A CHONDRULE FROM THE MOKOIA (CV3) CHONDRITE WITH ANOMALOUSLY LOW ^{26}Mg*: EVIDENCE FOR A MULTI-STAGE HISTORY.

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Introduction: Several studies have been carried out on the bulk Al-Mg system in chondrules [1–3] but no clear consensus has been reached on the timing of their formation with respect to CAIs. In previous work [4] we analyzed Mg isotopes and ^{27}Al/^{24}Mg in 21 chondrules from CV3 chondrites Allende, Mokoia and Vigarano. Over half of our chondrules show Al-Mg systematics consistent with separation from a reservoir when ^{26}Al/^{27}Al = 1.8 ± 0.2 ×10^{-5}, ~1 Myr after CAIs assuming homogenous distribution of ^{26}Al. The other chondrules have initial ^{26}Al/^{27}Al < 1.8 ×10^{-5} or unmeasurable amounts of ^{26}Mg*. However, one chondrule, which we describe here, was found with different isotope systematics from the others.

Experimental: Chondrules were physically separated from bulk samples of Allende (BM1969, 148), Mokoia (BM1910, 729) and Vigarano (BM1920, 347) and each was split into two fragments. One fragment was mounted in a polished resin block and characterized using the Zeiss EVO 15LS SEM and Cameca SX100 EMPA at the NHM. The other fragment was dissolved and Mg separated using column chemistry [5, 6]. Mg isotopes were measured using the Thermo Finnigan Neptune MC-ICP-MS at the University of Bristol. Samples were bracketed with the DSM-3 isotopic reference standard for Mg [7]. Al/Mg ratios were measured by quadrupole ICP-MS (Agilent 7700x) at the NHM.

Results: Mokoia (MOK13B) is a porphyritic olivine chondrule (~400 μm) dominated by $Fo_{100–96}$ with areas of intergrown anorthite laths and Al-rich, Ti-bearing clinopyroxene. It also contains several blocky spinel grains, 10–25 μm in size, which may be relict material or have crystallized within MOK13B. Future analyses of O-isotopes and trace elements can determine the provenance of spinel in this chondrule.

MOK13B has anomalously low μ^{26}Mg* (−15.4 ± 3) for its near-chondritic ^{27}Al/^{24}Mg (0.08). It plots in a "forbidden zone" of the Al-Mg isochron that cannot be explained by a simple single-stage history by decay of ^{26}Al from a reservoir with $\mu^{26}Mg^*_i \geq -38$. This implies a multi-stage history where MOK13B formed from a low-Al/Mg material that then underwent a chemical fractionation event to increase Al/Mg after decay of ^{26}Al. Alternatively, it may have formed in a region with anomalous $\mu^{26}Mg^*_i$ or $^{26}Al/^{27}Al_i$ compared to other chondrules or CAIs.

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