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The Holocene environmental history of a small coastal lake on the north-eastern Kamchatka Peninsula

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Abstract

© 2015. A radiocarbon and tephra-dated sediment core from Lifebuoy Lake, located on the north-east coast of Kamchatka Peninsula, was analysed for pollen, spores, diatoms, chironomids and tephra in order to uncover regional environmental history. The 6500-year environmental history of Lifebuoy Lake correlates with the broad regional patterns of vegetation development and climate dynamics with both diatoms and chironomids showing near-synchronous changes. Between ca. 6300 and 3900 cal. yr. BP, the lake ecosystem was naturally enriched, with several Stephanodiscus species dominating the diatom plankton. This natural eutrophication state is likely to be due to a combination of the base-rich catchment geology, the fertilisation effect of several fires in the catchment, silica input from tephra layers and, possibly, nitrogen input from seabirds. The substantial tephra deposit at about 3850 cal. yr. BP might have stopped sedimentary phosphorus from entering the lake water thus decreasing the trophic state of the lake and facilitating the shift in diatom composition to a benthic Fragiliariaceae complex. Both diatoms and chironomids showed simultaneous compositional changes, which are also reflected by statistically significant changes in their rates of change 300-400. years after the arrival of Pinus pumila in the lake catchment. The rapid increase in both total diatom concentration and the percentage abundance of the large heavy species, Aulacoseira subarctica might be a response to the change in timing and intensity of lake spring turn-over due to the changes in the patterns of North Pacific atmospheric circulation, most notably westward shift of the Aleutian Low. The two highest peaks in A. subarctica abundance at Lifebouy Lake occurred during opposite summer temperature inferences: the earlier peak (3500-2900. cal. yr. BP) coincided with warm summers and the latter peak (300. cal. yr. BP-present) occurred during the cold summer period. These imply that A. subarctica shows no direct response to the changes of summer air temperature. Instead, it appears to thrive during the periods of increased winter precipitation, thicker ice and late spring turn-over periods, i.e., shows indirect response to climate. The clearest effect of tephra deposition on the lake ecosystem is above 908 cm (ca. 3800 cal. yr. BP) where the tephra deposit might have caused the shift from Stephanodiscus-dominated planktonic assemblages to the Fragilariaceae complex of benthic species. Tephra deposits might have also contributed towards the development of eutrophic plankton from about 6300 cal. yr. BP. It is not certain if several tephra deposits influenced diatom and chironomid changes during the last 300 years.

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Keywords

Chironomids, Diatoms, Kamchatka, Natural eutrophication, Pollen, Tephra, Total phosphorus reconstruction