SPECTRAL ANALISYS OF THE QUADRANGLE Ac-H-08 NAWISH ON CERES F.G. Carrozzo[1], M.C. De Sanctis[1], E. Ammannito[3], M. Ciarniello[1], A. Frigeri[1], A. Raponi[1], F. Zambon[1], F. Tosi[1], J.-Ph. Combe[2], A. Longobardo[1], L.A. McFadden[4], E. Palomba[1,7], C. Pieters, K. Stephan[5], C.A. Raymond[6] and C.T. Russell[3]. [1]Istituto di Astrofisica e Planetologia Spaziali, Istituto Nazionale di Astrofisica, Via del Fosso del Cavaliere 100, I-00133 Rome, Italy, [2]The Bear Fight Institute 22 Fiddler's Road, Winthrop WA 98862, [3]University of California, Los Angeles, California, USA, [4]Goddard Space Flight Center, Greenbelt, MD 20771, USA, [5]Institute of Planetary Research, German Aerospace Center (DLR), Rutherfordstrasse 2, D-12489 Berlin, Germany, [6]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA, [7]ASDC-ASI, via del Politecnico snc, 00133 Rome, Italy (giacomo.carrozzo@iaps.inaf.it)

Introduction: Ceres is the most massive body in the asteroid main belt. It should represent a unique remnant of the primordial population of large planetesimals that were removed later by dynamical mechanisms [1,2]. Ceres' meteoritic analogues have not been observed. Its spectrum, in the visible and near-infrared range, is distinct from that of any known meteorite. Although Ceres spectrum could resemble those of the carbonaceous chondrites (CM), it shows a more complex mineralogy. Ceres' spectral signatures observed, have been attributed to a variety of minerals and evidence of aqueous alteration has been found.

NASA's Dawn Science Team is conducting a mineralogical mapping campaign of the dwarf planet Ceres. Here, we map the principal spectral parameters, which characterized Ceres' surface, and in particular the Ac-H-8 Nawish quadrangle located in the equatorial region of Ceres (lon 144°-216° E, lat 22°S - 22°N). A 80 km size crater Nawish (194.2°E and 12.2°N) occurs in the northern sector, giving the name to the quadrangle. The maps were produced by using the data acquired by the Visible and Infrared Mapping Spectrometer (VIR) [3] onboard Dawn spacecraft.

Dataset analysis: Dawn mission was divided into different phases on the basis of the spacecraft altitude from the target's surface: Approach, Rotation Characterization (RC), both before gravitational capture and orbiting of Dawn, then the orbital phases Survey, High-Altitude Mapping Orbit (HAMO), and Low-Altitude Mapping Orbit (LAMO). Each phase is different from the others in terms of duration, illumination conditions and altitude over the surface, decreasing from Approach to LAMO. The mineralogical maps presented here have been produced by using the HAMO dataset, for spatial covering and spatial resolution reasons. We also use the images of the Framing Camera [4] of the LAMO mission phase to better identify the geological units.

Typically, light can only penetrate into asteroid terrains a distance roughly equal to few times its wavelengths; a few micrometers for visible and near-infrared light [5]. VIR analyzes the reflected light of the target covering the 0.25–5.1 µm wavelengths. VIR is provided by two channels, visible and infrared, but in this work we consider only the IR channel data because of the lack of relevant spectral features in the visible spectral domain. In order to study the spectral properties (i) we remove the uncorrected artifacts present in the VIR data [6], (ii) then we apply a photometric correction of the spectra to report the spectra at standard observation geometry as described in [7], afterward (iii) we remove the thermal contribution from the spectra, and finally (iv) we computed the band center and the band depth of the absorptions at ~2.7, and 3.1 µm after the evaluation of the continuum and its removal. The continuum has been computed as the straight line between the two local maxima.

Results: We mapped the absorptions due to the OH fundamental stretch and the NH_4 at ~2.7 and ~3.1 µm respectively. We produced maps of the depth and the center of both these absorption bands. In addition, we performed an additional spectral analysis of the 4.0 µm band to derive more information about the composition. This study, based on the analysis of the band centers, not revealed substantial variation in composition across the Nawish quadrangle (fig. 1 and 2). The presence of absorptions at 2.73 µm is consistent with a surface heterogeneously covered by Mg-phyllosilicates [8], while the 3.06 µm absorption is attributed to ammonia-bearing species such as NH_4-phyllosilicates [8].

Impact craters are the most prevalent geomorphic feature distributed across the quadrangle's surface, with more craters in the eastern versus the western part [9]. The cratered terrain unit is the oldest of Ceres [10] and resurfacing appears to be primarily driven by impacts. Conversely, the younger smoothed material unit, characterized by a low crater density, is associated with Kerwan crater, one of the major crater on Ceres [11]. Crater material related with other two large impacts outside the quadrangle are present respectively in the north-western corner in correspondence with Dantu crater walls, and in the eastern part related with the Azacca crater. Although there is not present a clear and detectable contact with these two units, it is put around the isoline 0 on the basis of the changing of the topographic elevation (Fig 1). The analysis of the band depth at 3.06 µm shows the same roughly spatial dichotomy. The western part of the quadrangle, where smooth material is present, is characterized by high band depth values, while the eastern part, where cratered terrains are present, is characterized by low-intermediate values (Fig 2). The spectral position of this absorption does present any relevant variations; nevertheless the spatial distribution of the band depth at 3.06 µm reflects the high concentration of NH_4-phyllosilicates in Dantu and in Kerwan regions, also described in [12]. It seems that the cratered terrains have been altered or covered by new material with higher concentration of ammoniated mineral species.

The map of the band depth at 2.7 µm does not show the same spatial dichotomy (Fig. 3). Low band depth is observed in Consus and Azacca regions. Heat-induced dehydration of phyllosilicates due to impacts could reduce the intensity of the band at 2.7 and 3.1 [13]. In general, a decrease of the intensity is observed on the floor and the ejecta of the craters. This is particularly evident in the craters located in the right-bottom part of the quadrangle. An exception is represented by Nawish crater where an increase is present around the area. High band depth values are also found in the smoothed terrains. Impact heating could have different role in these cratering events causing different band depths values. The most likely explanations is that the variability in the strengths of these two diagnostic mineral absorptions is associated with a variation in the abundance of phyllosilicates relatives to the presence of other mineralogical phases on Ceres' surface [12].

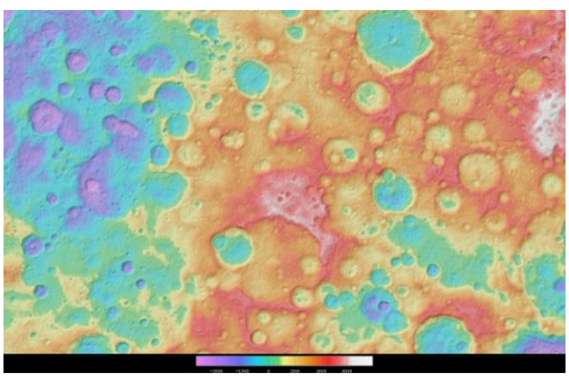

Figure 1. *Topographic map of the quadrangle.*

Other spectral features have been identified in the 3.3-4 µm spectral range revealing the presence of other two absorptions at about 3.3 and 3.95 µm. In this last case we did not produce any map. Uncertainties in the instrument calibration in the 3.3-3.5 spectral range do not allow for interpreting univocally,these bands, thus we did not consider these two absorption bands for our analysis.

We attribute the absorption at 3.95 µm to the presence of Mg-carbonates. Although the chemical composition is fairly uniform across the mapped quadrangle (Mg-phyllosilicates and NH_4-bearing phyllosilicates are ubiquitous), we found variations in the strength of the absorptions. Only in few localized areas, the band center moves toward longer wavelengths. This variation suggests the presence of different carbonate species, such as sodium carbonate [8].

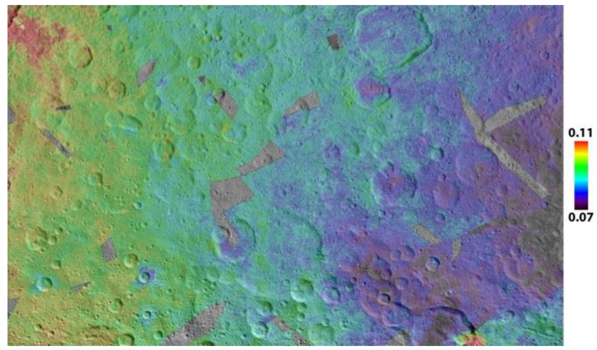

Figure 2. *Band depth map at 3.1µm is correlated with the abundance of NH_4-phyllosilicates.*

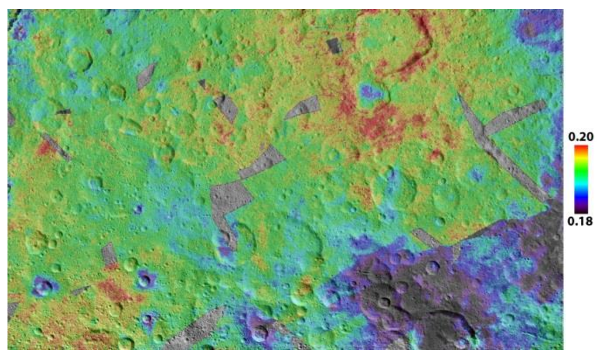

Figure 3. *Band depth map at 2.7µm indicates the distribution of the OH-rich minerals.*

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