FOSSIL RECORD OF ^{7}Be AND ^{10}Be IN A CAI: IMPLICATIONS FOR THE ORIGIN AND EARLY EVOLUTION OF OUR SOLAR SYSTEM.

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Introduction: Short-lived now-extinct chronological studies of the first forming Solar system solids provide high temporally resolved records of specific events and processes leading to the formation of our Solar system. The abundances and mode of genesis of the short-lived radionuclides additionally delimit their provenance from specific source(s). The low binding energy of lithium, beryllium, boron isotopes restricts their production predominantly by spallation reactions of oxygen and carbon nuclides and also under a very restrictive conditions in stellar nucleosynthesis. Amongst these, decay of ^{7}Be to ^{7}Li in 53.06 ± 0.12 days [1], and ^{10}Be decays to ^{10}B in $T_{1/2}$= 1.387±0.012 Million years (Ma) [2] provide a very unique opportunity to understand formation and early evolution of the Solar system [3-5]. Lithium-Beryllium-Boron isotope systematics in a type B1 CAI from Efremovka (CV~3.1-3.4) was carried out using secondary ion mass spectrometer [5] to understand (1) irradiation in the early Solar system (2) constraint amongst the suggested competing scenario for production of ^{10}Be and by inference other nuclides in the early solar system.

Sample: Efremovka CAI 40 (E40) is a partial broken piece of a type B1 CAI with exposed two dimensional surface of ~6.4×4.8 mm. It consists of abundant large euhedral spinels (typical size ~200 µm), zoned large melilite crystals (upto few mm), pyroxene, and rare anorthite. E40 CAI has been studied previously for petrography, mineralogy, ^{26}Al-^{26}Mg isotope systematics, and Rare earth elemental (REE) abundances [9]. E40 has Wark-Lovering rim of typical width of ~200 µm surrounding the half of its perimeter.

Result and Discussion: Analysis of large melilite in Efremovka E40 yields isochron corresponding to ^{7}Be/^{9}Be of $(1.2\pm1.0)\times10^{-3}$ (95% conf.) and concurrently ^{10}Be/^{9}Be ratio of $(1.6\pm0.32)\times10^{-3}$ (2σ). The previous ^{26}Al-^{26}Mg isotope systematics in the CAI yielded ^{26}Al/^{27}Al $(3.4\pm1.0)\times10^{-5}$ (2σ) [9] implying its formation/ last resetting at 0.45±0.3Ma. Isotopic records of ^{7}Be, ^{10}Be, and ^{26}Al in a type B CAI from Efremovka (E40) allow to draw following constraints: (1) Young Sun underwent *multiple episodes* of enhanced magnetic activity during young stellar pre-main sequence stages (2) the intensity of the *later episode* of irradiation occuring at the end of “class I” stage of pre-main sequence evolution recorded by this CAI was *higher* than those seen by canonical CAIs (3) *Irradiation* is the *prime source of ^{7}Be,* and also ^{10}Be, is constrained by short half life of ^{7}Be. The isotopic properties (^{7}Be, ^{10}Be, ^{26}Al), morphology (texture, modal grain sizes), and petrology (mineral compositions) of CAI, can cogently be explained by irradiating a CI (Carbonaceous Ivuna ≈ Solar) composition precursors near the reconnection region for about an year by a super flare (X-ray luminosity $L_x \approx 10^{32}$ ergs) during the terminal ‘class I’ pre-main sequence stage. The short duration of irradiation is also able to explain preservation of faster diffusing lithium isotope records within the CAI.

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