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Producing Characteristics and Depositional Environments of Lower Pennsylvanian Reservoirs, Parkway–Empire South Area, Eddy County, New Mexico[1]

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ABSTRACT

The Parkway-Empire area, on the Northwest shelf of the Permian basin about 15 mi (24 km) northeast of Carlsbad, New Mexico, produces gas from stratigraphic traps within four Lower Pennsylvanian zones: lower and middle Morrow sandstones, Atoka sandstones, and Strawn limestones.

The lower Morrow sandstones, which occur at about 11,400 ft (3,470 m), are interpreted to be a prograding fluvial-deltaic sequence of channels and point bars with a northwest source. They trend toward the southeast, generally normal to the Morrowan paleoslope. The lower Morrow sands are separated from the middle Morrow sandstones by a widespread, dark-gray, organic lagoonal shale. In southeastern New Mexico, middle Morrow sandstones are a transgressive series of marine beaches and bars deposited along the northeast-trending ancient shoreline. Stratigraphic traps are created in the lower and middle Morrow sandstones by variations in cementation and depositional patterns. Productive Atoka sandstones occur at approximately 10,700 ft (3,260 m) and appear to be a series of prograding barrier bars deposited along the northeast-trending shoreline. Strawn limestones produce from a series of small, low-relief algal banks developed along northeast depositional strike. The Strawn limestones occur between 10,250 and 10,500 ft (3,120 and 3,200 m).

The area is economically attractive. Payout of a typical well occurs in 1.2 years with a rate of return of 78.1%. Pennsylvanian completions in this area have typical ultimate recoveries of approximately 1.5 bcf (42 × 10^6 m^3) of gas and 22,000 bbl (3.5 × 10^6 L) of condensate. The stacked nature of the reservoirs causes a success rate of 85.2% for this area. The high success rate, good production, and attractive economics make this area of the Morrow trend an important exploration target.

INTRODUCTION

The Parkway-Empire area is located on the Northwest shelf of the Permian basin in central Eddy County, New Mexico, about 15 mi (24 km) northeast of Carlsbad (Figure 1). It consists of eleven or more designated pools (fields).[3] Two discovery wells have led to aggressive development. The first of these, Southland Royalty Company 1 Parkway State located in Sec. 15, T19S, R29E, was completed from middle Morrow sandstones on August 24, 1978, for a flowing potential of 2,714 MCFGD (77 × 10^6 m^3/day). As of December 31, 1982, cumulative production was 1.3 bcf (37 × 10^6 m^3) of gas and 20,000 bbl (3.5 × 10^6 L) of condensate. The second well, Southland Royalty Company 1 Empire Federal State Commission located in the SW¼ of Sec. 27, T18S, R29E, was completed from an Atoka sandstone in June 1980, for a calculated absolute open flow (CAOF) of 1,800 MCFGD (51 × 10^3 m^3/day). It had produced 1.3 bcf (37 × 10^6 m^3/day) of gas by December 31, 1982, when it was flowing 1,200 MCFGD (34 × 10^3 m^3/day). This well was originally completed in the lower Morrow in May 1980, where it produced a small amount of gas before being plugged back to the Atoka. Since these two wells were drilled, about 30 additional wells have been drilled, extending the various Parkway and Parkway West pools north to the Empire South pools to form one large producing area. Besides Southland Royalty Company, major operators in the area are Petroleum Corporation of Texas, Threshold, Amoco, Conoco, and Hondo (ARCO).

The Parkway-Empire South area produces gas from four Pennsylvanian zones and oil from several Permian zones. The Pennsylvanian production occurs from four distinct sequences: lower Morrow sandstones, middle Morrow sandstones, Atoka sandstones, and Strawn limestones.

Permian productive zones include Wolfcamp carbonates, Bone Spring carbonates, San Andres carbonates, Grayburg carbonates, and Queen and Seven Rivers sandstones. The Wolfcamp and Bone Spring carbonates have not yielded commercial quantities of oil. The Queen, Seven Rivers, Grayburg, and San Andres sediments produce oil from 1,800 to 2,500 ft (550-760 m) in large portions of the study area. These zones are economic objectives and are being developed in portions of the study area. Economically, the significant production in this area is gas occurring between 10,200 and 11,500 ft (3,100 and 3,500 m) in the Strawn, Atoka, and Morrow. As of December 31, 1982, cumulative production from these zones in 99 wells in the Parkway–Empire South area was 109 bcf (3.09 × 10^9 m^3) of gas and 1,600,000 bbl (260 × 10^6 L) of condensate. The

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Jack W. Becher and Michael G. Metcalf helped develop the regional concepts used in this paper. They prepared the regional environmental maps, and Metcalf prepared the Atoka net sand isopach map. Statistical production data were compiled by E. R. Andrews. Gilbert R. Barragan drafted the figures, and Nelta G. Baccus and Janet C. George typed the drafts and final manuscript. All these people are employees of Southland Royalty Company. Special thanks is given to these individuals for their help and efforts and to Southland Royalty Company, who permitted publication of this study.

[3]The state of New Mexico designates pools rather than fields. In productive areas, each producing zone is assigned a separate pool name, such as Parkway Atoka West and Empire Morrow South.

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Figure 10—Core description and lithology, and porosity and permeability plots based on density Company 1 Empire Federal 22 well.

ity porosity and permeability is difficult, but in general the thicker sandstones tend to have better porosity and permeability. To define middle Morrow reservoirs, a net effective porosity thickness map, Figure 12, was prepared.

Gas production in the middle Morrow sands is related not to structure but to porosity development. Areas with approximately 10 or more net feet (3 m) of effective porosity should be productive. Producing wells in both the lower and middle Morrow sandstones have porosities generally ranging between 8% and 14%. In contrast to the lower Morrow sandstones, water production rarely occurs from the middle Morrow sands.

Cumulative middle Morrow production in the mapped area was 41.1 bcf (1.16×10^9 m^3) of gas and 553,000 bbl (90 $\times 10^6$ L) of condensate from 53 wells as of December 31, 1982.

Examples of five logs of the Morrow section in the study area are shown in Figure 13. These logs show typical curve shapes for point bars and channels. Note the bell-shaped gamma-ray curve in the lower Morrow of the Coquina 1 Bass State well. This curve has a sharp bottom with a gradational upward increase in radioactivity. These gamma-ray responses are typical for point bars. Observe also the box-

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Figures 14 and 15 are
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