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# Introduction to GOHFER® Fracture Modeling Software

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3D Multidisciplinary Integrated Geomechanical Fracture Simulator and Completion Optimization Tool  
(Grid Oriented Hydraulic Fracture Extension Replicator)

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Many resource developments have progressed from single wells, holding acreage, to full pad or cube developments, with stacked layers of horizontal wells. In these cases it is not possible to effectively design a fracture treatment based on simulation of a single frac stage, or even a single well. Each fracture stage pumped, alters the stress field, and affects the geometry of every subsequent stage. To model all the dynamic interactions correctly requires a full three-dimensional earth model, and fracture simulator that can represent the complex stress/strain interference effects generated while pumping.

## What is GOHFER?

- Grid Oriented Hydraulic Fracture Extension Replicator
- A deterministic numerical simulator of rock deformation, fracture propagation, and fluid/solid transport in a heterogeneous three-dimensional spatially variable earth model
- Fluid flow and solid transport are solved using discretized finite difference formulations
  - Automatic time-stepping algorithm based on Courant Number ( $N_C$ ) for solid and fluid transport between adjacent cells ( $dQ/dV < N_C$ )
- Transport formulation is single phase, multi-component
  - Up to 10 fluid components with rheologic mixing rules, and up to 10 "proppant" components with varying diameter and specific gravity
- Rock deformation for fracture aperture based on Boussinesq displacement of a semi-infinite half space (1895) modified for local normal stresses applied to a shear-decoupled rock mass represented by a Cartesian gridded fracture surface with variable rock mechanical and reservoir properties
- Fracture extension criteria based on field calibrated "process-zone stress (PZS)", not "fracture toughness" or critical stress intensity, which devolve from an assumption of an infinite stress singularity at the fracture tip.
  - Process zone, as described by Barenblatt, is a more physically consistent tip condition, with the added advantage that it can be directly measured in the field

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## Choosing a Fracture Growth Simulator

- I'm often asked, "What makes GOHFER different" from other "models"?
  - The simple answer is "everything"!
- GOHFER has been in continuous development since 1978 (45+ years).
- It is the only frac simulator that is based on decades of actual laboratory and field experiments directed at fluid rheology, proppant transport, screenout behavior, proppant conductivity under realistic multi-phase non-Darcy flow conditions at long-term stress, and actual post-frac production matching and forecasting.
  - Practically all others are based on overly simplistic theories from before 1960 and rely on linear-elastic deformation solutions or "pseudo" models with inaccurate transport and production models.
  - Every element of input data can be traced to a specific field measurement or data source, not "what feels right".
- GOHFER is the only practical fully 3D fracture simulator available for multi-well, full pad development, including evolution of a time-dependent stress field.

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## Features and Benefits

GOHFER 3D is leading the industry into the future with the most current research and technology while challenging outdated philosophies and paradigms giving you more confidence and predictability in your completion strategy. GOHFER's formulation has been used extensively and successfully in all regions globally in all types of reservoirs and does not require a special module for individual environments. GOHFER's timely technical support and comprehensive software documentation is unparalleled in the industry.

- Can handle multiple wells, including vertical and horizontal in the same model
- Multi-layer completions, zipper fracs and offset depletion effects
- Full 3D geo-mechanical earth model input or optional input of 2D surface map with digital reference well log data
- Variable inter/intra-stage fracture stress shadow interference between each fracture and stage on each well
- Wellbore breakdown gradient and angle & breakdown pressure and orientation calculations
- Geosteering of laterals and engineered completions
- Models both longitudinal and transverse fracture components
- Pressure diagnostic analysis, production forecasting and rate transient analysis
- Full multi-well pad optimization algorithm

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## GOHFER Functionality

- Well Construction –
  - Surface well locations, directional surveys, casing strings, ball seats, geo-steering, MWD/LWD log processing for engineered completions
- Petrophysics –
  - Input log ascii standard (LAS) files and core data, process to generate reservoir and mechanical rock properties to derive a calibrated stress profile
- Pumping Diagnostics -
  - Input rate and pressure data from pre-frac injection/falloff tests (DFITs) to conduct step-rate, blowdown, closure (G-function), and after-closure analyses to calibrate model inputs
- 3D Geologic Modeling –
  - Import full 3D mechanical earth models or 2D surface structure maps to define spatially variable reservoir and mechanical properties
- Import microseismic event locations for comparison with modeled fracture geometry
- DAS/DTS integration, perf erosion, diversion, extreme limited-entry designs

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## GOHFER Functionality (2)

- Fracture Simulation –
  - Single well (vertical or horizontal), multi-well, multi-stage fracture growth
  - Stress/strain interference between all stages in one or many wells
  - Pore pressure depletion modeled for “parent-child” fracture interaction (frac hits)
  - Outputs time dependent 3D state variables for many fracture parameters
- Fluid and Proppant Library –
  - Catalog of complex non-Newtonian frac fluid rheology and ability to develop new fluid models from lab data
  - Expansive library of hundreds of proppant types and sizes, with generation of generic proppant conductivity parameters
- Post-frac Production Forecasting –
  - Single stage, or multi-stage comingled production forecasts based on created fracture geometry, treatment materials, well geometry and reservoir properties
- Production Analysis –
  - Actual field/well production data analysis with decline curves and rate-transient analysis for economic evaluation and re-frac potential, integration with CMG and reservoir simulators
- Optimization – Run multiple well and fracture spacing cases to determine maximum economic value

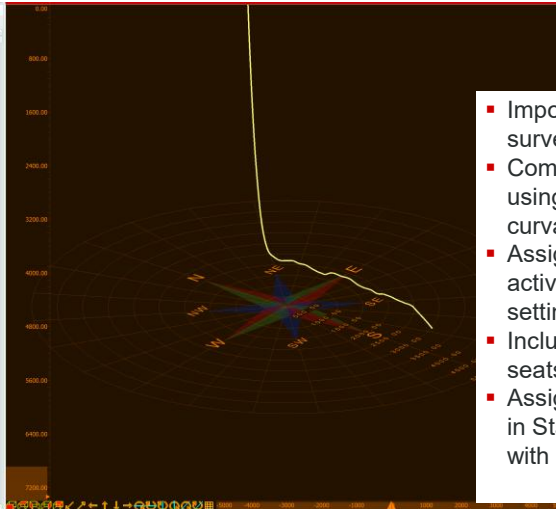
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# Well Construction

MD/INC/AZI

Well 03 - Survey is the directional survey for placing the perforations.

| Insert   | MD, FT | INC   | AZI    | TVD, FT | N, S, FT | E, W, FT |
|----------|--------|-------|--------|---------|----------|----------|
| Add      | 17     | 0     | 0      | 0.00    | 0.00     | 0.00     |
| Delete   | 50     | 0.2   | 201.7  | 80.00   | 0.00     | -0.00    |
| Sort     | 100    | 0.2   | 202.4  | 120.00  | 0.00     | -0.10    |
| Set Down | 310    | 0.4   | 214    | 210.00  | 0.00     | -0.00    |
| Thin     | 300    | 0.4   | 208.8  | 300.00  | 0.00     | -1.07    |
| Partic   | 390    | 0.8   | 210.4  | 390.00  | 1.57     | -1.00    |
| Reset    | 400    | 0.8   | 202.2  | 470.00  | 2.48     | -1.00    |
|          | 570    | 1.1   | 201.8  | 560.00  | 3.62     | -1.62    |
|          | 750    | 1.4   | 202.6  | 740.00  | 5.12     | -4.75    |
|          | 840    | 1.7   | 203.0  | 830.00  | 6.17     | -4.80    |
|          | 930    | 2.0   | 203.6  | 920.00  | 7.20     | -4.34    |
|          | 1020   | 2.8   | 204.0  | 1010.00 | 7.75     | -4.03    |
|          | 1069   | 3.34  | 204.06 | 1060.00 | 20.00    | -10.40   |
|          | 1100   | 3.80  | 203.20 | 1100.00 | 20.00    | -10.20   |
|          | 1252   | 5.28  | 217.08 | 1201.11 | 31.57    | -16.30   |
|          | 1344   | 6.04  | 211.71 | 1302.42 | 38.18    | -23.00   |
|          | 1437   | 7.0   | 200.43 | 1400.00 | 44.72    | -30.00   |
|          | 1528   | 7.85  | 200.31 | 1520.17 | 49.92    | -42.70   |
|          | 1620   | 8.84  | 200.20 | 1610.20 | 53.00    | -50.40   |
|          | 1713   | 9.87  | 207.03 | 1700.00 | 56.00    | -59.13   |
|          | 1805   | 10.11 | 210.9  | 1700.00 | 58.70    | -65.82   |
|          | 1897   | 10.58 | 210.9  | 1800.12 | 60.40    | -70.20   |
|          | 1982   | 11.14 | 210.7  | 1900.00 | 62.10    | -75.10   |
|          | 2067   | 11.03 | 214.30 | 2000.01 | 63.00    | -124.40  |
|          | 2150   | 10.90 | 210.9  | 2100.00 | 65.00    | -140.00  |
|          | 2238   | 10.01 | 210.13 | 2200.10 | 67.00    | -164.01  |
|          | 2321   | 9.06  | 210.00 | 2300.00 | 69.00    | -170.00  |
|          | 2408   | 10.43 | 207.04 | 2400.00 | 72.00    | -190.00  |
|          | 2491   | 10.18 | 202.48 | 2400.10 | 75.70    | -200.10  |
|          | 2576   | 10.62 | 200.63 | 2500.70 | 78.67    | -224.10  |
|          | 2662   | 10.37 | 200.27 | 2600.10 | 81.01    | -230.00  |
|          | 2747   | 9.08  | 207.11 | 2700.10 | 86.67    | -262.00  |
|          | 2832   | 9.71  | 200.14 | 2800.00 | 91.00    | -280.00  |
|          | 2919   | 9.87  | 200.71 | 2900.00 | 97.00    | -270.00  |
|          | 3000   | 9.91  | 202.61 | 2974.80 | 102.62   | -290.82  |
|          | 3090   | 12.30 | 200    | 3000.20 | 100.00   | -300.20  |
|          | 3170   | 12.1  | 200.70 | 3040.30 | 110.17   | -320.10  |
|          | 3255   | 11.80 | 200.33 | 3024.40 | 110.70   | -330.00  |
|          | 3341   | 11.22 | 201.51 | 3008.71 | 120.00   | -350.00  |
|          | 3428   | 10.74 | 201.00 | 3000.10 | 121.07   | -371.01  |
|          | 3511   | 10.11 | 202.34 | 3070.70 | 127.62   | -380.30  |
|          | 3597   | 9.04  | 201.40 | 3060.00 | 140.10   | -380.10  |
|          | 3682   | 9.33  | 201.00 | 3044.40 | 146.42   | -411.07  |



- Import standard well surveys: MD, INC, AZI
- Compute TVD, N/S, E/W using minimum radius of curvature method
- Assign multiple casing or active tubing strings setting depths and IDs
- Include multiple ID ball seats
- Assign wellhead location in State Plane or UTM, with elevation

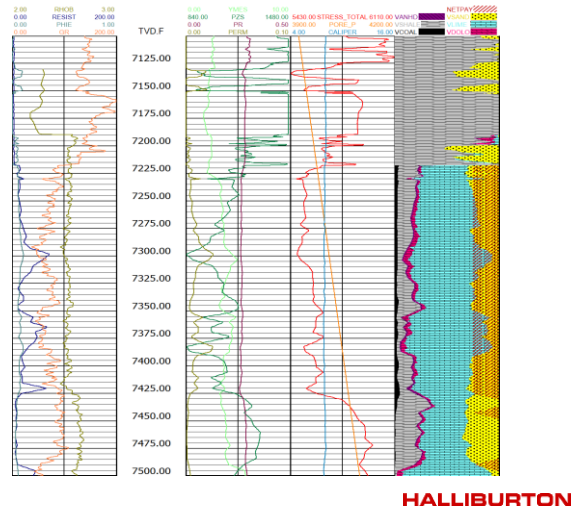
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Complete log-derived petrophysical analysis is needed to define reservoir and mechanical properties.

Well logs are the primary input source for reservoir properties.

Logs provide the required input for rock mechanical properties and show variation with depth, needed to predict fracture height growth.

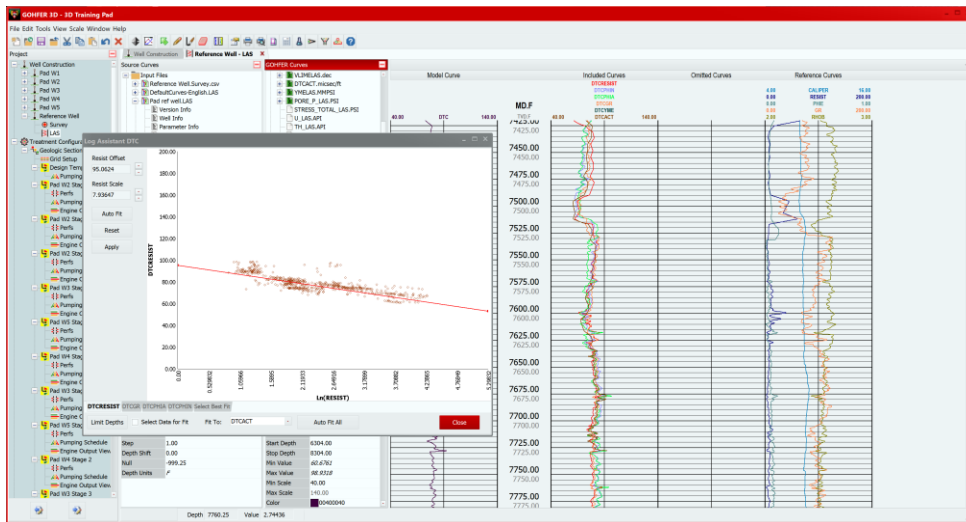
Pore pressure, stress, and extension pressure cannot be determined from logs or core and must be calibrated by an effective DFIT.



The basic inputs for determining rock properties come from log analysis.

Unfortunately, too many times the logs are not processed correctly, and corrections to density, porosity, and sonic logs for organic and hydrocarbon content of formations are not made. If improperly processed logs are then incorporated in 3D earth models the models themselves are incorrect and will negatively impact the value of any design modeling conducted with them. The same is true when mechanical properties are only computed where full-waveform sonic logs are available. This leads to wide gaps in the necessary data for fracture modeling. The correct data must be generated from properly processed logs, then spatially distributed based on realistic depositional and structural geologic frameworks.

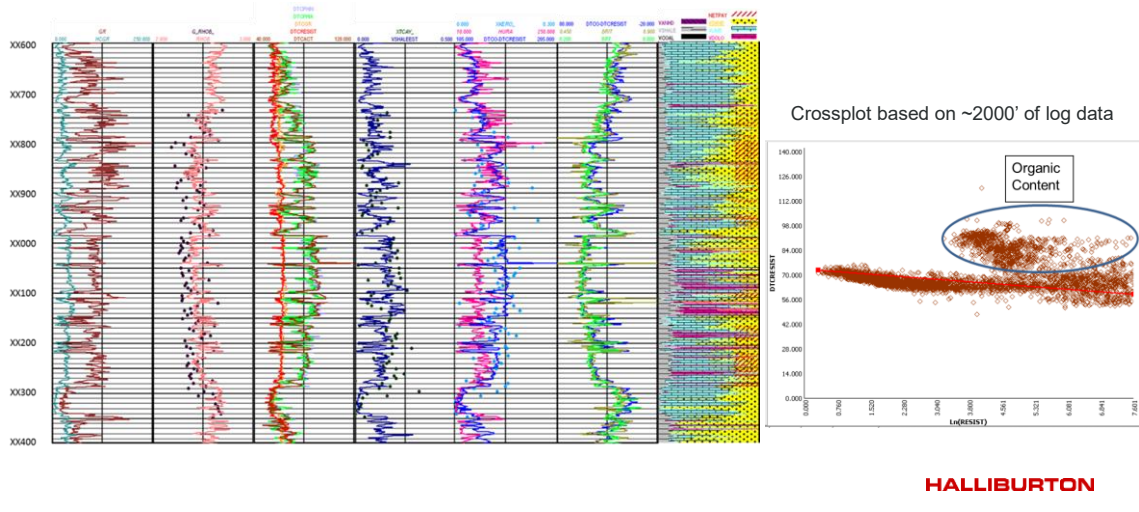
Process full log suite from "Reference Well": Generate Synthetic Sonic and Mech-Prop Logs (Also imports any core data for log calibration)



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## Corrections to Sonic Slowness Provide Information on Pay Zones and useable mechanical properties:

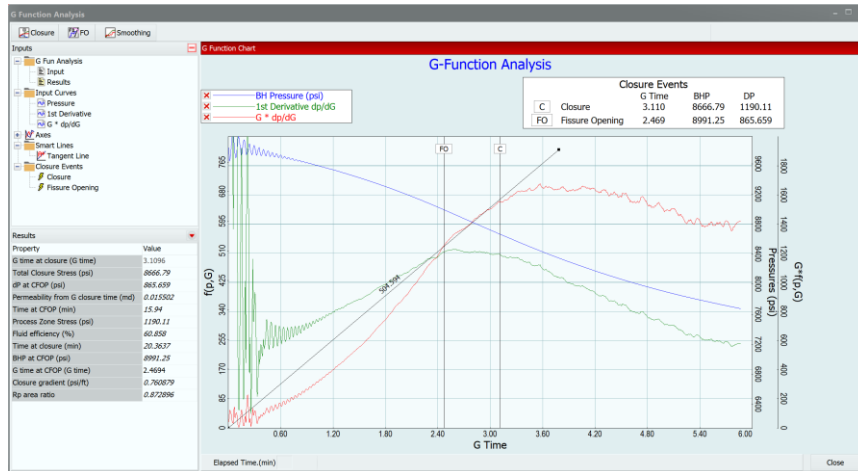
Avalon Shale, Permian Basin Example (SPE 169565)



Similar to Passey, Q.R., Creaney, S., Kulla, J.B., Moretti, F.J., and Stroud, J.D., 1990, A practical model for organic richness from porosity and resistivity logs: American Association of Petroleum Geologists Bulletin, v. 74, no. 12, p. 1777–1794. [Also available at <http://archives.datapages.com/data/bulletns/1990-91/data/pg/0074/0012/0000/1777.htm>.]

Also see SPE 11528, Rickman, Mullen, Petre, Grieser, and Kundert, 2008 for “Brittleness” definition.

## G-Function Derivative Analysis of Diagnostic Fracture Injection Test Data

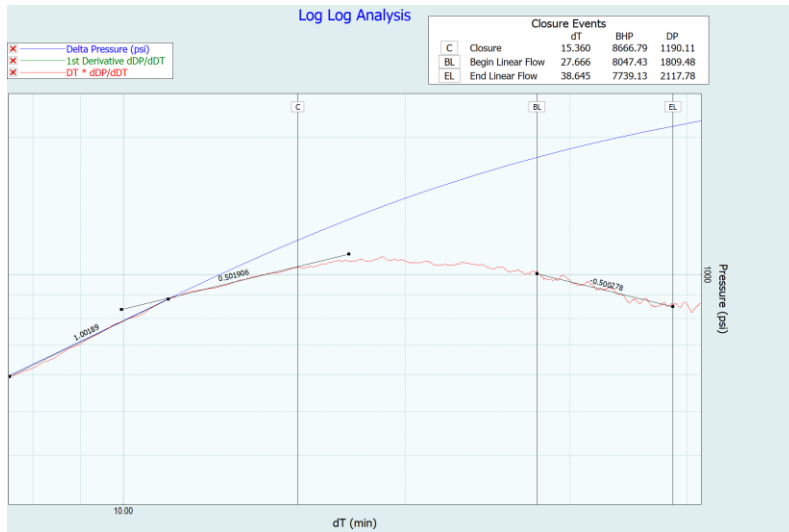


Output of analysis includes:

- Pore pressure
- Closure stress
- Fluid efficiency
- Fracture extension pressure
- Process-zone stress
- Stress anisotropy
- Perf efficiency
- Near-well friction
- Stimulated system perm

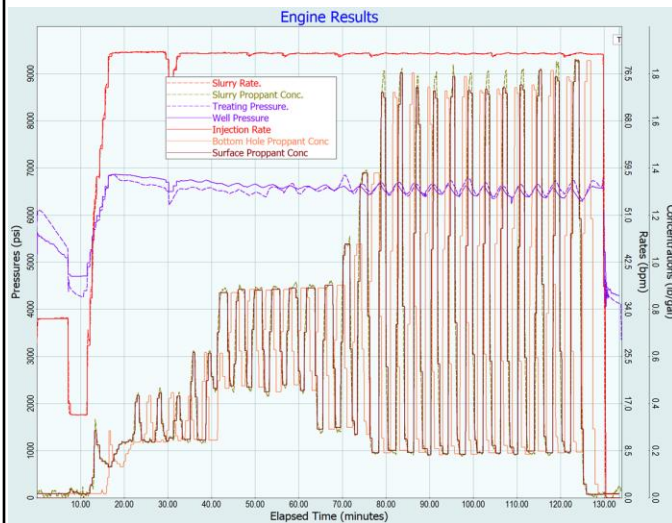
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## Flow Regime Identification Before, During, and After Closure



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## Ability to Import Digital Job Data and History-Match or Design Treatments: Bayswater ACM Treatment Example

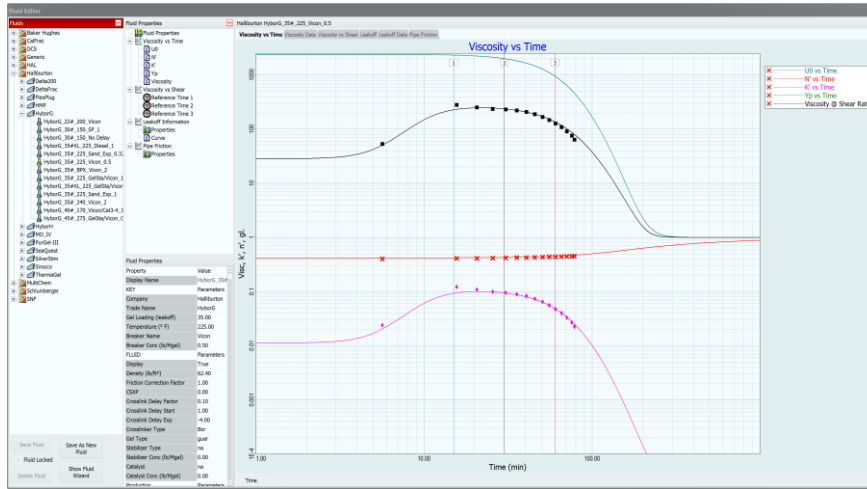


Import job data from ascii file or direct digital connection to frac van or remote satellite feed for job history matching.

|                     |                                                          |
|---------------------|----------------------------------------------------------|
| Total Clean Volume: | 395,183 gallons                                          |
| Total Proppant:     | 235,286 lbs                                              |
| Conc. Fluid Lost:   | 26,717.45 gal                                            |
| Fracture:           | Gross Frac Length & Proppant Conc                        |
|                     | Length (ft)                                              |
| Transverse 5        | 3000.00 260.00 38.2682 31.2399 70.00 0.176249 2.19108    |
| Transverse 6        | 1120.00 240.00 28.7512 28.4151 90.00 0.128399 1.14989    |
| Transverse 7        | 740.00 220.00 25.4225 18.717 85.00 0.0526474 0.314221    |
| Transverse 8        | 1040.00 200.00 28.1633 20.9057 110.00 0.0802993 0.876234 |
| Transverse 9        | 880.00 220.00 24.4652 17.1382 110.00 0.0623919 0.514952  |
| Transverse 10       | 880.00 180.00 25.9363 18.9545 90.00 0.0389136 0.441245   |
| Transverse 11       | 1380.00 100.00 12.5364 7.15891 60.00 0.0243849 0.520169  |
| Transverse 12       | 1240.00 260.00 26.1214 19.8864 90.00 0.122867 0.963028   |
| Transverse 13       | 3000.00 260.00 37.8396 30.5269 70.00 0.179931 2.23805    |
| Longitudinal 1      | 530.00 40.00 15.4799 13.1519 30.00 0.107758 7.58611      |
| Longitudinal 2      | 270.00 40.00 13.5862 10.5513 15.00 0.07131 4.9891        |
| Longitudinal 3      | 210.00 70.00 16.5084 13.4388 15.00 0.0630111 5.94761     |
| Flowing Area        | 85282.7 sq ft                                            |
| Propped Area        | 68800.0 sq ft                                            |
| Fluid:              | Slickwater, 130F                                         |
| Proppants:          | Begler Sand 100 Mesh (A)<br>Begler Sand 40/70 (B)        |

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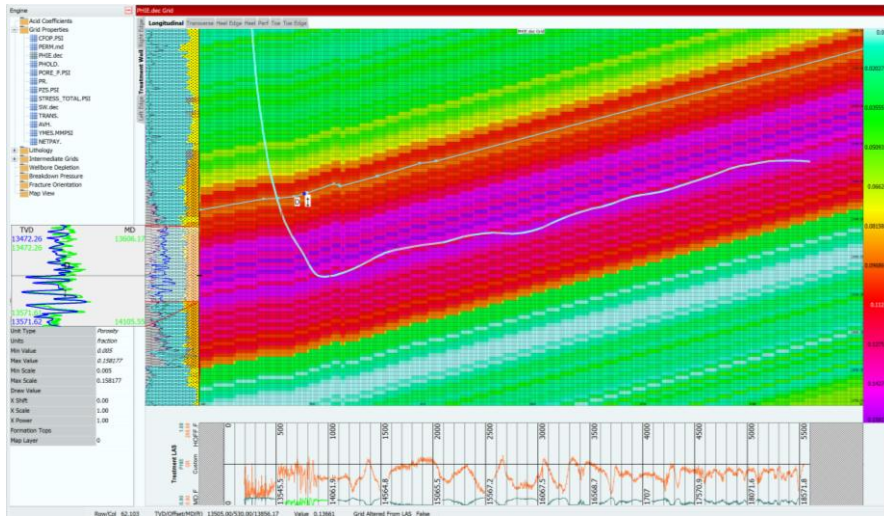
## Generation of Complex Rheology Model from Lab Data



An extensive library of fluids is provided but fluid properties change with local conditions.

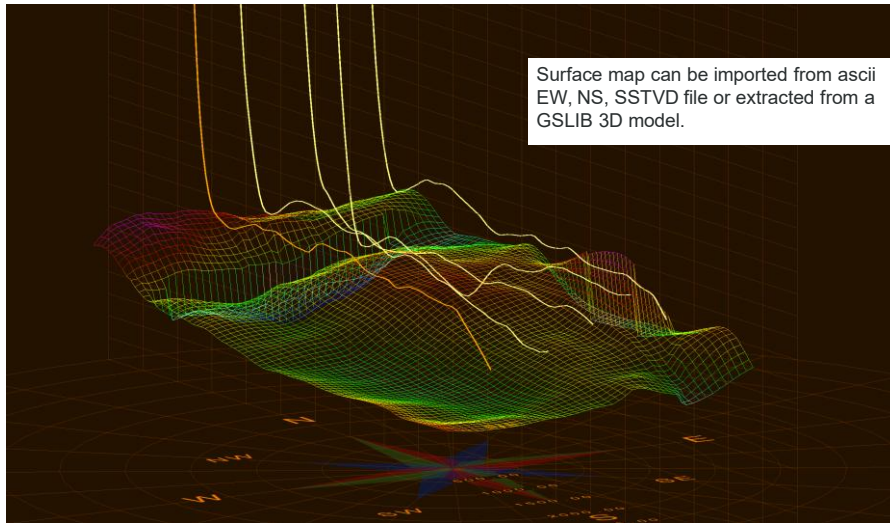
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## GOHFER Geo-Steering Capabilities



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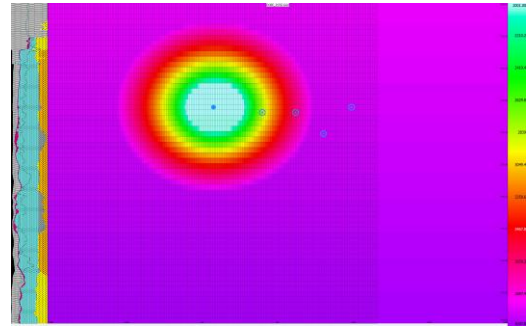
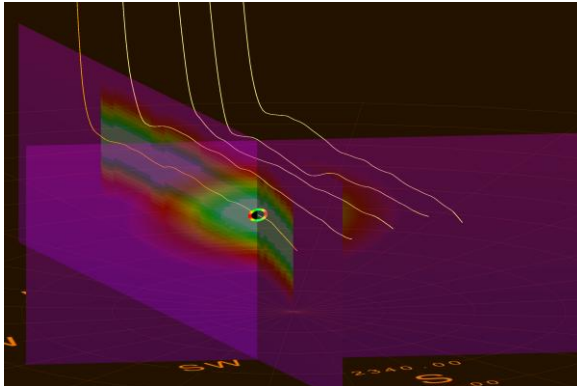
## Example of Structure Map and Well surveys



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## Pore Pressure Profile

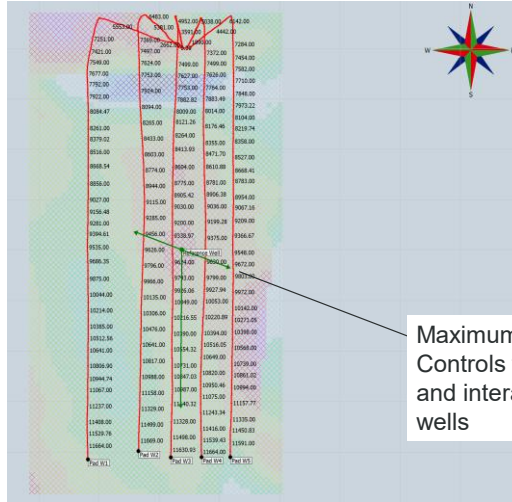
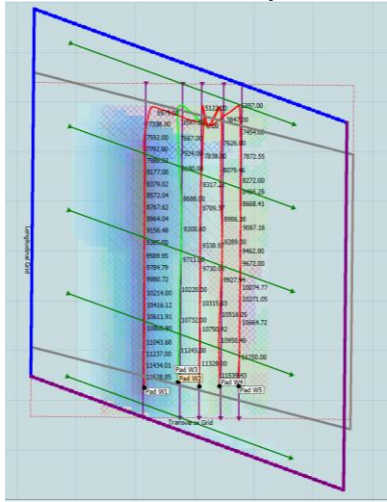
Gunbarrel view of depletion radius and 3D view of depletion extent along completed parent well.



GOHFER implements a pore pressure depletion model, tied to each well survey and using inner and outer vertical and horizontal radii of depletion and  $\ln(r_o/r_i)$  pressure profile or imports from reservoir simulator.

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# Wellhead Locations and Stress Tensor Azimuth with Structure Map



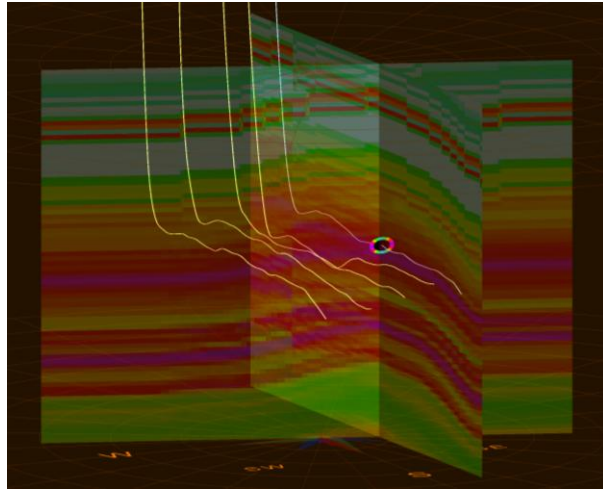
Maximum stress azimuth Controls fracture direction and interaction with offset wells

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Spatially variable rock properties may be described by integrating log data from multiple wells in a three-dimensional earth model

Complex geology and spatially variable rock properties may control fracture growth and impact communication vertically and laterally across the pad.

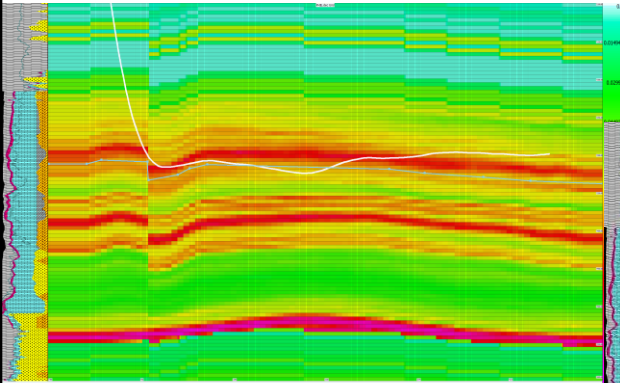
Full earth models also help define complex geological structure.



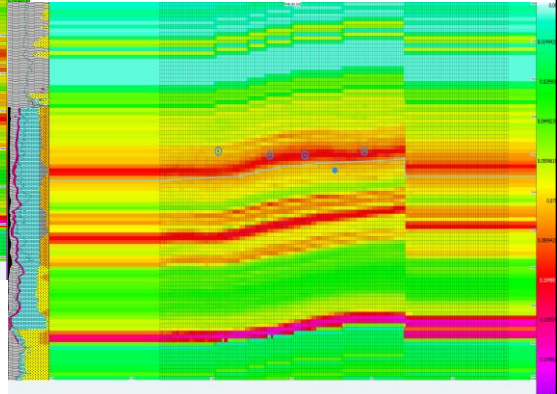
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All these factors must be incorporated in a model to describe geologic structure, spatially variable reservoir and mechanical properties, variable pore pressure and stress field, well surveys and landing points, well azimuth and inclination, and location of each fracture initiation point in the system. All these factors act together to affect treatment effectiveness, fracture communication, and reservoir performance.

## Example of Detailed Grid Data with Spatially Variable Properties

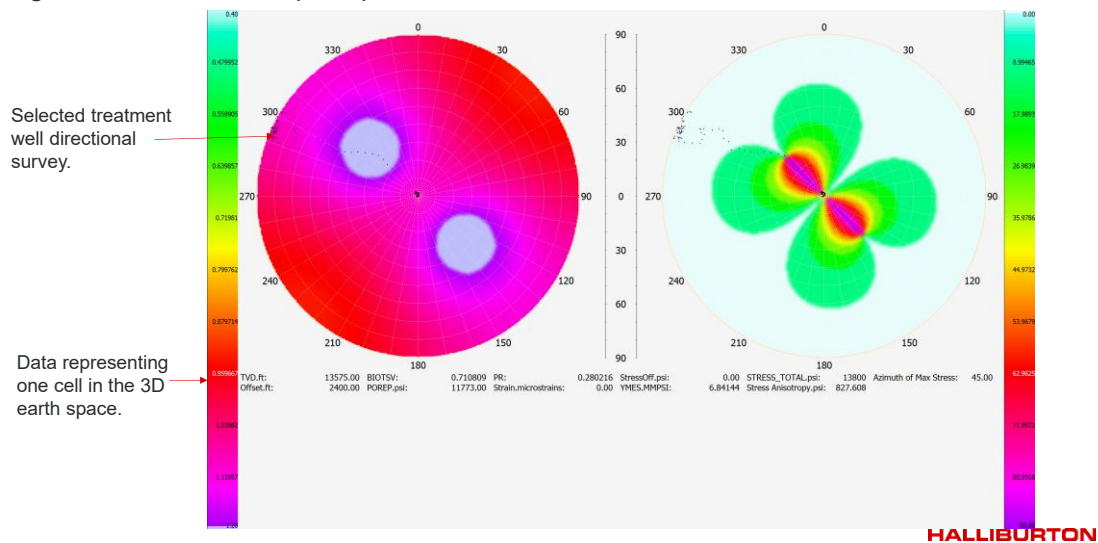


Geo-steering along each lateral, using any log track, builds longitudinal and transverse structure and exports 2D surface map.

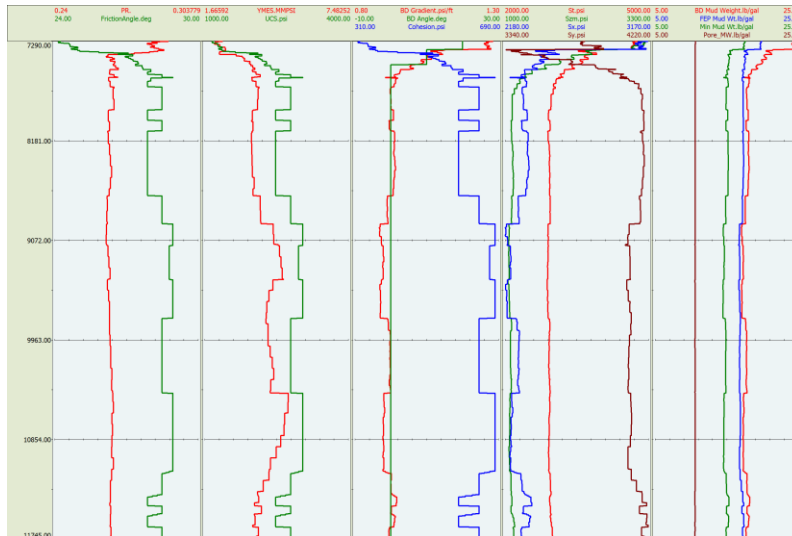


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# Fracture Breakdown Gradient and Orientation based on rock properties at each grid cell and defined pore pressure and stress tensor



## Wellbore Stability and Safe Mud-Weight Window vs. MD for Each Well



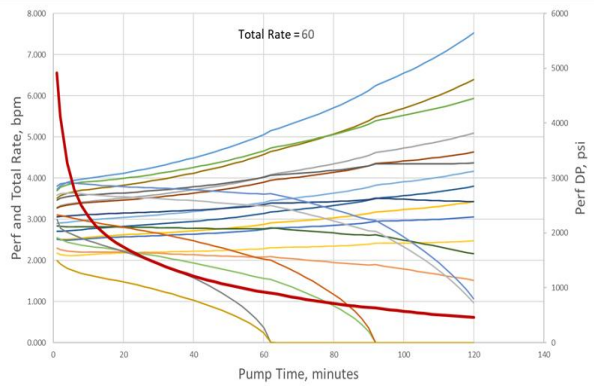
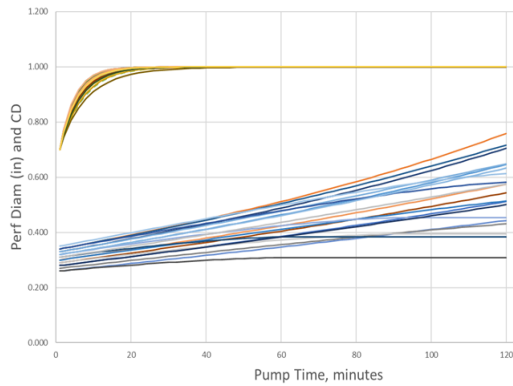
Calibrated rock strength and failure properties based on calibrated LAS processing.

- Wellbore Stability
- FADTC.deg
- FA.deg
- UCSDTC.PSI
- UCS.PSI
- COHESION.PSI

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## Perforation Erosion and Flow Diversion Modeling:

10 Clusters, 2 holes/cluster, Random EHD (0.26-0.34", 0.307" average); 60 bpm (3 bpm/hole), 2 psd sand concentration. All  $C_D=0.7$

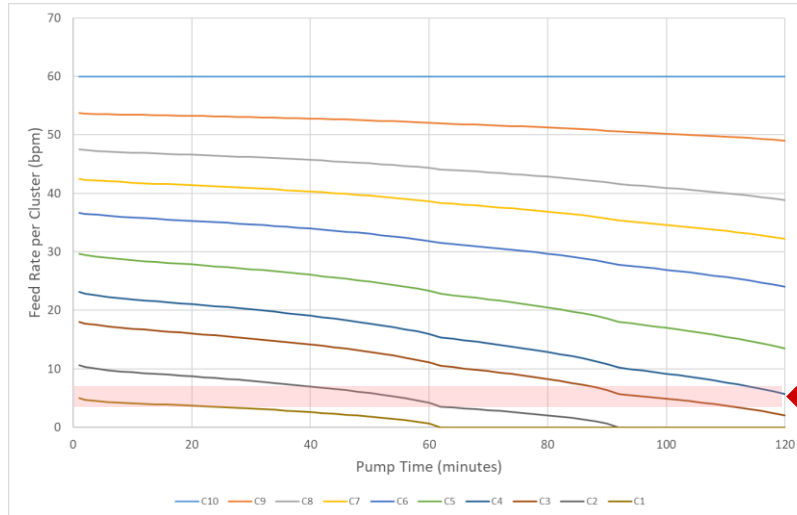


30' cluster spacing, 300-ft stage length, back pressure 908 psi at toe and 71 psi at heel.

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## Wellbore "Feed Rate" Into Each Cluster:

60 bpm into 20 holes in 10 clusters with 2 holes per cluster, average 0.307" EHD



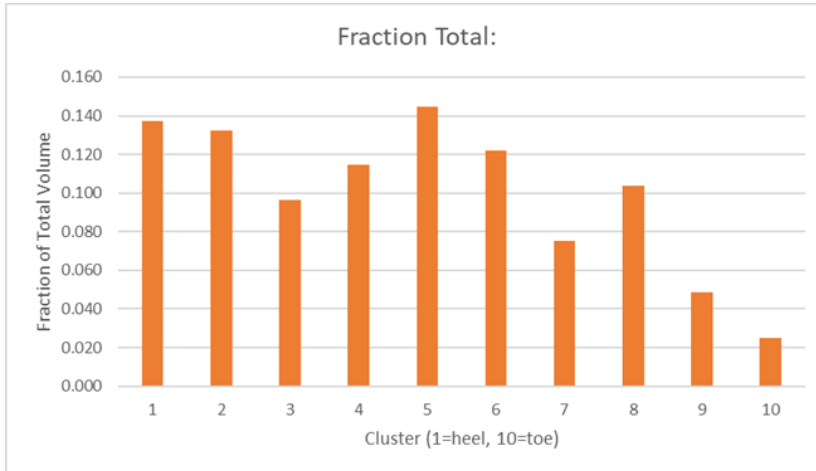
Possible minimum sand transport rate to avoid sedimentation in pipe.

(Based on minimum transport rate of 5-7 fps for fine sand in water, 4.5-5.5" ID)

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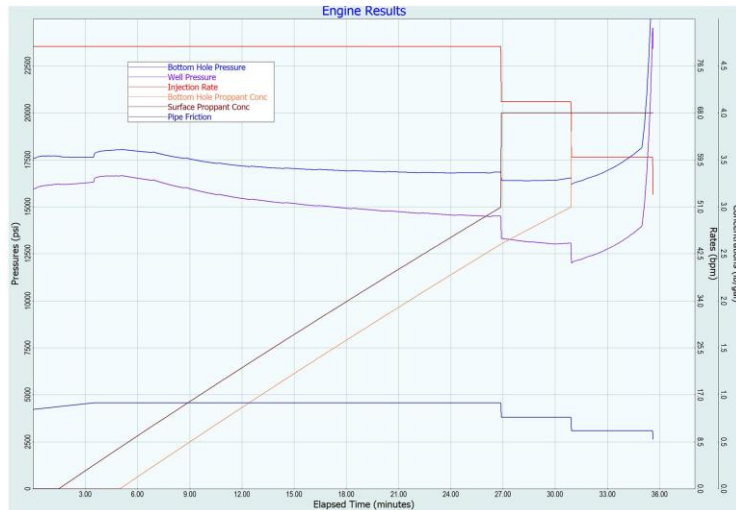
[https://www.engineeringtoolbox.com/slurry-transport-velocity-d\\_236.html](https://www.engineeringtoolbox.com/slurry-transport-velocity-d_236.html)

## Distribution of Stage Volume per Cluster (for comparison to DAS uniformity index)



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## Physics-based screen-out model is unique to GOHFER



- 7-cluster horizontal well stage with previous stage stress-shadow
- Screenout develops at the sandface because the sand input rate exceeds the transport rate through the near-well region
- Well pressure is NOT transmitted to the fracture body but is lost to ear-well friction as tortuosity increases
- With a positive initial tortuosity and negative erosion coefficient, tortuosity increases with pump rate and sand mass
  - Example uses  $T_{init} = 600 \text{ psi}/\sqrt{\text{bpm}}$  and  $\text{erosion} = -0.8$
- Positive erosion factor reduces tortuosity over time
- Zero initial tortuosity has no effect
- Default coefficients in "DAT" file are the exponential rise rate (2) and critical sand concentration (6 ppa)

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# GOHFER Design Template for Multiple Stages/Multiple wells

| Pumping Stages                             |         |                    |                  |                 |                     |                   |                       |                 |                 |                   |                |                            |
|--------------------------------------------|---------|--------------------|------------------|-----------------|---------------------|-------------------|-----------------------|-----------------|-----------------|-------------------|----------------|----------------------------|
| Design Schedule Run Parameters Display All |         |                    |                  |                 |                     |                   |                       |                 |                 |                   |                |                            |
| Insert                                     | Stage # | Elapsed Time:mm:ss | Stage Time:mm:ss | Fluid           | Clean Stage Vol:GAL | Cum Clean Vol:GAL | Proppant              | Slurry Conc:PPA | Cum Proppant:LB | Slurry Rate:BBL/M | Cum Slurry:BBL | Cum Clean Fluid Rate:BBL/M |
|                                            | 1       | 0:00               | 1:59             | Silk-Vis 6 gpt  | 5000.00             | 5000.00           | Badger Sand 40/70 (A) | 0.00            | 0.00            | 60.00             | 119.05         | 60.00                      |
| Add                                        | 2       | 1:59               | 21:39            | Silk-Vis 6 gpt  | 5000.00             | 10000.00          | Badger Sand 40/70 (A) | 0.00-4.00       | 100000.00       | 60.00             | 1418.04        | 54.99                      |
|                                            | 3       | 23:38              | 5:00             | SlickWater 120F | <Flush>             | 55000.00          | Badger Sand 40/70 (A) | 0.00            | 100000.00       | 60.00             | 1718.04        | 60.00                      |
| Delete                                     | 4       | 28:38              | 5:00             | SlickWater 120F | 0.00                | 55000.00          | Badger Sand 40/70 (A) | 0.00            | 100000.00       | 0.00              | 1718.04        | 0.00                       |
| Total                                      |         | 33:38              |                  |                 |                     | 55000.00          |                       |                 | 100000.00       |                   | 1718.04        |                            |

**Geologic Section Depletion - Design Template 1** X

Name: Design Template 1 ☐ Coil Job

Description:

Design Type: Design Schedule ☐ Foam ☐ Acid

Design Schedule

Reservoir Properties Wellbore Fluids **Design Creation**

Prefix:  Create Designs

First Stage Number: 1

**Stages**

Fracture Spacing(ft):

Clusters Per Stage:

Stage Length(ft):

Number of Stages:

Perf Diameter(in):

Holes Open Per Cluster:

**Wellbore Defaults**

Treated Length(ft):

Perf Set Back(ft):

**Treatment Wells**

☐ Pad W1

☐ Pad W2

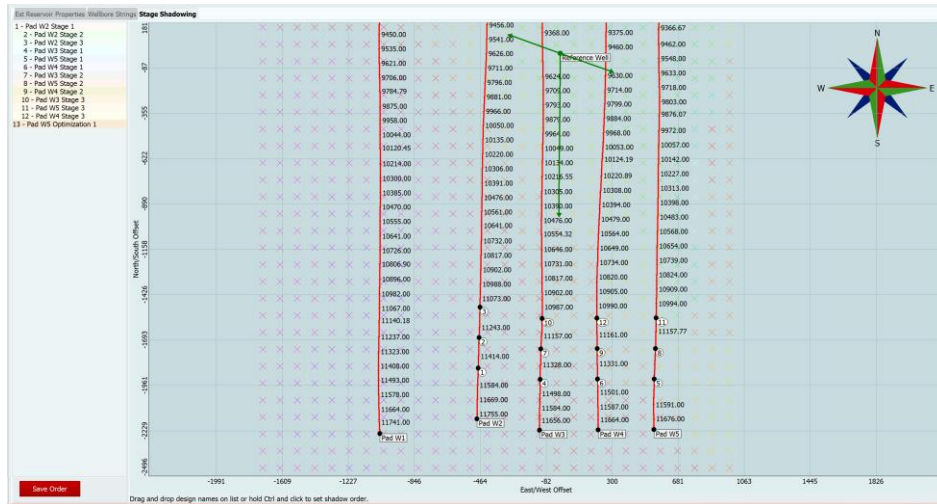
☒ Pad W3

☒ Pad W4

☒ Pad W5

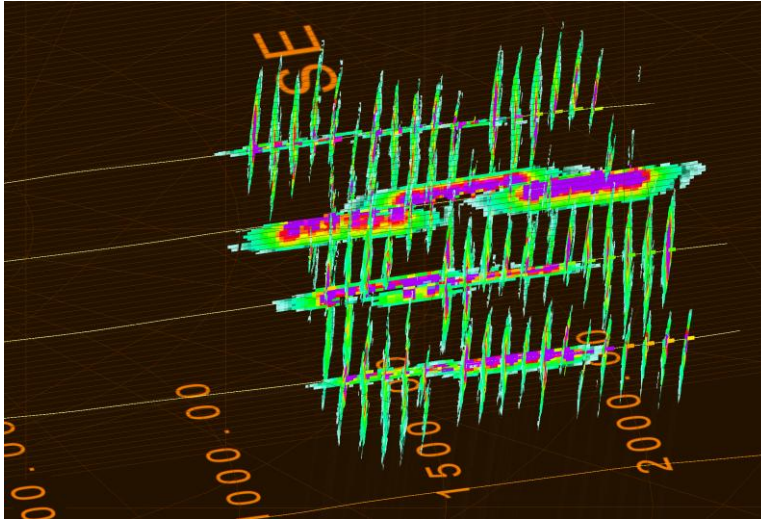
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## Graphical and List-Based Chronological Stage Shadow Order



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## Effective Producing Conductivity for Multiple Transverse and Longitudinal Fractures



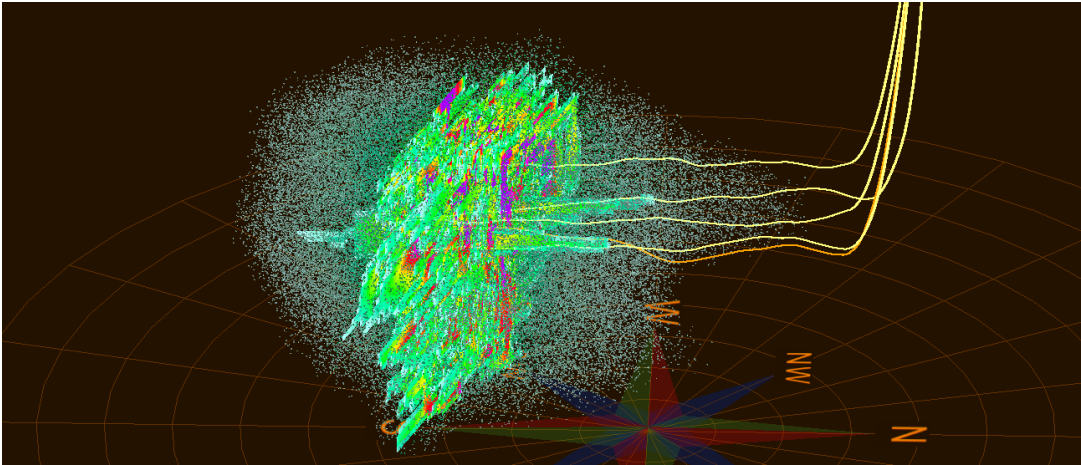
Effective fracture conductivity estimates are based on more than 30 years" lab and field research.

The data are unique to GOHFER.

Predictions confirmed by post-frac RTA and well performance.

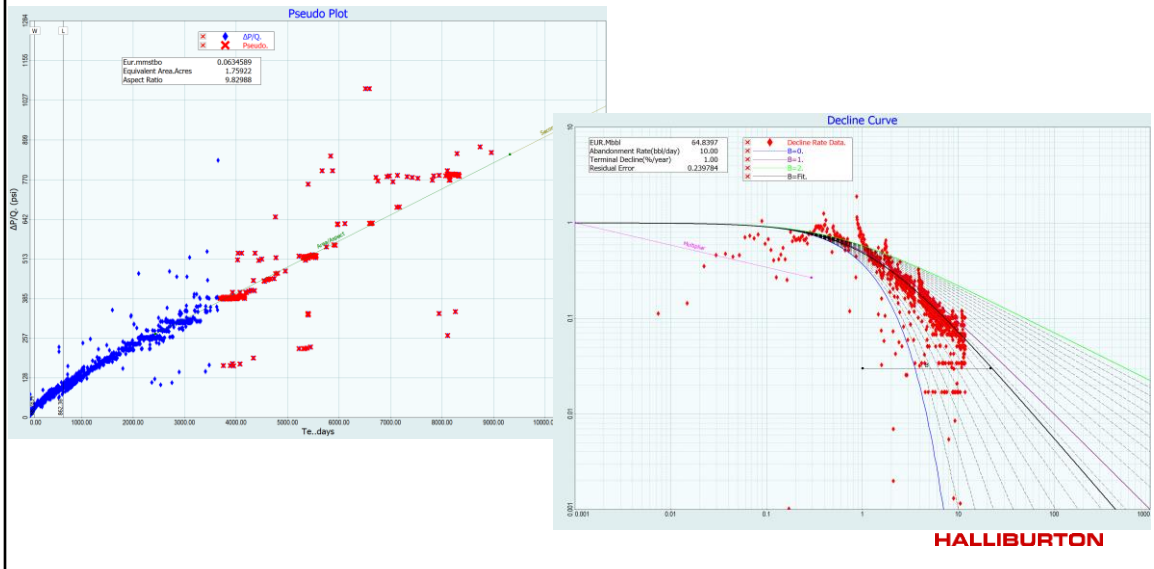
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Stress shadow cloud caused by induced strain from fracture opening may influence MS and DAS observations

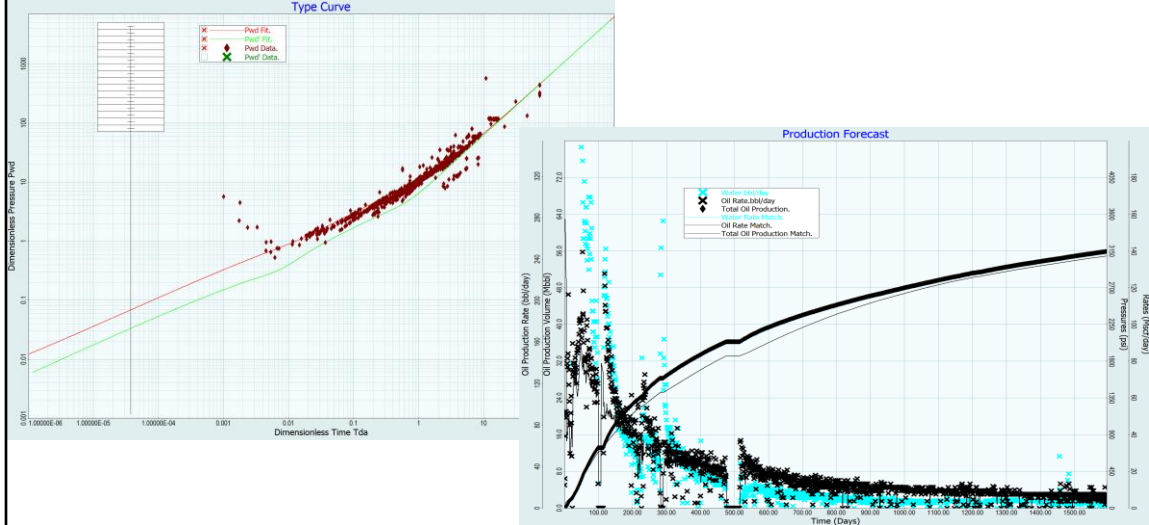


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## Reserve Estimates from Material Balance and Decline Curves



# Production Analysis Example – Permian Basin



Optimization by frac spacing and well spacing, or by stage length and frac length.

Varying well spacing changes the drainage area and reservoir volume available to each well, and controls time to production transient interference between wells.

Frac spacing controls IP and time to interference between fractures.

**Optimization**

|                       |                   |                       |                   |
|-----------------------|-------------------|-----------------------|-------------------|
| Group Optimize        | By Well Spacing ▾ | Optimize              | By Frac Spacing ▾ |
| Min Well Spacing(ft)  | 300               | Min Frac Spacing(ft)  | 15                |
| Max Well Spacing(ft)  | 900               | Max Frac Spacing(ft)  | 30                |
| Optimization Step(ft) | 200               | Optimization Step(ft) | 15                |

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Development Optimization results can be presented “by section”.

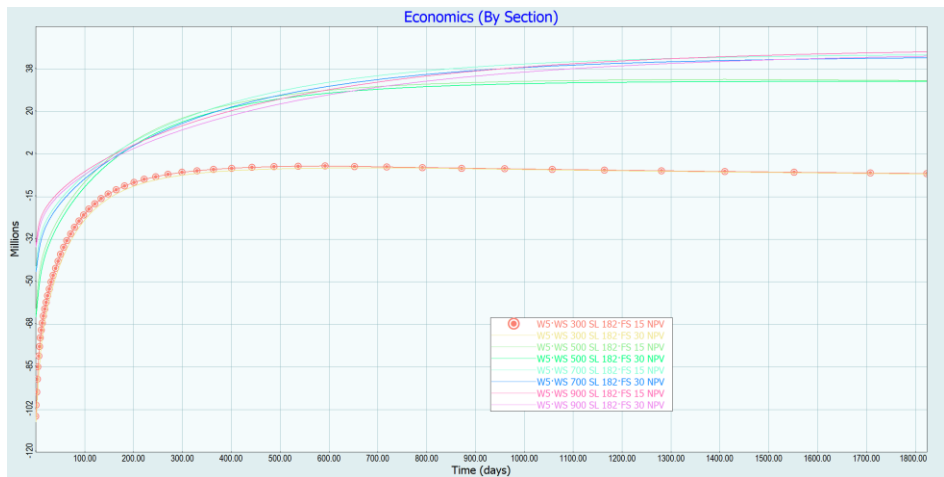
The wells drilled to fill a 1-mile section are included, along with the stimulation cost for all the stages on all the wells.

Once run, the output can be toggled between “by well” and “by section”.

| ✖ Display Results by Section |                 |                 |                |          |              |               |                       |                |                   |
|------------------------------|-----------------|-----------------|----------------|----------|--------------|---------------|-----------------------|----------------|-------------------|
| Well Spacing.ft              | Stage Length.ft | Frac Spacing.ft | Frac Length.ft | # Stages | Cum Oil,Mbbl | Cum Gas,MMscf | Total Cost (millions) | NPV (millions) | Wells Per Section |
| 300.00                       | 182             | 15              |                | 50.00    | 3412.8       | 5119.2        | \$111.00              | (\$5.83)       | 17.60             |
| 300.00                       | 182             | 30              |                | 50.00    | 3446.68      | 5170.02       | \$111.00              | (\$6.06)       | 17.60             |
| 500.00                       | 182             | 15              |                | 50.00    | 3368.78      | 5053.16       | \$66.60               | \$32.41        | 10.56             |
| 500.00                       | 182             | 30              |                | 50.00    | 3404.72      | 5107.08       | \$66.60               | \$32.07        | 10.56             |
| 700.00                       | 182             | 15              |                | 50.00    | 3264.11      | 4896.17       | \$47.57               | \$43.02        | 7.54286           |
| 700.00                       | 182             | 30              |                | 50.00    | 3248.5       | 4872.76       | \$47.57               | \$41.80        | 7.54286           |
| 900.00                       | 182             | 15              |                | 50.00    | 3052.15      | 4578.22       | \$37.00               | \$44.27        | 5.86667           |
| 900.00                       | 182             | 30              |                | 50.00    | 3010.5       | 4515.76       | \$37.00               | \$42.47        | 5.86667           |

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Graphical displays of rate, cumulative production, and net-present value are provided for all cases, along with tabular data output.

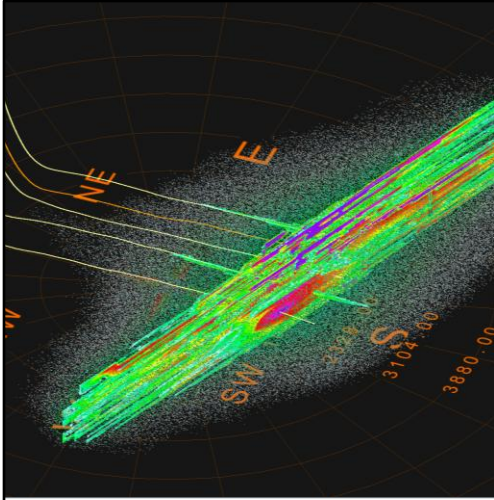


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## Summary of GOHFER Functionality

- Start-to-finish data integration
  - Log processing and petrophysics
    - » Possible integration with wireline and Cerebro bit inputs
  - Impact of perforation geometry and efficiency
    - » Possible integration with perforating, Prodigy, Cerebro, Fracture ID, SPECTRUM 3D, D2F
  - Input of geo-mechanical earth model
    - » Integration with Decision Space, Permedia (Landmark), Petrel, CGG
  - Output of fracture geometry and effective conductivity, along with reservoir description
    - » Integration with Nexus and other reservoir simulators
  - Input of pore pressure profile from historical production match
    - » Integration with all customer/client reservoir simulators
- Complete toolbox for well planning and pad development economic optimization

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THANK YOU

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