Tracing the Evolution of Ice and Organics from Interstellar Ice Grains to Evolved Solar System Icy Bodies

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Understanding the evolution of interstellar ice grains from Dense-Molecular-Cloud (DMC) stage to an evolved Solar System like ours over 4.6+ billion years through various stages will provide necessary information to address the Origin of Life on Earth [Owen 2008].

The overarching research goal at the "Ice Spectroscopy Laboratory (ISL)" that I lead at the Jet Propulsion Laboratory is to understand how ice and organics co-exist and co-evolve from the DMC stage to comets [Altwegg, Balsiger et al. 2016], surfaces and interiors of icy bodies in our Solar System. In our laboratory, we study from radiation processing of interstellar ice grains containing simple organics to MeV electron bombardment of Europa's surface using laboratory analogs. In order to understand the physics and chemistry of these ices, we developed spectroscopic techniques such as laser-ablation mass spectrometry [Henderson and Gudipati 2015] in addition to conventional infrared, ultraviolet, and laser-spectroscopy.

It is important to determine "tracer species" [Radhakrishnan, Gudipati et al. 2018] that can be followed along the path of the evolution of interstellar ice grains into a fully evolved Solar System. It is expected that comets originated from Oort Cloud preserve the primordial material, while short-period comets originating from Kuiper Belt may be thermally processed to some extent, hence depleted in super-volatiles such as N_2, CO, O_2, etc.

This presentation discusses an overview of the research we conducted at ISL over the past decade and summarizes outstanding questions.

Acknowledgments: The research presented here was funded by NASA Research and Analysis Programs such as Solar System Workings, Rosetta Mission (US), and was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (NASA).

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