Paleoenvironmental reconstruction of coastal marsh successions during early Holocene sea-level rise

LAEL VETTER[1]*, KATHRYN M. SCHREINER[2], BRAD E. ROSENHEIM[3], BARRY KOHL[1], BRIANNA M. STEINMETZ[1], LEE NEWSOM[4] AND TORBJÖRN E. TÖRNQVIST[1]

[1]Department of Earth and Environmental Sciences, Tulane University, New Orleans, LA 70118 USA (*correspondence: lvetter@tulane.edu)

[2]Large Lakes Observatory, University of Minnesota Duluth, Duluth, MN 55812 USA

[3]College of Marine Sciences, University of South Florida, St. Petersburg, FL 33701 USA

[4]Department of Anthropology, Pennsylvania State University, State College, PA 16801 USA

Coastal marshes perform essential ecosystem services, including nutrient filtering, soil organic matter storage, and storm surge abatement, and yet much is still unknown about their formation and fate under periods of rapid sea level rise. During the early Holocene, sea level rise in coastal Louisiana was one of the fundamental controls over marsh development and sustainability. Here, we investigate plant community composition and succession in early Holocene coastal Louisiana marshes using lignin phenol biomarkers, stable carbon isotopes, and plant macrofossils collected and analysed from peat layers recovered from coastal sediment cores. Benthic foraminiferal assemblages are analysed to reconstruct estuarine salinity gradients. New cores collected in southeast Louisiana contain a sedimentary record of an early Holocene transgressive sea-level sequence 14-25 m below present sea-level: an immature paleosol overlain by basal peat that accumulated in an estuarine marsh, overlain by marine lagoonal muds. A re-established marsh peat is present 1-4 m above the initial transition to full marine conditions, indicating a sequence of marsh development, rapid sea-level rise, followed by further marsh development as the rate of relative sea-level rise decelerated.

Plant community composition in coastal marshes was determined through cupric oxide oxidation and lignin-phenol and non-lignin-phenol abundances. Plant macrofossils. and microfaunal assemblages were further used to determine marsh type. Additionally, ratios of specific lignin-phenol biomarkers give information about the degradation state of soil organic matter and the specific source of stabilized organic matter within the peats. These results have important implications for reconstructing the response of coastal marshes and their plant communities to variable rates of sea-level rise, especially in today's changing climate.