# A MERCURY ISOTOPIC STANDARD

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## Introduction

Given their potential applications as a tracer for source and transport of Hg, and as an indicator in paleoclimatic studies, a technique to precisely and accurately measure Hg isotope ratios is highly in need. Moreover the method must be applicable to low concentration levels found in environmental samples (nanograms to tens of nanograms). For such low levels, multi-collector ICPMS appears to be best suited for mercury isotope analyses, however the method is known to induce a degree of mass bias that is likely comparable to or greater than the natural variations in mercury isotope ratios. Consequently, it is desirable to have an Hg isotope standard that can be used to correct for instrumental fractionation. None exists at present. We have found that high precision mercury isotope ratios can be made using sputtering ionization from a solid target without the significant mass bias inherent in ICPMS, albeit the sensitivity is greatly reduced, and thus large samples (tens of micrograms) are required.

## Experimental

Small grains of cinnabar (mercury sulfide) from the Almeden, Spain ore were mounted on carbon rods and analyzed with a multi-collector SIMS instrument (ISOLAB-54). Twelve analyses on 4 mineral grains were performed to determine Hg isotope ratios $^{198}Hg/^{202}Hg$, $^{199}Hg/^{202}Hg$, $^{200}Hg/^{202}Hg$, $^{201}Hg/^{202}Hg$, $^{204}Hg/^{202}Hg$ and $^{198}Hg/^{204}Hg$ (Table 1). Data for each analysis were calculated from measurements of 3 to 20 blocks, which are 30 to 200 measurements in total.

## Results and Discussion

Twelve analyses were conducted on 4 mineral grains to determine mercury isotope ratios $^{198}Hg/^{202}Hg$, $^{199}Hg/^{202}Hg$, $^{200}Hg/^{202}Hg$, $^{201}Hg/^{202}Hg$, $^{204}Hg/^{202}Hg$ and $^{198}Hg/^{204}Hg$ (Table 1). Data for each analysis were calculated from measurements of 3 to 20 blocks, which are 30 to 200 measurements in total. Internal precisions (2RSE) for all the ratios are less than 80ppm. Based on these 12 analyses, the external precisions (reproducibility; 2RSD based on 12 analyses on 4 grains from a same mine) are 0.1-0.8‰ for isotopic ratios $^{198}Hg/^{202}Hg$, $^{199}Hg/^{202}Hg$, $^{200}Hg/^{202}Hg$, $^{201}Hg/^{202}Hg$ and $^{204}Hg/^{202}Hg$. One-hour runs of continuous sputtering and data acquisition on some samples reveal no evidence of small scale isotopic heterogeneities in the mineral grains. While such precision approaches the best obtained by ICPMS, the SIMS results provide us with a much better estimate of the "true" isotopic composition of mercury. A solution of the cinnabar has been prepared for use as an ICMS isotopic standard for mercury to be available for other labs.