2019 CO_2 Conference Week

Friday, Theme Session 3 - Summary of the Wednesday Short Course Entitled

Science, Engineering and Effects of Transmissive Natural Fractures

(APTA Short Course #22)

George H.W. Bush Convention Center

Midland, Texas

Short Course Summary

This one-day short course is the culmination of years of work on understanding the critical roles that fluid transmissive fractures play in oil and gas extraction and flooding. The understandings have very rapidly accelerated with the insights coming to industry from the horizontal well revolution. Combining those with the biochemical process awareness from residual oil zone studies made this the perfect time for the multi-discipline short course subject.

The speakers laid out the important science principles involved in commercial effects* of transmissive fractures and followed by several actual case histories from the Permian Carbonate and Wolfcamp Plays, the San Juan Basin, and the Gulf Coast. Parallels to other basins and oil and gas plays were addressed in a cursory way during the main talks but again in the panel discussion at the end of the day.

* *Effects such as sour oil in sweet oil plays, anomalously high water cuts, inability to pump off laterals, suppressed methane concentrations, induced seismicity and others*

Agenda for the CO_2 Conference Short Course #22
Science, Engineering and Effects of Transmissive Natural Fractures

AM Session

Times	Topical Area	Speaker…
8:05-9:00	A Intro to Course and the New Age: Horizontal Age and Resource Plays	Steve Melzer, APTA
9:00-10:00	B. Fault/Fracture Science Keynoter: Relationships Between Fractures, Faults, and Production	John Lorenz, FractureStudies.com
10:00-10:15	*Break*	
10:15-11:45	C. Fracture Engineering Keynoter: Impacts of Faults/Fracture Detection and Fault Property Identification	Richard Baker, Consulting Engr
12:00-1:00	***Catered Lunch at noon***	

PM Session:

1:00-1:30	D. Tectonic History Considerations and Flow Fields	Bob Trentham, UTx Perm Basin
1:30-2:00	E. Economical and Low-Risk approach to Effective Fracture Detection and Completion Optimization in Lateral Wells	Don Herman, Cordax & Earle Drack, PetroMar
2:00-2:45	F. Borehole Imaging Data	BakerHughes
2:45-3:05	G. Spatial Aspects of Fracture Zones	Open Discussion
2:45-3:05	H. Case History #1: Carbonates (San Andres #1) – SW Gaines	Melzer
3:05-3:20	*Break*	
3:20-3:50	I. Case History #2: Gulf Coast Fault Case History	Alex Bump, UT BEG
3:50-4:15	J. Case History #3: Fault-Controlled Production in the San Juan Basin	Scott Cooper, Fracture Studies.com
4:15-4:45	K. Case History #4: Delaware Basin Horizontal Wolfcamp Case History: H_2S and excessive extraneous water linked to shallow seismically mapped features	Amy Patterson, Jetta Operating
4:45-5:00	L Panel of All Speakers: Other Basins?, Where Studies Should go from Here?	All Speakers
5:00-5:15	M. Wrap-up & Review Forms	
5:15	*Adjourn to the Reception at the Permian Basin Petroleum Museum*	

New Insights on Transmissive Faults/Fractures from the the ROZ Studies and Horizontal Well Revolution (2)

Why the Science is Important: Occasional Producing Well Frustrations - Low Oil Cuts, Sour Oil and Gas, Drilling Area 'Condemnation', and Injectant Containment Issues

(the Transmissive Natural Fracture/Fault Connection)

I. Fracture Science: Where Does the New Science Come From?
II. Engineering Issues of Natural & Induced Fractures
III. Types of Transmissive Fractures/Faults
IV. What are the Diagnostic Measurements?
V. From the Field: New Realizations/Case Histories

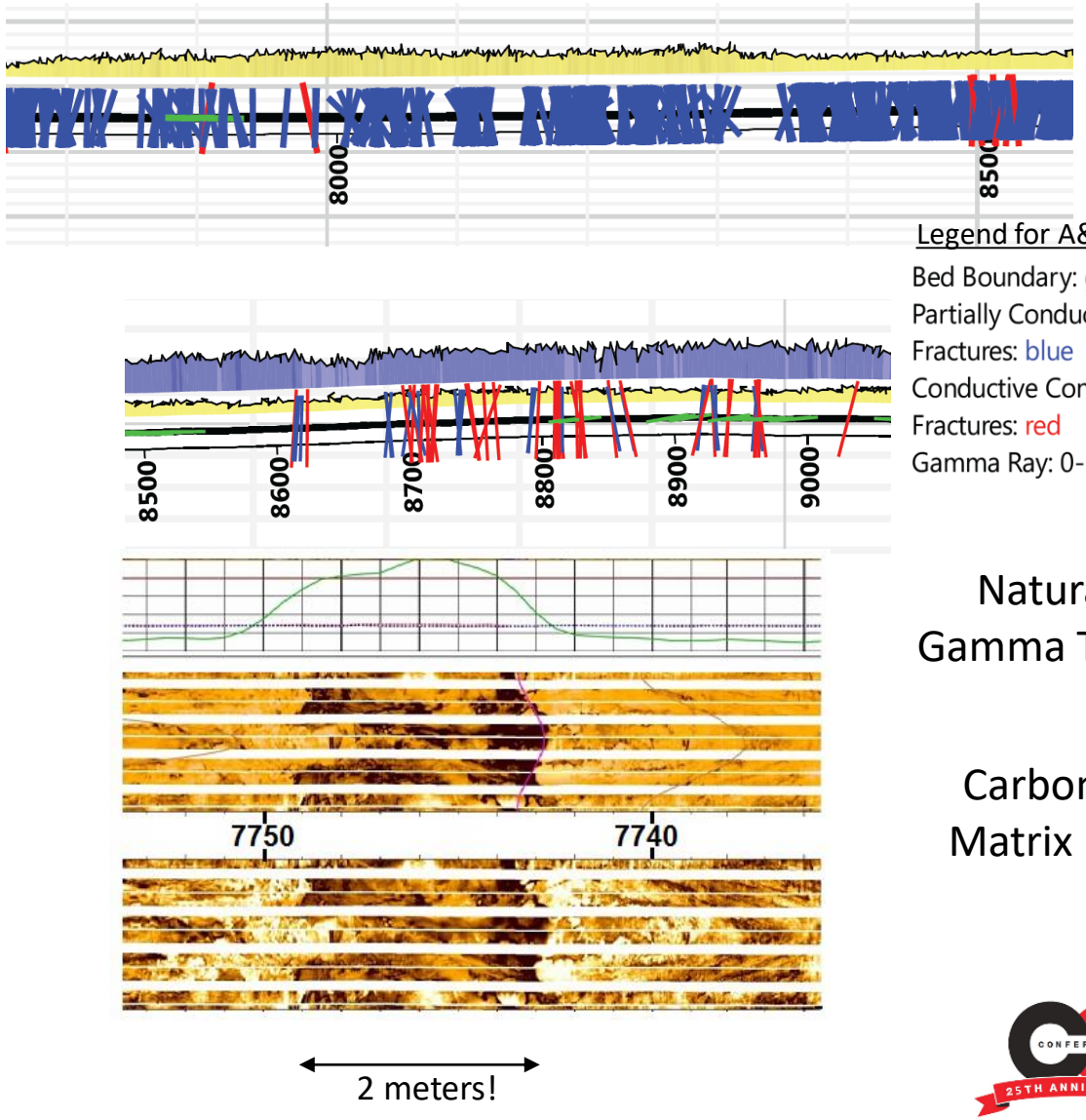
For This Purpose, we are Currently Using Our Own Fault/Fracture Categorization Framework for Near Vertical, 'Fluid Transmissive Faults' (VTFs)

A. Localized Natural Fractures

B. Flexural Faults/Fractures Over Deep Seated Structures

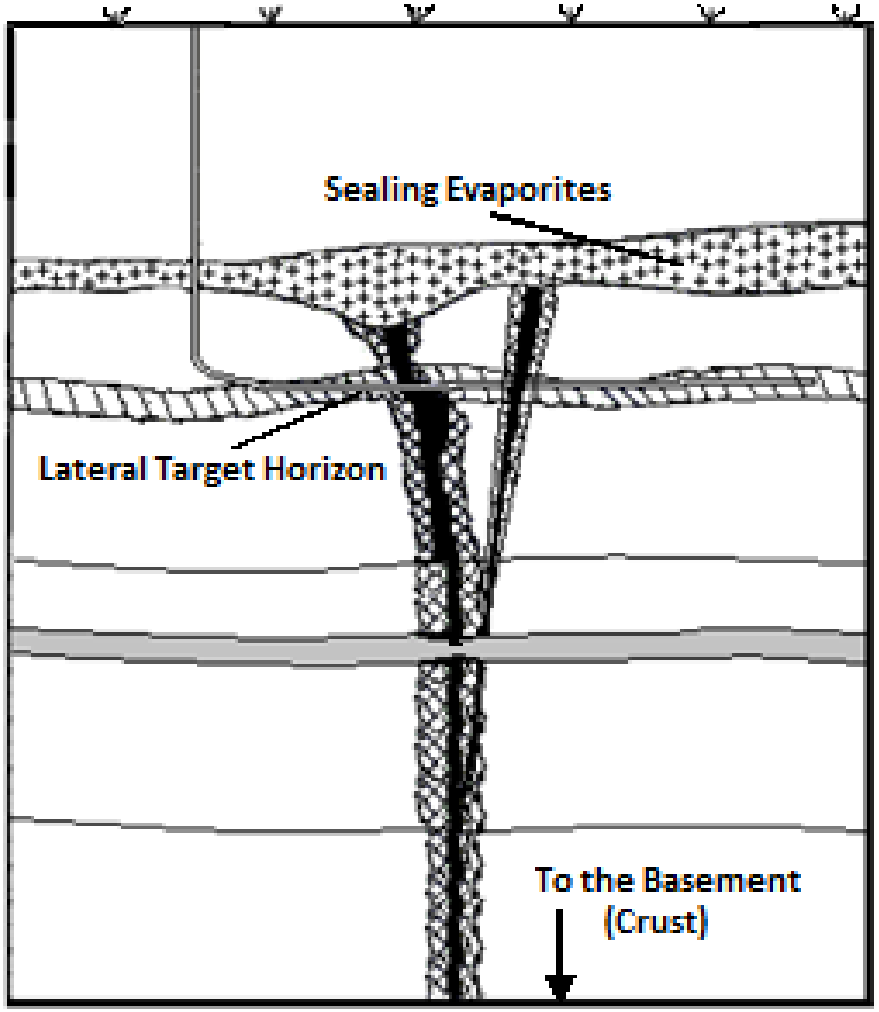
C. Crustal Basement Based, Recurrent Faults/Lineaments

D. And After The Course and BEG's Presentation, We Need to Add Gravity-Induced Faults

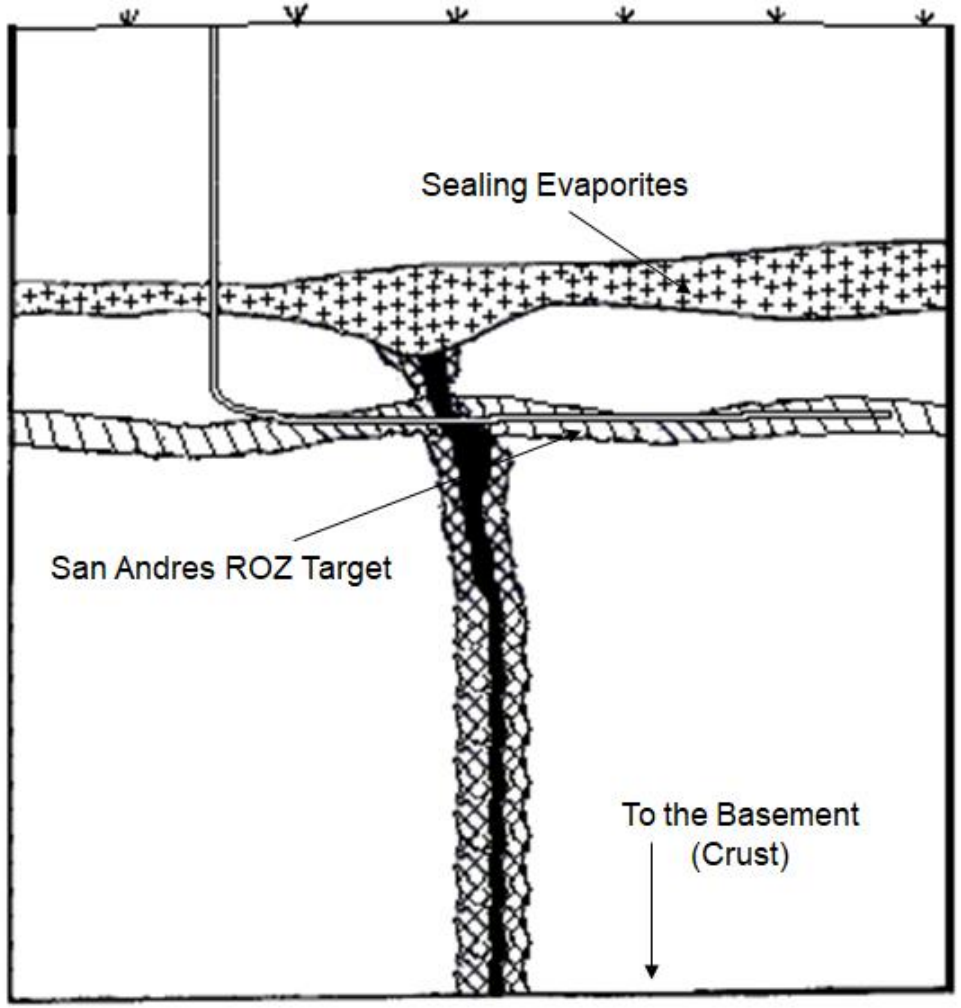


Images Compliments of Schlumberger Oilfield Services

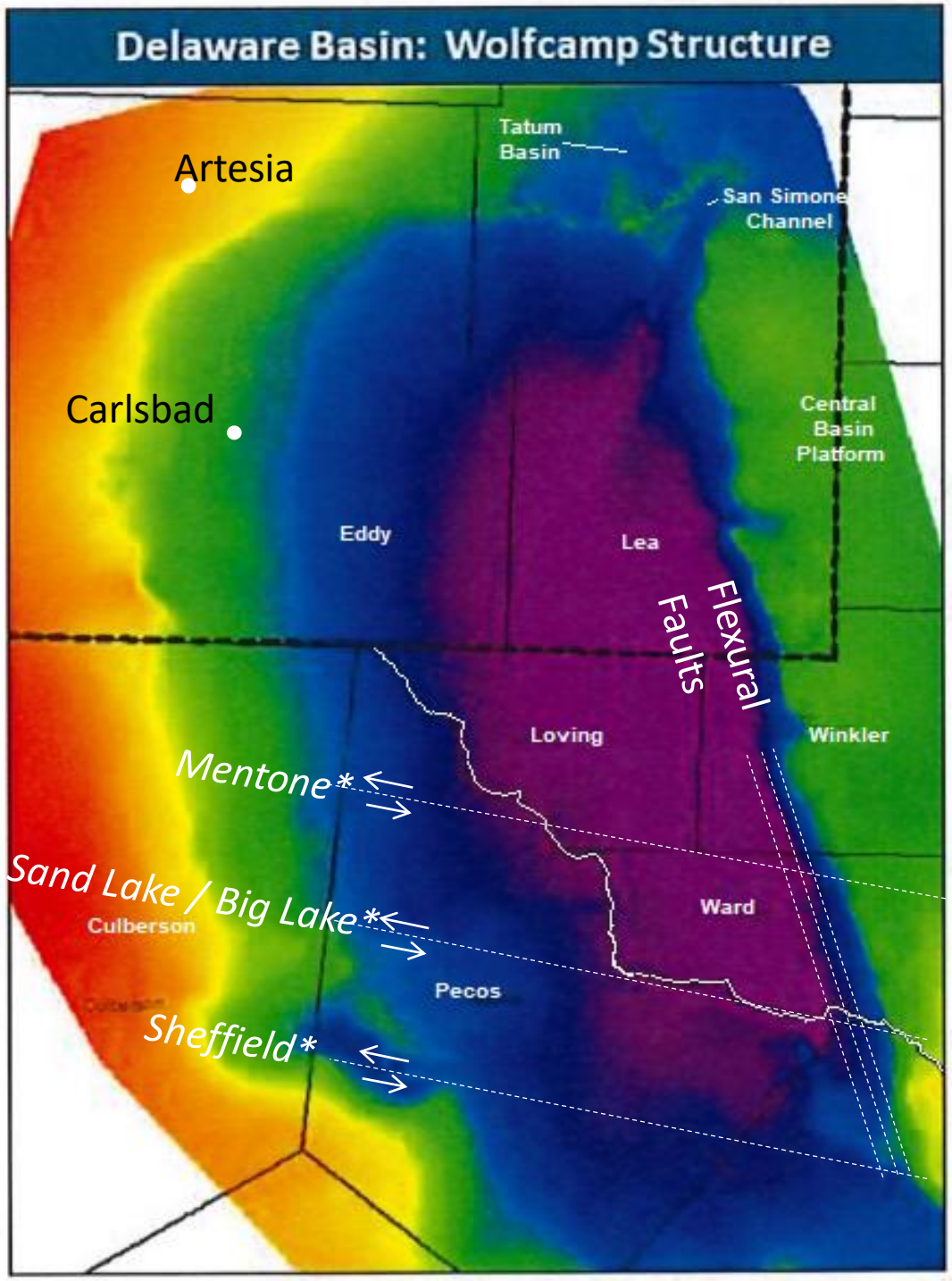
Basin Setting



Platform Setting

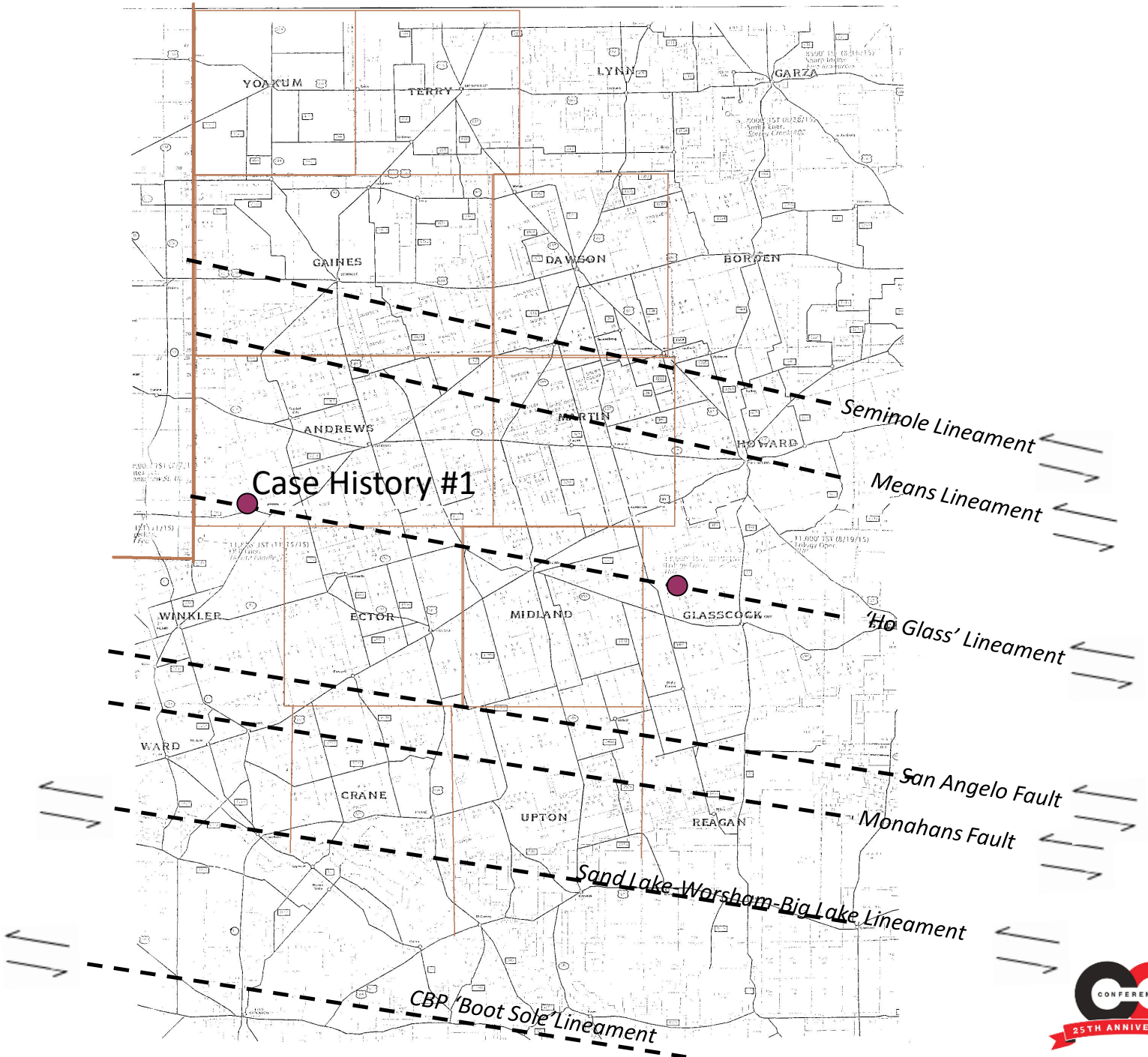


Basin Setting Idealized Lineaments (C) with Selected Key Flexural Faults (B) Superimposed

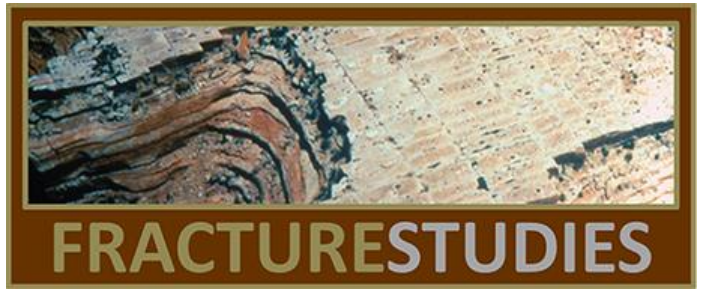


Platform Setting Lineaments *(Linearly Idealized)* Recurrent (& Modern) Basement Faults (Basement Lineaments)

Melzer CO2nsulting



Faults and Fracture Science



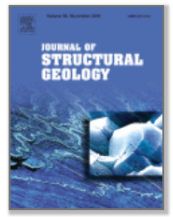
Fault Vs. Fracture
Is it just a matter of terminology?

- To a geophysicist: any planar discontinuity is a ‘fracture.’
- To a geologist: any plane with shear offset is a ‘fault.’

ELSEVIER

Journal of Structural Geology

Volume 92, November 2016, Pages 12-29



Glossary of fault and other fracture networks

D.C.P. Peacock [a], C.W. Nixon [a], A. Rotevatn [a], D.J. Sanderson [b], L.F. Zuluaga [a]

⊞ Show more

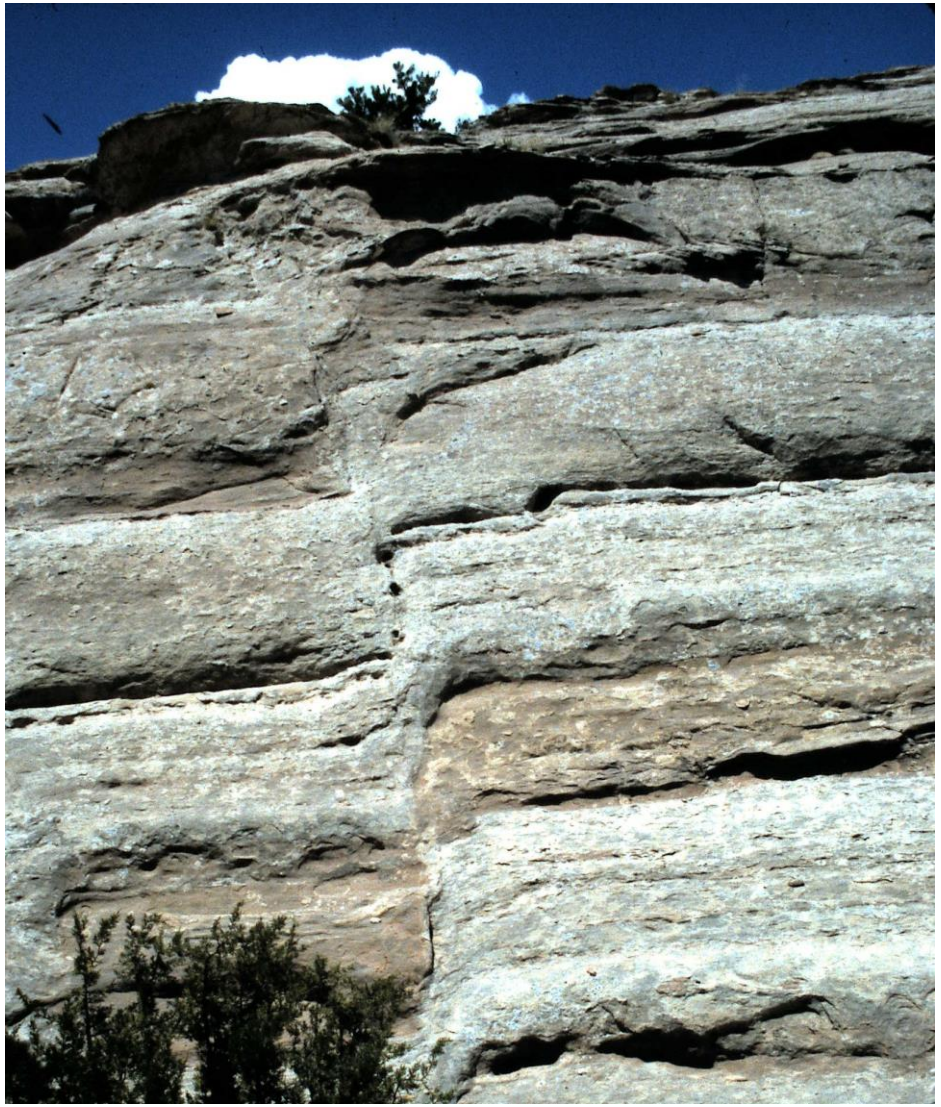
https://doi.org/10.1016/j.jsg.2016.09.008

All faults are fractures, but not all fractures are faults.

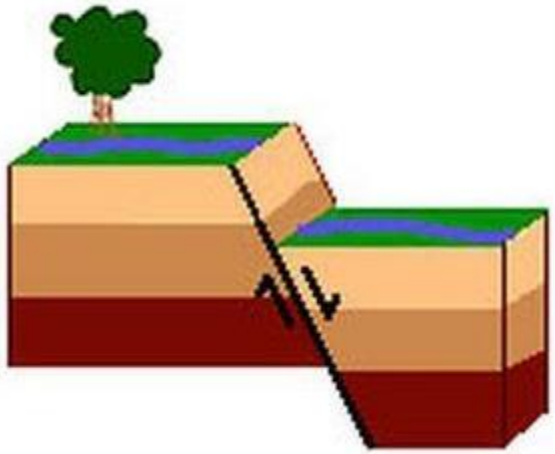
FRACTURESTUDIES

CONFERENCE CO2 25TH ANNIVERSARY

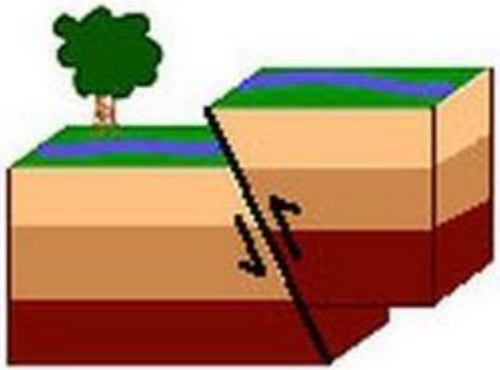
Faults can have different characteristics in different lithologies



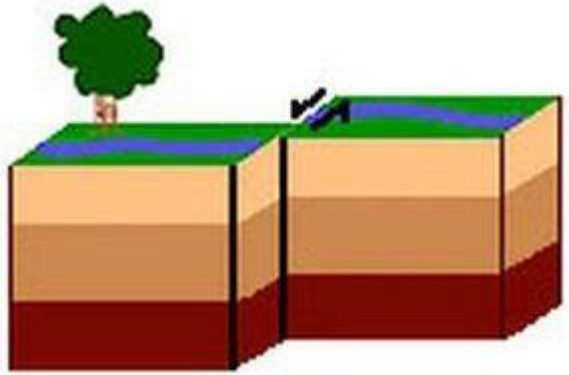
Three fault types



Normal



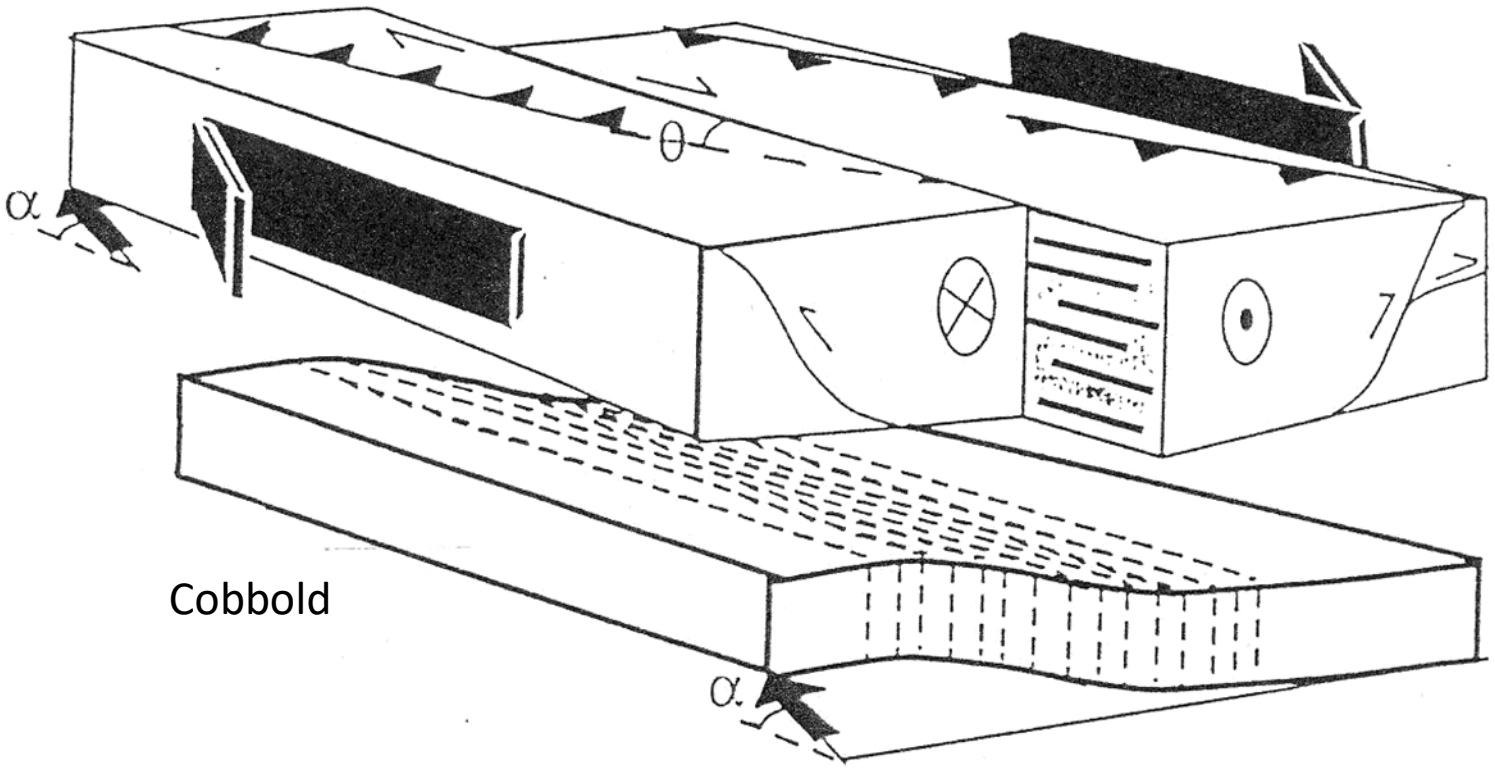
Reverse



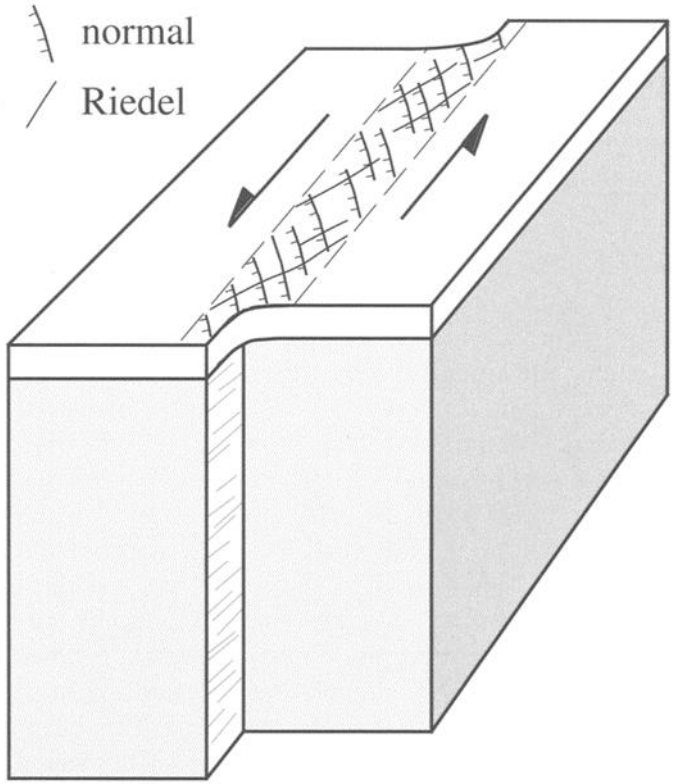
Wrench

https://www.pinterest.com/pin/223561568986337253/

Wrench (Stike-Slip) Faulting



Cobbold

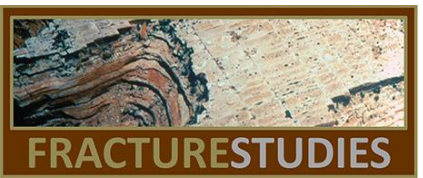


Continental scale

Regional scale

Summary

- Fracture halos/corridors developed along faults
- Different scales
- Seismically resolvable?
- Different permeability characteristics
- Different character in different formations
- Interference, pressures, heterogeneous fluids
- Identified with multi-disciplinary approaches



WILEY Blackwell

John C. Lorenz and Scott P. Cooper

Atlas of Natural and Induced Fractures in Core

AAPG
Advancing the World of Petroleum Geosciences™

WILEY Blackwell

John C. Lorenz and Scott P. Cooper

Applied Concepts in Fractured Reservoirs

AAPG
Advancing the World of Petroleum Geosciences™

FRACTURESTUDIES

CONFERENCE 25TH ANNIVERSARY

Faults and Fractures: Engineering Issues

Richard Baker

RES-SOLVE SOLUTIONS

Course on Fracturing: Natural Faults/Fractures, Hydraulic and Induced Fractures; How do they fit together?

Richard Baker

Midland, December 2019