13.13: The Effects of Clay Content on Mechanical Behavior of Mudrocks

Mark Zablocki, Tufts University

ABSTRACT

Results of experiments performed on resedimented specimens consisting of mixtures of Gulf of Mexico Eugene Island Clay (GoM-EI) and Min-U-Sil 40, a crushed quartz silt, indicates that material behavior varies with clay content in two distinct manners. Density based parameters (porosity, and wave velocities), have bi-directional behavior with a clear inflection point separating a grain supported domain from a clay supported domain. This inflection point decreases in clay content as the stress level increases. The maximum particle packing efficiency corresponds with the minimum porosity for the mixtures at a given stress level and separates clay supported and grain supported behaviors. Strength related parameters (effective friction angle, lateral stress ratio, and undrained strength), show a monotonic increase or decrease in behavior with no discernible grain domain and clay domain boundary. Parameters are more sensitive to stress level with increasing clay content. Strength parameters appear to reflect a simple mixture of the inherent constituent properties.

CLICK ON IMAGE FOR LARGER VIEW

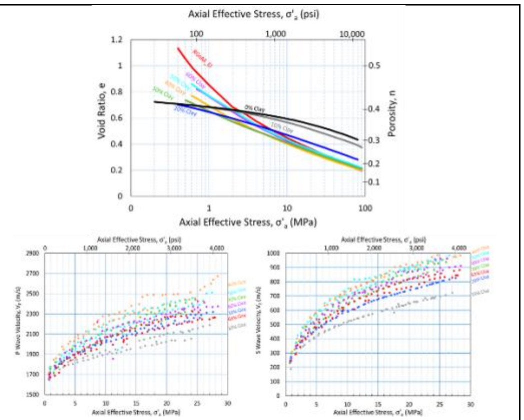

Fig 1: Top: average uniaxial compression curves up to 90 MPa, from 2 to 3 measurements performed on resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens. Bottom: measured P wave velocity (left) and S-wave velocity (right) by axial effective stress during uniaxial compression up to 30 MPa measured on resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens.

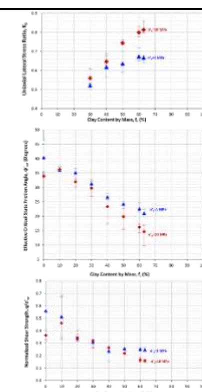

Fig 2: Top: average and range of lateral stress ratio (K_0) measured at 1 MPa and 10 MPa during consolidation of resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens. Middle: average and range of effective critical state friction angle measured at 1 MPa and 10 MPa during undrained shearing. Bottom: average and range of maximum shear strength normalized to the maximum consolidation stress measured at 1 MPa and 10 MPa during undrained shearing.

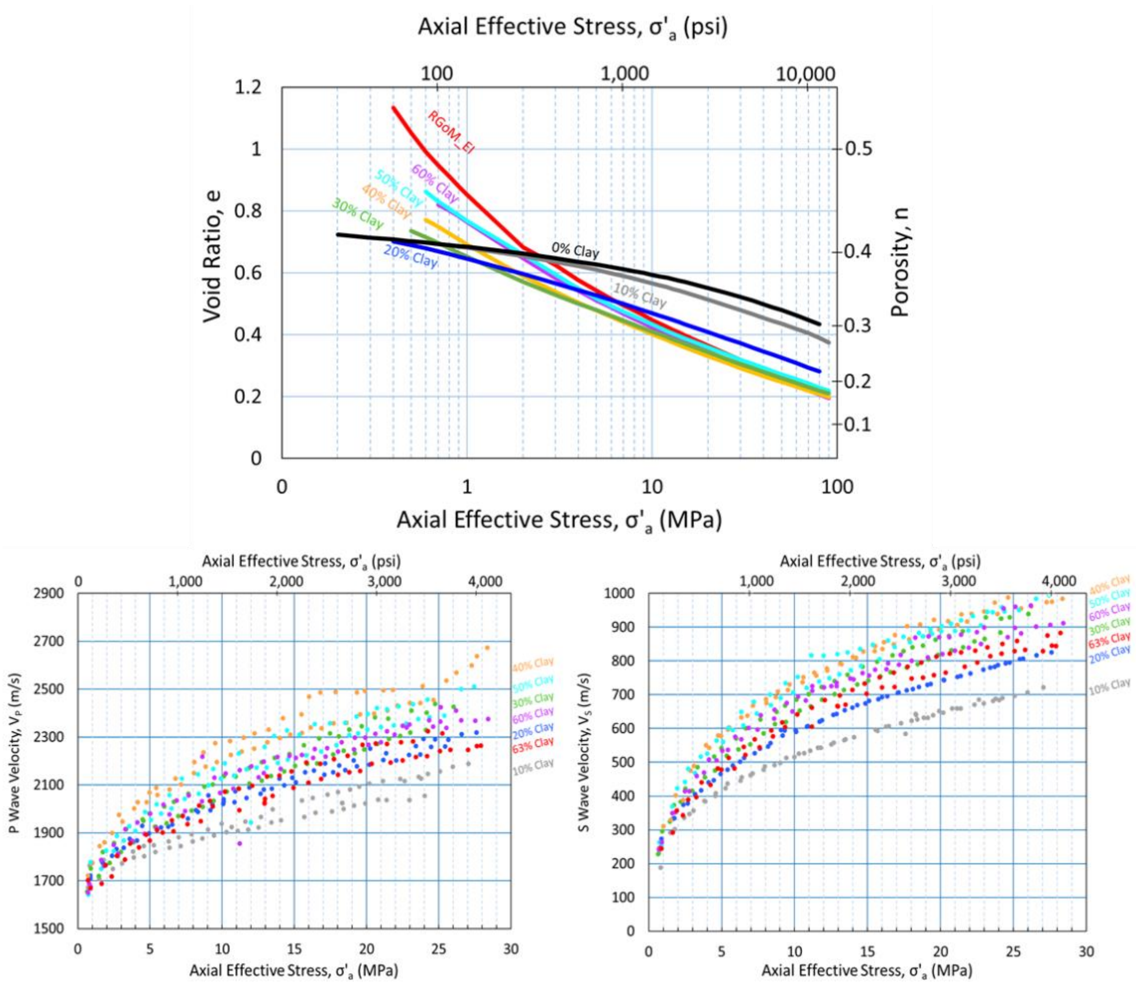

Fig. 1: Top, average uniaxial compression curves up to 90 MPa, from 2 to 3 measurements performed on resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens. Bottom left, measured P wave velocity by axial effective stress during uniaxial compression up to 30 MPa measured on resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens. Bottom right measured S wave velocity by axial effective stress during uniaxial compression up to 30 MPa measured on resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens.

Back

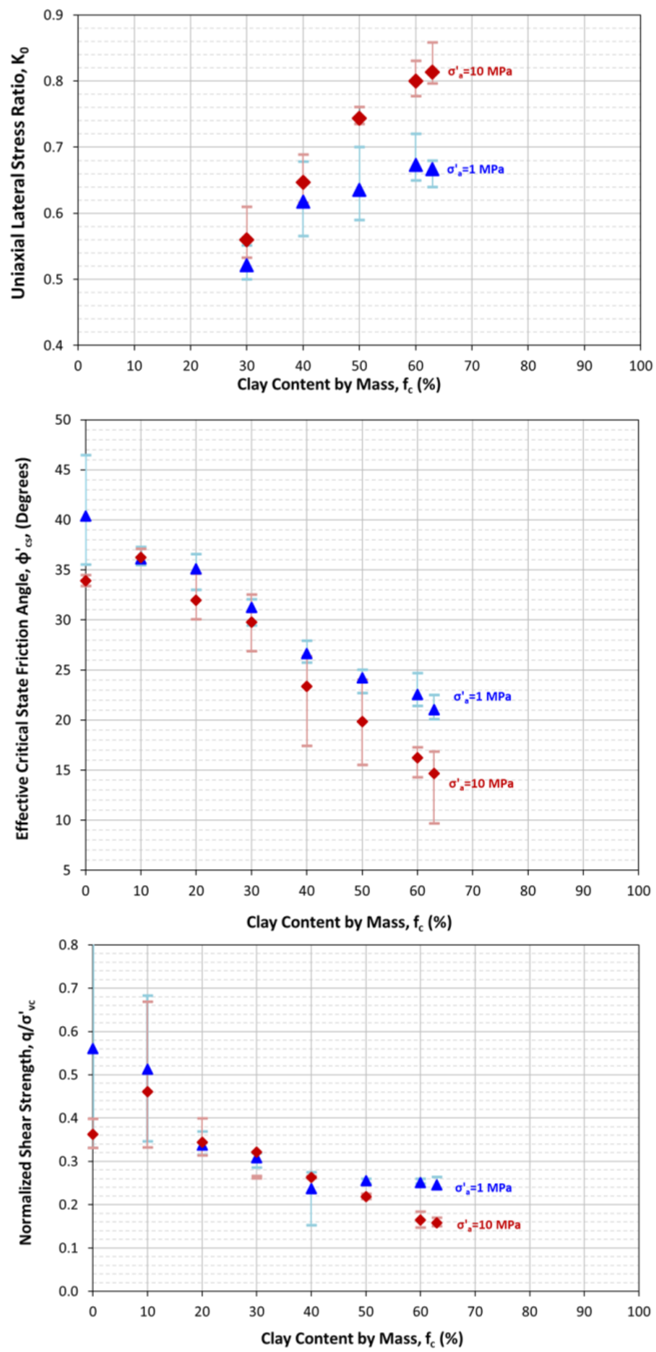

Fig. 2: Top: average and range of lateral stress ratio (K_0) measured at 1 MPa and 10 MPa during consolidation of resedimented Gulf of Mexico Eugene Island Clay and quartz silt mixed specimens. Middle: average and range of effective critical state friction angle measured at 1 MPa and 10 MPa during undrained shearing. Bottom: average and range of maximum shear strength normalized to the maximum consolidation stress measured at 1 MPa and 10 MPa during undrained shearing.

Back