turbidites. An outward-radiating paleocurrent pattern suggests northeastward transport of sand through a single major inner-fan-channel complex, succeeded by radial downfan dispersal to smaller middle-fan channels, outer-fan lobes, and fan-fringe deposits. Sandstone-to-shale ratios are 99:1 in inner-fan-channel deposits, 10:1 in middle-fan-channel deposits, 2.5:1 in middle-fan-levee deposits, 1.3:1 in middle-fan-interchannel deposits, 11:1 in outer-fan-lobe deposits, 2.6:1 in fan-fringe deposits, and 0.25:1 in basin-plain deposits. Orderly and progressive downfan changes in most sedimentary parameters, such as maximum clast size, thicknesses of fining- or coarsening-upward cycles, facies, and facies associations permit the growth history of the fan to be determined. The Gottero Sandstone provides a useful model for petroleum exploration in small deep-sea fans characterized by a mixture of grain sizes and deposited adjacent to tectonically active, convergent continental margins.

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Comparison of Tectonic Framework and Depositional Patterns of Hornelen Strike-Slip Basin in Norway and Ridge and Little Sulphur Creek Strike-Slip Basins of California

Deposition in basins that develop adjacent to strike-slip faults can yield thick nonmarine sequences with similar facies and geometry. In this paper, we compare 3 basins of different age and size whose tectonic and depositional characteristics suggest a similar origin and history.

The Hornelen basin developed during the Middle Devonian in western Norway. The basin is bounded on the north and south by east-west trending faults; the northern fault is considered to have been a zone of major right-slip movement. The basin is 60-70 km (38-43 mi) long, 15-25 km (9-16 mi) wide, and about 1,250 km^2 (480 mi^2) in areal extent; its 25,000 m (82,000 ft) of fill accumulated at an estimated rate of 2.5 m/1,000 yr (8 ft/1,000 yr). The Ridge basin developed during the Miocene and Pliocene between the right-lateral San Gabriel and San Andreas faults in southern California. The basin is 30-40 km (20-25 mi) long, 6-15 km (4-10 mi) wide, and about 200 km^2 (80 mi^2) in areal extent; its 7,000-11,000 m (23,000-36,000 ft) of fill accumulated at an estimated rate of about 3 m/1,000 yr (10 ft/1,000 yr). The 3 Little Sulphur Creek basins probably developed 4-2 m.y.B.P. along the east side of the right-lateral Maacama fault zone in northern California. These basins cumulatively are about 12 km (7 mi) long, 1.5-2 km (0.9-1.2 mi) wide, and about 15 km^2 (6 mi^2) in areal extent; their 5,000 m (16,000 ft) of fill accumulated at an estimated rate of about 2.5 m/1,000 yr (8 ft/1,000 yr).

Coarse angular sedimentary breccia, which constitute a relatively small volume of the basin fill, was deposited in each of these basins along the active right-slip-fault margins as talus, landslide, and small but steep debris-flow-dominated alluvial fans. Along other margins of the basin, a much larger volume of the fill accumulated as larger streamflow-dominated alluvial fans, braided-stream, meandering-stream, fan-delta, and deltaic deposits. Lacustrine deposits that include turbidites and local chemical precipitates accumulated in the centers of the basins. The basin floors are generally tilted toward the active right-slip-fault margins so that the basin axes and the depocenters are subparallel to and shifted toward this margin. Sediment was transported toward the basin axis from surrounding highlands and then longitudinally down the basin axis. The basin fills were syndepositionally folded and faulted, and postdepositionally folded into large plunging synclines. The basins lengthened over time and contain thicknesses of sediment that are comparable to or greater than their widths.

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Retardation of Vitrinite Reflectance in Green River Oil Shales, Piceance Creek Basin, Northwestern Colorado

Vitrinite reflectance (R_o) of coaly inclusions in the otherwise alginitic rocks of the Green River Formation, northwestern Colorado, is greater in sandstones, marlstones, and organic-lean oil shales than in adjacent organic-rich oil shales. The R_o of the coaly inclusions in these organic-lean rocks increases from about 0.30% for samples with a maximum burial depth of less than 1,000 m (3,300 ft) to 0.55% for samples with a maximum burial depth of more than 1,500 m (5,000 ft). The higher R_o in the organic-lean rocks (oil yield < 10 gal/ton with the modified Fischer assay method) thus appears to record the thermal history of the area more precisely. In contrast, coaly inclusions from oil shales (yields > 10-15 gal/ton) all have lower R_o values—typically in the range 0.20-0.27—regardless of depth of burial. This retardation effect appears to be very localized and has not altered the vitrinite in coaly material as close stratigraphically as 30 cm (12 in.) to rich oil-shale beds.

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In-Place Barrier Drowning on Louisiana Continental Shelf

An extensive data set consisting of vibracores, seismic reflection profiles, surface sediment sampling, bathymetry, and historical maps and bathymetric charts strongly suggests that the two major shoals on the western Louisiana shelf, Ship Shoal and Trinity Shoal, originated through the in-place drowning of earlier barrier-island systems. The last barrier remnants were still visible in the early 1800s.

The island systems originated as delta-flank barriers during the abandonment of Holocene lobes of the Mississippi delta. The islands probably developed through rapid shoreface retreat and transgression of deltaic distributary-mouth bar sands along the central part of the abandoned "headland." Flanking these headlands, regressive barrier spits and islands developed in response to a high rate of sediment supply from the eroding headland. These barriers prograded into the progressively deeper water of old interdistributary bays. Rapid, local, relative sea level rise, due to delta lobe subsidence, prevented the destruction of these flanking barriers by the erosional effects of the retreating shoreface. Consequently, the barriers drowned in place and the shoreline was "instantaneously" displaced approximately 15-20 km (10-12 mi) landward.

Ship Shoal and Trinity Shoal provide the only convincing case of recent barrier island in-place drowning along the United States coastline. An additional, possible example may exist in the western extension of the Maguire Island chain off Prudhoe Bay, Alaska.

Barriers subject to in-place drowning have the potential of preserving thick reservoir sands in the geologic record. These Louisiana shelf shoals, in particular, may be rapidly buried by the prodelta muds of a new phase of delta progradation. In contrast, barrier islands along coastlines with a slower relative rate of sea level rise, such as the United States east coast, are generally completely removed by the eroding shoreface. Their sand is transported seaward into an inner-shelf sand sheet. This sand sheet may subsequently be molded into linear sand ridges by contemporary storm-generated shelf currents. Such ridge sands are stratigraphically and sedimentologically distinct from the drowned barriers.

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Carbonate Pore Systems: Porosity/Permeability Relationships and Geologic Analysis

The porosity/permeability relationships of the common carbonate rock types have been studied, with emphasis on the variety of pore types in upward-shoaling grainstone sequences including: Smackover, Lansing, Salem, and San Andres Formations. A result of these studies is an improved conceptual understanding of permeability gained from the cross-plotting of porosity and permeability data from plugs and whole cores accompanied by textural and fabric analyses of rock samples, thin-sections, serial sections, and pore casts. Importantly, many depositional rock types cross-plot as distinctly different populations, commonly yielding linear trends on semi-log paper. These trends indicate a degree of order in the seemingly chaotic pore systems of carbonate rocks which have undergone cementation and/or compaction. For grainstone samples, there appears to be a change in the slope of this trend between the compaction and cementation phases of diagenesis.

Once the depositional texture and fabric of the rock are defined in terms of porosity and permeability, the evaluation of fractures and secondary porosity can be addressed. The secondary porosity is observed to be as high as 14% of the rock volume in the Smackover example and 21% of an oolitic sample from the Lansing Formation. Pore casts and serial sections reveal that the grain-moldic porosity is poorly connected to the intragranular pore system and contributes little to the permeability of the rock. This insight allows quantitative estimates of this type of secondary