

GeoMech IITR: A Matlab based Software for Standard Well log analysis and Geomechanical Modeling

Basic Tutorials

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Features

General Features

- Simple GUI platform for well log analysis
- Visualisation of wireline Log Data: load and plot wireline log to visualise log data
- Synthetic Log Modeler: Create any synthetic log data using our equation modeler
- Interpret the lithology:use our create lithology file to interpret the lithology by using several logs
- Advanced Visualisation: Create Cross Plots and Histograms
- Curve Fitting Tools: Find linear,exponential and Power law fitting to model lab data

Standard Well Log Interpretation Tools

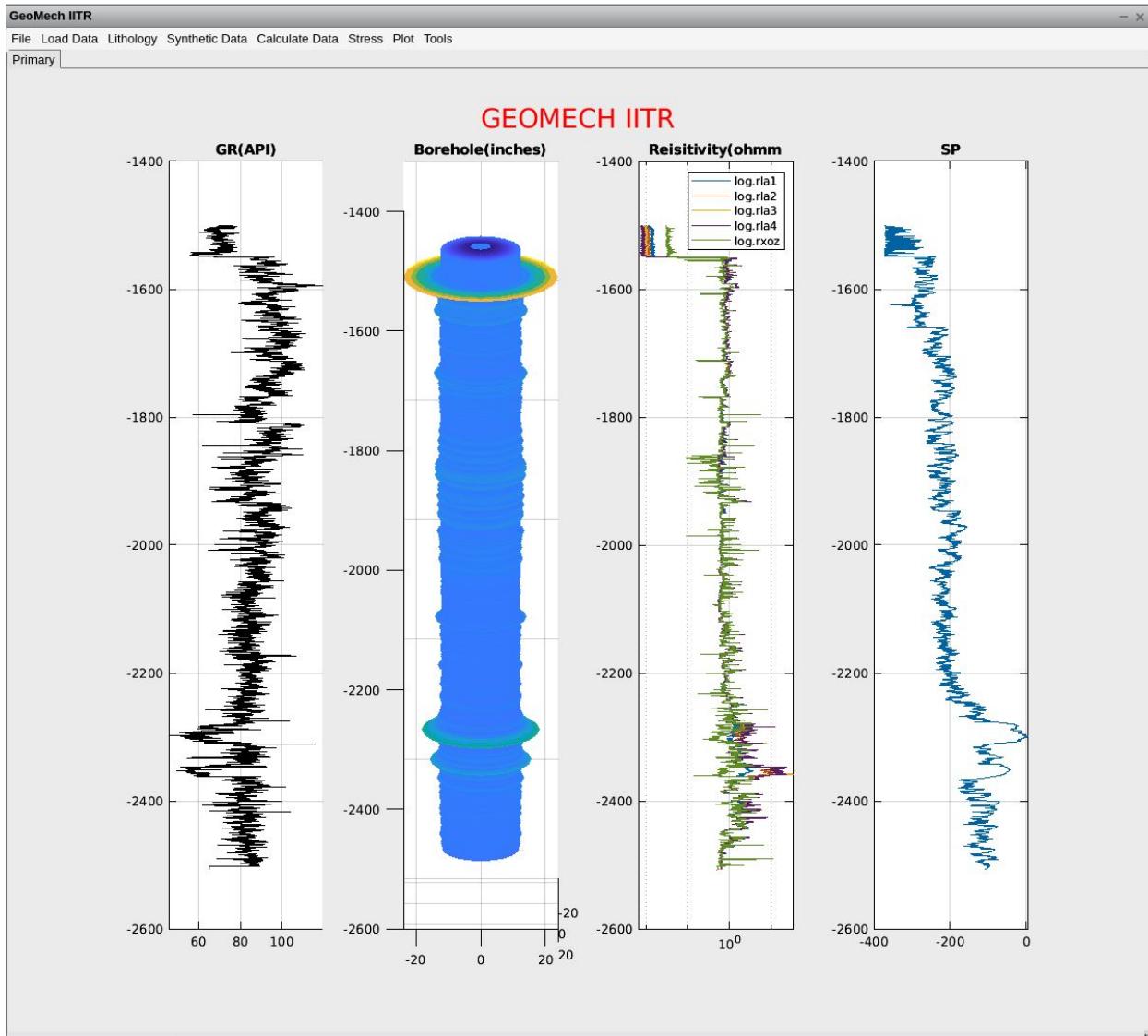
- Inbuilt Shale Volume Calculation using different models
- Inbuilt Density and DT Porosity Calculation
- Inbuilt Synthetic Density, VP and VS modeler
- Create Well Section/Lithology: Create lithology/well section based on different type of formation or fluid
- Inbuilt Fluid Density/DT modeler
- Synthetic Data Modeler: create log data based on different lithology/well section
- Advanced Synthetic Data Modeler: Advance Tool for modeling and create synthetic log based on any type of equation varying different set of lithology/well section

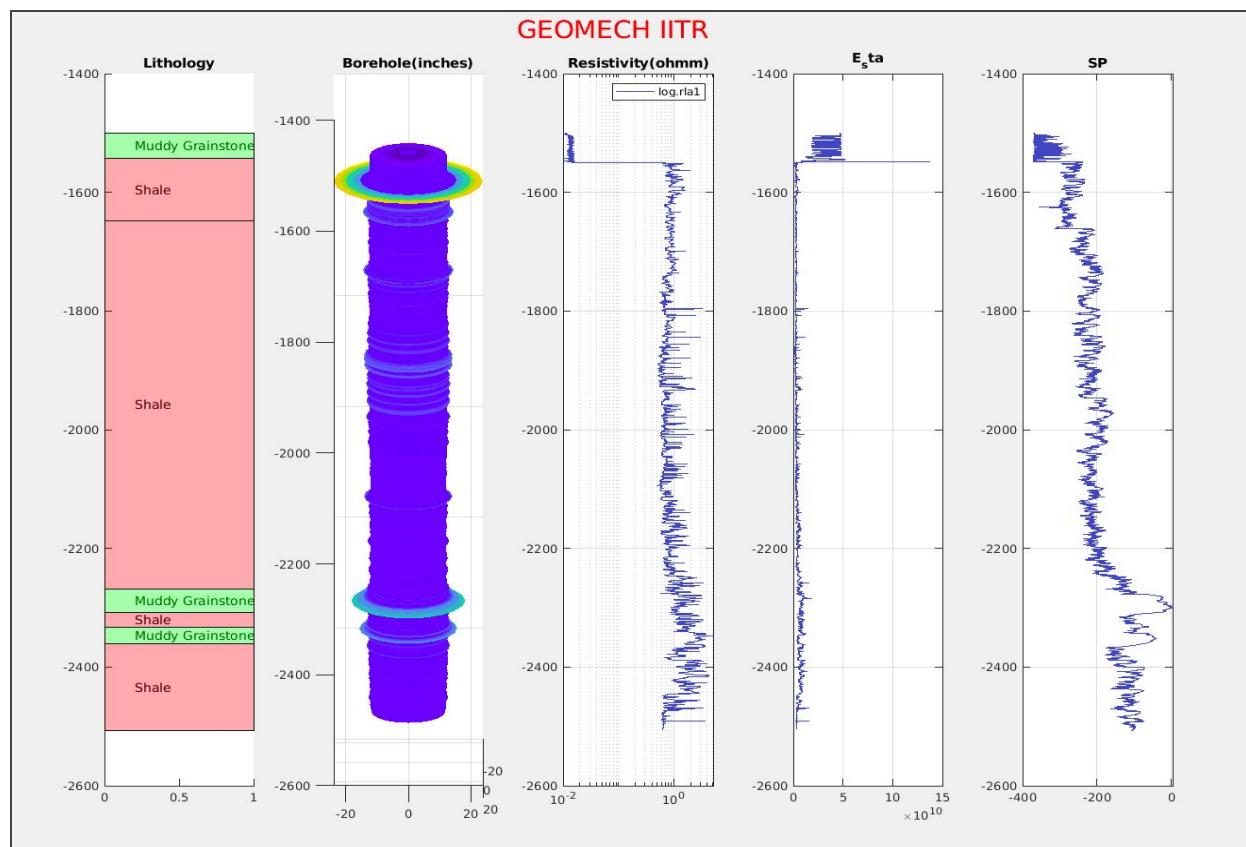
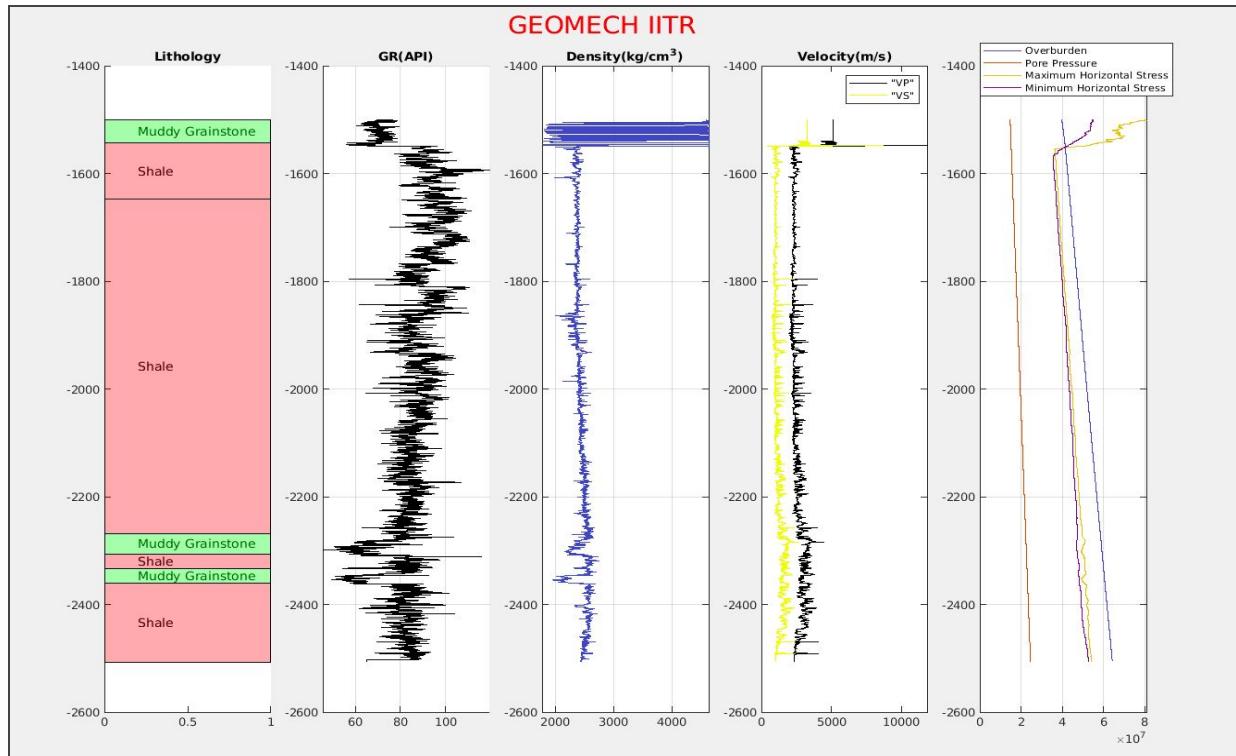
Geomechanical Tools

- Elastic parameter and Poisson Ratio Modeling: calculate bulk and young modulus
- UCS and Friction angle Modeler: Calculate UCS and friction angle using different equation in different lithology
- Inbuilt Pore Pressure Estimator:Calculate overpressure zone and model pore pressure using dt or resistivity using various different method like ratio method, eaton's method etc
- Principal Stress Calculator: Calculate the three stress using tectonics strain
- Fracture Pressure Estimation:
- Stress around Wellbore and Failure Analysis

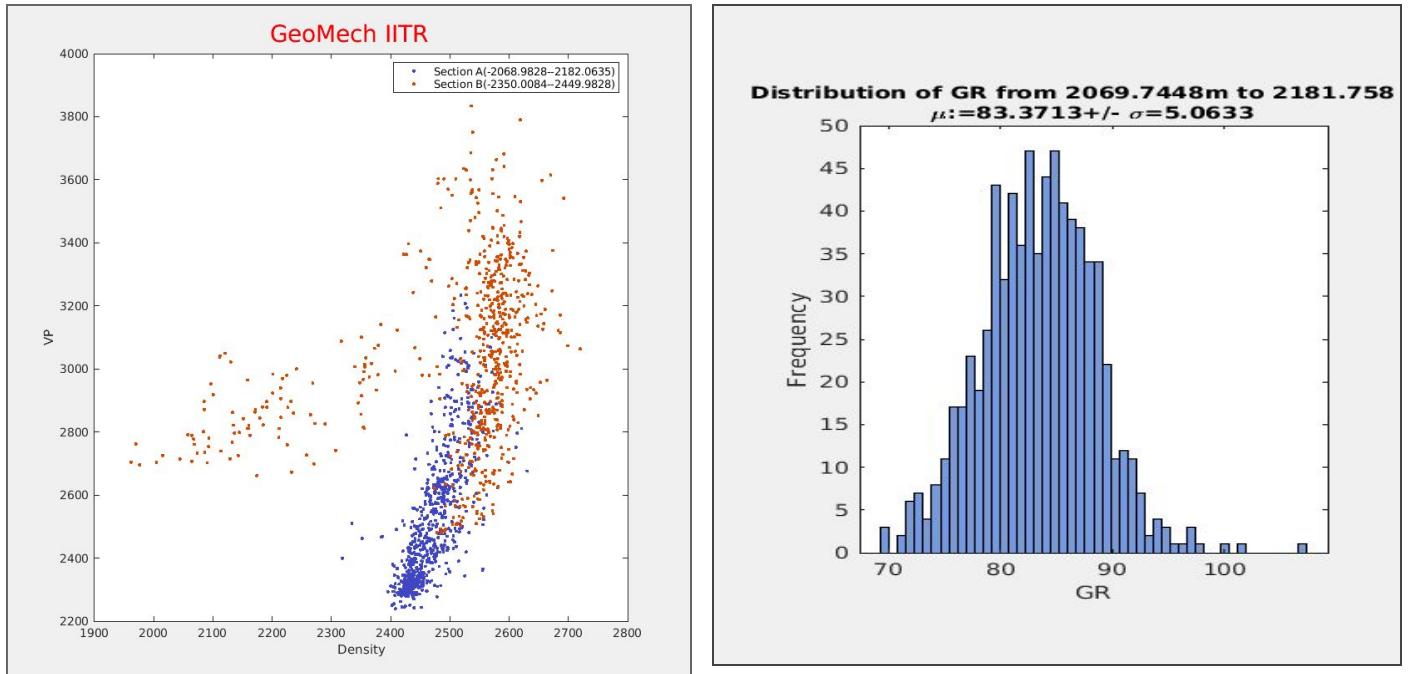
Important Tools

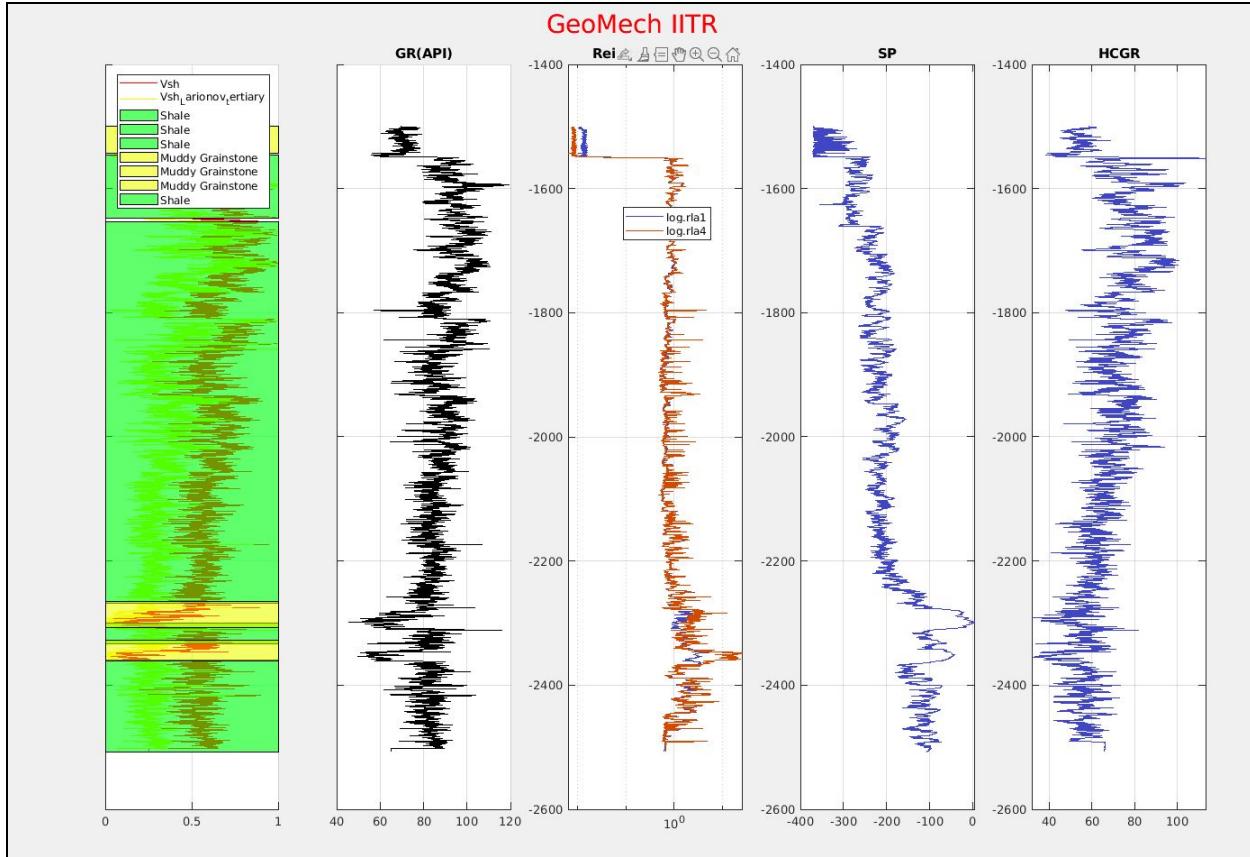
Plotting tools



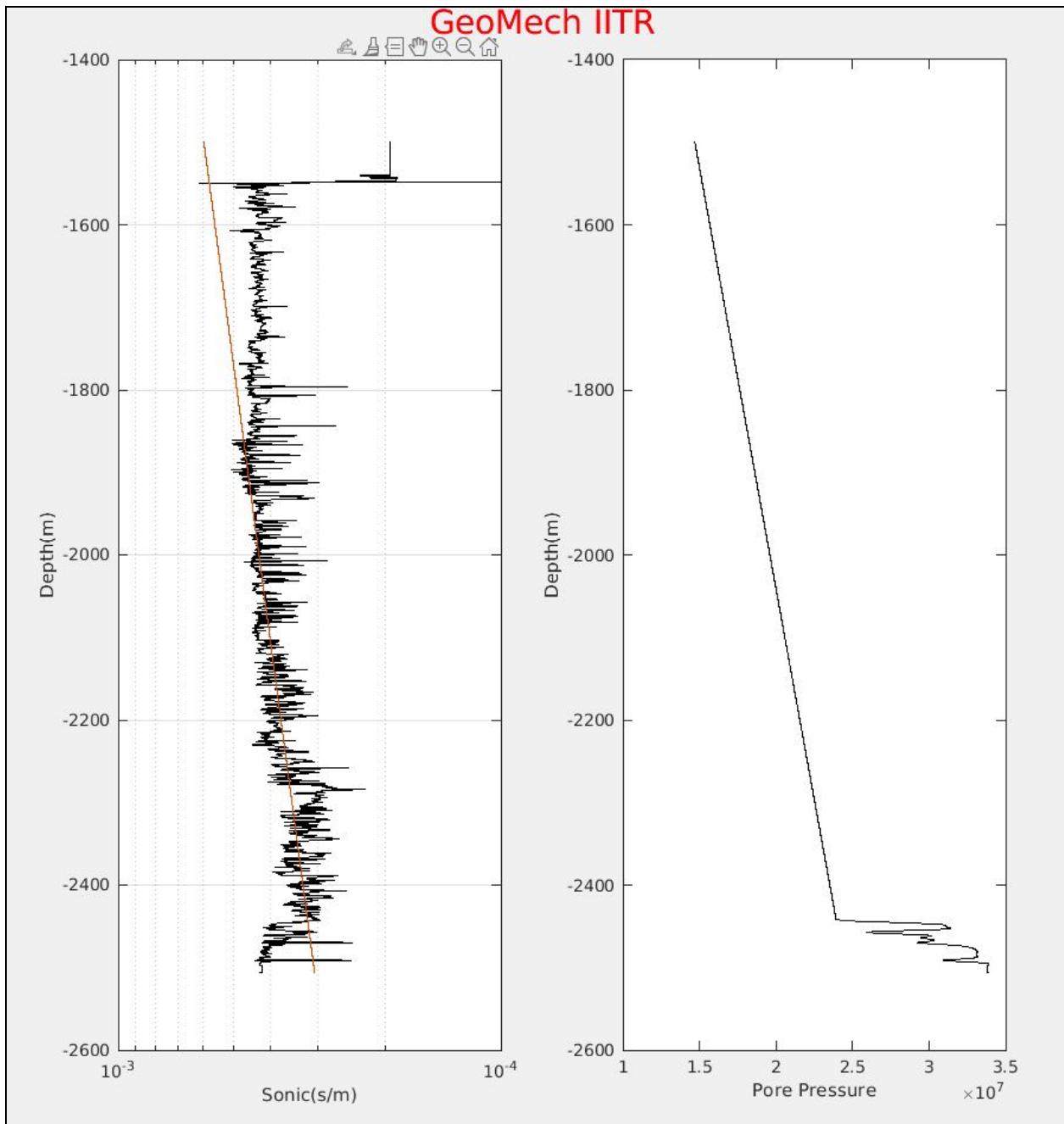


CrossPlots and Histograms

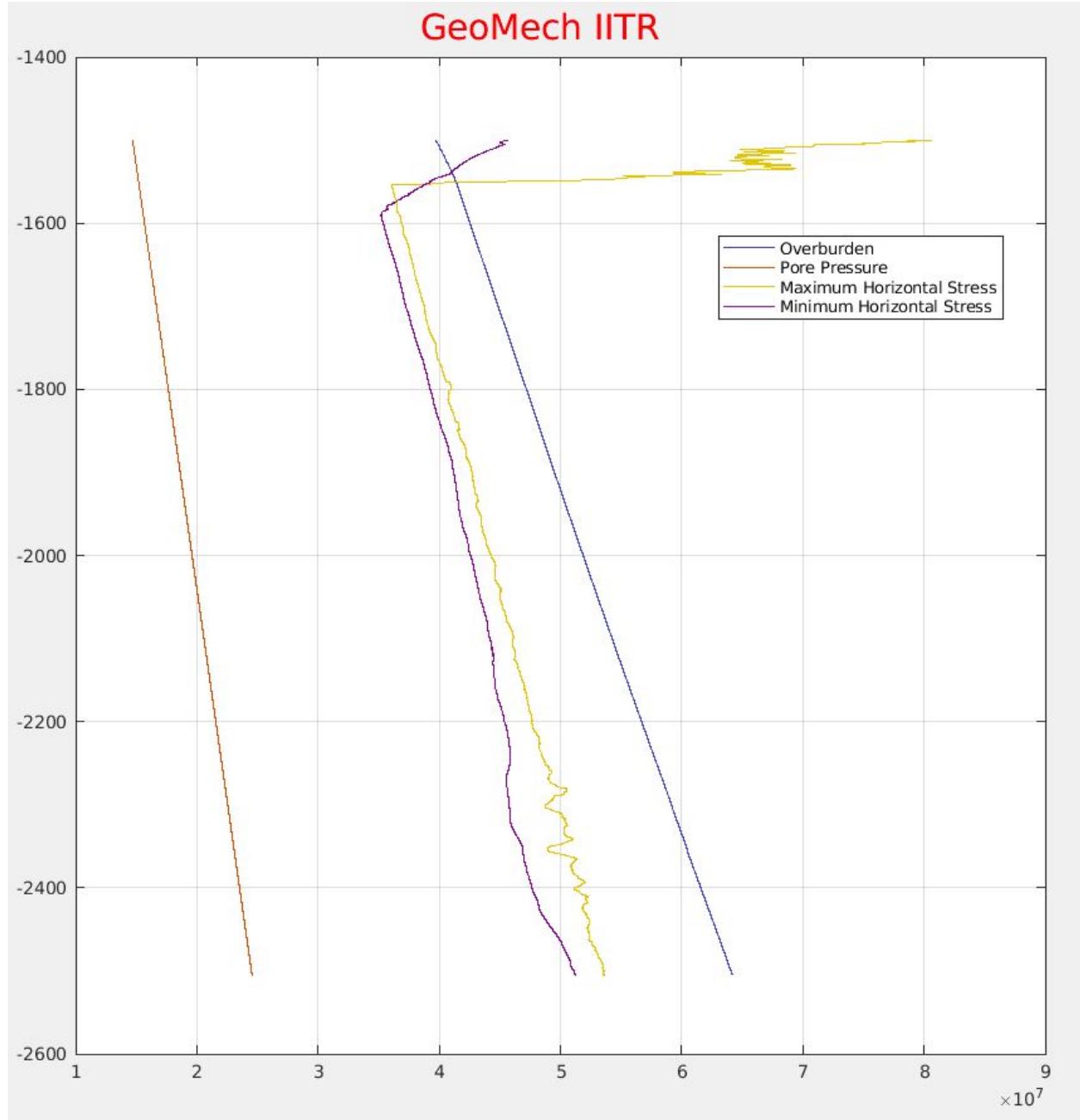




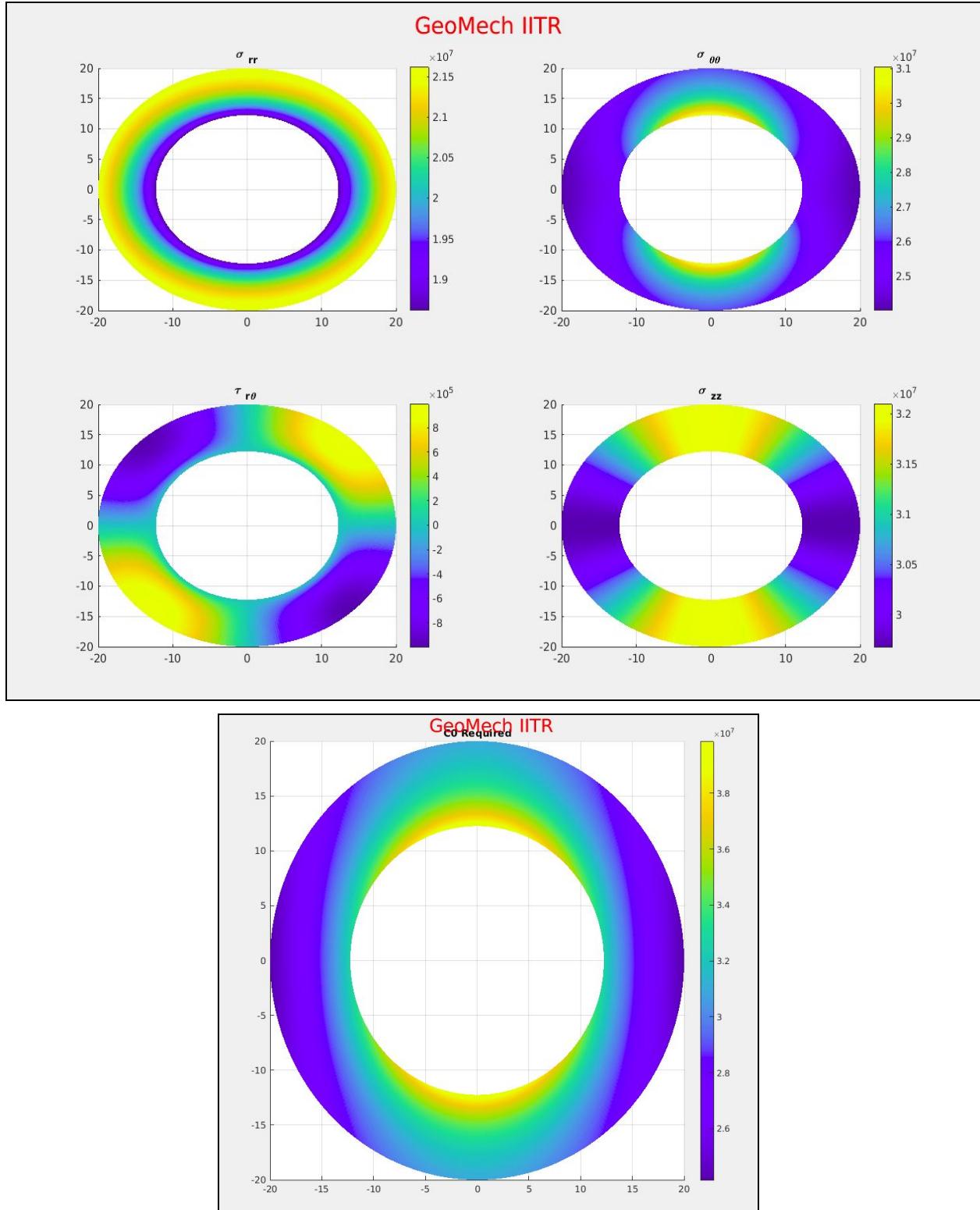
Create Lithology



Pore Pressure Calculation



Overburden and Horizontal Stress



Stress in Cylindrical Borehole and Maximum C0 required Calculation

Getting Started with GeoMech IITR

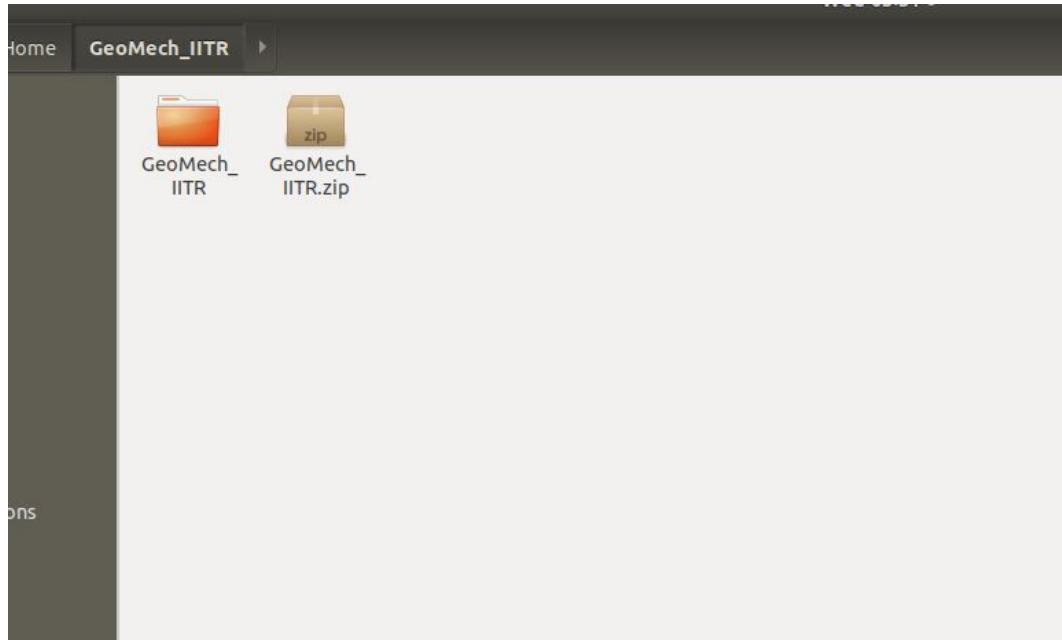
GeoMech IITR application can be forked and downloaded from
https://github.com/singhsatyampratap/Geomec_ESC_IITR

There are more than 60 in-built functions in the folder with GeoMech_IITR as the function. The aim of this software is to provide a platform for standard well log interpretation with prime focus on geomechanical modeling. It may be used for a number of other applications ranging for standard well log interpretation, petrophysics, reservoir characterisation etc.

GeoMech IITR gives you freedom to model and create anytype synthetic log. Its equation modeler even allows the use of a different set of equations on different lithologies/well sections. GeoMech IITR platform is quite handy as it can be used both as GUI application as well as general programming based application. The inbuilt functions are created such that it can be easily used in matlab to compute and perform advanced analysis using Matlab Toolbox.

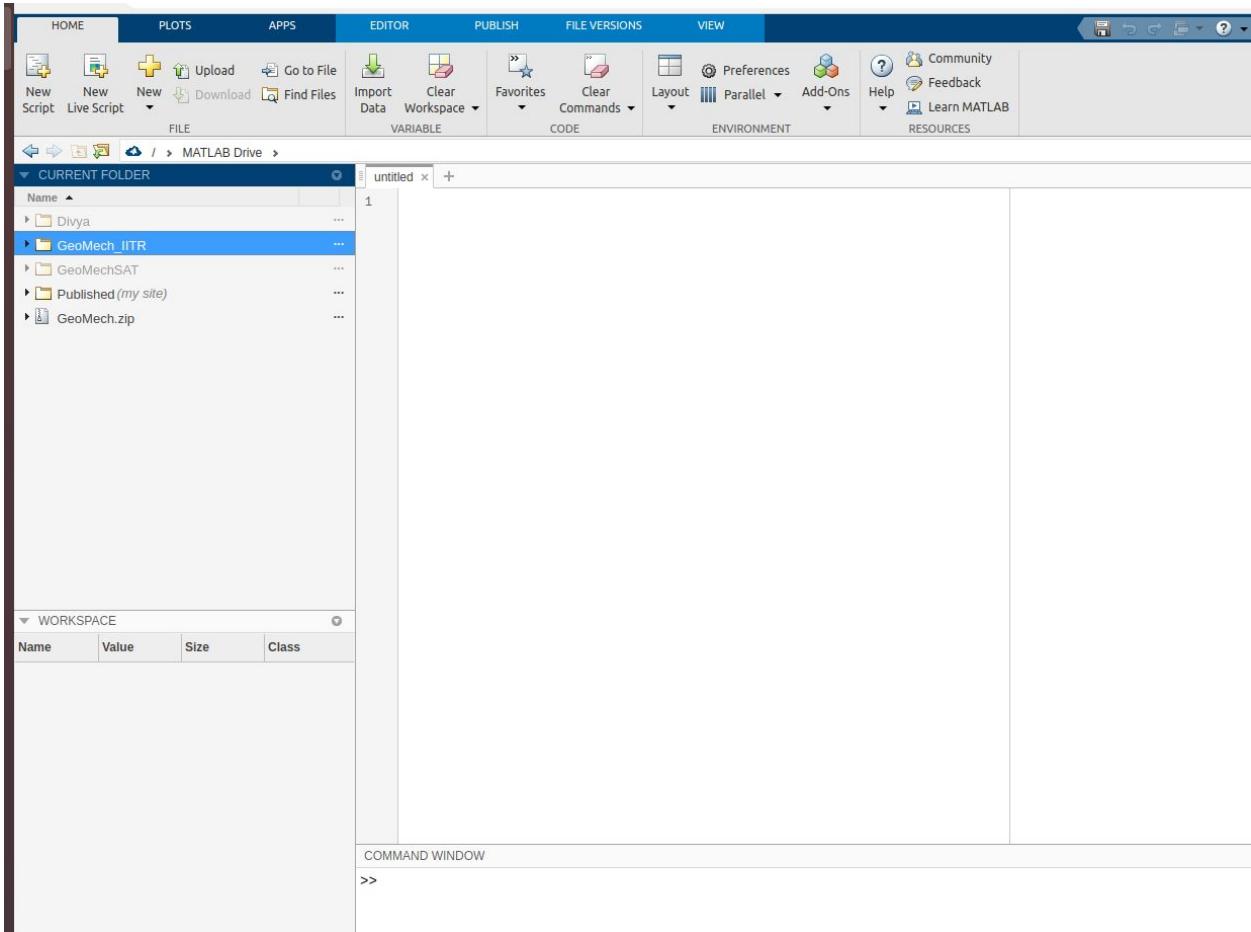
Step to Start GeoMech IITR

1. Downloaded the GeoMech IITR zip file
2. Extract the file.

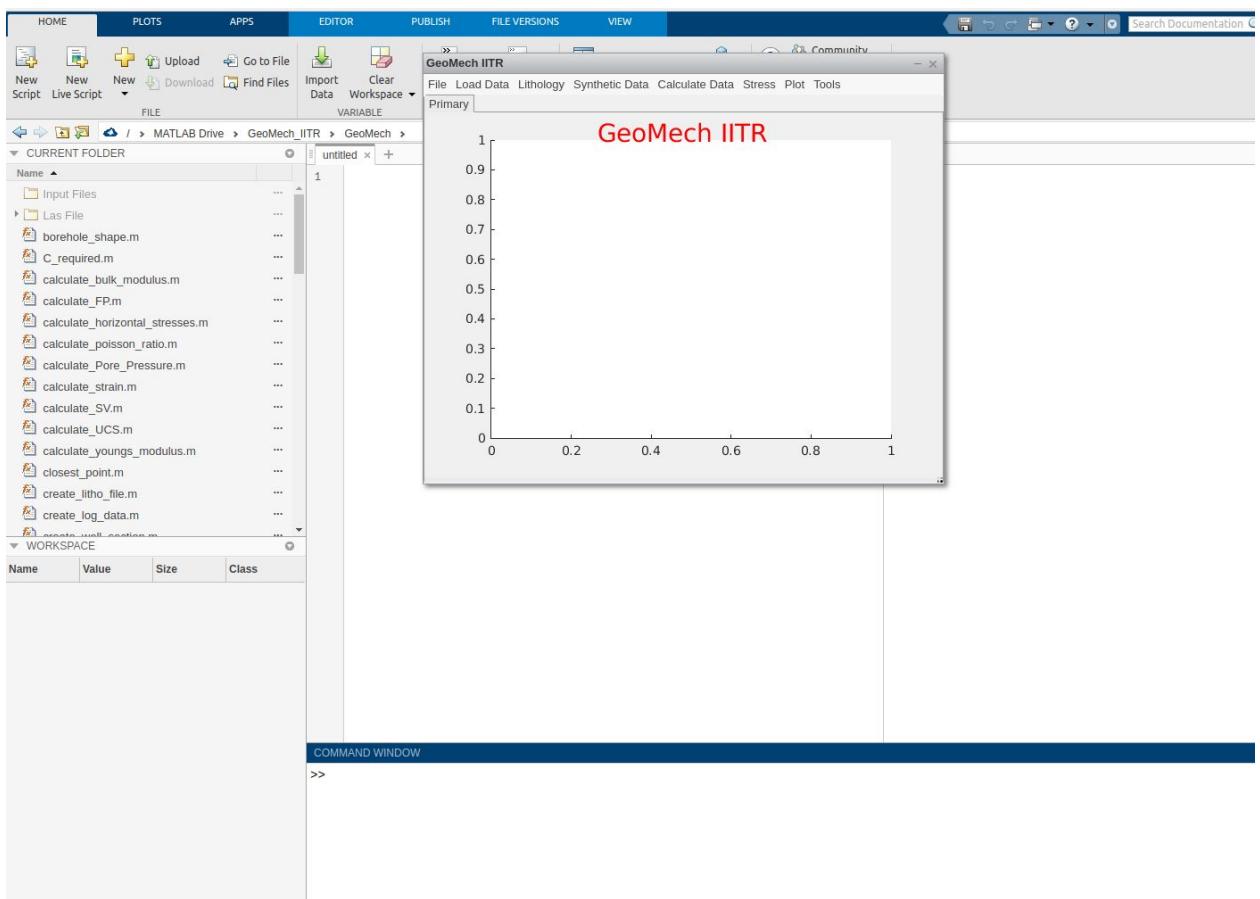


3. Start MATLAB and copy the GeoMech_IITR folder

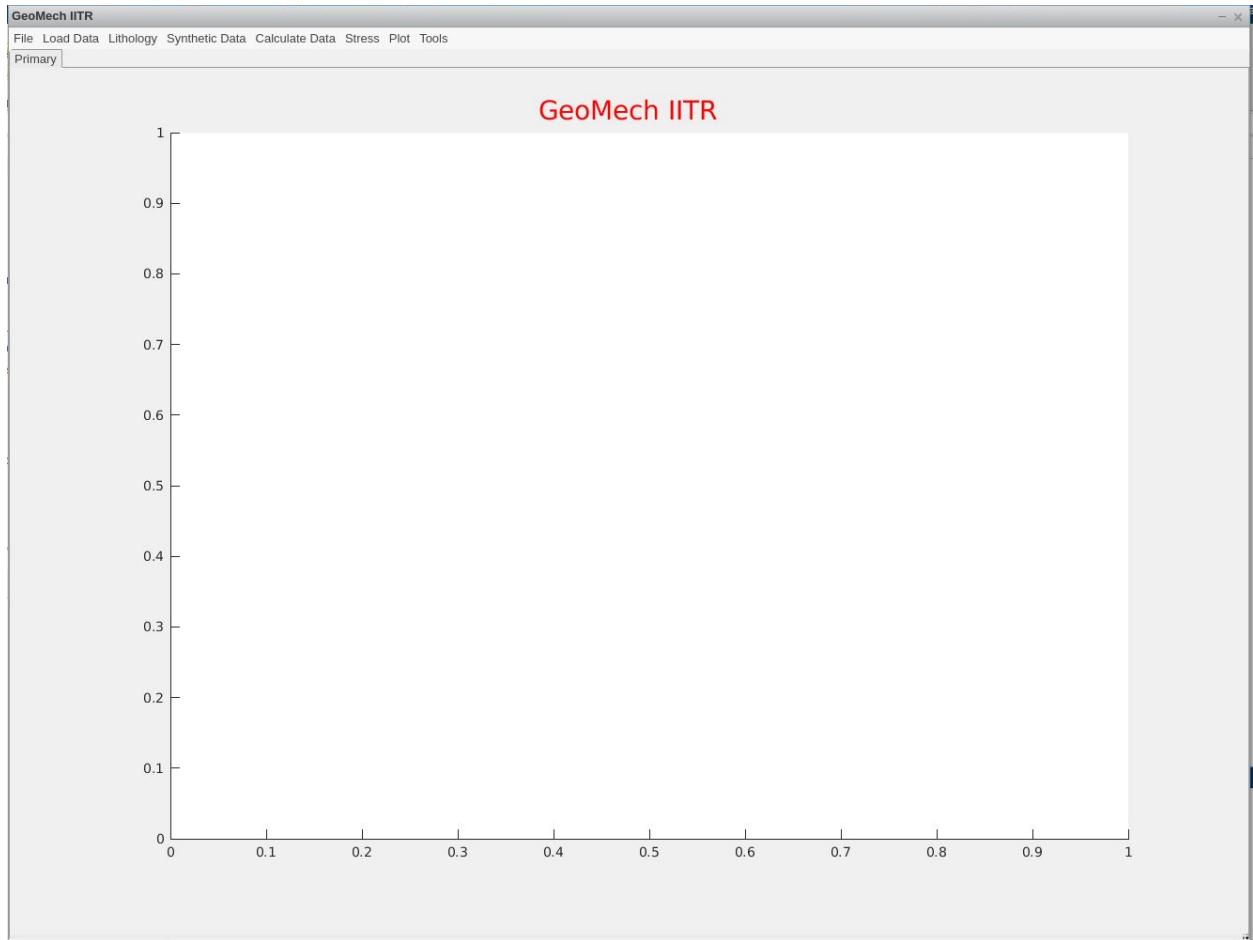
4. Paste the GeoMech_IITR folder current folder



5. Open the Folder (you will see various function of GeoMech IITR)
6. Run GeoMech_IITR in Command Window



Starting window of GeoMech IITR



It has three component : Plotting area, Menu Bar and Tab

Menu Bar Description

File

1. New : to get started with new window
2. Create Data from LAS: generate two file(.xlsx and .txt which is used in the GeoMech IITR application
3. Import Data File: Used to import data files to the application window.
4. Save as JPG: save the current plots as JPEG image
5. Clear Screen: Reset the plotting area
6. Add Tab:Adding tab in current window
7. Exit: exiting the GeoMech IITR application

Load Data

Load the different log data as log.logname. For eg Density will be loaded as log.Density

1. Density: Loads Density as log.Density
2. Borehole Shape:Loads borehole shape as log.BS which can be used for 3d visualization.
3. dtco: Loads dt and Vp data as log.dtco and log.VP
4. dtsm: Loads dtsm and Vs data as log.dtsm and log.VS
5. GR: Loads GR log as log.GR
6. Resistivity: Loads multiple Resistivity data.
7. Fluid: Loads data as Fluid Density and DT which can be used for porosity calculation.
Allows to use different values for different well section/formation.
8. Load other log data: Loads other log data like SP, NPHI, CALI etc

Lithology

1. Create Lithology Data: used to interpret different log data and create a txt file containing lithology data
2. Load Lithology Data: Load Lithology Data as log.litho

Synthetic Data

1. Create synthetic log: a) Constant log data using lithology/well section b) using equation modeler
2. Density: create synthetic Density log using VP log based on Gardener Equation

3. VP :create synthetic VP and dtco log using Density log based on Gardener Equation
4. VS:create synthetic VS and dtsm log using VP log based on Greenberg and Castagna Relation
5. Poisson Ratio using Lithology: create a poisson ratio based on value for different lithology type

Tutorials

Creating data files from LAS file.

Note: You will need SeisLab

(<https://in.mathworks.com/matlabcentral/fileexchange/53109-seislab-3-02>) for creating data files for GeoMech IITR. This can be downloaded from the link above.

To run SeisLab functions, copy folder S4M to your computer and add it and its subfolders to your Matlab path (please note that folders that start with "@" are class directories and need not be included explicitly in the Matlab path; Matlab will find them anyway; the same is true for "private" folders).

The screenshot shows the MATLAB interface with the following details:

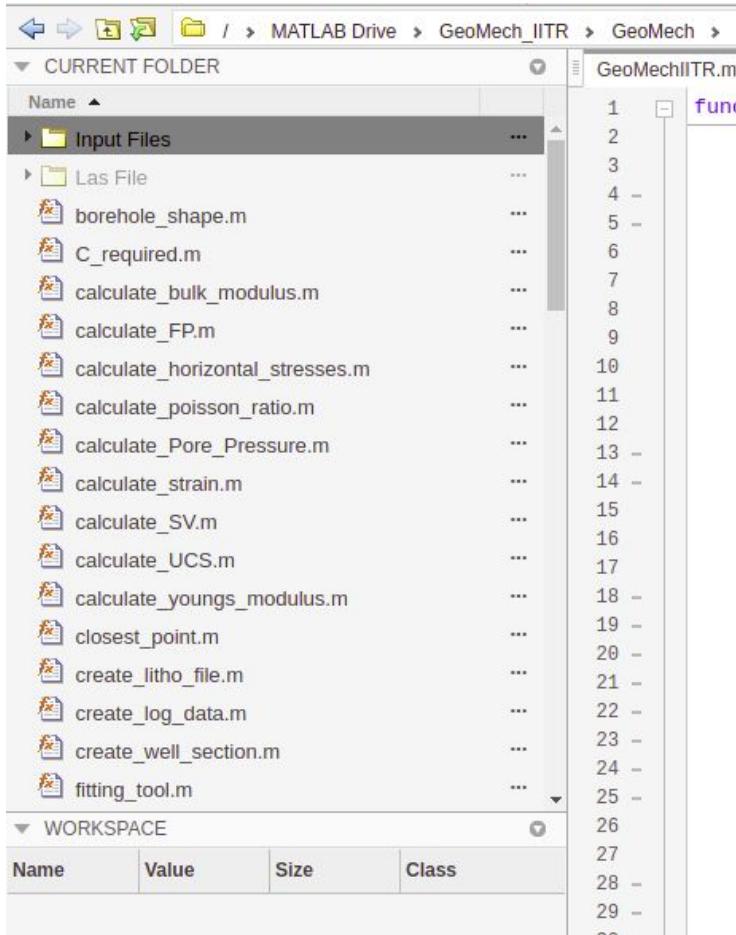
- Top Bar:** Script, Live Script, FILE, VARIABLE, Commands, ENV.
- Path Bar:** MATLAB Drive > GeoMechSAT > Seislab Function > SeisLab 3.02 > SeisLab 3.02 >
- Current Folder Browser:** Shows a folder named 'S4M' containing files: ACKNOWLEDGEMENT, Description.txt, license.txt, README.txt, S4M_3p014PD.pdf, and What is new in SeisLab. A context menu is open over the 'S4M' folder with options: Open (highlighted), Enter, Rename (F2), Create Zip File, Delete (Delete), New, Share, Indicate Files Not on Path, Add to Path, Cut (Ctrl+X), Copy (Ctrl+C), and Paste (Ctrl+V).
- Editor:** The code for 'read_las_file.m' is displayed. The code reads LAS files and performs some preprocessing. The 'clean_up_well_log' function is highlighted.

```

112 -         else
113 -             error(['Unknown LAS-file ve
114 -                 end
115 -             end
116 -         else
117 -             error(['The file specified, "',f
118 -                 end
119 -             %
120 -             Remove unnecessary fields
121 -             wlog=clean_up_well_log(wlog);
122 -
123
127 -     % Remove certain text fields i
128 -     %     is "unknown".
129 -
130 -     fields={'wellname','country','county'
131 -             'location','field','company'
132 -
133 -     lfields=length(fields);
134 -     bool=false(1,lfields);
135 -
136 -     for ii=1:lfields
137 -         try
138 -             txt=wlog.(fields{ii});
139 -             if isempty(txt) || ~isempty(fi
140 -                 bool(ii)=true;
141 -             end
142 -         catch

```

- Unzip GeoMech IITR and copy all the files
- Paste it in the current matlab folder.
- You will see all the functions copied to current folder as follow

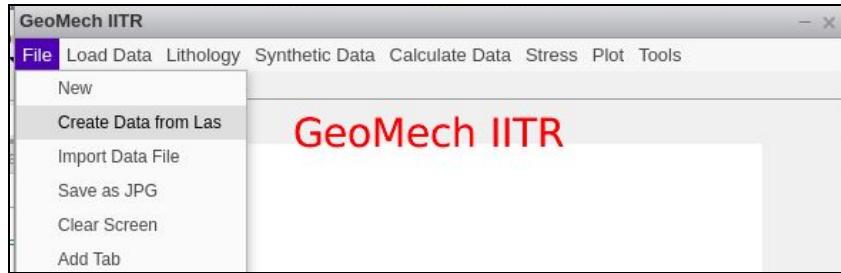


- Now Go to matlab command window and Type **GeoMechIITR**

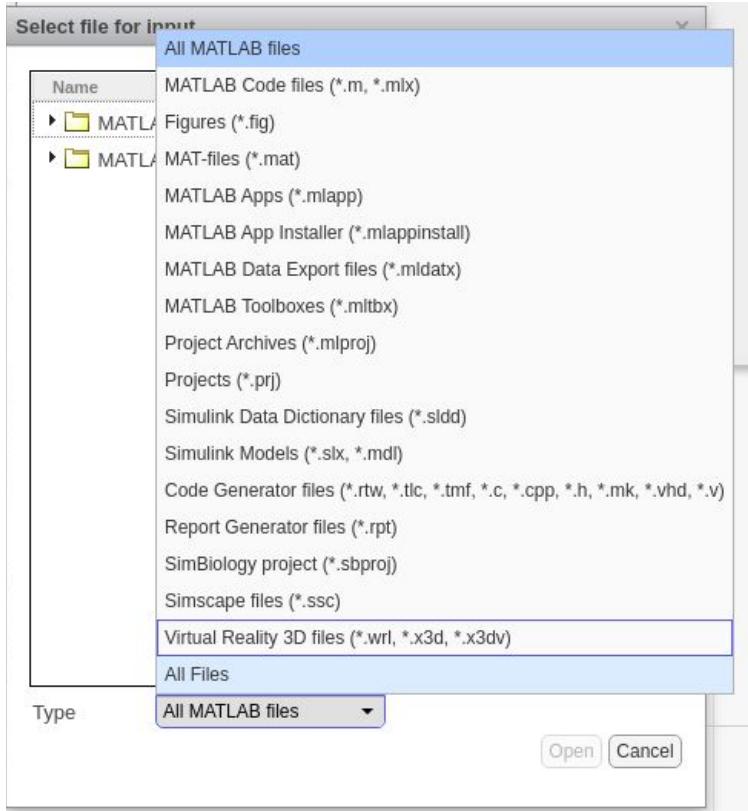
The screenshot shows the MATLAB Command Window. The title bar says 'COMMAND WINDOW'. The window contains the command '=> GeoMechIITR|'.

- This will start GeoMech IITR and now you are ready to work on it.

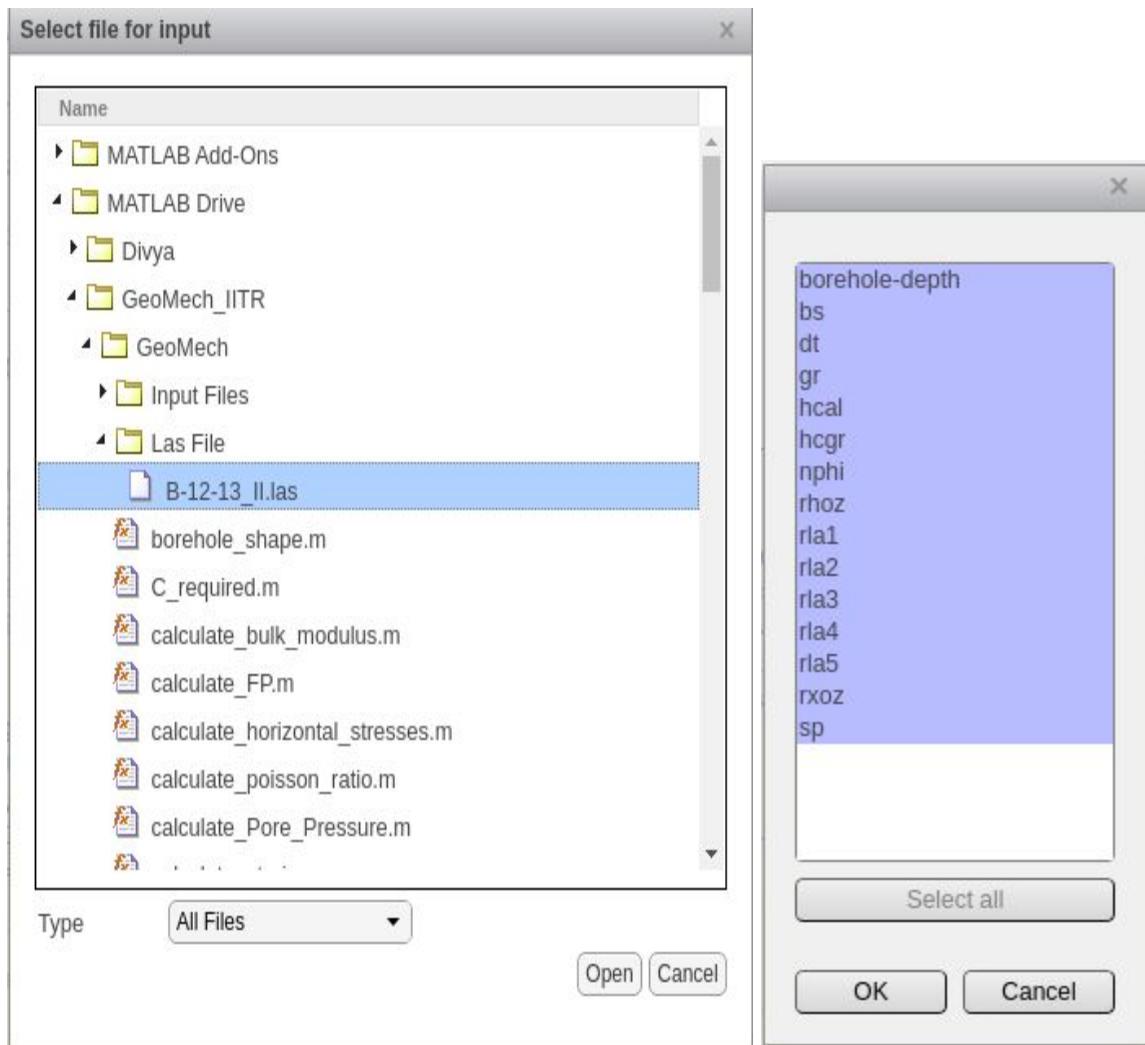
- Now to create data files from LAS files.(Data files are two files that are currently supported by GeoMech IITR 1. '.xlsx' file: contains log data 2. '.txt' file: contains information about log type)
- Go to File> Create Data from LAS



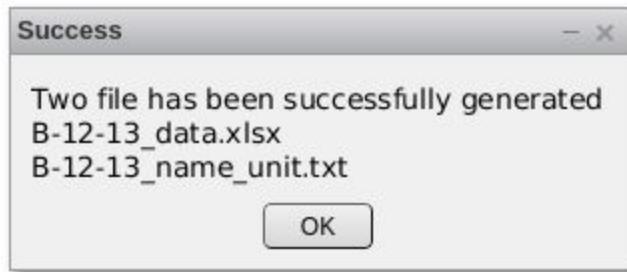
- Now a terminal will open first select the type of file to ALL MATLAB files as it may not show the .LAS file format



- Go to the file location of the LAS file and open the file
- Select all the data that log contains of those that are relevant for you

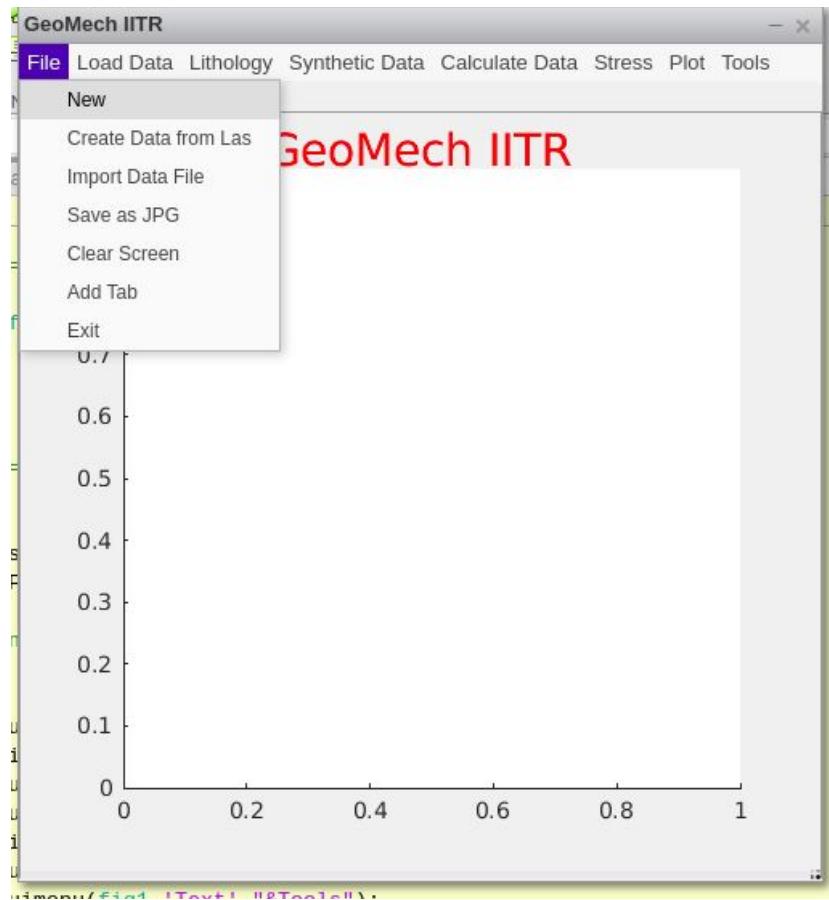


- Click on okay this will create two file (.xlsx and .txt)



Importing Data to GeoMech IITR

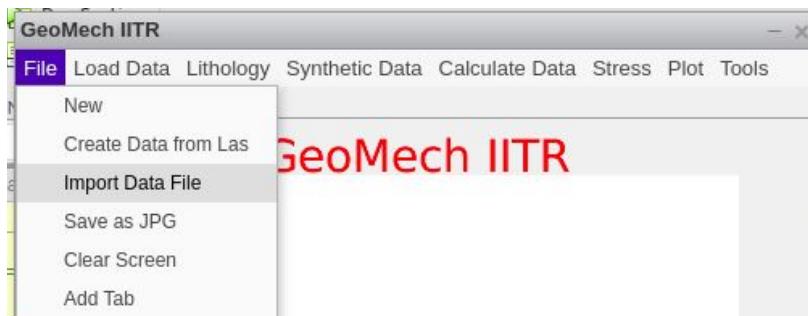
- To start working on GeoMech IITR you will need to import data from the two file you have created from las data
- To get started, Go to File> New



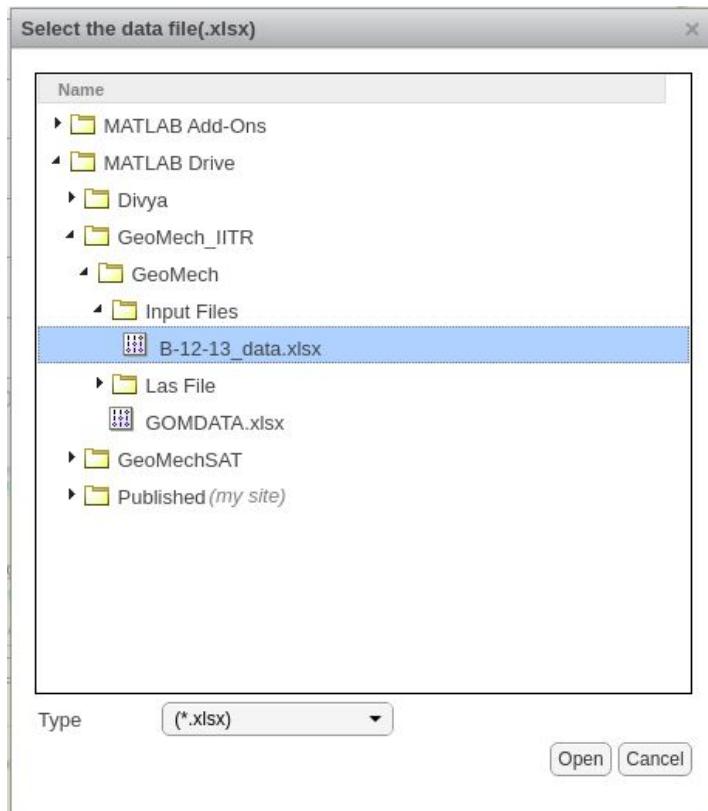
- If successfully a new file will be create and you will receive following message



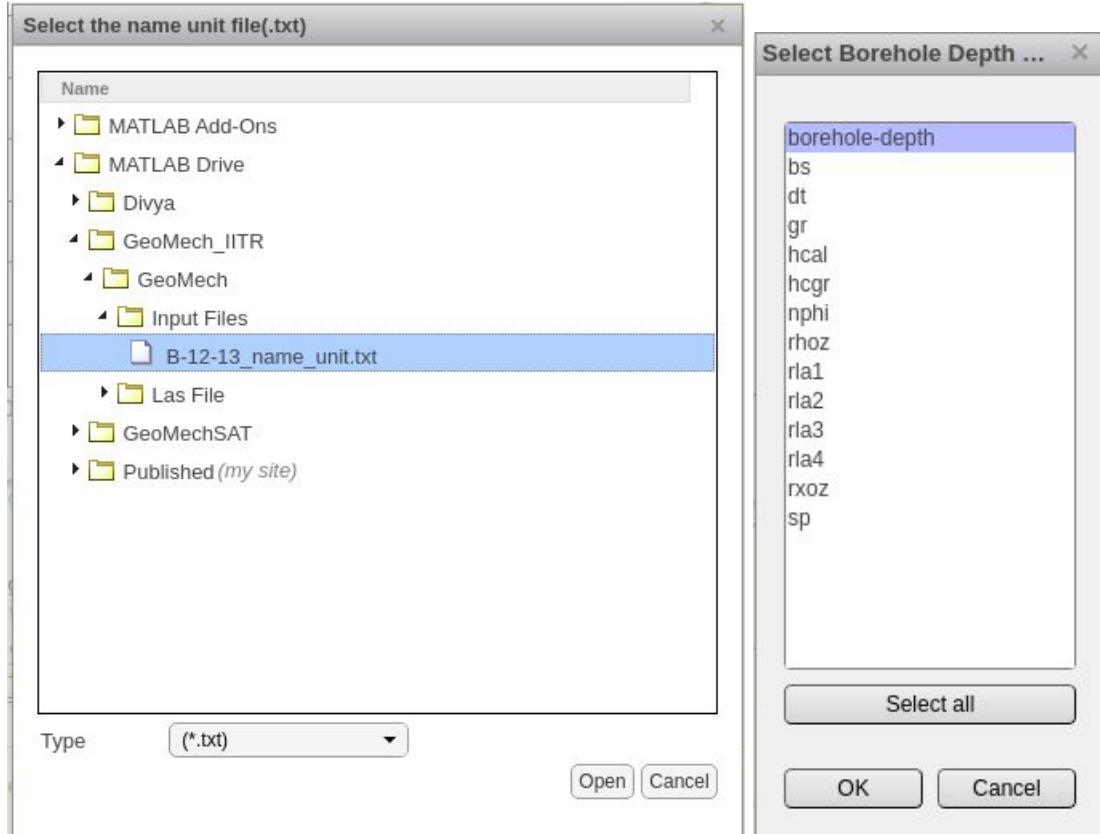
- To Import the data to the application, Go to File > Import Data File



- File Select the .xlsx file(the one containing all the log data)



- Then Select the .txt file that contains information about log type.
- Next is to select the Borehole Depth file.



If successful, the following window pop up showing the process is successful.



Loading log Data to GeoMech IITR

Before starting any analysis or plotting make sure that you have loaded relevant data using our load data menu. Although you can directly jump to any type calculation and plotting GeoMech IITR will guide you through but it is not recommended because there may be trouble for loading it again and again. There are inbuilt load functions which are necessary for different type of analysis and calculation in GeoMech and there are **other log** data functions to load any other type of data that is not defined in our libraries.

Inbuilt load function

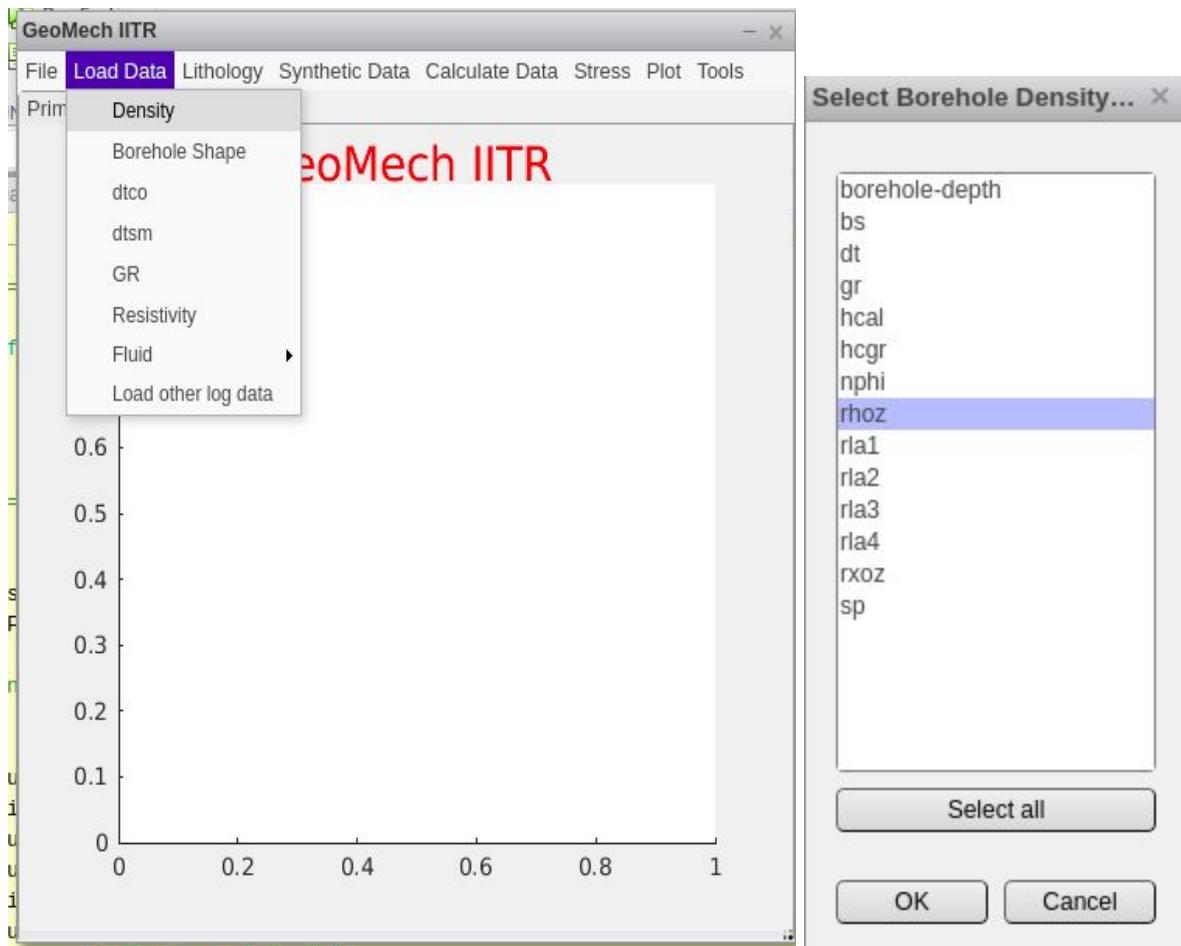
1. Density
2. Borehole Shape
3. dtco
4. dtsm
5. GR
6. Resistivity
7. Fluid: Density and DT

Loading Data is similar for all inbuilt type load functions. If you want to use GeoMech IITR programmatically the function name are as

`log=load_logtype(log)`

Where input is `log`: a struct (a user defined data type which contains log information and data)
Any data can be easily as `log.logname` for e.g Density can be accessed as `log.Density`

- For loading Density. Go to Load dat> Density
- Select the density log from list

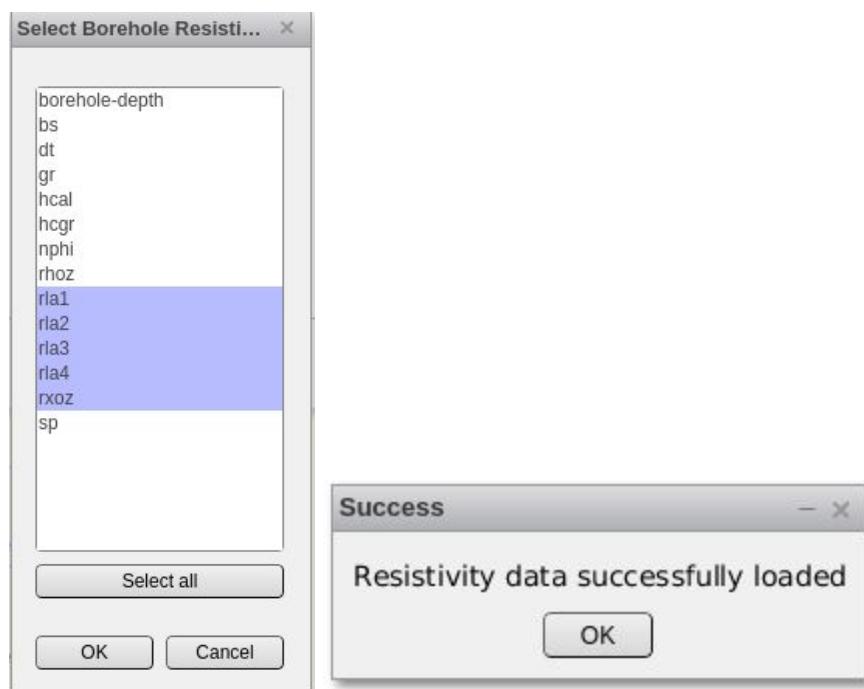
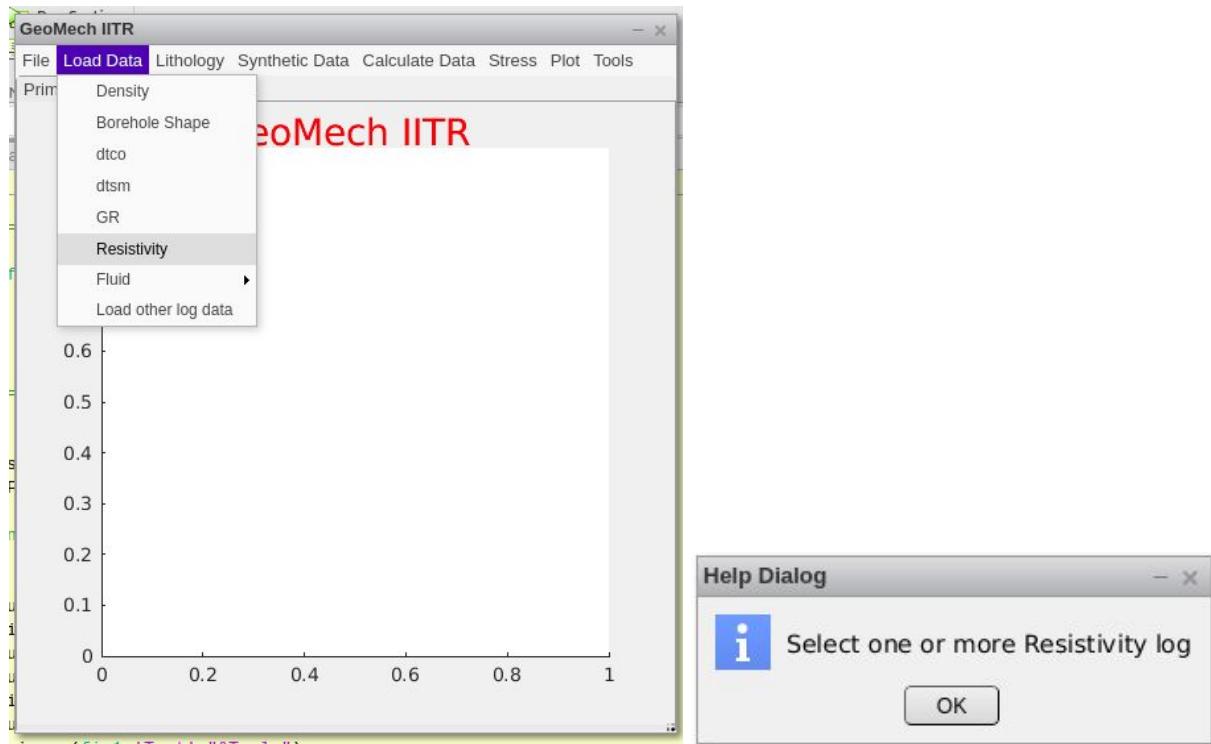


- Density will be loaded as log.Density

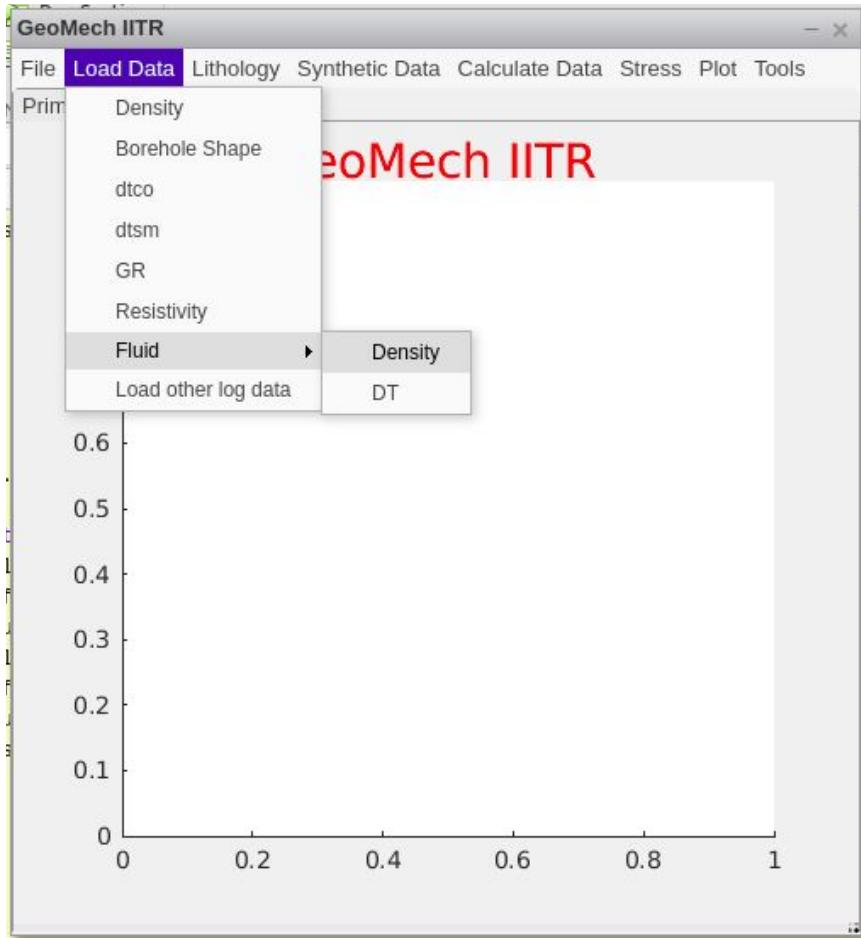


Similarly other data can also be loaded

For e.g In case Resistivity one or data can be simultaneously load as log.resistivitylogname

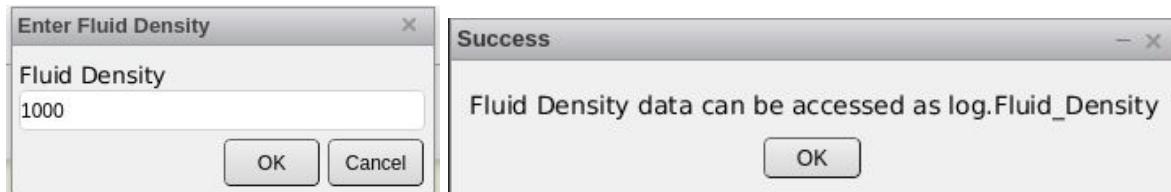


Similarly Fluid Density and Fluid DT is a constant log that can be created. This log may be used in porosity calculation etc.



- So you can use a constant value for the whole log.
- Create a well section defining different type of fluid zone and use it to defining Fluid Density
- To create well section, Go to Tools> create well section



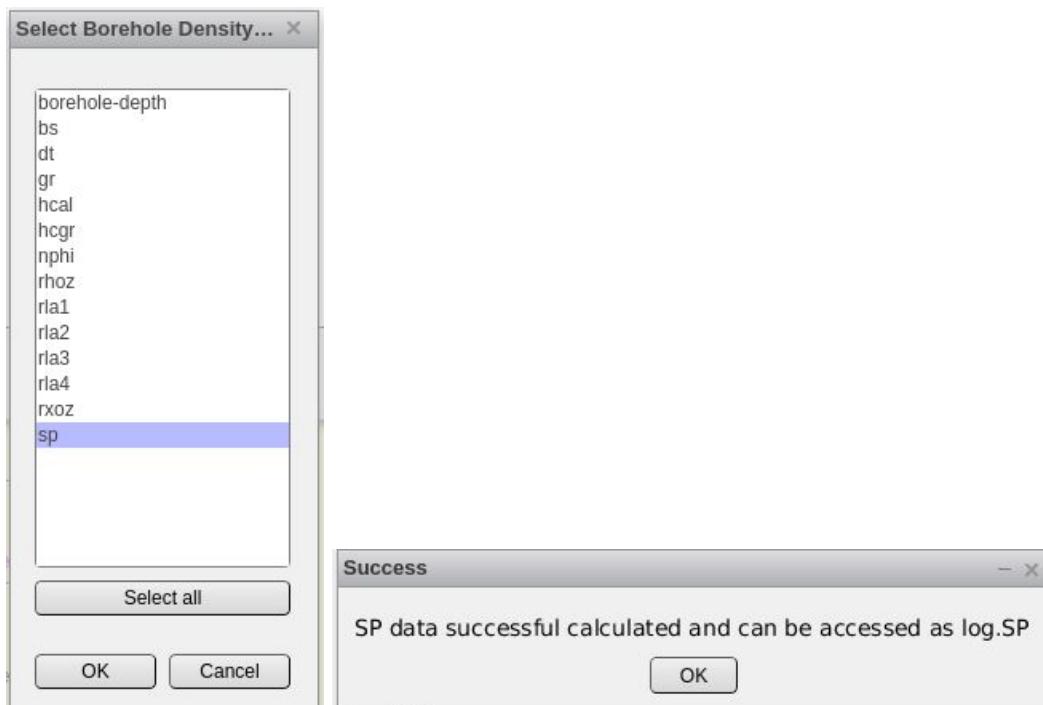


Loading Other Data

- To any other type of data that is not included in our iinbuilt function
- Go to Load Data> Load other log data and enter the log name

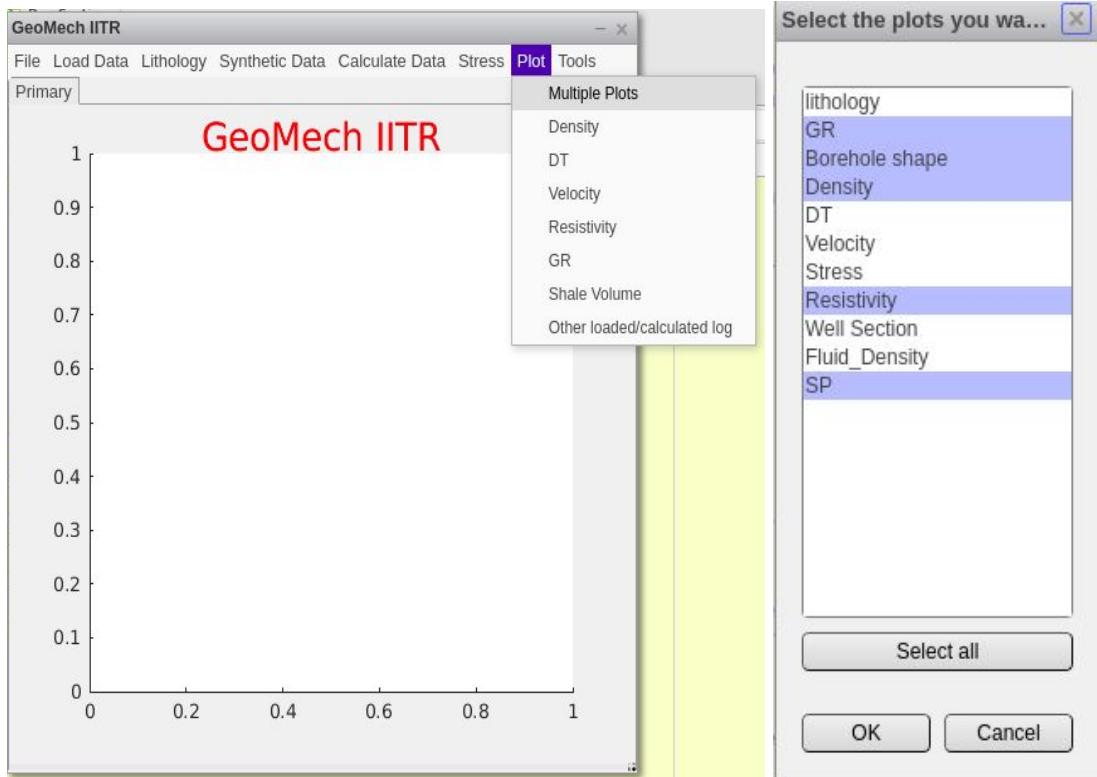


- Select the log from list and your data will be loaded

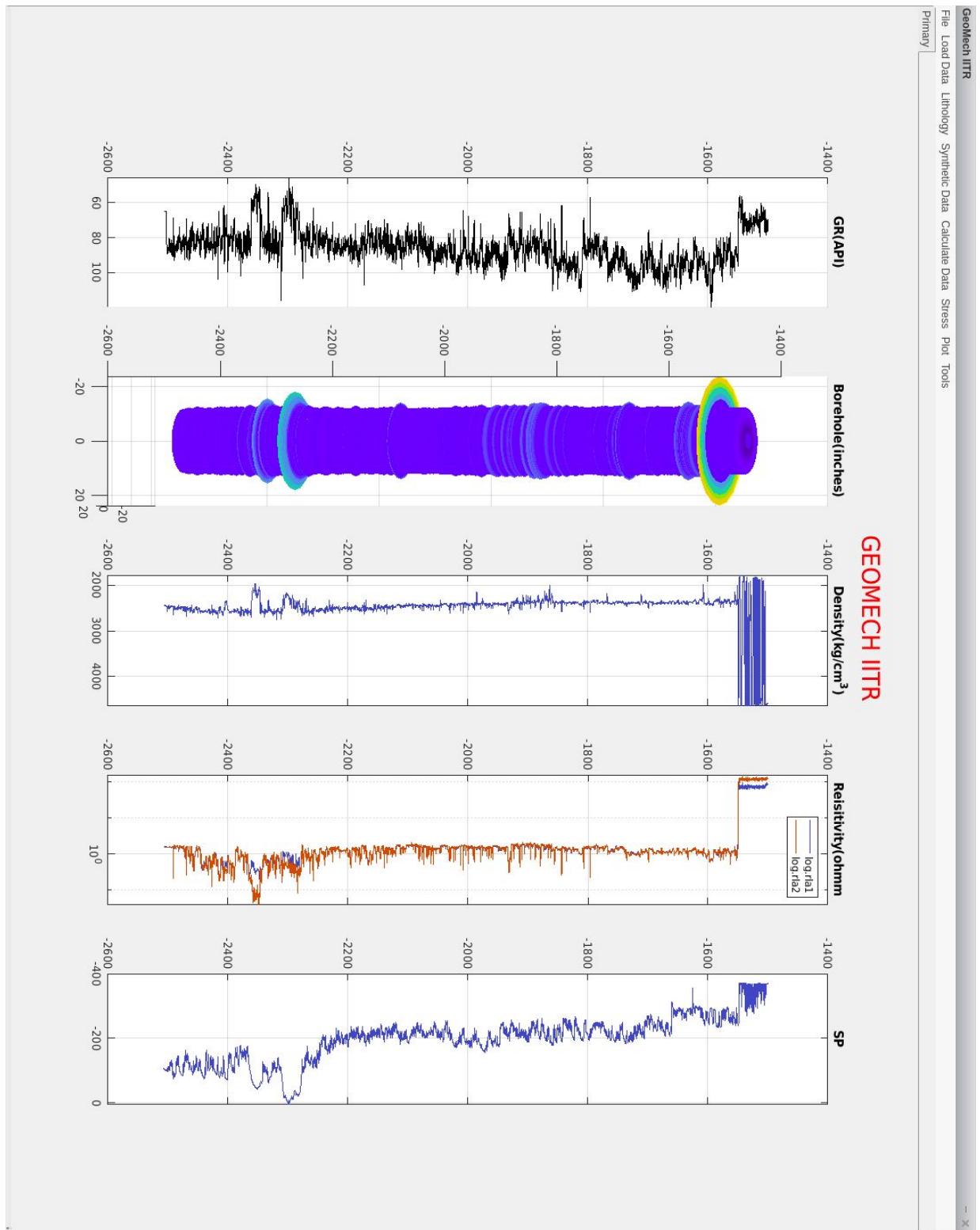


Plotting loaded Data

- To Plot and Visualise the data, Go to Plot> Multiple Plots
- Select all the log that you have already loaded using ctrl+mouse click
- Press Ok

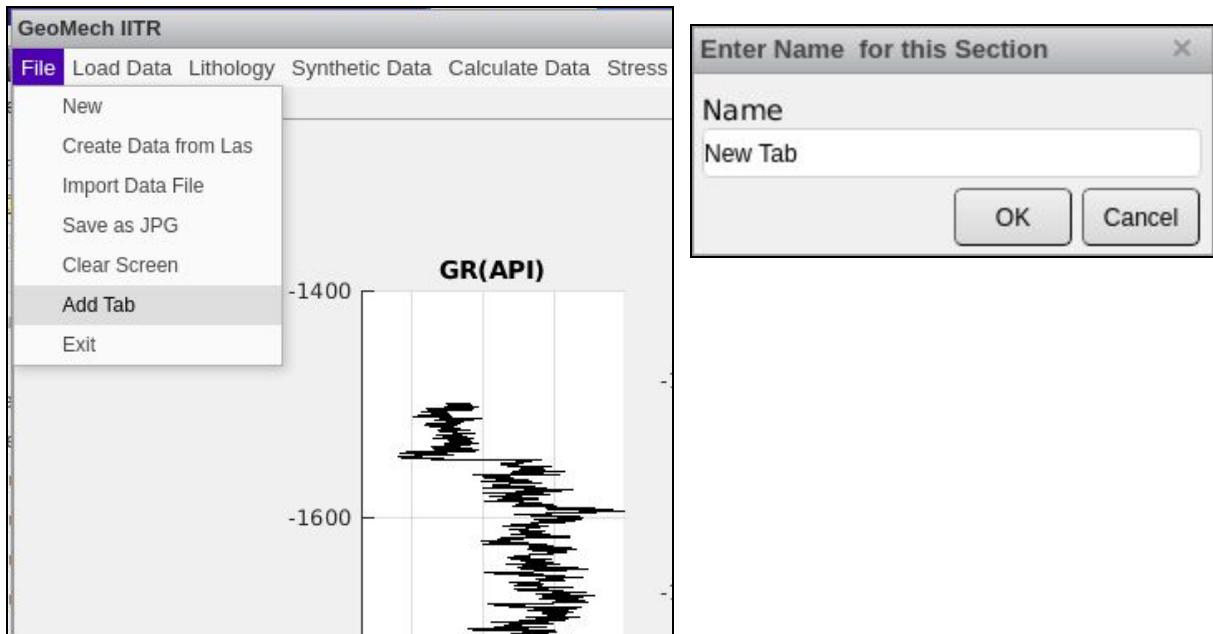


- Plotting tool will guide you through the various option for plotting
- For e.g if you choose Resistivity plot it will let you select which of them to plot



Adding New Tab

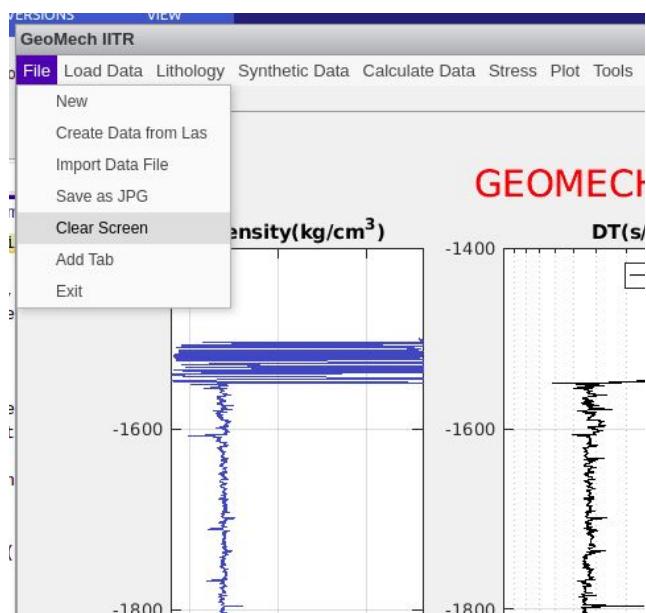
- Go to File > Add Tab
- Enter the tab name



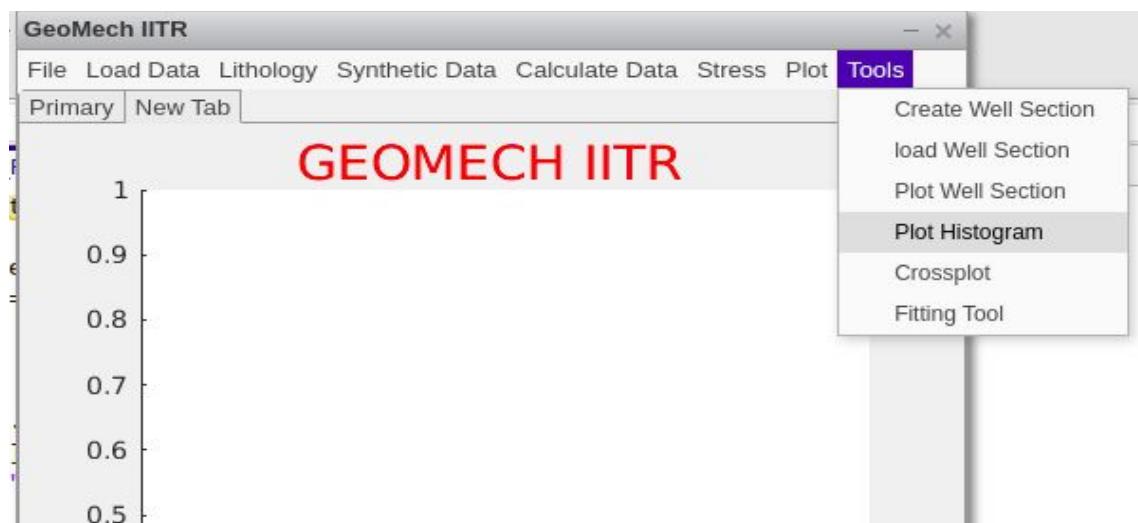
- A New tab will be created for Plotting

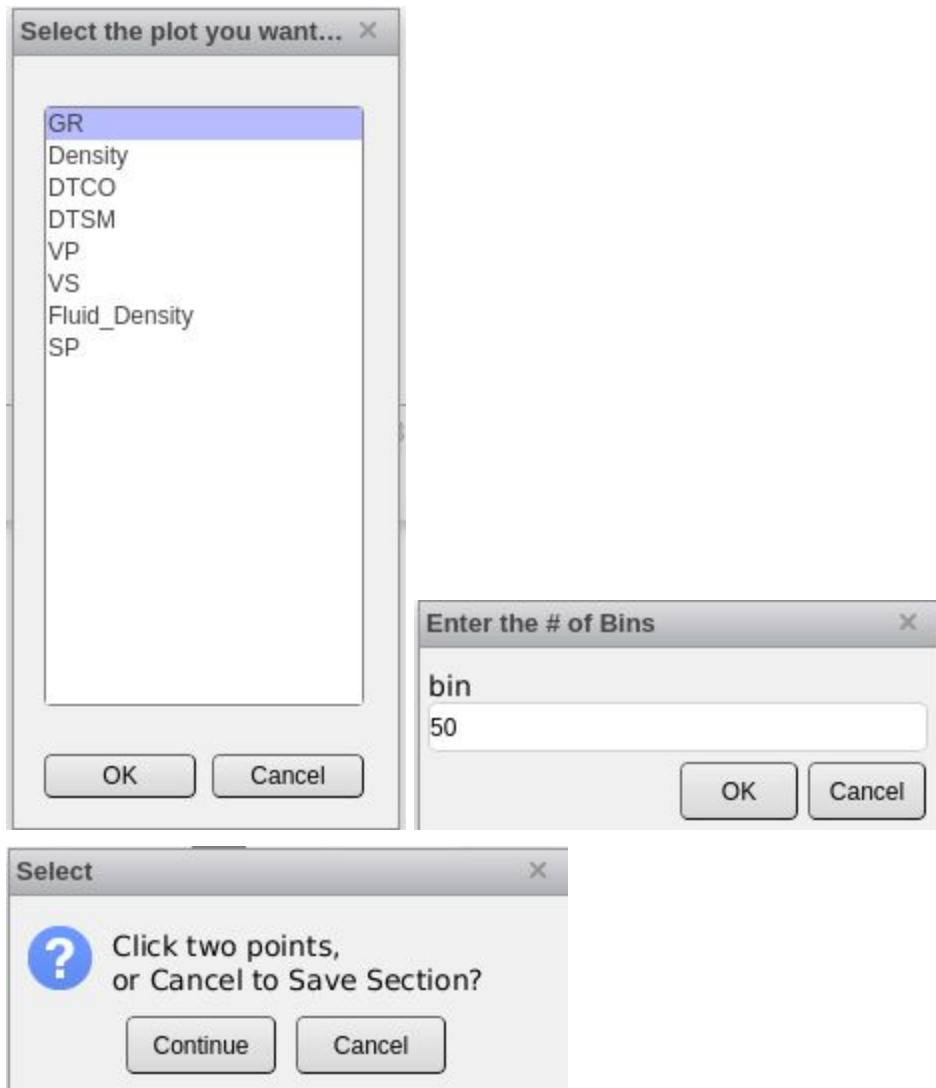


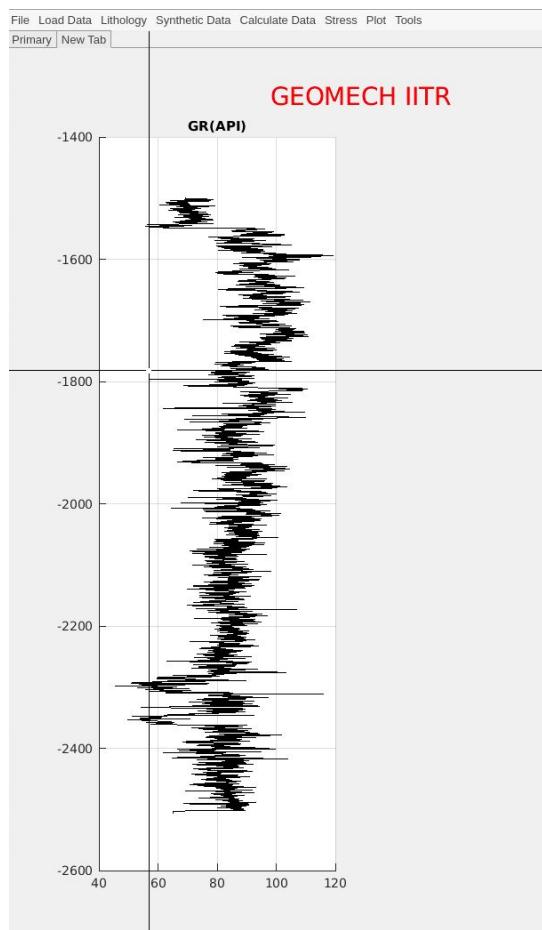
Clearing Screen for new plot

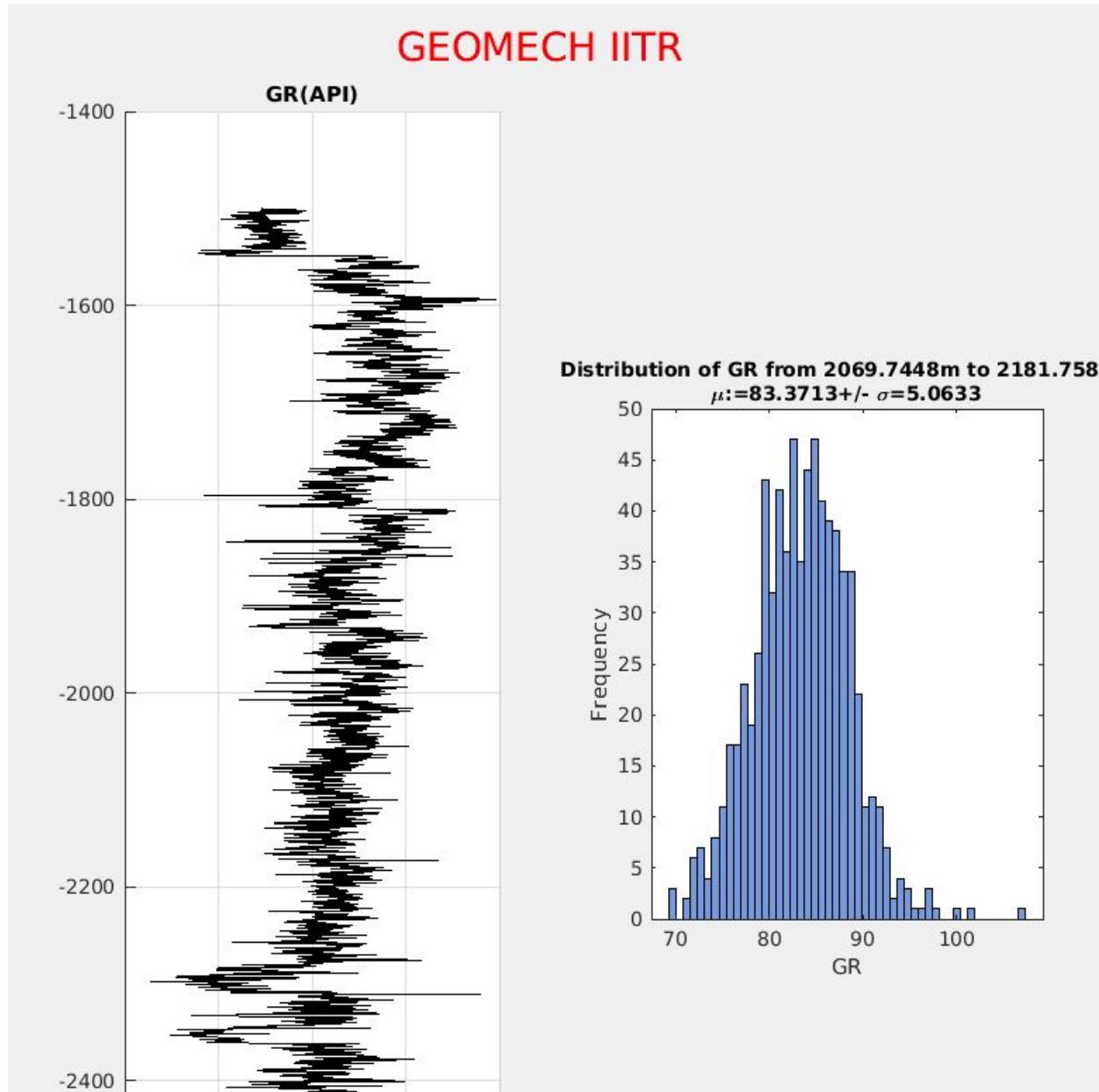


Histograms

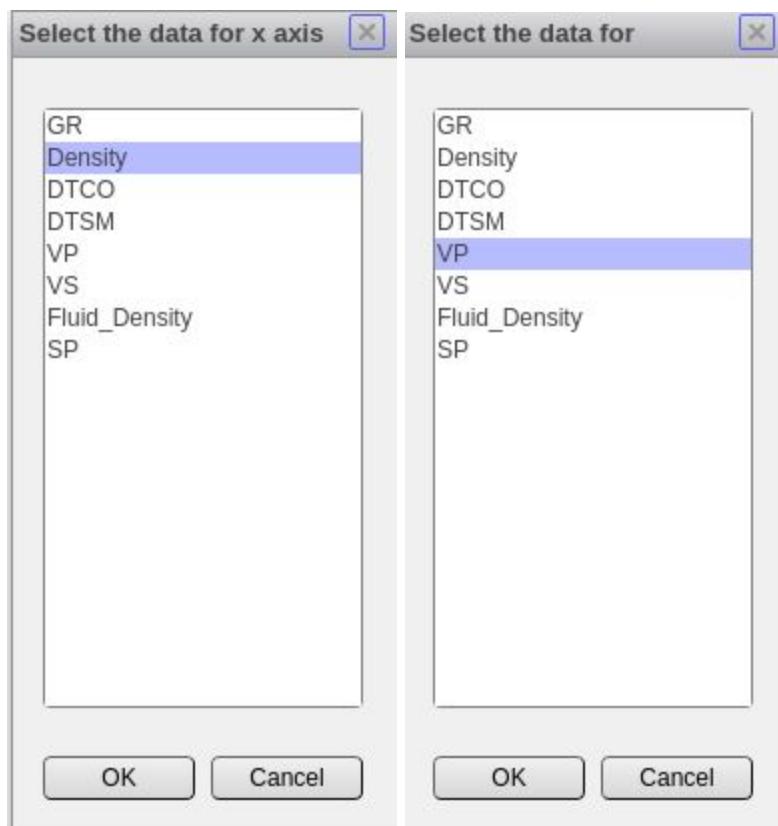
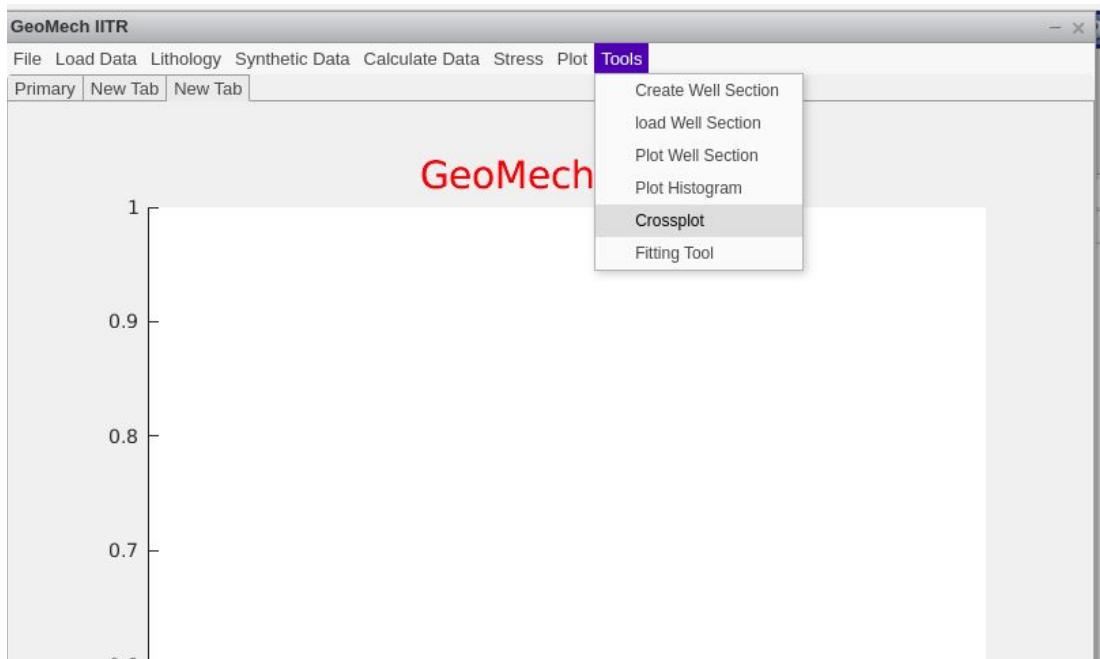


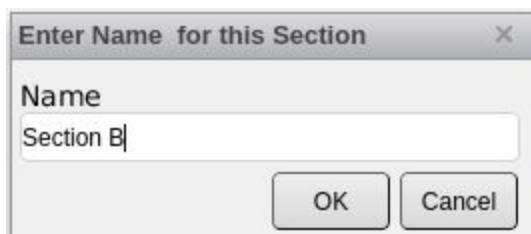
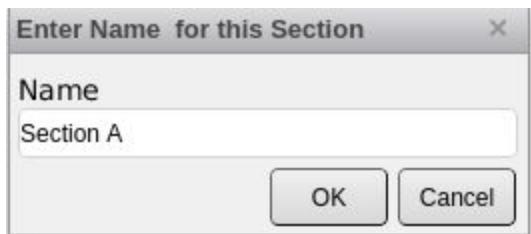


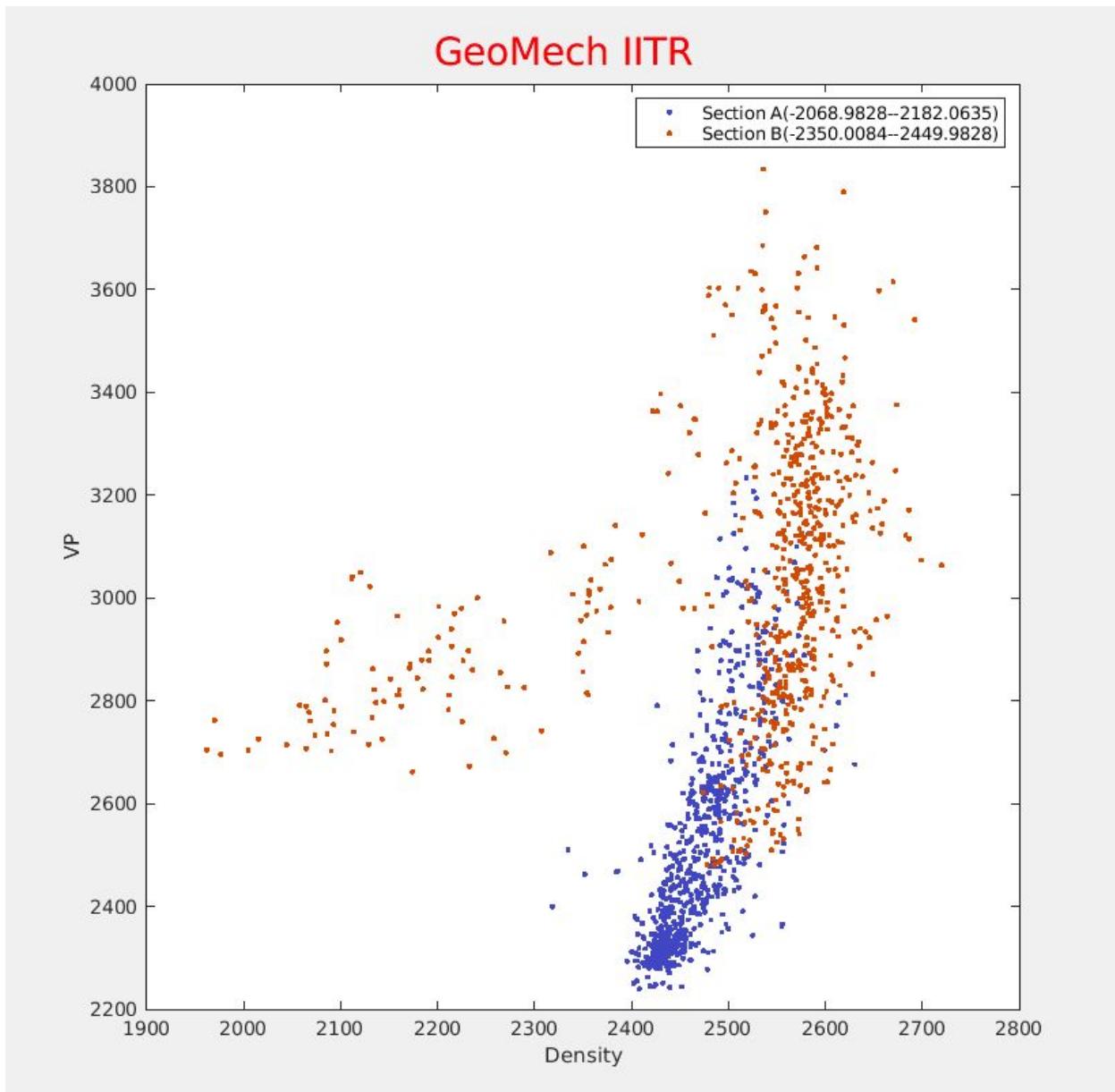




Crossplot

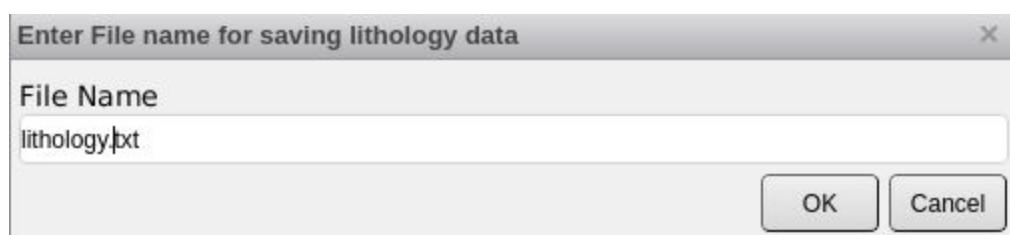
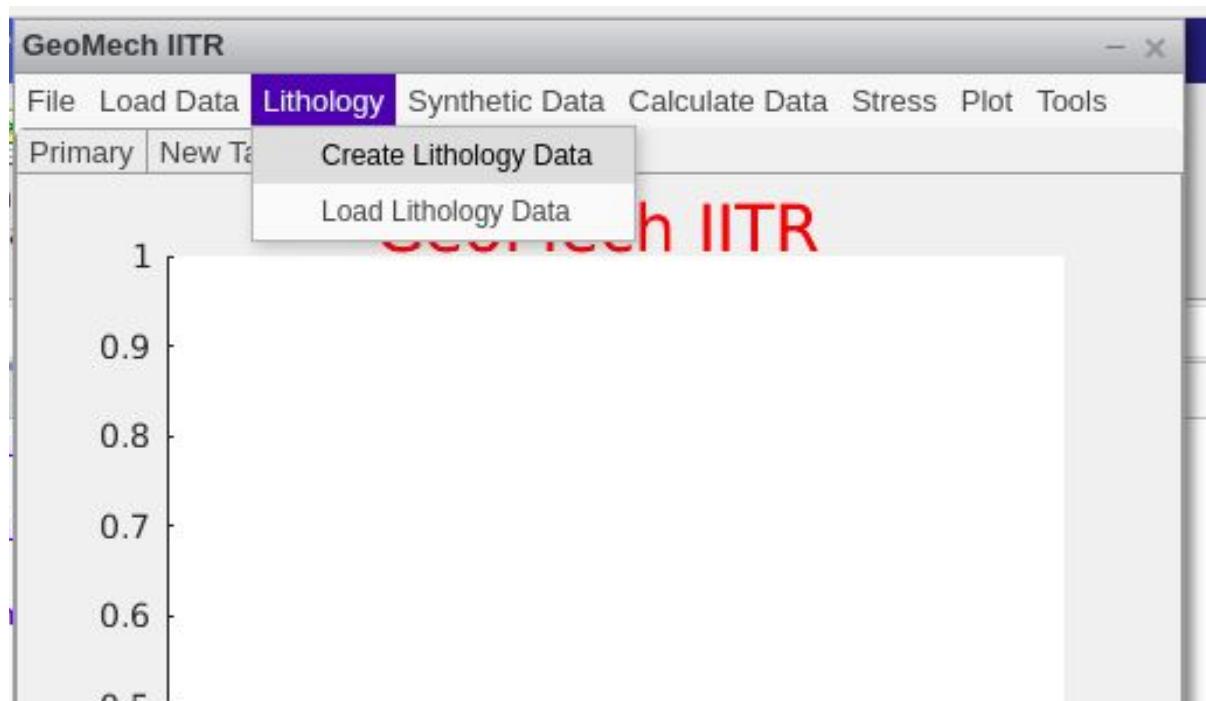


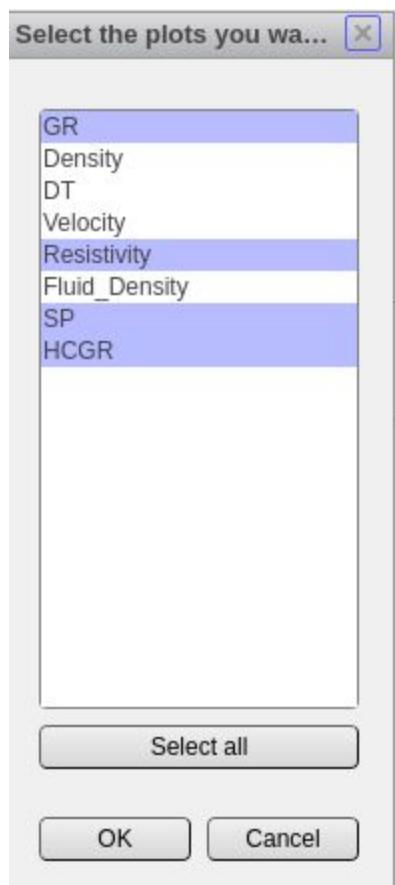


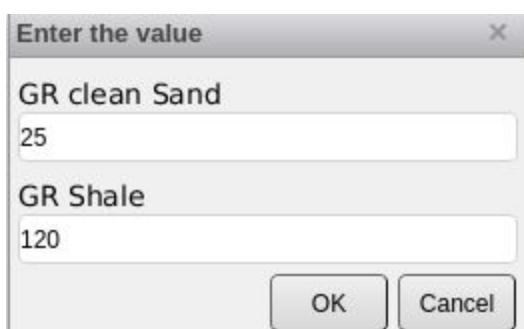


Creating Lithology File

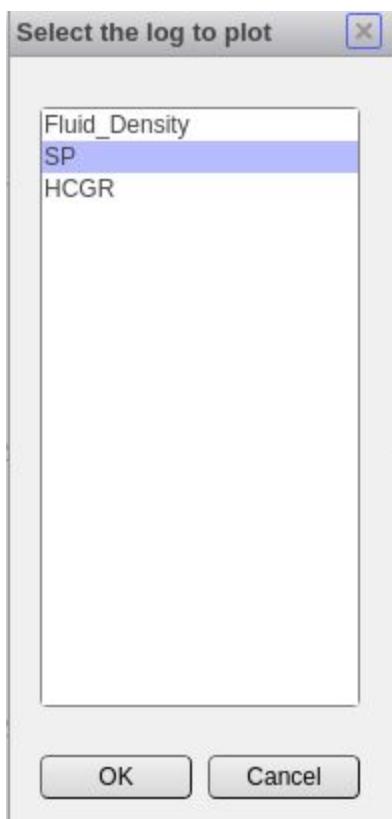
Using GeoMech IITR

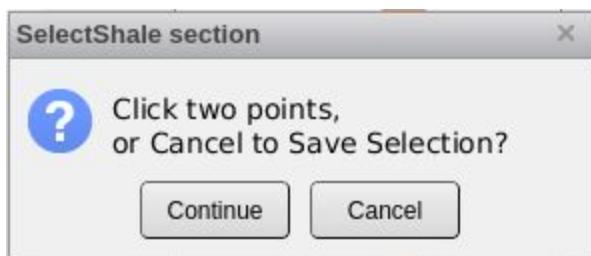


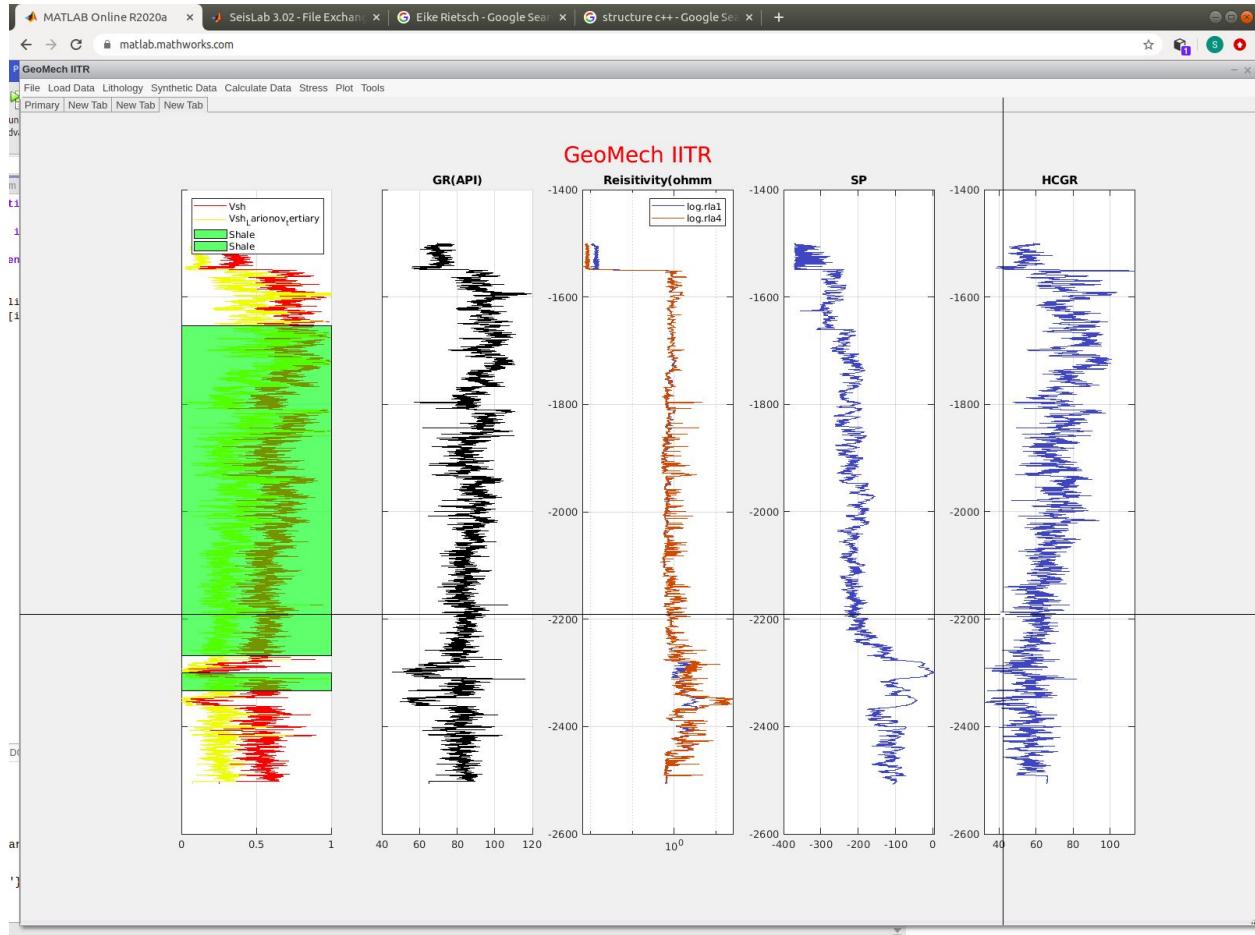


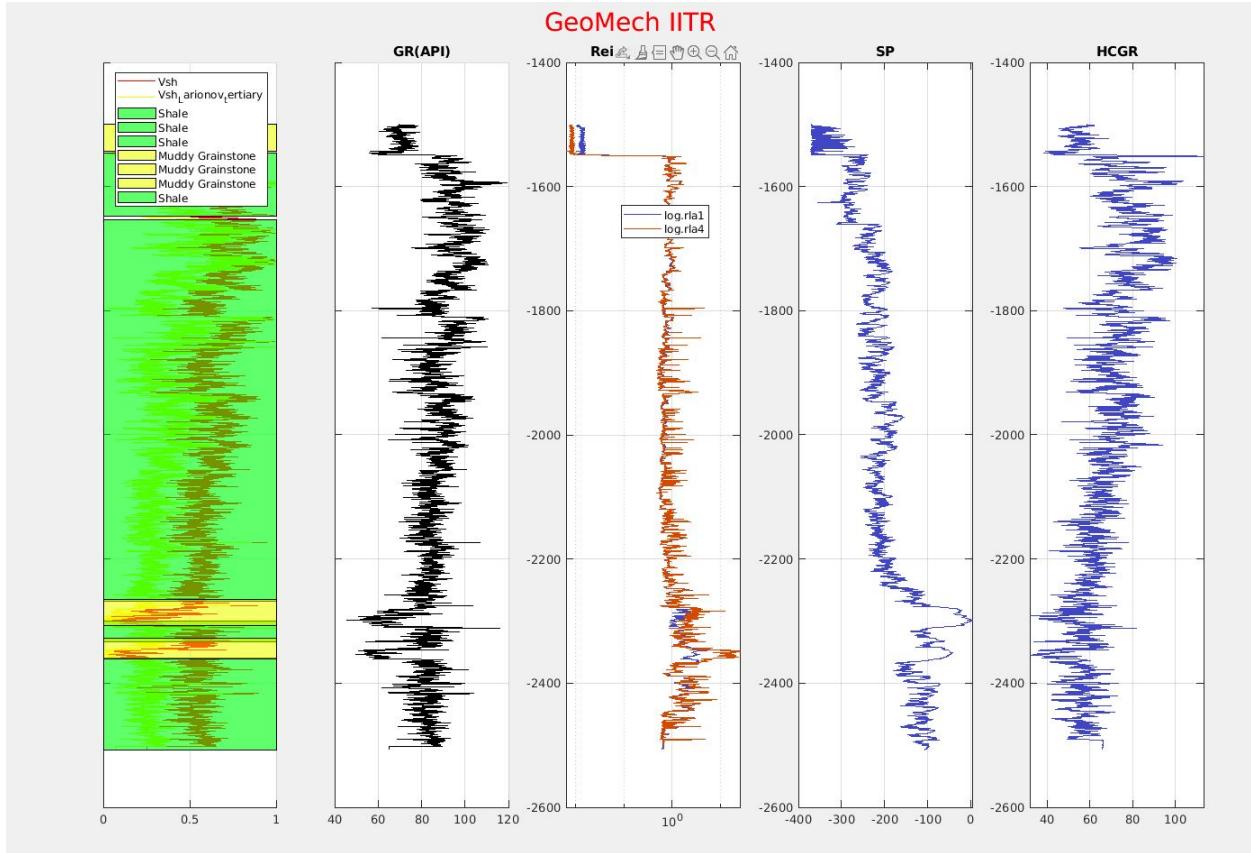










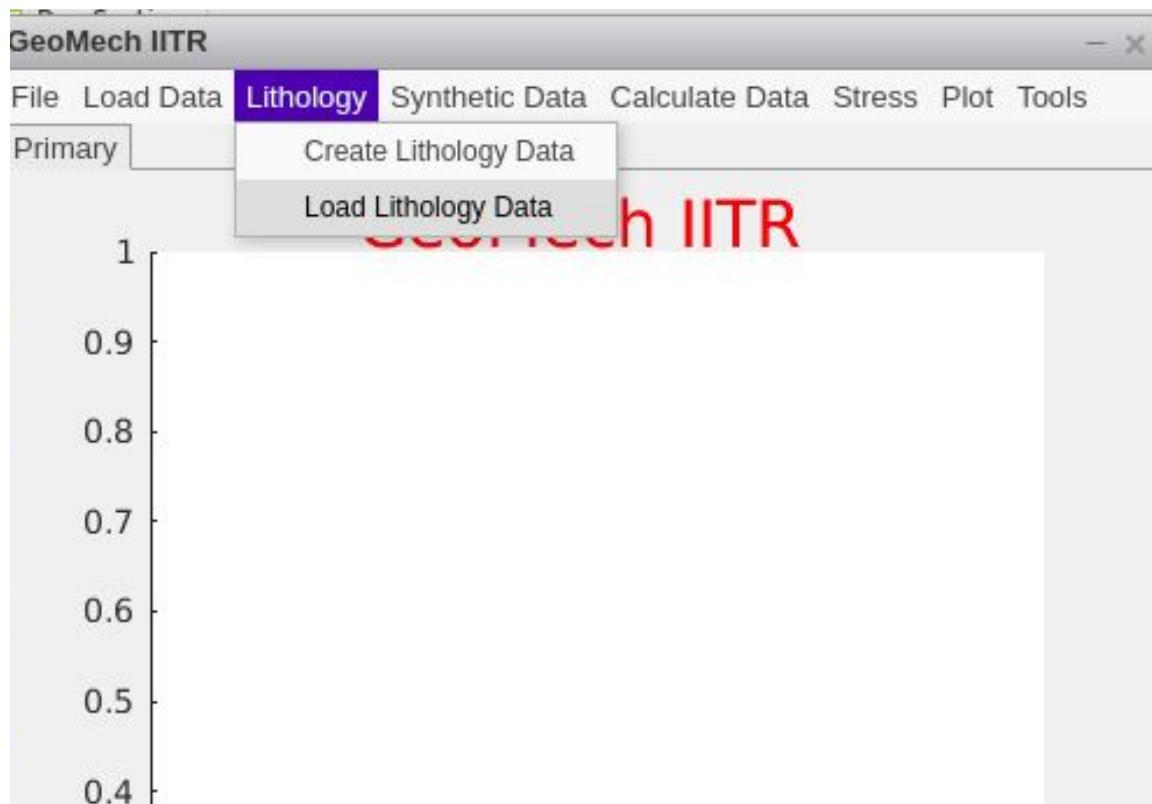


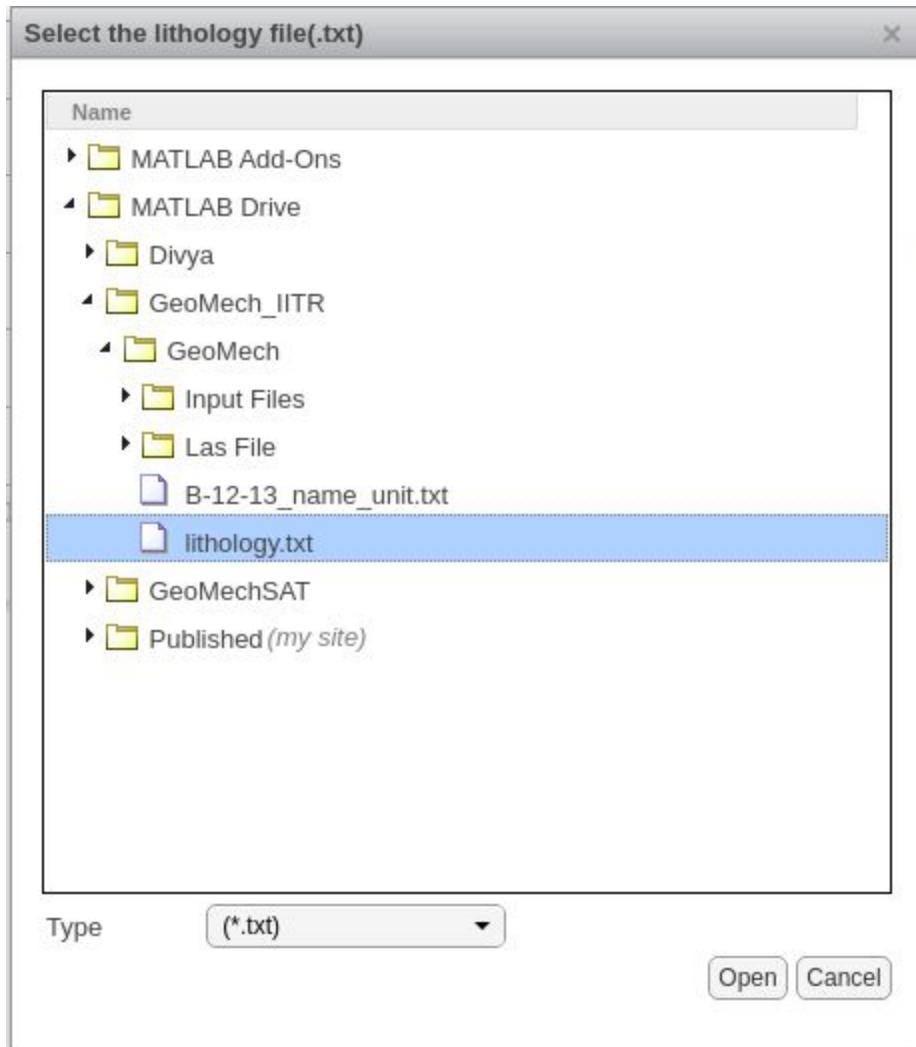
Using Text Editor

Open ▾ *Untitled Document 1

```
-1653,-2268,Shale
-2300,-2333,Shale
-2359,-2507,Shale
-1500,-1543,Muddy Grainstone
-2265,-2307,Muddy Grainstone
-2327,-2360,Muddy Grainstone
-1545,-1647,Shale
```

Loading Lithology



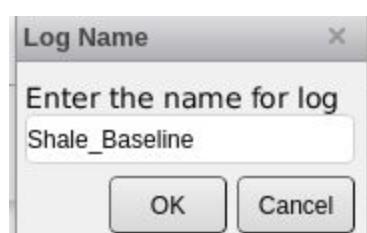
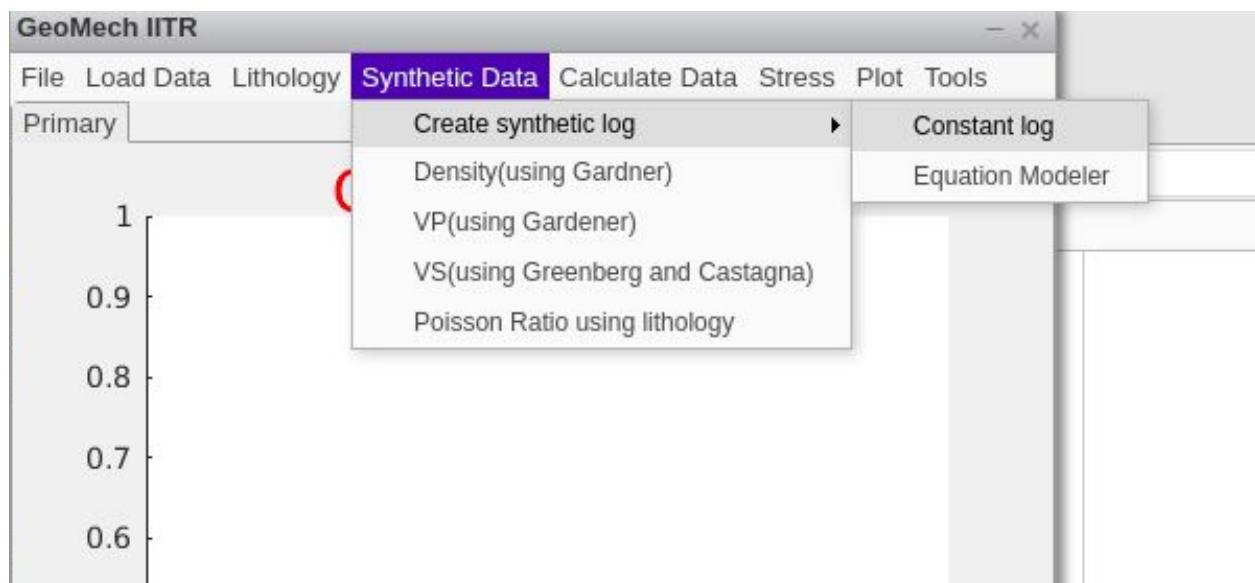


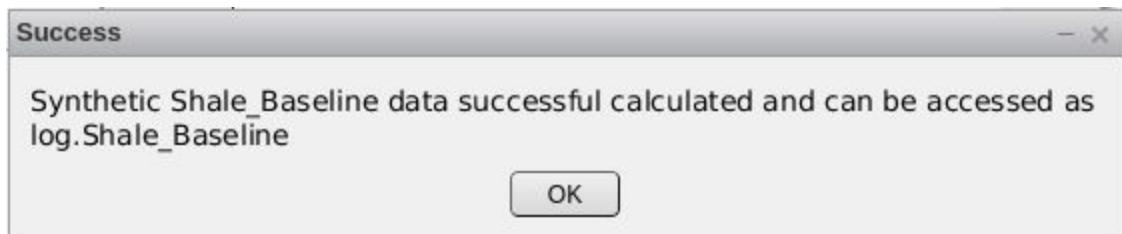
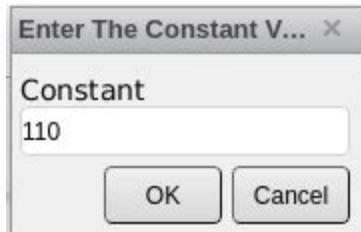
Creating Synthetic Data

User Defined Synthetic Data

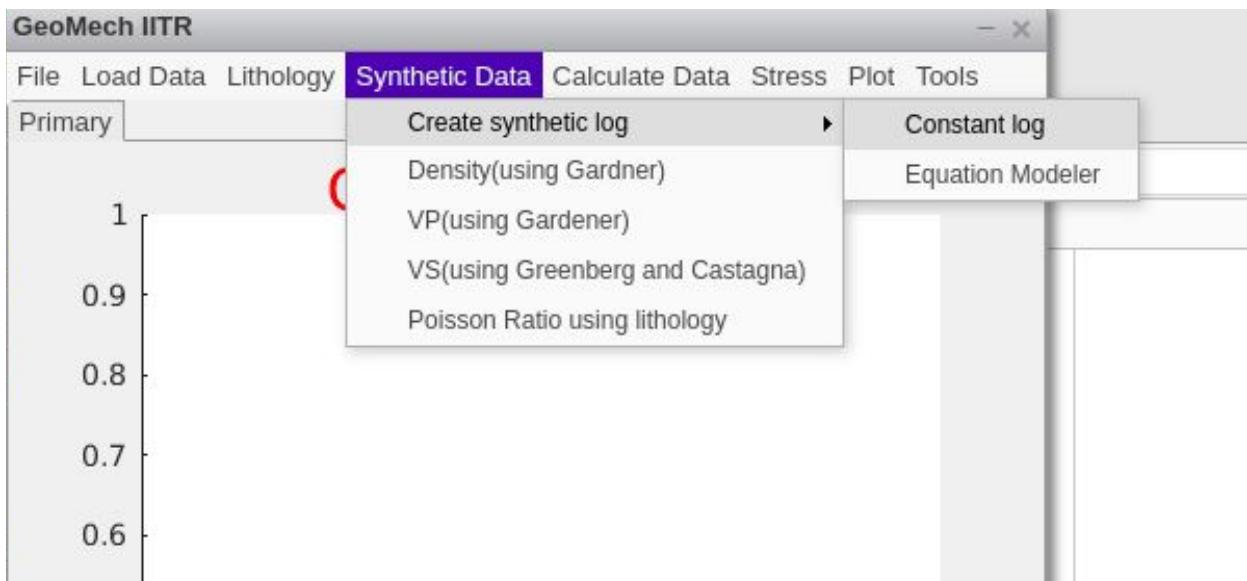
Constant log

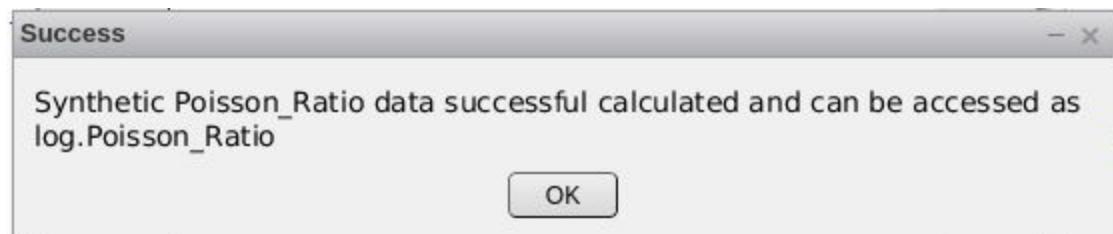
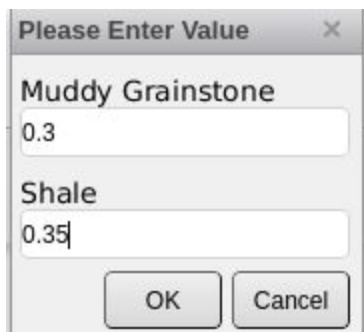
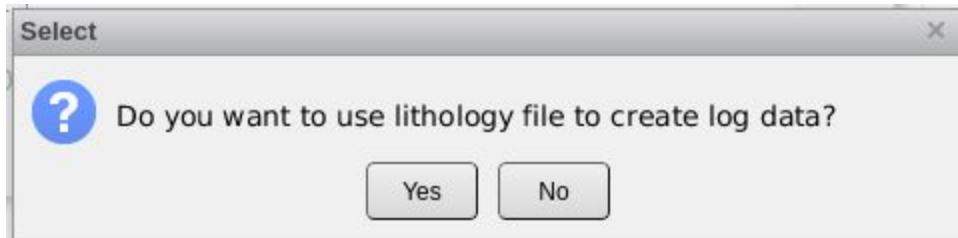
Without lithology/well section file(E.g:Creating Shale Baseline)



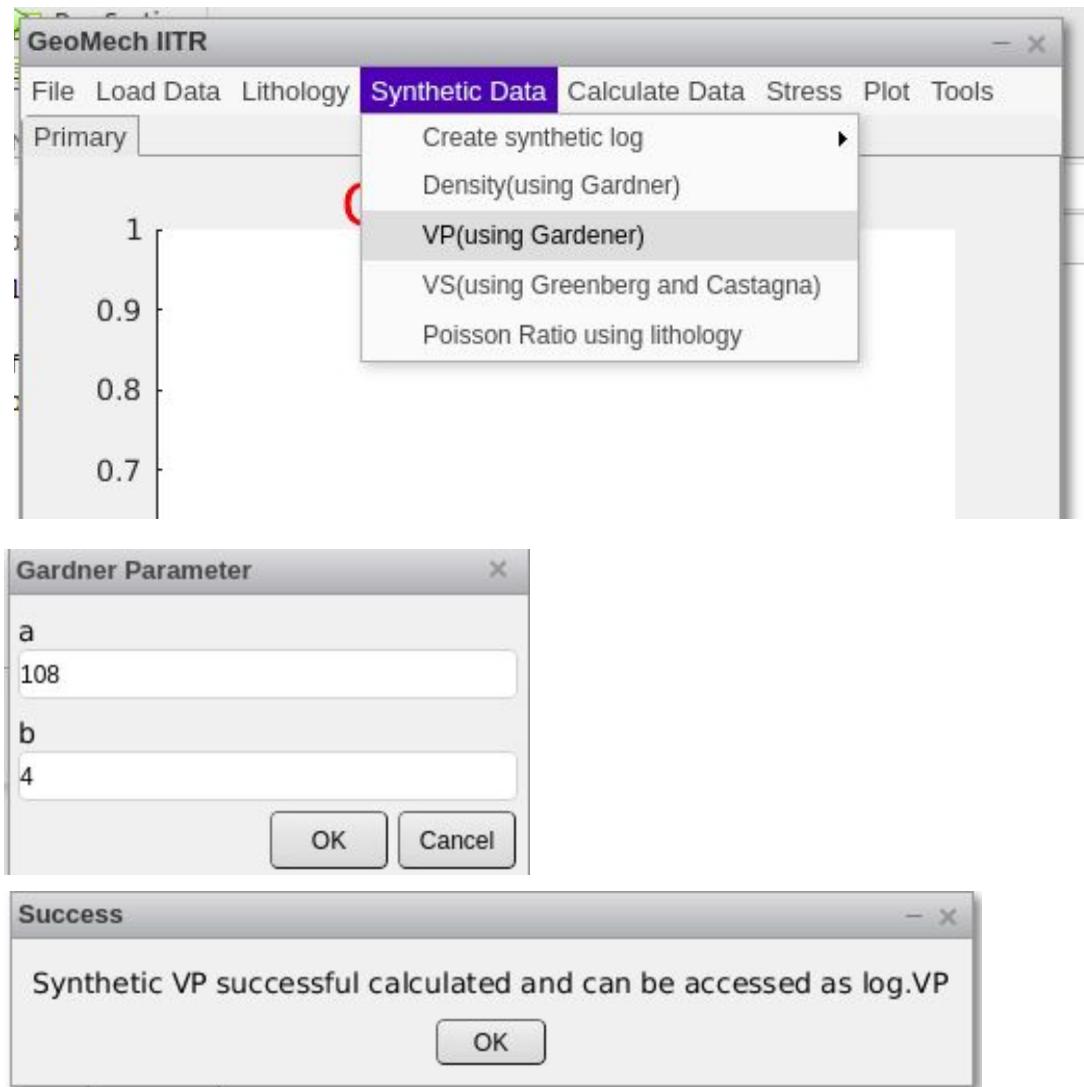


Lithology/Well Section based log (E.g. Poisson Ratio)





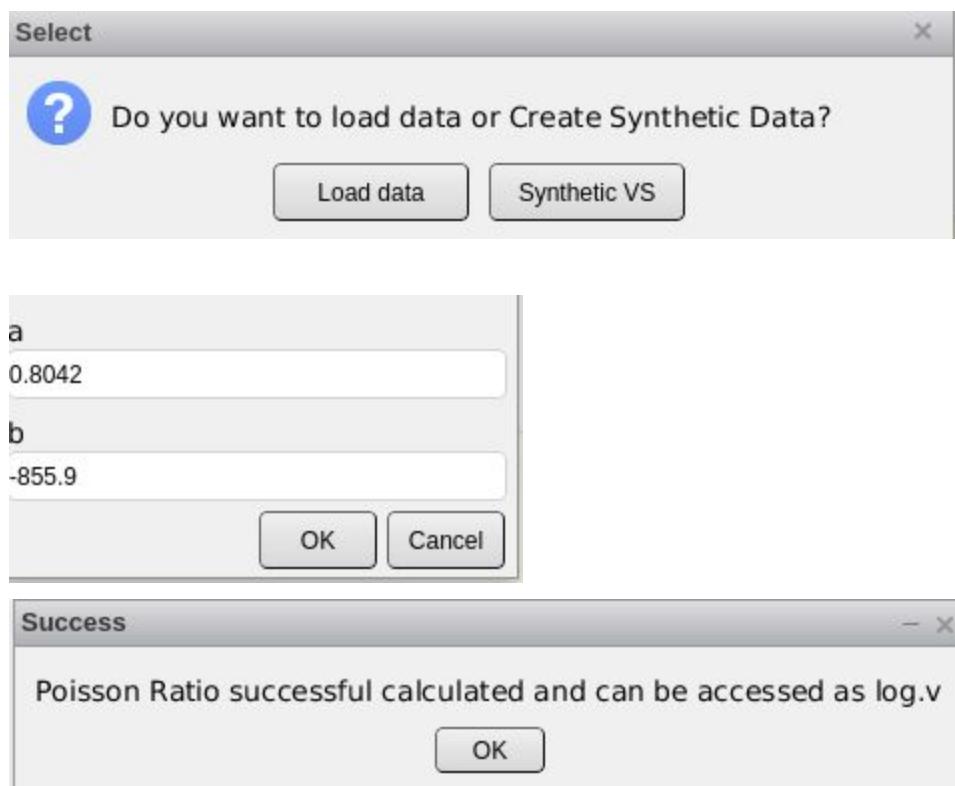
Inbuilt Synthetic log modeler



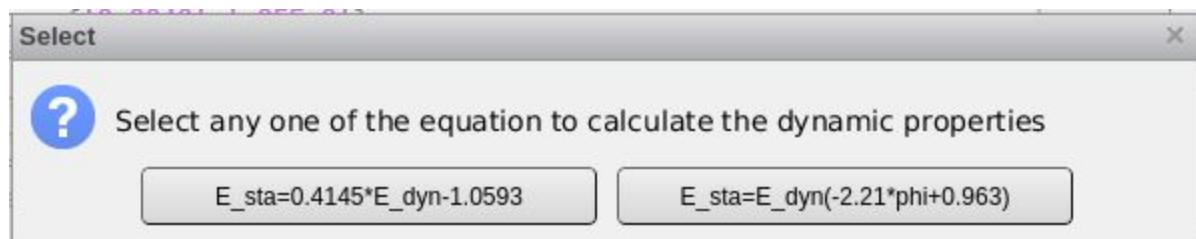
Calculating Elastic Parameters/Other equation based log

Using Inbuilt Function

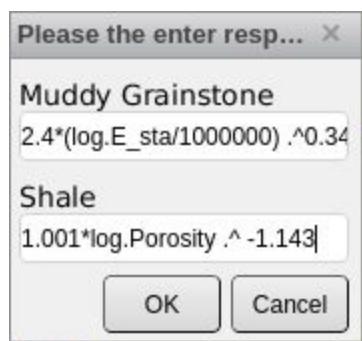
Poisson Ratio



Static and Dynamic Young's Modulus



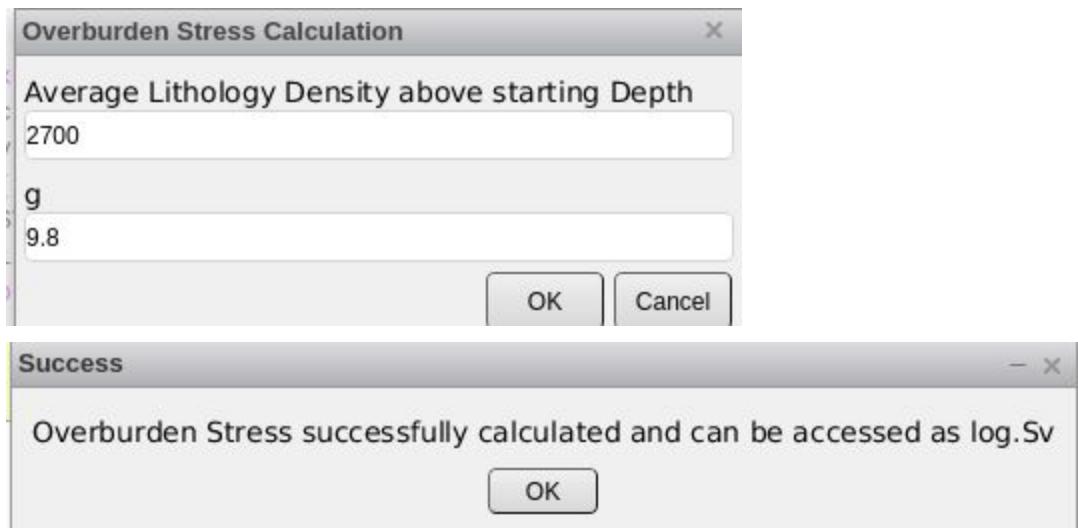
UCS



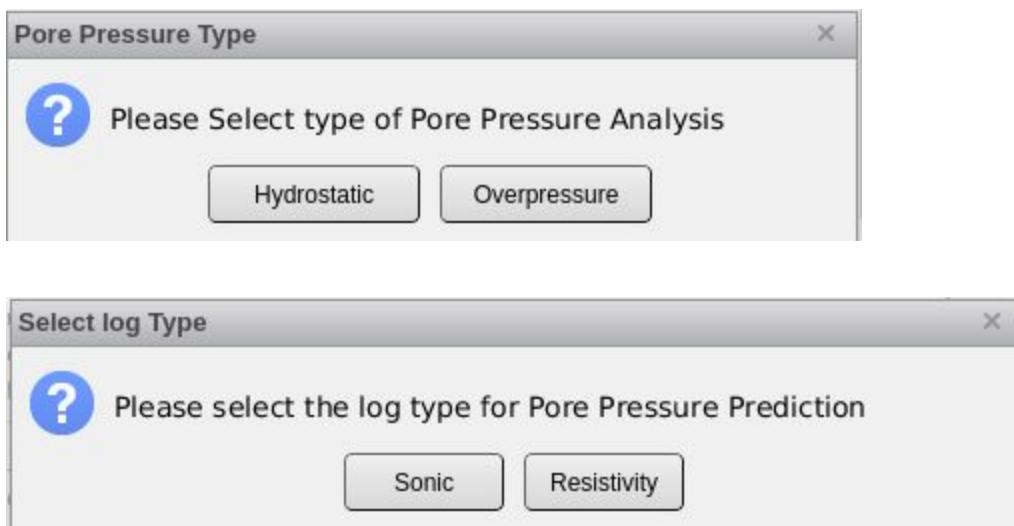
Using equation Modeler

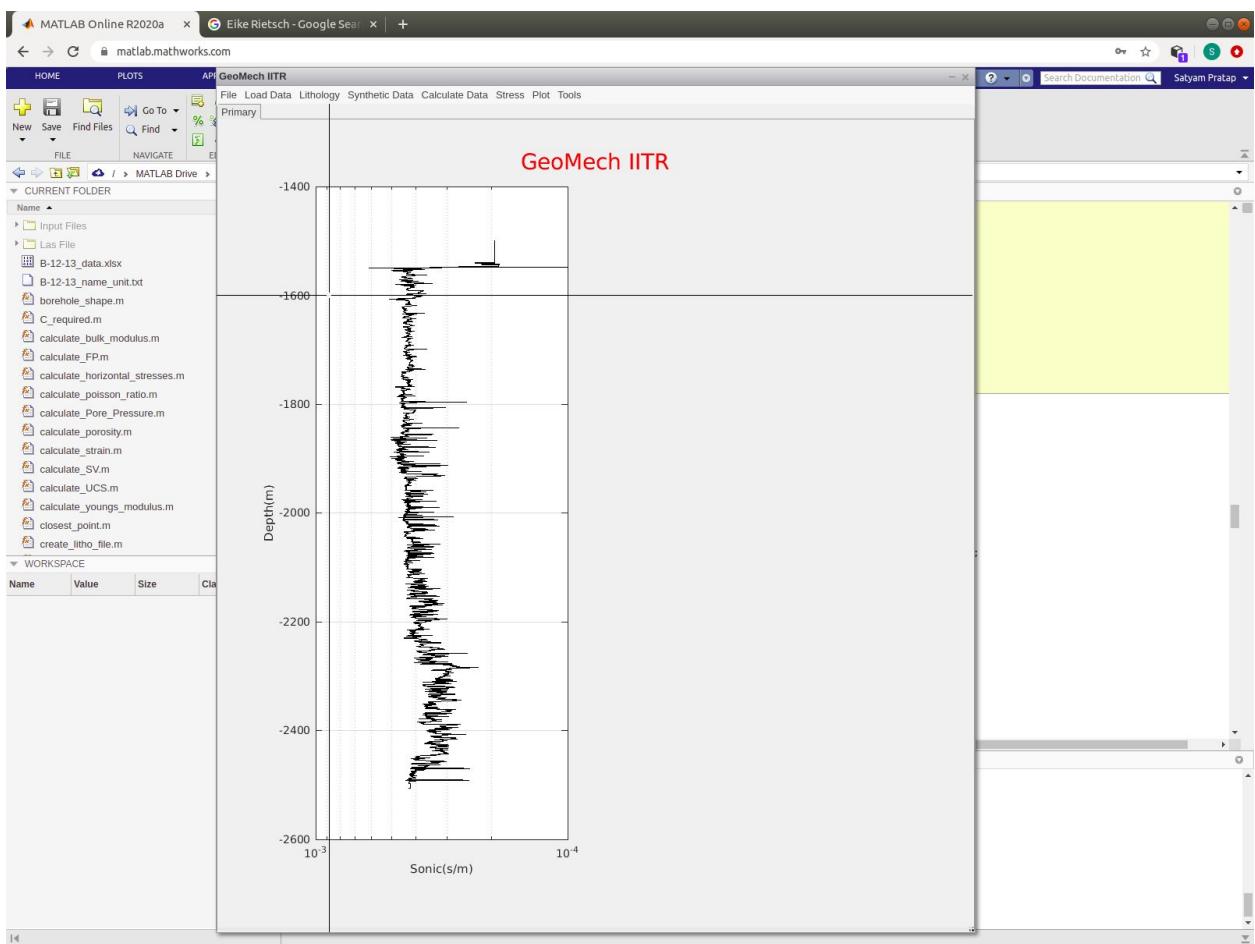
Stress and Pore Pressure Calculation

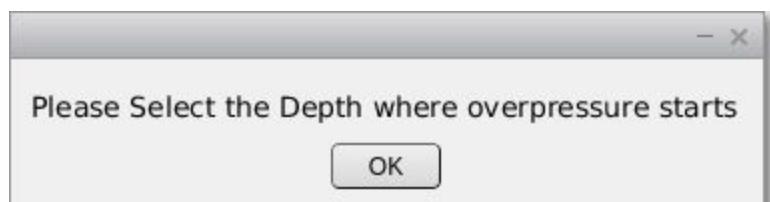
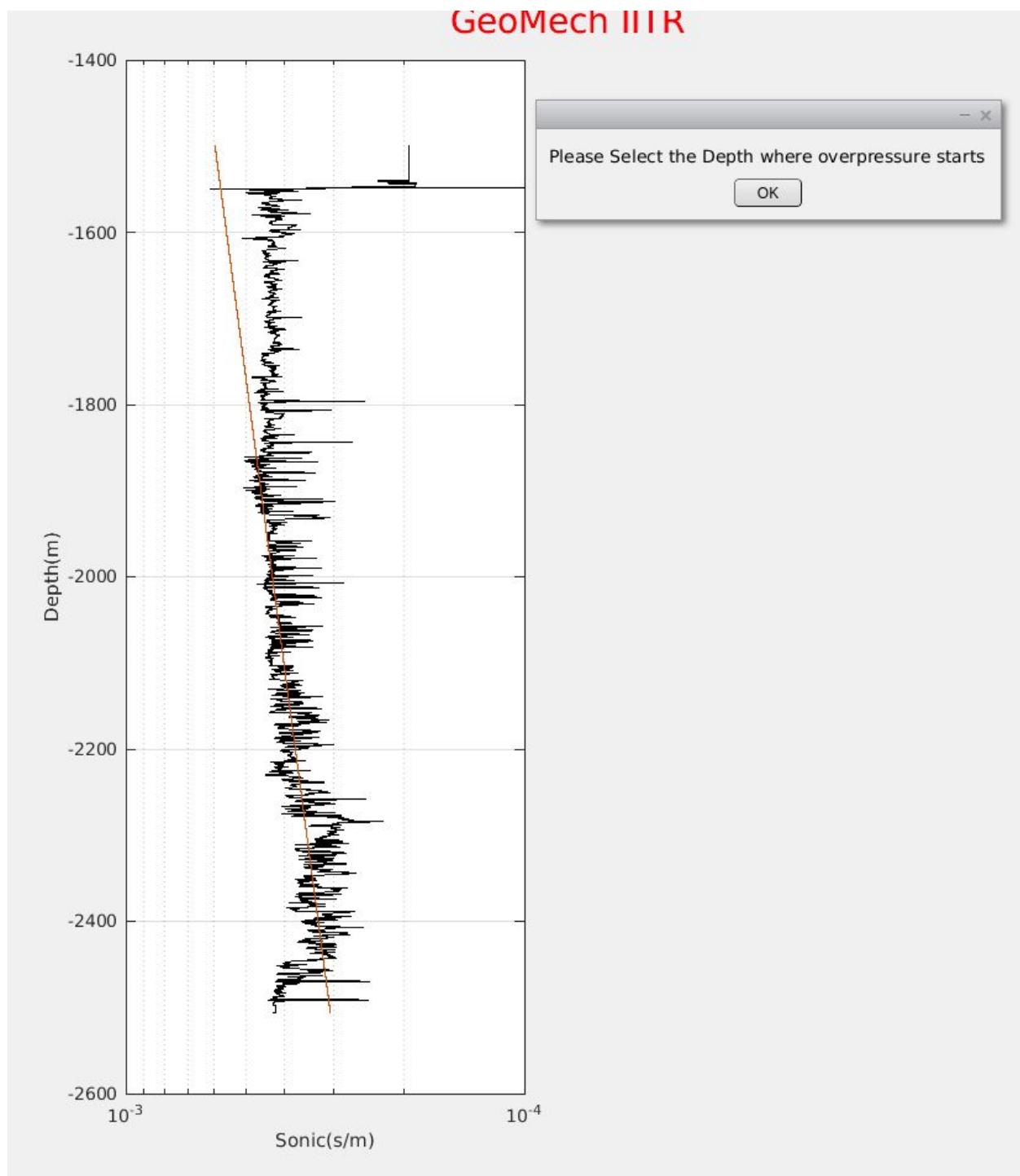
Overburden Stress Calculation

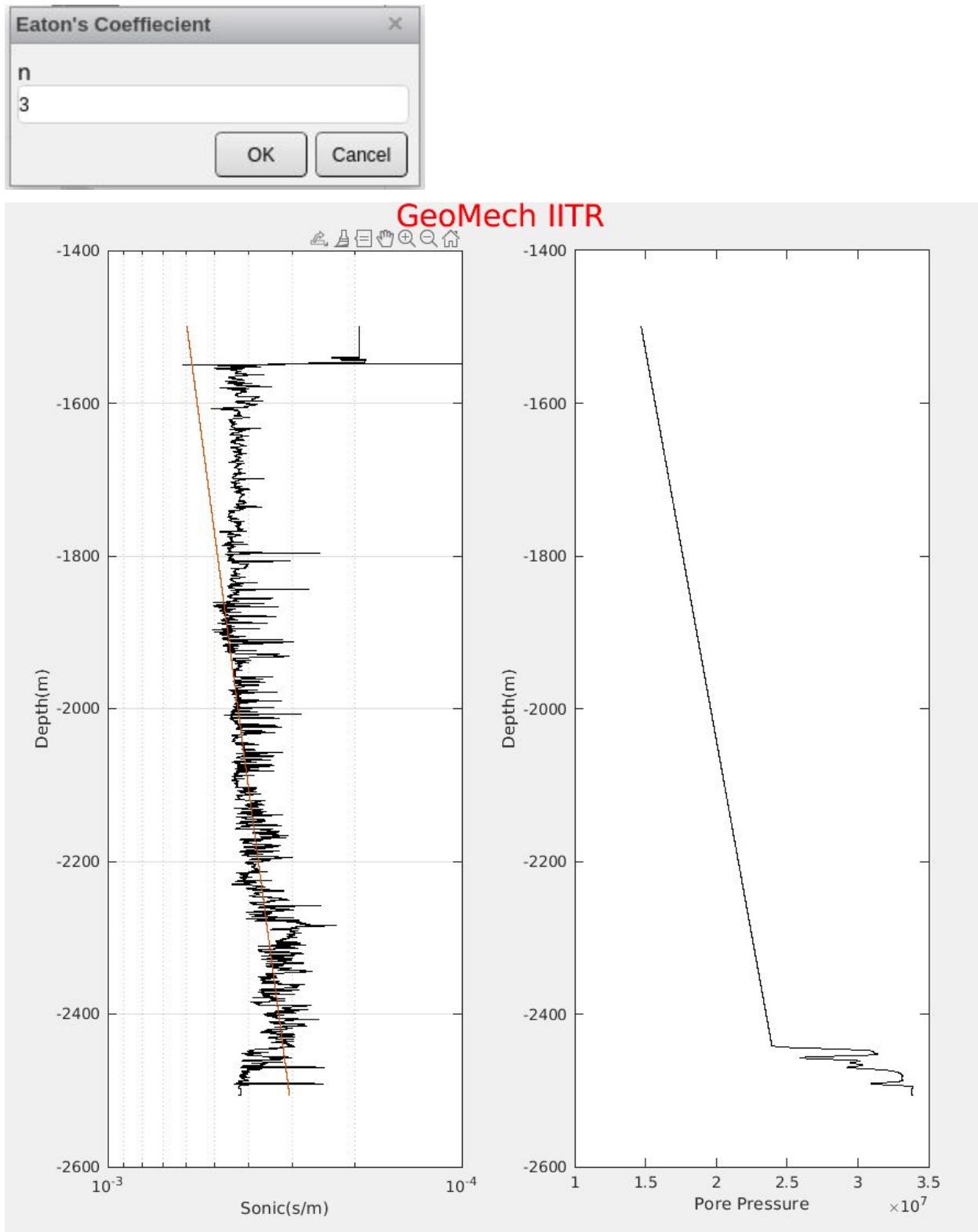


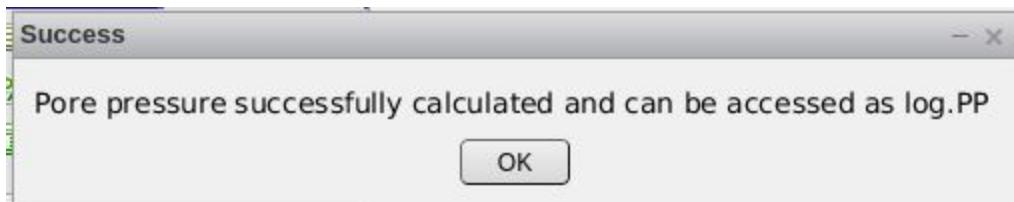
Pore Pressure Calculation



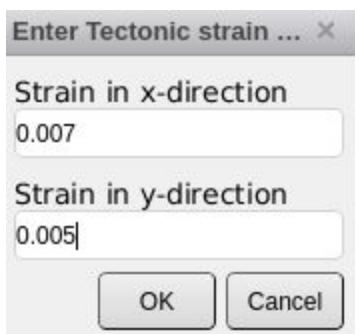
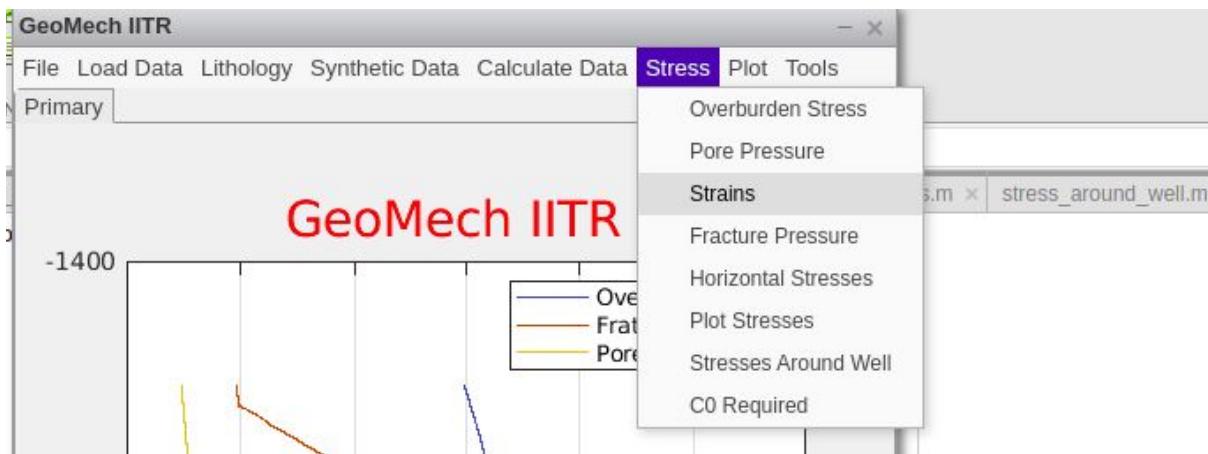


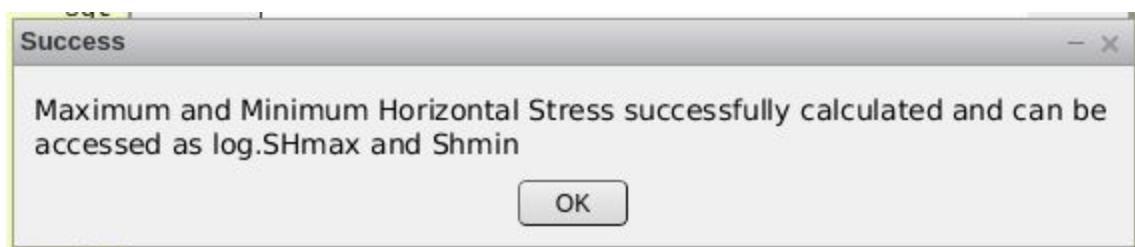
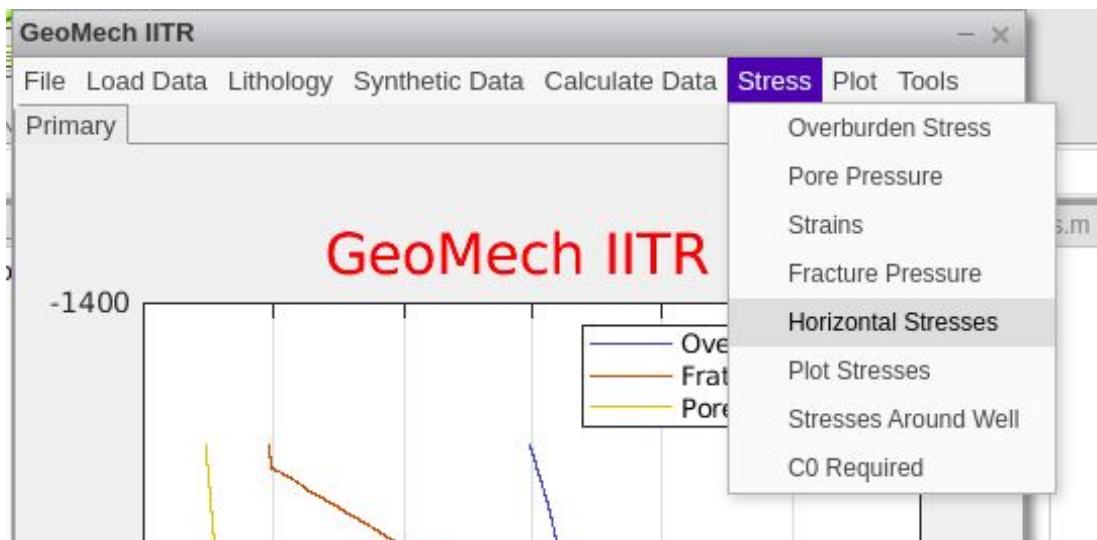


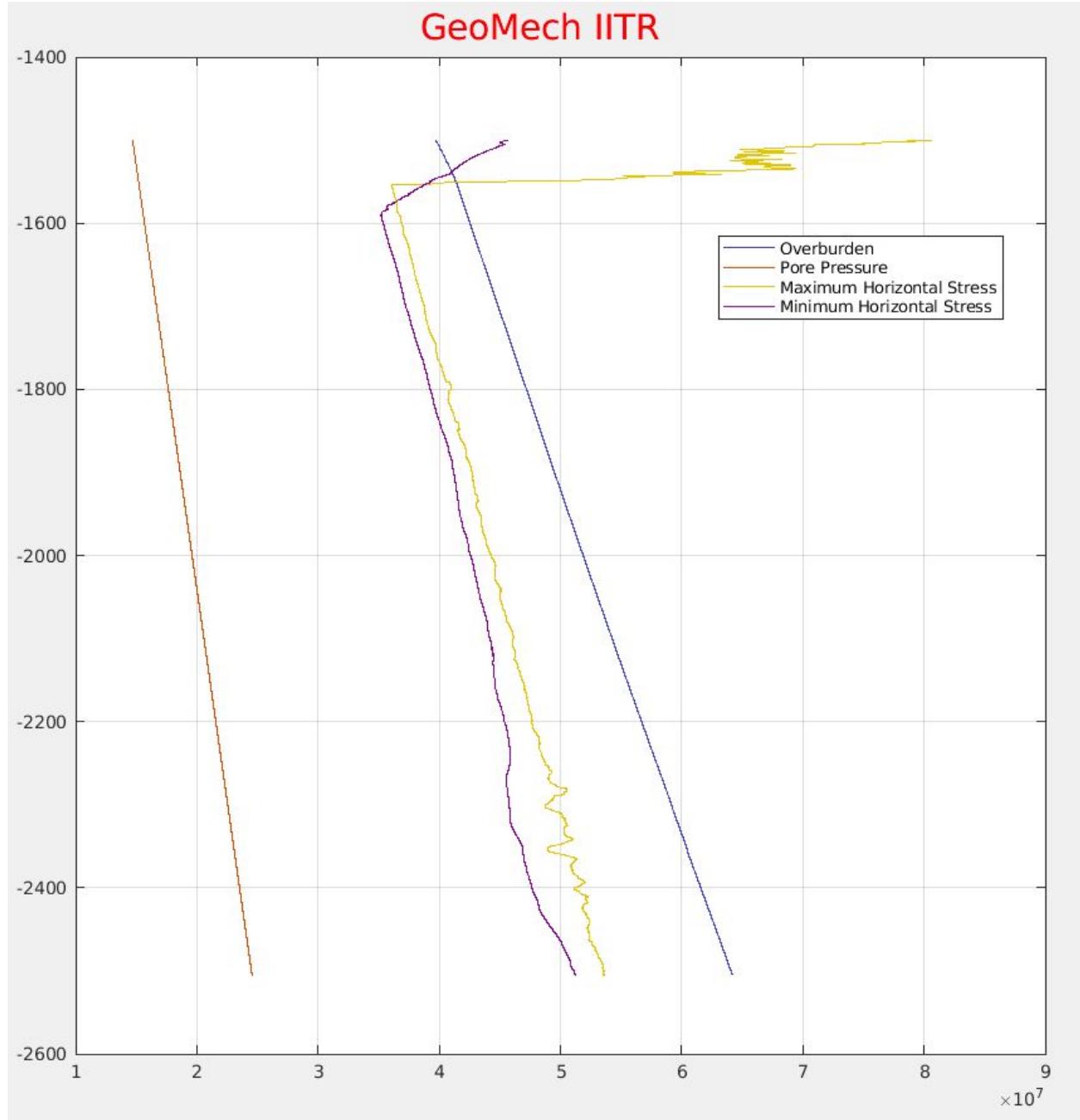


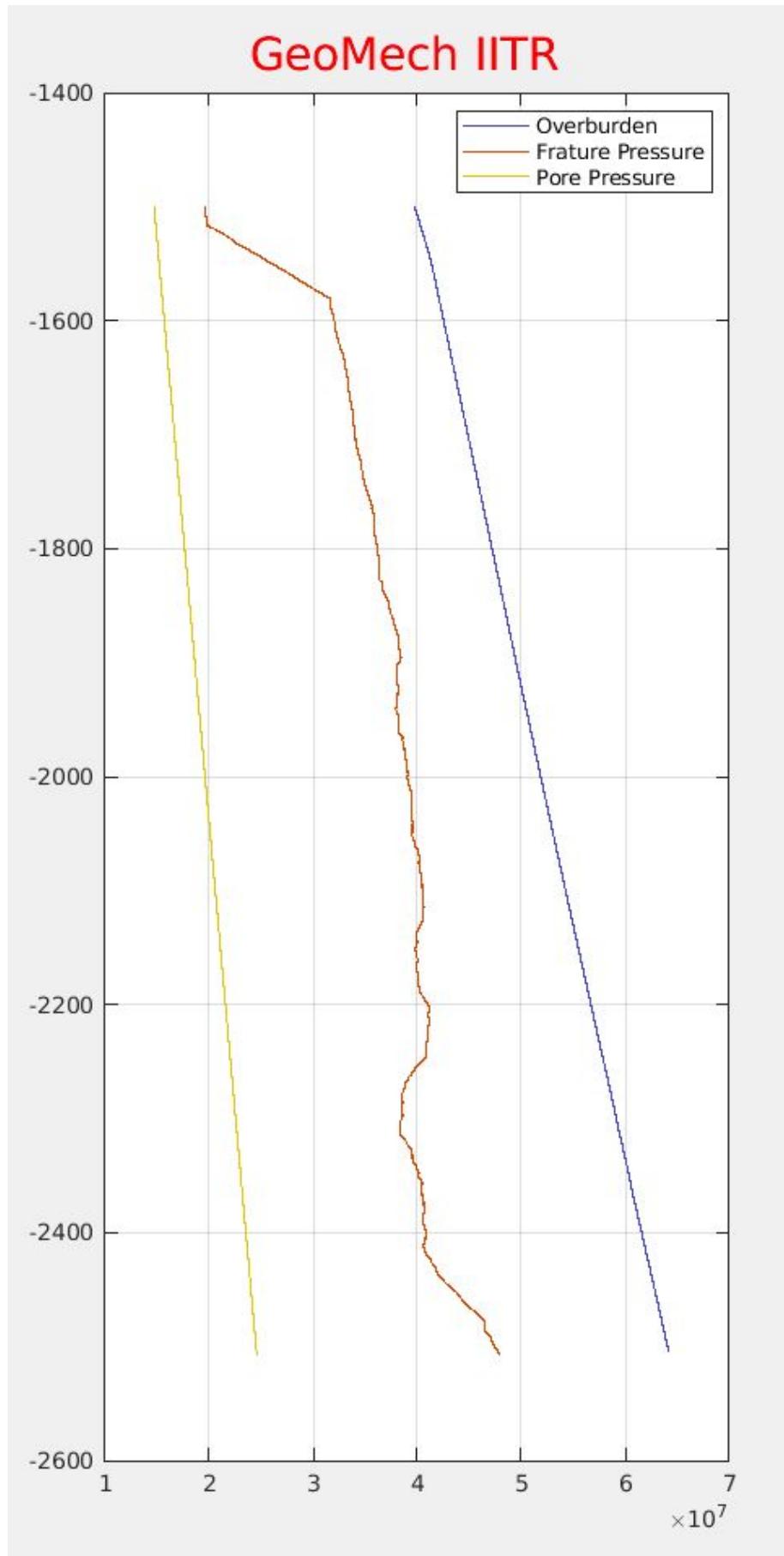


Horizontal Stresses and Fracture Pressure

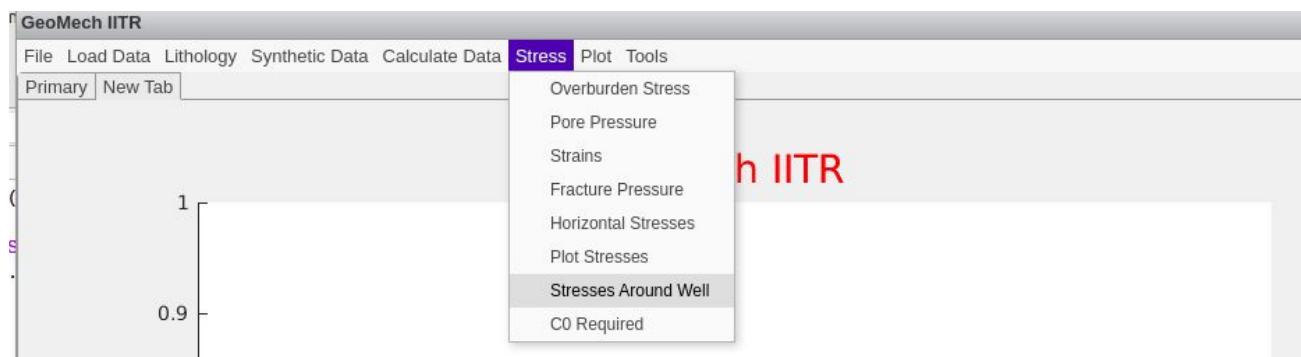


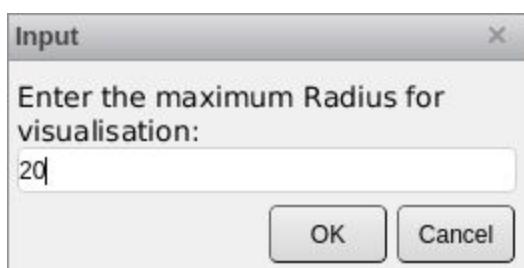
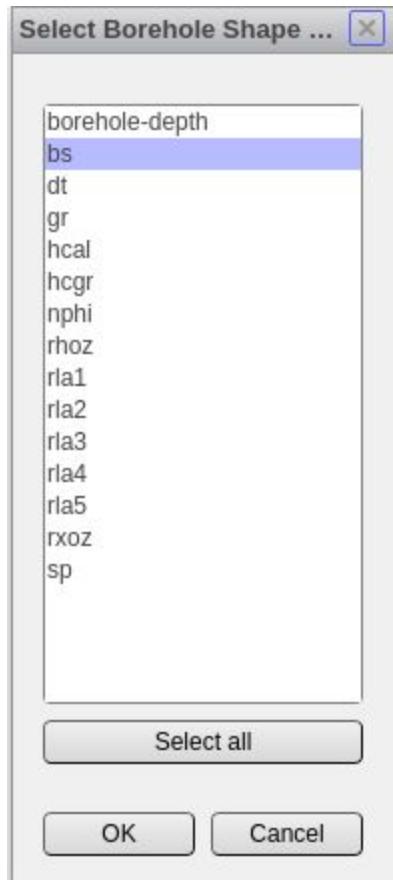


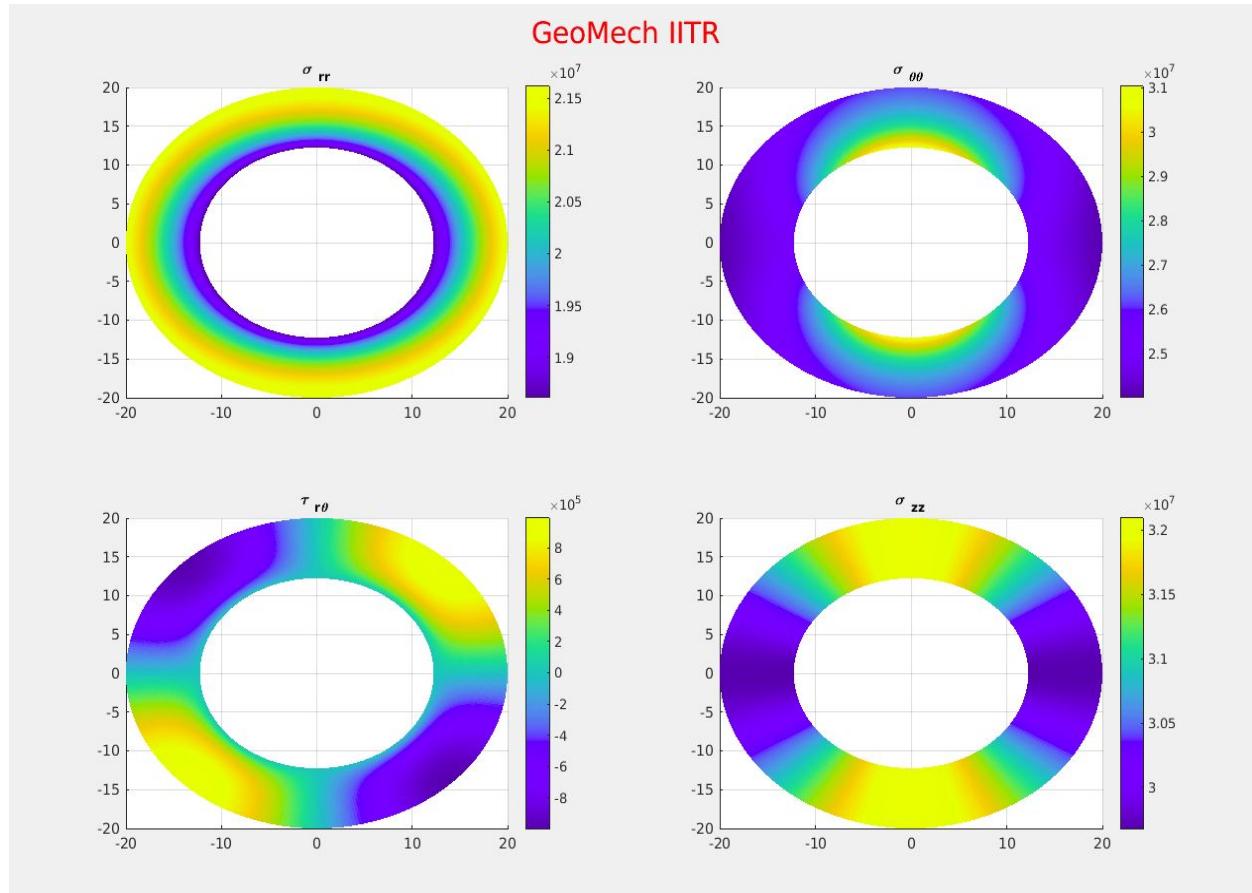




Stress in circular Borehole







Calculating C0 required

Input

Enter the Depth:

OK **Cancel**

