



Titan and Earth: Sisters or Strangers?

T. Owen (1), H. Niemann (2), S. Atreya (3), and D. Gautier (4)

(1) Institute for Astronomy, University of Hawaii, USA, (2)Code 915, NASA Goddard Space Flight Center, USA, (3), Department of Atmospheric, Oceanic, and Space Sciences, University of Michigan, USA, (4), Observatoire de Paris-Meudon, France.

As the only other world in our solar system with a nitrogen-dominated atmosphere, Titan naturally invites comparisons with Earth. One obvious similarity is the highly non-solar ratio of nitrogen to noble gases; but on Titan this ratio is over 1000 times greater than it is on Earth. The reason(s) for this difference may be found in the manner of Titan's origin or in its internal structure. On Earth, most of the carbon that is missing from the atmosphere is now in the form of CO₂ bound up in carbonate rocks. On Titan, we find CH₄ instead of CO₂, and this gas must have a source that replenishes the atmosphere even today, allowing carbon to avoid the isotopic fractionation we find in nitrogen and oxygen. Instead of carbonate rocks on Titan, the deposited carbon is a mixture of liquid hydrocarbons and precipitated aerosols on the surface, producing mud, slush, swamps and perhaps occasional lakes, all highly flammable. What is the source of methane and how does the gas reach the atmosphere? Formation of methane in Titan's interior is an attractive hypothesis, testable by accurate values of D/H in Titan's H₂O. Alternatively, methane may be trapped as clathrate hydrates floating on a subcrustal ammonia-water ocean. The choice between these extremes has implications for the early Earth and the composition of Saturn.

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