EPSC Abstracts
Vol. 10, EPSC2015-98, 2015
European Planetary Science Congress 2015

Ceres hyperspectral observations by VIR on Dawn: First Results

M.C. De Sanctis[1], E. Ammannito[1,2], F. Capaccioni[1], M.T. Capria[1], G. Carrozzo[1], M. Ciarniello[1], A. Frigeri[1], S. Fonte[1], M.Giardino[1], A. Longobardo[1], G. Magni[1], S. Marchi[1,9], E. Palomba[1], A. Raponi[1], F. Tosi[1], F. Zambon[1], J-P. Combe[3], T.M. McCord[3], L.A. McFadden[4], H.McSween[5], C. M. Pieters[6] , R. Jaumann[7], J-Y Li[8], S. Joy[2], C. A. Polanskey[3], M.D. Rayman[10], C. A. Raymond[10], C. T. Russell[2] and the Dawn Science Team, [1]Istituto di Astrofisica e Planetologia Spaziali, Istituto Nazionale de Astrofisica, Rome, Italy, [2]University of California Los Angeles, Earth Planetary and Space Sciences, Los Angeles, CA-90095, USA, 3Bear Fight Institute, Winthrop, WA, USA; [4]NASA, GSFC, Greenbelt, MD, USA; [5]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN, [6]Institute of Planetary Research, DLR, Berlin, Germany [7]Department of Geological Sciences, Brown University, Providence, RI 02912, USA,8 Planetary Science Institute, [9]SSERVI, Southwest Research Institute , Boulder, CO. , [10]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA-91109 (mariacristina.desanctis@iaps.inaf.it)

Abstract

The Dawn spacecraft [1] is at Ceres, the second of its targets. Ceres is the most massive body in the asteroid belt and was discovered in 1801 by Giuseppe Piazzi in the Palermo Observatory. It was catalogued by the IAU as a dwarf planet in 2006. Ceres (together with Vesta) represents the key to understand some important points relative to the role of the protoplanet size and the water content in determining the evolution of protoplanets and minor bodies. Ceres is thought to be differentiated, and hydrated minerals were proposed to exist on its surface [2,3]. Its low density [3] associated with the presence of transient water vapour[4], suggests a high content of ice inside the body and on its surface. Ceres seems to have been subject to differentiation and hydrothermal activity, and might host a liquid subsurface layer even today. Dawn is equipped with a Visible and InfraRed Mapping Spectrometer (VIR) [5] that fully accomplishes its scientific objectives at Ceres. Here we report about the first VIR results at Ceres

1. Introduction

VIR is an imaging spectrometer coupling high spectral and spatial resolution in the VIS (0.25-1.0 μm) and IR (0.95-5.0 μm) spectral ranges. VIR will acquire data during Approach, Survey, High Altitude Mapping (HAMO) and Low Altitude Mapping (LAMO) orbits that provided very good coverage of the surface.

2. Results

The surface composition of Ceres is poorly understood through its nearly featureless visible spectrum. Its visible reflectance spectrum has a steep UV absorption edge that begins at a relatively short wavelength, around 0.4 μm, unlike many C-type asteroids where the UV drop-off begins around 0.6 to 0.7 μm [6]. The near-IR spectrum has a strong absorption band centered at about 3-μm. The absorption features in the 3-μm region were attributed to structural water in clay minerals [7,8] but could also be ammoniated clays [9]. Moreover the presence of carbonates and iron-rich clays are reported [10].

On approach to Ceres, Dawn obtains images and hyperspectral data on different occasions, starting in January 2015. VIR data, with resolution larger than Hubble images, will reveal the first details of the Ceres' surface composition and in Fig. 1 are shown two spectra of Ceres taken from two different regions of the surface.

The spectra show large differences in the thermal emission (Fig. 1) corresponding to different temperatures of the surface.

The first data indicates an overall spectral homogeneity but some regions of the surface show spectral differences corresponding to different properties of the surface (Fig.2).

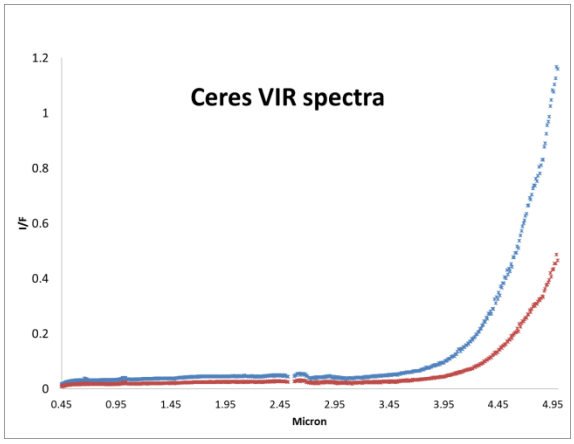

Fig.1 Two VIR spectra taken from the two different regions of Ceres.

Fig.2 RGB image obtained by VIR during the Approach using different VIS and IR color combinations. Top: Image obtained with the following color combination R= 656 nm, G = 530 nm, B = 450 nm; Bottom: Image obtained with the following color combination R = 1.6 μm, G = 2.0 μm, B = 2.4 μm

3. Conclusions

During these last months, VIR observed the surface of Ceres under different illumination conditions and at increasing spatial resolution.
The first spectra acquired show an overall global homogeneity but some differences can be seen on specific regions. VIR observed Ceres also in the thermal infrared range, deriving surface temperatures. These temperatures also show some local diversity. The study of the hyperspectral images from 0.25 to 5 μm will improve our understanding of Ceres composition and thermal properties and will do a step forward in the comprehension of the nature of this dwarf planet.
.

Acknowledgements

VIR is funded by the Italian Space Agency–ASI and was developed under the leadership of INAF-Istituto di Astrofisica e Planetologia Spaziali, Rome-Italy. The instrument was built by Selex-Galileo, Florence-Italy. The authors acknowledge the support of the Dawn Science, Instrument, and Operations Teams. This work was supported by ASI and NASA. A portion of this work was performed at the JPL/NASA.

References

[1] Russell, C.T. et al., Science, 336, 684, 2012.
[2] McCord et al., Space Science Reviews 163:63, 2011
[3] Thomas, P.C., Parker, J.Wm., McFadden, L.A., et al. Nature, 437, 224-226, 2005
[4] Kuppers et al., Nature, 505, 525–527, 2014
[5]De Sanctis M.C. et al., Space Sci. Rev., DOI 10.1007/s11214-010-9668-5 , 2010.
[6] Li et al.,Icarus, doi:10.1016/j.icarus.2005.12.012, 2006
[7] Lebofsky, L.A., Feierberg, M.A., Tokunaga, A.T., Larson, H.P., Johnson, J.R.,. Icarus 48, 453–459. 1981 [8] Feierberg, M.A., Lebofsky, L.A., Larson, H.P.,
Geochim. Cosmochim. Acta 45, 971–981, 1981
[9] King, T.V.V., Clark, R.N., Calvin, W.M., Sherman, D.M., Brown, R.H.,Science 255, 1551–1553, 1992
[10] Rivkin, A.S., Volquardsen, E.L., Clark, B.E., Icarus 185, 563–567, 2006