Stratigraphic Architecture of Transgressive Tidal Inlet Fill

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Understanding coastal sedimentary response to sea-level rise (SLR) is important for interpretation of ancient deposits and predicting future impacts to modern coasts. Interpreting transgressive coastal deposits is difficult because processes active along retreating coasts remove most primary coastal lithosomes. Evidence supporting the occurrence of barriers on the shelf during lower sea levels primarily consists of paralic deposits preserved seaward of modern barriers. Tidal inlet fill deposits are also useful for defining former shoreline positions because basal inlet strata have the highest preservation potential in retrograding barrier systems. However, no compelling evidence has been presented documenting widespread inlet fill deposits on the shelf. This is probably because they were not preserved or a suitable analog has yet to be offered, deluding investigators. Existing inlet fill stratigraphic models do not fully characterize facies associations and stratal geometry produced during rapid coastal retreat because they are based on late Holocene barriers where inlet fill deposition is dominated by lateral migration. Landward migrating systems in a regime of rapid SLR are not considered. Here we present a morphostratigraphic model for inlet fill sedimentation and assess preservation potential along the transgressive Louisiana coast (relative SLR ~1 cm/a; shoreface retreat >15 m/a). Using a bathymetric time-series (1887-2006), we developed an evolutionary model for inlet response to rapid SLR and then applied this knowledge to subsurface data acquisition. In this way, morphodynamics influencing inlet evolution are directly related to resulting stratigraphy. Results demonstrate that transgressive inlet fill differs greatly from the lateral-fill models because: 1) transgressive inlet channels backfill with ebb delta sands during landward migration, 2) landward migration produces stratal geometry characterized by dip-elongate, symmetrical channel fills instead of the strike-elongate geometry produced by lateral migration, and 3) transgressive inlet fill lithology is highly varied because it is largely dependent upon estuarine sediment supply, tidal prism, and storm impacts rather than an updrift littoral sand source. The presence of an ebb delta influences preservation potential because it provides fill material and protects underlying inlet fill deposits during transgression. Inlet fills are absent along coastal sectors where inlets lack ebb-tidal deltas.