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The importance of catchment vegetation for lake sediment mercury records

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In this study we have used a long, Holocene, sediment profile from a small headwater lake in Southern Germany to determine how changes in the vegetation affected the sediment accumulation in general and the accumulation of mercury in particular. The sediment samples were analyzed for their content of total mercury, organic matter quality/quantity and geochemical composition, and the vegetation development was determined using pollen analysis.

Over the course of the Holocene, two major shifts in vegetation occurred, both coincide with changes in mercury accumulation. The period prior to 9000 BP was dominated by non-forest vegetation (e.g., *Corylus avellana*), and mercury concentrations around 60 ng g^{-1} (90 μg m^{-2} yr^{-1}). About 8500 BP there was a shift to forest vegetation (mainly *Quercus robur*), which coincides with increases in both mercury concentrations and accumulation rates (115 ng g^{-1} and 140 μg m^{-2} yr^{-1}, respectively). This vegetation shift also drastically decreased the influx of mineral particles to the lake, likely because the development of a closed forest decreased soil erosion. During the following 3500 years – when the vegetation remained dominated by *Quercus robur* – mercury concentrations were stable around 115 ng g^{-1}, while mercury accumulation rates decreased to about 110 μg m^{-2} yr^{-1} due to a gradual decrease in sediment accumulation during the latter part of this period. Around 5000 BP there is a second shift in the vegetation as *Quercus robur* is replaced by *Fagus sylvatica* and *Abies alba* as the dominant tree species, and again this shift leads to an increase in both mercury concentrations and mercury accumulation rates (200 ng g^{-1} and 140 μg m^{-2} yr^{-1}, respectively).

This shows that the vegetation – and not only the concentration of mercury in the atmosphere – has an influence on the amount of mercury that is accumulated in a lake's sediment. Firstly, the vegetation will influence the interception of mercury, and other atmospherically derived elements, because coniferous forest intercepts more mercury from the atmosphere than deciduous forest. Secondly, changes in the vegetation will also affect the re-emission of mercury, because of differences in the shading. Thirdly, the vegetation will influence soil stability, production of litter, litter quality, degradation of soil organic matter. This will, in turn, affect the cycling of organic material, which is an important vector for many trace elements, and the soil erosion. Thus, before using lake sediment records to study the historical changes in mercury loading to the environment there is a need to constrain if there have been any changes in the vegetation. However, this study also shows that long lake-sediment records have a large potential as natural laboratories to study the effect of slow processes, like vegetation development, on the transport and accumulation of mercury and other trace elements through the landscape.