Surficial mineralogy of dwarf planet Ceres

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The Dawn spacecraft has been acquiring data on dwarf planet Ceres since January 2015 (1). The VIR spectrometer (0.25-5.0 μm) acquired data at different altitudes providing information on the composition of the surface of Ceres at resolutions ranging from few kilometers to about one hundred meters (2). The average spectrum of Ceres acquired by VIR is well represented by a mixture of dark minerals, Mg-phyllosilicates, ammoniated clays, and Mg- carbonates (3). This result confirms and extends previous studies based on ground based spectra. Mg- phyllosilicates have been associated with the 2.72 μm absorption band precluded from telescopic measurements owing to the atmospheric absorptions. The ammoniated clays have been identified through the presence of an absorption feature centered at 3.06 μm as already suggested by (4) while the 3.9 μm absorption feature is indicative of the presence of carbonates as previously concluded by (5). Maps of the surface at about 1 km/px show that the components identified in the average spectrum are present all across the surface with variations in their relative abundance (6). Some localized areas however have peculiar spectral characteristics. One example is the spectrum of the bright faculae within Occator crater that is most consistent with a large amount of Na-carbonates and possibly ammonium salts (7). In addition, water ice has been detected on the surface (8) and organic rich regions have been identified in some localized areas across the surface (9). The retrieved composition indicates a pervasive aqueous alteration and at least localized hydrothermal activity of the surface of Ceres. In addition, the co-existence of ammonia-bearing hydrated minerals, water ice, carbonates, and organic material indicates a complex chemical environment that could allow the formation of prebiotic molecules making Ceres a primary target for exobiological studies.

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