**UNDERSTANDING WATER IN THE SURFACES OF AIRLESS BODIES THROUGH LABORATORY MEASUREMENTS OF THE 3- AND 6-MICRON ABSORPTION FEATURES.** C. A. Hibbitts[1], K. Stockstill-Cahill[1], D. Takir[2], C. Honnibal[3], P. Lucey[4], S. Li[4],[1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [2]JETS/ARES, NASA Johnson Space Center, [3]NASA Goddard Space Flight Center, [4]University of Hawaii, Honolulu, HI.(Contact: Karl.hibbitts@jhuapl.edu)

**Motivation:** Water, as $H_2O$ or OH, is ubiquitous in the surfaces of airless solid bodies through-out the inner solar system. The 3-µm absorption feature has long been known to provide great insight into the hydration states of minerals [e.g. 1,2], meteorite samples [e.g. 3,4,5], and has been used to infer water on asteroids [e.g. 6,7]. More recently the 6-µm absorption feature has been recognized as providing valuable information on the state of water on airless surfaces. Due to the symmetric stretch of the $H_2O$ water molecule, the presense of a a 6-µm band is indicative of molecular water, and, unlike the 3-µm band is insensitive to the dissociated water molecule, or hydroxyl [e.g. 8,9]. Spectroscopy in the 6-µm region has provided the first unequivocal detection of molecular water on the surface of the Moon [10,11]. With the expectation that this new remote sensing technique for characterizing water on airless bodies will quickly be applied to asteroids, we have analyzed the 6-µm region of previously-taken laboratory reflectance spectra of carbonaceous meteorites and compare the nature of the 6-µm feature to the 3-µm feature.

**The Laboratory Measurements.** Reflectance spectra from the near-infrared to ~ 8 µm were obtained at the Laboratory for Spectroscopy under Planetary Environmental Conditions at the Johns Hopkins University Applied Physics Laboratory of 13 chondrite meteorite and one analog. Ambient spectra were obtained at room temperature $N_2$-purged. Desiccated spectra were obtained after heating under ~ $1e^{-7}$ to $1e^{-6}$ torr at ~ 80C for ~12 hours. Spectra of 13 carbonaceous chondrites and one terrestrial analog Figure 1 shows as-acquired data (thin line) and post-processed data (thick lines).

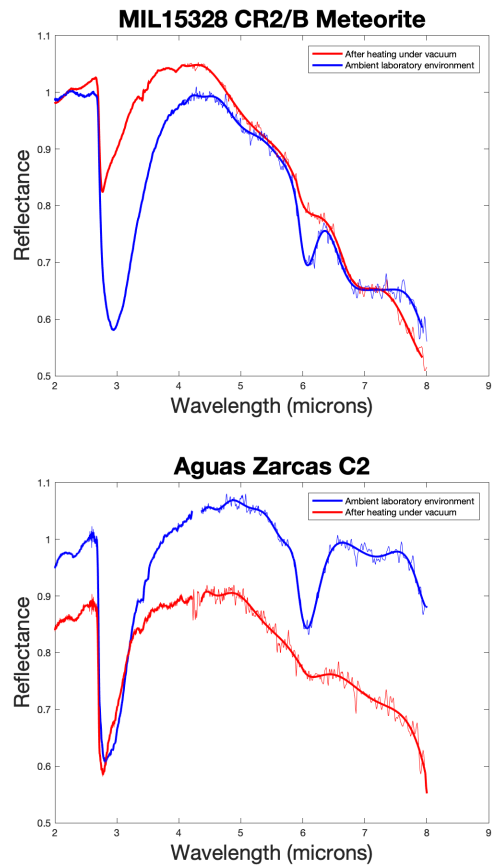


Figure 1. Desiccation decreases the depth of both the 3-and 6-µm band and affects their shapes, though differently. The 6-µm band is only sensitive to $H_2O$, whereas OH can be at least partially responsible for a 3-µm band.

**Results and Discussion:** Ambient spectra have a more rounded 3-µm band and a deeper 6-µm. After desiccation, the 3-µm band can appear very asymmetric, centered short of 3-µm, potentially interpreted as being indicative of only hydroxyl; however the remaining 6-µm band demonstrates there is residual molecular $H_2O$. The depths and areas the 3- and 6-µm absorption features are larger in the hydration spectra as observed by previous researchers [4,5]. The 3-µm band positions consistently shift to longer wavelength with increasing abundance of adsorbed molecular water, whereas the 6-µm band can shift to shorter wavelengths upon hydration. The shift in the 3-µm asymmetric stretch to shorter wavelenths when less water is present has been interpreted as indicative of stronger bonding between the residual water molecules and adsorbate than is the bond between water molecules themselves; a stronger bond → shorter bond length→ higher frequency and shorter wavelength for the vibration. The mechanism for the opposite shift in the 6-µm symmetric vibration is not yet clear.

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**Acknowledgements:** Part of this work has been supported by NASA Hayabusa2 Participating Scientist Program grant NNX17AL02G.