Parameterization of a Sediment Phosphorus Model

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**Management Significance**

Sediment phosphorus release, i.e., internal loading, is widely known to retard the time course of lake recovery from eutrophication. Dramatic changes in rates of sediment phosphorus release have been observed in Chautauqua Lake as a result of reductions in external nutrient loading and resolution of legacy deposits of phosphorus. An ability to forecast the future response is valuable in projecting the trophic state conditions that may represent the end game for restoration of Chautauqua Lake.

**Conceptual Framework**

Chemical fractionation techniques partition the phosphorus contained in particulate matter into three categories: non-exchangeable-P (that associated with organic matter), exchangeable-P (that associated with Fe/Al and some Ca) and refractory-P (not organic and inert matter). The fate of particulate phosphorus in the sediment and its treatment in modeling exercises may be organized around these fractions.

**The Model**

The kinetic model proposed here is intended to be nested within a larger model framework, SED2K. That model examines both fate and transport components of the diagenesis of particulate organic matter (POM) and related processes and chemical species. The model presented here focuses on the fate of one POM component (phosphorus) as conceptualized through the three operationally defined fractions described previously.

**Parameterizing Organic-P Diagenesis**

Particulate organic (non-exchangeable) phosphorus undergoes diagenesis (solubilization) in the sediment yielding soluble P. The observations of Penn et al. (1995; see below), indicate that diagenesis is well described as a first-order decay. Here, contemporary sediment P profiles will be collected and compared with those from 1994 to establish the value for the diagenesis constant, k.

**Parameterizing P Sorption Kinetics**

Sorption characteristics on sediment particulate will be described using a Langmuir isotherm (illustrated below). Sediment, stripped of its phosphorus through chemical extraction, will be suspended in artificial lake water over a range of phosphorus concentrations and incubated on a shaker for 24 hours. Equilibrium concentrations of particulate (ν) and dissolved (Cd) phosphorus will be measured and fit to the Langmuir equation to determine the parameters describing sorption kinetics (b, νmax).

**Application**

Sediment porewater phosphorus profiles will be collected using peeper technology. The profiles will be fit using the model described above with diagenesis and sorption coefficients as determined here. The model will then be applied to predict future rates of sediment phosphorus release as a function of the rate of deposition of phosphorus to the sediment.