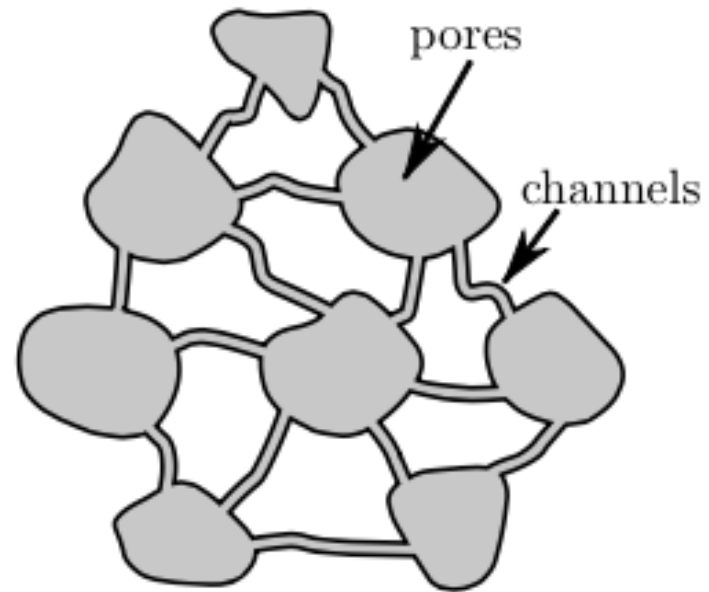


Effective stress



Effective stress tensor

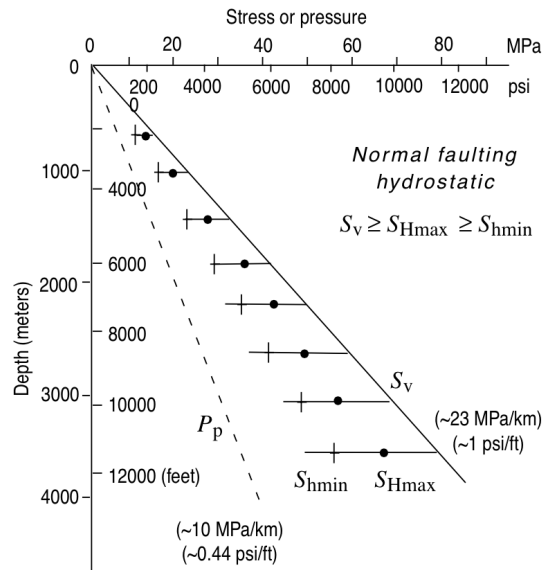
$$\boldsymbol{\sigma}_{eff} = \begin{bmatrix} S_{11} & S_{12} & S_{13} \\ S_{12} & S_{22} & S_{23} \\ S_{13} & S_{23} & S_{33} \end{bmatrix} - \begin{bmatrix} P_p & 0 & 0 \\ 0 & P_p & 0 \\ 0 & 0 & P_p \end{bmatrix}$$

$$\boldsymbol{\sigma}_{eff} = \begin{bmatrix} S_{11} - P_p & S_{12} & S_{13} \\ S_{12} & S_{22} - P_p & S_{23} \\ S_{13} & S_{23} & S_{33} - P_p \end{bmatrix}$$

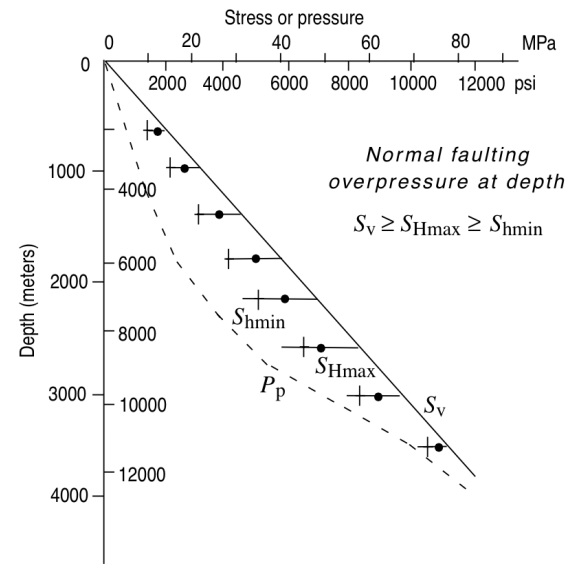
- Faulting depends on the effective stress

Stress magnitudes at depth

Normal faulting



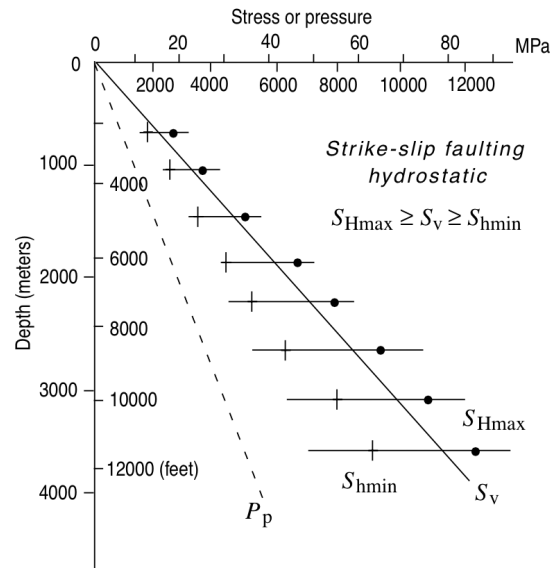
Hydrostatic



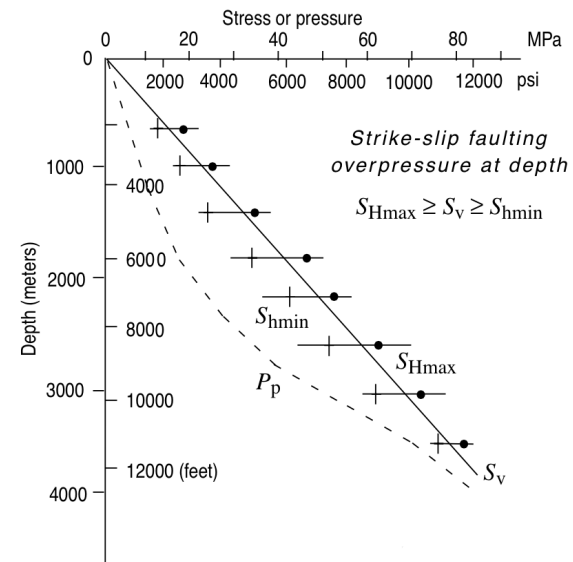
Overpressure

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Strike-slip faulting



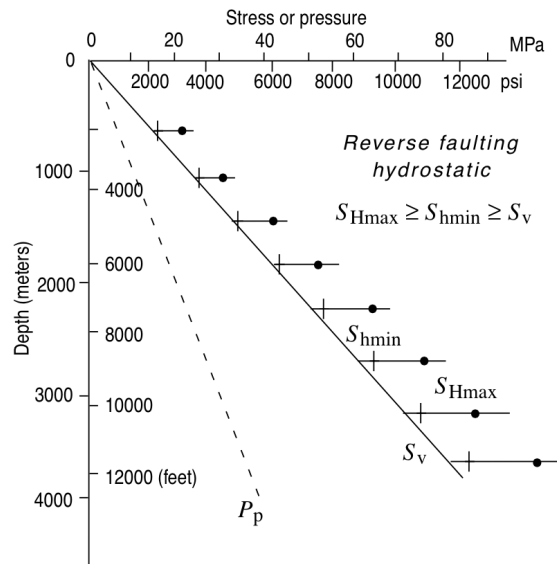
Hydrostatic



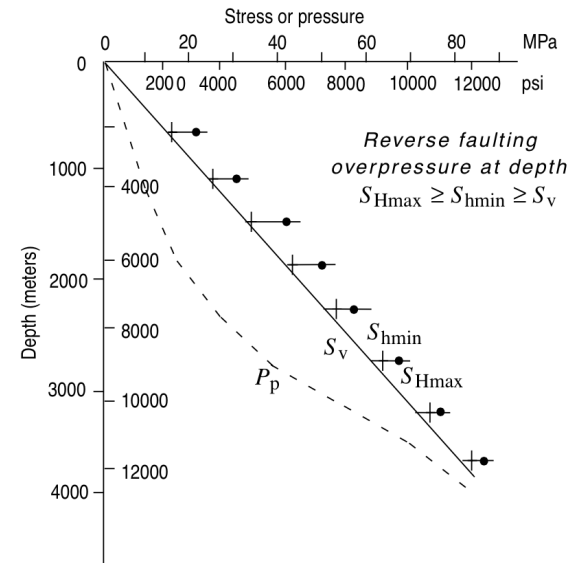
Overpressure

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Reverse faulting



Hydrostatic



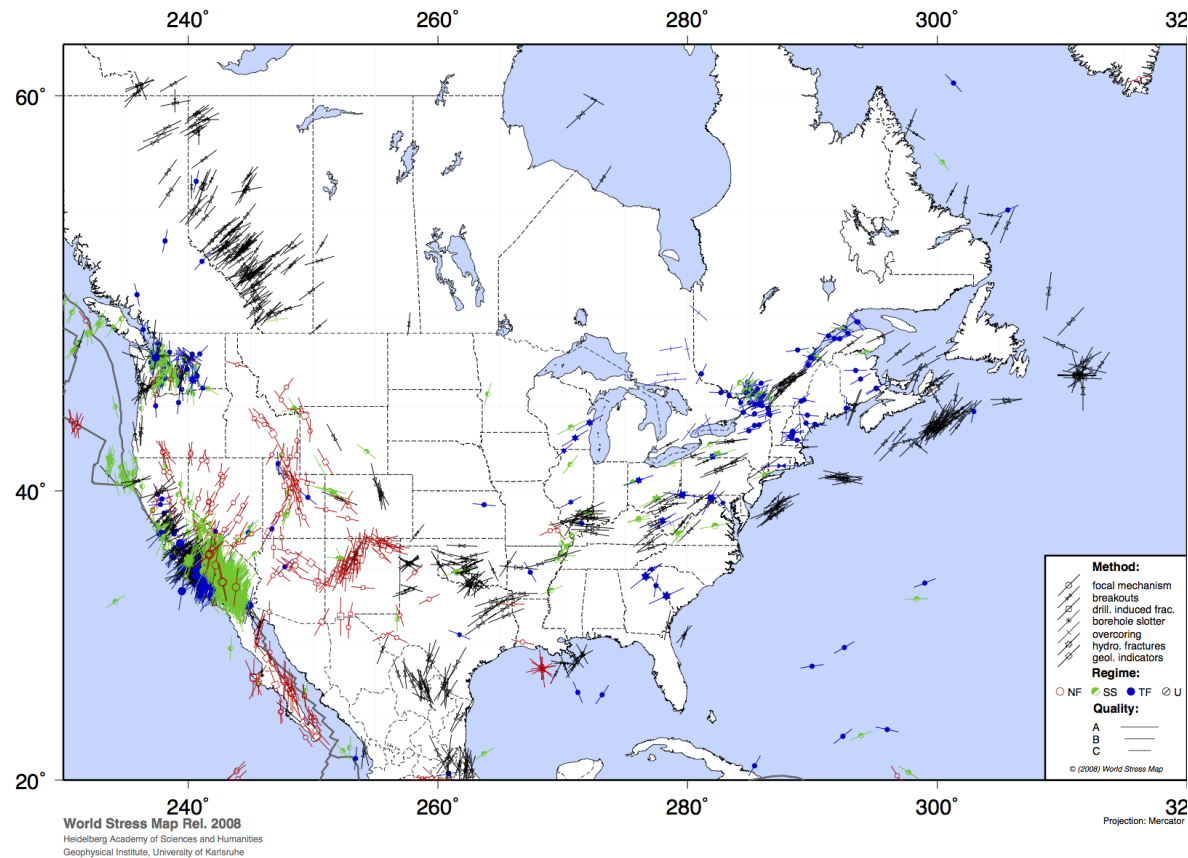
Overpressure

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Stress measurement techniques

- S_v - integration of density logs
- S_3 (S_{hmin} , except in reverse faulting) is obtained from mini-fracs and leak-off tests. Zoback (Chapter 6)
- P_p measure directly or estimated from geophysical logs or seismic data. Zoback (Chapter 2)
- Bound S_{Hmax} with frictional strength of crust or observations of wellbore failures. Zoback (Chapter 4, 7, 8)
- Orientation of principal stresses from wellbore observations, geology, earthquake focal mechanisms. Zoback (Chapter 5, 6)

Stress maps



Pore pressure at depth

$$P_p^{\text{hydro}} = \int_0^z \rho_w(z) g dz \approx \rho_w g z_w$$

Ratio of pore pressure to S_v

$$\lambda_p = P_p / S_v$$

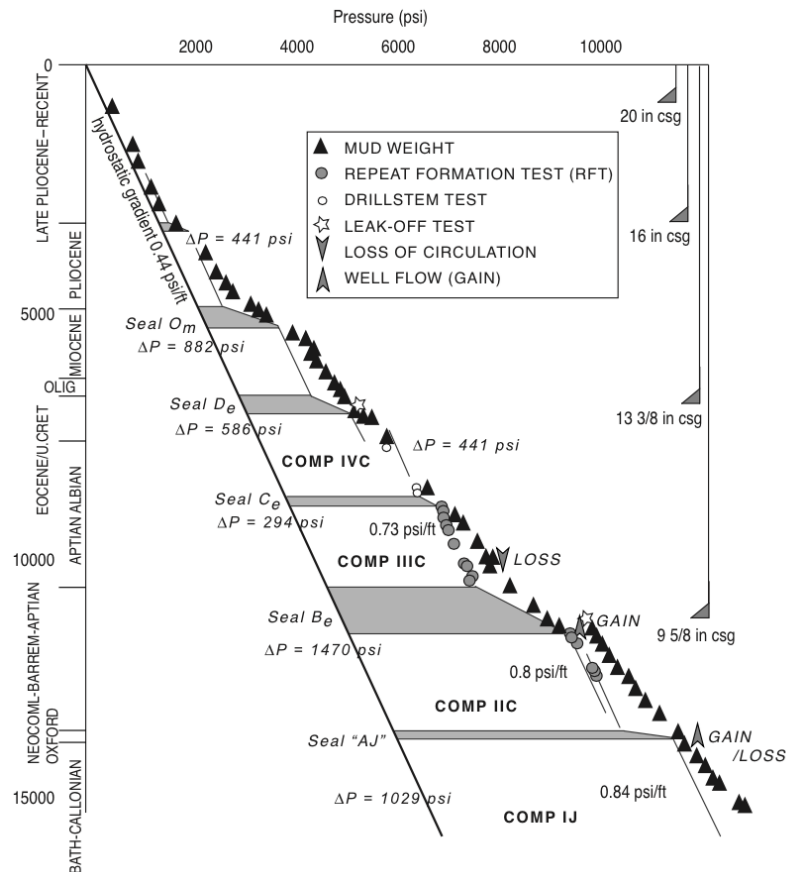
Hydrostatic: $\lambda_p \approx 0.44$

Lithostatic: $\lambda_p = 1$

Overpressure

Monte Cristo field (onshore near Gulf of Mexico, Texas)

Reservoir Compartmentalization



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