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Signature of supernova neutrino-process in CAI and SiC presolar grains

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Some rare isotopes such as 7Li, 10B, 138La, and 180Ta are considered to be synthesized by neutrino-induced reactions in core-collapse supernovae (neutrino process). However, there is no clear evidence for synthesis by the neutrino-process except for astronomical observation of fluorine in early generations of stars. Calcium and aluminum rich inclusions (CAIs) are generated in early solar system formation with contamination of an astrophysical event. The correlation between 138La/139La and 50Ti/48Ti ratios in CAIs was reported [1]. It was suggested that the enhancement of 50Ti was consistent with the prediction of Type Ia supernova models, but the production of 138La cannot be explained by these modes. Here we present that this correlation can be quantitatively reproduced by core-collapse supernova with weak s-process in the progenitor. This result suggests that the correlation between 138La/139La and 50Ti/48Ti is the first evidence that core collapse supernovae produced the rare isotopes including 138La and the ejecta of the supernova contributed the early solar materials. The Ti isotopes are produced in the weak s-process before the supernova explosion, and the present result is consistent with the recent [2] showing that the correlation between the anomalies of 46Ti and 50Ti in CAIs can be reproduced only by the weak s-process before the core collapse supernova explosion. In addition, we calculate the correlation between 7Li/6Li (11B/10B) and 138La/139La in presolar grains originating from core-collapse supernovae [3]. The results show that the combination of the two isotope ratios depends on the layers in the massive star. The SiC grains are considered to originate from mixing of the materials of Si rich layers and C rich layers under C/O > 1 environments. The results show that even if SiC grains are formed in such conditions it is possible to assign their origin. These studies show the importance of the isotopic abundance analysis in CAIs and presolar grains.

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