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CONCENTRATION OF HEAVY METALS IN THE WATERS AND SURFACE SEDIMENTS OF WILGREEN LAKE, MADISON COUNTY, KENTUCKY: AN EVALUATION OF PLAUSIBLE SOURCES

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Heavy metal pollution remains a problem in natural waters, particularly for localities near plausible anthropogenic sources. We assayed the level of heavy metals in surface waters and within surface sediments of Wilgreen Lake, whose watershed drains industrial, urban, agricultural, and residential areas near Richmond, Kentucky. We sampled both surface (oxic) and deep waters (anoxic) when the lake was stratified over Summer 2010. Water samples were treated according to U.S. Environmental Protection Agency (EPA) protocols and were digested with trace-metal-grade nitric and hydrochloric acids. Sediment samples were collected with a grab sampler and digested using established EPA procedures with trace-metal-grade nitric acid and hydrogen peroxide. Both water and sediment samples were sent to Activation Laboratories for analysis, and were measured via ICP/MS and ICP/OES, respectively.

All water samples had heavy metal concentrations far below the safety limit for drinking water as determined by the EPA and Kentucky Division of Water (KDW). Lead and nickel were elevated above chronic criteria for aquatic habitat as established by the KDW, or 1.273 and 0.8 µg/L, respectively. Several metals - lead, thorium, and thallium - showed increases in concentration in deeper, anoxic waters compared to oxygenated, surface samples, implying their diffusion out of anoxic sediments. Water-borne lead concentration spiked up to 3 µg/L in anoxic waters of station TF-3; the acute exposure threshold for lead is 1.273 µg/L, with 2 additional samples exceeding this value.

In surface sediments, heavy metal concentrations mostly show no systematic increase or decrease at stations distributed across the lake. However, two stations, M2 and TF-1, located near the inflow of Taylor Fork, showed considerably higher concentrations of lead, chromium, and cobalt than other grab samples. For example, the background lead concentration within surface sediments is about 30 mg/L, but lead levels at stations M2 and TF-1 were 70 and 110 mg/L, respectively. Elevated metal concentrations within sediments in the upper reaches of Taylor Fork can occur from two very different sources. Metals may have originated in the watershed from upstream industrial sources and accumulated within sediments, or they may have entered the lake from septic systems and/or runoff from adjacent residential areas. We continue to investigate these possibilities.