Numerical simulation on small-scaled granite during compression deformation

Ssu-Ting Lai[1], Nobuaki Fuji[1], Ikuo Katayama[2], Yann Capdeville[3],Luis Fabian Bonilla[1,4]

[1]Institut de Physique du Globe de Paris, Univ Paris Diderot, UMR 7154 CNRS, F-75005 Paris, France
[2]Department of Earth and Planetary Systems Science, Hiroshima University, Higashi-Hiroshima, Japan
[3]Laboratoire de Planétologie et de Géodynamique de Nantes, Nantes, France
[4]Université Paris Est – IFSTTAR, Cité Descartes, 77447 Marne-la-Vallée Cedex 2, France

We present an application of the full waveform numerical modeling to experimental seismic records on a centimetre-scale rock sample using spectral-element method (SEM). This method can detail the procedure of the changes in the velocity structure of rocks during the deformation that allows us to understand the history of the earthquake nucleation. We first recall the experimental records in the laboratory by Zaima and Katayama (2018). The triaxial compression experiment with one-source and one-receiver is applied on a granite rock sample. The P- and S-wave propagating perpendicularly to the compression direction are recorded by the receiver directly opposite the source. Therefore, the changes in velocity structure during the earthquake nucleation can be measured. We briefly outline the spectral-element method and present the system built for full waveform data processing. The numerical examples that illustrate the capabilities of the method and its interest in the time-lapse three-dimensional synthetic waveform modeling of the rock sample during deformation. The regular relationship among velocity, quality factor and stress suggests that understanding the temporal variation of seismic wave characteristics through numerical modeling can provide insights into the mechanisms of rupture and earthquakes.

Key Points:

- Rock mechanics
- Seismology
- Numerical modeling
- Earthquake nucleation