



ÉCOLE DOCTORALE SCIENCES DE LA TERRE



Subject offered for a contract starting october 2014

SUBJECT TITLE: Monitoring of the subduction interface by GPS and InSAR

Advisor: **Christophe VIGNY, DR CNRS**
Host lab/ Team : **ENS- Laboratoire de Géologie de l'ENS- UMR 8538**

Financing: Initial Training Network (ITN) Européen ZIP.

For more information go to <http://ed109.ipgp.fr>, section: *Offres de these (PhD offer)*, You must apply on the Doctoral School website

Presentation of the subject: (1 or 2 pages)

Description: The “laboratoire de Géologie” at ENS Paris seeks to appoint a PhD student in monitoring of the subduction interface by satellite geodesy (GPS and INSAR). The successful applicant will join the “Géodynamique, Sismologie et Géodesie” group and work in a multi-disciplinary environment in close collaboration with Dr. C. Vigny, Dr. A. Schubnel, and Pr. R. Madariaga at ENS, Dr. M. Moreno, T. Dahm, F. Rolandone and C. Ranero at secondment institutions GFZ-Potsdam, UPMC and CSIC.

During the last decade, the Aceh (2004, Mw>9.1), Maule (2010, Mw 8.8) and Tohoku-Oki (2011, Mw 9) earthquakes dramatically shed light on the seismogenic and tsunamigenic hazard due to subduction megathrusts. The Chilean subduction is one of the most active in the world, with 4 mega earthquakes in the last 120 years (1906, 1922, 1960 & 2010). However, no major earthquake occurred in North Chile since the 1877 Mw 8.6 subduction earthquake that produced a huge tsunami. Nevertheless, geodetic measurements conducted over the last two decades in this area show that the upper plate is actually deforming, which reveals some degree of locking (or coupling) on the subduction interface. This accumulation of elastic deformation is likely to be released in a future earthquake. Because of the long elapsed time since 1877 and the rapid accumulation of deformation (thought to be 6–7 cm yr⁻¹), many consider this area is a mature seismic gap where a major earthquake is due and seismic hazard is high. Using dense GPS measurements, we recently found that the North Chile seismic gap is not homogeneous, but rather segmented in at least two highly locked segments bounded by narrow areas of weak coupling. Located in the middle of North Chile, the region of Iquique (located at ~20°S) is the locus of an important decrease of the amount of coupling on the subduction interface. This finding raises number of important questions: Is this feature permanent or transient? Is it representative of friction laws variations on the plate interface? If so, can we characterize them with space geodesy? Can we correlate the upper plate deformation anomalies with seismicity on the slab interface? and upmost important: what role will this abnormal area play in the expected next mega-thrust earthquake in the region ? Will the rupture nucleate there? will it stop there ? Will it impede the 1877 mega earthquake (and Tsunami) scenario and favour separated individual (and therefore smaller) rupture of each segment?

The objective of this PhD is to observe, quantify and analyze the interplate kinematics gathering as much information as possible on this peculiar area of Iquique. We will integrate space geodesy (precise reanalyses of the long cGPS time series of the existing network, times series of INSAR

interferograms, increased dense GPS surveys around the area), seismology (creation and usage of a seismicity catalogue based on several years of operation of local seismological networks) and numerical simulations to study with an unprecedented precision the physical mechanisms of great earthquakes in this region. Extensive available marine seismic data will be integrated in the study. It will provide new opportunities to improve the assessment of earthquake and tsunamic hazards.

Candidates must hold an MSc in Earth Sciences, Applied Mathematics, Physics or a related discipline. Experience in geodynamics, geodesy, seismology, numerical modeling and programming languages is highly advantageous.

ENS is situated in the heart of down town Paris is an extremely liveable city and has one of the highest qualities of life in the world. During his PhD, the candidate will collaborate with people at secondment institutions GFZ-Potsdam, UPMC, and CSIC as well as with others PhD students of ZIP.