Oil and gas discovery wells drilled in New Mexico in 1987

Ronald F. Broadhead

New Mexico Geology, v. 10, n. 3 pp. 54-59, Print ISSN: 0196-948X, Online ISSN: 2837-6420.
https://doi.org/10.58799/NMG-v10n3.54

This page is intentionally left blank to maintain order of facing pages.

Oil and gas discovery wells drilled in New Mexico in 1987

by *Ronald F. Broadhead*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

Introduction

Fewer wells were drilled for oil and gas in New Mexico in 1987 than in 1986. Data obtained from the New Mexico Oil Conservation Division indicate 938 wells were completed in 1987, down 24% from the 1,243 wells completed in 1986 and down 67% from the record 2,867 wells completed in 1981. In the Permian Basin, southeast New Mexico, 740 wells were completed in 1987, down from 838 completions in 1986; 431 wells were completed as oil producers, 170 wells were completed as gas producers, and 139 wells were plugged and abandoned, resulting in a success rate of 81%. In the San Juan Basin, northwest New Mexico, 198 wells were completed in 1987, down from 405 completions in 1986; 79 wells were oil producers, 100 wells were gas producers, and 19 wells were plugged and abandoned, resulting in a success rate of 90%. In addition, eight wells were completed in the Bravo dome carbon dioxide gas field of southern Union and eastern Harding Counties. The downturn in drilling was accompanied by decreased exploratory efforts. Despite this, however, significant exploratory drilling continued in the Baca, Acoma, Raton, Tucumcari, and Estancia Basins and on the Sierra Grande uplift (Fig. 1).

Total footage of hole drilled in 1987 was 4,767,394 ft, down from 6,756,266 ft drilled in 1986. The average depth of wells drilled in 1987 was 5,083 ft, 352 ft less than the average depth of wells drilled in 1986.

For purposes of this report, a *significant wildcat discovery* is defined as a well in which commercial amounts of oil or gas were discovered in a stratigraphic unit more than 5 miles from the limits of previously discovered pools with commercial production from that stratigraphic unit. A *significant wildcat dry hole* is defined as a dry hole that was drilled in a not-yet-productive basin or a part of a basin and in which petroleum reservoirs were evaluated. The locations of significant wildcat wells that were drilled in 1987 are shown in Figure 1. Table 1 summarizes the significant wildcat discoveries, and Table 2 summarizes the significant wildcat dry holes. Table 3 lists other significant wildcat wells that were being drilled, were not completed, or were held "tight" at the end of 1987.

Each well is designated by a number in parentheses that refers to its location in Fig. 1 and its description in Tables 1, 2, or 3.

Southeast New Mexico

Drilling activity remained slow in 1987 in the three geologic subdivisions of the Permian Basin: the Delaware Basin, the Central Basin platform, and the Northwest shelf. Drilling activity was also light on the Roosevelt dome. Despite the slow drilling activity, however, the Permian Basin and Roosevelt dome yielded several significant oil and gas discoveries in 1987 (Fig. 1; Table 1). Kinney (1967, p. 26–27) presented stratigraphic charts of oil- and gas-producing rock units in southeast New Mexico.

The Delaware Basin, the deep-marine part of the Permian Basin, yielded eight significant discoveries in 1987. Gas was discovered in Atokan (Pennsylvanian) clastics in two wells, the Petrus Oil No. 1 Henshaw Federal (1) and the Sun Exploration & Production No. 1 NM Federal Com. (6). Oil was found in the Strawn Series (Pennsylvanian) in the Yates Petroleum Corp. No. 1 Compromise Federal Com. AEJ (2). Gas was found in upper Pennsylvanian strata in the Yates Petroleum Corp. No. 4 Williamson BC (3). Oil was found in basinal Permian sandstones in four wells: the Frank Boyce No. 1 State BB (4), the Indrex Inc. No. 1 Four Forks Federal (5), the Conoco No. 11 Bell Lake Unit (7), and the Enron Oil & Gas No. 1 Owen Mesa Federal Com. 26 (40). Because of the slack gas market, exploration in the Delaware Basin was concentrated on finding new oil reserves and not on finding new gas reserves. Major targets for oil exploration were basinal sandstones of the Bone Spring Formation and Delaware Mountain Group (Permian), including the Brushy Canyon and Cherry Canyon sandstones. There was also exploration

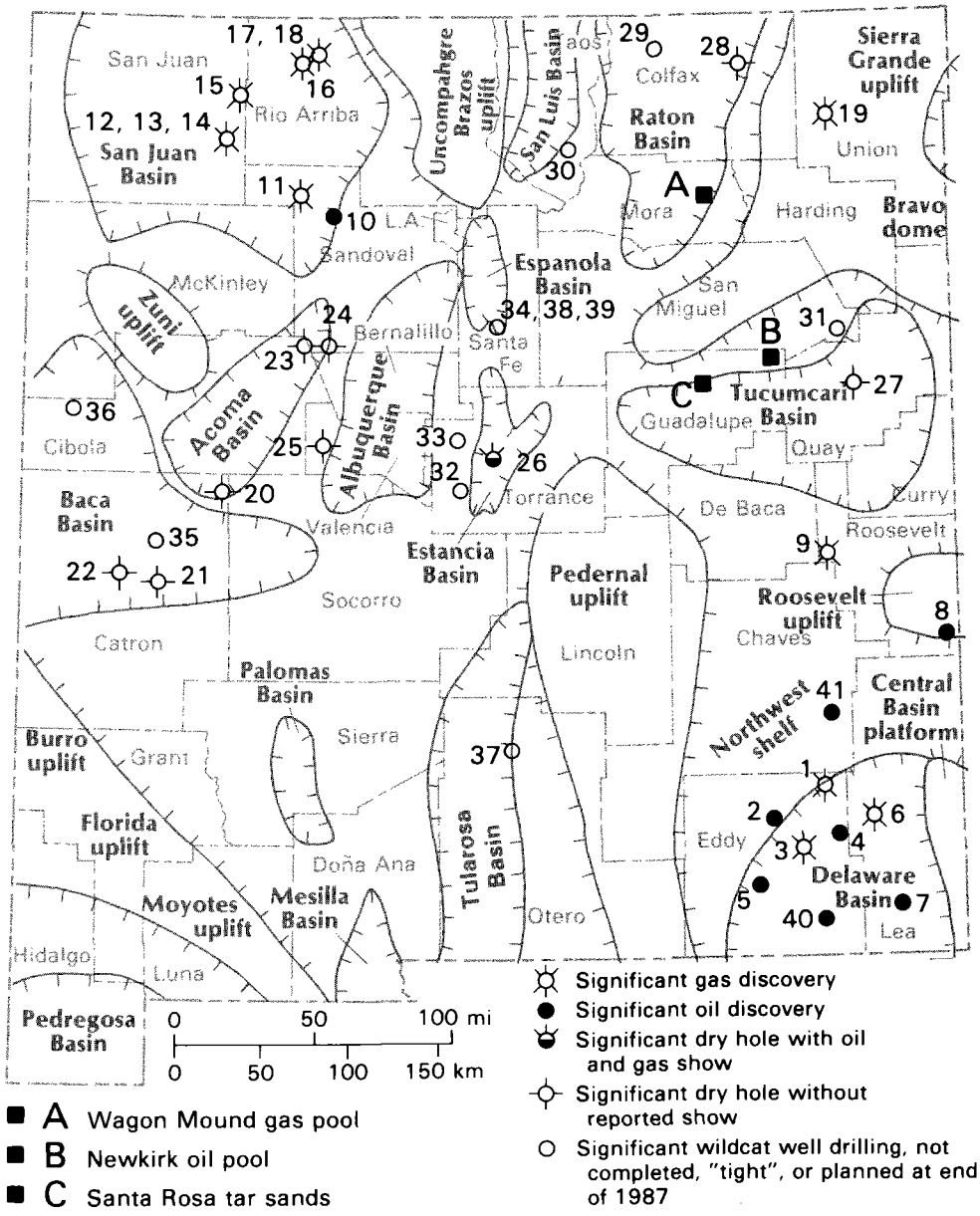

FIGURE 1—Significant oil and gas discoveries and wildcat wells drilled in New Mexico in 1987. Major geologic features are taken from Broadhead and King (in press), Cather and Johnson (1984), Kelley (1978), Kottlowski and Stewart (1970), Meyer (1966), Molenaar (1977), Thompson and Jacka (1981), Woodward et al. (1978).

for oil in Wolfcamp (Lower Permian) and Cisco, Canyon, and Strawn (Upper to Middle Pennsylvanian) carbonate reservoirs. There was limited exploration for gas in the deep (10,000–14,000 ft) Atokan and Morrowan (Lower Pennsylvanian) clastic units.

Development drilling in the Delaware Basin was almost exclusively for oil in 1987. Major targets for development drilling were oil reservoirs in the shallow (4,000–6,000 ft) Delaware Mountain Group (Permian) and moderately deep (6,000–10,000 ft) Bone Spring Formation (Permian). Few development gas wells were drilled in the Delaware Basin in 1987; mostly, gas development was in reservoirs of the deep Atokan and Morrowan (Lower Pennsylvanian) clastic units.

No significant wildcat discoveries were made on the Central Basin platform in 1987. Exploration was concentrated on deep Silurian and Devonian targets under the platform and along the western border areas of the platform. Several exploratory wells were drilled for this purpose and a few were successful. Development drilling was mostly for oil in the shallow (2,000–5,000 ft) Yates, Seven Rivers, Queen, Grayburg, and San Andres Formations (Permian). Sirgo–Collier Inc. continued development of a waterflood unit in the Dollarhide Queen oil pool of southeast Lea County.

One significant wildcat discovery was made on the Northwest shelf in 1987. Oil was discovered in the Devonian in the Bell–Foy & Middlebrook No. 1 Culp Ranch Unit (41). Limited exploration continued for oil in Wolfcamp (Lower Permian), Pennsylvanian, and Silurian–Devonian reservoirs.

Development of oil and gas pools on the Northwest shelf continued at a fast pace in 1987. Main targets were oil reservoirs in the shallow (less than 6,000 ft) Queen, Grayburg, and San Andres Formations (Permian). Conoco and Phillips conducted extensive infill drilling programs to develop waterfloods in the Grayburg and San Andres Formations (Permian) at the Maljamar oil pool of northern Lea County. Phillips and Mobil conducted similar drilling programs to develop waterfloods in the Grayburg and San Andres at the Vacuum oil pool of northern Lea County. Chevron developed a waterflood of the Grayburg and San Andres in the Eunice–Monument oil pool of central Lea County.

The only gas pool developed extensively in 1987 was the West Pecos Slope Abo pool of west-central Chaves County. McKay Oil Corporation completed more than 80 wells in that pool. Average depth was approximately 3,400 ft. McKay was able to increase gas yields from Abo wells with the aid of a carefully designed, computer-assisted, artificial fracturing program (Mickey, 1987). The increased gas yields, as well as development of a market for Abo gas, allowed development of the West Pecos Slope pool while development of other New Mexico gas pools languished.

The Roosevelt dome and adjacent areas were drilled sparsely in 1987. Despite the slow pace of drilling, however, two signifi-

TABLE 1—Significant wildcat discoveries in New Mexico in 1987; the term formation is used in an informal sense. **BOPD,** bbls oil per day; **BWPD,** bbls water per day; **BCPD,** bbls condensate per day; **MCFGPD,** thousand ft^3 gas per day; **IPCAOF,** initial potential, calculated absolute open flow; **IPF,** initial potential, flowing; **IPP,** initial potential, pumping; **owwo,** old well worked over.

Number on Fig. 1	Location (section–township–range, county)	Operator, well number, and lease	Completion date (mo/yr)	Total depth (ft)	Formation at total depth	Producing formation	Producing interval (ft)	Initial potential	Oil gravity (degrees API)
1	14–16S–30E, Eddy	Petrus Oil No. 1 Henshaw Federal	8/87	11,775	Atoka (Pennsylvanian)	Atoka (Pennsylvanian)	10,374–10,390	IPCAOF 1,514 MCFGPD	
2	30–18S–27E, Eddy	Yates Petroleum Corp. No. 1 Compromise Fed. Com AEJ	3/87	9,800	Mississippian	Strawn (Pennsylvanian)	8,720–8,725	IPF 6 BOPD + 795 MCFGPD	57.1
3	7–20S–29E, Eddy	Yates Petroleum Corp. No. 4 Williamson BC (owwo)	5/87	11,640	Morrow (Pennsylvanian)	upper Pennsylvanian	10,029–10,051	IPF 110 MCFGPD	
4	16–19S–31E, Eddy	Frank Boyce No. 1 State BB	9/87	6,000	Delaware (Permian)	Delaware (Permian)	4,665–5,866	IPP 162 BOPD + 123 MCFGPD + 180 BWPD	
5	15–22S–25E, Eddy	Indrex Inc. No. 1 Four Forks Federal	6/87	10,860	Barnett (Mississippian)	Bone Spring (Permian)	4,345–4,419	IPF 55 BOPD + 123 MCFGPD + 59 BWPD	44
6	24–18S–33E, Lea	Sun Exploration & Production No. 1 NM Federal Com.	5/87	13,740	Chester (Mississippian)	Atoka (Pennsylvanian)	12,955–12,970	IPF 8,784 MCFGPD + 696 BCPD	
7	31–23S–34E, Lea	Conoco No. 11 Bell Lake Unit	2/87	8,900	Bone Spring (Permian)	Cherry Canyon (Permian)	6,805–6,810	IPP 263 BOPD + 230 MCFGPD + 182 BWPD	
8	27–7S–37E, Roosevelt	H. L. Brown Jr. No. 1 Federal Com. 27	9/87	9,089	granite (Precambrian)	Silurian–Devonian	8,845–8,892	IPF 202 BOPD + 544 MCFGPD	45
9	27–2S–29E, Roosevelt	Marshall Pipe & Supply No. 1 McGee	5/87	7,206	Precambrian	Pennsylvanian	6,759–6,769	IPCAOF 1,522 MCFGPD	
						Montoya (Ordovician)	7,056–7,082	IPCAOF 2,513 MCFGPD	
10	28–20N–2W, Sandoval	Hixon Development No. 1 Hugh Foster	4/87	4,640	Gallup (Cretaceous)	Gallup (Cretaceous)	3,882–3,915	IPP 12 BOPD + 2.4 MCFGPD	
11	6–21N–4W, Sandoval	Gary Williams No. 13 Ceja Pelon 6	3/87	2,370	Chacra (Cretaceous)	Chacra (Cretaceous)	2,078–2,202	IPF 35.9 MCFGPD	
12	2–24N–9W, San Juan	Dugan Production Corp. No. 3 Blanco Wash	9/87	6,306	Dakota (Cretaceous)	Fruitland (Cretaceous)	1,632–1,642	IPF 6 MCFGPD + 5 BWPD	
13	5–24N–9W, San Juan	Dugan Production Corp. No. 1 Phillips	10/87	1,850	Pictured Cliffs (Cretaceous)	Fruitland (Cretaceous)	1,704–1,717	IPF 61 MCFGPD	
						Pictured Cliffs (Cretaceous)			
14	5–24N–10W, San Juan	Dugan Production Corp. No. 2 Sears Roebuck (owwo)	8/87	5,500	Gallup (Cretaceous)	Fruitland (Cretaceous)	1,642–1,658	IPF 88 MCFGPD + 1.5 BWPD	
15	10–27N–8W, San Juan	R&G Drilling No. 30 Graham A	9/87	2,345	Pictured Cliffs (Cretaceous)	Fruitland (Cretaceous)	1,610–1,620	IPF too small to measure	
16	4–29N–3W, Rio Arriba	Robert L. Bayless No. 1 Jicarilla 451	3/87	8,700	Morrison (Jurassic)	Fruitland (Cretaceous)	3,678–3,779	IPP 156 MCFGPD + 6 BWPD	

(continued on page 56)

TABLE 1 (continued)

Number on Fig. 1	Location (section–township–range, county)	Operator, well number, and lease	Completion date (mo/yr)	Total depth (ft)	Formation at total depth	Producing formation	Producing interval (ft)	Initial potential	Oil gravity (degrees API)
17	18–30N–2W, Rio Arriba	Robert L. Bayless No. 1 Jicarilla 519	7/87	8,703	Dakota (Cretaceous)	Pictured Cliffs (Cretaceous)	3,723–3,728	IPF 754 MCFGPD	
						Gallup (Cretaceous)	7,280–7,704	IPF 1,013 MCFGPD	
18	11–30N–3W, Rio Arriba	Robert L. Bayless No. 1 Jicarilla 456	3/87	4,052	Pictured Cliffs (Cretaceous)	Fruitland (Cretaceous)	3,694–3,726	IPF 382 MCFGPD	
						Pictured Cliffs (Cretaceous)	3,726–3,729		
19	36–26N–29E, Union	Sofia Exploration No. 1 Roxana State	3/87	3,764	Precambrian	Glorieta (Permian)	1,652–1,744	IPF 544 MCFGPD, CO_2	
						Yeso (Permian)	1,880–1,892		
40	26–24S–29E, Eddy	Enron Oil & Gas No. 1 Owen Mesa Federal Com. 26	7/87	12,860	Atoka (Pennsylvanian)	Bone Spring (Permian)	7,952–7,962	IPF 75 BOPD + 544 MCFGPD + 92 BWPD	43
41	11–12S–30E, Chaves	Bell–Foy & Middlebrook No. 1 Culp Ranch Unit	11/87	10,280	Devonian	Devonian	10,251–10,280	IPF 426 BOPD	

cant wildcat discoveries were made. Oil was found off the south flank of the dome in reservoirs of Silurian–Devonian age in the H. L. Brown Jr. No. 1 Federal Com. 27 (8). Northwest of the dome, gas was found in Pennsylvanian reservoirs in the Marshall Pipe & Supply No. 1 McGee (9); that discovery extended the area of Pennsylvanian production northward toward the Tucumcari Basin. In that same well, a gas completion was also attained in a Montoya (Ordovician) reservoir that develops the Tule Montoya gas pool; the Tule Montoya pool was discovered in 1986 and extended the area of Ordovician production approximately 25 miles northward from previously known limits. Development activities in Roosevelt County were slow in 1987 and were generally restricted to Pennsylvanian oil pools.

Elsewhere in southeast New Mexico, Cibola Energy staked a location in the Sacramento Mountains for their No. 1 Ysletano Canyon Federal (37). That well is scheduled to reach a total depth of 3,800 ft in Devonian strata.

Northwest New Mexico

In 1987, 198 wells were completed in northwest New Mexico, down from 405 completions in 1986 and 863 completions in 1985. Almost all of the wells were drilled in the San Juan Basin. The diminished rate of drilling in 1986 and 1987 has been caused by depressed gas prices and a depressed market for gas, which is the primary petroleum product of the San Juan Basin. Depressed oil prices have also taken a toll on drilling activity in the San Juan Basin.

Exploratory drilling resulted in nine significant discoveries in the San Juan Basin (Fig. 1; Table 1) in spite of the depressed drilling activity. Exploration was concentrated on the eastern side of the basin. Oil was discovered in Gallup sands (Cretaceous) in the Hixon Development No. 1 Hugh Foster (10). In the Gary Williams No. 13 Ceja Pelon 6 (11) marginal quantities of gas were discovered in the Chacra interval(Cretaceous). Significant discoveries of gas were made in both the Pictured Cliffs and Gallup sands (Cretaceous) in the Robert L. Bayless No. 1 Jicarilla 519 (17). In six wells (12, 13, 14, 15, 16, 18) significant low-volume gas discoveries were made in the Fruitland Formation (Cretaceous) at depths of 1,600 to 3,800 ft. Fruitland production in two of those wells (13, 18) was commingled with gas production from the upper part of the Pictured Cliffs Sandstone (Cretaceous). In those wells, Fruitland and Pictured Cliffs reservoirs may be in dynamic hydraulic contact with each other. Fruitland gas reservoirs have been ignored for many years because of low production volumes; exploration and development have been concentrated in deeper, more prolific reservoirs in the Upper Cretaceous. However, lower costs involved with drilling the shallower Fruitland reservoirs (mostly less than 2,000 ft) compensate partially for the low volumes of gas production. Choate et al. (1984) estimated that the total gas contained within Fruitland coal beds more than 2 ft thick in the San Juan Basin is 31 trillion ft^3 (TCF); most of that gas is within the New Mexico part of the basin.

Most development drilling for gas in the San Juan Basin was in sandstone reservoirs in the Pictured Cliffs Sandstone, Mesaverde Group, and Dakota Sandstone (Cretaceous). Other targets of gas drilling were coal beds and sands in the Fruitland Formation.

Major targets of development drilling for oil in the San Juan Basin were the Gallup Sandstone and Niobrara Shale (Cretaceous). Several development wells were completed in two or more of the following Cretaceous units: Gallup Sandstone, Dakota Sandstone, and the Juana Lopez, Greenhorn Limestone, and Graneros Shale Members of the lower part of the Mancos Shale. The thickness of each completion zone is typically 300–500 ft. Stone et al. (1983) and Molenaar (1977) summarized the stratigraphy of Cretaceous rocks in the San Juan Basin.

Two exploratory wells were drilled in the presently nonproductive Acoma Basin. The Austra–Tex No. 1 Exxon Mineral Fee (23) was abandoned at a total depth of 7,000 ft with no reported shows. The Austra–Tex No. 1–7 Rio Puerco Federal (24) was abandoned at a total depth of 6,324 ft in reported arkosic sediments of Permian or Pennsylvanian age.

The Española Basin is a frontier basin in northwest New Mexico. Two marginally commercial oil discoveries were made in 1985 in Upper Cretaceous strata at the southern end of the basin (Broadhead, 1986). Three confirmation wells were drilled by Bruce Black in 1986 but did not encounter commercial quantities of petroleum. Three additional confirmation wells (34, 38, 39) are scheduled to be drilled in 1988. Black (1984a, b) discussed aspects of petroleum exploration and structure in the Española Basin.

Elsewhere in northwest New Mexico, the New Mexico & Arizona Land Company No. 5 Penteco Trinity (25) was drilled on the Lucero uplift west of the Albuquerque Basin and subsequently was abandoned. Three intervals in the Pennsylvanian were perforated and acidized without yielding production or shows. A location was staked near the end of 1987 to drill the Merrion Oil & Gas No. 1 Galestina Canyon (36) in the southern part of the Gallup sag of western Cibola County; that well is scheduled to be drilled to a total depth of 3,000 ft.

Northeast New Mexico

Petroleum exploration continued in the frontier areas of northeast New Mexico in 1987. Wildcat wells were drilled in the Estancia, Tucumcari, and Raton Basins. Exploration for carbon dioxide concentrated on the Bravo dome. Petroleum has not been produced commercially in northeast New Mexico except during a brief period in the 1970's when marginally commercial amounts of gas were produced from the Morrison Formation (Jurassic) and the Dakota Sandstone (Cretaceous) at the currently inactive Wagon Mound field in Mora County (Fig. 1, letter A). In the 1980's, the Newkirk pool(Fig. 1, letter B) has produced 488 bbls heavy oil from the Santa Rosa Sandstone (Triassic) with the aid of a pilot steamflood project. In the 1930's, approximately 153,000 tons of tar sands were mined from the Santa Rosa Sandstone near the town of Santa Rosa in Guadalupe County

(Gorman and Robeck, 1946; Fig. 1, letter C).

In the Estancia Basin of Torrance County, the Benz, Lyle & Curtis No. 1 Benz (26) was spudded in 1984 and was finally abandoned in 1987 after being drilled to a total depth of 796 ft. Oil-cut and gas-cut salt water was reportedly swabbed from perforations in the Yeso Formation (Permian). The Bruce Wilson No. 1X Judd (32) was spudded in 1987 and was drilled to a total depth of 2,830 ft. Casing was set to total depth, and several intervals were perforated in the Pennsylvanian section; no shows were reported.

Exploratory activity continued in the Tucumcari Basin in 1987. One significant well, the Knightsbridge Petroleum No. 1 Triple Crown (27), was drilled in the central part of the basin. That well reached a total depth of 7,604 ft in Pennsylvanian strata and has been temporarily abandoned. On the northern flank of the Tucumcari Basin, plans were made to re-enter the Tom L. Ingram No. 1 Gihon (31) and to drill to a projected total depth of 5,500 ft to test the Pennsylvanian and Wolfcampian sections.

In the New Mexico part of the Raton Basin, the Export Petroleum No. 1 Moore Ranch State (28) was drilled through the Cretaceous section and reached a total depth of 2,936 ft in the Chinle Formation (Triassic); no shows were reported. The Pennzoil No. 33 Van Breamer (29) was drilled to a total depth of 2,085 ft to test Cretaceous coals for gas and was "tight" at the end of 1987. Although the New Mexico part of the Raton Basin is not yet productive of oil and gas, gas has been produced from small fields in the Colorado part of the basin. Several exploratory wells drilled in past years in the New Mexico part have encountered promising shows of gas and might be marginally commercial if gas prices and gas demand were more favorable. Speer (1976) and Woodward(1987) discussed the petroleum geology of the Raton Basin.

Leonard Minerals made plans to drill their No. 1 Taos Trough Unit (30) in the Sangre de Cristo Mountains of Taos County. The well will spud in the Pennsylvanian section and is scheduled to be drilled to a total depth of 6,000 ft. The No. 1 Taos Trough Unit will be the first petroleum exploration well drilled in Taos County.

Development of the Bravo dome carbon dioxide gas field continued in 1987 and eight wells were drilled. The main reservoir at Bravo dome is the Tubb sand (Permian), although minor production comes from the Santa Rosa Sandstone (Triassic) and shows of carbon dioxide have been encountered in the Glorieta Sandstone, upper Clearfork Member of the Yeso Formation, and the Abo Formation (Permian). Most carbon dioxide produced from the Bravo dome field is used for enhanced oil recovery in the west Texas part of the Permian Basin. Eventually, as production from oil fields under waterflood in the New Mexico part of the Permian Basin wanes, carbon dioxide will be used for enhanced oil recovery in the New Mexico part of the Permian Basin. A relatively minor amount of carbon dioxide produced from the

TABLE 2—Significant wildcat dry holes drilled in New Mexico in 1987; the term formation is used in the informal sense. **D&A,** dry and abandoned; **TA,** temporarily abandoned.

Number on Fig. 1	Location (section–township–range, county)	Operator, well number, and lease	Completion date (month/year)	Total depth (ft)	Formation at total depth	Status	Comments
20	21–3N–9W, Catron	Black Oil No. 6 Santa Fe Pacific Railroad	6/87	680	Mancos (Cretaceous)	D&A	No reported shows. Upper Cretaceous test.
21	2–4S–13W, Catron	Shell Western Exploration & Production No. 1 SWEPI et al. State	9/87	7,000		D&A	"Tight" hole. No reported shows. Extensively cored and 2–4 DST's run.
22	21–3S–15W, Catron	Shell Western Exploration & Production No. 1 Mangus Mountains Federal	11/87	7,700		D&A	"Tight" hole. No reported shows.
23	23–12N–4W, Cibola	Austra–Tex No. 1 Exxon Mineral Fee	9/87	7,000		D&A	"Tight" hole. No reported shows.
24	7–12N–2W, Sandoval	Austra–Tex No. 1–7 Rio Puerco Federal	10/87	6,324	Granite wash (Pennsylvanian)	D&A	No reported shows.
25	35–6N–3W, Valencia	New Mexico & Arizona Land Company No. 5 Penteco Trinity	6/87	1,650	Precambrian	D&A	Perforated 1458–1474 ft, 1484–1490 ft, 1524–1528 ft, acidized, no reported shows.
26	18–5N–9E, Torrance	Benz, Lyle & Curtis No. 1 Benz	5/87	796	Yeso (Permian)	D&A	Spudded in 4/84. Swabbed slight oil–cut and gas–cut salt water from perforations in Yeso (Permian). To be completed as water well.
27	6–9N–31E, Quay	Knightsbridge Petroleum No. 1 Triple Crown	5/87	7,604	Pennsylvanian	TA	No reported shows.
28	16–29N–24E, Colfax	Export Petroleum No. 1 Moore Ranch State	6/87	2,936	Chinle (Triassic)	D&A	No reported shows. Was scheduled to drill to 4,000 ft in Precambrian.

TABLE 3—Significant wildcat wells that were being drilled, not completed, "tight", or planned in New Mexico at the end of 1987. **owdd,** old well drilled deeper.

Number on Fig. 1	Location (section–township–range, county)	Operator, well number, and lease	Comments
29	30–30N–19E, Colfax	Pennzoil No. 33 Van Breamer	Reached total depth of 2,085 ft. "Tight" hole.
30	35–24N–14E, Taos	Leonard Minerals No. 1 Taos Trough Unit	Location staked. Scheduled to be drilled to 6,000 ft to test Pennsylvanian section.
31	31–13N–30E, San Miguel	Tom L. Ingram No. 1 Gihon (owdd)	Well drilled to 2579 ft in Yeso Formation (Permian) and abandoned in 1986. Scheduled to reenter and drill to 5,500 ft in Precambrian.
32	6–3N–7E, Torrance	Bruce Wilson No. 1X Judd	Drilled to total depth of 2,830 ft. Perforated 1,628–1,634, 1,876–1,882, 2,246–2,252, and 2,440–2,444 ft and swabbed water.
33	12–6N–6E, Torrance	John Aday No. 2 D'Spain	Spudded in 1983. Drilled to total depth of 1,900 ft. Shut in.
34	7–13N–9E, Santa Fe	Black Oil No. 2 Leigh	Scheduled to drill to 4,200 ft to test Upper Cretaceous section.
35	27–1S–13W, Catron	Shell Western Exploration & Production No. 1 SWEPI et al. Aspen Federal	Scheduled to drill to 9,000 ft to Precambrian.
36	27–8N–18W, Cibola	Merrion Oil & Gas No. 1 Galestina Canyon	Scheduled to drill to 3,000 ft to Precambrian.
37	7–14S–11E, Otero	Cibola Energy No. 1 Ysletano Canyon Federal	Location staked. Scheduled to be drilled to 3,800 ft in Devonian strata.
38	1–13N–8E, Santa Fe	Black Oil No. 1 Leigh	Location staked. Scheduled to drill to 3,500 ft in Upper Cretaceous strata.
39	12–13N–8E, Santa Fe	Black Oil No. 4 Ferrill	Location staked. Scheduled to drill to 4,000 ft in Upper Cretaceous strata.

☞

Bravo dome field is converted into dry ice and bottled, liquid forms.

The Sofia Exploration No. 1 Roxana State (19) was drilled on the Sierra Grande uplift in Union County and a new carbon dioxide gas field was discovered by that well. Initial potential was 544 thousand ft³ gas per day (MCFGPD) from reservoirs in the Glorieta Sandstone and Yeso Formation (Permian). Development of this new field is scheduled to commence in 1988. Broadhead (1987) discussed the occurrence of carbon dioxide in Union and Harding Counties.

Southwest New Mexico

Four significant exploration wells were drilled in the Baca Basin of southwest New Mexico in 1987. The Black Oil No. 6 Santa Fe Pacific Railroad (20) was drilled with air to a total depth of 680 ft in the Mancos Shale (Cretaceous) and was abandoned. That well had been scheduled originally to be drilled to 1,000 ft to test the Dakota Sandstone (Cretaceous), but it was abandoned after a water-bearing zone was encountered in the Mancos. The Black well is located 4 ft west of the Transocean No. 1 Turner–Santa Fe Pacific Railroad, which was abandoned in 1977 after being drilled to a total depth of 5,220 ft in Precambrian rocks.

Shell Oil Company drilled three exploratory wells in 1987. The Shell Western Exploration & Production No. 1 SWEPI et al. State (21; Fig. 2) was drilled to a total depth of 7,000 ft and was "tight" at the end of 1987. The Shell Western Exploration & Production No. 1 Mangus Mountains Federal (22) drilled to a total depth of 7,700 ft and was "tight" at the end of 1987. Both these wells had been scheduled to reach total depth in Precambrian basement. The Shell Western Exploration & Production No. 1 SWEPI et al. Aspen Federal (35) was "tight" and not completed at the end of 1987. The well was scheduled to drill to a total depth of 9,000 ft in Precambrian rocks. The Shell drilling and exploratory program constitutes the first comprehensive program to evaluate and test the petroleum potential of central Catron County. Primary targets in Catron County are Upper Cretaceous sandstones, the San Andres Formation, Glorieta Sandstone, and sandstones and carbonates in the Yeso Formation (Permian), and Pennsylvanian sandstones and limestones.

No exploration wells were drilled elsewhere in southwest New Mexico in 1987. However, the Paleozoic and Lower Cretaceous sections of the Pedregosa Basin are promising targets (Thompson, 1980, 1981).

Effect of discoveries on oil and gas production

In 1986, New Mexico was the seventh largest producer of crude oil and the fourth largest producer of natural gas in the United States (Energy Information Administration, 1987). Production of crude oil and lease condensate in New Mexico in 1987 was approximately 71.5 million bbls, a decrease of 5.5% from the 75.7 million bbls produced in 1986 (New Mexico Oil Conservation Division data). Production of natural gas in 1987 was approximately 808 billion ft³ (BCF), an increase of 16% from the 693 BCF produced in 1986 (New Mexico Oil Conservation Division data). In 1986, 89% of the state's oil and 56% of the state's gas were produced from the Permian Basin; 11% of the state's oil and 44% of the state's gas were produced from the San Juan Basin. As of December 31, 1986, New Mexico had proved oil reserves of 644 million bbls, a decrease of 44 million bbls from December 31, 1985 (Energy Information Administration, 1987); the Permian Basin contains 92% of the state's oil reserves and the San Juan Basin contains 8% of the state's oil reserves. As of December 31, 1986, New Mexico had natural gas reserves of 12.5 trillion ft³, an increase of 1.1 trillion ft³ from December 31, 1985 (Energy Information Administration, 1987); the Permian Basin contains 24% of the state's gas reserves and the San Juan Basin contains 76% of the state's gas reserves.

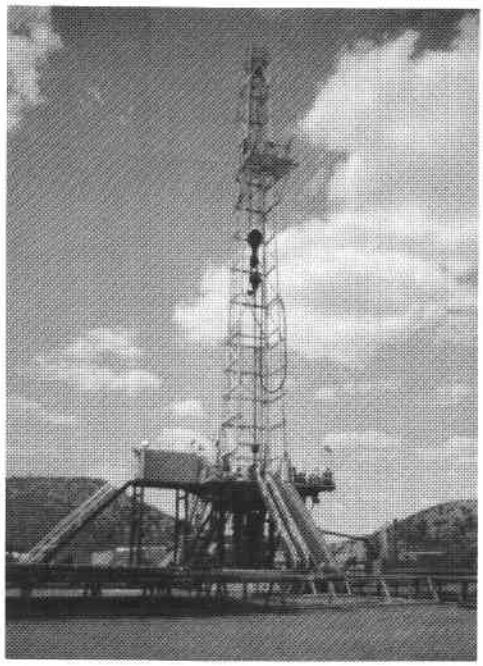

FIGURE 2—Shell No. 1 SWEPI et al. State (Fig. 1, no. 21; Table 2, no. 21) drilling in the Baca Basin, July 1987.

The decrease in oil production in 1987 can be attributed to a decline in the price of oil during 1986 and early 1987. The price of west Texas intermediate crude oil with a gravity of 40° API fell 55% from a high of $27.25/bbl in January 1986 to a low of $12.25/bbl in July 1986 (Fig. 3). The price of west Texas intermediate crude oil subsequently rose to $20/bbl in August 1987 and declined to $18/bbl in December 1987.

The sharp fall in oil prices at the beginning of 1986 was due to a sudden rise in oil production by several major producing countries (notably Great Britain and Latin American and Middle Eastern countries) in an effort to increase income from oil revenues. The rise in oil production created an oversupply of oil and caused prices to plummet. A gradual reduction of world petroleum stocks and partially successful attempts by OPEC nations to reinstate production ceilings caused a subsequent gradual price increase. Because of the decrease in oil prices, many marginal and stripper wells were shut in or plugged, and their production may never be regained unless oil prices increase sufficiently to justify the expense of re-opening such wells. Stripper wells are defined as wells that produce less than 10 bbls oil per day. Approximately 20% of oil production in New Mexico is from stripper wells.

Declining oil prices have also resulted in a decrease in drilling activity, which is reflected in the rig count for the state (Fig. 3). Oil reserves found and developed during the "boom" drilling years of 1980–82 reached peak development in 1983 and 1984. The drilling slump of 1983–85 and the more serious decrease in drilling in 1986 and 1987 led to fewer exploratory and development wells being drilled than in the boom years. As a consequence of decreased drilling, fewer discoveries were made and existing reserves were not developed as quickly as in the past. The inevitable result was decreased production. Oil discoveries made in the last five to six years in the Delaware Mountain Group (Delaware Basin), Bone Spring Formation (Delaware Basin), and the Gallup and Dakota Sandstones (San Juan Basin) provide major new exploration targets and have added new oil reserves and production that have supplanted declining production and reserves of older pools. Continued oil discoveries in the Permian and San Juan Basins will encourage exploratory drilling and development. However, the number of active rotary rigs in New Mexico is tied to the price of oil (Fig. 3). Declines in future reserves and production will probably be halted only if oil prices rise enough to substantially increase the number of active rigs. Until then, exploratory discoveries will not keep pace with production and reserves will decline, unless a major field is discovered by one of the few rigs drilling currently.

The increase in gas production in 1987 was caused by an increased demand for gas, rather than an increased capability to produce gas. Primary markets for New Mexico gas are in California; apparently those markets improved substantially in 1987. Nevertheless, New Mexico gas will continue to face stiff competition in California from fuel oil, hydroelectric power, and imported Canadian gas. Consumption of natural gas is expected to increase slightly during 1988 (Beck, 1988). The long-term demand for gas is also expected to increase (American Gas Association, 1984).

Most of the gas produced in 1986 and 1987 was not replaced by new discoveries. Although calculated gas reserves increased by 1,102 BCF from 1985 to 1986, only 3 BCF were represented by new field discoveries and only 154 BCF were represented by extensions of existing fields (Energy Information Admin-

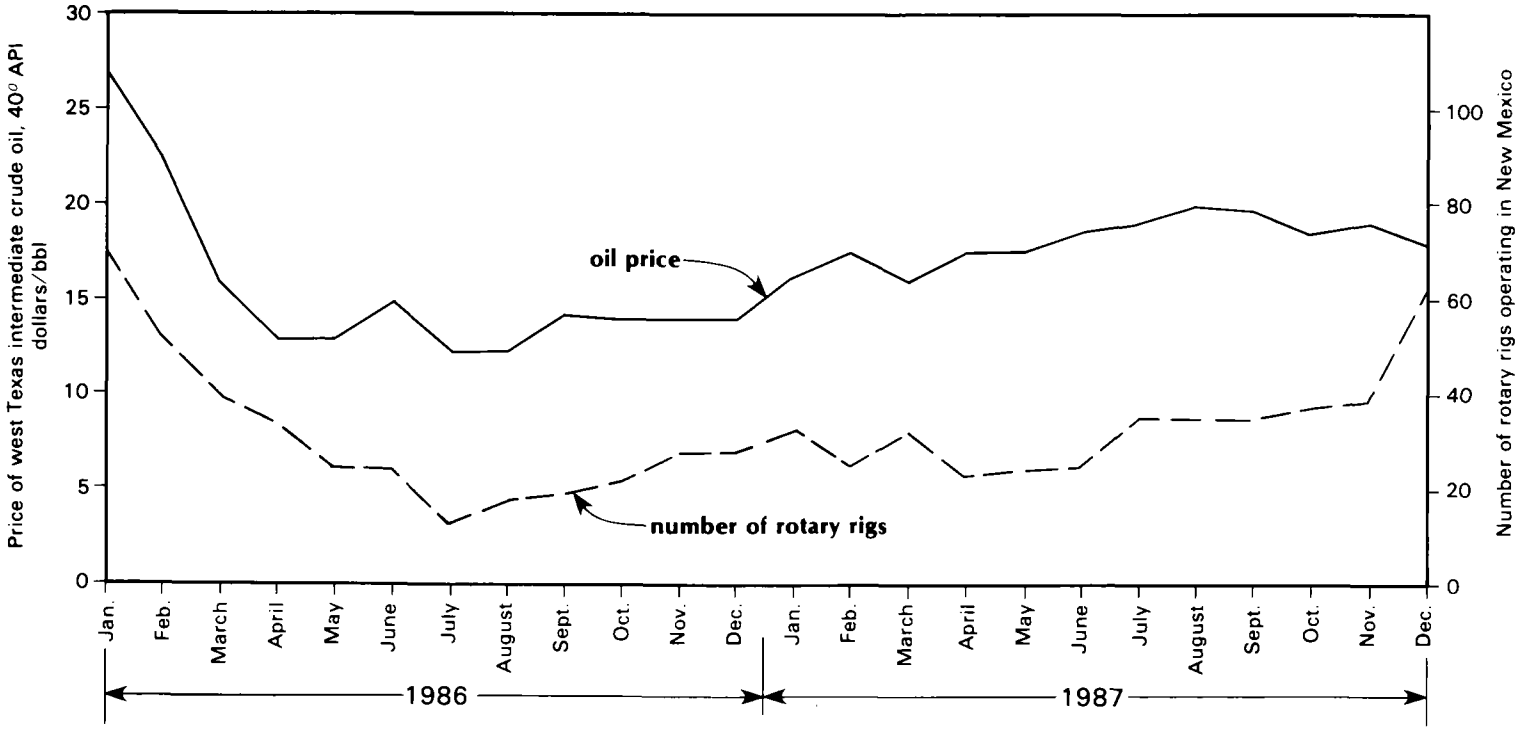

FIGURE 3—Monthly crude oil prices and number of active rotary rigs in New Mexico during 1986 and 1987. Data from Oil and Gas Journal (1986a, b; 1987a, b).

istration, 1987); the remaining calculated increase of 945 BCF was caused by revision of reserve calculations in known fields. Because 1986 production was 677 BCF, real gas reserves actually decreased by 520 BCF during 1986. Generally, only the very best gas prospects, or those gas prospects required to hold leases, were drilled in 1987. The larger, existing gas pools in the San Juan Basin continued to be developed in 1987, but at a slower pace than in previous years. The West Pecos Slope Abo gas pool of northwest Chaves County was the only major gas pool developed aggressively during 1987.

ACKNOWLEDGMENTS—Prentiss Childs of the New Mexico Oil Conservation Division provided the well completion statistics. Robert Bieberman, Frank Kottlowski, Roy Johnson, and Sam Thompson III reviewed the manuscript. Lynne McNeil typed the manuscript and Rebecca Titus drafted the figures.

References

American Gas Association, 1984, The gas energy demand outlook—1984–2000: American Gas Association, Arlington, Virginia, 90 pp.

Beck, R. J., 1988, Production slide and demand growth will moderate during the coming year: Oil and Gas Journal, v. 86, no. 4, pp. 41–43, 46, 48–53.

Black, B. A., 1984a, Hydrocarbon potential of the Española Basin—a progress report: New Mexico Geological Society, Guidebook to 35th field conference, pp. 223–226.

Black, B. A., 1984b, Structural anomalies in the Española Basin: New Mexico Geological Society, Guidebook to 35th field conference, pp. 59–62.

Broadhead, R. F., 1986, Oil and gas discovery wells drilled in New Mexico in 1985: New Mexico Geology, v. 8, no. 2, pp. 36–40.

Broadhead, R. F., 1987, Carbon dioxide in Union and Harding Counties: New Mexico Geological Society, Guidebook to 38th field conference, pp. 339–349.

Broadhead, R. F., and King, W. E., in press, Petroleum geology of Pennsylvanian and Lower Permian strata, Tucumcari Basin, east-central New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 119.

Cather, S. M., and Johnson, B. D., 1984, Eocene tectonics and depositional setting of west-central New Mexico and eastern Arizona: New Mexico Bureau of Mines and Mineral Resources, Circular 192, 33 pp.

Choate, R., Lent, J., and Rightmire, C. T., 1984, Upper Cretaceous geology, coal, and the potential for methane recovery from coal beds in the San Juan Basin—Colorado and New Mexico: American Association of Petroleum Geologists, Studies in Geology Series No. 17, pp. 185–222.

Energy Information Administration, 1987, U.S. crude oil, natural gas, and natural gas liquids reserves, 1986 annual report: U.S. Department of Energy, Energy Information Administration, 1986 annual report, DOE/EIA–0216(86), 103 pp.

Gorman, J. M., and Robeck, R. C., 1946, Geology and asphalt deposits of north-central Guadalupe County, New Mexico: U.S. Geological Survey, Oil and Gas Investigations, Preliminary Map 44.

Kelley, V. C., 1978, Geology of Española Basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Geologic Map 48, scale 1:125,000.

Kinney, E. E. (ed.), 1967, The oil and gas fields of southeastern New Mexico: Roswell Geological Society, 1967 Symposium Supplement, 195 pp.

Kottlowski, F. E., and Stewart, W. J., 1970, The Wolfcampian Joyita uplift in central New Mexico: New Mexico Bureau of Mines and Mineral Resources, Memoir 23, pt. I, pp. 1–31.

Meyer, R. F., 1966, Geology of Pennsylvanian and Wolfcampian rocks in southeast New Mexico: New Mexico Bureau of Mines and Mineral Resources, Memoir 17, 123 pp.

Mickey, V., 1987, High-tech approach to Abo success: Southwest Oil World, v. 36, no. 3, pp. 13–14.

Molenaar, C. M., 1977, Stratigraphy and depositional history of Upper Cretaceous rocks of the San Juan Basin area, with a note on economic resources: New Mexico Geological Society, Guidebook to 28th field conference, pp. 159–166.

Oil and Gas Journal, 1986a, Selected U.S. and world crude prices: Oil and Gas Journal, v. 84, no. 2, p. 85; no. 6, p. 134; no. 10, p. 79; no. 15, p. 146; no. 19, p. 90; no. 23, p. 67; no. 28, p. 120; no. 32, p. 115; no. 36, p. 133; no. 41, p. 97; no. 45, p. 124; no. 49, p. 68.

Oil and Gas Journal, 1986b, Hughes rig count: Oil and Gas Journal, v. 84, no. 2, p. 85; no. 6, p. 134; no. 10, p. 79; no. 15, p. 146; no. 19, p. 90; no. 23, p. 67; no. 28, p. 120; no. 32, p. 115; no. 36, p. 133; no. 41, p. 97; no. 45, p. 124; no. 49, p. 68.

Oil and Gas Journal, 1987a, Selected U.S. and world crude prices: Oil and Gas Journal, v. 85, no. 2, p. 83; no. 6, p. 54; no. 10, p. 53; no. 15, p. 75; no. 19, p. 78; no. 23, p. 77; no. 28, p. 99; no. 32, p. 85; no. 37, p. 83; no. 41, p. 103; no. 45, p. 98; no. 49, p. 92.

Oil and Gas Journal, 1987b, Hughes rig count: Oil and Gas Journal, v. 85, no. 2, p. 83; no. 6, p. 54; no. 10, p. 53; no. 15, p. 75; no. 19, p. 78; no. 23, p. 77; no. 28, p. 99; no. 32, p. 85; no. 37, p. 83; no. 41, p. 103; no. 45, p. 98; no. 49, p. 92.

Speer, W. R., 1976, Oil and gas exploration in the Raton Basin: New Mexico Geological Society, Guidebook to 27th field conference, pp. 217–226.

Stone, W. J., Lyford, F. P., Frenzel, P. F., Mizell, N. H., and Padgett, E. T., 1983, Hydrogeology and water resources of San Juan Basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Hydrologic Report 6, 70 pp.

Thompson, S., III, 1980, Pedregosa Basin's main exploration target is Pennsylvanian dolostone: Oil and Gas Journal, v. 78, no. 42, pp. 202, 207, 210, 215.

Thompson, S., III, 1981, Petroleum source rocks in exploration wells drilled to Paleozoic or Mesozoic units, Hidalgo and Grant Counties, New Mexico: New Mexico Energy Institute, Report EMD–2–66–3306, 120 pp.

Thompson, S., III, and Jacka, A. D., 1981, Pennsylvanian stratigraphy, petrography, and petroleum geology of the Big Hatchet Peak section, Hidalgo County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Circular 176, 125 pp.

Woodward, L. A., 1987, Oil and gas potential of the Raton Basin, New Mexico: New Mexico Geological Society, Guidebook to 38th field conference, pp. 331–338.

Woodward, L. A., Callender, J. F., Seager, W. R., Chapin, C. E., Gries, J. C., Shaffer, W. L., and Zilinski, R. E., 1978, Tectonic map of Rio Grande rift region in New Mexico, Chihuahua, and Texas; *in* Hawley, J. W. (compiler), Guidebook to Rio Grande rift in New Mexico and Colorado: New Mexico Bureau of Mines and Mineral Resources, Circular 163, sheet 2. □