Does Benthic Biogeochemistry Drive Algal Blooms in Shallow, Subtropical Florida Lakes?

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Algal blooms have become increasingly common occurrences in shallow lakes, including in Lake Washington and Blue Cypress Lake, located in east-central Florida (USA). These blooms have raised concerns about cultural eutrophication and questions about whether the nutrients that fuel them come from allochthonous (external) or autochthonous (internal) sources. To determine if the nutrients that cause these blooms come from within the lakes, specifically from phosphorus in bottom deposits, a sediment characterization and flux study was conducted. Characterization of the lake deposits involved collecting sediment cores from sites throughout the two shallow waterbodies and measuring porewater nitrogen, phosphorus, and metal species at depths in the profiles. In a related study, we collected a second group of sediment cores that were continuously incubated over a period of 24 hours, with overlying samples of water collected every 4-6 hours. Water samples were analyzed for soluble reactive phosphorus (SRP), as well as N_2, O_2, ammonium, and nitrate. Statistical analysis of bulk sediment and porewater indicated spatial variability in benthic substrate lithology and element concentrations, especially in Lake Washington. Regardless of porewater and substrate element concentrations, nutrient fluxes into the overlying waters were extremely low or below the detection limit in both lakes. The only noticeable flux from the sediments to the water column was from N_2 gas, suggesting there was denitrification in Blue Cypress Lake and nitrogen fixation in Lake Washington at the time of sampling. It is possible that SRP is bound by oxidized iron, aluminum, and calcium at the sediment/water interface, particularly under oxic conditions, thereby preventing nutrient release into the overlying water. Internal recycling of nutrients does not appear to be fueling algal blooms in these lakes, suggesting that allochthonous nutrient sources are the major driver of primary productivity.