HOMOGENIZATION OF ISOTOPIC RATIO IN SOLAR NEBULA. T. Nakamoto[1] and A. Takeishi[1] [1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology (Meguro, Tokyo 152-8551, Japan, nakamoto@geo.titech.ac.jp)

Introduction: It is known that the isotopic compositions, except for some highly volatile elements, of solar system materials show very little variations; deviations from normal are of the order of a few parts in 10^4 or less. It is supposed that the material formed the solar system came from various nucleosynthesis sites, such as supernovae, AGB stars, and so forth, so dust particles involved in the parental molecular cloud that formed the solar system had various isotopic ratio. This implies that the isotopic ratio of solar system material was homogenized at a certain stage in a course of the solar system formation processes.

Aim and Model: Here, we explore some possibilities that all the solid material in the solar system was once evaporated and mixed well to become isotopically homogeneous in the solar nebula. To examine that, we model the gravitational collapse of a molecular cloud core with a certain rotation, which is characterized by the rotation angular velocity, and model the disk accretion formed by the cloud collapse, which is characterized by the strength of turbulence in the disk. The temperature of the disk is calculated, and if the temperature is high enough, say 2000 K in our current model, it is supposed that dust particles there are evaporated completely. When such a high temperature gas cools and the temperature becomes below 2000 K, solid dust particles, which have a common isotopic ratio, are assumed to condense. And we think that these solid particles will form planets and other objects in the solar system seen today.

Results: According to our numerical simulations with a wide range of model parameters, we have found that (1) almost all the materials in the disk may be once evaporated and isotopically homogenized if the rotation angular velocity of the initial molecular cloud core is low enough, e.g., 1×10^{-15} s^{-1}; (2) the disk formed from such a low rotation cloud core has a small radius, smaller than 100 AU, and the total mass of the disk is of the order of one hundredth of the solar mass. These results seem to be consistent with observed features of our solar system.

Discussions: In the present work, we explored a possibility that a high temperature disk homogenized the isotopic ratio of materials. The disk was globally hot. But some other mechanisms may produce isotopically homogenized materials. For example, a huge number of local heating events, which may relate to chondrule formation, evaporate and homogenize almost all the materials in the solar nebula, if isotopically heterogeneous dust particles are mechanically well mixed in advance. This possibility would be explored in future.

CHRONOLOGICAL STUDY OF OXYGEN ISOTOPE COMPOSITION FOR THE SOLAR PROTOPLANETARY DISK IN A FLUFFY TYPE A CAI FROM VIGARANO. N. Kawasaki[1], S. Itoh[2], N. Sakamoto[3] and H. Yurimoto[1]. [1]Natural History Sciences, Hokkaido University, Sapporo 060-0810, Japan. E-mail: kawasaki@ep.sci.hokudai.ac.jp [2]Department of Earth and Planetary Sciences, Kyoto University, Kyoto, 606-8502, Japan. [3]Creative Research Institution, Hokkaido University, Sapporo, 001-0021, Japan.

Introduction: Fluffy Type A Ca-Al-rich inclusions containing reversely zoned melilite crystals are suggested to be direct condensates from solar nebular gas [1]. We conducted an investigation of ^{26}Al–^{26}Mg systematics of a fluffy Type A CAI from Vigarano, named V2-01, with known O isotopic distributions of reversely zoned melilite crystals [2]; we also conducted O isotope measurements of coexisting minerals. The O and Al–Mg isotope measurements were conducted using SIMS of Hokkaido University (Cameca ims-1280HR).

Results and discussion: Two of six reversely zoned melilite crystals showed continuous variations in Mg isotopic composition, with δ^{25}Mg becoming small along the direction of crystal growth, which supports the idea that they originated through condensation. Petrography suggests that the constituent minerals of V2-01 formed in the following order: first spinel and fassaite enclosed by melilite, then reversely zoned melilite crystals, and spinel and diopside in the Wark-Lovering rim. The spinel enclosed by melilite has ^{16}O-rich compositions (Δ^{17}O ~ −24‰) and an initial value of $(^{26}Al/^{27}Al)_0 = (5.6 \pm 0.2) \times 10^{-5}$. The fassaite enclosed by melilite crystals shows variable O isotopic compositions (Δ^{17}O ~ −12‰ and −17‰) and plots on the isochron with $(^{26}Al/^{27}Al)_0 = (5.6 \pm 0.2) \times 10^{-5}$. The O isotopic compositions of reversely zoned melilite showed continuous variations in Δ^{17}O along the direction of crystal growth, suggesting that surrounding nebular gas, during the formation of the reversely zoned melilite, changed from ^{16}O-poor (Δ^{17}O values larger than −10‰) to ^{16}O-rich (Δ^{17}O ~ −25‰) [2]. The six reversely zoned melilite crystals show indistinguishable initial $(^{26}Al/^{27}Al)_0$ values with an average $(^{26}Al/^{27}Al)_0$ of $(4.7 \pm 0.3) \times 10^{-5}$, which is clearly distinguishable from the value of enclosed spinel and fassaite, indicating a younger formation age than the enclosed spinel and fassaite. The spinel and diopside from the Wark-Lovering rim show ^{16}O-rich compositions (Δ^{17}O ~ −23‰) with $(^{26}Al/^{27}Al)_0 = (4.5 \pm 0.4) \times 10^{-5}$. The values of $(^{26}Al/^{27}Al)_0$ are consistent with the formation sequence inferred from petrography. The formation period for the V2-01 CAI is estimated to be 0.18 ± 0.07 Myr from the difference in initial $(^{26}Al/^{27}Al)_0$ values. These data suggest that the O isotopic composition of solar nebular gas surrounding the CAI changed from ^{16}O-rich to ^{16}O-poor and back to ^{16}O-rich at least recorded as one cycle during the first ~0.2 Myr of Solar System formation.

References: [1] MacPherson G. J. and Grossman L. 1984. *Geochimica et Cosmochimica Acta* 48: 29–46. [2] Katayama J. et al. 2012. *Meteoritics and Planetary Science* 47: 2094–2106.