# Nucleosynthetic strontium isotope variability in allende CAIs

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Calcium and aluminum rich inclusions (CAIs) are thought to be the first condensates in the early solar system. Most CAIs show a variety of nucleosynthetic isotope anomalies for heavy elements. Brennecka et al. [1] reported that Sr, Mo, Ba, Nd and Sm isotope composition in CAIs were uniform, yet distinct from the solar system average compositions. However, most of previous studies analyzed "bulk" CAIs without detailed petrological description. Mineral assemblages of the CAIs are variable depending on the environment and/or the process of individual CAI formation. The difference of mineral assemblages can be observed even within a single CAI. Therefore, it is important to determine the isotope compositions of heavy elements not only for different types of CAIs, but also of multiple spots within a single CAI.

In this study, we performed *in-situ* measurements of $^{84}Sr/^{86}Sr$ ratios in two Allende CAIs using TIMS combined with a micro milling system, together with detailed petrological descriptions using SEM-EDS. Two specimens of the Allende meteorite were sliced into two respective slabs of which one sides were used for mineralogical analysis and the other sides were used for Sr isotope analysis. We selected two relatively large CAI grains; a cm-sized fluffy type A (FTA) inclusion and a fine-grained spinel-rich (FS) inclusion. Using the micro-milling system, we sampled 8 spots from the FTA inclusion and 3 spots from the FS inclusion for the analysis of $^{84}Sr/^{86}Sr$ ratios.

The mean $\mu^{84}Sr$ values ($10^6$ relative deviations from NIST 987) were 165 ppm and 60 ppm for samples from the FTA inclusion and from the FS inclusion, respectively. Notably, one spot from the FTA inclusion showed the greatest $\mu^{84}Sr$ value ($273 \pm 21$ ppm) compared to those of CAIs ever reported. Assuming that the FTA inclusion predates the FS inclusion, our results would imply that the extent of Sr isotope anomaly in the CAI-forming region was large and heterogeneous at the earlier stage, which subsequently shifted towards low and relatively homogeneous $\mu^{84}Sr$ values when FS inclusions formed. The isotopic shift was most likely caused by the effective mixing of nebular dusts including p- and/or r-process-enriched carriers (i.e., high $\mu^{84}Sr$) and isotopically normal grains.

[1] Brennecka et al. (2013) *PNAS*, **110**, 17241.