A STUDY OF CU AND CR DURING IRON METEORITE CRYSTALLIZATION.

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Introduction: In contrast to many other trace elements, the Cu and Cr trends observed in most magmatic iron meteorite groups have not been explained by fractional crystallization. Here, we present the results of an experimental study that determined the solid metal/liquid metal partitioning behavior for these two elements. These experimental partitioning results were then used to model elemental trends produced during fractional crystallization and compared to the Cu and Cr iron meteorite trends.

Experiments and Results: Experiments were conducted at 1 atm in evacuated silica tubes in the Fe-Ni-S system, using techniques similar to previous work [1]. Run temperatures varied from 1050°C to 1450°C, to produce experiments that had solid metal coexisting with liquid metal over a range of liquid metal S concentrations (3 to 30 wt%). Major and minor elements were analyzed by electron microprobe at the Carnegie Institution of Washington. Trace elements were measured using laser ablation ICP-MS microanalysis at the University of Maryland.

Both Cu and Cr exhibit similar chalcophile (S-loving) solid metal/liquid metal partition coefficients (D), whose values decrease as the S content of the metallic liquid increases. The partitioning values of Cu and Cr are similar over the entire range of S contents examined, but the Cu and Cr trends observed within an iron meteorite group [2, 3, 4] are quite different. Thus, fractional crystallization alone cannot have created both the Cu and Cr trends in these magmatic irons; another process must be responsible for the trend of at least one of these elements.

Crystallization Modeling: The D(Cu) experimental data were parameterized using a linear fit and a fit based on the free FeS domains in the metallic liquid. A simple fractional crystallization model [5] was run using different initial bulk S contents and these two parameterizations for D(Cu). The linear fit for D(Cu) produced decreasing Cu crystallization trends consistent with those observed in magmatic iron meteorite groups. Different initial S contents produced different Cu crystallization trends.

However, modeling that used the D(Cu) fit based on FeS domains did not produce any results that matched the iron meteorite trends, demonstrating that the modeling is sensitive to the choice of the mathematical expression for D(Cu). Despite the sensitivity, our work shows that the Cu trends observed in some magmatic iron meteorite groups could be formed by fractional crystallization. Our modeling work did not produce any crystallization results consistent with the steeper Cr iron meteorite trends.

References: [1] Chabot N. L. et al. 2007. *Meteoritics & Planetary Science* 42:1735-1750. [2] Wasson J. T. 1999. *Geochimica et Cosmochimica Acta* 63: 2875-2889. [3] Wasson J. T. and Richardson J. W. 2001. *Geochimica et Cosmochimica Acta* 65: 951-970. [4] Wasson J. T. et al. 2007. *Geochimica et Cosmochimica Acta* 71: 760-781. [5] Chabot N. L. 2004. *Geochimica et Cosmochimica Acta* 68: 3607-3618. [6] Supported by NASA grant NNG06GI13G.