Signatures of the Impact Histories of Comets and Asteroids within Shocked Phyllosilicates, Enstatite, and Forsterite Minerals

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Throughout the lifetime of the solar system, collisions between small bodies and impacts on the surfaces of small bodies in the Kuiper Belt have occured at speeds of 1.5 - 3 km s^{-1} (*Stern, Astron J 124, 2002*), typically at 1-10 km s^{-1} between Trojan asteroids (*Marzari et al. Icarus 119, 1996*), and at ~4-8 km s^{-1} in the asteroid belt (*Farinella and Davis, Icarus 97, 1992)*. Shock effects recorded by minerals composing these bodies are one observable legacy of this evolutionary process, whether they were generated through large collisions, micrometeoroid impacts, or processing during the formation of the solar system. Shock metamorphism has been observed in cometary samples such as those from Comet Wild 2 (*Keller et al. Geochim. Cosmochim. Acta 72, 2008; Tomeoka et al. MAPS 43, 2008; Jacobs et al. MAPS 44, 2009)* as well as in forsterites and enstatites found in meteorites (*McCausland et al. AGU, 2010*).

To investigate the observable signatures of these processes, we have conducted a suite of impact experiments at NASA Johnson Space Center's Experimental Impact Laboratory (EIL). Target materials included Mg-rich forsterite (olivine), Mg-rich enstatite (orthopyroxene), and antigorite and lizardite (both in the serpentine group of phyllosilicates).

Alumina-ceramic spheres were launched at speeds ranging from ~2.0 – 2.6 km s^{-1} into targets at temperatures from 25°C to -100°C. Recent advancements have been made in cooling targets in the EIL's vertical gun. Liquid nitrogen (LN_2) is fed through a unique jacket surrounding the metallic sample container to chill the samples. Real-time values from temperature sensors attached to the sample holder are converted to target temperature through predetermined regression relationships, providing the target temperature at the time of impact with sub-degree accuracy. Fourier Transform Infrared Spectrometer (FTIR) data in the near to mid-IR will be presented, along with trends relating temperature and velocity with impact speeds, and thereby peak shock stresses experienced by the impacted minerals.

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