THE WEAK THERMAL EVOLUTION OF THE PRIMITIVE HYDROUS ASTEROIDS RECORDED IN DEHYDRATED CM CARBONACEOUS CHONDRITES

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The variety of thermal evolution process in the primitive hydrous asteroids can be understood from the study of dehydrated carbonaceous chondrites [e. g., 1]. We are studying more than 40 samples of CM and CM-like carbonaceous chondrites in order to identify and characterize samples having been dehydrated by heating. Synchrotron XRD analysis indicates that matrix phyllosilicates in PCA91084, Y-86695, LAR 06318, ALH 84033, DOM 03183, ALH 83100, and MIL 05152 are decomposed mainly to amorphous phases and secondary olivine and pyroxene are not crystallized. The results suggest that these samples suffered weak heating. The interpretation is confirmed by low maturation grade of organics measured by micro-Raman spectroscopy, low analytical totals of matrices and detection of ~0.3 wt% Cr2O3 in large ferroan olivines in type-II chondrules measured by FE-EPMA. TEM observation of matrices of some samples shows that the degree of crystalline-to-amorphous transformation varies between samples and thus the temperature of heating differs between samples.

Oxygen isotopic ratios of all seven samples were analyzed by laser-fluorination mass spectrometer [2]. The results show that Y-8665, DOM 03183, ALH 83100, and MIL 05152 distribute on the CM-CO line, while PCA91084, ALH84033, and LAR06318 are plotted on the CCAM line. Based on FE-SEM and TEM observations, matrices of the latter three samples are abundant in small primary silicates: they suffered low degree of aqueous alteration.

The seven samples showing dehydration have many mineralogical, textural, and chemical characteristics in common: they contain abundant PCPs, primary accretionary rocks [e. g., 3] and have matrix composition of typical CM chondrites [4]. Therefore, these samples are products of weak heating of typical CM chondrites such as Murchison. However, bulk oxygen isotope ratio varies among samples and does not show any correlations with the heating degree, but samples with low hydration degrees have ^{16}O-rich composition. This suggests that the oxygen isotope compositions were established prior to heating.

All dehydrated CMs found in the present study and in a previous study [5] show only weak heating effects. This implies that parent bodies of typical CMs were not heated to high temperature, or they have lost mechanical strength due to increase of porosity during heating and cannot deliver their pieces as meteorites to the Earth.

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