Exercise objective:

To predict rock property using the *3D Seismic* + *Wells, Rock Property Prediction* tool which is part of the Machine Learning plugin. In this exercise, we want to predict a Porosity cube.

Well data Preparation

Seismic (and/or attributes) and **Well**(s) need to be available in the survey. If not, **import** seismic and wells (track, logs, markers, time-depth curve or checkshot).

Workflow:

- Open the Machine Learning Control Center with the sicon .
- 2. Click on Seismic + Wells > 3D Seismic
- 3. Select Rock Property Prediction, and Press Go.



- 4. The "Property Prediction from Seismic" window pops up.
- 5. Select the *Extract* and *Input Data* tabs.

For seismic attributes, select 4 Dip steered median filter and 7a AI Cube Std

- **6.** Select: Survey, Target Log (e.g. Porosity), and Wells as indicated in the window.
- 7. Press the Logs Tab.

| a Property Prediction from Seismic | – 🗆 X |
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| 🗇 Extract 🛛 🕅 Train 🛛 🛩 Apply | |
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| 🔊 Input Data 🔹 Logs | |
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| Image dimensions inl:1 🗧 crl:1 🗧 z:33 🗘 🗋 Symmetric | |
| Edge/Gap Policy O Exclude incomplete O Add data | |
| Output Deep Learning Example Data | ✓ Select ✓ Extract |
| | Proceed Oclose ? |

8. **Click** the 'Select Well Data' button

9. In the "Select Logs for Data Extraction" window, **Select** the *PHI (Porosity)* logs for wells F03-2, F03-4 and F06-1 by left clicking and dragging to select them. Observe that the 'Select Target Logs' needs to be set in the dropdown menu. Once selected, the green color for the logs turns yellow, indicating that they have been selected

Report Prediction from Seismie 🖑 Extract 🛛 🕅 Train 🛛 🛩 Apply 📄 🥣 🔒 🔕 Are you selecting Seismic and Well Data from this survey only? • Yes O No 🏁 Input Data 🛛 💺 Logs Select Well Data Wells Target(s) Extract between <Start of data> <End of data> \sim Extra Z above/below (ms) 0 0 Output Deep Learning Example Data Select ... Select Proceed Sclose ? Select Logs for Data Extraction select Target Logs RHOB VEL OK OCancel

2 F03-3 3 E03-4 4 E06-

10. Press OK.

The well F02-1 is not selected. and will be used as a blind well.

11. The *"Input Data"* and *"Logs"* tabs should now be set

Input data can be modified using the "Select Well Data" button. Keep the default parameters as indicated in this window.

12. Specify a new name for the *Output* Deep Learning Example Data (e.g. DL_Example_Data_Porosity_st1x1x33z4)

13. Click "Extract"

| Property Prediction from Seismic | | - | |
|------------------------------------------------------------------------------|---------|-----------|---------|
| 🖑 Extract 🕅 Train 🖌 Apply | | | |
| Are you selecting Seismic and Well Data from this survey only? • Yes | s 🔿 No | | |
| 🏁 Input Data 🔹 Logs | | | |
| Select Well Data | | | |
| Wells | Target(| s) | |
| PHI F03-2 F03-4 F06-1 | | | |
| Extract between <start data="" of=""> < <end data="" of=""></end></start> | ata> ~ | | |
| Extra Z above/below (ms) 0 0 | | | |
| Output Deep Learning Example Data | ~ | Select | Extract |
| | C | Proceed 😣 | Close ? |

14. The *Train* tab gets activated. Train the extracted examples data using the default learning algorithm Scikit-learn (Ensemble: Random Forests).

Different machine learning platforms and parameters can be tested. Keep the default parameters for this exercise.

- **15. Specify** a new *Output mode*l name e.g. DL_Ex_Predict_Porosity.
- 16. Under the *Parameters* Tab, **select** "Ensemble" and "Random Forests"
- **17. Go back** to the "Training" tab and **Press** Run.



18. Press Close in the "Machine Learning training log" window, when the processing finishes, indicated by the line "Finished Batch Processing"

| | Machine Learning training log | \times |
|--------------|------------------------------------------------------|----------|
| | File | |
| | Finished: Thu 01 Jun 2023, 09:40:42 | |
| | Correlation coefficient with validation data: 0.5386 | |
| | Saving model. | |
| | Model saved. | |
| | Process: 'Machine Learning Training' | |
| | Finished: Thu 01 Jun 2023, 09:40:52 | |
| | Finished batch processing. | |
| | | - 1 |
| | Close Ø F | eload |
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| Training F | Parameters Advanced | |
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When the computation finishes, close the Progress Viewer window.

QC results by displaying the predicted Porosity on the test Inline, 362) and overlay the crossing well F02-1, with the porosity log.

23. Right Mouse Click on the Inline folder > Add Default Data e.g. Deep Steered Median Filter. Type: 362 in the In-line field Change the In-line no to 362



24. Right Mouse Click on the In-line 362 > Add > Attributes. Select under Stored the new predicted porosity (e.g. ML_Porosity_Prediction), and Press "OK".

25. Modify the Porosity colour limit to (0.25-0.35)



26. Right Mouse Click on the well folder> Add, **Select** the well F02-1, **Hit** Ok.

27. Right Mouse Click on the Well F02-1 > Display
> Properties, Select Porosity log, Change the color bar to Porosity. Modify the Porosity color range similar to the predicted porosity cube range (0.25 - 0.35).

28. Apply to All Wells, and Hit Close.

| | 0.25 | 0.35 | Porosity | In-line | 362 🌲 |
|------|------|-------|----------|---------|-------|
| | | | | | |
| 500 | | | | | |
| 1000 | | | | | |
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| | 🛞 Loa | d Wells | | _ | | \times |
|---------------|------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|
| | Select | Input Wells | | | | |
| | [| ∎ + Filter * | | | | |
| | | ✓ F02-1 ☐ F03-2 ☐ > F03-4 < ☐ F06-1 | | | | |
| | 20 | 6_training_v6\WellI | ⊘ OK Solution OK SolutionO | Cancel | 😯 н | elp |
| 🍓 Display pro | perties of | : F02-1 | | _ | | × |
| Left Log | Right L | og Markers Tra | ack | | | |
| S | elect log | Porosity | ł | | • | |
| | Specify | data range | ▼ 🗌 Flip | | | |
| Log range (n | nin/max) | 0.25765201 0.407 | 581 🗌 Logarit | hmic | | |
| | Style | ☑ Well log | smic 🗌 Log tub | e | | |
| Line th | nickness | 1 | | | | |
| Li | ne color | | le | | | - |
| | Fill | Right of log | ▼ 🗌 single (| color | | |
| 1 | Fill with | Porosity | | or table | | |
| | | Porosity | ▼ 0.25 | 0.35 | | |
| Log display w | /idth (m) | | 2 | 250 | | |
| | | Apply to | all wells | | | |
| Save as D | efault | |] | 😢 Close | 8 | lelp |
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If result is satisfactory, go back to the previous Step and **Apply** the trained model to the entire survey.

- **29.** Go back to the Apply tab > Volume subselection > In-line range and reset of the entire range.
- **30. Keep** all other default parameters and **Press** Run to continue.

| Apply 'DL_Ex_Predict_Porosity' | | | | _ | | \times |
|-------------------------------------------|--------------------------------|---|--------|------|-------|----------|
| Apply along | In-line ~ | | | | | |
| Input for '4 Dip steered median filter' 🖐 | 4 Dip steered median filter | ~ | Select | | | |
| Input for '7a AI Cube Std' 🖐 | 7a AI Cube Std | ~ | Select | | | |
| Volume subselection | 100/300-750/1250 (463 samples) | | Select | | | |
| Output 'PHI' | ML_Porosity_Prediction | ~ | Select | CBVS | | ~ |
| Execute in Batch | Options | | | | | |
| | | | 🛛 😒 Ri | in 🔞 | Close | ? |

| Positions | | | | | | _ | | × |
|---------------------|-------|--------|----------|------|----------|-------|----|-----|
| Specify Positions | | | | | | | | |
| Volume subselection | Range | | • | - | - | | | |
| Inline Range | 100 | ÷ 750 | <u>^</u> | | | | | |
| Crossline Range | 300 | ÷ 1250 | - - | | | | | |
| Time Range (ms) | 0 | 1848 | <u>^</u> | | | | | |
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| | | | | OK 🌝 | 1 | ancel | ЮН | elp |