Astrobiological implications of impact cratering on Titan

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Photochemical processes occur in Titan's atmosphere, forming hydrocarbons, nitriles, and solid aerosol particles from the parent molecules CH_4 and N_2. These compounds are deposited on the surface of Titan, creating a layer of organic molecules. In a world lacking in oxygen, impacts by comets create environments in which the surface organics can react with liquid water to form interesting prebiotic molecules such as purines and amino acids. In this work, we quantify the extent by which impacts have modified the suite of organic compounds found on Titan's surface. Taking likely values for the cratering rate at Titan, we find a melt layer on the order of 0.1 - 1 m thick averaged over the surface in the last 3.5 Ga. Comets also provide a supply of organics to the surface of Titan, but at a rate 10^5- 10^6 times lower than the production of atmospheric organics. We thus do not expect comets to contribute a significant portion of organics to the surface of Titan. Future exploration of impact craters on Titan would allow for the determination of the extent of the pre-biotic chemistry that has taken place there, providing information relevant to the processes that led to the origin of life on Earth.