

Thermal stability of water and hydroxyl on lunar regolith surrogates as explored by temperature program desorption experiments

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Abstract. Temperature Program Desorption (TPD) experiments were performed to explore the thermal stability of adsorbed water and hydroxyl on lunar regolith surrogates. Mechanically micronized JSC-1A was chosen to simulate the mare regions, while micronized albite was used to represent the lunar highlands. Both samples were found to have a continuous distribution of molecular chemisorption sites for water extending from 150 to 400 K. These data were analyzed to assign desorption energies to the distribution of sites, with calculated desorption energies ranging from 0.5 to 1.3 eV. Results indicate that the albite samples have at least twice as many chemisorption sites as the multiphase JSC-1A after adjusting for a difference in grain size between the samples, probably because there are fewer defects in the glass portion of JSC-1A. There is also evidence for the recombinative desorption of hydroxyl. A broad 18 m/z peak (H₂O) was observed at ~550 K when degassing the sample for the first time to 750 K. Subsequent heatings of the sample to 750 K did not exhibit water desorption at this temperature; all water had essentially desorbed by 400 K. Additionally, diffuse reflectance infrared spectra comparing unheated and heated samples showed a loss of an infrared absorption that is consistent with hydroxyl. Thus, we infer that this desorption of water at 550 K was due to the recombinative desorption of hydroxyls as water. The lack of readsorption of hydroxyl furthermore suggests the accumulation of adsorbed hydroxyl is a ‘slow’ process on laboratory timescales.