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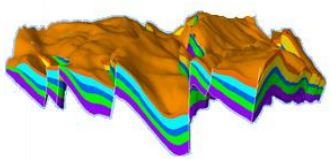
Petrel 2017 Property Modeling
Module 3: Scale-up well logs

Petrel 2017 Property modeling

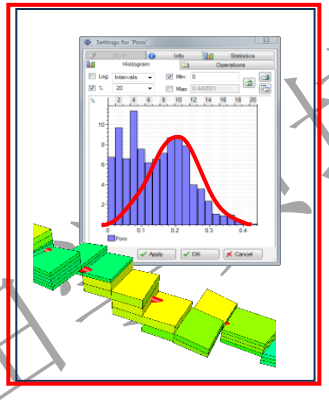


Intro

Petrel Property Modeling objective and workflow

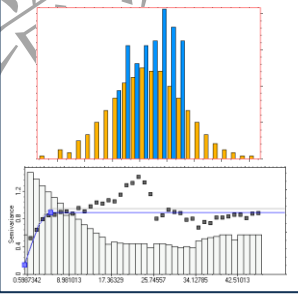
Property modeling data preparation

Scale up well logs

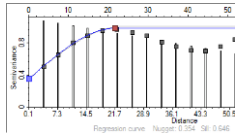


Univariate and bivariate geostatistics

Basic statistics

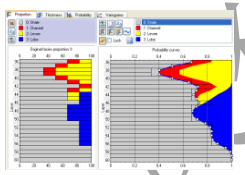


Variogram modeling

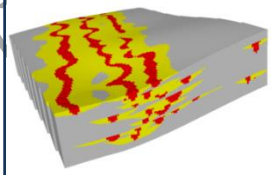


Facies modeling

Discrete data analysis

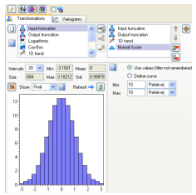


Stochastic facies modeling

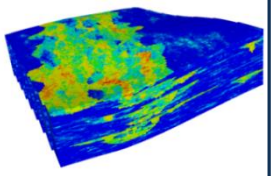


Petrophysical modeling

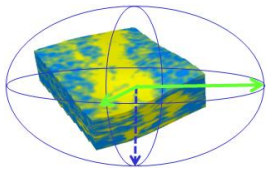
Continuous data analysis



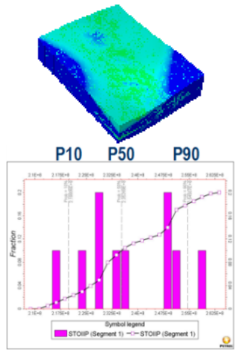
Stochastic and deterministic petrophysical modeling



Use of secondary information for property modeling



Volume calculation and Uncertainty analysis



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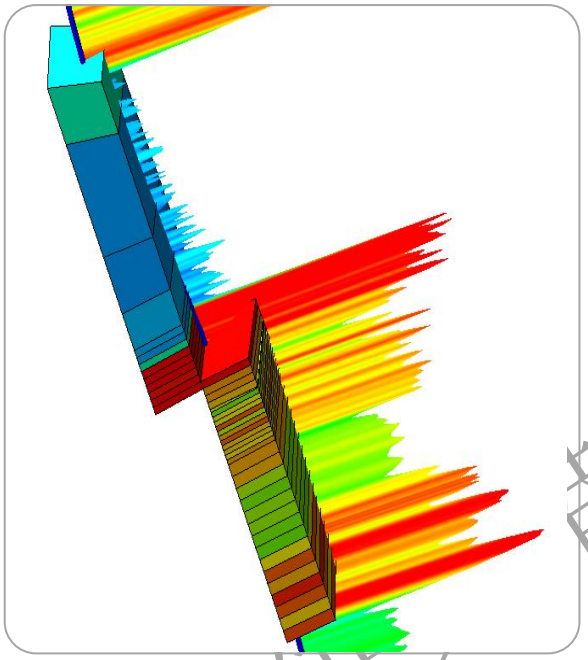
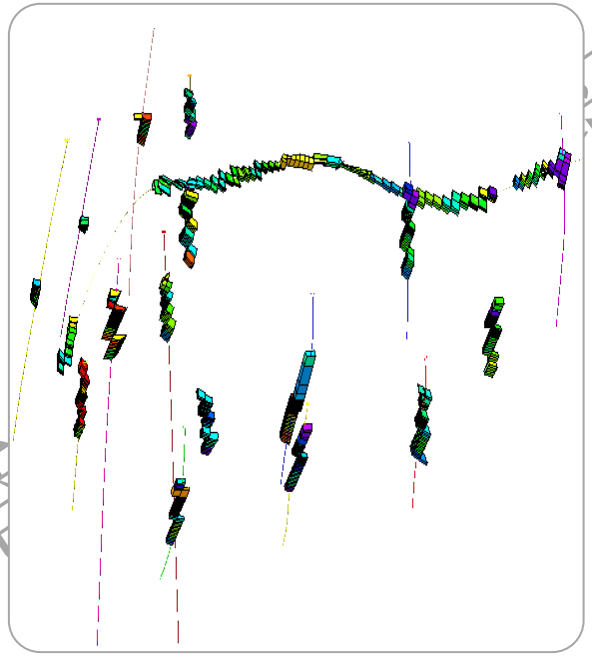
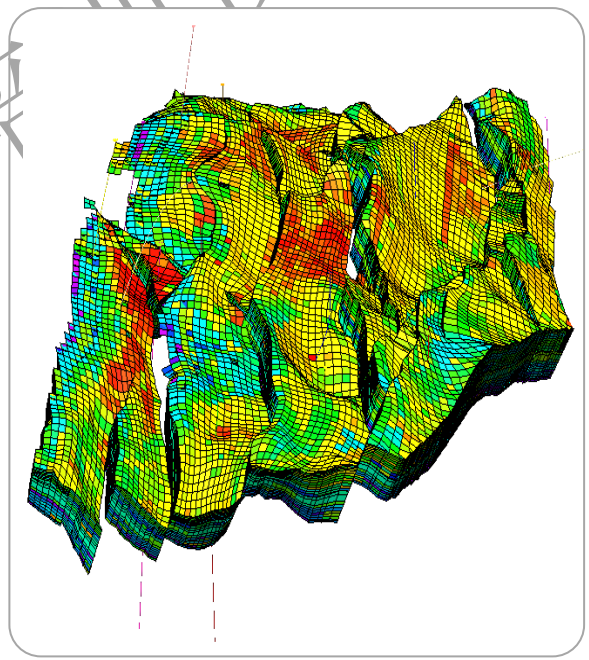
Scale up well logs: Process







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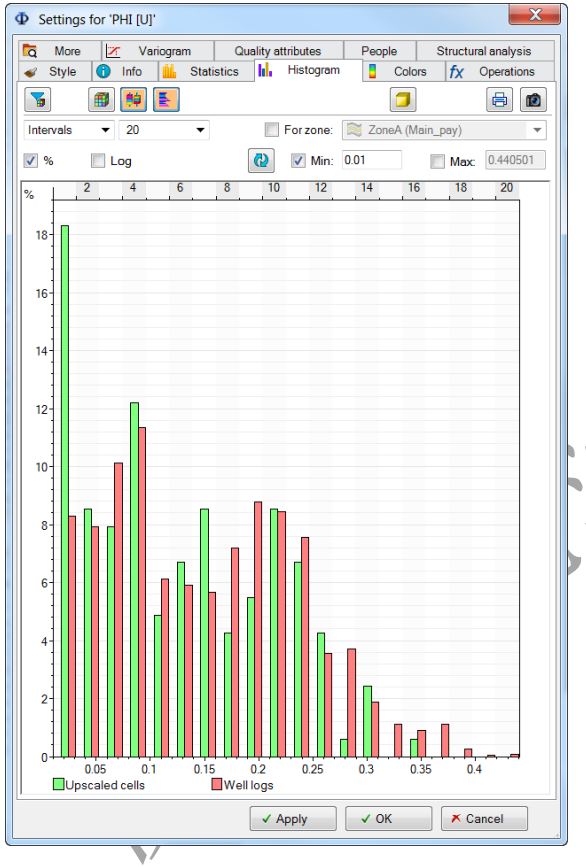
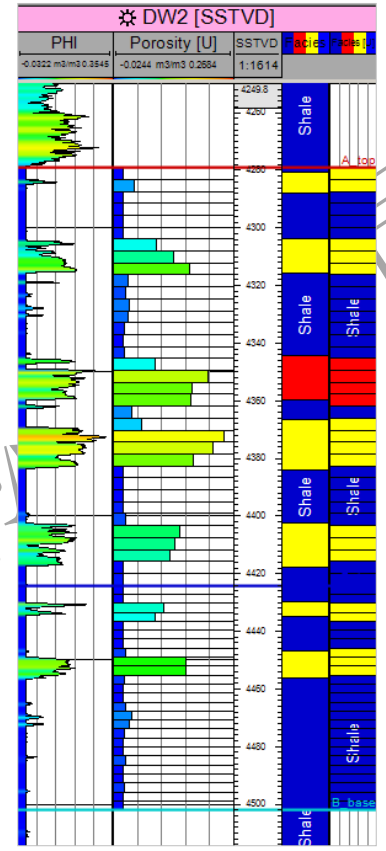
Scale up well logs:
What to consider when upscaling well logs

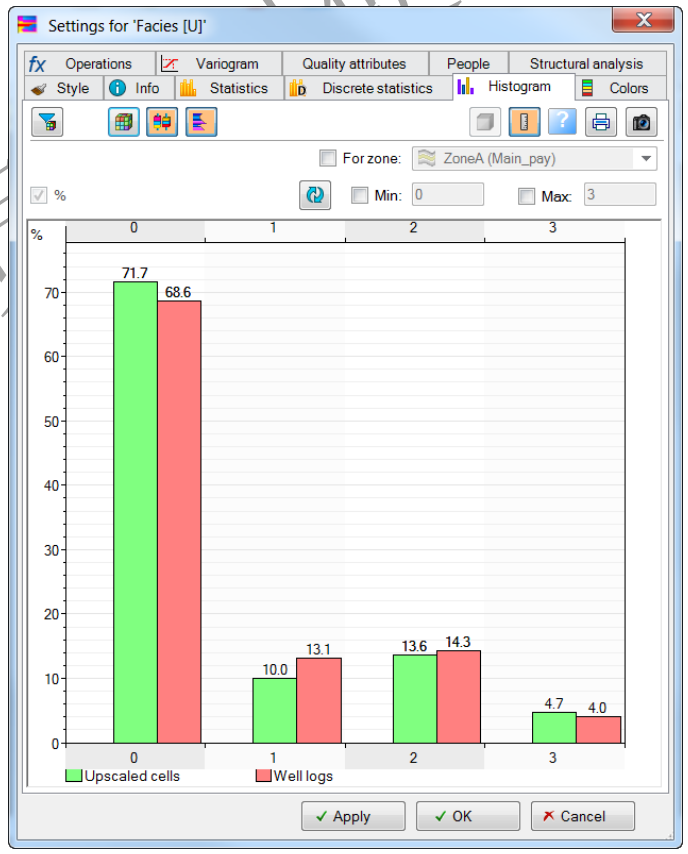
Continuous logs



Well track



Discrete logs



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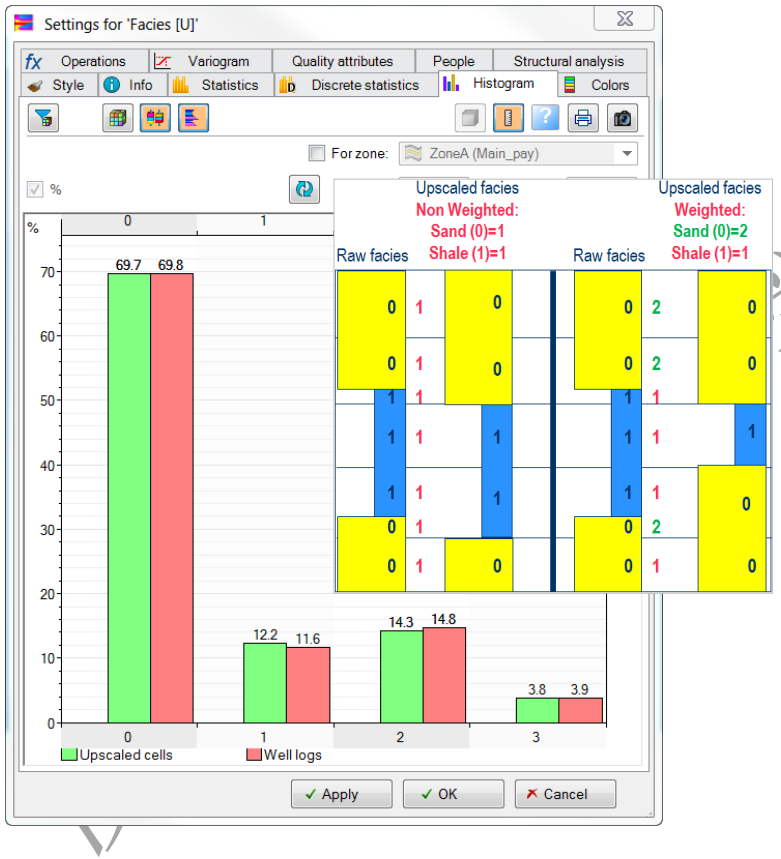
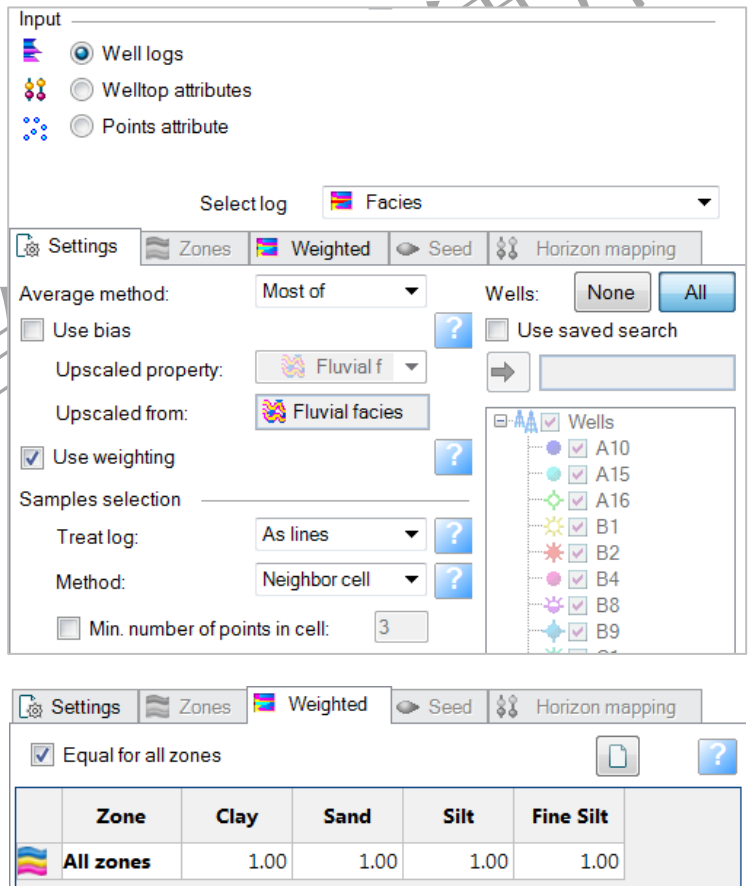
Scale up well logs: Discrete logs facies/lithology





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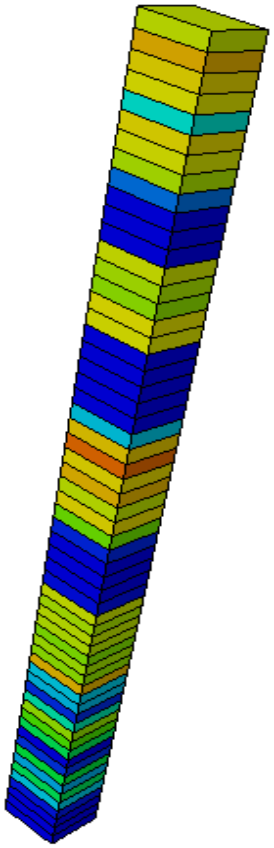
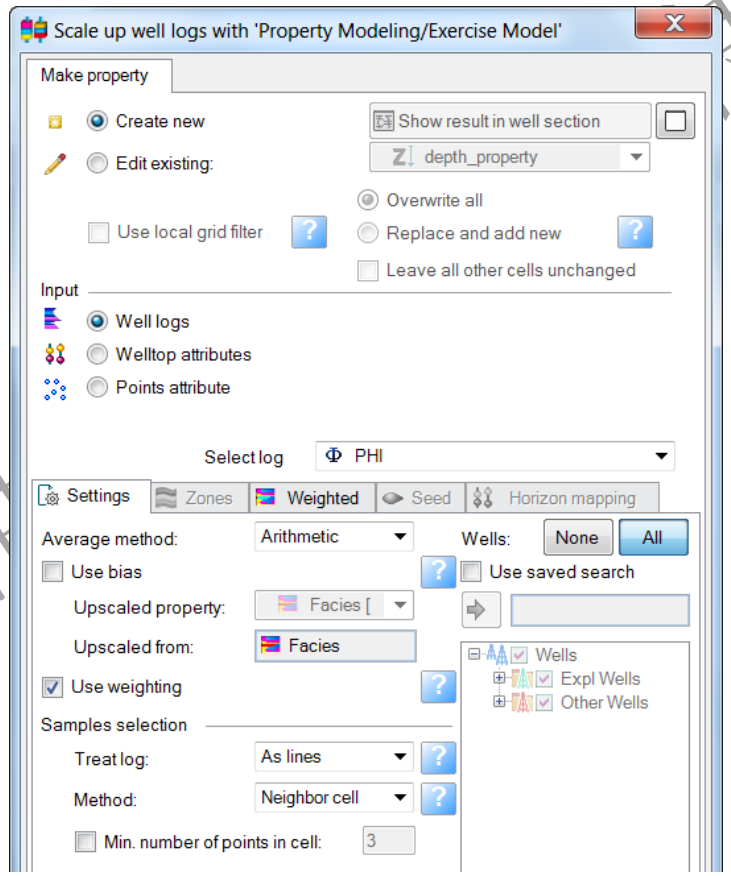
Scale up well logs:
Continuous logs petrophysical properties





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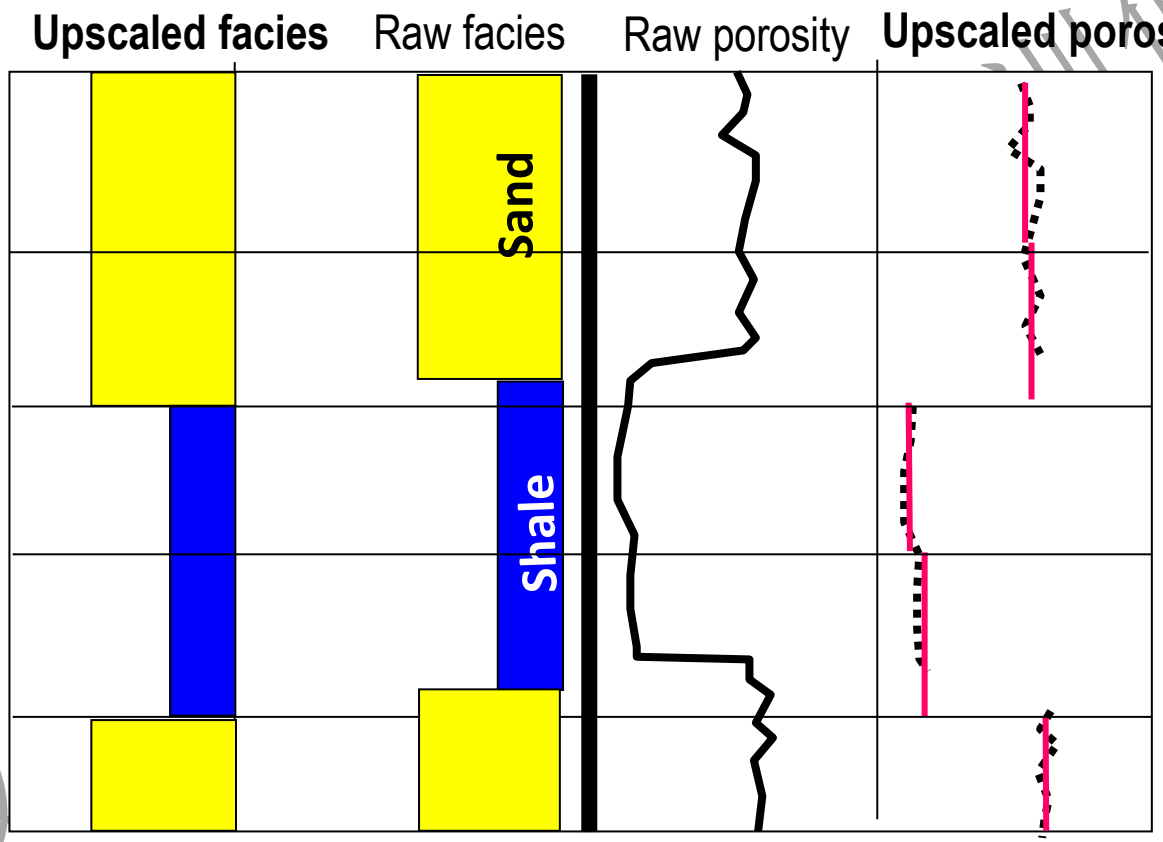
Scale up well logs:
Concept of biasing to a discrete log



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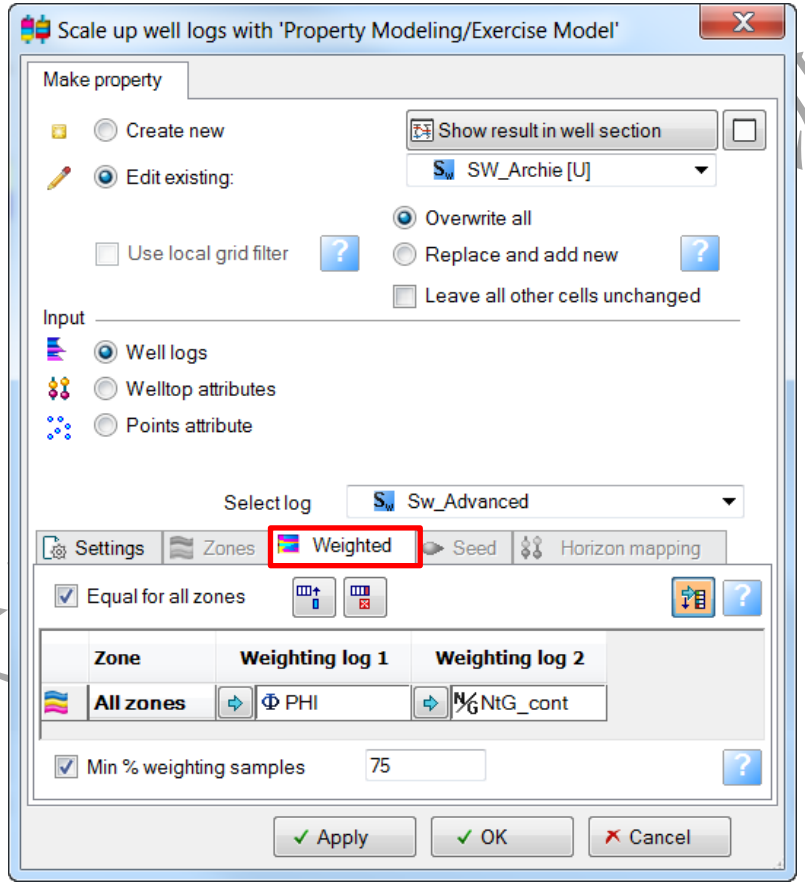
Scale up well logs: Continuous logs petrophysical properties – Use weighting



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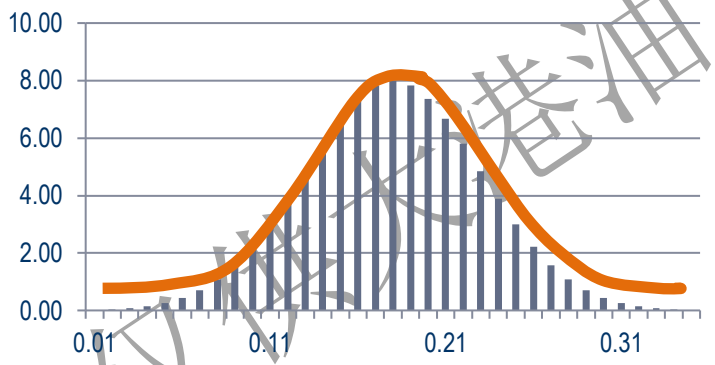
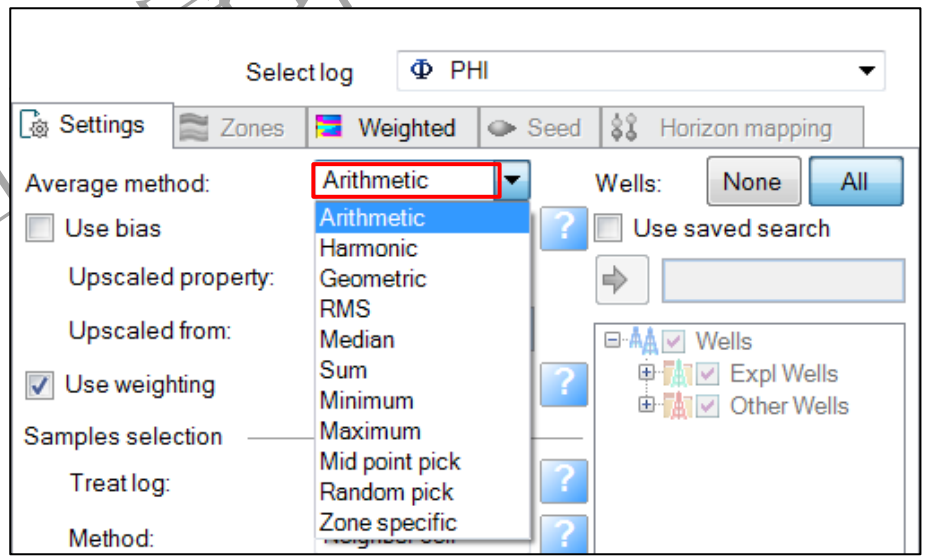
Scale up well logs: Porosity/Sw/NtG (Arithmetic Mean)

Arithmetic mean is used for properties such as Porosity, Water saturation (Sw)*, and Net-to-Gross (N/G) because these are additive variables.

Arithmetic Mean $x_a = \frac{1}{n}\sum_{i=1}^{n} x_i$





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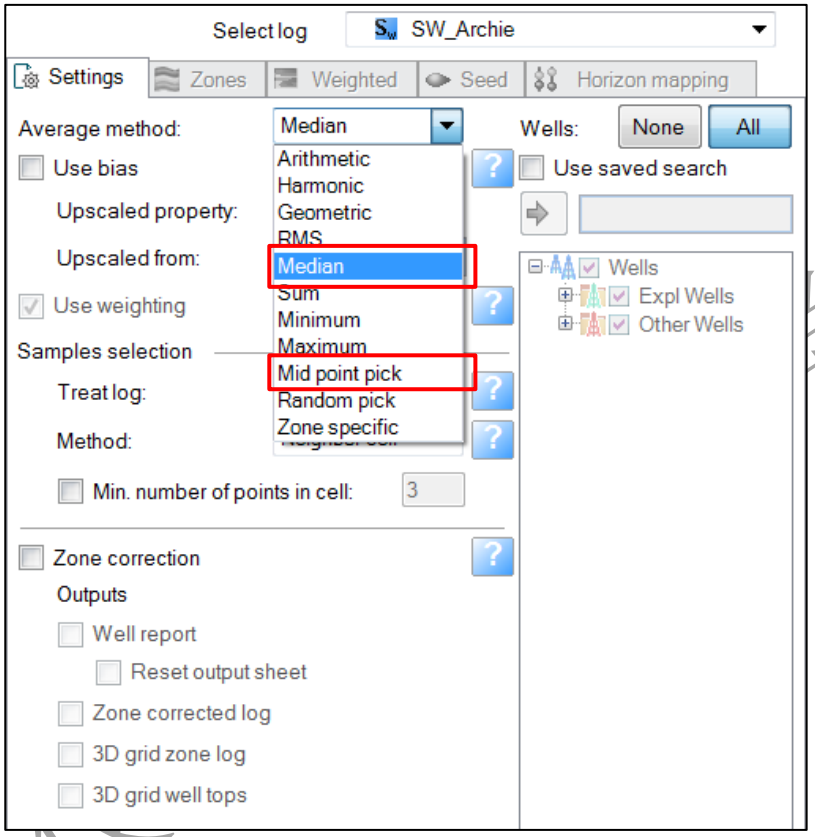
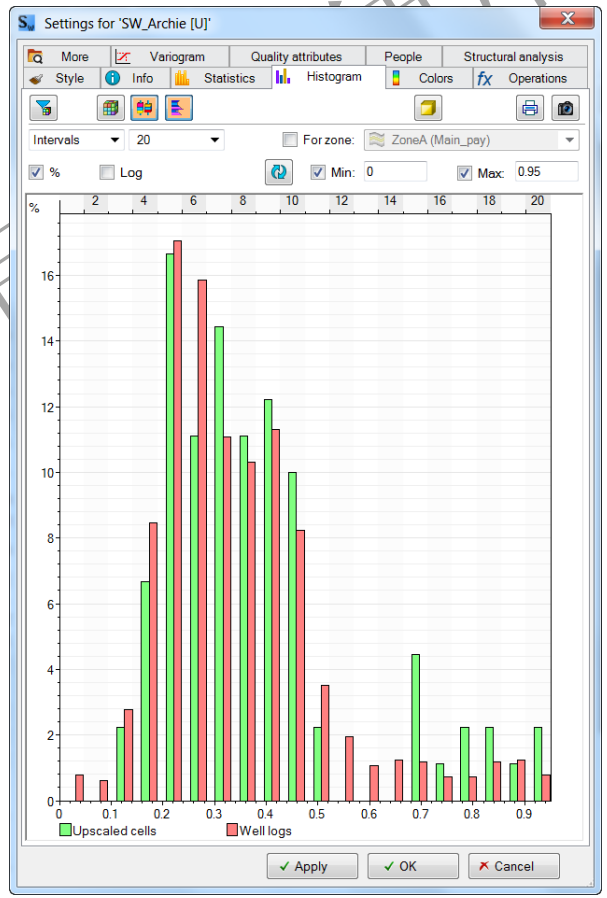
Scale-up well logs:
Sw (Arithmetic Mean vs. Median/Mid-Point Pick)





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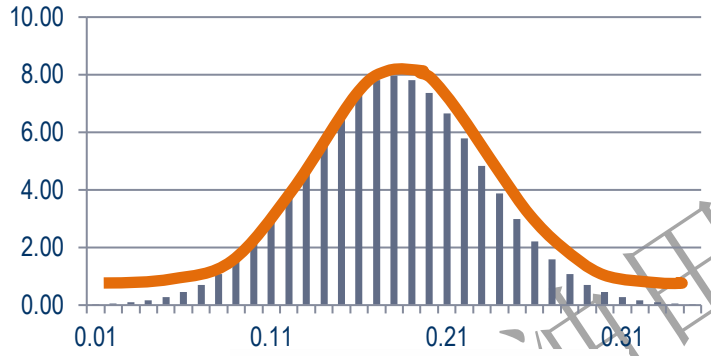
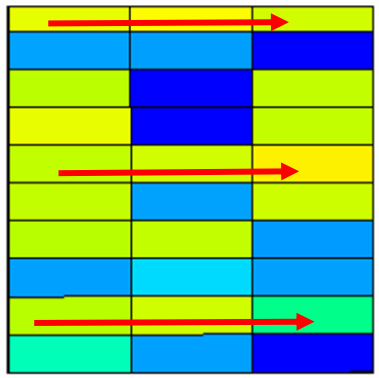
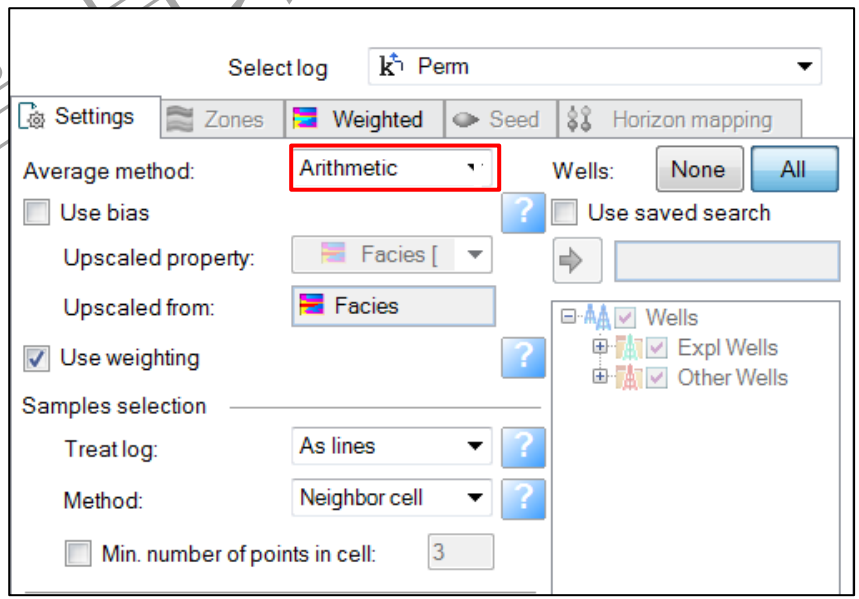
Scale up well logs: Permeability logs (Arithmetic Mean)

Arithmetic Mean $x_a = \frac{1}{n}\sum_{i=1}^{n} x_i$







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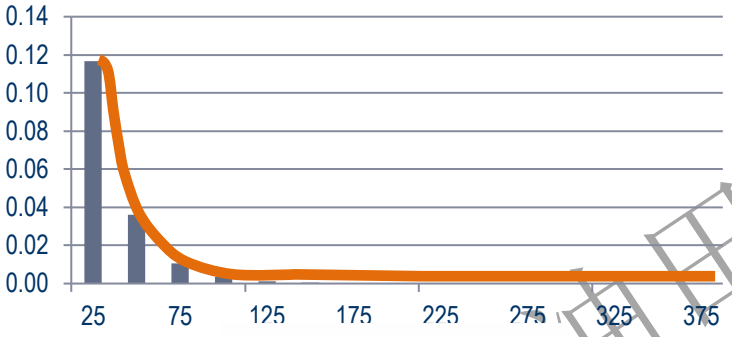
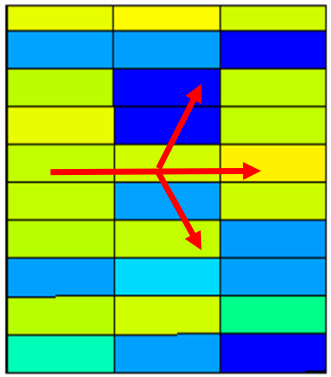
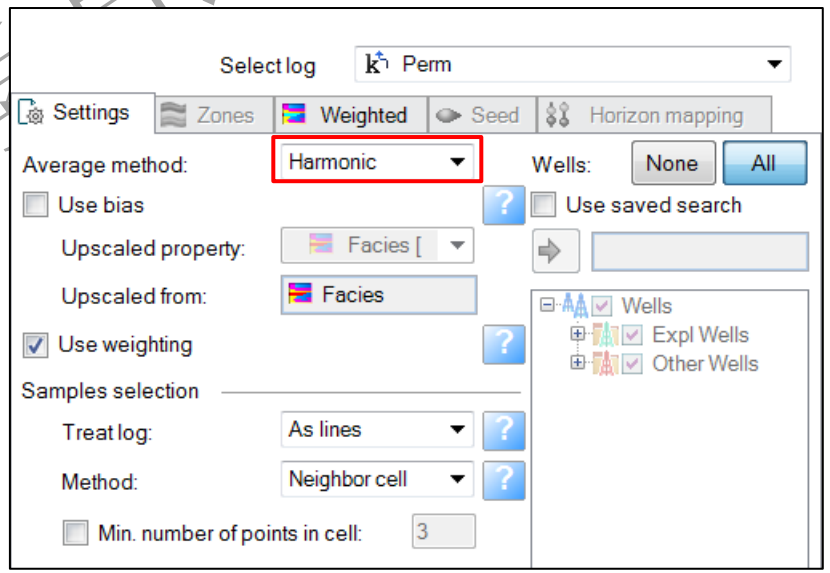
Scale up well logs: Permeability logs (Harmonic Mean)

Harmonic Mean $x_h = \dfrac{n}{\sum_{i=1}^{n} \dfrac{1}{x_i}}$







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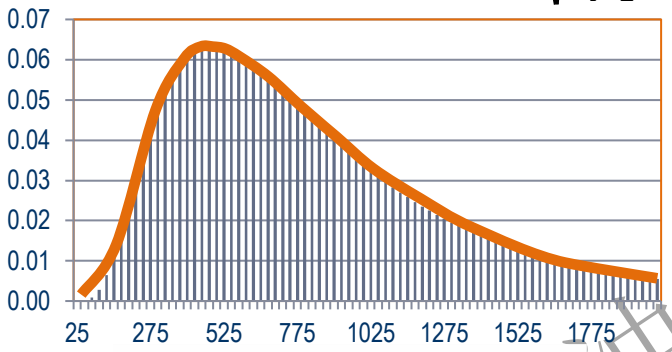
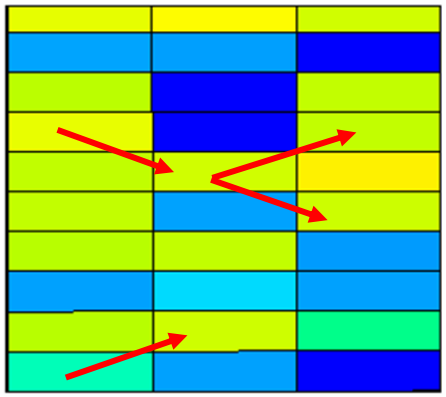
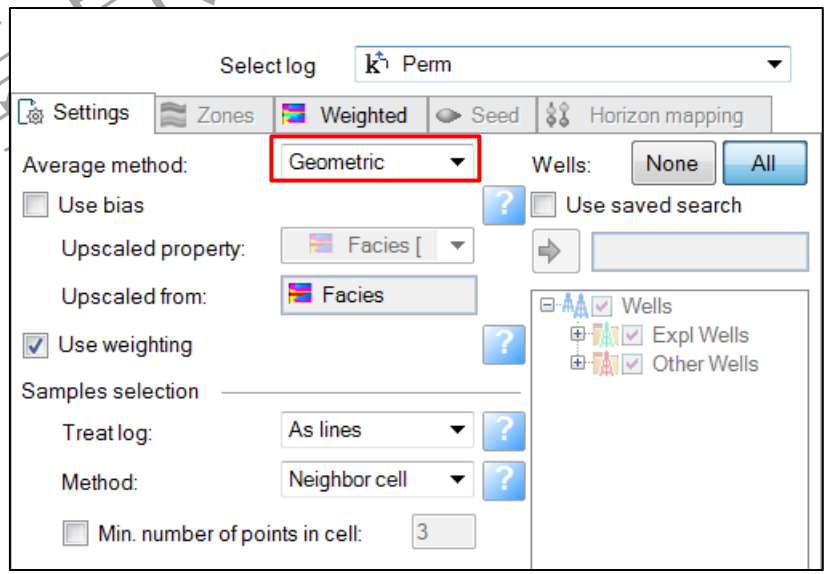
Scale up well logs: Permeability logs (Geometric Mean)

Geometric Mean $x_g = \sqrt[n]{\prod_{i=1}^{n} x_i}$







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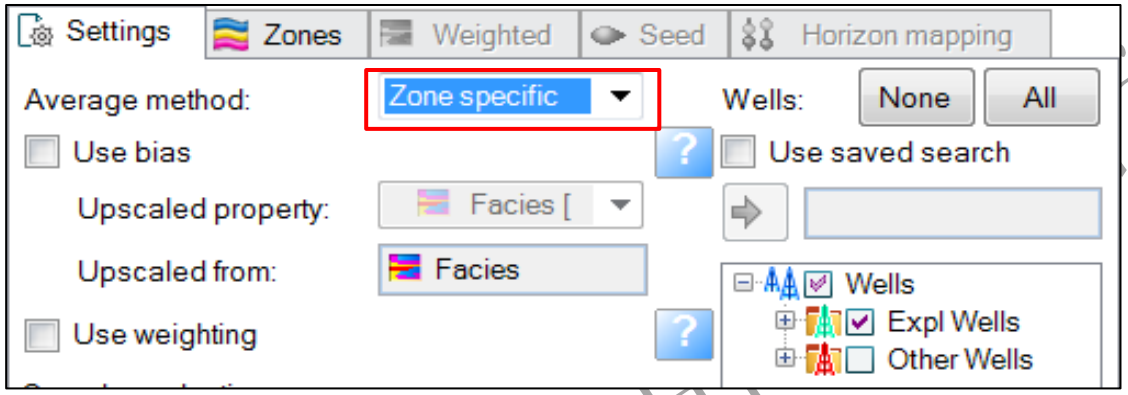
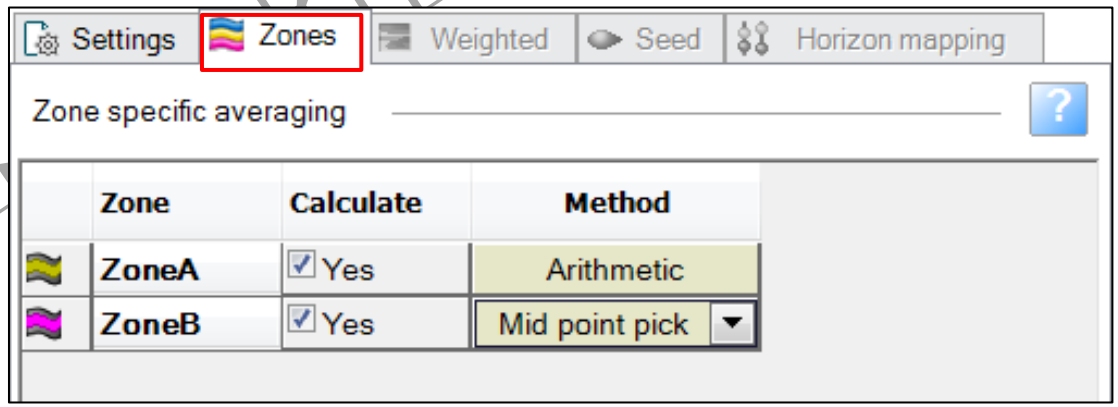
Scale up well logs: Zone-specific scale up





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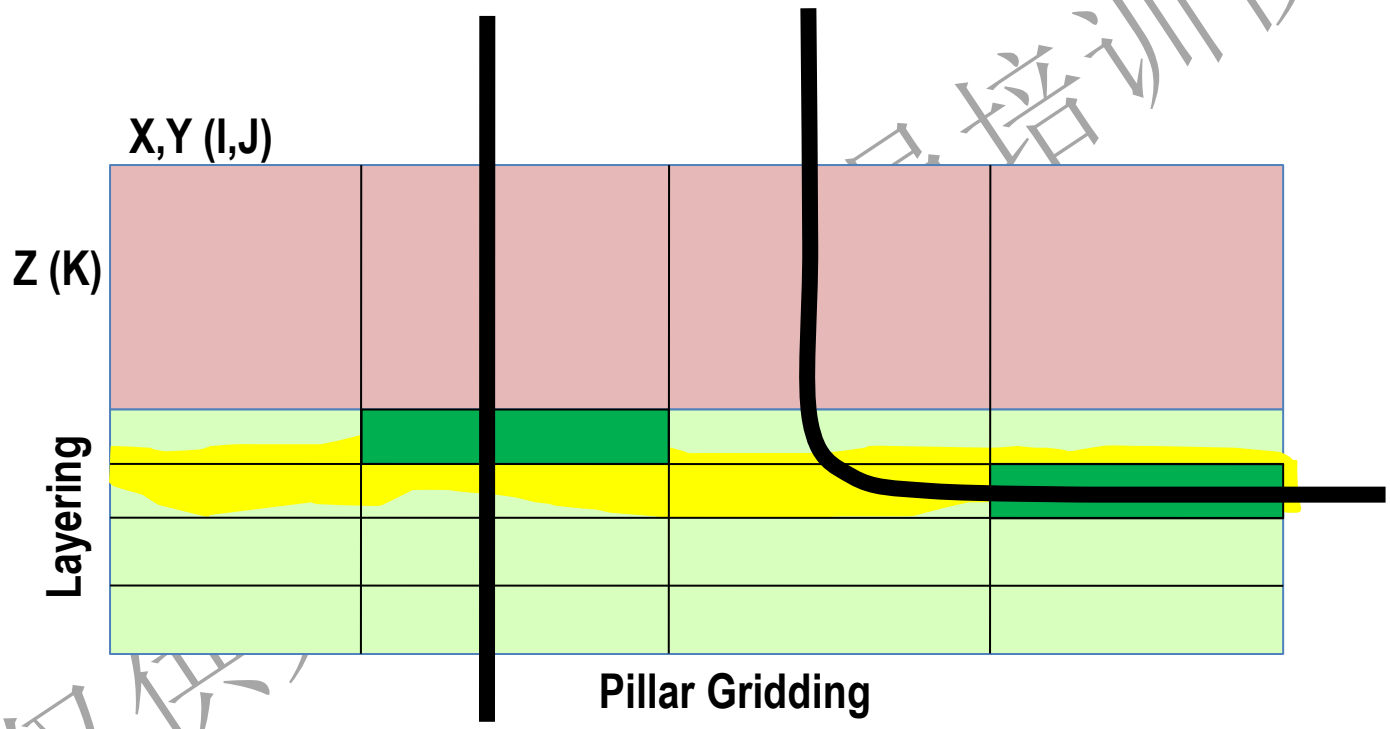
Scale up well logs: 3D grid considerations
Cell size (I, J, K)



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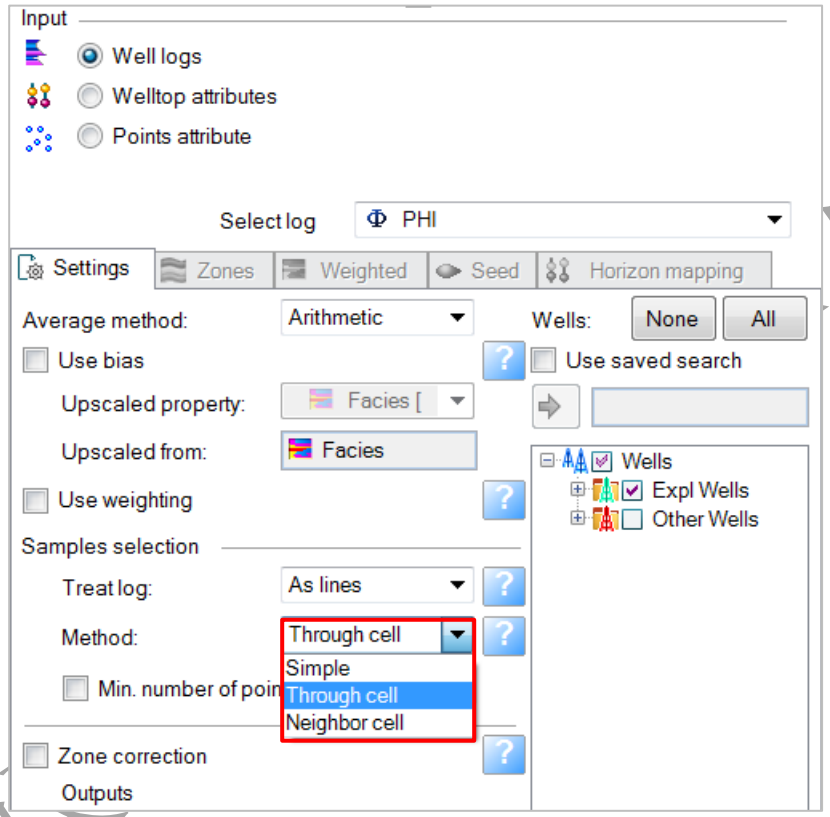
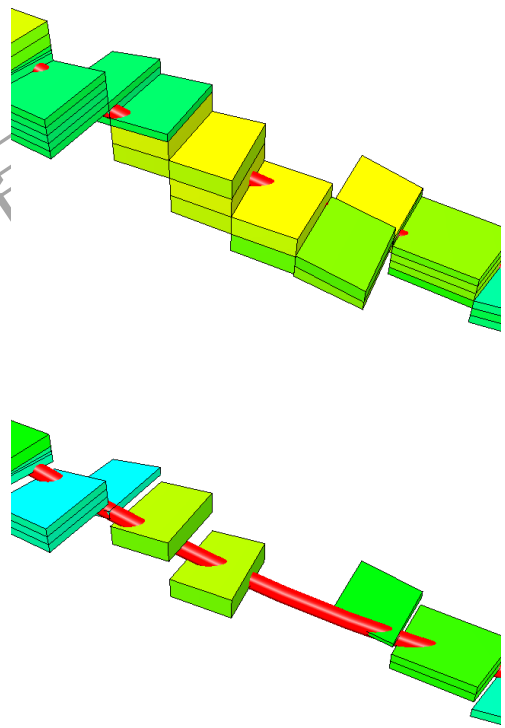
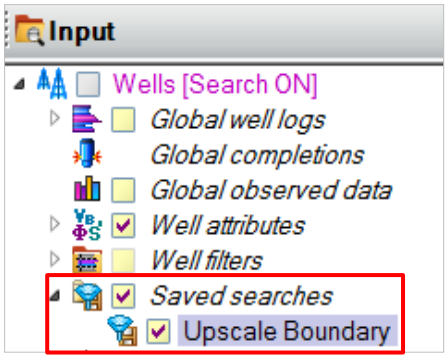
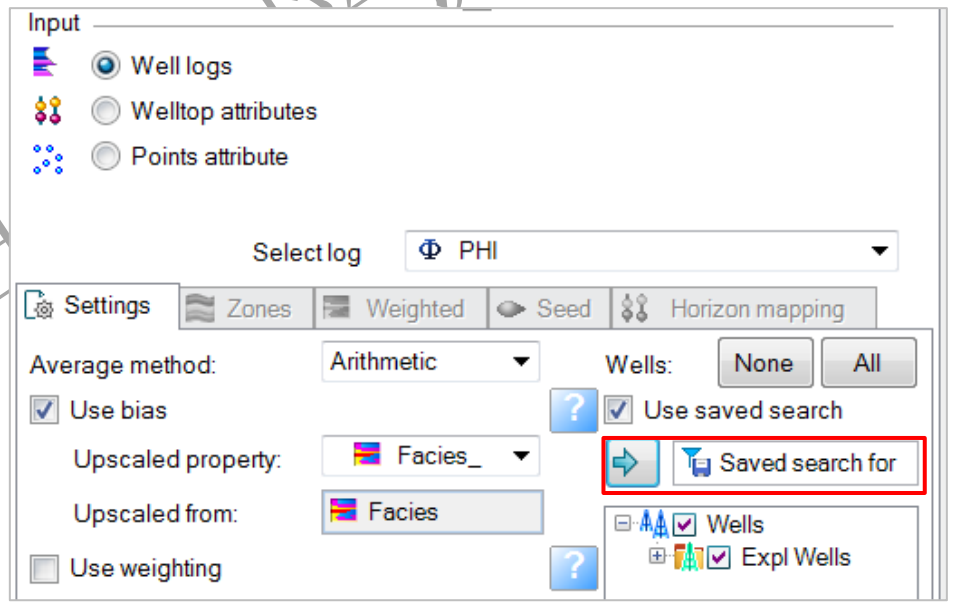
Scale up well logs: 3D grid considerations
Well type and spacing

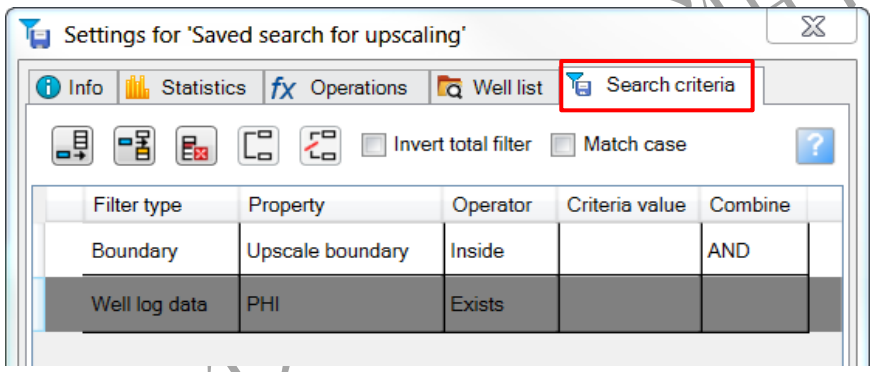




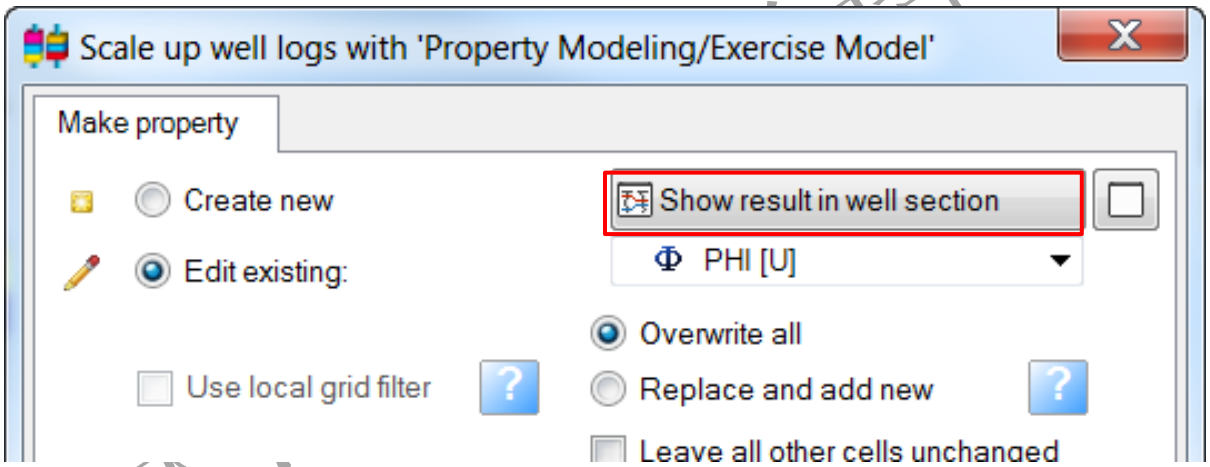
Scale up well logs: Filter by well saved search







Scale up well logs:
Upscaled logs quality control well section



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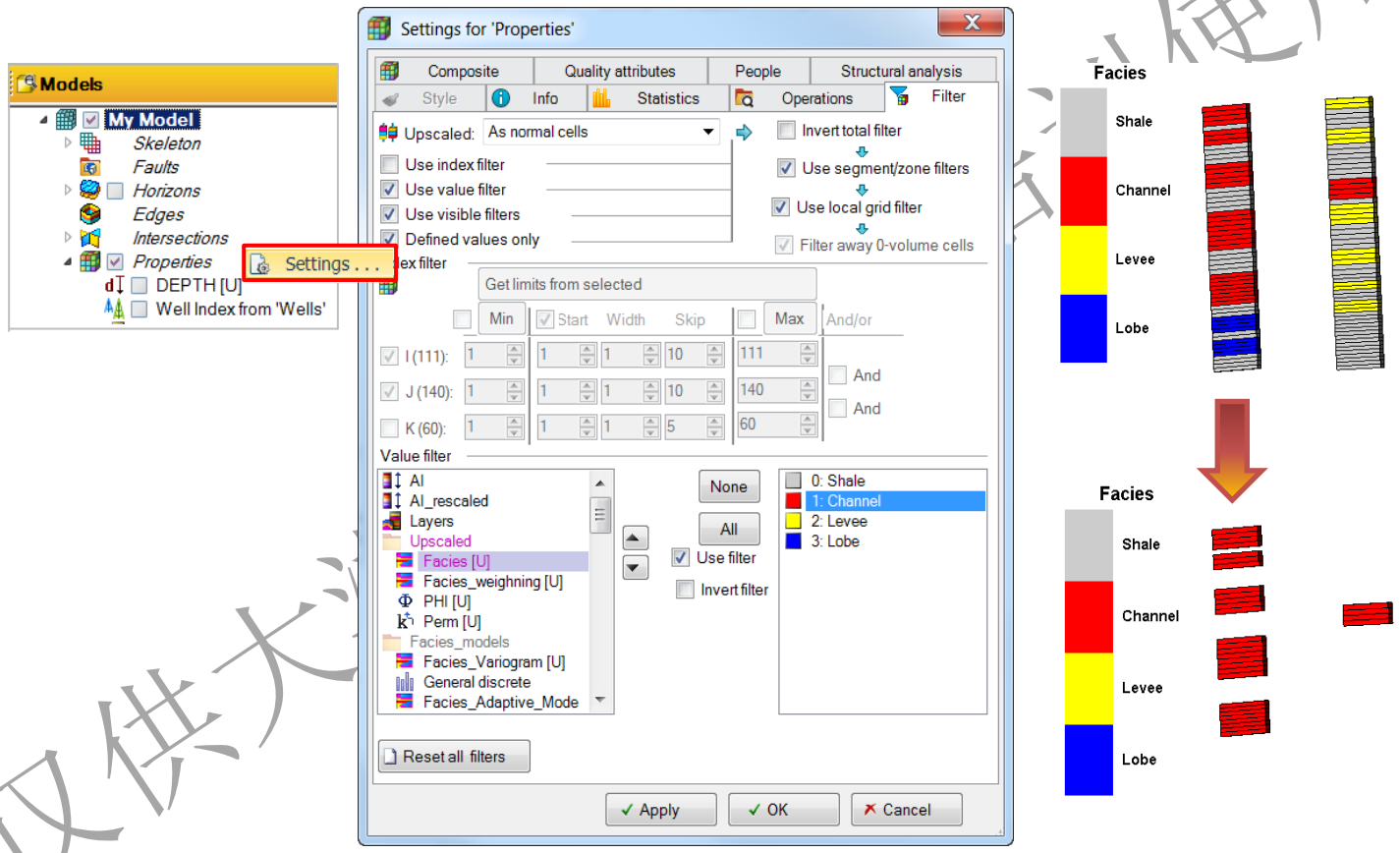
Scale up well logs: Upscaled logs quality control filters



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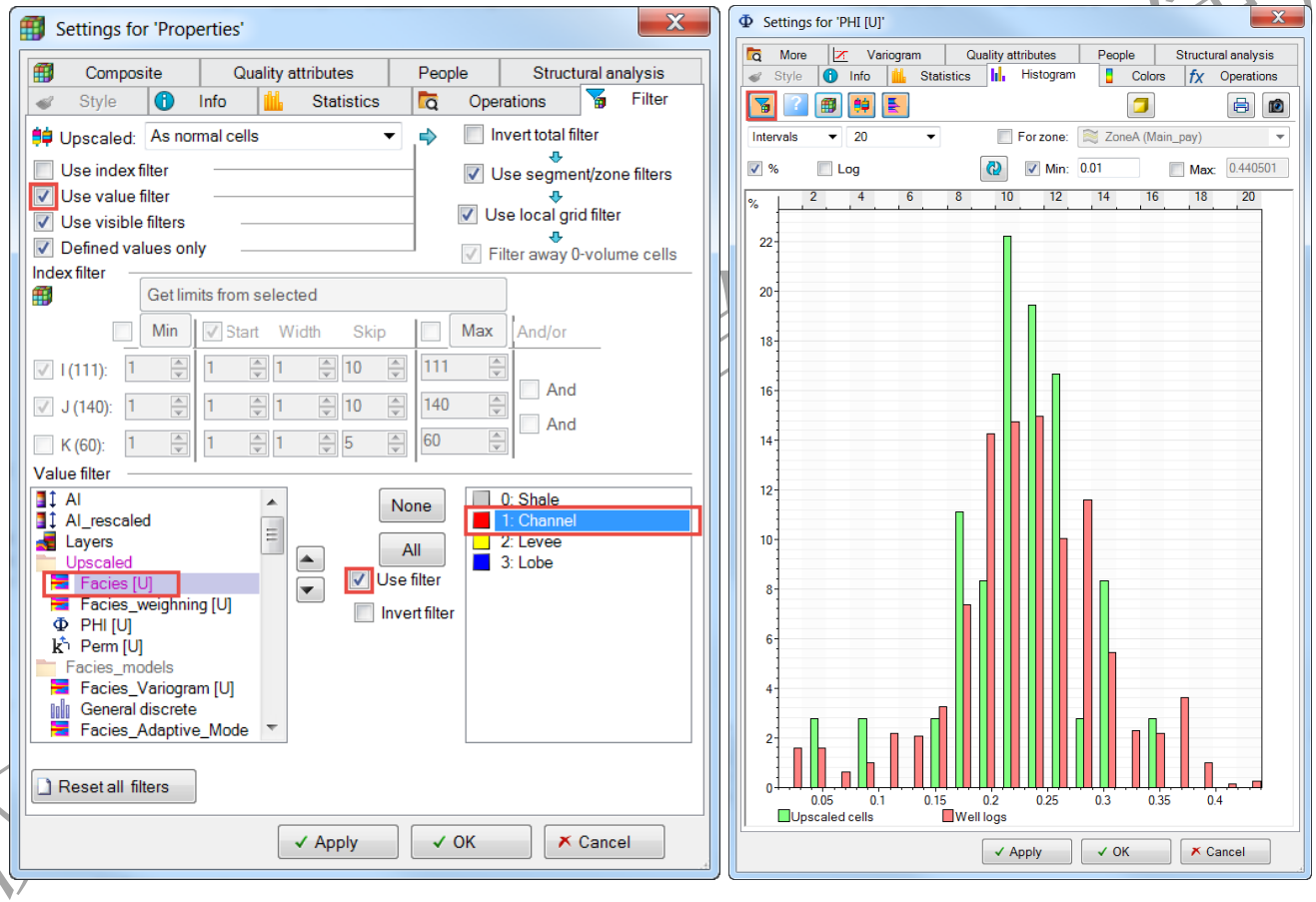
Scale up well logs: Upscaled logs quality control histogram and filter (applied result)



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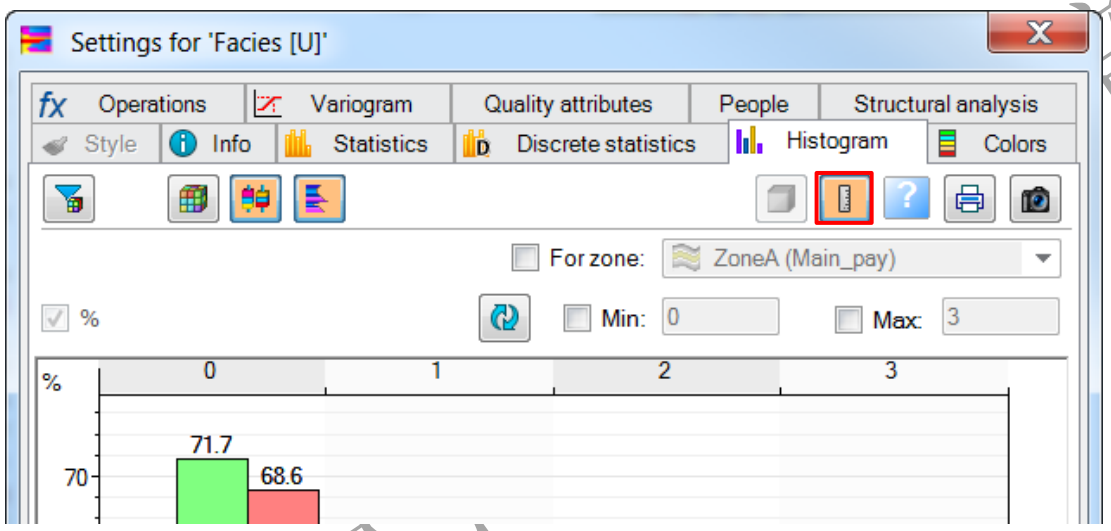
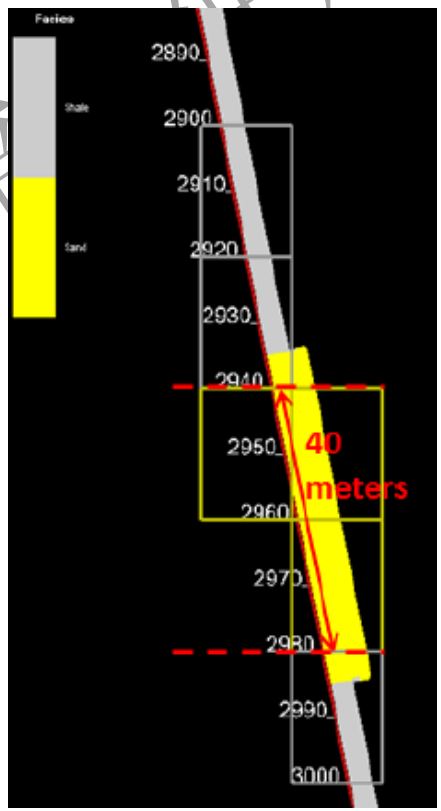
Scale up well logs: Upscaled logs quality control histogram and filter (applied result)





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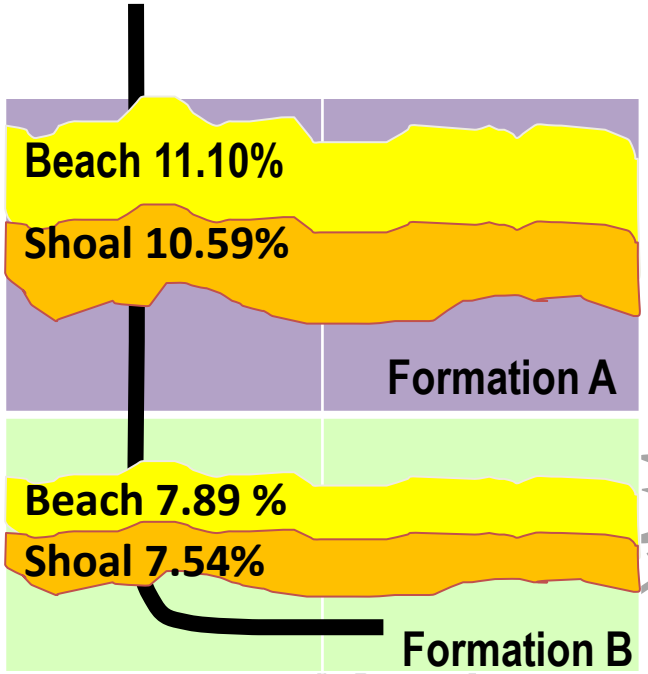
Simpson's paradox: The importance of upscaling



Well-Log Average Porosity				
	Shoal		Beach	
	Avg Por	# Samples	Avg Por	# Samples
Form A	10.59%	10.526 M_1	11.10%	1.023 N_1
Form B	7.54%	6.597 M_2	7.89%	1.641 N_2
Aggregate	9.41%		9.13%	

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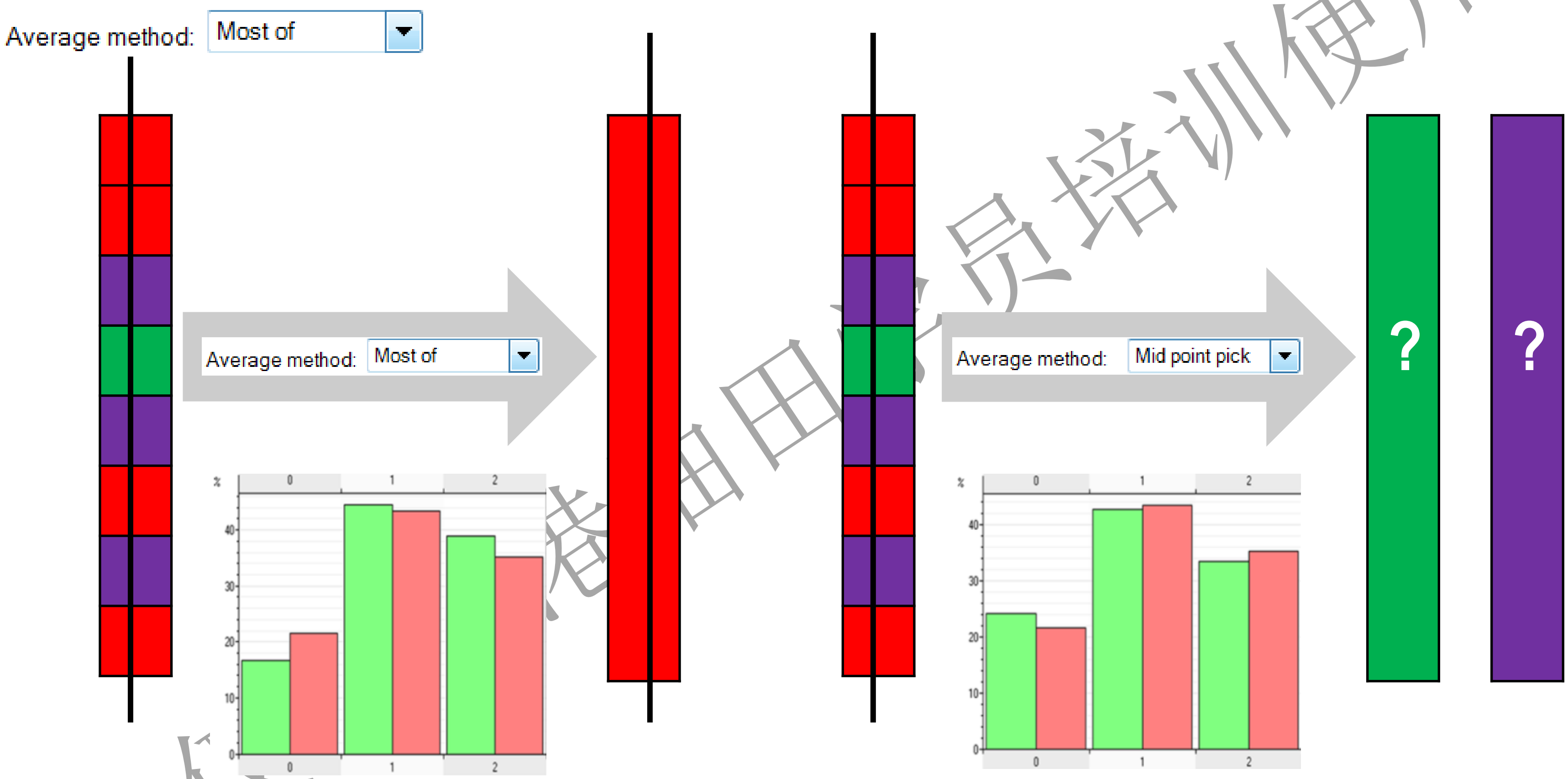
Change of support problem: Upscaling method



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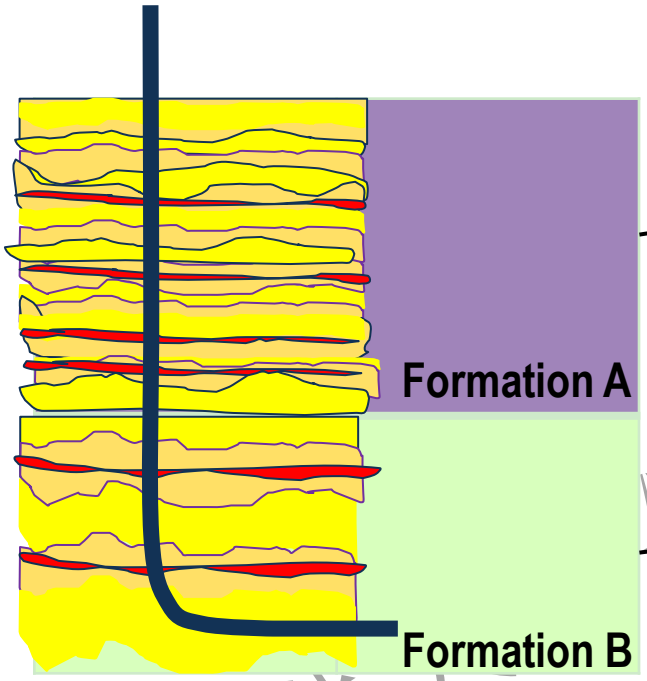
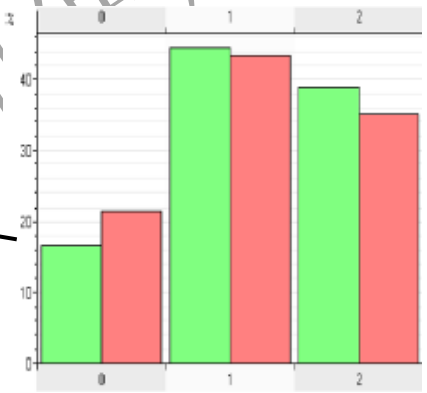
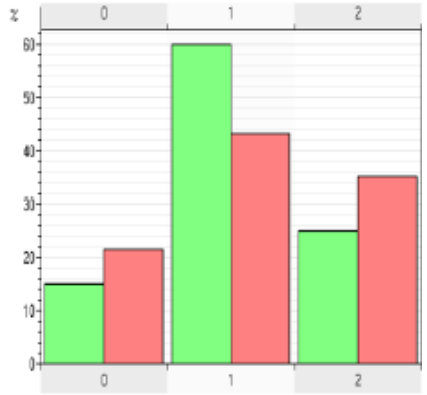
Change of support problem: Layering



Upscaling with **2 ft** thick grid cells



Upscaling with **8 ft** thick grid cells



Note: The original well log sample rate is 0.25 ft.

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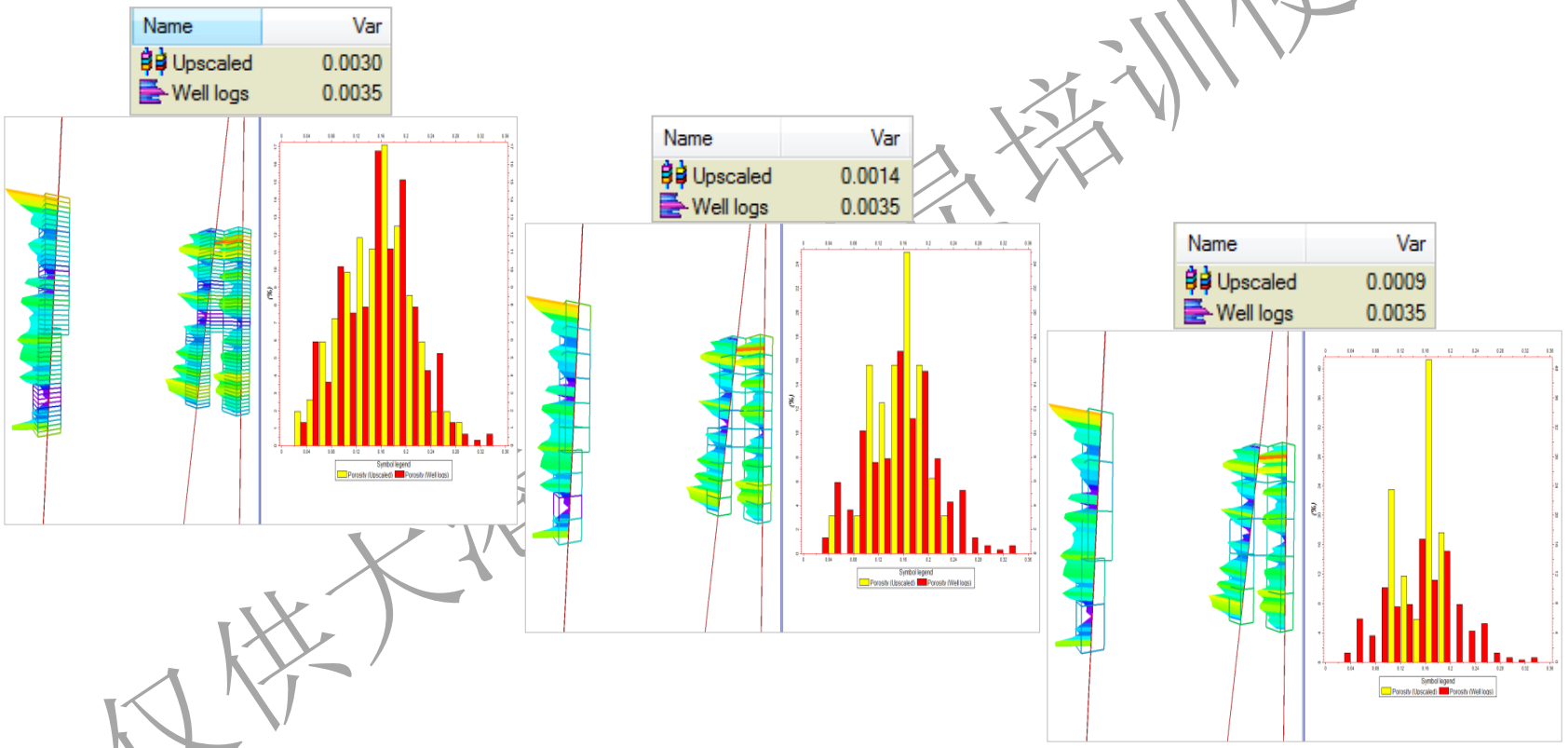
Scale up well logs: Practical considerations



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Exercises

- Scale up discrete logs: Facies
- Scale up continuous logs:
  - Porosity
  - Water saturation
  - Permeability