Spatial and Temporal Correlations of Cadmium in Sediment and Surface Water in a Temperate Freshwater Impoundment

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Background/Objectives. Cadmium concentrations in sediment and surface water have been studied for over 20 years in a shallow, freshwater impoundment in the eastern United States. Accumulations of cadmium in sediment resulted from historical discharges of treated process water from an adjacent manufacturing facility. Previous studies have demonstrated that surficial sediment concentrations of cadmium are highly variable across the impoundment, and that there is a long-term trend of declining surface sediment concentrations. Despite evidence of significant sediment deposition since the release ended, cadmium remains entrained in very shallow sediment intervals in most portions of the impoundment.

The objective of this study was to evaluate the temporal and spatial relationships between cadmium concentrations in surface sediment and surface water.

Approach/Activities. Sampling of sediment and surface water in the impoundment was completed periodically from the 1990s through 2017. Studies included collecting shallow sediment samples for metals analysis (using ICP-MS, EPA Method 6020A) and sampling of surface water to evaluate long-term and seasonal fluctuations in dissolved cadmium concentrations and other water quality parameters.

Results/Lessons Learned. An examination of surface water and sediment data from 20 years of studies at the site revealed strong correlations between long-term declines in surficial sediment concentrations and dissolved cadmium concentrations in surface water. Surface water cadmium concentrations were also observed to fluctuate on a seasonal time scale – concentrations were elevated in the winter months and lower during the summer months. Furthermore, elevated sediment and surface water concentrations of cadmium are spatially correlated. A multiple regression model was used to evaluate the temporal and spatial effects of sediment cadmium on surface water concentrations, as well as the influence of variables such as temperature, dissolved oxygen, and other water chemistry parameters. The observations of long-term and seasonal fluctuations, and spatial correlations, in surface water dissolved cadmium concentrations support the hypothesis that cadmium remains in state of seasonal flux between sediment and surface water in the impoundment as concentrations decline over longer time scales.