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Primary Carrier Phase of High Siderophile Elements in Ordinary Chondrites: Insights from *In Situ* LA-ICP-TOF-MS Analysis

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The high siderophile elements (HSEs) comprise rhenium, gold, and the platinum group elements (PGEs: Os, Ir, Ru, Rh, Pt, and Pd). Most of the PGEs condensed from a cooling nebular gas as refractory metal nuggets at temperatures above ~1600 K [1]. These refractory metal nuggets have been identified within various chondritic components of carbonaceous (CC) chondrites, including chondrules, sulfides, and matrix, but they are mostly found in calcium-aluminum-rich inclusions (CAIs) [2]. In contrast, non-carbonaceous (NC) chondrites are almost entirely devoid of CAIs, which suggests that HSEs are hosted by different chondritic components. This PGE carrier could represent residues of high degrees of metal melting or high-temperature condensates. This study examines the distribution and concentration of HSEs in chondritic components of unequilibrated H chondrites found in Antarctica. We performed elemental mapping via Laser Ablation-Inductively Coupled Plasma-Time-Of-Flight-Mass Spectrometry (LA-ICP-TOF-MS) to identify the main carrier phases and subsequent spot analysis via Laser Ablation-Tandem ICP-MS (LA-ICP- MS/MS) to quantify the HSE concentrations.

LA-ICP-TOF-MS elemental mapping revealed that most PGEs in the analyzed regions are concentrated in small metal grains (<100 µm), primarily within the interchondrule matrix. Quantitative LA-spot analysis shows moderate variations in HSE concentrations, with taenite showing a greater enrichment (10×) than kamacite (6×) relative to CI composition. The distinct HSE pattern in these metals suggests that kamacite and taenite formed under conditions where Pd condensed in a solid solution with Fe-Ni [3]. Neither evaporation nor condensation effects alone can fully explain the determined HSE patterns of metal grains in H chondrites. In contrast, CAIs display an HSE pattern dominated by condensation effects, notably marked by Pd depletion. The differences in HSE patterns and concentration carriers between NC and CC chondrites may indicate extensive metal melting in the inner compared to the outer Solar System. However, whether this effect is primarily driven by nebular processes or parent body alteration remains unclear.

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