BENSON-MONTIN-GREER DRILLING CORP.

EXHIBITS IN CASE NO. 4067
BEFORE THE
NEW MEXICO OIL CONSERVATION
COMMISSION

March 5, 1969

INDEX

REFERENCES

1. B-M-G, "METHODS OF INTERPRETATION OF PRESSURE BEHAVIOR IN THE OIL PRODUCING FRACTURED SHALE RESERVOIRS OF THE PUERTO CHIQUITO POOL, RIO ARRIBA COUNTY, NEW MEXICO November 1, 1966", Pages 23 - 28 and Figures 9, 10, 11 and 12.

2. MUSKAT, "PHYSICAL PRINCIPLES OF OIL PRODUCTION", Pages 485 - 486.

3. MUSKAT, "PHYSICAL PRINCIPLES OF OIL PRODUCTION", Page 887.

4. MUSKAT, "PHYSICAL PRINCIPLES OF OIL PRODUCTION", Page 487, Equation 2.

5. "METHODS OF INTERPRETATION etc." (see Reference 1).

6. "METHODS OF INTERPRETATION etc." (see Reference 1), Page 12, 20, Figure 30, Figure 6.

7. "METHODS OF INTERPRETATION etc." (See Reference 1), Page 40.

8. "METHODS OF INTERPRETATION etc." (see Reference 1), Reference 18.

9. "METHODS OF INTERPRETATION etc." (see Reference 1), Page 28.

GEOLOGICAL BASIS FOR DETERMINING AREA OF EXPLORATION

Two criteria form the basis for the determination of the subject exploratory area. These are:

1. Adequate development of a zone within the Niobrara member of the Mancos Shale, and

2. Proximity to the steeply dipping Hogback rising out of the basin.

The exploratory area lies on a portion of the west rim of the basin, and as shown by the structural contour map (Figure 2) at the end of this section, the formations exhibit some of the steepest dips found anywhere in the San Juan Basin. Some of the dips are twice as steep as was found in the Verde Gallup Pool to the southwest.

Development of a critical zone within the Niobrara is shown by three cross-sections prepared from electric and radioactive logs of wells in the area. These cross-sections are included at the end of the text in this section. These cross-sections show certain correlative markers within the Niobrara, which for convenience are listed alphabetically from A to E. We consider Marker A to be the top of the Niobrara.

The first of these cross-sections, Figure 3, which is along a southwest-northeast line, goes through the well in which first production was obtained in this area. This well was originally drilled by Standard of Texas and is now operated by Benson-Montin-Greer Drilling Corp. and designated on the cross-section as Benson-Montin-Greer Drilling Corp. No. M-5 Standard of Texas. The well was completed with an uncemented liner in 800

feet of open hole, so it is impossible to tell exactly the zone from which the production originates. It is believed, however, that in this well it is coming from the zone colored in brown on the cross-section.

This zone is obviously better developed in the wells in the central part of the cross-section. Definite thinning of the zone occurs to the southwest, as is evident in the non-commercial well drilled by Standard of Texas in the southeast quarter of Section 14, Township 31 North, Range 14 West (left-hand log on Figure 3). The zone also appears to be deteriorating to the northeast as shown by the Southern Union No. 1 Jones in Section 22, Township 32 North, Range 13 West (right-hand log on cross-section). Interpretation of this well's log, however, is more indefinite than interpretation of logs of wells in the area to the south and west in which the zone definitely thins. The well with the apparently thickest section of the zone colored in brown is the Texas National No. 1 Johns. We believe its section is probably no thicker, however, than the three wells next south of it, for as can be seen from the cross-section, this well also has an apparently thicker section all the way from Marker A to E. This anomaly is probably best explained by assuming this well to have a straighter hole than the others and therefore indicating thicker sections.

The second cross-section (Figure 4) is also from the southwest to the northeast, displaced approximately two miles east of the first cross-section for the greater part of its length. It lies a little more directly north and south and is

designated as a south-north cross-section.

All the logs on this cross-section, except the Southern Union No. 1 Jones, are ES Induction surveys and the correlations are a little more definite than the wells on the first cross-section. Here again the positive thinning of the main prospective producing interval is noted to the south, along with possible deterioration to the north in the vicinity of the Southern Union No. 1 Jones.

The third cross-section (Figure 5) is an east-west cross-section and goes through the other producing well in the proposed unit area. This well is the Lloyd B. Taylor No. 1 Vic Walker in the northwest quarter of Section 6. Here the producing interval is defined a little more closely (as compared to the B-M-G M-5) in that 5½" casing was set in this well at 2248 feet and the well was completed with approximately 260 feet of open hole. A natural oil show of approximately 3 barrels of oil per day was encountered in this well below the casing between 2250 and 2400 feet. It is believed the bulk of this oil show was picked up in the first 70 feet below the casing. This is not definite, however, as actual productivity tests of the oil shows were not made in the open hole below the 5½" casing.

It also appears from this cross-section that the zone has deteriorated in the westernmost well, Pan American Petroleum Corporation No. 1 Ute Mountain Tribal H. This is not definite, however, as we have no assurance that the logs are

exactly comparable in electrical characteristics. Even so, with the information now available, the logical interpretation is that the main prospective zone would be non-productive in the vicinity of this well.

No effort has been made to contour the thickness or attempt to analyze the relative quality of the indicated main prospective pay zone. The area of the obviously better zone, however, is shown on the contour map, Figure No. 6 at the end of this section. The area which carries this significantly better section has been colored on Figure No. 6 in blue. It is noted that this area generally follows the synclinal trend as indicated by the structural contours. Whether this is of significance is at this time unknown.

As to the second criterion (proximity to the area of steeply dipping beds), we consider as most promising the area along the strike of the steepest dipping beds, with no limits laterally along the strike, but with certain down-dip and up-dip limits, the locations of which are estimated as follows:

Down-Dip: Here we draw on experience in West Puerto Chiquito, in which high capacity production has been obtained as far as one mile basinward from point of basin flexure. We have accordingly estimated the down-dip limit as being within one mile of this point, which approximately coincides with the zero contour on the structural maps herein.

Up-Dip: Here we have bases for three separate postulations for the location of the up-dip limit. These are:

1. Comparison with earlier pools.

2. Locus of possible up-dip faulting.

3. Indication of possible boundary condition affecting pressure build-up survey in the Taylor No. 1 Vic Walker.

Each of these are discussed as follows:

1. Up-dip limit of commercial production found in the Boulder Pool is within the contour interval 100 feet to 200 feet higher than the point of up-dip flexure. In the Verde Gallup Pool, the wells drilled at a position structurally higher than the 200 foot contour interval above the point of up-dip flexure were substantially poorer wells than those drilled in the main field. On the average, wells in this area would be considered not commercial. If this structural position of up-dip limit of commercial production in the Boulder and Verde Gallup Pools has any significance, and it seems to us it does, then one hesitates to include in the La Plata area as lands holding promise of production anything which lies structurally higher than 200 feet above the point of maximum up-dip flexure.

2. Locus of possible faulting: As discussed in Section D herein, there is strong evidence that a fault occurs in the vicinity of basin flexure. Since the amount of flexure is nearly the same on the up-dip side of the Hogback as on the basin side, it seems possible that an area of faulting may occur at or near this line of maximum flexure on the up-dip side. If so, this would place an area of faulting along the 4,000 to 4,100

foot contour interval (contour reference point being "E" marker).

3. Information from pressure build-up survey on the No. 1 Vic Walker: As discussed in Section D herein, there appears to be a good possibility that some kind of boundary affecting fluid flow characteristics lies within a distance of about 2,000 feet from the Taylor No. 1 Walker. In view of Items 1 and 2 above, plus the fact that the better developed part of the Niobrara section appears to deteriorate to the west of the No. 1 Walker, it is logical to assume that this boundary condition is on the up-dip side. 2,000 feet horizontally from the No. 1 Walker is the approximate location of the 4,100 foot contour interval, and this accordingly seems a likely location for the up-dip limit of production.

With down-dip and up-dip limits as above described, the prospective area meeting the qualifications of our second criterion becomes the area colored in red on Figure 7.

If we now define the most prospective area for production as being the one which meets both criteria, we arrive at the area on Figure 8 which is colored in yellow. A secondary area, or area with potential producing possibilities but regarded as inferior to the primary area, is shown on this Figure 8 as the area colored in brown. These primary and secondary areas (yellow and brown on Figure 8) are sometimes herein referred to as Areas A and B respectively.

On the north side of the proposed unit, Area B lies approximately along the strike and within a distance of about one mile from the north boundary of Area A. On the southwest

side of the unit it lies within approximately one mile of the boundary of Area A but restricted somewhat because of the poor section in the Elizabeth Elliott well in the northwest quarter of Section 8.

It appears likely that Areas A and B are divided into at least two fault blocks by a sealing fault in the vicinity of the zero contour. Location of this fault and the method in which it divides Areas A and B into two fault blocks is shown on Figure No. 9. Elsewhere herein, particularly with respect to Area A, reference is made to the fault blocks lying on either side of this fault. The basinward fault block is sometimes referred to as the "basin block" and the up-dip fault block sometimes referred to as the "rim block".

Mention should also be made in this section of possible additional zones of production. As previously indicated, the principal zone of interest is the one colored in brown on the three cross-sections. The adjacent yellow and green zones may also be productive, and completion methods should include stimulation of these zones. In addition, however, to the section lying between the D and E markers, we believe the zones lying between markers B and C deserve testing. These three zones lying between the B and C markers appear to have adequate continuity across the lands covered by the proposed unit area to offer possibilities of commercial production. In the drilling of his No. 1 Walker, Lloyd Taylor reported oil shows at depths which correspond roughly with the zones between the B and C markers. When the No. 1 Walker was at a depth of 2,250 feet

a 24-hour bailing test, which was witnessed by a Benson-Montin-Greer representative, indicated a natural productivity of 3 barrels per day. This show, having persisted to the depth drilled in the time required, is considered a show which warrants testing. These prospective producing zones in the No. 1 Walker are cemented off behind the $5\frac{1}{2}$" casing, which is bottomed at 2,248 feet.

Further, regarding additional zones of interest, attention is called to the apparent development below the E marker in the Texas National No. 1 Johns shown on cross-sections Figures 2 and 4.

This apparent anomaly might of course be explained as a partial duplication of the overlying zones, resulting from faulting, particularly since this well lies close to the postulated fault along the basin flexure. On the other hand, this would require reverse or thrust faulting, and we do not know if tectonics in this area have been such as to permit this type faulting. Faults have been penetrated in East Puerto Chiquito with vertical displacement of as much as 280 feet. These, however, were normal (slip-type) faults. Accordingly, unless strong evidence to the contrary were developed, we would anticipate here at La Plata that faults would also be normal.

Accordingly we believe wells in the area should be drilled to a depth adequate to penetrate this possible additional zone. And in fact, for wells in the vicinity of the Texas National No. 1 Johns, consideration should be given to coring this interval.