e2s UPPA energy environment solutions	**DOCTORAL POSITION**	UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

For details about the program E2S-UPPA, please visit our website: **http://e2s-uppa.eu/en/index.html**

From : **September 1st 2018 to September 1st 2021**

Title:

Experimental characterization and modeling of seismo-electromagnetic waves

Thesis abstract:

A seismic wave propagating in a porous media generates electromagnetic (EM) wavefields through the so-called seismoelectric conversion. The EM contribution can then be divided into two different categories 1) a co-seismic transient electric field accompanying the seismic wave, 2) an electromagnetic wave generated by the conversion of seismic into EM energies at the interface separating two different porous media. The first EM wave follows the seismic and does not carry that much more information compared to the seismic whereas the depth-converted EM waves have potentially huge application in near-surface Geophysics since, for example, a water-oil contact would generate an EM seismoelectric conversion where the seismic field could be poorly sensitive to such an interface. The quantitative understanding of the conversion at interfaces is still poorly known and has only been seldom observed in the field and in a few laboratory experiments.

The first task of the PhD student will be to design, run and measure seismic and electromagnetic signals in a poro-elastic medium with the presence of interface(s) of various types and geometries. The seismic measurements will be performed by laser interferometry whereas the electrical potential measurements will be done with a mesh of electrodes buried in the porous medium. Once the experiments performed, he/she will analyze quantitatively the experimental measurements by comparing them with direct numerical simulations performed with an existing numerical code. She/he will then take in hand the poro-elastic code developed by the other PhD student also involved in the overall CHICkPEA program (see scientific context below) and use it in the various contexts studied within the laboratory experiments.

Finally, the PhD student will perform a theoretical and numerical upscaling of the experimental results to the field scale (exploration geophysics scale, few hundred meters), the ultimate goal being to run an acquisition at the field scale to strengthen the theoretical and numerical results obtained at the lab-scale.

The whole project is challenging from the experimental point of view since we propose for the first time to employ innovative tools for studying the EM conversion at interfaces. Numerically, the challenge is even bigger since it consists into matching real laboratory data with a full 3D quite complex poro-elasticity direct simulation. Eventually, the main thread throughout this experimental/numerical study would be to find and identify a measurement procedure to enhance the amplitudes of EM conversions at interfaces in exploration geophysics.

Key words:
Wave propagation, porous media, seismoelectric, electromagnetic, laboratory experiments, exploration geophysics.

Funding:
E2S scientific challenges project from the university of "Pau et des Pays de l'Adour" UPPA

Working conditions:

Hosting laboratory:
Laboratoire des Fluides Complexes et leurs Réservoirs (LFCR), UMR 5150 UPPA/CNRS/TOTAL

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Localisation address:
Université de Pau et des Pays de l'Adour, campus of Pau, Pyrénées-Atlantiques, France

Laboratory expertise:

The LFCR has recognized expertise in terms of sub-surface geophysics and experimental geophysics. The PhD student will be a member of the team « Geological Reservoirs Caracterisation ».

Thesis Director: Daniel Brito (LFCR)
Deputy thesis Director: Hélène Barucq (INRIA-LMAP)
Scientific team: Clarisse Bordes (LFCR), Julien Diaz (INRIA-LMAP), Stéphane Garambois (ISTerre, University Grenoble Alpes)

Starting Date: September 1st 2018
Duration: 3 years

Gross salary: 1 870 € / month (which includes extra gratification for teaching duties – 32h per year)

Mission - Main activities:

Scientific framework
The proposed PhD is part of a project called « CHaracterIzation of Conducting Poro-elastic media using Experimental and advanced numericAl methods" (CHICkPEA) led by H. Barucq (LMAP-INRIA), funded by E2S-UPPA from 2018 to 2021. CHICkPEA, one of the two selected propositions within the "New Challenges E2S-UPPA", is a transdisciplinary Mathematics/Geophysics project. 2 PhD and 1 Post-Doctorate have been funded for the CHICKPEA project: PhD1 on the experimental/modeling side (the present proposition) and PhD2 & the Post-Doc on the numerical/programming side. PhD1, PhD2 and Post-Doc will all start in 2018.

Purpose(s)
The goal of CHICkPEA is to improve the accuracy of the images by developing new models and numerical methods for the simulation of elastic and electromagnetic wave propagation in porous media. The numerical model (developed by PhD2 and Post-Doc) will be confronted to laboratory experiments carried out in saturated sand where propagating mechanical and electromagnetic waves will be precisely monitored (PhD1).

Expected results
The expected outcomes of the project are : one experimental protocol for understanding electro-mechanical wave propagation and physical properties in porous rocks, one piece of software for the simulation of elastic and electromagnetic waves, one inverse problem solver able for characterizing conducting porous media from the knowledge of the diffracted seismic or electromagnetic fields. The targeted applications are geothermal exploitation, CO2 storage and oil exploration.

Research collaborations
The CHICkPEA is a collaborative project between the LMAP-INRIA (laboratory of Applied Mathematics) and LFCR (laboratory of complex fluids and reservoir), between applied mathematicians and geophysicists. The collaboration between both groups and in particular between the 2 PhD students and the Post-Doctorate will a key of the success of this project. The two labs are located in the same building in the Pau university campus.

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Applicant's profile:

The candidate should be interested in geophysics (theoretical and modelling) and should also have a strong predilection for experimental work.

Particulars skills are sought in seismic and signal processing, elastodynamic modeling, poro-elastic modeling, electromagnetism.

The ideal candidate has a master degree in Geophysics/Physics/Mechanics. He/She is rigorous and highly motivated. The candidate must have a good English level and the capacity to work autonomously.

Application - Evaluation criteria:

Application file assessment: Selection committee

Candidates will first be selected based on their application file.

Those selected after this first step, will then be interviewed.

Application files will be evaluated based on the following criteria:

- Grades and ranking during your Master degree, steadiness in your academic background
- English language proficiency
- Candidate's ability to present her/his work and results

Work experience similar to an internship in a laboratory – or likewise; previously achieved research work (reports, publications).

Application will include: *(in a single pdf file)*

- CV
- Cover letter
- Master degree grade transcripts and ranking
- Reference letter
- Contact details of at least two people, from you work environment, who can be contacted for further reference

Application must be send to the following email address with the title "Doctoral application": **daniel.brito@univ-pau.fr**
For more details, please visit our websites: **http://e2s-uppa.eu/en/index.html**

Application deadline: 1st May 2018