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Community Available Osmium Reference Materials for Routine Isotopic Analysis

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The rhenium-osmium (Re-Os) isotope system has seen increasingly widespread adoption within the geoscience community, both as a geochronological tool and isotopic tracer for understanding extraterrestrial and terrestrial processes[1].

Analytical approaches for Re and Os have traditionally relied on either Isotope Dilution Thermal Ionization Mass Spectrometry (ID-TIMS) or a mix of ID-TIMS and Multi-Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS) for obtaining isotope measurements, with instrument performance monitored using Re and Os standard solutions. Rhenium standards are trivial to prepare, requiring dissolution of high purity Re metal in nitric acid, and hence tend to be developed in-house at each respective Re-Os laboratory. Osmium, being a noble metal, is much more challenging to prepare with any degree of gravimetric precision, and instead, requires the use of Os salts (e.g. ammonium hexacloroosmate - $(NH_4)_2OsCl_6$) dissolved in HCl, with the most recognized Os standard being the Durham Romil Osmium Solution (DROsS).

One issue plaguing DROsS, and most other Os salt standard solutions, is the non-stoichiometry of Os salt compounds (Os known to few percent), meaning they have limited applicability for calibrating Re-Os tracer solutions. A secondary issue with Os standard solutions is that their $^{187}Os/^{188}Os$ isotope composition is less radiogenic (e.g. $^{187}Os/^{188}Os$ = 0.106-0.160) than most studied crustal materials (e.g. $^{187}Os/^{188}Os$ = >0.13-40), meaning that instrumental non-linearity effects at high $^{187}Os/^{188}Os$ ratios may be underrepresented.

Here, we present several new Os standards prepared from $(NH_4)_2OsCl_6$ or a mixture of $(NH_4)_2OsCl_6$ and high purity ^{187}Os metal (>99%) that address these short comings. The Os standard prepared from pure $(NH_4)_2OsCl_6$ was thermogravimetrically calibrated using methods modified after Selby and Creaser (2001) and Markey et al. (2007) and was principally developed for calibrating Re-Os tracer solutions. The two solutions prepared from a mixture of $(NH_4)_2OsCl_6$ and ^{187}Os metal (>99%), however, serve as radiogenic Os standard solutions that can be used for routine Os isotopic analysis.

[1] Rooney, A.D., Hnatyshin, D., Toma, J., Saintilan, N.J., Millikin, A.E.G., Selby, D., & Creaser, R.A. (2024), *GSA Bulletin 136, 4091-4129.*

[2] Selby, D. & Creaser, R. A. (2001) *Economic Geology 96, 197-204.*

[3] Markey et al. (2007) *Chemical Geology 244, 74-87.*