Reduced diversity and productivity of diatoms and other protists during the Early Holocene in the subarctic North Pacific

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Marine protists are a phylogenetically diverse group of single-celled eukaryotes that respond sensitively to changes in environmental conditions. Yet, our understanding how long-term climate variability has shaped the taxonomic composition is mostly unknown, especially of non-biomineralizing groups, such as green algae, since traditional micropaleontological studies are limited to the analysis of microfossil remains with often hardly discernable morphological differences between species (e.g. diatoms). Here we present a sedimentary ancient DNA (sedaDNA) record of the marine sediment core SO201-2-12KL, which was retrieved from the eastern continental slope of Kamchatka at 2173 m water depth (N 53.992660°, E 162.375830°) and covers the past 19.9 thousand years. We applied sedaDNA metabarcoding to 63 samples using a diatom-specific, short plastid marker that is part of the rbcL gene. Additionally, we used metagenomic shotgun sequencing on a subset of 26 samples to investigate the overall taxonomic composition of protists. Metagenomic shotgun sequencing revealed a variety of unicellular plankton groups mostly from green algae (especially Bathycoccus) and diatoms. At 11.1 cal kyr BP only single sequences assigned to green algae, diatoms and coccolithophorids could be detected. Metabarcoding showed strong variability in the richness of diatom sequence variants, which was highest during Heinrich Stadial 1 and the Younger Dryas. From about 11.4 cal kyr BP diatom taxonomic diversity strongly decreased until about 10.7 cal kyr BP. This was associated with highest taxonomic and phylogenetic turnover recorded over the past 19.9 cal kyr. Concomitant with this we recorded sequences assigned to Skeletonema subsalsum, a coastal diatom associated with low salinities or freshwater. Tentatively, as we wait for the confirmation by further sequencing, we suggest that the reduced protist diversity during the Early Holocene resulted from sea surface freshening, which led to a strengthened vertical stratification which could have reduced past productivity due to limited nutrient supply from deeper waters to the photic zone.