Quest the Stellar Origins of Neutron-Rich Iron Group Isotopic Anomalies in the Solar System

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Mass independent isotopic anomalies of neutron-rich iron group elements in Ca-Al rich inclusions (CAIs) of primitive meteorites were believed to be created by incomplete mixing of stellar materials in the early solar epoch [1]. Those neutron-rich isotopes, such as ^{48}Ca, ^{50}Ti, and ^{54}Cr are mainly synthesized by nuclear statistical equilibrium process during the last stage of stellar evolution. Because most of neutron-rich isotopes, especially ^{48}Ca, cannot be ejected from core-collapse type-II supernovae (SNeII) explosion [2], neutron-rich type-Ia supernovae (nSNeIa) are instead the most likely stellar site for the prodution and subsequent injection of these isotopes into instellar medium [3]. Considering of the solar abundances of alpha nucleii (^{40,44}Ca, ^{48}Ti, and ^{56}Fe) relative to ^{48}Ca, nSNeIa have to occur infrequently (~once per ten thousand year) [3] compared to other types of supernovae.

Shen and Lee (2003) [4] reported a correlation line between ^{138}La/^{139}La and ^{50}Ti/^{48}Ti in CAIs, however, the current nucleosynthesis theory suggested that ^{138}La was synthesized by a neutrino process, which is believed to occur during explosion of SNeII [5]. Thus there was a controversy about the stellar-nucleosynthetic origin of these anomalies.

We will report our high precision ^{48}Ca/^{44}Ca data for Allende CAIs which confirm that there is no simple correlation between ^{48}Ca/^{44}Ca and ^{50}Ti/^{48}Ti. By comparing these data with the ^{48}Ca/^{44}Ca, ^{50}Ti/^{48}Ti, and ^{54}Cr/^{52}Cr correlation line among differentiated meteorites discovered by Chen *et al.* (2011) [6], we propose that there were two types of stellar sources contributing to ^{50}Ti inf CAIs, the first one came from nSNeIa, while the other came perhaps from O/Ne layer of SNeII where the neutrino process is thought to be producing ^{138}La.

[1] Wasserburg *et al* (1980) *In Early Solar System Processes and the Present Solar System*, 144-191. [2] Nomoto *et al* (2013) *ARA&A* **51**, 457-509. [3] Woosley (1997) *ApJ* **476**, 801-810. [4] Shen and Lee (2003) *ApJL* **596**, L109-L112. [5] Heger *et al* (2005) *PhLB* **606**, 258-264. [6] Chen *et al* (2011) *ApJL* **745**, L23.