Reconstructions of past microbial flora from ice core samples on Gregoriev Glacier, Kyrgyz Tienshan

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Ancient DNA has been obtained from many kinds of substrates. Ice cores, permafrost, as well as subfossil and recent skeletal remains stored in museums are potentially accessible for DNA analysis. Ancient DNA analyses are helpful in clarifying the phylogenetic relationships among organisms with branching dates (time-tree). Analyses of extinct ice cores have often been used in reconstructing past environments. However, the DNA in these samples is often highly degraded and fragmented, and therefore in order to analyze the small amount of DNA preserved in these samples, an effective technique to extract total DNA, shotgun sequencing from ancient DNA extracts, and bioinformatics and molecular evolution analysis from large-scale sequence data set are required. Ice cores drilled from glaciers can provide a means of direct analysis of microbes in the past. The species composition of microorganisms in the ice core could reflect the environmental condition at that time.

Several recent studies have focused on the effect of glacier microorganisms such as snow algae and bacteria on the melting of glacial ice. Despite the ecological importance in glacial environments, little is known about microbial evolutionary dynamics, because of the lack of knowledge regarding past microbial information. We report the results of microbial community structure and their evolution by molecular DNA analysis collected from the ice core samples collected on Gregoriev Glacier, Kyrgyz Tienshan. We successfully reconstruct the microbial community in the ice core samples. We also present detailed pictures of snow algal distribution patterns on glaciers over the Arctic, Antarctic, and Asian high mountains, using the sequences of the nuclear rDNA internal transcribed spacer 2 (ITS2) region. Our results enhance understanding of the enigmatic time scale of snow algal microevolution, which has the potential to elucidate environmental responses of them to the drastic climatic change events of the Quaternary.

Keywords: ice core, microorganism, ancient DNA

