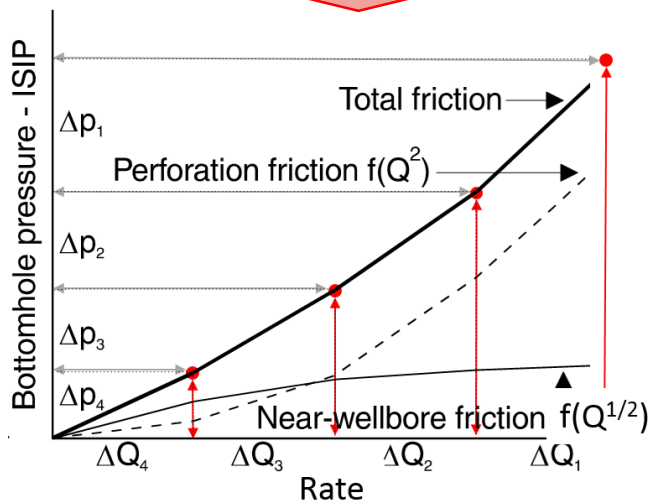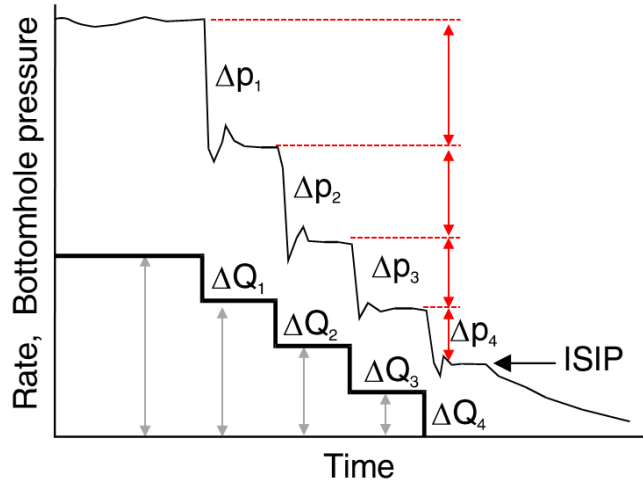# Shooting Holes in the "Perfs Open" Calculation of the Rate Stepdown Test

Liberty Engineering Perspective

Can't Pump Into a Zone?

High entry friction

High perf friction

Severe fracture tortuosity

Re-perforate

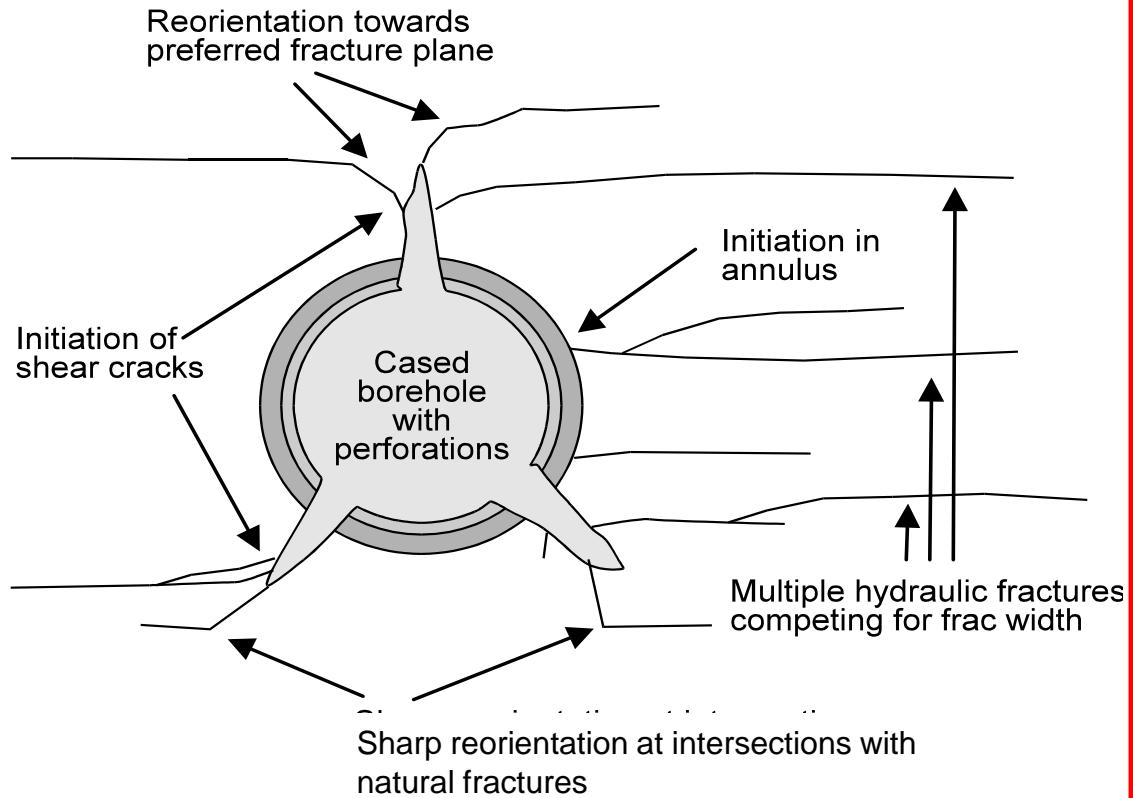Ball-out treatment

Spot acid

Use proppant slugs

Initiate with high viscosity fluid

Increase gel loading

Increase rate

Future wells may have altered completion strategy such as FEWER perfs

*SPE paper 25892 by Cleary *et al.* and SPE 25916 by Martinez e*t al.*

SPE paper 62549 by Weijers *et al.*

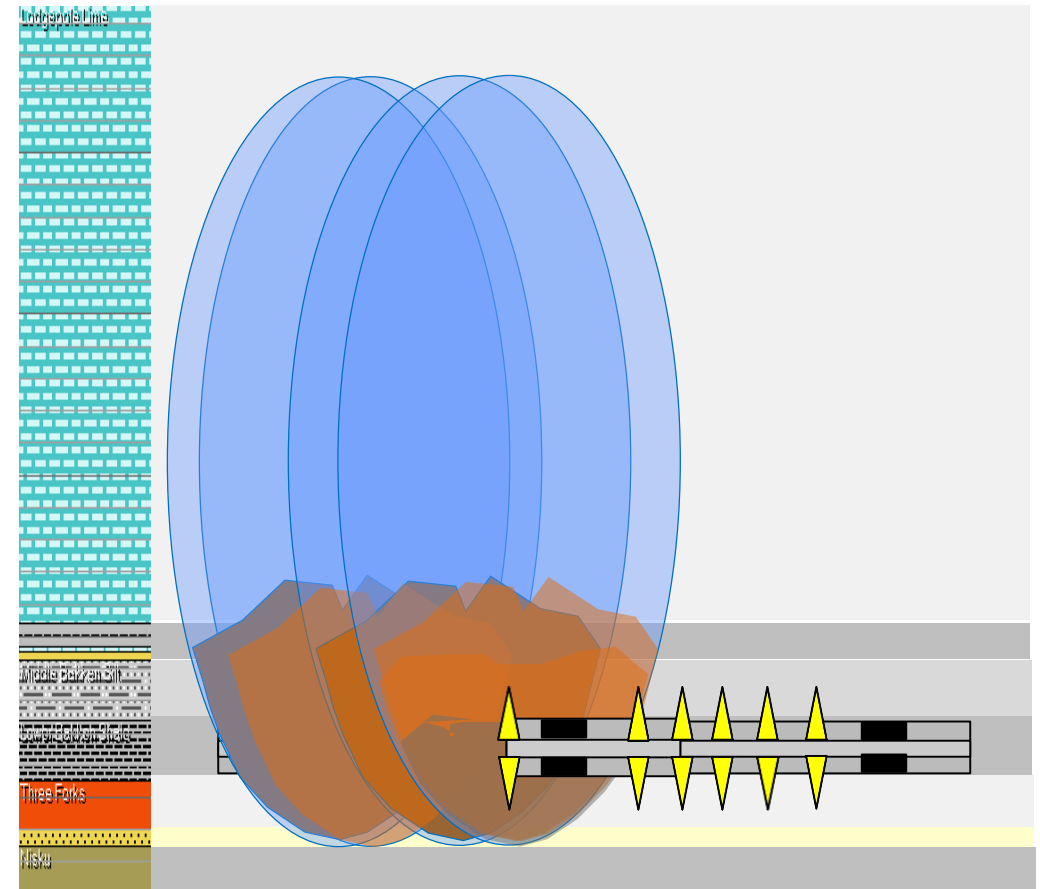LIBERTY

Perforation or Near-Wellbore Friction?

Past S/D Focus
Vertical wells; Proppant placement issues

Reorientation towards preferred fracture plane

Initiation in annulus

Initiation of shear cracks

Cased borehole with perforations

Multiple hydraulic fractures competing for frac width

Sharp reorientation at intersections with natural fractures

Current S/D Focus
Horizontal wells; Reservoir connectivity&open clusters

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Holes in the "Perfs Open" Calculation

Example Stepdown Test Results for Two Perforation Schemes at 80 bpm

Completion Type	Extreme Limited Entry (20 Perfs)
Total Friction @ Surface (psi)	4,000
Wellbore Friction ± Measurement Error (psi)	2,000 ± 400
Entry Friction Downhole (psi)	2,000 ± 400
Near-Wellbore Friction (psi)	300
Measured Perforation Friction (psi)	1,700 ± 400
Estimated Perfs Open	15 - 20

Holes in the "Perfs Open" Calculation

Example Stepdown Test Results for Two Perforation Schemes at 80 bpm

Completion Type	Extreme Limited Entry (20 Perfs)	High Perf Count (100 Perfs)
Total Friction @ Surface (psi)	4,000	2,500
Wellbore Friction ± Measurement Error (psi)	2,000 ± 400	2,000 ± 400
Entry Friction Downhole (psi)	2,000 ± 400	500 ± 400
Near-Wellbore Friction (psi)	300	300
Measured Perforation Friction (psi)	1,700 ± 400	200 ± 400
Estimated Perfs Open	15 - 20	29 - ∞

Not useful

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Holes in the "Perfs Open" Calculation

- Stepdown test provides "the best cheese between the holes"
- Near-wellbore friction not affected by erroneous wellbore friction estimates
- Perforation friction can be significantly affected by erroneous wellbore friction estimates
  - Wellbore friction ($\sim Q^{\sim 1.5}$) has similar rate sensitivity as perforation friction ($\sim Q^2$)
  - Depending on the completion, perforation friction may be small in comparison to measurement error
- In those cases, determining number of perfs open is like…

…. cutting the cheese

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