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## **APPENDIX**

APPENDIX A

General Information for Well Model

Table A1 Water Influx Parameters for Oil Layers

Name	Water Influx for Each Oil Layers							
	Depth (ft TVD)	Water Influx Model	Water Influx System	Reservoir thickness (ft)	Reservoir Radius (ft)	Outer/Inner Radius Ratio	Encroachment Angle (degrees)	Aquifer Permeability (md)
Oil Layer #1	5000	Hurst-van Everdingen- Modified	Radial Aquifer	40	920	6	180	200
Oil Layer #2	6000			40	920	6	180	150
Oil Layer #3	7000			40	920	6	180	100
Oil Layer #4	8000			40	920	6	180	50

Table A2 PVT Input Data in MBAL for Oil Layers

Reservoir Fluid	Oil @ 5000’ TVD	Oil@ 6000’ TVD	Oil@ 7000’ TVD	Oil@ 8000’ TVD
Separator	Single-Stage			
Use Tables	No			
Use Matching	No			
Controlled Miscibility	No			
Solution GOR	275 (scf/stb)	400 (scf/stb)	540 (scf/stb)	750 (scf/stb)
Oil gravity	40 (API)			
Gas gravity	0.8 (sp. gravity)			
Water salinity	10000 (ppm)			
Mole percent H2S	0 (percent)			
Mole percent CO2	5 (percent)			
Mole percent N2	0 (percent)			
Pb, Rs, Bo correlation	Vazquez-Beggs			
Oil viscosity correlation	Petrosky et al			



Table A3 Input Data - Relative Permeability for Oil and Gas Layers

	Relative Permeability	
Parameters	Oil Layers	Gas Layer
Rel. Perm. From	Corey Functions	Corey Functions
Hysteresis	No	No
Modified	No	N/A
Water Sweep Efficiency	100%	100%
Gas Sweep Efficiency	100%	N/A

Table A4 Input Data - Residual Saturation and Corey Exponents for Oil and Gas Layers

Oil Layers	Residual Saturation (fraction)	End Point (fraction)	Exponent
K <sub>rw</sub>	0.15	0.5	4
K <sub>ro</sub>	0.2	0.8	4
K <sub>rg</sub>	0.02	0.5	2
Gas Layers	Residual Saturation (fraction)	End Point (fraction)	Exponent
K <sub>rw</sub>	0.15	0.6	3
K <sub>rg</sub>	0.05	0.8	2

Table A5 Input Data for Option Summary in PROSPER

Parameters	Input Data		
	Oil Gas Lift	Oil Non-Gas Lift	Gas Non-Gas Lift
Fluid	Oil		Dry and Wet Gas
PVT Method	Black Oil		
Equation Of State	N/A		
Separator	Single-Stage		
Hydrates	Disable Warning		
Water Viscosity	Use Pressure Corrected Correlation		
Water Vapour	No Calculations		Calculated Condensed Water Vapour
Viscosity Model	Newtonian Fluid		
Steam Option	No Steam Calculations		
Flow Type	Tubing		
Well Type	Producer		
Artificial Lift	Gas Lift (Continuous)	None	N/A
Lift Type	No Friction Loss In Annulus	N/A	
Predicting	Pressure and Temperature (offshore)		
Temperature Model	Rough Approximation		
Range	Full System		
Completion	Cased Hole		
Sand Control	None		
Inflow Type	Single Branch		
Gas Coning	No		

Table A6 Input Data for IPR

Parameter	For Oil Layers	For Gas
Reservoir Model	Fetkovich	Petroleum Expert
Mechanical/ Geometrical Skin	Enter Skin by Hand	Enter Skin by Hand
Drainage Area (acres per layer)	61	51
Dietz Shape Factor	31.6	31.6
Wellbore Radius	0.255 ft	0.255 ft
Mechanical Skin	5	5

Table A7 Input Data for Downhole Equipment

Tubing OD	2.875”
Tubing ID	2.441”
Tubing Inside Roughness	0.0006
Casing OD	7”
Casing ID	6.184”
Gas Lift Valve Size / Type	1” Orifice
Gas Lift Valve Setting Depth	5825’ MD/ 4000’ TVD

Table A8 Input Data for Geothermal Gradient

Formation Measured Depth (ft)	Formation Temperature (deg F.)
0	70
7064	240
10912	310

Table A9 Input Data for Directional Survey

ft MD	ft TVD
0	0
1020	1019
2010	1986
3000	2561
4020	3075
5010	3562
5825	4000
7020	4963
7064	5000
8298	6000
9601	7000
10912	8000

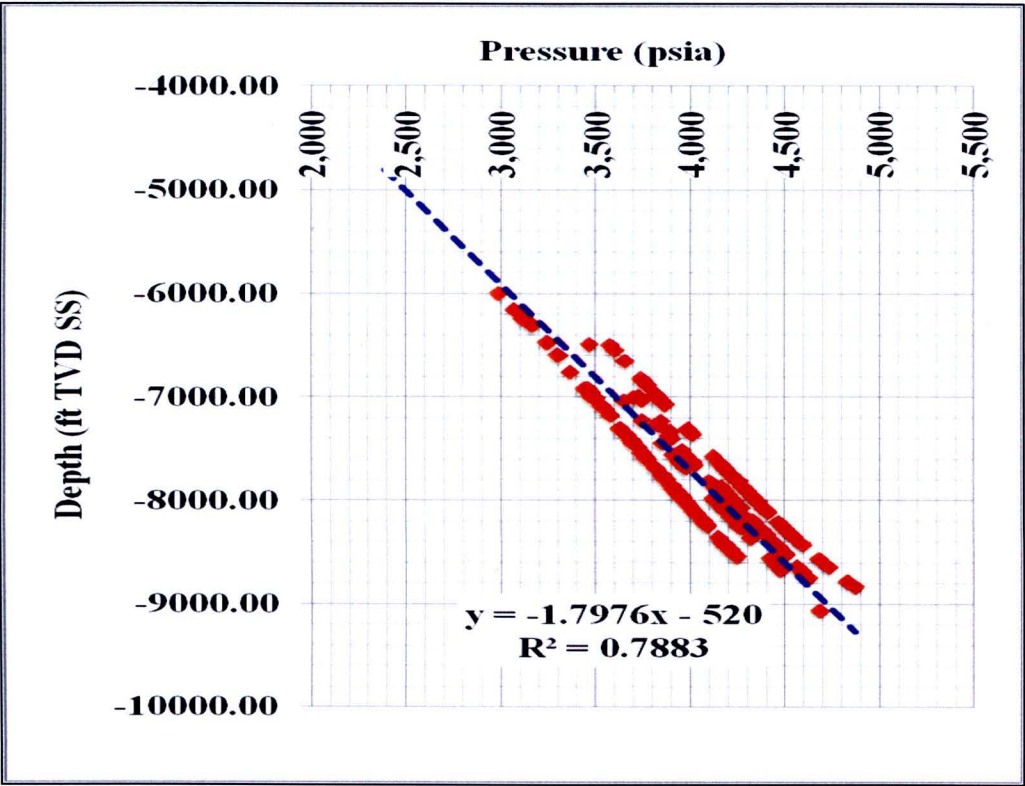


Figure A1 Reservoir Pressure Profile

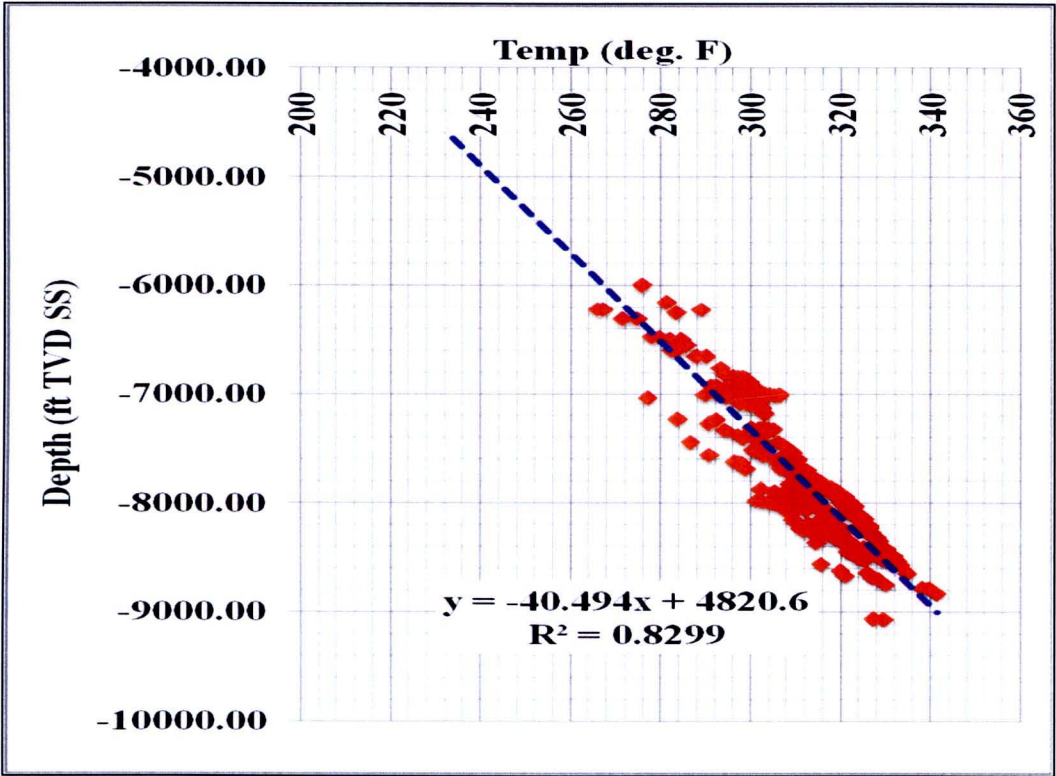


Figure A2 Reservoir Temperature Profile



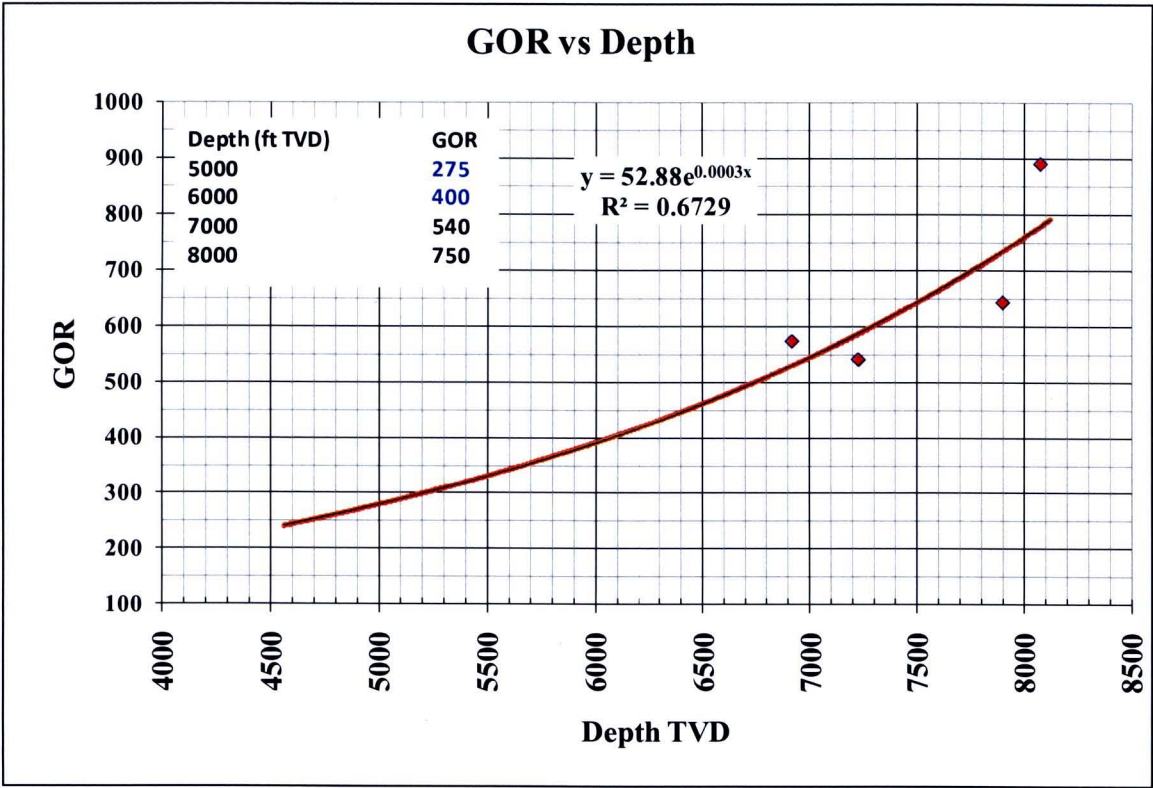


Figure A3 Initial Formation GOR Correlation

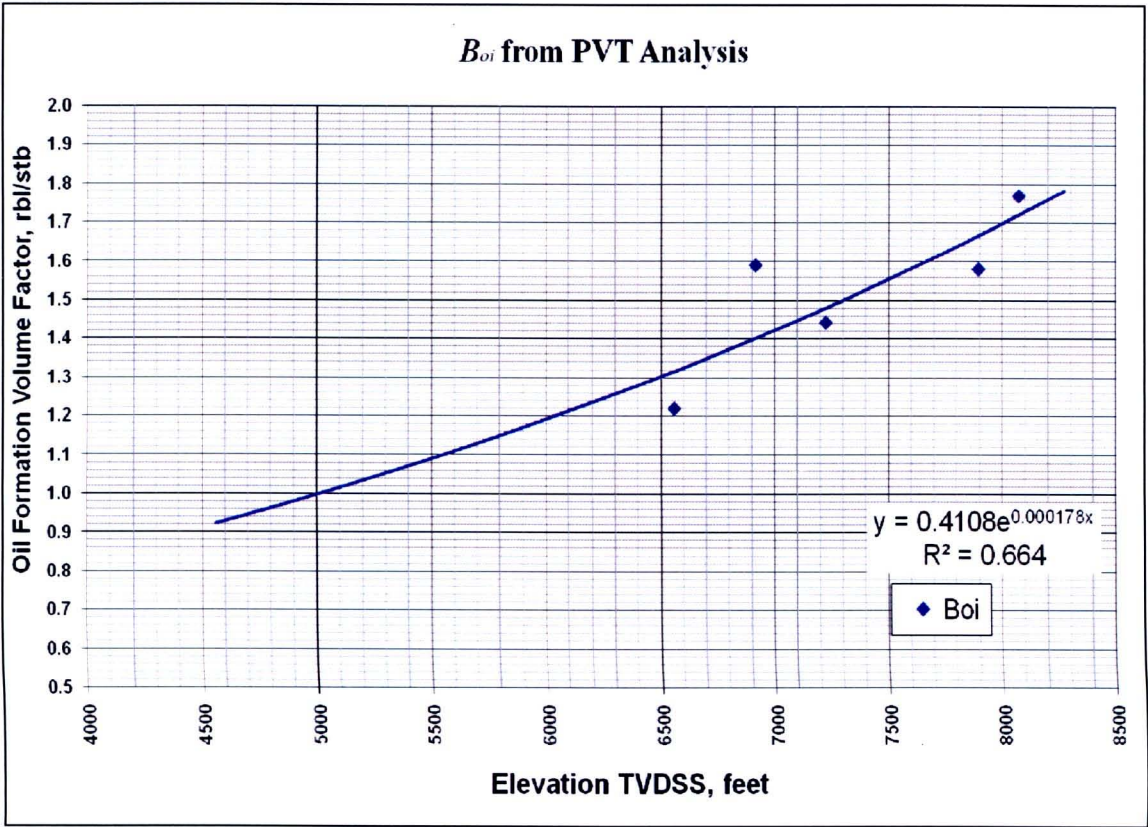


Figure A4 Initial Oil Formation Volume Factor ( $B_{oi}$ ) Correlation

Tank Input Data - Water Influx

✓ Done ✗ Cancel ? Help

Tank Oil-5000-ft + - ✕ Disabled

Tank Parameters	Water Influx	Rock Compress.	Rock Compaction	Pore Volume vs Depth	Relative Permeability	Production History
Model Hurst-van Everdingen-Modified						
System Radial Aquifer						
Reservoir Thickness		40	feet			
Reservoir Radius		920	feet			
Outer/Inner Radius ratio		6				
Encroachment Angle		180	degrees			
Aquifer Permeability		200	md			

Figure A5 Tank Input Data – Water Flux for Oil Layer @ 5000’ TVD

Tank Input Data - Rock Properties

✓ Done ✗ Cancel ? Help

Tank Oil-5000-ft + - ✕

Tank Parameters	Water Influx	Rock Compress.	Rock Compaction	P
Rock Compressibility		3.28736e-6	1/psi	

Figure A6 Tank Input Data - Rock Compressibility for Oil Layer @ 5000’ TVD

Tank Input Data - Relative Permeabilities

✓ Done

✗ Cancel

ⓘ Help

Plot

Copy

Calc

Tank Oil-5000-ft 

+ - ✗

☐ Disabled

Tank Parameters

Water Influx

Rock Compress.

Rock Compaction

Pore Volume vs Depth

Relative Permeability

Production History

Rel Perm. fromCorey Functions

HysteresisNo

ModifiedNo

Water Sweep Eff.100percent

Gas Sweep Eff.100percent

	Residual Saturation	End Point	Exponent
	fraction	fraction	
Krw	0.15	0.5	4
Kro	0.2	0.8	4
Krg	0.02	0.5	2

Figure A7 Tank Input Data - Relative Permeability for Oil Layer @ 5000' TVD

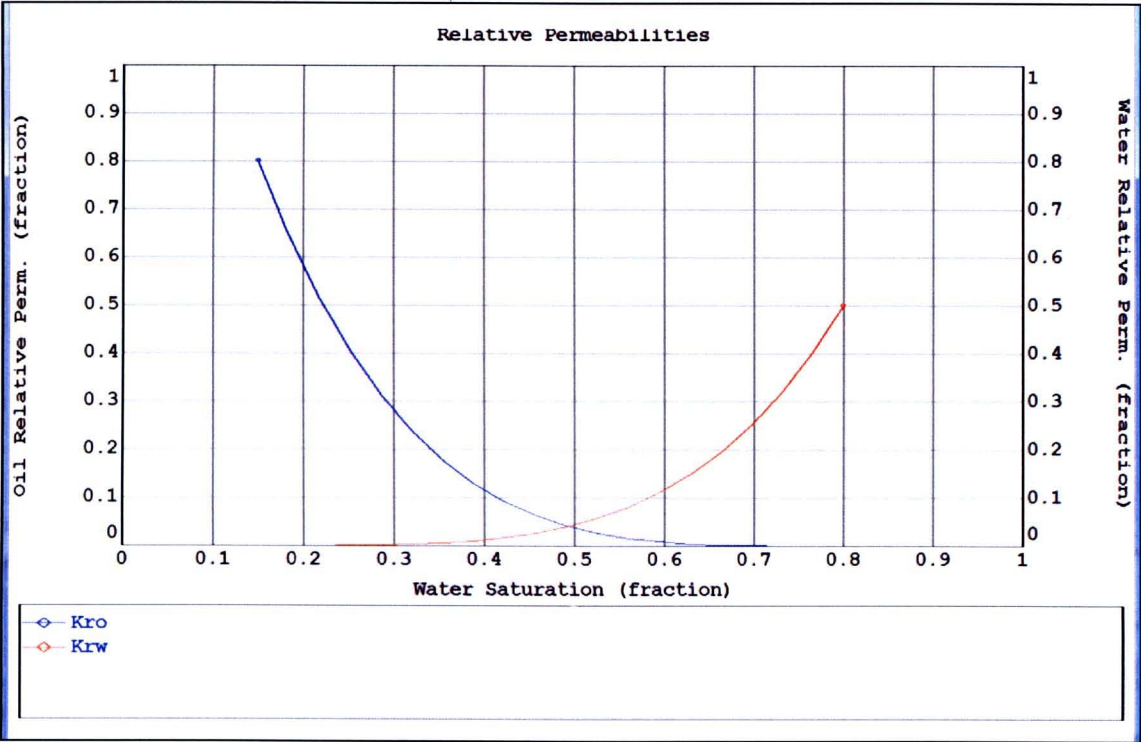


Figure A8 Water-Oil Relative Permeability from MBAL



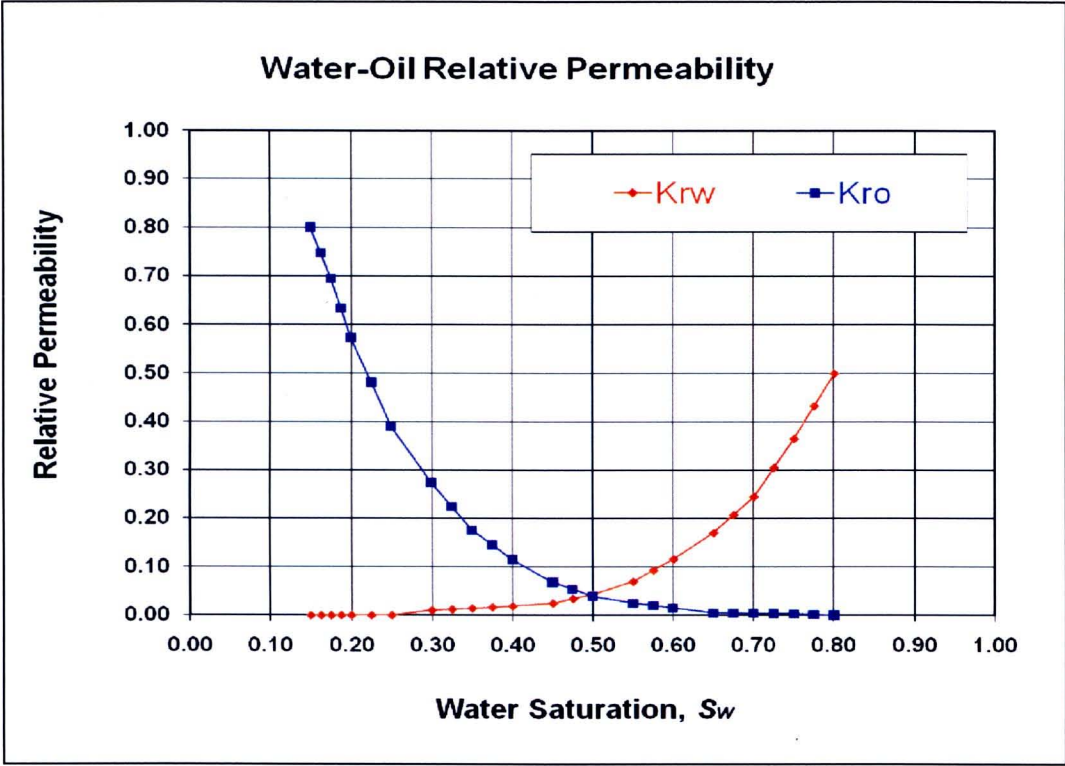


Figure A9 Water-Oil Relative Permeability from Core Analysis

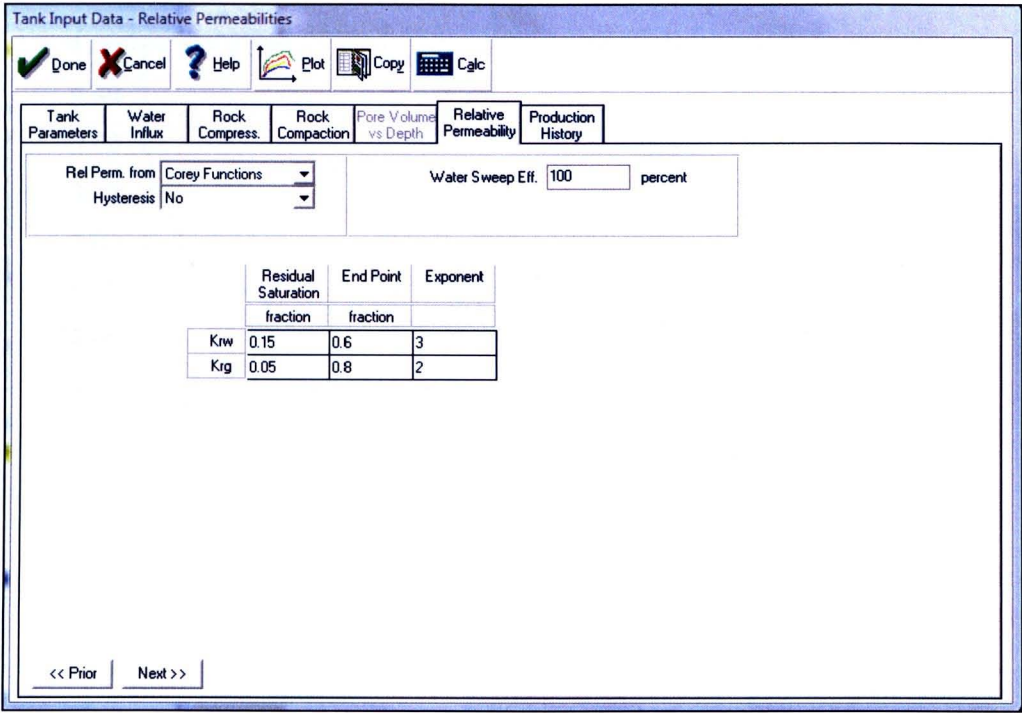


Figure A10 Tank Input Data - Relative Permeability for In-situ Gas Zone



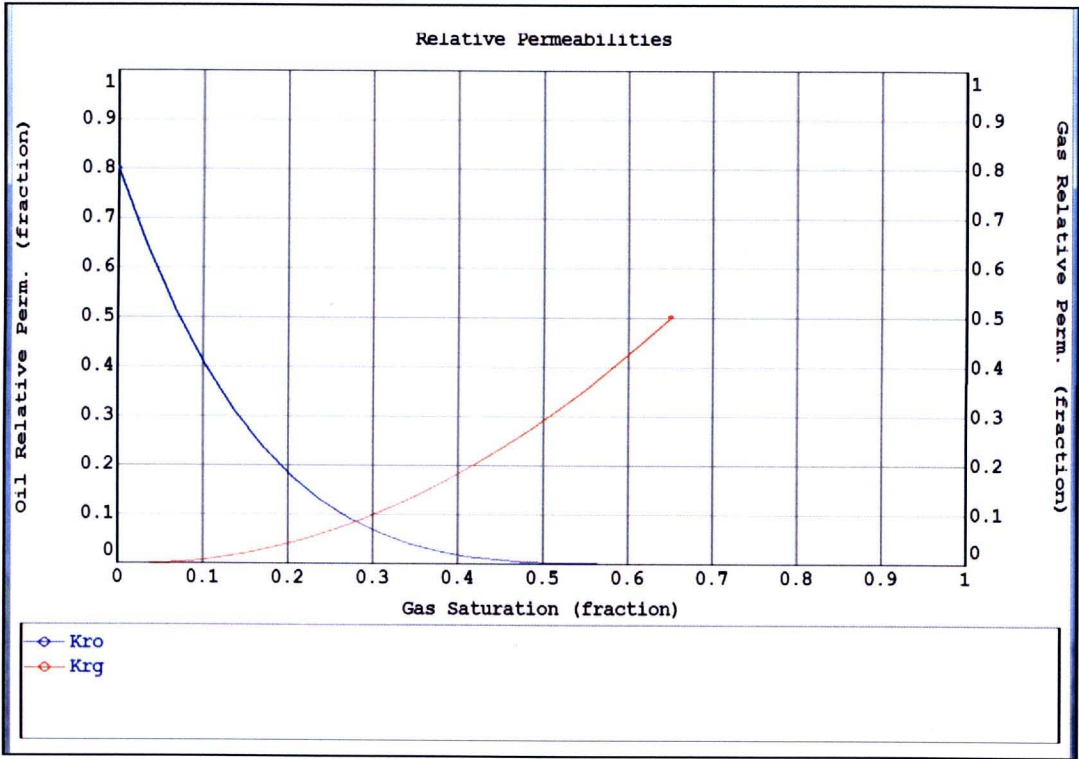


Figure A11 Gas-Oil Relative Permeability from MBAL

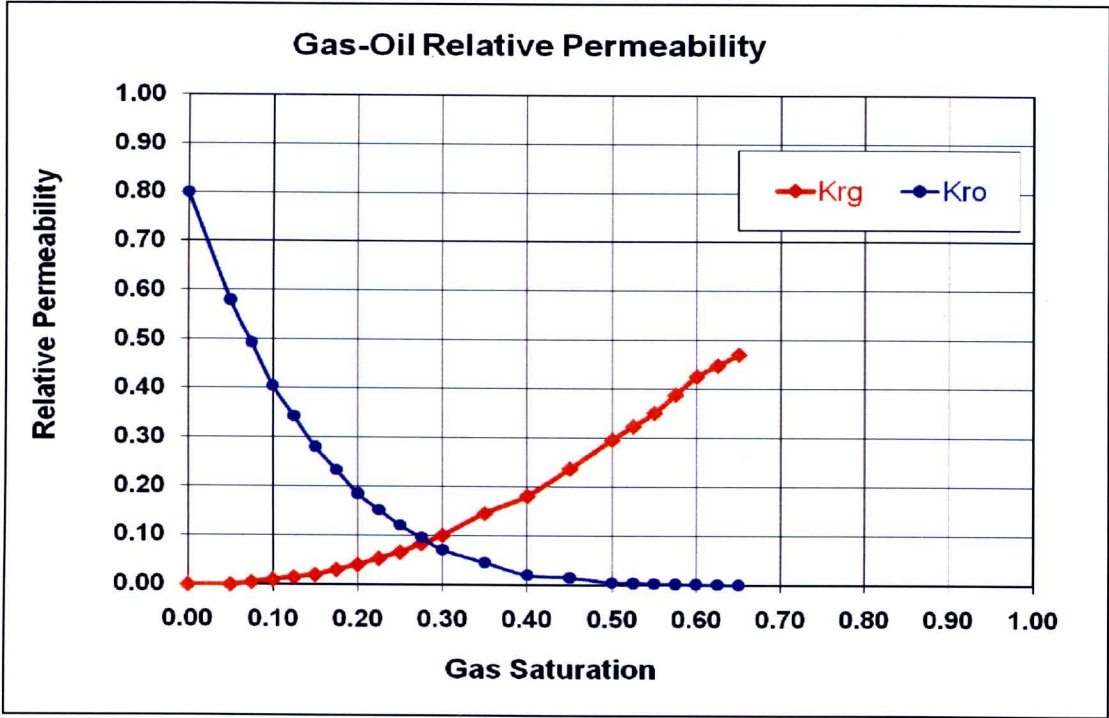


Figure A12 Gas-Oil Relative Permeability from Core Analysis

Inflow Performance Relation (IPR) - Select Model

DoneValidateCalculateReportTransfer DataSand Failure

CancelResetPlotExportSave Results

HelpTest DataSensitivityGAP

Select ModelInput Data

Model and Global Variable Selection

**Reservoir Model**  
PI Entry  
Vogel  
Composite  
Darcy  
**Fetkovich**  
MultiRate Fetkovich  
Jones  
MultiRate Jones  
Transient  
Hydraulically Fractured Well  
Horizontal Well - No Flow Boundaries  
Horizontal Well - Constant Pressure Upper Boundary  
MultiLayer Reservoir  
External Entry  
Horizontal Well - dP Friction Loss In WellBore  
MultiLayer - dP Loss In WellBore  
SkinAide (ELF)  
Dual Porosity  
Horizontal Well - Transverse Vertical Fractures  
SPOT

**Mechanical / Geometrical Skin**  
Enter Skin By Hand  
Locke  
MacLeod  
Karakas+Tariq

**Deviation and Partial Penetration Skin**

Reservoir Pressure	2500	psig
Reservoir Temperature	240	deg F
Water Cut	0	percent
Total GOR	275	scf/STB
Compaction Permeability Reduction Model	No	
Relative Permeability	Yes	
Correction For Vogel	Yes	

(a)

Inflow Performance Relation (IPR) - Input Data

DoneValidateCalculateReportTransfer DataSand Failure

CancelResetPlotExportSave Results

HelpTest DataSensitivityGAP

Select ModelInput Data

Fetkovich Reservoir Model

Reservoir Permeability	200	md.
Reservoir Thickness	40	feet
Drainage Area	61	acres
Dietz Shape Factor	31.6	
WellBore Radius	0.255	feet
Rel. Permeability Of Oil	0.8	fraction

Calculate Dietz

Reservoir Model Mech/Geom Skin Dev/PP Skin Sand Control Rel Perms Viscosity Compaction

(b)

Figure A13 (a) and (b) Examples of IPR – Input Data for Oil Layer



Inflow Performance Relation (IPR) - Select Model

DoneValidateCalculateReportTransfer DataSand Failure

CancelResetPlotExport

HelpTest DataSensitivity

Select ModelInput Data

Model and Global Variable Selection

**Reservoir Model**  
Jones  
Forchheimer  
Back Pressure  
C and n  
MultiRate C and n  
MultiRate Jones  
External Entry  
**Petroleum Experts**  
Hydraulically Fractured Well  
Horizontal Well - No Flow Boundaries  
MultiLayer Reservoir  
Horizontal Well - dP Friction Loss In WellBore  
SkinAide (ELF)  
Dual Porosity  
Horizontal Well - Transverse Vertical Fractures  
MultiLayer dP Loss In WellBore  
Modified Isochronal  
Forchheimer With Pseudo Pressure  
MultiRate Forchheimer With Pseudo Pressure  
SPOT

**Mechanical / Geometrical Skin**  
Enter Skin By Hand  
Locke  
Mackinac  
Karakas+Tanig

**Deviation and Partial Penetration Skin**  
Mogk+Hosain

Reservoir Pressure2750psig

Reservoir Temperature255deg F

Water Gas Ratio0STB/MMscf

Condensate Gas Ratio25STB/MMscf

Compaction Permeability Reduction ModelNo

(a)

Inflow Performance Relation (IPR) - Input Data

DoneValidateCalculateReportTransfer DataSand Failure

CancelResetPlotExportSave Results

HelpTest DataSensitivityGAP

Select ModelInput Data

Petroleum Experts Reservoir Model

Reservoir Permeability	10	md
Reservoir Thickness	15	feet
Drainage Area	51	acres
Dietz Shape Factor	31.6	
WellBore Radius	0.255	feet
Perforation Interval	1	feet
Time Since Production Started	1	days
Reservoir Porosity	0.17	fraction
Connate Water Saturation	0.15	fraction
Non-Darcy Flow Factor (D)	0.00041663	1/(Mscf/day)
Non-Darcy Flow Factor (D)	Calculated	
Permeability Entered	Gas Permeability	

Calculate Dietz

Reservoir Model Mech/Geom Skin Dev/PP Skin Sand Control Rel Perms Viscosity Compaction

(b)

Figure A14 (a) and (b) Example of IPR – Input Data for Gas Layer

## VITAE

Chitrlada Ardthasivanon graduated from Master's Degree Program in Petroleum Engineering in 2010, Department of Mining and Petroleum Engineering from Chulalongkorn University. Moreover, she received Master of Professional Computing from University of Southern Queensland, Australia in 2005. And now she has been working with one of the major oil and gas production and exploration company, Chevron E&P Limited.





