The Molecular Complexity of Titan's Enigmatic Haystack Ice Cloud

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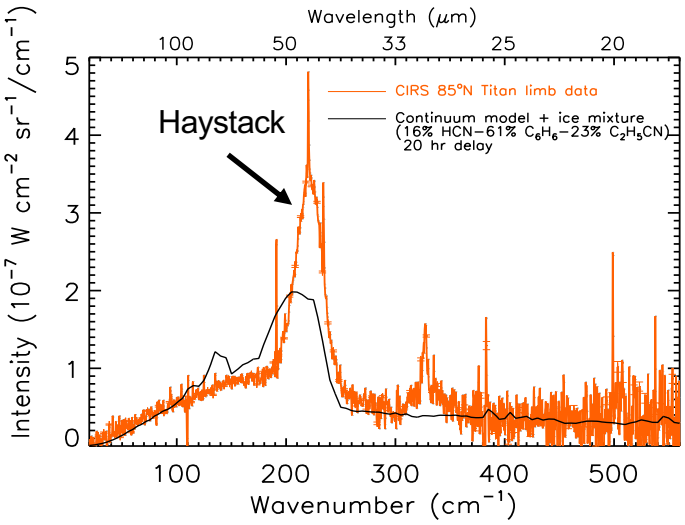
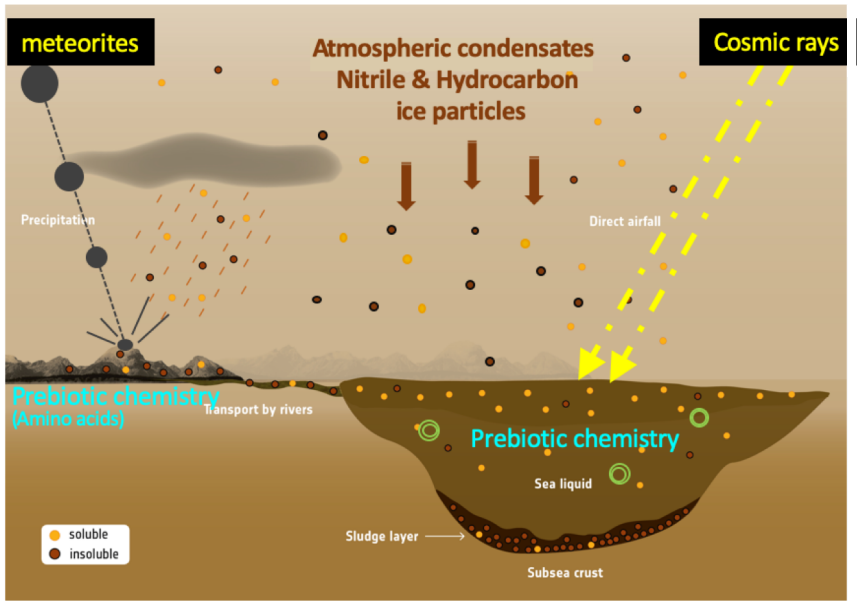
What is the science question? What is the chemical composition of the ice cloud particles in Titan's atmosphere?

What were your findings? Results from a laboratory study indicate that co-condensed ice made of a vapor mixture of ethyl cyanide, hydrogen cyanide, and enriched in benzene, is the best chemical candidate so far obtained for the intriguing Haystack ice cloud observed by the Cassini CIRS instrument.

What was the impact? While co-condensation may be a common process in Titan's stratosphere, it is usually thought that the clouds in Titan's atmosphere are formed by the condensation of either a single pure chemical compound or layers of single chemical compounds. Chemical interactions in Titan's atmosphere are thus much more complex than previously expected.



Synthetic spectrum of a co-condensed C_2H_5CN-HCN-C_6H_6 ice cloud (derived from the laboratory data) compared to a CIRS-observed spectrum.



Possible prebiotic chemistry at Titan's surface

Why does it matter? Our study reveals the rich chemical diversity of Titan's clouds as compared to Earth's water vapor clouds. The atmospheric components, production, loss, and evolution on exotic Earth-like worlds like Titan provide clues to the possible prebiotic chemistry that occurs at the surface of such planetary bodies, as well to potentially habitable environments in the Solar System and beyond.

Nna-Mvondo, D., Anderson C.M., Samuelson R.E., 2019. Detailed infrared study of amorphous to crystalline propionitrile ices relevant to observed spectra of Titan's stratospheric ice clouds. Icarus, 333, 183-198.
https://doi.org/10.1016/j.icarus.2019.05.003.

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