COMPOSITION OF SCHREIBERSITE IN IIG IRON METEORITES.

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Introduction: The six members of the IIG group are distinguished by having the highest known bulk P content of any iron meteorite group, with ~2 wt% P, and low Ni and S [1]. Large amounts of coarse schreibersite $(FeNi)_3P$ are also common in IIG irons. Due to these characteristics and the trace element concentrations of the IIG irons, it has been proposed that the IIG irons formed from a metallic core of an asteroid-sized body that separated into two distinct components due to experiencing liquid immiscibility in the Fe-Ni-S-P system [1]: a less dense S-rich liquid and a higher density P-rich liquid. The elevated P contents of the IIG irons are interpreted to result from being samples of the P-rich component. Additionally, it is proposed that the IIG irons are related to the more numerous IIAB irons, with the IIAB irons crystalizing from the metallic core prior to liquid immiscibility and possibly from the S-rich immiscible liquid. One prediction of this model is that the coarse schreibersites in IIG irons formed originally as a liquidus phase during crystallization. In this work, we test this prediction by pursuing two tasks: 1) Measuring the trace element compositions in the IIG iron Twannberg [2] in the metal and schreibersite phases. 2) Performing laboratory experiments that form schreibersite as a liquidus phase. By comparing the trace element compositions measured in the IIG iron and in the laboratory experiments, we seek to evaluate the origin of the IIG irons.

Measurements of IIG Twannberg Schreibersite and Metal: Twannberg is a IIG iron, which totals >20 kg with multiple masses and may have been part of a larger shower [2]. Twannberg exhibits a range of schreibersite crystals, from cm-sized to micron-sized. Several large, cm-sized skeletal schreibersites were easily identifiable in the thick section of Twannberg (#36467) provided by B.A. Hofmann for this study. Smaller schreibersites were also identified and analyzed but are not the focus of this project as they represent formation via exsolution rather than as a liquidus phase. A Hitachi TM 3000 desktop SEM with Bruker Q70+ EDS at APL was used to determine the abundances of Fe, Ni, and P in the metal and schreibersite phases in the prepared Twannberg specimen. Trace element concentrations were determined by LA ICP-MS (ThermoFinnigan Element2 with New Wave UP213) at the University of Maryland for 15 elements: Co, Ga, Ge, As, Mo, Ru, Rh, Pd, Sb, W, Re, Os, Ir, Pt, and Au.

Laboratory Experiments in the Liquid Metal-Schreibersite System: Experiments were conducted in a 1 atm vertical tube furnace using an evacuated and sealed silica tube method similar to the Fe-Ni-P experiments of [3]. Starting compositions were mixed from powders of Fe, Ni, and P. A total of 24 trace elements were added at ~100 ppm each and included: V, Cr, Mn, Co, Cu, Zn, Ga, Ge, As, Mo, Ru, Rh, Pd, Ag, Sn, Sb, W, Re, Os, Ir, Pt, Au, Pb, and Bi. Experiments were run at temperatures of 950–1100°C for durations of 3–6 days and produced run products that consisted of solid $(FeNi)_3P$ and quenched metallic liquid. Previous experiments in the Ni-free Fe-P system indicated that at 1100°C, equilibrium was achieved in <1 day in this system [4]. Starting compositions were varied from 10–40 wt% Ni, to produce products with a range of Ni contents that spanned those found in iron meteorites and to complement the previous Ni-free results. Major element abundances were determined by a Hitachi TM 3000 desktop SEM with Bruker Q70+ EDS and trace element concentrations were measured by LA ICP-MS, the same analytical approaches used for the Twannberg iron meteorite measurements.

Discussion: To compare the experimentally determined (schreibersite)/(liquid metal) values to (schreibersite)/(solid metal) values measured in Twannberg, (solid metal)/(liquid metal) partition coefficients from [5] were used along with the experimental liquid metal compositions of 10.5-12 wt% P. The Twannberg measurements show an element pattern largely consistent with that predicted from the previous Ni-free experiments, but with some notable offsets for a few elements, such as Ni and Au. Comparison to the Ni-bearing experiments will provide key insight into better interpreting the Twannberg measurements; measurements of the Ni-bearing experiments were recently completed, data processing is currently in progress, and the results will be presented at the meeting. Our initial work is supportive of the theory that the IIG irons formed with schreibersite as a liquidus phase, which is indicative of forming from a liquid highly enriched in P, such as would be produced from a metallic core that experienced liquid immiscibility in the Fe-Ni-S-P system.

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