RELATIONSHIPS BETWEEN DEPTHS OF WATER ICE ABSORPTION BANDS – INDICATOR OF CHANGES IN PARTICLE SIZE OF WATER ICE ON THE SURFACE OF GANYMEDE. K. Stephan[1], R. Jaumann[1], C.A. Hibbitts[2], G.B. Hansen[2]. [1]DLR, German Aerospace Center, Rutherfordstrasse 2, 12489 Berlin, Germany; [2]PSI, Planetary Science Institute, Northwestern Division (katrin.stephan@dlr.de).

Introduction: During the Galileo Mission Ganymede, one of the icy Galilean satellites was observed with the Near Infrared Mapping Spectrometer (NIMS) [1] and the Solid State Imaging System (SSI) [2]. NIMS observed the satellite in the spectral range between 0.7 and 5µm with spatial resolutions up to 3 km/pixel. A detailed analysis of spectral variations across the surface of Jupiter's satellite Ganymede included relationships between the well known absorption bands of water ice at 1.5 and 2 µm [1]. The ratio of the measured band depths reveals global differences which cannot be explained by compositional changes. Images acquired by SSI with spatial resolutions up to 50 times better than NIMS provided the geomorphological context of the study. Both data sets were geometrically reprojected to make a comparison between them possible.

Results: NIMS spectra were normalized by removal of the specific continuum in order to compare band depths of different observations without the influence of photometric effects. Band shapes were approximated by a mathematical function to determine the accurate wavelength position and depths of the specific absorption band [4]. Measured band depths of both the water ice absorption at 1.5 and 2µm vary across the surface of Ganymede in a similar way as the visual albedo changes, as seen in the SSI imaging data (Fig. 1a-c). However, the variations of the ratio of the band depths at 2 and 1.5µm show a distinct global pattern depending on latitude (Fig. 1d). The equatorial region exhibits measured values lower than 1 which imply that the absorption band at 1.5 µm is deeper than the band at 2µm. Values increase in the direction toward the poles, where the absorption band at 2µm is distinctly deeper than the band at 1.5µm. Regions where the measured values reach values equal to one or higher occur at latitudes between 37 and 46°N and 39°S. In the case of bright impact craters like Osiris, or bright grooved terrain like Xibalba Sulcus, which are at least partly located in these regions, the latitude of the transition occurs at a slightly lower latitude of 33°N and 27S° respectively. Ratios which were measured using high resolution NIMS observations support the global trend. Comparing the values referring to the different terrain types, the same lateral pattern was observed. Therefore, the ratio of the band depths at 2 and 1.5µm for the specific terrain types is not constant over the entire surface of the satellite. However, secondary regional variations were recognized in regions which are located either within the polar or the equatorial regions. Regional ratio variations show relatively low values in regions with high concentration of dark material like the ancient dark terrain and dark impact ejecta. The lowest values were measured in the ejecta of the crater Kittu. Observed areas of the bright grooved and smoothed terrain like Uruk Sulcus show intermediate values. Highest values were measured in the vicinity of ice-rich impact craters which occur independently of the location.

Discussion: Spectral variations on the surface of Ganymede are caused by complex interactions between relative abundance, mixing style and particle size of the surface materials [5]. However, ratio variations of the band depths at 2 and 1.5µm reflect latitudinal variations in the particle size of water ice, with smaller particles at the polar regions and an increasing of particle size towards the equator [6]. Water ice located in the polar regions is assumed to have particle sizes smaller than 50µm [6] caused by energetic particles of Jupiter's magnetosphere which impact the surface of Ganymede at the poles, resulting in sputtering of water ice and redepositing water ice as frost in relatively cold regions [7,8]. Equatorial regions are protected from this effect due to Ganymede's own magnetic field and exhibit larger particle sizes than the polar regions [6]. In general, absorption bands become deeper with increasing particle size of water ice [6,9]. However, with increasing particle size the water ice bands saturate and band depths decrease again. The band at 2µm saturates already at a particle size of water ice greater than 50µm, while the saturation of the band at 1.5µm occurs at a particle size greater than 200µm. A decreasing in band depth at 2µm opposite to the band depths at 1.5µm may account for the observed ratios in the equatorial regions. At regional scale ice-rich impact craters seem to exhibit finer particles compared to their surroundings, which would agree with the excavation of fresh ice-rich material due to impacts on Ganymede. But, the observed regional variations require further examination. Many high resolution observation are located within the region, where the absorption band at 2µm is saturated. Different mixing style of the surface materials in dark and bright terrain [5] as well may influence the behavior of the two bands at a regional scale. So, further work will con-

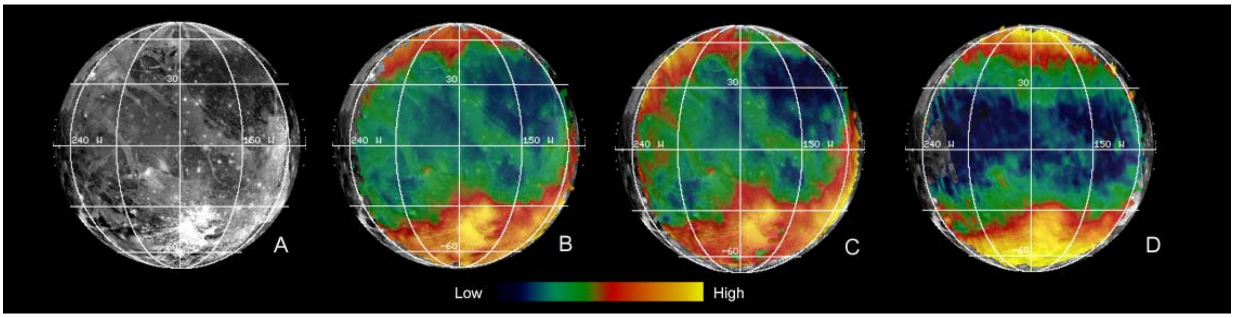

Figure 1: Comparison between visual albedo, band depths at 2 and 1.5µm and ratio of band dephts for the global NIMS observation of Ganymede's anti-Jovian hemisphere: **(a)** a global SSI image in an orthographic map projection centered at 0°lat and 180°lon compared to the measured band depths at 1.5µm **(b)** and 2µm **(c),** and the ratio of band depths at 2µm/1.5µm **(d).**

centrate on this.

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