Impact Cratering as an Astrobiological Process on Titan

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Abstract: NASA's Cassini mission has revealed Saturn's larger moon Titan to be a world rich in the "stuff of life." Reactions occurring in its dense nitrogen-methane atmosphere produce a wide variety of organic molecules, which subsequently rain down onto its surface. If these molecules mix with water found in impact melts on Titan's surface, they may react to form biological molecules such as amino acids. However, these “impact oases” are short-lived (lasting only hundreds to thousands of years), and thus are unlikely to support a biosphere. Liquid water is also available in Titan’s subsurface ocean, located 40-170 km below its icy surface. If the organic molecules found on Titan’s surface can migrate to the ocean through the impact cratering process, and the resulting concentrations are high enough, Titan’s ocean may provide a longer-lived environment for life to thrive in.

In this presentation, I will report on several aspects relating to impact cratering as an astrobiological process on Titan. First, I will describe experimental work seeking to determine the type and quantity of biomolecules formed under conditions analogous to those found in transient liquid water environments on Titan. Second, I will describe how this material may move from the organic-rich surface to the water-rich interior through impact cratering, and whether this provides concentrations of organic material sufficient for life to thrive. Lastly, I will describe the best sites to identify biological molecules on Titan, and how we may sample this material with a landed asset such as NASA’s Dragonfly mission. The information we obtain from studying prebiotic chemistry on Titan will provide clues to the origin of life on our own world and worlds throughout the universe.