MINERALOGICAL ANALYSIS OF QUADRANGLE Ac-H-6 HAULANI ON THE DWARF PLANET CERES. F. Tosi[1], F.G. Carrozzo[1], F. Zambon[1], M. Ciarniello[1], A. Frigeri[1], J.-Ph. Combe[2], M.C. De Sanctis[1], M. Hoffmann[3], A. Longobardo[1], A. Nathues[3], A. Raponi[1], E. Ammannito[4,1], K. Krohn[5], L.A. McFadden[6], C.M. Pieters[7], K. Stephan[5], C.A. Raymond[8], C.T. Russell[4], and the Dawn/VIR Team.
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Introduction: Quadrangle Ac-H-6 '*Haulani*' (lat 22°S-22°N, lon 0°E-72°E) is one of five quadrangles that cover the equatorial region of the dwarf planet Ceres. This quadrangle is notable for the high albedo (bright) ejecta that extend around crater Haulani, which gives the name to the quadrangle. In Dawn's *Framing Camera* (FC) [1] color-ratio composite images, crater Haulani is clearly distinct compared to surrounding terrains. Haulani's bright material displays a very small or even negative ("blue") spectral slope in the range from the visible to the near infrared, which is a peculiar occurrence compared to rest of the quadrangle and more generally to the average surface of Ceres.

FC clear-filter images also enabled the Dawn team to obtain an accurate topographic map and a geologic map of the Haulani quadrangle, useful to investigate the emergence of possible correlations between geology/geomorphology and surface composition.

Data set and results: Hyperspectral images returned by the *Visible and InfraRed* (VIR) *mapping spectrometer* onboard Dawn [2], operating in the overall range 0.25-5.1 μm, enabled a careful mineralogical analysis of the Haulani quadrangle. In the *Survey* phase carried out in June 2015, yielding a spatial resolution of ~1.1 km/px, and in the *High-Altitude Mapping Orbit* (HAMO) phase, carried out from mid-August to mid-October 2015 and yielding an average pixel resolution of ~0.38 km, VIR obtained nearly complete coverage of Ac-H-6.

Based on this dataset, crater Haulani keeps standing out compared to the rest of the quadrangle. Albedo maps obtained in the near infrared range at 1.2 μm and 1.9 μm reveal that the floor and ejecta of Haulani are indeed a patchwork of inherently bright and dark materials (**Fig. 1**). The spectral features centered at 2.7 and 3.06 μm, respectively indicative of the presence of hydrous minerals and ammoniated phyllosilicates [3], show a substantial decrease of band depth in crater Haulani's floor and bright ejecta (**Fig. 2**). Similar, but less prominent, spectral behavior, is observed in other small craters found across this quadrangle.

Two spectral slopes, calculated in the near infrared range 1.891-1.163 μm and 2.250-1.891 μm on the basis of VIR data (**Fig. 3**), are essentially consistent with the spectral slope obtained from FC data in the visual range 0.555-0.829 μm at higher spatial resolution: i.e., it is confirmed that crater Haulani generally corresponds to a neat reduction of spectral slopes, particularly in its floor and ejecta. These spectral slopes indicate a different average grain size compared to the surrounding area, revealing that here the regolith grains are overall coarser, having being processed by space weathering for a shorter time.

Finally, the information arising from the band depths computed at 2.7 and 3.06 μm can be combined in a single map, which represents the mutual behavior of these two parameters. A 2D-scatter plot from the global VIR dataset obtained at Ceres during HAMO is first build for this purpose. Then two color maps are produced for Haulani quadrangle: 1) one using a four-color scheme, with VIR pixels colored in blue if the two absorption bands are strong, orange if they both are weak, green where a strong 2.7-μm absorption band is associated with a weak 3.06-μm absorption band, and magenta where a strong 3.06-μm absorption band is associated with a weak 2.7-μm absorption band (**Fig. 4**); 2) a four-color, two-dimension color table, partially masked by the 2D-scatter plot from the global dataset. In the second color map, only the purest compositions are represented by colored pixels, while all the others are dark.

Also in this case, crater Haulani turns out to be the most distinct feature with respect to the average composition of Ceres within this quadrangle.

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References: [1] De Sanctis, M.C., et al. (2010). Space Sci. Rev. 163 (1–4), 329-369. [2] Sierks, H., et al. (2011). Space Sci. Rev. 163 (1–4), 263-327. [3] De Sanctis, M.C., et al. (2015). *Nature* 528, 241-244.

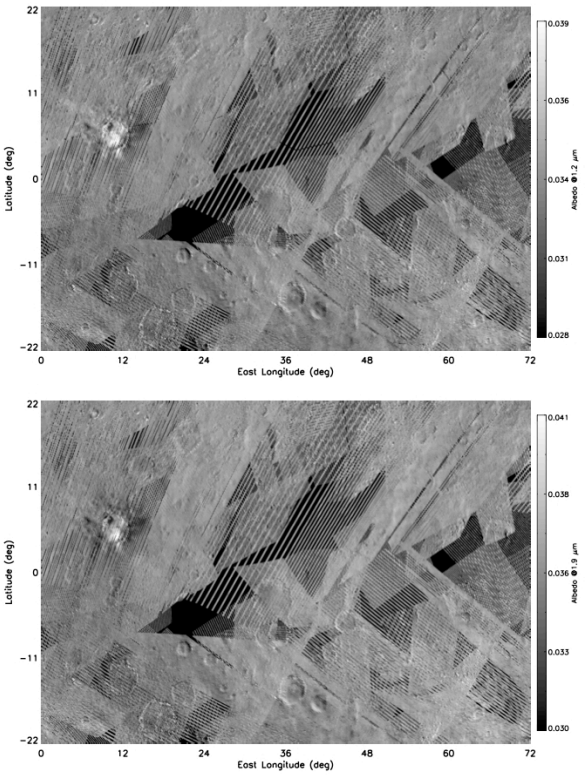

Fig. 1. Albedo maps obtained in the near infrared range at 1.2 µm (top panel) and 1.9 µm (bottom panel). From these maps, the floor and ejecta of crater Haulani reveal a patchwork of inherently bright and dark materials.

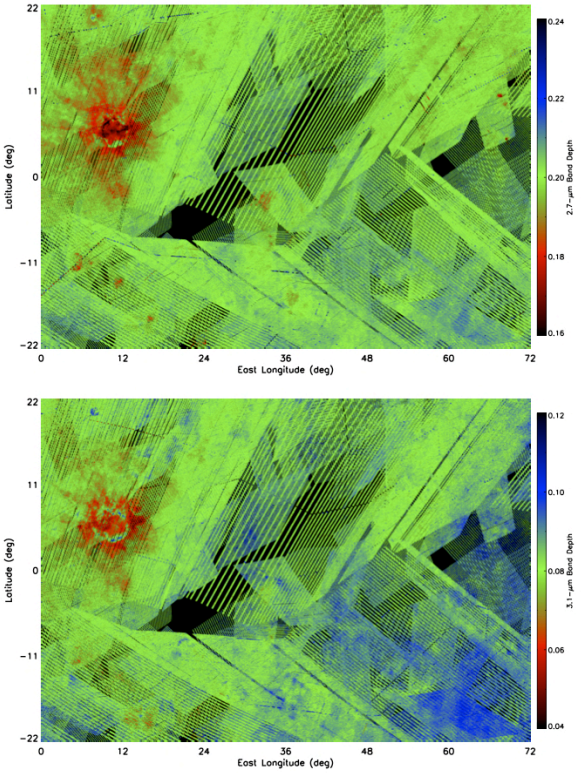

Fig. 2. The spectral features centered at 2.7 µm (top panel) and 3.06 µm (bottom panel), respectively diagnostic of hydrous minerals and ammoniated phyllosilicates, show a substantial decrease in their depths in crater Haulani's floor and bright ejecta.

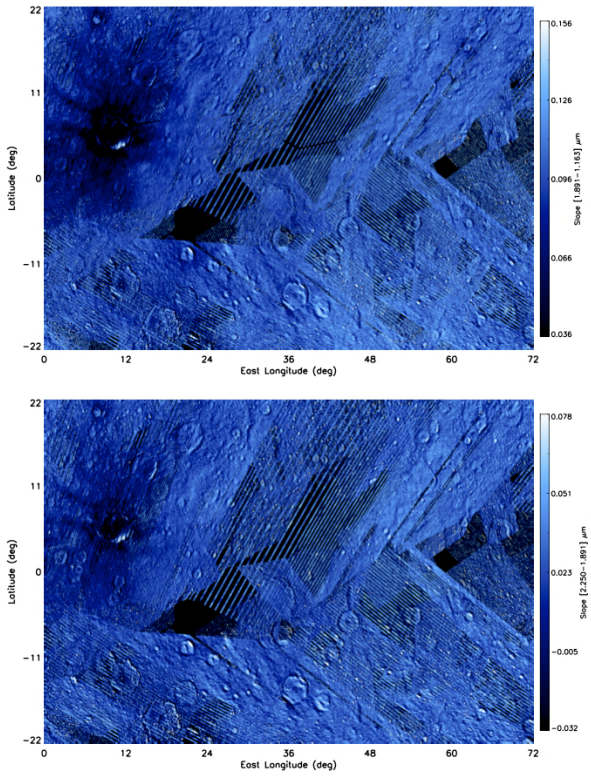

Fig. 3. Two spectral slopes, calculated in the near infrared range 1.163-1.891 µm (top panel) and 1.891-2.250 µm (bottom panel) on the basis of VIR data, follow the same trend of the spectral slope obtained from FC data in the visual range 0.555-0.829 µm at higher spatial resolution.

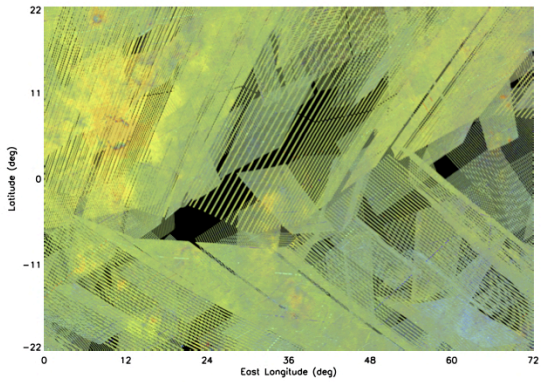

Fig. 4. Four-color map of quadrangle Haulani. Colors are related to the mutual behavior of the 2.7-µm and 3.1-µm band depths, in such a way that orange/yellow means that both absorption bands are weak, while green means strong 2.7-µm absorption band associated with weak 3.06-µm absorption band.