

# Black Oil Tracers

Evaluating production formation allocations to match GeoChem/Oil fingerprinting diagnostics

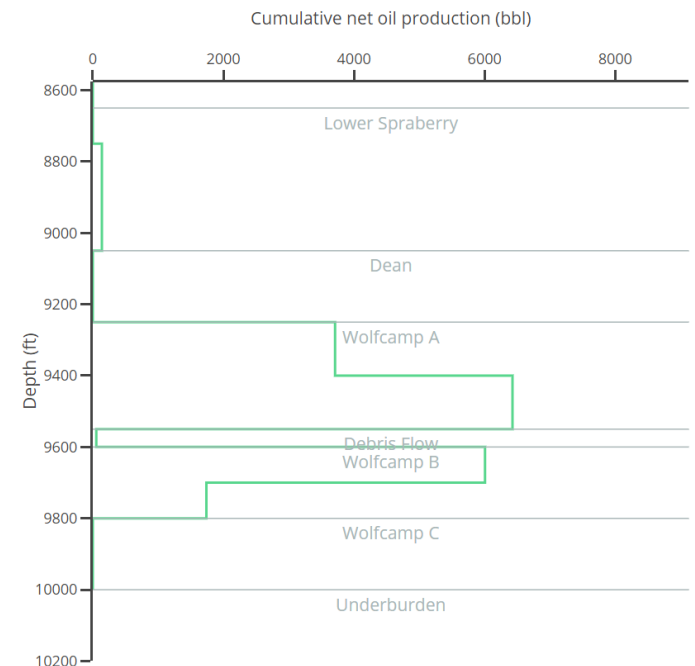
# Motivation

Geochem or oil fingerprinting is a helpful diagnostic tool to reveal the stratigraphic distribution of production from a given well. While there is meaningful uncertainty in Geochem data, this sort of diagnostic can help provide constraints on propped area distributions and bench-specific permeabilities. In the best of cases, time-lapse geochemistry could give an indication as to how depleted area is changing over time and provide guidance on proppant conductivity, embedment, or matrix compaction.

A standard method of evaluating production distributions in the static model is to use the “Flow by layer” chart in the visualization tool or “Raw\_Res” files. While this method is adequate for simple or single-bench models, multi-bench models can get complex. The per-well results view in this method is somewhat approximate. The properties are allocated to each well based on upon the well that is physically closest to a given fracture element. In cases with a lot of fracture collisions and varying drawdown schedules, this can cause an inaccuracy.

*In these scenarios, the more simple and accurate method would be to track the oil "molecules" with the black oil tracer capability.*

Flow by layer chart for the “High Noon” well in the Midland template



# Setup – Part 1

Fluid Model Options → Advanced

With black oil tracers enabled, we initialize the matrix with a small mass fraction of an individual component which is tracked and undergoes the same mass balance equations as all other components in the model. By ‘tracing’ the oil from the formation into the wellbore, we can more easily understand where production is occurring in the formation.

## BLACK OIL TRACER COMPONENTS ?

	Black oil tracer components ?	
1	Jo Mill	☰
2	Lower Spraberry	☰
3	Dean	☰
4	WA	☰
5	WB	☰

Set up layers that correspond to the outputs in Geochem. The more layers that are specified the longer the simulation will take to run. (These are individually track components for which mass balance need be computed; it is the same concept as to why it would be ill-advised to run a 30+ component compositional model.)

A rule of thumb is to keep it under eight traced components.

# Setup – Part 2

## Fluid Model Options → Advanced

BLACK OIL TRACER PARTITIONING ?

	Black oil tracer component ?	Black oil tracer partitioning ?
1	Jo Mill	Oil
2	Lower Spraberry	Oil
		Gas
3	Dean	Oil ▾
4	WA	Oil ▾
5	WB	Oil ▾

Specify the type of hydrocarbon that is being traced for each layer.

Jo Mill

Lower Spraberry

Dean

WA

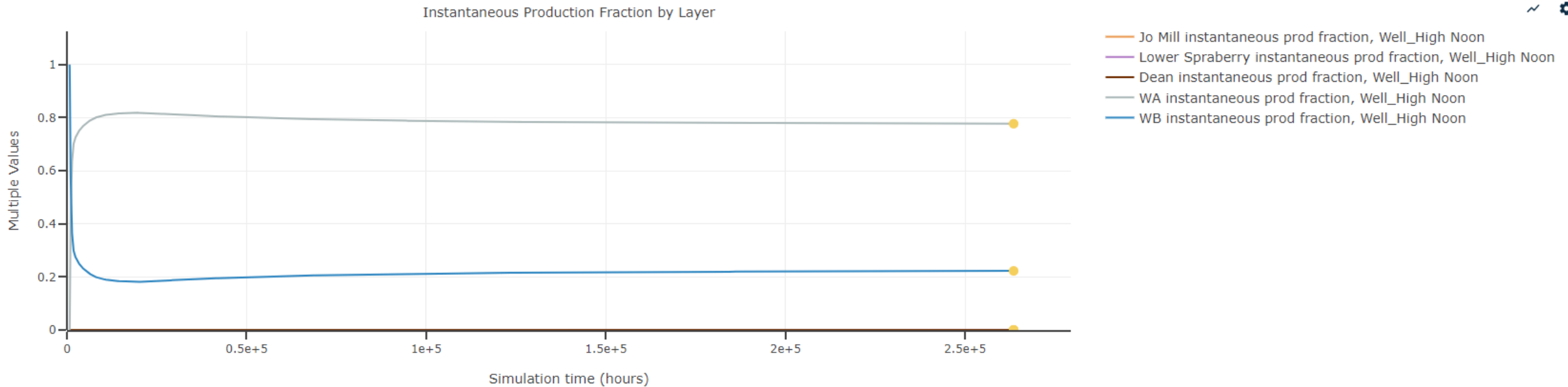
WB

BLACK OIL TRACER MASS FRACTIONS ?

	Black oil tracer component ?	Jo Mill mass fraction ?	Lower Spraberry mass fraction ?	Facies 3 mass fraction ?	Dean mass fraction ?	Facies 5 mass fraction ?	Wolfcamp A mass fraction ?	Facies 7 mass fraction ?	Barrier mass fraction ?	Wolfcamp B mass fraction ?
1	Jo Mill	0.001	0	0	0	0	0	0	0	0
2	Lower Spraberry	0	0.001	0.001	0	0	0	0	0	0
3	Dean	0	0	0	0.001	0.001	0	0	0	0
4	WA	0	0	0	0	0	0.001	0.001	0.001	0
5	WB	0	0	0	0	0	0	0	0	0.001

Finally, specify the initial mass fraction of the tracer components for each layer of the static model.

# Evaluating Results



The well 'High Noon' was landed in the WB. The above plot tells us that over the long term the instantaneous production from the Wolfcamp B is 20% and 80% from the Wolfcamp A. The sum of all the curves on this plot should equal 1.

Tuning parameters such as  $Sh_{min}$ , toughness, permeability by layers, proppant conductivity, and proppant trapping can help match Geochem results.

# Relevant sim\_track outputs

The following outputs are added to the sim\_track file when black oil tracers are enabled:

Aggregation level	Required model input/s	Attribute	Definition
Well	Well, extracompositionaltrackingfileoutputting set to true or black oil tracers defined	<Name of component> inj	Total mass injection of the specified component
Well	Well, extracompositionaltrackingfileoutputting set to true or black oil tracers defined	<Name of component> prod	Total mass production of the specified component
Well	Well, extracompositionaltrackingfileoutputting set to true or black oil tracers defined	<Name of component> fraction recovered	Total mass of specified component produced by subject well divided by total mass of the component injected into subject well. Will be "nan" if no oil injected into well.
Well	Well, extracompositionaltrackingfileoutputting set to true or black oil tracers defined	<Name of component> fractional recovery rate	Total mass production rate of specified component divided by total mass of the component injected into subject well. Will be "nan" if no oil injected into well.
Well	Well, extracompositionaltrackingfileoutputting set to true or black oil tracers defined	<Name of component> cumulative prod fraction	Cumulative mass of the 'black oil tracer' produced in the well divided by the total amount of black oil tracers produced in the well
Well	Well, extracompositionaltrackingfileoutputting set to true or black oil tracers defined	<Name of component> instantaneous prod fraction	Mass production rate of the 'black oil tracer' in the well divided by the total mass production rate of black oil tracers in the well
Wellgroup	Well grouping, and either extracompositionaltrackingfileoutputting or black oil tracers defined	wellgroup <Name of component> inj	Cumulative mass of the component injected into the well group
Wellgroup	Well grouping, and either extracompositionaltrackingfileoutputting or black oil tracers defined	wellgroup <Name of component> prod	Cumulative mass of the component produced from the well group
Wellgroup	Well grouping, and either extracompositionaltrackingfileoutputting or black oil tracers defined	wellgroup <Name of component> fraction recovered	Cumulative mass of the component produced from the well group divided by the cumulative mass of the component injected from the well group
Wellgroup	Well grouping, and either extracompositionaltrackingfileoutputting or black oil tracers defined	wellgroup <Name of component> fractional recovery rate	Cumulative mass production rate of the component produced from the well group divided by the cumulative mass of the component injected from the well group
Wellgroup	Well grouping, and either extracompositionaltrackingfileoutputting or black oil tracers defined	wellgroup <Name of component> cumulative prod fraction	Cumulative mass of the 'black oil tracer' produced from the wellgroup divided by the total amount of black oil tracers produced from the wellgroup
Wellgroup	Well grouping, and either extracompositionaltrackingfileoutputting or black oil tracers defined	wellgroup <Name of component> instantaneous prod fraction	Mass rate of the 'black oil tracer' produced from the wellgroup divided by the total mass prod rate of black oil tracers produced from the wellgroup



# Thank You!

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