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Mercury in forest ecosystems near chlor-alkali plant in the Czech republic

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A mercury electrolysis chlor-alkali plant has been operating in Neratovice, the central Czech Republic since year 1948. We focused on the assessment of mercury contamination in the plant surroundings. To assess the contamination extent we sampled organic and mineral soils, bedrock, bark, needles and tree rings from several forest sites with variable distance from plant. The soils were predominately arenic cambisol and the vegetation cover composed of mixed to coniferous forests (majorly Pinus sylvestris).
At all the sites, the highest concentrations occurred in the organic rich O horizons of the forest soils. The Hg concentrations increased from Oi horizon (up to 252 μg/kg) with fresh organic matter, through Oe horizons (up to 617 μg/kg) to the Oa horizons (up to 813 μg/kg) with relatively highly decomposed organic matter. The Hg concentrations in mineral soil were significantly lower in range from 3 to 44 μg/kg. Sandstone bedrock contained low Hg concentrations from 2.7 to 4.7 μg/kg. The difference between the high Hg in organic and low Hg in mineral horizons results from order of magnitude different content of soil organic matter. In the same time low Hg in mineral soil indicates low level of Hg migration down the soil profile.
Apart from the simple comparison of Hg concentrations, insight into the patterns of soil Hg distribution can be gained by examining the stoichiometric ratios of Hg to C. Soil Hg/C should be greater in areas with greater atmospheric Hg deposition. O horizons of sites closer to plant up to 4.5 km exhibited elevated Hg/C ratios (2.0 - 2.2 μg/g) with respect to those at more distant sites (0.7 – 0.9 μg/g). Values of mineral soil Hg/C ratios varied irrespective to the distance from the plant.
Organic soil Hg pool decreased from 13.6 mg/m2 in distance of 1.9 km from the plant to 2.6 mg/m2 in distance of 9 km. But the mineral soil Hg pool ranging from 7.6 to 12.3 mg/m2 exhibited no trend with distance. The polluted sites up to 2.5 km from the plant exhibited untypical greater size of organic Hg pools with respect to mineral ones. Thus the increased Hg deposition at these sites outpaced the effect of greater density and thickness of mineral soils.
Alike organic soil, the Hg concentrations in the 1 year and 2 year old needles of Pinus sylvestris decreased with the distance from plant from 33 to 19 μg/kg. To observe the historical differences between Hg depositions at the individual soil sampling sites we assessed the Hg concentrations in the Pinus sylvestris tree rings. Atmospheric Hg deposition at the sites closest to the plant decreased significantly since year 1941. The Hg concentrations in individual tree rings at each site prior to year 1941 were indifferent. Therefore tree rings can be evaluated as a valuable archive of pollution with Hg at the individual plots.
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