QUE97186 AND RBT04143: TWO EXTREME VARIETIES OF CV3 CARBONACEOUS CHONDRITES

H. Ishida[1], T. Nakamura[1], H. Miura[1], and Y. Kakazu[1]. [1]Department of Earth and Planetary Material Sciences, Tohoku University, Miyagi 980-8578 Japan. h-ishida@s.tohoku.ac.jp.

CV3 meteorites of reduced type are known to retain the most primitive mineralogical characteristcs of CV3 chondrites, because it has undergone the least degrees of aqueous alteration and thermal metamorphism [e.g., 1]. At the beginning of the present study, we have carried out petrologic study on six CV3 samples, RBT04143, QUE97186, GRA06101, LAP04843, LAP02206, and LAP02228 in order to identify reduced type CV3s. The results showed that RBT04143 and QUE97186 are classified to reduced CVs and further mineralogical and isotope study was carried out on the two meteorites to uncover their formation and evolution process.

RBT04143 has a very porous matrix and rounded undeformed chondrules. Submicron to several-micron size silicates of mostly olivine and minor amounts of low- and high-Ca pyroxene are major phases in matrix. Individual matrix olivine were analyzed by using FE-EPMA and showed a wide range of Fe/(Mg+Fe) ratios from Fa0 to 80. The wide Fa variation indicates that olivine dust in the solar nebula had an extreme wide range of Fe/Mg ratios and RBT04143 has undergone the least degrees of aqueous alteration and thermal metamorphism after accretion of parent body.

On the other hand, the matrix of QUE97186 is highly compacted with porosity much lower than RBT04143 and chondrules are flattened to high aspect ratios and show a preferred orientation. The texture strongly suggests that the meteorite has experienced shock impact on the meteorite parent body. Olivine and pyroxene phenocrysts in QUE97186 chondrules show undulatory extinctions and planar deformation fractures. This result indicates that the meteorite experienced shock pressure around 20GPa according to the results of previous shock recovery experiments [2] and shock-stage classification scheme [3].

Shock-induced heating resulted in homogenizing matrix olivine composition: QUE97186 matrix olivine showed Fa range from Fa45 to 60, which is much narrower than that in RBT04143. Low melting temperature material is also subject to heating: troilite grains in the matrix are totally or partially melted, suggesting that peak shock temperature exceeded Fe-FeS eutectic melting temperature of 1000°C. So as to estimate the cooling rate from peak residual temperature (800~1300℃ based on internal energy increase derived from hugoniot calculation [2] and mineralogical observation), we simulated homogeneization of Fa with time by considering size distribution of matrix olivine and Fe-Mg diffusion length by both grain-boundary and lattice diffusion [4-6]. The results of simulation indicate that the cooling rates are in the range from 10^{-5}-10^{-1} K/sec. This corresponds to the heating region smaller than 10 m on the QUE97186 parent body.

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