

Exploration of Environmental Tungsten Stable Isotope Fractionation Using MC-ICP-MS

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Tungsten (W) is mobile in natural waters at high pH^[1] and the detection of W at six National Priority List sites resulted in W being classified as an emerging contaminant in 2012^[2]. Modern advances in the measurement of stable metal isotopes by MC-ICP-MS can be applied to contribute to the understanding of the fate and transport of W in the environment.

We have developed W chemical separation procedures and multi-dynamic MC-ICP-MS measurement techniques for the analysis of W isotope ratios ($^{182}\text{W}/^{183}\text{W}$, $^{184}\text{W}/^{183}\text{W}$, $^{186}\text{W}/^{183}\text{W}$). The NIST-3163 W standard was mixed with multiple matrices, purified, and analyzed to ensure that our chemical separations did not induce W isotope fractionation. Following technique verification, experiments were done to examine the behavior of W in solutions at pH 2, 6, and 8, in contact with clay media. Solutions of NIST-3163 were added to kaolinite (KGa-1b) and montmorillonite (SWy-2) clay standards. After shaking, the solutions were removed, filtered through 0.45 μm filters and analyzed. Mass dependent fractionation of NIST-3163 was measured in solutions after contact with the clays: $^{182}\text{W}/^{183}\text{W}$ ratios deviated positively relative to NIST-3163, while $^{184}\text{W}/^{183}\text{W}$ and $^{186}\text{W}/^{183}\text{W}$ ratios showed negative deviations. The magnitude of $\delta^{186}\text{W}$ deviation from NIST-3163 is on the order of -1%. Preliminary W isotope compositions from evaporative lakes in Nevada (high pH, high W concentrations) also suggest that mass dependent fractionation of W occurs in these settings, though more data and field control are needed to confirm these observations. Variations in pH and the formation of W oxides may fractionate W in environmental settings. We will discuss our plans for further environmental sampling to investigate W stable isotope signatures as well as ongoing work to examine W isotope variation in global ore deposits and ore concentrate materials.

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[1] Koustospyros *et al* 2006, *Journal of Hazardous Materials* **136**, 1-19 [2] EPA **505**-F-11-05, May 2012, Technical Fact Sheet – Tungsten.