Al-Mg choronology of chondrules in the RBT04143 CV3 chondrite

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Al-Mg chronology of chondrules in primitive chondrites indicates most formed 1-3Ma after the oldest Ca-Al-rich inclusions (CAIs), regardless of chondrite types, Mg#, and $\Delta^{17}O$ ($=\delta^{17}O-0.52\times\delta^{18}O$) values, suggesting that distinct isotope reservoirs with different redox states existed contemporaneously [1-2]. However, formation ages of chondrules in CV3 chondrites are not well understood because of radiogenic ^{26}Mg loss by later disturbance [e.g. 3]. Here we report Al-Mg systematics of chondrules with diverse $\Delta^{17}O$ and Mg# from the Roberts Massif (RBT) 04143 $CV3_{red}$ chondrite, one of the most primitive CV chondrites [4].

Six chondrules (4 type-I, 1 type-II, and 1 plagioclase-rich) were selected for Al-Mg isotope analyses and are separated into two groups; one with Mg# > 96 and $\Delta^{17}O$ of ~ –5‰ and the rest with Mg# < 96 and $\Delta^{17}O$ of ~ –2‰ [5]. Al-Mg isotope analyses of plagioclase, olivine, and low-Ca pyroxene were performed with the WiscSIMS CAMECA IMS-1280 [2].

Three chondrules have resolvable ^{26}Mg excesses, with inferred initial $(^{26}Al/^{27}Al)_0$ ratios ranging from $(3.6\pm1.5)\times10^{-6}$, to $(5.7\pm1.4)\times10^{-6}$, while other three chondrules show little to no ^{26}Mg excess with upper limits of $(^{26}Al/^{27}Al)_0$ ratios < 5×10^{-6}. RBT 04143 is a breccia containing domains with different degrees of thermal metamorphism [4]. Chondrules without ^{26}Mg excess are located in the altered domains and show systematically lower olivine Mg# than enstatite and formation of nepheline, which are not observed in those with ^{26}Mg excesses that are located in the unaltered domains.

Assuming homogeneous distribution of ^{26}Al in the early solar system, the formation ages of the three unaltered chondrules are estimated at from 2.3 (–0.2/+0.3) to 2.7 (–0.4/+0.6) Ma relative to the time of canonical $(^{26}Al/^{27}Al)$ ratios of 5.25×10^{-5} [6], similar to those of chondrules in Kaba ($CV3_{oxB}$) [7] and most of other chondrites [1]. They include chondrules with dfferent Mg# and $\Delta^{17}O$ values, suggesting distinct isotope reservoirs existed contemporaneously.

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