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

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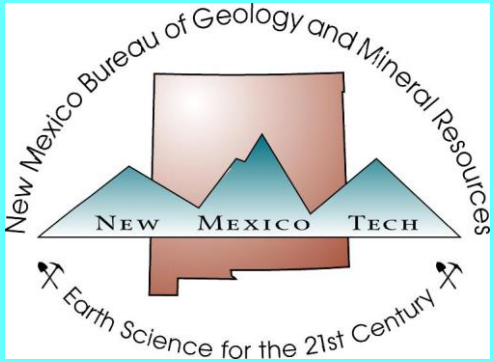
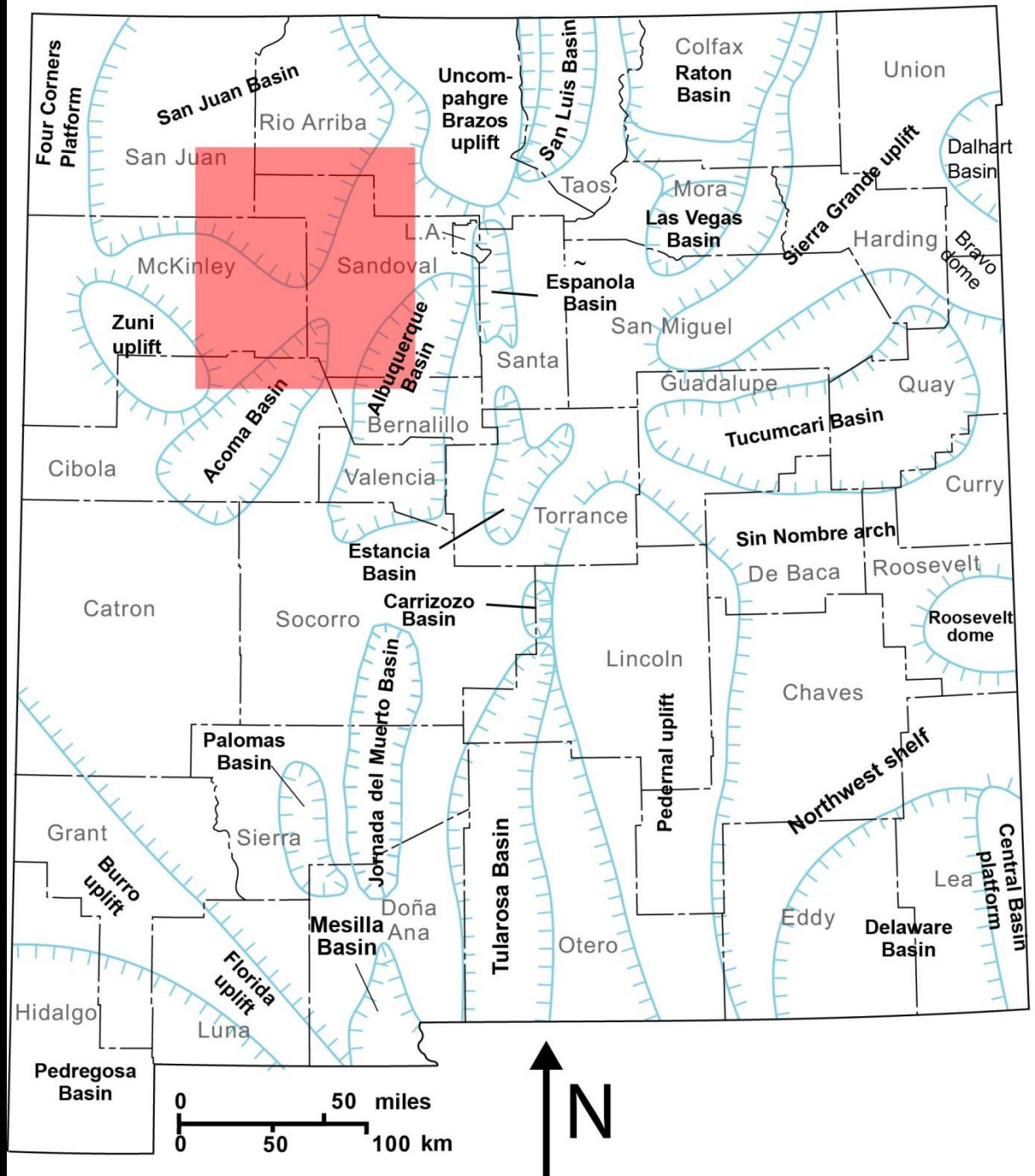
Abstract

Oil has been produced from northwestern Sandoval County at the southeastern end of the San Juan Basin since the 1950's. Cumulative production is 19.2 MMBO. The Mancos Shale (Upper Cretaceous) is the primary producing unit. Most Mancos oil has been produced from the Mancos C zone at the base of the Upper Mancos Shale. Horizontal drilling in the Mancos C caused a resurgence in production from 69.5 MBO in 2011 to 2.1 MMBO in 2015. The Mancos C is 400 to 600 ft thick. Productive reservoir intervals are laminations and thin beds of fine-grained marine shelf sandstones intercalated with kerogen-rich marine shales. TOC of the shales varies from 1 to 3% and generally increases in a northeast, offshore direction. Oil-prone kerogens dominate. In far northwestern Sandoval County where the Mancos C is 5400 ft deep, production has been established in 150 wells. Ro varies from 0.85 to 1.04%. The Mancos C is at peak oil generation throughout most of this area. Depth to Mancos C is approximately 5400 ft in this area and the Mancos C is 400 to 600 ft thick. Southeastward as the Mancos C rises out of the basin, thermal maturity decreases. The Mancos C is immature near its outcrop in central Sandoval County. The southeast limit of Mancos C production coincides roughly with the transition from the lower the upper oil windows. Production is scattered in areas where peak oil generation has not been attained.

The Mancos Shale in the Southeastern San Juan 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



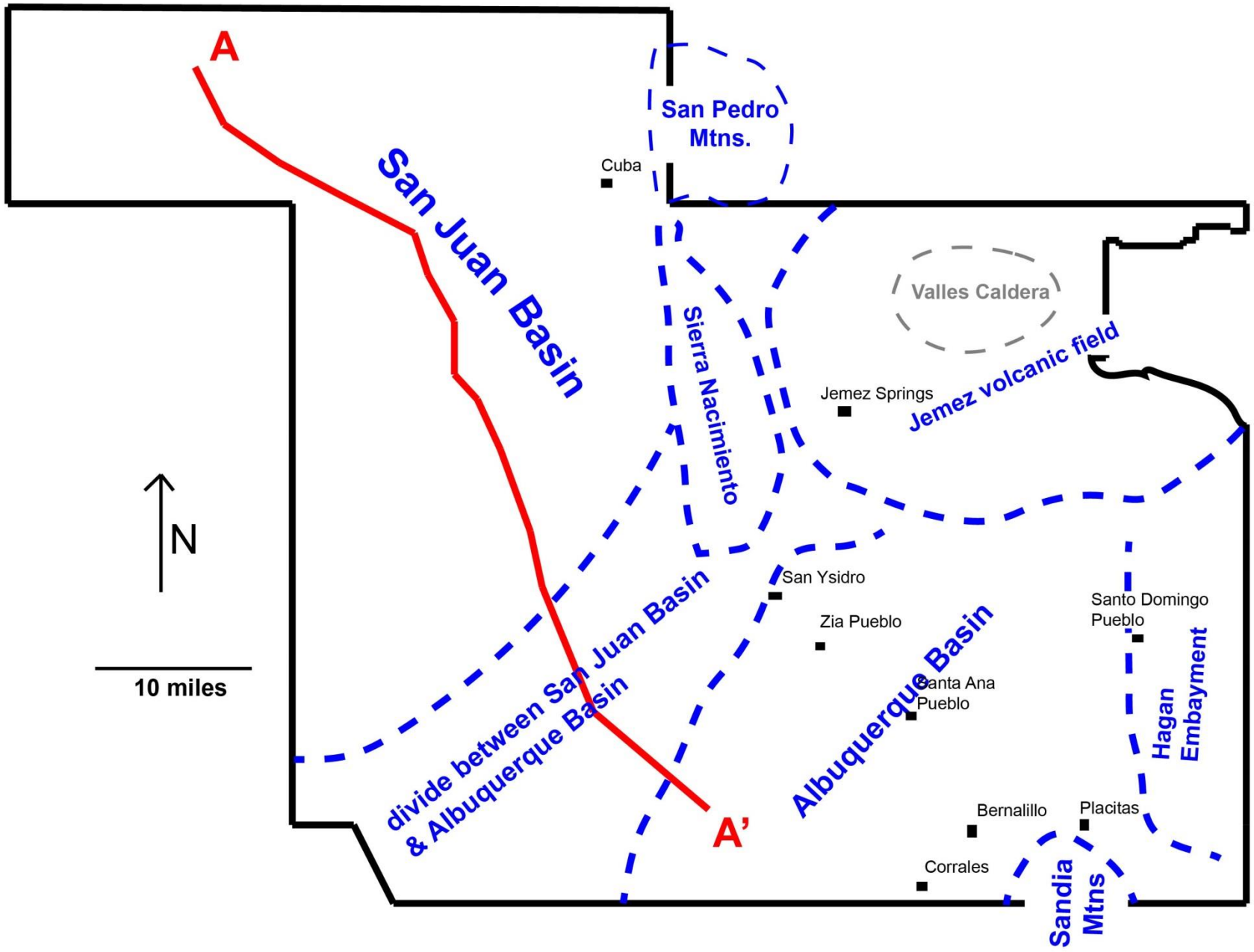

Four Corners Platform
San Juan Basin
Rio Arriba
San Juan
Uncom-pahgre Brazos uplift
San Luis Basin
Colfax
Raton Basin
Union
Dalhart Basin
Taos
Mora
Las Vegas Basin
Sierra Grande uplift
Harding
Bravo dome
L.A.
McKinley
Sandoval
Espanola Basin
Zuni uplift
Albuquerque Basin
San Miguel
Santa
Guadalupe
Quay
Tucumcari Basin
Acoma Basin
Bernalillo
Cibola
Valencia
Curry
Torrance
Sin Nombre arch
Estancia Basin
De Baca
Roosevelt
Catron
Socorro
Carrizozo Basin
Roosevelt dome
Lincoln
Chaves
Jornada del Muerto Basin
Palomas Basin
Pedernal uplift
Northwest shelf
Grant
Sierra
Burro uplift
Tularosa Basin
Central Basin platform
Lea
Doña Ana
Mesilla Basin
Eddy
Delaware Basin
Otero
Florida uplift
Hidalgo
Luna
Pedregosa Basin
0 50 miles
0 50 100 km
N

Outline of talk

- Purpose of research
- General geologic framework
- Production history, oil & gas – Mancos contributions
- Production & petroleum geology of Mancos Shale
- Summary

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.


A
San Pedro Mtns.
Cuba
San Juan Basin
Sierra Nacimiento
Valles Caldera
Jemez volcanic field
Jemez Springs
N
10 miles
San Ysidro
Zia Pueblo
Santo Domingo Pueblo
Albuquerque Basin
Hagan Embayment
Santa Ana Pueblo
divide between San Juan Basin & Albuquerque Basin
A'
Bernalillo
Placitas
Corrales
Sandia Mtns

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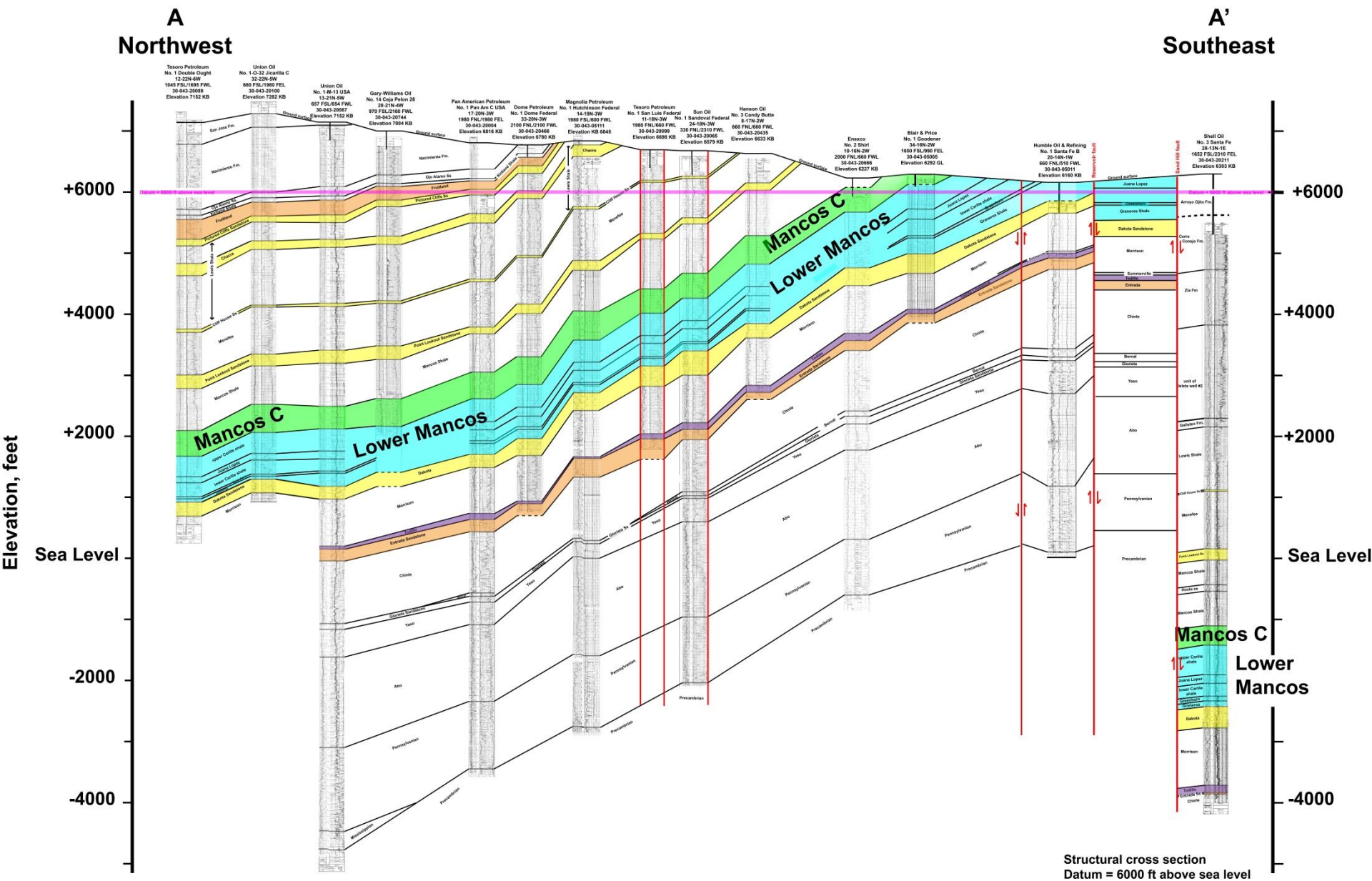
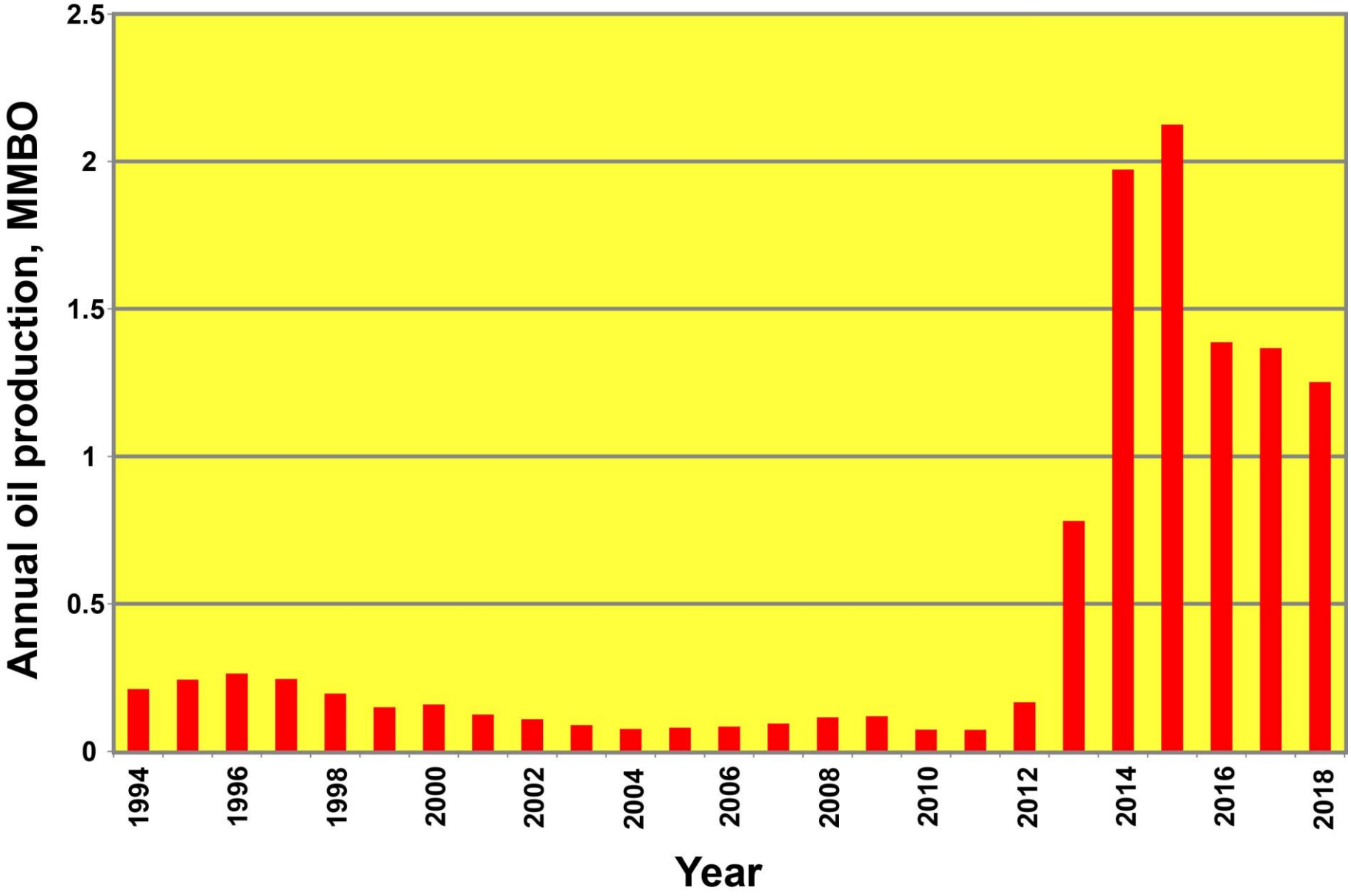
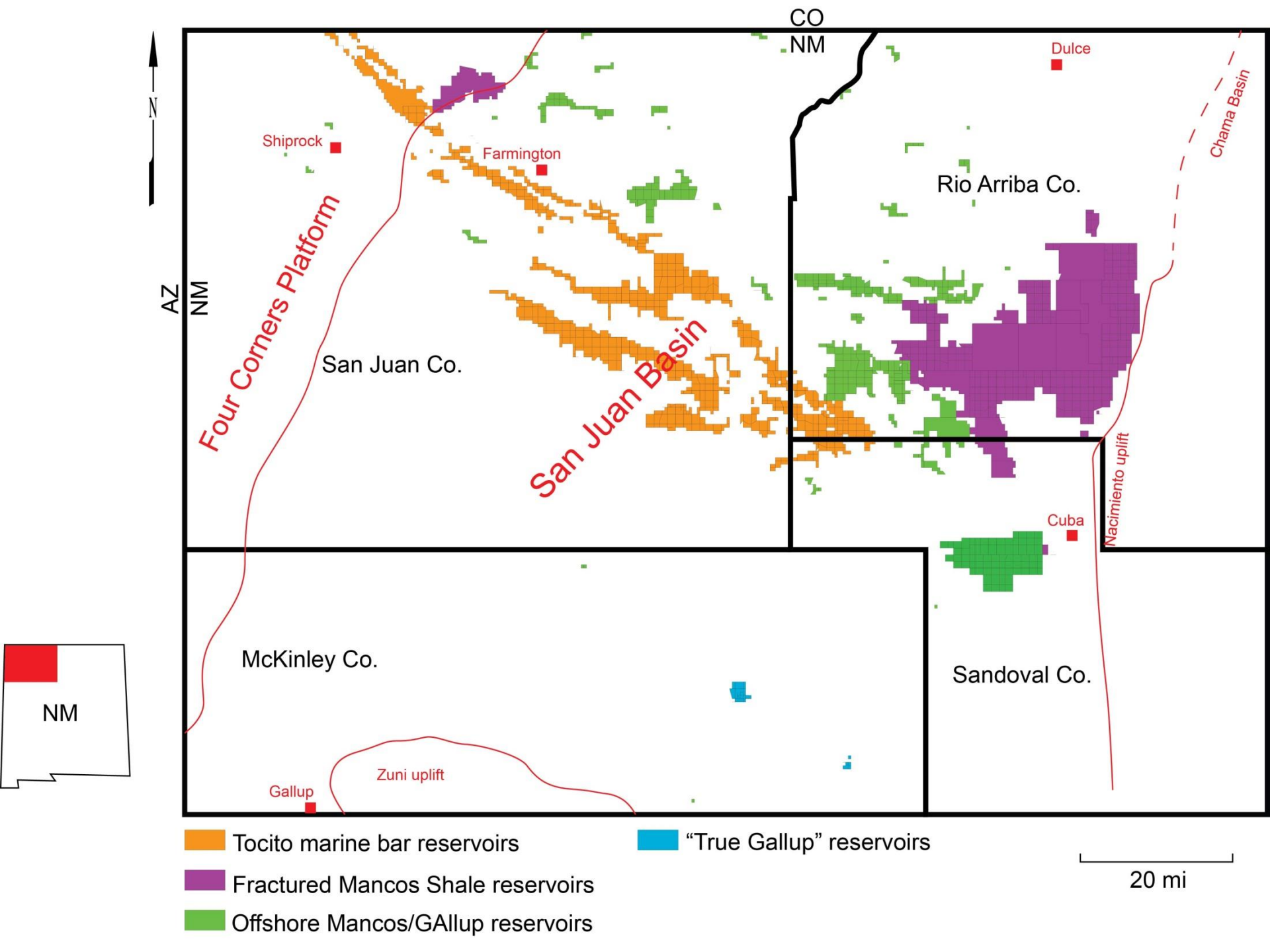
Sandoval County Project

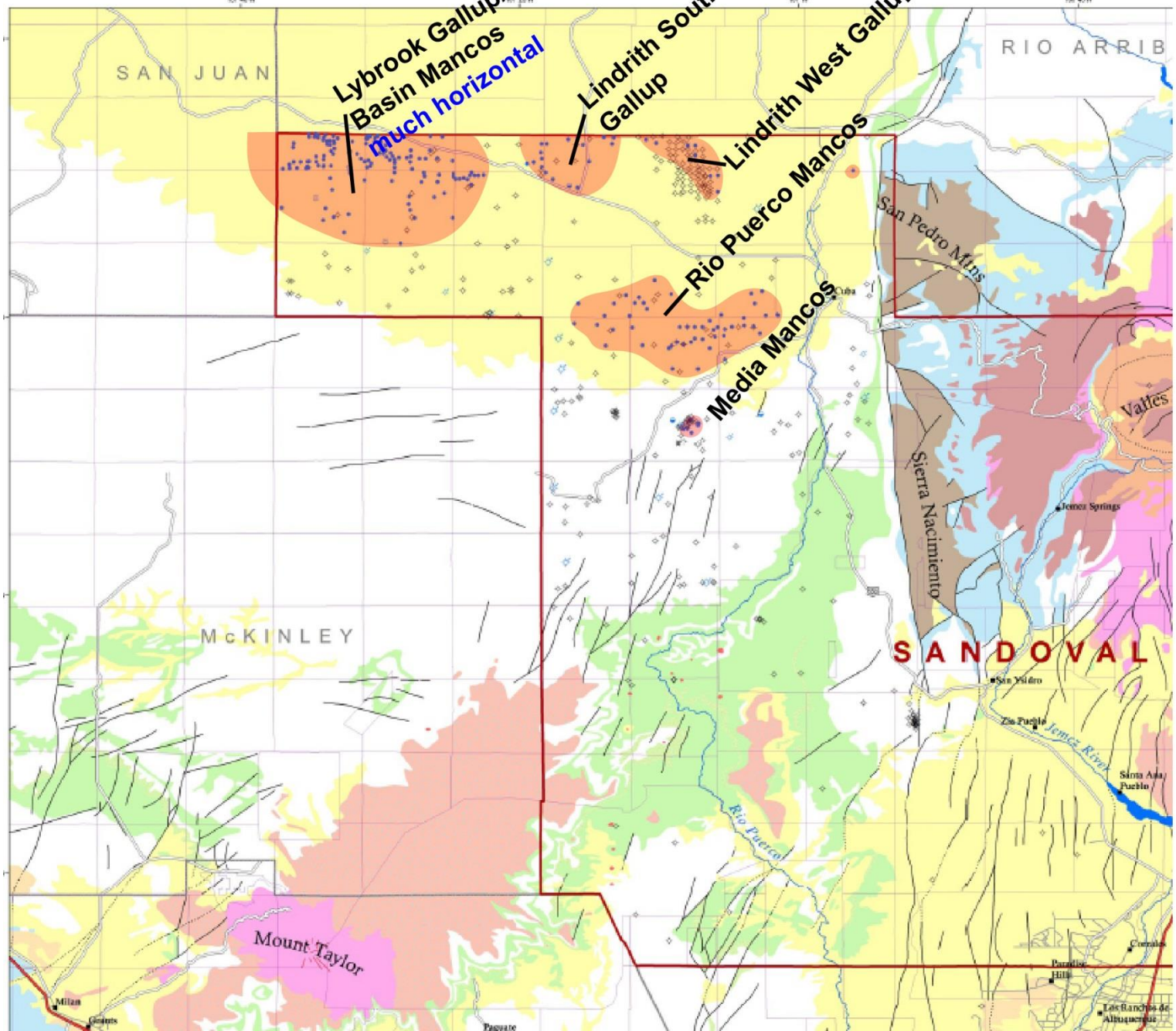


Sandoval County Oil Production




CO
NM
N
AZ
NM
Shiprock
Farmington
Dulce
Chama Basin
Rio Arriba Co.
Four Corners Platform
San Juan Co.
San Juan Basin
Nacimiento uplift
Cuba
McKinley Co.
Sandoval Co.
Zuni uplift
Gallup
NM
Tocito marine bar reservoirs
Fractured Mancos Shale reservoirs
Offshore Mancos/GAllup reservoirs
"True Gallup" reservoirs
20 mi

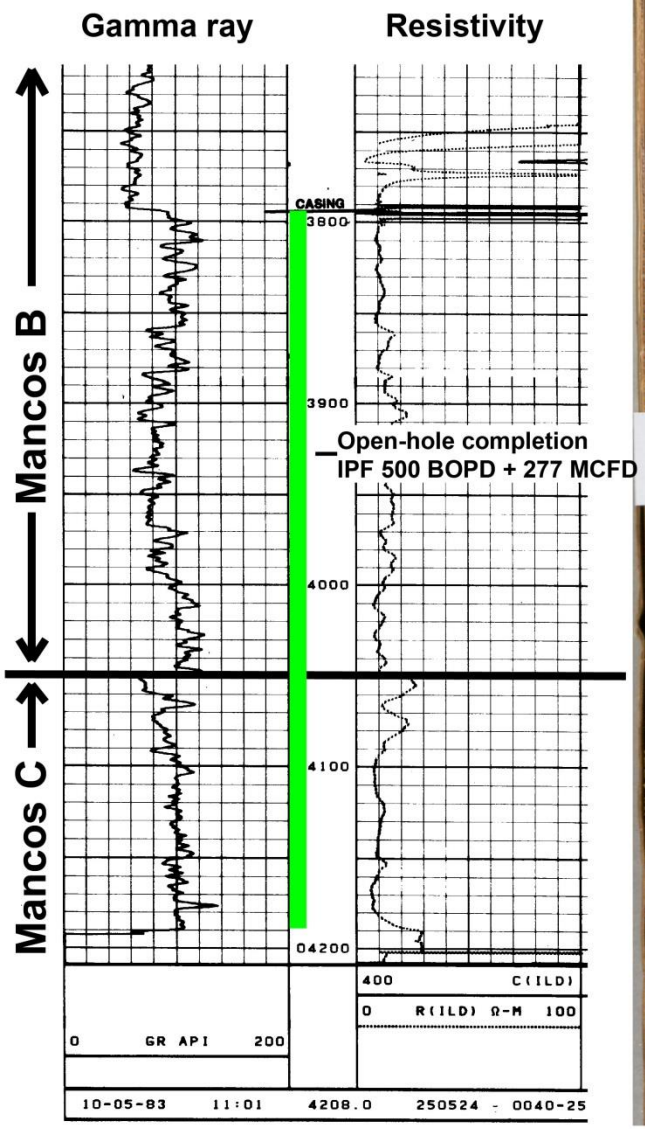
Upper Mancos oil production



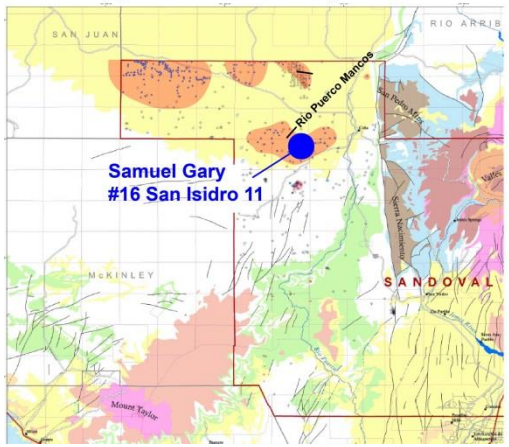
Kirtland Sh	
Fruitland Fm	
Pictured Cliffs Ss	
Lewis Shale	Chacra sands
Cliff House Ss	
Menefee Fm	
Point Lookout Ss	
Upper Mancos Sh	Mancos A
	Mancos B
	Mancos C
Lower Mancos Sh	upper Carlile sh
	Juana Lopez
	lower Carlile sh
	Greenhorn Ls
	Graneros Sh
Dakota Ss	

10 miles

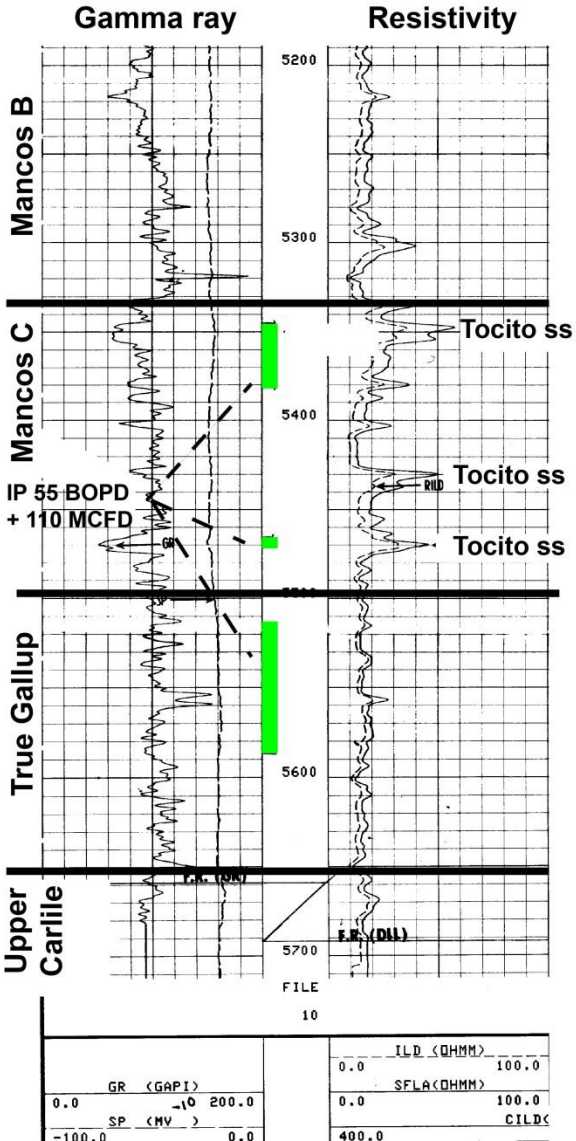
Samuel Gary Oil Producers
No. 16 San Isidro 11
Sec. 11 T20N R3W
Sandoval Co., NM
Rio Puerco Mancos oil pool

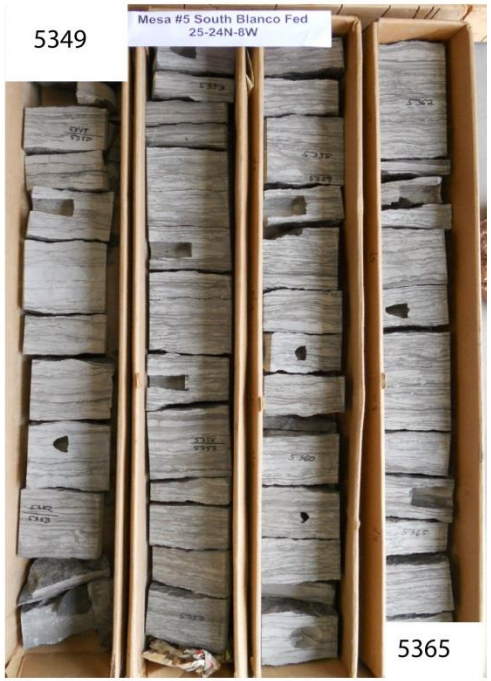


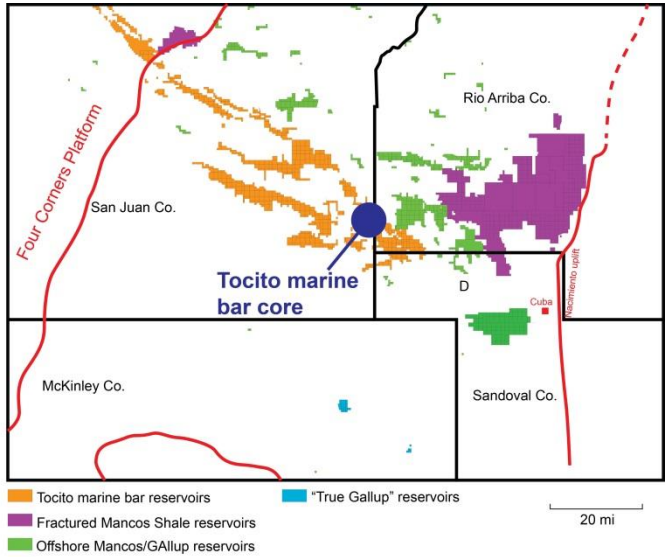
Upper Mancos oil production



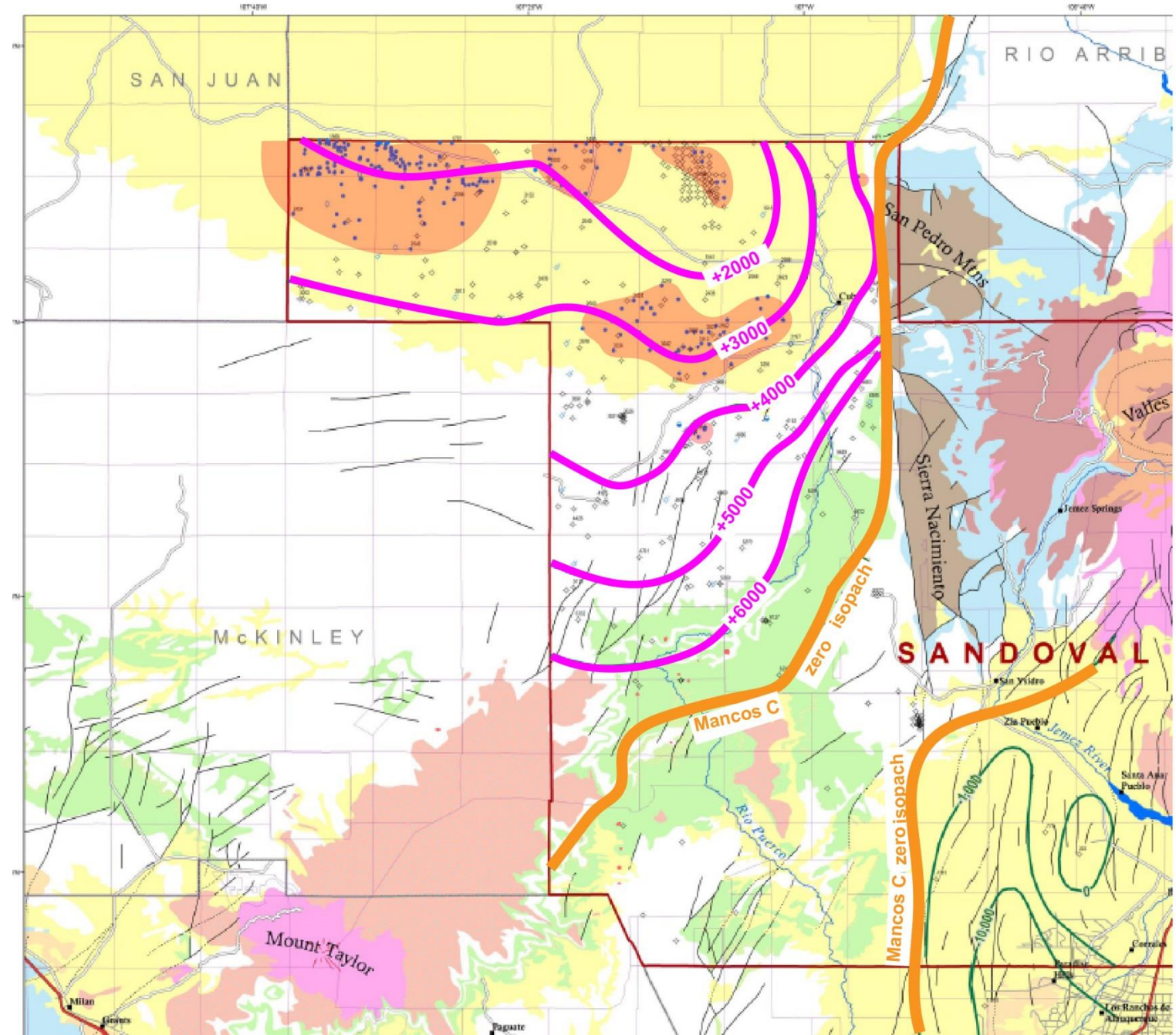
Mesa Petroleum
No. 5 South Blanco 25 Fed.
Sec. 25 T24N R8W
San Juan Co., NM
Lybrook Gallup oil pool







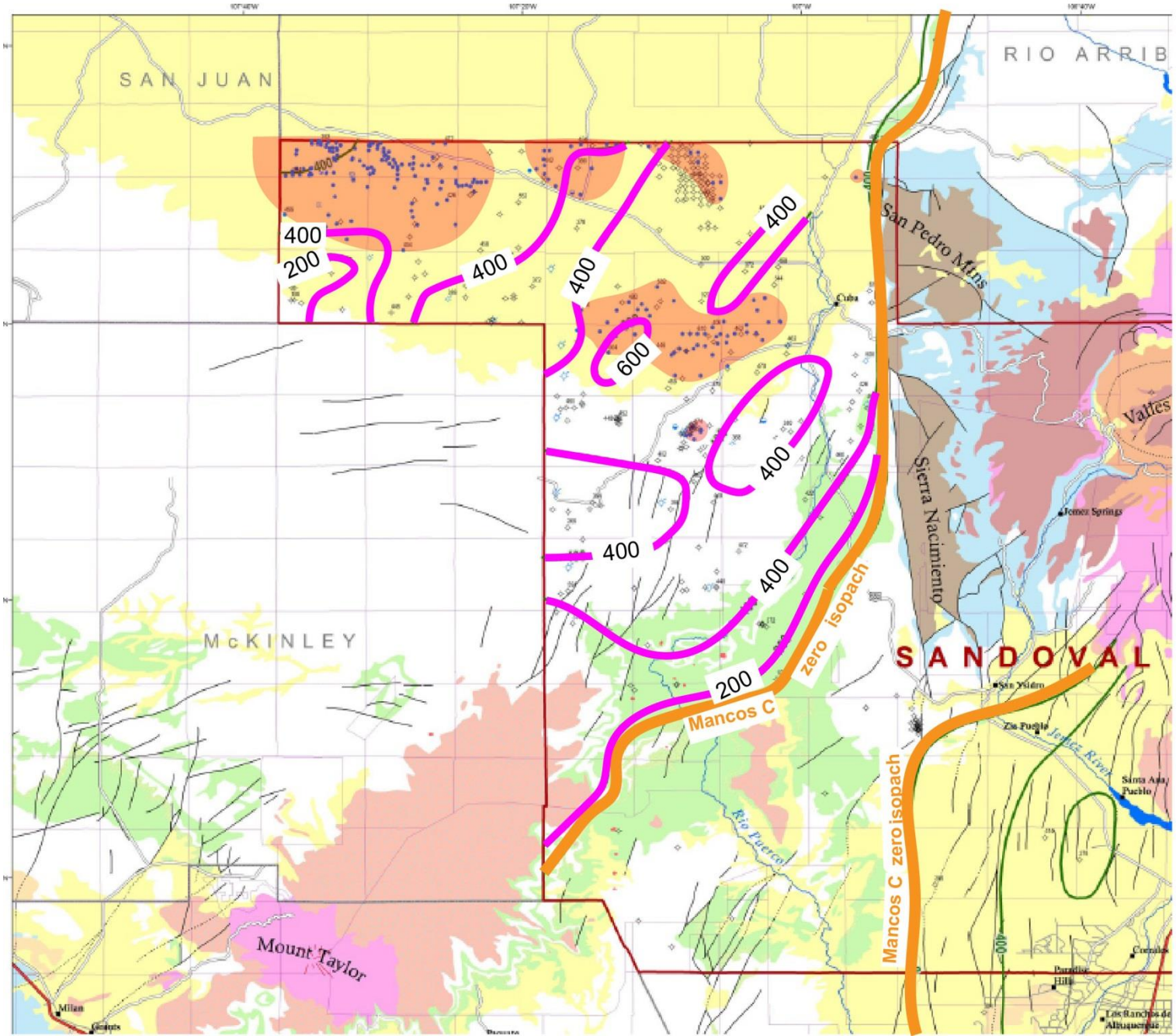
Mancos C Structure



Kirtland Sh	
Fruitland Fm	
Pictured Cliffs Ss	
Lewis Shale	Chacra sands
Cliff House Ss	
Menefee Fm	
Point Lookout Ss	
Upper Mancos Sh	Mancos A
	Mancos B
	Mancos C
Lower Mancos Sh	upper Carlile sh
	Juana Lopez
	lower Carlile sh
	Greenhorn Ls
	Graneros Sh
Dakota Ss	

10 miles

Mancos C Isopach



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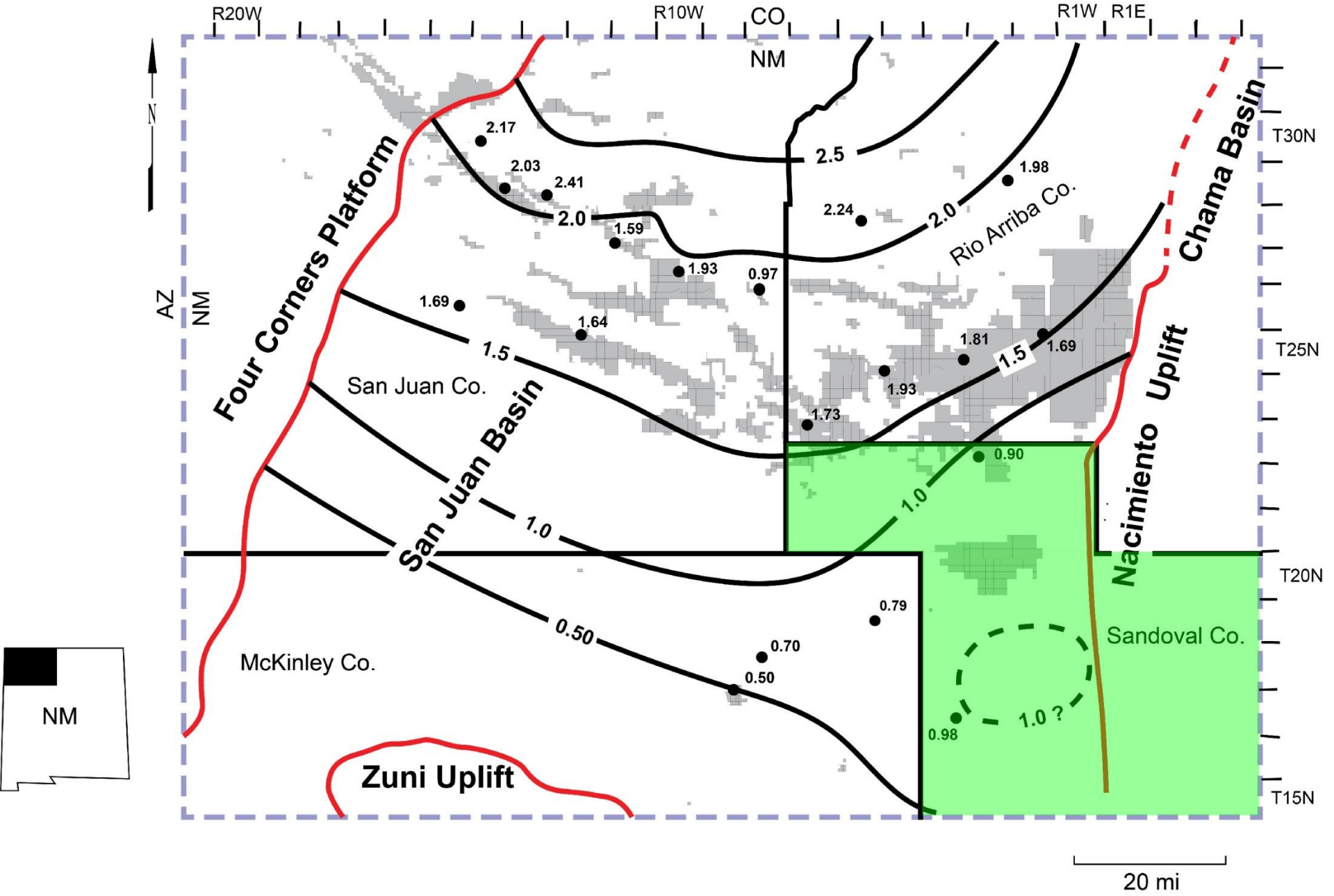
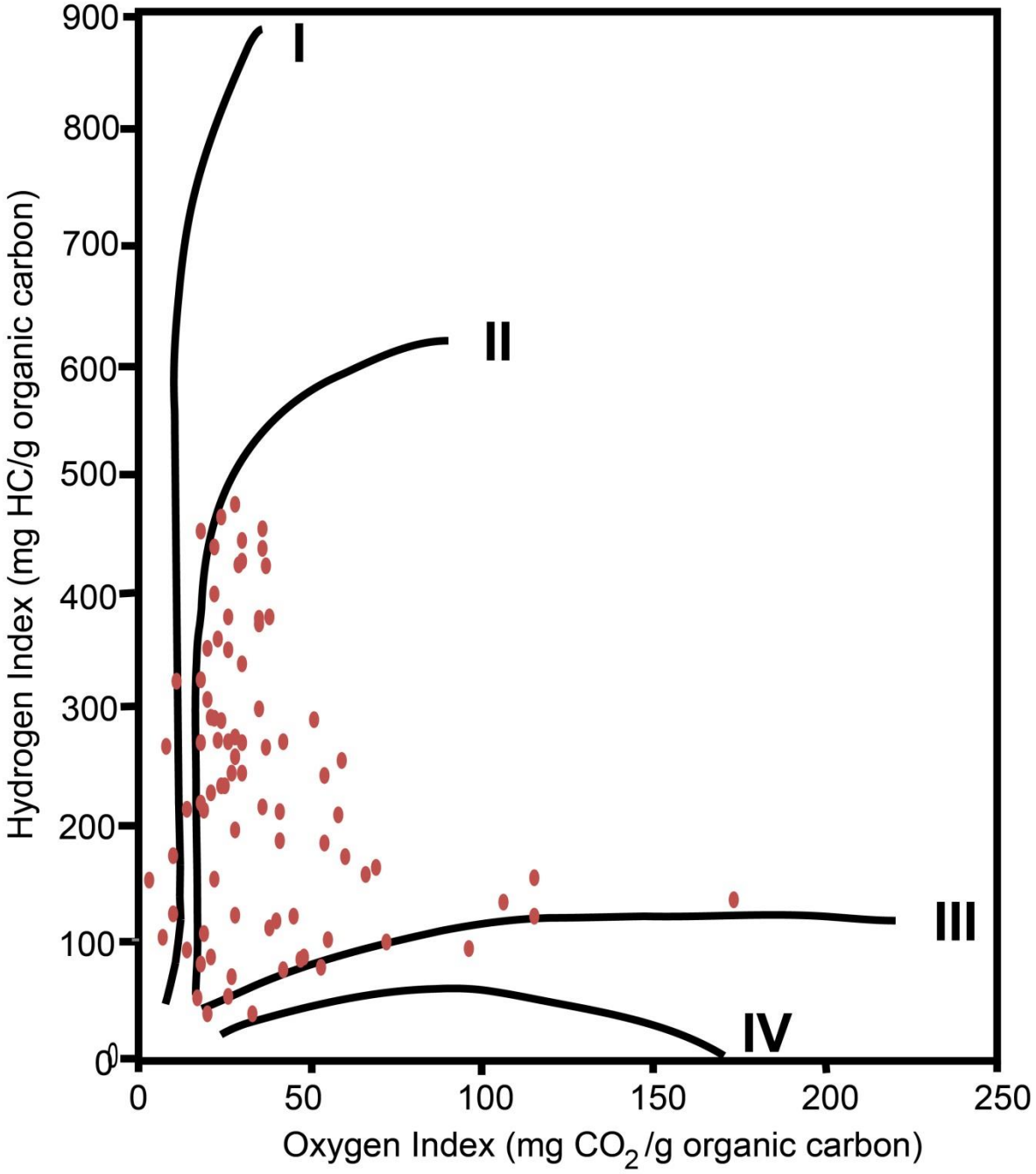
	Mancos C
Lower Mancos Sh	upper Carlile sh
	Juana Lopez
	lower Carlile sh
	Greenhorn Ls
	Graneros Sh
Dakota Ss	

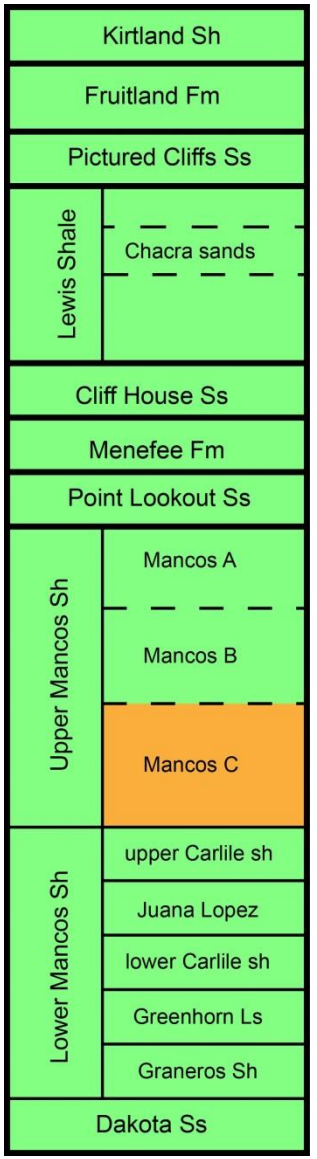
10 miles

Mancos C Total Organic Carbon



Mancos C


900
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
I
II
III
IV
Hydrogen Index (mg HC/g organic carbon)
Oxygen Index (mg CO_2 /g organic carbon)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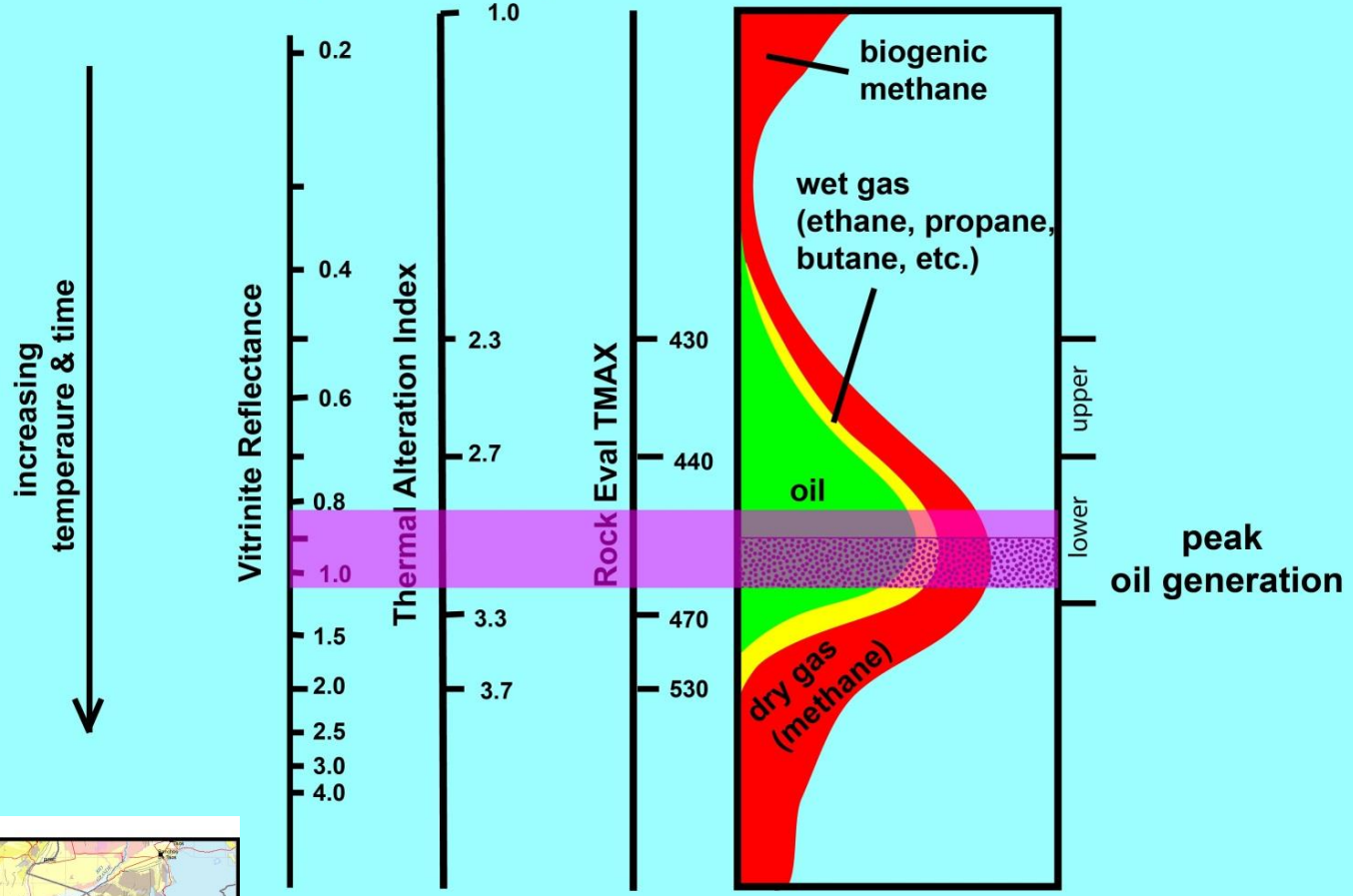
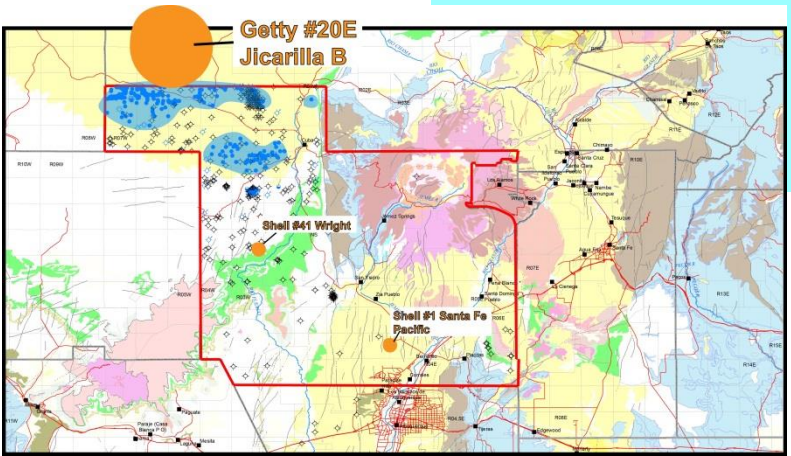
Mancos A
Mancos B
Mancos C
Lower Mancos Sh
upper Carlile sh
Juana Lopez
lower Carlile sh
Greenhorn Ls
Graneros Sh
Dakota Ss

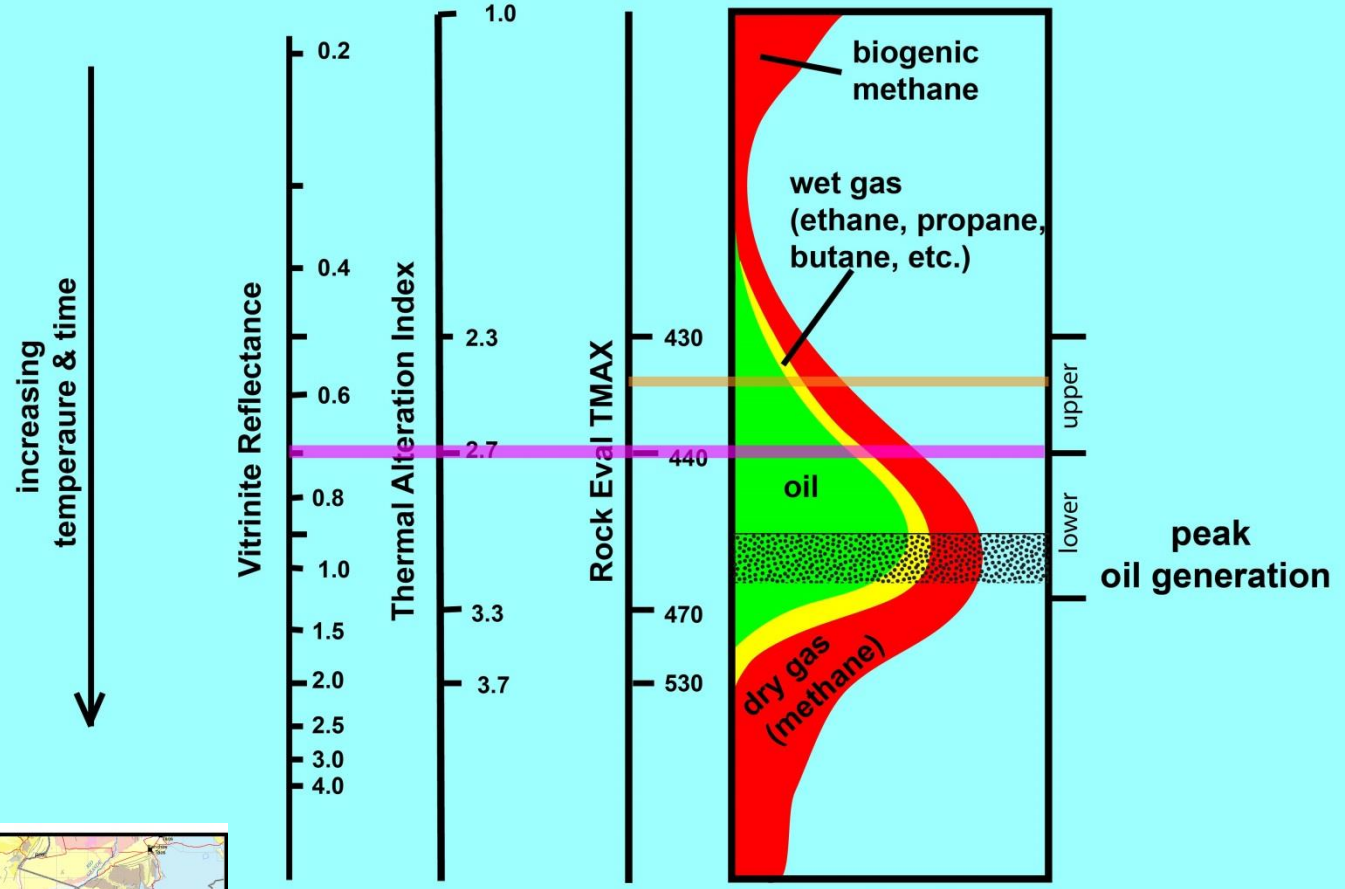
Thermal maturation Mancos C
Getty No. 20E Jicarilla B well
Sec. 31, T25N, R5W, Rio Arriba County, NM

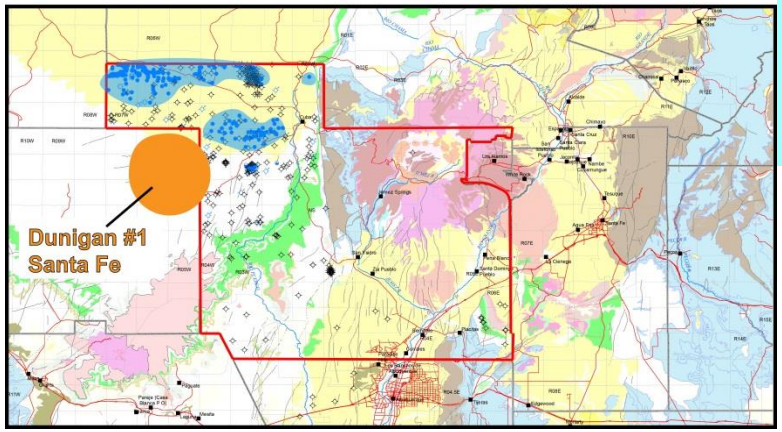




Mancos C @ 5994 ft

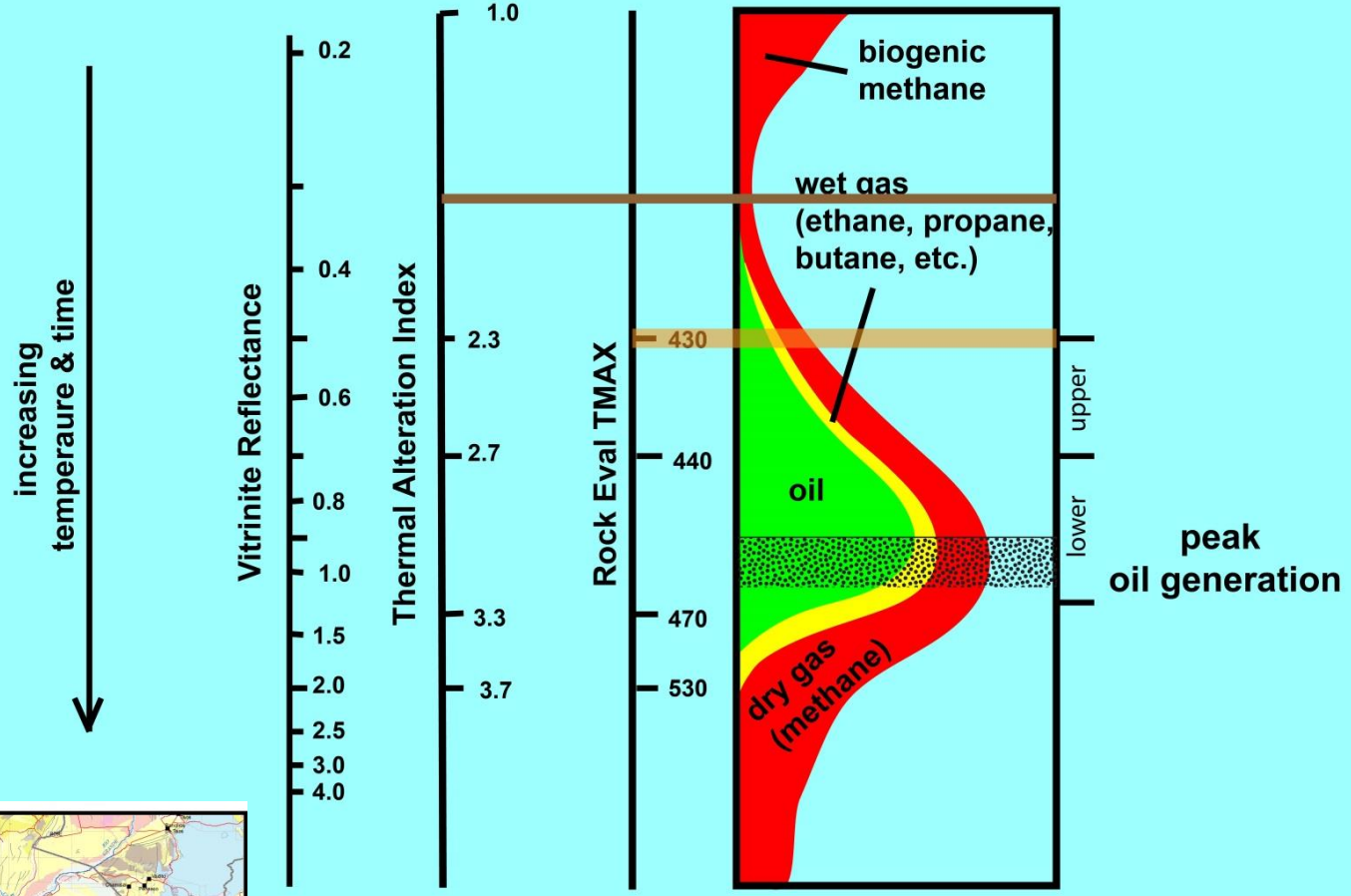
Thermal maturation Mancos C
Dunigan No. 1 Santa Fe well
Sec. 31, T19N, R5W, McKinley County, NM

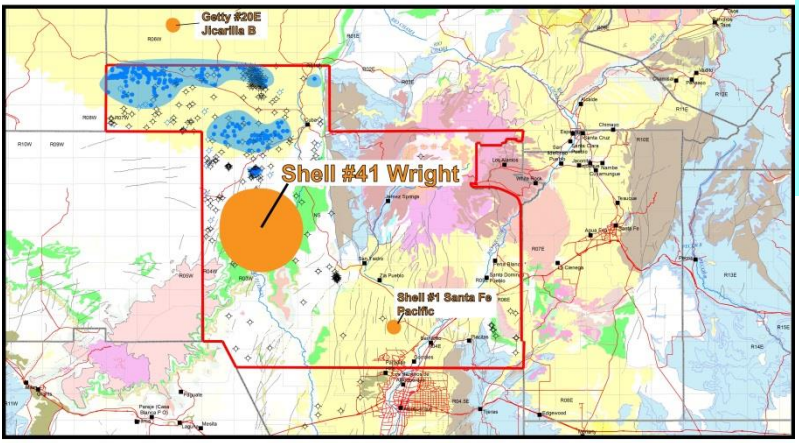




Mancos C @ 2804 ft

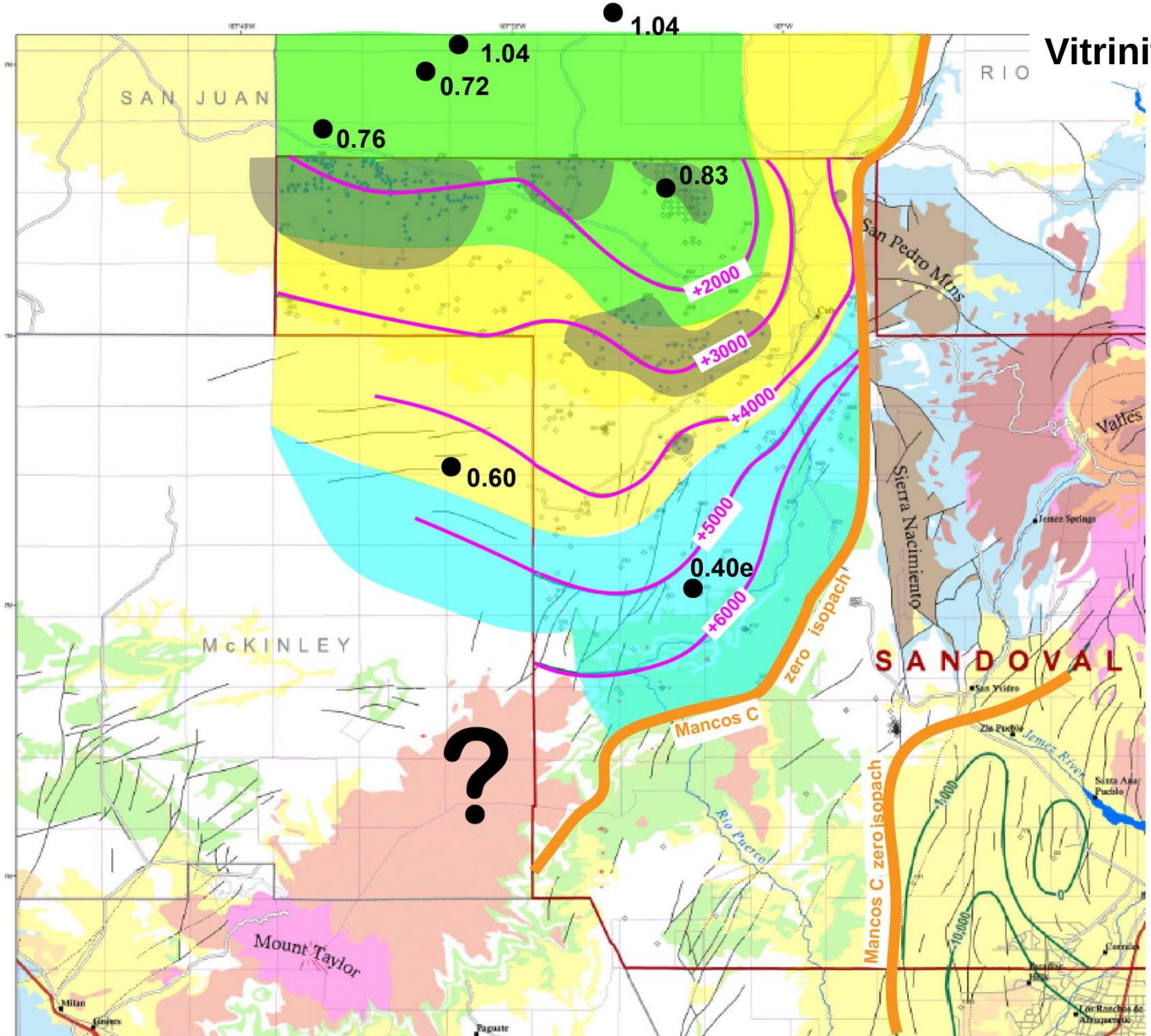
Thermal maturation Mancos C
Shell No. 41 Wright well
Sec. 26, T17N, R3W, Sandoval County, NM





Mancos C @ 972 ft

Mancos C Thermal Maturity



Vitrinite Reflectance

immature

upper oil window

lower oil window

10 miles

Summary

- In southeast San Juan Basin, strata are abruptly terminated to east by high-angle faults that form mountain ranges
- On the southeast into Sandoval County strata gradually rise to surface where they are truncated by erosion
- Production of oil and associated gas revitalized since 2012 by horizontal drilling in Mancos Shale
- The Mancos C zone of the Upper Mancos Shale dominates Mancos production and has been the object of recent horizontal drilling

Summary (cont'd)

- **Mancos C sands in southeast San Juan Basin are finer grained and more bioturbated than Tocito sands to northwest, resulting in poorer reservoirs that inhibit migration**
- **Limits of oil accumulations on the southeast are controlled primarily by thermal maturity**
- **Thermal maturity is controlled by depth of burial with Mancos shales mature and productive to northwest and immature and nonproductive where they rise out of the basin to the southeast**

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