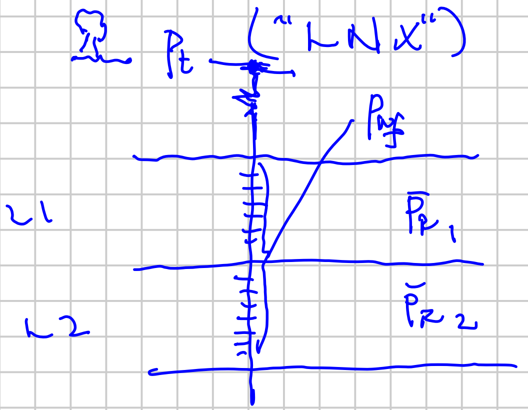
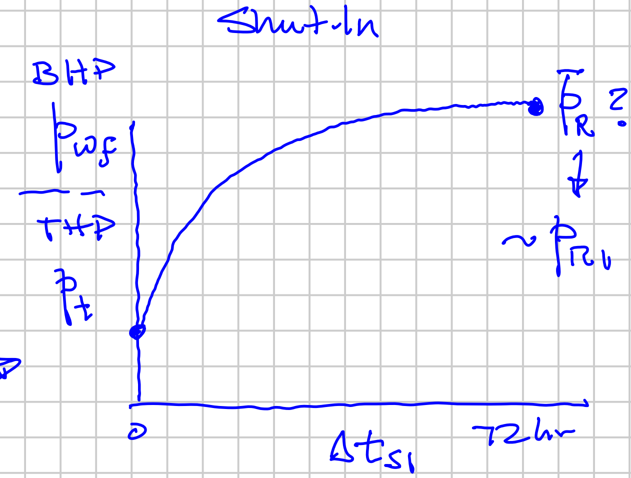
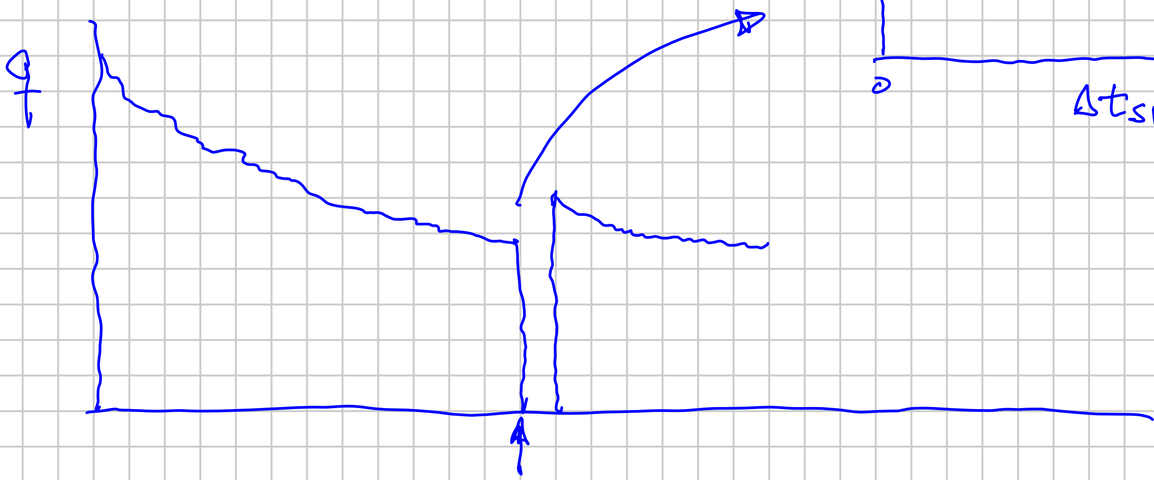
Note Title 10/8/2018

LAYERED NO-CROSSFLOW RESERVOIRS

("LNX")





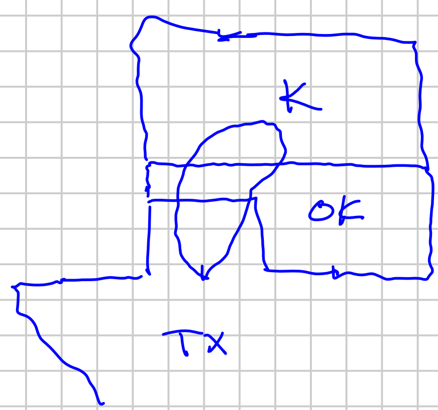


Hugoton | W. Texas

Three Geologic Zones

H K W

99%



LNX ⇒ Differential Depletion

$\frac{k_1}{V_1} > \frac{k_2}{V_2}$ $\qquad p_{R1} \; ^2 \; p_{R2}$

"VR" ⊛

$\frac{\{J^\circ | C_R\}}{\{IFIP | HCPV\}}$ $\qquad \left[\frac{\{kh, s\}_{N_w}}{HCPV}\right]_{RFU}$ ~ Rate of Drainage Factor

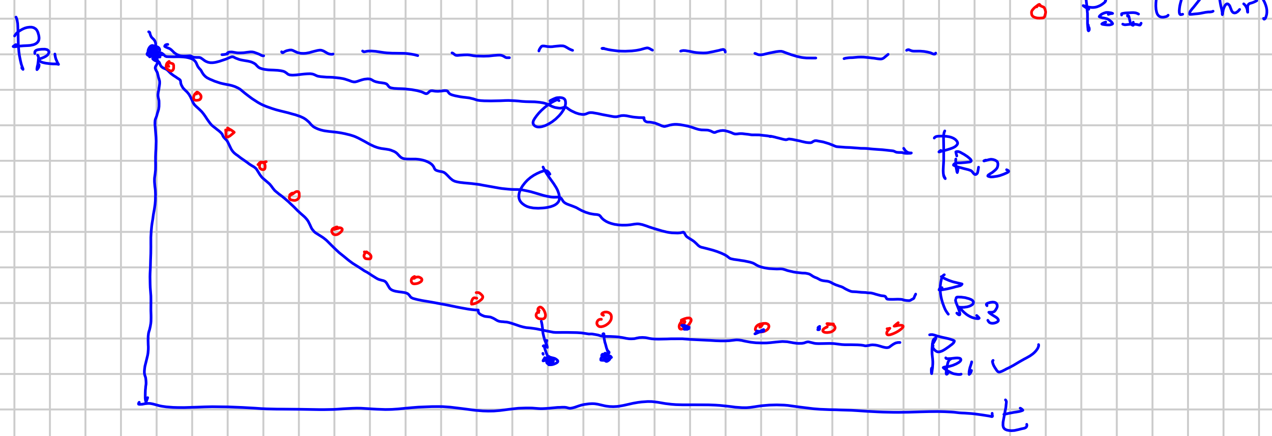
"Voidage Ratio"

RFU	VR
1	210
2	35
3	100

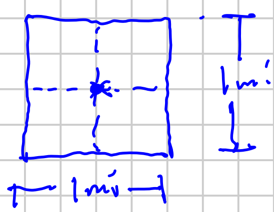
⇒ Rank High-to-Low VR

RFU	VR	To Equalize VR, N_w
1	210	5
3	100	10
2	35	30

* VR ≃ Decline Constant "D" in Arps Eq.



640 acres / section



Section

1 mi ≈ 5280 f ~ 1600 m

43560 ft / acre

10 ft^2 ~ 1 m^2

4360 m^2 / acre

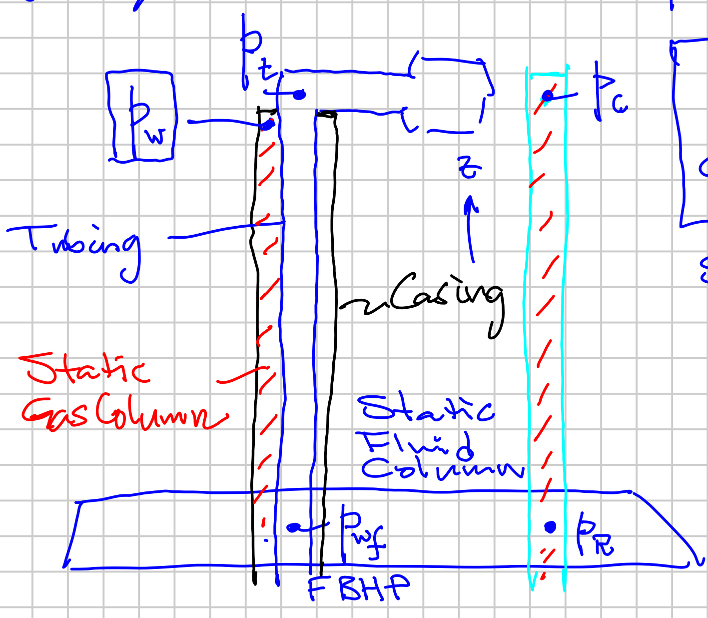
1000 m^2 / mål

4 mål = 1 acre

Drilling Spacing Unit.
1 gas well / section

$P_{wf} - P_t =$
(1) gravity
(2) friction

$P_{wf} - P_w =$
(1) gravity



Darcy L.P. Gas

$$q_g = "C_R"\left(p_R^2 - p_{wf}^2\right)$$

Surface Datum using gas gradient correction BH→Surf/

— Reservoir Datum

$$\rho_g(p,T) : \frac{dp}{dz} = \rho_g g$$

$$\frac{P_{wf}}{P_w} = \text{const}$$

The standard backpressure equation for a well producing from a single layer reservoir is given by Fetkovich (1975).

$$q_g = C_R(p_c^2 - p_w^2) \tag{1}$$

The backpressure constant, C_R, is defined as:

$$C_R = \frac{4.18khe^S}{T_R\left(\ln\frac{r_e}{r_w} - \frac{3}{4} + s\right)\mu_g z} \tag{2}$$

with q_g in std m3/d, p in bar, k in md, h in m, T_R in K, and μ_g in cp. The gravity term, S, is defined as:

"Static"

$$S = \frac{0.0684\gamma_g D}{\bar{T}\bar{z}} \tag{3}$$

TVD

This S must not be confused with the skin factor, s.

The surface datum pressures, p_c and p_w, are converted to bottomhole pressures through the gravity term. The different pressure datums are shown in **Fig. 1**.

$$p_R = e^{S/2}p_c\,; \quad p_{wf} = e^{S/2}p_w \tag{4}$$

$\frac{p_R}{p_c} \approx \frac{p_{wf}}{p_w} \approx e^{S/2}$

p_c "p_R"

p_w "p_{wf}"

$q_g = C_R(p_c^2 - p_w^2)$

Same Eq. for 1-layer or n-layer system

LNX

$$\bar{C}_R \quad \Big| \quad \bar{p}_c$$

$$\bar{C}_R = \sum_{l=1}^{N_l} C_{Rl}$$

$$\underbrace{\bar{p}_c^2(t)}_{} = \frac{\sum_{l=1}^{N_l} C_{Rl} \cdot \bar{p}_{cl}^2(t)}{\bar{C}_R}$$

Mesure

$$p_R^2(t) = \frac{\sum_{l=1}^{N_l} C_{Rl} \cdot p_{Rl}^2}{C_R}$$