Clays as a tool to inform origin of life on Mars

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Ammonia is present on Ceres and other Solar System bodies. Remote sensing of planet Ceres and other asteroids has observed spectral features due to NH4+ bands associated with phyllosilicates. Ammonia may be present on Mars as well, but has not, to date, been detected in surface materials at Gale Crater, Mars, using the Sample Analysis at Mars (SAM) instrument suite on the Mars Science Laboratory (MSL) Curiosity Rover. Our team studies NH4-montmorillonite as a potential source of NO evolution in SAM analyses of martian samples. We prepared multiple NH4-smectites using a variety of dioctahedral Fe-bearing smectites to probe the influence of smectite chemistry and structure on the spectral features due to NH4. We have collected reflectance spectra of a large suite of NH4+-treated smectites in order to characterize these spectral bands for comparison with spectra of Ceres and other planetary bodies, where it has already been detected using the Visible and InfraRed Mapping Spectrometer (VIR) using Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) spectra from orbit and NIR spectra on landed missions. Identifying and characterizing ammonia in our Solar System will help define the availability of N for prebiotic chemistry, uncover the N cycle on other planetary bodies, and inform the origin of life. Spectral properties of these NH4+-smectites vary depending on the environmental conditions during measurement. Our experiments indicate significant reduction in the hydration features and enhancement of the NH4+ features for spectra of ammoniated smectite measured under dry air or vacuum conditions.

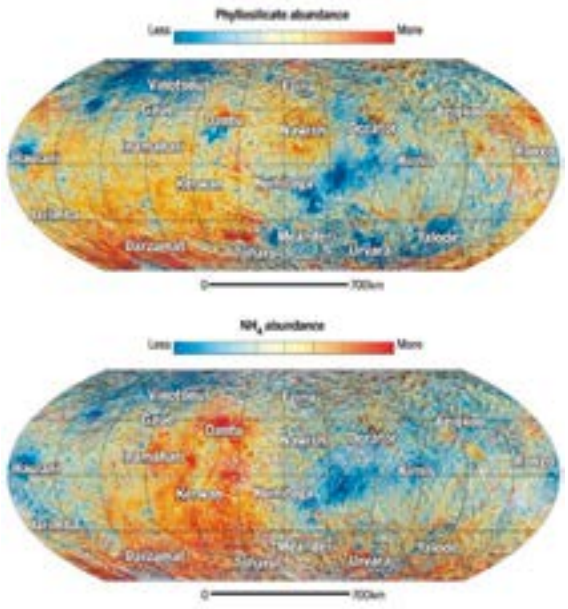

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FIGURE 1
Distribution of phyllosilicates and ammonium across the surface of Ceres.