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Are Dansgaard-Oeschger cycles and multicentennial cycles of the Holocene and the last glacial interconnected?

G. Bond

Lamont-Doherty Earth Observatory Palisades NY USA 10964 gcb@ldeo.Columbia.edu

New high resolution climate records from North Atlantic deep sea cores reveal a persistent 300 to 500 year-duration cycle (not necessarily periodic) that can be traced through both the present interglacial or Holocene and the last glacial to at least 110,000 years ago. In Marine Isotope Stage 2, where Dansgaard-Oeschger (D-O) cycles are best developed, this robust multicentennial cycle is modulated by a pattern that matches D-O cycles recorded in Greenland ice. It also appears to match subtle oscillations within D-O cycles that are evident in only in the highest resolution ice core records. The findings imply that the two scales of climate variations may be interconnected. The presence of the multicentennial cycle within the Holocene poses an enigma, however, because it must operate independently of ice sheets and instead must arise from ocean-atmosphere interactions.

The multicentennial cycle has been identified in records of oxygen isotopes, of Mg-Ca based sea surface temperatures, of concentrations of ice rafted debris, and of petrologic tracers, particularly hematite-stained grains and Icelandic glass. Cold phases of D-O cycles correspond to increases in ice rafted debris, increases in the petrologic tracers, and increases in oxygen 18. In the Holocene, those shifts were accompanied by a 1 to 2 degree lowering of sea surface temperatures.

Analyses of lithic grains in sediment traps that collect debris released from melting Arctic sea ice suggest that the ice rafted debris in the multicentennial cycle may not come from icebergs, but rather from multiyear sea ice flushed from the Arctic Ocean into the subpolar North Atlantic. If so, surface winds may play a key role in the origin of this cycle and its interconnection with D-O cycles. D-O cycles therefore may be fundamentally related to shifts in at least Northern Hemisphere planetary wave circu-

lation rather than ice sheet instabilities.

Acknowledging the large errors in sediment and ice core chronologies, the multicentennial cycle does not appear to be periodic. It is intriguing though that the 1470-year pacing (or multiples thereof) thought to characterize D-O cycles contains exactly three multicentennial cycles of 490-year duration.