Review of Hydraulic Properties for Sediments in the 200 Areas

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Presentation Topics ...

- 200 Area database on soil properties ...
- Variability and scaling for 200 Area samples ...
- Recent data at the ILAW site in 200 East Area ...
- Anisotropy results for sediments at the ILAW site

200 Areas Database ...

- 183 samples from 12 sites in 200 Areas have data on PSD, bulk density, moisture retention and saturated K
- Moisture retention and saturated K data corrected for gravel content
- Data grouped into six categories: SS, sand mixed w/ finer fraction; S, sand; SSG, sand and gravel mixed w/ finer fraction; GS, gravelly sand; SG1, sandy gravel w/ gravel fraction < 60%; SG2, sandy gravel w/ gravel fraction >60%
- Variability and scaling results available for the 183 samples
- Data on PSD, bulk density, moisture retention, saturated and unsaturated K available for 42 samples

Location of Sites in 200 Areas Plateau

Correcting Saturated K for Gravels: Bouwer and Rice (1984)

$$K_b = K_s \left(\frac{e_b}{e_f} \right)$$

K_b = saturated K for the bulk sample
K_s = saturated K for the < 2 mm fraction
e_b = void ratio for the bulk sample
e_f = void ratio for the < 2 mm fraction

Correcting Moisture Retention for Gravels: Gardner (1986)

$$q_b = \frac{W_f\, r_b / r_w}{1 + m_g / m_f}$$

è$_b$=volumetric moisture content of the bulk soil including gravel
w$_f$=laboratory-measured gravimetric moisture content of the fine fraction (< 2 mm)
ñ$_b$=bulk density of the entire sample (including gravel)
ñ$_w$=density of water
m$_f$ and m$_g$= respective dry masses of the fines and gravel as recovered from the bulk field sample

Scaling Relationships: Vogel et al. (1991)

$$K(h) = a_k K^*(h^*)$$

$$q(h) = q_r + a_q [q^*(h^*) - q_r^*]$$

$$h = a_h h^*$$

á$_{è}$, á$_{h}$, á$_{k}$=mutually independent scaling factors for moisture content, pressure head and hydraulic conductivity, respectively.

For texturally similar soils, scaling factors are:

$$a_k = K_s / K_s^*$$

$$a_q = (q_s - q_r)/(q_s^* - q_r^*)$$

$$a_h = h_c / h_c^*$$

Macroscopic Anistotropy Relationships: Polmann (1990)

$$< LnK > = < LnK_s > - A < y > - s^{2}_{LnKs} l[p - p^{2} < y > - z^{2} < y >]/(1 + Al)$$

$$s^{2}_{LnK} = s^{2}_{LnKs}[(1 - p < y >)^{2} + z^{2} < y >^{2}]/(1 + Al)$$

$$K_h^{eq} = \exp[< LnK > + (s^{2}_{LnK} / 2)]$$

$$K_v^{eq} = \exp[< LnK > - (s^{2}_{LnK} / 2)]$$

where s^{2}_{LnK} = variance of log unsaturated conductivity (which depends on mean tension),

<ø> = mean tension,

s^{2}_{LnKs} = variance of $\ln K_s$

$<LnK_s>$=mean of $\ln K_s$,

p = slope of the â versus $\ln K_s$ regression line,

æ= óä/ó lnKs,

óä = standard deviation of the residuals in the â versus $\ln K_s$ regression,

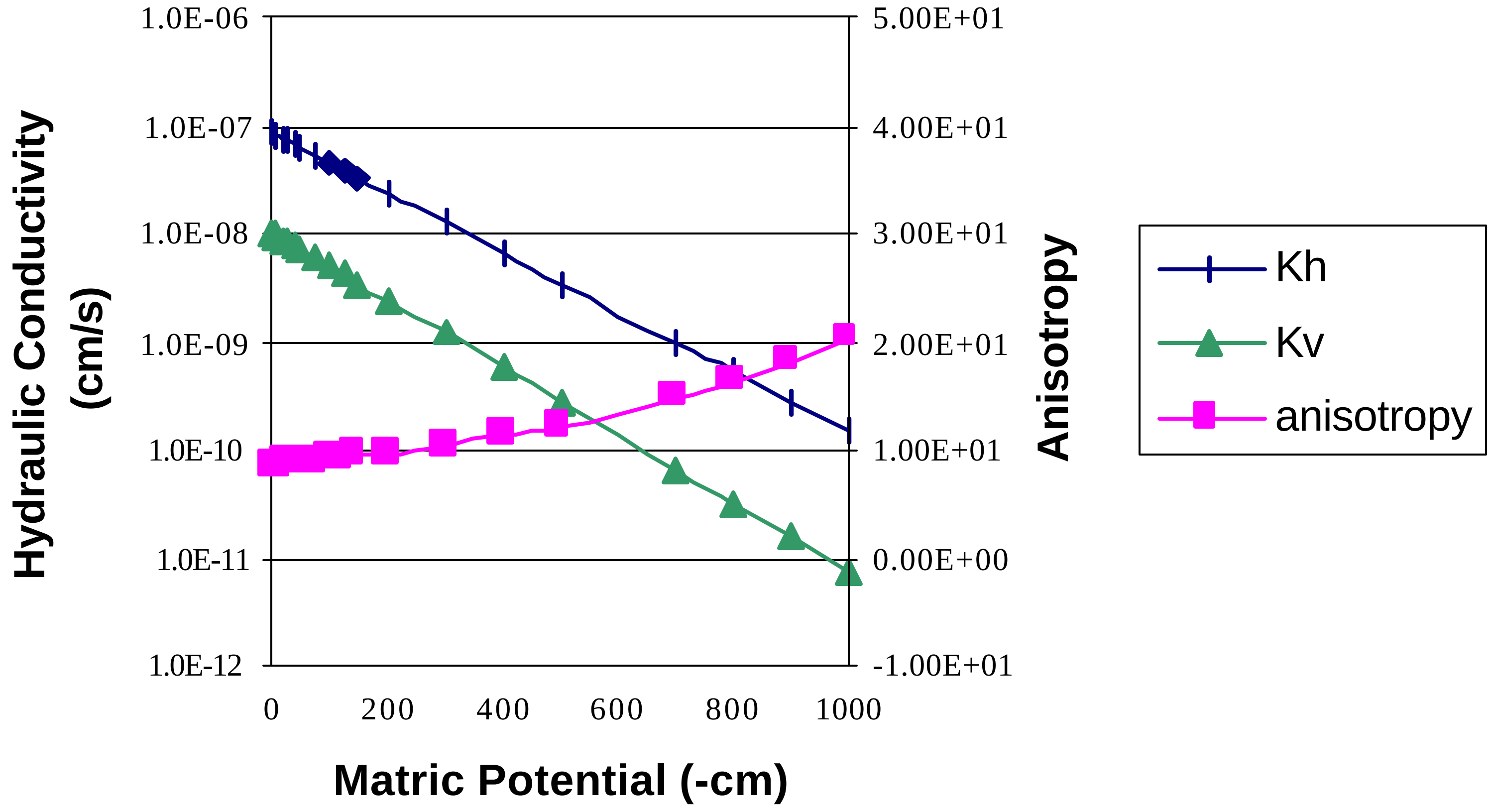
A = mean slope, â, for $\ln K_s$ vs. ø ,

ë = vertical correlation lengths for $\ln K_s$ (assumed to be same as that of â),

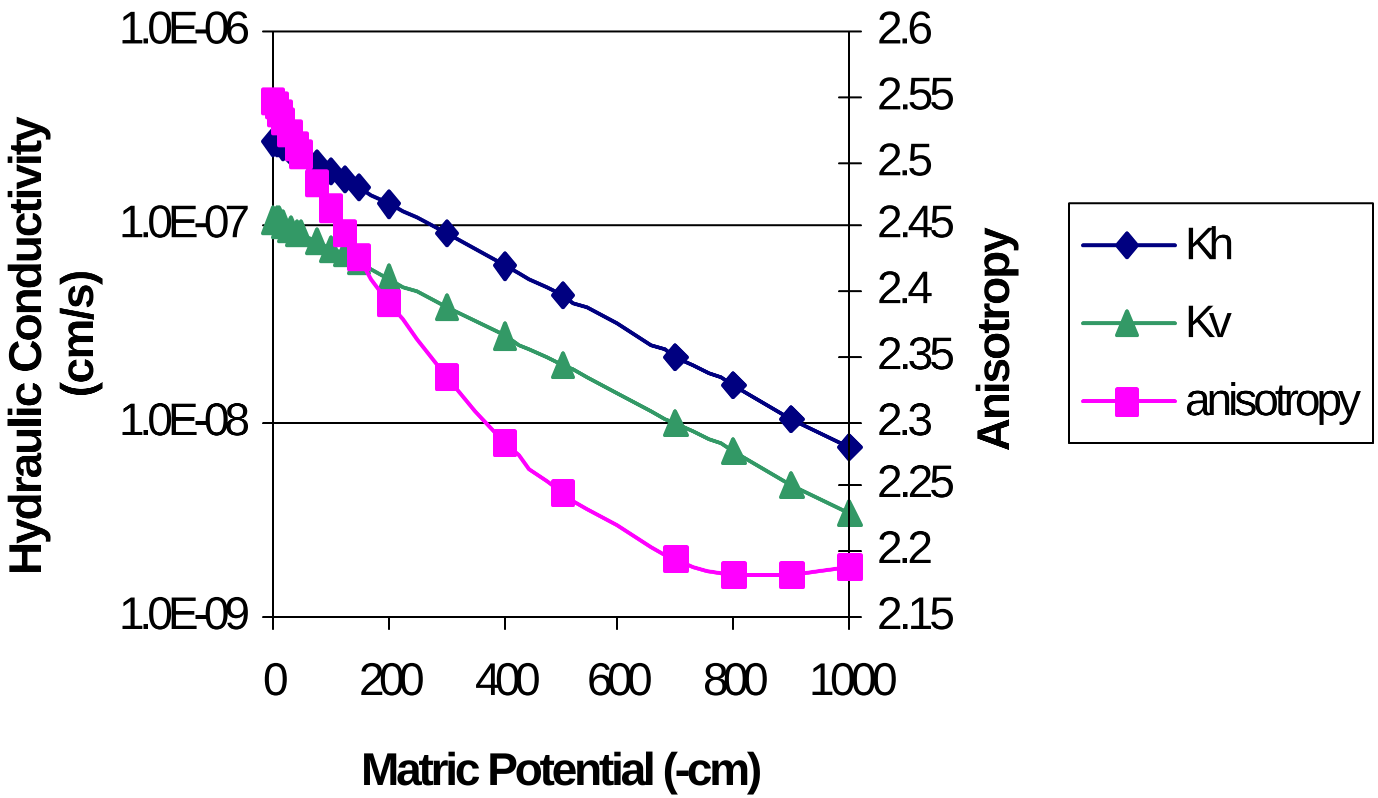
K_h^{eq} = equivalent unsaturated horizontal conductivity, and

K_v^{eq} = equivalent unsaturated vertical conductivity.

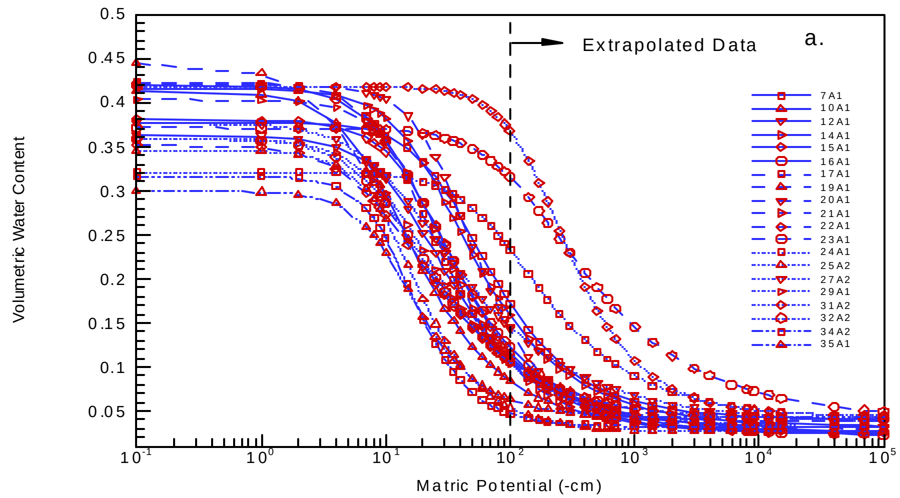
Macroscopic Anisotropy for the Hanford Sandy Sequence at the ILAW Site in 200 E Area

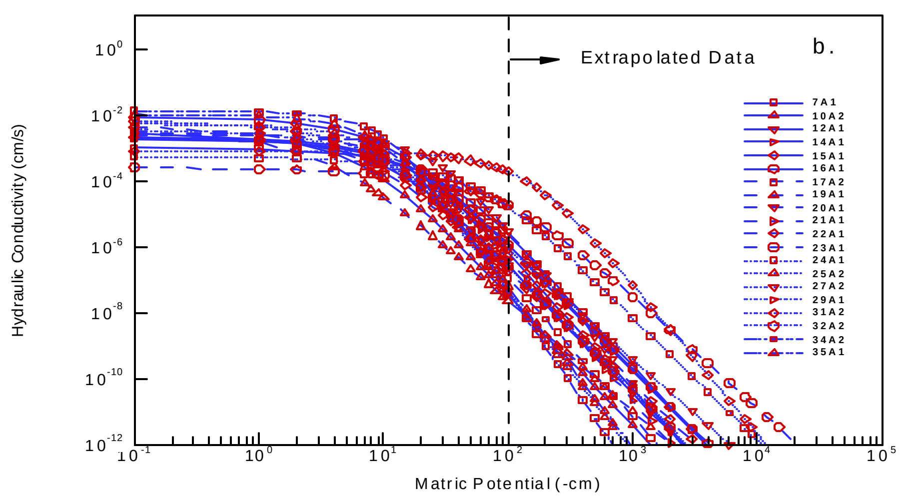


Macroscopic Anisotropy for the Hanford Gravelly Sequence at the ILAW Site in 200 E Area



Moisture Retention and Unsat K Data for the Hanford Sandy Sequence at the ILAW Site





Moisture Retention and Unsat K Data for the Gravelly Sequence at the ILAW Site