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OIL AND GAS IN THE NEW MEXICO PART OF THE PERMIAN BASIN

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Abstract—The Permian Basin is one of the premier oil and gas producing regions of the United States. The New Mexico part of the basin has produced a cumulative total of 4142 million barrels of oil (MMBO) and 18.7 trillion ft^3 (TCF) of natural gas. It contains 1112 designated, discovered oil reservoirs and 672 designated, discovered gas reservoirs. Of these reservoirs, 1781 have been grouped into 17 plays based on common geologic characteristics. The Permian section has dominated production with 10 plays that have produced 2834 MMBO and 11.2 TCF gas. Production of both oil and gas are dominated by Leonardian- and Guadalupian-age dolostones and sandstones of the Abo, Yeso, Glorieta, San Andres, Grayburg, Queen and Yates formations. Most of the reservoirs in these formations were deposited in a back-reef, restricted-shelf setting. The most prolific Abo reservoirs were deposited in a shelf-margin reef setting. Significant production is also obtained from basinal carbonates of the Bone Spring Formation and basinal sandstones of the Delaware Mountain Group. The pre-Permian section has also yielded major volumes of oil and gas. Reservoirs in the 7 pre-Permian plays have produced 973 MMBO and 6.9 TCF gas. Pre-Permian oil production is dominated by restricted-shelf dolostones of the Ellenburger, Simpson and Montoya formations (Ordovician), restricted-shelf dolostones of the Thirtyone and Fusselman formations (Silurian-Devonian) and open shelf–shelf margin limestones and dolostones of the Canyon and Cisco sections (Pennsylvanian: Missourian-Virgilian). Pre-Permian gas production is dominated by fluvial, deltaic, strandplain and submarine fan sandstones of the Morrowan section (Pennsylvanian) and open shelf to shelf margin limestones and dolostones of the Canyon and Cisco sections.

INTRODUCTION

The Permian Basin produces oil and natural gas from Lea, Eddy, Chaves and Roosevelt Counties in southeast New Mexico (Fig. 1). Through the end of 1991, oil and gas reservoirs (pools) in these counties had produced a total of 4142 million barrels of oil and condensate (MMBO) and 18,737 billion ft' (BCF) of gas. During 1991, production in these counties was 65.6 MMBO worth approximately $1.265 billion, and 465 BCF gas worth approximately $0.660 billion. As of December 1991, southeast New Mexico had proved reserves of 694 million MMBO and proved gas reserves of 3471 BCF (Energy Information Administration, 1992). Approximately 93% of the state's oil production and 46% of the state's gas production is from the Permian Basin. In 1991, the State of New Mexico received more than $832 million from taxes, royalties and investment earnings derived from oil and gas exploration and production throughout the state (New Mexico Oil and Gas Association, 1992).

The Permian Basin of southeast New Mexico contains 1112 designated, discovered oil reservoirs (pools) and 672 designated, discovered gas reservoirs (pools). Most oil reservoirs have produced between 0.01 and 1 **MMBO** and less than 0.1 BCF gas (Fig. 2a, b). Most gas reservoirs have produced between 0.1 and 10 BCF gas and less than 0.01 **MMBO** (as condensates; Fig. 2c, d). Eighty-eight percent of the oil has been produced from reservoirs that have yielded more than 1 MMBO; 93% of the gas has been produced from reservoirs that have yielded more than 5 BCF gas. The designated oil and gas reservoirs have been grouped into 17 plays based on common geologic characteristics (Table 1). These plays are briefly discussed below.

OIL AND GAS RESERVOIRS

Ordovician play

Reservoirs of the Ordovician play are found primarily on structures associated with the Central basin platform, although a significant subcrop gas play is present on the Northwest shelf in Chaves County (Fig. 1). **114 MMBO** and 237 BCF gas have been produced from the 38 designated reservoirs in this play, out of dolomites in the Ellenburger and Montoya formations and sandstones (primarily the Connell, Waddell and McKee sandstones) of the Simpson Group (Table 1). Trapping occurs on anticlines, faulted anticlines and along sub crop unconformities (Figs. 3, 4).

Ellenburger and Montoya reservoirs are generally composed of siliceous, fine- to coarse-crystalline dolomite that was deposited in a stable restricted shelf setting (Wright, 1979). These dolomites exhibit excellent permeability from vugular and fracture porosity developed as a result of tectonic and diagenetic (erosional and dissolutional) processes (Kerans, 1988). Conversely, Simpson reservoirs are composed of rounded, fine- to coarse-grained sandstones deposited along the ancestral Central basin platform as a series of coalescing strandline deposits (Wright, 1979). Depths to these reservoirs range from 6000 ft on the Northwest shelf and Central basin platform to over 15,000 ft in the Delaware Basin.

Siluro-Devonian play

One hundred nineteen designated Siluro-Devonian reservoirs are found in southeast New Mexico. Cumulative production from this play totals 438 **MMBO** and 440 BCF gas, with most of the hydrocarbons produced from anticlines that often are bounded on one or more sides by high-angle faults (Table 1). Production is found in high permeability dolomites of the Fusselman (Silurian) and Thirtyone (Devonian; Hills and Hoenig, 1979) formations at depths ranging from 7000 to over 17,000 ft.

Siluro-Devonian dolomite reservoirs are very similar to those found in the Ordovician section, both in their depositional and burial/diagenetic histories. Porosity development is primarily secondary in origin, commonly being vugular or fractured in nature. Although most reservoirs are trapped in anticlines, major production is also from sub crop unconformity traps located around higher structures on the Central basin platform (Figs. 3, 4). The presence of numerous exposure surfaces within these dolomite sections offers the potential for many as yet unrecognized stratigraphic or combination traps (Mazzullo, 1990). With improved geological and geophysical methods and models, it may be possible to further develop this already significant play.

Mississippian play

The Mississippian play in southeast New Mexico is relatively insignificant as to overall production, having accumulated a total of 2 MMBO and 18 BCF gas (Table I) from 23 designated reservoirs. Production is located in northern Lea and eastern Chaves Counties (Fig. 1) and comes mostly from isolated, low-permeability bioclastic limestone shoals. Hydrocarbons are trapped either purely stratigraphically or in combination with associated structures. Approximately 40% of the total production at the 10-well Austin reservoir has come from the 1957 discovery location.

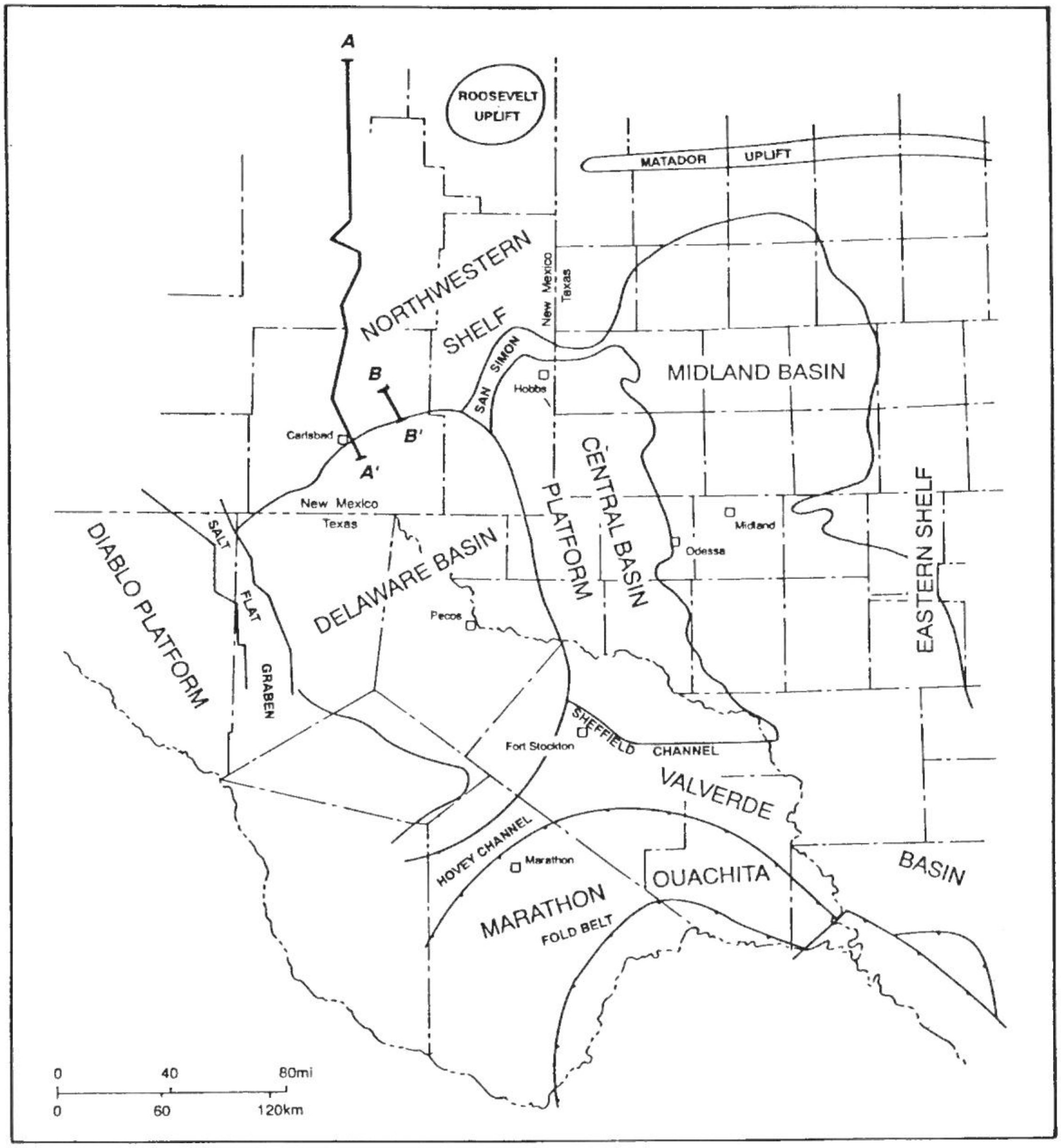

FIGURE 1. Principal structural elements in southeast New Mexico (after Hills, 1984).

Morrowan play

Morrowan (Early Pennsylvanian) strata compose one of the most significant gas producing zones in southeast New Mexico. The 214 designated Morrowan reservoirs, located primarily in Eddy, Lea and southernmost Chaves Counties (Fig. 1), have a combined production of over 2789 BCF of nonassociated gas and 21 MMB of condensate (Table I). Most of these reservoirs have been developed on 320-acre spacing and range in depth from less than 7000 ft to well over 15,000 ft in the deeper portions of the Delaware Basin (Fig. I). Average reservoir depth is 11,100 ft with estimated completed well costs (in 1985 dollars) of $858,000 (James, 1985).

The Morrowan section can be subdivided into three distinct zones, commonly designated as the Lower ("A"), Middle ("B") and Upper ("C") intervals. Productive reservoirs are found almost exclusively in the siliciclastic Lower and Middle Morrowan intervals and are generally composed of angular to subangular, medium- to very coarse-grained quartzose sandstone deposited principally in fluvially dominated (Lower Morrowan) and wave dominated (Middle Morrowan) deltaic settings (Anderson, 1977; James, 1985; Mazzullo and Mazzullo, 1985). Net pay is generally 20-30 ft thick, but can range to over 80 ft in distributary channel facies. Trapping commonly occurs by a combination of stratigraphic, structural and/or diagenetic factors, with both silica and clay cementation greatly affecting reservoir characteristics (Anderson, 1977; James, 1985; Mazzullo and Mazzullo, 1985).

Atokan play

One hundred thirty-five Atokan age reservoirs have combined to produce over 476 BCF of primarily nonassociated gas and 5 MMB of condensate (Table 1) in southeast New Mexico. The bulk of these reservoirs lie either in the Delaware Basin or near its margin on the Northwest shelf and can be found at depths ranging from 8500 ft to over 14,000 ft. Production is generally found in fluvial-deltaic and strandline sandstones averaging 10% porosity, which were derived primarily from the Pedernal Highlands to the northwest. However, significant but scattered production is also found in southern Lea and Eddy Counties from a trend of low-porosity carbonate mounds (James, 1985). Reservoirs of limited extent are common in the Atokan interval and trapping generally occurs by a combination of structural and strati-

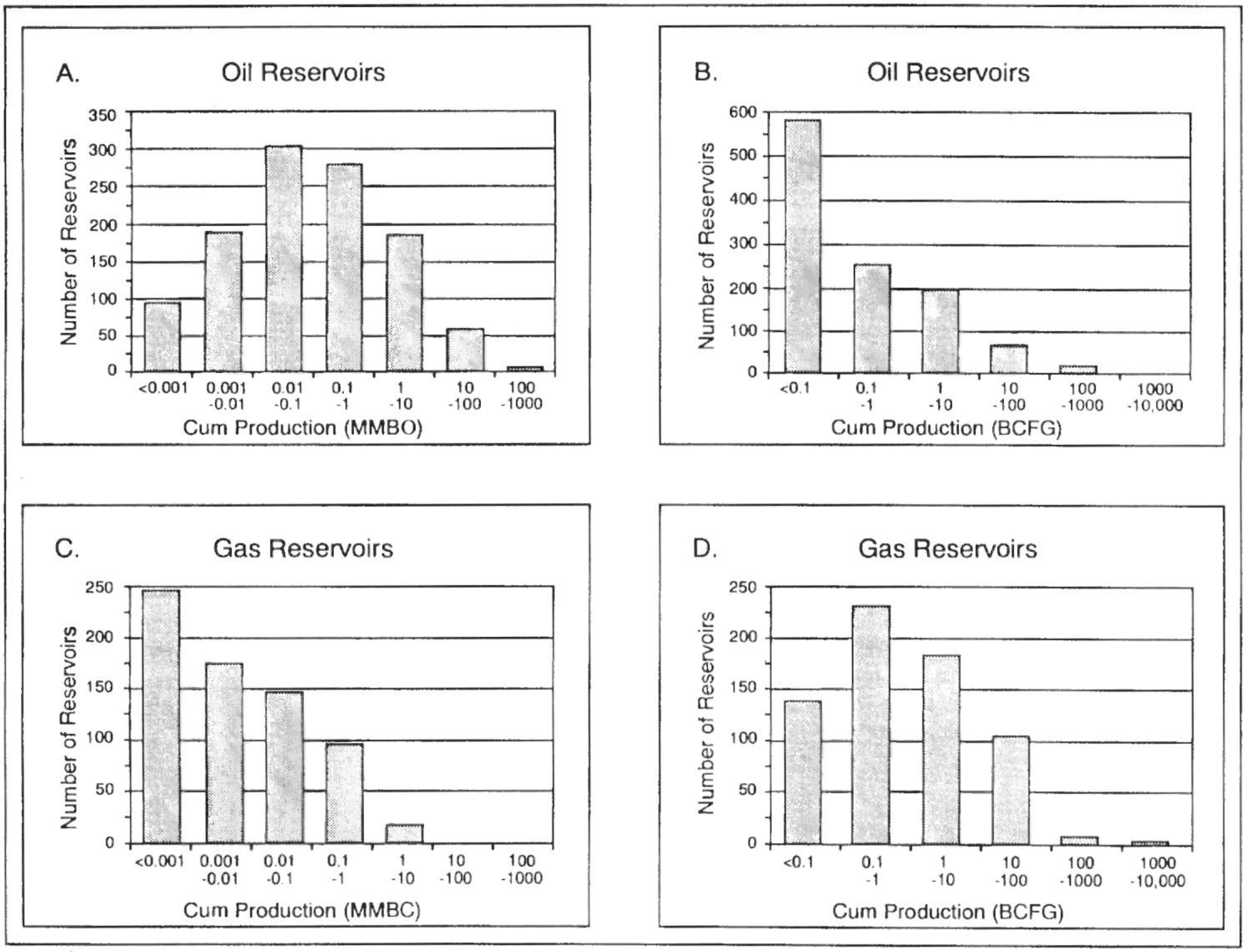

FIGURE 2. Size distribution of oil and gas reservoirs in the New Mexico part of the Permian Basin, defined by cumulative production as of 12/31/91. A. cumulative oil production from oil reservoirs; B. cumulative associated gas production from oil reservoirs; C. cumulative condensate production from gas reservoirs; D. cumulative nonassociated gas production from gas reservoirs.

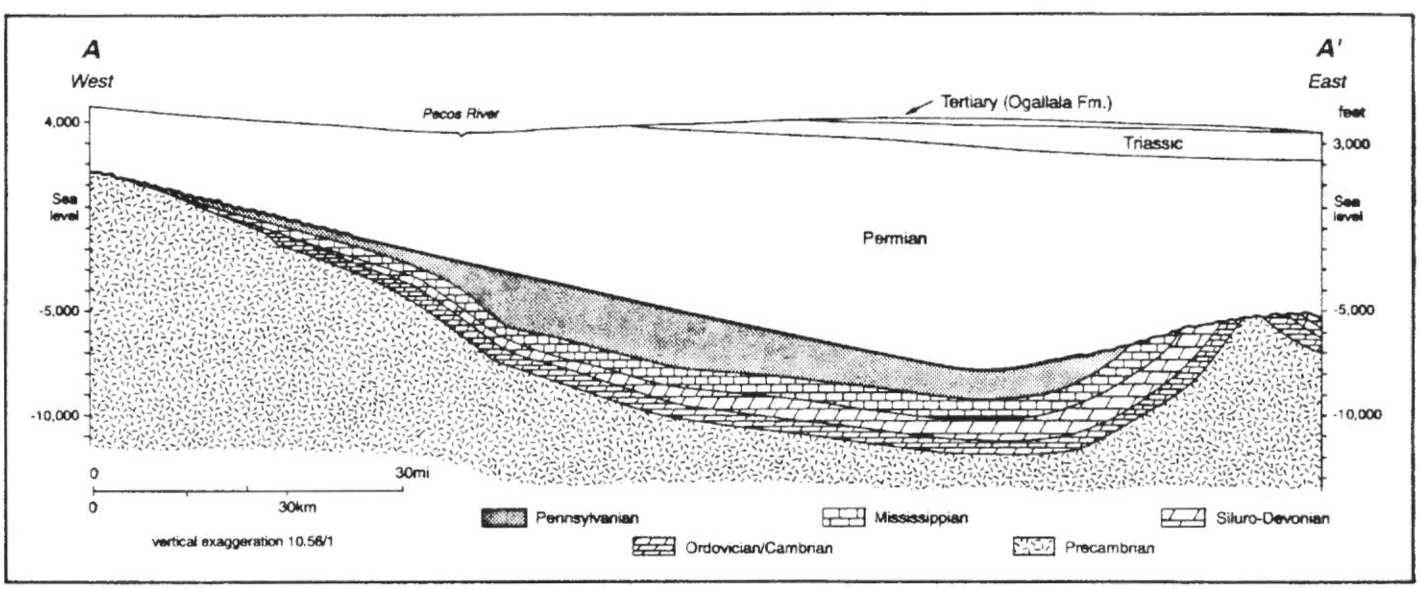

FIGURE 3. Cross section from the Northwest shelf/Delaware Basin on the west to the Central basin platform on the east (after Grant and Foster, 1989).

TABLE 1. Summary of oil and gas plays in New Mexico part of the Permian Basin. MMBO = million barrels of oil ± condensate; BCF = billion ft³ of gas.

Play	Reservoir Age	Principal Productive Stratigraphic Units	Depositional Setting	Main Reservoir Lithology	Main Trap Types	Cumulative Production (1/1/92) Oil + condensate (MMBO)	Cumulative Production (1/1/92) Gas (BCF)	No. of Reservoirs	Reservoirs with most production: Oil	Reservoirs with most production: Gas
Ordovician	Ordovician	Montoya, Simpson, Ellenburger	shallow restricted shelf	dolostone, sandstone	anticlines, faulted anticlines, unconformity	114	237	38	Brunson (Ellenburger) (28 MMBO) (18 BCF)	Monument (McKee/Ellenburger) (63 BCF) (0.6 MMBO)
Silurian-Devonian	Silurian, Devonian	Thirtyone, Fusselman	shallow restricted shelf	dolostone	anticlines, faulted anticlines, unconformity, stratigraphic(?)	438	440	119	Denton (98 MMBO) (52 BCF)	Crosby (95 BCF) (0.9 MMBO)
Mississippian	Mississippian	Mississippian	shallow open shelf	limestone	stratigraphic	2	18	23	Bronco (0.4 MMBO) (0.35 BCF)	Austin (11 BCF) (0.2 MMBO)
Morrow	Pennsylvanian	Morrow	fluvial, deltaic, strandplain, submarine fan	sandstone	stratigraphic, combination	21	2789	214	Empire South (1.4 MMBO) (125 BCF)	Carlsbad South (235 BCF) (0.08 MMBO)
Atoka	Pennsylvanian	Atoka	fluvial, strandplain, shelf, shelf margin	sandstone, limestone	stratigraphic, combination	5	476	135	Antelope Ridge (2.0 MMBO) (77 BCF)	Antelope Ridge (77 BCF) (2.0 MMBO)
Strawn	Pennsylvanian	Strawn	shallow open shelf, ramp	limestone	stratigraphic, combination	45	334	98	Lusk (20 MMBO) (89 BCF)	Lusk (89 BCF) (20 MMBO)
Upper Pennsylvanian	Pennsylvanian	Cisco, Canyon	shallow open shelf, shelf margin	limestone, dolostone	stratigraphic, combination	348	2638	192	Vada (53 MMBO) (135 BCF)	Indian Basin (1,253 BCF) (8.0 MMBO)
Granite Wash	Permian (Wolfcampian)	Granite Wash	alluvial fan	sandstone, conglomerate, granite(?)	combination	7	34	4	Wantz (6.8 MMBO) (33 BCF)	Wantz (33 BCF) (6.8 MMBO)
Wolfcamp Carbonate	Permian (Wolfcampian)	Wolfcamp	shelf, shelf margin, basin	limestone	stratigraphic	118	316	197	Denton (39 MMBO) (10 BCF)	(Kemnitz (69 BCF) (16 MMBO)
Abo Fluvial/Deltaic Sandstone	Permian (Leonardian)	Abo	fluvial-deltaic	red-bed sandstone	stratigraphic(?)	<1	287	5	Pecos Slope (0.04 MMBO) (241 BCF)	Pecos Slope (241 BCF) (0.04 MMBC)
Abo Platform Carbonate	Permian (Leonardian)	Abo	shelf-margin reef, restricted shelf	dolostone	stratigraphic	430	738	62	Empire (220 MMBO) (300 BCF)	Empire (300 BCF) (220 MMBO)
Yeso Platform	Permian (Leonardian)	Yeso (Drinkard, Tubb, and Blinebry zones)	restricted shelf	dolostone, sandstone	anticlines	250	2998	66	Drinkard (72 MMBO) (650 BCF)	Blinebry (965 BCF) (35 MMBO)
Bone Spring Basinal Sediments	Permian (Leonardian)	Bone Spring	deep basin	dolostone	stratigraphic	51	91	124	Scharb (14 MMBO) (13 BCF)	Avalon East (16 BCF) (0.6 MMBO)
Glorieta and upper Yeso shelf	Permian (Leonardian)	Glorieta, Paddock, Yeso	restricted shelf	dolostone	anticlines	133	348	31	Vacuum (64 MMBO) (79 BCF)	Vacuum (79 BCF) (64 MMBO)
San Andres and Grayburg Platform	Permian (Guadalupian)	Garyburg, San Andres	restricted shelf	dolostone, sandstone	stratigraphic, combination	1227	1276	178	Hobbs (311 MMBO) (307 BCF)	Hobbs (307 BCF) (311 MMBO)
Delaware Mountain Basinal Sandstone	Permian (Guadalupian)	Delaware	deep basin	sandstone	stratigraphic	61	93	133	Paduca (14 MMBO) (16 BCF)	Paduca (16 BCF) (14 MMBO)
Upper Guadalupian Platform	Permian (Guadalupian)	Yates, Queen	restricted shelf	sandstone	stratigraphic anticlines	557	5020	162	Langlie-Mattix (128 MMBO) (451 BCF)	Jalmat (1,701 BCF) (72 MMBO)

graphic mechanisms. Many of the deeper Atokan reservoirs are significantly overpressured and require extreme care when drilling.

Strawn play

Although both clastics and carbonates have combined to produce over 45 MMB of oil and condensate and 334 BCF gas from the 98 designated Strawn (Middle Pennsylvanian) reservoirs found in southeast New Mexico (Table 1), by far the most significant production has been established in isolated biohermal shelf limestones and associated facies located along a northeast-trending shelf break in central Lea and Eddy Counties. Depths to Strawn reservoirs range from less than 8000 ft to over 12,000 ft, with many of the deeper reservoirs commonly being overpressured. Net pay in most productive bioherms averages from 10 to 50 ft, but can be as thick as several hundred feet in the better reservoirs (Thorton and Gaston, 1967). Porosity values in the productive carbonates are generally quite low, averaging from 2 to 9%; however, associated permeability can be quite high (over 100 millidarcies). Trapping is generally stratigraphic in nature, but often shows signs of structural enhancement.

Upper Pennsylvanian play

Upper Pennsylvanian reservoirs found in the Cisco/Canyon sections are very significant contributors to both oil and gas production in south eastern New Mexico, having produced over 2638 BCF gas and 348 MMB oil and condensate through 1991 (Table 1). They are found at depths ranging from 5900 to 11,500 ft and have undergone steady exploration and development since the 1950s, with the most recent significant development activity occurring in the Indian Basin/Dagger Draw reservoir complex of west-central Eddy County.

Upper Pennsylvanian production comes almost exclusively from carbonate reservoirs located in either of two separate areas, a northeastern area comprising northern Lea, eastern Chaves and southern Roosevelt Counties, or western Eddy County (Fig. 1). Reservoirs in these areas are unique in that those found in the northeastern area, commonly referred to as the Tatum Basin, produced oil and associated gas from thin (10 to 35 ft), laterally extensive biohermal shelf limestones (Carleton, 1977), whereas the reservoirs of Eddy County produce lighter condensate as well as both associated and nonassociated gas from shelf margin dolomite banks that locally attain over 750 ft in thickness (David, 1977; Frenzel, 1988). Trapping for both types of reservoirs is primarily stratigraphic, although in both cases it appears that carbonate development often is localized on older, more deep-seated structures.

Granite Wash play

The Granite Wash play is very small and localized, being found only in areas on or adjacent to the remnants of major Pennsylvanian uplifts

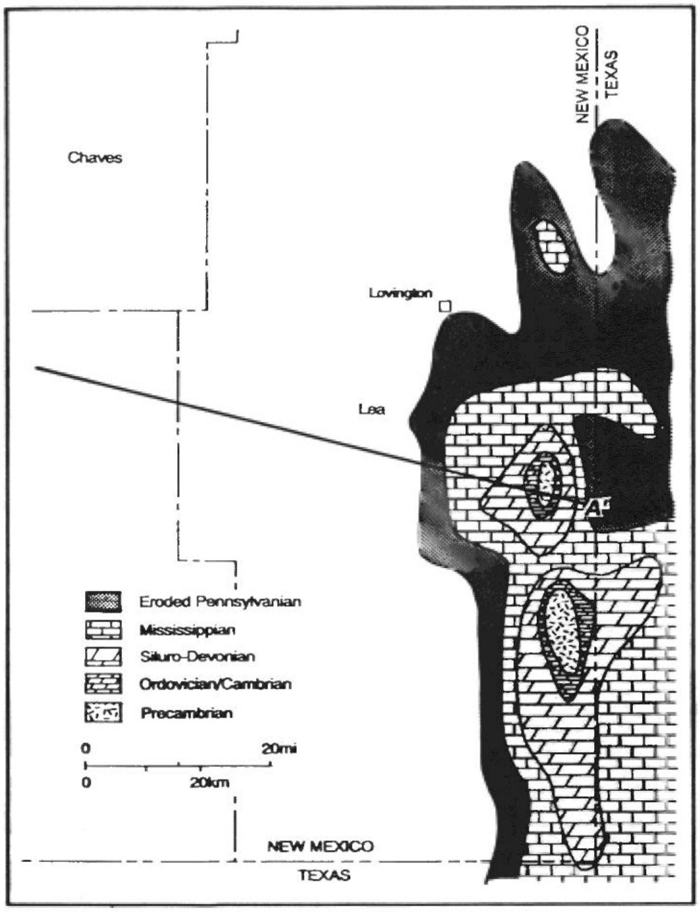

FIGURE 4. Pre-Permian subcrop patterns developed by Wolfcampian erosion of the Central basin platform (after Grant and Foster, 1989, and Oriel et al., 1967).

that persisted into Early Permian time. Only four Granite Wash reservoirs have been designated. By far the most prominent is Wantz Granite Wash, which is found near the New Mexico crest of the Central basin platform in southern Lea County. Cumulative production from this Wolfcampian play has totaled 34 BCF gas and 7 MMBO through 1991, with most of the reservoirs being found in sandy conglomerates and petrologically immature sandstones of alluvial fan and fluvial origin (Bowsher and Abendshein, 1988).

Wolfcamp carbonate play

Reservoirs of the Wolfcamp carbonate play lie on the Northwest shelf in the Delaware Basin. The 197 reservoirs in this play have produced 118 MMBO and 316 BCF gas (Table **I).** Reservoirs are in limestones. Most reservoirs on the shelf produce oil and associated gas by solution-gas drive. Reservoirs in the basin produce nonassociated gas; many nonassociated gas reservoirs on the west side of the basin tend to produce substantial volumes of condensate. Traps are mostly stratigraphic. Depths to reservoirs range from 8000 ft on the Northwest shelf to more than 13,000 ft in the Delaware Basin.

Wolfcamp reservoirs were deposited in several different depositional environments (Table **1).** Barrier reefs were formed along the shelf edge, which occupied the approximate position of the Abo shelf edge (Fig. 5; Malek-Aslani, 1970); production is obtained from reef wall boundstones, backreef skeletal grainstones and forereef talus. Reservoirs north of the barrier reefs are formed mostly by phylloid-algal patch reefs deposited on a shallow shelf; some patch reefs are capped by grainstones that also form important reservoirs (Malek-Aslani, 1985; Cys, 1986). Reservoirs south of the barrier reef were deposited in a basinal setting, either as small algal mounds interbedded with basinal shales (Anderson, 1977) or as carbonate debris flows near the shelf edge (Loucks et al., 1985). Trapping mechanisms are principally stratigraphic. In most reservoirs, net pay ranges from 10 to 30 ft.

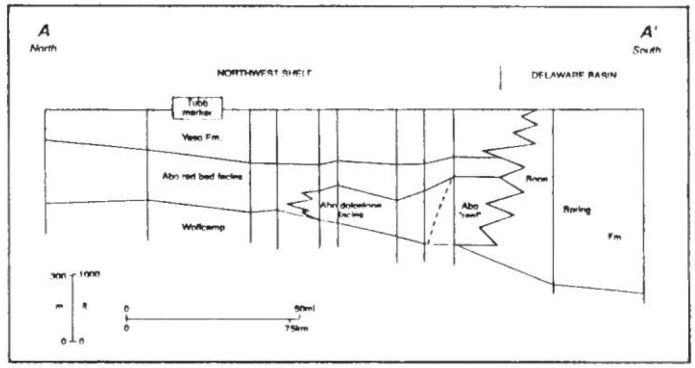

FIGURE 5. North-south stratigraphic cross section through Abo and lower Yeso strata (after Broadhead, 1984). See Fig. 1 for location.

Abo fluvial-deltaic sandstone play

Reservoirs of the Abo fluvial-deltaic sandstone play lie on the Northwest shelf in northwestern Chaves County. The five reservoirs in this play have produced 287 BCF gas and 0.04 MMBO (Table **1).** Reservoirs are in "tight," fine- to very fine-grained, silty, arkosic, red-bed sandstones of the Abo Formation. The reservoirs produced nonassociated gas and minor condensate by pressure-depletion drive. Because of the low permeability of the Abo, most walls must be artificially fractured before they can be produced economically. Depths to reservoirs range from 2500 ft to 4700 ft.

The Abo sandstone reservoirs were deposited as a red-bed facies in a south-flowing fluvial-deltaic complex north of the Abo shelf edge (Fig. 5; Broadhead, 1984; Bentz, 1992). The sandstones are lenticular and interbedded with red shales. The trapping mechanism for Abo gas is poorly understood, but appears to be largely stratigraphic. Production is confined to the sandy distal lobes of the fluvial system. Updip reservoir limits may be formed by capillary pressure barriers. The Abo is 400 to 650 ft thick in the producing areas, but net pay averages approximately 30 ft.

Abo platform carbonate play

Reservoirs of the Abo platform carbonate play lie on the Central basin platform and on the Northwest shelf. The 62 reservoirs in this play have produced 430 MMBO and 738 BCF gas (Table 1). Reservoirs are in dolostones. Most reservoirs produce oil and associated gas by a combination of solution-gas and water drive. Nine smaller reservoirs have produced nonassociated gas. Depths to reservoirs range from 6000 ft to approximately 9000 ft.

Abo carbonate reservoirs fall into two distinct groups. One group produces from a trend of fringing barrier reefs that grew along the southern edge of the Northwest shelf (Fig. 5; LeMay, 1972). In this group, traps are predominantly stratigraphic and are located in porous reef masses of dolostone 5 to 13 mi long and 1to 5 mi wide. Net pay ranges from less than 50 ft in the smaller reservoirs to a maximum of 726 ft in the large Empire reservoir.

A second group of Abo carbonate reservoirs produces from shallow-shelf dolostones on the Central basin platform and on the Northwest shelf north of the Abo reef (Fig. 5). On the Central basin platform, traps are formed by broad low-relief anticlines. Known reservoirs on the Northwest shelf are sparsely scattered; many appear to have an anticlinal component to their trapping mechanism. Net pay is approximately 20 ft in most reservoirs.

Yeso platform play

Most reservoirs of the Yeso platform lie on the Central basin platform. A few minor reservoirs are located on the southeasternmost part of the Northwest shelf. Reservoirs in this play produce from the Drinkard, Tubb and Blinebry members of the Yeso Formation (Permian). Drinkard and Blinebry reservoirs are principally in dolostones and limestones; Tubb reservoirs are principally in sandstones. The 66 reservoirs in this play have produced 250 MMBO and 2998 BCF gas (Table 1). The reservoirs produce oil and associated gas primarily by solution-gas drive; many reservoirs had a primary gas-cap drive. Depths to reservoirs range from 5000 ft to more than 7000 ft.

The Yeso reservoirs were deposited on a restricted shallow-marine shelf. The dolostone, limestone and sandstone reservoirs are interbedded with shale and anhydrite. The carbonate reservoirs are generally in a peritidal facies. Most traps are formed by anticlines, but some are formed by pinchout of permeable zones on the flanks of structural noses. Net pay is 20 to 30 ft in most reservoirs.

Bone Spring basinal sediments play

Reservoirs of the Bone Spring basinal sediments play are present in the Delaware Basin. The 124 reservoirs in this play have produced 51 MMBO and 91 BCF gas (Table 1). Reservoirs are in dolostones and sandstones of the Bone Spring Formation. Most of the reservoirs produce oil and associated gas by solution-gas drive, but six are designated as gas reservoirs that produce by pressure depletion. Depths to reservoirs range from 5000 ft to more than 10,000 ft in the deeper parts of the basin.

Bone Spring dolostone reservoirs were deposited as carbonate debris flows downslope of the Abo-Yeso shelf edge (Fig. 5) and Bone Spring sandstone reservoirs were deposited as siliciclastic turbidites (Gawloski, 1987; Mazzullo and Reid, 1987; Saller et al., 1989). The reservoir rocks are interbedded with dark basinal shales and micritic carbonates. The dolostones are the principal reservoirs. Traps are stratigraphic or combination stratigraphi6-structural. Porous debris flow and turbidite reservoirs were deposited in channels perpendicular to the shelf margin. The porous reservoirs pinch out depositionally updip as they rise on the submarine slope. Net pay is approximately 20 to 30 ft in most reservoirs.

Glorieta and upper Yeso shelf play

Reservoirs of the Glorieta and upper Yeso shelf play lie along the western part of the Central basin platform and the southern edge of the Northwest shelf along the Abo reef trend. The 31 reservoirs in this play have produced 133 MMBO and 348 BCF gas (Table 1). Reservoirs are in dolostones and sandstones. Most of the reservoirs produce oil and associated gas by solution gas or water drive, but reservoirs on the southern part of the Central basin platform produce nonassociated gas. Depths to reservoirs range from 2500 ft to more than 6000 ft.

Glorieta and upper Yeso reservoirs were deposited on a restricted shallow marine shelf. Most production is obtained from dolostones. Sandstones contribute to production in northern Eddy County. To the east in Lea County, sandstone beds are thin or absent. Most traps are formed by anticlines.

San Andres and Grayburg platform play

Reservoirs of the San Andres and Grayburg platform play lie on the Northwest shelf and on the Central basin platform. The 178 reservoirs in this play have produced 1227 MMBO and 1276 BCF gas (Table 1). Reservoirs are in dolostones and sandstones. Most of the reservoirs produce oil and associated gas by solution-gas drive, but water drive is the dominant producing mechanism in some reservoirs. Depths to reservoirs range from 1600 ft in western Eddy County to more than 4000 ft along the New Mexico—Texas border.

Reservoirs in the lower San Andres Formation produce from dolostones deposited in subtidal and peritidal environments on a restricted shelf north and east of the Getaway and Goat Seep shelf-margin and reef complexes (Fig. 6). These reservoirs occur mostly along an east-west trend centered on the border between Lea and Roosevelt Counties. Traps are largely stratigraphic with porosity zones pinching out updip to the north and northwest (Gratton and LeMay, 1969; Ward et al., 1986). Net pay ranges from 20 to 40 ft in most reservoirs.

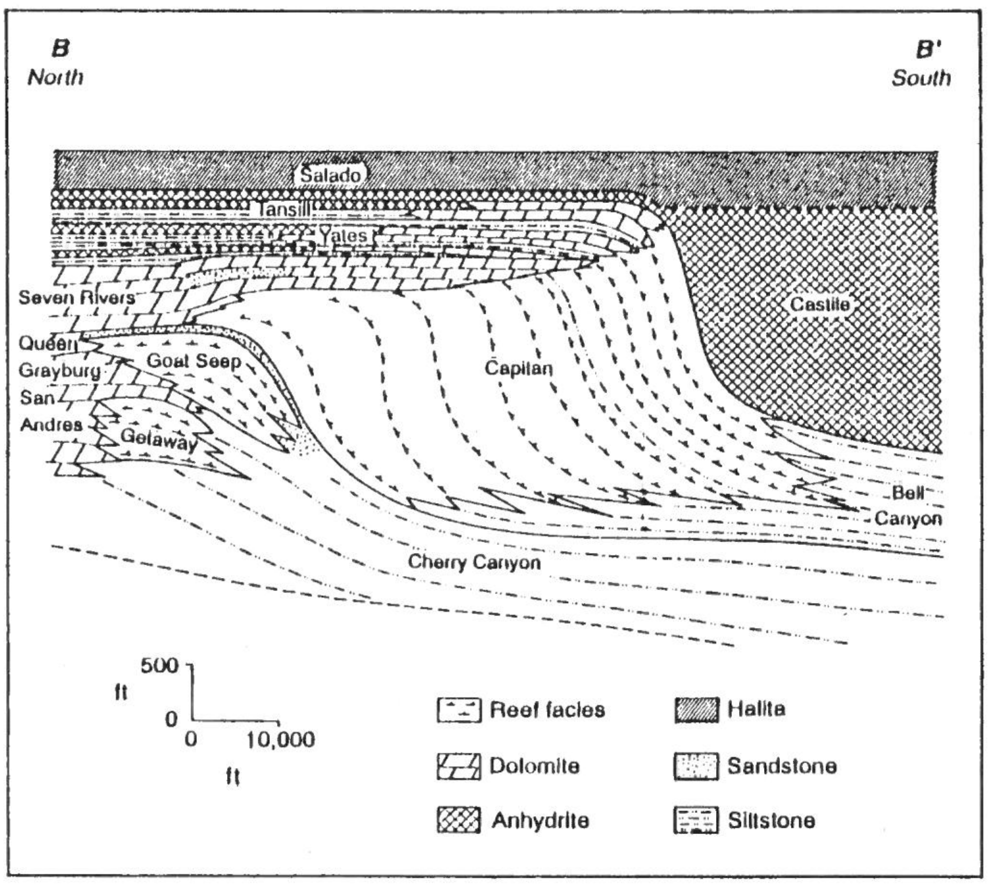

FIGURE 6. North-south cross section through Guadalupian and Ochoan strata, showing Getaway, Goat Seep and Capitan shelf-margin carbonate buildups (after Garber et al., 1989). See Fig. 1 for location.

Reservoirs in the upper San Andres and Grayburg formations produce from dolostones and dolomitic sandstones deposited in a backreef environment north of the Goat Seep reef complex (Fig. 6; Ward et al., 1986; Lindsay, 199 I). In most reservoirs, production is primarily from the Grayburg Formation. These reservoirs are present mostly on the Central basin platform and on the Northwest shelf along an east-west trend in northern Eddy and central Lea Counties. Traps are mainly stratigraphic and are formed by evaporitic plugging of porosity in an updip direction. Net pay ranges from 100 to 140 ft in the larger reservoirs.

Upper Guadalupian platform play

Reservoirs in the upper Guadalupian platform play lie on the Northwest shelf and Central basin platform. Most reservoirs on the Northwest shelf are located along an east-west trend in northern Eddy and central Lea Counties. These reservoirs produce from the Artesia Group (upper Guadalupian); sandstones in the Yates and Queen Formations dominate production, but dolostones in the Tansill, Yates and Seven Rivers Formations are significant reservoirs in some fields. Several important Queen reservoirs are present in southeast Chaves County, north of the main productive trend. The 162 reservoirs in this play have produced 557 MMBO and 5020 BCF gas (Table 1). Most of the reservoirs produce oil and associated gas by solution-gas and water drive; the 33 designated gas reservoirs have pressure-depletion drive. Depths to reservoirs range from 1400 ft on the Northwest shelf to more than 4000 ft in the San Simon syncline.

Upper Guadalupian reservoirs were deposited on a restricted shallow marine shelf. The reservoirs are found north of the shelf edge defined by the Capitan reef complex (Fig. 6; Ward et al., 1986; Borer and Harris, 1991). Traps are largely stratigraphic. Most production in the Yates is obtained from sandstones of the middle shelf; porosity is plugged in an updip shoreward direction by the impermeable evaporitic facies of the inner shelf. Much of the production in the Queen is obtained from eolian sandstones of the inner shelf; porosity is plugged in an updip direction by dolomite and anhydrite cements (Malicse and Mazzullo, 1990). Net pay is 10 to 30 ft in most reservoirs.

Delaware Mountain basinal sandstone play

Reservoirs of the Delaware Mountain basinal sandstone play are present in the Delaware Basin. Production is obtained from sandstones in all three formations that constitute the Delaware Mountain Group; in ascending order, Brushy Canyon, Cherry Canyon, Bell Canyon. The 133 reservoirs in this play have produced 61 MMBO and 93 BCF gas (Table **I).** The major reservoirs produce by solution-gas drive. All but seven of the reservoirs produce oil and associated gas; the other seven produce nonassociated gas. Depths to reservoirs range from 4000 ft to more than 7000 ft.

Delaware sandstone reservoirs were deposited in straight to slightly sinuous channels by shelf-derived density currents (Harms and Williamson, 1988). The channels were eroded into basinal siltstones. Traps are stratigraphic or combination stratigraphic-structural; the major component of trapping is the geometry of the channel-shaped sandstone body (Berg, 1979; Harms and Williamson, 1988). Net pay is 15 to 20 ft in most reservoirs.

The Delaware play has recently been one of the more active plays in southeast New Mexico. Exploratory drilling has mostly been targeted at traps in the lower two units of the Delaware Mountain Group (Brushy Canyon and Cherry Canyon formations). Production in older fields has been obtained primarily from Bell Canyon sandstones in the uppermost Delaware Mountain Group.

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A nitroglycerine charge opens up first producing oil well of the middle Pecos Valley area on December 24, 1920. Photograph by Moss. Courtesy of Southeastern New Mexico Historical Society of Carlsbad.