PETROLOGIC INVESTIGATION OF THE
GALLUP FORMATION IN THE
MALLON OIL COMPANY
DAVIS FEDERAL 3-15
RIO ARRIBA COUNTY, NEW MEXICO

TerraTek

RESERVOIR POTENTIAL AND SENSITIVITY

The lack of matrix porosity in the sandstones of the Gallup Formation indicates that production from the cored interval must come from the large, open or partially filled fractures that characterize this zone. Some additional production could certainly result from the abundant microfractures revealed by fluorescence microscopy, although the influence of these fractures may be minimal under reservoir conditions. As is the case with many Cretaceous reservoirs, other locations may encounter these Gallup sandstones where carbonate cementation is not quite so pervasive. Unfortunately, we do not have the means to make any accurate predictions at this time.

Reservoir treatment with strong acid is not recommended under most circumstances. Iron-rich carbonates, pyrite, and glauconite could react with the acid, and if the acid is allowed to "spend" itself chemically, insoluble iron hydroxide gels could precipitate in existing pores and fractures. If acid is used for clean-up purposes only, the acid should be circulated out of the borehole while still in a somewhat concentrated state. Iron hydroxides should not form under these circumstances.

In spite of relatively large amounts of expandable illite/smectite occuring in the sandstone reservoir, much of that clay seems protected by abundant kerogen coatings and might not react with fresh water drilling fluids. Nonetheless, Terra Tek can perform a simple, inexpensive test to determine the degree of water sensitivity. We do recommend that Mallon Oil pursue this procedure if fresh muds are being used. Otherwise, KCl drilling fluid is preferred.

If hydraulic fracturing is a common completion procedure in this area, liberation of clay material might present a problem. This migration of fines often results in pore bridging clays finding their final resting place in pore throats or packs, thereby reducing permeability. If fracturing is performed in the

GEOLOGIC   CONCLUSIONS

1.   Structural mapping and cross-sections indicate the three primary structural elements - the Gavilan "nose", syncline, and monocline - in the Pool are genetically related and behave as a single, unified structural entity.

2.   Dip rates along the east side of the Unit range from 2 to 6 degrees, while dips throughout most of the Unit and Gavilan are generally less than 1.5 degrees. With the exception of the crest of the Gavilan nose and the bottom of the syncline, nonzero dips exist throughout the Pool area.

3.   The (Laramide) tectonic forces responsible for the development of the "nose", syncline, and monocline are also responsible for the development of a pool-wide fracture system.

4.   Landsat and photogeologic interpretations show a widespread distribution of multi-directional fractures: a conjugate system oriented NW-SE and NE-SW, and regional fractures at oblique angles to the conjugate set. No one fracture direction dominates or results in a barrier to flow.

5.   A representative induction log cross-section through sixteen wells depicts the pronounced stratigraphic uniformity in the Niobrara producing intervals across the Pool.

6.   Core photographs and descriptions of fractures and lithology identified several discrete, highly-laminated and thin-bedded intervals in the Niobrara "B" which are preferentially fractured relative to adjacent units. These highly anisotropic

and brittle zones range from 2 to 20 feet in thickness, are generally encased in more massive (plastic) lithologies, and behave, despite extreme vertical and horizontal heterogeneity, as a single, reservoir response unit.

7.   Although a multi-directional fracture distribution similar to that observed on the surface exists at reservoir depths, the plastic, healing nature of the massive lithologies encasing the brittle zones has created a series of discrete reservoir intervals behaving in a highly-compartmentalized and stratified fashion.

8.   Core photomicrographs show that reservoir storage capacity and permeability derives from a system of large open fractures fed by a network of microfractures. The photos suggest the reason why oil saturations and minor fluorescence occur in certain plug samples: oil migrating through open fractures resulted in minor saturations along grain contacts adjacent to the fractures.

9.   Analyzed porosities and permeabilities in the core indicate a distinct lack of matrix contribution to production.

CAVILAN MANCOS POOL AREA
Rio Arriba County, New Mexico

OPERATOR/WELL NAME	LOCATION U-S-T-R	COMPLETION DATE	12/86 PRODUCTION BOPD	MCFD	GOR	DAYS	CUMULATIVE MBO	CUMULATIVE 01/01/87 MMCF
Amoco Production Co.								
Oso Canyon Fed #1	E 24-24N-2W	12/10/84	0	0	-	0	1.6	NR
Oso Canyon Fed A-1	F 14-24N-2W	02/03/85	0	0	-	0	0	0
Oso Canyon Fed B-1	F 11-24N-2W	02/05/85	0	0	-	0	2.2	NR
Oso Cny Gas Com C-1	F 15-24N-2W	Location	-	-	-	-	-	-
Siefert Gas Com #1	D 22-26N-2W	Completing	-	-	-	-	-	-
SUBTOTAL			0	0		0	3.8	0
Dugan Production Corp.								
Divide #1	H 35-26N-2W	05/13/83	1	6	9307a	8	0.1	0.1
Divide #2	P 35-26N-2W	Location	-	-	-	-	-	-
Divide #3	K 35-26N-2W	12/26/86	26	38	1465	6	0.2	0.2
Lindrith #1	O 36-35N-2W	11/19/84	8	58	7142a		5.3	30.7
Tapacitos #2	L 25-26N-2W	10/30/80	16	90	5714	31	27.0	24.5
Tapacitos #3	D 36-26N-2W	Location	-	-	-	-	-	-
Tapacitos #4	O 36-26N-2W	03/01/86	153	105	692	29	25.9	17.4
Wendy #1	A 26-26N-2W	Location	-	-	-	-	-	-
SUBTOTAL			204	297	1456		58.4	73.0
Mallon Oil								
Davis Fed Com 3-15	O 3-25N-2W	01/03/87	-	-	-	-	-	-
Fisher Fed 2-1	A 2-25N-2W	06/17/85	302	320	1061	31	141.3	116.7
Howard Fed 1-8	H 1-25N-2W	07/18/85	242	768	3172	22	177.6	167.9
Howard Fed 1-11	K 1-25N-2W	11/18/85	264	1073	4063	22	123.6	213.8
Johnson Fed 12-5	F 12-25N-2W	10/24/85	82	393	4817	30	22.0	70.7
Post Fed 13-6	F 13-25N-2W	03/18/86	91	108	1190	30	17.2	29.4
Ribeyowids Fed 2-16	P 2-25N-2W	02/11/85	88	270	3077	31	72.9	78.9
SUBTOTAL			1069	2932	2743		504.6	677.4

GAVILAN MANCOS POOL AREA
Rio Arriba County, New Mexico
12/86 PRODUCTION

OPERATOR/WELL NAME	LOCATION U-S-T-R	COMPLETION DATE	BOPD	MCFD	GOR	DAYS	CUMULATIVE 01/01/8 MBO	MMC
Jerome P. McHugh								
Beek's Babbitt #1	G 17-25N-2W	10/15/85	158	187	1181	24	3.8	4.5
Boyt & Lola #1	I 11-24N-2W	12/03/84	2	8	3623	31	5.1	29.8
Boyt & Lola #2	D 12-24N-2W	01/10/85	5	11	2258	31	9.9	17.6
Continental Divide #1	B 12-25N-2W	Location	–	–	–	–	–	–
Dewey Bartlett #1	1 4-25N-2W	03/11/87	–	–	–	–	–	–
Dr. Daddy-0 #1	C 33-25N-2W	05/16/85	91	113	1246	31	10.0	15.4
E. T. #1	C 28-25N-2W	09/19/83	33	456	13708	20	95.7	100.4
Four O's #1	C 19-25N-2W	Location	–	–	–	–	–	–
Full Sail #1	O 29-25N-2W	06/15/84	81	167	2055	31	123.4	127.9
Full Sail #2	I 28-25N-2W	05/24/85	34	519	6330	13	12.9	49.3
Full Sail #3	F 29-25N-2W	11/01/85	20	122	6093	29	6.2	22.3
Full Sail #4	Lot 3 30-25N-2W	Completing	–	–	–	–	–	–
Greener Grass #1	J 10-24N-2W	08/20/85	95	31	329	31	17.0	5.6
High Adventure #1	H 8-25N-2W	Completing	–	–	–	–	–	–
High Adventure #2	M 9-25N-2W	02/11/87	–	–	–	–	–	–
Homestead Ranch #2	N 34-25N-2W	05/16/85	281	423	1506	14	122.0	83.9
Janet #1	A 27-25N-2W	02/17/83	32	378	11829	20	132.9	126.4
Janet #2	I 21-25N-2W	09/01/83	77	441	5767	15	125.2	154.3
Janet #3	E 21-25N-2W	12/18/85	70	172	2448	31	14.5	12.2
Lady Luck #1	Lot 3 30-25N-2W	02/21/86	0	0	–	0	3.9	3.8
Loddy #1	A 5-24N-2W	08/30/85	75	288	3821	16	1.4	4.7
Mother Lode #1	F 20-25N-2W	09/02/83	57	233	4060	27	163.6	166.8
Mother Lode #2	H 3-24N-2W	01/23/86	109	366	3353	18	13.1	19.0
Native Son #1	K 3-24N-2W	06/07/84	154	234	1515	21	226.8	84.6
Native Son #2	A 34-25N-2W	11/18/83	279	988	3549	6	356.7	471.8
Native Son #3	N 27-25N-2W	02/21/85	98	912	9353	8	18.5	55.5
New Horizon #1	I 33-25N-2W	10/01/85	7	28	4005	31	2.2	7.0
Ralphie Tigger #1	O 2-24N-2W	Location	–	–	–	–	–	–
Tapacitos Canyon #1	E 27-26N-2W	Completing	–	–	–	–	–	–
Twilight Zone #1	O 4-26N-2W	01/21/85	4	14	3150a	14	2.2	5.2
Wildfire #1	J 12-24N-2W	Completing	–	–	–	–	–	–
Wright Way #1	N 26-26N-2W / C 2-24N-2W	09/29/83	44	69	1580	31	105.6	86.5
SUBTOTAL			1806	6160	3411	–	1572.6	1654.5

GAVILAN MANCOS POOL AREA
Rio Arriba County, New Mexico

OPERATOR/WELL NAME	LOCATION U-S-T-R	COMPLETION DATE	12/86 PRODUCTION BOPD	MCFD	GOR	DAYS	CUMULATIVE 01/01/8 MBO	MMC
Meridian Oil Company								
Hawk Federal #2	C 35-25N-2W	03/25/84	110	389	3543	20	86.1	221.0
Hawk Federal #3	K 35-25N-2W	01/03/85	143	186	2113	29	139.5	186.3
Hill Federal #1	F 24-25N-2W	09/17/85	26	916	35922	24	7.2	62.4
Hill Federal #2Y	G 25-25N-2W	01/10/86	86	237	2765	26	4.6	13.5
Hill Federal #3	D 36-25N-2W	01/09/86	97	91	937	31	9.1	6.6
SUBTOTAL			462	1819	3937	130	246.5	489.8
Merrion Oil and Gas								
Krystina #1	K 14-24N-2W	01/07/85	0	0	–	0	4.9	20.9
Oso Canyon Gas Com C-1	F 13-24N-2W	01/11/85	0	0	–	0	2.1	6.2
Rocky Mountain #1	N 24-24N-2W	01/22/85	0	0	–	0	1.3	12.5
SUBTOTAL			0	0	0	0	8.3	39.6
Mesa Grande Resources								
Bearcat #1	O 22-25N-2W	04/21/86	87	239	2754	27	15.0	35.9
Brown #1	N 17-25N-2W	03/20/85	59	438	7492	20	26.4	49.7
Gavilan #1	A 26-25N-2W	03/21/82	24	358	15203	13	84.3	549.7
*Gavilan #2	J 26-25N-2W	02/14/85	3	130	38381	31	1.7	47.9
Gavilan #3	E 26-25N-2W	07/23/83	21	137	6448	30	34.7	258.1
Gavilan-Howard #1	F 23-25N-2W	04/23/84	55	494	9016	18	90.5	455.5
Hatley Hawkeye #1	J 23-25N-2W	Location	–	–	–	–	–	–
Hellcat #1	F 22-25N-2W	10/19/85	24	219	9124	30	4.2	28.1
Invader Fed #1	D 1-24N-2W	05/04/86	0	0	–	0	1.1	2.3
Intruder #1	I 20-25N-2W	Location	–	–	–	–	–	–
Marauder #1	N 8-25N-2W	04/17/86	80	310	3859	??	7.2	25.7
Phantom #1	M 16-25N-2W	Location	–	–	–	–	–	–
Prowler #2	B 5-25N-2W	Location	–	–	–	–	–	–
Rucker Lake #2	K 24-25N-2W	08/26/83	85	283	3339	31	129.0	147.6
Rucker Lake #3	L 25-25N-2W	08/10/83	88	101	1147	31	109.7	108.8
SUBTOTAL			523	2579	4931		519.8	1643.7

*Operated by E. Alex Phillips of Mesa Grande Resources

GAVILAN MANCOS POOL AREA
Rio Arriba County, New Mexico

OPERATOR/WELL NAME	LOCATION U-S-T-R	COMPLETION DATE	12/86 PRODUCTION				CUMULATIVE 01/01/8_	
			BOPD	MCFD	GOR	DAYS	MBO	MMC_
Mobil Oil Corp.								
Lindrith B Unit 34	G 32-25N-2W	01/29/86	93	298	3188	25	18.4	57.8
Lindrith B Unit 37	G 4-24N-2W	01/29/86	43	314	7269	31	23.9	64.8
Lindrith B Unit 38	K 4-24N-2W	06/03/86	19	172	8935	23	4.6	43.0
Lindrith B Unit 72	A 8-24N-2W	Completing	-	-	-	-	-	-
Lindrith B Unit 73	A 6-24N-2W	Completing	-	-	-	-	-	-
Lindrith B Unit 74	A 9-24N-2W	Completing	-	-	-	-	-	-
SUBTOTAL			155	784	5058		46.9	165.6
Reading and Bates								
Davis Federal 24-10	N 10-25N-2W	Location	-	-	-	-	-	-
Green Lee Fed 41-24	A 24-25N-3W	Location	-	-	-	-	-	-
Howard Fed 43-15	I 15-25N-2W	03/04/86	14	383	28248	30	1.6	11.5
Ingram Fed 34-16	I 16-25N-2W	Location	-	-	-	-	-	-
Sherman Fed 22-34	F 34-26N-2W	Location	-	-	-	-	-	-
SUBTOTAL			14	383	28248	-	1.6	11.5
TOTAL GAVILAN POOL AREA			3163	10377	3281	-	2964.5	4804.0

Notes: a = Well producing during 12/86, but rates not representative. Rate indicated is from a representative month.

MANCOS POOL

Reservoir Simulation Study

ASSUMPTIONS

RESERVOIR CONDITIONS AND PROPERTIES

° Initial Pressure	1534 psia	@ +370'
° Initial Saturation Pressure	1534 psia	(C.O.U. L-11)
° Temperature	162° F	
° Porosity	1.0%±	
° Net Pay	2-30' Zones	(1 zone Modeled)
° Initial Water Saturation	10%	
° Irreducible Water Saturation	10%	
° Residual Oil Saturation	10%	
° Critical Gas Saturation	1.0%	
° OOIP	3000 STB/acre	(BMG Calculation, Others)
° Rock Compressibility	10×10^{-6} 1/psi	
	(Gavilan Tech. Comm., Mobil Lindrith B Unit #38)	
° Relative Permeability	See Exhibit 3	
° Permeability	10 Darcy-Feet (BMG, Sun Calculations)	

FLUID PROPERTIES

Oil

° Obtained from C.O.U. L-11)	See Exhibit 4
° Initial Saturation Pressure	1534 psia
° Initial FVF	1.297
° Initial Solution Gas-Oil Ratio	478 SCF/STB

Water

° Density	1.021 gm/cc
° FVF	1.021
° Viscosity	0.44 CP
° Compressiblity	3.2×10^{-6} 1/psi

Exhibit 2