Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18793

Experimental approaches to the study of (exo)planetary interiors.

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Knowledge of the composition and interior structure of observed exoplanets is crucial in the search for habitable worlds by improving target selection for space missions. While our solar system provides important examples of the range of possible planet compositions and interiors for a Sun-like star, a much wider diversity of chemistry, layering, and thermal structure is required to explain the observed distribution of exoplanet masses and radii associated with other kinds of stars. Experiments can provide accurate measurements of phase equilibria and the physical and thermal properties of phase assemblages in the interiors of planets with diverse compositions and sizes. In this contribution we present two different avenues for experimental work conducted at high pressure and temperature conditions to investigate deep exoplanetary interiors. In the first set of experiments conducted between 20 and 60 GPa and up to 4000 K, we present results showing how experiments can constrain phase relations applicable to a range of planetary compositions. In the second, we present a new type of experiment designed to precisely map phase diagrams from calorimetry at high pressure and temperature. As an example, we will present results on the partial melting of iron and iron alloys. We will discuss how technological improvements make it possible to increase the accuracy and precision when determining melting phase relations, reducing uncertainties when extrapolating to the extreme pressures and temperatures of super-Earth and sub-Neptune exoplanetary interiors.