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Mineralogy of Martian Interior of Isotopic Chemical Model

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Abstract

The InSight mission, slated for a November, 2018 landing on Mars, will conduct geophysical measurements to reveal the internal structure of Mars. Analysis of the InSight data will require high-quality mineralogical data at the pressure and temperature conditions expected for the interior of Mars. Martian mantle bulk chemical composition models have been proposed based on geochemical or isotopic models. These models vary significantly in the (Mg+Fe+Ca)/Si ratio, allowing variations between olivine:pyroxene ratios. Geochemical models tend to have divalent cation to silicon ratios closer to Earth pyrolitic models and higher than isotopic models, resulting in a larger ratio of olivine:pyroxene. Experimental investigations have been made on geochemical compositional models, but currently only a few simple predictions have been made on the isotopic compositional models. Utilizing a large volume press (LVP) and laser-heated diamond-anvil cell (LHDAC), the isotopic compositional models will be investigated. Mineralogy, chemical compositions of the minerals, phase boundaries, and equations of state of the minerals will be measured and investigated. The LVP will allow large volume samples to be prepared at multiple pressure and temperature conditions present in the Mars mantle (5-25 GPa and 1500-200K). EPMA, x-ray diffraction, Mössbauer spectroscopy, and raman spectroscopy will be used to analyze the samples. LHDAC at synchrotron facilities with in situ XRD and laser heating will be used to measure the equation of state of minerals and phase boundaries. Utilizing these techniques, the isotopic compositional model can be experimentally investigated to assist in the analysis of InSight data.