On the Coagulation Mechanism of Montmorillonite in Dilute Suspensions

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B+Tech Oy

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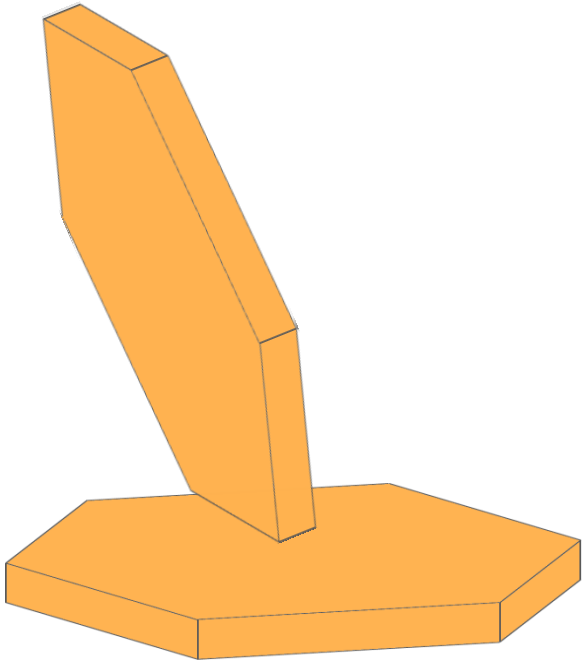
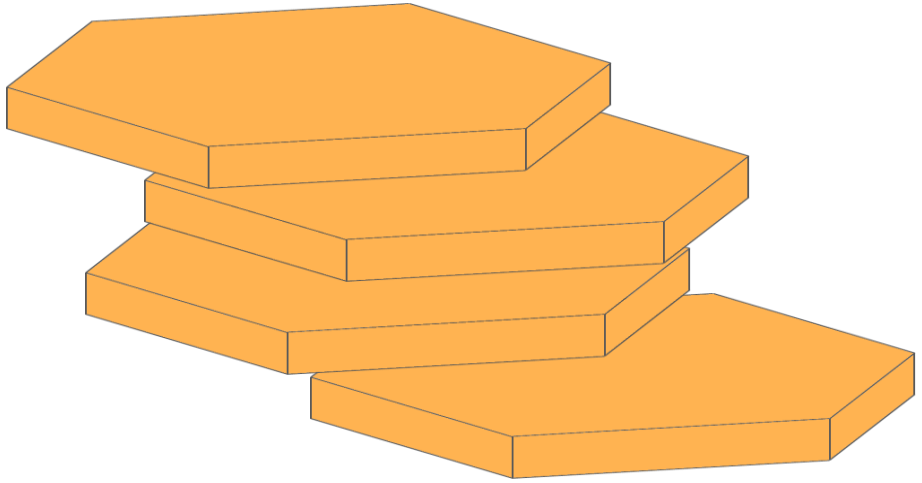
Montmorillonite

Montmorillonite flocculates but how, and why?

Attachment orientation

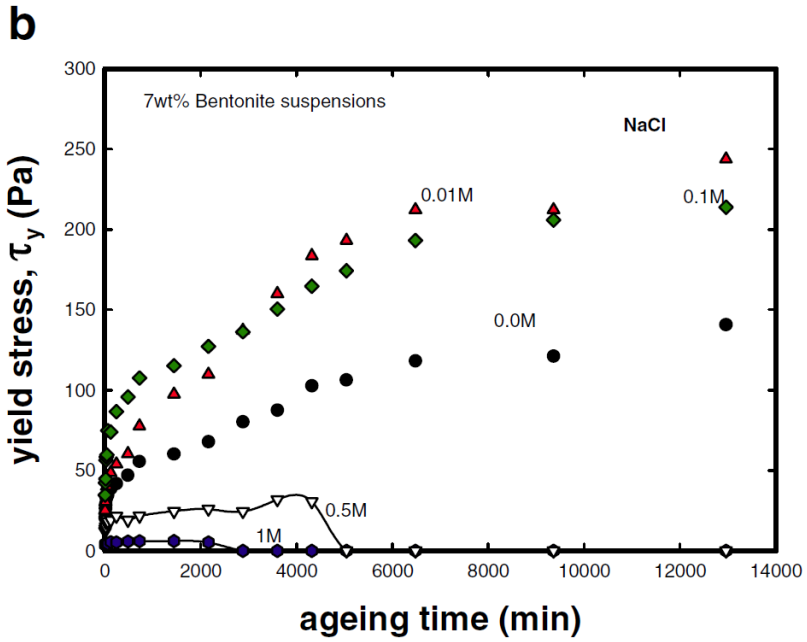


Edge-Face

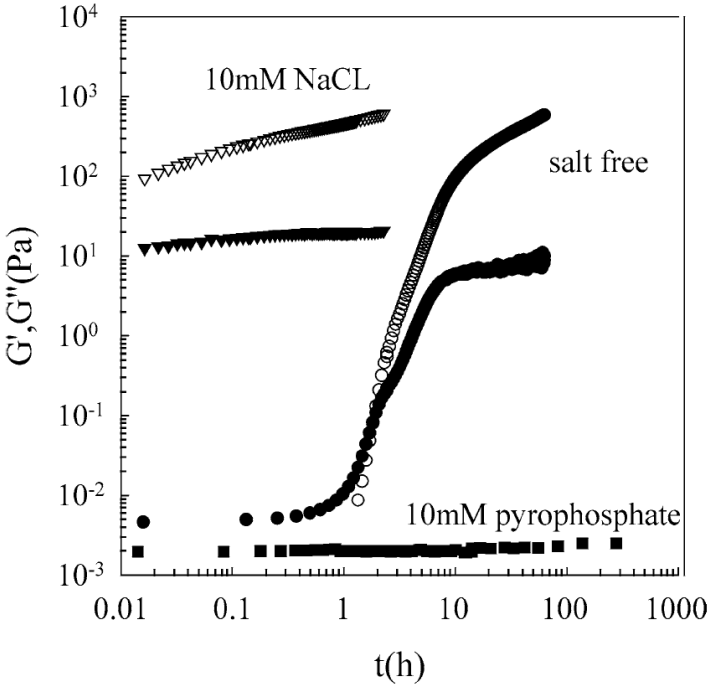


Face-Face

Time dependency



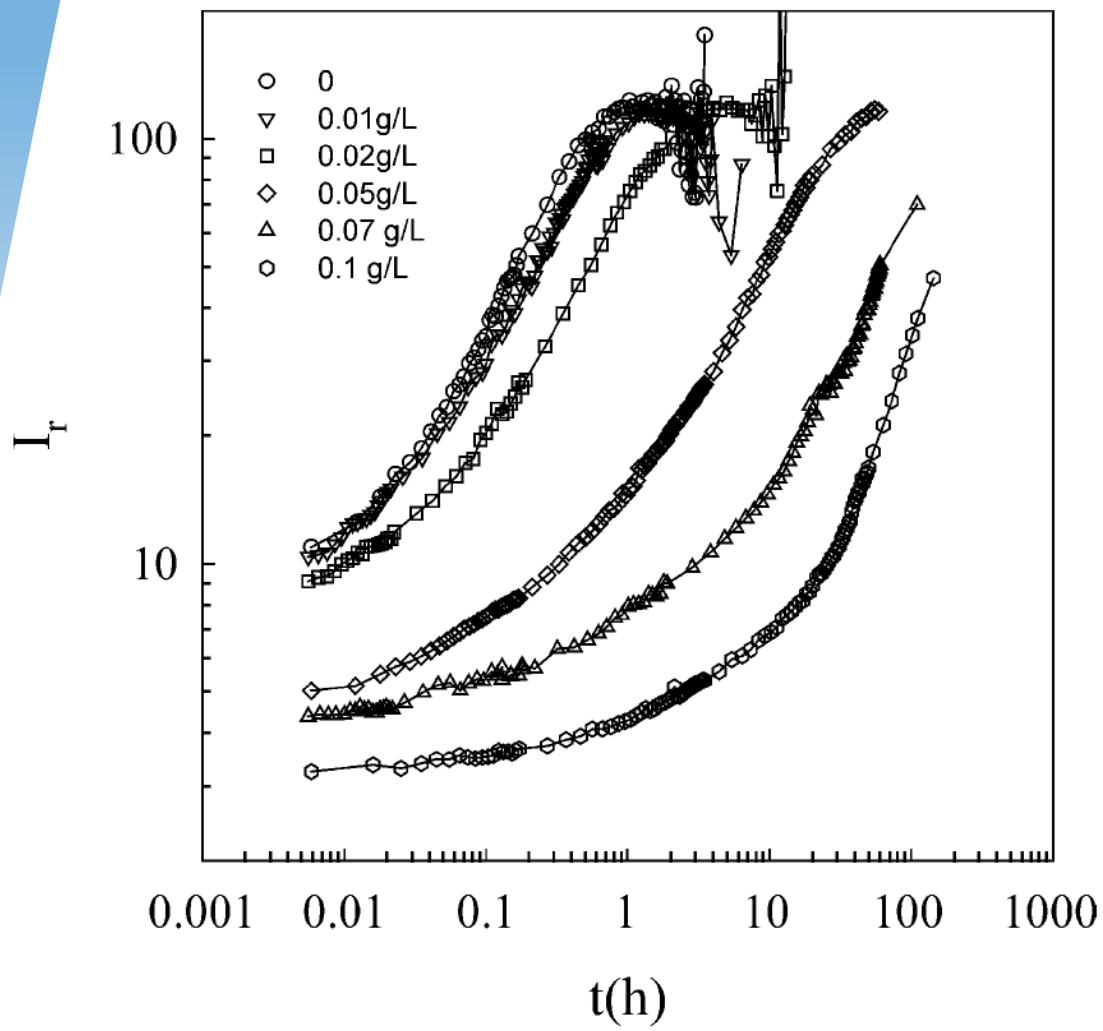
Chang *et al.*, *Rheol. Acta* **2014**, 53, 109.



Mongondry *et al.*, *J. Colloid Interface Sci.* **2004**, 275, 191.

Time-dependency indicates that collision frequency plays a part in montmorillonite coagulation

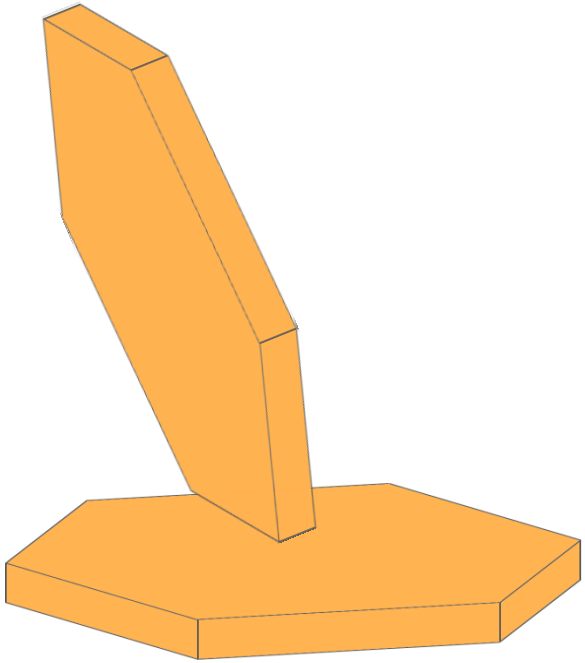
Time dependency

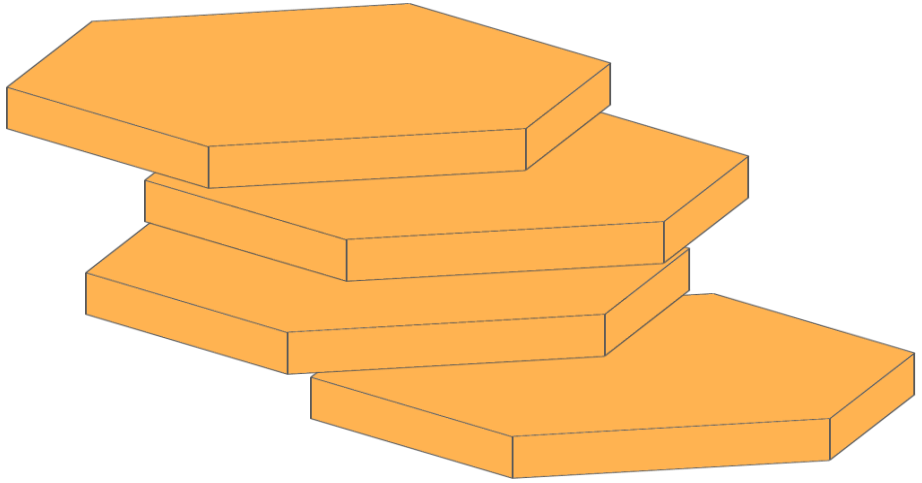


Mongondry *et al.*, *J. Colloid Interface Sci.* **2004**, 275, 191.

Particles size increases over time even with added phosphates

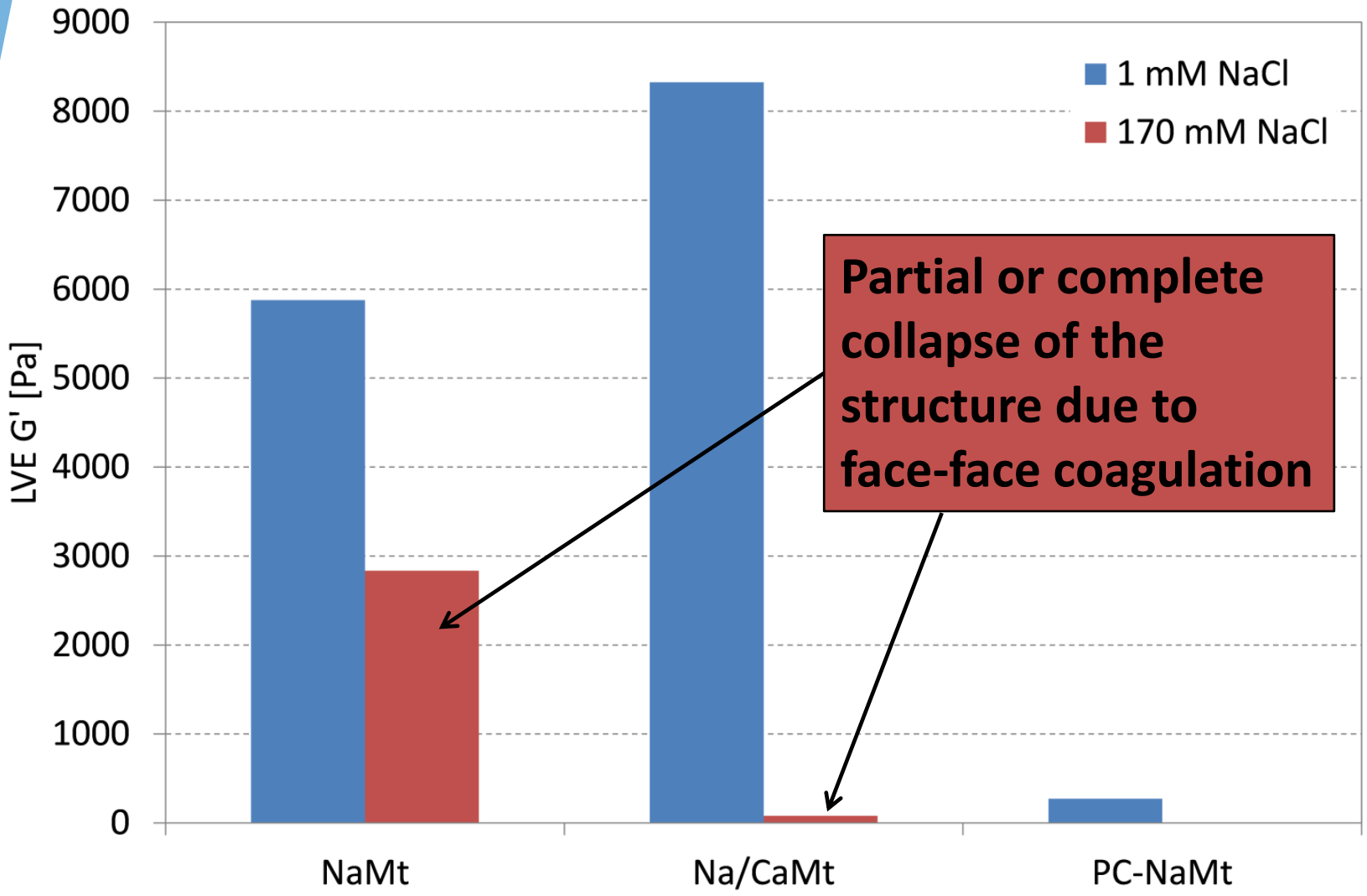
Floc structure



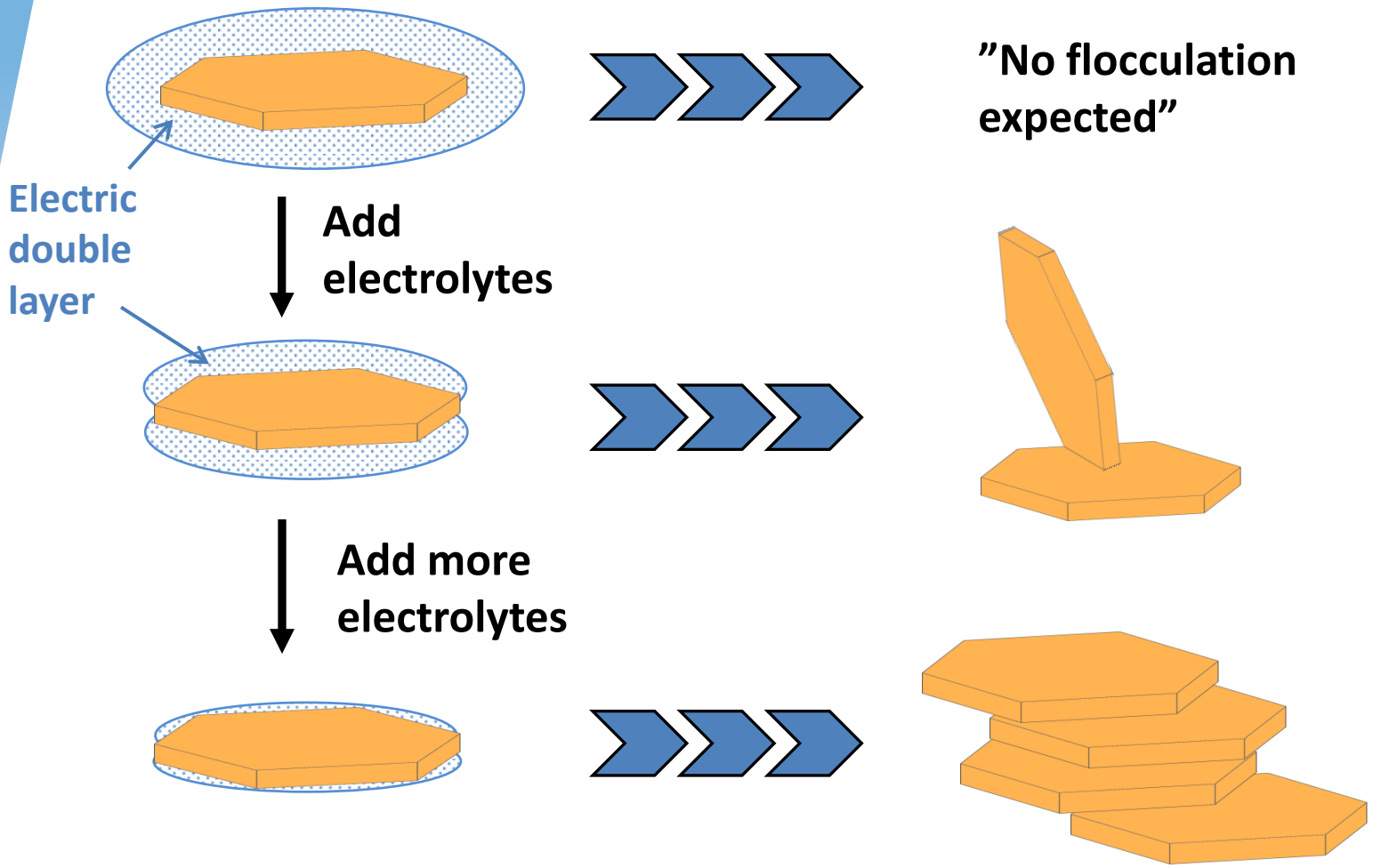


[I, φ]

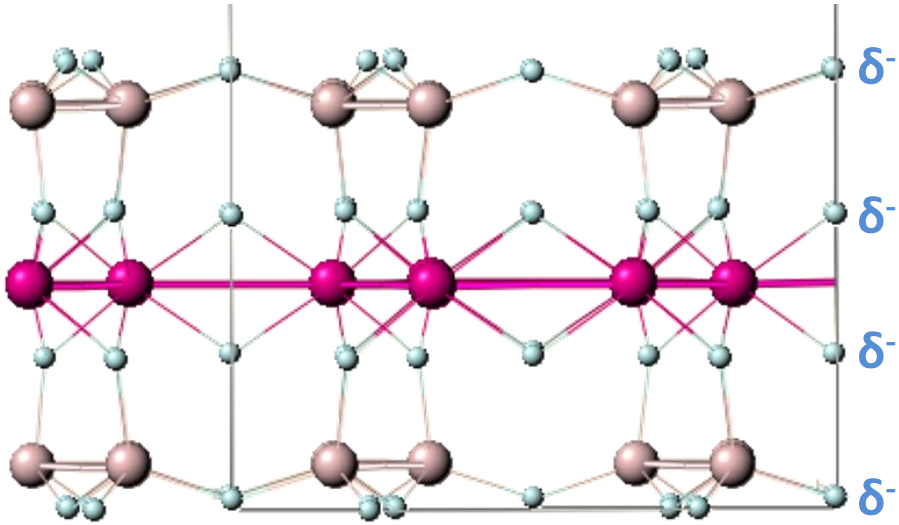
Effect of salt



Electrostatic phenomena

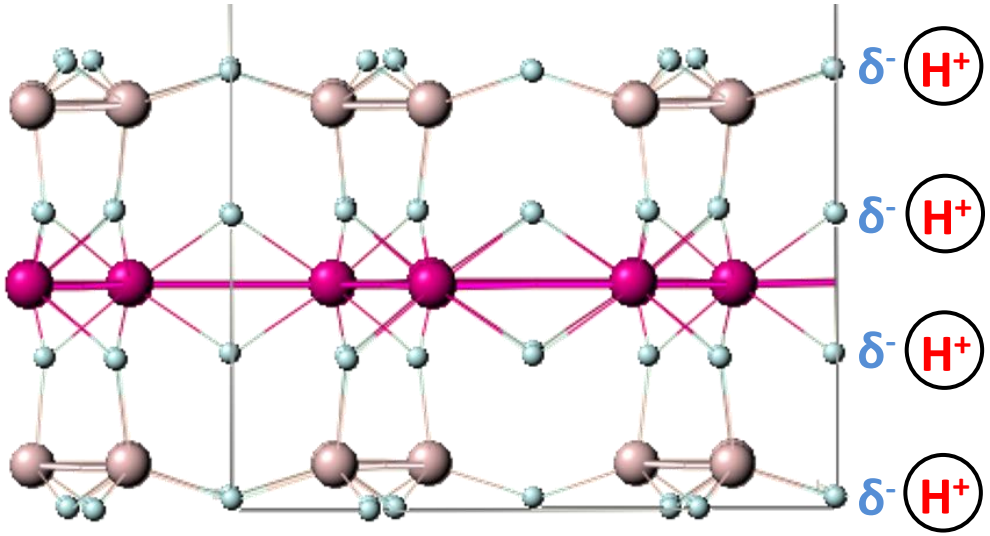


Edge charge



(Modified from *webmineral.com)*

Edge charge



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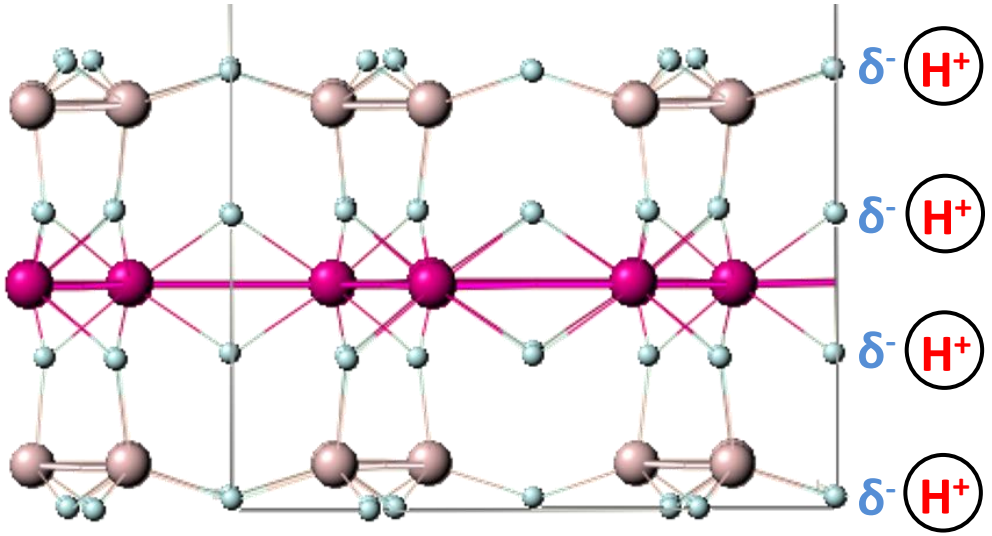
Edge charge



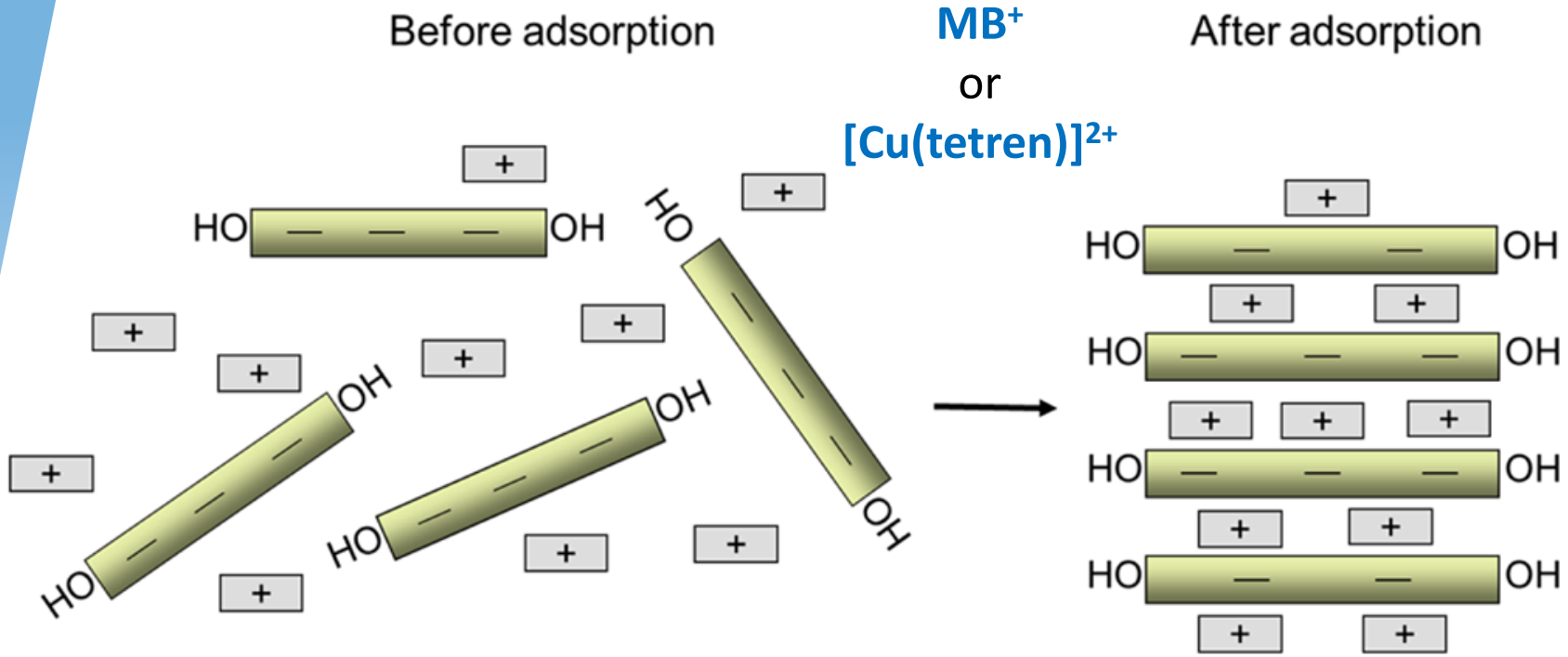
SiO_2 IEP ~2

Al_2O_3 IEP ~8-9

SiO_2 IEP ~2

(Modified from *webmineral.com)*

Edge IEP evaluation

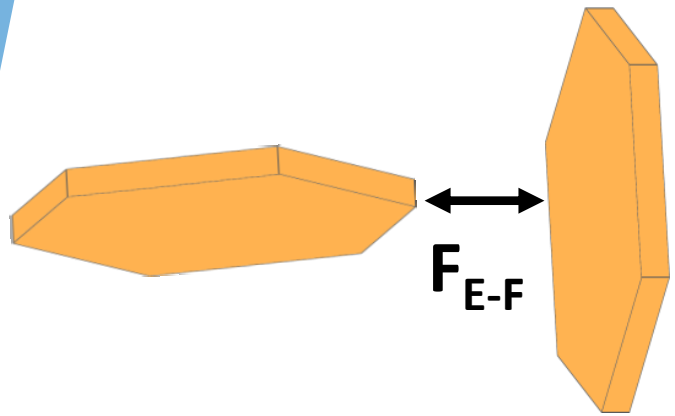


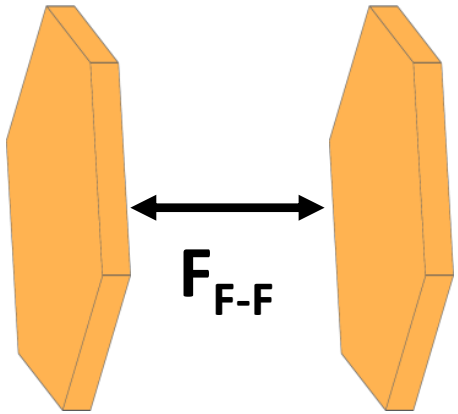
Structural charges are blocked with cations
and the isoelectric point of edges is measured.

IEP_{edge} between 4.0 – 5.3

Pecini *et al.*, *Langmuir,* **2013**, 29, 14926.

Repulsion/attraction





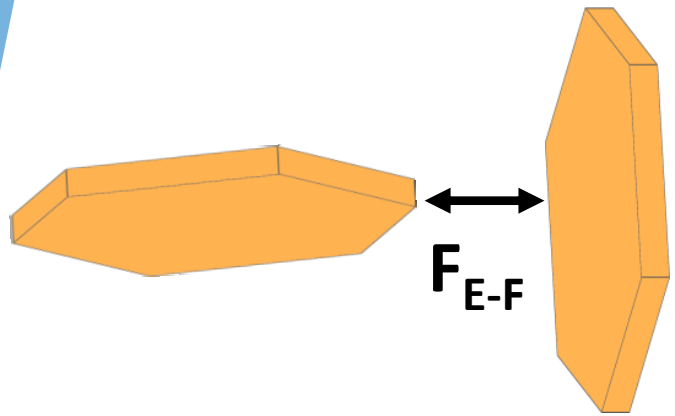
$\sigma_E > 0$	$F_{E-F} < 0$
$\sigma_E \sim 0$	$F_{E-F} \sim 0$
$\sigma_E < 0$	$F_{E-F} > 0$

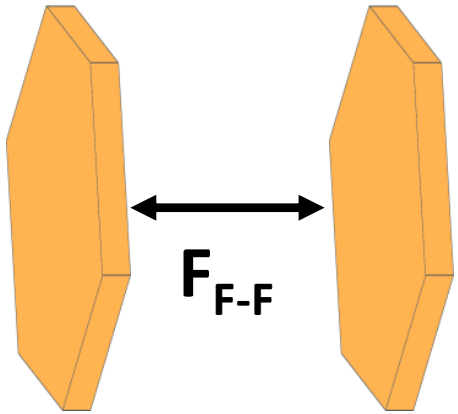
$F_R(A, \psi_0)$ | $A_{E-F} << A_{F-F}$

$\Downarrow$

$F_{E-F} << F_{F-F}$

Repulsion/attraction





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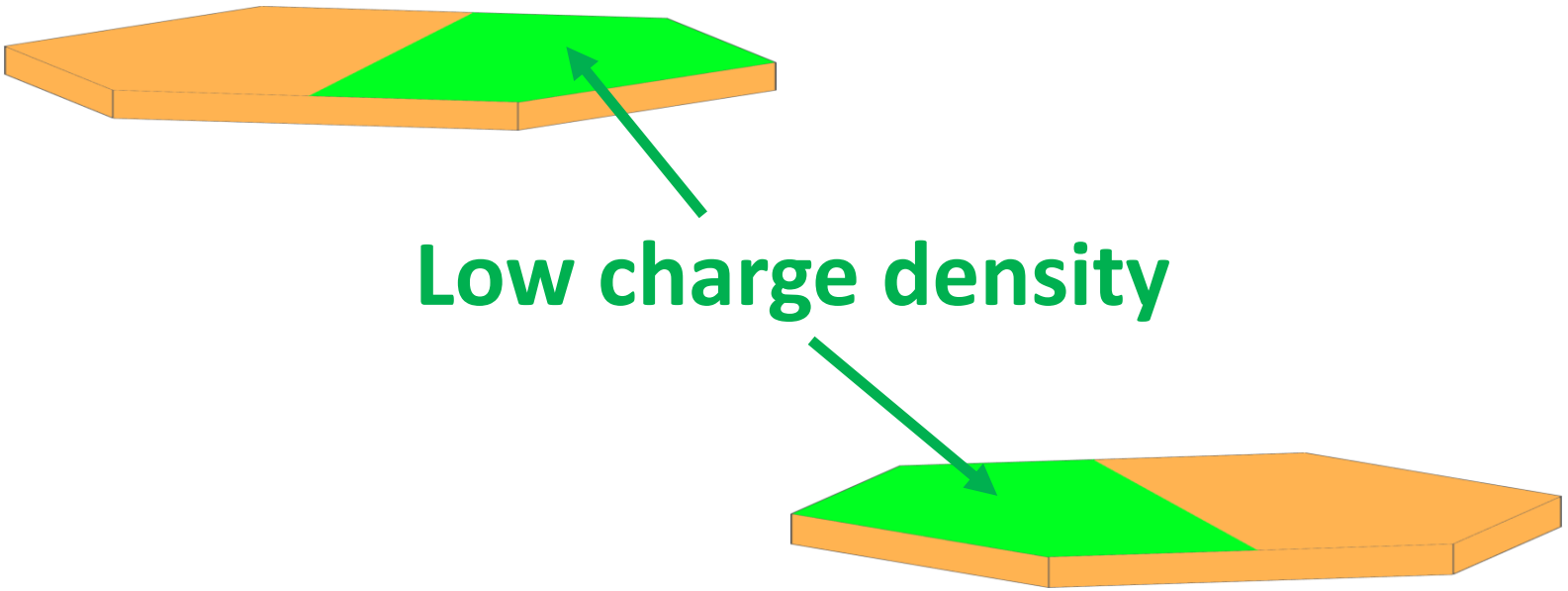
$F_A(A, \psi_0)$ | $A_{E-F} << A_{F-F}$

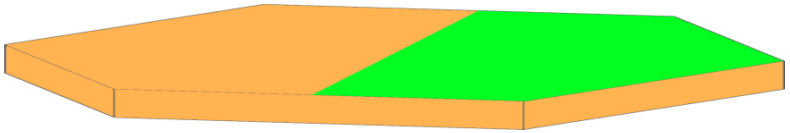
$\Downarrow$

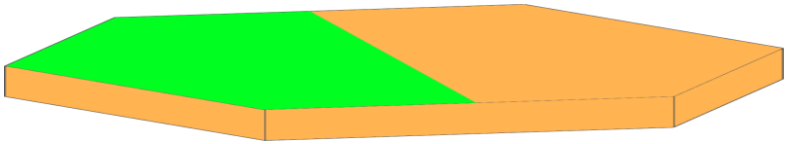
$F_{E-F} << F_{F-F}$

Charge heterogeneity



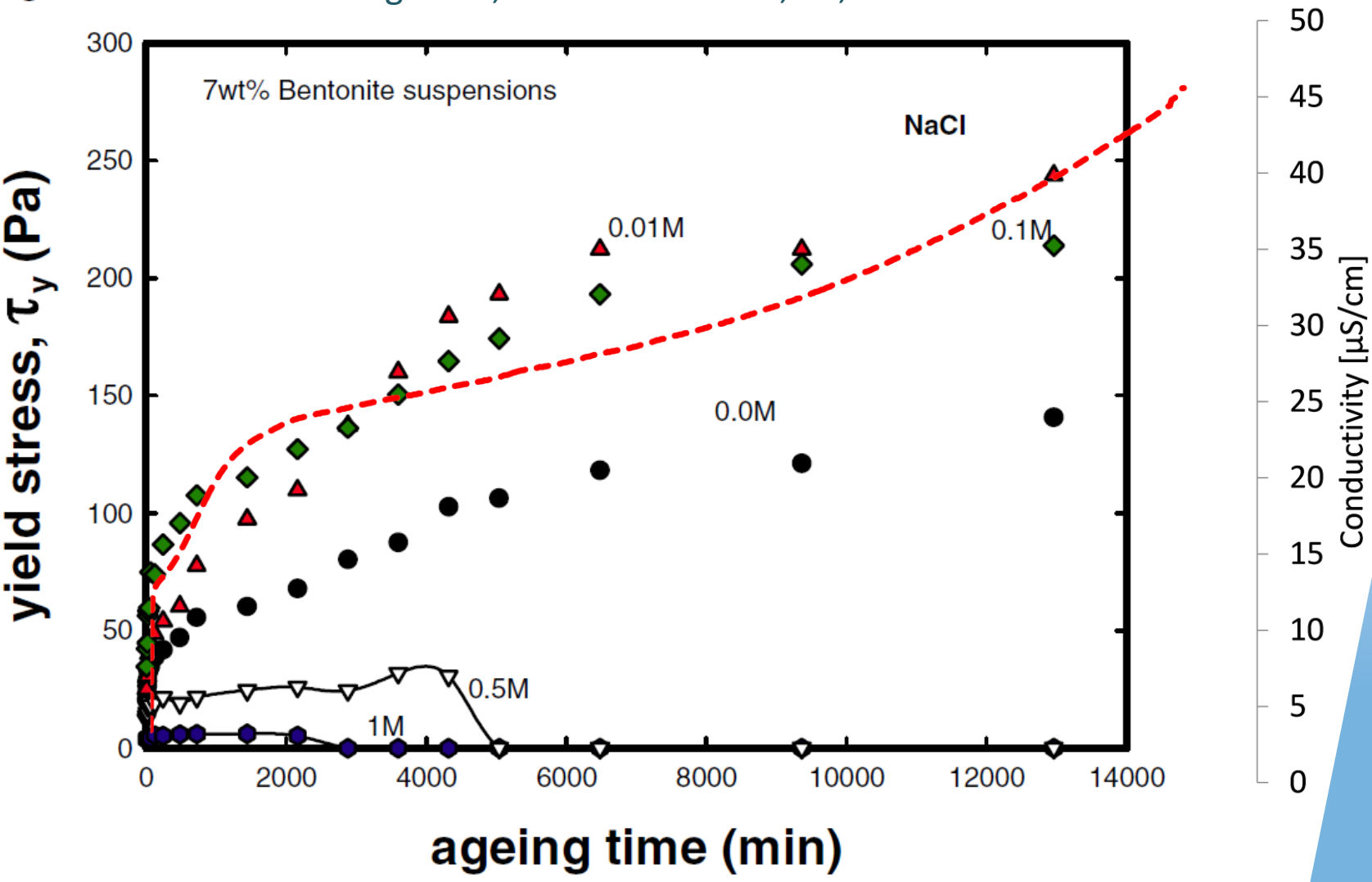
Charge heterogeneity





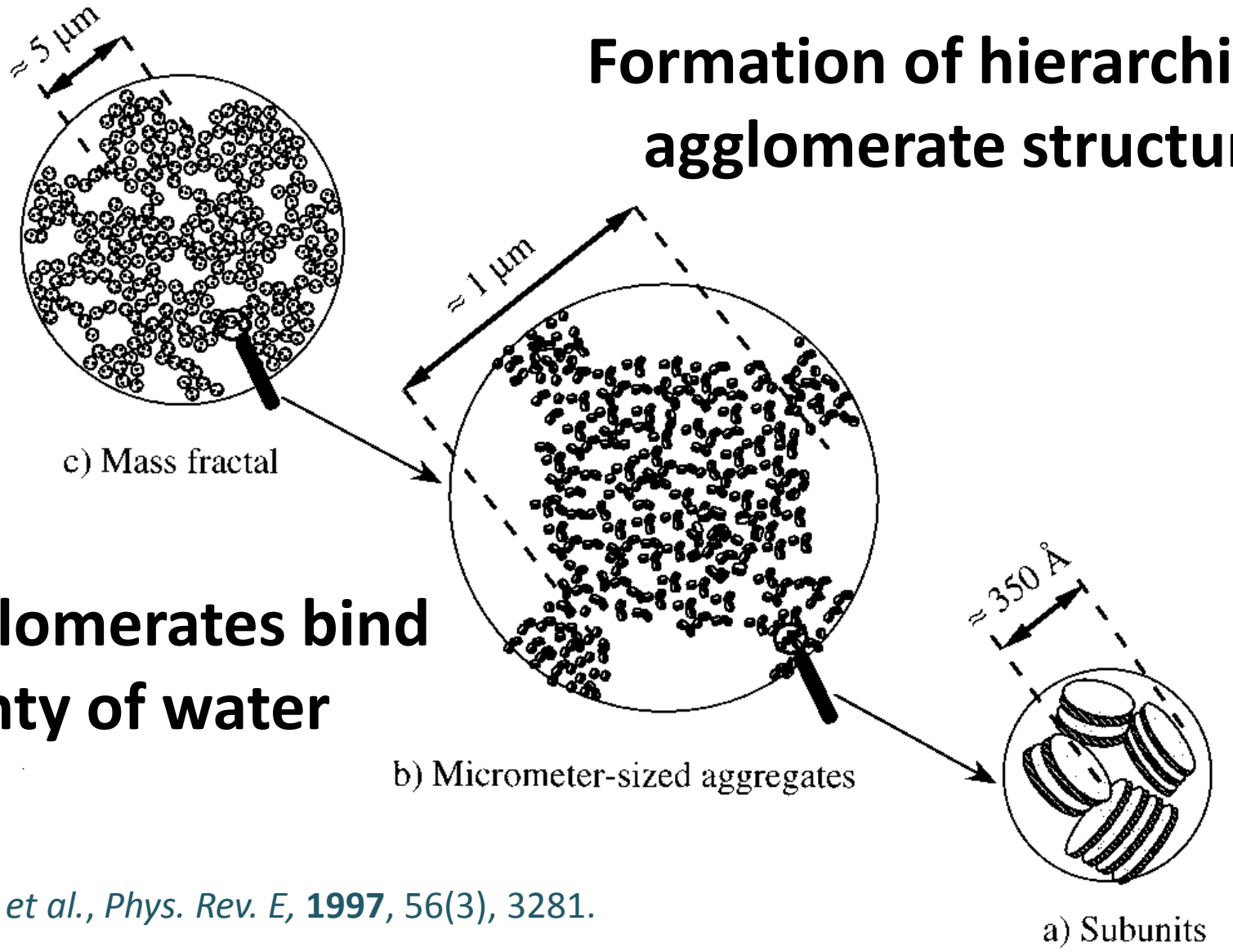
The role of dissolution?

Chang *et al.*, *Rheol. Acta* **2014**, 53, 109.



Macroscopic structure

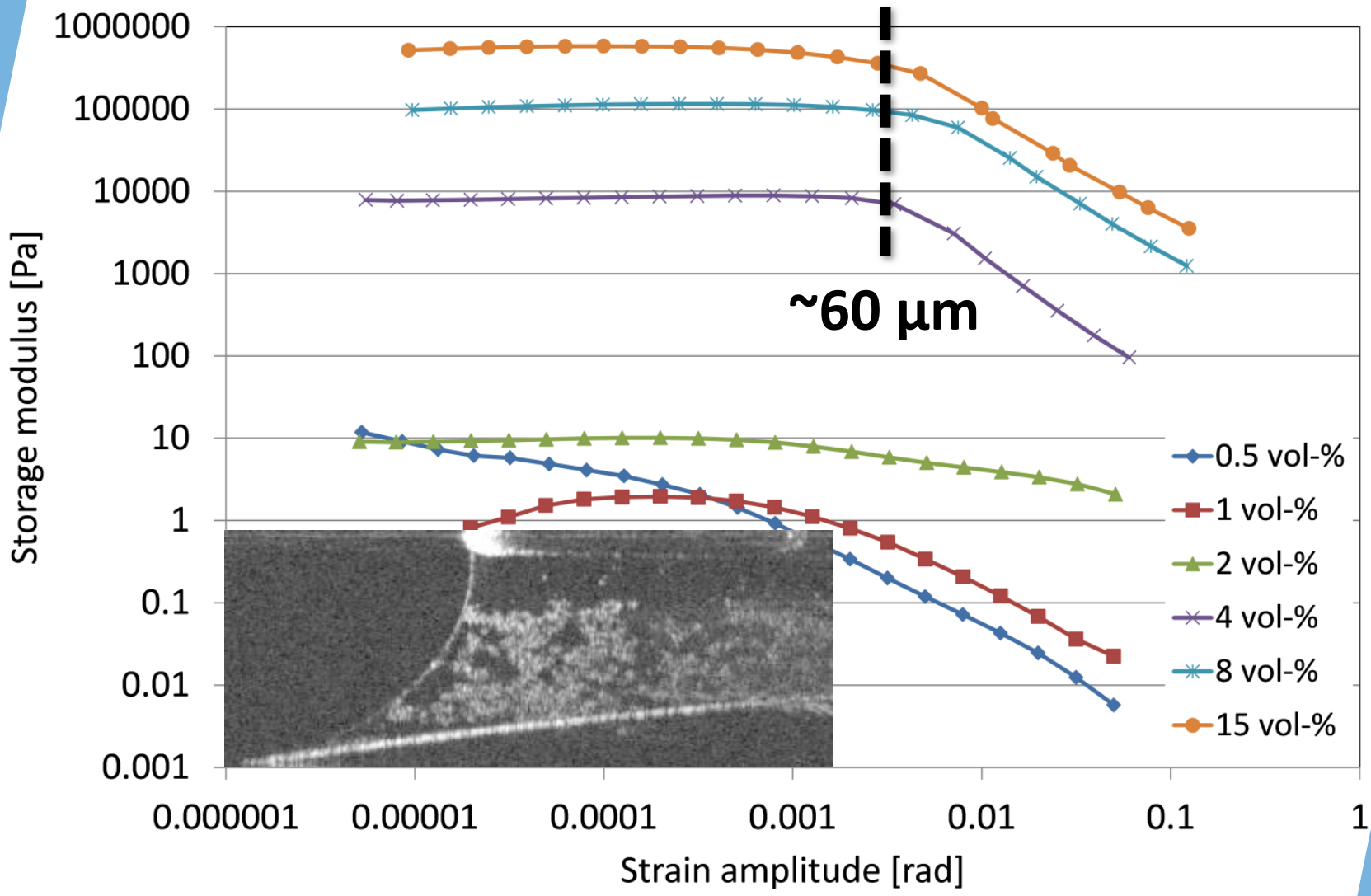
Formation of hierarchical agglomerate structures



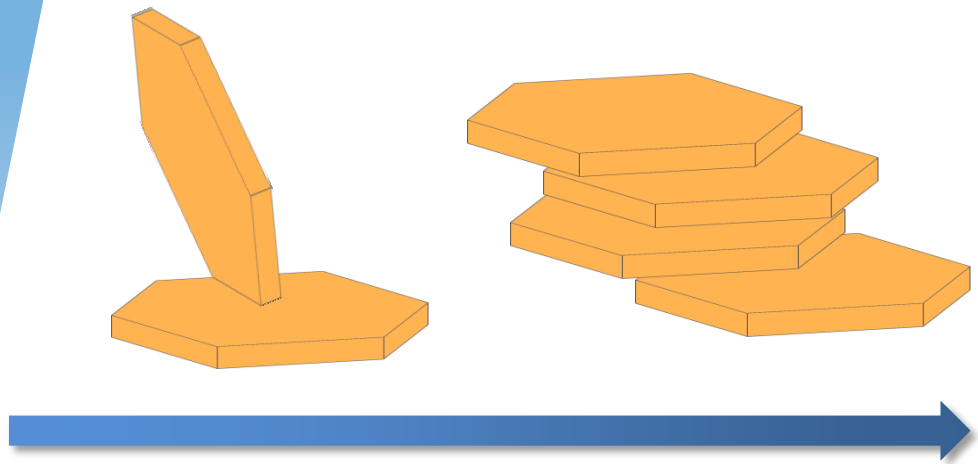
Agglomerates bind plenty of water

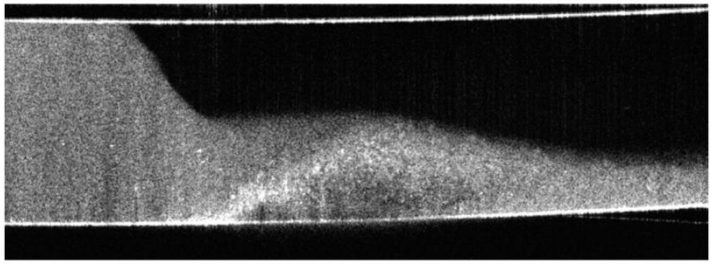
Pignon *et al.*, *Phys. Rev. E,* **1997**, 56(3), 3281.

50/50 Na/Ca-Mt, 1 mM NaCl



Summarizing words





[I, φ]

The tendency of montmorillonite to flocculate is beneficial with regards to the potential hazard that erosive loss of material presents (e.g. radionuclide migration). Artificial fracture tests have demonstrated however, that colloidal material forms in low salinity environments, and that these colloids migrate with the water flow. How far downstream are these colloids likely to travel?