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Late Pleistocene sea-ice variation and long-term land-ocean linkage in the Bering Sea

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Sea-ice distribution in the Bering Sea is characterized by large interannual variability due to large seasonal variations in daylight and insolation. The Bering Seas contain sediments with high accumulation rates appropriate for the reconstruction of surface and deep water conditions, and for the validation of climate/ocean hypotheses that call on these regions as a variable source of open Pacific intermediate and deep water. In addition, climate change records from these basins tend to be extremely sensitive to high frequency changes due to the semi-isolated nature of these marginal seas. Sea level drop, for example, may produce a profound effect on water mass circulation, sea-ice formation, salinity, and biological productivity in these basins. In the last glacial cycle, there were dramatic surface climate changes within the Bering Sea and enhanced dense water formation probably from the Okhotsk and the Bering Seas. The degree of ventilation of deep and intermediate Pacific waters appears to have been fluctuating during the cold and warm periods, reflecting changes in the configuration of Pacific ocean circulation. It is clear the influence of changes in conditions in the Bering Seas on subsurface water formation may play a critical role in determining glacial-interglacial climate variability. We focus both on the long-term ocean and climate trends, as well as the evolution of higher frequency glacial-interglacial to millennial scale oscillations through the Pliocene-Pleistocene. In this study, three piston cores, KH99-03-UMK-3A, KH99-03-BOW-9A, and MR06-04-PC23 are analyzed which were obtained by cruise KH99-03 by R/V Hakuho-maru (ORI/JAMSTEC) and by MR0604 of R/V Mirai (JAMSTEC). Age model of the cores were constructed by using magneto stratigraphy, AMS radio-carbon-dating, and optically stimulated luminescence (OSL) dating. Ice-rafted debris (IRD), defined as a series of terrigenous grains that are transported by drifted ice, are one of many useful paleoceanographic proxies to reconstruct sea-ice history from marine sediments. Terrigenous clastic grains are incorporated into sea-ice and icebergs through fluvial supply, coastal suspension freezing, cliff-fall and so on. In the seasonal sea-ice area, especially, the grains are caught into sea-ice during coastal suspension freezing and when sea-ice grounded near coastline on continental shelf. The grains are subsequently transported far away from land to sea by drifting sea-ice and icebergs. IRD variation in the sediment cores shows significant drastic changes. The coarse IRD grains (> 1mm in diameter) that are counted on transparent X-ray image of sediment cores has f has positive correlation with ice-algae abundance of photosynthetic plankton, diatom in same sediment cores. The fine particles (160 to 900 micron meter in diameter)has also good correlation with the ice-algae. The results suggest that coarse particle in the sediment is the IRD, derived from sea-ice and /or ice-berg from the glacier. Time series data reconstructed from the sediment cores shows land-ocean linkage in the Bering Sea, relating sea-ice expantion and sea-level changes in the last glacial cycles.

Keywords: Bering Sea, sea-ice, land-ocean linkage, late Pleistocene