HW #3

1.

a. Hydrostatic pore pressure in MPa = depth(m)*g(m/s^2)*water density(kg/m^3) /10^6.

b. Porosity: Here both limestone and shale have the same density (2.7 g/cc). Therefore, we don't need to distinguish them.

$$\phi = \frac{\rho_{ma} - \rho_{log}}{\rho_{ma} - \rho_{fl}}$$

c. Compressional and shear wave velocity is given by the inverse of the interval times, with conversion factor = 0.3048/10^{-6} from ft/μs to m/s.

d. Poisson's ratio: $\nu = \frac{V_p^2 - 2V_s^2}{2(V_p^2 - V_s^2)}$

Shear modulus: $G = \rho V_s^2$

Young's modulus: $E = 2G(1 + \nu)$

e. UCS from Sonic log and Density log:

For Marble Falls formation: UCS (sonic) = 0.4067 E$^{0.51}$

UCS (density) = 135.9 exp(-4.8ϕ)

For Duffer formation: UCS (sonic) = 2.4 E$^{0.34}$

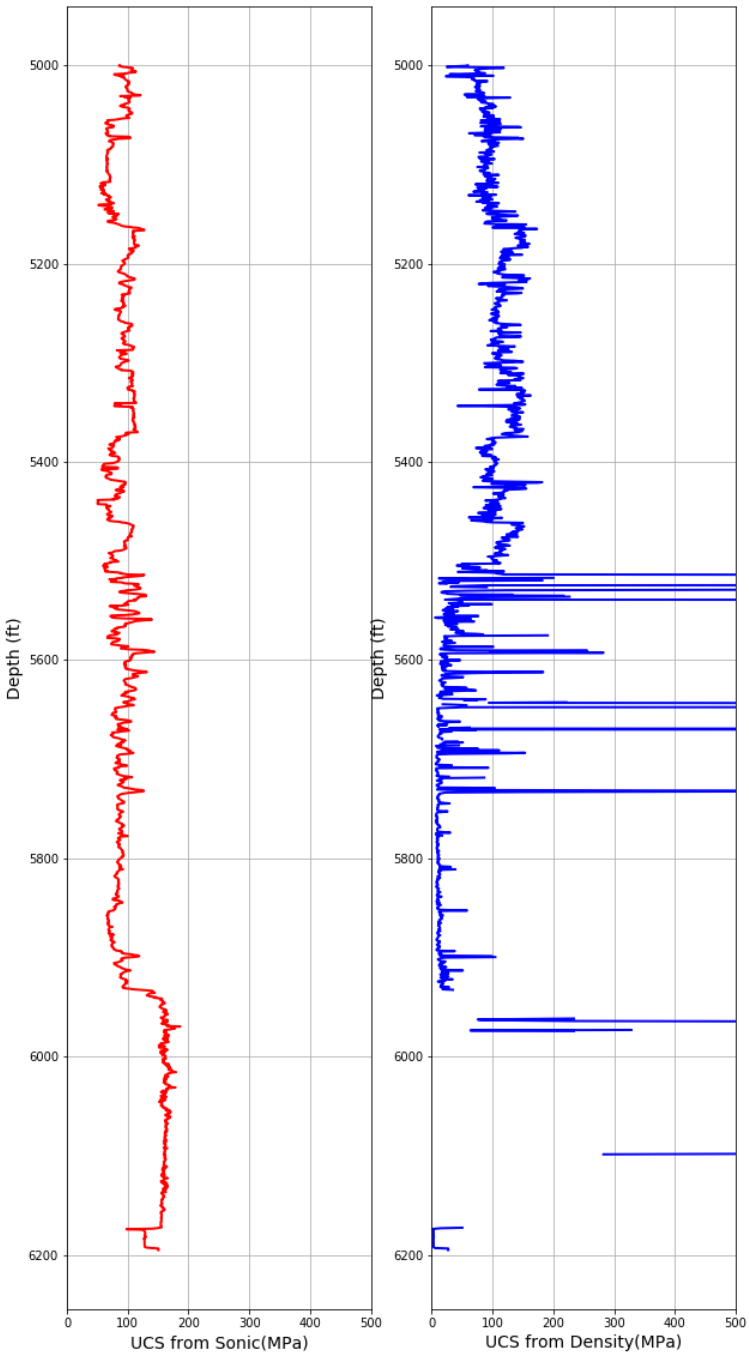
UCS (density) = 135.9 exp(-4.8ϕ)

For Barnett formation: UCS (sonic) = 0.0528 E$^{0.712}$

UCS (density) = 1.001 ϕ$^{-1.143}$

f. Plot of UCS from sonic and density logs:

(Some gaps in the plot are seen because values of porosity equal to or less than 0 are ignored).

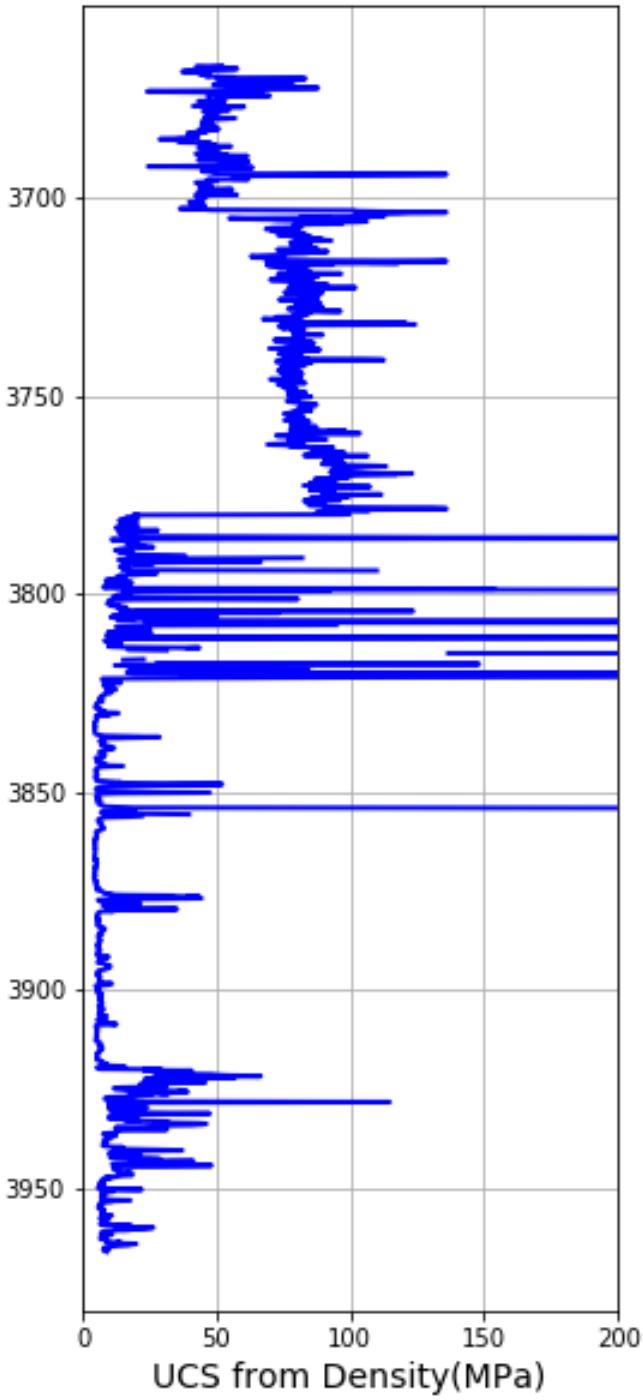

Depth (ft)
5000
5200
5400
5600
5800
6000
6200
0
100
200
300
400
500
UCS from Sonic(MPa)
Depth (ft)
5000
5200
5400
5600
5800
6000
6200
0
100
200
300
400
500
UCS from Density(MPa)

2. Answers:
    a. Absolute difference at 5100 ft: 20.832 MPa
    b. Absolute difference at 5300 ft: 14.490 MPa
    c. Absolute difference at 5800 ft: 74.798 MPa
    d. UCS from sonic logs at 5100 ft: 66.553 MPa
    e. UCS from sonic logs at 5300 ft: 91.063 MPa
    f. UCS from sonic logs at 5800 ft: 87.790 MPa

3. For the Volve field, I don't have the interval times for shear and compressive wave velocities. Therefore, only the density log is used to calculate the UCS.
   Plot of UCS vs depth is shown in the next page.

   It is assumed that at the depth of 3780m the correlation changes and the same correlation used for Barnett is used.

   All the codes are included in the folder.


3700
3750
3800
3850
3900
3950
0
50
100
150
200
UCS from Density(MPa)