HALLIBURTON

PowerReach Service: Hybrid Coiled Tubing & Jointed Pipe Technology

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ICoTA

Challenges to Well Intervention

On Surface

- Size and Weight Restrictions
- Reel Capacity
- Foot Print

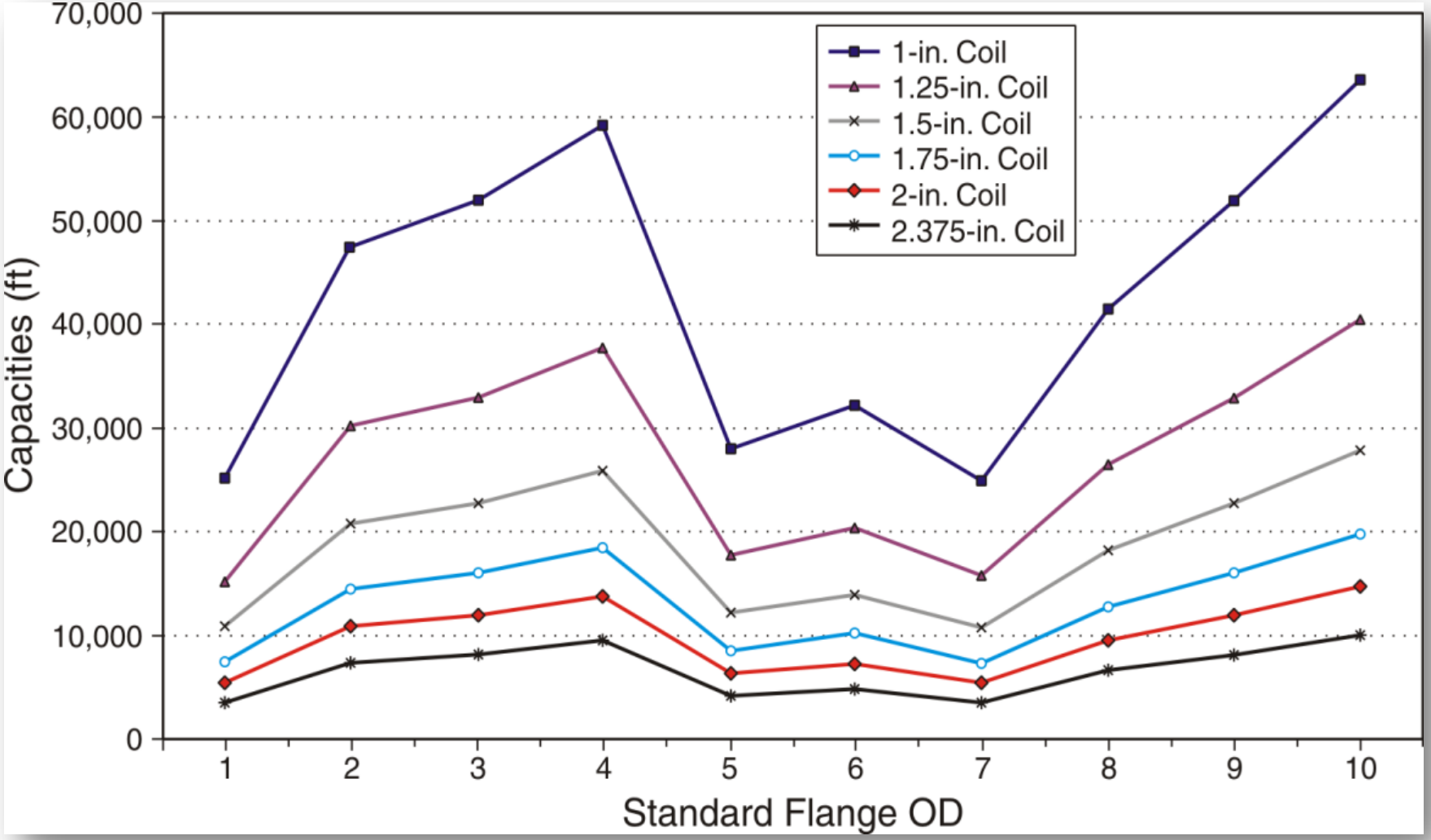
Downhole

- Lockup
- Drilling Plugs
- Wellbore Cleanouts
- Multi-zone Stimulation

Transportation Size and Weight Limits

- Width Limits
- Height Limits
- Length Limits
- Weight Limits

Coil Tubing Reel Capacity



Coil Tubing Lock-up

Coil tubing is more prone to lock-up if:

- Applied to highly deviated or horizontal wellbores
- Applied to wells with high dogleg severity
- Using smaller coil tubing

Drilling Plugs

Limitations to drilling plugs:

- Inability to reach target depth on long, extended wells
- Inability to apply sufficient weight and torque at the bit to drill.

Wellbore Cleanouts

Limitations to wellbore cleanouts:

- Small-OD coil is more prone to lockup
- Small-OD coil limits flow rate
- Long coil lengths present a large capital investment

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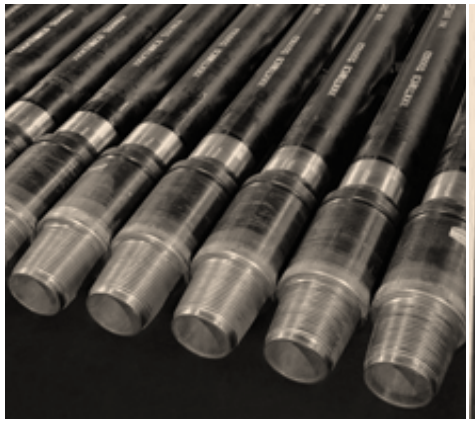
Multi-Zone Stimulation

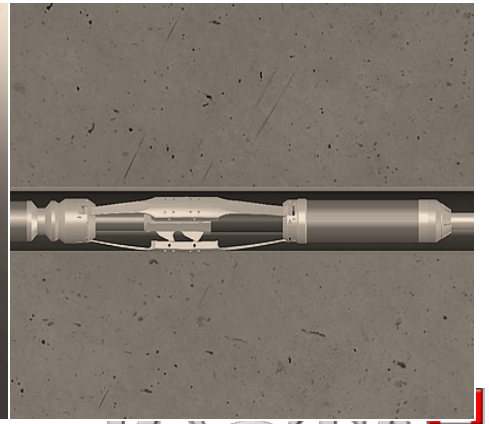
Limitations to multi-zone stimulation:

- The fluid flow rate pumped is limited by pressure and velocity (pumping proppant).
- Remedial options are limited because of rate constraints, increasing risk, and reducing operational efficiency.

Current Solutions

- Jointed Pipe
- Optimal Taper and Pipe Size
- Drag-Friction Reducing Fluids
- Mechanical Deep-Reach Aids



Jointed Pipe

Limitations to of Jointed Pipe:

- Slower pipe-running speed compared to using CT
- Personnel in work basket while moving pipe
- Cannot circulate fluid continuously while making up pipe joints
- Remedial options are restrained

Tapered Coil Tubing

Limitations to of Tapered Coil Tubing:

- Limited flow rate
- Restricted by reel capacity
- Design constrained by local weight and height restrictions
- High cost
- Specially set up injector

Friction Reducing Fluids

Limitations to of Friction Reducing Fluids:

- High cost
- Possible modeling inaccuracies when determining concentrations
- Compatibility issues
- Logistics
- Human error when mixing and pumping
- Quality control

Mechanical Aids

Limitations of mechanical deep-reach aids:

- High cost
- Compatibility with proppant-laden fluids
- Tractor dimensions will limit pump rates
- Not applicable to all CT applications
- Reliability and vulnerability to hole conditions may be problematic

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Hybrid System

Winner of the
2010 World Oil Award
For Best Completion
Technology

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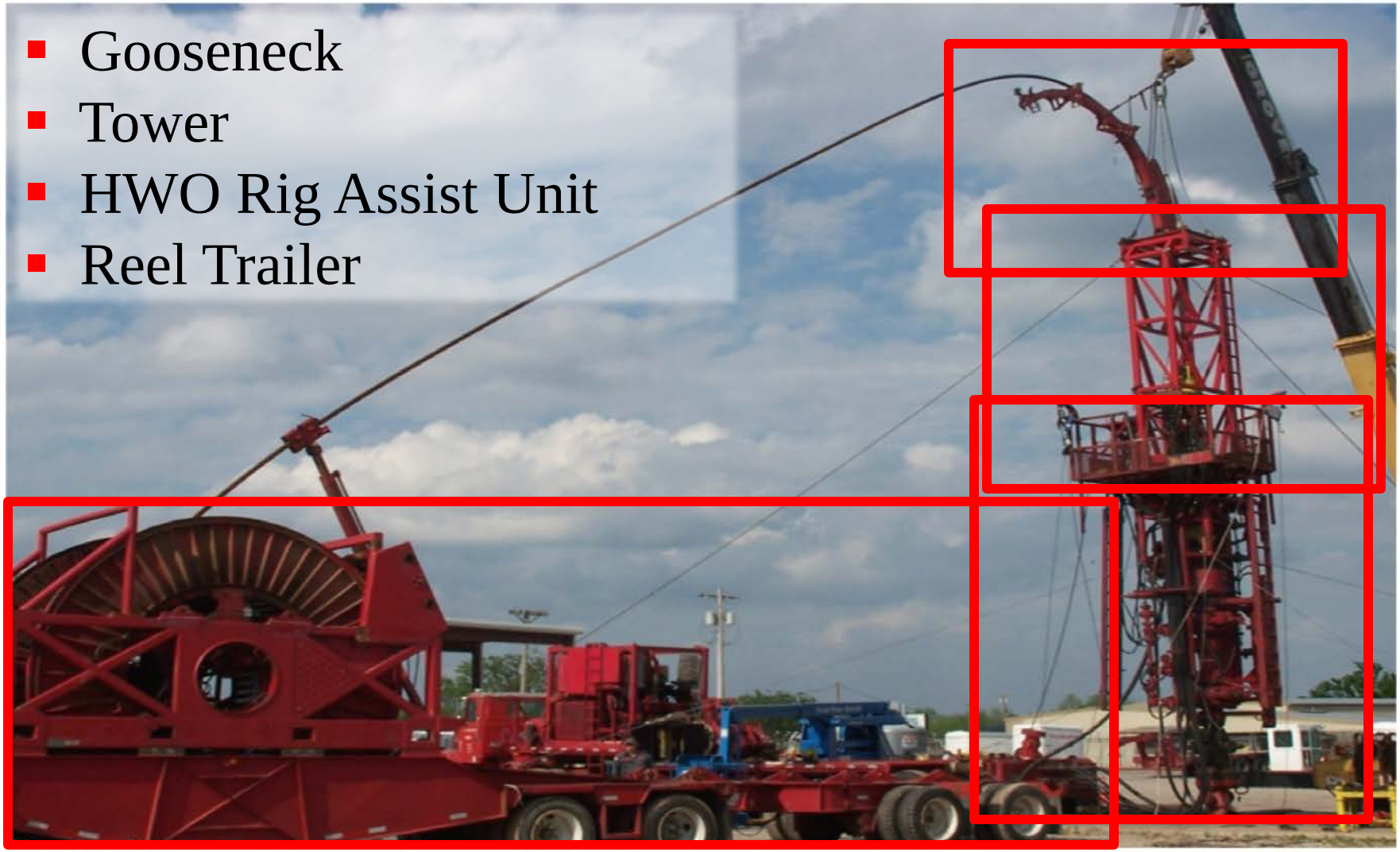
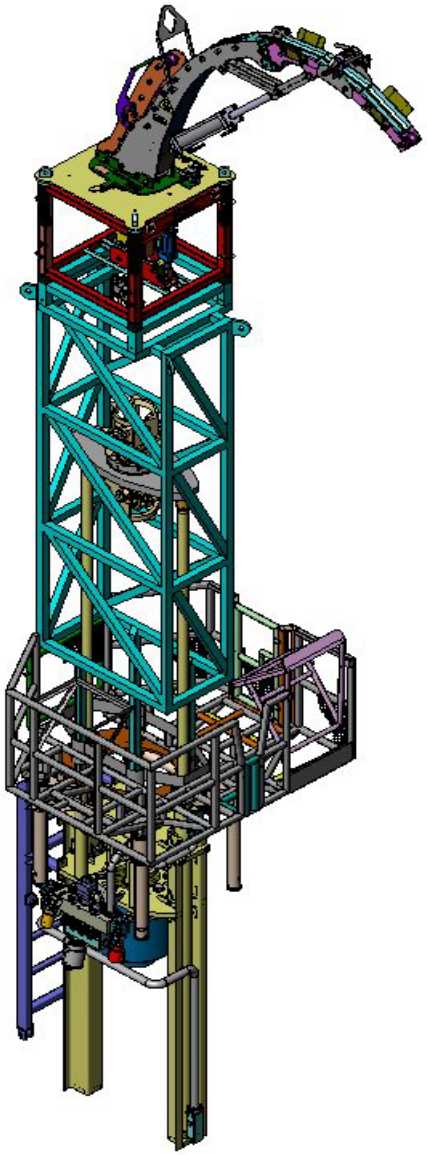
Hybrid System – What is it?



Hybrid System – What does it do?

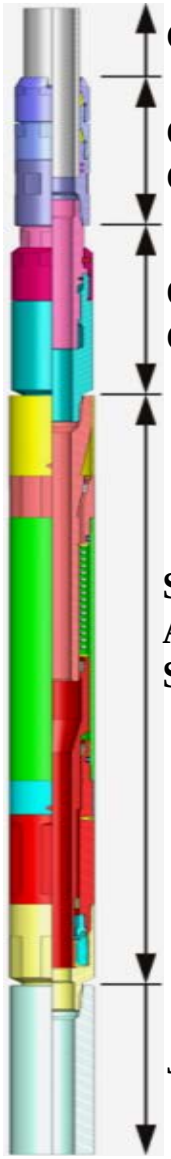
- HWO unit runs jointed pipe and CT
- Rig-less operation
- Well control package – no wireline
- Deeper penetration before lockup
- Higher pull/push capacity
- Can apply more force at TD for drill-outs
- Enables higher pumping rates
- Forward and reverse circulation
- Safe and effective operations
- Cost saving



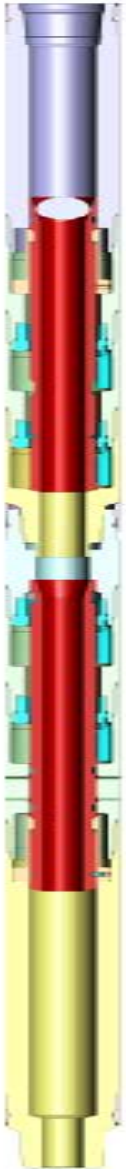
Hybrid System – Where can it be used?

- Multi-zone stimulation
- Wellbore cleanout
- Drilling
- Remedial cementing
- Gravel packing
- Cutting windows
- Conformance
- Screen repair
- Fishing operations
- Well control

Well Control Safety Valves

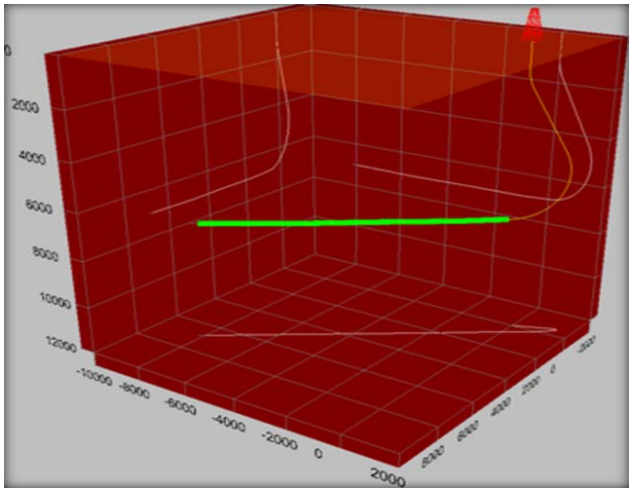


Closed Position



Open Position

Coil Tubing vs. Hybrid System



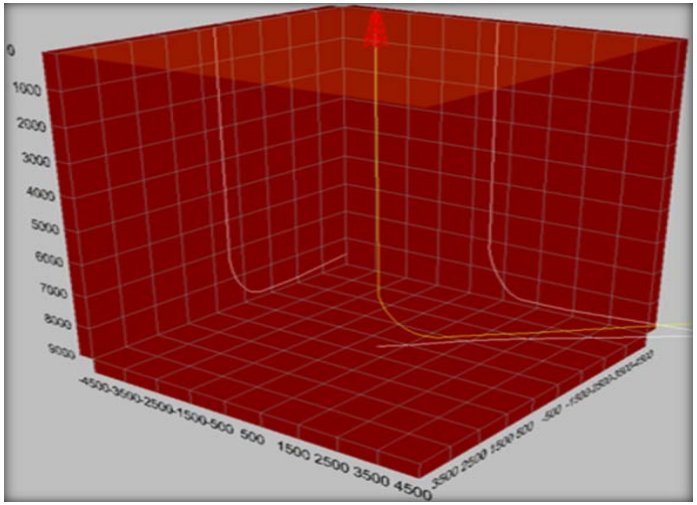
Deep Well 1

- 10 3/4-in. casing to 8,368 ft MD
- 7-in. liner to 18,368 ft MD (TD),
- Lateral from 9,500 ft MD to TD.

Solution

- Coil Tubing: 18,420 ft of 1 3/4-in. CT to TD
- Hybrid: 10,080 ft of 2 3/8-in. CT can be run in conjunction with 2 3/8-in. jointed pipe to TD

Coil Tubing vs. Hybrid System



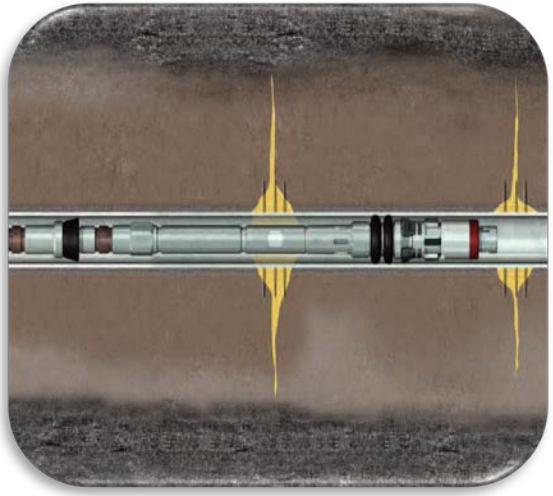
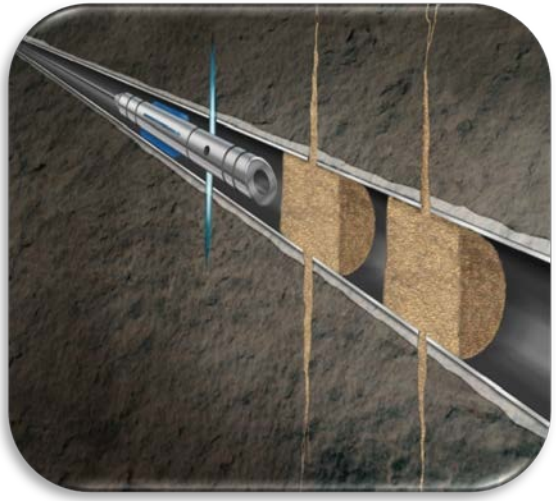
Deep Well 2

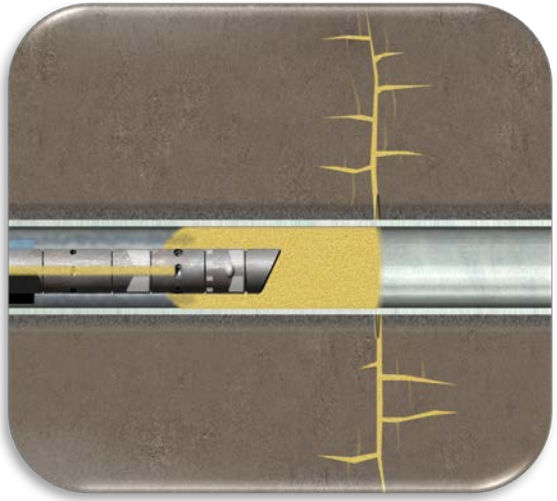
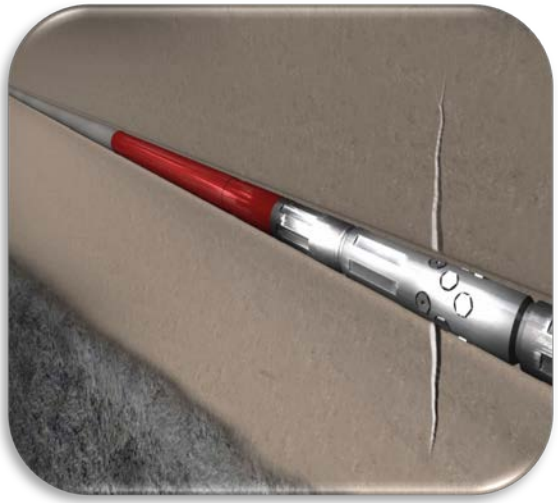
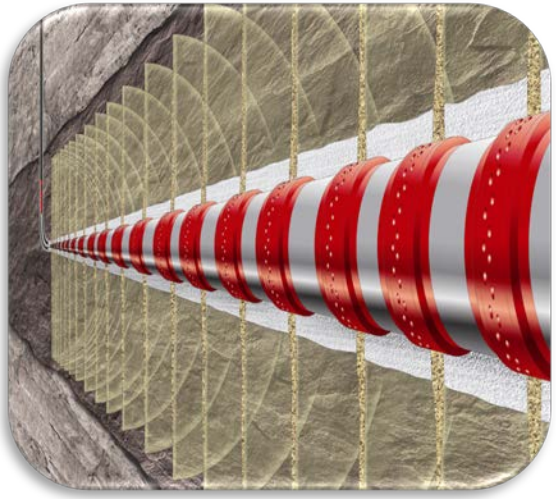
- 5 1/2-in. casing to 16,000 ft MD
- Lateral from 9,573 ft MD to TD.

Solution

- Coil Tubing: Using 1-3/4-in. CT, even after manipulation of the friction factor to simulate friction reducing aids, target depth could not be reached.
- Hybrid: 10,000 ft of 2 3/8-in. CT run in conjunction with 2 3/8-in. jointed pipe can be used to reach target depth.

Pinpoint Stimulation

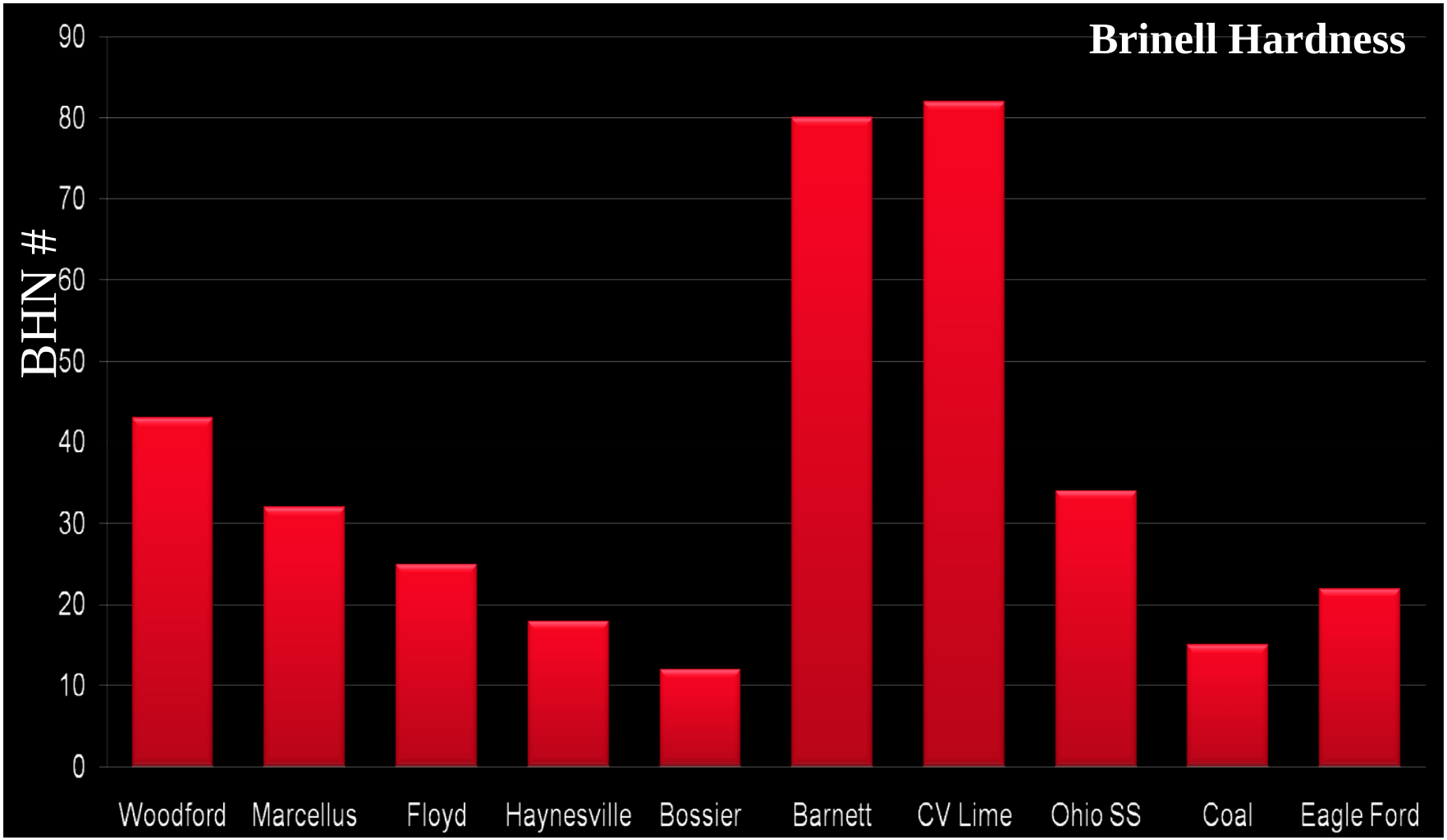



What can you do with two flow paths?

- Efficiently place single fracs
  - Rate per interval
  - Fracture /proppant placement
  - Reduced HHP requirement & footprint
- Circulate
  - Hydrajet perforate
  - Re-perforate
  - Spot acid/pad/treatment
  - Zero flush
  - Cleanout premature screenout
- Manage screenout risk
  - More aggressive frac designs
  - Higher proppant concentration
  - Larger proppant
  - Place higher conductivity
  - Shorter ramps, less fluids, less time
- Downhole Mixing
  - Higher rates
  - Real-time prop conc control at perfs
  - Real-time reservoir response
  - Far-field diversion
- Zonal isolation
  - Sand plug setting
  - Dynamic diversion (Bernoulli effect)
- Dead-leg Pressure Interpretation

Increase Stimulated Reservoir Volume



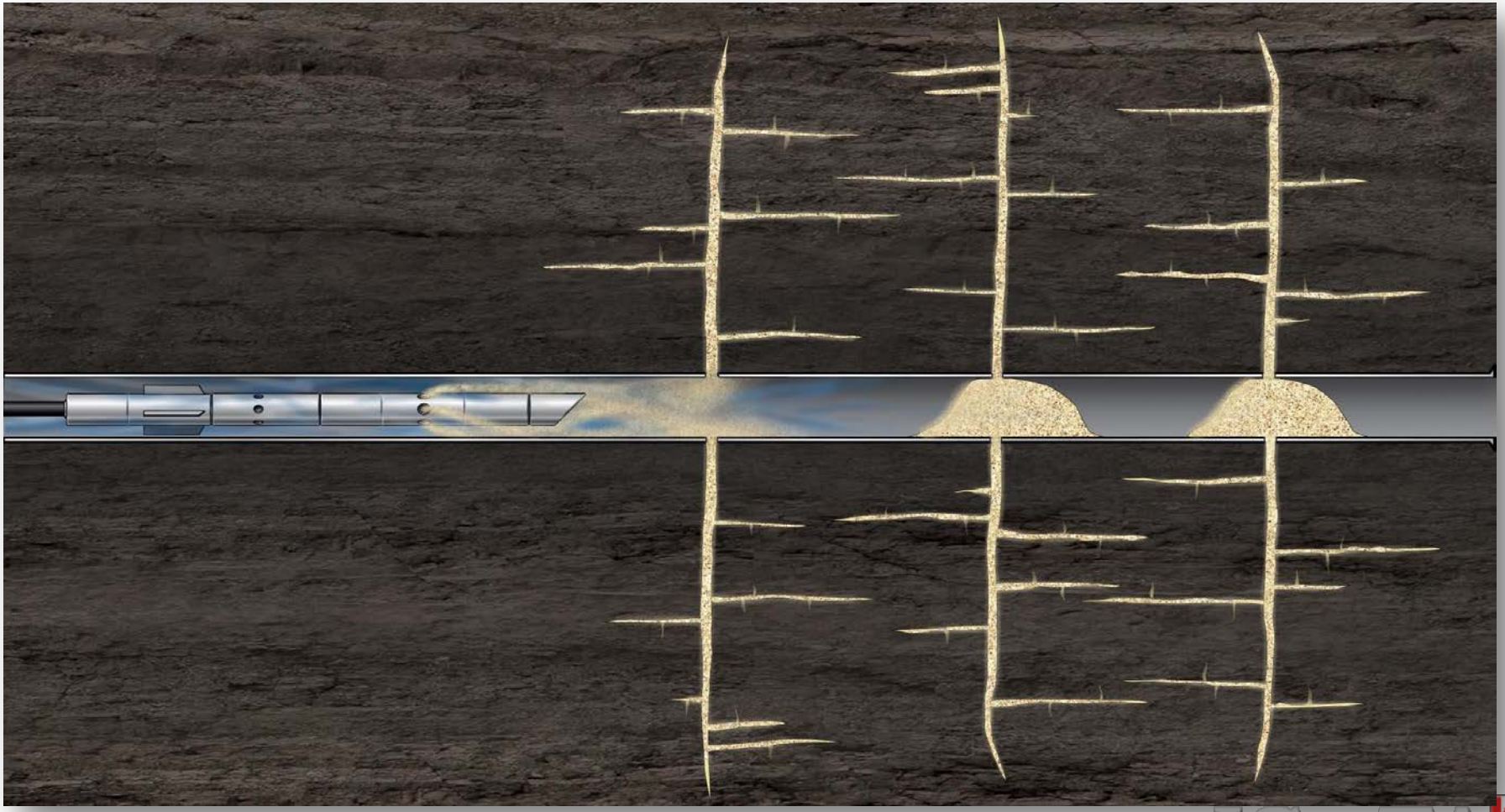
Fracture Intensity in Ductile Rock

CobraMax HJA

- Improves the process of setting proppant plugs to isolate intervals
- Reduces the time between intervals of a multi-stage fracturing treatment
- Improves Hydra-Jet service performance

Reservoir Diversion in Moderately Brittle Rock

CobraMax ® DM



CobraMax DM Benefits

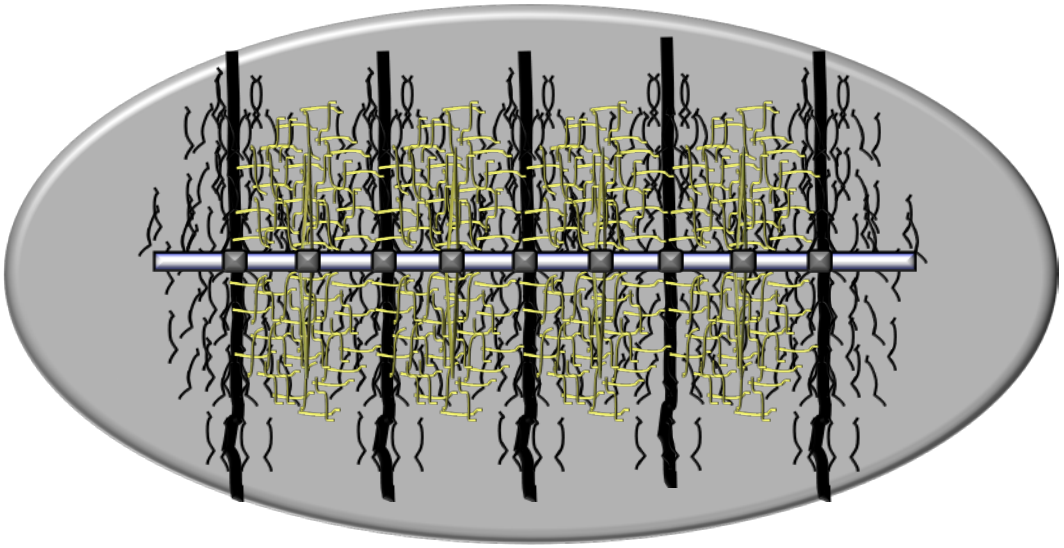
Benefits

- Low Risk:
  - Ability to prevent screenouts and rapid screenout recovery.
- Operational efficiency:
  - Complete job & cleanout in one trip.
  - No need to drill out plugs
  - Reduce footprint on location
- Stimulation effectiveness:
  - Customize every fracture treatment – respond to the rock.
  - Accurately place every fracture.
  - Place proppant accurately and deeper into the reservoir.
  - Maximize near wellbore conductivity – no overflushing.
  - Induce far-field reservoir diversion to increase stimulated reservoir access.

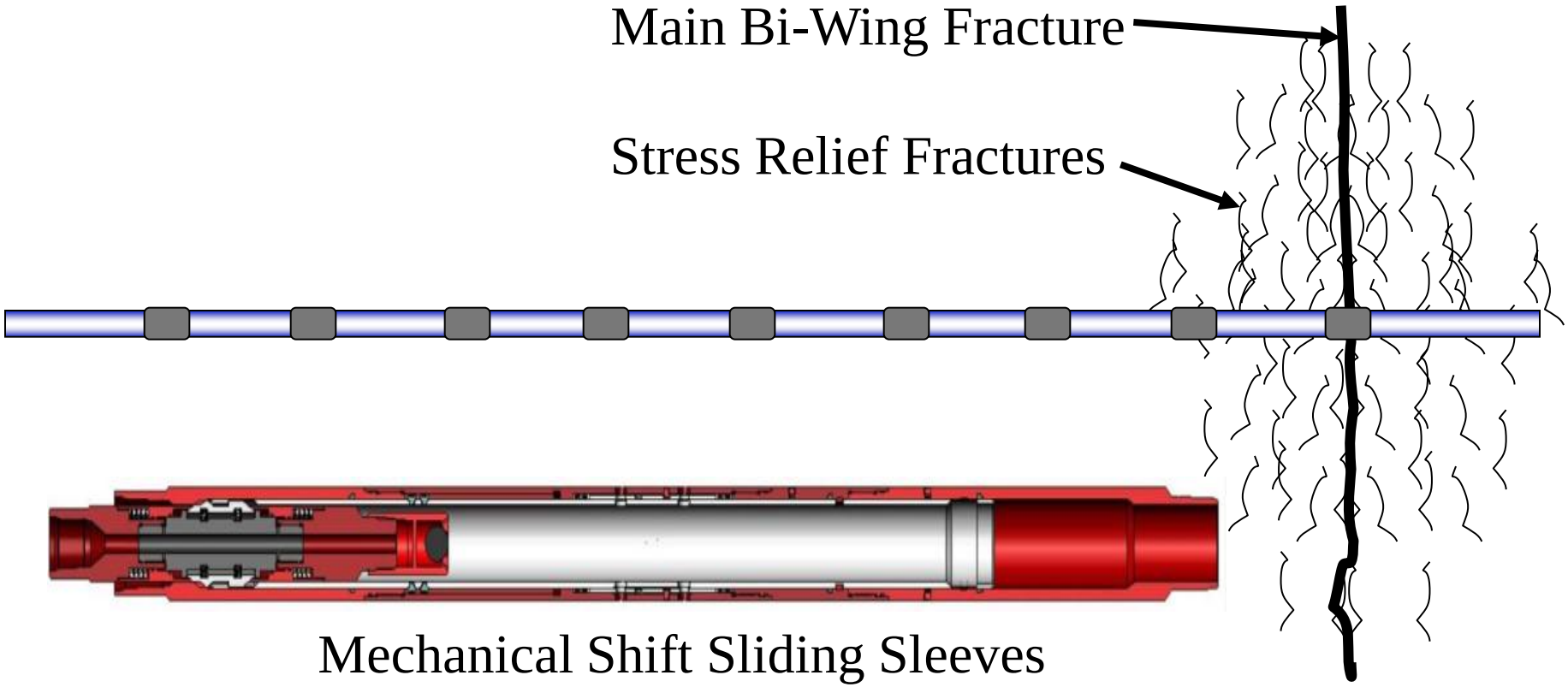
Stress Induced Complexity in Brittle Rock

Reduce or possibly reverse the stress anisotropy in brittle rock by applying alternating sequence fracturing.

- Individual interval treatments using mechanical shift sliding sleeve
- Optimize fracture treatment using downhole mixing
- Accurate proppant placement
- Low contingency cost



Alternate Sequence Fracturing

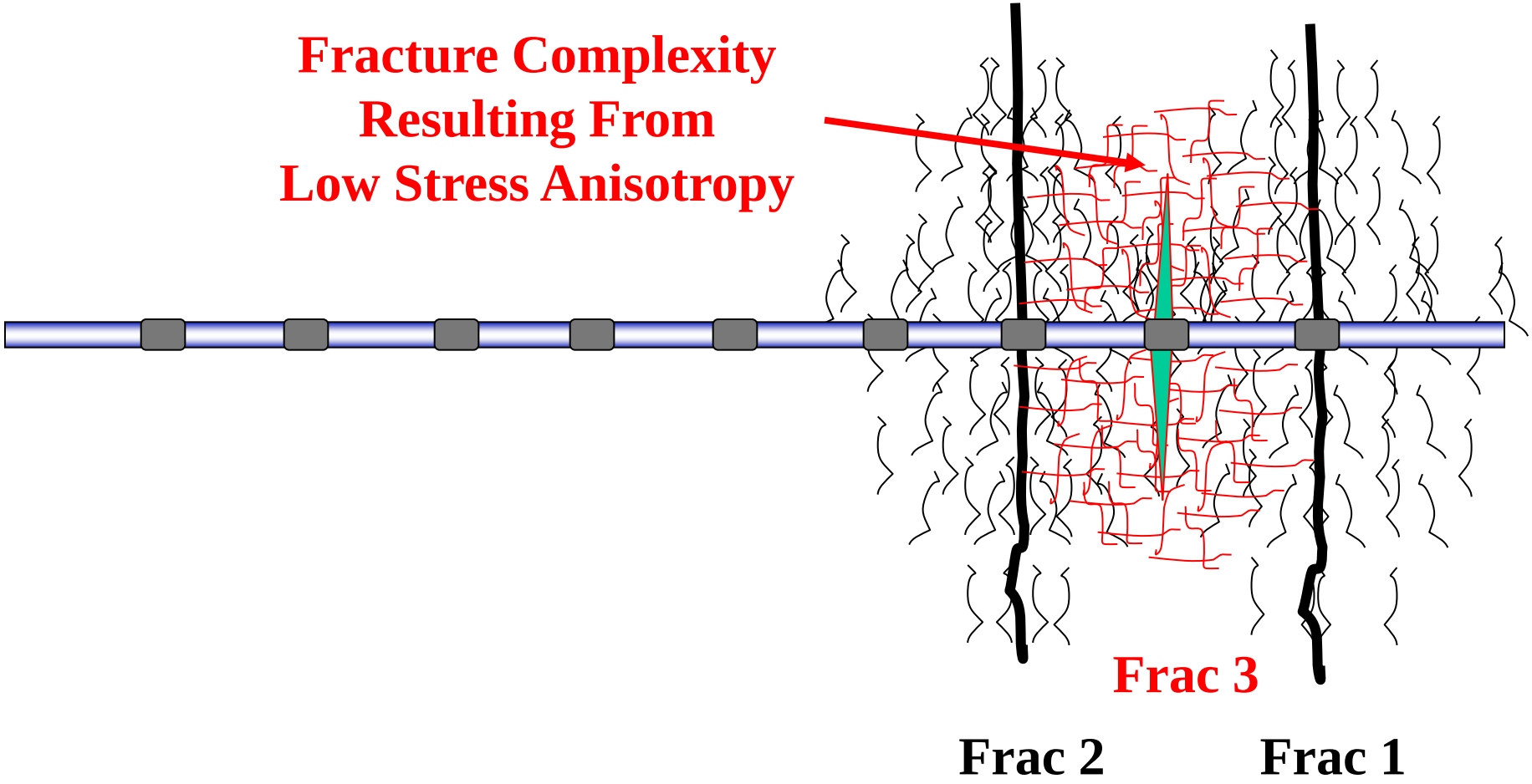


Mechanical Shift Sliding Sleeves

Delta Stim Completion

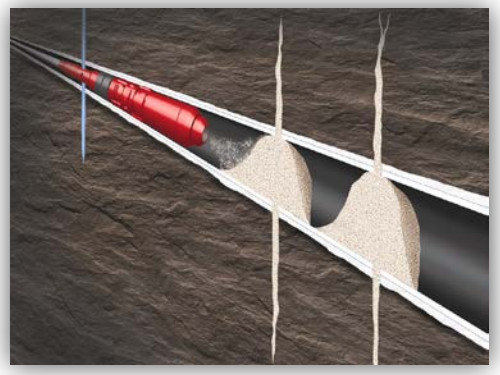
Frac 1

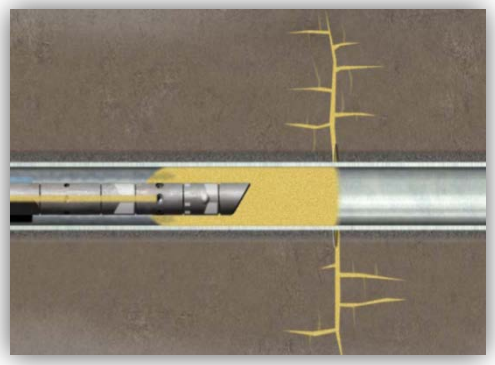
Alternate Sequence Fracturing

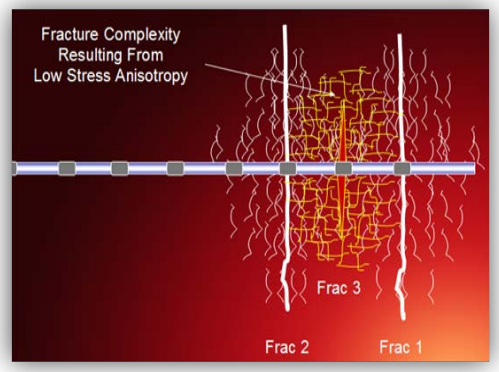


Multi-Zone Stimulation Using PowerReach

- Maximize Stimulation Reservoir Volume.
- Reduce overall completion time.
- Customize every fracture treatment.
- Accurately place every fracture.
- Place proppant accurately into the fracture.
- Maximize near wellbore conductivity.
- Reduce Risk of Excessive Non-Productive Time.







PowerReach Conclusions

- Reach deeper deeps before lockup
- Gain the efficiency of coil tubing at deeper depths
- Reduce completion time by hanging jointed pipe
- Provides complete well control
- Higher flow rates can be achieved
- More weight on bit can be applied

Questions?