An Alternative Earth: COMMENT

Rapid climate change and Arctic Ocean freshening: COMMENT and REPLY

REPLY

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The primary goal of the Comment by Carlson and Clark (2008) appears to be to draw attention to the Carlson et al. (2007) paper, which disputes the findings of de Vernal et al. (1996). A joint reply focusing on significant issues with the in Carlson and Clark (2008) paper therefore appears appropriate.

De Vernal et al. (1996) applied the modern analogue technique to dinocysts to estimate sea-surface salinity (SSS) at the mouth of the St. Lawrence River at the onset of and during the Younger-Dryas (YD) event. Their data did not support the idea of enhanced freshening during the YD. Subsequently, Lowell et al. (2005) reported on an unsuccessful search for a viable route that could have been the spillway via which Lake Agassiz water made its way through the Great Lakes–St. Lawrence River system into the North Atlantic. This is consistent with de Vernal and others' conclusions.

Carlson et al. (2007) write “We corrected the Mg/Ca record in Globigerina bulloides [Gb] for sea surface temperature (SST) and salinity effects using an existing SST record (from de Vernal et al., 1996).” The idea that one may employ the results of one proxy to correct another is naïve. Dinocysts represent conditions in the photic zone where August SSS ranged from 30 psu to 31 psu (de Vernal et al., 1996). Planktic foraminifera such as G. bulloides could not have developed with such a low salinity. G. bulloides shells were either carried into the area by a salter subsurface layer, as in the modern Gulf of St. Lawrence, or developed sporadically when suitable conditions prevailed.

Carlson et al. (2007) apply a dinocyst-inferred summer SST shift from ~8 °C to ~16 °C to the isotopic paleotemperature equation using an 18O-record from Neogloboquadrina pachyderma such as G. bulloides could not have developed with such a low salinity. G. bulloides shells were either carried into the area by a salter subsurface layer, as in the modern Gulf of St. Lawrence, or developed sporadically when suitable conditions prevailed.

Carlson et al. (2007) conclude “the dinoflagellate-cyst salinity reconstruction for the St. Lawrence River is in error during the YD.” If this were true, one would have thought that they might have been more cautious in using temperatures reconstructed with the same dinocyst transfer function, as assumed in their paper.

Carlson et al. (2007) contest the assumption that the meltwater flux through the McKenzie River outlet to the Arctic Ocean computed in Carlson and Peltier (2005) could have caused the YD event, based upon the reference to Peltier et al. (2006). However, modern coupled atmosphere-ocean climate models such as the NCAR (National Center for Atmospheric Research) CSM1.4 model used in Peltier et al. (2006) are heavily damped. Thus the magnitude of the freshwater forcing needed to cause a significant slowdown of the Atlantic meridional overturning circulation may be an overestimate. Their concerns regarding the carbon dating of freshening events in the Arctic also fails to recognize the issue of reservoir age for the interval of time.

Further support for Peltier (2007) and Tarasov and Peltier (2006) is provided by Darby et al. (2002), Moore (2005), Stokes et al. (2005), and Hillaire-Marcel and de Vernal (2008).

REFERENCES CITED


Durand, S., 2000, Les isotopes de l'uranium dans le St. Laurent. MSc memoir: Montréal, Université du Québec à Montréal, 30 p.


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