EWG-IE 2021 ONLINE WORKSHOP
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The role of fines on internal instability and its impact on undrained mechanical response of gap-graded soils

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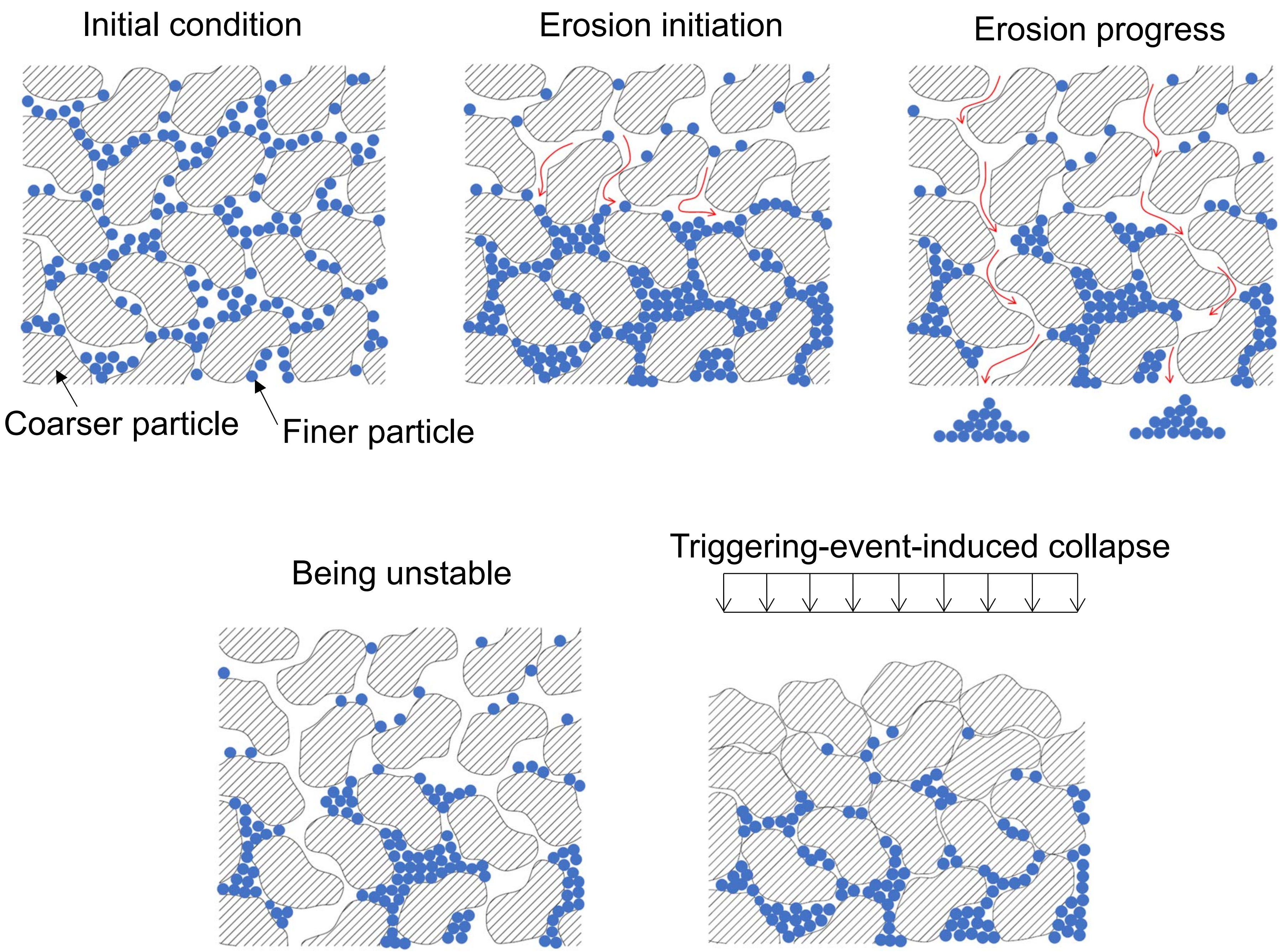
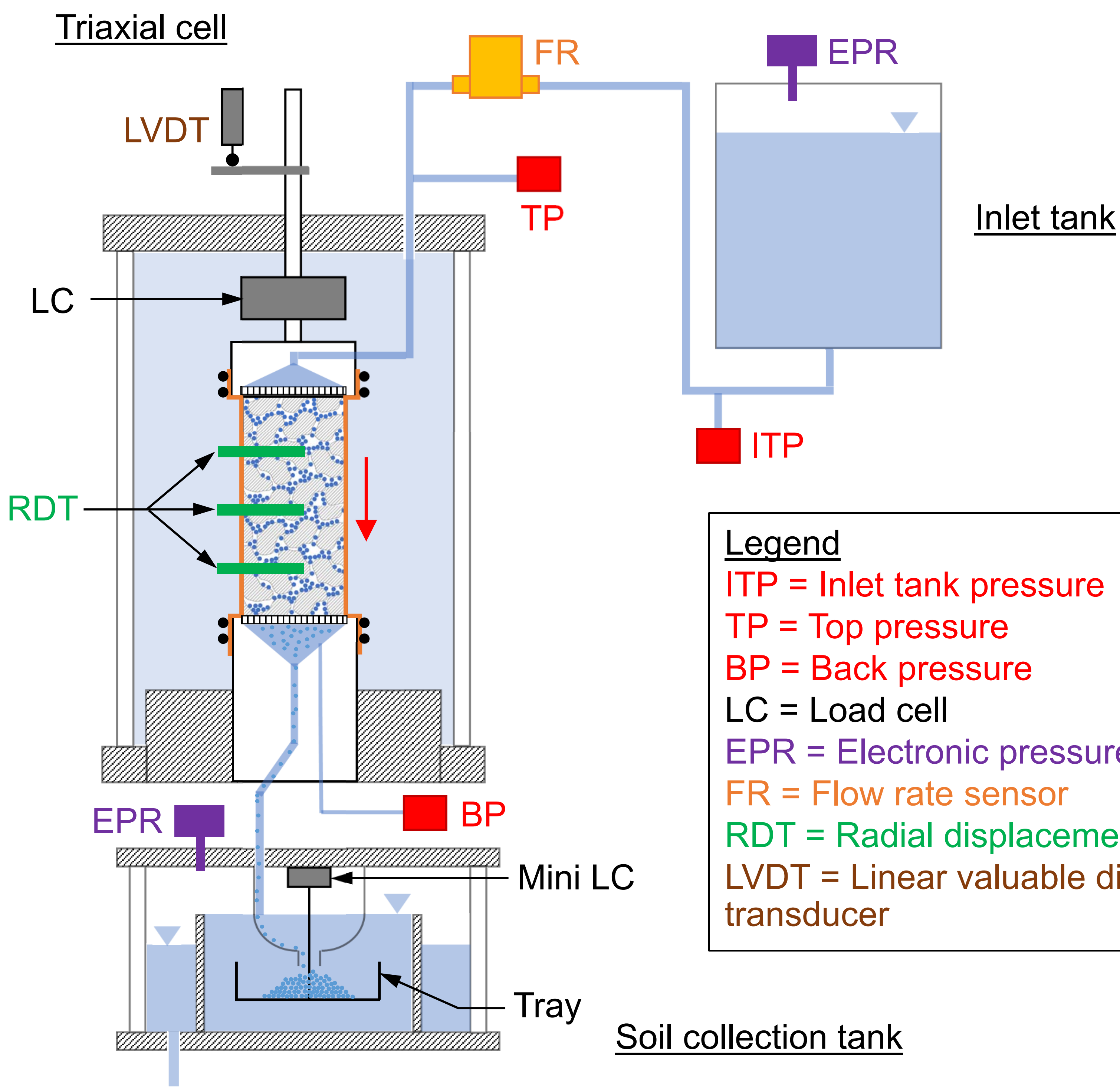
Possible suffusion mechanism

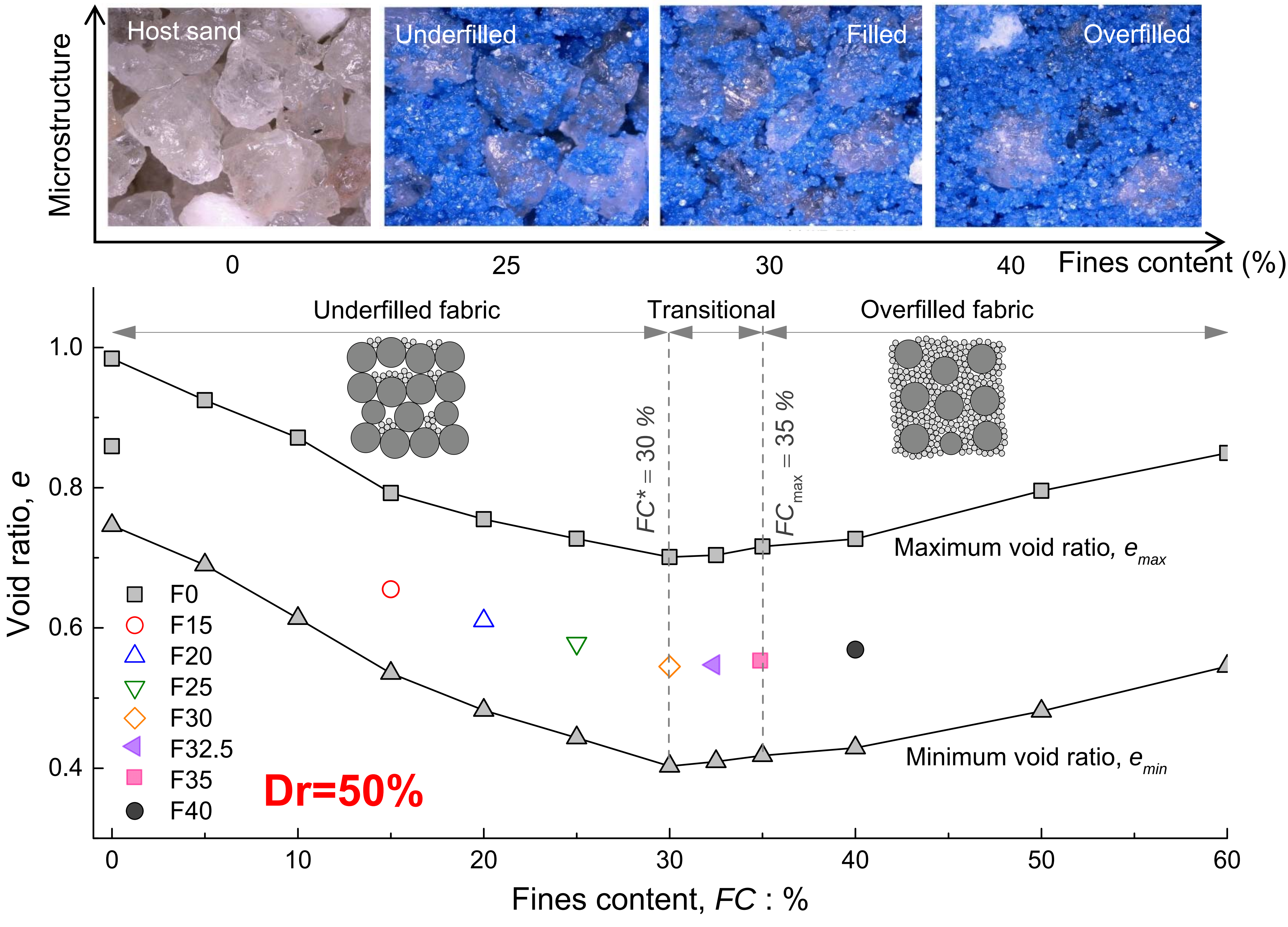


Pressure-controlled Triaxial Erosion Device

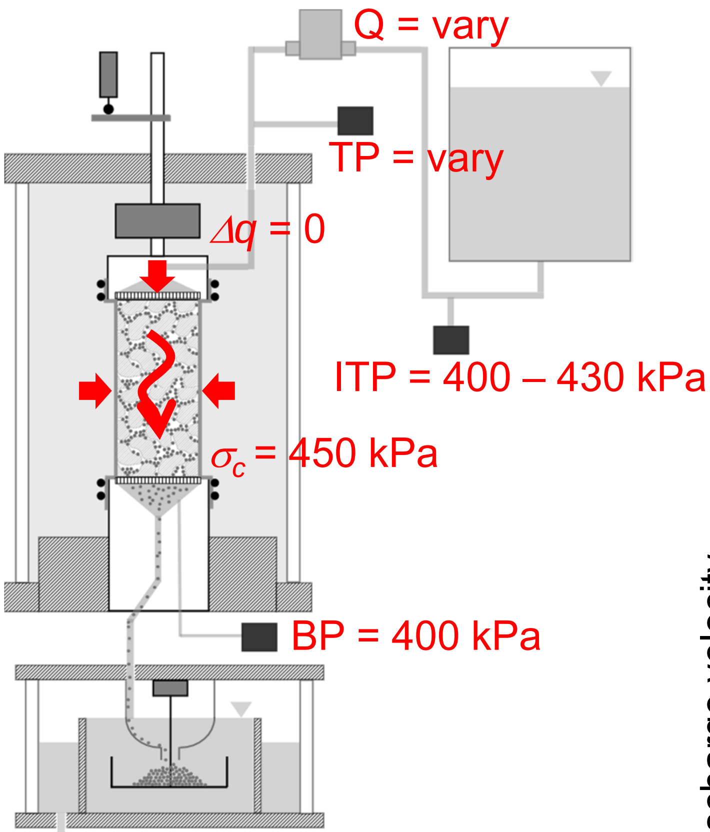


Legend
ITP = Inlet tank pressure
TP = Top pressure
BP = Back pressure
LC = Load cell
EPR = Electronic pressure regulator
FR = Flow rate sensor
RDT = Radial displacement transducer
LVDT = Linear valuable displacement transducer

Test conditions



Typical test results



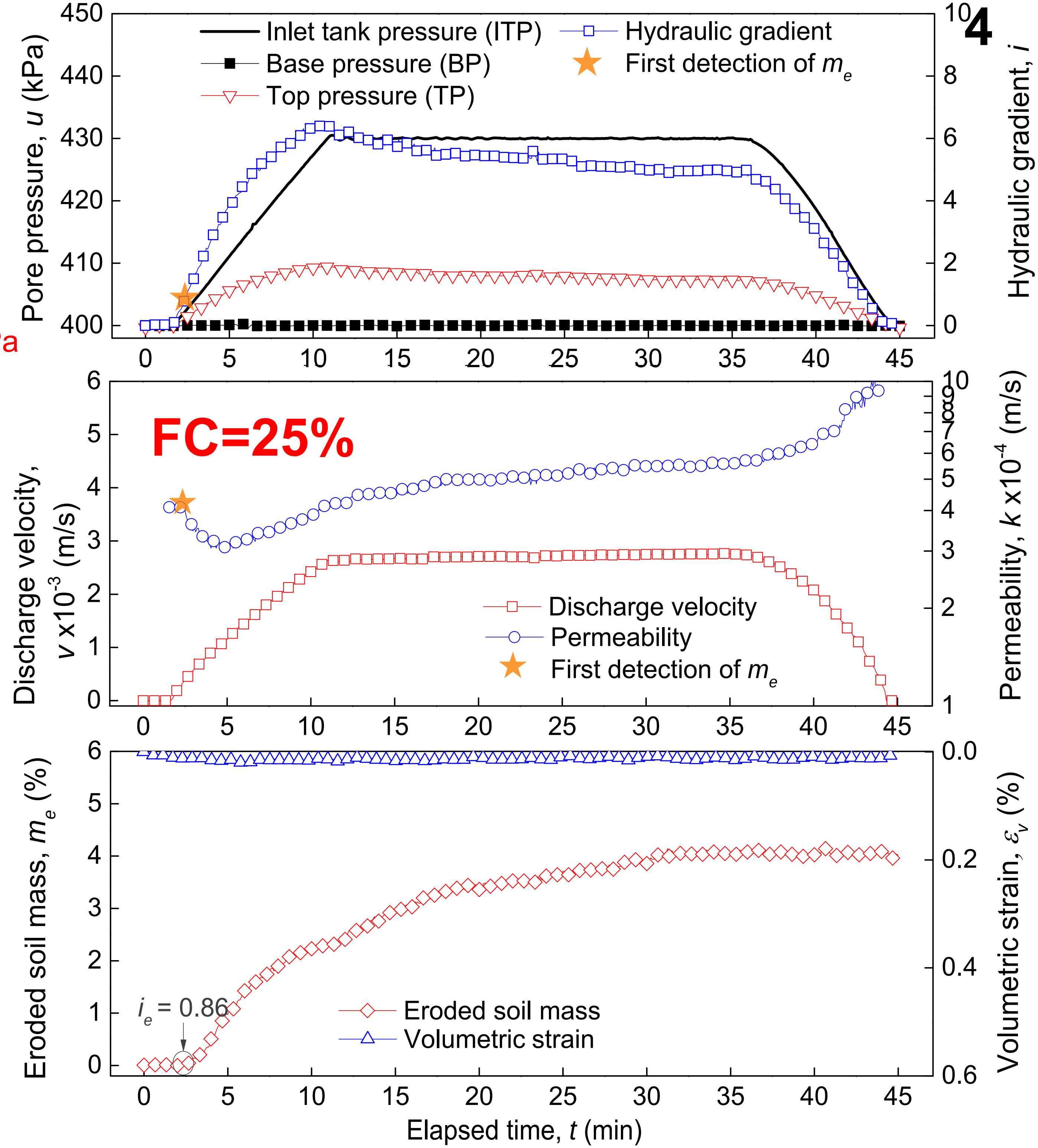
Darcy (1856) equation:

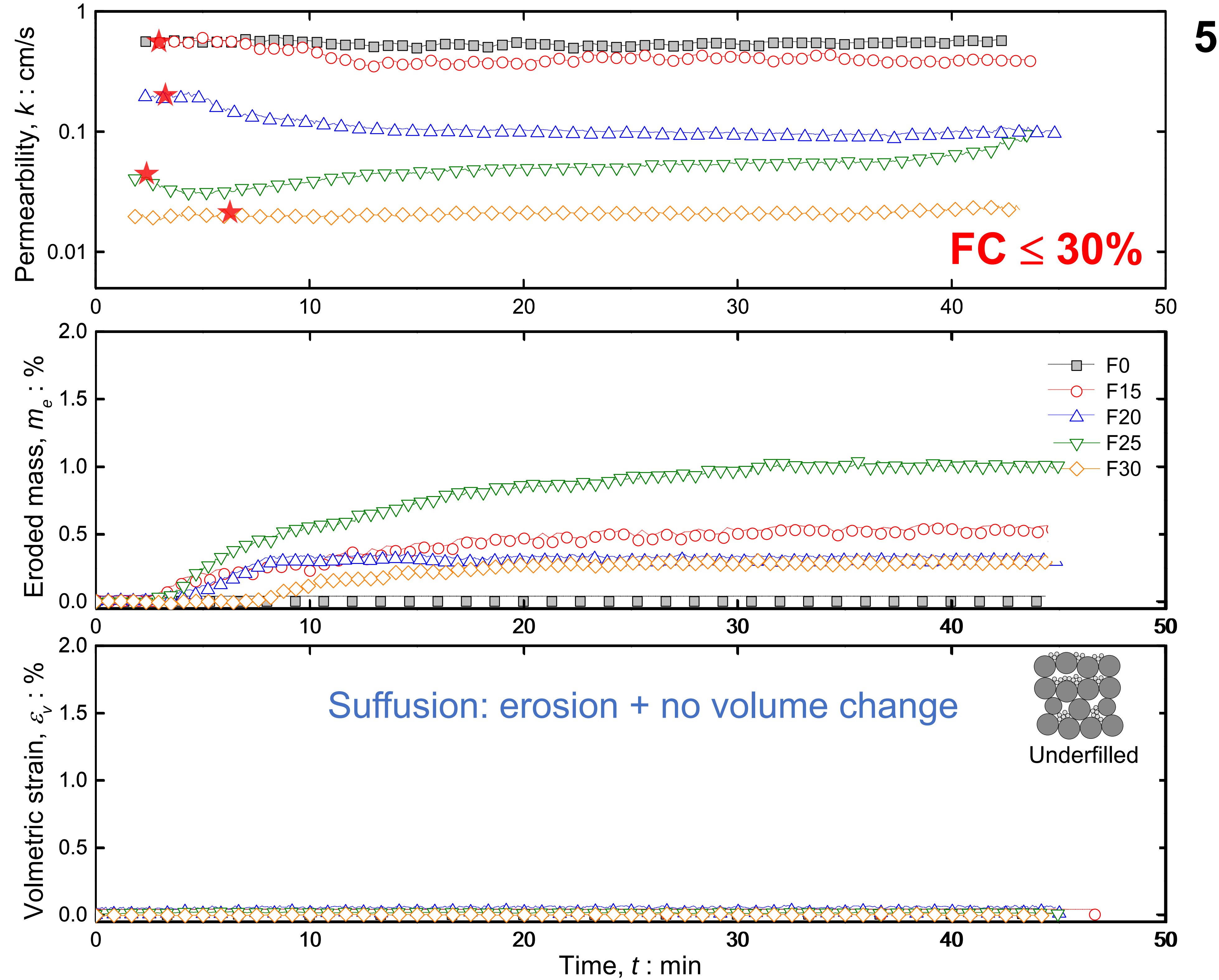
$$k = Q / i A$$

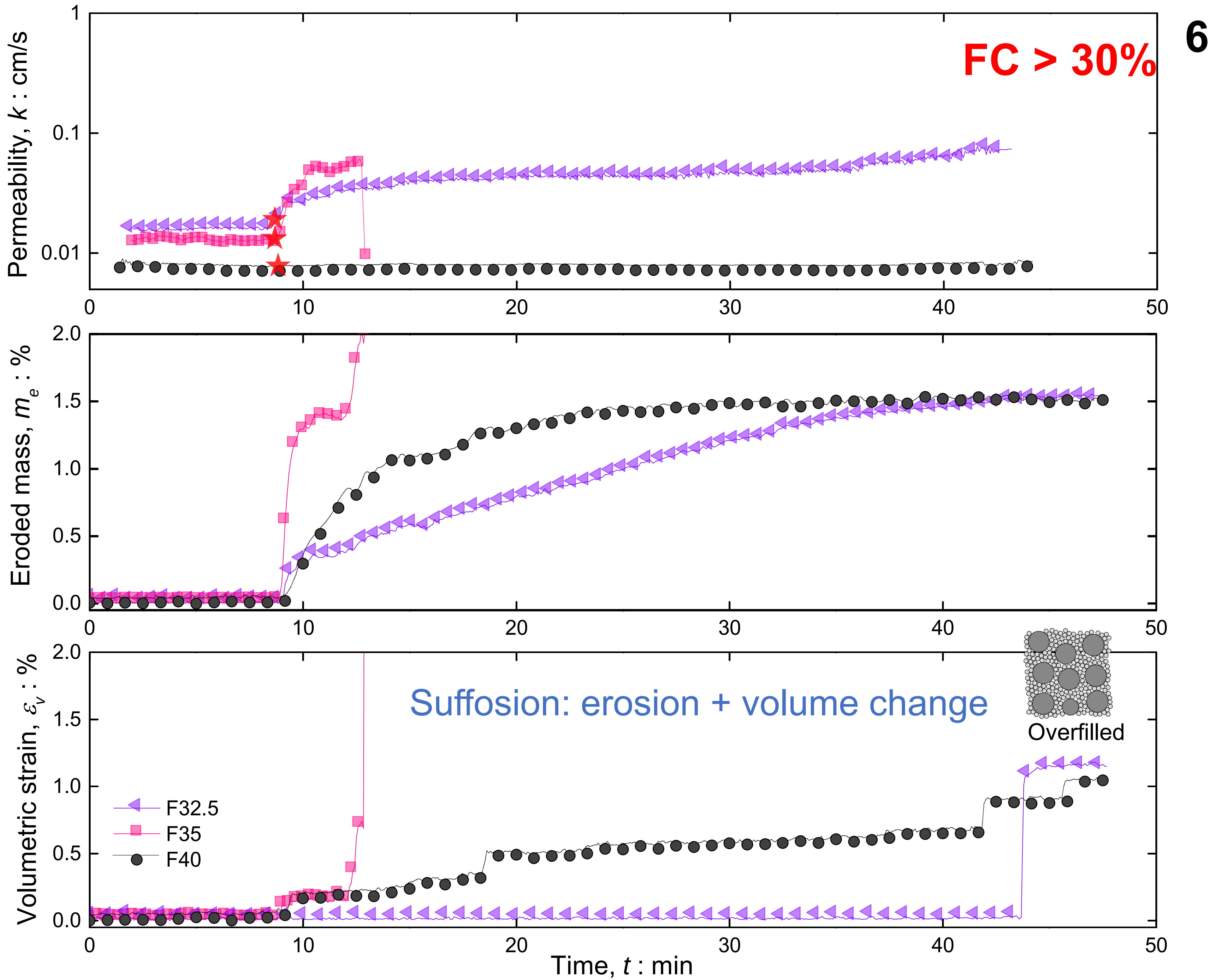
$$i = \Delta u / L\gamma_w$$

$$\Delta u = TP - BP$$

k = Permeability
Q = Water flow rate
i = Hydraulic gradient
A = Area
L = Length
Δu = Differential pore pressure
γ_w = Unit weight of water

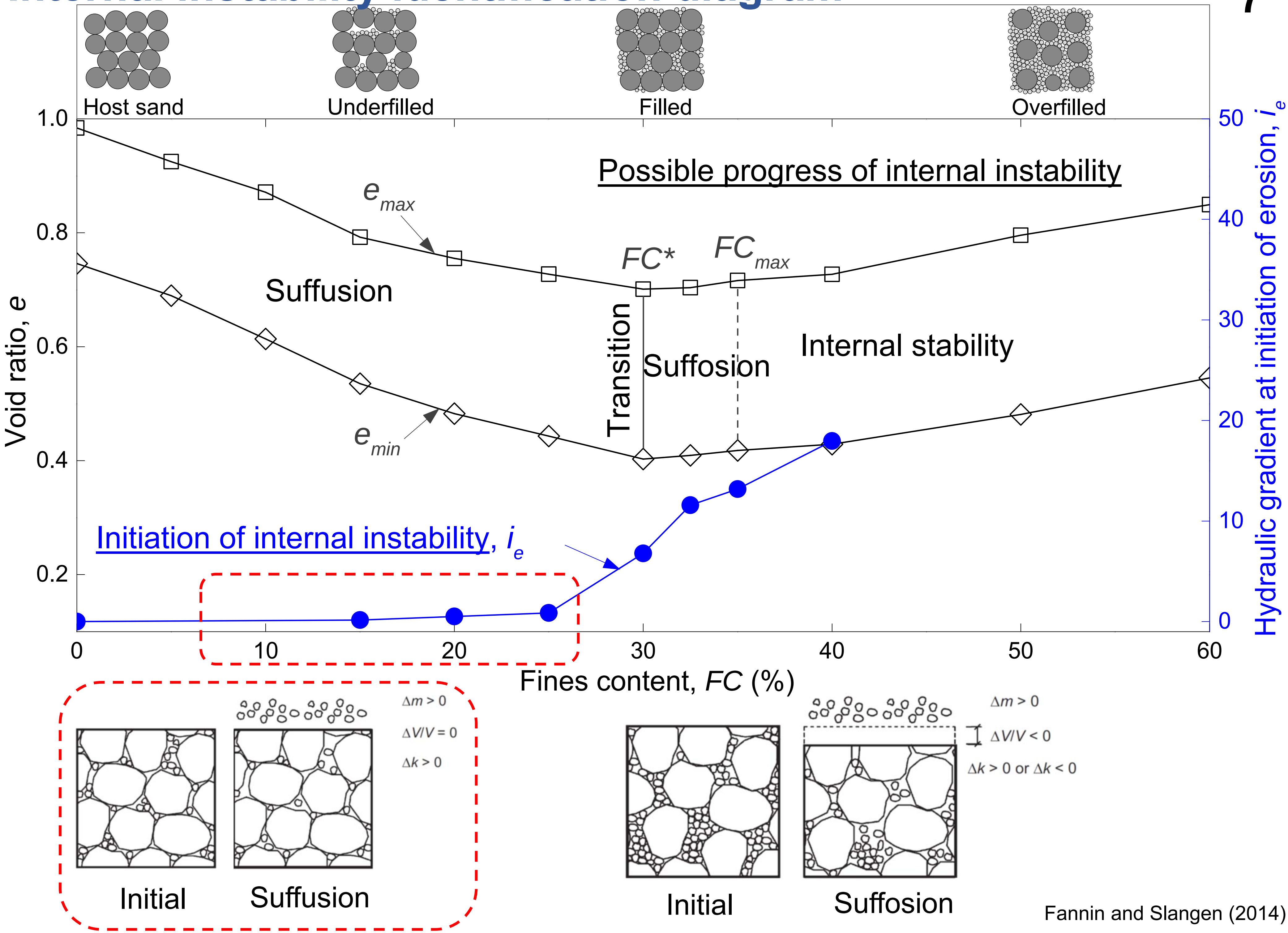



5
Permearbility, k : cm/s
FC ≤ 30%
Eroded mass, m_e : %
F0
F15
F20
F25
F30
Volmetric strain, ε_v : %
Suffusion: erosion + no volume change
Underfilled
Time, t : min



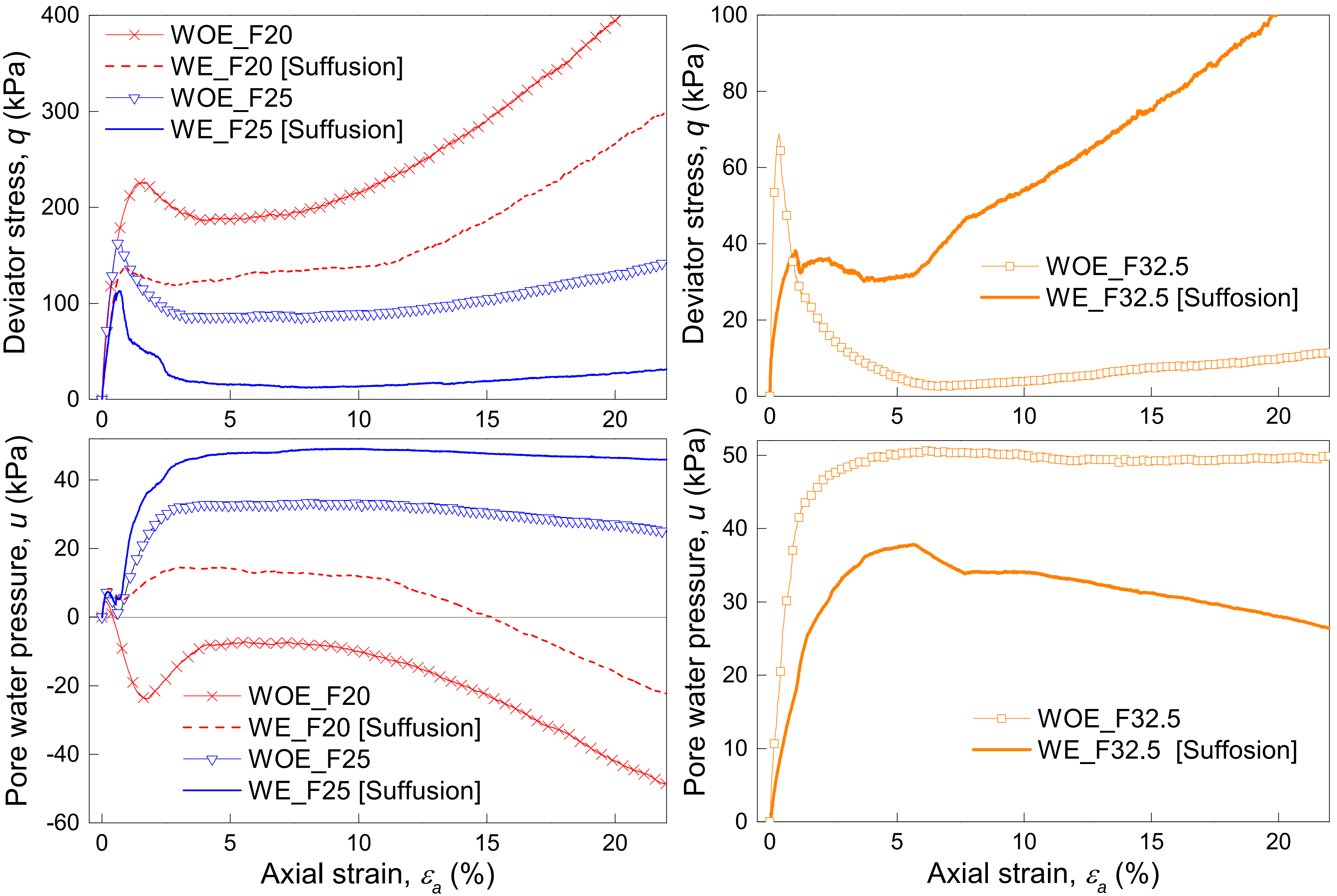
6
FC > 30%
Permeability, k : cm/s
Eroded mass, m_e : %
Volumetric strain, ε_v : %
Suffosion: erosion + volume change
Overfilled
F32.5
F35
F40
Time, t : min

Internal instability identification diagram



Fannin and Slangen (2014)

Undrained mechanical response



Summary

- If FC < FC*, soil is susceptible to suffusion initiated at relatively small hydraulic gradients (coarse-dominated microstructure).

- When suffusion occurs, seepage-induced mass loss without volume change, with change in permeability, is observed.

- The post-suffusion soils showed smaller shear strength and more contractive response.

- When suffosion occurs, seepage-induced mass loss accompanied by reduction in volume is observed.

- The post-suffosion soil showed more dilative tendency at large strain level.

For more details

Prasomsri, J., & Takahashi, A. (2020). The role of fines on internal instability and its impact on undrained mechanical response of gap-graded soils. *Soils and Foundations*, *60*(6), 1468-1488.

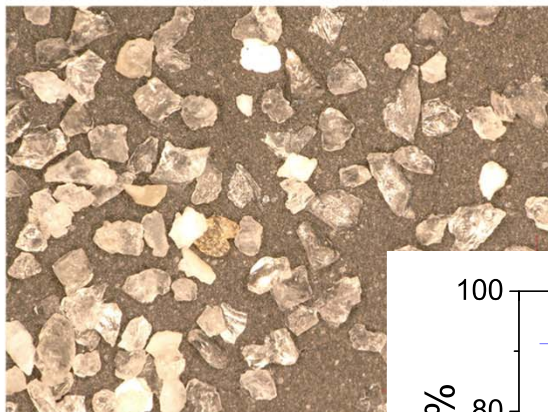
Future work: Well-graded soils

Silica #4 - #10 (20X)

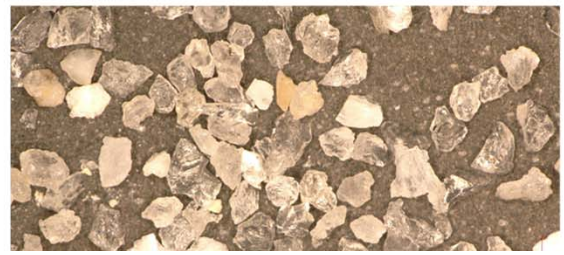
Silica #10 - #16 (20X)

Silica #16 - #20 (20X)

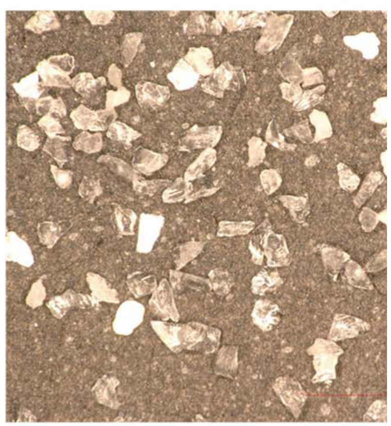
Silica #20 - #40 (50X)



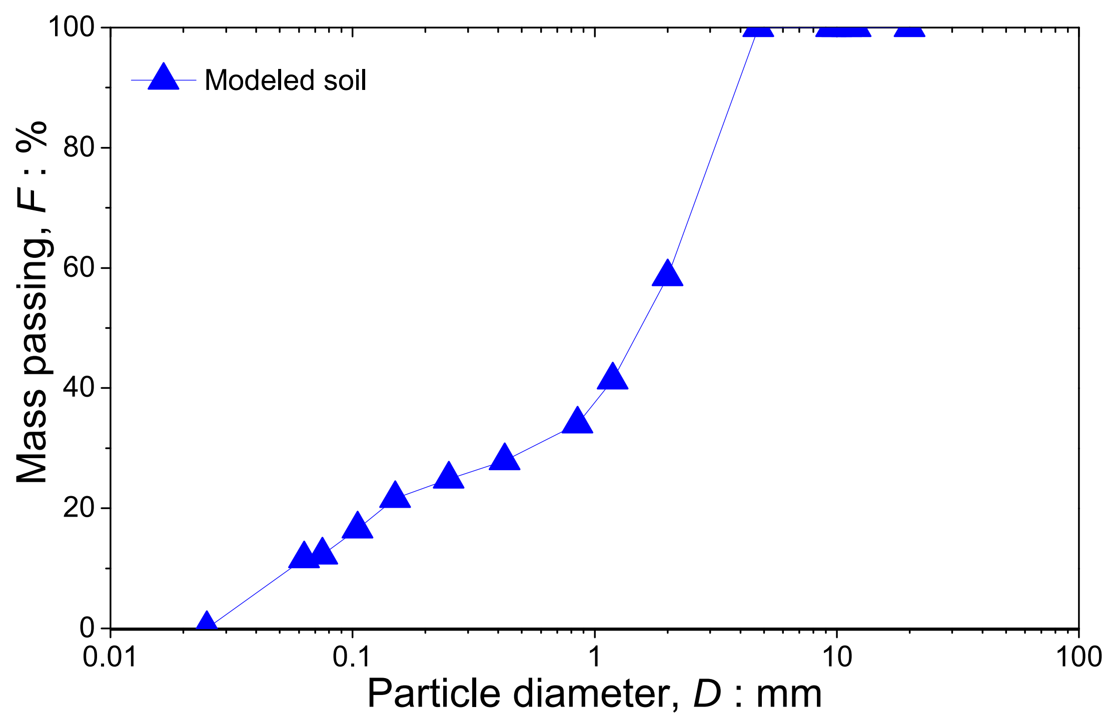
Silica #40 - #60 (100



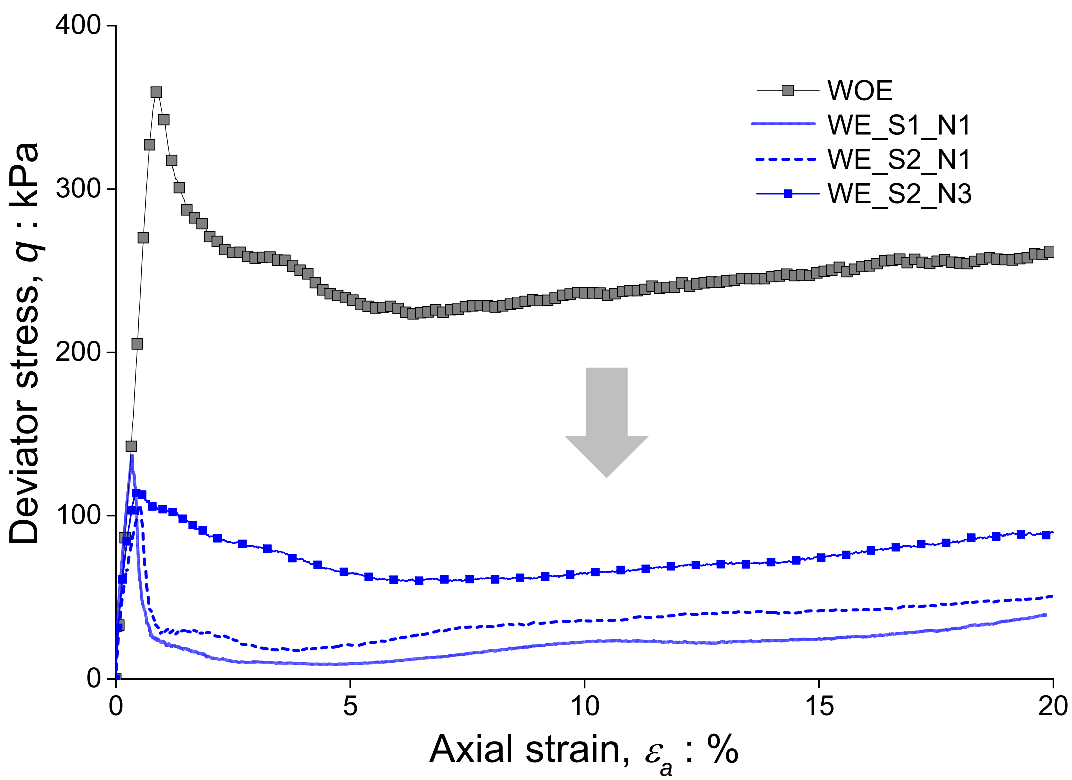
Silica #100 - #140 (100X)

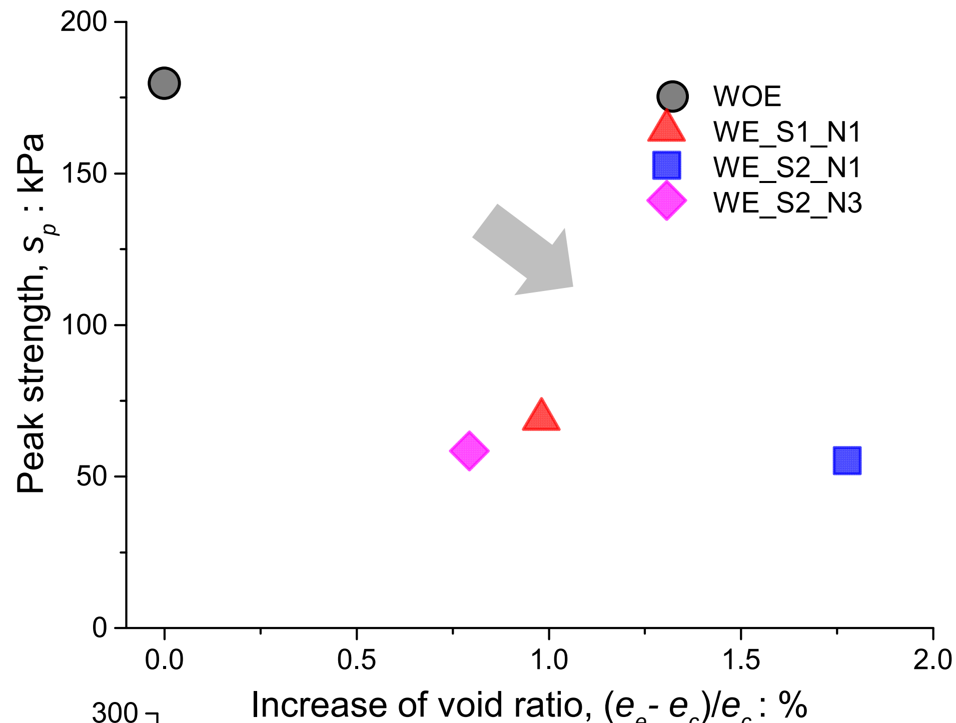


Silica #140 - #200 (15

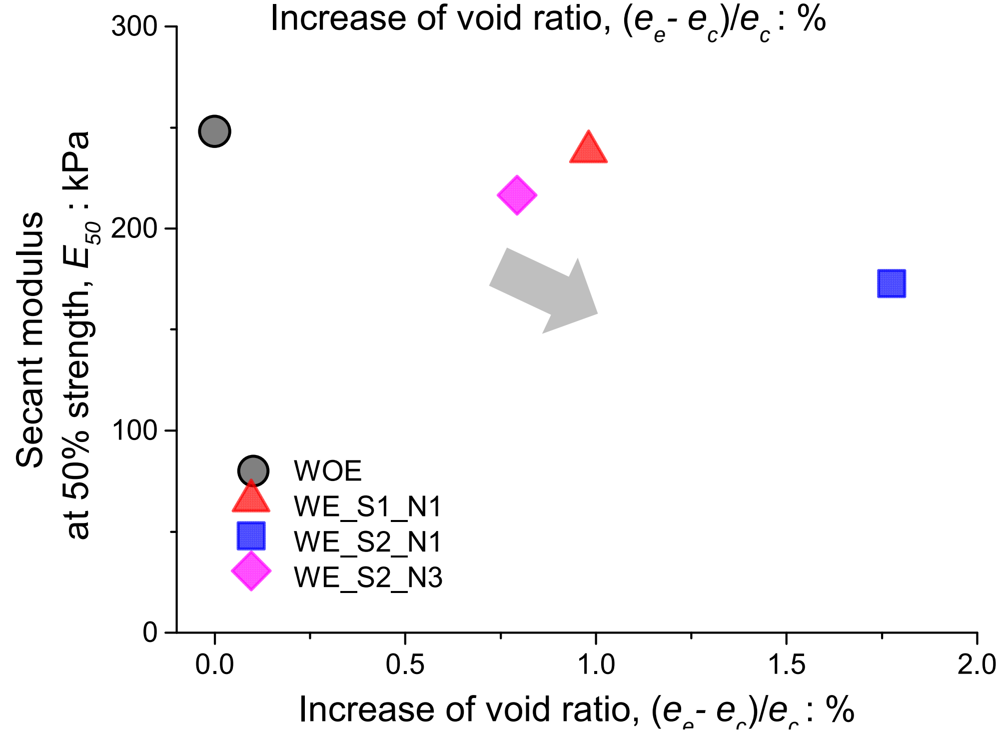


Future work: Well-graded soils





Post-suffusion strength and stiffness significantly decrease even for well-graded soils!!



Thank you for your attention