

**FICHE NAVETTE: DOCTORANTS IDEX**

SECTOR : Higher Education Institution

LOCATION: France, Grenoble

RESEARCH FIELD: **RISK MODELLING, ASSESSMENT AND MANAGEMENT** + Paleoseismology, Archeology, Architecture, Lacustrine Limnology, Earthen cities, Hazards and Vulnerabilities for resilience

RESEARCHER PROFILE:

□ *First stage researcher (Master Degree level required)*

**INSTITUTION: Univ. Grenoble Alpes, University of Innovation**

One of the major research-intensive French universities, Univ. Grenoble Alpes<sup>1</sup> enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL<sup>2</sup>). The vibrant ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alpes is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled "Initiative of Excellence". This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations", "Digital technology").

**Key figures:**

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

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<sup>1</sup> Univ. Grenoble Alpes

<sup>2</sup> ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

## **MANDATORY REFERENCES:**

CDP TITLE: **RISK@Univ. Grenoble Alpes**

SUBJECT TITLE: Archeoseismology by the joint approaches of Seismic impact on prehistorical sites and Risk Estimation, focus on architectural resilience of archeological remains in Chanchan and Machu Picchu, Peru.

PRIMARY SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): ISTerre

SECONDARY SCIENTIFIC DEPARTMENT (LABORATORY'S NAME): CRAterre AE&CC

PRIMARY DOCTORAL SCHOOL (where the candidate will be registered): [Terre Univers Environnement](#)

SECONDARY DOCTORAL SCHOOL: SHPT , Sciences de l'homme, du politique et du Territoire

SUPERVISOR NAME(S): AUDIN Laurence & GANDREAU David

## **SUBJECT DESCRIPTION:**

Human beings are prone to settle in seismotectonic settings in Peru (Philip and England, 2005). In order to properly assess the seismic hazards, it is mandatory to catalog and accurately estimate the effects of previous earthquakes either for public facilities, buildings or heritage areas.

Peru exhibits a combination of strong seismic hazard and high vulnerability, through the presence of active faults in densely populated areas. Such settings in Cuzco region represent the next major issue for risk and seismic hazards estimations (Audin et al., 2016). Recently, archeological studies demonstrated that faulted and disturbed architectural relicts and prehistoric remains can be used as valuable markers to extend the catalog of paleoseismicity, evaluate the resilience of the past civilizations to seismic hazards. We here propose to decipher a 3000 years old continuous seismic records after two prehistoric emblematic monumental edifices (earthen and granitic structures), and to explore the past paraseismic building capacities that have been lost or unknown for paraseismic engineering.

Archeoseismology is an emerging discipline, traditionally defined as investigating the effects of earthquakes on ancient archaeological remains. Here we propose to map and study the archeoseismic impacts on archeological remains, the preserved record in archeological soils and artificial drainages to catalog prehistoric earthquakes and their induced effects. The overall purpose is to extend the knowledge in terms of time window for two given emblematic seismic sites: the subduction zone along coastal Peru (Chanchan WHS) and the crustal fault of Cuzco Vilnacota (Machu Pichu WHS).

Ancient monumental architecture in Peru goes back to 3000yrs BC and the construction techniques have been used throughout the country, proving to be a sustainable resource for prehistoric civilizations. Prehistoric and historical complex building strategies sign the ability of past societies to design suitable paraseismic constructions and properly maintain them through time.

## **ELIGIBILITY CRITERIA**

Applicants:

- must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

## **REQUIRED SKILLS**

- Theoretical skills

Similar techniques are used in archeology and geomorphology to address the millennial time scale and cm-long markers. Indeed, structural evidences of past seismic shaking are classically gathered by geomorphic studies on the fault system itself, by trenching for paleoseismology in the sedimentologic record at the fault, as can be done for prospection purposes on archeological sites. We here propose to explore the key record of paraseismic strategies, seismic damages, subsequent repairs or abandonment preserved in the archeological buildings and structures themselves. Indeed most archeological sites in active seismic regions expose unstudied remains of ancient structures bearing signs of palaeoseismic deformation. It includes a list of induced effects, such as walls offset by surface fault; buried, uplifted or subsided coastal facilities, liquefaction or tsunami evidences, but also more subtle evidences for resilient sites. Identifying and dating these markers will permit to extent the local seismic catalog for these

emblematic heritage sites and regain the ancient knowledge or resilience capacities that were lost through time. In this PhD project, the student will define the seismic risk evolution through historical time in case study areas that permit to merge the efforts from the transdisciplinary team of researchers.

- **Methodological skills:** French + English or English + Spanish. To justify for at least one of the following experience : High resolution LIDAR / Architecture / Paleolimnology / Paleoseismology / Raw Material & Heritage/ Programmation. As a multidisciplinary approach needs a full dedication, we expect the candidate to be able to skype in English, if not able to visit and discuss with the team in Grenoble.

- ✓ ISTERre for paleoseismology and seismic settings, GIS, geomorphology and dating methods
- ✓ CRAterre for architectural damages induced by seismic shaking
- ✓ EDYTEM for lacustrine records of major environmental changes in the nearby tectonic lake, climatic, metallic signature of the human occupation (gold, bronze
- ✓ LECA for DNA tracing of environmental changes in the nearby tectonic lake (resilience, changes in agricultural modes, human occupation evolution, abandonment of sites..)

**The aims of this PhD project** are focused in: (1) the identification and analysis of the archaeological relicts disturbances in buildings and ground deformations along lake shores or in lacustrine cores for their characterization, dating and classification as coseismic markers (or not); (2) the study of the regional seismotectonics and recent faulting evidence around the chosen sites for the evaluation of the seismic potential of the target fault (3) the analysis of the urban geology and architecture versus the available geotechnical data in order to test if the expectable ground response of the city site could induce the observed deformation

#### **International Context**

- ✓ UGA / ISTERre-Equipe Cycle, ENSAG-Equipe CRAterre
- ✓ IRD cooperation with INGEMMET in Peru
- ✓ LMI SVAN Laboratoire Mixte International IRD - Séismes et Volcans dans les Andes du Nord

The PhD position is a part of the multidisciplinary international project that aims at unraveling the archeological record of major crustal seismic events in buildings. The aim of the PhD will be to bridge the architectural, archeological and paleoseismological observations the describe the past effect and resilience of prehistoric iconic settlements that builded megapoles in seismic settings. It includes the analysis of the seismic response of lacustrine environments expected during strong shaking. Seismic measurements could be part of the work and would include the analysis of ambient vibrations and earthquake recordings. The candidate is expected to perform field measurements, participate to international meetings (INQUA and AGU), and cooperate in an international team scientific the scientific project.

- **Language:** A good level in French and English is an asset

#### **APPLICATION PROCEDURE**

Applicants will attach a file including:

- Their CV
- A cover letter / letter of motivation
- A summary of previous work done/publications in Master 1 and Master 2
- A record of the grades of Master 1 and Master 2
- A copy of their last diploma

Address to send their application: [laurence.audin@ird.fr](mailto:laurence.audin@ird.fr) ; [gandreavid@hotmail.com](mailto:gandreavid@hotmail.com)

#### **SELECTION PROCESS**

Application deadline: **May 31, 2018** at 17:00 (CET)

Applications will be evaluated through a three-step process:

1. Eligibility check of applications on **June 7, 2018**
2. Selection: the applications will be evaluated by a Review Board in June 2018

3. Results will be given by **July 12, 2018**.

TYPE of CONTRACT: temporary-3 years of doctoral contract

JOB STATUS: Full time

HOURS PER WEEK: 35

CONTRACT STARTING DATE: **October 1, 2018**

APPLICATION DEADLINE: **May 31, 2018**

Salary: 1768.55 € gross per month