

COMETARY WATER CHEMISTRY IN SUPPORT OF RECENT SPACECRAFT MISSIONS. D. C. Boice¹ and R. Wegmann², ¹Southwest Research Institute, Space Science & Engineering Division, 6220 Culebra Road, San Antonio, TX 78238 (Dboice@swri.org), ² Max-Planck-Institut fuer Astrophysik, Karl-Schwarzschild-Str. 1, 85741, Garching, Germany.

Introduction: Water chemistry is central in understanding the physics and chemistry of comets. It is a major source of ions and electrons that further initiate key gas-phase reactions, leading to the plethora of molecules and atoms seen in cometary atmospheres. The relevant physico-chemical processes in cometary comae are identified within a modeling framework to understand *in situ* measurements of comets from spacecraft missions (e.g., Halley, Borrelly, Tempel 1, Wild 2) and to provide valuable insights into the intrinsic properties of their nuclei [1].

Details of these processes are presented, from the collision-dominated inner coma to the solar wind interaction region.

Comet Model Results: The results for the Deep Space 1 (DS1) encounter with comet 19P/Borrelly include thermodynamics (e.g., temperature and velocity structure) and photo- and gas-phase chemistry (e.g., composition, gas and electron energetics) throughout the cometary atmosphere. The effects of photoelectrons that react via electron impact reactions are important to the overall ionization, as originally discussed by Boice et al. [2] and recently revisited by Bhardwaj [3] and Boice and Wegmann [4]. This extensive modeling effort to investigate these important cometary processes is highly relevant to past, on going, and future spacecraft missions to comets [5].

Summary and Conclusions: A bow shock was predicted at about 70,000 km and confirmed by DS1. (No penetration of the contact surface was predicted or observed.) The plasma speed steadily decreased from about 350 km/s (solar wind) to about 2 km/s at closest approach with an electron temperature of about 20,000K and an ion temperature of about 200,000K at closest approach. These values are consistent with the *in situ* measurements of the PEPE instrument onboard DS1. This model chemistry successfully accounted for the Halley water-group composition [6]. However, the relative model abundances for Borrelly differ significantly from those measured by PEPE [4, 5]. Subsequent data reduction is currently ongoing and model results are being rechecked with new electron impact cross sections and other basic data. At this point, it can't be ruled out that there may be something significantly different between the water chemistry of Borrelly and Halley.

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