AMMONIA HYDRADES IN THE [0-1 GPa] PRESSURE RANGE : IMPLICATIONS FOR THE INTERNAL STRUCTURE OF LARGE ICY SATELLITES.

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Models of Jovian and Saturnian subnebulae support the idea that ammonia may be an important compound of the large icy satellites of the outer planets. Moreover, the internal magnetic field discovered by the Galileo spacecraft within Ganymede and the induced magnetic field within Callisto can be explained by the existence of deep liquid layers within these two icy satellites. According to thermal evolution models of large icy satellites, ammonia may be responsible for the persistence of such liquid layers. However description of internal structures is not accurate mainly because of the lack of experimental data above 0.3 GPa in the ammonia-water phase diagram.

The peritectic melting temperature of the 25 wt% ammonia water solution in the [0, 1 GPa] pressure range has been investigated using a high pressure - low temperature membrane sapphire anvil cell (Mousis et al, JGR, 2002). Experimental results are in agreement with those presented by Hogenboom et al. (Icarus 1997) in the [0, 0.4 GPa] pressure domain where the peritectic melting temperature follows a plateau at 180 K. The present experimental work completes the lack of data between 0.4 and 0.7 GPa. It suggests that the peritectic melting temperature above 0.5 GPa is much higher than that between 0 and 0.4 GPa and does not vary very much with pressure at least up to 1 GPa. This implies the existence of at least two high pressure ammonia hydrates.

The behavior of the peritectic melting curve above 0.5 GPa plays an important role during the cooling of a deep liquid layer in the interiors of large icy satellites because crystallization of ammonia-bearing phases may occur among the high-pressure ices. In the case of Titan, the crystallization of high-pressure hydrates implies that
the thickness of an initial 15 wt% ammonia rich liquid layer must be about 260 kilometers and not 335 kilometers at 230 K (Grasset et al., PEPI, 2000). Actually, if the initial fraction of ammonia relative to ices is greater than 11 wt%, taking the partial ammonia depletion into account leads to a final liquid layer thinner than previously inferred.