SURVEYING METEORITE ANALOGS FOR EARTH QUASI-SATELLITE (469219) KAMO`OALEWA

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**Kamo`oalewa's Atypical Spectrum:** The Earth quasi-satellite Kamo`oalewa is a small asteroid whose current orbital state keeps it within ~1.5-4.5 × 10^7 km of the Earth. It is an object of interest for spacecraft study [1-3]. We conducted an observing campaign to characterize Kamo`oalewa upon its discovery in 2016 by the Pan-STARRS survey [4]. Using the Large Binocular Telescope and the Lowell Discovery Telescope, we characterized its rotational properties and its reflectance spectrum in visible and near-infrared wavelengths (~0.4-2.2 microns). Notably, our observations found its reflectance spectrum to be unusually reddened (increasingly reflective with increasing wavelength), and to display a feature indicative of silicates near 1.0 micron [5]. Our analysis found that explanations of this spectrum based on the behavior of other near-Earth asteroids to be insufficient (Figure 1, note that the curve for (63) Ausonia, an example of a reddened silicate-rich Sw-type asteroid, is less red than our observations). Additionally, invoking mixtures of anhydrous silicates with meteoritic metal is insufficient (Figure 1, note the behavior of the virtual mixture of metal from Gibeon with silicates from Vaca Muerta). Overall, we find that the spectral match to lunar samples, combined with the dynamical properties of this object, lends support to a lunar origin for Kamo`oalewa.

Comparisons to Lunar Materials: We noted that our spectrum of Kamo`oalewa displays similarities to several samples of Lunar soils as collected by the Apollo missions [5]. Here we further note that this spectrum compares closely with those of isolated agglutinates across a variety of Apollo samples [6]. Surveying spectra available through the RELAB database finds that slab spectra of the fusion crust from Lunar meteorite sample Y-791197,72 displays a similar slope to Kamo`oalewa, while a powdered sample (92) is less steeply red. (Figure 1) [7].

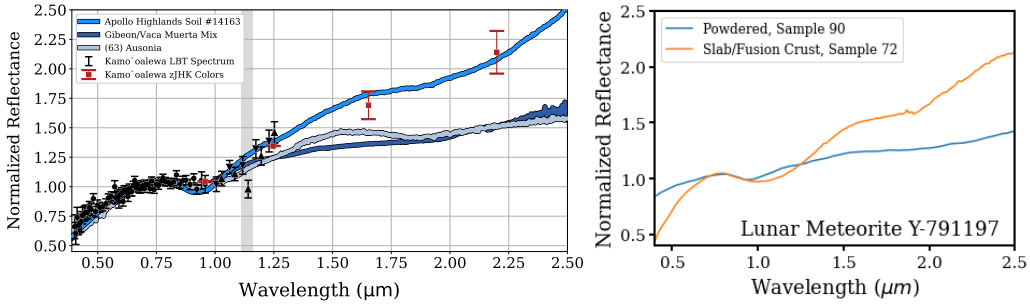

Figure 1: Left: Reflectance spectrum of Kamo`oalewa compared (points) with curves of the Sw-type asteroid (63) Ausonia, a virtual mixture of meteoritic metal with silicates (Gibeon/Vaca Muerta mix), and a lunar highlands soil sample (#14163). From [5]. Right: Spectra of two samples of the lunar meteorite Y-791197, from [7].

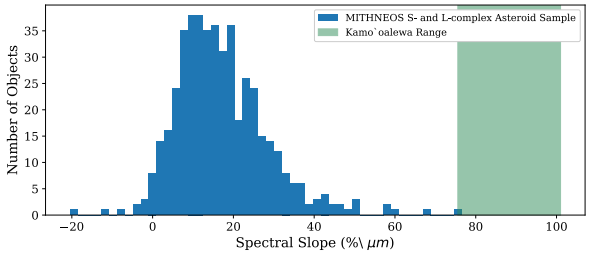

Figure 2. Comparison of the spectral slope of Kamo`oalewa with other near-Earth asteroids. Kamo`oalewa (green region) has a higher best-fit spectral slope than all S- and L-type NEAs observed by the MITHNEOS survey [6].

Acknowledgements: This work is supported by NASA Near-Earth Object Observations Program Grant NNX17AJ19G (PI: Reddy). We thank Renu Malhotra, Audrey Thirouin, Olga Kuhn, Albert Conrad, Barry Rothberg, Juan A. Sanchez, David Thompson, and Christian Veillet for their efforts and support in the data collection and interpretation as reported in [5]. We thank Richard Binzel for discussions relating to lunar materials.

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