A Search for HDO and Detection of Prebiotic Volatiles in the Inner Coma of Comet C/2012 S1 (ISON). B. P. Bonev[1,2,6], E. L. Gibb[1,3,6], M. A. DiSanti[1,4,6], G. L. Villanueva[1,2], L. Paganini[1,2], M. J. Mumma[1,4,5], [1]Goddard Center for Astrobiology - NASA GSFC, Mail Stop 690, Greenbelt, MD 20771, [2]Catholic University of America, Washington, DC 20064, [3]University of Missouri – St. Louis, St. Louis, MO 63121, [4]Solar System Exploration Division, NASA Goddard Space Flight Center, Mail Stop 690, Greenbelt, MD 20771, [5]University of Maryland, College Park, MD 20742, [6]Visiting Astronomer at the Infrared Telescope Facility, which is operated by the University of Hawaii under Cooperative Agreement No. NNX-08AE38A with NASA.

The emergence of the terrestrial biosphere may be linked to delivery of exogenous water and prebiotic organic matter from bodies like asteroids, comets, meteorites, and interplanetary dust roughly within the first billion years of Earth's history. A major challenge to astrobiology is to test this possibility and to evaluate the relative contributions from various classes of small bodies. A key element in this interdisciplinary effort is measuring both the chemical composition and the deuterium abundances of cometary volatiles.

The D/H ratios of molecules released from cometary nuclei are considered signatures of the chemical formation pathways of volatiles in planet-forming disks. Outstanding questions include: are cometary D/H ratios consistent with theories of the chemical evolution of volatile matter in the solar nebula? Does the HDO/H_2O ratio vary substantially among the comet population and what would be the implications for understanding the origins of Earth's water?

In this presentation we will report detections of H_2O and several prebiotic volatiles and a sensitive search for HDO in the coma (expanding atmosphere) of comet C/2012 S1 ISON, observed from the NASA Infrared Telescope Facility atop Maunakea, Hawaii. We will discuss both the significance and the limitations of our upper limit for the water D/H ratio in this comet.

We will also compare our compositional studies of ISON with outputs from astrochemical models (cf. Gibb et al., this meeting) that predict D/H ratios and relative abundances of prebiotic molecules at the midplane of the protoplanetary disk from which the solar system formed. There are a number of parameters and assumptions behind each output of the models tested against our measurements in ISON. Among those we will discuss several critical factors that strongly influence the predicted abundances and directly relate to the origin and evolution of prebiotic volatile matter in the early solar system.

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