

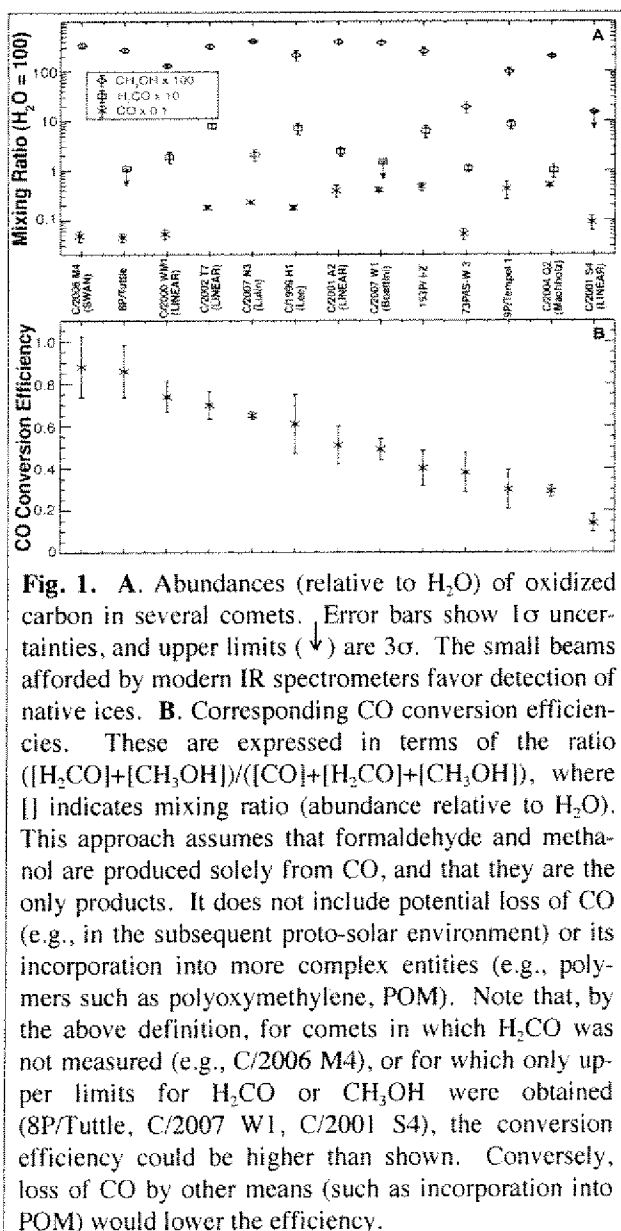
A COMPARISON OF OXIDIZED CARBON ABUNDANCES AMONG COMETS. M. A. DiSanti¹, M. J. Mumma¹, B. P. Bonev^{1,2}, G. L. Villanueva^{1,2}, Y. L. Radeva^{1,3}, K. Magee-Sauer⁴, E. L. Gibb⁵ ¹NASA-Goddard Space Flight Center, Greenbelt, MD USA (michael.a.disanti@nasa.gov), ²Catholic University of America, Washington, DC USA, ³University of Maryland, College Park, MD USA, ⁴Rowan University, Glassboro, NJ USA, ⁵U. Missouri-St. Louis, St. Louis, MO USA.

Comets contain relatively well preserved icy material remaining from the epoch of Solar System formation, however the extent to which these ices are modified from their initial state remains a fundamental question in cometary science. As a comet approaches the Sun, sublimation of the ices contained in its nucleus (termed “native ices”) releases parent volatiles into the coma, where they can be measured spectroscopically.

One means of assessing the degree to which interstellar ices were processed prior to their incorporation into cometary nuclei is to measure the relative abundances of chemically-related parent volatiles. For example, formation of C_2H_6 by hydrogen atom addition (e.g., to C_2H_2) on surfaces of ice-mantled grains was proposed to explain the high C_2H_6 to CH_4 abundance observed in C/1996 B2 (Hyakutake) [1]. The large C_2H_6/CH_4 abundance ratios measured universally in comets, compared with those predicted by gas phase production of C_2H_6 , establishes H-atom addition as an important and likely ubiquitous process.

CO should also be hydrogenated on grain surfaces. Laboratory irradiation experiments on interstellar ice analogs indicate this to require very low temperatures ($T \sim 10\text{-}25$ K), the resulting yields of H_2CO and CH_3OH being highly dependent both on hydrogen density (i.e., fluence) and on temperature ([2],[3]). This relatively narrow range in temperature reflects a lack of mobility below 8-10 K on the one hand, and reduced sticking times for H-atoms as grain surfaces are warmed above 20 K on the other. The relative abundances of these three chemically-related molecules in comets provides one measure of the efficiency of H-atom addition to CO on pre-cometary grains (Fig. 1).

Here, we compare the oxidation sequence of carbon in several comets observed with modern near-infrared echelle spectrometers, which favor the detection of native ices. We use our measured native abundances of CO, H_2CO , and CH_3OH (Fig. 1, top panel) to assess the efficiency of H-atom addition. Our results show their relative abundances to vary considerably among comets (Fig. 1, bottom panel), suggesting a range of conditions experienced by their nascent ices. Comparison with laboratory yields can provide information on conditions in the formative environment.



References: [1] Mumma et al. (1996) *Science*, 272, 1310. [2] Hiraoka et al. (2002) *Astrophys. J.*, 577, 265. [3] Watanabe et al. (2004) *Astrophys. J.*, 616, 638.