PeGn624 Homework # 11

- Assigned: 2009-02-13
- Due: 2009-02-20

1 Question 1: Right-Hand-Side Expansion

The primary variables are P_o, S_o, T. When $T < T_s$, $S_g = 0$ and T_s is used as the fourth primary variable. When $T \geq T_s$, S_g is used as the fourth primary variable.

1.1 Part (a): Water Equation for $T < T_s$

Eq. 1 represents the right-hand-side of the water component equation. Expand the finite difference operators in Eq. 1 in terms of the primary variables for a 1D problem. Collect terms for δP_o, δS_o, δT, and δT_s.

$$\mathsf{RHSW} = \frac{\mathsf{VR}}{\Delta t}\Delta_t\left(\phi(S_w\xi_w X_{w1} + S_g\xi_g Y_{w1})\right) \tag{1}$$

1.2 Part (b): Oil Equation for $T < T_s$

Eq. 2 represents the right-hand-side of the oil component equation. Expand the finite difference operators in Eq. 2 in terms of the primary variables for a 1D problem. Collect terms for δP_o, δS_o, δT, and δT_s.

$$\mathsf{RHSO} = \frac{\mathsf{VR}}{\Delta t}\Delta_t\left(\phi(S_o\xi_o X_{o2})\right) \tag{2}$$

1.3 Part (c): Water Equation for $T \geq T_s$

Eq. 1 represents the right-hand-side of the water component equation. Expand the finite difference operators in Eq. 1 in terms of the primary variables for a 1D problem. Collect terms for δP_o, δS_o, δT, and δS_g.

1.4 Part (d): Oil Equation for $T \geq T_s$

Eq. 2 represents the right-hand-side of the oil component equation. Expand the finite difference operators in Eq. 1 in terms of the primary variables for a 1D problem. Collect terms for δP_o, δS_o, δT, and δS_g.

2 Question 2: Alternate Right-Hand-Side Expansion

$$A = (\phi(S_w \xi_w X_{w1} + S_g \xi_g Y_{w1})) \tag{1}$$

$$A^{\ell+1} = A^{\ell} + \left(\frac{\partial A}{\partial P_o}\right)^{\ell} \delta P_o + \left(\frac{\partial A}{\partial T}\right)^{\ell} \delta T + \left(\frac{\partial A}{\partial S_o}\right)^{\ell} \delta S_o + \left(\frac{\partial A}{\partial S_g}\right)^{\ell} \delta S_g \tag{2}$$

2.1 Part (a): Water Equation for $T \geq T_s$

Expand Eq. 1 using the following approach. Start with Eq. 1. Evaluate $A^{\ell+1}$ using Eq. 2. Expand the finite difference operators in Eq. 1 in terms of the primary variables for a 1D problem. Collect terms for δP_o, δS_o, δT, and δS_g. Prove that the result is the same as 1(c).