The Mancos Shale in the Albuquerque Basin:  
A Play Limited by Structure and Associated Thermal Maturity*  

Ron Broadhead¹  

Search and Discovery Article #11274 (2019)**  
Posted December 16, 2019  

*Adapted from oral presentation given at 2019 AAPG Rocky Mountain Section Meeting, Cheyenne, Wyoming, September 15-18, 2019  
**Datapages © 2019. Serial rights given by author. For all other rights contact author directly. DOI:10.1306/11274Broadhead2019  

¹New Mexico Bureau of Geology and Mineral Resources, a Division of New Mexico Tech, Socorro, NM, United States (ron@nmbg.nmt.edu)  

Abstract  

The Mancos Shale (Upper Cretaceous) has exploratory interest in the nonproductive Albuquerque Basin, a Late Tertiary rift basin formed by dominantly by faults. The Mancos C’ zone is the primary oil producing unit in the San Juan Basin and is of major interest in the Albuquerque Basin. Evaluation of Mancos C thermal maturity is essential to resource evaluation. The Albuquerque Basin is sparsely drilled with cuttings available only on a few deep wells. To evaluate Mancos C thermal maturity, a published gravity model of Tertiary fill thickness was used to project depth to the Mancos C in undrilled areas. A depth-dependent maturation model based on vitrinite reflectance was developed. Together these two models allowed estimation of thermal maturity throughout the basin. Depth to Mancos C varies widely. The Zianna Uplift in the north bifurcates the basin. A deep arm west of the uplift has higher oil potential with the Mancos C at or near peak oil generation over a 60 mi² area. To the east of the uplift lies a divide that separates the Albuquerque Basin from the Santo Domingo Basin to the north. The Mancos C on the divide is at peak oil generation and has higher oil potential of a 30 mi² area. The Mancos C has insufficient thermal maturity on the Zianna Uplift and on uplifted blocks east and west of the Albuquerque Basin. To the south of the Zianna Uplift, the basin is deeper, and the Mancos C is within the thermogenic gas window.
The Mancos Shale in the Albuquerque Basin: A play limited by structure and associated thermal maturity

*Ron Broadhead*
New Mexico Bureau of Geology & Mineral Resources
a Division of New Mexico Tech
Outline of talk

• Purpose of research
• Geologic framework – structure & stratigraphy
• Thermal maturation profiles of key wells
• Thermal maturation model developed from Ro data
• Model used to project maturation into undrilled areas
• Thermal maturity of southern part of basin where model is invalid
• Summary
Rio Grande rift basins - Late Tertiary
Purpose of Project

A proposed exploratory well intended to test the Mancos Shale near the city of Rio Rancho in south-central Sandoval County raised concerns among citizens groups about the effects of possible drilling and oil production of scarce groundwater supplies in the region. The Sandoval County Planning and Zoning Dept. and the County Commission requisitioned this study of Sandoval County to determine the potential for oil resources, and therefore possible production as well as potential environmental impacts of production on groundwater aquifers. This presentation focuses on the resource potential.
Tectonic subdivisions of Albuquerque Basin
Shell #1 Santa Fe
Mancos C at 5420 ft (+333 ft MSL)
New Mexico Bureau of Geology & Mineral Resources
Sandoval County Project
Structural cross section
Datum = sea level

R. Broadhead 2/2018
Thermal maturation Mancos C
Shell No. 1 Santa Fe well
Sec. 18, T13N, R3E, Sandoval County, NM

Mancos C @ 5420 ft
$R_o$ vs depth
Shell No. 1 Santa Fe Pacific

Depth, feet

$R_o = 0.000102 \times \text{(Depth)} + 0.036$

$r^2 = 0.85$
Predicted Thermal maturation Mancos C
Northwest arm Albuquerque Basin
about Sec. 18, T13N, R2E, Sandoval County, NM

Mancos C est. @ 8230 ft
Predicted Thermal maturation Mancos C
Albuquerque-Santo Domingo divide
about Sec. 13, T13N, R3E, Sandoval County, NM

Mancos C est. @ 10,340 ft
Predicted Thermal maturation Mancos C
southern Santo Domingo Basin
about Sec. 32, T15N, R4E, Sandoval County, NM

Mancos C est. @ 13,600 ft
Shell # 1 West Mesa Federal
Mancos C at 17,780 ft
(-11,983 ft MSL)
Thermal maturation Mancos C
Shell No. 1 West Mesa Federal well
Sec. 24, T11N, R1E, Bernalillo County, NM

increasing temperature & time

Mancos C @ 17,780 ft
Mancos C Thermal Maturity in Southern ABQ Basin?

- Modern temperature gradient increases to south
- Depth dependent maturation model not applicable in south, but likely that most of southern basin is in the gas window
SUMMARY

- Albuquerque Basin is a N-S trending Late Tertiary basin of the Rio Grande rift.
- Fault blocks have subdivided Albuquerque Basin into several sub-basins.
- Infilled by Late Tertiary sediments, > 21,000 ft in places, much thinner on shallow fault blocks.
- A maturation model based on a vertical profile of Ro measurements in one well was used to predict thermal maturity in wells without Ro or in undrilled areas.
- Mancos C, the predominant Mancos reservoir in the San Juan Basin, is thermally immature on the shallower fault blocks and is within the thermogenic gas window in the deeper parts of the basin.
SUMMARY (cont’d)

- The Mancos C is within the oil window and at or near peak oil in the northwest arm of the Calabacillas sub-basin (60 mi\textsuperscript{2}) and on the divide that separates the Calabacillas sub-basin and the Santo Domingo sub-basin (30 mi\textsuperscript{2})
- Ro measurements are lacking in southern part of basin, but higher present-day geothermal gradients suggest the Mancos C may be widely in the thermogenic gas zone
Acknowledgements

• Sandoval County Planning & Zoning Department for providing funding
• Mr. Mike Springfield, Director of Sandoval County Planning & Zoning Department
• Dr. Alex Rinehart, NM Bureau of Geology, who worked on environmental aspects of possible future drilling
• Brigitte Felix, NM Bureau of Geology, for GIS support
• Dr. Van Romero & Dr. Dan Fine of New Mexico Tech for facilitating contact with the county