Energy-based Liquefaction Assessment Approach for Pumiceous Sands

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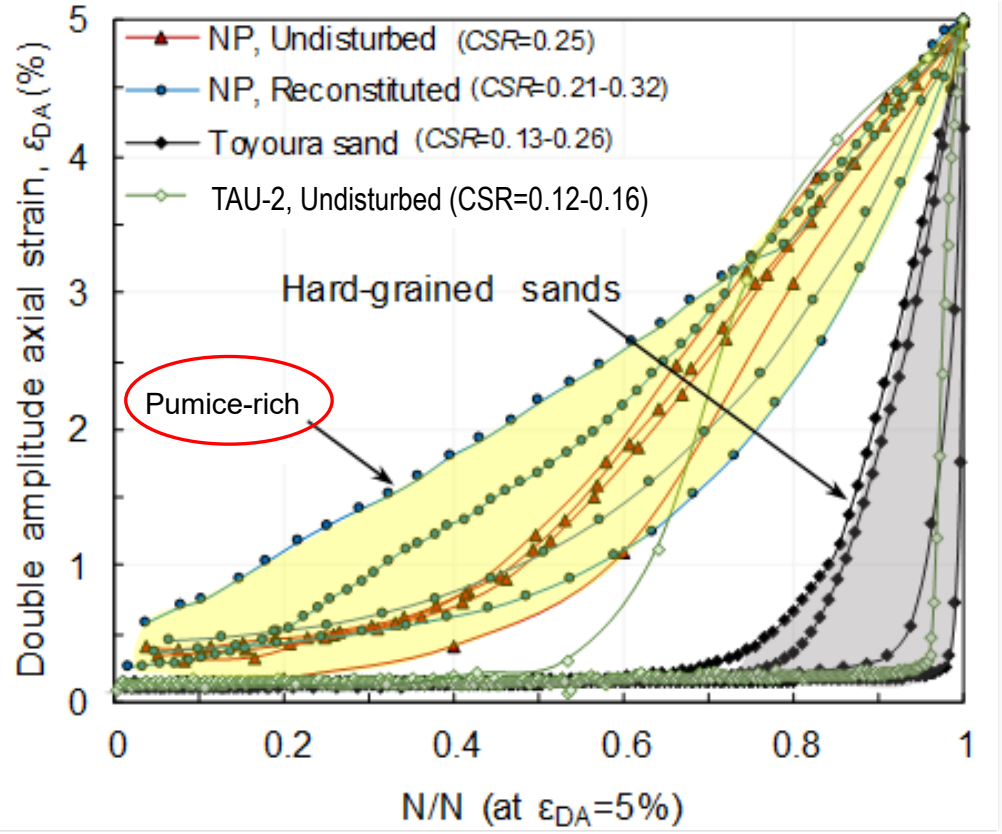
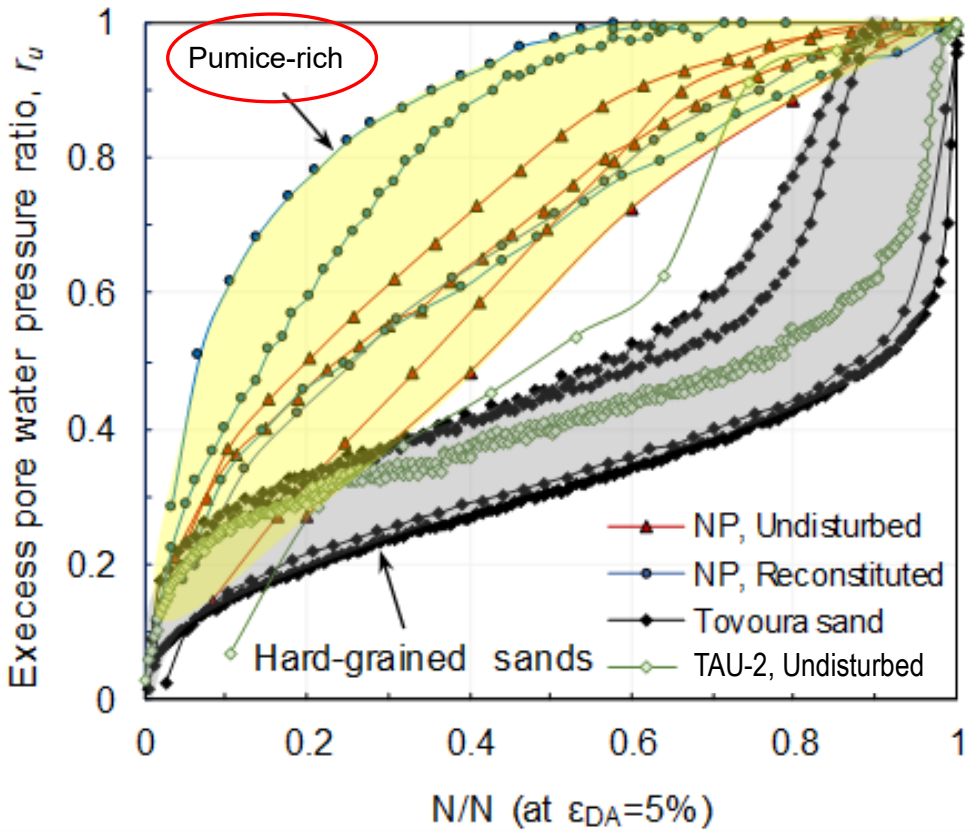
Undrained cyclic response

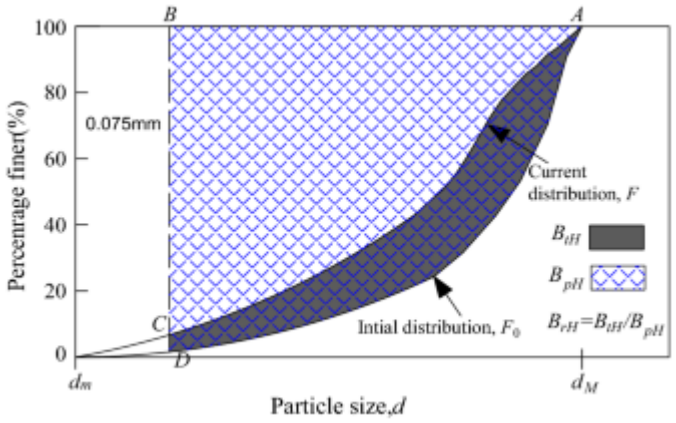


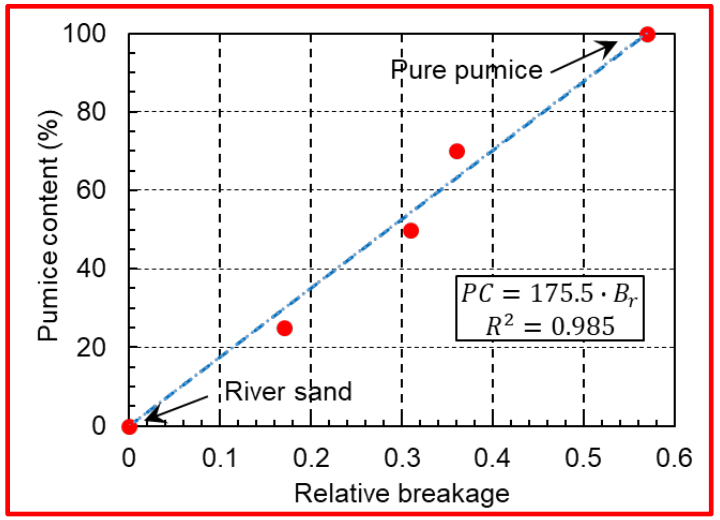


Pumice-rich specimens showed:

- very contractive behaviour during the initial cycle of loading (due to the **occurrence of particle crushing**).
- gradual deformation under high r_u (due to the **formation of more stable soil skeleton**).

Proposed method





OR, use index properties

Determine V_s profile

Obtain disturbed samples

Perform modified MDD test & estimate relative breakage, B_r

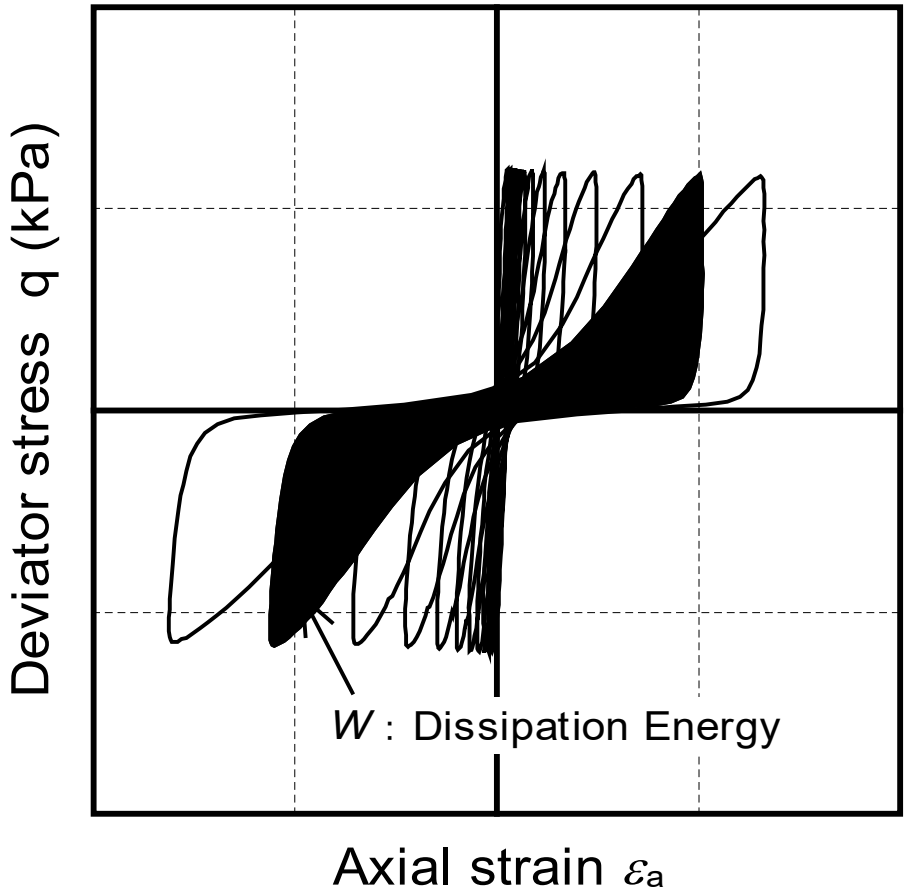
Quantify the pumice content (PC)

Estimate $(CRR)_{field}$

At target depths
(e.g. pumice-rich layer)

Shear Work

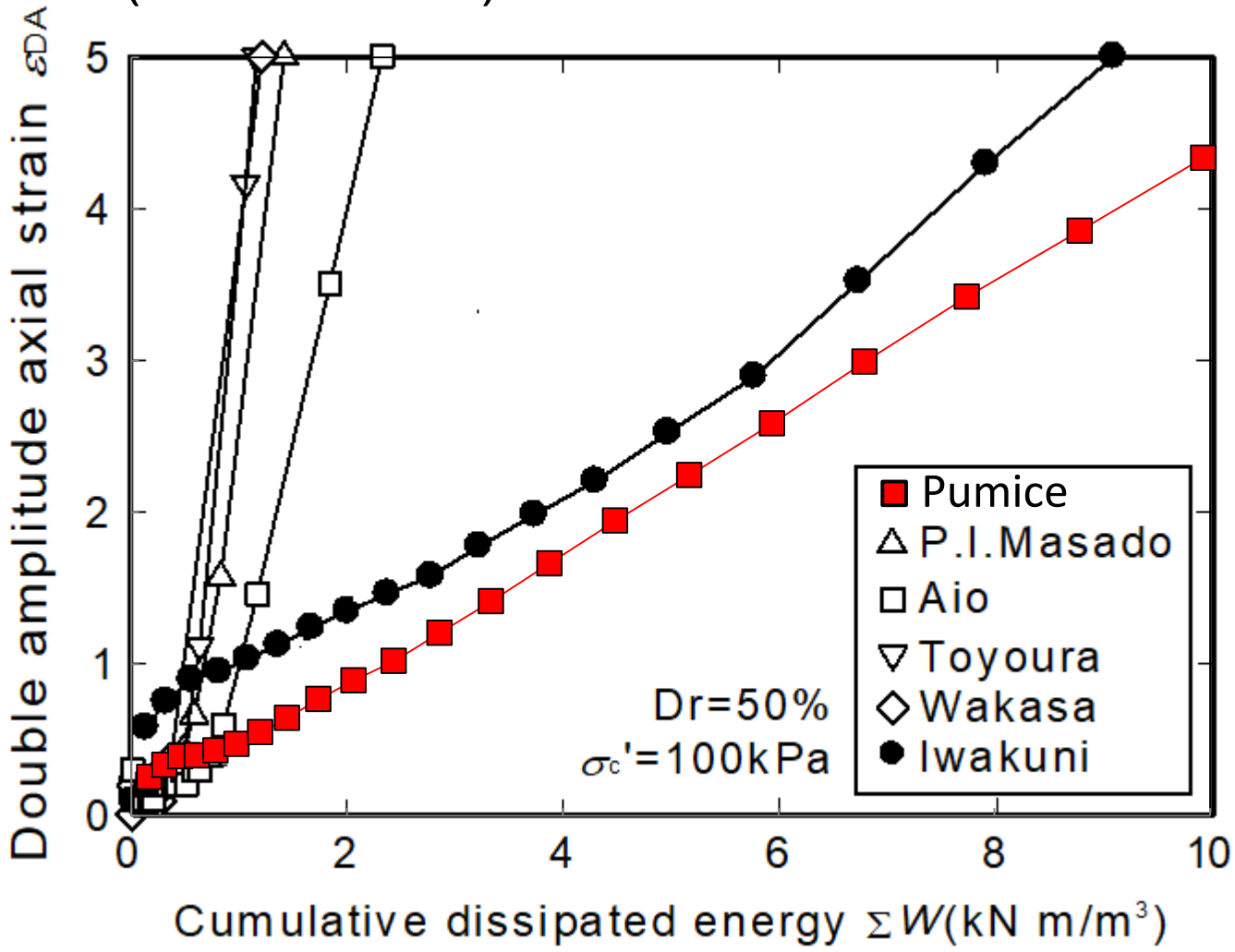
Cumulative dissipated energy ΣW



The cumulative dissipated energy ΣW is the energy consumed by the soil during plastic deformation until liquefaction. Thus, the energy-absorption capacity is high when this value is large, and consequently, the liquefaction strength would also be high.

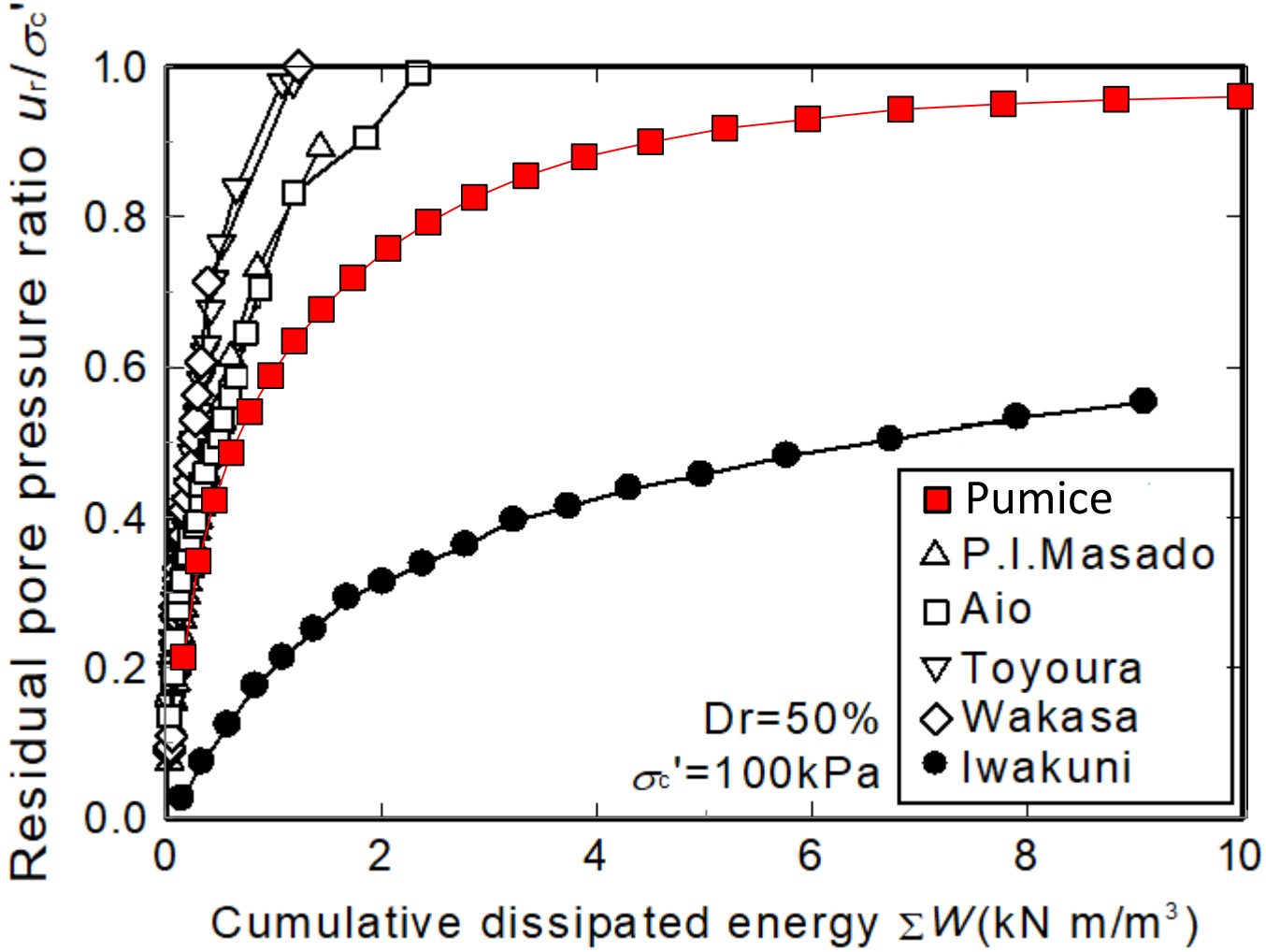
Cumulative dissipated energy (1)

- Pure pumice sand (reconstituted)



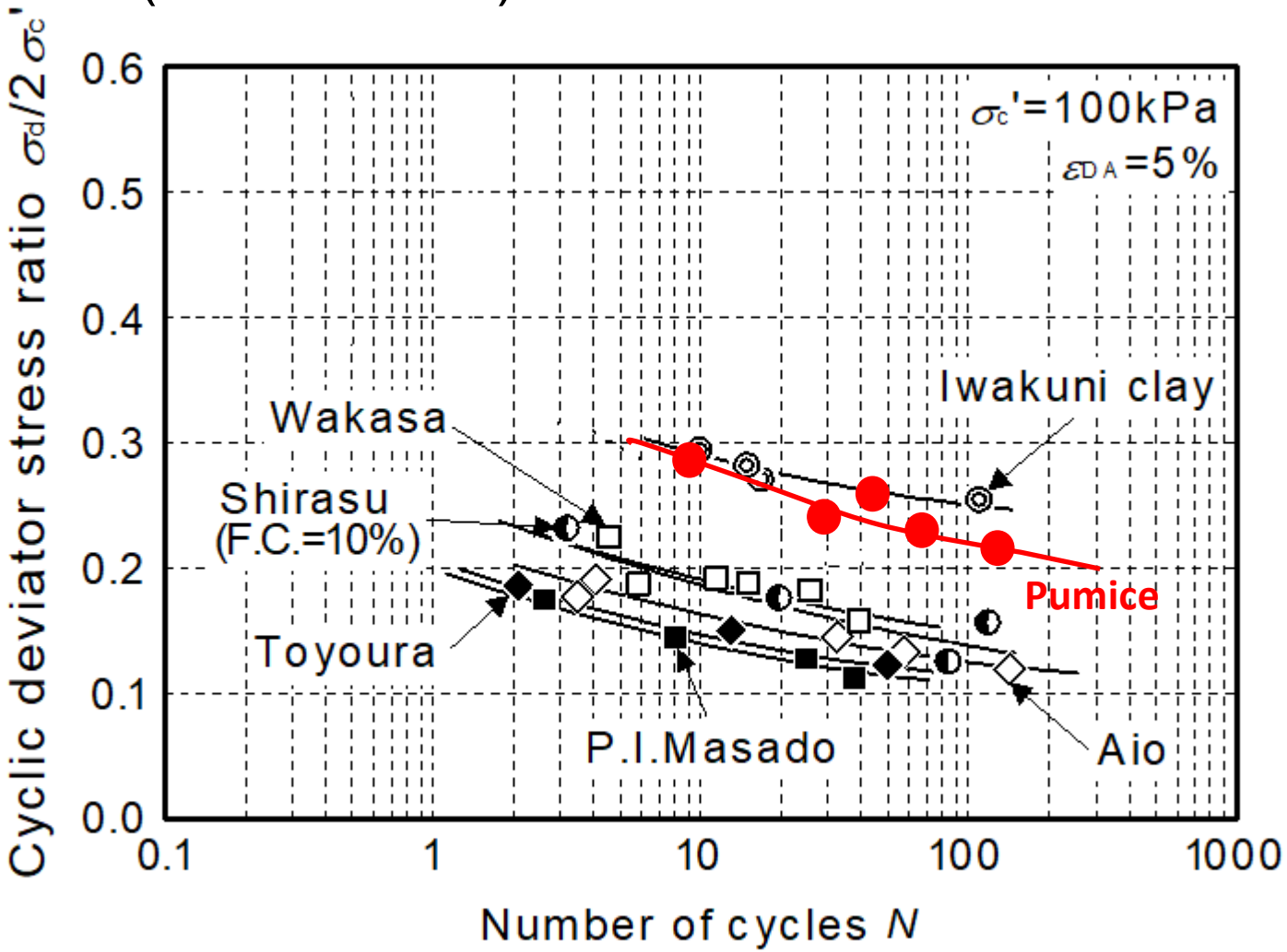
Cumulative dissipated energy (2)

- Pure pumice sand (reconstituted)



Liquefaction resistance curves

- Pure pumice sand (reconstituted)

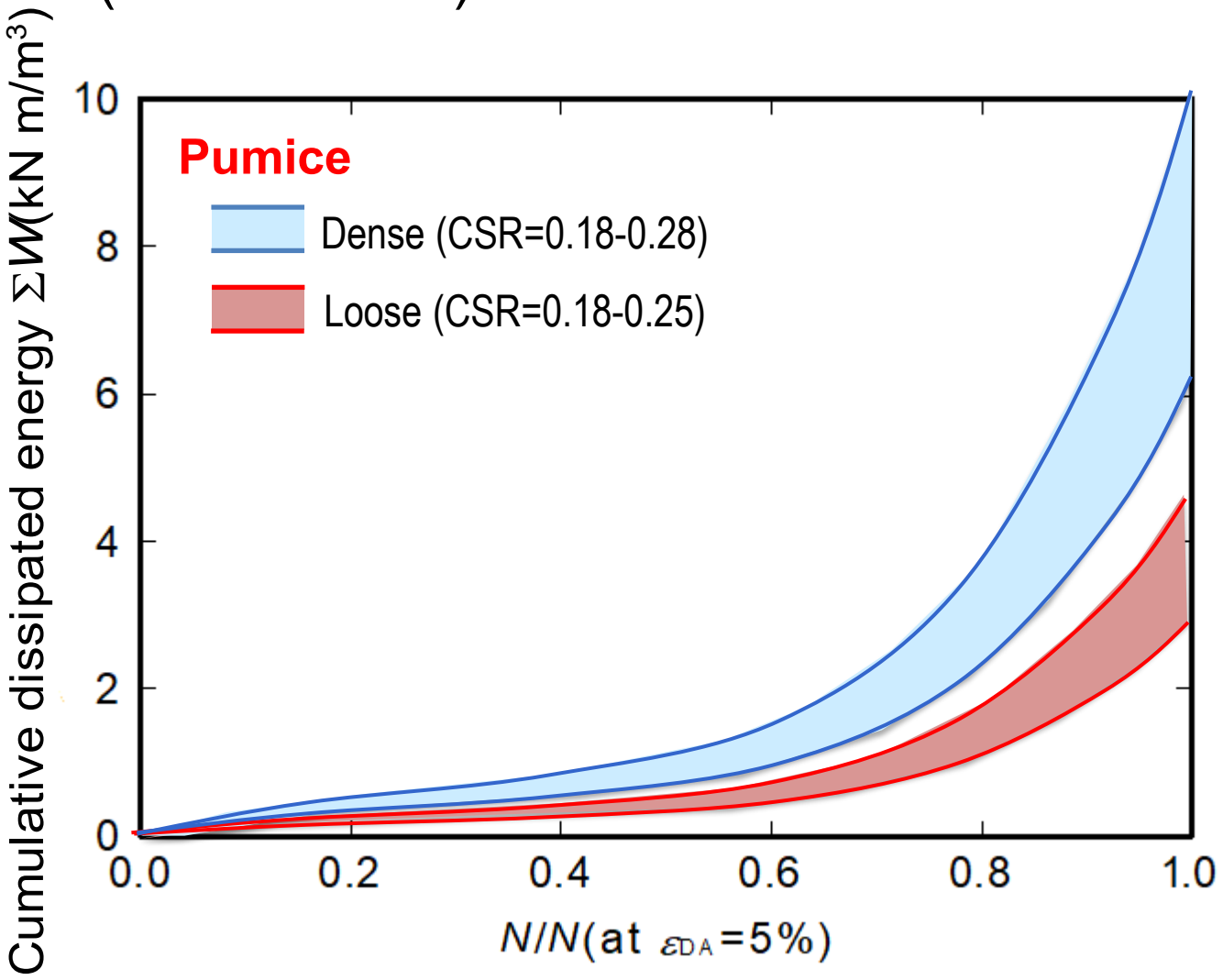


Observations

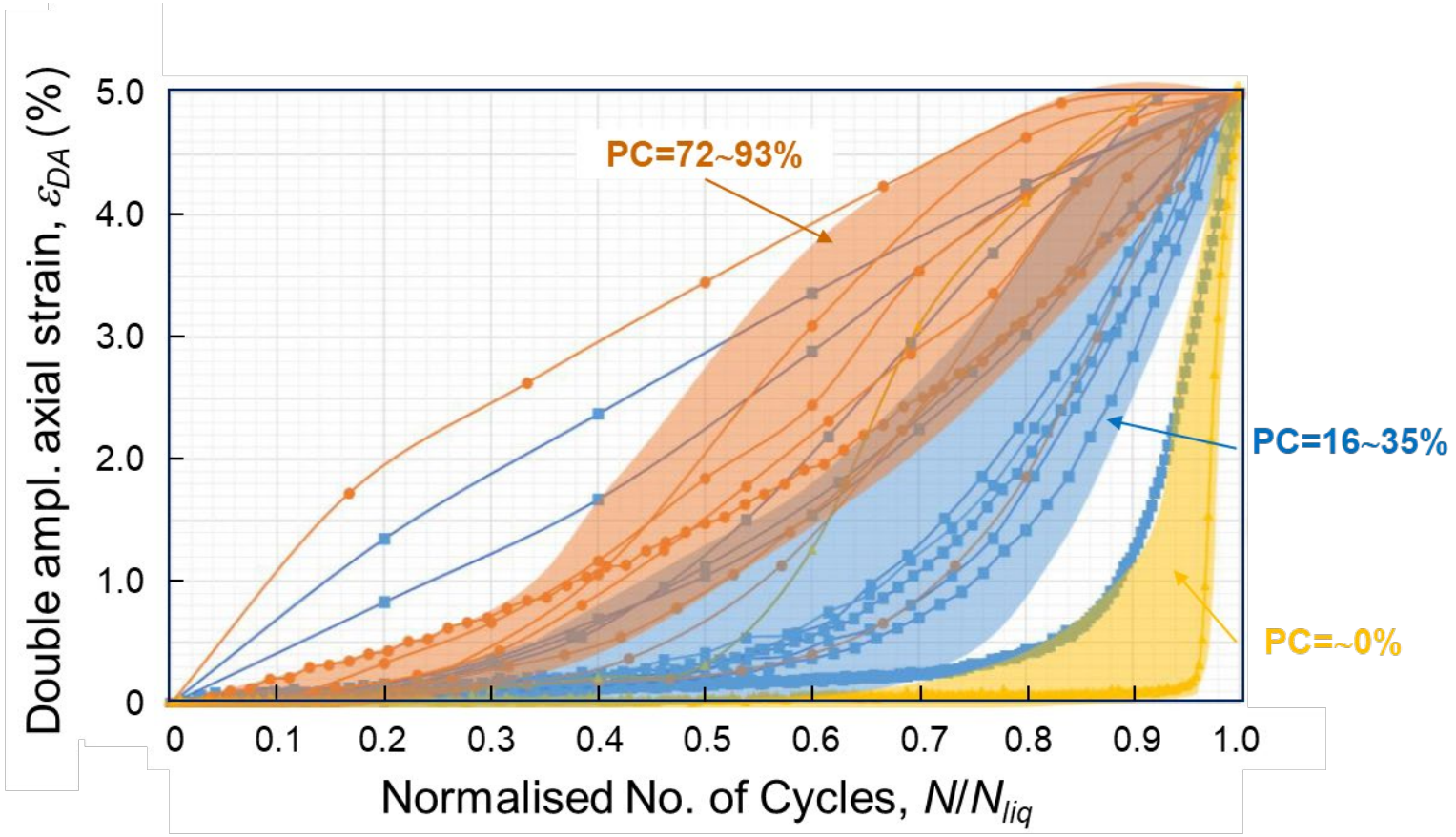
- The pore pressure and deformation response of pumice sand showed intermediate behaviour between sand and clay. During cyclic triaxial testing, pumice sand underwent considerable particle crushing.
- The liquefaction resistance of pumice sand is about twice higher than that of Toyoura sand. The cyclic deviator stress ratio of pumice sand is almost the same as that of Iwakuni clay.
- The cumulative dissipated energy for pumice sand is larger than that of natural sand, because some energy is spent as the particles undergo crushing. It is believed that this is the reason why the liquefaction resistance of pumice sand is higher than that of natural sand.

Cumulative dissipated energy (3)

- Pure pumice sand (reconstituted)



Undisturbed pumice-rich specimens



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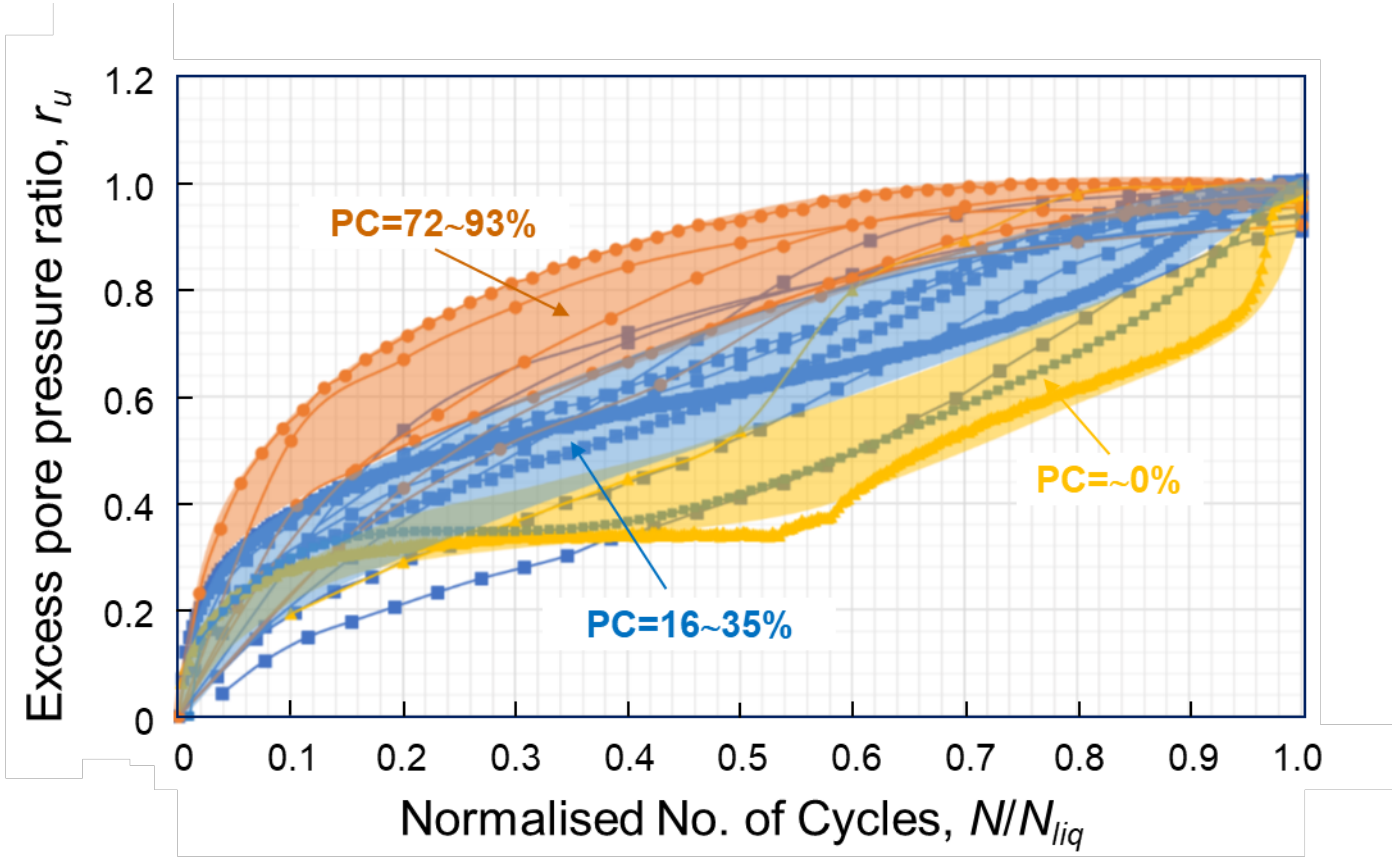
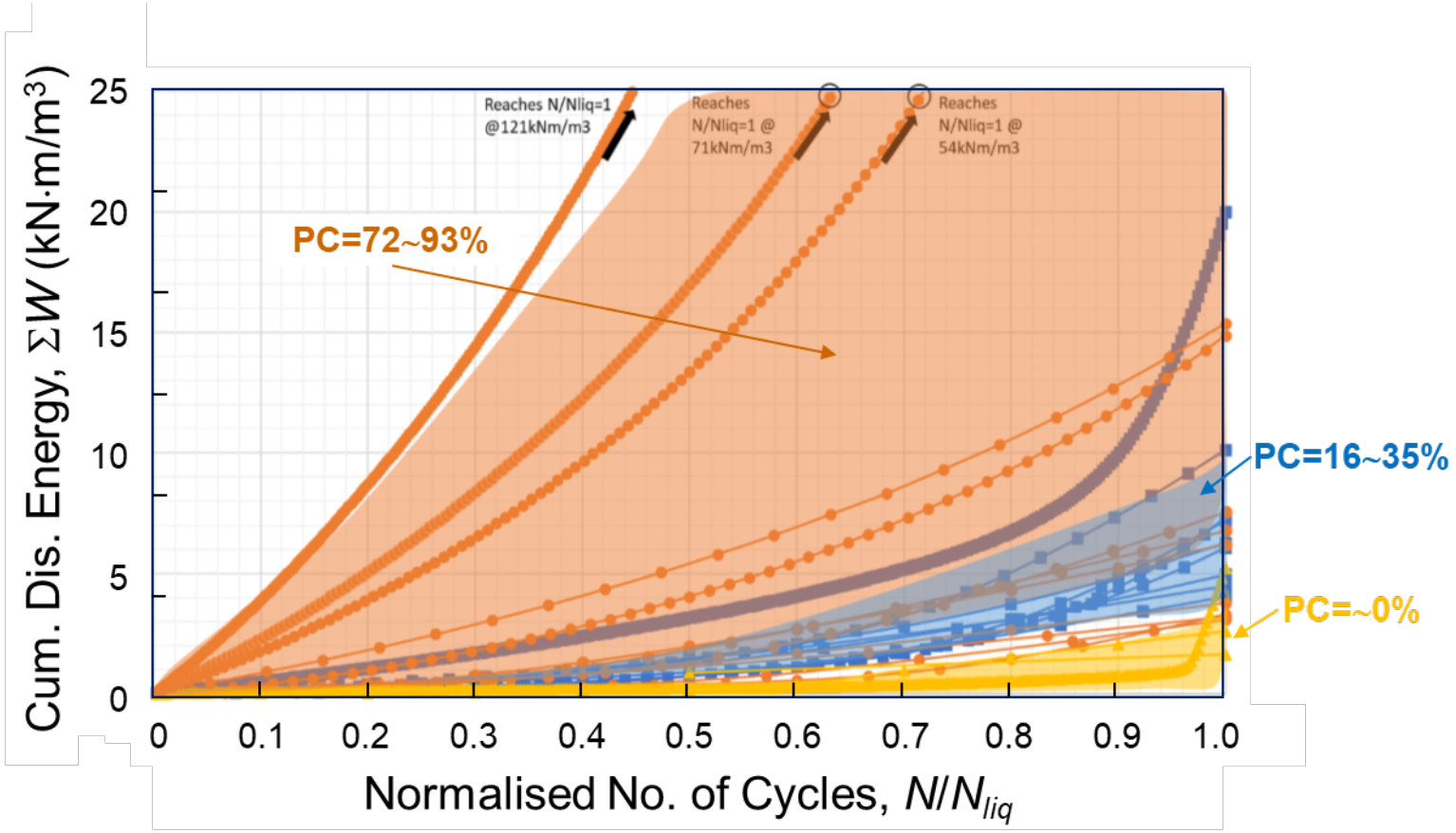


Undisturbed pumice-rich specimens



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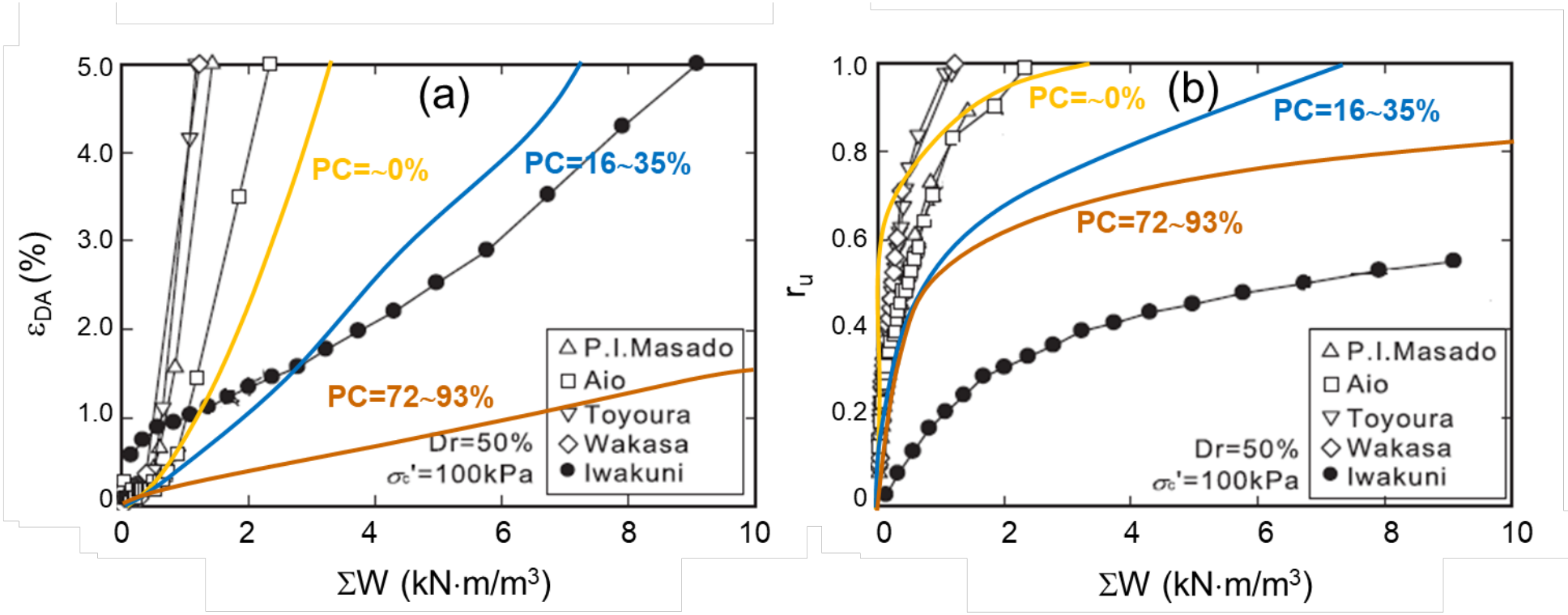
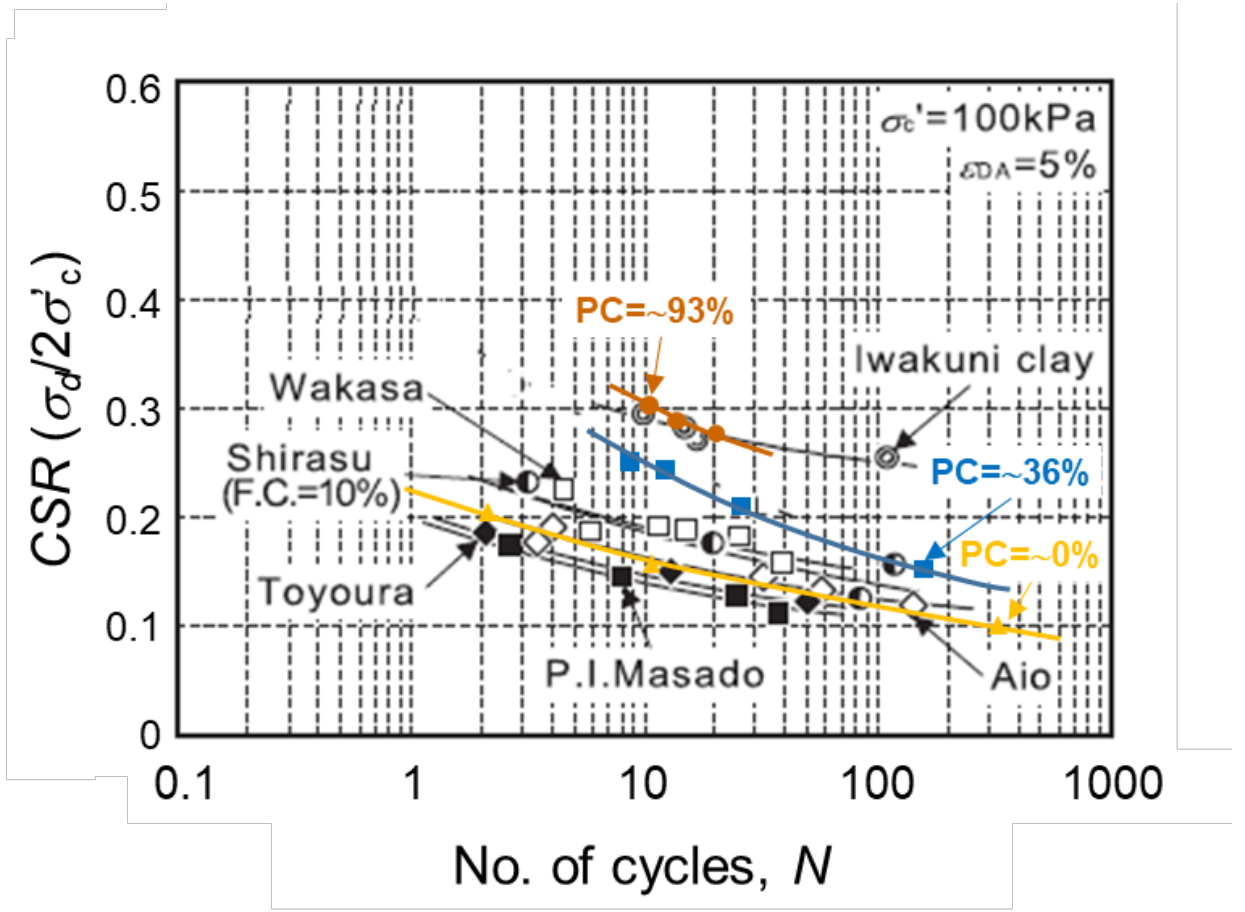


Undisturbed pumice-rich specimens



Energy-based concept

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Energy Capacity

$$\frac{\Sigma W}{\sigma'_0}$$

Function of:

- Relative density
- Pumice content
- Fines content
- Earthquake parameters
- etc.

Energy Demand

Expressed in terms of:

- Seismic energy arriving at the site
- Ground motion intensity (Arias intensity, etc.)?
- etc.