"Deweyville' Terraces and Depostits of the Texas Gulf Coastal Plain

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Abstract

Bernard (1950) defined the Deweyville beds as underlying a terrace along Sabine River that is intermediate in elevation between Pleistocene Beaumont alluvial plain surfaces and Holocene floodplains, and which has abandoned meanders that are considerably larger than those of the Beaumont surface or modern highly sinuous Sabine channel. Subsequent workers identify 2 or 3 distinct terraces and/or suites of deposits that fit the original morphostratigraphic concept of the Deweyville along the Sabine and other rivers of the Texas Coastal Plain, but most commonly attribute oversized meanders to greater annual discharge and/or extreme high magnitude floods during the late Pleistocene glacial period. This paper builds on the idea of a broader stratigraphic concept for "Deweyville" terraces and deposits, and suggests a process model that emphasizes fluvial responses to interacting climatic and glacio-eustatic controls.

We suggest the multiple "Deweyville" terraces and underlying fills of the Texas Gulf Coast should be treated as a series of unconformity-bounded allostratigraphic units that record: (a) abandonment of Beaumont isotope stage 5 alluvial plains ca. 100 ka, which partitioned post-Beaumont incised valleys; and (b) multiple episodes of lateral migration, aggradation, and/or degradation within those valleys during the stage 4, 3, and 2 glacial cycle when channels were graded to shorelines at mid-shelf or farther basinward positions. "Deweyville" allostratigraphic units of the Sabine, Trinity, Guadalupe, and Nueces Rivers have steeper gradients than modern floodplains, and the youngest "Deweyville" surfaces are onlapped by Holocene strata at or near modern bay-head deltas. Similar units are present in the Colorado and Brazos(?) valleys, but onlap by Holocene strata occurs 100 km or more inland from the present highstand shoreline.

"Deweyville" allostratigraphic units may represent a glacial period process regime with more annual runoff, but smaller peak discharges than present. The deep inland penetration of tropical moisture and/or tropical cyclones, responsible for most extreme floods on Coastal Plain rivers, was rare through the 80-90 ky of the glacial cycle when temperatures were cooler and the Gulf was smaller. "Deweyville" allostratigraphic units also lack clear evidence for high magnitude overbank floods, as they are sand-dominated, much like channel facies of late Holocene streams, but there is a paucity of vertical accretion floodplain facies which suggests most flood events remained within bankfull channel perimeters. The shorter wavelength, highly sinuous meanders typical of the present interglacial process regime may reflect adjustments to bank-stabilizing vertical accretion facies produced by deep overbank floods, and, in lowermost reaches of the Coastal Plain, to a forced flattening of gradients due to post-glacial sea level rise.

Introduction

The Texas Gulf Coastal Plain consists of a series of low-gradient, fan-shaped alluvial-deltaic plains that emanate from each major river valley (Fig. 1). Coastal plain deposits were initially subdivided into three "morphostratigraphic units" of presumed Pleistocene age, and designated the Willis (oldest), Lissie, and Beaumont (youngest) Formations (Hayes and Kennedy, 1903; Duessan, 1914; 1924; Doering, 1935; see Morton and Price, 1987; DuBar et al., 1991 for reviews). Bernard (1950) first differentiated post-Beaumont landforms and deposits when he described the Deweyville terrace and beds along east Texas rivers. Elsewhere, post-Beaumont strata went, for the most part, unnamed and undifferentiated but were assumed to be Holocene in age.

Most genetic interpretations for Texas Coastal Plain surfaces and deposits were developed when the Pleistocene was divided into four long glacials with sea level lowstand and three long interglacials characterized by sea level highstand. Following Fisk's (1944) model for the Mississippi River, valley entrenchment and sediment bypass was inferred for glacial periods, and large-scale depositional units were interpreted to represent alluvial terraces and deltaic plains constructed during transgression and highstand. Beaumont strata were assigned to the "Sangamon" interglacial (e.g. Doering, 1956; Winker, 1979), or to a subsequent shorter-lived "Peorian" interglacial (e.g. Bernard and LeBlanc, 1965), whereas post-Beaumont valleys were presumed to represent entrenchment during the "Wisconsin" glacial, and filling with post-glacial sea level rise.

This paper is part of a continuing reevaluation of the genetic stratigraphy of Texas Gulf Coastal Plain fluvial deposits. This type of reevaluation becomes necessary when the empirical foundations of previous models have been substantially revised. Such is the case for the simple linkage between coastal plain depositional units and glacio-eustasy, a satisfactory model when the concept of four long Pleistocene interglacials was accepted, but one that needs reevaluation today. Willis, Lissie, Beaumont, and post-Beaumont strata are, for example, now thought to represent the entire Plio-Pleistocene to Holocene (DuBar et al., 1991), but studies of oxygen isotopes in marine sediments show seven glacial-interglacial cycles during the last 700,000 years alone (Chappell and Shackleton, 1986; Williams et al., 1988). Blum and Price (1994; in press) present the first stages of this reevaluation, showing that Beaumont alluvial plains consist of cross-cutting incised valley fills deposited over the last 3-400 ky or more. This paper builds on previous work to suggest a "Deweyville allostratigraphic framework", as well as a genetic model that emphasizes fluvial response to interacting glacio-eustatic and climatic controls.

Background to Deweyville Terraces and Deposits

Barton (1930) first discussed the large relict channels on terraces of east Texas Rivers as distinct from those on older Beaumont or younger floodplains. Some 20 years later, Bernard (1950) formally recognized the Deweyville beds as underlying a terrace along Sabine River that is intermediate in elevation between Pleistocene Beaumont surfaces and Holocene floodplains, and which has channel dimensions much larger than the modern Sabine. He also noted similar terraces along the Neches, Trinity, San Jacinto, and Nueces Rivers (Angelita terrace of Price, 1933), and suggested that large arcuate scars along valley walls in the Brazos and Colorado valleys were correlative to Deweyville meanders, but buried by younger deposits.

Following this early work, similar terraces were recognized and studied throughout the Gulf Coastal Plain in Arkansas, Louisiana, and Texas, and in most cases workers identify 2-3 terraces that fit Bernard's Deweyville concept (e.g. Gagliano and Thom, 1967; Saucier and Fleetwood, 1970; Aten, 1983; Alford and Holmes, 1985; Pearson et al., 1986; Blum and Valastro, 1994). Moreover, Environmental Geologic Atlas maps published by The University of Texas' Bureau of Economic Geology identify at least 2 "Deweyville" terraces in the lower reaches of coastal plain valleys, except those of the Rio Grande, Colorado, and Brazos Rivers

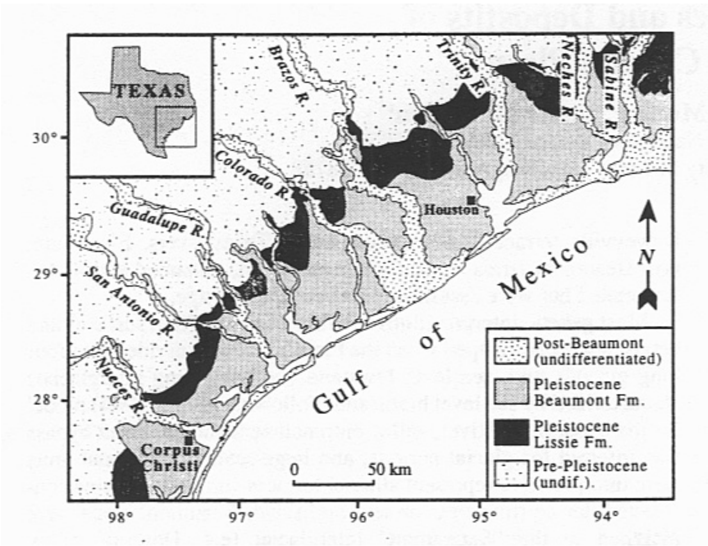

Figure 1. Geologic map of the Texas Coastal Plain between Sabine and Nueces Rivers, illustrating principal fluvial axes, the distribution of Lissie and Beaumont alluvial plain strata, and post-Beaumont valleys (simplified from DuBar et al., 1991).

(Fisher et al., 1972; Brown et al., 1976; McGowen et al., 1976). Finally, seismic reflection and core-based studies of recent strata of the now-submerged east Texas shelf interpret terraces within the incised valley of the Sabine and Trinity Rivers, and suggest they correlate with Deweyville terraces onshore (Pearson et al., 1986; Thomas, 1990; Anderson et al., 1992; Thomas and Anderson, 1994).

Few chronometric controls are available for Deweyville terraces. Bernard (1950) inferred a latest Pleistocene age, whereas Bernard and LeBlanc (1965), Gagliano and Thom (1967), and Saucier and Fleetwood (1970) cite unpublished radiocarbon ages of ca. 30-17 ka from Deweyville deposits. Saucier and Fleetwood (1970) also suggest Deweyville terraces in Arkansas can be traced to late Wisconsin valley trains of Mississippi River. More recent estimates range over an order of magnitude, as Alford and Holmes (1985) suggest an early to middle Holocene age for Deweyville terraces along Sabine River, based on associated archaeological materials, and Thomas (1990) places Deweyville terraces of the Trinity valley in isotope stage 5c, ca. 100 ka, based on correlations with the Trinity incised valley fill offshore, and ages for the offshore record from oxygen isotope curves.

Barton (1930) provided an initial explanation for large meanders on terraces of east Texas rivers, suggesting late Pleistocene streams were larger than modern channels, and rainfall must have been greater. Bernard (1950) reviewed a number of explanations, but clearly favored linking Deweyville deposition and terrace formation to a cycle of rising then falling sea level during the latest Wisconsin. Subsequent workers (Gagliano and Thom, 1967; Saucier and Fleetwood, 1970; Alford and Holmes, 1985) favored climatic controls, using hydraulic geometry relations to suggest Deweyville meander scars represent mean annual discharges significantly greater than modern. Most recently, Saucier (in Autin et al., 1991) suggests changes in precipitation seasonality and intensity, and changes in vegetation, were more important than changes in mean annual discharge, whereas Thomas (1990) linked deposition to rising sea level during isotope stage 5c, and Gagliano (1992) suggests Deweyville terraces represent Pleistocene "superfloods".

"Deweyville" Allostratigraphic Framework

Studies that followed Bernard (1950) illustrate the complexity of post-Beaumont alluvial deposits of the Texas Gulf Coastal Plain, but also muddy the "Deweyville" waters a bit, as it seems that different workers are talking about different things. Because of the regional significance of the "Deweyville" phenomenon, we outline a broader conceptual framework, one that future studies can test and refine.

We suggest the distribution and variability of the "Deweyville" phenomenon can best be understood within the context of the large-scale geomorphology of the Texas Coastal Plain. For example, Winker (1979) and Galloway (1981) differentiate *extrabasinal* from *basin fringe* and *intrabasinal* fluvial systems. Extrabasinal systems (Rio Grande, Colorado, and Brazos) drain tectonic hinterlands, have large sediment supplies, and construct laterally extensive alluvial-deltaic headlands. By contrast, basin fringe fluvial systems (Sabine, Trinity, Guadalupe, and Nueces) cannibalize basin margins, whereas intrabasinal streams (San Jacinto, Navidad, and Aransas) drain updip parts of the basin fill. Because of the small drainage areas and sediment loads of basin-fringe and intrabasinal streams, they commonly flow into the basin at interdeltaic bights that consist of alluvial, bay-head deltaic, estuarine, and barrier island/strandplain depositional systems. Complementary to the above, Morton and McGowen (1980) show that rivers entering the basin over deep-seated structural lows have gradients much less steep than those that enter the basin, or flow over, deep structural highs. Examples of low gradient streams would be the Sabine, Neches, Trinity, and Brazos, which enter the basin over the Houston embayment, and the Rio Grande, which enters the basin over the Rio Grande embayment. High gradient streams like the Colorado, Guadalupe, and Nueces emerge from the high-relief Edwards Plateau and cross the San Marcos arch before discharging into the Gulf.

Within this larger context, our mapping and construction of long profiles shows multiple terraces with Deweyville characteristics within post-Beaumont valleys of basin fringe fluvial axes (Fig. 2). For low-gradient east Texas rivers, like the Trinity, Sabine, and Neches, two terraces occur below the Beaumont surface and above the level of modern floodplains, and project seaward beyond modern bay-head deltas until they are cut out by modern bays. In addition, large arcuate scars are ubiquitous along valley walls (i.e. Lake Anahuac in the Trinity valley), and have always been referred to as "Deweyville" (see Gagliano and Thom, 1967; Aten, 1983; Pearson et al., 1986); but their long profiles coincide with modern floodplains, and they have been buried by veneers of younger floodbasin and/or delta plain facies, hence they are no longer terraces in the classic sense. By contrast, for steeper gradient basin fringe rivers like the Guadalupe and Nueces, three distinct terraces occur well above modern floodplains, at least down to the bay-head delta plain, where the lowest "Deweyville" surface is onlapped and buried.

For the extrabasinal Colorado and Brazos valleys, Bernard (1950) suggested similar terraces might have been present, but they are now buried by younger alluvial deposits. Indeed, Blum and Valastro (1994) show that terraces with "Deweyville" characteristics are present in the Colorado valley, but onlap by Holocene strata occurs 100 km updip from the modern shoreline (Fig. 3). Mapping and stratigraphic data remain unavailable for much of the Brazos system, but White and Weigand (1989) correlate a Brazos terrace near the confluence with Navasota River, with the Deweyville. Bernard et al. (1970) show that modern floodplain facies veneer the post-Beaumont Brazos valley through the lowermost 100 km. By inference, Deweyville deposits would be buried by Holocene strata through the lower part of the Brazos valley, as they are in the Colorado, but the updip limits of onlap might be considerably greater due to the lower valley gradient.

In summary, landforms and/or deposits that correspond to Bernard's (1950) concept appear to be present along all of the major Texas Coastal Plain rivers except perhaps Rio Grande(?). However, the presence of multiple "Deweyvilles" complicates the picture, as do morphologic and stratigraphic differences that correspond to large-scale geomorphological setting. Hence, following recent efforts in the Gulf Coast (Autin, 1992; Blum and Valastro, 1994), we suggest "Deweyville" landforms and deposits should be treated as unconformity-bounded allostratigraphic units (NACSN, 1983), since some deposits have a similar age, origin, and genetic significance, but no longer have surface expression as a terrace. Fundamental characteristics of a "Deweyville" allostratigraphic

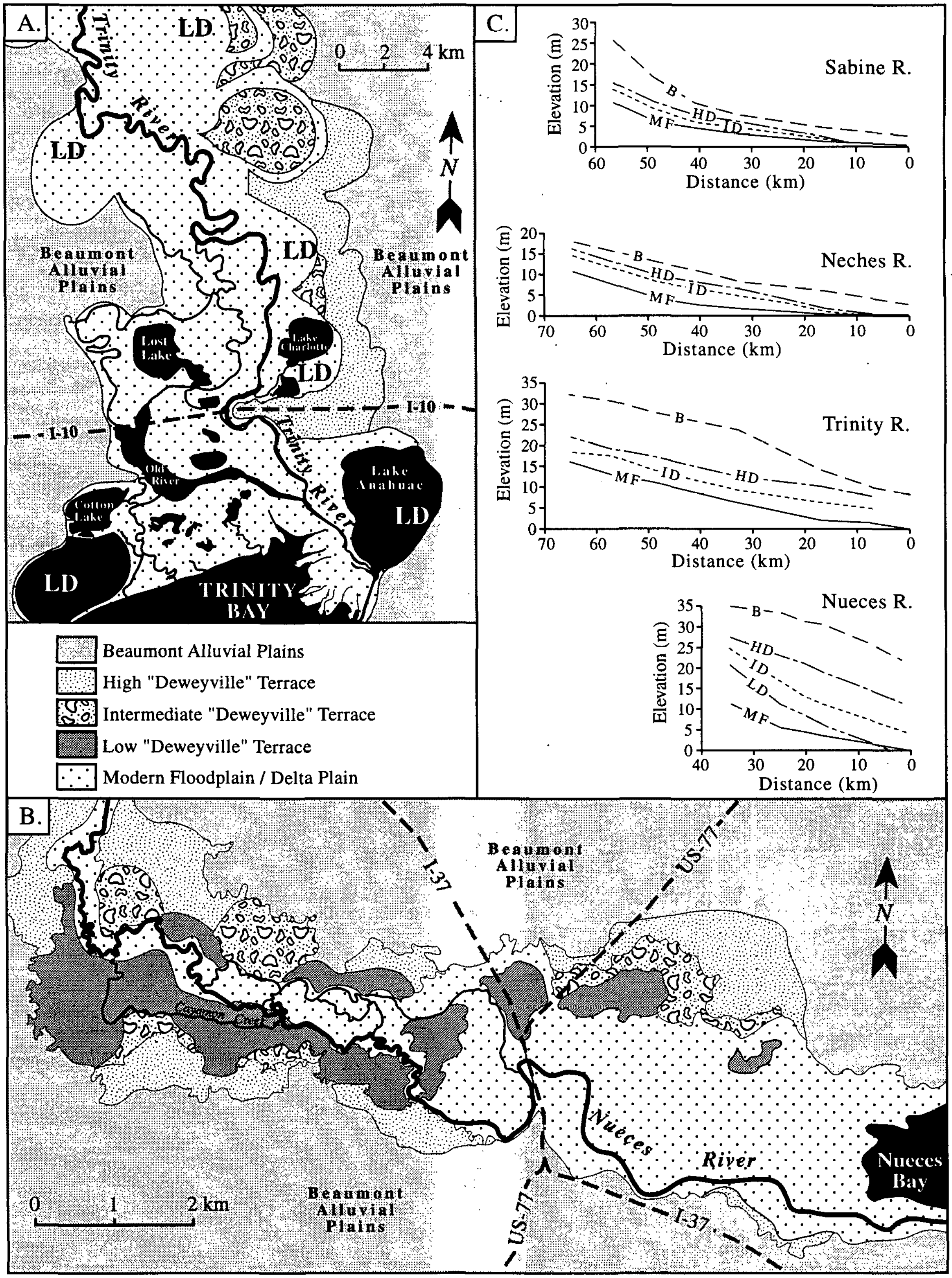

Figure 2. (a) Surficial geologic map of the lower Trinity valley. (b) Surficial geologic map of the lower Nueces valley. Maps illustrate distribution of high, intermediate, and low Deweyville terraces, plus low Deweyville channel scars (LD) now covered by thin veneers of Holocene floodplain or delta plain facies (Trinity valley). (c) Longitudinal profiles for the basin fringe Sabine, Neches, Trinity, and Nueces Rivers. B = Pleistocene Beaumont surface, HD = highest "Deweyville" terrace, ID = intermediate "Deweyville" terrace, LD = lowest "Deweyville" terrace, and HF = Holocene floodplain. For the Sabine, Neches, and Trinity, the lowest "Deweyville" profile coincides with, or dips below, the Holocene floodplain, and is not plotted separately.

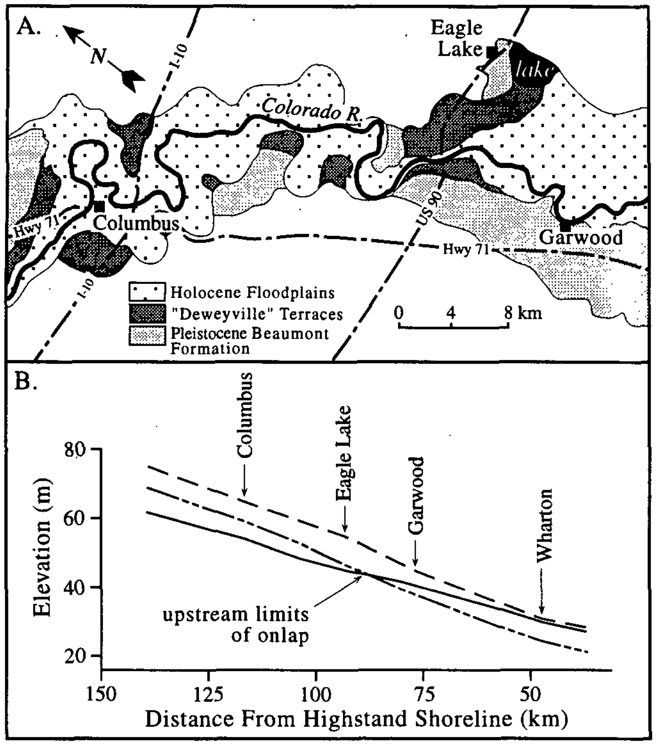

Figure 3. (a) Surficial geologic map of the lower Colorado valley between Columbus and Garwood, TX., illustrating distribution of Beaumont, "Deweyville", and Holocene landforms and deposits. Note that different "Deweyville" terraces have not been differentiated. (b) Long profiles of depositional surfaces in Colorado valley between Ellinger and Wharton, TX., illustrating onlap of "Deweyville" surfaces by deposits of Holocene age between towns of Eagle Lake and Garwood. Adapted from Blum and Valastro (1994).

framework might be as follows (Fig. 4): (a) the entire post-Beaumont succession should be bounded by a composite basal unconformity that traces up and out of the valley to soils on Beaumont surfaces; (b) the oldest "Deweyville" allostratigraphic unit occurs at the highest elevations, with successively younger units at successively lower elevations; (c) each "Deweyville" unit should be bounded by unconformities that trace up, and laterally to, soils developed on older units, and the upper boundary to each "Deweyville" unit should be defined by a soil profile; (d) "Deweyville" units project seaward to shorelines lower in elevation and farther seaward than today; and (e) the updip limits of onlap and burial of "Deweyville" units by younger strata depends on sediment supply and valley gradient.

Lithological characteristics play no formal role in definition of allostratigraphic units, but a number of workers note that facies underlying Deweyville terraces are coarser than Beaumont or Holocene deposits (e.g. Gagliano and Thom, 1967; Saucier and Fleetwood, 1970; see also Autin et al., 1991). Blum and Valastro (1994) suggest that gravely or sandy channel facies extend to the top of most sections in "Deweyville" correlatives of the Colorado valley, and vertical accretion facies are rare, which contrasts with late Holocene deposits where vertical accretion facies are thick and volumetrically significant. Our observations in the Sabine, Neches, Trinity, and Nueces valleys supports the view of limited to non-existent vertical accretion facies in "Deweyville" units, and an abundance of such facies in Holocene deposits. We also note that gravel and sand quarries occur frequently on "Deweyville" surfaces because of the lack of fine-grained overburden.

A precise chronology for "Deweyville" allostratigraphic units awaits future work, but stratigraphic relations indicate they fall between deposition of Beaumont alluvial plain strata and development of modern floodplains. The Colorado River is the only fluvial system with chronological control on Beaumont or younger strata. The youngest Beaumont meanderbelts have, for example, produced thermoluminescence ages ranging from ca. 119 to 102 ka, suggesting alluvial plains were abandoned during late isotope stage 5 as the Colorado incised and extended across the newly subaerial shelf in response to sea level lowering (Blum and Price, 1994; in press). At the other end of the time window, the youngest deposits correlative to Deweyville have produced radiocarbon ages that fall within isotope stage 2, ca. 20-14 ka (Blum and Valastro, 1994). From this, we infer that "Deweyville" allostratigraphic units were deposited sometime within the isotope stage 4, 3, and 2 glacial period.

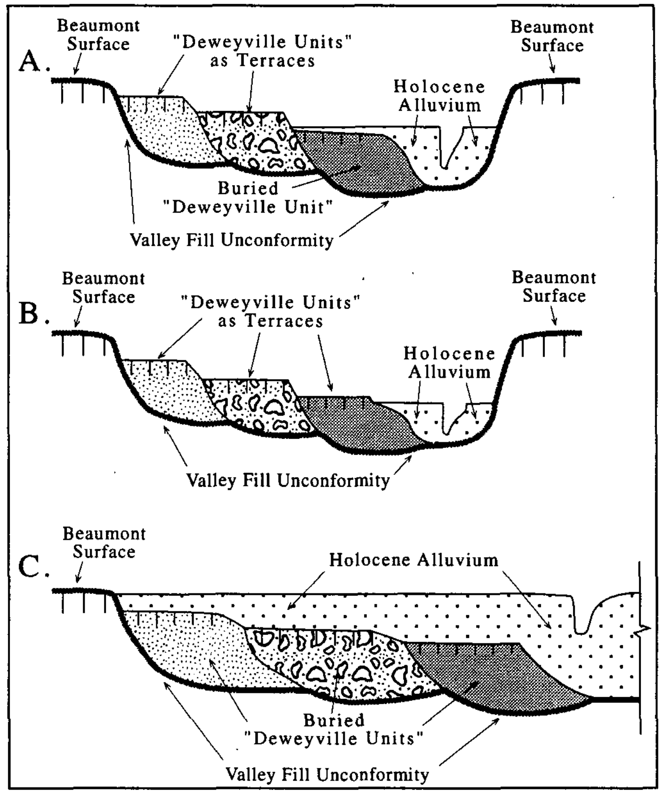

Figure 4. Schematic valley cross-sections contrasting "Deweyville allostratigraphy" in different geomorphic settings along the Texas Coastal Plain, at similar distances updip from modern highstand shorelines. (a) Low-gradient basin fringe fluvial axis, where high and intermediate Deweyville surfaces remain as terraces, but low Deweyville surfaces occur at the same elevation as modern floodplains, and are veneered by floodplain / delta plain strata. (b) Steep-gradient basin fringe fluvial axis, where low Deweyville surfaces remain as a terrace above modern floodplains until onlapped at modern bay-head deltas. (c) Extrabasinal fluvial axes, where all "Deweyville" surfaces have been onlapped and buried by Holocene strata, and post-Beaumont valleys are nearly filled. Relative scale of valley fill sequences as indicated. "Deweyville" allostratigraphic units are shown occurring on one side of the valley for illustration purposes only.

Genetic Model for "Deweyville" Allostratigraphic Units

Although climate change and/or changes in base level undoubtedly played a significant role in determining "Deweyville" morphological and stratigraphic characteristics, two problems should be addressed. First, values of precipitation or discharge suggested by previous workers seem extreme, perhaps out of the range of possibilities for the climate system in this region. It seems unlikely, for

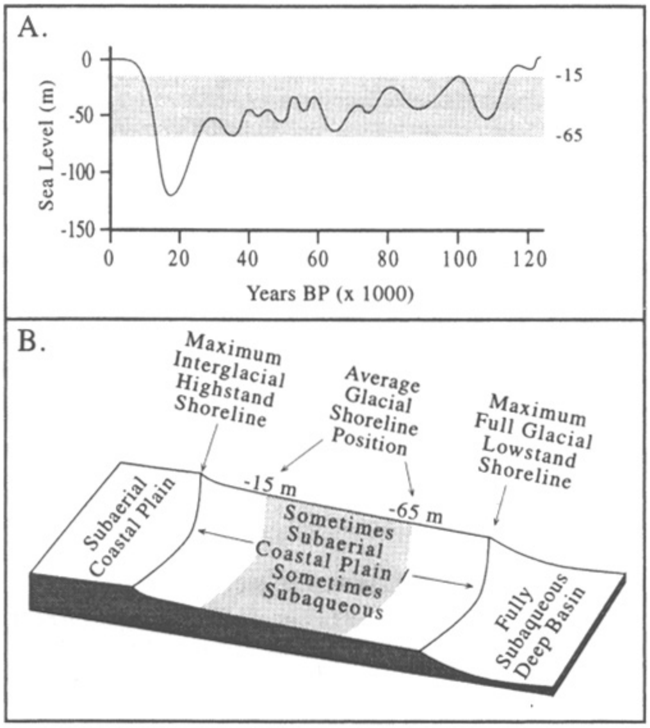

Figure 5. (a) Eustatic sea level curve inferred from oxogen isotopes for last 125 ky (adapted from Chappell and Shackleton, 1986), with shaded area representing inferred depths of -15 to -65 m below present. (b) Schematic illustration of differences between interglacial highstand, intermediate glacial period, and full-glacial lowstand shoreline positions. As in Figure 5a, shaded area represent depths of -15 to -65 m below present. Based in part on J. R. Suter (pers. communication, 1995).

example, that mean annual discharge could have been significantly more than present, or that the glacial period would have had larger peak discharges than the present interglacial. Second, the nature of base level influence needs reevaluation in light of present understanding of glacio-eustasy, which is very different from the model that prevailed when Bernard (1950) conducted his work. Here we present a revised genetic model that can be tested or refined in future investigations.

Glacial Versus Interglacial Climate Systems

Our model draws on Porter's (1989) concept of "average Quaternary glacial conditions". Most discussions of Quaternary climate or sea-level change focus on end-members such as the full-glacial or interglacial. However, oxygen isotope curves (Chappell and Shackleton, 1986; Williams et al., 1988) show that 80% of any middle to late Pleistocene 100 ky glacial cycle was intermediate in character, with global temperatures cooler than full interglacial conditions, but not as cold as a full-glacial, and with eustatic sea level at -15 to -65 meters (Fig. 5a). For Texas Coastal Plain rivers, this would translate to cooler land temperatures, and a cooler and smaller Gulf precipitation source for the entire stage 4, 3, and 2 glacial cycle. Moreover, rivers were extended to shorelines in mid-shelf or farther basinward positions, and much of the shelf was a subaerial extension of the coastal plain (Fig. 5b). Such conditions represent the norm for the last 100 ky, and the Holocene interglacial should be regarded as unique, with a warm climate, a large and warm Gulf precipitation source, and rivers graded to updip shoreline positions.

At a more specific level, Toomey et al. (1993) reconstruct the isotope stage 2 glacial climate of the Edwards Plateau, source terrain for the Colorado, Guadalupe, and Nueces Rivers. Regional temperatures were significantly cooler, and there was more effective moisture, but perhaps more important were the types of precipitation events, and the nature of upland soil mantles. Tropical cyclones were probably rare to non-existent when sea level was low and the Gulf was cooler (e.g. Wendland, 1977; Hobgood and Cerveny, 1988), as were high-intensity convectional storms, and most precipitation would have been derived from midlatitude cyclonic storms. Several lines of evidence also converge to show that full-glacial precipitation fell on uplands that were covered by deep soil mantles no longer present in the area today.

Precipitation events characteristic of the full-glacial on the Edwards Plateau might have prevailed through earlier parts of the last glacial cycle, and throughout the southcentral United States. Given the relationship between tropical cyclone frequency and sea surface temperature, or convectional storm frequency and land temperature, such storms should have been infrequent at best during the entire stage 4, 3, and 2 glacial period. Moreover, deep soils present at full-glacial time on the Edwards Plateau should have been present through earlier parts of the last glacial cycle as well, since soils on these limestone uplands would have required a long time to form, probably through some combination of eolian dust influx and in situ weathering of bedrock, and therefore reflect long-term landscape stability. Although details may have differed elsewhere in the southcentral United States, landscape stability may have been the norm for the entire glacial period, especially if convectional and tropical storms were insignificant, and most precipitation resulted from less intense but areally widespread midlatitude cyclones.

Global climate changes that led to wastage of isotope stage 2 ice sheets resulted in changes in climate and vegetation in the southcentral United States. Toomey et al. (1993) suggest that post-glacial sea level rise, coupled with increased surface temperatures, promoted frequent inland penetration of warm, moist tropical air, and corresponding increases in the frequency of tropical cyclones and convectional storms. On the Edwards Plateau, these changes triggered a period of landscape instability and soil erosion so that upland landscapes now consist of exposed bedrock. Again, although details may differ, Holocene landscape instability may have been widespread in the southcentral United States due to the shift from glacial to interglacial climates.

Glacial Versus Interglacial Fluvial Systems

Fundamental differences between glacial and interglacial climates would have resulted in equally fundamental differences in fluvial process regimes. While glacial periods had more effective moisture, related mean annual discharge values are not critical to explaining "Deweyville" characteristics (see Saucier, in Autin et al., 1991), since the morphology and depositional style of alluvial channels depend on floods that are less frequent (recurrence intervals of 1-10 years), and 1-3 orders of magnitude greater, than mean annual discharge (Wolman and Miller, 1960; Wolman and Gerson, 1978; Knox, 1983). Hence glacial to interglacial changes in storm types and landscape stability, and their effects on floods, should have been the most important factors.

Most extreme floods on the larger coastal plain rivers result from the inland penetration of tropical cyclones, or El Nino phenomena, and the related extreme rainfalls. Most importantly, these would be the only historic floods comparable in magnitude to those needed to explain the large channels common to "Deweyville" surfaces on hydraulic geometry grounds alone. As outlined above, it seems unlikely that tropical flood-generating mechanisms would have been significant during the glacial period. By contrast, precipitation from midlatitude cyclones, common to Spring and Fall months during the late Holocene, produces frequent moderate magnitude floods. We suggest such storms were the dominant flood-producing mechanism during the glacial period, and frequent moderate magnitude floods dominated "Deweyville" discharge regimes.

Regardless of meteorological cause, flood peaks, as contrasted with flood volume, are conditioned by rates at which precipitation is converted to discharge, which in turn reflects vegetation cover, soil mantles, and other landscape characteristics. For the Edwards Plateau, source region for the Colorado, Guadalupe, and Nueces Rivers, rates at which runoff was transferred to stream channels would have been at a minimum through the glacial period when uplands were covered by deep soils and a good vegetation cover, and a maximum during the Holocene interglacial when the bedrock landscape was exposed. By comparison, holding flood volume constant, glacial period discharge hydrographs would have been less peaked and more broad-based than those characteristic of the Holocene. Hence, not only were extreme flood-generating mechanisms less likely during the glacial period, but rates of runoff and resultant flood hydrographs were conditioned by upland landscape stability, and flood peaks should have been smaller and more broad-based than today (less flashy).

Sedimentary facies typical of "Deweyville" allostratigraphic units also suggest extreme floods were unimportant during their formative period. The paucity of vertical accretion facies indicates that most floods remained within bankfull channel perimeters, overbank flooding was a rare to non-existent occurrence, and "Deweyville" floodplains were constructed by lateral accretion and migration of point bars and channels. This contrasts with the late Holocene, with flashy floods that exceed bankfull channels, floodplain construction by vertical accretion and avulsion, and thick successions of fine-grained vertical accretion facies (Blum and Valastro, 1994). Waters and Nordt (1995) suggest similar changes in processes of floodplain construction for the Brazos River near College Station.

The absence of vertical accretion facies, and the inferred absence of overbank floods, may help explain the enigmatic large Deweyville channels. Examination of curves that relate discharge characteristics to channel geometry, upon which many empirical hydraulic geometry equations are based (e.g. Carlston, 1965; Dury, 1965), shows considerable variability in meander geometry for a given discharge. This may reflect largely on the influence of bank-stabilizing muds (see Schumm, 1960; 1969), with higher than average meander wavelengths and radii of curvature reflecting a lack of muds in floodplain settings, and lower values reflecting muddy systems. More recent thinking on floodplain processes support these views, as Brackenridge (1988) argues the thickness of vertical accretion facies is related to flashiness of the discharge regime.

In sum, we suggest that channels on Deweyville terraces may reflect hydraulic adjustments to the absence of bank-stabilizing muds, which in turn reflects an absence of deep and flashy overbank floods through the isotope stage 4, 3, and 2 glacial. Smaller channel dimensions on Holocene floodplains may simply reflect the presence of bank-stabilizing muds, which in turn may result from the deep, flashy overbank floods characteristic of the present interglacial.

Role of Glacio-Eustasy and Base Level Change

"Deweyville" allostratigraphic units extend farther upstream than the influence of base level changes during the last glacio-eustatic cycle, so their fundamental characteristics must be attributed to other causes, perhaps those outlined above. Nevertheless, base level changes played a major role in shaping the geomorphic and stratigraphic framework in downstream reaches of valleys on the present-day coastal plain. Post-Beaumont valleys initially formed in response to sea level lowering below isotope stage 5 interglacial positions, when channels incised Beaumont alluvial plains, and extended across the newly subaerial shelf. Glacial period rivers then flowed through a series of laterally-confined valleys, with channels extended to shorelines in mid-shelf or farther basinward positions (see Suter and Berryhill, 1985; Suter, 1987; Anderson et al., 1992; Thomas, 1990; Thomas and Anderson, 1994). However, this long-term degradational mode was punctuated by multiple "Deweyville" episodes of lateral migration and/or minor aggradation with sediment storage, followed by renewed valley incision with terrace formation. With post-glacial sea-level rise, the lower reaches of coastal plain rivers switched from degradational to aggradational modes, with progressive onlap of "Deweyville" profiles by Holocene deposits.

In upstream reaches of the coastal plain, differences between "Deweyville" and Holocene depositional systems may be a function of changes in the climate system, as suggested above. But the volumetric significance of vertical accretion facies in downstream reaches of Holocene floodplains is greatly enhanced by a forced shortening of channels, flattening of longitudinal gradients, and forced storage of sediments in response to post-glacial sea level rise and shoreline trangression. Indeed channel shortening, valley aggradation, and reductions in depositional slope during late transgression and highstand has promoted avulsion and development of the anastamosing or distributary channel patterns seen in the lowermost reaches of modern-day streams. Low sediment yield basin fringe and smaller systems have yet to fill post-Beaumont incised valleys, so avulsion remains confined within the boundaries of the valley itself. At the other end of the spectrum, the high sediment yield Colorado River has filled its incised valley, and avulsed to reoccupy a Beaumont isotope stage 5 channel course (Blum, 1994; Blum and Valastro, 1994; Blum and Price, in press).

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