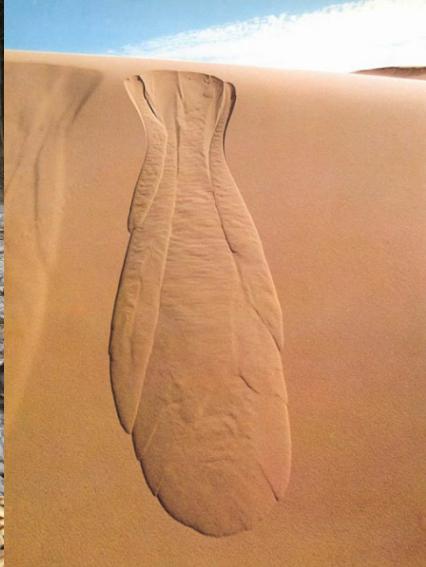


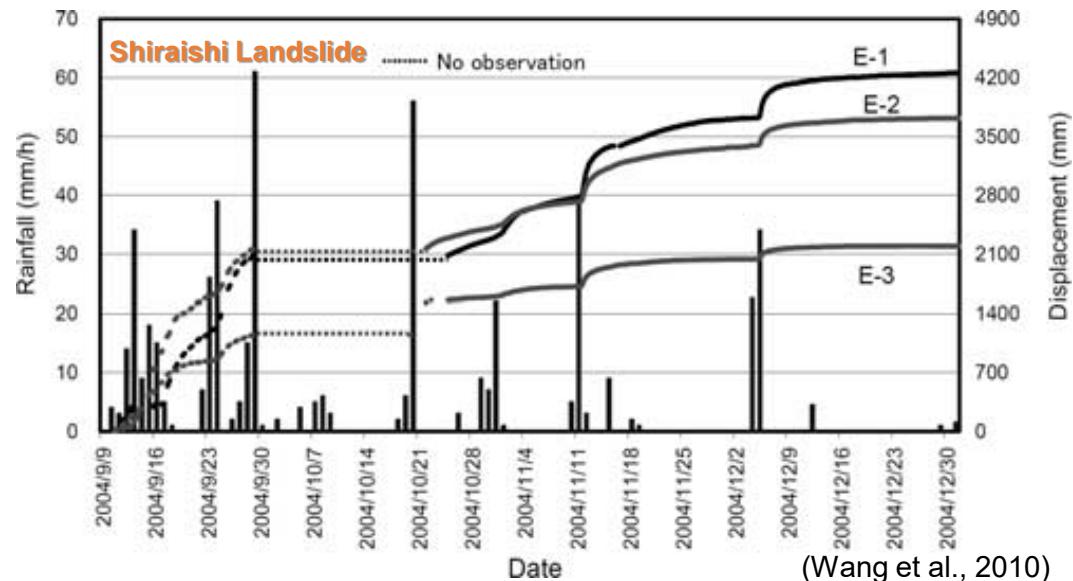
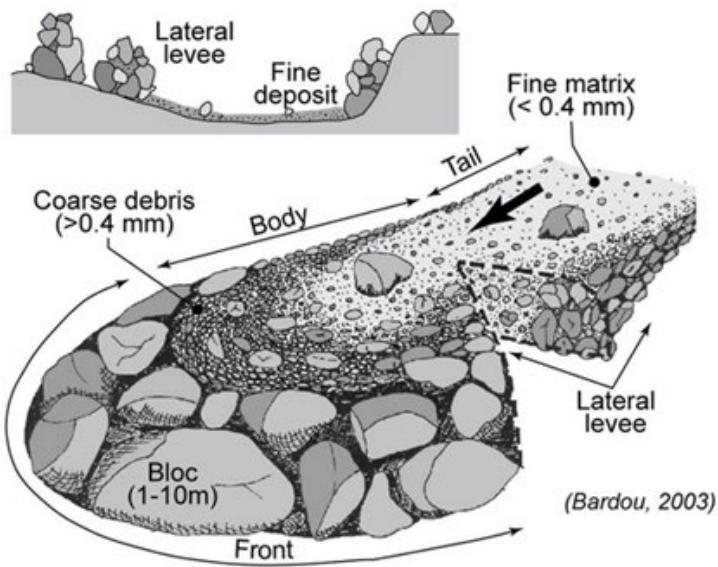
Characteristics of Mechanical Response and Acoustic Emission During Granular Shearing

○ Yao JIANG¹, Gonghui WANG²

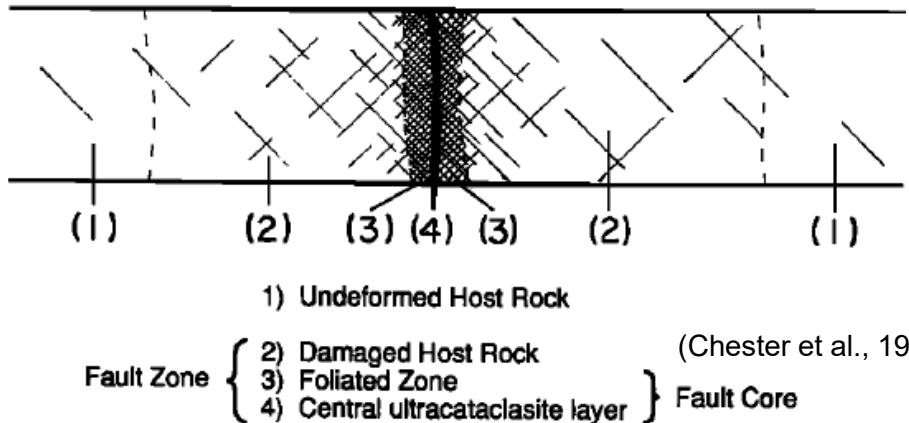
1. Institute of Mountain Hazards and Environment, Chinese Academy of Sciences (yjiang@imde.ac.cn)
2. Research Center on Landslides, Disaster Prevention Research Institute, Kyoto University



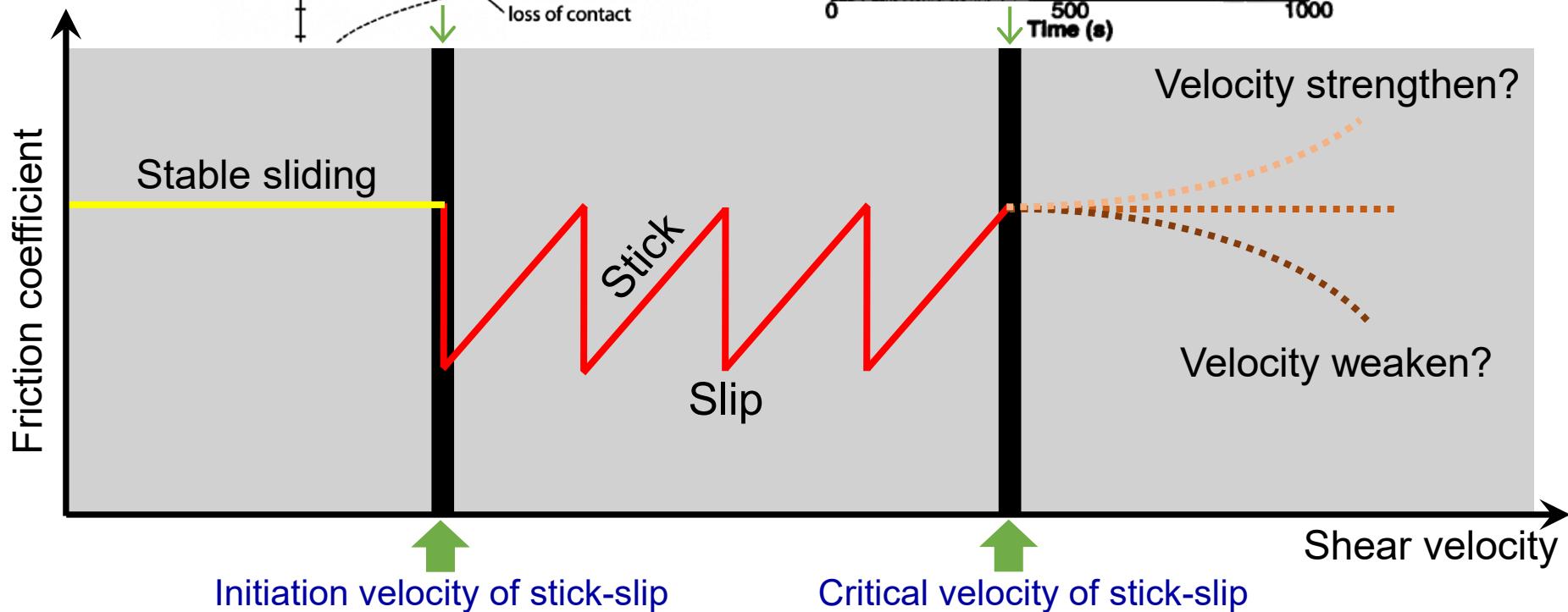
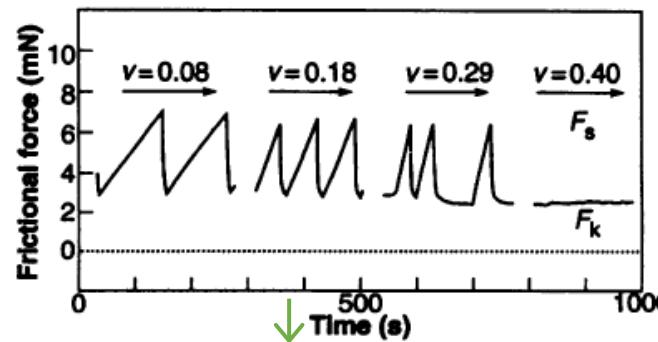
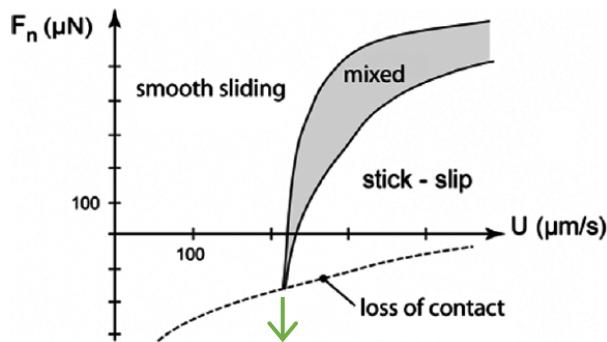
Friction Motions in Geo-science



Internal Structure of Principal Faults of the North Branch San Gabriel Fault

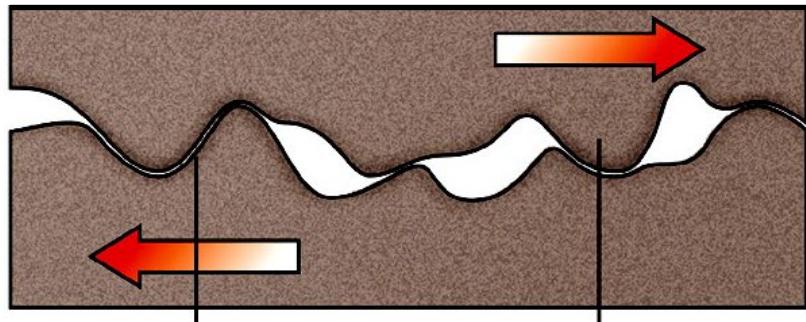


Velocity Dependence of Friction



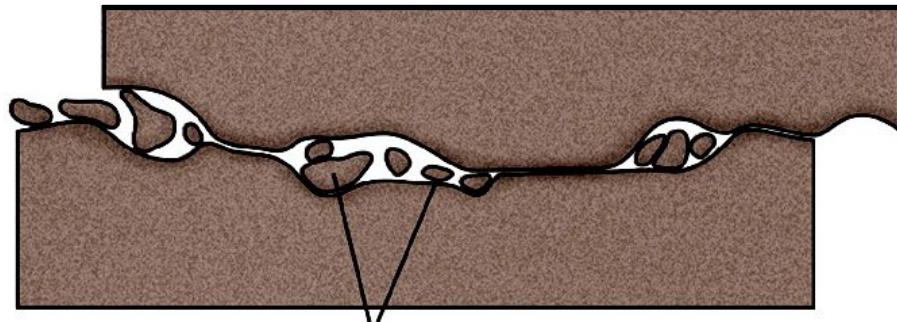
Possible Mechanism

◆ Asperity model (Rock-on-rock surfaces)



Two surfaces
in contact

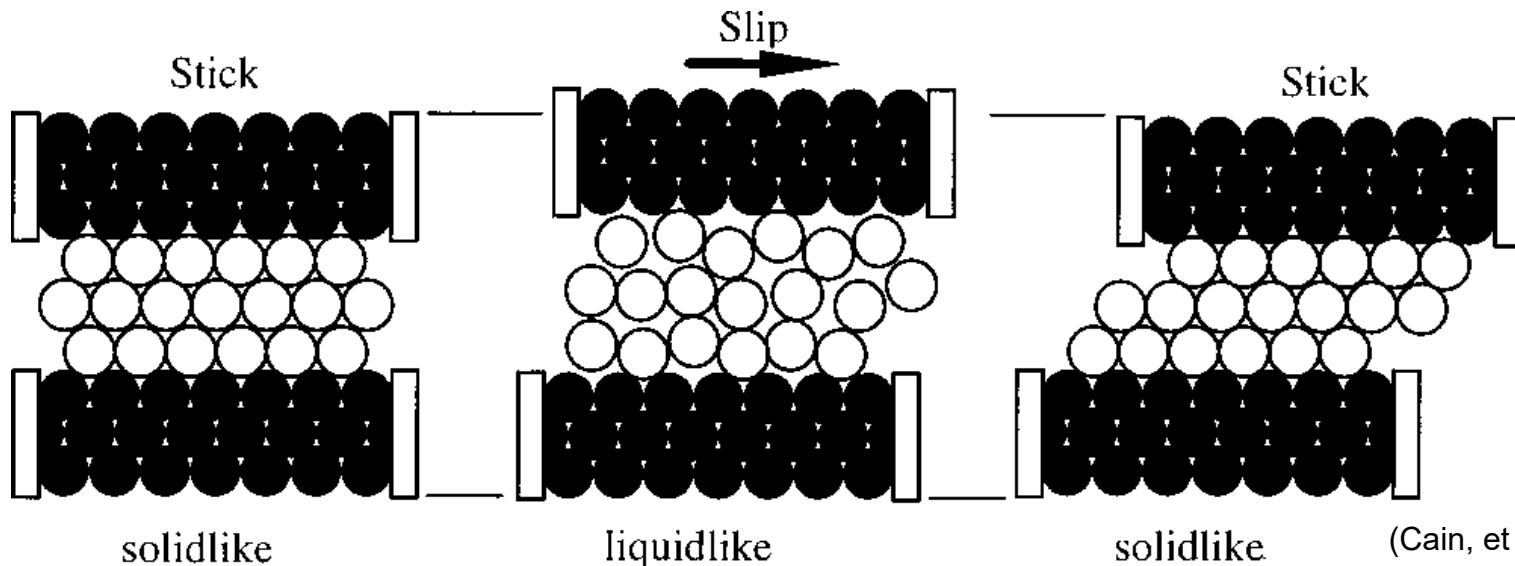
Asperity
(protrusion)



Broken-off asperities

(Modified from Rice et al., 2006)

◆ Grain-bridge model (Granular assemblages)



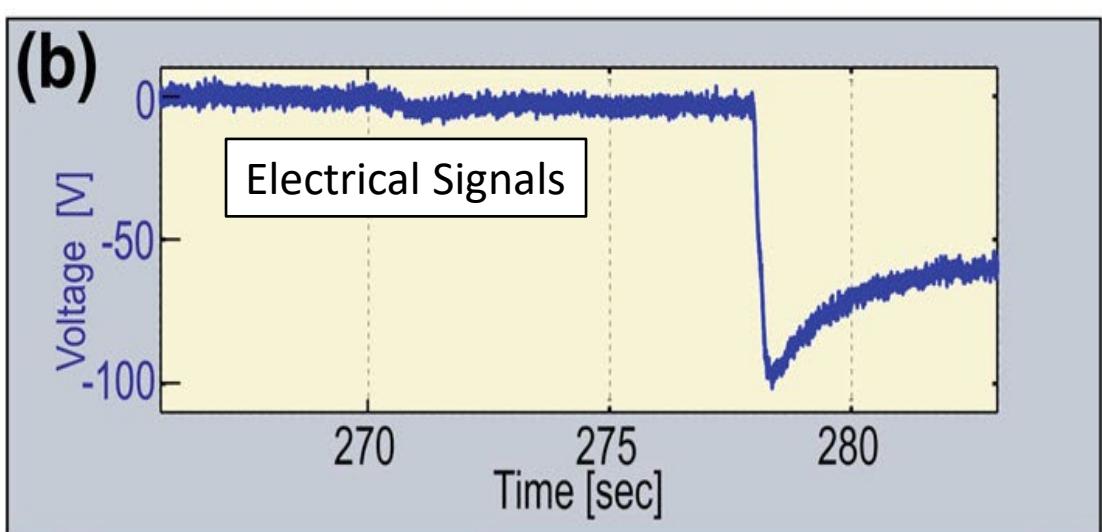
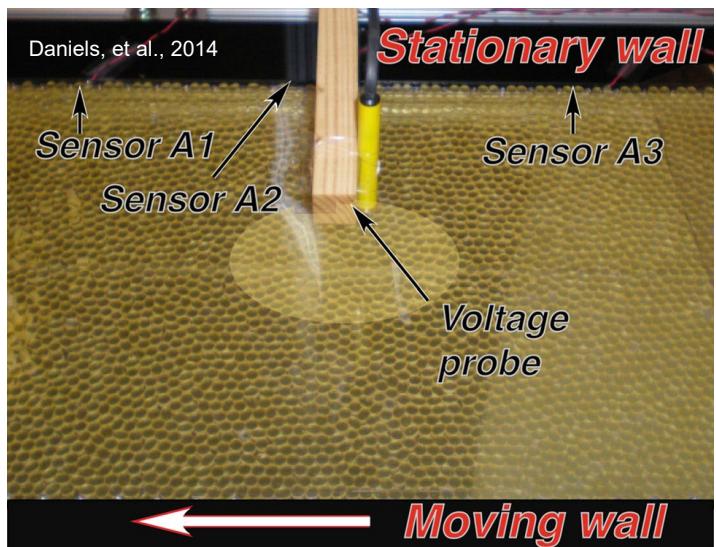
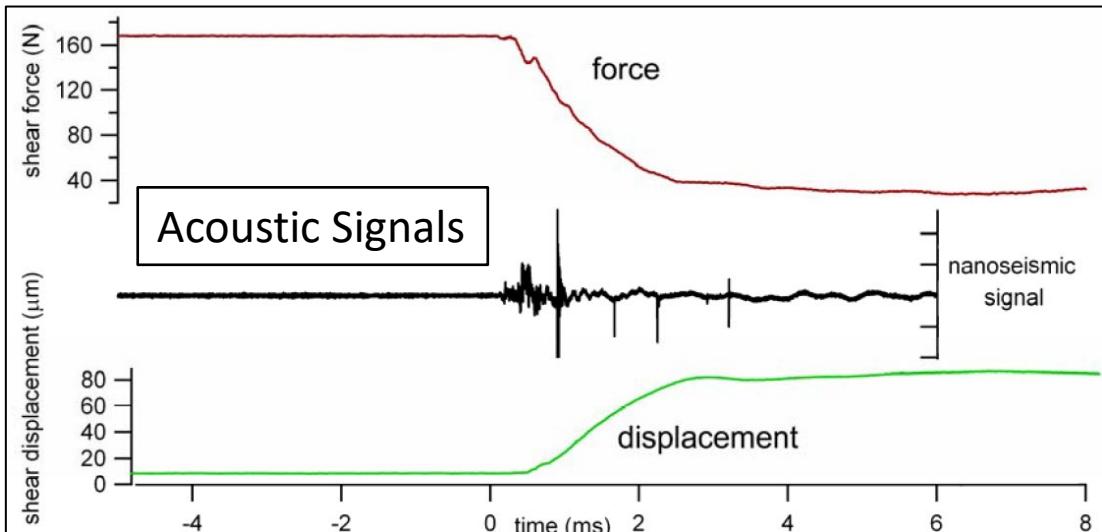
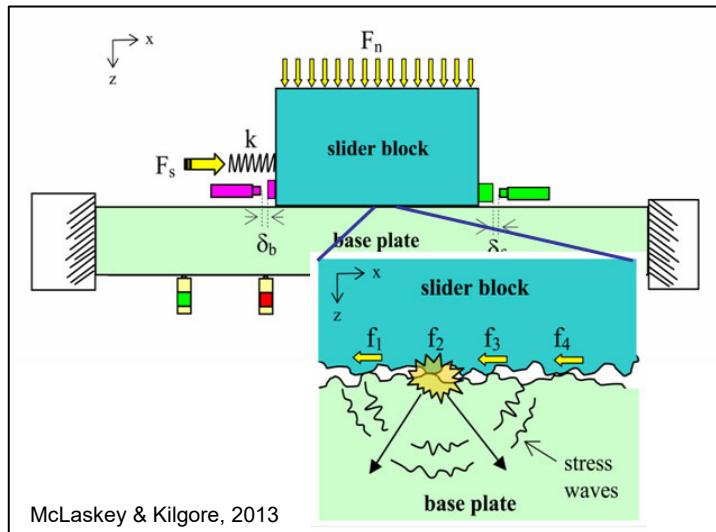
solidlike

liquidlike

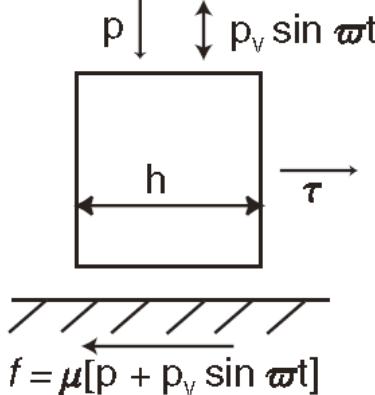
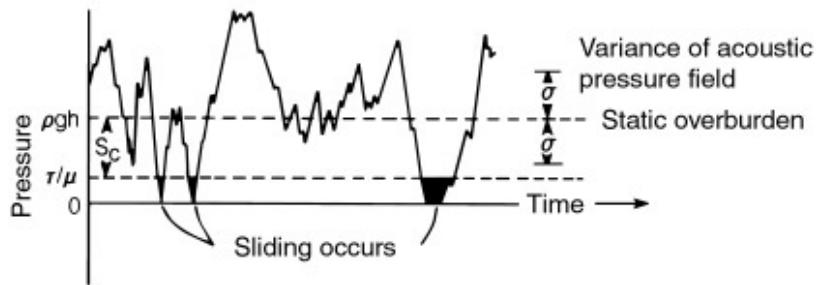
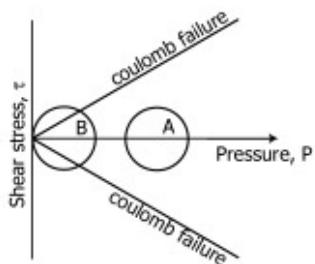
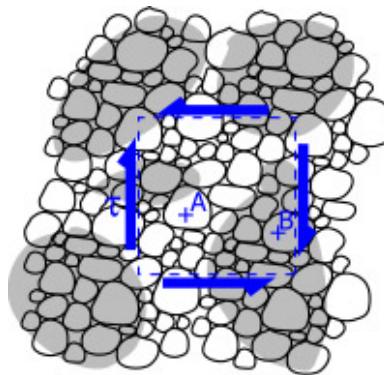
solidlike

(Cain, et al., 2001)

Correlations of Frictional Instability

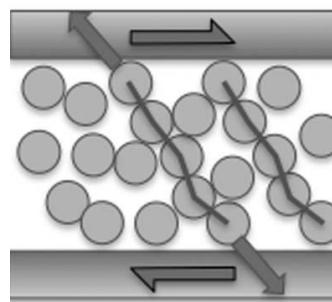


Acoustic Fluidization and Instability

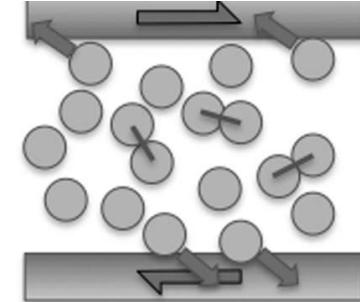


(Melosh, 1990, 1996, 2005)

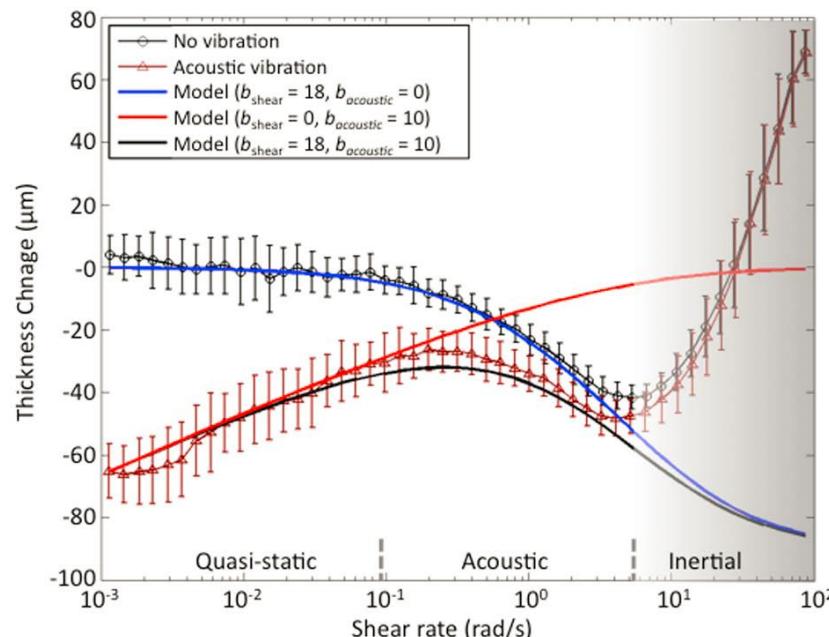
- Acoustic can induce stress fluctuations and support parts of overburden.
- Shearing itself generates acoustic vibration and sample dilatation.



(a) Low shear rate



(b) High shear rate



(van der Elst et al., 2012)

Motivations

- Whether the ***particle sizes*** have significant influence on the granular instability?
- Whether the ***characteristics of AE*** are dependent on particle sizes?
- Whether the generated AEs are ***precursors*** to failure ***or resultant*** phenomena?

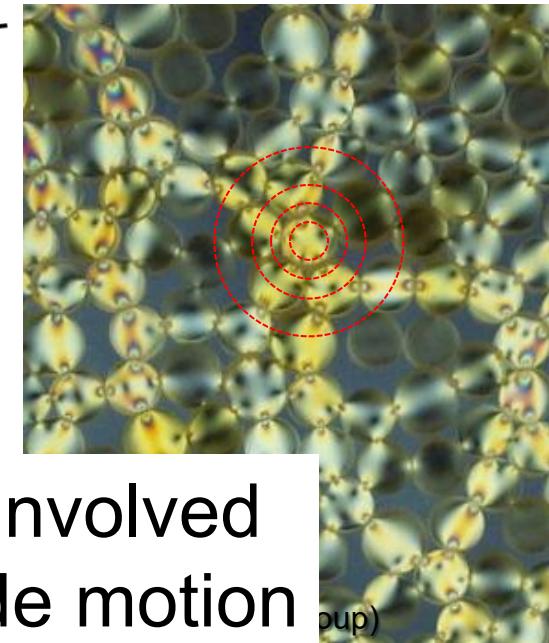
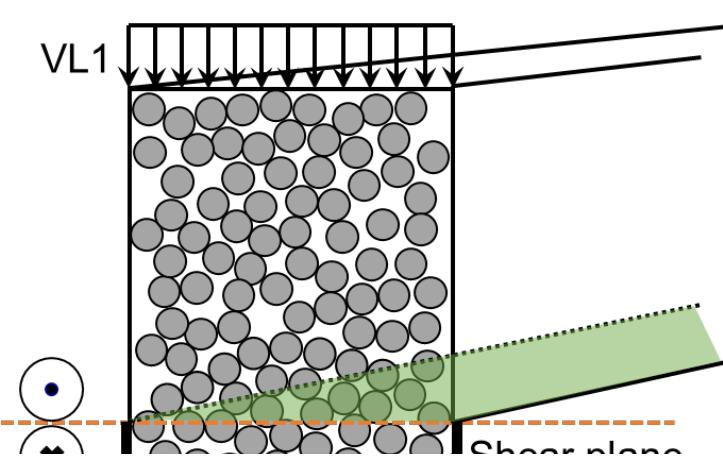
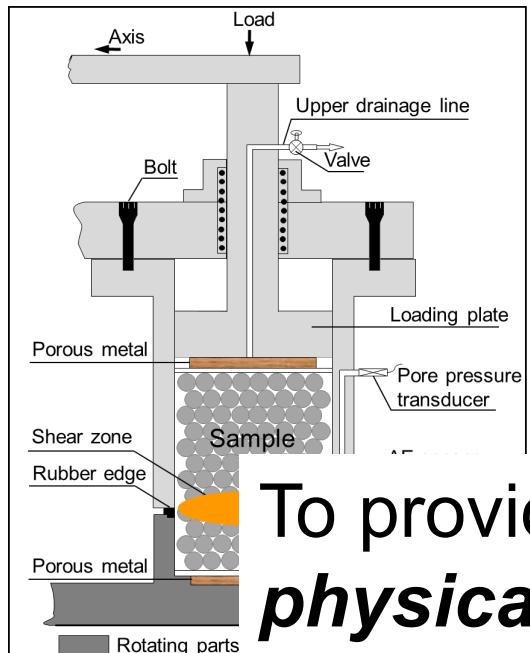
Background



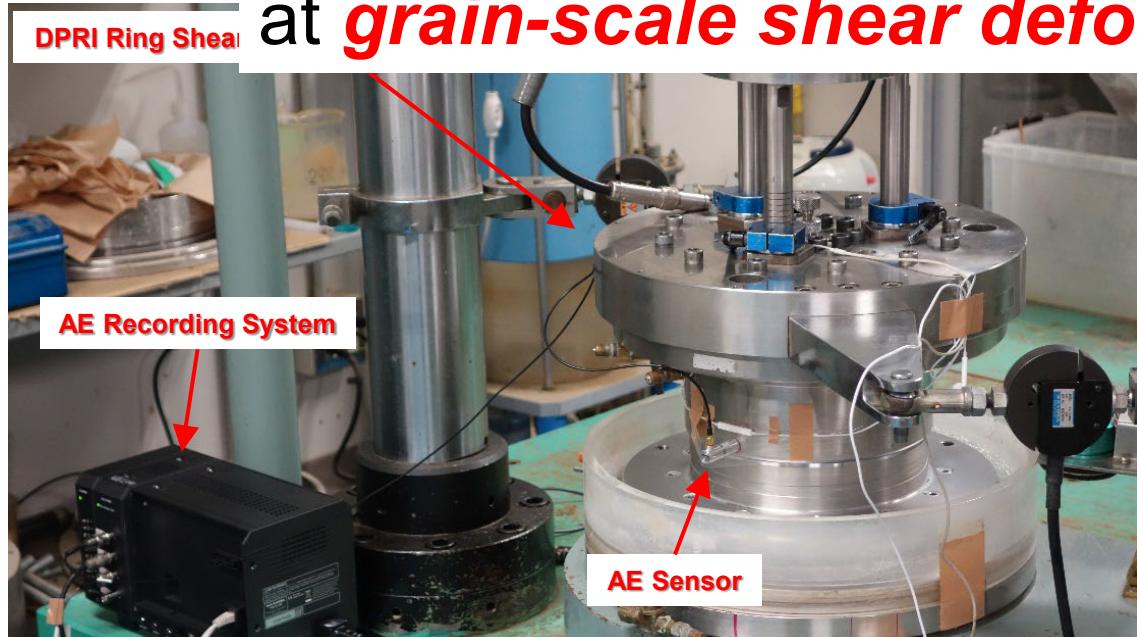
Experimental results



Discussion and Summary



To provide more insight on the involved
physical processes of landslide motion
at **grain-scale shear deformations**.



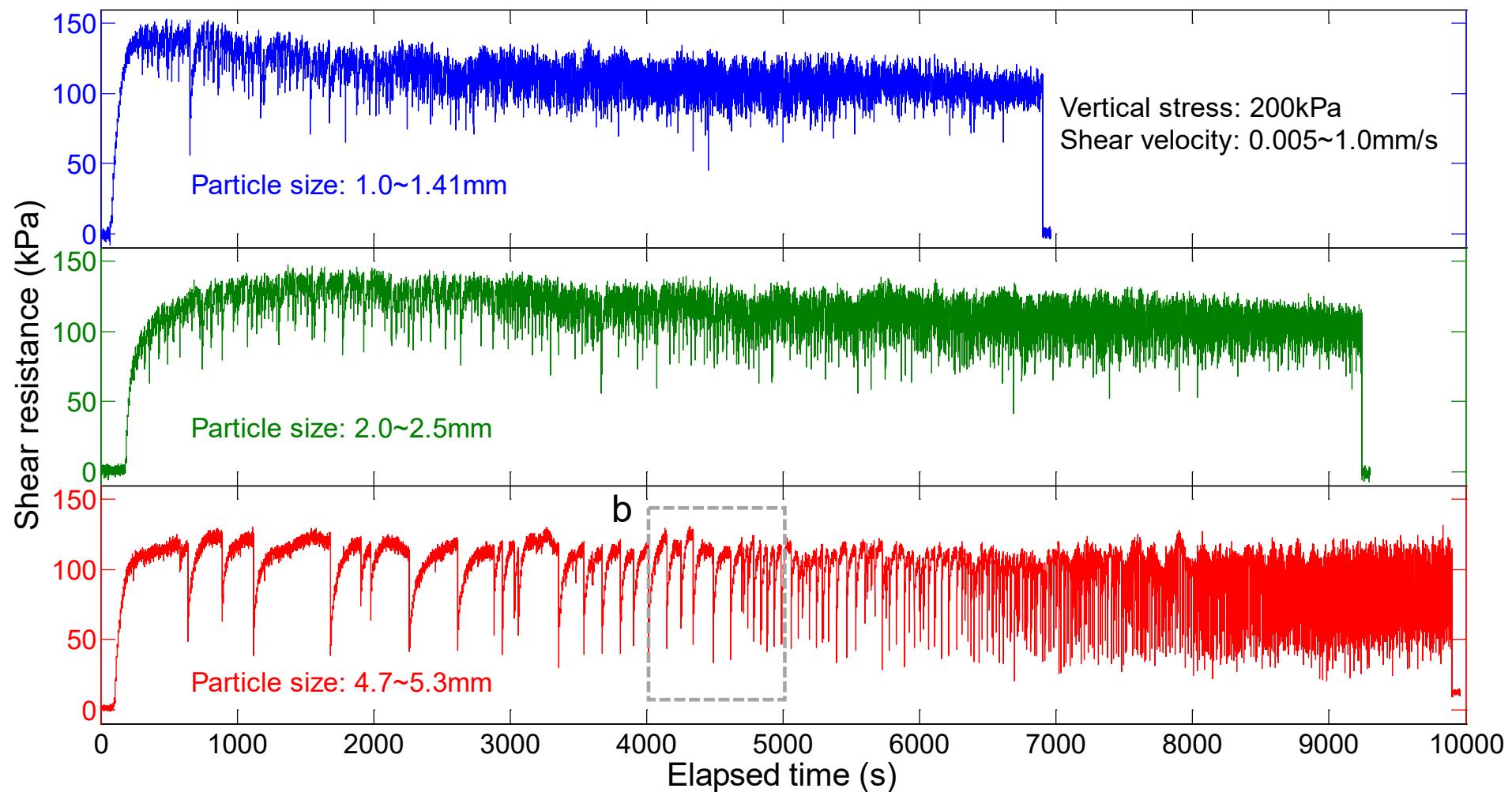
- AE Sensor: NF 900S-WB;
- Sampling frequency: 1MHz;

Background
○○○○○○○○

Experimental results
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Discussion and Summary
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Frictional Instabilities



Particle size and shear velocity dependence of frictional instability

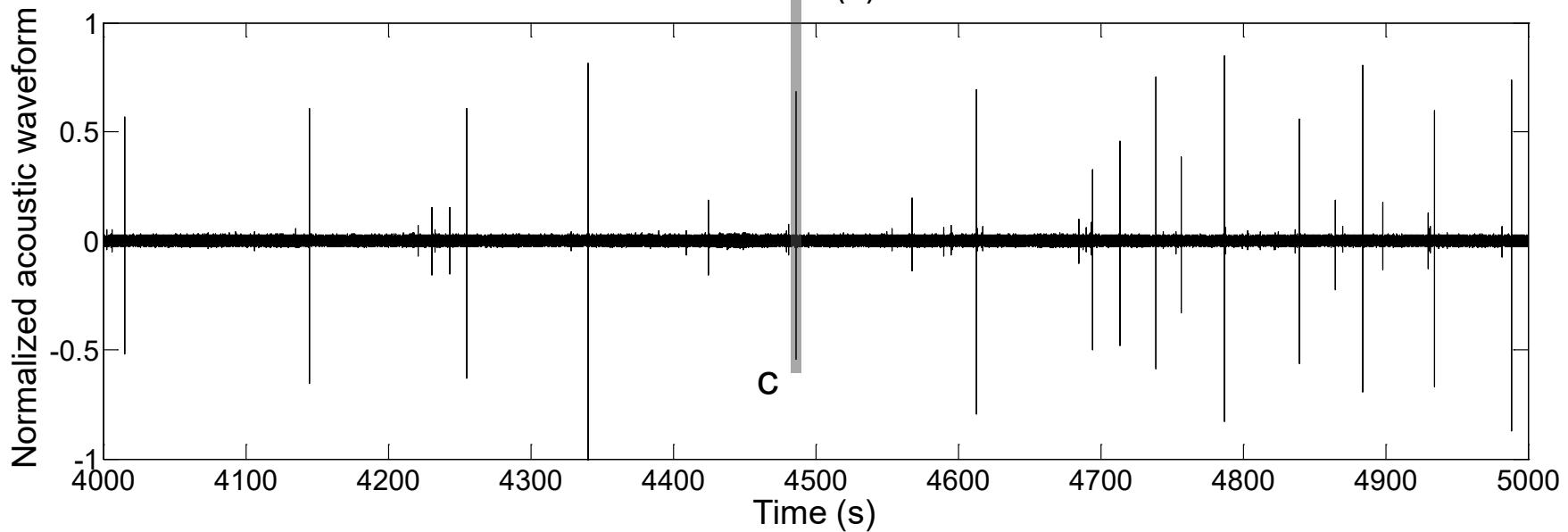
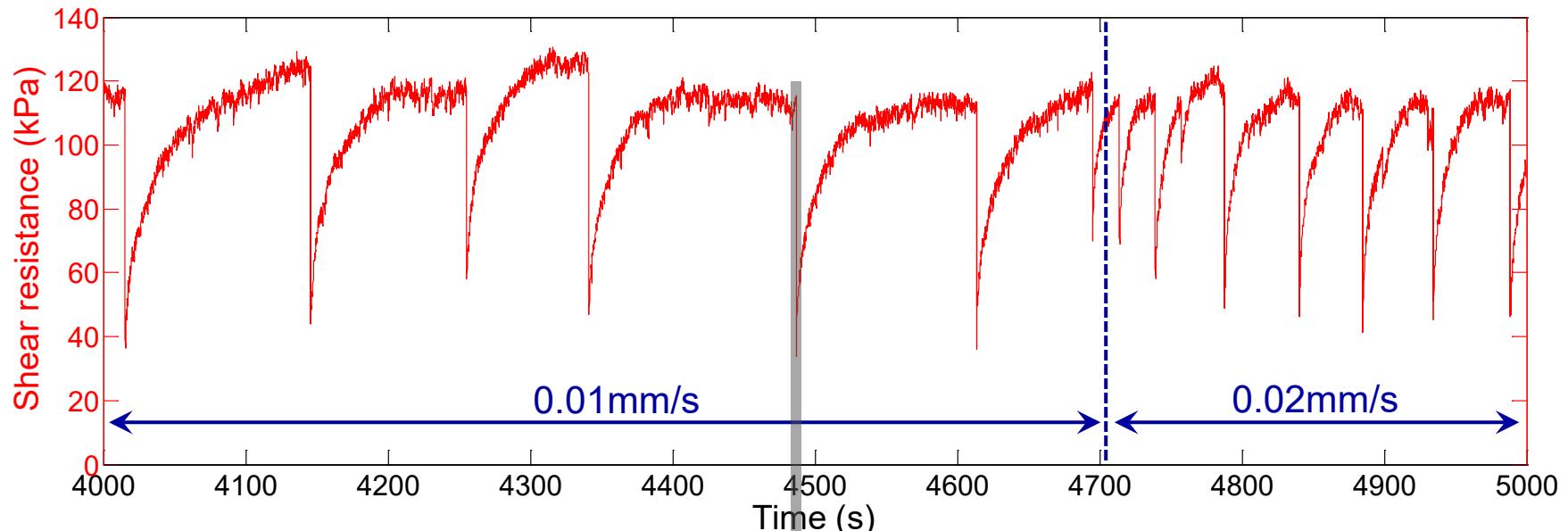
Background



Experimental results



Discussion and Summary



A strong correlation between acoustic emissions and frictional instabilities.

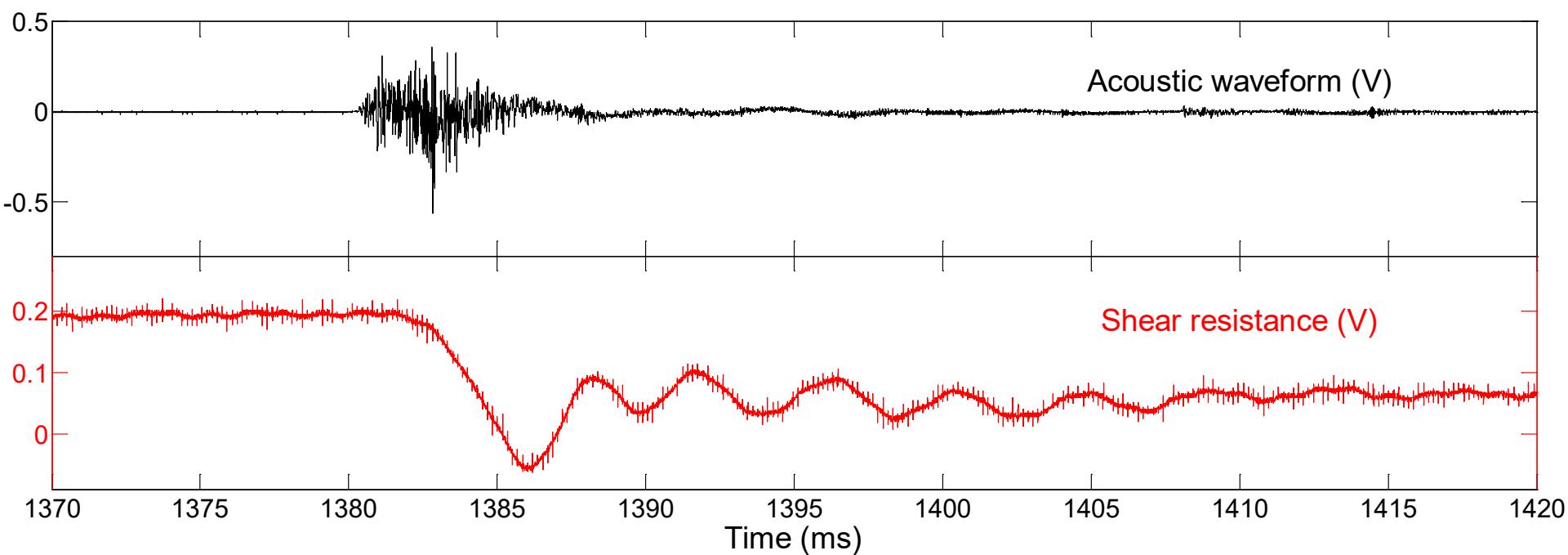
Background



Experimental results



Discussion and Summary

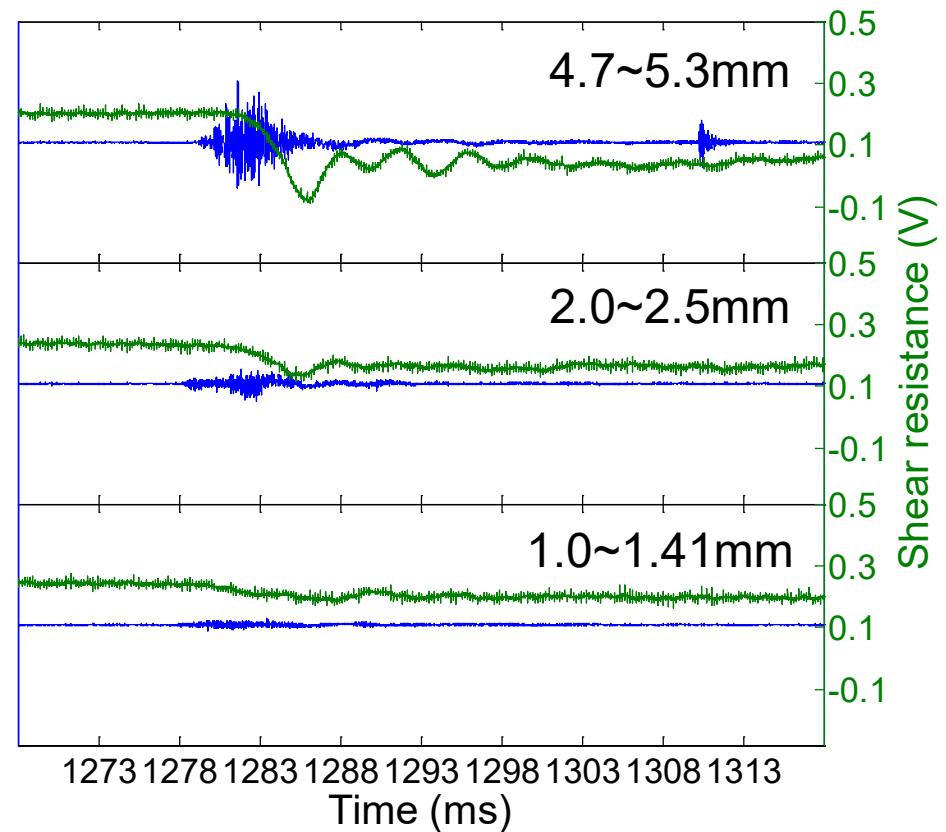
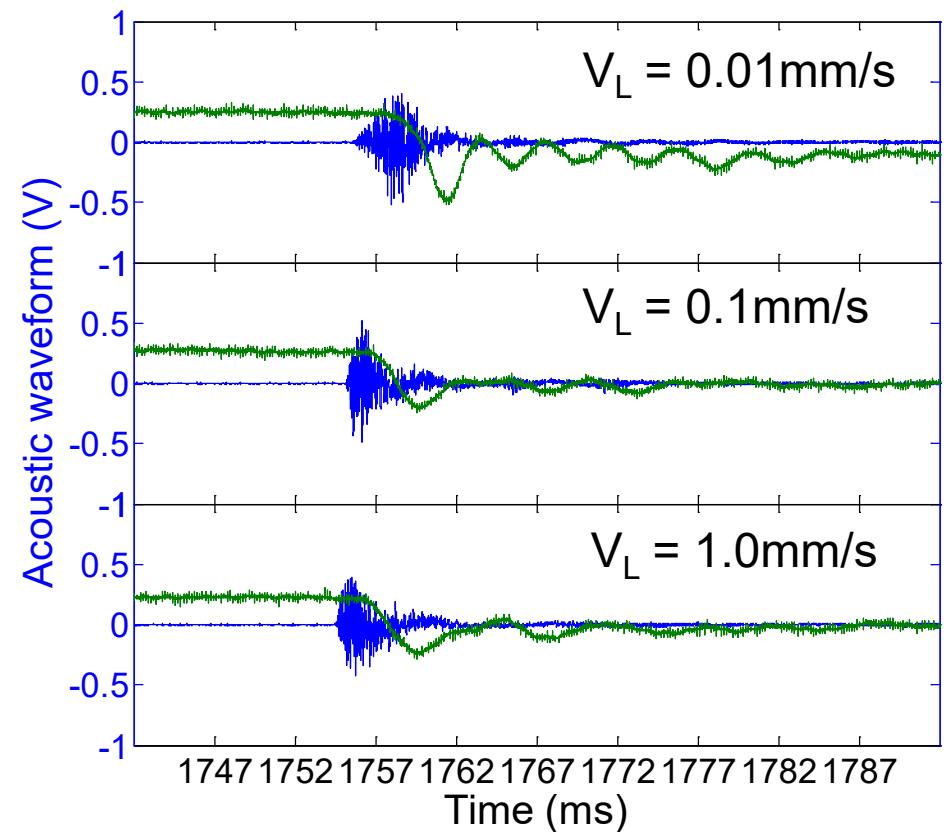


Background
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Experimental results
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Discussion and Summary
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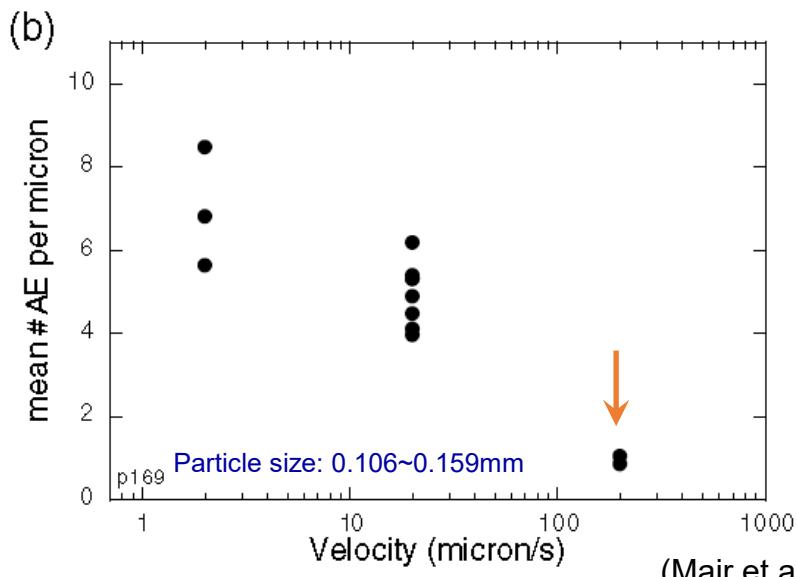
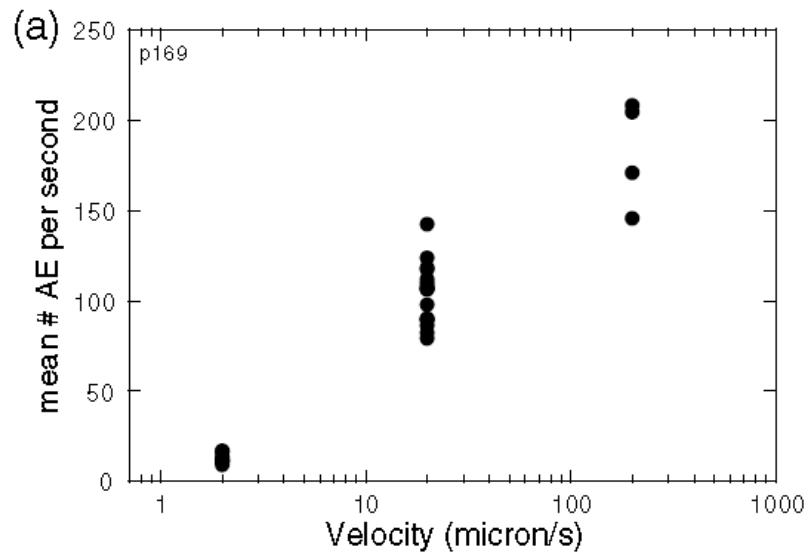
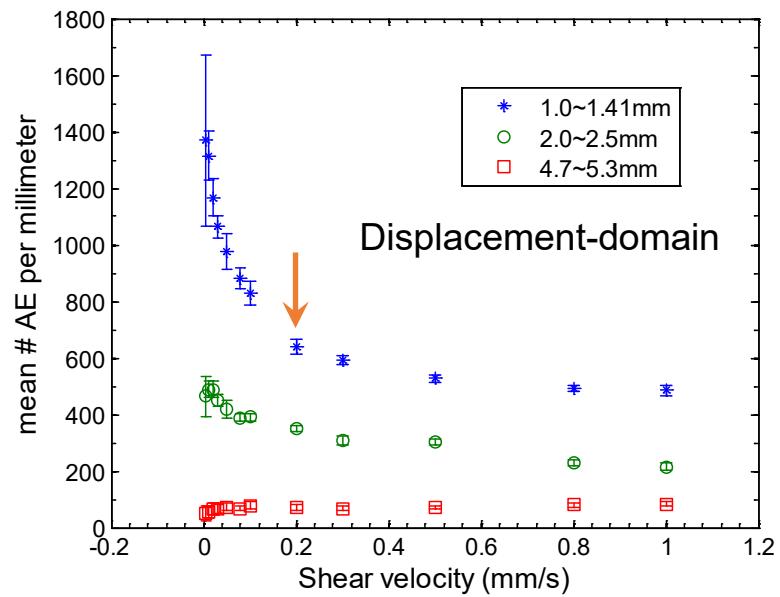
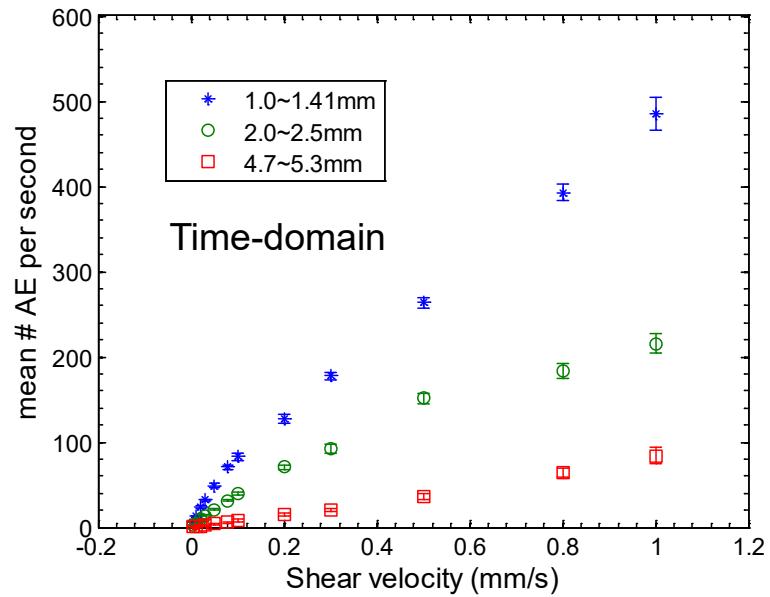
AE Characteristics



Particle size: $4.7\sim5.3\text{mm}$

Shear velocity: 0.005mm/s

Occurrence Rate of AE Events



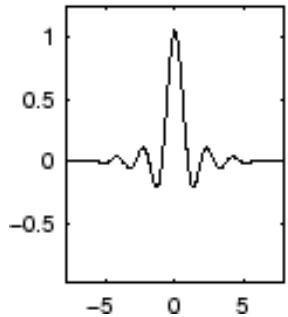
(Mair et al., 2007)

Frequency Analysis

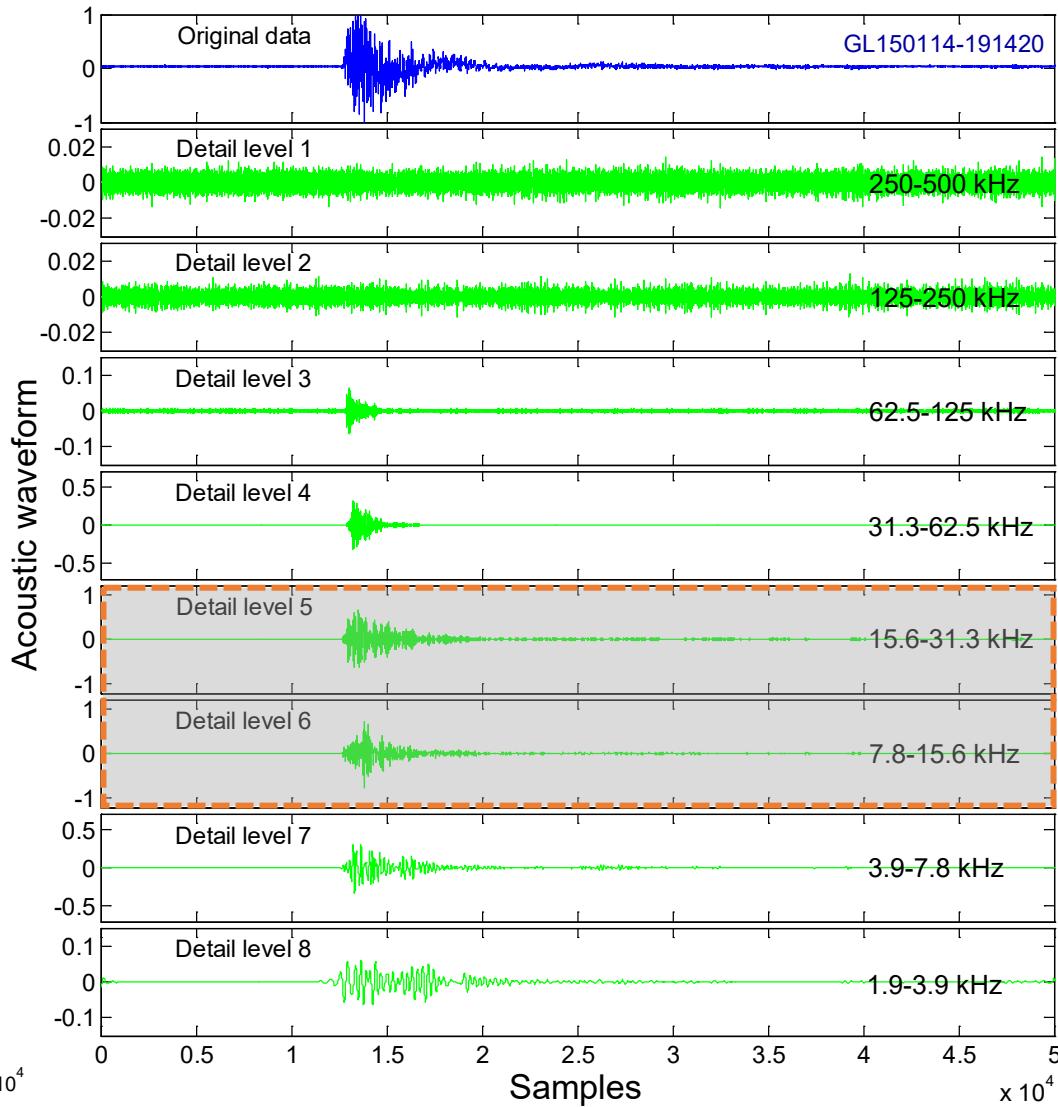
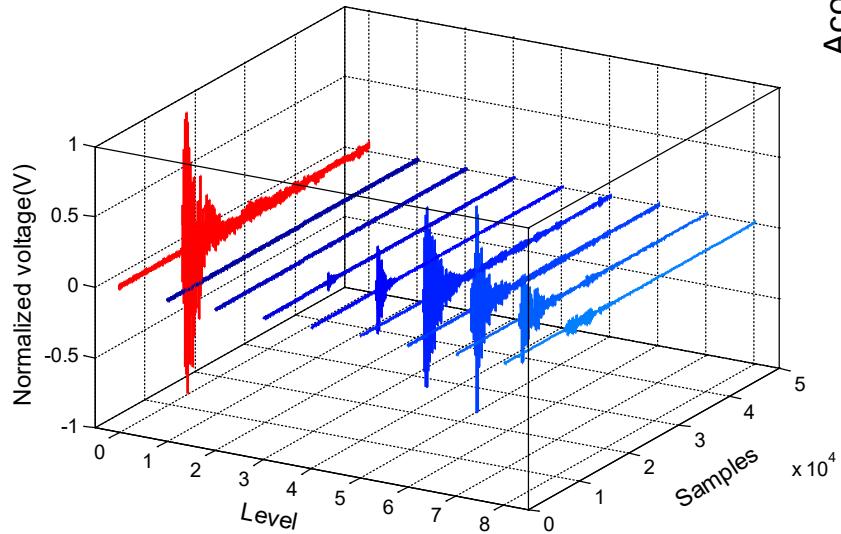
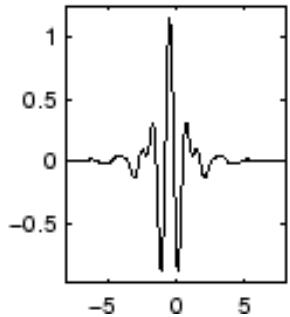
Method: **Discrete Wavelet Transform**

Purpose: To analyze the frequency characteristics in time-domain for acoustic signals.

Meyer scaling function



Meyer wavelet function



Background



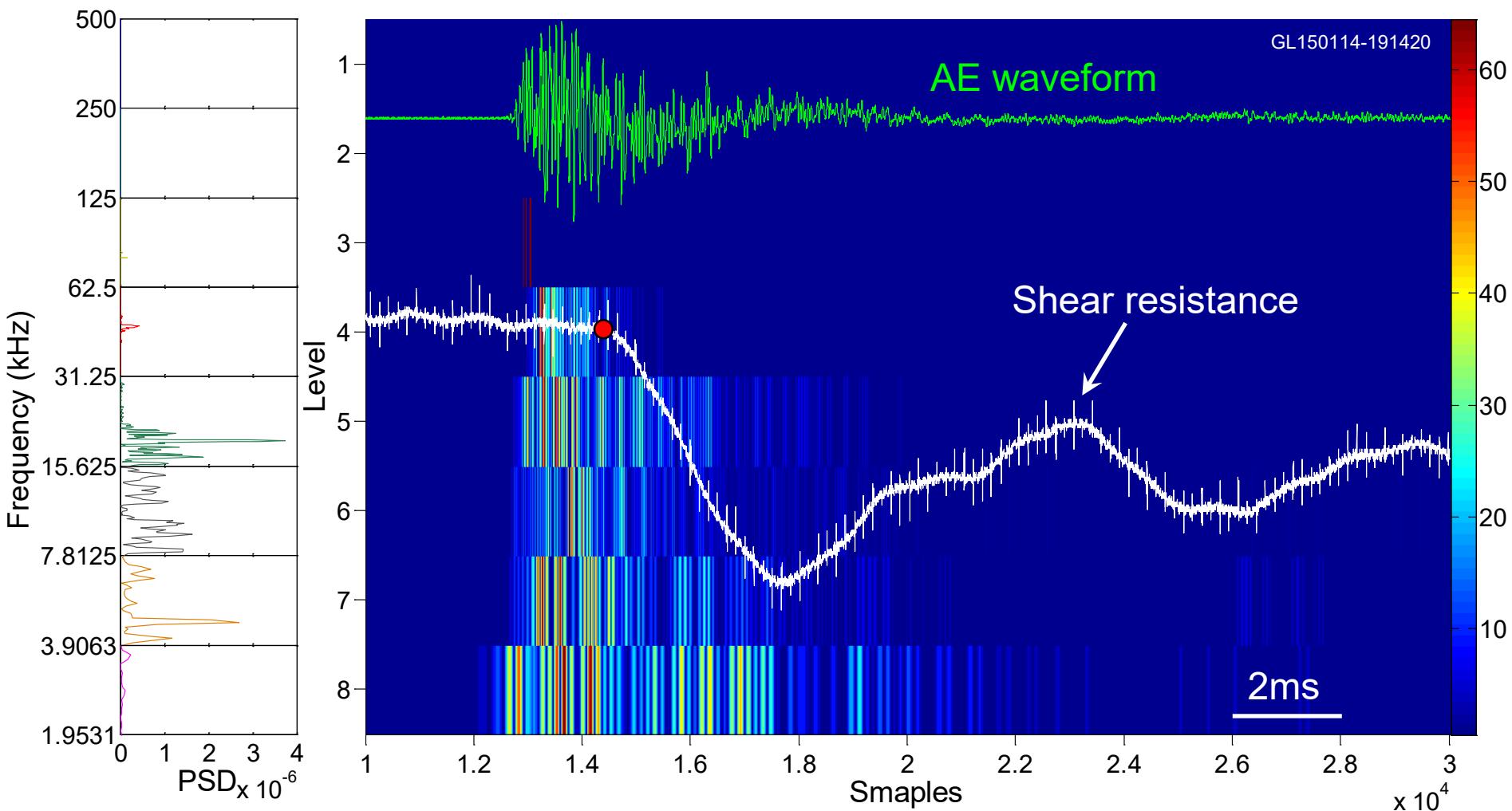
Experimental results



Discussion and Summary



AE and Shear Resistance Drop



AE priors to the failure of granular materials

Background



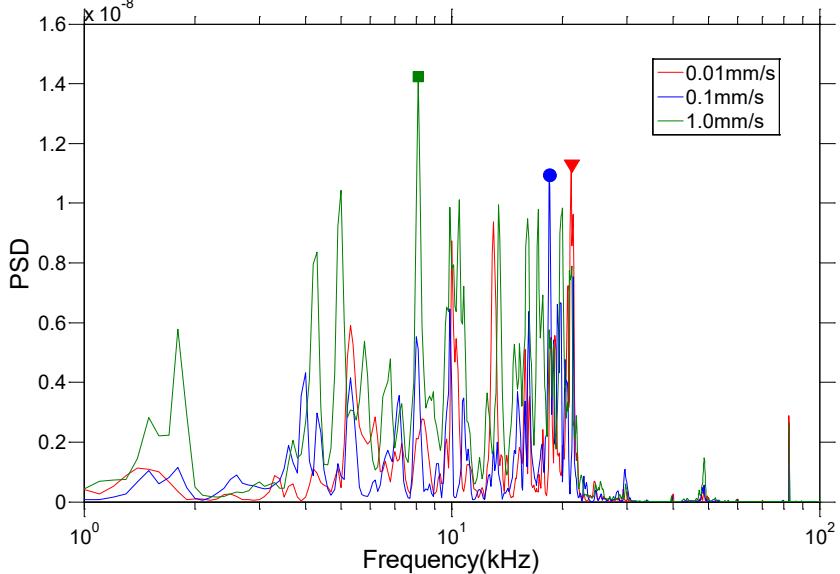
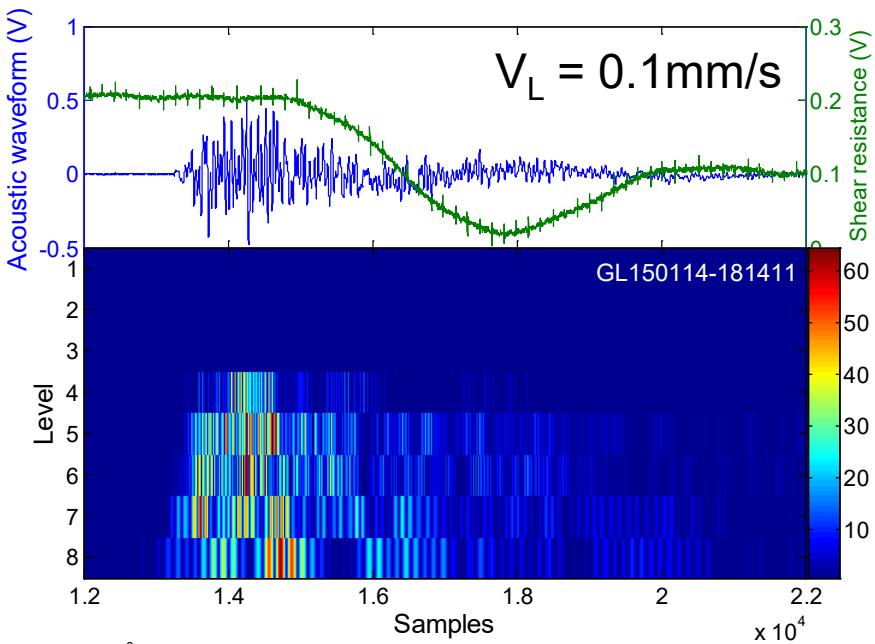
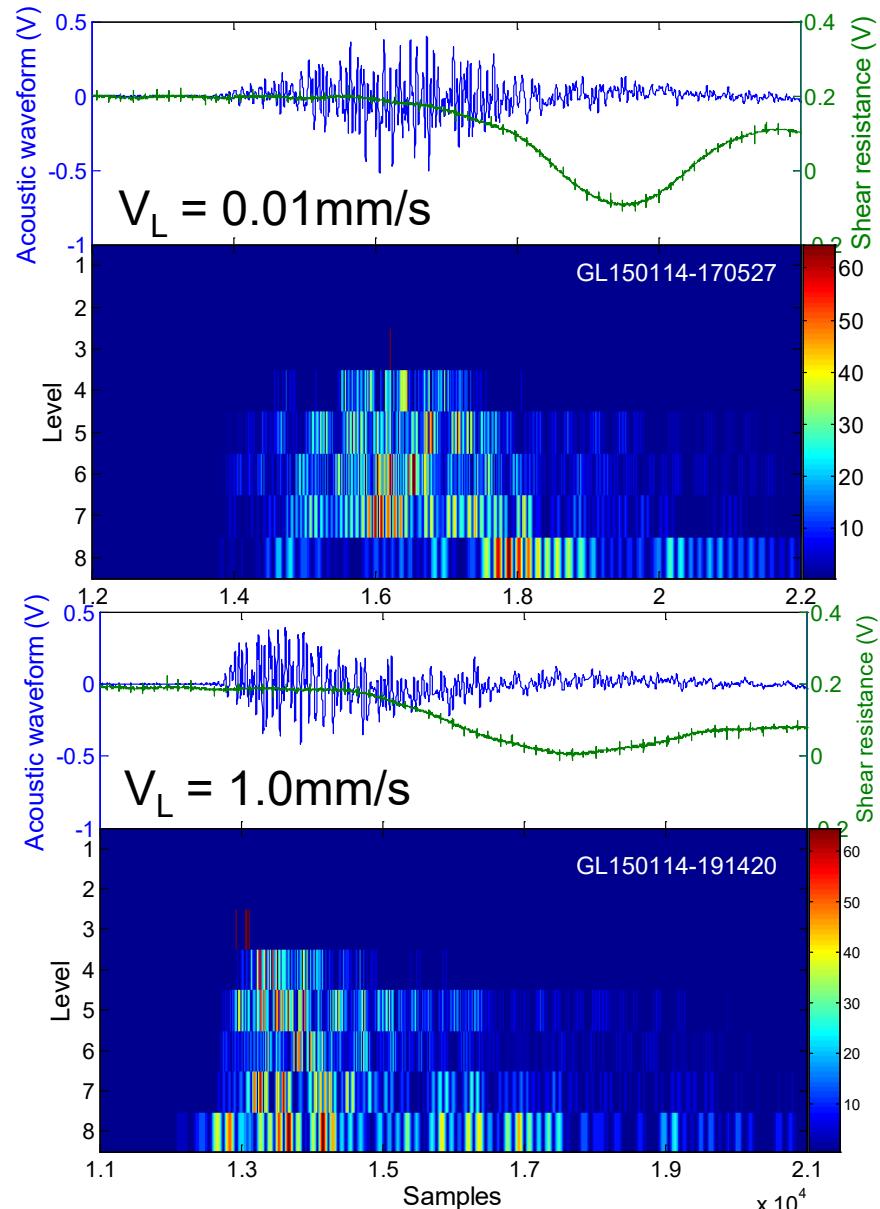
Experimental results



Discussion and Summary



Time-frequency Spectra of AEs



Background



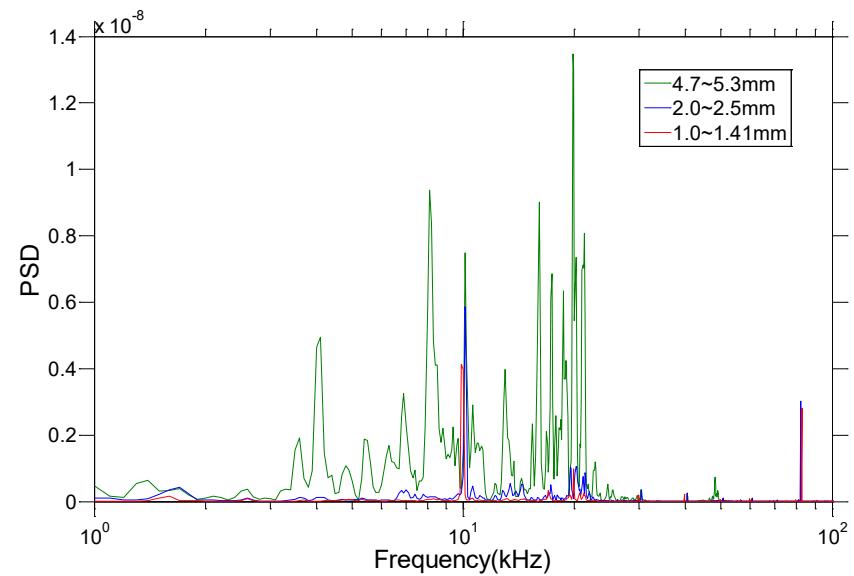
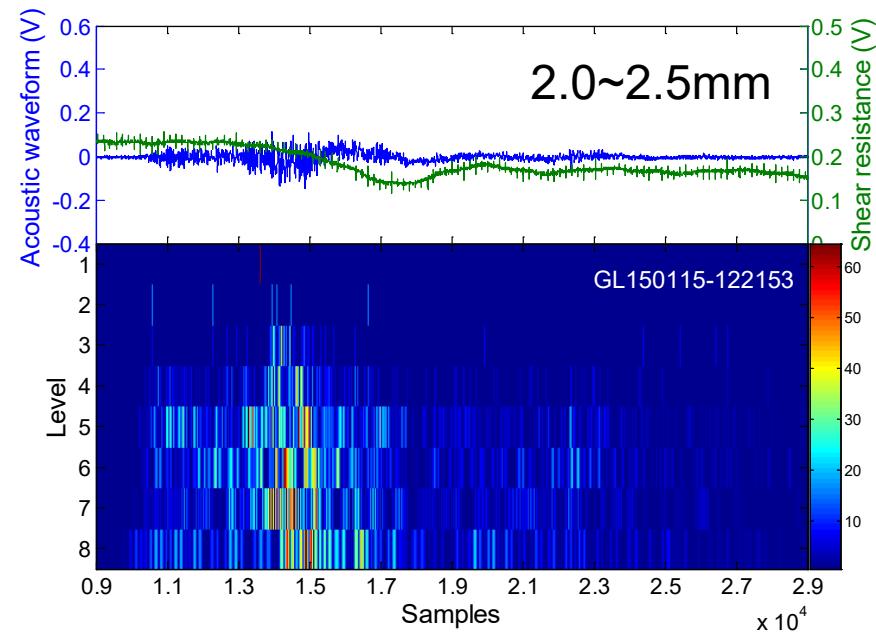
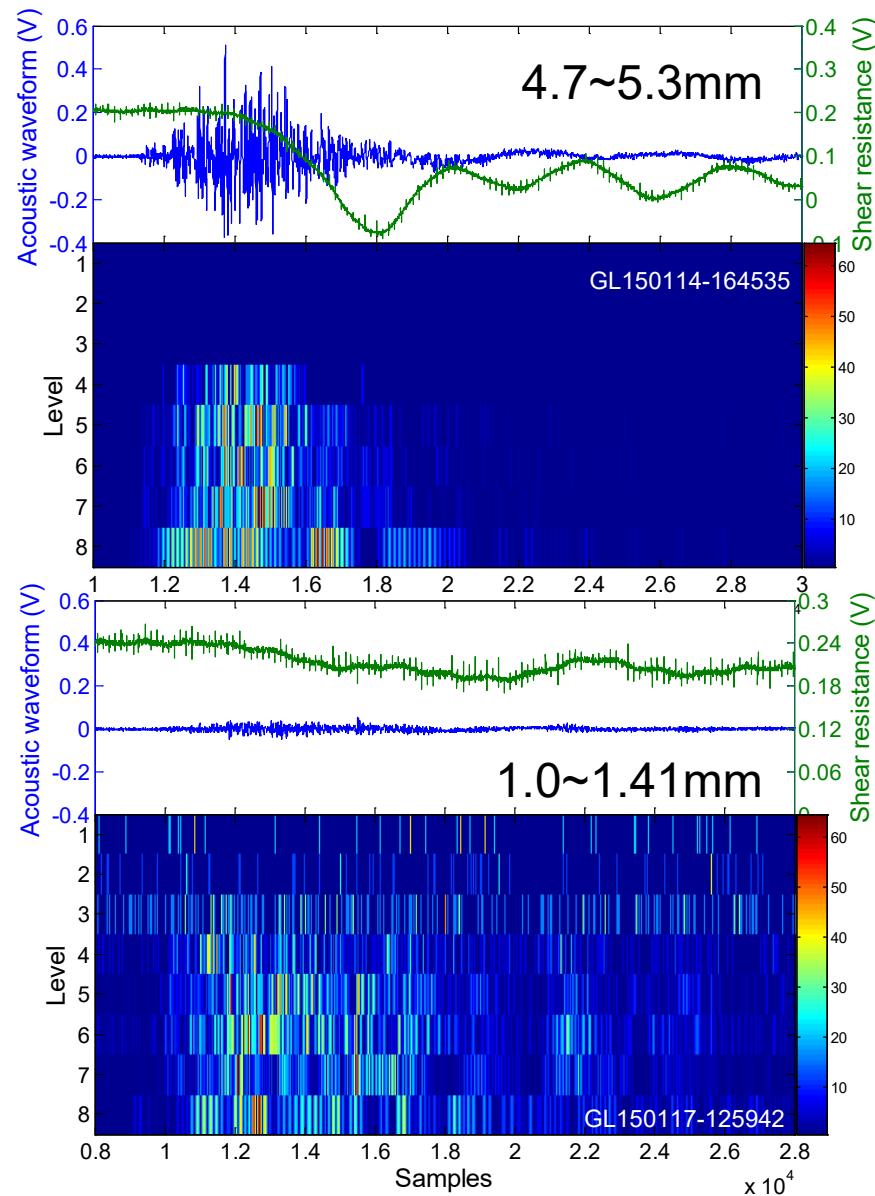
Experimental results



Discussion and Summary



Time-frequency Spectra of AEs



Key Findings and Future Work

- ***Large particle size shows more catastrophic instability.***
- ***AEs are *in kHz-range* characteristics and occurrence rate increases with increase of shear rate for granular materials.***
- ***Resistance release events are associated with AE generation, which precedes failures.***



Thank you for
your attention!