EPSC Abstracts
Vol. 13, EPSC-DPS2019-845-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Spectral Characterization of Lucy Mission Targets

Benjamin N. L. Sharkey (1), Vishnu Reddy (1), Juan A. Sanchez (2), Matthew R.M. Izawa (3), and Joshua P. Emery (4,5)

(1) Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona, USA, (2) Planetary Science Institute, Tucson, Arizona, USA, (3) Institute for Planetary Materials, Okayama University-Misasa, Misasa, Japan, (4) University of Tennessee, Knoxville, TN, USA, (5) Northern Arizona University, Flagstaff, AZ, USA

(sharkey@lpl.arizona.edu)

Abstract

We report near-infrared (0.7-2.5 µm) spectra for each of the six target asteroids of the forthcoming NASA Discovery-class mission *Lucy* [1]. Five Trojan asteroids of Jupiter (the binary (617) Patroclus system, (3548) Eurybates, (21900) Orus, (11351) Leucus, and (15094) Polymele) are well-characterized (sufficient signal-to-noise to distinguish differences between all objects), and a course survey-quality spectrum was collected for main belt asteroid (52246) Donaldjohanson. Our observations of Patroclus and Eurybates are consistent with previous reported results [2,3]. The surface compositions of these asteroids are unconstrained due to the lack of absorption features in the spectra. We apply radiative transfer modeling using Hapke formalism [4] for a variety of compositional endmembers, performing a thorough investigation of model parameter space. We find that the linear spectrum and low albedo of Patroclus imply a statistically distinct composition when compared to the other *Lucy* targets. Models for Eurybates are consistent with a hydrated surface that can accommodate up to ~5% water ice (by weight). Models for D-type asteroids Orus and Leucus are consistent with each other and require a significantly increased content of a reddening agent (e.g. iron-rich silicates or tholin-like organics) when compared with Patroclus. Polymele has similar spectral slopes as Patroclus, but a higher albedo more closely aligned with Orus/Leucus/Eurybates, defying simple grouping.

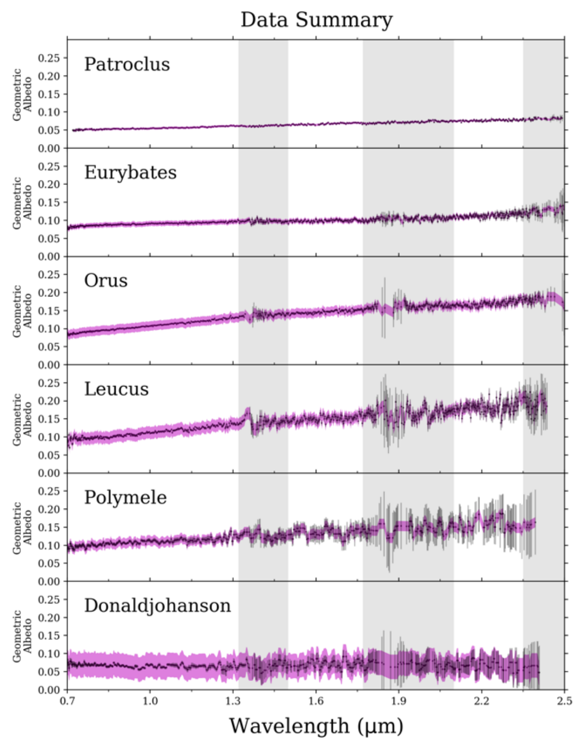

Figure 1: Near-infrared (0.75-2.5 µm) spectra of all six asteroid targets of the Lucy mission obtained using the SpeX instrument on the NASA Infrared Telescope Facility (IRTF) on Mauna Kea, Hawai'i. Conversion from relative reflectance to geometric albedo was performed by scaling to visual albedos as reported by NEOWISE [5,6,7]. The conversion was performed by extending observed linear slopes from 0.7-1.3 µm to the bandpass reported by NEOWISE. Relative uncertainties in our spectra are given by the black error bars, the uncertainties of the NEOWISE measurements (corresponding to a vertical translation of our data) are given by the magenta shaded regions. The gray bars indicate the location and extent of the atmospheric water bands.

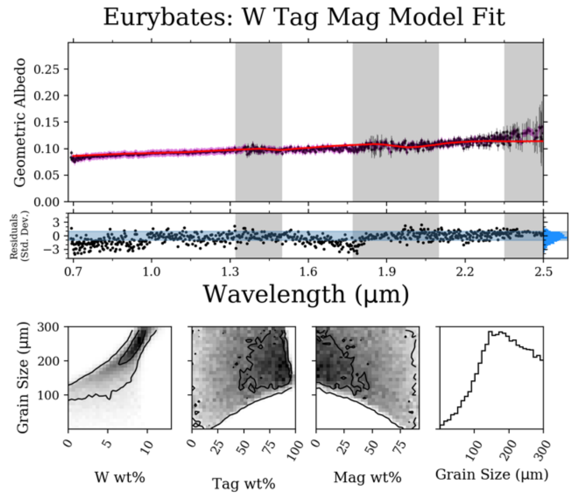

Figure 2: Top: Comparison of our spectrum of C-type Trojan Eurybates with a hydrated model including water ice (W), Tagish Lake (Tag), and magnetite (Mag). Middle: Fit residuals scaled to observational uncertainties. Bottom: Hapke fit parameter distributions as a function of effective grain size. The neutral slope of Eurybates closely matches that of a combination of Tagish and magnetite for a wide range of large grain sizes beginning near 130 µm. We find that as much as ~5 wt. % water ice is consistent with our data across a variety of models, with increasing allowances at higher grain sizes which suppresses absorption bands. This is consistent with the usage of kerogen and amorphous carbon as different darkening agents. The inclusion of water ice modestly improves fits near 2.2 µm vs. two component models.

Acknowledgements

This work was supported by NASA Earth and Space Science Fellowship (PI: Sharkey) and Near-Earth Object Observations (NEOO) program grant NNXAL06G (PI: Reddy). We thank the NASA IRTF TAC for awarding time to this project, and to the IRTF telescope operators and MKSS staff for their support. The authors wish to recognize and acknowledge the significant cultural role and reverence the summit of Mauna Kea has always had within the indigenous Hawaiian community. We are most fortunate to have the opportunity to conduct observations from this mountain.

References

[1] Levison, H. F. and Lucy Science Team: *Lucy: Surveying the Diversity of the Trojan Asteroids: The Fossils of Planet Formation*, 47th Lunar and Planetary Science Conference, Houston, United States, 2016.

[2] Yang, B. & Jewitt, D.: *A Near-infrared Search for Silicates in Jovian Trojan Asteroids*, *Astron. J.* **141,** 95 (2011).

[3] Emery, J. . & Brown, R.: *Constraints on the surface composition of Trojan asteroids from near-infrared (0.8–4.0 µm) spectroscopy*, *Icarus* **164,** 104–121 (2003).

[4] Hapke, B. *Theory of Reflectance and Emittance Spectroscopy*. (Cambridge University Press, 2011). doi:10.1017/CBO9781139025683

[5] Mainzer, A. K. *et al.*: NEOWISE Diameters and Albedos V1.0. *NASA Planet. Data Syst. id. EAR-A-COMPIL-5-NEOWISEDIAM-V1.0* **247,** (2016).

[6] Grav, T., Mainzer, A. K., Bauer, J. M., Masiero, J. R. & Nugent, C. R.: *WISE*/*NEOWISE* OBSERVATIONS OF THE JOVIAN TROJAN POPULATION: TAXONOMY. *Astrophys. J.* **759,** 49 (2012).

[7] Masiero, J. R. *et al.* MAIN BELT ASTEROIDS WITH *WISE* /NEOWISE. I. PRELIMINARY ALBEDOS AND DIAMETERS. *Astrophys. J.* **741,** 68 (2011).