Geophysical Research Abstracts, Vol. 9, 08432, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08432

Methane hydrates in Titan's interior

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The non-zero orbital eccentricity of Titan is attributed to the presence of a liquid layer either on the surface of or somewhere inside Titan. It has also been hypothesized that a significant amount of methane clathrate hydrates as well as ammonia monohydrate were trapped in Titan during accretion. The presence of atmospheric methane was previously explained by cryogenic activity of water-ammonia magma able to induce melting of near-surface methane clathrate hydrates, resulting in the release of methane into the atmosphere. In an attempt to clarify the nature and origin of methane in Titan, we report melting phase relations in methane-water system up to 3 GPa, in a series of *in-situ* experiments in externally heated diamond anvil cells. We observe that above a pressure of $\sim$1.5 GPa, melting temperature of methane clathrate hydrates increase rapidly and the melting temperature does not appear to be significantly affected by the presence of ammonia. We propose that thermal profile of Titan twice intersect the melting curve of methane clathrate hydrates, causing generation of melt which is composed of water-ammonia-methane. These processes that are envisioned to occur at depths of $\sim$600-700 km ($\sim$1.4 GPa), provide source of methane in atmosphere, and also offer an explanation for the orbital eccentricity observed for Titan.