Subsidence Associated with Active Growth Faulting on the Mississippi Delta: Displacement Rates and Steering of the Mississippi River

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We present data from an industry-grade seismic volume located over 800 km2 of Breton Sound, LA that images the Quaternary section of the Mississippi Delta. In our study region paleontological data from petroleum wells is used to estimate long term (greater than 1 Myr time-spans) subsidence rates between 0.2 - 0.3 mm/yr. Using the upper 1 km of this volume we have identified and mapped 6 regional growth faults that extend to the present-day Earth surface. Measurements of fault displacement were obtained for the relatively shallow section by determining the progressive offset of seismic horizons by faults. Faults have displacements that increase roughly linearly with burial depth from as shallow as ~200 mbsf to 1500 mbsf. Vertical displacement rates associated with these faults are relatively small compared to background subsidence rates. For the six faults studied, long-term displacement rates are only between 4 - 8 % of the regional subsidence rate. We have assessed the control of subsurface faulting on surface topography of Mississippi River delta using co-registered maps of fault traces and orthophoto quadrangles and field work. This analysis has revealed a number of instances where faulting affects modern surface morphology. Data from laboratory experiments will be presented that suggests steering of the modern day river by growth faults is likely a consequence of punctuated fault movement. During these short time-span events, vertical displacement rates on faults are many orders of magnitude greater than long term rates and thus are able to produce topographical expressions large enough to steer channels over short time intervals.