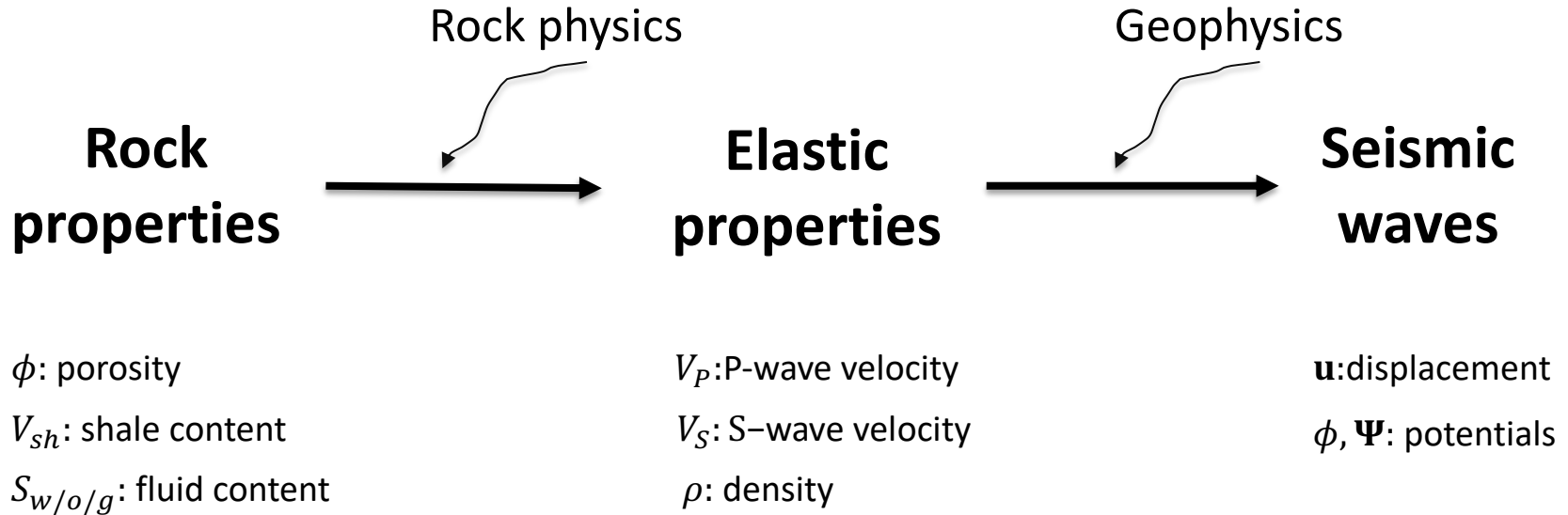


4. Rock Physics

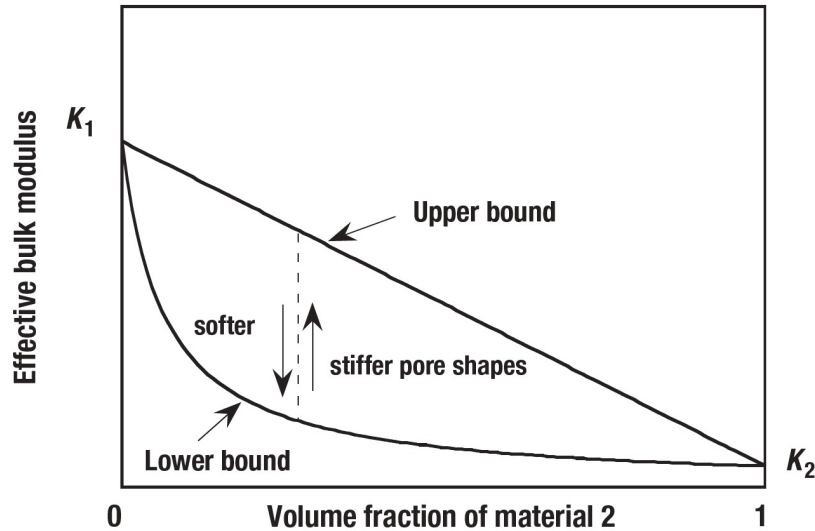
M. Ravasi

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): $1/M = \sum_i f_i / M_i$

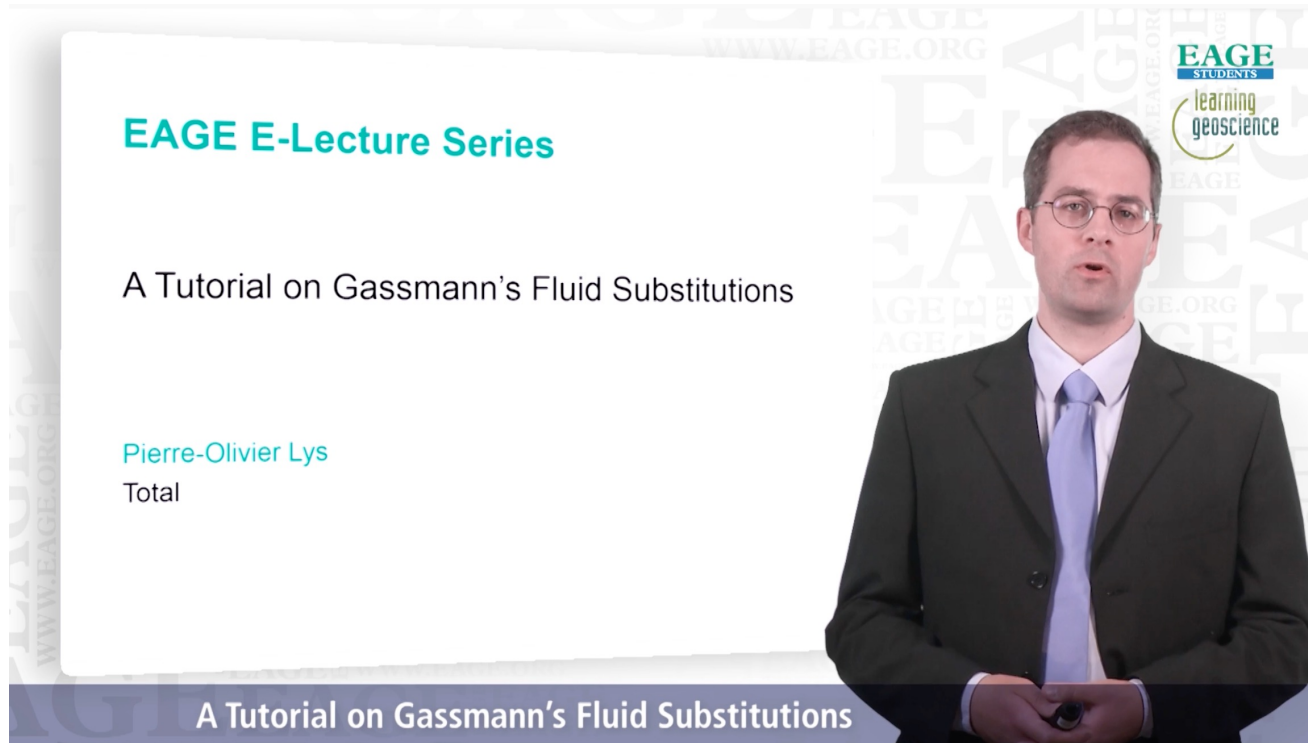
Gassmann Fluid substitutions

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

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

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

Gassmann Fluid substitutions

A video frame from the EAGE E-Lecture Series. On the right, a man in a dark suit, light blue shirt, and light blue tie stands with his hands clasped. The background is a white slide with text. The slide has a repeating watermark of 'EAGE' and 'WWW.EAGE.ORG'. In the top right corner of the slide is the 'EAGE STUDENTS learning geoscience' logo. The slide text includes 'EAGE E-Lecture Series' in teal, 'A Tutorial on Gassmann's Fluid Substitutions' in black, and 'Pierre-Olivier Lys' and 'Total' in teal.

EAGE E-Lecture Series

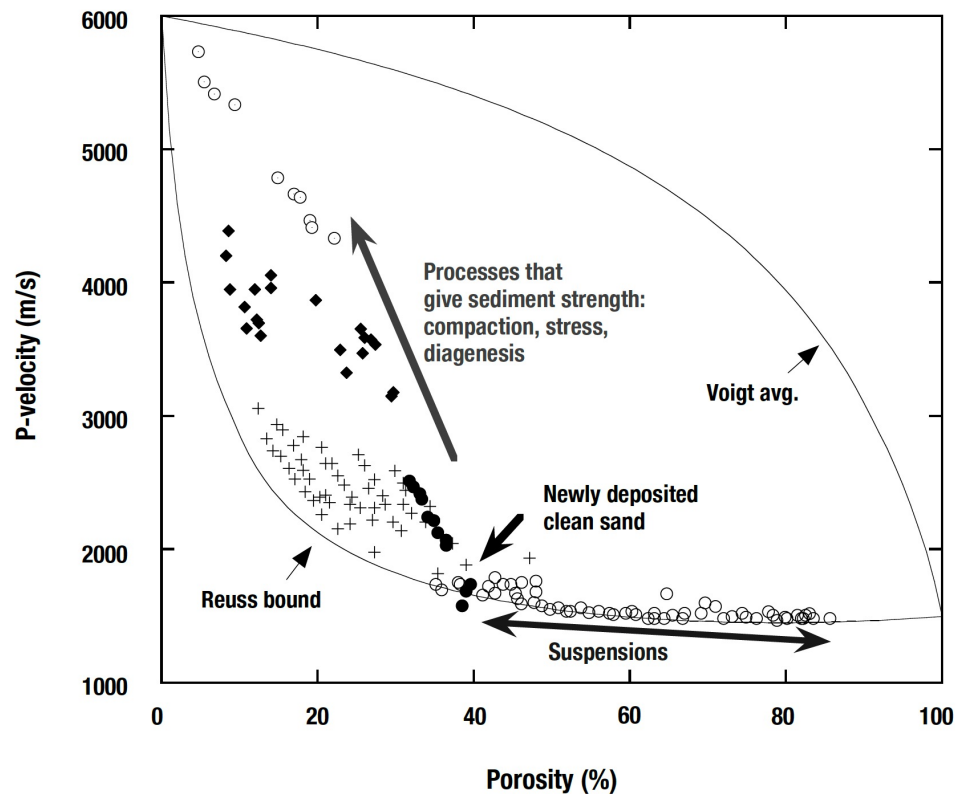
A Tutorial on Gassmann's Fluid Substitutions

Pierre-Olivier Lys
Total

A Tutorial on Gassmann's Fluid Substitutions

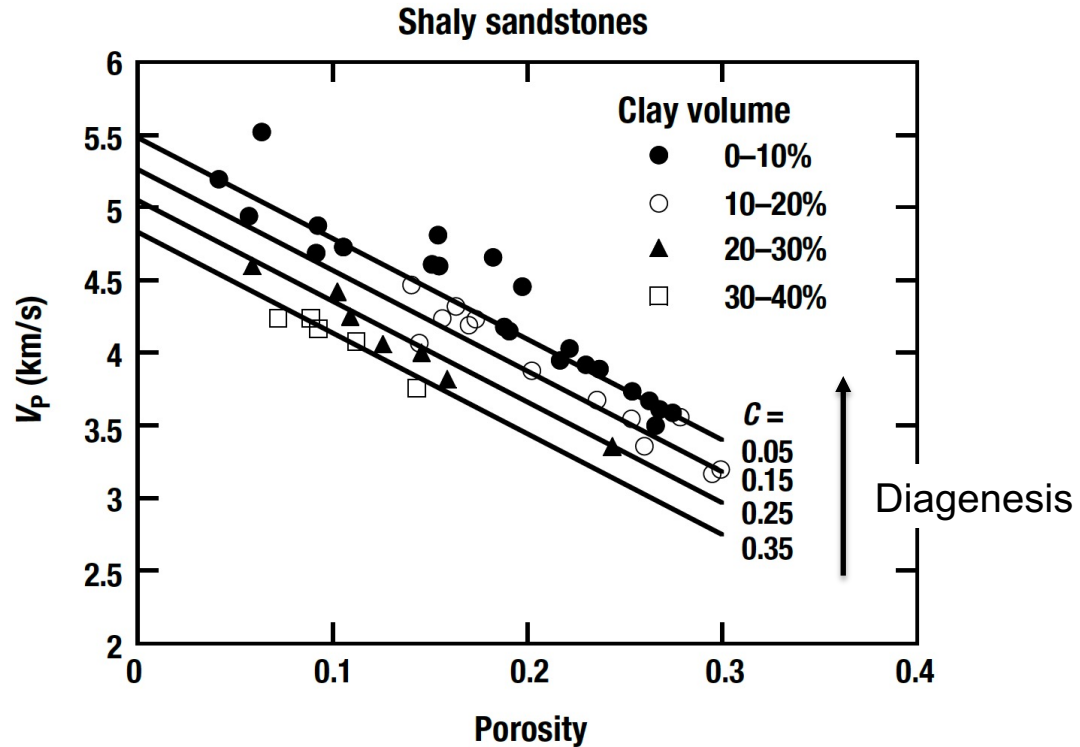
EAGE E-Lecture: <https://www.youtube.com/watch?v=C6LOsvCjyw8>

Velocity-Porosity relation – field evidence

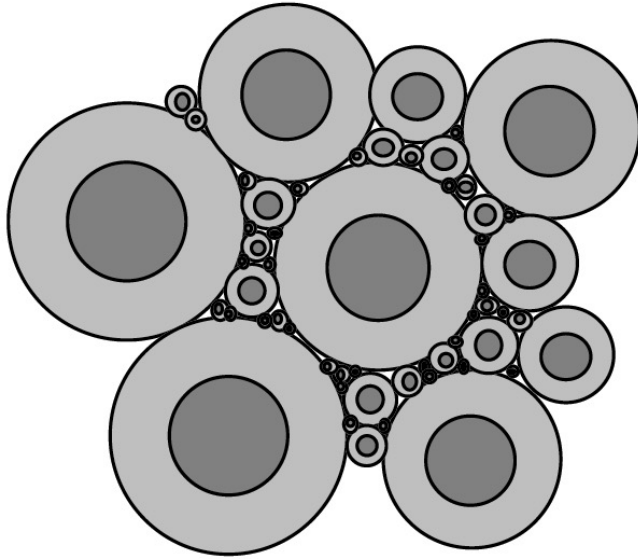


Source: Avseth, P., Mukerji, T., and Mavko, G., Quantitative Seismic Interpretation

Velocity-Porosity relation - empirical



Velocity-Porosity relation - theoretical



Friable Sand Model

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

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