MICROBIAL RECYCLING VERSUS PRIMARY PRODUCTIVITY AS THE DOMINANT CONTROL ON CARBON ISOTOPE CYCLING IN EUTROPHIC ENVIRONMENTS: NEW INSIGHTS INTO THE ORIGIN OF ISOTOPIC SHIFTS IN ORGANIC-CARBON-RICH SEDIMENT

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A comparative study of carbon-isotope cycling in two highly productive modern lakes (Mendota, USA and Greifen, Switzerland) shows that a transition in the 13C of organic and inorganic carbon from an initial negative 13C-excursion to a positive 13C-excursion is predicted as eutrophication intensifies. In Lake Mendota, carbon accumulation rates correlate with historical water-column nutrient levels and a long-term trend towards 13C-depletion in sedimentary carbon with progressive eutrophication (up to 0.15 mgPO4/l). In Lake Greifen, carbon accumulation rates also track historical nutrient concentrations but, the sediments exhibit two distinct 13C trends. During the initial phase of eutrophication, when nutrient concentrations were below 0.2 mg/l, negative trends in the 13C of sedimentary organic and inorganic carbon were observed. However, once nutrient concentrations rose above a threshold of 0.2 mg PO4/l, positive trends in 13C developed. During the negative 13C excursions, molecular organic geochemical and isotopic analyses indicate that bacterial biomarkers (e.g. hopanols and FAMEs) display extreme 13C-depletion diagnostic of chemoautotrophy and methanotrophy, and have increased accumulation rates. This shows that microbial recycling processes (methylotrophy, chemoautotrophy, fermentation and methane-oxidation), while not the dominant source of organic carbon to the sediments, have contributed sufficient amounts of 13C-depleted biomass to influence the isotopic composition of bulk sedimentary carbon. The subsequent positive 13C excursions as nutrient loading further increases is the response to excess contributions of photoautotrophic biomass relative to the 13C-depleted biomass derived from microbial recycling. In light of these and other recent findings, traditional models of organic carbon deposition relying on enhance preservation in a permanently anoxic basin with low primary productivity wi