Fe and Zn isotopes in human body

T. OHNO[1], A. SHINOHARA[2], M. CHIBA[2] AND T. HIRATA[1]

[1]Department of Earth and Planetary Sciences Tokyo Institute of Technology, Tokyo, Japan. (tohno@geo.titech.ac,jp)
[2]Department of Epidemiology and Environmental Health, Juntendo University School of Medicine, Tokyo, Japan.

The study of natural isotopic variation for Fe and other metal elements has had a significant influence in many research fields such as biology, planetary, earth and environmental sciences.

In this study, precise isotopic ratios of $^{56}Fe/^{54}Fe$ and $^{68}Zn/^{66}Zn$ have been measured on human red blood cell (RBC) samples by means of multiple collector-inductively coupled plasma-mass spectrometry (MC-ICP-MS). The mass spectrometric interferences were successfully minimized by employing desolvating nebulizer system. The Fe and Zn were chemically separated and purified by ion chromatography to minimize the non-mass spectrometric interference. The RBC samples were collected from four males and one female. The $^{56}Fe/^{54}Fe$ isotopic ratios for all RBC samples show significantly lower (1.3-1.6‰ per mass unit) than the value for reference material IRMM-014. Although there were no significant variation in Fe isotopic ratios for four male samples, Fe isotopic ratio for female RBC sample shows 0.3‰ per mass unit higher than the mean value of the male RBC samples. The $^{68}Zn/^{66}Zn$ isotopic ratio for human RBC samples were 0.2‰ per mass unit heavier than those for JMC Zn reference material. These results are consistent with previously published data (Maréchal et al., 1999; Walczyk and Blanckenburg, 2002; Stenberg et al., 2003). In order to test the possible seasonal change in Fe and Zn isotopic ratios, blood samples were collected from a human body every month over a year. The Fe and Zn isotopic data reveal that no significant seasonal variation could be found on Fe and Zn in human RBC samples. Our results imply the difference in mechanism and/or efficiency of absorption and metabolism between the metallic elements in the human body. The isotopic ratio data for Fe and Zn can provide the new information about the usage and metabolism of the metallic elements in human body.

References

Maréchal C.L., Telouk P. and Albarède F. (1999), *Chem. Geol.* **156**, 251-273.

Walczyk T. and von Blanckenburg F. (2002), *Science* **295**, 2065-2066.

Stenberg A., Malinovsky D., Rodushkin I., Andrén H., Pontér C., Öhlander B. and Baxter D.C., (2003), *J. Anal. At. Spectrom.* **18**, 23-28.

Accumulation of Co by *Saccharomyces cerevisiae*

T. OHNUKI[1], N. KOZAI[2], T. OZAKI[1], T. YOSHIDA[1], A. J. FRANCIS[3], H. IEFUJI[4] AND T. SAKAI[5]

[1]Advanced Science Reseach Center, Japan Atomic Energy Research Institute, Ibaraki 319-1195, Japan, (tozaki@popsvr.tokai.jaeri.go.jp)
[2]Department of Environmental Science, Japan Atomic Energy Research Institute, Ibaraki 319-1195, Japan, (kozai@nucef.tokai.jaeri.go.jp)
[3]Environmental Sciences Department, Brookhaven National Laboratory, Upton, New York 11973, USA, (ajfrancis@bnl.gov)
[4]Environmental Research Division, National Research Institute of Brewing, Hiroshima 739-0046, Japan (iefuji@nrib.go.jp)
[5]Advanced Radiation Technology Center, Japan Atomic Energy Research Institute, Gunma 370-1292, Japan, (tsakai@takafisv.taka.jaeri.go.jp)

We examined the accumulation of a hazardous element of Co by yeast (*Saccharomyces cerevisiae)* cells and its effects on other elements. The yeast was cultured in nutrient media containing Co of 0.1, 0.5, and 1.0 mM. Effects of Co on growth of the yeast in a nutrient medium were determined by measuring the optical density at 600 nm (OD_{600}). Amount of accumulated Co, Fe, P, K and Zn, and chemical form of Co were determined by the micro-particle induced X-ray emission (μ-PIXE) and by X-ray absorption fine structure (XAFS). In μ-PIXE analysis peak intensity of element was normalyzed to that of S.

Presence of Co slowed the growth. Micro-PIXE analysis showed that the intensity of Co peaks in the PIXE spectrum increased with an increase of OD_{600}, and with an increase in Co concentration. The intensity of Fe peak in the yeast samples cultured in the nutrients containing Co of 0.5 and 1 mM was higher than that of the control samples, while the intensities of P and Zn were the same as those of the control samples. The intensity of K peak was kept at approximately 0.2-fold of the control samples up to 0.3 OD_{600}, then increased with an increase of OD_{600} to be attained the same intensity of the control samples. XAFS spectrum of the accumulated Co in the yeast indicated that distance and coordination numbers of the nearest neighbor oxygen was the same as $Co(NO_3)_2$, and the second neighbor atom was detected suggesting complexation of Co with the functional group of the yeast

These results indicate that Co association with yeast is accompanied with the increase of Fe uptake and the decrease of K uptake. It is concluded that interaction of hazardous element with microorganisms affests the migration behavior of not only hazardous element itself, but also those of essential ions of microorganisms in the environment.