Speciation and isotopic signatures of Hg in the Lake Baikal – Angara River food-web

V.N. EPOV[1]*, M.V. PASTUKHOV[2], V. PERROT[1],
E. TESSIER[1], V.I. GREBENSHCHIKOVA[2], J. SONKE[3],
D. AMOUROUX[1] AND O.F.X. DONARD[1]

[1]LCABIE, IPREM, UPPA-CNRS-5254, Pau, 64053, France
(*correspondence: vladimir.epov@univ-pau.fr)
[2]Institute of Geochemistry SB RAS, Irkutsk, 664033, Russia
[3]LMTG, CNRS-UMR-5563, Toulouse, 31400, France

Toxicity of Hg is well known. Once Hg(II) enters the ecosystem, it is converted to the toxic MeHg by bacteria, then accumulates throughout the aquatic food-chain. Fish tend to concentrate mercury by a factor of 10^5-10^7 compared to Hg water content, which can lead to dangerous levels in fish even in areas with tolerable aquatic Hg(II) concentration.

In this work we investigated Hg signatures in the Lake Baikal ecosystem. Different trophic levels were studied: plankton, herbivorous fish – roach (*Rutilus rutilus lacustris*) and carnivorous fish – perch (*Perca fluviatilis*). Different size and age fish-species were obtained from Lake Baikal (LB) and from Angara River (AR). LB samples were collected in a pristine area, while AR samples were collected in the anthropogenically Hg-contaminated Bratsk water-reservoir. The main source of anthropogenic Hg (Hg electrolysis plant) was closed in 1998.

Summary of the results are presented in the Table below. Total Hg concentration is presented for freeze-dried samples. Samples of the lower level in the food-chain shows lower concentrations of the total Hg. Same species from Hg-contaminated region (Bratsk) have 5-11 times higher concentration of Hg. The relative content of MeHg (%) in AR samples was found to be slightly lower. Isotopic composition of Hg was measured using Nu PlasmaHR. Mass-dependent (for ^{204}Hg, ^{202}Hg, ^{200}Hg, ^{198}Hg) and mass-independent (for ^{201}Hg, ^{199}Hg) fractionation is observed. This fractionation proves that the magnetic-isotope effect plays an important role in the environmental reactivity.

Food-web sample	**total Hg, µg kg^{-1}**	**MeHg, %**
Plankton (LB)	25 ± 7	12.4
Roach (LB)	204 – 479	91.6 – 97.9
Perch (LB)	427 – 1214	89.9 – 97.3
Plankton (AR)	55 ± 11	51.5
Roach (AR)	1034 – 5209	89.4 – 94.4
Perch (AR)	3197 – 11676	88.8 – 95.3

Table 1: Summary for total Hg and MeHg concentration in Lake Baikal – Angara River food-web samples.

The response of Cretaceous calcareous nannoplankton to $p\mathrm{CO}_2$ and ocean acidification

E. ERBA AND C. BOTTINI

Department of Earth Sciences, University of Milano, 20133 Milano, Italy (*correspondence: elisabetta.erba@unimi.it)

Recent environmental change and instability pose urgent questions regarding biota ability to keep pace with excess CO_2, increase in acidity and drop in pH of surface waters. Calcareous nannoplankton cannot efficiently calcify if the medium acidity passes a critical level, but laboratory studies are not conclusive as to assess crises, adaptations, evolutionary innovation and/or extinctions. The geological record indicates that ocean biota can adapt to higher acidity, but while the current decrease in pH is compressed in a very short period of time, past changes in oceanic acidity occurred over tens of thousands of years, giving time for life to adjust or even take advantage.

Within the oceanic biosphere, calcareous nannoplankton play a key-role as is abundant from coastal to open ocean settings, has a 220 My-long evolutionary history, is one of the most effective calcite producers of the planet, and is extremely sensitive to environmental variations. We explored cases of excess CO_2 derived from major volcanic episodes and marked by calcareous nannoplankton changes in evolutionary rates, species richness, abundance, and calcite production.

Available stratigraphy and cyclochronology allow high-resolution dating of biotic and environmental fluctuations, providing the precision necessary for understanding the role of $p\mathrm{CO}_2$ and ocean acidification on nannoplankton biocalcification and evolution. Selected case histories are the Aptian and the latest Cenomanian, corresponding to the onset and climax of the mid-Cretaceous SuperGreenhouse, respectively. During formation of the Ontong Java-Maniniki and Caribbean Plateaus, rapidly increasing $p\mathrm{CO}_2$ reached values as high as 2000 ppm, causing a calcification crisis and accelerated evolutionary rates. Maximum ocean acidification, was preceded by a 0.5-1 my–long period of biocalcification decline, dwarfism and production of “deformed-malformed” coccoliths. During the Aptian, the acidification climax lasted some 200 ky and is marked by short-lived abundance peaks of peculiar nannoliths, perhaps representing alkalinity recovery following $CaCO_3$ dissolution.

As far as evolution is concerned, rising $p\mathrm{CO}_2$ triggered false extinctions (Lazarus effect) among calcareous nannoplankton; conversely, a major origination episode perhaps represents a biocalcification strategy to overcome ocean acidification.