

A 3D visualization of a subsurface reservoir. The reservoir is shown as a layered structure with various colors representing different geological layers. Several wells are depicted as vertical lines extending from the surface into the reservoir. Pie charts are placed at the top of some wells, likely representing production or injection profiles. The entire scene is set against a dark background.

# Boundary and Initial Conditions

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# Boundary and Initial Conditions

- What is our differential equation?

$$\checkmark \frac{\partial}{\partial x} \left( \frac{k}{\mu B} \frac{\partial P}{\partial x} \right) + \frac{Q}{A \partial x} = \frac{\partial}{\partial t} \left( \frac{\phi}{B} \right)$$

- What do we want to see by solving the differential equation?

- ✓ A function P (pore pressure) of x (location) and t (time)

- Why do we want to see pore pressure for locations and times?

- ✓ 압력이 너무 떨어지면 생산이 안됨 → 생산 기간 계산 가능

- ✓ 압력이 너무 올라가면 파쇄, 단층 슬립 발생 → 안정성 검토 가능

- ✓ ...

- What do we need to solve the differential equation?

- ✓ Conditions for  $t=0$  → initial conditions

- ✓ Conditions for  $t>0$  → boundary conditions

# Boundary and Initial Conditions in Reservoir Simulation

- Initial conditions in reservoir simulation
  - ✓ Initial pressure
  - ✓ Initial saturation
  - ✓ ...
- Boundary conditions in reservoir simulation
  - ✓ Production/Injection rates at a well
  - ✓ Well pressure at a well
    - Wellhead/Bottom-hole pressure
  - ✓ Conditions at aquifers and faults
  - ✓ ...

# Dirichlet Condition

- Specify the values that the solution needs to have along the boundary
- In reservoir simulation

$$\checkmark Q = -\frac{kA}{\mu} \nabla P$$

- ✓ For a well, a constant well bottom-hole pressure condition
- ✓ For a reservoir boundary, a constant pressure condition
  - Pore volume is infinite

# Neumann Condition

- Specify the values that the derivative of the solution needs to have at the boundary
- In reservoir simulation
  - ✓ For a well, a constant flow rate condition
  - ✓ For a reservoir boundary, a constant temporal derivative of pressure condition