Redox dynamics and the rate of internal nutrient loading in Lake Myvatn, Iceland

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The sub-arctic Lake Myvatn is one of the most productive lakes in the Northern Hemisphere. It has a mean depth of ~2 m and a water residence time of ~27 days. It is fed by groundwater, cold and warm, rich in many nutrients, e.g. Si and P. In addition, there is internal cycling of elements within the lake. Organic matter on the lake bottom decomposes and returns part of the nutrients directly to the water while part of the elements diffuse through the sediment into the water.

The rate of the internal loading of nutrients in Lake Myvatn depends on the redox state in the bottom waters. High oxygen levels limit the mobility of Mn and Fe while low oxygen levels enhance the mobility of the metals. Remobilization of these metals from the sediment-water interface also mobilizes the co-precipitated/adsorbed elements, like the surface reactive phosphorus (P), causing increased rate of phosphorus flux from the bottom sediments.

The redox state at the water-sediment interface is different between areas in Lake Myvatn. High oxygen levels occur where the bottom is dominated by *Tanytarsus gracilentus* larvae while oxygen levels are lower at areas inhibited by *Chironomus islandicus*. *T. gracil* are tube building, silk spinning larval colonies which pump water into the uppermost part of the sediment and aerate it, opposite to *Chiron.* Therefore, the rate of internal loading of redox sensitive metals and P is higher in areas dominated by *Chiron.* within Lake Myvatn.

Primary production of diatoms and green algae in Lake Myvatn is limited by N due to high P concentration in the inflowing groundwater. The production of the N-fixating bacteria *Anabaena flos aqua*, which is present in Lake Myvatn, is however limited by P since *Anabaena* is self-sustainable with respect to N, if not limited by of micronutrients. High density of *Anabaena* causes lower water transparency which limits the potential growth of *T. gracil* on the bottom, causing even faster flow of P from the bottom. This is a positive feedback process, a loop that can continue until light becomes limiting for *Anabaena* growth.