VARIATIONS IN INITIAL ^{26}AL ABUNDANCES AMONG FINE-GRAINED CA-AL-RICH INCLUSIONS IN THE REDUCED CV CHONDRITES.

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Introduction: Ca-Al-rich inclusions (CAIs) are composed of high-temperature condensates from a solar-composition gas [1] and the oldest objects formed in our Solar System, as determined by U-corrected Pb−Pb chronology [2]. Most of CAIs are thought to have contained detectable amounts of live ^{26}Al, a short-lived radionuclide with a half-life of ~0.7 Myr, at their formation [3]. Recent high-precision ^{26}Al–^{26}Mg mineral isochron studies using secondary ion mass spectrometry (SIMS) revealed detailed distributions of initial ^{26}Al/^{27}Al values, $(^{26}Al/^{27}Al)_0$, for individual CAIs in the CV chondrites [4−10]. The data show that coarse-grained, igneous CAIs and fluffy Type A CAIs show similar variations in $(^{26}Al/^{27}Al)_0$, which range from ~5.2 to ~4.2 × 10^{-5} [10]. However, few studies have obtained such high-precision ^{26}Al–^{26}Mg mineral isochrons of fine-grained inclusions (FGIs); only two FGIs have been examined [4, 10]. Volatility-fractionated trace-element patterns [11, 12] and complex multi-layered structures [13, 14] of FGIs in CV chondrites are indicative of condensates formed directly from the solar nebular gas. In this study, we obtained new ^{26}Al–^{26}Mg mineral isochrons of five FGIs from the reduced CV chondrites, Efremovka, Vigarano and Thiel Mountains 07007 (TIL 07007), by *in situ* measurements using SIMS. Since FGIs are likely to be condensates from a solar nebular gas, ^{26}Al–^{26}Mg mineral isochrons of them enable a more systematic comparison of $(^{26}Al/^{27}Al)_0$ between CAIs formed by condensation and by melt crystallization than has previously been achieved.

Experimental: Al−Mg isotopic compositions of minerals in FGIs were measured using a Cameca ims-1280HR SIMS instrument at Hokkaido University. An $^{16}O^-$ primary beam accelerated to 23 keV was employed in the experiment. We used both the peak-jumping mode and the multicollection mode, depending on the secondary ion intensities of Mg-isotopes from the minerals. The full analytical procedures are reported in [8, 10].

Results and Discussion: FGIs *HKE02* and *HKE03* from Efremovka, *HKV03* from Vigarano, and *TIL01* from TIL 07007 are fine-grained, spinel-rich inclusions. They have irregular shapes and complex multi-layered textures composed mainly of spinel, melilite, and diopside. The CAI *TIL02* from TIL 07007 is a compound object consisting of fine-grained, anorthite-pyroxene-rich core enclosed by fluffy Type A CAI-like melilite-rich mantle. The entire inclusion of *TIL02* is surrounded by Wark-Lovering rim [13]. We measured Al−Mg isotopic compositions of melilite and spinel in each FGI and defined ^{26}Al–^{26}Mg mineral isochrons. The obtained ^{26}Al–^{26}Mg mineral isochrons give $(^{26}Al/^{27}Al)_0$ of (5.19 ± 0.17) × 10^{-5} for *HKE02*, (5.00 ± 0.17) × 10^{-5} for *HKV03*, (4.53 ± 0.18) × 10^{-5} for *TIL02*, (4.43 ± 0.31) × 10^{-5} for *TIL01*, and (3.35 ± 0.21) × 10^{-5} for *HKE03*. The $(^{26}Al/^{27}Al)_0$ values for the FGIs *HKE02* and *HKV03* are essentially identical to the whole-rock CAI value of $(^{26}Al/^{27}Al)_0$ ~ 5.2 × 10^{-5} [15, 16], while those for the other three FGIs are clearly lower than the whole-rock CAI value. The observed significant variation in $(^{26}Al/^{27}Al)_0$ for the FGIs, from (5.19 ± 0.17) to (3.35 ± 0.21) × 10^{-5}, corresponds to a formation age spread of 0.44 ± 0.07 Myr. These variations are similar to, but slightly larger than those for igneous CAIs ranging from ~5.2 to ~4.2 × 10^{-5} [5, 7]. Our data imply that CAI condensation events continued for, at least, ~0.4 Myr at the very beginning of our Solar System, if ^{26}Al was distributed homogeneously in the forming region. Alternatively, the observed variation in $(^{26}Al/^{27}Al)_0$ would also raise a possibility of heterogeneous distributions of ^{26}Al in the forming region, corresponding to a range over, at least, $3.4 \times 10^{-5} < (^{26}Al/^{27}Al)_0 < 5.2 \times 10^{-5}$.

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