DIVERSITY OF TYPES OF HYDRATED MINERALS ON C-CLASS ASTEROIDS. A. S. Rivkin, *Massachusetts Institute of Technology, Cambridge MA 02139, USA, (asrivkin@mit.edu)*, E. S. Howell, *Arecibo Observatory, HC03 Box 53995, Arecibo PR 00612, USA*, S. J. Bus, *Institute for Astronomy, 640 N. A'ohoku Place #209, Hilo HI 96720, USA*.

The C-class asteroids include many large asteroids: 1 Ceres, 2 Pallas, and 10 Hygiea (three of the four largest) are members of the C class or related subclasses. The Themis family, one of the largest and longest-recognized asteroid dynamical families is also composed of C-class asteroids. Numerically, the C-class and related asteroids dominate the asteroid belt as a whole. Understanding these asteroids is essential to understanding the asteroid belt as a whole.

Absorption features in the 3-μm region are diagnostic for water- and hydroxyl-bearing minerals (hereafter "hydrated minerals") on airless, rocky bodies like the asteroids. Although hydrated minerals have been found on members of practically every asteroid spectral class, the C-class asteroids in particular have the deepest features and the largest fraction of hydrated members[1].

The carbonaceous chondrite meteorites are the best analogs to the C asteroids. These common meteorites also often contain hydrated minerals. Rivkin et al. [2] adapted techniques developed for spectral studies of carbonaceous chondrites [3,4] to measure the H/Si ratio in 16 C-class asteroids, finding many of the hydrated ones to have H/Si ratios consistent with the hydrated CM-type carbonaceous chondrites. The data in that study were taken using the United Kingdom Infrared Telescope (UKIRT) from 1996-2000. Additional data have been taken over the last two years using SpeX on the IRTF [5].

Inspection of the spectra reveals that there are two different band shapes in the 3-μm region for C-class asteroids, shown in Figure 1. While most of the bodies with detectable 3-μm absorptions have band shapes like 2 Pallas and 48 Doris (and consistent with CM meteorites), there are also several asteroids with shapes like 1 Ceres. Before recent observations [2], it was thought that Ceres had a unique band shape among asteroids. However, we have found that it is shared by the asteroids 10 Hygiea and 24 Themis, as well as others (Figure 2). This band shape is unknown in the meteorites, and has been attributed to either ammonium-bearing phyllosilicates or a thin water ice frost [6,7]. Neither one was necessarily expected on asteroid surfaces.

The asteroids involved are important ones for a number of reasons: the Themis family is thought to provide a significant fraction of zodiacal dust and IDPs [8] and understanding the surface mineralogy of Themis will help us place IDP samples in context. Ceres is by far the largest asteroid, and it is unclear whether its history and composition is unusual as a result.

Figure 3 shows the distribution of the different band shapes with semi-major axis. Although the sample size is still small, the objects with Ceres-like band shapes appear to be concentrated at a few specific places while the Pallas-like objects are spread throughout the belt.

We will present these data and discuss the cause of the Ceres-like band shape, and possible causes for the distribution of these two classes of hydrated asteroids.

References:

[1] Rivkin et al. (2002) in *Asteroids III*
[2] Rivkin et al. *MAPS* (2003)
[3] Miyamoto and Zolensky *MAPS* (1993)
[4] Sato et al. *MAPS* (1997)
[5] Rayner et al. *PASP* **155** (2003)
[6] Lebofsky et al. *Icarus* (1981)
[7] King et al. *Icarus* (1992)
[8] Kortenkamp and Dermott, *Icarus*, (1998)

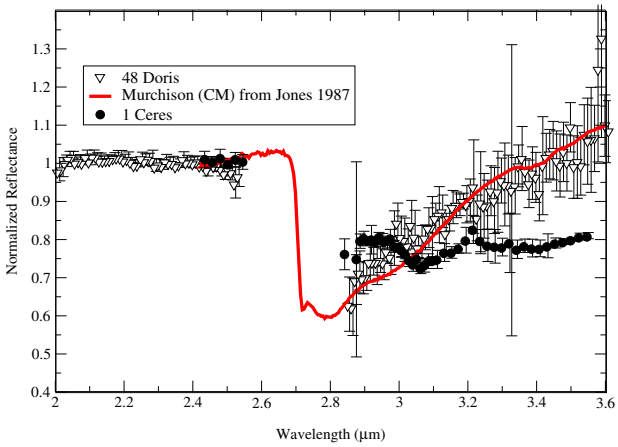

Figure 1: Comparison of asteroid spectra. The asteroid spectra include the representatives of the two classes of hydrated C-class asteroid spectra. Most asteroids look like 48 Doris, which shows similarity to the meteorite Murchison [9]. These are "Pallas-type" bands. The spectrum of 1 Ceres has a different band shape, implying different hydrated minerals are responsible.

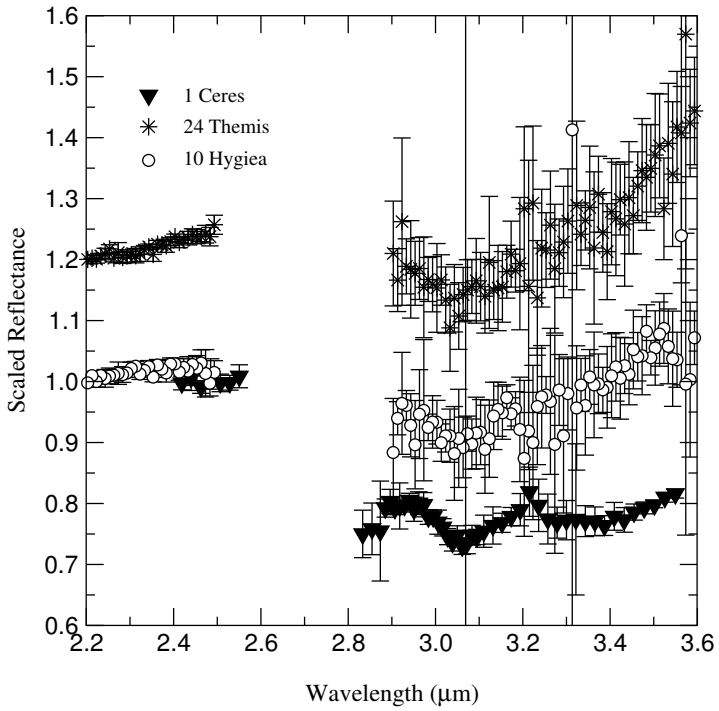

Figure 2: Objects with 3-μm band shapes similar to Ceres include 10 Hygiea, the fourth-largest asteroid, and 24 Themis, the largest member of the important Themis dynamical family. The band on Ceres has been attributed to water ice frost and ammoniated phyllosilicates, which requre very different formation scenarios. The identification of other asteroids which share this band shape will aid in determining its cause. The solid vertical line shows the common band minimum for all of these objects. The Themis spectrum has been offset for clarity.

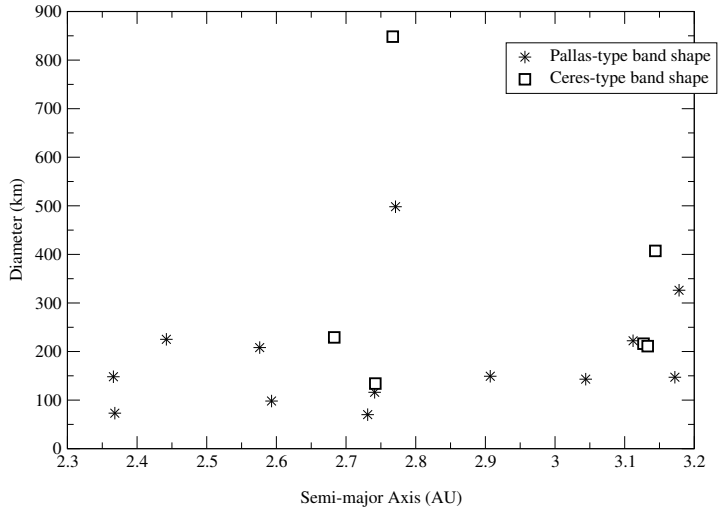

Figure 3: The distribution of asteroids with Ceres-like and Pallas-like band shapes in semi-major axis and diameter. It appears that the Ceres-like asteroids are restricted to small areas in semi-major axis, though the sample size of Ceres-type objects is still quite small.