Plasticity Effects on Velocity Trends

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ABSTRACT

Piezoelectric elements were used to transmit and receive compressional (P) and shear (S) wave signals through the specimens while they were being consolidated up to 10MPa. P and S-wave velocities were measured concurrently through a variety of clays with different plasticities in the vertical direction (C_{33} and C_{55}, respectively). There was a lack of plasticity trend in the P-wave velocity results; however, the S-wave velocity showed a distinct increase in velocity with decreasing plasticity. The lowest plasticity material, Presumpscot Clay, has the highest V_s, while the lowest plasticity clay, RGOM-EI, has the lowest V_s, as seen in **Fig. 1**. When the results are plotted in terms of V_p/V_s ratio as a function of vertical effective stress (σ'_v) (**Fig. 2**), we observe a distinct ordering and slope of the different materials, following a plasticity trend. Based on the slope and intercept, a model is created that can predict the V_p/V_s ratio as a function of stress with a single input parameter: liquid limit (w_L).

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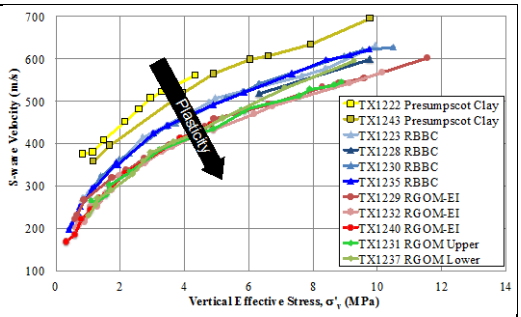


Fig. 1: The S-wave velocity results are shown to increase as a function of vertical effective stress. The lowest plasticity clay (Presumpscot Clay) and the highest plasticity clay (RGOM-EI) are the two extreme velocities, with the rest of the materials ordering themselves in between the two, following a plasticity trend.

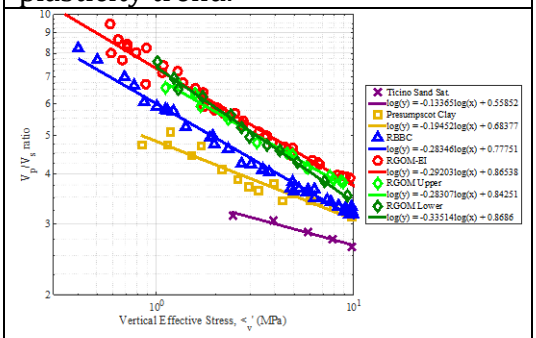
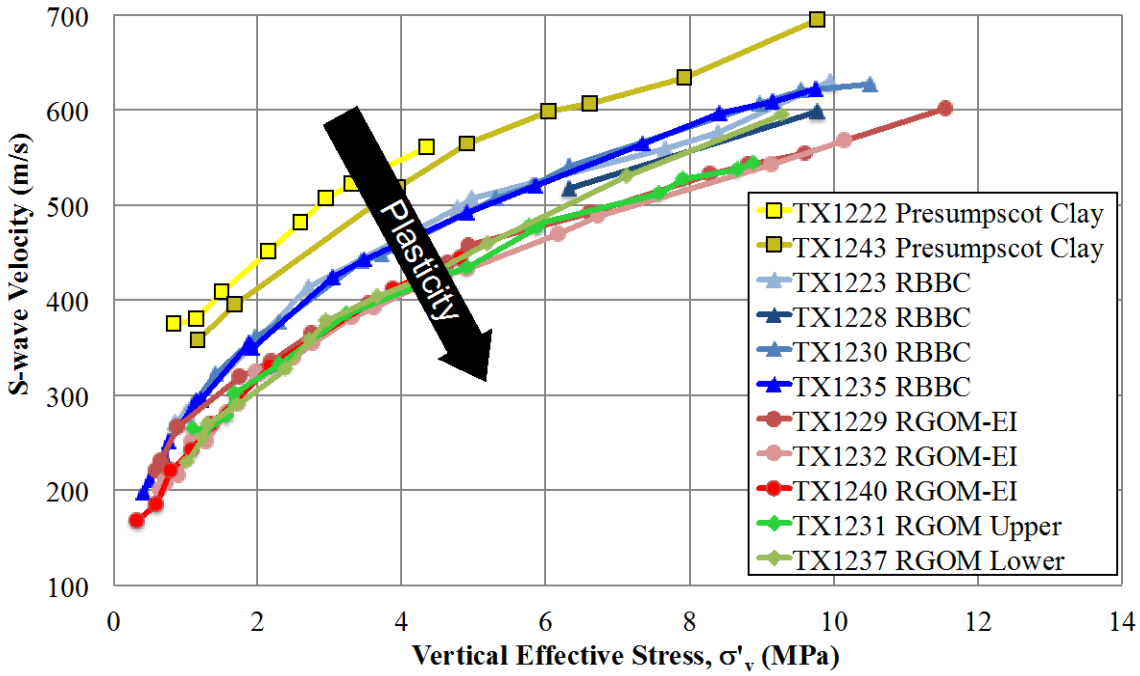


Fig. 2: The V_p/V_s ratio, often used as an indicator of lithology, is plotted as a function of vertical effective stress, with all the data points from a variety of tests shown here. The slope and y-intercept of the best-fit lines are respectively α and β in the equation $\log(V_p/V_s) = \alpha \log(\sigma_v') + \beta$. A model is developed that can predict this graph based on a single input parameter, liquid limit (w_L), which is an indicator of plasticity.



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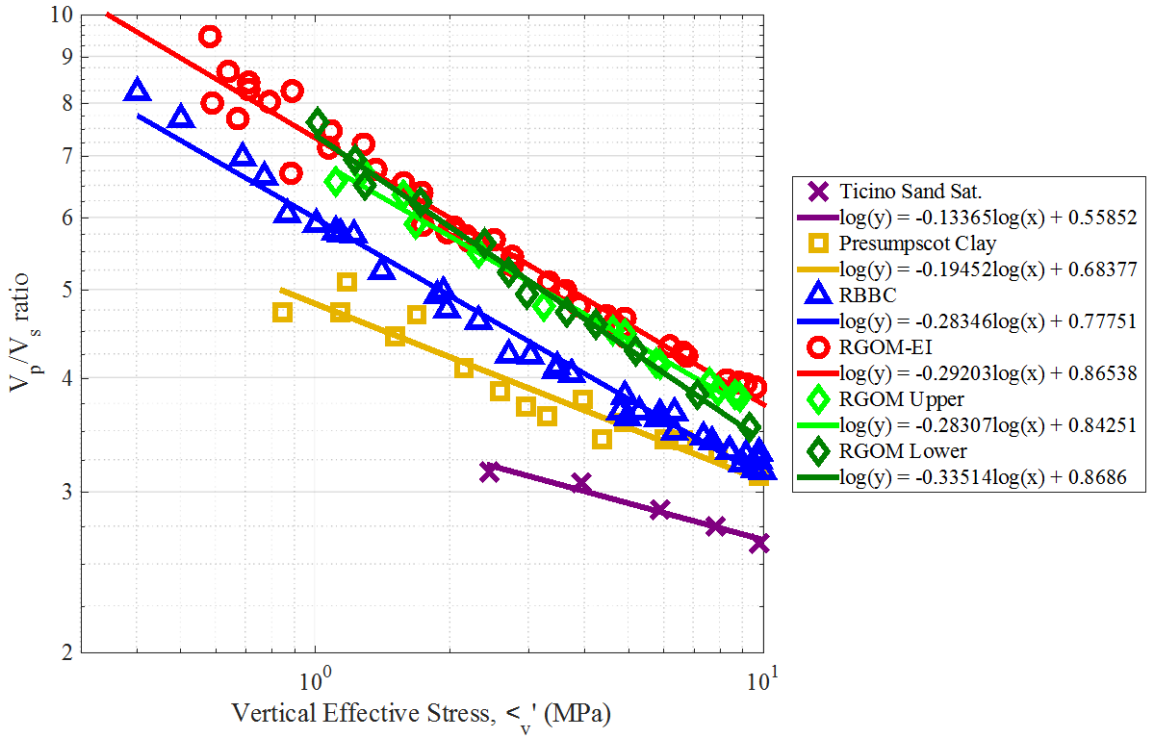

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