THE VOLATILE COMPOSITION OF CO-DOMINATED COMET C/2016 R2 (PANSTARRS)

A. J. McKay[1,2], M. A. DiSanti[1], M. S. Kelley[3], A. L. Cochran[4], N. Dello Russo[5], M. Womack[6], K. Wierzchos[6], N. Biver[7], J. Bauer[3], O. Harrington Pinto[6], R. J. Vervack, Jr.[5], B. Bonev[8], E. Gibb[9], N. Roth[9], H. Kawakita[10], [1]NASA GSFC, [2]USRA, [3]University of Maryland, [4]University of Texas at Austin/McDonald Observatory, [5]Johns Hopkins University Applied Physics Laboratory, [6]University of South Florida, [7]Observatoire de Paris, [8]American University, [9]University of Missouri St. Louis, [10]Kyoto Sangyo University.

Comets contain primitive volatile material that is reflective of the physics and chemistry operating in the protosolar disk during planet formation. The volatile content of comets is typically dominated by H_2O, followed by CO_2 and CO, and then trace amounts of species such as CH_4, NH_3, CH_3OH, C_2H_6, H_2CO, and HCN. However, this is not always applicable, especially for CO, for which abundances compared to H_2O vary by several orders of magnitude. N_2, while difficult to detect remotely, has been found to be heavily depleted in comets, with NH_3 being the dominant volatile reservoir for nitrogen.

In December 2017 we obtained spectra of comet C/2016 R2 (PanSTARRS) that were extremely atypical for comets observed at optical wavelengths. Usually dominated by neutral species such as CN and C_2, the optical spectrum of C/2016 R2 was devoid of these features and was instead dominated by ionic emissions from CO^+ and N_2^+, with the N_2^+ detection being the most secure detection of N_2^+ in a comet obtained in the age of digital detectors (Cochran and McKay 2018). Additional sub-mm observations showed strong CO emission (Wierzchos and Womack 2017, 2018, de Val Borro et al. 2018, N. Biver this meeting and in prep.), confirming the hypervolatile-rich nature of this comet suggested by the optical spectra.

We present additional observations of C/2016 R2 obtained with the IRAC instrument on the Spitzer Space Telescope, iSHELL on the NASA IRTF, ARCES at Apache Point Observatory, the Tull Coude Spectrograph at McDonald Observatory, and Arizona Radio Observatory 10-m Submillimeter Telescope during January-February 2018 aimed at characterizing the volatile composition of this unusual comet. We will discuss our measured abundances of key species, compare these to the abundances observed at 67P/Churyumov-Gerasimenko (including N_2/CO), and discuss implications for the chemistry in the early Solar System.

References:

Cochran and McKay 2018, Astrophysical Journal Letters, 854, L10
de Val Borro et al. 2018, Astronomer's Telegram, February 2018
Wierzchos and Womack, 2017, Central Bureau Electronic Telegram, #4644
Wierzchos and Womack, 2018, submitted to AJ