An ion-microprobe study of Be-B systematics on CO and CH CAIs

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Beryllium-10, which decays to 10B with a half life of 1.4 Myr [1], cannot be produced by stellar nucleosynthesis but by spallogenic reactions induced by galactic and/or stellar cosmic rays. Hence, signatures of the former presence of 10Be in CAIs and other solar system materials provide important clues to understand irradiation conditions in the early solar system.

In the present study, we conducted Be-B isotopic measurements using a NanoSIMS 50 (at AORI, Univ. of Tokyo) on refractory inclusions in primitive chondrites, Y81020 (CO3.05) and SaU290 (CH3). A melilite-rich CAI in Y81020 shows 10B excesses which are correlated with Be/B, indicating the presence of 10Be when the CAI formed. The inferred initial 10Be/9Be ratio of the CO CAI is comparable to those of CV CAIs [e.g., 2, 3] within uncertainties, suggesting that the CO CAI experienced irradiation processes similar to CV CAIs. In contrast, a melilite-rich CAI in SaU290 shows no resolvable excesses in 10B from the terrestrial abundance. Previous studies have demonstrated that 26Al-poor CAIs (e.g., CM hibonite-rich CAIs and CV FUN inclusions) typically show low 10Be/9Be ratios than those of most normal CAIs [4, 5]. The 26Al-poor signature of these CAIs is interpreted as their formation prior to the injection of 26Al in the solar system [e.g., 6]. These observations may suggest that 26Al-poor CAIs record irradiation history in the protosolar molecular cloud [4, 7] and/or heterogeneous distribution of 10Be in the early solar system [5]. A substantial fraction of CH CAIs also has little 26Al [e.g., 8], suggesting possible relationship to 26Al-poor CAIs in CMs and CVs. The 10Be-poor signature of the CH CAI observed in this study, therefore, support the above hypothesis.