SHOCK13-2013-000691
Abstract for an Invited Paper
for the SHOCK13 Meeting of
the American Physical Society

Thermodynamic Paths in Planetary Collisions: Shock Vaporization of SiO_2, MgO, and Fe

RICHARD KRAUS, Harvard University

The final stage of terrestrial planet formation is punctuated by a series of violent collisions that lead to the observed diversity of the surviving planets. These collisions are sufficiently energetic to melt and vaporize large fractions of the colliding bodies and affect their bulk composition. However, our understanding of the thermal and chemical evolution of the terrestrial planets is severely limited by our lack of knowledge of planetary materials at the conditions achieved during these giant impact events. I will describe my work to advance the state of knowledge of planet-forming minerals at the extreme states achieved during planetary collisions. I will focus on recent shock-and-release experiments performed at the Sandia Z machine under the Fundamental Science Program, where I am developing techniques to measure the temperature, density, and entropy along the liquid-vapor dome. Using magnetically accelerated flyer plates at impact velocities of tens of km/s, we can access the entire range of phase space relevant to the giant impact stage of terrestrial planet formation. Our data on SiO_2, MgO, and Fe highlight the importance of the entropy generation at high shock pressures, reveal the deficiencies of previous equation of state models, and are being used to constrain new multi-phase equations of state. I will discuss how these data will address key questions about the formation of planets inside and outside our Solar System.