The Role of Ammonia on Titan

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The Cassini spacecraft will arrive at Saturn in 2004 and spend 4 years exploring Saturn, its rings and icy satellites, and in particular the atmosphere-shrouded giant satellite Titan. The cold Saturnian system may have incorporated a lot of ammonia when it formed. This ammonia may have been photolyzed to yield the thick nitrogen atmosphere of Titan, and Titan's crust and mantle may still be ammonia-rich.

Ammonia-rich (up to 30%) ice has properties substantially different from 'pure' water ice. First, its radar absorptivity is much higher, and this may explain the low radar albedo of Titan. Understanding radar images to be taken of Titan by Cassini may require subsurface scattering and absorption to be taken into account.

Secondly, recent measurements at the University of Arizona confirm early measurements by Kargel (1990) that suggest ammonia rich ice has around 3 times lower thermal conductivity than water ice at the same temperature. This effect will steepen the geothermal temperature gradient, and coupled with the low melting point of ammonia-rich ice implies for the same surface temperature and heat flow that the melting isotherm is only at 20km depth, rather than ~100km.

The implications of ammonia on Titan's geomorphology and evolution, and prospects for its detection by the Cassini Saturn Orbiter and the Huygens Probe will be discussed.