

13.11: Laboratory measurements of lateral stress evolution in resedimented mudrocks

Athma Bhandari, UT Austin - Institute for Geophysics

ABSTRACT

Uniaxial strain testing of resedimented Gulf of Mexico - Eugene Island (smectite-rich material) and resedimented Boston Blue Clay (illite-rich material) under drained conditions revealed that the uniaxial lateral stress ratio (K_0) does not change with time and stress level ($\sigma'_a = 15 - 45$ MPa). In the meantime, the vertical creep (decrease in the void ratio) continues approximately at a log-time decreasing rate ($C_a/C_c = 1.3 - 2.1\%$), consistent with other observations. I document K_0 of 0.75 for the smectite-rich material and 0.58 for the illite-rich material. I maintained the uniaxial strain condition (constant radius) in our experiments by direct feedback from a linear variable differential transformer sensor mounted in the radial direction. I kept constant the axial effective stresses (σ'_a) of 15 MPa, 30 MPa, and 45 MPa over ~ 10 days each. After lateral stress perturbations from the K_0 stress state, the stress ratio changes towards K_0 . The rate of change is higher in the smectite-rich material than in the illite-rich material. A better understanding of the lateral stress ratio and its evolution will help constrain better lateral stress or fracture gradient in the subsurface.

CLICK ON IMAGE FOR LARGER VIEW

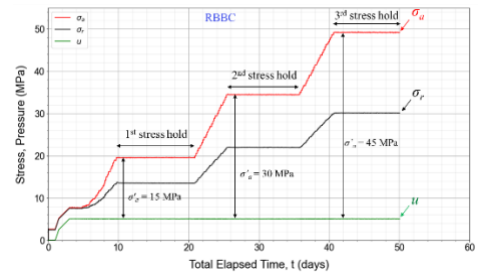


Fig 1: Test program showing stress, pressure versus elapsed time.

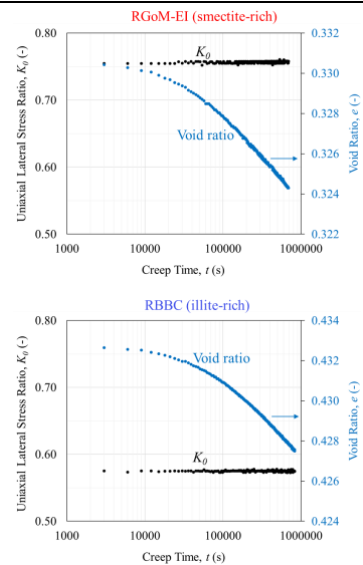


Fig 2: Vertical creep (decrease in the void ratio) and K_0 evolution with time

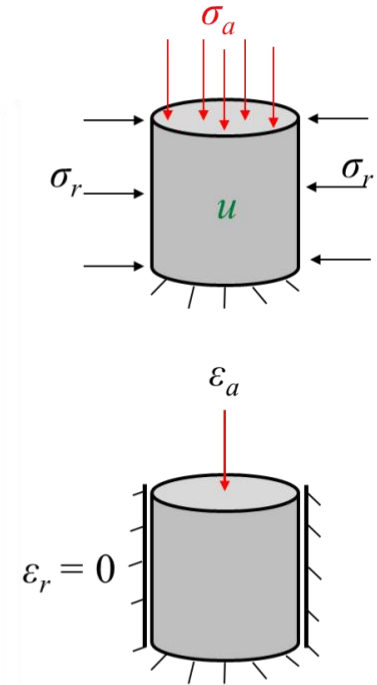
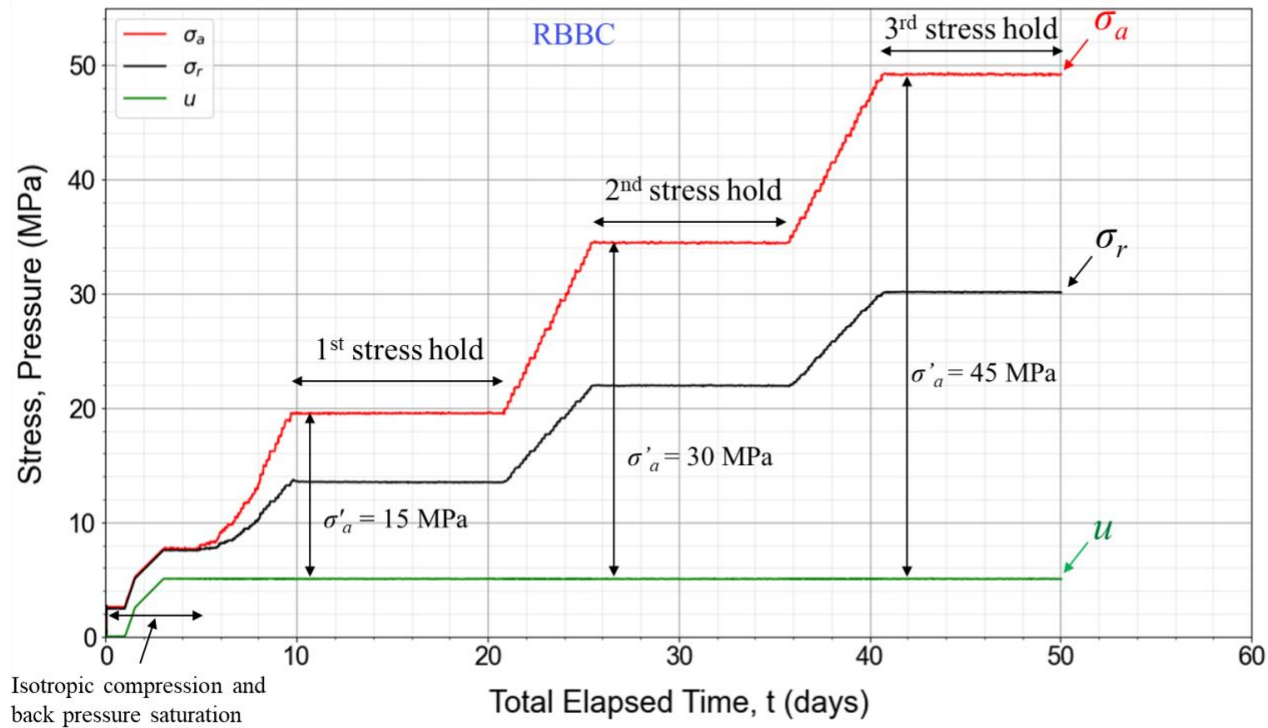


Fig. 1: Test program showing stress and pressure versus elapsed time. After initial isotropic compression and back pressure saturation, I incrementally loaded the specimen axially in small stress increments (red curve) until I reached the axial effective stress of 15 MPa. I held the stress constant at 15 MPa for 10 days. I then increased the axial effective stress to 30 MPa and held it constant for 10 days. Finally, I increased the axial effective stress to 45 MPa and held it constant for 10 days. I held the pore pressure (green curve) constant at 5 MPa during the stress increments and three stress holds.

[Back](#)

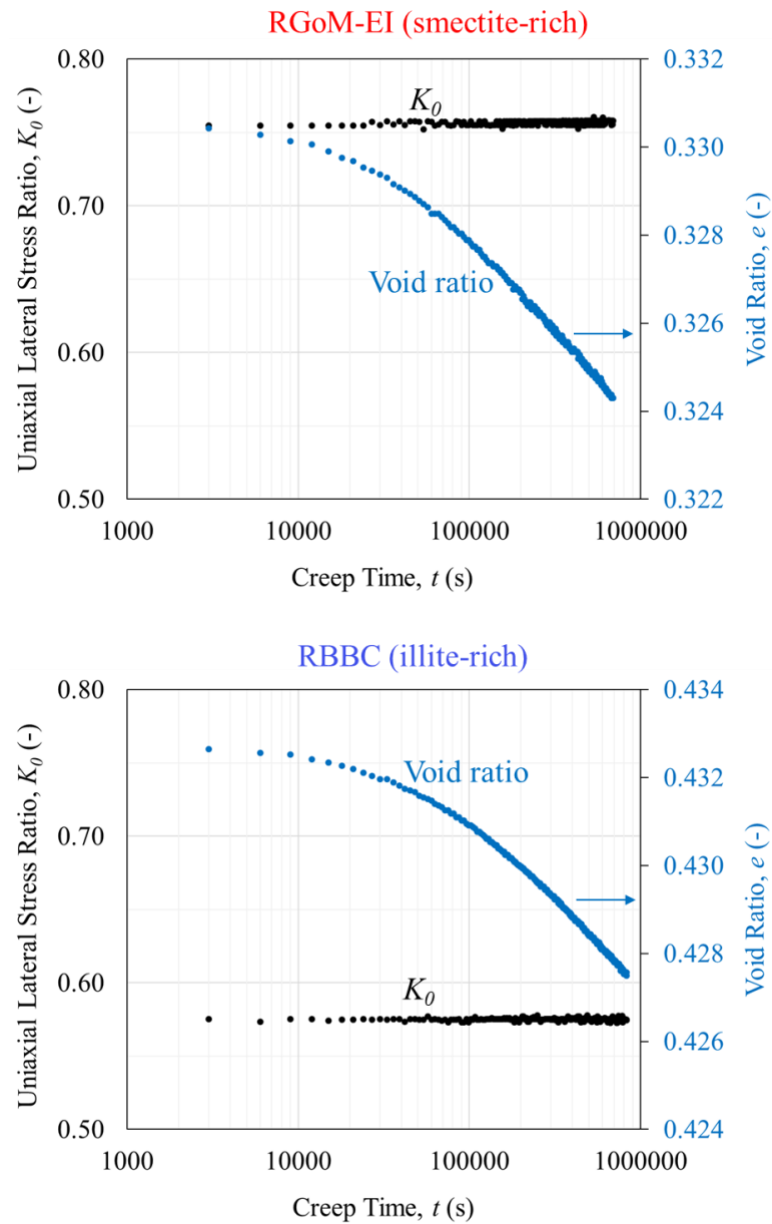


Fig. 2: Vertical creep (decrease in the void ratio) and K_0 evolution with time. The lateral stress ratio (K_0) remains constant with time while I continue to measure void ratio decrease.

[Back](#)