OCC

May 10, 1973

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Dear Sir:

Herewith is presented to you a summary geological report on an area in Eddy County, and an adjacent portion of Chaves County, New Mexico. The report deals with both surface and subsurface structural interpretations. Said interpretations are the result of work done in the general area through a period of years. Accompanying this report are four maps.

LOCATION:

The area under consideration lies in the northwest portion of Eddy County, and a small adjacent portion of Chaves County, New Mexico immediately to the west. The center of the area is approximately twenty-five miles west of the City of Artesia and some six miles southwest of the village of Hope.

More specifically the area under consideration comprises the following lands:

T-17-S, R-21-E, N.M.P.M.
Sections 20, 21, 22, 23, 26, 27, 28, 29, 30, 31, 32, 33, & 34.

T-18-S, R-21-E, N.M.P.M.
Sections 3, 4, 5, 6, 7, 8, & 9.

T-17-S, R-20-E, N.M.P.M.
Sections 25 & 36.

T-18-S, R-20-E, N.M.P.M.
Section 1.

ROADS:

The area is readily accessible by ranch roads stemming from U. S. Highway #83 closely adjacent to the northeast. The ranch roads are mainly of natural gravel and are fairly well maintained.

CULTURE:

The area is almost exclusively devoted to grazing lands. Formerly some of the land around the village of Hope was irrigated and farmed, but due to the drop in the levels of the Artesian water, farming is no longer possible.

TOPOGRAPHY AND DRAINAGE:

The area is of the well dissected upland type with rounded hills and a well developed drainage pattern. The maximum relief from hill crests to valley floors

is approximately 200 feet. Relief increases rapidly to the west, and decreases to the east. Drainage is through intermittent streams generally eastward to the Pecos River.

AREAL GEOLOGY:

With the exception of small amounts of recent alluvium in the larger intermittent stream beds, the exposed beds consist of dolomitic limestones of upper Permian age. The writer regards these as belonging to the San Andres formation. However, some geologists refer to the uppermost of these beds as the Grayburg formation. If this is the case, the separation from the underlying San Andres must be an arbitrary one. In either case they consist of hard, generally heavy beaded, amorphous to finely crystalline dolomitic limestone that ranges from medium to dark gray in color.

GEOLOGIC SECTION:

Based on data obtained from the microscopic examination of well samples it is reasonable to expect a geologic section - in descending order - for the area under consideration as follows:

Permian

SAN ANDRES FORMATION:
Hard, generally medium to heavy bedded, commonly dense, medium to dark gray dolomitic limestone. Thickness approximately 900'.

GLORIETA FORMATION:
White to honey yellow to red, medium grained, quartz sandstone. Ranges from highly porous to well cemented. Thickness approximately 25' to 35'.

YESO FORMATION:
Light red colored shale, often gypsiferous; thin limestones; thin gypsum and anhydrite beds, and generally yellow, fine sandstone. Thickness approximately 2,000'.

ABO FORMATION:
Commonly dark red, sticky shale. Beds of anhydrite and thin limestones may be present. The area is one of the transition in lithology for the Abo.

WOLFCAMP FORMATION:
It is not uncommon for the name "Wolfcamp" to be assigned to the calcareous beds lying immediately below the Abo formation. The writer prefers to put such beds in the Pennsylvanian. The term Wolfcamp from the Glass Mountain area of Texas is very questionable. Such a possible unit has never been defined in New Mexico and its use is purely arbitrary.

Pennsylvanian

The Pennsylvanian age beds as exposed to the west of the considered area in the Sacramento mountains are named the Magdalena formation. In said Sacramento mountains the unit has not been subdivided into named members as far as any published report sets forth. Within the area of southeastern New Mexico many geologists have used the general Trans-Pecos Texas section that in descending

order is as follows: Cisco; Canyon; Strawn; Millsap, and Bend. This range apparently encompasses much of Pennsylvanian time. Now the names Atoka and Morrow of Oklahoma have been added. Both are of lower Pennsylvanian age, belonging to Pottsville time. It is interesting to note that none of these units have been identified or described for any specific area of New Mexico. Apparently these units are identified almost exclusively from electric log records.

The top of the Pennsylvanian beds in southern New Mexico is marked by a widespread and major unconformity, but without marked angularity. Erosion has been the major factor. The result has been that the Pennsylvanian beds vary markedly in thicknesses in short distances.

In the Eddy County-Chaves County area the Pennsylvanian beds thin rapidly to the west. In the area under consideration the rate of thinning appears to be rather uniform, as is shown on an accompanying isopach map.

In any case the Pennsylvanian beds may be characterized as follows: medium gray to black, sometimes calcareous shales; light to medium to dark gray, amorphous to finely crystalline limestones; fine to medium, to coarse to finely conglomeratic, generally gray sandstones.

Mississippian

Beds of Mississippian age in the area are represented by the Lake Valley formation of lower Mississippian age. It may or may not be present in the area under consideration. Like most of the pre-Permian beds in the area it is thinning rapidly to the west. It consists of white, amorphous to finely to sometimes coarsely crystalline, essentially pure limestone. It may be either cherty or fossiliferous. In the immediate area thicknesses are as follows: (by samples)

Sunray-DX Test C NE SW Sec. 30-T-18-S, R-23-E ---------- 30'
Mobil No. 1 U Federal, C NE SW Sec. 9-T-17-S, R-24-E ---------- 30'
Southern Union No. 1 Elliott, C SW SW Section 24-T-18-S,R-23-E---- 30'
Black No. 1 Shildneck, NW SW Sec. 24-T-16-S, R-20-E ----------None

Devonian

Beds of Devonian age in the area are represented by the Percha formation of upper Devonian age. Like the Lake Valley the Percha may or may not be present. Where present it consists of black, fissile shale. It thins rapidly to the west. In the immediate area thicknesses,from samples, are as follows:

Sunray-DX Test C NE SW Sec. 30-T-18-S, R-23-E ---------- No Percha
Mobil No. 1 U Federal, C NE SW Sec. 9-T-17-S, R-24-E ---------- 20'
Southern Union No. 1. Elliott, C SW SW Sec. 24-T-18-S,R-23-E--- 40'
Black No. 1 Shildneck, NW SW Sec. 24, T-16-S, R-20-E ---------- No Percha

Many geologists in this area use the name Woodford rather than Percha. Woodford in its type location in Oklahoma is known as the Woodford chert. The writer is at a loss as to why that name is used for the New Mexico Percha.

Silurian

Beds of Silurian age in the area are represented by the Fusselman formation. This is the formation that has been popularly called Devonian. This is a complete fallacy. The paleontologists of the U. S. Geological Survey have long identified the limited fauna, that is best represented in the upper portion of the formation, as being of Niagaran age. This means that the upper portion of the Fusselman is middle Silurian in age. Thus the formation grades from middle through lower Silurian in age. Locally, as well as over wide areas of New Mexico, the Fusselman consists of dense, amorphous to finely crystalline dolomite. The uppermost portion is sometimes a highly dolomitic limestone. A profound erosional unconformity marks the top of the formation. In turn it rests conformably on the underlying upper Ordovician. The contact is difficult to recognize.

Ordovician

Ordovician time is represented over wide areas of New Mexico by the upper Ordovician Montoya formation and by the lower Ordovician El Paso formation. In almost every instance the two units are separated by either a thin sandstone or a sandy dolomite. This thin unit, that seldom exceeds five to ten feet, probably represents all of Middle Ordovician time.

Locally the Montoya consists of some 160' to 170' of generally dense, hard, light gray to brownish gray interbedded limestone and dolomites. It is quite often distinctly crystalline.

Locally, the El Paso formation consists of some 360' to 375' of generally dense, hard, dark brownish gray, interbedded limestones and dolomites. Commonly the unit shows marked crystallinity.

Cambrian

The Cambrian, where present, is represented by the Bliss sandstone. It is usually red in color and consists of fine to coarse sandstone made up of sharp fragments of quartz and feldspar, indicating that the material has been derived from weathered granite.

M A P S

Map No. 1

Map No. 1 was originally a portion of a much more extensive subsurface interpretation. The portion herewith presented has been checked as related to newer available data and warranted changes made accordingly. Interestingly enough such changes have been relatively minor.

The structural interpretation as shown is on the top of what the writer considers to be the top of the beds of Pennsylvanian age. The writer is perfectly willing to recognize that other geologists may give the top of this predominantly carbonate unit some other names such as Wolfcamp or Cisco, however, in final analysis, the names are essentially academic. What is of particular value, as related to structural interpretation, is to use the same stratigraphic marker. This has been done as far as possible for Map No. 1.

It must also be recognized that inasmuch as the top of the carbonate zone, herein called the top of the Pennsylvanian, is an erosional unconformable surface, any structural interpretation must also be in part paleo topography. To the extent paleo topography plays a part, the structural extremes, as shown, may actually be sharper and of greater value. Thus the structural interpretation may actually be of minimum amounts.

The structural feature under consideration is actually within, or bordering on, a structurally critical area. The alignment of the structural high as shown extending in a northeasterly to more easterly direction from the southwest corner of Section 1, T-18-S, R-20-E, into Section 9, T-17-S, R-24-E, is in good accord with the regional structural alignment to the southeast and east.

Immediately south of the main portion of the structure there is shown a somewhat circular closed feature. This area, on the surface, is badly broken and distorted and may well be indicative of deep seated faulting. The closing of the area is actually arbitrary. It may well be a portion of a structural alignment extending from the northeast portion of T-18-S, R-19-E into the northeast portion of T-19-S, R-23-E, as shown by the dashed line on the map.

The alignment of the Y-O feature and the probable extension of the Huapache fault are also shown on Map No. 1. Naturally, they play a part in the overall structural picture of the general area.

The datum values as used for the various tests as shown on the map were determined in large part from the microscopic examination of well cuttings by the writer. Where the values are followed by the letter R, the values were obtained from data reported by the operators that the writer believed to be reliable. Other tests have been drilled in the area but well cuttings were not available and available reported data appeared to be unreliable.

The structural interpretation as shown is essentially self-explanatory and appears to be a reasonable presentation. Admittedly, the closed feature centering around the northeast corner of Section 31-T-18-S, R-21-E, is questionable inasmuch as the value assigned to the Texas Oil & Gas Co. test in Section 23, T-18-S, R-20-E, is open to question. No cuttings from this test were available to the writer and data as reported by the operators leave much to be desired.

Assuming that the interpretation shown centering around the test in Section 23 is reasonably correct, the question might well be asked as to why this test was unproductive. As previously stated, surface data indicate that the immediate area appears to be very structurally disturbed and it may well be that it is actually structurally separated from the area that is under immediate consideration.

Perhaps it could be questioned as to why a contour interval of 250' has been used rather than a more detailed interval of 100'. The use of the 250' interval was preferred for the sake of simplicity. The control used is both good and accurate, but admittedly limited by the absence of tests drilled plus a few from which data were not reliable. Therefore, little or nothing could have been gained by use of a 100' contour interval.

Map No. 2

Map No. 2 is a simple surface reconnaissance map on which are recorded dip and strike symbols, plus dashed lines denoting fracture lines. These latter may well be indicative of deep seated faulting.

Map No. 2 was prepared from surface examinations of exposures of hard, competent limestones. It was made entirely on the basis of dip and strike data. No one bed could be sufficiently well defined and extensive enough to be used for the purpose of plane table mapping. This simple map was made entirely independently from any subsurface data and at a considerably different time.

The available surface data as shown on the map rather clearly indicate an essentially closed surface structure, with a long axis extending from the approximate southwest corner of Section 1, T-18-S, R-20-E, into at least Section 4, T-18-S, R-21-E, Beyond this latter area no exposures of limestone, or other competent beds were found.

Map No. 3

Map No. 3 is a composite structural interpretation, with the surface data from Map No. 2 superimposed on the subsurface interpretation of Map No. 1. The composite map thus presents a most interesting, combined structural interpretation.

Both the subsurface interpretation and the surface data clearly indicate the presence of an essentially closed structural "high", centering around Section 32, T-17-S, R-21-E. No dip or strike data for the area of Sections 2 and 3, T-18-S, R-21-E are available, however, these data are present for the critical portions of the indicated feature. The regional inclinations of the beds to the east, northeast essentially supply this control.

As previously stated, the surface and subsurface interpretations were made entirely independently and at appreciably different times. This makes the remarkable coincidence of the two sets of data all the more impressive.

It must therefore be concluded that the composite map very strongly indicates the presence of a structurally high area centering around Section 32, T-17-S, R-21-E.

Map No. 4

Map No. 4 is a very simple isopach presentation as related to the carbonate horizon that the writer calls the Pennsylvanian formation. This map is actually taken from a regional isopach map of Eddy County. The portion here presented has been checked for any data made available since the construction of the regional map. It should be noted that all thicknesses used were obtained from the microscopic examination of well cuttings by the writer.

Control for the general area herewith presented is admittedly limited, but is still reasonably reliable. It will be noted that isopach contours could have been moved slightly as related to a test in Section 9, T-17-S, R-24-E, and also for a test in Section 30, T-18-S, R-23-E, as in each case the data were obtained subsequent to the contours as shown. These small changes were not made for the reason that the new figures as related to the older contours illustrated that the interpretation stood up quite well as shown.

The map indicates that for the area under consideration the Pennsylvanian beds should have variable thicknesses of from 1,800' to 2,700'.

It should be further noted that throughout the Eddy County-Chaves County area the paleo geography shows a fairly constant rate of thinning of the Pennsylvanian beds as they approach the old shore lines. Also, based on normal paleo geology and paleo geography the thinning can be expected to take place in very considerable proportion from the bottom of the series. Hence, if thicknesses of 1,800' to 2,700' are present there is ample room for the more generally productive units of the general area to be present.

POTENTIALLY PRODUCTIVE HORIZONS

The available data as herein set forth indicate the presence of a structural "high" of considerable size centering generally around Section 32, T-17-S, R-21-E, Eddy County, New Mexico. Assuming that this interpretation is correct, the question of potential pay beds for gas and/or oil becomes the all important factor.

Based on available data from tests drilled in the general area it appears that hope for commercial production of gas and/or oil is restricted to the following formations, in descending order: San Andres, Pennsylvanian, Silurian, Upper and Lower Ordovician.

San Andres: Prospects for any commercial production of either gas or oil from the San Andres locally are very remote. Locally it is an artesian aquifer and even in this it produces in short supply.

Pennsylvanian: The beds of Pennsylvanian age have all the prerequisites for oil and gas production, namely; marine origin, source beds; reservoir beds; and sufficient thicknesses.

The lithology of the Pennsylvanian beds is extremely variable and subject to rapid lateral variations. These variations occur in the limestones, sandstones and shales. Giving names to any of the units of the Pennsylvanian is a very questionable matter.

Well developed sandstone beds can be expected to be interbedded with the limestones and shales. Some of these may well be expected to be relatively coarse because of the fact that shore lines were relatively close during the time of deposition. Good porosities and permeabilities in some of the limestones are also to be expected.

The history of the Pennsylvanian beds in the general area indicates that they are more prospective for gas production than for oil production, but the latter cannot be ruled out.

Silurian: The middle to lower Silurian Fusselman dolomite is definitely prospective for the commercial production of oil and to a lesser degree for gas.

As previously stated, the top of the Fusselman is marked by a profound unconformity. Also, at best, there is a long time hiatus between Fusselman time and the deposition of any overlying beds. The oldest beds on top of the formation in the general area are of upper Devonian age. In many areas beds of Pennsylvanian age rest directly on the Fusselman with no beds of either Mississippian or Devonian age present. This condition, together with much post Fusselman orogeny, has made possible the development of both porosity and permeability in the Fusselman.

The Fusselman in itself has little to offer in the way of source beds for either gas or oil, but it commonly offers excellent reservoir space. Most of the oil in the Fusselman reservoirs probably comes from the Pennsylvanian. Some could have come from the shales of the Devonian Percha formation.

Ordovician: The limestones and dolomites of the beds of upper and lower Ordovician age in the considered area may have some potentialities as related to gas and/or oil production, but inasmuch as there is no known formational shutoff from the overlying Fusselman beds, their productive capabilities are essentially negative if water is encountered in the Fusselman.

Therefore, from a practical approach, the hope for commercial production of gas and/or oil in the discussed area must be virtually restricted to the beds of Pennsylvanian and Silurian ages. The former is primarily prospective for gas and the latter for oil.

Depths:

Based on available data the Pennsylvanian beds should be entered at an approximate depth of 3,800' to 4,000' and the Fusselman dolomite could be expected to be reached by an approximate depth of 6,600' to 6,800'. On such a basis an approximate depth of 7,000' could be expected to constitute an adequate test for a location in Section 32, T-17-S, R-21-E, Eddy County, New Mexico.

CONCLUSIONS AND RECOMMENDATIONS

Based on the data herein contained, together with the accompanying maps, it is the opinion of the writer that the area generally centering around Section 32, T-17-S, R-21-E, Eddy County, New Mexico, meets the necessary requirements needed to be considered distinctly prospective for the commercial production of gas and/or oil and therefore warrants testing by drilling operations.

Respectfully submitted,

H. S. Cave

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