P-V-T of complex garnet solid solutions up to 16 GPa and 800K

CHRISTOPHER BEYER[1], TIZIANA BOFFA-BALLARAN[1], ALEXANDER KURNOSOV[1] AND DANIEL J. FROST[1]

[1]Bayerisches Geoinstitut, University of Bayreuth, Germany
christopher.beyer@uni-bayreuth.de

Garnet is an important mineral because it is a major phase in the the upper mantle and dominates mafic rocks at these conditions. Therefore the elastic behavior of garnet solid solutions plays a major role in the interpretation of seismic data and is important for estimating the density contrast between subducting slabs and the surrounding mantle. We present high-pressure and high temperature single-crystal X-ray diffraction measurements, condcuted in an externally-heated DAC on three complex eclogitic garnet compositions. The experimental conditions covered pressures up to 16 GPa and temperatures up to 800 K. The compression behaviour shows that the almandine component has a strong effect on the bulk modulus of the solid solution, in fact 10 – 20 mole% of almandine is sufficient to overprint the reported minimum of the bulk moduli along the pyrope grossular join [1]. Minor compositional variations of Ca and Mg within the Mg-Fe-Ca garnet ternary are not resolvable within the analytical errors. In contrast to previous studies, no evidence was found that garnets have a K' significantly different from 4. The high-temperature experiment revealed that the relatively small fraction of almandine in a solid solution increased the softening of garnet with temperature, yielding a $(\partial K_T/\partial T)_P$ of -0.026(1) GPa K^{-1}. Finally, the experimental volumes and calculated densities have been compared to self-consistent thermodynamic models [2] [3]. The comparison clearly revealed that volume and elastic properties cannot be linearly interpolated as a function of composition. Moreover, it has been shown that the excess properties vary not only as a function of composition and pressure, but also as a function of temperature.

[1]Du, W, Clark, S.M., Walker, D. (2015) *Am. Min.* **100**, 215-222 [2]Stixrude, L. & Lithgow Bertelloni, C. (2005), *Geophys. J. Int.* **162**(**2**), 610-632 [3]Stixrude, L. & Lithgow Bertelloni, C. (2011), *Geophys. J. Int.* **184**(**3**), 1180-1213