ELEMENT DISTRIBUTION IN ALLENDE DETERMINED BY LA-ICP-MS.

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Introduction: In this reconnaissance study on a Allende CV3 chondrite thick section, the distribution of 26 major and trace elements between chondritic components (matrix, chondrules, one CAI) was evaluated.

Methods: Femtosecond laser ablation ICP-MS was used as it offers reduced fractionation of volatile elements during sampling [1]. Ablation yields were corrected for by internal standardization to the sum of major element compounds. This procedure requires the accurate quantification of all major elements and thus a suitable reference material. To this end, CANS, a chondrite analog nanoparticle standard with major and minor element and Se and Te abundances similar to that of CI chondrites was produced by flame spray synthesis [2, 3] and its composition established by various analytical methods. Major and minor element and Se, Te abundances were then quantified using CANS, while additional trace elements were quantified by the combined use of CANS and NIST SRM 612. Data is presented as line scans using 80 µm spot sizes. Accuracy has been evaluated by repeated analyses of a powder tablet prepared from the Cold Bokkeveld CM2 chondrite.

Results and Discussion: Refractory lithophile trace elements like Nd, Sm, Zr and Hf track each other very well, suggesting that these elements can be well determined down to the 100 ng/g level (e.g. for Hf in the matrix). Compared to other lithophile elements, the Nb abundance was observed to be elevated in a chondrule sulfide rim.

Provided that representative line scan data is obtained, the method can be used to evaluate chondrule matrix complementarity [4,5] for a large number of elements. For example Fe/Mg, Si/Mg and Al/Ti tend to be lower in chondrules than in the matrix, while the bulk appears to be CI chondritic (as judged from a rather limited data set).

In regard to chronology, the distribution of many parent daughter elements can be evaluated by this method. Not surprisingly, much larger variations among the different components are observed for Rb/Sr and U/Pb, than for Sm/Nd and Y/Zr (as a proxy for Lu/Hf).

Except for the analyzed CAI and the chondrule with the sulfide rim, the volatile lithophile elements Rb and Na track each other, with both elements showing strong enrichments in chondrules and depletions in the matrix. This distribution is in sharp contrast to the distribution of chalcophile volatile elements that tend to be strongly depleted in chondrules and much less depleted in the matrix. This supports the observation that the correlation between moderately volatile element depletion and condensation temperature in bulk chondrite samples requires the correct mixture of matrix and chondrules [6].

Conclusions: A novel LA-ICP-MS method has been developed in order to evaluate elemental distributions of a large number of major and trace elements in chondritic meteorites. A reconnaissance study on a section from the Allende chondrite suggests that this method will offer further insight into chondrite genesis, for example in regard to elemental complementarity or volatile element depletion and redistribution.

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