STANDARD ADDITION ANALYSIS OF RH AND AU IN IVB IRON METEORITES. J.J. Bellucci, R. D. Ash, W.F. McDonough, and R.J. Walker, Department of Geology, University of Maryland; College Park, MD 20742. (bellucci@umd.edu)

Introduction: The abundances of the Highly Siderophile Elements (HSE) Ru, Rh, Pd, Os, Ir, Pt, Re and Au can be used to constrain the conditions of formation of the iron meteorites including pre-accretionary nebular processes, accretion of the parent body, oxygen fugacity, and crystallization history of the parent melt. The combination of isotopic analyses (Pt-Re-Os) and high precision abundance analyses (e.g., isotope dilution analyses) of the HSE provide sensitive indicators that allow for critical testing of these processes as well as establishing co-genetic relationships of samples. In terms of condensation characteristics, most of the HSE are refractory, with Rh having a volatility comparable to Mg and Si, whereas Pd being slightly less refractory and Au being the most volatile. Both Rh and Au are mono-isotopic elements and thus, high-precision isotope dilution techniques cannot be used for their analyses. Here we use a standard addition analysis technique with ICP-MS for 10 IVB iron meteorites. This method yields ±6-8.5% (2 s.d.) precision results for Rh and Au determinations.

Methods: Samples were cut with a diamond-wafering blade using de-ionized water as a coolant. To avoid cross-contamination the blade was cleaned after each cut by cutting a piece of carborundum and by changing the cooling water. Each sample was then manually polished by a separate piece of carborundum. Primary solutions were created by dissolving ~50 mg of iron meteorite in 10 mL of ultra pure aqua regia and a drop of HF (to prevent precipitation). Complete dissolution was achieved by heating (~120ºC) these mixtures in sealed Teflon vials for 24 hours. These solutions were subsequently diluted with 90-100 mL of 18.2 M-Ω water and weighed to ensure the proper dilution factor. Analyses were conducted using a Thermo Finnigan Element2 ICP-MS at the University of Maryland.

The meteorites Hoba and Ternera were used to construct calibration curves for the ^{197}Au measurements, while Hoba and Cape of Good Hope were used for the ^{103}Rh measurements. The initial Au and Rh calibration solutions contained 2.5 mL of the primary dissolved meteorite solution, 2.5 mL ultra pure 2% HNO_3, and 0.25 mL 10 ppb Yb solution (drift monitor) in 2% HNO_3. Six standard addition Au solutions were created from a 100 ppt Au, Pd, Pt, Ir, Rh, Ru solution (created from a 100ppm certified stock solution) added at .05 mL, maintaining a constant volume, which resulted in a standard addition curve of 0 ppt-50 ppt in 10 ppt increments. Six standard addition Rh solutions were created with a 10 ppb solution of Au, Pd, Pt, Ir, Rh, which resulted in a standard addition curve of 0 ppb-5 ppb in increments of ~1 ppb. The samples solutions were created using 2.5 mL of the primary meteorite solution along with, 2.5 mL HNO_3, and 0.25 mL 10 ppb Yb.

Rhodium and Au concentrations in the standards were determined from a drift-corrected calibration curve. The concentrations of the samples were determined relative to the drift-corrected calibration curve. Concentrations determined for other HSE in these solutions compare well to the existing data by isotope dilution [4].

Results: Gold and Rh abundances are shown below in Table 1.

Table 1. Gold and Rh abundances in ppm for IVB irons.

IVB Irons	Au	2 st. dev.	Rh	2 st. dev.
Cape of Good Hope	0.0440	0.002	3.50	0.18
Hoba	0.0641	0.004	3.54	0.29
Iquique	0.0493	0.003	3.41	0.08
Santa Clara	0.0907	0.004	3.86	0.15
Skookum	0.105	0.005	3.76	0.23
Tawallah Valley	0.152	0.008	3.53	0.04
Ternera	0.130	0.005	3.96	0.25
Tlacotopec	0.0505	0.003	3.43	0.25
Warburton Range	0.111	0.005	3.75	0.08
Weaver Mountain	0.0950	0.004	3.61	0.15

Discussion: Precision for Au data is 6% RSD or better (2 s.d.) and for Rh is 8.5% RSD or better and compare favorably with that for neutron activation analysis [1,2] and Laser Ablation- ICP-MS [3]. Our Au data are on average 13% lower than reported in[1] and [3] and are irreconcilable with data determined by INAA [2]. Our standard addition Rh data do not correlate with those reported in [2, 3], with concentrations that are both higher and lower than previously reported. The regular, linear changes in concentration we observe for our Au and Rh data (Figures 1 and 2) are consistent with closed-system fractional crystallization. The linear trends for Rh and Au (Figure 2) illustrate the precision achieved through standard addition with relation to isotope dilution.

The chondrite normalized HSE patterns for IVB irons (Figure 1) are distinct among groups of iron meteorites. Addition of the Rh and Au data better define the HSE pattern for the more volatile HSE.

These data provide additional evidence for high-temperature, condensation-related fractionation of the more volatile HSE from the more refractory HSE, presumably in the nebular prior to planetesimal accretion.

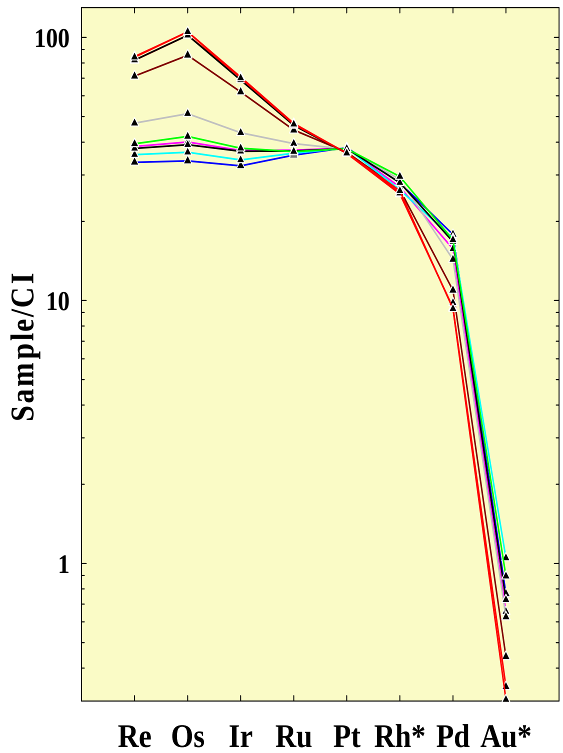

Figure 1. C1 chondrite normalized HSE patterns of IVB irons. Extreme depletion of Au likely reflects fractionation of Au from more refractory HSE via a nebular condensation process [3].

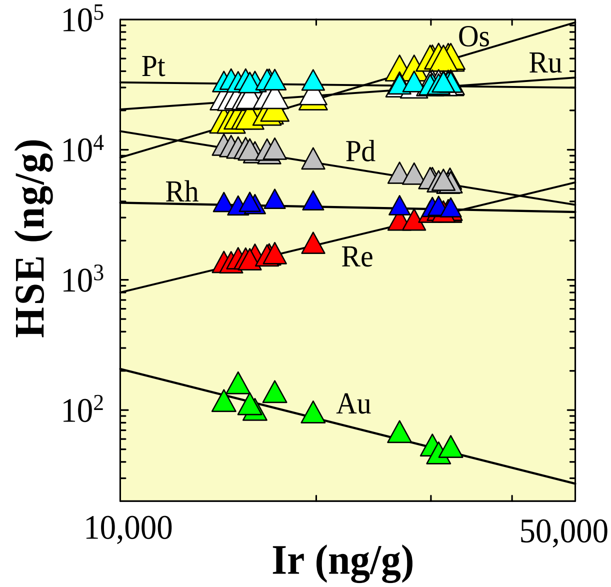

Figure 2. Logarithmic plot of Ir vs. other HSE. Concentration are in ng/g. All seven HSE are generally well correlated. Negative slopes for Pd and Au reflect the incompatibility of these elements during crystal-liquid fractionation.

References: [1]Rasmussen et. al. (1984) *GCA*, 48, 805-813. [2] Ryan et. al. (1990) *Chem Geol*, 85, 295-303. [3] Campbell & Humayun (2005) *GCA*, 69, 4733-4744. [4] Walker et. al (to be submitted) *GCA*.