RHENIUM AND OSMIUM ABUNDANCES AND OS-187/OS-186 RATIOS IN IIAB AND IIIAB IRON METEORITES. John W. Morgan[1], Richard J. Walker[2] and Jeffery N. Grossman[1], [1] U.S. Geological Survey, Reston, VA 22092, USA. [2]Department of Geology, University of Maryland, College Park MD 20742, USA.

Using resonance ionization mass spectrometry, Re and Os abundances were determined by isotope dilution (ID) and $^{187}Os/^{186}Os$ ratios measured in 11 samples of 9 group IIAB and 11 group IIIAB iron meteorites (Table 1). Chemical and intrumental techniques were described previously [1,2]. Results agree well with previous ID and neutron activation results [3-5] except for Casas Grandes (ref. 3 too high) and Charcas and Henbury (our results too low). Discrepant samples may have been thermally or mechanically abused [6], or mislabeled.

In the IIAB and IIIAB groups, Os and Re generally correlate inversely with Ni. In the IIAB group the log-log variation of Re and Os with Ni has seemed continuous [4]. More precise ID data, however, indicate a break in slope between IIA and IIB irons, with each sub-group best fit by separate straight lines. A similar break in slope occurs in group IIIAB at about 9.0% Ni, as previously noted [4]. The IIIB irons show an apparent positive correlation of Re and Os with Ni. In iron meteorites, abundances of refractory siderophile elements are highly correlated. Log Re–log Os variation In IIAB irons is best fit by separate straight lines for the IIA and IIB subgroups. The log-log variation in IIIAB irons appears linear, with the IIIB irons tightly clustered. Within the IIIB subgroup , Re abundances appear constant with Os variation, or slightly negatively correlated. The variation of $^{187}Re/^{186}Os$ with log Os abundance for IIAB irons shows a negative correlation in the IIA sub-group, but IIB meteorites are positively correlated. In group IIIAB, $^{187}Re/^{186}Os$ is negatively correlated with log Os abundance for irons with up to 9.0% Ni. The IIIB meteorites may also be co-linear, with Campbellsville (8.65% Ni) falling in with both the IIIA and IIIB trends. This meteorite may represent a pivotal change in conditions during the formation of IIIAB irons. The linear variation of log (Re, Os) with log Ni in the IIA sub-group and in IIIAB irons with <9.0% Ni) seems to result from fractional crystallization with constant partition coefficients, k's or more generally with constant $(k_E\text{-}1)/(k_{Ni}\text{-}1)$, where E = Re or Os. In the late stages of crystallization as represented by the IIB and IIIB sub-groups, partitioning of trace elements and Ni may be markedly influenced by formation of a new S-rich phase; either solid FeS or an immiscible sulfide melt [7]. In the presence of metal, partitioning of siderophile elements into sulfide is negligibly small. The slope of log E vs log Ni then becomes $(a \cdot k_R\text{-}1)/(a \cdot k_{Ni}\text{-}1)$, where a and $(1\text{-}a)$ are weight fractions of solid metal and sulfide, respectively. With k_{Ni} slightly less than 1 over a wide range of compositions, k_E in the range 2 to 12 (as for Ir), and a as small as 0.17 [8], the slope for log(Os,Re) vs. log Ni clearly may become close to zero, or even slightly positive.

Re and Os trends in IIIB irons with Ni >9.0% also may be explained by addition of primary melt with approximately chondritic Re/Os towards the end of core freezing [4]; but the almost constant Re and Os abundances observed are not specifically predicted. This mechanism has difficulty describing trends in IIB irons because late additions would need to be precisely titrated against Ni to produce linear log (Os,Re) vs log Ni.

Our isotopic results (Table 1) agree well with earlier data [3] with which they have been combined. Terrestrial studies show that a ^{187}Re decay constant of $1.59 \times 10^{-11} \cdot y^{-1}$ [9] gives acceptable age concordance with other isotope schemes [10,11]. Isochrons yield the following initial $^{187}Os/^{186}Os$ ratio, slope and age, respectively: IIAB, 0.800 ± 0.012, 0.0730 ± 0.0020, 4.43 ± 0.12 Ga; IIIAB, 0.801 ± 0.020, 0.0725 ± 0.0046, 4.40 ± 0.27 Ga; and pooled IIAB and IIIAB "best estimate," 0.801 ± 0.009, slope = 0.0726 ± 0.0016, age = 4.41 ± 0.09 Ga. These ages may not be separable from the 4.56 Ga age of chondrites because of uncertainty in the ^{187}Re decay constant, but seem consistent with inferred cooling rates [12]. Radiogenic ^{107}Ag data suggest that chondrites and irons are much closer in age, however [13]. There are now two different isotopic techniques that can be applied to iron meteorites. With improved isotopic techniques, the chronology and history of the iron meteorites may soon become much clearer.

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Table 1. Re and Os abundances and Os isotopic data in magmatic iron meteorite groups IIAB and IIIAB.

	Re ppb	Os ppb	$^{187}Os/^{186}Os$	$^{187}Re/^{186}Os$
IIB Central Missouri	1.476±.043	12.74±.011	1.165±.016	4.662±.144
IIB Sandia Mountains	9.072±.097	55.76±0.45	1.272±.018	6.558±.088
IIB Mount Joy	24.20±.22	134.1±1.2	1.311±.015	7.278±.094
IIA Lombard	166.9±1.5	789.7±7.1	1.450±.015	8.541±.111
IIA Tocopilla	229.9±2.3	1085.±10.	1.390±.017	8.550±.14
IIA Tocopilla	247.0±3.0	1090.±10.	1.452±.014	9.160±.15
IIA Filomena	217.9±2.2	1030.±8.2	1.439±.013	8.549±.111
IIA Filomena	217.9±2.1	1041.±12.	1.426±.014	8.459±.121
IIA Coahuila	1299.±12.	9813.±127.	1.200±.016	5.330±.091
IIA Bennett Co.	5077.±51.	57360.±570.	1.048±.010	3.555±.045
IIA Negrillos	5111.±56.	65270.±590.	1.044±.010	3.145±.045
IIIB Campbellsville	3.689±.060	17.08±0.17	1.437±.021	8.728±.170
IIIB Grant	3.015±.080	22.88±0.25	1.161±.021	5.279±.151
IIIB Tieraco Creek	3.393±.076	28.02±0.36	1.167±.021	4.935±.130
IIIB-An Treysa	83.41±.83	572.8±4.2	1.245±.019	5.867±.074
IIIA Tamaragul	38.13±.44	237.4±2.2	1.256±.012	6.472±.098
IIIA Charcas	140.6±2.2	1234.±18.	1.160±.017	4.583±.137
IIIA Trenton	192.4±1.7	1537.±9.	1.177±.012	5.040±.055
IIIA Henbury	274.2±3.6	2765.±30.	1.113±.015	3.987±.068
IIIA Loreto	405.0±4.0	3828.±40.	1.111±.011	4.256±.062
IIIA Casas Grandes	420.3±4.6	3630.±35.	1.131±.011	4.656±.070
IIIA Costilla Peak	1538.±13.0	18430.±180.	1.031±.009	3.351±.045