A combined study of Be-B and Al-Mg systematics on CH and CH/CB CAIs

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Beryllium-10, which decays to ^{10}B with a half-life of 1.4 Myr [1], is considered as a key indicator of irradiation processes in the Early Solar System (ESS). However, recent numerical studies [2, 3] have demonstrated that ^{10}Be can be produced by stellar processes with neutrino reactions, which rendered reconsideration of the origin of ^{10}Be in the ESS. In order to further understand the origin of ^{10}Be, it is important to determine the accurate initial abundances of ^{10}Be in several types of meteoritic components. Previous studies implied that CH and CB chondrites contain a high proportion of the outer solar system material based on their bulk Mg- and Cr-isotopic compositions and ^{15}N-rich bulk compositions [e.g., 4, 5]. If this is correct, CH and CB CAIs may have information different from CAIs in other types of chondrites. In the present study, we have conducted Be-B and Al-Mg measurements on CH and CH/CB CAIs with newly determined Be/B relative sensitivity factors using synthetic glass standards.

We studied 8 CAIs from the Sayh al Uhaymir 290 (CH) and the Isheyevo (CB/CH) chondrites. Be-B and Al-Mg measurements were conducted with a NanoSIMS 50 at Atmosphere and Ocean Research Institute (AORI), The Univ. of Tokyo. Seven out of 8 CAIs show highly variable initial ^{10}Be/^{9}Be ratios ranging from 1.1 to 33 x 10^{-4}. They cannot be explained by a molecular cloud origin [6, 7] or a stellar origin [3], suggesting that they have experienced solar cosmic ray irradiation near the proto-Sun. In contrast to Be-B systematics, all CAIs studied here do not show resolvable excesses in ^{26}Mg. This could be attributed to: (1) heterogeneous distribution of ^{26}Al in the protoplanetary disk, (2) formation prior to injection of ^{26}Al, or (3) late formation after a significant decay of ^{26}Al. (1) is unlikely because CH and CB/CH CAIs may have formed in the same region as that of CV CAIs (= near the proto-Sun) as inferred from the Be-B systematics [e.g., 8-12, this study]. (2) is possible because CH and CB/CH CAIs have highly refractory nature relative to CV canonical CAIs. (3) may be a simpler interpretation. If (3) is the case, the transportation mechanism from near the proto-Sun to the accretion region of CH and CB parent bodies must have existed at least until the timing of CH and CB/CH CAI formation.

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