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Petrology and Al-Mg isotopic composition of WA, the most important yet least known CAI

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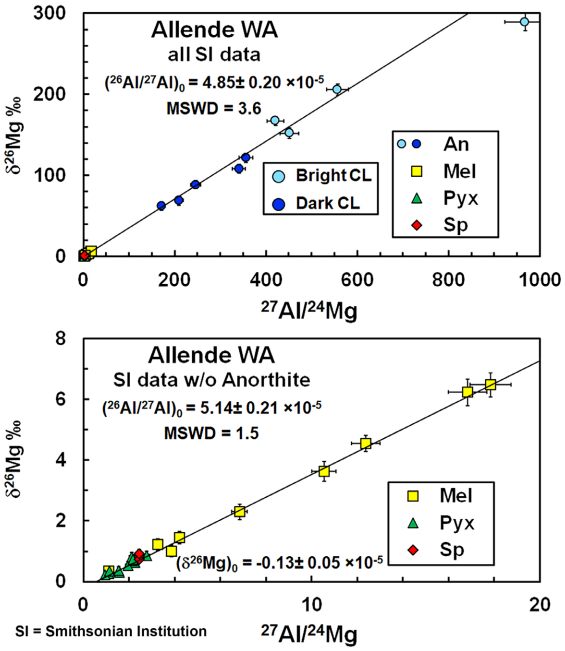

Lee et al. [1] first reported excess ^{26}Mg in mineral residues from BG2, an Allende calcium-aluminum-rich inclusion (CAI), possibly due to decay of extinct ^{26}Al, but no mineral isochron was established. Later work by the same group [2] did demonstrate a mineral isochron in a second Allende inclusion named WA. This showed *in situ* decay of ^{26}Al in the CAI and provided "definitive evidence for the present of ^{26}Al in the early solar system" [2] with initial $^{26}Al/^{27}Al = (5.1 \pm 0.6) \times 10^{-5}$. Despite WA being the discovery object for early solar system ^{26}Al, and unlike many individual CAIs that have become famous by name, WA remains virtually unknown. Remnants of WA now reside at the Smithsonian, and we initiated a high-precision Al-Mg isotopic study of it and a detailed petrologic study (never done before). WA is a ~1 cm-sized Type B1 inclusion, with a nearly-monomineralic mantle of aluminous melilite enclosing a core containing magnesium-rich melilite, Ti-Al-rich diopside, spinel and anorthite. Only minor – albeit complex – secondary alteration is present. Melilite is Åk $_{<2\ -75}$. Pyroxene contains 12-24 wt. % Al_2O_3 and 2-10 wt. % TiO_2 (as Ti^{4+}). Anorthite and spinel are near end-member $CaAl_2Si_2O_8$ and $MgAl_2O_4$ except that spinel at the CAI edge is enriched in FeO. Ion microprobe (SIMS) analyses of WA anorthite by the Caltech group [3, 4] showed that high $^{27}Al/^{24}Mg$ anorthite is disturbed. Our high precision SIMS data (Fig. 1) for phases other than anorthite yield a tight isochron with slope $^{26}Al/^{27}Al = (5.14\pm0.21)\times10^{-5}$ with MSWD = 1.5, identical to [2]. Similar to [3, 4], anorthite data is disturbed; including it gives $^{26}Al/^{27}Al = (4.85\pm0.20)\times10^{-5}$, MSWD = 3.6. Data for anorthite with dark cathodoluminescence ($^{27}Al/^{24}Mg < 400$) is less scattered than that with bright cathodoluminescence ($^{27}Al/^{24}Mg > 400$).

[1] Lee T., Papanastassiou D.A. and Wasserburg G.J. (1976) *Geophys. Res. Lett.* **3:** 109-112; [2] Lee T., Papanastassiou D.A. and Wasserburg G.J., (1977) *Ap. J.* **211:** L107-110; [3] Huneke J.C., Armstrong J.T. and Wasserburg G.J., (1983) *GCA,* **47:** 1635-1650; [4] Armstrong J. T. and Wasserburg G. J. (1983) *LPSC XIV*, 11–12 (abstract).