the field consists largely of echinoderm-fusulinid packstone and grainstone interbedded with phylloid algal packstone. The remainder of the field has very little data available. Production from the northern half of the field is generally low.

Laterally continuous, high-porosity dolomites appear to be present throughout the field. These dolomites can transmit large volumes of fluid and are responsible for a water breakthrough problem in the field.

As a result of complex variations in depositional and diagenetic facies, the reservoir is a laterally and vertically heterogeneous rock body with complex production problems.

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Ken Regan (Delaware) Field, Reeves County, Texas

The Ken Regan field located in northern Reeves County, Texas, was discovered in July 1954. Discovery was from Delaware (Olds) sands at an approximate depth of 3,300 ft (1,005 m).

For the past 29 years, the field has experienced periods of active development followed by long periods of no activity. To date, the ultimate field limits have not been established and development continues.

The reservoir is a deep marine channel similar to, but slightly older than, the Ramsey sand of the upper Bell Canyon. Deposition of the Olds channel was from the northeast along the bottom of the basin. Subsequent eastward tilting has positioned the trap along the western boundary of the channel. Because of the irregularity of bottom-floor topography, prediction of the channel direction remains a challenge.

Oil economics have played an important part in development of this field and many like it. Drops in oil prices can completely choke off development in "bread and butter" pays such as the Delaware sand. The operators who do the best with the least expenditure will survive to continue to develop fields of this nature.

Ken Regan field will be 30 years old in July 1984. It should continue to expand in size until the ultimate channel terminus is found or until economics preclude further drilling. Use of modern concepts of deep marine sedimentation has influenced much of the drilling which has occurred in recent years.

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Langley Deep Field, Discovery and Interpretation

In May 1978, ARCO Oil and Gas Co. completed the Langley Deep Unit 1 well in Lea County, New Mexico, discovering a deep gas field with production from two horizons. The discovery well produces gas from a northwest-southeast-trending anticline that has a reverse fault at the Ellenburger formation on the northeast flank of the structure. This reverse fault, possibly persistent to the base of the Wolfcamp Formation, generated an anticlinal feature in the upthrown block at the Devonian level. The fault itself is the trap at the Ellenburger formation.

Major seismic evaluation of the eastern flank of the Delaware basin had proceeded for 10 years prior to the discovery of the Langley Deep field. The first major seismic group shoot, conducted in 1968, started on the Central Basin platform and proceeded into the Delaware basin. These seismic records had good, continuous, shallow reflectors. Deeper reflectors were present only on the Central Basin platform or in the deeper part of the Delaware basin but not on the eastern flank of the basin. By changing the field acquisition parameters and later the processing techniques, ARCO Oil and Gas Co. was able to improve the quality of the data and to identify continuous reflectors from the Delaware basin up onto the Central Basin platform, at least at the Devonian level. These improved seismic data delineated an anticlinal feature with an associated fault trap that is the Langley Deep field.

Since the discovery of the Langley Deep field in 1978, a new geologic interpretation has been proposed for the eastern rim of the Delaware basin. A major conclusion, based on seismic control, the well control from this field, and on subsurface control throughout southern Lea County, New Mexico, is that a strike-slip fault was activated during the Late Pennsylvanian and Early Permian and caused deformation resulting in the formation of the Langley Deep structure.

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Ben South (Tannehill) Oil Field, Stonewall County, Texas

Ben South is one of 157 Tannehill oil fields on the northeastern shelf of the Permian basin. Texas Railroad Commission District 7B has 66 Tannehill oil fields while District 8A has 21.

The discovery well for the Ben South field was the Ryder Scott Management (Sauder) 1 McMeans, completed in 1973. Ben South field production has totaled 749,340 bbl of oil through March 1983 from 13 wells.

Oil production is from the lower Tannehill (lower Wolfcamp) sands underlying the Stockwether Limestone. These Tannehill sands were deposited in a fluvial environment. Channel-fill and point-bar deposits make up the pay sands. The trapping mechanism is both stratigraphic and structural.

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Lower Pennsylvanian Reservoirs of Parkway-Empire South Field Area, Eddy County, New Mexico

The Parkway-Empire area is located on the Northwest shelf in central Eddy County, approximately 15 mi (24 km) northeast of Carlsbad, New Mexico. This area produces oil and gas from the lower and middle Morrow sandstones, Atoka sandstones, and Strawn limestones. Oil is also produced from the Queen and Seven Rivers sandstones, and the Grayburg, San Andres, and Wolfcamp dolomites. All of these zones are productive from stratigraphic traps.

The lower Morrow sandstones occur at a depth of about 11,400 ft (3,474 m). They are interpreted to be a prograding fluvial-deltaic sequence of channels and point bars sourced from the northwest. They trend toward the southeast, normal to depositional strike. The lower Morrow sandstones are separated from the middle Morrow sandstones by a widespread, dark gray, organic, lagoonal shale. In the Parkway area, the middle Morrow sandstones are thought to be a transgressive series of marine beaches and submarine bars which trend toward the northeast, parallel to depositional strike. Stratigraphic traps are created in the lower and middle Morrow sandstones by variations in cementation and depositional patterns. Productive Atoka sandstones occur at a depth of approximately 10,700 ft (3,261 m). These sands are thought to be a series of prograding beaches with a northeast trend. Strawn limestones produce from a series of small, low-relief algal banks developed along depositional strike to the northeast. The Strawn limestone is about 300 ft (91 m) thick and occurs between 10,250 and 10,500 ft (3,124 and 3,200 m).

Wells in this area have typical ultimate recoveries of between 1.0 and 3.0 bcf of gas. The combination of stacked reservoirs and good production makes this area of the Morrow trend especially attractive.

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Marfa Basin of West Texas: Foreland Basin Subsidence and Depocenter Migration

The Marfa basin, encompassing approximately 6,000 mi^2 (15,539 km^2) of Presidio and Brewster Counties in west Texas, is a foreland basin that formed in the late Paleozoic in response to the encroaching Ouachita-Marathon thrust belt. The basin is one of several, including the Arkoma, Fort Worth, and Val Verde basins, that developed along the southern margin of the North American craton during convergence of North America and Africa-South America in Pennsylvanian to Permian time. We present a model of the formation of the Marfa basin in which basin subsidence is effected by compression from plate convergence and by loading owing to the emplacement of the Marathon fold-thrust complex.

A model of foreland basin evolution by thrust loading as applied to the Idaho-Wyoming thrust belt can be applied with some modification to the Marfa foreland basin. Preexisting northwest-trending faults in the Marfa region were reactivated by the Marathon thrust belt as the latter advanced onto the continental margin toward the craton. Subsidence owing to compression and thrust loading first formed the Tesnus basin, a Pennsylvanian basin now buried beneath the Marathon overthrust. In the later stage of thrust-sheet emplacement, the depocenter split into two prongs, and the Marfa and Val Verde basins collected thick sections of Wolfcamp sediments.

Preexisting northwest trends, which result from a Precambrian rifting event and the late Precambrian to Cambrian development of the Delaware aulacogen, controlled the location of subsidence in front of the thrust sheet. The fragmented craton was composed of northwest-trending high and low areas including the Diablo platform and the Delaware basin. These fragments behaved much like piano keys, subsiding first in a central region to form the Tesnus basin and later in adjacent regions forming the Marfa and Val Verde basins.

The model is supported with data from 63 well logs that indicate the position of the depocenters through time and that suggest the differential elevation of crustal slices controlling the formation and location of the three Pennsylvanian-Permian foreland basins.

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Detrital and Authigenic Clay Minerals in Lower Morrow Sandstones of Eastern New Mexico

Sandstone reservoirs of the Morrow Formation of southeastern New Mexico are important natural gas reservoirs. Production from this unit is affected by the types and distributions of detrital and authigenic clay minerals present in the rocks. Thus, X-ray diffraction and scanning electron microscopic analyses of samples from the lower Morrow reservoirs were conducted to understand the types, morphologies, petrographic positions, and regional trends of clays in the unit.

By far, authigenic kaolinite and chlorite are the major clays present in the lower Morrow sandstone reservoirs. The kaolinite content of the clay fraction of the formation can reach a maximum of 100%, whereas that of chlorite can be as high as 59%. When both are present, authigenic kaolinite and chlorite can effectively reduce much of the permeability of the sandstone reservoirs. Smectite, illite, and mixed-layer smectite-illite are relatively insignificant clays in the lower Morrow, except in certain small areas of the study area, and are largely detrital in origin.

The distribution of smectite, illite, and mixed-layer smectite-illite reflects the depositional processes acting in each of the facies of the lower Morrow. These clays are most abundant in immature fluvial-deltaic and basinal sandstones and relatively deficient in reworked marine sandstones. Distribution of authigenic kaolinite and chlorite also mimics the facies pattern, but is not controlled by it. In the lower Morrow, kaolinite increases landward while chlorite increases toward the basinal facies.

Successful treatment procedures for reservoir sandstones must differ with the different clay mineral types present.

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Queen Formation of Millard Field, Pecos County, Texas: Its Lithologic Characteristics, Environment of Deposition, and Reservoir Petrophysics

The Queen Formation is a sequence of interbedded siliciclastics, carbonate mudstones, and evaporites, that extend across a large area of the subsurface Permian basin in west Texas and southeastern New Mexico. We present a description of the lithologic and diagenetic characteristics of the formation in Millard field, Pecos County, Texas, and propose a model for its depositional environment and reservoir formation.

The Queen Formation in Millard field consists of four major lithologic characteristics: (1) cross-stratified or ripple-laminated sandstones of eolian origin, and a sabkha mudflat facies complex composed of (2) unfossiliferous and anhydritic mudstones, either massive or ripple-laminated; (3) thin dolomicrite crusts with birdseye structures and desiccation cracks; and (4) anhydrite in the form of discrete nodules, beds of nodular-mosaic texture and massive beds in the mudstones and sandstones, and as palisade anhydrite in the mudstones and dolomicrites.

Production from the Queen Formation in the field is consistently from two eolian sandstone units, designated the Queen A and C, which can be correlated across the field area. SEM examination of these sandstones indicates a positive correlation between the amount of grain-lining, authigenic smectite and porosity, and concomitantly an inverse relationship between anhydrite cement content and porosity. The porosity of the sandstone reservoirs in the Queen is of secondary origin.

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Pre-Leonardian Geology of Midland Farms Field Area, Andrews County, Texas

The Midland Farms (Ellenburger) oil field was discovered on September 16, 1952, with the completion of Anderson-Pritchard's 1 Fasken-24 well, drilled on an indicated single-fold seismic structure. The field produces from vuggy, fractured