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The P-T conditions of garnet inclusion formation in diamond: thermal expansion of synthetic end-member pyrope

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Pyrope, Mg3Al2Si3O12, due to the abundance of garnet in Earths's upper mantle, has been studied many times. A number of different investigations have measured its physical and thermodynamic properties at high temperature or pressure and, even more recently, under simultaneous high P-T conditions (e.g. Zou et al., 2012). This abstract reports thermal expansion results on pyrope, as part of a much wider project on the determination of the physical properties of garnet, in order to obtain geobarometric information on the formation conditions of its inclusion in diamond. Our experimental approach is based on the elastic method (e.g. Izraeli et al., 1999; Howell et al., 2010; Nestola et al., 2011; Howell et al., 2012), which takes into account the thermoelastic properties of both diamond and any tiny solid phase inclusion within it. The method requires accurate and precise knowledge of thermal expansion and compressibility behavior in order to calculate precisely the pressure and temperature formation conditions of the diamond–inclusion pair. Thus, in order to do this, we measured the thermal expansion of an end-member synthetic single crystal of pyrope up to 1100 K at 52 different temperatures. This was done by measuring the ao unit-cell edge with high precision and accuracy under heating and cooling conditions. This allows excellent experimental reproducibility, which is also checked by monitoring any diffraction peak broadening over the entire range of temperatures. Fitting the temperature-volume data to the thermal expansion equation of Berman (1988), we obtained a room temperature volume-thermal expansion coefficient equal to 2.72(2)[U+F0B4]10-5K-1. Using the same pyrope crystal, in situ high-pressure measurements are now in progress in order to determine its isothermal bulk modulus. The use of our results, along with the dK/dT data of Zou et al (2012), we plan to calculate the pressure of formation of diamonds containing pyrope-rich garnet inclusions.

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