SPECTRAL ANALYSIS OF ENCELADUS' SOUTH POLE. F. Scipioni[1], P. Schenk[1], R. Clark[2], F. Tosi[3], J.-Ph. Combe[4], C. Dalle Ore[5]. [1]Lunar and Planetary Institute, 3600 Bay Area Blvd. 77058 Houston, Texas, United States, scipioni@lpi.usra.edu; [2]PSI, Tucson, AZ; [3]INAF-IAPS, Rome, Italy; [4]Bear Fight Institute, Winthrop, WA; [5]Seti Institute, Mountain View, CA.

Introduction: Enceladus' surface is composed almost entirely by pure water ice. The Cassini spacecraft has observed present-day geologic activity at the moon's southern polar region (the so-called "Tiger Stripes") in the form of eruptive plumes of volatile gases (H_2O, CO_2, NH_3, CH_4), which are the major source of Saturn's E-ring. Some of this material falls on Enceladus' surface to form deposits that extend to the north and whose highest concentration is at the South Pole.

[1] produced Enceladus' ISS color maps at different ranges of phase angle, on a global and local scale, revealing a peculiar behavior of South Pole Terrain (SPT). At low phase angles (< 10°), the portion o surface edging the SPT shows low albedo compared to their higher phase appearance (Figure 1).

Data analysis: In this work, we aim to investigate if the portion of surface surrounding the SPT shows the same anomalous behavior in the IR portion of the spectrum too. We analyzed Cassini/VIMS spectra of Enceladus South Pole, ranging between 0.8 and 5.1 µm.

We grouped the selected VIMS dataset per phase angle ranges: 10°-20°, 20°-30°, 30°-40°, and 40°-50°. For each phase angle group, we calculated the depth of the main water ice absorption bands and reflection peak (1.25, 1.50, 2.02, and 3.60 µm), and the values of the spectral indicators used to reveal the presence of submicron ice grains (the asymmetry and minimum shift of the 2 µm absorption band; the decrease in band depths ratio 1.5/2.0 µm; the decrease of the reflection peak at 2.6 µm; the suppression of the Fresnel reflection peak; the decrease of the 5 µm reflectance relative to the 3.6 µm peak; [2]).

For all phase angle ranges, we created global maps describing trends of each of the considered spectral indicators across the surface. The maps were created by sampling Enceladus' southern polar region surface with a 1°x1° fixed-resolution grid and then by averaging the band depths and peak values inside each square cell.

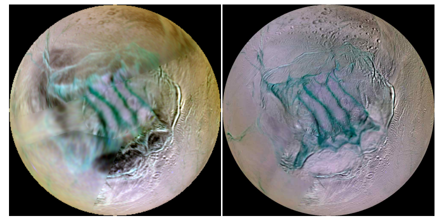

Figure 1: IR3-GRN-UV3 Maps of Enceladus' South Pole obtained by [1] mosaicking ISS images. The left maps had been produced considering images taken at a phase angle < 10°. In the map on the right, the phase angles ranges between 10° and 40°.

Results and Discussion: Figure 2 and 3 are two examples of (preliminary) maps produced in this work. In Figure 2, we show the variation of the water ice absorption band at 2.02 µm, while in Figure 3 the variation of the band depths ratio 1.5/2.0 µm is represented. The four maps in Figures 2 and 3 differs in phase angle range: 10°-20° (top left), 20°-30° (top right), 30°-40° (bottom left), and 40°-50° (bottom right).

The four maps shown in Figure 2 and those in Figure 3 display clear trends, even though the available data do not cover the south polar region completely. In Figure 2, the water ice absorption band decreases with decreasing phase angle range, confirming what it had been observed by [1] in ISS images. Since Enceladus is composed mostly by pure water ice, it seems likely that the observed variations are bounded with a grain size effect, rather than a variation in composition. This conclusion is supported by results shown in Figure 3, where the ratio increases with the phase angle. The variation in ratio between the two water ice absorption band depths, indeed, is sensitive to a gradient in grain size, with the ratio increasing with increasing phase angle.

The spectra calculated in this work will be further analyzed by a radiative transfer model, developed by [3], that allows to allows one to quantify the contribution of Rayleigh scattering from the sub-micron particles, which will ultimately yield composition, grain size, temperature, and a relative measure of the amount of sub-micron particles for the regions of interest identified in the maps.

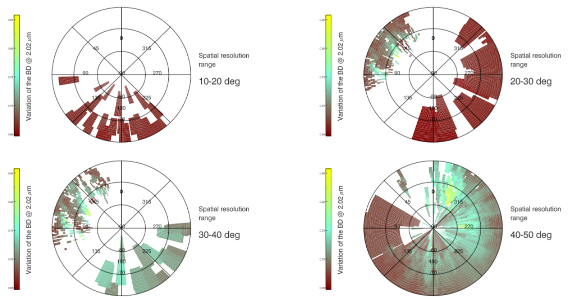

Figure 2: Variation of the water ice absorption band at 2.02 µm on Enceladus' South Pole, for four ranges of phase angles.

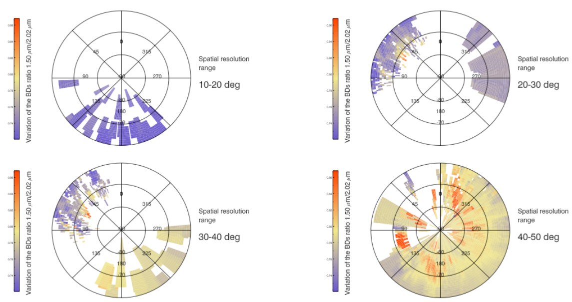

Figure 3: Variation of the band depths ratio 1.5/2.0 µm on Enceladus' South Pole, for four ranges of phase angles.

References:

[1] Schenk, P. (2014) 45th LPSC. LPI Contribution No. 1777, p.2618.

[2] Clark, R. et al. (2013) in The science of Solar System ices, Springer Science+Business Media New York.

[3] Clark et al., 2012. Icarus 218, 831–860.