

Surprise Production from the Lansing Kansas City Formation, Cimarex Mendota Ranch Wells, Hemphill County, Texas*

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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

Dow, W.G., 1977, Kerogen studies and geological interpretations: Geochemical Exploration Journal, v. 7, p. 79-99.

Mitchell, J., 2015, Economic Development of Pennsylvanian Age Granite Wash Reservoirs with Horizontal Wells in the Anadarko Basin: AAPG Search and Discovery Article #10734, Web Accessed February 11, 2016, http://www.searchanddiscovery.com/documents/2015/10734mitchell/ndx_mitchell.pdf.

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



AAPG Mid-Continent Meeting
Tulsa, Oklahoma
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A**S**
PALO
DURO
BASIN**A'****N**

ANADARKO BASIN

PANHANDLE FIELD
GAS OIL

Mendota Ranch wells

MESOZOIC CLASTICS

MIDDLE PERMIAN EVAPORITES

EARLY PERMIAN CARBONATES

AMARILLO UPLIFT-
WICHITA MTS.

Lansing Kansas City Fm.

OVERPRESSURE

GRANITE

WASH

PENNSYLVANIAN

MISSISSIPPIAN CARBONATES

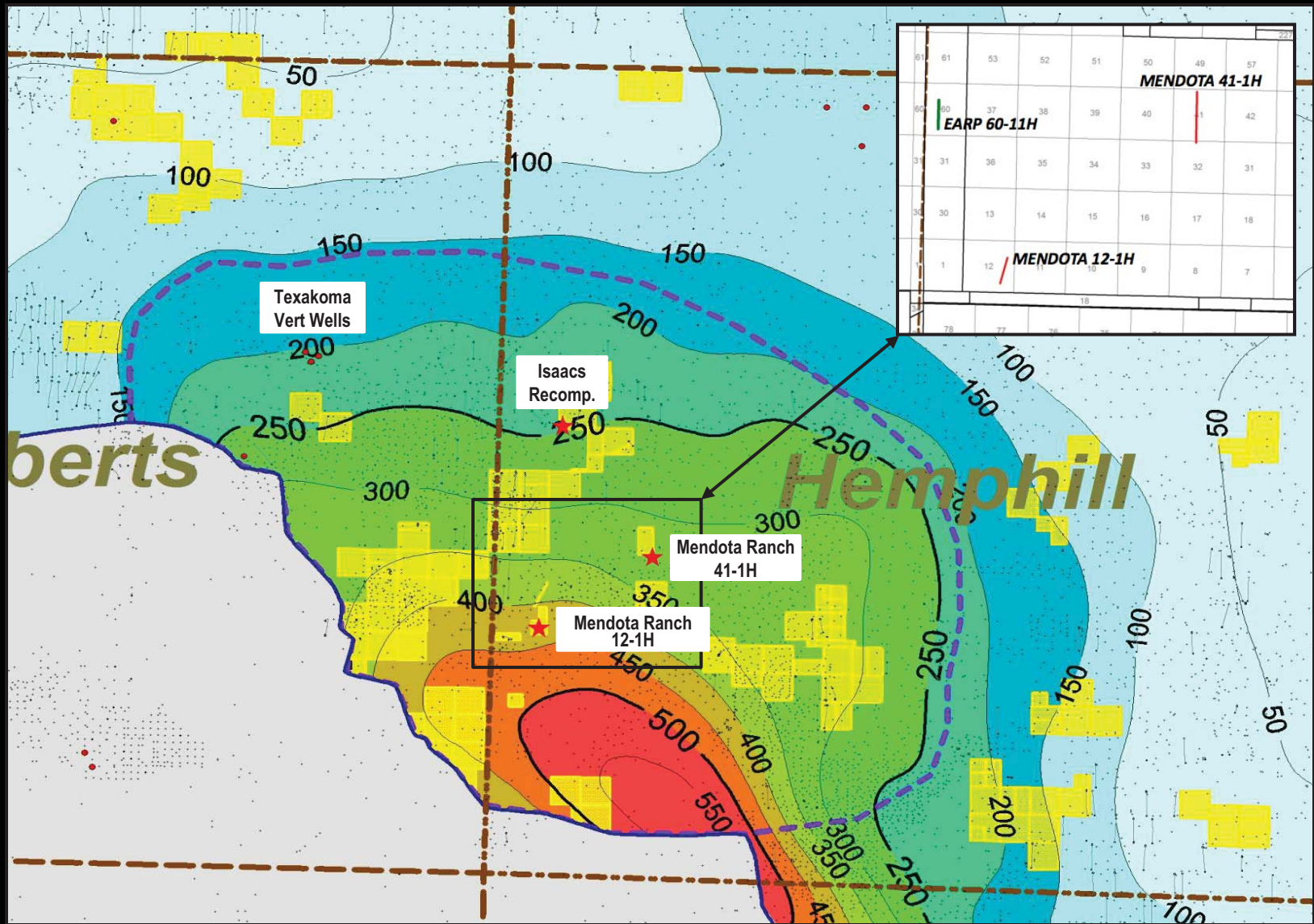
DEVONIAN - CAMBRIAN CARBONATES

CAMBRIAN - PRECAMBRIAN

IGNEOUS BASEMENT

HYDROCARBONS IN
PERMIAN RESERVOIRSHYDROCARBONS IN
PENN. - MISS. RESERVOIRS3000m 10,000'
Approximate
scale50 mi
80 km

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)

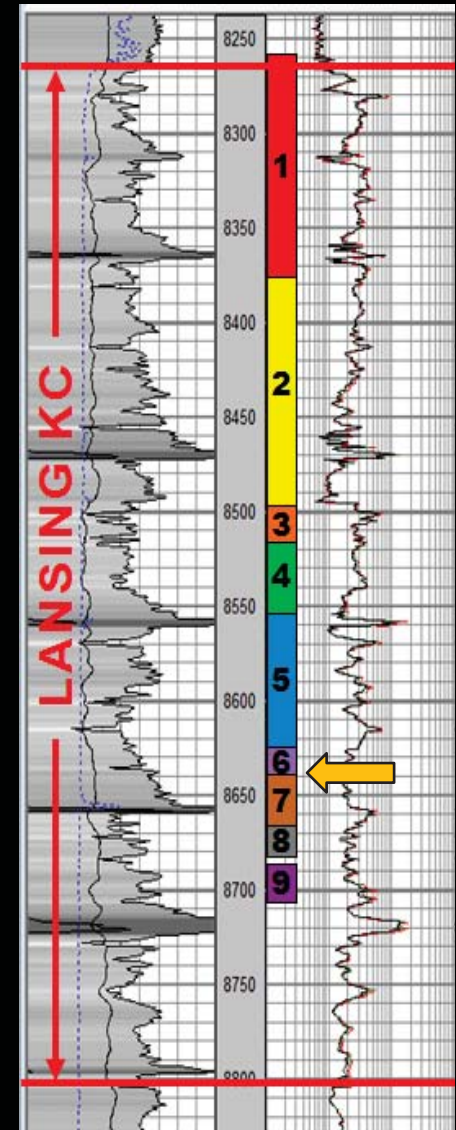
Drilled horizontal Mendota Ranch 12-1H

- 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?

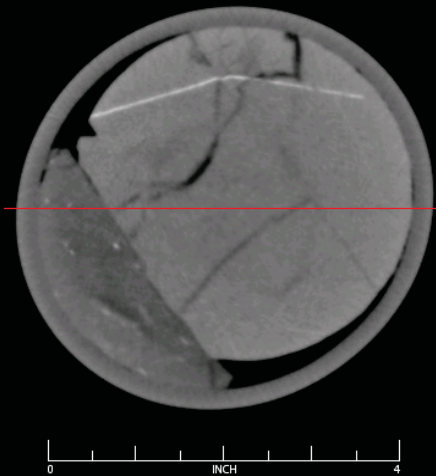


Conventional Core
High-Frequency CT

Cimarex Energy

Mendota Ranch #12-1H
Mendota, Northwest
Hemphill County, Texas, US

Axial: 8636.64 ft

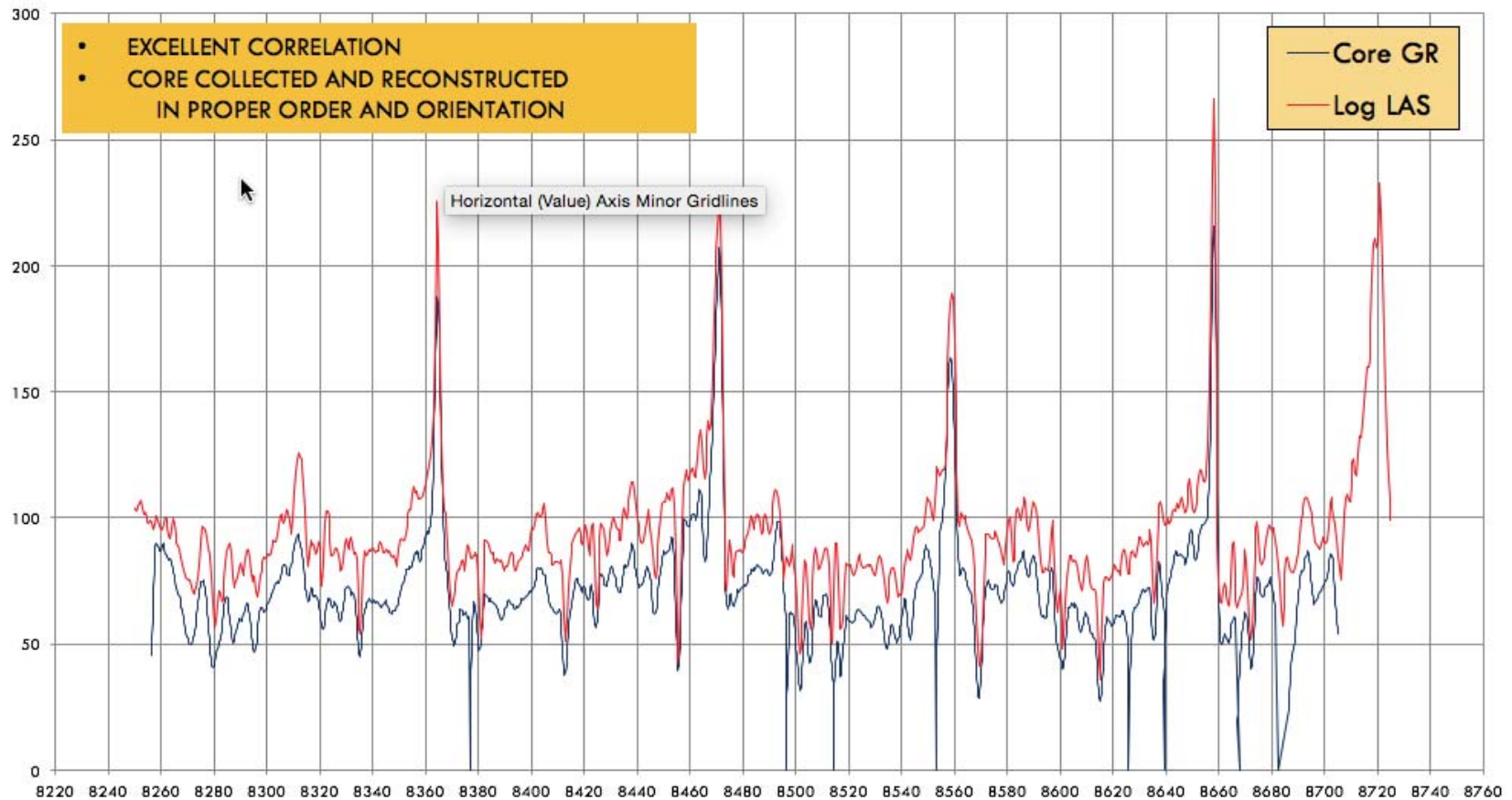


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**CORE PACKED OFF - MULTIPLE
INDUCED AND NATURAL (?)
FRACTURES. ONLY 3' FROM
BASE OF CORE 6.**

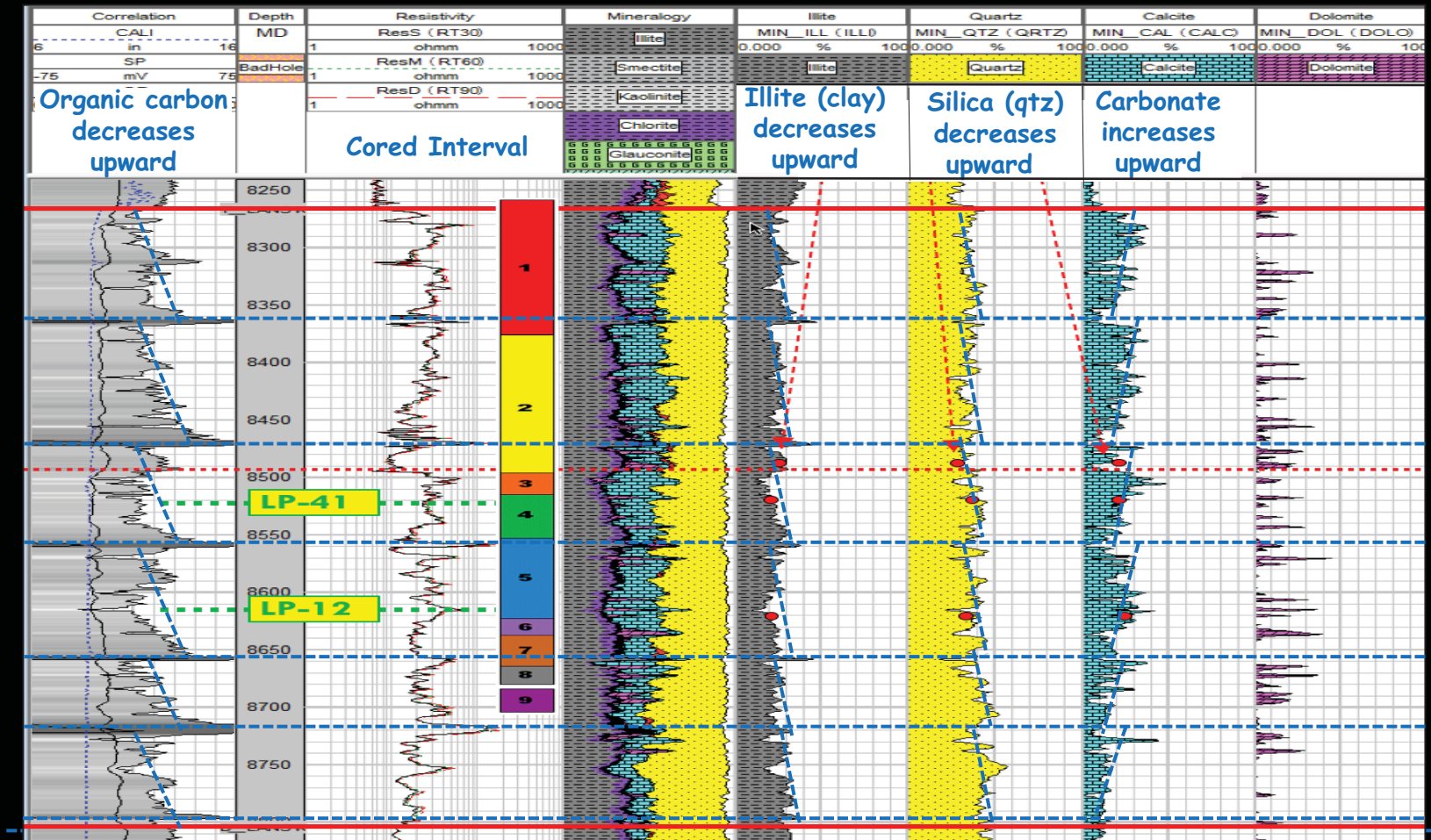


CORE GR vs LOG GR

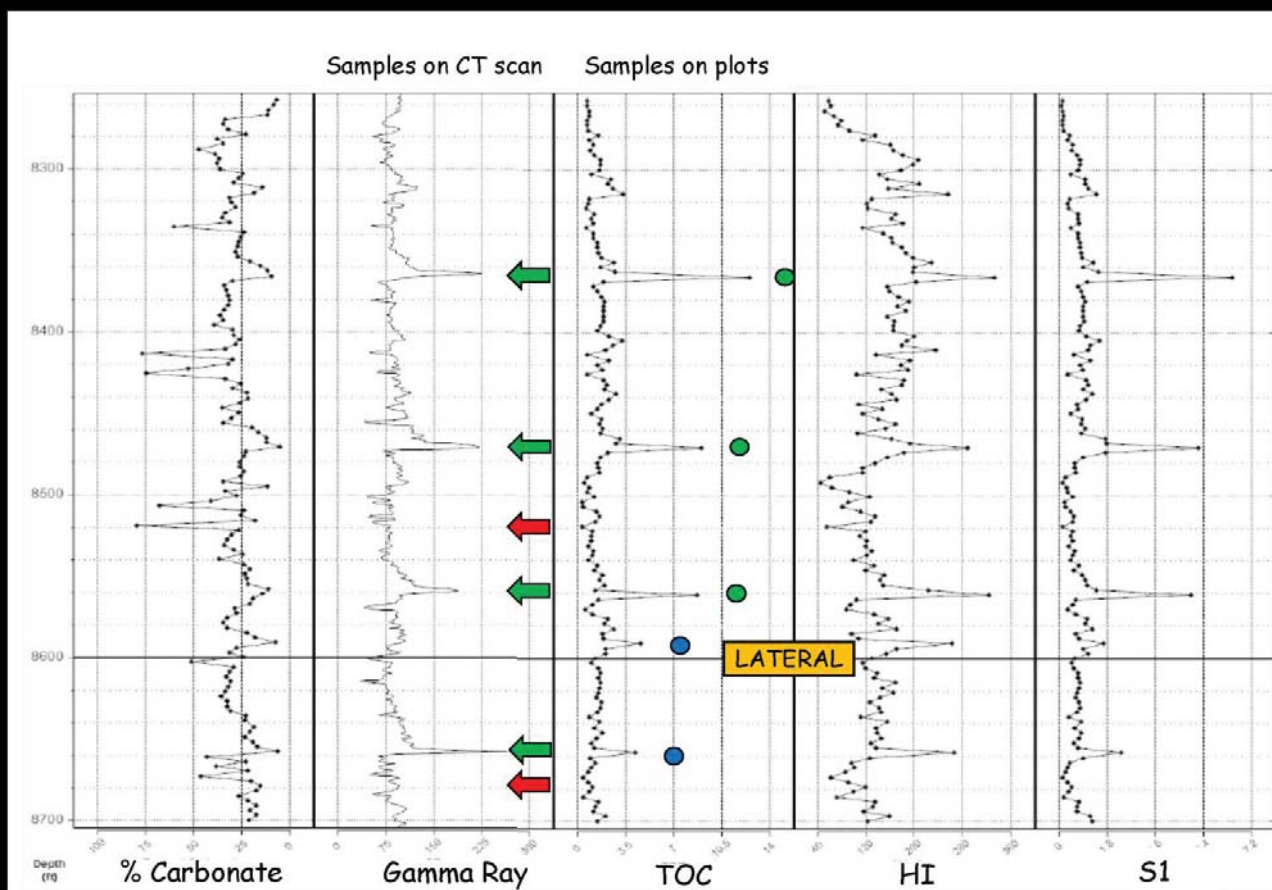


Blue lines show six major parasequences bounded by organic-rich flooding surfaces and shallowing upward marine sedimentary cycles.

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

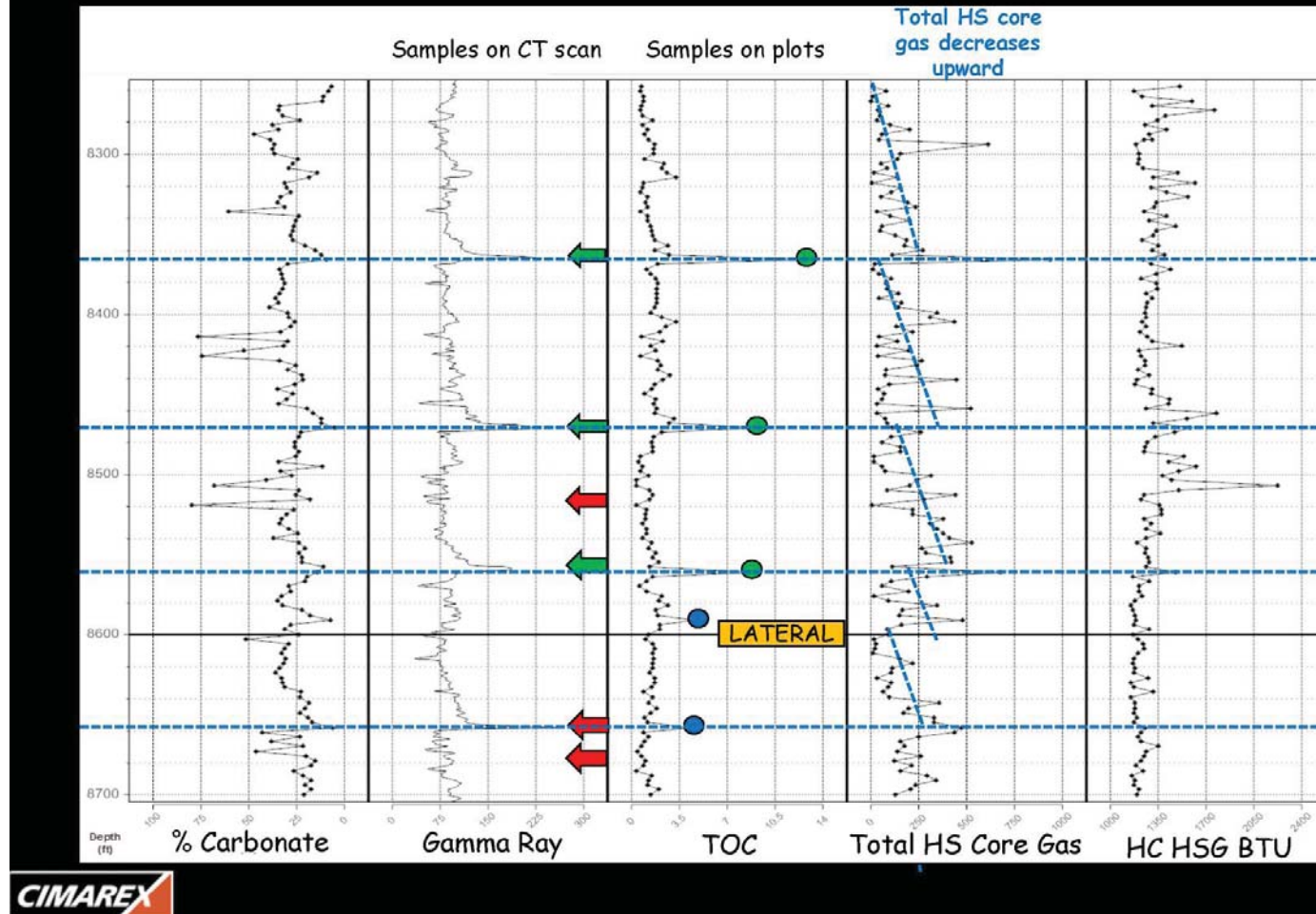


CIMAREX, MENDOTA RANCH 12-1H CORE



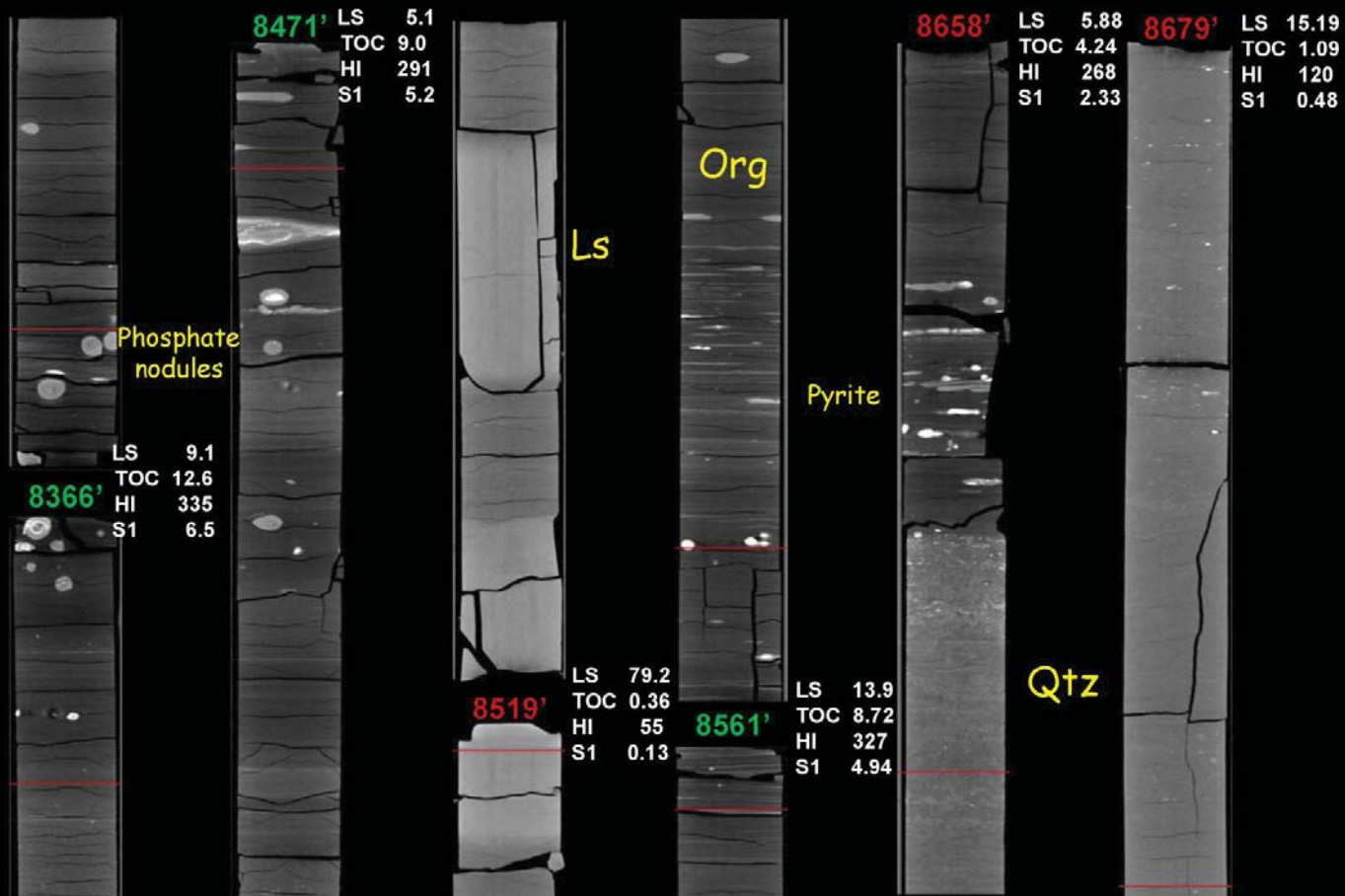
Presenter's notes: Comparison of weight percent carbonate, wire line gamma ray log, weight percent TOC, hydrogen index (HI) and free hydrocarbons (Rock-Eval S1). The most organic-rich samples also contain the best quality kerogen and the highest free hydrocarbons (oil). The three shales highlighted in 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.

CIMAREX, MENDOTA RANCH 12-1H CORE



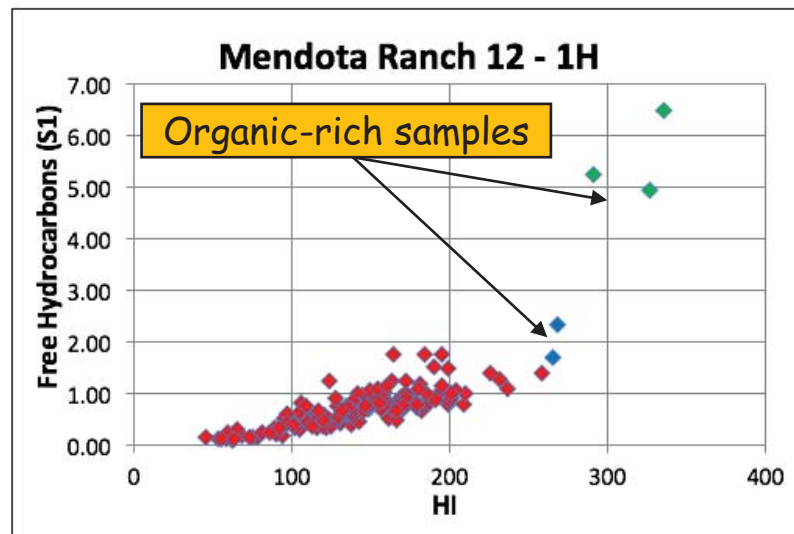
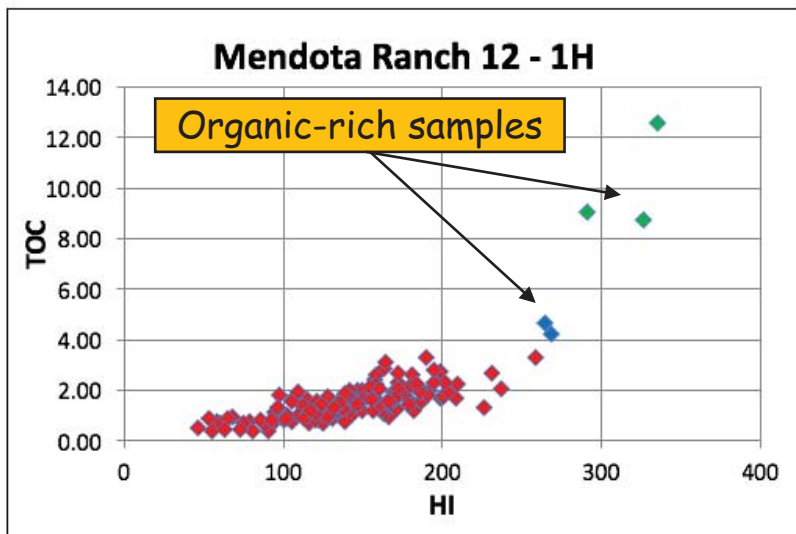
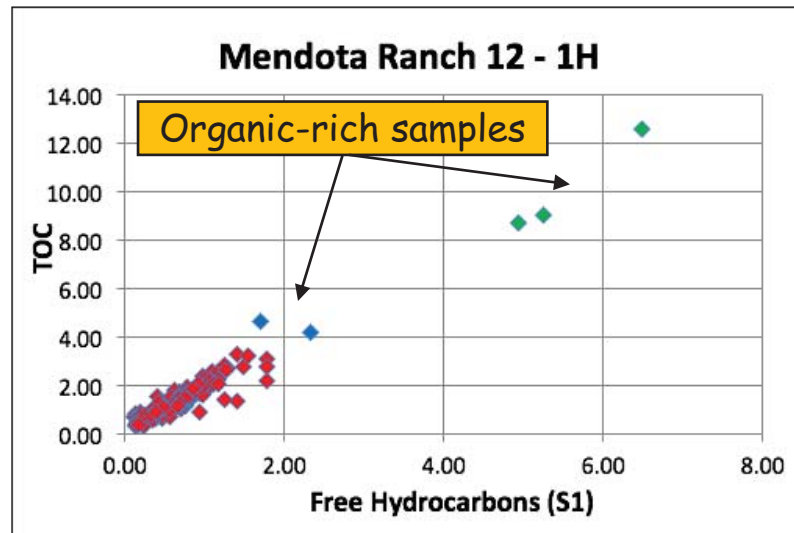
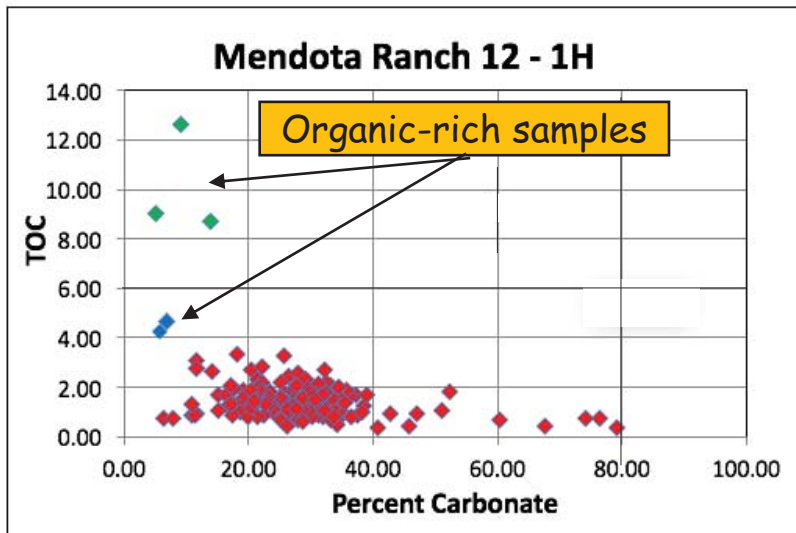
Presenter's notes: Similar to the previous plot but total headspace gas and headspace hydrocarbon gas BTU substituted for HI and S1. The five highlighted samples generally also have the highest total gas contents in the isojar. Because the gas is still present in the rocks when they are put into the isojar. 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.

Representative CT Scans and Geochemical Data

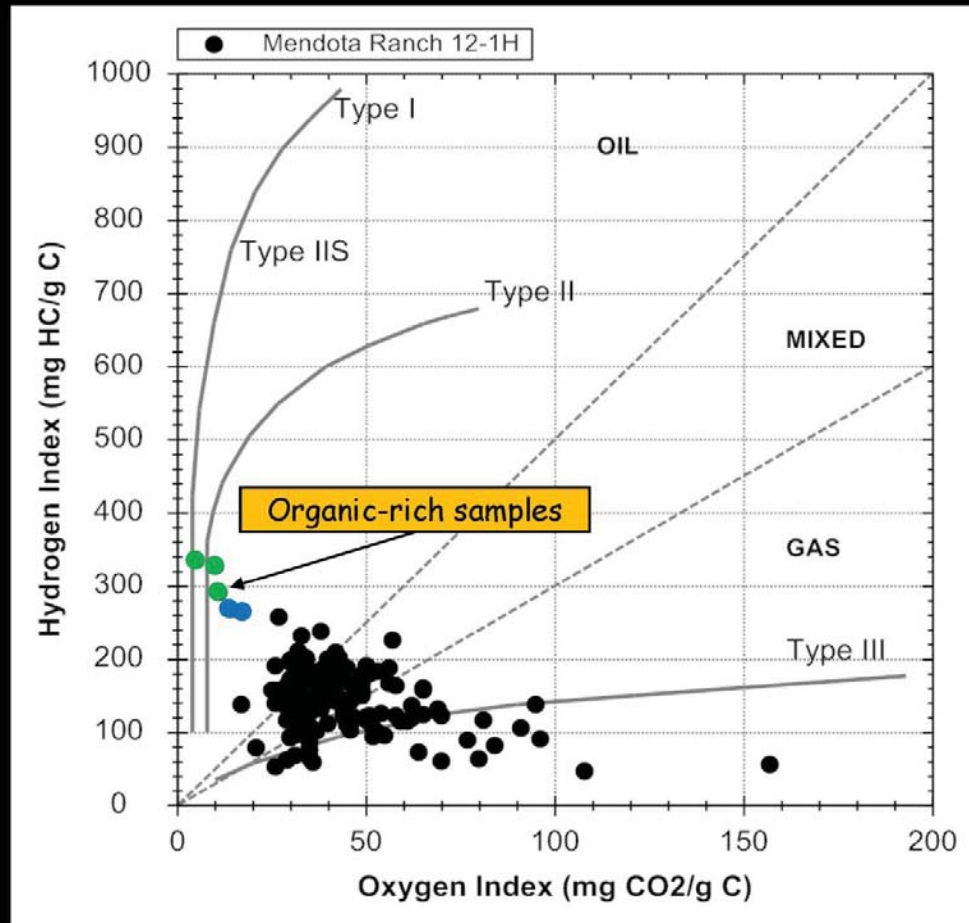


Presenter's notes: Representative CT scans of four organic-rich phosphatic shales and two organic-lean limestones with basic geochemical data shown. The positions of the samples are indicated by red arrows on slides 2 and 4.

CIMAREX, MENDOTA RANCH 12-1H CORE

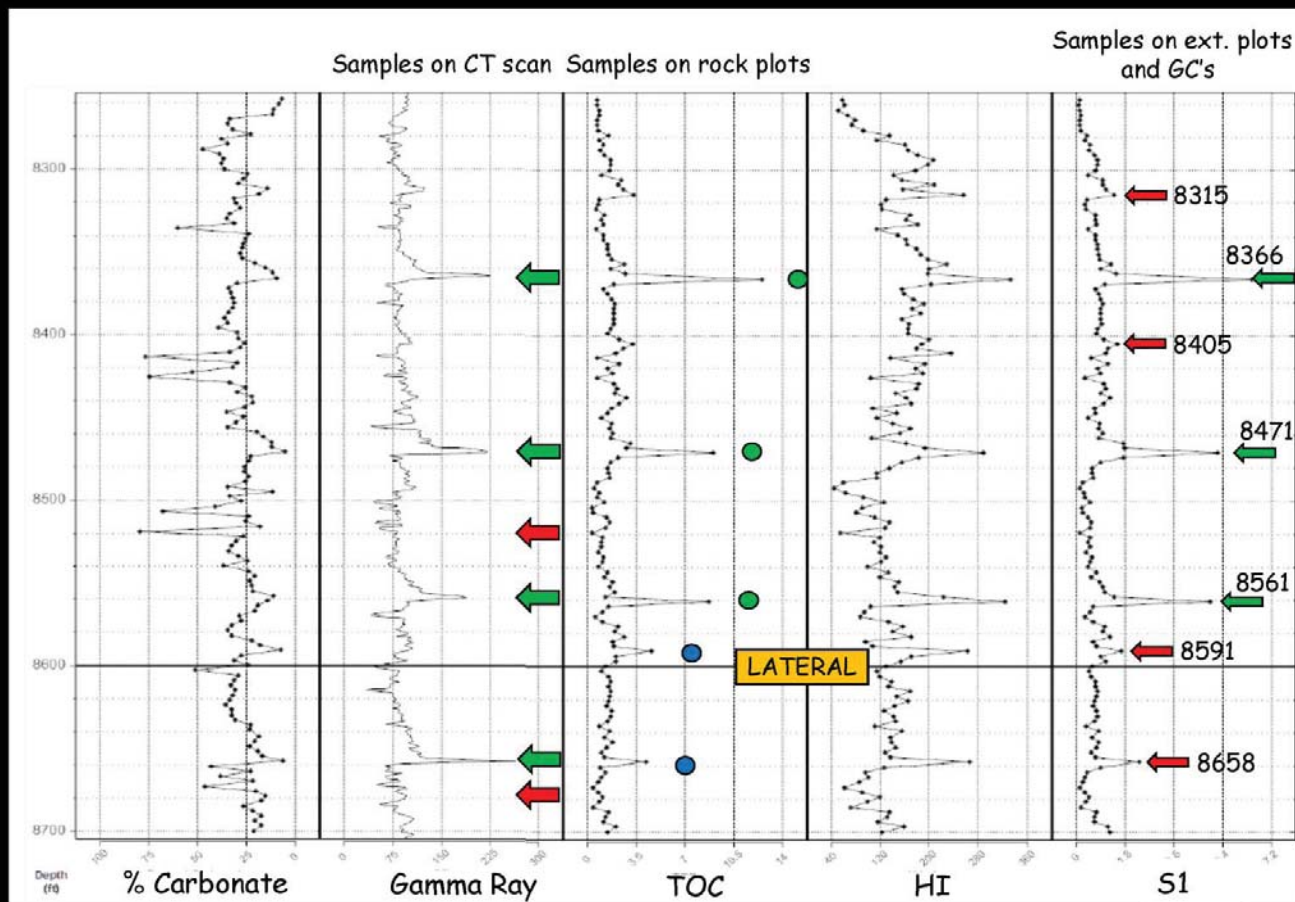


VAN KREVELEN DIAGRAM KEROGEN TYPE



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.

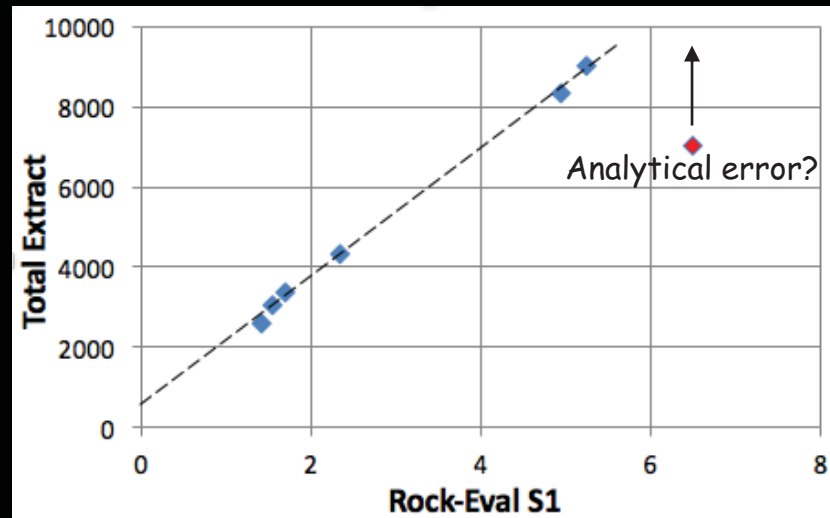
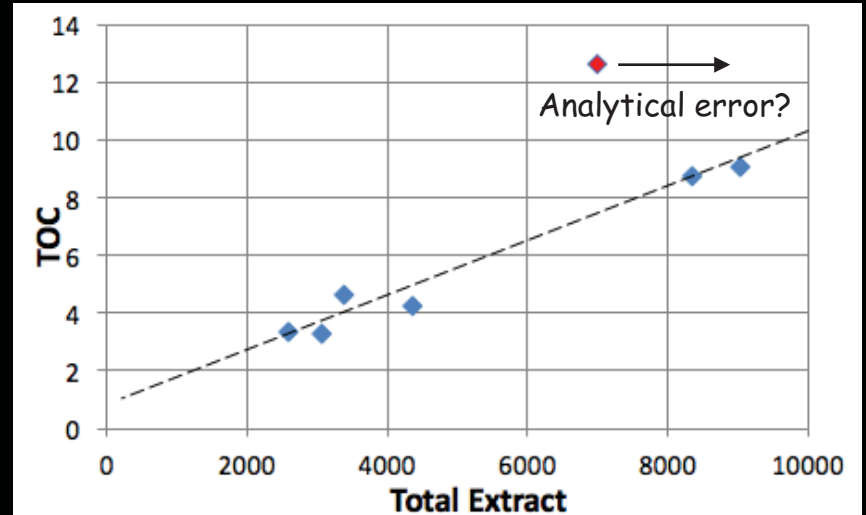
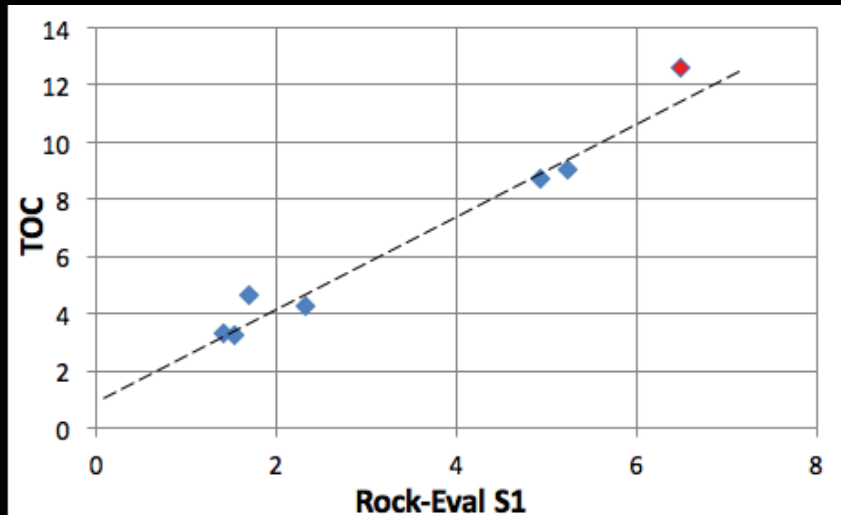
CIMAREX, MENDOTA RANCH 12-1H CORE



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.

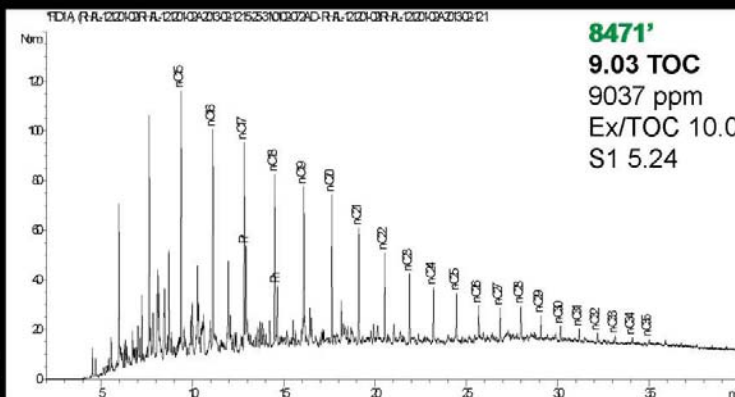
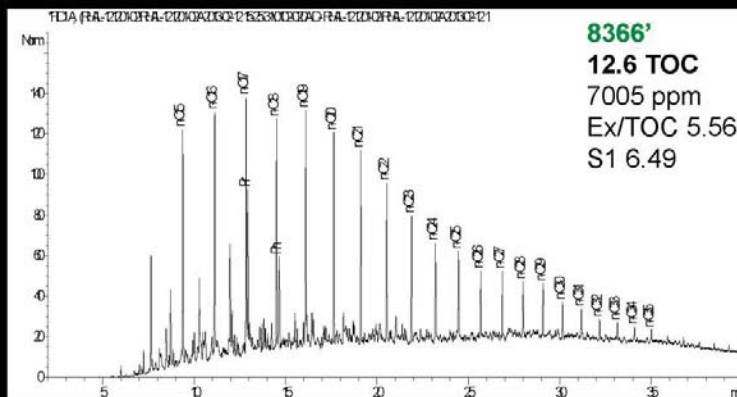
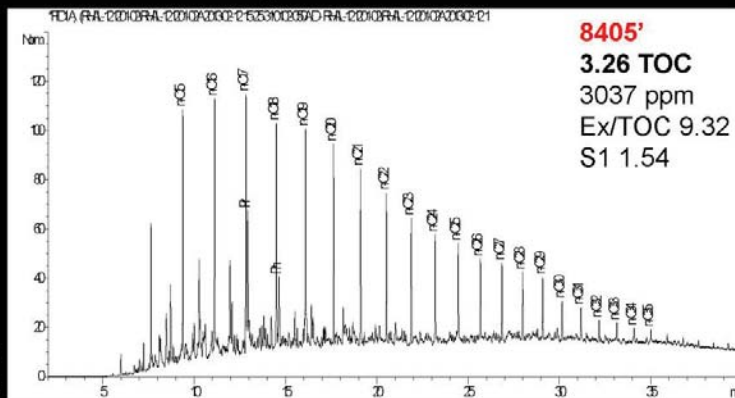
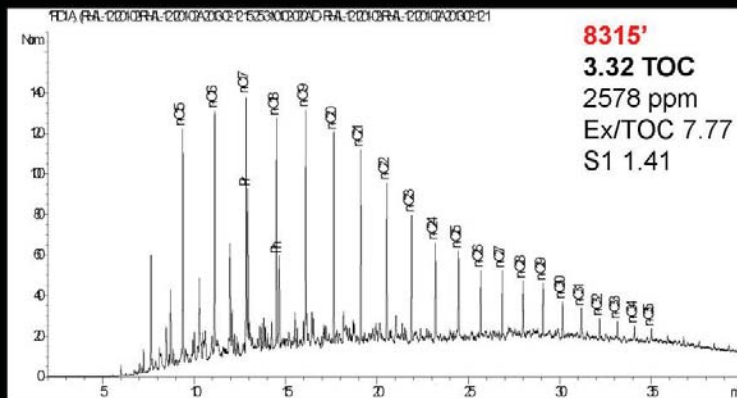
Core Extract GC Samples

Mendota Ranch 12-1 Core Samples



Core Extract Gas Chromatography

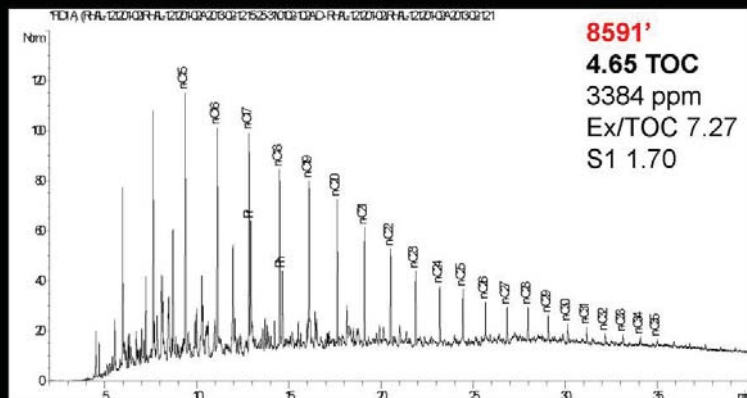
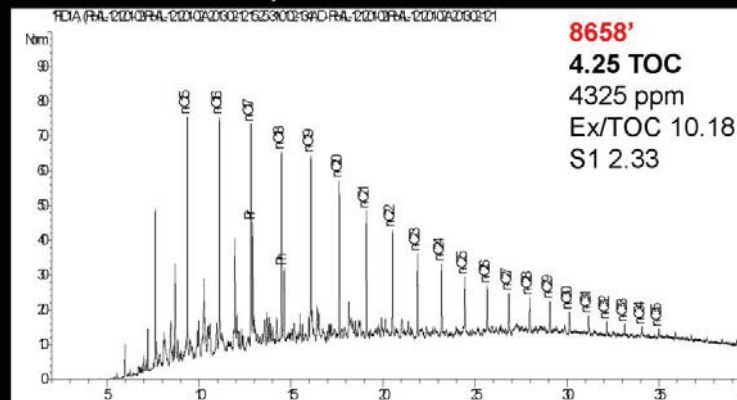
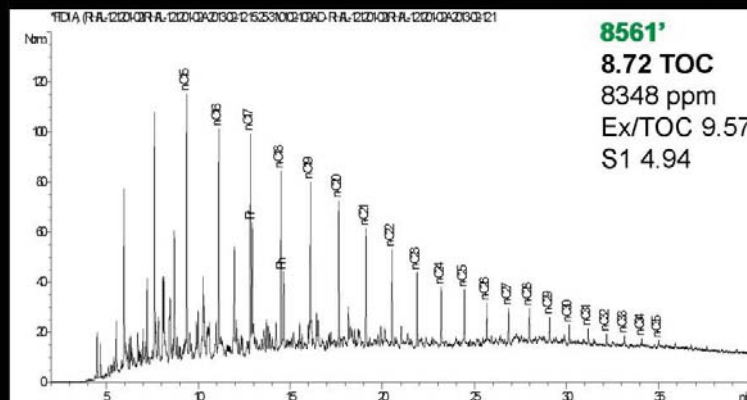
Mendota Ranch 12-1 Core Samples



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



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

Lansing/KC Project

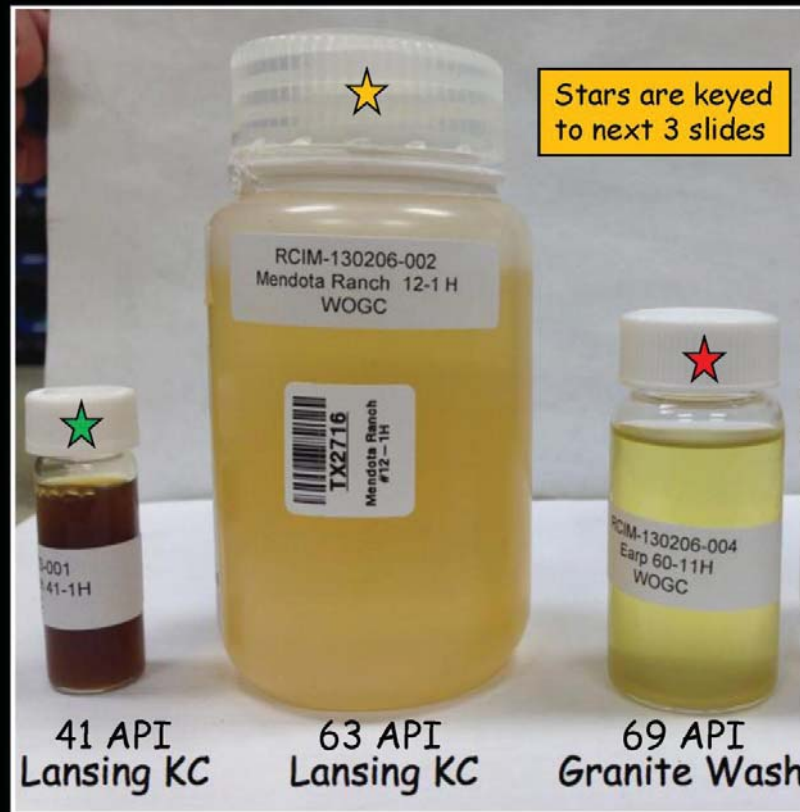
Mendota Ranch 41-1H Lansing/KC Formation

- Disappointing results: IP 115-125 BOPD peak
- Rapid decline & low gas content

Mendota Ranch 12-1H Lansing/KC Formation

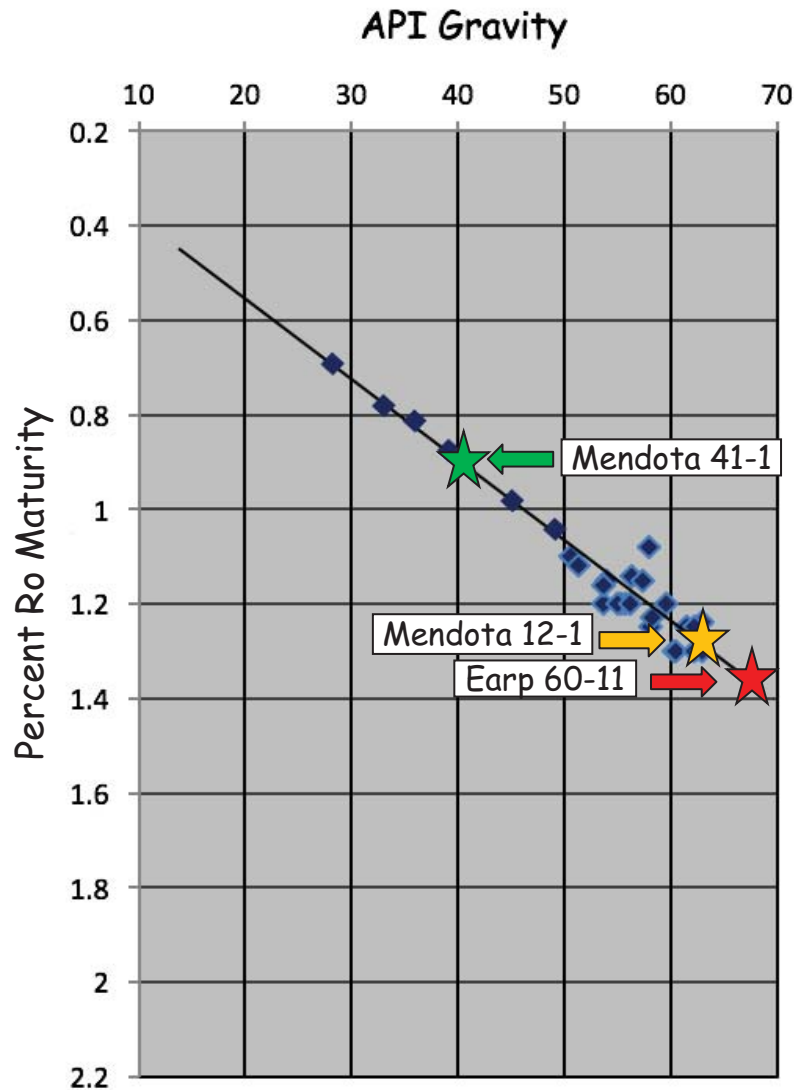
- Pilot hole, cored, advanced logs run, samples analyzed
- Half lateral drilled before losing returns
- Produced *condensate and gas unstimulated* from toe

Visual comparison of the Mendota Ranch 41-1H, 12-1H, and Earp 60-11H, produced oils, Hemphill County, Texas.



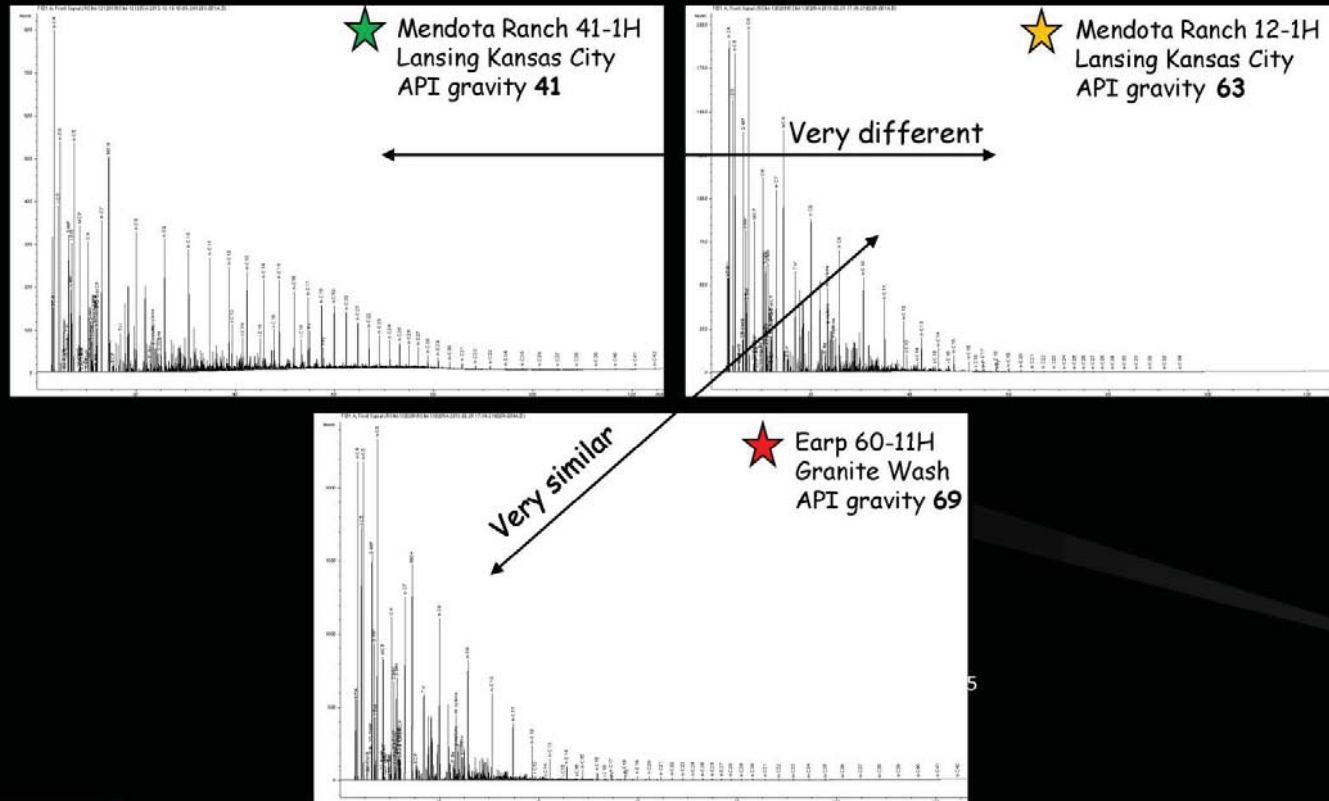
Presenter's notes: Visual comparison of the produced oils from the wells described in this report. The Mendota Ranch 41-1H and 12-1H oils are from the Lansing Kansas City Formation, the Earp 60-11H is from the Granite Wash Formation, and the Mendota Ranch 63-5 is from the Morrow Formation. On this basis alone, the Mendota Ranch 12-1H and Earp 60-1H oils appear quite similar and different from the other two oils.

CALIBRATION OF OIL API GRAVITY WITH %RO MATURITY



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.

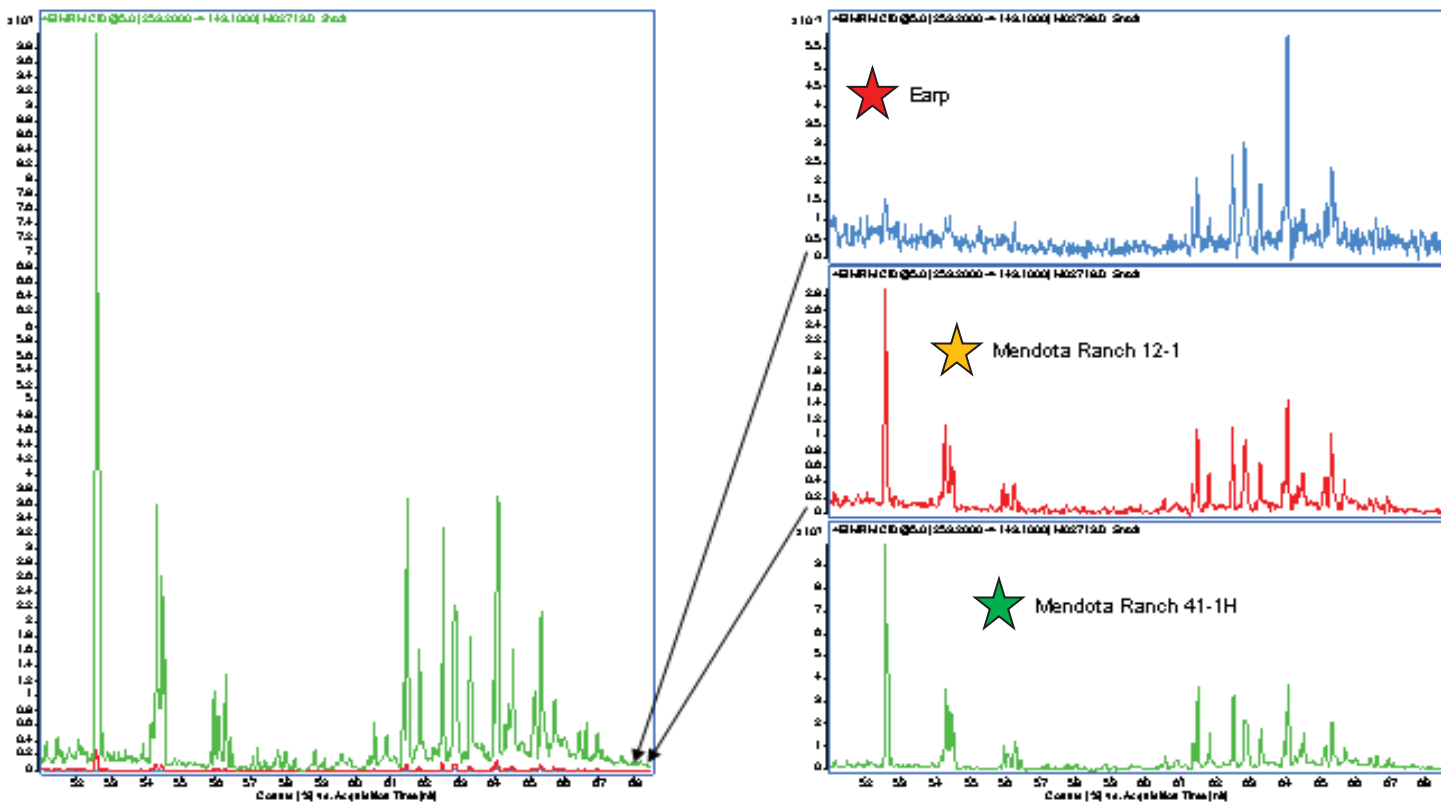
Whole oil gas chromatograms of Mendota Ranch 41-1H, 12-1H, and Earp 60-11H, produced oils, Elk City area, Hemphill County, Texas.



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.

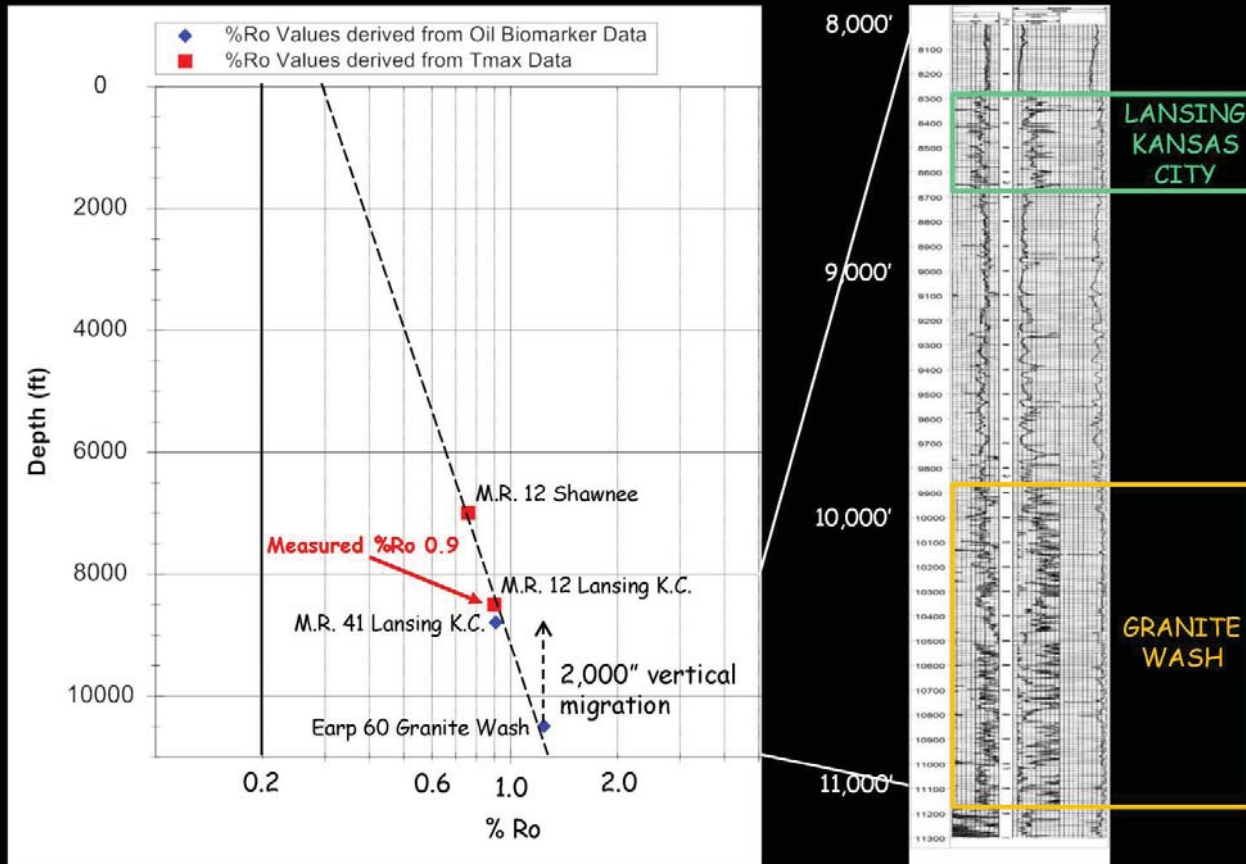
Light Hydrocarbon Biomarker Correlation

Monoaromatic Steroids (MAS) from Mendota Ranch & Earp oils



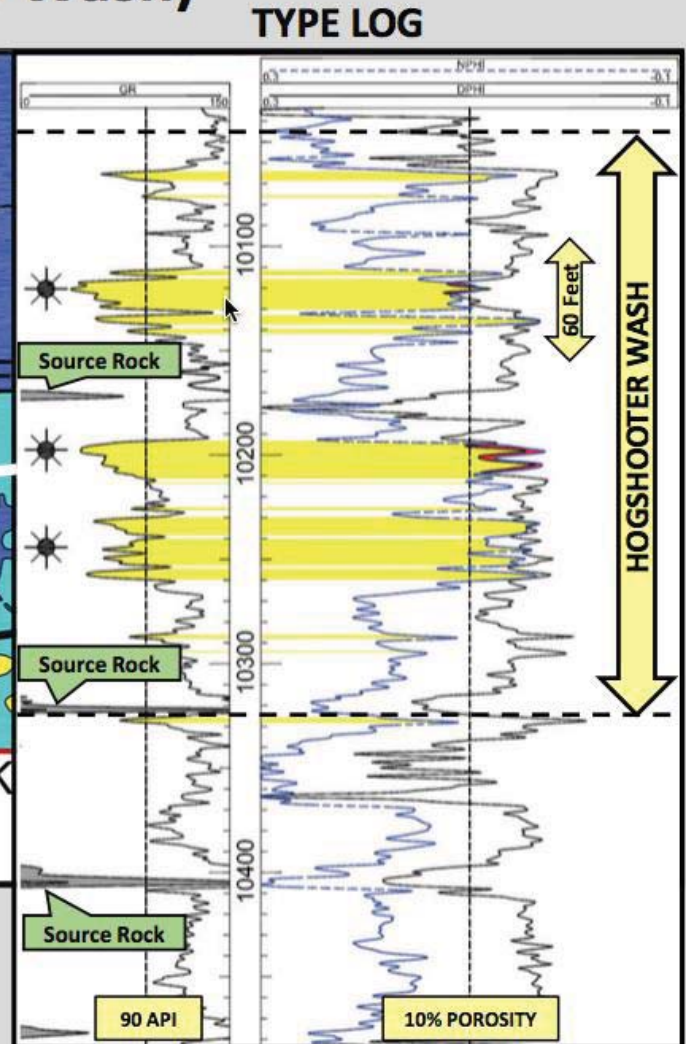
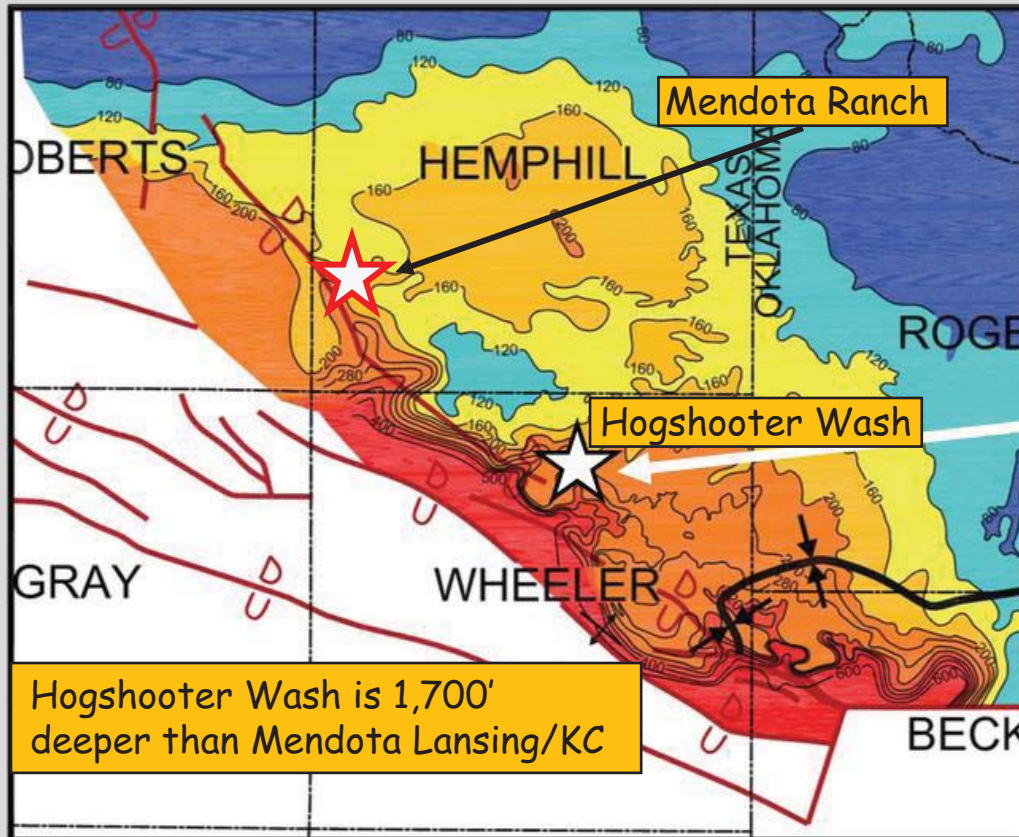
In MAS peak distribution, **Mendota Ranch 12-1** resembles **Mendota Ranch 41-1H**. In size, **Mendota Ranch 12-1** resembles **Earp**. A small amount of the green oil mixed with a lot of the blue oil could produce the red oil.

Maturity Profile, Mendota Ranch 41 & 12 Wells



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.

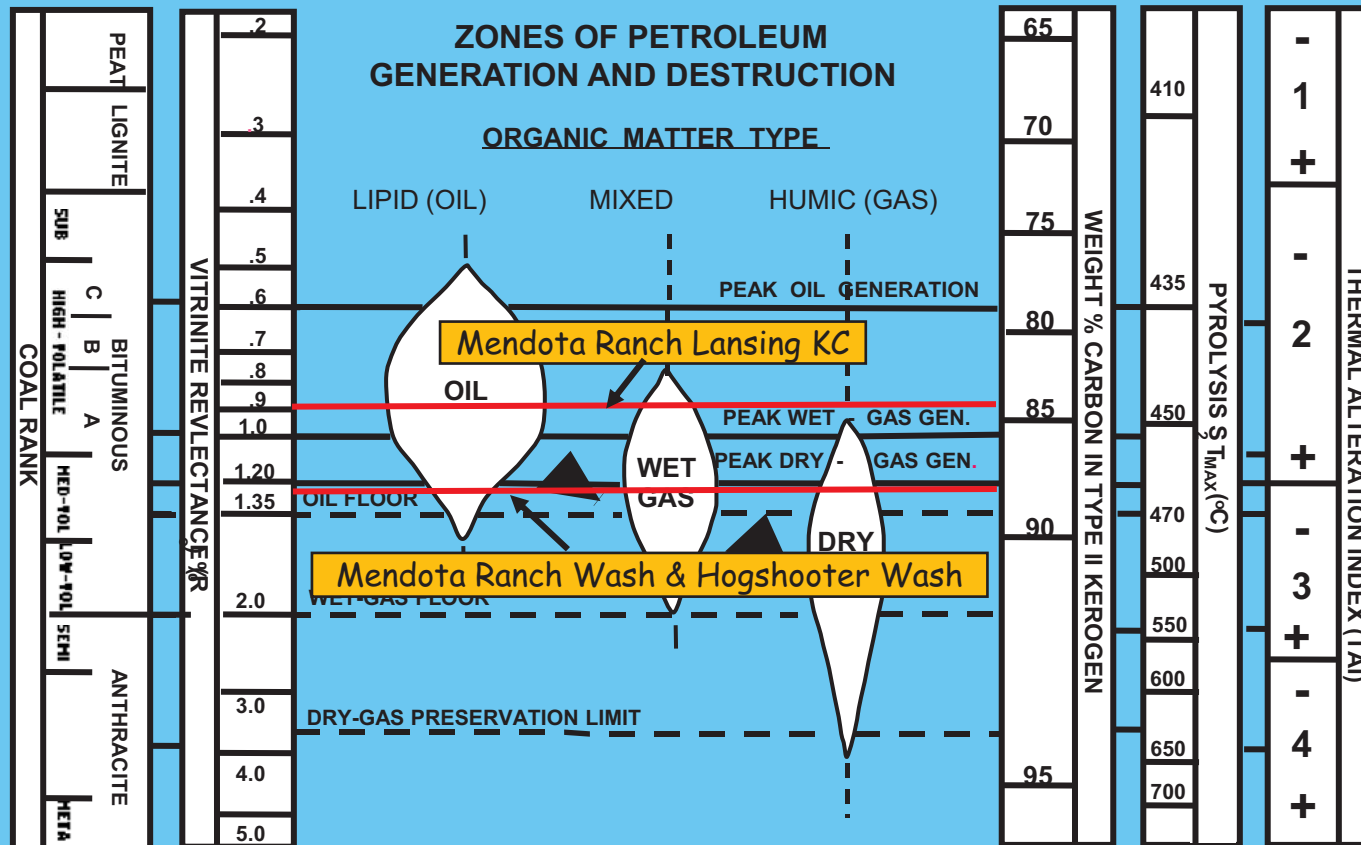
Isopach Map: Hogshooter Wash (Missourian) (Upper Kansas City Wash)



Interval Isopach Map
Contour Interval: 40/100 Ft

12 Miles

Mendota Ranch Lansing KC Maturity

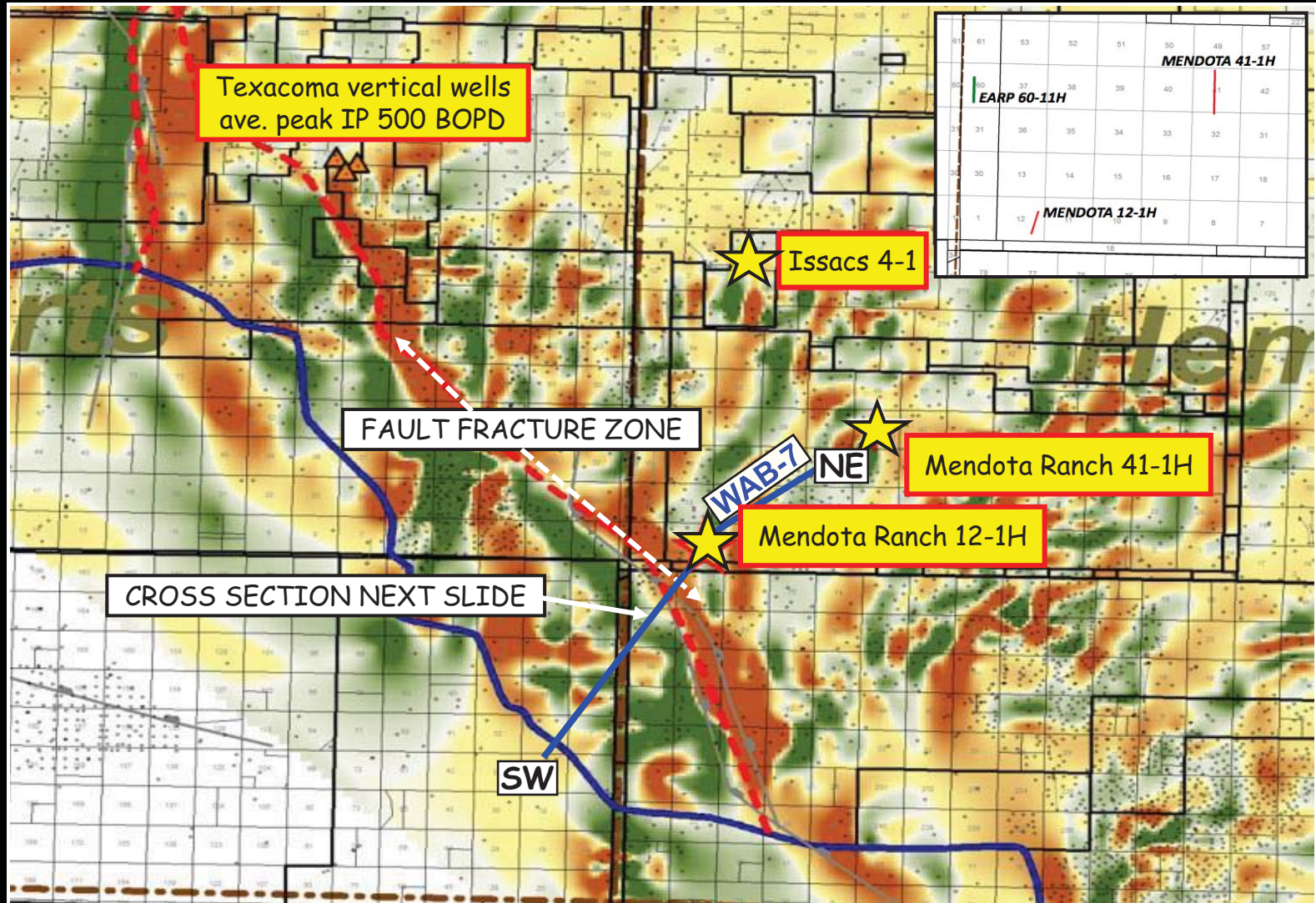


CORRELATION OF VARIOUS MATURATION INDICES AND ZONES OF PETROLEUM GENERATION AND DESTRUCTION

GEOCHEMISTRY CONCLUSIONS

- 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.

LANSGING STRUCTURE - 2nd DERIVATIVE MAP



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.