Eukaryotic diversity in late Pleistocene marine sediments around a shallow methane hydrate deposit in Japan Sea

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Eukaryotic DNA has been detected from detrital organisms such as planktonic remains, spores, cysts, and pollen from marine and lacustrine sediments, associated with the intense upwelling and the high primary productivity. However, a large proportion of deposited eukaryotic DNA is aerobically biodegraded in shallow marine sediments. Cold seep sediments are often anaerobic near the sediment–water interface, so eukaryotic DNA in such sediments is expected to be preserved. As the abundance and biodiversity of eukaryotic DNA in deeply buried marine sediments are largely unknown, we investigated marine sediments at depths up to 31.0 meters below the seafloor (mbsf; 97 ka) around a shallow methane hydrate deposit in the eastern Japan Sea. Quantitative PCR analysis revealed the reproducible recovery of eukaryotic DNA in deep marine sediments in the vicinity of the methane hydrate deposit. Pyrosequencing of an 18S rRNA gene variable region generated total 9,366 reads from 5 samples, which was sufficient to cover the biodiversity based on rarefaction curves. Phylogenetic analysis revealed that most of the eukaryotic DNA originated from radiolarian genera of the class Chaunacanthida, which have $SrSO_4$ skeletons, the seagrass genus *Zostera*, and the seaweed genus *Sargassum*. Eukaryotic DNA originating from planktonic fauna and land plants were also detected. Diatom sequences closely related to *Thalassiosira* spp., known as indicator species for cold climates, were obtained from sediments deposited during the last glacial period (MIS-2). Land plant sequences of the genera *Alnus* and *Ulmus* were found in sediments deposited during the warm interstadial period (MIS-3). These results suggest the long-term persistence of eukaryotic DNA from terrestrial and aquatic sources in marine sediments associated with cold seeps, and that the genetic information from eukaryotic DNA from deeply buried marine sediments associated with cold seeps can be used to reconstruct environments and ecosystems from the past.

Keywords: Ancient DNA

Wind erosion alters ecosystem carbon balance and carbon sequestration potential in a temperate grassland

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Wind erosion and deposition of soil could greatly alter soil C pool and ecosystem C balance in arid and semi-arid ecosystems. Land use change is one of the most important driving forces influencing the intensity of wind erosion in those regions. However, how wind erosion under different land use scenarios will affect ecosystem C balance and its capacity for future C sequestration are poorly quantified. Here, we established an experiment in Xinlinhot, Inner Mongolia, and simulated different intensity of land use in grassland: control, 50% of aboveground vegetation removal (50R), 100% vegetation removal (100R) and tillage (TI). We monitored lateral and vertical carbon flux components from 2013 to 2016. We found that wind deposition resulted in net C gain during growing seasons, whereas wind erosion induced net C loss. Adding up the lateral C flux across the whole year, ecosystems under control behaved as a C sink of 44.85 g C m^{-2} yr^{-1}. However, under relative degradation ecosystems, the disturbance managements resulted in a net C loss, and the loss strength increased from 3.35 g C m^{-2} yr^{-1} under 50R to 135.86 g C m^{-2} yr^{-1} under TI and the erosion intensity increased rapidly with experimental duration. Land use also significantly altered the biological vertical carbon flux. The net ecosystem exchange (NEE) shifted from a net uptake of 86.85 g C m^{-2} yr^{-1} under control to a net emission of 35.12 g C m^{-2} yr^{-1} under TI treatment. With the increase in land use intensity, the contribution of lateral C flux to ecosystem C balance increased from 34% under control to 79% under TI. Wind erosion caused by land use changes not only result in dramatically surface soil C loss, but also significantly decrease soil C sequestration potential by altering soil texture. Permanent losses of organic carbon sequestration potential were 0.10 kg C m^{-2}, 0.12 kg C m^{-2} and 0.31 kg C m^{-2} in 50R, 100R, and TI, respectively. Overall, our study demonstrated that wind erosion could result in irreversible soil degradation and shape the landscapes of arid and semi-arid regions in the long term. Appropriate land use is critical to protect grassland ecosystems from being crashed.

Keywords: temperate grassland, land use changes, wind erosion/deposition, C balance, C sequestration potential

Evaluation the physiological effects of extremely high temperature on temperate paddy rice using temperature gradient chamber

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Changes in growths and physiological responses of food crops impacted by climate change are critical for the yield ability. In particular, understanding the effects of high temperature on temperate paddy rice will be important for the food security in East Asia. Under the warmed condition, the lower quantity and quality of gain yield have been reported. The heat wave of 2016 in South Korea was the worst in over 22 years. To understand the effects of extremely high temperature on temperate paddy rice, we examine the measurement data for 2016 from TGC (Temperature Gradient Chamber) where the air temperature was raised gradually 0℃ to 3℃. NDVI (Normalized Difference Vegetation Index), PRI (Photochemical Reflectance Index) and chlorophyll fluorescence observations were analyzed how the high temperature affected the physiological activities of rice. The result was shown that the stress in photosynthesis efficiency was increased according to warm up conditions. Further, the infertile ears were mostly occurred in the 3℃ higher temperature condition than 2016. Moreover, the remained photosynthate by those infertility caused the more tillers and the second ears emerged apart from the infertility ears. However, the second ears had generally low yield ability. The chlorophyll content and vegetation index did not decline even in the late grain filling period. Our result represented that the warmed condition in 2016 would be the critical limit for the stable yield of temperate paddy rice. Continuous TGC experiments will be expected to enhance understandings in the growth and physiological response of crops in the future climate change, and become a foundation of the adaptive technology development.

Keywords: Global warming, Heat stress, temperature gradient chamber(TGC)

