LI-BE-B AND AL-MG ISOTOPIC COMPOSITIONS IN CH AND CH/CB CAIS: IMPLICATION FOR THE ORIGIN OF ^{10}BE IN THE EARLY SOLAR SYSTEM.

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Introduction: 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. The stable isotopes of Li, Be, and B are also made by irradiation processes [e.g., 4,5]. Thus, the quantitative understanding of initial ^{10}Be abundances and stable Li-Be-B isotopic compositions would provide important constraints on the origin of ^{10}Be in the ESS. Previous studies have provided hints for in-situ irradiation signatures of ^{7}Li/^{6}Li, initial ^{10}B/^{11}B and initial ^{10}Be abundances in Calcium, Aluminum-rich Inclusions (CAIs) [e.g., 4-8]. However, most of Li-Be-B data come from CAIs in CV and CM chondrites that have experienced thermal and/or aqueous alteration processes. Therefore, it is possible that some of the observed isotopic compositions might be disturbed by secondary processes. In the present study, we have conducted Li-Be-B and Al-Mg measurements on CAIs in least-altered CH and CH/CB chondrites.

Samples and Analytical Methods: Seven melilite-rich CAIs and one grossite-rich CAI were selected from the Sayh al Uhaymir 290 (CH) and the Isheyevo (CH/CB) meteorites. Petrographic observations and major element concentrations of these CAIs were obtained with FE-EPMA at The Univ. of Tokyo. Lithium, Be-B, and Al-Mg measurements were performed using a NanoSIMS 50 at Atmosphere and Ocean Research Institute (AORI), The Univ. of Tokyo. The instrumental mass fractionation was determined from measurements of NIST SRM610, 612 glasses and a Madagascar hibonite. The Be/B and Al/Mg relative sensitivity factors were determined from measurements of synthetic melilitic glasses [9] and a Madagascar hibonite.

Results and Discussion: All CAIs studied here do not show resolvable excesses in ^{26}Mg, which is in agreement with previous studies [e.g., 10]. In contrast to Al-Mg systematics, five out of 8 CAIs show highly variable initial ^{10}Be/^{9}Be ratios ranging from 6.9 to 33 × 10^{-4}. If the observed variations in initial ^{10}Be/^{9}Be ratios were produced by in-situ cosmic ray irradiation, ^{7}Li/^{6}Li ratios would be affected by spallation products. However, all CAIs with resolvable ^{10}B excesses show the chondritic isotopic ratio (^{7}Li/^{6}Li =12.06 [11]) within uncertainties. In order to understand the observed relationship between initial ^{10}Be/^{9}Be and ^{7}Li/^{6}Li, we estimated irradiation effects on ^{7}Li/^{6}Li in CAIs using the observed initial ^{10}Be/^{9}Be ratios and spallation production ratios [12]. Considering low Li concentr tions in observed CAIs (26 to 63 ppb), this simple calculation suggests that the observed ^{7}Li/^{6}Li ratios are inconsistent with in-situ irradiation of refractory solids. This could be attributed to: (1) isotopic fractionation from spallogenic ^{7}Li/^{6}Li ratios, (2) condensation from an irradiated chondiritic gas, or (3) partial loss of spallogenic Li and isotopic exchange with a chondritic gas, (4) ^{10}Be was not produced by solar cosmic ray irradiation, but by stellar processes [2,3]. (1) is unlikely because Mg and B isotopes do not show mass dependent fractionations. (2) is a simple interpretation because the observed ^{7}Li/^{6}Li ratios are nearly chondritic. (3) is possible because petrographic observations suggest that some of the CAIs were probably once molten. (4) is also possible because neutrino-induced nucleosynthesis [2,3] predominantly produces ^{7}Li, which is in sharp contrast to the case for cosmic ray irradiation. [3] has pointed out that low-mass supernovae provided ~8 ‰ of ^{7}Li in the solar system but a negligible amount of ^{6}Li. If the stellar products were introduced during or after the solar system formation, ^{7}Li/^{6}Li ratios would have been shifted to ^{7}Li-rich compositions from the chondritic value. Unfortunately, our analytical precision does not resolve excesses in ^{7}Li from the chondritic value. High precision Li isotopic measurements are required to check this scenario.

References: [1] Korschinek G. et al. 2010. *Nuclear Instruments and Methods in Physics Research* B268:187-191. [2] Yoshida T. et al. 2008. *The Astrophysical Journal* 686:448-466. [3] Banerjee P. et al. 2016. *Nature Communnications* 7:13639. [4] Chaussidon M. et al. 2006. *Geochimica et Cosmochimica Acta* 70:224-245. [5] Liu M. -C. et al. 2010. *The Astrophysical Journal Letters* 719:L99 (5pp). [6] McKeegan K. D. et al. 2000. *Science* 289:1334-1337. [7] MacPherson G. J. et al. 2003. *Geochimica et Cosmochimica Acta* 67:3165-3179. [8] Wielandt D. et al. 2012. *The Astrophysical Journal Letters* 748:L25 (7pp). [9] Fukuda K. et al. 2016. *Metsoc,* Abstract #6459. [10] Krot A. N. et al. 2008. *The Astrophysical Journal* 672:713-721. [11] Seitz H. -M. et al. 2007. *Earth and Planetary Science* 260:582-596. [12] Yiou F. et al. 1967. *Physical Review* 166:968-974.