

**EXTRATERRESTRIAL DELIVERY OF ORGANIC MATERIALS TO PLANETARY SURFACES: A COMPARISON OF NATURAL IMPACT PHENOMENA AND LABORATORY EXPERIMENTAL APPROACHES** J.G. Blank, NASA Ames Research Center and Blue Marble Space Institute of Science, MS 245-3 Moffett Field CA 94035 USA; jennifer.g.blank@nasa.gov

The influx of organic molecules from exogenous sources via impacts may be a dominant contributor to the prebiotic inventory of organic materials on planetary surfaces. This phenomenon may be important for, or vital to, the origin of life. A significant body of research has explored the production and modification of organic compounds as they are processed in this extreme way. This work has shown that high pressures associated with impacts retard the kinetics of reactions that involve bond breaking (e.g., pyrolysis) and promote polymerization of organic materials including simple hydrocarbons and peptides. Thus, impacts promote the generation of larger organic compounds as well as their destruction or modification.

Impacts generate high pressure shock compression and release, accompanied by high temperatures, high pressures, and extreme changes in tensile forces of variable duration. This dynamic shock regime differs substantially from a static high pressure event. A large range in scale associated with impact phenomena, encompassing several orders of magnitude or more, challenge the design of laboratory experiments and selection of appropriate apparatus. Impact phenomena can be modeled using hydrodynamical simulations, but the parameters utilized by these codes rely on material equations of state gleaned from empirical data. In addition, durations of impact simulations are usually short. For example, the duration of shock loading is proportional to the width of the impactor, and asteroids and comets may be meters or kilometers in diameter and have accompanying shock compression event of up to  $\sim 1$ s duration if solid; simulation runs typically cover events lasting nanoseconds to milliseconds. The conditions of shock are also influenced by impact velocity, and extraterrestrial impact velocities are typically tens of km/s. Impactor material density and strength are other key parameters that influence shock response, and values for extraterrestrial objects are loosely constrained or represented by average values determined by remote observation.

Material heterogeneity in composition, grain size, and pore space affect its strength and add additional complexity resulting from differences in compression/expansion and phase stability. One way to minimize heterogeneity in experimental samples is by use of powdered materials. However, powders introduce additional features, such as pore spaces, and thus respond differently than solid materials during the shock deformation process.

This presentation will provide an overview of the physics of impact phenomena relevant to exogenous delivery of organic materials. I will focus on conditions associated with comet and asteroid impacts on Earth, Mars, and Europa and discuss the degree to which experimental studies succeed and fall short of mimicking these scenarios as we envision them. I will use examples of experimental results from the literature and new molecular dynamical simulations of hydrated amino acids to help illustrate relevant processes and possible chemical products.