# Aluminium-26 systematics of CV3 chondrules: Evidence for a multi-stage thermal history

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Despite several studies of high precision Al-Mg systematics in chondrules, no clear consensus about the formation time of chondrules in relation to CAIs has emerged [1-3]. Following from previous work [1] we have analysed 21 chondrules from the CV3 metorites Allende, Mokoia and Vigarano for their Mg isotopes and $^{27}Al/^{24}Mg$ in order to characterise their initial $^{26}Al/^{27}Al$. Chondrules were physically separated from their host meteorite and divided into two portions, one of which was dissolved for Al-Mg isotopic analysis. Mg isotopes were measured using a Thermo Finnigan Neptune MC-ICP-MS; samples were bracketed with the DSM-3 isotopic reference standard for Mg [4]. The other portion was characterised by Zeiss EVO 15LS SEM. The chondrules exhibit a range of textural types and compositions.

A recent study of Allende chondrules [2] reported that most chondrule data fall on a simple isochron indicating they were separated from a nebular reservoir when $^{26}Al/^{27}Al = \sim 1.2 \times 10^{-5}$. In contrast, our data show a more complex story. Around half of the chondrules appear to have been separated from a nebular environment when $^{27}Al/^{26}Al = 1.8 \times 10^{-5}$. The others show variable initial $^{26}Al/^{27}Al$ ratios and some have unmeasureably low amounts of initial $^{26}Al/^{27}Al$. There is no clear trend with chemistry or degree of alteration, but all fully melted chondrules had lower initial $^{26}Al/^{27}Al$.

We conclude that many chondrules are likely to have experienced more than one stage of fractionation and melting in order to explain their Al-Mg systematics. Models of chondrule formation involving processing through more than one parent body may be required to achieve this.

[1] Claydon *et al* (2014) 77th Meteoritical Society meeting abs. 5164; [2] Luu *et al*, *PNAS 2015* [3] Bizzarro M. *et al* 2004. *Science*, **431**: 275-278 [4] Galy A. *et al* 2003. *J. Analytical Atomic Spectrometry*, **18**:1352-1356.