Recent studies of the biology and ecology of large, living, algal symbiont-bearing foraminifera have vastly improved the potential for use of these organisms for paleoecologic interpretation and as sediment tracers. Using assemblage composition, size, shape, and lamellar thicknesses, the depth and habitat of the biocoenosis can be predicted from the thanatocoenosis. Robust, commonly spinose, forms are characteristic of the turbulent intertidal and shallow subtidal zone of modern carbonate environments. Robust forms are succeeded by intermediate forms on reef and lagoon slopes. Flatter, larger forms characterize depths approaching the limits of the euphotic benthos. Presence or absence of algal symbiont-bearing species also indicates the relative primary productivity of the paleoenvironment.

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Deltaic Systems and Associated Growth Faulting of Vicksburg Formation (Oligocene), South Texas

The Vicksburg Formation (Oligocene) in south Texas contains several geopressured giant gas fields. These fields occur in sandstone facies to a depth of 17,000 ft (5,182 m) and are associated with stacked deltaic systems complicated by growth faults.

Analysis of cores and electric logs from the McAllen Ranch field (Hidalgo County, Texas) indicate that the sandstones were deposited in shallow water. Cores from the field contain root traces and plant debris, trace fossils (e.g., *Ophiomorpha*), and other evidence of shallow-water deltaic environments. Maps of net sandstone thickness show outlines of high-constructive lobate deltas. Depocenters are developed along growth faults.

The structural style of growth faulting in the Vicksburg Formation is due to a combination of rapid sedimentation and diapirism of shales from the underlying Jackson Group. The displacement and number of growth faults increase with depth. Alternation of down- and up-to basin faults is characteristic, with tilting of beds related to thickness variations of depositional units.

A series of coarsening-upward sequences are recognizable on electric logs. These sequences have a maximum thickness of 1,500 ft (457 m) and good lateral continuity in the middle part of the formation, but are interrupted by numerous growth faults in the lower Vicksburg. Growth faults over structural highs associated with shale tectonism create gas traps for many gas fields.

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Depositional and Tectonic Evolution of a Basement-Bounded, Intracratonic Basin, Palo Duro Basin, Texas

Continental collision along the southern margin of the North American continent during Pennsylvanian time created northwesterly directed compressional stress that was transmitted to the continental interior along boundary faults of the southern Oklahoma and Delaware aulacogens. As a result, numerous basins and uplifts were formed in the aulacogens and edges of the craton, including the Anadarko, Delaware, Midland, and Palo Duro basins, the Amarillo-Wichita uplift, Matador-Red River arch, and Central Basin platform.

The Palo Duro basin is a basement-bounded, or yoked, shallow intracratonic basin filled largely with Pennsylvanian and Permian strata. Its tectonic-depositional history may be divided into four stages: (1) formation of the basin between basement blocks (Matador arch, Amarillo uplift) that were uplifted along boundary faults of the southern Oklahoma aulacogen during Early Pennsylvanian time, and subsequent deposition of basement-derived, fan delta "granite wash" around uplifts flanking the basin; (2) planation and burial of uplifts through Early Permian time, and infilling of the deep basin with shelf-margin carbonate and basinal facies; (3) encroachment of continental red-bed facies from sources in New Mexico and Oklahoma and deposition of thick Middle to Upper Permian marine evaporites in sabkha environments; (4) marine retreat during Late Permian time and development of a Triassic lacustrine basin brought about as a result of continental rifting and drainage reversal.

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Utah-Arizona Hinge Line–Thrust Belt—Potential New Hydrocarbon Province

The Overthrust-hinge line belt of central Utah is part of the Rocky Mountain orogenic complex. When viewed in its entirety, the hinge line extends many miles to the north and south, representing the western margin of the North American continent during Paleozoic time. Except for occasional eastward transgressions of the seas onto the continental shelf, the position of this transition zone remained closely confined through Triassic time.

An ancient continental margin with superimposed overthrusting and the ability to successfully explore such a setting have excited the petroleum industry.

The Overthrust-hinge line play has now been extended from southwest Utah-northwest Arizona to southeast Arizona and into Mexico. Recent geologic and geophysical work in Arizona indicates the presence of deep troughs and large anticlines that are locally covered by multiple thrust plates.

Much of southwest Arizona has previously been defined as part of the Basin and Range province. Many Tertiary-filled basins are bounded by mountain ranges (horsts) made up of allochthonous Mesozoic, Paleozoic, and Precambrian strata.

Some of the most favorable areas to explore for oil and gas have been defined within and below the allochthonous sequences. Deep regional grabens and rifts were probably filled with mostly marine sediments and some salt deposits. We believe that some of these salt sequences will be documented within the Jurassic system.

The marine sediments in the Sonora trough, just south of Arizona in Mexico, are more than 45,000 ft