EFFECTS OF NONAGRICULTURAL HUMAN ACTIVITY ON SEDIMENT QUALITY: A COMPARISON OF TRACE ELEMENT CONCENTRATIONS IN EIGHT SMALL RESERVOIRS

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Abstract: Reservoir bottom sediments can be valuable sources of information on the occurrence, magnitudes, and trends of human-associated environmental contaminants because they integrate sediment from throughout the contributing basin. Sediment cores collected from eight small reservoirs in eastern Kansas with basins of diverse land-use combinations were analyzed for arsenic, cadmium, chromium, copper, lead, nickel, and zinc. The sediment in some cores was age dated using cesium-137. Specific objectives were to: (1) determine the occurrence and trends of trace elements in the reservoir bottom sediments, (2) assess sediment quality with respect to available guidelines, and (3) interpret the effects of nonagricultural human activity (in the basin or the reservoir) on sediment quality within and among the eight reservoirs.

A comparison of trace element concentrations in the sediments indicated that sediment quality in the eight reservoirs generally was comparable for arsenic, cadmium, chromium, and nickel. However, substantial differences among the reservoirs were indicated for copper, lead, and zinc. For copper, substantial concentration increases in samples from two reservoirs most likely were caused by applications of copper sulfate to control algal blooms. For lead, the depositional profile in sediment from four reservoirs corresponded to the history of leaded gasoline use. That is, an initial increasing trend in lead deposition was replaced with a more recent decreasing trend. Substantial variability in zinc concentrations among the reservoirs may be indicative of differences in vehicular traffic volume and associated tire wear. Overall, the reservoir least affected by human activity had the smallest (or among the smallest) sediment concentrations for each of the trace elements analyzed.

Sediment concentrations of arsenic, chromium, and nickel exceeded consensus-based threshold effect concentrations (TECs) for harmful effects on sediment-dwelling organisms in all samples from every reservoir. For copper, lead, and zinc, the results were more variable. In the case of copper, sediment concentrations frequently exceeded the consensus-based probable effect concentration (PEC) for harmful effects on sediment-dwelling organisms in samples from the reservoirs that had been treated with copper sulfate. For lead, sediment concentrations frequently exceeded the TEC for several reservoirs. Results for the oldest reservoir indicated that, following the phase out of leaded gasoline, it will take at least several decades for lead in newly deposited reservoir bottom sediments to return to baseline concentrations. Sediment concentrations of zinc typically exceeded the TEC for several reservoirs. Cadmium concentrations in samples from all reservoirs typically were less than the TEC. Trace element concentrations in sediment cores for two reservoirs indicated that, for certain trace elements in certain areas, historical baseline concentrations may exceed the TECs prior to the effects of substantial nonagricultural human activity in the basins.