Deformation in depleting reservoirs

Subsidence

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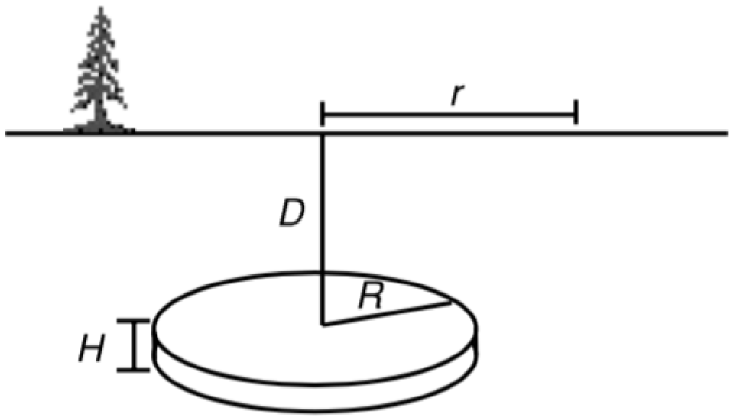
Geertsma (1973) dispacement solution

$$u_z(r,0) = -\frac{1}{\pi} c_m (1-\nu) \frac{D}{\left(r^2 + D^2\right)^{3/2}} \Delta P_p V$$

$$u_r(r,0) = +\frac{1}{\pi} c_m (1-\nu) \frac{D}{\left(r^2 + D^2\right)^{3/2}} \Delta P_p V$$



 Zoback, *Reservoir Geomechanics* (Fig. 12.17, pp. 414)

$$\frac{u_z(r,0)}{\Delta H} = A(\rho,\eta) \qquad \rho = r/R$$
$$\frac{u_r(r,0)}{\Delta H} = B(\rho,\eta) \qquad \eta = D/R$$

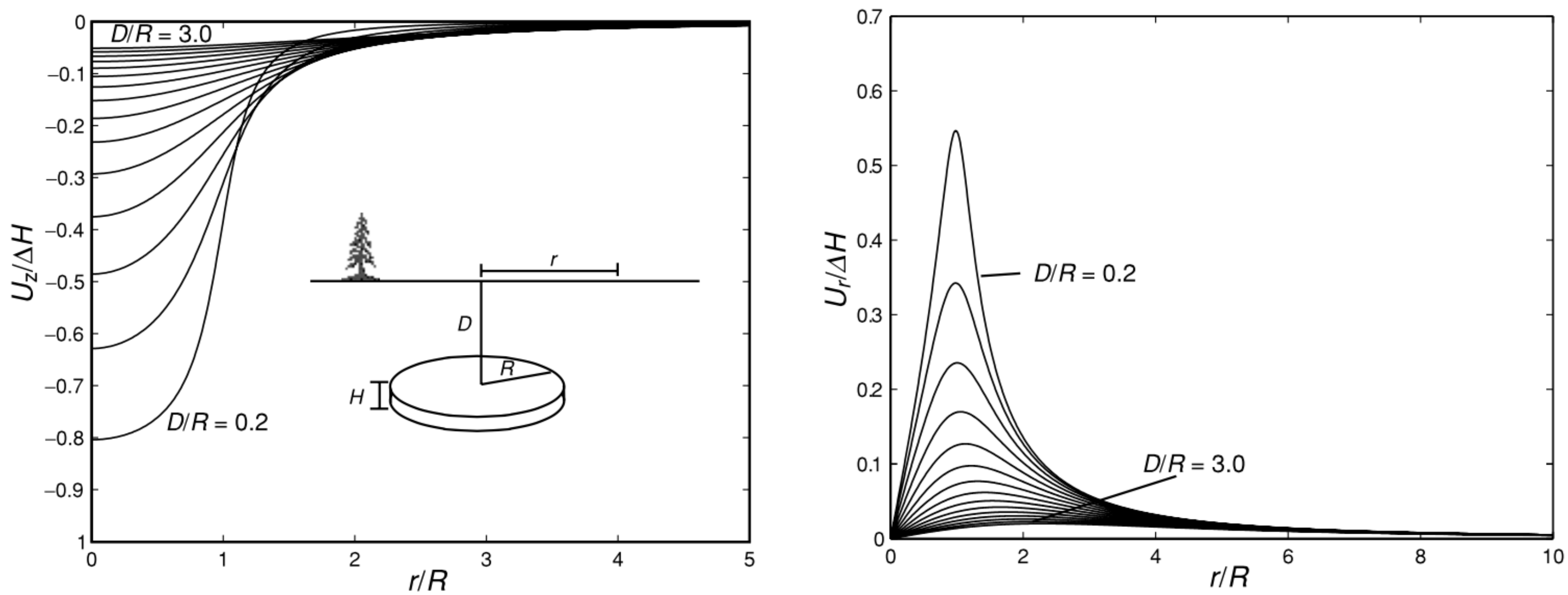
where

$$A = \begin{cases} -\frac{k\eta}{4\sqrt{\rho}}F_0(m) - \frac{1}{2}\Lambda_0(p,k) + 1 & \text{for} \quad (p<1) \\ -\frac{k\eta}{4}F_0(m) + \frac{1}{2} & \text{for} \quad (p=1) \\ -\frac{k\eta}{4\sqrt{\rho}}F_0(m) + \frac{1}{2}\Lambda_0(p,k) & \text{for} \quad (p>1) \end{cases}$$
$$B = \frac{1}{k\sqrt{\rho}}\left(\left(1 - \frac{1}{2}k^2\right)F_0(m) - E_0(m)\right)$$

with

$$m = k^2 = \frac{\rho}{(1-\rho)^2 + \eta^2} \quad \text{and} \quad p = \frac{k^2\left((1-\rho)^2 + \eta^2\right)}{(1-\rho)^2 + k^2}$$

Subsidence and horizontal dispacement



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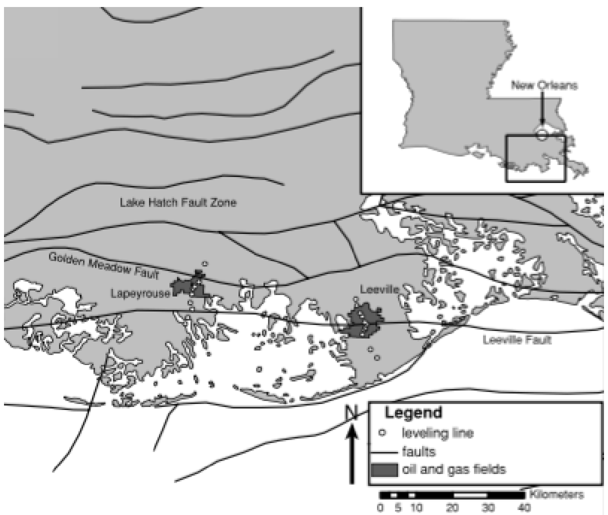
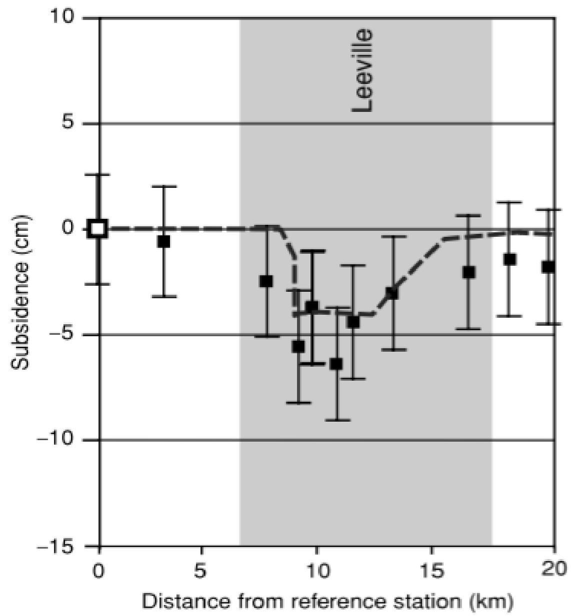
Leeville case study





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