Invited personnel：Guillaume Richard (Institut des Sciences de la Terre d'Orléans)
Host researcher：Hikaru Iwamori (JAMSTEC)
Period：16th May, 2017 – 26th May, 2017
Purpose：Studies on coupled effect of grain-size evolution and phase mixing: A two phase model for the ductile deformation of rocks

Seminar information：
Date and time: May 23rd、2017、JpGU@Makuhari
Abstract:

Rocks are complex materials and particularly their rheological behavior under geological stresses remains a long-standing question in geodynamics. Numerical modeling is the main tool to test large scale lithosphere dynamics but encounter substantial difficulties to account for this complexity. One major unknown is the origin and development of strain localization. This localization is observed within a large range of scales and is commonly characterized by sharp grain size reduction. These considerations argues for a control of the microscopic scale over the largest ones through one predominant variable: the mean grain-size. However, the presence of second phase and broad grain-size distribution may also have an important impact on this phenomenon.

To address this question, we built a model for ductile rocks deformation based on the two-phase damage theory of Bercovici & Ricard 2012. We aim to investigate the role of grain-size reduction but also phase mixing on strain localization. Instead of considering a Zener-pining effect on damage evolution, we propose to take into account the effect of the grain-boundary sliding (GBS)-induced nucleation mechanism which is better supported by experimental or natural observations (Precigout et al 2016).

This continuum theory allows to represent a two mineral phases aggregate with explicit log-normal grain-size distribution as a reasonable approximation for polymineralic rocks. Quantifying microscopic variables using a statistical approach may allow for calibration at small (experimental) scale. We use the interface density as a measure of mixture quality, and propose that its evolution is controlled by the dominant deformation mechanism. Based on the microscopic set of equations derived from these hypothesis, we compute grain-size dependent viscosity fields for a 2D creep flow model using anorthite/pyroxene gabbroic composition. The influence of initial parameters such as grain-size variability, phase proportions and strain-rate field on the occurrence and importance of strain-localization is then discussed.