HIGH-PRECISION Al-Mg ISOTOPIC SYSTEMATICS IN USNM 3898 – THE BENCHMARK "ALL" FOR INITIAL $^{87}Sr/^{86}Sr$ IN THE EARLIEST SOLAR SYSTEM.

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Introduction: The lowest value for initial $^{87}Sr/^{86}Sr$ in any solar system material, known as ALL [1], is from an Allende compact Type A CAI labelled *USNM 3898* (sample D7 of [1]). [2] and [3] give detailed descriptions of this ~0.7 cm elliptical CAI, but the salient points here are (1) it contains melilite, spinel, fassaite, perovskite, hibonite, and rhönite; (2) there is only minor secondary alteration; and (3) melilite near the outer edge of the CAI is far more aluminous than that in the interior, Åk <10 in the mantle *vs.* Åk=10-45 in the interior. The Rb-Sr isotopic systematics of *USNM 3898* were later re-examined by [3], who also studied its Al-Mg isotopes *via* secondary ionization mass spectrometry (SIMS). The latter data gave a well-defined isochron with initial $^{26}Al/^{27}Al = (4.5 \pm 0.7) \times 10^{-5}$. Although just within error of the solar system initial value of $^{26}Al/^{27}Al = (5.23 \pm 0.13) \times 10^{-5}$ [4], the value obtained by [3] for *USNM 3898* is somewhat lower than many CV3 CAIs. The relatively large error arises from the older-generation ion probe (Cameca ims-3f) used for the analyses. Given the importance of this particular CAI to early solar system chronology, we re-analyzed its Al-Mg isotopic systematics using the IMS 1280 at the Univ. of Wisconsin.

Results: Figure 1 shows that our isotopic data for spinel, pyroxene, rhönite, hibonite, and just melilite having $^{27}Al/^{24}Mg$ <30 give a coherent isochron (upper line) with $^{26}Al/^{27}Al = (4.88 \pm 0.14) \times 10^{-5}$ and $\delta^{26}Mg^* = 0.068 \pm 0.073$ (MSWD = 2.3). However, the most aluminous melilites ($^{27}Al/^{24}Mg \sim 68$) in the outermost margin of the CAI plot distinctly below this isochron. Including these data with all other data (lower line) yields $^{26}Al/^{27}Al = (4.56 \pm 0.11) \times 10^{-5}$ and $\delta^{26}Mg^* = 0.068 \pm 0.073$ (also MSWD = 2.3). Fitting the outer melilites alone to an isochron forced through zero gives approximately the same value.

Discussion: Similar to data from [3], our data from the CAI interior give an isochron that is lower (marginally) than the solar system initial $^{26}Al/^{27}Al$ value [4], and the entire data set (including the outermost melilites) gives an isochron that is clearly resolved from the canonical value. The outermost melilites obviously record a later event than the interior of USNM 3898. There is very little secondary alteration in *USNM 3898* at all, and post-analysis imaging of the SIMS spots by SEM showed that that those outer melilite spots are uncontaminated. Thus we conclude that the isotopic signatures of these outer melilites record a later heating event that melted the outer margins of the CAI, evaporating substantial magnesium from the melt and giving rise to the aluminous mantle melilite.

References: [1] Gray C. M., Papanastassiou D. A. and Wasserburg G. J. (1973). *Icarus* 20: 213-239; [2] Teshima J. and Wasserburg G. J. (1985). *Lunar Planet. Sci. XVI*, 855-856. [3] Podosek F. A. *et al.* (1991) *Geochimica et Cosmochimica Acta* 55: 1083–1110; [4] Jacobsen B. *et al.* (2008). *Earth Planet. Sci. Lett*. 272, 353–364.

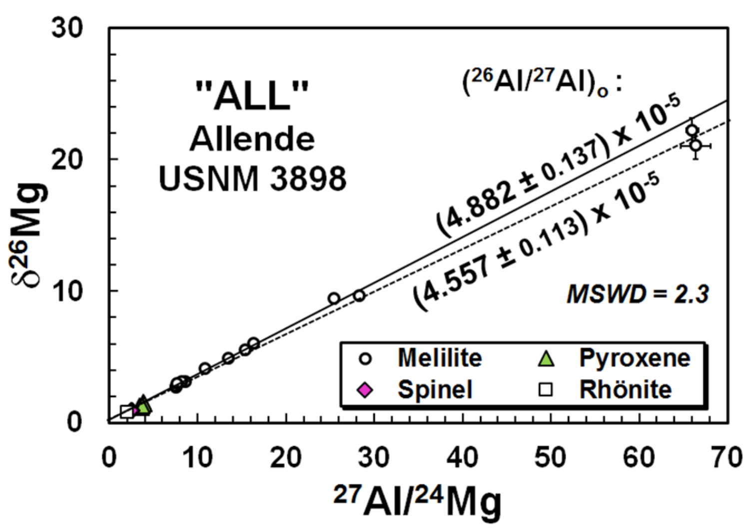

Figure 1. Al-Mg isotopic data for USNM 3898 (UW data only). Error bars are mostly smaller than data symbols.