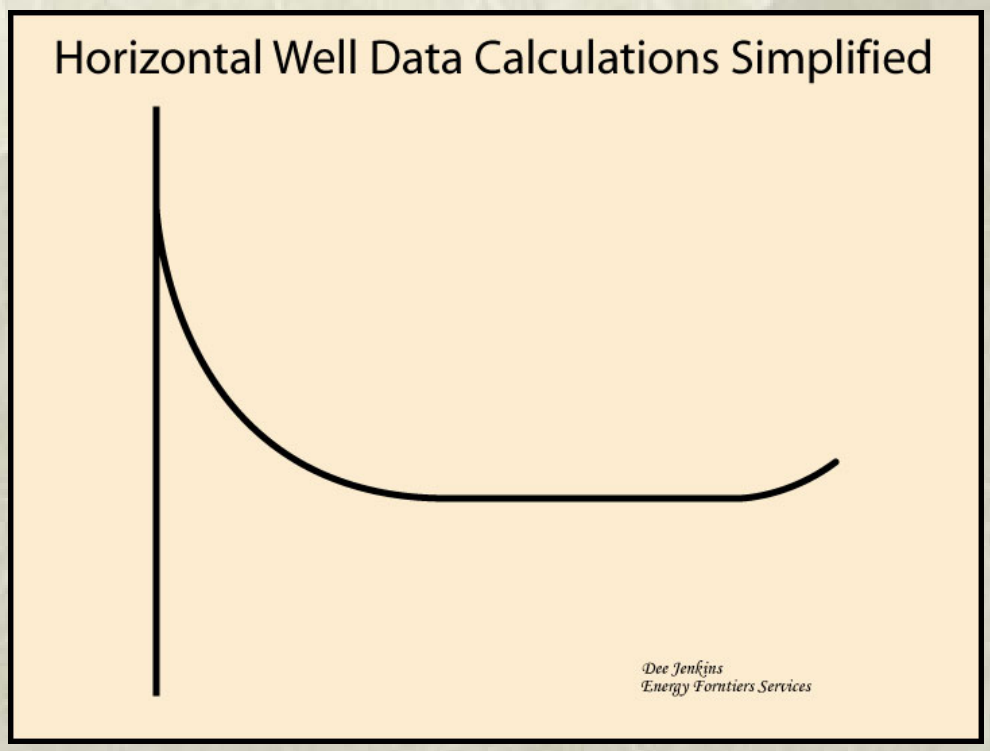
A Short Set of HNAV Examples

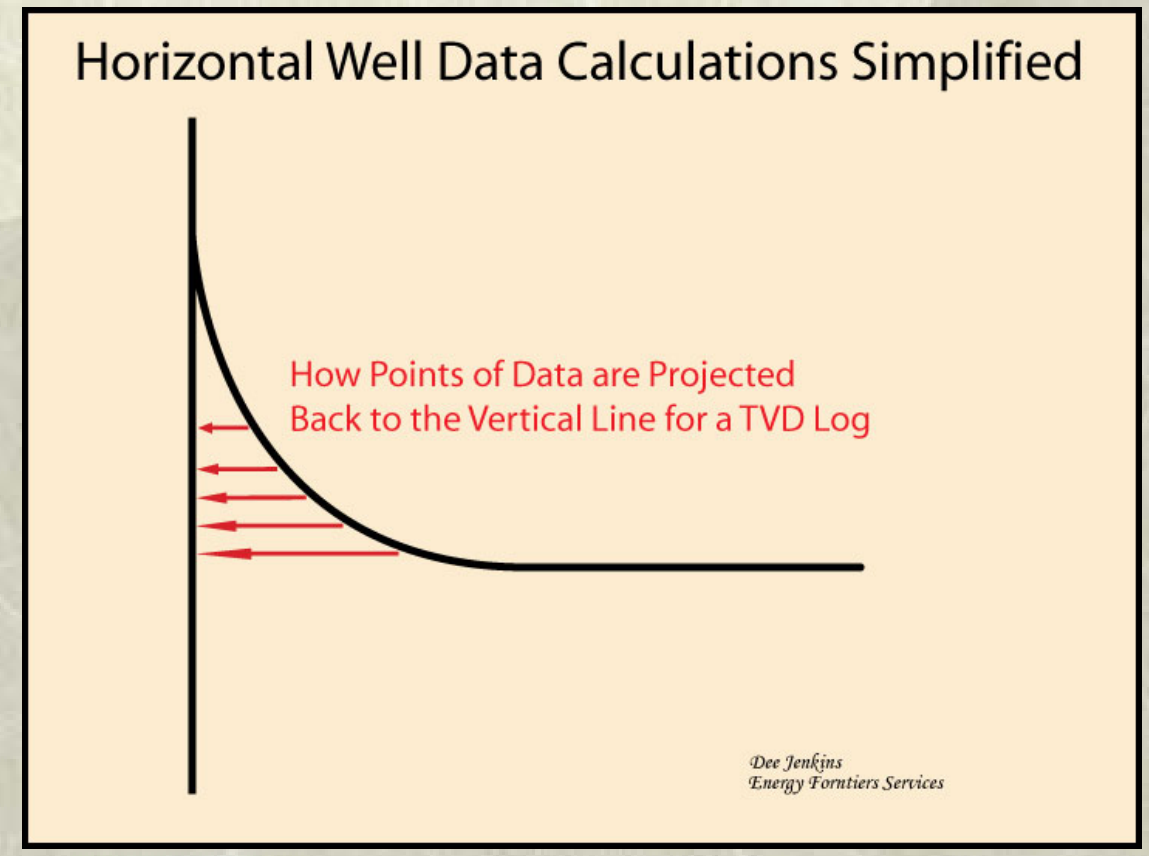
Why Geo-Navigation is Important in Your Every-Day Horizontal Wells

Let Us Begin with Some Basics



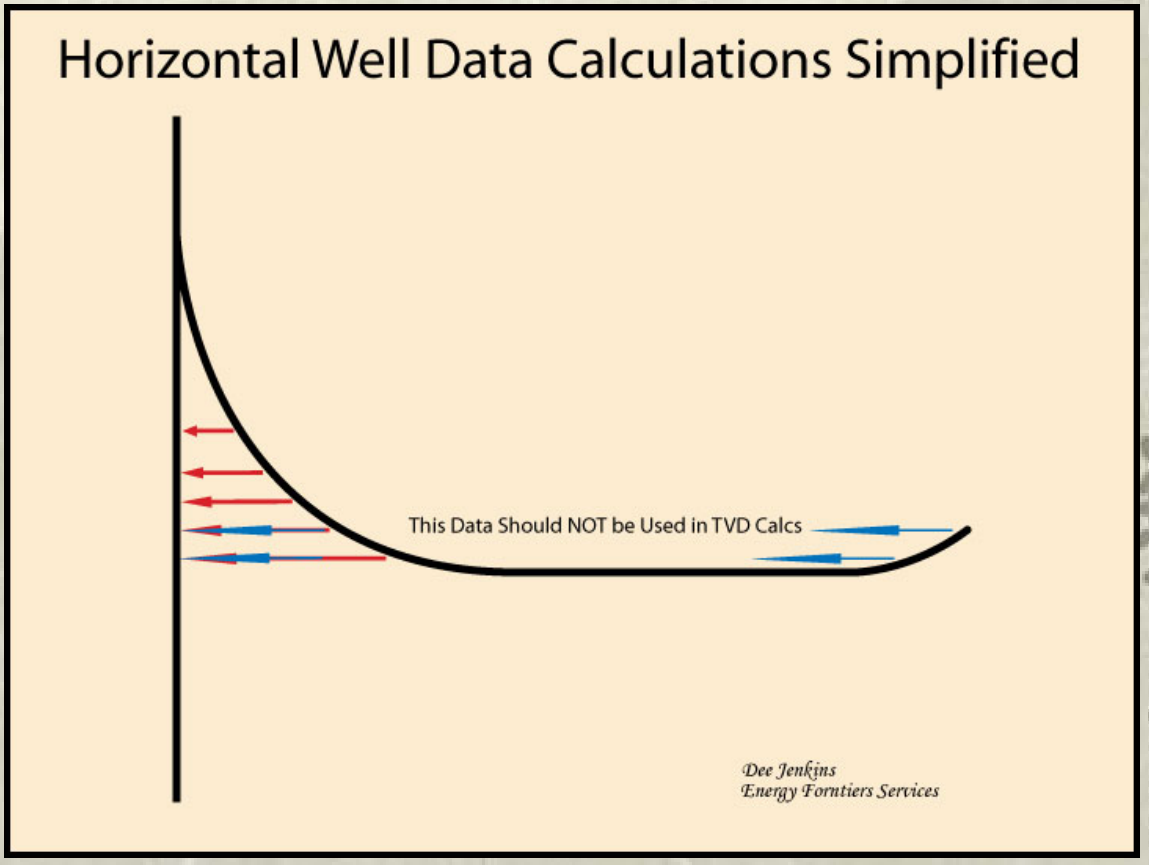
- A Vertical Pilot Hole and Lateral with a “Hook” at the End

How Most People Construct a TVD Log



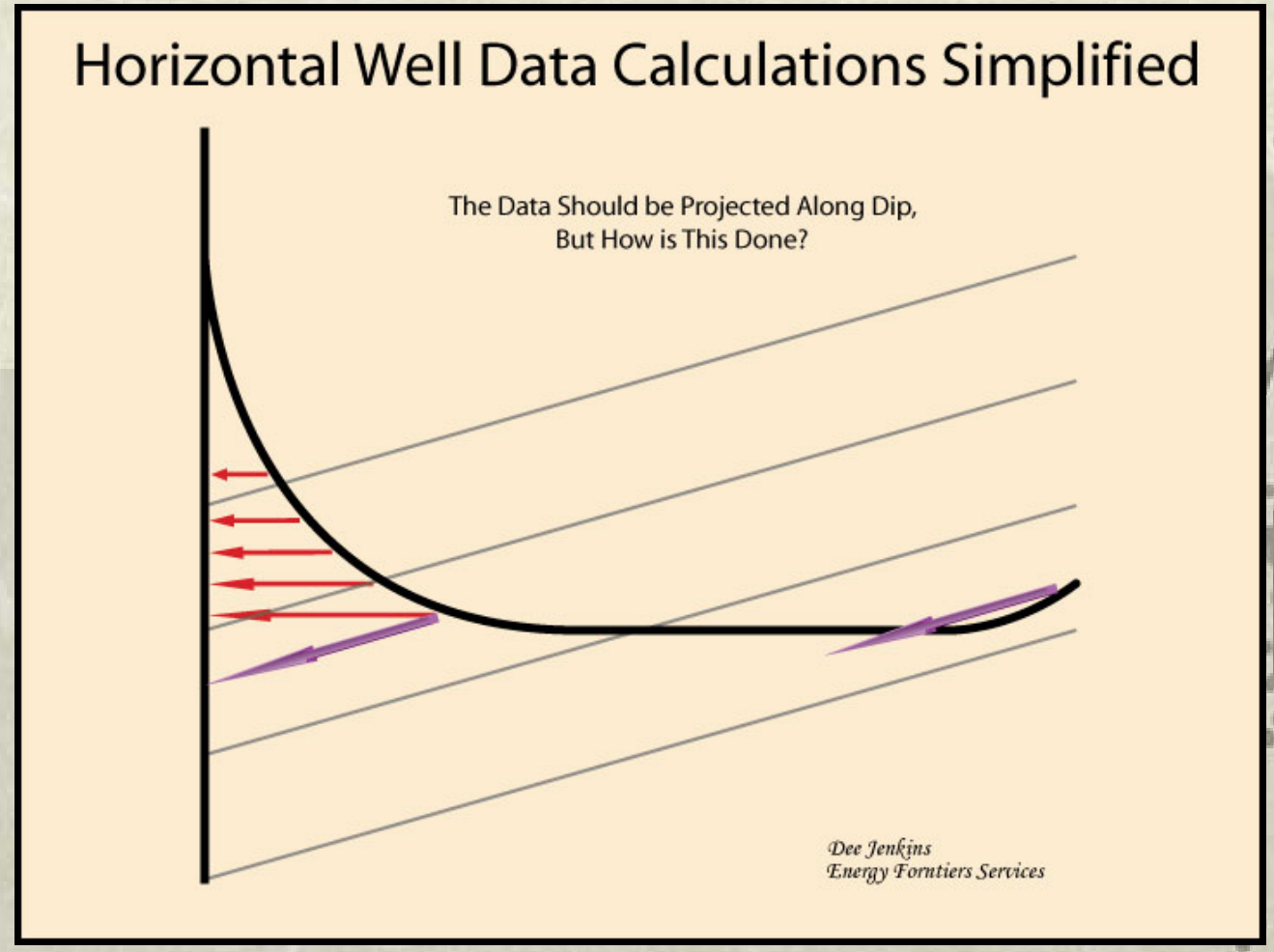
- Points in the Curve are Projected into the Vertical

Limitation of TVD Logs in a Repeated Section



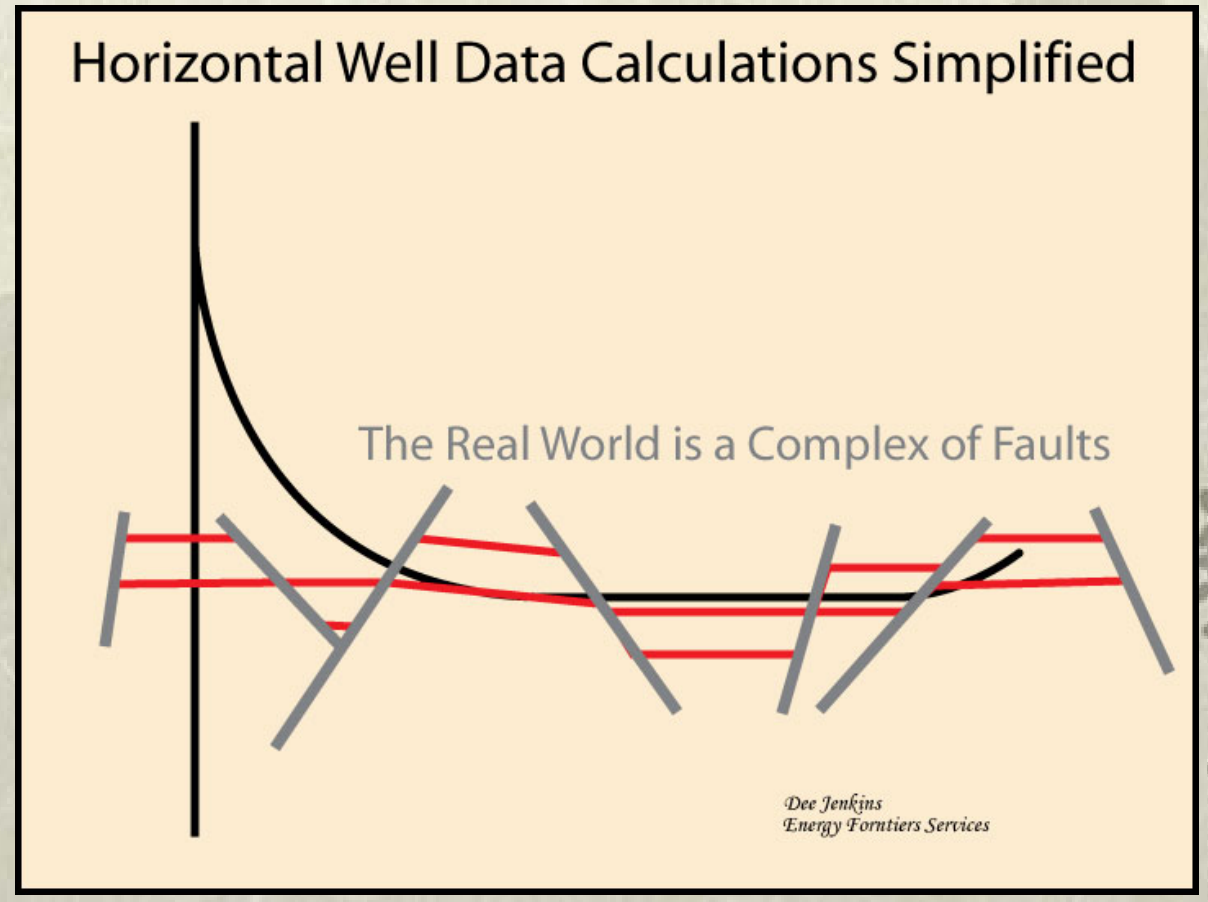
- Notice the Blue Arrows WOULD Overlay the Red
- These Points of Data are NOT Normally Included

Our Log Needs a Correction for Dip



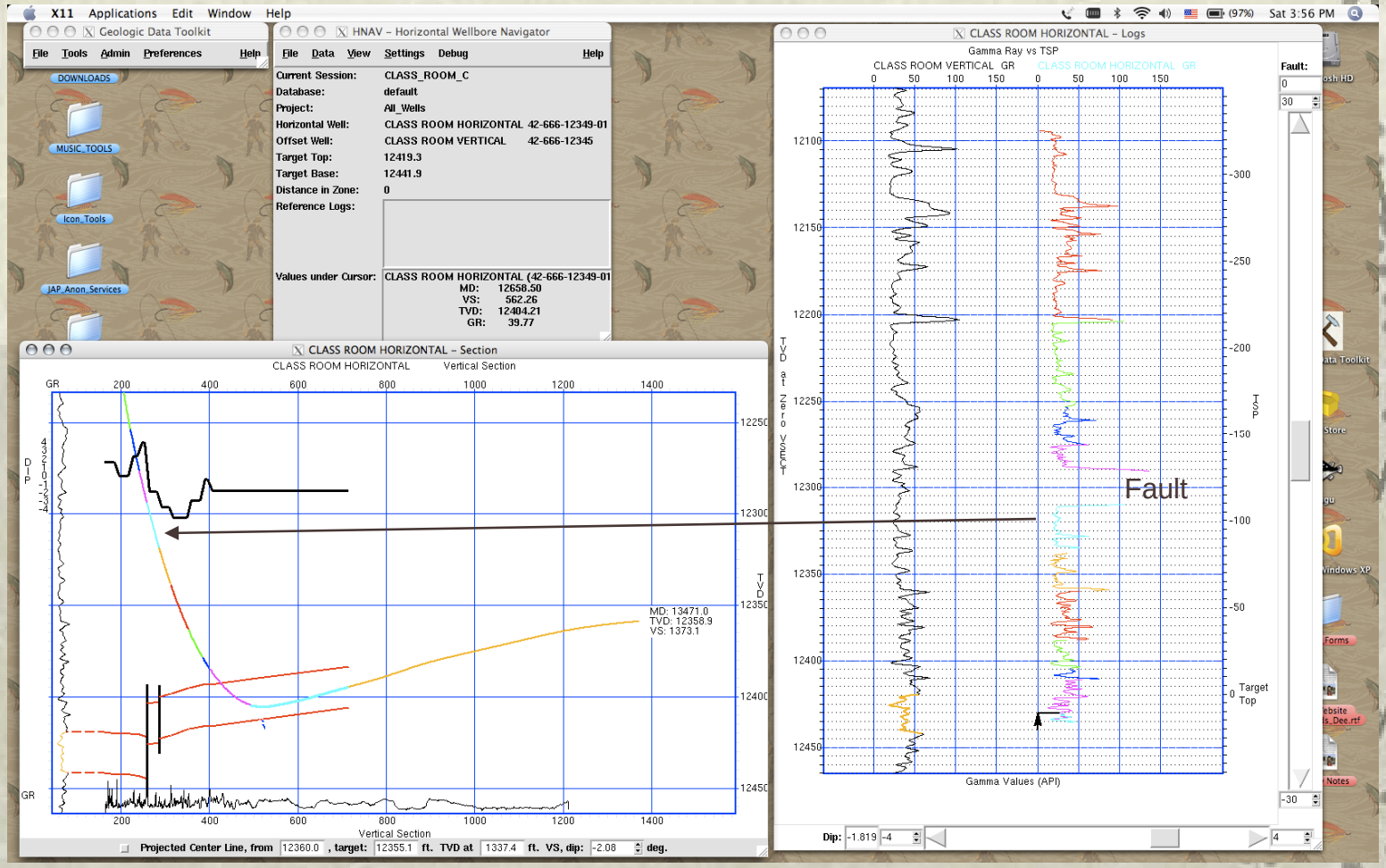
- Data SHOULD be Projected Back Along Dip
- How do We Decide What is the Correct Dip?
  - The Answer lies in Finding Correlable Horizons

Our Application Will Tell Us the Real Story and Define Dips and Faults



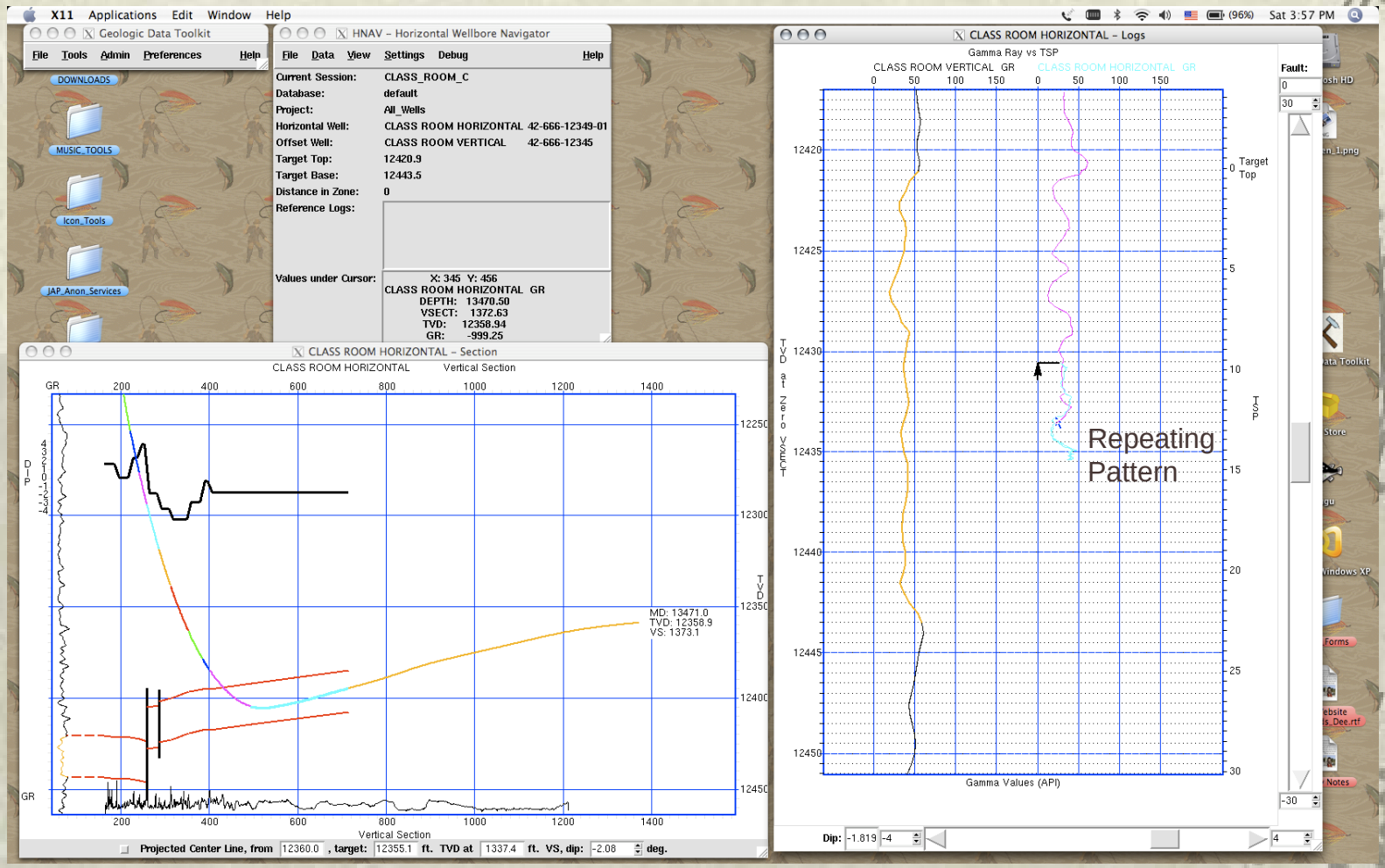
- Let the Data "Speak" to Us with a Data Visualization Tool

How Our Software Looks



- We Can Zoom in Any Window
- The Repeating Section at the Start of this Well is Very Important Because it Gives an Accurate Dip
- The Colored Segment on the Log is the Same Piece as on the Section

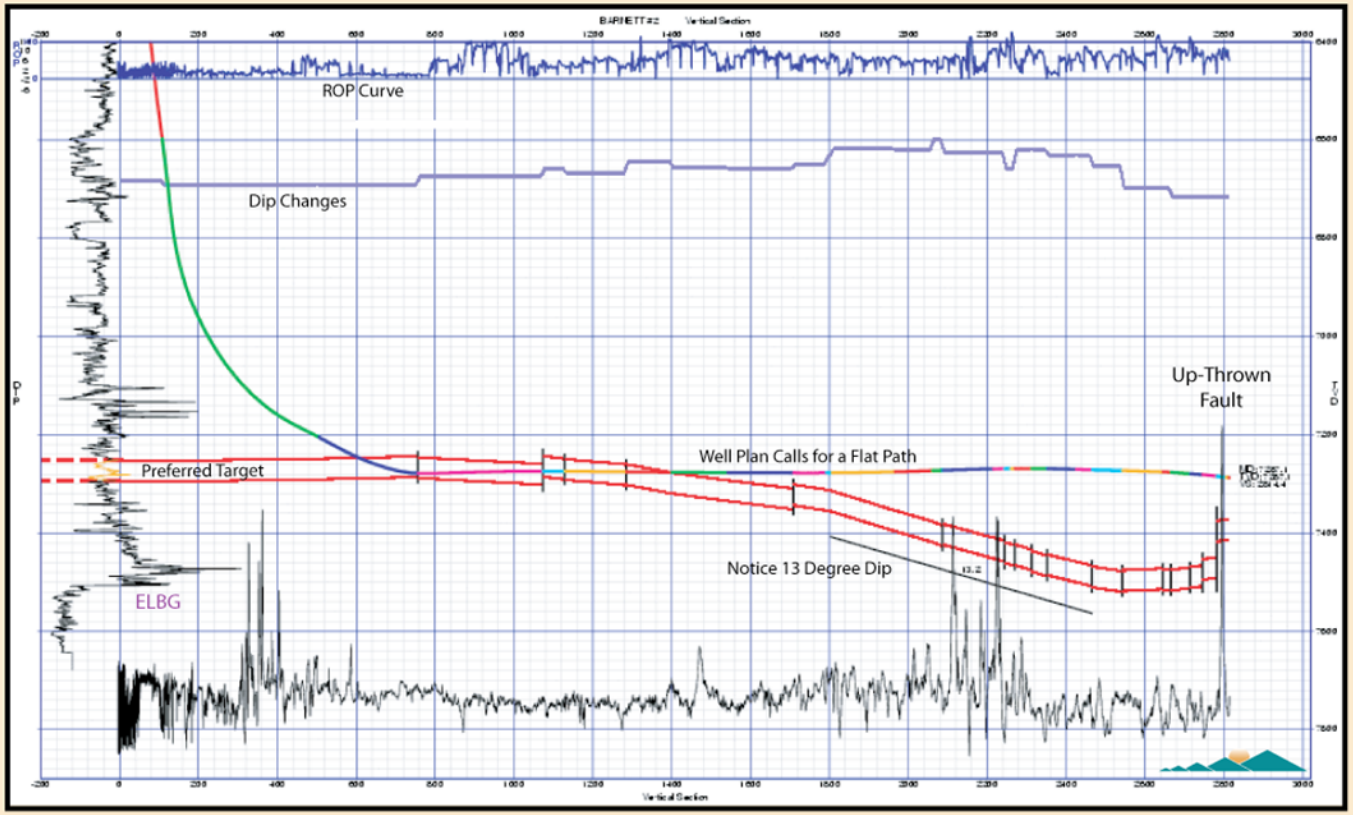
How Our Software Looks



- Section View and Log View with Control Mouse Driven Pop-Up Menu
- Notice the Repeating Section on the Log Where the Well “Loops” Through the Strata

A “Live” Example

Barnett Shale Example



Cross Section View
Horizontal Traverse Through Section

- Following Post-Drill Appraisal,Operator Initiated “Live” Navigation on All Wells
- This Well was a Success for Four Sevens - Did not Drill Too Far, Did Not Cone Water, Good Rate of Production

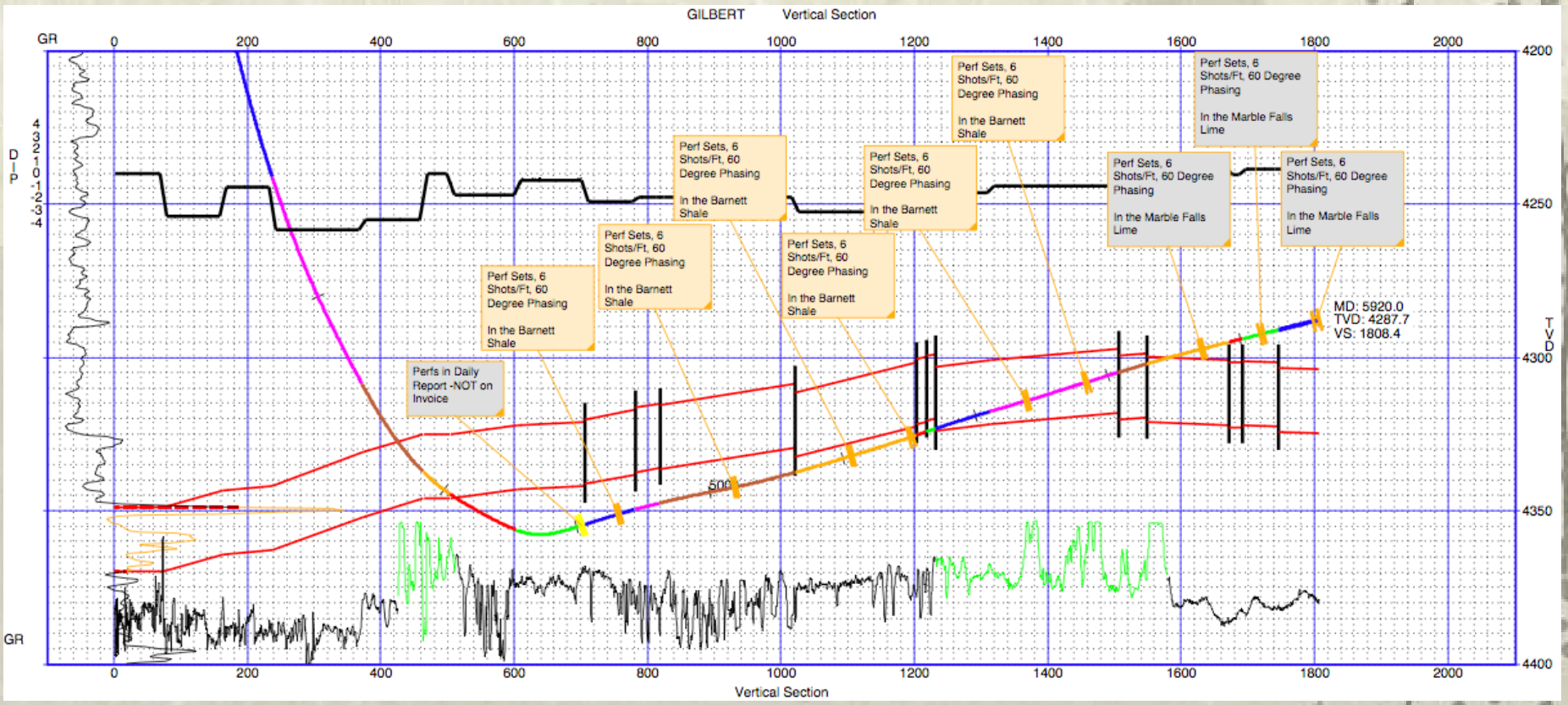
"Life is Harsh"

- Your Geo-Navigation Shouldn't Be

Another Operator's Lessons in Parker, Palo Pinto, and Erath Counties, Texas

- Small Investor Funded Public Company
- Drilled $15 MM Worth of Hz Wells (4)
- Have 1 Producer
- History:
  - Started with Gilbert 1 H Interpretation
  - Did Post-Completion Evaluations on All Other Wells
  - Remediation and Redrills Justifying Round II of Financing

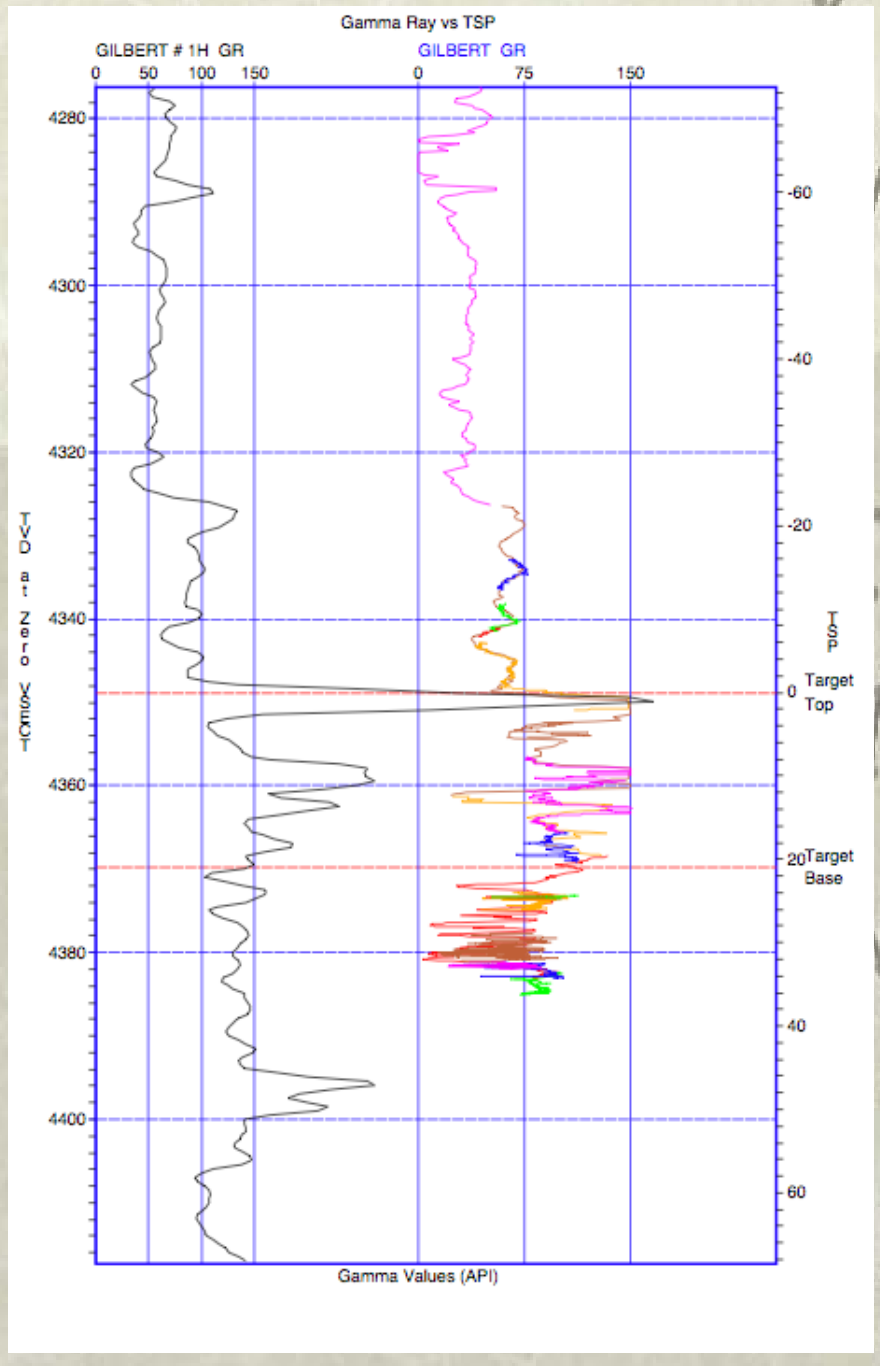
Gilbert 1H Example



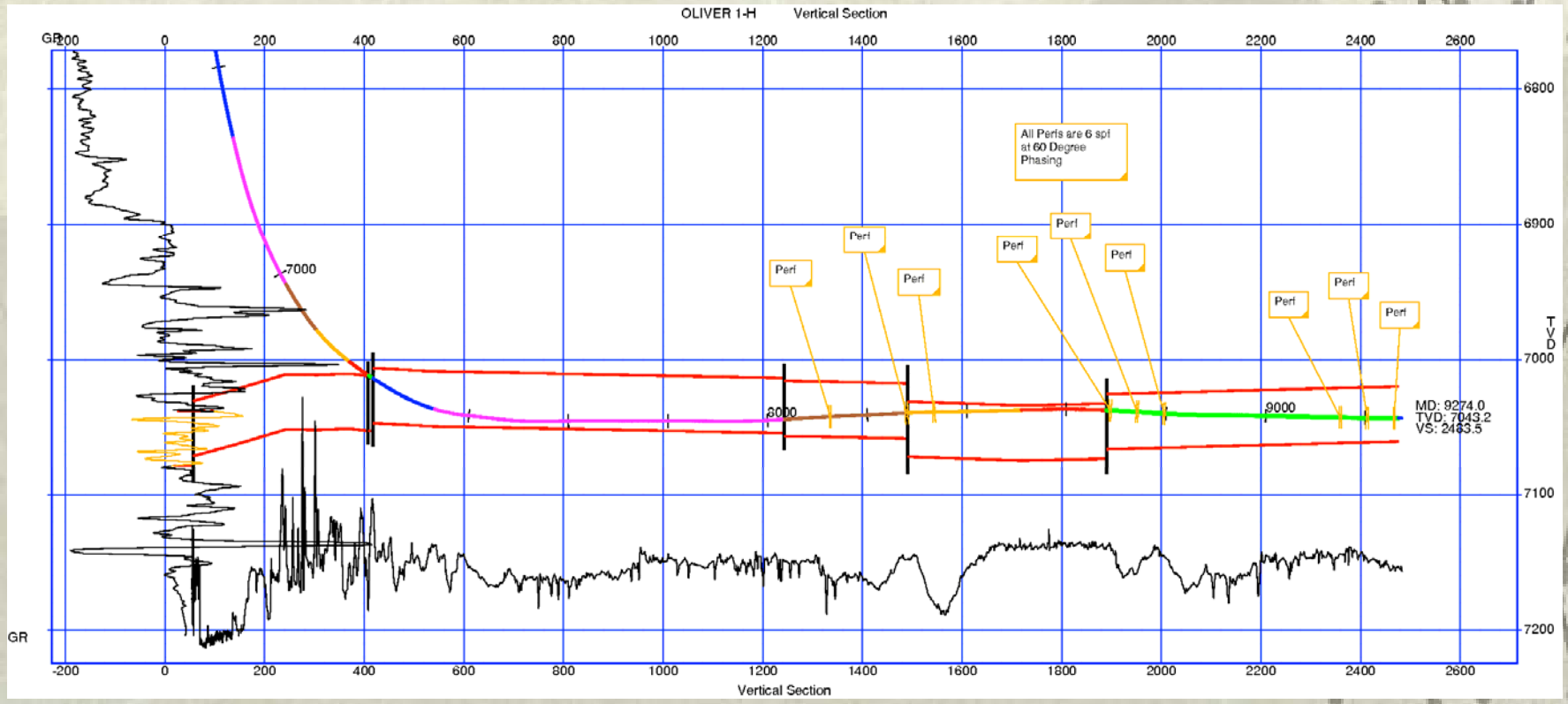
- Produced Gas with Slugs of Water Until Well Loaded Up - Note Well is in Marble Falls and has Perfs on the Faults

Gilbert 1H Logs Let's Review:

- We Build a TSP Log that Correlates to an Offset Log or Pilot Hole
- Take Small Segments & View Them at a Low Angle
- OR, Shift Them Up & Down for Faults
- Match Them to the Pattern on the Offset Log

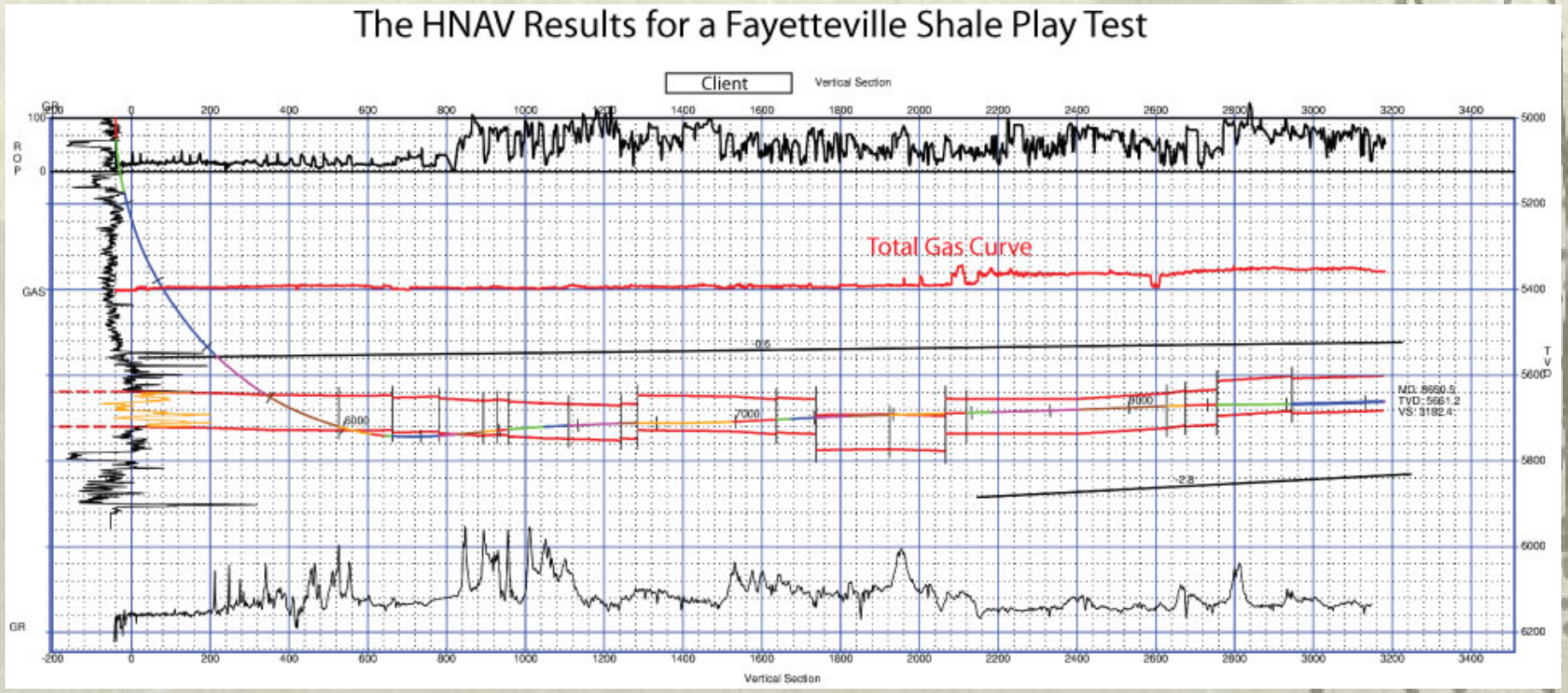


Still Another Barnett Example



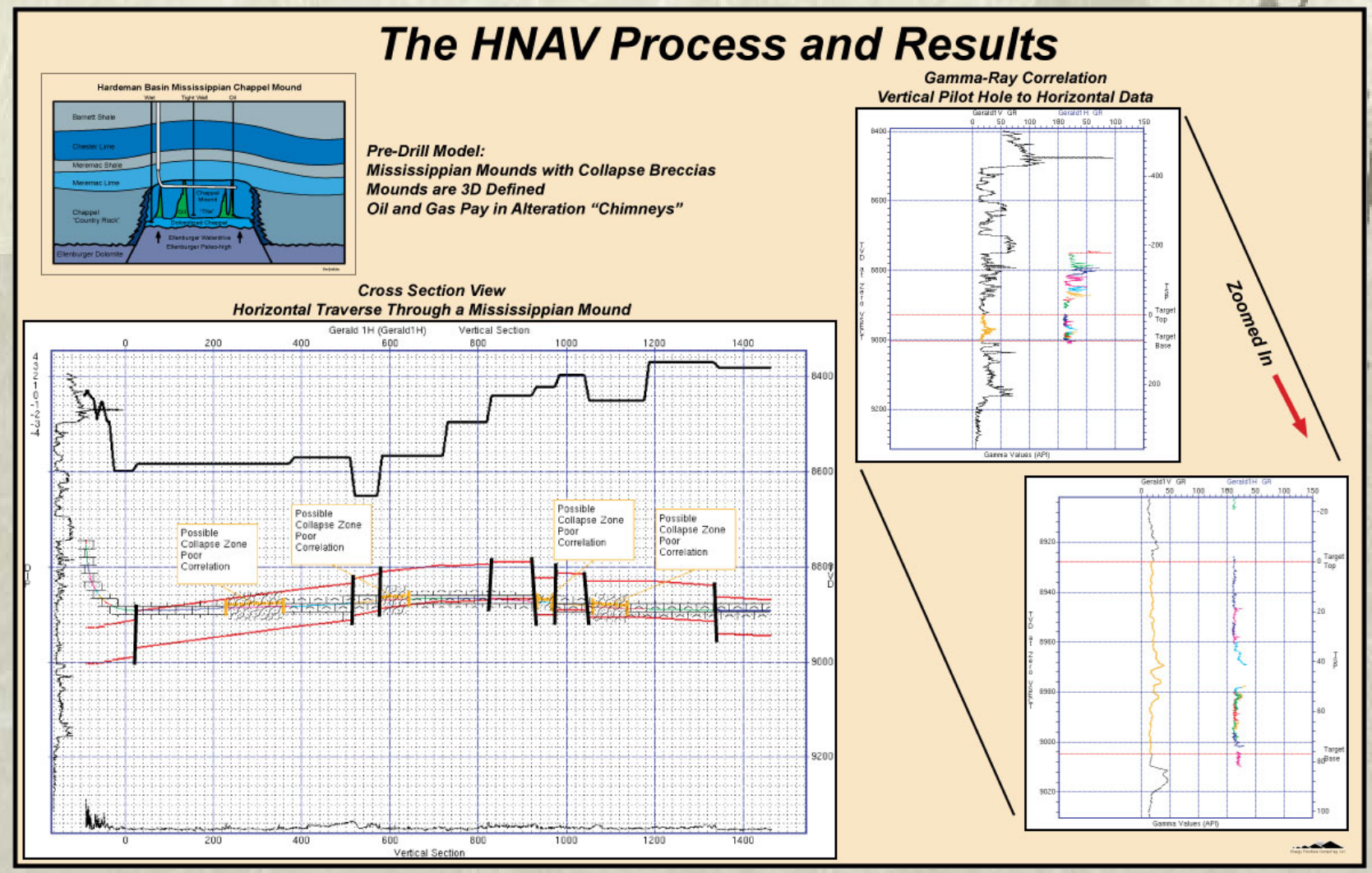
- Perforations on Fault Zones - More Water!

Another Shale Play Example



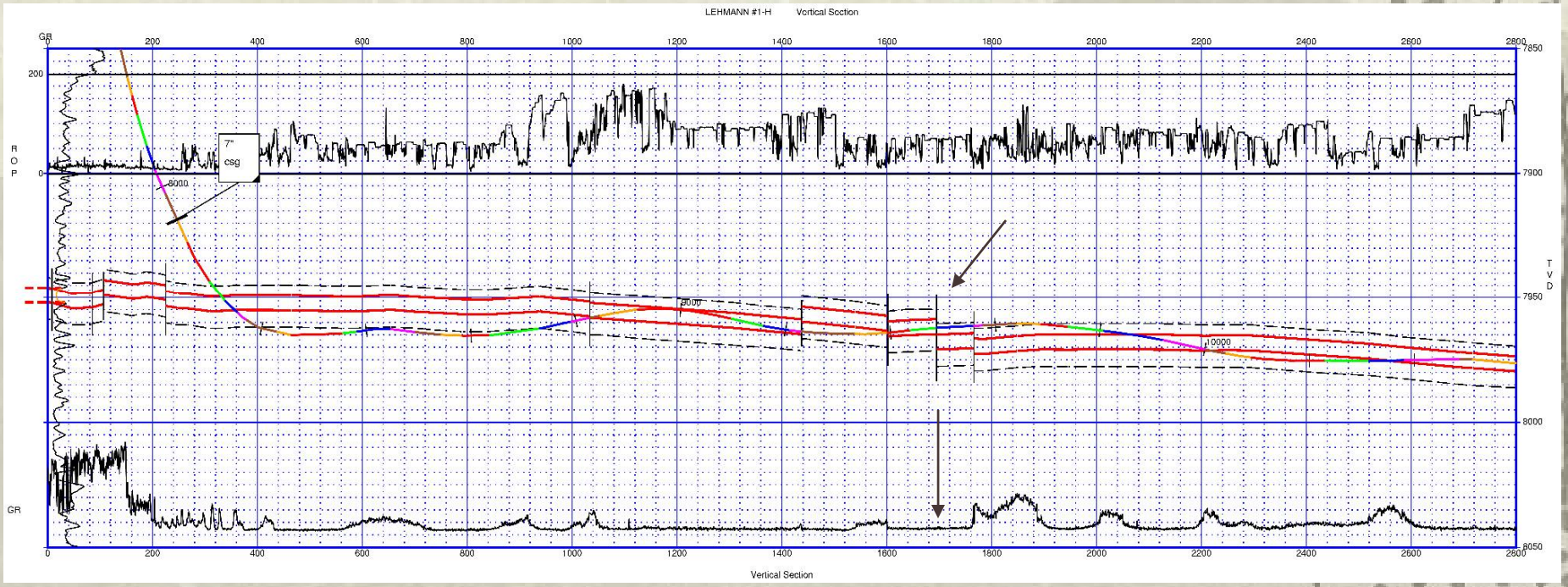
- The Fayetteville Shale Play in Arkansas
- Note: Gas Increases in Certain Fault Blocks

Fancy Example of a Mississippian Biohermal Reef, with Lithologies



- Hardeman Basin Miss Bioherm with Collapse Breccias and Shows

An Example of a Subtle Fault Petrohawk Lehman 1H in James Lime of Nacogdoches County, East Texas



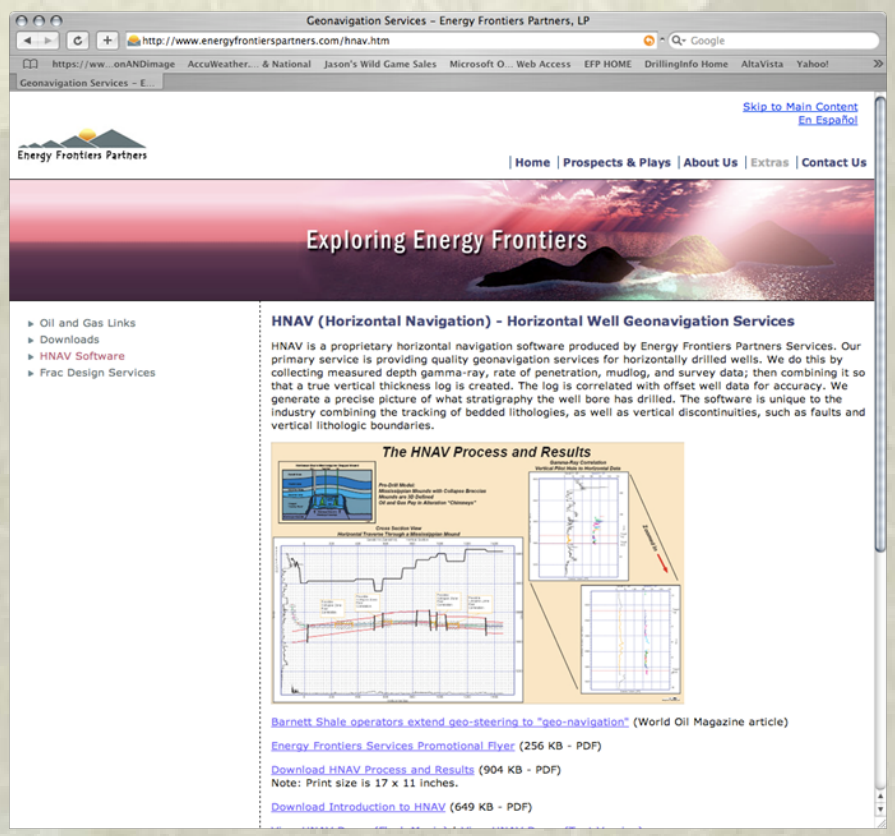
- Most Faults Can be Easily Discriminated, Just Looking at a Log
- But the Trick is Finding the Displacements of the Fault and Direction
- Here is a Clean Gamma to Clean Gamma Fault! Coooool…
- Note: Even With Faults, Navigator Kept it On Target

Conclusions

- Geo-Steering is Evolving into Geo-Navigation. Tracking Zones is Still Important, but -
  - Knowing Locations of Faults is Critical
  - Knowing Fault Magnitudes, and
  - Perforation Planning is Critical

HNAV is the ONLY Tool that Can Define Fault Throw

What? More Questions? Then Try the NHAV Link to More Info



- All Information on Methods and **Examples**