

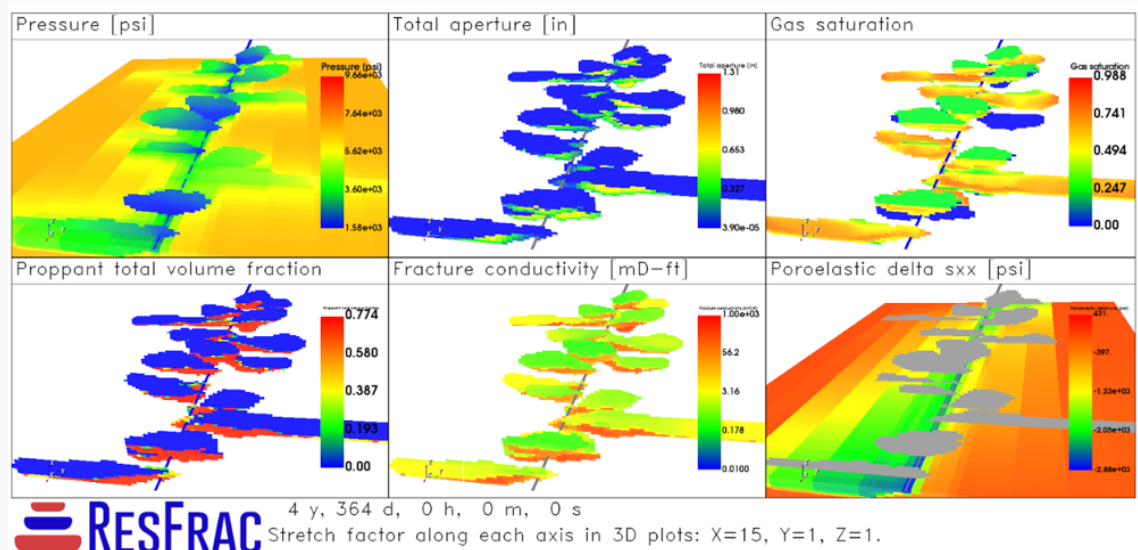
# Simulate the entire life cycle of an unconventional well in a SINGLE SIMULATION

ResFrac is the first three-dimensional, fully compositional simulator to seamlessly couple hydraulic fracturing, wellbore, geomechanical, and reservoir simulation. A single simulation captures the life-cycle of an unconventional well or pad: hydraulic fracturing, shut-in, closure, production, and any subsequent child fracturing or refracturing.

By coupling processes throughout the life of a well into a single simulation, ResFrac more accurately models well performance and is uniquely capable of modeling parent-child relationships, shale EOR, refracs, and more in an integrated platform that provides a collaboration platform across the many technical petroleum disciplines.

Combining these capabilities allows frac designs to be compared directly on the basis of predicted production instead of relying on proxies or laborious handoffs between softwares. Handoffs from fracture simulators to RTA or reservoir simulators are often 'black box' and involve a loss of information and physics. ResFrac avoids these problems by seamless simulating fracturing and production together, in a single simulation run.

## FULLY INTEGRATED HYDRAULIC FRACTURING AND RESERVOIR SIMULATION



a. Screenshot above shows pressure distribution post-fracturing in fracture and matrix (top left). Proppant distribution (bottom right) holds the fracture open, creating fracture aperture (top center). Higher aperture allows for higher conductivity areas (bottom center). Gas saturation (top right) varies as a function of geologic layer and fracture pressure, where greater drawdown results in higher production and larger poroelastic stress changes (bottom right).

RESFRAC SHORTENS THE HYDRAULIC FRACTURING LEARNING CURVE, ALLOWING USERS TO COLLABORATE AND TEST NOVEL IDEAS IN A DIGITAL ENVIRONMENT BEFORE GOING TO THE FIELD.

## EVALUATE DESIGNS BASED ON PRODUCTION FORECASTS

- No need for unreliable proxies or complex hand-offs between software
- Entire life cycle in a single simulation

## INDUSTRY-LEADING REALISM IN FLUID FLOW AND PROPPANT TRANSPORT

- Fracture fluid flow includes multiphase, non-Darcy, and non-Newtonian flow effects
- Proppant transport includes bulk gravitational convection, gravitational settling, hindered settling, clustered settling, screenout, and the effect of proppant on slurry viscosity
- Model a wide variety of fluid additives: tracers, non-Newtonian fluids, crosslinking gels

## COLLABORATE ON A SINGLE SOFTWARE

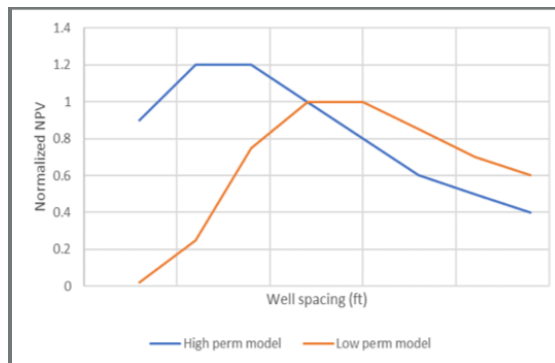
- Simulating the entire life cycle of unconventional wells in one model requires inputs from geology, geomechanics, completions, reservoir, and production experts
- Customers use ResFrac as a platform to facilitate collaboration between disciplines and to distill the various perspectives into a coherent model

## SIMULATE COMPLEX FRACTURING OPERATIONS

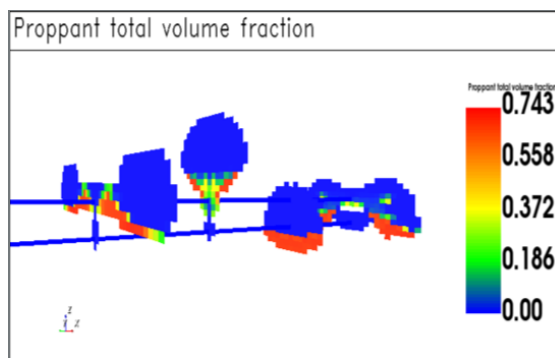
- Multi-well pads, parent-child wells, and/or refracturing in a single simulation
- Model appropriate timing of fracs: zipper, sequential, simultaneous, etc.
- Simulate EOR and IOR in unconventional wells: CO<sub>2</sub> injection, miscible gas, etc.

## BROAD APPLICABILITY

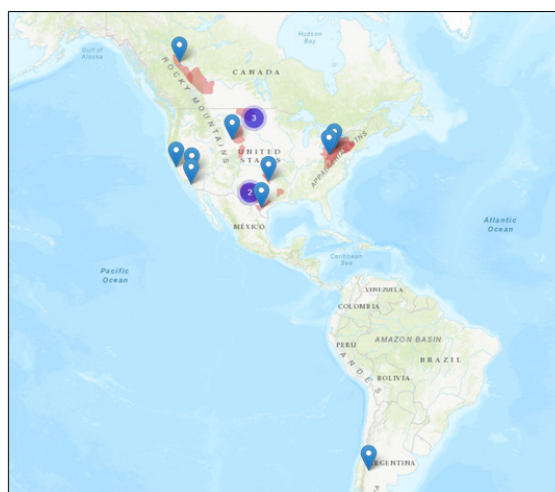
- ResFrac is a full physics model making it equally applicable to
- ResFrac is used by more than 25 operators across every major shale play



b. NPV analysis for well spacing with high and low permeability assumptions



c. Fracture collision during child well frac with remobilization of proppant in parent (upper) well



d. ResFrac is being used in every major shale play in the Americas: Midland, Delaware, Eagle Ford, Bakken, Utica, Marcellus, Vaca Muerta, SCOOP/STACK, Power River, Montney, and Haynesville