Problem 1 (60 points)

Given the reservoir conditions below, and a desire to keep breakout widths as small as possible for wellbore stability, which direction and type of well (e.g. vertical, horizontal, $\phi = 20^\circ$, etc.) would be the safest to drill. Support your recommendation with a figure. Preferably one that quantitatively shows the expected wellbore breakout widths for a given drilling trajectory.

You can assume a Mohr-Coloumb failure criterion with an unconfined compressive strength of the rock of 34 MPa and an internal friction of $\mu_I = 1$. The Poisson ratio is $\nu = 0.2$.

- $S_{H_{\text{max}}} = 115$ MPa in the direction N30$^\circ$E
- $S_{h_{\text{min}}} = 90$ MPa
- $S_v = 70$ MPa
- $P_p = P_m = 33$ MPa