MODERATELY VOLATILE ELEMENTS OF VARIOUSLY SHOCKED ORDINARY CHONDRITES.

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Introduction: Stable isotopes of moderately volatile elements (MVE) such as Cu and Zn are useful tools to investigate fractionation effects induced by condensation and evaporation. Ordinary chondrites (OC) may have experienced shock events on their parent bodies as they present multiple shock features, resulting in the loss of volatile elements and subsequent possible isotope fractionation of MVE. Those chondrites represent the most abundant group of meteorites with more than 85% of the total world collection. Yet they have been poorly studied for their stable isotope compositions. Results have been published but generally as part of broader studies (e.g. [1, 2]). Therefore, new stable isotopes data are required in order to reconcile literature data with the shock stage of OC and behavior of MVE isotopes. In the recent years, high precision isotope measurement of gallium, another MVE, has shown promising results regarding isotopic fractionation in volatility-controlled processes such as condensation and evaporation [3]. Gallium will be investigated together with Cu, Zn, and refractory Fe isotopes. These new measurements will be compared to previous studies in order to evaluate the possible shock effects on MVE isotopes in ordinary chondrites. In this study, H ordinary chondrites have been selected over the other subgroups (L and LL) because they exhibit the highest metallic iron content compared to the other ordinary chondrites [4]. The type-6 was preferred because of the high degree of thermal metamorphism they experienced; the homogenization induced would make it easier to highlight the isotope fractionation possibly generated during the shock event [5].

Samples and methods: A series of 15 H6 ordinary chondrites collected from Antarctica have been classified for their shock and weathering stages according to the classification established by [6] and [7], respectively. Chips of each sample weighing between 100 to 170 mg were gently crushed to powder in an agate mortar and dissolved using various mixtures of HNO_3-HF-HCl acids. A 5% aliquot of each sample solution was taken before purification chemistry for trace elements measurements. Elemental data were collected by ICP-MS using two different instruments at ULB and VUB, each time applying In as internal standard. The total reproducibility estimated based on USGS reference materials is better than 10% RSD. Isotopic analyses were performed using the Nu plasma II HR-MC-ICP-MS at ULB relying on an Apex-Q desolvating sample introduction system.

Results and Discussion: Out of the 15 H6 ordinary chondrites, we have classified based on shock stage 10 samples as S2, 2 samples S3, 1 sample S4, and 2 samples S5. As for weathering stage, 9 samples exhibited W1, 5 samples W2, and 1 sample W3. We report new bulk isotopic data for the MVE Zn, Cu, and the recently developed Ga as well as more refractory Fe in all H6 chondrites. Preliminary results show that the range of delta values for each isotope is negatively correlated with volatility, meaning that elements with lower 50% condensation temperature (Zn: 726 K, Ga: 968 K, Cu: 1037 K, and Fe: 1334 K [8]), appear to display larger degrees of isotope fractionation. We aim to link these variations to the observed shock degrees and weathering stages. The new data for Ga, together with Zn, Cu, and Fe values, will allow us to highlight possible shock-related effects caused during the impact events that were responsible for the ejection of the meteorites from their parent body/ies. Isotopic data in combination with trace element profiles could also help us to determine the role of weathering in fractionating those same isotope ratios, modifying and/or erasing the signal from the parent body/ies.

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