SYSTEMATIC SPATIAL VARIATIONS IN THE DUST-TO-GAS RATIO WITHIN ENCELADUS' PLUME. M.M. Hedman[1], D. Dhingra[2], C.J. Hansen[3], G. Portyankina[4], S. Ye[5] [1]Physics, Department, University of Idaho. 875 Perimeter Drive, MS 0903, Moscow ID 83844-0903, [2]Department of Earth Sciences, Indian Institute of Technology Kanpur, Kalyanpur, Kanpur 208016, Uttar Pradesh, India. [3]Planetary Science Institute, Tucson AZ 85719, [4]Laboratory for Astronomy and Space Physics, University of Colorado, Boulder Co 80303 [5]Department of Physics and Astronomy, University of Iowa, Iowa City IA 52242

Simultaneous measurements of the gas and dust components of Enceladus' plume reveal that the plume material above Baghdad and Damascus sulci has a dust-to-gas mass ratio that is roughly an order of magnitude higher than the material above Alexandria and Cairo sulci.

Remote-sensing measurements of the plume's particle and gas content were made during a solar occultation that occurred on day 138 of 2010. On that day, Enceladus' plume passed between the Sun and the Cassini spacecraft, enabling Cassini's Ultraviolet Imaging Spectrograph (UVIS) and the Visual and Infrared Mapping Spectrometer (VIMS) to obtain measurements of the gas and dust respectively. The UVIS measurements of the plume's gas content are described in [1], while a more recent paper [2] describes the VIMS data and the information they provide about the plume's particle content. These data revealed that the dust signal was more concentrated around Damascus and Baghdad sulci than the gas signal (see Figure 1).

Similar trends in the plume's dust-to-gas ratio are also found in data obtained when Cassini flew through the plume in 2009, during which time the Ion and Neutral Mass Spectrometer (INMS), Radio and Plasma Wave Science (RPWS) and Cosmic Dust Analyzer (CDA) instruments made in-situ measurements of the plume's gas and dust densities [3]. Again, the material above Damascus and Baghdad sulci has a higher dust-to-gas ratio than the material above Alexandria and Cairo sulci (see Figure 2).

These observations indicate that there are substantial and systematic trends in the characteristics of the cryovolcanic activity associated with different parts of the South Polar Terrain. Similar trends may be responsible for grain-size differences among material seen above Damascus, Baghdad and Cairo sulci observed in high spatial resolution VIMS observations [4]. All these trends likely reflect variations in the source material and/or the plumbing connecting relevant reservoirs to the surface. Further examination of these spatial variations should provide additional insights into Enceladus' geological activity and subsurface conditions,.

References: [1] Hansen, C.J. et al. (2011) *GRL,* **38**, 11202. [2] Hedman, M.M. et al. (2018) *Icarus,* **305**, 123-138. [3] Dong et al. (2015) *JGR*, **120**, 915-937. [4] Dhingra D. et al. (2017) *Icarus*, **292**, 1-12

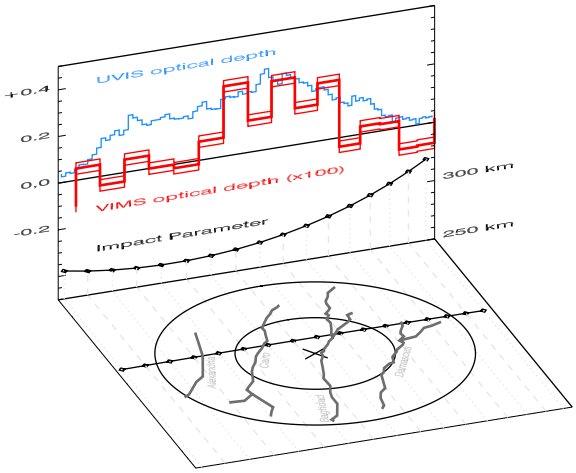

Figure 1: The upper panel shows the optical depth of the plume at ultraviolet and infrared wavelengths measured by UVIS and VIMS, while the bottom panel shows how the instrument's line of sight passed over the south polar terrain., Note that UVIS sees a signal over all the tiger stripes, while VIMS only sees a signal over Baghdad and Damascus. This implies the dust-to-gas ratio is higher over Baghdad and Damascus sulci. (From [2])

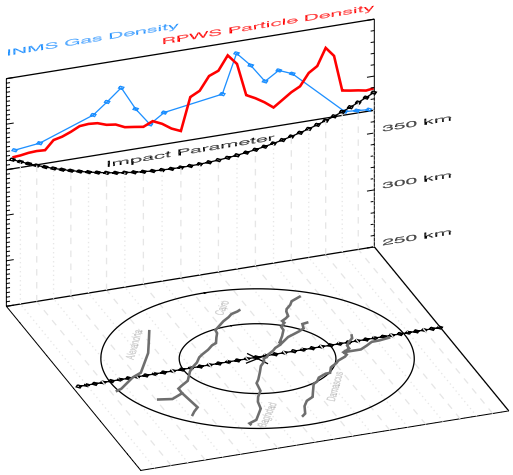

Figure 2: The upper panel shows the density of dust and gas measured by RPWS and INMS, while the bottom panel shows the trajectory of the spacecraft over the south polar terrain. Note that the dust-to-gas density generally increases from left to right. (From [2])