ESRF	**Experiment title:** X-Ray diffraction and equation of state of hydrohalite, a major component of water-rich planetary bodies.	**Experiment number**: HC4440
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Shifts: 12	**Local contact(s)**: Davide Comboni and Michael Hanfland	*Received at ESRF:*

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Scientific background

Observations from space probes strongly support the presence of dissolved ionic species (e.g. Mg, Na, Cl, SO4) in deep oceans of icy moons like Ganymede, Europa, Enceladus and Titan to pressures of several GPa. Eutectic salt saturated phases (e.g. hydrohalite for H2O-NaCl) are expected at the surface and interior of these planetary bodies through their thermal evolution. Accurate P-V-T equations of state (EoS) of relevant materials are of capital importance to better constrain the structure, dynamic and evolution of icy worlds. Even if predicted as a major specie at the surface and interior of icy worlds , no equation of states for hydrohalite exists to date due to the very limited amount of data available in the litterature.

We propose to run high-pressure, low temperatures single crystal and powder X-Ray diffraction experiment to characterize the volumes hydrohalite NaCl•2(H2O), in the 50K – 300K and 0 – 2200MPa range.

Experimental procedure

Samples consisted in a NaCl aqueous solution of 5.5 mol/kg concentrations (above the eutectic) loaded in a diamond anvil cell (DAC), equipped with 700µm culets diamonds, with a Pt-lined stainless-steel gasket (150µm wide, 70µm thick pressure chamber) directly at the ESRF prior to the start of the beamtime. We used membrane-driven Le Toullec DAC design with Boehler-Almax cut diamonds to maximize the reciprocal space sampling for single crystal XRD. The DAC was then loaded in the cryostat and cooled below freezing temperature at the lowest pressure possible to form hydrohalite (around 100-300 MPa can be achieve with large culet diamonds). Pressure was measured using standard Ruby fluorescence. X- Ray diffraction data were measured along isobars. For each pressure steps 5-10 temperature steps were achieved from 100K to close to melting (250-300K) to recover the

thermal expansion. This was repeated every 200 MPa up to 2200 MPa at the ice VII+NaCl transition.

Preliminary results

We were able to obtain over 50 volume data points for hydrohalite over the entire range of conditions planned (0-2300 MPa, 100 – 300 K). This will allow us to derive an accurate equation of state for this important planetary phase, which currently doesn't exist.

Furthermore, we were able to recover at atmospheric pressure a new NaCl-hydrate phase characterize using single crystal X-Ray diffraction. We were also able to collect new single crystal X-Ray diffraction data on an unidentified high-pressure, low temperature phase of NaCl hydrate that will allow us to solve its structure.