Reservoir Geomechanics

Homework No. 1 – Overburden Stress and Porosity
Due 8:00 am UTC Feburary 24th, 2020
If you want to see the current time in UTC, please google: current time in UTC

In this homework, you will be calculating the vertical stress (overburden stress) and porosity using two different datasets, one from a well in the Barnett shale in Texas, and the other from a well in the Gulf of Mexico (GOM).Both datasets will be used in future homework assignments.

Utilize Matlab (recommended) or Excel for calculation and answer the questions below. Both datasets can be downloaded by clicking the right tab on the top of this page.

Use the following units in your calculation: 'ft' for depth, 'g/cm^3' for density, 'psi' for overburden stress and pore pressure, and 'psi/ft' for overburden stress gradient and pore pressure gradient.

I. Compute the overburden stress and the overburden gradient

1. Make a plot of density versus depth

- Barnett data – assume a reasonable surface density 1.8778 g/cm^3 to extrapolate to the first measurement point.

- GOM data – use a density of 1.0 g/cm^3 from the surface to the sea floor (depth of 1000 ft) and a formation density of 1.7 g/cm^3 at the sea floor. Linearly interpolate the density between the sea floor and the depth at which the data starts (at the depth of 3515 ft).

2. "Block" the log into 5 depth units by assuming an approximately constant density over a given range of depths. Compute and plot the averaged density in each block and your blocked density as a function of depth for each dataset.

3. Calculate and plot the overburden stress as a function of depth using both the "blocked" log and the continuous densities for each dataset. On the same plot, show hydrostatic pore pressure 0.44 psi/ft versus depth as a reference. Use 9.8 m/s^2 to approximate g, the acceleration due to gravity.

4. Calculate the overburden gradient (overburden stress divided by the depth) for each data set using the continuous density data. Plot the overburden gradient versus depth.

II. Compute porosity from the density measurements

Use the continuous density data and the formula $\rho_b = (1 - \phi)\, \rho_{matrix} + \phi\, \rho_{fluid}$ to compute porosity assuming full saturation of 1.0 g/cm^3 water in the pores. Here ϕ is the porosity. For ρ_{matrix}, assume

2.7 g/cm^3, which is a reasonable value for a mixture of qtz, feldspar, mica and clay. Plot porosity as a function of depth for each dataset.

III. Answer the questions on the page below

Use the calculations from I and II to answer the questions on the page below. The answers will be posted a day after it is due. Numerical entry-type responses have a range of acceptable values and are graded electronically, so please adhere to the value of constants given here. We will specify the units that we want the answer in, so please do not write units in the answer, just write the number.