ON THE NUCLEOSYNTHETIC ORIGIN OF ^{10}BE IN FUN-CAIS.

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Introduction: A key issue raised by the presence short-lived radionuclides (SLRs) in the protoplanetary disk is to decipher whether the birth of the solar system occurred in generic conditions or required a specific astrophysical context involving an unusual sequence of stellar events [1, 2]. While some SLRs, such as ^{26}Al, are most probably resulting from stellar nucleosynthesis [3, 4], the initial abundance of ^{10}Be is of uttermost interest since it is only efficiently produced by accelerated-particle-induced reactions [5]. The presence of extinct ^{10}Be in FUN-CAIs suggests that a baseline concentration of ^{10}Be in the early solar system was inherited from the protosolar molecular cloud [6]. We investigated different astrophysical scenarios to explain this baseline concentration of ^{10}Be [7].

Results: These ^{10}Be nuclei cannot have been produced by irradiation of the FUN-CAIs themselves since i) it would lead to an overproduction of ^{6}Li in these objects, ii) the induced ^{10}Be/^{9}Be ratio would have been much higher in pyroxene than in melilite (contrary to the measurements) and finally the irradiated FUN-CAIs would have experienced too much heating to retain other large nucleosynthetic anomalies. It was suggested that enhanced trapping of galactic cosmic rays (GCRs) in the protosolar molecular cloud could lead to high ^{10}Be concentration in the protoplanetary disk [8]. However, taking into account the constraints on the low-energy part of the ^{10}Be GCR spectrum, we found that the trapping mechanism provides a negligible amount of ^{10}Be in the molecular cloud core (i.e the inferred initial ratio stays at least 40 times lower than the baseline recorded in FUN-CAIs).

Irradiation of the presolar molecular cloud by background GCRs produce a steady-state ^{10}Be/^{9}Be ratio lower than that recorded in FUN-CAIs suggesting that the presolar cloud may have been irradiated by an additional source of CRs. Considering cosmic rays (CRs) acceleration in a supernova remnant, we find that the ^{10}Be abundance recorded in FUN-CAIs can be explained by either the irradiation of a giant molecular cloud by CRs produced by about 50 supernovae exploding in a superbubble generated by a large star cluster of at least 20,000 members or alternatively by the irradiation of the presolar molecular cloud by freshly accelerated CRs escaped from an isolated supernova remnant (SNR) at the end of the Sedov–Taylor phase. In the second picture, the SNR resulted from the explosion of a massive star that ran away from its parent OB association and eventually interacted with the presolar molecular cloud during the radiative stage. This model provides an explanation for the injection of other short-lived radionuclides such as ^{26}Al, ^{41}Ca, and ^{36}Cl [4].

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