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HORIZONTAL DRILLING AT VACUUM GLORIETA WEST UNIT, LEA COUNTY, NEW MEXICO: A CASE HISTORY

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EXTENDED ABSTRACT

Texaco Exploration and Production, Inc. put a horizontal initiative into place in mid 1997 at the Vacuum Glorieta West Unit (VGWU), Lea County, New Mexico. The purpose of the project was to: 1) add reserves that could not be produced by way of conventional methods; 2) increase daily oil production; 3) reduce the amount of produced water. VGWU is located approximately 22 miles northwest of Hobbs, New Mexico in central Lea County on the Northwest Shelf of the Delaware Basin (Figure 1). Extensive drilling in the area began with the initial 1929 discovery of the Vacuum Field, which was a San Andres completion in the Socony Vacuum Oil Company's Bridges State #1. Development continued in this field and deeper pay zones were discovered. It wasn't until January 11, 1963 that the Vacuum Glorieta Pool was discovered by Texaco's New Mexico "O" State NCT-1 #12 (Figure 2). Drilled to a total depth of 6920' it was completed for an initial flowing potential of 82 BO in 8 hours (264 BOPD) from perforations at 5945' to 5949'. Although it was called the Vacuum Glorieta Pool, the completed interval was actually in the Paddock member of the Yeso Formation. The New Mexico Oil Conservation Commission in Hobbs designated the Vacuum Glorieta Pool as starting at the top of the Glorieta and ending at the top of the Blinebry (Figure 3). Rapid development extended the field to the north and east after the initial discovery.

VGWU is geologically located on the western edge of the Vacuum High, which is an asymmetric north to northeast anticline. During Permian time the Leonardian age rocks were deposited on broad shelves and in lagoons that formed behind the extensive reefs that rimmed much of the Delaware Basin in southeastern New Mexico. In the southern half of VGWU the Upper Paddock is limestone composed of fine- to coarse-grained, oolitic-peloidal grainstones. The grainstones are crossbedded and contain many small anhydrite laths as described by Burnham, 1991. It is the oolitic-peloidal grainstone limestone that is the target of horizontal drilling at VGWU. This limestone is present only in the southern half of VGWU, which is where the oolite grainstones shoals are found (Figure 4). It is the ooid grainstone that has not been dolomitized and has well preserved oomoldic with minor intercrystalline porosity. Figure 5 is a schematic block diagram of the Paddock depositional environment from Burnham, 1991 and Figure 6 is a type log with the Upper Paddock limestone present.

Waterflood operations began in 1992 with the infill drilling of injectors. Response of the waterflood was less than 50% of the predicted response due to rapid water breakthrough. This early water breakthrough is thought to be due to the highly fractured Lower Paddock dolomite taking most of the injected water. Water injection profiles of several wells indicated water was preferentially injecting into the Lower Paddock and not into the Upper Paddock limestone. This oolitic limestone in the Upper Paddock was not being properly drained by the waterflood, therefore, a considerable amount of oil was being left in the Upper Paddock reservoir. It is for this reason the Upper Paddock was targeted as a horizontal candidate. By setting a cast iron bridge plug above the existing perfs and drilling a ±90-degree horizontal well within the selective limestone interval, ranging in thickness from 7-30 feet, oil not being swept by the waterflood as well as additional reserves can be recovered more efficiently than a conventional vertical wellbore (Figure 7).

In July 1997, the VGWU #86 was selected as the first Upper Paddock limestone test and a 1024' lateral was drilled. Communication between the geologist and the field during drilling was very critical because any change of lithology or drill rate would dictate a vertical change in the well path direction. If silt and sand began to show up in the samples, the lateral was getting too high. If the drill rate slowed down significantly and there was a reduction in limestone porosity, the lateral was too low. Before recompletion of VGWU #88, production was 14 BOPD, 12 MCFGPD, and 471 BWPD. The horizontal recompletion production was 491 BOPD, 72 MCFGPD, and 794 BWPD. Within 16 days production averaged around 82 BO and 258 BW per day. A 20,000 gallon 15% HCL acid job was put into the lateral using coiled tubing. Production increased to 608 BO and 828 BW per day. The 60-day test after acid was 248 BO and 613 BW per day. In 1997 eight additional wells were drilled (Figure 8).

A total of 31 laterals (24 producers and 7 injectors) have been drilled and completed to date in existing wellbores, where each lateral (1000ft.-1800ft. in length) was typically drilled out of 5½" casing at an average cost of $305,000 per well. Performance from these horizontal wells has been better than expected with incremental production rates ranging from 50 BOPD to 700 BOPD. Cumulative incremental production attributed to horizontal drilling through August 2001 is 1.2 million barrels of oil and the ultimate incremental production is expected to be 2.6 million barrels of oil (Figure 9).

REFERENCE

Burnham, Dan E., 1991, Depositional Environments and Facies Distribution of the Permian Paddock Member of the Yeso Formation, Vacuum (Glorieta) Field, Lea County, New Mexico: University of Texas of the Permian Basin Masters Thesis.

Figure 1. VGWU Field location and associated geologic features.

Figure 2. Map of VGWU showing current producing and injection wells. Discovery well for the "Vacuum Glorieta Pool" is also noted.

Figure 3. Stratigraphic column for the VGWU area with the unitized interval highlighted.

Figure 4. Top of Paddock Structure Map showing presence of oolitic limestone in southern half of VGWU.

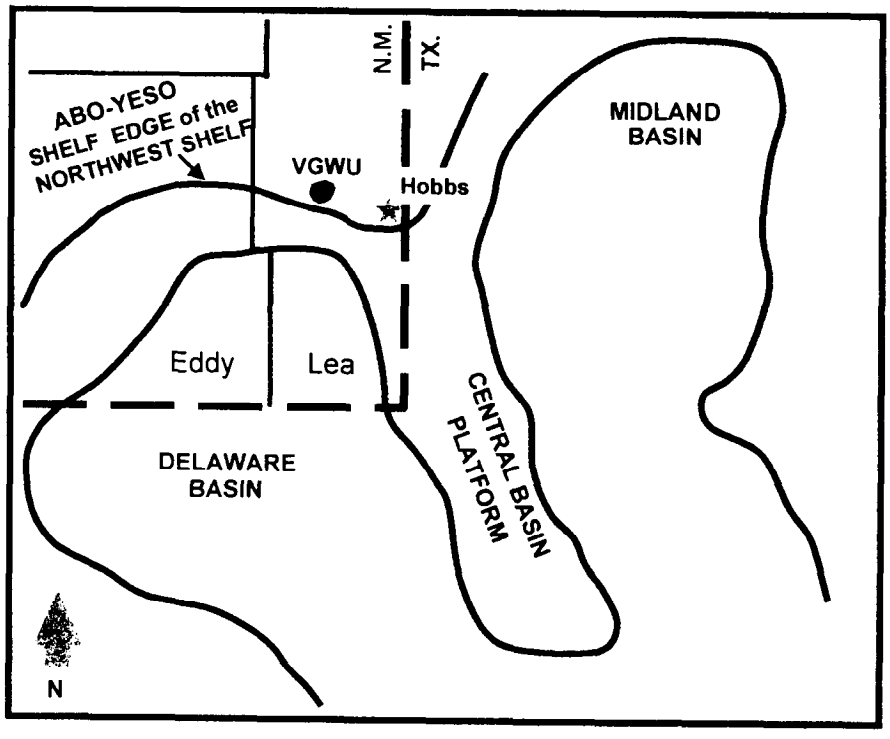
Figure 5. Schematic Block Diagram of the Paddock depositional environment, from Burnham 1991.

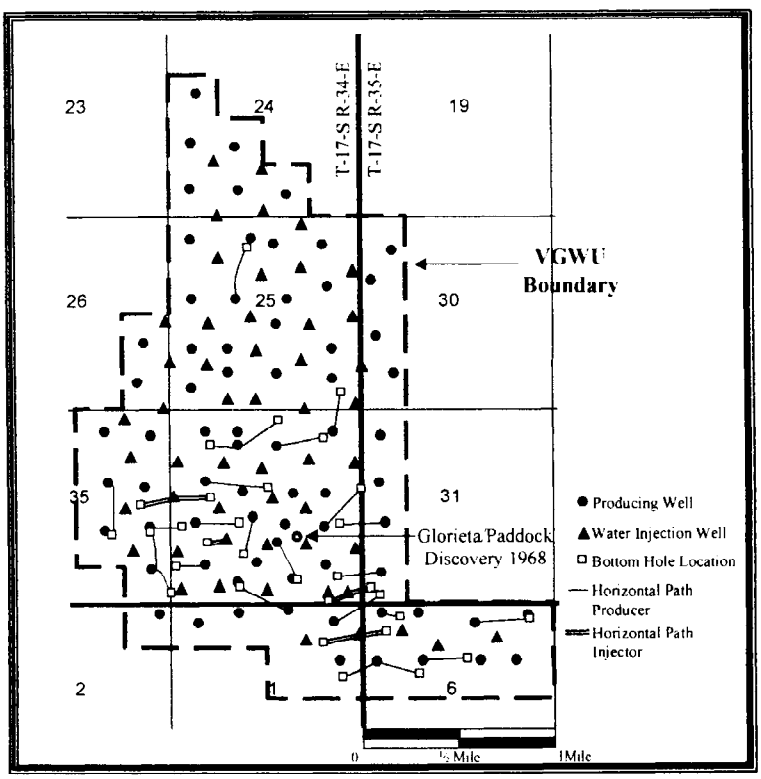
Figure 6. Type log of VGWU with Upper Paddock limestone present.

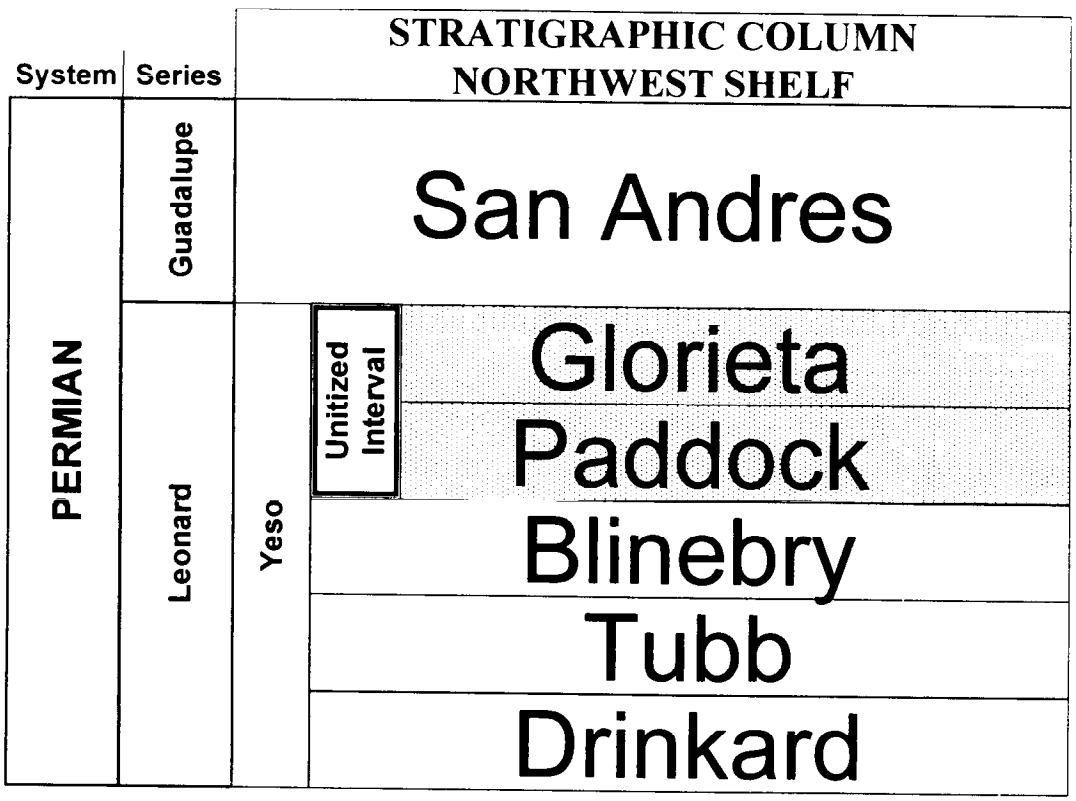
Figure 7. Diagram of procedure used to set a CIBP above perfs in vertical wellbore and drill a lateral into the high porosity Upper Paddock limestone.

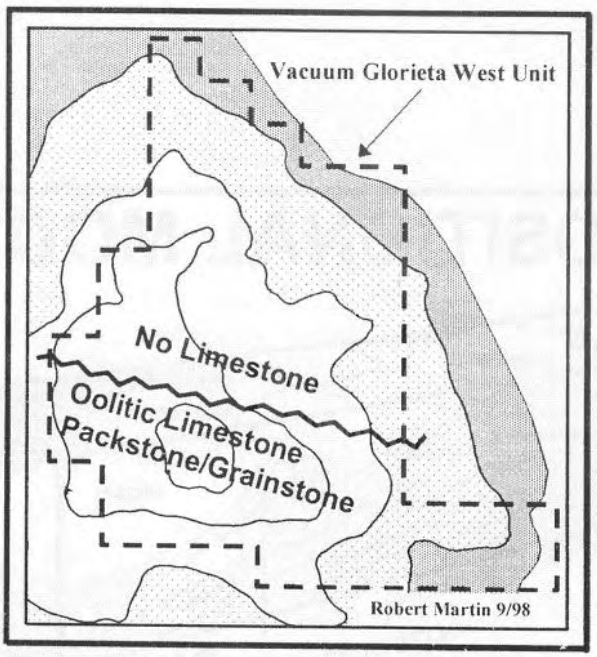
Figure 8. Spreadsheet of first 9 horizontal wells drilled at VGWU and the results from each phase of completion.

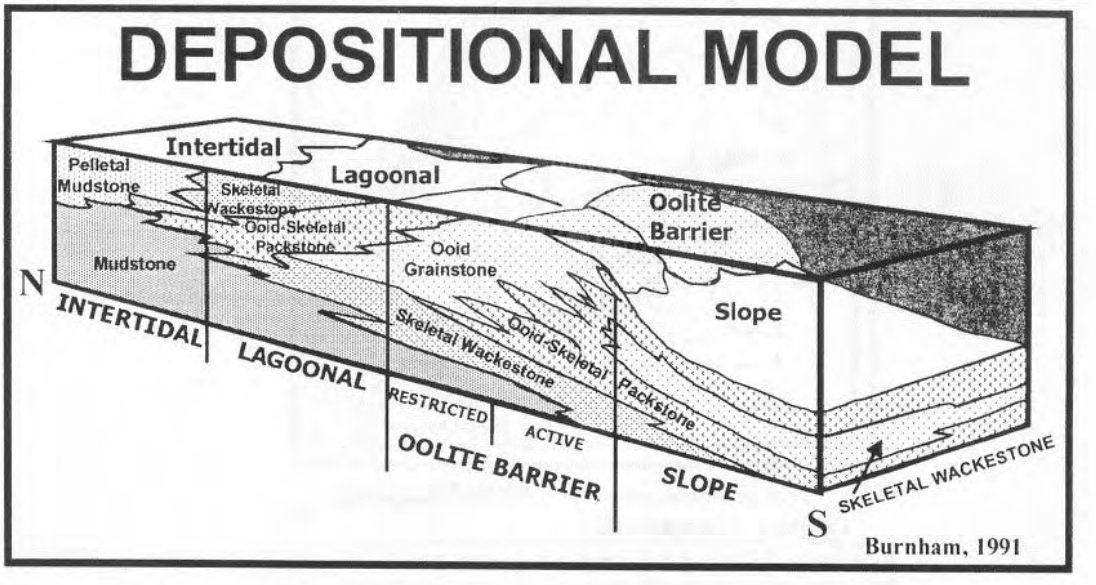
Figure 9. Graph of VGWU daily production showing estimated total incremental barrels of oil to be recovered in shaded area due to horizontal production.


N.M.
TX.
ABO-YESO
SHELF EDGE of the
NORTHWEST SHELF
VGWU
Hobbs
MIDLAND
BASIN
Eddy
Lea
CENTRAL BASIN
PLATFORM
DELAWARE
BASIN
N

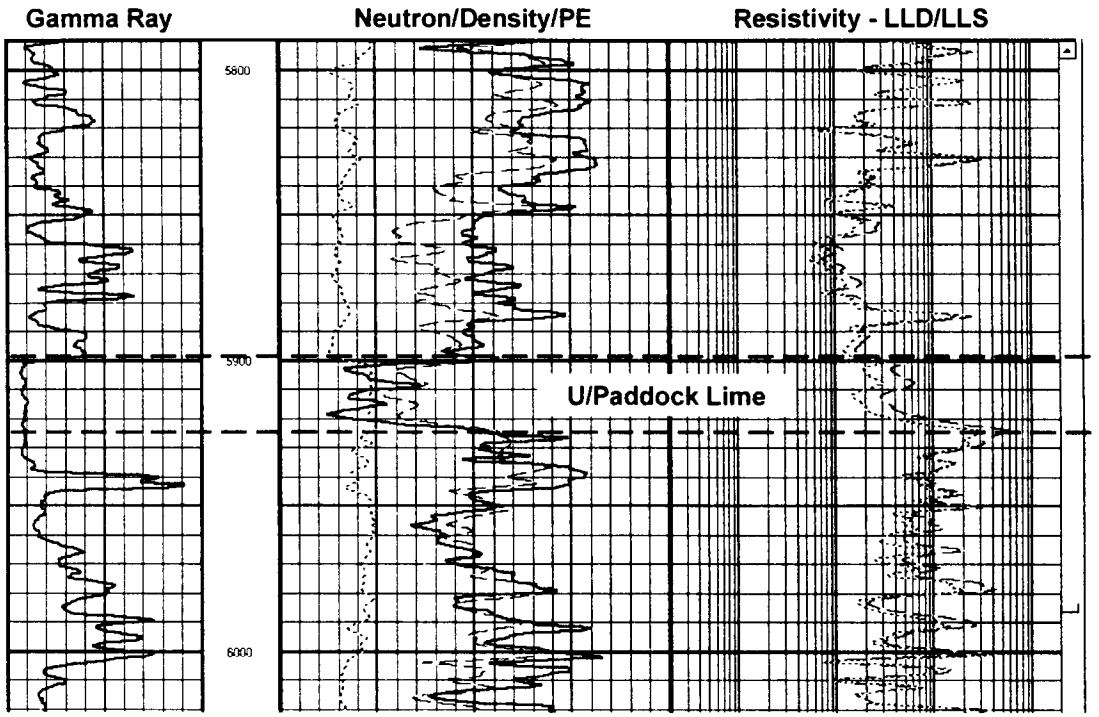

23
24
19
T-17-S R-34-E
T-17-S R-35-E
VGWU
Boundary
26
25
30
35
31
Glorieta Paddock
Discovery 1968
2
1
6
Producing Well
Water Injection Well
Bottom Hole Location
Horizontal Path
Producer
Horizontal Path
Injector
0
½ Mile
1Mile

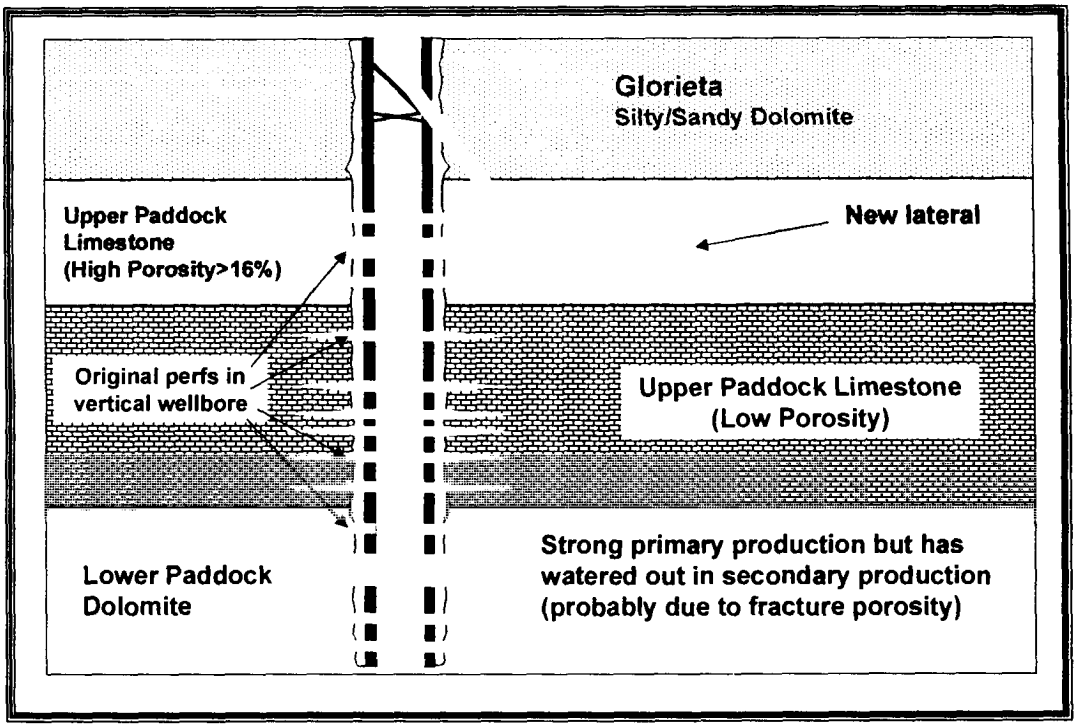

System
Series
STRATIGRAPHIC COLUMN
NORTHWEST SHELF
PERMIAN
Guadalupe
San Andres
Leonard
Yeso
Unitized Interval
Glorieta
Paddock
Blinebry
Tubb
Drinkard


Vacuum Glorieta West Unit
No Limestone
Oolitic Limestone
Packstone/Grainstone
Robert Martin 9/98
Top of Paddock
Contour Interval = 50'
0
½ Mile
1Mile
- 2100
- 2050
- 2000
- 1950
- 1900

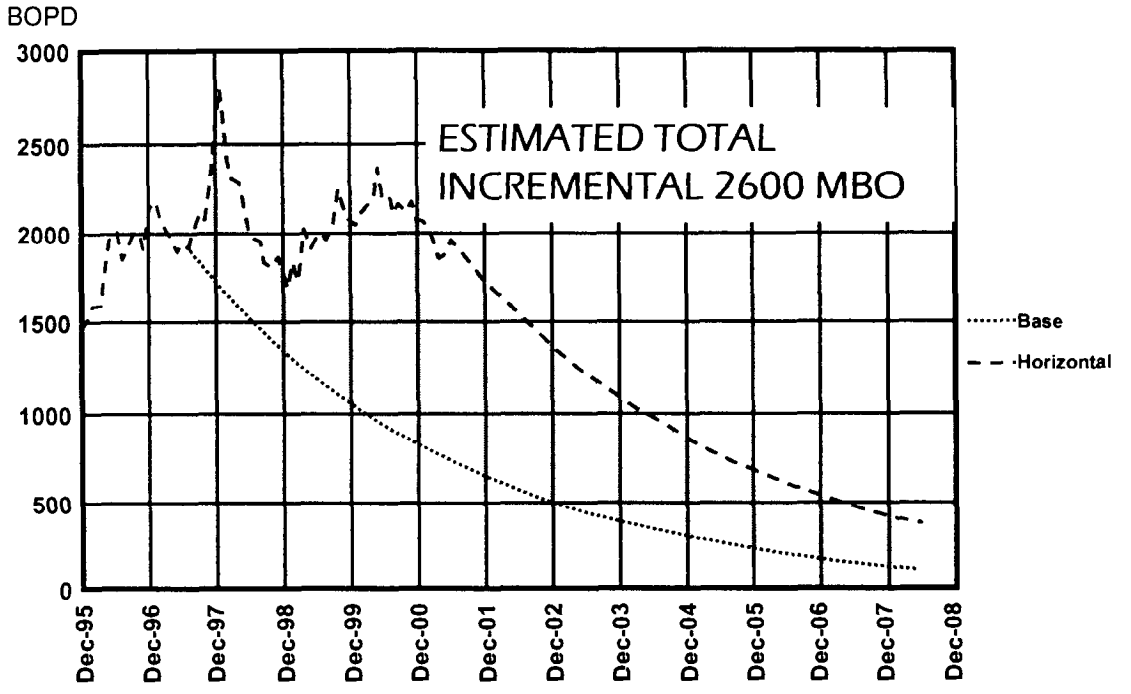

DEPOSITIONAL MODEL
Intertidal
Lagoonal
Oolite Barrier
Pelletal Mudstone
Skeletal Wackestone
Ooid-Skeletal Packstone
Mudstone
Ooid Grainstone
Slope
N
INTERTIDAL
LAGOONAL
Skeletal Wackestone
Ooid-Skeletal Packstone
RESTRICTED
ACTIVE
OOLITE BARRIER
SLOPE
SKELETAL WACKESTONE
S
Burnham, 1991

VGWU #79


Gamma Ray
Neutron/Density/PE
Resistivity - LLD/LLS
5800
5900
6000
U/Paddock Lime


Glorieta
Silty/Sandy Dolomite
Upper Paddock Limestone (High Porosity>16%)
New lateral
Original perfs in vertical wellbore
Upper Paddock Limestone (Low Porosity)
Lower Paddock Dolomite
Strong primary production but has watered out in secondary production (probably due to fracture porosity)

WELL	TEST PRIOR TO DRILL		TEST AFTER DRILL		TEST PRIOR TO ACID		TEST AFTER ACID		30 DAY TEST AFTER ACID		60 DAY TEST AFTER ACID	
86	14	471	179	342	81	253	608	828	228	624	248	613
88	147	3815	887	269	395	381	794	830	527	847	484	843
118	83	785	0	0	0	0	394	635	111	464	98	360
23	0	0	21	2126	SI		23	1138	24	1084	23	1104
70	7	246	97	526	67	448	358	201	173	997	138	937
114	45	1471	505	391	94	239	276	1174	130	1098	174	1112
115	99	1826	446	193	195	241	801	318	219	209	265	325
89	50	333	64	798	52	496	99	1298	44	1352	37	1267
103	20	115	603	190	113	99	1006	243	172	115	190	197
TOTAL	**465**	**9063**	**2802**	**4835**	**997**	**2158**	**4359**	**6666**	**1627**	**6790**	**1657**	**6758**


BOPD
3000
2500
2000
1500
1000
500
0
ESTIMATED TOTAL
INCREMENTAL 2600 MBO
Base
Horizontal
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08