Water

$$\frac{\phi}{B_w}\frac{\partial S_w}{\partial t} + \left[\frac{\phi S_w}{B_w} c_w + \frac{\phi S_w}{B_w} c_r\right]\frac{\partial p}{\partial t} = \frac{\partial}{\partial x}\left[\frac{k k_{rw}}{\mu_w B_w}\frac{\partial p}{\partial x}\right] + \tilde{q}^w$$

$$\frac{\phi}{B_{w,i}}\frac{S_{w,i}^{n+1} - S_{w,i}^{n}}{\Delta t} + \frac{\phi_i S_{w,i}^{n}(c_w + c_r)}{B_{w,i}}\frac{p_i^{n+1} - p_i^{n}}{\Delta t} = \frac{1}{\Delta x_i}\left(\lambda_{w,i-1/2}\frac{p_{i-1}^{n+1} - p_i^{n+1}}{\Delta x_{i-1/2}} + \lambda_{w,i+1/2}\frac{p_{i+1}^{n+1} - p_i^{n+1}}{\Delta x_{i+1/2}}\right)$$

$$+ \tilde{q}_{w,i}$$

Multiply by $\frac{B_{w,i}\Delta t}{\phi}$

$$S_{w,i}^{n+1} = S_{w,i}^{n} + \frac{B_{w,i}\Delta t}{V_i \phi_i}\left[T_{w,i-1/2}\left(p_{i-1}^{n+1} - p_i^{n+1}\right) + T_{w,i+1/2}\left(p_{i+1}^{n+1} - p_i^{n+1}\right) + Q_{w,i}\right]$$

$$- S_{w,i}^{n}\left(c_w + c_r\right)\left(p_i^{n+1} - p_i^{n}\right)$$

$$\vec{S}_w^{n+1} = \vec{S}_w^{n} + \bar{\bar{d}}_{12}^{-1}\left[-\bar{\bar{T}}\,\vec{p}^{\,n+1} + Q_w \right] - \bar{\bar{C}}_{tw}\left[\vec{p}^{\,n+1} - \vec{p}^{\,n} \right]$$

$$C_{tw,ii} = S_{w,i}^{n}\left(c_{w,i} + c_{r,i} \right)$$

$$d_{12,ii} = \frac{V_i\,\phi_i}{B_{w,i}\,\Delta t}$$

total trans.

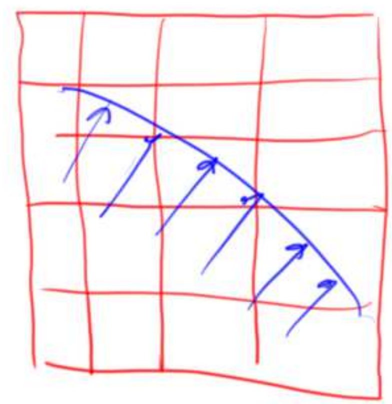
$$\bar{\bar{T}} = T_w + \frac{B_o}{B_w} T_o$$

$$T_w = \begin{bmatrix} T_{w,1/2} + T_{w,3/2} & -T_{w3/2} & \\ -T_{w,3/2} & T_{w,3/2} + T_{w,5/2} & -T_{w,5/2} \\ & & \ddots \end{bmatrix}, \quad T_o = \ldots$$

$$T_{w,i-1/2} = \frac{k_{i-1/2}\,k_{rw,i-1/2}\,A}{\Delta x_{i-1/2}\,\mu_w\,B_w}$$

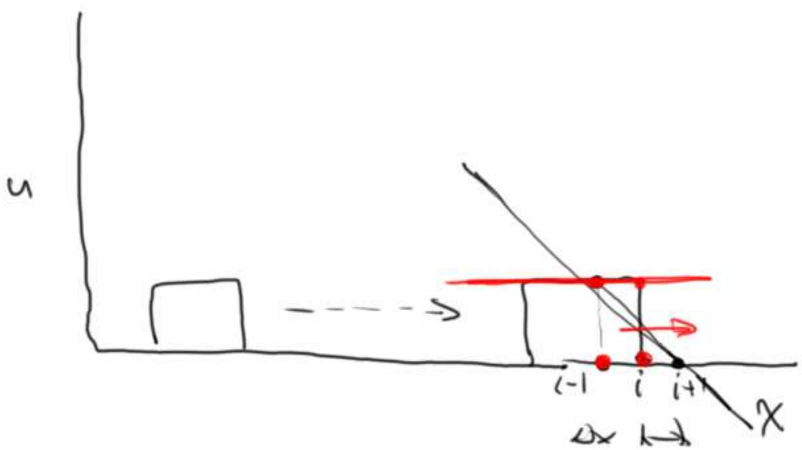
$$\frac{B_o}{B_w}\frac{\partial}{\partial x}\left(\frac{k\,k_{ro}}{\mu_o B_o}\frac{\partial p}{\partial x}\right) + \underbrace{\frac{\partial}{\partial x}\left(\frac{k\,k_{rw}}{\mu_w B_w}\frac{\partial p}{\partial x}\right)} = \frac{\phi\, c_t}{B_w}\frac{\partial p}{\partial t} - \left(\frac{B_o}{B_w}\right)\tilde{q}_o - \tilde{q}_w$$

$$\frac{k}{\mu B_w}\left(\frac{\partial k_{rw}}{\partial x}\frac{\partial p}{\partial x} + k_{rw}\frac{\partial^2 p}{\partial x}\right)$$



$$A\frac{\partial p}{\partial t} = B\frac{\partial p}{\partial x} + C\frac{\partial^2 p}{\partial x^2}$$

$$\frac{\partial^2 u}{\partial t^2} = c^2\frac{\partial^2 u}{\partial x^2}$$



$$\frac{\partial u}{\partial x} \approx \frac{u_{i+1} - u_{i-1}}{2\Delta x}$$

$$A \frac{\partial p}{\partial t} = B \frac{\partial p}{\partial x} + C \frac{\partial^2 p}{\partial x^2}$$

$$A \frac{\partial p_i}{\partial t} = B \frac{P_i - P_{i-1}}{\Delta x} + C \frac{P_{i+1} - 2P_i + P_{i-1}}{\Delta x^3}$$

$$A \frac{\partial P_i}{\partial t} = B \frac{P_{i+1} - P_{i-1}}{2\Delta x} + \left(C + \frac{B \Delta x}{2} \right) \frac{P_{i+1} - 2P_i + P_{i-1}}{\Delta x^2}$$