Temporal Scales of Mass Transport on the Mississippi River Delta Front from Results of a New Regional Survey

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ABSTRACT

The Mississippi River Delta Front (MRDF) is an apron of rapidly depositing and weakly consolidated sediment extending from the subaerial portions of the Birdsfoot Delta of the Mississippi River. Key morphological elements include (1) gullies, seafloor depressions in water depths ~5–70 m transporting mudflows downslope, forming (2) positive relief mudflow lobes between ~50–200 m water depth, that evolve over poorly constrained temporal and spatial scales. The first geological survey of the MRDF in ~40 years was undertaken in 2017, led by LSU, BOEM, and USGS scientists. Twenty-eight piston cores collected off of distributaries of the MRDF, up to 8.9 m in length, were analyzed (using a Geotek multi-sensor core logger) for resistivity, magnetic susceptibility, density, core stratigraphy and compared with CHIRP subbottom data. Observed undulation and discontinuities in density profiles occurring 0.7–2.0 m into the seabed in gullies, are not present outside of the gullies. Keller et al. (2016) demonstrated that undulations in density profiles correspond to flood deposits, preserved at seasonal scales. Keller et al. (2016) also identified short-term deposition

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rates of ~0.1 cm/day, and longer-term sedimentation rates of 1.3–8 cm/yr. However, Obelcz et al. (2017) showed overall gully deepening of ~1 m/yr. If discontinuities in core density profiles represent the lower depth boundaries of mass-transport events, and accretion rates of Keller et al. (2016) can be used to estimate the frequency of these events, then landslides have minimum return periods of ~9 years. Three temporal scales of seabed sedimentation are evident: seasonal deposition by flood events and related storm reworking of annual flood deposits; rapid sediment slumping and annual-scale creep-like mass transport that produces bathymetric deepening (~1 m/y) in gullies, with detachment planes likely below 2 m in the seabed; deposition of mudflow deposits >0.7 m thick in gullies, over decadal timescales.