PCBs AND OCPs IN SOME MEDIA FROM LAKE HOVSGOL AND SURROUNDING AREA, MONGOLIA

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Abstract

The PCBs and OCPs levels were investigated in sediment and zooplankton from Lake Hovsgol and soil and air in the settlement of Khankh, Mongolia. Total PCB congeners in zooplankton, sediments, air and soil from the Hovsgol Region comes to 0.993 ng/g WW, 0.36 ng/g DW, 96 pg/m^3 and 7 ng/g DW, accordingly. It is possible that the presence of PCB in soil results from the using of PCB electrical equipment in past in the region. PCB congener pattern in zooplankton and sediment under the comparison with Lake Baikal indicate on atmospheric transport of PCB in the region at present. There is a possibility of modern entrance of some pesticides in the environment at present time. The additional studies of the distribution of POPs are needed for the region especially for terrestrial environment. The investigation was supported by RFFI-GFEN № 07-05-92116 and RFFI № 07-05-00697.

Introduction

Lake Hovsgol is the part of big water system in the Central Asia[1]. The system includes Lake Hovsgol locating on the territory of Mongolia, Lake Baikal locating on the territory of Russia and the Selenga River connecting the lakes and a lot of inflowing into the lakes rivers (Figure 1). Lake Hovsgol is named younger brother of Lake Baikal. Lake Hovsgol is situated in tectonic depression on the elevation up to 1600 m under sea level and on 1100 m upper of Lake Baikal [1]. It is 136 km long. The wide of the lake comes to 36,5 km, mean wide is up to 20,3 km. 414 km of shoreline encloses an area of 2,760 square km [1]. 46 rivers and rivulets flow into the lake. The mean depth of Lake Hovsgol is up to 139 m, maximum depth comes 262 m [1]. The Egiyn-Gol River being a tributary of the Selenga River is the only outflowing from the lake river. There are not a evident sources of POPs nearby of the lake. It is possible that Hovsgol Lake is good object for the investigation of the consequence of the long range transport.

The aim the study to investigate POPs levels in different media of environment including sediment and zooplankton from Lake Hovsgol and soil and air in the settlement of Khankh,.

Materials and Methods

Samples of zooplankton from the layer of 0-25 m and surface sediments from Lake Hovsgol were collected in February-March, 2005[2]. Passive air samplers (PAS) using polyurethane foam disks (PUF-disks) were installed in settlement of Khankh on the northern shore of Hovsgol Lake in May-June, 2008. The construction of PAS used in the study was suchlike to ones described in [3]. PUF disks were precleaned by Soxhlet extraction for 10-12 h using dichloromethane (DCM). Soil sample were collected nearby to the site of setting up of PAS. All samples after collection and the PUF disks at the end of sampling period were transported to the institute of Geochemistry and stored at –30^{0}C prior to the analysis.

Sample extraction and analysis. Samples were analyzed for 28 PCBs, including indicator PCBs (28, 52, 101/90, 138, 153, 180), *p,p'*-DDT and its metabolites, α-HCH, γ-HCH, HCB, *trans*-nonachlore (TNCL) at the laboratories of the Institute of Geochemistry in Irkutsk (Russia). PUF disks were Soxhlet extracted using DCM. Surrogate standards (PCB 14 and PCB 65) were added in solvent prop to extraction. The extract were purified on an aluminum oxid / silica gel / silica gel+H_2SO_4 column. Published analytical methods were used for soil and sediment [4]. The POPs were analyzed using gas chromatography with a ^{63}Ni electron-capture detector (GC-ECD). The Hewlett – Packard 5890 series II GC was equipped with a 0.25 μm × 60 m DB-5 capillary column (J&W

Scientific). The amounts of PCBs and OCPs in air in sampling time were obtained assuming that sampling rates were 3.5 m^2 in a day. The comparison was made with the POPs levels in environment of Lake Baikal and Lake Baikal Region.

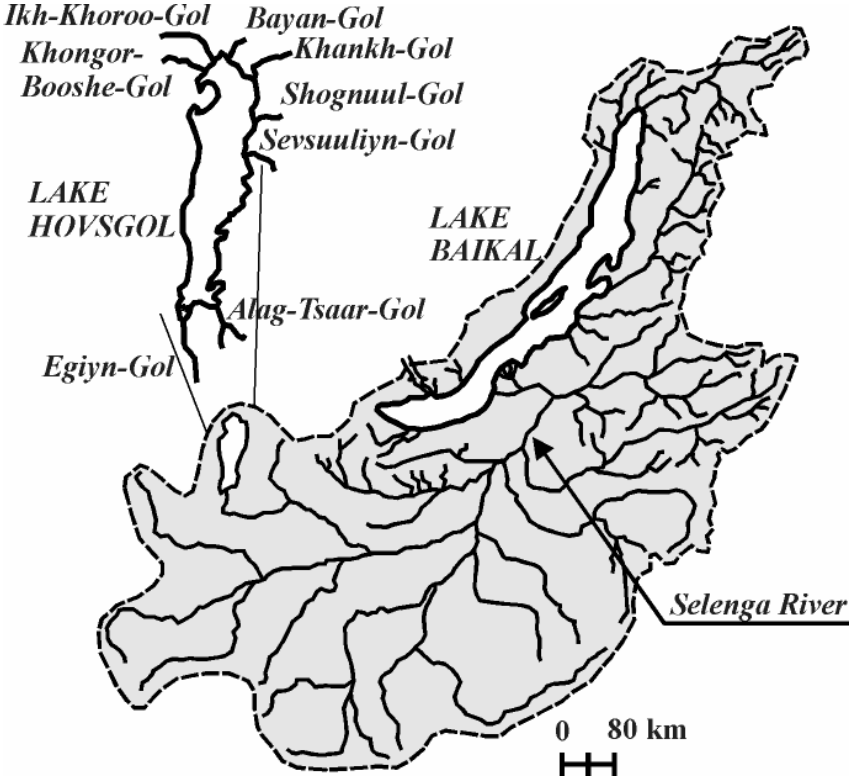

Figure 1. The scheme of water system Lake Hovsgol – the Selenga River – Lake Baikal.

Results and Discussion

The results are presented in Table and Figures 2 and 3.

PCBs. Total PCB congeners in zooplankton, sediments, air and soil from the Hovsgol Region comes to 0.993 ng/g WW, 0.36 ng/g DW, 96 pg/m^3 and 7 ng/g DW, accordingly. The PCB levels were lower than in corresponding media from the Lake Baikal region [2,5,6,7] (in 2.5 times for sediments, 4 times for zooplankton and up to 20 times for air) for the exception of soil. PCB levels from the settlement Khankh correspond to the levels in soil from some town of the Baikal Region and higher than background levels of the Lake Baikal Region in 2 order magnitude. It is possible that the phenomenon can results from the using of PCB electrical equipment in past in the region. The assumption is confirmed by congener pattern of PCB in soil. The congener pattern in soil from Khankh is similar to ones found in area surrounding industrial centers of the Lake Baikal Region (Figure 2). It was found previously that technical mixture of PCB is significant source of PCB and PCDD/F in the Usol'e-Sibirskoe located in about 150 km from Lake Baikal [5,6,7,8]. The problem of PCB in soil in the Hovsgol Region and surrounding areas demands of continuation of the investigation.

On the other hand PCB levels and PCB congener pattern in air, zooplankton and sediment indicate that there is not a PCB source in the Hovsgol Region at present time for the exception of atmospheric transport from other areas. Lower chlorinated PCB congeners contribute more parts in total PCBs in zooplankton and sediments from Lake Hovsgol than in the media from Lake Baikal.

It is interestedly that PCB congener pattern in air from Khankh is similar to ones found in the Olkhon Island, biggest island in middle part of Lake Baikal [5]. It is probably result of influence of evaporation from the surface of the two big lakes. The levels of PCB in air from Khankh in May-June were considerably lower than ones found in the Irkutsk Region [5] in June-August. The different can partly result from different season of sampling and lower temperature in May-June in the Hovsgol region than in June-August in the Irkutsk Region. Maximal temperature in both the Hovsgol Region and the Lake Baikal Region are observed in July[1,9]. The investigation of season distribution of POPs levels in air are continuing in the Hovsgol Region.

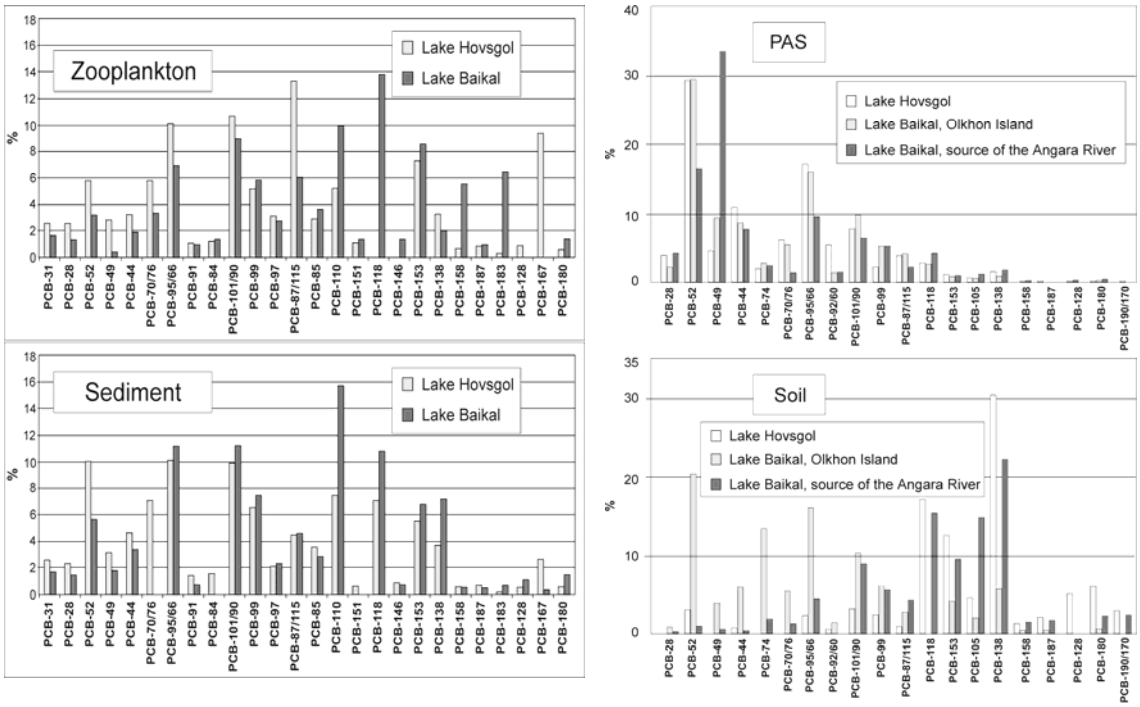

Figure 2. The relative PCB congeners patterns in zooplankton, sediments from Lake Hovsgol, air and soil from the Hovsgol region in comparison with data for the Lake Baikal Region [2,7,8] (%).

DDT and its metabolites. The sum of DDT and its metabolites in zooplankton, sediments, air and soil from the Hovsgol Region comes to 0.14 ng/g WW, 0.016 ng/g DW, 15 pg/m^3 and 10 ng/g DW, accordingly. The DDTs levels in zooplankton and sediment from Lake Hovsgol were considerably lower than in ones from Lake Baikal. While DDTs levels in air and especially in soil from Khankh were higher than in ones from the shore of Lake Baikal [7,10]. The problem takes additional investigations.

The relations of *pp'*-DDT, *pp'*-DDD and *pp'*-DDE is different in samples from the Hovsgol Region. The zooplankton and sediment are characterized with predominance of *pp*'-DDE (90 and 70 % accordingly), while *pp*'-DDT levels comes to 65 % in soil. *pp*'-DDD levels in air is up to 20 % while *pp*'-DDE and *pp*'-DDT contribute equal parts in total DDTs.

pp'-DDT/ *pp'*-DDE ration comes to 0.10-0.24 in zooplankton and sediments from Lake Hosgol, 0.48 in air and 3.07 in soil from Khankh. The value in soil can indicate on resent usage of the pesticide in the region but the addition investigation are needed.

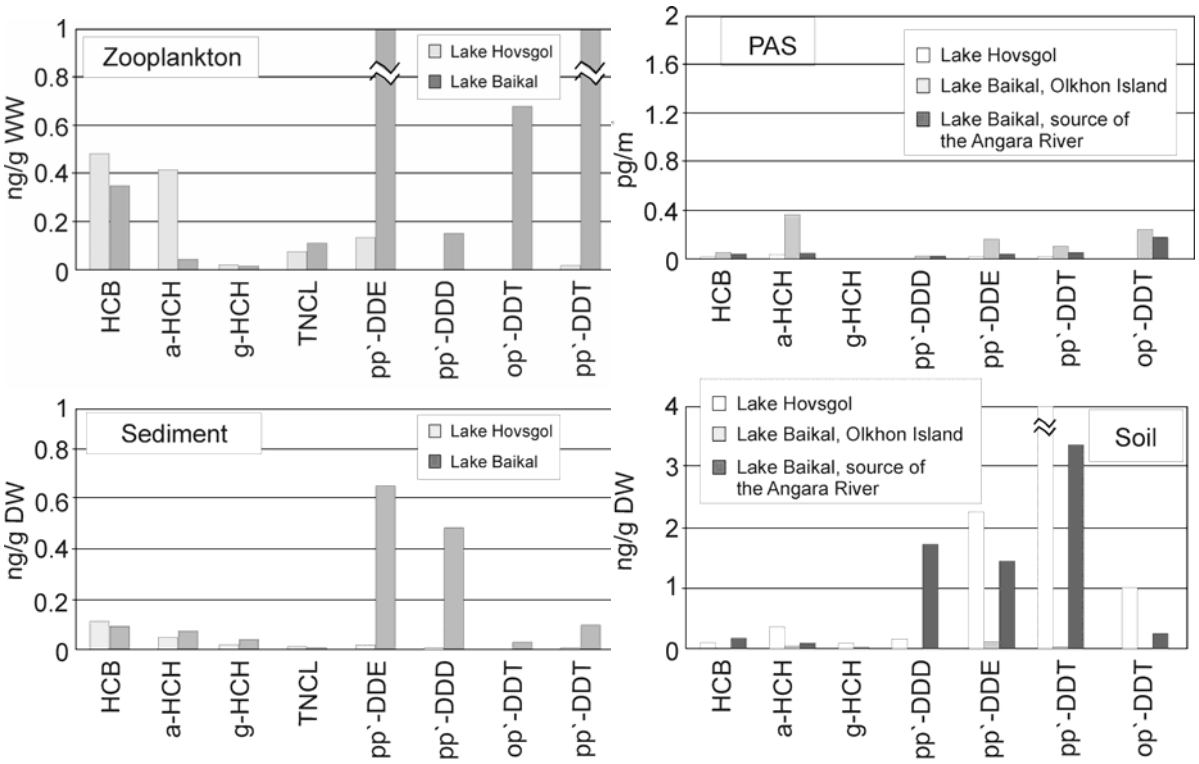

Figure 2. The levels of some organochlorine pesticides in zooplankton, sediments from Lake Hovsgol, air and soil from the Hovsgol region in comparison with data for the Lake Baikal Region [2,7,8,10] (%).

HCHs. The sum of α and γ-HCHs in zooplankton, sediments, and soil from the Hovsgol Region comes to 0.44 ng/g WW, 0.06 ng/g DW, and 0.49 ng/g DW, accordingly (Figure 3). The level of α-HCH in air comes to 34 pg/m^3. γ-HCH was not determined in air due to analytical problems. HCHs levels in sediment, soil and air from the Hovsgol Region were comparable or lower than in ones from the Lake Baikal Region. While α-HCH level in zooplankton from Lake Hovsgol was higher than in zooplankton from Lake Baikal in 9 times.

α- / γ- HCH ratio comes to 2,28 in sediments, 3.33 in soil and 19 in zooplankton from Lake Hovsgol. The values are within the bounds of α- / γ- HCH ratio values for samples from the Lake Baikal region for the exception of index for zooplankton. The α- / γ- HCH ratio in zooplankton of Lake Baikal sampled in December 2004 comes to 2.98 [2]. The α- / γ- HCH ratio upper one in samples from the Hovsgol Region indicate on using technical mixture HCH in the region.

TNCL. The sum of TNCL in zooplankton, sediments, and air from the Hovsgol Region comes to 0.07 ng/g WW, 0.006 ng/g DW, 0.5 pg/m^3, accordingly. The levels of the compound were comparable in sediment both Lake Hovsgol and Lake Baikal [2]. The TNCL level in air in settlement of Khankh was considerably lower than in air of the Lake Baikal Region[5].

Thus the investigation are show that levels of POPs in most of samples from the Hovsgol Region are low but there are some signs indicating on past entrance of PCB in the environment of the region. There is a possibility of modern entrance of some pesticides in the environment at present time. The additional studies of the distribution of POPs are needed for the region especially for terrestrial environment.

Acknowledgments

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