HIGH PRECISION MAGNESIUM-ISOTOPIC ANALYSIS USING MC-ICPMS: PRELIMINARY RESULTS FOR A CV CAI AND CHONDRULES FROM AN ORDINARY CHONDRITE.

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Introduction: A ^{26}Al-^{26}Mg decay system (half-life: 0.73 Myr) has been used for chronological discussions, e.g., relative age differences between CAIs and chondrules (e.g. [1]). High precision magnesium isotope measurements of the oldest known solids, calcium-aluminum-rich inclusions (CAIs), reveal that the initial ^{26}Al/^{27}Al ratio is 5.25 x 10^{-5} [2, 3]. However, based on the measurements of achondritic meteorites of known Pb-Pb ages, it is suggested that the initial ^{26}Al/^{27}Al ratio is 1.33 x 10^{-5} [4], significantly lower than that of CAIs. The discrepancy may imply heterogeneous distribution of ^{26}Al in the early solar system. To further verify the distribution of ^{26}Al in the early solar system, precise magnesium isotope measurements are required for various components in various types of meteorites. Among them, chondrules data are very few and limited only to carbonaceous chondrites [5,6]. Furthermore, difference in the ^{54}Cr stable isotope anomaly between ordinary and carbonaceous chondrites suggests different accretion regions of their parent bodies [7]. In order to better understand the distribution of ^{26}Al, we are developing a technique for high precision magnesium isotopic measurements using multi-collector inductively coupled plasma mass-spectrometry (MC-ICPMS). Here we report our preliminary results. We conducted for the first time Al-Mg measurements of ordinary chondrite chondrules and compared the ^{26}Al/^{27}Al initial ratio with those of other types of chondrules.

Sample and methods: We have studied one CAI from NWA3118 (CV3) and five chondrules from NWA7936 (L3.15). Their polished sections were prepared and chemical compositions of major mineral phases were determined with a JEOL JXA-8530F electron microprobe at the University of Tokyo. These components were picked up from their sections using a micro grinder and crushed in an agate mortar. Fragments of one CAI and five chondrules are dissolved in concentrated HNO_3 after that some steps dissolution have been done. Sample aliquots were passed through cation-exchange resin (Bio-Rad AG50W-12X, 200–400 mesh) for chemical separation of magnesium from other elements. Magnesium isotope measurements were performed with a Thermo Scientific Neptune plus MC-ICPMS at the University of Tokyo. The bracketing procedure has been done using the DSM-3, pure magnesium standard [8]. The JB-2 terrestrial standard was also measured. Other portion of sample dissolutions was used to determine ^{27}Al/^{24}Mg ratio with a Thermo Scientific iCAP Q ICPMS at the University of Tokyo.

Results and discussion: The CAI is classified into type B, which has fassaite and spinel rich core and melilite rich mantle. Five chondrules are classified into type IA (FeO-poor olivine, ol > 80%) and type IAB (FeO-poor olivine, ol < 80%, px < 80%). One of four chondrules shows porphyritic textures and the others show barred olivine textures. We separated pure Mg from each samples with higher than 90% yield. Shown below are our preliminary results at present. The μ^{26}Mg* value of the CV CAI is 927.2 ± 37.5 ppm (2sd) and ^{27}Al/^{24}Mg is 2.5 ± 0.2 (2sd). The model isochrons assuming the intercept of the μ^{26}Mg*$_0$ value to be -40 ppm [2] or -15.9 ppm [3], suggesting that the ^{26}Al/^{27}Al initial ratio is (5.31 ± 0.45) x 10^{-5} or (5.18 ± 0.40) x 10^{-5} respectively, consistent with the canonical value [2, 3]. The LL chondrules show the μ^{26}Mg* values of 3.2 ± 25.5 to -16.9 ± 24.4 (2sd) and ^{27}Al/^{24}Mg of 0.102 to 0.109 (nearly solar ^{27}Al/^{24}Mg ratios of 0.11) for 4 chondrules and 0.06 for one chondrule. So far we did not find ^{26}Mg excesses or deficits from DSM-3 and any correction between ^{27}Al/^{24}Mg ratios and μ^{26}Mg* values in LL chondrules. We are trying to improve precision of the analysis and will measure more chondrules with various ^{27}Al/^{24}Mg ratios to test the homogeneity of the initial ^{26}Al/^{27}Al ratio in the early solar system.

References: [1] Kita N. T. et al. (2013) *Meteoritics and Planetary Science*, **48**, 1383-1400. [2] Jacobsen B. et. al. (2008) *Earth and Planetary Science Letters*, **272**, 353-364. [3] Larsen K. K. et al. (2011) *The Astrophysical Journal Letters*, **735**, L37. [4] Schiller M. et al. (2015) *Earth and Planetary Science Letters*, **420**, 45-54. [5] Bizzarro M. et. al. (2004) *Nature*, **431**, 275-278. [6] Luu T.-H. et al. (2015) *Proceedings of the National Academy of Sciences*, **112**, 1298-1303. [7] Warren P. H. (2011) *Earth and Planetary Science Letters*, **311**, 93-100. [8] Galy A. et al. (2003) *Journal of Analytical Atomic Spectrometry*, **18**, 1352-1356.