

# Acoustic signatures of slow and fast laboratory earthquakes

Federico Pignalberi<sup>1</sup>, Carolina Giorgetti<sup>1</sup>, Nathalie Casas<sup>1</sup>, Elisa Tinti<sup>1</sup>, Chris Marone<sup>1,2</sup>, Cristiano Collettini<sup>1</sup> and Marco Maria Scuderi<sup>1</sup>

1 Dipartimento di Scienze della Terra, La Sapienza Università di Roma, Rome, Italy, 2  
2 Department of Geosciences, Pennsylvania State University, University Park, Pennsylvania, USA

Mail to: federico.pignalberi@uniroma1.it

## 1. Motivations

- Can the same fault patch host the entire spectrum of fault slip behavior under the same stress condition?
- What are the seismic signatures of slow and fast laboratory earthquakes?

## 2. Experimental method

- Biaxial apparatus BRAVA2
- Double direct Shear configuration
- Sample material: Quartz gouge g.s. 10  $\mu\text{m}$

### Acoustic setting

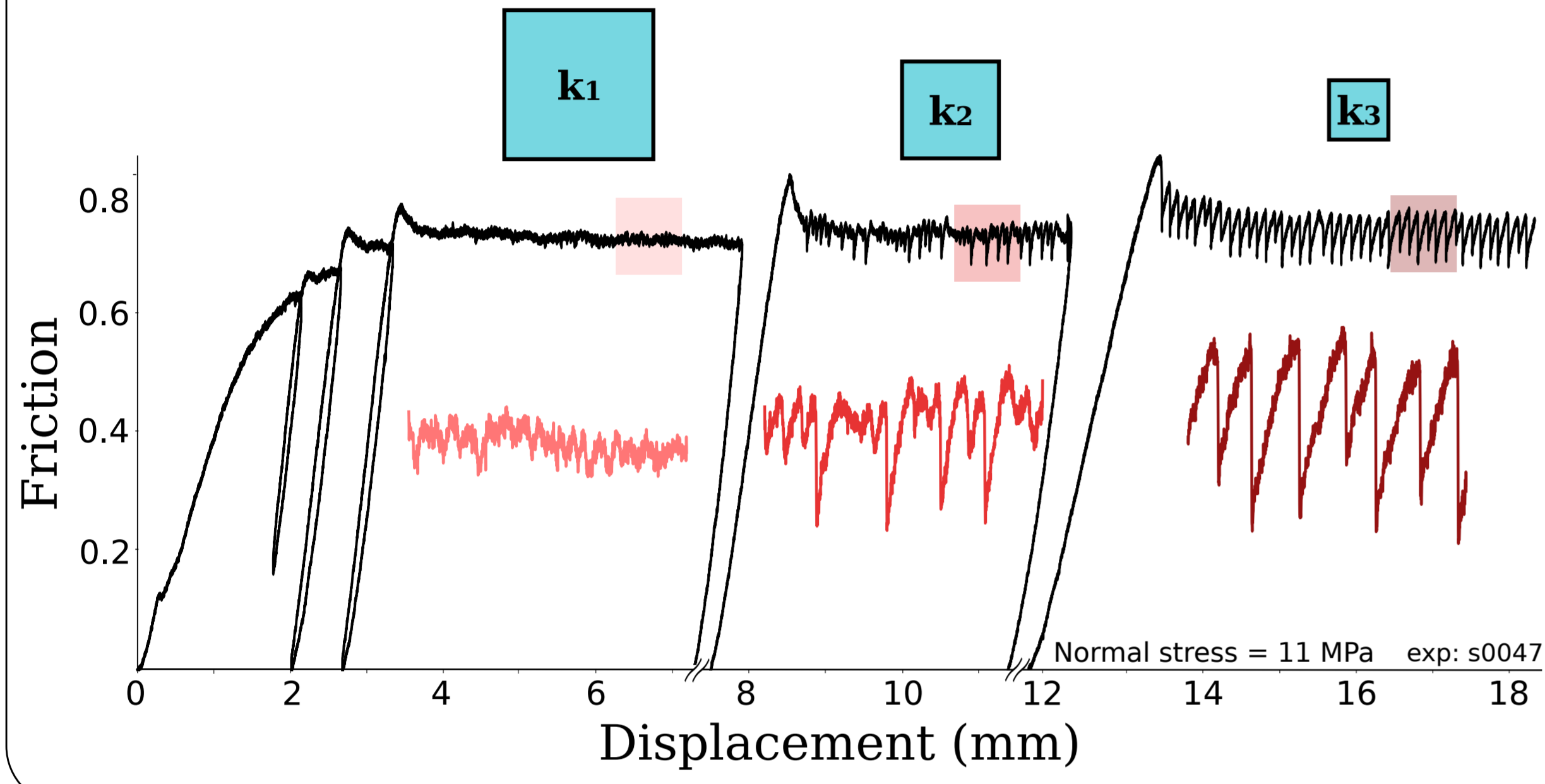
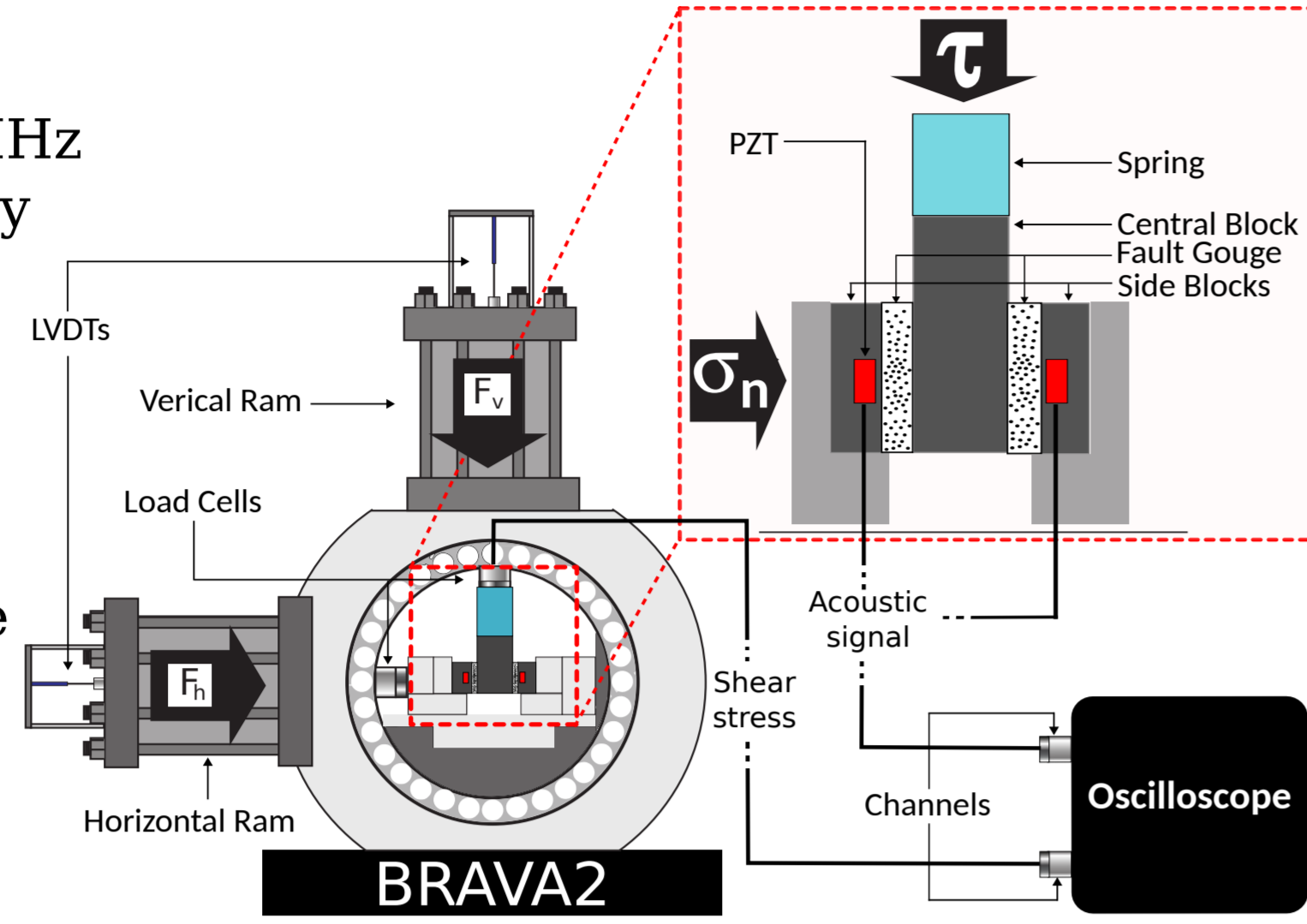
- PZT central frequency 1MHz
- AE recorded continuously
- Recording rate: 6.2 MHz
- No amplification
- 16 bit digitization
- 0.4 Volt range

- Three springs to modulate the machine stiffness:

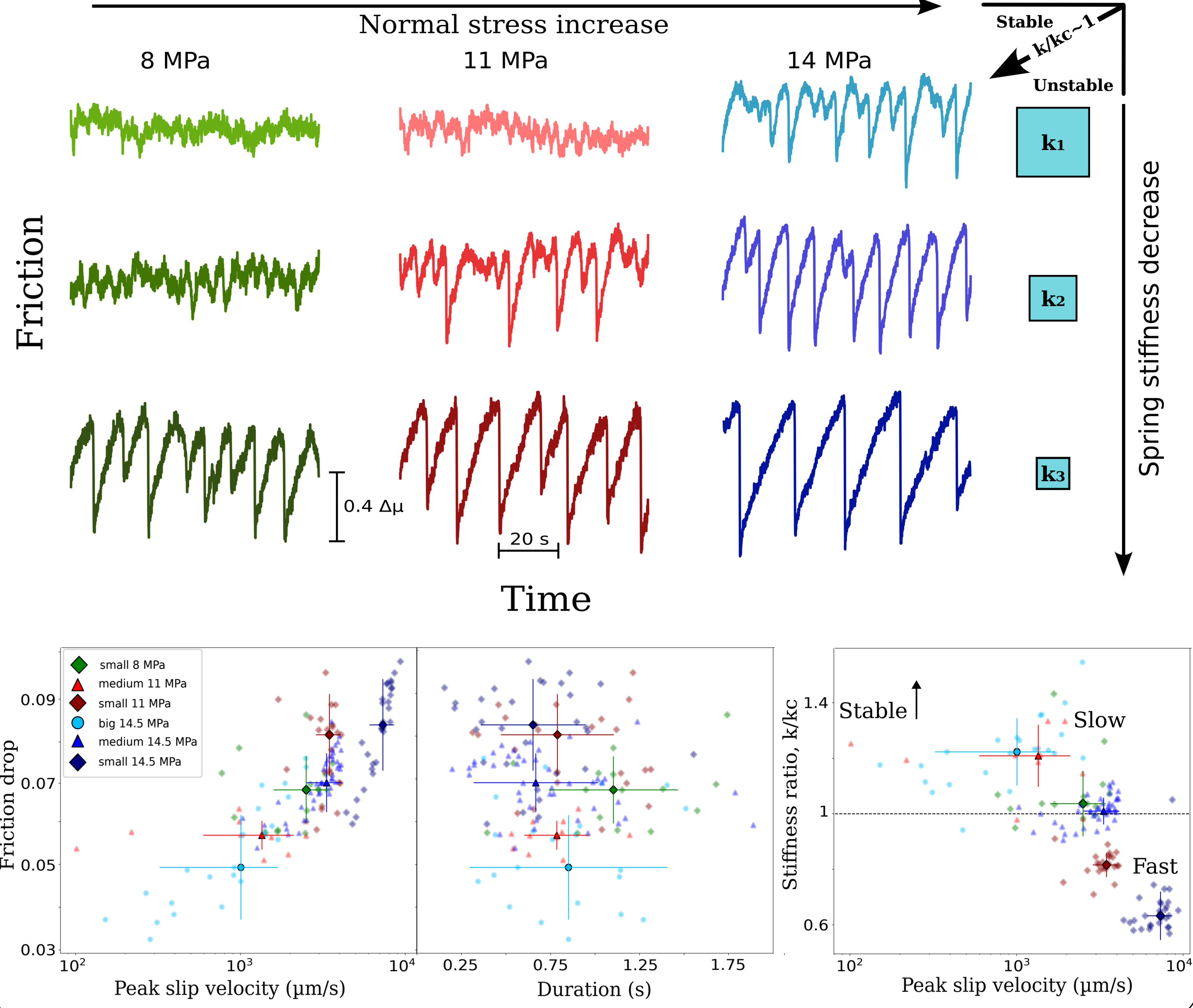
$$k_1 = 6.35 \times 10^{-2} \text{ kN}/\mu\text{m}$$

$$k_2 = 5.12 \times 10^{-2} \text{ kN}/\mu\text{m}$$

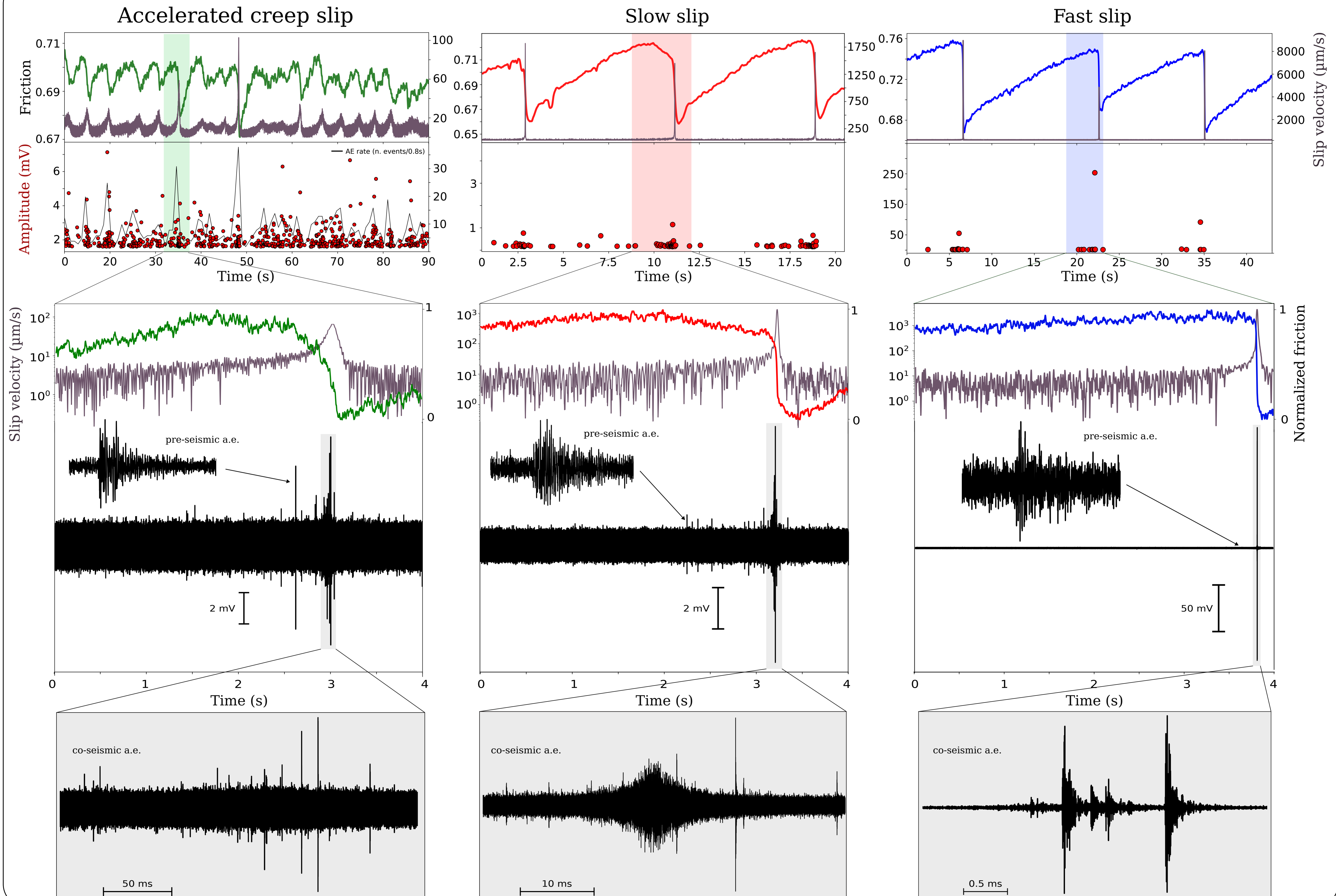
$$k_3 = 2.91 \times 10^{-2} \text{ kN}/\mu\text{m}$$



## 3. Mechanical data



## 4. Acoustic signatures



## 5. Take home messages

• Through the modulation of the machine stiffness we are able to reproduce the entire spectrum of fault slip behavior under the same stress condition. This suggests us that the same fault patch can generate both slow and fast laboratory earthquakes.

• Slow and fast laboratory earthquakes show different acoustic signatures. Slow slips are characterized by an emergent release of energy and a clear increase of seismicity in the fault acceleration phase (pre-seismic). Fast slips are characterized by an impulsive release of energy without any inter-seismic seismicity and low seismicity in the pre-seismic.