A NEW AND PRECISE DETERMINATION OF THE ISOTOPIC ABUNDANCES AND ATOMIC WEIGHT OF MERCURY

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Introduction

The isotopic composition of most elements can be determined with a high degree of precision by modern methods of isotope ratio mass spectrometry. The relative abundances of the seven stable isotopes of mercury have been somewhat problematic. There have been considerable differences in values obtained by different methods and different analysts on different materials. Attempts to make high precision measurements of mercury isotope ratios have been thwarted by the combination of a very high first ionization potential and high volatility of mercury salts that renders TIMS techniques useless as well as by mass-dependent fractionation effects in the production and handling of vapor phase samples.

Experimental

Our lab has been developing methods of high-precision, isotope ratio measurements of Hg using the ISOLAB-54 mass spectrometer. This is a SIMS instrument equipped with a Daly detection system and five Faraday cups. The primary ions are 18 Kev Ar^+. To determine the isotopic composition of natural mercury, seven samples of the mercury ore mineral cinnabar have been analyzed. Samples come from the U.S., China, and Spain.

Small grains or crystals of cinnabar, mounted onto spectrographically pure carbon rods, were the secondary ion source. Data were collected when stable ion currents of 10^{-11} amps or greater were achieved. Duplicate analyses were performed on all samples.

Results and Discussion

The relative abundances given in Table 1 are the means of the values determined on all samples.

Table 1: measured isotope abundances

isotope	measured relative atomic abundance (%)	relative atomic mass
196	0.1548	195.965815
198	9.9583	197.966752
199	16.862	198.968262
200	23.083	199.968309
201	13.177	200.970285
202	29.880	201.970626
204	6.8852	203.973476

The measured isotopic composition and the relative, physical atomic masses of the isotopes yield a calculated **atomic weight of 200.600**.

Conclusions

The measured range of 198Hg/204Hg ratios is 0.15 permil of the mean and significantly greater than the uncertainty of the measurement for individual samples. This range reflects real differences in the isotopic composition of different samples of cinnabar and is likely due to mass-dependent fractionation during petrogenesis. Extraction and refinement of mercury from its ore minerals can result in mercury reagents with atomic weights different from that reported here. Also mercury with different natural and anthropogenic histories can have different isotopic compositions. On going research will better define these differences.

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