EXCESS BORON 10 OBSERVED IN CHONDRULES FROM Y82094 (C3.2) CHONDRITE.

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Introduction: Beryllium-10 (^{10}Be), which decays to ^{10}B with a half-life of 1.4 Myr [1], is considered as a key indicator of irradiation processes by solar or galactic cosmic rays (SCR or GCR) in the early solar system (ESS). A number of Be-B isotopic studies have been conducted on coarse-grained CAIs mostly from CV chondrites [2-6], which suggest the presence of live ^{10}Be at the time of CAI formation. The inferred initial ^{10}Be/^{9}Be ratios are mostly in the range of (0.5-1) × 10^{-3}. Recent studies including small CAIs from CH/CB chondrites [7-9] have revealed that the initial ^{10}Be/^{9}Be ratios in CAIs may be much more variable (from ~10^{-4} to ~10^{-2}), strongly suggesting the SCR origin of ^{10}Be in CAIs [9].

Chondrules are thought to be originated from isotopically and spatially different regions from CAI formation regions, because of their ^{16}O-poor *vs* ^{16}O-rich compositions, high *vs* low ambient temperatures, etc. (e.g., [10, 11]). Hence, ^{10}Be in chondrules, if present, would give important constraints for the origin and distribution of ^{10}Be in ESS. Sugiura [12] analyzed anorthite in chondrules from Y82094 (ungrouped C3.2) chondrite [13] and found a possible correlation between ^{10}B excesses and Be/B ratios, but the results were not conclusive due to large errors. In order to better understand the distribution of ^{10}Be in chondrules, we conducted Be-B isotope analyses for chondrules in Y82094 chondrite using NanoSIMS 50 at Atmosphere and Ocean Research Institute, the University of Tokyo.

Samples and Analytical Conditions: Y82094 was originally classified as CO, but now classified as an ungrouped C3.2 chondrite because of its high abundances of chondrules, CAIs and AOAs than other CO chondrites [13]. We so far conducted Be-B isotope analyses for four POP chondrules, Y94-42C2, Y94-42C14, Y94-73A3 and Y94-73A5. We analyzed fine-grained mesostasis and euhedral high-Ca pyroxene grown in mesostasis in these chondrules. Be-B isotopic measurements were performed with NanoSIMS 50. Analytical conditions were essentially the same as those described in [9, 14]. The ^{9}Be/^{11}B relative sensitivity factor was determined from measurements of NIST 610 and 612 glasses [14].

Results and Discussion: In the ^{10}B/^{11}B *vs* ^{9}Be/^{11}B diagrams, the two chondrules, Y94-42C2 and -42C14, show almost equilibrated B isotopic compositions with the slopes (i.e., the inferred initial $(^{10}Be/^{9}Be)_0$ ratios) of ~zero, (0.6 ± 1.2) × 10^{-3} and (0.1 ± 0.8) × 10^{-3} (2σ errors), respectively, and the elevated initial ^{10}B/^{11}B ratios of 0.257 ± 0.007 and 0.260 ± 0.005 (2σ errors), respectively, compared with the chondritic value (^{10}B/^{11}B = 0.248 [15]). In chondrule Y94-73A5, the data show a clear positive correlation with the inferred $(^{10}Be/^{9}Be)_0$ = (6.3 ± 1.7) × 10^{-3} (10 times higher than those for the typical CV CAIs!) and a normal $(^{10}B/^{11}B)_0$ = 0.2459 ± 0.0051. However, the data show a better correlation if plotted in the ^{10}B/^{11}B *vs* 1/^{11}B diagram, so that the data may be better understood as a mixing line, instead of an isochron: one component is B-rich with a normal B isotopic composition (possibly a surface contamination) and another is B-poor with excess ^{10}B. In chondrule Y94-73A3, only one analysis spot shows a very high ^{10}B/^{11}B ratio of 0.298 ± 0.019, but the other four spots show normal ^{10}B/^{11}B ratios within uncertainties. The results show that B isotope heterogeneity has been well preserved in this chondrule (i.e., little secondary alteration effect on the parent body) and localized existence of excess ^{10}B-carrier within the precursor materials of this chondrule. At least four chondrules so far analyzed in Y82094 show clear excess in ^{10}B. However, there is no clear evidence of live ^{10}Be at the time of the chondrule formation, but it is more likely that excess ^{10}B was introduced into these chondrules by excess ^{10}B-bearing precursor materials (CAI-like materials?). Further Be-B isotope studies for chondrules, esp. those in other types of chondrites, are required to better understand the distribution of ^{10}Be or excess ^{10}B-bearing materials in ESS.

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