HIGH RESOLUTION STRATIGRAPHY OF A RECENT DELTA LOBE PROGRADATION: NORTH-CENTRAL GULF OF MEXICO

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ABSTRACT

The barrier shoreline protecting Barataria Bay in southeastern Louisiana is the product of several cycles of delta progradation, abandonment and marine transgression over the past 4000 years. These cycles have ceased since the current position of the Mississippi River Delta, and the Barataria shoreline is being eroded as protective barrier islands are diminishing and back-bay marshes are becoming inundated by sea level rise. It is necessary to identify the stratigraphic framework of these delta-building events, both for basic geologic understanding and to locate potential resources suitable for future shoreline renourishment projects. An extensive collection of geophysical and sediment core data from Barataria Bay and offshore establishes the stratigraphic architecture for the Bayou Des Families delta, which prograded the area approximately 4000 years before present. The results of this study describe the regressive/transgressive cycle that occurred from inception to abandonment of the delta, and provide a high-resolution seismic and textural characterization of associated sedimentary facies, including prodelta, distributary and flooding deposits.

Additional Index Words: Mississippi River Delta, Barataria Basin, fluvial deposits

INTRODUCTION

The Mississippi River delta plain west of the present day birdfoot delta is an amalgamation of shallow-water delta complexes created as the river shifted from one dominant course to another. These complexes are composed of a cyclic facies assemblage associated with river distributaries and delta lobes. Distribution of these assemblages is controlled by river gradient and receiving basin dimensions. Due to decreasing gradient at the receiving basin, the river loses current velocity and quickly drops its sediment load, building a delta lobe that progrades across the basin. Once progradation reaches a point where the river gradient can no longer maintain flow, the river course is abandoned for a more favorable gradient, starting a new progradational cycle. After abandonment, subsidence due to dewatering and compaction lowers the subaerial portion of the delta below sea level, which allows marine processes such as waves and tides to rework the upper delta units. If subsidence is rapid, the subaqueous progradational facies may be buried and preserved following the marine transgression.

West of the present day birdfoot delta, FRAZIER, (1967), identified four separate delta complexes (Fig. 1) with 10 subdelta lobes that formed during the past 6000 years. Within the subdelta lobes are recognizable facies that identify stages of progradational development. These facies are described by COLEMAN (1982), and include the subaqueous portion of the delta: prodelta, delta front, distributary, interdistributary basins and associated overbank deposits. Subsequent abandonment facies associated with the delta cycle include erosional headland, flanking barrier, and tidal delta deposits (PENLAND *et al*., 1988).

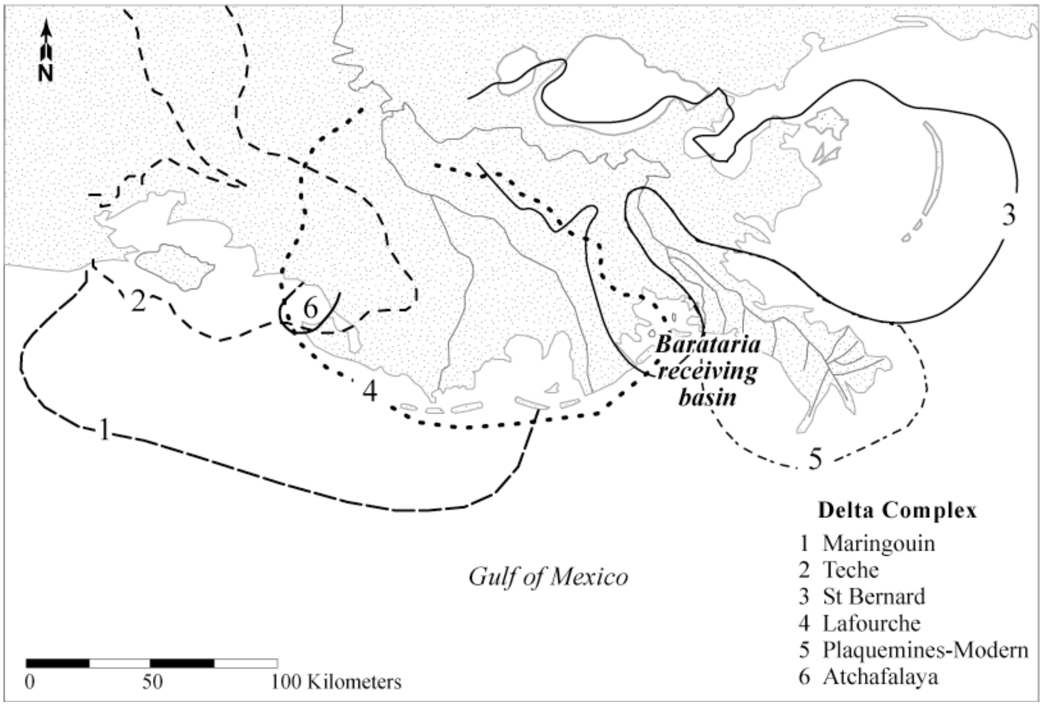


Figure 1. Location of Holocene delta complexes of the Mississippi River delta plain. Modified from FRAZIER (1967).

Whereas the efforts of previous research have furthered our understanding of the depositional history within receiving basins, detailed spatial distribution of offshore features associated with Holocene delta building are not clearly identified. It is becoming increasingly important to recognize laterally distinct sedimentary units within the coastal zone, not only to understand their influence on shoreline evolution, but also to identify their potential for shoreline nourishment. The purpose of this paper is to characterize one of the last delta progradations into the Barataria receiving basin and provide a high-resolution spatial distribution of associated features.

Analysis of a very dense dataset of geophysical and sediment core data in this area has resulted in the recognition of particular facies associated with subdelta stratigraphy. The data provide a high-resolution characterization of relict delta transgressive/regressive cycles in this area and allows for the distinction between delta front, distributary mouth bar, distributary channels, interdistributary bays and flooding deposits.

METHODS

As part of a sediment resource inventory of Barataria Bight, the U.S. Geological Survey (USGS), in cooperation with the University of New Orleans (UNO), collected 1,050 line-km of high-resolution single-channel seismic and sonar reflection (HRSP) and CHIRP profiles. The profiles were used to coordinate a sediment collection strategy, and 200 vibracores up to 20 feet in length were collected (Fig. 2). The field surveys were conducted onboard the USGS R/V G.K. Gilbert during the summer of 2000. Additionally, thirty-eight 40-foot sediment borings were collected in the area in a cooperative effort by the US Army Corps of Engineers (USACE). For a detailed account of the methodology, see KINDINGER *et al*. (2001).

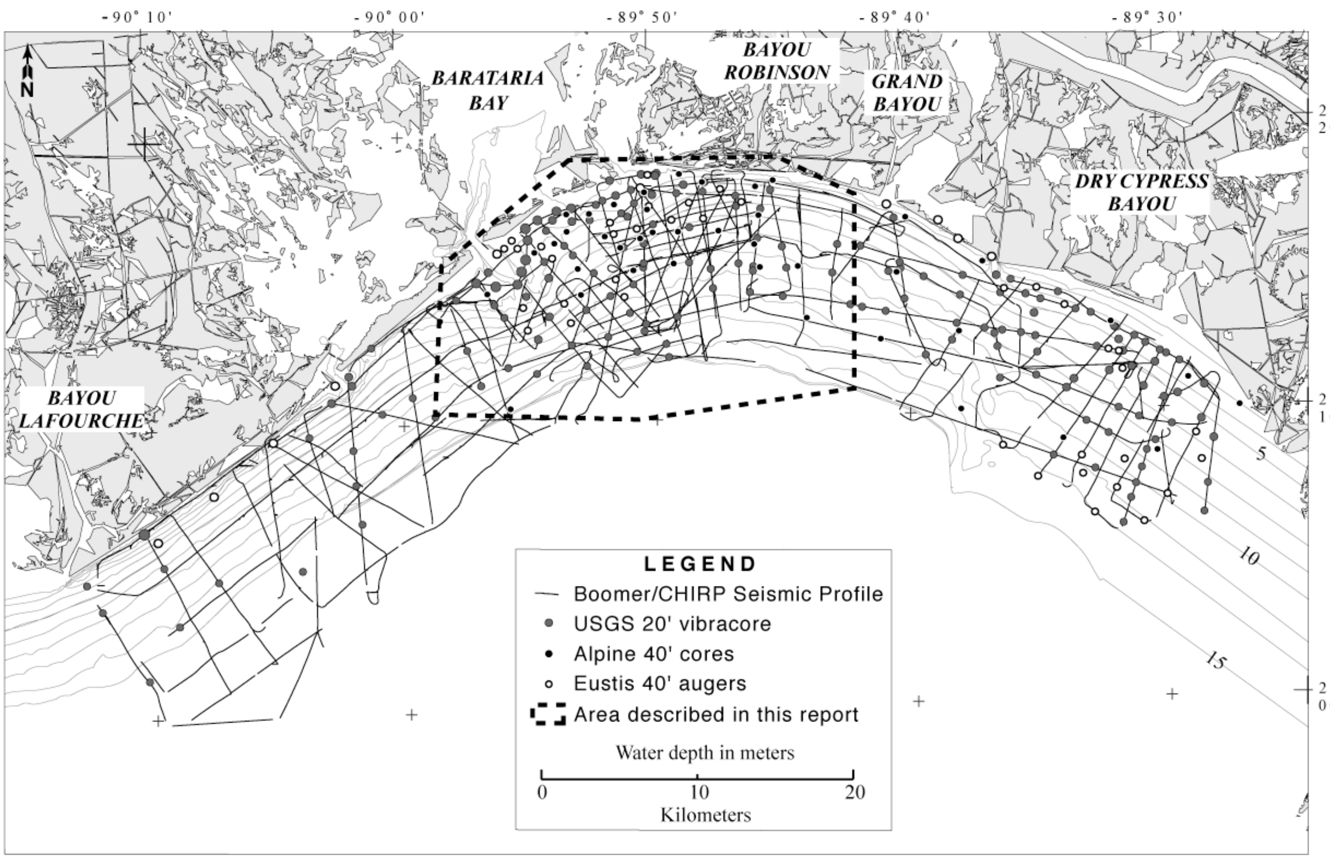


Figure 2. Map of study area showing location of high-resolution, single-channel seismic data and sediment cores used in this report.

The geophysical surveys were processed and interpreted at the USGS facility in St. Petersburg, FL. The sediment cores were analyzed and described by the UNO Coastal Research Laboratory. Grain sizes were determined using a *Coulter LS 200* particle-size analyzer, and are shown in this paper within textural ternary plots. The textural descriptions shown in the core profiles were digitized from visual interpretations recorded on core description sheets and are semi-quantitative, for more information see FLOCKS (2004). Radiocarbon dates were determined at a commercial laboratory.

DISCUSSION

Recent Delta Progradation - review

The Barataria Basin along the southern Louisiana coast is situated between the St. Bernard, Lafourche and Plaquemines-Modern deltaic complexes (Fig. 1) (KOSTERS, 1989). Delta progradation, coupled with transgressive submergence over the past 4000 years, has produced the present day shoreline. Between 3600 and 2000 ybp, an early delta from the St. Bernard delta complex, identified by FRAZIER (1967) as the Bayou des Families delta, prograded into the basin. Subsequent work by LEVIN (1991) further refined the Bayou des Families progradation and suggested the event may have occurred as early as 4600 ybp (Fig. 3).

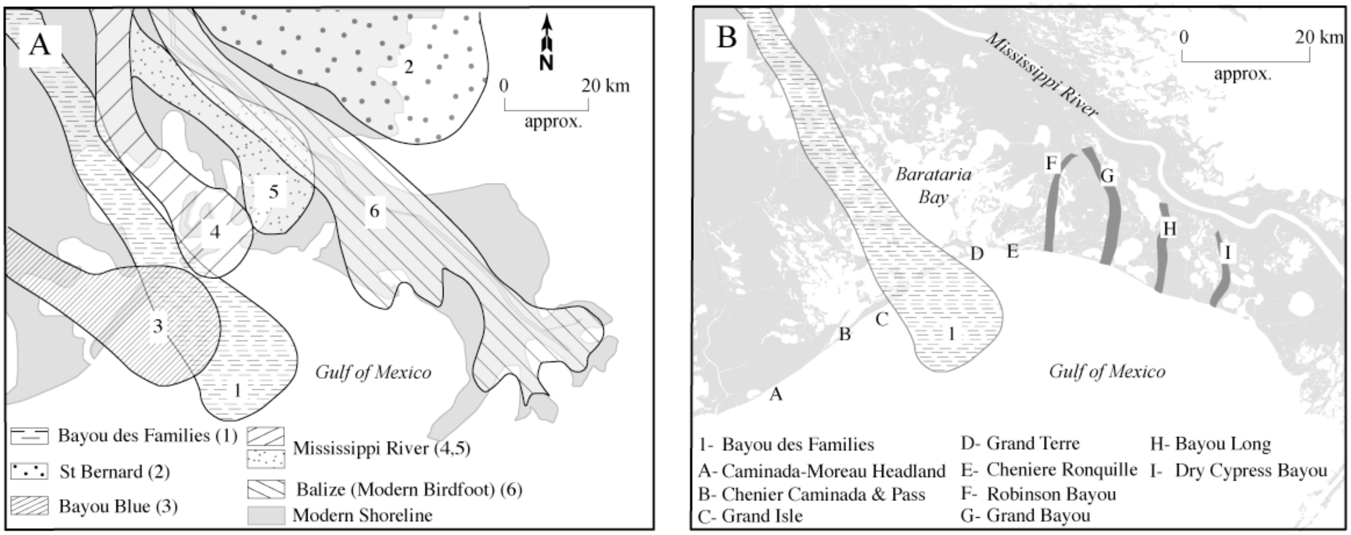


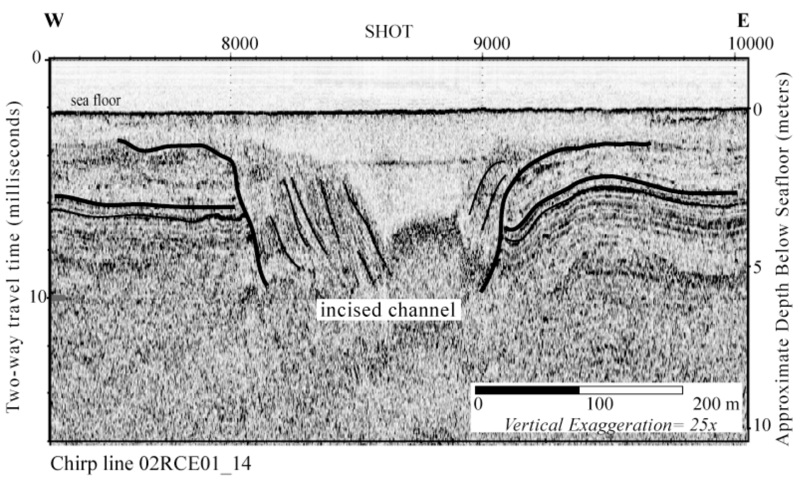
Figure 3. (A) Delta lobe progradation near Barataria basin within the last 5000 years, modified from LEVIN (1991). (B) Location of modern features associated with the current morphology.

Approximately 3500 ybp, deposition from the Lafourche delta complex occupied the west portion of Barataria basin. Around 2600 ybp, the Bayou Blue delta developed from a crevasse along the east side of Bayou Lafourche and extended 50 km southeast to present day Grand Isle (PENLAND and BOYD, 1985; LEVIN, 1991). Continued deposition from the Lafourche delta complex developed the Caminada-Moreau headland at Bayou Lafourche, with general abandonment of the complex near Caminada Pass about 400 ybp. Reworking and transport of sediments from the abandoned delta lobes east of the headland developed the Cheniere Caminada beach ridges, as sediments were captured on the updrift side by relict Lafourche distributaries (GERDES, 1985).

Concurrent with the progradation and abandonment of Bayou Lafourche, the Mississippi River began building the Plaquemines delta lobe in the eastern portion of the Barataria basin (PENLAND and BOYD, 1985), beginning about 950 ybp. A complex system of multi-branching distributary channels prograded into the basin, with Robinson Bayou and bayous Grand, Long and Dry Cypress building the seaward portions of this delta complex. Sediments transported east due to the reworking of the abandoned Lafourche subdeltas (Bayou Blue) were impounded by these recent distributaries, creating the Cheniere Ronquille beach ridges. By 300 ybp, the current Balize delta began to build onto the outer continental shelf, reducing sedimentation at the Plaquemines complex. As relative sea level rose, erosion of the beach ridges and headlands associated with these subdelta lobes produced the flanking barrier islands of the present day shoreline.

Recent Delta Progradation – analysis of new data

CHIRP profiles within Barataria Bay exhibit patterns consistent with buried fluvial channel deposits as identified elsewhere in the coastal Gulf of Mexico (KINDINGER *et al.*, 1994; SUTER *et al.*, 1991). Interpretations of these profiles have been used to delineate a relict channel that follows the eastern side of the bay (Fig. 4). This channel may represent the last position of the Bayou des Familles distributary north of the present day barrier shoreline, and is consistent with the locations indicated by KOSTERS (1989) and Levin (1991). The occurrence of the channel provides a source for the depositional features identified offshore, and supports their spatial distribution.



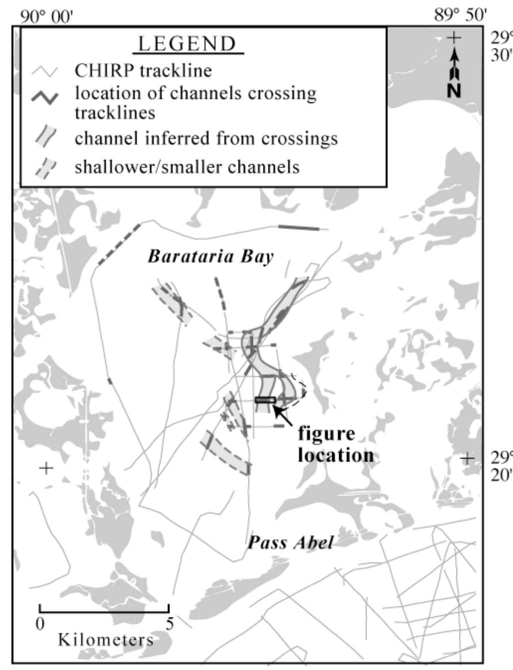


Figure 4. Seismic profile showing a buried incised channel in Barataria Bay (left). Channel location determined from seismic profile interpretations (right). This feature represents the feeder channel for the offshore deposits identified in this study.

Offshore, reflective horizons in CHIRP profiles outline a seaward portion of facies associated with subdelta lobe deposits. The offshore deposits are identified in this paper as delta front (A), distributary-mouth bar (QBD), distributary channel (C1, C2), interdistributary bays (D1-D3), crevasse (E), marine and non-related prodelta deposits (F1-F4), and recent ebb-tidal delta deposits (Table 1). The spatial distribution of these deposits are divide A and QBD into deep (Fig. 5), C through F into middle (Fig. 6), and F with tidal deposits into surface features (Fig. 7). The following discussion describes these features in further detail.

Facies	*Character Code*	*Depositional Environment*	*Physical Characteristics*	*Seismic Characteristics*
Ebb-tidal delta	ETD	Marine	Medium sand to sandy silt, shell meterial	Distinct basal reflector, sea-ward dipping reflectors
Prodelta/ Marine	F	Fluvial/ Marine	Laterally variable, generally coarsening upward, laminated silts and clays	Horizontal to low angle reflectors
Ravinement		Marine	Erosional, shell lags and sands	Distinct seaward dipping reflector throughout study area
Crevasse Splay	E	Fluvial	Coarsening upward silts and cross - bedded sands	Down-dipping reflectors with distinct basal reflector.
Inter-distributary Bay	D	Estuarine	Laminated to bio-turbated silts with abundant organic material	Low angle, parallel reflectors with acoustically transparent 'fill'
Distributary Channel	C	Fluvial	Fining upward sequence of silty sands, grading into laminated sandy silts	High angle reflectors, distinct dog-leg reflectors and acoustic noise
Distributary Mouth Bar	QBD	Fluvial	Cross-bedded sands, laminated sandy silts	Homogenous pattern with distinct surficial reflectors
Delta Front	A	Fluvial	Laminated silts and lenticular sands	Dipping parallel reflectors with occasional high angle cross-cutting reflectors

Table 1. Description of delta-related facies identified in this report. Shading pertains to depth/age relationship between deposits, with F and ETD being surficial and youngest.

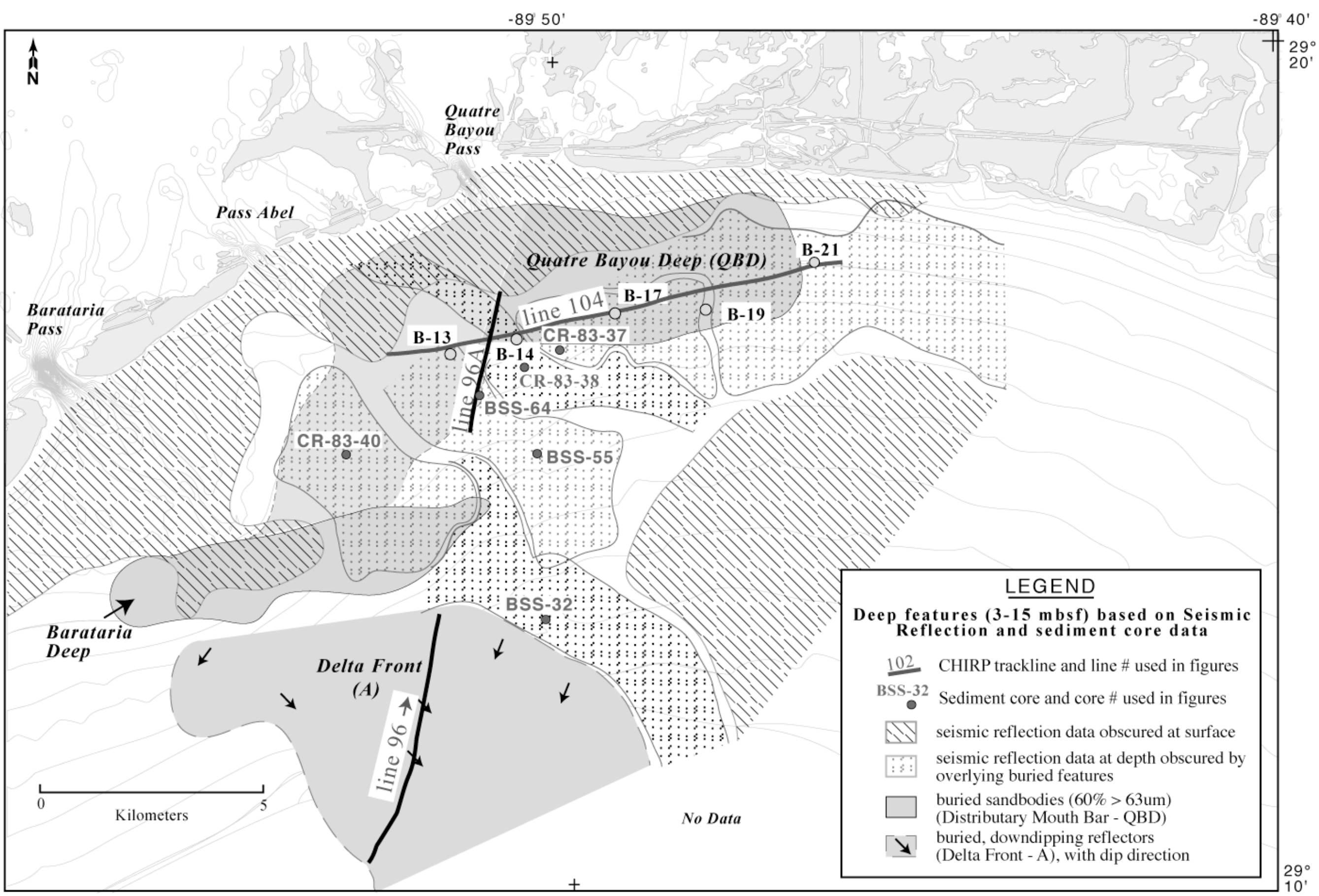


Figure 5. Subsurface distribution of deep, progradational features identified in seismic profiles and sediment cores (3 – 15 meters below sea floor). Extent of the sandbodies shown are based on sand-resource criteria of at least 60% sediment grain-size greater than 63 microns in diameter.

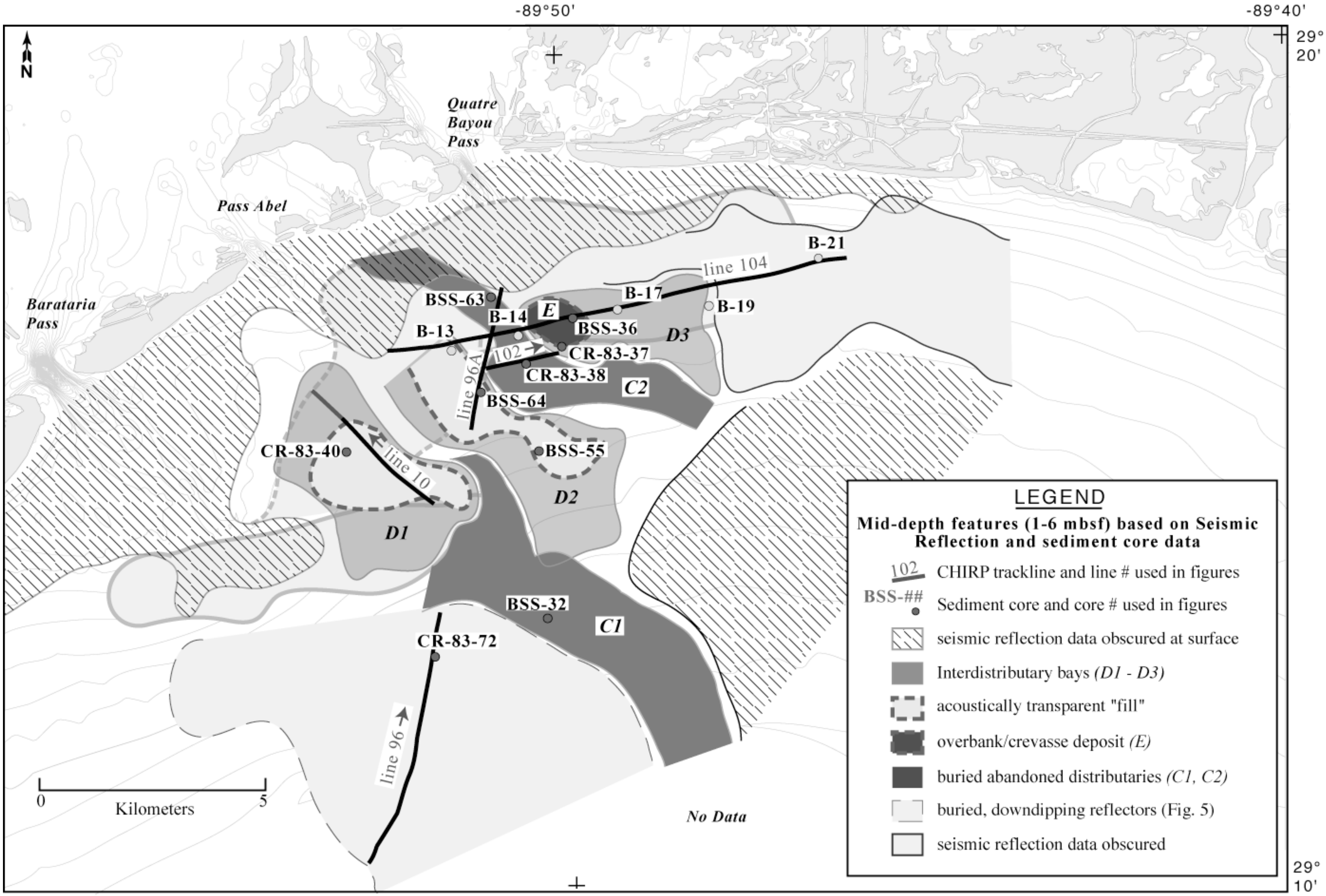


Figure 6. Subsurface distribution of progradational features identified in seismic profiles and sediment cores (1 – 6 meters below sea floor). Distributaries (C1, C2) and interdistributary bays (D1-D3) overlay delta front and distributary mouth bar deposits (A & QBD).

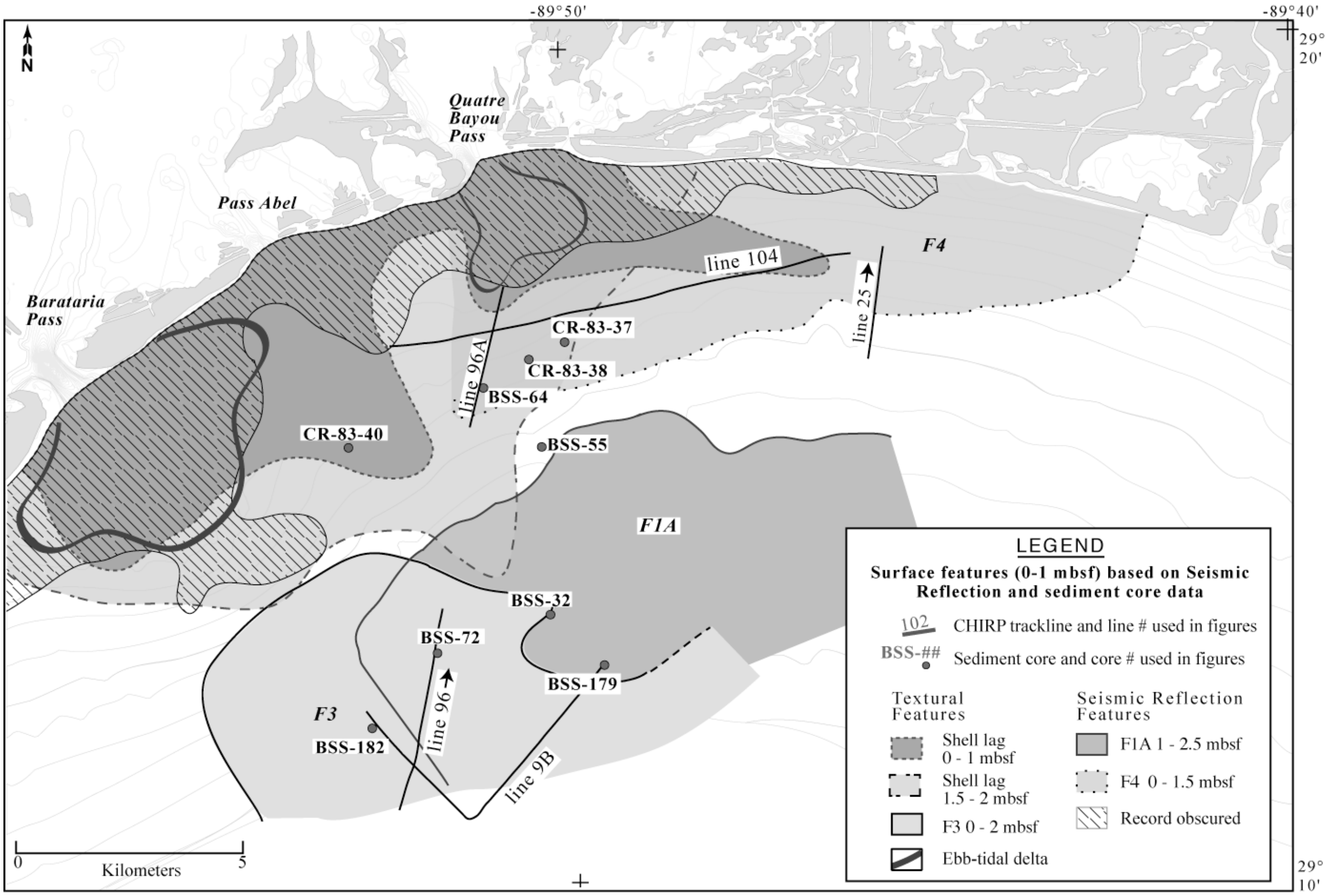


Figure 7. Near surface distribution of features identified in seismic profiles and sediment cores (0 - 2 meters below sea floor).

Delta Front (A) Deposit:

Seismic profiles from the seaward portion of the study area reveal distinct down-dipping parallel reflections (Fig. 8). The reflections are truncated or offlapping at 2 meters bsf and dip seaward at roughly 0.2 degrees to a depth of almost 8 meters before onlapping onto a pronounced reflection seen throughout the study area. Frequent chaotic or high-angle reflections interrupt the section and represent channels incised into the unit. The location and seaward slope of the reflections resemble delta front facies as seen elsewhere in the coastal environment (COLEMAN, 1982). Sediment cores that penetrate this unit exhibit a consistent pattern of interlaminated silts and lenticular sands (Fig. 9). Organic material is dispersed throughout, but shell material is absent, indicating a fluvial source and high sedimentation rates. In seismic profiles and cores there appears to be a high degree of deformation to the bedding surfaces. This deformation is probably due to post-burial dewatering and subsidence. Noisy seismic data at depth in the southeastern portion of the study area prohibit the mapping of this unit (Fig. 6). However, several sediment cores in this area show lenticular sands and laminated muds below 2 meters. This lithology suggests that the delta front deposits wrap around the seaward terminus of the study area.

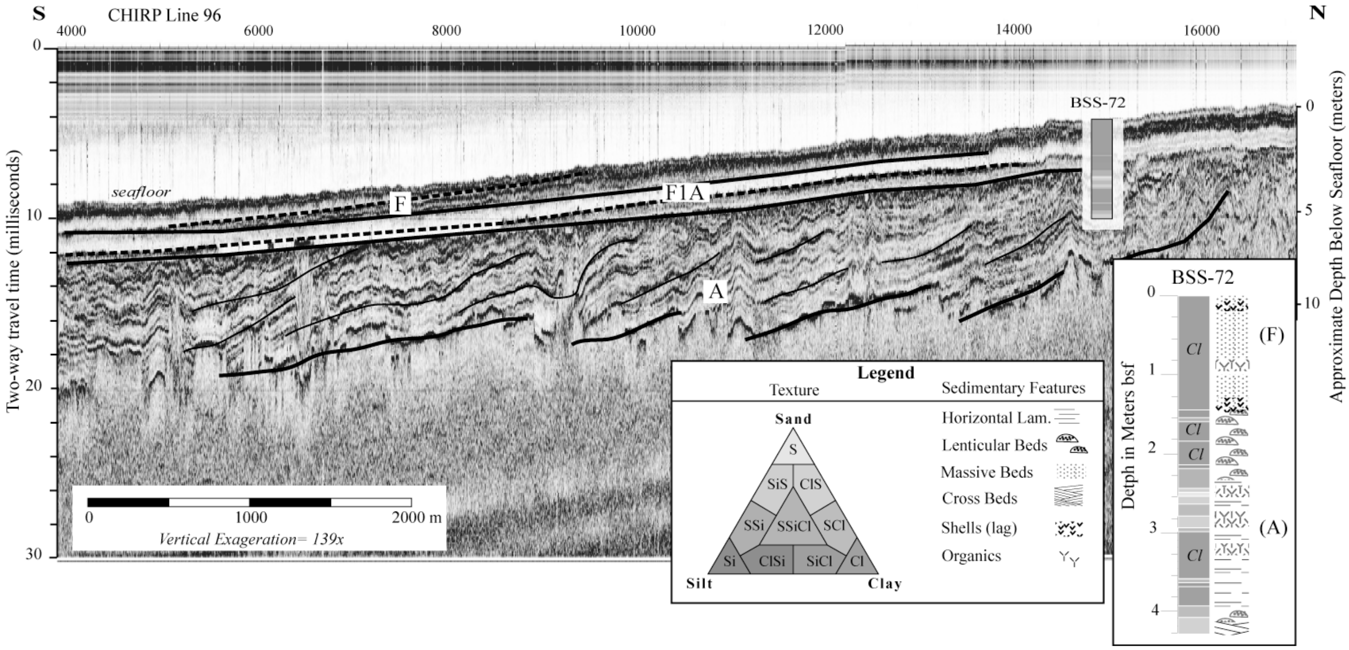


Figure 8. CHIRP profile and sediment core showing position of the delta front (A) and overlying deposits. CHIRP and core locations are shown in figure 5.

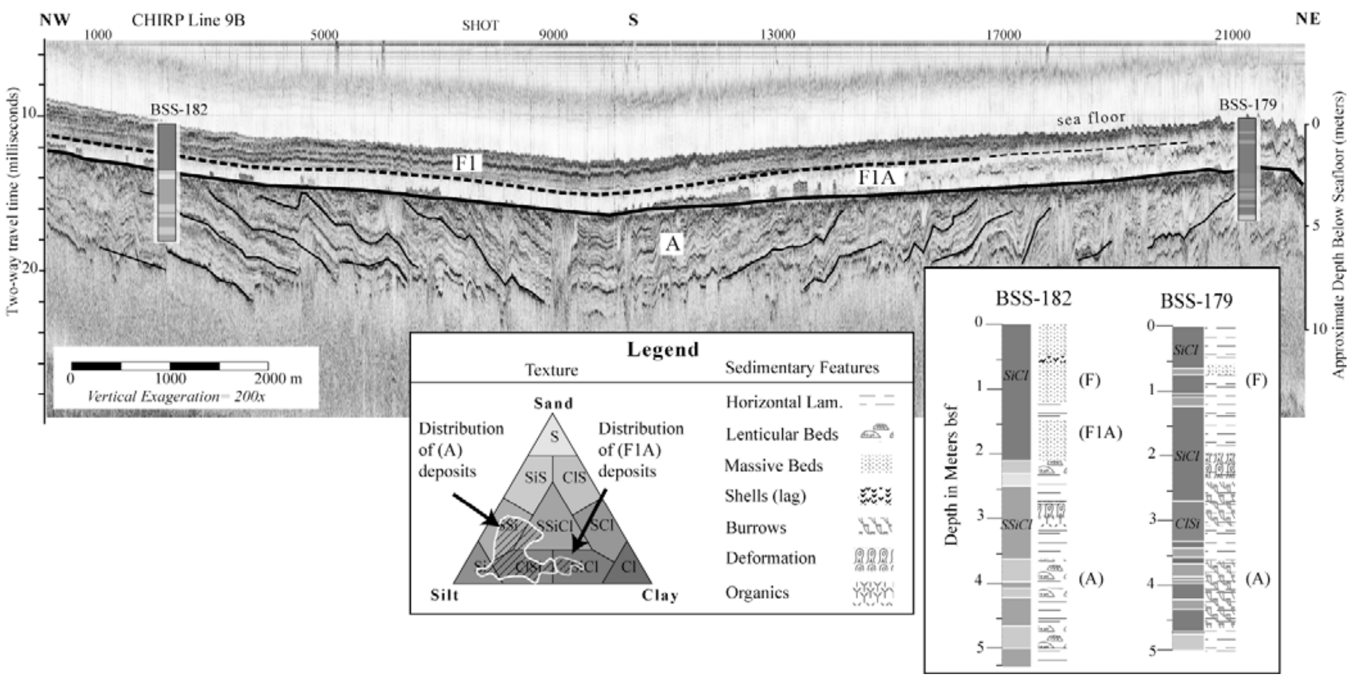


Fig. 9. CHIRP profile and sediment core descriptions showing deposits associated with delta front (A) and overlying marine/prodelta deposits (F). The rotation in clinoform orientation shown in the profile is an artifact due to a change in acquisition transect. Locations of CHIRP line and sediment cores are shown in figure 16.

Distributary Mouth Bar (QBD) Deposit:

Landward of the delta front (A) and adjacent to Quatre Bayou Inlet is a sandy unit that covers an area of approximately 23 km^2. The deposit is 1 to 3 meters thick and 2 to 5 meters below the sea floor (bsf). This feature (Fig. 5) was first identified for its sand resource potential and named 'Quatre Bayou Deep' (QBD) (KINDINGER *et al.*, 2001). In seismic profile, the top of the unit returns a strong reflection (Fig. 10). Any acoustic response below this strong return is obscured, so that the thickness of this sandy unit cannot be readily determined from the seismic data. Depth to the surface reflection is highly variable, and the stratigraphic horizon it represents appears to be deformed and incised. Sediment cores penetrating the unit are composed of cross-bedded fine-grained sand and laminated sandy-silts with lenticular and rippled sand laminations (Fig. 11). Mica and organic material is common within the laminations and rafted organic material such as wood is present near the surface of the unit. The spatial distribution of QBD shown in Figure 5 is based on criteria for sand resource, and reflects the distribution of sediments with a sand fraction (grain size > 63 um) greater than 60%. The spatial extent of the feature naturally encompasses a wider range of grain size, thus the figure represents only the nucleus of the QBD sandbody. A similar feature seaward of QBD was also identified in KINDINGER *et al.*, (2001), and named 'Barataria Deep'. For sand-resource purposes these two features were kept separate, however, analysis of 40-foot sediment cores between the features suggests they are related stratigraphically. The lithology and stratigraphic position of QBD indicate that the deposit represents the distributary mouth bar of the Bayou Des Families delta.

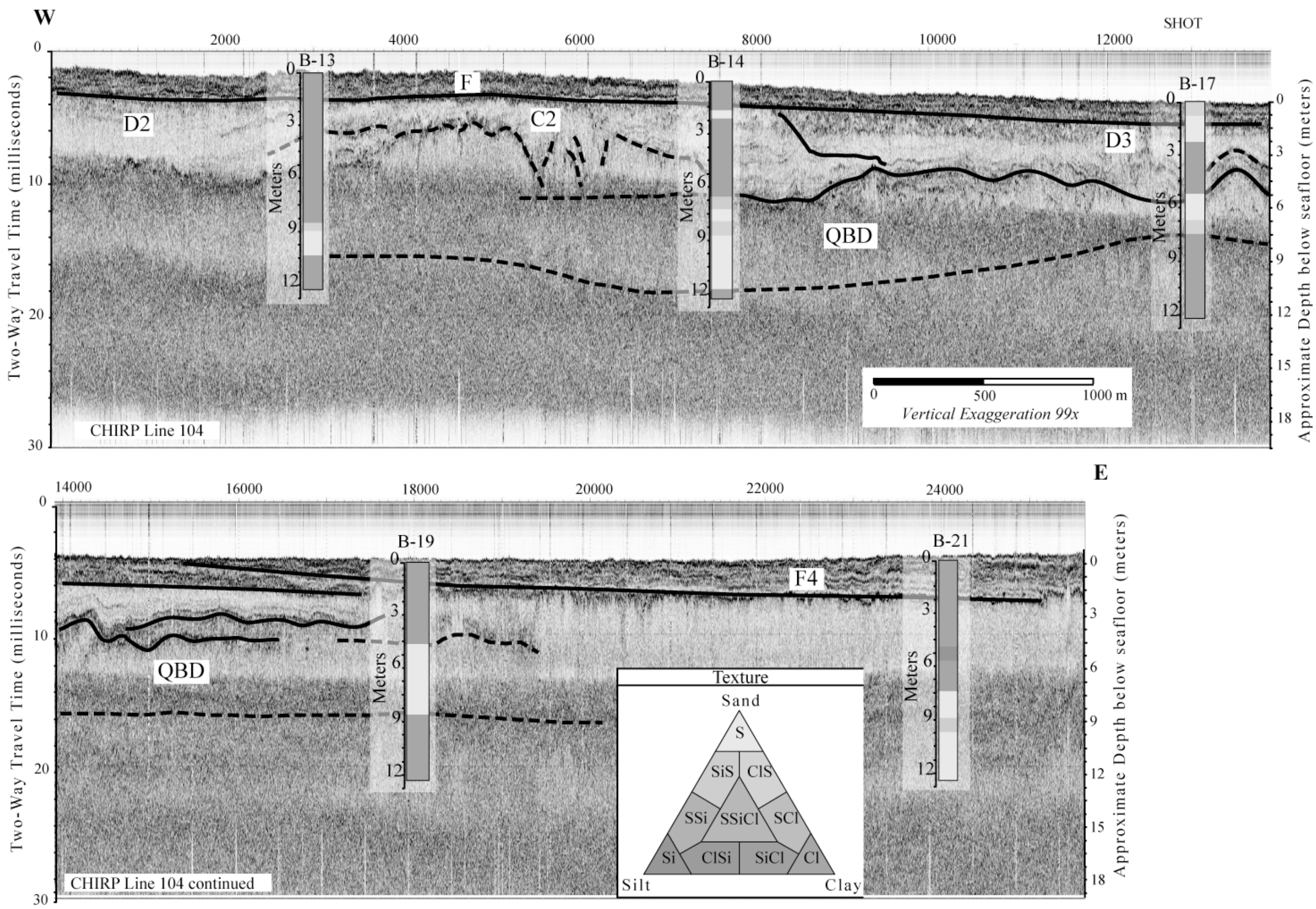


Figure 10. CHIRP profile and sediment borings showing position of the Quatre Bayou Deep (QBD) sandbody and overlying deposits. CHIRP and core locations are shown in figure 5. Shading in borings correlate with texture ternary plot (inset).

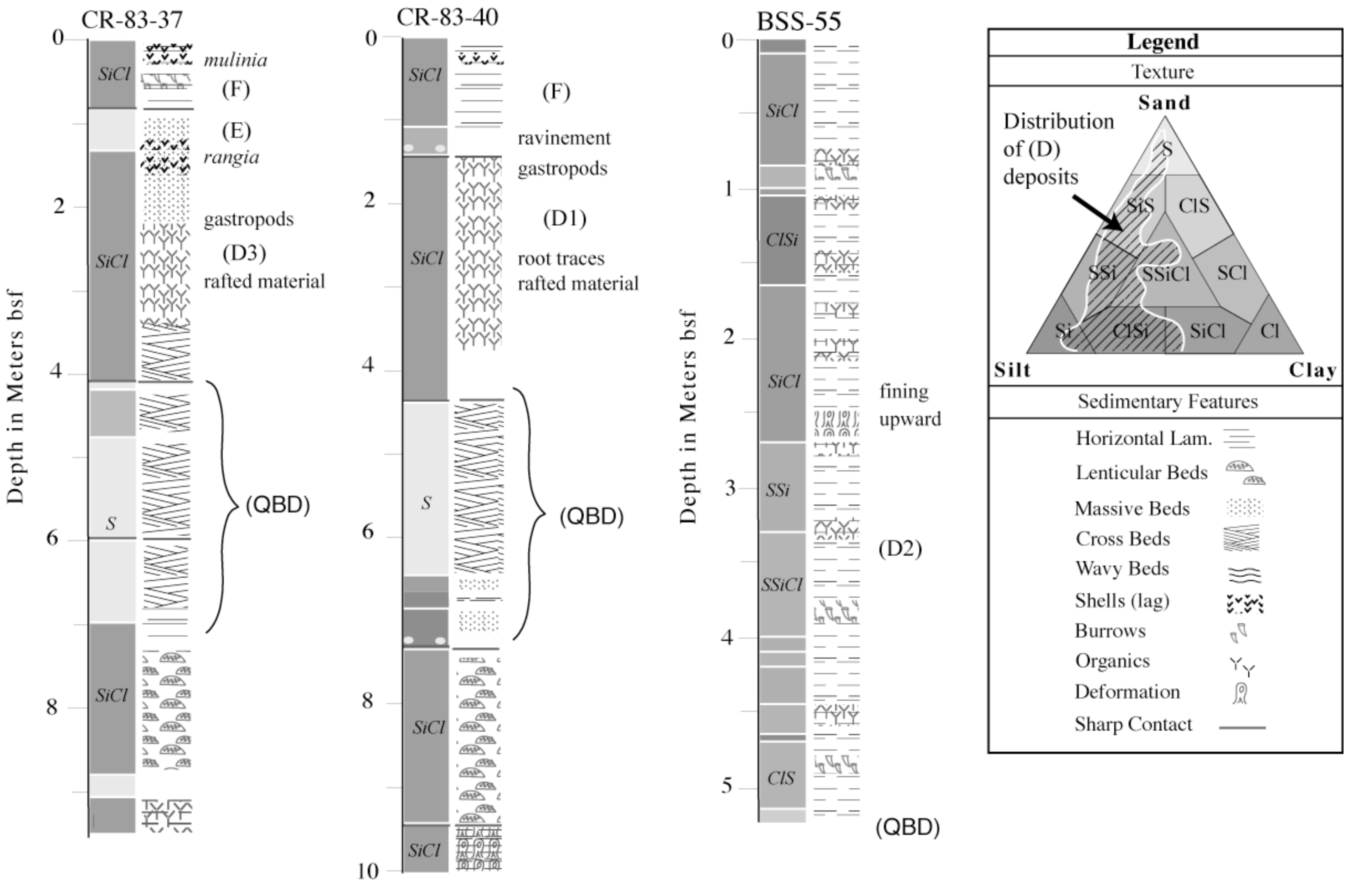


Figure 11. Sedimentologic descriptions of cores acquired within the distributary mouth bar (QBD) and overlying interdistributary (D) environments. Core locations are shown in figures 5 & 6. Measured grain-size distribution for interdistributary (D) deposits shown in inset. Sediment core BSS00_55 is not to scale with the longer CR-# cores.

Distributary (C1, C2) Deposits:

The surfaces of QBD and A are laterally variable, but are generally overlain by two distinct lithologic sequences associated with fluvial channels and interdistributary basins. Both features can be mapped in both areal extent and depth (Fig. 6). Their distribution shows that they are distinct and related. Seismic profiles in the distributary units show very high-angle reflections with distinct lateral extent. The reflection incise the deeper QBD unit (Fig. 12). These long, narrow features are shore-perpendicular and partition the interdistributary bay deposits (Fig. 13). It is difficult to determine the base of these features in seismic profile because the record is obscured at depth. Lithologies in these units are dominated by up to 2 m of interbedded sands and silts. The sands exhibit a high degree of climbing ripples and cross-bedding. The lithology fines upward and is accompanied by an increase in bioturbation and organic material (Fig. 10). Some root traces and slumping occur in the sediments near the surface of the unit. These characteristics are consistent with the life of a distributary channel. Over time, the channels are abandoned for more favorable fluvial gradients. This transition to a decreased hydraulic regime produces a partitioned distribution of grain-size in the sediments from this environment (Fig. 10). As the channels become less active and a marsh environment develops, fine sands deposited by weakening currents are replaced by finer-grained suspended-sediments, with increasing organic material (DIMARCO et al., 1986; COLEMAN, 1982). Locally derived organic material extracted from the upper portion of C2 provides a calibrated radiocarbon age of 3,700 to 3,490 ybp. This radiocarbon age of the channel deposit is within the 4,600 to 2,900 ybp range estimated for the Bayou des Familles delta by LEVIN (1991). The organic material was extracted from a section of fining-upward laminated muds and sands, with no bioturbation. The lithology indicates that during this time of deposition the channel may still have been weak, but active. Above this section the sand content diminishes and bioturbated, olive-grey muds persist, further indicating channel abandonment.

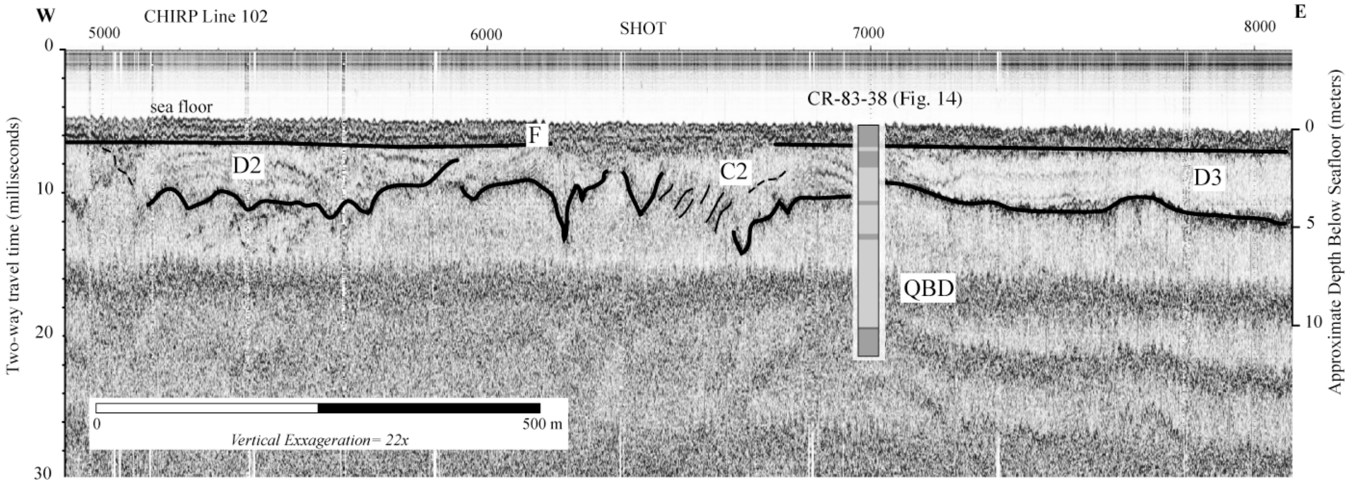


Figure 12. CHIRP profile and sediment core descriptions showing deposits associated with distributary mouth-bar (QBD), distributary channel (C2), interdistributary bays (D2 & D3), and overlying marine/prodelta deposits (F). Locations of CHIRP line and sediment core are shown in figure 6. Description of core is shown in figure 14.

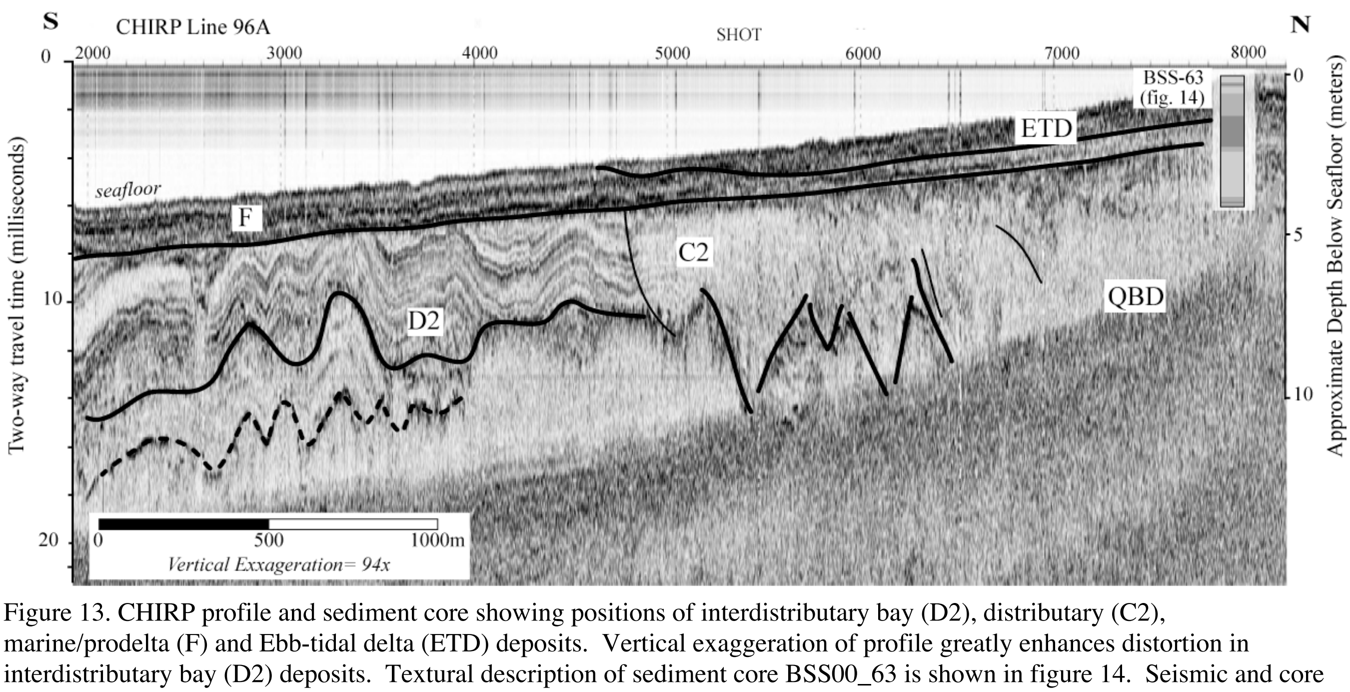


Figure 13. CHIRP profile and sediment core showing positions of interdistributary bay (D2), distributary (C2), marine/prodelta (F) and Ebb-tidal delta (ETD) deposits. Vertical exaggeration of profile greatly enhances distortion in interdistributary bay (D2) deposits. Textural description of sediment core BSS00_63 is shown in figure 14. Seismic and core locations are shown in figure 6.

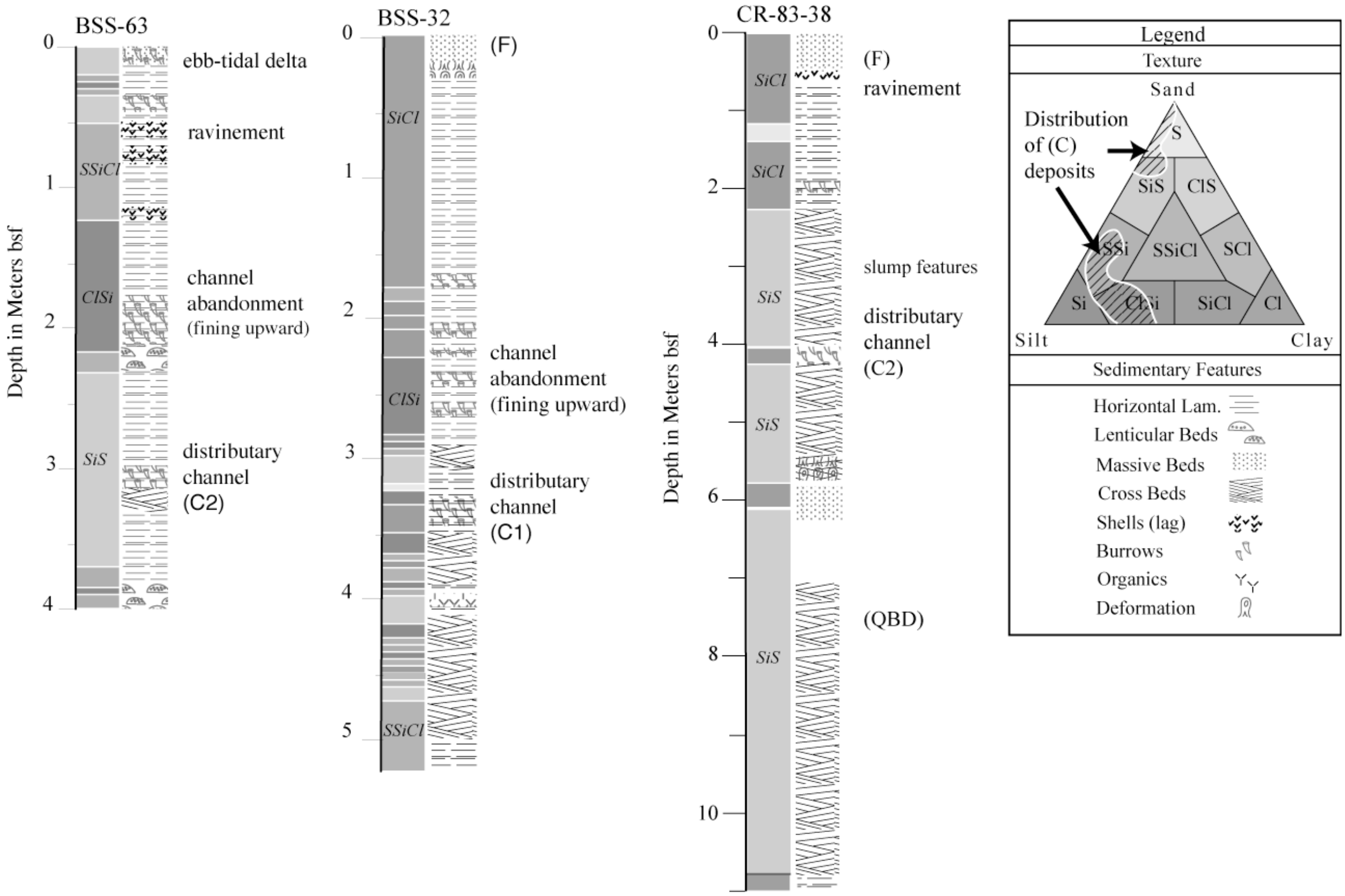


Figure 14. Sedimentologic descriptions of cores acquired within the distributary (C) and marine/prodelta (F) environments. Core locations are shown in figures 5 & 6. Measured grain-size distribution for (C) deposits is shown in inset. Sediment core CR-38 is not to scale with the shorter BSS00_# cores.

Interdistributary Bay (D1, D2, D3) Deposits:

Most cores show a gradational contact followed by laminated muds and lenticular sands with abundant organic material, root traces, and occasional rafted material, material commonly associated with interdistributary bays (Fig. 11, feature D). Correlation of seismic profiles shows three spatially distinct basin-shaped features (Fig. 15, features D1-D3). These features have an area of 40, 40 and 24 km^2, respectively, and are elongate, with their axis trending radially seaward. The central portions of these features contain an acoustically transparent “fill”. A strong reflection at about 4.5 meters bsf in seismic line 10 corresponds to a lithologic change from muds to muddy sands and represents the base of unit D1. Above this horizon, the sediments are described as dark grey laminated clay/silts with lenticular sands. The unit contains a large amount of organic material, with some rafted debris near the base and shell material, including gastropods, throughout. Bioturbation is common, with burrows increasing upward. A sediment core from D2 shows a fining upward sequence. This transition, along with the lenticular sands, produces a wide variability in grain-size distributions (Fig. 11). These sediments were deposited in a low-energy environment with abundant vegetation. As relative sea level rose gradually, water depths increased to a depth where weak currents and wave action reworked the existing coarse-grained material into lenticular deposits. This environment is consistent with previous descriptions of interdistributary bay sediments (COLEMAN, 1982; MCBRIDE *et al.*, 1990), and their spatial distribution is similar to marsh/bay environments in the modern birdfoot delta.

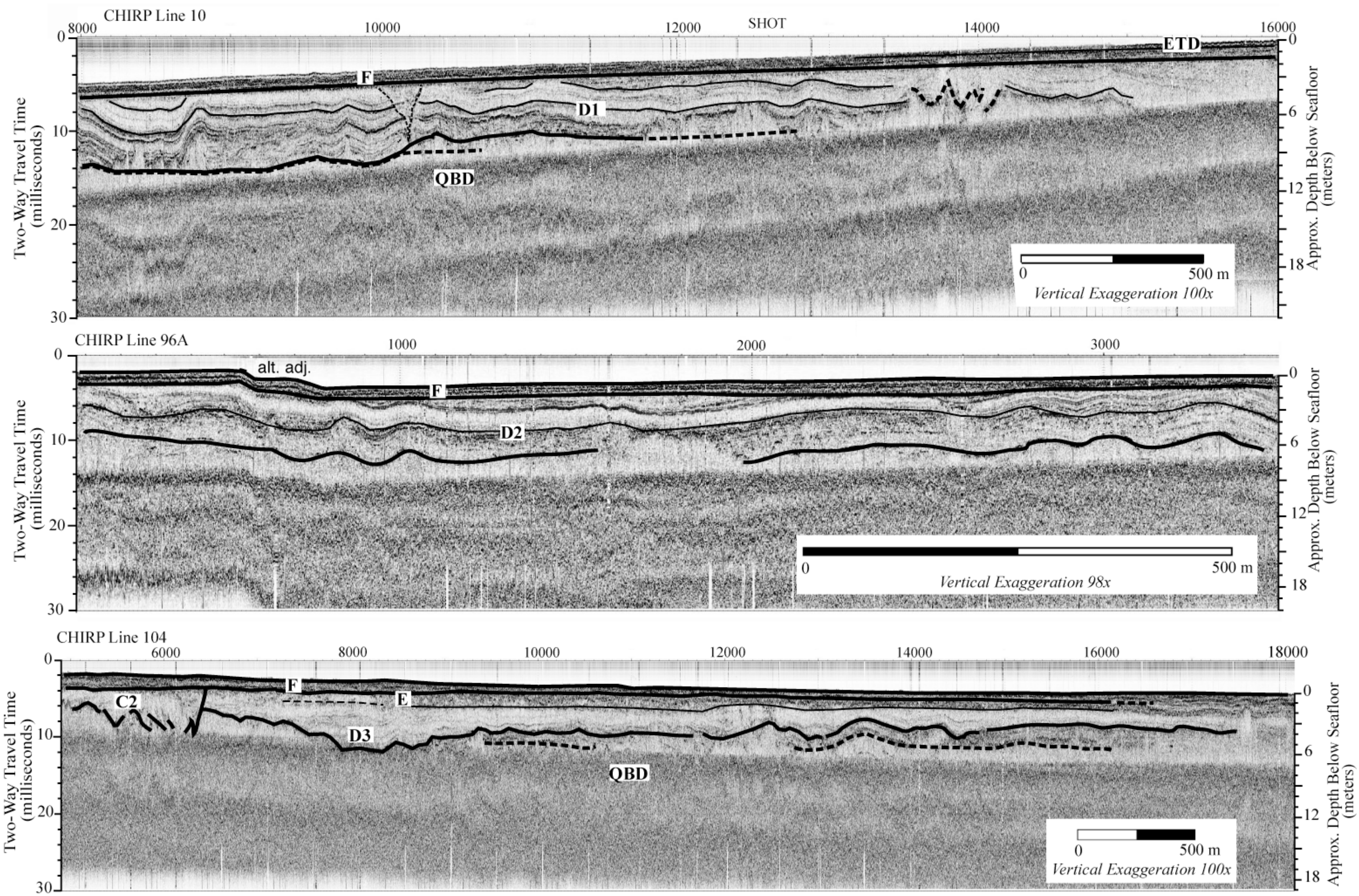


Figure 15: CHIRP profile and showing interdistributary bays (D1-D3) and associated deposits. Profile locations are shown in figure 6. The drop in profile seen in CHIRP line 96A (altitude adjustment) is an acquisition artifact.

Crevasse or Overbank (E) Deposit:

There is an interval of coarsening upward sands and silts adjacent to C2 and within D3 (Fig. 16). The unit (E) is 1 meter thick, with crossbedded sands at the base. Bioturbation, organic material, and Rangia occur in this section. The lithology and position of this feature relative to C2 and D3 suggest this locally constrained deposit may be a crevasse or overbank-splay deposit that developed prior to channel abandonment and sea-level rise.

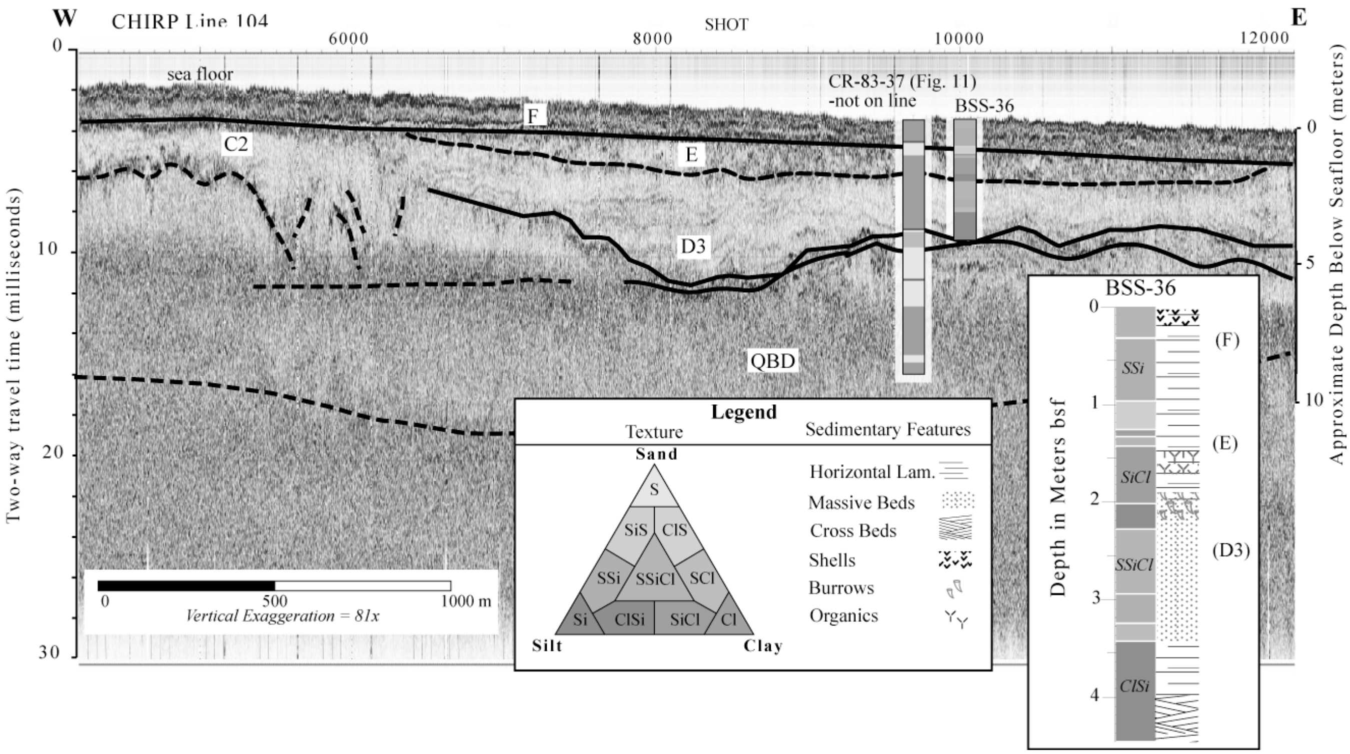


Figure 16. CHIRP profile and sediment core descriptions showing deposits associated with distributary mouth-bar (QBD), distributary channel (C2) and associated crevasse deposits (E), interdistributary bay (D3) and overlying marine/prodelta deposits (F). Locations of CHIRP line and sediment cores are shown in figure 6.

Marine and non-related prodelta (F1, F1A, F2-F4) Deposits

Throughout the study area, seismic profiles exhibit a distinct reflection that overlies and truncates the top of mid-depth features C and D. This reflector deepens seaward, from 1.5 to 2.5 meters bsf (Figs. 13 & 15). The pervasiveness of this horizon suggests it is the ravinement surface that formed after abandonment, subsidence and inundation of the subdelta. In sediment cores, the horizon is accompanied nearshore by a shell lag and offshore by a sand layer (Figs. 11 & 14). The shell lag includes species Mulinia, indicative of increasingly marine environment. Although distinct in seismic profile, this contact is subtle in core profile, indicating a gradual transition from subsiding subdelta to flooded embayment.

The unit above the ravinement surface can generally be described as a coarsening-upward sequence of laminated silts and clays, but laterally the unit is divided into several areas of variable lithology (Fig. 7). Offshore, the unit is characterized as dark grey laminated silts and clays (F1) that can be mapped as parallel, horizontal reflections in seismic profile (Figs. 8 & 9). This facies shows a wide range in grainsize due to highly variable silt/clay ratios and the presence of sand stringers. Within subunit F1 a pronounced, acoustically transparent zone occurs in the seismic profiles (F1A) along the seaward portion of the study area (Figs. 8 & 9). This zone does not extend over the progradational units

(C & D), and expands seaward to a width of one meter at the end of the study area. Grain-size distribution in F1A exhibit a higher percentage of clay than elsewhere in the study area (Fig. 9), which could suggest a more significant contribution of marine or distal-prodelta material. The position of the deposit and thickening seaward characteristic indicate that it is not associated with the Bayou Blue subdelta of the Lafourche complex, which prograded into the study area from the north (PENLAND and BOYD, 1985; LEVIN, 1991). Adjacent to F1A, a texturally distinct zone of massive clay occurs at the surface (Fig. 7, feature F3). This unit is seaward of the Barataria Pass ebb-tidal delta, and is up to one meter thick. The massive texture of the deposit is in contrast to the laminated silts and clays, which predominate the surficial sediments. Core descriptions show this unit to be primarily clay, devoid of shell or organic material, and non-bioturbated. Finally, a distinct sequence in seismic profile occurs nearshore, from Quatre Bayou to the east (Fig. 7, feature F4). Low angle, parallel reflections occupy the upper 1.5 meters of the subsurface (Fig. 17). This feature thins seaward, and the reflections become obscured by noise in the area of Quatre Bayou Pass. Sediment cores in this unit contain laminated silts and clays, with rare sand stringers. Shell fragments are absent and only the upper portion contains bioturbation. This unit is probably related to delta front deposits of the Plaquemines-Modern subdelta, which prograded into the area from the north and east prior to 500 ybp.

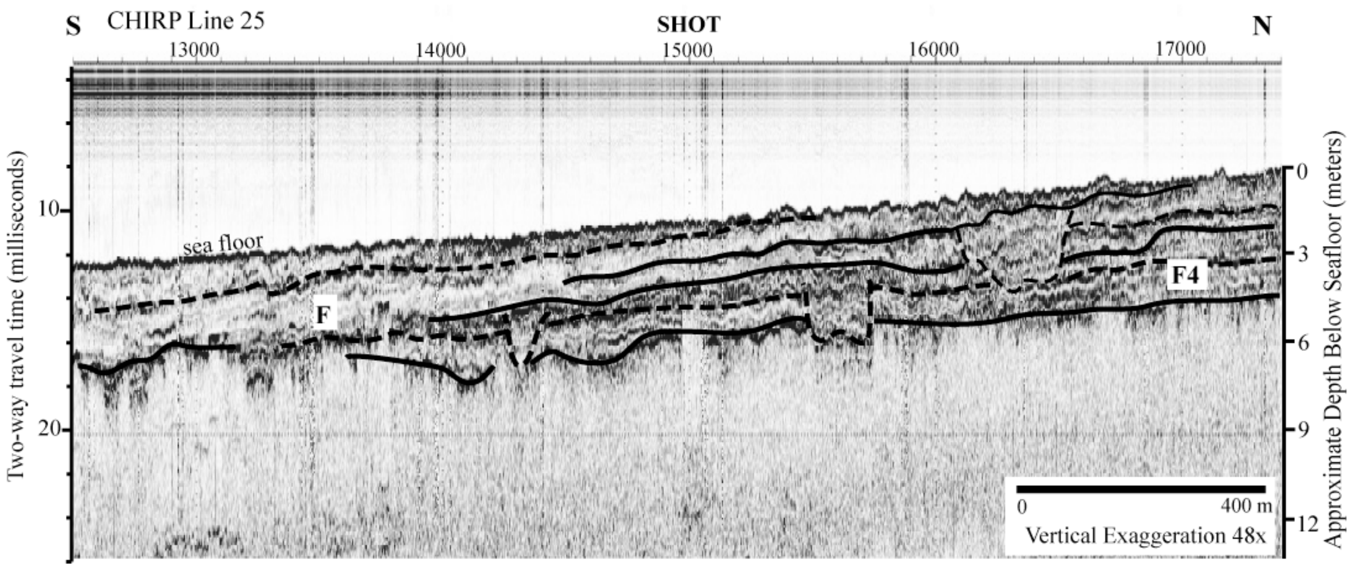


Figure 17. CHIRP profile and interpretation showing near surface marine/prodelta (F) and possible Plaquemines-Modern prodelta (F4) accumulations. Location of profile shown in figure 7.

Throughout the study area the upper units (F) contain at least one laterally extensive shell lag in addition to that found at the basal ravinement surface (Fig. 9). A strong seismic reflector within unit F corresponds to a shell/sand layer and correlates with the base of the ebb-tidal delta deposits (Figs. 12 & 14). This horizon marks the development of the present Plaquemine shoreline and subsequent deposits associated with tidal inlet morphology, as sediments from the reworked Bayou Blue headland contributed to the beach ridges of Cheniere Ronquille and Grand Terre barrier islands (Fig. 3). Remaining deposits associated with the Bayou Blue headland were either incorporated within unit F or eroded.

Near the modern ebb-tidal deltas, unit F coarsens upward into a dark brown sandy unit (Fig. 14). This transition corresponds to coarser material being supplied to the environment from the shore face during storms and from tidal inlet currents. These deposits coarsen shoreward and consist of thinly laminated fine-sand and silty-sand with abundant shell fragments (FITZGERALD *et al.*, 2004). These sediments represent inner shelf and proximal ebb-tidal delta facies. The distribution and architecture of the ebb-tidal deltas within the study area are described in FITZGERALD *et al*., (2004) and KINDINGER *et al*., (2001).

SUMMARY

The deposits described in this paper represent a progradational sequence of delta front (A), distributary mouth bar (QBD), channel (C) and interdistributary bay (D) facies associated with the Bayou des Families delta lobe (Fig. 18). These features are followed by distal deposits from adjacent delta progradations (ex. Modern-Plaquemines) and marine-transgressive sediments (F). Prior to onset of the Bayou des Families delta into the Barataria Basin, the study area was an open embayment, isolated between earlier St. Bernard lobes to the north, relict Teche delta deposits and initial Lafourche progradations to the west (KOSTERS, 1989). The few sediment cores that extend into these units encounter stiff clay and lenticular sands, overlain by a sandier unit which contains rip-up clasts (Figs. 11 & 14). In seismic profiles the surface of this unit returns a hard reflections, dipping seaward. The horizon is interpreted to be a ravinement surface associated with Late Holocene delta plain deposits.

The delta front deposits (A & QBD) represent the initial progradation of the delta into the basin (Fig. 18-1). As the delta front migrated through the study area, the upper units (C & D) were deposited that represent the final arrangement of distributary channels and interdistributary bays. Originally the interdistributary bays contained a brackish environment and supported fresh water species of clams and gastropods. Root traces and rafted material indicate a shallow water environment that is subjected to periodic flooding, as is the case in the present day birdfoot delta. The adjacent distributary channels contained moderate flow as evidenced by cross-bedded and rippled sands (Fig. 18-2). Sometime after 3600 ybp, as the subdelta was abandoned, current velocities in the channels decreased and the channels infilled with fine-grained material containing abundant organics as the interdistributary bays (D1-D3) began infilling (Fig. 18-3). As subsidence rates overcame deposition, relative sea level within the interdistributary bays rose to a point where wave and current action reworked the coarser-grained material into lenticular deposits. As subsidence continued, the subdelta deposits were gradually flooded, reworking existing deposits and producing a ravinement surface that is more evident in seismic section than in sediment cores. Continued flooding and transgressions from adjacent delta progradations produced laterally variable deposits of marine and prodelta sediments (F and F4). The prodelta sediments were introduced during the last progradation of the Lafourche delta to the west and the nearby Plaquemines-Modern delta complex to the east (Figure 1). Shell lags and sand stringers within this unit show an increasingly open bay environment. At the present time, increasing tidal energy at the inlets between barrier islands is creating a seaward prograding ebb-tidal delta within the study area (Fig. 18-4).

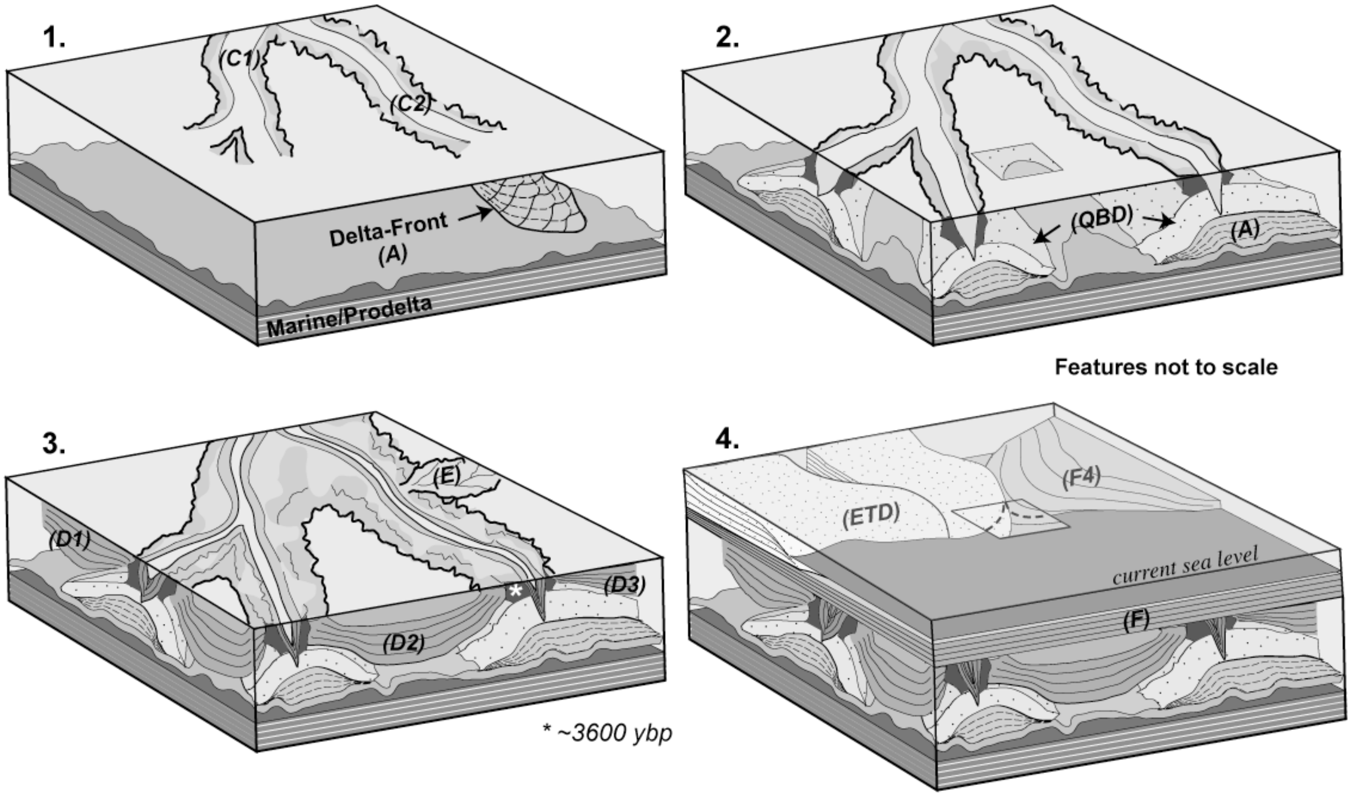


Figure. 18. Recent geologic development of the nearshore adjacent to Grand Terre Island: 1) Initial progradation of Distributary Channels (C1 & C2) into the Barataria Bight, associated with the Bayou des Families delta progradation; 2) Further deposition of Delta-Front (A) and Distributary Mouth Bar (QBD) deposits. 3) As progradation passes beyond the study area, Interdistributary Basins (D1-D3) and Crevasse (E) develop, while flow in distributary channels diminish. 4) After abandonment and subsidence, ravinement and marine deposits (F) inundate area, along with distal deposits from the Plaquemines-Modern delta (F4), followed by Ebb-Tidal Delta deposits (ETD) associated with the present-day inlets.

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