INFLUENCE OF CARBON AND SULFUR ON THE PARTITIONING OF TUNGSTEN BETWEEN SOLID AND LIQUID METAL. H. V. Lauer Jr.¹, J.H. Jones², and C.S. Schwandt³,¹Lockheed-Martin SMS&S, 2400 NASA Rd1, Houston, TX 77058 (howard.v.lauer1@jsc.nasa.gov); ²SN2 NASA/JSC, Houston, TX 77058 (john.h.jones1@jsc.nasa.gov), (craig.s.schwandt1@jsc.nasa.gov)

Introduction: Tungsten is an important element for constraining the conditions that prevailed in the terrestrial planets during core formation. Consequently, a large number of experiments have been performed to evaluate the effects of a number of intensive variables (T, P, fO₂, etc) on W partitioning between metal and silicate and between solid and liquid metal.

Normally when doing high-pressure experiments, graphite is often used as an encapsulating container material. This could complicate the interpretation of the results of these experiments. For example, influenced changes in the D_W with increasing pressure could be the result of C that has diffused into the starting material as the experiment has proceeded.

To give some insight into C-bearing experiments, we performed W partitioning experiments between solid metal and liquid metal in the Fe-Ni-C and Fe-N-S systems at 1-Bar [1]. Our results show that S and C have opposite effects on D_W. Consequently it would be of interest to perform a set of experiments looking at the partitioning of W in between solid metal and liquid metal in Fe-Ni-C-S systems.

Experimental and Analytical: Mixtures of Fe-, Ni-, and W- metal powders and C- and pyrite powder were pressed into pellets and placed into alumina crucibles and sealed in evacuated silica tubes using our standard techniques [2]. Charges were placed in 1-bar furnaces and run at temperature for 1-4 days. The charges were quenched, made into polished thin sections, and analyzed using a Cameca SX-100 electron microprobe.

In this set of experiments, we did analyze for C by employing the following method. We made a thin-section that contained three “standards”, magnesite, and two Fe-Ni metals: one with and one without carbon. Instead of coating our sections with carbon, the area around the section was covered with silver paint. A stripe of silver paint was then applied to the section connecting the edge of the specimen to the external silver paint. The magnesite was then used to calibrate the two standard metals for C. The first for C and the other was the C blank. This painting technique was then used on the unknown sections.

Results and Discussion: Figure 1 shows the results for a set of experiments on the Fe-Ni-C-S system where the S content in the samples is high and thus the carbon content doesn’t seem to affect the W distribution significantly.

![Figure 1](image.png)

Figure 1: Plot of lnD_W vs 10⁴/T(K) for Fe-Ni-W-C-S samples with 29 > S > 18.5 wt%. The carbon content in the sample is shown beside the data point.

Figure 2 shows the measured logarithmic dependence of the C distribution for the samples in our collection that has been analyzed to date.
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Figure 2: Figure 2 shows the distribution of carbon as a function of reciprocal temperature. The range of S content in the samples is given in the legend.

Figure 3 shows the results of experiments on the Fe-Ni-W-C-S metal system for charges that contain slightly less sulfur. It is obvious that for these samples the effect of the carbon on the W distribution between solid and liquid metal is large in comparison to those reported in Figure 1.

Figure 4: In D^W vs 10^4/T(K) for sample charges that have S content in the liquid between 7.5 and 9.5 wt%. The C content in each charge is shown in the figure.

Figure 5: ln D^W vs 10^4/T(K) for charges with 6.0 > S > 0.6 wt% and 3.35 > C > 1.10 wt%.

SUMMARY: Our results show that the carbon content in a Fe-Ni-W-C-S liquid metal / solid metal samples will influence the distribution of W between the solid and liquid metal.

Care must be utilized when doing sealed tube experiments. We found that graphite can communicate with the sample in such experiments by vapor transport. Thus a word to the wise; try to analyze for C in your experiments if there is a remote chance that it could get in them.