MINERALOGCAL MAPPING FO AC-05 (FEJOKOO) QUADRANGLE OF CERES. S. Singh[1], J-P. Combe[1], L. A. McFadden[2], O. Ruesch[2], T. McCord[1], H. G. Hughson[4], F. Jambon[3], M. Ciarniello[3], F.G. Carrozzo[3], S. Fonte3, E. Ammannito[4], M. C. DeSanctis[3], , K.H.G. Knudson[3], C.A. Raymond[4], C.T. Russell[4], [1]Bear Fight Institute (22 Fiddlers rd, Winthrop, WA, ssingh@bearfightinstitute.com), [2]NASA GSFC, [3]IAPS – INAF, Rome, Italy, [4]Jet Propulsion Laboratory-California Institute of Technology, Pasadena, CA, USA

Introduction: NASA's Dawn spacecraft orbited the dwarf planet Ceres beginning March 2015, and science operations are planned through December, 2017, are planned. To date, mapping the planet with a framing camera (FC) [1], visible and infrared spectrometer (VIR) [2] and gamma-ray and neutron detector (GRaND) [3] has been accomplished. Spacecraft positions provide data for gravity models and place constraints on its interior structure. Here we examine the spectral reflectance of surface features in the Fejokoo quadrangle (Ac-05) located within 21-66 °N and 270-360 °E, interpret their spectral signature with respect to surface mineralogy and address the following scientific questions:

1. What is the surface composition in this quadrangle?
2. How does it compare to the global composition of Ceres?
3. Is there a correlation between morphological features and surface composition?
4. What are the implications for the formation and evolution of Ceres' surface?
5. Define a correlation between young-old craters?

Band Parameters: The VIR observations and global band parameter maps were provided by the VIR team in radiometrically calibrated format. The band parameters were at 2.7 µm and 3.1 µm (BI and BII) were calculated and chosen depending on the knowledge of Ceres surface composition. Ceres surface spectra is dominated by the absorption bands centered at 2.7 µm and 3.1 µm (BI and BII) confirming the widespread occurrence of O-H bearing phyllosilicates seen by Dawn VIR instrument [4]. VIR spectra of Ceres is dominated by the absorptions associated to O-H bearing phyllosilicates i.e., the most prominent absorption near 2.7 and 3.1 µm, referred to as BI and BII, respectively. The 3.1 µm signature had been attributed to a variety of different phases including water ice, hydrated or NH_4 -bearing clays and bructie [5]. Ammoniated mineral species, NH_4-bearing annite, antigorite, and NH_4-montmorillonite are accounted for to cause these particular absorption band. The strong and narrow absorption centered at 2.7 µm is a characteristic feature of OH-bearing minerals [5]

Maps: The band depth distribution of BI and BII are shown in Fig. 1 a & b. large values of the band depth correspond to the Fejokoo crater's bright material facing south and few near bright material near Cozobi crater. We do observe small values of band depth that corresponds to the Oxo crater and its ejecta in the north-west direction; also, Cozobi carter's southern ejecta flow.

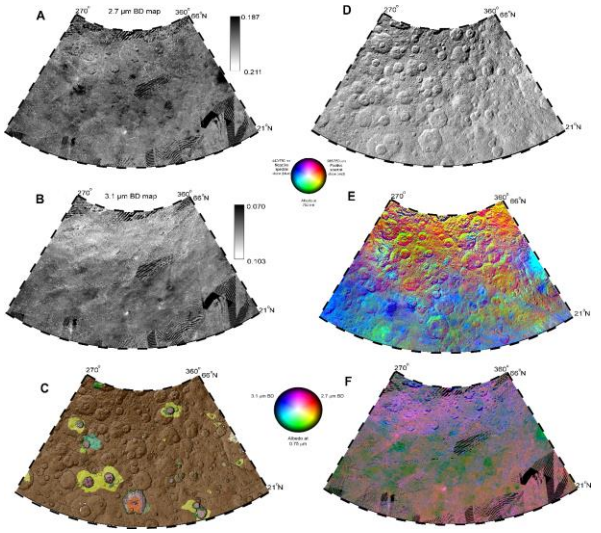

Figure 1: Lambert conical maps of the Ac-05 quadrangle. A, B) BI and BII maps, C) Geological map [6], D) LAMO Framing Camera map, E, F) color composite maps illustrating the extreme composition.

Color Maps: Compostie color maps have been obtained using different combinations of FC (Fig. 1D) filters during HAMO. In the flase color combination, Figure 1E, red color corresponds to positive spectral slope with the band ratio R(0.965 µm)/R(0.75 µm), green – FC albedo at 0.75 µm, blue = negative spectral slope R(0.44 µm)/R(0.75 µm). The features that appears the reddest strongly reflect positive slope. Green marks the high albedo area, blue marked at negative slope (Oxo), and where features are very reflective with positive slope at all wavelengths is the high albedo (e.g, yellow, Fejokoo's bright spot).

Another color composite of Ac-05 quadrangle is obtained using the VIR spectrometer data to illustrate the abundance of phyllosilicates with respect to the albedo. The image in Fig. 1F has been obtained combining FC albedo map and using VIR data with the following color combination: red = BI, green = FC albedo at 0.45 µm, Blue = BII. In this color code, green areas have high albedo, while redder areas have higher BI band depth, and bluer areas have higher BII band depth. The areas where all three are present in high amount appears white.

We display the composition of spectral parameter BI and BII of Ac-05 in context with global composition (Fig. 2). These maps shows the overall distribution of

the BI w.r.t BII (2.7 & 3.1 µm, respectively) using a 2D rainbow color representation. A two-dimension scatter plot of the total surface of Ceres observed by VIR for reflectance at 2.7 µm as a function of the 3.1 µm absorption band depth is shown is panel a of Fig. 2. We show maps in two different color composite. The color scheme is designed to enhance the location and boundaries of the data cloud and the colors represented have a direct correspondence to the colors on the map below. Regions in green indicates areas with relatively high phyllosilicates (BI) concentration and low ammoniated phyllosilicates (BII). The region in blue indicates areas with relatively high BI and BII band depth, where are yellowish color represent the absence of both Bi and BII band depths. They define a spatially-coherent region including Fejokoo crater, Cazobi crater, and Oxo's ejecta. These maps shows an overview of the composition map ovelayed on the FC map. This suggest a large mineralogical varriations acrosss the quadrangle. The majority of the quadrangle is rich in green color which represent the high abundance of BI or phyllosilicates. locations are correlated to geological features such as ejecta from youngest craters, high altitude and slopes of tholi. There are only few locations in the quatrangle where both BI and BII are present in high absundance. First, inward south facing slope of the fejokoo crater, where streaks of bright material hundered of meters wide and ~ 5 km long are found. Second, an unnamed crater just south west of fejokoo crater, the east facing wall with bright material similar to fejokoos bright material. Both, of these location show high abundance in phyllosilicates and ammoniated phyllosilicates.

Key features: *Oxo:* Oxo is prime meridian at roughly 42 °N lies Oxo crater. With its bright crater wall material and bright ejecta rays Oxo is among the brightest features observed on Ceres (second only to the bright spots in Occator crater). Identified as youngest crater lacks in both Bi and BII. However, it is the only location on Ceres till date where water ice has been identified [7].

Fejokoo: This crater is located in the south-central region of its eponymous quadrangle, and is the largest well de-fined polygonal crater on Ceres. A bright material located on the south facing wall has unique composition than rest of the quadrangle. Rich in both BI and BII, whereas the Central peek rich in phyllosilicates (high BI).

Takel Crater has A small bright spot on the east facing wall of the crater This particular location shows high abundance of ammoniated phyllosilicates and absence of 2.7 micron absorption band depth. High ammoniated phyllosilicates location is slightly off from the bright spot on the crater wall. However, it starts adjacent to the bright spot (south western rim of the crater) and extends to the plain region. This particular spot has nothing in common with smooth crater wall material and lobate flow material (As mentioned in the Hughson et al., 2016 paper).

Abellio & Victa Crater: These are the only areas that hosts the darkest material found in the Fejokoo quadrangle. A clear compositional boundary between walls can be seen, whereas the central peak and the rims shows the absence of both Bi and BII.

References: [1] Ruesch et al., 2016, Science 353. [2]Russel et al., 2011, SSR, 163-3-23. [3] Prettyman et al., 2016, LPI, 1903, p.228. [4]Ammannito *et al. 2016, Science,353,* aaf4279. [5]De Sanctis *et al.*, 2015, Nature 528, 241-244. [6] Hughson et al., 2017, Icarus (under review) . [7] Combe et al., 2016, Science, 353, aaf3010-1

Figure 2: 2D global scatter plots of BI w.r.t BII and the color schame used in the maps below. Maps: Overlaid maps of FC and surface composition.