GEOPRESSURE PRESSURE PREDICTION FOR ULTRADEEP WELLS: WHEN THE RESERVOIR BECOMES THE ENEMY

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Fusion Petroleum Technologies Inc.

JUST A REMINDER OF WHAT HAPPENS IF WE SCREW UP!

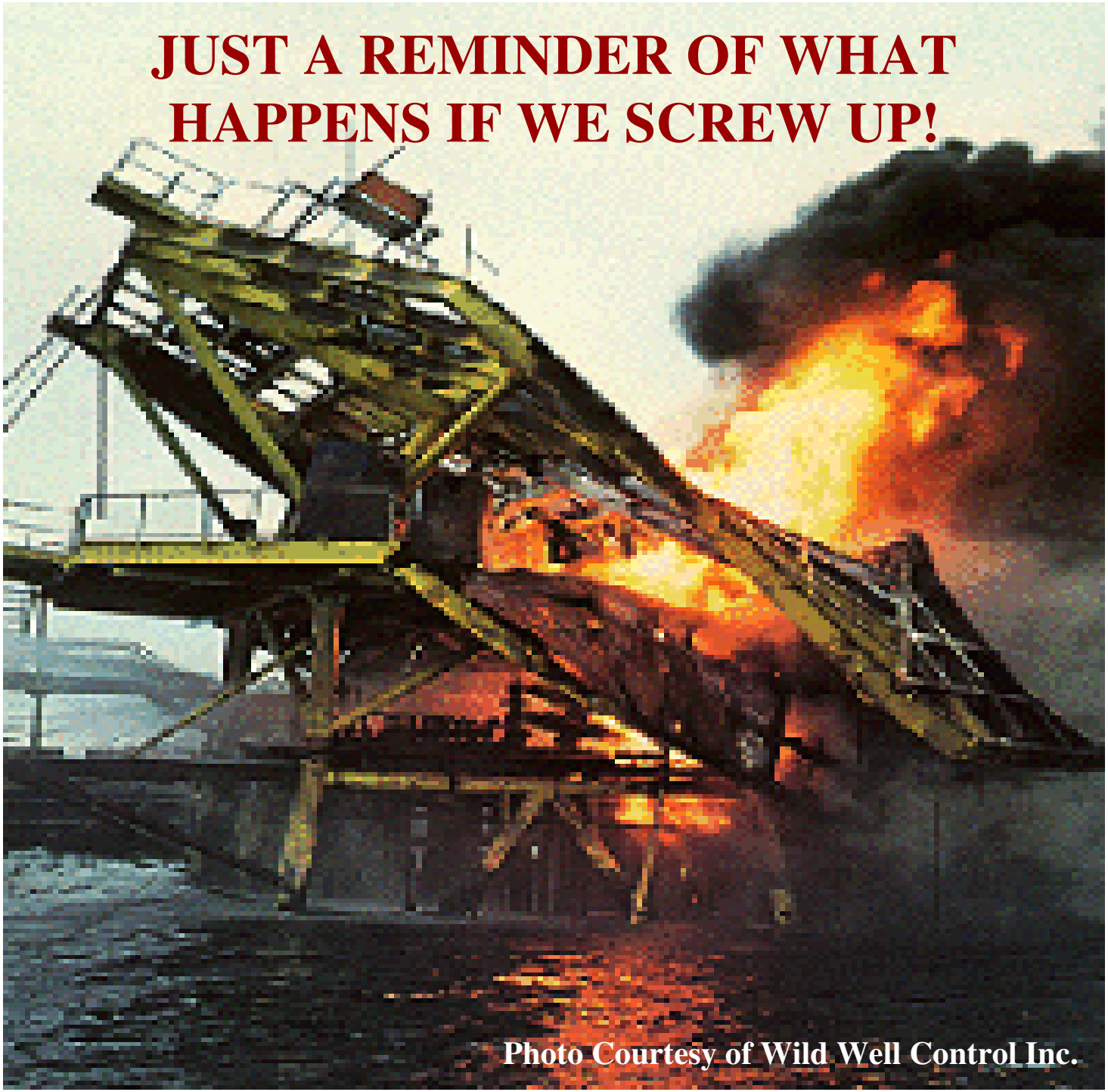
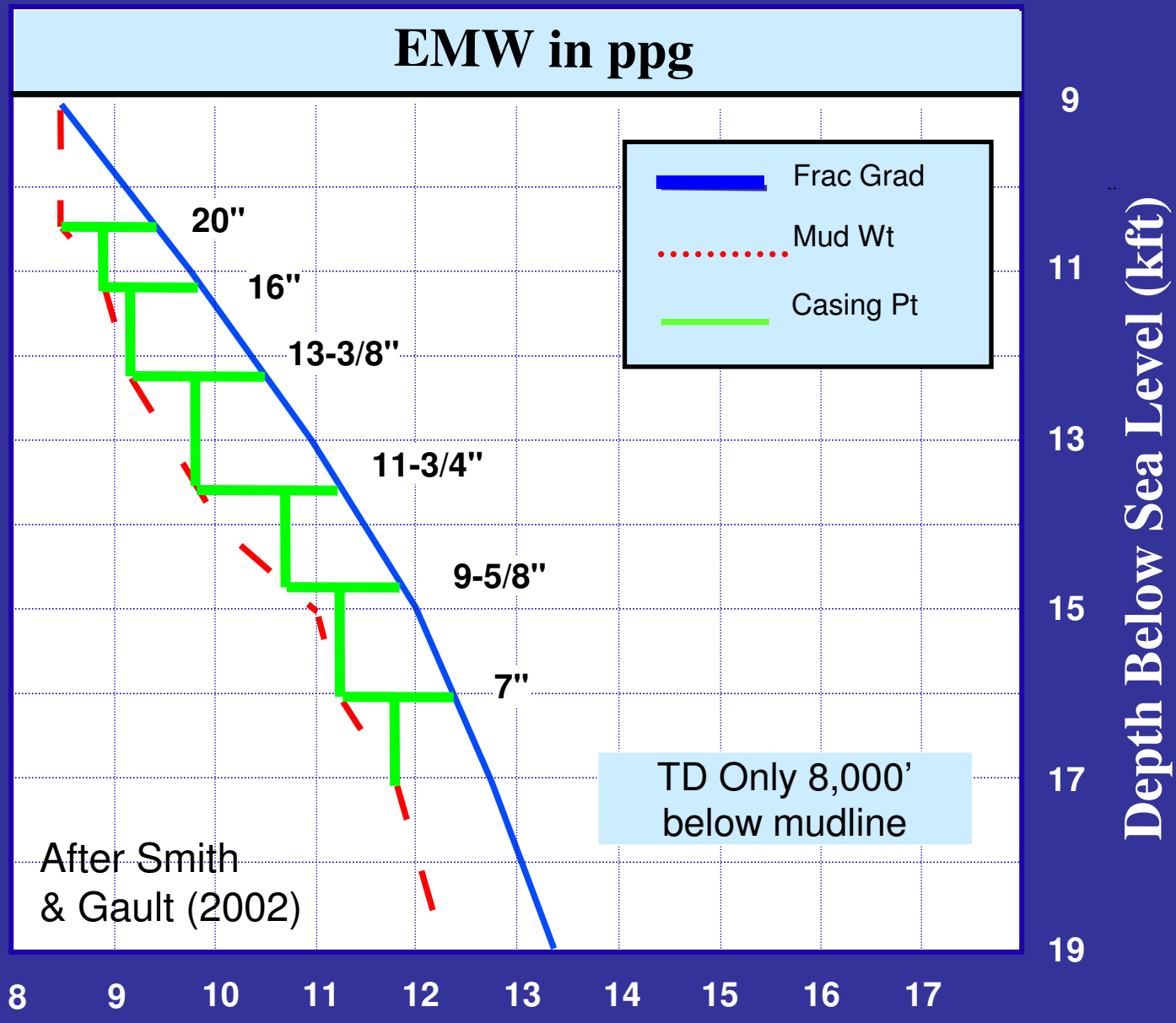


Photo Courtesy of Wild Well Control Inc.

Casing Program Design In A Nutshell



BURIAL MODEL FOR SAND BODIES

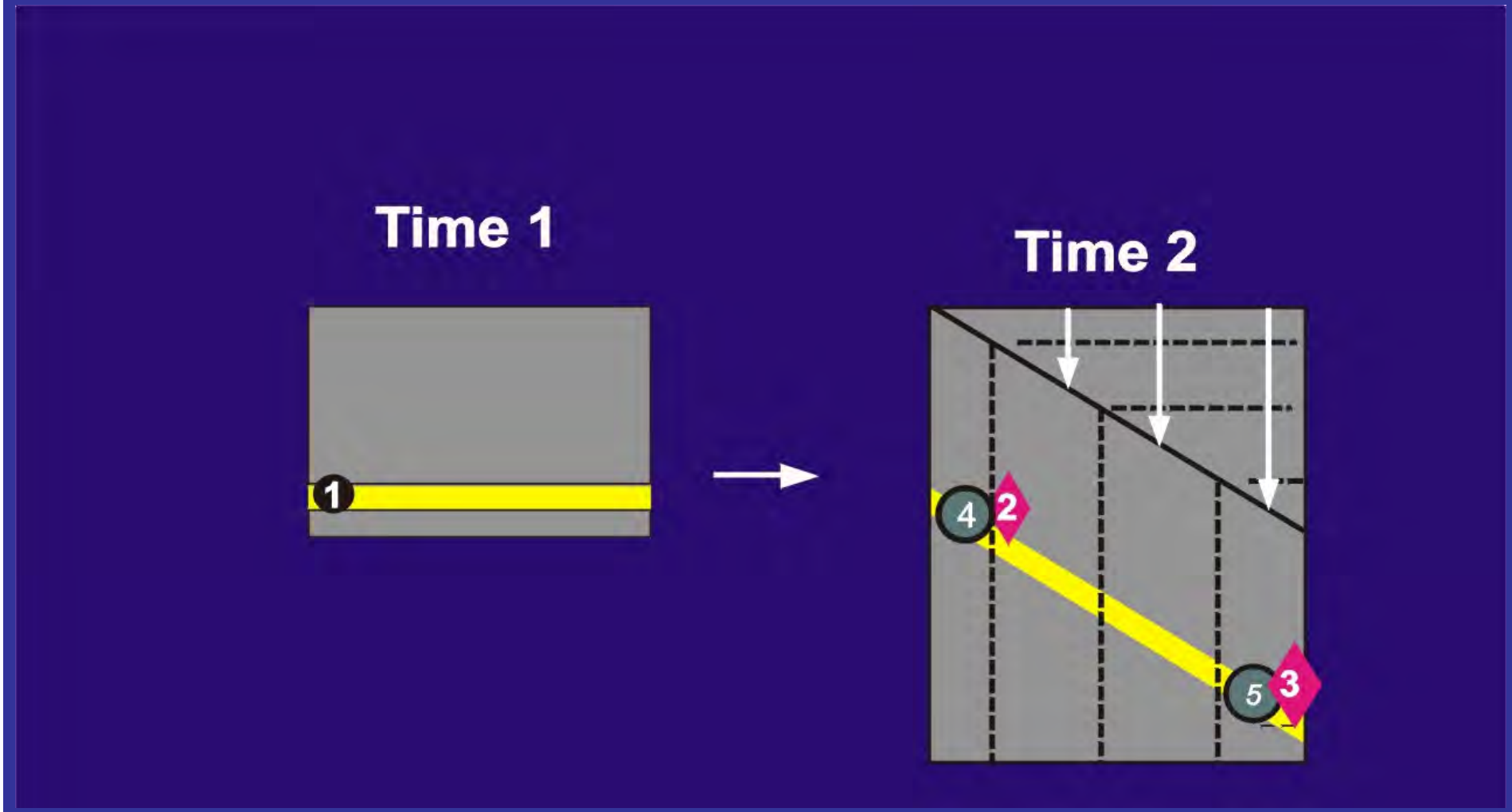


Figure from Stump et al. (2002)

PRESSURE REGIME IN SAND BODIES

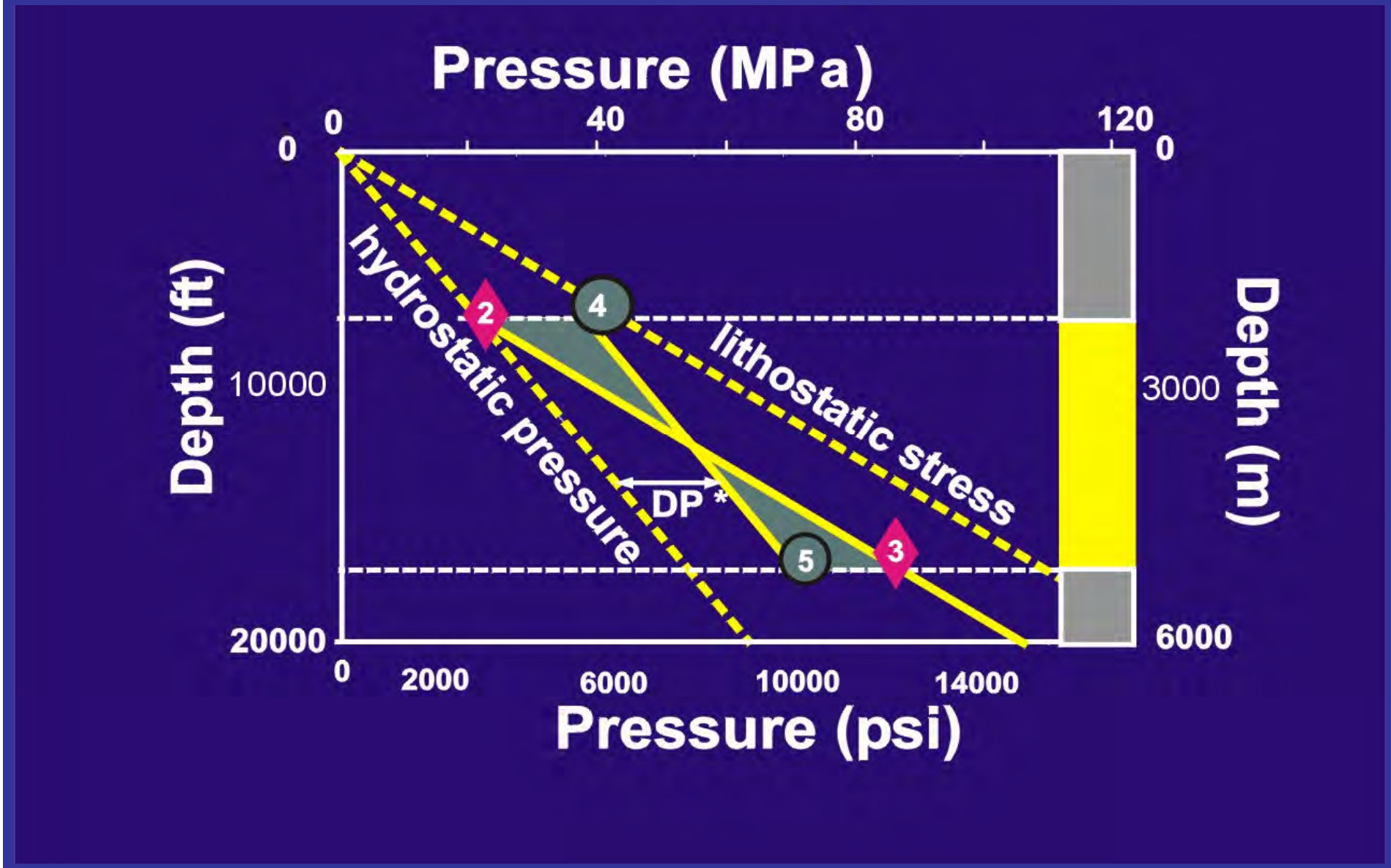


Figure from Stump et al. (2002)

HYDROLOGIC MODEL FOR SAND BODIES

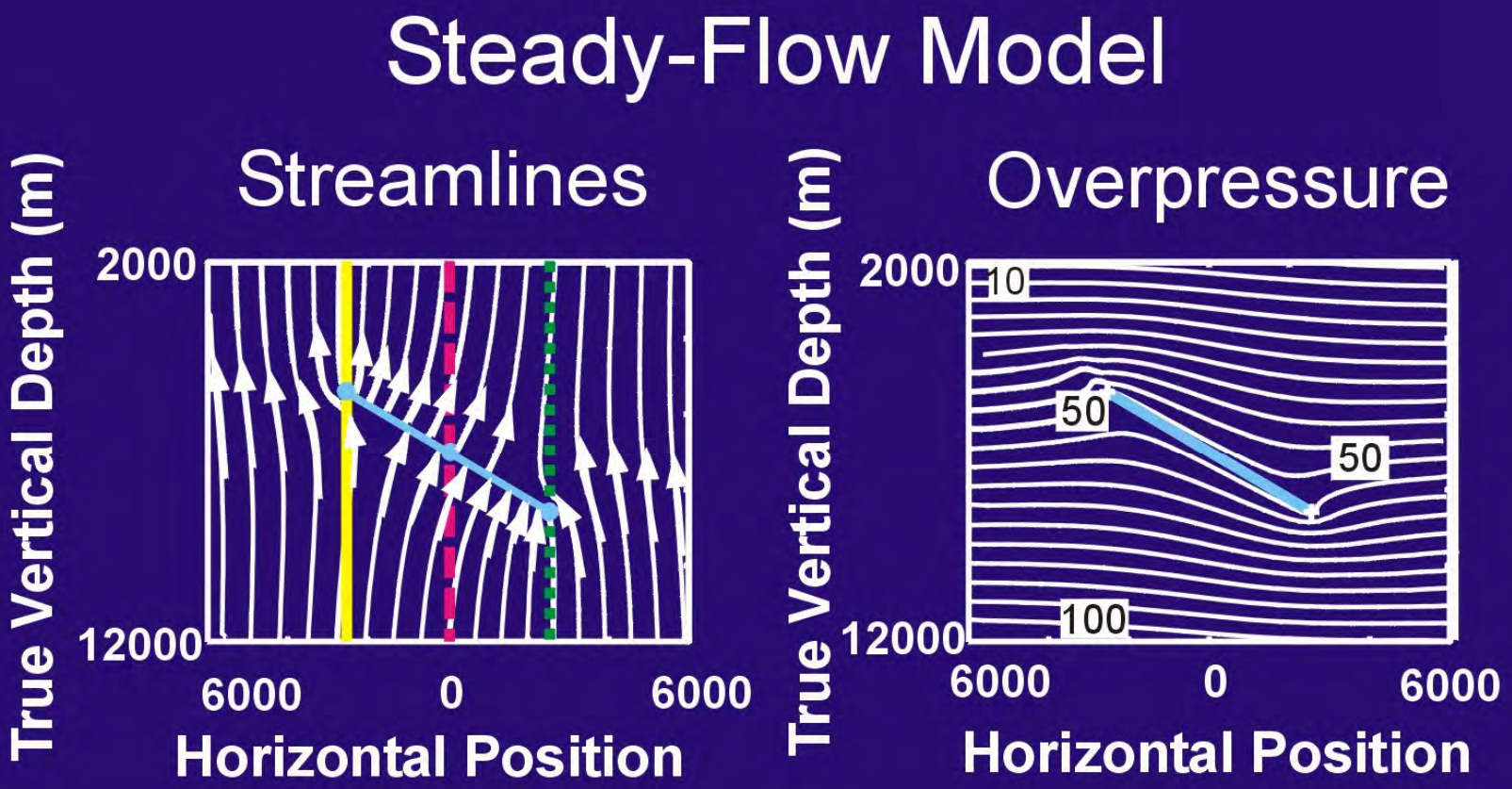


Figure from Stump et al. (2002)

MODELS FOR LOADING OF SANDS

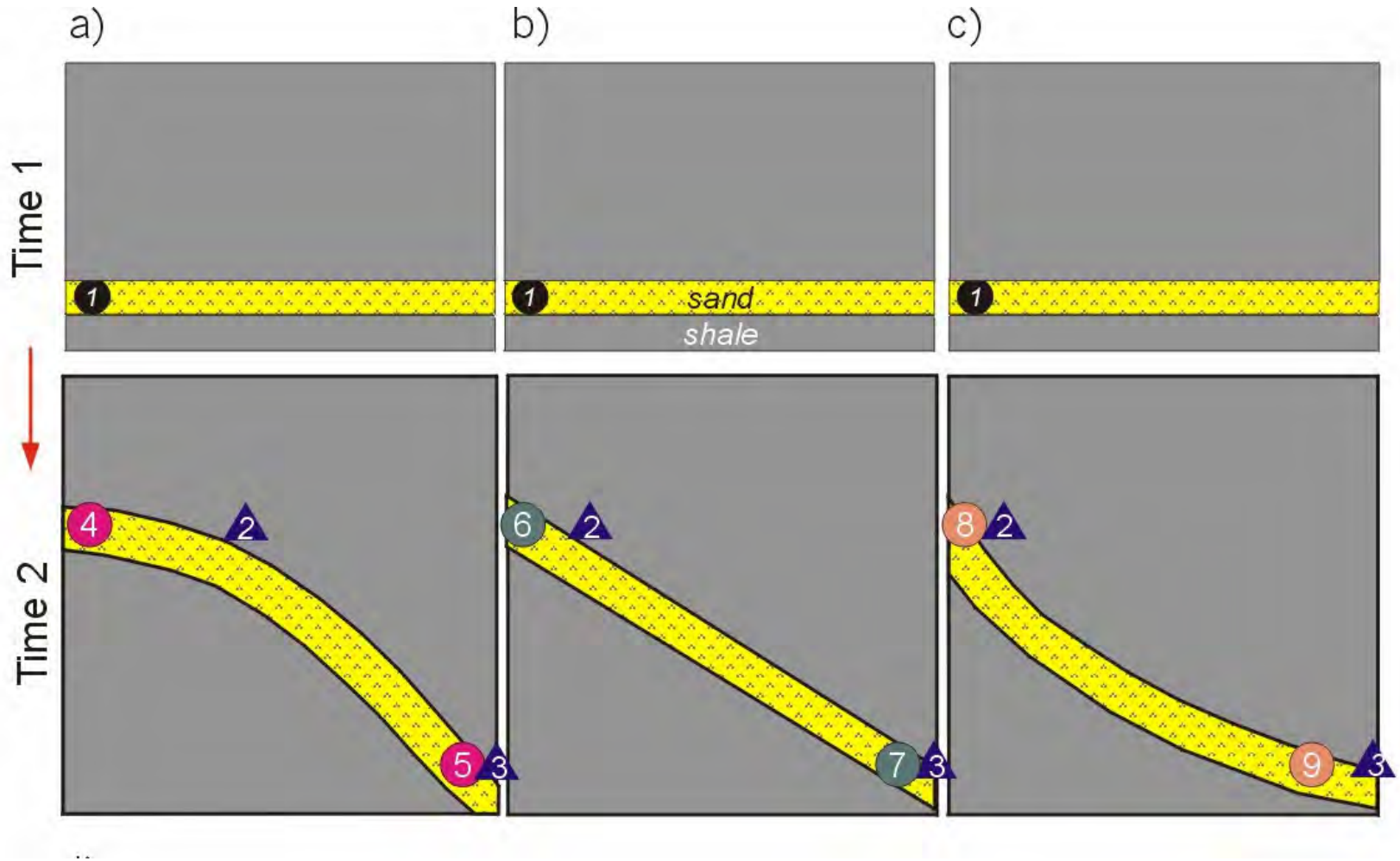


Figure from Stump et al. (2002)

PRESSURE PROFILE FOR DIFFERENT STRUCTURES

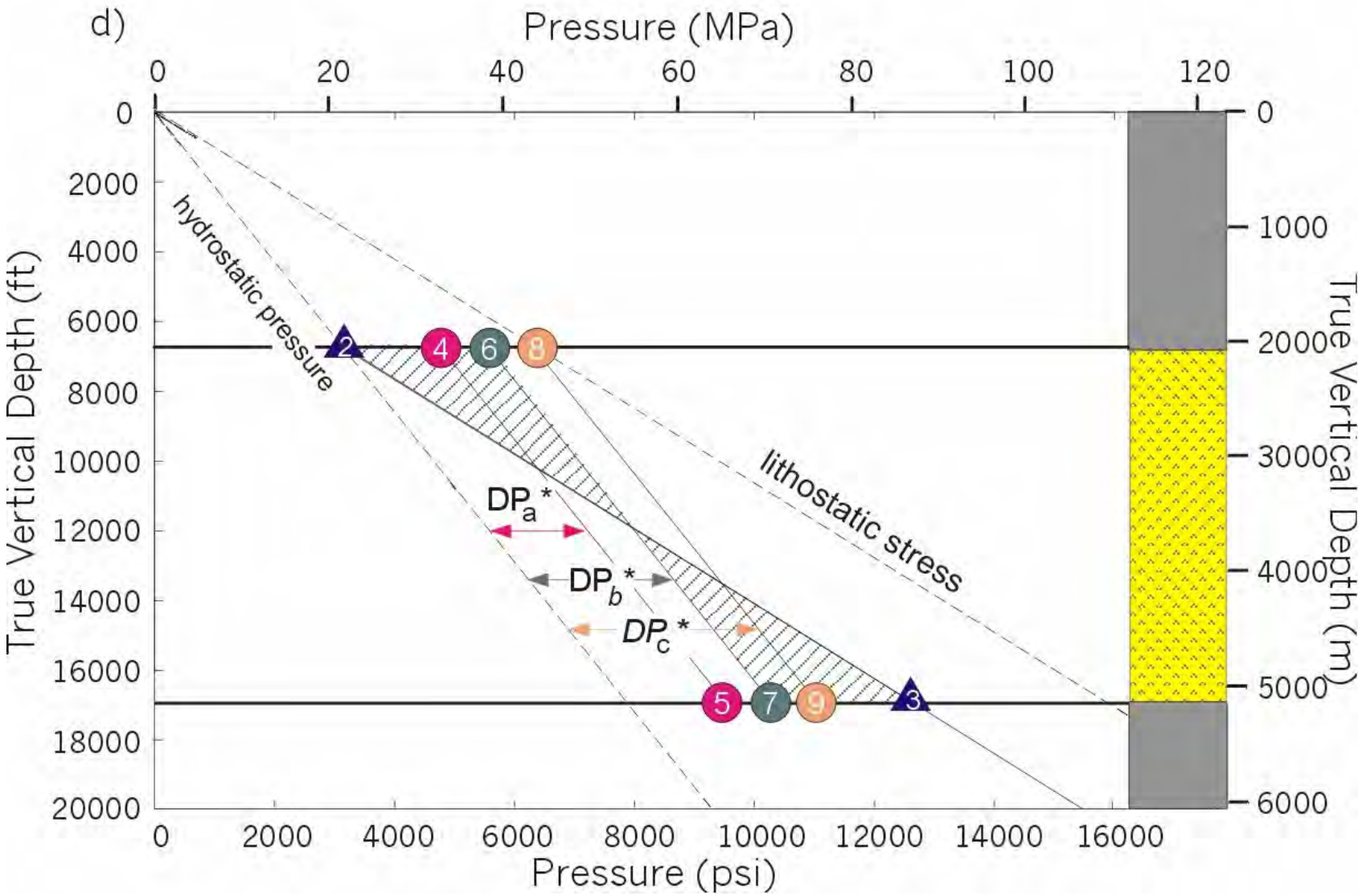
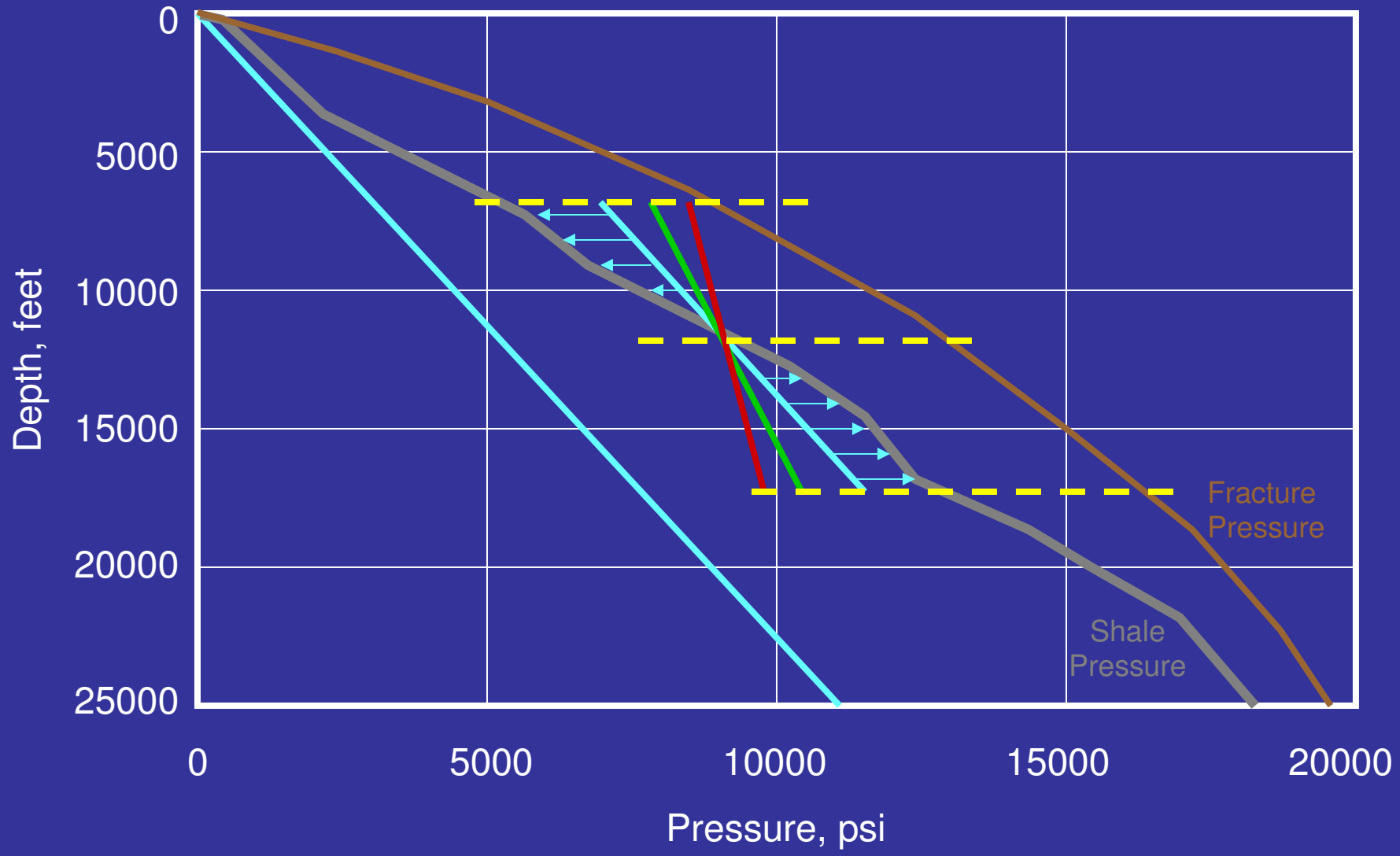


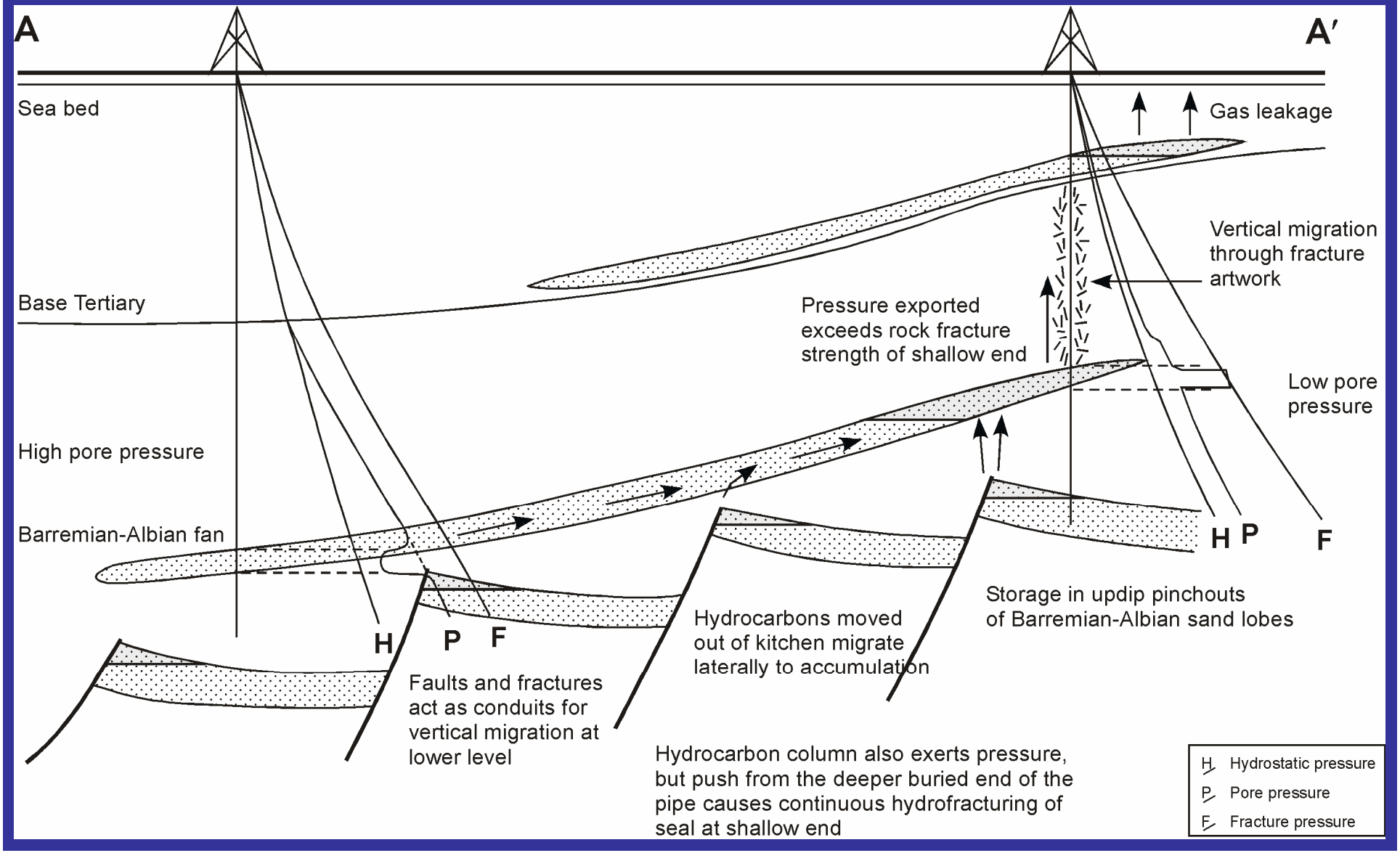
Figure from Stump et al. (2002)

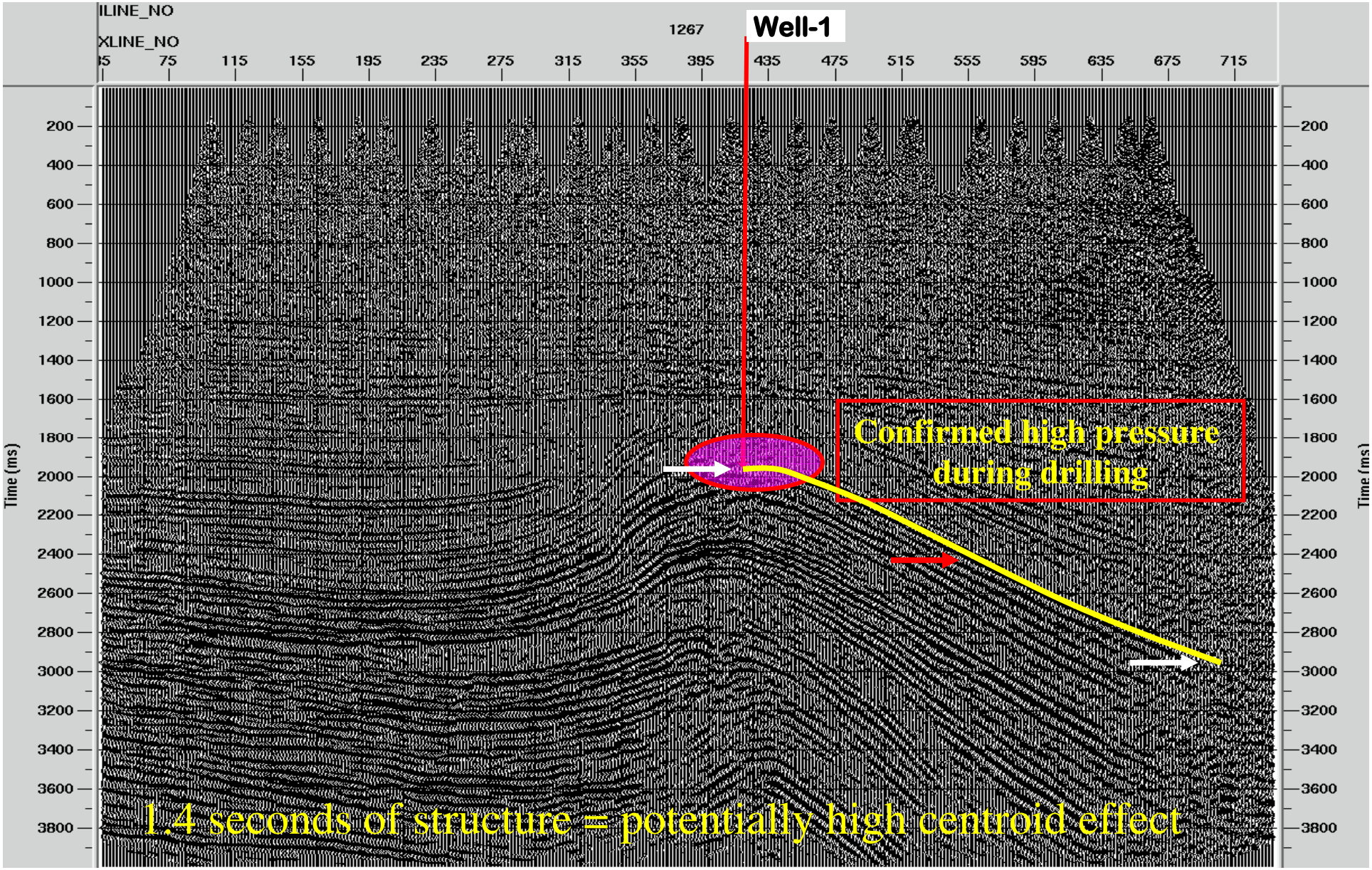
Centroids For Three Different Fluids



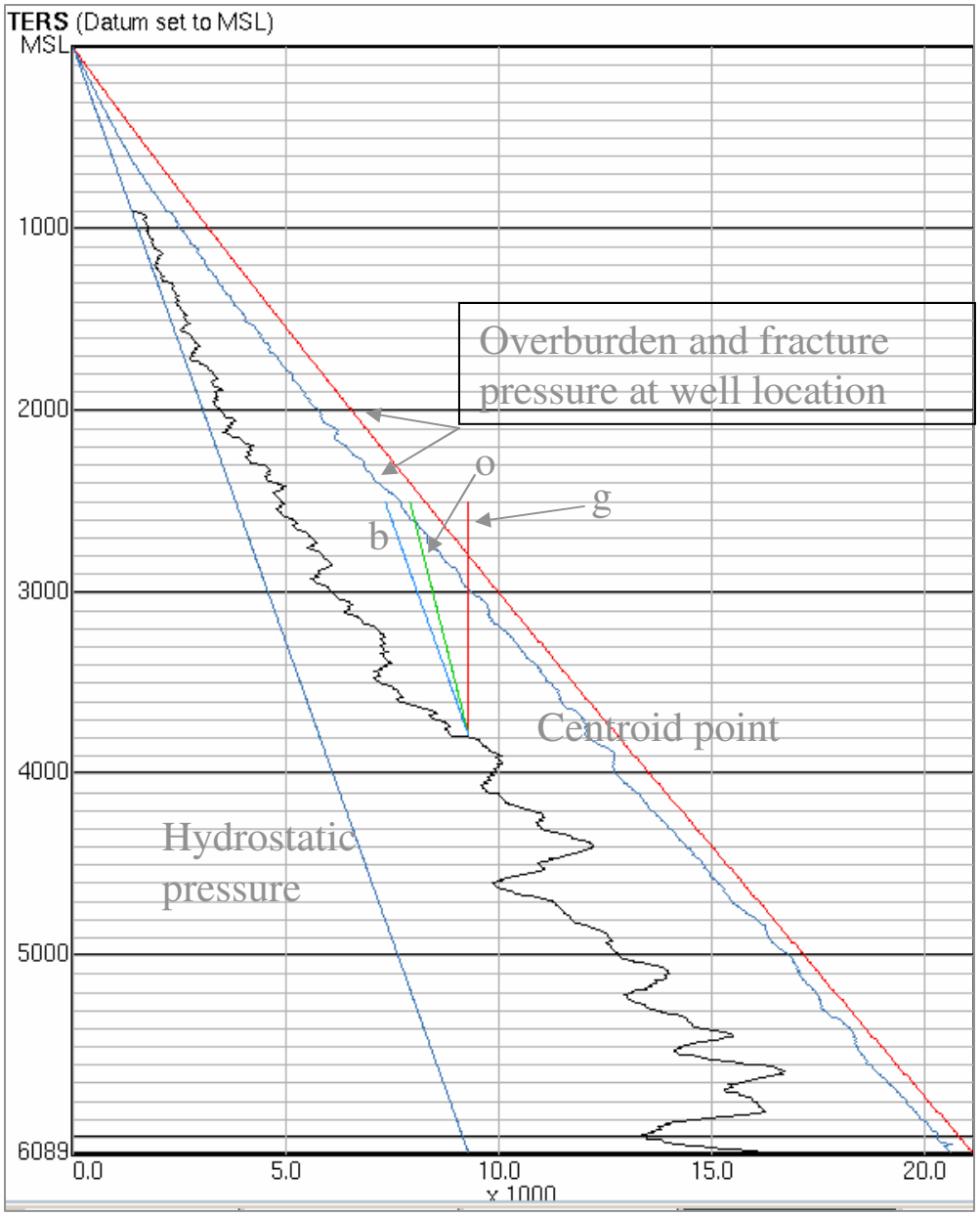
The Centroid is the mass balance point for influx and outflow of fluid in the sand

Lateral Transfer Through Sands




ILINE_NO
XLINE_NO
1267
Well-1
Confirmed high pressure during drilling
1.4 seconds of structure = potentially high centroid effect
Time (ms)

Centroid Calculation of Sand Pressure at The Well



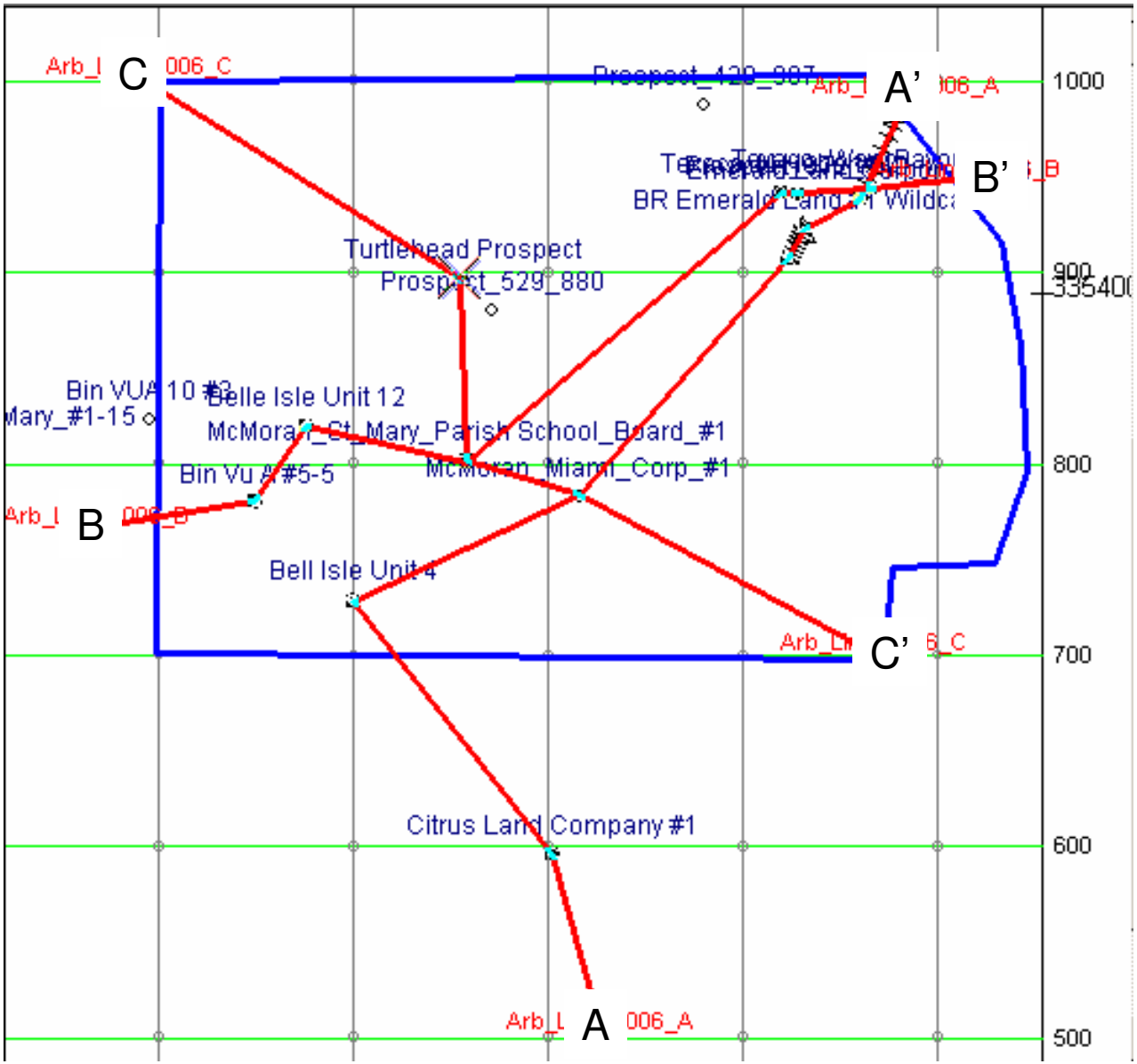
PSI

"b": brine sand pressure

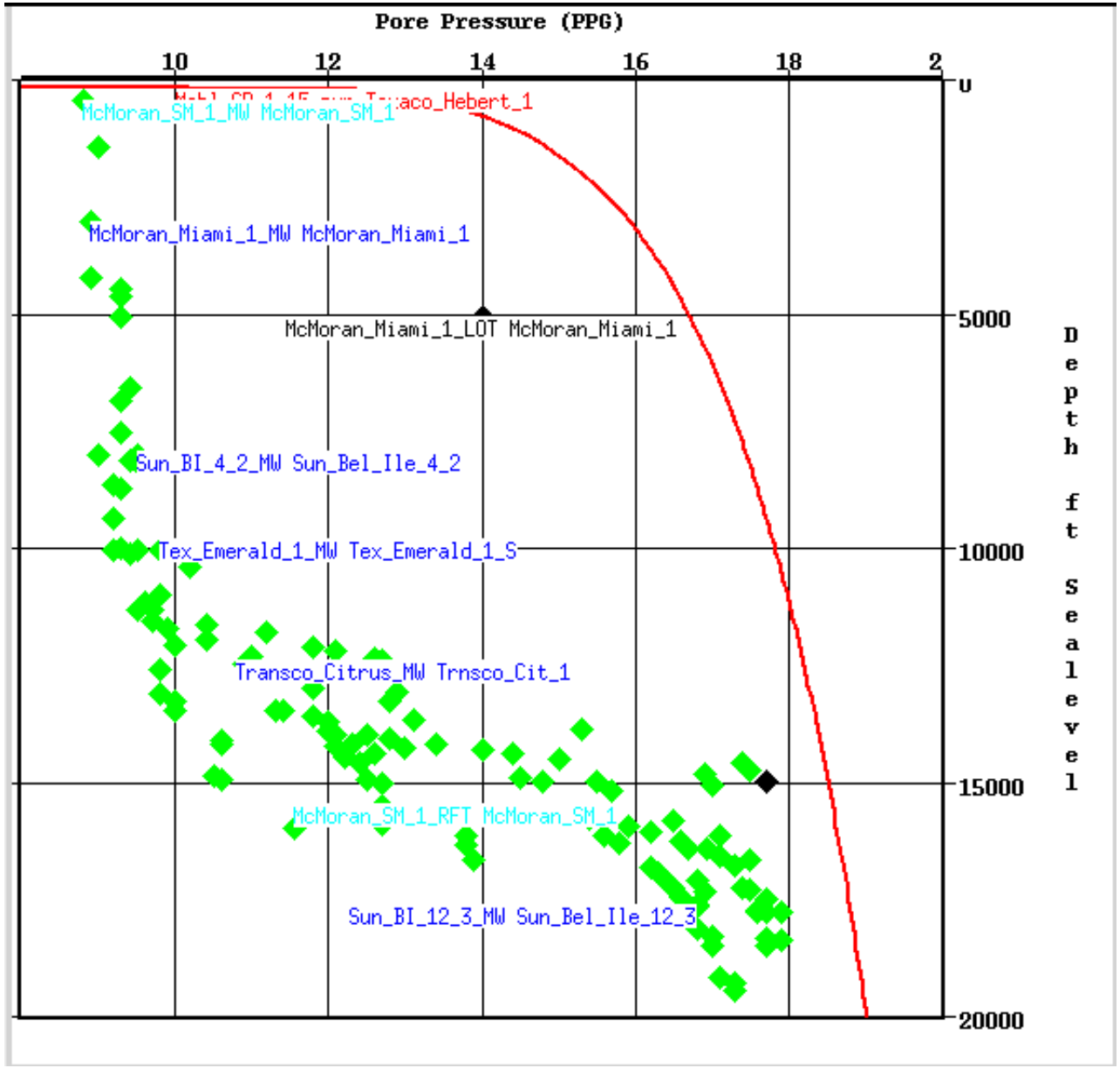
"o": oil sand pressure

"g": gas sand pressure

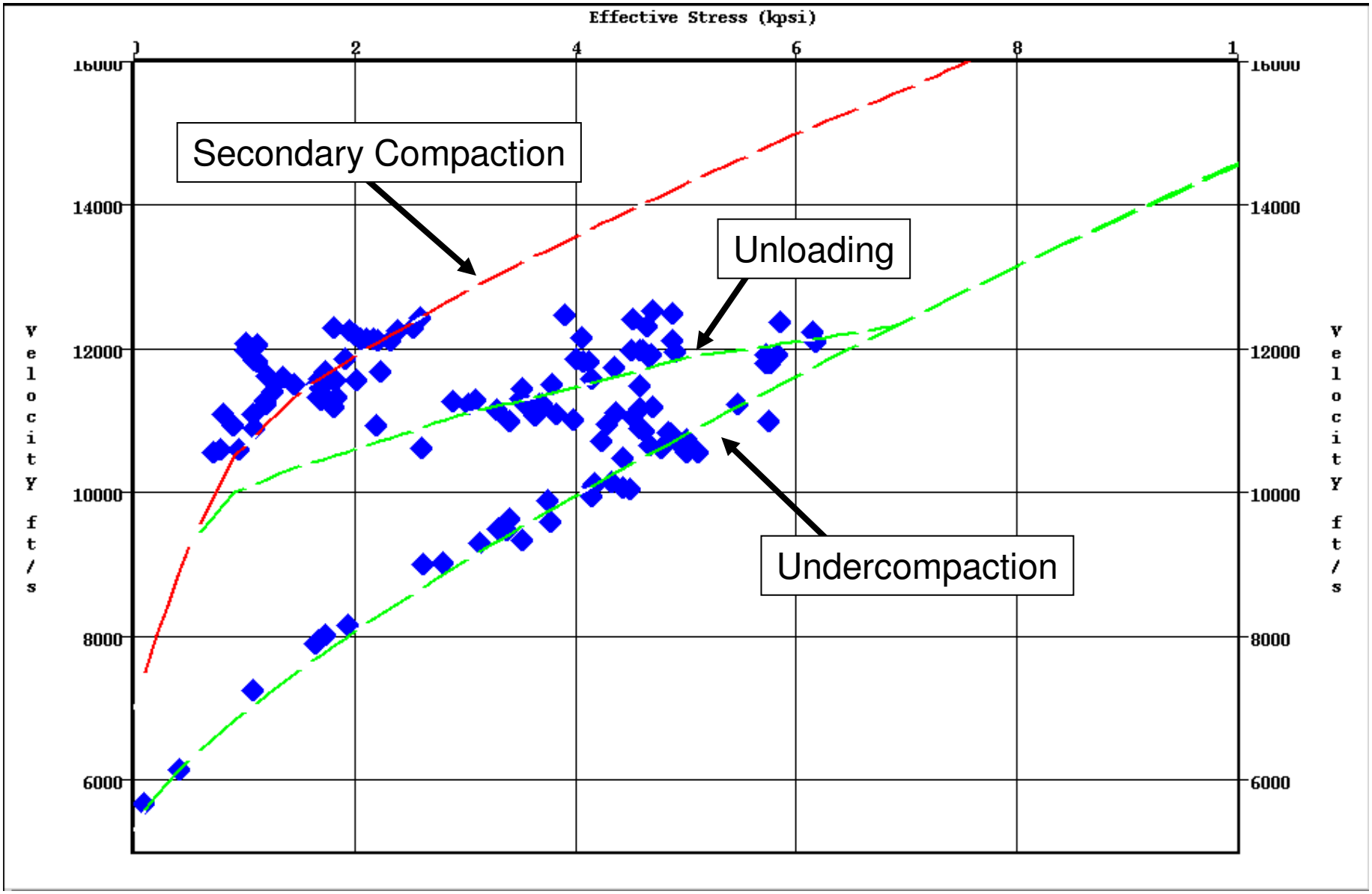
South Louisiana Case History



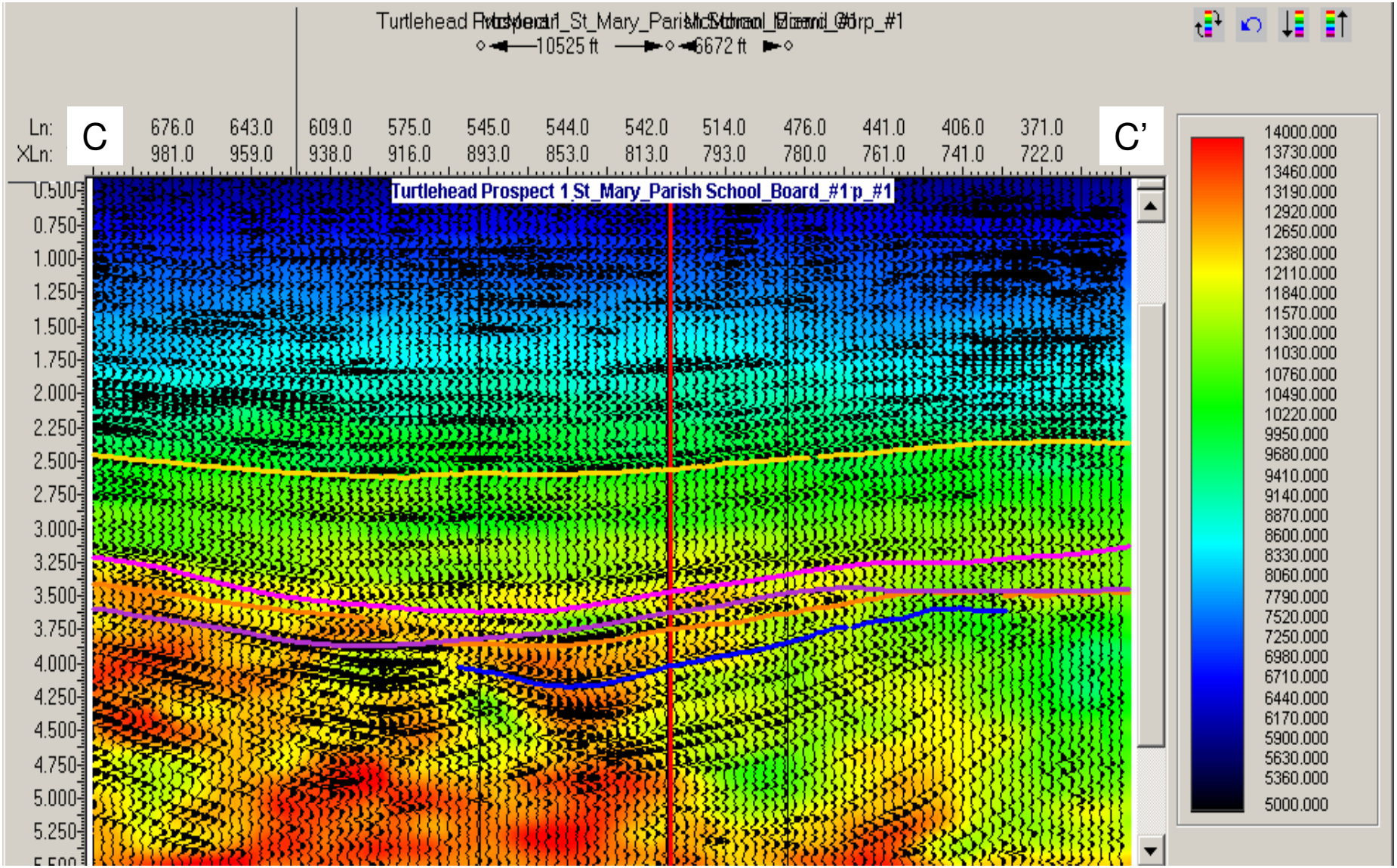
Pressure Data From Calibration Wells



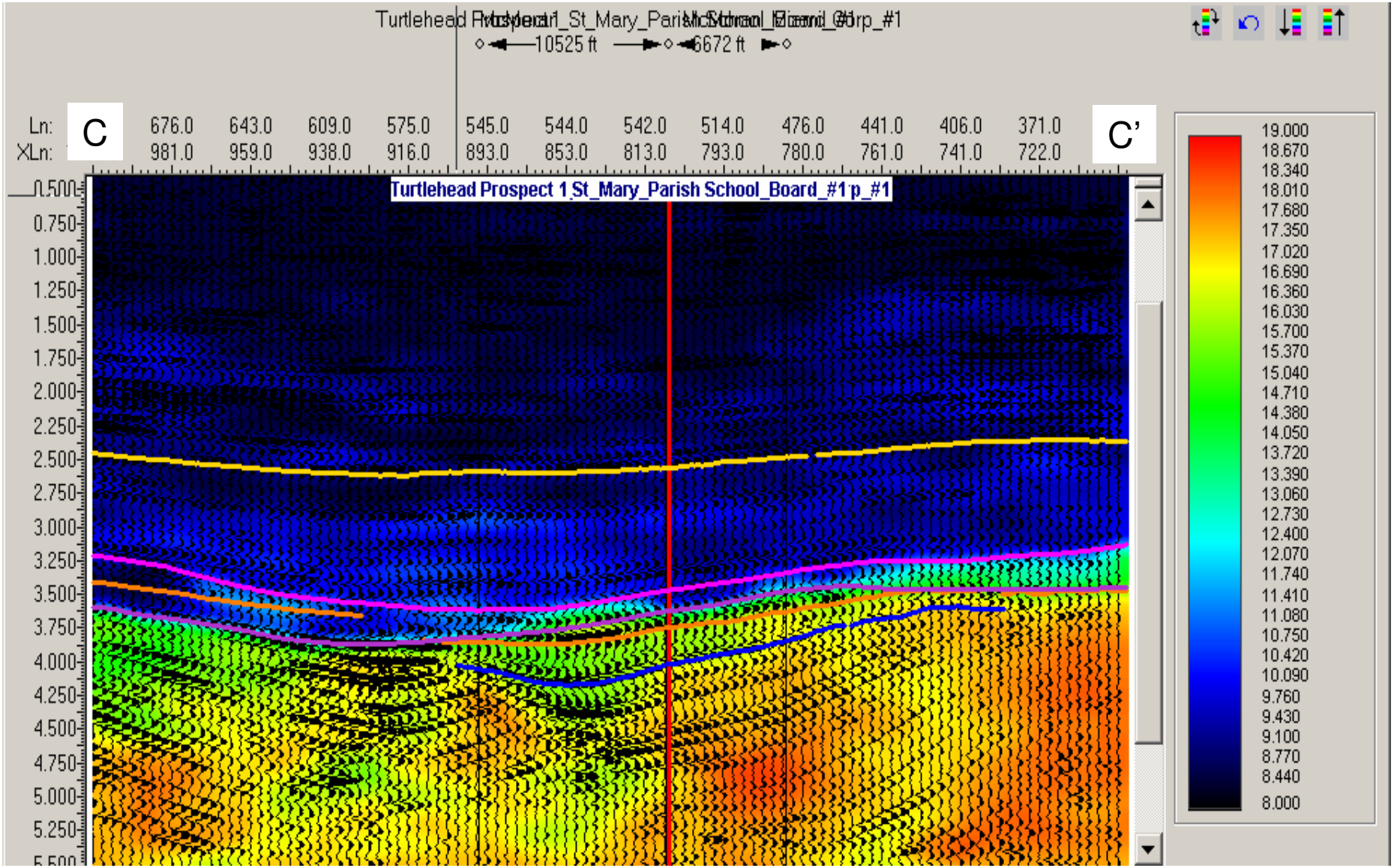
Effective Stress Calibration With Multiple Mechanisms



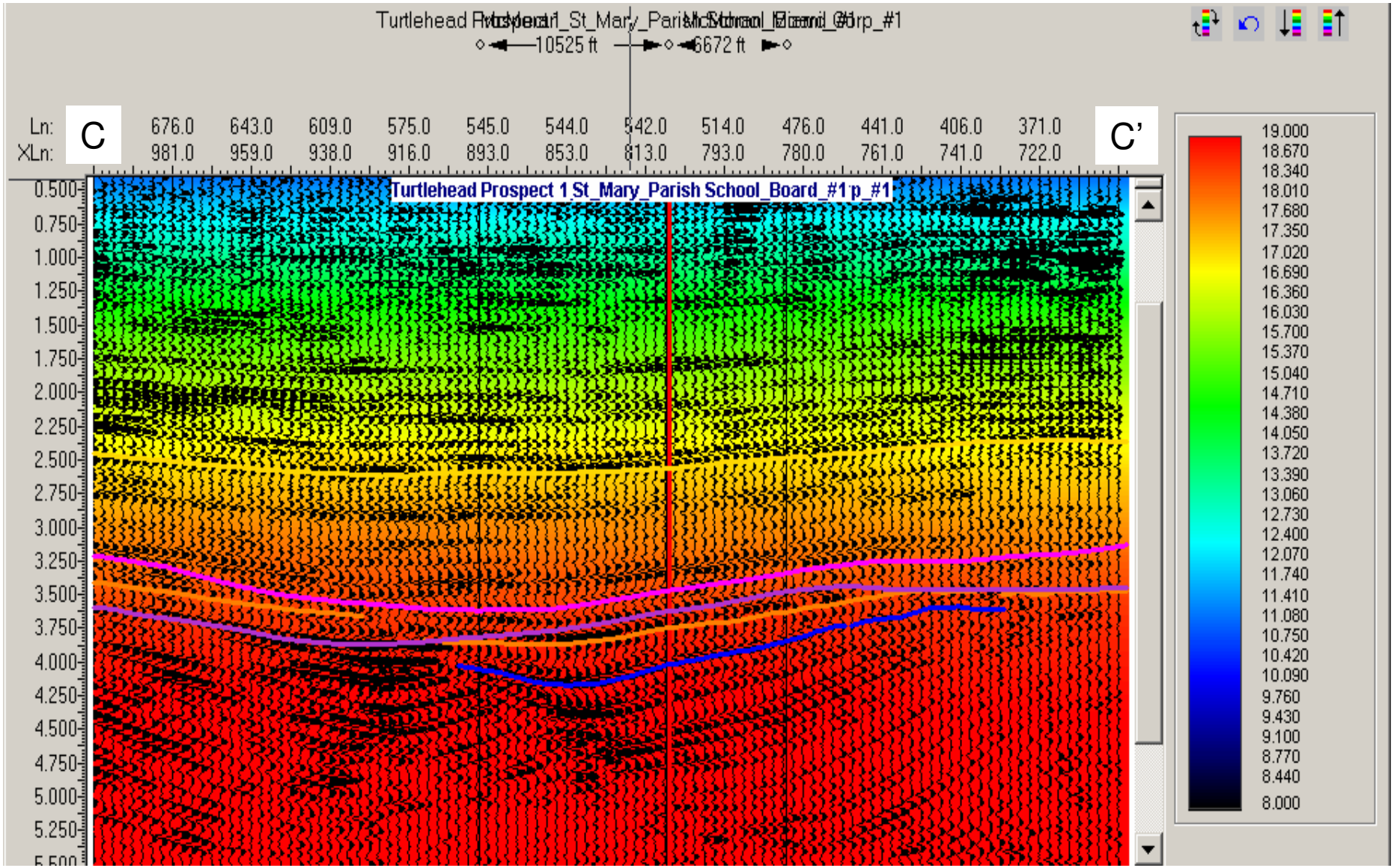
Interval Velocity For Arbitrary Line C-C’

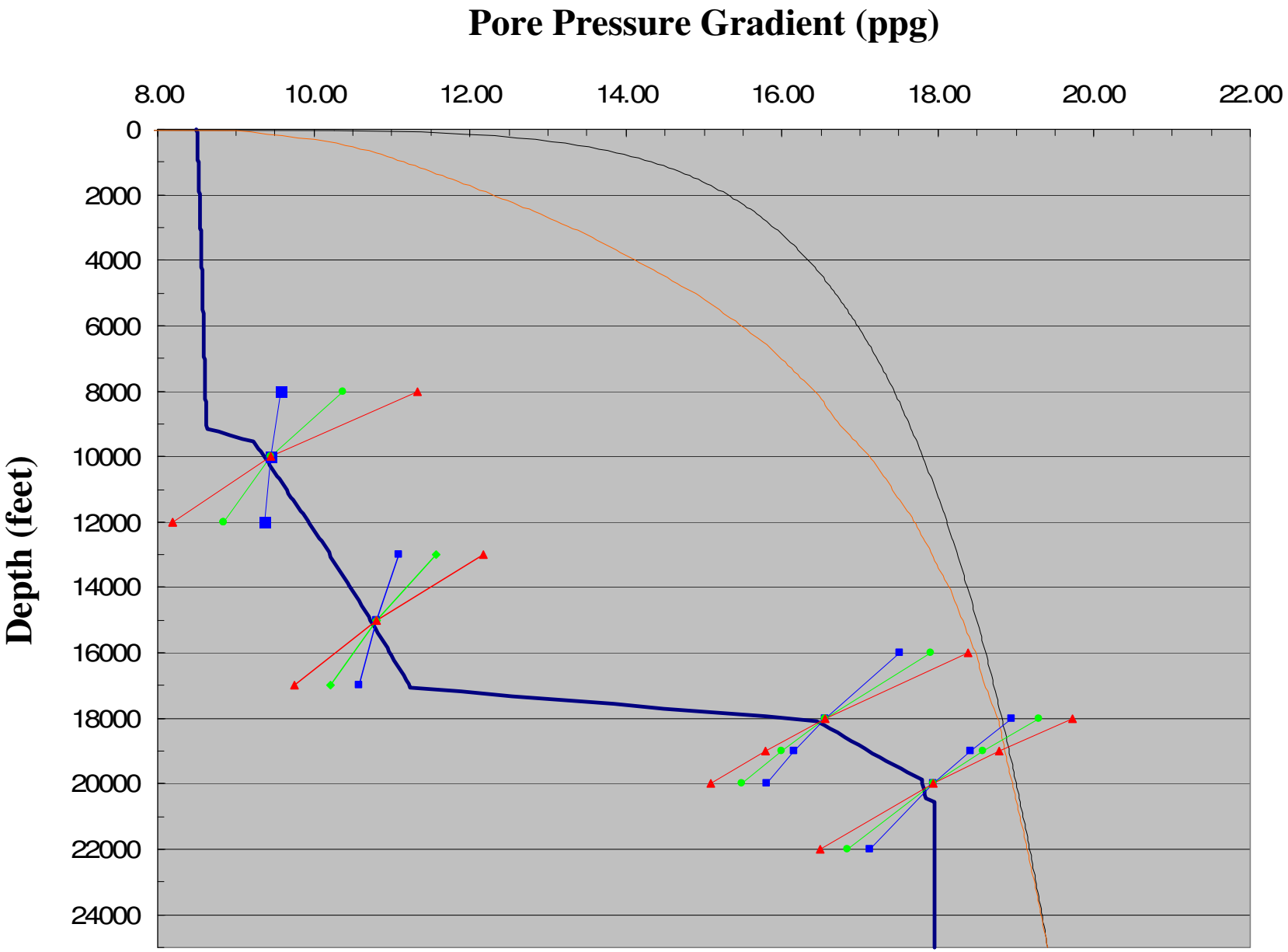


Pore Pressure Gradient For Arbitrary Line C-C’

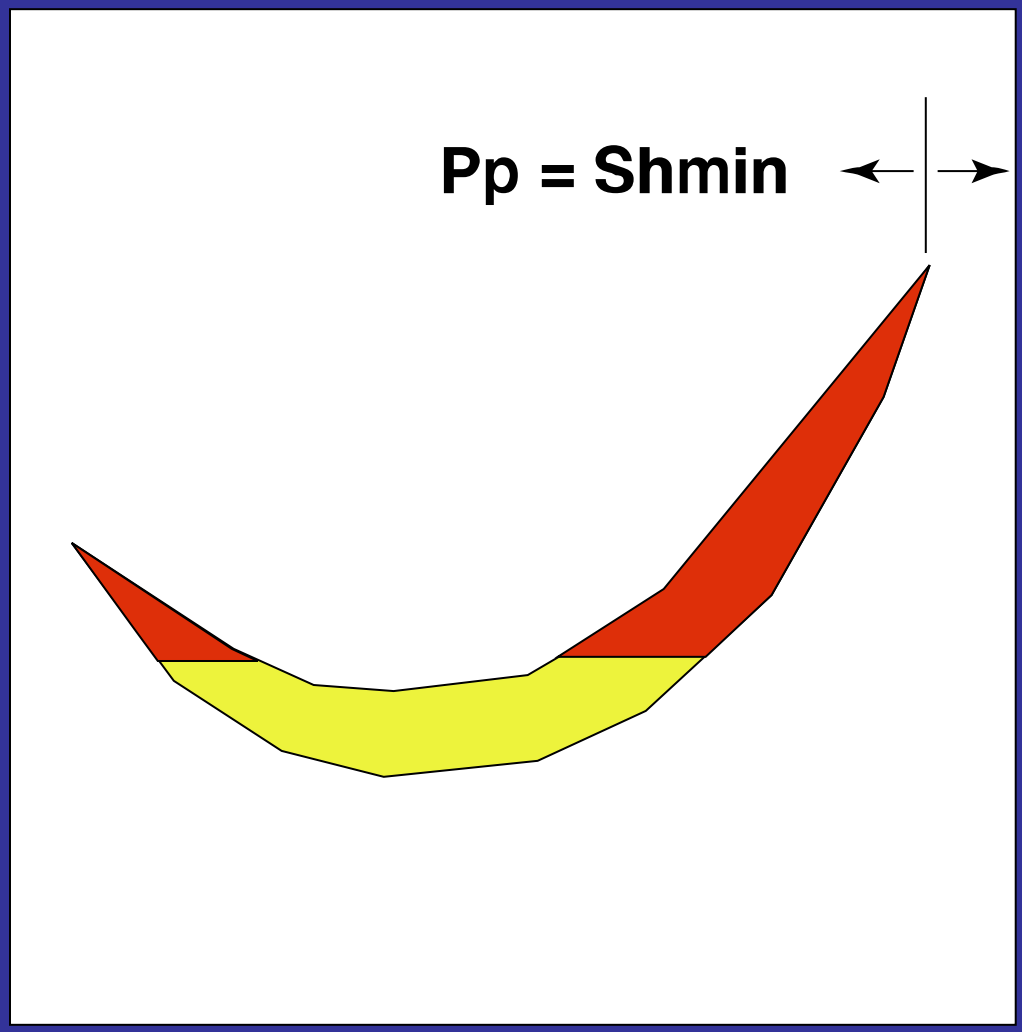


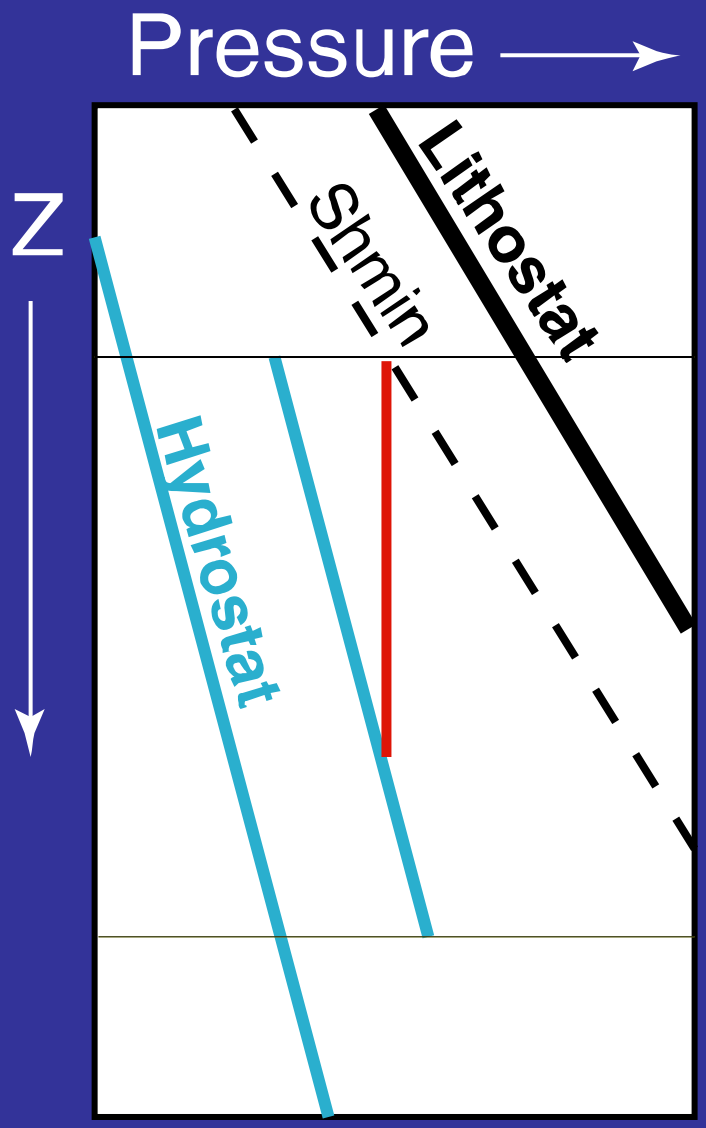
Fracture Pressure Gradient For Arbitrary Line C-C’




Pore Pressure Gradient (ppg)
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
Depth (feet)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000

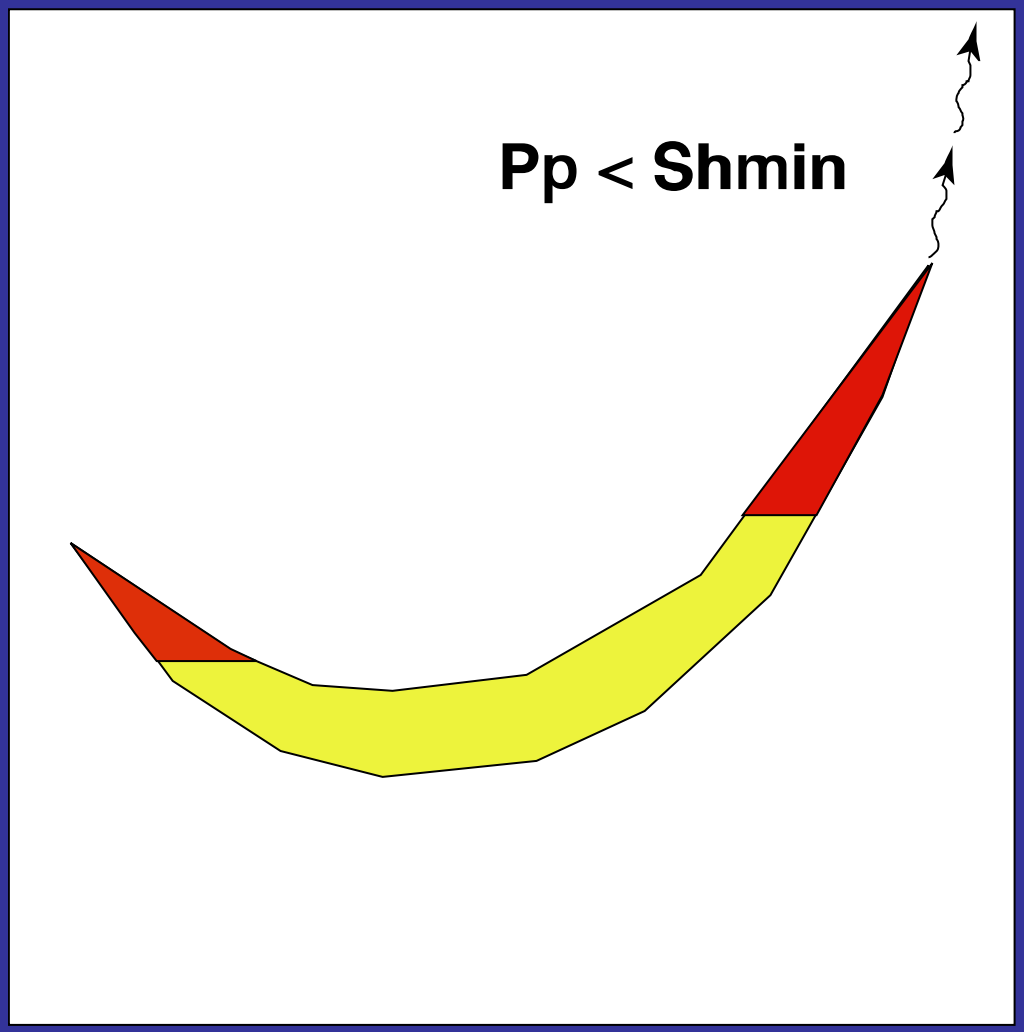
Migration Due To Seal Failure

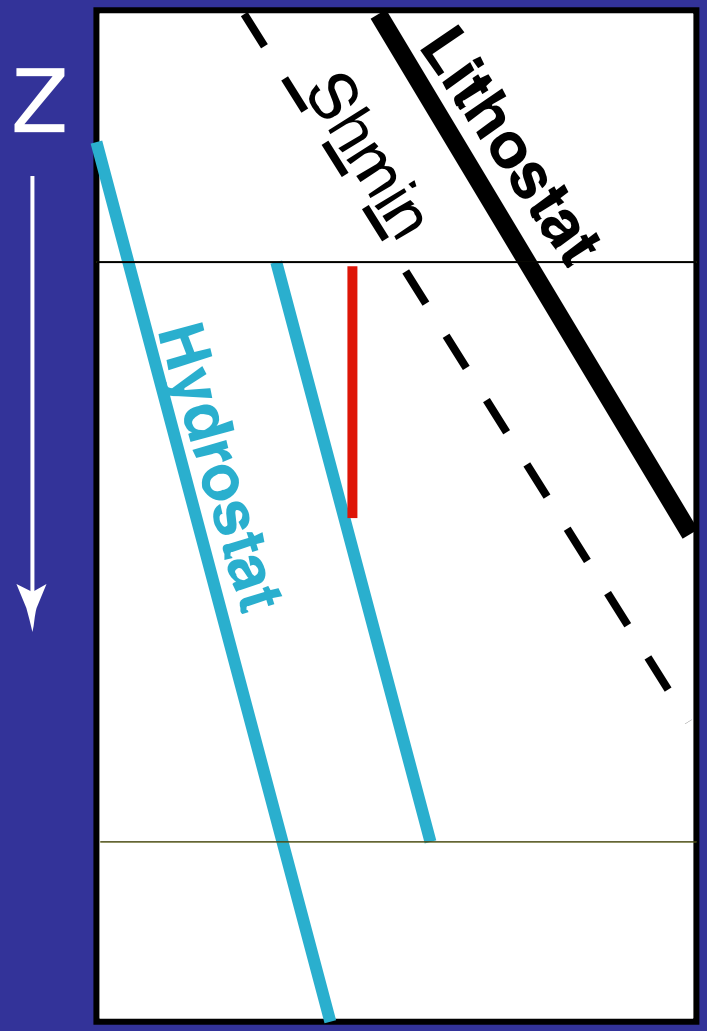




Courtesy of Penn State University

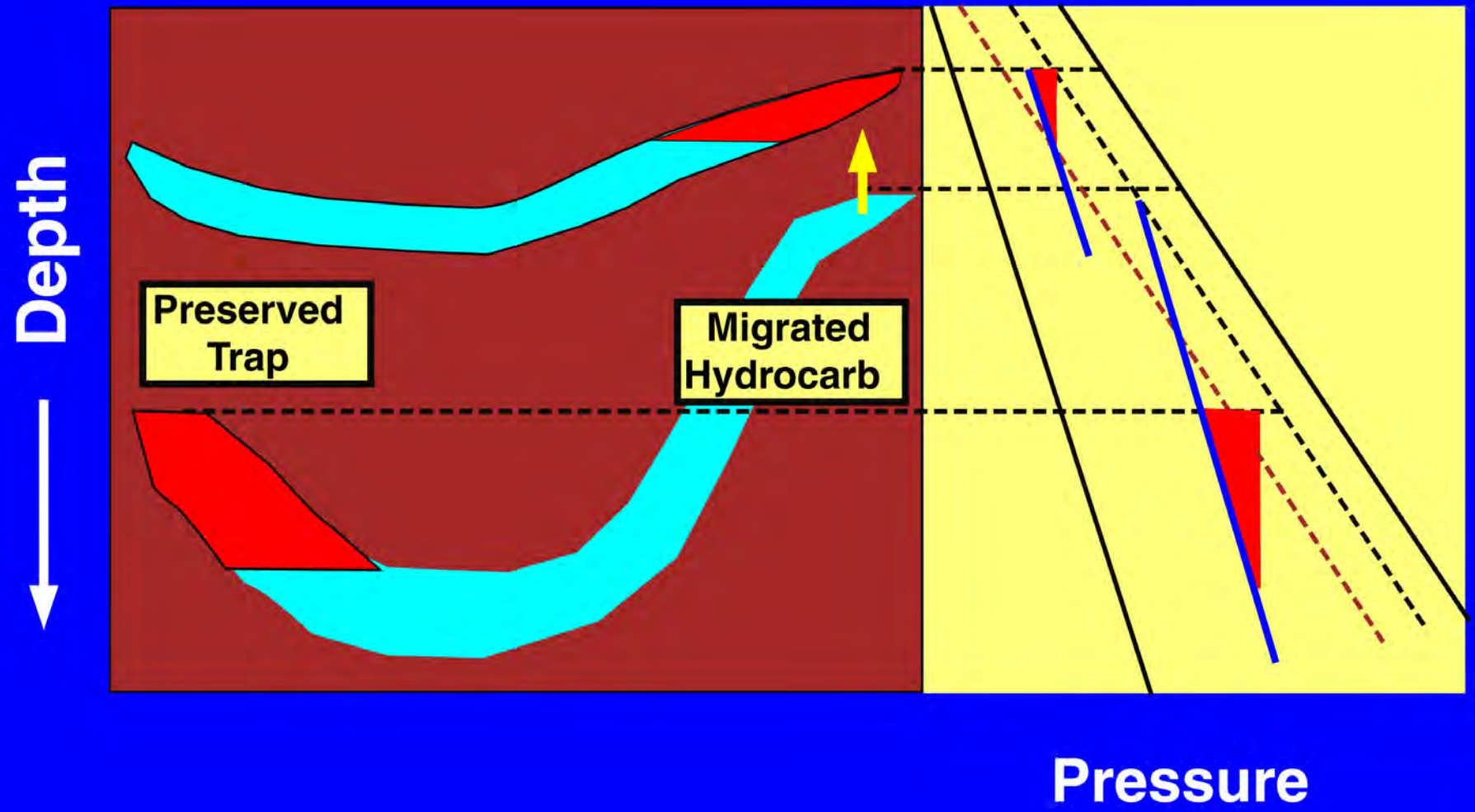
Migration Due To Seal Failure



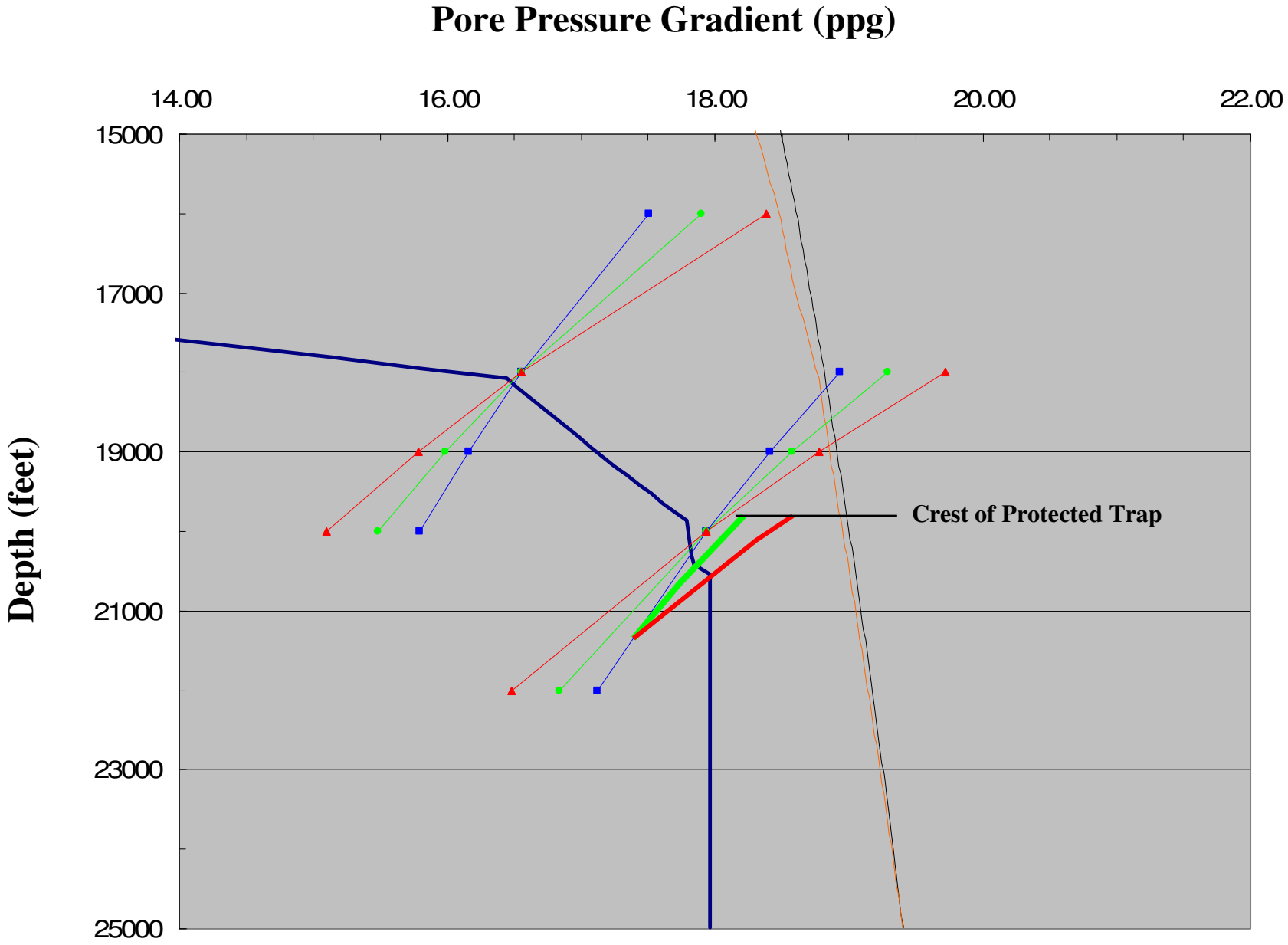


Courtesy of Penn State University

Implications for Secondary Migration and Trap Potential

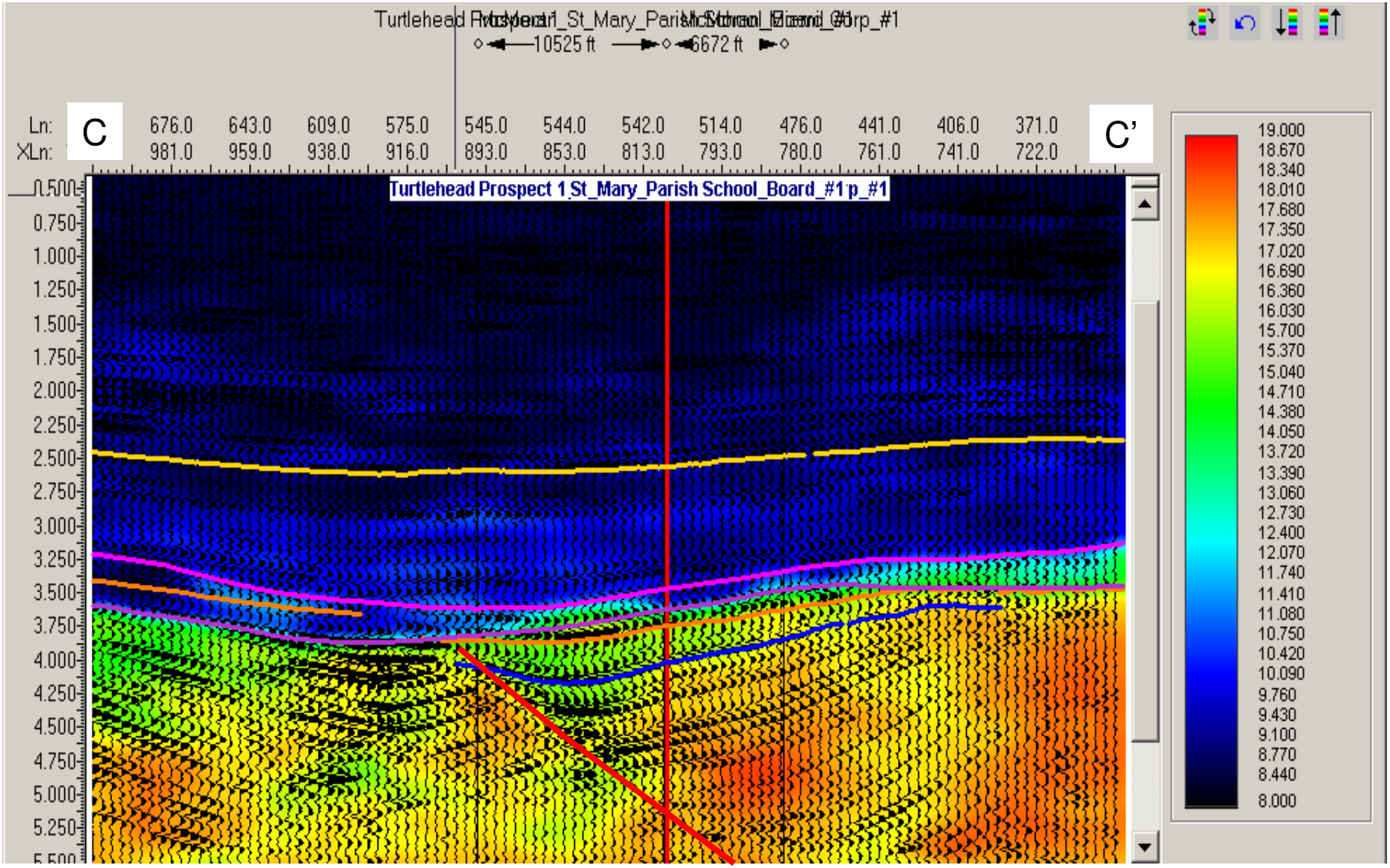


Courtesy of Penn State University

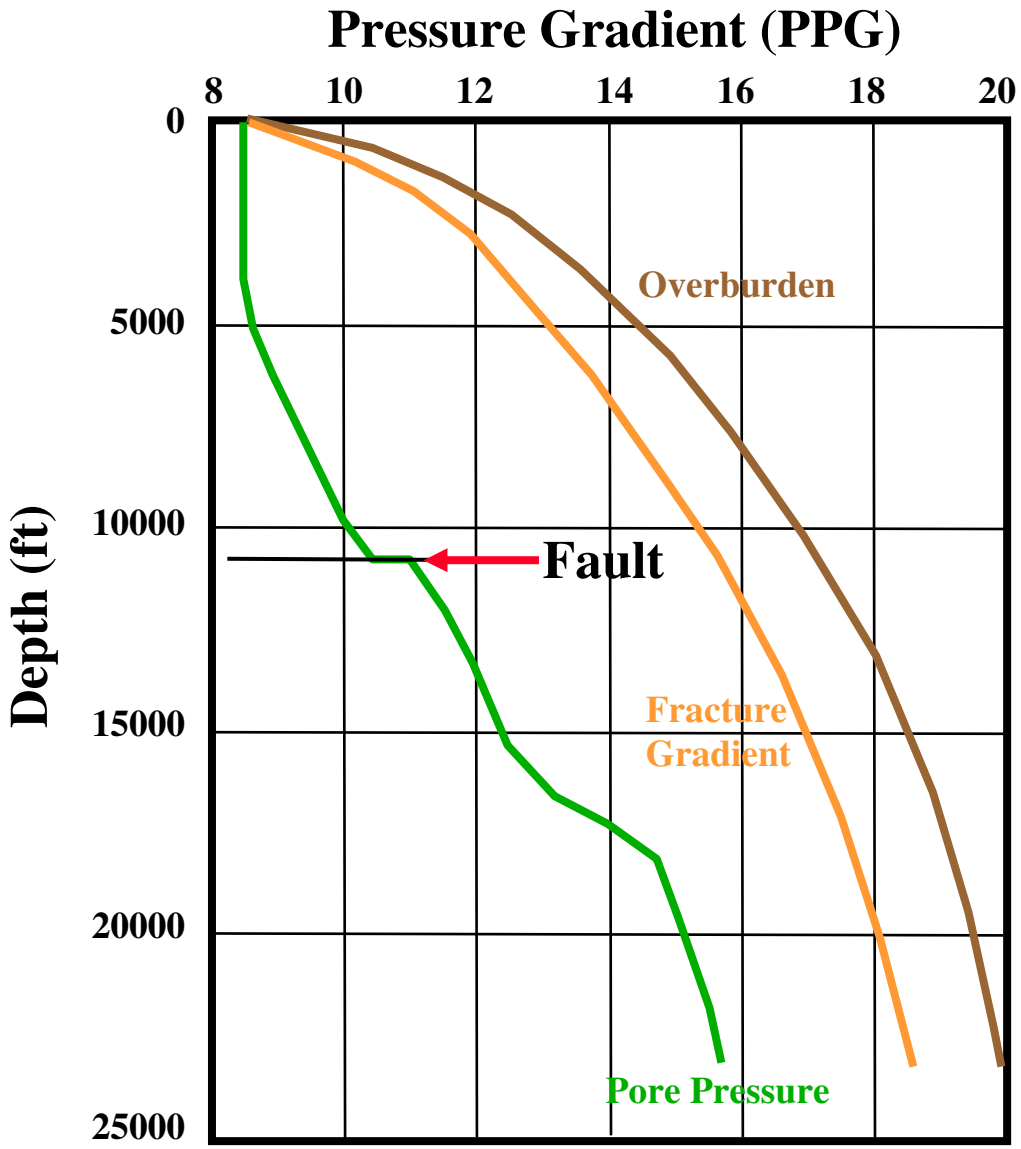


The primary trap has a blown seal, but the lower-relief side of the reservoir still can hold a column

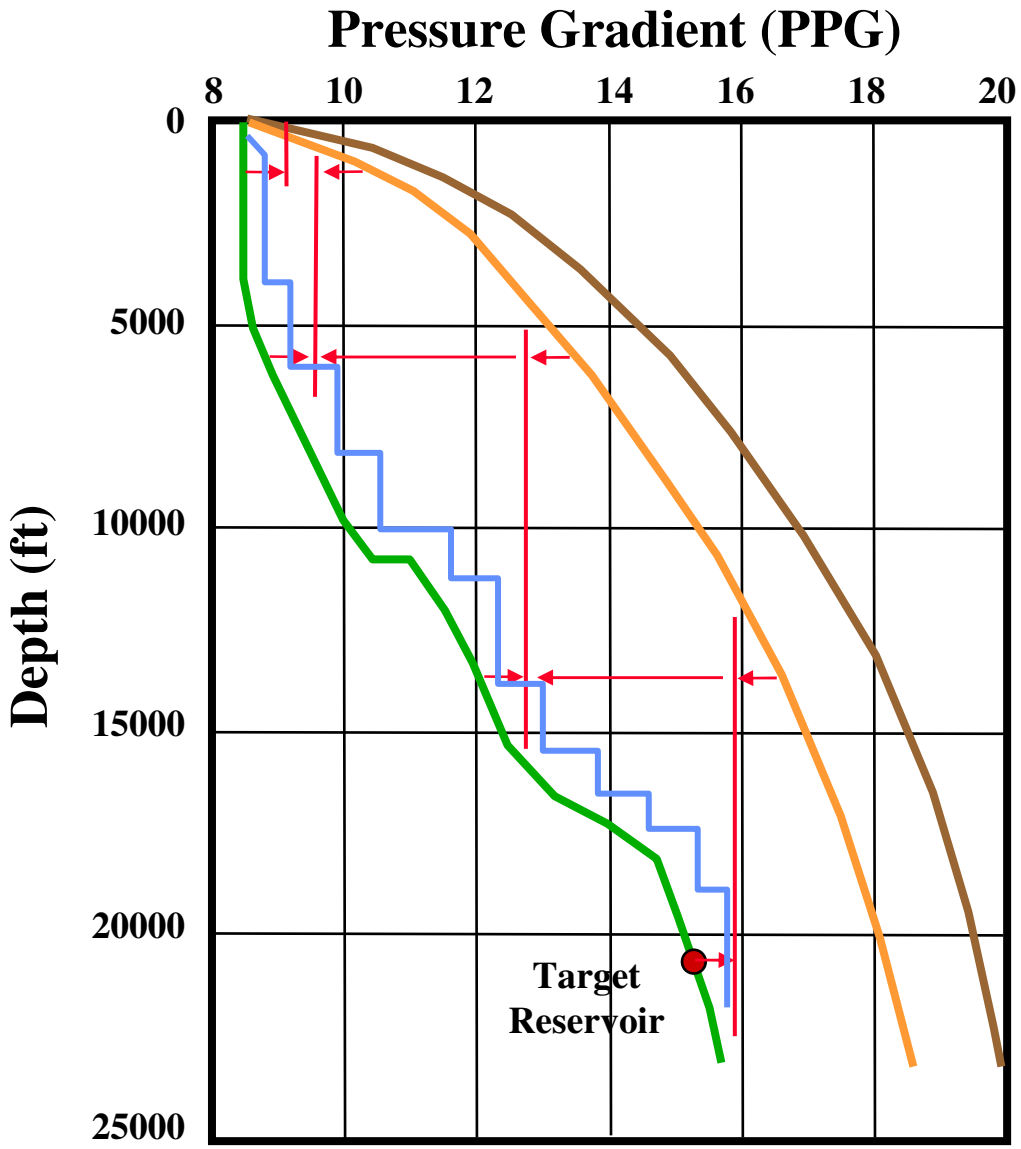
Pore Pressure Gradient For Arbitrary Line C-C’



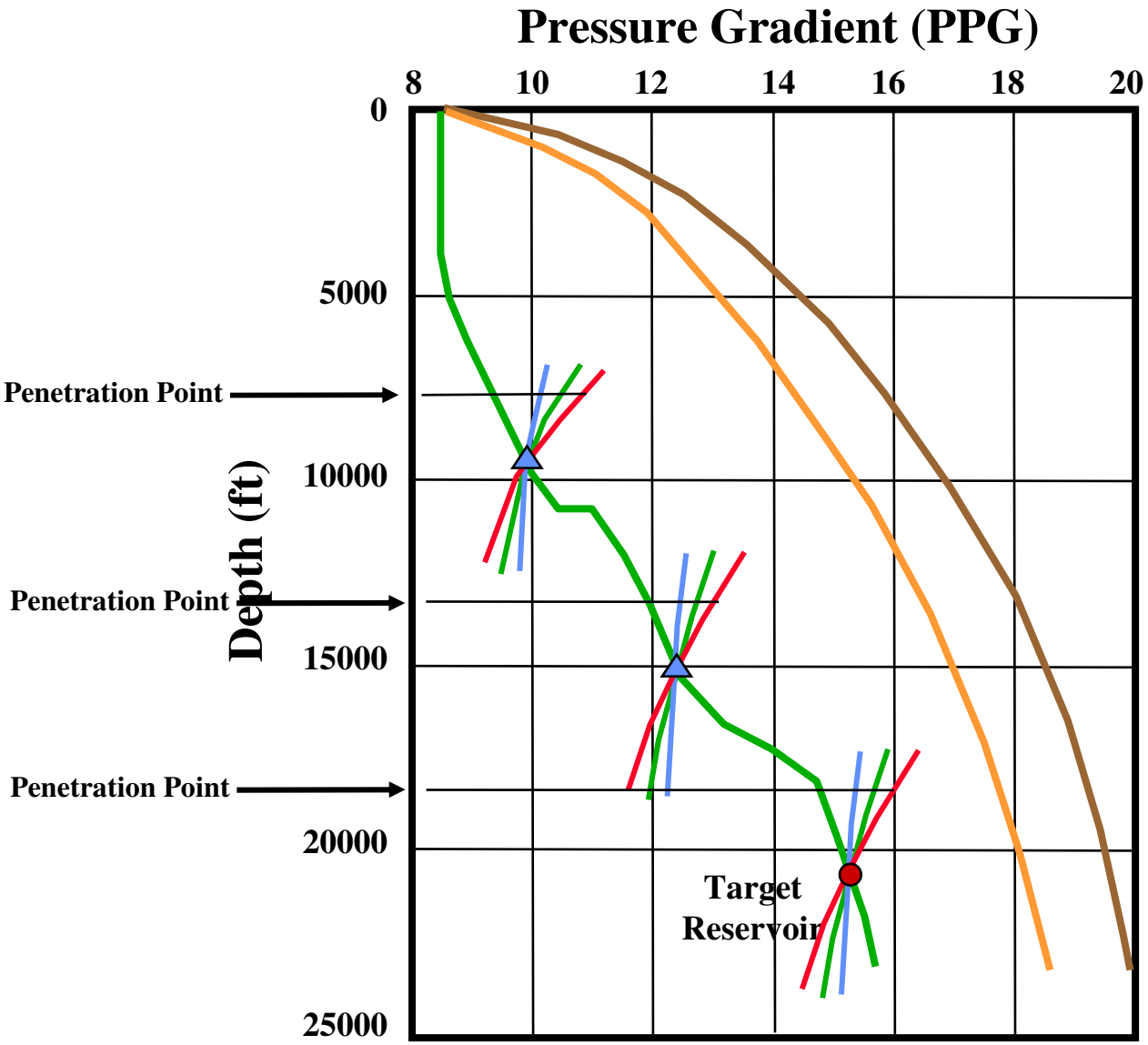
Predicted Pore Fluid and Fracture Pressures in Casing Program Design



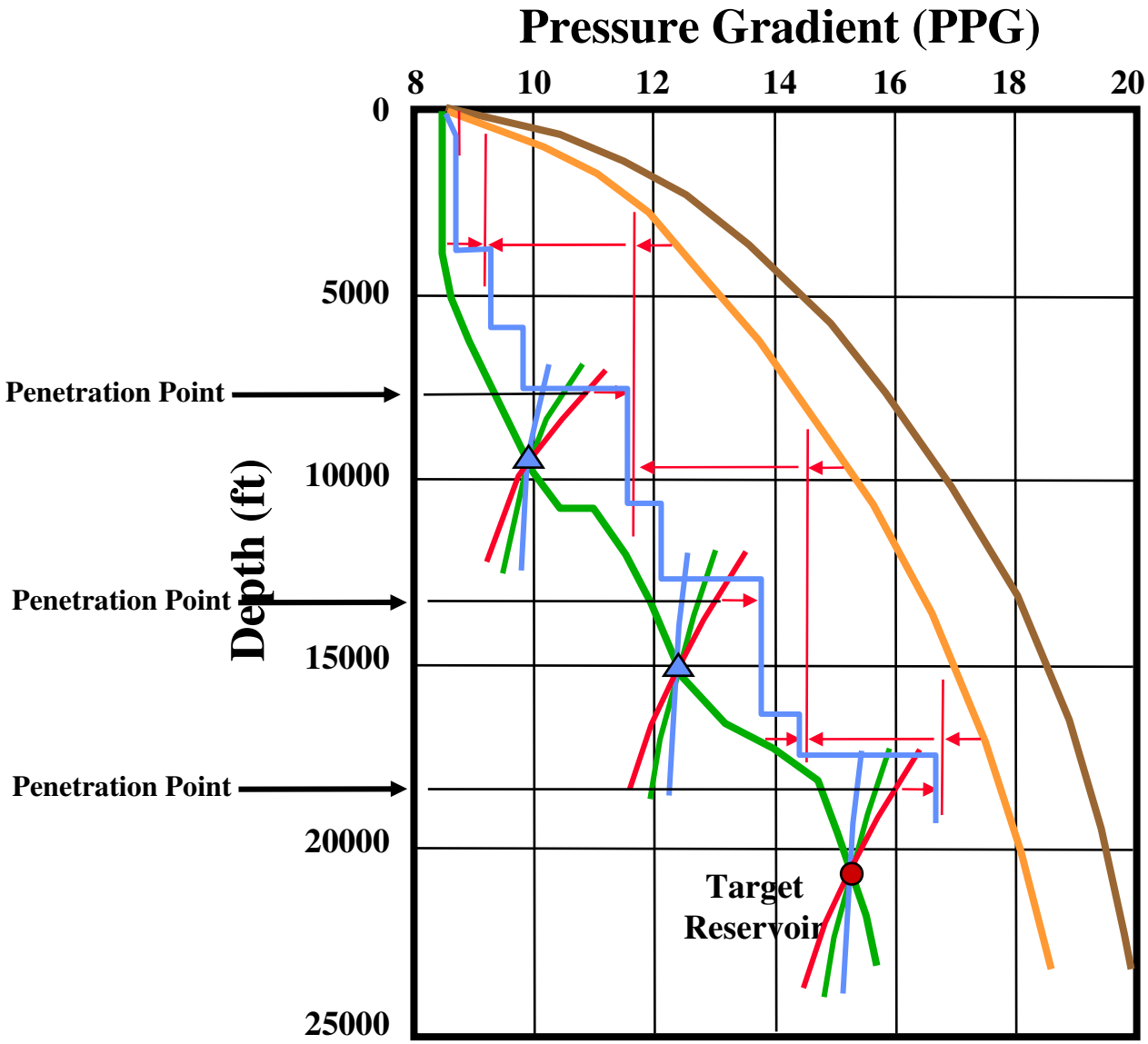
Predicted Pore Fluid and Fracture Pressures in Casing Program Design (Shales Only)



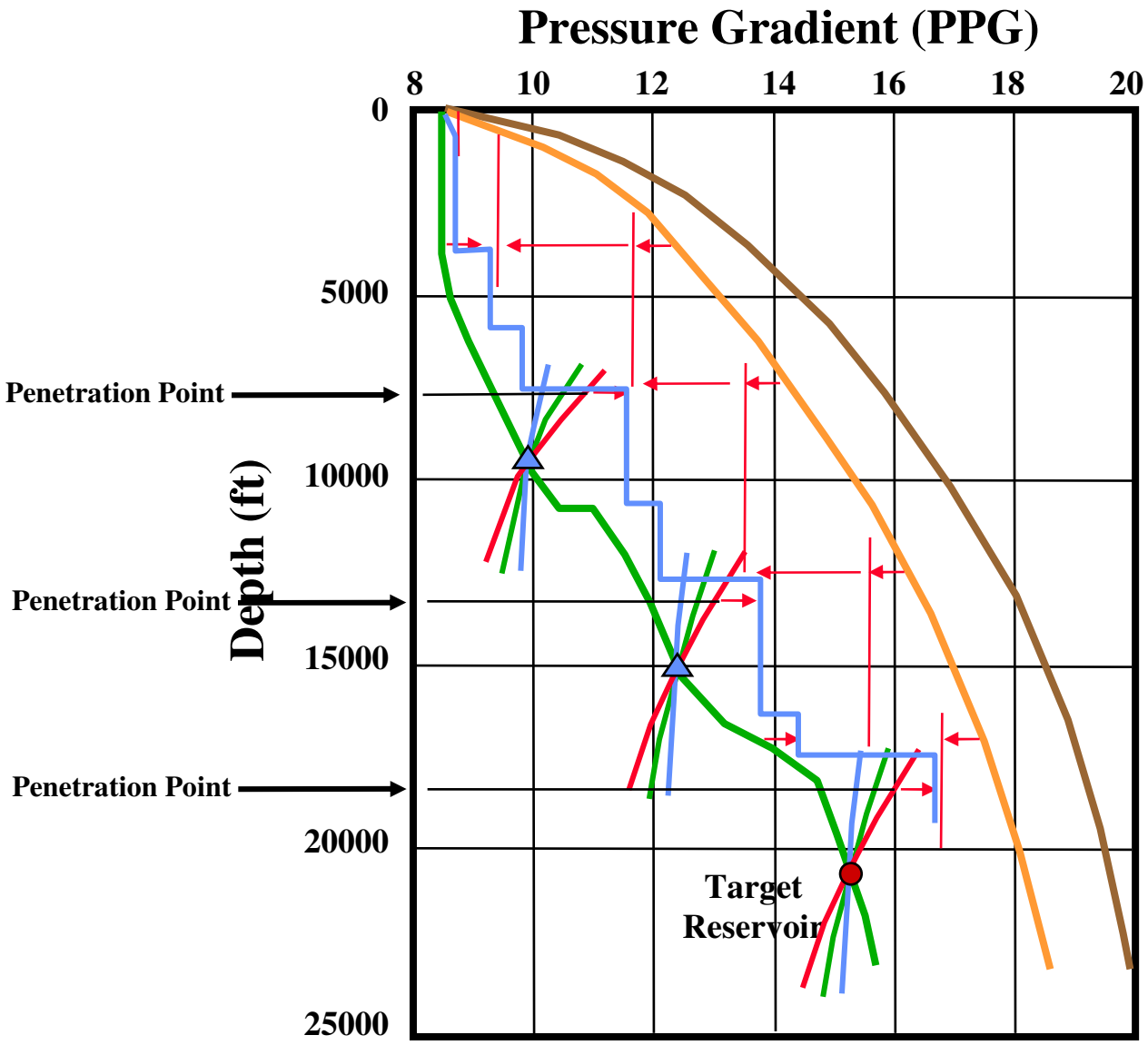
Predicted Pore Fluid and Fracture Pressures in Casing Program Design (Sands Included)



Predicted Pore Fluid and Fracture Pressures in Casing Program Design (Minimum Plan)



Predicted Pore Fluid and Fracture Pressures in Casing Program Design (Conservative Plan)



Closing Thoughts

- **Reservoirs exist in pressure balance with their surroundings, so a robust prediction of shale pressures is the first step in accurate prediction of reservoir pressures**
- **Large reservoirs, when structured, can become conduits for lateral transfer of fluids in the subsurface that can create or destroy a prospect**
- **There is a direct relationship between the drilling window and the structural height of reservoir that can hold a seal**
- **Robust prediction of reservoir pressures requires accurate maps of the entire reservoir and full integration with DHI analysis and depositional systems analysis to determine reservoir connectivity**
- **Shallow reservoirs can become major drilling hazards if they are connected to deep highly-pressured rocks that have blown seals**
- **The selection of what depth to penetrate a reservoir MUST take into account the basic physics of reservoir behavior or the results can be very unpleasant**


WE MUST STAY HUMBLE, OR NATURE MAY PUT US IN OUR PROPER PLACE
Photo Courtesy of Wild Well Control Inc.