Exploring silicate thermodynamics and conductivity at extreme conditions with laser-driven dynamic compression

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Dynamic compression experiments now allow recreating planetary interior conditions in the laboratory, providing valuable data on material properties at unprecedented pressures and temperatures.

We will report on decaying shock experiments on stishovite, quartz, fused silica using interferometric Doppler interferometry (VISAR) and streaked optical pyrometry (SOP) to document the melting line to 5 Mbar, equation of state and optical properties of SiO_2 up to 20 Mbars. Comparing the data along these three Hugoniot curves (P-T paths) provides a unique way to unravel how density affects the specific heat and electrical conductivity[1].

In addition, new shock temperature and sound speed measurements on $MgSiO_3$ along the enstatite Hugoniot reveal the melting temperature at 2.5 Mbar and allow us to accurately constrain the thermodynamics of the melt up to 7 Mbar. Finally, we will discuss how these new data contribute to a better understanding of the cooling of the magma oceans in young terrestrial planets and exo-planets.

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