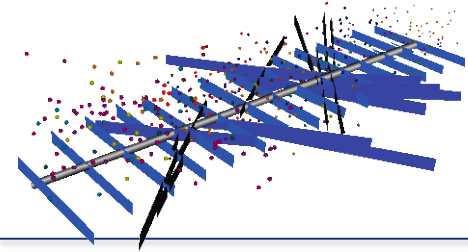


An abstract graphic in the top-left corner featuring a cluster of blue rectangular bars, some thin black lines, and a spray of small, multi-colored dots (red, yellow, green, blue, purple) emanating from the center.

UR Add-on pack



KURC / Add-on pack

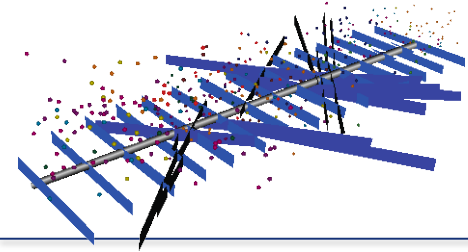


KURC – KAPPA Unconventional Resources Consortium

- KURC-1: 2012 – 2015 /
- KURC-2: 2016 – 2020
- KURC options are exclusive to members for 3 years since their release

UR Add-on pack

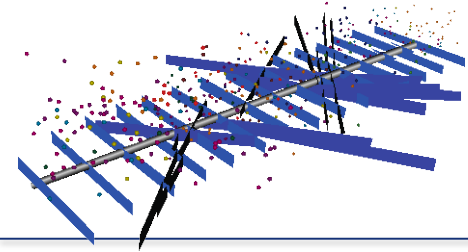
- New developments + all KURC-1/2 features post-exclusivity period
- Specific license privilege in Saphir 💎, Topaze 🟠 and Rubis 🔴
- Non-digressive, per stand-alone license
- Available since KW v5.20.01 (2018)
- Latest update KW v5.30.03 (July 2020)



Add-on pack: Analytical



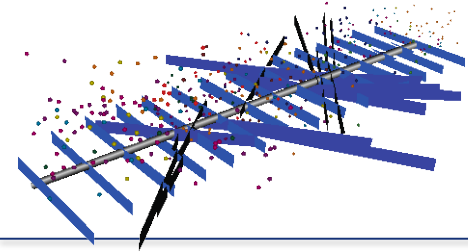
- ◆◆ DFN analytical model with conjugate fractures
- ◆◆ Anomalous diffusion model
- ◆◆ Multi-zone fractional model
 - ◆ Dynamic Drainage Area corrected Linear Flow plot
 - ◆ Flowing Material Balance plot
 - ◆ Statistical EUR



Add-on pack: Numerical



- ◆◆ Fast numerical models for SRVB & Trilinear geometries
 - ◆ Water flowback with static Initialization
- ◆◆◆ Numerical DFN model
- ◆◆◆ Numerical model with composite zones
- ◆◆◆ Load and display of microseismic data
- ◆◆◆ Simulation of Klinkenberg effect
- ◆◆◆ Fickian diffusion
- ◆◆◆ Refrac for a MFHW
- ◆◆◆ DFN Upscaling
- ◆◆◆ Loading properties of fracs



Add-on pack: New in v5.30.03



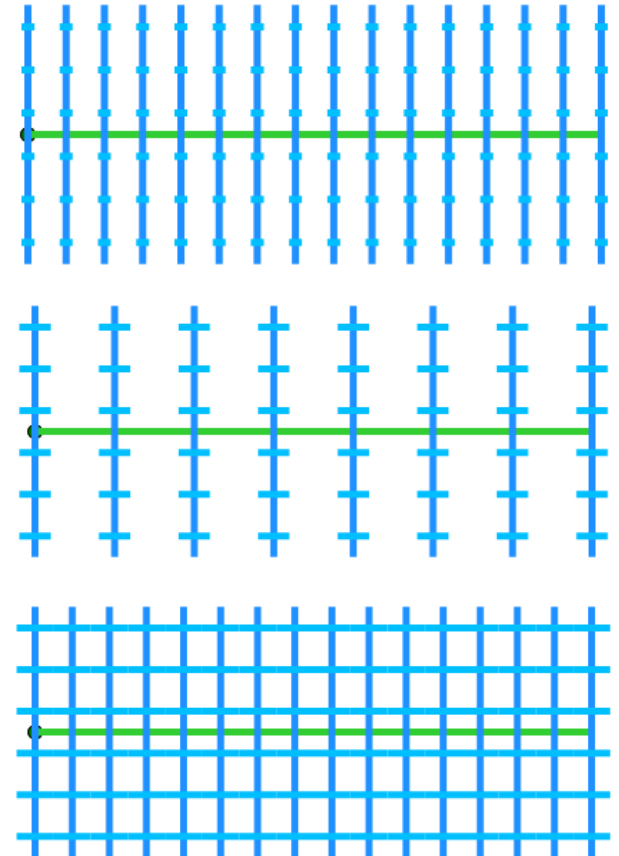
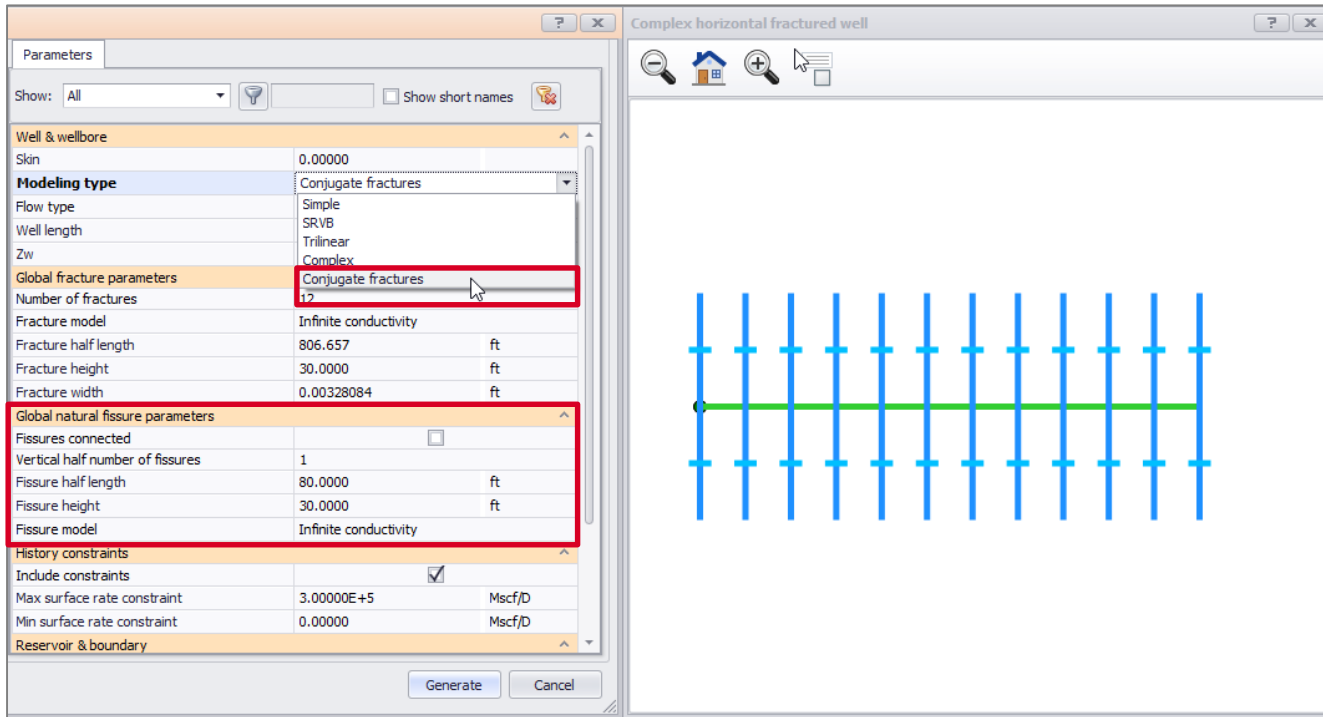
To be released by the end of July 2020:

- ◆◆◆ Load from Fracturing Software
- ◆◆◆ Confined PVT
- ◆◆◆ Multiple KrPc
- ◆◆◆ Stochastic DFN realizations
- ◆◆◆ Interference with DFN: Fast Marching Method
- ◆◆◆ Stimulated zones around the fractures
- ◆◆ Numerical 'butterfly' model

DFN analytical model



- Conjugate fractures: # fissures and geometry



Anomalous Diffusion



v5.30



Anomalous Diffusion analytical model is made internal

Well model [Horizontal fractured]

Horizontal fractured

☐ Rate dependent skin ☐ Time dependent skin

Reservoir model [Homogeneous]

Homogeneous

Homogeneous
Dual porosity pseudo steady state
Dual porosity transient (slab)
Dual porosity transient (sphere)
Radial composite
Anomalous Diffusion
Multi-zone fractional dimension

Use M,D Definition

- Well: Simple MFHW or Trilinear
- Single layer models only
- Matrix: single/double porosity
- Can include changing WBS, rate-/time-dependent skin

| Well & wellbore | |
|----------------------|---------------------|
| Wellbore storage | 0.01 |
| Skin | 0.00000 |
| Modeling type | Trilinear |
| Flow type | Simple |
| Well length | SRVB |
| Zw | Trilinear |
| Number of fractures | Conjugate fractures |

| Reservoir & boundary | | |
|-------------------------------------|-------------|-------------------|
| Initial pressure | 5000.00 | psia |
| Transmissibility | 0.2 | md.ft |
| Permeability | 1.00000E-3 | md |
| Thickness | 200.000 | ft |
| Porosity | 0.1 | |
| Primary diffusion exponent | 0.7 | |
| Secondary diffusion exponent | 0.3 | |
| Reservoir | Homogeneous | |
| kz/kr | 1.00000 | |
| Total compressibility | 3.00000E-6 | psi ⁻¹ |

Additional parameters:

α_f and α_m

(also for outer zone in Trilinear)

Multi-zone fractional dimension



Multi-zone fractional dimension analytical model is made internal
Selected in Well or Reservoir model dialog (the two are synchronized)

A screenshot of a software interface with three main sections: 'Well model [Multi-zone fractional dimension]', 'Reservoir model [Multi-zone fractional dimension]', and 'Boundary model [Infinite]'. Each section has a dropdown menu set to 'Multi-zone fractional dimension', which is highlighted with a red rectangle. The 'Well model' section also includes checkboxes for 'Rate dependent skin' and 'Time dependent skin'. The 'Reservoir model' section includes checkboxes for 'horizontal anisotropy' and 'Use M,D Definition'. The 'Boundary model' section includes a dropdown menu set to 'Infinite' and a checkbox for 'Show average pressure'.

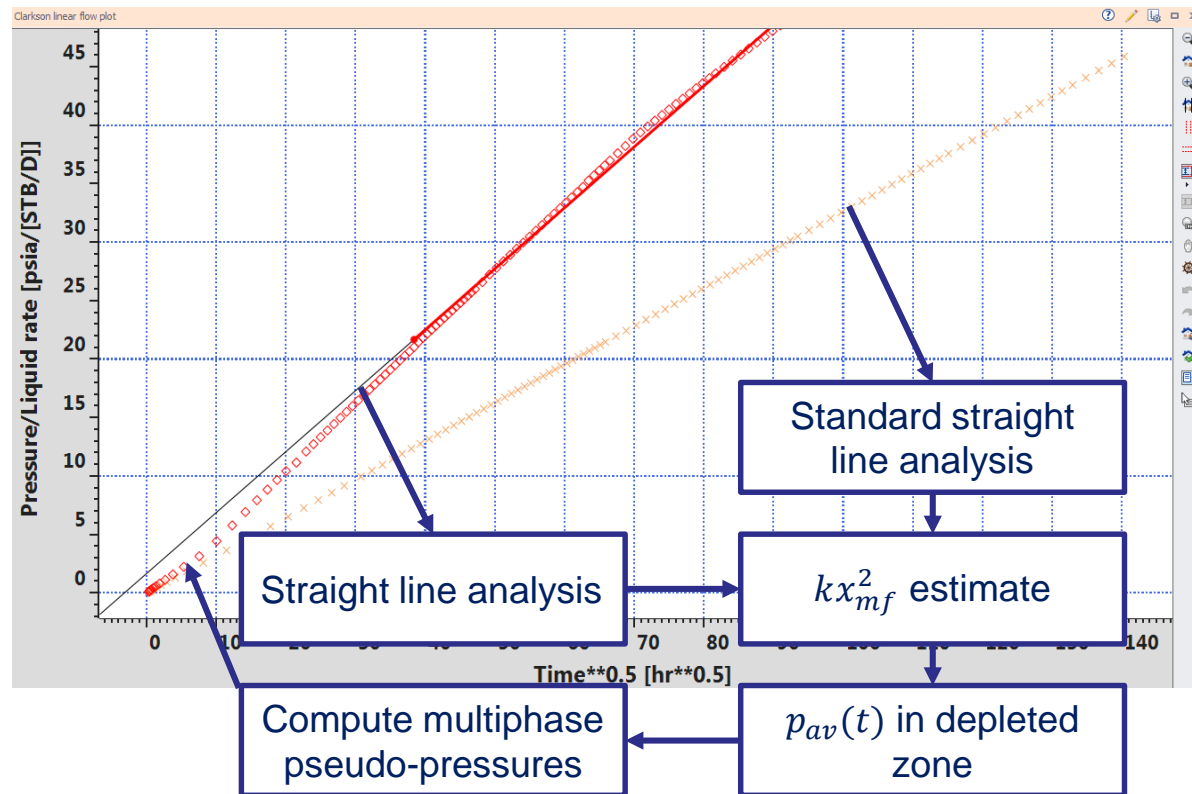
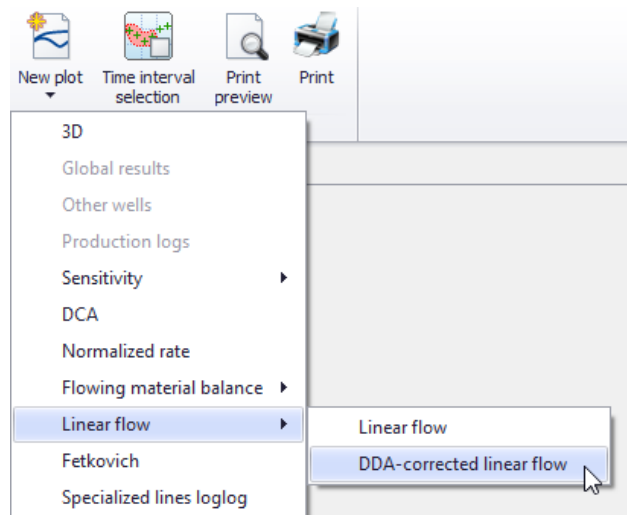
- Boundary: infinite / circular / linear
- Compatible with multilayer geometry
- Compatible with time-dependent skin
- Not available with time-dependent well mode

Clarkson DDA Linear Flow plot



Linear flow analysis modified
using pseudo- p from Dynamic
Drainage Area concept

Multiphase extraction



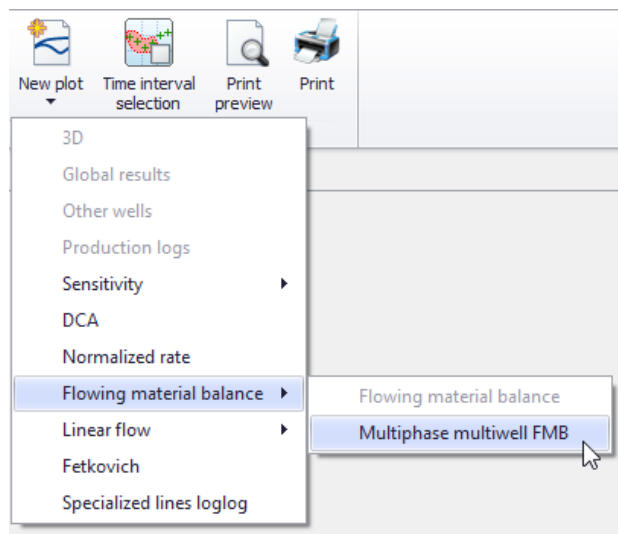
Multiphase/multiwell FMB Plot



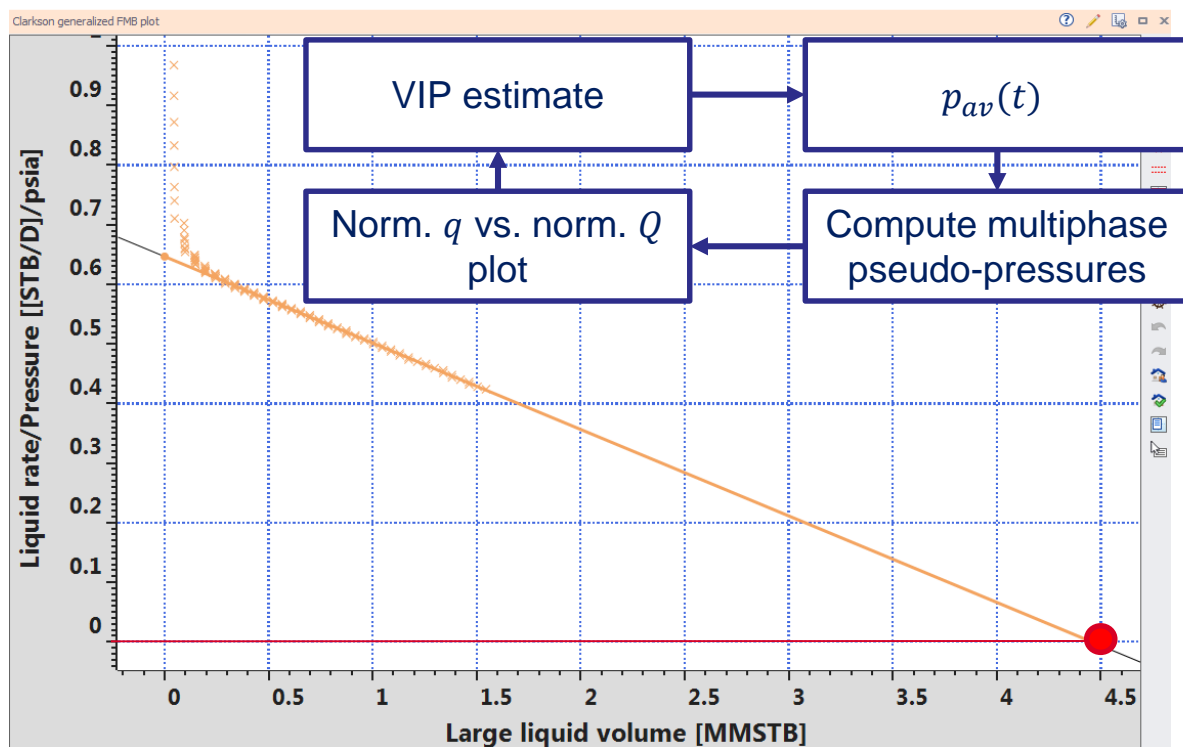
General Flowing Material Balance equation modified using pseudo- p and p_{av} from MB calculations

Multiphase extraction

except: Dry gas + Water, Wet gas + Water, EoS + Water



$$\frac{q_o}{\Delta p_{pw}} = \frac{1}{b} - \frac{1}{bN} \left(\frac{\Delta p_{pav} N}{\Delta p_{pw}} \right)$$



Statistical EUR



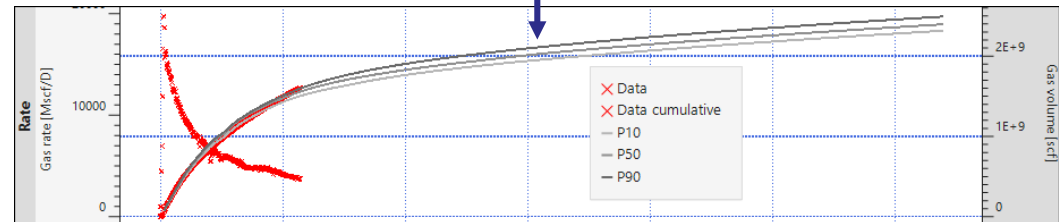
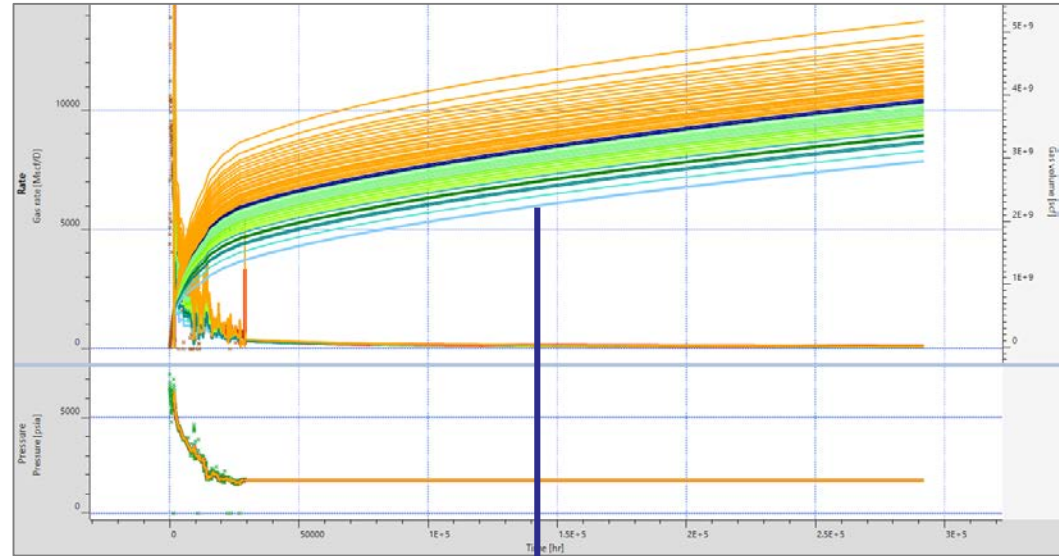
- Single forecast
- Monte Carlo + Improve for uncertainty estimate
- **Monte Carlo + Model Mining**: replacing the CPU expensive nonlinear regression step by a data mining proxy



Model
Mining

Model Mining is activated when:

- Model forecast is done
- There are multiple Monte Carlo sensitivity runs on the forecast
- The sensitivity runs 'bracket' historical Q_{cum}



Water flowback

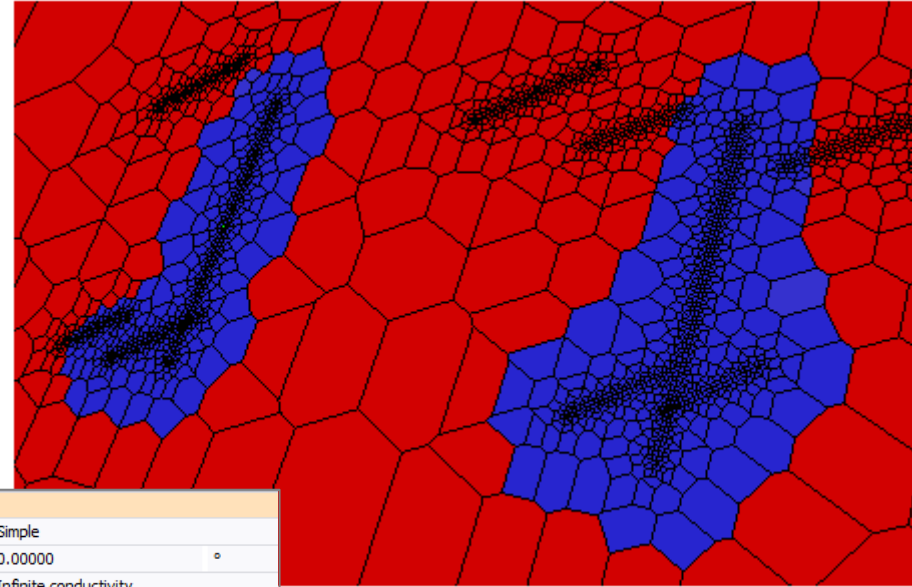


To model the post fracture treatment water flowback:

- The user inputs the total injected water volume
- The injected volume is divided between the connected hydraulic and natural fractures (accounts for Kr end points)
- The local pressure increase is not modeled

Available in the numerical model:

- Multiphase PVT includes water
- Real PVT are used
- Well is set to MFHW



| Well 1 | | |
|-----------------------------------|-------------------------------------|-------|
| Modeling type | Simple | |
| Drain angle | 0.00000 | ° |
| Fracture model | Infinite conductivity | |
| Number of fractures | 15 | |
| Fracture half length | 300.000 | ft |
| Fracture height | 30.0000 | ft |
| Fracture mid-point height | 15.0000 | ft |
| Width | 0.00328084 | ft |
| Fracture angle | 90.0000 | ° |
| Zw | 15.0000 | ft |
| Well length | 1000.00 | ft |
| Stimulated zones around fractures | <input type="checkbox"/> | |
| Include injected water | <input checked="" type="checkbox"/> | |
| Injected water | 5000.00 | MMSTB |
| Rate dependent skin | <input type="checkbox"/> | |

Klinkenberg effect



For gas observed permeability can be higher than the true/absolute permeability of the rock due to slippage

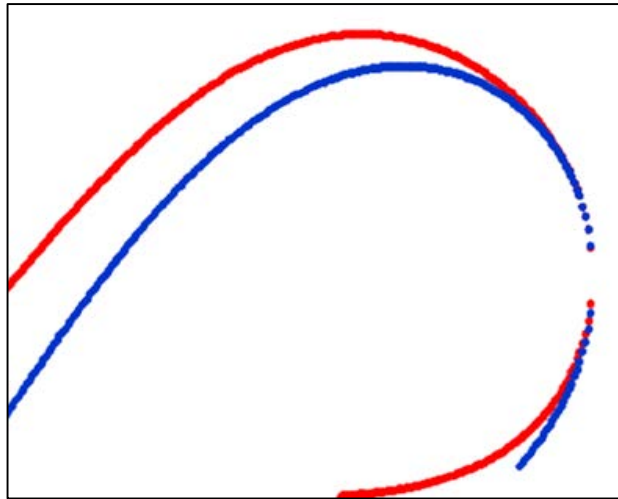
Available in the numerical model:

- PVT is set to dry gas
- Real PVT are used
- Reservoir type: homogeneous

| Well 1 ^ | | |
|---------------------|-------------------------------------|-------|
| Zw | 15.0000 | ft |
| Perforation length | 30.0000 | ft |
| Well length | 30.0000 | ft |
| Rate dependent skin | <input type="checkbox"/> | |
| Skin | 0.00000 | |
| Wellbore model | None | |
| Bottomhole MD | 6000.00 | ft |
| Include constraints | <input type="checkbox"/> | |
| Reservoir ^ | | |
| Initial pressure | 7246.55 | psia |
| Reservoir type | Homogeneous | |
| Transmissibility | 1000.000 | md.ft |
| Permeability | 33.3333 | md |
| Thickness | 30.0000 | ft |
| Porosity | 0.1 | |
| Klinkenberg | <input checked="" type="checkbox"/> | |
| Klinkenberg b | 200.000 | psia |
| Net-to-gross | 1.00000 | |
| kz/kr | 1.00000 | |

Confined PVT

The size of the pores ~ the size of hydrocarbon molecules ('confined')
→ PVT is different from the phase behavior in a laboratory cell



- Fluid Definition Type: EoS
- Check 'Confined PVT'
- 'Pore radius' is available in Reservoir Properties

KAPPA PVT

Rubis license required

Quick flash

Import

Main

Fluid system

Equations of State (EOS)

Interfacial tensions

Equations of State

Fluid type

Oil / Gas

Dry gas

Wet gas

Dead oil

Saturated oil (bubble point fluid)

Condensate (dew point fluid)

Define from lab report

Equation of State

Water

Problem definition

Common functionalities

Non uniform parameters

Vertical anisotropy

Horizontal anisotropy

Rubis license required

Load horizons

Load from geosimulator

Property sets

Improve on multiple wells

Faults with throws

Nonlinear diffusion

Common functionalities

Use real PVT

Non Darcy flow

Unconsolidation

Allow aquifers

Rubis license required

Temperature modeling

Gravity

Confined PVT

Reservoir

| | | |
|-------------------|-------------|-------|
| Initial pressure | 5000.00 | psia |
| Variable type | Composition | |
| Reservoir type | Homogeneous | |
| Transmissibility | 0.0184281 | md.ft |
| Permeability | 6.14271E-4 | md |
| Thickness | 30.0000 | ft |
| Porosity | 0.1 | |
| Net-to-gross | 1.00000 | |
| kz/k _r | 1.00000 | |
| Pore radius | 1.00000E-8 | m |

Fickian diffusion



PVT includes gas & Real PVT are used

Available under 'Reservoir type' 

or 'Reservoir properties' 

Generate numerical model

Main options

- ☐ Include other wells
- ☒ Show average pressure
- ☒ Output result fields
- ☐ Output well drainage results (Rubis only)

Advanced

- Time stepping
- Numerical settings

Parameters

Wellbore storage calculator

Show: All ☐ Show short names

| | | |
|---------------------|-----------------------------------|---------|
| Perforation length | 250.000 | ft |
| Well length | 250.000 | ft |
| Rate dependent skin | <input type="checkbox"/> | |
| Skin | 0.00000 | |
| Wellbore model | Constant | |
| Wellbore storage | 9.50978E-4 | bbl/psi |
| Bottomhole MD | 6000.00 | ft |
| Include constraints | <input type="checkbox"/> | |
| Reservoir | | |
| Initial pressure | 4228.00 | psia |
| Reservoir type | Fickian diffusion | |
| Transmissibility | Homogeneous | |
| Permeability | Dual porosity pseudo steady state | |
| Thickness | 25.00000 | ft |
| Porosity | 0.2 | |
| Net-to-gross | 1.00000 | |
| Diffusion time | 10.0000 | hr |
| Diffusion ratio | 1.00000 | |
| kz/kr | 1.00000 | |

Generate Cancel

Reservoir properties

Topology

- Uniform
- Layered
- Regional
- Complex

Click to edit, right-click to assign

| Layer # | Default |
|----------|---------|
| Layer #1 | Default |

Property set definition

Name: Default

Show: All ☐ Show short names

| | |
|----------------------|-----------------------------------|
| Reservoir type | Fickian diffusion |
| Permeability | Homogeneous |
| Porosity | Dual porosity pseudo steady state |
| Net-to-gross | Constant porosity |
| Diffusion time | 10.0000 hr |
| Diffusion ratio | 1.00000 |
| kz/kr | 1.00000 |
| Lower layer leakage | 1.00000 |
| Rock compressibility | 3.00000E-6 psi ⁻¹ |

KrPc: Default

Initial state: Default

Pressure dependent properties: Default

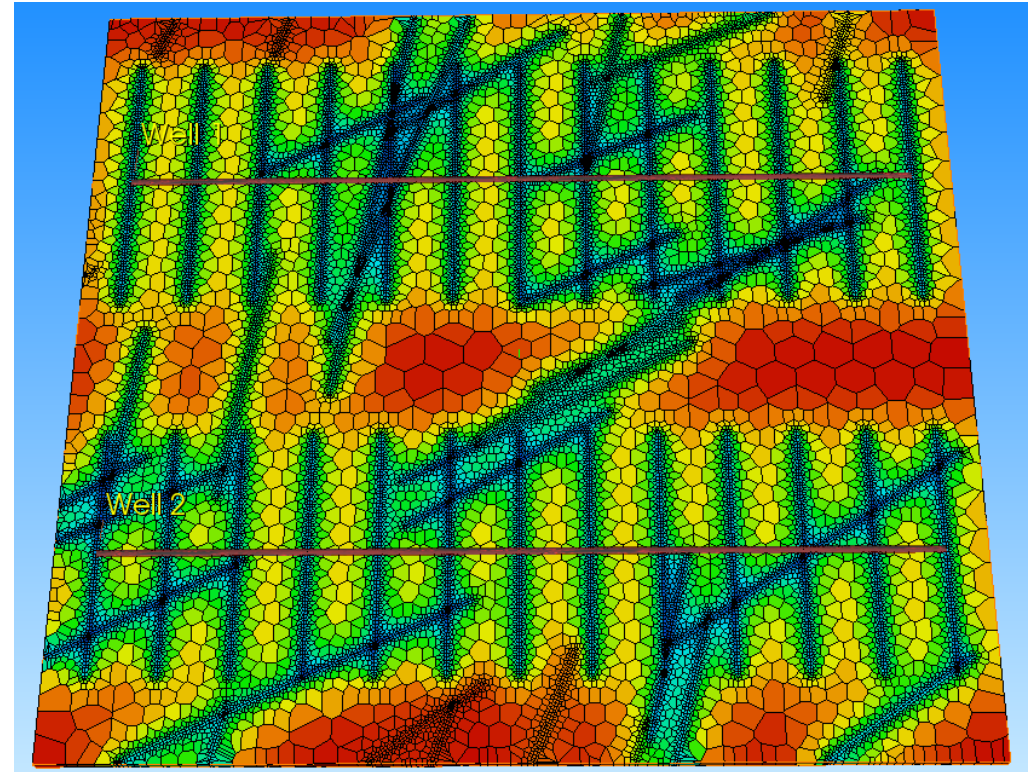
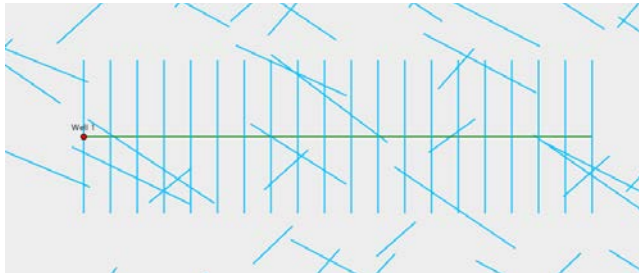
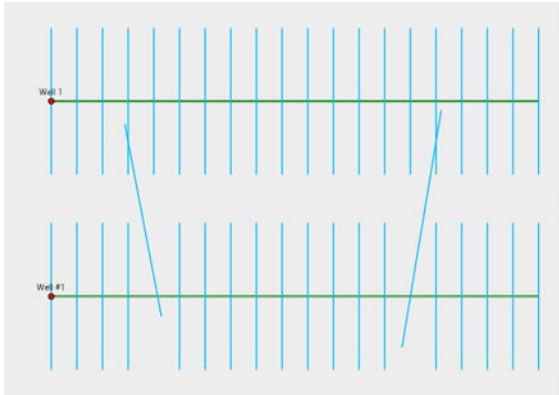
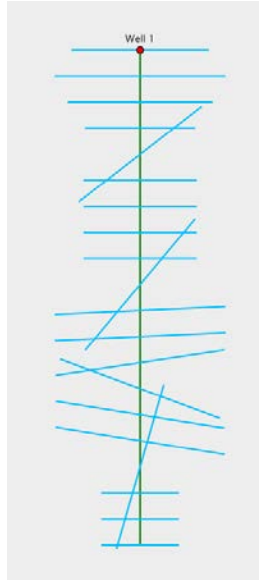
Desorption: Default

OK Cancel

Numerical DFN



DFN and well fractures have distinct properties, including relative permeabilities and $k(p)$.

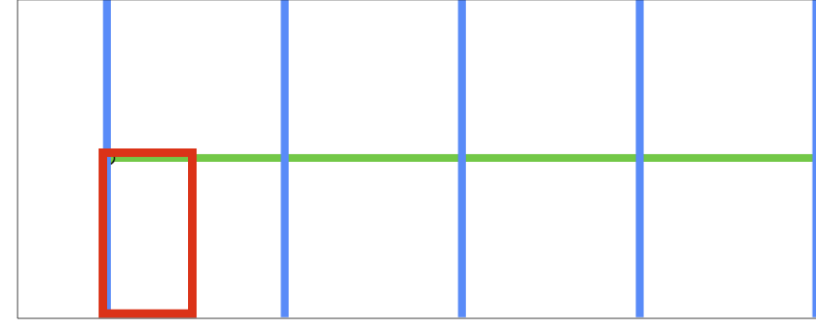


Fast numerical models

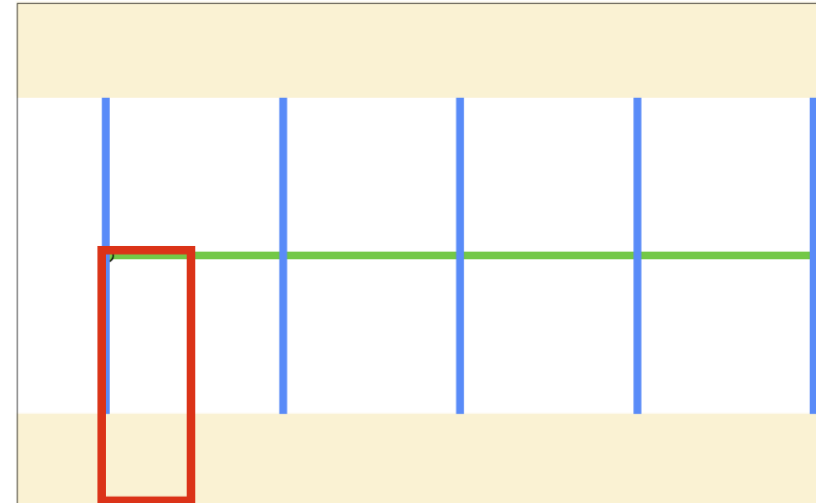


Very useful in the case of complex PVT and a simple but very long MFHW to tune the fracture properties prior to running the full numerical model

Stimulated
Reservoir
Volume
bounded
(SRVB)



Trilinear



Well model

- Finite radius
- Infinite conductivity fracture
- Finite conductivity fracture
- Limited entry
- Horizontal
- Fractured horizontal
- Fractured horizontal + SRVB**
- Fractured horizontal + Trilinear

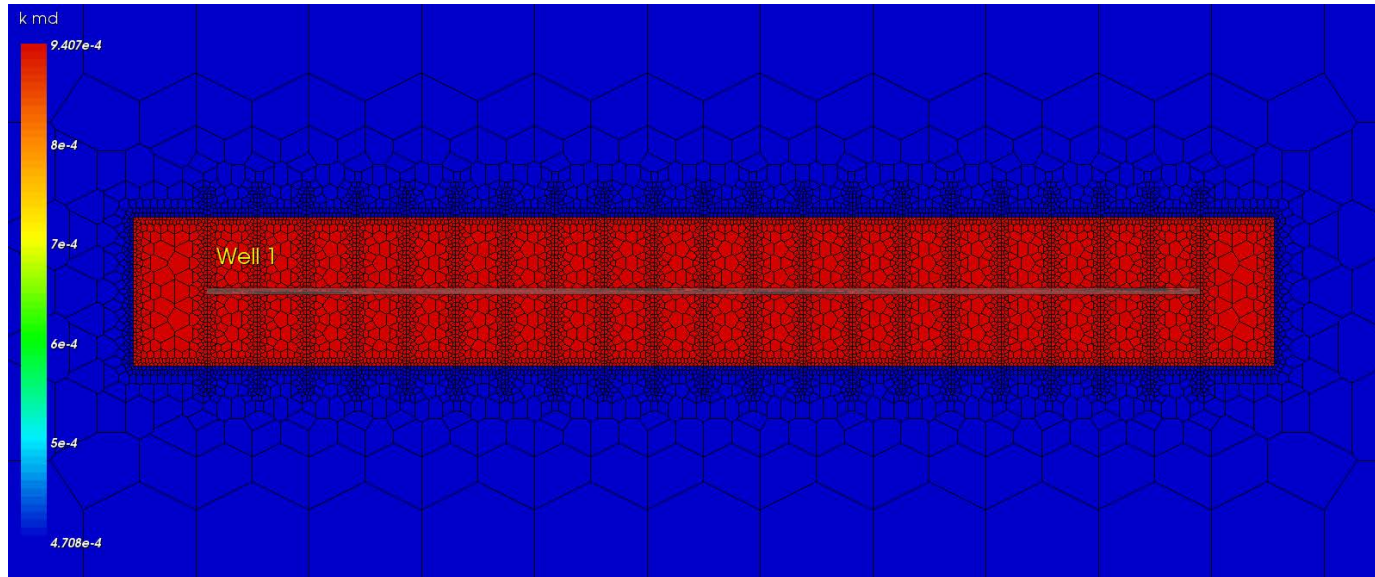
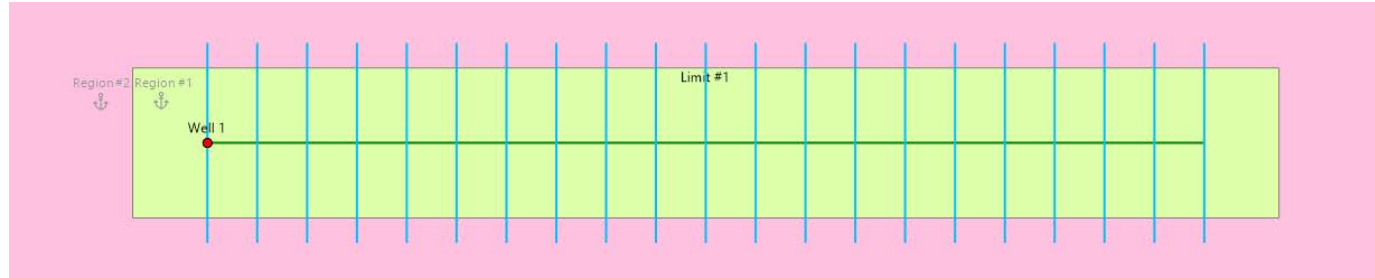
Can be initiated from
an analytical model
via the Dashboard

Composite zones



Composite limits are now allowed to cross fractures to simulate enhanced area close to the well

| Region #1 | |
|----------------|-----------------------------------|
| Reservoir type | Homogeneous |
| M | 1.00000 |
| D | 1.00000 |
| Net-to-gross | 1.00000 |
| Region #2 | |
| Reservoir type | Homogeneous |
| M | Homogeneous |
| D | Dual porosity pseudo steady state |
| Net-to-gross | 1.00000 |



DFN Upscaling



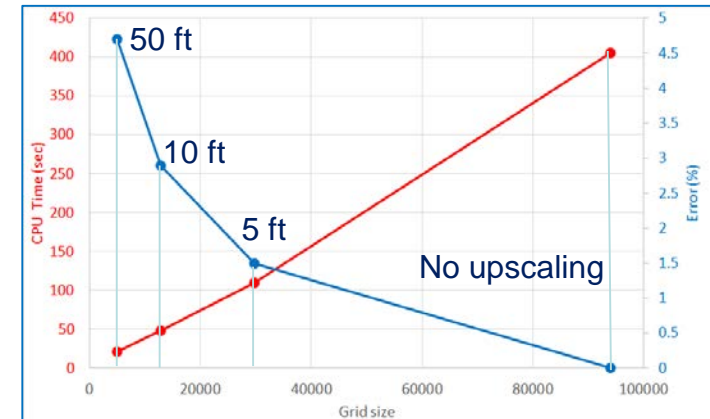
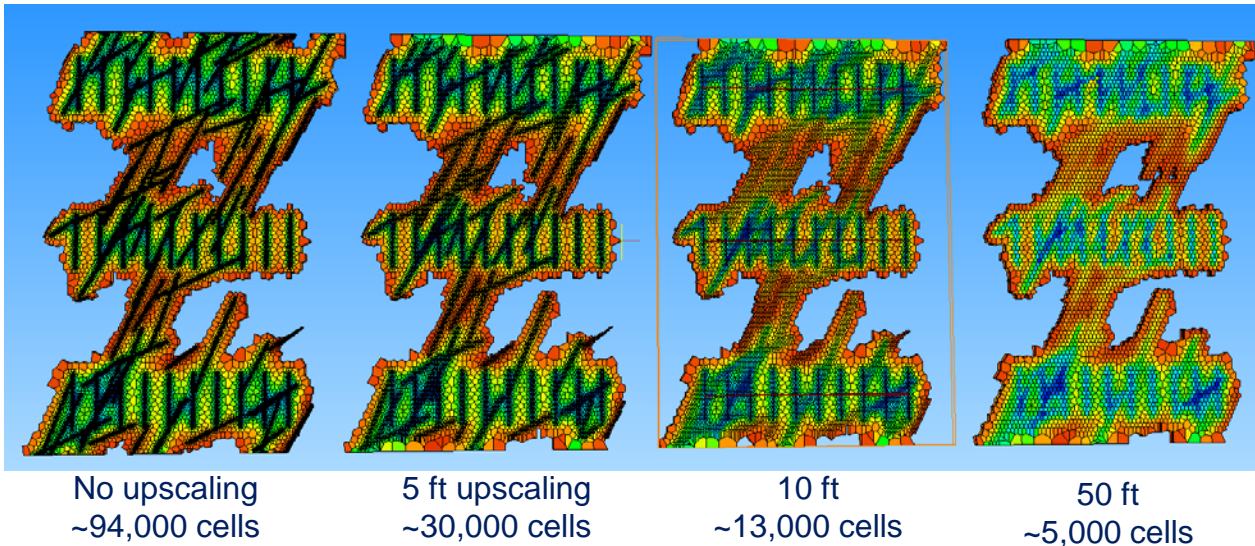
v5.30



DFN upscaling reduces the refinement of the grid (and gridblock count), correctly accounting for the matrix-to-fracture flow and interaction

- DFN added in Map 
- Upscaling parameters are available in Grid 
- Min gridblock size changes from 'DFN resolution' to 'DFN coarse resolution'

| | | |
|-----------------------|---------|-------------------------------------|
| DFN upscaling | | <input checked="" type="checkbox"/> |
| DFN resolution | 4.00000 | ft |
| DFN coarse resolution | 50.0000 | ft |



Stochastic DFN realizations



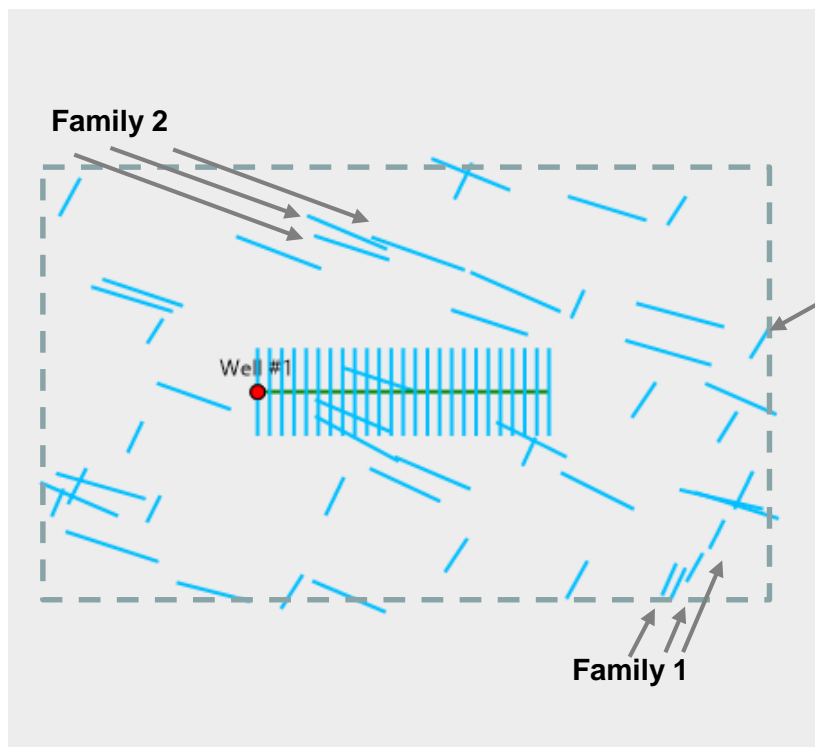
New in v5.30.03



DFN

'Map' → 'DFN' → 'Generate'

Location can be defined μ -seismic, if loaded



DFN geometry stochastic generation

Global settings

Fissures parameters

| | |
|------------------------------|--------------------------|
| Number of fissures | 50 |
| Use microseisms events | <input type="checkbox"/> |
| X minimum | -2500.00 ft |
| X maximum | 2500.00 ft |
| Y minimum | -1500.00 ft |
| Y maximum | 1500.00 ft |
| Impose random generator seed | <input type="checkbox"/> |

Fissure families

Family parameters

| | | | |
|------------------------|----------------|----------|--|
| Fraction | 0.5 | Fraction | |
| Minimum fissure length | 200.000 | ft | |
| Maximum fissure length | 300.000 | ft | |
| Power | 1.50000 | | |
| Strike angle | 30.0000 | ° | |
| K strike | 400.000 | | |

Family name

- Family 1
- Family 2

Add Delete

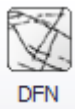
Interference with DFN: FMM



New in v5.30.03



At least 2 wells must exist in the map

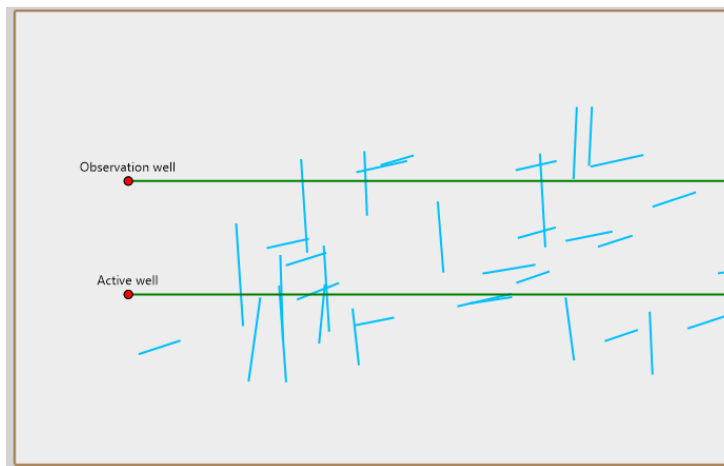
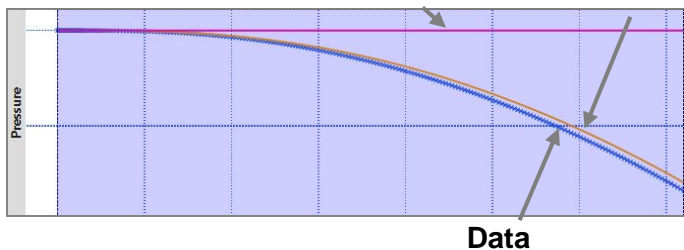


‘Map’ → ‘DFN’ → ‘Generate’

Interference time is an input to constrain the DFN

A number of realizations are run using Fast Marching (flow in fractures only) to pick one closest to the interference time

Then a full model is run in Analysis



DFN geometry stochastic generation

Global settings

| | | |
|------------------------------|--------------------------|----|
| Fissures parameters | | |
| Number of fissures | 50 | |
| X minimum | -4000.00 | ft |
| X maximum | 4000.00 | ft |
| Y minimum | -1000.00 | ft |
| Y maximum | 1000.00 | ft |
| Impose random generator seed | <input type="checkbox"/> | |

Fissure families

| | | |
|------------------------|---------|----------|
| Family parameters | | |
| Fraction | 0.5 | Fraction |
| Minimum fissure length | 300.000 | ft |
| Maximum fissure length | 500.000 | ft |
| Power | 1.50000 | |
| Strike angle | 75.0000 | ° |
| K strike | 400.000 | |

Family name

| | |
|----------|--------|
| Family 1 | Add |
| Family 2 | Delete |

Fast marching

☒ Use fast marching

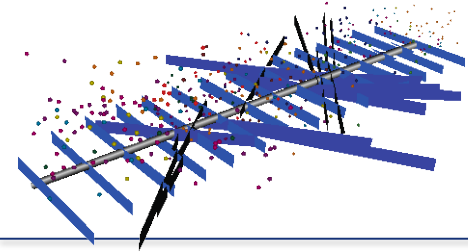
Fast marching parameters

| | |
|----------------------|------------------|
| Well 1 | Active well |
| Well 2 | Observation well |
| Interference time | 300.000 hr |
| Max realizations | 100 |
| Max calibration runs | 5 |
| Conductivity | 10.00000 md.ft |
| Width | 0.00328084 ft |
| Porosity | 0.1 |

Final time: 0.0982475 hr

Computing fast marching models ...

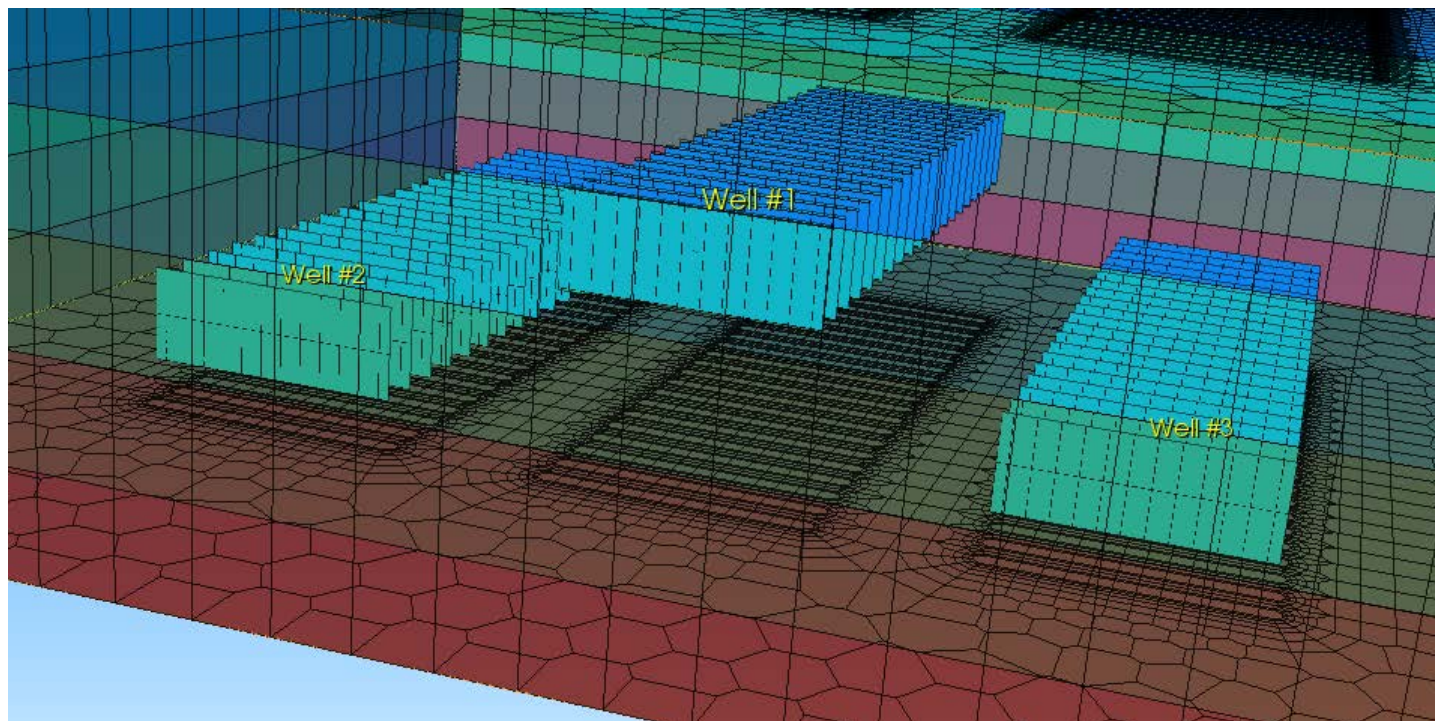
Generate OK Cancel



Accelerated initialization



Large models with multiple MFHWs are initialized using specific faster procedures

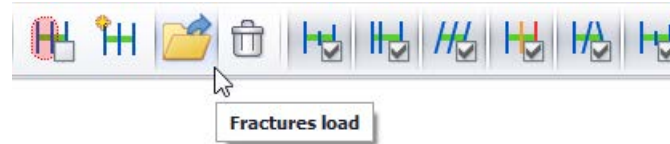


Loading properties of fracs

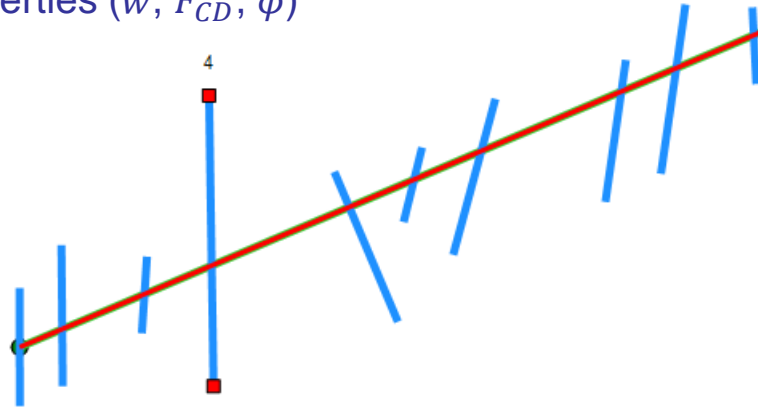


The option allows loading individual fracture properties for a complex MFHW from a file

- MFHW well modeling type should be set as 'Complex'
- 'Load' button is available in the well dialog
- Tick the options prior to loading a file:
 - Half-length
 - Fracture position (MD)
 - Angle to the wellbore
 - Individual properties (w , F_{CD} , ϕ)
 - Offset

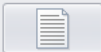



| Geometry and properties - Fracture #4 | | |
|---------------------------------------|---------|-------|
| Measured depth | 7631.17 | ft |
| Fracture half length | 1134.53 | ft |
| Fracture angle | 67.8886 | ° |
| Fracture offset | 192.914 | ft |
| Fracture height | 400.000 | ft |
| Fracture conductivity | 150.000 | md.ft |
| Fracture width | 0.01 | ft |
| Fracture porosity | 0.1 | |




Load from file...

Data Source







C:\Users\kostyleva\Desktop\Fractures definition - Nc ...

Separators

☒ Space

☒ Tab

Others: ;

| Column | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 |
|--------|---------------|----------|----------|-----------|---------------|
| Type | Fracture name | MD Start | Xf | Angle | Offset |
| Unit | | ft | ft | ° | Undefined |
| 1 | Fracture name | MD | Xf | Angle | Fracture name |
| 2 | | | [ft] | [degrees] | Xf |
| 3 | Fracture #1 | 6000 | 462.151 | 67.1651 | MD Start |
| 4 | Fracture #2 | 6361.64 | 550.908 | 67.5127 | Angle |
| 5 | Fracture #3 | 7060.38 | 300 | 63.117 | Offset |
| 6 | Fracture #4 | 7631.17 | 1134.53 | 67.8886 | Width |
| 7 | Fracture #5 | 8822.01 | 635.809 | 48.9681 | -6.92786 |
| 8 | Fracture #6 | 9350.3 | 300 | 53.0675 | 192.914 |
| 9 | Fracture #7 | 9920.6 | 630.716 | 51.8192 | 250.219 |
| 10 | Fracture #8 | 11110.2 | 559.728 | 58.7486 | -42.3358 |
| 11 | Fracture #9 | 11576.7 | 667.894 | 58.7188 | -209.228 |
| 12 | Fracture #10 | 12235 | 300 | 69.9204 | -311.902 |
| | | | | | -166.042 |
| | | | | | -83.1065 |

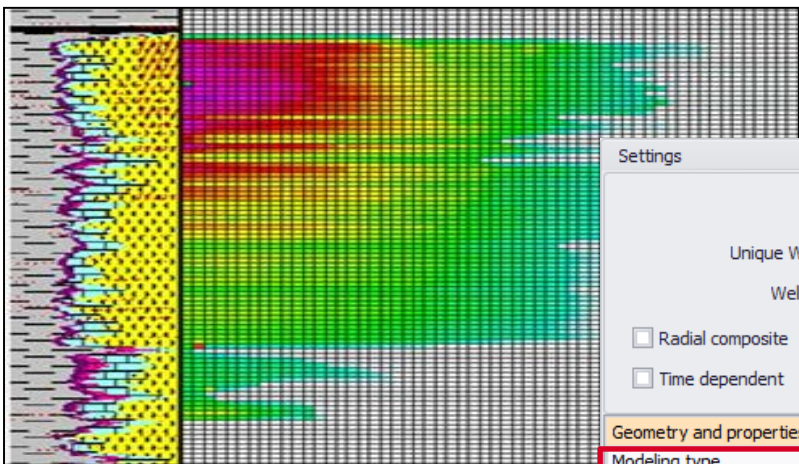
Load from fracturing software



New in v5.30.03



Fracture properties can be non-uniform along the fracture plane





Settings

Name: Field H Well 25

Unique Well ID:

Well type: **Horizontal fractured**

☐ Radial composite ☐ Multiple fractures 

☐ Time dependent  ☐ Inflow control devices

Geometry and properties

| | | |
|-----------------------|---------|----|
| Modeling type | Complex | |
| Drill floor elevation | 0.00000 | ft |
| Well radius | 0.3 | ft |
| Drain angle | 0.00000 | ° |
| Well length | 2000.00 | ft |
| Zw | 15.0000 | ft |

Import fracture data ☒

Stimulated zones around fract... ☐

Rate dependent skin ☐

Location

Input well head ☐

| | | |
|---|----------|----|
| X | -1000.00 | ft |
| Y | 0.00000 | ft |

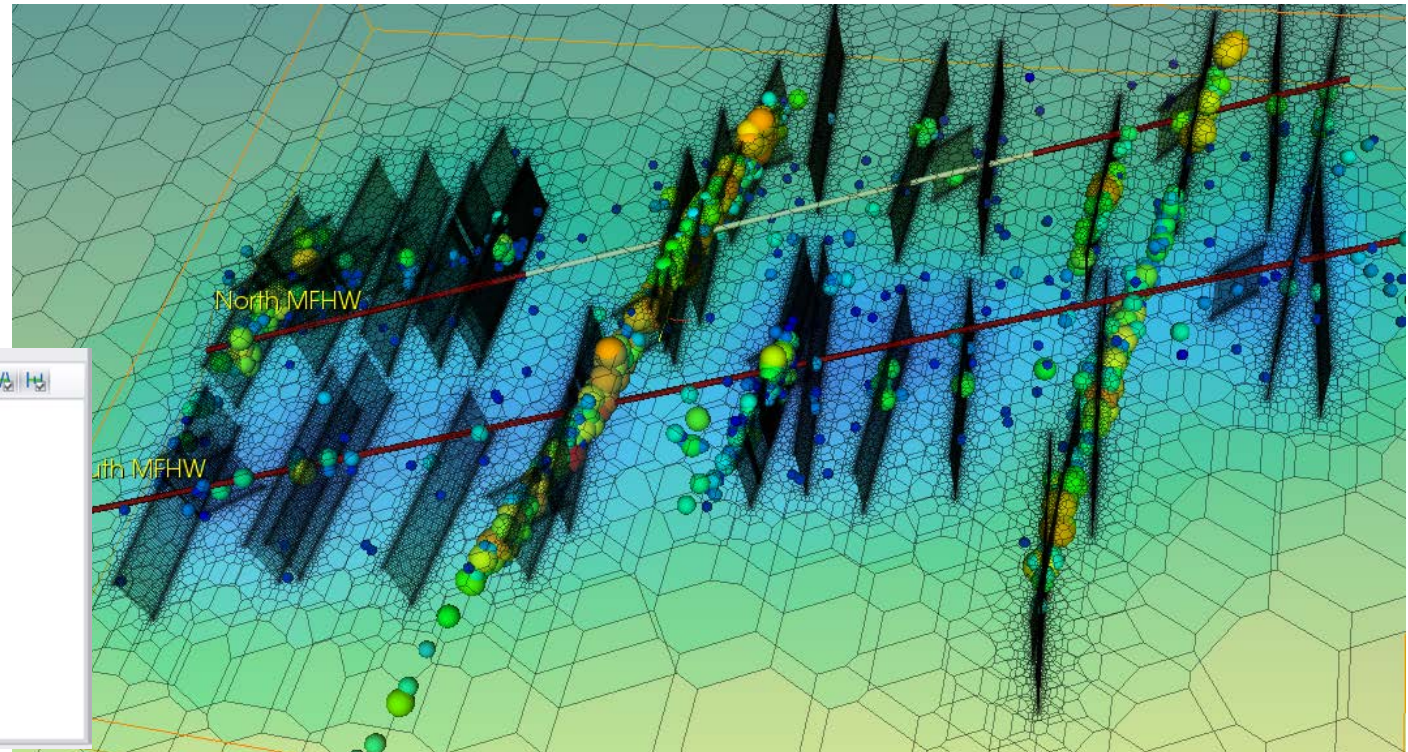
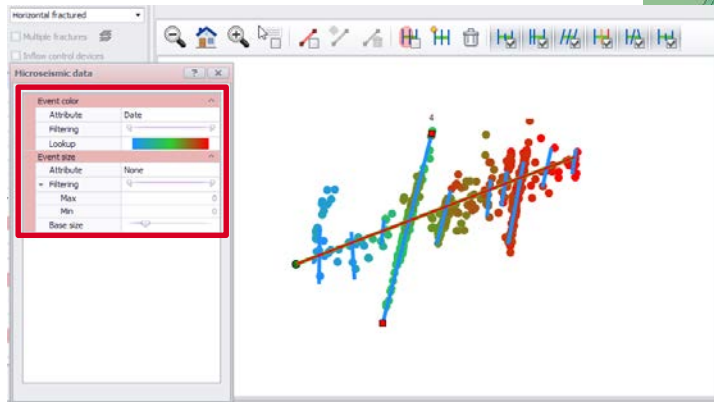
- Define a MFHW as 'Complex'
- Activate 'Import fracture data'
- Load properties from *.csv or *.xml:
 - Index, TVD and location at the well
 - (X,Z): w_f , k_f , F_{CD} , φ , β
- Define fracture MD and angles

Microseismics



Load and display of microseismic events to constrain the MFHW configuration

Visualizing attributes:
date, amplitude, stage index



Stimulated zones




New in v5.30.03



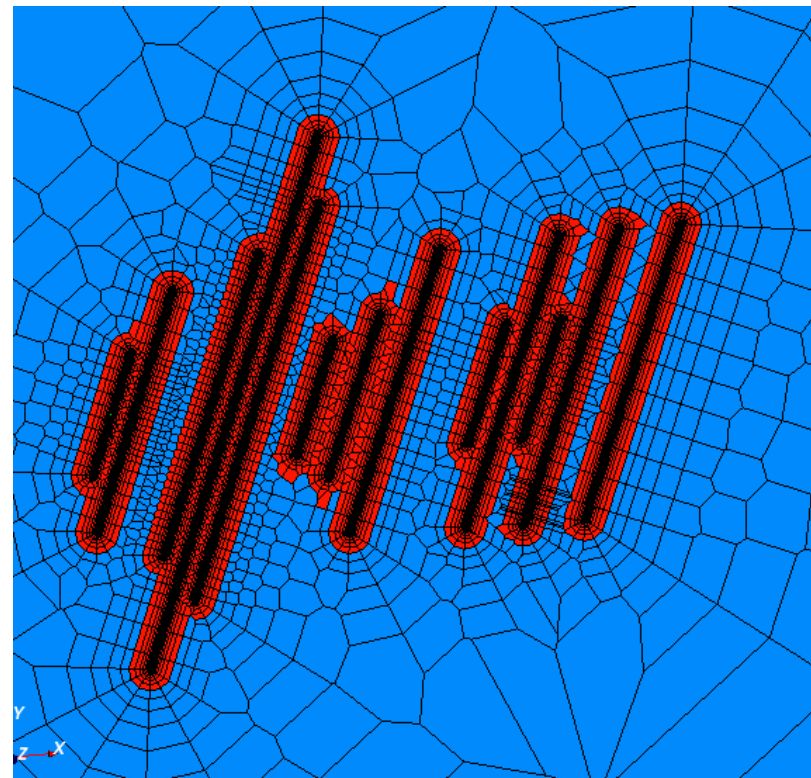
Stimulated zones around fractures of a MFHW

- Available for both Simple and Complex well types
- Defined by radius of the zone, k and ϕ multipliers

| Parameters | | |
|---|-------------------------------------|----|
| Show: All  <input type="checkbox"/> Show short names | | |
| Well 1 | | |
| Modeling type | Simple | |
| Drain angle | 0.00000 | ° |
| Fracture model | Infinite conductivity | |
| Number of fractures | 13 | |
| Fracture half length | 360.000 | ft |
| Fracture height | 30.0000 | ft |
| Fracture mid-point height | 15.0000 | ft |
| Width | 0.00328084 | ft |
| Fracture angle | 90.0000 | ° |
| Zw | 15.0000 | ft |
| Well length | 2000.00 | ft |
| Stimulated zones around fractures | <input checked="" type="checkbox"/> | |
| Stimulation radius | 50.0000 | ft |
| Permeability multiplier | 4.00000 | |
| Porosity multiplier | 1.00000 | |
| Rate dependent skin | <input type="checkbox"/> | |
| Wellbore model | None | |
| Bottomhole MD | 6000.00 | ft |

These parameters can be regressed upon in 'Improve'

| Improve | |
|----------------------------------|--------------------|
| Parameters | Targets |
| Constant parameters | |
| Well 1 | |
| <input type="radio"/> | Theta |
| <input type="radio"/> | N |
| <input type="radio"/> | Xf |
| <input type="radio"/> | Hf |
| <input type="radio"/> | Zf |
| <input type="radio"/> | Width |
| <input type="radio"/> | Beta |
| <input type="radio"/> | Zw |
| <input type="radio"/> | Lw |
| <input checked="" type="radio"/> | Stimulation radius |
| <input checked="" type="radio"/> | k multiplier |
| <input checked="" type="radio"/> | phi multiplier |



Compatible with numerical SRVB/Trilinear models

Refrac



v5.30




The option allows opening some MFHW fractures at a later time

- Well is set as a MFHW
- Fractures are Finite conductivity

(a) **Regular** refrac pattern:

| | |
|---------------------------|-------------------------------------|
| Refrac | <input checked="" type="checkbox"/> |
| Refrac elapsed time | 18.0000 Month $\rightarrow T$ |
| Number of fractures at t0 | 12 $\rightarrow a$ |
| Refrac ratio | 4 $\rightarrow b$ |
| Infill | <input type="checkbox"/> |

(b) **Irregular** refrac pattern:

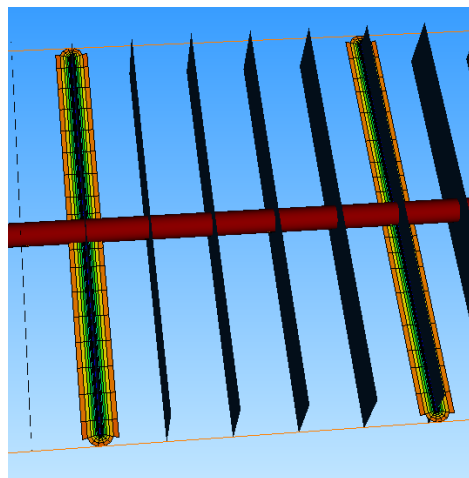
- Complex MFHW + indiv.properties 
- Each fracture has its own refrac time T

(c) **Infill** option:

- All fractures start with matrix properties and switch to high conductivity at refrac elapsed time T

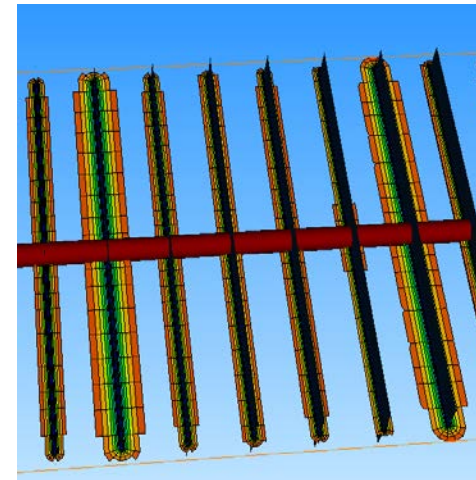
Before refrac (time = 0):

$$N_f = a$$



After refrac (time = T):

$$N_f = a + b(a - 1)$$



Multiple KrPc

Matrix, well fractures and natural fissures can have independent sets of KrPc

- Multiphase PVT is defined & real PVT are used

The screenshot displays the KAPPA software interface with three overlapping windows: 'Matrix', 'Well fractures', and 'Natural fissures'. Each window has a 'DFN' (Discrete Fracture Network) icon and a 'Properties' icon. The 'Matrix' window shows the 'PVT & diffusion' tab with 'Multiphase' selected. The 'Well fractures' window shows the 'Generate numerical model' tab with 'Redefine KrPc in hydraulic fractures' checked. The 'Natural fissures' window shows the 'DFN' tab with 'Redefine KrPc in natural fissures' checked. The 'Reservoir properties' window shows the 'Topology' tab with 'Layer #1' selected and 'Redefine KrPc in hydraulic fractures' checked. The 'Properties' window shows the 'Property set definition' tab with 'KrPc: Default' selected.

Matrix

PVT & diffusion

PVT

Single phase

Multiphase

Reference fluids: Gas

Define advanced PVT

Diffusion

Relative permeability

Unconsolidation

Desorption

Well fractures

Generate numerical model

Main options

Include other wells

Show average pressure

Output

Output result fields

Output well drainage results (Rubi only)

Advanced

Time dependent

Use well intake

Redefine KrPc in hydraulic fractures

Apply unconsolidation in hydraulic fractures

Use DFN

Time stepping

Numerical settings

Keep dialog open

Natural fissures

DFN

Load

Generate

Delete

Export

Redefine KrPc in natural fissures

Apply unconsolidation in natural fissures

Reservoir properties

Topology

Uniform

Layered

Regional

Complex

Click to edit, right-click to assign

Layer #1

Default

Well fractures

Redefine KrPc in hydraulic fractures

Apply unconsolidation in hydraulic fractures

Use DFN

Matrix

KrPc: Default

Initial state: Default

Pressure dependent properties: Default

Desorption: Default

Geothermal gradient

Numerical 'butterfly' model



New in v5.30.03



The butterfly model is the numerical counterpart of the multi-zone fractional dimension (MZFD) analytical model. The model solves on a 1D simplified geometry, but benefits from accounting for the non-linearities.

- Constant thickness geometry
- The width of the area perpendicular to the flux varies with a power-law relationship
- Wellbore: constant / changing
- Boundary: infinite / circular / linear

Parameters

Show: All ☐ Show short names

| | | |
|-----------------------------|----------------------------|---------|
| Reference Well | | |
| Modeling type | Butterfly | |
| Total fracture half-length | Simple | |
| Wellbore model | SRVB | |
| Include constraints | Trilinear | |
| | Butterfly | |
| Reservoir | Complex | |
| Initial pressure | 9000.00 | psia |
| Variable type | Composition | |
| Initial gas-oil ratio | 3000.00 | scf/stb |
| Transmissibility | 0.1 | md.ft |
| Permeability | 5.00000E-4 | md |
| Thickness | 200.000 | ft |
| Porosity | 0.1 | |
| Net-to-gross | 1.00000 | |
| Minimal distance | 1.00000E-6 | ft |
| Number of zones | 2 | |
| Butterfly boundaries | | |
| Boundary type | Infinite | |
| Zone#1 | | |
| Fractional dimension | 0.7 | |
| Outer radius | 1000.00 | ft |
| Interface area control type | Consistent volume (behind) | |
| Zone#2 | | |
| Fractional dimension | 0.3 | |

A decorative graphic in the top-left corner consisting of several blue diagonal lines, a thin black line, and a cluster of small, multi-colored dots.

THANK YOU



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