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X-ray Diffraction Study of the Phase Boundary Between High-Clinoenstatite and Ringwoodite + Stishovite

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Introduction: The phase transformation of high-clinoenstatite to ringwoodite + stishovite has important implications for the structure of the Earth's transition zone (410 – 670 km). It has been proposed that the 520-km seismic discontinuity could be due to this phase transformation. However, the conditions at which the transformation occurs remain poorly defined. This experiment is to determine the phase boundary using in situ X-ray diffraction technique.

Methods and Materials: The starting material is synthetic orthopyroxene (Mg90). The powdered samples were dried in a vacuum oven at 160ºC for several hours prior to sample loading. Powdered NaCl (mixed with BN) was used as the pressure standard. The sample assembly was compressed to about 17 GPa at room temperature using the 250-ton LVP coupled with a T-Cup device. Temperature was then increased up to 1000ºC. Following quenching from this temperature, the oil pressure was increased again to achieve higher pressure. Temperature was increased again up to 1200ºC. X-ray diffraction data were collected at each temperature to monitor the phase transformation. The pressure was calculated based on the Decker's EOS of NaCl and the temperature was measured by a W-3%Re/W-25%Re thermocouple.

Results: We did not observe the phase change of high-clinoenstatite to ringwoodite + stishovite at all conditions in the current experiments. This could be due to either that we did not cross the phase boundary or that the kinetics of transformation is too sluggish at temperatures used, or both. Attempt to obtain higher temperature failed because of a blowout. Further experiments are needed to investigate this subject.

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