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RECENT OIL AND GAS EXPLORATION IN THE ALBUQUERQUE BASIN

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Abstract—A history of oil and gas exploration in the Albuquerque basin through 1980 was summarized in the Albuquerque Country II Guidebook (Black, 1982). This article is an attempt to update this history and cover the intervening 18 years of activity. More importantly, it attempts to analyze the results of pre-Tertiary tests in light of our present recognition that the basin is part of a major rift system, which has now been proven to have movable hydrocarbons.

INTRODUCTION

While rift systems represent only 5% of the world's basins by area, half of them (2.5% by area) contain 10% of the world's hydrocarbon reserves (Klemme, 1980). This obviously makes rifts, with proven parameters for oil and gas accumulations, very attractive targets for exploration and ones which can, and often have, produced "elephants." The Albuquerque Basin has all the earmarks of a future productive rift basin.

POST-1982 EXPLORATION

In the 18 years between 1981 and 1998, five additional wells were drilled in the basin (Fig. 1). Of these, only two have drilled deep enough to test the Pre-Tertiary section, although at least two of the three Tertiary tests may also have been attempts to reach the Mesozoic.

In July 1984, Utex Oil drilled the Westland Development No. 1-1J1E on the mesa west of Albuquerque in sec. 1, T10N, R1E. Scout tickets reported the well was in Cretaceous at a total depth of 16,665 ft. However, this well probably did not, in fact, reach Cretaceous rocks. Neither log correlations nor lithology descriptions support an interpretation that the well got out of the Tertiary section. No oil shows and only minor gas shows were reported in the well.

In early 1986, the oil and gas industry experienced a crippling downturn as oil prices plummeted from the mid $30s to under $10 a barrel. This suppression of oil and gas prices has, except for the short period of the Gulf War, continued unabated to date. Low oil prices helped account for the lack of activity for the next 10 years, but in late 1995, gas prices began to recover significantly and gas exploration began to slowly recover.

In 1995, Vastar farmed out several prospects to Davis Oil. In mid January 1996, Davis drilled the Tamara No. 1 in the northern part of the basin in sec. 3, T13N, R3E. This well spudded in the Santa Fe Group and drilled the Cretaceous section from 6270 ft to 8400 ft. Less than 100 ft of Morrison were present (probably due to faulting). The top of the Entrada was drilled at 8545 ft. The well was bottomed at 8732 ft in the top of the Triassic Chinle. At the Dakota, the well ran well over 1000 ft lower than the 1972 Shell SFP No. 1, 3 mi to the southeast. Only minor shows of oil and gas were reported in the well.

Davis followed up this test three months later, in March 1996, with a second well in the southern part of the basin in sec. 19, T4N, R1E. This well, the Davis Angel Eyes No. 1, was drilled to a total depth of 8074 ft. The well only tested part of the Tertiary and did not penetrate to the deeper Mesozoic rocks. No information is available on oil or gas shows in this well.

The next year, in August 1997, another partial Tertiary test was drilled in the southern part of the basin in sec. 33, T5N, R1E. The Twining Drilling Corp. No. 1 NFT drilled to a depth of 7441ft in one of the deeper parts of the basin. No information on shows of oil or gas, if

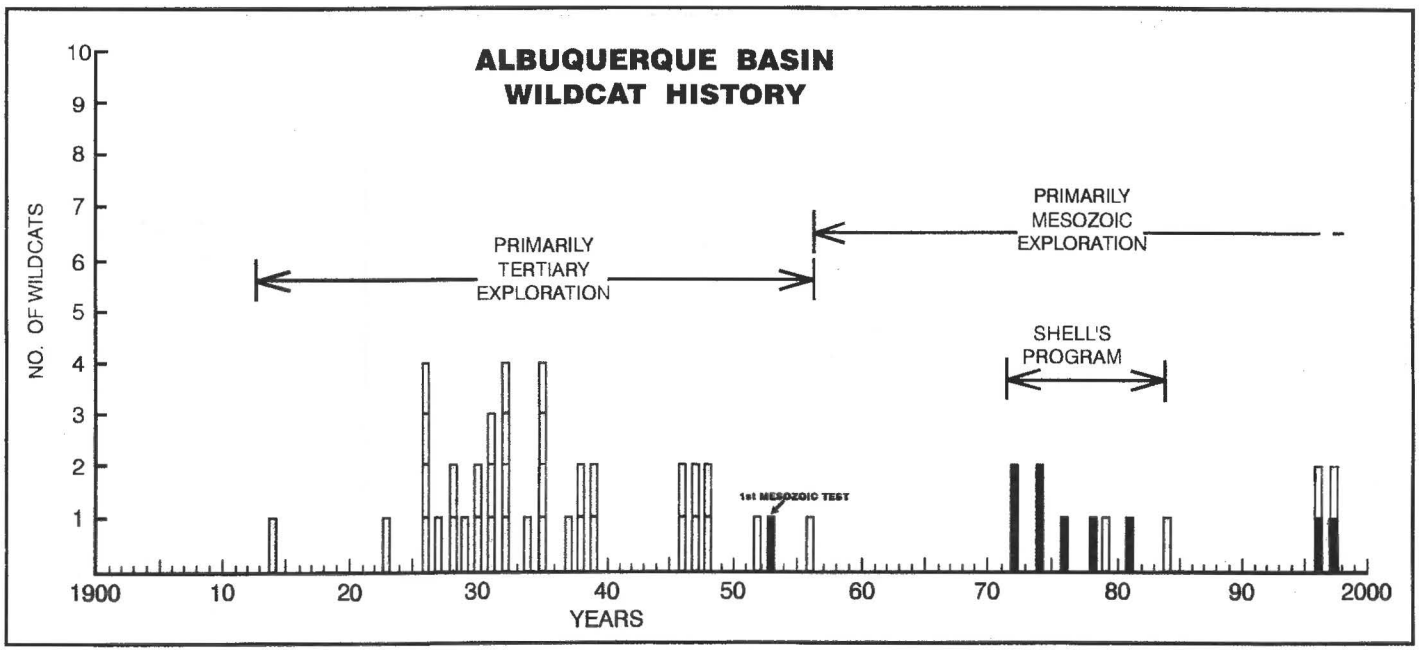

FIGURE 1. Histogram showing wildcat activity in the Albuquerque Basin for 1900 through 1998. Mesozoic tests are shown in black.

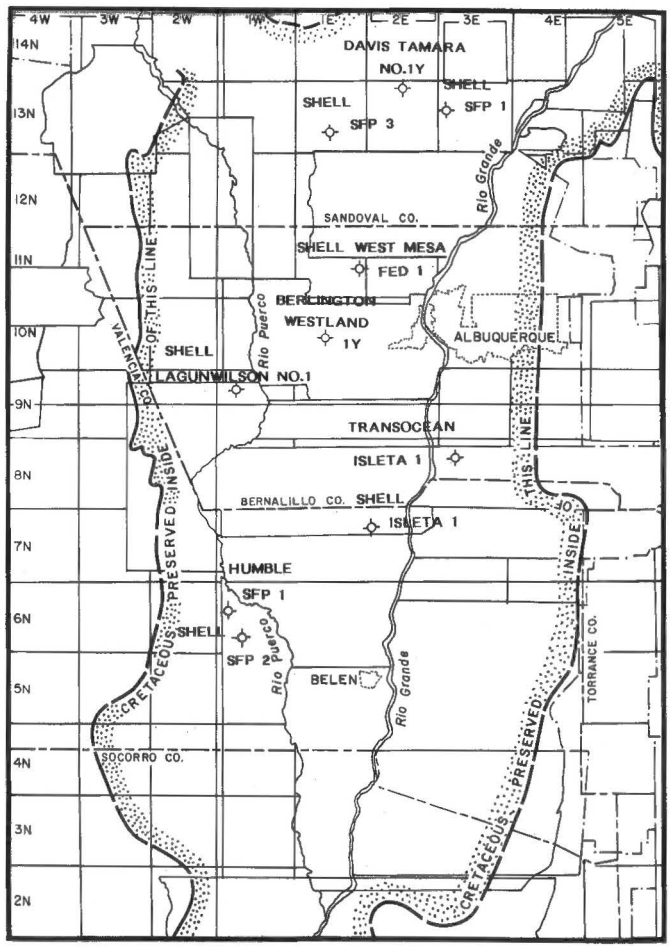

FIGURE 2. Outline map of the Albuquerque basin showing wildcat oil and gas tests that have penetrated Mesozoic rocks (updated from Black, 1982).

any, is available.

The last test in the basin was the Burlington Resources Westland Dev. Corp. No. 1Y. This well was drilled in October 1997, in sec. 21, T10N, R1E, on the western side of the rift. It was spudded in Quaternary sand and eventually bottomed in the Triassic Chinle at 7800 ft. The well drilled over 5000 ft of Tertiary section, including over 500 ft of unexpected intrusive Tertiary igneous sills and dikes. The top of the Cretaceous section was penetrated at 5210 ft. Only 60 ft of Jurassic Morrison was drilled, from 7430 ft to 7490 ft. The top of the Jurassic Todilto was penetrated at 7490 ft and the top of the Entrada was drilled at 7560 ft. The top of the Chinle was penetrated at 7700 ft. A few minor shows of oil were seen in the well, and only very minor shows of gas were noted on the mud log.

ANALYSIS OF THE PRE-TERTIARY TESTS

One of the most important questions an explorationist interested in the Albuquerque basin must answer is: Why haven't the 10 known Mesozoic tests in or on the flanks of the basin (Fig. 2) found commercial oil and gas? Table 1 compares these 10 tests against the necessary parameters that are normally considered requisite for commercial oil and gas accumulations. It also includes columns on the presence or absence of oil and gas shows, subcommercial production tests, probable seismic closure, and whether the well was probably located on closure on a high block adjacent to source rocks in the basin.

The tabulated results are the writer's best estimate of these factors and may or may not be accurate, because access to all the test data and the seismic was limited. The estimates are based on both known data and the probable exploration philosophy which prevailed at the time the well was drilled. The wells and their results on this table should not be viewed simply against the listed criteria, but should also be looked at in their structural and stratigraphic content, the philosophical reasoning behind the tests, and where these wells were physically drilled in the rift system.

It is particularly important for explorationists to recognize the great majority of oil and gas accumulations in rift basins are found on structural highs located in high blocks that are in, or immediately adjacent to, the rift proper. These high structural blocks are typically adjacent to deeper graben blocks, which have provided adequate maturity for the contained source rocks. It is generally believed that the intervening tensional normal faults have acted as avenues for migration of hydrocarbons out of the low areas, up the faults, and into the reservoirs available on the highs.

When we look at the history of exploration in the Albuquerque basin, and the locations of the tests, it is obvious that most, if not all of the tests, have not been located properly to exploit locations that are statistically best for structural hydrocarbon traps in rift systems (namely on the highs immediately adjacent to source potential).

As a Senior Staff Geologist for Shell Oil in the early 1970s the writer was, in part, instrumental in instigating that company's original exploration efforts in the basin. Those initial efforts were not directed toward exploiting highs in the rift, but were aimed at drilling the deeper, hotter, low areas in the rift. This was a deliberate attempt, using the San Juan Basin as an analog, to drill the deep Cretaceous section, which was stratigraphically similar to the adjacent San Juan Basin. The purpose was to try to tap the in-situ oil and gas that was believed being generated and stratigraphically trapped in the deeper mature areas. The philosophy was to look for another San Juan Basin type deep central basin gas accumulation in the Albuquerque basin. Until 1986, and with the exception of the Shell SFP No. 1, the Shell Laguna Wilson No. 1, and the TransOcean No. 1 Isleta, the first ten wells drilled into the Mesozoic section were, in fact, drilled in the deeper parts of the basin, and reflected this San Juan Basin analogy philosophy.

The important point is that the play was not initially made as a structural play, but rather it was made as a stratigraphic play in a structural rift system. The rift tectonics, however, provided numerous structural possibilities in addition to the stratigraphic trapping potential. The striking difference between the structural styles of the Rio Grande rift and the adjacent San Juan Basin can be envisioned from the block diagram in Figure 3, which illustrates the higher potential for structural traps in the rift.

Shell was successful in finding deep gas in the Cretaceous section in several of their initial wells. Ironically, because of the extreme depths, difficulty in making completions, and the poor reservoir character found in the deeper wells, they were deemed non-commercial, even though gas was being generated and was present in the Cretaceous rocks. Drill stem tests and sustained production tests (that produced a hundred thousand cubic feet of gas a day or less) were not commercial for Shell when the wells were costing several million dollars to drill and complete. Shell's theories on source rocks, maturation and oil and gas generation in the deep Albuquerque basin were right, but they were unsuccessful in making commercial wells with the technology at that time.

While the structurally high blocks in the basin were not tested at this time, three wells that appeared to be in higher positions need to be explained. The Shell SFP No. 1 was drilled in part because of expiring acreage and was primarily a stratigraphic test to find out if indeed a Cretaceous section was even present in the northern end of the basin. The location was picked on a surface nose in the Santa Fe Group where no apparent northerly closure was present. Although, not intended primarily to test a high block in the basin, it ended up low on a relatively high block, which was probably also an old paleohigh.

The Shell Laguna Wilson No.1 was drilled on the western flank of the basin on a surface structural nose (this well may technically be outside of the rift) and in an immature, shallow Cretaceous section. Several large fault blocks separate it from the deep basin proper, and may have provided barriers to oil migration.

Table 1. Critical hydrocarbon parameters, oil and gas shows, and structural considerations in the ten Mesozoic test in the Albuquerque basin

Known Mesozoic penetrations in the basin	Source rocks present	Maturity present	Reservoirs present	Favorable migration route present	Seal present	Structural or stratigraphic trap present	Proper timing	Oil and/or gas shows present	Subcommercial oil and/or gas tested	Seismic closure present	Located on high blockadjacent to mature source rocks
Humble SFP# 1 11/16/53	Y	Y	N	Y	Y	N	Y	Y	N	N	N
Shell SFP # 1 6/19/72	Y	N	Y	?	Y	N	Y	Y	N	?	N
Shell Laguna Wilson # 1, 9/21/72	Y	N	Y	N	Y	?	N	Y	N	?	N
Shell SFP # 2, 3/29/74	Y	Y	N	Y	Y	N	Y	Y	N	N	N
Shell Isleta # 1, 10/25/74	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
Shell SFP # 3, 4/19/76	Y	N	Y	?	Y	N	N	?	N	N	N
Transocean Isleta # 1, 10/4/78	Y	?	N	Y	Y	N	Y	Y	N	N	N
Shell West Mesa Fed. # 1, 12/30/80	Y	Y	N	Y	Y	N	Y	Y	Y	N	N
Davis Tamara # 1, 1/12/96	Y	N	Y	?	Y	?	?	Y	N	?	N
Burlington Res. Westland # 1, 10/25/97	Y	Y	Y	Y	Y	N	Y	Y	N	N	N

NOTE: (?) indicates general lack of data or strong indications one way or the other.

The TransOcean well was the first conscious attempt to get on a high block adjacent to the "cooking pot." This well was drilled on a pass-through farm out from Shell Oil to Black Oil, who turned it over to TransOcean. Subsequent geophysics showed the well was located in a low saddle and was not on a closed high.

CONCLUSIONS

Oil and gas exploration in the Rio Grande rift has been going on sporadically for at least 85 years (Fig. 1). While no large commercial accumulation has yet been found, high gravity oil is being produced in the Santa Fe embayment of the Española basin in the rift. Additionally, tens to hundreds of thousands of cubic feet of gas have been tested from wells in the Española and Albuquerque basins of the rift. Oil and gas shows in exploration wells and oil on the outcrop has been reported in several areas along the rift. All of the necessary parameters for commercial oil and gas accumulations have been documented in several of the rift basins. The structural style is becoming well known, with numerous recent articles, published gravity, and the release of seismic data revealed in recent articles (Russel and Snelson, 1994). The writer believes it is now more a matter of when, rather than if, a commercial discovery will be found.

Future exploration efforts should continue to concentrate on both the stratigraphic and structural aspects of the play, but in the writer's opinion, until closed structural traps are located and drilled, the potential of the rift in general, and the Albuquerque basin in particular, will not be exploited to its full potential.

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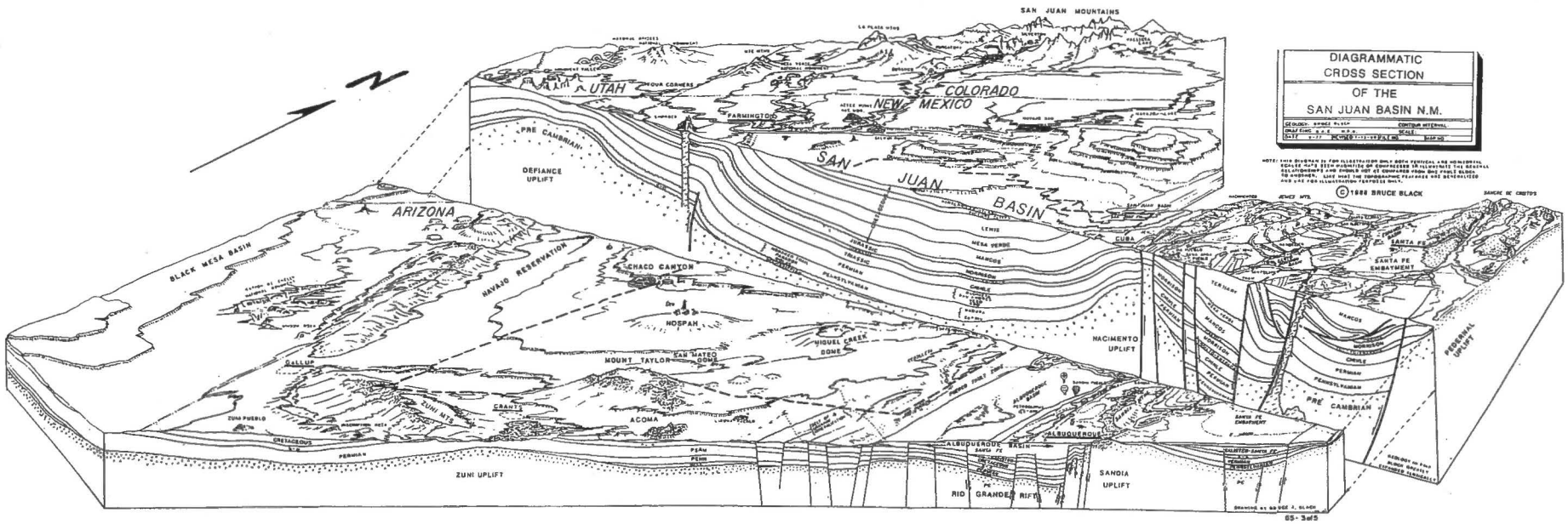

FIGURE 3. Block diagram of the San Juan Basin and the Rio Grande rift. Front section of the diagram through the Albuquerque area is drawn to scale. The cut through the center of the San Juan Basin, the northern end of the Albuquerque basin, the Hagan embayment and the Santa Fe embayment of the Española basin, is vertically exaggerated. Note the structural complexity and potential for structural traps in the rift area, where Laramide thrusting and later Tertiary extensional faulting provides numerous structural trap possibilities.