Evidence for an Old Parana Delta and Diachroneity in Global Highstands

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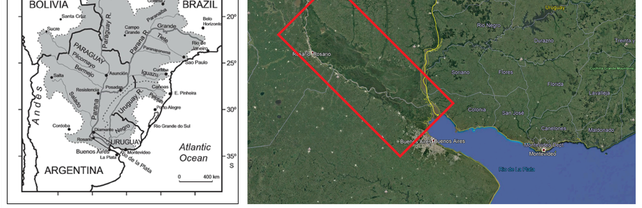
Introduction

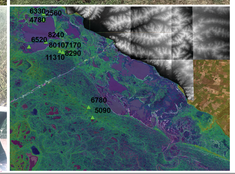
Deltas are vital food-producing areas in low-lying littoral regions that are greatly affected by minor changes in sea level. Most modern deltas have initiated over the last 5000-7000 years. A range of factors including tectonic displacement, isostasy, climate, drainage basin morphology, fluvial and sediment discharge, tides, and coastal currents (Stanley and Warne, 1994) impacts the development of deltas. These are all considered important factors, but the common driving factor behind the initiation of modern deltaic systems is the static conditions of global sea level during the Holocene, allowing fluvial sediments to prograde seaward from stable shorelines accreting subaerial landmasses (Stanley and Warne, 1994). During the Holocene time, this started between 5000-7000 yrs ago which is why it is irregular that the Parana Delta began forming before this time. In a study done by Stanley and Warne in 1994, the oldest radiocarbon dates available from 36 depocenters around the world were used to evaluate the timing of the initiation of Holocene deltas. This study dated the transgressive muds at the base of the deltaic sequences that conformably overlies the Pleistocene deposits in these deltas. The dates gathered from these basal muds date the oldest transgressive mud of any of these deltas to be approximately 8000 yrs B.P., in the mid Holocene. This is indicative of when the earliest signs of transgression ending, while at the same time the Parana Delta appears to have already began prograding into the Rio de la Plata Estuary. The purpose of this study is to map out the upper zone of the delta and collect samples to date, then try to determine why this delta initiated before the deltas in the rest of the world. The purpose of this project is to assess the lithofacies distribution of fluvio-deltaic sediments and the geomorphology of the early highstand Parana Delta, Argentina. The collection of sediment cores from across the delta will be used to accomplish the following three objectives: identification and description of lithofacies across the upper delta and create a sequence stratigraphic framework; map the distribution of these facies in the subsurface across the upper delta and create a depositional model; use the dates collected from radiometric dating conducted at the University of Nebraska to test the initial data which suggests the delta initiated at approximately 8000 yrs B.P. as well as further constrain the ages of different parts of the delta and develop a chronological model for the development of the Parana Delta.

Study Area



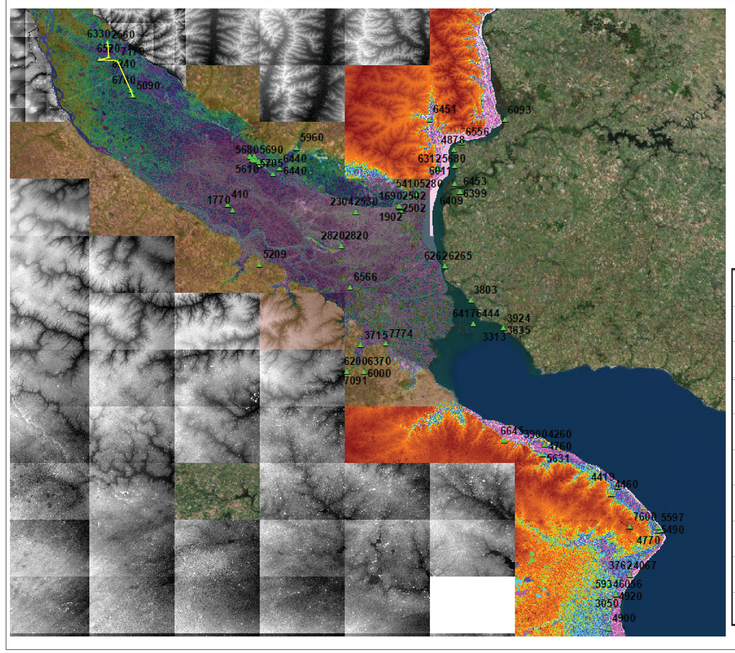
The Paraná Delta lies between Argentina and Uruguay where the mouth of the Parana River meets the Rio de la Plata Estuary (RPE). The RPE is a large, funnel-shaped estuary that extends from the Paraná River mouth near the city of Diamante in the Northwest and widens to the Southeast connecting into the Atlantic Ocean near Buenos Aires, Argentina. The development of the delta and associated coastal plains occurs in an extensive low-lying area between the high plains of Provinces of Entre Rios and Buenos Aires within the inner Rio de la Plata Estuary during the time of maximum expansion of the Holocene transgression (Iriondo 1979). The Parana River is one of the largest rivers in the world and the second largest in South America. The Paraná has a drainage area of approximately 3,000,000 km2 with its tributaries spanning from the upper reaches of the Parana Basin in southern Brazil over to the front range of the Andes in northwestern Argentina. In addition to the Parana River, the Uruguay River also drains into the Rio de la Plata. It is the second largest river in the RPE and has a drainage area of about 365,000 km2. The Uruguay River has an average water discharge of ~6,000 m3 s – 1 and a high water discharge of ~37,700 m3 s – 1. The upper part of the Rio de Plata, at the confluence of the Parana and Uruguay Rivers, is a freshwater setting due to the large discharge of these two rivers (Urien 1972).

Methods



Site Selection
Aerial and Satellite Imagery
ASTER Digital Elevation Model
Dutch Auger
PVC Suction Core
Optically Stimulated Luminescence (OSL) Dating
AMS Radiocarbon Dating
Stratigraphic Corelation

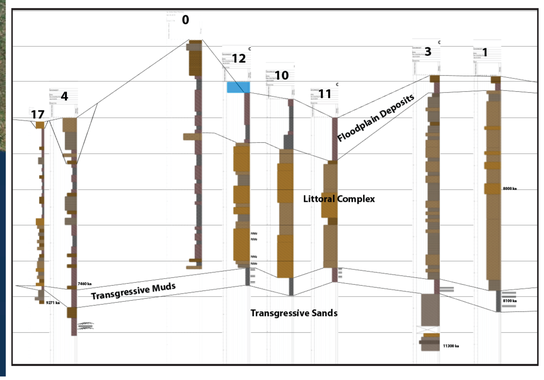
Results

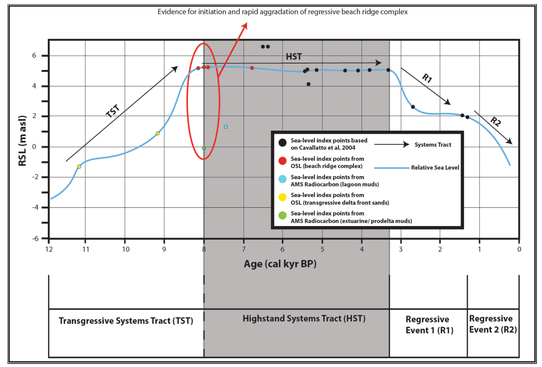


Analysis of OSL and AMS radiocarbon dating samples from the northwestern area of the Rio de la Plata Estuary, dates of 11,310 yrs BP (for early Holocene transgressive sands), 9,240 yrs BP (for mid Holocene transgressive interbeded sands and clays), 8,000 yrs BP (for mid Holocene transgressive muds), 8,000 yrs BP (for mid Holocene coastal littoral deposits).

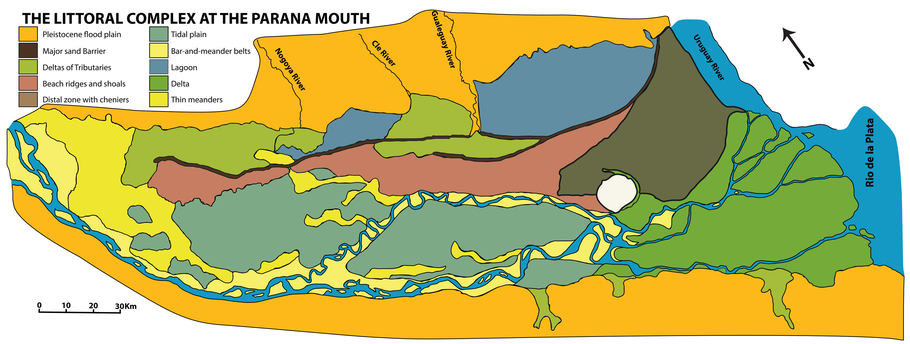
These newly aquirred dates were then corelated to 39 additional radiocarbon dates collected from sampling sites across the mid to lower Rio de la Plata Estuary and Atlantic coastal margin of Northeastern Buenos Aires Province.

In addition to the new dates aquirred, seventeen exploratory wells were drilled using a dutch auger system. These were drilled to analyze and classify the textures of the Parana Delta and associated littoral ridge complex.





Discussion & Conclusions



Evolution of the Rio de la Plata Estuary:

18,000/20,000 yrs BP: Begining of Holocene transgression, sea level begins to rise and inundate the Rio de la Plata paleovalley

9,000/10,000 yrs BP: Holocene Transgression invading inner Rio de la Plata Estuary

8,600/8,000 yrs BP: Decrease in rate of sea-level rise, allowing early development of littoral complex

8,000 yrs BP: Initiation of littoral ridge complex and early wave-dominated delta development

6,000 yrs BP: Holocene Transgressive Maximum, littoral ridge complex and wave dominated Parana Delta prograde to Gualeguay confluence with bifurcation of Parana River

6,000 - 2,500 yrs BP: Sea-level begins to fall, upper section of littoral ridge complex and old Parana delta canibalized by current Parana River an redisposited as wave-dominated delta with attached muddy chenier plain.

2,500 - 1,700 yrs BP: Sea-level continues to fall, progradation of muddy chenier plain and continuation of Parana Delta growth

1,700 yrs BP - Present: Sea-level falls to present day level, Parana Delta transitions from wave dominated to fluvial dominated and develops current delta geomorphology seen at present day

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