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TITLE: Seeing through Frost on Enceladus.

PRESENTATION TYPE: Assigned by Committee (Oral or Poster)

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AUTHORS (FIRST NAME, LAST NAME): Paul Helfenstein[1]

INSTITUTIONS (ALL): 1. Center for Radiophysics and Space Research, Cornell University, Ithaca, NY, United States.

ABSTRACT BODY: It is now well-established that active cryovolcanism on Enceladus populates the E-ring with icy dust grains, that re-accreting E-ring particles bombard and globally modify the surfaces of Enceladus and its satellite neighbors (cf. Verbiscer *et al.* 2007, *Science* **315**, pp. 815; Kempf *et al.* 2010, *Icarus* **206**, 446-457), and that direct fallout from eruptive plumes creates distinct, predicable broad-scale regional patterns of albedo and color on the surface of Enceladus (Schenk *et al.* 2010, *Icarus* **211**, 740-757). However, at present it is not clearly established how thickly that plume fallout mantles the surface from location to location, how the presence of plume fallout affects the appearance and detection of underlying geological features, how rapidly the deposits accumulate, how long they have been accumulating, or how plume fallout, E-ring bombardment, and endogenic processes like thermal annealing and seismic shaking, for example near active tiger stripe rifts, compete and combine to modify the shape of geological structures at size-scales of kilometers or less that are much smaller than those that are represented in the regional albedo patterns found by Schenk *et al.* (2010).

Early Cassini Narrow Angle Camera (NAC) images of Enceladus' Western Hemisphere (leading-side) that were obtained at relatively large phase angles (α>90°) and spatial resolutions better than about 1 km/pixel clearly identify peculiar circular albedo structures with diameters of tens of kilometers. One feature (here called P_1) at 9.1°S, 83.0°W is conspicuously darker than its surroundings, while an adjacent feature (P_2) at 24.1°S, 73.5°W is comparable in brightness to its surroundings except for a relatively bright diffuse patch that appears to be ejecta from a superposed small impact crater. The subdued circular surface relief of these features and overprinting by quasi-linear tectonic features suggest that they may be palimpsest-like structures or else surface expressions of diapirism (cf. Spencer *et al.* 2009, In "Saturn after Cassini-Huygens", Springer-Verlag. 683–724; Helfenstein *et al.* 2010; *American Geophysical Union, Fall Meeting 2010*, abstract #P23C-04). More recent Cassini high-resolution imaging of the region over a wide range of illumination geometry reveals a systematic change in the appearance of the circular albedo features as the phase angle decreases from α=124° to α=31° -- the circular albedo features that are so clearly visible at large phase angles are

completely masked at small phase angles. The decrease in the albedo contrast with decreasing phase angle is dramatic: The average albedo contrast between the circular P_1 and P_2 features diminishes from 27±3% at phase α=124° to only 1.3±0.2% at α=31°. A likely explanation for this photometric behavior is that it reveals a top layer of frost or snow that scatters light strongly at relatively small phase angles, but which becomes more transparent as phase angles increase allowing Cassini to see through to underlying features. It is also possible that the changing photometric contrasts arise from terrain-dependent differences in regolith properties like surface roughness or regolith grain-size.

INDEX TERMS: [5470] PLANETARY SCIENCES: SOLID SURFACE PLANETS / Surface materials and properties, [5422] PLANETARY SCIENCES: SOLID SURFACE PLANETS / Ices, [5464] PLANETARY SCIENCES: SOLID SURFACE PLANETS / Remote sensing, [6280] PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS / Saturnian satellites.

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