THE GEOLOGICAL SURVEY OF WYOMING
S.H. Knight, State Geologist

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REPORT ON THE STRUCTURAL RELATIONS OF THE NE$\frac{1}{4}$ SEC. 36, T.20N., R.78W. AND ADJACENT AREAS OF THE ROCK CREEK OIL FIELD, CARBON COUNTY, WYOMING

by

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Laramie, Wyoming
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This report has not been reviewed for conformity with the editorial standards of the Geological Survey OF Wyoming. In April, 1988, the original manuscript was retyped and minor editorial alterations were made by Sheila Roberts, editor.

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SUMMARY OF CONCLUSIONS

A careful evaluation of all available data indicates that:

1. It is not necessary to postulate the existence of a fault between Alva Dixon Well no. 6 and State Well no. 7 to satisfy the structural relations.

2. That if such a fault exists, it is, in all probability, not of sufficient magnitude to form an effective seal against the migration of oil.

CONCLUSIONS

1. Agreement of field data: The field data on which the maps of the Ohio Oil Company, the State Land Office, and the Geological Survey of Wyoming are based are in such close agreement that any variations have no significance.

2. Interpretation of data: Structural interpretations are based upon the locations, elevations, and depths of wells to established horizons. A one-percent variation between the recorded depth and the actual depth of a well or a variation of the boring from a vertical line to the extent of 1° or 2° would have a material effect upon the structural interpretation.

The available data permit a number of possible interpretations, five of which have been treated.

3. Interpretation no. 1A (see accompanying map): This interpretation is based upon a structural contour map with contours drawn on the top of the Wall Creek horizon. The slight deviation of the strike between Alva Dixon Well no. 6 and State Well no. 10 is interpreted as showing a very shallow synclinal fold on the west flank of the main structure.

4. Interpretation no. 1B (see accompanying map): This interpretation is based upon a structural contour map with contours drawn on the top of the Wall Creek horizon with an assumed fault lying between Alva Dixon Well no. 6 and State Well no. 7. The abnormal spacing of the 4850-, 4900-, 4950-, and 5000-foot contours south of the fault indicate that it is not a correct interpretation.

5. Interpretation no. 2A (see accompanying map): This interpretation is based upon a structural contour map with contours drawn on the top of the first Muddy horizon. The deviation in strike between Alva Dixon Well no. 6 and State Well no. 10 is interpreted as a shallow synclinal fold on the west flank of the main structure. This is in agreement with interpretation no. 1A.

6. Interpretation no. 2B (see accompanying map): This interpretation is based upon a structural contour map with contours drawn on the first Muddy horizon with an assumed fault lying between Alva Dixon Well no. 6 and State Well no. 7. The unnatural spacing of the 4,100- and 4,150-foot contours indicates that this is an incorrect interpretation.

7. Interpretation no. 2C (see accompanying map): This interpretation is based upon a structural contour map with contours drawn on the first Muddy horizon with an assumed fault lying between Alva Dixon Well no. 6 and State Well no. 7 and an assumed fault lying between State Well no. 7 and State Well no. 10. This is a possible interpretation.

8. If there should be a fault lying between Alva Dixon Well no. 6, and State Well no. 7, then:

a. The strike of the fault is, in all probability, at right angles or nearly at right angles to the main axis of the anticline.

b. The fault may lie at any position between the two wells. Therefore, an area of State land may lie south of the fault.

c. The maximum vertical displacement (throw) would not be sufficient to form an effective seal against the migration of oil. Interpretation no. 2C shows a vertical displacement of 50 feet.

d. The transverse fault or faults of the order of magnitude indicated may facilitate rather than retard the migration of oil.

INTRODUCTION

The investigations set forth in this report were made at the request of the State Board of Land Commissioners, as set forth in a letter, under date of September 6, 1934, from C.H. Fitzpatrick, Commissioner of Public Lands.

PURPOSE OF THE INVESTIGATIONS

To determine, as far as all available data permit, the structural relations of the productive oil horizons along the western flank of the Rock Creek oil field, Carbon County, with special reference to the possibilities of a fault which would act as an effective seal against the migration of oil from State land, particularly the SW1/4NE1/4 sec. 34, T.20N., R.78W.

FIELD INVESTIGATIONS

Two independent field surveys of the area were made during the investigations. First, the locations and surface elevations of all wells having a bearing on the problem were made by plane table. Later on, an independent check

of well elevations was made with a Y level. In both surveys, locations were tied by a closed traverse to the NE corner sec. 34. Vertical surface elevations were referred to the same section corner, the elevation of which was assumed to be 7,150 feet. All available outcrops were examined to determine if the surface geology might have any bearing on the problem. It was found that all data relative to locations and elevations of wells was recorded on the map of the Ohio Oil Company and the findings of the above surveys were in such close agreement that any differences would have no material effect upon the problem.

INTERPRETATION OF DATA

The problem is one in subsurface geology. Its interpretation is based entirely upon the relations between relative surface elevations of wells and the recorded depths from the surface to a recognized stratigraphic horizon. The validity of the structural interpretation is therefore dependent upon (1) the number and distribution of wells, (2) their surface elevations, and (3) the position, both vertically and laterally, of the points where wells penetrate the same stratigraphic horizon. The first two factors can be accurately determined. The accuracy of the third factor is one which cannot be checked. A variation of less than one percent in the recorded elevation of the first Muddy horizon in State Well no. 7 would materially effect the problem. A deviation of this well of not more than two degrees from the vertical would obviate any structural complications. Inasmuch as the character of the data is such that any differences between recorded and true relations would tend to compensate in the various wells, the interpretations are given in terms of recorded data without adjustments for probable differences. However, it must be borne in mind that the available data are not sufficient to draw a definite and precise interpretation

of the structural relations at the depths at which the oil-producing horizons lie. It has, therefore, been necessary to set up a number of interpretations to which the data conform or do not conform and to draw logical conclusions from these interpretations.

Interpretation no. 1A

(see accompanying map)

The interpretation is based upon a structural contour map with contours drawn on the top of the Wall Creek horizon. In the interpretation, the deflection of the strike between Alva Dixon no. 6 and State Well no. 7 is represented as a very shallow syncline on the west flank of the main Rock Creek anticline. In my judgment, there is nothing inconsistent in this interpretation. It is entirely in keeping with the behavior of folded rocks in this region.

Interpretation no.1B

(see accompanying map)

This interpretation is based upon a structural contour map with contours drawn on the top of the Wall Creek horizon. The interpretation is based upon a minimum deflection of strike and a maximum of faulting. An assumed fault (A-A') is shown lying between Alva Dixon Well no. 6 and State Well no. 7. The abnormal relations of the 4850-, 4900-, 4950-, and 5000-foot contours lying between A-A' and B-B' indicate that this is not a correct interpretation.

Interpretation no. 2A

(see accompanying map)

This interpretation is based upon a structural contour map with contours drawn on the top of the first Muddy horizon. The interpretation is based upon a maximum deflection of strike and a minimum of faulting. The transverse shallow syncline shown in interpretation no. 1A is slightly deeper at this horizon. This transverse syncline in the First Muddy is entirely consistent with the behavior of folded rocks in this region.

Interpretation no. 2B

(see accompanying map)

This interpretation is based upon a structural contour map with contours drawn on top of the first Muddy horizon with a minimum deflection of strike and a single transverse fault lying between Alva Dixon Well no. 6 and State Well no. 7. The abnormal spacing of the 4100- to 4150-foot contours north of the fault indicate that this is not a correct interpretation. I have been unable to construct a satisfactory map on the basis of single fault lying between the two wells mentioned above, without recourse to a deflection of strike.

Interpretation no. 2C

(see accompanying map)

This interpretation is based upon a structural contour map with contours drawn on top of the first Muddy horizon with a minimum deflection of strike and two faults, one lying between Alva Dixon Well no. 6 and State Well no. 7 and the other lying between State Well no. 7 and State Well no. 10. This is a possible interpretation.

Position of a possible fault between Alva Dixon Well no. 6 and State Well no. 7: If there should be a fault between Alva Dixon Well no. 6 and State Well no. 7 there is no evidence to indicate where this fault might be located. Therefore, an area of State land may lie south of the assumed fault.

The probable maximum vertical displacement of a possible fault lying between Alva Dixon Well no. 6 and State Well no. 7 and its bearing upon the migration of oil: It does not seem probable that any possible fault lying between the above-named wells would have a maximum vertical displacement (throw) of sufficient magnitude to form an effective barrier against the migration of oil from State land to adjacent land to the south. The maximum vertical displacement in interpretation 2C is approximately fifty feet at a point 200 feet west of the east line of the SW1/4NE1/4 sec. 34. It is not believed that a fault of this magnitude would act as an effective barrier for the migration of oil. A recent opinion on the relations of faulting to the migration of oil under geological conditions which pertain to the Rocky Mountain region, published in U.S. Geological Survey Professional Paper 163 (page 21) entitled *The significance of geologic conditions in Naval Petroleum Reserve No. 3, Wyoming*, reads as follows:

1. Under favorable conditions, especially in firm consolidated strata, faulting that has yielded open fissures has been an important factor in the migration and accumulation of oil and gas.

2. Differential pressure, caused by the release of pressure through fault fissures, has been largely responsible for the migration of oil and gas to the places of accumulation, enriching the sands immediately around the fissures as well as the fissures themselves.

3. The migration of gas and oil through fissures has been upward either to the surface or from one bed to another. Fissuring has also facilitated the lateral migration of oil and gas through porous beds toward these points of escape. This corresponds with the lateral migration of oil and gas through sands toward producing wells.

4. The propulsive force of expanding gas, more especially the gas absorbed in oil and water under high pressure, has been one of the important factors in the migration of oil through porous strata toward fissures where the pressures were relieved.

5. Oil is propelled more effectively than water by the propulsive force of absorbed gas. Immediately upon the release of pressure, the absorbed gas expands and propels the oil from within. The comparatively high absorption capacity of oil and its tendency to remain entangled with the flowing and expanding gas appears to be largely responsible for this effective propulsion.

6. The migration and accumulation of oil and gas under the influence of differential pressures caused by faulting has been a comparatively rapid process, not the long drawn out process that is generally pictured.

7. The occurrence of faults in the Rocky Mountains and Midcontinent fields is a valuable criterion in the search for petroleum. In these regions, a closed structure that is faulted should generally be given preference to one that is not faulted. Further application of these facts may possibly be made in other fields.

8. Shallow sands have generally undergone more advance drainage of oil and gas through fault fissures than have the deeper sands.

State Geologist

October 30, 1934

STRUCTURAL CONTOURS DRAWN ON TOP OF THE FIRST MUDDY HORIZON. CONTOURS HAVE NOT BEEN ADJUSTED

INTERPRETATION 2B

INTERPRETATION BASED UPON AN ASSUMED FAULT LYING BETWEEN STATE WELL NO. 7 AND ALVA DIXON WELL NO. 6. ABNORMAL RELATIONSHIP OF CONTOURS INDICATES INCORRECT INTERPRETATION.

CONTOUR INTERVAL 50 FEET

SCALE 1 INCH = 300 FEET

ELEVATIONS & LOCATIONS BY THE GEOLOGICAL SURVEY OF WYOMING

DEPTHS TO TOP OF FIRST MUDDY SAND FROM STATE LAND OFFICE RECORDS.

This map has not been reviewed for conformity with the editorial standards of the Geological Survey of Wyoming

STRUCTURAL MAPS OF A PORTION OF THE ROCK CREEK OIL FIELD By S.H. Knight October 15, 1934

STRUCTURAL CONTOURS DRAWN ON TOP OF THE FIRST MUDDY HORIZON. CONTOURS HAVE NOT BEEN ADJUSTED

INTERPRETATION 2A

INTERPRETATION BASED UPON A MAXIMUM DEFLECTION OF STRIKE AND A MINIMUM OF FAULTING.

CONTOUR INTERVAL 50 FEET
SCALE 1 INCH = 300 FEET

ELEVATIONS & LOCATIONS BY THE GEOLOGICAL SURVEY OF WYOMING

DEPTHS TO TOP OF FIRST MUDDY SAND FROM STATE LAND OFFICE RECORDS.

STRUCTURAL CONTOURS DRAWN ON TOP OF WALL CREEK HORIZON

INTERPRETATION 1A

INTERPRETATION BASED UPON A MAXIMUM DEFLECTION OF STRIKE AND A MINIMUM OF FAULTING.

CONTOUR INTERVAL 50 FEET
SCALE 1 INCH = 300 FEET

ELEVATIONS & LOCATIONS BY THE GEOLOGICAL SURVEY OF WYOMING

DEPTHS TO TOP OF WALL CREEK HORIZON FROM STATE LAND OFFICE RECORDS.

0 300' 600' 900'
1 INCH = 300 FEET

STRUCTURAL MAP
OF A PORTION OF THE
ROCK CREEK OIL FIELD

STRUCTURAL CONTOURS DRAWN ON TOP OF THE FIRST MUDDY HORIZON. CONTOURS HAVE NOT BEEN ADJUSTED.

INTERPRETATION 2C

INTERPRETATION BASED UPON AN ASSUMED FAULT LYING BETWEEN STATE WELL NO. 7 AND ALVA DIXON WELL NO. 6 AND A SECOND ASSUMED FAULT LYING BETWEEN STATE WELL NO. 7 AND STATE WELL NO. 10.

ELEVATIONS & LOCATIONS BY THE GEOLOGICAL SURVEY OF WYOMING

DEPTHS TO TOP OF FIRST MUDDY SAND FROM STATE LAND OFFICE RECORDS.

CONTOUR INTERVAL 50 FEET
SCALE 1 INCH = 300 FEET

STRUCTURAL CONTOURS DRAWN ON TOP OF WALL CREEK HORIZON

ELEVATIONS & LOCATIONS BY THE GEOLOGICAL SURVEY OF WYOMING

DEPTHS TO TOP OF WALL CREEK HORIZON FROM STATE LAND OFFICE RECORDS.

POSITION OF WALL CREEK IN TRAPSHOOTER WELL NO. 1 AND MIKE LUNDY WELL COMPUTED.

INTERPRETATION 1B

INTERPRETATION BASED UPON A MINIMUM DEFLECTION OF STRIKE AND A MAXIMUM OF FAULTING.

CONTOUR INTERVAL 50 FEET
SCALE 1 INCH = 300 FEET