Holocene palynomorph records since the last deglaciation from the Chukchi Sea shelf sediments, western Arctic Ocean

So-Young Kim1, Seung-II Nam1, Leonid Polyak2, Irina Deliusina3

1 Arctic Research Centre, Korea Polar Research Institute, Korea
2 Hyd Polar Research Center, 1090 Carmack Rd., Columbus, USA
3 Department of Earth and Planetary Sciences, University of California, Davis, California, USA

Organic-walled microscopic organisms in marine sediments such as dinoflagellate cysts, pollen, spores and freshwater algae from the Chukchi Sea shelf sediments document spatial and temporal variations in the paleoenvironmental history in relation to regional climatic changes during the Holocene. The records presented here are derived from a sediment core from the shallow shelf of the Chukchi Sea in the western Arctic (core ARA02B/01A-GC), a site which allows us to assess the timing of the Bering Strait opening and its influence over the regional environmental system during the last post-glacial interval. The sediment core contains a rich concentration of terrestrially derived pollen and spores, indicating considerable changes in vegetation over the catchment area including the territories of both North America (Alaska and Northern Canadian Arctic) and Northern Siberia (Chukotka peninsula and Northern East-Siberian coast) during the last 16 kyr BP. We speculate that the palynomorphs were predominantly supplied from eroded shelf sediments during intervals of extensive sea-ice coverage, while they were carried to the shelves by large rivers (Yukon, Mackenzie and Siberian rivers) and then transferred by oceanic currents during low sea-ice coverage intervals. In particular, the percentage ratio between tree-herb pollen and spores, and the algae Pediasium in the palynomorph assemblages represent significant changes in the western Arctic vegetation associated with freshwater inputs, including increased forest vegetation between 8 and 4 kyr BP, a climatic optimum at 5 kyr BP and a termination of the low sea-ice interval at 3 kyr BP. In parallel, marine palynomorphs (dinoflagellate cysts) document significant changes in the marine environments, typically for a dinoflagellate cyst concentration at ca 11 kyr BP suggesting increased nutrient inputs and marine productivity in the study area. Our palynomorph proxy records illustrate the complexity of interactions between land-ocean and highlighting the need for high-resolution records for a better understanding of the western Arctic climate system.

Dinoflagellate cyst assemblages are dominated by protoperidinioid and gonyaulacoid groups, which represent 22–84% and 14–78% of the assemblages, respectively. The most abundant protoperidinioid taxa include Brigantedinium spp. and Pentapharsodinium diacle. The gonyaulacoid group is dominated by Operculodinium centrocarpum and Spiniferites elongatus. P. diacle is generally associated to low salinity and summer stratified waters, frequently observed in Arctic and sub-Arctic regions.

Integrated marine-terrestrial proxy: ARA02B/01A-GC core

A gravity core (ARA02B/01A-GC) obtained from the Chukchi Sea shelf of the western Arctic Ocean during ARAON cruise ‘ARA20B.’

Percentages of pollen and spores in core ARA02B/01A-GC and HLY05
ARA02B/01A-GC core

Study area

• Expansion of forest vegetation in the western Arctic region according to the early Holocene climate warming
• Increased forest vegetation in association with Holocene climatic amelioration
• Differentiation of North American and East-Siberian ecosystem zones?