) Eur J Mineral, 24(4): 563-573.
Nestola, F., Nimis, P., Ziberna, L., Longo, M., Marzoli, A., Harris, J.W., Manghnani, M.H., and Fedortchouk, Y. (2011) EPSL, 305(1–2):249-255.