Insights Into Refracturing

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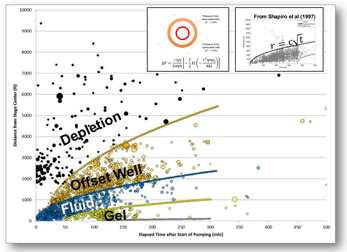
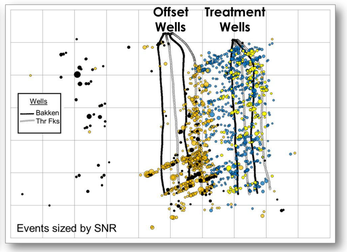
Frac Hits on Offset Producers

Frac hits can occur on offset producing wells when well spacing is too tight.

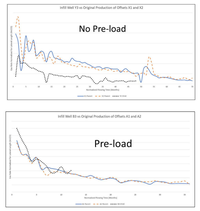
URTEC: 2670043





Mitigation Strategies

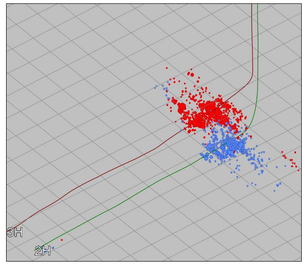
- Shut in nearby parent wells
- Abandon nearby parent wells
- Keep parent flowing during child frac
- Small pre-loads of parent wells
- Refrac's of parent wells
- Large pre-loads of parent wells
- Co-development of wells(zipper frac's, offsetting clusters)
- Pressure barrier

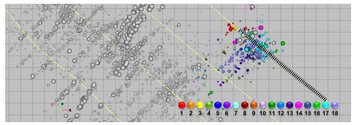


SPE-194374-MS

Bullhead Refrac's of Parent Wells

Results in predominance of microseismic activity towards heel of well and restimulation does not progress to toe





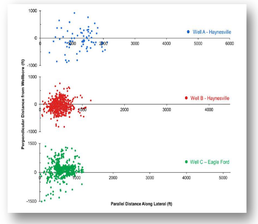
Microseismicity prior to treating with diverters

- Diverter alone does not solve the problem

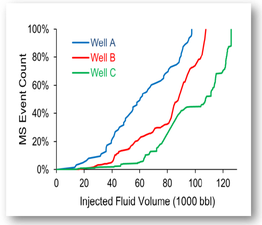
Microseismic Observations

Pressure drop along lateral results in higher pressures at heel casing a blowout. A time lag between start of pumping and onset of microseismic activity is observed.

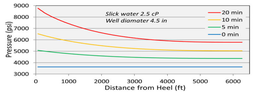
Microseismicity Along Lateral



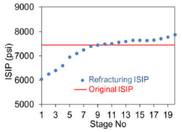
Event Count vs. Injected Fluid Volume



Pressure Drop Along Lateral



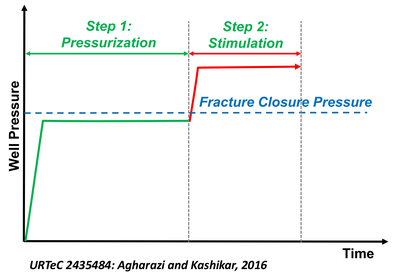
ISIP's Along Lateral



URTeC 2435484: Agharazi and Kashikar, 2016

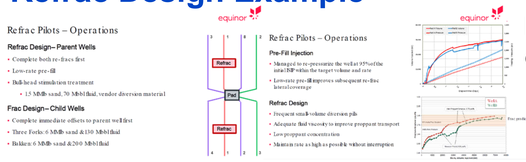
Optimized Re-Stimulation

A low-rate, long-duration pressurization step keeps pressure below fracture closure pressure and encourages re-pressurizing entire lateral. A high-pressure stimulation step initiates shear failures on critically stressed fractures.



URTeC 2435484: Agharazi and Kashikar, 2016

Refrac Design Example



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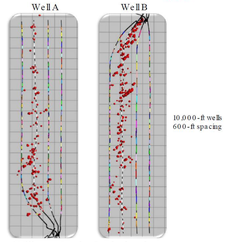
Obervations Using 2-Step Method

A Observations show microseismicity occurring from heel to toe along lateral.

Surface Microseismic Data

Key Observations

- Possible to stimulate >75% lateral with diversion job in un-cemented well (10,000-ft lateral)
- Lateral coverage shrinks over time
- Results confirmed in subsequent Microseismic survey



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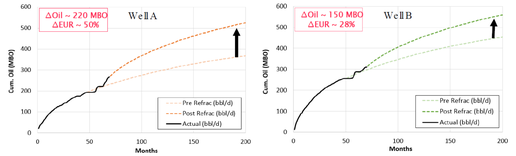
Increased Parent Well Production

Parent well shows up to 35% uplift



- Refracs demonstrated substantial EUR uplift (+35% range)
- Initial rate improvement over 5 x pre-refrac with sustained pressure support
- Refracs were economical by themselves (ie. w/o including potential benefits on child wells)

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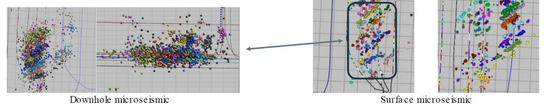
Pre-Load Saves the Child Wells Too

Pressurizing parent well reduces fluid propagation of child well towards depleted parent well

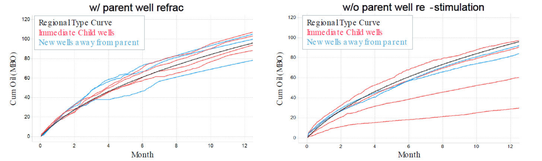
Limiting Asymmetry on Child Wells

Key Observations

- Observed severe fracture asymmetry toward parent wells w/o parent well re-stimulation
- Refrac lessened asymmetry toward depleted well
- Refrac contributed to better fracture placement, and therefore better production of child wells



Child Well Production



- Thanks to parent well refrac, production of child wells immediately next to parent well is consistent with the average well performance in the area
- Production loss >25% is common for immediate child wells otherwise

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Conclusions

Refrac'ing parent well using Two-Step method allows effective stimulation of parent well without installing a new well liner.
Parent well shows up to 35% uplift
Offset child wells performance mimics local typical type curve and minimizes fluid loss to nearby depleted parent wells.

MicroSeismic FracPx KARST ALERT MicroThermal ENERGY CO2SeQure