HW-1: MACONDO EXERCISE (PSI) ANSWERS

In this exercise, we will plot the Macondo well pressures as 1) pressures, 2) overpressures, and 3) equivalent mudweights (e.g. Fig. 2.1).

1) Calculate Hydrostatic Pressure and Lithostatic Stress with Depth:
    a. Fill out Table 2 based on Table 1 and Equations 1, 2, and 3.
2) Plot hydrostatic and lithostatic pressure on Figure 1 in terms of 1) Pressure, 2) Excess Pressure, and 3) Equivalent Mudweight.

Parameter	Value and Units
Hydrostatic gradient	$0.44\ \frac{PSI}{ft}$
Overburden gradient	$1.0\ \frac{PSI}{ft}$
Water Depth	5000 feet
Total Depth	20,000 feet
Reservoir Pressure	12,000 PSI
Reservoir Depth	18,000 feet

Table 1: Parameters for the exercise

To convert pressure (in psi) to equivalent mudweight (in ppg):

$$.052 * Mudweight\ (PPG) * TVDss\ (ft) = Pressure(PSI) \quad \text{Eq. 1}$$

$$Mudweight\ (PPG) = \frac{Pressure\ (PSI)}{.052 * TVD_{ss}(ft)} \quad \text{Eq. 2}$$

$$u^* = u - u_h \quad \text{Eq. 3}$$

Depth	Hydrostatic (u_h)		Lithostatic (σ_v)		Hydrostatic Effective Stress (σ_v - u_h)
feet	*PSI*	*PPG*	*PSI*	*PPG*	*PSI*
5000	2200	8.5	2200	8.5	0
8000	3520	8.5	5200	12.5	1680
12000	5280	8.5	9200	14.7	3920
15000	6600	8.5	12200	15.6	5600
18000	7920	8.5	15200	16.2	7280
20000	8800	8.5	17200	16.5	8400

3) Plot the measured reservoir pressure as a point on the same graphs. Reservoir Excess pressure (u*) is calculated from Eq. 3. The equivalent mudweight for the reservoir is calculated from Eq. 2.

Reservoir Presssure (u_{oil}) = 12,000 PSI

Reservoir Depth = 18,000 feet

$u_h = \rho_w g z$

$u_h(z = 18{,}000\ ft) = 0.44 \frac{psi}{ft} * 18{,}000\ ft$=7920 PSI.

Reservoir overpressure (u^*):

$u^* = u - u_h$

$u^* = 12{,}000 - 7920 = 4{,}080\ PSI$

Calculate the Equivalent Mud Weight for of the reservoir pressure (Eq. 2)=

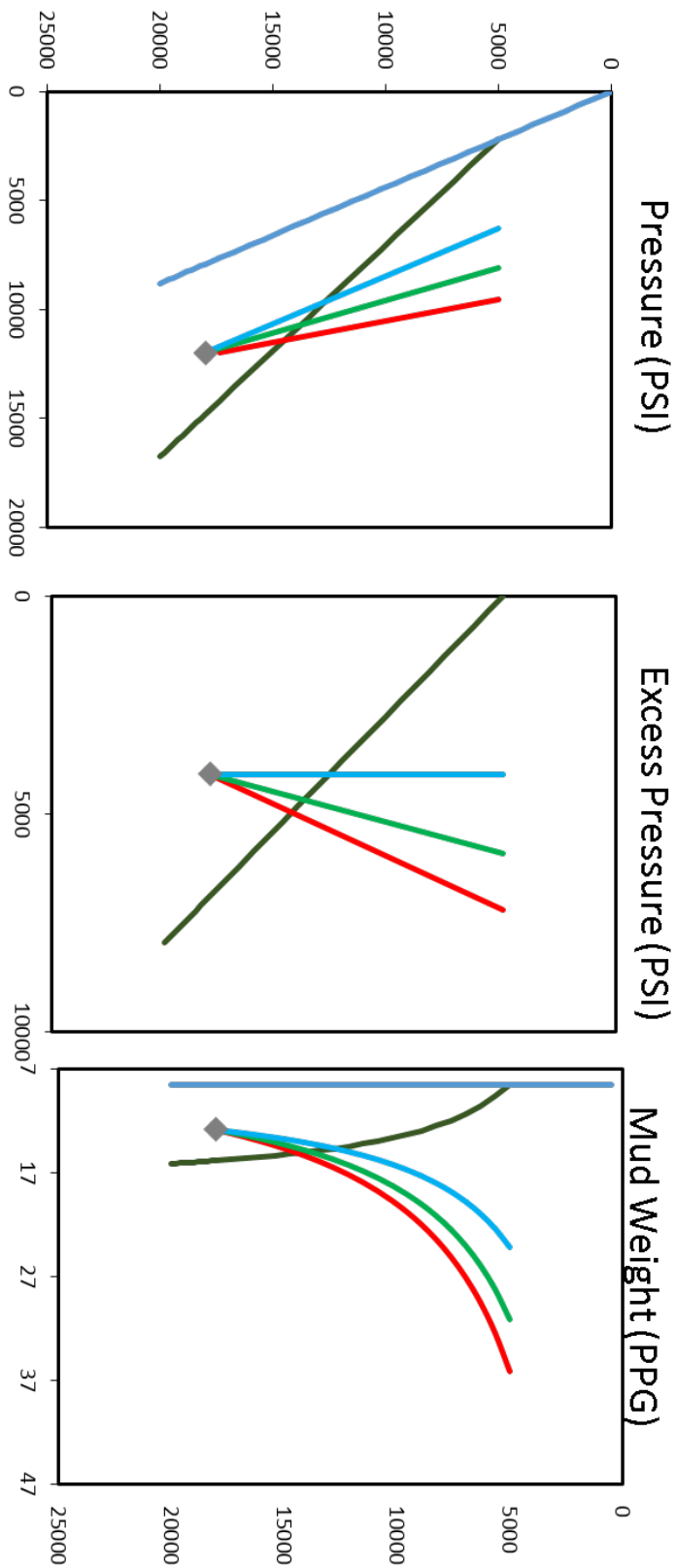
Reservoir Pressure in Mud Weight (PPG)

$$\frac{\mathbf{12{,}000\ PSI}}{(\mathbf{.052 * 18{,}000 ft})} = \mathbf{12.8\ PPG}$$

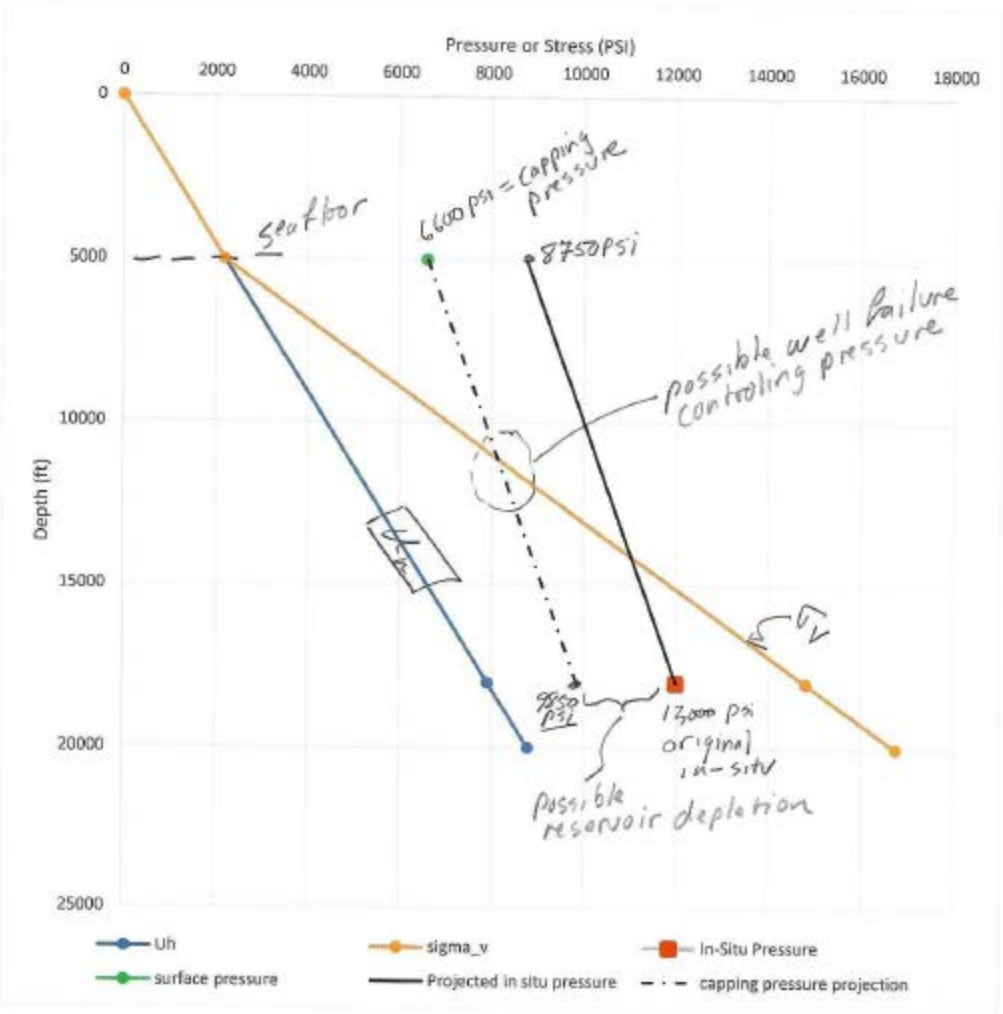
4) <u>Assume that the well is capped at the seafloor. Plot the pressure from the reservoir to the seafloor assuming a static column of oil fills the wellbore.</u>

$$\text{Oil Gradient} = 0.25 \frac{PSI}{ft}$$

Depth	Oil Pressure inside casing (u_{oil})		**Overpressure (u^*_{oil})** (u_{oil} - u_h)
feet	*PSI*	*PPG*	*PSI*
5000	8,750	33.7	6550
8000	9,500	22.8	5980
12000	10,500	16.8	5220
15000	11,250	14.4	4650
18000	12,000	12.8	4080



MACONDO Pressures



The projection of the subsurface pressure to the surface results in a capping pressure of 8750 psi. However, the observed pressure at the seafloor after capping (6600 PSI) results in an interpreted reservoir pressure of 9850 psi. The lower pressure was interpreted (initially) to be due to either well failure at around 9500' or depletion. Ultimately it was found that depletion was the cause.