by sparry calcite. More recent episodes of cementation have left some gravitational voids.

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Influence of Various Fold Mechanisms on Fold Geometry in Growth Faulted Areas

Growth faults and associated folds are the dominant structural features along many passive margins, including the U. S. Gulf Coast. Most of the exploration effort in these areas is directed toward prediction of fold geometry and location of fold crests. Previous attempts to explain geometry have focused on only one folding mechanism per fold. A new concept presented in this paper is that multiple folding mechanisms are operative and variously contribute to the geometry of each fold. Recognition of the dominant fold mechanism enhances prediction of fold geometry.

Folding caused by growth faulting, or tectonic folding, causes fold crests to shift basinward with depth. Drape compaction causes vertical alignment of fold crests, and differential compaction puts fold crests in the area of greatest sandstone percentage. Folds dominated by tectonic folding lie within the concave trace of growth faults. Tectonic folds bulge upward above regional dip, a phenomenon here termed "upfolding." An isopach of an interval above an upfold reveals thickening in all directions away from the fold crest. If upfolds have sufficient relief, shallower layers may align vertically due to the dominance of drape compaction. Subsurface studies of gas fields along the central Texas Gulf Coast provide examples of the contribution of various mechanisms to a single fold. Separating the contribution of fold mechanisms aids in prediction of fold geometry and has important implications for hydrocarbon exploration.

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Stress Release, Joints, and Instability on Submarine Slopes

Mass movements related to gradual stress release within a sediment section may be quantitatively important on submarine slopes, particularly when such stress release involves joint sets. The sequence of events that promotes this phenomenon has been established by numerous terrestrial studies. The process involves: (1) mass wasting or erosion to remove vertical stress (overburden) or lateral stress (such as through canyon cutting); (2) consequent elastic rebound of the unloaded section; and (3) opening of existing joints and/or formation of new joint sets. The presence of joints, which constitute planes of weakness within the sediment section, controls and reduces the stability of the affected slope; that is, the stability of the slope may no longer be dependent on the inherent strength of the sediments.

The results of this process have been observed on the continental slope off the Mid-Atlantic coast of the United States. There, exposed Tertiary sediments have a well-developed joint pattern that has been observed in sidescan-sonar images, from submersible operations, and in a piston core. The measured preconsolidation stress on an Eocene core sample suggests that more than 100 m (330 ft) of overburden may have been removed from parts of the area. Intact Eocene blocks, which represent apparent failure along joint planes, have fallen from canyon walls on the lower slope and moved onto the upper rise.

We suggest that this process has the potential to operate on most deeply eroded surfaces and that exhumed (overconsolidated) sediments do not necessarily represent stable conditions despite their typical relatively high shear strengths.

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Sedimentary Processes Along Sagavanirktok River, Eastern North Slope, Alaska

The Sagavanirktok River is the second-largest river on the North Slope of Alaska (drainage basin area = 14,364 km^2, 5,500 mi^2; length = 267 km, 165 mi). Maximum discharge recorded during the spring breakup was 2,320 m^3/sec (82,000 cfs); flow ceases during the winter freeze. The river flows through terrain underlain by continuous permafrost ranging up to 300 m (1,000 ft) thick. It is a coarse-gravel, braided river that is degradational through most of its length, becoming aggradational on the last 20 km (12 mi) of delta plain. The active channels contain longitudinal bar complexes and large transverse bars, including T-bars at the ends of chutes incised into the inactive fluvial plain. Chutes form during spring breakup owing to blockage of the river by ice from icings (aufeis), or by ice drives that jam and direct the river laterally onto the inactive fluvial plain.

Relict fluvial systems also exist as terraces elevated 10-30 m (30-100 ft) above the active river. This terrain contains wind-aligned lakes developed in the permafrost active layer. Next to the terrace scarp is an eolian levee composed of silt and fine sand derived from the active river.

Numerous small, high-gradient alluvial fans have formed along hills adjacent to the lower alluvial plain. Coarse gravel is transported down-fan to the Sagavanirktok River primarily by debris flows that have prominent sieve lobes at the ends of U-shaped channels. The flows are fed by spring runoff, melting of ground ice during the thaw season, and by ground-water-fed springs (small icings).

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Petrography and Diagenesis of Upper Smackover Formation (Oxfordian), Atlanta and Pine Tree Fields, Southwestern Arkansas

The upper Smackover Formation (Oxfordian) in Atlanta and Pine Tree fields is a regressive, shallowing-upward sequence that was deposited on the upper part of a carbonate ramp that sloped gently to the south. Low-relief salt anticlines active during upper Smackover deposition led to the localization of high-energy grainstones.

In the study area, the upper Smackover is divided into the following rock types: (1) bioclast-oncoid-ooid grainstone, (2) sandy ooid grainstone, (3) sandy peloid-ooid grainstone, (4) sandy calcareous shale, and (5) well-sorted ooid grainstone. The 5 rock types represent deposition in subtidal to supratidal environments.

The upper Smackover was affected by diagenesis in the marine-phreatic, freshwater-phreatic, freshwater-vadose, and late-burial diagenetic environments. Early cementation in the marine-phreatic and freshwater realm preserved primary interparticle porosity. Dissolution of unstable minerals in the freshwater realm created secondary porosity. Preservation of porosity during late-burial diagenesis was controlled by 2 sedimentologic factors: (1) presence of abundant detrital quartz, and (2) sorting. Porosity was also affected by late-burial cementation.

Atlanta and Pine Tree fields are productive from the upper Smackover Formation and the Schuler Formation. In Atlanta field, the producing zone in the well-sorted ooid grainstone is a structural-stratigraphic trap. The producing zones in the bioclast-oncoid-ooid grainstone in both Atlanta and Pine Tree fields are structural traps.

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Characteristics of Mississippi Fan Sediments, DSDP Leg 96

Sedimentologic, paleontologic, geochemical, and geotechnical studies were conducted on cores drilled at eight sites on the Mississippi fan during the Deep Sea Drilling Project Leg 96. Together with seismic and well log data, these studies allow development of a number of depositional facies within an overall fan-lobe model. The central middle-fan channel of the youngest Mississippi fan-lobe was an effective conduit for the transport of coarse-grained material; only clays and minor amounts of silt spilled over the channel margins. The channel fill deposit is basically an upward-fining sequence, commencing with coarse-grained sands and gravels, overlain by sands, sandy-silty muds, and muds. The basal coarse-grained sediment interval is approximately 134 m (450 ft) thick. The swale deposits, the overbank deposits adjacent to the meandering channel, and the marginal overbank deposits, are characterized by fine-grained turbidites and hemipelagics. Basically, both sites contain a minor upward-coarsening sequence.

Deposits on the lower fan, in the area where the channel shifts position frequently, show alternating sequences of channel fill, levee, and overbank deposits. Sediments near the channel terminus have upward-coarsening sequences (i.e. channel-mouth depositional lobes) and contain 47 to 65% sand.

Most of the sparse microfauna in both sands and muds are benthic species characteristic of inner and middle neritic origin. Traces of biogenic methane and other hydrocarbons were found in the underlying lobes but not in the youngest lobe. All sediments are underconsolidated, resulting from the extremely high accumulation rates of 6-12 m/1,000 yr (20-40 ft/1,000 yr).

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Lithologic Characteristics of Mississippi Fan

Deep Sea Drilling Project Leg 96 drilled eight sites on the youngest fan lobe of the Mississippi fan; well logs were run at six sites to complement core recovery. Four sites were drilled on the middle fan across the meandering channel: in a swale, on a point bar, in the channel thalweg, and in overbank deposits. The swale section consists of mud deposited mainly as fine-grained turbidites. The youngest fan lobe extends to 384 m (1,260 ft) subbottom at the overbank site and consists mainly of muds with clayey and silty zones. The gamma log indicates that most of the lithologic zones coarsen upward. Both channel sites have gravel overlain by pebbly muds, which corresponds to a zone of high-amplitude reflectors. The basal coarse unit is approximately 135 m (443 ft) thick. The channel fill shows a fining-upward sequence from gravel to interbedded sands and silts to sandy muds, and is capped by a 50-m (164-ft) thick homogeneous mud section. The sand section on the point bar side of the channel bend is 30 m (98 ft) thicker than on the thalweg site.

Four sites were drilled on the lower fan lobe, two adjacent to the channel and two near the channel terminus. Well logs indicate 47% net sand for the youngest lobe and 65% for the underlying lobe. The channel generally switches position, building an alternating section of channel fill and overbank deposits.

The channel-mouth depositional lobes coarsen upward, and individual sand layers range in thickness from 0.2 to 10 m (0.7 to 33 ft). They are deposited by turbidity currents.

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What is COMFAN?

COMFAN (Committee on Deep-Sea Fans) is an informal, international group of scientists that was hosted by Gulf Research & Development Co. in September 1982 to analyze the findings of deep-sea fan research accomplished during previous years. The group also reviewed the future plans for DSDP drilling on the Mississippi fan (Leg 96) and provided recommendations.

It was realized that tectonic setting and sea level variations have major influences on volumes of sediment supply, type of sediment, rates of accumulation, nature of fan growth, facies distribution, and stratigraphic sequences.

Deep-sea fans can be divided into three categories. Elongate fans develop in response to medium to high sediment input dominated by mud and fine sand. These fans have a major river as their primary source (e.g., Mississippi, Bengal, Indus, Amazon, and Rhone fans). Radial fans result from a lower sediment input with higher sand/clay ratios (e.g., La Jolla, Navy, San Lucas, Redondo fans). Slope aprons are a third category that, although not submarine fans, are closely related turbidite systems. Most fans are hybrids rather than true end members.

Three major conclusions were generated: (1) comparing modern fans with ancient turbidite systems is almost impossible because of scale differences and different study techniques; (2) slope failure may be a more direct source of fan deposits rather than deltaic systems; and (3) major fan accumulations most likely occur during the end of a sea level lowering or during the initial period of sea level rise, and sedimentation rates may be very high.

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Seismic Stratigraphy of Western Colombian Basin, Caribbean Sea

Multichannel seismic reflection profiles disclose the regional stratigraphy of the western Colombian basin. The basement complex is the seismic unit below the deepest, continuous reflection horizon that can be traced throughout the basin. The basement complex reflection signature on the flanks of the Mono Rise and adjacent areas is smooth, continuous, and characterized by local occurrences of internal reflectors, and is equivalent to the Late Cretaceous Horizon B in the Venezuelan basin. In the central basin, the reflection signature is rough with abundant diffractions typical of normal oceanic crust.

The sediment overlying the basement complex is subdivided into five mapping units. Unit CB5, which directly overlies the basement complex, is thickest on the Mono Rise and thins down the flanks of the rise. This unit is equivalent to the Upper Cretaceous to Middle Eocene pelagic unit bounded by seismic horizons A″ and B″ in the Venezuelan basin. Unit CB4, characterized by pervasive, small offset faulting, is restricted to the crest of the Mono Rise. Units CB3 and CB2 contain subparallel, variable amplitude, continuous reflectors that fill the regional basement complex relief. They are Middle Tertiary terrigenous distal turbidites and hemipelagic deposits. Unit CB1 thickens toward southern Central America and shows complicated reflection patterns typical of a deep-sea fan complex. A jump correlation to Deep Sea Drilling Project Site 154 is used to assign a Late Miocene to Quaternary age to unit CB1. Development of unit CB1 was concurrent with the uplift of and magmatic activity in southern Central America.

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Sedimentologic and Stratigraphic Framework of Some Modern Crevasse Splay Sands

A series of cores taken along strike and dip transects through the Baptiste Collette crevasse splay, modern Mississippi River delta, have been analyzed to determine the sedimentologic nature and potential reservoir quality of modern crevasse splay sands. Internal geometry, lateral and vertical continuity, and sedimentary characteristics were determined to construct a model of crevasse splay depositional systems applicable to hydrocarbon exploration.

The stratigraphic framework is more complex than previously recognized. This complexity is demonstrated by the presence of several fine-grained (61-125μ) sand bodies (1-2 m, 3-6 ft thick), reflecting deposition in 3 distinct environments. Subaerial levee sands, which thicken toward the proximal end of the splay, contain 50-80% fine-grained (88μ) sand, 10% interlaminated muds, and 5-25% rooting. Distributary mouth-bar and point-bar deposits (-2 m, -6 ft, MSL) are 50-60% fine-grained sand (88μ), 40-50% interlaminated mud, with $<$5% cross-bedding and gradational base. The deeper (-6 m, -20 ft, MSL) channel sands are 80-95% fine-grained (88μ) sand, with 20-75% crossbedding, 10% interlaminated mud and erosional base. These correlatable sands are encased in thick, organic-rich, bioturbated, bay and abandoned-channel muds forming an impermeable seal.

Channel sands have the greatest reservoir potential, being more laterally continuous along dip, clean (5% silt and clay), well sorted, fine-grained and more homogenous, with few permeability barriers (i.e., mud layers and laminae). Conversely, the shallower bar and levee deposits have poorer reservoir quality, being less clean, less continuous laterally along dip, and with more permeability barriers.

It is felt that this study will complement the limited knowledge of modern crevasse splay systems as well as provide insights into the exploration or enhanced recovery of hydrocarbons in ancient equivalents, such as the Admire 650′ Sandstone of Kansas.

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Experimental Hydrothermal Dedolomitization

Hydrothermal replacement of dolomite by calcite has been examined through experimental reactions carried out in teflon-lined stainless steel bombs, at temperatures ranging from 50° to 200°C (122° to 392°F), at