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Linkage between climate variability in high latitudes, deep-ocean circulation, and eolian sediment transport

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The major unknown in paleoceanographic modeling is whether the changes of climate variability can be clearly seen in the ocean sediment, and whether linkages between climate, ocean, and sedimentary processes are well enough understood to predict all three components using computer models. New attempts have been made recently to combine existing models, or to build new ones in order to link the atmospheric and hydrospheric processes to the sedimentation processes. A great deal of effort has been directed toward a better understanding of changes in sediment supply, sea-level changes, and atmospheric and ocean dynamics generated by exogenic forces. In our study, we focus on long-term, large-scale changes in ocean circulation and their effect on the sedimentary system. Ocean circulation changes occur at millennial and shorter time scale and are faster than endogenic (tectonic) forces and changes in orbital parameters. Paleoceanographic records indicate that the most dramatic changes of the global ocean circulation on centennial to millennial time scales are caused by meltwater events in high latitudes. During the Quaternary, these events were strong enough to substantially slow down or even reverse the thermohaline conveyor in the Atlantic Ocean. This restructuring of the ocean circulation could have led to substantial warming or cooling of the abyssal ocean and consequent sea-level changes that could have contributed noticeably toward sea level change (major changes of the quaternary sea level are caused by glaciation-deglaciation events). In our study, we investigate the role of global ocean circulation changes in eolian sedimentation because eolian sediment behaves as a passive tracer, similar to other passive tracers and therefore the additional complexity of biogeochemical processes can be omitted from simulations. Importantly, as this tracer is well readable in the sedimentary record, paleocirculation modeling can be verified against stratigraphic data. Here we focus on the changes in large-scale eolian sedimentation patterns linked to abrupt changes of the ocean circulation caused by meltwater events in the high latitudes of both hemispheres.