

Title of the doctoral project: Characteristics of quaternary fault activities in the Armorican Massif using geomorphology and geophysical techniques.

Key words: Tectonics, Morphology, Paleoseismology

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Context: France is situated far from plate tectonic boundaries and considered now a stable continental region with a very low strain rate, especially in the north west. However, the recent Mw4.9 2019 Le Teil and 2023 La Laigne earthquakes highlighted that active faults are not all clearly identified and should be better characterized. The Armorican Massif is cross-cut by several inherited faults and shear zones, which formed during the Cadomian and Hercynian orogens, the opening of Mezo-Cenozoic basins and several compressional phases over the Cenozoic. The historical and instrumental seismicity present a moderate activity, trending SE-NW, in agreement with the direction of main regional shear zones and faults. Besides these observations, identifying active faults (i.e., active over quaternary, then the last 2 Ma) and what drives the deformation, remains a difficult task.

Objectives: this project proposes to analyze major faults of the Armorican Massif using high resolution data available since few years. Guided by the recent seismicity locations, and based on satellite images and topographic data, the PhD. candidate will first map precisely the fine structure of faults and analyze their interactions with the morphology and quaternary deposits. Then, sites of interests will be investigated during field work campaigns, where geological and geophysical tools will be deployed to characterize the fault structures at depth, and their links with the observed surface scarps. The goal will be to detect and localize possible discontinuities at depth in the quaternary deposits, identify their lithology and quantify their thickness. Finally, the PhD. candidate will perform paleo-seismological trenching to look for deformation in the quaternary deposits.

Environments and collaborations: the LPG (Nantes facility), through the OSUNA, is now in charge of the observation and characterization of seismic activities along faults and shear zones in the NW part of France, and involved in the development of new techniques to acquire high resolution topography (LiDAR). The PhD. candidate will benefit from the expertise of seismologists and geomorphologists in the lab, and regional collaborations in geomorphology and geophysics (Géosciences Rennes and Université Gustave Eiffel) in the frame of current projects (*QASArm*, *ALEP*, *SALLE*), funded by the observatory (OSUNA). Finally, the French action FACT (ACTIVE Faults) launched in 2019 through the research infrastructure Résif/Epos-France gather national experts in seismo-tectonics, collaborating each other to better understand active faults in France.

Required profile

The PhD. candidate will be a graduate student in Earth sciences and will need to use the common tools to study active faults (GIS, electric, seismic and radar geophysics). A good knowledge of basic notions in field work geology, geomorphology, tectonic and geophysics is required. A strong ability to work as a team is also required.