A new indicator for diatom production proposed by varved sediments of Lake Suigetsu, Japan

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Primary production in aquatic environments is produced by phytoplankton, such as diatoms. The precise estimation of the primary production has remained a difficult problem instead its significances for ecological and biogeochemical cycles in water bodies. Amounts of organic remains in marine and lacustrine sediments are biased by taphonomic processes like transportation of allogenic plant fragments, dilution by terrestrial mineral particles and dissolution and decomposition of organic remains. Recent methodologies infer the past production and/or productivity indirectly. Our study propose a direct way to estimate the past diatom production based on cell size distribution of populations, which only reflects growth processes of diatoms. In asexual cell division, a mother cell forms two new valves of the daughters and divide into two cells; one is the same size as the mother and the other is smaller than the mother. The mean cell size of the population decreases along with cell divisions and has close relationship with diatom production. The variation in cell size of diatom population has been interpreted as the different amount of production since 1970s (Burckle & McLaughlin 1977; Burckle et al. 1981). These researches interpret the abundant occurrence of large valves proves high productivity, although they used deep sea sediment with poor estimated amount of diatom valves and did not explain the difference in the cell size distribution with diatom life cycle in sufficient depth.

Varved sediments from Lake Suigetsu should be precise record of the past diatom production, because their sedimentary structure supports extremely good preservation of diatom valves and annual resolution of valve fluxes. We quantified the past diatom production (flux) from the varved sediments and compared them with the size distribution. The results showed that skewed distribution in small size class represents large amount of the production (high productivity), whereas broad distribution with relatively many large valves indicates small amount of the production (low productivity). Our evidence opposes to the previous studies but its reliability demonstrates the cell size distribution to be a new indicator for the past diatom production, not effected by taphonomic processes. This indicator can estimate diatom production and productivity from any sediments even if they have poor preservation of diatom valves and limited time controls. For example, we will discuss 40 ka paleolimnology in Lake Biwa, which has poor valve preservation, low sedimentation rate and less time controls, in relation to the diatom production based on this indicator.

(References)

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