STUDY OF CHONDRULES IN CH CHONDRITES - II: BULK CHEMICAL COMPOSITIONS OF CHONDRULES

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Introduction: Chondrules in CH chondrite show distinct features from those in other chondrites, such as 1) small size distribution, 2) abundant cryptocrystalline type, 3) depletion of some refractory and volatile elements, and 4) abundant occurrence of silica minerals [e.g., 1-3]. These features characterize the unusual origin of CH chondrules. In order to explore their formation, we conducted a systematic study of chondrules from the Asuka 881020 and SaU 290 CH chondrites, in comparison with those in other primitive chondrites, Y-81020 (CO3.05), Y-793408 (H3.2) [4], and Sahara 97159 (EH3). We measured the bulk chemical compositions of chondrule by broad beam analysis technique using EPMA.

Petrography: Chondrules in Asuka 881020 and SaU 290 are small in size (53 and 84 μm in average size, respectively). They are divided into porphyritic (P) and non-porphyritic (NP). In Asuka 881020 and SaU 290, the abundances of NP chondrule are 70 and 45%, respectively. NP-chondrules are mainly cryptocrystalline, with a small amount of radial pyroxene type. Silica-bearing chondrules (S) also show cryptocrystalline texture, but contain cristobalite, often quartz, especially in the peripheral parts. Their abundances are 3% in Asuka 881020, and 4% in Sau 290.

Bulk composition of chondrule: We measured the bulk compositions of 323 and 93 chondrules in Asuka 881020 and SaU 290, respectively. Their characteristic features are as follows; 1) Atomic Si/(Si+Mg+Fe) ratio increases from P (0.44 and 0.43 in Asuka 881020 and SaU 290, respectively), NP (0.48 and 0.46) to S (0.63 and 0.51). 2) Atomic Al/(Al+Na+K) ratio decreases from P (0.95 and 0.95), NP (0.92 and 0.93), to S (0.77 and 0.82). 3) Atomic Mg/(Mg+Fe) ratio decreases from P (0.94 and 0.94) and NP (0.95 and 0.95), to S (0.80 and 0.88). 4) Some NP and S chondrules are depleted in Al, Ca, Ti and Na.

Discussion: The characteristic features of NP and S chondrules are the same as shown in previous studies [e.g., 1-3]. They experienced complete melting and rapid cooling. They were also subjected to fractionation of refractory and volatile elements, along with Mg/Si fractionation, resulting in the depletion of olivine. On the other hand, P chondrules do not show such processes, and are similar to those in the other chondrites. However, they are evidently depleted in Na, in comparison with those in other chondrites, and are more magnesian than those in CO and H3. We suggest that even the precursor materials of P chondrules in CH chondrites formed under higher temperatures and more reducing conditions than chondrules from other chondrite groups. This is not inconsistent with the oxygen isotopic compositions for chondrules in Asuka 881020 [5].

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