

AV The Lower Tertiary Wilcox Trend in the Deepwater Gulf of Mexico*

By
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Abstract

Initial Lower Tertiary penetrations in the western deepwater Gulf of Mexico documented a 6,000'+ succession of Wilcox (upper Paleocene – lower Eocene) turbidites located 250 miles down-dip from their fluvial and deltaic equivalents. These same thick turbidites have also been discovered 200 - 300 miles to the east, in new exploration wells in this emerging trend. Regional synthesis demonstrates a systematic progression from lower slope to extensive fan sands, to starved distal basin.

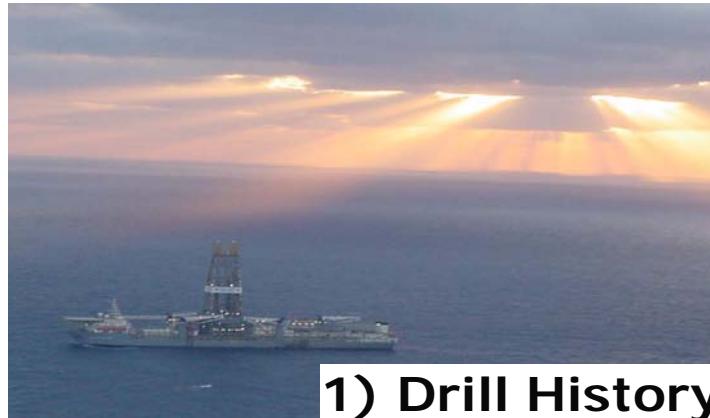
The deepwater Wilcox Trend covers 30,000+ square miles. Well target depths range from 12,000' – 35,000' subsea, water depths range from 4,000' – 10,000', salt canopies vary from 7,000' - >20,000' thick, and cover approximately 90% of the trend. Twenty+ wildcats have been drilled in the Wilcox Trend, with 12 announced discoveries, ranging from 40 – 500 MMboe recoverable reserves. Ultimately, the Wilcox trend has the potential for recovering 3 – 15 bboe reserves from these and additional untested Louann salt-cored structures.

The Jack #2 production test (Walker Ridge 758) had a sustained flow rate over 6,000 bopd from approximately 40% of the reservoir. The test occurred in 7,000' of water and greater than 25,000' subsea, and established six world production test records. Test results significantly increase understanding of trend deliverability.

Many technical challenges need to be resolved to move the billions of barrels of resource trapped in deepwater Wilcox structures to recoverable economic reserves. These challenges include complex sub-salt imaging improvements, reservoir quality, sand distribution, and flow capability, and cost effective drilling and completion, facility, and infrastructure designs.

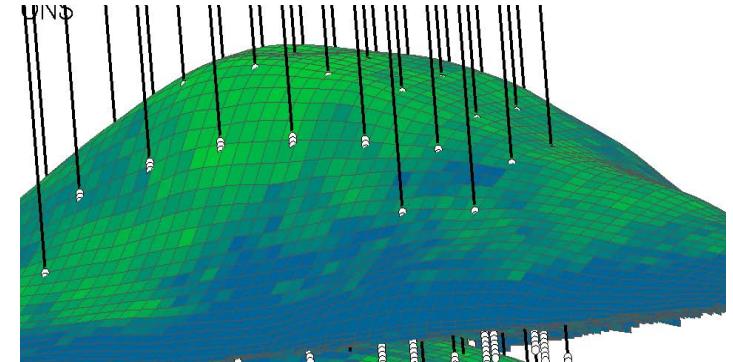
The Lower Tertiary Trend in the Deepwater Gulf of Mexico

Dave Rains; Larry Zarra, Dave Meyer



1) Drill History

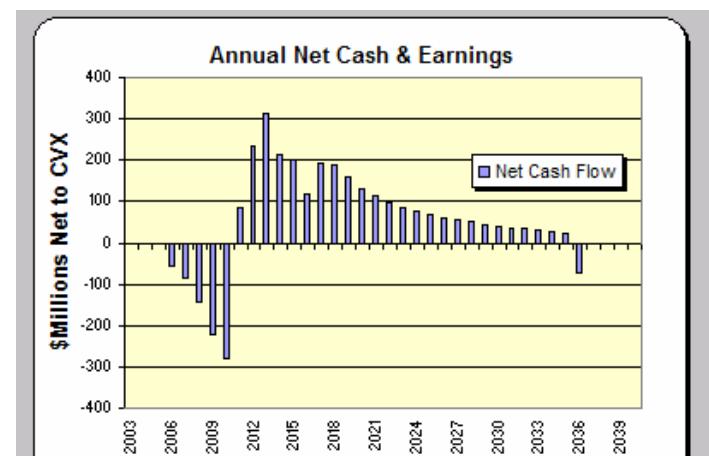
Agenda



2) Trend Characteristics



3) Jack Well Test



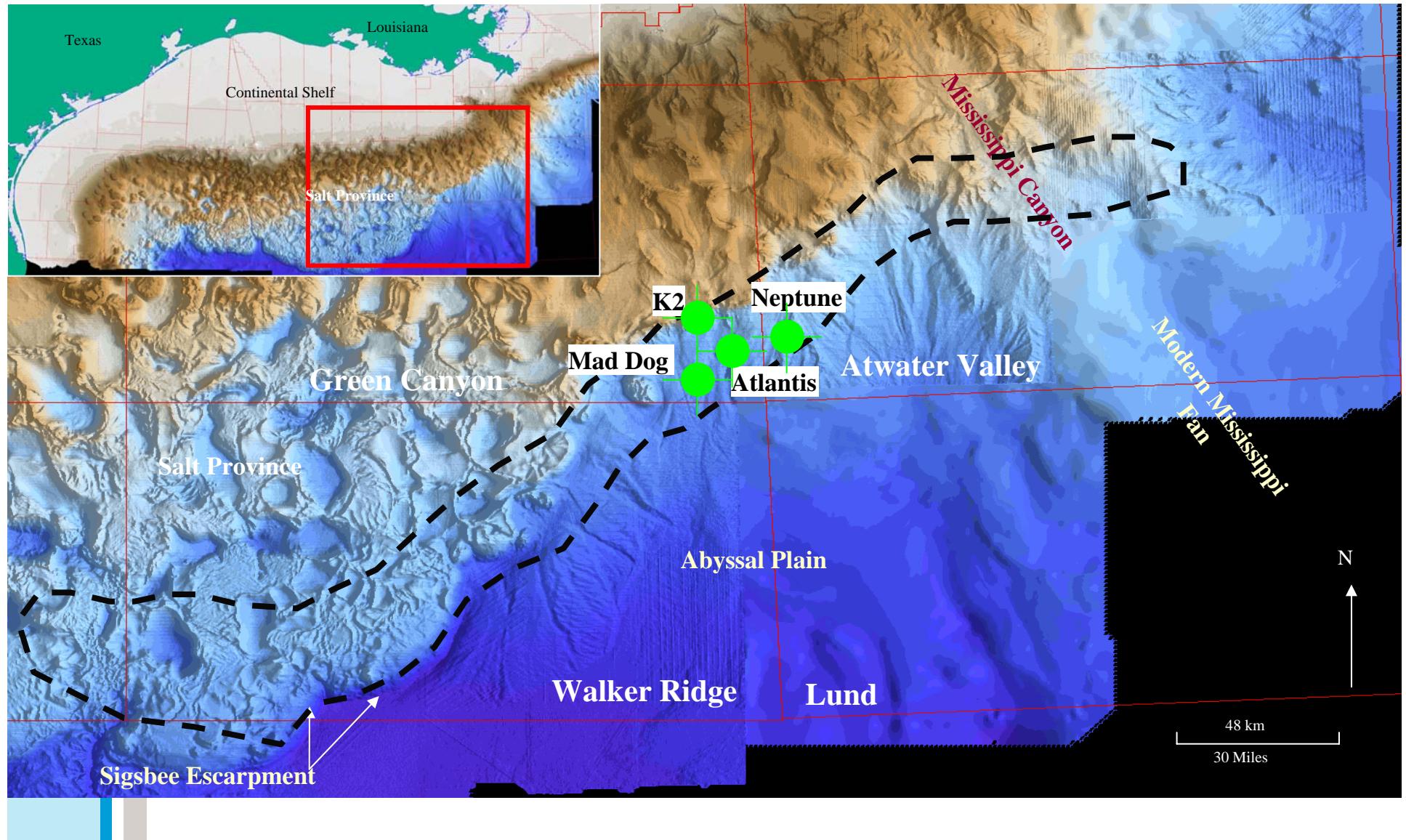
4) Trend Challenges



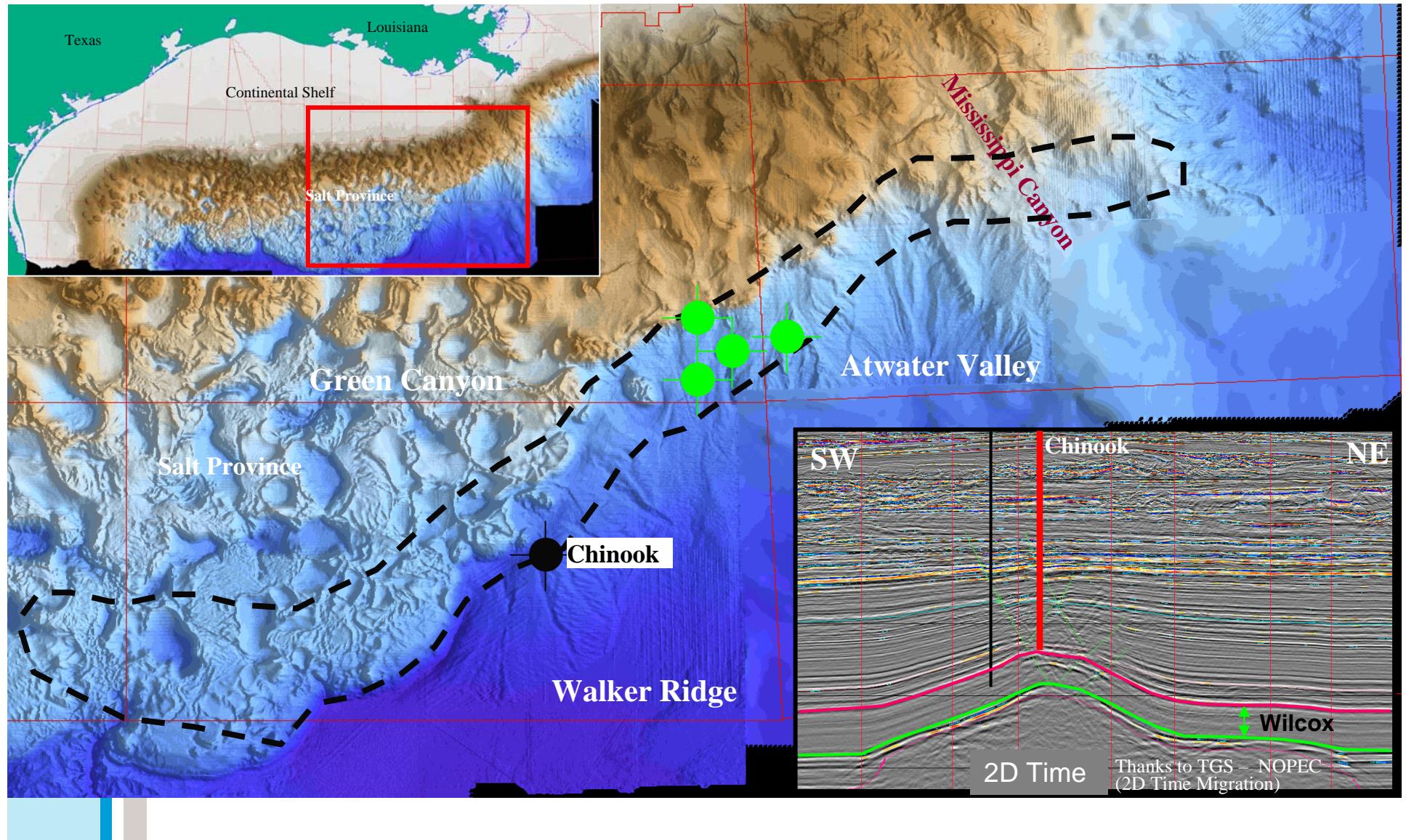
Trend Drill History



Lower Tertiary: Drill History



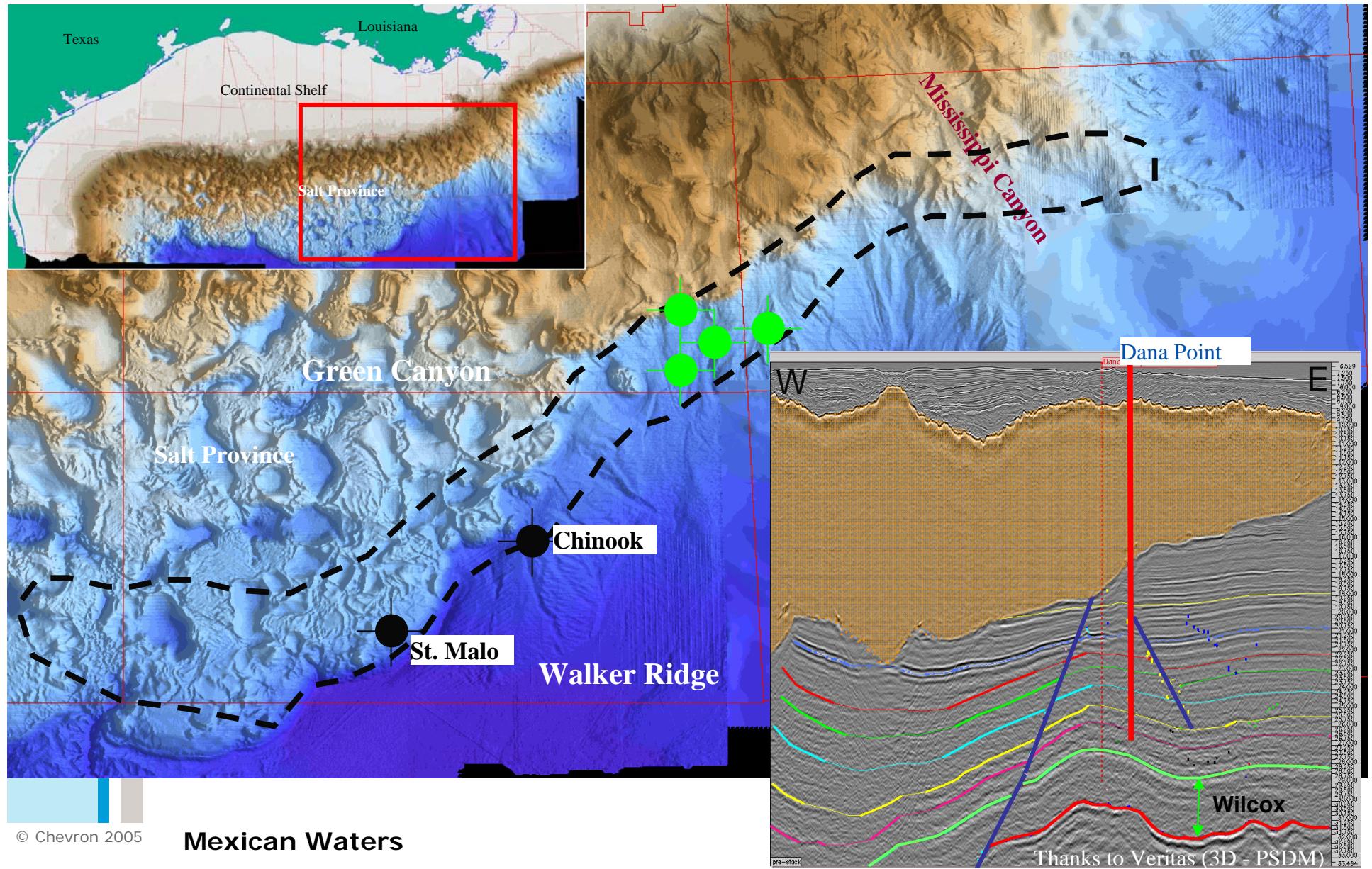
Lower Tertiary: Drill History



© Chevron 2005

Mexican Waters

Lower Tertiary: Drill History

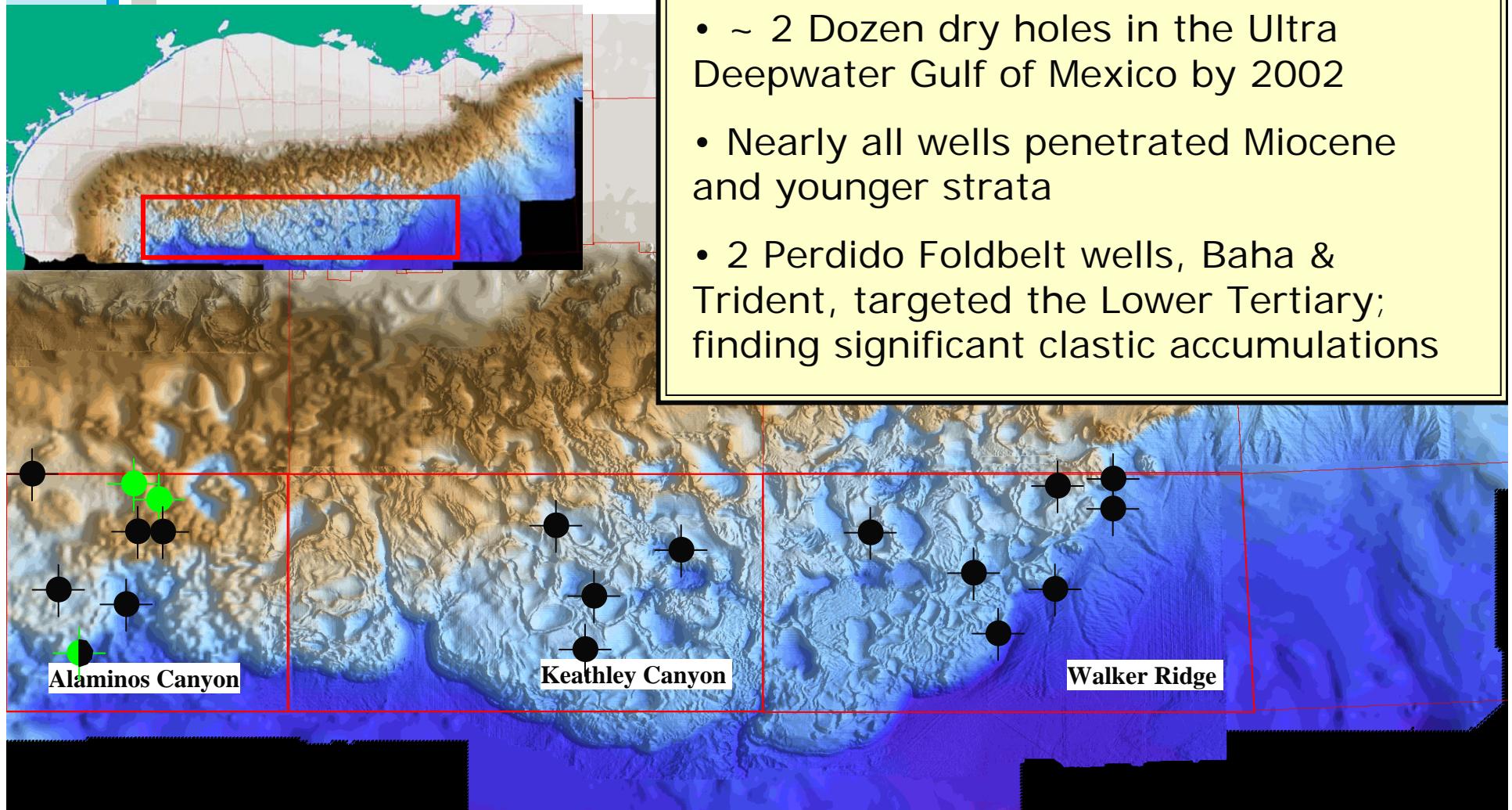




Lower Tertiary: Drill History

Wells in the Ultra Deepwater GOM prior to 2002

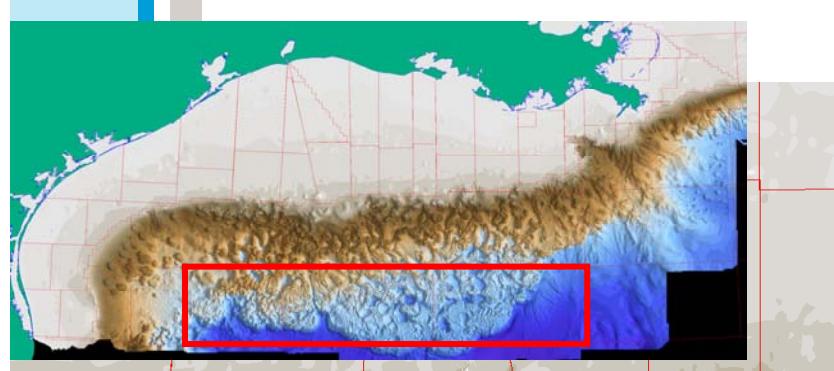
- ~ 2 Dozen dry holes in the Ultra Deepwater Gulf of Mexico by 2002
- Nearly all wells penetrated Miocene and younger strata
- 2 Perdido Foldbelt wells, Baha & Trident, targeted the Lower Tertiary; finding significant clastic accumulations



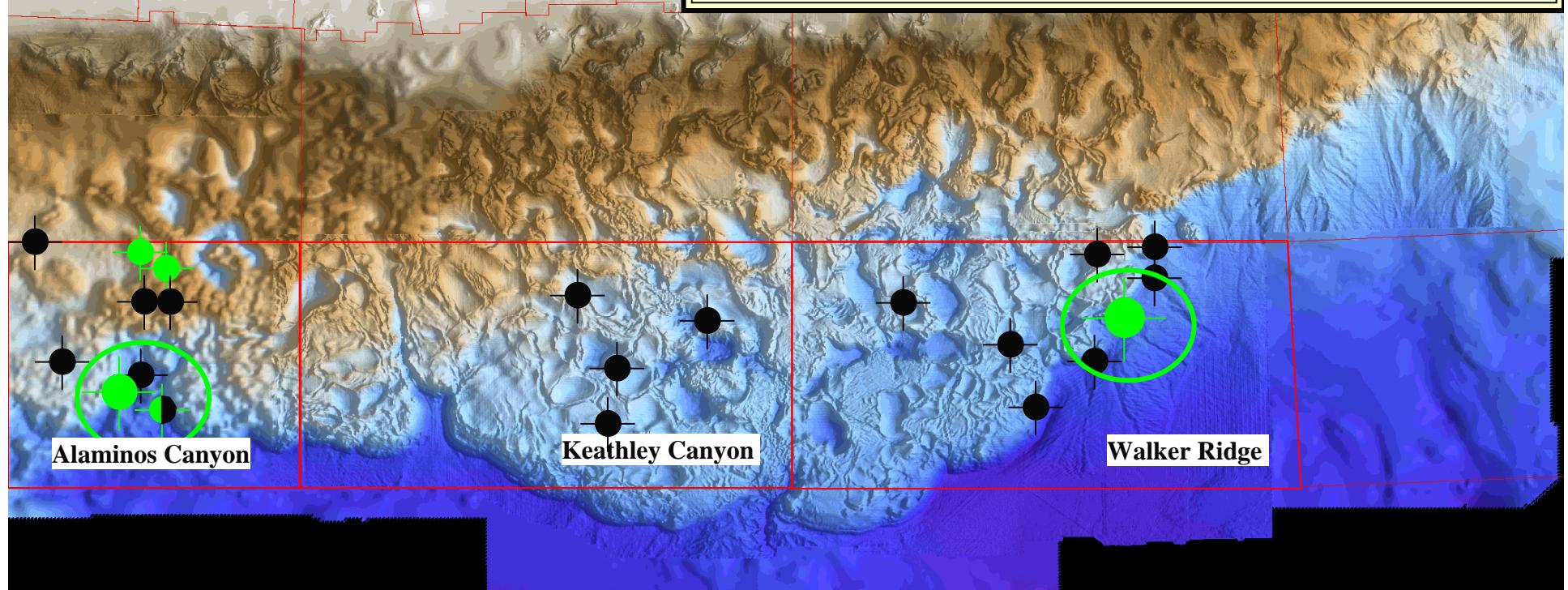


Lower Tertiary: Drill History

Wells that Changed Everything



- Cascade, 2002, WR 206. Oil Discovery in the Eocene/Paleocene (Wilcox).
- Great White, 2002, AC 857. Oil Discovery in the Eocene/Paleocene (Wilcox)

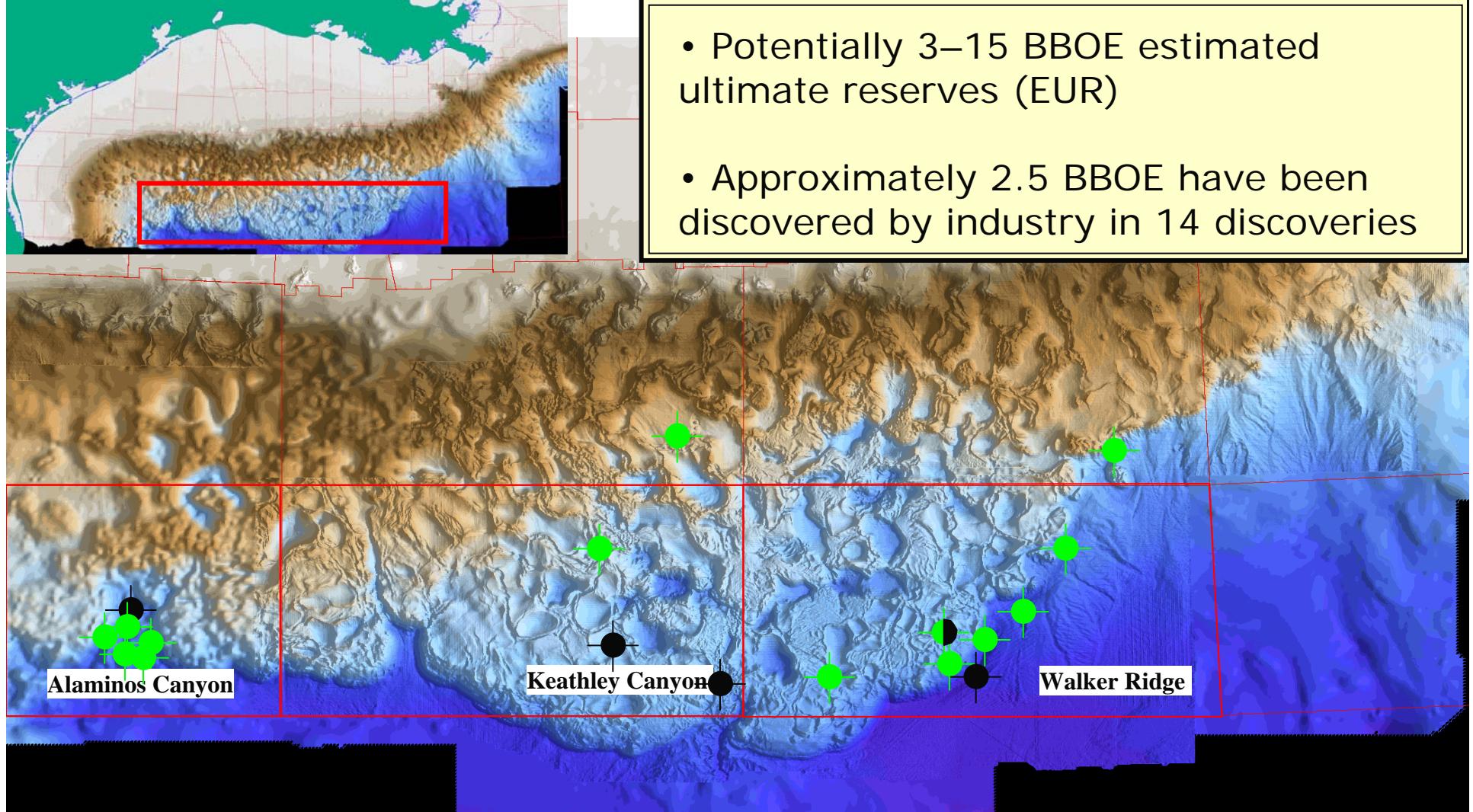




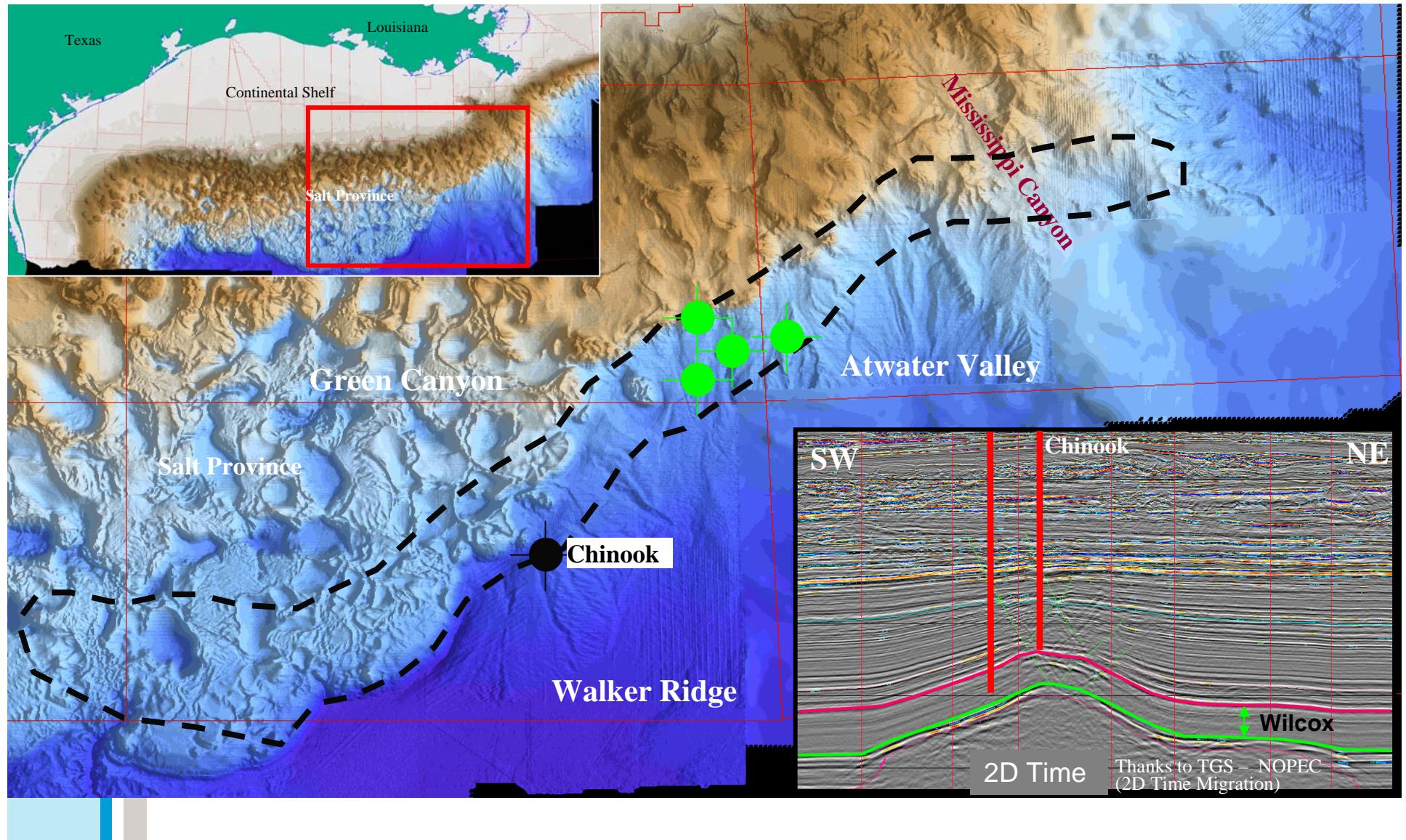
Lower Tertiary: Drill History

Wells in the Lower Tertiary since 2002

- Potentially 3–15 BBOE estimated ultimate reserves (EUR)
- Approximately 2.5 BBOE have been discovered by industry in 14 discoveries



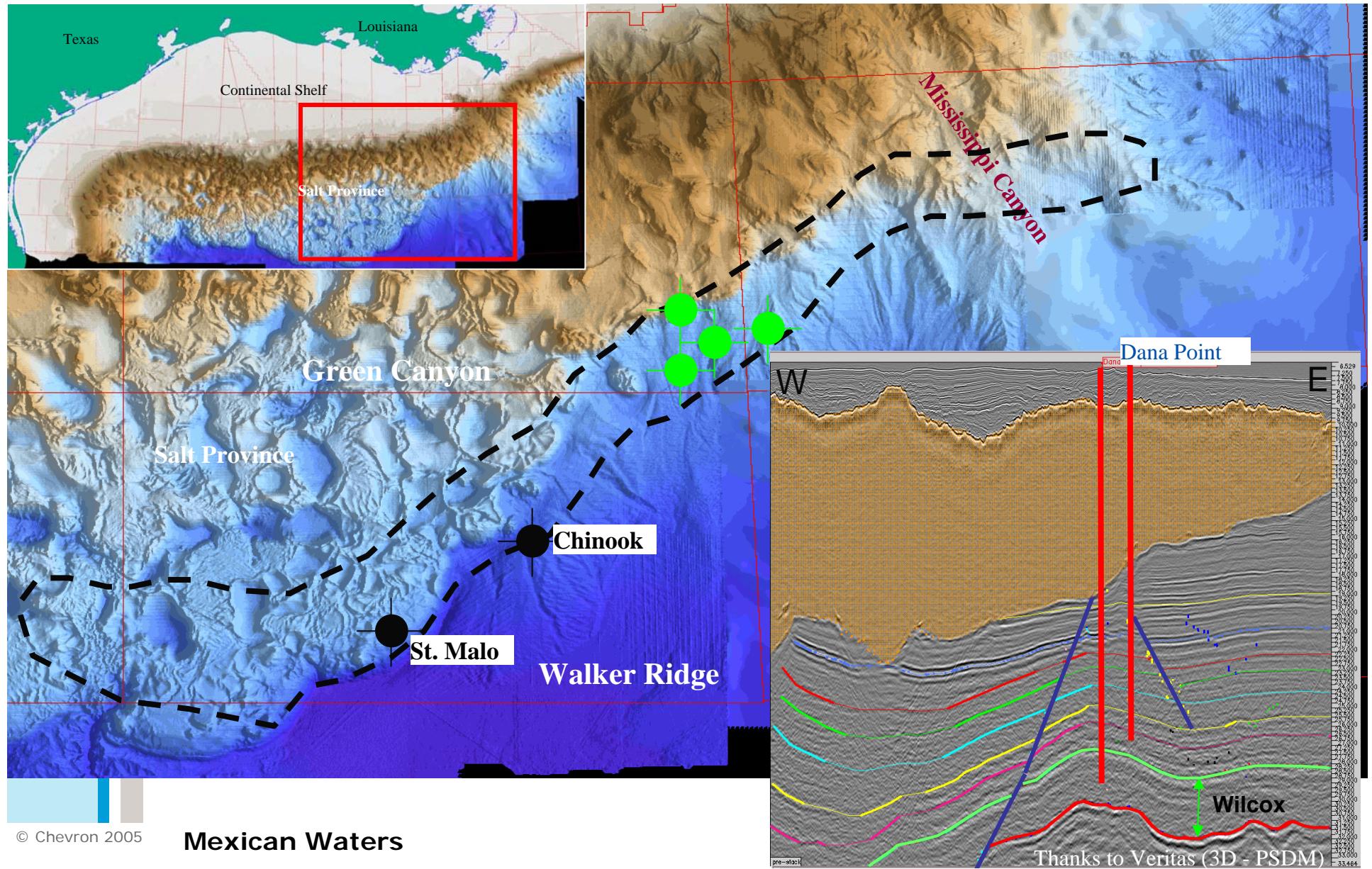
Lower Tertiary: Drill History



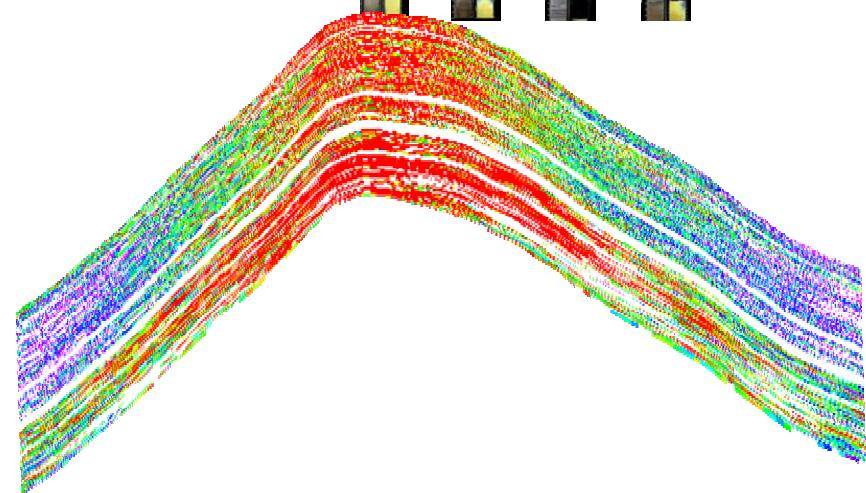
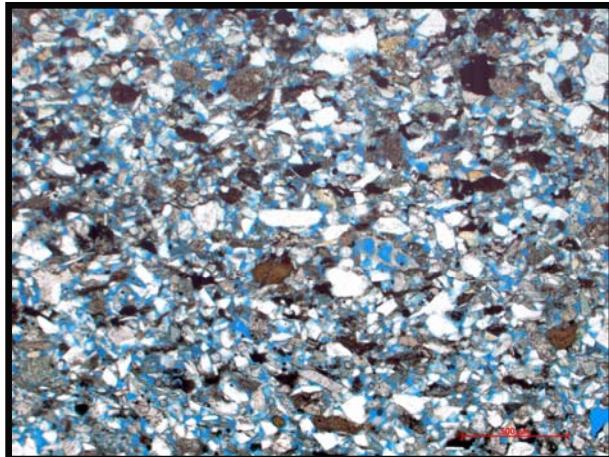
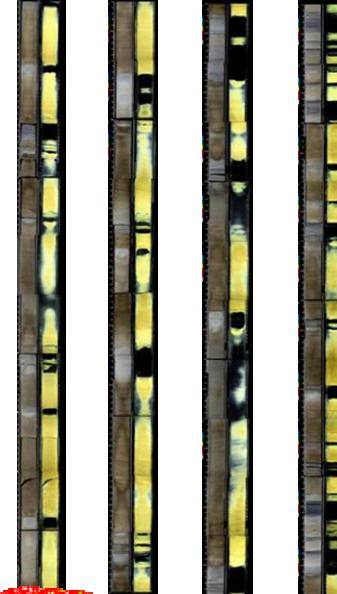
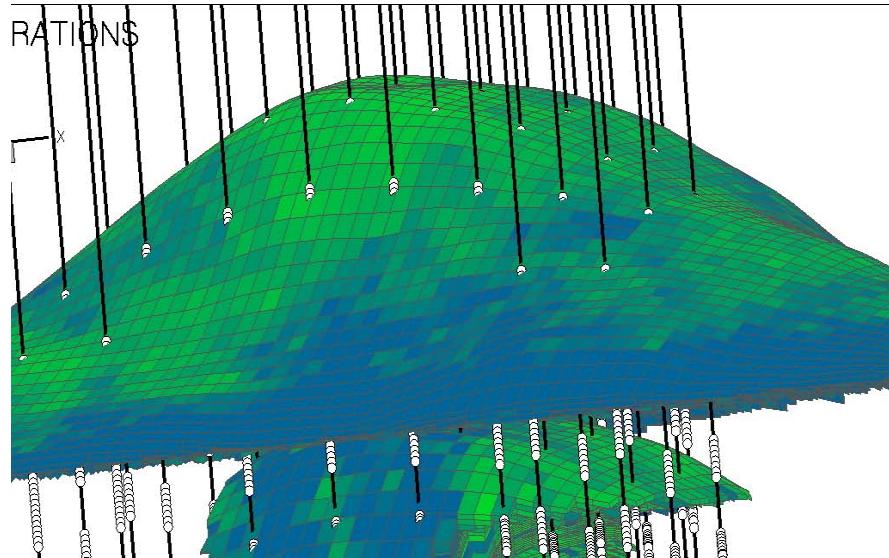
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Mexican Waters

Lower Tertiary: Drill History

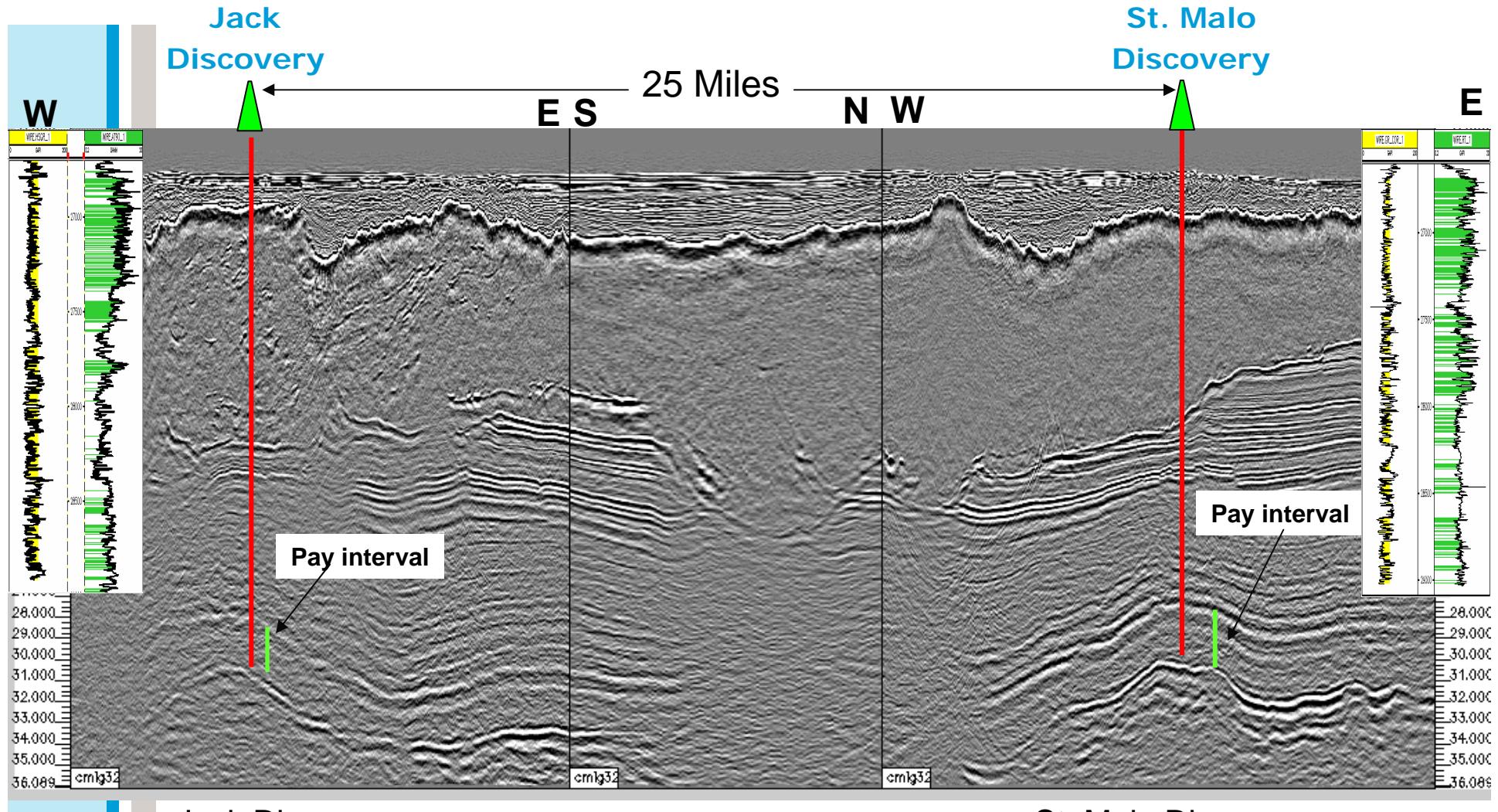


Agenda: Trend Characteristics





Trend Characteristics: Structural Styles



Jack Discovery

350' Net Pay

© Chevron 2005

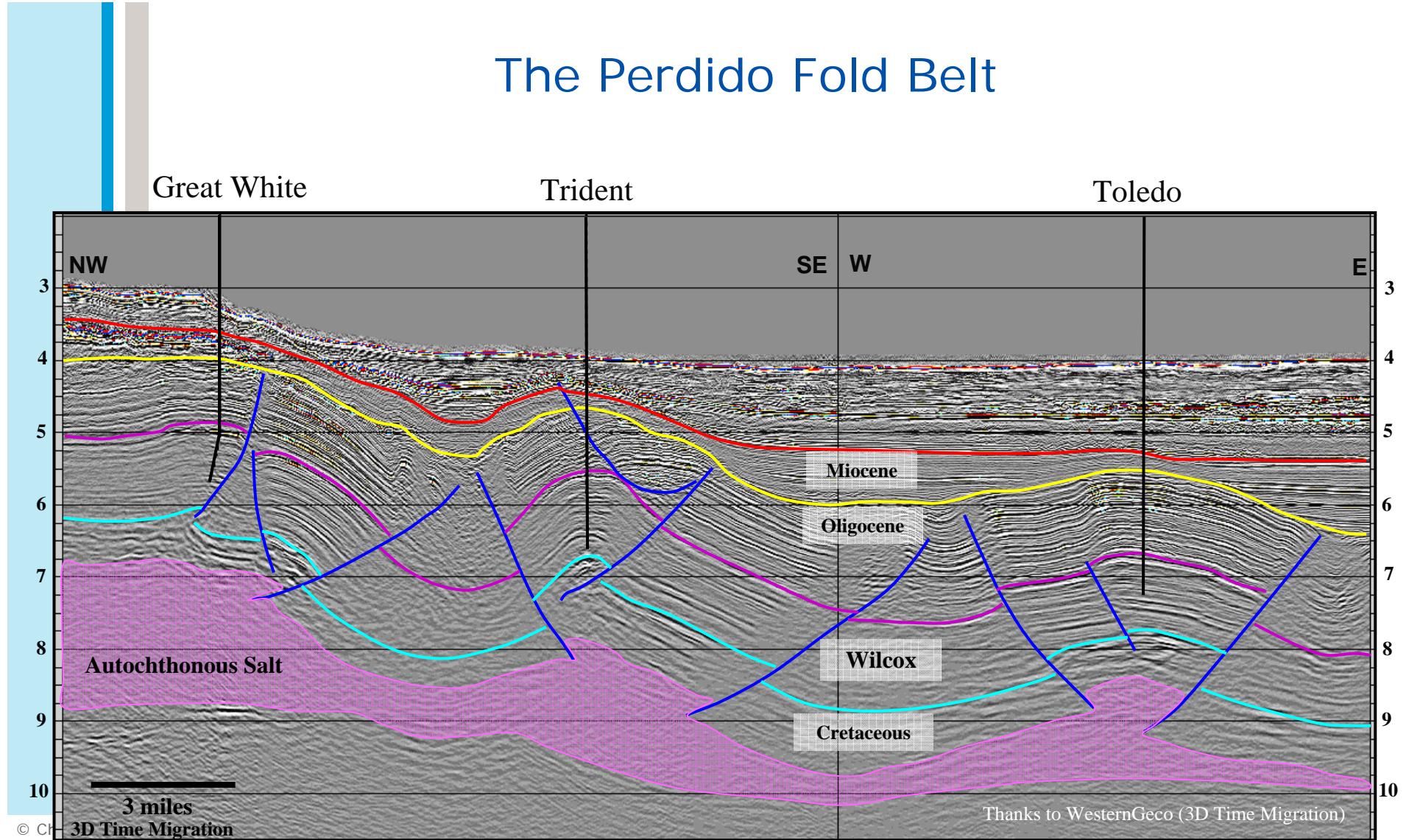
St. Malo Discovery

600' + Net Pay



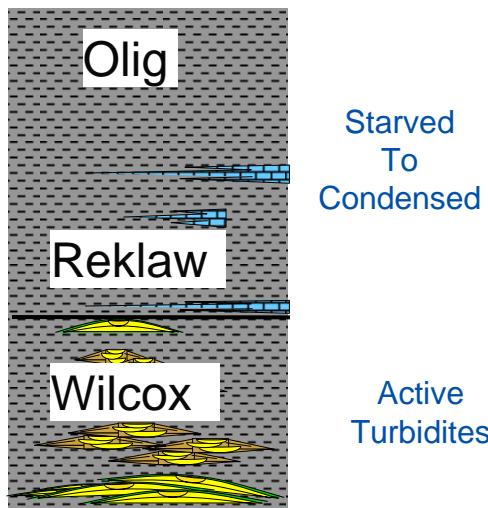
Trend Characteristics: Structural Styles

The Perdido Fold Belt



Trend Characteristics: Seal & Source

Seal

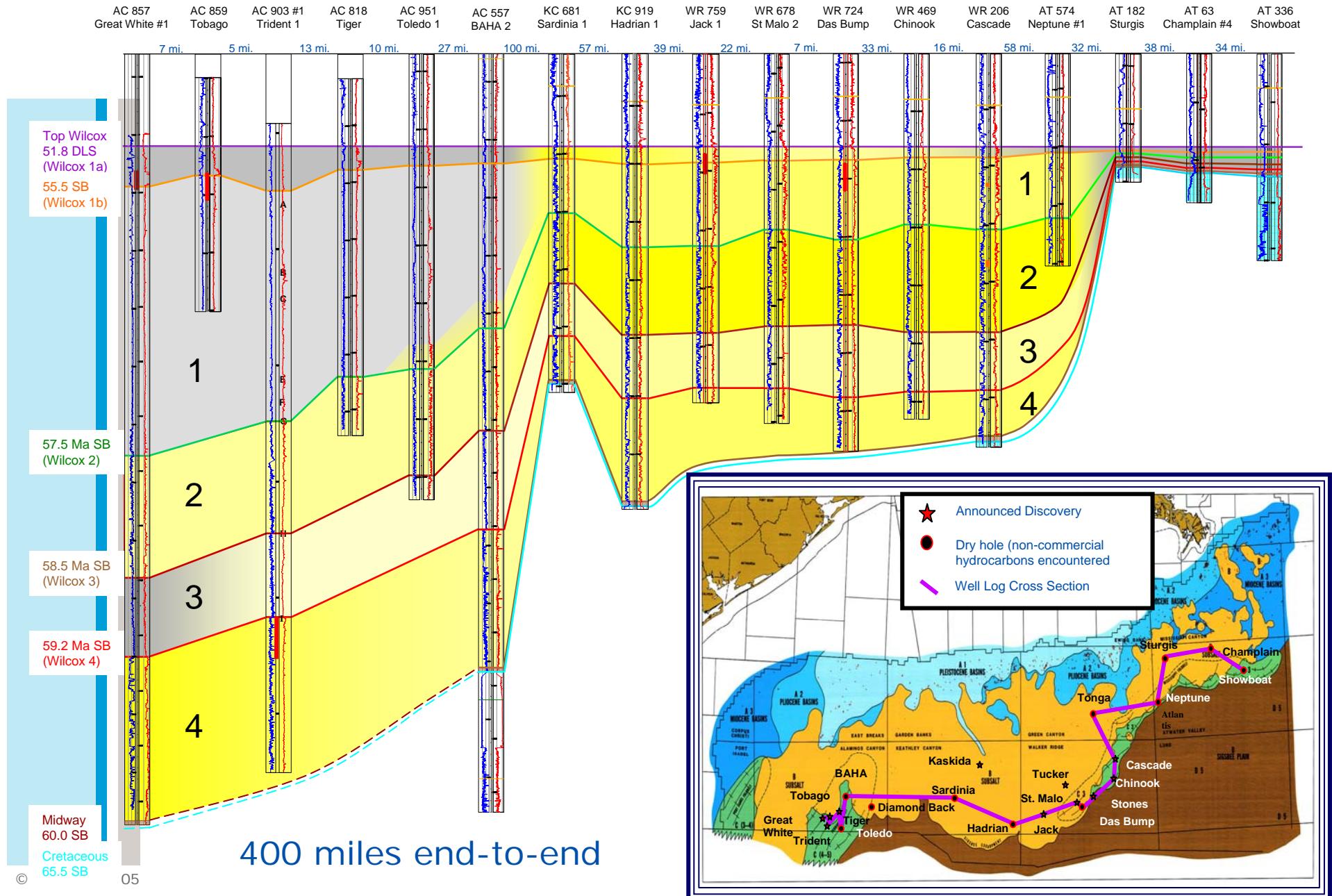


- Wilcox Turbidites are overlain by thick, regional Reklaw Shale
- Wilcox is partitioned into 2 reservoirs by regional debris flow

Source

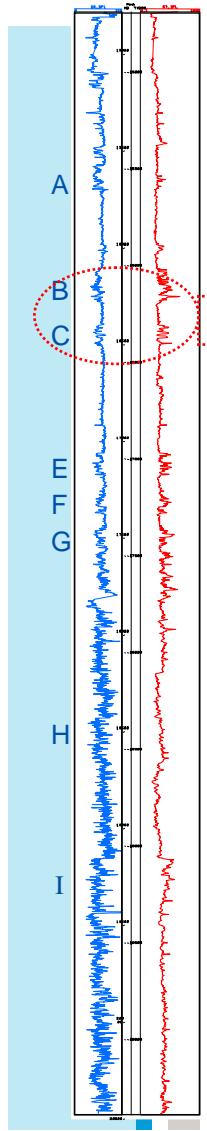
- Lower Tertiary Clastics are charged by Cretaceous and Jurassic source rocks
- Low GOR (<350)
- Viscosity varies significantly: 1-10+cp
- Viscosity varies vertically and laterally within structures suggesting complex filling histories
- API 22-41°
- 0-2% Sulfur
- Current reservoir pressure is >19,000 psi; Temp is >230° F

Wilcox Regional Cross Section – Alaminos Canyon to Atwater Valley



Trend Characteristics: Reservoir

AC 903 #1
Trident #1



- Average channel width ~ 1,000 – 1,500'
- Width of meanders ~ 4,000' - 8,000',
- Amplitude of meanders ~ 5,000' - 10,000'

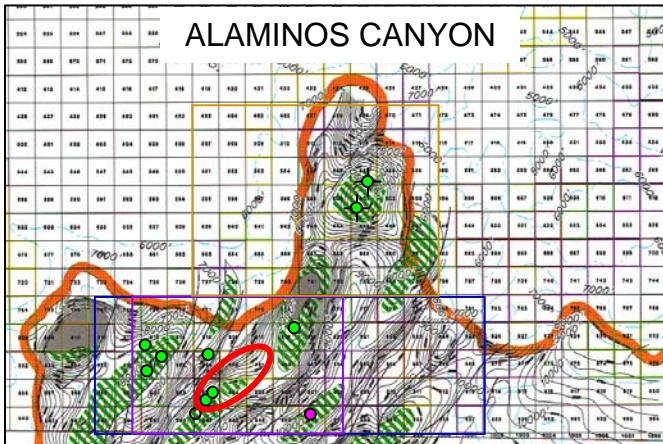
Leveed Channel Morphology 60 foot slices through flattened PSDM

Low sinuosity
cut-off meander

AC 903 #2
AC 903 #1

-390

Thanks to WesternGeco (3D Time Migration)



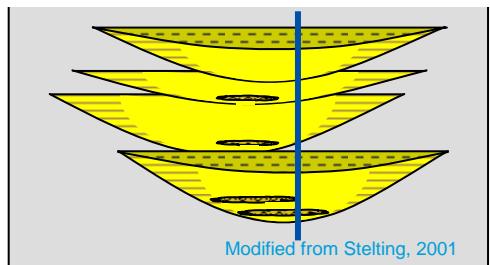
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High sinuosity meander
and cut-off

-330

3 mi.

Whole core based schematic model for
leveed channel systems



Leveed
Channels

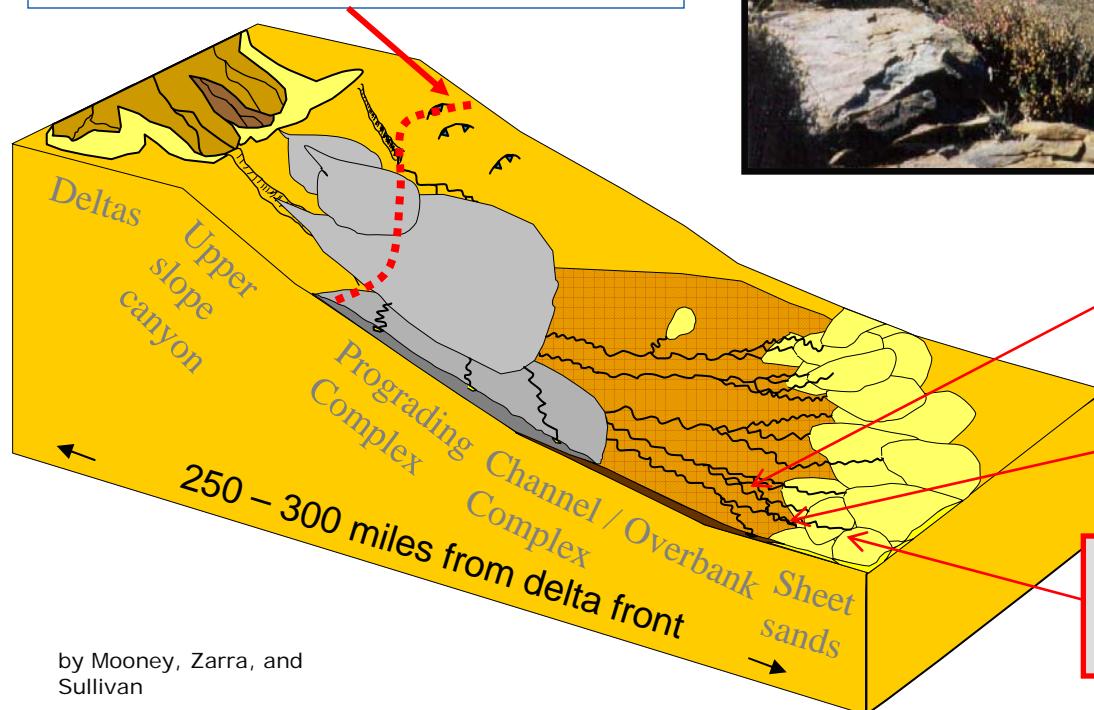
Trend Characteristics: Reservoir

Interpreted Depositional Environment and Analog

Analog: Tanqua – Karoo Basin,
South Africa



Downdip limit of onshore well
and seismic control for Wilcox



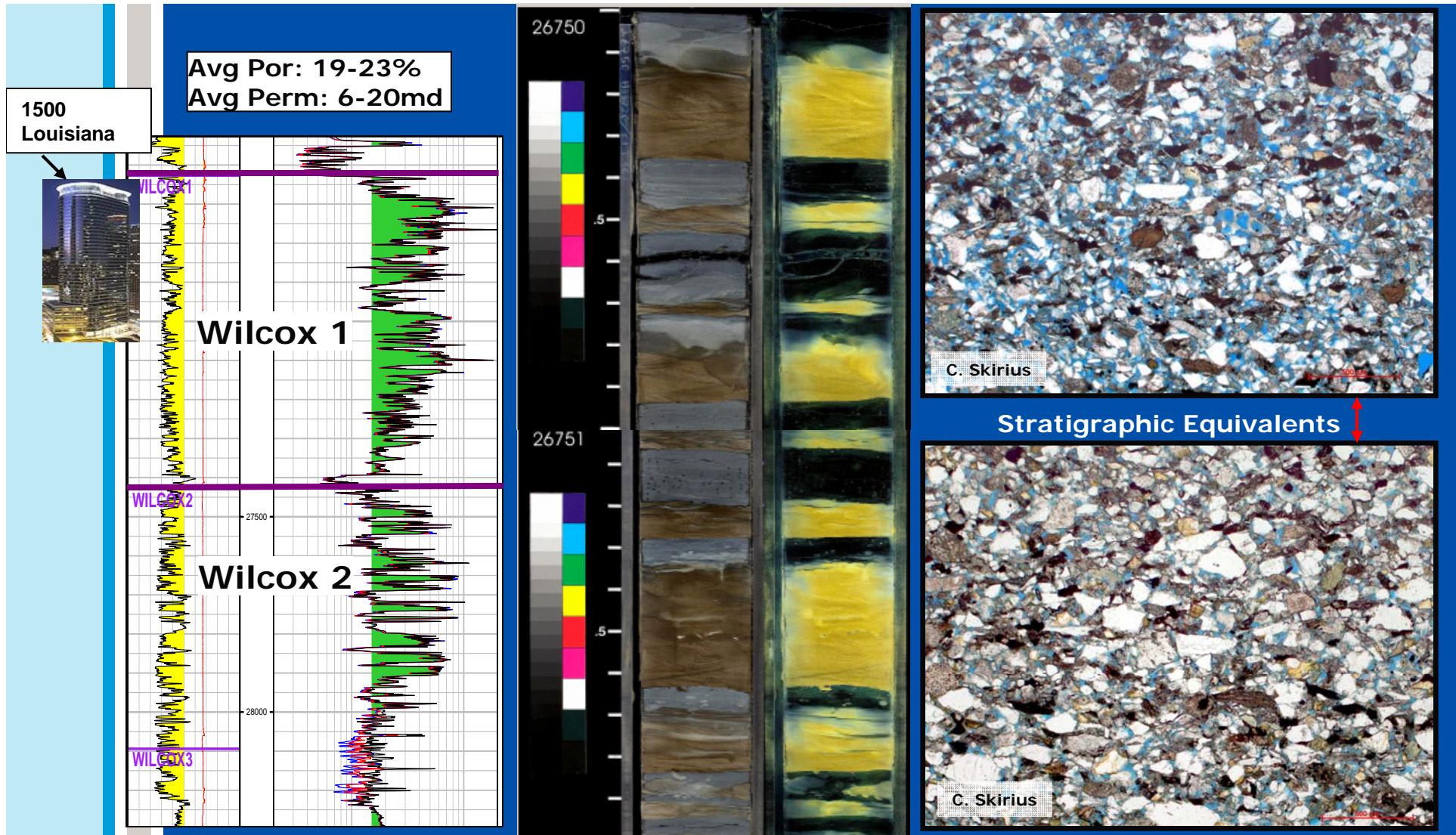
Low aspect ratio
sinuous channels

Amalgamated
channels (Wilcox 2)

Extensive unconfined
sheet sands (Wilcox 1)



Trend Characteristics: Reservoir





Agenda: Jack Well Test





Jack Extended Well Test

- Why a well test?
 - No production from new trend
 - Low permeability reservoir
 - Thin-bedded reservoir
 - Frontier drawdowns for Deepwater GOM
 - Effectiveness of fracture stimulation
 - Lease expirations



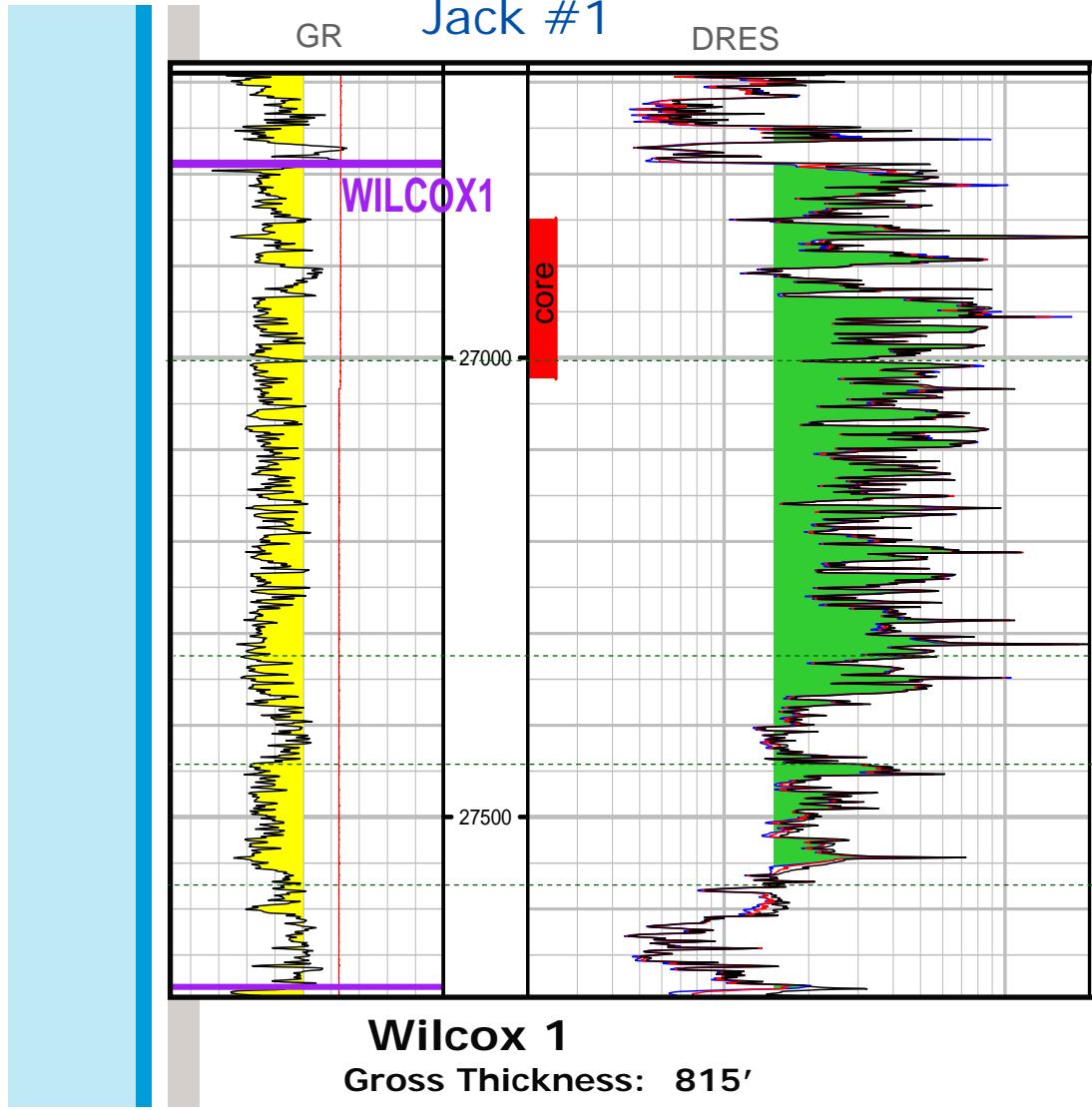
Jack Extended Well Test

- 7,000' of Water
- 20,000' Under the sea floor
- Sustained a flow rate of more than 6,000 barrels of crude oil per day
- The test represented approximately 40 percent of the total net pay measured in the Jack #2 well.
- Well Flowed for 23 days
- Well test cost Chevron and partners more than \$125MM
- Jack partnership "sold" data/results to industry
- Broke ~2 dozen World Records for well testing





Jack Extended Well Test



Jack #2 correlative test intervals

Not Tested

Fractured Limestone 26,540 – 26,588'

Upper Zone
Perfs 26,626 – 26,720' MD (94')

72' Sand Not Perforated

Middle Zone
Perfs 26,832 – 27,146' MD (314')

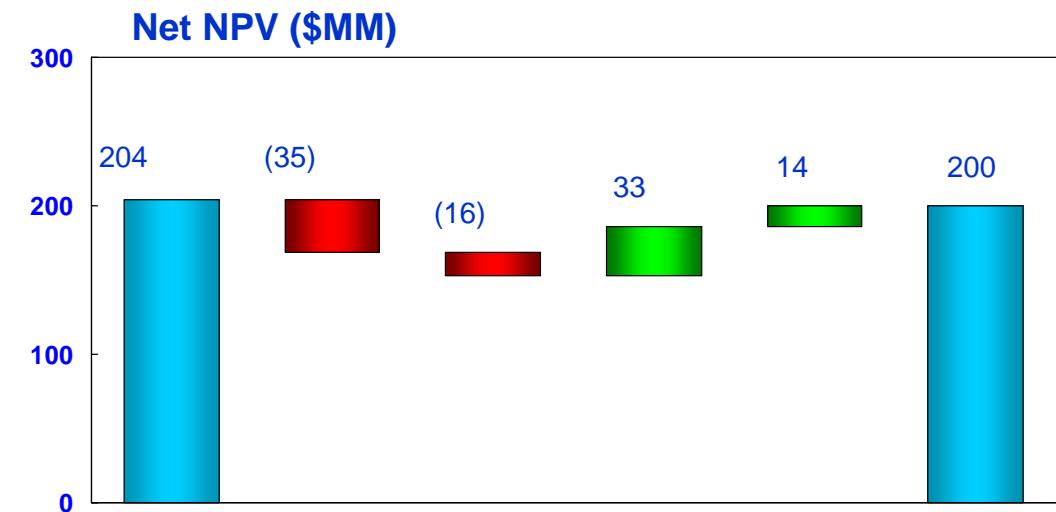
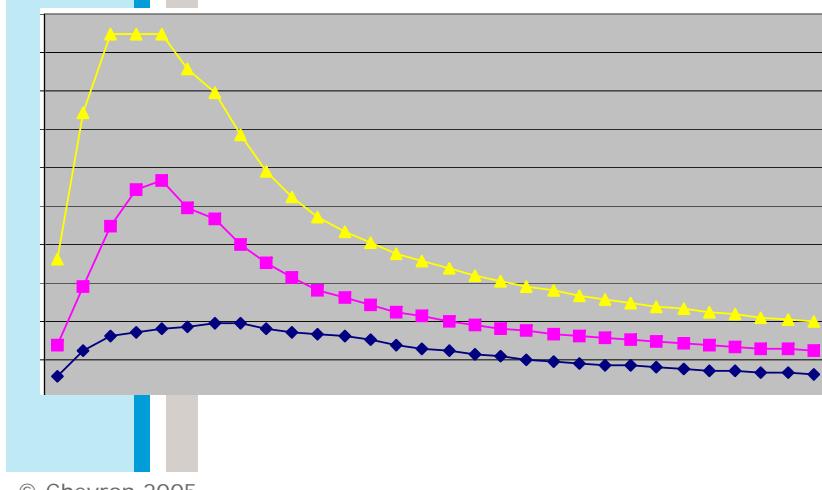
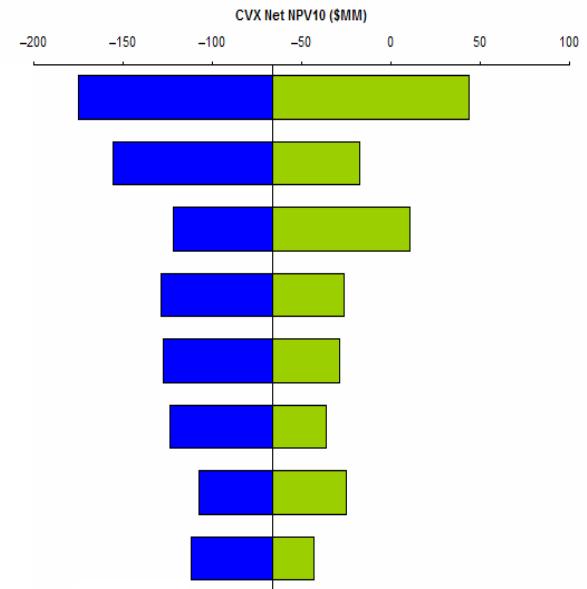
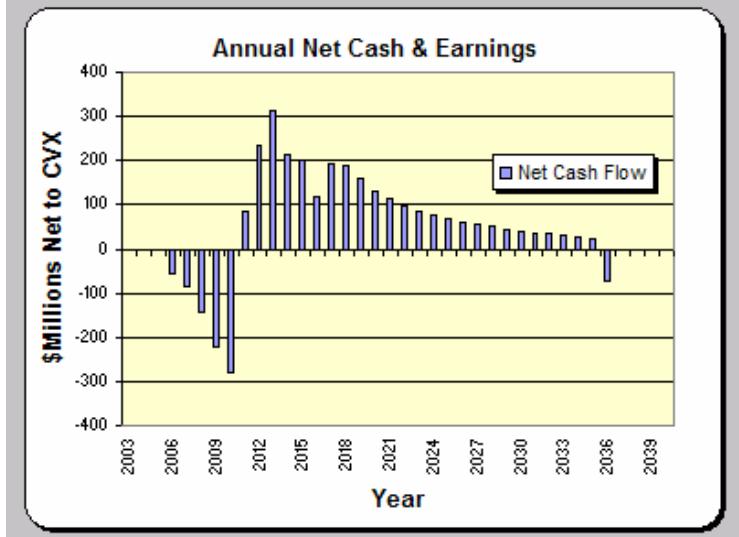
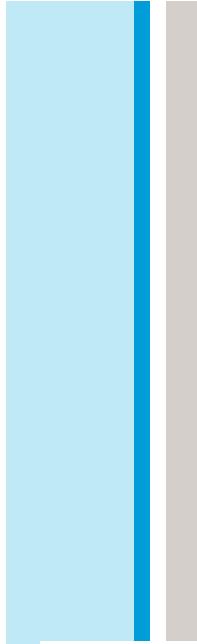
71' Sand Not Perforated

Lower Zone
Perfs 27,258' – 27,385' MD (127')

Test

Deeper pay intervals in well were not tested

Agenda: Trend Challenges -Subsurface & Economic





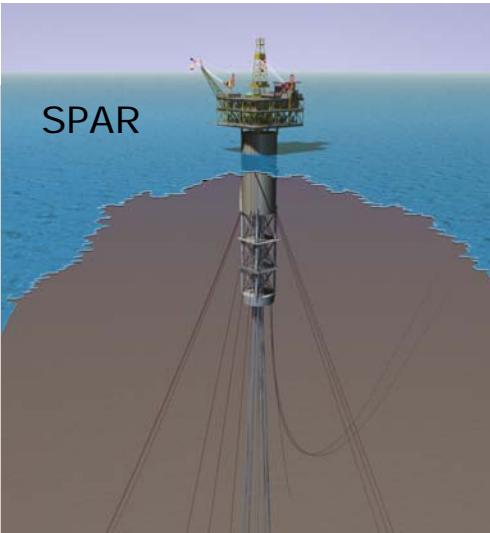
Damage Control

We just found
the next
Prudhoe Bay
Baby!



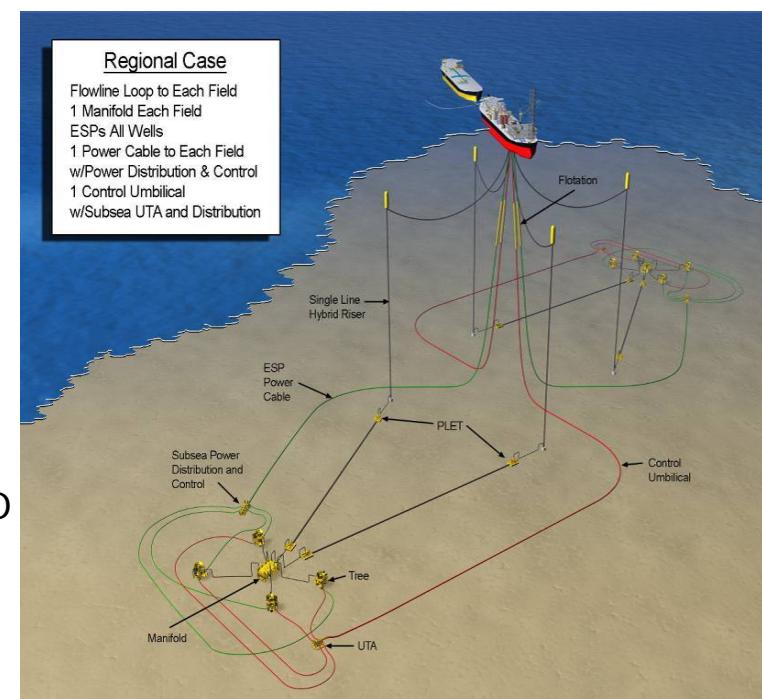
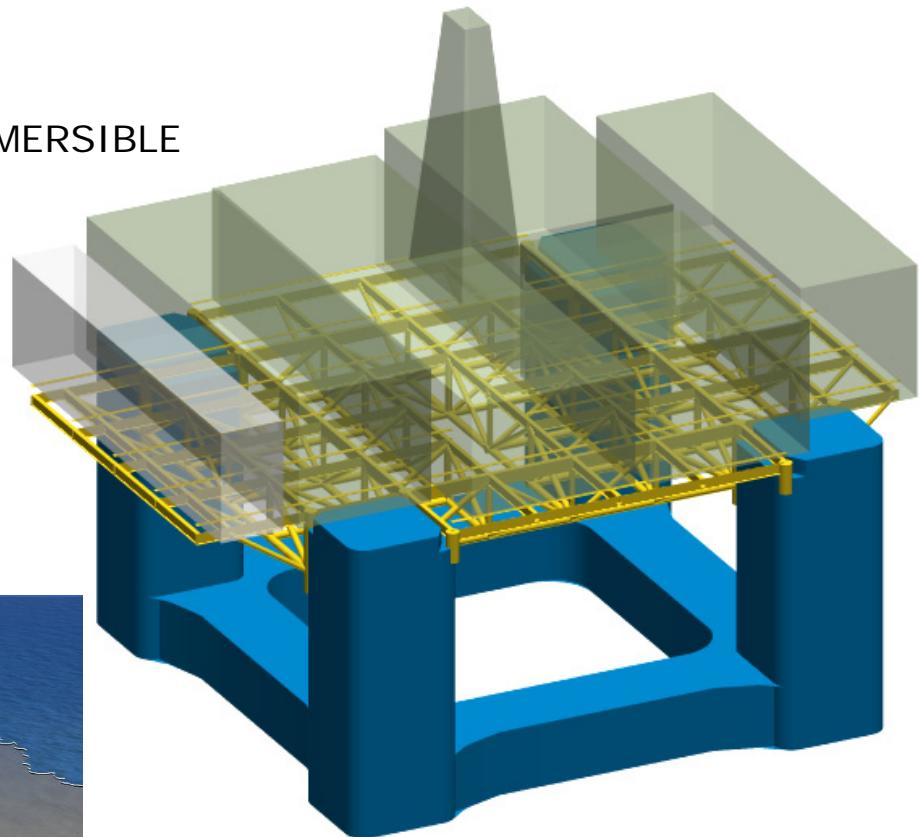


Trend Challenges: Development Options



SPAR

SEMI-SUBMERSIBLE



FPSO

FPSO can also be used as
Early Product System



Trend Challenges: High Cost Environment

- Sunk Capital
 - Jack Discovery Well (04) \$80MM
 - Jack 2 Well (05) \$124MM
 - Jack Well Test (06) \$125MM
- Future Capital
 - 10-20 Development Wells (~\$150MM each)
 - Facility Costs (>\$1,000MM)



Trend Challenges: Development Complexities

- Water depths range from 5,000 to 10,000'
- Majority of play is under salt canopies (7,000' - > 20,000' thick)
- Complex Sub-salt imaging
- Reservoir depths range from 12,000' – 35,000' subsea
 - >200 days to D&C each well
- Limited number of vessels to drill in ultra-deepwater
- High temp & pressure reservoirs
- Complex completions, with significant intervention costs & frequency

....But yet



Trend Conclusions

- **2-5 Billion barrels of OOIP per discovery**
- **Approximately 2.5 BBOE recoverable reserves have been discovered by industry**
- **Estimated reserves per discovery: 100 to 600 MMBO**
- **Estimated Trend Ultimate Recoverable Reserves: 3 – 15 BBOE**
- **Wildcat success rate is ~ 65%**



Acknowledgements

Thanks to:

- Fugro
- TGS-NOPEC
- CGGVeritas
- WesternGeco

For permission to show seismic data

Thanks also to:

- Co-Workers in Exploration, Appraisal, and Technology Co.
- Management
- Chevron Lower Tertiary industry partners