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COMPARISON OF REFLECTANCE SPECTRA OF C ASTEROIDS AND UNIQUE C CHONDRITES Y86720, Y82162, AND B7904; T. Hiroi, SN3, NASA Johnson Space Center, Houston, TX 77058, C. M. Pieters, Dept. of Geological Sciences, Brown University, Providence, RI 02912, and M. E. Zolensky, SN2, NASA Johnson Space Center, Houston, TX 77058.

Reflectance spectra (0.3-2.6μm) of 11 carbonaceous (C) chondrite powders (<100 or <125μm) including "unique" ones Y86720, Y82162, and B7904, have been measured and compared with those of 14 C asteroids. Among those C chondrites, only three "unique" ones had close counterparts among C asteroids (Y86720 and 1 Ceres, Y82162 and 704 Interamnia, and B7904 and 31 Euphrosyne). Mixing calculations of those C chondrites by Hapke's isotropic model were also performed to improve fits of reflectance spectra of all the 14 C asteroids. If the grain-size distributions of those asteroid surfaces are similar to those C chondrite powders, the result suggests that all tested C asteroids contain a high amount of heated C chondrite material, such as Y86720, Y82162, and B7904.

The C asteroids have been believed to be the counterparts of C chondrites based on their reflectance spectra around visible wavelength range. However, not many studies have been done using longer near-infrared wavelengths ranging up to 2.6μm, which contain important mineralogical information. In this paper, reflectance spectra (0.3-2.6μm) of 14 C asteroids [1,2] have been compared with those of 11 C chondrites including "unique" ones that have characteristics of both CI and CM groups and show evidence of thermal metamorphism [3].

Shown in Fig. 1 are bidirectional reflectance spectra (30° incidence and 0° emergence angles) of C chondrites grouped according to their spectral characteristics. Those meteorites were ground and dry-sieved into size fractions of <100μm except for Ivuna and three "unique" ones (<125μm). Every care was taken to avoid any samples with weathering effects. Orgueil and Ivuna (CI1) have characteristic absorption bands around 0.47 and 1.95μm, ALH83100, Murray, and ALHA81002 (CM2) have a common band around 0.75μm, Renazzo (CR2) has a featureless red spectral profile, Vigarano (CV3) has some extremely shallow and broad absorption bands, and Bells (CM2) has an intermediate reflectance spectrum of CI1, CM2, and CR2 groups measured in this study. These results are consistent with previous studies [4,5] except for the possible differences in standard materials, spectrometer configurations, and sample mineral assemblages. B7904, Y82162, and Y86720 ("unique") have a characteristic absorption edge around 0.3-0.45μm. Their reflectances decrease to only 55-80% at 0.3μm (scaled to 100% at 0.55μm) while all the others decrease to 25-45%. Those spectral features can greatly change if the smaller grain-size portions of the samples are removed [5].

After comparing reflectance spectra of these 11 C chondrite powders and 14 C asteroids, only three asteroids had close counterparts among these C chondrites, which are all "unique" ones. These fits are shown in Fig. 2. Scaled asteroid spectra of 1 Ceres, 31 Euphrosyne, and 704 Interamnia have good fits with Y86720, B7904, and Y82162, respectively. Reflectances at 0.55μm of those scaled asteroid spectra, have the same order with the IRAS albedoes [6] plotted after being scaled by 0.65. In order to get better fits for the other asteroids, mixing calculations were performed using Hapke's isotropic model [7]. The results of the spectral fits are shown in Fig. 3, and the calculated volume abundances of C chondrite groups on all the tested C asteroids are plotted versus their average distances from the sun (semimajor axis) in Fig. 4. Unique C chondrites are abundant on these C asteroids, based on their spectral characteristics, which suggests the C asteroid surfaces may be thermally metamorphosed as was suggested based on mineralogical evidences in those "unique" C chondrites. There seems to be no clear correlation between the distance from the sun and the abundance of the "unique" C chondrites.

This modeling analysis necessarily assumes that there is a direct relation between meteorite and asteroid spectra and that alteration in the terrestrial or asteroid environment is minimal. The fact that the largest asteroid 1 Ceres is included among the C asteroids well-fit with unique C chondrites supports the validity of this kind of approach for C asteroid reflectance spectra. If this kind of analysis is also valid for other C asteroids, the results suggest that the most abundant (as falls) C chondrites do not really represent the surface material of the tested C asteroids. The large difference of the size range between C asteroids tested (100-900km) and most C chondrites that fall to the earth (<1m), may be the reason for such a situation.

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References: [1] Chapman C. R. and Gaffey M. J. (1979) In Asteroids, pp. 1064-1089. [2] Bell J. F. *et al.* (1988) Lunar Planet. Sci. XIX, 57-58. [3] Ikeda Y. (1992) *Proc. NIPR Symp. Antarct. Meteorites, 5*, 49-73. [4] Gaffey M. J. (1976) *JGR, 81*, 905-920. [5] Johnson T. V. and Fanale F. P. (1973) *JGR, 78*, 8507-8518. [6] Tedesco E. F. (1989) In Asteroids II, pp. 1090-1138. [7] Hapke B. (1981) *JGR, 86*, 3039-3054.

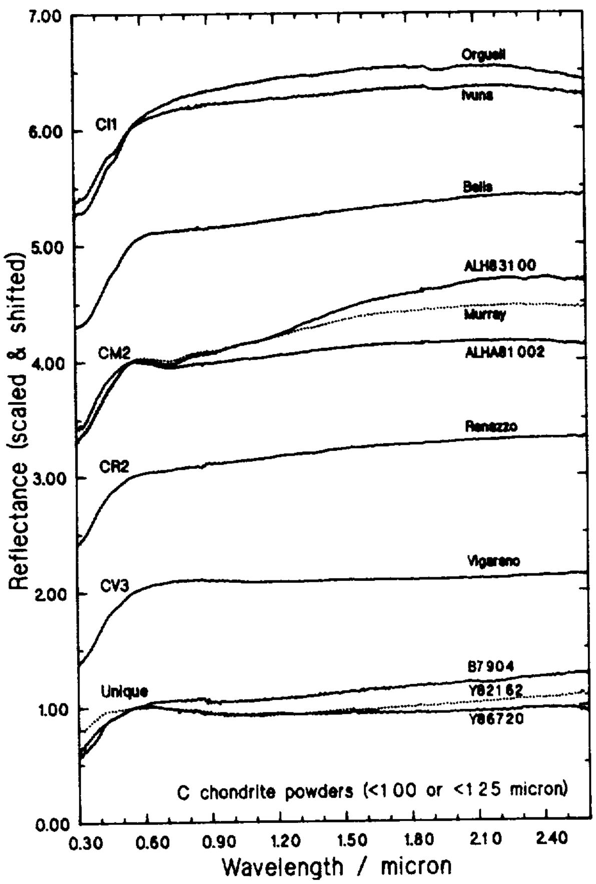

Fig. 1. Reflectance spectra of C chondrite powders.

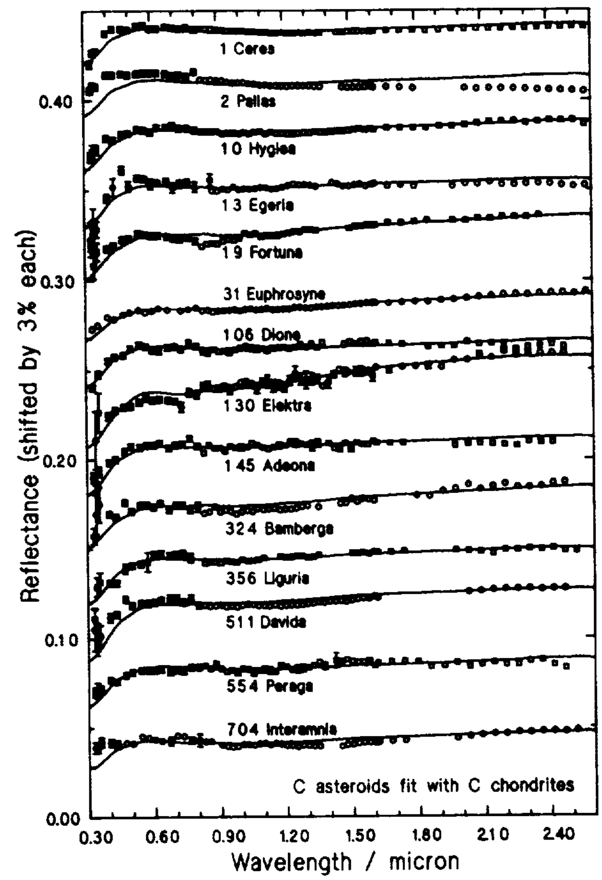

Fig. 3. Reflectance spectra of C asteroids [1,2] fit with those of C chondrite powders by Hapke's isotropic model.

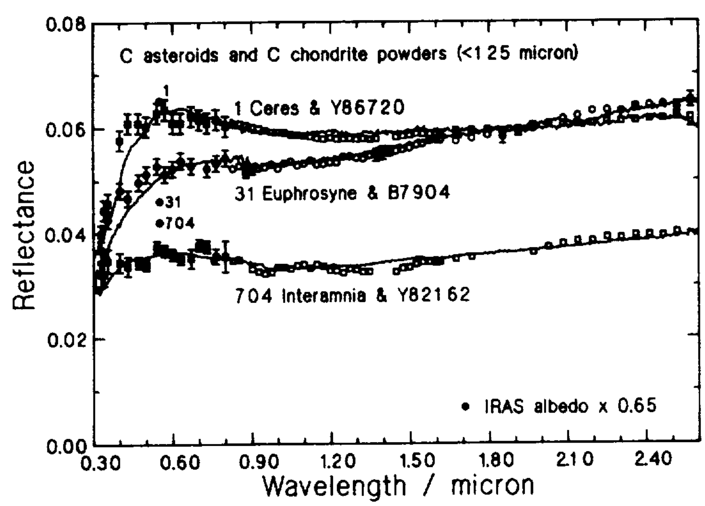

Fig. 2. Counterparts found between C asteroids and C chondrites.

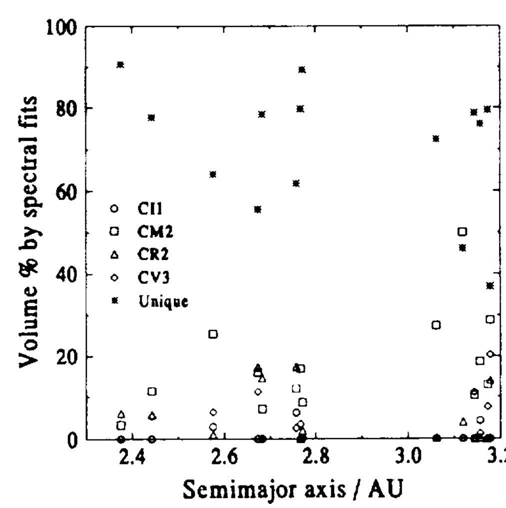

Fig. 4. Calculated C-chondrite volume % vs. semimajor axes of C asteroids.