"reef-prone" shelf of moderate depth. The reef was enveloped by clayey and carbonate muds which prograded across the shelf. Nearly 3,000 million bbl of recoverable oil in Redwater and nine companion reefs attests to favorable trap-to-source relations in this basin setting.

Recognition of "reef-prone" cycles of deposition and early understanding of the depositional/tectonic framework which affects reef distribution are important in guiding exploration for Redwater-like reefs in new areas. Local, less predictable factors can influence the effectiveness of the reefs as traps and the success of exploration. Subsequent basin history is critical, for depth of burial affects the feasibility of seismic exploration and imposes regional cometamorphic patterns of hydrocarbon distribution.

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DIVERGENCE BETWEEN DIP DIRECTION OF CROSS-STRATA AND ENCLOSING CROSS-STRATA SET BOUNDARIES: A CHARACTERISTIC OF ALLUVIAL POINT-BAR SANDS

Repeated post-flood mapping and trenching of laterally accreting point bars along steep, meandering streams in southeastern Louisiana reveal a characteristic divergence between the azimuths of dip of scoured set boundaries and the cross-strata which they enclose. The interrelation offers a potential criterion for recognition of ancient point-bar deposits.

After floods, long curving sand waves are observed to be normal to the low-stage channel high on the emergent point-bar surfaces, but curve in the direction of flow to near parallelism with the low-stage channel near low water level. Cross-strata sets exposed in trenches on the emergent point bar are bounded by scoured surfaces which slope radially toward the low-stage channel (*i.e.*, they mimic the radial slope of the point-bar surface in the meander bend). The enclosed cross-strata dip generally in a downstream direction or obliquely toward the higher part of the point bar, diverging from the channelward dip direction of the scoured set boundaries by 80°–135°.

Sand waves which generated the cross-strata appear to have migrated downstream parallel with contours on the point bar or obliquely up onto the point bar, as revealed in the "frozen" post-flood surface sand-wave patterns. The inferred sand-wave migration pattern and growth of the point bar by lateral accretion into the flood-scoured channel were confirmed by sonic sounding during floods.

Sandstones of apparent point-bar–lateral accretion origin form part of complex belt-like bodies of sandstone in the Carboniferous of central Pennsylvania. The alleged point-bar sandstones are composed of unidirectionally dipping sets of cross-strata, crudely sigmoid in shape, which thin both up and down the dip of the scour surfaces bounding the sets. Enclosed cross-strata dip, on the average, in directions perpendicular to the dip of the set boundaries, indicating that flow was along the original strike, rather than down the dip, of the scour surfaces. Lateral accretion of the point bar into the channel appears to have progressed by addition of sand deposited in the lee of sand waves migrating parallel with the point-bar surfaces, as observed on the modern point bars.

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CHARACTER, ORIGIN, AND SIGNIFICANCE OF LATE SILURIAN BARRIER ISLAND—FUYK SANDSTONE MEMBER OF RONDOUT FORMATION, HUDSON VALLEY, EASTERN NEW YORK STATE

The Rondout Formation of New York State records two transgressive episodes, each represented by 20 ft of section, and each having occurred on a basin-wide scale as determined through correlation with equivalent units in Pennsylvania and central New York. The initial rate of each transgression was sufficiently rapid to allow the development of subtidal carbonate environments. As the rate of transgression slowed, the relative rate of sedimentation increased, allowing shoreline intertidal and supratidal environments to prograde into the line of section. The second transgressive episode was characterized by the development of a quartz sandstone barrier island–dolomite lagoon complex near shore and a coral-stromatoporoid biostromal environment offshore. Preservation of the barrier was effected by the intertidal and supratidal sediments deposited during the progradational phase of sedimentation.

Geometrically, the sand body attains a thickness of 20 ft, a width of 0.5 mi, and scattered exposures occur through a length of 4 mi.

Internally, the sand body can be subdivided into a basal biosparite calcarenite, grading upward into a well churn-burrowed, fragmental fossiliferous quartz sandstone, a thin-bedded cross-stratified and burrowed quartz sandstone, and a medium-bedded, cross-stratified quartz sandstone. Grain size, bedding thickness, skeletal content, and structures change both laterally and vertically.

Paleocurrent data and the character of the sand body suggest that it developed through the southward longshore transport of sediment derived from both terrigenous and offshore-marine sources.

Recognition of the constructional and preservational history of the Fuyk Member has contributed to an understanding of the relation of this and other less well-preserved sandstone bodies (deposited during the same time interval in Pennsylvania and New York) to associated carbonate sediments and to the transgressions in general.

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CONTOUR CURRENTS AND TURBIDITY CURRENTS

Turbidity currents transport sediments downslope and account for many graded sequences included in displaced clastic sediment embedded in deep-water deposits. Contour currents flow parallel with the isobaths and transport fine sediments for thousands of miles along the continental margins. The resulting deposits of these processes are turbidites and contourites. These two deep-water deposits commonly have been confused, even in modern sediments.

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GEOMETRY OF DEVONIAN SWAN HILLS REEF COMPLEX—ALBERTA, CANADA

The Swan Hills reef complex is in the subsurface of west-central Alberta, 96 mi northwest of Edmonton. Early in 1957, Home Oil Company Limited discovered oil in these rocks at Virginia Hills and Swan Hills, and other discoveries in similar reservoirs within this complex soon followed. Before this, no commercial hydrocarbon production had been obtained from the rocks of this formation in Western Canada. By the end of 1966, the Swan Hills Formation ranked second in Western Canada in order of recoverable oil reserves.

Between the year of discovery and the end of 1966, a total of 219,160,459 bbl of oil and 48 Bcf of gas have been recovered from 12 oil fields and 1 gas field. Total remaining recoverable reserves are estimated at 2,105,955,111 bbl of oil and 1,380 Bcf of gas.

The oil is a paraffin-base crude with a gravity ranging from 38° to 45° API. Sulfur content of the crude may run as high as 0.42 percent but generally is less than 0.2 percent.

Drilling depths differ considerably, depending on the position of the field relative to the regional dip, ranging from 6,950 ft in the northeast to 11,350 ft in the western parts of the producing area.

The Swan Hills Formation is probably early Late Devonian in age and occupies a stratigraphic position low in the Beaverhill Lake Group. The reef complexes of this formation are situated along the edge of a broad carbonate platform south of the Peace River arch and east of the Western Alberta ridge. Continuing reef growth formed limestone mounds that consist largely of successive layers of superimposed atolls, each having an organic rim surrounding lagoon deposits. The resulting rocks form a complex pattern of porosity and permeability. The limestones of the reservoirs, with a few exceptions, have not been dolomitized. Stromatoporoids are the dominant organisms. The fields are simple stratigraphic traps, the oil and gas being held in the porous reef rocks by the surrounding impermeable rocks.

In the productive area, the Swan Hills reefs are enclosed in a shale and dense limestone facies of the Beaverhill Lake Group. North and northeast of this area, in northern Alberta, a gradual lateral facies change to predominantly shale of the basin facies occurs. South and southeast in southern Alberta and Saskatchewan, there is a lateral facies gradation to dense limestone and dolomite, accompanied by a gradual thinning of the total thickness. A band of coarsely crystalline vuggy dolomite is present along the margin of this shelf. Farther south, anhydrite is interbedded with the dolomite and salt beds are present.

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### Storms and Sedimentary Processes Along Northern British Honduras Coast

The destructive capacity of coastal storms is well known; it is not generally known that, in some places, storms may be the principal agents of coastline construction. This capability of storms can be demonstrated along the coast of northern British Honduras, which is on the southern edge of the Caribbean storm track and is struck by periodic hurricanes and lesser storms.

The coastline of British Honduras is a complex of lagoons, mangrove marshes, and barrier ridges. Comparison of individual lagoons indicates an evolutionary sequence as tidal deltas grow into the lagoon from the rear edge of the barriers. Other, less active, sedimentary processes are: (1) filling of the lagoon with mud and shell debris, (2) encroachment by mangrove marshes, and (3) gradual elevation of mudflats. Together, these processes represent "normal" conditions.

Numerous abandoned tidal deltas occur along the barriers. In these deltas, the seaward mouth of the tidal channel has been blocked by barrier ridges. Thus, the construction of barrier ridges represents an additional process which, at least locally, is able to upset the balance of forces responsible for the construction of tidal deltas. Major storms can be shown to be the cause.

Scattered, newly formed beaches composed of soft, black, $H_2S$-rich mud occur in small bights along the coast. At Northern River Lagoon, the sequence, from top to bottom, of black mud (18 in.), flotsam (2 in.), and clean quartz sand (at least 4 ft) indicates that the beaches did not accrete slowly, but formed during a single event. As these beaches do not appear on photographs taken in 1944, the most likely event is Hurricane *Hattie*, which struck the coast in 1961.

At Midwinters Lagoon, a well-developed tidal channel, open in 1944, is now blocked by a beach at least 100 ft wide with ridge-and-swale topography. If colonized by mangrove, this beach probably will become a permanent addition to the barrier ridges.

The development of the British Honduras coast can be understood only by considering both "normal" and "catastrophic" events. The complex interplay of all agents must be appreciated.

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### Diagenetic Changes of Organic Sediments in Atchafalaya Basin, Louisiana

Most sediments have been developed in association with some forms of biological activity. Thus the changes in distribution and the corresponding function of the organic matter in solubilization, complex formation, translocation, and subsequent recrystallization of secondary minerals must be considered in studying diagenetic processes during the post-deposition interval. An undisturbed core 120 ft long was obtained from the fresh-water environment of the Atchafalaya basin and studied. A deep boring from a brackish environment of the lower Mississippi delta was included for comparison. The organic matter in the sediments was hydrolyzed with 6N HCl for 12 hr; the clear hydrolysates separated were neutralized with NaOH. The soluble forms of total hydrolyzable-N, α-amino acid-N, hexosamine-N, and $NH^+_4$-N were determined quantitatively by a simple micro-steam distillation technique. The results showed that, in the Atchafalaya basin, the α-amino acid-N was higher in lacustrine environments (145 μg/g at 30-ft and 81 μg/g at 120-ft depths) and lower in well-drained swamps (68 μg/g at 67-ft and 49 μg/g at 96-ft depths). The distribution of hexosamine-N ranged from 95 μg/g at 30-ft to 36 μg/g at 120-ft depths. In the lower Mississippi delta core, the α-amino acid-N decreased sharply from 220 μg/g at the surface of a brackish-marsh environment to only 30 μg/g in a prodelta environment at a depth of 100