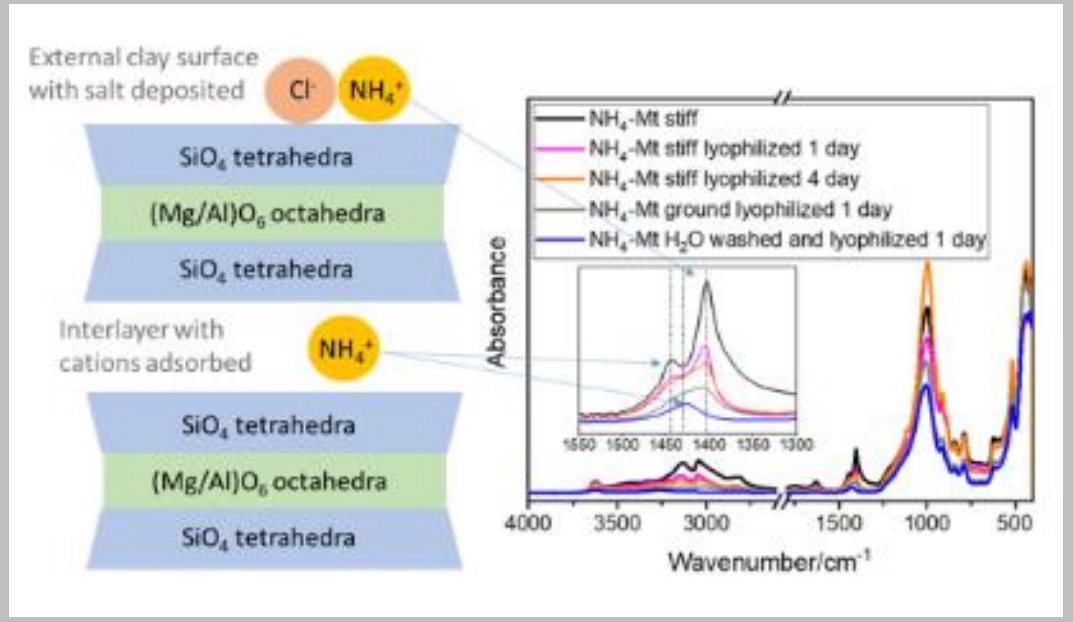
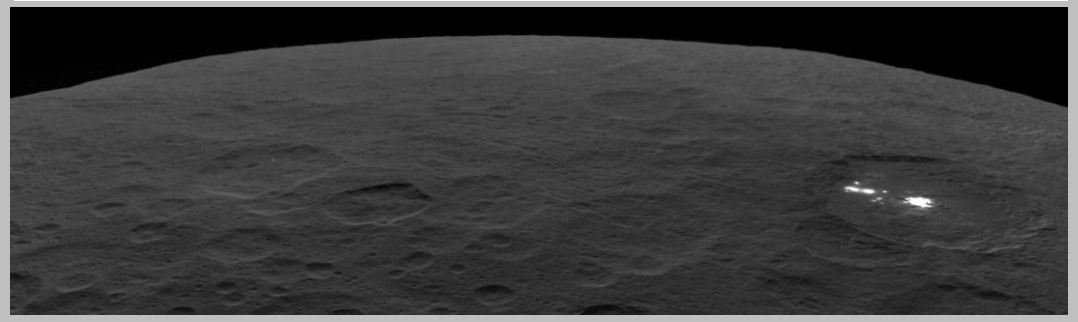
Characterization of NH_4-montmorillonite under conditions relevant to Ceres





Images: ATR-FTIR spectra of the samples before and after lyophilization (Top, credit: Muñoz-Iglesias V. CAB/INTA-CSIC). Ceres' surface and bright regions in Occator Crater (Bottom, credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA)

Ceres, dwarf planet of the main asteroid belt, is considered a relic ocean world since the NASA/Dawn mission discovered evidences of aqueous alteration and cryovolcanic activity. Unexpectedly, a variety of ammonium-rich minerals were identified on its surface, including phyllosilicates, carbonates, and chlorides.

The existence of ammonia-bearing minerals spread along Ceres' surface opened a debate about its origin, since theses phases are found at greater distance from the Sun. The study of the temporal stability of these minerals at Ceres' subsurface and surface conditions can help to find the response to this uncertainty. In this research it was performed a primary experimental approach. NH_4-montmorillonite, in coexistence with NH_4Cl salt, was characterized after its exposition to low temperature and high vacuum for several days. The aggregation state of the samples played a key role in both the stability and the spectroscopic response.

The combination of different techniques, i.e., Raman and IR spectroscopies, XRD, and SEM/EDX, assisted the assignment of the bands to each particular molecule. In this regard, the signatures of the mineral external surface were distinguished from the interlayered NH_4^+ cations.

Analyzing mineral textures exposed to extreme planetary environments by spectroscopic techniques is notable interest for future space missions, where this type of analytical technique is planned to be used. From the data obtained in this work and future analyses, it will be possible to create new databases that will include spectra of target minerals, obtained under diverse factors such as temperature, pressure, and compaction.

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