Rapid, precise and accurate Os isotope ratio measurements of nanogram to sub-nanogram amounts using multiple Faraday collectors and amplifiers equipped with 10^{12} Ω resistors by N-TIMS

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At present, the precise and accurate Os isotopic ratios are commonly determined as the OsO_3^- ion via peak-hopping electron multiplier (SEM) or static collection with Faraday cups and amplifiers equipped with 10^{11} Ω resistors, by negative thermal ionization mass spectrometry (N-TIMS) [1,2,3]. Here we present a new approach to obtain rapid and precise (0.1 % or better) Os isotopic compositions for small (ng to sub-ng) amounts of Os extracted from geological samples using static collection with Faraday cups and amplifiers equipped with 10^{12} Ω resistors, by N-TIMS/Triton Plus [4]. The results show that the measurement repeatability of Os isotopic ratios changes as a function of signal intensity that varied from 0.005 to 0.05 V (10^{11} Ω equivalent signal, i.e., 0.001 V is equivalent to ~62500 cps) for $^{192}OsO_3^-$. At $^{192}OsO_3^-$ ion beams greater than 0.02 V with 50 ratios measured over a 10 minute acquisition time, the repeatability of Os isotopic ratios is better than that obtained by conventional peak-hopping SEM at $^{192}OsO_3^-$ = ~200,000 cps with 500-100 ratios measured over a 30-60 minute acquisition time. At $^{192}OsO_3^-$ ion beams of ~0.04 V or above, the $^{187}Os/^{188}Os$ and $^{186}Os/^{188}Os$ data, for loads of 1 and 0.1 ng Os reference materials can be measured with a repeatability of < 0.1 % (2σ) and deviate by < 0.1 % from the accepted values. Similar results can be achieved for Os load sizes in geological samples as low as ~0.025 ng. At much higher $^{192}OsO_3^-$ ion beams (~0.5-1 V) with 300 ratios taken (total acquisition time circa one hour), the Faraday measurements of 1 to 3 ng Os loads of reference material solutions can generate high-precision $^{186}Os/^{188}Os$ data with a repeatability of 30-50 ppm and a mean intermediate precision of 10-30 ppm. While the smaller signal intensities used in concert with 10^{12} Ω amplifiers necessarily yield lower precision measurements than the best achievable with larger signals on 10^{11} Ω amplifiers, the repeatability we have achieved on reference materials can expand the application of the ^{190}Pt-^{186}Os decay system to geological samples containing significantly less Os than those normally measured on 10^{11} Ω amplifiers, if isotopic variations in excess of 50 ppm are present.

[1] Creaser R. A. *et al* (1991) *GCA* **55**, 397-401.[2] Volkening J. *et al* (1991) *JMS* **105**, 147-159.[3] Walczyk T. *et al* (1991) *JAC* 341, 537-541.[4] Liu and Pearson (2014) *Chemical Geology* **363**, 301-311.