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Decoupled resetting of Pb-Pb and Al-Mg chronometers in CAIs: Implications for early Solar System chronology

HAOYU LI[1], YANKUN DI[1,2], YURI AMELIN[2,3], GERRIT BUDDE[4] AND FRANÇOIS L.H. TISSOT[1]

[1]California Institute of Technology
[2]Australian National University
[3]Guangzhou Institute of Geochemistry, CAS
[4]Brown University

The absolute Pb-Pb and relative Al-Mg chronometers have revealed significant age inconsistencies in the duration of calcium-aluminum-rich inclusions (CAIs) formation and the time between chondrule and achondrite formation when using CAIs as the age anchor [1]. The origin of these age discrepancies remains controversial, as it could either point to ^{26}Al heterogeneity, or to the fact that the dates do not faithfully reflect the formation time of the early Solar System (ESS) materials. For CAIs in particular, understanding the origin of these issues is hindered by the fact that U-corrected Pb-Pb ages are available for only 5 CAIs, with only 2 of them also having been dated by the Al-Mg chronometer.

To shed new light into this fundamental question of the ESS chronology, we investigated the Pb-Pb (U-corrected) and Al-Mg systematics of a set of 5 CAIs from Allende. Our results show that the U-corrected Pb-Pb ages of CAIs from CV_{ox} chondrite Allende are more variable than their counterparts from CV_{red} chondrite Efremovka [2] and are generally younger by an average of ~0.48 Ma, while an outlier, the most altered Allende CAI, is younger than Efremovka CAIs by ~1.2 Ma. In contrast, Al-Mg dates of these CAIs are close to the canonical value [3], corresponding to a ~0.2 Ma age interval, which implies that the Pb-Pb system is more readily reset than the Al-Mg system in altered Allende CAIs. The Al-Mg dates are likely to represent the time of the last melting event of the CAI, while the Pb-Pb date can be disturbed by alterations, such as occurred in the Allende parent body. The observed discordance in CAI dates derived from these two chronometers indicates that the resetting of Pb-Pb and Al-Mg systems can be decoupled in CAIs. Our findings call for an in-depth study of the comparative robustness of Pb-Pb and Al-Mg chronometers to post-formation resetting in CAIs. At the conference, we will discuss the implications of these findings on the ESS chronology.

[1] Amelin Y. et al. (2025) *NSR*, **12(9)**, nwaf281. [2] Connelly, J.N. et al. (2012) *Science* **338**, 651–655. [3] Jacobsen et al. (2008) *EPSL* **272**, 353-364.