

# 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  $\delta P_o$ ,  $\delta S_o$ ,  $\delta T$ , and  $\delta T_s$ .

$$\text{RHSW} = \frac{\text{VR}}{\Delta t} \Delta_t (\phi(S_w \xi_w X_{w1} + S_g \xi_g Y_{w1})) \quad (1)$$

### 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  $\delta P_o$ ,  $\delta S_o$ ,  $\delta T$ , and  $\delta T_s$ .

$$\text{RHSO} = \frac{\text{VR}}{\Delta t} \Delta_t (\phi(S_o \xi_o X_{o2})) \quad (2)$$

### 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  $\delta P_o$ ,  $\delta S_o$ ,  $\delta T$ , and  $\delta S_g$ .

### 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  $\delta P_o$ ,  $\delta S_o$ ,  $\delta T$ , and  $\delta S_g$ .

## 2 Question 2: Alternate Right-Hand-Side Expansion

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

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

### 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  $\delta P_o$ ,  $\delta S_o$ ,  $\delta T$ , and  $\delta S_g$ . Prove that the result is the same as 1(c).