MINOR OCCURRENCE OF CAIs IN CHONDRITIC METEORITES.
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Introduction: The abundance of Ca,Al-rich inclusions (CAIs) in chondritic meteorites (chondrites) is not simple to accurately measure, and is sometimes overestimated. Here we perform a simple calculation to show that there is a natural upper limit for the modal abundances of CAIs. We will show that CAIs can only be a minor component and their occurrence should therefore follow a Poisson distribution. We explore to what extent such a distribution introduces a bias when obtaining CAI modal abundances from thin sections.

Results: Chondrites have Al-concentrations of (wt%, in increasing order): EH: 0.82, EL: 1.00, CH: 1.05, H: 1.06, R: 1.06, CM: 1.13, CR: 1.15, L: 1.16, LL: 1.18, K: 1.30, CO: 1.40, CK: 1.47, CV: 1.68 [1]. The addition of CAIs to chondrites would increase their bulk Al-concentration. The slope of such an increase in a plot with the vol% of CAIs on the x- and Al in wt% of bulk chondrites on the y-axis depends on the abundances and densities of the accompanying components, especially on the amount of metal, as this has a distinct density from all other silicates and oxides. Assuming a mean CAI Al-concentration of 17.36 wt% [2] and a density of 3.1 g/cm³ for CAIs as well as for chondrules and matrix and a density of 8.0 g/cm³ for metal, the slope varies between 0.14 and 0.17 if 0 and 15 vol% metal, respectively, was present. That is, without metal, each single vol% of CAI added to a chondrite increases its Al-budget by 0.17 wt% and with 15 vol% metal present by 0.14 wt%. CV-chondrites contain the highest Al-concentration (1.68 wt%) among all chondrites. If all Al were contributed by CAIs, 12.0 vol% of CAIs were needed in case of 15 vol% metal was present and 9.9 vol% of CAIs were needed in case metal was absent. Reported metal abundances in CV-chondrites do not exceed 5 vol%. This means that if CAIs account for the entire Al budget, the CVs have 10.5 vol% of CAIs. It is clear that Al is not contained entirely within CAIs, however. A significant proportion of the Al budget resides in chondrules and matrix. CI chondrites, which have a composition similar to the Sun [3], contain 0.86 wt% Al [1]. A plausible approach may be to assume that the material that makes up the chondrite groups was initially CI-like, and CAIs were added into this region in such a way as to increase the total Al budget. In this case, in CV3 chondrites only 4.8 vol% of CAIs are sufficient to top up the missing Al.

A Poisson distribution has the characteristic that there might be a lot of CAIs in one place, but only few in another. It is therefore crucial to perform a proper statistical interpretation of obtained CAI modal abundances. We set up a computer model to apply this statistical treatment. Inputs are the modal abundance and size-distribution of CAIs and the studied area in mm². First results indicate that too small areas may introduce a large bias in obtained modal abundances.

Conclusions: The most Al-rich chondrite class are CV-chondrites, and we calculate that this class likely has a maximum CAI abundance of 4.8 vol%, and other chondrite classes will have less than this.