The Late Quaternary Rio Grande Delta— A Distinctive, Underappreciated Geologic System

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ABSTRACT

The delta of the Rio Grande/Rio Bravo in southernmost Texas and northern Tamaulipas is one of the major deltas of North America. Over 600,000 people live on the Holocene delta and river plain, and a million more on its Pleistocene ancestors, yet geologic knowledge is limited. Combining available geologic information with global satellite photography gives a balanced view of an important delta.

The Holocene delta begins at a point west of San Benito, Texas, forming a classic eastward-opening delta. Over half of the delta lies south of the present Rio Grande drainage. The delta passes westward into a floodplain that becomes entrenched into older rocks westward to Roma. In this delta, distributary channels or *resacas* are extremely sinuous and show a pronounced levee rise. A yazoo stream in the floodplain cuts northward across Pleistocene deposits to form a displaced delta. The delta plain is extensively modified by eolian processes. Erosion of clay-rich algal mats from exposed *esteros* (large, shallow ephemeral lakes) create complex 'clay dune' deposits that form 6 m (20 ft) high hills (*lomitas*) on the flat plain. Dominant SE to SSE winds affect sand movement along the transgressive shorelines. Longshore movement is particularly effective on the north side of the delta, less so on the south side.

The delta appears to have formed between 8000 and 3000 years BP by a robust, sediment-loaded Rio Grande. This period occurs during the Holocene Climatic Optimum, which was a dry time (altithermal) on the High Plains. Since 3000 years BP, the delta has been much less active and has been transgressed by barrier systems. The delta today is inactive, because of upstream reservoirs built since the 1940s. Before then, the river had irregular high discharge due to tropical systems and contributions from the upper Rio Grande system. The Pleistocene deltas that form the Beaumont surface underlying McAllen, Edinburg, and Harlingen probably exhibit similar landforms.

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THE LATE QUATERNARY RIO GRANDE DELTA :

A Distinctive, Underappreciated Geologic System

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- The delta of the Rio Grande/Rio Bravo in southernmost Texas and northern Tamaulipas is one of the major deltas of North America. Over 600,000 people live on the Holocene delta and river plain, and a million more on its Pleistocene ancestors, yet geologic knowledge is limited. Combining available geologic information with global satellite photography gives a balanced view of an important delta.
- The Holocene delta begins at a point west of San Benito, Texas, forming a classic eastward-opening delta. Over half of the delta lies south of the present Rio Grande drainage. The delta passes westward into a floodplain that becomes entrenched into older rocks westward to Roma. In this delta, distributary channels or *resacas* are extremely sinuous and show a pronounced levee rise. A yazoo stream in the floodplain cuts northward across Pleistocene deposits to form a displaced delta.
- The delta plain is extensively modified by eolian processes. Erosion of clay-rich algal mats from exposed *esteros* create complex "clay dune" deposits that form 6 m (20-ft) high hills (*lomitas*) on the flat plain.
- Dominant SE to SSE winds affect sand movement along the transgressive shorelines. Longshore movement is particularly effective on the north side of the delta, less so on the south side.
- The delta appears to have formed between 8,000 and 3,000 years BP by a robust, sediment-loaded Rio Grande. This period occurs during the Holocene Climatic Optimum, which was a dry time (Altithermal) on the High Plains. Since 3,000 years BP, the delta has been much less active and has been transgressed by barrier systems.
- The delta today is inactive, because of upstream reservoirs built since the 1940s. Before then, the river had irregular high discharge due to tropical systems and contributions from the upper Rio Grande system.
- The Pleistocene deltas that form the Beaumont surface underlying McAllen, Edinburg and Harlingen probably exhibit similar landforms.

SUMMARY

- Major point-source delta in western Gulf (Late Pleistocene and Holocene)
- Densely settled (1-2 million people) but geologic knowledge is sparse
- River and valley subject to great floods, but otherwise area is semiarid
- Consistent SSE winds in semiarid climate generate distinctive features; lomitas (clay dunes), mudflats
- Transgressive shoreline system highly variable



Texas Gulf Coast Shorelines

(From Ewing, 2016, **Texas Through Time**; UT Bur. Econ. Geol.)



Rio Grande Basin

456,000 km³ contributing Major water sources to north, west, southwest



RELATION TO LGM LOWSTAND









Hurricane Beulah – storm of record

Hit valley in Sept 1967
15-30" (to 75 cm) rainfall
8-14' storm surge Pt Isabel and N
Created river flood of
6230 m³/s (220,000 cfs)
at Rio Grande City –
with dams in place!
\$100 million damage in US alone
(prob. \$5-15 billion today)

Delta Overview



Resacas and Lakes



Major Resacas (US Side)



Sinuous Channels, Upper Delta



Sinuosity = 2.68 MB Width =1.24-1.77 km M Wavelength =1.6 km M Arc Height = 515 m MB Height = 3-5m Channel Width: Today 33m Historic 60-120m

Outer delta closeup



Lomitas and Esteros



Algal mats and clay dunes







Lake with dune filling R. La Pita



R. Cuates cut-through by lake



Boca Chica Dunes and Boca del Rio



Profiles of bay and barrier



Irrigation and Flood Control



Dams and Canals



Sunset, Sal del Rey

