PHOEBE AND IAPETUS SPECTRAL ANALYSES USING ISS/CASSINI IMAGES. E. Tatsumi[1,2,3] and A. R. Hendrix[2], [1]Instituto de Astrofisica de Canarias, Tenerife, Spain (etatsumi@iac.es), [2]Dept. of Astrophysics, Univ. of La Laguna, Tenerife, Spain, [3]Univ. of Tokyo, Tokyo, Japan, [4]Planetary Science Institute, Tucson, AZ, USA.

Introduction: The Cassini Orbiter carried out its tour through the Saturnian system in the 2004 - 2017 timeframe. The Cassini Imaging Science Subsystem (ISS) was the high-resolution imaging device on the Cassini Orbiter and was been designed for investigations of the bodies and phenomena found within the Saturnian planetary system [1]. ISS acquired high-resolution imaging data on the outer Saturnian moons, Phoebe and Iapetus during the Cassini's flybys on 11 June 2004 and 31 December 2004, respectively. Phoebe's low density of 1630±45 kg/m^3 and dark geometric albedo value ~8% are indicative of an ice-rock mixture [2,3]. Iapetus is known with its two distinct terrains, the dark leading side and the bright trailing side [4]. This dark material has been hypothesized to be transported from Phoebe [2]. The composition of this dark material is generally inferred to be carbon-rich, but the form of the carbon is unknown. Visible Infrared Mapping Spectrometer on the Cassini spacecraft identified the absorption around 3 – 3.6 µm, corresponding to the polycyclic aromatic hydrocarbon (PAH) molecules [5]. Recently, the reflectance spectral studies in UV region are shedding light on the form of carbon in the Solar System. Both the laboratory measurements of carbonaceous materials and telescopic measurements of carbonaceous asteroids show the large variation on UV reflectance corresponding to the state of carbon [6,7,8], although the quantitative interpretation is still not very easy. In this study, we utilize the images of Phoebe and Iapetus taken by ISS/Cassini and extract the global and regional ultraviolet (UV)-visible spectra. We focus on the variations in UV reflectance across Phoebe and Iapetus and discuss the possibility of the detection of carbon and hydrated minerals.

Data reduction: ISS consists of two framing cameras: a narrow-angle camera with a square field of view (FOV) 0.35˚ across, and a wide-angle camera with a FOV 3.5˚ across. Each camera has a large number of spectral filters with the effective wavelength ranging from 200 to 1100 nm [1]. In this study, we used the images from narrow-angle camera. Images are calibrated through the pipeline implemented in ISIS3 ("cisscal"). Missing pixels are interpolated with the function "lowpass" in ISIS3. The image set with a variety of color filters is shifted to be coaligned with the (CL1, GRN) image (effective wavelength of 568 nm).

Results: First, we obtain disk average spectra of both objects and check the consistency with spectra of a previous study [9] which showed that Phoebe has slightly blue spectrum and Iapetus has red spectrum.

Phoebe. We utilize 5 sets of 11 wavelength, 266 – 1001 nm, images with different rotational phases. The disk-average spectra are very flat at visible wavelengths and exhibit an absorption toward UV wavelengths (Fig. 1). However, there are differences between spectra in UV spectral shape (namely the upturn in 266 to 343 nm region).

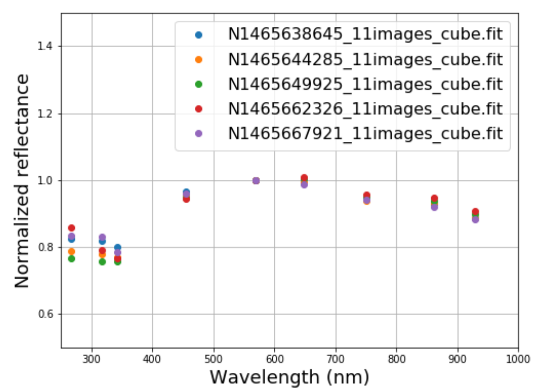

Figure 1. The global average spectra with different rotational phase of Phoebe on 11 June 2004. UV slope shows small variation with rotational phase.

Iapetus. We utilize two observation sets of 10 and 19 wavelengths, 266 – 1001 nm (Fig. 2). We took the regional spectra of several points, dark terrain, bright terrain, and center of the Falsaron crater (Fig. 3). As described by Porco et al. [2], the bright terrain has a bluer spectrum than the dark terrain. Although the dark terrain and center of the crater have very similar spectra at visible wavelengths, these spectra are different at UV wavelengths. The material inside of the crater shows more absorption in UV. Moreover, the dark terrain and inside of the crater shows a small turn-up at the shortest wavelength, while the bright terrain shows a continuous drop-off in UV range.

Ratio maps are also created, and show that two distinct regions are different in the spectral slope (e.g., 750 nm/ 569.2 nm). In the center of the Falsaron crater there is a region with less UV absorption. Note that this region is a part of the crater and not whole crater floor. It is possible that this spectral difference is can be correlated with a smaller crater inside of the Falsaron crater.

Discussions: When the spectra of the dark terrain of Iapetus and Phoebe are compared, the dark terrain of Iapetus is much redder in visible wavelength. However, if we compare in UV range, both has similar turn-up. This might be caused by presence of a carbonaceous material which has peak at 220 – 270 nm [7].

The UV absorption difference between the Iapetus dark terrain and the center of the crater is also interesting. If the crater was formed after the dark material, they might be expected to exhibit the same spectra. However, we see a difference, suggesting that the material in the crater could be excavated deeper material of Iapetus after the dark material had covered this side. This material with more UV absorption, for example, could be the mixture of material from Iapetus and the dark material. The smaller crater inside of Falsaron crater excavated the deeper iced layer and hydrated the dark material on surface, because the hydrated mineral usually shows the deeper absorption in UV [10]. Another hypothesis is the smaller crater inside the Falsaron crater excavated the fresh dark material. In this case, the space weathering may cause the less UV absorption by metamorphism of hydrated minerals [11] or carbonization [8] on Iapetus. Denk et al. [12] discuss color variations within the dark terrain and this could be related to those; this is under investigation.

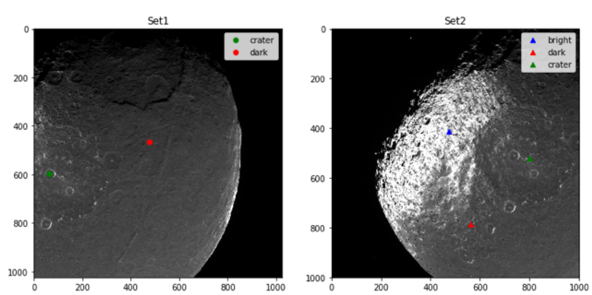

Figure 2. Two different rotational phase images of Iapetus. Left image is Set 1 and right image is Set 2. The big crater, Falsaron, centered in Set 2 can be seen on the left edge of Set 1. Bright terrain can be seen next to the Falsaron crater in Set 2.

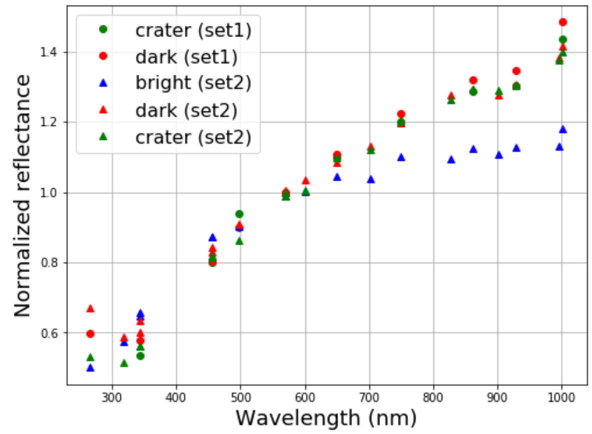

Figure 3. Regional spectra of Iapetus. The dark terrain and the crater have redder spectra than the bright terrain in visible wavelength. However, the dark terrain and the center of the Falsaron crater show different spectra in UV range. The center of the crater has deeper absorption in UV range.

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