13.03: Sensitivity of Velocity to Compression and Shear Stress Paths

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ABSTRACT

The porosity of mudrock depends on both the mean effective stress and shear stress. Iso-porosity contours, as modeled in Modified Cam Clay (MCC), are elliptical surfaces of equal porosity in σ'_m vs q space. MCC assumes that these surfaces are independent of the loading path if the material is normally consolidated. If P-wave velocity is primarily controlled by porosity, the iso-porosity and iso-velocity ellipses are assumed to be equivalent. This study explores the validity of the iso-velocity concept by deriving it from velocities measured during drained compression and undrained shear for RGoM-EI mudrock. Triaxial tests from 1-10 MPa along different stress paths reveal that vertical P and S-wave velocities are dependent on both mean effective stress and shear stress, and measured velocities are consistent with iso-velocity contours as described by MCC. P-wave velocities remain constant during undrained shear while the mean effective stress undergoes significant reduction. The results for drained compression and undrained shear show good

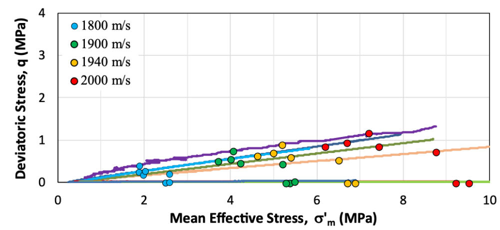


Fig 1: Stress paths of mudrocks with iso-velocity points overlain on ray paths. Samples compressed along the x-axis are hydrostatic (K = 1), while the purple path is uniaxial compression (K = 0.66 – 0.75). The orange and dark green paths are at K = 0.85 while the light and dark blue paths are K = 0.75. Pre-consolidation stress of specimen is 0.8 MPa.

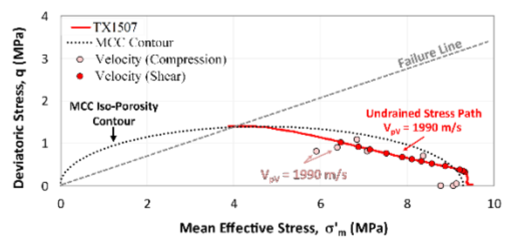
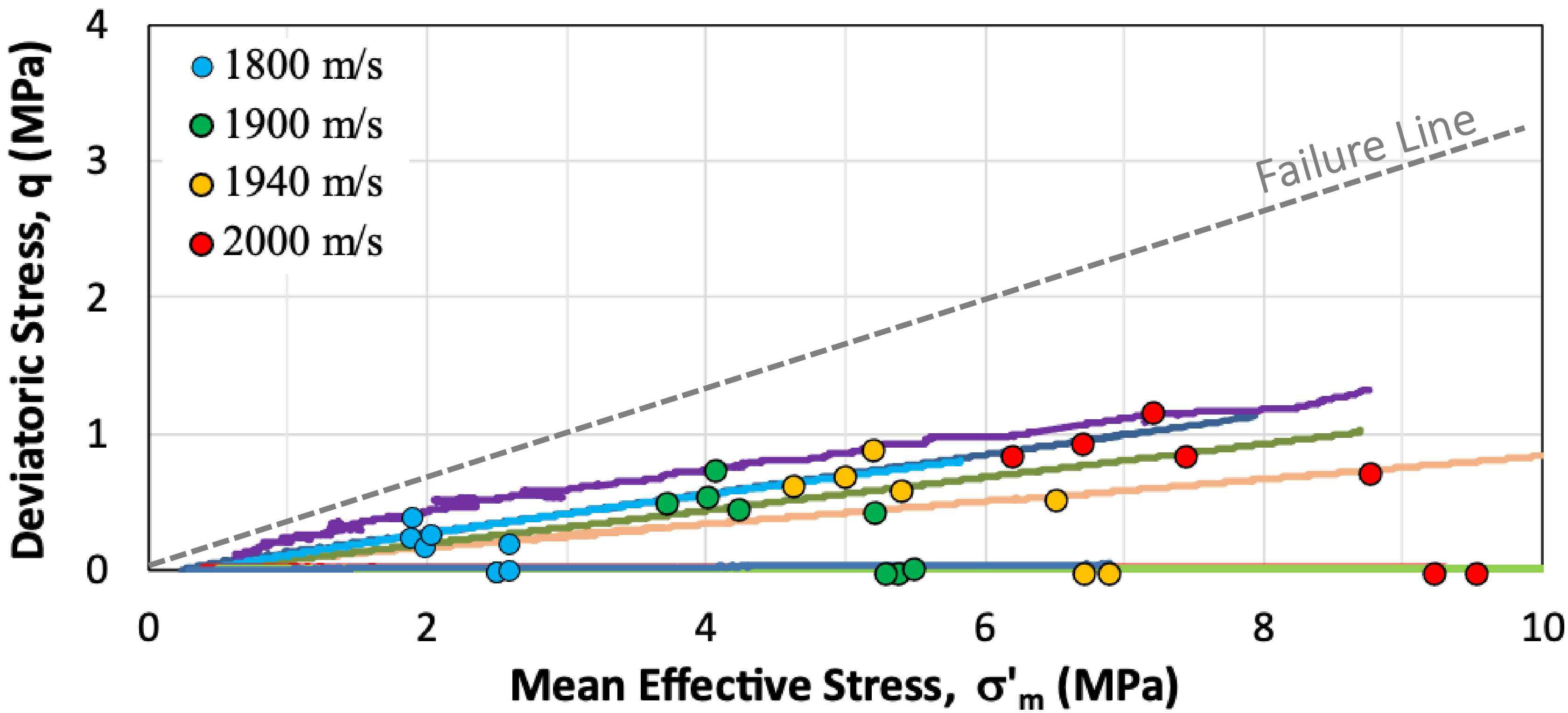


Fig 2: Solid lines are undrained shear stress paths performed after triaxial compression along varying stress paths. Movement to the upper right is caused by apparent overconsolidation due to creep, and once the line starts pointing toward the origin the specimen has failed. Dots represent iso-velocity points collected during compression as seen in figure 1.

agreement, supporting the concept of path-independent behavior. **CLICK ON IMAGE FOR LARGER VIEW**	



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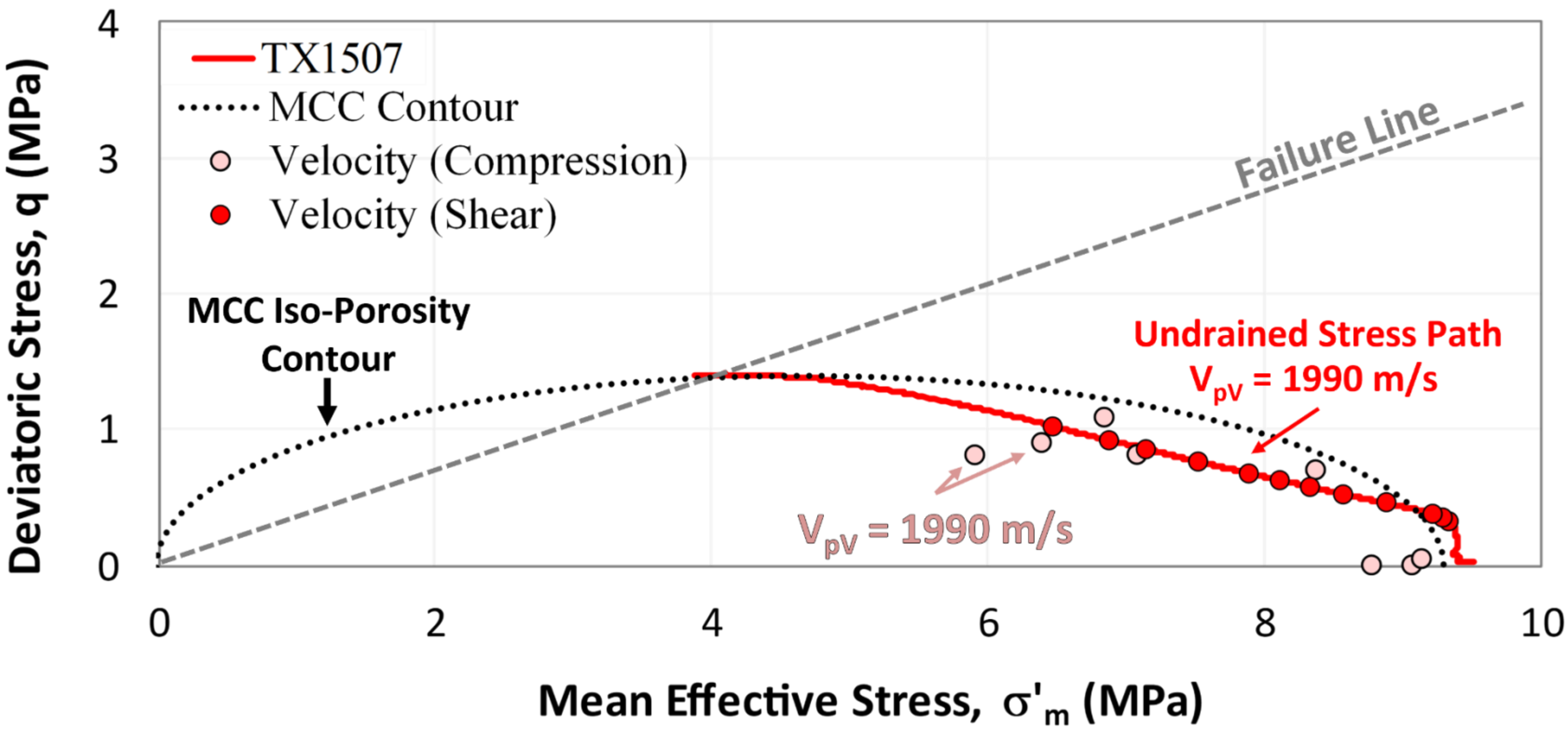

Fig. 2: The undrained stress path had a measured velocity 1990 m/s, which is in agreement with the 1990 m/s iso-velocity curve derived from drained compression. Furthermore, these iso-velocity curves are similar to the Modified Cam Clay iso-porosity ellipse calculated using the same friction angle.

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