ID de Contribution: **52** Type: **Talk**

Insights into fault evolution and rupture dynamics in a strike-slip context from 3D Discrete Element models

lundi 30 mars 2026 10:23 (13 minutes)

Strike-slip continental faults often show complex geometries, inherited from their past history. More particularly, they display branches, bends, and steps, also referred to as geometric asperities. Thus, far from being straight-lined, continental strike-slip faults are characterised by disconnected and misaligned sections, whose length and separating distance vary as the faults mature in time.

The presence of those discontinuities (or complexities) along the fault could affect earthquake rupture dynamics; indeed, the extensional or compressional nature of these discontinuities results in stress heterogeneities along the fault system. In addition, depending on the degree of development of the latter, the deformation at fault complexities can show various levels of localisation, balancing between fault segments well connected by fractures and fault portions dominated by damaged zones where the deformation is distributed. As a consequence, fault complexities often act as nucleation- or end-points for seismic ruptures.

In order to study the effect of fault geometry on earthquake ruptures, we developed a 3D numerical model of an evolving continental strike-slip fault, based on the Discrete Element Method (DEM).

In this model, an initially intact medium is subjected to a strike-slip tectonic regime and, thanks to the DEM capability to explicitly describe progressive failure mechanisms, it evolves through different stages of deformation that eventually lead to the emergence of a structure presenting complexities similar to that of natural faults. We are thus able to analyse the relationship between fault maturity and fault geometry. In addition, multiple local ruptures occur along the fault. Therefore, we can characterise the evolution of the earthquake cycles with geological history: on one hand, for each earthquake, we explore how the rupture is spatially affected by fault complexities; on the other hand, we look at the way successive earthquakes progressively modify the geometry of the fault system. Finally, we compare those observations with natural cases.

Speaker information

PhD 3rd year

Auteurs: ALLEMAND, Adélaïde (IPGP); Dr SCHOLTÈS, Luc (Université Clermont Auvergne, CNRS, IRD, OPGC, Laboratoire Magmas et Volcans); Dr KLINGER, Yann (CNRS, IPGP)

Classification de Session: PhD Talks

Classification de thématique: Earth and Environment