

Exercise objective:


To predict lithology logs using the “*Lithology classification tool*”, which is part of the machine learning plugin.

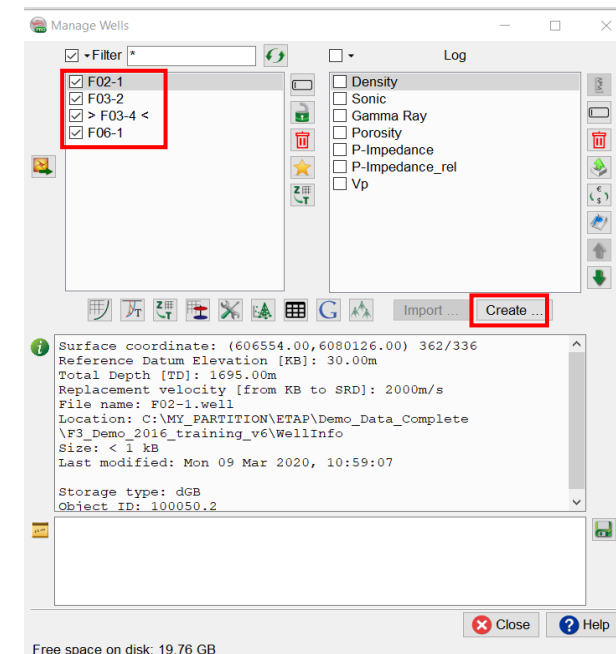
Well data Preparation

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

Workflow:

For the purpose of this exercise, we will create a fake lithology log using Mathematics (as no lithology log exists in the survey)

1. **Open** the Well Manager .
2. **Select** All Wells in the “Well Manager”, and **Hit Create**.

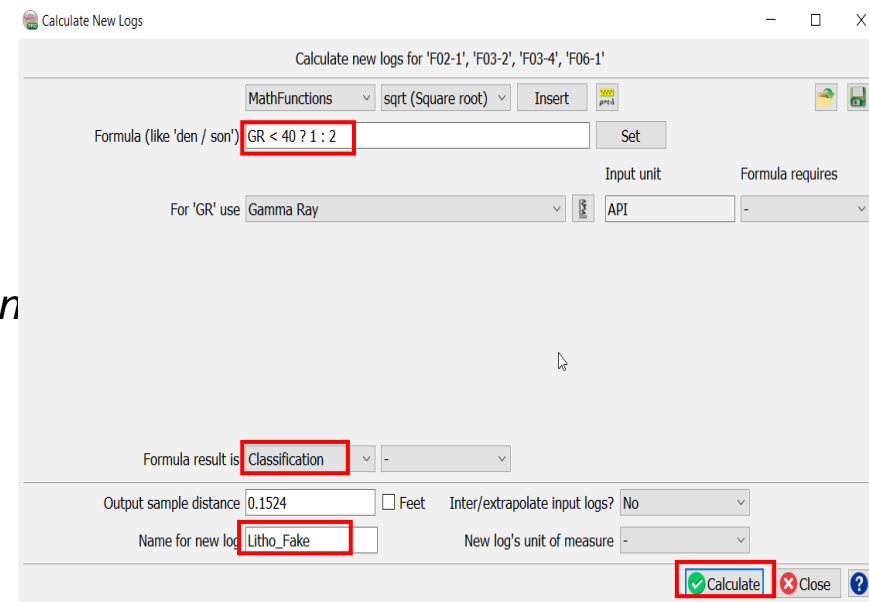


Workflow cont'd:

3. In the “Calculate a New Well Log” window, **Specify** the parameters as indicated below to create a fake litho-log:


- a. **Select**: MathFunctions.
- b. **Type** the Formula: $GR < 40 ? 1 : 2$
- c. **Hit** Set.
- d. **Select** Gamma Ray log.
- e. **Select** for the *Formula Results, Classification*
- f. **Type** Name for new log: Litho_Fake.
- g. **Select** Output Unit of Measures: None.

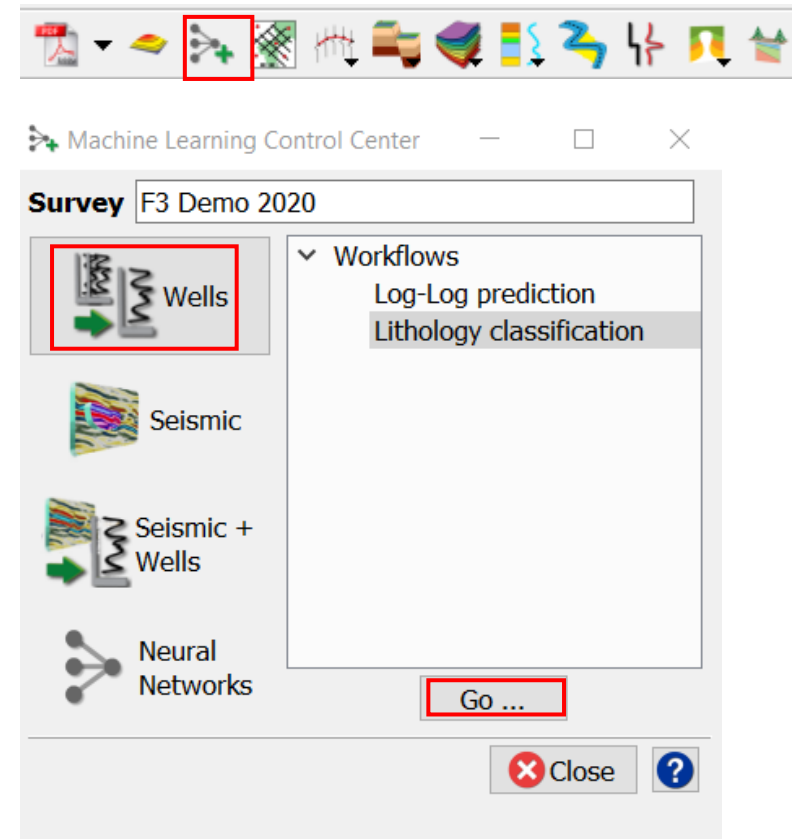
4. **Press** Calculate.




The screenshot shows the 'Calculate New Logs' window. The title bar reads 'Calculate New Logs'. The main area is titled 'Calculate new logs for 'F02-1', 'F03-2', 'F03-4', 'F06-1''. The 'MathFunctions' dropdown is set to 'MathFunctions', and the 'sqrt (Square root)' dropdown is set to 'sqrt (Square root)'. The 'Formula (like 'den / son')' field contains 'GR < 40 ? 1 : 2'. The 'Set' button is highlighted. The 'For 'GR' use' dropdown is set to 'Gamma Ray'. The 'Input unit' dropdown is set to 'API'. The 'Formula requires' dropdown is set to '-'. The 'Formula result is' dropdown is set to 'Classification'. The 'Output sample distance' field is set to '0.1524'. The 'Inter/extrapolate input logs?' dropdown is set to 'No'. The 'Name for new log' field is set to 'Litho_Fake'. The 'New log's unit of measure' dropdown is set to '-'. The 'Calculate' button is highlighted with a red box.

Workflow cont'd:

5. **Open** the Machine Learning Control Center with the  icon.
6. **Click** on Wells.
7. **Select** *Lithology classification*.
8. **Hit** Go.



Workflow cont'd:

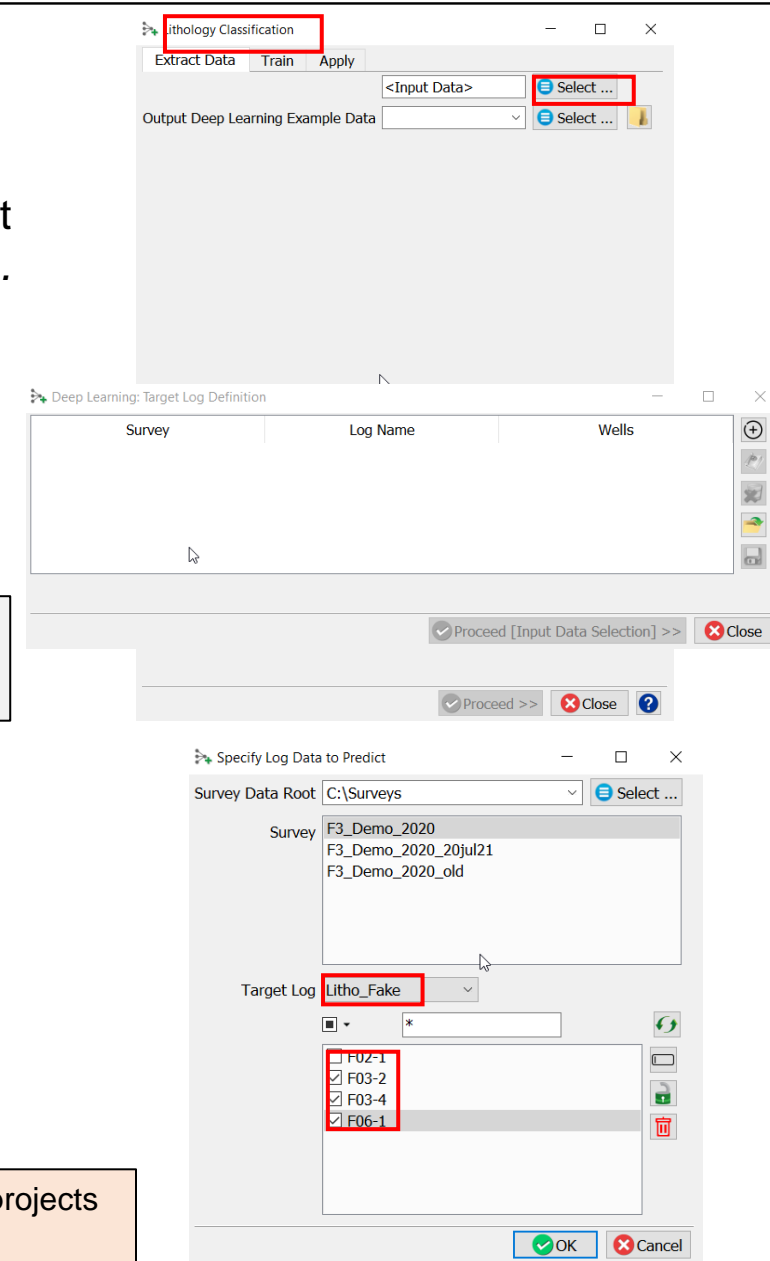
9. "Lithology Classification" window pops up. **Press** Select - Input Data. **Select**  icon in the "Target Log Definition".

10. "Log Data to predict" window pops up. **Select:** *Survey**, *Target Log*, and *Wells* as indicated in the window.
In this case the "Litho_Fake" log will be predicted.

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

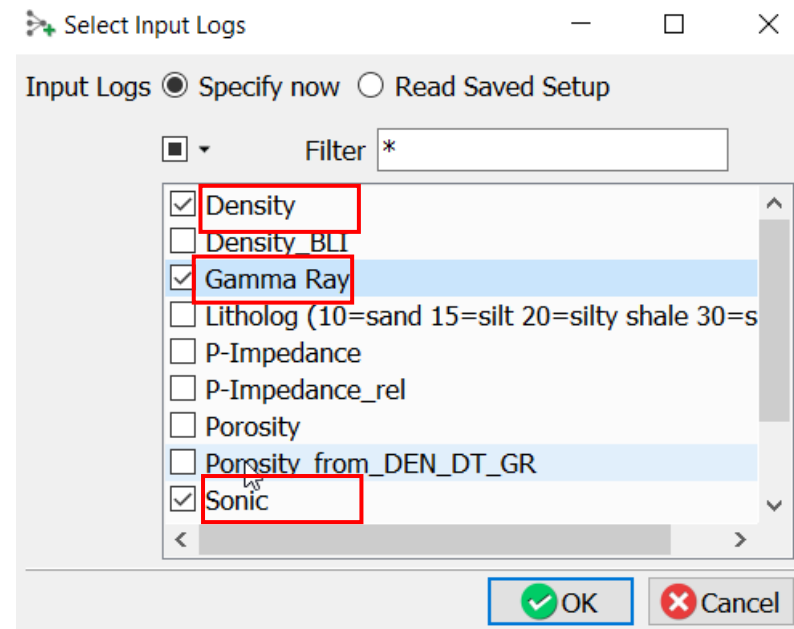
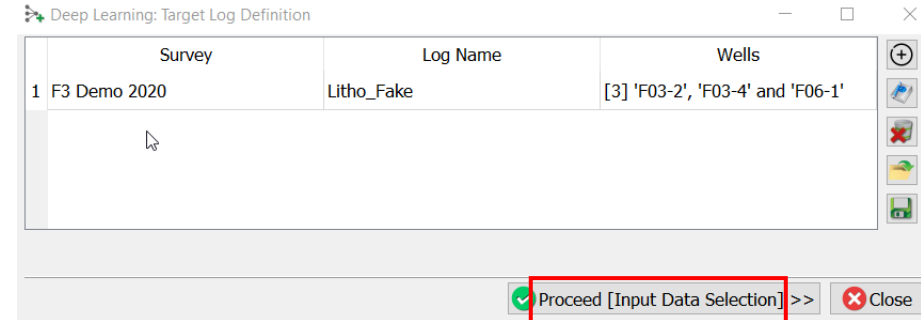
11. **Press** OK.

* The option to select data from other surveys is available only in commercial projects (not in the free demo project)



Workflow cont'd:

11. “*Deep Learning: Target Log definition*” window pops up.
12. **Press** Proceed [Input Data Selection].
13. In the “*Select Input Logs*” window, **Select** the Density, Sonic and Gamma Ray logs.
14. **Press** OK.



Workflow cont'd:

15. “*Input Log Selection*” window pops up.

Input Logs can be modified here. Keep the default parameters as indicated in the window.

16. **Specify** a new name for the “*Output Deep Learning Example Data*” (e.g. *DL_Example_Data_Lithology_st10*).

17. **Press** Proceed.

Input Log Selection

	Survey	Input Log 1	Input Log 2	Input Log 3
1	F3 Demo 2020	Density	Gamma Ray	Sonic

Stepout from center log sample: 10

Extract between: <Start of data> <End of data>

Log sampling Z Step (m): 0.1524

Edge/Gap Policy: ☒ Exclude incomplete ☐ Add data

Output Deep Learning Example Data: DL_Example_Data_Lithology_st10

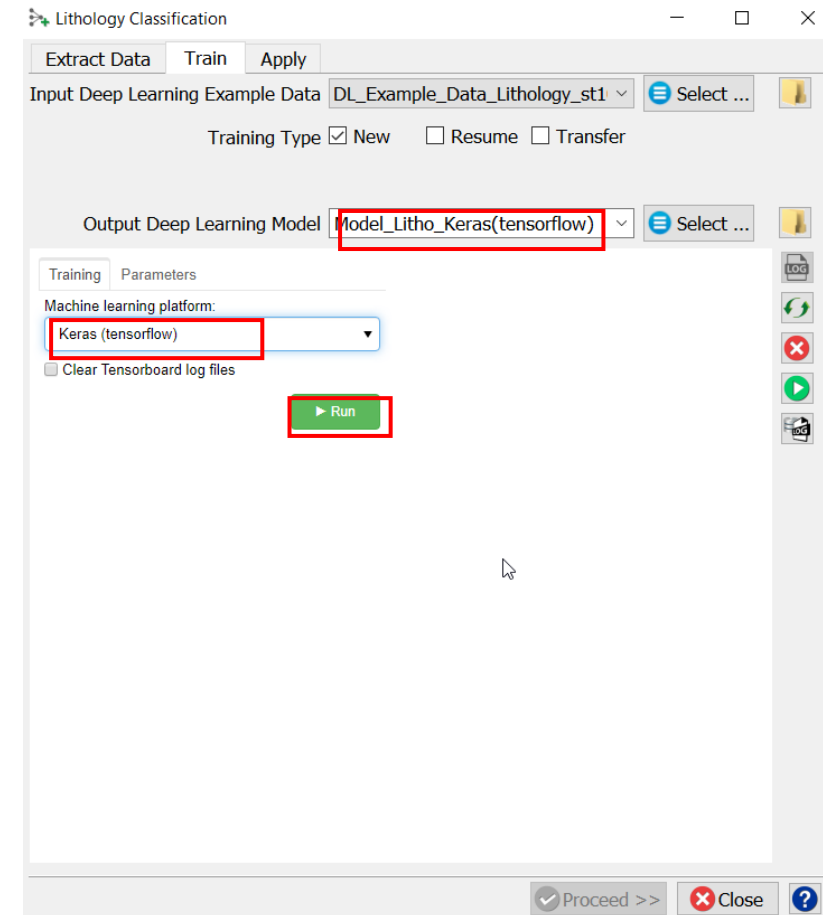
Buttons: Proceed >> (highlighted), Close, Apply, ?

Workflow cont'd:


18. **Select** Training Type New.
19. “*Train*” tab becomes active. Train the extracted examples using the default learning algorithm (e.g. Keras (tensorflow)).

Different machine learning platforms and parameters can be tested.

20. **Keep** the defaults parameters. **Specify** a new *Output model* name (Model_Litho_Keras(tensorflow)).
21. **Press** Run.

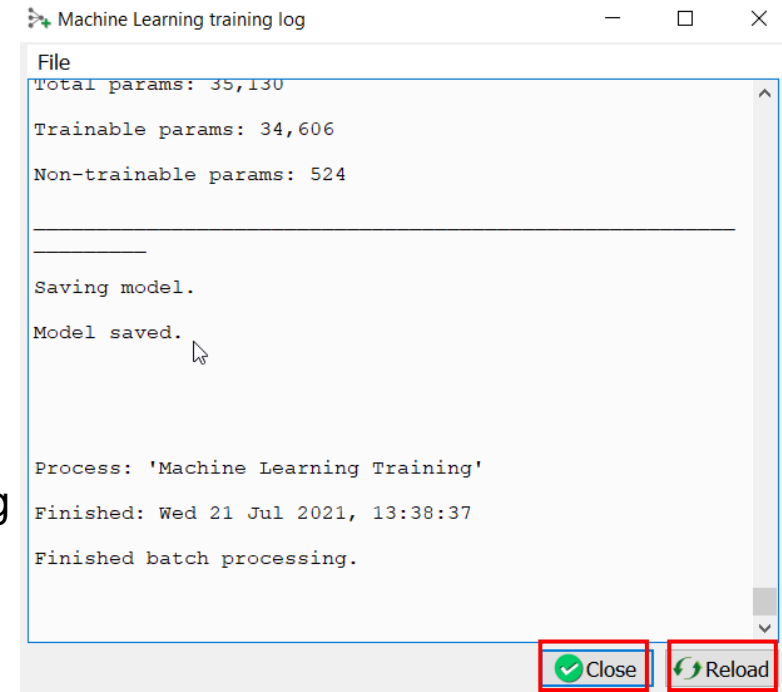


Workflow cont'd:

22. The Machine Learning training log file pops up. Otherwise **Click** on  icon.

23. **Hit** Reload to refresh the window.

24. When the processing is done, **Close** the training log file.



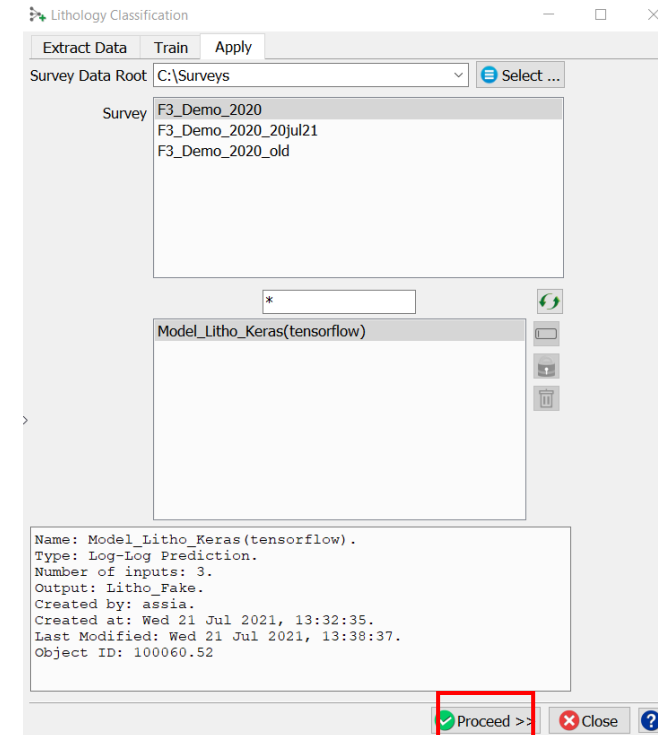
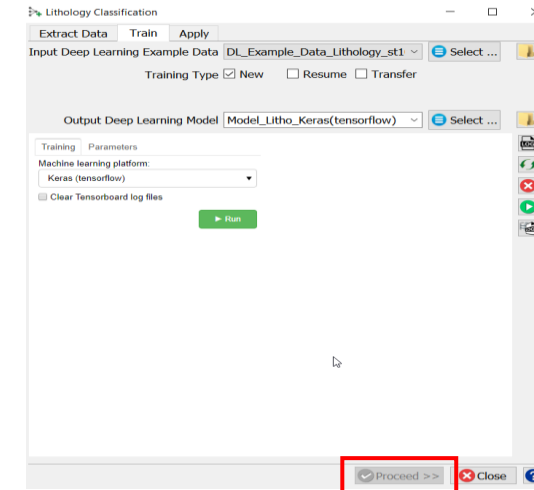
Workflow cont'd:

25. **Hit** Proceed in the 'Lithology Classification-Train' Window.
26. "Apply" tab get activated, **Verify** the Survey and Model are correct. Otherwise, modify accordingly.

*The Survey, Training model can be modified here.

27. **Press** Proceed.

* The option to select data from other surveys is available only in commercial projects (not in the the free demo projects)



Workflow cont'd:


28. "Apply created training model" window pops up.
29. **Apply** the trained model to a blind well (not used in the training process). **Select** F02-1.
30. **Keep** default parameters. **Type** a new Log name for the predicted lithology log "Litho_Fake_Predicted".
31. **Press** Run to continue.

Apply 'Model_Litho_Keras(tensorflow)'

Input log for 'Density' Density

Input log for 'Gamma Ray' Gamma Ray

Input log for 'Sonic' Sonic



Apply to * 

- ☐ > F03-4 <
- ☒ F02-1
- ☐ F03-2
- ☐ F06-1

Extract between <Start of data> <End of data>


Log sampling Z Step (m) 0.1524

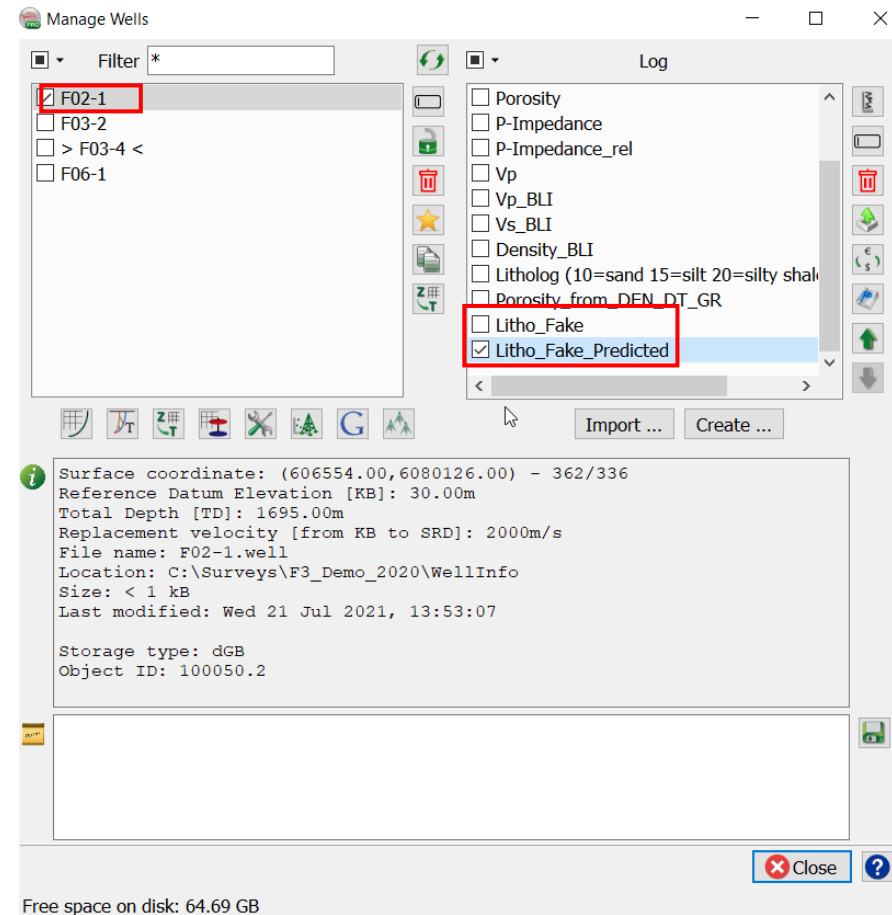
Log name for 'Litho_Fake' Litho_Fake_Predicted

 Run  Close

Workflow cont'd:

QC results by displaying the predicted log adjacent to the recorded log

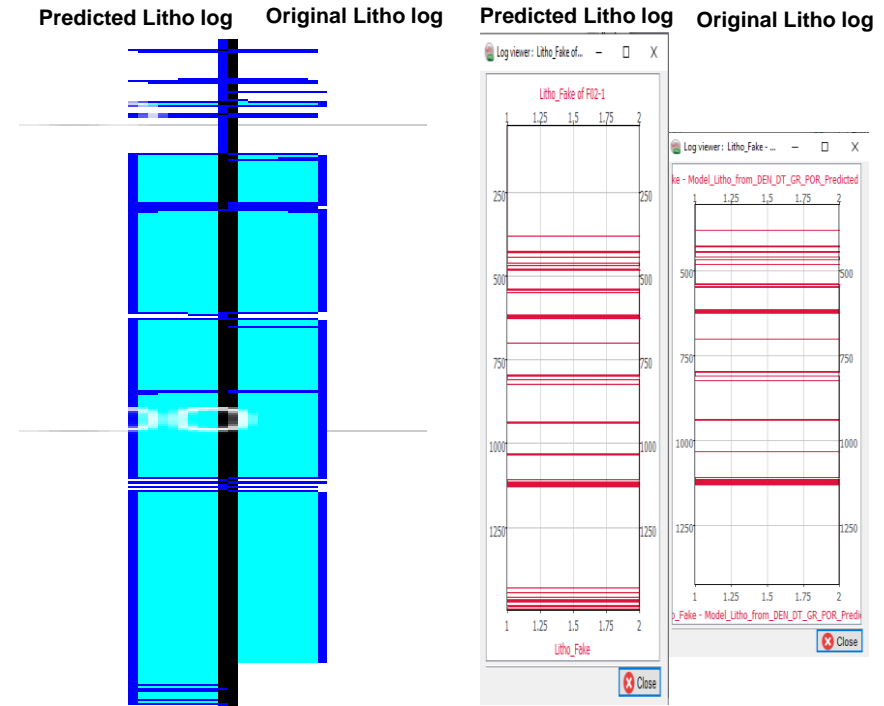
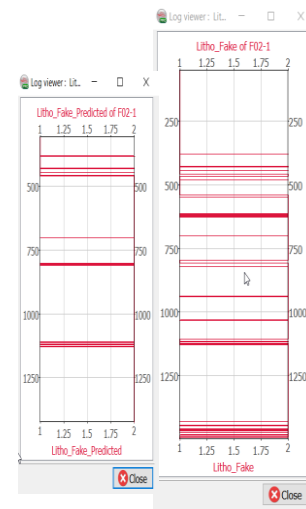
32. **Click** on the Well Manager  icon.
33. **Select** the blind well F02-1, Litho_Fake and Litho_Fake_Predicted logs.
34. **Click** on view logs.



Workflow cont'd:

35. **Compare** the original vs predicted litho-log.

Note: The missing parts at the top and base of the predicted log are due to missing values in the input logs.



Workflow cont'd:

If result is satisfactory, go back to the previous step and Apply the trained model to all Wells

36. **Select** All Wells. Keep default parameters as indicated in the window.
37. **Press** Run to continue.

Apply 'Model_Litho_Keras(tensorflow)'

Input log for 'Density' Density

Input log for 'Gamma Ray' Gamma Ray

Input log for 'Sonic' Sonic

Apply to ☒ *

- ☒ > F03-4 <
- ☒ F02-1
- ☒ F03-2
- ☒ F06-1

Extract between <Start of data> <End of data>

Log sampling Z Step (m) 0.1524

Log name for 'Litho_Fake' Litho_Fake_Predicted