M-type asteroid (16) Psyche: evidence for a silicate regolith. Z. A. Landsman[1], J. P. Emery[2], and H. Campins[1], [1]University of Central Florida, 4111 Libra Drive, Physical Sciences Bldg. 430, Orlando, FL 32816-2385, (zlandsman@knights.ucf.edu) [2] Dept. of Earth & Planetary Sciences, University of Tennessee

Introduction: Asteroid (16) Psyche is a Tholen "M" asteroid, a taxon characterized by moderate albedos and red, featureless visible-wavelength spectra [1]. Radar data [2] and comparisons with iron meteorites suggest that some M-types have high metal content, and a few may be remnant iron cores. Psyche's high radar reflectivity and high bulk density make it a likely metal asteroid candidate [3]. Intriguingly, there is also spectroscopic evidence for both pyroxene [5,6] and hydroxyl (attributed to hydrated minerals) [7] on Psyche's surface. Psyche is a unique object and is the target of the NASA mission *Pysche*, planned to launch in 2023 [4].

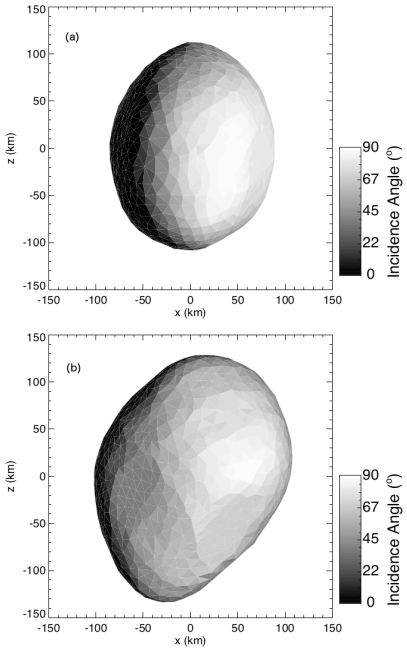

Figure 1. Lightcurve inversion shape model of (16) Psyche [8,9] as seen from the Spitzer Space Telescope during the 5.2—7.6 µm observation (a; 2004-05-14) and 7.4 – 14.2 µm observation (b; 2006-03-17).

Methodology: To test the hypothesis that Psyche's surface is dominated by metal, we have analyzed mid-infrared (5.2-14.2 µm) spectra of Psyche collected using two data sets from the Spitzer Space Telescope's Infrared Spectrograph (Figure 1). We aim to constrain Psyche's composition and thermal properties through thermophysical modeling and analysis of Psyche's emissivity spectrum.

Results: Our thermophysical modeling results suggest Psyche's surface is heterogeneous, with different fractions of silicate and metal across the surface. The hemisphere observed on 2006-03-17 has a thermal inertia $\Gamma < 75$ J m^{-2} K^{-1} s$^{-1/2}$ and bolometric emissivity of $\varepsilon \sim 0.9$, consistent with a silicate-dominated surface. The hemisphere observed on 2004-05-14 has a thermal inertia $\Gamma > 30$ J m^{-2} K^{-1} s$^{-1/2}$ and bolometric emissivity $\varepsilon = 0.7$-0.5, suggesting that this hemisphere of Psyche has a higher metal content.

The emissivity spectrum of Psyche from the 2006-03-17 observation (Figure 2) reveals excess emission from ~9-12 µm. This feature is attributed to the Si-O stretch and bend fundamental band in silicates and is associated with fine-grained and/or underdense silicate regolith [10,11]. The spectrum is qualitatively similar to enstatite chondritic spectra [12] and is consistent with the presence of a fine-grained silicate regolith on the hemisphere observed on 2006-03-17.

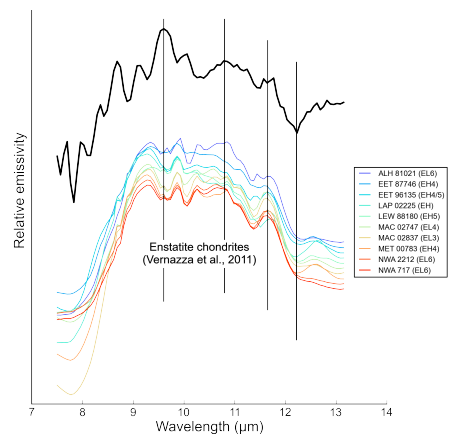

Figure 2. Psyche's emissivity spectrum (black) shown with the spectra of enstatite chondrites [12]. Vertical lines highlight common features.

Conclusions: (16) Psyche is a complex object. Thermophysical modeling results suggest there is rotational variation in the silicate and metal content across Psyche's surface. The emissivity spectrum of the silicate-rich surface is consistent with fine-grained silicate regolith and qualitatively similar to the spectra of enstatite chondrites.

Acknowledgments: Z.L. gratefully acknowledges support from UCF's Center for Lunar and Asteroid Surface Science and the Florida Space Grant Consortium. We thank L. Lim and D. Cruikshank for their Spitzer observations. We thank P. Vernazza for the meteorite spectra shown in Figure 2.

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