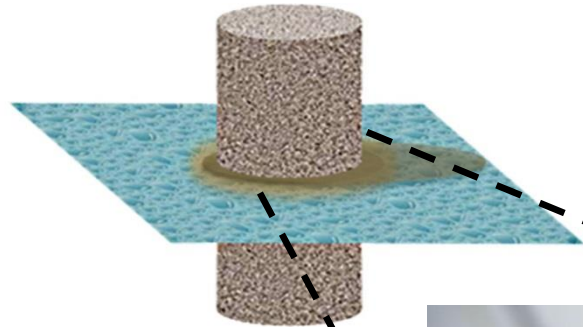


**Detachment of colloids at a
swelling clay-water interface:
*Conclusions based on
rheological measurements***

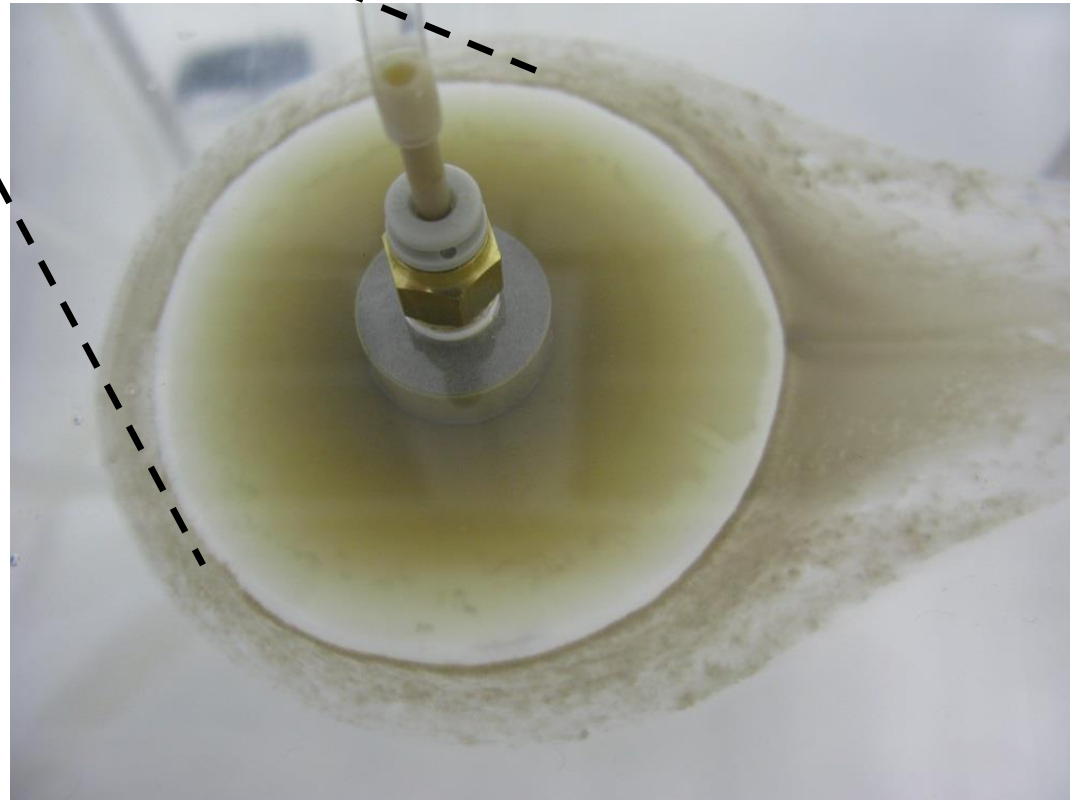
Rasmus Eriksson

B+Tech Oy

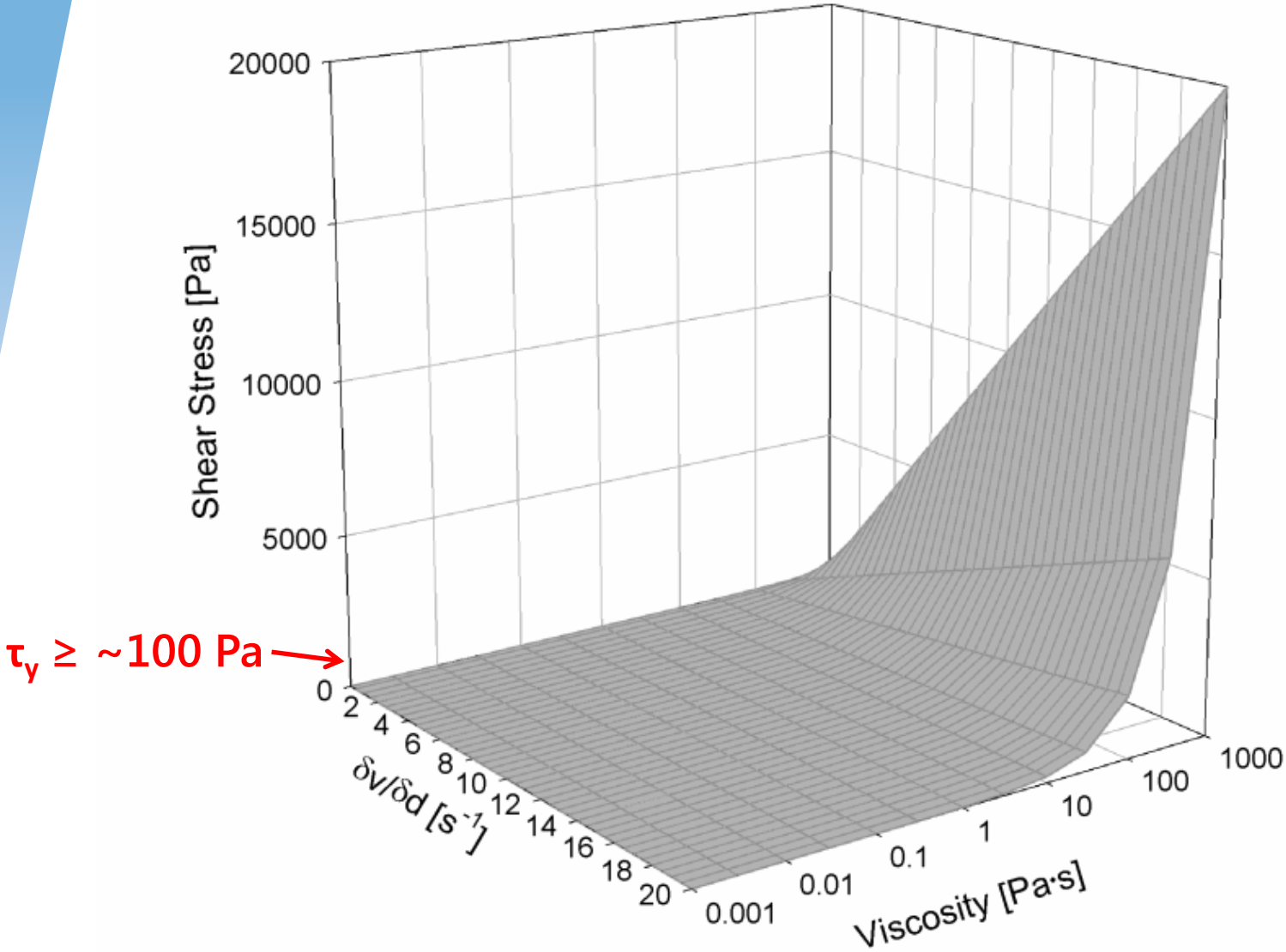
Background



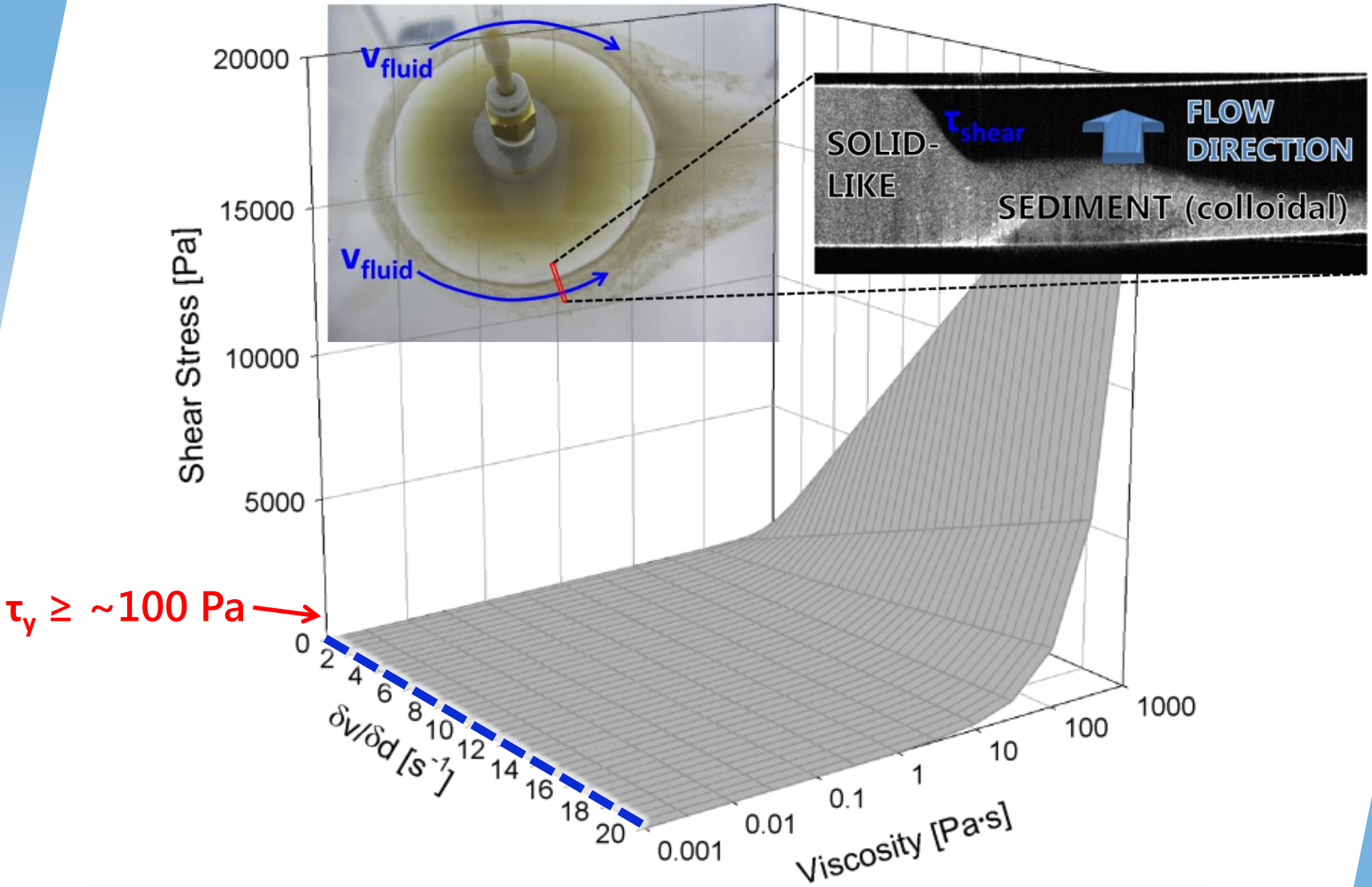
**Detachment
mechanism?**



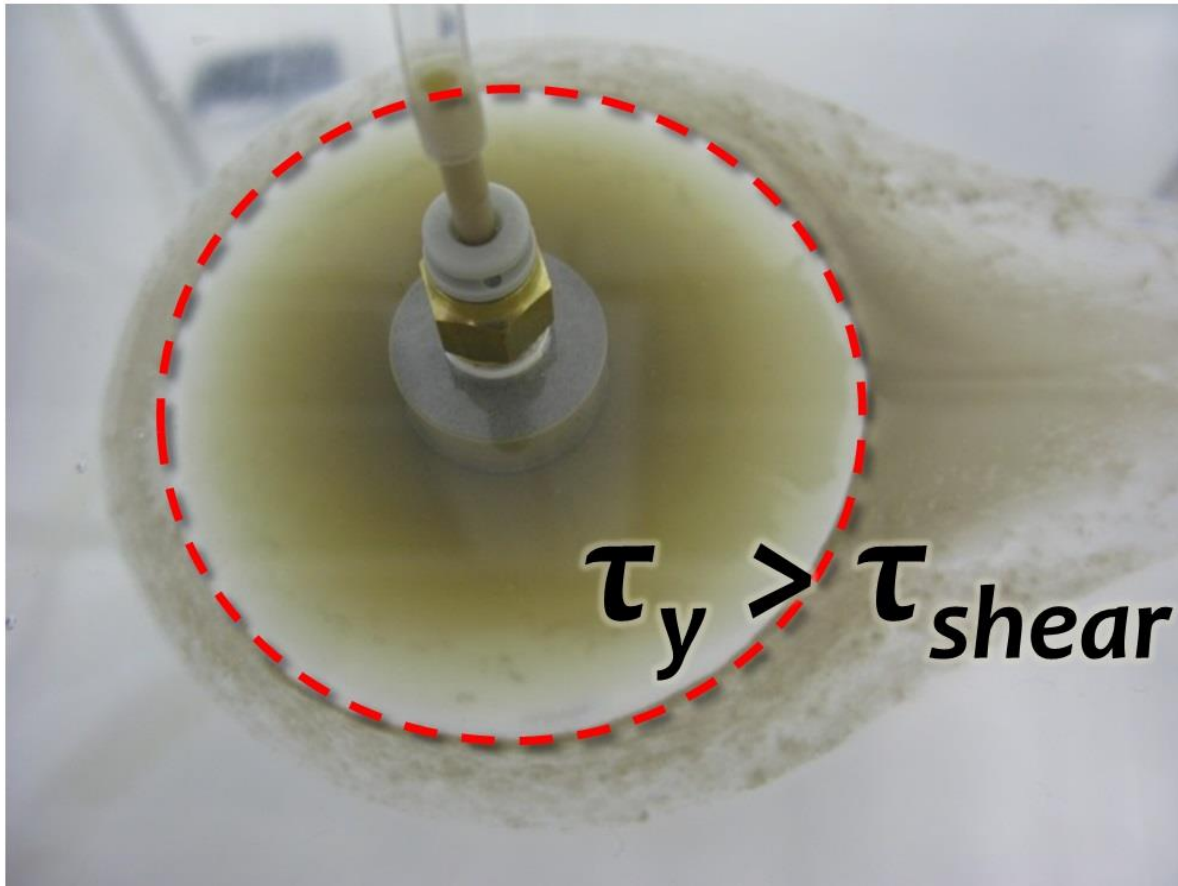
Shear stress



Shear stress



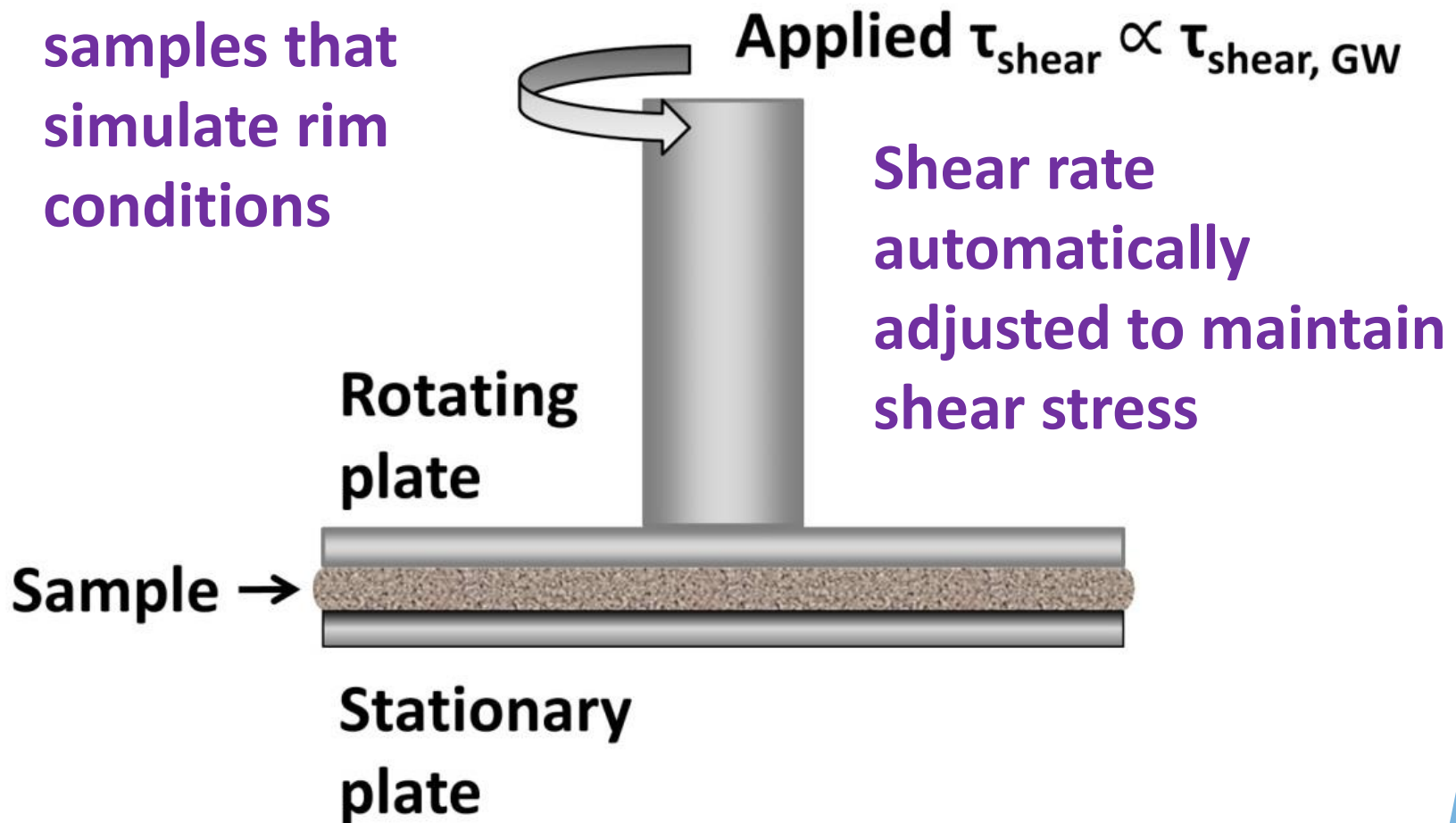
Shear stress



Effect of prolonged small shear stress?

Future experiment?

Prepare samples that simulate rim conditions



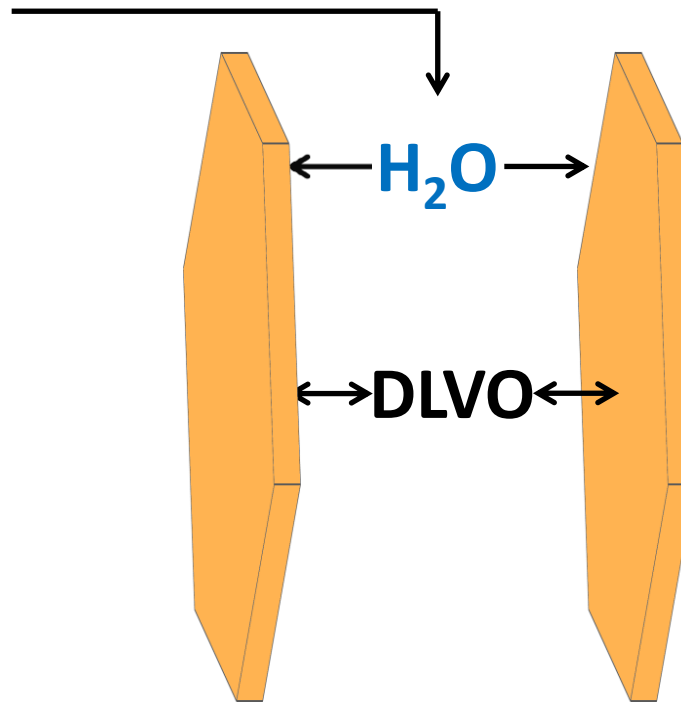
Could be utilized to study mechanical erosion (e.g. piping) on a wider scale

Swelling mechanism

Assumption: *chemical forces induce detachment*

~~Brownian motion (too weak to overcome adhesion)~~

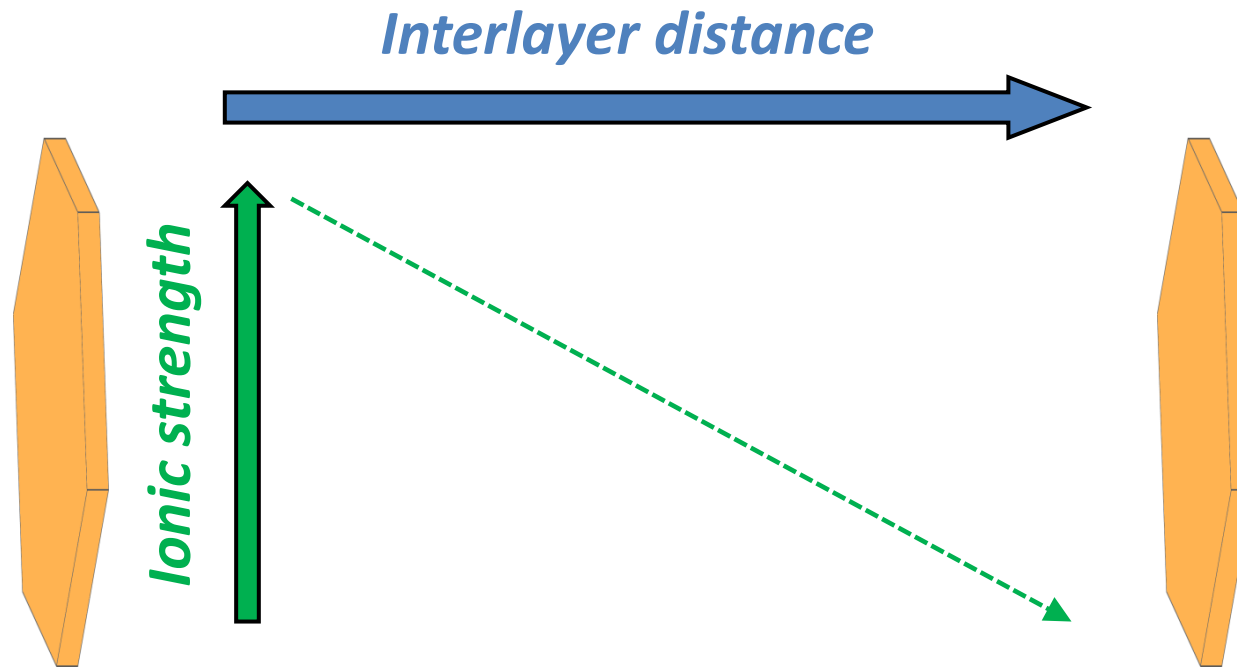
Osmosis



Swelling

Interaction energy as a function of interlayer distance:

- Assume constant number of (counter)-ions
- $\Psi_0 = -100$ mV, $A_H = 2 \cdot 10^{-20}$ J



Results

1 nm (3 M)	→	Φ : <i>Negative (Attraction)</i> Slope: <i>Negative (strong repulsion)</i>
2 nm (1.5 M)	→	Φ : <i>Negative (Attraction)</i> Slope: <i>Positive (Attraction)</i>
5 nm (0.6 M)	→	Φ : <i>Negative (Attraction)</i> Slope: <i>Positive (Attraction)</i>
10 nm (0.3 M)	→	Φ : <i>Negative (Attraction)</i> Slope: <i>Positive (Weak attraction)</i>
50 nm (0.06 M)	→	Φ : <i>Negative (Attraction)</i> Slope: <i>Positive (Negligible attraction)</i>

↑
Less than one kT

Conclusions

Particle detachment mechanism	Osmotic swelling (balance of forces: osmotic pressure / particle interactions / GW flow (velocity) / Brownian motion)
Groundwater chemistry / Clay – groundwater interactions	<p>Increased ionic strength (of GW) → reduced osmotic driving force / flocculation due to compressed double layers</p> <p>Porewater composition largely depends on pore model (single vs. multi)</p>
Groundwater velocity	Should have limited to no effect within expected range of velocities