EFFECT OF THE SALTING-OUT ON THE HABITABILITY OF PLANETARY AQUEOUS ENVIRONMENTS

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Introduction
Salt-out is a phenomenon based on the electrolyte-nonelectrolyte interaction, in which under certain conditions the solvent has a preferential interaction with one of them, decreasing the solubility of the contrary [1]. We suggest this phenomenon may occur within icy moons, such as Europa, during the evolution of aqueous fluids. A representative chemical system is constituted by H2O-MgSO4-CO2[2].

Methodology
• Salt-out experiment is performed in a high pressure chamber equipped with a sapphire window, which allows monitoring runs by Raman spectroscopy.
• Pressure and temperature are recorded during clathrate formation in the system H2O-MgSO4-CO2. The initial composition of the aqueous solution is 17 wt% MgSO4, saturated with CO2.
• During the experiments, the system is subjected to different pressure and temperature regimes, which are relevant within the icy moons crusts.

Results
Raman bands, which are followed during the experiments.

Table 1. Frequencies of key bands.

Figure 3. Raman spectrum of liquid phase in the chamber at 2°C and 34 bar. Fermi doublet frequencies (insert) corresponds to CO2(v)

Table 2. Salt concentration at different depth X-points of the liquid phase.

As water molecules are removed from the solution, the salt concentration rises near to the interface. Then, the proximity becomes denser and tend to diffuse to the bottom, appearing a gradient of salt amount along the liquid. These facts are checked at 0°C and 35 bar by Raman spectroscopy (see table 2 and figure 4).

Conclusions
The salt-out process may has a great influence on fluid geochemistry of the icy moons and, consequently to the habitability because of its effects on chemicals solubility. Nutrients can be concentrated near the interfaces. Distribution of the hydrated phases during competitive crystallization has a direct impact on the nutrient exchange between deep liquid reservoirs and upper layers. Fluid movement occurs when clathrates dissociate, which might be associated with tidal heating of the moon.

References