THE BORON ISOTOPIC RATIOS OF A FINE-GRAINED INCLUSION FROM THE ALLAN HILLS 77307 CHONDRITE (CO3.0).

M.-C. Liu[1], J. Han[2], A. Brearley[3] [1]Dept. of Earth, Planetary, and Space Sciences, UCLA (mcliu@ucla.edu), [2]Lunar and Planetary Institute, [3]Dept. of Earth and Planetary Sciences, Univ of New Mexico.

Introduction: Beryllium-10 (decays to ^{10}B, $t_{1/2}$ = 1.3 Myr) is a radionuclide that exclusively requires a spallation origin. Therefore, one could obtain important insights into the irradiation environment during Solar System formation by understanding the distribution and abundance of this radionuclide in meteoritic inclusions. Most previous data are derived from B isotopic analysis of coarse-grained CV3 Ca-Al-rich Inclusions (CAIs) that have $^{26}Al/^{27}Al$ close to the canonical level of 5×10^{-5}, and inferred $^{10}Be/^{9}Be$ ratios between 4×10^{-4} and 1×10^{-3} [1–5]. Such observed ^{10}Be variations have been regarded as a "smoking gun" for intense irradiation occurring in the solar nebula. However, it has recently been proposed that irradiation of the presolar molecular cloud by accelerated, escaping cosmic rays from an isolated supernova remnant could yield $^{10}Be/^{9}Be$ as high as 3×10^{-4}. It is therefore possible that the Solar System could have formed with this level of ^{10}Be as a background abundance, and any $^{10}Be/^{9}Be$ ratios higher than this background level, as were seen in some coarse-grained CAIs, would then be a result of subsequent irradiation in the solar nebula [6]. It should be pointed out that coarse-grained CAIs have been thermally processed so that they are not ideal samples to assess whether ^{10}Be of molecular cloud origin comprises a good portion of the total ^{10}Be inventory in the solar nebula. Instead, fine-grained CAIs should more faithfully record the amount of ^{10}Be inherited from the molecular cloud, because these samples probably never came too close to the Sun after their formation and thus probably experienced low fluxes of energetic projectiles. If the inheritance model is correct, fine-grained CAIs should have $^{10}Be/^{9}Be$ close to the background ratio of 3×10^{-4}. Up to now, very little data on ^{10}Be abundances have been reported for fine-grained CAIs, most likely due to the small grain sizes and/or pervasive contamination with chondritic boron. Here we report preliminary data on one fine-grained CAI from one of the most primitive chondrites ALHA77307 (CO3.0), hoping to better constrain the ^{10}Be abundances in this unmelted refractory inclusion.

Experimental: The fine-grained CAI is ~200 μm ×100 μm in size, and is composed of melilite, spinel and diopside. Only in melilite can one obtain higher Be signals relative to B. The boron isotopic analysis was performed on the UCLA ims-1290 ion microprobe. A 5nA $^{16}O^{-}$ primary beam, focused into a ~2 μm spot, was generated by a Hyperion II Radio-Frequency source. Secondary ions with a mass sequence $^{9}Be^{+}$, $^{10}B^{+}$, $^{11}B^{+}$, $^{27}Al^{++}$ and $^{28}Si^{++}$ were collected in peak-hopping mode with the axial electron multiplier. Synthetic melilite glasses with a range of Be/B ratios [7] and NIST 614 were used as standards to correct for the relative sensitivity factor and instrumental mass fractionation, respectively. Isotope ratios were calculated by using total counts [8].

Result and Discussion: Elevated, yet uniform within errors, $^{10}B/^{11}B$ ratios (weighted average = 30.2±17.7‰, 2σ) relative to the chondritic value (=0.2481) were found in the CAI, and are independent of Be/B (Fig 1). No ^{10}Be isochron can be inferred from this dataset, but one scenario that could result in this observation involves closed-system isotopic resetting of the CAI after ^{10}Be had completely decayed away. If this is true, one would not be able to assess the ^{10}Be proportion derived from the inheritance of molecular cloud material. Another possibility is that this CAI never had any ^{10}Be, and the observed supra-chondritic $^{10}B/^{11}B$ ratios represent mixing between spallogenic and chondritic B, as was proposed in [9]. Given that to arrive at such a high $^{10}B/^{11}B$ in the nebula gas would require a very high fluence of charged particles, which would result in $^{10}B/^{9}Be > 3\times10^{-2}$ [9], in-situ irradiation of initially B-free refractory inclusion would be favored. If this scenario is correct, ^{10}Be that came into the Solar System as molecular cloud material would just be a minor component. More data from such inclusions will be needed to shed light on the ^{10}Be abundances and distribution during the period of condensation of refractory inclusions.

References: [1] McKeegan, K. D. et al. (2000) *Science, 289,* 1334–1337. [2] Sugiura, N. et al. (2001) *MAPS, 36,* 1397–1408. [3] MacPherson, G. J. et al. (2003) *GCA, 67,* 3165–3179. [4] Wielandt, D. et al. (2012) *ApJL, 748*, L25. [5] Srinivasan, G. et al. (2013) *EPSL, 374,* 11–23. [6] Tatischeff, V. et al. (2014) *ApJ, 796,* 124 (20pp.). [7] Dunham E. et al. (2017) *LPS XLVIII*, #1507 (abstr.) [8] Ogliore, R. C. et al. (2011) *NIMPR B, 269,* 1910–1918 [9] Liu, M.-C. et al. (2010) *ApJL, 719,* L99–L103.