SEARCH FOR ABSORPTION FEATURES IN MERCURY'S VISIBLE REFLECTANCE SPECTRA: RECENT RESULTS FROM MESSENGER. Faith Vilas[1] Deborah L. Domingue[1], Ann L. Sprague[2], Noam R. Izenberg[3], Rachel L. Klima[3], Elizabeth A. Jensen[1], Jörn Helbert[4], Mario D'Amore[4], Karen R. Stockstill-Cahill[5], and Sean C. Solomon[6]. [1]Planetary Science Institute, 1700 E. Fort Lowell Rd., Suite 106, Tucson, AZ 85719, fvilas@psi.edu; [2]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85719; [3]The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723; [4]DLR, Rutherfordstrasse 2, Berlin, Germany; [5]Center for Planetary Sciences, Smithsonian Institution, Washington, DC 20560; [6]Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC 20015.

Introduction: The MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft has acquired a large sample of color images of different areas on Mercury's surface with its Mercury Dual Imaging System (MDIS) wide–angle camera (WAC), and broadly distributed higher-resolution spectra with the Mercury Atmospheric and Surface Composition Spectrometer (MASCS). Collectively, these data contribute to the study of Mercury's surface mineralogy. Albedo and color differences are observed in the MDIS images and correlate with surface geologic units, showing variations in surface mineralogy and tying them to geological processes [cf. 1]. Guided by these differences, we started our search with the MDIS color images because of their extensive coverage across Mercury's surface. The areas we examined included northern high latitudes, radar-bright craters, different terrain types, different terrain ages, excavated material, the Caloris basin area, impact melt, young material, bright material, hollows, and crater rays overlying other terrain.

Effects on MESSENGER images of MDIS detector readout rate and temperature and scattered light have recently been identified. In particular, data taken with the 749-nm filter have been questioned. These effects are being quantified and corrected and could change the results of our study. All corrections should be completed shortly.

Preliminary results largely confirm earlier findings that there are no major absorption features in most reflectance spectra of Mercury's surface. There is, in particular, no evidence for submicroscopic ilmenite ($FeTiO_2$) inclusions in a transparent host material in impact melts as seen on the Moon [2]. Mercury's close proximity to the Sun subjects its surface to an environment where alteration of the surface material, or "space weathering," likely occurs at intensity levels unparalleled in the Solar System and masks most absorption features in reflectance spectra of Mercury's surface.

We now, however, identify subtle absorption features of varying spectral width and placement in reflectance spectra of high-albedo material, correlated with what appear to be younger features presumably not yet fully affected by space weathering [3]. These generally divide into two categories: a feature centered near ~600 nm similar to the absorption features observed in laboratory spectra of sulfides [4] and a feature centered at a longer wavelength (~900 nm). We present examples of these below to illustrate aspects of our results. The reflectance data (expressed as *I/F*, where *I* is light reflected from Mercury's surface and *F* is incident sunlight) have been corrected to account for global geometric effects.

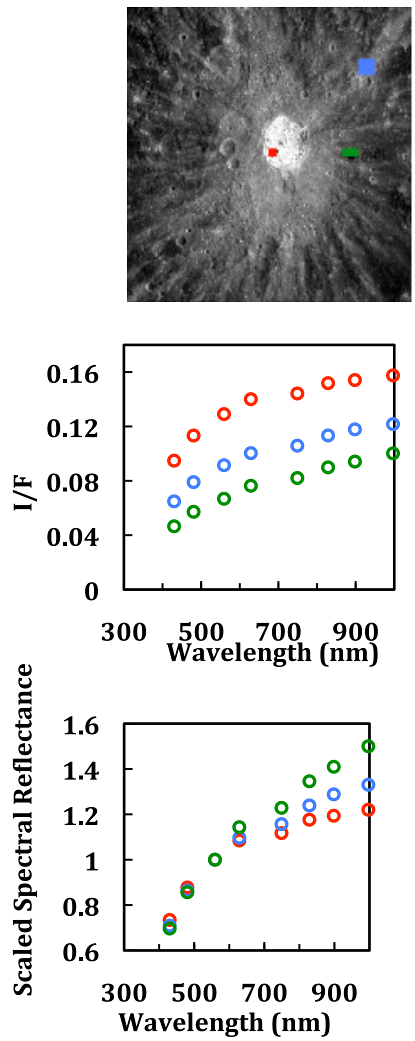

Fig. 1. Linear mixing of materials of different albedo in the same color image suite is demonstrated in color images of Kuiper crater (11.3°S, 328.5°E, 60 km diameter) sampled at three locations. No absorption feature is resolved here. Colors denote highlighted

areas in top panel. Middle panel shows *I/F*. Bottom panel shows reflectance scaled to 1.0 at 559 nm. The gradation from dark, to dark plus crater ray, to bright crater material is evident.

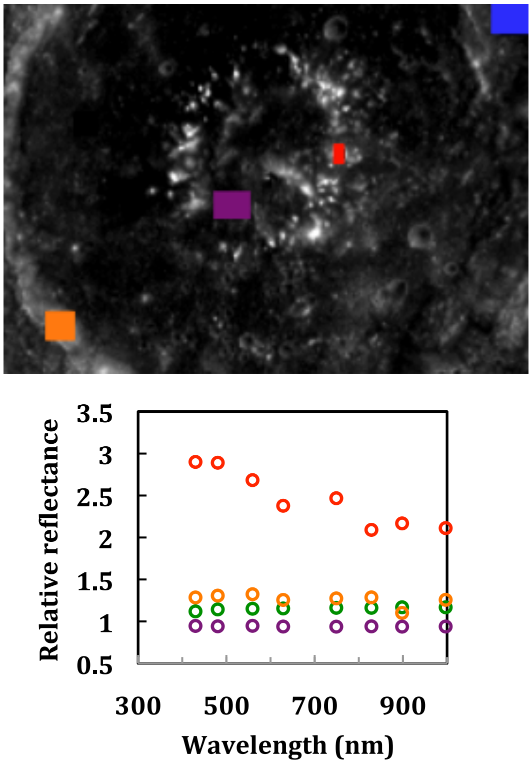

Fig. 2. Ratios of *I/F* photometry at Atget crater (25.7°N, 166.1°E, 100 km diameter) (top panel). Points in the bottom panel are ratios of *I/F* photometry for four areas of varying albedo (keyed by color to the top panel, except for green points located off the image area displayed) to the dark blue area, all from the same color suite. The Atget material lacks absorption features except for the bright peak-ring material (red), which shows a potential feature centered near 600 nm. Ratios of images from the same color set serve to remove instrument artifacts and highlight potential spectral features.

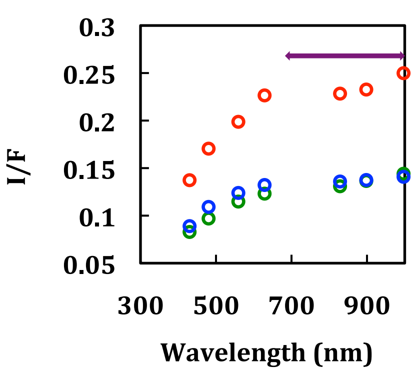

Fig. 3. *I/F* photometry for three areas of hollows [5]: (red) wall of 15-km-diameter crater (66.5°N, 153.2°E) (Fig. 1F in [5]); (blue) Sander crater floor (42.6°N, 154.4°E, 47 km diameter); (green) Tyagaraja crater floor (3.7°N, 211.6°E, 97 km diameter); 749-nm filter value removed. The spectral coverage of a potential absorption feature estimated to be centered near 900 nm is marked by a horizontal bar beginning near 700 nm. This absorption feature extends to longer wavelengths than covered by the MDIS filters, and is notably different in spectral width and placement than the feature seen in the spectrum of Atget bright material. This feature is present in all tested hollows areas and is consistent with relatively blue material [5].

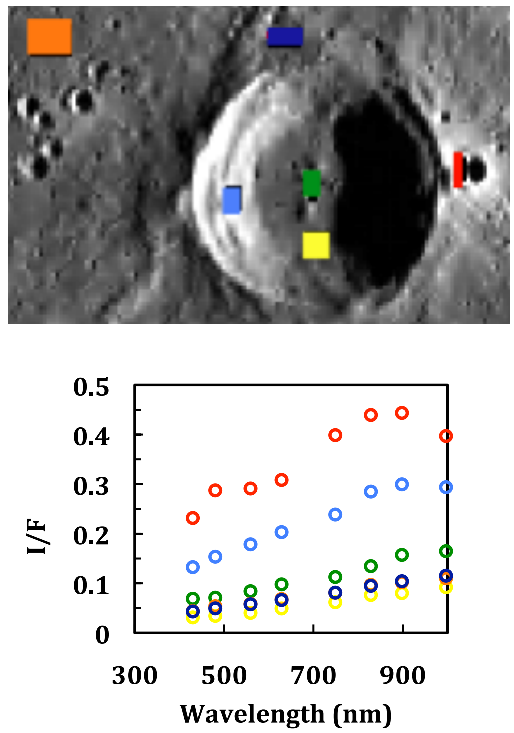

Fig. 4. *I/F* photometry for radar-bright crater W (81°N, 269°E, ~47 km diameter) [6] and adjacent bright crater (top, red) (~6 km diameter). Material in the latter crater shows an absorption feature not seen in W or surrounding material that differs from the absorption seen in hollows but is similar to that in Atget bright material.

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References: [1] Ernst, C.M., et al. (2010), *Icarus*, **209**, 210–223. [2] Tompkins, S.C., and Pieters, C.M. (2010, *MAPS*, **45**, 1152–1169. [3] Vilas, F., et al. (2011) abstract EPSC-DPS2011-989. [4] Helbert, J., et al. (2012), *LPS*, **43**, this mtg. [5] Blewett, D.T., et al. (2011) *Science*, **333**, 1856–1859. [6] Harmon, J. et al. (2001), *Icarus*, **149**, 1 -15.