ResGeo 202 Reservoir Geomechanics
Spring 2017, Stanford Online

Homework 6 – Constraining Stress Magnitudes from Wellbore Failure
Due 23 May 2017, 07:30 UTC

Please direct any questions to the Piazza discussion forum on the course website

Note that the deadline is in Coordinated Universal Time (UTC). If you want to see the current time in UTC, please google: "Current time in UTC."

Background

In this assignment, you will build a stress polygon diagram to constrain the possible stress magnitudes for sample data from the Barnett shale. The image logs from which the fractures were picked in Homework 5 showed **no signs of drilling induced tensile fractures or wellbore breakouts**. Use these key observations of the lack of wellbore failure combined with the relations for borehole stresses and frictional faulting theory to construct a stress polygon or 'Zoback-o-gram'.

Utilize a scientific computing or plotting program such as Microsoft Excel or MATLAB to follow the steps below. **Then, answer the questions on the webpage below this .PDF document.**

Instructions

Part 1: Given values
Use the values below for your calculations of the components of the stress polygon.

Given Values for Part 1:
S_V = 1.10 psi/ft; This is the vertical stress calculated from Homework 1.

P_P = 0.56 psi/ft; This is the pore pressure calculated for Barnett.

μ = 0.67; Coefficient of sliding friction.

Given Values for Part 2:
w_{BO} = 0; Width of Wellbore Breakout (expressed as an angle), setting this value to 0 signifies no wellbore breakouts were observed and the stress state is below the line plotted.

T_0 = 0 psi/ft; Rock tensile strength. Rocks are very weak in tension.

C_{eff} = 4.0 psi/ft; Effective rock compressive strength.

ΔP = 0.15 psi/ft; Additional pore pressure from drilling mud weight

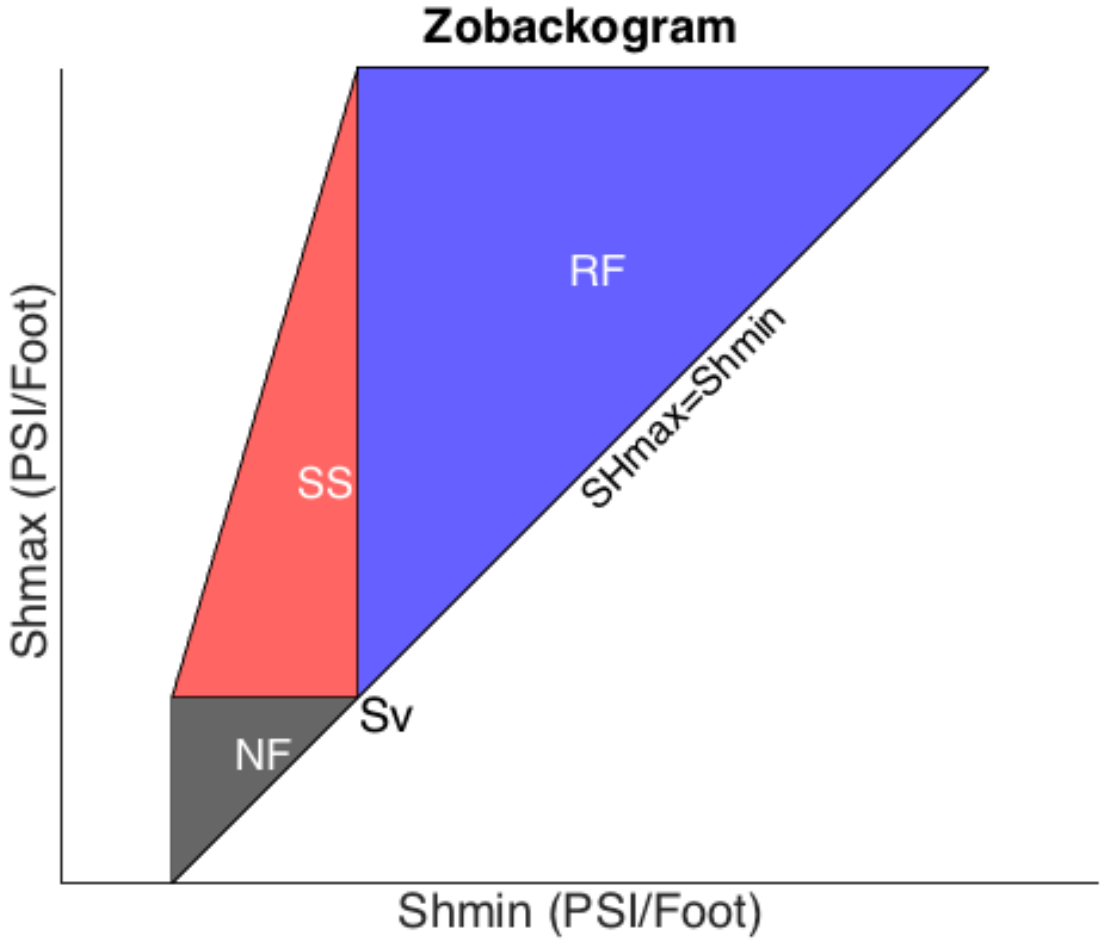
Assume $\sigma^{\Delta T} = 0$; That means no thermal stresses

Part 2: Calculate stress magnitude constraints for each faulting regime
Use frictional faulting theory relationships from Homework 4 (lecture 6, slide 29) to calculate the stress magnitude constraints for each faulting regime in units of psi/ft.

a. Plot your results on S_{Hmax} vs. S_{hmin} axes as is customary for the stress polygon.

b. Plot the value given of S_V on the same axes and draw in the boundaries between the allowed stress magnitudes for each faulting regime. Label each area correspondingly.

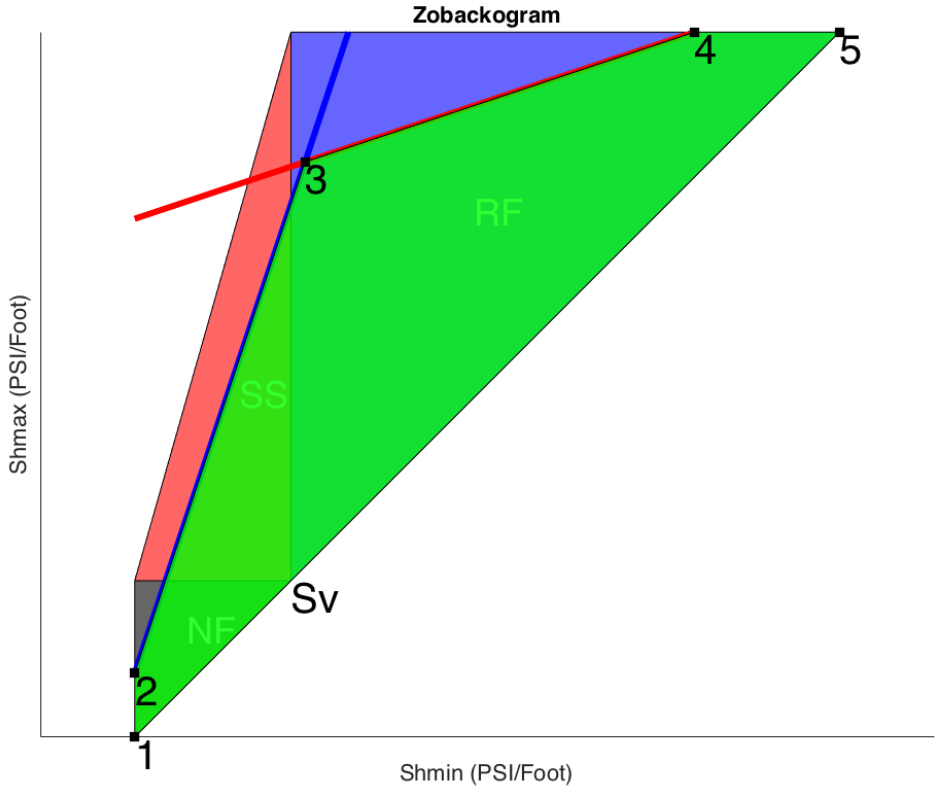
   Your plot should look something like this:



Part 3: Calculate stress magnitude constraints from wellbore failure observations
Use relationships for wellbore stress magnitudes (Lecture 9, slide 23) to calculate the stress magnitude constraints in units of psi/ft.

a) Calculate the appropriate wellbore failure contour lines for both tensile (blue line) and compressive failure (red line) using the constants given in Part 1 and the observations of no drilling induced tensile failures or wellbore breakouts.

b) Plot the results on the same axes used in Part 2. Use the observation of no wellbore breakouts or Drilling Induced Tensile Fractures to constrain the area of the polygon corresponding to allowable stress states. Shade this area (green).



Part 4: Answer the questions on the webpage below this .PDF document.
Use the stress polygon plot and the calculations from Parts 1–3 to find the coordinates of the points marked 1 through 5 in the above plot in PSI/ft. Enter their coordinates on the webpage below this .PDF document. The answers will be posted after the due date.

Numerical entry type responses have a narrow range of acceptable values and are graded electronically, so please adhere to the value of constants given here to prevent misgrading of your submissions.