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Petrography of fine-grained rim surrounding chondrule in the Acfer331 CM2 chondrite

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Introduction

Chondrules in chondrites are commonly surrounded by fine-grained rim (FGR). It is widely believed that the rims were formed by accretion of dust in the solar nebula (Metzler et al. 1992) or in the parent body (Tomeoka and Tanimura, 2000). Because of changing in textures and chemical compositions by the physical processes in the parent body, such as aqueous alteration, in order to estimate the origin of FGR, it is important to estimate the changes of petrography for the FGR corresponding to the degree of aqueous alteration. In this study, we try to estimate the effect of aqueous alteration process to study about the petrography and chemical compositions of matrix and FGRs in the area for the different degree of aqueous alteration in the Acfer331 CM2 chondrite.

Analytical methods

The samples in this study were used in thin sections of Acfer331 CM2 chondrite. Since the major minerals in the matrix of Acfer331 chondrite are clay minerals consists of hydrous minerals, by polishing operation to make thin section using water, the expansion, deformation and fracture of matrix were occurred to destroy the original texture (Oohashi et al., 2008). Therefore, we made thin sections with and without water to estimate whether the original texture was destroyed or not. In order to estimate the original texture of matrix, cutting fragment of Acfer 331 CM2 chondrite with diamond blade are also compared with those of thin sections. As results, the petrography of matrix in a thin section with water indicates to be selectively destroyed a part of FeO-rich phyllosilicates and resulting from many voids in the matrix area relative to that of thin section without water and cutting fragments. A thin section without water were adopted. Petrographic observation, X-ray elemental mapping of thin sample (12 x 14 mm), and bulk quantitative analysis of the 30 x 30 micrometer were performed by FE-SEM-EDS system (JEOL JSM-7000F + Oxford INCA Energy) at Hokkaido University.

Results and Discussion

The major minerals in FGR and matrix consist of fine-grained phyllosilicaltes. From X-ray mapping of whole thin sections, there are different chemical distribution for vein of MgO-rich and CaSO4 2H2O in the matrix. Previous study suggests that different MgO chemical compositions of matrix are corresponding to the degree of aqueous alteration (Howard et al., 2009). Using the distribution of MgO-rich and CaSO4 2H2O, two different regions are divided. And the comparison of petrography of FGRs is corresponding to these two regions.

Region (1) are without vein of CaSO4 2H2O and MgO-poor. FGRs in region (1) show layered structure with inner and outer rim. In the Fe?Si+Al?Mg ternary diagram, the quantitative analyses areas in the inner rim are plotted at MgO-rich area relative to that of outer rim and matrix surrounding FGR, which are plotted the same area.

Region (2) are with vein of CaSO4 2H2O and MgO-rich. FGR in region (2) shows no layered structure with inner and outer rim. In the Fe?Si+Al?Mg ternary diagram, the FGR and matrix show the similar range of chemical compositions plotted for the total variation of FGR and matrix from region (1).

The degree of aqueous alteration from matrix at region (2) seems to be higher than that of region (1) because of MgO-rich and CaSO4 2H2O vein. In addition, the inner rim of FGR from region (1) shows the MgO-rich variation compared with that of matrix surrounding FGR, but FGR from region (2) shows no obvious layered structure and no different chemical variation relative to that of matrix surrounding FGR. As results, this suggests that FGR from region (2) is subject to the aqueous alteration with mm-scale in the parent body.

Keywords: aqueous alteration, fine-grained rim, carbonaceous chondrite, matrix