Ice and organics in asteroids and comets
Joshua P. Emery

Asteroids and comets, still generally discussed and researched as distinct types of bodies, are increasingly recognized as forming a continuum from ice-free to ice-rich. Comets have long been known to possess abundant ice and readily measurable amounts of organic material. Inference of past ice along with current organics on asteroids came several decades ago from analyses of meteorites. More recently, astronomical observations have revealed direct evidence for ice and organics on asteroid surfaces, strengthening the sense of a continuum of volatile abundances on small bodies. At the same time, spacecraft missions and continued remote observations have led to a much deeper understanding of the structure of comets and the nature of their volatile and organic components.

Water is one of the most interesting and important materials in the Universe. The unique physical and chemical properties of this simple molecule ensure that, when present, it generally has a dramatic effect on its environment. In the solar nebula, since H and O were two of the most abundant elements, H_2O in turn was a dominant molecule. At heliocentric distances (temperatures and pressures) where H_2O condensed to ice, it rivaled all other solids in mass, thereby affecting accretion. Given the well-known delivery mechanisms of both comets and asteroids to near-Earth space, they both must be considered as potential sources of terrestrial volatiles.

A remarkable array of complex, abiotic organic compounds were present in the Solar System during the period of planet formation. Carbonaceous meteorites record these materials, analysis of which indicates an array of formation mechanisms and sources (parent body, nebular, interstellar). Thermochemical models of the solar nebular provide a framework for thinking about the distribution of organics of various types, and generally suggest the dominance of parent body processes in the outer Main Belt of asteroids, nebular (perhaps catalytic) processes in the middle part of the nebula, and a large fraction of inherited interstellar material in the cold, distant reaches. Asteroids and comets together sample this entire range of distances. Their organic components therefore provide an excellent window for investigating these processes.

In this talk, I will review observational constraints concerning the abundance and composition ice and organics on asteroids and comets as a lead-in to further discussions of the implications for Solar System evolution.