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Changes in the deep ocean conveyor and eolian sediment transport caused by meltwater events in high latitudes

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The major unknown in paleoceanographic modeling is whether the changes of the ocean circulation can be clearly seen in ocean sediment, and whether the water mass motion can be effectively traced in ocean models. Long term, large-scale changes in ocean circulation offer the greater potential to address this unknown. On a millennium time scale, the most dramatic changes of the ocean circulation are caused by meltwater events in the high latitudes. It is thought that some of these events were strong enough to halt or even reverse the thermohaline conveyor in the Atlantic Ocean. Earlier studies emphasized the role of such meltwater events in the North Atlantic. A series of our recent numerical experiments show that freshening of the Southern Ocean can lead to even stronger restructuring of the global thermohaline conveyor that can lead to substantial abyssal warming. It is shown that the thermohaline circulation changes caused by southern freshwater impacts are traceable in eolian sedimentation pattern. Eolian sediment is behaved to be a tracer of the ocean currents similarly to other passive tracer and can be simulated without the complication of including biogeochemical processes. The advantage of using this tracer is that it is easier readable in sediment. A combination of an ocean global circulation model and a large-scale 3-D sediment transport model is employed to simulate the global ocean thermohaline conveyor and distribution of the global sediment accumulation patterns. Two different group of experiments have been carried out: (1) the experiments with a spatially homogeneous inorganic eolian sediment source at the sea surface to depict the circulation change only, and (2) experiments with realistic present-day eolian dust source. Idealized northern and southern meltwater events, superimposed on the present-day sea surface climatology, caused the deep-ocean circulation changes that were easily traceable in sedimentation patterns. Thus, an approach can be proposed that may be used for verification of the ocean paleocirculation reconstructions.