$^{26}$Al–$^{26}$Mg mineral isochrons of nebular condensates from the Efremovka CV3

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Ca-Al-rich inclusions (CAIs) in meteorites, the oldest objects formed in the Solar System [1], likely formed near the protosun [e.g. 2]. Many CAIs contained detectable 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) offer detailed distributions of initial $^{26}$Al/$^{27}$Al values, ($^{26}$Al/$^{27}$Al)$_0$, for individual CAIs [e.g. 4, 5]. In this study, we newly obtained $^{26}$Al–$^{26}$Mg mineral isochrons for two nebular condensates, a fine-grained spinel-rich inclusion and a fluffy Type A CAI, from the Efremovka CV3 by using SIMS.

The obtained $^{26}$Al–$^{26}$Mg mineral isochron of the fine-grained spinel-rich inclusion gives ($^{26}$Al/$^{27}$Al)$_0$ = (5.16 ± 0.22) × 10$^{-5}$. This is essentially identical to the canonical value determined by whole-rock $^{26}$Al–$^{26}$Mg isochron studies for CAIs [6, 7] as well as initial values for nebular condensates from literature [4]. On the other hand, the $^{26}$Al–$^{26}$Mg mineral isochron of reversely zoned melilite crystals in the fluffy Type A CAI gives ($^{26}$Al/$^{27}$Al)$_0$ = (4.39 ± 0.13) × 10$^{-5}$, which is significantly lower than the canonical value. Reversely zoned melilite crystals in a fluffy Type A CAI from the Vigarano CV3, V2-01, showed ($^{26}$Al/$^{27}$Al)$_0$ = (4.69 ± 0.13) × 10$^{-5}$, which is also slightly lower than the canonical value [5]. The initial $^{26}$Al/$^{27}$Al values for the observed nebular condensates range from (5.16 ± 0.22) to (4.39 ± 0.13) × 10$^{-5}$. This range corresponds to a formation age spread of 0.16 ± 0.05 Myr, similar to that for melted-CAIs of ~0.2 Myr inferred from $^{26}$Al–$^{26}$Mg mineral isochrons of individual melted-CAIs showing a range of ($^{26}$Al/$^{27}$Al)$_0$ from ~5.2 to ~4.2 × 10$^{-5}$ [4]. These data imply that nebular condensates formed contemporaneously with the melted-CAIs during ~0.2 Myr from the canonical age.