HW-5.2: Pore Pressure Prediction—Eugene Island 330

(Porosity & Velocity to effective stress)

Goal:

This homework supplements the discussion of pore pressure prediction discussed in Chapter 5 (Flemings, 2021). We will predict pressure in the E.I.-330 A20ST well. See Chapter 5, Figures 5.4-5.6, and 5.13, (Flemings, 2021)). We will use the normal compaction trend parameters that you derived in HW5.1. We will both calculate by hand and use the spreadsheet **'NCT_Spread_sheet_and_PPP_EI-330'** to predict the pressure.

Hubbert Approach

Use Hubbert's approach to predict pore pressure in the E.I.-330 A20ST well. See Chapter 5, Figures 5.4-5.6.

Approach:

$\sigma_v' = \sigma_v - u$ Eq. 1

$u = \sigma_v - \sigma_v'$ Eq. 2

$n = n_0 e^{-\beta \sigma_{v'}}$ Eq. 3

$u = \sigma_v - \frac{1}{\beta} \ln\left(\frac{n_o}{n}\right)$ Eq. 4

Based on the normal compaction trend shown in Figure 1 (i.e. $\beta = 2.15\ x10^{-4}\ and\ n_o = 0.38$) (or based on your own interpreted NCT parameters from HW 5.1), calculate the pore pressure (u) and fill in Table 1 and then plot these values in Figure 2. Double your value of β and re-calculate the pore pressure and place in the right column of Table 1.

Exercise:

Calculate the in-situ pressure at four different depths (Table 2) using Equation 4.

Depth (ft)	n	u_h (PSI)	σ_v (PSI)	u (Eq. 4) (PSI) β=0.000215 PSI^{-1}	u (Eq. 4) (PSI) β= 2β
4714	0.243	2091	4123		
6657	0.25	2951	5987		
7231	0.31	3206	6543		
7854	0.3	3482	7157		

Table 2. *Exercise for estimating pore pressure at EI-330.*

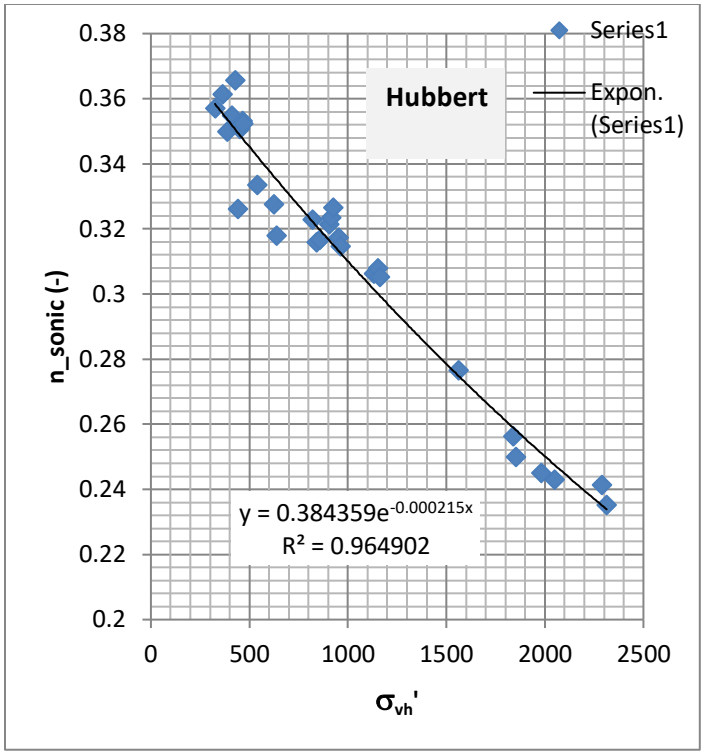

Figure 1: *Compression curve from NCT Exercise. This analysis shows* . $\beta = 2.15\ x10^{-4}$ *and* $n_o = 0.38$ (Eq. 3).

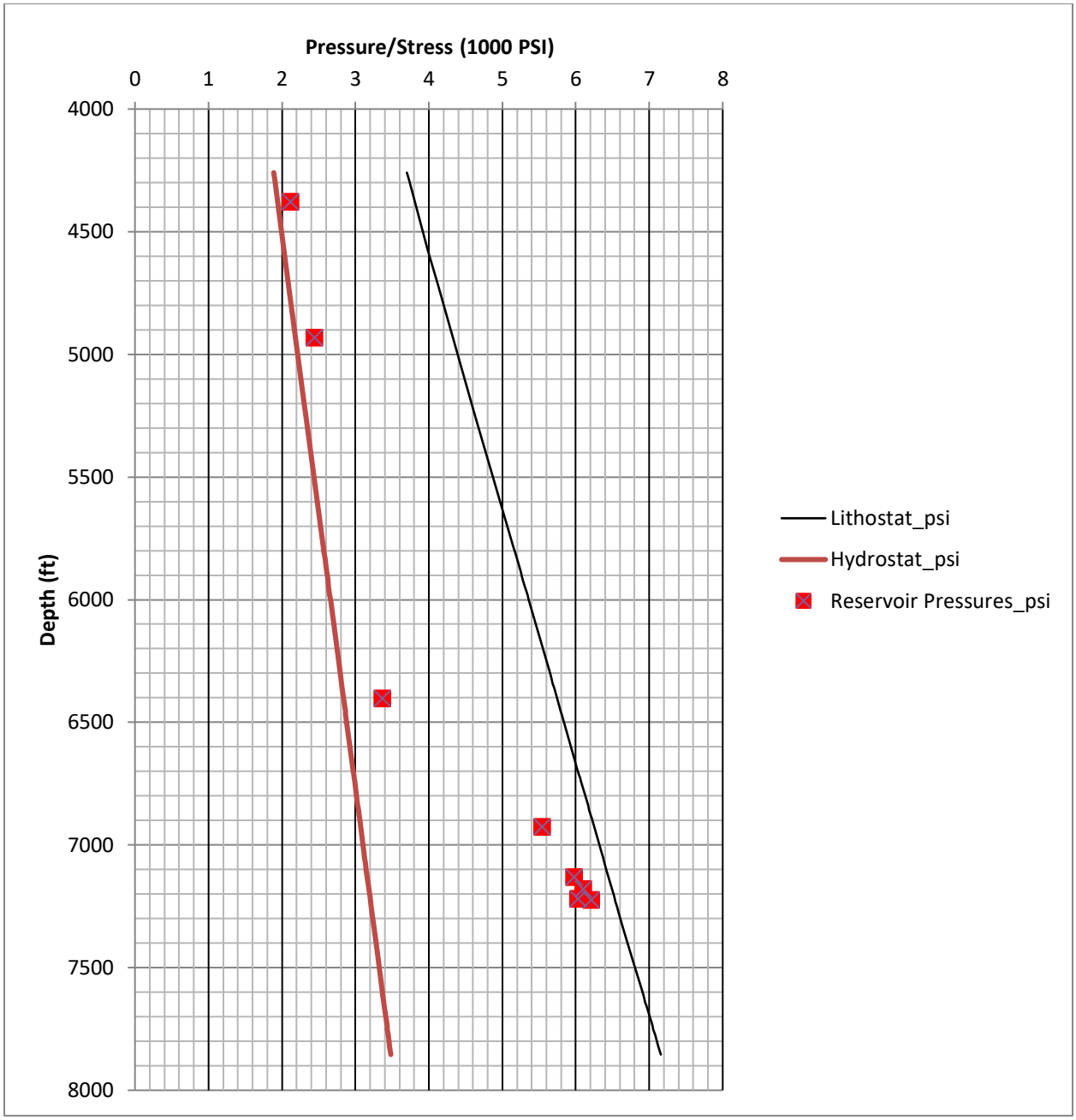

Figure 2: *Plot your calculated pore pressures here. Compare your pressure prediction to the observed pressures (red squares).*

Compare your hand drawn result to the analysis of all the mudrock velocity data in the E.I.-330 A20ST well by using the 3rd tab of the spreadsheet **'NCT_Spread_sheet_and_PPP_EI-330'.** Make sure that you have the correct NCT parameters entered into the box on the right side of the first tab (see Readme file for the spreadsheet).

Pore Pressure Bowers
(velocity to effective stress)

We will use the Bowers Approach (Bowers (1995)):

$\sigma_v' = \sigma_v - u$ Eq. 1

$u = \sigma_v - \sigma_v'$ Eq. 2

$u = \sigma_v - \left(\frac{V-5000}{A}\right)^{\frac{1}{B}}$ Eq. 3

Use the parameters that you have defined from your normal compaction trend analysis (HW 5.1) or use the example below where A= 4.475, and B =0.852(Fig. 1) for the Eugene Island 330 field.

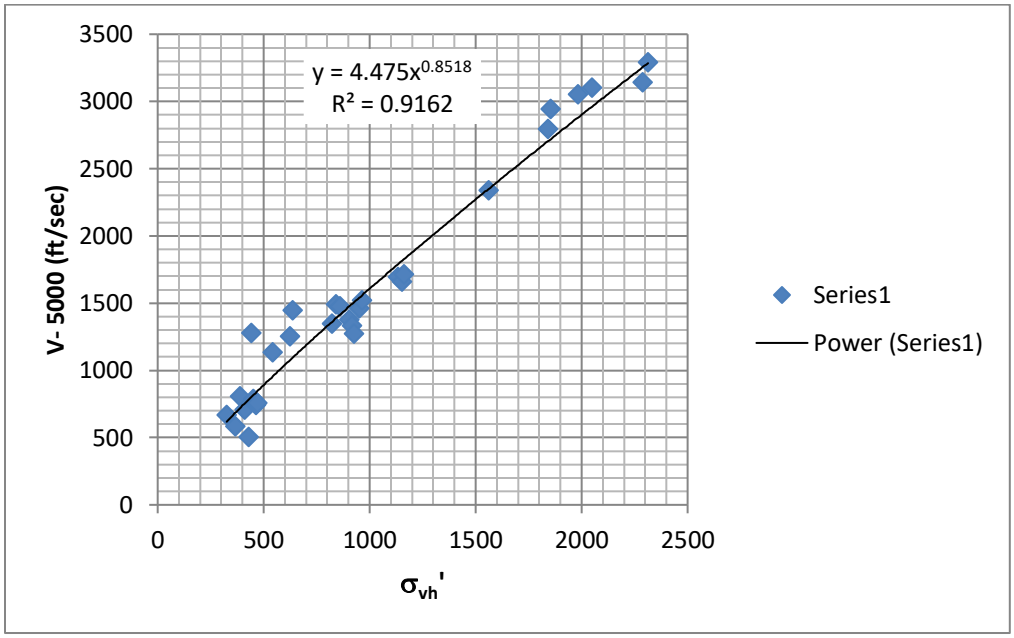

Fig. 3: Velocity vs. hydrostatic effective stress between 1000' and 5300' in the Pathfinder well.

1. Calculate the value of the pore pressure and fill in the table below and then plot these values in Figure 2.

Depth (ft)	Vel (ft/s)	Uh (psi)	σ_v (psi)	u	σ_v '
4717	8102	2189	4239		
5258	8289	2440	4754		
5945	8439	2757	5423		
7210	6668	3345	6638		
7854	6788	3644	7273		

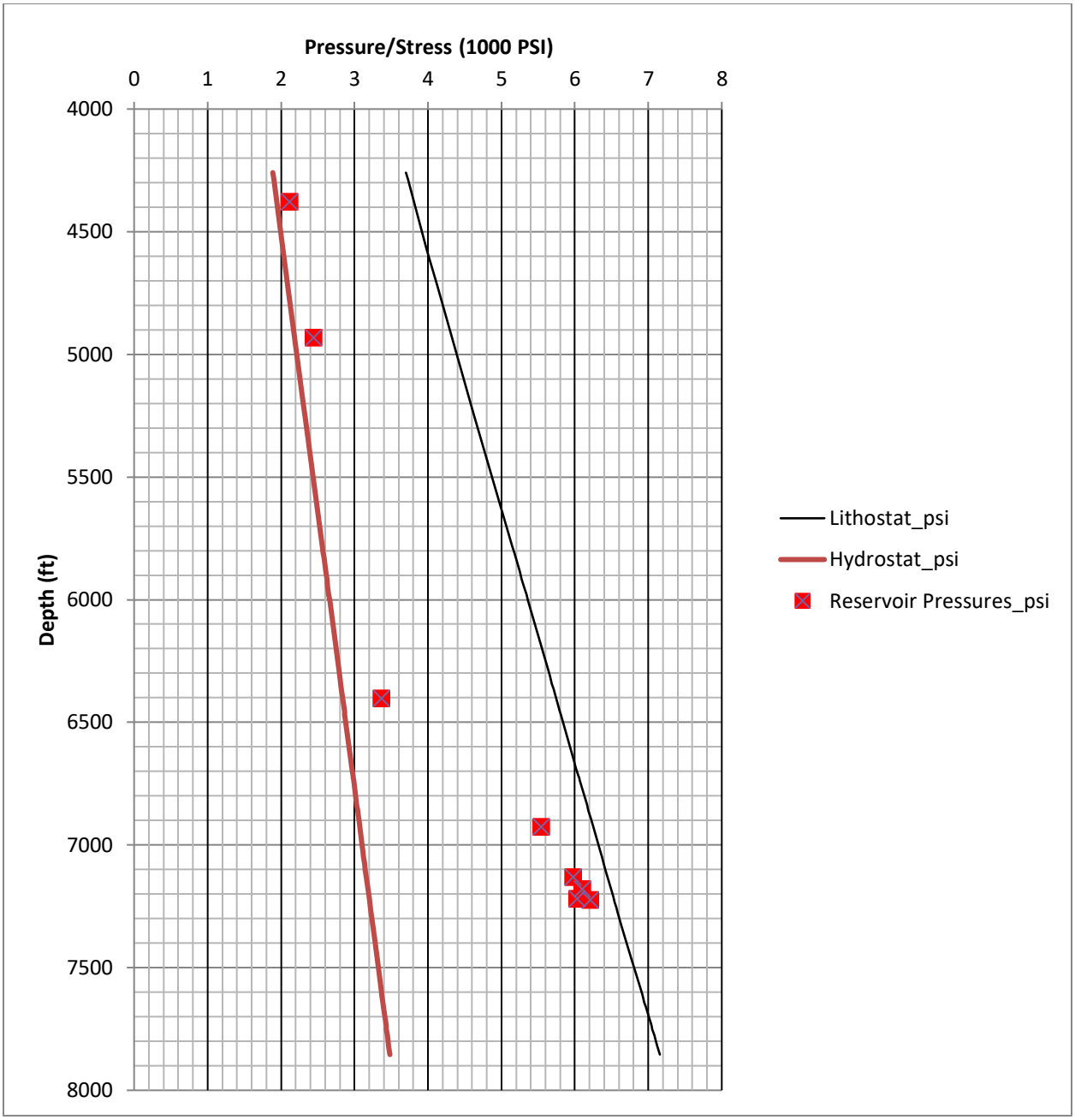

Fig. 4: Plot your calculated pore pressures here. Compare your pressure prediction to the observed pressures (red squares).

Compare your hand drawn result to the analysis of all the mudrock velocity data in the E.I.-330 A20ST well by using the 3rd tab of the spreadsheet **'NCT_Spread_sheet_and_PPP_EI-330'.** Make sure that you have the correct NCT parameters entered into the box on the right side of the first tab (see Readme file for the spreadsheet).

Flemings, P. (2021). *A Concise Guide to Geopressure: Origin, Prediction, and Applications*: Cambridge Press.