THE DISTRIBUTION OF TRACE ELEMENTS BETWEEN KAMACITE AND TAENITE IN THE BREMERVÖRDE UNEQUILIBRATED CHONDRITE.

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Introduction: The metal is a common component in ordinary chondrites. Models proposed to explain its genesis, showed that it has a nebular origin [1] but its composition was fixed during parent body metamorphism [2]. The partitioning of trace elements among the different metal phases is sensitive to thermal events on parent asteroids. The chemical study of the Fe-Ni metal in unequilibrated chondrite allows us to evaluate the thermal history of these meteorites [3] as the unequilibrated chondrites are preserved from differentiation process. To shed some light on the thermal history of unequilibrated chondrite, we studied the distribution of minors and trace elements between kamacite and taenite in metal grains of the Bremervörde chondrite (type H/L3.9).

Methods: We analyzed trace and minor elements in adjacent grains of kamacite and taenite in the Bremervörde chondrite using NanoSIMS. Under a Cs+ primary ion beam of ~1nA and 16KeV, we performed the analysis of ^{56}Fe, ^{62}Ni, ^{59}Co, ^{65}Cu, ^{198}Pt, ^{161}Ir, ^{184}W and ^{197}Au in both phases. Our ion images were obtained by scanning 15x15µm^2 areas of 128x128 pixels. The mass resolution was set around 9000 (Cameca definition), which solves interference problems with pertinent molecules at the desired mass. To calibrate our data we used the standards NIST SRM 663, NIST SRM 661, synthetics 51.5%Ni and 30% Ni Fe-Ni metal alloy.

Results: We made thirty two measurements in kamacite and taenite of 16 metal grains. Fourteen of the measured grains are in the matrix. The correlation between the ions yields of Fe and of the other elements in the standards allowed us to calculate the abundance of these elements by knowing of concentration of Fe in the sample and current intensity [4]. Ion yields of all elements show good correlation whith ^{56}Fe ion yield. Disagreements exist with Hus et al. [4] for Pt and Au, for which the authors found weaker correlation.

Discussion: The abundances of minor and trace elements show large ranges of variations among the metal grains which is expected for unequilibrated chondrites [5, 6]. The calculated partition coefficients between kamacite and taenite $D_{k/t}(E)$ display preferential affinities of Cu, Pt, Ir, W and Au to taenite, and Co to kamacite. We found that the ionic size of the main oxidation state of the elements could affect the partition of the elements in the same way as in Krymka [6].

In plots of $([E]/[Ni])_k/([E]/[Ni])_t$, it is shown that the chemical equilibration among the two metal phases is reached at one single temperature. The temperature is calculated from the slope of the correlation between $([Co]/[Ni])_k$ and $([Co]/[Ni])_t$ and adopting the method of Wasson and al. [7]. It indicates that kamacite-taenite equilibration occurred during the thermal metamorphism of the Bremervörde parent body.

References:

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