Diel mercury-concentration variations in a mercury impacted stream

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Diel concentrations of filtered and particulate mercury (Hg) and methylmercury (MeHg), and associated water quality parameters, in East Fork Poplar Creek (Tennessee, USA) were evaluated bi-hourly for a 30-hr period during the summer and winter seasons to determine if biogeochemical Hg and MeHg cycles respond to the daily photocycle. This creek is contaminated with high levels of inorganic Hg (baseflow unfiltered Hg ~70 ng/L). Results from the summer field campaign revealed a doubling of particulate Hg and MeHg concentrations during the nighttime periods concurrent with increases in total suspended sediment; diel changes in the activity of macrobiota affecting the suspension of contaminated sediments is likely responsible for these patterns. There were no diel patterns in filtered Hg (~11 ng/L) or dissolved organic carbon quantity (~2 mg/L) or quality (SUVA-254 ~2.7 L/mg C/m). Dissolved gaseous Hg (Hg(0)) concentrations, measured on a subset of samples, peaked mid-day (0.45 ng/L) with a minimum measured just prior to sunrise (0.20 ng/L) likely reflecting the effects of Hg photo-reduction; overall, Hg(0) represents a small fraction (<1%) of Hg in the system therefore a diel cycle is not observed in the bulk Hg measurement. Concentrations of filtered MeHg varied, with daytime increases of ~50% over nighttime concentrations (nighttime low of 0.22 to a mid-day maximum of 0.31 ng/L) representing about one third of the variability observed for a morning sample over the annual cycle (from 0.1 to 0.4 ng/L). Elevated daytime concentrations relative to nighttime indicate that photo-demethylation is not a dominant process in this stream in the summer, possibly due to shading from overhanging vegetation during the growing season. The large variability in dissolved MeHg, which appears to be correlated with the daily photocycle, implies key controls on net methylation occur within the stream or on the stream bed. Reasons for daytime highs include factors such as small scale temperature increases in the water column and photosynthetic activity of stream biofilm generating conditions that promote methylation. Periphyton biofilms in wetlands and lakes and epiphytic microbial communities on a dominant filamentous alga in one stream system have been implicated in methylmercury production; however, further research is required to determine the role of in-stream biofilms to MeHg patterns in this stream system.