EVOLUTION OF CHONDRULE MG ISOTOPE COMPOSITIONS DURING MULTIPLE HEATING EVENTS

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Introduction: Recent precise chronological studies of meteoritic materials report that chondrules formed 1-3 million years after calcium-aluminum rich inclusions (CAIs) formation [1] and/or simultaneously with CAIs formation [2]. Many chondrules are believed to have been heated multiple times during their formation [3]. The number of times a chondrule was heated, and the timeframe over which this happened provide important clues to the heating processes occurring in the protoplanetary disk. Magnesium isotopes are an important key to tracking this, because they are one of the major elements of major constituents (olivine and pyroxene) of chondrules, and contain a radiogenic component from the decay of the short-lived isotope ^{26}Al. If a chondrule was melted many times, aluminum-poor minerals (olivine and pyroxene) in the chondrule should contain higher ^{26}Mg/^{24}Mg ratio relative to those of chondrules heated fewer times, because heating will homogenize ^{26}Mg-excesses generated from high aluminum phases (plagioclase and mesostasis glass).

Multiple chondrule heating may provide a clue for the heterogeneity of oxygen isotopes of chondritic materials. Oxygen isotopes of chondrules in ordinary chondrites exhibit a smaller variation than those in carbonaceous chondrites [e.g. 4]. The oxygen isotope compositions of chondrules can be changed through isotope exchange between chondrule and surrounding nebular gas during chondrule melting [e.g. 5]. If Mg isotopes of aluminum-poor minerals of chondrules are different among chemical chondrite groups, there is a possibility that chondrule reheating processes were different in their separate regions in the protoplanetary disk, and this can be tied into the degree of homogenization of the oxygen isotopes.

Aim and method: To investigate the evolution of magnesium isotopes of chondrules during chondrule multiple heating, high precision magnesium isotope measurements of olivine and pyroxene of individual chondrules in primitive carbonaceous (CO3.0 Yamato-81020, CR2 NWA852, CR2 NWA1567) and ordinary chondrites (LL3.1 Bishunpur) have been performed. First, in order to determine final solidification time of chondrules, Mg isochrons of individual chondrules have been obtained using Secondary Ion Mass Spectrometry (SIMS) after petrological investigation. Following that, careful sample collections from olivine and pyroxene have been carried out using a micro-drill system. Finally, high precision Mg isotopes of olivine and pyroxene of individual chondrules have been obtained with Multi-Collector Inductively-Coupled Plasma Mass Spectrometry (MC-ICPMS). A total of 12 chondrules (3 from Y81020, 4 of NWA1567, 5 of NWA852) have been found to be suitable for SIMS studies because of their primitiveness, showing Al/Mg ratios of 20 to 80. The SIMS results will be presented at the meeting.

References: [1] Kita N. T. et al., 2005, *Chondrites and the Protoplanetary Disk*, ASP Conference Series 341, eds. Krot A. N., Scott E. R. and Reipurth B.. [2] Bizzarro M. et al., 2004, *Nature* 431, 275-278. [3] Nagahara H., 1981, *Nature* 292, 135-136. [4] Clayton R. N. et al., 1983, in *Chondrules and their origins*, Lunar and Planetary Institute, 37-43. [5] Yurimoto H. and Kuramoto K., 2004, *Science* 305, 1763-1766.