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Surface water productivity in the Bering Sea and the subarctic North Pacific in response to global climate cooling during the last 2.32 Myrs

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Surface water productivity in the northwestern Pacific decreased abruptly at 2.73 Ma marking the intensification of the northern hemisphere glaciation (NHG). However, it no longer changed after 2.5 Ma in response to further climate cooling recorded in other proxies such as alkenone SST, siliciclast mass accumulation rate (MAR), eolian dust content and MAR. Although the Bering Sea is a highly productive region as a marginal sea located in the subarctic North Pacific, variation of surface water productivity in response to the global climate cooling since the NHG has not been known. Here we analyzed biogenic opal content and MAR from IODP Expedition 323 Site U1343, which is located in a high biological productivity area known as the "Green Belt" of the Bering Sea. Biogenic opal content and MAR ranged from 1% to 45% and from 2 g/cm2/kyr to 23 g/cm2/kyr, respectively. Surface water productivity was high during the interglacial periods and low during the glacial periods. Surface water productivity changed from distinct 41 kyr cycles to 100 kyr cycles after 1.2 Ma. In addition, surface water productivity in the Bering Sea decreased gradually from 2.32 Ma, which is opposite to that of ODP Site 887 in the northeastern Pacific (Gulf of Alaska) known as a high nutrient low chlorophyll area in modern days. Such anti-correlation of surface water productivity between the Bering Sea and the northeastern Pacific can be explained by the degree of nutrient concentration of the Alaskan Stream, which flows into the Bering Sea from the Gulf of Alaska. The increase of the surface water productivity in the northeastern Pacific since the NHG is attributed to the strengthened upwelling system and more Fe input under windy conditions. Increased surface water production consumed more nutrients, leading to less nutrient supply by the Alaskan Stream into the Bering Sea. The decrease of surface water productivity in the Bering Sea was also accompanied with the increase in sea ice diatoms at Site U1343 from 2.32 Ma. In conclusion, the decrease in surface water productivity in the Bering Sea during the last 2.32 Ma is most likely due to the global climate cooling, leading to extensive sea ice cover and decreased advective nutrient supply by the Alaskan Stream.