COMPARISON OF ROCK SPECTRAL CLASSES OBSERVED AT CAPE YORK AND SOLANDER POINT ON THE RIM OF ENDEAVOUR CRATER BY THE OPPORTUNITY PANCAM. W.H. Farrand[1] , J.R. Johnson[2], J.F.Bell III[3],M.S. Rice[4], S.P. Wright[5]. [1]Space Science Institute, 4750 Walnut St., #205, Boulder, CO 80301, farrand@spacescience.org, [2]Applied Physics Lab, Johns Hopkins University, Laurel, MD. [3]Arizona State University, Tempe, AZ, [4]California Institute of Technology, Pasadena, CA, [5]Auburn University, Auburn, AL.

Introduction: The VNIR multispectral capability of the Pancam on the Opportunity rover has been used to distinguish several rock spectral classes on the segment of the rim of Endeavour crater known as Cape York [1,2]. Several of these spectral classes have also been observed on the rim segment further to the south, Solander Point, that is currently being examined by Opportunity [3]. In this work, we focus on a subset of these spectral classes and compare spectra and derived spectral parameters of these materials with terrestrial analog materials.

Spectral Classes Considered: From the exploration of the southern point and western slopes of Cape York, six primary spectral classes were defined by [1]. A follow-on paper [2], tracked Opportunity's traverse from the northern tip of Cape York along the "inboard" (eastern) flank of Cape York, including the portion known as Matijevic Hill. Over that portion of Cape York six main spectral classes, including some of the same classes observed in the earlier study and with sub-classes of some of those classes, were delineated. The main spectral classes in [2] were the light-toned veins, the Grasberg Fm., the coatings and matrix materials of the Matijevic Fm., the hematitic spherules (blueberries) on the bench unit of Cape York and in scattered occurrences on Matijevic Hill, the spherules ("newberries") occurring within the Matijevic Fm., and the Shoemaker Fm. On Solander Point, the Grasberg Fm. and Shoemaker Fm. have also been observed to date. Here, we present comparisons with terrestrial analog materials for the the various sub-classes of light-toned veins, Grasberg Fm., and the Matijevic Fm.

Interpretations of VNIR Class Spectra: Fig. 1 shows representative spectra of the classes considered here. The vein spectrum shown is from the bench unit vein Monte Cristo. Veins were also observed in the Matijevic Fm. materials [4] and light-toned veins / fracture fills also formed a boxwork around polygonal blocks on some portions of the Matijevic Fm. While all these light-toned vein materials displayed similar spectra, **Fig. 2** shows distinctions between these veins in terms of their 535 nm band depth and their 934 to 1009 nm slope. The higher 535 nm band depth of the bench unit veins is nominally indicative of more crystalline ferric oxide minerals compared to the smaller veins on Matijevic Hill and to the boxwork veins.. The more negative 934 to 1009 nm slope of the bench unit veins is nominally consistent with those veins being more hydrated (having a deeper 1 μm overtone band).

The Matijevic Fm. matrix and dark-toned coating materials (**Fig. 3**) are distinct from each other in several spectral parameters including blue-to-red slope and 754 to 1009 nm slope. They are also distinct from each other in terms of the position of their reflectance peak position as determined by fitting polynomials to bands from 535 to 904 nm. These parameters will be compared to terrestrial analog materials below.

The Grasberg Fm. clean surface spectra are broadly similar to those of the "purple" materials (in 673, 535, 432 nm composites) of the Burns Fm. which were extensively explored by Opportunity for most of its mission [e.g., 5]. However, Grasberg is distinct from Burns both in terms of its fitted NIR band minimum position (fit with a 3rd degree polynomial over bands from 754 to 1009 nm) and in terms of 535 nm band depth.

Comparisons to Terrestrial Analog Materials: The veins have been interpreted as gypsum on the basis of APXS data showing enrichments of Ca and S and Pancam evidence of the negative 934 to 1009 nn slope [1]; although the boxwork veins have a different composition [6].

In the plot of fitted reflectance peak position vs. 803/904 nm ratio (**Fig. 4**), Grasberg Fm. surfaces from northern Cape York plot closest to the fields of lab spectra parameters from ferrihydrite and hematite. The band minimum position of clean Grasberg surfaces is also the 864 nm band or co-equal with the 904 nm band which would be consistent with red hematite, perhaps also with ferrihydrite.

The plot of 754 to 1009 nm slope vs. 904 nm band depth of Matijevic Fm. surfaces (matrix and coatings) has the same trend and plots in the same field as ashes and tuffs from several hydrovolcanic eruption centers sampled in Idaho [7], but pedogenically weathered [8] soils from Haleakala plot away from that trend.

Conclusions: Of the spectral classes considered here, the light-toned bench unit and Matijevic Hill veins are consistent with gypsum and the boxwork veins with some material with a 1 μm water overtone band. The Grasberg Fm. is consistent with its containing red hematite, perhaps with some variable admixture of ferrihydrite. Finally, the Matijevic Fm. matrix and

coatings could have followed a palagonitic alteration sequence similar to hydrovolcanic tuffs, but different from pedogenically weathered basaltic ashes.

References: [1] Farrand, W.H. et al. (2013) *Icarus*, 225, 709. [2] Farrand, W.H. et al. (2014) in preparation. [3] this meeting. [4] Farrand W.H. et al. (2013) *LPSC 44*, #2482. [5] Squyres, S.W. (2006) Science, 313, 1403. [6] Arvidson, R.E. et al. (2014) *Science*, in press. [7] Farrand, W.H. et al. (2013) *LPSC 44*, #2249. [8] Schiffman, P. et al. (2000) *G3*, *1*, 2000GC000068.

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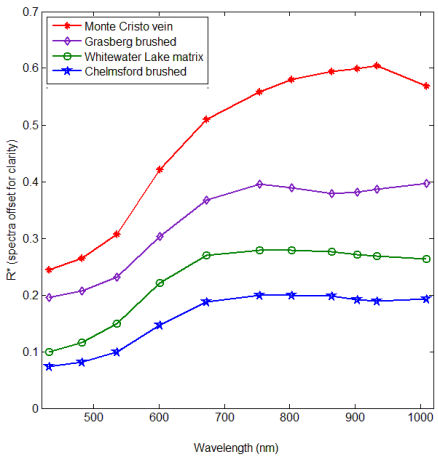

Fig. 1. Spectra of Cape York and Solander Point VNIR classes. Chelmsford is a coating on Whitewater Lake (Matijevic Fm.).

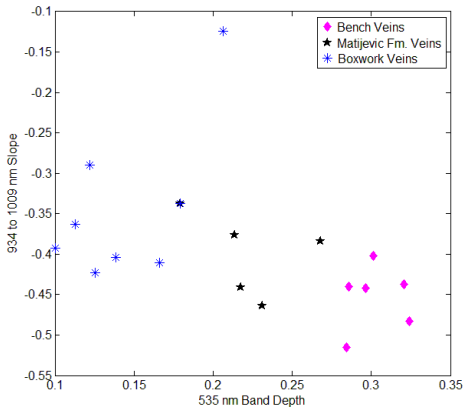

Fig. 2. 934 to 1009 nm slope vs. 535 nm band depth for sub-classes of veins observed by Opportunity.

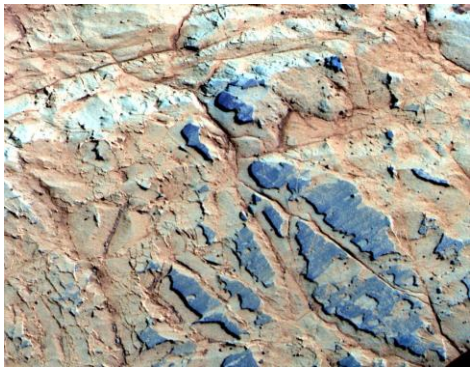

Fig. 3. Sol 3074 P2564 L357 view of Whitewater Lake showing light-toned matrix and dark-toned coatings.

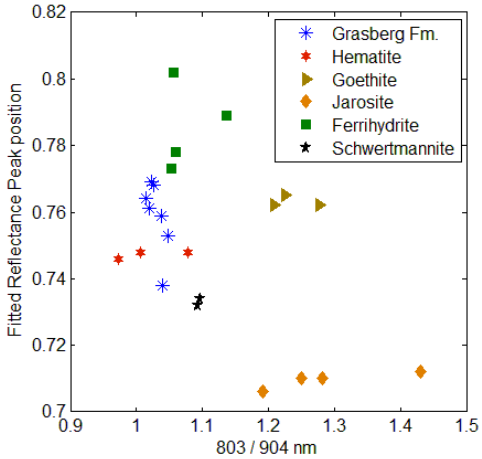

Fig. 4. Fitted reflectance peak position vs. 803/904 nm ratio for Grasberg surfaces compared to USGS library spectra .

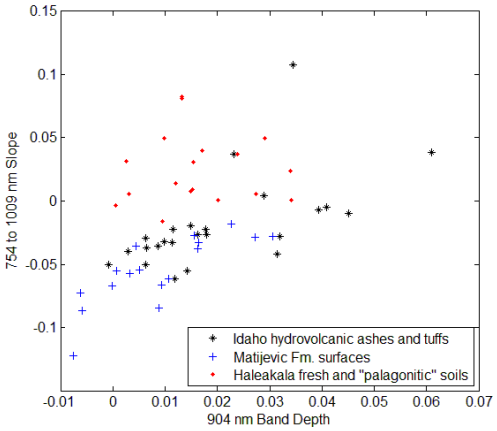

Fig. 5. 754 to 1009 nm slope vs. 904 nm band depth for Matijevic Fm. surfaces compared with hydrovolcanic ashes and tuffs and pedogenically weathered Haleakala soils.