A COMPARISON OF OVERBANK SEDIMENTATION THICKNESS AND TEXTURE IN NON-EMBANKED FLOODPLAINS DURING THE 2011 AND 1973 FLOODS ALONG THE LOWER MISSISSIPPI RIVER, USA

Franklin T. Heitmuller1, Paul F. Hudson1, and Richard H. Kesel1

1 Assistant Professor, Department of Geography and Geology, The University of Southern Mississippi
2 Associate Professor, Head of Studies - Sustainable and Environmental Sciences, U.C. The Hague, Leiden University, The Netherlands
3 Professor, Department of Geography and Anthropology, Louisiana State University

ABSTRACT
The 2011 flood along the Lower Mississippi River established new stage records at various locations from Mississippi (peak discharge of 65,400 m³/s) to Vicksburg, Mississippi (to 16,903 m³/s) in Vicksburg, Mississippi to Louisiana, and compares the results with floodplain deposition during the prolific 1973 flood in the same area. Notably, the study sites occur in floodplains that are not protected by flood-control levees (dikes). Also, the study reach has exhibited an alarming trend of increasing stages for a green flood discharge. Results show considerable variability in sediment thickness ranging from 1 m to 25 m and are deposited along natural levees. At some sites on natural levees, however, little sediment was deposited despite an increase of up to 4 m. Overall, most sites are characterized by less than 10 m of overbank sediment and are considerably less than thicknesses measured following the 1973 flood. All depositional sub-environments, including natural levees, meander scrolls, and backswamps, were subject to less sedimentation than the 1973 flood. Additional comparisons of texture with the 1973 flood indicate that natural levees do deposits are coarsest. Coarsest thick deposits on meander scroll ridges are finer, and capillary backwater and capillary deposits are somewhat coarser for the 2011 flood sediments. These data indicate relatively energetic, sediment-deprived overbank flow conditions that possibly occurred post-sudden inflows of surficial floodplains sediments from proximal sub-environments and transported them to distal areas of the floodplain. The well-documented decline of suspended-sediment loads along the Lower Mississippi River floodplain shows the overbank sediment deposition in 2011, but another important factor is that the annual peak suspended-sediment load (1,046,000 tons/day) for 2011 occurred during a minor overbank event two months prior to the larger flood. Where peak discharge was associated with a suspended sediment load of only 175,000 tons/day. These results have important implications for flood control and environmental restoration efforts because, at present, floodplain sequestration of sediment plays a minor role on both the increase in flood stage along the study reach and does not explain the limited delivery of sediment to coastal environments.

Key Words: 2011 flood, flooding, Lower Mississippi River, sedimentation

STUDY AREA - LOWER MISSISSIPPI RIVER

RESULTS

2011 FLOOD AND METHODS

This photo was taken along a flood-control levee in November 2011 near Red River Landing. The photo clearly exposes the 1973 flood (left) and 2011 flood (right).

Figure 5. Relatively thick overbank sediments in 1973 (left) clearly show differences in elevation and identification of a buried flow-grained organic-rich deposit.

REFERENCES

CONCLUSIONS

The relatively thin overbank sediment measurements indicate that the prolific May – June 2011 flood along the Lower Mississippi River did not transport large volumes of sediment into non-embanked, alluvial floodplain environments. The sediment thickness results presented here are comparable to depositional thicknesses in floodplains along the Upper Mississippi River during the great 1933 flood (20 to 200 mm average) (Gomez et al., 1995, 1997, Magilligan et al., 1998), indicating that extreme floods are not always associated with profound agro-environmental adjustments in floodplain settings. Interestingly, suspended-sediment load data (Figure 8) just upstream of the study area indicate a peak load (1,045 metric tons/day) during a relatively minor high-flow event from late February to March, whereas the peak-mapped flood during the larger May – June flood was 843 metric tons/day. Apparently, sediment exhaustion during the earlier event contributed to the reduced amounts of floodplain deposition observed in the study area. The particle-size data indicate that flow velocities across the floodplain were likely higher in 2011 than 1973, which is quite plausible considering the evidence for increasing channel-bed elevations in the study area (Wallace et al., 2004). Although less sediment was deposited on natural levees deposits were very coarse and less associated with the backwater channels in 2011. The fine-grained “flm” on meander scrolls likely was deposited during the warning stage of the flood, possibly representing fine aggradation of ponded water. In contrast, the fine-grained, sediment-deprived overbank flow occurred across meander scrolls, then it is quite plausible to assume pre-existing soil particles were detached (stripped) from the rippled surface and subsequently transported to their floodplain environments. Evidence of this phenomenon can be observed in the relatively coarse 2011 backswamp deposits (18% sand) when compared to 1973 (6% sand), suggesting a nearly excavated source instead of simply muds derived from evaporation of stranded flood water.

CONTRIBUTORS

This research was funded as a National Science Foundation Award # 1117179, as part of the RAPID research grant mechanism. Goebel is supported by the U.S. Geological Survey and Oza is supported by the University of Amsterdam for field and laboratory assistance.

The Geological Society of America Annual Meeting and Exposition
Charlotte, NC; November 4-7, 2012

Figure 7. Average % sand content of overbank sediments deposited by the 1973 (Kesel et al., 1974) and 2011 Lower Mississippi River floods in various depositional sub-environments in the study area.