P137-007 Room: 301B Time: May 30 10:12-10:24

Fluctuation frequency of oxygen isotope reservoirs in the early solar system

Shoichi Itoh[1]; Hisayoshi Yurimoto[1]

[1] Natural History Sci., Hokudai

It is generally accepted that the refractory inclusions (Ca-Al-rich inclusion (CAI)) are the oldest materials in the solar system (4567Ma, Amelin et al., 2002). In addition, since the CAI contains the radiogenic ^{26}Al, the CAI formed at first several Myrs in the early solar system.

For the oxygen isotope distribution of coarse-grained Ca-Al-rich inclusion (CAI), in general, the ^{16}O-rich phases are spinel and fassaite and the ^{16}O-poor phases are melilite and anorthite (e.g., Clayton, 1993). To explain the heterogeneous oxygen isotopic distribution among the minerals, recently, the following crystallization sequence has been proposed by the results of O isotopic petrography in type A 7R19-1 (a) CAI from Allende CV3 chondrite with the evidence of coexistence among ^{16}O-rich and 16O-poor melilite crystals (e.g., Yurimoto et al., 1998). Initially, this CAI crystallized from ^{16}O-rich CAI liquid, which the crystallization sequence of the CAI minerals is the order of spinel, melilite and fassaite. Secondly, this CAI experienced partial melting in ^{16}O-poor gas. Following O isotopic exchange reaction between ^{16}O-rich liquid and ^{16}O-poor gas, melilite and fassaite recrystallized from the ^{16}O-poor liquid. However, such O isotopic petrography has not been evaluated by chronology.

In this study, we report a high precision Al-Mg isotopic study of coarse-grained CAIs from Y81020 CO chondrite and Allende CV chondrites, in order to evaluate the chronological sequence of ^{16}O-rich and -poor isotope exchange event using ^{26}Al-^{26}Mg internal isochron.

We measured Mg isotopes of three coarse-grained CAIs, which is a fragment of type A Y20a CAI from Y81020 CO chondrite, a fragment of type A 7R-19-1 (a) CAI and a type B HN3-1 CAI from Allende CV chondrite. The study of O isotopic petrography of 7R-19-1 (a) and HN3-1 from Allende has been reported previously (e.g., Yurimoto et al., 1998). Al-Mg isotopic analysis was performed by the Cameca ims-1270 SIMS instrument using four faraday cups of the multi-collection system (Itoh et al., 2007).

In 7R-19-1(a) CAI, the timing of heating events for ^{16}O-rich and ^{16}O-poor phases are clearly distinguishable and the time interval is about 0.23+-0.11Myr.

In Y20a CAI, at least five flash multiple heating events occurred from the internal Al-Mg isochron. Remarkable fact from the result of Y20a shows that the dynamical O isotopic fluctuation from ^{16}O-rich to ^{16}O-poor, and then ^{16}O-rich WR-rim formation event occurred within ~0.5Myr in the early solar system. In addition, the relative age of interior ^{16}O-poor melilite and ^{16}O-rich outer melilite in Y20a shows that the O isotopic exchange events occurred within analytical uncertainty (less than 0.01Myr).

In HN3 CAI, the timing of heating events for ^{16}O-rich and ^{16}O-poor phases are not clearly distinguishable and at least two heating events occurred with O isotope fluctuation.

The time interval among heating events is less than 0.1Ma.

If the spatial heterogeneity of ^{26}Al exists in the early solar system, it could not be acceptable to compare with these isochron from all CAIs. However, each internal isochron from a CAI is not related with the heterogeneity of ^{26}Al in the early solar system or not. Therefore, the duration of CAI formation from each internal isochron is varied, and in Y20a CAI, at least shows the duration of CAI formation about 0.5Myr. In addition, the ^{16}O-rich and ^{16}O-poor gaseous nebular reservoirs exist in the early solar system during Y20a CAI formation. Although it is unclear whether two isotopic different environments continue to exist in the early solar system, the O isotopic compositions of gaseous nebula reservoirs surrounding each CAI fluctuated from ^{16}O-rich to ^{16}O-poor or ^{16}O-poor to ^{16}O-rich, and it takes less than 0.01Myr times to switch the fluctuation of oxygen isotope reservoirs in the case of Y20a CAI.