Simulated Sediment Transport in Modeling of the Ocean Circulation Changes Caused by Southern Meltwater Events

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The major unknown in paleoceanographic modeling is whether the changes of the 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. One of the most dramatic changes of the ocean circulation are the glacial cycles on a millennium time scale. In the course of these cycles, the strongest impact on the ocean thermohaline circulation is imposed 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 for the present–day sea surface conditions, freshening of the Southern Ocean can lead to even stronger restructuring of the global thermohaline conveyor and result in substantial abyssal warming. We explore how a hypothesized freshening of the high latitudes around Antarctica may alter the ocean thermohaline circulation and whether these changes, if any, can be traced in eolian sedimentation pattern. Eolian sediment is chosen because it behaves in a similar way as a passive tracer and can be simulated without the complication of including biogeochemical processes. We present sedimentation patterns obtained using simulations of the ocean currents in MOM–2 ocean model. Sedimentation rates are computed in an off-line sediment transport model. There are two groups of experiments. In the first group, we use a spatially homogeneous inorganic eolian sediment source at the sea surface to depict the circulation change only. To assess a more realistic sedimentation pattern, the present–day eolian dust pattern was specified as an input in the sediment transport model. It is shown that the sediment pattern in both groups reflect the circulation changes. To compare with geologic record, simulation of the sediment transport during the last glacial maximum was carried out with idealized and present–day realistic dust sources. Idealized southern meltwater event, superimposed on the glacial sea surface climatology, was easily traceable in sedimentation patterns.

Additional Resources: http://www.essc.psu.edu/~*bjhaupt*

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