

Mercury in the central European lake district - case study Plešné lake

Tomas Navratil (1), Jan Rohovec (1), Tereza Novakova (1), Sarka Matouskova (1), Jiri Kopacek (2), and Jiri Kana (2)

(1) Institute of Geology CAS, v.v.i., Environmental Geology and Geochemistry, Prague 6, Czech Republic (navratilt@gli.cas.cz), (2) Biology Centre CAS, v.v.i., České Budějovice, Czech Republic

The central European lake district extends within the Bohemian forest and Bavarian forest Mountains. It includes 8 glacial lakes extending in altitudes from 935 to 1087 m a.s.l. All of them have been oligotrophic and forests of the lake catchments are dominated by Norway spruce (*Picea abies*). Plešné lake (PL) catchment is at 1087 m a.s.l. and it covers area of 0.67 km². In 2004, the forest at PL catchment was infested by the bark beetle (*Ips typographus*) and 88%–99% of trees had died by 2011.

In contrast to relatively detailed research of North American and Scandinavian lake ecosystems the information concerning Hg contamination of central European lake ecosystems are rather scarce. The PL ecosystem can provide base for assessment of Hg contamination as well as for changes induced by the bark beetle infestation.

In 2016, mean annual Hg concentration in bulk precipitation at Plešné lake reached 3.0 ng/L and bulk Hg deposition flux amounted at 4.6 $\mu\text{g}/\text{m}^2$. The most important pathway of Hg deposition to the forest ecosystems has been litterfall. The highest Hg concentrations in litterfall material at PL were found in lichens 205 $\mu\text{g}/\text{kg}$, mixture of unidentifiable organic debris 159 $\mu\text{g}/\text{kg}$ and bark 123 $\mu\text{g}/\text{kg}$. Litterfall spruce needles averaged at 56 $\mu\text{g}/\text{kg}$, only. Removal of spruce due to bark beetle infestation caused decrease of litterfall Hg fluxes. Recent litterfall fluxes in the unimpacted stands reached 55.8 $\mu\text{g}/\text{m}^2$, while in the impacted dead stands they amounted 23.0 $\mu\text{g}/\text{m}^2$, only. The qualitative composition of the litterfall in the infested stands was typical with absence of needles and prevalence of twigs and bark.

To assess changes in Hg distribution within the soil profile due to forest dieback the soil data from year 1999 were compared with 2015 data. The mean Hg concentrations in the O horizons decreased from 424 to 311 $\mu\text{g}/\text{kg}$ between years 1999 and 2015, and in A horizons the situation was reversed and an increase from 353 to 501 $\mu\text{g}/\text{kg}$ occurred. The means of Hg concentration in mineral soil remained relatively similar at 145 and 121 $\mu\text{g}/\text{kg}$. Increased Hg concentrations in A horizons were concurrent with increased organic C concentrations from 24.5% in 1999 to 39.9% in 2015. Ratio Hg/C in the A horizon remained rather comparable (1.27 and 1.47). In O horizons Hg/C ratio decreased from 0.9 to 0.5 comparing 1999 and 2015 due to changes in litterfall composition and total deposition due to canopy absence since 2005.

Tributaries and lake water Hg concentrations were assessed to estimate the fluxes of Hg within lake catchment. PL lake water contained on average 4.4 ng/L of Hg and 8.2 mg/L of DOC. Mean annual Hg concentration in four lake tributaries ranged from 2.0 to 16.5 ng/L. The differences in Hg concentrations among individual streams were driven by DOC concentrations ranging from 2.1 to 21.2 mg/L. The differences between the Hg and DOC concentrations tributaries result from differences in hydrology of the individual sub-catchments.

The financial support was provided by the Czech Science Foundation project No. GA16-14762S.