Abstract

The Cimarex Mendota Ranch 41-1H well in Hemphill County, Texas was completed in the middle of the Upper Pennsylvanian Lansing Kansas City Formation with the lateral at about 8,900 feet TVD. Wire line logs showed five thin, organic-rich zones about 100 feet apart separated by relatively tight, organic lean silica and carbonate. The well had an initial production of about 100 bopd of 41 API degree crude oil and about 125 mcfg per day. Production declined rapidly suggesting limited matrix porosity in the producing formation.

The Mendota Ranch 12-1H well was drilled five miles to the southwest of the MR 41-1H well and a 440’ conventional core was taken over most of the Lansing Kansas City Formation. The core encountered four of the thin (5-8’) organic-rich zones seen in the MR 41-1H well. TOC in these zones ranged from about 4 to 13 %, the kerogen was type II oil-generating and the thermal maturity was estimated by several means to be close to 0.9% Ro. Rock extracts were correlated to the produced oil from the MR 41-1H well, indicating that the oil is indigenous to the producing formation and most likely originated primarily in the thin, organic rich zones.

The MR 12-1H lateral was drilled at about 8,600’ close to the same stratigraphic position as the lateral in the MR 42-1H well. When the lateral had reached about half of its designed length, the well began producing about 240 bopd of 63 API condensate and 9,000 mcfg per day from the un-stimulated open hole, which was clearly not indigenous to the producing formation. Gas chromatography showed this condensate and gas as very similar to the 69 API degree condensate and gas produced from the
Granite Wash in nearby wells. Light hydrocarbon biomarker analysis indicated the MR 12-1H condensate is primarily from the Granite Wash and mixed with a minor amount of MR 41-1 Lansing Kansas City crude oil, which is consistent with the open-hole production. The MR 12-1H lateral encountered a deep fracture zone through which Granite Wash condensate and gas migrated vertically about 2,000’ into the Lansing Kansas City Formation from underlying Granite Wash reservoirs.

References Cited


Surprise Production from the Lancing/Kansas City Formation, Cimarex Mendota Ranch Wells, Hemphill County, Texas

AAPG Mid-Continent Meeting
Tulsa, Oklahoma
October 6, 2015

Wallace Dow
Adjunct Professor
Tulsa University
LANSING STRUCTURE - ResD > 15 ohms
Cimarex Lansing/Kansas City Project
Hemphill County, Texas

Interest first piqued by Texakoma verticals
- 3 Lansing/KC and 1 Marmaton
- Lansing/KC IPs averaged approx. 500 BOPD (No geochemical data)

Performed recompletion on Isaacs 1-4 vertical
- Disappointing results: 20-25 BOPD peak (No geochemical data)

Drilled horizontal Mendota Ranch 41-1H
- Disappointing results: 115-125 BOPD peak; 20 MBO EUR (Oil sample)

Drilled horizontal Mendota Ranch 12-1H
- Drilled pilot hole, cored, and ran advanced logs (Core data & oil sample)
MENDOTA RANCH 12-1H

CORE ACQUISITION

- RECOVERED 442' OF 454' CORED (97.3% REC)
- 9 CORE RUNS - ATTEMPTED 120' / RUN
  - RUNS 1 AND 2 - FULL 120' REC
  - RUNS 3 THRU 9 - RANGE FROM 13' TO 72' REC
    - EACH TERMINATED BY LOSS OF ROP (JAM)
  - NEXT SLIDE BASE OF CORE 6 (JAM)
BASE OF CORE 6 - CAUSE OF JAM?

CORE PACKED OFF - MULTIPLE INDUCED AND NATURAL (?) FRACTURES. ONLY 3' FROM BASE OF CORE 6.
CORE GR vs LOG GR

- EXCELLENT CORRELATION
- CORE COLLECTED AND RECONSTRUCTED IN PROPER ORDER AND ORIENTATION

Core GR
Log LAS

Horizontal (Value) Axis Minor Gridlines
Blue lines show six major parasequences bounded by organic-rich flooding surfaces and shallowing upward marine sedimentary cycles.

Cimarex, Mandota Ranch 12-1H, Lansing/Kansas City Core

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<th>Correlation</th>
<th>Depth</th>
<th>Res (RT30)</th>
<th>ResM (RT60)</th>
<th>Min. ILL</th>
<th>Illite (clay)</th>
<th>Silica (qtz)</th>
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Organic carbon decreases upward
Cored Interval
Illite (clay) decreases upward
Silica (qtz) decreases upward
Carbonate increases upward
Presenter’s notes: Comparison of weight percent carbonate, wire line gamma ray log, weight percent TOC, hydrogen index (HI) and free hydrocarbons (Rock-Eval S1). The most organic-rich samples also contain the best quality kerogen and the highest free hydrocarbons (oil). The three shales highlighted in green and the two in blue are highlighted in the same way on all of the other plots and the locations of CT scan photos in slide 3 are shown by the red arrows.
Presenter’s notes: Similar to the previous plot but total headspace gas and headspace hydrocarbon gas BTU substituted for HI and S1. The five highlighted samples generally also have the highest total gas contents in the isojars. Because the gas is still present in the rocks when they are put into the isojars. The gas is tightly held and is not in porous and permeable rock. The three shales highlighted in green and the two in blue are highlighted in the same way on all of the other plots and the locations of CT scan photos in slide 3 are shown by the red arrows.
Presenter’s notes: Representative CT scans of four organic-rich phosphatic shales and two organic-lean limestones with basic geochemical data shown. The positions of the samples are indicated by red arrows on slides 2 and 4.
CIMAREX, MENDOTA RANCH 12-1H CORE

Mendota Ranch 12 - 1H

Organic-rich samples

Mendota Ranch 12 - 1H

Organic-rich samples

Mendota Ranch 12 - 1H

Organic-rich samples

Mendota Ranch 12 - 1H

Organic-rich samples
Presenter’s notes: Van Krevelen diagram from Rock-Eval Hi and OI data showing the five samples containing oil source kerogen and the remaining gas only generating kerogen: Version # 3.
Presenter’s notes: Comparison of weight percent carbonate, wire line gamma ray log, weight percent TOC, hydrogen index (HI) and free hydrocarbons (Rock-Eval S1). The most organic-rich samples also contain the best quality kerogen and the highest free hydrocarbons (oil). The three shales highlighted in green and the two in blue are highlighted in the same way on all of the other plots and the locations of CT scan photos in slide 3 are shown by the red arrows.
Core Extract GC Samples

Mendota Ranch 12-1 Core Samples

Analytical error?

Analytical error?
Core Extract Gas Chromatography

Mendota Ranch 12-1 Core Samples

8315'
3.32 TOC
2578 ppm
Ex/TOC 7.77
S1 1.41

8405'
3.26 TOC
3037 ppm
Ex/TOC 9.32
S1 1.54

8366'
12.6 TOC
7005 ppm
Ex/TOC 5.56
S1 6.49

8471'
9.03 TOC
9037 ppm
Ex/TOC 10.0
S1 5.24

Presenter’s notes: Rock extracts from several Lansing KC core samples showing a great degree of similarity.
Core Extract Gas Chromatography

Mendota Ranch 12-1 Core Samples

8561'
8.72 TOC
8348 ppm
Ex/TOC 9.57
S1 4.94

8658'
4.25 TOC
4325 ppm
Ex/TOC 10.18
S1 2.33

8591'
4.65 TOC
3384 ppm
Ex/TOC 7.27
S1 1.70

Presenter’s notes: Rock extracts from several Lansing KC core samples showing a great degree of similarity.
Lansing/KC Project

Mendota Ranch 41-1H Lansing/KC Formation
- Disappointing results: IP 115-125 BOPD peak
- Rapid decline & low gas content

Mendota Ranch 12-1H Lansing/KC Formation
- Pilot hole, cored, advanced logs run, samples analyzed
- Half lateral drilled before losing returns
- Produced *condensate and gas unstimulated from toe*
Visual comparison of the Mendota Ranch 41-1H, 12-1H, and Earp 60-11H, produced oils, Hemphill County, Texas.

Presenter’s notes: Visual comparison of the produced oils from the wells described in this report. The Mendota Ranch 41-1H and 12-1H oils are from the Lansing Kansas City Formation, the Earp 60-11H is from the Granite Wash Formation, and the Mendota Ranch 63-5 is from the Morrow Formation. On this basis alone, the Mendota Ranch 12-1H and Earp 60-1H oils appear quite similar and different from the other two oils.
Comparison of Mendota Ranch 41-1 and 12-1 Lansing/Kansas City produced oils with Earp 60-11 Granite Wash produced condensate based on API gravity and %Ro reservoir maturity.
Whole oil gas chromatograms of Mendota Ranch 41-1H, 12-1H, and Earp 60-11H, produced oils, Elk City area, Hemphill County, Texas.

Presenter’s notes: Whole oil gas chromatograms show an excellent correlation between the Mendota Ranch 12-1H Lansing KC and Earp 60-11H Granite Wash produced oils. The Mendota Ranch 41-1H produced oil is less mature and probably indigenous to the Lansing Kansas City Formation.
In MAS peak distribution, **Mendota Ranch 12-1** resembles **Mendota Ranch 41-1H**. In size, **Mendota Ranch 12-1** resembles **Earp**. A small amount of the green oil mixed with a lot of the blue oil could produce the red oil.
Presenter’s notes: Mendota Ranch #41-1H Lansing KC and Earp #60-11 H Granite Wash produced oil equivalent %Ro values and Lansing KC #12 measured core %Ro value. Plot shows no overburden removal since maximum burial unless the thermal gradient is lower in the shallow portion of the well than in the deeper portion.
Hogshooter Wash is 1,700' deeper than Mendota Lansing/KC
Mendota Ranch Lansing KC Maturity

ZONES OF PETROLEUM GENERATION AND DESTRUCTION

ORGANIC MATTER TYPE

LIPID (OIL) MIXED HUMIC (GAS)

WEIGHT % CARBON IN TYPE II KEROGEN

2.0 2.5 3.0 3.5 4.0 4.5 5.0

VITRINITE REVEL TANCE (%)

Mendota Ranch Lansing KC

Mendota Ranch Wash & Hogshooter Wash

CORRELATION OF VARIOUS MATURATION INDICES AND ZONES OF PETROLEUM GENERATION AND DESTRUCTION

DOW, 1977
The Lansing/Kansas City Formation in the Cimarex Mendota Ranch wells is self sourcing because rock extracts correlate well with produced 41-1H crude oil.

Maturity is 0.9% Ro at peak oil generation and very early gas generation so reservoir pressures are low resulting in an ineffective solution gas drive.

Condensate and gas produced from the 12-1H well correlate very well with Granite Wash production in the nearby Earp 60-11H well indicating vertical migration through fractures.
LANSING STRUCTURE - 2nd DERIVATIVE MAP

Texacoma vertical wells
ave. peak IP 500 BOPD

Issacs 4-1

Mendota Ranch 41-1H

Mendota Ranch 12-1H

FAULT FRACTURE ZONE

CROSS SECTION NEXT SLIDE
OVERALL CONCLUSIONS

- The Lansing/Kansas City Formation in the Cimarex Mendota Ranch wells is self oil charged but has low gas content, poor porosity (~3%), and very low permeability.

- Gas and condensate produced from the Lansing/Kansas City in the 12-1H well have migrated vertically about 2,000’ via fault related fracture systems from Granite Wash reservoirs.

- The Lansing/Kansas City Formation in this area is not viable economically unless vertical migration through fracture systems has occurred from deeper Granite Wash reservoirs and natural fracture permeability is present.