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Lake sediments as an unique evolutionary record of diatoms

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A 240-thousand-year morphological evolution of a diatom lineage is presented from investigation of Lake Biwa boring core called 200-m core. Tempo and mode of the evolution is examined from 245 subsamples, each of which represents several hundred years record of diatom population in the lake. Time interval of them distributes between 200 and 5000 years and the mean is about 1000 years. Such time resolution is the highest among researches dealing with morphological evolution. The results show continuous morphological change in a lineage which begins from Stephanodiscus vestibulis like species and ends with S. suzukii which is an extant endemic in Lake Biwa. During the transitional sequence, three times of directional change was occurred intermittently. The directional changes are occurred in 200-190, 160-150 and 130-120 ka and last within 10 thousand years, respectively. Stases stand for longer periods between the directional changes, which is characterized by unbiased random walk in valve morphology. The directional changes correspond with climatological transitions, from interglacial to glacial period, from warm phase to cold phase during glacial period and from glacial to interglacial period. These coincidences predict glacial-interglacial environmental changes drive the diatom evolution. However, any directional change was not observed after S. suzukii appeared in the last interglacial. Morphological variation in temporal population seems to decrease in this period. Further research should reveal more immediate cause and mechanism of the diatom evolution. Climate and environmental change in the Quaternary, especially in the last glacial and the Holocene has been well examined with combined proxies from sedimentology, mineralogy, geochemistry, and paleontology like pollen analysis. Comparing them with diatom evolution should promote understanding of evolutionary history of diatoms and its backgrounds.

Diatom fossils are not only an environmental proxy but also an exceptional example showing evolution in geological time scale. Lake sediments provides advantage for describing it with their high sedimentation rate and good preservation of diatom fossils. This is the first step to understand diatom which is the most successful unicellular algae which has increased its biomass and diversity throughout Cenozoic ecosystem. Quaternary glacial-interglacial cycles greatly affects on chemical and physical property of lakes and their global distribution. Essential aspects, such as ecology and evolution, are remaining in the studies on lake sediments deposited under these variable environments.

Keywords: lake sediment, diatom fossil, Quaternary, morphological evolution, biogeography