Permeability behavior in the Ursa Basin

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ABSTRACT

Uniaxial consolidation experiments on 29 silty clays and one clayey silt constrain vertical permeability in overpressured mudstones near the seafloor of the Ursa Basin, Northern Gulf of Mexico. The vertical permeability of clayey silt is between 7.7 $\cdot 10^{-17}$ and 8.5 $\cdot 10^{-19}$ m^2 as porosity declines from 0.4 to 0.2. Permeabilities of silty clays are significantly lower at any given porosity. I infer *in-situ* permeabilities by extrapolating the log-linear permeability-porosity relationships back to *in-situ* porosities. Low permeabilities, accompanied by high sedimentation rates, can cause severe overpressure near the seafloor, which controls fluid flow and can reduce slope stability.

CLICK ON IMAGE FOR LARGER VIEW

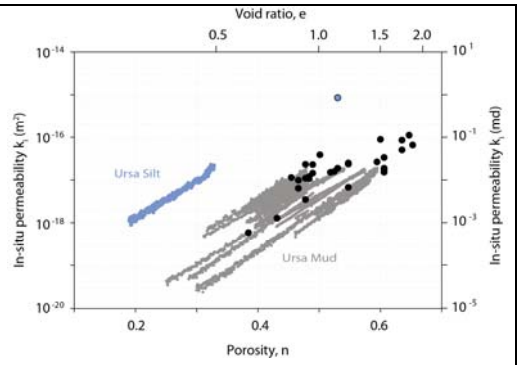

Fig. 1: Integrated Ocean Drilling Program (IODP) Site U1324. Lithology, LWD logs, *in-situ* permeabilities and lab-derived permeabilities, specific surface area, and clay fraction.

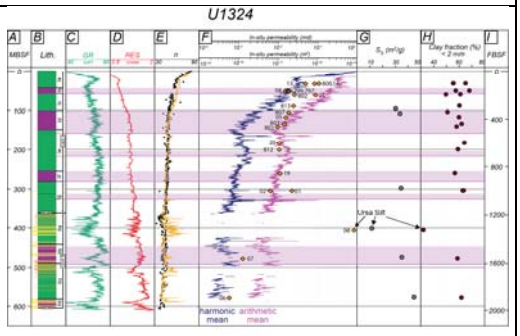

Fig. 2: Integrated Ocean Drilling Program (IODP) Site U1324. Lithology, LWD logs, in-situ permeabilities and lab-derived permeabilities, specific surface area, and clay fraction.

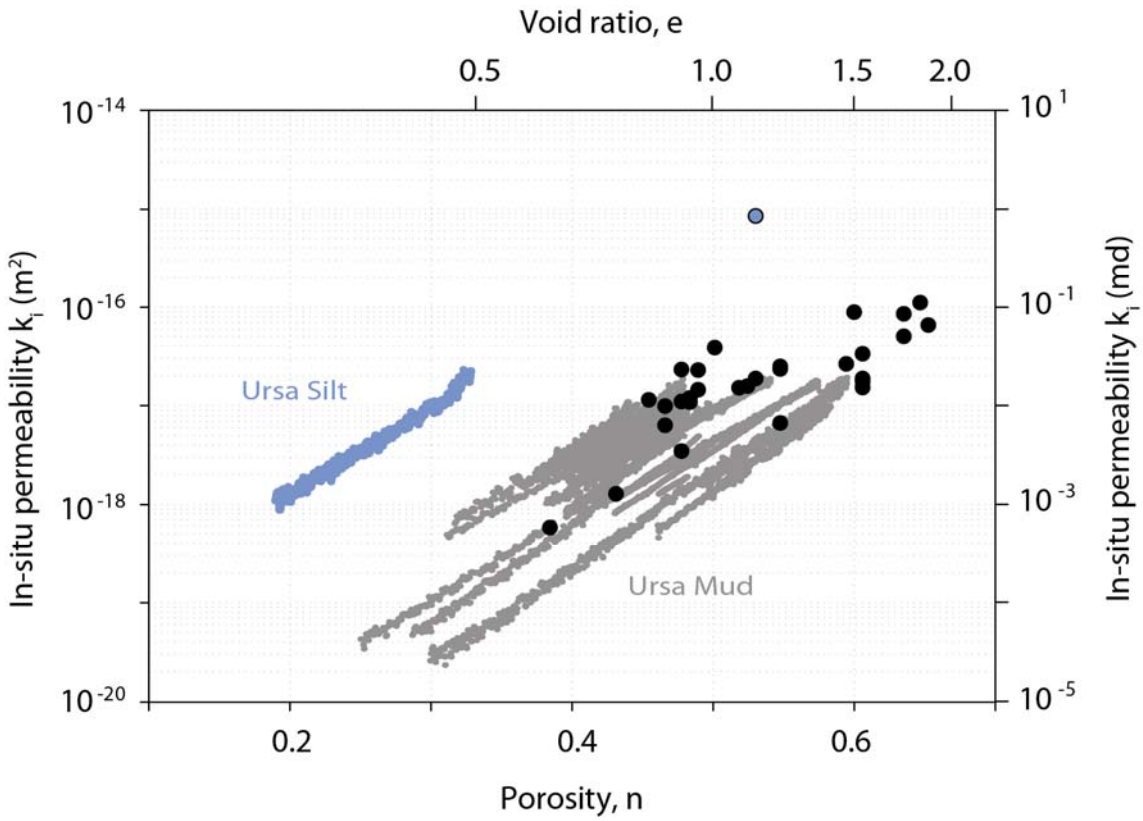

Fig. 1: Predicted *in-situ* permeabilities of single Ursa Silt sample (dark blue) and 29 Ursa Mud samples (black). Individual log-linear permeability – porosity relationships of Ursa Silt (light blue) and Ursa Mud (gray) are extrapolated to *in-situ* porosity derived from logging-while-drilling (LWD) bulk density log to get *in-situ* permeability.

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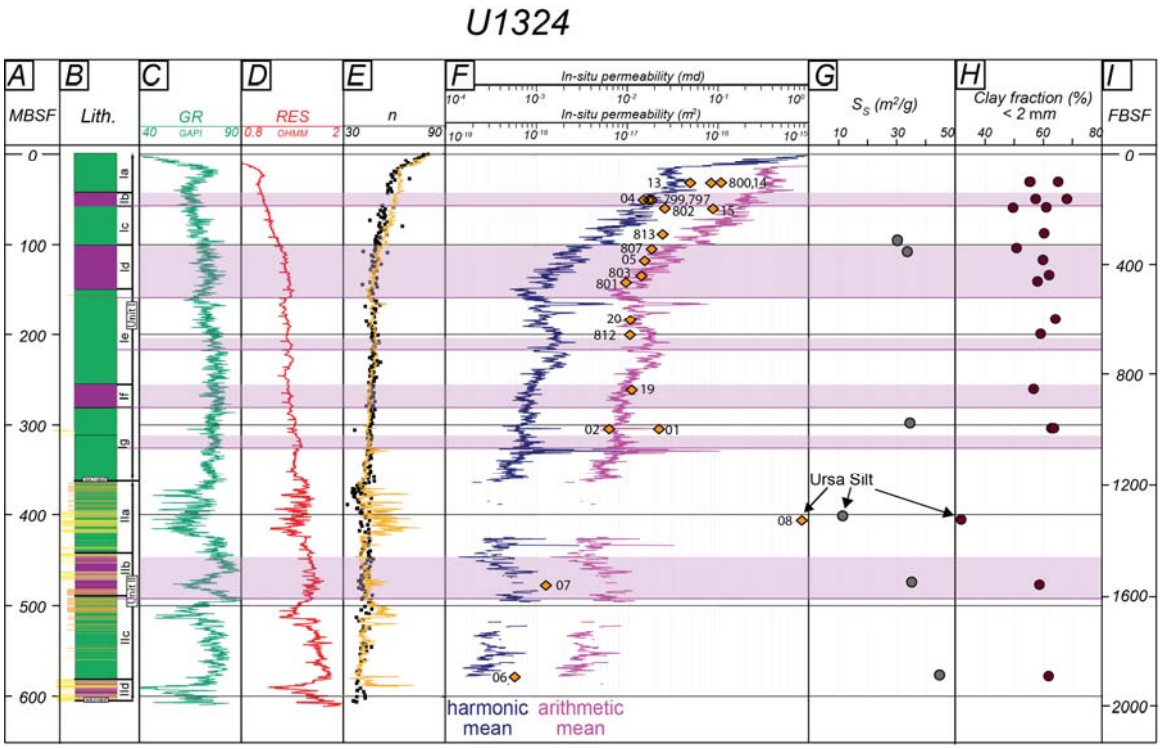

Fig. 2: IODP Site U1324 (modified from Flemings et al., 2008). A) Depth in meters below seafloor (mbsf). B) Lithology, Mass Transport Deposits (MTDs) are delineated in purple, siltstones in orange, sandstones in yellow, and mudstones in green. C) Gamma Ray (GR) from logging-while-drilling (LWD) data. D) Resistivity (RES) log. E) Porosity interpreted from shipboard moisture and density (MAD) measurements (solid symbols). Porosity interpreted from logging-while-drilling (LWD) bulk density log assuming a grain density of 2740 kg/m^3 and water density of 1024 kg/m^3 (orange line). F) *In-situ* permeabilities are (symbols) and arithmetic mean and harmonic mean of permeability – porosity relationships. Both were calculated using log-derived porosity. Density log was filtered using the GR as an indicator of grain size. Numbers refer to CRS test number. G) Specific surface area measurements. H) Clay fraction < 2μm in percent (Sawyer et al., 2008). I) Depth in feet below seafloor (fbsf). Shaded areas across all logs represent locations of MTDs.

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