Long-Term (~80 ka) Crustal Movements in the Mississippi Delta and Lower Mississippi Valley

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Crustal movements underneath the Mississippi Delta (MD) have profound implications for the sustainability of this highly vulnerable coastal environment within the context of climate and sea-level change. Some recent studies have suggested that crustal subsidence in the MD occurs at rates as high as ~5 mm/yr. However, this view has not been corroborated by long-term geological data stretching back into the Miocene. This presentation addresses crustal movements in and around the MD during the last ~80 ka by means of an analysis of longitudinally continuous late Pleistocene fluvial strata (the Prairie Complex) in the Lower Mississippi Valley (LMV).

A systematic geochronologic study of the Prairie Complex with optically-stimulated luminescence (OSL) dating reveals that a significant portion of these strata formed during marine isotope stage (MIS) 5a (~80 ka) when relative sea level was roughly comparable to present sea level in the Gulf of Mexico. MIS 5a fluvial strata are longitudinally traceable over a distance of ~700 km from the MD to the central LMV. The MIS 5a Mississippi River long profile is distinctly different from the present-day long profile, featuring up to 18 m of uplift in the southern portion of the LMV, just north of the MD, and more than 20 m of subsidence near the present-day shoreline.

Considering that the Mississippi River likely graded to a comparable base level during MIS 5a as it does today, these differences are explained as the result of flexure of the crust during the past 80 ka due to sediment loading, a geological process that has been identified, but rarely quantified, for more than 50 years. The intersection of the two long profiles at about 30° N in the MD points to a hinge line separating uplift and subsidence that lies very close to the position inferred by previous studies. North of the hinge line, a peripheral bulge was formed. South of the hinge line, the long-term (~80 ka) average subsidence rate increases downdip but is less than 0.4 mm/yr, an order of magnitude less than values suggested by some recent studies. However, it is conceivable that subsidence rates increase offshore due to the progressively increasing sediment load in that direction. Nevertheless, our findings indicate that subsidence due to sediment loading contributes only a small proportion to the rapid subsidence of the land surface in the Mississippi Delta.