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Spectral properties of fresh impact craters in the Saturnian and Jovian system

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Abstract

We investigated the spectral properties of fresh (more or less un-weathered) impact craters on the icy satellites of Saturn, which were observed by the Cassini spacecraft. In addition, Galileo SSI and NIMS observations of the Jovian satellite Ganymede have been included in the investigation in order to compare the spectral properties of fresh impact craters on icy bodies in two different planetary systems. Although, the surfaces of the icy satellites in the Saturnian system are known to be dominated by H_2O ice, the spectral properties of fresh impact craters provide compositional information of the satellites' upper crustal material but also reveal information about the impact event itself and/or the surface temperature at the crater's location.

1. Introduction

The imaging instruments onboard the Cassini spacecraft detected the icy satellites of Saturn allowing the study of their geological and spectral surface properties. Especially Cassini ISS and VIMS data acquired during few targeted flybys at relatively low latitudes enable a detailed investigation of individual impact craters on Dione, Rhea and Tethys such as the prominent impact craters Creusa and Inktomi. In addition, several sufficiently resolved Galileo SSI and NIMS observations of the Jovian satellite Ganymede covering numerous morphologically fresh impact craters, are available.

The investigated impact craters have been chosen based on their morphological surface characteristics. The investigation of their spectral properties focused on the analysis of the spectral signature of H_2O ice in comparison with H_2O ice model spectra (1-3) including the numerous absorptions of H_2O ice, which are known to be an indicator for the abundance as well as the sizes of the individual H_2O ice particles (4-6).

2. Results

All investigated impact craters exhibit a high visible albedo and are composed of relatively pure H_2O ice confirming an uppermost layer of the studied satellites dominated by H_2O ice. The sizes of the H_2O ice particles, however, vary dramatically and have been found rather to be an indicator for the environmental conditions. The fresh impact craters on the Saturnian satellites exhibit relatively small (~5 – 40 µm) H_2O ice particle sizes. In contrast, the H_2O ice particle sizes of fresh impact craters on Ganymede partly increase up to ~1mm. The comparison of the H_2O-ice particle sizes with the maximum surface temperatures at the approximate location of the impact site (7-9) reveals a direct correlation between the H_2O ice particle sizes and surface temperature. The smallest H_2O ice particle sizes (~5 µm) are confined to Creusa located on Dione at ~50°N and a surface temperature of ~80 K (7, 9). At similar surface temperatures the H_2O ice particle sizes on Ganymede and the Saturnian satellites are quite similar. Nevertheless, impact crater Tammuz located close to Ganymede' equator (~13°N), where the surface temperature can reach least 150 K (8), exhibits H_2O ice particle sizes up to ~1mm. Thus, the derived particles sizes rather reflect the surface environment than the crustal properties.

References

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