

REFLECTANCE SPECTRA OF SOME FRACTIONS OF MIGEI AND MURCHISON CM CHONDRITES IN THE RANGE OF 0.3-2.6  $\mu\text{m}$ 

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**INTRODUCTION:** Some spectral differences exist between type CI and CM meteorites. These differences include in particular the slope of the spectral curve in the near-IR region. The reflectance spectral curves of CI's are neutral in the 0.9-2.6  $\mu\text{m}$  range, while for CM meteorites the increasing of the reflectance with wavelength in this region is typical. This phenomenon is often called as "reddening". The various slopes of the spectral curves are also typical for the reflectance spectra of C-type asteroids and the degree of the reddening increases in general with heliocentric distance (1). The reddening observed in CM chondrites is not understood. Johnson and Fanale (2) observed that as CM chondrites are more finely powdered their spectra become more reddened. In the process of meteorite crushing the chondrules are broken up. Those authors suggested that in this case the silicate components of the chondrules (mainly olivine), which have higher IR reflectivities, were able to contribute more to overall spectrum. Gaffey and McCord (3) proposed two possible physical mechanisms, which could produce such effect. But it is also possible that the presence of the organic polymers in the matrix material results in the reddening of CM spectra (4,5).

To test these two hypotheses the matrix material and the material enriched in olivines were separated from Migei and Murchison CM chondrites using binocular microscope. The spectra of these fractions were compared with the spectra of the bulk samples of Migei and Murchison. The spectra of bulk Orgueil (CI1) samples were also measured, but not discussed here. The specimens were powdered and sieved to obtain two particle size fractions (40-100 and 100-200  $\mu\text{m}$ ). The 40-100  $\mu\text{m}$  powders were ground and sieved to <40  $\mu\text{m}$ . Bidirectional reflectance spectra were measured in the range of 0.3-2.6  $\mu\text{m}$  using the RELAB spectrometer (Brown University, USA).

**MIGEI:** The data obtained show that the spectral curves of the samples enriched in olivines are redder than those of the matrix material in the near-IR. Thus the presence of the olivine grains and chondrules appears to be responsible for the Migei reddened spectra (Fig.1a-c). The spectral curves of matrix material (40-100 and 100-200  $\mu\text{m}$ ) even have some negative slopes. Their slopes and albedos almost don't depend on the particle sizes, but the slopes and albedos of the fractions enriched in olivines are strongly affected by the particle sizes. This result shows that significant disparity between the grain sizes in the matrix and those of the chondrules and olivine aggregates, is responsible for the increasing of the spectral reddening with the decreasing of particle sizes. This effect is consistent with one of two mechanisms proposed by Gaffey and McCord (3).

The finest "matrix" fraction (<40  $\mu\text{m}$ ) is contaminated with olivines, because after grinding of 40-100  $\mu\text{m}$  powder the olivine grains from the internal parts of the matrix particles reached the surface and have affected to the spectral characteristics. The spectrum is redder and albedo is higher than those of the coarser matrix fractions.

**MURCHISON:** The albedos of the "matrix" powders are lower than those of the fractions enriched in olivines, but the spectral curves of Murchison "matrix" and "enriched in olivines" fractions have identical slopes in the near infrared for similar particle sizes (Fig.1d-f). In addition, there is a shallow inflection near 1  $\mu\text{m}$  in the "matrix" spectra, so the spectral contribution of olivine is evident. This "contamination" seems to result from the petrological peculiarities of Murchison, rather than low quality of separation.

**BULK SAMPLES:** The bulk samples of Migei and Murchison seem to be weathered, because they were ground to powders several years ago, while the "matrix" and "enriched in olivines" fractions are relatively fresh. The spectra of bulk samples are even more particle size dependent than those of the fractions enriched in olivines (especially for Murchison). Further studies are needed to understand these effects of the weathering.

**ABSORPTION FEATURES:** Only two absorption features are presented in the spectra of the most "clean" matrix powders: UV-falloff shortward of 0.5  $\mu\text{m}$  and weaker feature centered at 0.74  $\mu\text{m}$  (similar features are presented in CCD spectra of some low albedo asteroids(6)). Both features appear to be the charge transfer ones, related with  $\text{Fe}^{3+}$ -bearing clay minerals. Hydrosilicates in carbonaceous chondrites are in the intimate intergrowth with the opaque phases. The latter suppress other absorption bands of hydrosilicates and significantly decrease the albedo. The broad shallow feature near 1  $\mu\text{m}$  due to olivine is presented in the spectra of "bulk", "enriched in olivine" and some "matrix" powders.

**IMPLICATIONS FOR C-TYPE ASTEROIDS:** The spectra of the most "clean" Migei matrix fractions indicate that the reddish slopes of CM spectral curves in the near infrared are due to the enhanced olivine feature, rather than to organic matter. We can propose that the red slope of the spectra of some C-type asteroids may indirectly

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suggest the presence of olivine in the surface material. At the same time the red-sloped spectra of more distant D-type asteroids seem to be due to the presence of organic materials (7,8). If so then the chemical (or physical) form of this organic matter must be quite different from the organic materials which would be on the surfaces of the parent bodies of CM chondrites (most likely C-type asteroids). It is also possible that the content of organic components in CM matrix is too low to change the slope of the spectra.

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Fig.1. Bidirectional reflectance spectra of various Migei and Murchison fractions (normalized to 1 at 0.56  $\mu\text{m}$ ). a) Migei (particle size 100-200  $\mu\text{m}$ ); b) Migei (40-100  $\mu\text{m}$ ); c) Migei (<40  $\mu\text{m}$ ); d) Murchison (100-200  $\mu\text{m}$ ); e) Murchison (40-100  $\mu\text{m}$ ); f) Murchison (<40  $\mu\text{m}$ ). 1. Matrix material. 2. Bulk material. 3. Material enriched in olivines as compared with the bulk samples.

