Elevated Mississippi River discharge during glacial times: a 7,000 year wet event on the North American continent

Heather W. Hill, David J. Hollander, Benjamin P. Flower and Terrence M. Quinn

1. ABSTRACT

Sedimentary basins proximal to major rivers can provide a unique, high-resolution assessment of the oceanic and continental responses to changing hydrographic regimes attributed to abrupt climate variability. Documenting these regime changes under climate extremes, including glacial time periods that are often considered cold and dry in temperate North America, is important to understand the potential extremes associated with changing paleoclimatic conditions. The Orca Basin in the northern Gulf of Mexico records warm interglacial climates in which Mississippi River discharge contributed to regional sea-level rise. Associated with the wet interglacial, a 5-fold increase in the eustatic signal is synchronous with the fluvial inputs and may suggest that southern migration of frontal weather systems promoted enhanced precipitation of Gulf of Mexico moisture to the continent, resulting in oceanic biological and physical changes. Results of this study will be discussed in the context of regional and climate fluctuations, paleoclimatic proxies and global circulation models.

2. INTRODUCTION

- Floods are an important component of Many climatic fluctuations: they mobilize sediment and nutrients and can produce biological changes where they discharge into the ocean

- Floods in the Mississippi River (MR) Basin (Figure 1) have been linked to climate variability associated with changing hydrographic regimes.

- MR discharge/suspended sediment proxies and algal n-alkanes (Figure 2) point to an increase in marine production. Further, a 3C cooling in SST, as determined from oceanic productivity (Figure 3), which shutes moisture to central U.S. through anticyclonic atmospheric circulation

- Gulf of Mexico moisture flux controlled by position of polar jet streams and seasonal migration of Bermuda High (Figure 4), which controls moisture to central U.S. through anticyclonic atmospheric circulation

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3. SCIENTIFIC APPROACH

- Study Site: Orca Basin (Figure 5)
- Insoluble residue
- Organic biomarkers
- Algal n-alkanes

4. INCREASED MISSISSIPPI RIVER DISCHARGE AND ENHANCED MARINE PRODUCTIVITY

- Organic biomarkers
- Algal n-alkanes

5. LIS CONTROL ON MR DISCHARGE

- Major controls: 1. Laurentide Ice Sheet meltwater discharge and increased primary production from 26.2-24.4 m
- Two primary mechanisms to explain the observed changes: 1) Laurentide Ice Sheet meltwater discharge and 2) Increased input due to changes in atmospheric circulation patterns

6. HYDROLOGIC CONTROLS ON MR DISCHARGE

- Intensification of frontal boundary and seasonal migration of ITTC and westward shift of Bermuda High (Figure 6)
- Intensification of Bermuda High during sea deglaciation (Figure 7)
- Suggests possible control of Mississippi River discharge.

7. CONCLUSIONS

- Increased MR discharge from 31-38 ka attributed to hydrology driven event
- Westward shift of BH and enhanced moisture into central U.S. possibly due to cold SST and rising solar insolation
- Concurrent increase in marine productivity driven by enhanced nutrients from discharge

8. ACKNOWLEDGEMENTS

The authors would like to thank Ethan Goddard for laboratory assistance with all analyses. Jen Flannery and Dave Adams helped with preparation of organic samples. We also thank the IAMRAS program for core collection.