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The chemical composition of impact craters on Titan

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We investigate the spectral behavior of nine Titan impact craters in order to constrain their surface composition using Visual and Infrared Mapping Spectrometer (VIMS) data and a radiative transfer code (RT) [e.g. 1] in addition to emissivity data. Past studies have looked at the chemical composition of impact craters either by using qualitative comparisons between craters [e.g. 2;3] or by combining all craters into a single unit [4], rather than separating them by geographic location or degradation state. Here, we use a radiative transfer model to first estimate the atmospheric contribution to the data, then extract the surface albedos of the impact crater subunits, and finally constrain their surface composition by using a library of candidate Titan materials. Following the general characterization of the impact craters, we study two impact crater subunits, the 'crater floor' and the 'ejecta blanket'. The results show that Titan's mid-latitude plain craters: Afekan, Soi, and Forseti, in addition to Sinlap and Menrva are enriched in an OH-bearing constituent (likely water-ice) in an organic based mixture, while the equatorial dune craters: Selk, Ksa, Guabonito, and Santorini, appear to be purely composed of organic material (mainly unknown dune dark material). This follows the pattern seen in [4], where midlatitude alluvial fans, undifferentiated plains, and labyrinths have surface spectra consistent with a mixture of tholin-like spectral features and water ice-like spectral features, while the equatorial undifferentiated plains, hummocky terrains, dunes, and variable plains appear to have spectra similar to a dark material and tholin-like mixture in their very top layers. These observations also agree with the evolution scenario proposed by [3] wherein the impact cratering process produces a mixture of organic material and water-ice, which is later "cleaned" through fluvial erosion in the midlatitude plains. This cleaning process does not appear to operate in the equatorial dunes, which seem to be quickly covered by a thin layer of sand sediment (with the exception of the freshest crater on Titan, Sinlap). Thus, it appears that active processes are working to shape the surface of Titan, and it remains a dynamic world in the present day.

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