

Research Topic for the Arts et Métiers ParisTech - CSC PhD Program

Subfield: Applied solid mechanics, faulting, contact mechanics, viscoplasticity, rock mechanics, geophysics, seismic cycle, earthquake prediction

ParisTech School: Arts et Métiers ParisTech

Title: INFLUENCE OF RHEOLOGICAL AND FRICTIONAL SLIP PROPERTIES ON FAULT MECHANICS, DEFORMATION RATES AND LOCALIZATION PHENOMENA

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Short description of possible research topics for a PhD:

In the last two decades, considerable observational and theoretical work has been devoted to all aspects of earthquake prediction research, for solving fundamental questions concerning the mechanics of fault systems, as well as for answering questions regarding earthquake hazard.

The european natural observatory of the Corinth Rift (<http://crlab.eu>), a very rapidly deforming area (opening strain rate of $\sim 10^{-6}$ /yr) where one or more earthquakes with magnitudes above 6 are expected in the coming decades provides a framework in which the mechanics of faults can be studied in details. It is densely instrumented and provides an exceptional data base (seismological, GPS and strain data).

All the prediction approches in the litterature rely on some probalistic description of earthquake generation and timing, through empirical laws guided, or structured, by some simplification of the underlying physical process. This requires that relevant physical models and observational constraints are put at the core of any probabilistic law seismic-hazard assessment. Based on numerical modeling of the CRL region with realistic rheology and fault geometry, our objective is to constrain these key mechanical parameters by improving our ability to model the mechanics of faults in the Corinth Rift as well as their interactions.

Required background of the student: Solid Mechanics, Physics, Geophysics, Applied Mathematics,

2-3 representative publications of the group:

[1] F. Chinesta, A. Ammar, H. Lamari, N. Ranc. *Atoms, Molecules and Flows: Recent Advances and New Challenges in their Multi-Scale Numerical Modeling at the Beginning of the Third Millenium*. Trends in Engineering Computational Technology, B.H.V. Topping Edt., Saxe-Coburg Publications, Chapter 13 : 247-269, 2008.

[2] Hlène Lyon-Caen, Panayotis Papadimitriou, Anne Deschamps, Pascal Bernard, Kostas Makropoulosb, Francesco Pacchiania "First results of the CRLN seismic network in the western Corinth Rift: evidence for old-fault reactivation", *Comptes Rendus Geoscience, Volume 336, Issues 4–5, March 2004, Pages 343–351*

[3] P. Bernarda, H. Lyon-Caen, ... « Seismicity, deformation and seismic hazard in the western rift of Corinth: New insights from the Corinth Rift Laboratory (CRL) », *Tectonophysics, Volume 426, Issues 1–2, 30 October 2006, Pages 7–30*

[4] I. Gueye, S. El Arem, F. Feyel, F.-X. Roux, G. Cailletaud : A new parallel sparse direct solver : presentation and numerical experiments in large-scale structural mechanics parallel computing, *International Journal for Numerical Methods in Engineering*, Vol. 88(4), P. 370-384, 2011.

[5] Lambotte, S., Lyon-Caen, H., Bernard, P. , « Reassessment of the rifting process in the Western Corinth Rift from relocated seismicity », *Geophysical Journal International, Volume 197, Issue 3, 2014, Pages 1822-1844*

FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:

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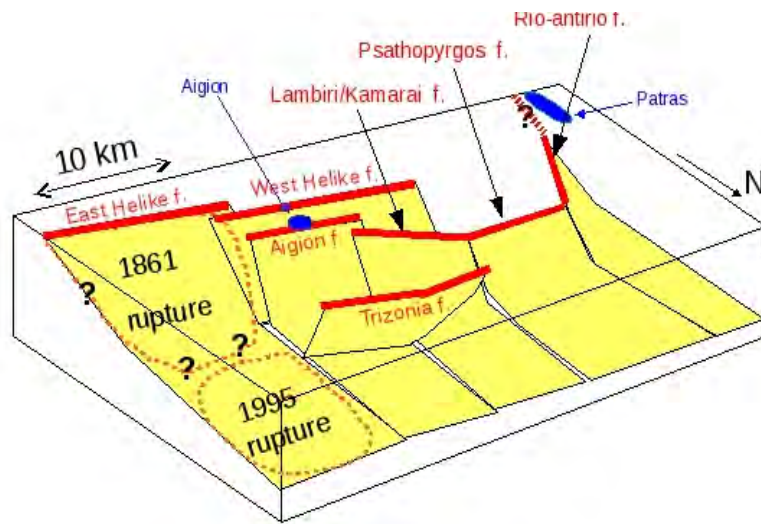


Figure 1: sketch of the major active faults of the CRL area. Surface scarps in red. Trizonia fault is the only south dipping fault. The 1995 may have occurred on the Helike fault (uncertain dip and connectivity)

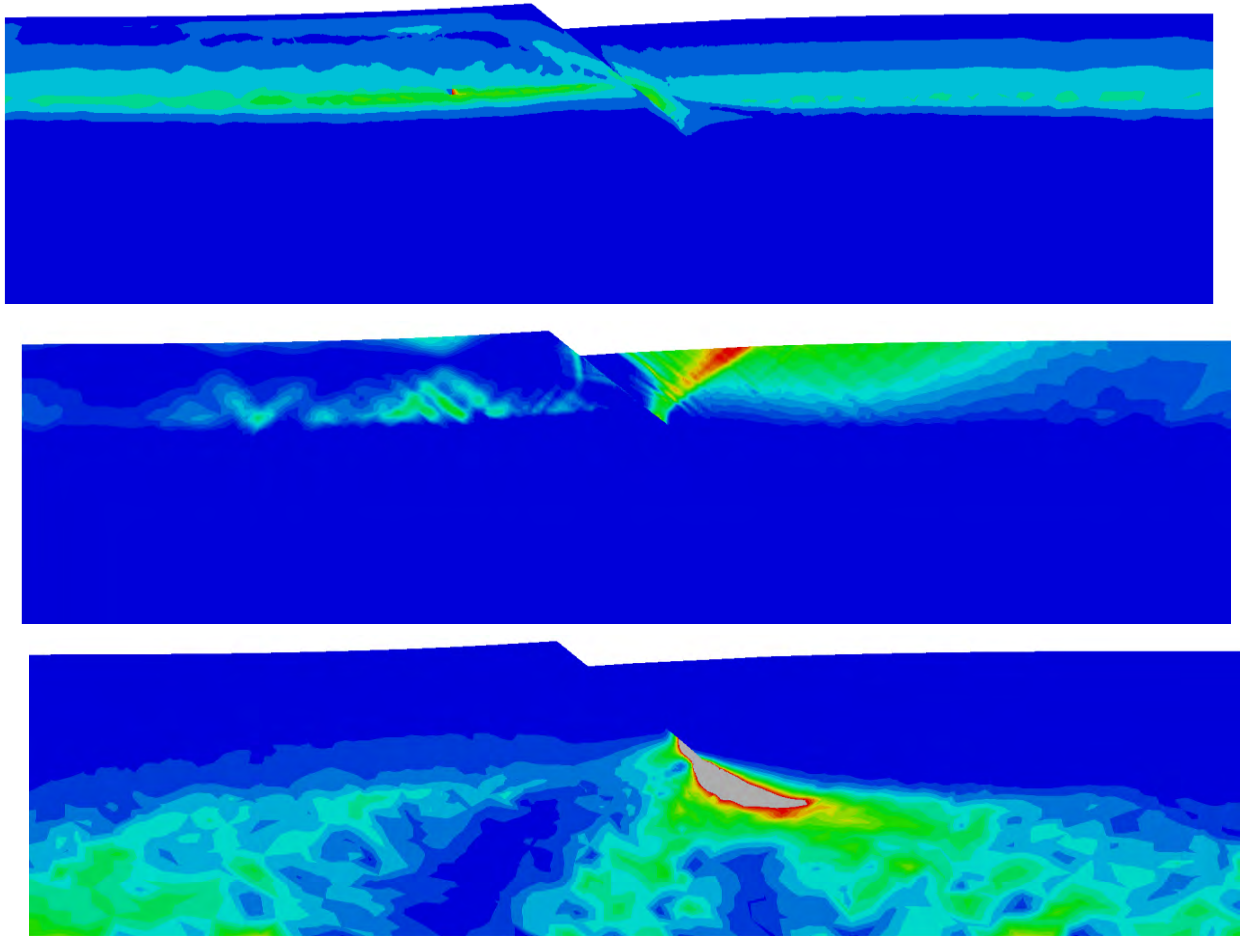


Figure 1: Stress and strain near fault zone. (a) Mises equivalent stress (b) Equivalent plastic strain (c) Equivalent creep strain.