INFRARED SPECTROSCOPY OF EUCRITE JUVINAS UNDER VACUUM: IR ABSORPTION OF WATER AND ORGANIC SPECIES. **L.A. McFadden[1],** D.S. Ebel[2], M.J. Loeffler[3], J. Boesenberg[2], R.A. Baragiola[3], [1]Department of Astronomy, University of Maryland, College Park, MD 20742, [2] Dept. Earth & Planetary Sci., American Museum of Natural History, New York, NY 10024, [3]University of Virginia, Laboratory for Atomic and Surface Physics, Charlottesville, VA 22903

Introduction: Infrared spectra of asteroid 4 Vesta show absorption features in the 3-μm region at the 1% level [1]. During three other apparitions and at different sub-Earth latitudes, there is no evidence of absorption between 2.9 and 3.6 μm [2]. Infrared spectra of HED meteorites were used to constrain the depth of any 2.6-4μm feature in Vesta's spectrum [2]. IR absorptions in this region in the meteorite spectra were presumed to be due to adsorbed water from the terrestrial atmosphere and limited the ability to characterize the spectra of Vesta. However, a reported quartz veinlet in the Serra de Magé eucrite meteorite suggests deposition from a liquid water solution [3]. Whether the IR absorptions in HEDs in the 2.6-4 μm region are due to a*d*sorbed telluric water, a*b*sorbed primordial water, or structural OH [4,5], is an important question that we begin to address with experiments reported here. Feldspar and pyroxene can incorporate significant water as H in their structures [6], and transmission FTIR analyses of the vesicular eucrite Ibitira [7] revealed conspicuous water bands between 3000 and 3700 cm^{-1} (2.7-3.3 μm). We present preliminary IR spectral reflectance measurements of an HED meteorite under controlled laboratory conditions. Preliminary results suggest there may be both a*d*sorbed and a*b*sorbed water within the meteorite itself. The implications for both the interpretation of the asteroid spectra and the formation of asteroids are intriguing.

Experiment: To investigate the nature of the 2.6-4 μm absorptions in HED spectra we measured the reflectance spectrum of Juvinas, an equilibrated eucrite containing predominantly low-calcium pyroxene and plagioclase. The sample was crushed in air to a grain size of <75 μm at the American Museum of Natural History and transferred to U. Virginia. The sample was then pressed into 1 cm pellets (dry, 3000psi for 5 min), and their infrared reflectance spectrum between 1 and 5 μm was measured under high vacuum (10^{-8} torr)

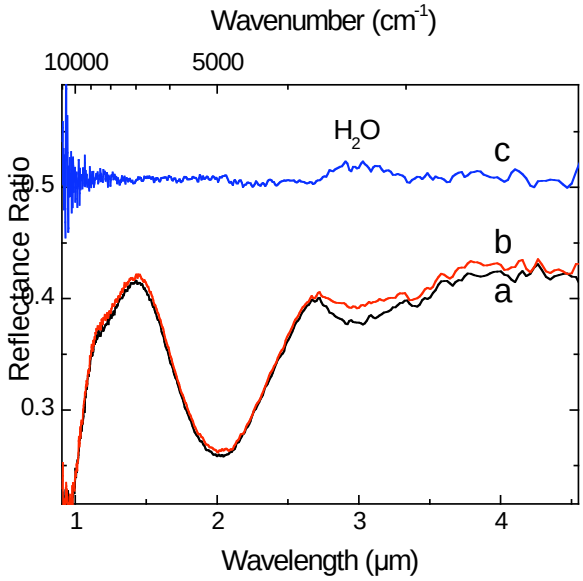

Figure 1. Infrared reflectance of the Juvinas meteorite (<75 μm) normalized to that of a diffuse gold substrate: (a) initial, (b) after heating at 450 K for ten hours, (c) ratio of (a) and (b) divided by 2. All measurements were made under high vacuum.

using a Thermo-Nicolet Nexus 670 FTIR spectrometer at 32 cm^{-1} resolution.

Initial Results: Even under high vacuum, adsorbed water was observed in the infrared spectrum of Juvinas, as is evidenced by the band near 3 μm consistent with the O-H stretch vibration (Fig. 1); the stronger 2 μm band is from pyroxene. Weaker absorptions at 3.4 μm are ν_{CH} bands [8] and may also be of scientific interest. Next we performed in situ heating of the sample at 450 K for 10 hours (Fig. 1b). We found that the strength of the water absorption became weaker; this is seen more clearly in the ratio of the reflectance before heating to that after heating (Fig. 1c). However, some of the water and the C-H features remain. We will continue with experiments to verify the nature of the water, to determine whether it is adsorbed during sample preparation, is primordial to the meteorite [7], and/or whether it is structural OH or H_2O.

Discussion: Recent discoveries have underscored the importance of volatiles on planetary bodies. The origin and history of planetary volatiles, especially water, are central to the search for life beyond Earth. Basaltic achondrite meteorites are the 'ground truth' for observations of differentiated asteroids which lie at the boundary between protoplanets and planets. Therefore, it is critical to understand everything about water in the achondrites, some of which represent the asteroid Vesta [9,10].

The abundance of water and its distribution is critical to establishing the nature and extent of planetary processes that will be observed at Vesta upon arrival of the Dawn spacecraft in 2011 [11,12].

References:

[1] Hasegawa et al (2003) GRL DOI 10.1029/2003GL018627.

[2] Rivkin et. al. (2006) Icarus, 180, 2, 464-472.

[3] Treiman A.H., Lanzirotti A., and Xirouchakis D. (2004). Earth Planet. Sci. Lett.. 6977, 1-11.

[4] Demouchy S., Mackwell S. (2006) Phys. Chem Minerals 33: 347-355.

[5] Lebofsky, L.A. et al. (1981) Icarus, 48, 453-459.

[6] Keppler H. and Smyth J.R. (eds.)(2006). Reviews in Mineralogy #62.

[7] Burbine, T.H. et al. (2006) LPSC XXXVII, Abstract #2220.

[8] Freund, M.M. and Freund, F.T. (2006) Astrophys. J. 639:210-226.

[9] Burbine T.H. et al. (2001) MaPS 36, 761-781.

[10] Pieters C.M. et al. (2005) Proc. International Astronomical Union 1: 273-288.

[11] Russell, C.T. et al. (2004) Planetary and Space Science, 52, 465-489.

[12] Russell, C.T. et al. (2006) Adv. Space Res. 38, 2043-2048.