**CALCULATED WATER CONCENTRATIONS ON C-CLASS ASTEROIDS.** A. S. Rivkin, *Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge MA 02139, USA, (asrivkin@mit.edu)*, J. K. Davies, *Astronomy Technology Centre, Royal Observatory, Edinburgh, UK.*

Water of hydration has been observed on C-class and related (B, G-class) asteroids for over twenty years, through an absorption band in their reflectance spectra near 3 $\mu$m. This feature has also been observed in carbonaceous chondrite meteorites, particularly the CM and CI groups. Miyamoto and Zolensky (1994) [1] showed that the integrated intensity of the 3-$\mu$m band in carbonaceous chondrites is linearly related to the hydrogen to silicon atomic ratio in those meteorites. Sato et al. (1997) [2] found that the 2.9 $\mu$m to 2.53 $\mu$m reflectance ratio is closely correlated to the integrated intensity of the 3-$\mu$m band. In tandem, these findings provide a way to determine the water content of asteroids via remote observations, if we assume a value for the bulk $SiO_2$ concentration and that the powders observed by Miyamoto and Zolensky and Sato et al. are representative of the regoliths of C asteroids. We have obtained spectra of 13 C, B, and G-class asteroids using the United Kingdom Infrared Telescope (UKIRT) from 1996-2000, and present the water contents of these bodies.

Figure 1, after [2], shows the 3.2/2.5 $\mu$m reflectance ratio vs. the 2.9/2.5 $\mu$m reflectance ratio for carbonaceous chondrites of the CM, CI, CR, CO, thermally metamorphosed CI/CM, and CV classes, and the observed asteroids [3]. Most of the asteroids fall within the trend defined by the meteorites, with two notable exceptions: 1 Ceres and 375 Ursula. These bodies are currently the only low-albedo asteroids with 3-$\mu$m spectra which fall outside the meteorite trend.

Figure 2 presents the derived water contents for the C-class (and related) asteroids. The water contents for 1 Ceres and 375 Ursula were determined in the same way as the other asteroids despite their falling off of the meteorite trend, and these values should be considered appropriately. A $SiO_2$ bulk weight percent of 30% was used, near the average for CM chondrites [4]. Variation in 3-$\mu$m band depth, which may be important on these bodies [5] was not considered in this analysis. In order to be consistent with the tables in [4], all H was assumed to be in $H_2O$, though in reality some (or all) of the hydrogen may be in OH.

Asteroids are found with water contents between zero and 13.5%. For comparison, CM chondrites have an average $H_2O$ content of 10.5%. Most of the asteroids have lower values, clustering around 7%. Interestingly, however, two of the three asteroids with water contents over 10% (13 Egeria and 106 Dione) are G-class asteroids. Burbine (1999) [6] suggested that the CM condrites may be derived from G-class asteroids based on 0.4–2.5 $\mu$m spectra. We find that 13 Egeria and 106 Dione both have derived water contents consistent with the CM average. The G asteroid 19 Fortuna was found by Burbine to have a very close match to the CM spectra to 2.5 $\mu$m. We find its water content to be lower than the CM average, but by less than 2 $\sigma$. The unusual, thermally metamorphosed CI/CM chondrite Y-793321 has a lower water content than the CM meteorites [4], and is perhaps more consistent with the C asteroids than the CM meteorites are, as first proposed by [3]. However, most of the asteroids in this work have derived water contents which are even lower than Y-793321.

In general, the measured water contents for the asteroids in this study are much lower than seen in Orguiel. The difference is in fact even greater than shown in Figure 2. This is because the $SiO_2$ weight percentage in Orguiel is lower than in CM meteorites. Since the H/Si ratio is what is measured in the spectra, assuming a Si concentration like Orguiel's leads to a lower measured hydrogen concentration in the asteroids.

While the water contents in the asteroids in this study are systematically lower than the CM average, the presence of asteroids with derived water contents similar to those found in CM meteorites suggests that regolith processes are not strongly dehydrating these bodies, and that the reflectance spectra are measuring compositional differences rather than maturity differences.

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References: [1] Miyamoto and Zolensky (1994) *Meteoritics* **29** 849–853. [2] Sato et al. (1997) *Meteor. Plan. Sci.* **32** 503–507. [3] Hiroi et al.(1996) *Meteor. Plan. Sci.* **31** 321–327. [4] Jarosewich (1990) *Meteoritics* **25** 323–337. [5] Howell et al. (2001) *Asteroids 2001* 62. [6] Burbine (1998) *Meteor. Plan. Sci.* **33** 253–258.

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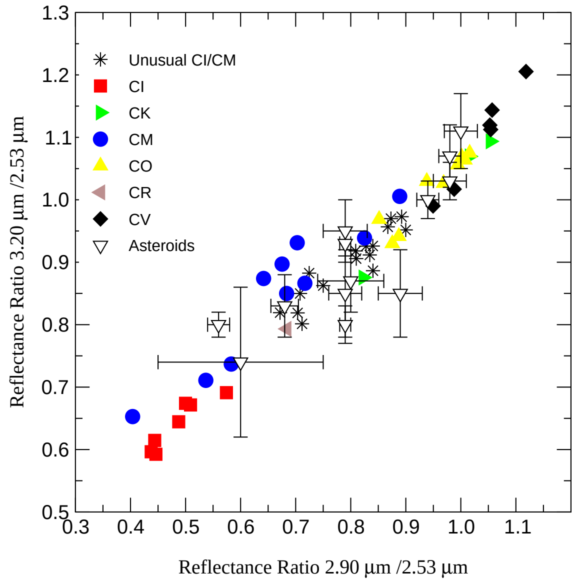


Figure 1: The C-class asteroids in this study all follow the trend seen in meteorites by [2] except 1 Ceres and 375 Urusla, which fall below the trend. This suggests that the majority of these asteroids have absorption features like those seen in the meteorites.

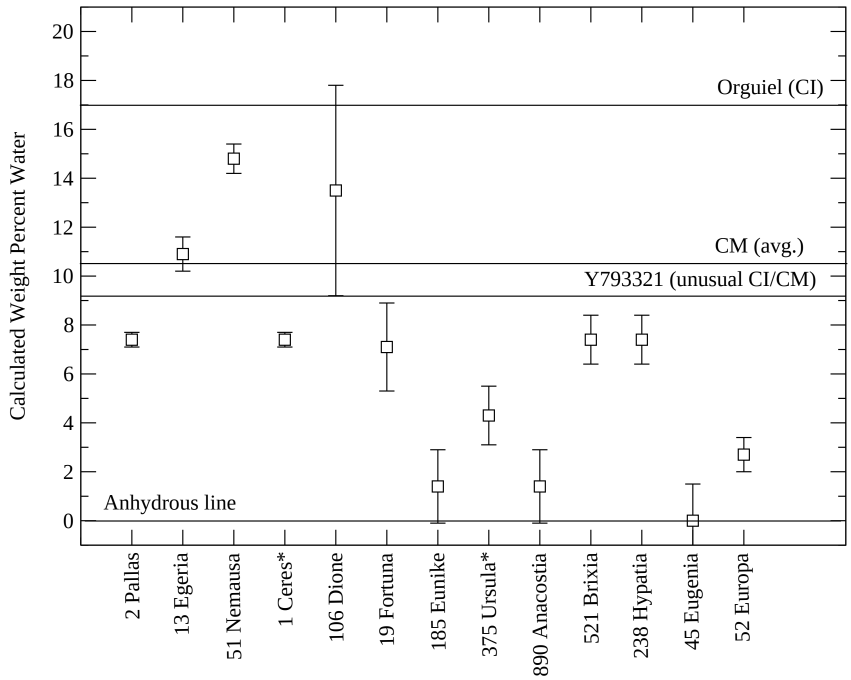


Figure 2: Using the relations found by [1] and [2], we determined the H:Si ratio for asteroids using their 3-$\mu$m spectra. That can be converted into weight percent $H_2O$, as described in the text. Most asteroids in this study fall below the CM line, suggesting they have less water than those meteorites. Values for meteorite water contents taken from [3].