NEAR-IR REFLECTANCE SPECTRA OF M-ASTEROIDS 250 BETTINA, 369 AERIA, 413 EDBURGA, AND 931 WHITTEMORA.

P. S. Hardersen[1,2], M. J. Gaffey[1,2], S. Kumar[1,2], S. K. Fieber-Beyer[1,2], J. J. Crowell[1,2], and A. M. Crowell[1]. [1]University of North Dakota, Department of Space Studies, 4149 University Avenue Stop 9008, Grand Forks, ND 58201, [2]Visiting Astronomer at the Infrared Telescope Facility under contract from the National Aeronautics and Space Administration, which is operated by the University of Hawai'i, Mauna Kea, HI 96720. Hardersen@space.edu.

Introduction: The study of asteroids via ground-based near-infrared (NIR: ~0.8 to 2.5-μm) spectral reflectance measurements is currently the most efficient and diagnostic technique to constrain asteroid surface major mineral abundances of a large number of objects [1,2,3,4,5,6]. When combined with complementary data at other wavelength intervals (i.e., visible-λ, ~3-μm, radar), the ability to constrain an asteroid's dominant surface mineral(s) and metallic abundance becomes stronger when the various datasets produce consistent interpretations [7,8,9].

Acquiring a very large (>1000) dataset of asteroid NIR spectra would facilitate study of asteroid surface mineralogies and the search for meteorite analogs for individual asteroids, while allowing higher precision study of main asteroid belt chemical and thermal characteristics based on inferences derived from the mineralogies of asteroids [10].

As a complementary effort to increase the number of ground-based NIR asteroid spectra, the ongoing M-asteroid NIR spectral survey has the goal of obtaining spectra for all Tholen-defined M-asteroids [11].

Previous results: [12,13] reported the first detections of weak, ~0.9-μm absorption features in the spectra of some M-asteroids. [13] attributes these features to low-Fe pyroxenes for six M-asteroids. However, more recent work by [14,15,16] has shown broad spectral and mineralogic diversity among the M-asteroid population. Olivine and spinel-related absorption features, as well as pyroxene absorption(s), have been detected. Additionally, some M-asteroids are featureless throughout the NIR region.

Implications of these results include refinement of M-asteroid interpretations and identification of potential meteorite analogs. The principal interpretation in [13] suggests that the low-Fe pyroxene is remnant mantle material of differentiated, relatively chemically-reduced asteroids. Other potential interpretations were suggested, including Bencubbinites as potential meteorite analogs and the low-Fe pyroxene as a product of a smelting-like process, but not without difficulties [13]. Possible meteorite analogs for other M-asteroids include the pallasites and CO/CV-chondrites [14]. Troilite has also been potentially identified on one M-asteroid [16].

Work by [8] suggests the presence of phyllosilicates on some M-asteroid surfaces from the detection of a 3-μm absorption feature. The nature of 3-μm absorptions is problematic as they are not diagnostic identifiers of phyllosilicate minerals [1]. The abundance of surface phyllosilicates necessary to produce a ~3-μm absorption is also not constrained. If the phyllosilicate interpretation is correct, however, then it becomes potentially necessary to reconcile differing interpretations.

Observations/Data reduction: Observations of 250 Bettina, 369 Aeria, 413 Edburga, and 931 Whittemora were conducted at the NASA Infrared Telescope Facility (IRTF), on Mauna Kea, HI, from April 19-21, 2005 (UT). NIR spectra were obtained with the SpeX spectrograph in prism mode (*R*~95) [17].

Spectral data were reduced using a combination of IRAF and SpecPR [18,19]. IRAF was used to extract each spectrum into a 1-D array of fluxes and to conduct the wavelength calibration. Primary SpecPR reductions include empirically determining the nightly standard star extinction coefficients, channel shifting and averaging asteroid and solar analog star spectra, and determining absorption band centers and areas, as necessary.

Results: Initial spectra for each of the asteroids is presented in Figures 1-4 below:

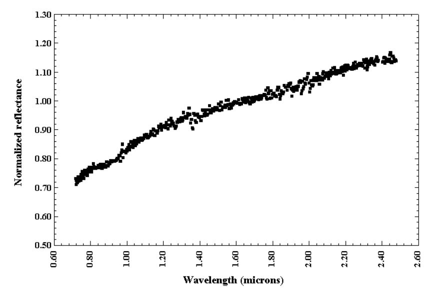

Figure 1. 250 Bettina. Average of 20 spectra.

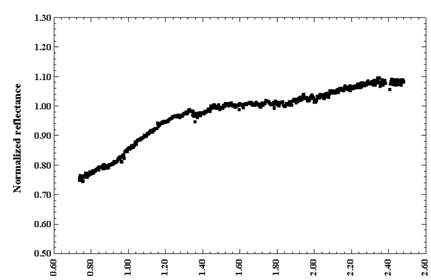

Figure 2. 369 Aeria. Average of 10 spectra.

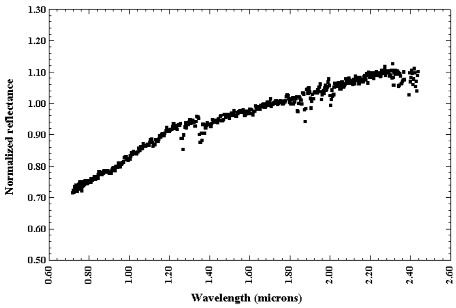

Figure 3. 413 Edburga. Average of 20 spectra.

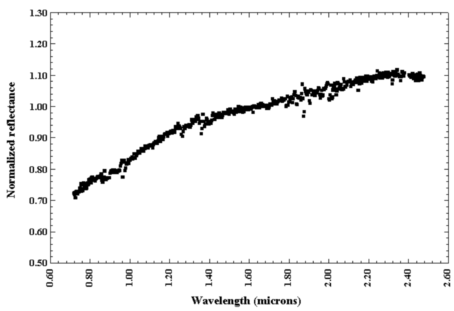

Figure 4. 931 Whittemora. Average of 10 spectra.

250 Bettina. This asteroid has a diameter of 79.75 ± 4.6 km and an IRAS albedo of 0.2581 ± 0.033 [20]. It orbital parameters are: *a* = 3.150 AU, *i* = 12.81°, and *e* = 0.128.

The average NIR spectrum in Figure 1 displays a weak ~0.9-μm absorption feature superimposed on a reddish spectrum. Isolation of the feature via division by a linear continuum results in a band center of ~0.91-μm. 250 Bettina's spectrum is similar to the featured spectra in [13] and the range of interpretations, as outlined above, apply.

369 Aeria. This asteroid has a diameter of 60.00 ± 1.2 km and an IRAS albedo of 0.1919 ± 0.008 [20]. Its orbital parameters are: *a* = 2.650 AU, *i* = 12.71°, and *e* = 0.098.

The average NIR spectrum in Figure 2 includes broad, weak ~1- and ~2-μm absorption features superimposed on a reddish spectrum. This spectrum displays similarities to a mesosiderite spectrum, Veramin [21]. This potential meteorite analog, as well as other possibilities, will be investigated.

413 Edburga. This asteroid has a diameter of 31.95 ± 2.8 km and an IRAS albedo of 0.1466 ± 0.029 [20]. Its orbital parameters are *a* = 2.584 AU, *i* = 18.72°, and *e* = 0.343.

The average spectrum in Figure 3 is generally featureless with the presence of residual atmospheric water vapor features at ~1.4- and ~1.9-μm. The traditional interpretations for a featureless, moderate albedo M-asteroid NIR spectrum includes the enstatite chondrite and NiFe meteorite analogs [22,23].

931 Whittemora. This asteroid has a diameter of 45.27 ± 3.4 km with an IRAS albedo of 0.1704 ± 0.028 [20]. Its orbital parameters are: *a* = 3.181 AU, *i* = 11.46°, and *e* = 0.225.

The average NIR spectrum in Figure 4 is generally reddish and featureless within the noise of the data. The enstatite chondrite and NiFe meteorite interpretations also apply to this asteroid.

Future work: Additional spectra of each of these asteroids, with the exception of 931 Whittemora, will be reduced and compared to the initial results presented here.

Currently, this M-asteroid survey has acquired NIR spectra for 35 asteroids, of which data has been reduced for 25 asteroids. Observations, data reduction, and analyses will continue to fully constrain the mineralogical and spectral diversity of this group of asteroids.

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