Mean vs. deviatoric stress plots, stress paths, and pore pressure prediction.

Maria A Nikolinakou, Research Scientist

ABSTRACT

We discuss the principles behind the 3 pressure prediction workflows: VES (based on vertical effective stress); MES (based on mean stress) and FES (based on the full stress tensor). Both VES and MES methods assume a unique relationship between porosity and effective stress (i.e., unique compression curve). The VES method calculates pressure from the overburden, whereas the MES one incorporates an independently estimated mean total stress. We discuss that the compression curve is not unique, but depends on the ratio of shear to mean effective stress during compression. Hence, for a measured porosity value, the value of mean effective stress (and therefore overpressure) depends on the deviatoric (shear) stress (Fig. 1). In other words, both mean and shear stress contribute to pore pressure. We show how the FES method incorporates multiple compression curves and non-vertical iso-porosity lines (Fig. 2). We discuss that velocity measurements can be coupled with geomechanical results to predict pressure.

CLICK ON IMAGE FOR LARGER VIEW

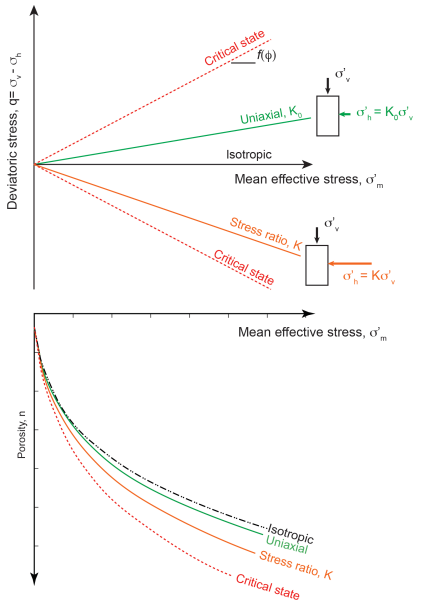


Figure 1: Compression paths (top) for different ratios of shear to mean effective stress; corresponding compression curves (bottom) ranging from isotropic compression (no shear) to critical state (shear failure).

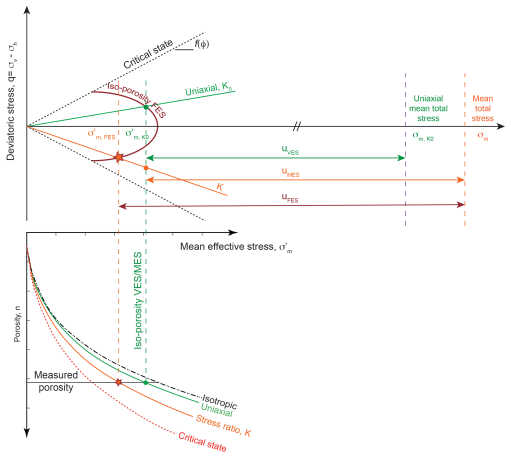
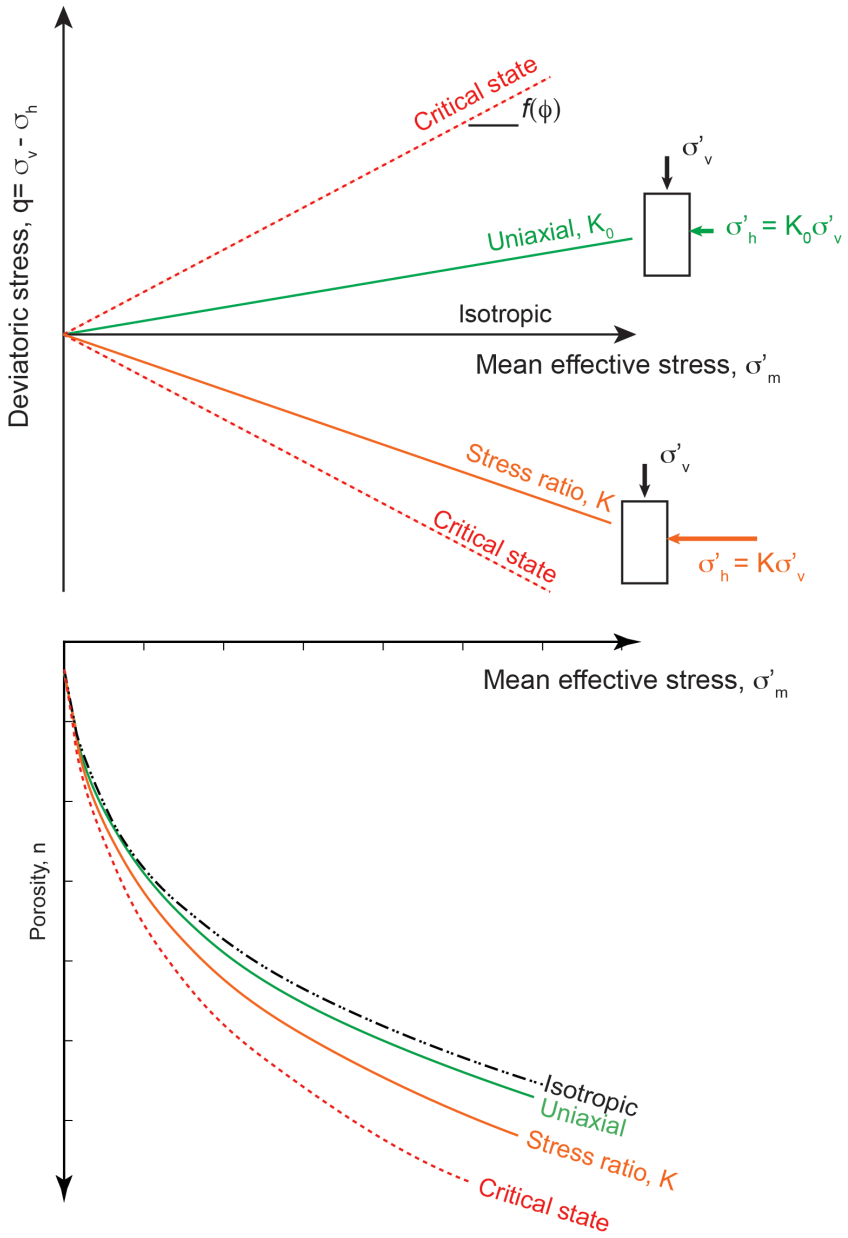


Figure 2: Pressure prediction using the VES (green), MES (orange) and FES (brown) methods. Both VES and MES assume a unique compression curve, whereas the FES method incorporates shear into pressure prediction. The mean total stress is independently calculated (e.g., geomechanical model).



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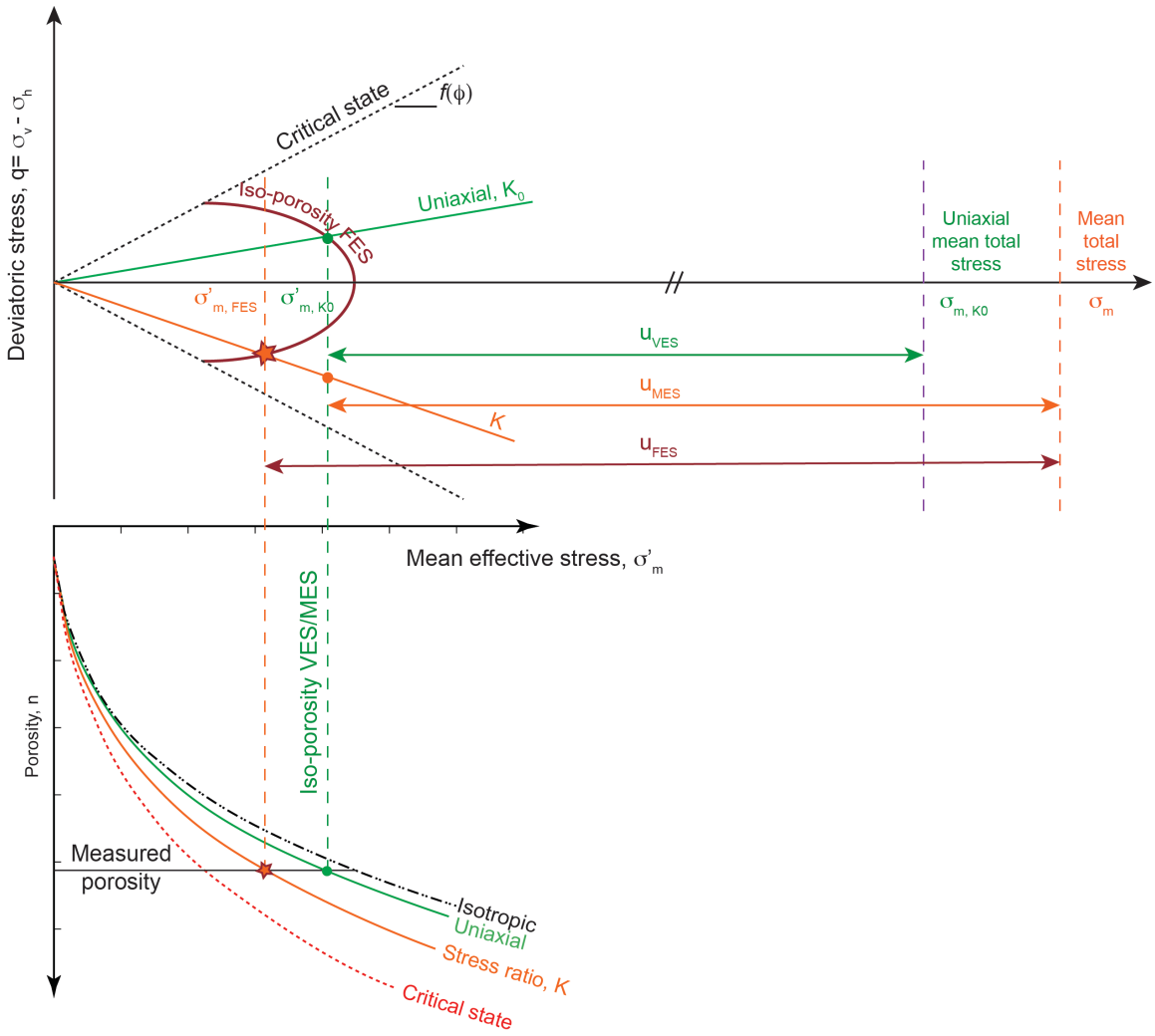

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