Al-Mg ISOTOPE SYSTEMATICS IN THE EFREMOVKA E60 CAI: EVIDENCE OF RE-EQUILIBRATION.

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Introduction: In recent years, the calcium-aluminum-rich inclusion (CAI) E60 from the Efremovka reduced CV3 chondrite has been used as an age anchor for the Al-Mg extinct chronometer ($t_{1/2}$ ~0.73 Ma) since an internal Al-Mg isochron corresponding to a ^{26}Al/^{27}Al ratio of $(4.63\pm0.44)\times10^{-5}$ has been determined for it [1] and a highly precise ^{207}Pb-^{206}Pb age of 4567.11±0.16 Ma has also been reported [2]. However, recent investigations have noted discrepancies between ^{207}Pb-^{206}Pb ages and ^{26}Al-^{26}Mg systematics in several meteoritic materials. For example, Al-Mg systematics in the angrites D'Orbigny and Sahara 99555 anchored to the E60 CAI yield ages that are ~2 Ma younger than the Pb-Pb ages for these achondrites ([3] and references therein). Therefore, with the goal of assessing the suitability of the E60 CAI as a time anchor for the ^{26}Al-^{26}Mg system, we initiated a high-precision laser ablation multicollector inductively coupled plasma mass spectrometer (LA-MC-ICPMS) study of internal ^{26}Al-^{26}Mg isotope systematics in this inclusion. We have previously presented some preliminary results from this investigation [4]. Here, we report the results of further analyses that demonstrate evidence for re-equilibration of the Al-Mg system in E60.

Analytical: A polished thick slice of the Efremovka E60 CAI was studied at UH using a Cameca SX-50 electron microprobe and a JEOL JSM-5900LV SEM equipped with a Thermo Electron energy dispersive spectrometer. Magnesium isotopes were measured with a Thermo-Finnigan Neptune MC-ICPMS instrument and a Photon Machines fast excimer laser ablation system (producing 193 nm wavelength and 4 ns pulse length) at ASU using methods similar to those described earlier [4].

Results and Discussion: Previously we reported analyses of a diopside-rich rim (1 spot), diopside in the interior (2 spots), melilites in the rim and in the interior (3 spots each), and anorthites in the rim (3 spots) of the E60 CAI [4]. Since anorthites in E60 are typically fine-grained and we used beam spots up to ~90 μm, we were unable to get clean analyses of this phase, and the highest ^{27}Al/^{24}Mg ratios reported in [4] were only up to ~16. The majority of these preliminary data defined a slope corresponding to a ^{26}Al/^{27}Al ratio of $(2.9\pm0.5)\times10^{-5}$ and an initial ^{26}Mg/^{24}Mg ratio of 0.23±0.09 ‰ (MSWD=0.9); the exceptions were the melilite rim analyses which fell above this isochron. We have now made additional analyses of interior diopside (2 spots), melilites in the rim and the interior (2 spots each) and anorthites in the rim (4 spots). We used beam spot sizes of ~30-40 μm, and were able to obtain ^{27}Al/^{24}Mg ratios up to ~90 for the anorthites. With the exception of the 3 previous melilite rim analyses, all the data taken together define an Al-Mg isochron with a slope corresponding to a ^{26}Al/^{27}Al ratio of $(3.20\pm0.35)\times10^{-5}$ and an initial ^{26}Mg/^{24}Mg ratio of 0.19±0.08 ‰ (MSWD=1.5). Assuming a canonical initial Solar System ^{26}Al/^{27}Al ~5×10^{-5}, these data indicate that the Al-Mg system in E60 was re-equilibrated ~0.5 Ma after the beginning of the Solar System.

References: [1] Amelin Y. et al. 2002. *Science* 297:1678-1683. [2] Amelin Y. et al. 2006. Abstract #1970, 37th LPSC. [3] Spivak-Birndorf L. et al. 2009. *GCA*, in press. [4] Wadhwa M. et al. 2009. Abstract #2495, 40th LPSC.