Compression and Permeability Behavior of Gulf of Mexico Mudrocks, Resedimented vs. In-Situ

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ABSTRACT

Uniaxial consolidation tests of resedimented mudrocks from the offshore Gulf of Mexico reveal compression and permeability that is very similar to those of intact core and wireline measurements. Laboratory-prepared (resedimented) mudrocks are used as testing analogs because accurate in-situ measurements and intact cores are difficult to obtain. However, few direct comparisons between laboratory-prepared mudrocks, field behavior, and intact core behavior have been made. We resediment silty claystone obtained from Plio-Pleistocene-aged mudrocks in the Eugene Island Block 330 oilfield and characterize its compression and permeability behavior. The resedimented mudrocks decrease in void ratio (e) from 1.4 (61% porosity) at 100 kPa of effective stress to 0.34 (26% porosity) at 20.4 MPa. The compression behavior is described with a power function between specific volume (v=1+e) and effective stress (σ'_v):

$v=1.85\sigma'^{-0.108}_v$

Vertical permeability (k) decreases from $2.5\cdot10^{-16}$ m^2 to $4.5\cdot10^{-20}$ m^2 over this range, and we model the permeability as a log-linear function of porosity (n):

$\log_{10} k = 10.83n - 23.21$

Porosity of the resedimented mudrock falls above the sonic-derived porosity and below the density porosity at all effective stresses. Intact core specimens display similar compression and permeability behavior to the resedimented specimens. These similarities show that resedimented Gulf of Mexico mudrock is a reasonable analog for field behavior in the Gulf of Mexico.

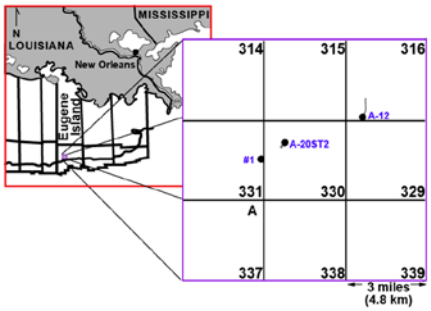


Figure 1: Location of Eugene Island Block 330 oilfield

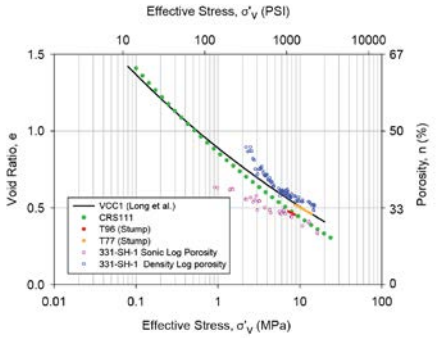
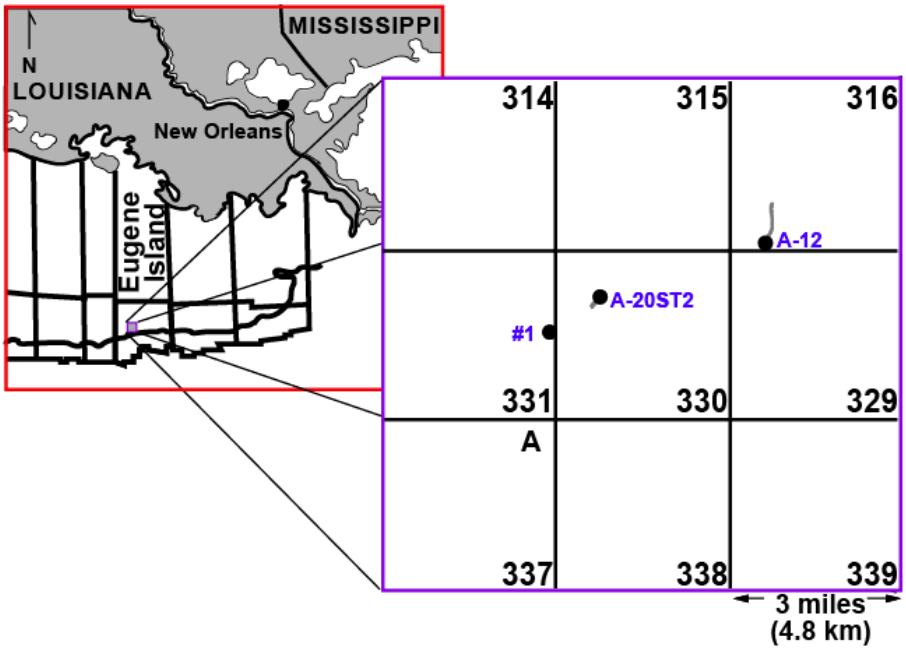


Figure 2: Resedimented compression curve (porosity vs. effective stress) is shown with green dotted line. Pink and blue circles record wireline estimates of in situ porosity based on sonic and density logs. The similarity between the resedimented and observed compaction profiles suggest that resedimented Gulf of Mexico mudrock is a reasonable analog for field behavior in the Gulf of Mexico.

CLICK ON IMAGE FOR LARGER VIEW



Index map showing Eugene Island Block 330 oilfield, consisting of block 330 and the surrounding blocks, and the locations of wells used in this study.

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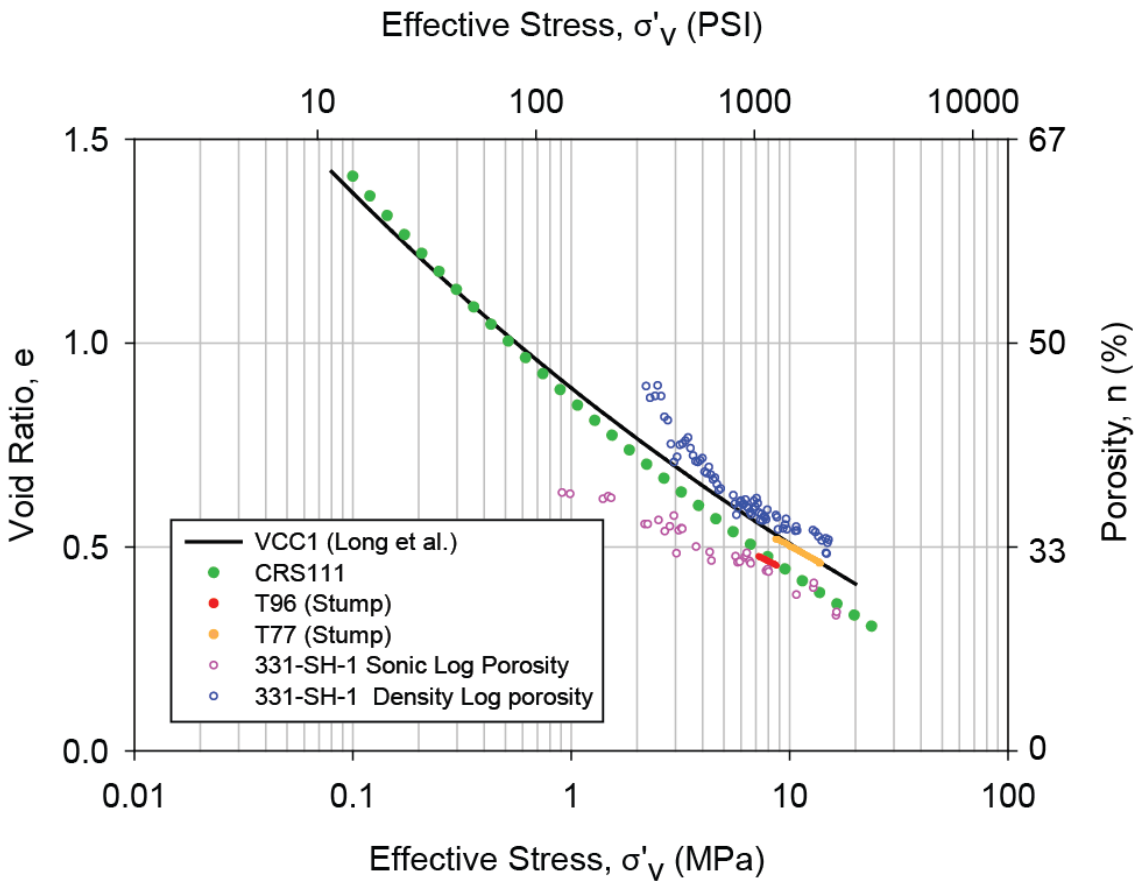

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