Lawrence Livermore National Laboratory
NUCLEAR SYSTEMS SAFETY PROGRAM
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WM Project 10,11,16
Docket No.
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Distribution:
BLACKFORD
(Return to WM, 623-SS)

Mr. Mike E. Blackford, MS-623ss
Project Officer, WMGT
Division of High-Level Management, NMSS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Transmittal of Letter Report

References: FIN No. A-0297

(a). BMI/ONWI-589
(b). BMI/ONWI-590
(c). BMI/ONWI-621

Dear Mr. Blackford:

In accordance with your task order, we reviewed and evaluated three DOE documents (listed above) with respect to hydrocarbon resources and their potential of the Palo Duro Basin. We reviewed these three reports as a unit. Our conclusion is as follows:

The historic yield and probable hydrocarbon potential of the Palo Duro Basin are low. Potential source and reservoir rocks are present, as are structural and stratigraphic traps. The lack of hydrocarbon yield is attributed to the combination of a relatively shallow basin and low thermal gradient, so that thermal maturity and hydrocarbon generation have not yet been achieved. We feel that the conclusions reached in the DOE documents are consistent with the data presented and with most other information available for the region.

If you have any questions, please let us know.

Sincerely yours,

Dae H. (Danny) Chung
Leader
NRC Nuclear Waste Mgt. Project Team

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DHC/ic
Encls. as stated.

cc: P.S. Justus, WMGT
J.S. Trapp, WMGT

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REVIEW OF THE SUBJECT DOE DOCUMENT

by

NRC Nuclear Waste Management Project Team
Lawrence Livermore National Laboratory, Livermore, California

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SUBJECT: Petroleum Geology of the Palo Duro Basin, Texas Panhandle, by Peter R. Rose, BMI/ONWI-589, March, 1986

Hydrocarbon Resources of the Palo Duro Basin, Texas Panhandle, by Peter R. Rose, BMI/ONWI-590, March, 1986

Petroleum Potential of Two Sites in Deaf Smith and Swisher Counties, Texas Panhandle (2 Vols.), by Peter R. Rose, BMI/ONWI-621, September, 1986

As requested, the above three reports were reviewed as a unit.

Essential conclusions of these reports are that the historic yield and probable hydrocarbon potential of the Palo Duro Basin are low. Potential source and reservoir rocks are present, as are structural and stratigraphic traps. The lack of hydrocarbon yield is attributed to the combination of a relatively shallow basin and low thermal gradient, so that thermal maturity and hydrocarbon generation have not yet been achieved.

In general, the conclusions reached in the reports are consistent with the data presented and with most other information available for the region. However, several items appear to require comment.

1. Geology and reservoir potential of Upper Permian and Younger Rocks

The report contains no details concerning the characteristics of rocks younger than the middle Permian Tubb formation. These are very briefly described (ONWI-589) and then dismissed as potential source and/or reservoir rocks. This may be the case, but the report notes that dolomites in the San Andres Formation are reservoir rocks adjacent to the Matador Arch. Reservoir potential elsewhere within the Palo Duro Basin is dismissed on the grounds that the dolomites are salt plugged. However, data to support this conclusion is not presented and the statement itself appears to constitute a considerable generalization.

Also, Warren, in a review article in Geotimes (1987), cites recent studies that focus on evaporite sequences as potential hydrocarbon source rocks.

The Triassic Dockum Group is lithologically similar to sedimentary sequences that produce oil and gas at many locations in the world. its complex stratigraphy would seem to provide a variety of potential stratigraphic traps.

Therefore, it would appear that a thorough appraisal of the hydrocarbon potential of the Palo Duro Basin should have included a review of the characteristics of rocks younger than Mid Permian.

2. Differing Opinions Concerning Thermal Maturity of Lower Pennsylvanian and Mississippian Rocks

As noted above, the author attributes the low recorded hydrocarbon yield of the Palo Duro Basin to a lack of thermal maturity within most of the strata within the basin. Ruppel (1987), in a recent review, indicates that both Mississippian and Pennsylvanian rocks within the Palo Duro Basin are of sufficient thermal maturity to generate petroleum, although low total organic carbon contents of most rocks within the Mississippian section make these rocks unlikely sources. However, Ruppel indicates that the Pennsylvanian shales within the Palo Duro Basin have good source rock potential.

It would appear that before this issue can be resolved, more definite determinations should be made of thermal gradient and thermal maturity of rocks within at least those portions of the Palo Duro Basin relevant to the Deaf Smith site.

3. Potential for Hydrocarbon Migration through the Deaf Smith Area

Rose indicates that hydrocarbons generated in the Palo Duro Basin can be expected to migrate updip and accumulate in local structural and stratigraphic traps. In ONWI-621 he indicates that the Deaf Smith site is away from any expectable migration route and that the petroleum generating potential of rocks downdip of the area is low.

Ruppel (1987) suggests that petroleum generation should be occurring in at least the deeper portions of the Palo Duro Basin south of the Deaf Smith site toward the Matador Arch.

Exhibit 2 in ONWI-590 indicates that there have been hydrocarbon shows in a number of wildcats drilled south of the Deaf Smith area. Shows are indicated in rocks ranging from Mississippian to Wolfcamp in age.

Updip migration could be occurring in the Deaf Smith area from sources at depth south of the site with movement toward portions of the Oldham Nose structure that lie to the north. The potential for stratigraphic trapping within the Pennsylvanian clastic section present at depth beneath the Deaf Smith area is not well known in part because of limited deep drilling. A possible structural trap is noted to exist east of the site.

In summary, while the lack of historic production provides a strong argument in favor of a low hydrocarbon potential for the Palo Duro Basin, other data suggests that undiscovered hydrocarbon resources should exist and be the objective of future exploration. Resolution of the issue of thermal maturity within the basin could provide key data and should be a subject of further basin studies undertaken during site characterization.

References

Warren, J. K. (1987), "Evaporites", Geotimes. Vol. 32, No. 2, pp 22-23.

Ruppel, S. C., (1987), "Mississippian System in Palo Duro Basin, Stratigraphy and Oil Potential", Oil and Gas Journal, Feb. 9, 1987, pp 42-46.

Ruppel, S. C. (1987), "Finding Palo Duro Reservoirs Will Require Synthesis of Techniques", Oil and Gas Journal, Feb. 16, 1987, pp 82-85.