Searching for Molecular H_2O on Nominally Anhydrous Asteroids: Preliminary Results. A. Arredondo[1] and M. M. McAdam[2], [1]Southwest Research Institute, San Antonio, TX, USA (anicia.arredondo-guerrero@swri.org). [2]NASA Ames Research Center, Moffat Field, CA, USA.

Introduction: It is generally assumed that asteroids have different compositions depending on where they formed in the solar nebula, with silicates forming nearer to the Sun and ices forming farther from the Sun. The 3 µm absorption feature is used to measure the amount of hydration on asteroids [1]. The shape of the feature is thought to relate to degree of alteration, with broad, bowl shapes corresponding to ice frost and sharp, checkmark shapes corresponding to aqueously altered phyllosilicates [2].

Unexpectedly, silicate-rich S-type asteroids have been observed to have 3 µm features [3,4,5,6]. The origin of the signature of hydration is unclear and likely caused by multiple factors. Evidence from meteorites could suggest that some water could be primordial but a large 3 µm survey of nominally anhydrous main belt asteroids potentially suggests an exogenic source (i.e., hydrated materials delivered via impacts or from hydroxyls generated through solar wind interactions with the regolith). [3, 4] observed 33 main belt S-type asteroids to search for 3 µm features and investigate the relationship with heliocentric distance. One of these asteroids is (7) Iris (Figure 1), a large (D = 200 km) asteroid found in the inner asteroid belt (a = 2.385 AU).

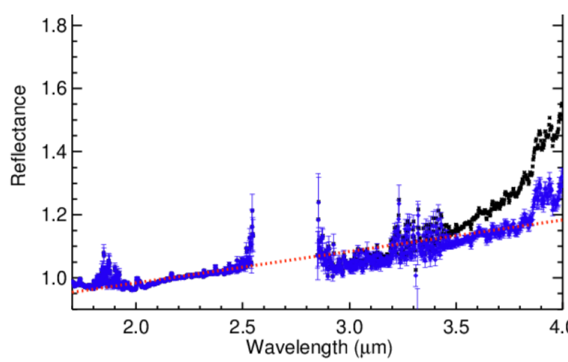

Figure 1. IRTF+SpeX observation of (7) Iris. Over plotted on the data (black) is the thermal continuum (red) and the thermally corrected data (blue). Iris shows a 3 µm band with a depth of 4.13+/-1%.

Observations at 3 µm cannot distinguish between hydroxyls (either from exogenic hydrated minerals or grain interactions with the solar wind) and molecular water. However, molecular water produces a spectral feature at 6 µm that has no contribution from hydroxyl and can be used to unambiguously identify its presence. This feature has successfully been used to detect molecular water on the sunlit Moon by the Stratospheric Observatory for Infrared Astronomy (SOFIA) [7].

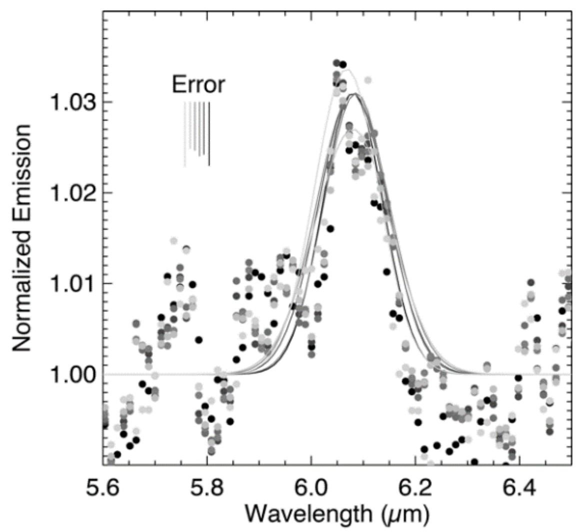

Figure 2. *6 µm emission feature from observations of the sunlit Moon [7]. The feature is on the order of 1%, corresponding to a water abundance of ~200 µg/g.*

Methods: We use the FORCAST spectrometer on SOFIA to observe four of the S-type asteroids identified by [3, 4] to have 3 µm features. We observe the asteroids in two grisms with spectral coverage between 4.9-8.0 µm and 8.4-13.7 µm. The first grism is used to search for and characterize the 6 µm band indicative of molecular water. The second grism is used to help constrain the thermal inertia of the asteroids and to characterize olivine and pyroxene features that are prominent on S-type asteroids.

We use the Near-Earth Asteroid Thermal Model (NEATM) [8] to model the thermal contribution to the spectrum of each asteroid. We remove the thermally modeled flux to give an emissivity spectrum. We convert the strength of the detected 6 µm band to water abundance using a laboratory derived relationship between water-bearing glass in heating experiments [7,9].

Results: We report preliminary results featuring the non-detection of a 6 µm emission feature in the spectrum of (7) Iris. A non-detection of molecular water implies that the 3 µm signature of hydration has a significant contribution by exogenic hydrated material from the mid/outer asteroid belt. This is likely more similar to the dark material on Vesta rather than water from comets.

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