Geophysical Research Abstracts, Vol. 7, 07616, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07616

Relationships between Laurentide Ice Sheet variations, Greenland Dansgaard-Oeschger events and sedimentary record in the Orca Basin (Gulf of Mexico).

T. Sionneau (1), V. Bout-Roumazeilles (1), H. Hill (2), B. Flower (2), C. Kissel (3), A. Trentesaux (1)

(1) Université de Lille 1, UMR 8110 PBDS CNRS, Bat SN5, 59655 Villeneuve d'Ascq cedex, France

(2) College of Marine Science, University of South Florida, St. Petersburg, Florida 33701, USA

(3) Laboratoire des Sciences du Climat et de l'Environnement, Laboratoire mixte CNRS-CEA, Avenue de la Terrasse, 91198 Gif sur Yvette, France

(thomas.sionneau@ed.univ-lille1.fr / Phone: + 33.3.20.43.43.96)

To understand the evolution of the global climatic system, a lot of benefits can be obtained by studying the relationships between climatic phenomena at high and low latitudes.

The Gulf of Mexico appears to be an ideal site for such studies. On the one hand, during the last glacial cycle, it was influenced by glacial meltwater discharges from the southern margin of the Laurentide Ice Sheet via the Mississippi River (Teller et al., 2002). Indeed, the Laurentide Ice Sheet fluctuated between growing and melting periods (Marshall and Clarke, 1999) in response to recurrent temperature changes that were recorded in Greenland ice cores as Dansgaard-Oeschger cycles (Dansgaard et al., 1993). On the other hand, it is the place of the Atlantic Warm Pool where the Gulf Stream initiates, since the closure of the Isthmus of Panama, 4.6 million years ago (Haug and Tiedemann, 1998).

For this reason, during the PAGE cruise (IMAGES), a 34.16 metres long piston core, MD02-2552, was recovered in a small (400 km^2) anoxic basin created by salt tectonics and located about 290 km southwest of the Mississippi Delta in the Louisiana

continental slope, at 26˚55'N and 91˚20'W: the Orca Basin (Tompkins and Shephard, 1979; Flower et al., 2004).

It provides a 50,000 years sedimentary record that was studied by magnetic susceptibility, isotopic ratio (δ^{18}O), laser grain-size and clay fraction XRD analyses.

Since no dating has been realised on the MD02-2552, the chronology was determined by extrapolation of the MD02-2551 one (Flower et al., pers. com.), using magnetic susceptibility for core correlation. It seems to be correct in our case since the two cores are very close (a few meters) and subject to same sedimentological processes. MD02-2551 age model has been established from several AMS radiocarbon dates and comparing its δ^{18}O record with those of previous studies.

Several rapid fluctuations of these different parameters were identified from around 43 to 18 kyr B.P. (Sionneau et al., 2004). All these events appear to be related to meltwater pulses from proglacial lakes at the southern margin of the Laurentide Ice Sheet. This hypothesis is in agreement with the following observations: (1) each event corresponds to an abrupt increase of the (I+C)/S clay-mineral ratio (I: illite, C: chlorite, S: smectite) indicating a massive input of illite and chlorite originating from the northern Mississippi River watershed; (2) these intervals of intense detrital supply correlate with low δ^{18}O excursions probably due to freshwater inputs from ice sheet melting (since the shifts observed in the δ^{18}O are too large to record only SST changes); and (3) high values of magnetic susceptibility confirm the evidence of intense detrital supply during these periods.

Using the GISP record, these rapid events are relatively well correlated with Dansgaard-Oeschger oscillations. It means that the ice-margin fluctuations of the Laurentide Ice Sheet (43-18 cal ka B.P.) seem to be almost synchronous with climate variations on Greenland, as it was demonstrated for the Scandinavian Ice Sheet (Mangerud et al., 2003).

However, there is a time-lag, of about 1100 ± 260 yrs, between Greenland interstadials (temperature maximum) and rapid fluctuations of the different parameters on the Orca Basin sedimentary record. It may be explained by a natural delay between climatic phenomena of high and low latitudes or by a problem of chronology between the two records.

Moreover, after 18,000 cal B.P., during the last deglaciation, extreme environmental conditions in the Orca Basin seem to have disturbed the sedimentary record by favouring recrystallization phenomena between the different clay minerals (Tompkins and Shephard, 1979).

References:

Dansgaard, W., Johnsen, S.J., Clausen, H.B., Dahl-Jensen, D., Gundestrup, N.S., Hammer, C.U., Hvidberg, C.S., Steffensen, J.P., Sveinbørnsdottir, A.E., Jouzel, J., Bond, G., 1993. Evidence for general instability of past climate from a 250-kyr ice-core record. Nature 364, 218-220.

Flower, B.P., Hastings, D.W., Hill, H.W., Quinn, T.M., 2004. Phasing of deglacial warming and Laurentide Ice Sheet meltwater in the Gulf of Mexico. Geology 32, 597-600.

Haug, G.H., Tiedemann, R., 1998. Effect of the formation of the Isthmus of Panama on Atlantic Ocean thermohaline circulation. Nature 393, 673-676.

Mangerud, J., Løvlie, R., Gulliksen, S., Hufthammer, A.-K., Larsen, E., Valen, V., 2003. Paleomagnetic correlations between Scandinavian Ice-Sheet fluctuations and Greenland Dansgaard-Oeschger events, 45,000-25,000 yr B.P. Quaternary Research 59, 213-222.

Marshall, S.J., Clarke, G.K.C., 1999. Modeling North American Freshwater Runoff through the Last Glacial Cycle. Quaternary Research 52, 300-315.

Sionneau, T., Bout-Roumazeilles, V., Trentesaux, A., 2004. Relation entre les variations de la calotte glaciaire Laurentide et l'enregistrement sédimentaire dans le Bassin d'Orca (Golfe du Mexique). Annales de la Société Géologique du Nord 11, 83-84.

Teller, J.T., Leverington, D.W., Mann, J.D., 2002. Freshwater outbursts to the oceans from glacial Lake Agassiz and their role in the Climate change during the Last deglaciation. Quaternary Science Reviews 21, 879-887.

Tompkins, R.E., Shephard, L.E., 1979. Orca Basin: depositional processes, geotechnical properties and clay mineralogy of Holocene sediments within an anoxic hypersaline basin, northwest Gulf of Mexico. Marine Geology 33, 221-238.