B, North Juniper, JY, Providence, Prudence, Stescott, and Tippen gas fields, and Prothro (Ramsey structure) and Wilie oil fields where it joins the east-west Matador arch at the structure known as "Narcisso" on the Cottle and Motley county line.

The producing Atoka sandstones or conglomerates consist of medium to coarse, predominately subangular, quartz grains with traces of glauconite. These stratigraphic traps were deposited as offshore sand bars on the northeast and southwest flanks of the Masterson arch. The Atoka conglomerates are erratic, as they were deposited on a steeply dipping erosional surface, with rapidly changing dips. The entire Atoka section between the base of the Caddo Limestone and the top of the Mississippian limestone consists of very hard, dark-gray to black calcareous shale and conglomerate beds. The Atoka shale is very thin on the structural axis, with no conglomerate deposition, but thickens basinward with the development of many different conglomerate lenses.

The Providence Atoka gas field in extreme southeast Cottle County was discovered in October 1973, with the successful completion for 10,200 Mcf/day of the "Gus" Edwards 1 J. J. Gibson. Development to date reveals more than 141 ft (43 m) of gas column with no indication of water, which is present at different subsea depths in other gas fields on this trend. Average absolute open flow for the 14 gas wells in the Providence Atoka field is 11,600 Mcf/day. The porosity ranges from 15 to 21% with average pay thickness of 18 ft (5.5 m).

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Depositional Systems and Petroleum Potential of Lower Permian Strata, Palo Duro Basin, Texas

Lower Permian (Wolfcampian) strata of the Palo Duro basin consist of thick, terrigenous clastic and carbonate facies which were deposited in (1) fan-delta, (2) high-constructional delta, (3) carbonate-shelf and shelf-margin, and (4) slope and basinal systems. Lateral and vertical facies sequences across the basin indicate that these strata are regressive deposits and they document the first episodes of Permian marine retreat from the Texas Panhandle.

Terrigenous clastic sediment was derived from highlands which surrounded part of the Palo Duro basin. Exposed Precambrian granite in the Amarillo uplift, Sierra Grande uplift, and Bravo dome yielded large quantities of arkosic sand (granite wash) to fan-delta systems which emptied into shallow-marine environments in the northern part of the basin. Along the basin's southeastern margin, high-constructive deltas prograded westward from the Wichita Mountains, depositing quartz-rich sand and mud across the shelf.

Seaward of the clastic facies belt, a carbonate-shelf-margin complex, averaging 1,000 to 1,200 ft (300 to 365 m) in thickness and facing south toward the Midland basin, dominated Wolfcampian deposition in the Palo Duro basin. The western shelf margin consists of a superposed sequence of carbonate strata exhibiting limited basinward progradation. Contrarily, the eastern shelf margin is composed of several superposed, progradational carbonate sequences, individually averaging several hundred feet in thickness. During early to middle Wolfcampian time, the eastern shelf margin prograded westward 10 to 30 mi (16 to 48 m) while the western margin remained stationary. Shelf margins shifted in response to deposition of slope sediments in front of the shelf and in feeder channels, creating a foundation for subsequent carbonate buildups.

Potential hydrocarbon reservoirs are thick zones of shelf-margin dolomites, delta-front sandstones, and fan-delta arkoses. Porosity figures in those facies are as high as 10 to 20%. Each potential reservoir facies is juxtaposed with potential source beds and nonporous sealing beds.

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Sedimentology and Source-Bed Geochemistry of Spraberry Sandstone, Midland Basin, West Texas

The Spraberry Sandstone is a Lower Permian (Leonard) unit restricted entirely to the subsurface of the Midland basin of West Texas. Production of oil from the Spraberry reservoir began in 1949 in east-central Dawson County. Permeability of the reservoir rocks ranges from 0 to 2.5 md, and porosity averages 10%. Major production is made possible by fracture porosity.

The Spraberry Sandstone is approximately 305 m thick and consists of upper and lower sandy and silty members separated by a middle member consisting of predominantly dark argillaceous carbonate rock and calcareous shale. Detailed study of sedimentary structures, vertical sequences, and petrography suggests that the Spraberry represents sedimentation from a series of coalescing submarine-fan complexes. The dark, finer grained intervals within the Spraberry may be the source beds for the petroleum being produced from the formation, although no published data exist to support this.

Samples from the finer grained intervals in two cores from the Tex-Harvey and Pegasus fields (Midland County) were analyzed by means of various geochemical techniques to determine their source-bed potential. Total organic carbon content of the samples ranged from 0.68 to 2.42 wt. %. Soluble organic matter extracted via Soxlet ranged from 1,892 to 6,598 ppm by weight. The carbon preference index as determined from gas chromatograms of the paraffinic-napthenic fraction ranged from 1.14 to 1.22. Kerogen coloration values were between 2.0 and 3.2, with the mode being 2.3. Hydrocarbons comprised from 0.65 to 8.6% of the total organic carbon and 17 to 71% of the total extractable organic matter. Compared with criteria commonly used to judge source-bed potential, the Spraberry has most requirements and probably contained its own source beds.

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Stratigraphy and Entrapment of Hydrocarbons in San Miguel Sands of Southwest Texas

The San Miguel section of the middle Taylor in the

Maverick basin of the Rio Grande embayment is a series of overlapping sand bars striking northeast-southwest. Grain-size plots and core descriptions indicate that these bars developed in a shallow-marine shelf environment. There are as many as five cycles of sand sedimentation, all but one having established production. These sandstones have a cumulative production of over 50,000 bbl of oil since 1948. Over 30,000,000 bbl of oil has been produced from stratigraphic-type fields discovered since 1970. Stratigraphic-type fields have produced over 90% of the total production. Structural traps, caused by differential compaction over volcanic necks, account for the remainder. Torch field, associated with a volcanic neck in Zavala County, and Sacatosa field, a stratigraphic trap in Maverick County, are typical. The depth and density of control, as well as the subtle expression of the traps, leave many prospective areas.

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Independent Geologists—Endangered Species

During the last 5 years, while constantly complaining about a supposed lack of competition in the extractive industries, the U.S. Congress and administrative regulatory agencies have focused their power to make this "lack of competition" real. Current examples are: (1) in the SEC, the constant effort to broaden the definition of a security and bring the attendant registration and disclosure requirements to bear on the most mundane joint venture; (2) in the Congress and the SEC, the pressure to bring about accounting changes limiting independents' access to equity markets and encouraging sellouts and mergers; (3) in the IRS, grotesque definitions of joint ventures as partnerships, partnerships as corporations, and farmouts as income; (4) in the FERC, strained interpretations of gas contracts as "convenants running with the land" in order to introduce the principle of administrative confiscation of mineral rights without due process. The ponderous weight of the regulatory hand weighs most heavily on the independent geologist who has no legal or accounting staff.

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Stratigraphy and Exploration Geology of Marble Falls Group, Llano Uplift to Southern Part of Fort Worth Basin

The Marble Falls Group is a Lower Pennsylvanian carbonate complex that crops out in a discontinuous arcuate belt rimming the east, north, and west sides of the Llano uplift. The carbonate beds accumulated on the eastern part of the Texas craton, which sloped toward the adjacent Fort Worth basin. Three units within the Marble Falls Group have been mapped in the outcrop area. They are informally referred to as the "lower limestone," "middle shale," and "upper limestone." The same tripartite subdivision is evident in the subsurface north of the Llano uplift in Lampasas, Mills, Hamilton, Comanche, and Brown Counties.

Marble Falls gas production in the southern part of the Fort Worth basin is almost exclusively from the upper limestone. The upper Marble Falls forms several northeast to southwest-trending carbonate-bank complexes. The bank complexes terminate abruptly and pass laterally into shale and dark spiculitic limestone. Both structural and stratigraphic traps are evident within the bank complexes. Pottsville field in Hamilton County is a steep-sided structural trap from which 10 wells have produced approximately 33 Bcf of gas at depths of 2,600 to 2,900 ft (792 to 884 m). Santa Anna field in Coleman and Brown Counties is a large stratigraphic trap discovered in 1928. More than 100 gas wells have been completed in Santa Anna field. Early production records are not available. However, the incomplete data that are published substantiate the fact that Santa Anna is a large, economically attractive field, in which many wells have produced at least 1 to 2 Bcf of gas at depths of 2,300 to 2,400 ft (700 to 732 m).

Porosity tends to develop within three facies of the upper Marble Falls limestone: phylloid algal limestone, stromatoporoid limestone, and oolitic carcarenite. At the outcrop, the algal, stromatoporoid, and oolitic facies are most prevalent near the edge of bank complexes. However, they are by no means restricted to the outer part of the banks. Fractures related to a system of mostly down-to-basin normal faults enhance permeability in many places.

Structure is complicated and difficult to perceive without seismic data. Even where seismic data are available, standard isopach mapping techniques cannot be employed because there are no continuous shallow seismic reflectors. Moreover, topographic highs capped by Edwards Limestone outcrops tend to yield poor-quality records.

In spite of the problems inherent in exploring a structurally and stratigraphically complex area, there are undoubtedly undiscovered, commercially attractive gas fields in the southern part of the Fort Worth basin. The high exploration risk is to some extent offset by shallow depth, low acreage costs, and the attractive nature of potential targets.

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San Andres Facies Patterns, Palo Duro and Dalhart Basins, Texas

Regional facies analysis of San Andres/Blaine (Guadalupian, Permian) strata of the Palo Duro and Dalhart basins by use of cores, cuttings, and well logs is of interest for hydrocarbon exploration. San Andres rocks are composed of dolomite, anhydrite, and salt and exhibit basinward (southerly) facies changes from supratidal to subtidal. Supratidal facies reflect many features of modern, low-relief coastal sabkhas.

Lower San Andres strata include five mappable cyclic units; each cycle is comprised of (1) subtidal to intertidal shelf carbonates (basal transgressive facies), (2) lower sabkha, nodular and bedded anhydrite, and (3) upper sabkha salt formed in brine ponds and evaporating pans. Cycles represent repetitive progradation of facies to the south through time. Salt beds pinch out in the central and southern parts of the Palo Duro basin and mark the basinward limit of the upper sabkha evaporating terrane. Upper San Andres intertonguing anhydrite