

Lessons from a Decade of Discovery Thinking*

Charles A. Sternbach¹

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Abstract

AAPG/DPA Discovery Thinking Forums began in 2007. This initiative of the 100th Anniversary committee featured discoverers telling stories about new field or new play discoveries at invited Forums at AAPG Annual Meetings. These immediately became a popular and integral part of the ACE Technical Program. Global interest required that Discovery Thinking forums should also become a part of the ICE Technical program, which they did in 2012.

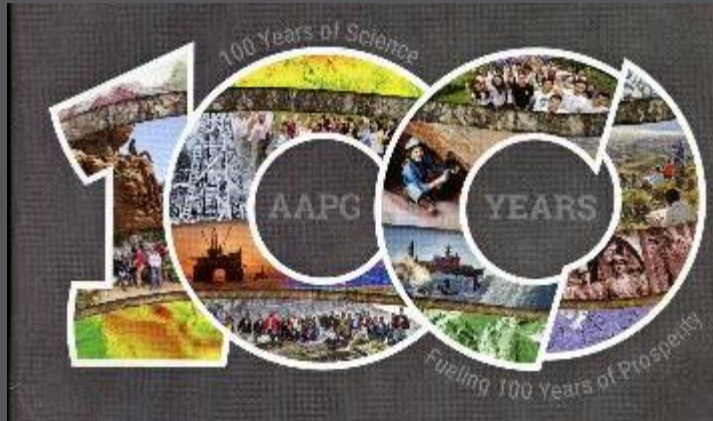
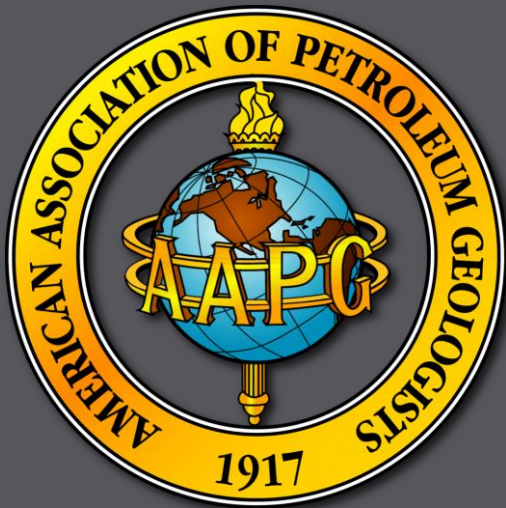
In the decade since inception, 18 Discovery Thinking Forums have been hosted at both ACE and ICE events. More than 100 speakers and their co-authors have presented discoveries they know well commonly to standing room only audiences. We owe these “100 who made a difference” heartfelt gratitude as we celebrate the AAPG Centenary. They have generously gifted us with hard won and costly insights leading to significant discoveries. They offer analogs for technical and business success. Their greatest lesson to us? As Michel T. Halbouty said of pioneering wildcatters: “If they could do it, why can’t we?” During the two Discovery Thinking Forums planned for the Houston ACE 2017, we pay tribute to the 115 men and women who have participated in these forums. We will feature several brief representative vignettes of previous presentations spotlighting valuable exploration lessons. These will be distributed throughout a lively program of 8 new significant discoveries in a morning and afternoon forum.

Resources hosted on the AAPG Search and Discovery website (Special Collections, Discovery Thinking) form an enduring heritage to modern and future explorers. Multimedia presentations of previous Discovery Thinking talks have been viewed more than 40,000 times (as of this writing). In addition, AAPG/DPA has launched Playmaker Forums, 1-day stand-alone events on Discoveries. Playmakers also offer a collection of multimedia presentations. Thanks to all the presenters. We celebrate their success and thank them for leaving their heritage better than they found it. May they inspire us to continuously make new discoveries.

<http://www.searchanddiscovery.com/specialcollections/discoverythinking.html>.

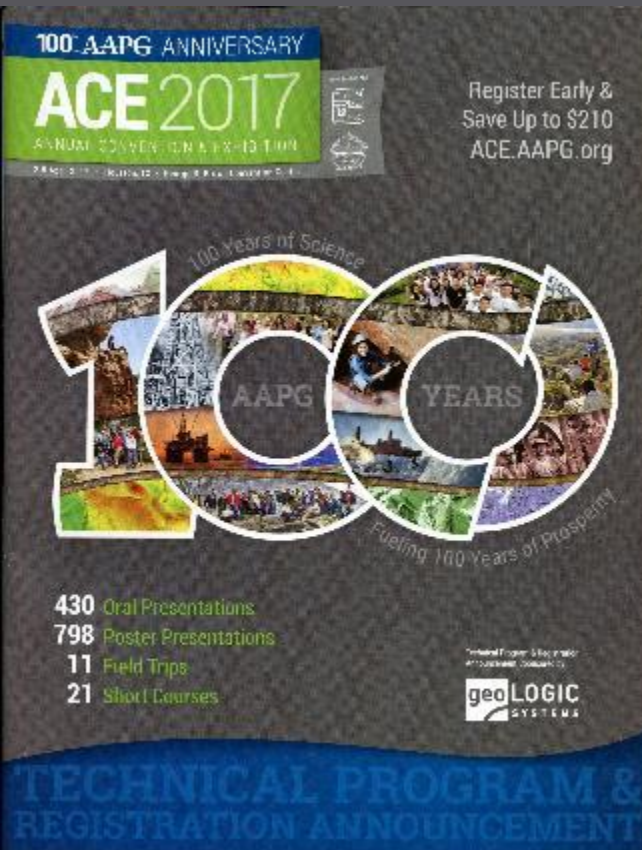
Discovery Thinking

Houston ACE April 3, 2017 Morning,
Charles Sternbach and Paul Weimer



Today's Programs

#17,18 ACE Houston, 2017



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 21 Short Courses

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TECHNICAL PROGRAM & REGISTRATION ANNOUNCEMENT

Discovery Thinking Forum, Houston ACE April 3, 2017 (#17)

Chairs: Charles Sternbach and Paul Weimer

(WORKING LIST) WESTERN HEMISPHERE and GOM SESSION

- “Lessons in Exploration Creativity from a Decade of Discovery Thinking Forums”, Charles Sternbach, President-elect AAPG
- “Discovery of a Bolivian Foothills Giant Gas Field: Incahuasi”, Philippe Mallard, Total, SA.
- “Redtail Field, A Thermal Anomaly on the Eastern Extension of the Colorado Mineral Belt, Denver Basin, Colorado, John Forster, Exploration Advisor, Whiting (and Mark Sonnenfeld, Mark Williams)
- “Discovery of the Utica Shale—Update on an evolving giant”, Bill Zagorski, Chief Geologist, and Taylor McClain, Senior Geologist, Range Resources
- “A Fresh Look to Exploration and Discoveries in Mississippi Canyon, Northern Gulf of Mexico”, Eric Zimmermann, Vice President – Geology, LLOG,

Discovery Thinking Forum, Houston ACE April (#18)

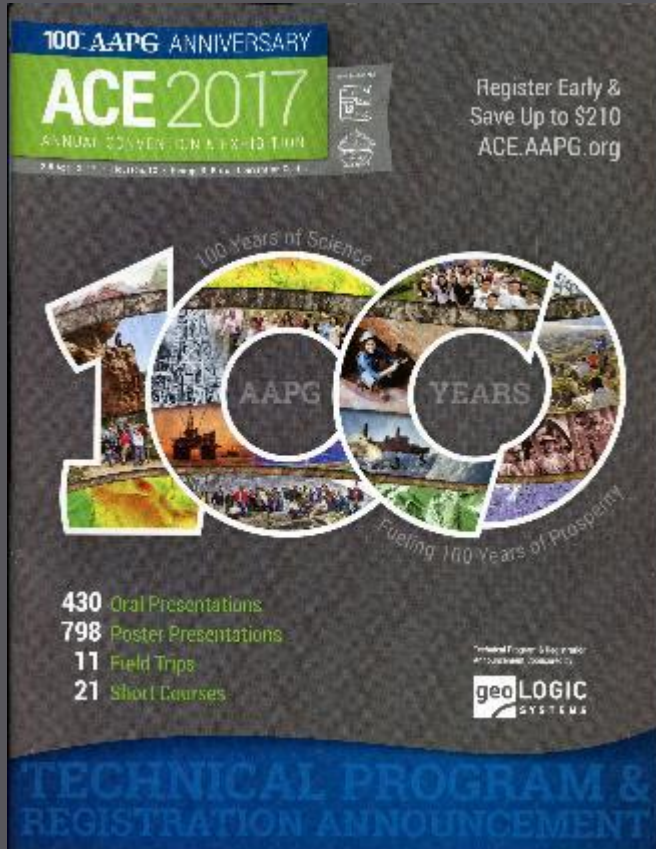
Chairs: Charles Sternbach and Paul Weimer

(WORKING LIST) GLOBAL SESSION

- “The Future of Exploration- the next decade” Bob Fryklund IHS, Chief Strategist- Upstream and Pete Stark
- “The Petroleum System of the Mauritania- Senegal Basin”, Dorie McGuinness, Exploration VP- Geology, Kosmos
- “Opening new oil basins: a pattern of discoveries”, Angus McCoss, Exploration Director, Tullow, “The Greater Gorgon Area, Northwest Australia: Exploration to Production” Mike McLerie, Geophysical Advisor, Chevron Eurasia Business Unit

Discovery Thinking Vignettes

Chaired by: C. Sternbach and P. Weimer

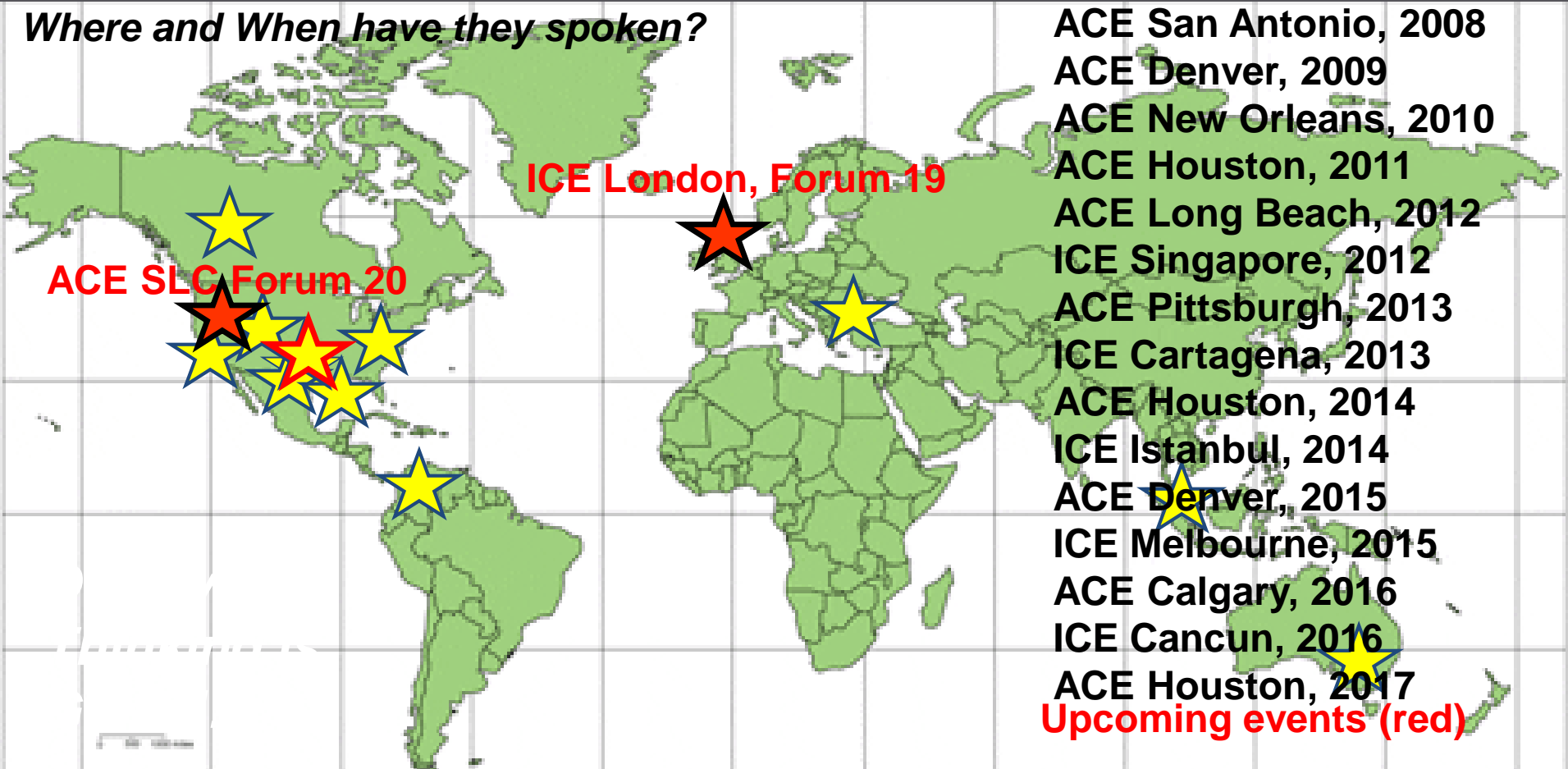


- Morning Break
 - Orion Skinner
 - Dick Stoneburner
 - James Cearley
- Afternoon Break
 - Hans Ronnevik
 - Ed LoCricchio
 - Greg Jewell

Tribute to Past Speakers, organizers, and lessons for today

- Fulfilled Decade long promise to Recognize “100 who made a difference” (with 115+)
- Speakers include: 2 Sidney Powers, 6 Halbouty and 9 Outstanding Explorer awardees
- If you like Discovery Thinking forums, there are also Playmaker Programs
- Video Resources for Explorers on Search And Discovery, Special Collections

Where and When have they spoken?



- ACE San Antonio, 2008
- ACE Denver, 2009
- ACE New Orleans, 2010
- ACE Houston, 2011
- ACE Long Beach, 2012
- ICE Singapore, 2012
- ACE Pittsburgh, 2013
- ICE Cartagena, 2013
- ACE Houston, 2014
- ICE Istanbul, 2014
- ACE Denver, 2015
- ICE Melbourne, 2015
- ACE Calgary, 2016
- ICE Cancun, 2016
- ACE Houston, 2017
- Upcoming events (red)



Thank you to Co-Organizers

Discovery Thinking

- Charles Sternbach (18)
- Ed Dolly (8)
- Paul Weimer (8)
- Ted Beaumont (1)
- Gabor Tari (1)
- Peter Baille (1)
- Mike Canich (1)
- John Hogg (1)
- Victor Vega (1)
- John Kaldi (1)
- Jonathan Craig (1)
- Chandler Wilhelm (1)

Playmakers

- **Mike Party**
- **David Entzminger**
- **Rick Fritz**
- **David Cook**
- **Marty Hewitt**
- **David Dolph**
- **Bill Haskett**
- **Dan Billman**
- **Steve Sonnenberg**
- **Kurt Neher**
- **Greg Gordon**
- **Vaughn Thompson**
- **David Curtiss**
- **Susan Nash**
- **Amy Mahan**

Thanks to Linda Sternbach for her pioneering work in multimedia

Thank you to 115 previous Discovery Thinking speakers and their co-authors



A Special Thank You to the Following Speakers and Co-authors

Steve Kneller**Doug Strickland****Ray Thomasson****Bob Weimer****Marv Brittenham****John Amoruso****Marv Brittenham****Greg Robertson****Bill Zagorski****Mike Forrest****Dan Smith****James Cearley****Susan Cunningham****Stuart Burley****Greg Jewell****Carol Law****Robert Bridges**

I. Alarik

K. Johnson

K. Neher

R. Stupp

Tony Reid

S. Schulz

Trey Meckel**S. Algar****Bill Zagorski****Jason Roesink**

J. Anderson

Rob Spitzer**Marshall Deacon****Shane Matson****Jairo Lugo****Richard Stoneburner****Flavio Feijo****M. Orsi****Antonio Escalera****Hans Ronnevik**

Arild Jorstad

Flavio Feijo**Fiona MacAulay****John Dribus****Ernest Leyendecker****Scott Sheffield****Kristin Wood****Tony Hayward****V. Kothari**

N.P. Whiteley

T. Nicholson

J. Farnsworth

L. Buambua

D. Cunha

Tiffany Hopkins

K. Karcz

Dan Needham

G. Franco

**Roberto Carlos Rebelo
da Cunha****Pete Stark**

Bob Fryklund

John Cody**Chris Gonsalves**

Andrea Reynolds

J. Hnat

K. Keller

L. Walker

D. Druke

W. Langin

C. Wilhelm

Rafael Pinto**Bob Cassie****Glen Buick**

J. Sobey

M. Hrudy

Chandler Wilhelm

John Hogg**Brian Frost****Mike Erquiaga****Eco Petrol****Guillermo Mora**

M. Arrequin

L. Aguilera

Brian Horn**C.A. Sternbach****Phillippe Mallard****John Forster**

Mark Sonnenfeld

Mark Williams

Bill Zagorski**Taylor McClain****Eric Zimmerman****Bob Fryklund**

Pete Stark

Dorie McGuinness**Angus McCoss****Mike**

Thank You


Discovery Thinking

Chaired by: C. Sternbach and P. Weimer

Discovery Thinking Forum, Houston ACE April 3, 2017 (#17)

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(WORKING LIST) WESTERN HEMISPHERE and GOM SESSION

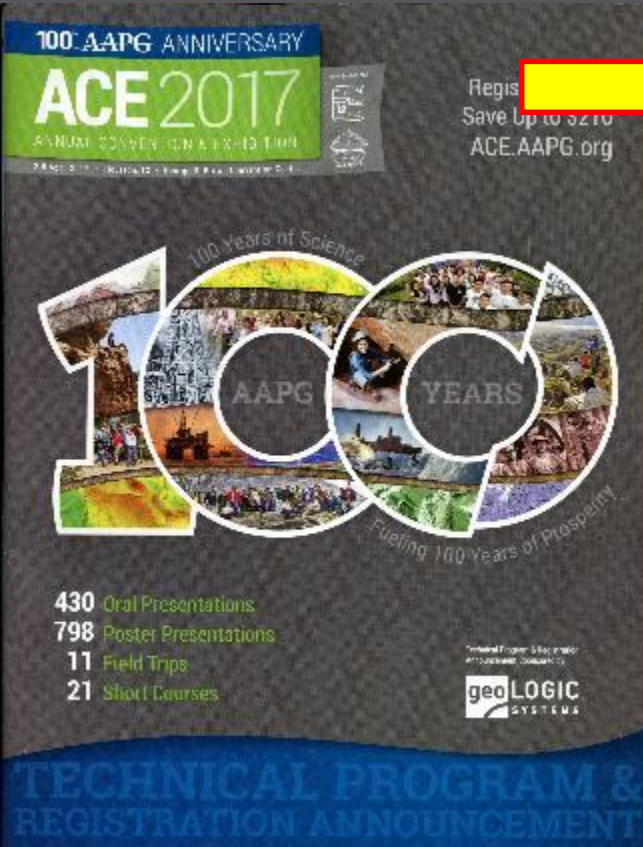
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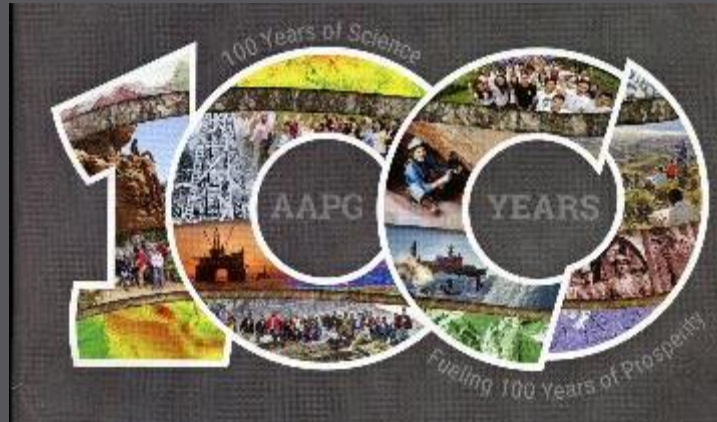
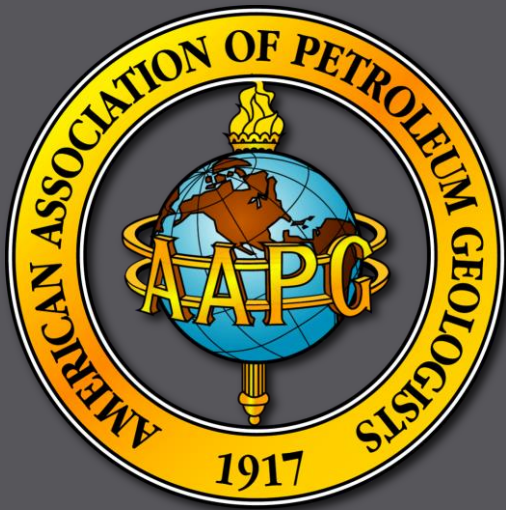
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Lessons from a Decade of Discovery Thinking

Charles A. Sternbach



Lessons from a Decade Of Discovery Thinking

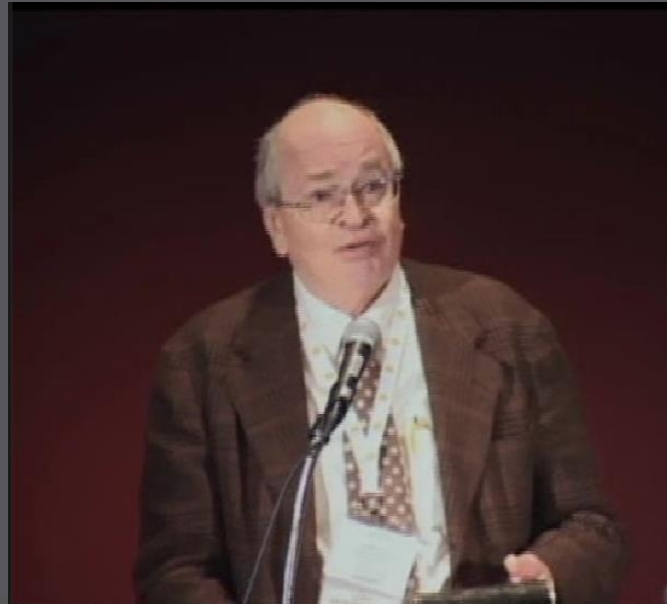
- Short vignettes from the video collection throughout the talks today
- Exciting Decade with many technological innovations
- Conceptual contexts for the Discoveries
- Technology Transfer, AAPG plays a key role
- Geoscience adds critical incremental value

Lessons from a Decade Of Discovery Thinking

- “Geology is a Science, Exploration is a Business”
- “History is valuable; additive to personal experience”
- Focus Efforts On Following Oil From Source To Trap...
- Think Like Oil!

• -- Marlan Downey

**DT #1, ACE San Antonio 2008
Sidney Powers Medalist**



Lessons from a Decade Of Discovery Thinking

- Technology Transfer around the globe.
- AAPG and other professional societies help transfer oil finding “know how”



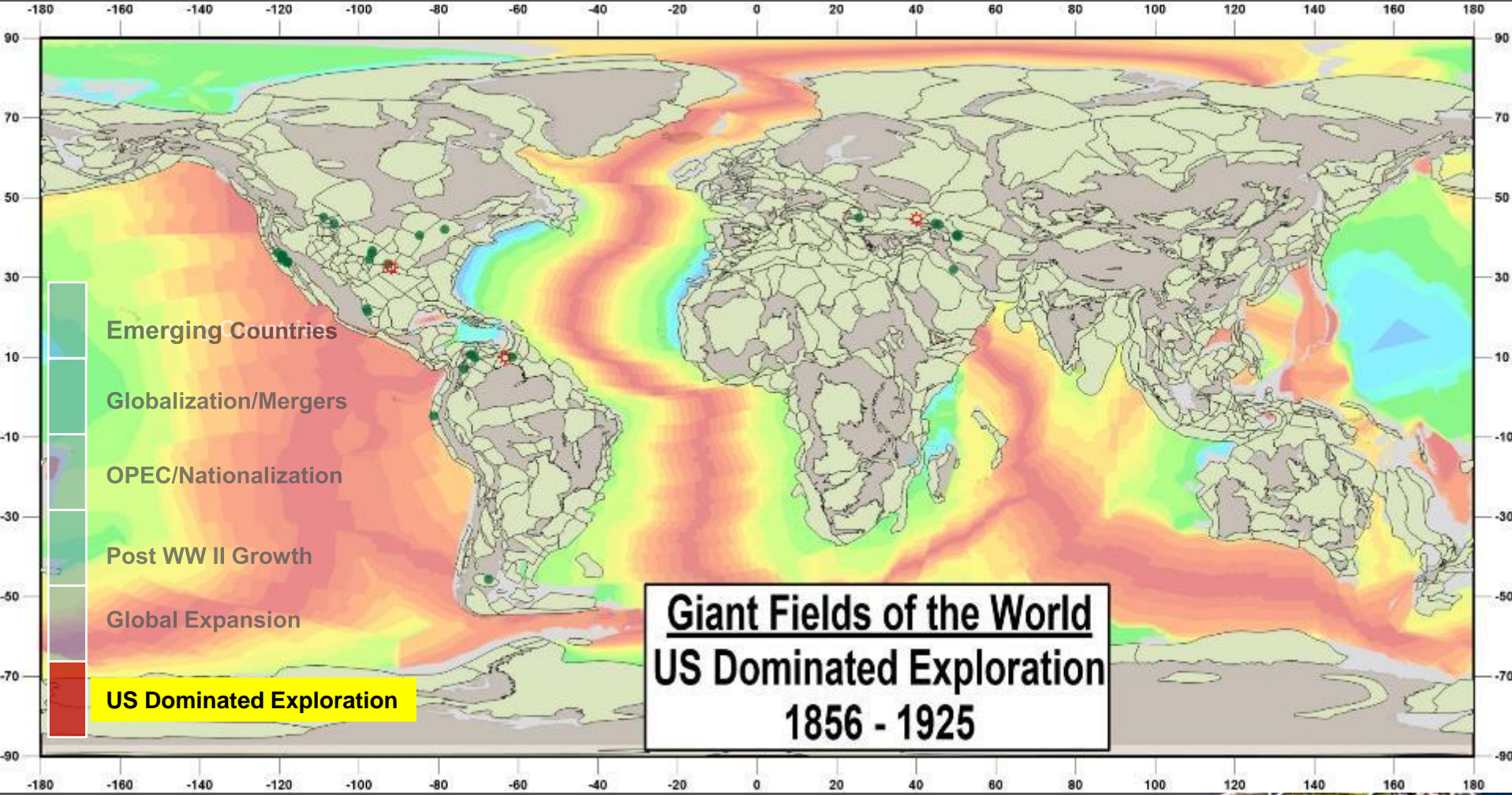
Everette Lee DeGolyer



Max Steineke



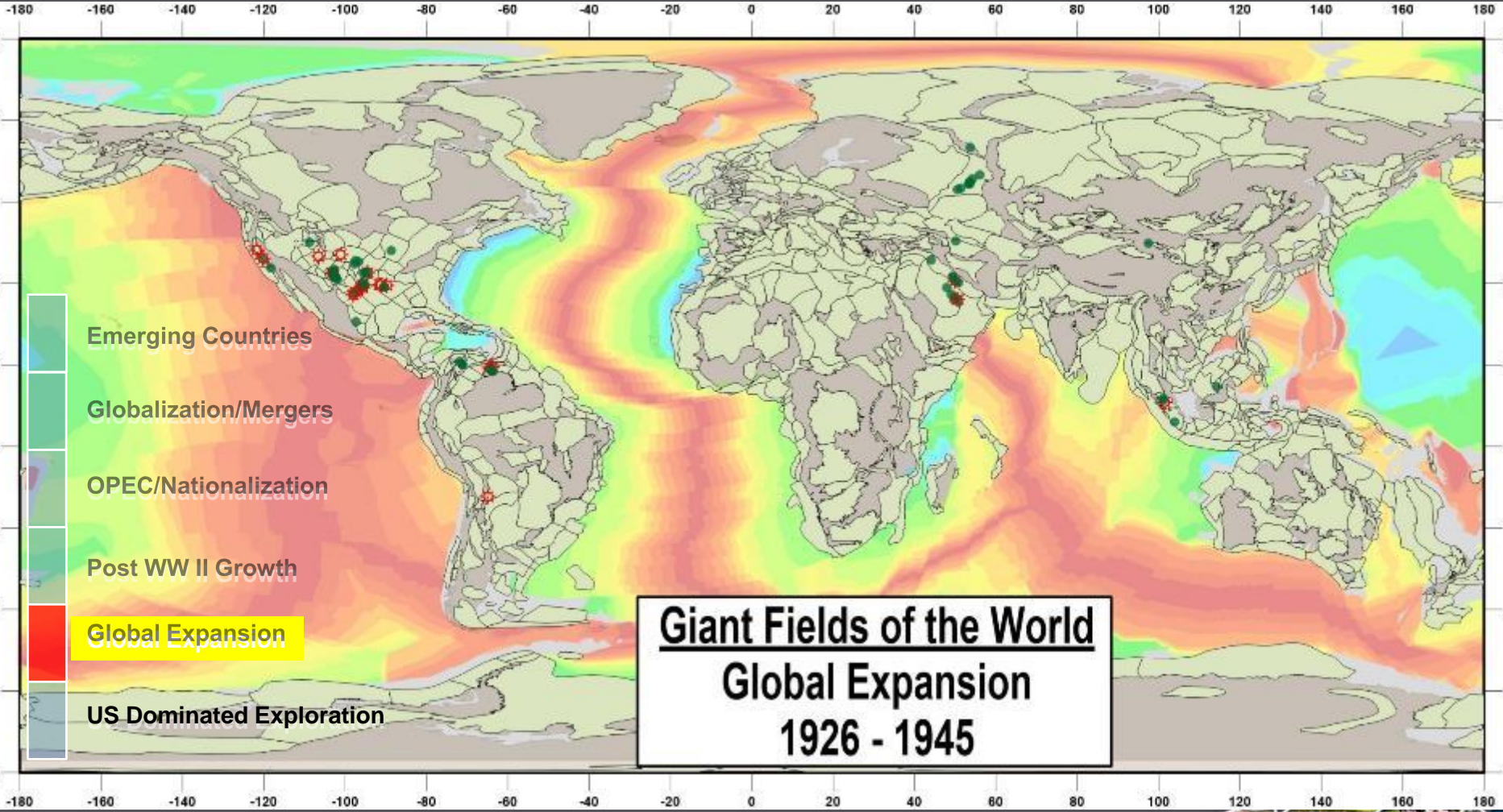
US Dominated Exploration 1856 – 1925



From Merrill and Sternbach, 2017 "The AAPG Century—Giant Fields through the decades"



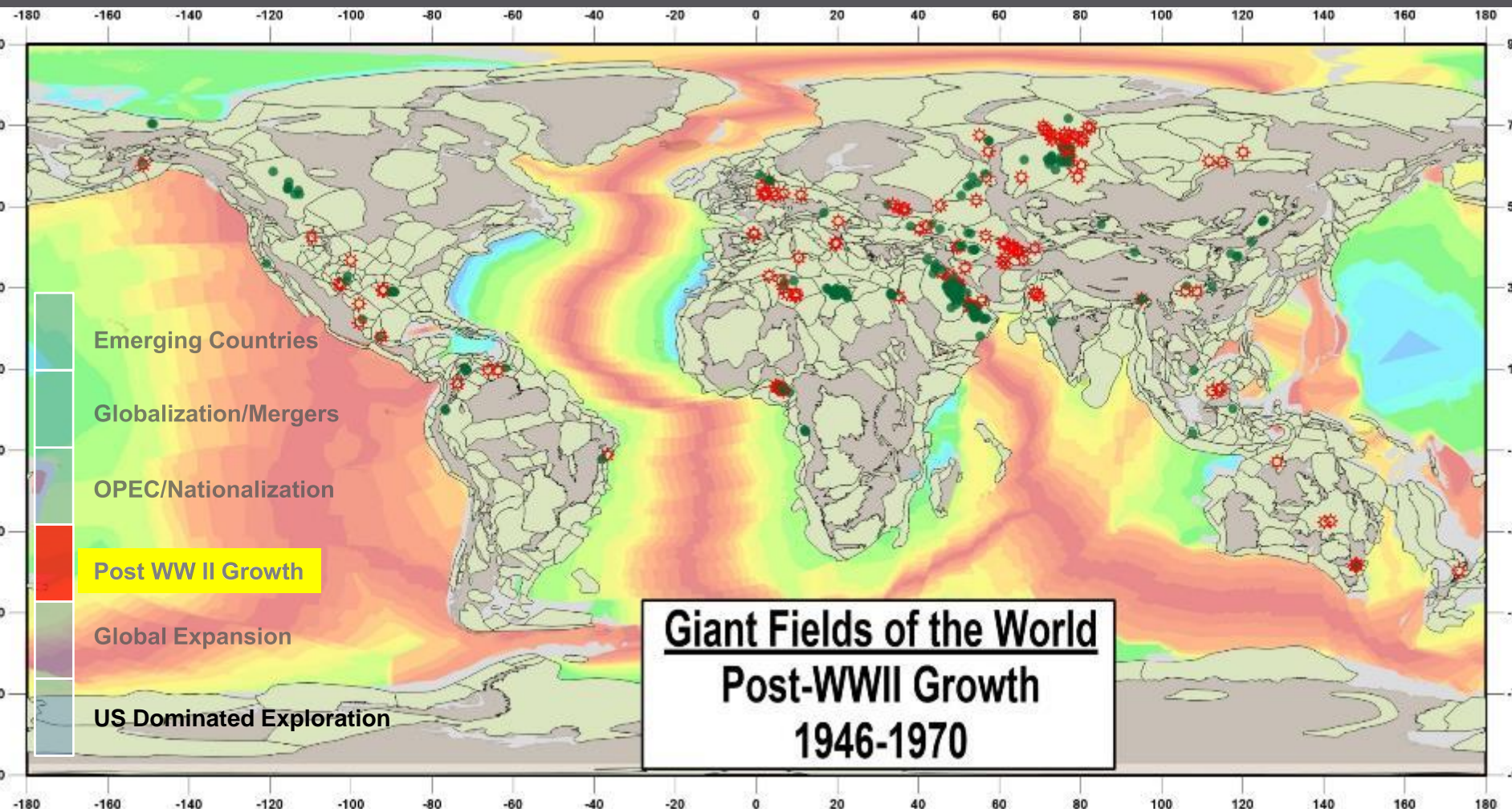
Global Expansion 1926 – 1945



From Merrill and Sternbach, 2017 “The AAPG Century—Giant Fields through the decades”



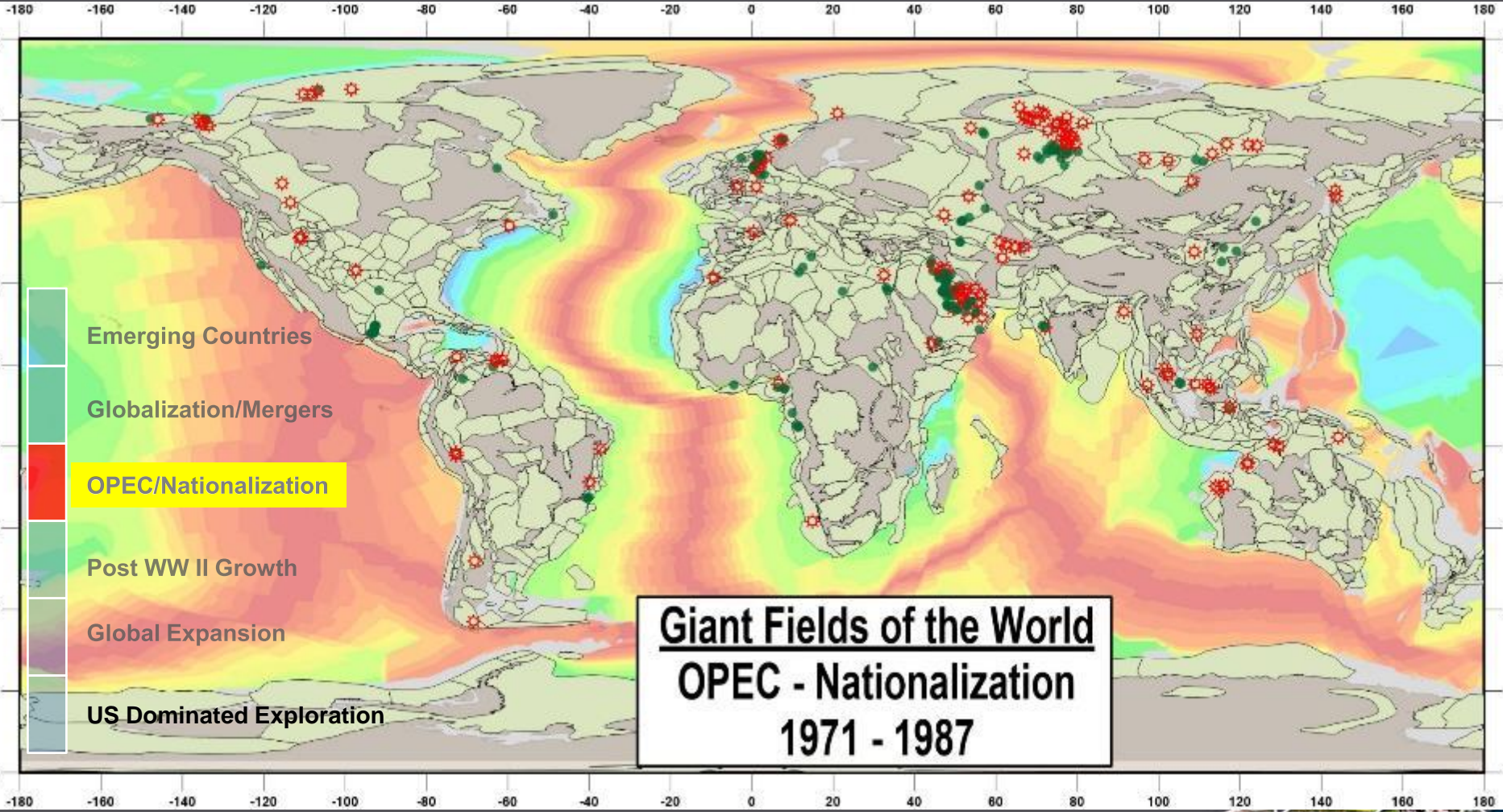
Post WWII Growth 1946 - 1970



From Merrill and Sternbach, 2017 "The AAPG Century—Giant Fields through the decades"



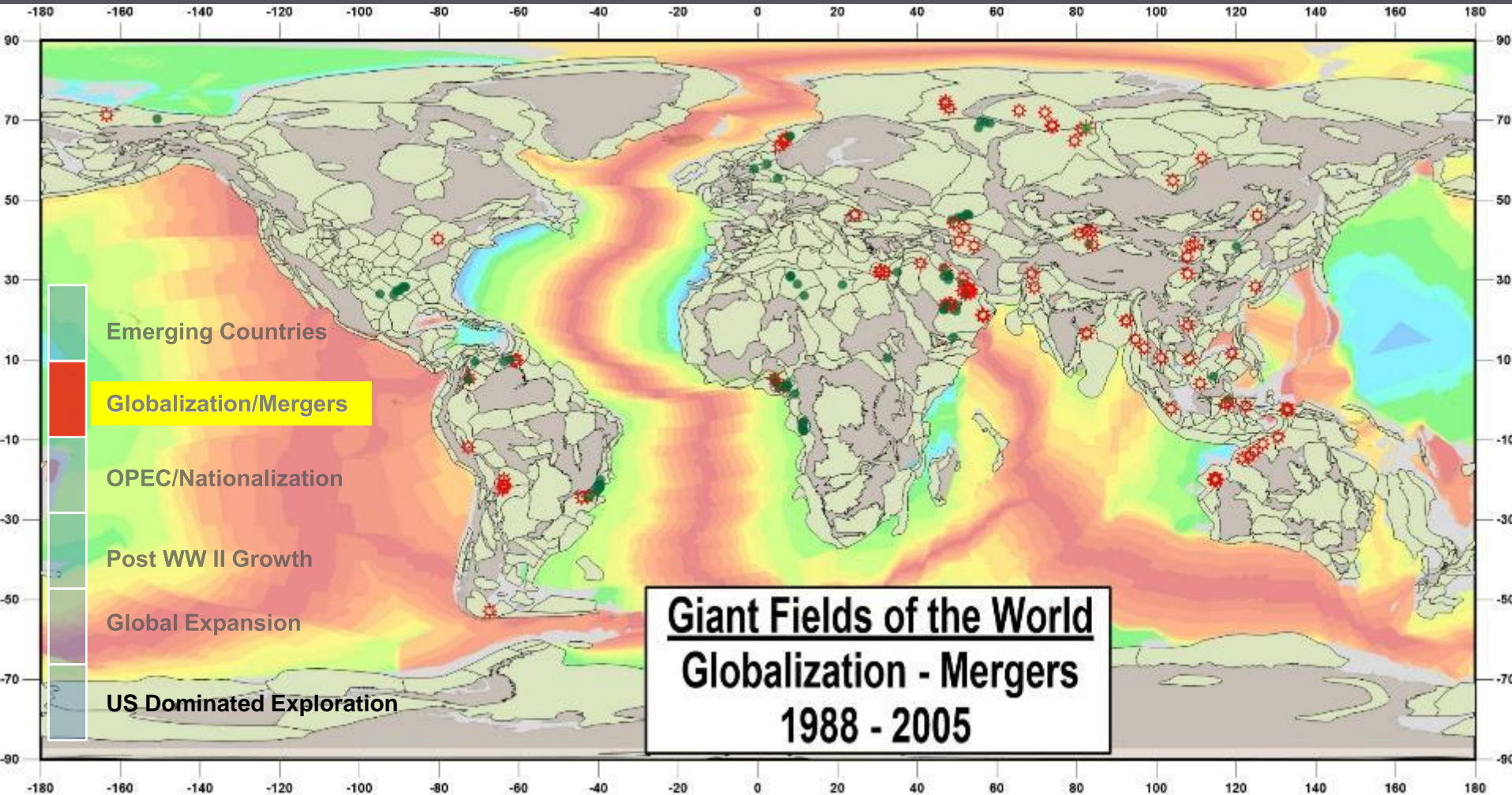
OPEC & Nationalization 1971 – 1987



From Merrill and Sternbach, 2017 “The AAPG Century—Giant Fields through the decades”

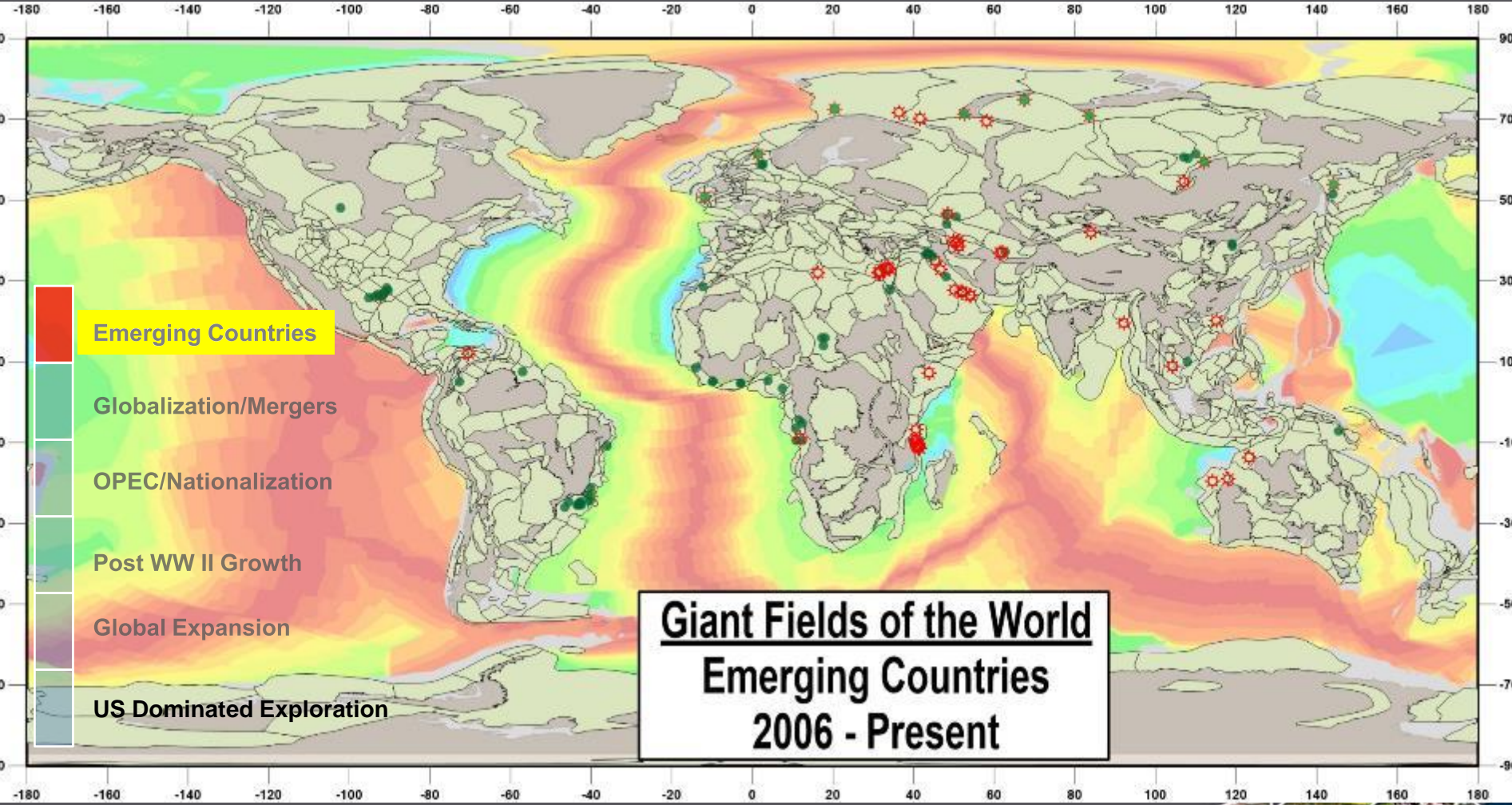


Globalization & Mergers 1988 – 2005



From Merrill and Sternbach, 2017 "The AAPG Century—
Giant Fields through the decades"

Emerging Countries 2006 – Present



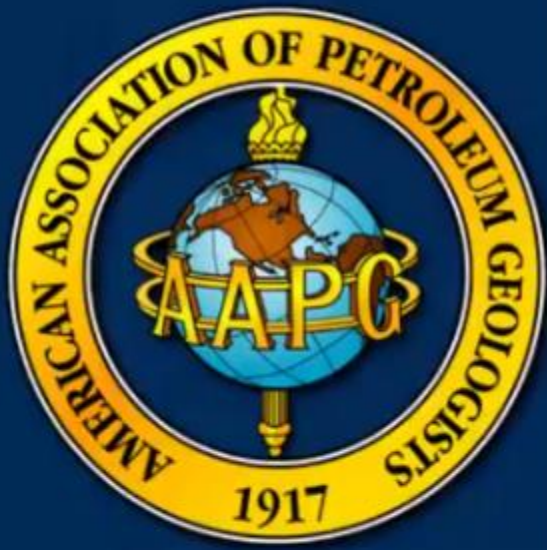
From Merrill and Sternbach, 2017 “The AAPG Century—Giant Fields through the decades”



Lessons from a Decade Of Discovery Thinking

- Multimedia: increases broadband
- Learning on demand
- Team learning
- Building on our Heritage

Legacy of Discovery: Resources for Explorers



Charles A. Sternbach

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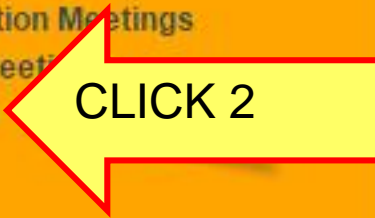


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**Chemostratigraphy
Williston basin, ND**



- AAPG Asia Pacific Regional Meetings
- AAPG DPA Playmaker Forums 
- AAPG Eastern Section Meetings
- AAPG Education Directorate
 - AAPG Hedberg Conferences
- AAPG ePosters
- AAPG European Regional Meetings
- AAPG Latin America and Caribbean Region
- AAPG Mid-Continent Section Meetings
- AAPG Pacific Section Meetings
- AAPG Rocky Mountain Section Meetings
- AAPG Southwest Section Meetings
- Discovery Thinking Forums 
- GCAGS Conventions
- GeoConvention (C SPG)
- Geophysical Corner Articles
- PAPG-ACT Conventions
- Tulsa Geological Society Presentations



Lessons from a Decade Of Discovery Thinking

- Discovery Thinking Forums allow people to tell of *their* success, *their* discoveries, *their* proudest and happiest of times.
- Their gift in return enables us to share in their glory, and perhaps to inspire us to our own great moments.
- “If they could do it, why can’t we?”
– Michel T. Halbouty

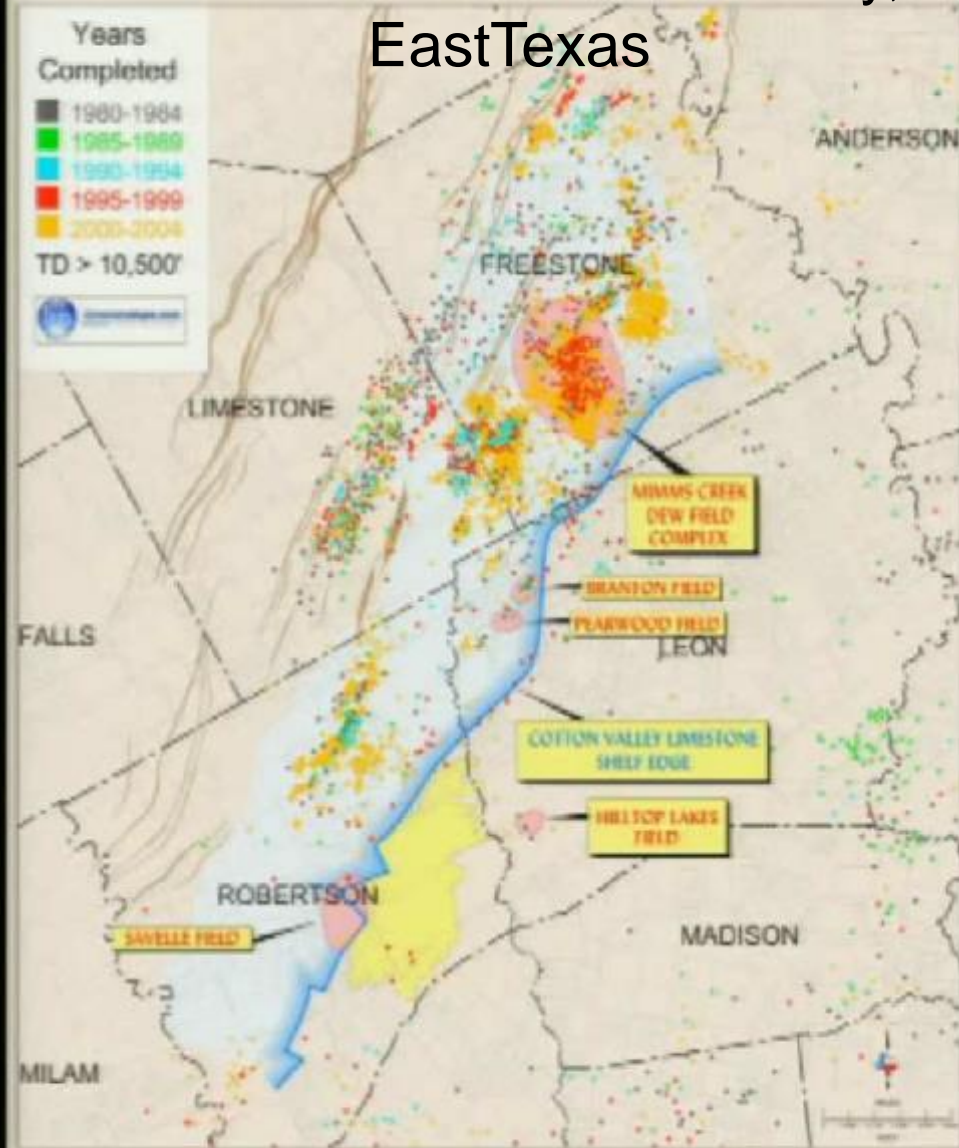
Lessons from a Decade Of Discovery Thinking

- Exploration is based on analogs
- Lateral Thinking
- Geology Makes the Incremental Difference
- Vignettes:
 - John Amoruso Cotton Valley, East Texas
 - Jim Henry, Wolfcamp, Permian Basin

Bossier E. and Cotton Valley, East Texas



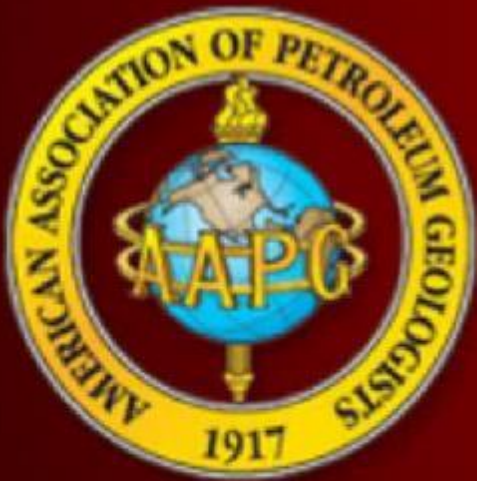
**John Amoruso, Outstanding Explorer
DT #3, ACE San Antonio 2010**



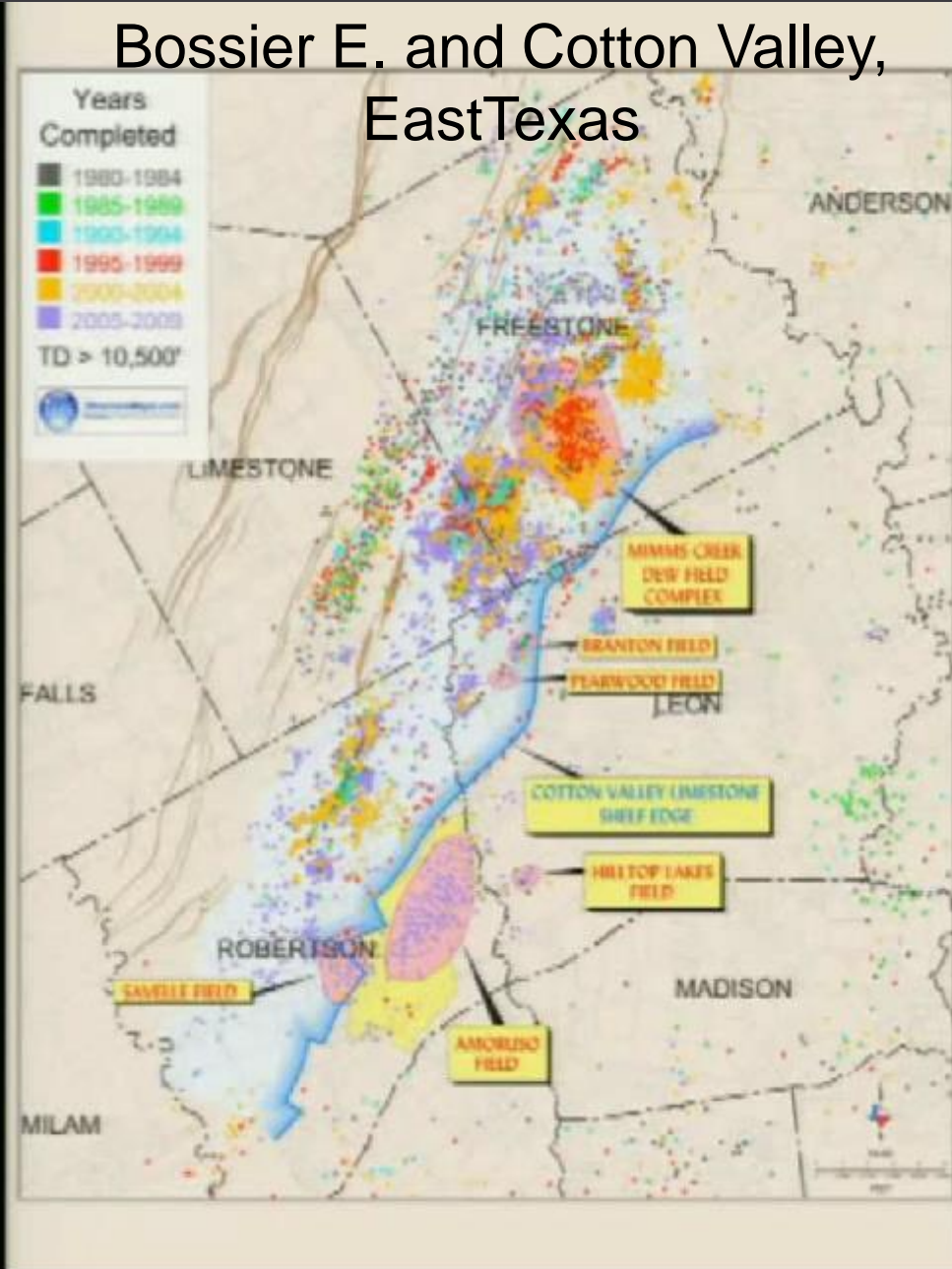
Bossier E. and Cotton Valley, East Texas



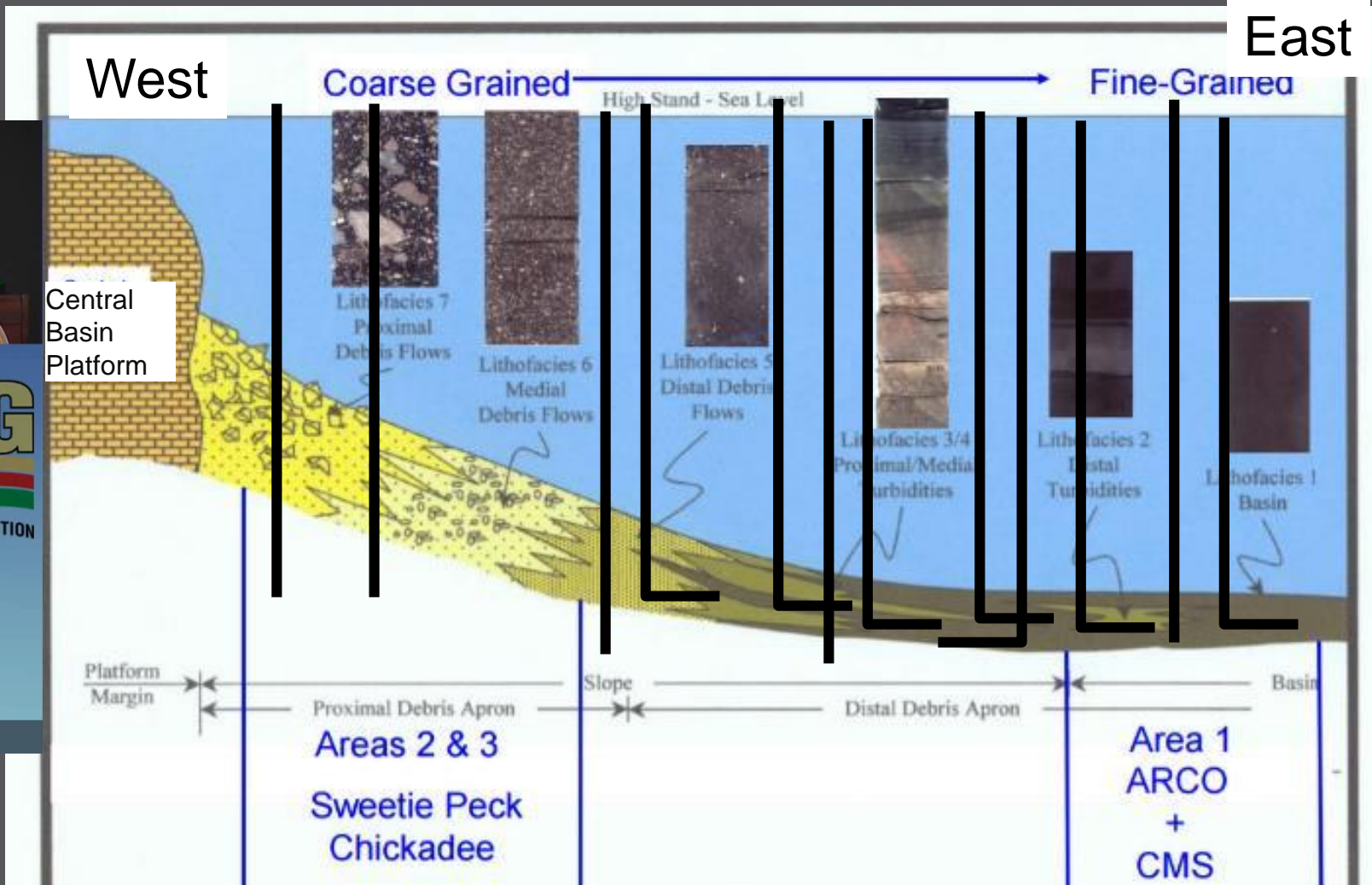
Discovery of Amoruso Field, A new East Texas giant



**John Amoruso, Outstanding Explorer
DT #3, ACE San Antonio 2010**



Wolfcamp Geology – Midland Basin



2012

Jim Henry

DT #5, ACE Long Beach, 2012



Wolfcamp/Wolfberry/Wolfbone Play, lessons

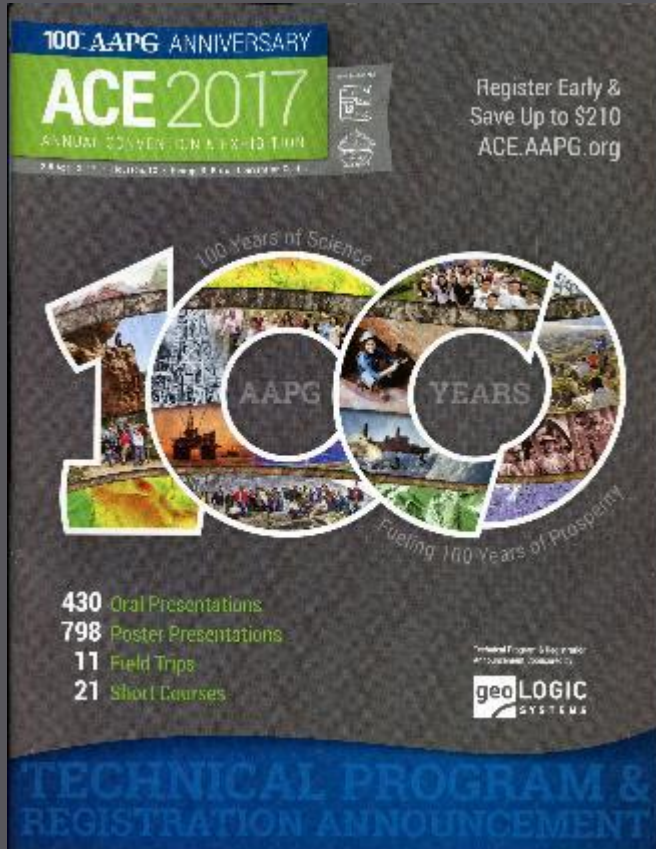
- Geology impacts completion strategy
- Thin beds require Hydraulic Fracturing
- Share the wealth with employees
- Advice to Young Professionals: Come to Midland!

Lessons from a Decade Of Discovery Thinking

- Vignettes from video collection throughout talks today
- Exciting Decade with many technological innovations
- Conceptual contexts for the Discoveries
- Technology Transfer, AAPG plays a key role
- Geoscience adds critical incremental value
- AAPG future focus on petroleum
- Global population and energy demand grows!
- “100 years of science fueling 100 years of prosperity”

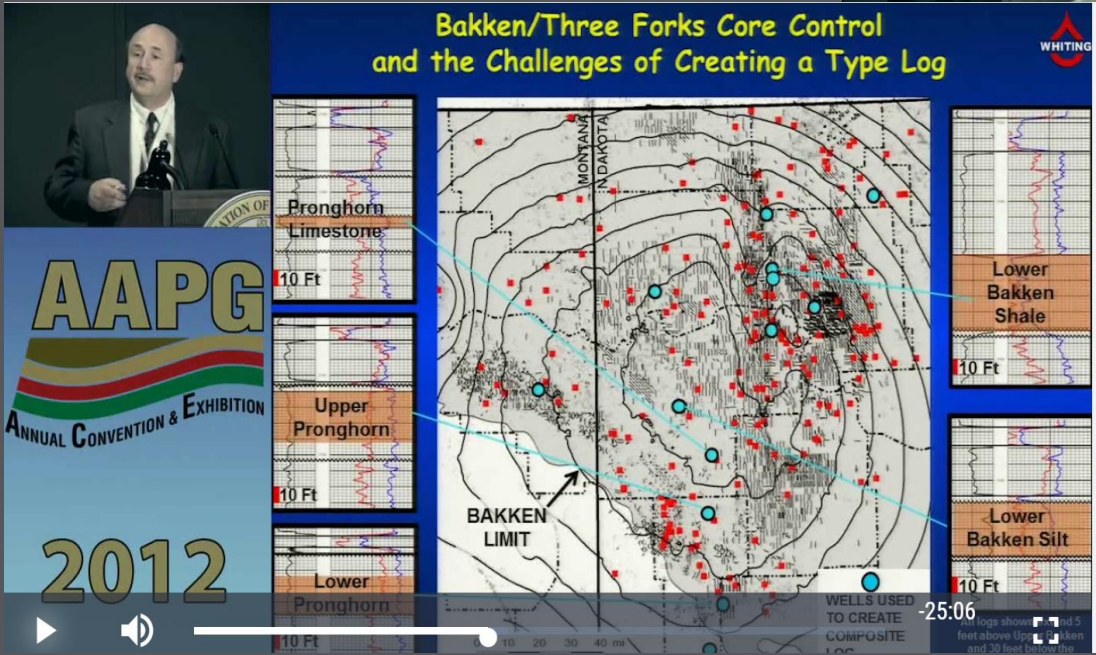
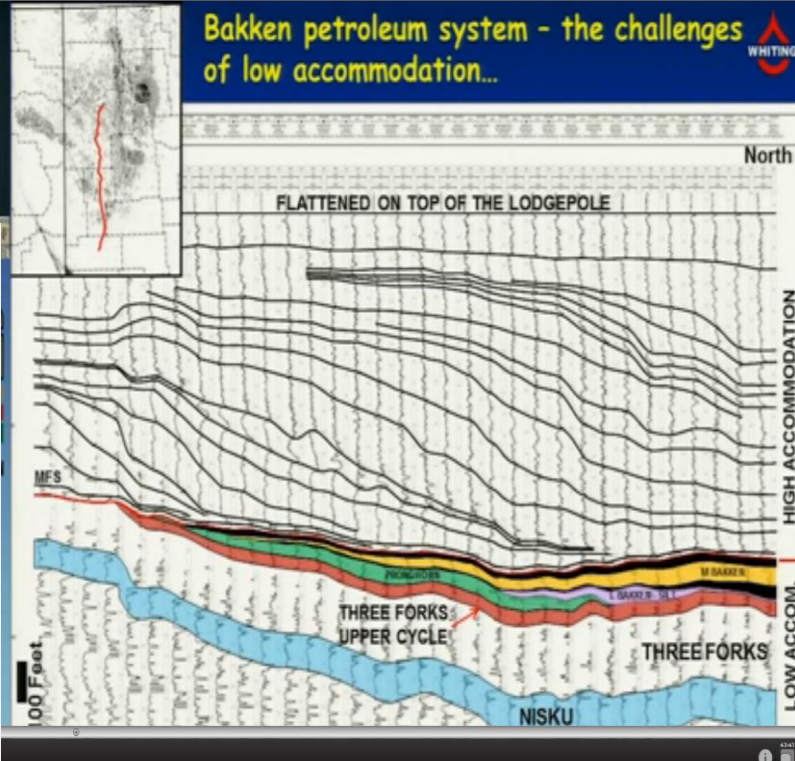
Discovery Thinking Vignettes

Chaired by: C. Sternbach and P. Weimer



- Morning Break
 - Orion Skinner
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- Afternoon Break
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Bakken, Williston Basin



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2012

Orion Skinner, Outstanding Explorer
DT #5, ACE Long Beach 2012



Bakken, lessons

- Open minded to sweet spots factors
- Many benches mean multiple play targets
- Hydraulic Fracturing of Horizontal wells
- Use SEM and core analysis on site
- Lag deposits define key horizons
- Core control key aspect

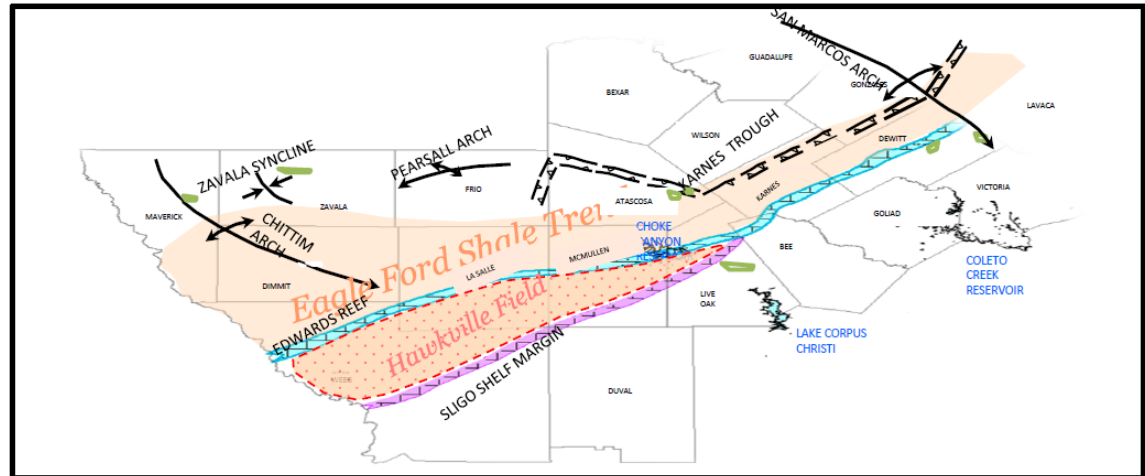
Orion Skinner, Outstanding Explorer

DT #5, ACE Long Beach 2012

Eagle Ford, GOM onshore,



Prospect Identification: Unconventional Analogy

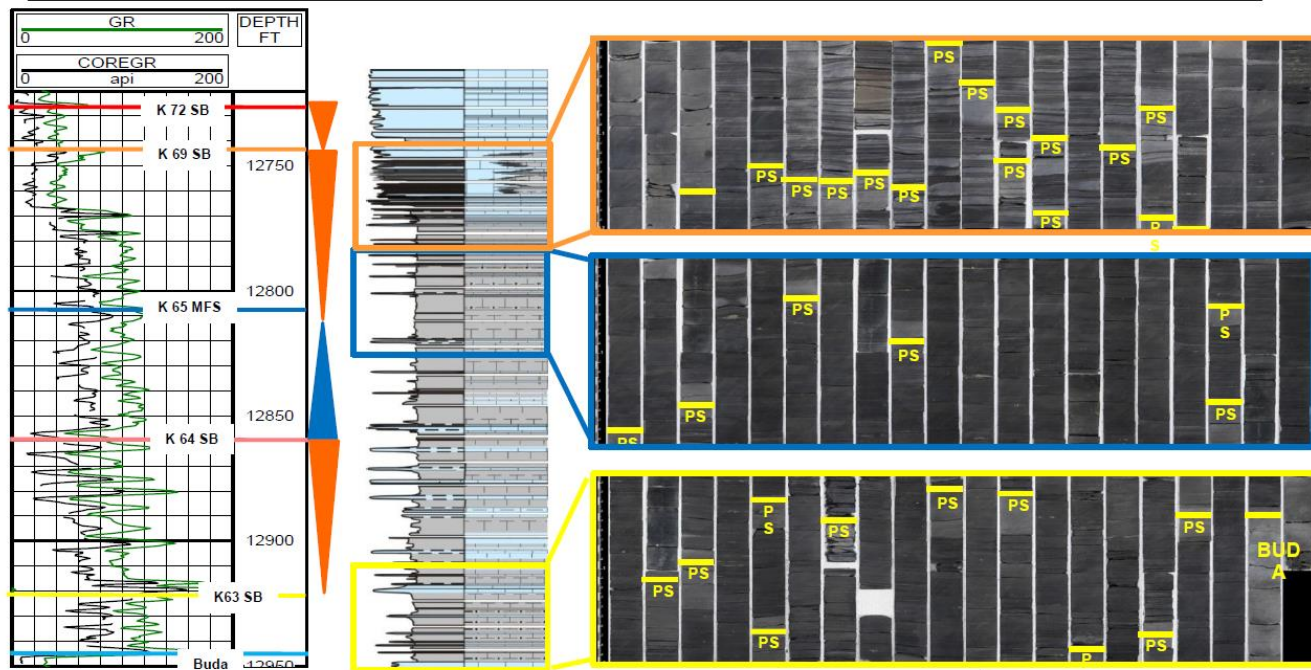


- Eagle Ford Shale Prospect
- Known regional source rock across large petroliferous basin
- Reservoir quality and geochemical attributes poorly understood
- The area was >10 MM acres with high side resource potential of >10 BBOE

Dick Stoneburner, Outstanding Explorer
DT #8, ICE Cartagena, Colombia 2013

Eagle Ford, GOM onshore,

**A Key Aspect of Quality Shale Reservoirs:
Vertical Heterogeneity**



Courtesy of Core Laboratories

**Dick Stoneburner, Outstanding Explorer
DT #8, ICE Cartagena, Colombia 2013**

Eagle Ford, GOM onshore,

Unconventional Exploration: A Different Way of Thinking

Conventional

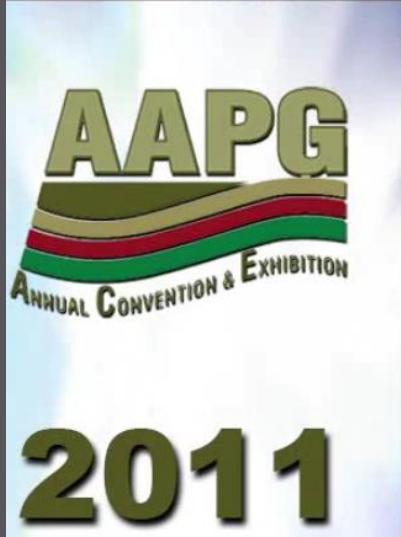
- Project identification focuses “outside in”
- Seismic control works “outside in”
- Stratigraphic support eventually focuses on the facies analysis local to the prospect
- Reservoir quality issues are relegated to the area of the prospect

Unconventional

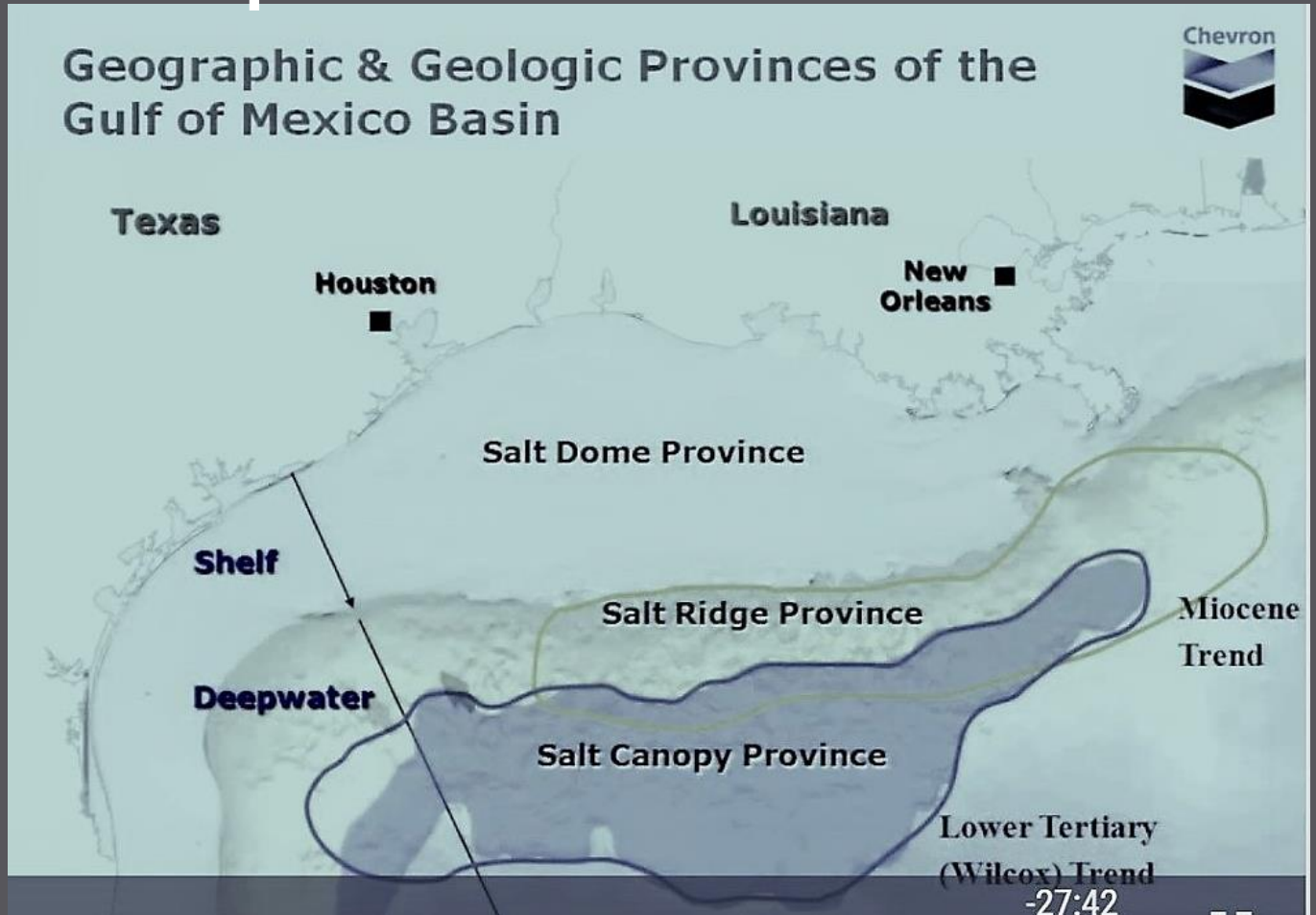
- Project identification focuses “inside out”
- Seismic control works “inside out”
- Stratigraphic support focuses on analysis of the entire basin
- Reservoir quality analysis is required over a very broad area of the basin

Dick Stoneburner, Outstanding Explorer
DT #8, ICE Cartagena, Colombia 2013

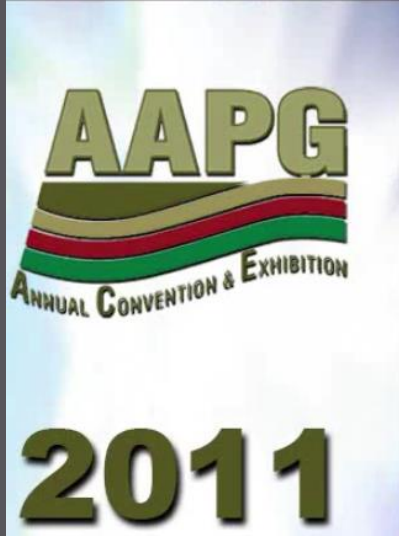
Deepwater GOM



James Cearley
DT #4, ACE Houston 2011

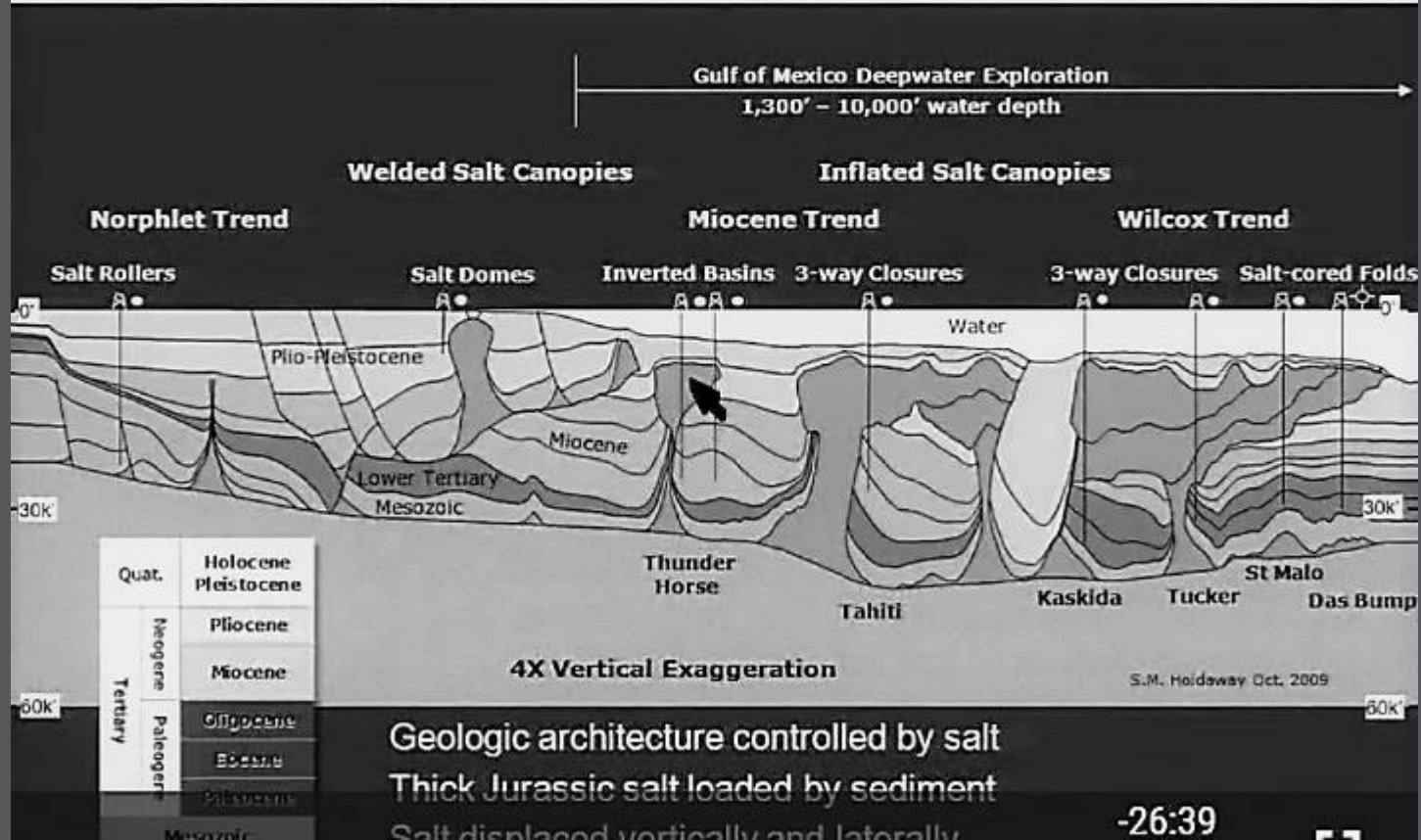


Deepwater GOM



James Cearley
DT #4, ACE Houston 2011

Deepwater Gulf of Mexico Evolution of Play Types and Salt Tectonics



-26:39



Wilcox Deepwater GOM, Lessons

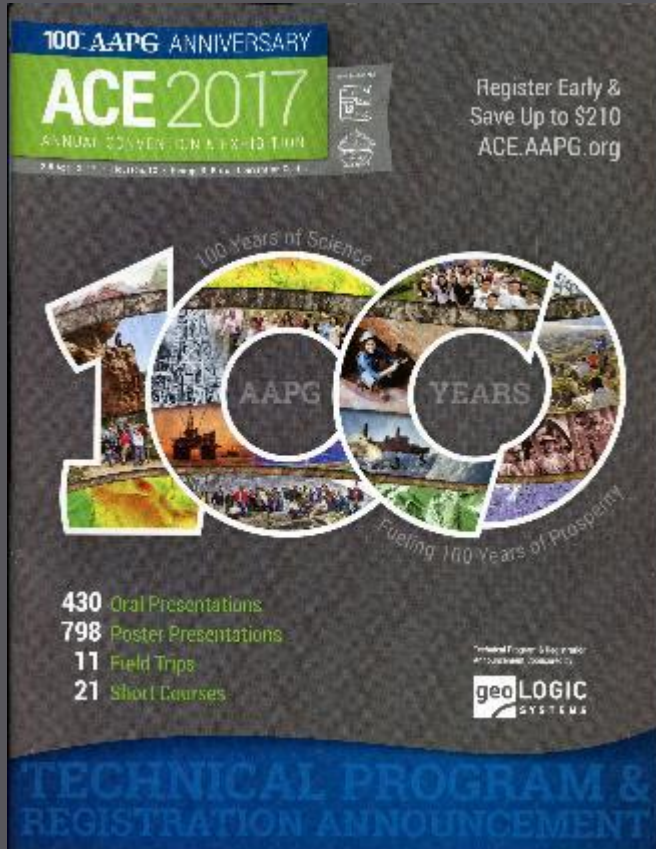
- Bet on Technology
- Integrate Technical information
- Exploration requires long term commitment
- Look for oil in place, you will find a way to produce
- Constantly test paradigms like:
 - “there is no sand basinward of shelf edge” (1983)
 - All salt is rooted (1984)
 - Why do you want to lease subsalt when you cant see? (1990)
 - Porosity/Permeability can’t survive 28,000 drill depth (2000)

James Cearley

DT #4, ACE Houston 2011

Discovery Thinking

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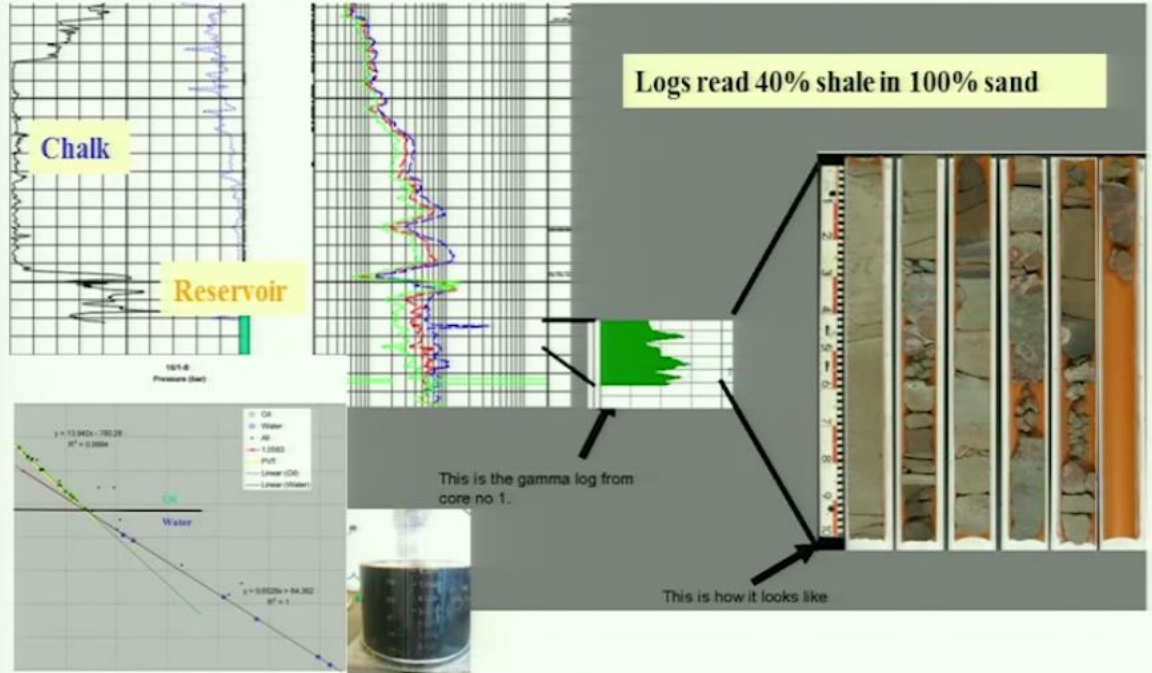


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Norwegian North Sea



Without core no discovery of the Edvard Grieg Field



AAPG Annual Convention & Exhibition 2014

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GEORGE R. BROWN CONVENTION CENTER



-19:33

Hans Ronnevik, Outstanding Explorer
DT #9, ACE Houston 2014



Norwegian North Sea, Lessons

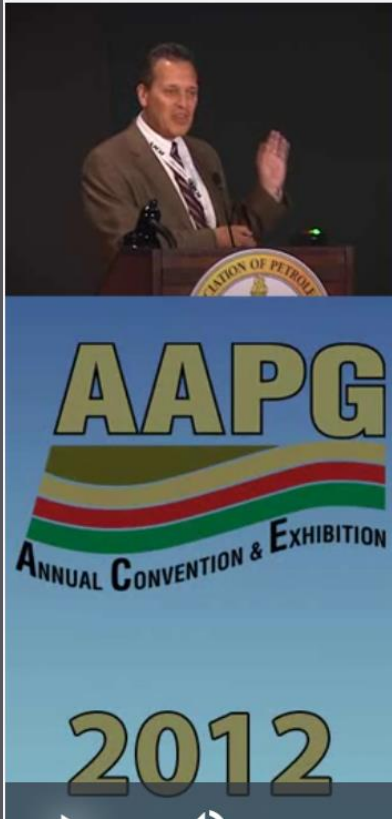
- Exploration is continuous unfolding reality
- Basement high tested early had no reservoir
- Flanking grabens were later seen to contain great thickness of sediments with improved seismic
- Logs indicated high GR sandstones with Darcy quality rock which would not have been completed without core
- Success involves will and skill

Hans Ronnevik, Outstanding Explorer

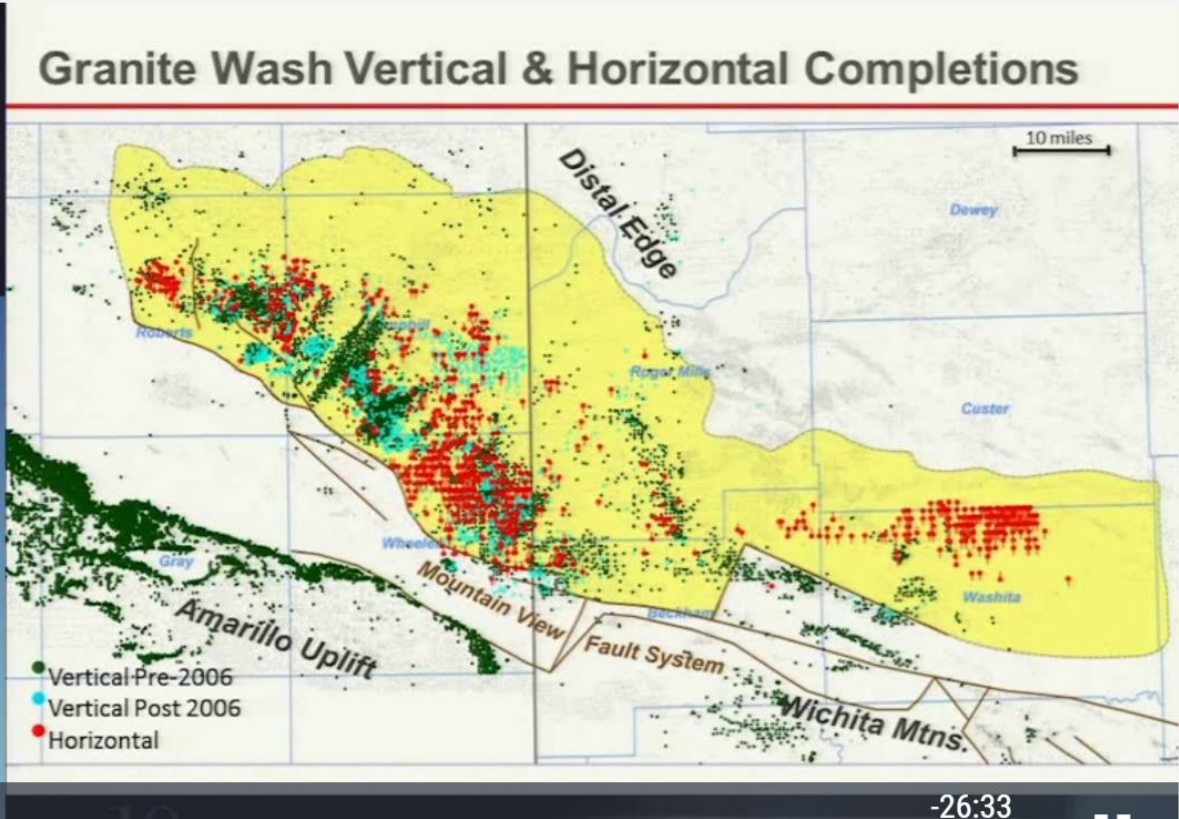
DT #9, ACE Houston 2014

Anadarko Basin, Texas Oklahoma

Discovery Thinking Forum, ACE 2012 Long Beach



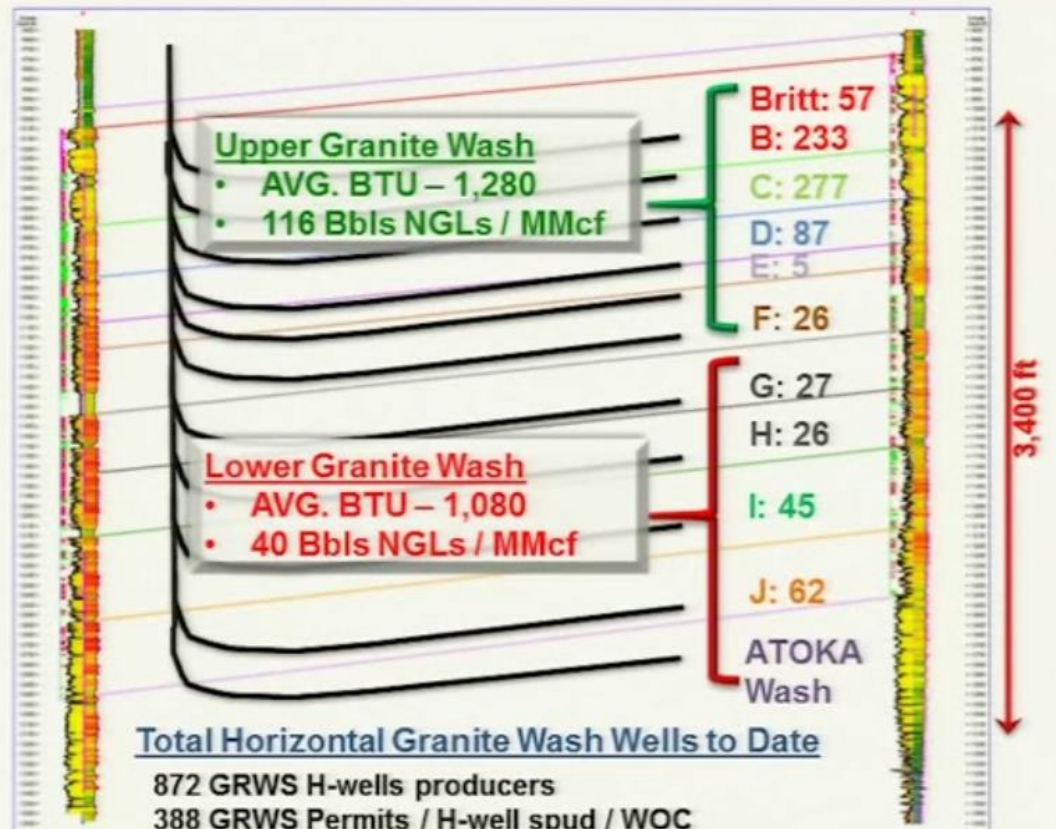
AAPG
ANNUAL CONVENTION & EXHIBITION
2012



Ed LoCiccio
DT #5, ACE Long Beach, 2012

Anadarko Basin, Texas Oklahoma

Eleven Stacked Horizons



Ed LoCriccio

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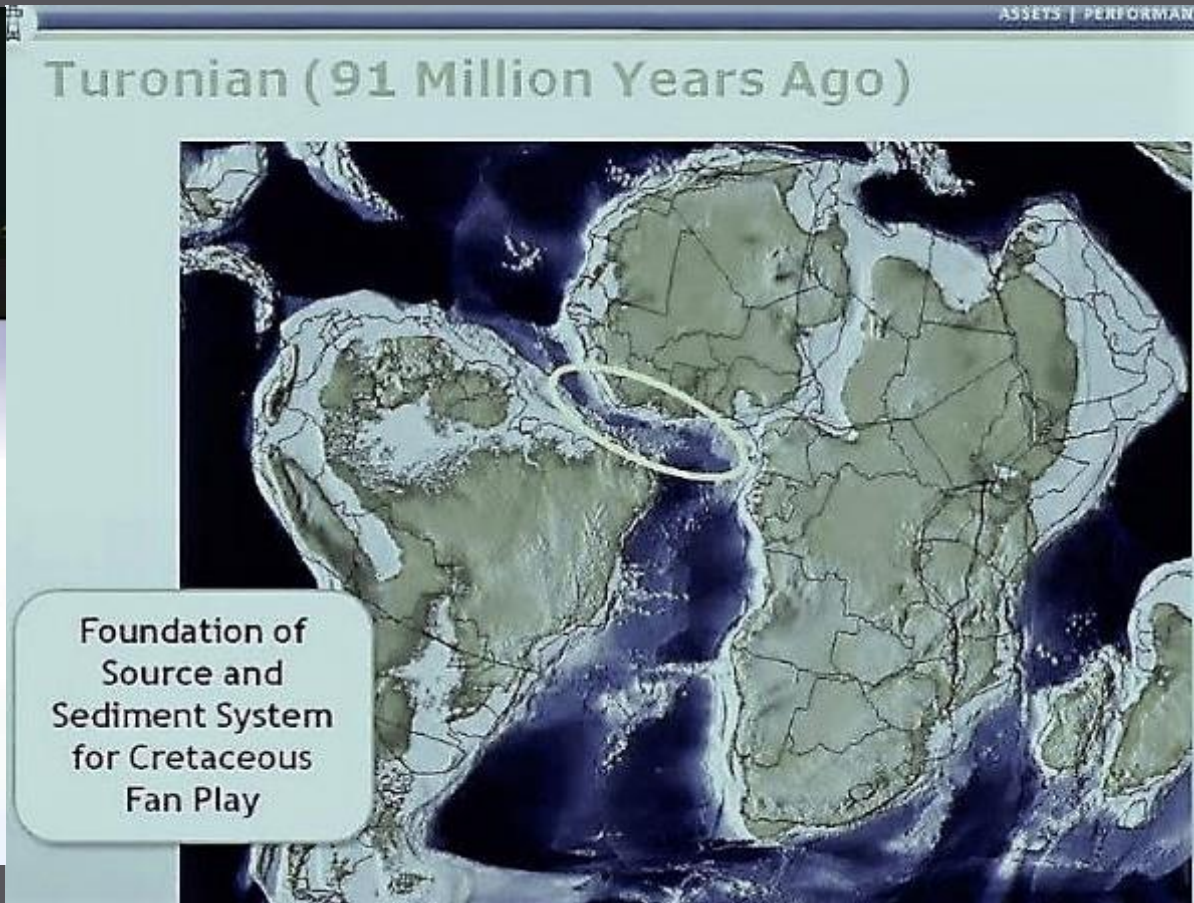
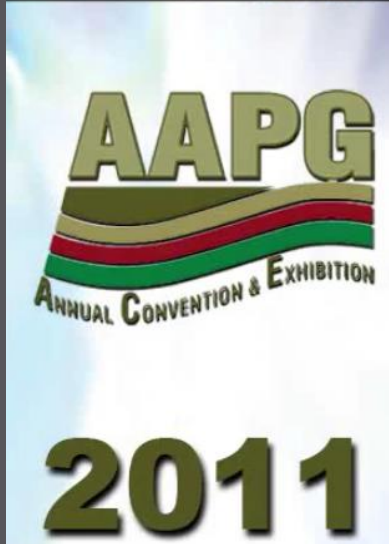
Anadarko Basin, TX OK Lessons

- Desmoinesian Granite Wash Play 2.5 million acres
- Multi-stacked resource play concentrates value
- Siliclastics shed from Wichita Mountains
- Geologic correlations key to steering
- Minimum of fifteen separate reservoirs
- Advent of horizontal drilling technology and isolated multi-stage fracture stimulation has revolutionized play in a “mature basin”
- Total Recoverable resources potential of 500 TCFE, (114 BBOE including NGL’s)

Ed LoCriccio

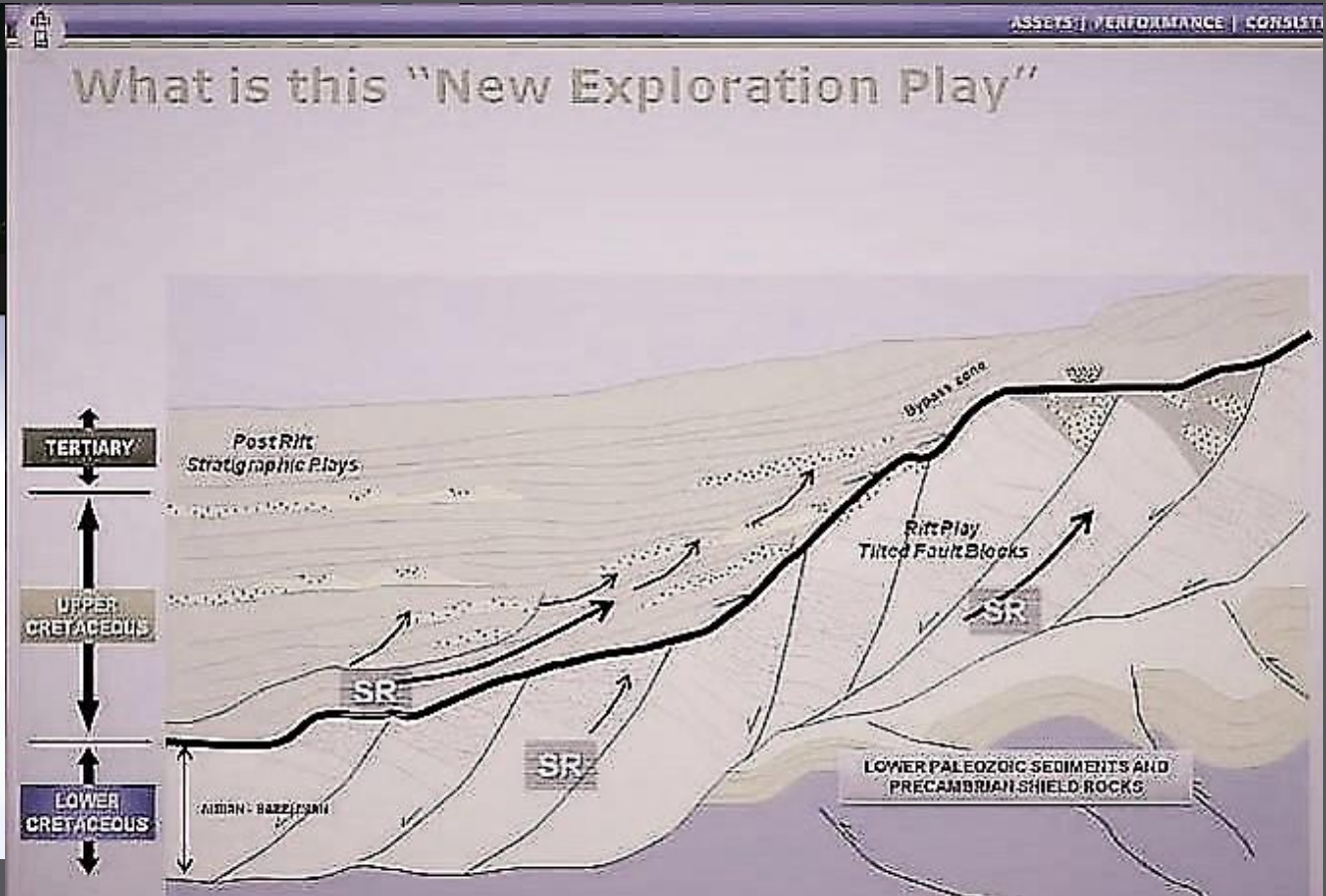
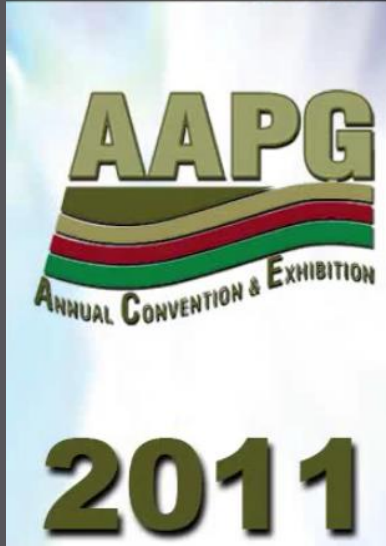
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Conjugate margins, W Africa



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DT #4, ACE Houston 2011

Conjugate margins, W Africa



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Conjugate margins, W Africa lessons

- Conventional wisdom questioned maturity on oceanic crust and if rift basins had source rock
- Team asked “What if?” “Why not”
- Found good hydrocarbon indications
- Regional evaluation of tacked turbidites of Turonian age
- Willingness to drill if it can open new plays
- 25 exploration wells between Sierra Leone-Ghana

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The Energy Challenge

There is more demand for energy globally as the world's population and living standards increase



Growing population

Global population is expected to increase from around 7 billion today to nearly 10 billion by 2050, with 67% living in cities.



Rising demand

Global energy demand will likely be almost 60% higher in 2060 than today, with 2 billion vehicles on the road (800 million today).



Ongoing supply

Renewable energy could triple by 2050, but we will still need large amounts of oil and gas to provide the full range of energy products that the world needs.



Decarbonization

Declining carbon intensity of the energy system is already happening; the future pace will be driven by market forces and policy choices

In Summary and Conclusion

- Geoscience plays a key role
- Oil reserves are grand, perhaps grander than we had dared to imagine
- AAPG and professional societies play a key role to play in technology transfer
- Population and Demand are growing.
- We will be focused on Discovery Thinking for a very long time to come!

Thank You