Typical Porosities

Sedimentary

1. clastic rocks (sandstone, shale, etc.) $\phi \approx 0.5$
   random packing of uniform spheres $\phi = 0.4$
2. evaporites (salt deposits) $\phi \approx 10^{-3}$

Igneous

1. intrusive rocks (like granite) $\phi \approx 10^{-3}$
2. extrusive rocks - $\phi > 10^{-3}$
3. ash deposits $\phi \approx 0.5$

Clastic Rocks

In clastic (sedimentary) rocks the initial porosity depends on

1. grain size - surface friction
2. shape - more irregular shapes have higher porosity
3. distribution - uniform size have higher porosity

Evolution of Porosity

1. consolidation - slip and rotation of grains
2. compaction - (plastic) deformation of grains
3. dissolution and precipitation

Fluid Saturation

suppose that the pore volume is partially filled with water (density ρ_w)

Define

$$S_w = \frac{\text{volume of water}}{\text{volume of pore}}$$

assume that ϕ is known

measure mass M_w

$$M_w = \rho_s(1-\phi)V + \rho_w(\phi V)S_w$$

but

$$M_{dry} = \rho_s(1-\phi)V$$

so

$$M_w - M_{dry} = \rho_w \phi V S_w$$

or

$$S_w = \left(\frac{M_w - M_{dry}}{V}\right)\frac{1}{\rho_w \phi} = \left(\frac{\rho_w - \rho_{dry}}{\rho_w \phi}\right)$$