



Subject offered for a contract starting October 2017

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**SUBJECT TITLE:**

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Host lab/ Team : *please fill in and leave out meaningless information*  
**IPGP- Tectonics – UMR7154**

Financing: Doctoral contract with or without teaching assignment

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*For more information go to <http://ed560.ipgp.fr>, section: Offres de these ( PhD offer), You must apply on the Doctoral School website*

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Presentation of the subject: (1 or 2 pages)

Vertical tectonics of the Dead Sea fault system in Gulf of Aqaba  
Y. Klinger (IPGP), E. Pons-Branchu (LSCE) and S. Jónsson (KAUST)

The Dead Sea fault bounds the Arabian plate to the West, allowing for northward motion of the Arabian plate relative to the Sinai micro plate. The fault is about 1200 km-long, connecting the Red Sea rift to the collision zone of Taurus-Zagros. Displacement along the Dead Sea fault is dominated by left-lateral horizontal motion. The slip rate has been determined at different time scales, from a decadal scale to several thousands of years, and it appears to be stable with an average horizontal slip-rate average of  $5 \pm 1$  mm/yr.

In few places, due to geometrical fault complexity, a significant part of the total deformation is accommodated by vertical motion in addition to the horizontal motion, e.g., extensional relay zones in the Dead Sea basin and Gulf of Aqaba have led to creation of major pull-apart basins.

More specifically, Gulf of Aqaba that is located at the southern end of the fault is formed by a succession of 4 pull-apart basins, including the Aragonese deep that reaches 1800 m below sea level. The gulf is 15-25 km wide and is surrounded by steep topography topping at about 2000 m above sea level, both in Egypt and in Saudi Arabia. Such dramatic topography strongly suggests that vertical deformation, in addition to horizontal motion, is significant in the region. This is confirmed by seismological data from the gulf that show normal faulting earthquake focal mechanisms in addition to dominant strike-slip faulting.

Because the region is undergoing intense urban and economic development along the entire coastal area, it is critical to assess the activity of the normal faults bounding the gulf, as any significant activity on these faults would impact development along the coast. Hence, this project aims at quantifying the part the vertical deformation plays in the total budget of deformation in Gulf of Aqaba.

On one hand we will take advantage of the interplay between eustatic variations, which relate to climatic changes, and tectonics to systematically map and date abandoned coral reefs that are found at various elevations along the Saudi Arabian coast of Gulf of Aqaba. These coral reefs are located on the footwall of the normal faults bounding the gulf and they record progressive uplift of the coast relative to the sea level at the date of formation. This part of the work involves mapping coral terraces on satellite images and in the field and carrying out actual dating of the corals (Th/U series, geochemistry and dating will be done at LSCE).

On the other hand, a bathymetry campaign in Gulf of Aqaba is schedule in Spring 2018. The applicant will be involved in the acquisition and interpretation of the bathymetric data to provide a new map of the offshore faults in the gulf.

Eventually, during the last part of the PhD, the applicant is expected to integrate fault geometry derived from the marine campaign with ages and height of marine terraces to build a consistent model of deformation of the gulf and to quantify the part of vertical/extensional deformation versus the part of horizontal deformation in the total deformation budget.

During this PhD project the applicant will be involved in the geochemistry preparation of coral samples for dating at LSCE, under supervision of E. Pons-Branchu. It is very likely that additional mapping and sampling will be required during the time period of the PhD, involving field work in Gulf of Aqaba, along the Saudi Arabian coast. The applicant will also be directly involved in the marine experiment, which includes about 1 month of data acquisition at sea. Data interpretation and tectonic modeling will be done under supervision of Y. Klinger at IPGP. During the entire PhD time, strong interaction is expected with S. Jónsson, at KAUST, and with other members of the project “Interdisciplinary Seismic Hazard Research in Gulf of Aqaba and Strait of Tiran (GAST)”, of which this PhD project is part.

The PhD applicant will be located in the tectonic team at IPGP.