The Red Planet and The Blue Planet: Past, Present and Future Symposium Speakers

Titan in a Test Tube: Organic Cryominerals Formed in the Lab

Presented by:
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Dr. Ellen Czaplinski is a first-year NASA Postdoctoral Fellow at the Jet Propulsion Laboratory working with Dr. Robert Hodyss. Her research interests include experimental laboratory studies of Titan surface chemistry, habitability of Titan's surface liquids, improving autonomous capabilities of ocean worlds missions, and robotic exploration of the lunar south pole. Dr. Czaplinski received her Ph.D. in Space and Planetary Sciences from the University of Arkansas in 2021, and a B.S. in Planetary Science from Purdue University in 2016. She was awarded the NASA Earth and Space Science Fellowship and the Zonta International Amelia Earhart Fellowship to support her Titan research in graduate school. Ellen enjoys rock climbing, hiking, strategic board games, tea, and training her dog, Stella.

Abstract:

Titan, Saturn's largest moon, has many hydrocarbons and nitriles that are created in the atmosphere from photochemical processes. Titan is Earth-like, in that it has a thick, nitrogen-dominated atmosphere and stable liquids on the surface. However, unlike Earth, Titan's surface temperature is ~90 K and the lakes and seas are filled with liquid hydrocarbons like ethane and methane. Additionally, more complex compounds may form in the atmosphere and eventually deposit onto the surface. For example, acetylene (C_2H_2) is a primary photochemical product in the atmosphere that has been identified on the surface. Recent laboratory work has demonstrated that co-crystals between two or more molecules (i.e., pyridine and acetylene) can form under Titan surface conditions. Co-crystals are stable structures held together by weaker intermolecular interactions like pi bonding.

Co-crystals can be good indicators of the geologic processes and chemical composition of Titan's surface, which will be important for future Titan surface missions. Specifically, the upcoming *Dragonfly* rotorcraft lander on Titan will study the surface in great detail. Providing laboratory measurements for potential surface materials, such as co-crystals, is important for connecting small-scale, molecular behaviors to large-scale surface features observed on Titan. I will discuss experimental setups that are used to analyze co-crystals in the lab, as well as past and ongoing results and implications from these studies.