

Seasonal phytoplankton and geochemical shifts in the subsurface chlorophyll maximum layer of a dimictic ferruginous lake

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Abstract

Subsurface chlorophyll maxima layers (SCML) are ubiquitous features of stratified aquatic systems. Availability of the micronutrient iron is known to influence marine SCML, but iron has not been explored in detail as a factor in the development of freshwater SCML. This study investigates the relationship between dissolved iron and the SCML within the dimictic, ferruginous lake Grosses Heiliges Meer in northern Germany. The occurrence of the SCML under non-ferruginous conditions in the spring and ferruginous conditions in the fall are context to explore temporal changes in the phytoplankton community and indicators of primary productivity. Results indicate that despite more abundant chlorophyll in the spring, the SCML sits below a likely primary productivity maximum within the epilimnion, inferred based on co-located dissolved oxygen, $\delta^{13}\text{CDIC}$, and pH maxima. The peak amount of chlorophyll in the SCML is lower in the fall than in the spring, but in the fall the SCML is co-located with elevated dissolved iron concentrations and a local $\delta^{13}\text{CDIC}$ maximum. Cyanobacteria and Chlorophyta have elevated abundances within the SCML in the fall. Further investigation of the relationship of iron to primary productivity within ferruginous SCML may help to understand the environmental controls on primary productivity in past ferruginous oceans.

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