Geophysical Research Abstracts
Vol. 16, EGU2014-4247, 2014
EGU General Assembly 2014

The pressure-volume equation of state of a synthetic grossular Ca3Al2Si3O12

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In the framework of a wide research project focused on mineral inclusions in diamonds we have investigated the compressibility of a synthetic grossular garnet (Ca3Al2Si3O12) with the purpose of providing new constraints on the diamond geobarometry. In fact, not only garnets are among the important phases of the Earth upper mantle but at the same time are one of the main phases found as inclusion in diamonds. Garnets are a crucial marker in determining the origin source of diamonds, which can be eclogitic and/or peridotitic. In particular, peridotitic diamonds include garnets characterized by about 90-92% of pyrope-almandine with the grossular component reaching about 6-8%, whereas eclogitic diamonds have garnets with the grossular component increased up to about 20-22%. In order to obtain information about the depth of formation of the diamond-garnet pair, beyond the classical chemical method, we propose the so called “elastic method”, which is based on the knowledge of precise and accurate thermoelastic parameters for both diamond and inclusion (e.g. Nestola et al. 2011 and references therein). We have determined the pressure – volume equation of state of a pure synthetic grossular garnet by single-crystal X-ray diffraction up to about 8 GPa. The resulting equation of state coefficients, together with those previously determined for pyrope and almandine end-members and their intermediate compositions (see Milani et al. 2013) will cover the compositional range of garnets found as inclusions in diamonds, allowing to construct a robust model to predict the elastic parameters for any garnet composition typical of eclogitic and/or peridotitic diamond.

The research was funded by the ERC Starting Grant to FN (grant agreement n° 307322).

References

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