MODERATELY VOLATILE ELEMENT FRACTIONATION IN CHONDRITES CONSTRAINED BY ISOTOPE DILUTION AND CD AND ZN STABLE ISOTOPE DATA

Ninja Braukmüller[1,2], C. Funk[2], W. Abouchami[2,3], H.J. Pickard[4], M. Rehkämper[4], A. Bragagni[2,5], S. Galer[3], C. Münker[2], H. Becker[1] and F. Wombacher[2], [1]Institut für Geologische Wissenschaften, Freie Universität Berlin, Malteserstr. 74-100, 12249 Berlin, Germany, (n.braukmueller@fu-berlin.de), [2]Institut für Geologie und Mineralogie, Universität zu Köln, Zülpicher Str. 49b, 50674 Köln, Germany (fwombach@uni-koeln.de), [3]Max-Planck-Institut für Chemie, Hahn-Meitner-Weg 1, 55128 Mainz, Germany, [4]Department of Earth Science and Engineering, Imperial College London, Royal School of Mines, Prince Consort Rd, Kensington London, SW7 2AZ UK, [5]Dipartimento di Scienze della Terra, Università degli Studi di Firenze, via La Pira 4, 50121 Firenze, Italy.

Introduction: Volatile elements are depleted in chondrites relative to the bulk solar system composition as represented by CI-chondrites. To disentangle the processes that affected volatile element abundances in the protoplanetary disk and on parent bodies we present high-precision isotope dilution data for 11 volatile elements (S, Cu, Zn, Ga, Se, Ag, Cd, In, Sn, Te and Tl) and Cd and Zn stable isotope compositions for carbonaceous, ordinary, enstatite and Rumuruti chondrites.

Results and interpretation: For carbonaceous chondrites, our results confirm that volatile elements with 50% condensation temperatures (T_C) between 1040 and 800 K show a progressive depletion with decreasing T_C, while volatile elements with 800 K > T_C > 500 K are almost unfractionated. This "hockey-stick" depletion pattern [1] represents the primary volatile element signature of the carbonaceous chondrite reservoir in the protoplanetary disk.

Ordinary and Rumuruti chondrites show a similar pattern for volatile element depletion but only for elements with T_C between 1040 K and 700 K (Cu, Ga, Ag, Zn, Te, Sn). As observed for carbonaceous chondrites, the abundances of plateau volatile elements (Zn, Te, Sn) in ordinary and Rumuruti chondrites covary with the matrix abundance, suggesting that ordinary and Rumuruti chondrites also contain a primitive CI-like matrix component. In contrast to carbonaceous chondrites, S and Se are less depleted, indicating different physicochemical conditions in the formation region of ordinary and Rumuruti chondrites in the protoplanetary disk. The highly unsystematic behavior of the most volatile elements Cd, In and Tl along with Cd and Zn (only ordinary chondrites) stable isotope fractionation suggest secondary redistribution processes on the respective parent bodies due to open system thermal metamorphism.

Enstatite chondrites show no systematic volatile element abundance patterns with T_C. Notably, their depletion pattern reveals similarities with evaporation experiments using carbonaceous chondrite powder under reduced conditions [1]. However, the rather uniform depletion of Cd, In and Tl together with unfractionated Cd and Zn stable isotope compositions in type 3 and 4 enstatite chondrites argue against extensive parent body alteration.

References: [1] Braukmüller N., Wombacher F., Hezel D. C., Escoube R. and Münker C. (2018) *Geochimica et Cosmochimica Acta* 239:17–48.