What material properties will govern the fault mechanical behaviour?

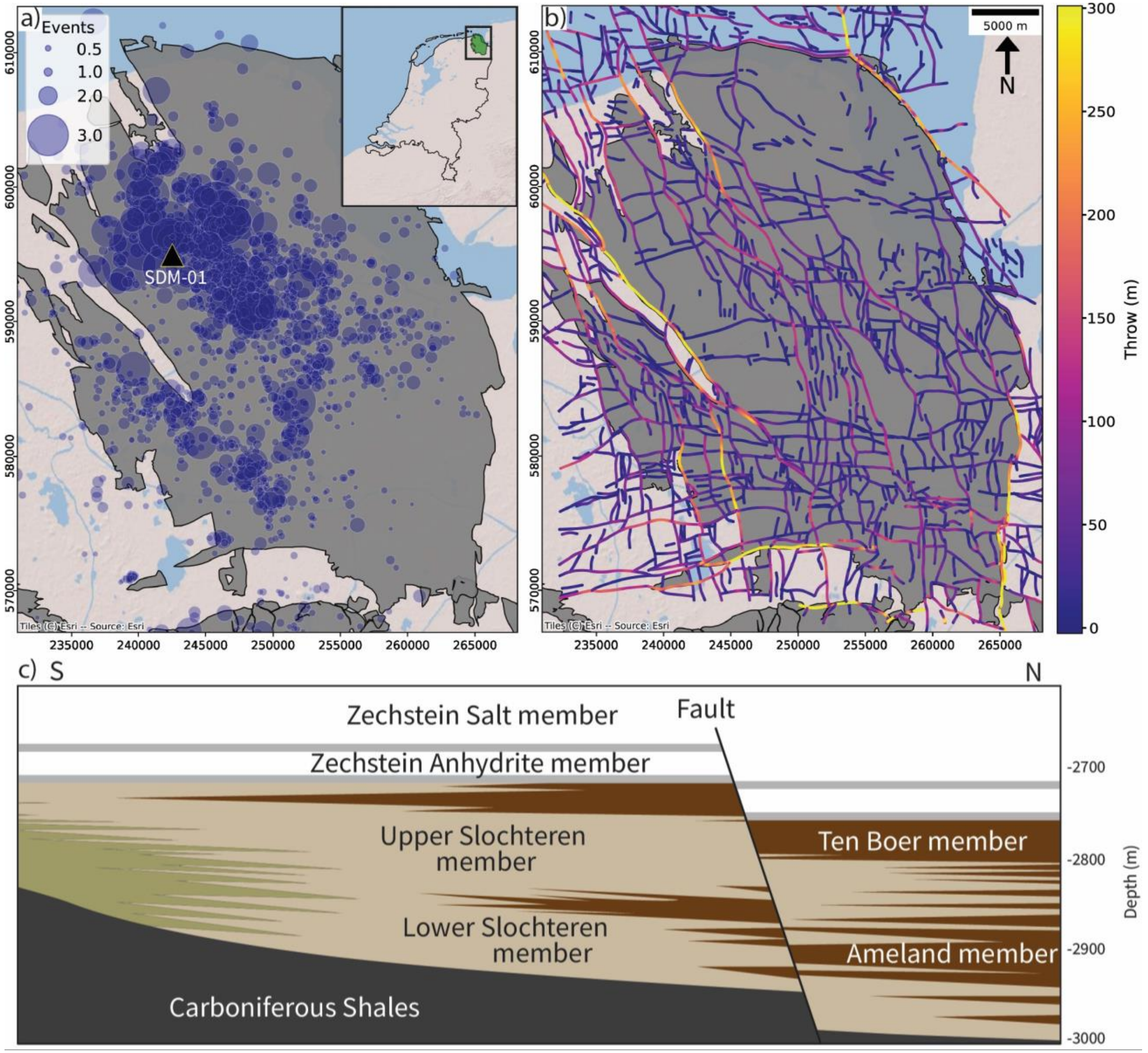
A) The weakest lithology

B) The strongest lithology

C) A homogeneous mixture

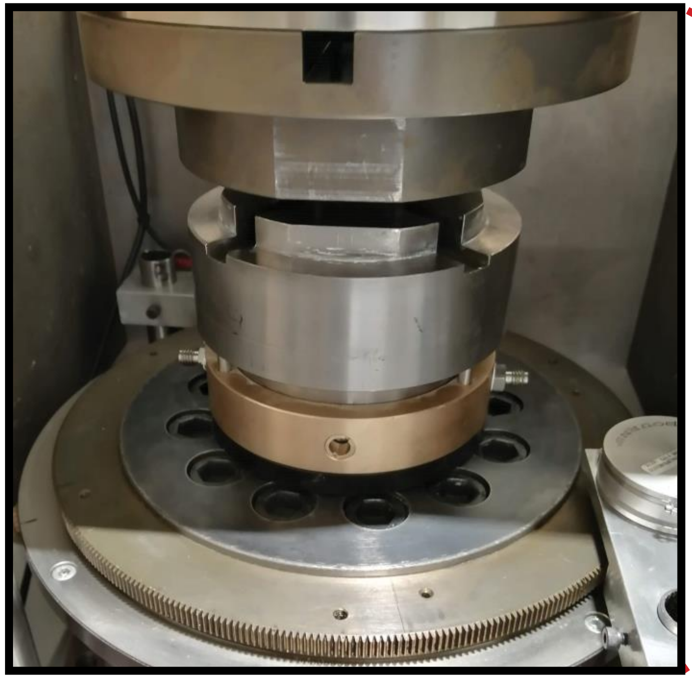
D) None of the above

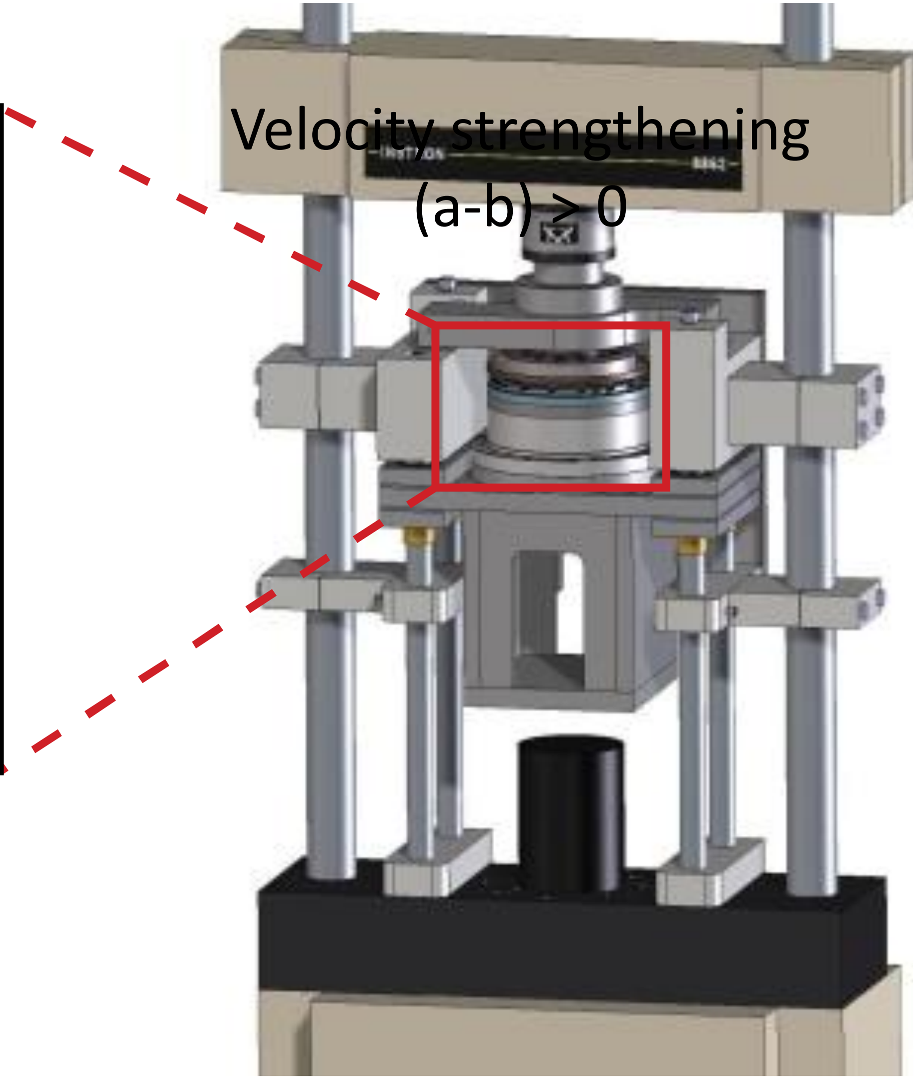
Geological and societal context



	Sandstone	Claystone
Quartz (%)	67	48
Feldspar (%)	19	7
Phyllosilicates	3	39
Other (%)	11	6

Experimental setup and procedure

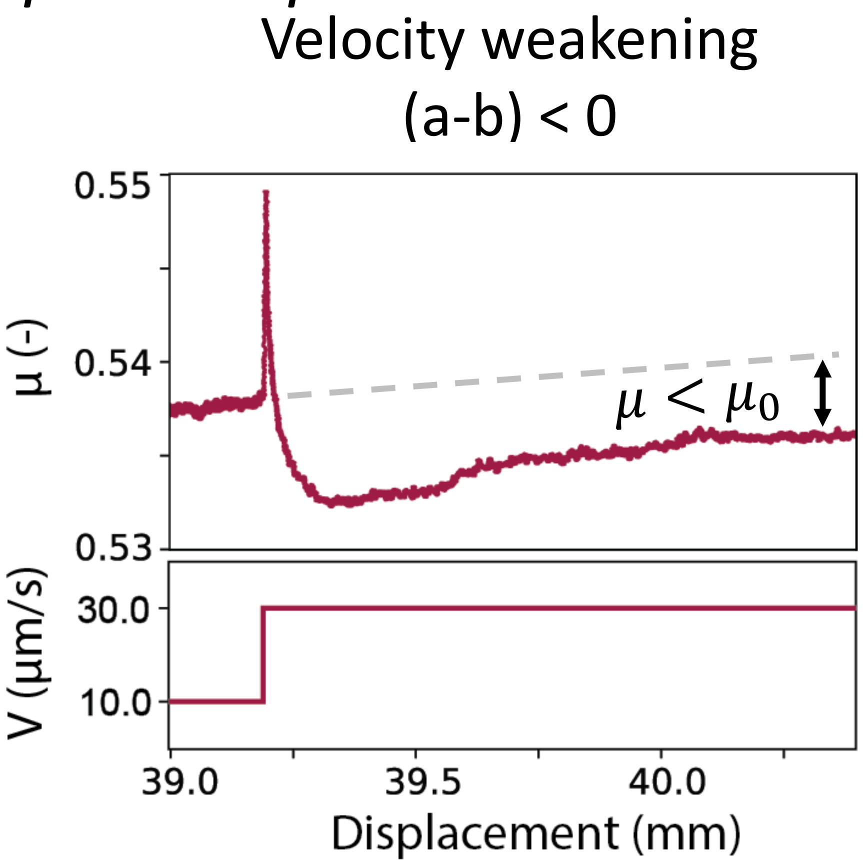


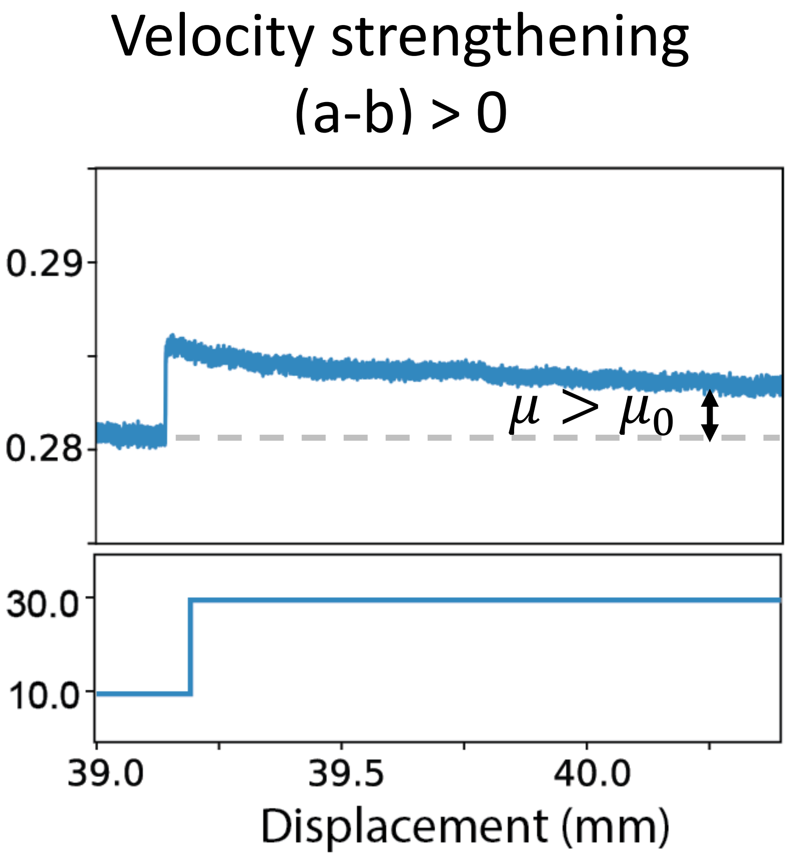


- Rotary shear configuration
- Normal stress σ_n= 5 MPa
- Velocity stepping sequence:

  10-30-100-300-1000-300-100-30-10 μm/s

Experimental setup and procedure





- Rotary shear configuration
- Normal stress σ_n= 5 MPa
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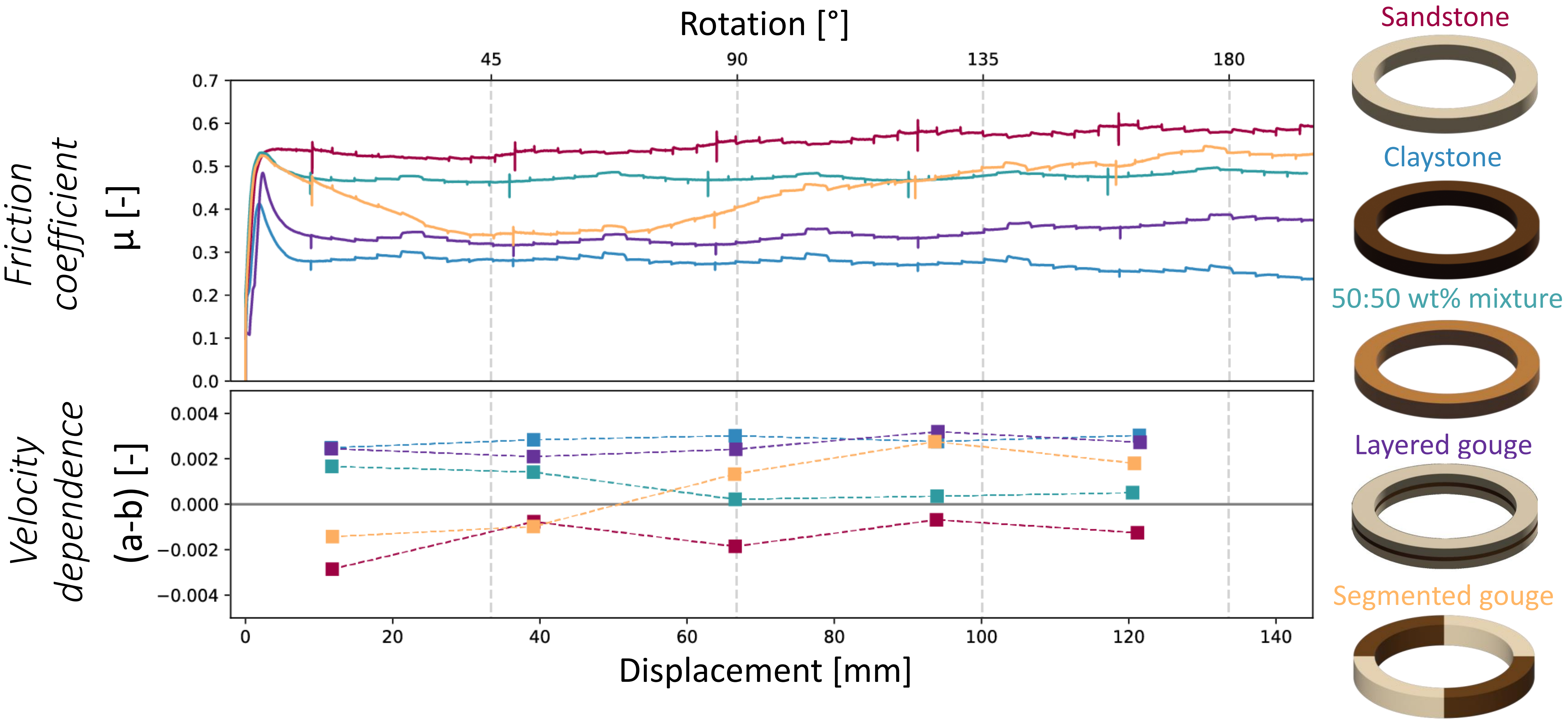
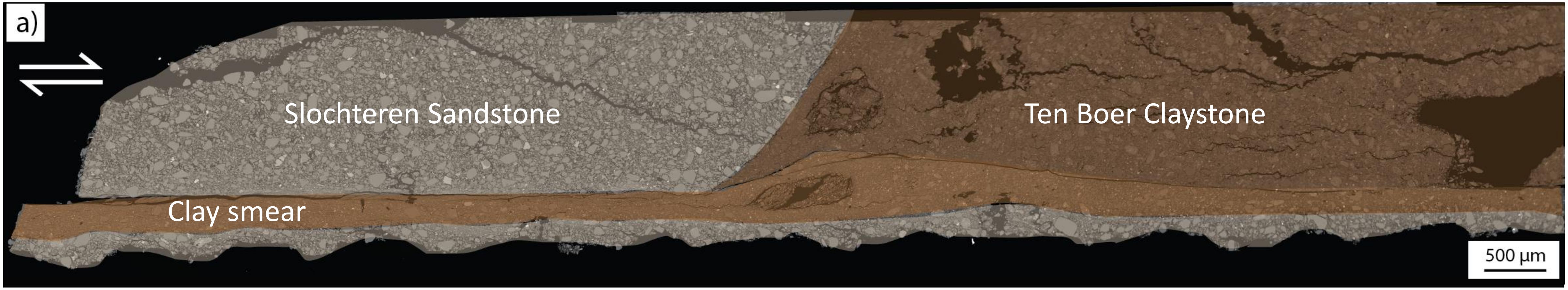
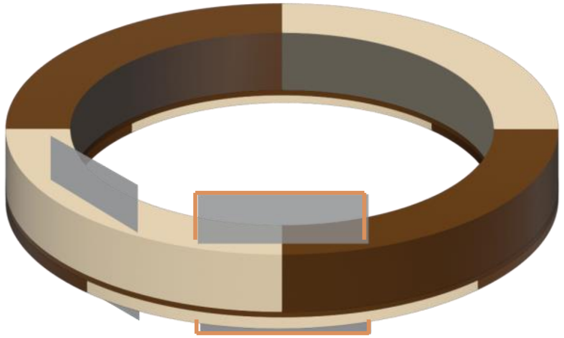
  10-30-100-300-1000-300-100-30-10 μm/s

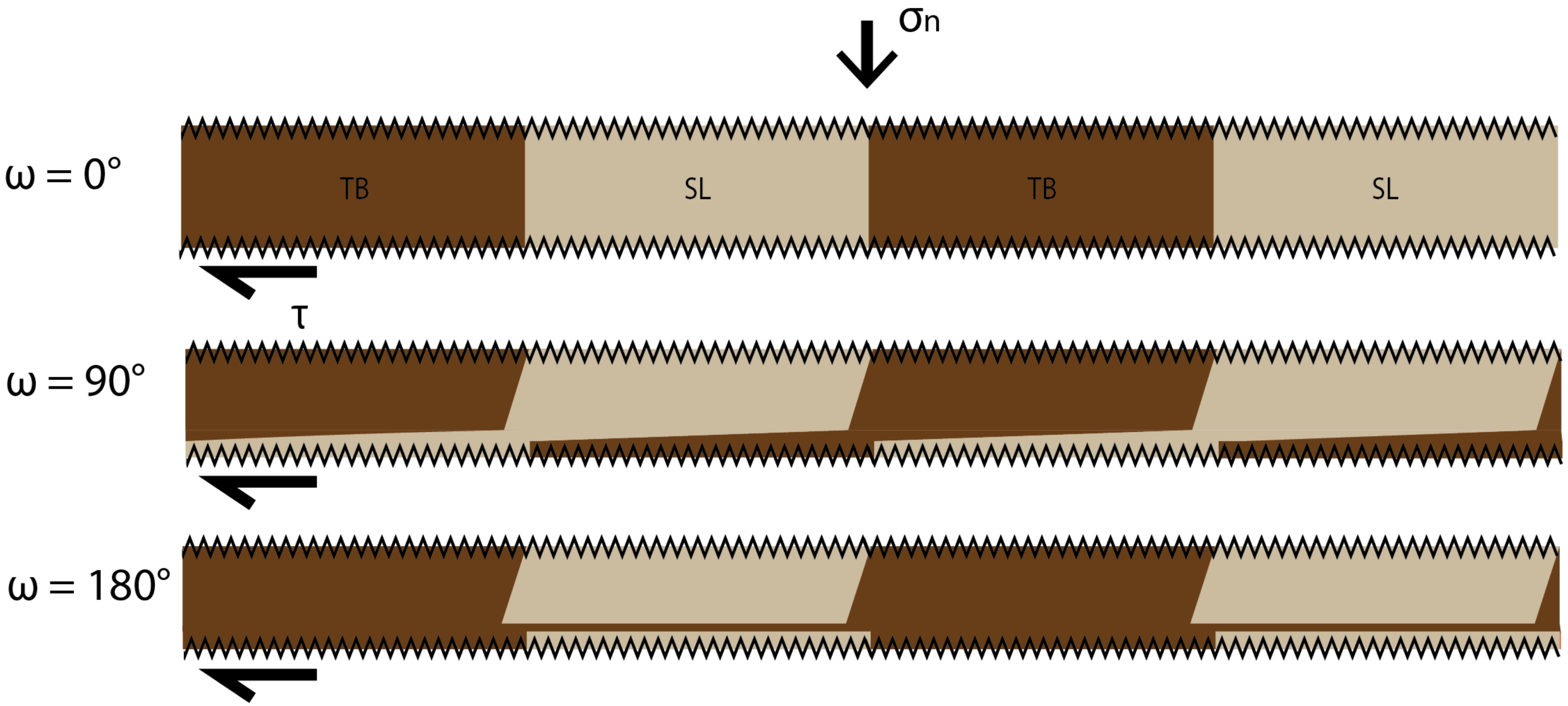


- Evolution friction coefficient
- Evolution velocity dependence

Microstructural evolution

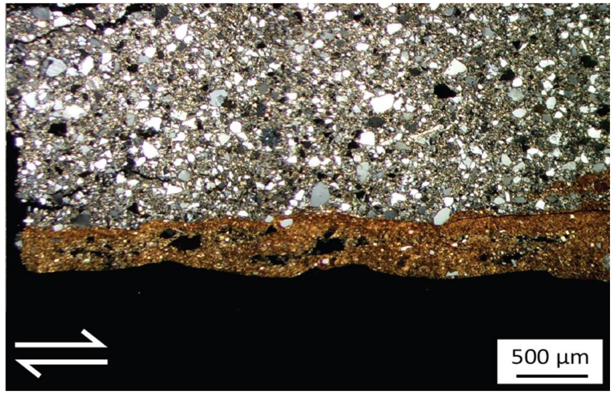






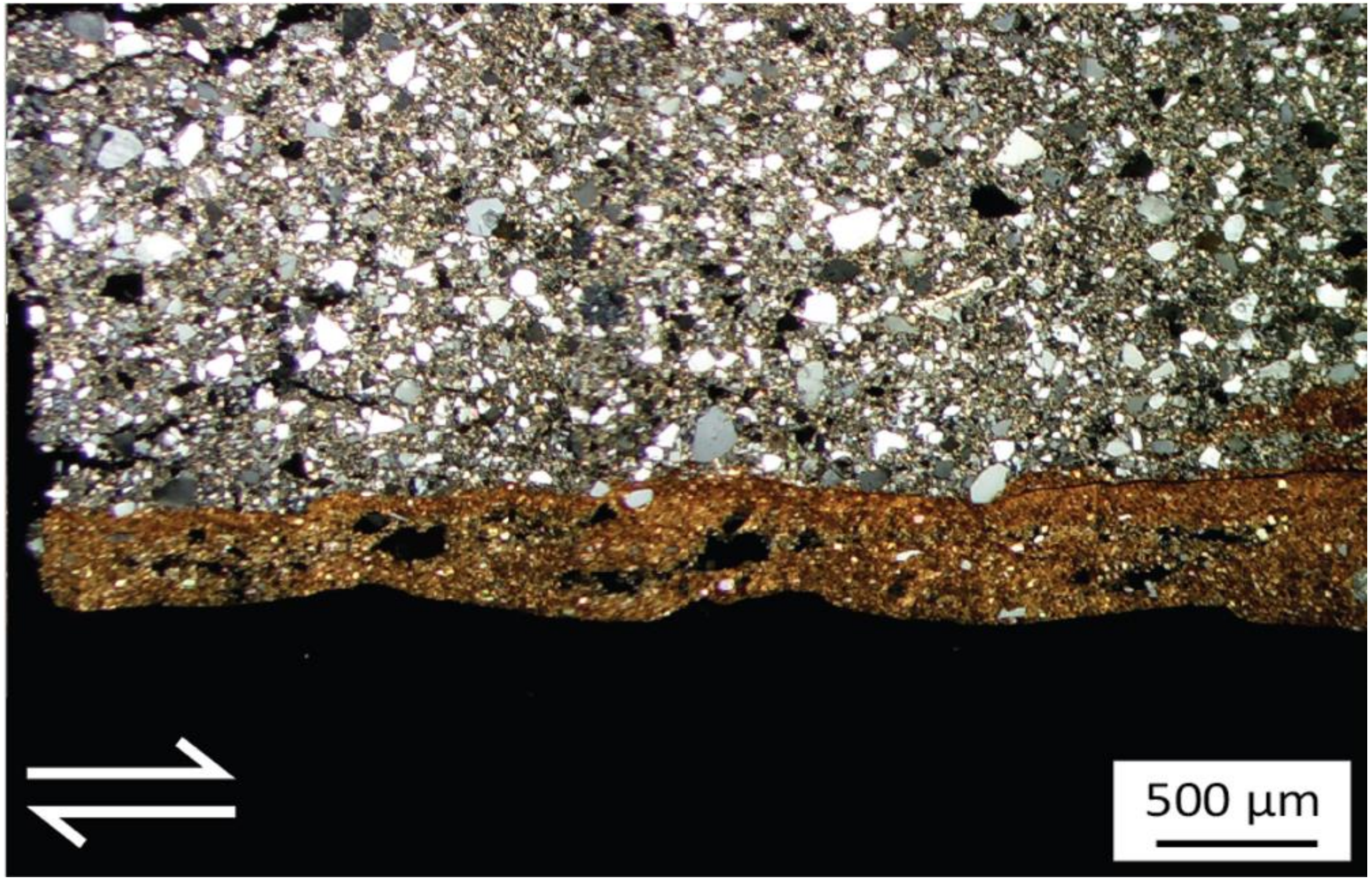
Microstructural evolution

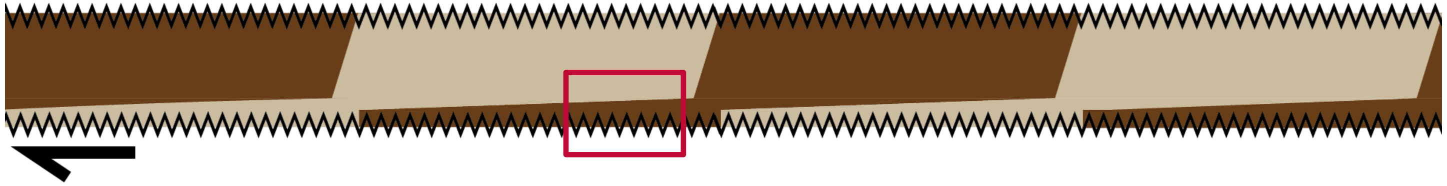
$\omega = 90\ °$



$\omega = 180\ °$

$\omega = 400\ °$

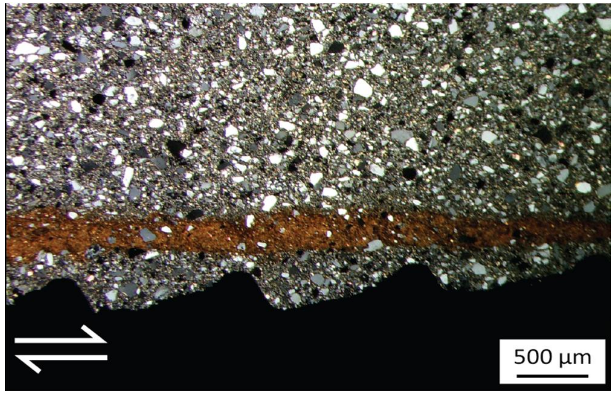




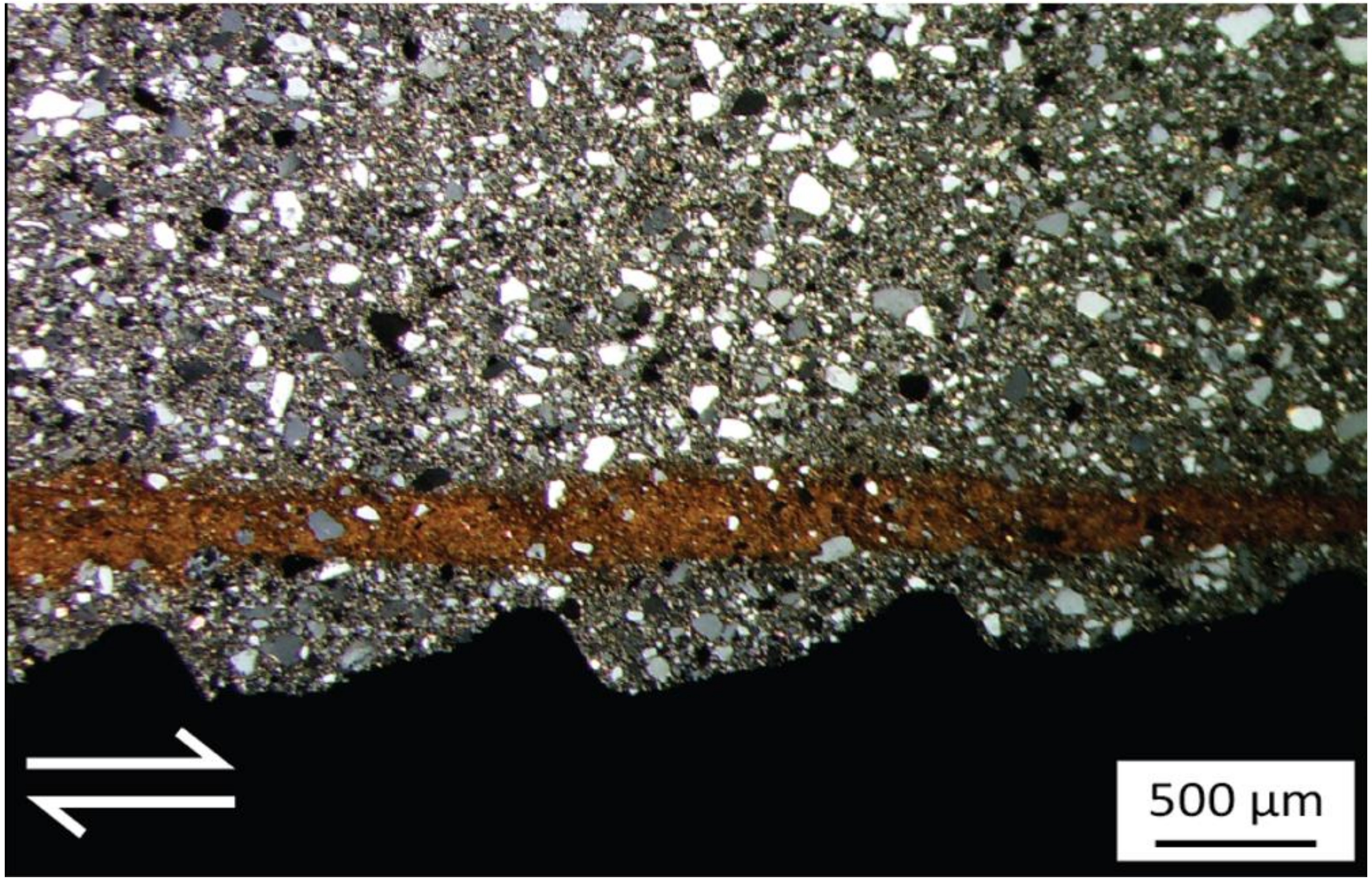
Microstructural evolution

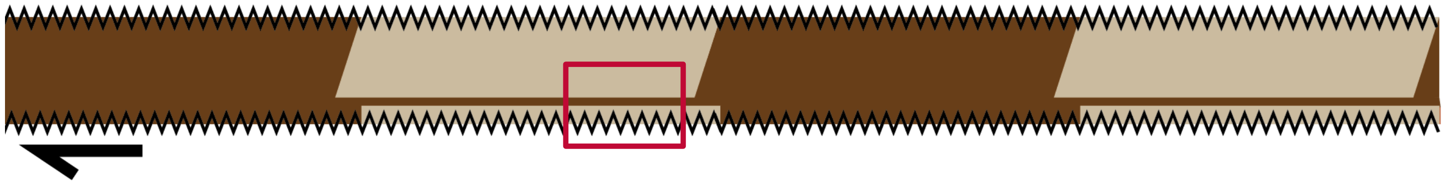
ω = 90 °

ω = 180 °



ω = 400 °



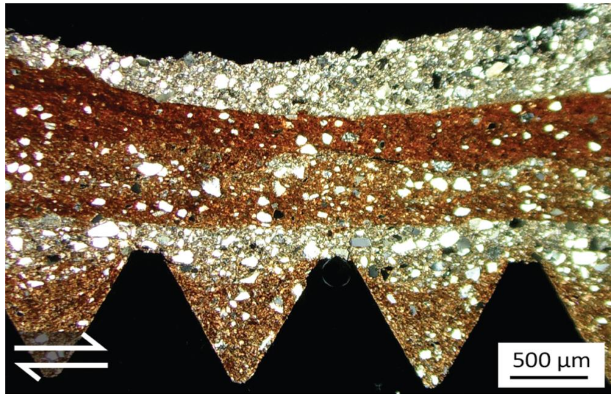


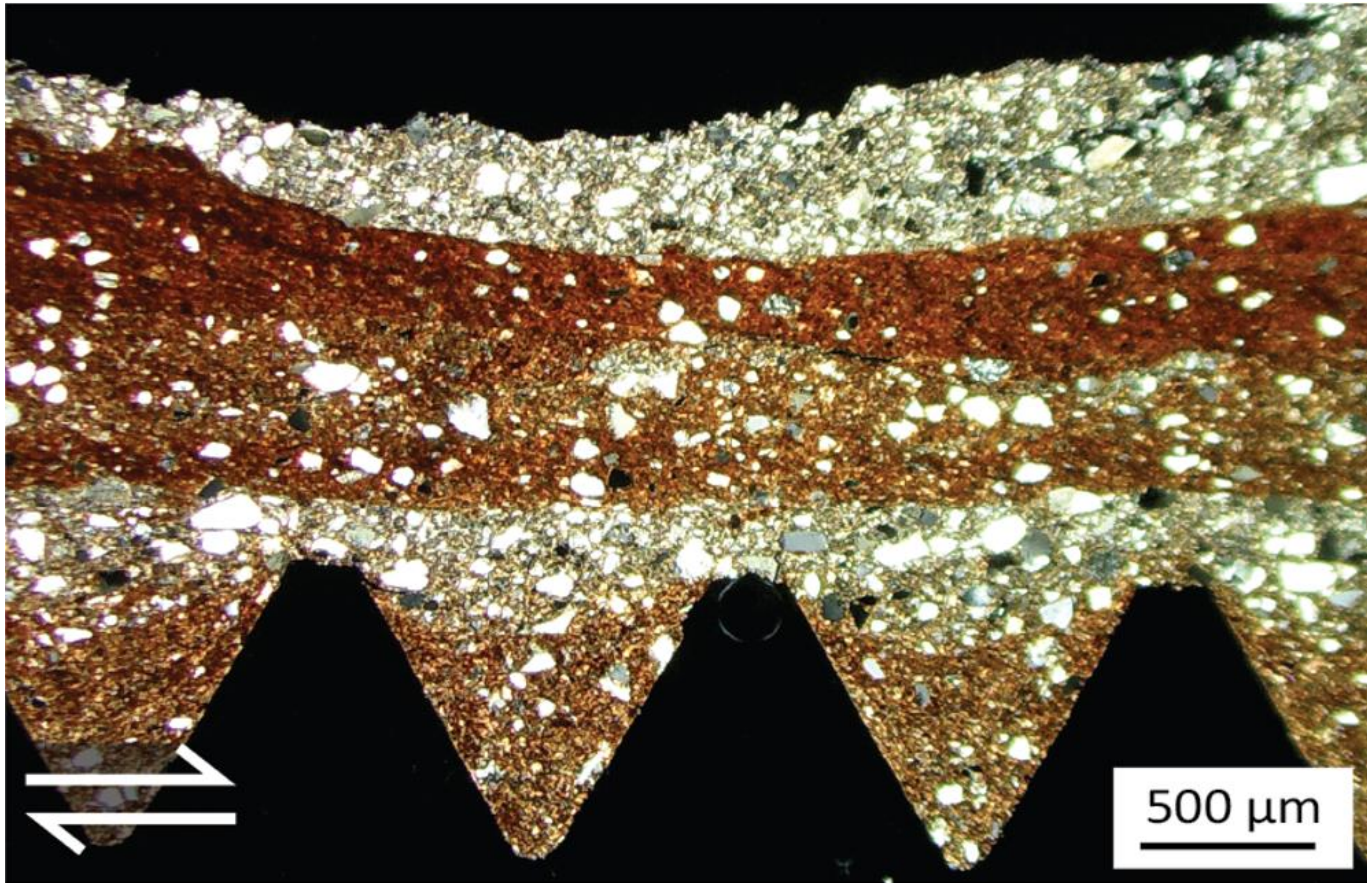
Microstructural evolution

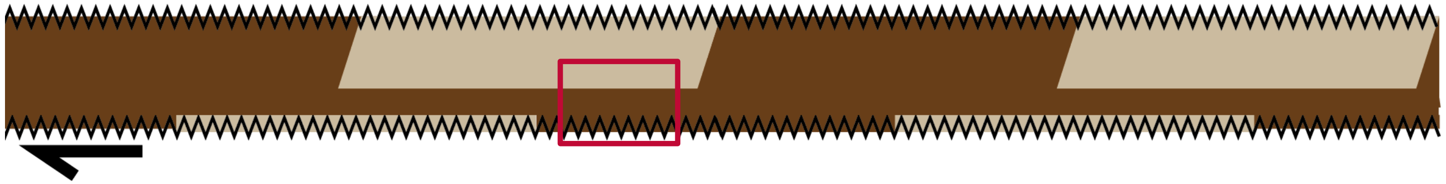
ω = 90 °

ω = 180 °

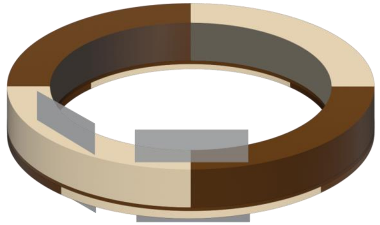
ω = 400 °

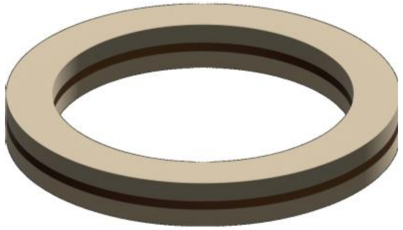


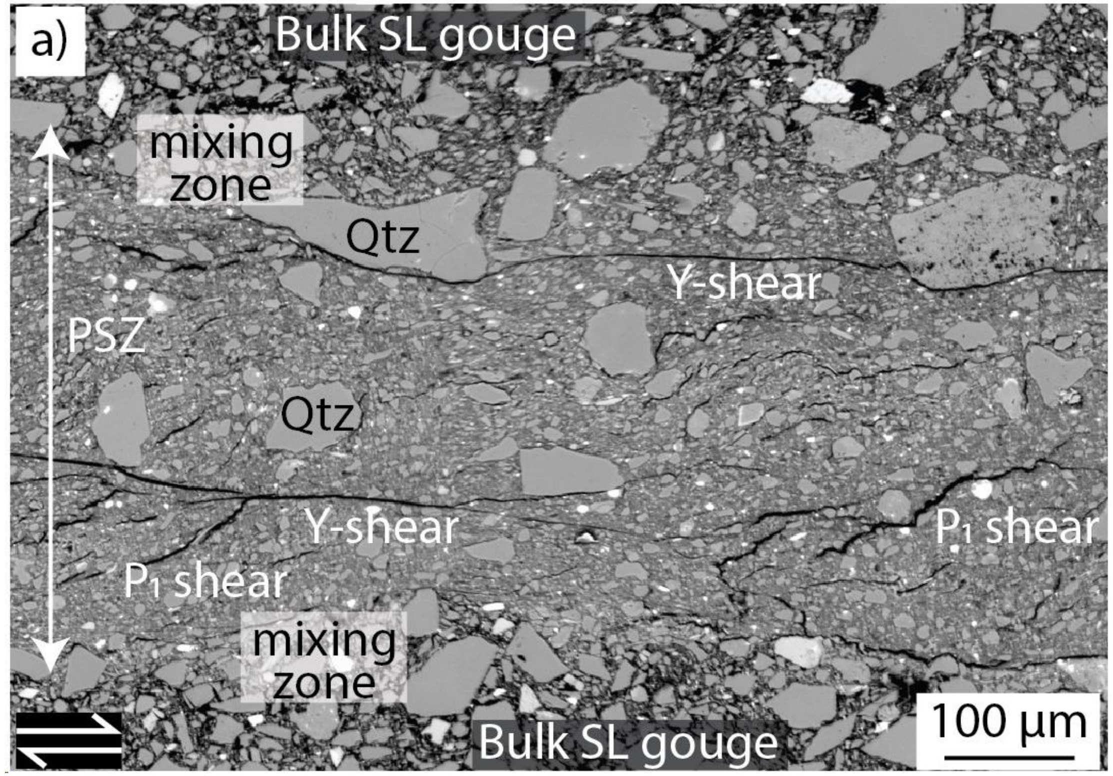


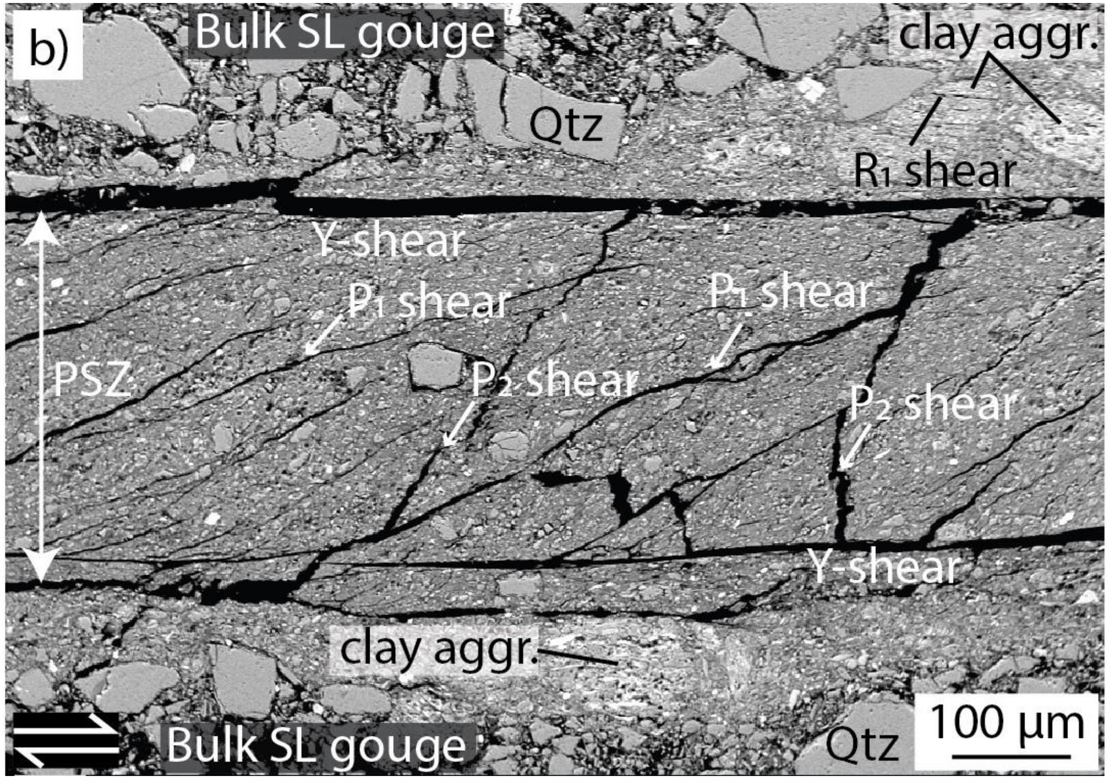


Segmented gouge *VS* *Layered gouge*









- Disrupted Y-shears
- Mixing with bulk SL gouge

- Continuous Y-shears
- No mixing with bulk SL gouge

What material properties will govern the fault mechanical behaviour?

A) The weakest lithology

B) The strongest lithology

C) A homogeneous mixture

D) None of the above

- Frictional strength and velocity dependence evolve with displacement
- The evolution is caused by clay smearing and mixing at the material interface
- Knowledge on scale of layering and fault offset required to predict mechanical behaviour

What material properties will govern the fault mechanical behaviour?

A) The weakest lithology

B) The strongest lithology

C) A homogeneous mixture

D) None of the above

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The frictional strength and stability of spatially heterogeneous fault gouges

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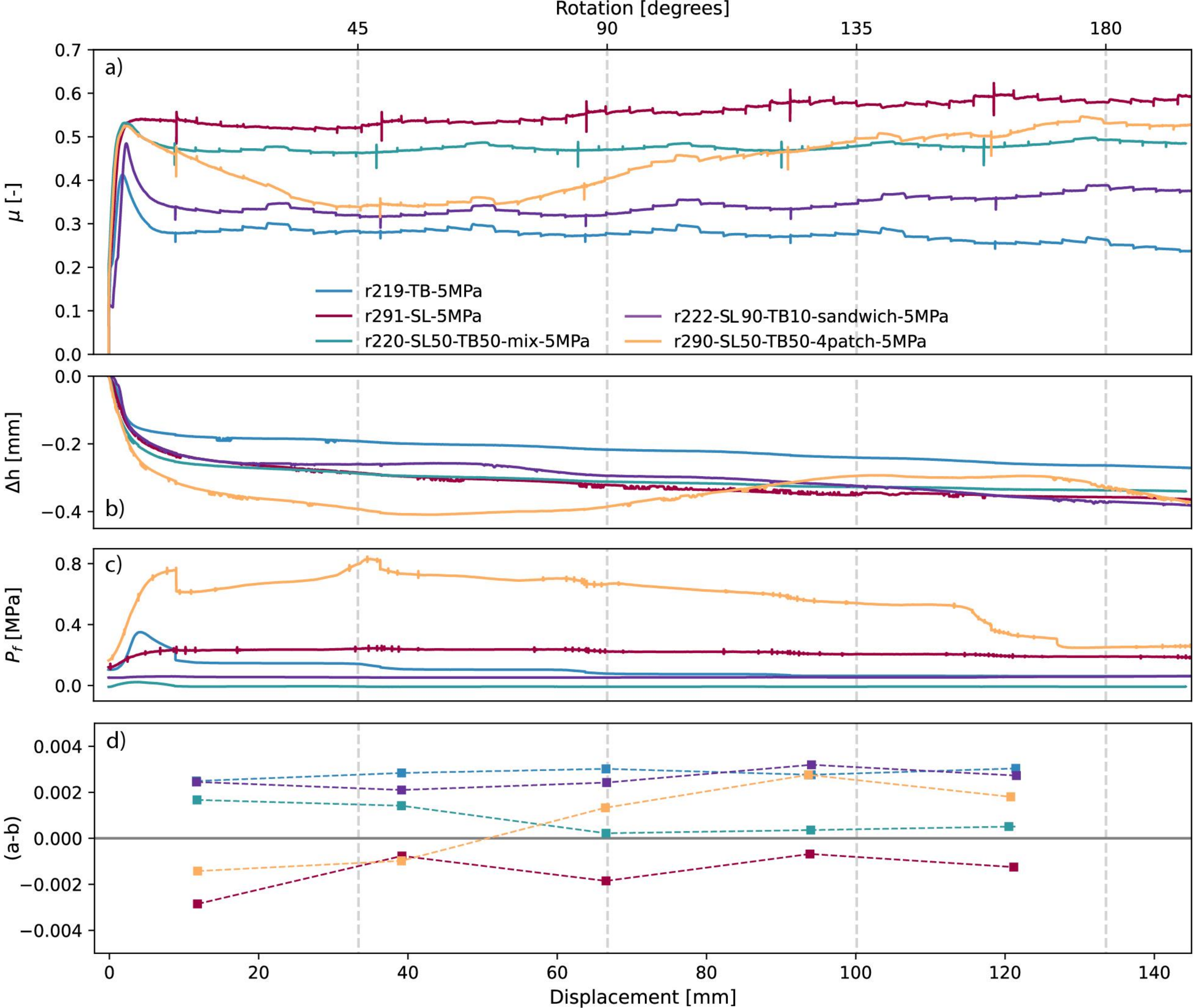
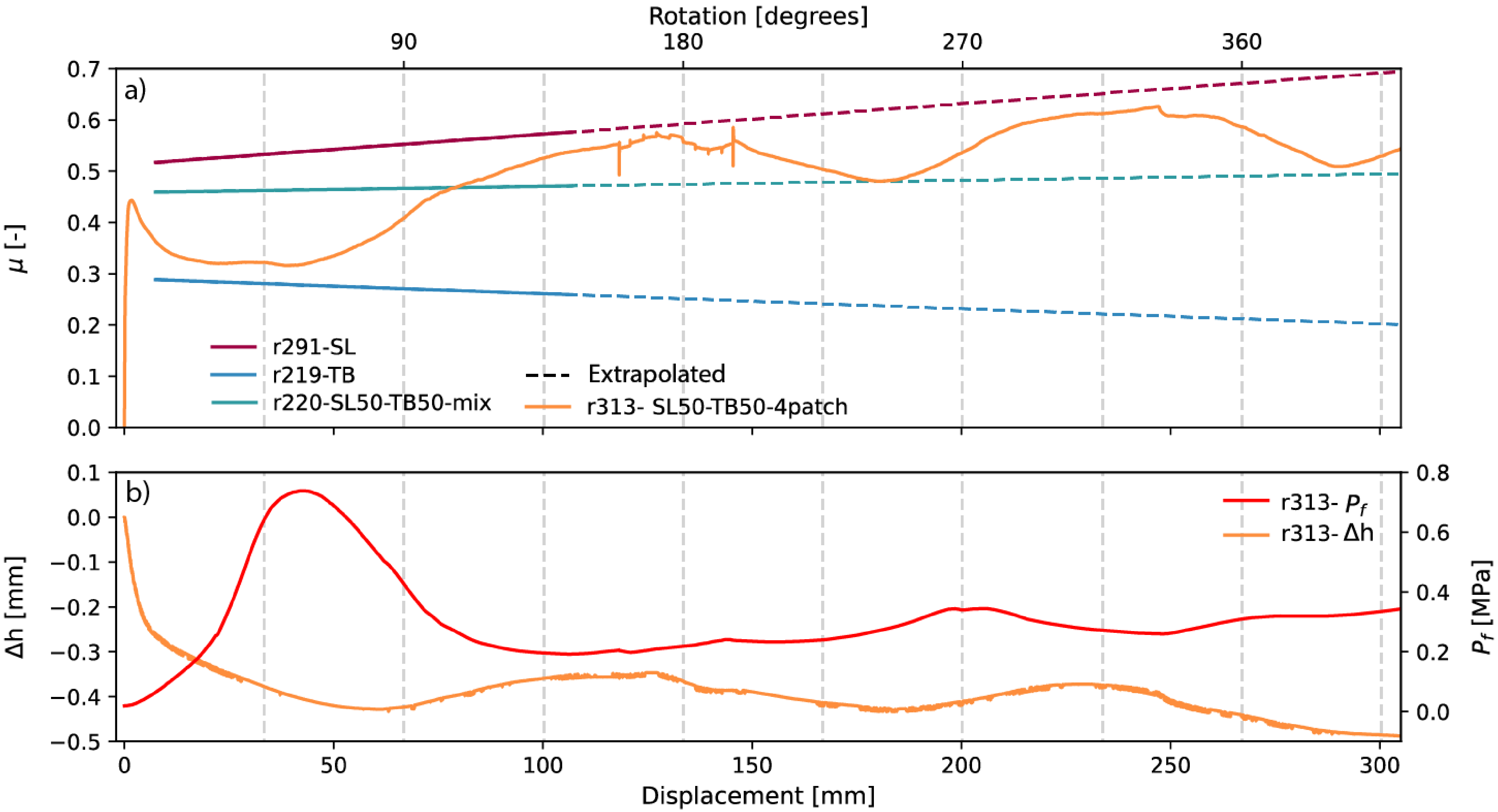
DeepNL

EPOS-NL EUROPEANPLATEOBSERVINGSYSTEM NETHERLANDS

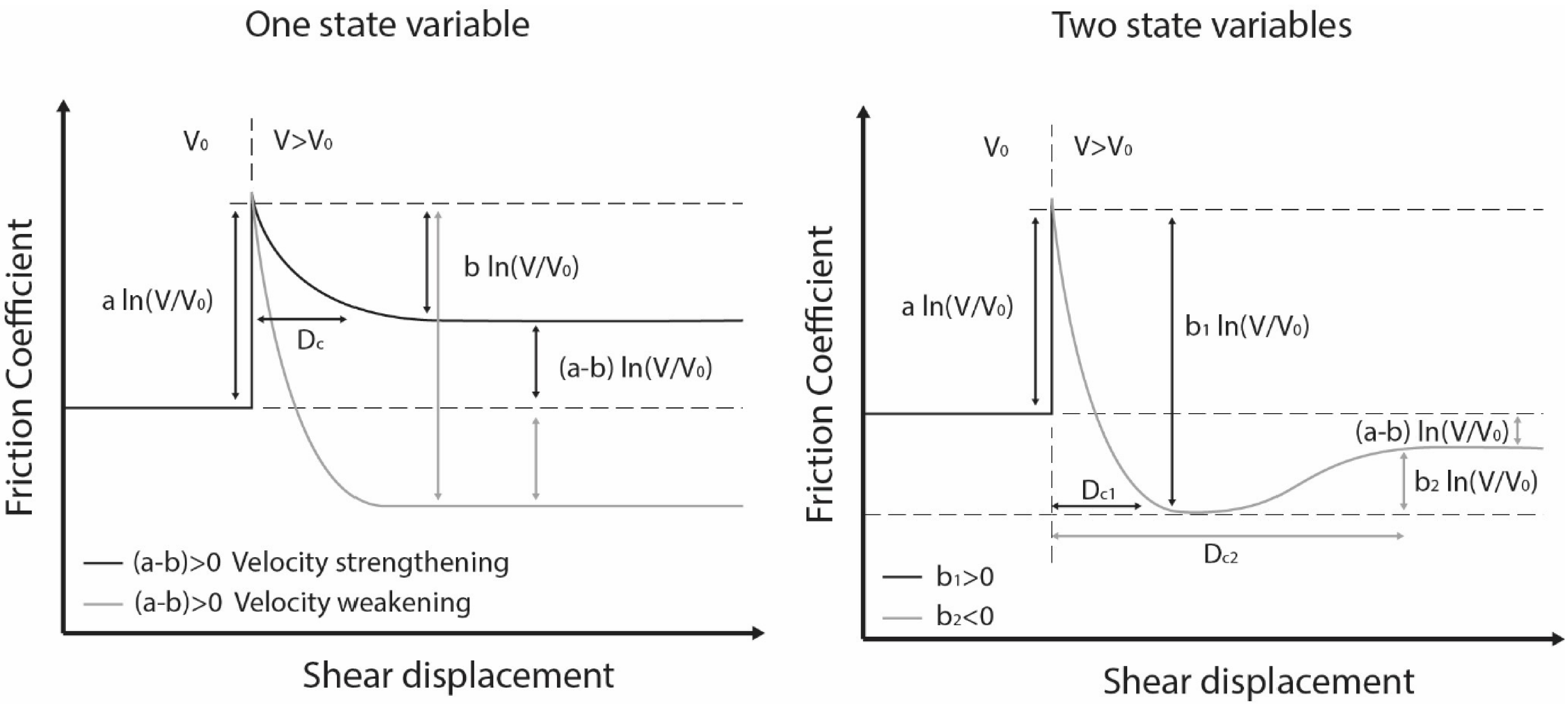
NWO

Additional slides


Rotation [degrees]
45
90
135
180
a)
μ [-]
r219-TB-5MPa
r291-SL-5MPa
r220-SL50-TB50-mix-5MPa
r222-SL90-TB10-sandwich-5MPa
r290-SL50-TB50-4patch-5MPa
b)
Δh [mm]
c)
P_f [MPa]
d)
(a-b)
Displacement [mm]



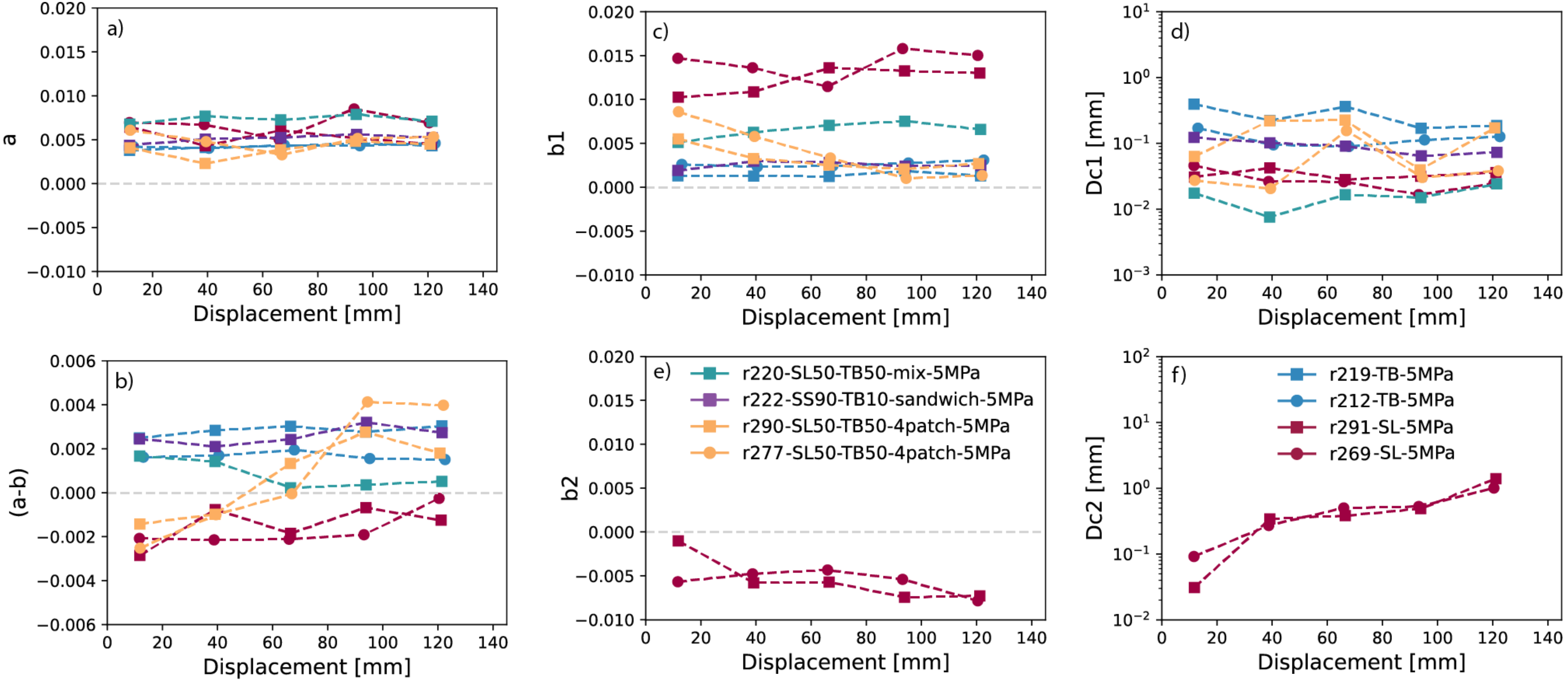
Rotation [degrees]
90
180
270
360
a)
μ [-]
r291-SL
r219-TB
r220-SL50-TB50-mix
Extrapolated
r313- SL50-TB50-4patch
b)
Δh [mm]
P_f [MPa]
r313- P_f
r313- Δh
Displacement [mm]



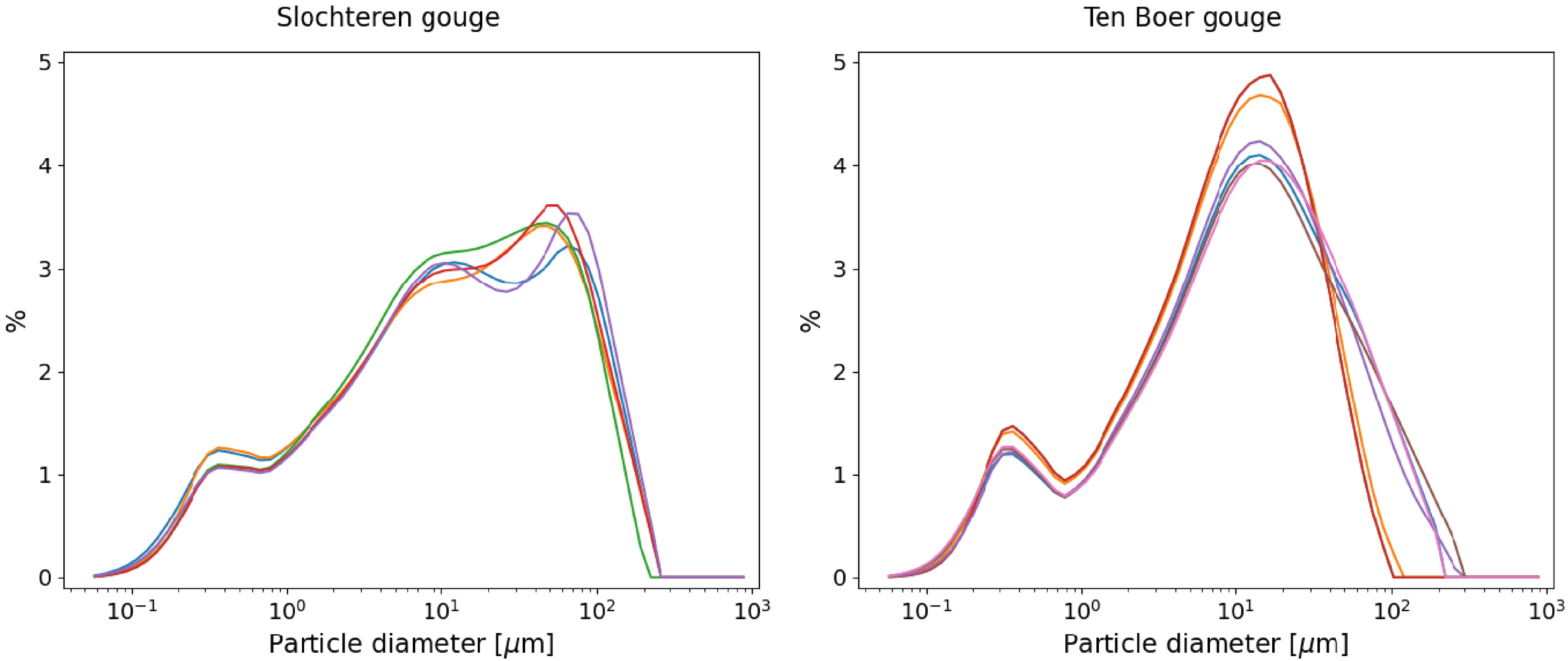
$$\mu = \mu_0 + a \cdot ln\left(\frac{V}{V_0}\right) + b_1 \cdot ln\left(\frac{V_0\theta_1}{d_{c,1}}\right) + b_2 \cdot ln\left(\frac{V_0\theta_2}{d_{c,2}}\right)$$

$$\frac{d\theta_i}{dt} = 1 - \frac{V\theta_i}{d_{c,i}}$$

$$\frac{d\mu}{dt} = k\left(V_{lp} - V\right)$$



a)
b)
c)
d)
e)
f)
a
(a-b)
b1
b2
Dc1 [mm]
Dc2 [mm]
Displacement [mm]
r220-SL50-TB50-mix-5MPa
r222-SS90-TB10-sandwich-5MPa
r290-SL50-TB50-4patch-5MPa
r277-SL50-TB50-4patch-5MPa
r219-TB-5MPa
r212-TB-5MPa
r291-SL-5MPa
r269-SL-5MPa



Slochteren gouge
Ten Boer gouge
%
Particle diameter [μm]
0
1
2
3
4
5
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}