THE COMPOSITION OF THE DWARF PLANET CERES. A. S. Rivkin[1], J-Y. Li[2], R. E. Milliken[3], L. F. Lim[4], A. J. Lovell[5], B. E. Schmidt[6], L. A. McFadden[2], [1]JHU/APL (andy.rivkin@jhuapl.edu), [2]U. Maryland, [3]JPL, [4]NASA GSFC, [5]Agnes Scott College, [6]UCLA,

Background: Ceres, the largest object between Mars and Jupiter, straddles many boundaries. Its low density suggests a significant ice fraction, like the Galilean and other satellites. It is too warm to allow ice to remain stable over much of its surface, but might maintain ice at a depth of a few meters [1,2]. It is large enough to be in hydrostatic equilibrium like the terrestrial planets, but it probably differentiated rock from ice rather than the metal-rock separation seen in the planets [3,4]. It is also too small to have had a large disruptive effect on the orbits of its neighbors, disqualifying it from planethood in the current IAU classification scheme.

What we know about Ceres has to this point been determined via remote sensing. Over the last 35 years, astronomers and geologists have pieced together our ideas of Ceres' surface composition, which along with modeling and laboratory efforts leads to our overall interpretation of this body. We will present our current synthesis of Ceres research as it stands in the pre-Dawn era.

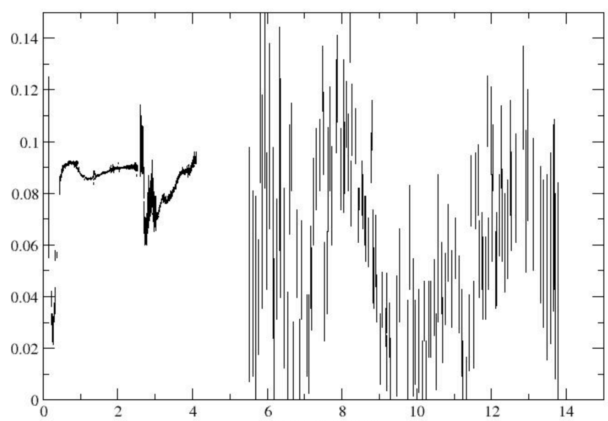

Figure 1: Concatenated Spectrum of Ceres, from 0.2-14 µm. The absorptions shown in Table 1 are all present. Data beyond 5 µm were converted from emissivity to reflectance using Kirchoff's Law. Data sources: [5,10,12,14,15].

Spectral information: The first observations of Ceres were made in the visible-near IR (0.4-2.5 µm) spectral region, and established an overall similarity to carbonaceous chondrites based on a low albedo and relatively flat spectrum. Its visible spectum places it within the C class, which dominates the middle of the asteroid belt [5,6].

Positive identifications of absorptions have been rare in this spectral region, beyond a decrease in reflectance shortward of 0.4 µm due to oxidized iron. A broad band centered near 1.1 µm is consistent with magnetite, which is also found in some carbonaceous chondrites [7]. Longer wavelengths have provided more quantitative identifications. A series of absorptions in the 3-4 µm region have been interpreted separately and as a group, with the most recent workers concluding brucite and carbonates are present [8-11]. Mid-IR (8-13 µm) observations have inconsistently found evidence for carbonates, but on the whole are consistent with the 3-4 µm observations [12,13]. A list of identified and yet-unidentified [14,15] absorptions in Ceres' spectrum is presented in Table 1.

Table 1: Identified spectral features on Ceres, their current interpretations, and the references in which they first appeared.

Mineral	Wavelengths	Reference
Carbonates	~3.3-3.4, ~3.9, ~11.3? µm	10,11
Brucite	3.06 µm	11
Magnetite?	~1.1 µm	7
??	~0.25 µm	14,15
Silicates	~10 µm	12,13

References: [1] Fanale and Salvail (1989) *Icarus, 82,* 97-110. [2] Schorghofer (2008) *ApJ, 682,* 697-705. [3] McCord and Sotin (2005) *JGR, 110.* [4] Thomas et al. (2005) *Nature, 437,* 224-226. [5] Bus and Binzel (2002), *Icarus, 158,* 146-177. [6] Johnson and Fanale (1973), *JGR, 35,* 8507-8518. [7] Larson et al. (1979) *Icarus, 39,* 257-271. [8] Lebofsky et al. (1981) *Icarus, 48,* 453-459. [9] King et al. (1992) *Science, 255,* 1551-1553. [10] Rivkin et al. (2006) *Icarus, 185,* 563-567. [11] Milliken and Rivkin (2009) *Nature Geo., 2,* 258-261. [12] Cohen et al. (1998), *AJ, 115,* 1671-1679. [13] Lim et al. (2005) *Icarus, 173,* 385-408. [14] Parker et al. (2002) *AJ, 123,* 549-557. [15] Li et al. (2006) *Icarus, 182,* 143-160.