

The Mancos Shale and “Gallup” zones in the San Juan Basin: geologic framework, historical production, future potential

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What is the Mancos Shale?

- **“layer of rock” Late Cretaceous in age (80-95 my old)**
- **Distributed throughout much of western U.S., deposited in Western Cretaceous Interior Seaway**
- **Preserved in Laramide (latest Cretaceous to Early Tertiary Basins)**
- **Traditionally viewed as a source rock of oil and natural gas and as a seal for conventional reservoirs**
- **Now viewed in places as a major reservoir of unconventional oil and natural gas producible through horizontal well technology**

The Mancos Shale was deposited over a large portion of the Western Interior Cretaceous Seaway

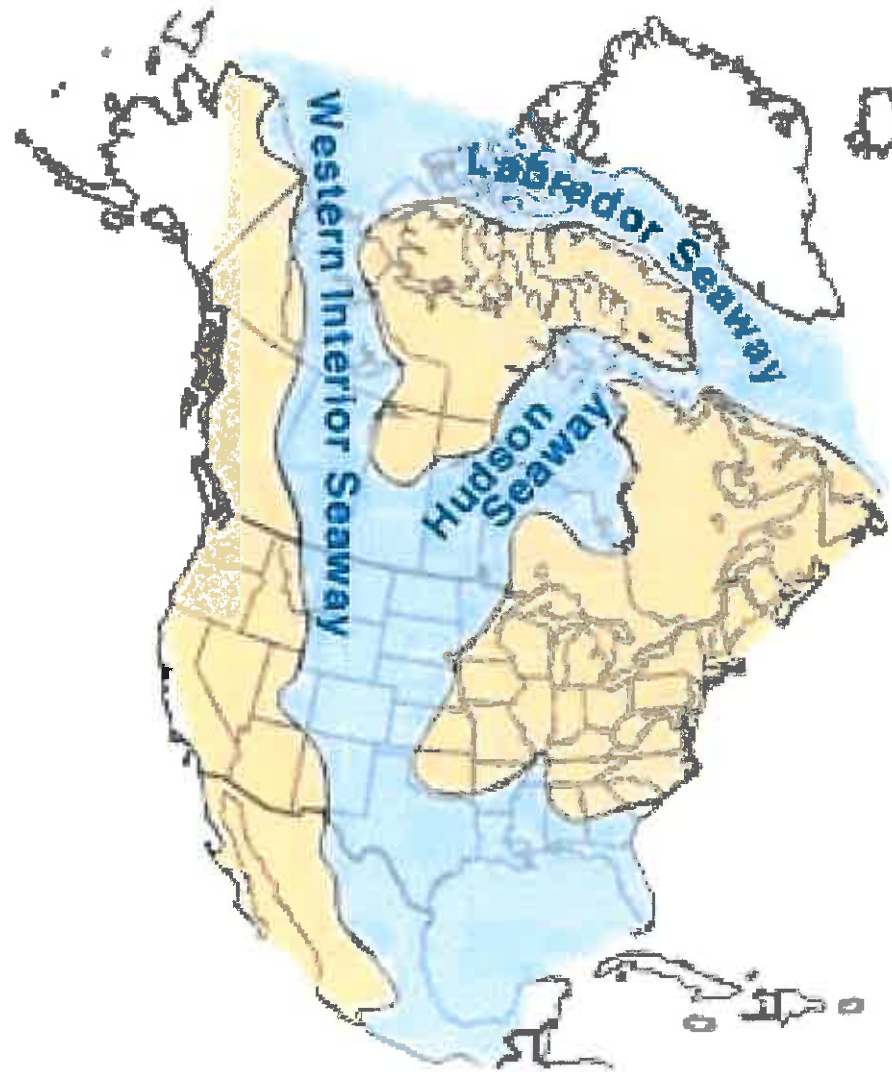
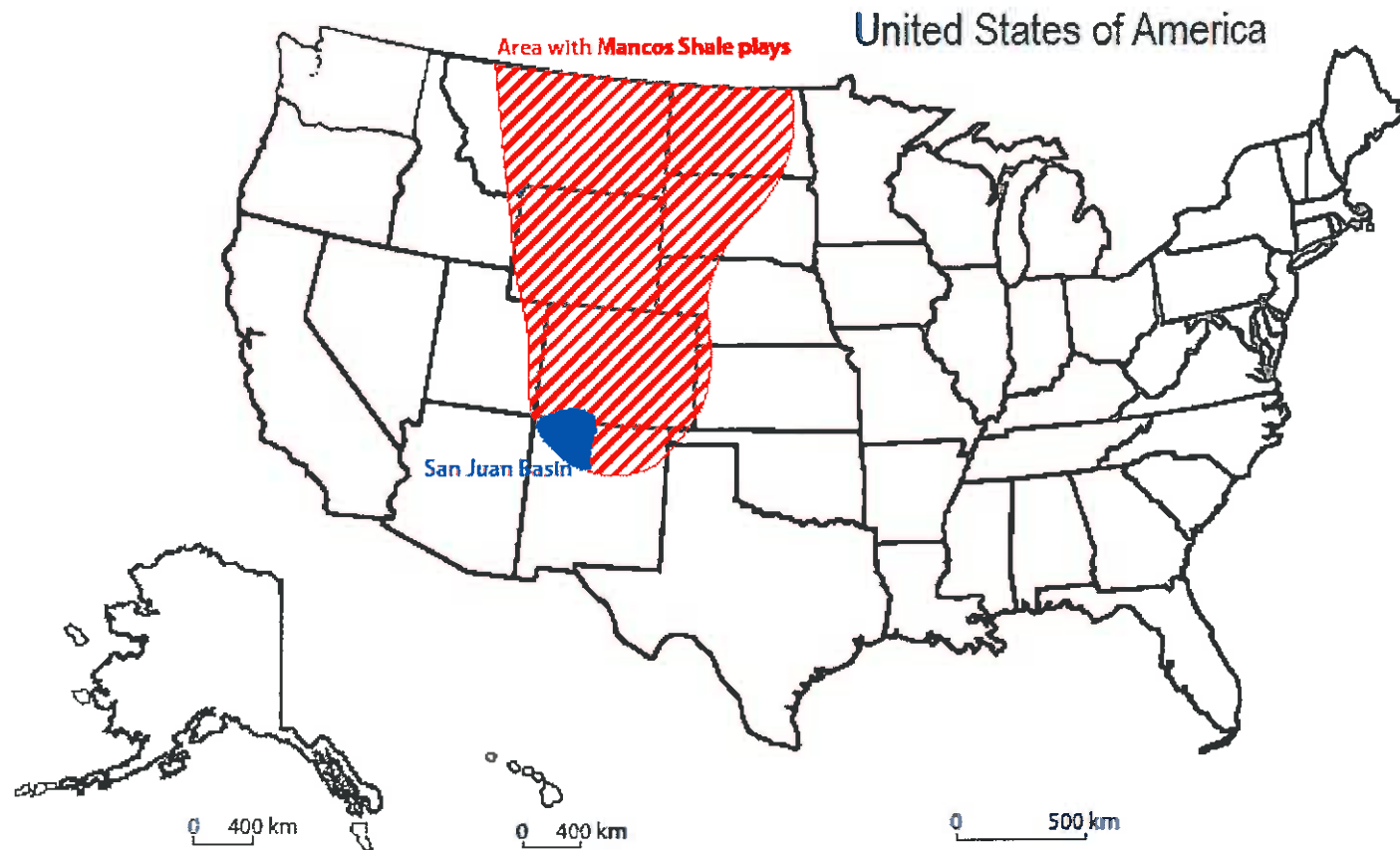


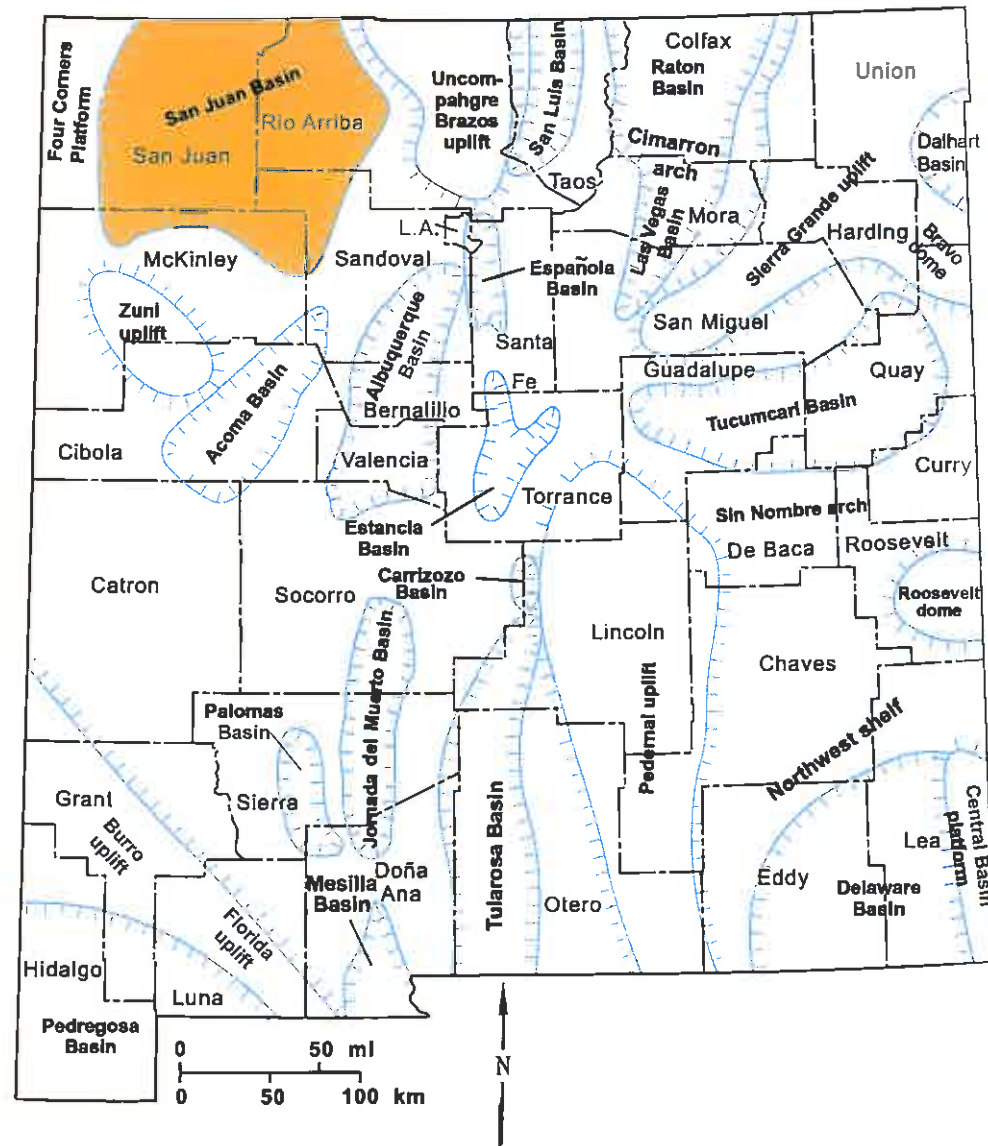
Figure by William A. Cobban and Kevin C. McKinney,
courtesy of U.S. Geological Survey

Mancos Shale plays, western U.S.

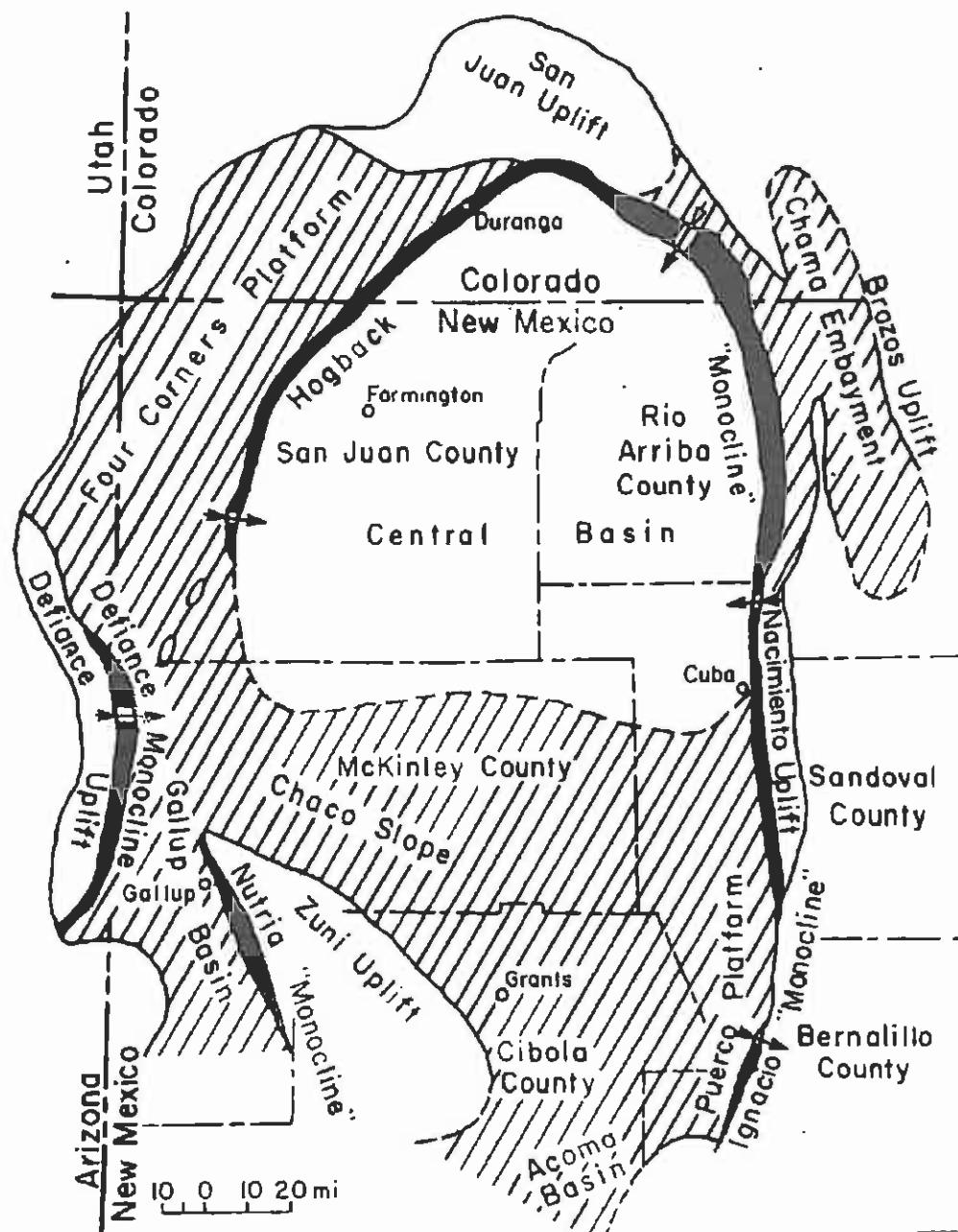


Mancos Shale plays boundary from Sonnenberg (2011)

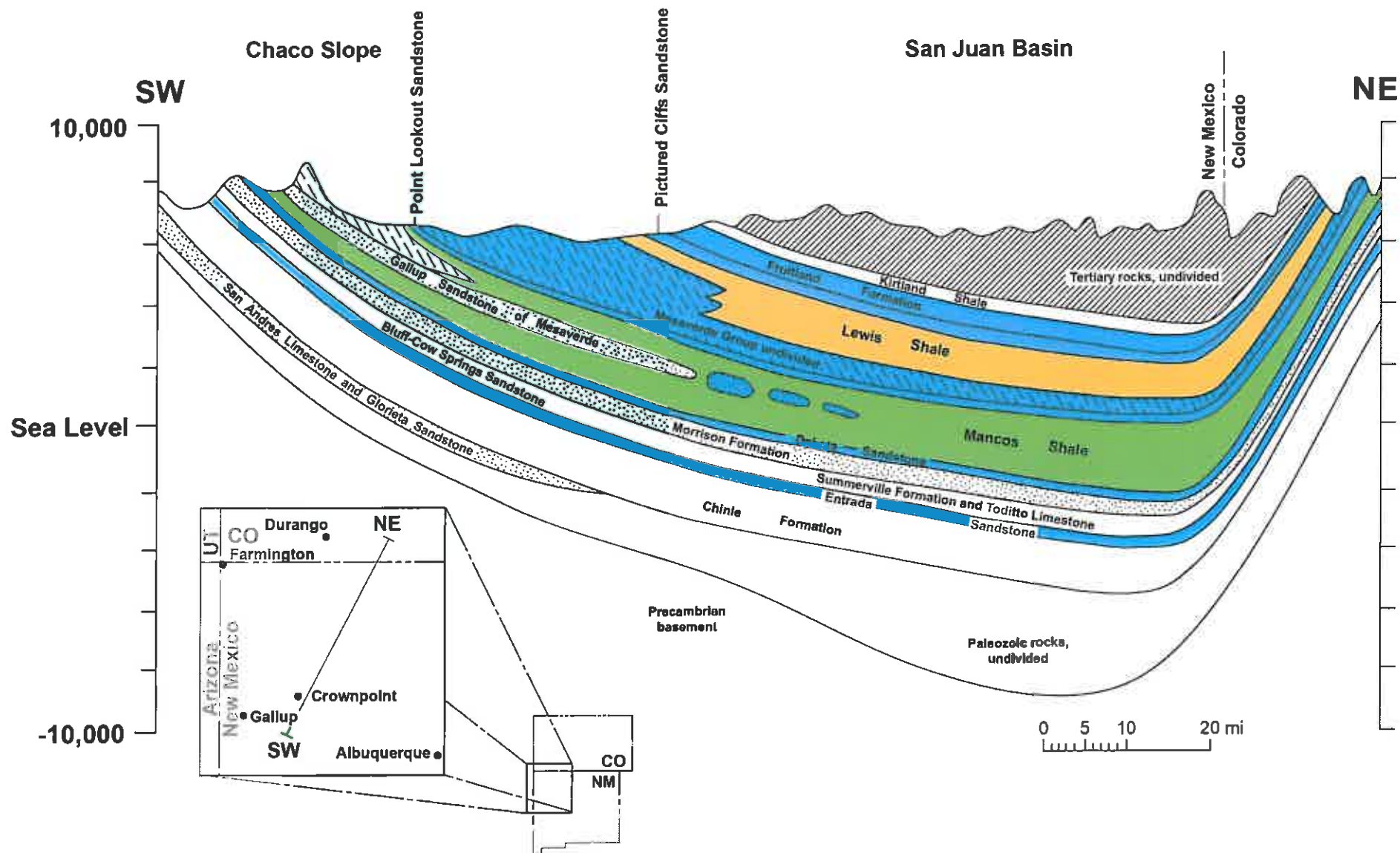
San Juan Basin



San Juan Basin geology

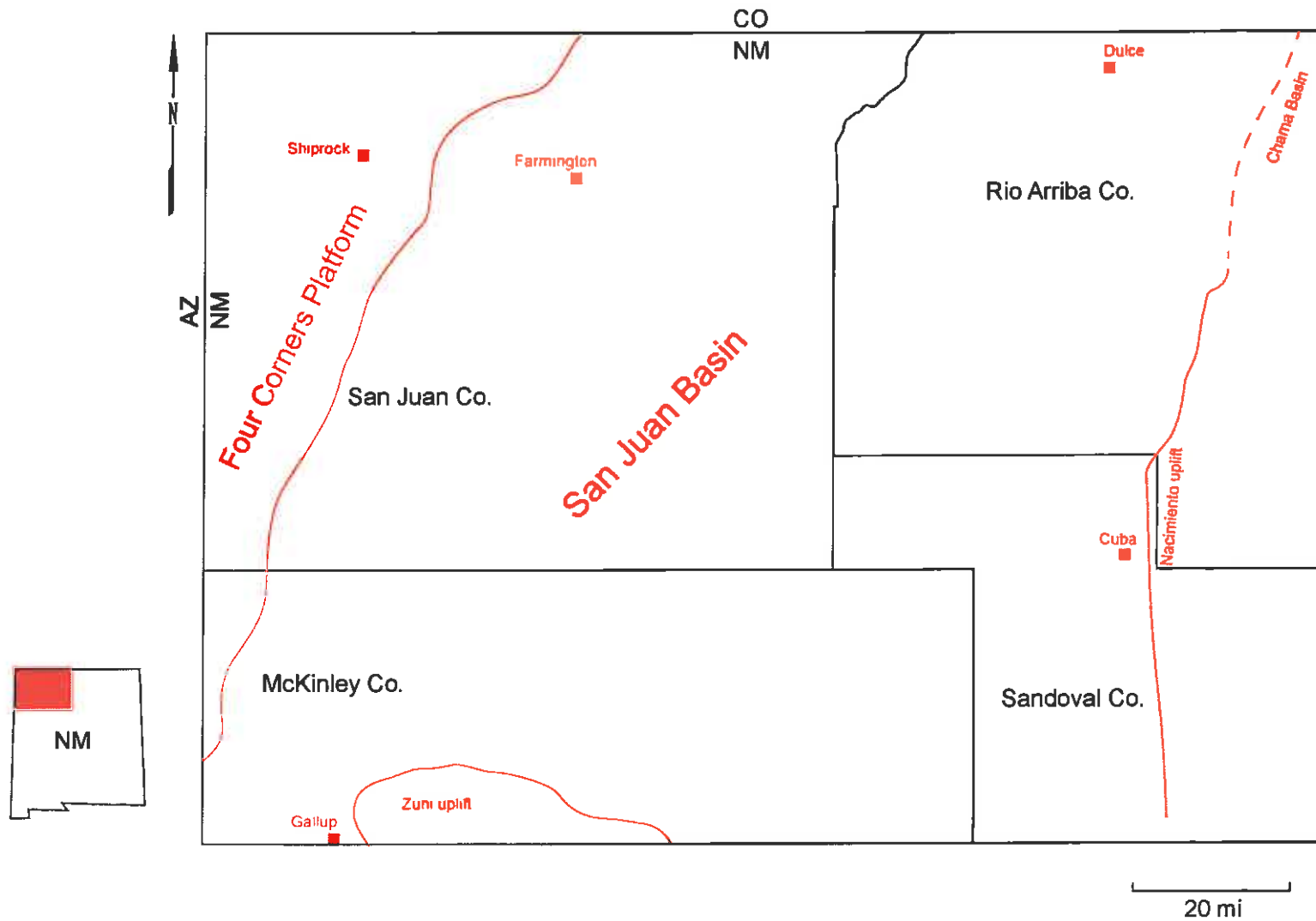


From Stone and others (1983)

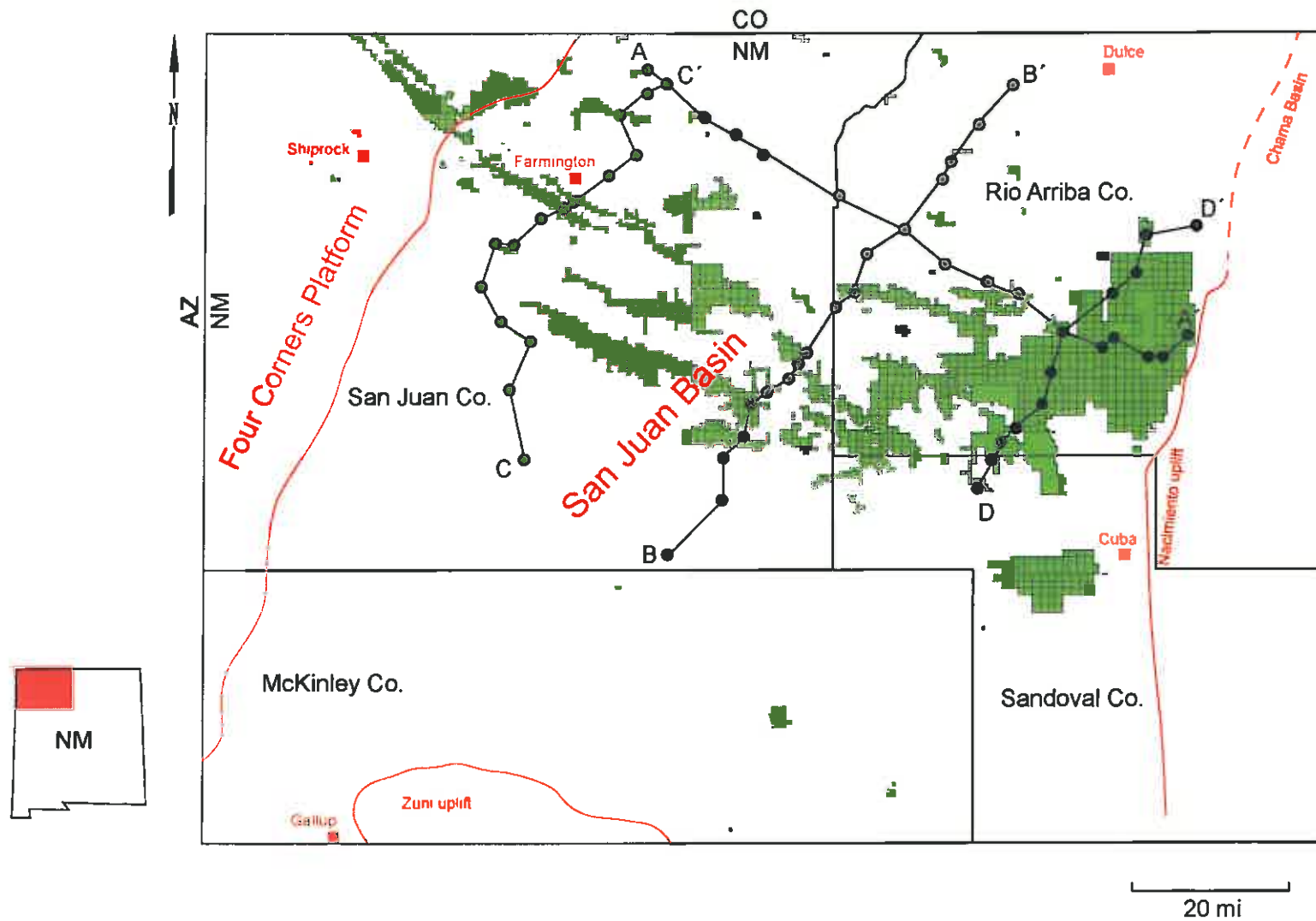


Cross section from Stone and others (1983)

Close-up of basin boundaries in NM



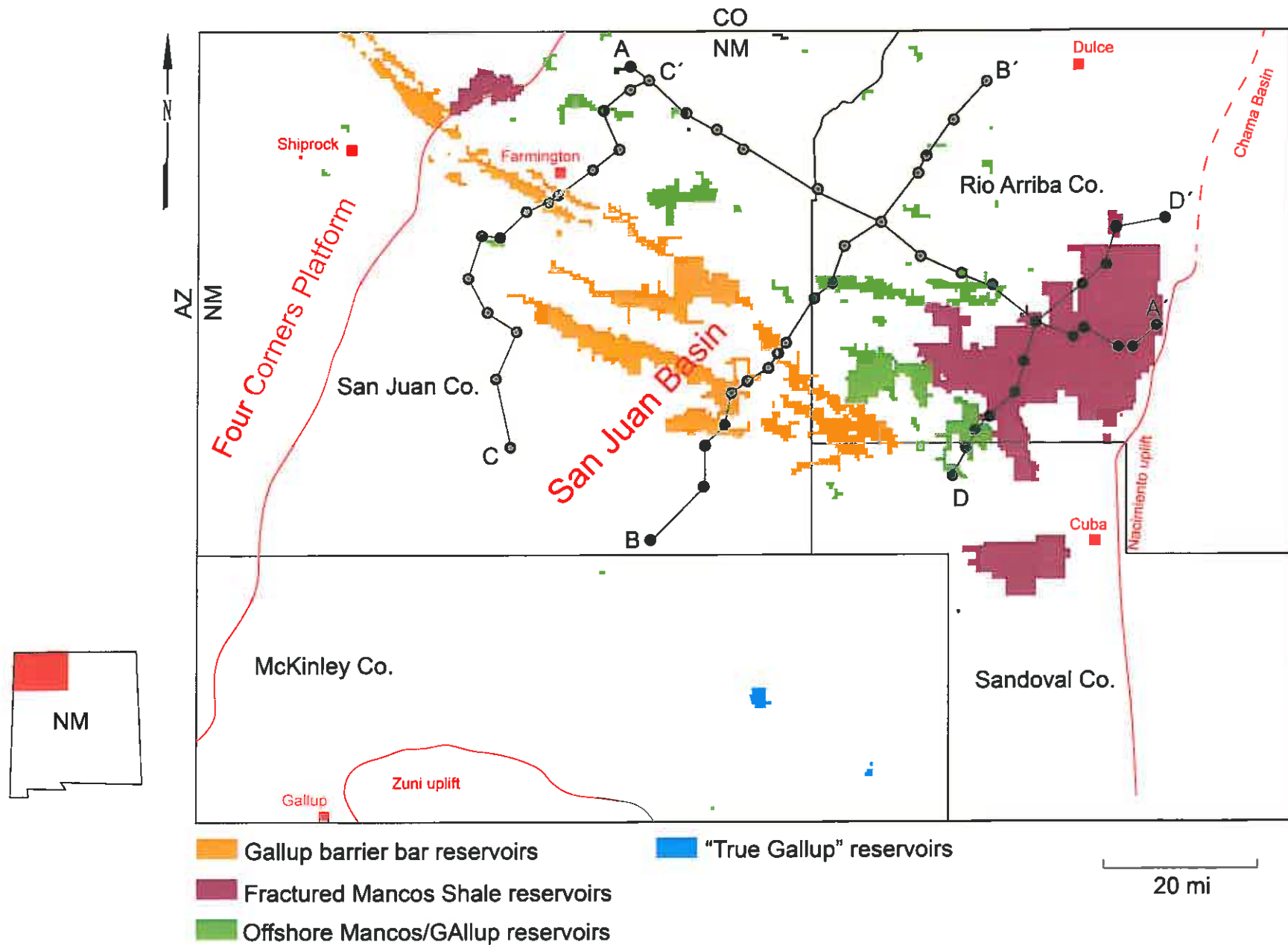
Mancos and “Gallup” reservoirs

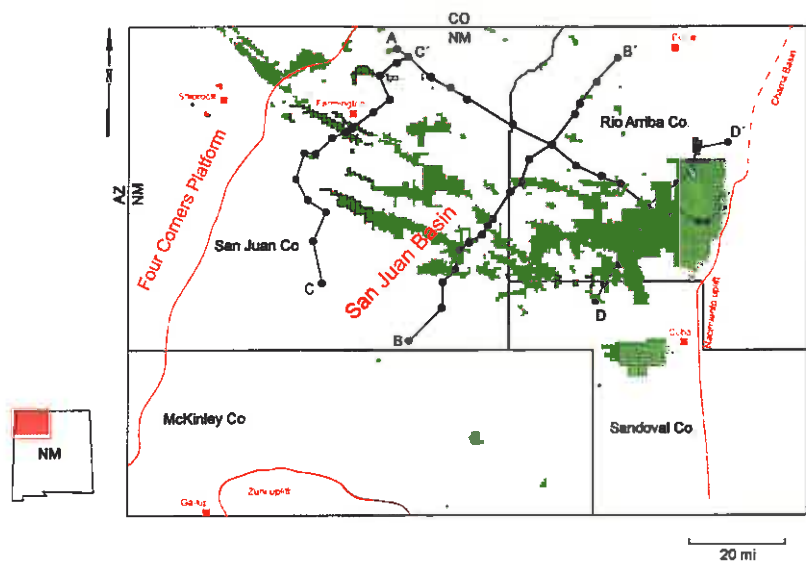
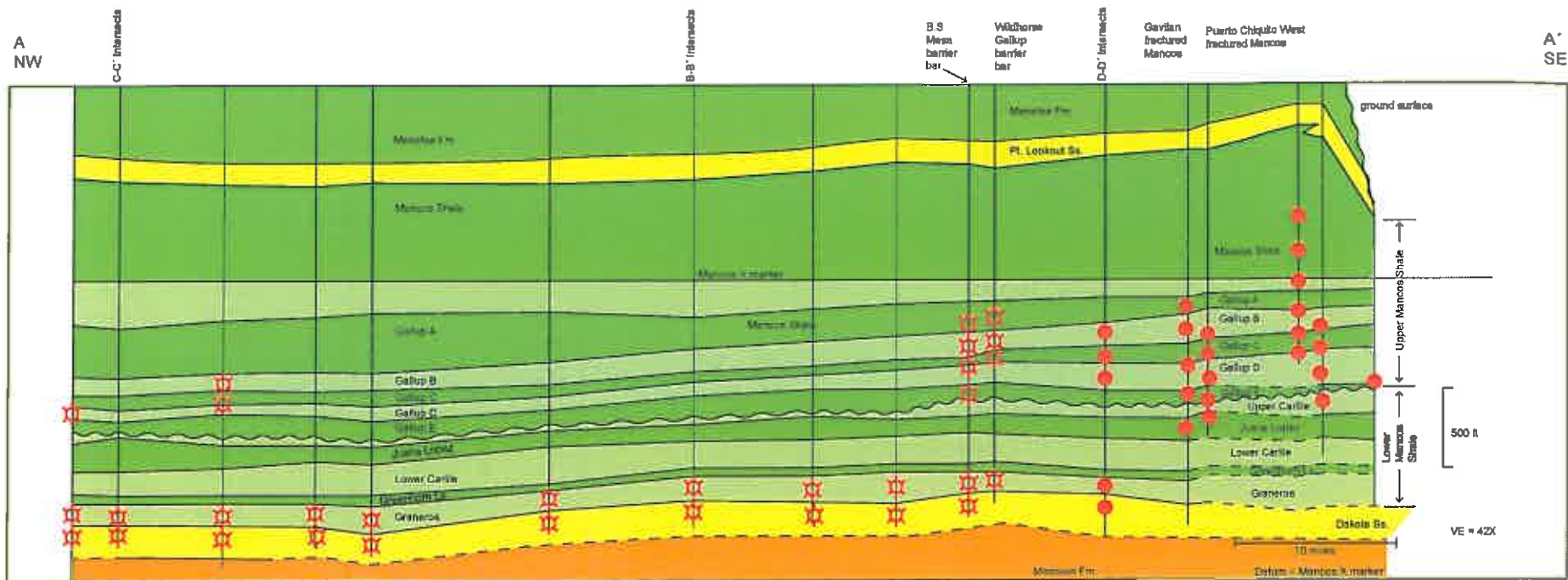


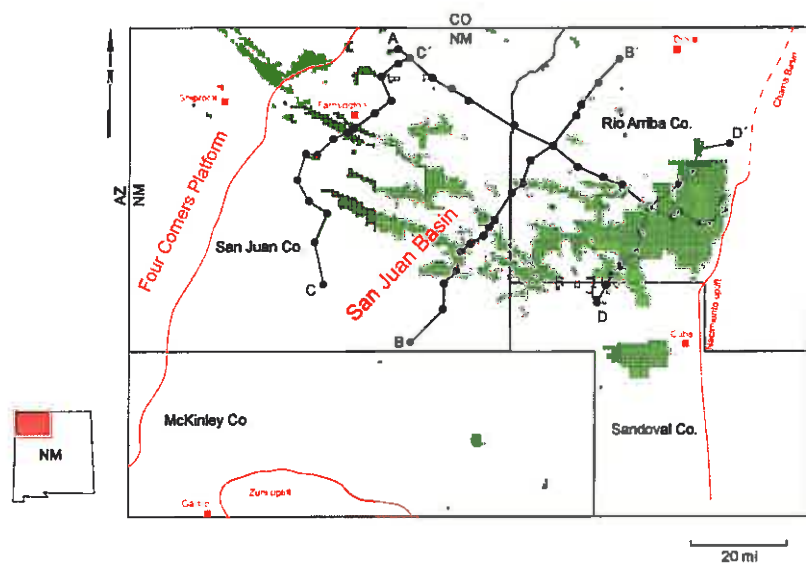
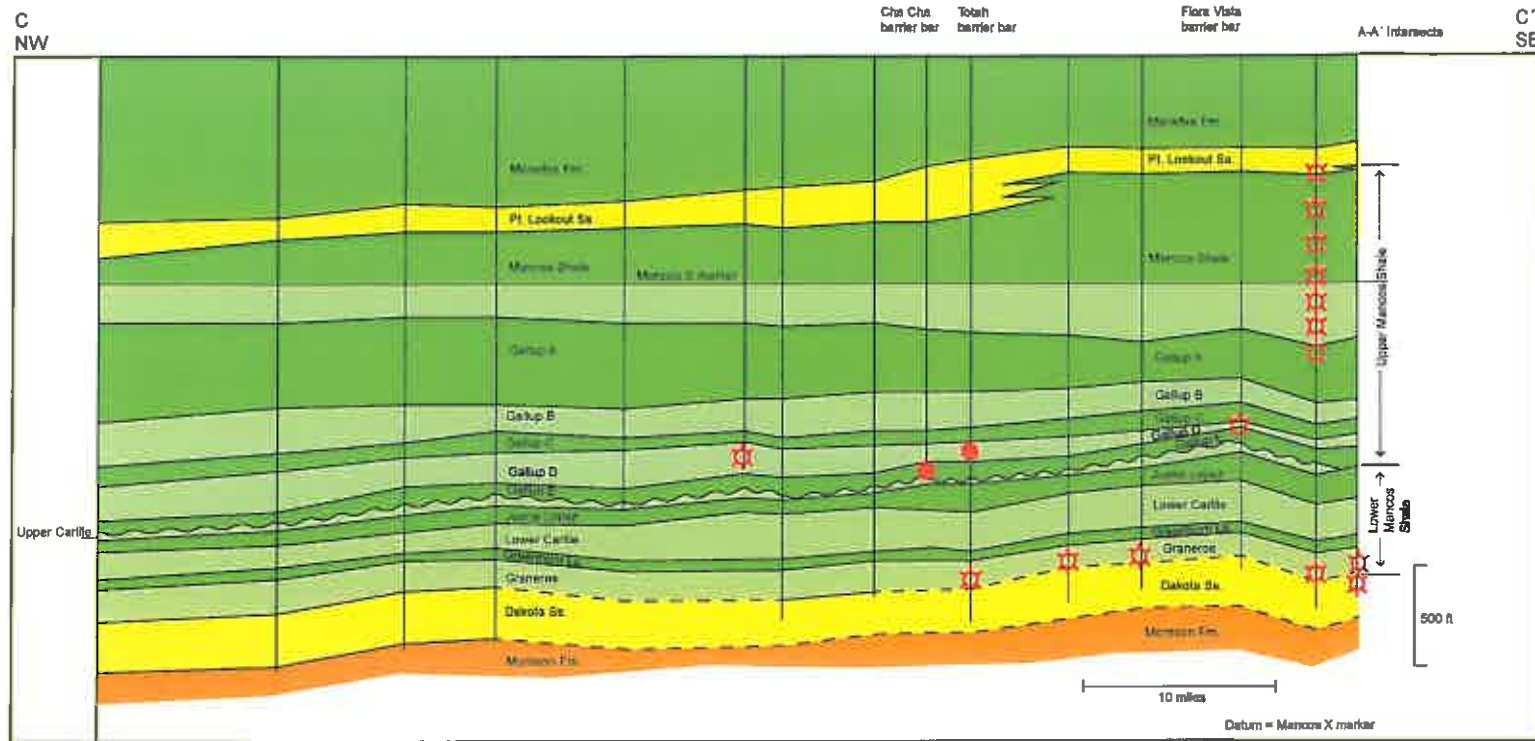
Three Mancos and “Gallup” plays

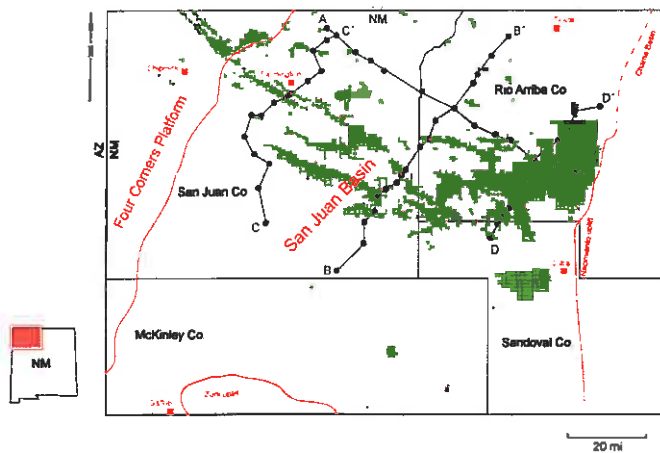
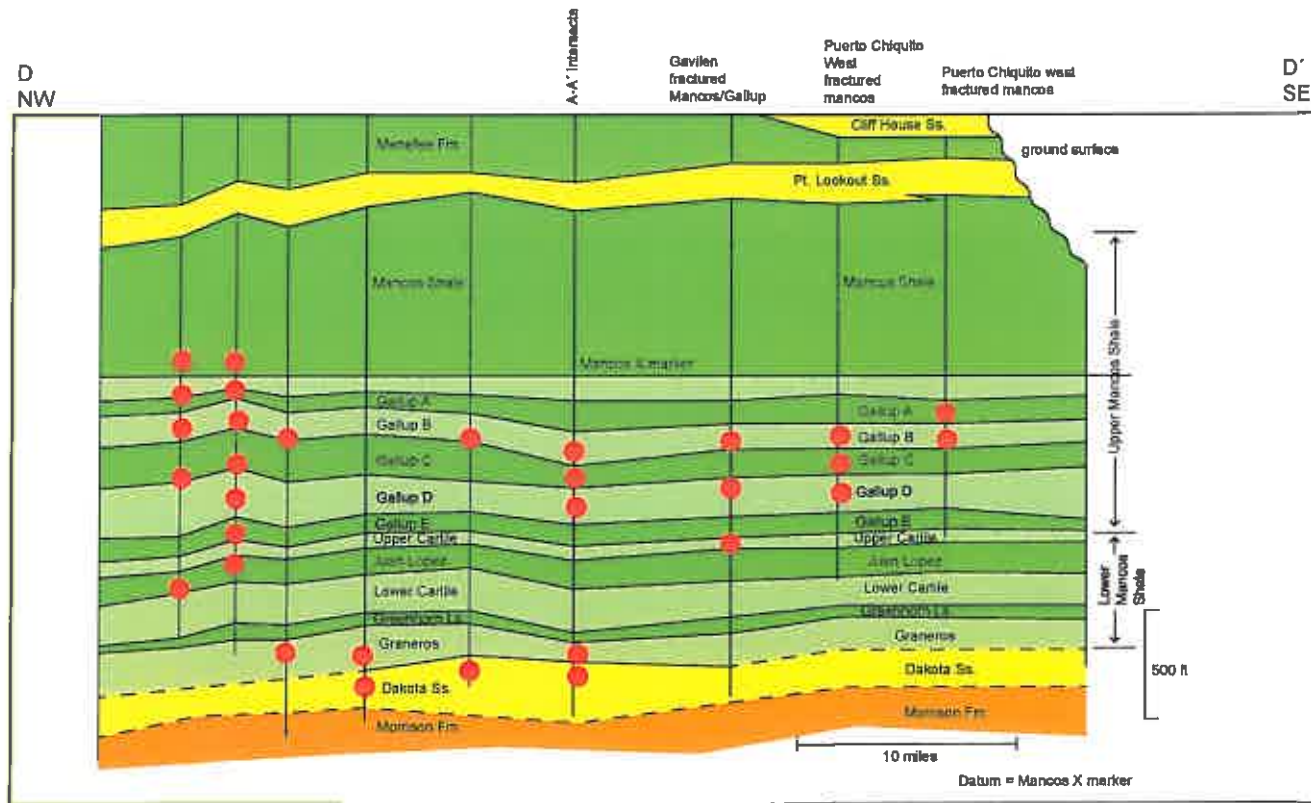
- **Older play – “Gallup” barrier bars/barrier island sandstone reservoirs along shoreline trend**
- **Older play – naturally fractured, oil-filled Mancos shales along eastern and western flanks of basin**
- **New play – offshore shales with thin sands with economic potential rendered by horizontal drilling & multi-stage fracking**

Mancos and “Gallup” reservoirs by play type





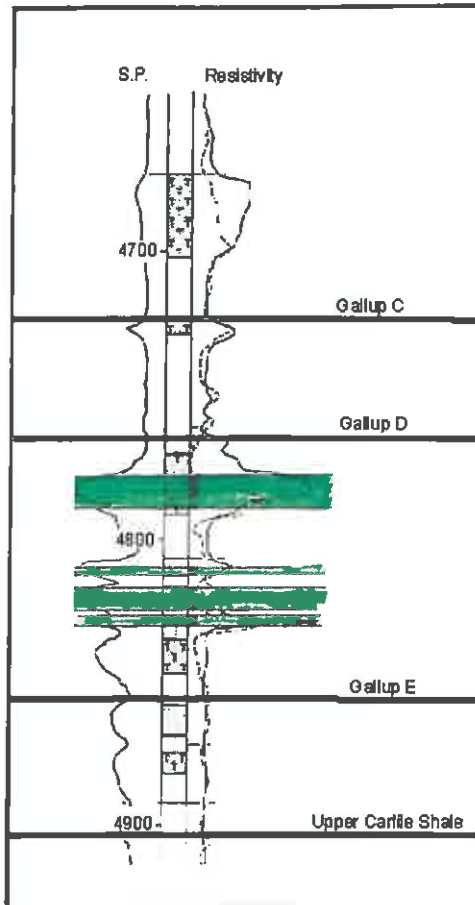




Older “traditional” barrier bar reservoir

Bisti pool

Bisti Gallup pool
Type log



Modified from Collins (1978)

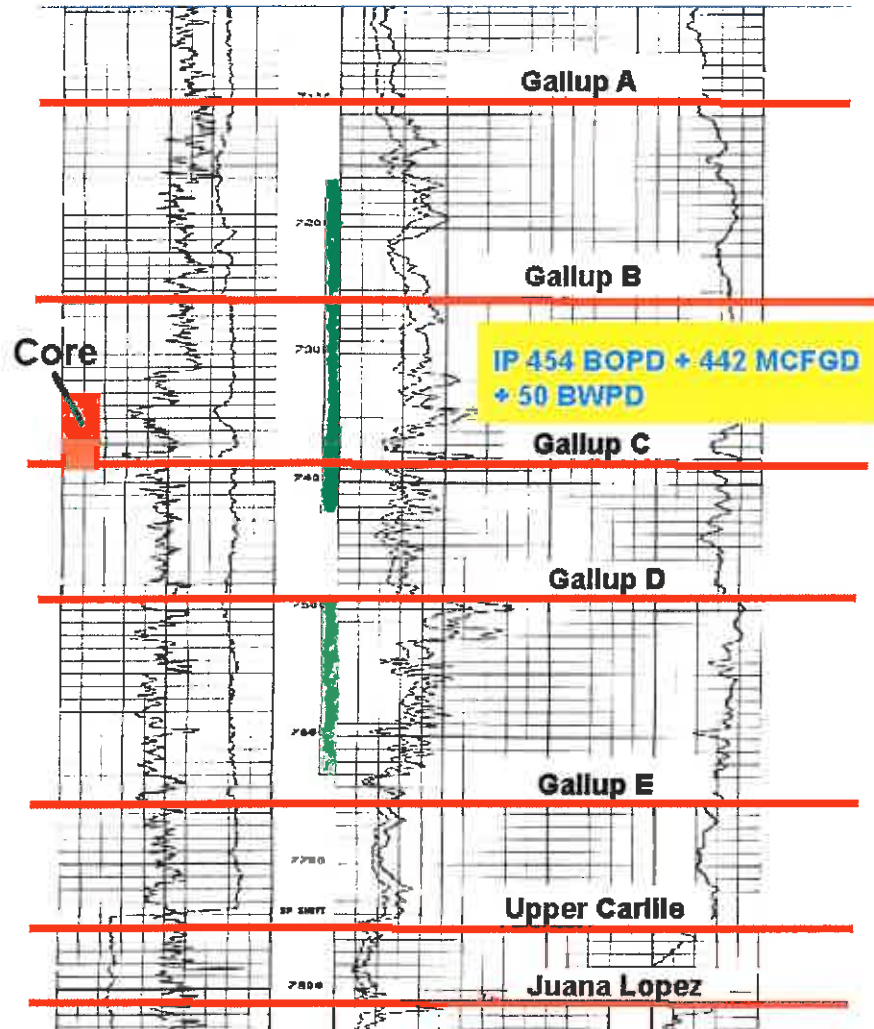


New “offshore” horizontal targets

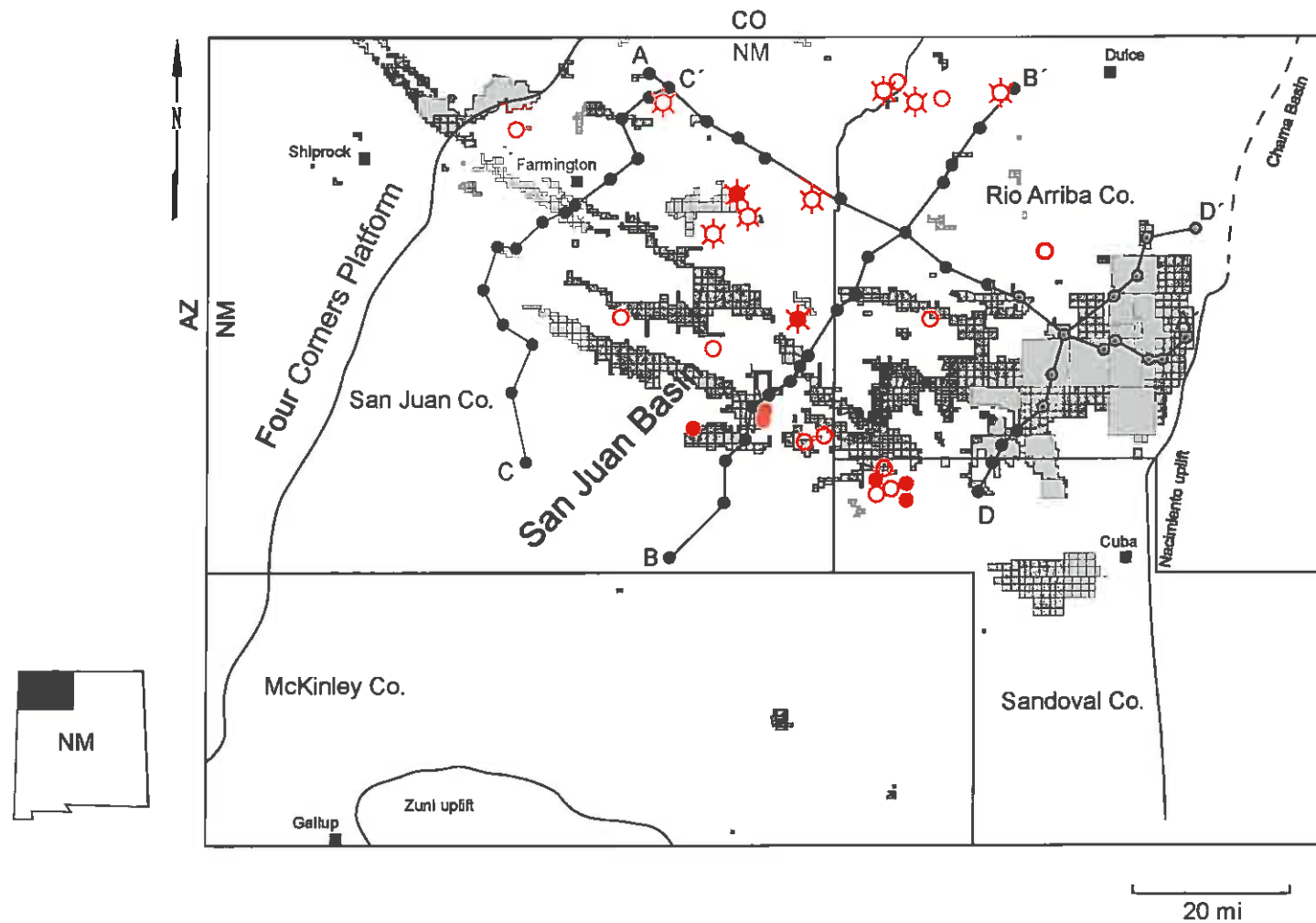
Amoco No. 14 Jicarilla A118
36-26N-3W

Gamma ray/ S.P.

Resistivity

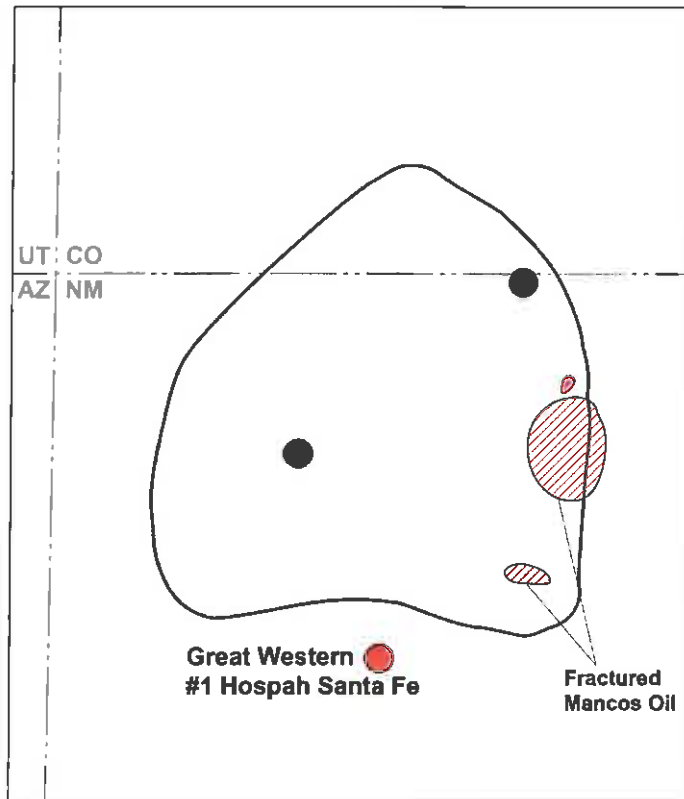


Recent Mancos Shale exploratory wells



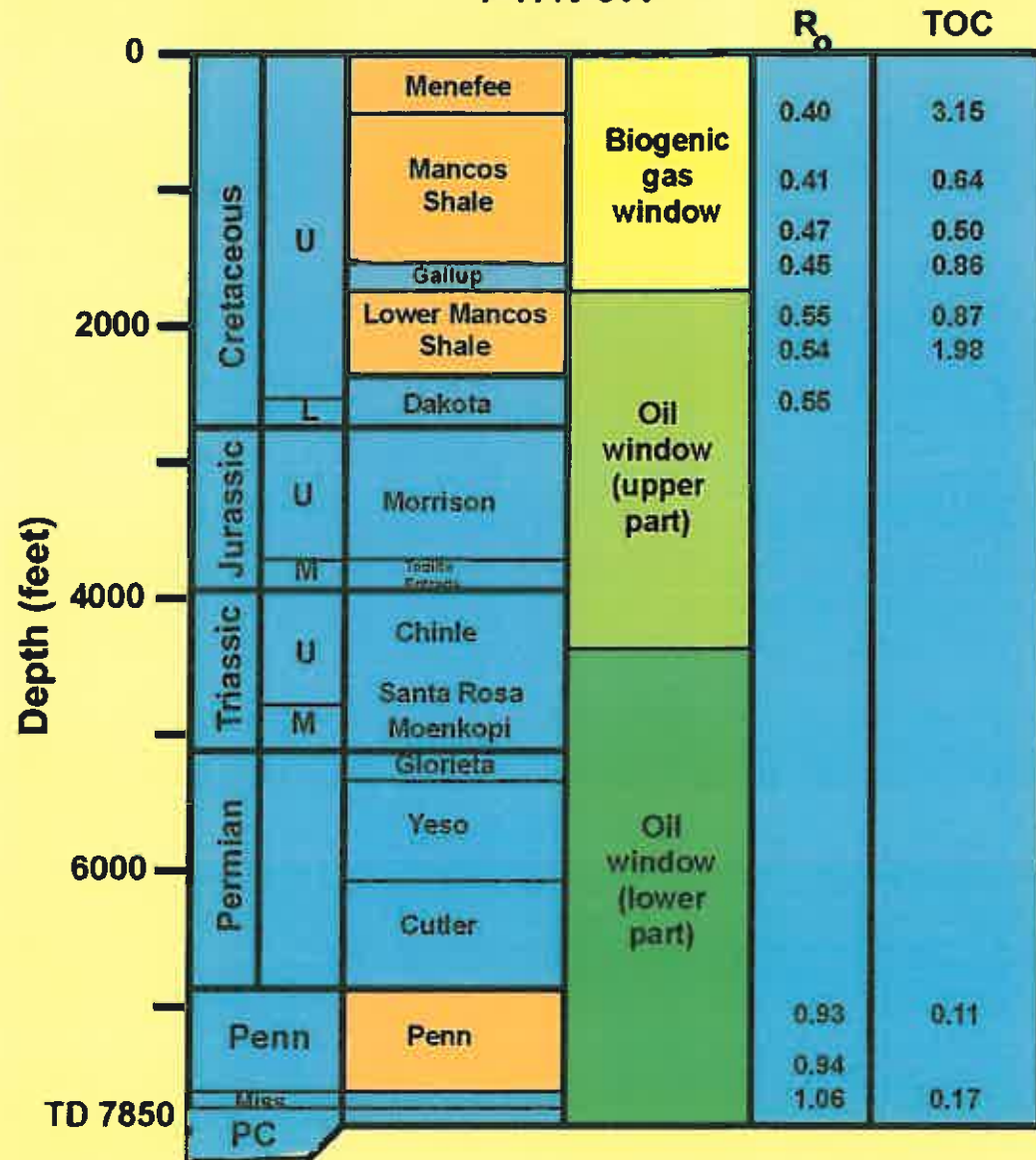
Hydrocarbon source rocks

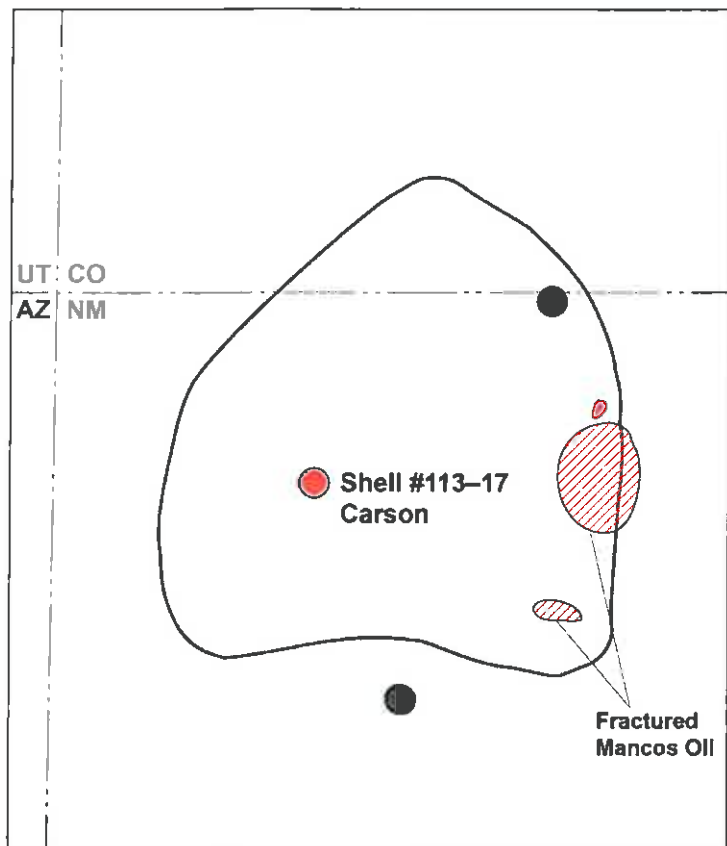
- **Mancos shales are organic-rich hydrocarbon source rocks**
- **Oil window in shallow, southern part of basin**
- **Thermogenic gas window in deeper northern part of basin**
- **Maturation influenced by depth and proximity to Tertiary San Juan volcanic field of southern Colorado**



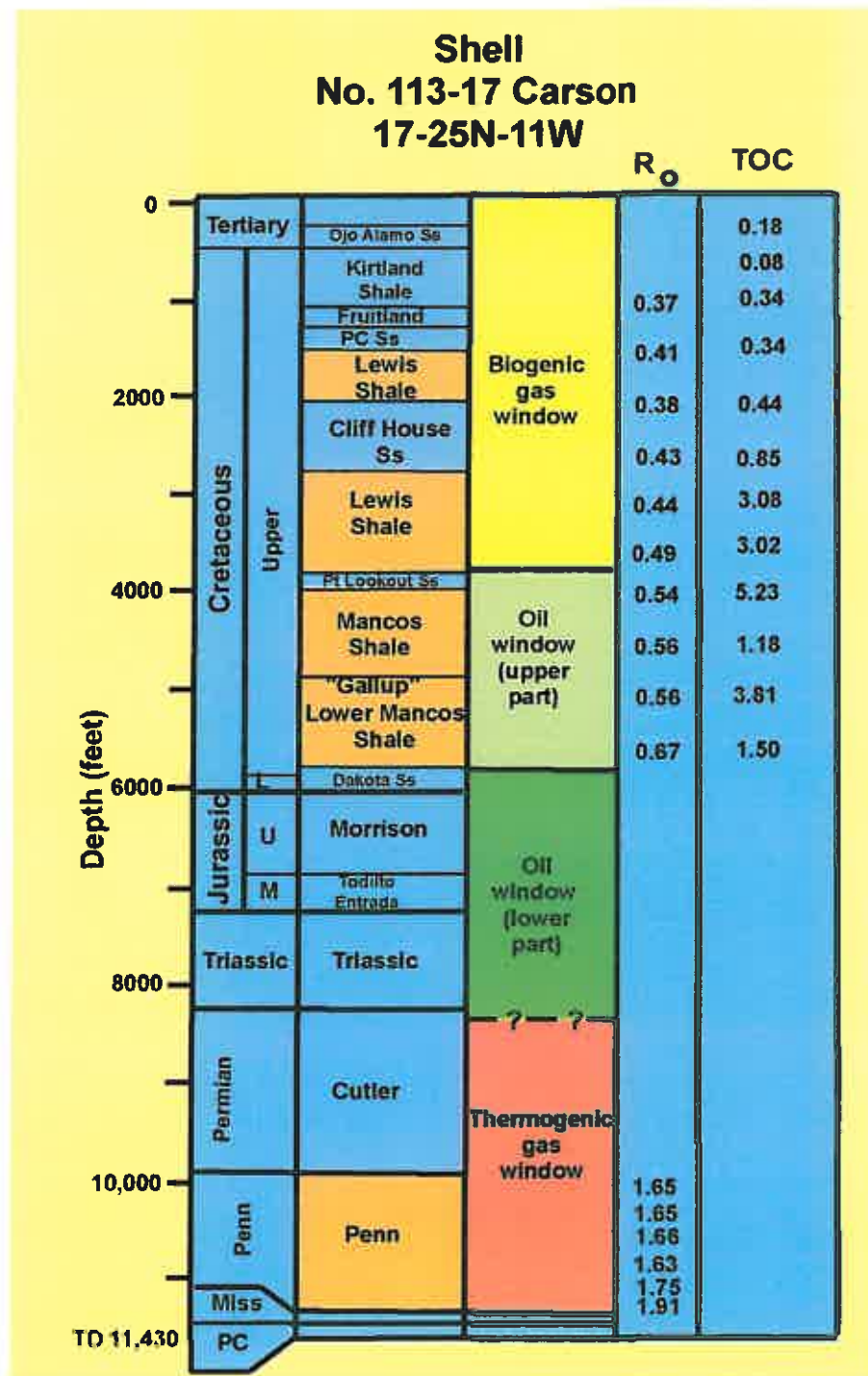
Source rock data from Keal (1982)

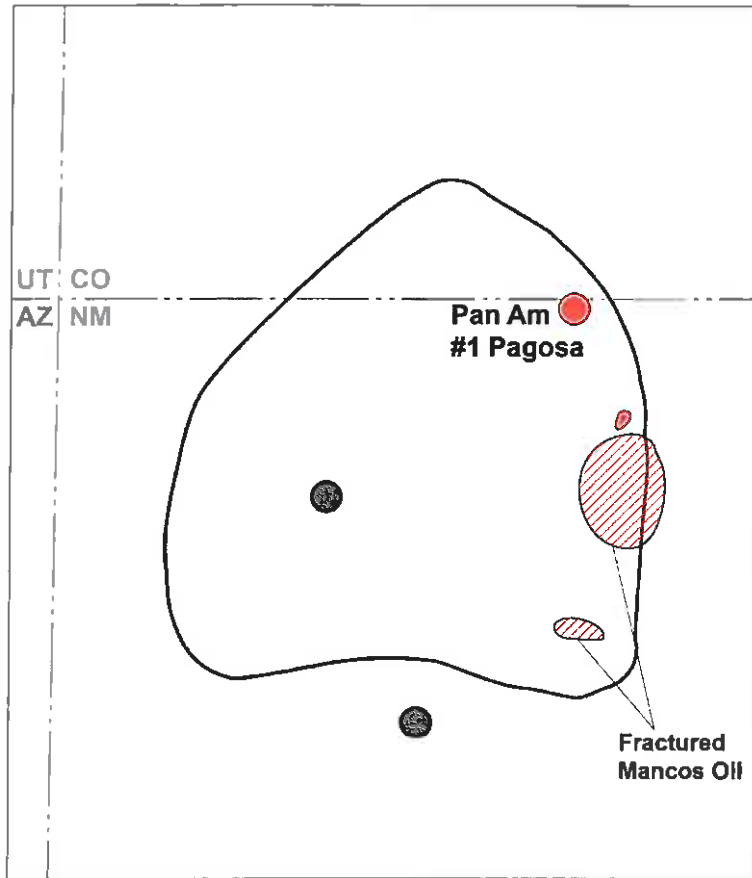
Great Western No. 1 Hospah Santa Fe 1-17N-9W



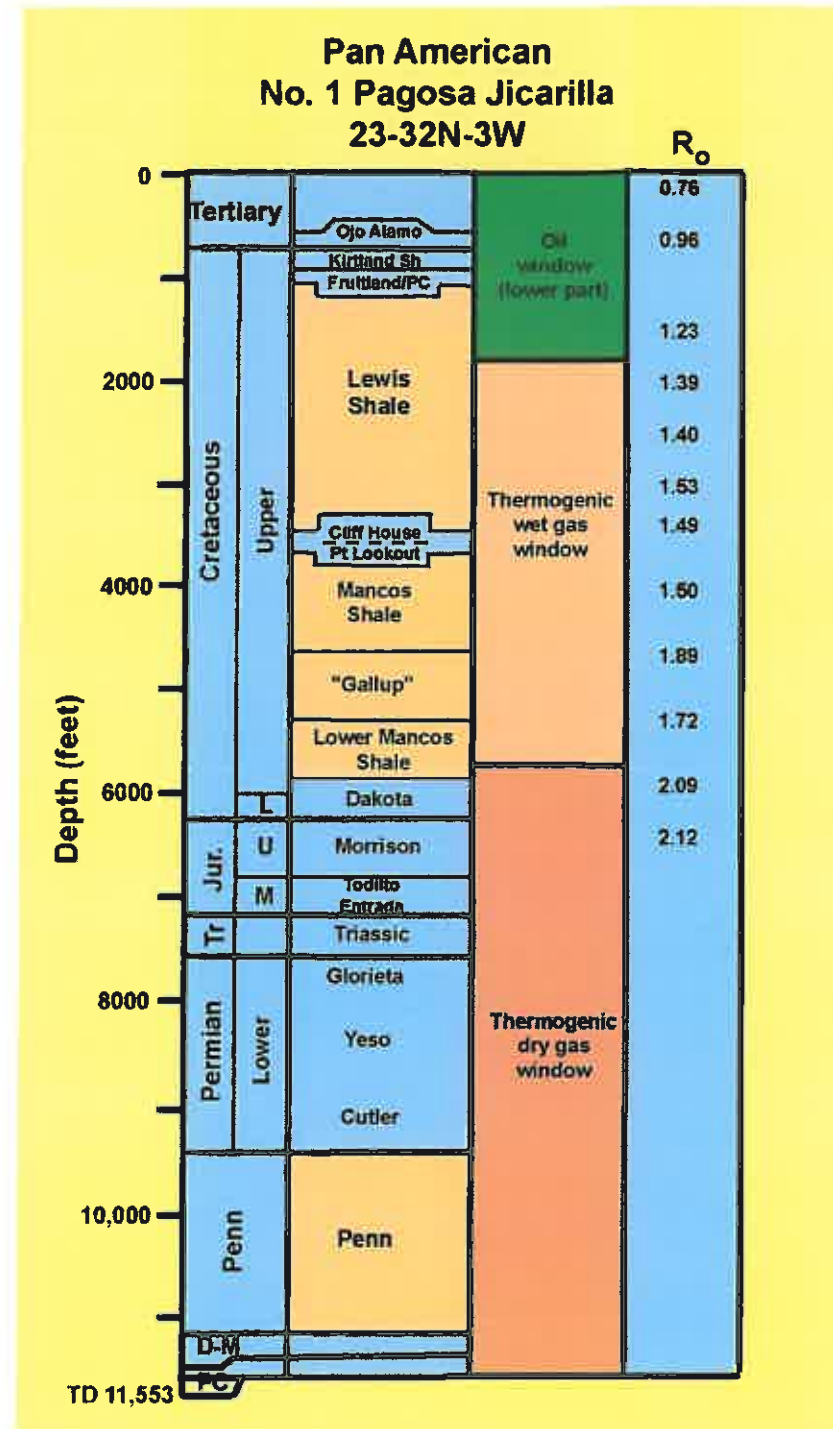


Source rock data from Keal (1982)





Source rock data from Russell (1979)



Induced seismicity?

In rare cases, injection/disposal of produced formation waters has been related to small Induced earthquakes. This relationship appears to occur in some cases where exceptionally large volumes of produced water have been injected in Structurally complex, highly faulted geologic terrains. There is suspicion that this may have taken place locally in the Raton Basin as a result of injection of waters produced in conjunction with coalbed methane (CBM) production.

Induced seismicity unlikely for Mancos oil production in San Juan Basin

- **131 million bbls (38.5 thousand bbls/well) produced water re-injected from CBM production in Raton Basin (CO & NM; National Research Council, 2010).**
- **777 million bbls (100 thousand bbls/well) produced water re-injected from CBM production in San Juan Basin (Fassett, 2010). No induced earthquakes.**
- **San Juan Basin in NM is mostly gentle north-dipping slope with simple structure and few faults. Raton Basin is highly complex with multiple generations of faults.**
- **CBM production requires the extensive natural fracture (cleat) system in coals to be dewatered to initiate CBM production. Production in Mancos will be from induced fractures with only “frack flowback water” produced – minimal water production compared to what has already been produced (and re-injected) as a result of CBM production.**

Conclusions

- **The Mancos and “Gallup” have been productive from San Juan Basin for many decades**
- **Almost all economic production has been from nearshore Gallup barrier bar sandstone reservoirs and from naturally-fractured Mancos shales along NW and SE margins of basin**
- **Minor, generally subeconomic production has been from vertical wells in “offshore” Mancos shales with thinly interlaminated sands**

Conclusions (cont'd)

- **The offshore Mancos play is areally and volumetrically far larger than the barrier/bar and naturally fractured Mancos plays**
- **Horizontal drilling and multi-stage fracking have the potential to render large parts of the offshore Mancos play economically viable**
- **Recent exploratory efforts have proven promising**

Conclusions (cont'd)

- **The Mancos is its own organic-rich source rock**
- **Oil window in southern part of basin and thermogenic gas window in northern deeper parts of basin**
- **The offshore Mancos play has the potential to revitalize the San Juan Basin with both oil and natural gas production**
- **Induced seismicity appears unlikely**

References cited

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