HW-1: Macondo Exercise (PSI)

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:
	1. 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):

$.052\*Mudweight (PPG)\*TVDss \left(ft\right)=Pressure(PSI)$ Eq. 1

$Mudweight (PPG)=\frac{Pressure (PSI)}{.052\*TVD\_{ss}(ft)}$ Eq. 2

$u^{\*}=u-u\_{h}$ Eq. 3

|  |  |  |  |
| --- | --- | --- | --- |
| Depth | Hydrostatic (uh) | Lithostatic (σv) | Hydrostatic Effective Stress (σv - uh) |
| *feet* | *PSI* | *PPG* | *PSI* | *PPG* | *PSI* |
| 5000 | 2200 | 8.5 | 2200 | 8.5 | 0 |
| 8000 | 3520 | 8.5 | 5110 | 12.3 | 1590 |
| 12000 | 5280 | 8.5 | 8990 | 14.4 | 3710 |
| 15000 | 6600 | 8.5 | 11900 | 15.2 | 5300 |
| 18000 | 7920 | 8.5 | 14810 | 15.8 | 6890 |
| 20000 | 8800 | 8.5 | 16750 | 16.1 | 7950 |

*Table 2: Fill in the hydrostatic pressure and the lithostatic stress at the given depth points.*

1. 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.**1**
2. Assume that the well is capped at the seafloor and the well bore is filled with oil of a static pressure gradient equal to 0.25 psi/ft. Plot the pressure from the reservoir to the seafloor assuming a static column of oil fills the wellbore.

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

|  |  |  |
| --- | --- | --- |
| Depth | Gas Reservoir Pressures (uoil) | **Gas Overpressure (u\*oil)**(uoil - uh) |
| *feet* | *PSI* | *PPG* | *PSI* |
| 5000 | 8830 | 33.9 | 6630 |
| 8000 |  9100 | 21.8 | 5580 |
| 12000 | 9460 | 15.1 | 4180 |
| 15000 |  9730 | 12.4 | 3130 |
| 18000 | 1212,00010000 | 10.7 | 2080 |

# Spread Sheet Exercises

1. Estimate the pore pressure at the seafloor if the borehole is filled with water, oil, or gas.
	1. Water =
	2. Oil =
	3. Gas =
2. Extra Credit: When the well was capped, the actual pressure was 6600 PSI at the well head and the hole was filled with oil (0.25 psi/ft gradient). Estimate the in-situ pressure when the well was first capped. Why do you think this pressure is different from the measured in-situ pressure when the well was drilled (i.e. $12,000$ psi)?

