

What Can We Learn from Granite Wash Fracture Stimulation Pressure Response?

WHEELER & HEMPHILL COUNTIES, TX

March 6, 2008 – Norman, Oklahoma

Bob Shelley

RED TECHNOLOGY ALLIANCE, LLC

Bill Grieser

HALLIBURTON ENERGY SERVICES, INC.



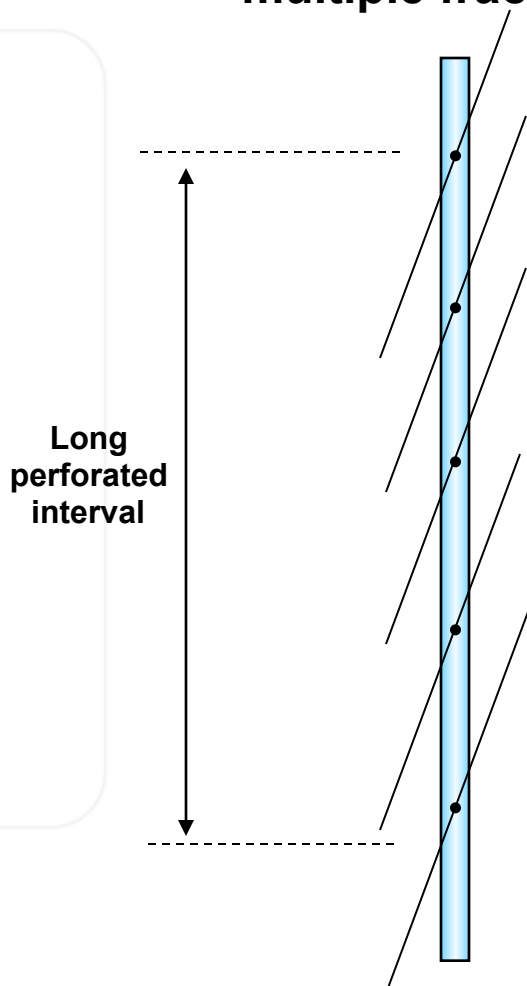
Fracture Stimulation Pressure Response

- A normal fracture pressure tend either increases slightly or remains relatively flat throughout a hydraulic fracturing treatment.
- A decreases in fracturing pressure can be interpreted as excessive fracture height growth or out of zone propagation.
- Moderate increases in net fracturing pressure can be attributed to fracture confinement, tip effects and/or proppant friction.
- Large increases in net fracturing pressure can be explained by the occurrence of multiple fractures and/or proppant bridging.
- We have observed a wide variation of stimulation pressure response (increases) on granite wash treatments. The magnitude of some indicate the presence of multiple fractures.

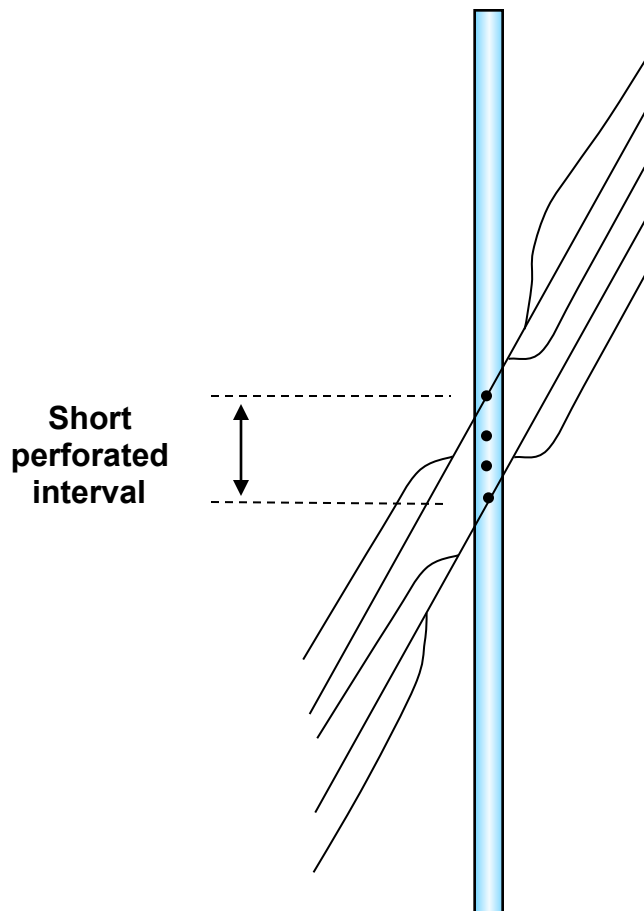


Multiple Fractures

**Completion-induced
multiple fractures**

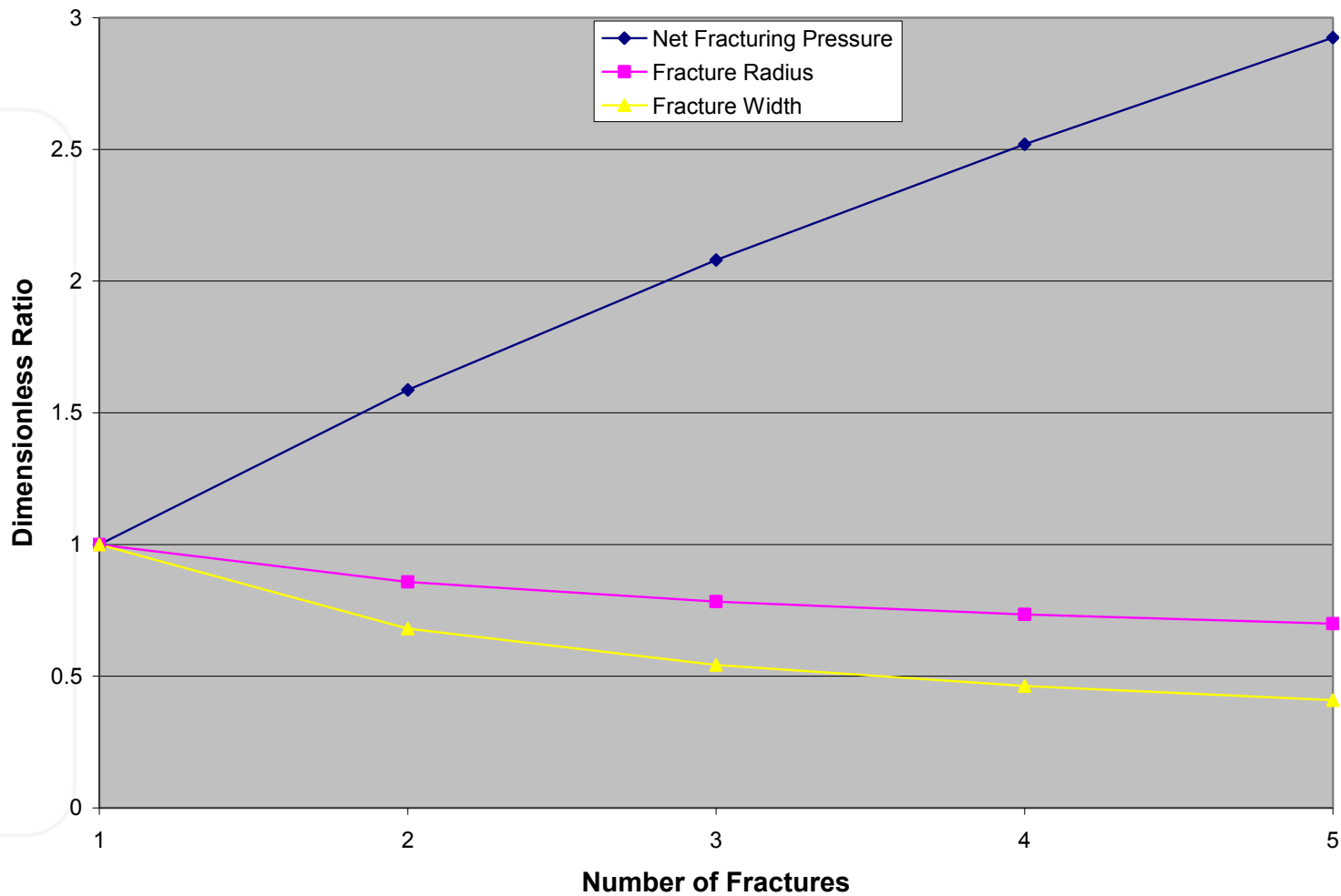


**Formation-induced
multiple fractures**



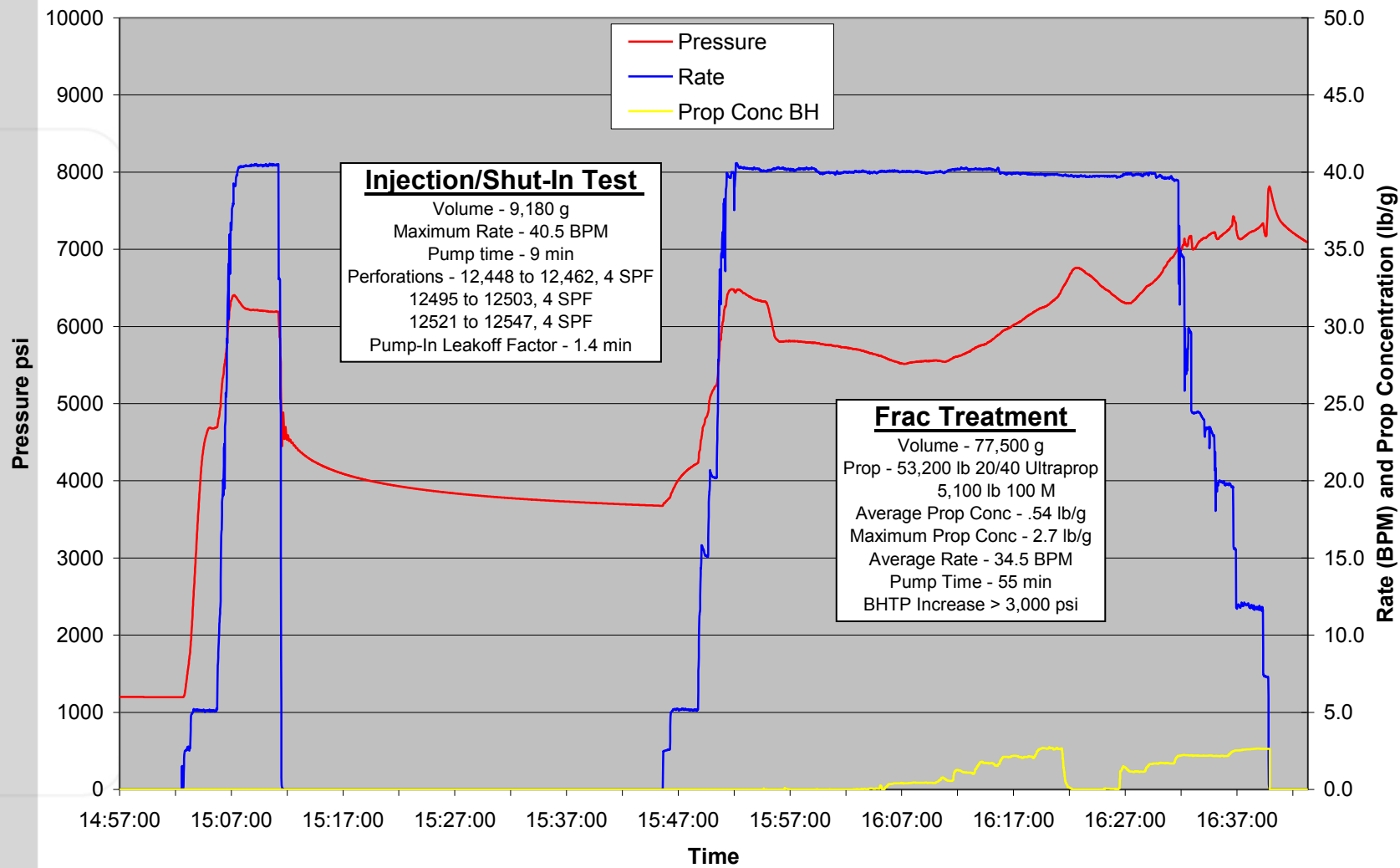


The Effect of Increasing the Number of Propagating Fractures





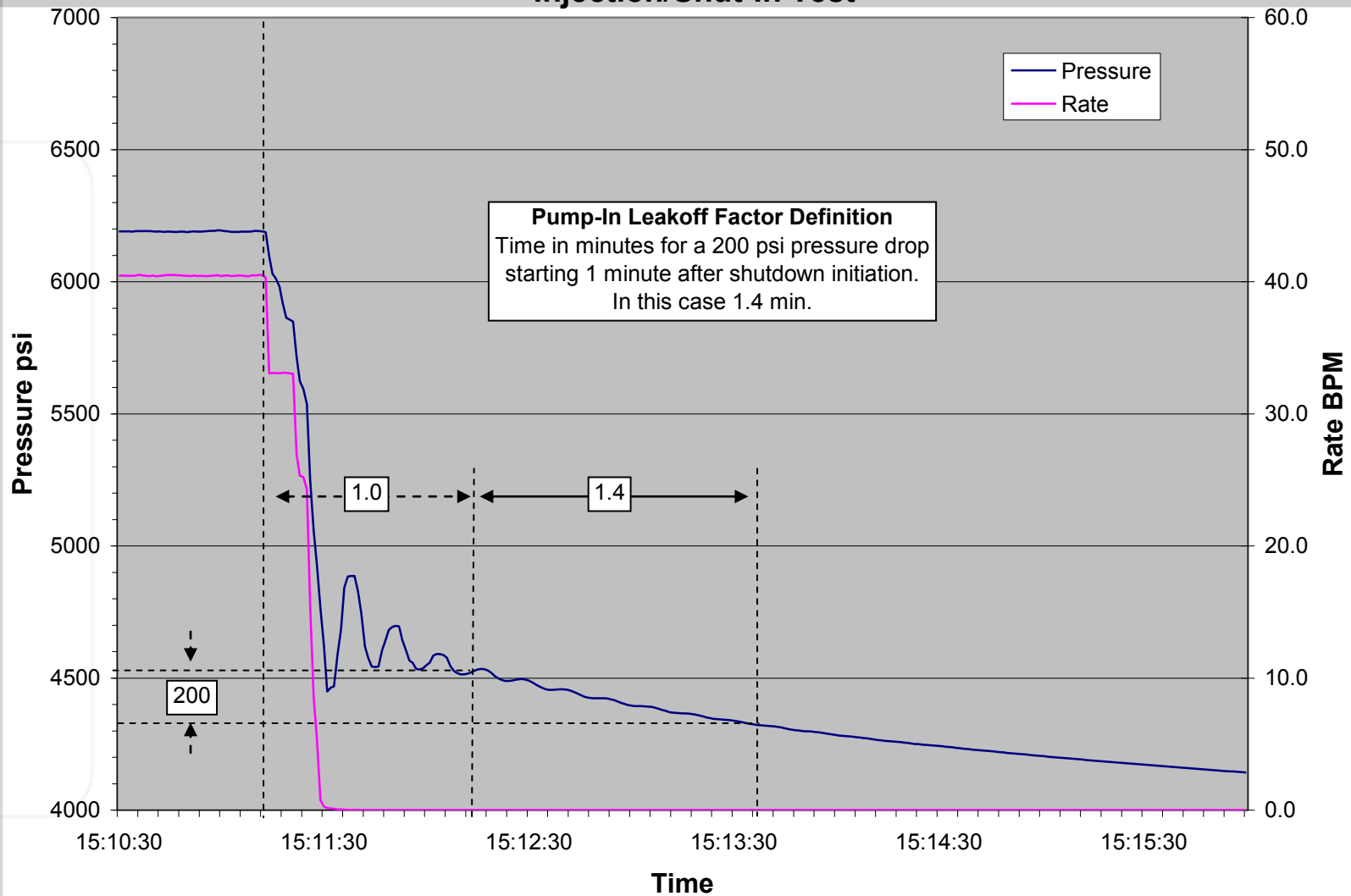
Frac Treatment Pressure Evaluation Methodology





Pump-In Leakoff Factor (PILF) Measurement

Injection/Shut-In Test

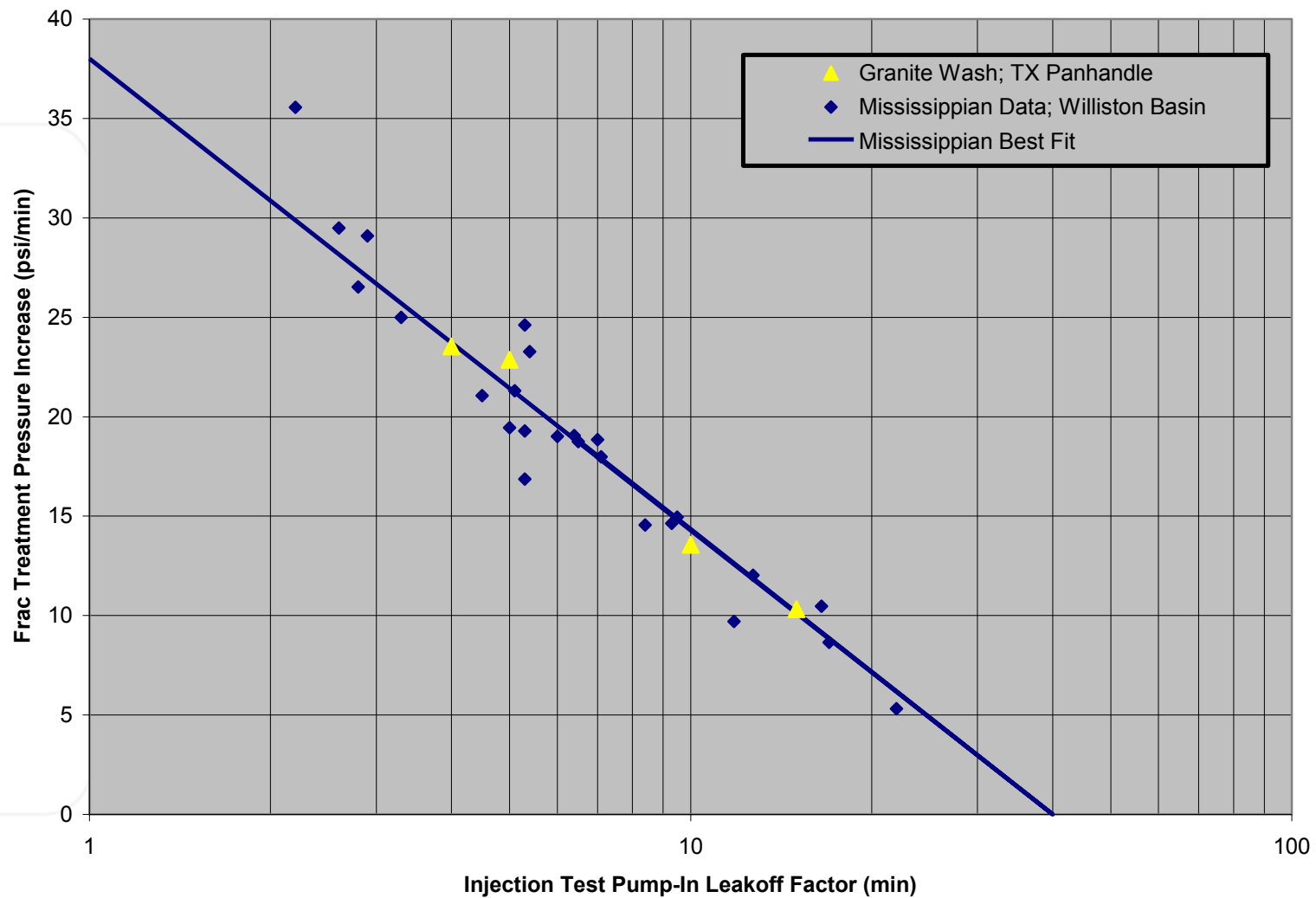


* Granite Wash Treatment Summary

WELL	TOP	BOTTOM	GROSS PERF	RATE BPM	PILF	FRAC TREATMENT PRESSURE RESPONSE
1	11563	11453	110	40	20	Normal - Frac went to completion
2	11495	11388	107	40	22	Normal - Frac went to completion
3	11547	11170	220	60	21	Normal - Frac went to completion
4	11569	11261	210	60	19	Normal - Frac went to completion
5	12340	12284	56	30	4	Screen Out on 2 ppg; 68 min
6	12327	12290	37	30	5	1/1 slope with 1/3rd 4ppg in; 70 min
7	12544	12448	96	50	9	Normal - Frac went to completion
8	12534	12412	122	50	10	1/1 slope with 1/2 6ppg in; 118 min.
9	12348	12274	74	40	14	Normal - Frac went to completion
10	12440	12348	92	50	16	Normal - Frac went to completion
11	12546	12405	141	40	15	1/1 slope with 1/4 8 ppg in; 155 min.

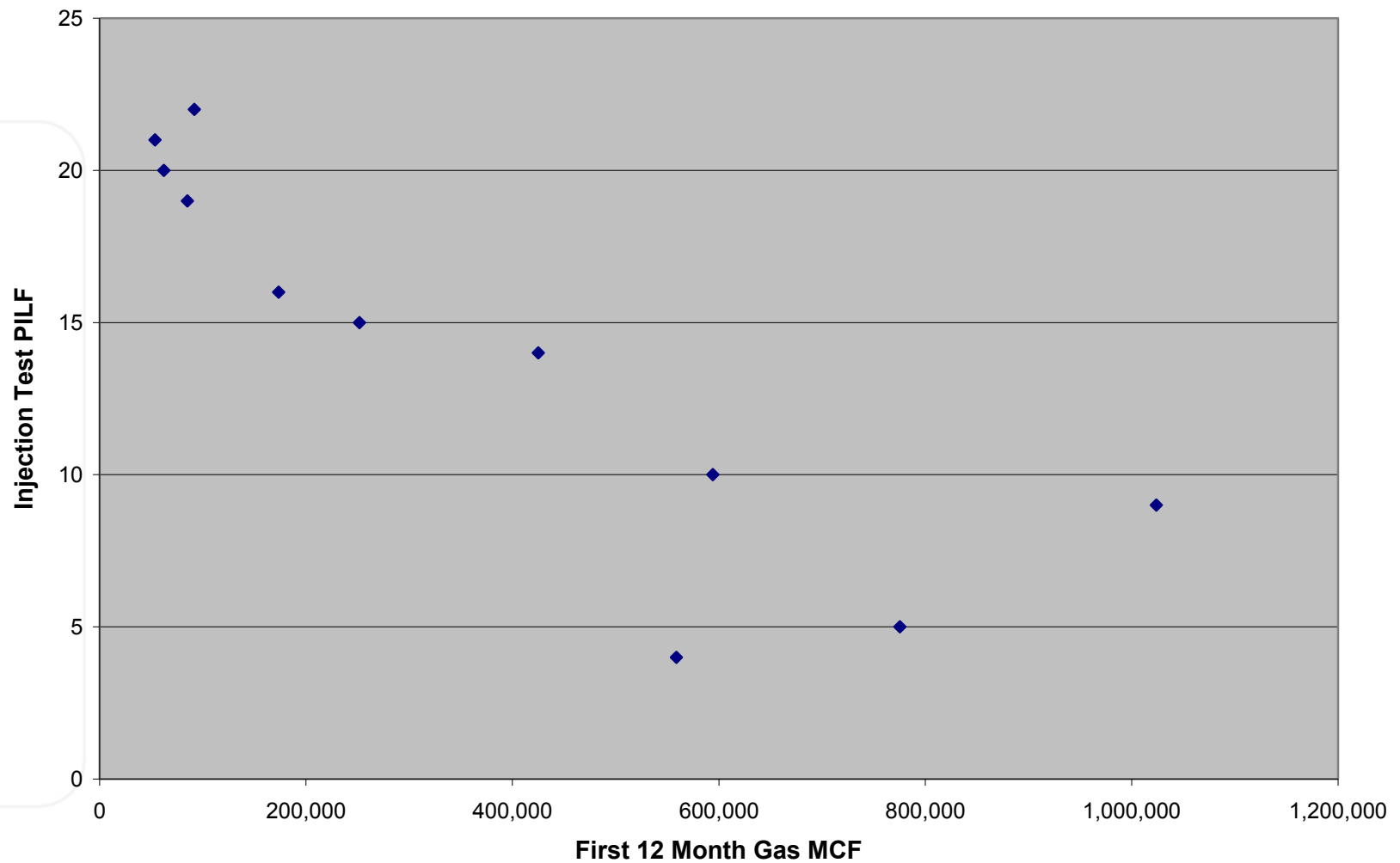


Injection/Shut-In Test PILF vs. Frac Pressure Response





Production vs. Injection/Shut-In Test PILF





Summary

- The Injection/Shut-In Test PILF measurement can be used as an indicator of reservoir productivity (Extent of Natural Fracturing).
- Natural Fractures are needed to obtain Granite Wash Reservoir Connectivity.
- Natural fractures in the Granite Wash contribute to the occurrence of multiple fractures which are detrimental to the placement of large hydraulic fracture stimulation treatments.
- The PILF measurement obtained from an injection/shut-in test can be used to predict hydraulic fracture stimulation pressure response for Granite Wash Frac Treatments.
- The stimulation pressure response observed on granite wash treatments is consistent with the pressure response for other naturally fractured reservoirs such as the Mississippian Carbonates in the Williston Basin.