Space Studies of the Earth-Moon System, Planets, and Small Bodies of the Solar System (B)
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TAMING THE UNTAMABLE: MAKING AN ENCELADULS-LIKE PLUME BY HYPERVELOCITY OBLIQUE IMPACTS AT THE NASA AMES VERTICAL GUN RANGE (AVGR) FACILITY

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Enceladus' plume was extensively investigated by the Cassini-Huygens mission [1-4], giving information about the icy moon interior, and the existence of a plausibly inhabited global ocean. The plume is a mixture of gas, sub-micrometer to micrometer ice, and non-ice particles, expanding into space from vents in the Tiger Stripes region [5]. Collecting plume's ice particles for signs of Life is a fundamental objective of future fly-by missions to Enceladus, and other icy moons, e.g., Europa, where icy plumes could exist. However, understanding particle collection on high-speed flybys through a plume environment is a challenging task. To address the above, in collaboration with the Applied Physics Laboratory (APL), we have been testing the collection of impact-generated ice grains from simulated ice plumes at the NASA Ames Vertical Gun Range (AVGR) facility [e.g., 6-7].

Of particular interest is the alteration of organic material in the particles during the high-speed collection process. Any such alteration could degrade the ability of instruments to detect biomarkers in the samples collected. An experimental and theoretical understanding of the organic alteration as a function of collection speed could be used to unravel these effects.

Methods: Plumes of -170°C ice particles traveling at an initial speed of 2 – 3 km/s were created by shooting 3-mm hollow Aluminum (Al) projectiles (up to 6 km/s) at liquid-nitrogen-cooled ice targets of synthetic seawater (SSW). An Al witness foil is positioned to determine particle size, and ice particle impact speed is determined by high-speed video. The ice particles

smash and sublimate on impact leaving salt residue, dents, and pits on the Al witness foil. We characterized Ice grains type, abundance, density, shape, and distribution caliper (Ferret) diameter via image pattern recognition analysis (ImageJ Software) of still camera photographs of the Al target.

Results: Our hyper-velocity impact experiments generated an Enceladus plume analog with an ice particle mean diameter within the particle size distribution (i.e., 2 micrometers to 50 micrometers) as determined by Cassini's multiple instruments [8]. Simulated impact speed ranged 0.2 km/s to 1-2 km/s. The continued experimental production of high-velocity, micrometer-sized ice grains is underway at the AVGR.

The relevance of ice particle generation is multifold, so are its applications. These include testing for fragmentation of molecular organics to interpret Cassini's data (e.g., Cassini Data Analysis Program) and studies of forwarding contamination (a planetary protection issue).

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