



Material Balance Simulator

Project Guide

Prof. Neetish Kumar Maurya

Presented by

Brindaa (24MT0111)

Shobhita (24MT0165)

Sathish (24MT0398)

Objective

- Develop a Material Balance Simulator
- Analyze Fluid Properties
- Estimate initial hydrocarbons in place (OOIP & OGIP)
- Evaluate Drive Mechanisms
- Estimate reservoir pressure for future prediction.
- Predict reservoir performance & production forecasting
- Making Web Interface for the Simulator

MBE Equation

Oil Reservoir MBE

$$\begin{aligned}
 & \text{Oil \& Dissolved Gas Production} \quad \text{Water Production} \quad \text{Water Injection} \quad \text{Gas Injection} \\
 & N_p [B_o + (R_p - R_s) B_g] + W_p B_w - W_i B_w - G_i B_g \\
 & = N \left[\underbrace{(B_o - B_{oi}) + (R_{si} - R_s) B_g}_{\text{Oil \& Dissolved Gas Expansion}} + \underbrace{(1 + m) B_{oi} \frac{(C_f + S_{wc} C_w)}{(1 - S_{wc})} \Delta P}_{\text{Compression of Pore Space + Connate water Expansion}} + \underbrace{m B_{oi} \left(\frac{B_g}{B_{gi}} - 1 \right)}_{\text{Gas Cap Expansion}} \right] + \underbrace{W_e}_{\text{Water Influx}}
 \end{aligned}$$

Gas Reservoir MBE

$$G(B_g - B_{gi}) + G B_{gi} \left[\frac{C_w S_w + C_f}{1 - S_w} \right] \Delta P_{ave} + W_e = G_p B_g + B_w W_p$$

Recap And Update

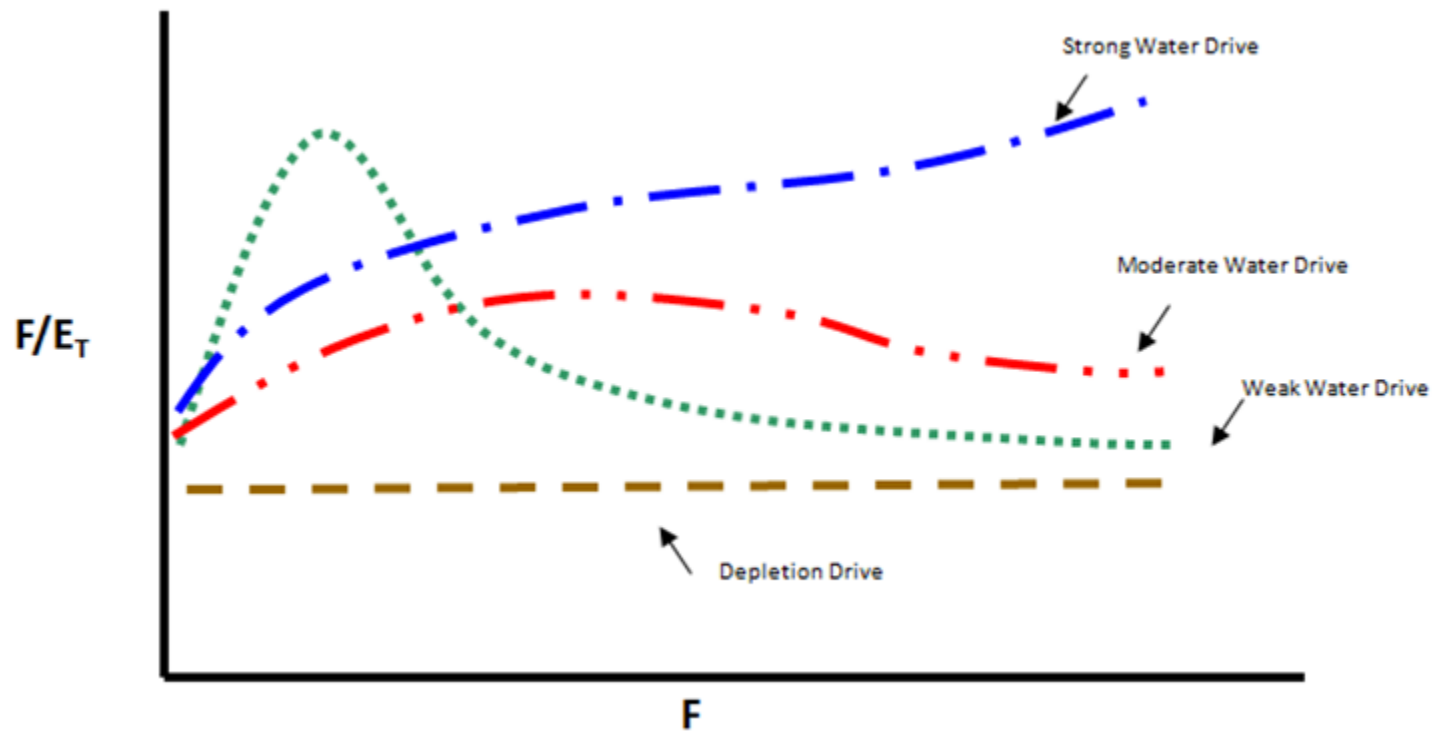
Previous Work

- Developed a material balance simulator for solution gas drive in oil reservoirs.
- Estimated key reservoir parameters via fluid properties and material balance calculations.

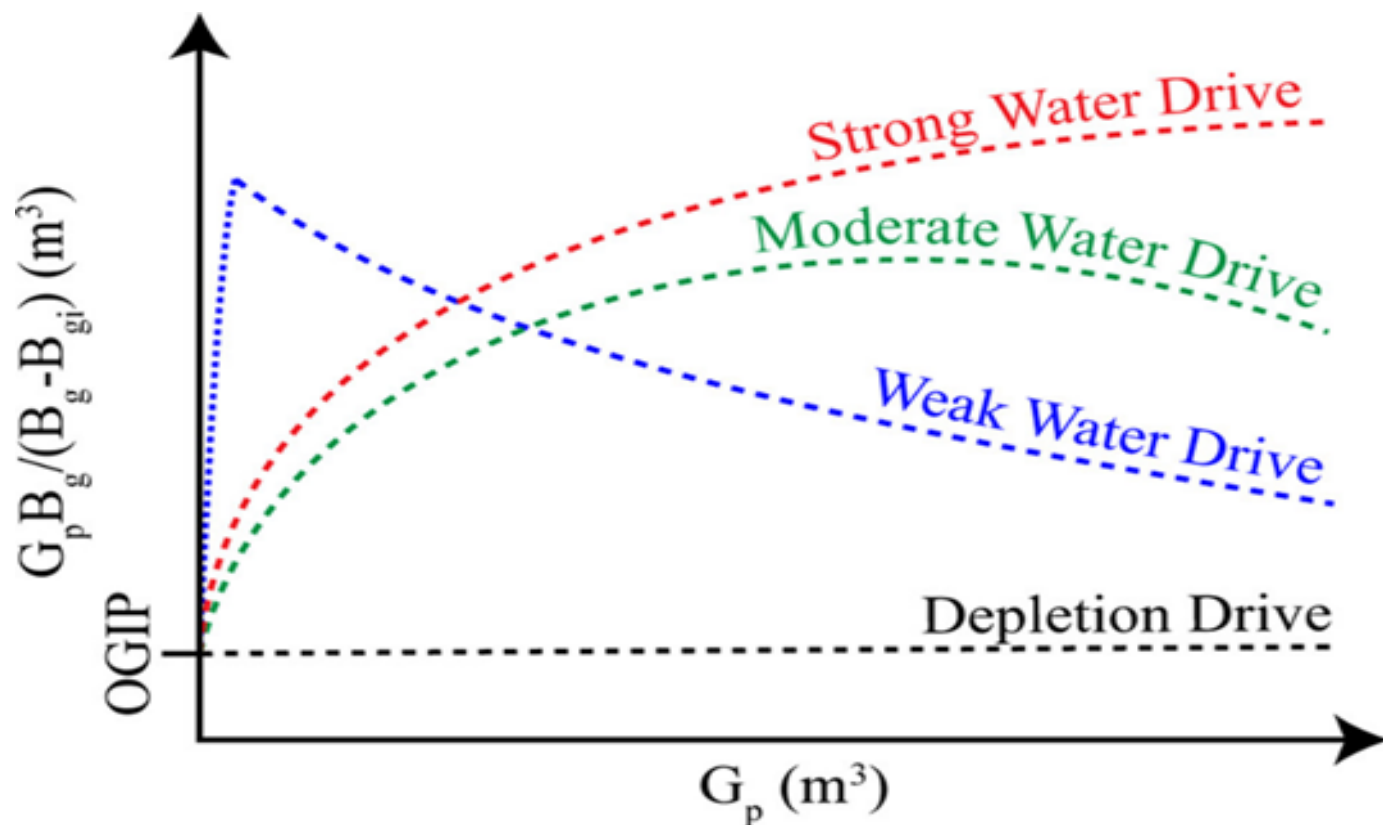
New Enhancements

- Extended the simulator to handle combination drive.
- Incorporated analysis for gas reservoirs with and without water influx.
- Developed a web interface for interactive simulation and visualization.

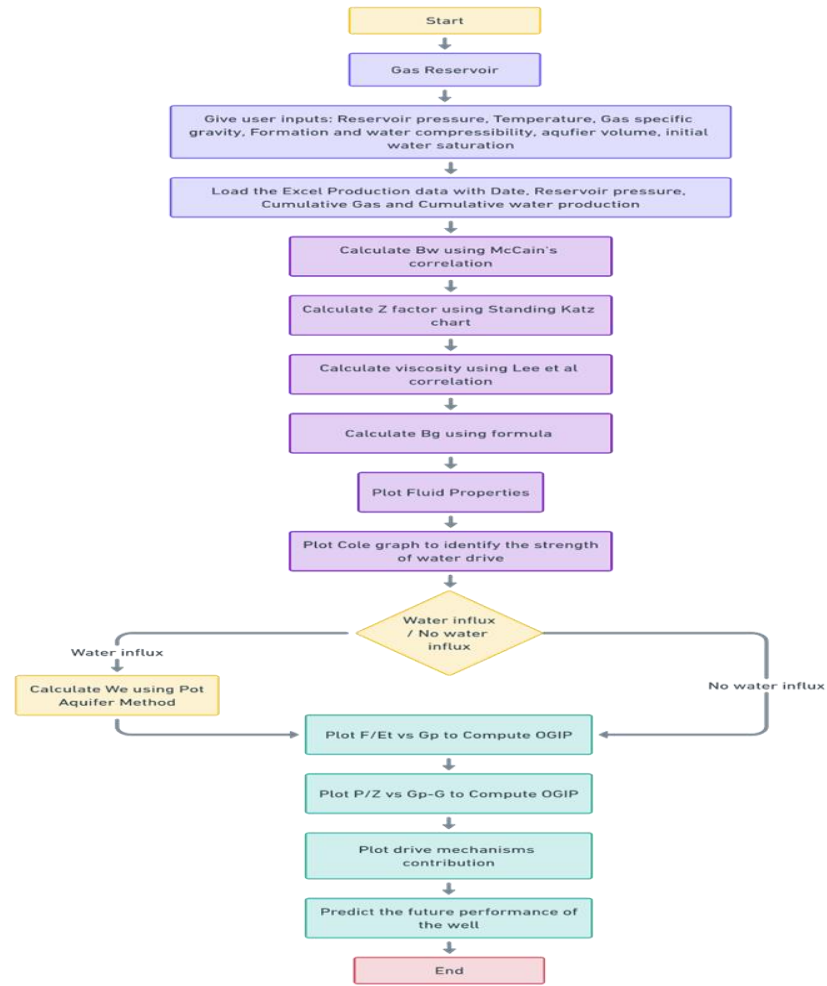
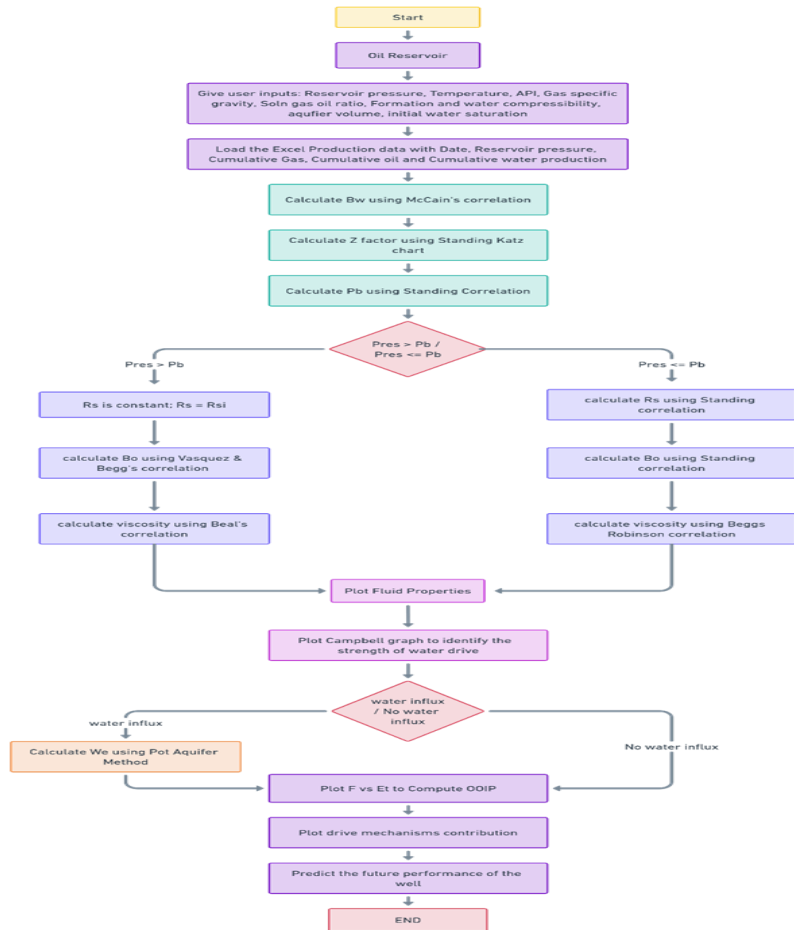
Campbell Plot



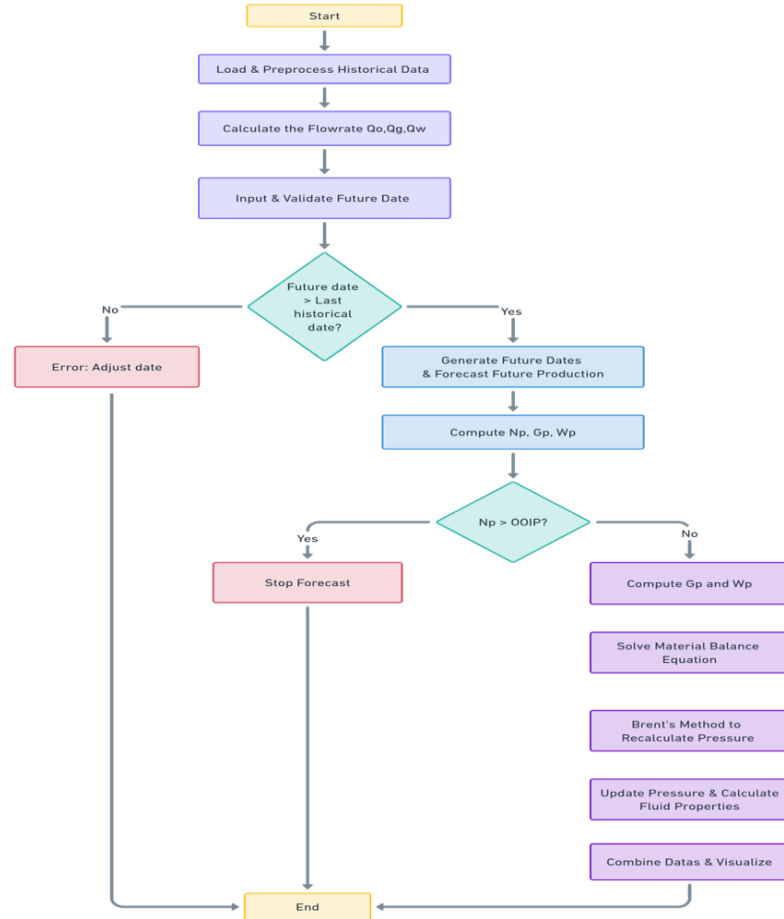
Cole Plot



Algorithms



Future Prediction



Dataset (Open Source)

Oil Reservoir Dataset

A	B	C	D	E
Date	Pressure	Cum Oil Production	Cum Gas Production	Cum Water Production
01-01-1995	4000	0	0	0
01-02-1995	3885.64	0.356222	178.111	0
01-03-1995	3836.75	0.586151	293.075	0
01-04-1995	3762.57	0.927019	463.509	0
01-05-1995	3705.21	1.24942	624.708	0
01-06-1995	3655.34	1.57649	788.245	0
01-07-1995	3707.56	1.57649	788.245	0
01-08-1995	3647.76	1.89402	947.012	0
01-09-1995	3602.54	2.20527	1102.63	0
01-10-1995	3565.38	2.50173	1250.87	0
01-11-1995	3531.51	2.80395	1401.98	0
01-12-1995	3502.16	3.09282	1546.41	0
01-01-1996	3471.13	3.39831	1699.16	0
01-02-1996	3442.89	3.70051	1850.25	0
01-03-1996	3418.26	3.98042	1990.21	0
01-04-1996	3393.39	4.27695	2138.47	0
01-05-1996	3370.5	4.56138	2280.69	0
01-06-1996	3348.37	4.85076	2425.38	0
01-07-1996	3327.59	5.12857	2564.29	0
01-08-1996	3306.68	5.41345	2706.73	0
01-09-1996	3286.27	5.69614	2848.07	0
01-10-1996	3266.93	5.96765	2983.83	0
01-11-1996	3247.3	6.24616	3123.08	0
01-12-1996	3228.61	6.51371	3256.86	0

Gas Reservoir Dataset

A	B	C	D
Date	Pressure	Cum Gas Production	Cum Water Production
01-01-1996	5300	0.0	0.0000
02-04-1996	5253	5.4	0.0000
02-07-1996	5209	10.7	0.0000
01-10-1996	5168	16.1	0.0000
01-01-1997	5128	21.5	0.0000
02-04-1997	5058	30.6	0.0000
02-07-1997	4991	39.7	0.0000
01-10-1997	4926	48.8	0.0001
01-01-1998	4863	58.0	0.0001
01-04-1998	4765	71.7	0.0002
01-07-1998	4670	85.3	0.0004
30-09-1998	4579	99.0	0.0007
01-01-1999	4487	112.9	0.0011
02-04-1999	4378	129.3	0.0017
02-07-1999	4272	145.7	0.0027
01-10-1999	4168	162.1	0.0039
01-01-2000	4064	178.6	0.0055

Web Interface

- The excel file should a column name as similar as
 - Date
 - Pressure
 - Cum Oil Production
 - Cum Gas Production
 - Cum Water Production
- Here the oil production unit is in MMSTB, Gas Production Unit is in MMSCF and water Production unit is in MMSTB.

Web Interface Link-

<https://mbsoftware-xuehd9wssyhwkucwvunhb.streamlit.app/>

Campbell Plot Validation

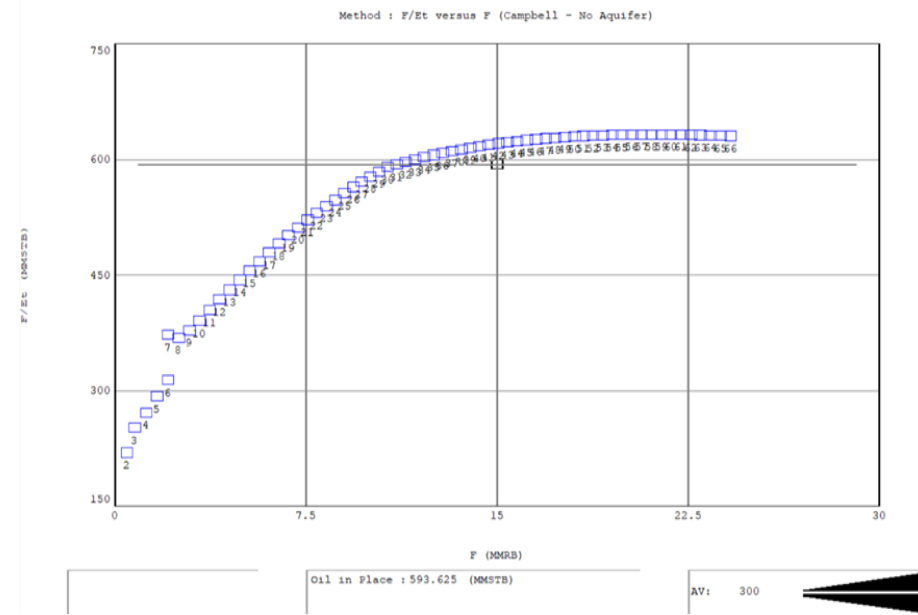
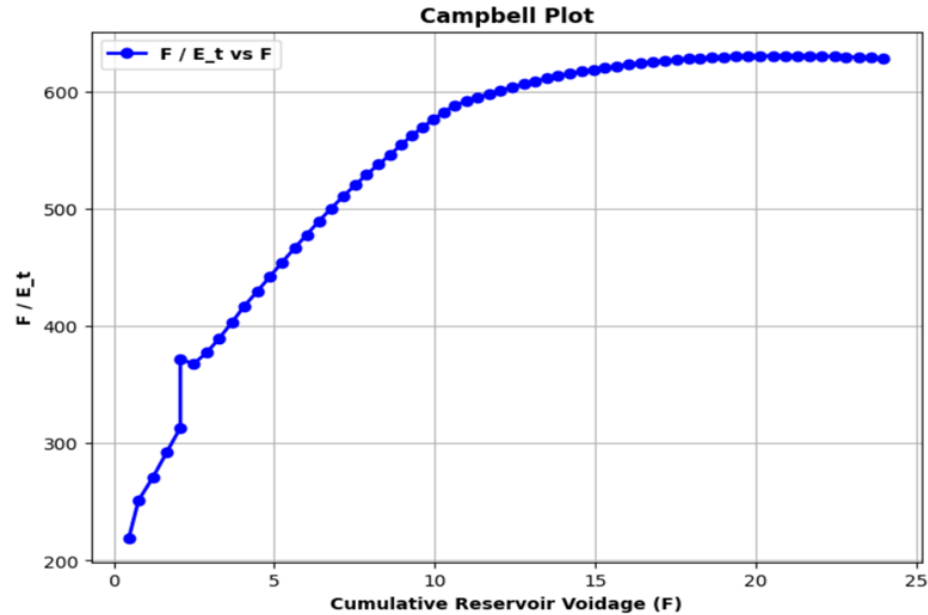


Fig - Oil Reservoir

Cole Plot Validation

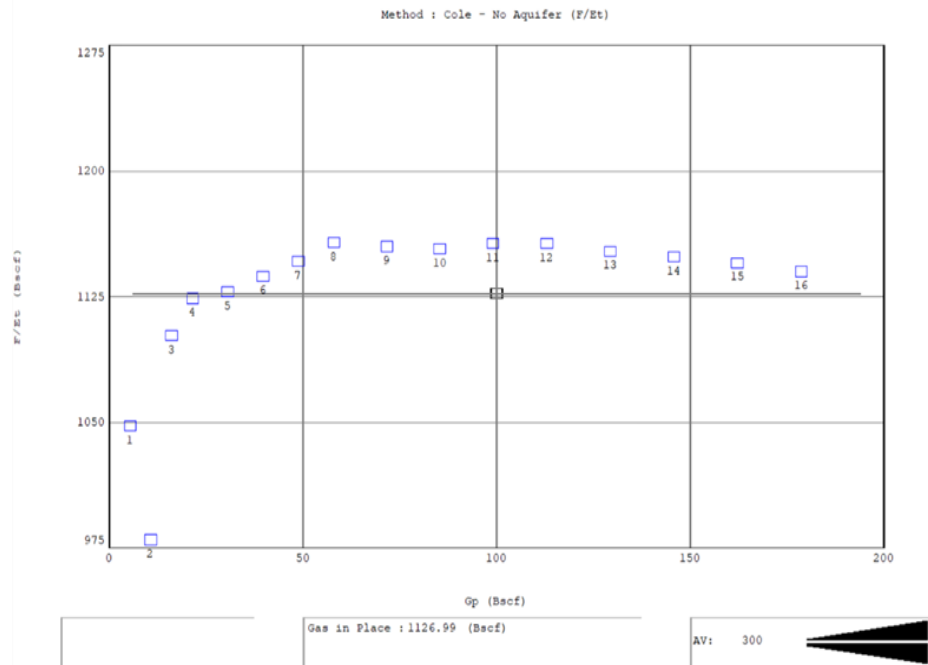
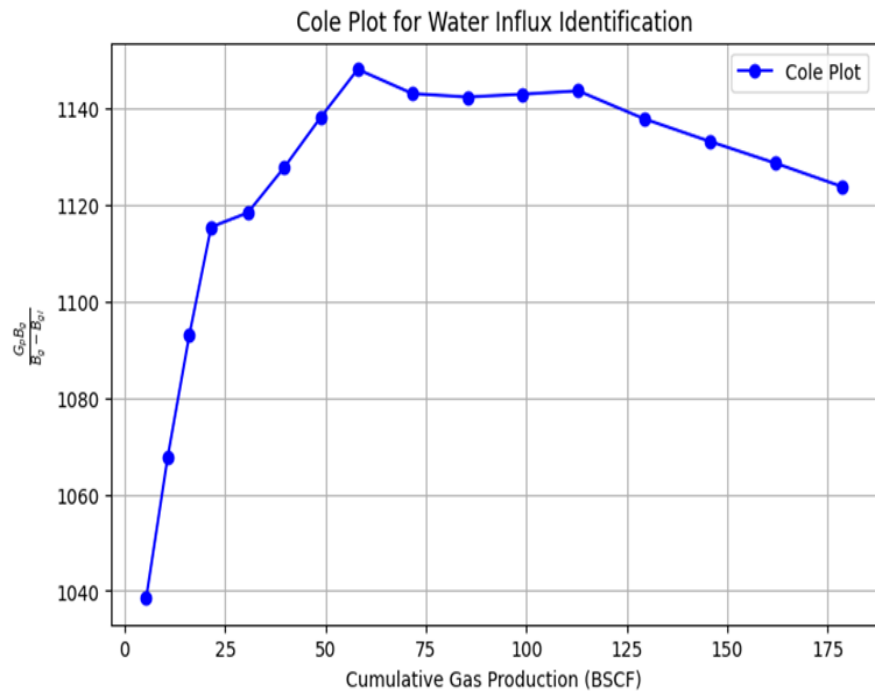


Fig - Gas Reservoir

Energy Plot Validation

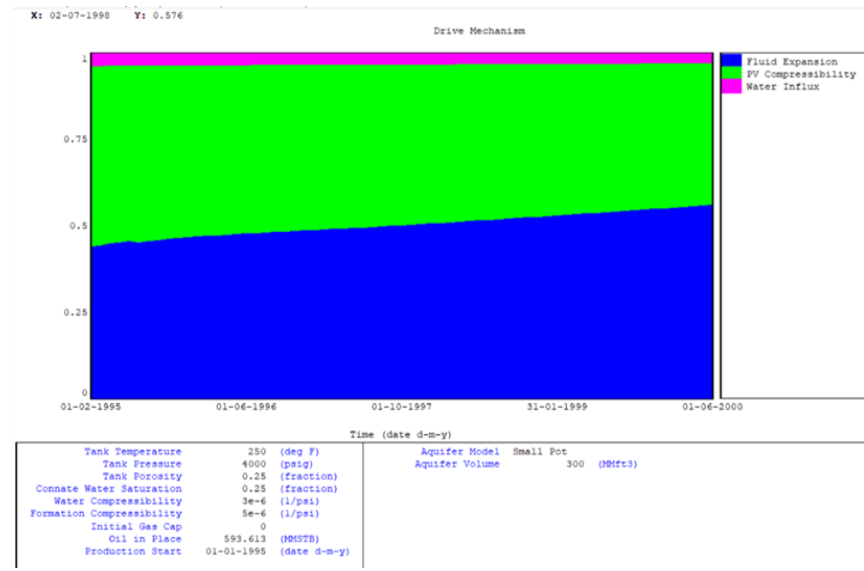
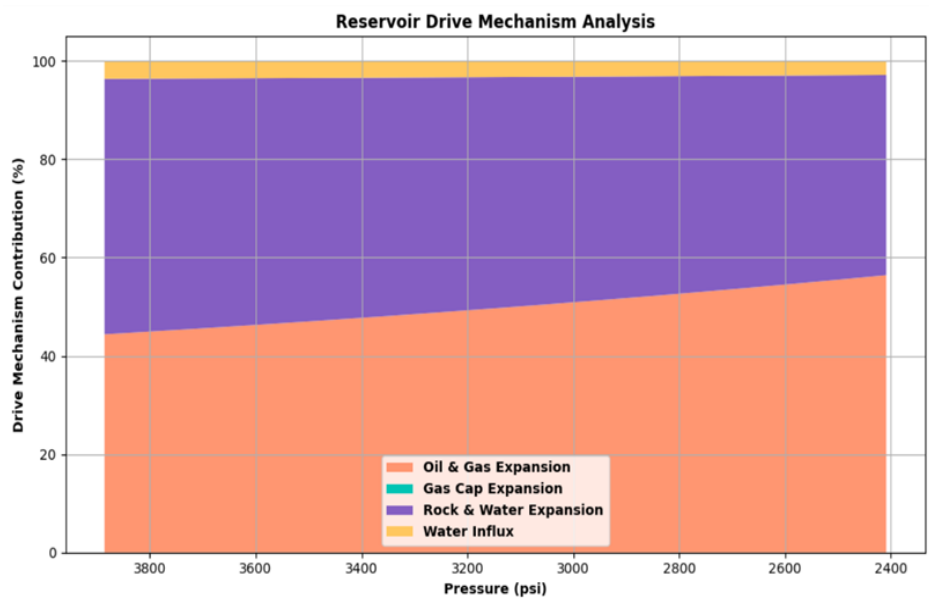


Fig - Oil Reservoir

Energy Plot Validation

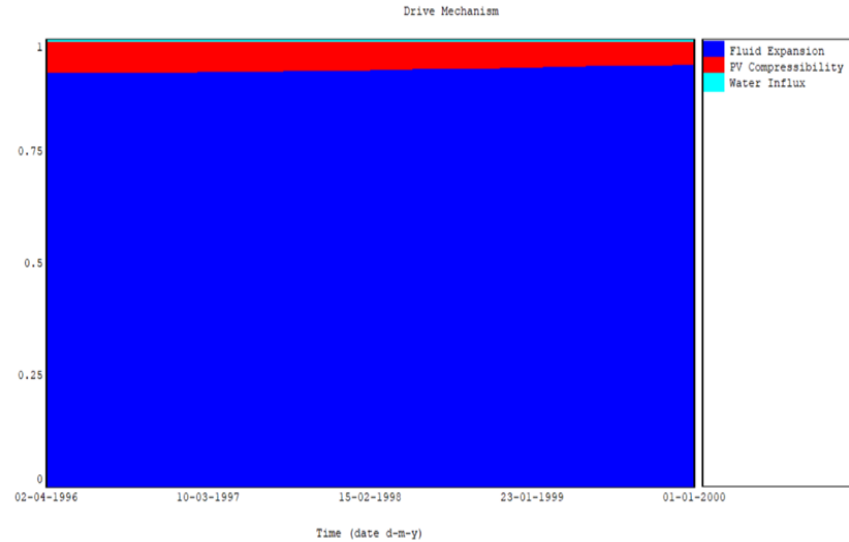
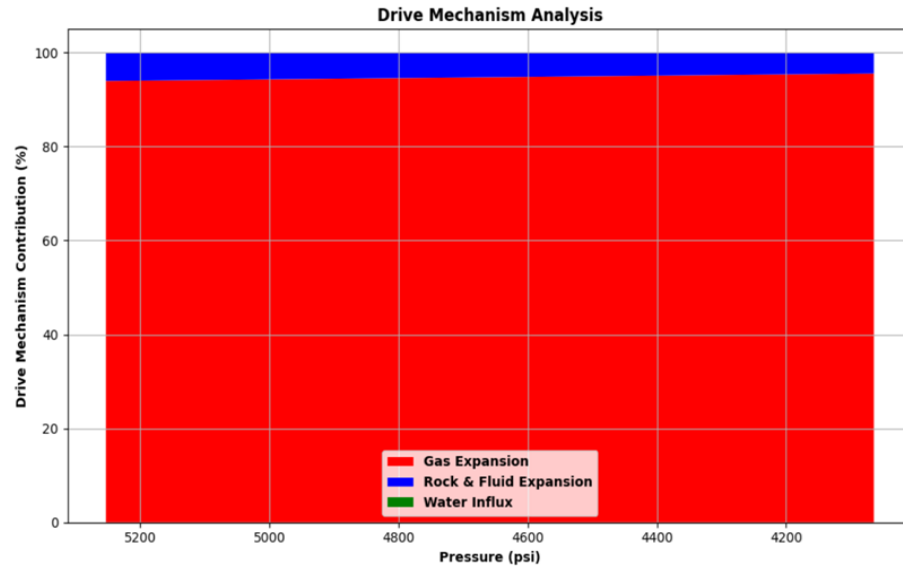


Fig - Gas Reservoir

Validation (Modified P/Z Plot)

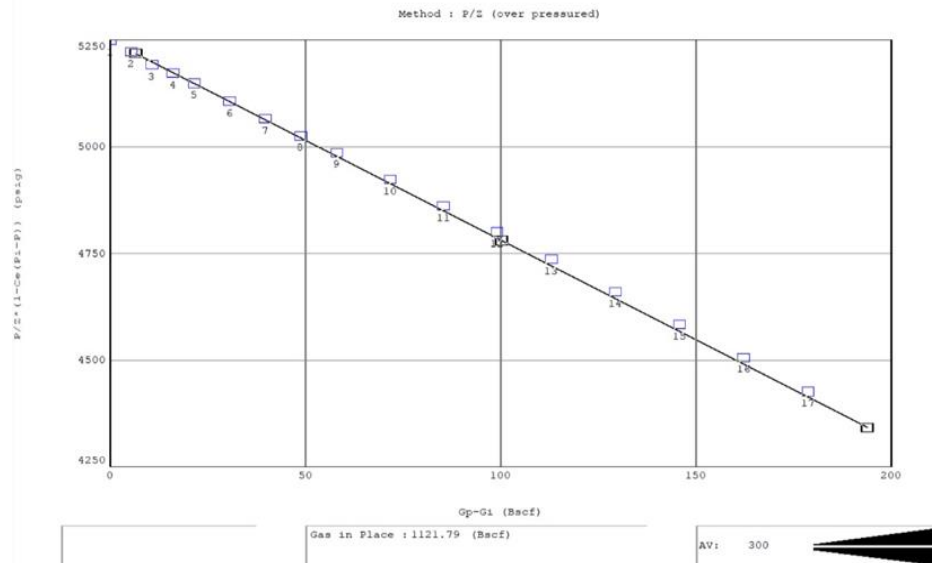
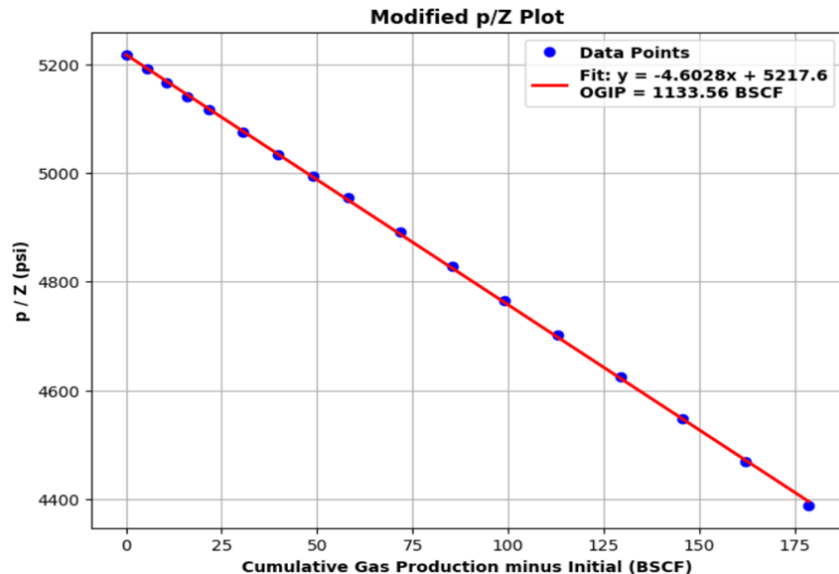
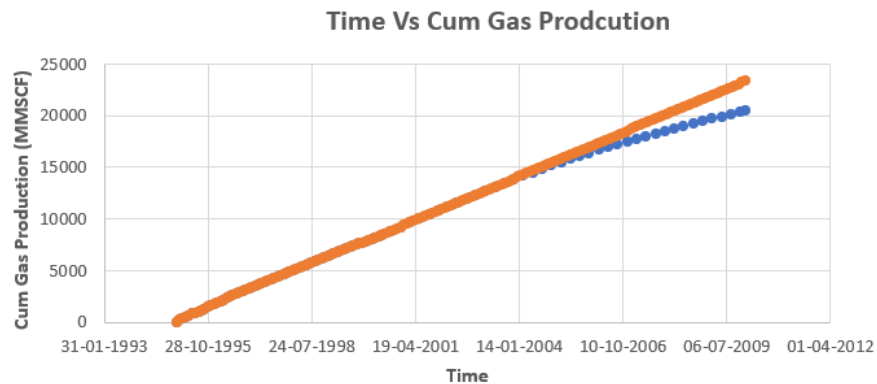
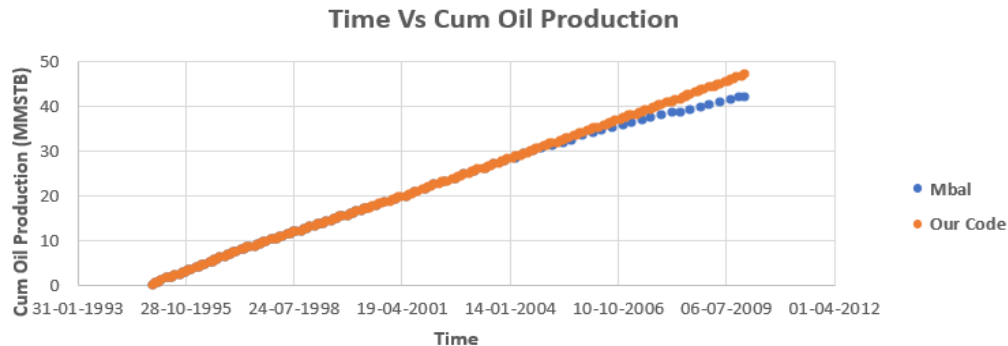
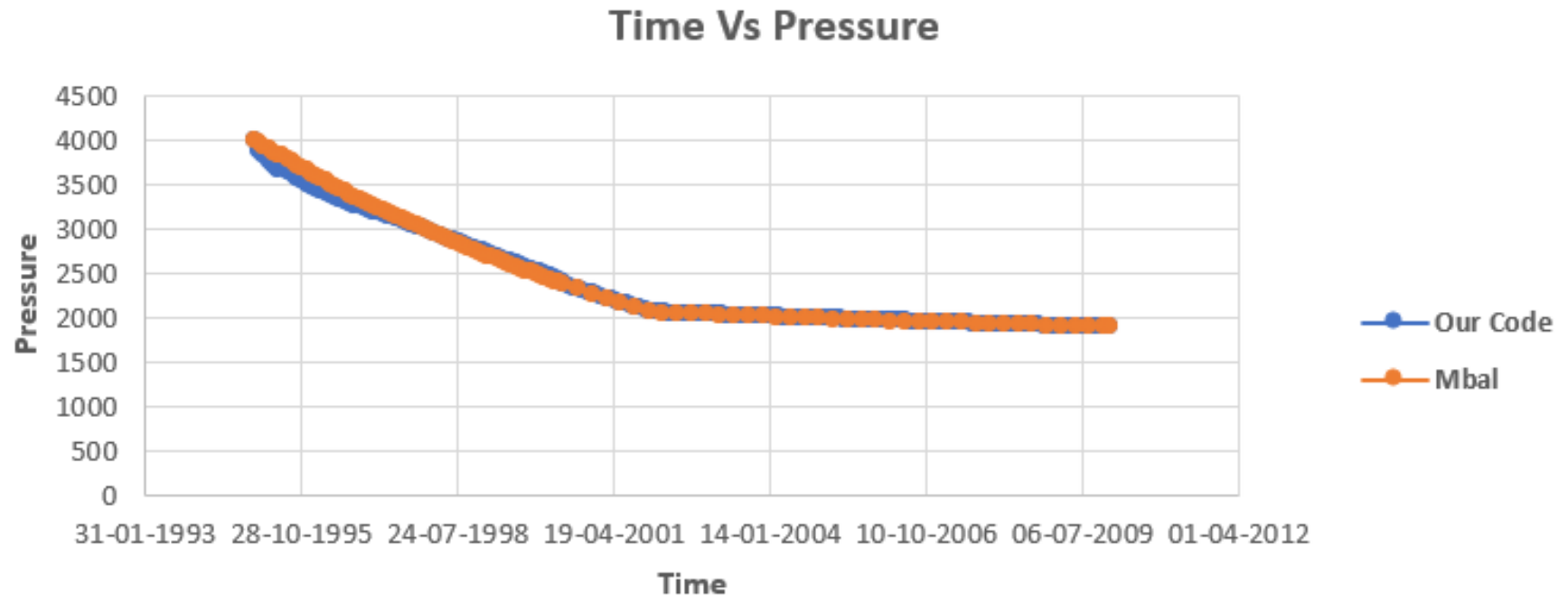


Fig - P/Z Vs Gp-Gi

Validation (Oil Reservoir)

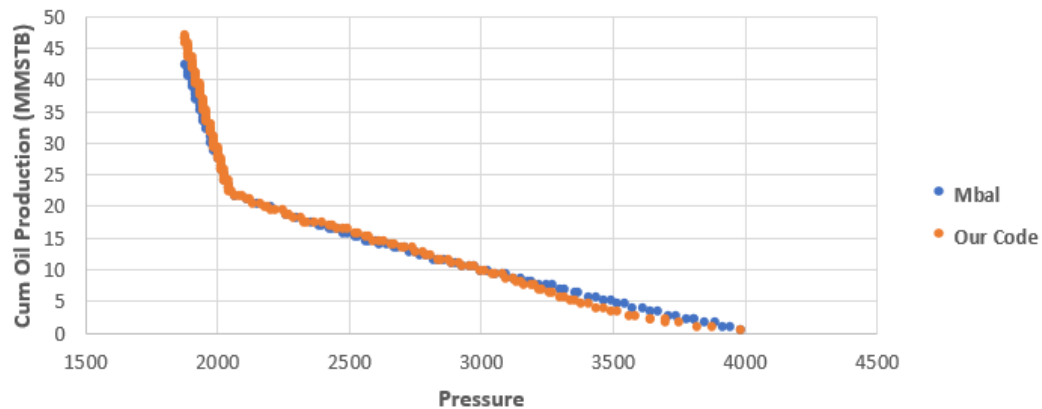


Validation (Oil Reservoir)

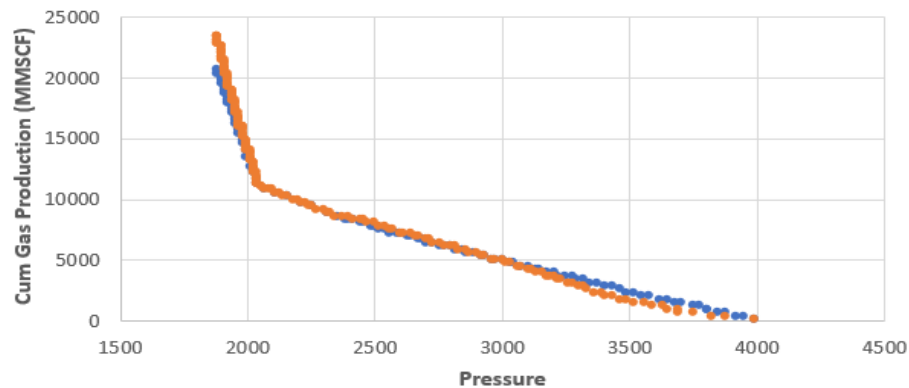


Comparison Plots (Oil Reservoir)

Pressure Vs Cum oi Production

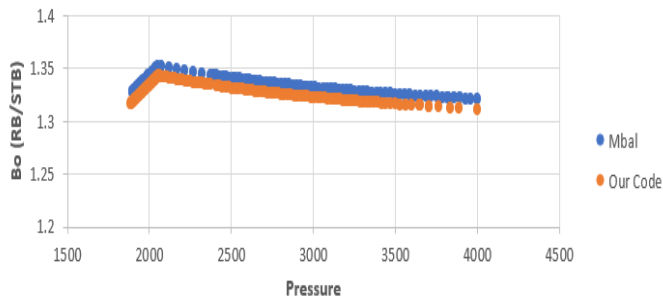


Pressure VS Cum Gas Production

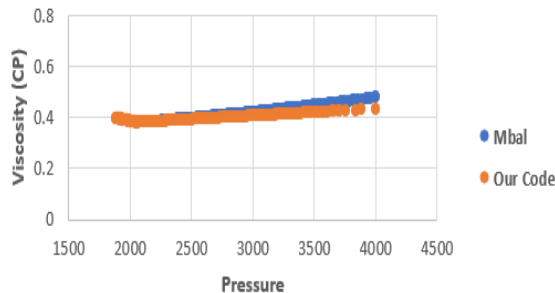


Comparison Plots (Fluid Properties)

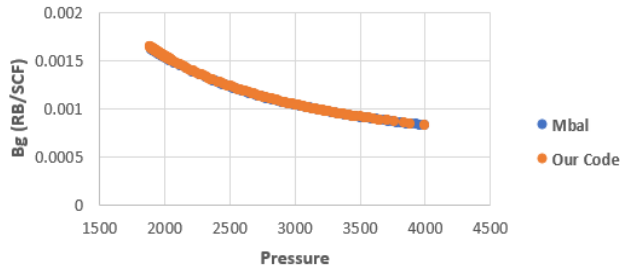
Pressure Vs Bo



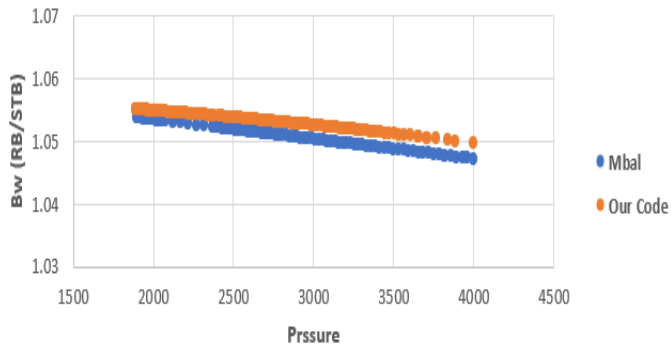
Pressure VS Viscosity



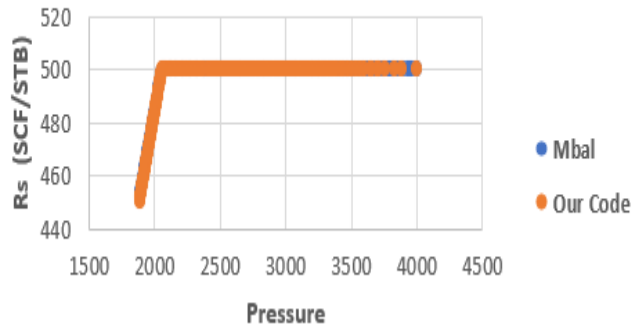
Pressure Vs Bg



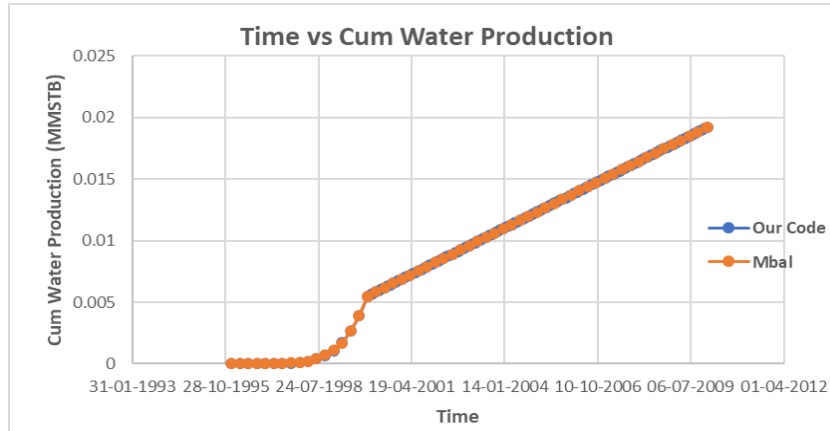
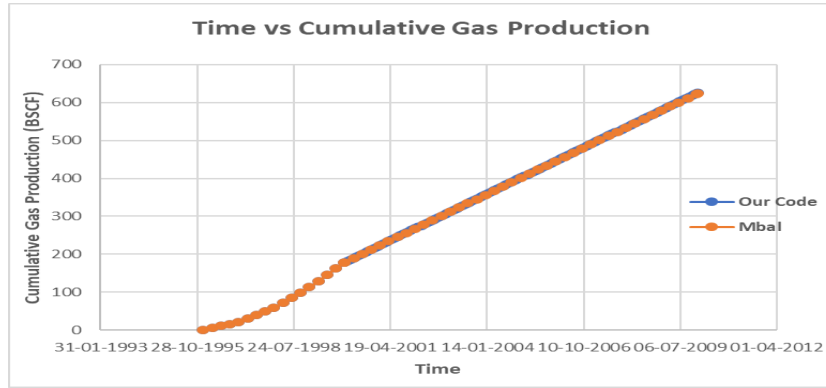
Pressure Vs Bw



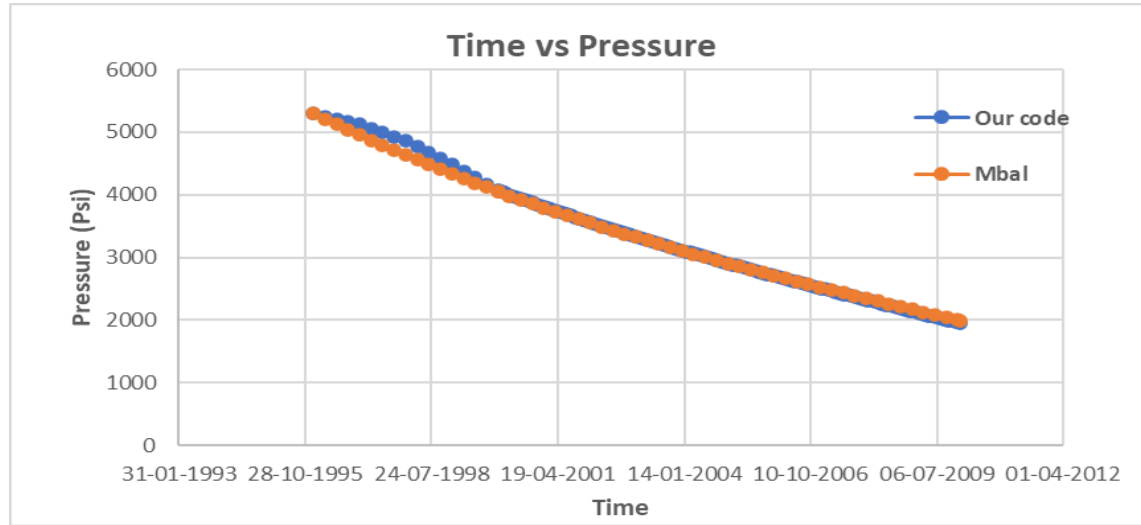
Pressure Vs Rs



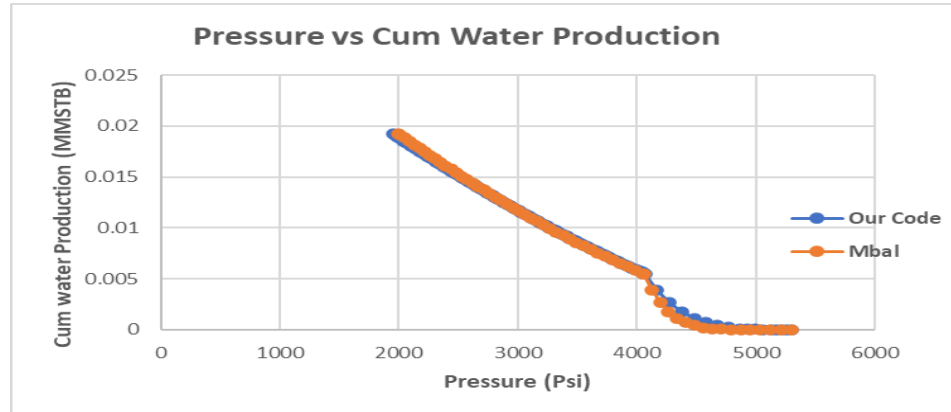
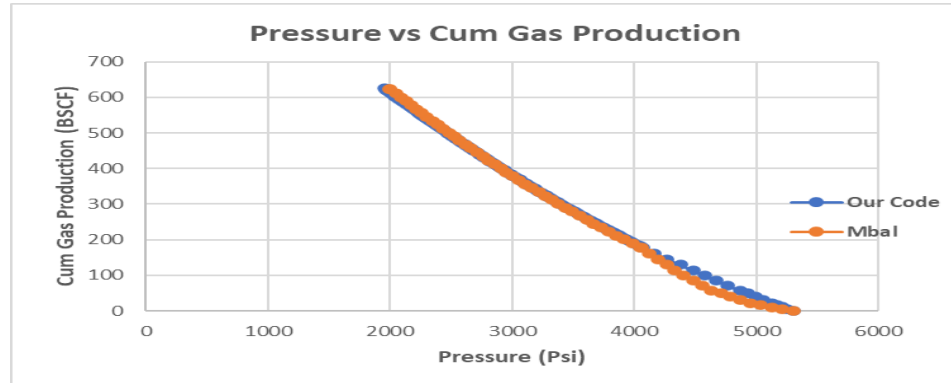
Validation (Gas Reservoir)



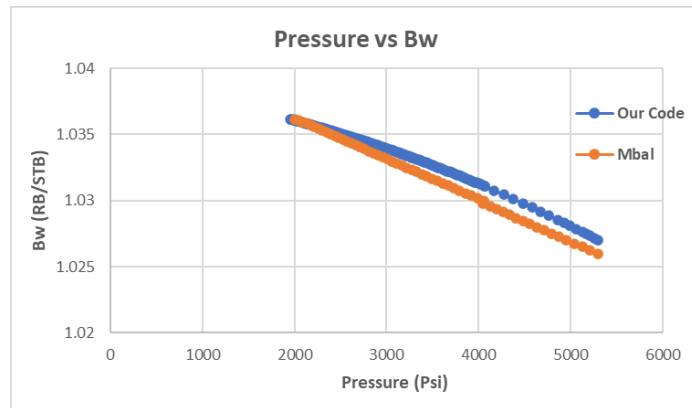
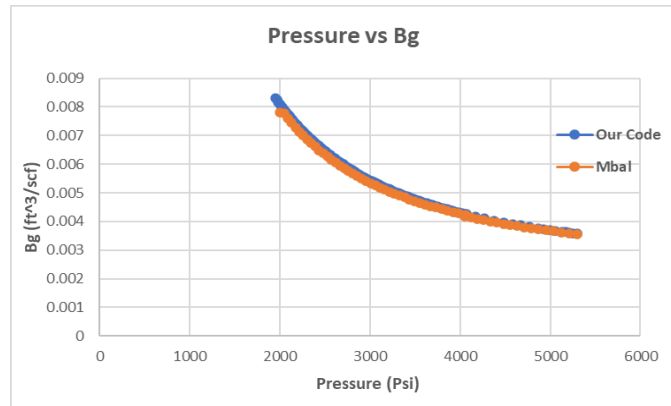
Validation (Gas Reservoir)



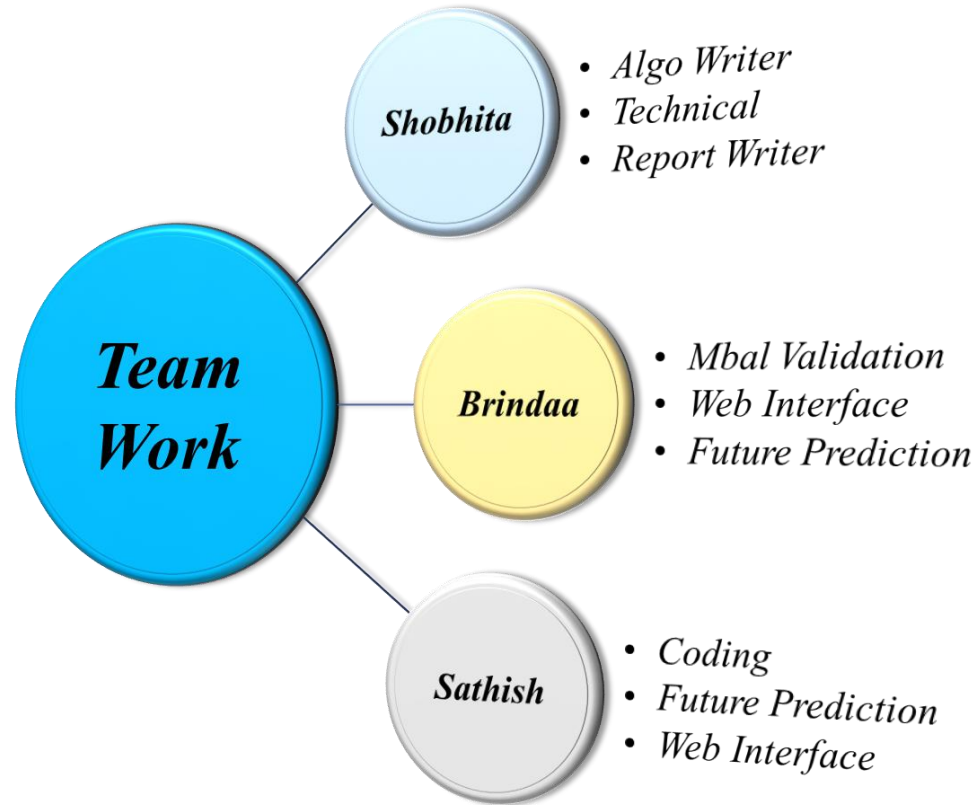
Comparison Plots (Gas Reservoir)



Comparison Plots (Fluid Properties)



Individual Contribution for a Project



Colab- [Link](#)

Thank You