EOS, Transactions, AGU, 2000 Ocean Science Meeting, Vol. 80, No. 49, December 07, 1999, page OS52-OS53

Glacial and Meltwater Deep--Ocean Conveyor: The Appraisal of Water Transport Alterations in a Numerical Model

Dan Seidov, Bernd J. Haupt

Earth System Science Center, Pennsylvania State University, University Park, PA 16802–2711, USA

dseidov@essc.psu.edu; bjhaupt@essc.psu.edu

Mark Maslin

Environmental Change Research Centre, Department of Geography, University College London, 26 Bedford Way, WC1H 0AP, London, GBR

Present--day ocean thermohaline circulation is driven by production of the North Atlantic Deep Water (NADW) forming a presumed global conveyor--type system, which provides a deep-ocean connection between all the most remote regions of the World Ocean. Data analyses and numerical models indicate that this conveyor has undergone substantial changes during glacial cycles of Pleistocene. The most dramatic changes are attributed to freshwater impacts characteristic of Heinrich events, when meltwater from melting icebergs suppresses the glacial deep convection in the northern North Atlantic. It is a widespread opinion that the conveyor was diminished at glacial and completely shut--off or even reversed during Heinrich events. We have tested the state of the global conveyor; at present, during glacial, and during meltwater events, using MOM--2 ocean circulation model with the tracer visualization technique that allows us to track actual deepwater motion. The results of these simulations challenge the idea of strong connections between northern parts of the North Atlantic and North Pacific Ocean. They favor the so--called "cold path" hypothesis implying the return of surface water necessary to replace the NADW via Drake Passage by the Antarctic Circumpolar Current and further to Benguela Current, rather than via Indonesian Throughflow and western Indian Ocean (an alternative "warm path" hypothesis). Also, our experiments indicate that the apparent asynchrony of Antarctic and Greenland climate records during the last glacial cycle of

Pleistocene can be explained by rebounds of the deep-ocean conveyor during Heinrich and Dansgaard-Oeschger meltwater episodes. On the basis of numerical modeling of several generic meltwater scenarios, we conclude that the deep--ocean conveyor can alone cause and sustain the bipolar asynchrony of the surface ocean climate. Since the centuries are required to warm the respective high latitudinal waters due to the deepwater--driven oscillating system, the observed climate millennial--scale leads and lags between the Hemispheres can be attributed to the change in the oceanic heat transport that results from the conveyor rebounds.