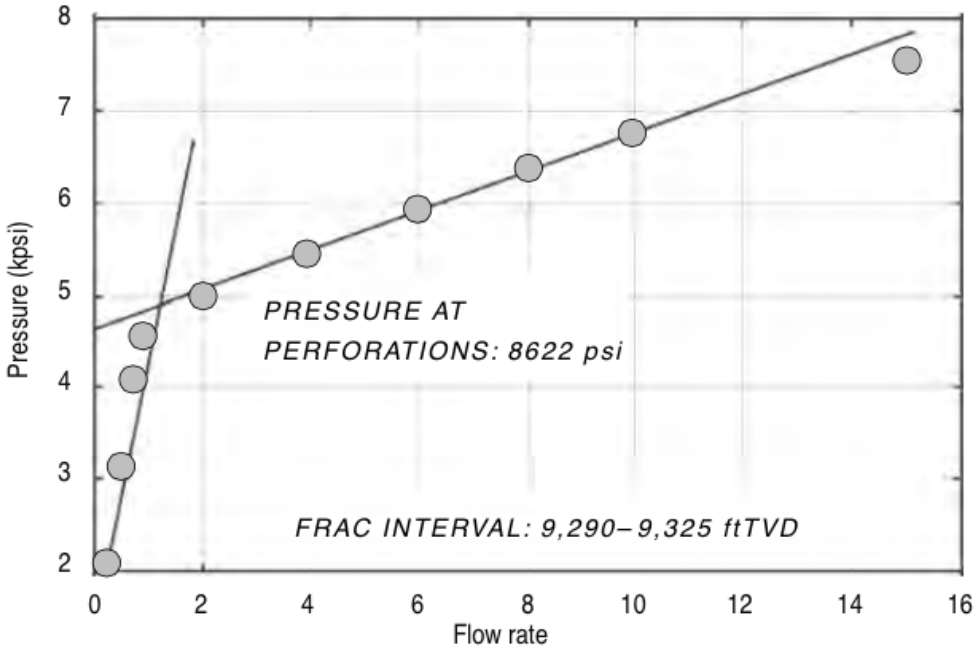
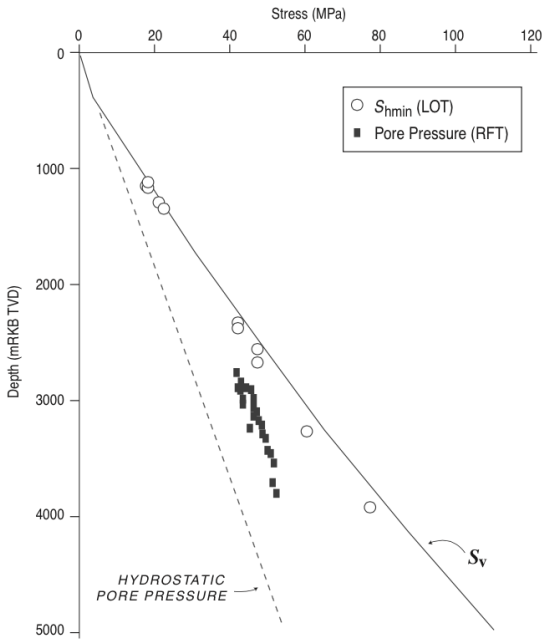
Step-rate test



 Zoback, *Reservoir Geomechanics* (Fig. 7.5, pp. 216)

Be careful!

When $S_3 \sim S_v$ integrate density logs



What about S_{Hmax}?

$$\Delta P = P_b - P_p$$

so

$$S_{Hmax} = 3S_{hmin} - P_b - P_p + T_0$$

or

$$S_{Hmax} = 3S_{hmin} - P_b(T = 0) - P_p$$

Does it work?

Consider a system with compressibility β_s

$$\beta_s = \frac{\Delta V_s}{V_s} \frac{1}{\Delta P}$$

$$\Delta P = \frac{1}{\beta_s V_s} \Delta V_s$$

$$\frac{\Delta P}{\Delta t} = \frac{1}{\beta_s V_s} \frac{\Delta V_s}{\Delta t}$$

Answer: Not very well.

Occurance of both drilling induced tensile fractures and breakouts

Allows for estimate of rock strength *in-situ*

Recall: S_{Hmax} from breakout data

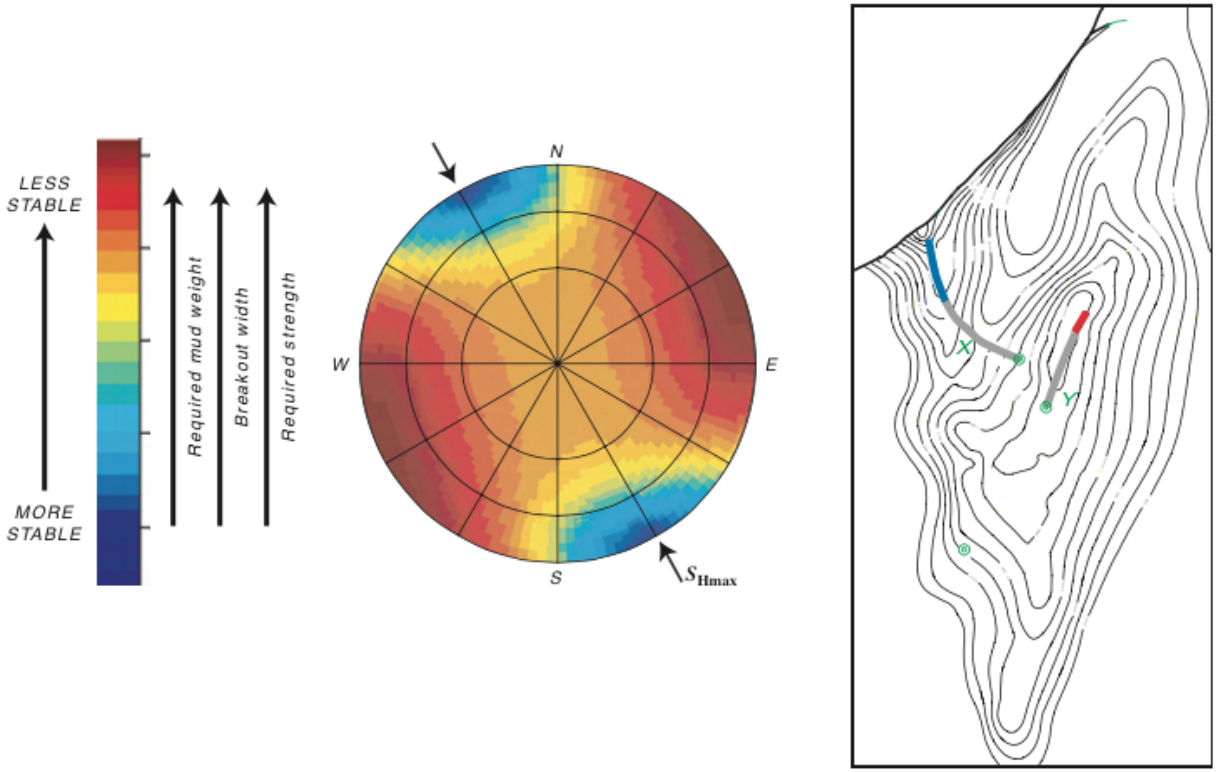
$$S_{Hmax} = \frac{(C_0 + 2P_p + \Delta P + \Delta\sigma^T) - S_{hmin}(1 + 2\cos(\pi - w_{bo}))}{1 - 2\cos(\pi - w_{bo})}$$

Recall: From Kirsch solution

$$S_{Hmax} = 3S_{hmin} - 2P_p - \Delta P - T_0 - \sigma^{\Delta T}$$

Geomechanical case study: Cook Inlet Alaska

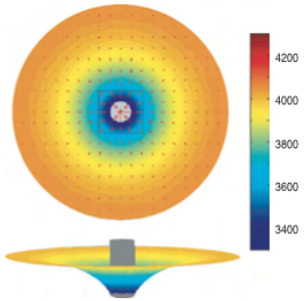
To case or not to case?

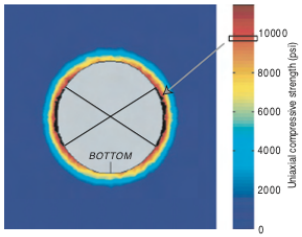


Emperical strength model from cores

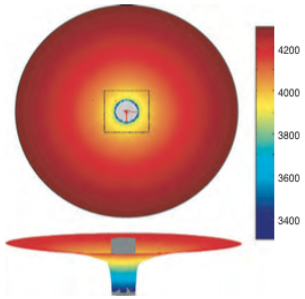
$$C_0 = 1.745 \times 10^{-9} \rho V_p^2 - 21$$

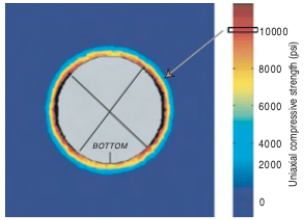
Pressure drawdown and sand production





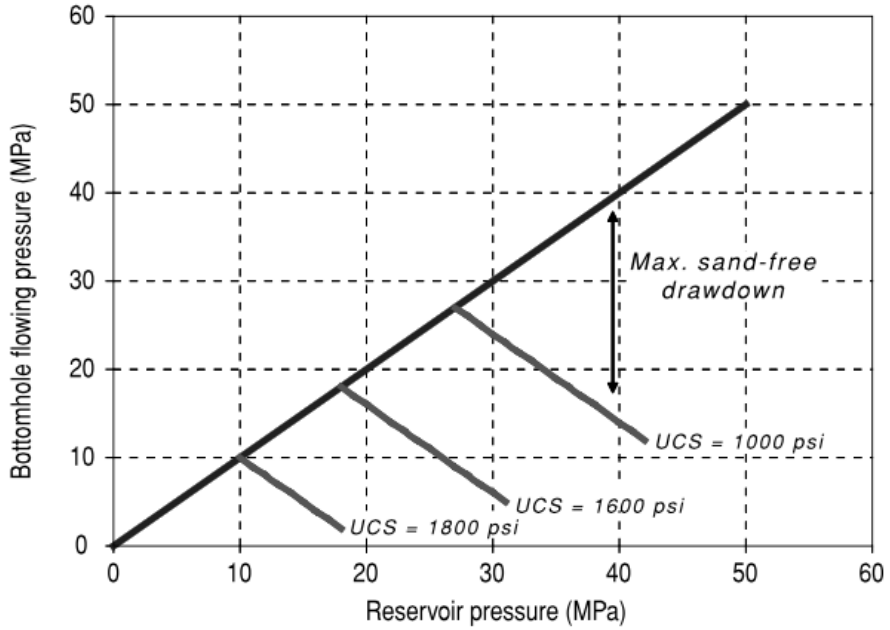
500 psi slow drawdown ~ 60° breakouts





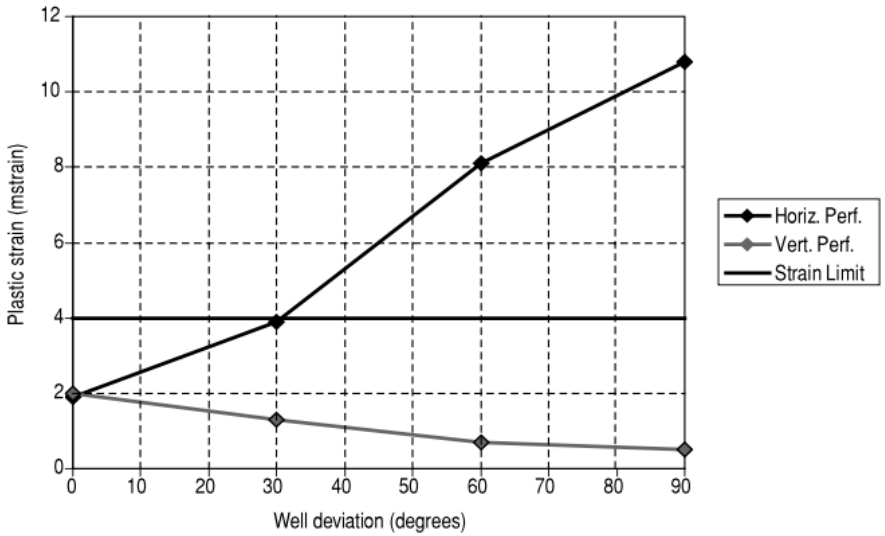
1000 psi rapid drawdown > 90° breakouts

Preventing sand production by limiting production rate

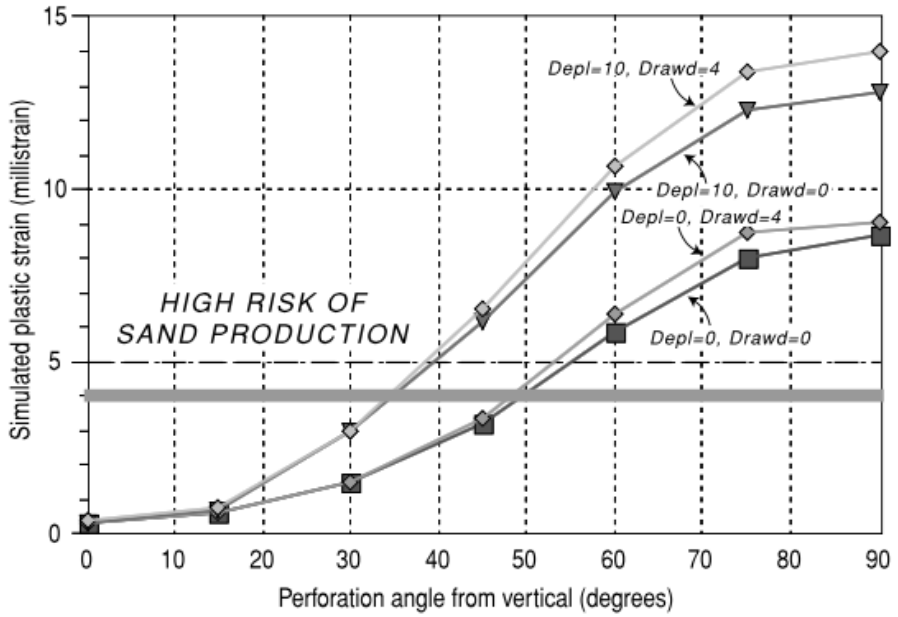


 Zoback, *Reservoir Geomechanics* (Fig. 10.23, pp. 336)

Preventing sand production with perforation orientation

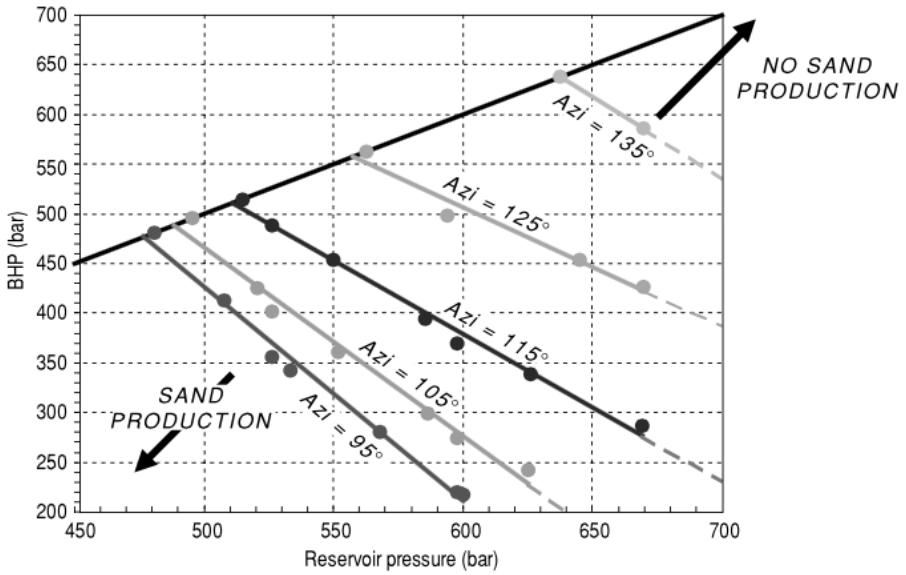


 Zoback, *Reservoir Geomechanics* (Fig. 10.24a, pp. 337)



Preventing sand production with azimuth changes

Considering fixed horizontal perforations



 Zoback, *Reservoir Geomechanics* (Fig. 10.24b, pp. 337)