

Finding Value in Old Fields; Chasing By-passed Pay in the Trail Field of Sweetwater County, Wyoming*

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Abstract

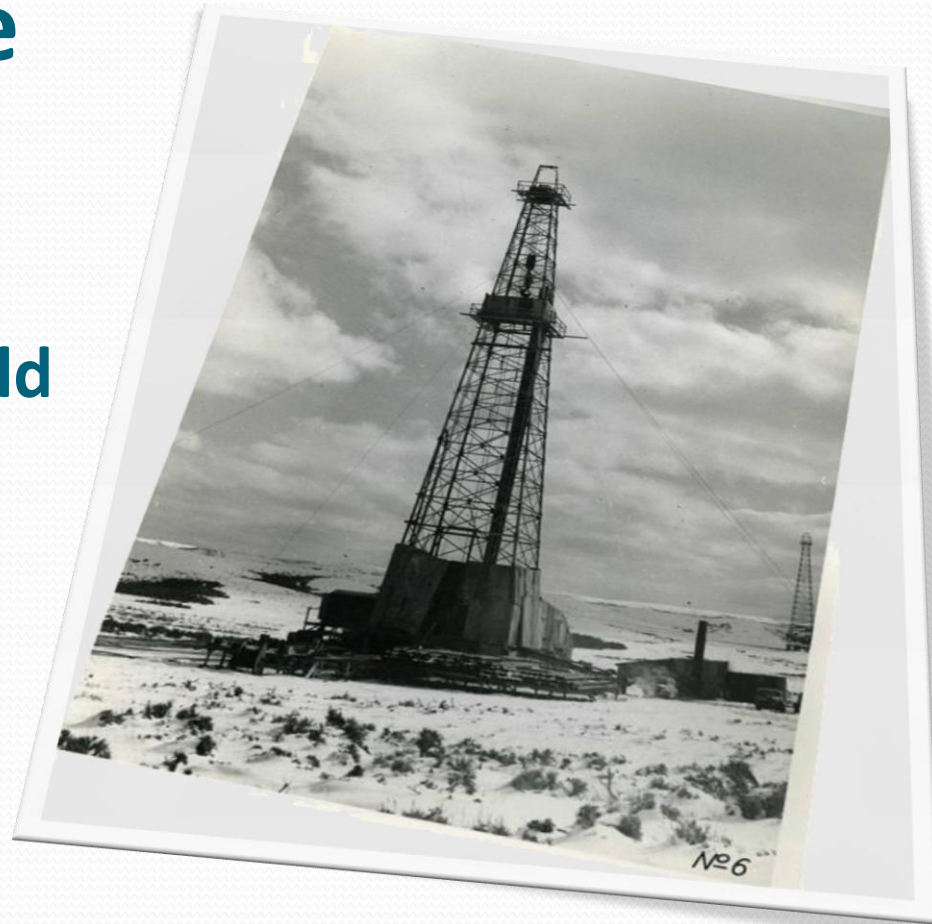
First gas production in the Trail field occurred in 1958 from high-permeability (>1 millidarcy) sandstones of the Canyon Creek Member of the Ericson Formation of the Mesaverde Group. The original wells in the field had cumulative production of up to 30 BCF. The field was quickly developed on 640-acre spacing and reached peak production in 1961 of about 4 BCF per year, falling to 0.5 BCF per year by 1989, when compression was brought on to stabilize rates. Farming-out the field was considered throughout the 1990's as the current operators considered the Canyon Creek reservoir nearly depleted; there was a bias towards continuing only to develop the proven reservoir. However, in 2005 the tight Almond Formation, Trail Member of the Ericson formation and the Blair formation, all within of the Mesaverde Group, were recognized as potential productive reservoirs. Through an extensive and ongoing process, these reservoirs have been proven highly economical to develop in a 40-acre-spaced drilling program; the geologic investigations included combing through old DST data to map higher permeable marine bars and fluvial channels, collecting current reservoir pressures, using RFT logs to identify bypassed pay and potential thief zones, modeling the fracture system that controls new frac treatments and gas production, and extensive stratigraphic modeling of these reservoirs using outcrop data to better map pay trends. With time, these models that allowed OGIP calculations to be made are currently being used to identify other potential reservoirs that are not now producing, guiding our investigative efforts to the zones with the greatest potential rewards. Today the Trail field's annual production far exceeds its 1961 peak and will continue to grow annually through the next five years.

Reference

Martinsen, O.J., A. Ryseth, W. Helland-Hansen, H. Flesche, G. Torkildsen, and S. Idil, 1999, Stratigraphic base level and fluvial architecture; Ericson Sandstone (Campanian), Rock Springs Uplift, SW Wyoming, USA: *Sedimentology*, v. 46/2, p. 235-259.

Finding value in old fields: chasing by-passed pay in the Trail Field of Sweetwater Co, WY

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Sr. Geologist, PG
Wexpro



All fields have by-passed pay zones

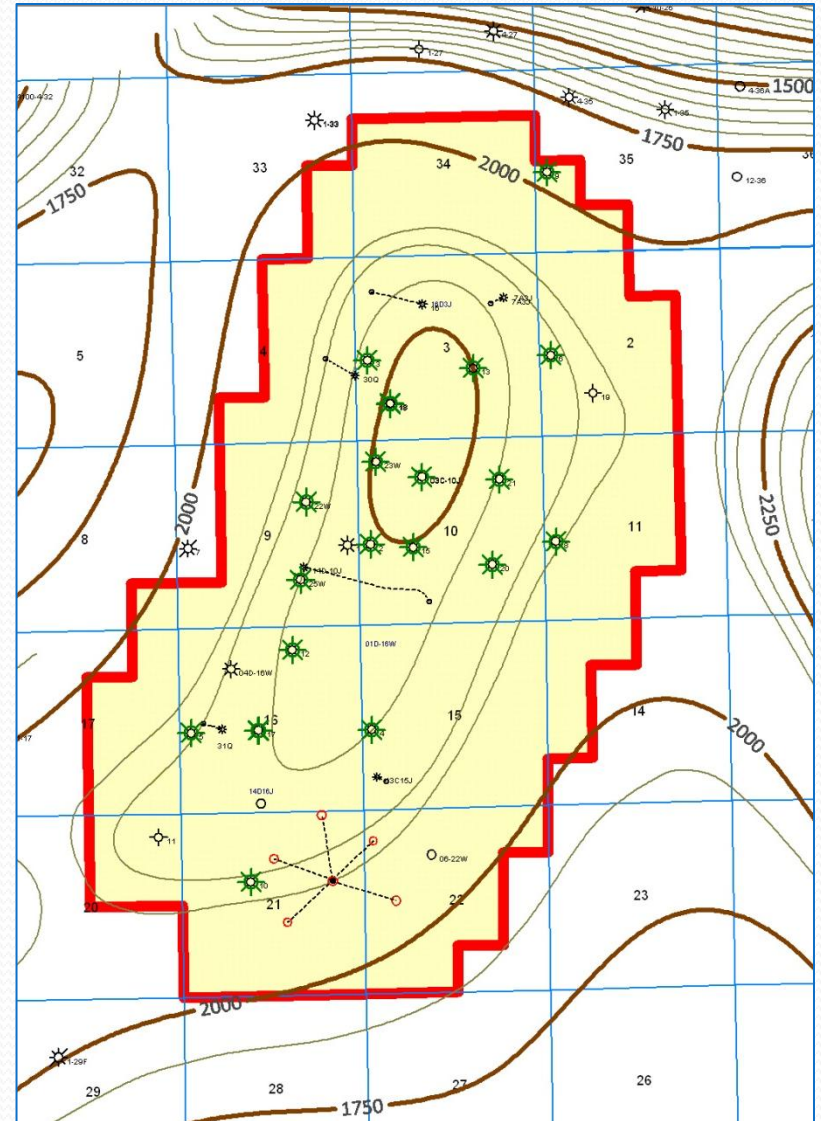
Why does pay get by-passed?

- low prices?
- high water?
- Prohibitive regulatory environment?
- high permeability risk?
- hurdles from past management's development thresholds?
- Outdated geologic model?



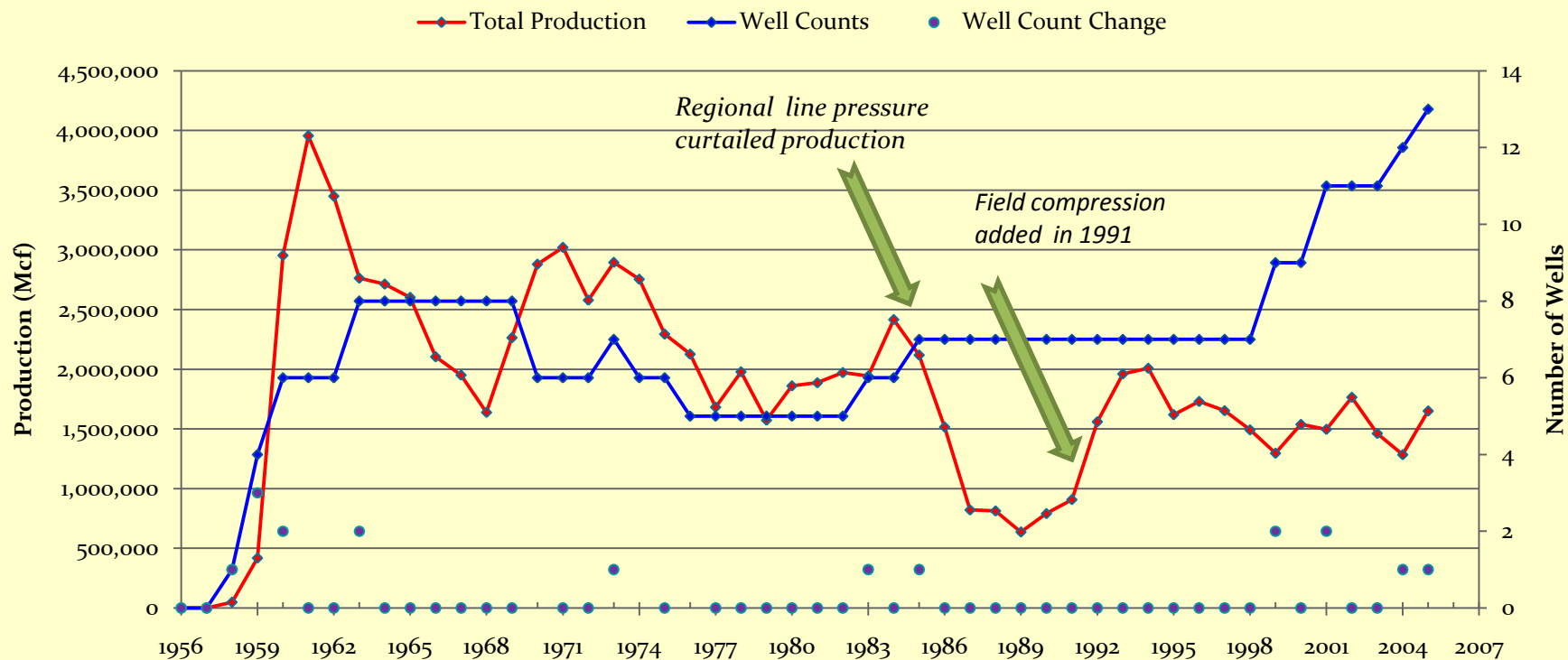
Trail Field

- Surface anticline leased in the 1940's.
- First well in 1952.
- First production in 1958; flowed 40 MMCF/D naturally.
- Peak production in 1962 on 640-acre development.
- 160-acre infill program initiated in 1999
- By 2006 total production from 20 surviving wells down to 4 MMCF/D.

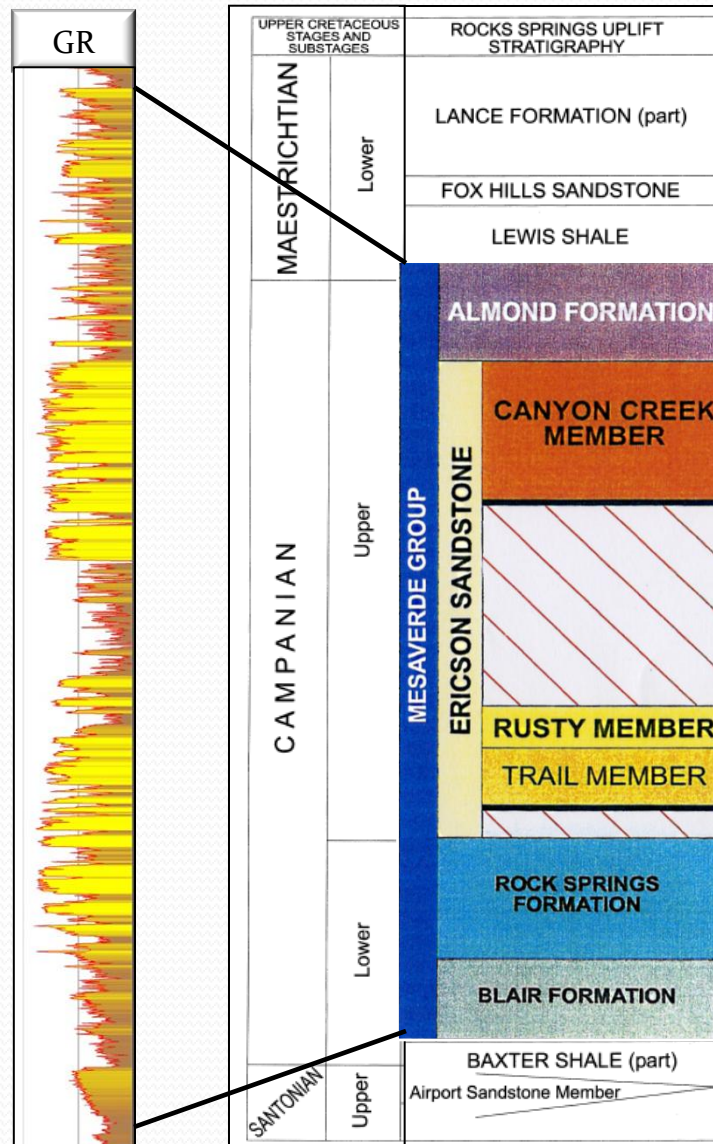


Death of a Gas Field

Trail Field Annual Production: 1958-2005



Stratigraphy



Reservoir compartmentalization suggests that this formation should be developed at 40-acre density

Historic Production suggests that this unit can be drained at 160-acre density

Reservoir compartmentalization suggests that this formation should be developed at 40-acre density

Martinsen
et al., 1999

Causes for by-passed pay in the Trail Field

- It was believed that only the Canyon Creek member was economic because:
 - The Almond formation made only minor gas
 - Trail member production declined too quickly
 - Management was in a 'wait and see' pattern as the field waited compression
- An ongoing EIS created an unfavorable regulatory environment
 - Under an EA in effect since 2000, the whole area can only have 56 new wells and disturb 505 acres.
 - As of 2005, 313 had been disturbed, so little remained to create a new development program.

Bottom Line

- No development was planned within the five-year SEC window for the Trail field; i.e., we were not booking new reserves or adding value to the company.
- This is a common situation for old fields

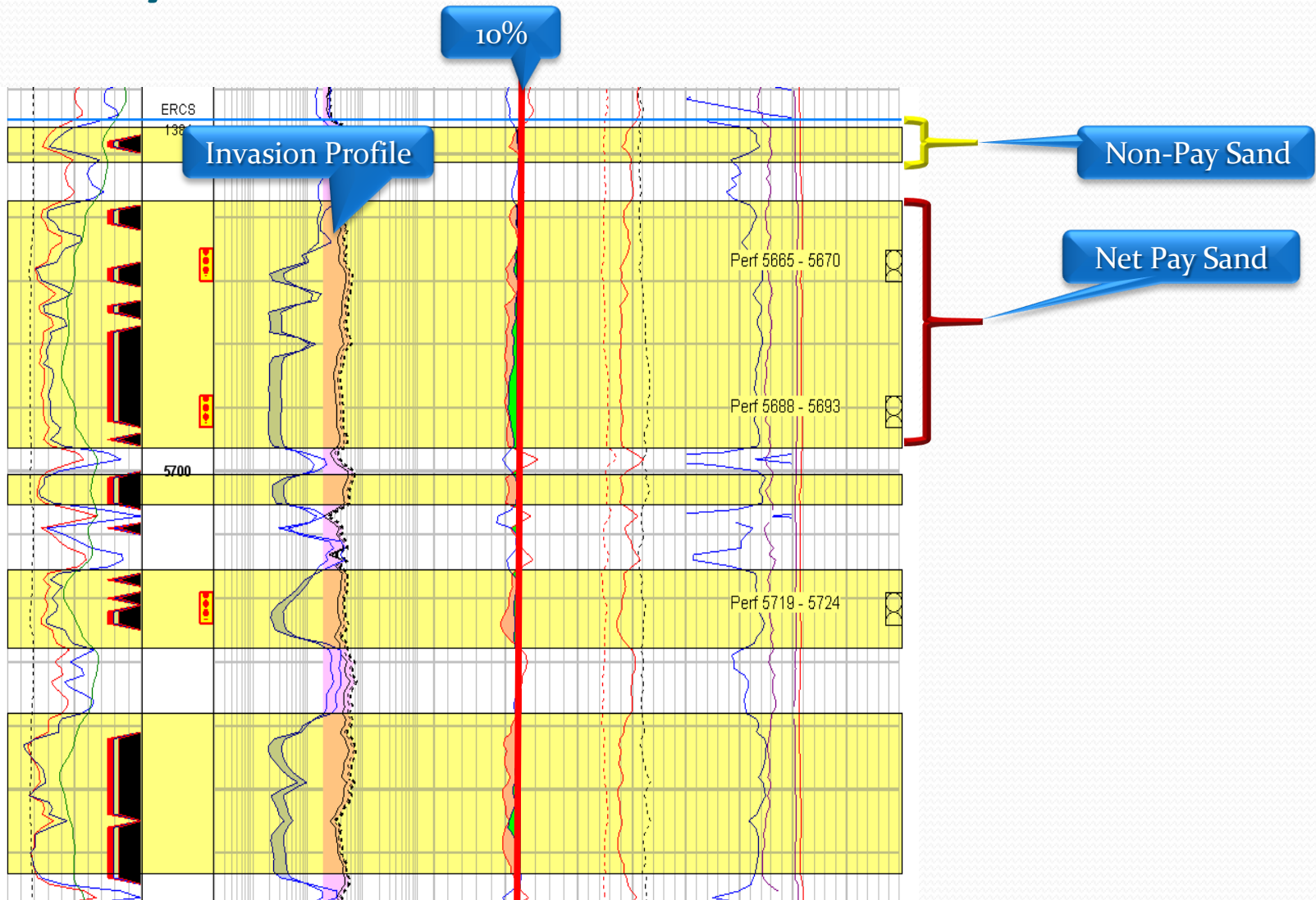
So how do you make by-passed pay PAY?

Start by mapping it

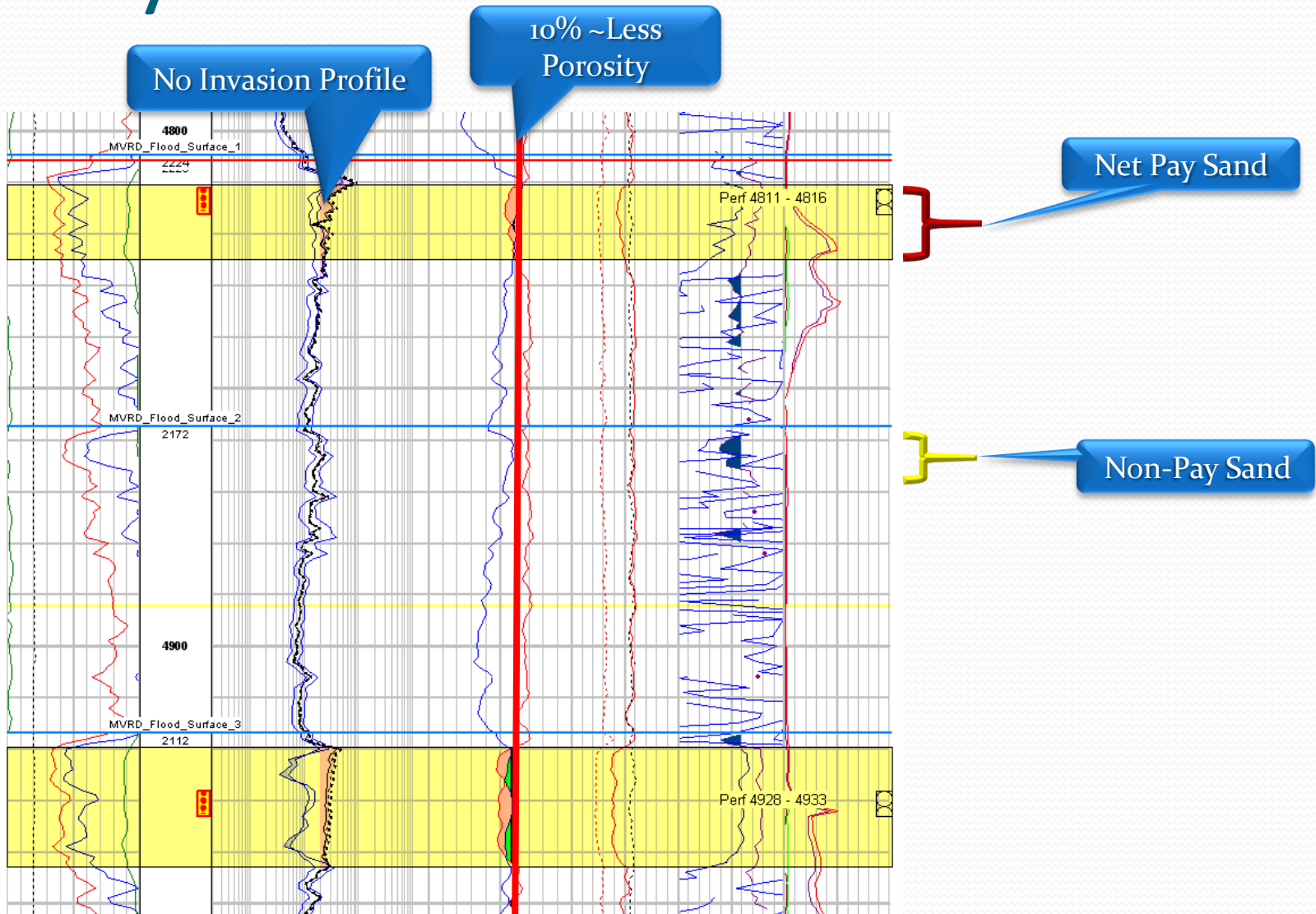
- If a reservoir rock contains hydrocarbons, map it.
- At this phase, no sand is too minor.



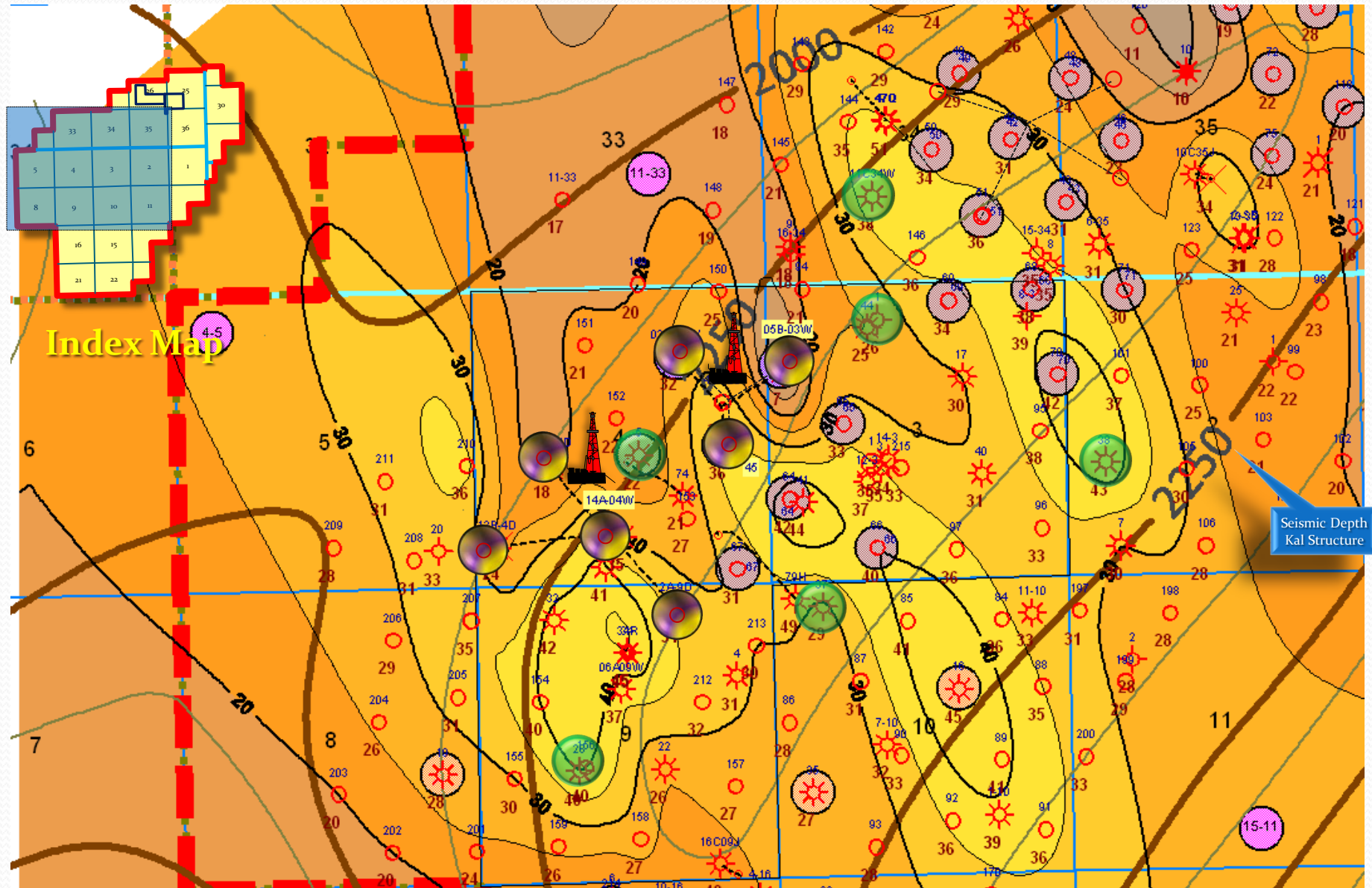
Porosity Cutoffs



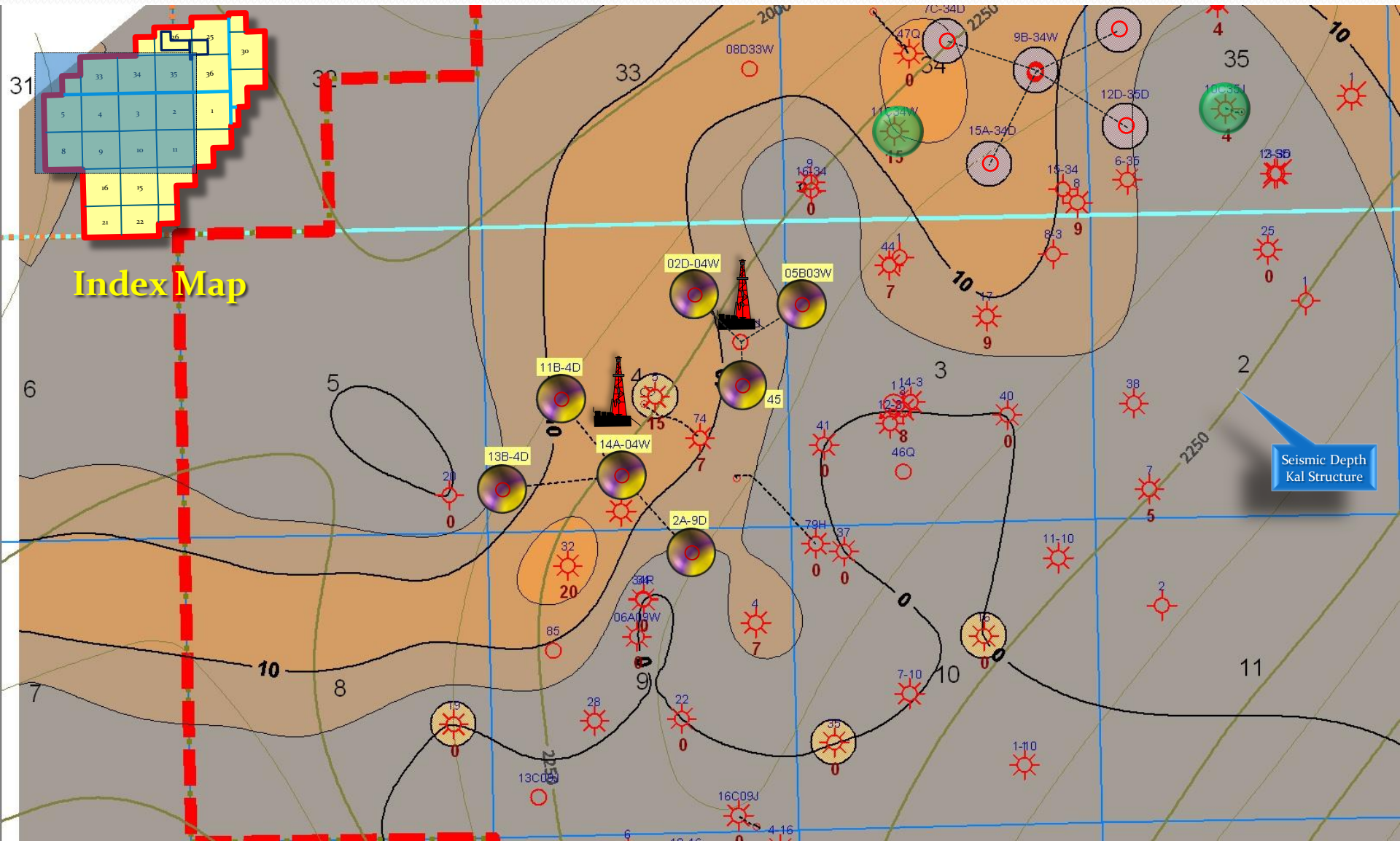
Porosity Cutoffs



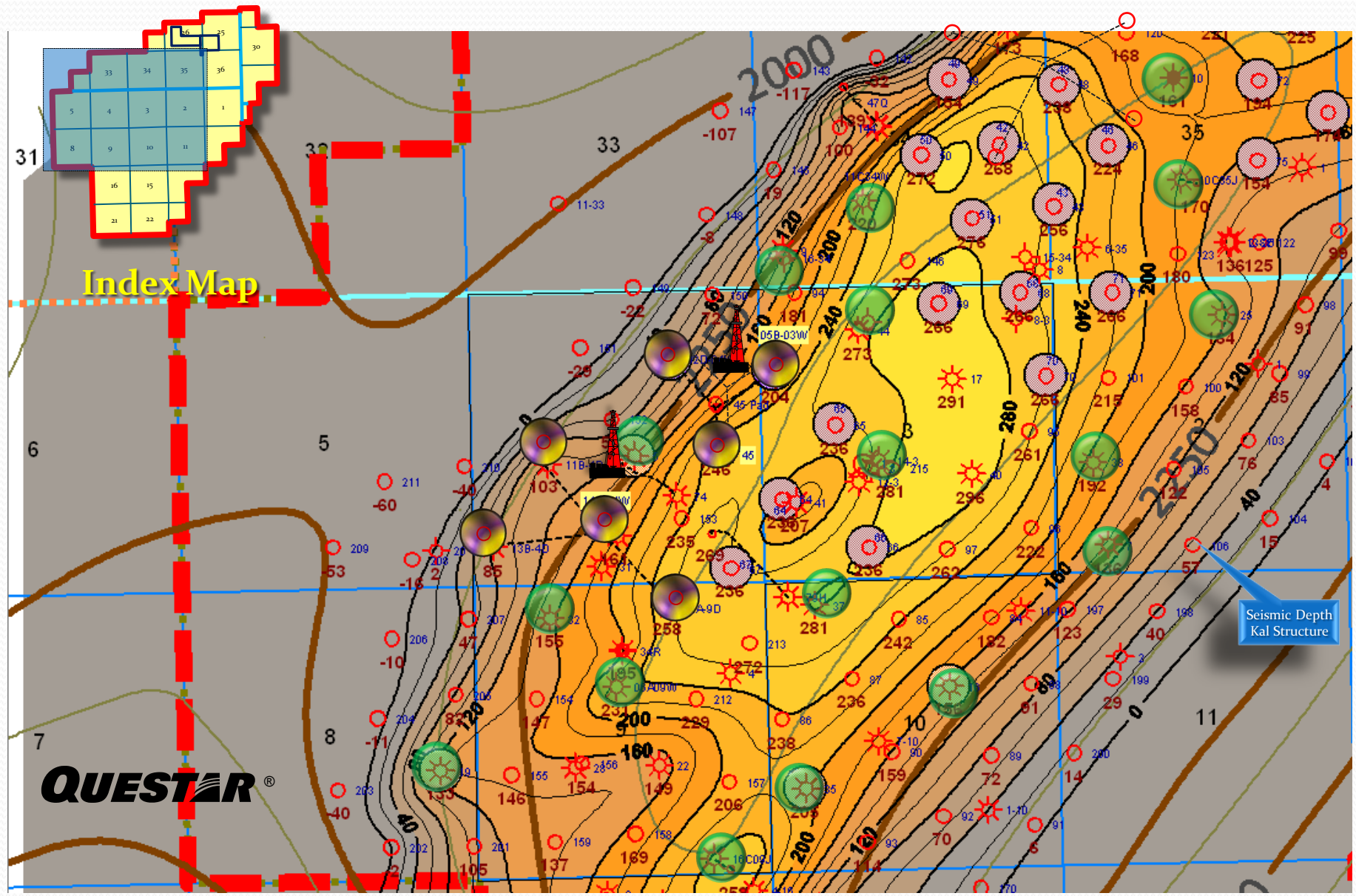
Index Map



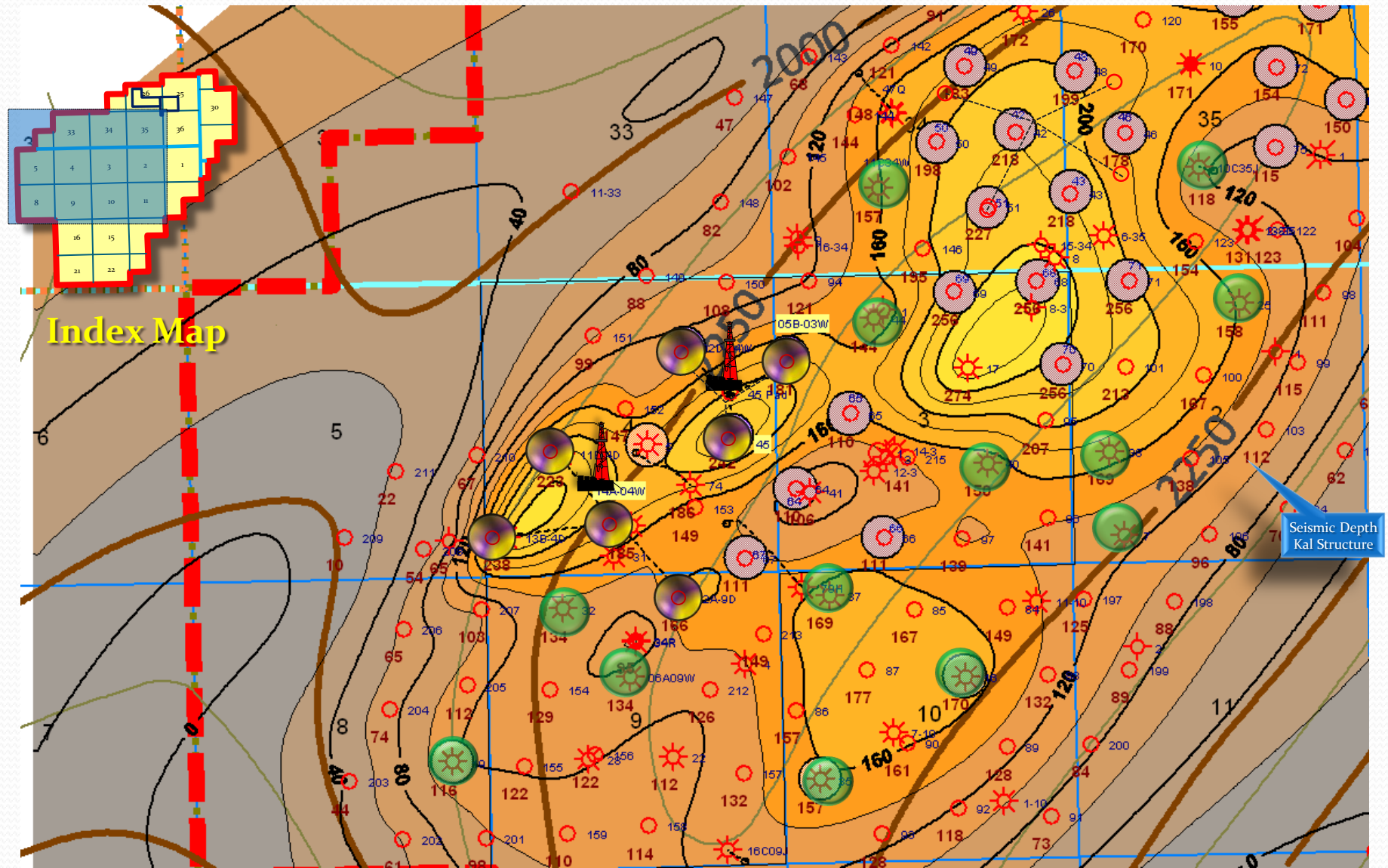
Almond L Pay



Canyon Creek Sd Pay

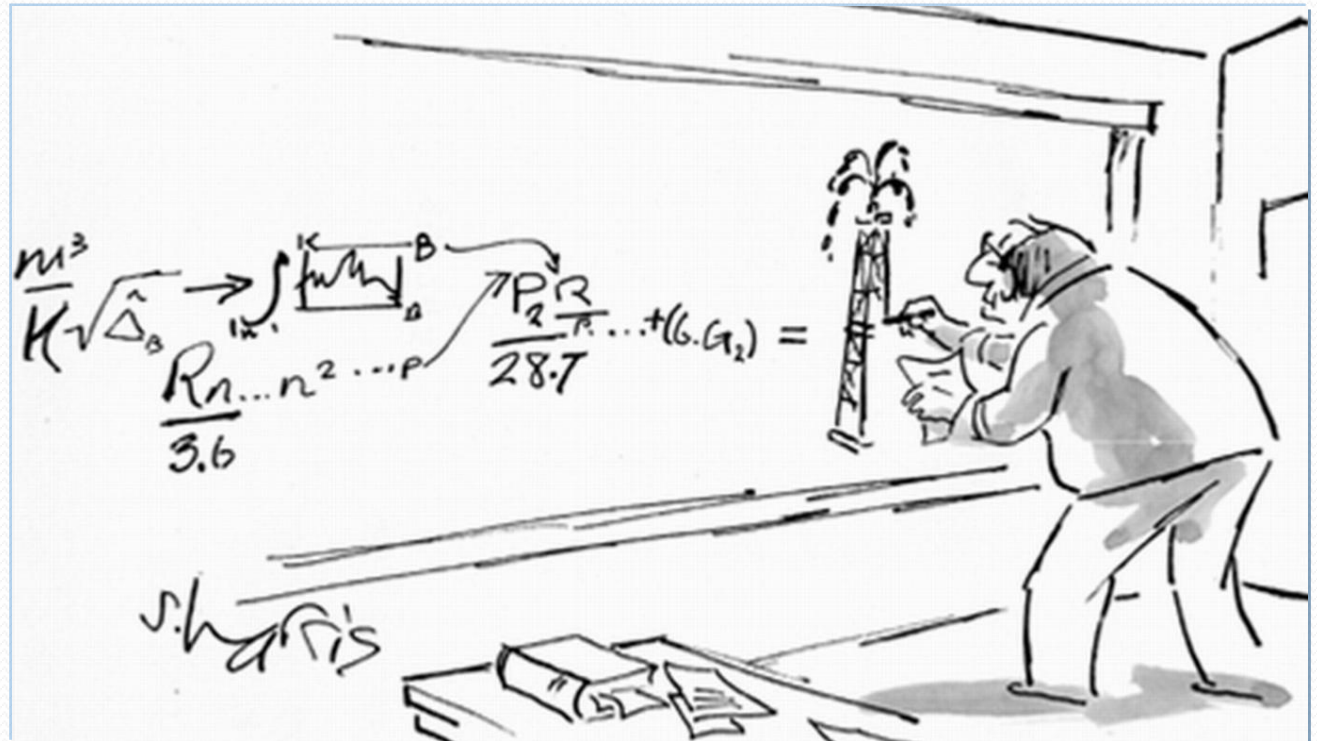


Trail Sd Pay



Calculate Some Quick Volumetrics

- Quick and easy planimetering.
- Treat sands consistently.



Reserve Allocation

Target	Zone	Trail 2	Trail 3	Trail 4	Trail 5	Trail 12	CCU 13	Trail 15	Trail 16	Trail 17	Trail 18	Trail 20	Trail 21	Trail 22W	Trail 23W	Trail 25W	Trail 7A-3J	Trail 04D-16W	Trail 03C-10J	EUR Reserve Allocation (Bcf)	Five Section OGIP (Bcf)	% Rec
	Section	10	3	15	16	9	16	3	10	3	16	3	10	10	9	9	10	16	10	3,9,10,15,16		
Almond	Almond A						O													36.11	363.37	9.9%
	Almond B						P			X				X			X					
	Almond C						P	O	O				O									
	Almond D				P		O	P	P	X	X	X	P	X	X	X	X	X	X			
	Almond E				&		R	P	P	X			P	X	X	X	X	X				
	Almond F				A		T	O	O		X	X	O	X		X		X				
	Almond G						U	R	R	X	X	X	R	X	X	X		X				
	Almond H						N	T	T		X		T		X		X		X			
	Almond I						I	U	U		X	X	U	X	X	X						
	Almond J						T	N	N				N	X		X		X				
	Almond K						Y	I	I				I	X	X	X		X	X			
	Almond L						T	T					T	X					X			
Canyon Creek	Canyon Creek	X	X	X	X	X	X	I	I	X	W	W	I	X	X	X		W	X	67.73	188.05	36.0%
		X	X	X	X	X	X	E	E	X	E	E	E	X	X	X		E	X			
		X	X	X	W	X	X	S	S		T	T	S	X	X	X		T	X			
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
		X	X	X	X	X	X															
Trail	Trail	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	27.37	433.75	6.3%
		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			
				X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			

Your Identified By-Passed Pay Has Probably Been Tested Before

Has anything changed?

- Are prices high enough to make it work?
- New comingling agreement?
- New take-away capacity?
- Frac technology?
- New water disposal capacity?
- Access to better data? Better tools?



In Our Case....

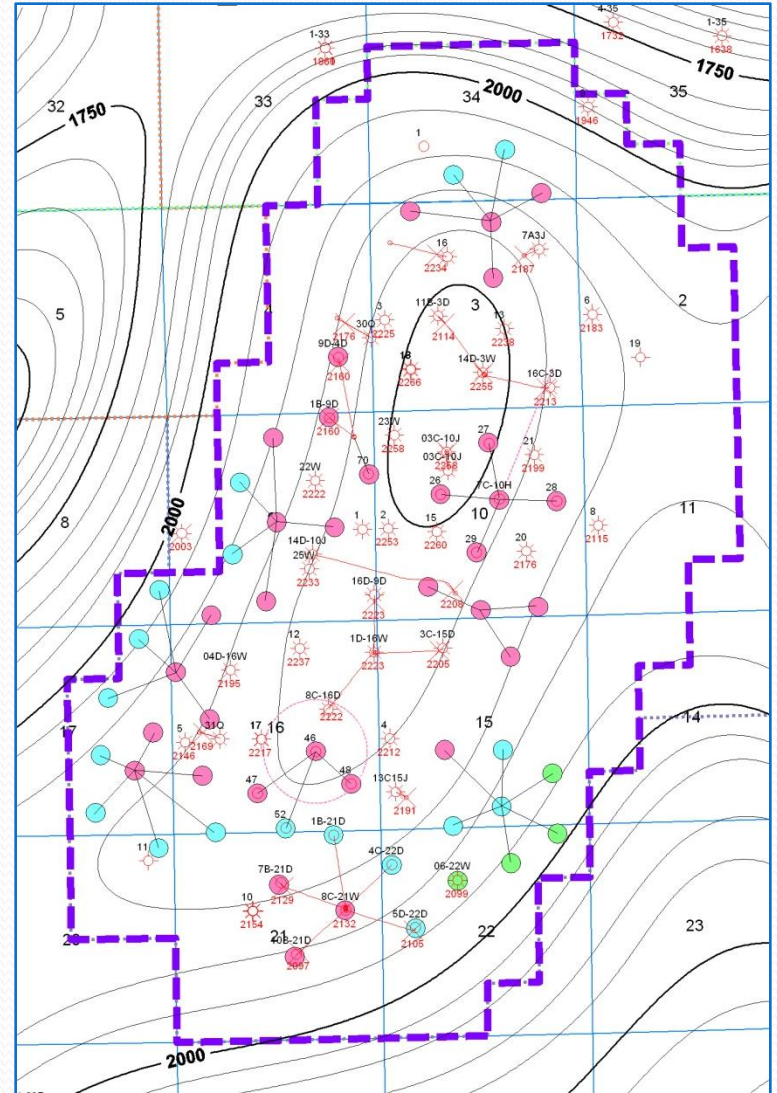
- We developed a new geological model
- Energized frac technology made a huge difference

A few recompletions proved that our bypassed pay could PAY.

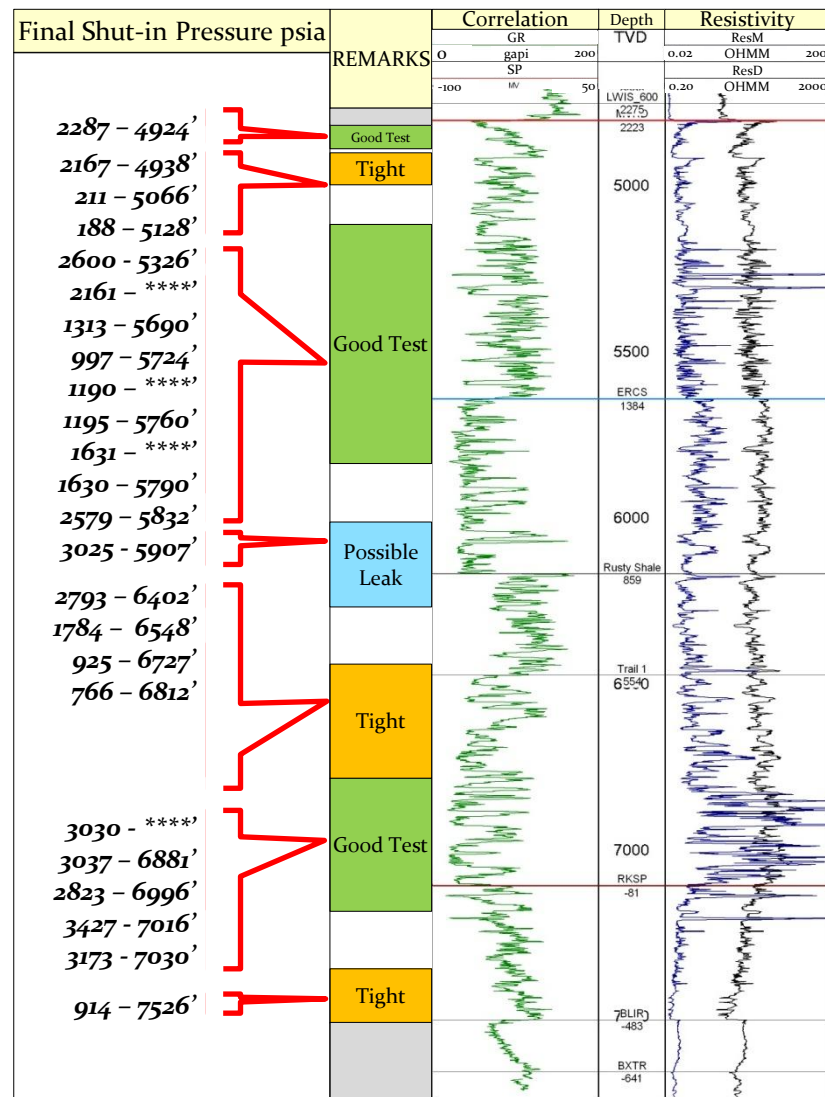


Now it's like any other field development

- How should we delineate an old field?
 - Recompletions only?
 - New Drills?
- We still have huge wildlife and disturbed acreage constraints



Trail Unit 1D-16W



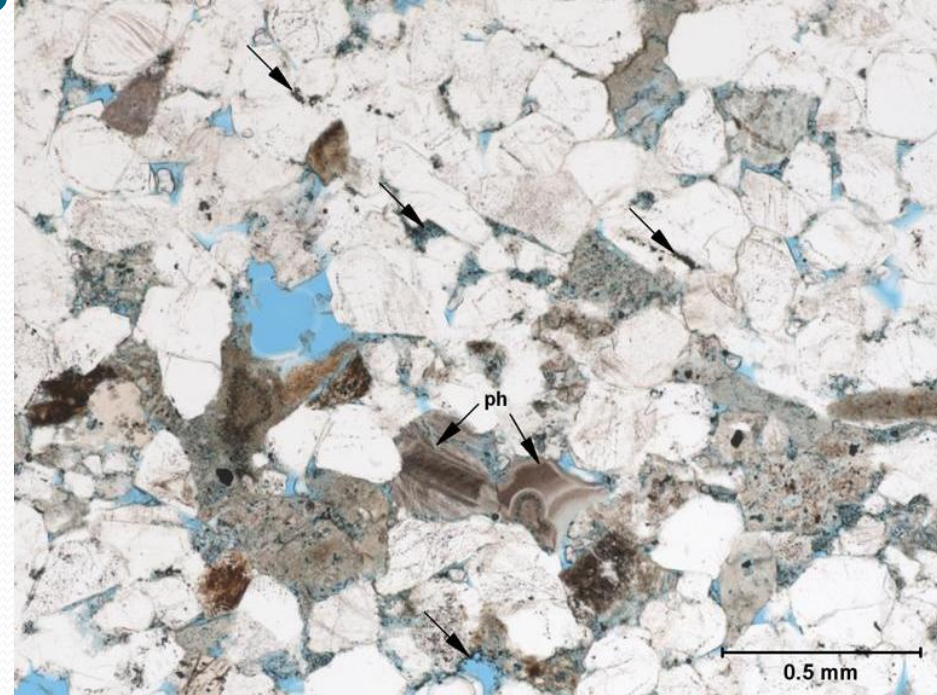
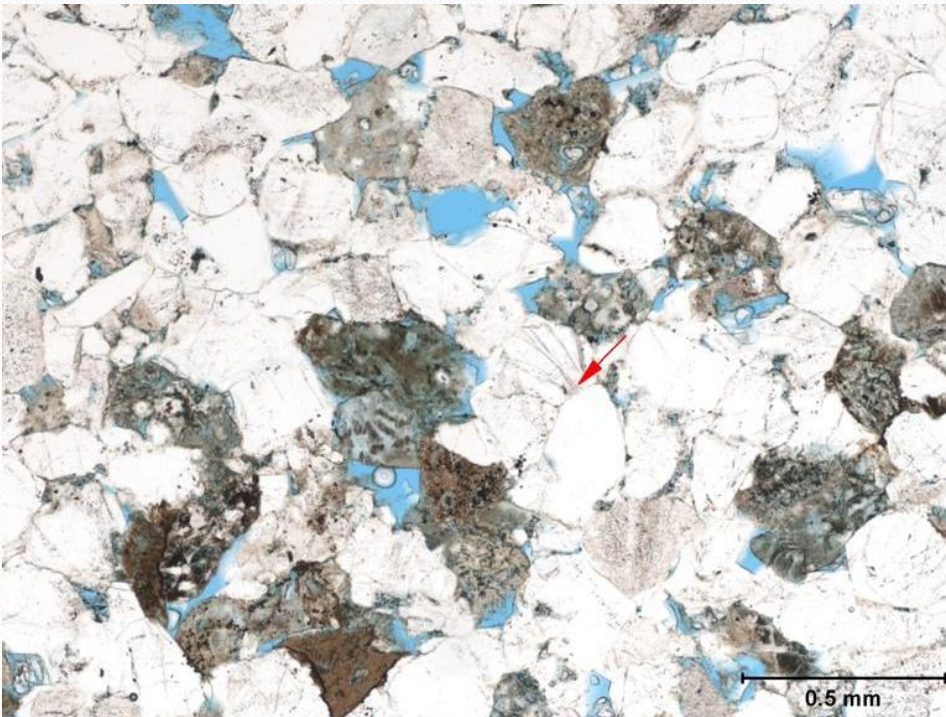
TD=7756

Canyon Ck Sands Vs. Trail Sands

Canyon Creek Sand

5879' Depth 14.3% Porosity

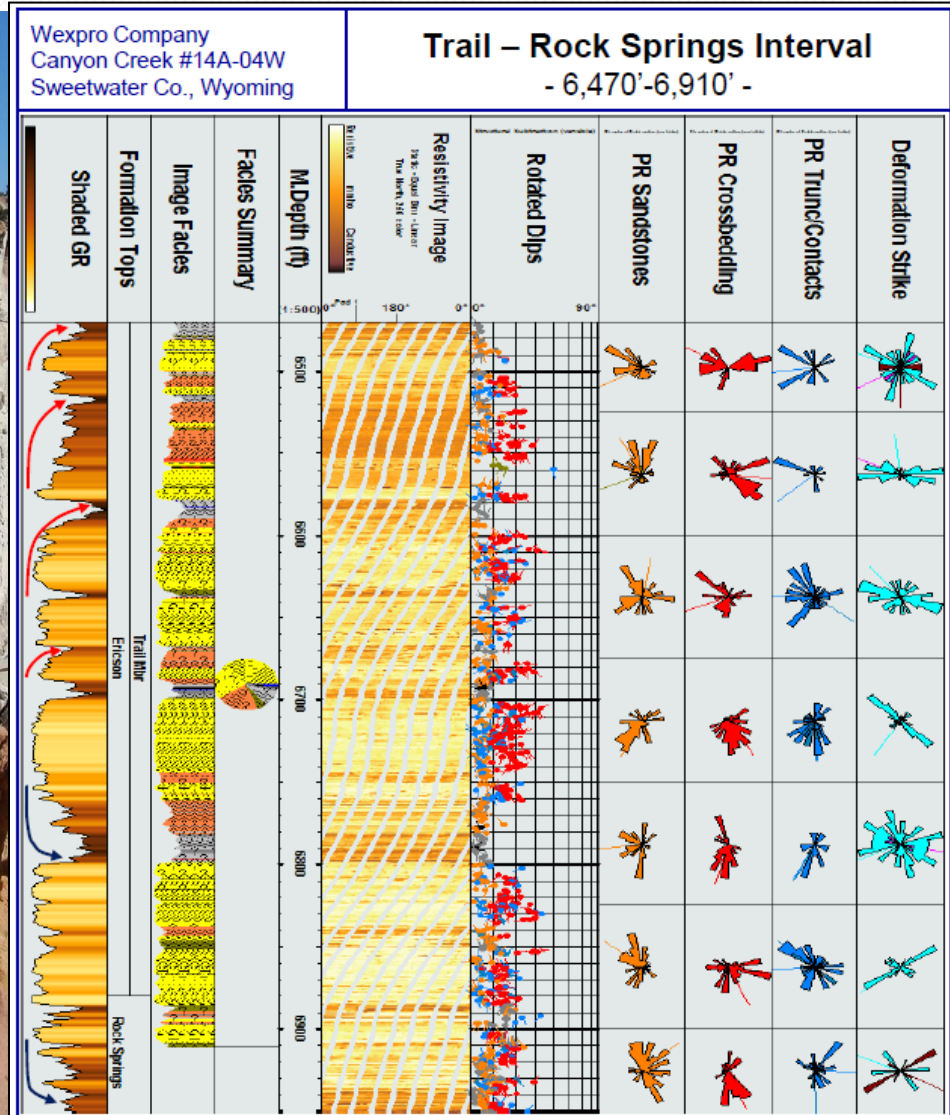
3.28 mD 30.6% Sw



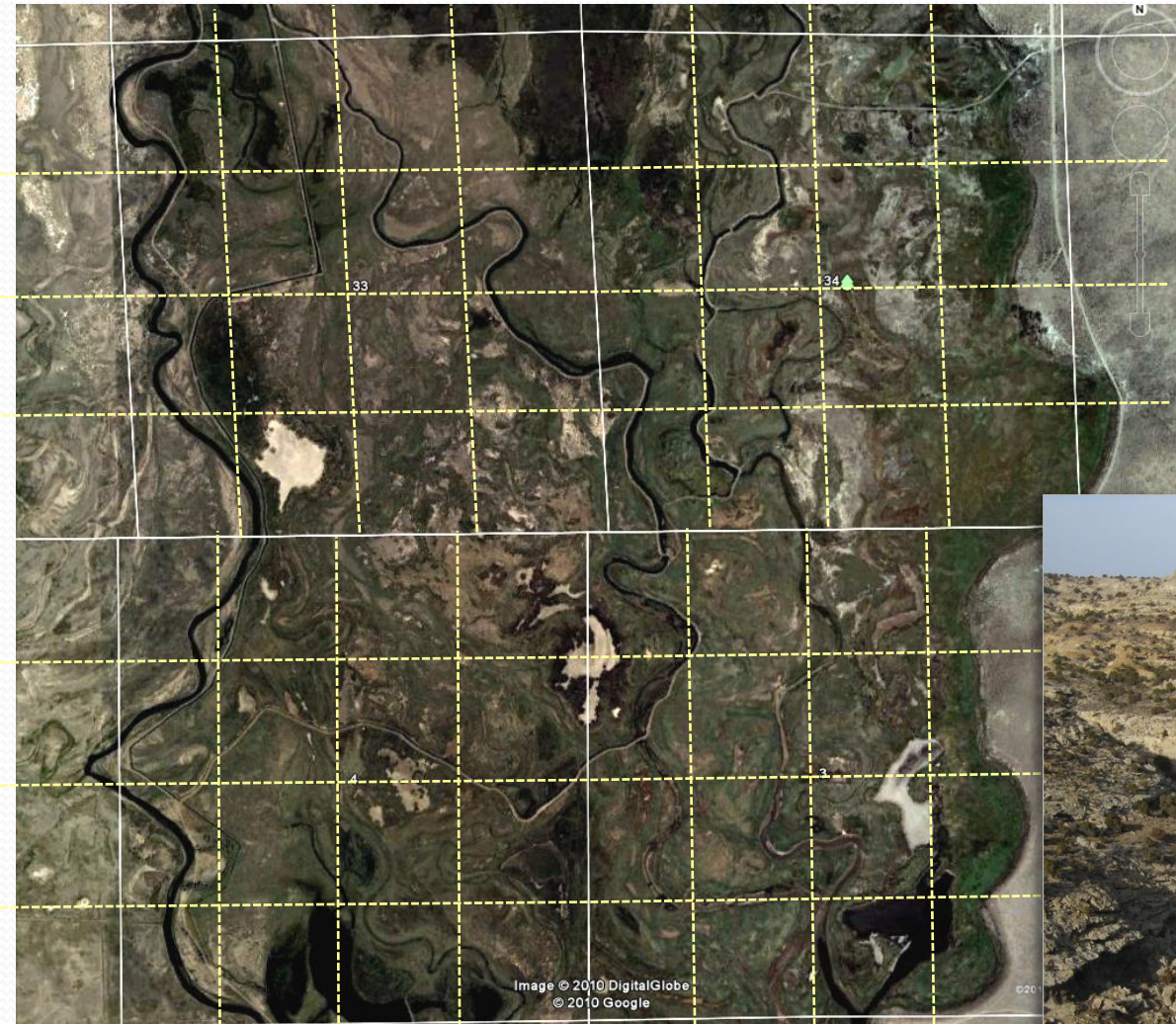
Trail Sand

7033' Depth 11.4% Porosity

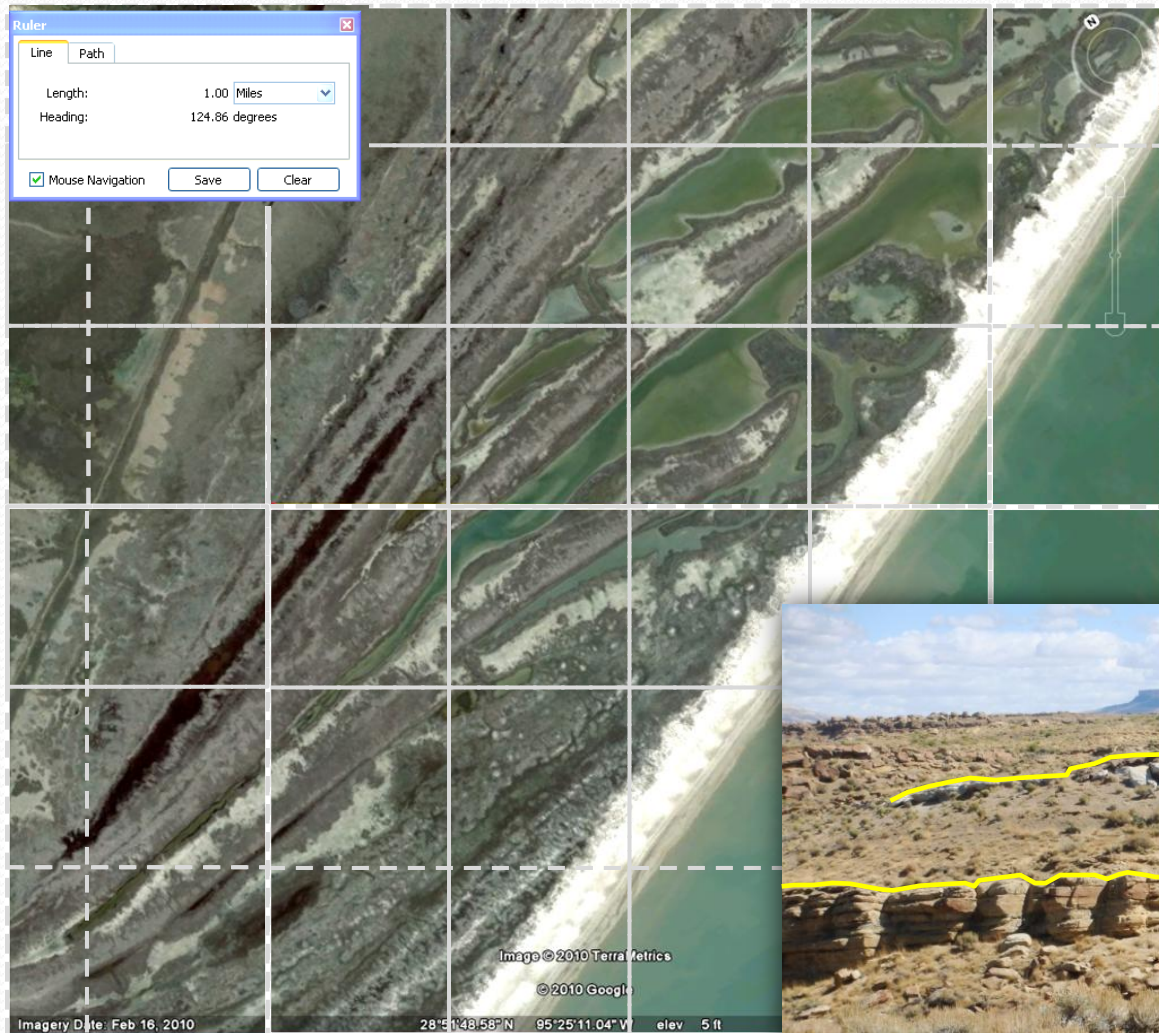
1.46 mD 31.9% Sw



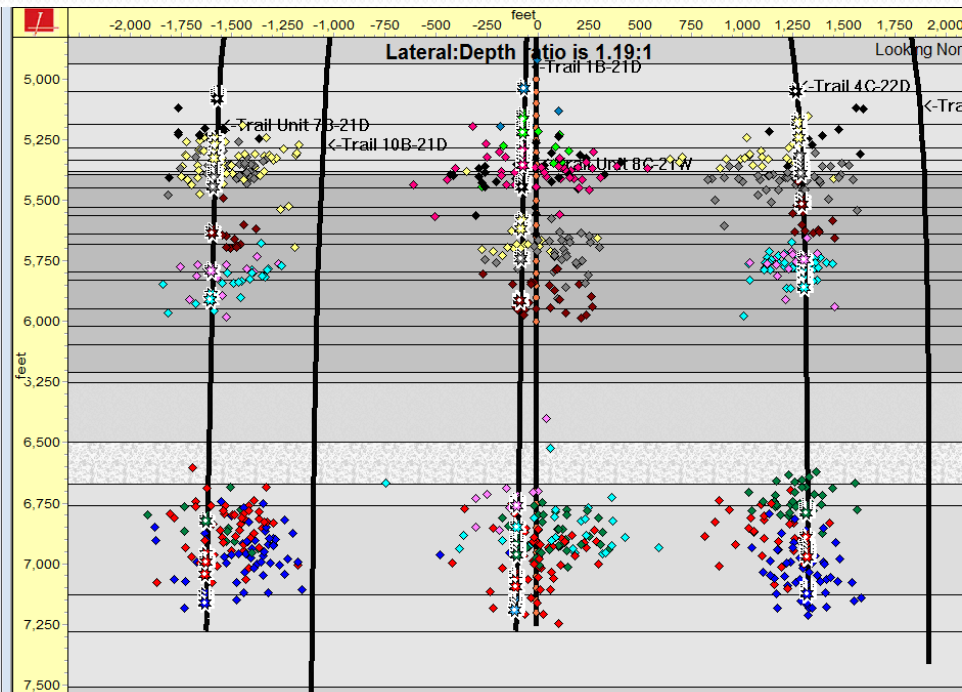
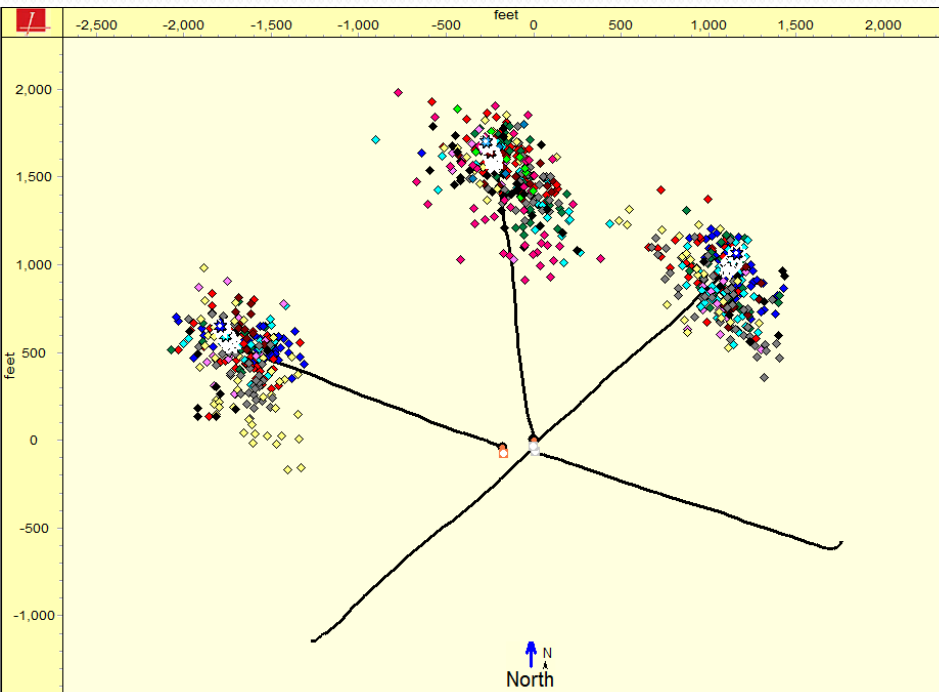
Analogues



Analogue

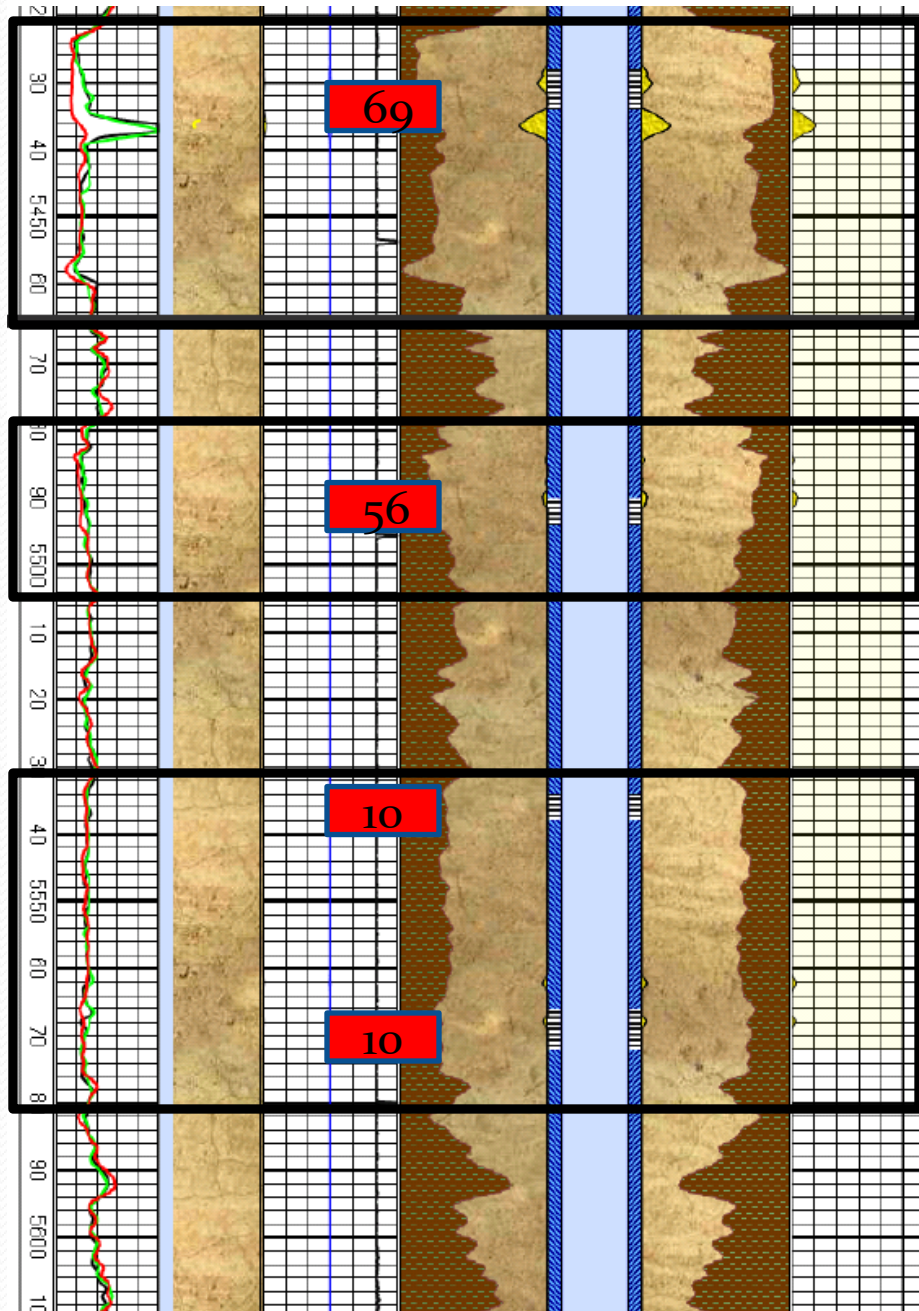


Getting the Spacing Right



- Frac half-length is only 310'
- Height growth is 240'-Classic penny fracs

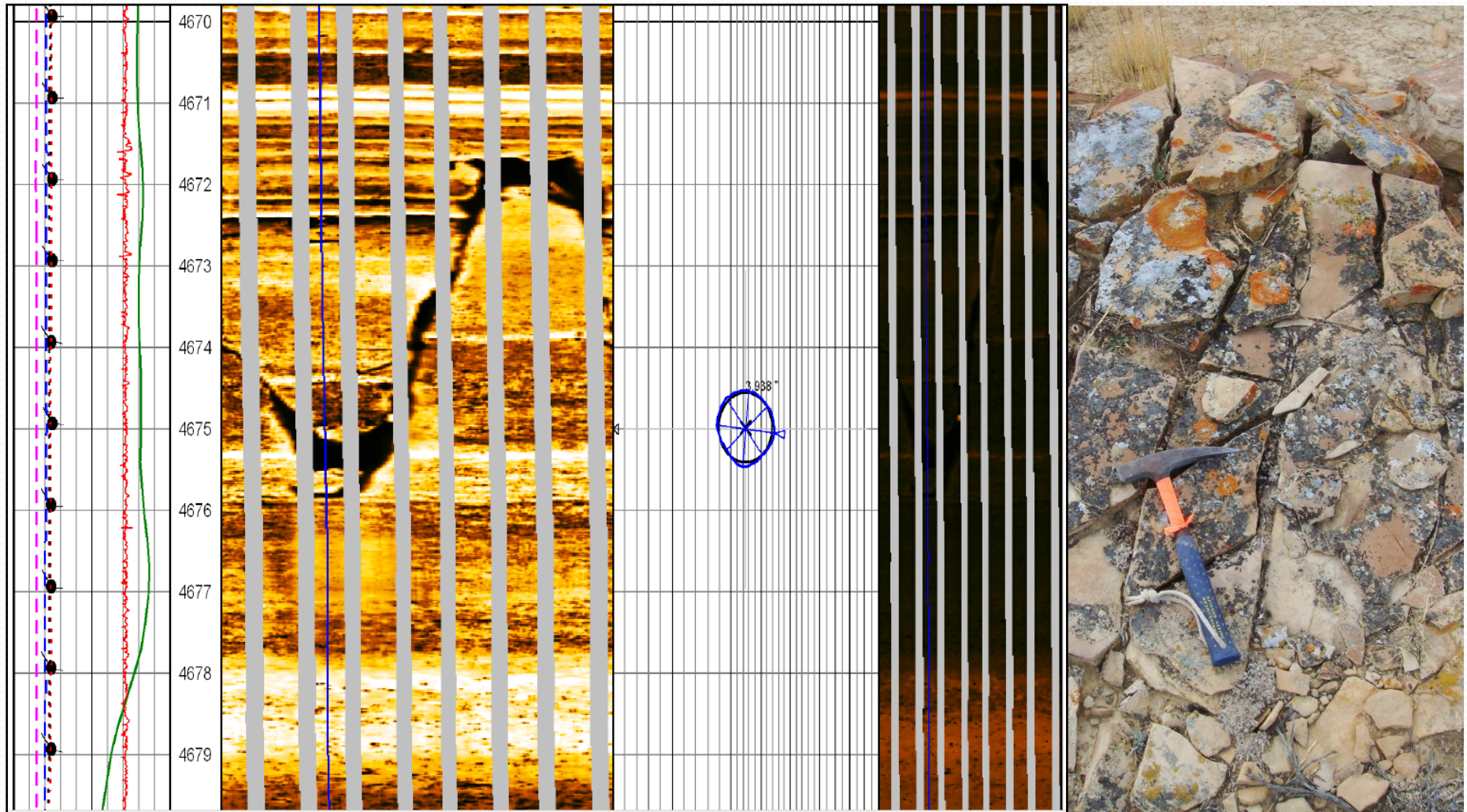
Canyon Creek 13B-04D



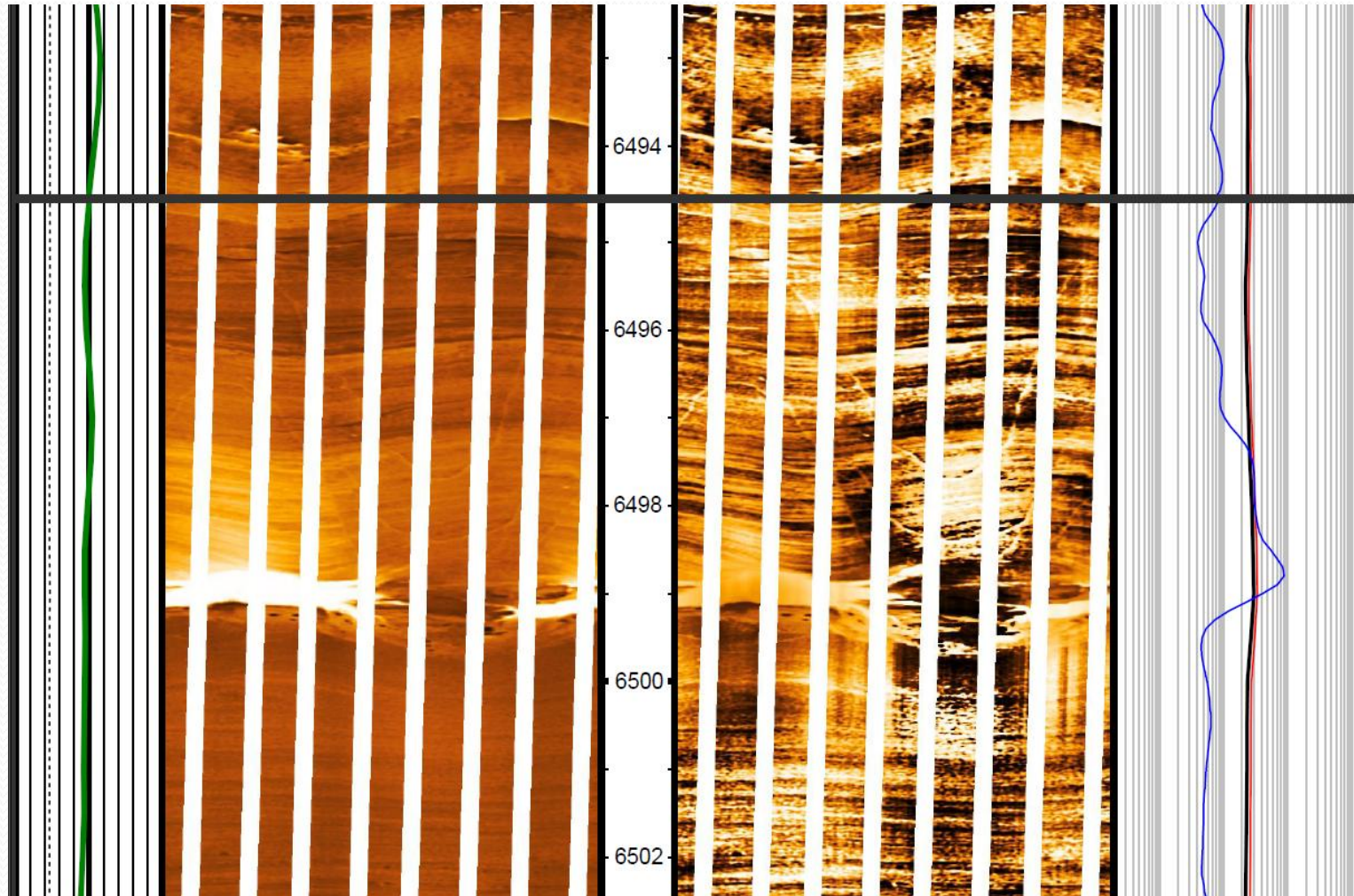
Results

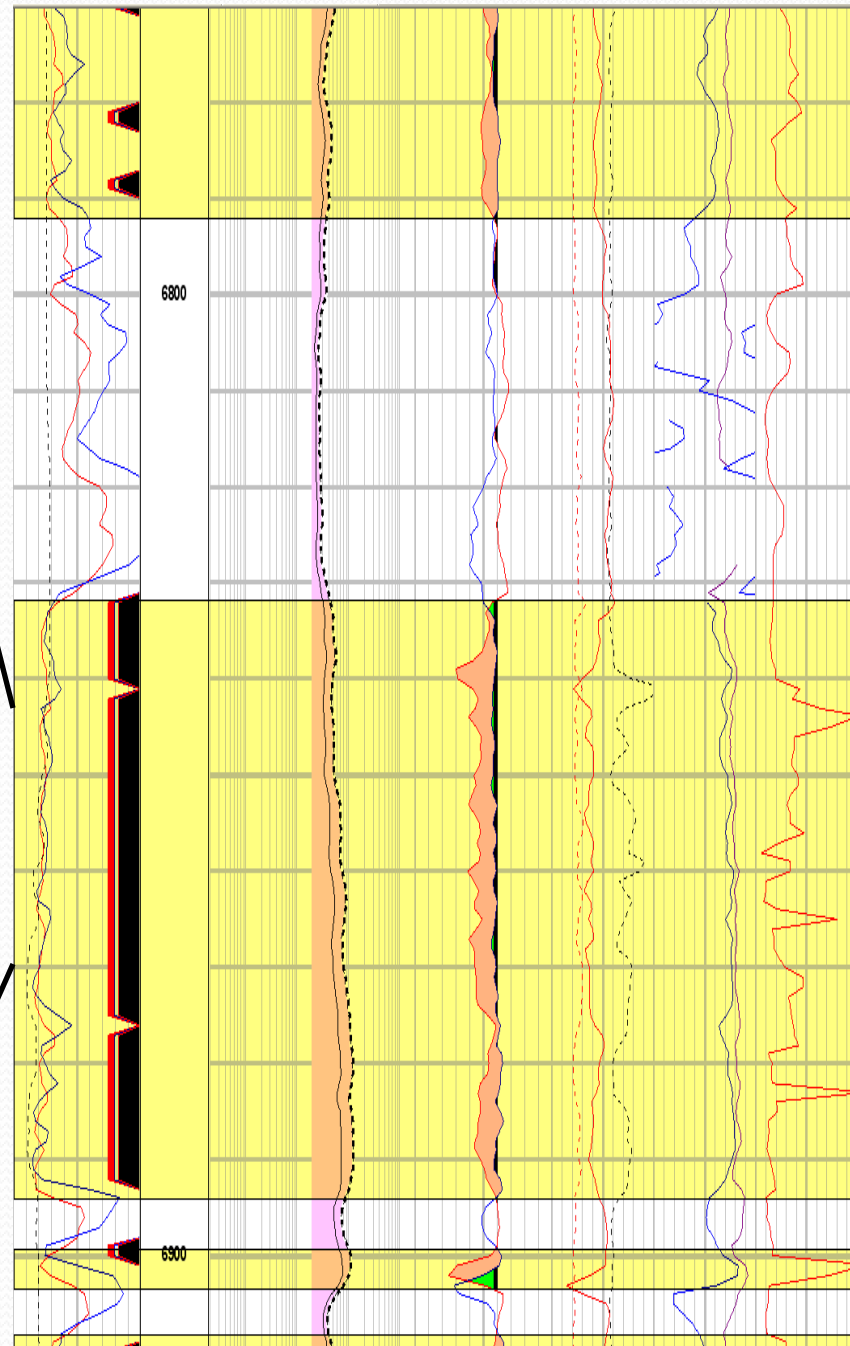
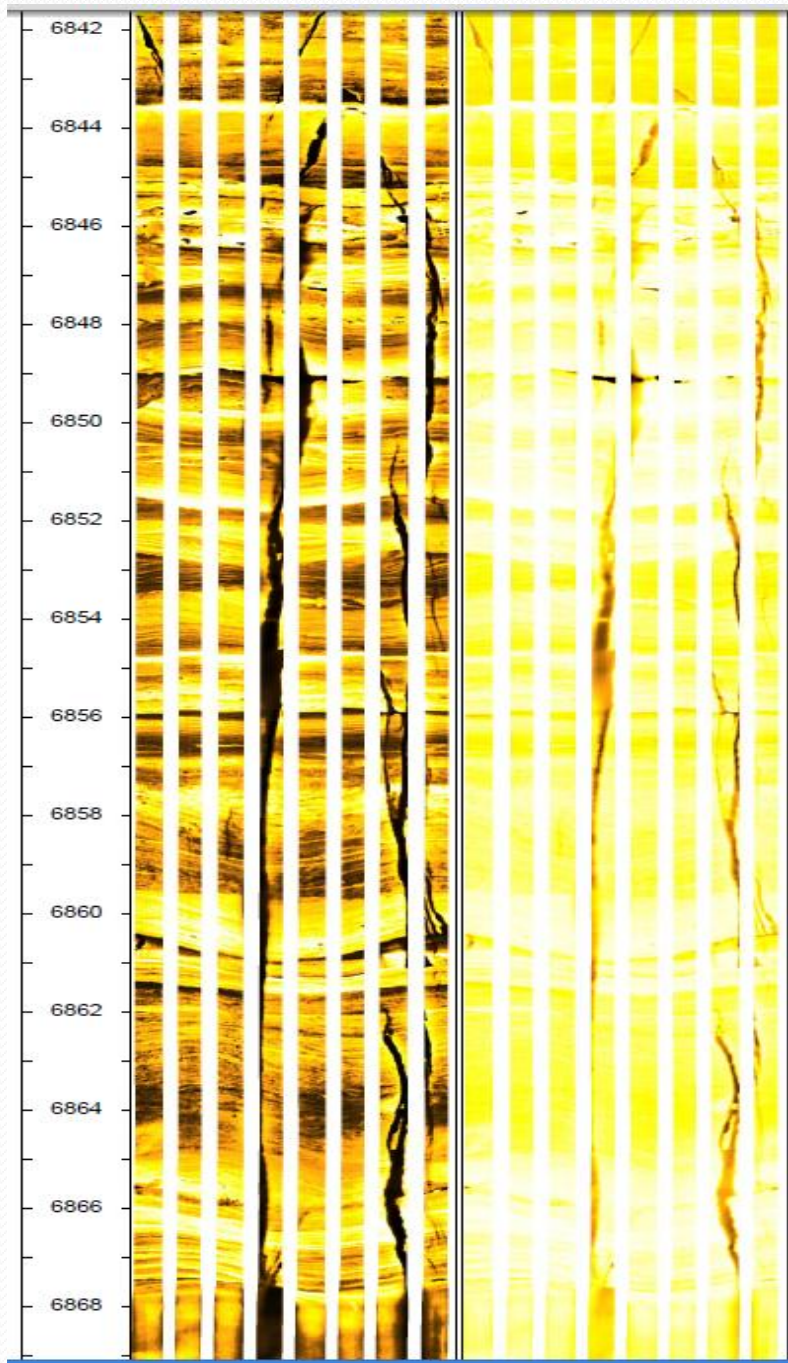
- Production results are encouraging for the first 8 VB wells in 2011
- Improved job placement (no screenouts)
- Reduced treating pressures = less hydraulic HP = cost savings
- Potentially improved zone containment in the Trail section

Vertical Perm Related to Faulting

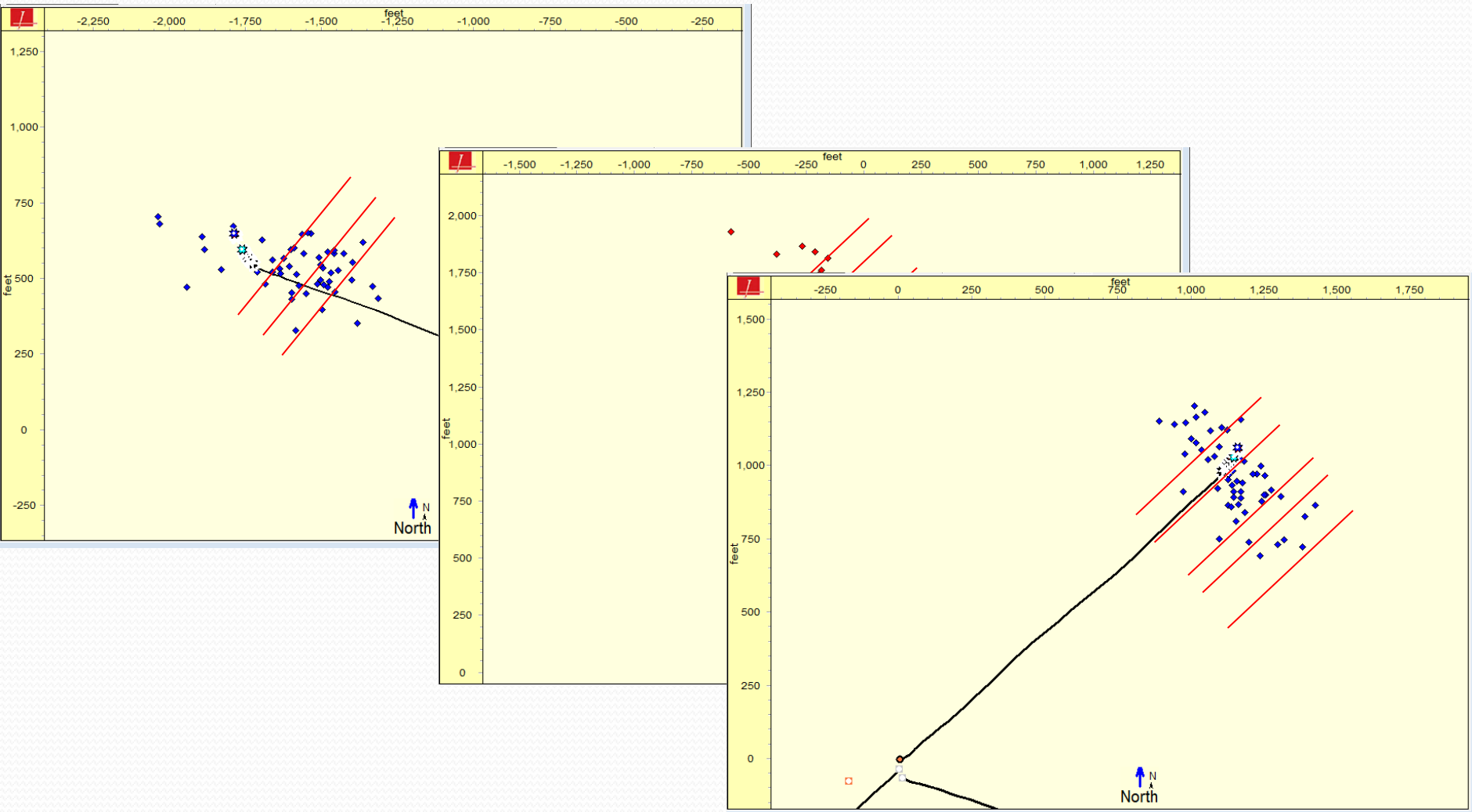


Vertical Partitioning Related to Deformation Bands





Elliptical or circular spacing?



The Future

Trail Field Annual Production: 1958-2011

