^{26}AL-DEPLETIONS IN ANOMALOUS AND SOLAR PLAC-LIKE CAIS SUGGEST HIGH DEGREES OF PROCESSING IN THE EARLY SOLAR NEBULA

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Introduction: Due to their large nucleosynthetic anomalies [1], platy hibonite crystals (PLACs) are thought to be among the oldest solids that formed in the solar system. Most of them lack evidence for incorporation of ^{26}Al, suggesting formation prior to injection and/or homogenization of ^{26}Al in the solar system [1].

Our combined study of O, Ca and Ti isotopes in a large number of PLACs and related CAIs (hereafter PLAC-like CAIs) revealed a correlation between Δ^{17}O, i.e., the mass-independent variation in O isotopes, and the range of large-scale anomalies in ^{48}Ca and ^{50}Ti (>100‰; [2]). Such a distribution is expected if the primordial (protosolar molecular cloud) dust was depleted in ^{16}O relative to the inferred solar value [2,3]. In addition, we can now use this relationship to distinguish between solar (solar O, δ^{48}Ca and δ^{50}Ti ≈ 0‰) and anomalous PLAC-like CAIs (^{16}O-depleted relative to solar, range of δ^{48}Ca and δ^{50}Ti).

We have studied the Al-Mg systematics in the same CAIs with the WiscSIMS Cameca IMS 1280 to investigate whether both solar and anomalous PLAC-like CAIs belong to the ^{26}Al-depleted population or whether these CAIs represent multiple generations with respect to their incorporation of ^{26}Al, in which case we would expect to find relationships between the degree of nucleosynthetic heterogeneity, O isotopes and ^{26}Al incorporation.

Results and discussion: Our results confirm that most solar and anomalous PLAC-like CAIs show no evidence for having formed in the presence of live ^{26}Al ($\delta^{26}Mg^{*}$ ≈ 0‰). Two CAIs of the anomalous population (δ^{48}Ca ≈ –20‰ and 80‰, δ^{50}Ti ≈ –20‰ and 60‰, respectively) have slightly enhanced $\delta^{26}Mg^{*}$ values, which could indicate ^{26}Al-incorporation at a ^{26}Al/^{27}Al ratio of ~$(1–1.5)\times10^{-5}$ or that the Mg isotopic heterogeneity in the early solar system was on the order of ~15‰.

Importantly, the results show that both isotopically anomalous and solar PLAC-like CAIs are depleted in ^{26}Al and that its abundance cannot be used for a relative chronology of PLAC-like CAIs. Both solar and anomalous PLAC-like CAIs likely formed in the earliest stages of solar system history, prior to arrival of this short-lived radionuclide. In particular, the presence of ^{26}Al-free PLAC-like CAIs with solar O, Ca and Ti suggests that highly homogenized reservoir(s) had been established prior to a widespread distribution of ^{26}Al.

References: [1] Ireland T. R. 1988. *Geochimica et Cosmochimica Acta* 54:3219–3237. [2] Kööp L. et al. (2014) *Meteoritcs & Planetary Science*, 49:#5384. [3] Krot A. N. et al. 2010. *The Astrophysical Journal* 713:1159–1166.