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Heat storage of cryogenic fluids of Triton

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Introduction: Potential missions to Uranus and Neptune systems are being planned recently. Icy moons of these planets are of special interest for the planetary community, especially Triton, since Voyager 2 showed that the satellite, despite its far distance from the Sun, is still active and may sustain cryovolcanic processes [1]. Volatiles as ammonia (NH3) and methanol (MeOH) are condensates at this region of the solar system, and potential candidates to form part of the geochemistry at the ice-rich interior. Their presence contribute to the stabilization of liquid aqueous reservoirs with astrobiological interest. A future mission with a lander could provide accurate information about the surface composition and the thermal state of the upper layers. We have obtained laboratory data of the cryogenic systems that will help characterize the aqueous environments.
Results: In this experimental work we are measuring with the high pressure μDSC7 evo calorimeter (SETARAM Instrumentation, France) the variation on the specific heat at temperatures down to 230 K and pressures up to 500 bar of solutions with planetological interest for icy moons [2-6]. Eutectic compositions of aqueous solutions of Na2CO_3, $NaHCO_3$, $MgCO_3$, MgSO4 and NaCl [7], and aqueous solutions of 10-100wt% MeOH and 10-30wt% NH3 have been already evaluated. The results are complemented with Raman spectroscopy to study the species responsible of the Cp values depending on the P-T conditions.
Discussion: Intriguing results have been obtained respect to the systems with MeOH and NH3. With the rise in temperature, Cp increases gradually to high values until the peritectic point. Raman signature shifts of the systems 20wt% MeOH and 15wt% NH3 are being analyzed with the aim to elucidate this strange behavior of the Cp and its relationship with the physico-chemical state of the system.
These results show how complex may be the estimation of the thermal evolution of planetary bodies with the time. In aqueous solutions, the heat retention is higher in the liquid reservoirs than in the solid crust. However, the presence of volatiles can alter this trend, and revert the thermal behavior. Future runs with CO_2 and at higher pressure are planned to complement this research.
References:
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