rotating faults remain closed. In both cases, formation and rotation of the faults may occur in one tectonic event. Fault displacements may therefore remain small and difficult to detect on seismic records. From the mechanical point of view, one has to differentiate between book shelf operations controlled by an externally imposed simple shearing and those responding to an imposed extension.

The mechanical analysis of book shelf operations induced by simple shearing shows that, under certain conditions, this operation requires less driving shear stress than an accommodation of the imposed shear by shear-parallel faulting. The operation of cross faults between neighboring Riedel faults in a wrench zone is a typical example.

Large-scale rotation of parallel normal faults in domino style (tilted block tectonics) is primarily associated with the extension of ductile substrata. It may be inferred from mechanical arguments and sandbox experiments how the process, and in particular the dip direction of the faults, is controlled by the way the substratal extension progresses, by the direction of a substratal squeeze flow, by the presence of a surface slope, and by the configuration of the rock boundaries that confine the set of faults in the direction of extension.

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Late Mississippian Lime Mud Mounds, Pitkin Formation, Northern Arkansas

Carbonates deposited under shallow, open shelf conditions during the Late Mississippian in northern Arkansas exhibit numerous discrete to coalescing lime mud mounds up to 20 m (65 ft) high and tens of meters in diameter. The mounds are composed of a carbonate mud core, typically with fenestrate texture, entrapped by a loosely organized framework dominated by cystoporate bryozoans and rugose corals in the lower part, and by blue-green algae and cryptostomous bryozoans in the upper part. Disarticulated crinozoan detritus is common throughout the core, suggesting that these organisms also contributed to entrapment of lime mud. During deposition, the mud core was indurated enough to support and preserve vertical burrows. Also, rubble of core mudstone is found on the flanks of some mounds, suggesting some erosion.

Intermound lithology is a shoaling-upward sequence dominated by oolitic and bioclastic grainstones and packstones. Shale is also present in minor amounts. The Pitkin mounds, interbedded with these intermound sequences, developed contemporaneously with them. Depositional relief was probably less than 3 m (10 ft). The mounds expanded laterally during periods of quieter water; their growth was impeded during times of higher energy. Contacts of the mound and intermound lithologic characteristics are sharp, truncating surfaces. Mound deposition ended with the onset of high energy conditions throughout the region.

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Cenozoic Basin Development in Hispaniola

Four distinct generations of Cenozoic basins have developed in Hispaniola (Haiti and Dominican Republic) as a result of collisional or strike-slip interactions between the North America and Caribbean plates. First generation basins formed when the north-facing Hispaniola arc collided with the Bahama platform in the middle Eocene; because of large post-Eocene vertical movements, these basins are preserved locally in widely separated areas but contain several kilometers of arc and ophiolite-derived clastic marine sediments, probably deposited in thrust-loaded, flexure-type basins. Second generation basins, of which only one is exposed at the surface, formed during west-northwesterly strike-slip displacement of southern Cuba and northern Hispaniola relative to central Hispaniola during the middle to late Oligocene; deposition occurred along a 5-km (3-mi) wide fault-angle depression and consisted of about 2 km (1 mi) of submarine fan deposits. Third generation basins developed during post-Oligocene convergent strike-slip displacement across a restraining bend formed in central Hispaniola; the southern 2 basins are fairly symmetrical, thrust-bounded ramp valleys, and the third is an asymmetrical fault-angle basin. Fourth generation basins are pull-aparts formed during post-Miocene divergent strike-slip motion along a fault zone across southern Hispaniola. As in other Caribbean areas, good source rocks are present in all generations of basins, but suitable reservoir rocks are scarce. Proven reservoirs are late Neogene shallow marine and fluvial sandstones in third generation basins.

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Comparison of Basin Types in Active and Ancient Strike-Slip Zones

Hydrocarbon exploration in strike-slip zones requires awareness of several distinct basin types, traditionally defined on the basis of bounding fault geometry: pull-aparts (P), fault-wedge basins (W), fault-angle basins (A), fault-flank basins (F), and ramp valleys (R). We compare the characteristics and frequency of these basin types in an active (40 post-Eocene basins of the northern and southern Caribbean) and ancient (19 Late Devonian-Carboniferous basins of the northern Appalachians) strike-slip setting. Pull-apart basins, which lengthen and deepen at fault discontinuities with increased strike-slip offset, constitute the best studied and most numerous basin type. Other recognizable basin types are less numerous and often shorter lived than pull-aparts, and this may reflect: (1) their role as precursory structures prior to concentration of strike-slip displacement on a single fault; (2) their role as interference structures at random fault junctures; and (3) the unlikelihood of preservation because of thinner sedimentary fill. Several disrupted basins of complex or unknown origin (D) appear to have initiated as pull-aparts and subsequently to have been been offset into halves or modified into compressional ramp valleys. Using observations from active basins, several geologic criteria for distinguishing compressional vs. extensional origin of reactivated ancient basins are discussed.

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Dead Sea Rift: Impact of Tectonics and Climate on Patterns of Sedimentation

The Dead Sea Rift, a classic strike-slip basin, occurs along a transform that connects the Red Sea, where sea-floor spreading is occurring, to the Taurus Mountains, where plate convergence is occurring. The rift formed primarily from left-lateral displacement of about 105 km (65 mi) since the Miocene, producing uplift and normal faulting along its shoulders. Sedimentation within the transform occurs primarily in elongate, asymmetric pull-apart basins such as the Dead Sea, as transform segments pass each other along the zone of strike slip.

Pleistocene and Recent patterns of sedimentation were mapped on a scale of 1:50,000 along the west bank of the Dead Sea for a distance of 50 km (30 mi). Three sedimentologic units are recognized: an older sequence of debris flows and shallow-water fans; a medial unit of fan deltas interfingering with shallow-to-moderately deep-water lacustrine deposits; and an upper unit comprised of beach gravels, deltaic sands, and playa deposits. Their combined thickness is about 3,500 m (11,500 ft) along the western border fault, where they exhibit repetitive small-scale cyclical patterns of deposition within a general fan delta complex that prograded into the Dead Sea; there, geophysical studies show that the prograding subsea fans have been intruded by salt diapirs.

Such patterns of deposition clearly are related to recurrent movement along the border faults, producing rhomb-shaped basins, high-relief topography, and a unique rift climate. As the moist air rises over the shoulders of the rift, it cools adiabatically yielding as much as 800-1,000 mm (31-39 in.) of rain per year to high discharge ephemeral streams that transport huge quantities of coarse clastics into the basin. Conversely, as the air descends into the basin, it warms adiabatically, evaporating more than 2,000 mm (80 in.) of water per year, thus causing a concomitant drop in the Dead Sea level, precipitation of evaporites, change in the base level, and progradation of fans into deeper water.

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Computer Modeling of Minnelusa (Pennsylvanian-Permian) Paleotopography in Eastern Powder River Basin, Wyoming, with a Case History

Most Minnelusa Formation (Pennsylvanian-Permian) oil production in the Powder River basin is from paleotopographic traps. These traps