

Equation of State of Mantle Pyrope

L. Wang (SUNY, Stony Brook)

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Introduction: Pyrope garnet is a major mineral in the Earth's upper mantle with a volume fraction approaching 40% in the transition zone owing to the dissolution of pyroxene into garnet. Hence, its physical properties are important for geophysical modeling to decipher the mantle composition and for understanding the mantle as a whole. Previous studies have been focused on the end member compositions, and EOS study on the natural mantle pyrope has not been conducted. In addition, mantle pyrope often contains significant amount of Cr_2O_3 , the effect of which on the physical properties of garnet is also unknown. I carried out this experiment to address these problems.

Methods and Materials: The high pressure (P), high temperature (T) experiment was conducted using multi-anvil press SAM85 coupled with a DIA-type device. The sample was compressed to the target pressure at room T , and then heated to the desired temperature. The diffraction patterns were collected at each condition following a standard P - T path for EOS study. The samples are natural pyrope crystals from the Four Corners area, Southwestern USA. They were brought up from the mantle to the surface by the explosive eruption of ultramafic diatremes. One crystal has a composition close to $\text{Py}_{71}\text{Alm}_{16}\text{Gr}_{13}$ and contains 3.8 wt% Cr_2O_3 . The second crystal has similar composition, but it contains almost no Cr_2O_3 .

Results: Analysis of collected data is under way. The results will provide the equation of state of pyrope under the upper mantle conditions, and constrain the elastic properties of garnet solid solutions. Comparison of two samples will testify the effect of Cr_2O_3 .