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TITLE: Unveiling clues from Spacecraft Missions to Comets and Asteroids through Impact Experiments

ABSTRACT BODY:

Abstract (2,250 Maximum Characters): The Deep Impact Spacecraft mission was the first to boldly face the challenge of impacting the surface of a comet, 9P/Tempel 1, to investigate surface and subsurface 'pristine' materials. The Stardust mission to Comet 81P/Wild 2 brought back an exciting surprise: shocked minerals which were likely altered during the comet's lifetime. Signatures of shock in meteorites also suggest that the violent past of the solar system has left our small bodies with signatures of impacts and collisions. These results have led to the question: How have impacts affected the evolutionary path taken by comets and asteroids, and what signatures can be observed?

A future planetary mission to a near-Earth asteroid is proposing to take the next steps toward understanding small bodies through impacts. The mission would combine an ESA led AIM (Asteroid Impact Mission) with a JHU/APL led DART (Double Asteroid Redirect Mission) spacecraft to rendezvous with binary near-Earth asteroid 65803 Didymus (1996 G2). DART would impact the smaller asteroid, 'Didymoon' while AIM would characterize the impact and the larger Didymus asteroid.

With these missions in mind, a suite of experiments have been conducted at the Experimental Impact Laboratory (EIL) at NASA Johnson Space Center to investigate the effects that collisions may have on comets and asteroids. With the new capability of the vertical gun to cool targets in the chamber through the use of a cold jacket fed by liquid nitrogen, the effects of target temperature have been the focus of recent studies. Mg-rich forsterite and enstatite (orthopyroxene), diopside (monoclinic pyroxene) and magnesite (Mg-rich carbonate) were impacted. Target temperatures ranged from 25°C to -100°C, monitored by connecting thermocouples to the target container. Impacted targets were analyzed with a Fourier Transform Infrared Spectrometer (FTIR) and Transmission Electron Microscope (TEM). Here we present the evidence for impact-induced shock in the minerals through both spectra and TEM imaging and compare with unshocked samples.

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