Insights into Mudstone Permeability Derived Through Resedimentation

Julia Schneider, The University of Texas at Austin

ABSTRACT

We find that vertical permeability of Boston Blue Clay (BBC) and silt mixtures, which are prepared through resedimentation, systematically increases with silt fraction. Backscattered Electron Microscope images show the change in pore size distribution and clay particle alignment with increasing silt fraction (see Day-Stirrat abstract). We interpreted that three main effects cause the permeability to increase with silt fraction: 1) silt bridging; 2) suppression of preferred, horizontal clay particle alignment; and 3) heterogeneity in clay density field. How permeability evolves in realistic sediment mixtures during burial is of critical importance for understanding the generation of overpressure and how mudstones seal CO_2 or hydrocarbons.

CLICK ON IMAGE FOR LARGER VIEW

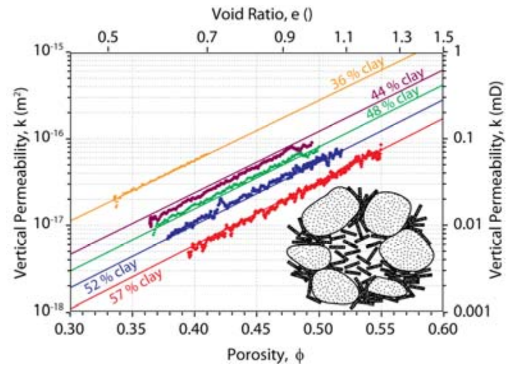
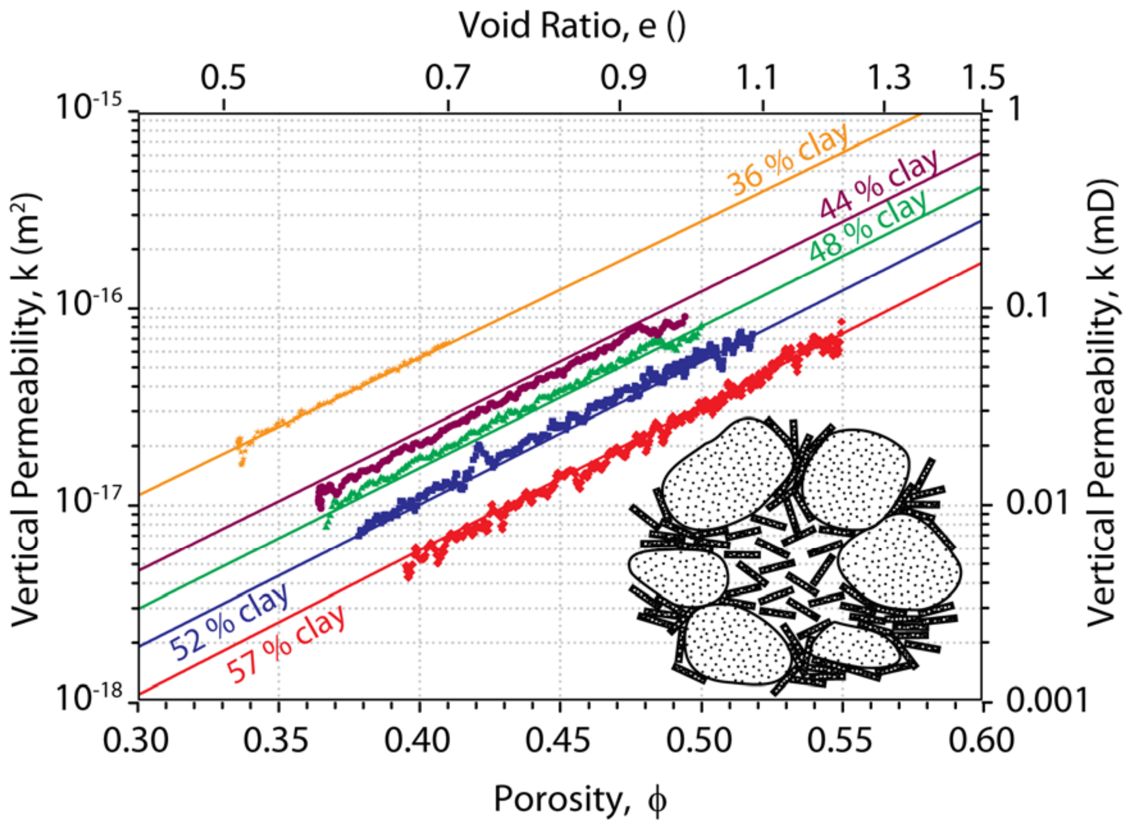


Fig. 1: Vertical permeability of BBC – silt mixtures. Symbols represent vertical permeability derived from uniaxial constant-rate-of-strain consolidation tests. Solid lines represent permeabilities predicted by our geometric mean model. Diamonds (red) = 57 % clay (pure BBC), squares (blue) = 52 % clay, triangles (green) = 48 % clay, circles (purple) = 44 % clay, stars (orange) = 36 % clay. Percentages represent fractions of solid mass < 2 μm. Inset figure: Cartoon showing three main effects causing an increase in permeability with silt fraction: 1) silt bridging; 2) suppression of preferred, horizontal alignment of clay particles; and 3) heterogeneity in clay density field.



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