## CAI size distributions in NCs and CCs.

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Introduction: Calcium- aluminum-rich inclusions (CAIs) were the first solids to form in the nebular disk and can act as tracers for early disk processing. It is hypothesized that, also at an early time, the disk was separated into two isotopically distinct reservoirs (e.g., Mo and Cr isotopes), the carbonaceous chondrite (CC) outer Solar System region and the non-carbonaceous chondrite (NC) inner Solar System region [1]. If proto-Jupiter formed by ~1 Ma, it would have created a pressure gap to keep the CC and NC reservoirs separated [2]. CAIs are found in both CC and NC materials, however they are much more common in CC material [3]. CAIs from CC materials are also more well-studied; over 12,000 CAIs have been found in systematic searches, while only ~350 NC CAIs have been found [e.g., 4]. Comparing the CAI modal abundance and sizes between NC and CC chondrites can inform us about disk dynamics in the early Solar System and can help to constrain the Jupiter gap model. Here, we focus on adding to the CAI populations and comparing their size distributions. We hypothesize that if the NC and CC CAI populations have similar size distributions, both populations were affected by similar disk processes.

Methods: To find CAIs, we used the Tescan Vega-3 XMU Scanning Electron Micropscope (SEM) at UCLA. We first x-ray mapped thin sections (Ordinary, Enstatite, Rumuruti and carbonaceous Renazzo (CR) chondrites) with <5 µm per pixel resolution, locating CAI candidates using the Al map or Mg-Ca-Al composite maps. Then we identified CAIs using an energy dispersive spectrometer (EDS) upon locating minerals such as spinel, hibonite, Al-Ti-diopside, anorthite, melilite, and perovskite. We used *ImageJ* to determine the size of all scanned meteorite sections and CAIs.

Results/Discussion: *CAIs found.* We systematically searched 76 NC sections and found 232 CAIs. Additionally, we searched one CR2 section (Acfer 395) and found 69 CAIs. The NC CAIs have an average apparent diameter of 46 µm (range from 4–382 µm) and a modal abundance of 0.009 area%. The CR2 CAIs have an average apparent diameter of 55 µm (range from 11–497 µm) and a modal abundance of 0.7 area%. These values are consistent with prior results [e.g., 3]. We directly compare our size distribution results to reported CV (Allende) and CM (Murchison) CAI size results [5]; 362 CV CAIs are 93 µm in average apparent diameter (30–1088 µm) and 325 CM CAIs are 36 µm in average apparent diameter (11–169 µm).

Comparing CAI size distributions. In Fig. A, we show the average apparent diameter (data points) and diameter range (shaded areas) for literature (black) and our study (blue) for (n) chondrites. We agree with [e.g., 3] that CV and CK have the largest CAI size average and range. CO, CM, ungrouped, CR, and CH CAIs have average sizes <100 µm and the largest CAIs are <600 µm. NC CAIs have a more limited size range and slightly smaller average CAI sizes ~50 µm. We also compare the shape of CAI size distrubtions by plotting cumulative sizes (Fig. B). The linear trend of the distrubutions (in log-log space) suggests that NC and CC CAIs have lognormal size distributions. The slope of
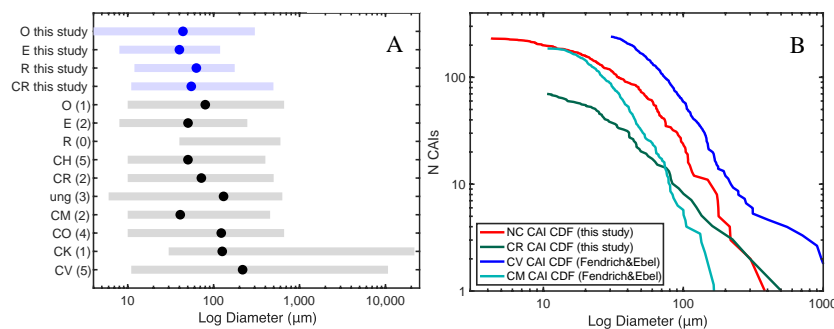
the linear trend indicates the power law exponent; we find the slopes to be between -1.5 to -1.9, except for the CR distribution which is shallower. In general, the NC and CC cumulative size shapes are rather similar. This evidence together suggests that, although the NC and CC average CAI sizes and CAI size ranges are distinct, a similar disk process allowed the formation of these CAIs, and the distribution did not change between CAI formation and accretion. The power law exponents imply that this process was coagulation and fragmentation in the hot, turbulent protoplanetary disk [6].

References: [1] Warren P. H. (2011) *Earth and Planetary Science Letters* 311:93-100. [2] Kruijer T. S. et al. (2017) *Proceedings of the National Academy of Sciences* 114:6712-6716. [3] Scott E. R. D. and Krot A. N. (2014) *Treatise on Geochemistry 2nd Edition* 1.2: 66-137. [4] MacPherson G. J. (2014) *Treatise on Geochemistry 2nd Edition* 1.3: 139-179. [5] Fendrich K. V. and Ebel D. S. (2021) *Meteoritics and Planetary Science* Nr 1:77-95. [6] Charnoz S. et al. (2015) *Icarus* 252:440-453.