Metal stable isotopes for sediment core GC-99 from Lake Baikal

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Metal stable isotopes, e.g., Fe, Zn, Mo, and Cd, have been analyzed for the authigenic portion of a sediment core, GC-99, of Lake Baikal, Russia, in order to study the sources and sinks for these trace metals in the Lake Baikal, the largest fresh water lake in the world, as well as potential proxy for the past climate changes in this region. Lake Baikal is located in the southern region of the Siberia of Russia, and was formed through rifting. It has very thick sediments, and is relatively undisturbed due to its high latitude and isolation, and hence may provide a complete record of the local geological history [1]. In this study, a ~ 3 meters gravity core (GC-99; 52°05'23"N, 105°15'24"E) sampled near the bore hole of BDP-99 in Lake Baikal is used. Samples are taken continuously every cm interval for the entire core. For the initial test, one sample is selected for every 10 cm interval continuously throughtout the entire core. In order to extract the authigenic portions, a series of leaching procedures were used to remove the carbonates, and to collect the authigenic fractions, while leaving the lithogenic sediments unaffected. Double spike technique is used for all four metal stable isotopic measurements in this study.

Initial results showed that there are significant isotopic variations for all four isotope systems, and in general, the data are plotted away from the bulk silicate Earth (BSE). For Fe isotope, the $\delta^{56}Fe/^{54}Fe$ varies from the BSE at 0 to -2, while most of the sample centering around -1. For Zn isotope, the $\delta^{66}Zn/^{64}Zn$ is noticeably lighter than the BES, varying from -0.6 to 0 in the top 50 cm. In contrast, the $\varepsilon^{114}Cd/^{110}Cd$ varies from the BSE at +2 to +6 in the top 50 cm, and the observed +6 $\varepsilon^{114}Cd/^{110}Cd$ is most likely the results of bio-activity, e.g., diatom. For the top 50 cm, if the top surface sample is discarded, there seems to be a general positive correlation among the Fe, Zn, and Cd data, and if these correlations are real, they probably reflect a mixing relationship between the dissolved portions from the sources and the isotopic signature that had experienced the uptake of bio-activity. More data, for the extire sediment core and other biological indicators and mineralogical compositions, are needed in order to test if this is correct. Unlike the other metals, Mo data are more of an indicator for the sediment source and/or redox condition of the lake. Preliminary data for the top 50 cm also show observable variations. Although preliminary, the results seem to indicate evidence of source variations and biological activities in the sediment core of Lake Baikal. More data and, in particular, the chronology of the sediment core are needed in order to better constrain the relationship between the Lake Baikal and regional climate changes in the past.

[1] Kuzmin M.I. and Yarmolyuk V.V. (2006) *Geol. Geophy*. **47**, 5-23.

Distribution of lead and lead isotopes in the Indian Ocean: data from the Japanese Indian Ocean GEOTRACES transect

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Anthropogenic Pb inputs have altered distributions of Pb and Pb isotopes in the modern ocean, but the impact of anthropogenic Pb inputs to the Indian Ocean has been unknown due to the lack of data. Here we discuss the distribution of Pb from 11 deep stations from the Japanese Indian Ocean GEOTRACES cruise (2009 Nov-Dec), from the Bay of Bengal and Arabian Sea to the Antarctic (18degN to 65degS). We will also show the Pb isotopic composition ($^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$) of these waters for the first time.

Because of the later industrialization and a delayed phase out of the leaded gasoline in the African and South Asian countries (and limited convection in the north), Pb concentrations in the surface waters of the Indian Ocean are higher (40-80 pmol/kg) than in the present-day North Atlantic and North Pacific (20-30 pmol/kg). The anthropogenic Pb has not penetrated deeply in the Indian Ocean yet; high Pb is confined to the upper 2000m and deep waters have low Pb (<10 pmol/kg, and as low as ~3 pmol/kg at some stations). Pb at the surface has low isotopic ratios ($^{206}Pb/^{207}Pb$ ranging 1.141-1.151 and $^{208}Pb/^{207}Pb$ ranging 2.417-2.429), and the ratios generally increase with depth due to the mixing with Pb of higher isotopic ratios in deep waters. The low isotopic ratios of the surface Pb reflect the anthropogenic origin of the Pb in the Indian Ocean: they fall onto the range of Pb isotopic ratios found in the aerosols collected from the major cities around the Indian Ocean [1]. The Pb isotopic ratios are lower in the northern stations (>20degS) than in the southern stations due to their proximity to anthropogenic Pb sources. The southernmost station (65degS) appears to be least affected by anthropogenic Pb inputs given the low Pb concentrations (4-9 pmol/kg) and distinctively high Pb isotopic ratios ($^{206}Pb/^{207}Pb$ =1.17-1.19; $^{208}Pb/^{207}Pb$ =2.44-2.46).

[1] Bollhöfer and Rosman (2000) *GCA* **64**, 3251-3262.