Note Title 10/9/2018

LNX DEPLETION CHARACTERISTICS

① Differential Depletion of RFUs

$(\bar{P}_R)_{RFU1}(t) \neq (\bar{P}_R)_{RFU2\ldots}(t)$

$\updownarrow \neq$

D_{RFU1} $\quad$ $D_{RFU2\ldots}$

Requires Voidage Ratio (VR)

"D"

Arps Decline Eq. $q = \dfrac{q_i}{[1+bDt]^b}$

$\dfrac{(kh)_1}{HCPV_1} = \dfrac{(100\ md)(100\ ft)}{100\ ft}$ $\qquad D = \dfrac{q_i}{Q_{pu}(1-b)}$

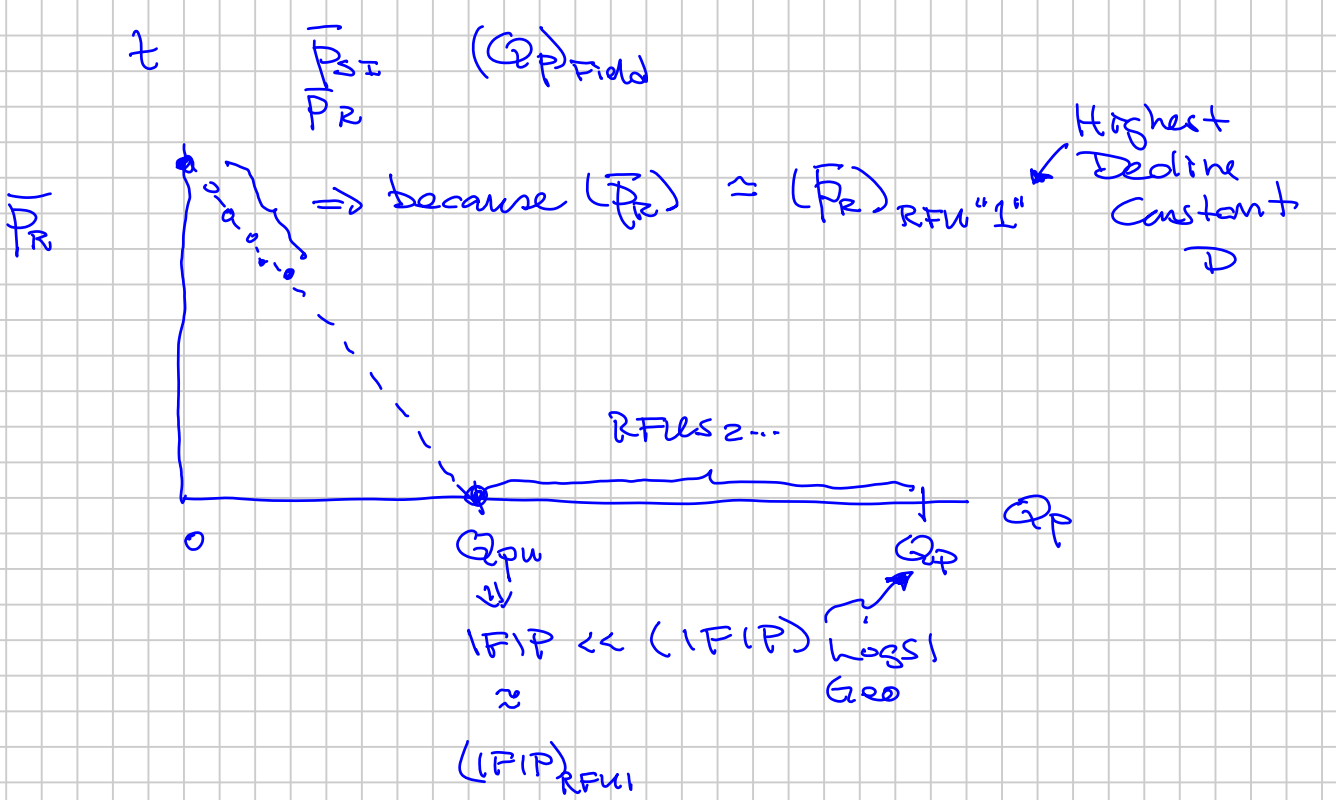
$\dfrac{(kh)_2}{HCPV_2} = \dfrac{(100\ md)(10\ ft)}{10\ ft}$ $\qquad q_i = \dfrac{kh(P_R - P_{wf})}{\left[\ln\frac{r_e}{r_w} + s\right]}$ (@start decline)

$\left(\dfrac{k_1}{k_2}\right) \Rightarrow \dfrac{VR_1}{VR_2} = \dfrac{D_1}{D_2}$ $\qquad Q_{pu} = \dfrac{HCPV}{B_i} \cdot RF_u$

$\frac{HCPV}{B_i}$ = IFIP

Oils: 5–35%; SGD (15–25)%; Gas: 60–98%

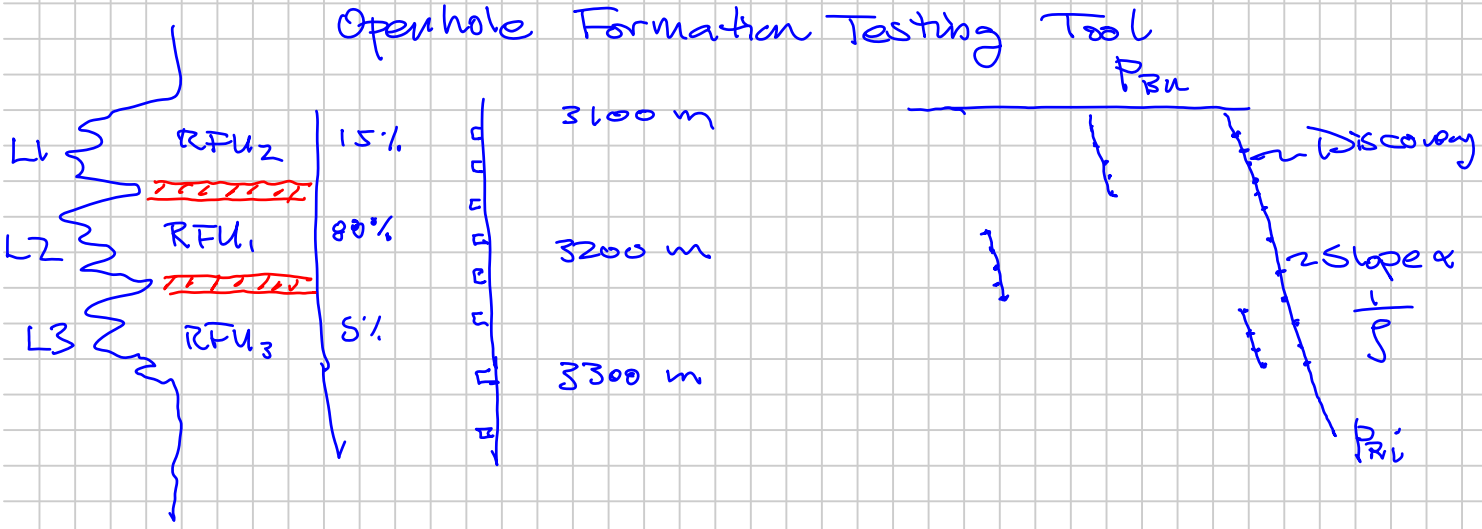
② Difficult to "see" Differential Depletion from conventional data used in material balance and rate (PTA, RTA)



(3) How to Verify Differential Depletion?

- "Late" Infill Wells with "MDT" (SLB)

Openhole Formation Testing Tool



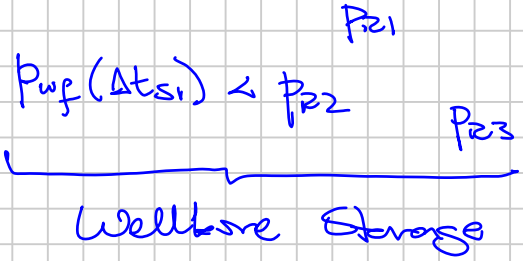
(4) What happens during a well shutin?

Metered Surface $q = 0$

$q_1 \neq 0$

$q_2 \neq 0$

$q_3 \neq 0$



Thereafter (wells)

$\bar{p}_{R3} > \bar{p}_{R1} > p_{wf} > \bar{p}_{R2}$

Producing into Wellbore L1 & L3

Injection into L2 from Wellbore

$\Sigma (q)_{RFW} = q = 0$ Surface

"Backflow"

"Wellbore Crossflow"

Shut-In

$J_{L1}(\bar{p}_{R1} - p_{wf}) + J_{L3}(\bar{p}_{R3} - p_{wf}) = -J_{L2}(\bar{p}_{R2} - p_{wf})$

$= J_{L2}(p_{wf} - \bar{p}_{R2})$

$p_{wf}^{SI}(\Delta t_{SI})$ satisfies this rate balance equation

(5) Longer well & field lives in LNK systems because Lower-"D" RFUs deplete slowly