CORSI DI DOTTORATO IN
SCIENZE DELLA TERRA
E
EARTH AND PLANETARY SCIENCES
DIDATTICA INTERNA aa 2023-2024

CORSI PROPOSTI DALLA SEDE DI FIRENZE

AVANZINELLI RICCARDO (riccardo.avanzinelli@unifi.it)
Measurements of isotope ratios through TIMS and MC-ICPMS and applications to Geosciences (6h, 1 CFU)
Date: 2nd half of June 2024
The aim of the course is to provide the basics knowledge of the analytical procedures for themeasurements of isotope ratios via multicollector Thermal (TIMS) andPlasma-sourced (MC-ICPMS) Mass Spectrometer. The course consists in 1 lessons (3 hours)and a laboratory experience (3 hours) at the Radiogenic Isotope Geochemistry Laboratory ofthe Università degli Studi di Firenze.Lesson 1 (3 hours): brief introduction to isotopes; chemical methods for samplepurification through cation exchange chromatography; description of TIMS and MCICPMSand differences. Corrections and key issues related to the measurements ofisotope ratios (e.g. Mass Bias and its correction). Static vs. Multidynamicmeasurements. Isotope Dilution measurements. Description of the completeanalytical procedure for selected isotopic systematics (e.g. Sr, Pb, U-Th).Lab experience (3 hours): Visit to the Radiogenic Isotope Geochemistry Laboratoryof the Università degli Studi di Firenze with practical experience of operating a TIMSinstrument for the measurements of isotopic ratios.

BELVEDERE MATTEO (matteo.belvedere@unifi.it)
Close-range photogrammetry paleontology and museum heritage. From pictures to 3D models basics (12h, 2 CFU)
Date: end of January-1st week of February 2024
3D data production and visualization have become an integral part of archaeological, paleontological studies and is increasing its importance in museum heritage conservation.
Close-range photogrammetry (surface 3D digitizing from digital photographs) is one of the most used, relatively cheap, and versatile method used for surface digitization.
This course will teach the basics of photogrammetry for paleontology and museum heritage.
Lesson 1: theoretical basic knowledge of Structure-from-Motion photogrammetry and how to take pictures
Lesson 2: workflow and comparison of the most commonly used software.

Lessons 3-4: practical lessons with samples brought by participants.
Participant number is limited to 10-15 (depending on next year's distancing rules); the course is primarily addressed to doctoral and master students; other participants are also welcome, although priority will be given to the previous categories. On the base of the nationality of participants, the course will be held in Italian or English.

Registration deadline 10 January 2024
For information, final dates and registration please contact Dr. Matteo Belvedere: (matteo.belvedere@unifi.it)

BIANCHINI SILVIA (silvia.bianchini@unifi.it)
Tecniche di detection and mapping da dati radar interferometrici satellitari applicate all'instabilità del terreno e dei manufatti (6h, 1 CFU)
Date: giugno – luglio 2024
Il corso consiste in lezioni frontali ed esercitazioni pratiche (su software ArcGIS pro) e si pone l'obiettivo di fornire conoscenze sui seguenti argomenti: cenni teorici di base di interferometria radar satellitare differenziale e multi-temporale PSI (Persistent Scatterers Interferometry); procedure e tecniche radar-interpretazione di dati radar interferometrici satellitari PSI per l'identificazione, mappatura e caratterizzazione di spostamenti del terreno a scala regionale e a scala locale.

BUCCIANTI ANTONELLA (antonella.buccianti@unifi.it)
Statistical Analysis of Compositional Data (6h, 1 CFU)
Date: September 2024, first week
Since Karl Parson wrote his paper on spurious correlation in 1897 a lot has been said about the statistical analysis of compositional data. The solution appeared in the 1980s when John Aitchison proposed to use logratios. Since then the approach has seen a great expansion, mainly building on the idea of the "natural geometry" of the sample space. Statistics is expected to give sense to our perception of the natural scale of the data, and this is made possible for compositional data using logratios. The aim of the course is to provide the basics knowledge of the statistical analysis of compositional data. It will be of interest of people working in different fields of science and includes information about methodology, case studies and user-friendly software.

DELLA SCHIAVA ELENA (elenadellaschiava@libero.it)
Indagini sui beni culturali durante il restauro: le terre di fusione di alcune sculture bronzee di Donatello e di altri autori del Rinascimento fiorentino (6h, 1 CFU)
Date: April, 16th-17th, 2024
- Introduzione (spiegazione dei lavori eseguiti, foto, esempi di alcune indagini su varie opere, obiettivi raggiunti)

- Cosa sono le terre di fusione nello specifico; le tecniche di fusione (foto, esempi, campioni di terre, opere, realizzazione di una scultura)
- Le tecniche analitiche per caratterizzare le terre
- Lo stato dell'arte sulle terre di fusione delle sculture (articoli di restauro, scientifici, bibliografie e letteratura)
- Considerazioni tecnologiche (il contributo alle indagini tecnologiche dei bronzi dato dagli studi sulle terre)
- Problematiche di conservazione delle terre in situ nelle statue (svuotamento, fenomeni di interfaccia metallo/anima)
- Come campionare le terre di fusione per ottimizzare i risultati analitici
- Campioni di terre: carrellata di esempi pratici di opere d'arte con visione di campioni prelevati
- Le terre di fusione del San Giovanni Battista (1571) di Vincenzo Danti (campionamento, indagini, obiettivi, risultati)
- Le terre di fusione di alcune sculture donatelliane realizzate fra gli anni '20 e '60 del XV secolo (campionamento, indagini, obiettivi, risultati)
- Conclusioni.

GAMBACORTA GABRIELE (gabriele.gambacorta@unifi.it)
Origin and fate of organic matter from land to oceans (12h, 2 CFU)
Date: 2 days – to be defined with the students
The course is aimed to provide participants with basic knowledge about fine-grained sediments and black shales origin, characteristics, transport and deposition. The course consists of frontal lessons and exercises that will allow the participants to better understand what explained during the class.
Lesson 1 (6 h):
- Introduction to organic facies and black shales; processes responsible for mudrocks and black shale erosion, transport and deposition; physical and chemical properties of mudrocks and source rocks; mudrocks and source rocks lateral and vertical heterogeneity from thin-section-, core-, log-, to seismic-scale.
- Organic matter production: type, amount, variation from proximal to distal settings, water column processes.
- Preservation processes: organic-matter degradation along the water column and at the sediment-water interface, organic carbon accumulation rate, burial efficiency, preservation factor.
Lesson 2 (6 h):
- Organic matter dilution: sediment supply, distribution of organic matter in the different depositional environments, detrital sedimentation rate impact on dilution and preservation of organic matter; principles of source rock sequence stratigraphy.

- Modern and ancient source rock depositional environments from marine to continental settings.
- Fine-grained sediments and black shales burial and diagenesis. An overview on present and future applications.

GOZZI CATERINA (caterina.gozzi@unifi.it)
1) Introduction & Basics of R (8h, 1,33 CFU)
Date: 2nd half of June 2024
R is both a programming language and an interactive environment for statistics with an extensive catalog of statistical and graphical methods. Its flexibility, power, sophistication, have made it an invaluable tool for scientists around the world. The aim of the course is to provide the basics to start using the R software. The course is organized in 2 lessons of 4 hours each and will be held at the Department of Earth Science of the University of Florence.
Lesson 1: An Introduction to R: How to install R and RStudio, launching RStudio, overview of the key components and features available, commands, operators and functions, help window.
Lesson 2: R applications to Earth Sciences: practical exercises in R using a geochemical dataset: reading data into the software, basics of research statistics, exploratory data analysis and production of different types of plots in ggplot2 and plotly packages (e.g. histograms, box-plots, bubble plots and correlations matrices)
2) Writing the PhD Thesis in LaTeX (4h, 0,66 CFU)
Date: 2nd half of May 2024 to be defined with the students
LaTeX is a powerful document preparation system for high-quality typesetting. It is most often used for medium-to-large technical or scientific documents but it can be used for almost any form of publishing. It was created by scientists for scientists and it has a large and active community of users. The aim of the course is to provide the basic knowledge to start typesetting a PhD thesis using LaTeX.
The course is organized in 2 lessons of 2 hours each and will be held at the Department of Earth Science of the University of Florence.
Lesson 1: An Introduction to LaTeX: The advantages of using LaTeX, typesetting text, font types, LaTeX environments, packages and templates.
Lesson 2: How to Write the Thesis in LaTeX: basic structure, sectioning, crossreferences, tables and figures, bibliography generation with Bibdesk.

LEPORE GIOVANNI ORAZIO (giovanniorazio.lepore@unifi.it)
Practical introduction to X-ray absorption spectroscopy (XAS) with applications to mineralogical and environmental sciences - Introduzione pratica alla spettroscopia di assorbimento di raggi X (XAS) con applicazioni alla mineralogia e all'ambiente (12h, 2 CFU)
Date: to be defined with the students

- Introduzione alle sorgenti di luce di sincrotrone.
- Introduzione teorica alla spettroscopia di assorbimento di raggi X (XAS).
- Tutorial pratico sull'analisi di dati XAS.
- Applicazioni alla mineralogia e alle scienze ambientali.
Il corso prevede lezioni frontali ed esercitazioni.
- Introduction to synchrotron light sources.
- Introduction to X-ray Absorption Spectroscopy (XAS).
- Practical tutorial on XAS data analysis.
- Applications to mineralogical and environmental sciences.
Class lectures and exercises.

MAESTRELLI DANIELE (daniele.maestrelli@gmail.com)
Analogue modelling of volcano-tectonic processes: from nature to lab (12h, 2 CFU)
Date: June, to be defined with students.

The aim of the course is to provide PhD students with an introduction to the study of volcano-tectonic processes in various tectonic contexts, from local- to regional-scale, through the use of advanced analogue modelling techniques and dedicated analyses.
Main topics:
• Introduction to analogue modelling techniques applied to the study of volcano-tectonic processes.
• The volcano-tectonic processes and magma-related deformations seen through analogue models: case studies and practical implications. From magma migration to magma emplacement/eruption and associated deformations: magma versus rifting (magma assisted rifting); magma emplacement in compressive and transcurrent settings; the structural control of local- to regional- scale tectonics on the formation and evolution of collapsed calderas and volcanic edifices; volcanic edifices and post collapse calderas deformation, caldera resurgence-associated deformation.
• Practice: modelling volcano-tectonic processes, lab exercises and analyses.

MANCA ROSAROSA (rosarosa.manca@unifi.it)
Applications of X-rays based techniques for the non-invasive characterization of geomaterials in cultural heritage (6h, 1 CFU)
Date: March-June 2024 - to be defined with the participants

The course aims at providing an overview of the possible applications of X-ray Fluorescence (XRF) spectroscopy and Particle-Induced X-ray Emission (PIXE) analysis to the non-invasive characterization of geomaterials, with a specific focus on the field of cultural heritage.
The principles of the two techniques will be presented and compared. The cases of ancient gold jewellery and glazed pottery will be examined. The course includes a visit

to the XRF lab of the Earth Sciences Department (Unifi) and to the LABEC, INFN, Sesto Fiorentino.

Part 1: Introduction on Geomaterials and Cultural Heritage. Non-invasive approaches: advantages and limitations. X-rays Fluorescence (XRF) spectroscopy, Particle-Induced X-ray Emission (PIXE) and Particle-Induced Gamma Emission (PIGE) analyses: introduction to basic theory.

Part 2: Case studies in the field of Cultural Heritage:

a) XRF and PIXE analysis of gold jewellery. Quantification and ternary diagrams. Secondary filters for detection of trace elements. Study of compositional gradients from the surface to the subsurface.

b) XRF and PIXE-PIGE analysis of glazes. The problems of light elements and overlapping X-rays lines. Indirect information on the layer structure.

MARCHETTI EMANUELE (emanuele.marchetti@unifi.it)
Infrasound array analysis of gravity currents (12h, 2 CFU)
Date: June-September 2024 to be defined with the students
- Introduction to time series analysis (spectral analysis, filtering, coherence and crosscorrelation)
- Infrasound acoustics, source mechanisms and array analysis.
- Source mechanisms of different gravity currents, (snow avalanches, debris flows, calving events, PDC)
- Fluid dynamics modeling of pressure waveforms.
- Real-time application for event detection, identification and notification.
- Implication for research and monitoring.

NATALI CLAUDIO (claudio.natali@unifi.it)
Identificazione di tenori di fondo geogenici e anomalie di origine antropogenica in sistemi ambientali (8h, 1,33 CFU)
Date: to be defined with the students – 2 last weeks of July
Il Corso si articola in 4 lezioni della durata di 2 ore che riguarderanno metodi di indagine per lo studio della variabilità naturale e l'identificazione dei contributi di origine antropogenica in diversi contesti ambientali (suoli, fiumi, lagune costiere). Saranno presentati vari casi di studio in cui si è potuto identificare il legame fra la matrice investigata (acqua, solido sospeso, sedimento di fondo, suolo) e le rocce del bacino di provenienza, gli accumuli preferenziali di alcuni metalli pesanti in relazione a diversi contesti deposizionali ed i contributi di origine antropogenica. Saranno illustrate le potenzialità dell'approccio di studio petrografico-geochimico a tali problematiche, e si affronteranno inoltre aspetti relativi alla vigente normativa ambientale.

MORANA MARTA (marta.morana@unifi.it)

1) High-pressure experimental techniques - Metodi sperimentali ad alta pressione (15h, 2,5 CFU)
Date: to be defined with the participants
Introduction to high-pressure experimental techniques; piston-cylinder and multianvil techniques; diamond anvil cells techniques; probing techniques based on electromagnetic radiation; pressure and equation of state; dynamic compression; synchrotron and neutron studies in Earth and planetary sciences.
Only class lectures.
Introduzione ai metodi sperimentali ad alta pressione; dispositivi piston-cylinder e multianvil; celle a incudine di diamante; tecniche di caratterizzazione ad alta pressione; pressione ed equazioni di stato; compressione dinamica; applicazioni con neutroni e luce di sincrotrone nelle scienze delle Terra e planetarie.
Il corso prevede solo lezioni frontali.

2) Physical aspects of color - Fisica del colore (15h, 2,5 CFU)
Date: to be defined with the participants
Light and color; polarization and crystals: refraction, dichroism, pleochroism; color from atoms and ions: crystal field theory; impurity colors; luminescence.
Only class lectures.
Luce e colore; polarizzazione e cristalli: rifrazione, dicroismo, pleocroismo; colore, atomi e ioni: teoria del campo cristallino; colore e impurezze; luminescenza.
Il corso prevede solo lezioni frontali.

PAZZI VERONICA (veronica.pazzi@unifi.it)
1) Subsoil models by integrating geophysical techniques (18 ore, 3 CFU)
Date: May-July 2024 (to be defined with the students)
The course aims at providing an overview on the possible integration of different geophysical techniques (e.g., electrical resistivity tomographies, seismic noise measurements, seismic refraction tomographies, ground penetrating radar) to reconstruct reliable subsoil models. After an introduction on the main geophysical techniques, the PhD students will be asked to read, understand, and present to the others a scientific paper that deals with the reconstruction of subsoil models thanks to geophysical data.

2) How geophysical techniques can help to deal with different environmental problems (12 ore, 2 CFU)
Date: May-July 2024 (to be defined with the students)
The aim of the course is to provide an overview on how different geophysical techniques can help in understanding different environmental problems (e.g.: soil instabilities, landfills, dam's stability...). After an introduction on the main geophysical techniques (e.g., electrical resistivity tomographies, seismic noise measurements, seismic refraction tomographies, ground penetrating radar), the PhD students will be asked to read, understand, and present to the others a scientific paper where the

geophysical techniques are employed to characterize and understand a specific environmental problem.

RANERI SIMONA, (simona.raneri@unifi.it)
1) Synchrotron X-ray microprobes for geomaterials (21h, 3,5 CFU)
Date: to be defined with the participants

Recent upgrades of European synchrotron radiation (SR) sources have favored the construction and optimization of beamlines for materials science applications, improving setups, spatial resolution and detection limits. In the field of geomaterials, integrated approaches combining different methods are often required. In some cases, the combination of chemical and structural information can be critical for material characterization and analysis. Indeed, some beamlines at large facilities offer the possibility to perform different types of measurements at the same analysis point, going beyond the information level achievable by conventional laboratory setup.
The course aims to provide an overview of the possibilities offered by synchrotron radiation sources in Europe, with a particular focus on X-ray techniques for the characterization of geomaterials, also illustrating case studies.
Opportunities offered by European research infrastructures, EU projects providing simultaneous access to several facilities, and research opportunities will be presented, including how to write a successful proposal for a synchrotron experiment.

2) Geosciences for Cultural Heritage: challenges and innovative methods (12h, 2 CFU)
Date: to be defined with the participants

Geosciences are becoming increasingly relevant to studying cultural heritage, given that many archeological and artistic objects are made of geomaterials. The characterization, provenance, technological issues, but also the preservation and conservation strategies of cultural heritage materials could benefit from the technological advances offered by the approaches and techniques of the geosciences. In particular, non-destructive and non-invasive techniques are particularly suitable for characterizing cultural heritage materials, which in most cases cannot be sampled or moved from their original set. In the field of conservation science, nanotechnologies open up new perspectives for the development of new strategies and approaches. Finally, large scale facilities are expanding the possibilities for the study of complex micro-samples that are typically sampled from precious cultural heritage objects. The upstreaming and downstreaming challenges offered by the geosciences for cultural heritages will be discussed, with case studies illustrating how different methodological approaches can answer the most common questions posed by archaeologists, art historians and heritage conservation scientists.

RIZZO ROBERTO EMANUELE (robertoemanuele.rizzo@unifi.it)
Faults and fractures networks in geoenergy applications (6h, 1 CFU)
Date: 2nd half of June 2024 to be defined with the students

Faults and fracture zones are fundamental features of geological reservoirs that control the physical properties of the rock. As such, understanding their role in in-situ fluid behavior and fluid-rock interactions can generate considerable advantages during exploration and management of reservoirs and repositories.
Review on the physical properties such as frictional strength, cohesion of faulted and fractured rock masses.
Statistical analysis of fault and fracture networks and their implications in fluid transport in the subsurface.
Modelling of fluid permeability of fractured rock masses.

TASSI FRANCO (franco.tassi@unifi.it)
Tecniche strumentali per analisi composizionali ed isotopiche di acque e gas (6h, 1 CFU)
Date: 13-14 Maggio o 21-22 Maggio 2024
Il corso si svolgerà in due lezioni della durata di 3 ore ciascuna ed ha come obiettivo la formazione degli studenti all'utilizzo di strumentazione recentemente acquisita dai laboratori di acque e geochimica dei fluidi del DST-UniFi. Nello specifico, verranno trattate tecniche cromatografiche con gli strumenti Erreci S1130 (IC) e Agilent 8860 (GC), spettrofotometria (Agilent Cary 60 UV-vis) e spettroscopia cavity ring-down (Picarro G2201-i, Picarro L2130-i, Picarro Caddy A2100). Alle informazioni di carattere teorico erogate con lezioni frontali, saranno affiancate esercitazioni in laboratorio con utilizzo dei suddetti strumenti.