Rapid, precise and accurate Os isotope ratio measurements of nanogram to sub-nanogram amounts using multiple Faraday collectors and amplifiers equipped with $10^{12}$ $\Omega$ 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 $10^{11}$ $\Omega$ 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 $10^{12}$ $\Omega$ 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 ($10^{11}$ $\Omega$ 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 % (2$\sigma$) 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 $10^{12}$ $\Omega$ amplifiers necessarily yield lower precision measurements than the best achievable with larger signals on $10^{11}$ $\Omega$ 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 $10^{11}$ $\Omega$ amplifiers, if isotopic variations in excess of 50 ppm are present.