

NEXT

A Schlumberger Company

Petrel 2017 Property Modeling Module 2: Data preparation



Schlumberger-Private

Property modeling data preparation: Initial dataset

Well/seismic data

- Facies logs:
 - lithology
 - rock types
 - sedimentological facies
- Petrophysical logs/core data;
 - mineral volumes
 - porosity and permeability
 - water saturation and net pay
- Secondary data: Seismic attributes (related to facies or petrophysics).

Petrel 2017 Property modeling

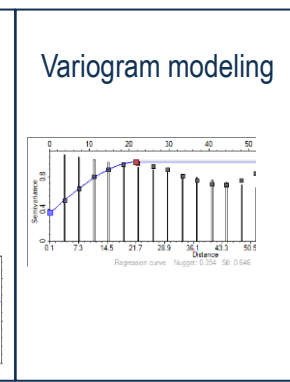
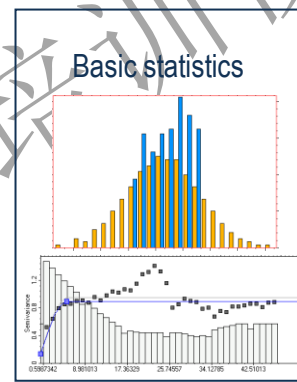
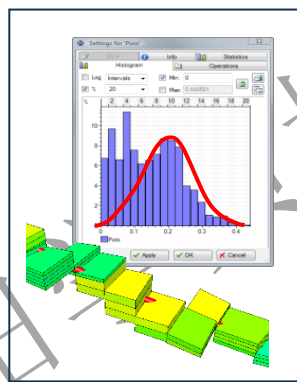
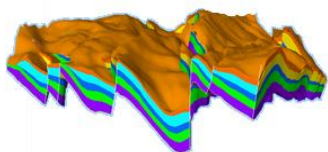
Intro

Property modeling
data preparation

Scale up well logs

Univariate and bivariate geostatistics

Petrel Property Modeling
objective and workflow

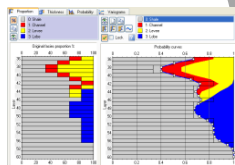


Facies modeling

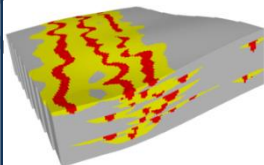
Petrophysical modeling

Volume calculation and
Uncertainty analysis

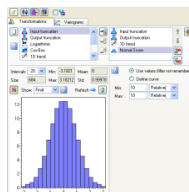
Discrete
data analysis



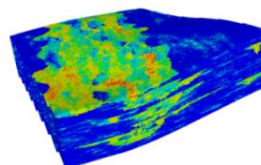
Stochastic facies
modeling



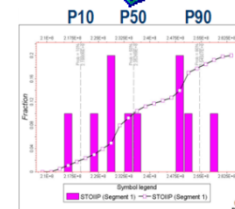
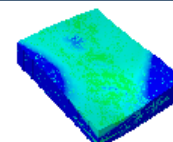
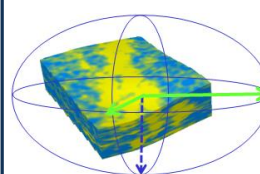
Continuous
data analysis



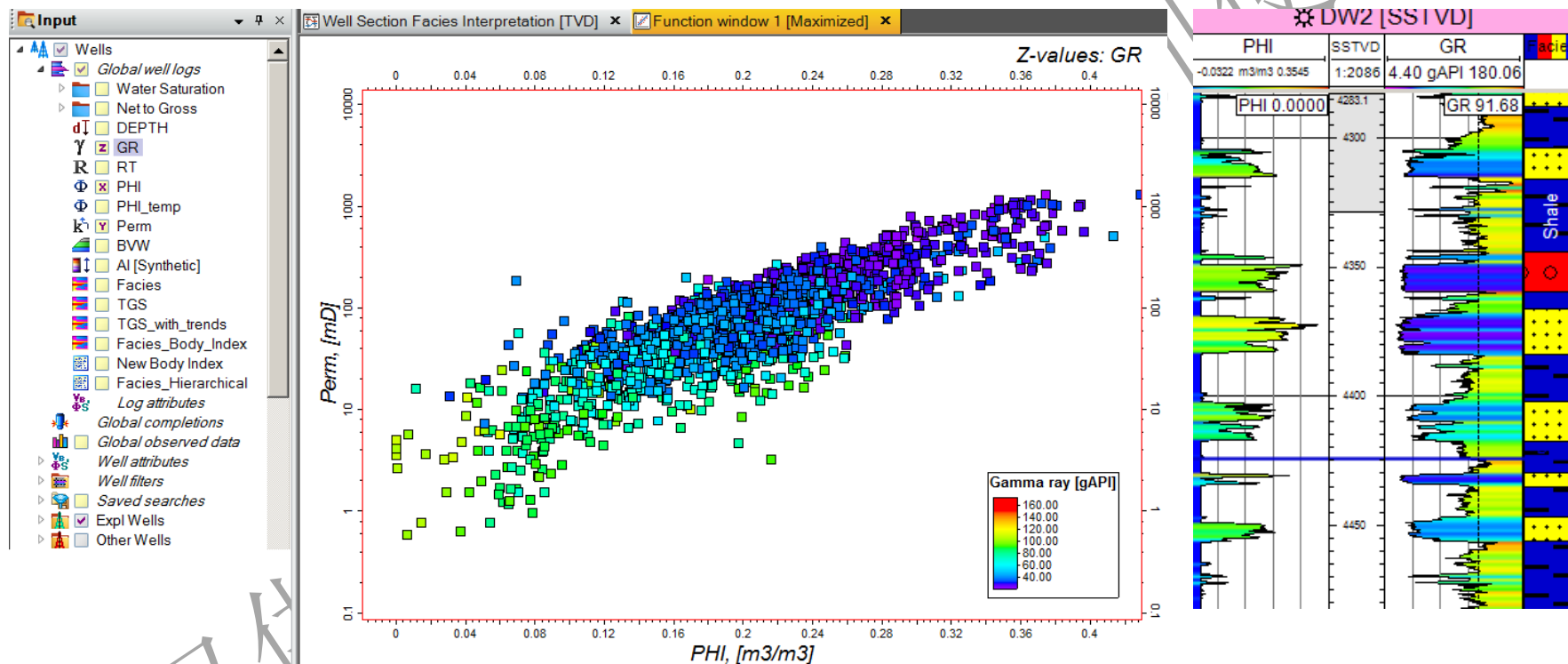
Stochastic and
deterministic
petrophysical modeling



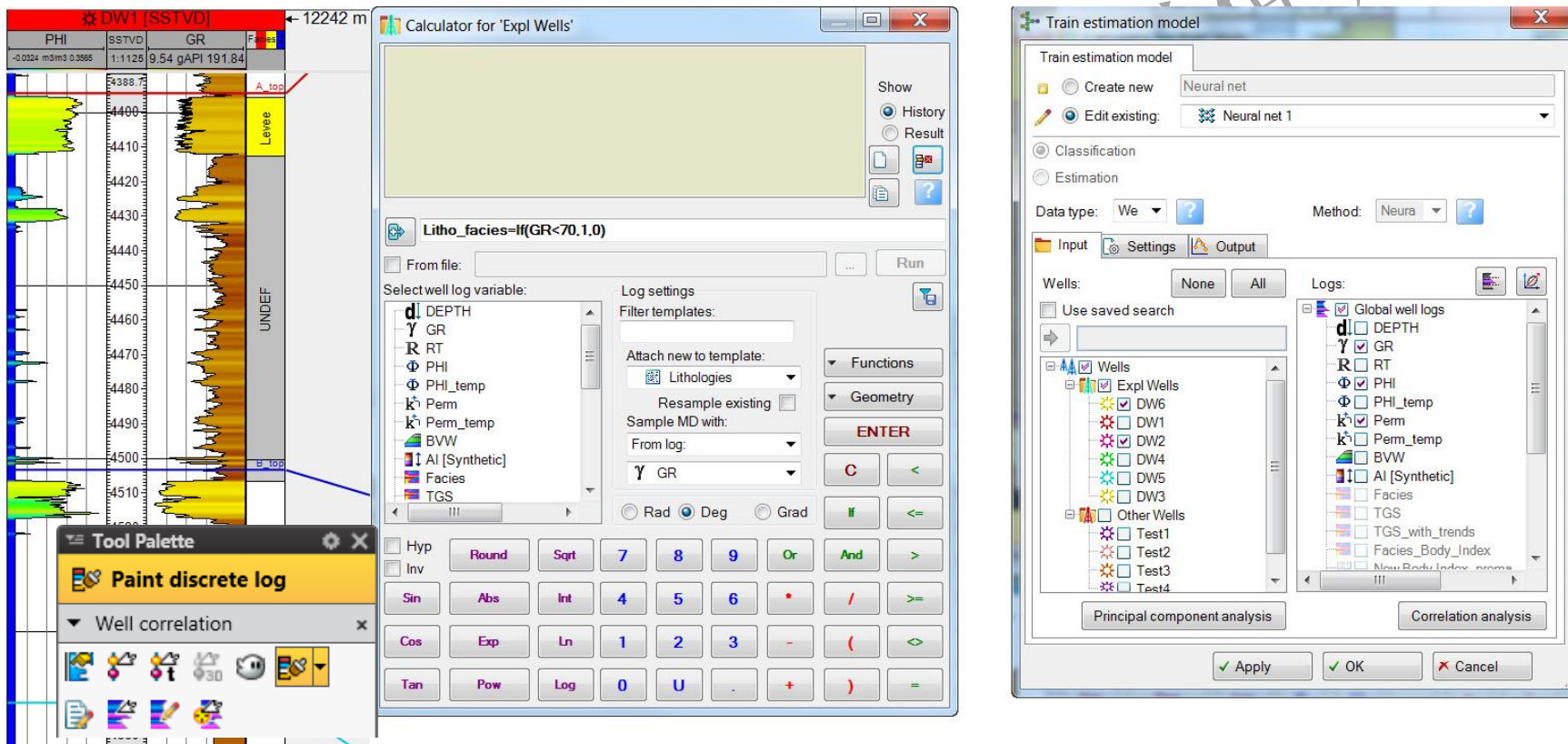
Use of secondary
information for
property modeling



Facies/lithology interpretation

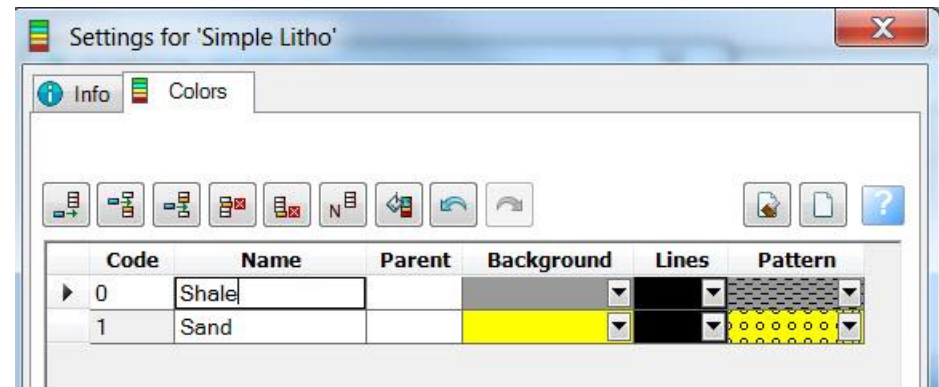
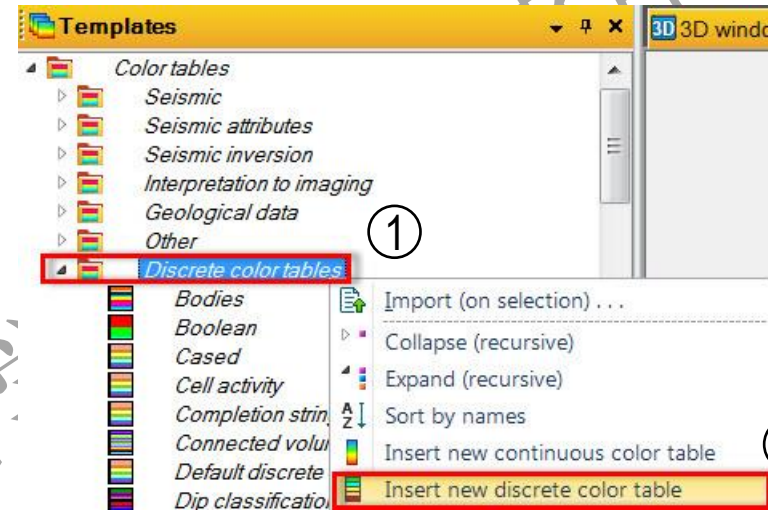


Facies/lithology interpretation in Petrel



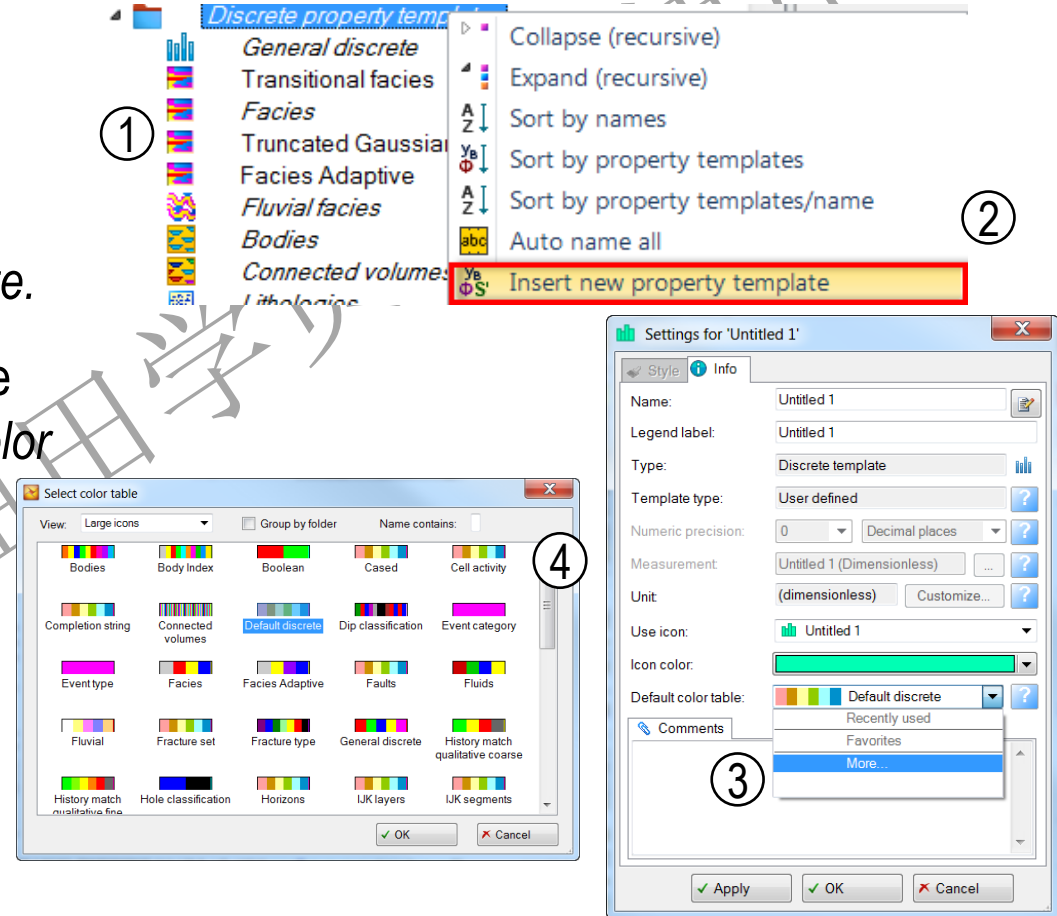
Create a facies template (1)

1. In the **Templates** pane, expand and right-click the **Discrete color tables** folder.
2. Click *Insert new discrete color table*.
3. Open the new Untitled 1 template and click the *Remove rows/Add rows* icon.
4. Enter the names of the facies and change the color and pattern on the **Colors** tab.
5. On the **Info** tab, rename the template.



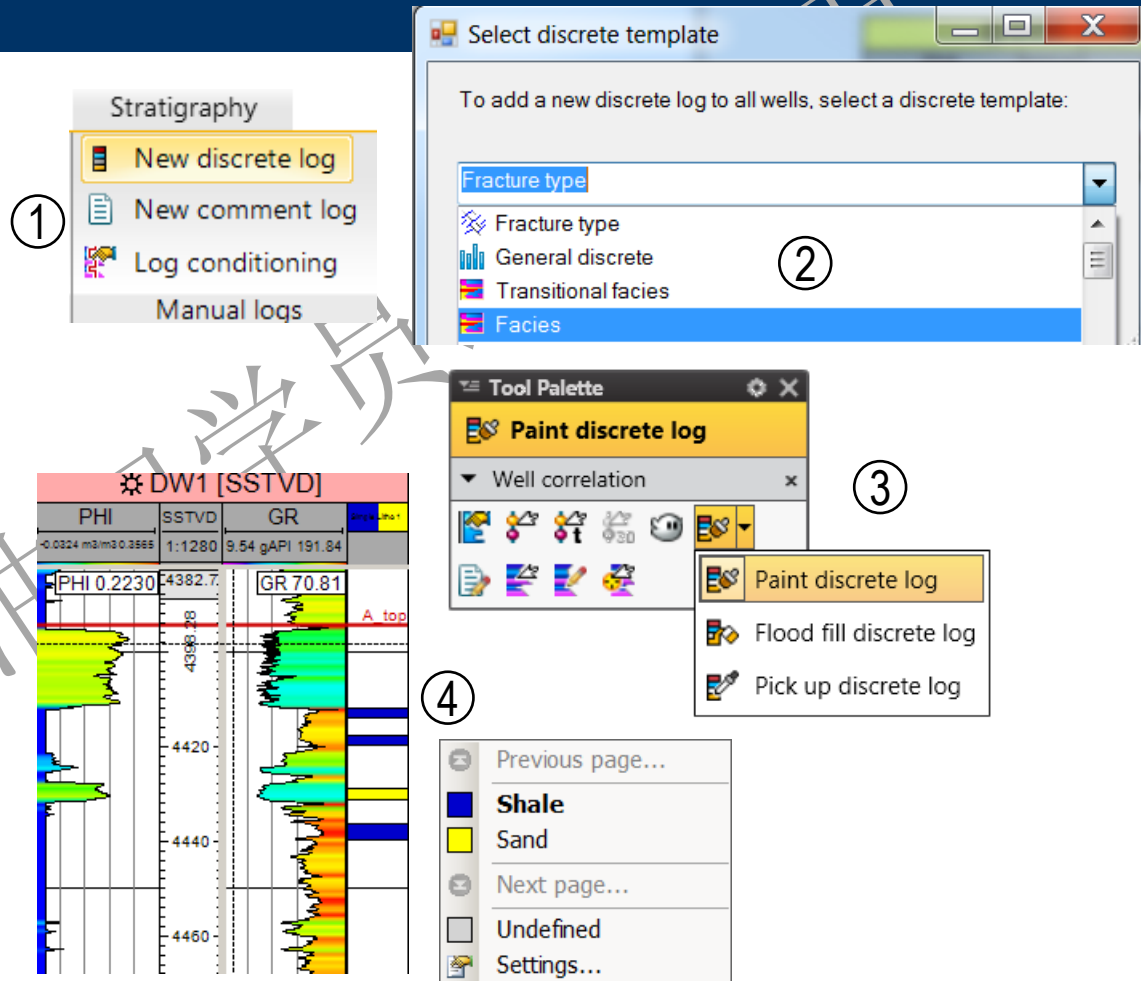
Create a facies template (2)

1. In the **Templates** pane, expand and right-click the **Discrete property template** folder.
2. Click *Insert new property template*.
3. Open the new Untitled 1 template and select More in the *Default color table* list.
4. Select the color table you previously created.



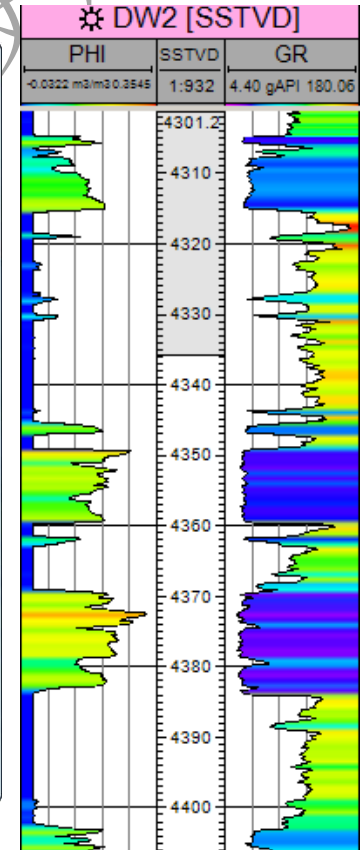
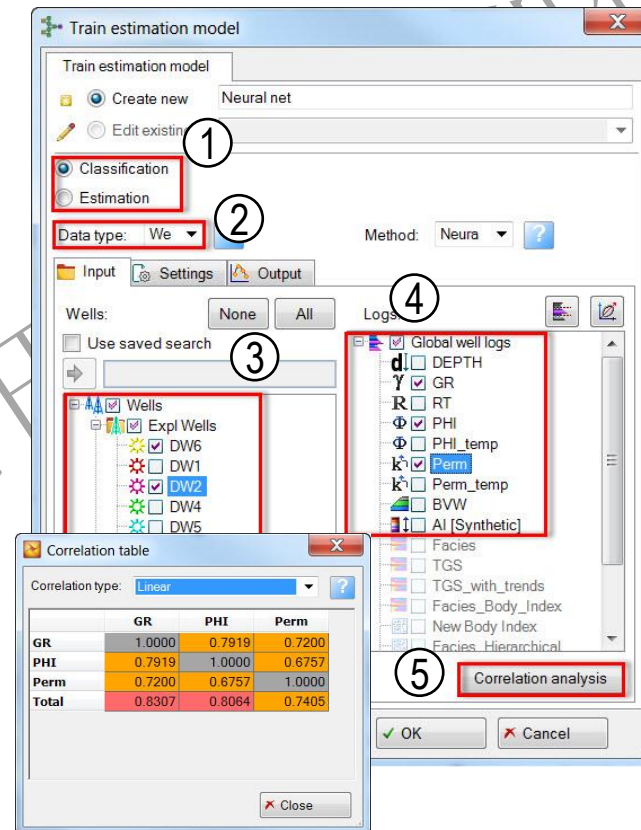
Create a new facies log using interactive facies interpretation

1. In **Stratigraphy**, click *New discrete log*.
2. Select a discrete template for the new interpretation.
3. From the **Well correlation Tool Palette**, click *Paint discrete log*.
4. Right-click in the empty track and select a facies code to interpret.



Neural networks method and input data

1. Choose the model type:
Classification for discrete logs or Estimation for continuous logs.
2. Choose Well logs as the Data type.
3. Choose the wells to use. (There should be logs in common.)
4. Choose the logs to use as input data.
5. Click *Correlation analysis* to see how selected logs interrelate.



Supervised or unsupervised classification

Input Settings Output

Neural net class

☒ Unsupervised 2 Classes ?

☐ Supervised Facies ?

Training

Max number of iterations: 20 ?

Error limit: 10 % ?

Cross validation: 50 % ?

Probability threshold: 0 ?

Unsupervised

Input Settings Output

Neural net class

☐ Unsupervised 3 Classes ?

☒ Supervised Facies ?

Training

Max number of iterations: 20 ?

Error limit: 10 % ?

Cross validation: 50 % ?

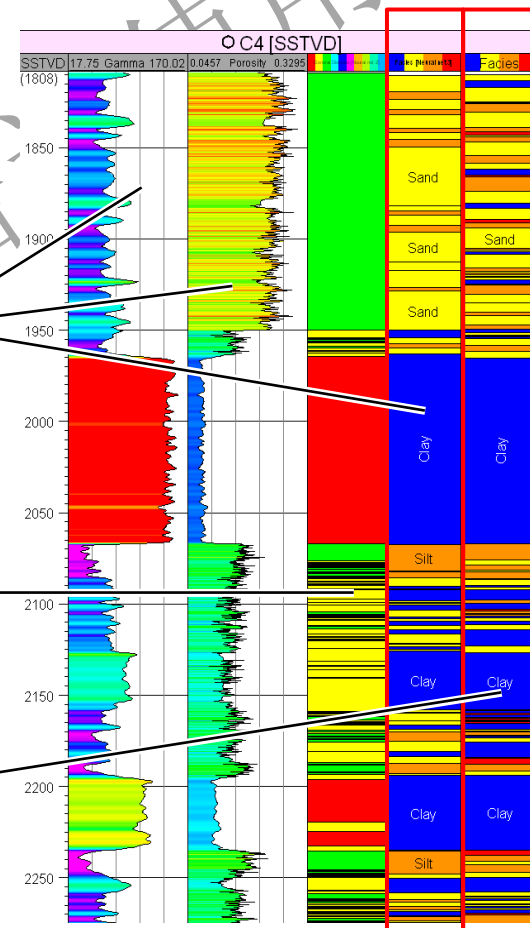
Probability threshold: 0 ?

Supervised

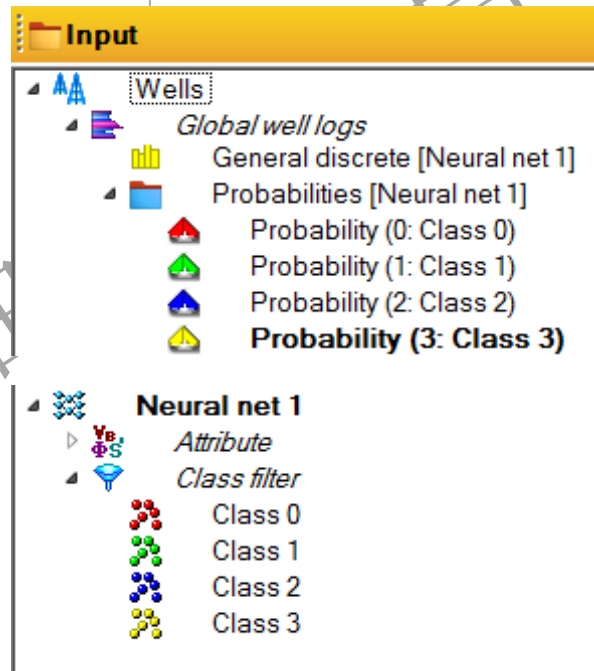
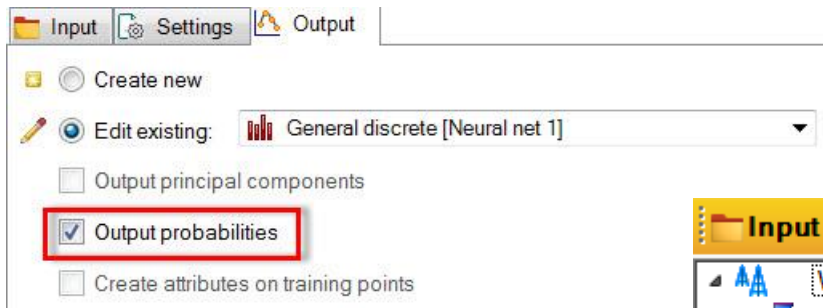
Original logs

Unsupervised

Supervised

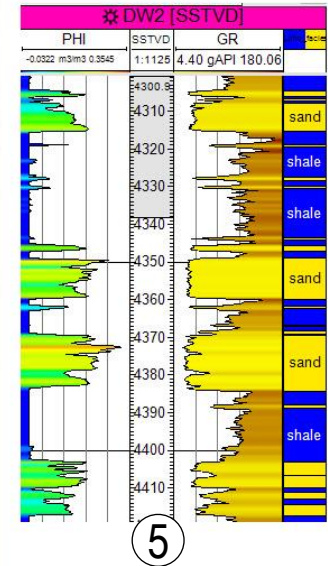


Neural networks (NN) training parameters and output



Create new facies log using the Well log calculator

1. Use a log calculator from the **Wells** folder or individual wells.
2. Enter a new log name and the expression.
3. Choose the property template you just made.
4. Click *ENTER*.
5. Compare in the **Well section** window.



Example of well log calculator

$$S_w = \sqrt[n]{\frac{a R_w}{\phi^m R_t}}$$

SW_Archie=sqrt((0.8*0.1)/(Pow(PHI_temp,2)*RT))

☐ From file: ... **Run**

Select well log variable:

- Water Saturation
- Net to Gross
- DEPTH
- GR
- RT
- PHI
- PHI_temp
- Perm
- BVW
- AI [Synthetic]
- Facies
- TGS
- TGS_with_trends

Log settings

Filter templates: water sat

Attach new to template: S_w Water saturation

Resample existing ☐

Sample MD with: From log: R RT

☐ Rad ☒ Deg ☐ Grad

Functions

Geometry

ENTER

C **<**

If **<=**

Hyp **Round** **Sqrt** **7** **8** **9** **Or** **And** **>**

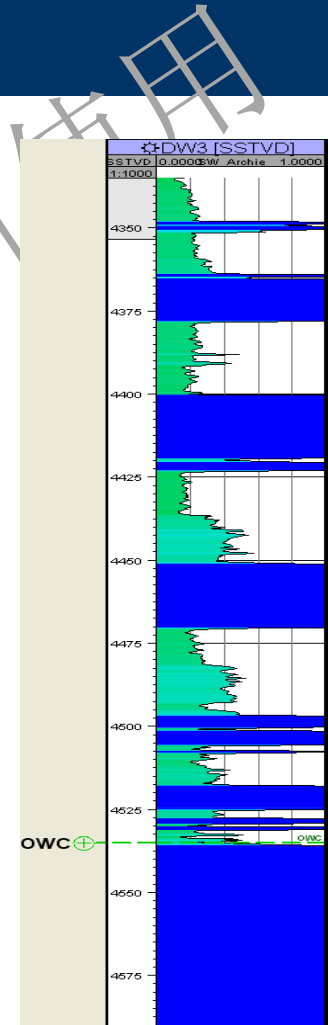
Inv **Abs** **Int** **4** **5** **6** ***** **/** **>=**

Sin **Exp** **Ln** **1** **2** **3** **-** **(** **<**

Cos **Pow** **Log** **0** **U** **.** **+** **)** **=**

Tan

☒ From file: D:\sw_formula.mac ... **Run**

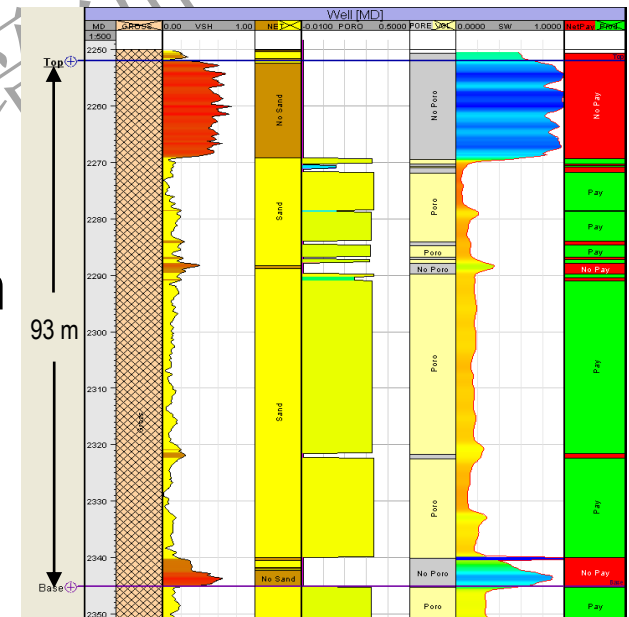


Net to Gross (NtG)

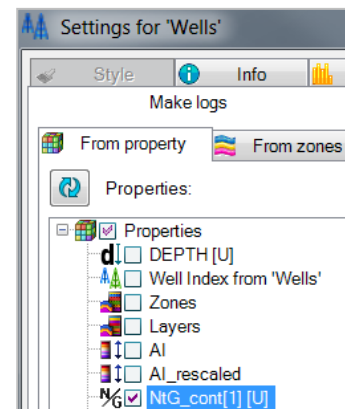
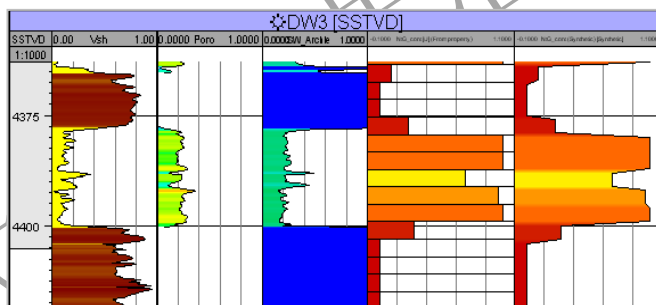
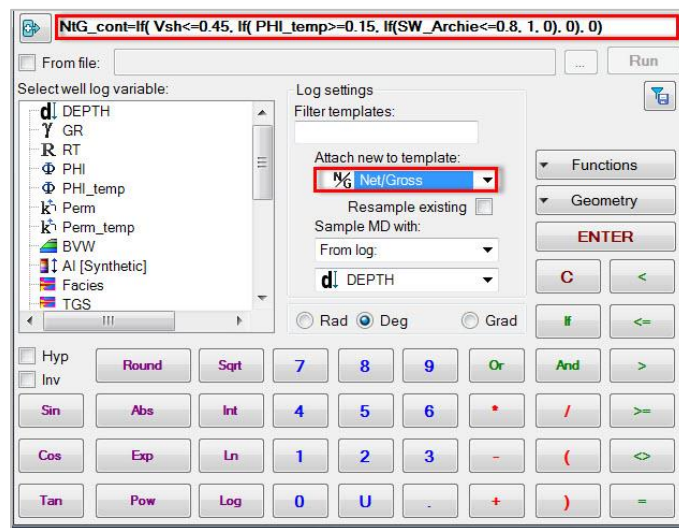
A fraction of the potential reservoir as a ratio of the total volume.

For example:

- Gross thickness = Total interval thickness =
 $2,345 - 2,252 = 93\text{m}$
- Net thickness = Total thickness of sand = 72 m
- Net to Gross = $72/93 = 0.774$
- Pore thickness = Net thickness * Porosity =
 $72 * 0.32 = 23.04\text{ m}$
- Hydrocarbon pore thickness =
 $\text{Pore thickness} * (1 - S_w) = 23.04 * (1 - 0.2) = 18.432\text{ m}$



Discrete Net-to-Gross (NtG) log



Exercises

- Calculate facies
- Interpret facies interactively
- Classify a neural network
- Create an SW log and property
- Create an NtG log