Subject offered for a contract starting october 2014

SUBJECT TITTLE:

Toward a mechanical model of earthquake cycle: The Dead Sea Fault as a test case

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Financing:	Doctoral contract with or without assignment

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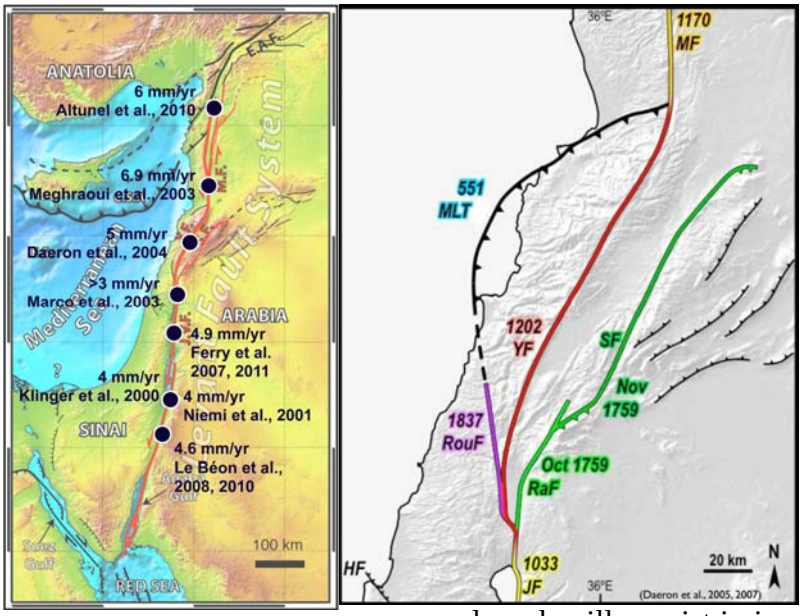
Presentation of the subject: (1 or 2 pages)

Toward a mechanical model of earthquake cycle: The Dead Sea Fault as a test case



Earthquake ruptures are modeled as dynamic shear fractures (Mode II) on a frictional interface. These frictional interfaces, faults, are known *a priori* and are geometrically very complex. To understand the seismic hazard associated with an earthquake one would need to know how these ruptures navigate through a geometrically complex fault/ crack system. We propose, for this PhD, to address this topic in the framework of the Dead Sea fault.

The PhD topic incorporates the various aspects needed to address this question. The first part of the proposed work will consist in improving the dataset available to constrain the history of earthquake ruptures along the Dead Sea fault. In parallel, we plan to realize sandbox experiments to study in details how strike-slip faults organize themselves through segmentation. In a last part, using a well-known tool called the Boundary Integral Equation Method (BIEM) the PhD candidate will test models of shear ruptures on the precisely defined fault geometry of the Dead Sea

fault. Hence, all these observation will be integrated to propose a unified model of earthquake rupture along the Dead Sea fault that will incorporate all the data available.

The first part of the PhD project will be devoted to work on the earthquake history of the southern part of the Dead Sea fault, between the Dead Sea and the Gulf of Aqaba. To do so, the PhD candidate will be in charge of analyzing results from the last paleosismological experiment (conducted in May 2014) and to take the lead for the next campaign that is schedule in October 2014. In addition, the candidate will also be involved in mapping and dating geomorphology in the Gulf of Aqaba, along the Saudi coast where we have initiated a new collaboration with colleagues of KAUST (in Jeddah). These data, in addition to the data we already gathered during the recent years will constitute a unique dataset to decipher the details of the great earthquake ruptures along the Dead Sea fault, between Lebanon and the Gulf of Aqaba. In order to understand well the various mechanisms that control the geometry of strike-slip faulting, and more specifically the lateral segmentation of faults, the candidate will also be involved in the strike-slip fault sandbox experiments that we have started with the colleagues of the university of Cergy and Paris 6. This part of the work will provide us with a way to test different parameters (rheology, thickness of brittle layer…) in a controlled environment to better understand what is actually controlling the segmentation of strike-slip faults. If the experiments are successful, we also plan to test materials with stick-slip behavior to see if we could reproduce earthquake rupture during sandbox experiments. Eventually, during the last part of the PhD, once we'll have a better understanding of strike-slip faulting, the candidate will evaluate several rupture propagation scenario that best agree with historical earthquakes data and fault geometry along the Dead Sea fault. If time allows, the candidate will build a pseudo-earthquake cycle model, based on BIEM, where one would semi-automatically alternate between implicit, quasi-dynamic and explicit, dynamic simulations to mimic a full earthquake cycle that would incorporate realistic boundary conditions (in that case long-term tectonic loading, see figure on the left inside).
Eventually, taking advantage of the unique setting of the Dead Sea Fault (numerous historical and geological data, well constrained fault geometry…) the PhD candidate will be able to propose a meaningful mechanical model of fault behavior that would be consistent with geological observation at different time scales. Because this region is largely inhabited with several large cities in short distances (Damascus, Jerusalem, Beyrouth to name only a few), understanding how earthquakes propagate and relate to each other in space and time is of primary importance to improve the regional seismic hazard.

The proposing team is composed of Y. Klinger (DR CNRS), specialized in earthquake mechanics and active tectonics, with a long experience along the Dead Sea fault. N. Cubas (MdC P6) and P. Souloumiac (MdC Univ. Cergy) will be involved for the sandbox experiments. H. Bhat (CR CNRS), will be involved for the fracture mechanics and dynamic rupture propagation