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Low temperature alkaline pH hydrolysis of oxygen-free Titan tholins

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Abstract

Titan, the largest moon of Saturn, is known for its dense and nitrogen-rich atmosphere. The organic aerosols which are produced in Titan's atmosphere are objects of astrobiological interest. In this paper we focus on their potential chemical evolution when they reach the surface and interact with putative ammonia-water cryomagma[1].

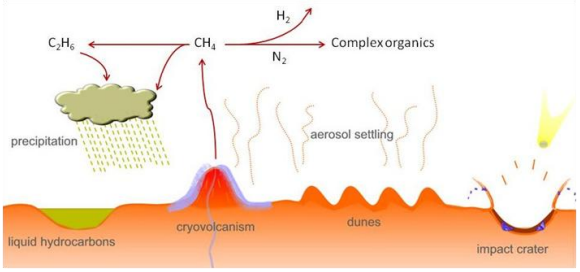

Figure 1: The methane cycle and different geological features present at Titan's surface, that may act as potential chemical inducers

In this context we have studied the evolution of alkaline pH hydrolysis of Titan tholins (produced by an experimental setup using a plasma DC discharge named PLASMA) at ambient and low temperature.

However, we identified oxygenated molecules in non-hydrolyzed tholins meaning that oxygen gets in the PLASMA reactor during the tholins synthesis [2]. Following this preliminary study the synthesis protocol has been improved by isolating the whole device in a specially designed glove box which protect the PLASMA experiment from the laboratory atmosphere.

After confirming the non-presence of oxygen in tholins produced with this new experimental setup, the study of oxygen-free tholins' evolution has been carried out.

A recent study shows that the subsurface ocean may contain a lower fraction of ammonia (about 5wt% or less [3]), as previously described by other teams [2, 4]. Thus new hydrolysis experiments will take this lower value into account. Additionally, a new report [5] provides upper and lower limits for the bulk content of Titan's interior for various gas species. It also shows that most of them are likely stored and dissolved in the subsurface water ocean. But considering the plausible acido-alkaline properties of the ammonia-water ocean, additional species could be dissolved in the ocean and present in the magma. They were also included in our hydrolysis experiments.

Taking into account these new data, four different hydrolysis have been applied to oxygen-free tholins. For each type of hydrolysis, we also follow the influence of the hydrolysis temperature on the organic molecules production.

The preliminary qualitative and quantitative results of those experiments will be presented at EPSC.

References

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