

^{26}Al - ^{26}Mg AND ^{207}Pb - ^{206}Pb SYSTEMATICS IN AN ALLENDE INCLUSION.

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Introduction: The determination of high-resolution time-scales of early solar system processes relies on precise, accurate, and consistent dating with long- (i.e., ^{207}Pb - ^{206}Pb) and short-lived (e.g., ^{26}Al - ^{26}Mg , ^{53}Mn - ^{53}Cr) chronometers. In recent years, the precision of mass spectrometric analyses has improved dramatically, but inconsistencies remain between the different high-resolution chronometers [1]. Sources of these discrepancies may be analytical (e.g., sample preparation, mass spectrometric measurements) or due to sample characteristics (e.g., heterogeneities, closure temperatures of different isotope systems). In this study we have analyzed the Mg and Pb isotope compositions of a single inclusion from Allende to check for potential Pb isotopic fractionation during extensive acid-leaching procedures, and also to evaluate the concordance of the Al-Mg and Pb-Pb chronometers.

Analytical Methods: We made Pb and Mg isotope analyses by MC-ICPMS of acid-leached residues and their corresponding leachates, as well as of unleached fractions from a single ~1.5 g Allende inclusion which was initially characterized as a chondrule [2], but is in fact likely to be a molten CAI. For Pb and Mg analyses, the sample was split into 3 interior (~100-400 mg) and 1 rim fraction (~300 mg) and each was crushed and acid-washed using increasingly aggressive (3 to 7) leaching steps. The remaining residues (R_{1-4} ~80 mg each) were then fully dissolved. For Al-Mg work, 5 interior fractions and 1 rim fraction were hand-picked or magnetically separated and were not subjected to any leaching procedures. The isotope measurements were corrected for instrumental mass bias using Tl-doping (for Pb) and sample-standard bracketing (for Pb and Mg).

Results and Discussion: Blank corrected $^{206}\text{Pb}/^{204}\text{Pb}$ ratios range from 27 to 3,457 for the leachates, and from 807 to 1,534 for the residues. Analyses of the NBS 981 standard (2 ppb) resulted in a typical precision of $\pm 0.05\%$ and $\pm 0.3\%$ (2σ SE) on the $^{207}\text{Pb}/^{206}\text{Pb}$ and $^{206}\text{Pb}/^{204}\text{Pb}$ ratios, respectively. Pb-Pb model ages for each of the residues R_{1-3} and the most radiogenic leachate are all concordant; taken together, these yield an internal isochron age of 4567.59 ± 0.10 Ma (MSWD=0.18) for this inclusion. This age is ~0.5 My older than the Pb-Pb age for the Efremovka E60 CAI [3], but ~0.9 My younger than the best estimate of the CV3 CAI age [4]. Mg isotope ratios in the 6 unleached fractions range from +3.72 to +4.59‰ (2σ SE $\sim \pm 0.05\%$) for $\delta^{25}\text{Mg}$ (relative to the DSM3 standard) and radiogenic $\Delta^{26}\text{Mg}^*$ excesses range from +0.73 to +1.01‰ (2σ SE $\sim \pm 0.02\%$). These 6 unleached fractions, with $^{27}\text{Al}/^{24}\text{Mg}$ ratios ranging from 2.2 to 3.1, yield an initial $^{26}\text{Al}/^{27}\text{Al} = (4.5 \pm 1.1) \times 10^{-5}$ (indistinguishable from the value of $(4.1 \pm 1.6) \times 10^{-5}$ based on the 5 interior fractions). This corresponds to a Al-Mg age of 4567.1 ± 0.4 Ma relative to the E60 CAI [3], which is marginally concordant with the Pb-Pb age for this inclusion. If the D'Orbigny angrite is used as an anchor [5,6], it translates to an Al-Mg age of 4569.2 ± 0.3 Ma for this inclusion, which is discordant with its Pb-Pb age but agrees with the CV3 CAI age of [4].

[1] Wadhwa, M. et al. 2007. Workshop on Chron. Meteorites & Early Solar Syst., A#4053. [2] Bouvier, A. et al., 2008. GCA, 72, A#1981. [3] Amelin, Y. et al., 2002. Science, 297, 1678. [4] Bouvier, A. et al., 2007. GCA, 71, 1583. [5] Spivak-Birndorf, L. et al., 2008. GCA, subm.. [6] Amelin, Y., 2008. GCA, 72, 221.