Sujet proposé pour un début de contrat en octobre 2018

TITRE du SUJET :

Rupture process of cracked granite during shear deformation inferred from loboratory experiments using waveform modeling

Directeur (trice) : **Fabian Bonilla (IPGP), bonilla@ipgp.fr**

Une co-direction de la thèse sera proposée tant à l'IPGP que dans le laboratoire partenaire de cette thèse le cas-échéant :
Nobuaki Fuji (IPGP, Sismologie : qui soutiendra l'HDR vers la fin 2018)

Equipe d'accueil : *Equipe de Sismologie*
IPGP– UMR7154

Financement : **Contrat doctoral avec ou sans mission d'enseignement**

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Développement du Sujet : (1 à 2 pages)

Earthquake is one of the major devastating disasters that cost life and economy of all the beings on the Earth. There have been many efforts to understand the physics of earthquake generation, which we still do not fully understand. Both weakening and rupture process need still to be studied from microscopic to macroscopic scales due to their high non-linearity. In this project, we will study the microscopic weakening and rupture process using laboratory and numerical experiments in order to cross-verify the results. We perform active seismic measurements during the laboratory experiments in order to infer the time-lapse detailed structure inside the system. We will first perform a series of deformation experiments within one-to-ten-centimeter scale granite. We propose several configurations of size of the system and of seismic measurements in order to obtain accurate and robust data for structural imaging. We will then analyze the time-lapse seismic data by trial-and-error forward modeling, that progressively takes into account the detailed effects such as anisotropy, anelasticity and porosity. Due to the dramatic parameter changes during the deformation of the rock that result in highly non-linear waveform distortion, we prefer not to use classical least square inversion schemes. On the other hand, the repetitive time-lapse active seismic data will constrain a coherent development of structural change. We will then numerically simulate the dynamic deformation processes, proposing some scenarios. We will then again calculate seismic waveforms for those scenarios to reproduce seismic observation of laboratory experiments. This cross-verification is an important step to understand what kind of dynamic features are really observable during the experiments. This project will thus detail a microscopic dynamics during the nucleation of earthquakes using full waveforms, which will have an impact on fundamental understanding of earthquake physics and improving large-scale seismic hazard estimates.

This project is in collaboration with Alexandre Schubnel, Harsha Bhat (ENS), XiaoPing Jia (Institut Langevin), Ikuo Katayama (Hiroshima University).