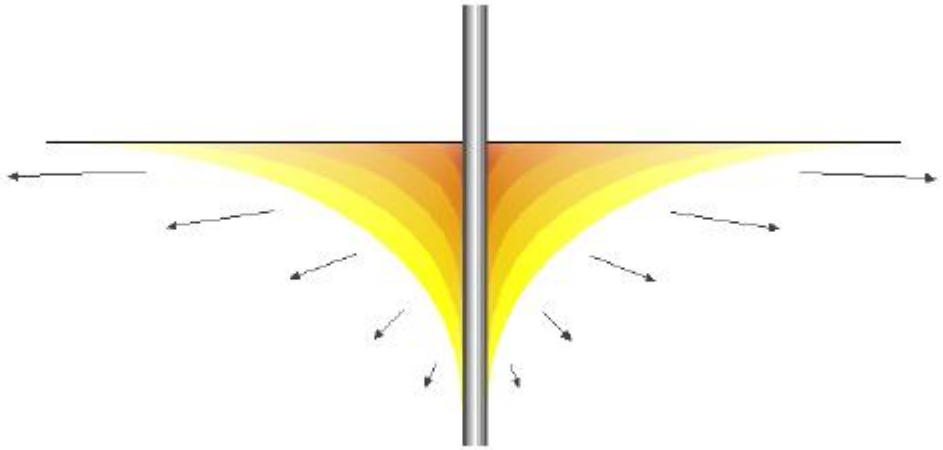
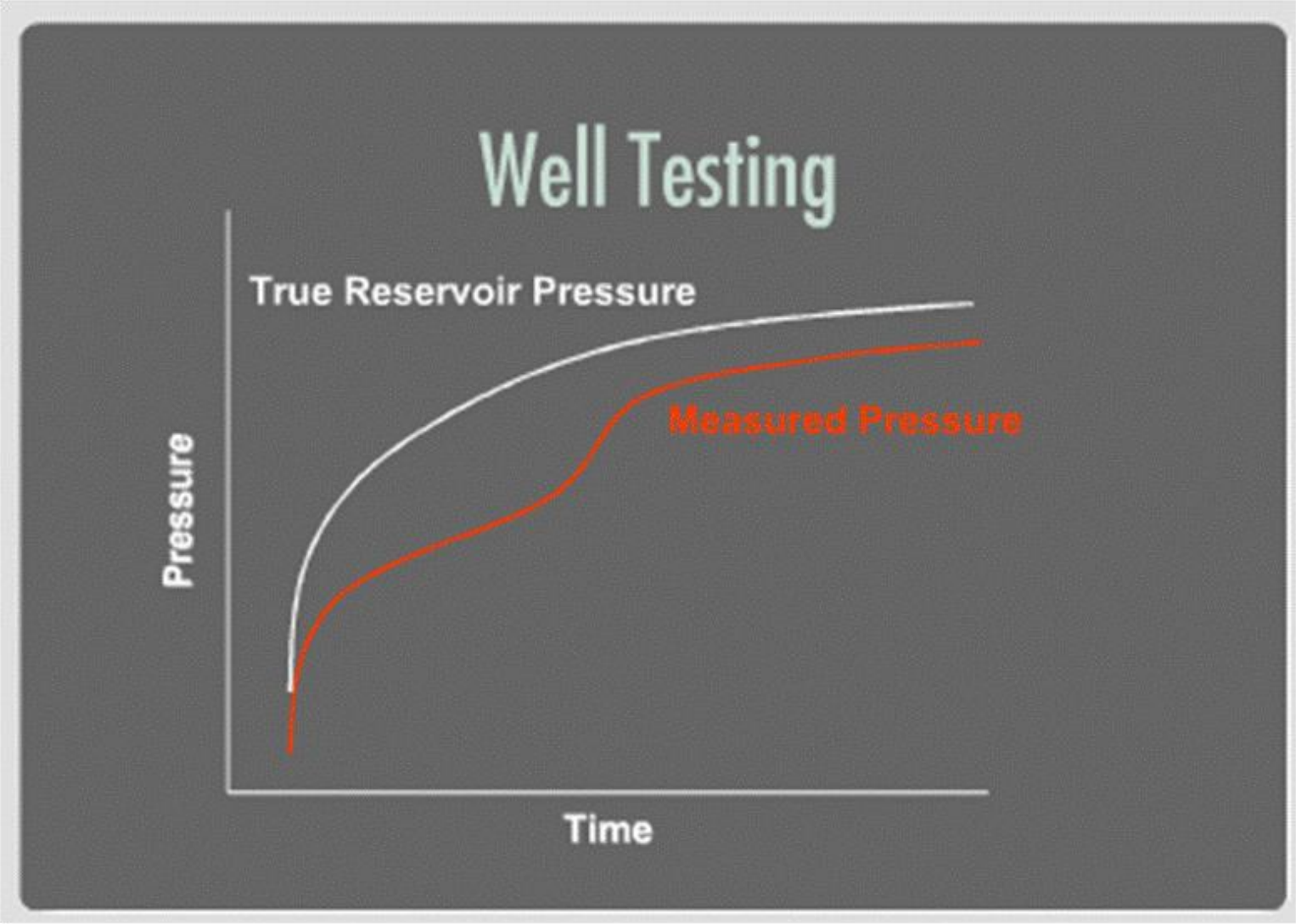
Advanced WellTest Analysis



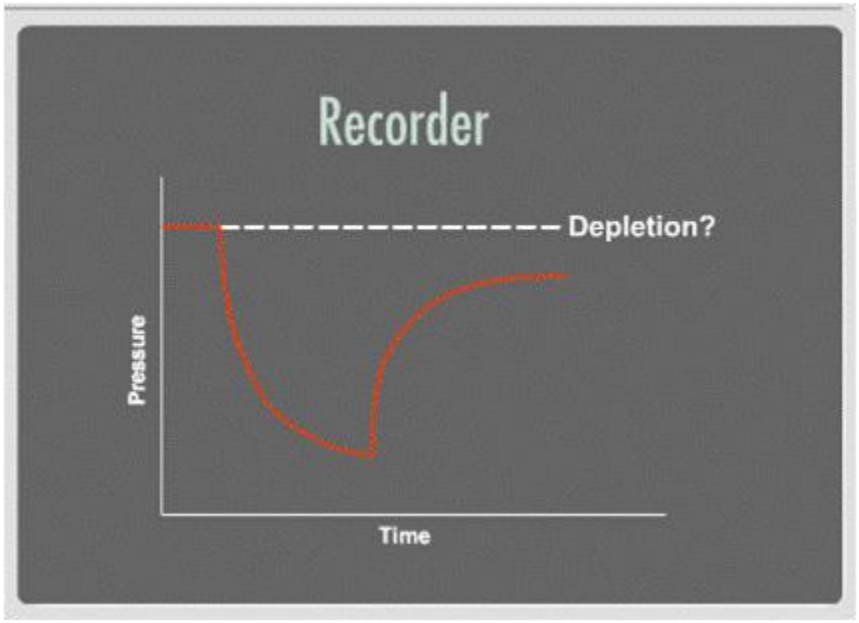
Non Reservoir Effects & Wellbore Dynamics

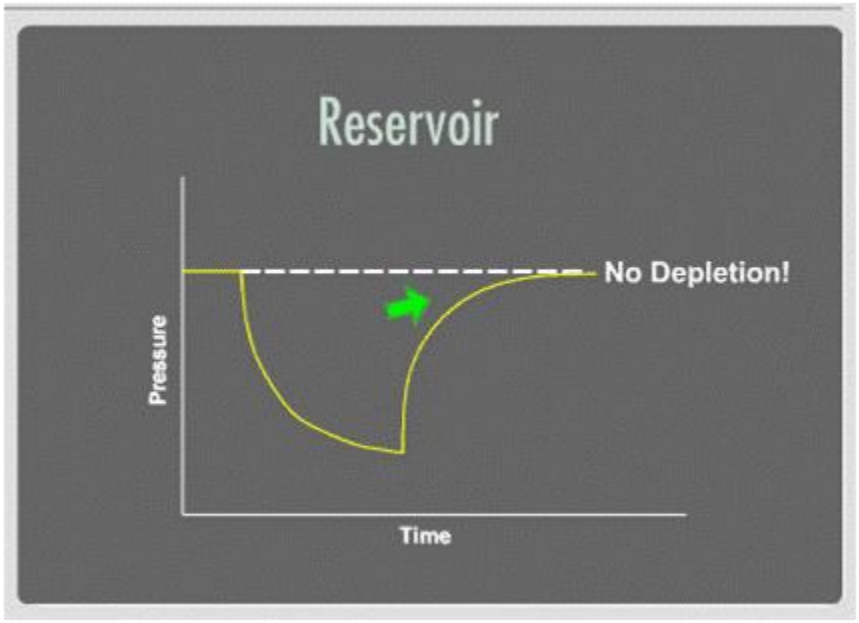
By: Shahab Gerami

WHAT YOU SEE MAY NOT BE WHAT THE RESERVOIR SAW



WHAT YOU SEE MAY NOT BE WHAT THE RESERVOIR SAW



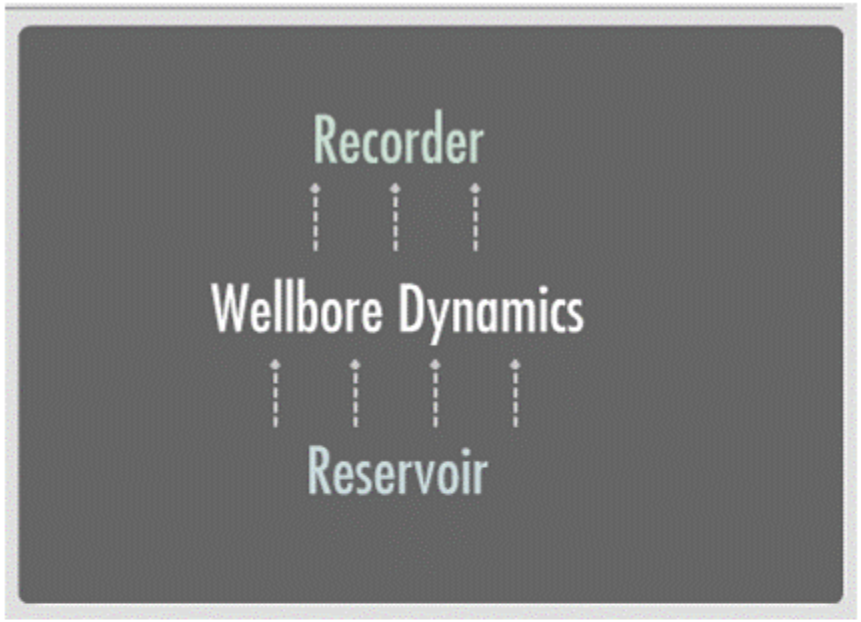


Theory

Reservoir (MPP) Pressures

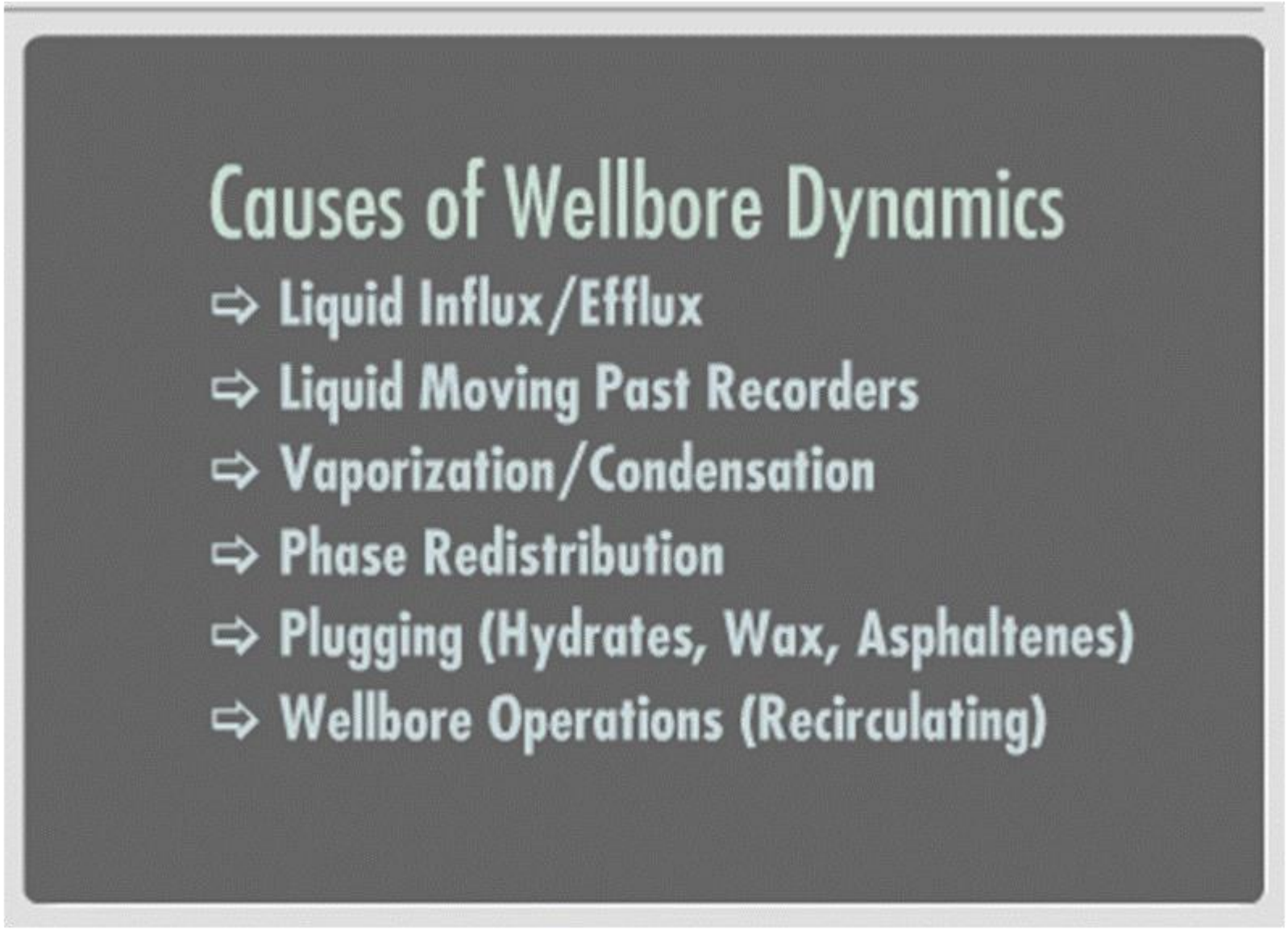
NOT

Recorder (RRD) Pressures



In other words,
what the **RECORDER** sees,
is **NOT**
what the **RESERVOIR** saw

CAUSES OF WELLBORE DYNAMICS



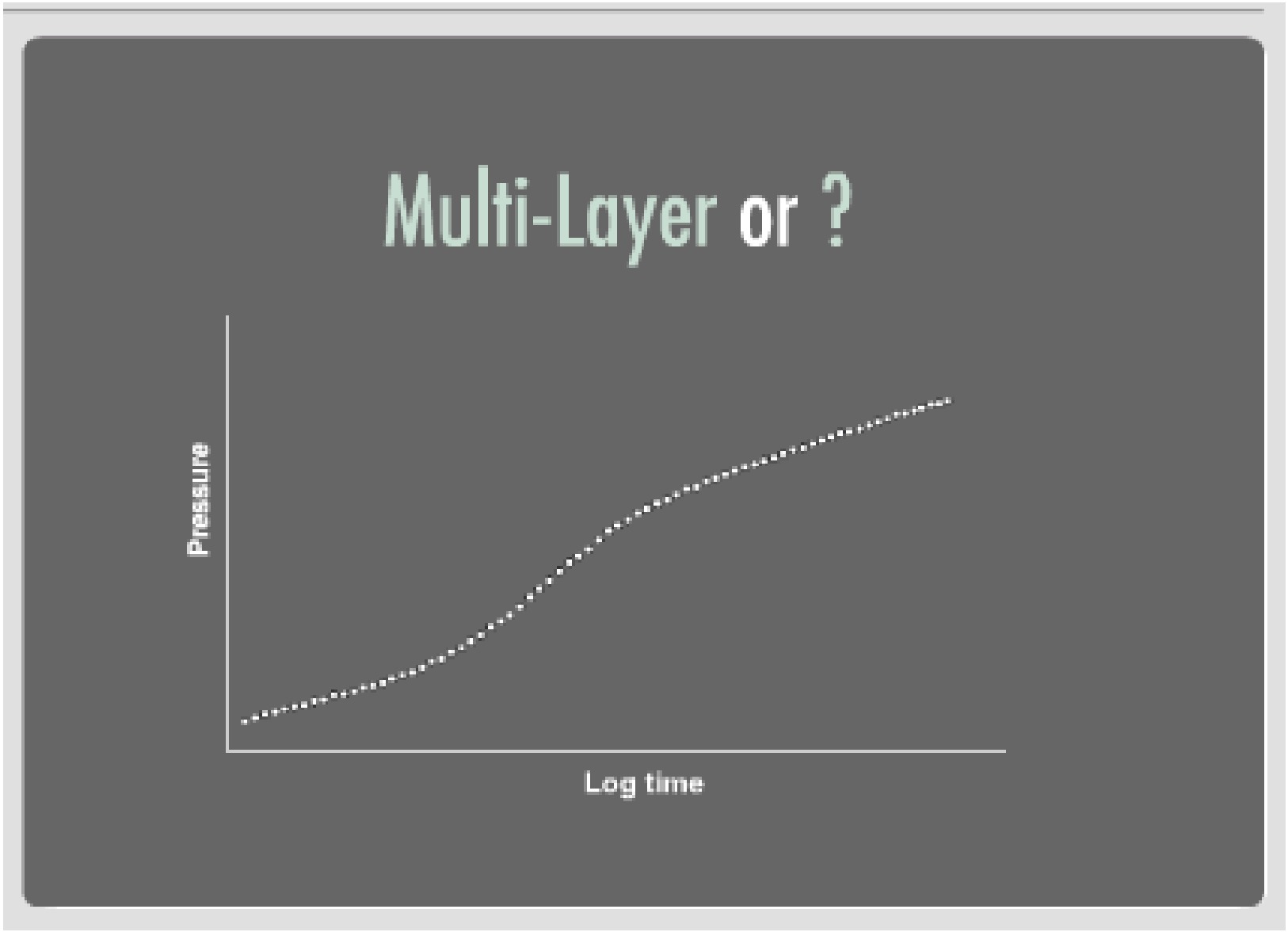
CAUSES OF WELLBORE DYNAMICS

Causes of Wellbore Dynamics

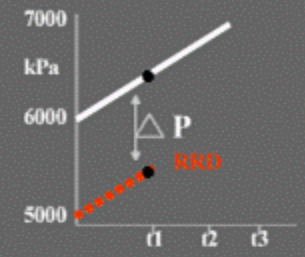
RECORDER EFFECTS

- ⇨ Malfunctions
- ⇨ Sampling Frequency Changes
- ⇨ Digital Chatter
- ⇨ Temperature Effects
- ⇨ Drift

Wellbore Dynamics



Changing Liquid Levels

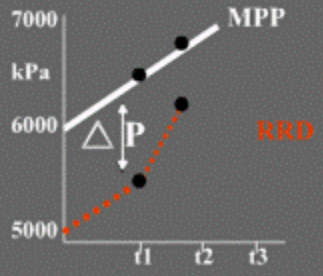


△ P = 100 x 10 = 1000kPa

LIQUID ABOVE RRD

Gas = 1 kPa/m
Liquid = 10 kPa/m

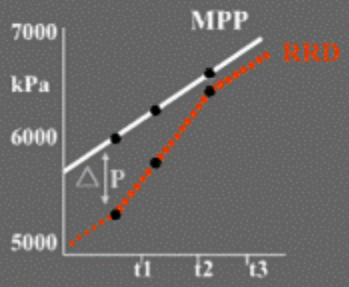
Changing Liquid Levels



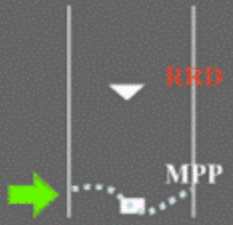
△ P = 50 x 10 + 50 x 1 = 550kPa

LIQUID HALFWAY

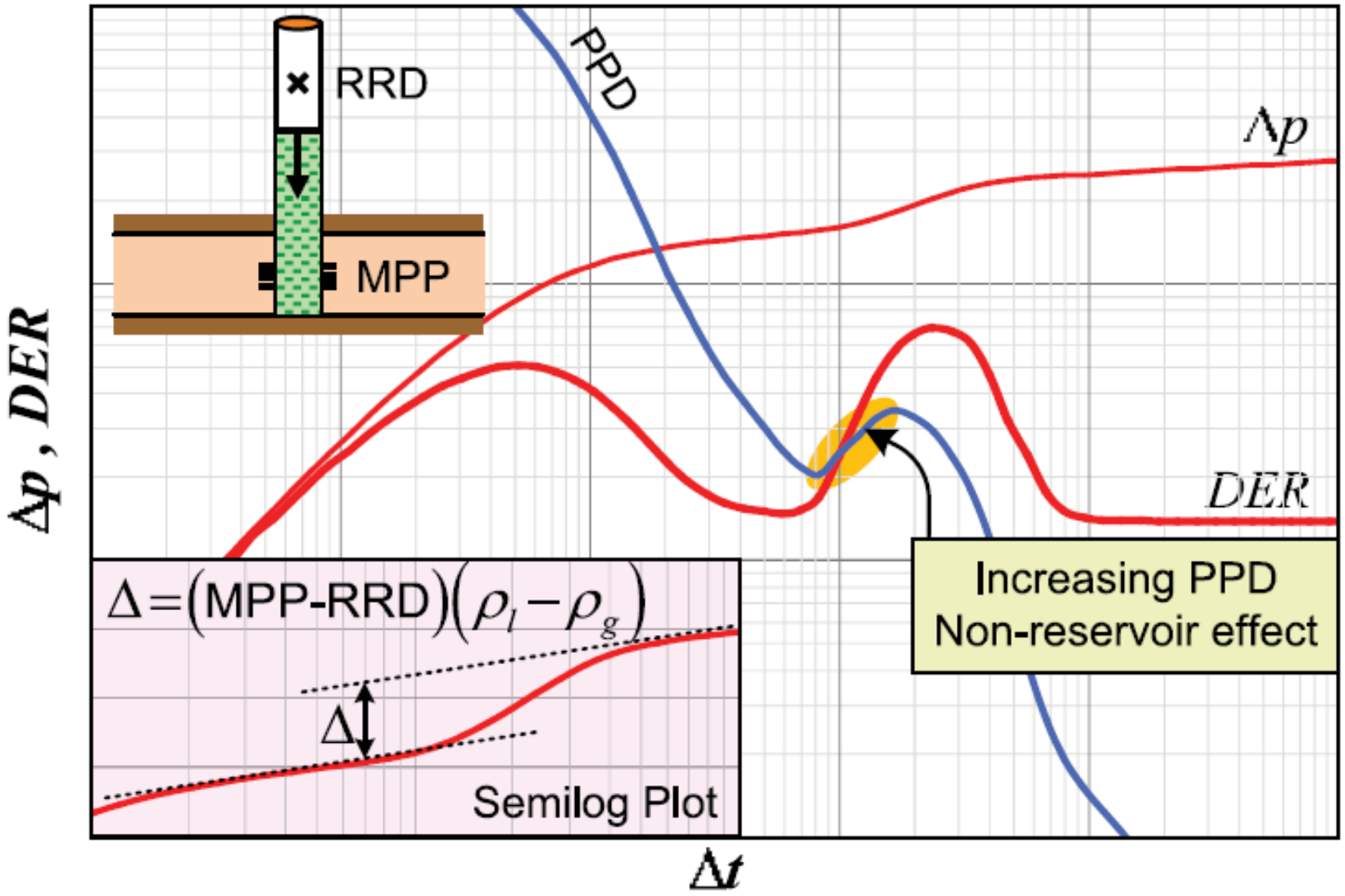
Changing Liquid Levels



LIQUID AT MPP

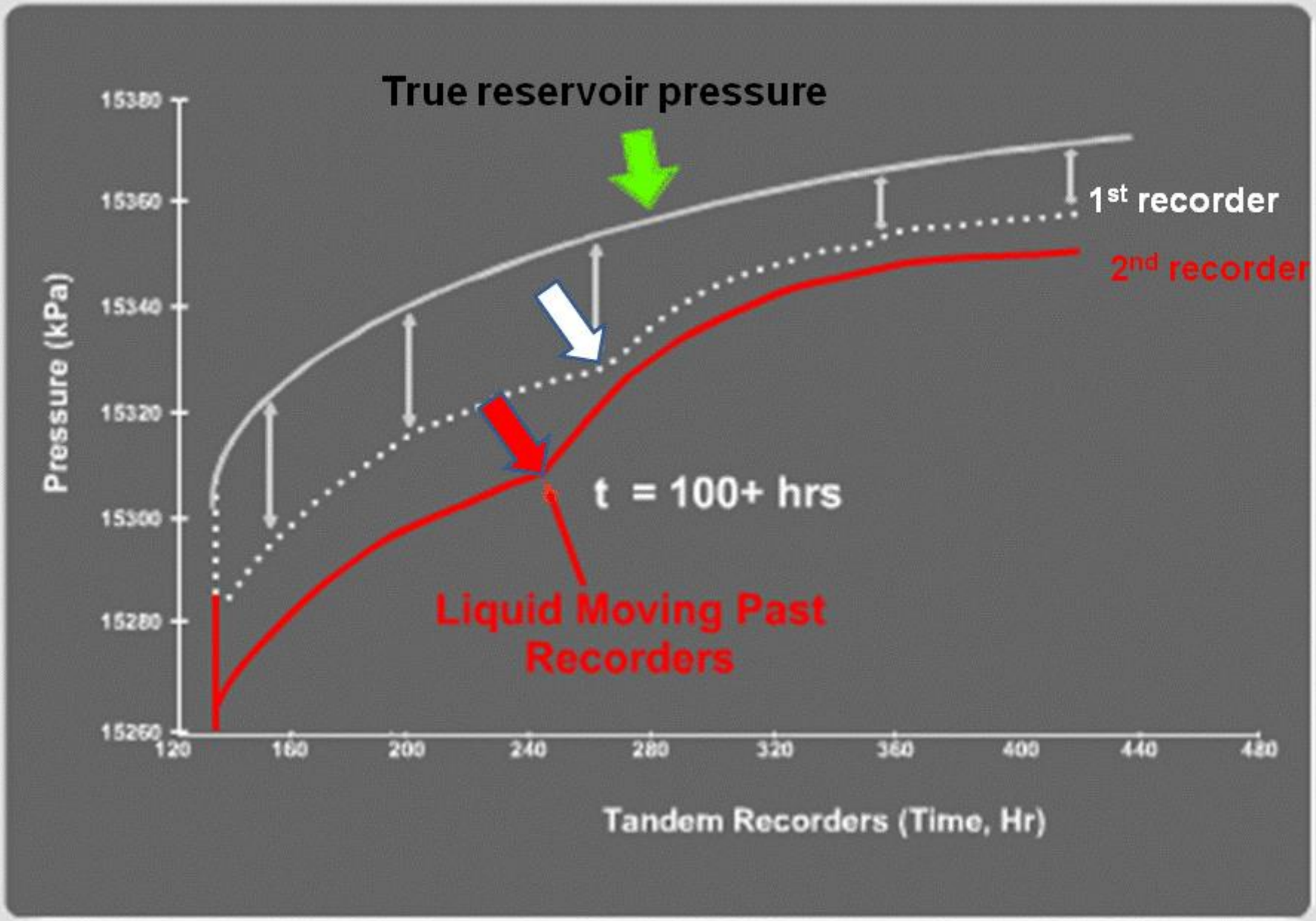


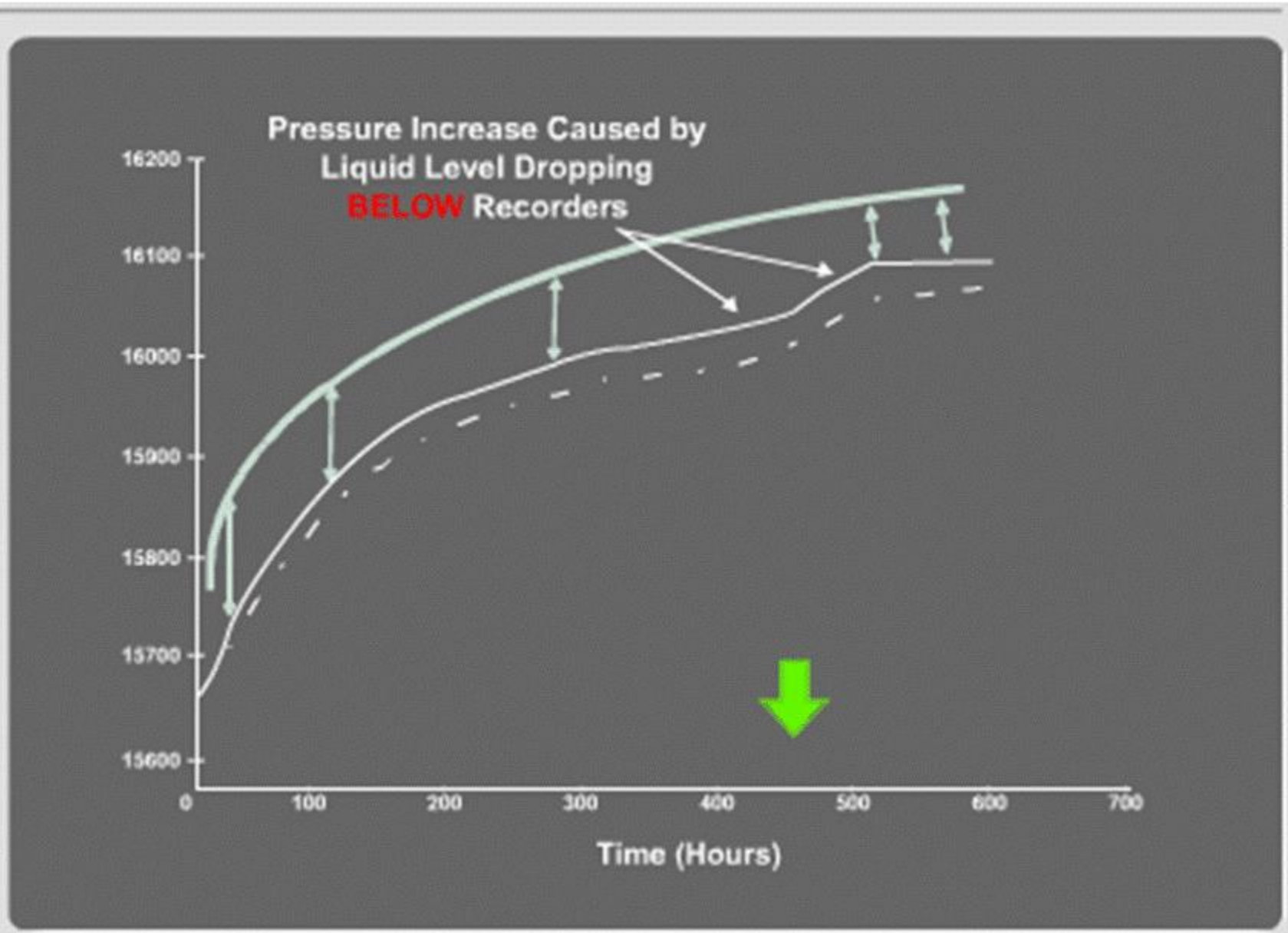
Liquid Falling Past the Recorder



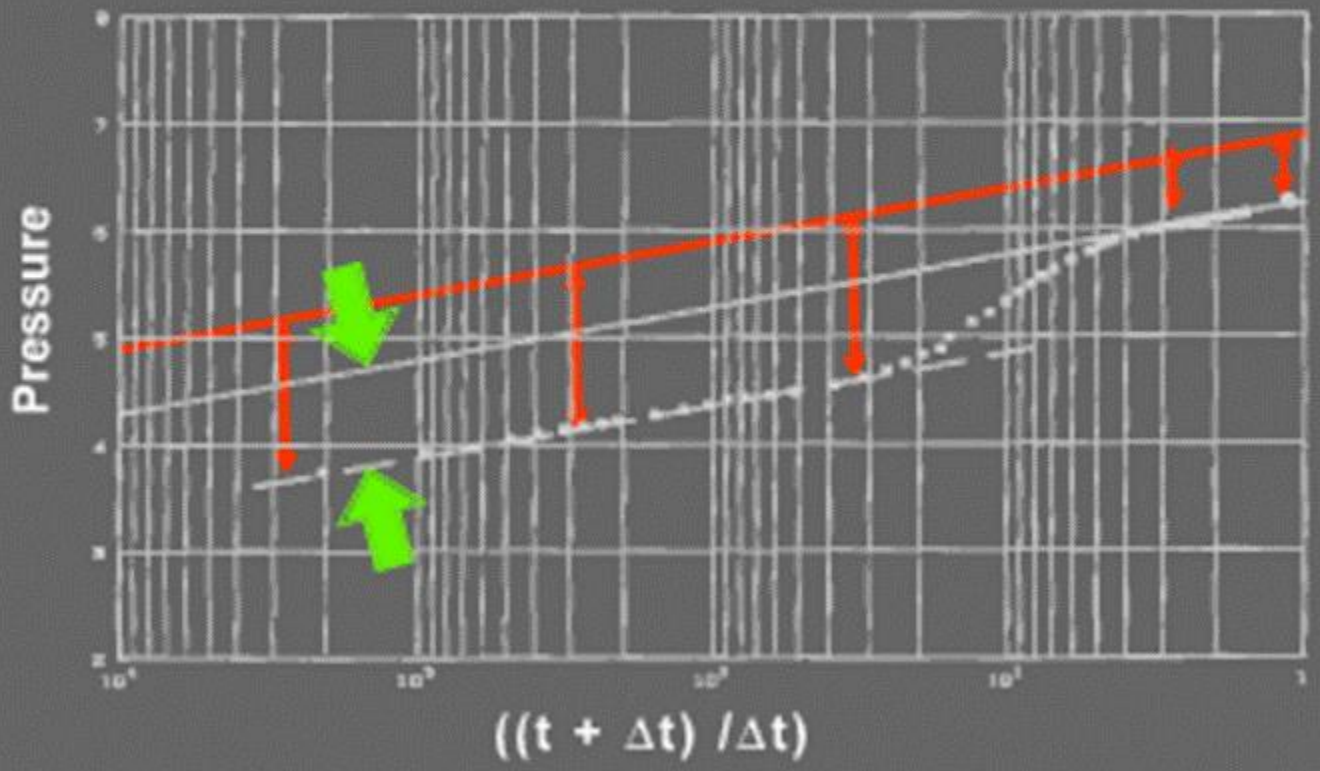
Liquid Falling Past the Recorder

- When liquid interface goes past the recorders, it creates a unique signature
- Often visible as parallel lines on semilog plot
- Can occur any time
- When it occurs at late time, it is often mis-interpreted as a boundary
- Identified by increasing PPD

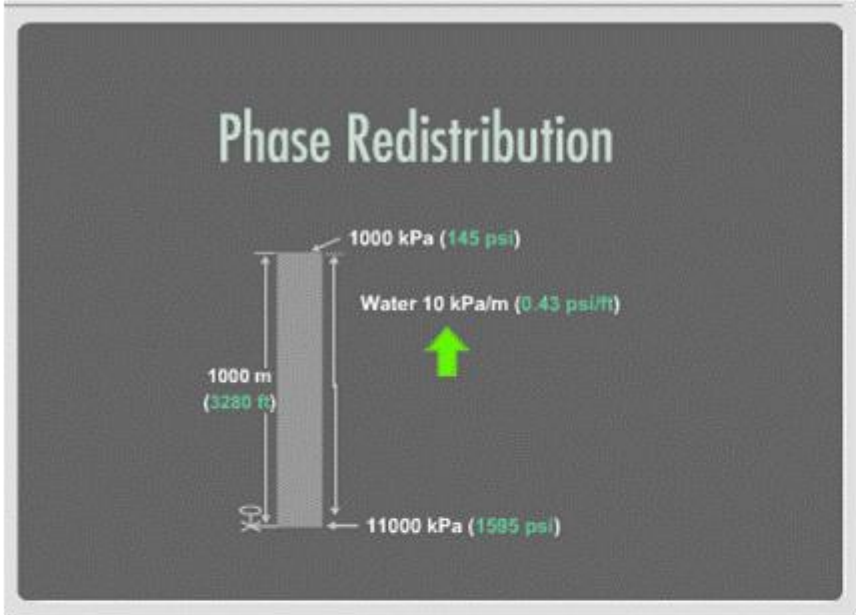

True reservoir pressure
1st recorder
2nd recorder
t = 100+ hrs
Liquid Moving Past Recorders
Pressure (kPa)
15380
15360
15340
15320
15300
15280
15260
120
160
200
240
280
320
360
400
440
480
Tandem Recorders (Time, Hr)

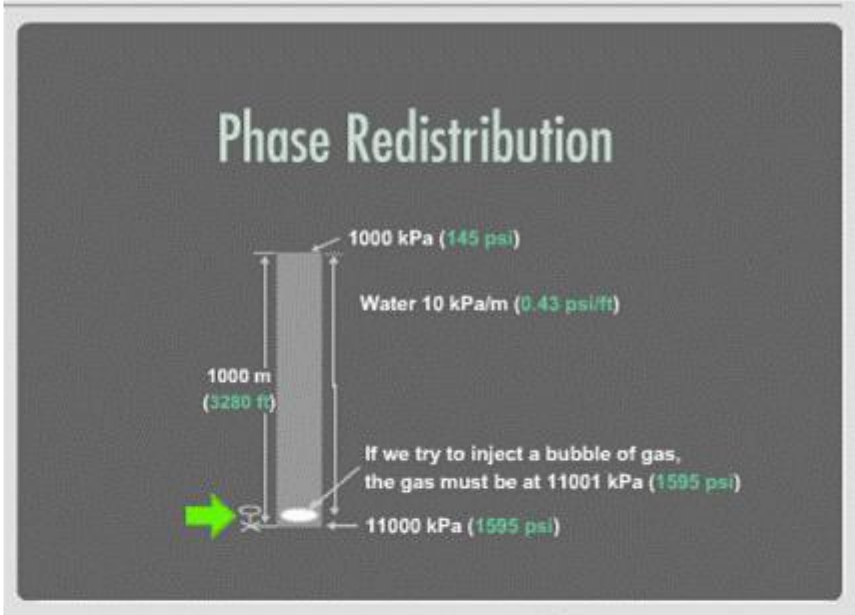

Pressure Increase Caused by
Liquid Level Dropping
BELOW Recorders
16200
16100
16000
15900
15800
15700
15600
0
100
200
300
400
500
600
700
Time (Hours)

Parallel Lines - Falling Liquid Level

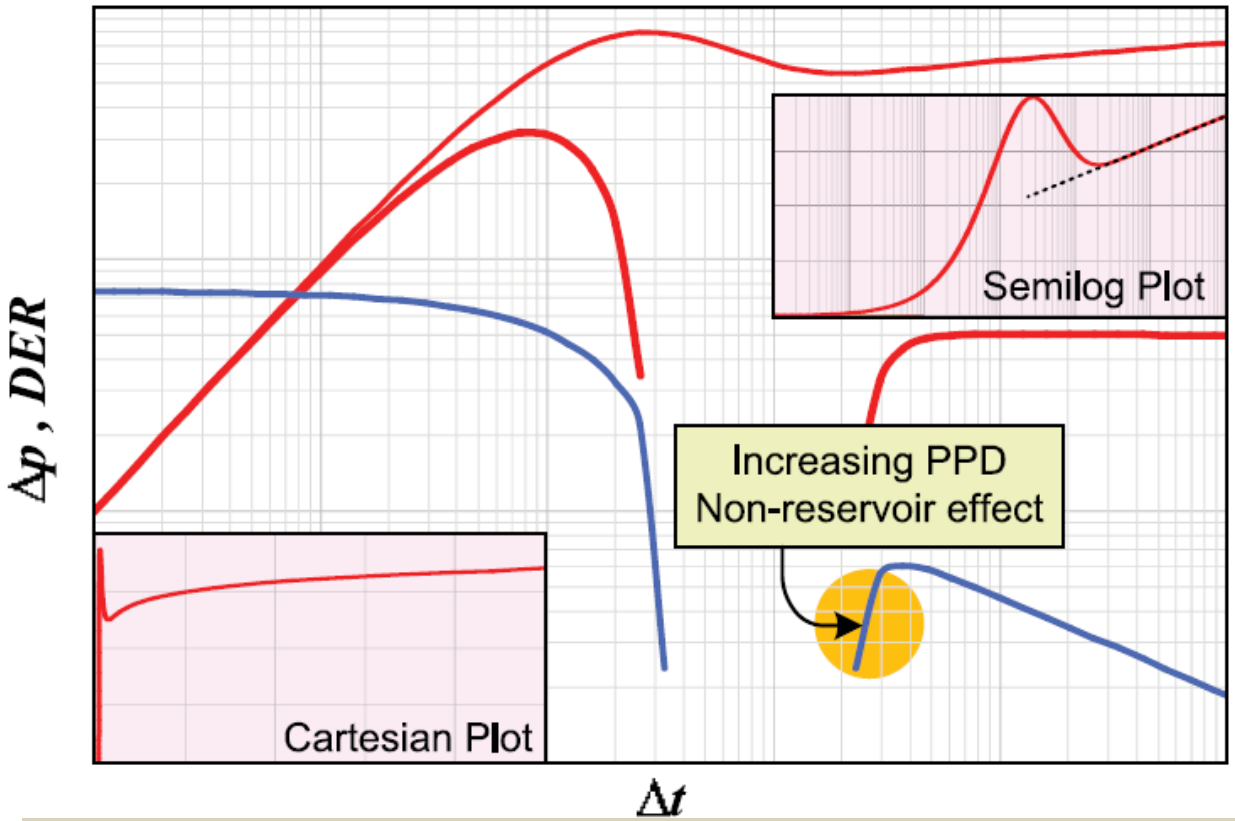


Phase Redistribution

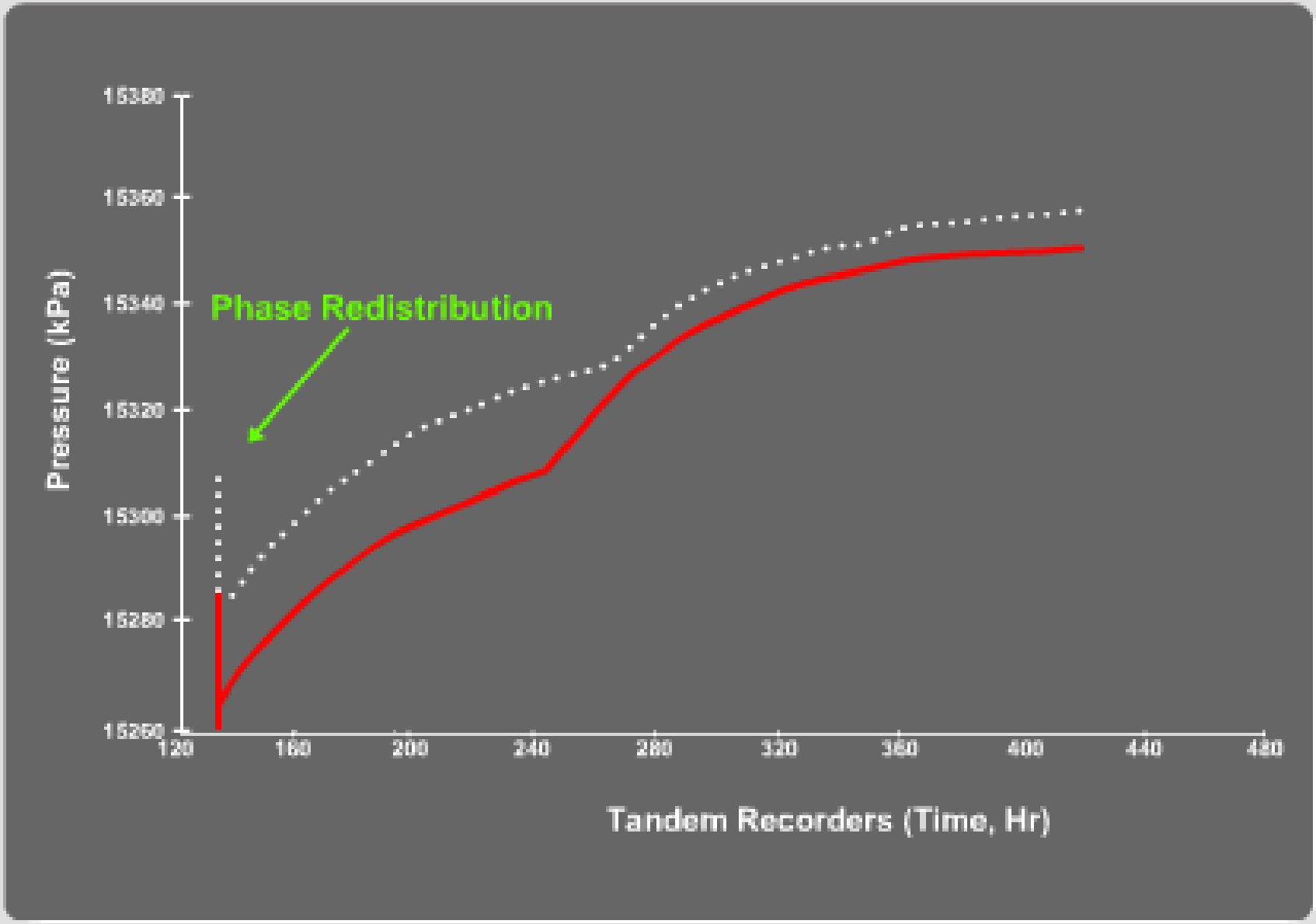


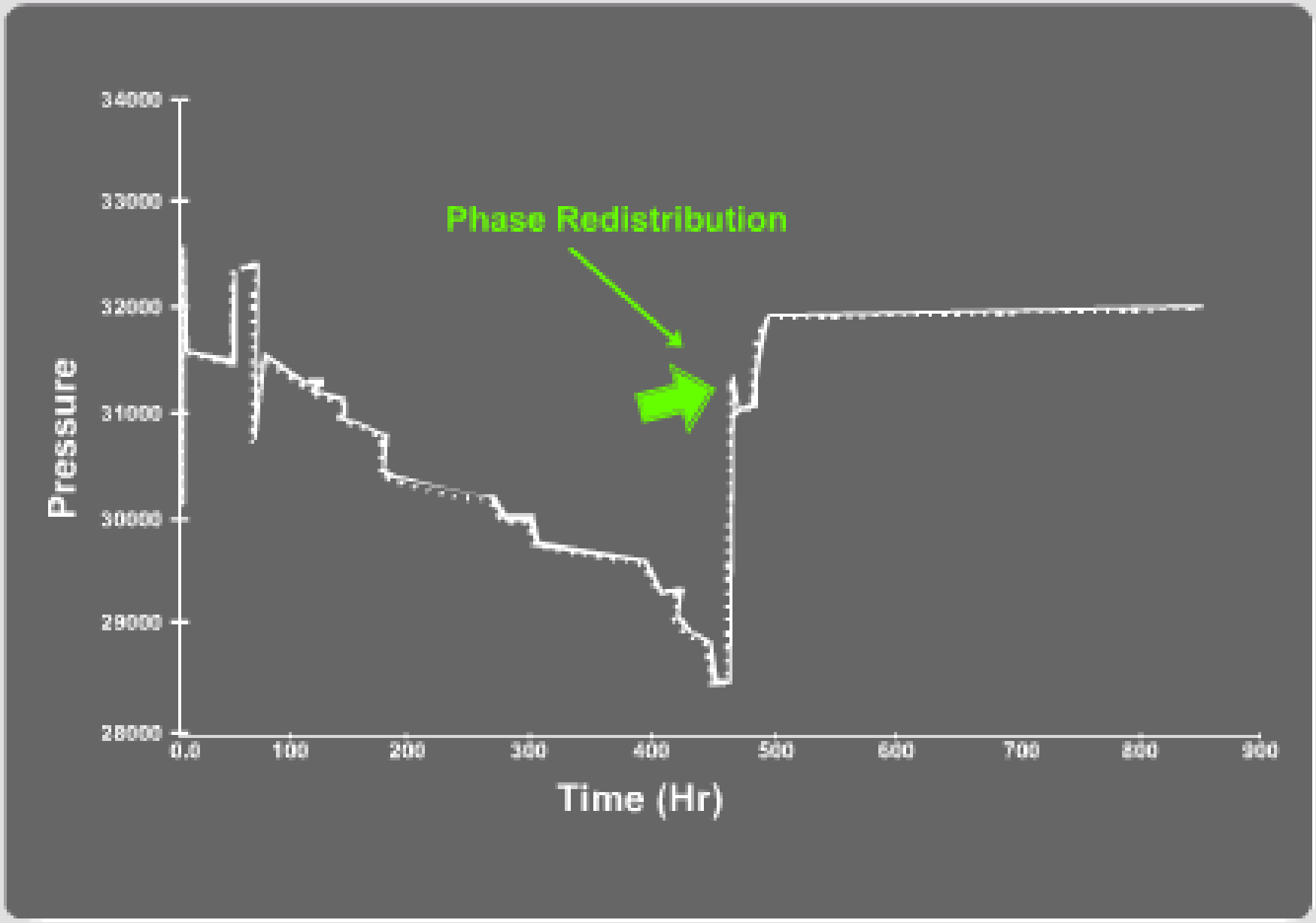


Phase Redistribution



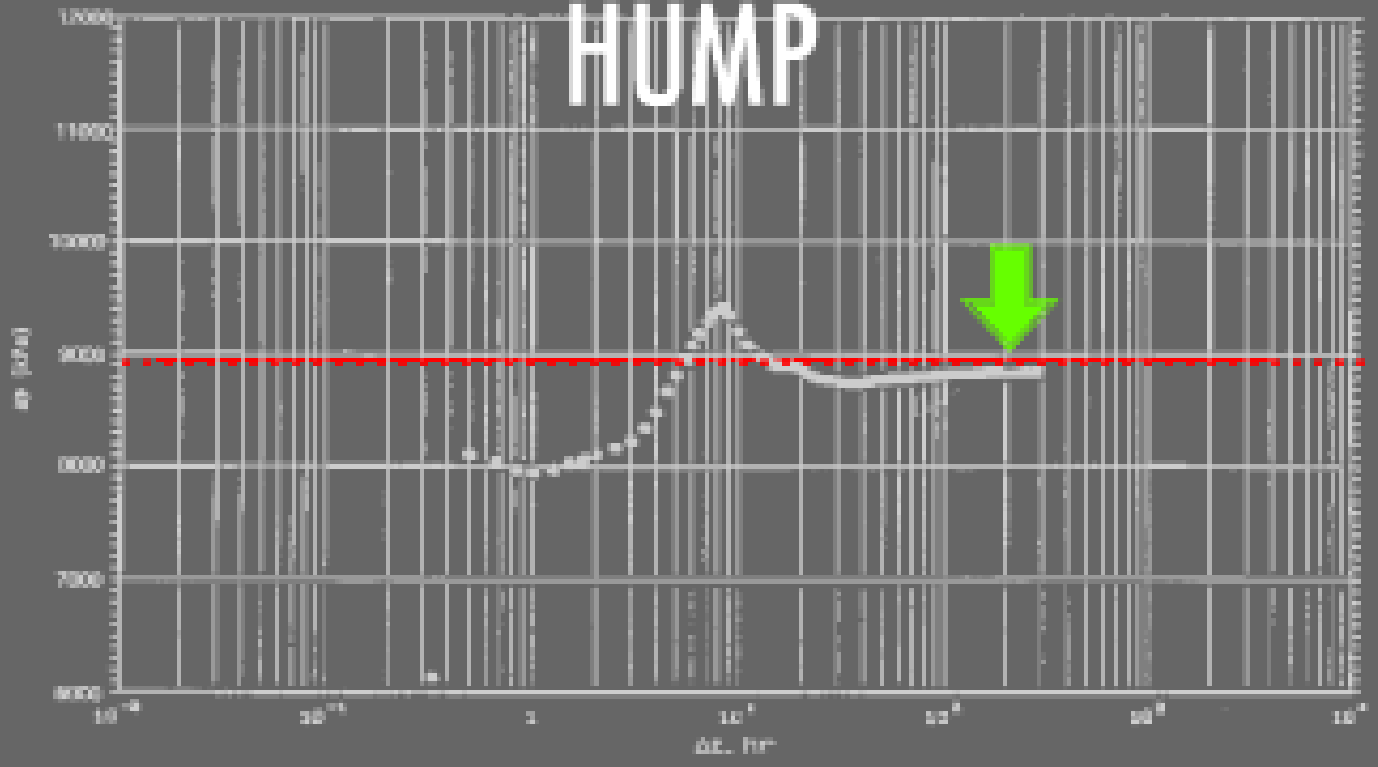
- Causes increase then decrease in wellbore pressure
- NOT related to location of recorders
- Characteristic hump always occurs at early time
- PPD goes negative before increasing


Phase Redistribution
Pressure (kPa)
15380
15360
15340
15320
15300
15280
15260
120
160
200
240
280
320
360
400
440
480
Tandem Recorders (Time, Hr)

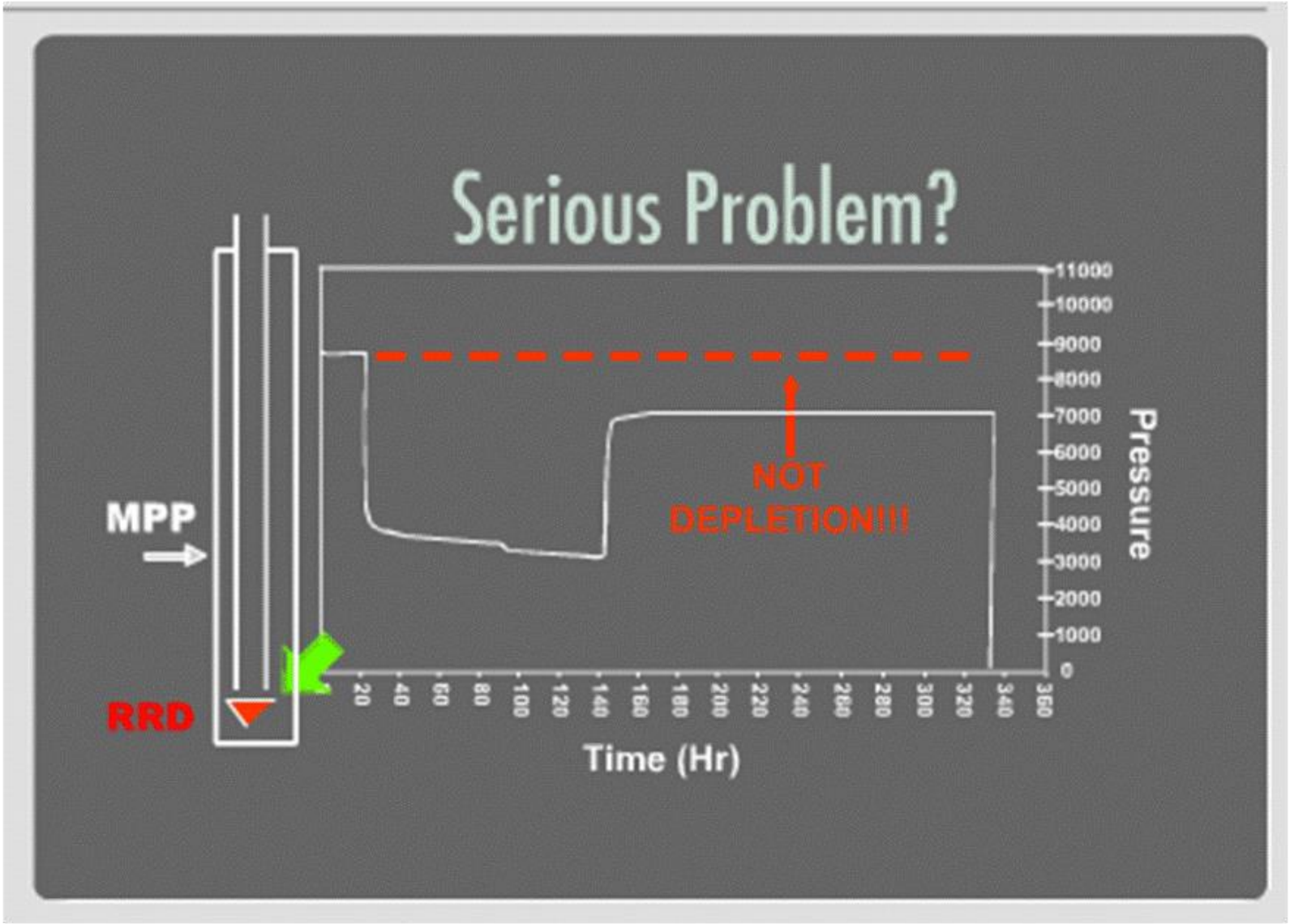

Phase Redistribution
Pressure
34000
33000
32000
31000
30000
29000
28000
0.0
100
200
300
400
500
600
700
800
900
Time (Hr)

Phase Redistribution

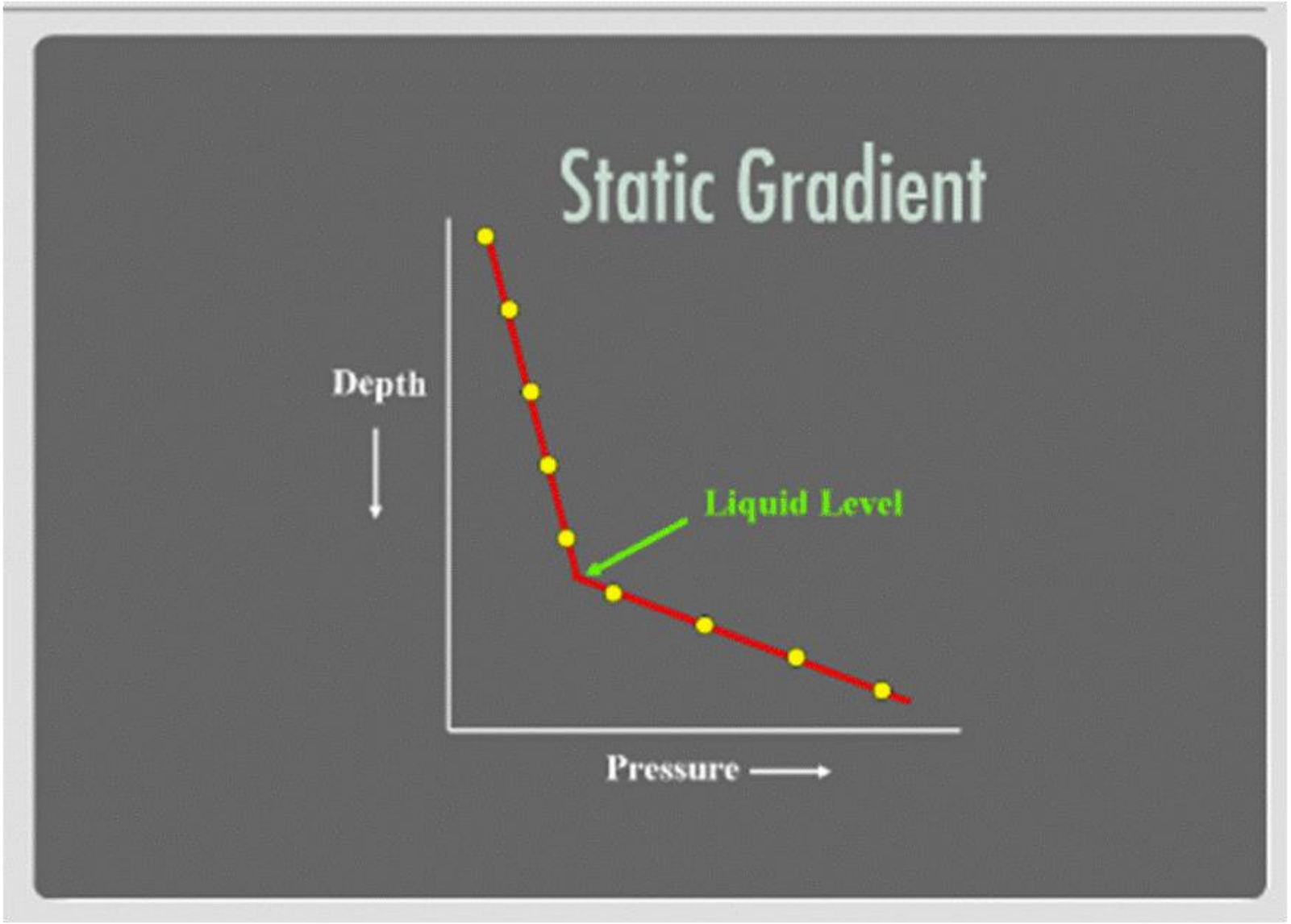
HUMP



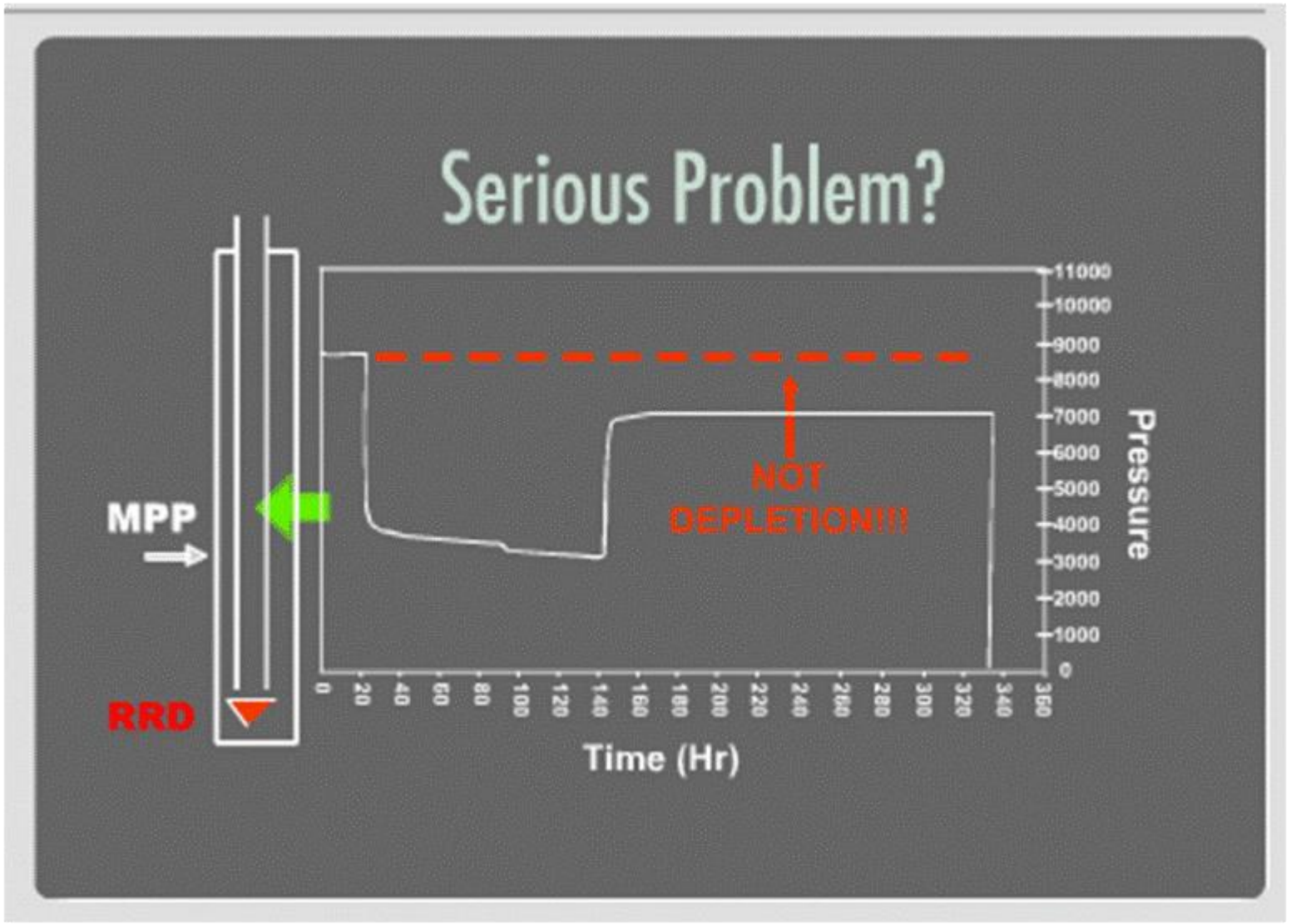
What the Recorder Saw



Static Gradient at the Beginning of the Test

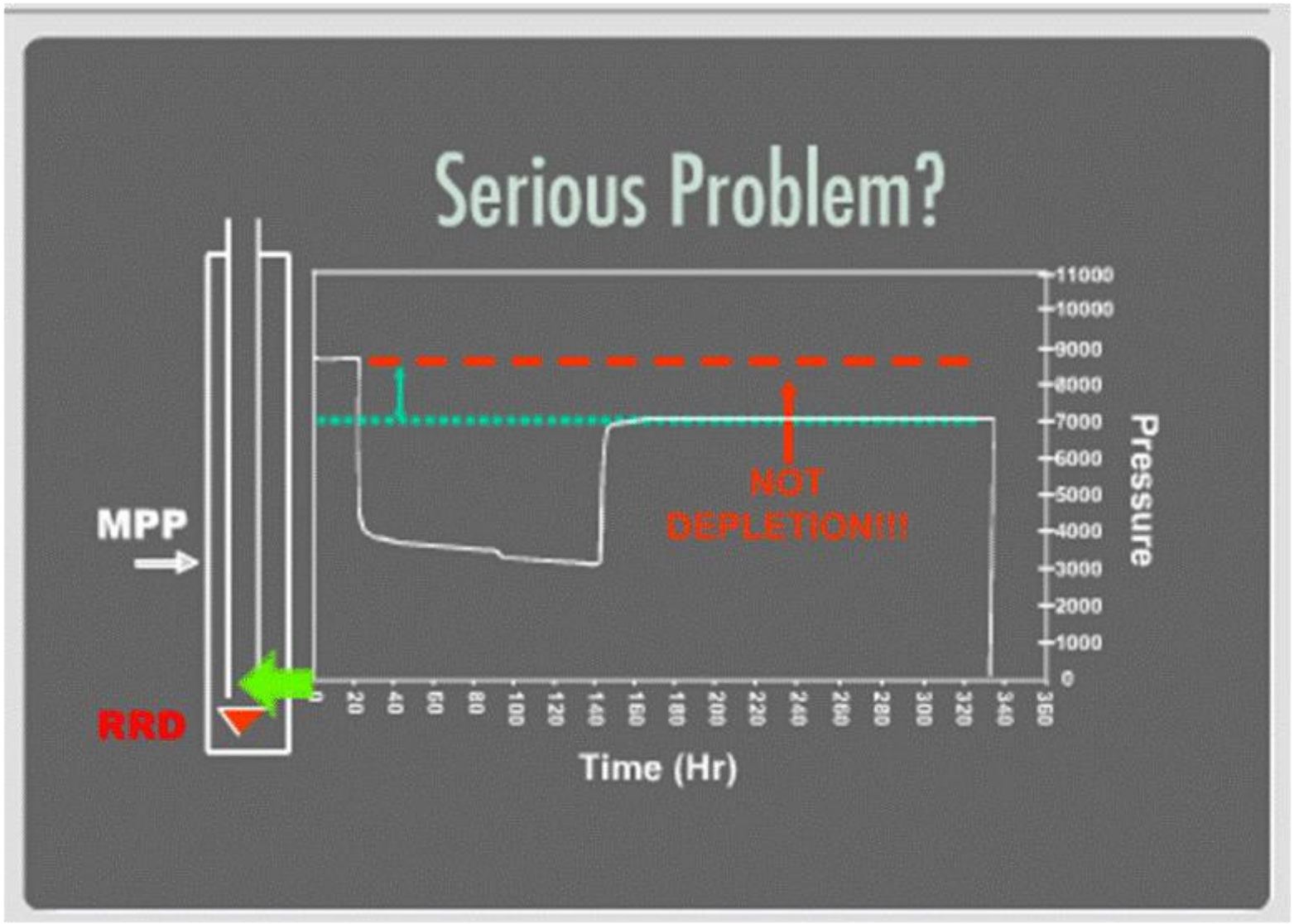


Liquid Level at the Beginning of the Test



What the Reservoir Saw

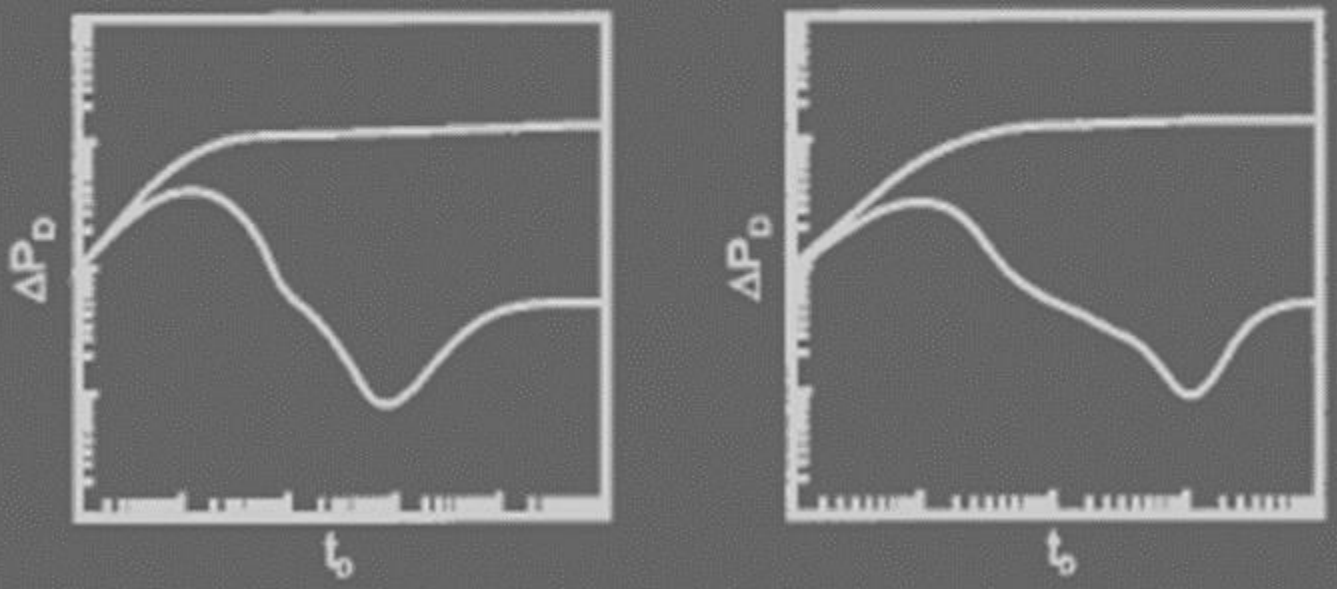
(Flowing the well+ shut-in +running another static gradient)

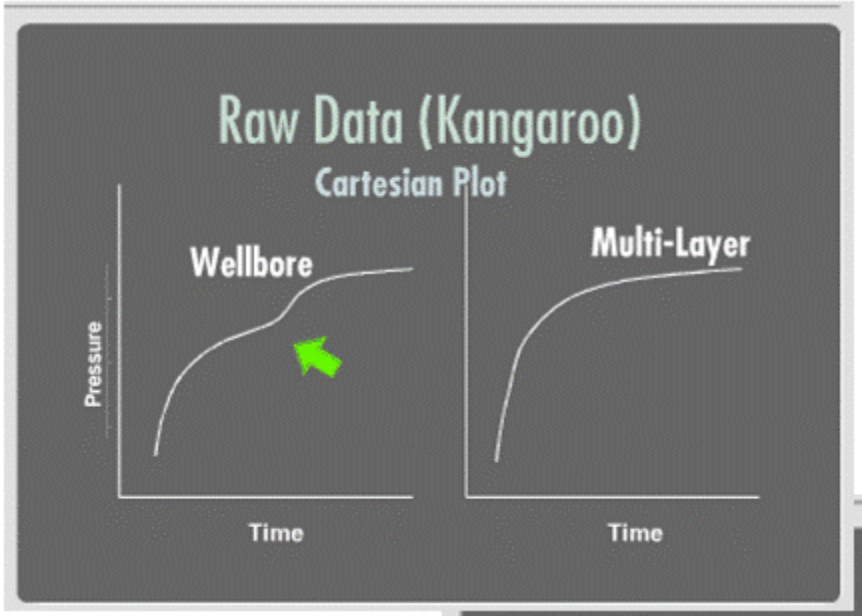


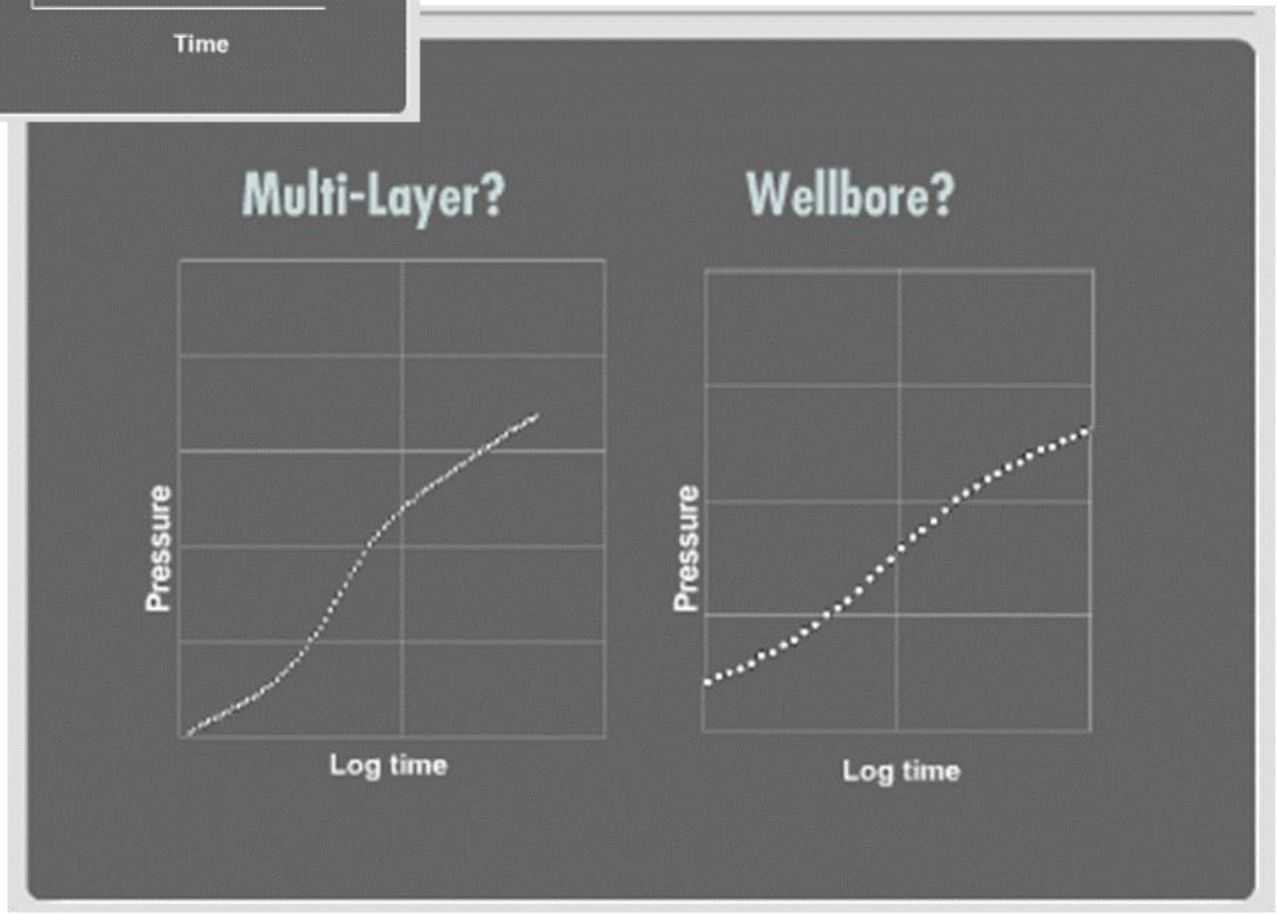
Drawdown Typecurve/Derivative

Dual Porosity?

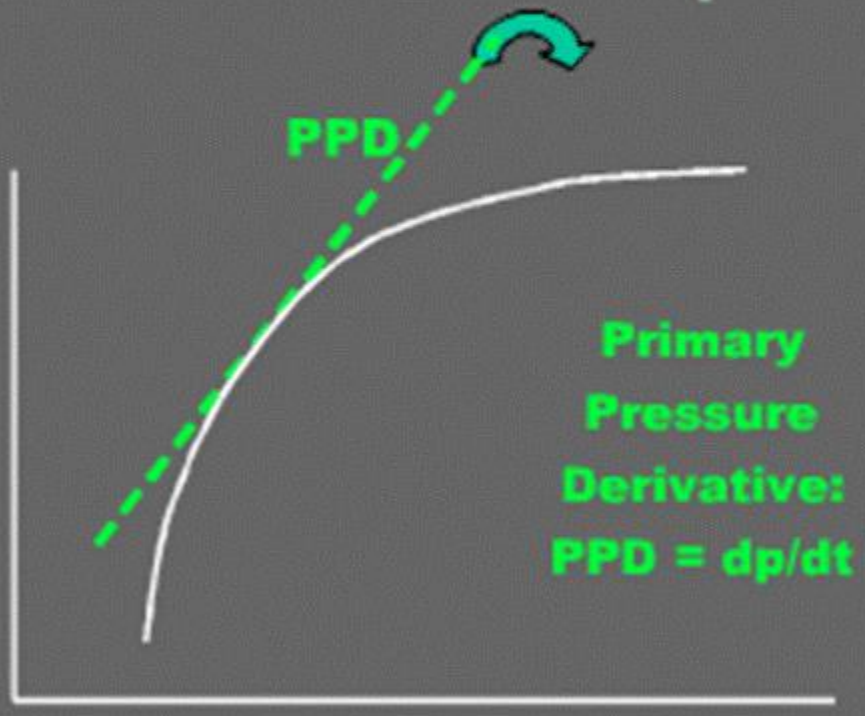
Phase Redistribution?




Raw Data (Kangaroo)
Cartesian Plot
Wellbore
Multi-Layer
Pressure
Time
Time


Multi-Layer?
Wellbore?
Pressure
Log time
Pressure
Log time

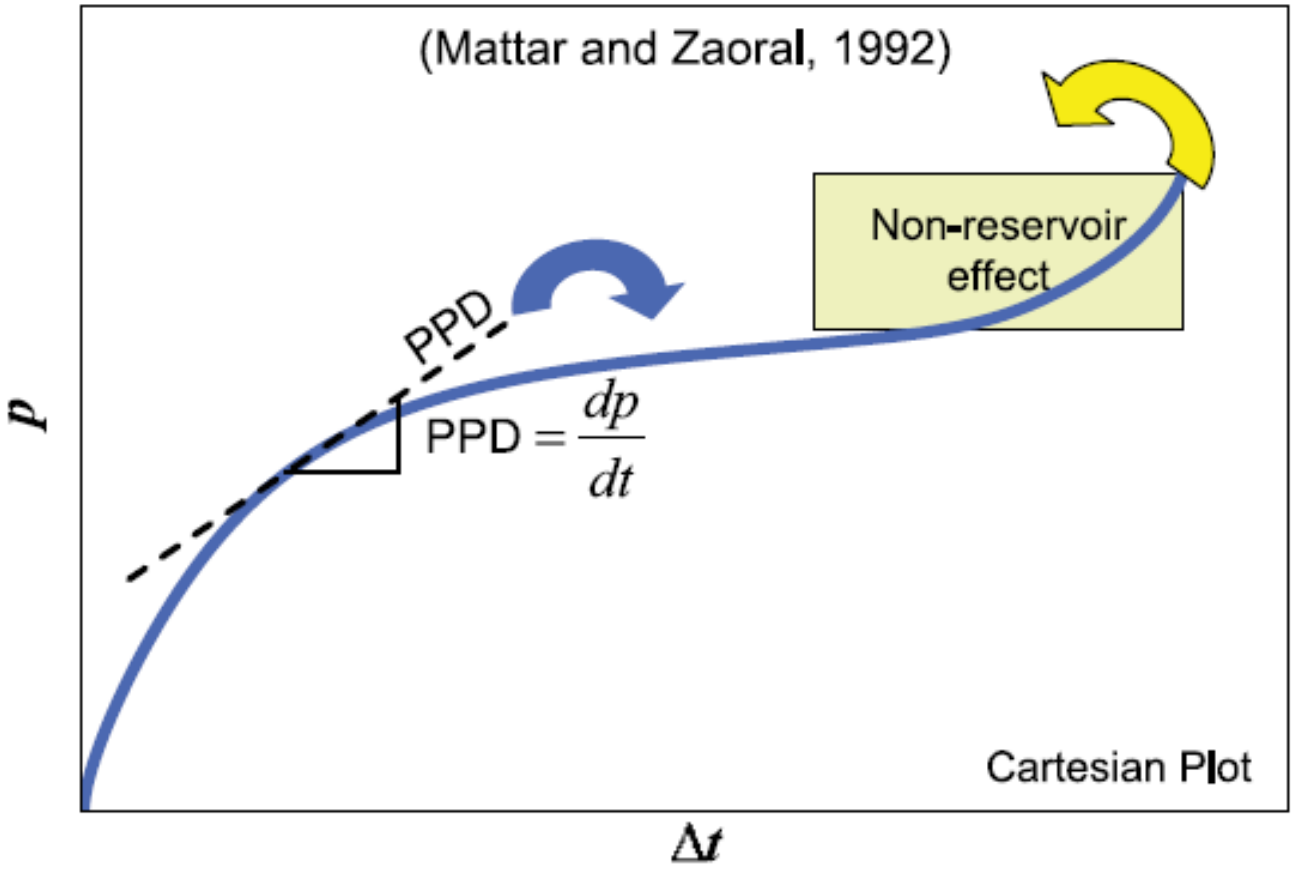
Normal Build-Up



Cartesian Plot

Primary Pressure Derivative

- No matter how complex a reservoir is, a buildup (*in Cartesian coordinates*) will ALWAYS be continuously concave downward for a single phase fluid (*except multilayer reservoirs with unequal* p_i)

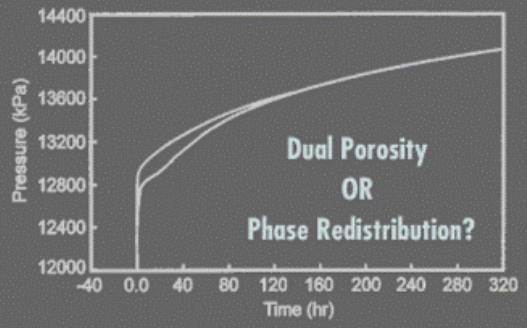


PPD Learnings

- ⇨ Reservoir effects CAN NOT cause an increase in the PPD.
- ⇨ An INCREASE in the PPD indicates Wellbore Dynamics (faulty recorder? liquid movement?...)
- ⇨ WELLBORE & RESERVOIR effects CAN be distinguished using the PPD.

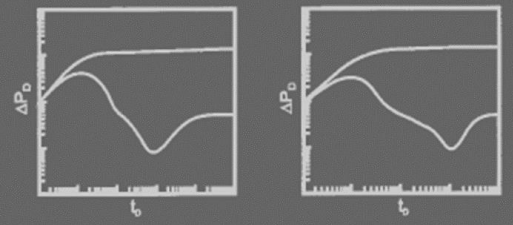
It is not practical to use PPD as a diagnostic for drawdown analysis because of rate changes and noisy measurements

Raw Data (Kangaroo)



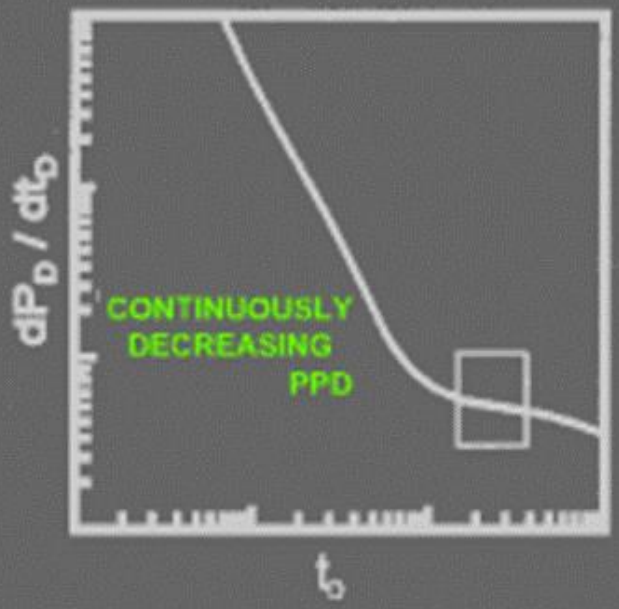
Drawdown Typecurve/Derivative

Dual Porosity?
Phase Redistribution?

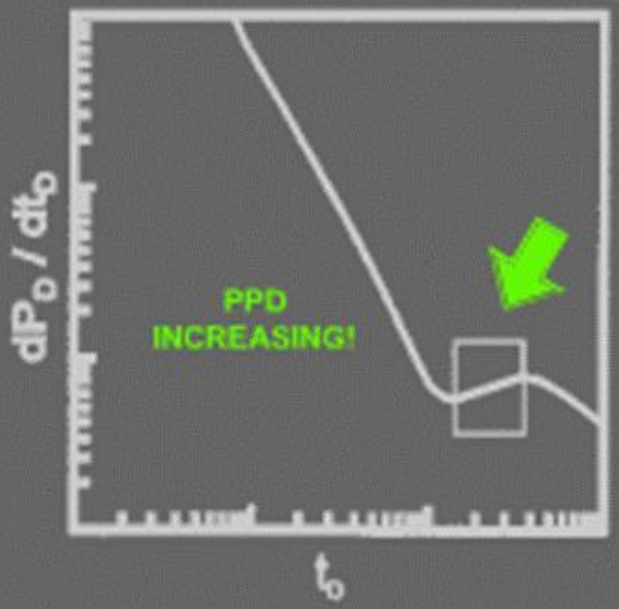


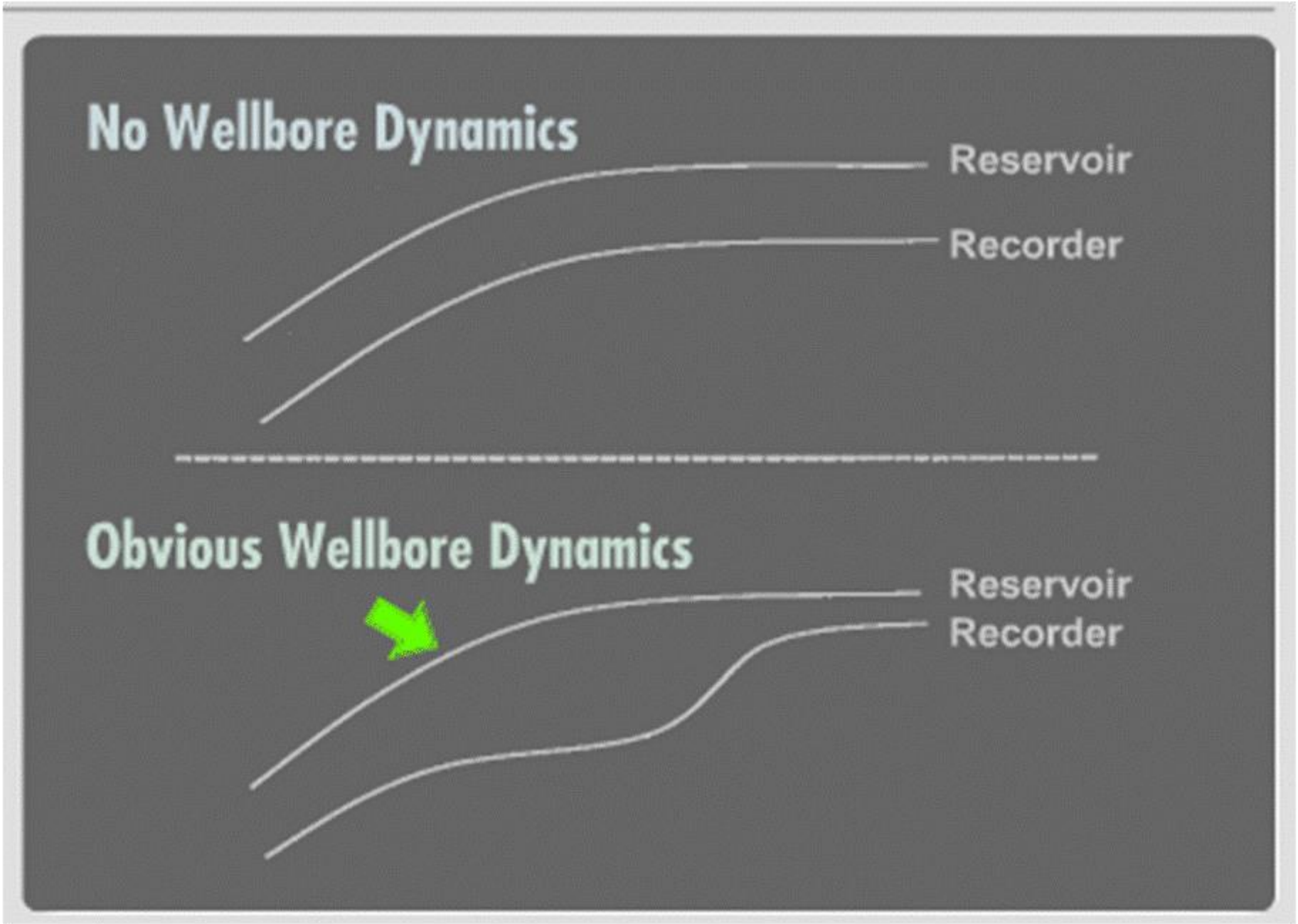
Drawdown PPD

Dual Porosity



Phase Redistribution




No Wellbore Dynamics
Reservoir
Recorder
Obvious Wellbore Dynamics
Reservoir
Recorder

Laws of Practice

Laws of Practice

1

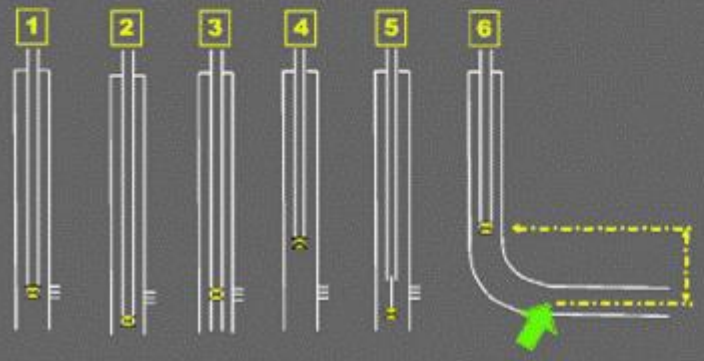
⇨ If it happens suddenly, it is **NOT** a reservoir effect.

⇨ Wellbore transients will **DOMINATE** over Reservoir transients.

Laws of Practice

2

⇨ Draw a Wellbore Schematic



Laws of Practice

3

⇨ Run a static gradient **BEFORE** & **AFTER** a test.

⇨ Run gradient to lowest perforation.

Laws of Practice

4

⇨ Examine the PPD to differentiate between **WELLBORE** & **RESERVOIR** effects.

OILMAN

دانلود رایگان جزوات ارشد

مهندسی نفت

تدریس خصوصی + نمونه سوالات امتحانی + جواب تشریحی ۱۰۰٪ موثر (مهندس مقصودی)

- ✓ تدریس خصوصی دروس مهندسی نفت ویژه دانشجویان ارشد علوم و تحقیقات تهران
- ✓ انجام پروژه ها و تکالیف دروس مهندسی نفت ویژه دانشجویان ارشد علوم و تحقیقات تهران
- مهندس مقصودی

Tel : 09188487112

Email : Eng.Maghsoudi@gmail.com