SUBSURFACE ALLIANCE

DATA DRIVEN | SCIENCE BASED | FIT-FOR-PURPOSE

Make sure to check the boxes before you FRAC:

- ☑ Geomechanics
- ☑ Diagnostic Tests
- ☑ Reservoir Integration
- ☑ Redesign Options

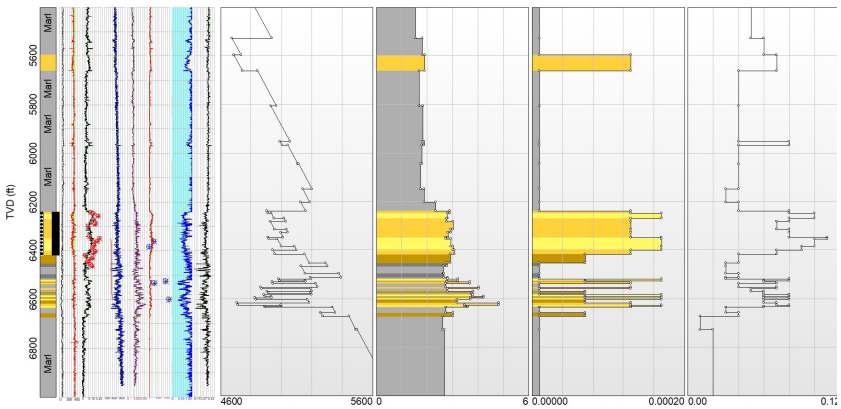
We are multi-discipline subsurface specialists using a team-of-teams approach to efficiently solve problems that have a direct business impact in today's fast-paced and evolving energy industry.

We provide high quality subsurface solutions by bridging the gap between geoscience and engineering.

Hydraulic fracturing, frac packing and well stimulation are critical components to the success of most wells these days. To optimize well completions, frac jobs must be designed through integration with a detailed reservoir characterization. Additionally, a detailed and calibrated geomechanical model is of upmost importance for history matching and design work. We use StimPlan™, which allows us to integrate multiple datasets for designing and analyzing key diagnostic tests, to improve productivity.

STIMULATION OVERVIEW

Geomechanical Models are the keystone of well stimulation. It is through these calibrated models that we can predict where injected fluids and proppants will navigate. The lowest stress intervals preferentially take pumped fluids, and the contrast with bounding layers dictates how well a stimulation stays "in zone" or grows in height. Coupled with fluid injection rates and viscosities, this defines the basics of fracturing simulation. Injectivity tests with pressure decline data are key to success.

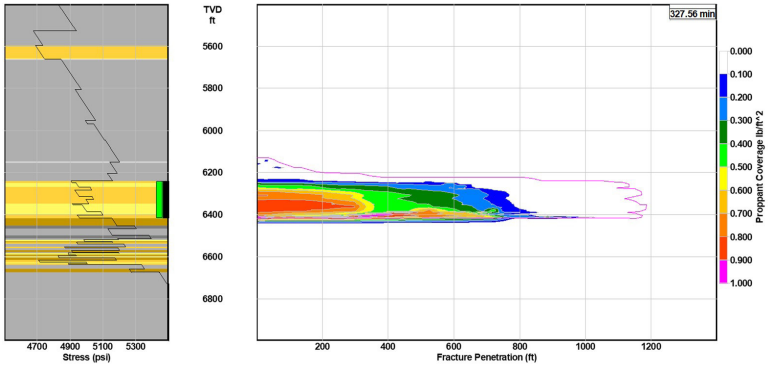


Example of a detailed geomechanical model. From left to right: lithology, input logs, stress profile (psi),Young's modulus (Mpsi), leakoff coefficient (ft/sqrt(min)), and porosity (v/v).

Injection Tests are critical to calibrating geomechanical and fracturing models. Diagnostic Fracture Injection Tests (DFIT) and Mini-fracs are used to identify closure pressure, net treating pressure, rate of fluid leakoff, reservoir pressure and permeability. These tests provide information about *in situ* stress and are critical to generating the overall framework for the design of a stimulation program. We help you build a diagnostic testing program customized to your needs, which is both time and cost efficient.

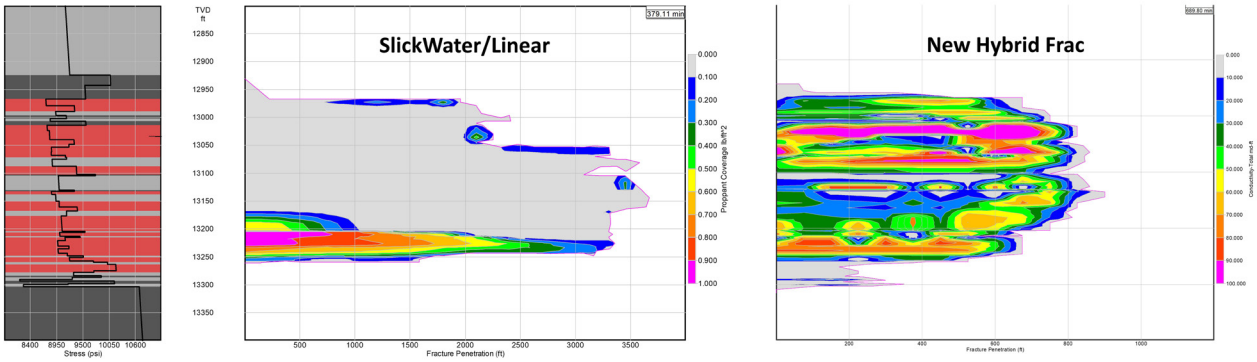
Shear Sonic response is an essential parameter for predicting elastic properties such as Young's Modulus and Poisson's Ratio, which are critical to model how fractures propagates and optimize proppant placement. Sonic shear is however an often missing dataset. We have a proprietary technology that can calculate your missing shear response in a straightforward manner, without the rigors of complex petrophysical mineralogy-based models such Greenberg-Castagna.

Reservoir Integration studies are critical to maximizing stimulation performance. We use Pressure Transient Analysis (PTA), Rate Transient Analysis (RTA), laboratory Porosity-Permeability data in combination with Reservoir Simulation to optimize your Fracs. Understanding reservoir permeability is critical for the surgical placement of proppants, acids and lateral landing depths within key intervals to maximize productivity.



Geomechanical model (left) and proppant distribution within a height contained frac.

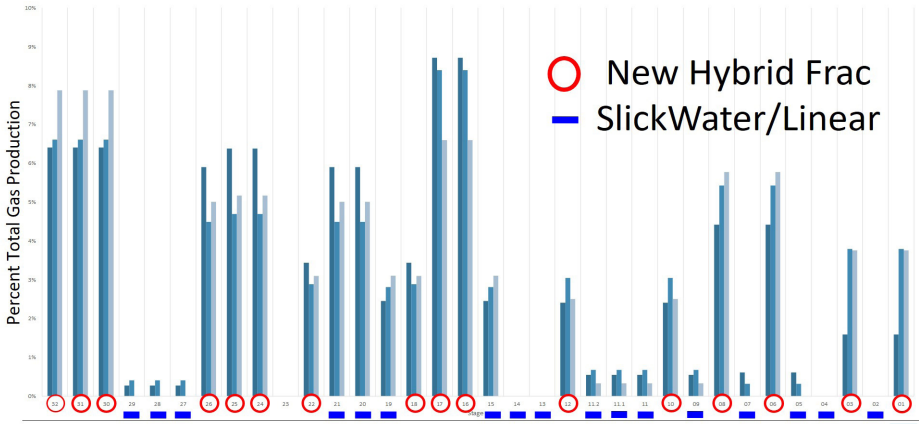
EXAMPLE OF MAJOR SUCCESS



Geomechanical model (left) and comparison of resulting proppant distribution in a slickwater (center) vs. hybrid frac (right).

Slickwater Frac Redesign: An operator wanted to place slickwater fracs into a deep Delaware Basin horizontal well. After analyzing offset production, it was determined that unpropped fracture conductivity was choking back production due to proppant dropout and duning effects. After redesigning stimulations with a hybrid frac, treatment types were alternated down the lateral.

Chemical tracers used to monitor the effectiveness of the treatment demonstrated a production increase of 3.5 times the gas produced with a standard slickwater frac. Additionally, water volumes were reduced by a third.



Right: Comparison of gas production rates of slickwater fracs vs. hybrid frac stages in the Delaware Basin.