Probing the Thermodynamic Properties of Mantle Rocks in Solid and Liquid States

Thesis by

Aaron S. Wolf

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"Science has achieved some wonderful things, of course, but I'd far rather be happy than right any day." —The Hitchhiker's Guide to the Galaxy

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Abstract

Our understanding of the structure and evolution of the deep Earth is strongly linked to knowledge of the thermodynamic properties of rocky materials at extreme temperatures and pressures. In this thesis, I present work that helps constrain the equation of state properties of iron-bearing Mg-silicate perovskite as well as oxide-silicate melts. I use a mixture of experimental, statistical, and theoretical techniques to obtain knowledge about these phases. These include laser-heated diamond anvil cell experiments, Bayesian statistical analysis of powder diffraction data, and the development of a new simplified model for understanding oxide and silicate melts at mantle conditions. By shedding light on the thermodynamic properties of such ubiquitous Earth-forming materials, I hope to aid our community's progress toward understanding the large-scale processes operating in the Earth's mantle, both in the modern day and early in Earth's history.

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