4. Rock Physics

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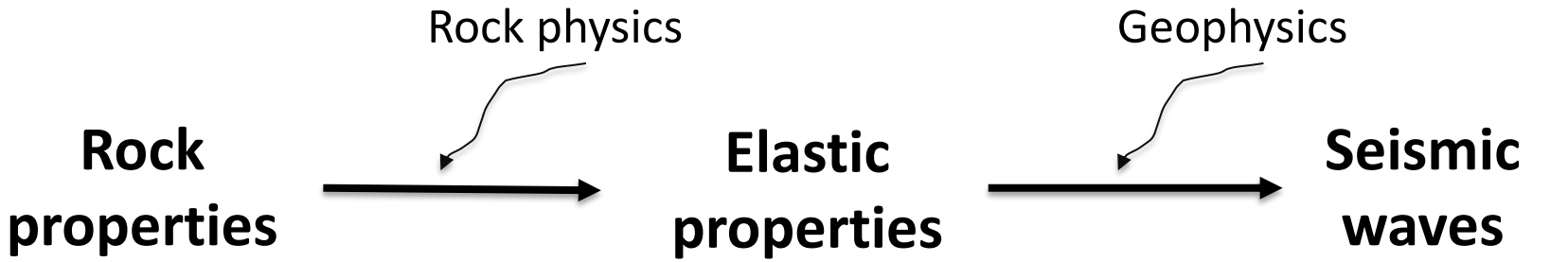
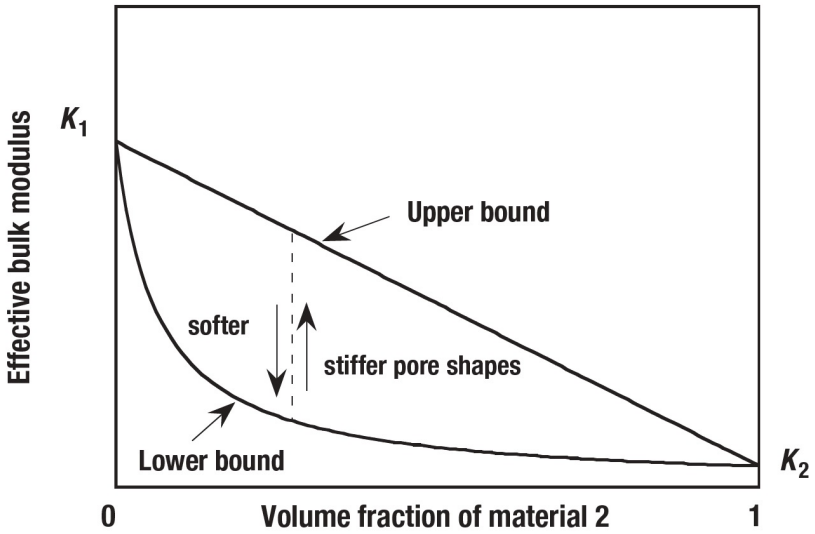
ERSE 210 Seismology

Rocks and waves



Mixing Laws



Source: Avseth, P., Mukerji, T., and Mavko, G., Quantitative Seismic Interpretation

UB -> **Voigt** (arithmetic average): $M = \sum_i \ f_i M_i$

LB -> **Reuss** (geometric average): $1/M = \sum_i \ f_i / M_i$

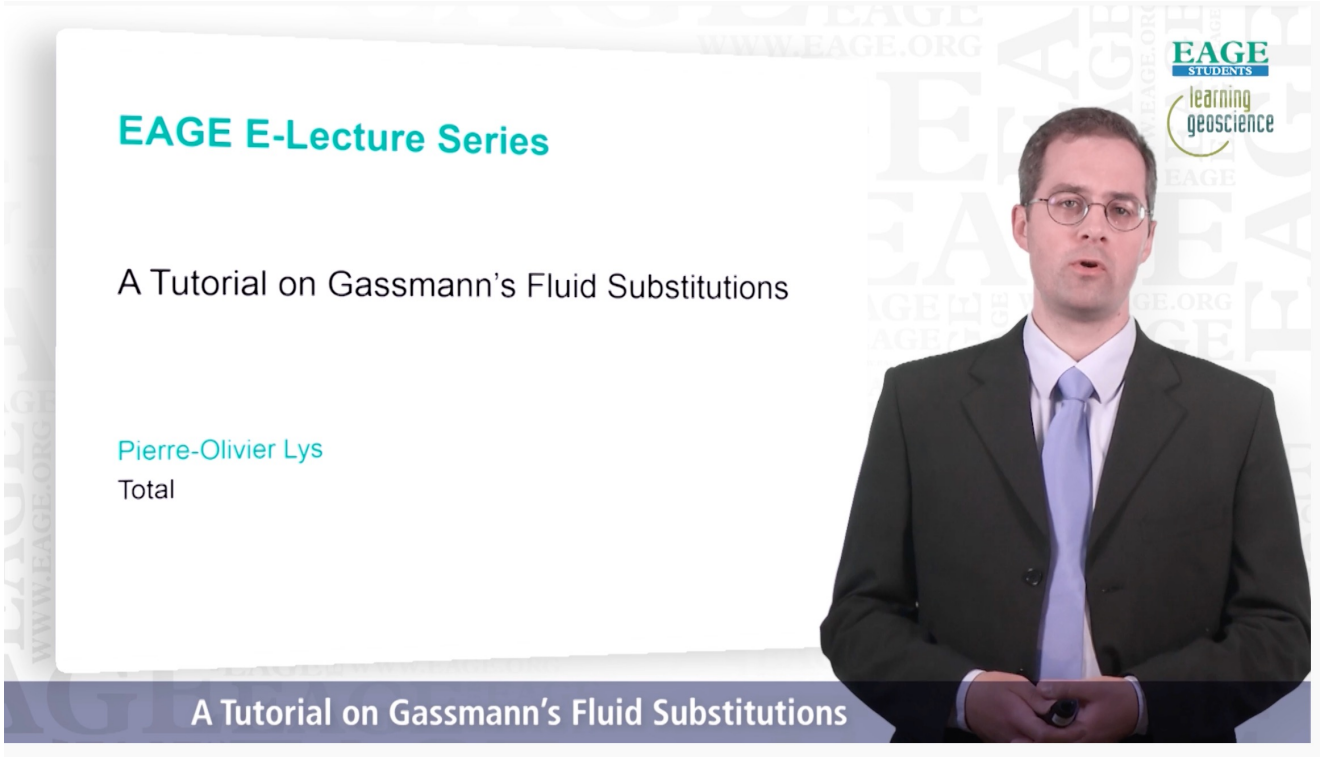
Gassmann Fluid substitutions

$$K_{dry} = \frac{K_1\left(\frac{\phi K_{min}}{K_{fl,1}} + 1 - \phi\right) - K_{min}}{\frac{\phi K_{min}}{K_{fl,1}} + \frac{K_1}{K_{min}} - 1 - \phi}$$

$$K_2 = K_{dry} + \frac{(1 - K_{dry}/K_{min})^2}{\frac{\phi}{K_{fl,2}} + \frac{1-\phi}{K_{min}} - \frac{K_{dry}}{K_{min}^2}}$$

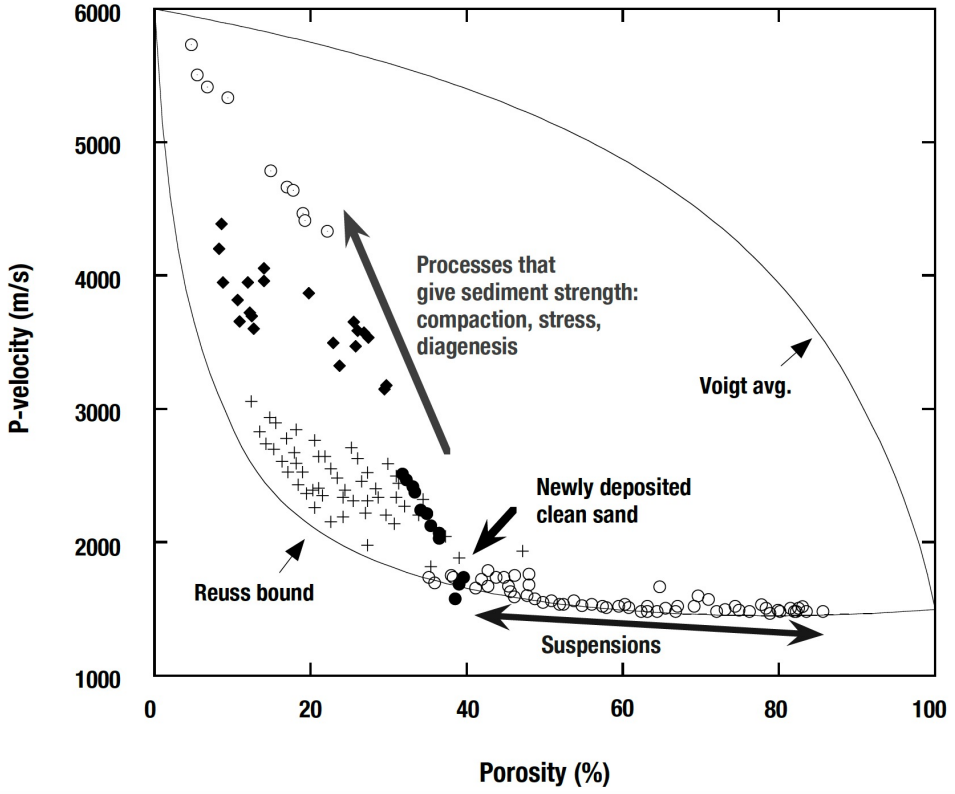
$$\mu_2 = \mu_1 \qquad \rho_2 = \rho_1 + \phi(\rho_{fl,2} - \rho_{fl,1})$$

Gassmann Fluid substitutions



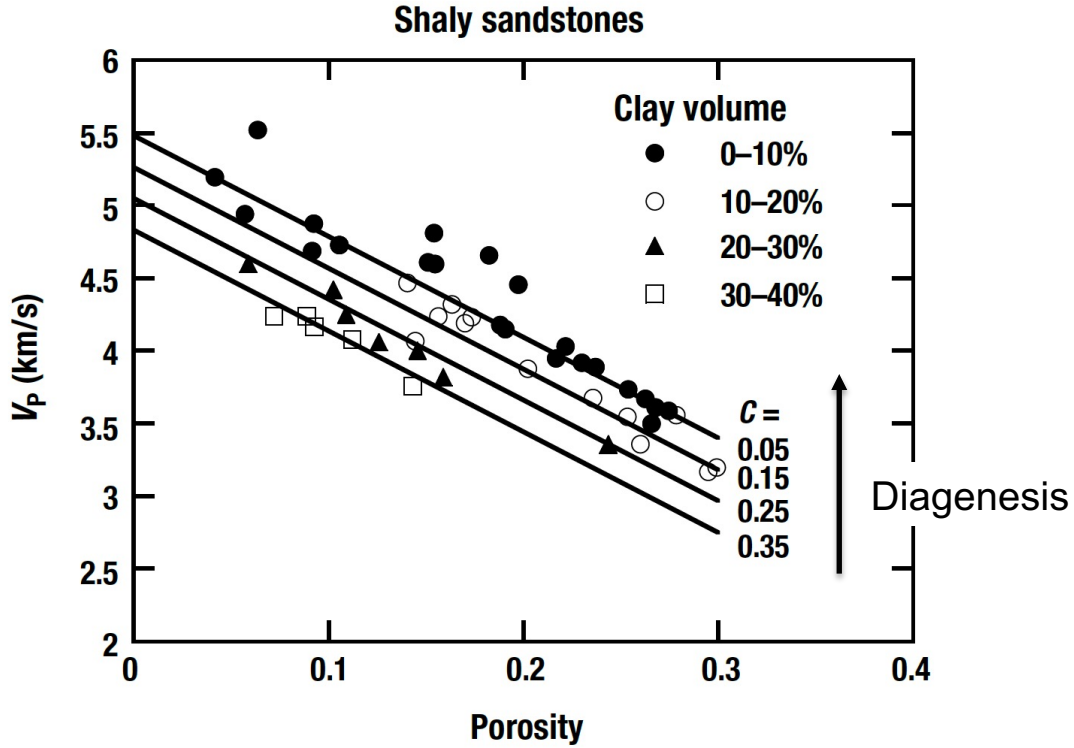
EAGE E-Lecture: https://www.youtube.com/watch?v=C6LOsvCjyw8

Velocity-Porosity relation – field evidence



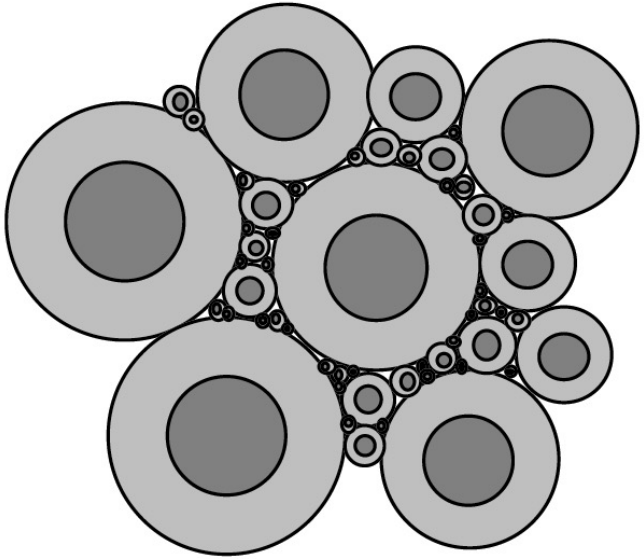
Source: Avseth, P., Mukerji, T., and Mavko, G., Quantitative Seismic Interpretation

Velocity-Porosity relation - empirical



Source: Avseth, P., Mukerji, T., and Mavko, G., Quantitative Seismic Interpretation

Velocity-Porosity relation - theoretical



Friable Sand Model

$$K_{\text{dry}} = \left[\frac{\phi/\phi_c}{K_{\text{HM}} + 4\mu_{\text{HM}}/3} + \frac{1-\phi/\phi_c}{K + 4\mu_{\text{HM}}/3} \right]^{-1} - \frac{4}{3}\mu_{\text{HM}}$$

$$\mu_{\text{dry}} = \left[\frac{\phi/\phi_c}{\mu_{\text{HM}} + z} + \frac{1-\phi/\phi_c}{\mu + z} \right]^{-1} - z$$