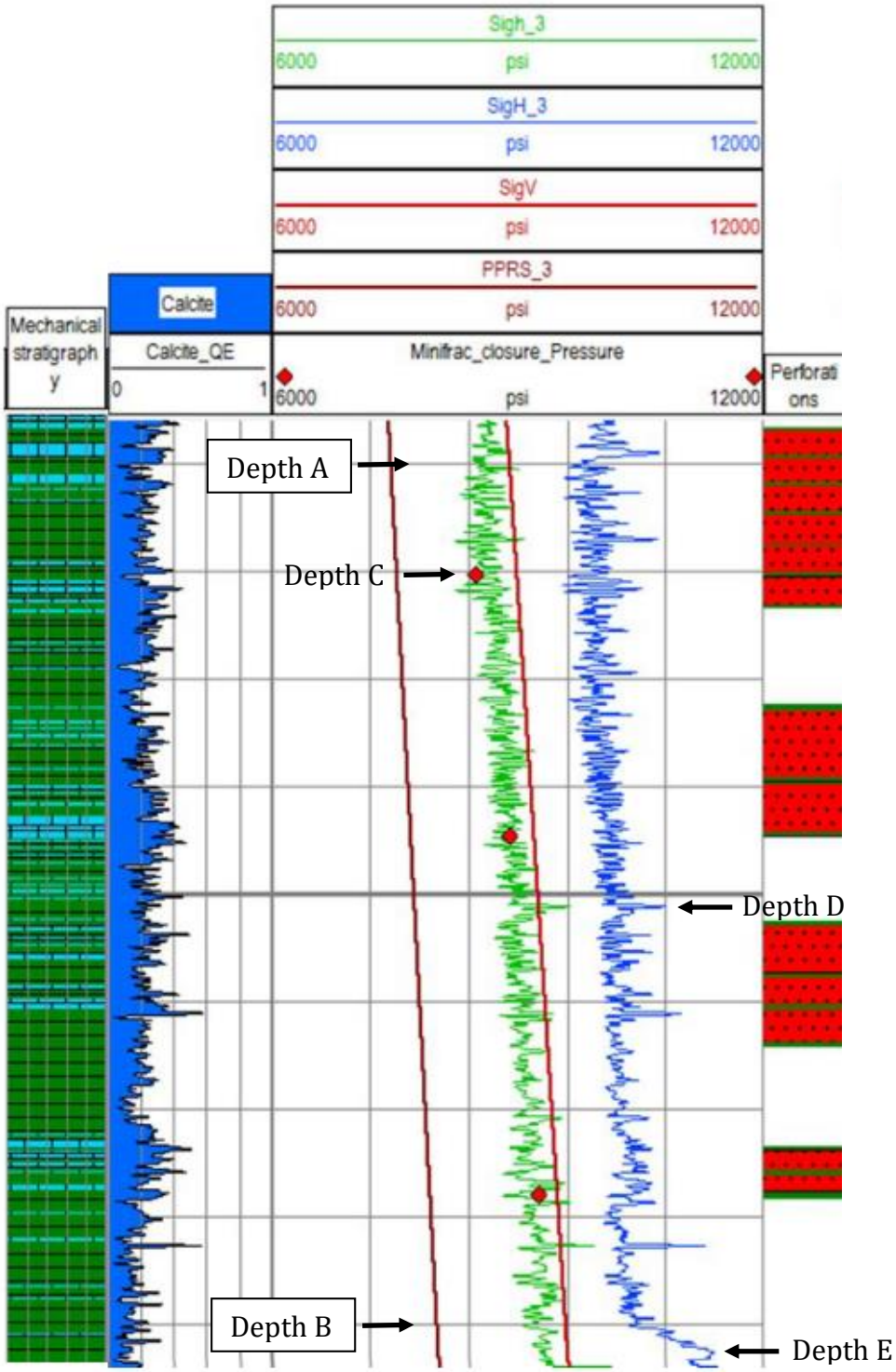
Project #1

1) The figure below displays principal stresses in a well from the Vaca Muerta Formation (SPE-180965-MS)



The figure does not show depth values. This is a way oil companies "sanitize" their data to do not reveal too much information that competitors could use to their advantage. We do know that depth grid spacing is 25 m.

a. Calculate the average pore pressure (PPRS_3) gradient between depth A and depth B in [MPa/km] and [psi/ft]
b. Calculate the average vertical stress (SigV) gradient between depth A and depth B
c. Calculate a reasonable guess for depth A
d. Write out stress tensors at depths A, B, C, D and E assuming vertical stress is a principal stress
e. Classify A, B, C, D and E according to stress regime (Normal, Strike Slip, Reverse)
f. Plot 3D Mohr circles of effective stresses for A, B, C, D and E
g. Plot p-q points for A, B, C, D and E
h. Plot I_1-J_2 points for A, B, C, D and E
i. In which direction would a hydraulic fracture open-up in the interval under study in this formation? Justify.

2) Go to https://github.com/dnicolasespinoza/GeomechanicsJupyter and download the files '1_14-1_Composite.las' and '1_14-1 deviation_mod.dev'. The first one is a well logging file (.LAS). You will find here measured depth (DEPTH - Track 1) and bulk mass density (RHOB - Track 8). Track 3 also shows bulk density correction (DRHO). Add RHOB to DRHO to obtain the corrected bulk mass density. The second file has the deviation survey of the well. Use this file to calculate true vertical depth subsea (TVDSS) as a function of measured depth (MD) in the well logging file. Water depth at this location is 104 m TVDSS. You may assume an average bulk mass density of 2 g/cc between the seafloor and the beginning of the density data. Summations with discrete data sets can be easily done through a 'for' loop or with a spreadsheet.

a. Plot all available tracks with depth in the y-axis.
b. Calculate and plot vertical stress using the density log.
c. Calculate and plot hypothetical 'hydrostatic' pore pressure.