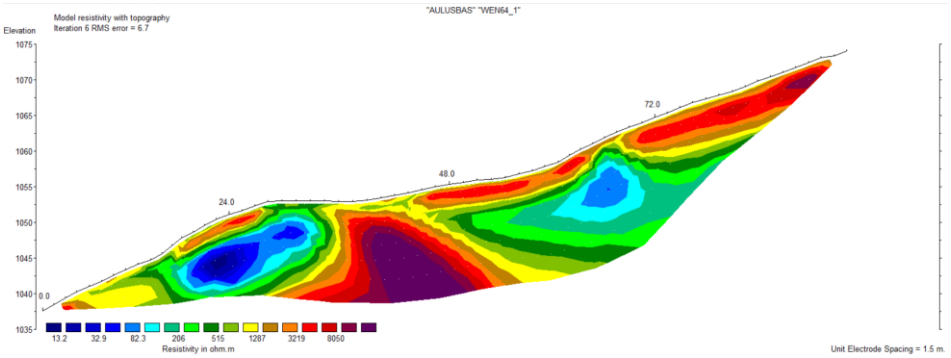
Description of courses in English in second year

LU2ST320 Mathematical tools for Earth Science

Professor: Nicolas Florsch

GENERAL PRESENTATION AND AIM OF THIS COURSE

Learn and relearn the basic mathematical concepts used in Earth Science. Derivatives, integrals, multi-variable functions, linear algebra, vectorial analysis, and the basics of ordinary and partial differential equations are concerned.



Electrical resistivity tomography showing a cavity (dark red)

TEACHING ORGANIZATION

Ten one-hour lectures and ten two-hour tutorial sessions.

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THE COURSE

Disciplinary knowledge

- ✓ Basic tools in mathematics applied to Earth Science
- ✓ Understanding of physical phenomena through modeling approaches

(a) Disciplinary know-how

- ✓ Elementary mathematical calculations
- ✓ Applications to Earth Science

(b) Transversal skills

Benefit from the universality of mathematics to tackle natural phenomena (from ecology to volcanology)

EVALUATION

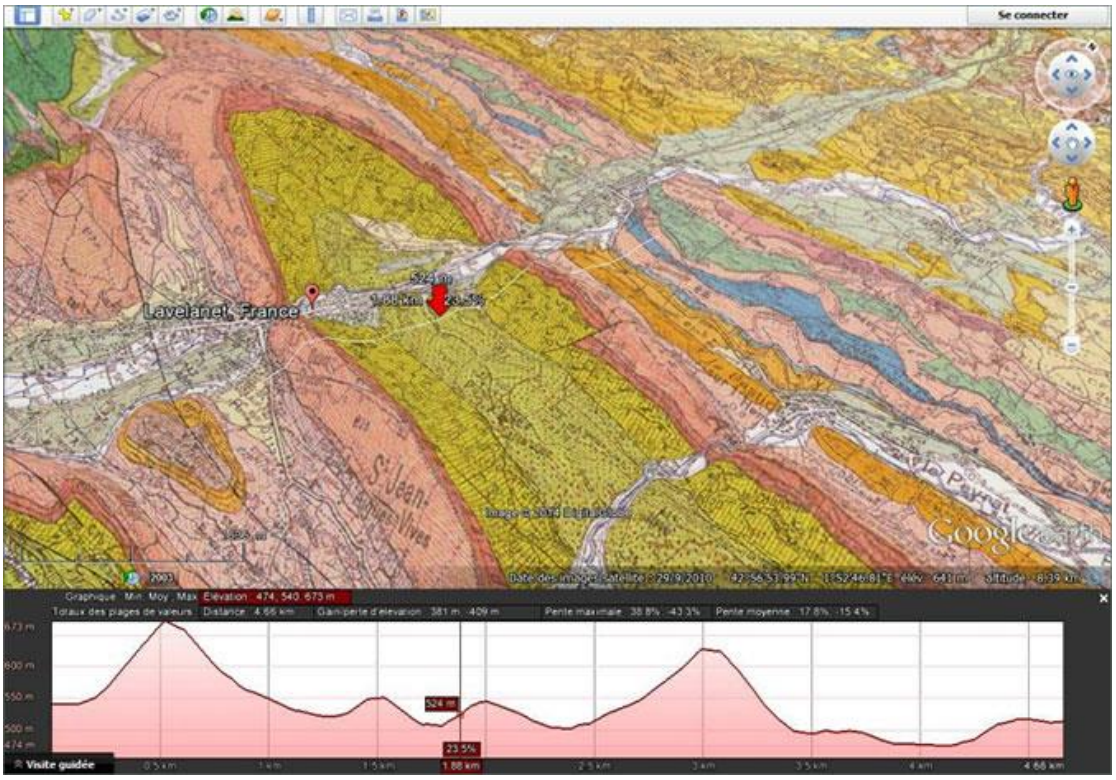
- ✓ 40% written exam
- ✓ 60% tutorial reports

LU2ST301 – cartographics tools

PROFSSORS IN CHARGE: Nicolas Loget and Claudio Rosenberg (nicolas.loget@upmc.fr; claudio.rosenber@upmc.fr)

Teaching persons : Nicolas Bellahsen, Damien Do Couto, Agathe Faure, Olivier Lacombe, Laurence Le Callonec, Nicolas Loget, Alain Rabaute, Claudio Rosenberg

GENERAL PRESENTATION AND AIM OF THIS COURSE



TEACHING ORGANIZATION

There are 22 practicals of 2h each and 11 lectures of 1h each.

The first 5 lectures provide the basic theory of cartographic projections, of GIS, and of the interpretation of geological maps. The following 7 lectures present the geological history of France based on the interpretation of the 1:1.000.000 geological map of France, in addition to more detailed ones in specific areas of interest.

SKILLS AND KNOWLEDGES ACQUIRED AT THE END OF THIS COURSE

Knowledge specific to the field of this course

- ✓ Geological history of France
- ✓ Principles of cartographic projections
- ✓ Geometric principles allowing for the 3D interpretation of geological maps

Skills

- Analyses and 3D construction of geological bodies based on geological and topographic maps.
- Construction of geological cross sections based on surface structures and their interpolation at depth.
- Integrating geometries assessed in map view within a sequence of tectono-sedimentary events.
- Sketching and interpreting a structural scheme, based on geological maps.
- 3D visualisation of geological units and their relationship to topography based on Google Earth

Interdisciplinary skills

- Interpretation of the structure and flow of subsurface water tables and their relationship with geological structures assessed on geological maps.
- Projet-based work, including bibliography, construction of cross sections, analysis and interpretation of maps on different scales.
- Introduction au SIG et aux outils de visualisation 3D

EVALUATION

- ✓ 30 % exam on subjects adressed in the practicals
- ✓ 15 % project prepared individually or in small groups
- ✓ 15 % practicals
- ✓ 40 % exam on the lecture course

UE – LU2ST032 – Paleontology

Head: Delphine Desmares and Isabelle Kruta

Speakers: Delphine Desmares, Isabelle Kruta, Carine Randon, Loïc Villier.

GENERAL PRESENTATION AND AIM OF THIS COURSE

Paleontology studies the history and mechanisms of biological evolution through fossils, the remains of organisms of the past. Paleontology is therefore by definition a science of observations at the interface of biology and geology. The general knowledge acquired forms the bases of these two disciplines. These bases are also essential for any student in geology wishing to do fieldwork and for those interested in biodiversity and evolution. Paleontology is a fundamental and indispensable background for any geologist.

The lecture aims to give students (in Earth and Life Sciences) the keys to interpret paleontological objects in relation to the sediments containing them (biostratigraphy, reconstruction of paleoenvironments)

Practical classes will focus on descriptive paleontology, i.e. what animals and plants looked like. Marine invertebrates (macro and micro) and fossil plants will be investigated. For practical sessions, one part will be dedicated to observation and another to one or more exercises placing the fossil in their time and paleoenvironmental context.

TEACHING ORGANIZATION

6 lectures of 2h.

9 practical classes of 2h.

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Students should be able to identify the main fossil groups (macro and micro). They must be able to position them stratigraphically and to give details on their mode and environment of life.

Knowledge specific to the field of this course

- ✓ Knowledge of taphonomic processes.
- ✓ Know how to observe, describe and identify the main fossil groups
- ✓ Know their stratigraphic distribution, their living environments and the trophic relationships
- ✓ Concepts in biostratigraphy.

Skills

- ✓ Know how to identify and describe a fossil.
- ✓ Make assumption about its age and living environment.

Interdisciplanary skills

- ✓ Know how to construct and present (orally) a scientific poster.

EVALUATION

- ✓ Online quizzes on moodle (10 / 100)
- ✓ Project: scientific poster (10 / 100)
- ✓ Practical classes examinations (30 / 100)
- ✓ Examinations (50 /100)

LU2ST303 – Field training in Normandy

Course leader: François BAUDIN (francois.baudin@sorbonne-universite.fr)

Teachers: Hélène BALCONE, Philippe D'ARCO, Elia D'ACREMONT, Christian HONTHAAS, Isabelle KRUTA, Laetitia LE POURHIET, Erwan MARTIN, Carine RANDON, Frédérique ROLANDONE, Loïc VILLIER and Pierpaolo ZUDDAS

GENERAL PRESENTATION AND AIM OF THIS COURSE

This four-day field training covers different aspects of Earth Sciences from natural outcrops and quarries in Normandy (Calvados and Manche). Remarkable geological objects are observed, described and analyzed in order to address the following items: (1) migmatites of the Pentevrian, one of the oldest basement of France, (2) Upper Neo-Proterozoic sedimentary succession (Brioverian) and the associated granitoids, (3) Lower Paleozoic sedimentary series of the Laize and Orne valleys, (4) the classical May-sur-Orne syncline and its regional angular unconformities, (5) metamorphism of the Flamanville granodiorite, (6) the Middle Jurassic succession of the Bayeux and Caen region including the historical stratotype of Bajocian, (7) Quaternary littoral deposits, (8) present-day tidal sedimentary dynamics.



ORGANIZATION OF THE FIELD TRAINING

Preparatory practical work on the campus (3h) and 4 days in the field

INTER-DISCIPLANARY SKILLS DEVELOPED AND EXPECTED LEVEL AT THE END OF THE COURSE

- Introduction to observation and analysis of natural geological objects
- Introduction to drawing on the field and initiation to the use of a geological notebook
- Tracking along the route on road, using geographic and geological maps at different scales
- Introduction to surveying a geological map
- Orientation with a compass and a map
- Measuring the direction and dip of a plane and a line using a compass.

Knowledge and progression rating

- Daily exercises carried out each evening upon return from the field
- Evaluation of the field notebook (accuracy, quality, care, etc.)
- Personal involvement during the field training

LU2ST302 – Minralogy, pétrology, magmatism (MPM)

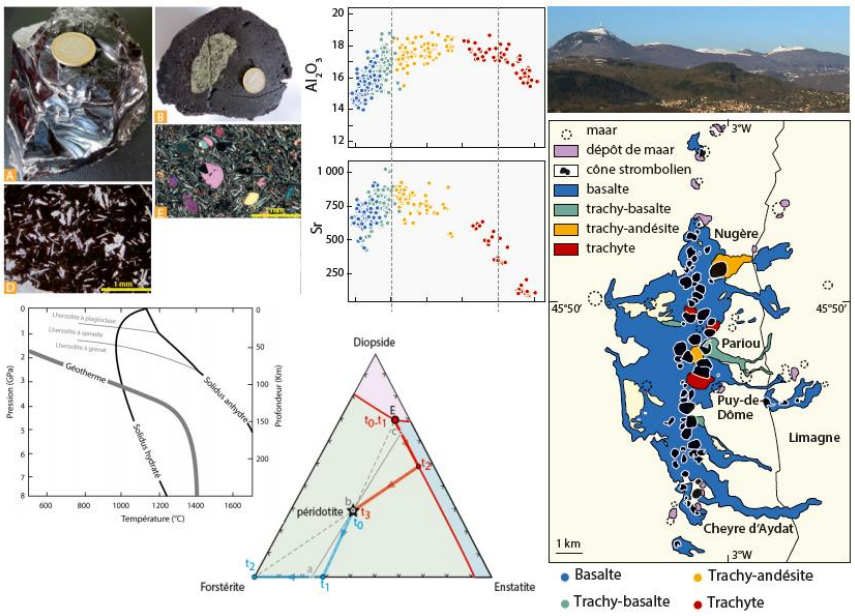
coordinators: Martin Erwan (erwan.martin@sorbonne-universite.fr)

D'Arco Philippe (philippe.darco@sorbonne-universite.fr)

Instructors : H. Balcone-Boissard, H. Bureau, C. Honthaas, P. D'Arco, E. Martin

GENERAL PRESENTATION AND AIM OF THIS COURSE

The goal of this UE is to learn how to read into a magmatic rock in order to decipher how, where and why it was generated and emplaced on the Earth surface.
The formation of magmatic rocks will be analyzed from their mineralogy and chemistry. The crystallization of magmas and the partial melting of rocks will be discussed from natural samples as well as their synthetic or theoretical analogues. The chemistry, mineralogy and textural variations observed in magmatic rocks will permit to discuss their origin and the way they were emplaced. Finally, all the magmatic processes will be linked their geodynamic context.



TEACHING ORGANIZATION

Lectures : 10 lectures (2h)

Practice classes : 10 classes (4h)

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Disciplinary knowledge

- ✓ Binary phase diagrams
- ✓ Ternary phase diagrams
- ✓ Mass balance
- ✓ Magmatism and geodynamic contexts
- ✓ Chemistry and structure of the magmatic minerals
- ✓ Notion of silica saturation

Disciplinary know-how

- ✓ Observation and description of magmatic rocks and minerals (petrography)
- ✓ Conception, description and interpretation of graphics from petro-geochemcial data.

Transverse skills

Basic chemistry, physics and math

EVALUATION

- ✓ 30% TP
- ✓ 70% Écrit

LU2ST035 – INTERNAL DYNAMIC OF THE EARTH

Professor in charge: F. Rolandone

Speakers: F. Rolandone, L. Bayle

GENERAL PRESENTATION AND AIM OF THIS COURSE

The objectives of this UE are to understand the structure and internal dynamic of our planet. This requires to study physical phenomena like the earth gravity field, the earth magnetic field, the propagation of seismic waves, the heat-flow and heat transfer… In addition, to understand surface observations, modeling is an important tool with the use of computer tools.

The practical works focus on quantitative applications of the internal dynamic processes of the Earth described in the lecture courses. We use the Matlab software as a tool to perform the calculations, the graphics and to visualize the geodynamic processes. This UE is linked with the UE LU2ST031 «Informatique pour les Géosciences » (Computer science for geoscience) in order to allow the students to acquire the basic requirements in computer science.

TEACHING ORGANIZATION

5 CM (lecture course) of 2h & 10 TP (practical work) of 2h

Course 1 : Seismology and Earth's structure

TP 1 & 2 Earth structure: PREM and waves propagation

Course 2 Gravimetry and Isostasy
TP 3 & 4 Gravimetry and Isostasy

Course 3 Geodynamic and plate tectonic
TP 5 & 6 Vertical movement and post-glacial rebound

Course 4 Earth's thermal structure
TP 7 & 8 Thermal structure of oceanic lithosphere

Course 5 Heat flow and convection
TP 9 & 10 Thermal structure of continental lithosphere

SKILLS AND KNIWLEDGE ACQUIRED AT THE END OF THIS COURSE

- ✓ Seismic waves propagation in the Earth
- ✓ Seismological structure of the Earth
- ✓ Calculations of thermal gradients
- ✓ Thermal structure of the Earth
- ✓ Calculations in gravimetry and isostasy

- ✓ Use Matlab to run programs and display graphics
- ✓ Write a report including text, figures and scientific argumentations.

EVALUATION

- ✓ 60 TP
- ✓ 40 Courses

For the practical works, the students have to submit five reports corresponding to the sessions listed above.

LU2ST033 – « Environnement, Patrimoine et Archéologie »

Faculty members in charge: Laurence Galoisy (SU-S), Sylvie Balcon-Berry (Su-L)

Teaching staff: Laurence Galoisy, Sylvie Balcon-Berry

GENERAL PRESENTATION AND AIM OF THIS COURSE

Lying on Archeology, Art History, the use of mineral resources and the evolution of our environment during the main 4 historical periods, this teaching is shared between the Faculty of Sciences (SU-S) and the Faculty of Arts (SU-L).

This UE aims to give a cross-trained formation to the students in the vast domain of Cultural Heritage.

1. Knowledge about materials used in Heritage buildings and the history of the construction
2. An introduction to natural, transformed or technological building materials
3. An introduction to the aging of Heritage materials to the environmental factors: water, humidity, air, biological factors…

Faculty members of the two faculties (SU-L and SU-S) will provide a teaching that will allow mutual interactions between students of the two Faculties.

TEACHING ORGANIZATION

10 courses

20 « supervised works » TD

The supervised works for the students of the faculty of Arts are given by a member of the SU-S Faculty and vice-versa for a student of the Faculty of Sciences.

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Knowledge of the petrology and mineralogy of the materials used in buildings relevant of Cultural Heritage

Historical evolution of monuments

Understanding the link between the construction of monuments over the ages and the materials used

Cross-disciplinary skills

Reading of articles and bibliography in French and in English from scientific and literary fields

EVALUATION

TD 40%

Courses 60%

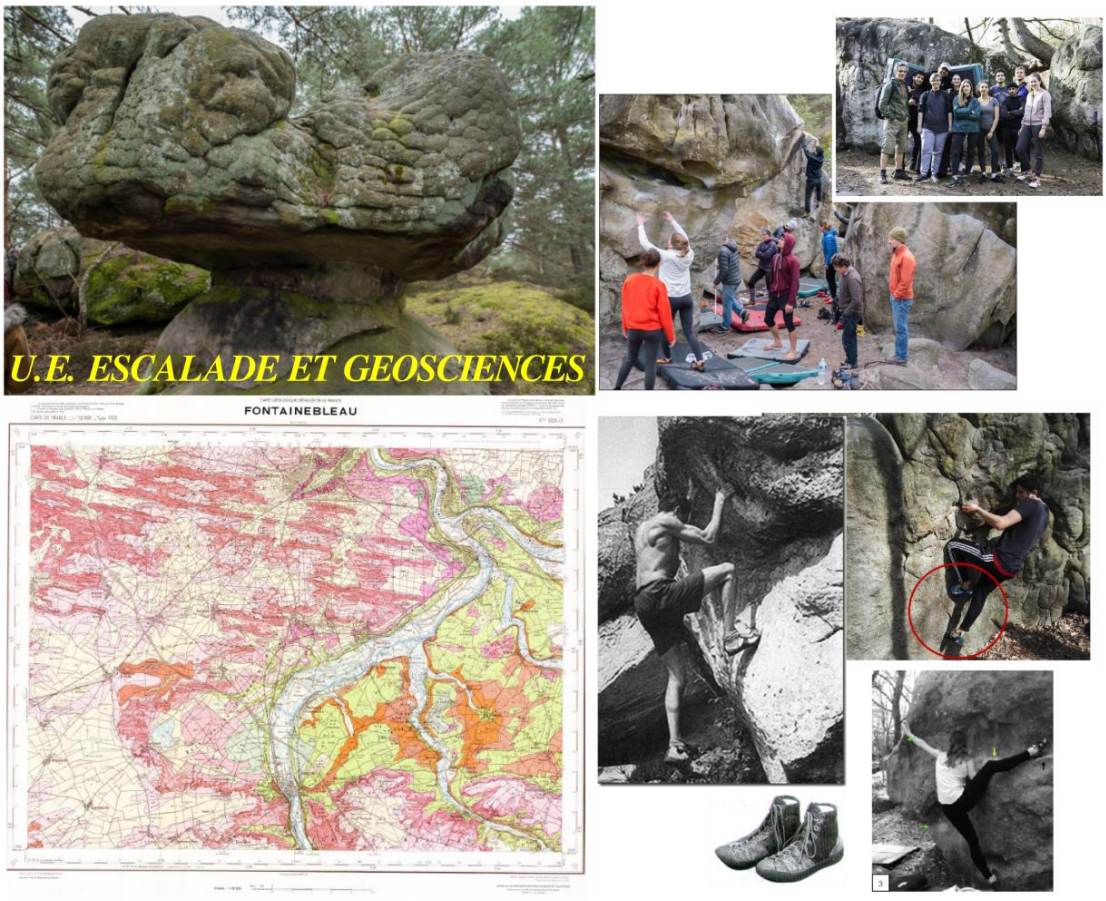
LU2ST034 – CLIMBING AND GEOSCIENCE

GENERAL PRESENTATION AND AIM OF THIS COURSE

Natural sciences have been linked for decades to sport, effort and personal challenge, as for Horace de Saussure (1740-1799), a Genevan Earth scientist credited with being a founder of moutaineering.

The present course revolves around the Fontainebleau forest and its exceptional sandstone boulders. These rocks found in a sand unit have a fascinating history, from unique geochemical characteristics to witnessing the birth and development of rock climbing, and the fine details of their petrology remain poorly understood. The aim of this course is to compare the various hypotheses offered over hundreds of years to explain how these boulders formed, using field observations and geochemistry. The visit of geological sites internationally reputed for rock climbing will allow combining petrographic observations to practicing rock-climbing, a very hands-on approach!

The basics for rock climbing and safe practice are presented by an expert teacher from the sports department. The necessary gear is provided.



TEACHING ORGANIZATION

The course includes:

- two practicals (2 hours each) with short lectures and application exercises to present the geology of the Fontainebleau forest and the models of formation of the sandstones
- four to five lessons of introduction to rock climbing indoors (Jussieu campus, ~1 h/lesson)
- three days for field geology and rock climbing in the Fontainebleau forest.

At the end of this course, student will make a written report about the geology and environment of the Fontainebleau forest, then show their work during an oral presentation, working in groups of two and three. To do so, students will choose a theme between the following:

- the Stampian basin and the Fontainebleau sands
- geomorphology and ecology of the Fontainebleau forest
- silicification of the Fontainebleau sands I: hypotheses and controversy
- silicification of the Fontainebleau sands II: micro-petrography
- origin of the Fontainebleau gritstone
- calcification of the sands and sandstones.

A selection of scientific articles will be provided. Each student will present part of the team's work over 5 to 7 minutes.

Prerequisites: basic knowledge in general geology (L1 level: rock types, elementary cartography) and chemistry (reactions, pH). There are no prerequisites for rock climbing, but being able to walk over a steep or unven path is necessary.

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Knowledge specific to the field of this course

- ✓ Petrography (being acquired)
- ✓ Cartography (being acquired)
- ✓ Basic geochemistry (being acquired)

Skills

- ✓ read a geological map
- ✓ geological cross-sections
- ✓ calculate scaling on a cross-section
- ✓ orient oneself in the field
- ✓ identify sedimentary rocks and differences between limestone and sandstone
- ✓ balance a chemical reaction
- ✓ calculate a reaction constant

Interdisciplinary skills

- ✓ Commenting and synthesizing a scientific article
- ✓ Using a presentation software

EVALUATION

- ✓ The rock climbing part is evaluated through progress and personal investment (including persistence and timeliness)
- ✓ The final exam takes place via an oral presentation followed by individual questions.
- ✓ The written report is individual.
- ✓ Cross-sections and other material from the practicals are evaluated.

LU2ST403 - Basis of Sedimentology & Tectonic

SEDIMENTOLOGY PART

LEADER :

Laurent Riquier (laurent.riquier@sorbonne-universite.fr)

CONTRIBUTORS :

F. Baudin, S. Boulila, D. Do Couto, L. Emmanuel, S. Gontharet, C. Gorini, LeCallonnec, L. Riquier, J. Schnyder, L. Segalen

GENERAL PRESENTATION AND AIM OF THIS COURSE

For the Sedimentology part, the objective of this module is to present the main sedimentary processes, which take place during the geological cycle of rocks.

During the lectures, we will first discuss the physical and (bio) chemical factors at the origin of sedimentation (weathering, biogenic and chemical production). Then we will focus on the sedimentary processes (transport, deposits, diagenesis) controlling the formation of sediments and sedimentary rocks (detrital, carbonate, evaporitic, etc.).

During the practical sessions, we will focus on the description of the constituents and the classification of sedimentary rocks based mainly on the macroscopic observation of rock samples and on the microscopic analysis of thin sections.

TEACHING ORGANIZATION

5 lectures (10h) & 10 practical session (10 h)

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Knowledge in Sedimentology

- Mastery of fundamental concepts of sedimentology, and sedimentary cycles

- Knowledge of the main sedimentary processes and associated factors related to the formation of sediments and sedimentary rocks

- Recognition and description of the constituents of the major families of sedimentary rocks at the macroscopic scale and at the microscopic scale

Expertise in Sedimentology

- Creation of captioned drawings of macroscopic samples and thin sections

- Interpretation of a diffractogram and identification of minerals

EVALUATION

Continuous assessment and final examination

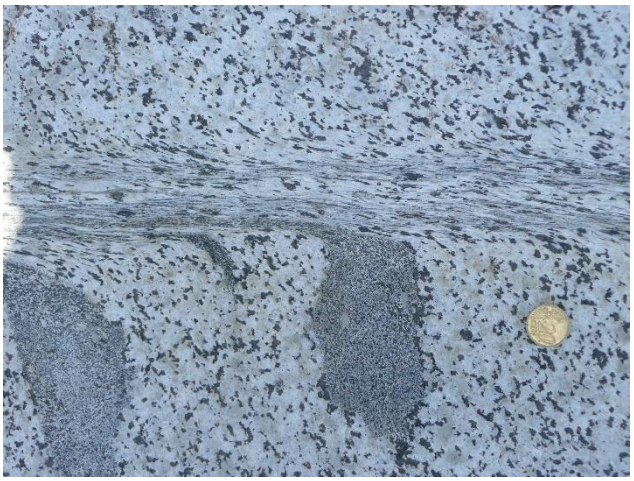
40 % Practical Session 60% Lectures

TECTONIC PART

Responsible persons : Catherine Homberg, Claudio Rosenberg

Teaching persons: Claudio Rosenberg, Catherine Homberg

GENERAL PRESENTATION AND AIM OF THIS COURSE



TEACHING ORGANIZATION

9 lectures, each of 1h, and 10 practicals, each of 2h

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Knowledge specific to the field of this course

- ✓ Stress and strength of rocks
- ✓ Fracture laws
- ✓ Strain and kinematics in the ductile field
- ✓ Folding mechanism
- ✓ Anatomy and development of major tectonic settings :convergent, divergent and strike-slip

Skills

- ✓ 3D structural analyses based on maps and cross sections
- ✓ Determination of paleo-stress orientations
- ✓ Determination of the fields of stability, fracturing, and of reactivation of pre-existing structures with Mohr diagrams
- ✓ Quantification of deformation
- ✓ Relative dating of deformation

Interdisciplinary skills

- ✓ Use of stereonet (Schmidt net) to represent planes and lines and analyse their spatial orientations
- ✓ Correlation of map view and cross section to reconstruct the 3D shape of solid bodies

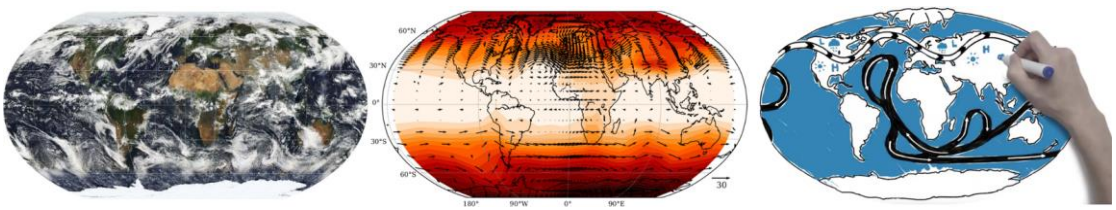
EVALUATION

- ✓ 40 % exam on the topics of the practicals
- ✓ 10 % practicals submitted throughout the semester
- ✓ 50 % exam on the lecture course

LU2ST045 – Meteorology

Course Instructors : Jean-Baptiste Madeleine (jmadeleine@lmd.jussieu.fr)
Maëlle Coulon-Decorzens, Florent Brient

GENERAL PRESENTATION AND AIM OF THIS COURSE



This course about the fundamentals of Meteorology will teach you how to understand and forecast the weather that we experience on a daily basis, both in tropical and temperate regions. To do this, the course will be based on both theoretical and practical, hands-on sessions through numerical calculations and the study of real meteorological events (climate of the tropics, temperate latitudes, poles) and through the use of a weather forecast model. Topics will include radiative transfer, atmospheric dynamics and the origin of winds, convection and atmospheric vertical motion, and cloud formation. The content of the course will be mainly based on physical equations, which will be explained using quantitative applications and numerical weather predictions (no prior programming knowledge required).

TEACHING ORGANIZATION

Courses (10h)

1. Introduction to atmospheric physics
2. Atmospheric vertical structure
3. Phase changes and cloud formation
4. Equations of motion
5. Numerical weather prediction (NWP)

Hands-on sessions (12h)

- Vertical profiles and skew-T log-P diagrams
- Pressure and temperature map analysis
- Weather forecast using maps and satellite imagery

Labs (8h)

Global climate simulations and numerical weather prediction

SKILLS AND KNOLEDGE ACQUIRED AT THE END OF THIS COURSE

Specific skills

- ✓ General circulation of the atmosphere
- ✓ Main atmospheric variables and orders of magnitude
- ✓ Hydrostatic equilibrium
- ✓ Hypsometric equation
- ✓ Buoyancy of a parcel
- ✓ Dry and wet adiabatic gradient
- ✓ Clausius-Clapeyron equation
- ✓ Prediction of instability in dry and humid atmosphere

- ✓ Cloud formation
- ✓ Pressure force, Coriolis force and geostrophic balance

General skills

- ✓ Usual mathematical tools (algebra, function analysis, integration, manipulation of vectors in two-dimensional space)
- ✓ Use of thermodynamic diagrams
- ✓ Gradient calculations from isocontour maps of a physical field
- ✓ Identification of 3D systems by 2D cartographic analysis

Cross-cutting skills

Use of numerical tools (Linux interface, Fortran and Python scientific computing, no prior knowledge of programming required), learning of the experimental approach (hypothesis → experiment → confirmation / refutation), analysis and interpretation of numerical simulations on real cases, joint analysis of models and observations, writing of a scientific report

EVALUATION

- ✓ Homework : 30%
- ✓ Final exam : 40%
- ✓ Labs : 20%
- ✓ Attendance and participation : 10%

LU2ST042 – History of hearth

Head: Isabelle Kruta et Delphine Desmares

Speakers: Anaïs Boura, Delphine Desmares, Isabelle Kruta, Carine Randon, Chrystele Sanloup, Loïc Villier.

GENERAL PRESENTATION AND AIM OF THIS COURSE

Lectures are dedicated to the evolution of the biosphere in relation to the most important events in the history of the geosphere. The radiations, biological crises, climatic and paleogeographic changes that have marked the Earth's history will be addressed...

TEACHING ORGANIZATION

8 lectures of 2h.

7 practical classes of 2h.

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Students should be able to list the main event of the Earth's History. They will be able to present arguments to discuss abiotic factors affecting the biosphere and the evolution of biodiversity.

Knowledge pecific to the field of this course

- ✓ Know the main events of the Earth's History and of the evolution of the biosphere.
- ✓ Know which groups-populated the oceans and continents during the different time periods of the Neoproterozoic and Phanerozoic.
- ✓ Know the causes and consequences of the five great mass extinctions.

skills

- ✓ Understand how the curves of paleobiodiversity are constructed and how to interpret them.

Interdisciplinary skills

- ✓ Have the scientific background necessary to understand the interactions between the geosphere and the biosphere..

EVALUATION

- ✓ Online quizzes on moodle (10 / 100)
- ✓ Practical classes examinations (40 / 100)
- ✓ Examinations (50 /100)

LU2T044- Laboratory internship

Head: Isabelle Kruta (isabelle.kruta@sorbonne-universite.fr)

Contributors : Véronique Charrière, Cécile Montarou

GENERAL PRESENTATION AND AIM OF THIS COURSE

Students are asked to contact laboratories (inside and outside Sorbonne Université) for internships on geoscience topics where they discover laboratory techniques and analyze data obtained (mineralogical, chemical, biological, geochemical, paleontological.). The internship topic as well as the methodological approach and results will be presented in a scientific poster, written in English.

The aims for this internship are to:

- Understand the principles and methods of the devices and/or techniques used
- Individually manipulate specimens/data/devices and obtain results
- Critically assess the results obtained (reproductivity, margins of error, etc…)
- Produce a written report describing the technique employed, its limits and the results.
- Format the report for poster and oral presentations.

The analytical laboratories hosting students will mostly be those of the UFR.918- TEB in SU, exceptionally in other labs of CNRS, MNHN, MétéoFrance, INRA...

TEACHING ORGANIZATION

30h in total including 7.5 days in the laboratories and 4H of English lessons for the preparation of the scientific poster in English.

SKILLS AND KNOWLEDGE ACQUIRED AT THE END OF THIS COURSE

Laboratory work, data acquisition and treatment, writing and formatting a scientific poster in English, search and quote bibliography, oral presentation of an internship.

EVALUATION

- ✓ 40% Scientific poster
- ✓ 40% Oral presentation
- ✓ 20% Supervisor's opinion on the internship