PPS24-P10 Room:Convention Hall Time:May 23 18:15-19:30

Beryllium-bron measurment of a melilite-rich calcium-aluminium-rich inclusions in the NWA5958 CM choudrite

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CAIs (Ca, Al-rich Inclusions) are the oldest object in the solar system. In CAIs, there are evidence of now-extinct isotopes like ^{26}Al and ^{10}Be. They have a short-half-life ($<$100Ma) and because of short-half-life, they are expected to indicate an accurate relative age. In order to estimate a relative age using now-extinct isotopes, it is required that they were homogeneously distributed in the solar nebula. In terms of ^{26}Al, it has been almost already proven that they were homogeneously distributed in the solar nebula, while 10Be has not proven yet. ^{26}Al decays by electron capture to ^{26}Mg with a half-life of 0.71Ma. ^{10}Be B-decays to ^{10}B with a half-life of 1.5Ma. In terms of Al-Mg chronology, it is difficult to detect excess of ^{26}Mg in CAIs which experienced late-stage alteration (e.g reheating in the nebula or asteroids), because the Mg diffusion in anorthite where Al-Mg measurements were made is fast. The B diffusion, however, in melilite where Be-B measurements were made is slow. Therefore, it is suggested that Be-B chronology is effective way to measure a relative age of CAIs which experienced late-stage alteration. Hence, it is significant to confirm that ^{10}B was distributed in solar nebula homogeneously or heterogeneously.

In this study, we have carried out Be-B measurements in one CAI (Type-A CAI) from CM chondrite NWA5958. This CAI consists mainly of a large melilite crystal and small spinel and perovskite are contained as inclusions in the melilite. Our SIMS measurements at Tohoku University showed that this CAI has ^{10}B excesses in melilite. The initial ^{10}Be/^{9}Be ratio inferred 4.6x10^{-2}. This ratio is much higher than those obtained in other CAIs from CV chondrites (e.g. 9.5x10^{-4} ; MacPherson et al. 2003, 7.2x10^{-4} ; Sugiura et al. 2001). We have also analyzed rare earth elements (REEs) abundance and oxygen isotopes ratios of this CAI. Melilite shows nearly flat (unfractionated) CI-normalized REEs pattern with anomalies in Eu and ^{16}O-rich composition, whereas melilites in CV chondrites usually have ^{16}O-poor composition (e. g. Clayton et al. 1977). REE pattern indicates that the large melilite in this CAI formed from a melt, thus the CAI experienced melting by reheating in the nebula. ^{16}O-rich oxygen isotope ratios suggest that this CAI stayed nearer the Sun, while CAIs in CV chondrite stayed away from the Sun because of ^{16}O-poor composition of melilite. Our result implies that the nebula gas near the Sun contained much more ^{10}Be than the gas far from the Sun. This suggests that ^{10}B was distributed in solar nebula heterogeneously and Be-B system can't measure a relative age.

Keywords: Be-B system, CAI, melilite