COMPARISON OF ORGANIC MATTER IN COMETS CHURYUMOV-GERASIMENKO & WILD 2 AND IN IDPS.

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Introduction: Infrared spectra of comet Churyumov-Gerasimenko acquired by the Visible and Infrared Thermal Imaging Spectrometer (VIRTIS) on the Rosetta spacecraft show a broad absorption between ~2.8 to 3.8 μm, where C-H, O-H, and N-H stretching features occur [1]. VIRTIS-H, covering the range 2 to 5 μm with high spectral resolution ($\lambda/\Delta\lambda$ = 3000 at 3 μm), resolves features within this broad absorption. The strongest absorption features in published VIRTIS-H spectra occur between 3.1 and 3.3 μm [1], consistent with aromatic C-H. Since this region of the infrared spectrum has been well studied in meteorites, interplanetary dust particles (IDPs), and samples of comet Wild 2 collected by NASA's Stardust spacecraft, a comparison with the organic matter reported on Churyumov-Gerasimenko is possible.

Comparison: While the Stardust aerogel contained significant organic contaminant, the infrared spectra of track-free regions of flight aerogel showed no detectable feature between 3.1 and 3.3 μm [2]. Contamination in the 3 μm region was dominated by a strong aliphatic $-C-H_3$ absorption feature at ~3.37 μm [2]. In some cases aliphatic $-C-H_2-$, associated with tracks produced by the captured particles, was detected at 3.42 μm, but aromatic C-H was below the detection limit [2], and the spectrum was featureless from 3.1 to 3.3 μm. These Wild 2 spectra are quite different from the VIRTIS-H spectrum of the surface of Churyumov-Gerasimenko, where any $-C-H_2-$ feature is significantly weaker than the 3.1 to 3.3 μm feature. Aromatic C was detected by Raman and C-XANES in some Wild 2 particles [2], indicating the presence of C-rings, but their H was too low to be detected in the infrared. The 3 μm region of spectra of the Wild 2 organic matter is very similar to the spectra of chondritic porous (CP) IDPs [3], suggested to have a cometary origin [4], which have aliphatic C-H features between 3.3 and 3.6 μm (with a $-C-H_2-$ to $C-H_3$ area ratio of ~2.5), but no detectable features between 3.1 and 3.3 μm.

Dicussion: The organic matter detected on the *surface* of Churyumov-Gerasimenko is distinctly different from that in Wild 2 particles and CP IDPs. One possible reason is that Churyumov-Gerasimenko and Wild 2 are very different comets. However, orbital modeling indicates both are Kuiper Belt comets of similar size, ~4 km for Churyumov-Gerasimenko and ~5 km for Wild 2, and that each was recently perturbed into its current orbit. Churyumov–Gerasimenko's perihelion was about 2.7 AU until February 1959, when a Jupiter encounter moved its perihelion inward to about 1.3 AU. Wild 2 orbited outside of Jupiter until September 1974, when a Jupiter encounter changed its orbital period from 43 years to about 6 years, and its perihelion to 1.59 AU.

Alternatively, because the majority of the Wild 2 particles likely originated in the *interior,* since active dust detectors recorded rapid changes in flux consistent with the passage of Stardust through dust jets [5], while VIRTIS measured the spectrum of the exposed *surface* of Churyumov-Gerasimenko, *the surface material of a comet may not be representative of its bulk material.*

References: [1] Capaccioni et al. (2015) Science, 347 no. 6220, DOI: 10.1126/science.aaa0628. [2] Sandford et al. (2006) Science, 314, 1720-1724. [3] Flynn et al. (2003) GCA, 67, 4791-4806. [4] Brownlee et al. (1993) LPSC XXIV, 205-206. [5] Sekanina et al. (2004) Science, 304, 1769-1774.