

PHOSPHORUS RELEASE FROM AEROBIC-SURFACED LAKE SEDIMENTS AND THE IMPORTANCE OF SULFATE REDUCTION

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A study was designed to determine if phosphorus (P) release from aerobic-surfaced lake sediments varies as functions of sulfate reduction rates and iron reduction. Over a one-year period, benthic chambers were used to measure soluble reactive phosphate (SRP), dissolved inorganic carbon (DIC), and oxygen fluxes of littoral sediments overlain by aerobic waters in a power-plant cooling reservoir. Sulfate reduction was measured by $^{35}\text{SO}_4^{2-}$ core injection. Measurements were made at two sites, one near the plant's effluent ("hot site"), and the other near the plant's intake ("cold site"). The hot site had significantly higher ($p < 0.05$) sediment SRP, DIC, and oxygen fluxes, and sediment sulfate reduction rates, than the cold site. Differences were greatest in September, when hot-site water temperature exceeded 40°C and solute fluxes rose dramatically. Relative P release (RPR) and estimates of carbon and phosphorus sediment loading were used to examine sediment P-storage. The hot site retained 65% of its annual P load, the cold site 92%. RPR data indicated sediments retained P selectively all year, except at the hot site in September when stored P was released. Overall, temperature was the only variable that significantly correlated to RPR ($R^2 = 0.53$). This was apparently due to its influence on sediment microbial metabolism and bioturbation. High temperatures diminished bioturbation at the hot site and may have decreased the sediment's ability to adsorb P. In September, high sediment oxygen demand apparently lowered hot site redox potentials sufficiently to reduce surface ferric iron, inducing the large P-flux. Total reduced inorganic sulfur (TRS) concentrations were highest when sulfate reduction rates were lowest, suggesting seasonal de-coupling of sulfur (S) oxidizers and reducers. In summer, tight coupling between reduced S oxidation and sulfate reduction decreased TRS in spite of high sulfate reduction rates. Although large variations in TRS concentrations of near-surface sediments were observed at both sites, TRS did not significantly correlate to P flux. This study's results did not support the idea that P fluxes from aerobic-surfaced sediments are controlled by sulfate reduction rates.

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