Predicting Static Data Using Dynamic Data and Quantitative Sample Characterization

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Abstract

This work develops an improved understanding of the stess-strain dependence of data along a “triaxial” stress path. “Static data” are defined as the large strain (> 10^-3) measurements on unloading and reloading along multistage tri-axial stress paths. “Dynamic data” are the small strain (The results of the strain dependent experiments are analyzed in terms of Young’s Modulus and Poisson’s ratio. A quadratic fit has been applied to static data. This allows us to separate the response into linear and nonlinear elastic terms, with coefficients M1, and M2 respectively. The rest of the strain is assumed to be irrecoverable strain. M1 is dominated by the contact modulus and is constant throughout the entire unload and reload cycles. M2 the nonlinear elastic term, is due to the opening and closing of compliant pores. These interpretations are based on the equality we find between M1 and the measured modulus determined from the velocity and the correlation we find between M2 with the measured irrecoverable strains. A compaction model (Myer’s, Hathon, 2014) is modified to fit irrecoverable strains. This work provides robust connection between the Young’s modulus derived from static and dynamic data to that derived from empirically based correlations. Based on this work the strain dependence of Young’s modulus can be predicted. A model has been used to predict the static data including the irrecoverable strains. This work also involves the use of thin section and/or microCT data to provide a mineralogical and textural based methodology to predict the model parameters. To conclude a robust modeling methodology is proposed that predicts a triaxial test with inputs from velocity data and sample characterization. Young’s modulus can be predicted from triaxial tests

which is key parameter in modeling geomechanical calculations like fracing and wellbore stability.