Doctoral School ED 413: Earth Sciences and Environment

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The doctoral school Earth Sciences and Environment (ESE-ED413) is one of the 10 doctoral schools of University of Strasbourg. It offers research trainings in ecology, geophysics, geochemistry, geology, geography and hydrology strongly linked to environmental sciences. The associated research teams and supervisors belong to one of the 3 research units recognized by CNRS and University of Strasbourg: Laboratoire d’Hydrologie et de Géochimie de Strasbourg (LHyGeS), Institut de Physique du Globe de Strasbourg (IPGS) and Laboratoire Image, Ville et Environnement (LIVE). This year, 73 PhD students are registered in the Doctoral School. The ESE is quite attractive since 1/3 of the students are coming from abroad.

The ‘congrès des doctorants’ is one of the most important event of the doctoral school. It gives the PhD students the opportunity to share their research experience and present their on-going work. It is also the opportunity for them to meet and have scientific exchange around poster presentations but also during lunch and dinner.

One of the specificity of the doctoral school ED413 is the important diversity of the research topics (see program). They cover a wide range of spatial scales (from nanometers to the earth) and time scales (from seconds to geologic periods) and a wide range of methods (in situ experiments, laboratory experiments, chemical analysis, mathematical and numerical modelling). They benefit also from numerous data provided by observatories in geophysics, in hydro-geochemistry and in urban area.
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<td>Isabelle Haupert (IPGS) The tectono-stratigraphic evolution of basement highs in hyper-extended deep-water rifted margins: the example of the briançonnais domain in the alps and comparisons with modern analogues.</td>
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Numerical modeling of three-phase compressible flow with gravity effects using the global pressure formulation.

14:10 – 14:30  Ivan Toloni (LHyGeS)

14:30 – 14:50  Sophie Gangloff (LHyGeS)
Characterization and evolution of dissolved organic matter in acidic forest soil and its impact on the mobility of major and trace elements (case of the Strengbach watershed)

14:50 – 15:10  Maximilien Lehujeur (IPGS)
Imaging of a deep geothermal reservoir using ambient noise correlation.

15:10 – 15:30  Coffee Break and poster session III

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Thermo-hydro-mechanical modeling of crack propagation in porous media using extended finite element methods.

15:50 – 16:10  Victor Hugo Pinto (IPGS)
Linking tectonic evolution with fluid history in hyper-extended rifted margins: Examples from the fossil Alpine and Pyrenean rift systems, and the present day Iberia rifted margin.

16:10 – 16:30  Atieh Ghafouri (LIVE)
Sustainable Urban Form; Multifunctionality and Adaptation Redefining urban spaces as multifunctional shared areas by using SOLAP as a decision-making tool

16:30 – 16:50  Benoit Pétri (IPGS)
Importance of the “Permian post-orogenic event” for the crustal architecture: insights from the Austroalpine domain

16:50 – 17:10  Nejib Abidi (LHyGeS)
Depollution of textile dyeing wastewater by natural clay

17:10 – 17:15  Closing of the CDD
Abstracts of Oral presentations
Imaging of a deep geothermal reservoir using ambient noise correlation

Lehujeur M., Vergne J., Maggi A., Schmittbuhl J. (IPGS)

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The ambient noise cross correlation technique is a method which was initiated about 20 years ago in Helioseismology. It was demonstrated that cross-correlating Sun’s surface motion recorded at two distinct points could lead to an estimation of the medium properties in-between the recording points. Nowadays this method is widely used in seismology and many applications can be found in the literature. This method allows to determine the Green’s function between each pair of receivers without using any active source. Thanks to this, it is now possible to perform tomography without knowing the seism locations and origin times as in classical tomography. However, this method is in most cases applied to regional to continental scales and the period range is larger than 5s to 10s. Even though the method has already been validated and is widely accepted in the scientific community, the uncertainties of the method remain not well known especially in the case of very short periods. Within the context of this study, we are working in the area of Rittershoffen (North-East of France) where a Geothermal plant is about to be installed (ECOGI project). The objective is to monitor the reservoir and be able to follow its evolution in time during the exploitation period. To do so, we apply the method of ambient noise tomography in a high frequency range (0.2 to 5Hz) in order to measure the seismic waves propagation velocities and their variability over time. Analysis of noise recorded over the last 3 years indicates that the high frequency content of the noise (larger than 1Hz) is dominated by the human activity while the low frequency content is dominated by the second micro-seismic peak coming from the Atlantic. At periods lower than 0.5s, the estimation of the dispersion curve remains uncertain due to the non uniformity of the anthropogenic sources. Using a combination of two seismological arrays, we propose a method that reduces the effects of non uniform source distribution and makes the method applicable at short periods.

Large-scale detection and characterization of seismological phenomena for the monitoring of traditional seismic events, and systematic data-mining of rare phenomena

Langet N. (IPGS), Maggi A., Michelini A., Brenguier F.

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In a first part, we present Waveloc, an algorithm for automated seismic event detection and location, whose principle relies on the migration of continuous waveforms. The kurtosis traces of the data are computed in order to enhance the first arriving phases, then migrated using a P-wave velocity model and stacked. The method has been applied successfully to 12 seismic swarms recorded at Piton de la Fournaise volcano, La Réunion Island, France, between 2009 and 2011, and has shown locations consistent with manual ones. Final results highlight a magnitude-dependent distribution of the events in a main seismic area just above sea-level.

In a second part, we work on a data set from the Kawah Ijen volcano (Indonesia) where 8 types of seismic events are recorded and we try to automate their classification. For that purpose, we extract some features from the signal and implement supervised learning methods. First results show that the problem is not straightforward as we are only able to separate clearly 2 main types of events.
Thermo-hydro-mechanical modeling of crack propagation in porous media using extended finite element methods

Shao Q. (CRP Tudor, LHyGeS), Bouhala L., Younes A., Núñez P., Makradi A.

In this work, a robust numerical tool is developed for the thermal-hydro-mechanical (THM) modeling of crack propagation in porous media. The flow of fluid in porous media is simulated using the Darcy’s law by Nonconforming Finite Element Method. Time splitting is used with the energy conservation equation to solve the fluid and the solid phases separately. In the fluid phase, a combination of Discontinuous Galerkin (DG) and Multi-Point Flux Approximation (MPFA) methods is used to solve the advection-diffusion heat transfer equation. While the conductive heat transfer equation in the solid phase is solved using the eXtended Finite Element Method (XFEM) to better handle the temperature discontinuities and singularities caused by the cracks. Further, the resulted temperature is used as body force to solve the thermo-mechanical problem using the XFEM. Then the Stress Intensity Factor (SIF) is computed in the post processing stage using the J-integral technique. Moreover, in order to reduce the computational cost and meanwhile maintain the accuracy of the model, the non iterative scheme with time stepping based on local error control is applied to solve this THM system. Several numerical examples are presented to demonstrate the utility of the proposed model in porous media.

3D velocity structure and precise location of the seismic swarm along the Emeelt fault using double-difference tomography

Munkhsaikhan A. (IPGS), Schlupp A., Dorbath C., Calo M., Ulziibat M.

This study focused on the area of newly discovered fault, Emeelt, located around 15 km from the capital of Mongolia. In April 2005, we started to observe a high seismic activity in this region. We installed 10 temporary stations with continuous recording in December 2008. Most of the 3591 events localized during the last 44 years at less than 140 km from this fault, occurred between 2005 and 2013 along the Emeelt fault (77.7%).

I completed the NDC bulletin by picking all phases on records at temporary stations between 2010 and 2013 inducing an increase of 54.6% of phase number. I selected 1061 events with minimum 6 P phases and two S phases, with an RMS less than 0.5s. To build a 3D structure around Emeelt fault I used around 27000 P and S arrivals.

I observe a velocity variance with, at the northeast part and below the seismicity, a high velocity of around 8.6km/s.

The distribution of the 1061 event is along 3 vertical lines with depth between 6 and 16 km and along azimuth N143, as the surface rupture. Now I am relocating all 3591 events to follow the evolution in time and space of the seismicity.
Copper isotope analysis to study copper transport processes in a vineyard context

Babcsányi I., Chabaux F., Granet, M., Imfeld G., (LHyGeS)

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Vineyards figure among the most copper-contaminated environments due to the extensive use of copper-based fungicides for centuries. Here we used Cu stable isotope ratios (65Cu/63Cu) as an integrative tool to trace the transport and the transformation of anthropogenic Cu in a vineyard context (Rouffach, Alsace) during a Cu-fungicides application period (May – July). The aim of the study was to assess Cu transport in soil, its mobilization from the top-soil during rainfall-runoff events and its retention in a wetland collecting runoff. Our data show that around 1% of Cu applied (in different forms) was exported from the catchment by surface runoff. It was collected by the stormwater wetland situated at the outlet that retained >68% of dissolved Cu and >92% of suspended solids-bound Cu during the studied period. Our copper isotopic data reveal that 65Cu was preferentially retained in the wetland from the dissolved phase (Δ65Cu_inlet-outlet from 0.03‰ to 0.77‰), which likely reflected short-term Cu sorption to mineral and organic matter. During high-flow conditions, dissolved Cu was less retained by the wetland and both dissolved and solid-bound Cu became isotopically lighter, reflecting the mobilization of reduced Cu colloids (e.g. CuxS) from the sediment. Our results demonstrate the potential of Cu stable isotope ratios to trace the transport of copper in complex and dynamic environments.

From late rifting to oceanic spreading in the Australo-Antarctic Basin: a new model for lithospheric breakup evolution

Gillard M. (IPGS), Autin J., Karpoff A.M, Manatschal G., Munschy M., Sauter D., Schaming M.

✉ mgillard@unistra.fr

Magma-poor rifted margins are still poorly understood, particularly in their distal part, where large surfaces of serpentinized mantle are exhumed. Several major questions still arise in the scientific community: How is extension accommodated during the last stage of rifting? What is the amount of magma and how is it related to the tectonic evolution? How can the lithospheric breakup be localized in time and space? The aim of this PhD project is thus to better understand the processes related to the transition from rifting to steady-state seafloor spreading in a magma-starved system. Here we took the example of the Australo-Antarctic margins. Seismic interpretation correlated with gravity and magnetic observations leads to a new model of evolution for the distal part of these margins. This model involves a clear polyphase evolution with several detachment faults exhuming mantle rocks before the emplacement of the first steady-state oceanic crust. This distal asymmetric context raises the question of the magnetic anomalies interpretation in such margins. We can also observe a gradual increase of the magmatic supply during the margin development. This observation leads to difficulties in the definition of the breakup location.
Seven years of postseismic deformation following the 2003 Mw=6.8 Zemmouri earthquake (Algeria) from InSAR Time Series

Cetin E. (IPGS), Meghraoui M., Cakir Z., M. Akoglu A., Mimouni O., Chebbah M.

We study the postseismic surface deformation of the Mw 6.8, 2003 Zemmouri earthquake (northern Algeria) using the Multi-Temporal Small Baseline InSAR technique. InSAR time series obtained from 31 Envisat ASAR images from 2003 to 2010 reveal sub-cm coastline ground movements between Cap Matifou and Delys. Two regions display subsidence at a maximum rate of 2.0 mm/yr in Cap Djenet and 3.5 mm/yr in Boumerdes. These regions correlate well with areas of maximum coseismic uplifts, and their association with two rupture segments. Inverse modeling suggests that subsidence in the areas of high coseismic uplift can be explained by after slip on shallow sections (< 5 km) of the fault above the areas of coseismic slip, in agreement with previous GPS observations. The earthquake impact on soft sediments and the ground water table southwest of the earthquake area, characterizes ground deformation of non-tectonic origin. The cumulative postseismic moment due to 7 years afterslip is equivalent to an Mw 6.3 earthquake. Therefore, the postseismic deformation and stress buildup has significant implications on the earthquake cycle models and recurrence intervals of large earthquakes in the Algiers area.

Crustal coda-wave properties in france and moment magnitude mw calibration

Denieul M. (IPGS), Cara M., Sèbe O.

Accurate magnitude estimation is necessary to establish reliable seismicity catalogs in order to assess seismic hazard. It is well known that crustal coda wave amplitudes present a lower variability than the direct waves (Mayeda et al., 2003). This amplitude stability offers great advantages for estimating accurate magnitude from a limited set of stations.

In this study, we develop a moment magnitude method from coda waves applicable on new digital seismograms as well as on old paper records. We first investigate the regional properties of coda waves in metropolitan France. This frequency analysis is performed in order to estimate the frequency dependent site effects and the regional quality factors Qc. The obtained information permits us to compute synthetic coda for each French region useful for modeling time-domain coda waves representing analog seismograms. Looking at the shape of observed time-domain coda envelopes, we found that the single-scattering model of Aki and Chouet (1975) only fits the synthetic coda envelopes when the propagation term presents a quadratic exponential term. After estimating the site and propagation terms from the rough coda and corrected of them the coda amplitudes, we obtain a source term that we called in its logarithmic form “coda magnitude Mc”. We calibrate then the coda magnitudes Mc with reference moment magnitude MW. We can thus determine moment magnitude MW directly from paper records using the obtained MC-MW scaling law.
Numerical modeling of three-phase compressible flow with gravity effects using the global pressure formulation

Schneider L. (LHyGeS), Di Chiara R., Schäfer G., Helluy P.

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The aim of this thesis in Hydrology and Applied Mathematics is to model the flow of a dense non aqueous phase liquid (DNAPL) in the subsurface by developing a code to simulate three-phase (DNAPL, water, and gas), compressible flow in porous media. Our approach is based on a Global Pressure Model: it leads to a partial decoupling of the pressure and the saturation equation. The new model is discretized by a Mixed Finite Elements and Discontinuous Finite Elements, implicit pressure-explicit saturation (IMPES) resolution method.

In the case of oil-water flow, an implementation of the gravity effects has been realized. In the absence of capillary pressure, the gravity effects may cause major difficulties. The behavior of the water saturation profile depends on the ratio between the flow injection rate and the density difference between oil and water. It is analytically possible to determine the general behaviour of the flux function which depends on those characteristic numbers.

In the last step of the project, the model will be extended to a three-phase and compressible flow. The most difficult part of the work is to estimate the three-phase variables (relative permeabilities, capillary pressures), based on the three pairs of two-phase data, and satisfying a Total Differential Condition.

Assessing ecosystem services provided by urban vegetation

Selmi W., Weber C., (LIVE)

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Urban green spaces, considered as a “green showcase”, have been the topic of numerous scientific researches during the past 20 years, investigating not only its socio-urban values but also its ecological ones (Clergeau, 2012). We define urban green spaces as all green spaces located on urban area managed by municipal services and include varied plant formations (Young, 2010) like lawns and urban trees that provides a large panel of ecosystem services such as preserving ecological balance, improving air quality, reducing the urban heat island effects, regulating local climate, etc.

Here we discuss the current conceptual framework dealing with ecosystem services delivered in urban area. Moreover, we suggest applying a bottom up approach in order to get preliminary results of ecological benefits provided by Strasbourg’s trees and lawns. Finally, we discuss some limitations of models and further guidance for assessing urban ecosystem services.
Characterization and evolution of dissolved organic matter in acidic forest soil and its impact on the mobility of major and trace elements (case of the Strengbach watershed)

Gangloff S., Stille P., Pierret M.C., Weber T., Chabaux F. (LHyGeS)

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Dissolved Organic Carbon (DOC) plays an important role in the behavior of major and trace elements in the soil and influences their transfer from soil to soil solution. The first objective of this study is to characterize different organic functional groups for the Water Extracted Organic Carbon (WEOC) fractions of a forest soil as well as their evolution with depth. The second objective is to clarify the influence of these organic functional groups on the migration of the trace elements in WEOC fractions compared to those in the soil solution obtained by lysimeter plates. All experiments have been performed on an acidic forest soil profile (five depths in the first meter) of the experimental spruce parcel in the Stengbach catchment.

The Infra-red spectra of the WEOC fractions show a modification of the molecular structure with depth. A Hierarchical Ascending Classification (HAC) of the evolution of Water Extractable Chemical Elements (WECE) with the evolution of the organic functional groups in the Organic Matter (OM) enriched soil compartments permits recognition of relationships between trace element behavior and the organic functional group variations. The results of this study are important for the understanding of the mobility and the migration of pollutants (as heavy metals) as well as nutrients in ecosystems.

Sustainable Urban Form; Multifunctionality and Adaptation Redefining urban spaces as multifunctional shared areas by using SOLAP as a decision-making tool

Ghafari A., Weber C., (LIVE)
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The aim of this thesis is studying the possibilities of reviving public, semi-public and private spaces for functions other than their main and during their idle hours to make multi-functional shared urban spaces. To this aim, understanding these spaces, their functions, and possible uses for them is of paramount importance. For this goal, it is imperative to determine the possibilities but also the limitations of these spaces considering legal and cultural restrictions, as well as the needs of the possible users.

In this research, studying and analyzing the global experiences in this field will lead us to identify the planning principles for the creation of multifunctional shared spaces adapted to the city of Strasbourg.

We try to put into practice the GIS software and also SOLAP for data analyzing. SOLAP is a tool for analyzing localized data (Spatial OLAP2) which can organize data in three faces as a data cubes: theme, time and location. This software has higher speed and more capabilities than other GIS software in terms of summarizing data and generating result and it is hoped to have a great value in this research as a decision-making tool.

Toloni I. (LHyGeS)

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The mechanisms governing the transport and retention kinetics of titanium dioxide (TiO2, rutile) nanoparticle (NP) aggregates were investigated in saturated porous media. Experiments were carried out under a range of well-controlled ionic strength (IS) and water velocity. As expected, the concentration in break through curves (BTC) increased with an increase of water velocity and decrease with an increase of IS. The maximum retained concentration on the solid phase (Smax) and the retention rate coefficient (k1) were evaluated by means of a model of convective-diffusive transport coupled with kinetic deposition. The parameters were optimized through the resolution of the inverse problem using the software HYDRUS 1D. The values resulted to be linearly dependent on collector efficiency, a parameter described from the filtration theory, which depends on water velocity and experimental conditions. These results imply that is possible, for an IS value, to calculate analytically Smax and k1 for different water velocities and thus simulate TiO2 deposition under these conditions.

Study of the deformation in Central Afar using InSAR NSBAS chain.

Deprez A. (IPGS), Doubre C., Grandin R., Ahmed Saad I.A., Masson F., Socquet A.

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The Afar Depression connects three continental plate. Previous tectonic and geodetic studies confirm that a large part of the current deformation is concentrated along volcanotectonic segments. However, the amount of extension accommodated by other non-volcanic basins and normal faulting remains unclear. Moreover, large transient displacements related to dyking sequence increase the difficulty to characterize the deformation field over simple time and space scales.

We attempt to obtain a complete inventory of the deformation within the whole Afar Depression and to understand the associated phenomena, which occurred in this singular tectonic environment.

We study, the behavior of the structures activated during the post-dyking stage of the rift segments.

We conduct a processing of a large set of SAR images; we use previous InSAR results and GPS data from permanent stations and from campaigns conducted within a GPS network particularly dense along the Asal-Ghoubbet segment.

The time series analysis allow us to point out the role of volcano activity on the localization of the extensive deformation within these rifts, describe the temporal evolution of the mostly aseismic fault slips, and characterize the behavior of the crust after the dyking events in relation to visco-elastic relaxation. We analyze several interesting small patches of localized deformation revealing transient displacements by combining time series results and seismic data collected in Djibouti by the OGA.
Linking tectonic evolution with fluid history in hyper-extended rifted margins: Examples from the fossil Alpine and Pyrenean rift systems, and the presentday Iberia rifted margin.

Pinto V.H., Manatschal G., Karpoff A.M. (IPGS)

Polyphase detachment faults are responsible for extreme crustal thinning and mantle exhumation. These structures are intimately linked with the evolution of distal parts of rifted margins. During the evolution of detachment faults, fluid-rock interaction plays an important role changing the chemical and physical properties of rocks, and consequently it has influence in the strain localization and structural evolution of the margin. Those changes are best indicated by hydration reactions in the continental and exhumed mantle domains. The aim of this study is to characterize the fluid signature in hyper-extended margins. The study of different sites that experienced different degrees of compressional and metamorphic overprint enables us to compare results and to define the general importance of fluid systems in the development of hyperextended rift systems.

The first results show that in all three geological settings fluid percolation can be recognized in fault rocks linked to the detachment systems. In the Alps and Iberia margin the major and trace elements show a gain in elements typical from mantle rocks. In the Pyrenees, detachment faulting crossed a range of crustal depths providing constraints on the depths of fluid migration.

Remediation by natural clay of effluent dyers - Dynamic Study in column percolation and numerical modeling of flow and reactive transport

Berez A. (LHyGeS), Ayari F., Schäfer G., Trabelsi Ayadi M.

The textile industry is the sixth largest polluting industries, behind industries such as chemical, pulp and paper and oil refining. It is therefore important to treat the effluent effectively.

In this work we used natural clays as adsorbent material to clean the effluent dyers. This material has the advantage of being available and inexpensive on one hand, on other hand it is endowed with a high adsorption capacity of organic and inorganic molecules. In the laboratory, experiments were conducted in a closed system said again batch and dynamic through a column percolation. Studied pollutant is an organic molecule used by the textile industry called Foron Blue: This is a synthetic dye of the azoic family. The experimental results were compared to mathematical models, both for the kinetics or adsorption isotherms, and have been verified by a statistical study. The adsorption column was also modeled using the MODFLOW software and computer code PMWIN.
The tectono-stratigraphic evolution of basement highs in hyper-extended deep-water rifted margins: the example of the Briançonnais domain in the Alps and comparisons with modern analogues

Haupert I. (IPGS)

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In this work I combine the study of seismic sections with that of field analogues exposed in the Briançonnais domain in the Alps. Mapping the pre-Alpine and Alpine structures of this domain and properly define their stratigraphic and tectonic evolution provide important insights into the processes controlling the formation and subsequent reactivation of distal rifted margins.

To better understand the margin's evolution during rifting, I review the existing structural, stratigraphic and age data of these domains from Liguria/Italy, across the French Alps to Grisons in Switzerland and I propose new constructed sections across the Briançonnais domain. These sections form the basis to discuss the rift-related tectono-stratigraphic and subsidence evolution of this domain. This study will enable to compare the along and across strike stratigraphic architecture of the Pre-Piemontais/Briançonnais domains and to compare them with those made at seismic sections imaging deep-water rifted margins (e.g. Campos (S-Atlantic), Newfoundland (N-Atlantic) and eastern Indian margins). The first results show that the principal Alpine structures in the Briançonnais domain reactivated mainly inherited pre-Alpine structures. The structural evolution and the change in vergence across the Briançonnais domain are likely controlled by the crustal architecture of the former rifted margin.

Active tectonic of Ulaanbaatar, Mongolia

Al Ashkar A. (IPGS), Granet M., Schlupp A.

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The active tectonics of Mongolia is influenced by the India-Asia collision and the Baikal rift extension. The region of Ulaanbaatar (capital) is considered relatively less active than the western part that has experienced great earthquakes (Mw≥7) in the last century. However, increasing seismic activity since 2005 has fostered the detection of unsuspected active faults with unknown seismic potential.

Here we present preliminary results on Avdar and Sharkhyn faults, newly discovered active faults within the region of Ulaanbaatar. Using remote sensing data (satellite images), field observations (microtopography), trench excavations and dating (OSL and radiocarbon), we document their geomorphologic expressions and Holocene to late Pleistocene palaeoseismic records. The both faults have a clear expression on 0.5-m resolution Pleiades satellite images and display systematic modifications of the drainage system (deflections, offsets) witch attest their activity.

We excavated trenches across the faults scarps (2 trenches on Avdar faults and 1 tranche on Sharkhyn fault). Samples (radiocarbon dating and OSL) were collected from the trenches to determine the age of palaeoseismic events. These trenches expose complex deformations associated with many wide and deep cryoturbation features (Avdar) witch disrupts the observation of palaeoseismic deformations over the main part of the trenches. A detailed study is underway to characterize the seismic deformations. The results of this study will be included in the seismic hazard assessment for the capital of Mongolia, Ulaanbaatar.
Importance of the “Permian post-orogenic event” for the crustal architecture: insights from the Austroalpine domain

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Following the Variscan orogeny, the Permian thermal event is classically characterized by the emplacement of large felsic and mafic complexes at all crustal levels in a lithospheric trans-tensional regime. At mid- to lower crustal levels, the building of the new continental crust is characterized by the emplacement of mafic intrusions associated with a high temperature metamorphic event at granulite facies conditions. Nevertheless, the link between regional metamorphism and magmatic intrusions remains poorly constrained. This study aims to understand how this post-orogenic thermal event modified the compositional and thermal structure of the Variscan lithosphere and controlled the subsequent Jurassic rifting leading to the opening of the Alpine Tethys. Our research project combines structural geology, igneous and metamorphic petrology and geochronology in the former hyper-extended Adriatic rifted margin outcropping in the Austroalpine Campo and Grosina units (SE-Switzerland and N-Italy). The main questions addressed in this work are: (1) how are mafic bodies emplaced at mid- to lower crustal levels; (2) what is the relation between this magmatism and the high temperature metamorphism; (3) what are the impacts on the crustal architecture and (4) how does the “Permian inheritance” control the location and structure of subsequent extensional systems.

Depollution of textile dyeing wastewater by natural clay

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Removal of dye from aqueous media by clay has been extensively studied. It has been shown that the adsorption capacity of clay is high for cationic dyes but limited for anionic dyes unless clay surface is modified. However, clay proved its efficiency in color removal from textile dyeing effluents containing anionic dyes. Attention has rarely been focused on the effect of textile dyeing additives in the adsorption of dye onto clay. The aim of this work is to investigate the influence of additives used in textile dyeing industry on the capacity of unmodified clay (Fouchana) to adsorb RR120 anionic dye, and propose possible mechanisms involved in these processes. Batch experiments were performed with Fouchana clay and RR120 dye at different pH, ionic strength and temperature conditions and in presence of additives of different nature. The interactions in the system clay-dye-additive were highlighted using IR spectroscopy analyses (FTIR) knowing the surface properties of the clay and the chemical characteristics of the RR120 dye.

The experiments showed that the adsorption capacity of the clay was enhanced in presence of additives derived from enzymatic products, and at high ionic strength and low pH. Additives may act surface charge modifier which favors adsorption of dye onto clay. The best fits of isotherm data were obtained with the Langmuir model indicating that adsorbed dye formed a monolayer on clay surfaces. The overall data showed that naturally existing clay may be a promising adsorbent to treat effluents from textile dyeing industry containing dyes and various chemical additives.
Abstracts
of
poster presentations
Soil liquefaction: a competition between buoyancy forces and ground acceleration


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The topic of my thesis is the numerical simulation and laboratory study of soil liquefaction. More precisely I want to characterize the liquefied state in a numerical granular medium and in an analogical one. I created a Fortran code using dynamic molecular theory which calculates the evolution of a bi-dimensional granular medium under gravity forces and inertial forces like shaking and buoyancy. I also work with a real medium composed of water, air and monodispersed beads or controlled density. We use particles 5 % denser than water (Ugelstad spheres, made of polystyrene), which increases the liquefaction phenomena. To characterize the liquefied state of the media we use an intruder (a ball or cylinder for instance) that we gently put on the top of our media, in numerical and analogical cases. Then we horizontally shake the media and we study the sinking of the intruder. Until now we study the effect of the presence of water, and the liquefaction according to the acceleration and the frequency of the shaking.

In the future we would like to study the effect of the ball density and of the partial saturation of the media, three dimensional effects, and the presence of air. We could apply the results for the study of soil liquefaction, but also for the remediation of polluted soils with air sparking, and for the study of debris flows.

The portneuf holocene deltaic complex (north shore of st-lawrence estuary): stratigraphic architecture of a regressive system forced by the glacio-isostatic rebound

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The North Shore of the St-Lawrence estuary is characterized by deltas progradation initiated at the time of early glacial margin retreat (Wisconsinian) of the Laurentide Ice Sheet. A sedimentary signature of a forced regression due to the glacio-isostatic rebound is investigated.

In the Portneuf peninsula (250 km northeastward from Québec city) a 85 m high and 7 km long coastal cliff allows the sedimentological, architectural and sequential studies of a Late Pleistocene to Holocene deltaic complex built in this forced regressive context.

The edification of this deltaic succession begins with deglaciation and subsequent marine invasion on flexed land. The early retreat of ice-sheet margin associated with huge sediment supply allows the building of a fluvioglacial delta. This system remains active until ice-sheet margins withdraw out from the Portneuf river watershed. Thus a drastic drop of sediment supply occurs while less meltwater reaches the delta. Therefore the deltaic progradation combines both mouth bars and shorelines structures. The progradation of the delta is now mainly fed by upstream erosion of the ancient fluvioglacial delta by marine currents and waves in the St-Lawrence estuary. At this time the glacio-isostatic rebound is still active, fluvial meanders and shorelines successively abandoned are staged at altitude from 90 m to present-day marine level.
Deformations of the Upper Rhine Graben by geodesy: local studies (geothermal) and regional studies (tectonic)

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This thesis uses the methods of space geodesy to study displacements in the Upper Rhine Graben. Two space geodetic methods are used, the GPS method and the analysis of data SAR (Synthetic Aperture Radar). The thesis focuses on two objectives. At the regional scale, the aim is to quantify the deformation of the Upper Rhine Graben. This study will contribute to characterize the seismic hazard in this region where the displacements are small and difficult to determine. At the local scale, the aim is to make a spatio-temporal monitoring of geothermal sites in northern Alsace. The local study is part of the LABEX G-Eau-Thermie, two sites are concerned for the geothermal study: the site of Soultz-sous-Forêts and site ECOGI near Rittershoffen. The geodetic methods will enable a new approach to the study of these sites where the existences of aseismic movements have been established.

In both cases the aim is to characterize surface displacements in areas of low strain rates, therefore the processing strategy will be decisive. An experimental protocol is developed in order to define the best processing strategy to retrieve vertical displacements. This work will also contribute to understand more general issues such as the earthquake-strain relationship, intra-plate deformation.

Landslide Hazard Assessment: Integration of multisource remote-sensing data and development of probabilistic models at regional and local scales

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Landslides, characterized by a particular size, geomorphology, comportment(s) and motion rate could a serious hazard in several regions of the world. Creating landslide maps is important to evaluate the extent of the phenomena in an area, to investigate the distribution types, pattern, recurrence and statistics in order to assess landslide susceptibility, hazard and risk.

Landslides of the Ubaye Valley (Southern French Alps) were studied by precise remote sensing analysis interpreting a set of orthophotographs and optical images (1956, 1972, 1994, 1995, 2000, 2004 and 2009), aided by existing reports (RTM catalogues), geomorphological maps (1989 and 2001) and field survey (2012). A cartography of sliding processes was updated for each date considering the (sub-) type (translational, rotational, rock-block-slide, mudslide, complex), geometrical characteristics (length, area, volume), the geomorphology and the degree of activity (fossil, latent, momentary or continuously active), vegetation evolution parameter (less, more or same vegetal cover) and an indicator of accuracy. Statistics were constructed using the different inventories created and geomorphological parameters characterizing landslides calculated in function of a 5m DTM (e.g. mean slope, more frequent aspect, difference in elevation...).

This study shows what parameters could be used to create a multi-temporal inventory in the aim to determine the evolution of landslide activity in a mountainous and vegetated area and then, assess the hazard.
Estimation of the gravimetric pole tide using GGP superconducting gravimeters.

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The movement of the Earth rotation axis induces a perturbation of the surface gravity field that can be recovered from the gravimetric data. It is usual to estimate the amplitude $A_{\text{observed}}$ and the phase $\phi_{\text{observed}}$ of the perturbation. Those values are compared to theoretical estimates $A_{\text{theoretical}}$ and $\phi_{\text{theoretical}}$ based on astronomically determined time series of the pole position. In this work, we use superconducting gravimeter (SG) data from the Global Geodynamics Project (GGP) and Earth orientation parameters provided by the International Earth Rotation and Reference Systems Service (IERS).

First, we compute the gravimetric factor $\delta = A_{\text{observed}} / A_{\text{theoretical}}$ and phase lag $\kappa = \phi_{\text{observed}} - \phi_{\text{theoretical}}$ at the Chandler period, using Strasbourg data. We discuss the influence of the processing, the importance of the corrections and the convergence with time of the computed values. Then, we extend the method to process jointly the gravity data from a set of SG stations and estimate a global gravimetric factor. We apply a spatial data weighting taking into account the latitude and longitude dependency (degree 2, order-1, surface spherical harmonics) of the gravity perturbation to improve the signal-to-noise ratio and decrease local effects that affect the individual estimates of the gravimetric factor.

Impact and Risk Assessment of Nano-TiO2 on Freshwater by Risk Assessment and Life Cycle Assessment (RA-LCA) Modeling

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Nanomaterials represent a growing market, but there is still little knowledge about their potential environmental risks and impacts. The objective of this thesis is to understand the behavior of TiO2 nanomaterials along their life cycle (from their production through use to end of life), combining risk assessment (RA) with life cycle assessment (LCA). Two approaches are used: (1) the analytical approach characterizing the nanoparticles properties, their sorption on different natural constituents (organic acids, clay, and quartz) and their transport in rivers; (2) the modeling approach based on the analytical data that will be used to calculate TiO2 fate and an effect factors and to feed a combined RA-LCA model. On this poster, the analytical methodology is presented as well as the way in which results will be included in the model. X-ray diffraction, dynamic light scattering, UV-visible spectrometry, and turbidity have already been used to assess the nanoparticles crystallographic phase, size and stability, respectively. However, no standardized methodology has been published to quantify nanoparticles in environmental media. A new protocol is currently implemented to measure TiO2 nanoparticle concentrations in the surrounding environment of a production site with inductively coupled plasma – mass spectrometry (ICP-MS).
Time constant determination of sedimentary transfer in the high Himalaya alluvial plain by means of U isotopic series

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Sediments transfer and alteration are two main processes playing a key role in landscape evolution and regulation of atmospheric CO2 content. An approach involving Uranium decay chain was proposed to study sediments dynamics in the Ganga's basin [1, 2], identifying short transfer time for fine sediments (<25 kyrs) and longer for coarser sediments (>100 kyrs). Himalayan Despite the innovative approach and the encouraging initial findings, some contradictory [3-5] and discordant [6, 7] results highlighted the importance to better understand processes controlling fractionation between U-series nuclides during sediments transfer within the alluvial plain.

Consequently, a second study was led on the Gandak River. The obtained data show significant disequilibria and U/Th fractionation but no upstream-downstream trends. Furthermore, important differences between similar samples were found.

The observed co-variations between (238U/232Th) and Ti/Th revealed that titanium-bearing minerals are likely to control U and Th assessment. Concurrently (230Th/238U) co-varies with (Nd, Ce, La, Sm)/Th ratios, supposing that minerals such monazite and xenotime should impact disequilibria. In contrast, sediment's lithological origin seems have only minor influence on disequilibria dynamic.

Numerical simulation of fluid flow and mass transfer in the continuum surface - vadose zone - aquifer

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Understanding the response of a water catchment to atmospheric forcing is of critical importance to hydrologists and remains a challenging task for various practical issues such as the sustainable use of water resources, water quality preservation and other protection against natural hazard. Catchment hydrodynamics is difficult to simulate because of the complex interactions between surface and subsurface, the nonlinearity and the variability of characteristic times associated with elementary processes, and the correct depiction of heterogeneity. A physically-based distributed hydrological model describing water catchment dynamics is proposed. The diffusive wave equation and the mixed form of the Richards equation are used to describe respectively river flow in complex drainage networks and subsurface flow in the non-saturated – saturated zone. The effect of topography is accounted for as well as the exchange between the river bed and the subsurface handled by a first order-approximation of fluxes. The first results show that the proposed approach reproduces fairly well the various flow mechanisms and the interactions between compartments of the catchment area. The further developments should focus 1- on a subsurface multilayer model presumed to better describe underground heterogeneity, and 2- on the introduction of a 2D surface runoff layer to describe overland flow.
Calcium isotope fractionation in two travertine-depositing systems at Baishuitai, SW China

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The hydrochemistry, carbonate precipitation rates, and seasonal and spatial variations in Ca isotope ratios ($\delta^{44/40}$Ca) of modern travertines deposited in two systems (canal and pool) were investigated at Baishuitai (Yunnan, SW China). Our preliminary results show that $\delta^{44/40}$Ca of all travertine samples are lighter than those of parent solution. In the canal, $\delta^{44/40}$Ca values of both waters and travertines show a downstream increase with absolute $\Delta^{44/40}$Ca$_{\text{travertine-water}}$ values equal to ~1.5‰. No seasonal variation in $\delta^{44/40}$Ca values in travertines are observed at the upper stream site. At the lower stream, however, travertines collected in winter are isotopically heavier than in summer. Compared with the canal, Ca isotopic fractionation between travertine and water is smaller (absolute $\Delta^{44/40}$Ca$_{\text{travertine-water}}$ ~1.1‰) in the pools where travertine precipitation rates are lower. Besides, in contrast to the canal, the winter travertine samples are isotopically lighter than the summer ones. The observed positive correlation between absolute $\Delta^{44/40}$Ca$_{\text{travertine-water}}$ and precipitation rates in our study is consistent with the model developed by DePaolo (2011) and suggests that, in the canal with high precipitation rates, the apparent fractionation is dominated by the kinetic fractionation factor associated with different reaction rates between isotopes during precipitation.

The performance of eco neighborhoods in Iran–Tehran/Iran

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Cities are developing and so their needs. The different types of living, requires, behaviors of citizens and etc, which is going to be changed according to the technology and urban developments. After a decade of auto mobilization, now we need to have more natural spaces, less noises, paying more attention to the energy consumption and air pollution. So the town halls made a creative decision and have created eco construction, which revalued eco neighborhoods. Iran is a country in which we want to construct the eco neighborhoods. We will try to stimulate the behavior of citizens to have a research on the different type of neighborhoods, which we can build in the city. We need to know if the Iranian are ready to accept and live in the eco neighborhoods.

So the first part of my work is about the general information of eco neighborhoods, the second is about, Iran Tehran (urban situation of the town, the seismicity, the type of construction, type of demanded places of habitation, social behavior, and all of this topics from eco neighborhood’s view, until when we will be leaded to: which type of eco neighborhood, situated in which part of the town, how to be acceptable, and what is its affect in the town?

As a conclusion, the last part, will design us an eco neighborhood in the countryside of Tehran.
The European Water Framework Directive imposed chemical and biological assessments in streams. If studies of chemistry uncertainties exist for a long time, few similar studies are still recent in hydrobiology. Our aim is to study impacts of uncertainties – understood as any action that may cause a data error – on biotic metrics, biotic index and final assessment. We focus on the French index: IBMR (Indice Biologique des Macrophytes de Rivière, AFNOR, 2004). From literature, among the sources of uncertainties it appears that the operator factor had the least influence, the seasonal variation and shading had a slightly stronger effect. And the habitat change had the major impact. We chose to analyse uncertainties based on the operator effect both on field and in laboratory such as taxa omission, identification error and abundance change. To study the uncertainties propagation on the IBMR, we will use reliable floristic sheets which will be artificially modified. Firstly a matrix of identification errors will be created with confusion score between taxa difficult to differentiate. Secondly, a selection module using this matrix will complete a random exchange without human bias. Thus the creation of new erroneous floristic sheets will allow us to measure the deviation from the reference.

We therefore suppose that fractionation do not only depend on weathering and transport stage but also on the mineralogical composition of samples. Moreover, the incomplete sample dissolution after the current treatment method is a major problem to evaluate the accuracy and precision of the measured data.