COLOR BANDING WITHIN THE INNER RIMS OF CRATERS IN MERIDIANI PLANUM: OBSERVATIONS BY THE OPPORTUNITY PANCAM AND HIRISE. W.H. Farrand[1], J.F. Bell III[2], B.C. Clark[1], L.A. Edgar[3], A.G. Hayes[3], J.R. Johnson[4], B.L. Jolliff[5], [1]Space Science Institute, 4750 Walnut St. #205, Boulder, CO 80301, farrand@spacescience.org, [2]Arizona State University, Tempe,AZ, [3]California Institute of Technology, Pasadena, CA, [4]Johns Hopkins University Applied Physics Lab, Laurel, MD, [5]Washington University, St. Louis, MO.

Introduction: During the course of its exploration of Meridiani Planum, the Mars Exploration Rover Opportunity has examined a number of large (near 100 m or more in diameter) craters including Endurance (~130 m), Erebus, Victoria (~750 m), and (at the time of the writing of this abstract) Santa Maria (~80 m). Erebus (~300 m) was an older crater with only portions of rim exposed. Both Endurance and Victoria craters retained a crater-form shape and displayed colored bands near the top of their in-place stratigraphy. The lightest toned band within the rim of Victoria crater has been interpreted as being diagenetic in nature [1 - 3] with the light-toned band cutting across physical layering in a number of places. A dark-toned band in Endurance crater, the top of which was dubbed the Whatanga contact, was also interpreted as being diagenetic in nature [4]. Both the layers in Endurance [5] and those in Victoria were also observed to show differences in chemistry. In addition to the single light-toned band, a set of three layered bands with distinct multispectral character have also been distinguished in Victoria crater [6]. Here we discuss the colored banding observed within crater rims by Opportunity and also present evidence from color HiRISE imagery that other craters in Meridiani Planum also appear to have similar uniform bands near the top of the crater rim.

Pancam and HiRISE multispectral imaging of Meridiani craters: Pancam collects 11 spectrally unique channels in the 430 to 1010 nm wavelength range. There are 2 overlapping channels for red or blue stereo for a total of 13 channels devoted to geologic analyses. These 13 filter datasets are known by the shorthand of "13f" data. These data are converted to radiance factor and then to relative reflectance (R*) by dividing radiance factor by the cosine of the solar incidence angle. More details on the Pancam instrument and its calibration are provided in [7, 8].

Pancam collected numerous 13f views of the walls of Endurance and Victoria craters as well as a large number of 4 color multispectral mosaics covering larger swaths of the crater walls. At the time of the writing of this abstract, a similar imaging campaign is underway at Santa Maria crater.

The High Spatial Resolution Imaging Science Experiment (HiRISE) collects color data centered in the blue/green, red, and near infrared (NIR) spectral regions. A number of scenes in the vicinity of the Opportunity landing site have been imaged by HiRISE.

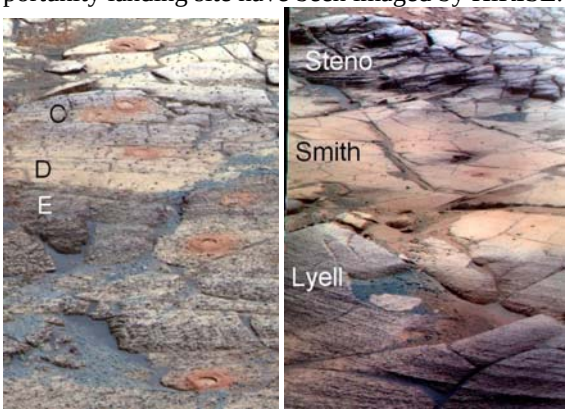

Fig. 1. (left) Sol 173 P2401 observation of Karatepe ingress path at Endurance crater. Units C, D, and E are texturally and spectrally similar to the Steno, Smith and Lyell units in the sol 1423 observation looking back at the ingress path at Victoria crater (right).

Color banding in Endurance and Victoria: A similar set of three color bands has been observed within the upper in-place bedrock of Meridiani Planum at Endurance and Victoria craters (**Fig. 1**). In Pancam L3, 5, 7 (673, 535, and 432 nm) composites these appear, from top to bottom, purple to cyan, buff to red, and purple to gray colored. In terms of their multispectral character (**Fig. 2**), the upper band has a relatively low 535 nm band depth and a negatively sloping to concave NIR spectral shape. This band is underlain by a light-toned band with a relatively higher 535 nm band depth and a convex spectral shape in the NIR. The lower band, of which only the upper portions are observed (with the lower portions being largely covered by drift consisting of basaltic sand and hematitic spherules) has a relatively low 535 nm band depth and a negatively sloping to concave NIR spectral shape.

Chemical changes between units: In Endurance crater, it was observed [5] that there was a marked increase in Cl from the "D" to the "E" layers of the Karatepe ingress path sampled by Opportunity. Likewise in Victoria crater Cl essentially doubles in going from the Smith to the Lyell layer. The Smith unit is texturally similar to the D Karatepe unit and also has a similar spectral character with a convex NIR spectral shape, a steeper blue-to-red slope and higher 535 nm

band depths. Likewise the Lyell layer is texturally similar to the E units (both an upper, E1, and lower, E2, component were sampled) in the Karatepe region with a coarser textured surface than that of the unit above. Spectrally, Lyell and the E units are darker in tone and both have negative NIR slopes from 800 to 936 nm.

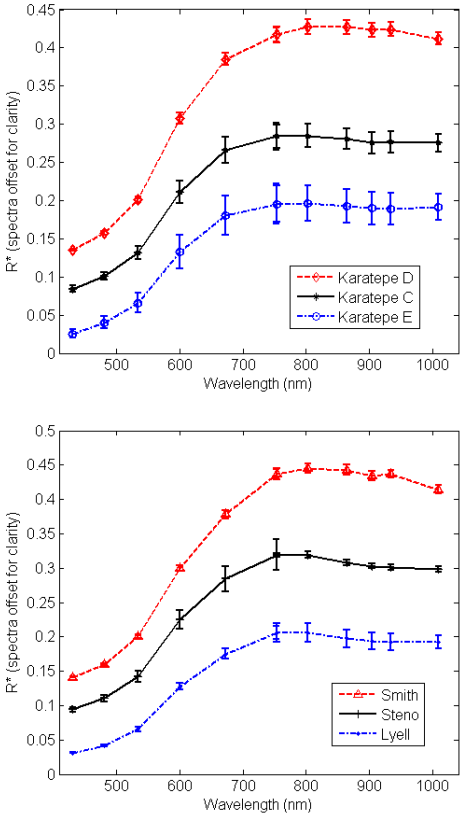

Fig. 2. (upper) Karatepe unit C, D, and E Pancam spectra. (lower) Victoria crater Steno, Smith, and Lyell Pancam spectra.

HiRISE views of light-toned band: Fig. 3 shows a decorrelation-stretched views of a subsection of HiRISE imagery over Victoria (from scene ESP-013954-1780) that shows a band that is cyan-colored in this representation. This band is discontinuously traceable around the rim of Victoria crater. This band seems to correspond to the Steno and/or Smith layers. A similar band is observable in other craters imaged by HiRISE that are in approximately similar states of erosion. Fresher craters, which have rims blanketed by fractured blocks or ejecta do not show this band. Preliminary examination of Pancam images from Santa Maria crater (**Fig. 4**) suggests that this might be the situation extant at that crater. That is, that this fresher crater has not been eroded sufficiently into the surrounding plain to expose this band.

Discussion: The presence of a similar appearing band, and potentially multiple layers, over several craters in the Meridiani Planum area suggests that a regional process was at work. If, as suggested in [1 - 3] this light-toned band is diagenetic in origin, it could be the result of a regional water table. The presence of multiple color bands (e.g., Steno, Smith, and Lyell) indicates possible different stands of this water table. It has been suggested by [9] that an upwelling regional water table in Meridiani Planum in the late Noachian to early Hesperian. The colored bands observed at Victoria and Endurance crater and the light-toned band observed in other craters in HiRISE imagery could be evidence of the last high stand of this water table.

References: [1] Edgar, L.A. et al. (2011) SEPM Spec. Pub, in revision. [2] Hayes, A.G. et al. (2011) JGR-Planets, in revision. [3] Arvidson, R.E. et al. (2011) JGR-Planets, 2010JE003746, in press. [4] McLennan, S.M. et al. (2005) *EPSL*, *240*, 95-121. [5] Clark, B.C. et al. (2005) *EPSL*, *240*, 73-94. [6] Farrand, W.H. et al. (2010) *GSA Annual Meeting abstract 213-12*. [7] Bell, J.F., et al. (2003) *JGR,108*, 2003JE002070. [8] Bell, J.F. et al. (2006) *JGR,111*, 2005JE002444. [9] Andrews-Hanna, J.C. et al. (2010) *JGR-Planets*, *115*, 2009JE003485.

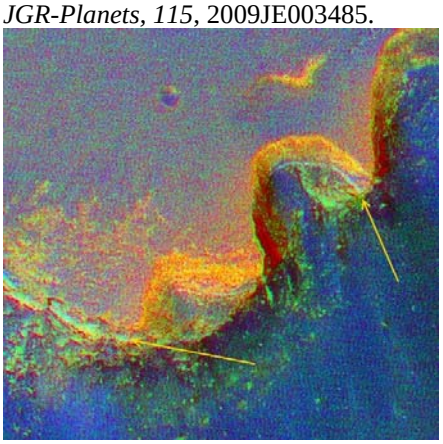

Fig. 3. Decorrelation stretch of subsection of HiRISE scene over rim of Victoria crater showing possible diagenetic band (in cyan, marked by arrows).

Fig. 4. Sub-section of sol 2453 L2,5,7 (753, 535, 432 nm) mosaic of inner rim of Santa Maria crater. Rim consists primarily of ejecta and fractured in-place blocks.