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Laboratory experiments on ammoniated clay minerals with relevance for asteroid (1) Ceres

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Recent observations with VIR spectrometer onboard Dawn spacecraft [1] have suggested the presence of ammoniated phyllosilicates widespread on the surface of asteroid (1) Ceres [2,3]. The global surface composition of Ceres as suggested by VIR average infrared spectrum in the 1-4 micron range appears to be due to a mixture of NH4-bearing phyllosilicates, serpentine, carbonates and a dark absorbing phase (magnetite or amorphous carbon) [2]. An absorption feature occurring near 3.1 micron in the average spectrum is considered the main evidence for the presence of NH4-bearing phase; nevertheless in the past several authors tried to explain this feature, as observed with telescopic spectra, invoking the presence of brucite, cronstedtite, water ice or clays [4].

In this project we are carrying out laboratory experiments with the aim of studying ammoniated phyllosilicates in the visible-infrared range. A suite of 9 clay minerals has been used for this study, including illite, nontronite and montmorillonite. In order to produce the ammoniated species we followed a modified procedure based on the one described in Bishop et al. (2002) [5]. All minerals were reduced in fine grain size (<36 micron), treated with ammonium hydroxide (NH4OH) and heated in oven at 200°C for 24 h at normal pressure conditions, before the measurements.

Reflectance spectra were acquired with the Fourier Transform Infrared Spectrometer (FTIR) in use at INAF-IAPS/P-LAB, in the range 1-14 [U+F06D]m, on both clay minerals and NH4-treated clays. Almost all spectra of NH4-treated species are characterized by the occurrence of several new absorption features, appearing at different wavelengths near 2, 3, 6 and 7 micron. In some cases the spectral shape of already existent absorption bands resulted deeply modified. A few species did not show the appearance of new features. These results suggest that NH4+ ions fix in various ways in different minerals. Nontronite and montmorillonite appear to be the best candidates, among the studied suite, to be used in future laboratory reproduced analog mixtures.

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