SHOCK17-2017-000640

Abstract for an Invited Paper
for the SHOCK17 Meeting of
the American Physical Society

Dynamic compression of liquids and applications in geophysics and planetary science[1]

PAUL ASIMOW, Caltech

Shock and dynamic ramp compression offer a number of distinct advantages for the study of the liquid state at elevated pressure, including absolute density measurement without diffraction, absolute pressure measurement without reference to uncertain high-temperature calibrants, and absolute internal energy measurements to define thermodynamic states. Given the essential roles of silicate and metallic liquids in terrestrial planet formation and evolution, dynamic studies focused on properties of such liquids inform numerous debates in geophysics and planetary science. In this talk, I will review the current understanding of compression mechanisms of silicate liquids and the constraints obtained from simulation, dynamic experiments and static experiments. We will consider the precision necessary to answer key questions about density crossovers between liquids and their coexisting solids in multicomponent systems, the vexing question of silicate liquid heat capacity under planetary interior conditions, and the universal behavior of the Grüneisen parameter in such liquids. Applications include magma ocean evolution and seismic anomalies at the core-mantle boundary. Turning to metallic liquids, we will consider how simultaneous density and sound speed measurements in Fe alloy liquids can help to resolve the uncertain composition of Earth's core. Overtaking experiments on the Hugoniot, pre-heated ramp compression experiments with graded density impactors, and detailed release wave profiles all carry information about the sound speed and can be performed along the isentropes most likely to characterize the outer core.

[1]NSF EAR-1426526, EAR-1547575