

Measurement of mercury isotope ratios using multicollector ICP-MS

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Recent developments of multi-collector inductively coupled plasma mass spectrometry (MC-ICP/MS) have led to a resurgence in stable isotope geochemistry of heavy elements, where mercury is still one of the more uncommon elements to study. Mercury fractionation has been investigated in terrestrial samples and in meteorite materials. It is still in question, whether mercury from anthropogenic sources is isotopically different from geogenic mercury, which would make it possible to trace sources of mercury according to their isotopic fingerprint.

We report on a study comparing different cold vapor techniques to measure precise isotope ratios of mercury in NIST standard Hg samples (Hg in solution and elemental Hg) using MC-ICP/MS. Optimized acquisition parameters were employed to measure isotope ratios in cinnabar samples from different deposits world wide, and in sediment profiles of pristine Canadian lakes.

Variations in Hg isotope ratios of naturally occurring cinnabar ores were detected and values of $\delta^{198/202}\text{Hg}$ relative to NIST SRM 1641d Hg solution will be reported. The typical external uncertainty of the δ values was 0.06 to 0.26 ‰. Using a 10 ng ml⁻¹ Hg solution and a 10 min measurement time, introducing 60 ng of Hg, the precision of the isotope ratio determination was better than 20 ppm. Absolute Hg ratios deviated from representative IUPAC values by approximately 0.2% per amu. In the absence of a precisely certified Hg isotope ratio standard, unambiguous determination of absolute Hg ratios was not possible, highlighting the urgent need for such standard materials

Analysis of chemical species of airborne particles collected at roadsides with heavy traffic

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Chemical species of elements which are comprised in airborne particles represent their origin, such as exhaust from internal combustion engines, abrasion of pavement and so on. Understanding the chemical species of elements in airborne particles has become useful information to assess the source of the particle and to elucidate behavior of the particle in the atmosphere. In this work, we have applied X-ray absorption fine structure (XAFS) spectroscopy to characterize the chemical species.

The sampling was carried out at heavy traffic roads (Route 246, Japan, etc.). Airborne particles were collected by four-staged Andersen air sampler equipped with a back-up filter. The chemical reagents such as oxide, nitrate, carbonate, sulfate and so on, the possible chemical species in airborne particles, were measured to compare with the airborne particle samples. In addition, tire samples and road paving materials were also measured. The XAFS measurement was performed using synchrotron radiation ring at BL-12C, Photon Factory, KEK, Japan.

From the iron XAFS spectra, the absorption edge of the particle collected from arterial road areas shifted towards lower energy at larger particle size. From comparison with reference materials, the chemical species of iron in airborne particles were ascribed to iron (II) silicate, iron (III) sulfate and iron (III) oxide. In addition, from the PLS calculation which was applied to quantify the chemical species of elements, it was observed that the relative abundance of iron (II) silicate increases and iron (III) sulfate decreases with an increase in a particle size. It suggests that the contribution of road paving materials becomes larger with increasing a particle size. It has been supposed that the zinc which was contained in arterial road area samples originated from tires. However, from the zinc XAFS spectra, the change of chemical species of zinc with a particle size was observed. It is considered that the source of particle containing zinc is different according to the particle size.